# PANGNIRTUNG WASTE WATER TREATEMENT PLANT

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# STRIKE FIRST CORPORATION

# SERVICE MANUAL (v2)

***UL / ULC***

## DRY CHEMICAL – HAND PORTABLE FIRE EXTINGUISHERS

All fire extinguishers should be installed, inspected & maintained in accordance with the National Fire Protection Association (NFPA) 10, 2007 Edition "Standard for Portable Fire Extinguishers" and the local authorities having jurisdiction.

When installation, inspection or maintenance is required, Strike First Corporation strongly recommends the work to be performed by NFPA 10 (2007) certified personnel. Fire extinguishers are pressure vessels and must be treated with respect and handled with care. They are mechanical devices and require periodic maintenance to be sure that they are ready to operate properly and safely.

Strike First Corporation makes O.E.M. parts available to insure proper maintenance. Substituting O.E.M. parts voids the Strike First warranty, as well as the UL & ULC Listings. **DO NOT SUBSTITUTE**.

Strike First Corporation does not service, maintain or recharge fire extinguishers. This manual is published as a guide to assist qualified service personnel in the inspection, maintenance and recharge of Strike First fire extinguishers only. **This service manual should be used in conjunction with the appropriate Parts Lists/Pictograms for each unit being serviced.** No service manual can anticipate all the possible malfunctions that may be encountered in the service of fire extinguishers. Due to the possibility that prior service performed on this equipment may have been improperly done, it is extremely important that all warnings, cautions and notes in this manual be carefully observed. Failure to heed these instructions could result in serious injury.

Strike First Corporation assumes no liability for service, maintenance or recharge of fire extinguishers by publishing this service manual.

For installation instructions of Strike First portable fire extinguishers please refer to all of the following:

1. Owner's Manual - included with the unit
2. NFPA 10 "Standard for Portable Fire Extinguishers – 2007 Edition
3. Local authorities having jurisdiction

For operation instructions on Strike First portable fire extinguishers please refer to one or all of the following:

1. Fire Extinguisher Nameplate/Label
2. Owner's Manual – included with the unit
3. NFPA 10 "Standard for Portable Fire Extinguishers – 2007 Edition
4. Your local authorized Strike First Distributor

**WARNING:** ALWAYS WEAR EYE PROTECTION WHEN SERVICING PRESSURIZED DRY CHEMICAL FIRE EXTINGUSIHERS.

**CAUTION:** PERSONS EXPECTED TO USE THIS FIRE EXTINGUISHER SHOULD BE TRAINED IN INITIATING ITS OPERATION AND IN THE PROPER FIRE FIGHTING TECHNIQUE.

***RECHARGE FIRE EXTINGUISHERS IMMEDIATELY AFTER ANY USE***

## INSPECTION* (ref. 7.2 - NFPA 10, 2007)

The inspection procedures outlined below may not be sufficient for every jurisdiction or location and should be used in conjunction with the NFPA 10 Standard for Portable Fire Extinguishers, 2007 Edition.

Fire extinguishers shall be manually inspected when initially placed in service. The inspection is intended to give reasonable assurance that the extinguisher is fully charged and operable. This is done by seeing that it is in its designated place, has not been actuated or tampered with, and there is no obvious physical damage or condition to prevent operation.

**WARNING:** FOR SAFETY PURPOSES, IF AN EXTINGUISHER SHOWS SIGNS OF CORROSION OR MECHANICAL DAMAGE, IT SHALL BE SUBJECTED TO A HYDROSTATIC PRESSURE TEST OR REPLACED.

***PERIODIC INSPECTION PROCEDURE***
(Monthly or more often if circumstances dictate)

Periodic inspection of the fire extinguisher shall include a check of at least the following items:

1. Location in designated place
2. No obstruction to access or visibility
3. Fullness determined by weighing or hefting
4. Seal and tamper indicators not broken or missing
5. Operating instructions on nameplate are legible and facing outward
6. Examine for obvious physical damage, corrosion, leakage, or clogged hose and/or nozzle.

## MAINTENANCE (ref. 7.2 & 7.3 - NFPA 10, 2007)

Maintenance, servicing & recharging shall be performed by trained and certified persons having available the appropriate servicing manual, the proper types of tools, recharge materials, lubricants, and Strike First O.E.M. replacement parts.

Fire extinguishers shall be subjected to maintenance at intervals of not more than 1 year, at the time of hydrostatic test, or when specifically indicated by an inspection. Extinguishers taken out of service for maintenance or recharge shall be replaced by spare extinguishers of the same type and at least an equal rating.

### MAINTENANCE PROCEDURE

1. Clean extinguisher to remove dirt, grease or foreign material. Check to make sure that the instruction nameplate and UL/ULC manifest are securely fastened and legible. Inspect the cylinder for corrosion, abrasion and dents. If any of these conditions are found or you doubt the integrity of the cylinder, hydrostatically test to factory test pressure, using the proof pressure method, in accordance with CGA Pamphlet C-1 and The National Fire Protection Association (NFPA) Pamphlet No. 10 “Standard for Portable Fire Extinguishers” 2007 Edition.
2. Inspect the extinguisher and replace any parts that are damaged, missing, corroded or O.E.M. substitute parts. Only factory O.E.M. replacement parts are approved for use on Strike First fire extinguishers.
3. Weigh the extinguisher. Extinguisher weight MUST fall within the + / - tolerance of the total charged weight limits in the “MAINTENANCE” section on the label. Any extinguisher not falling within the tolerance limits shall be properly recharged.
4. Check the date of manufacture stamped on the cylinder or the date of last hydrostatic test on the label affixed to the extinguisher. Cylinder must be hydrostatically tested every 12 years to test the pressure indicated on the nameplate.
5. Inspect the pressure gauge for damage. Depressurize and replace if necessary. If the pressure gauge indicator is below the green “RECHARGE” it may indicate a leak or discharge. If the pressure indicator is above the green “OVERCHARGED” it may indicate a faulty gauge or excess nitrogen. In both cases, depressurize and follow the recharge instructions.
6. Check pull (locking) pin for freedom of movement. Replace if bent or if removal appears difficult.
7. Check the discharge lever for freedom of movement. Inspect carrying handle for proper installation. If either is damaged, replace.
8. Remove nozzle or hose and horn assembly and inspect valve body interior for damage. Replace the hose if cut or cracked, or if threaded couplings are damaged. Blow air through the hose and nozzle assemblies using air or nitrogen at 50 psi (345 kPa) or less to insure that the passage is clear of foreign material.
9. Inspect valve assembly for corrosion or damage. Valve removal and / or valve part replacement should be made only after completely discharging the contents of the cylinder.
10. Reinstall nozzle or hose and assembly
11. Install new tamper seal and record service data on the extinguisher inspection tag.
12. Install the extinguisher on the wall hanger bracket (or in vehicle bracket) in its proper location. Check for correct fit – replace bracket if necessary.

## RECHARGE *(See Page 4 for RECHARGING PROCEDURE)*

RECHARGING [NFPA 10, 7.4, 2007] IS THE REPLACEMENT OF THE EXTINGUISHING AGENT

## TROUBLESHOOTING GUIDE

**WARNING:** BEFORE ATTEMPING TO CORRECT ANY LEAKAGE PROBLEM, BE SURE THAT THE EXTINGUISHER IS COMPLETELY EMPTY AND DEPRESSURIZED.

***Note:*** Check to determine the source of the leak before the extinguisher is empty. Leakage repairs will require that the extinguisher be completely empty and the valve assembly removed.

When re-installing the valve assembly, the cylinder must be placed in a suitable securing vice and valve installed hand tight.

| **PROBLEM** | **CORRECTIVE ACTION** |
|---|---|
| 1. Leak at collar o-ring | Remove valve assembly, clean collar thoroughly and install new collar o-ring. |
| 2. Leak through valve | Remove spring and valve stem assembly. Install new valve stem assembly. Check valve seat for scratches or foreign matter. |
| 3. Leak at safety relief nut | Remove safety nut, disc and gasket assembly. Replace with new Strike First safety nut, disc & gasket assembly. Tighten assembly to 25 ft-lbs. of torque. |
| 4. Leak during discharge under discharge lever | Remove spring and valve stem assembly. Install new valve stem assembly. Check valve seat for scratches or foreign matter. |
| 5. Leak during discharge | Tighten hose connection at elbow (10, 15 & 20 lb.). Replace swivel assembly on 5 lb. |
| 6. Defect in the cylinder* | Contact a Strike First dealer if under warranty, otherwise – mark "CONDEMNED" and remove from service or return to owner. |

***LIMITED WARRANTY***

STRIKE FIRST CORPORATION ("STRIKE FIRST") warrants its fire extinguishers ("Products") to be free from defects in material and workmanship for a period of six (6) years from the date of manufacture. Strike First's responsibility for defects in material or workmanship are limited to repair or replacement of the products for the original retail purchaser ("Consumer") only. This limited warranty does not cover defects resulting from modification, abuse, accident, alteration, misuse, exposure to corrosive conditions, or improper installation or maintenance. STRIKE FIRST is not responsible for the installation or the maintenance of the Products.

Defective Products for which a valid claim has been made shall be returned to STRIKE FIRST's facility at Scarborough, ON (416) 299-7767 for repair or replacement (or to other repair facilities pursuant to STRIKE FIRST's prior written authorization), and transportation costs to such locations shall be paid by Consumer.

STRIKE FIRST DOES NOT ACCEPT LIABILITY BEYOND THE REMEDIES PROVIDED IN THIS LIMITED WARRANTY, WHETHER BASED ON CONTRACT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, INCLUDING WITHOUT LIMITATION DAMAGES FOR ANY PERSONAL INJURY, PROPERTY DAMAGE, OR ANY DIRECT, INDIRECT, SPECIAL, CONSEQUENTIAL, INCIDENTAL, EXEMPLARY OR PUNITIVE DAMAGES, AND INCLUDING WITHOUT LIMITATION ANY LIABILITY FOR THIRD PARTY CLAIMS, IN EACH CASE EVEN IF STRIKE FIRST HAS BEEN ADVISED OF THE POSSIBILITY THEREOF. LAWS OF SOME JURISDICTIONS DO NOT ALLOW THE DISCLAIMER OF CONSEQUENTIAL OR OTHER TYPES OF DAMAGES, AND CONSUMERS MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM JURISDICTION TO JURISDICTION. UNDER SUCH CIRCUMSTANCES, THIS LIMITED WARRANTY AND THE LIMITATIONS AND DISCLAIMERS HEREIN SHALL BE TO THE GREATEST EXTENT PERMITTED BY LAW.

THIS LIMITED WARRANTY CONTAINS THE ENTIRE WARRANTY PROVIDED BY STRIKE FIRST, AND SHALL BE IN LIEU OF ANY AND ALL OTHER WARRANTIES OR CONDITIONS, WHETHER EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION, IMPLIED WARRANTIES AND CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Neither the Product distributor nor any other third party is authorized to make any conditions, representations or warranties on STRIKE FIRST's behalf. STRIKE FIRST neither assumes nor authorizes any representative or other person to assume for it any obligation or liability other than as expressly set forth herein.

Any disputes regarding or relating to this limited warranty will be resolved in the sole discretion of STRIKE FIRST.

| *REFERENCES IN THIS MANUAL:* | | *AVAILABLE FROM:* |
|---|---|---|
| NFPA 10 | Standard for Portable Fire Extinguishers<br>2007 Edition | National Fire Protection Association<br>1 Batterymarch Pk.<br>Quincy, MA 02169-7471<br>www.nfpa.org |
| *CGA C-1 | "METHODS FOR HYDROSTATIC TESTING OF COMPRESSED GAS CYLINDERS" | Compressed Gas Assoc., Inc.<br>4221 Walney Rd., 5th Floor<br>Chantilly, VA 20151<br>www.cganet.com |

# RECHARING PROCEDURE

**WARNING:** Before attempting to recharge be sure the extinguisher is completely empty and depressurized. Failure to comply could result in personal injury, death or property damage due to the violent movement of the loosened components.

1. Remove the hose assembly or nozzle.

2. Invert extinguisher and discharge all remaining expelent gas.

3. Remove the valve and syphon tube from the cylinder by rotating counter clockwise. Mark valve and cylinder if servicing more than one unit. Remove the chemical residue by inverting the cylinder. Failure to do so could result in the packing of powder.

4. Detach syphon tube from valve with counterclockwise rotation. Remove spring.

5. Using your finger or a suitable tool, press down on the valve stem located under the discharge handle.

6. Remove body o-ring.

7. With a small brush, thoroughly clean the interior and exterior of the valve body threads, paying particular attention to the seat area. ***Pay particular attention to the pressure relief groove cut into the threads of the valve body.***

8. Carefully inspect the new Valve Body O-ring and install. Be carefull not to damage o-ring on valve body threads.

9. Lubricate o-ring circumference. Strike First recommends "Parker O-Lube".

10. Clean outlet orfice with a small brush.

11. Clean the valve seat itself containing the sealing rubber. Strike First recommends replacing the valve stem assembly at every major service interval.

12. Place a small amount of lubricant along the circumferance of the small o-ring only.

13. Re-insert valve stem assembly into the valve body. Push into place with your finger.

14. Return spring to syphon tube, turn syphon tube clockwise into valve body.

15. Fill the unit with the correct amount and type of dry chemical as stated on the fire extinguisher nameplate. Clean the cylinder threads thoroughly.

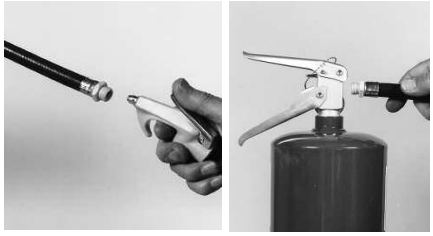
16. Return cleaned valve and syphon tube to the correct cylinder. NOTE: After filling cylinder, replace valve and syphon tube immediately while powder is still in an aerated state.

17. Rotate the valve in a clockwise direction until a "click" is heard. This engages threads and minimizes stripping. Hand tighten valve with clockwise rotation.

18. Place the pressurizing adaptor into valve outlet. Move regulator to desired pressure (use Dry Nitrogem ONLY). Connect Nitrogen source and allow pressure to felt at valve stem. Push down discharge handle. Nitrogen will be forced around valve stem and down syphon tube. A small bump may be noticed due to the displacement of dry chemical in the syphon tube. Once the gauge on the unit has reached the correct pressure, release the discharge handle. Remove recharge adaptor.

20. Thoroughly chech all areas on the unit that may leak pressure.
a) welds
b) gauge face & threads
c) valve body o-ring
d) valve stem seat

21. Place a pull pin through the valve body and discharge handle. Attach a sealing device.



22. Check nozzle and/or hose for blockage and retrun to unit.

23. Authourize service tag & date.

# *STRIKE FIRST CORPORATION*

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# SERVICE MANUAL (v2)

***UL / ULC***

## CARBON DIOXIDE – HAND PORTABLE FIRE EXTINGUISHERS

All fire extinguishers should be installed, inspected & maintained in accordance with the National Fire Protection Association (NFPA) 10, 2007 Edition "Standard for Portable Fire Extinguishers", local, state, provincial or federal fire codes.

When installation, inspection or maintenance is required, Strike First Corporation strongly recommends the work to be performed by NFPA 10 (2007) Certified personnel. Fire extinguishers are pressure vessels and must be treated with respect and handled with care. They are mechanical devices and require periodic maintenance to be sure that they are ready to operate properly and safely.

Strike First Corporation makes O.E.M. parts available to insure proper maintenance. Substituting O.E.M. parts voids the Strike First warranty, as well as the UL & ULC Listings. **DO NOT SUBSTITUTE**.

Strike First Corporation does not service, maintain or recharge fire extinguishers. This manual is published as a guide to assist qualified service personnel in the inspection, maintenance and recharge of Strike First fire extinguishers only. **This service manual should be used in conjunction with the appropriate Parts Lists/Pictograms for each unit being serviced.** No service manual can anticipate all the possible malfunctions that may be encountered in the service of fire extinguishers. Due to the possibility that prior service performed on this equipment may have been improperly done, it is extremely important that all warnings, cautions and notes in this manual be carefully observed. Failure to heed these instructions could result in serious injury.

Strike First Corporation assumes no liability for service, maintenance or recharge of fire extinguishers by publishing this service manual.

For installation instructions of Strike First portable fire extinguishers please refer to all of the following:

1. Owner's Manual - included with the unit
2. NFPA 10 "Standard for Portable Fire Extinguishers – 2007 Edition
3. Local authorities having jurisdiction

For operation instructions on Strike First portable fire extinguishers please refer to one or all of the following:

1. Fire Extinguisher Nameplate/Label
2. Owner's Manual – included with the unit
3. NFPA 10 "Standard for Portable Fire Extinguishers – 2007 Edition
4. Your local authorized Strike First Distributor

**WARNING:** CARBON DIOXIDE EXTINGUISHES FIRE BY DILUTING THE SURROUNDING ATMOSPHERE WITH INERT GAS KEEPING THE OXYGEN LEVEL BELOW THE PERCENTAGE REQUIRED FOR COMBUSTION. WHEN IT IS USED IN AN UNVENTILATED SPACE, SUCH AS A SMALL ROOM, CLOSET OR OTHER CONFINED AREA, PROLONGED OCCUPANCY OF THAT SPACE CAN RESULT IN LOSS OF CONSCIOUSNESS AND POSSIBLE DEATH DUE TO OXYGEN DEFICIENCY.

WHEN DISCHARGING CARBON DIOXIDE FOR RECHARGE, MAINTENANCE AND SERVICING, IT SHOULD ALWAYS BE DISCHARGED TO AN OUTSIDE ATMOSPHERE FOR THE REASONS STATED ABOVE.

**WARNING:** ALWAYS WEAR HAND AND FACE PROTECTION TO AVOID SKID CONTACT – CO2 (GAS OR SNOW) IS EXTREMELY COLD AND COULD CAUSE BURNS OR FROSTBITE.

**CAUTION:** PERSONS EXPECTED TO USE THIS FIRE EXTINGUISHER SHOULD BE TRAINED IN INITIATING ITS OPERATION AND IN THE PROPER FIRE FIGHTING TECHNIQUE.

***DISCHARGE TIME (APPROX.)***
5 LB. – 10 SEC.
10 LB. – 10 SEC.
15 LB. – 15 SEC.
20 LB. – 20 SEC.

***DISCHARGE RANGE (APPROX.)***
6 – 12 FEET

***RECHARGE FIRE EXTINGUISHERS IMMEDIATELY AFTER ANY USE***

## INSPECTION* (ref. 7.2 - NFPA 10, 2007)

The inspection procedures outlined below may not be sufficient for every jurisdiction or location and should be used in conjunction with the NFPA 10 Standard for Portable Fire Extinguishers, 2007 Edition.

Fire extinguishers shall be manually inspected when initially placed in service. The inspection is intended to give reasonable assurance that the extinguisher is fully charged and operable. This is done by seeing that it is in its designated place, has not been actuated or tampered with, and there is no obvious physical damage or condition to prevent operation.

**WARNING:** FOR SAFETY PURPOSES, IF AN EXTINGUISHER SHOWS SIGNS OF CORROSION OR MECHANICAL DAMAGE, IT SHALL BE SUBJECTED TO A HYDROSTATIC PRESSURE TEST OR REPLACED.

***PERIODIC INSPECTION PROCEDURE***
(Monthly or more often if circumstances dictate)

Periodic inspection of the fire extinguisher shall include a check of at least the following items:

1. Location in designated place
2. No obstruction to access or visibility
3. Fullness determined by weighing or hefting
4. Seal and tamper indicators not broken or missing
5. Operating instructions on nameplate are legible and facing outward
6. Examine for obvious physical damage, corrosion, leakage, or clogged horn obstruction.

## MAINTENANCE (ref. 7.2 & 7.3 - NFPA 10, 2007)

Maintenance, servicing & recharging shall be performed by trained and certified persons having available the appropriate servicing manual, the proper types of tools, recharge materials, lubricants, and Strike First O.E.M. replacement parts.

Fire extinguishers shall be subjected to maintenance at intervals of not more than 1 year, at the time of hydrostatic test, or when specifically indicated by an inspection. Extinguishers taken out of service for maintenance or recharge shall be replaced by spare extinguishers of the same type and at least an equal rating.

### MAINTENANCE PROCEDURE

1. Clean extinguisher to remove dirt, grease or foreign material. Check to make sure that the instruction nameplate and UL/ULC manifest are securely fastened and legible. Inspect the cylinder for corrosion, abrasion and dents. If any of these conditions are found or you doubt the integrity of the cylinder, hydrostatically test and mark (stamp) in accordance with CGA Pamphlet C-1 and The National Fire Protection Association (NFPA) Pamphlet No. 10 “Standard for Portable Fire Extinguishers” 2007 Edition. Properly dispose of cylinder if in violation of the standard.
2. Inspect the extinguisher and replace any parts that are damaged, missing, corroded or O.E.M. substitute parts. Only factory O.E.M. replacement parts are approved for use on Strike First fire extinguishers.
3. Check the date of manufacture stamped on the extinguisher cylinder dome. Cylinder must be hydrostatically tested every 5 years to test the pressure indicated on the nameplate (3000 psi, [20.69 MPa]). NOTE: COMPLETE MAINTENANCE should be performed whenever a hydrostatic test is being done. This includes an inspection of the interior of the valve assembly, the spring and valve stem assembly as well as the interior of the cylinder (using an appropriate inspection light). Strike First Corporation recommends replacement of the collar o-ring at hydrostatic test. The valve stem assembly should be checked for cuts in the seat area or any distortion and replaced if necessary.

4. Check pull (locking) pin for freedom of movement. Replace if bent or if removal appears difficult.
5. Check the discharge lever for freedom of movement. Inspect carrying handle for proper installation. If either is damaged, replace.
6. Remove the horn and swivel tube (5 lb. model) or hose and horn assembly (10, 15 & 20 lb. models) and inspect for damage. Replace the hose if cut or cracked, or if threaded couplings are damaged. Replace the horn if brittle, cracked or deformed. Blow air through the hose and nozzle assemblies using air or nitrogen at 50 psi (345 kPa) or less to insure that the passage is clear of foreign material.
7. Carbon dioxide hose assemblies have a continuous metal braid that connects to both couplings to minimize the static shock hazard. The reason for the conductivity test is to determine that the hose is conductive from the inlet coupling to the outlet orifice. A basic conductivity tester consisting of a flashlight having an open circuit and a set of two wires with a conductor (clamps or probe) at each end. (NFPA 10 A.7.3.1.3, 2007 Edition)
8. Inspect valve assembly for corrosion or damage to hose thread connection. Visually inspect the safety relief assembly for obstruction or damage – replace with complete Strike First O.E.M. safety relief assembly (tighten assembly to 25 ft. – lbs. of torque) if necessary. DO NOT SUBSTITUTE. Valve removal and / or valve part replacement should be made only after completely discharging the contents of the cylinder.
9. Inspect the 10, 15 & 20 lb. elbow for blockage or damage. The Strike First 5 lb. CO2 diffuser is built into the swivel tube. Check elbow and swivel tube for blockage or damage. Replace damaged parts with O.E.M. factory replacement parts only.
10. Reinstall horn and discharge tube (5 lb.) or hose and horn assembly (10, 15 & 20 lb.) to discharge valve. Check horn clip (10, 15 & 20 lb.) for damage and proper positioning. Replace, tighten or realign as necessary.
11. Weigh extinguisher and compare with weight stamped on valve. Recharge extinguisher if weight is not within indicated allowable tolerances (10% of charge weight).
12. Install new tamper seal and record service data on the extinguisher inspection tag.
13. Install the extinguisher on the wall hanger bracket (or in vehicle bracket) in its proper location. Check for correct fit – replace bracket if necessary.

## RECHARGE

RECHARGING [NFPA 10, 7.4, 2007] IS THE REPLACEMENT OF THE EXTINGUISHING AGENT

### RECHARGING PROCEDURE

**WARNING:** Before attempting to recharge be sure the extinguisher is completely empty and depressurized. Failure to comply could result in personal injury, death or property damage due to the violent movement of loosened components.

Use only an approved source of carbon dioxide (see minimum specification in NFPA 10, 2007, 7.4.3.9 or UL Standard 154). Do not use dry ice converters.

Use an approved pump, hose and recharge adapter to insure safe and efficient recharge operations.

1. Perform steps 1 thru 8 of the “MAINTENANCE PROCEDURE”.
2. Discharge all remaining carbon dioxide from the extinguisher.
3. Check the extinguisher nameplate (label) for the proper amount of CO2 to be pumped into the extinguisher. DO NOT OVERFILL.
4. Install the proper recharge adaptor. Adaptor must fit over diffuser tip on 5lb. Discharge Tube and elbow on 10, 15 & 20lb. without blocking diffuser holes. DO NOT REMOVE 5 LB. DISCHARGE TUBE OR 10, 15 & 20LB. ELBOW.
5. Place extinguisher on an accurate scale and attach carbon dioxide supply line to the recharge adaptor.
6. Attach a device such as a “pony spring clamp” to hold the extinguisher valve lever in the squeezed or open position. Pump the proper amount of CO2 into the extinguisher.
7. When the proper weight is reached, release the clamp, shut off the CO2 pump and vent the supply line.
8. Remove the CO2 supply line and recharge adapter from the extinguisher valve.
9. Install pull pin. Check for leaks using leak detection fluid or a solution of soapy water. If any leaks occur, refer to the TROUBLESHOOTING GUIDE.
10. Install tamper seal and attach new recharge tag.
11. Attach the horn or hose assembly to the extinguisher valve.
12. Weigh assembled extinguisher and confirm that the total weight is within the allowable tolerances indicated on the extinguisher stamped on valve.

## TROUBLESHOOTING GUIDE

**WARNING:** BEFORE ATTEMPING TO CORRECT ANY LEAKAGE PROBLEM, BE SURE THAT THE EXTINGUISHER IS COMPLETELY EMPTY AND DEPRESSURIZED.

***Note:*** Check to determine the source of the leak before the extinguisher is empty. Leakage repairs will require that the Carbon Dioxide extinguisher be completely empty and the valve assembly removed.

Strike First CO2 valve bodies and aluminum cylinders are 1 1/8" – 12 UNF STRAIGHT THREADS. When re-installing the valve assembly, the cylinder must be placed in a suitable securing vice and valve installed hand tight.

| **PROBLEM** | **CORRECTIVE ACTION** |
|---|---|
| 1. Leak at collar o-ring | Remove valve assembly, clean collar thoroughly and install new collar o-ring. |
| 2. Leak through valve | Remove spring and valve stem assembly. Install new valve stem assembly. Check valve seat for scratches or foreign matter. |
| 3. Leak at safety relief nut | Remove safety nut, disc and gasket assembly. Replace with new Strike First safety nut, disc & gasket assembly. Tighten assembly to 25 ft-lbs. of torque. |
| 4. Leak during discharge under discharge lever | Remove spring and valve stem assembly. Install new valve stem assembly. Check valve seat for scratches or foreign matter. |
| 5. Leak during discharge | Tighten hose connection at elbow (10, 15 & 20 lb.). Replace swivel assembly on 5 lb. |
| 6. Defect in the cylinder* | Contact a Strike First dealer if under warranty, otherwise – mark "CONDEMNED" and remove from service or return to owner. |

***LIMITED WARRANTY***

STRIKE FIRST CORPORATION ("STRIKE FIRST") warrants its fire extinguishers ("Products") to be free from defects in material and workmanship for a period of five (5) years from the date of manufacture. Strike First's responsibility for defects in material or workmanship is limited to repair or replacement of the products for the original retail purchaser ("Consumer") only. This limited warranty does not cover defects resulting from modification, abuse, accident, alteration, misuse, exposure to corrosive conditions, or improper installation or maintenance. STRIKE FIRST is not responsible for the installation or the maintenance of the Products.

Defective Products for which a valid claim has been made shall be returned to STRIKE FIRST's facility at Scarborough, ON (416) 299-7767 for repair or replacement (or to other repair facilities pursuant to STRIKE FIRST's prior written authorization), and transportation costs to such locations shall be paid by Consumer.

STRIKE FIRST DOES NOT ACCEPT LIABILITY BEYOND THE REMEDIES PROVIDED IN THIS LIMITED WARRANTY, WHETHER BASED ON CONTRACT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, INCLUDING WITHOUT LIMITATION DAMAGES FOR ANY PERSONAL INJURY, PROPERTY DAMAGE, OR ANY DIRECT, INDIRECT, SPECIAL, CONSEQUENTIAL, INCIDENTAL, EXEMPLARY OR PUNITIVE DAMAGES, AND INCLUDING WITHOUT LIMITATION ANY LIABILITY FOR THIRD PARTY CLAIMS, IN EACH CASE EVEN IF STRIKE FIRST HAS BEEN ADVISED OF THE POSSIBILITY THEREOF. LAWS OF SOME JURISDICTIONS DO NOT ALLOW THE DISCLAIMER OF CONSEQUENTIAL OR OTHER TYPES OF DAMAGES, AND CONSUMERS MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM JURISDICTION TO JURISDICTION. UNDER SUCH CIRCUMSTANCES, THIS LIMITED WARRANTY AND THE LIMITATIONS AND DISCLAIMERS HEREIN SHALL BE TO THE GREATEST EXTENT PERMITTED BY LAW.

THIS LIMITED WARRANTY CONTAINS THE ENTIRE WARRANTY PROVIDED BY STRIKE FIRST, AND SHALL BE IN LIEU OF ANY AND ALL OTHER WARRANTIES OR CONDITIONS, WHETHER EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION, IMPLIED WARRANTIES AND CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Neither the Product distributor nor any other third party is authorized to make any conditions, representations or warranties on STRIKE FIRST's behalf. STRIKE FIRST neither assumes nor authorizes any representative or other person to assume for it any obligation or liability other than as expressly set forth herein.

This limited warranty is governed by the laws of the province of Ontario, Canada. Any disputes regarding or relating to this limited warranty will be resolved in the sole discretion of STRIKE FIRST.

| *REFERENCES IN THIS MANUAL:* | | *AVAILABLE FROM:* |
|---|---|---|
| NFPA 10 | Standard for Portable Fire Extinguishers 2007 Edition | National Fire Protection Association<br>1 Batterymarch Pk.<br>Quincy, MA 02169-7471<br>www.nfpa.org |
| *CGA C-1 | "METHODS FOR HYDROSTATIC TESTING OF COMPRESSED GAS CYLINDERS" | Compresed Gas Assoc., Inc.<br>4221 Walney Rd., 5th Floor<br>Chantilly, VA 20151<br>www.cganet.com |
| *CGA C-6.1 | "STANDARDS FOR VISUAL INSPECTION OF HIGH PRESSURE ALUMINUM COMPRESSED GAS CYLINDERS" | |

CALEFACTIO

GMP Glycol Make-up Package

**INSTRUCTION** | **INSTRUCCIÓN** | **MODE D'EMPLOI**

# GMP6 / 18 / LC55 / LC100

## HYDRONIC SYSTEM FEEDER
## SISTEMA AUXILIAR DE GLICOL
## SYSTÈME D'APPOINT AU GLYCOL


ENGLISH ➔ 2
ESPAÑOL ➔ 7
FRANÇAIS ➔ 12

Québec (Canada)

calefactio.com

# GMP6-18-LC55-LC100 HYDRONIC SYSTEM FEEDER

### Installation, Operation and Maintenance

The GMP can be used with heating or cooling systems. It is used to maintain the system at a specific pressure. The GMP should be used to pressurize the system when it is at its lowest temperature.

### Installation Instructions

Do not install a pressure regulator or check valve between system feeder and the system.

Ensure that there is a system isolation valve to isolate the system feeder.

GMP6-18-LC55-LC100 : **Max pressure at 412.8 kPa (60 PSI)**

Factory set at 82.5 kPa (12 PSI)

### Operation Verification

It is important to check the proper functioning of each component before final connection

1. Make sure the tank is free of dirt.
2. Check the operation of the pump.
   a) Connect the pump directly into a wall outlet.
3. Check the operation of the pump/float assembly.
   a) Make sure that the float shaft is upright (90°) and that the float can move freely.
   b) Manually lift the float to ensure free movement of ball in the float.
4. Check the overall operation of the unit.
   a) Connect unit to system and close system isolation valve.
   b) Plug the pump to the wall outlet.
   c) Fill tank with solution mix of glycol/water – up to 50% glycol (we recommend a non-toxic propylene-based glycol).
   d) Open unit circulation valve (pump should start) to verify that the pump works properly.
   e) Close unit circulation valve and open system isolation valve.

## SYSTEM START-UP

1. Install the system feeder on a levelled and sturdy surface, or on optional wall mounting bracket (#GMP6WMS, for GMP6 only).
2. Fill system feeder tank with correct fluid required for system operation. If a water/glycol solution is used, the recommended concentration is 50% of non-toxic propylene glycol.

OPEN SYSTEM ISOLATION VALVE. INSERT PUMP ELECTRICAL PLUG INTO PIGGYBACK SWITCH PLUG, AND INTO WALL OUTLET.

**Note:** The pressure gauge on system feeder may indicate a different pressure than a gauge installed elsewhere in the system. This difference may be due to calibration variations, or elevation differences and is normal.

3. If the system pressure is below the pressure reducing valve (PRV) setting, the pump will start. The pump will run until the system is pressurized to the PRV setting. The pump may cycle rapidly. It is self priming to 8 feet.
4. If a higher system pressure is required, adjust the PRV to the desired value as follows:
   a) Close the isolation valve.
   b) Loosen the lock nut.
   c) Turn the screw clockwise until the gauge displays the desired pressure.
   d) Hold the screw and tighten the lock nut.
   (The standard system feeder PRV can be adjusted to 60 PSI.)
5. To get to a lower pressure, open the security valve and let the pressure go down below the desired pressure. From there, follow the steps stated in #4.

# MAINTENANCE

The GMP requires no scheduled maintenance.

### ➔ System pressure is below set point.

| POSSIBLE CAUSE | CORRECTIVE ACTION |
|---|---|
| System isolation valve closed. | Open the system isolation valve. |
| System is unplugged. | Plug the system in the wall outlet. |
| No power to the system | Verify that the wall outlet has power. |
| Low liquid level in the tank.<br>Float has stopped the system. | Add fluid. Find the source of the leak and repair. |
| Pressure reducing valve out of adjustment. | Adjust the PRV. |
| Control piggyback float not operating properly. | Verify operation of float.<br>Ensure that the float moves freely. |
| Defective pressure gauge. | Check pressure using another gauge.<br>Replace defective gauge. |
| Pump motor failure. | Replace pump. |

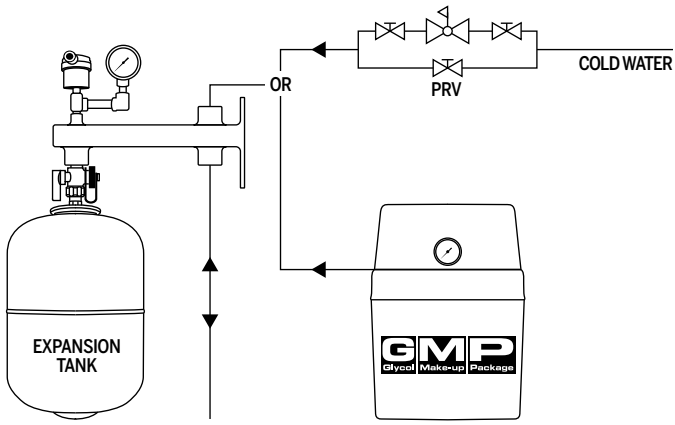
### ➔ Pump does not prime.

| POSSIBLE CAUSE | CORRECTIVE ACTION |
|---|---|
| External check valve or regulator installed between system and feeder. | Remove the check valve or regulator. |
| Pump is air locked. | Bleed the supply line. |

### ➔ Pump cycles continuously.

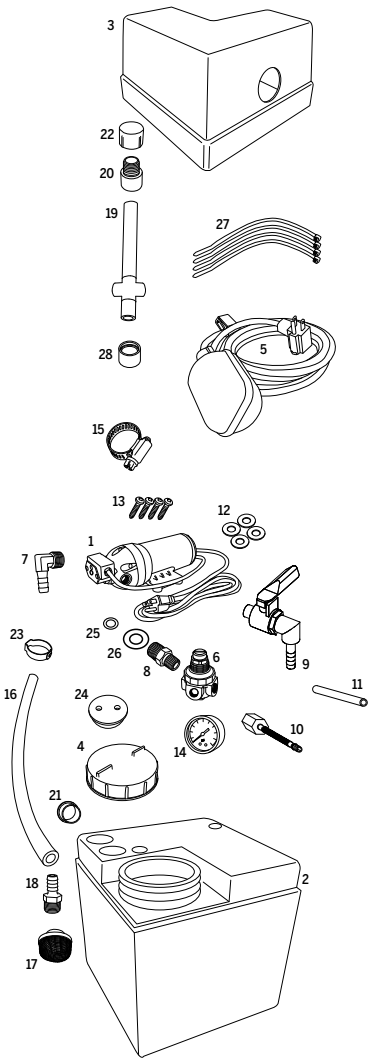
| POSSIBLE CAUSE | CORRECTIVE ACTION |
|---|---|
| Air is being removed from the system and replaced with liquid. | Allow sufficient time for air removal.<br>The pump will stop operating when air is removed. |
| External check valve or regulator installed between system and feeder. | Remove the check valve or regulator. |
| Control level piggyback float switch is not stopping the pump. | Ensure that the float is operating properly and that it is not held in the closed position (floating). |
| Leak in system. | Find source of the leak and repair. |

# CONNECTION DIAGRAM

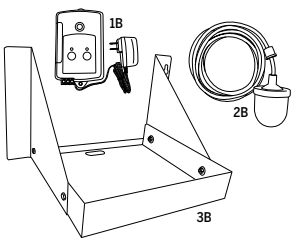


# GMP6-18 PARTS

| REF. | DESCRIPTION | PART # |
|---|---|---|
| 1 | Pump | GMP-PUMP |
| 2 | Tank | GMP-TANK-6* |
| 2 | Tank | GMP-TANK-18** |
| 3 | Gray cover | GMP COVER |
| 4 | Cap | GMP-LID |
| 5 | Piggyback float switch | GMP DOSER |
| 6 | Pressure reducing valve | XACV01275 |
| 7 | ⅜" MNPT x barbed fitting | GMP1396C |
| 8 | Fitting ⅜" MNPT x ¼" MNPT | GMP122CB |
| 9 | ⅛" MNPT x ¼" barbed valve | GMP1103* |
| 10 | 4½" Rigid black hose | XASBH4.5 |
| 11 | ¼" x 3" Clear hose | GMP36043 |
| 12 | Washer | GMPW146** |
| 13 | 1" Stainless steel screw | GMPSCREW-10** |
| 13 | ¾" Stainless steel screws | GMPT1112S1* |
| 14 | Pressure gage | GMPGAGE2 |
| 15 | Gear clamp | GMPCLAMP |
| 16 | ⅜" ø x 11 ½" Hose | B381001112* |
| 16 | ⅜" ø x 36" Hose | B3810036** |
| 17 | Strainer | GMP-STRAINER |
| 18 | Barbed x threaded fitting for strainer | GMP125-6C |
| 19 | ½" ø x 11 7/16" Pipe | PVC401212NP* |
| 19 | ½" ø x 33 ¼" Pipe | PVC401233NP** |
| 20 | ½" Male adaptor | GMP12AM |
| 21 | 1" Black shutter | APHP013A |
| 22 | ½" MNPT Cap | GMPCAP |
| 23 | ½" Clip | GMPCLAMP2 |
| 24 | Grommet | GMP-GROMMET |
| 25 | O-ring | GMPORING |
| 26 | 16 mm Washer | GMPITTWASHER |
| 27 | 6" Nylon clip | TW6** |
| 28 | Glued 1" x ¾" plastic fitting | PVC4034M** |




| OPTIONS | | |
|---|---|---|
| 1B+2B | Remote alarm panel c/w 9V battery | GMPAL |
| 2B | Remote alarm float / Dry contact | GMPDC |
| 3B | Wall mounting shelf | GMP6WMS |




*GMP6 part **GMP18 part

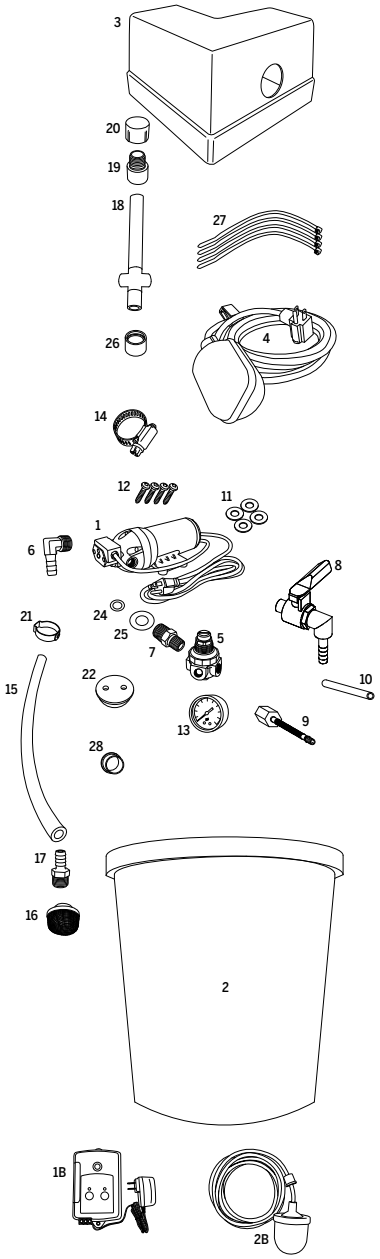
# GMPLC55-LC100 PARTS

| REF. | DESCRIPTION | PART # |
|---|---|---|
| 1 | Pump | GMP-PUMP |
| 2 | Tank | GMP-TANK-55* |
| 2 | Tank | GMP-TANK-100** |
| 3 | Gray cover | GMP COVER |
| 4 | Piggyback float switch | GMP DOSER |
| 5 | Pressure reducing valve | XACV01275 |
| 6 | ⅜" MNPT x barbed fitting | GMP1396C |
| 7 | Fitting ⅜" MNPT x ¼" MNPT | GMP122CB |
| 8 | ⅛" MNPT x ¼" barbed valve | GMP1103* |
| 9 | 4½" Rigid black hose | XASBH4.5 |
| 10 | ¼" x 3" Clear hose | GMP36043 |
| 11 | Washer | GMPW146* |
| 12 | 1" Stainless steel screw | GMPSCREW-10 |
| 13 | Pressure gage | GMPGAGE2 |
| 14 | Gear clamp | GMPCLAMP |
| 15 | ⅜"ø x 46" Hose | B3810046* |
| 15 | ⅜"ø x 57" Hose | B3810057** |
| 16 | Strainer | GMP-STRAINER |
| 17 | Barbed x threaded fitting for strainer | GMP125-6C |
| 18 | ½" ø x 42" Pipe | PVC4042* |
| 18 | ½" ø x 53 ¼ " Pipe | PVC405325** |
| 19 | ½" Male adaptor | GMP12AM |
| 20 | ½" MNPT Cap | GMPCAP |
| 21 | ½" clip | GMPCLAMP2 |
| 22 | Grommet | GMP-GROMMET |
| 24 | O-ring | GMPORING |
| 25 | 16 mm Washer | GMPITTWASHER |
| 26 | Glued 1" x ¾" plastic fitting | PVC4034M |
| 27 | 6" Nylon clip | TW6 |
| 28 | 1" Black Shutter | APHP013A |

**OPTIONS**

| | | |
|---|---|---|
| 1B+2B | Remote alarm panel c/w 9V battery | GMPAL |
| 2B | Remote alarm float / Dry contact | GMPDC |

*GMPLC55 part **GMPLC100 part



# WARRANTY

## 1 YEAR LIMITED WARRANTY ON GMP6-GMP18-GMPLC55-GMPLC100 FROM THE DATE OF PURCHASE OR 6 MONTHS AFTER FABRICATION DATE.

Calefactio Solutions Inc. warrants to the original purchaser ONLY that the products subject to this sale, are free of material and workmanship defects, and conform to the specifications published by Calefactio Solutions Inc.

This warranty is only valid if the product is installed and used under normal working conditions, and for the purpose for which it was intended, given the terms and conditions listed below. If the buyer does not provide protective storage, does not install or maintain the equipment according to manufacturer's instructions, this warranty will become NULL and VOID. In the event that the buyer discovers a material defect or notices malfunctioning from the products, they must immediately notify the installer / distributor / store from which the product was purchased, who will, in turn, notify Calefactio Solutions Inc. of the claim. Notifications for product malfunctions will not be received by Calefactio Solutions Inc. past the timeframe given for the warranty, which is determined, based on the date the product was manufactured.

If requested by the manufacturer, prior to attempting any repairs, defective products or parts thereof must be promptly returned to one of the manufacturer's warehouses, or sent to an authorized service representative, as indicated by the manufacturer. The manufacturer accepts no responsibility for loss or damage to the product(s) while in transit, nor will any warranty claim be considered unless the returned goods are received in the exact condition they were in prior to shipping. Claims for damage due to shipping are the sole responsibility of the customer and must be resolved by the customer directly with the shipping carrier. Repaired or replacement products will be shipped to customer at FOB factory terms. The manufacturer warrants replacement parts for ninety (90) days or for the remainder of the warranty of the product that was repaired or replaced.

If a claim is deemed valid, the manufacturer's sole obligation under warranty shall be, at their own discretion, to repair or replace the defective product. NO cash refunds will be given. Calefactio Solutions Inc. reserves the right to correct the malfunctioning of the product by using new or used replacement parts. Such repairs will be performed at Calefactio Solutions Inc.'s expense. Calefactio Solutions Inc. will NOT accept any claims from the customer for labour costs associated with the removal or reinstallation of the product and/or part thereof. No claims will be accepted for returned items which show obvious signs of repairs, alterations, and/or other modifications (to the product or any of its parts thereof) effected without first obtaining written authorization from Calefactio Solutions Inc. In the event that Calefactio Solutions Inc. is unable to repair the product, Calefactio Solutions Inc. will provide the buyer with a replacement product. While replacing parts or replacing the product itself, Calefactio Solutions Inc. reserves the right to make changes in the design, construction or materials if it is deemed necessary to replace defective products with new models of the same equipment and/or upgrade the parts of any product judged to be defective.

Under the terms of this warranty, in no event shall the manufacturer be held responsible or liable for:

**1.** Consecutive, indirect or particular loss or damages. Such damages include, but are not limited to, loss of profits, loss of capital, loss of revenue or savings, loss resulting from the non-use of the product or of associated equipment, downtime, cost of substitute equipment, facilities or services, injuries, property damages or any claims of third parties (including the customer). Some states / provinces do not allow limitations or exclusions of indirect or consecutive damages; therefore this clause may not be applicable in certain cases.

**2.** Damages, defects or malfunctioning caused by a failure to install and maintain the product in accordance with the printed instructions that were included with the product.

**3.** Malfunction or damages due to abnormal conditions of use, accidents, mishandling, neglect or misuse of the product (i.e. using the product for purposes other than for which it was intended).

**4.** Loss, damage and/or labour costs incurred as a result of the improper installation or the installation of defective parts or inadequate repairs/service by others, using unauthorized attachments or modifications.

**5.** Damage caused by (including but not limited to) sand or abrasive materials, buildup of chemical products, mud, oily residues, acids, corrosion, mishandling or improper installation.

**6.** Damage caused by natural disasters such as fire, wind, earthquakes, and lightning.

**7.** Parts, components or products not manufactured by Calefactio Solutions Inc. but used in conjunction with the products that are subject of this sale.

**8.** Any abuse or misuse by the customer.

All repairs and / or services performed by manufacturer for reasons other than those covered under this warranty will be charged according to the manufacturer's current equipment, parts and service fees.

Returned products or parts will NOT be accepted if returned to manufacturer without obtaining approval prior to shipment.

The present warranty is the sole warranty of the manufacturer. Any other warranties express or implied in law or in fact, including but not limited to, warranties of merchantability or fitness for particular purpose, are hereby specifically disclaimed.

Some states / provinces do not allow limitations on the duration of implied warranties; therefore, this clause may not be applicable to you. This warranty extends ONLY to the original purchaser and is therefore not transferable.

Québec (Canada)

**T** 450 951.0818
**F** 450 951.2165

**calefactio.com**

CALEFACTIO

# SISTEMA AUXILIAR DE GLICOL GMP6-18-LC55-LC100

### Instalación, funcionamiento y mantenimiento

El GMP se puede utilizar con un sistema de calefacción o enfriamiento hidrónico. Sirve para mantener una presión definida en el interior del sistema. Se debe utilizar para poner el sistema bajo presión cuando esté en su temperatura más baja.

### Instrucciones de instalación

No instale un regulador de presión o una válvula antirretorno entre el GMP y el circuito cerrado.

Asegúrese de que la instalación esté equipada con una válvula aisladora para aislar el GMP.

GMP6-18-LC55-LC100 : **presión máxima de 412.8 kPa (60 PSI)**

Ajuste de fábrica 82.5 kPa (12 PSI)

### Verificación del funcionamiento

Es importante verificar el funcionamiento de cada componente antes de la conexión final de la unidad.

1. Asegúrese de que el depósito esté libre de suciedad.
2. Verifique el funcionamiento de la bomba.
   a) Conecte la bomba directamente a una toma de pared
3. Verifique el funcionamiento del conjunto bomba / flotante
   a) Asegúrese de que el eje flotante esté en posición vertical (90°) y que los flotantes puedan moverse libremente.
   b) Levante manualmente cada flotante para asegurar el libre movimiento de la bola dentro del flotante.
4. Verifique el funcionamiento global de la unidad.
   a) Conecte la unidad al sistema y cierre la válvula de aislamiento del mismo.
   b) Inserte la ficha eléctrica de la bomba en la ficha del flotante (interruptor de puesta en marcha de la bomba) y luego en la toma de pared.
   c) Llene el depósito con la solución glicol / agua. La concentración de glicol de la solución no debe superar el 50%.
   d) Abra la válvula de circulación de la unidad (la bomba debe arrancar) para verificar el funcionamiento de la bomba.
   e) Cierre la válvula de circulación de la unidad y abra la válvula de aislamiento del sistema.

## PUESTA EN MARCHA DEL SISTEMA

1. Instale el GMP sobre una superficie plana y firme. También puede optar por el soporte de montaje de pared opcional (#GMP6WMS para GMP6 solamente)
2. Llene el depósito del GMP respetando la cantidad recomendada para su sistema. La concentración recomendada cuando se utiliza una mezcla agua / glicol es del 50%.

ABRA LA VÁLVULA AISLADORA DE LA INSTALACIÓN, INSERTE LA FICHA ELÉCTRICA DE LA BOMBA EN LA FICHA DEL INTERRUPTOR DE FLOTADOR DE CONTROL COMBINADO (PIGGYBACK) Y LUEGO EN LA TOMA DE PARED.

**Nota :** El manómetro acoplado al sistema auxiliar puede indicar una presión diferente de la indicada en un manómetro instalado en otro punto del sistema. La diferencia se puede explicar por variaciones en la calibración o por variaciones en las alturas de elevación, y puede ser normal.

3. Si la presión en el sistema es menor que el valor de ajuste del reductor de presión, la bomba se pondrá en marcha. La bomba continuará funcionando hasta que la presión del sistema alcance el valor de ajuste del reductor de presión. Los ciclos de la bomba se pueden acelerar. La bomba es autocebante a 8 pies.
4. Si es necesario que la presión en el sistema sea mayor, ajuste la válvula reductora de presión al valor requerido, de la siguiente manera:
   a) Desenrosque la tuerca autoblocante.
   b) Gire el tornillo en el sentido de las agujas del reloj hasta que el manómetro indique la presión deseada.
   c) Sostenga el tornillo en posición y apriete la tuerca autoblocante. El reductor de presión estándar del sistema auxiliar se puede ajustar hasta una presión de 60 psi.
   d) Atornille la tuerca de seguridad.

   (Se puede ajustar el alimentador PRV a 60 psi.)
5. Para obtener una presión menor, abra la válvula de seguridad y deje que la presión descienda por debajo del nivel de presión deseada. Repita los pasos del punto 4.

# MANTENIMIENTO

El GMP no requiere mantenimiento programado.

### ➔ La presión de instalación se sitúa por debajo del valor de ajuste.

| CAUSA POSIBLE | ACCIÓN CORRECTIVA |
|---|---|
| La válvula aisladora del sistema está cerrada. | Abra la válvula aisladora. |
| El sistema auxiliar no está conectado. | Conecte el sistema a una toma de pared. |
| El sistema auxiliar no está alimentado. | Verifique si la toma de pared cuenta con alimentación eléctrica. |
| El nivel del depósito es bajo. El interruptor de flotador ha apagado el sistema. | Agregue líquido. Encuentre la fuente de fuga y repárela. |
| El reductor de presión está mal ajustado. | Ajuste el reductor de presión (etapa 4 de la puesta en marcha) |
| El interruptor de flotador de control de nivel combinado (piggyback) no funciona correctamente. | Verifique si el interruptor de flotador de control de nivel combinado (piggyback) funciona correctamente. Asegúrese de que se mueva libremente. |
| El manómetro es defectuoso. | Verifique la presión con otro manómetro. Reemplace el manómetro defectuoso. |
| El motor de la bomba no está funcionando. | Reemplace la bomba. |

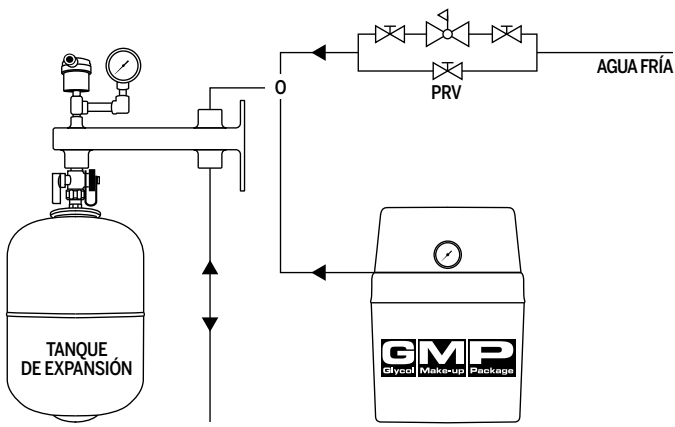
### ➔ La bomba no se autoceba.

| CAUSA POSIBLE | ACCIÓN CORRECTIVA |
|---|---|
| Se ha instalado una válvula antirretorno externa o un regulador de presión entre el sistema y el GMP. | Retire la válvula antirretorno o el regulador de presión. |
| Se ha formado una bolsa de aire en la bomba. | Purgue el conducto de alimentación. |

### ➔ La bomba cicla continuamente.

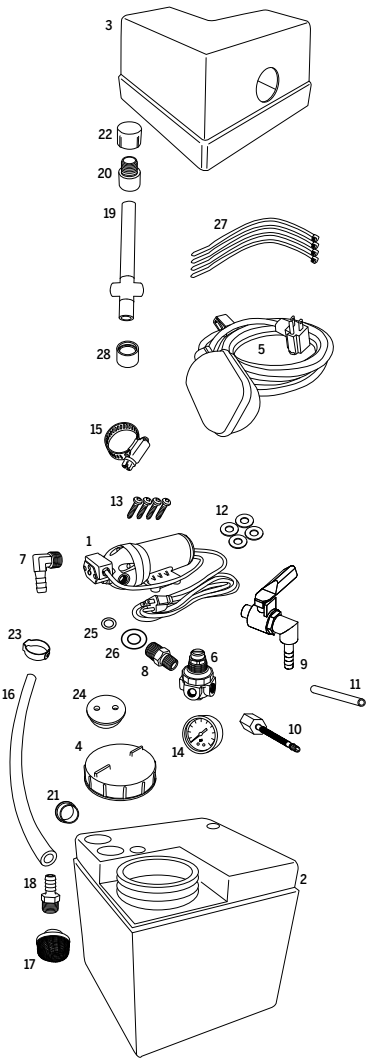
| CAUSA POSIBLE | ACCIÓN CORRECTIVA |
|---|---|
| El aire es expulsado del sistema para ser sustituido por líquido. | Deje transcurrir el tiempo necesario para que se expulse el aire. La bomba deja de funcionar cuando se purga todo el aire. |
| Se ha instalado una válvula antirretorno externa o un regulador de presión entre el sistema y el GMP. | Retire la válvula antirretorno o el regulador de presión. |
| El interruptor de flotador de control de nivel combinado (piggyback) no apaga la bomba. | Asegúrese de que el interruptor de flotador de nivel combinado funcione correctamente y no se mantenga en posición cerrada (flotante). |
| El sistema tiene una fuga. | Encuentre la fuente de fuga y repárela. |

# ESQUEMA DE CONEXIONES



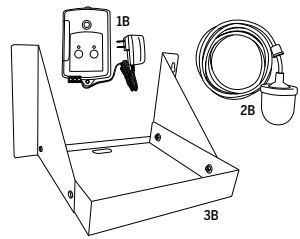
# PIEZAS GMP6-18

| REF. | DESCRIPCIÓN | N° PIEZA |
|---|---|---|
| 1 | Bomba | GMP-PUMP |
| 2 | Depósito | GMP-TANK-6* |
| 2 | Depósito | GMP-TANK-18** |
| 3 | Tapa gris | GMP COVER |
| 4 | Tapón | GMP-LID |
| 5 | Interruptor con ficha | GMP DOSER |
| 6 | Válvula de regulación de presión | XACV01275 |
| 7 | Empalme ⅜ pulg. MNPT x acanalado | GMP1396C |
| 8 | Empalme ⅜ pulg. MNPT x ¼ pulg. acanalado | GMP122CB |
| 9 | Válvula ⅛ pulg. MNPT x ¼ pulg. acanalada | GMP1103* |
| 10 | Manguera reforzada negra 4 ½ | XASBH4.5 |
| 11 | Manguera clara ¼ pulg. x 3 pulg. | GMP36043 |
| 12 | Arandela | GMPW146** |
| 13 | Tornillo 1 pulg. de acero inoxidable | GMPSCREW-10** |
| 13 | Tornillo ¾ pulg. de acero inoxidable | GMPT1112S1* |
| 14 | Manómetro | GMPGAGE2 |
| 15 | Abrazadera de apriete con tornillo sin fin | GMPCLAMP |
| 16 | Manguera ⅜ pulg. ø x 11 ½ pulg. | B381001112* |
| 16 | Manguera ⅜ pulg. ø x 36 pulg. | B3810036** |
| 17 | Tamiz | GMP-STRAINER |
| 18 | Empalme acanalado x fileteado para tamiz | GMP125-6C |
| 19 | Tubo ½ pulg. ø x 11 7⁄16 pulg. | PVC401212NP* |
| 19 | Tubo ½ pulg. ø x 33 ¼ pulg. | PVC401233NP** |
| 20 | Adaptador macho ½ '' | GMP12AM |
| 21 | Obturador negro 1 pulg. | APHP013A |
| 22 | Tapón ½ pulg. MNPT | GMPCAP |
| 23 | Lazo ½ pulg. | GMPCLAMP2 |
| 24 | Pasacable | GMP-GROMMET |
| 25 | Junta tórica | GMPORING |
| 26 | Arandela 16 mm | GMPITTWASHER |
| 27 | Lazo de nailon 6 pulg. | TW6** |
| 28 | Empalme de plástico pegado 1 pulg. x ¾ pulg. | PVC4034M** |




**OPCIONES**

| | | |
|---|---|---|
| 1B+2B | Panel de alarma a distancia C/A pila 9 V | GMPAL |
| 2B | Interruptor de nivel / contacto seco | GMPDC |
| 3B | Soporte de montaje de pared | GMP6WMS |




*Pieza GMP6 **Pieza GMP18

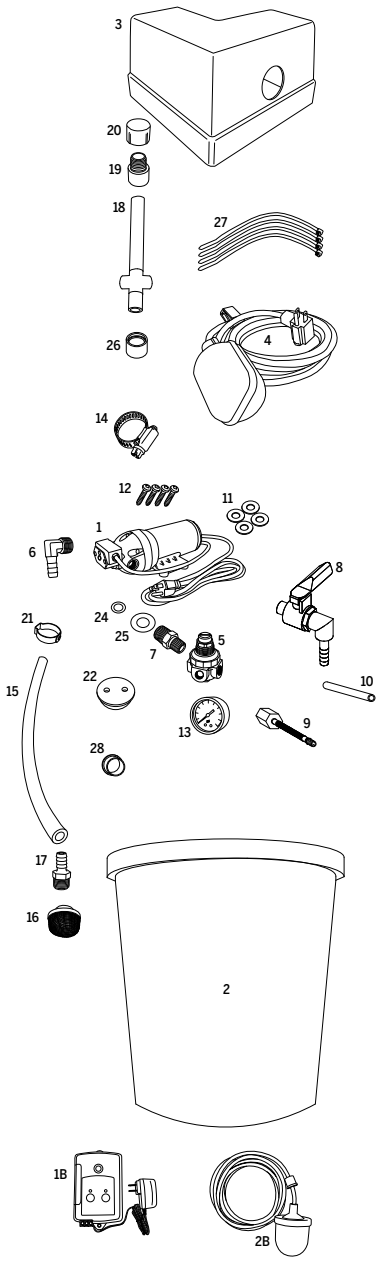
# PIEZAS GMPLC55-LC100

| REF. | DESCRIPCIÓN | Nº PIEZA |
|---|---|---|
| 1 | Bomba | GMP-PUMP |
| 2 | Depósito | GMP-TANK-55* |
| 2 | Depósito | GMP-TANK-100** |
| 3 | Tapa gris | GMP COVER |
| 4 | Interruptor con ficha | GMP DOSER |
| 5 | Válvula de regulación de presión | XACV01275 |
| 6 | Empalme ⅜ pulg. MNPT x acanalado | GMP1396C |
| 7 | Empalme ⅜ pulg. MNPT x ¼ pulg. acanalado | GMP122CB |
| 8 | Válvula ⅛ pulg. MNPT x ¼ pulg. acanalada | GMP1103* |
| 9 | Manguera reforzada negra 4 ½ | XASBH4.5 |
| 10 | Manguera clara ¼ pulg. x 3 pulg. | GMP36043 |
| 11 | Arandela | GMPW146* |
| 12 | Tornillo 1 pulg. de acero inoxidable | GMPSCREW-10 |
| 13 | Manómetro | GMPGAGE2 |
| 14 | Abrazadera de apriete con tornillo sin fin | GMPCLAMP |
| 15 | Manguera ⅜ pulg. ø x 46 pulg. | B3810046* |
| 15 | Manguera ⅜ pulg. ø x 57 pulg. | B3810057** |
| 16 | Tamiz | GMP-STRAINER |
| 17 | Empalme acanalado x fileteado para tamiz | GMP125-6C |
| 18 | Tubo ½ pulg. ø x 42 pulg. | PVC4042* |
| 18 | Tubo ½ pulg. ø x 53 ¼ pulg. | PVC405325** |
| 19 | Adaptador macho ½ '' | GMP12AM |
| 20 | Tapón ½ pulg. MNPT | GMPCAP |
| 21 | Lazo ½ pulg. | GMPCLAMP2 |
| 22 | Pasacable | GMP-GROMMET |
| 24 | Junta tórica | GMPORING |
| 25 | Arandela 16 mm | GMPITTWASHER |
| 26 | Empalme de plástico pegado 1 pulg. x ¾ pulg. | PVC4034M |
| 27 | Lazo de nailon 6 pulg. | TW6 |
| 28 | Obturador negro 1 pulg. | APHP013A |

**OPCIONES**

| | | |
|---|---|---|
| 1B+2B | Panel de alarma a distancia C/A pila 9 V | GMPAL |
| 2B | Interruptor de nivel / contacto seco | GMPDC |

* Pieza GMPLC55 ** Pieza GMPLC100



# GARANTÍA

## GARANTÍA LIMITADA DE UN (1) AÑO PARA LOS MODELOS GMP6-GMP18-GMPLC22-GMPLC100 A PARTIR DE LA FECHA DE COMPRA, O BIEN SEIS (6) MESES DESPUÉS DE LA FECHA DE FABRICACIÓN

Calefactio Solutions inc. garantiza al comprador original que los productos objeto de esta venta, están libres de defectos materiales, mano de obra, y se ajustan a las especificaciones publicadas por Calefactio Solutions inc.

Esta garantía sólo es válida si el producto se instala y se usa en condiciones normales de funcionamiento, y para el propósito con el que fue concebido, teniendo en cuenta los términos y condiciones que se enumeran a continuación. Si el comprador no proporciona protección de almacenamiento, no instalar o mantiene el equipo de acuerdo a las instrucciones del fabricante, esta garantía será nula y sin algún efecto. En el caso de que el comprador encuentra un defecto material o note un malfuncionamiento de los productos, el / ella debe notificar inmediatamente al instalador / distribuidor / tienda donde se compró el producto, que, a su vez, notificará a Calefactio Solutions inc. de la reclamación. Notificaciones de mal funcionamiento del producto no serán recibidas por Calefactio Solutions inc. pasado el plazo dado para la garantía, la cual es determinada, basada en la fecha de fabricación del producto.

Si lo solicita el fabricante, antes de intentar cualquier reparación, productos defectuosos o partes de los mismos deben ser devueltos inmediatamente a uno de los almacenes del fabricante, o enviados a un centro de servicio autorizado, según lo indicado por el fabricante. El fabricante no acepta ninguna responsabilidad por pérdidas o daños en el producto (s) en tránsito, ni se considerará ningún reclamo de garantía a no ser que se reciban las mercancías vueltas en la condición exacta que eran antes del envío. Las reclamaciones por daños debido al envío son de responsabilidad exclusiva de los clientes y deben ser resueltos por el cliente directamente con la empresa de transporte. Productos reparados o sustituidos serán enviados a la atención al cliente en los términos FOB de fábrica. El fabricante garantiza las piezas de repuesto durante noventa (90) días o por la garantía restante del producto que fue reparado o reemplazado.

Si la reclamación es considerada, la única obligación del fabricante bajo la garantía será, a su propia discreción, de reparar o reemplazar el producto defectuoso. No se dará ningún reembolso de efectivo. Calefactio Solutions inc. se reserva el derecho de corregir el mal funcionamiento del producto usando repuestos nuevos o usados. Estas reparaciones se llevarán a cabo a expensas de Calefactio Solutions inc. Calefactio Solutions inc. no aceptará ninguna reclamación por parte del cliente para los gastos de mano de obra asociados con la desinstalación o reinstalación del producto y / o parte del mismo. No se aceptarán reclamos por los artículos devueltos que muestran signos evidentes de reparaciones, alteraciones, y / u otras modificaciones (en el producto o cualquiera de sus partes) realizadas sin obtener primero la autorización por escrito de Calefactio Solutions inc. En el caso de que Calefactio Solutions inc. no puede reparar el producto, Calefactio Solutions inc. proporcionará al comprador un producto de reemplazo. Al reemplazar las piezas o reemplazar el producto en sí, Calefactio Solutions inc. se reserva el derecho de realizar cambios en el diseño, la construcción o los materiales si se considera necesario sustituir los productos defectuosos con nuevos modelos de un mismo equipo y / o actualizar las partes de cualquier producto juzgado como defectuoso.

Bajo los términos de esta garantía, en ningún caso, el fabricante se hará responsable de:

**1.** Consecutiva, indirecta o pérdidas particulares o daños. Tales daños deben incluir, pero no están limitados a, perdida de ganancias, perdida de capital o ahorros, pérdida de ingresos, la pérdida resultante por el no uso de los productos y de los equipos asociados, tiempo de inactividad, el costo de reemplazo del equipo, las instalaciones o los servicios, lesiones, daños a la propiedad o cualquier reclamación de terceros (incluido el cliente). Algunos estados / provincias no permiten limitaciones o exclusiones de daños indirectos o consecutivos, por lo que esta cláusula puede no ser aplicable a su caso.

**2.** Daños, defectos o mal funcionamiento causado por una falla en la instalación y mantenimiento del producto de acuerdo con las instrucciones impresas que fueron incluidas con el producto.

**3.** Mal funcionamiento o daños debido a condiciones anormales de uso, accidentes, mala manipulación, negligencia o mal uso del producto (es decir, la utilización del producto para fines distintos para los que fue destinado).

**4.** Pérdida, daños y / o costes de mano de obra incurridos como resultado de una instalación incorrecta o la instalación de piezas defectuosas o inadecuadas reparaciones / servicios por otros, utilizando modificaciones o accesorios no autorizados.

**5.** Los daños causados por (incluyendo pero no limitado a) materiales o partículas abrasivas, acumulación de productos químicos, lodo, residuos de hidrocarburos, ácidos, corrosión, mala manipulación o instalación inadecuada.

**6.** Los daños causados por desastres naturales tales como incendios, viento, terremotos y relámpagos.

**7.** Las piezas, componentes o productos no fabricados por Calefactio Solutions inc., pero utilizadas conjuntamente con los productos que son objeto de esta venta.

**8.** Cualquier abuso o mal uso por parte del cliente.

Todas las reparaciones y / o servicios realizados por el fabricante, por razones distintas de las cubiertas por esta garantía se cobrarán de acuerdo a los equipos actuales del fabricante, componentes y cargos por servicio.

El retorno de piezas o productos no serán aceptados si son devueltos al fabricante sin la previa obtención de la aprobación para su envío.

La presente garantía es la única garantía del fabricante. Cualquier otra garantía expresa o implícita en la ley o de hecho, incluyendo pero no limitando a, las garantías de comerciabilidad o aptitud para un propósito particular, son excluidas específicamente.

Algunos estados / provincias no permiten limitaciones en la duración de las garantías implícitas, por lo tanto, esta cláusula no puede ser aplicable para su caso.

Québec (Canada)

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CALEFACTIO

# SYSTÈME D'APPOINT AU GLYCOL GMP6-18-LC55-LC100

### Installation, fonctionnement et entretien

Le GMP peut être utilisé avec une installation de chauffage ou de refroidissement hydronique. Il sert à maintenir une pression définie à l'intérieur de l'installation. Il doit servir à mettre le système sous pression lorsqu'il est à sa température la plus basse.

### Directives d'installation

Ne pas installer un régulateur de pression ou un clapet de non-retour entre le GMP et le circuit fermé.

Assurez-vous que l'installation est dotée d'un robinet d'isolement servant à isoler le GMP.

GMP6-18-LC55-LC100 : **pression maximale 412.8 kPa (60 PSI)**

Réglage en usine à 82.5 kPa (12 PSI)

### Vérification du fonctionnement

Il est important de vérifier le fonctionnement de chaque composante avant le branchement final de l'unité.

1. Assurez-vous que le réservoir est exempt de saleté.
2. Vérifiez le fonctionnement de la pompe.
   a) Branchez la pompe directement dans une prise murale.
3. Vérifiez le fonctionnement de l'ensemble pompe/flotte.
   a) Assurez-vous que l'arbre à flotte est en position verticale (90°) et que les flottes peuvent bouger librement.
   b) Soulevez manuellement chaque flotte pour vous assurer du libre mouvement de la bille à l'intérieur de la flotte.
4. Vérifiez le fonctionnement global de l'unité.
   a) Raccordez l'unité au système et fermez la valve d'isolement du système.
   b) Insérez la fiche électrique de la pompe dans la fiche de la flotte (interrupteur de mise en marche de la pompe), puis dans la prise murale.
   c) Remplissez le réservoir de la solution glycol/eau. La concentration en glycol de la solution ne doit pas dépasser 50 %.
   d) Ouvrez la valve de circulation de l'unité (la pompe devrait démarrer) afin de vérifier le fonctionnement de la pompe.
   e) Fermez la valve de circulation de l'unité et ouvrez la valve d'isolement du système.

## MISE EN MARCHE DU SYSTÈME

1. Installez le GMP sur une surface plane et solide. Vous pouvez également opter pour le support de fixation mural offert en option (#GMP6WMS, pour GMP6 seulement).
2. Remplissez le réservoir du GMP en respectant la quantité recommandée pour votre système. La concentration recommandée lors de l'utilisation d'un mélange eau/glycol est de 50%.

OUVREZ LE ROBINET D'ISOLEMENT DE L'INSTALLATION, INSÉREZ LA FICHE ÉLECTRIQUE DE LA POMPE DANS LA FICHE DE L'INTERRUPTEUR À FLOTTEUR DE CONTRÔLE COMBINÉ (PIGGYBACK) PUIS DANS LA PRISE MURALE.

**Note :** Le manomètre couplé au système d'appoint peut indiquer une pression différente de celle indiquée sur un manomètre installé à un autre point de l'installation. La différence peut s'expliquer par des variations de calibration ou par des variantes dans les hauteurs d'élévation et peut être normale.

3. Si la pression dans le système est inférieure à la valeur de consigne du réducteur de pression, la pompe se mettra en marche. La pompe continuera de fonctionner jusqu'à ce que la pression de l'installation atteigne la valeur de consigne du réducteur de pression. Les cycles de la pompe peuvent être accélérés. La pompe s'auto-amorce à 8 pieds.
4. S'il est nécessaire que la pression dans le système soit plus élevée, réglez le réducteur de pression à la valeur requise comme suit :
   a) Dévissez l'écrou autoblocant.
   b) Tournez la vis dans le sens des aiguilles d'une montre jusqu'à ce que le manomètre indique la pression désirée.
   c) Maintenez la vis en position et serrez l'écrou autobloquant. Le réducteur de pression standard du système d'appoint peut être réglé jusqu'à une pression de 60 PSI.
   d) Bloquez la vis et serrez l'écrou de sûreté.
5. Pour obtenir une pression inférieure, ouvrir le robinet de sûreté et laisser descendre la pression sous le niveau de pression désirée. Refaire les étapes du point 4.

# ENTRETIEN

Le GMP ne requiert aucun entretien à intervalles fixes.

### ➔ La pression de l'installation se situe sous la valeur de consigne.

| CAUSE POSSIBLE | MESURE DE CORRECTION |
|---|---|
| Le robinet d'isolement du système est fermé. | Ouvez le robinet d'isolement. |
| Le système d'appoint n'est pas branché. | Branchez le système à une prise murale. |
| Le système d'appoint n'est pas alimenté. | Vérifiez si la prise murale est alimentée en électricité. |
| Le niveau du réservoir est bas.<br>L'interrupteur à flotteur a éteint le système. | Ajoutez du liquide. Trouvez la source de fuite et réparez. |
| Le réducteur de pression est mal réglé. | Réglez le réducteur de pression<br>(Étape 4 de la mise en marche). |
| L'interrupteur à flotteur de contrôle de niveau combiné (piggyback) ne fonctionne pas correctement. | Vérifiez si l'interrupteur à flotteur de contrôle de niveau combiné (piggyback) fonctionne correctement. Assurez-vous qu'il bouge librement. |
| Le manomètre est défectueux. | Vérifiez la pression à l'aide d'un autre manomètre. Remplacez le manomètre défectueux. |
| Le moteur de la pompe est en panne. | Remplacez la pompe. |

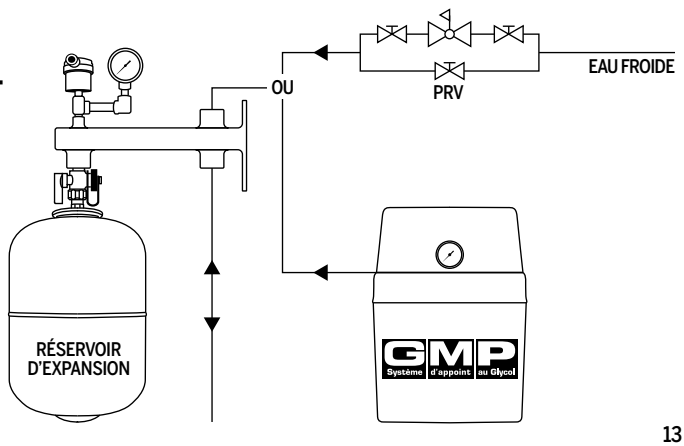
### ➔ La pompe ne s'auto-amorce pas.

| CAUSE POSSIBLE | MESURE DE CORRECTION |
|---|---|
| Un clapet de non-retour externe ou un régulateur de pression a été installé entre le système et le GMP. | Enlevez le clapet de non-retour ou le régulateur de pression. |
| Une poche d'air s'est formée dans la pompe. | Purgez la conduite d'alimentation. |

### ➔ La pompe cycle continuellement.

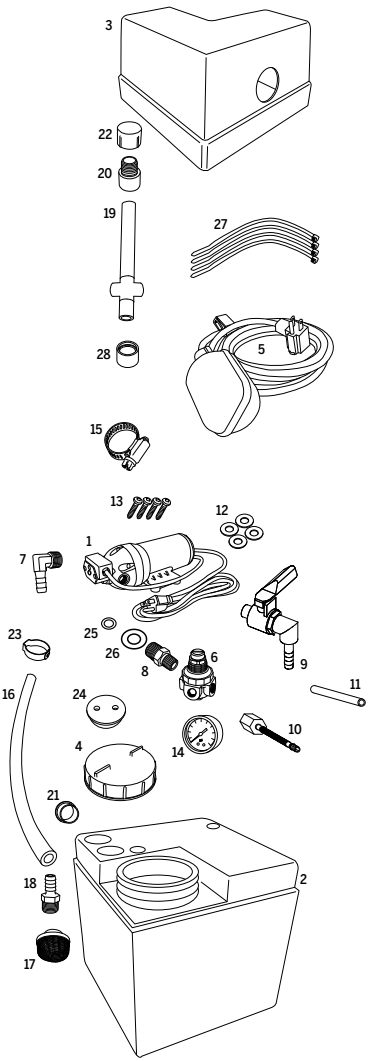
| CAUSE POSSIBLE | MESURE DE CORRECTION |
|---|---|
| De l'air est expulsé de l'installation pour être remplacé par du liquide. | Laissez le temps nécessaire pour que l'air soit expulsé. La pompe cesse de fonctionner lorsque tout l'air est purgé. |
| Un clapet de non-retour externe ou un régulateur de pression a été installé entre le système et le GMP. | Enlevez le clapet de non-retour ou le régulateur de pression. |
| L'interrupteur à flotteur de contrôle de niveau combiné (piggyback) n'éteint pas la pompe. | Assurez-vous que l'interrupteur à flotteur de niveau combiné fonctionne correctement et qu'il n'est pas maintenu en position fermée (flottaison). |
| Le système a une fuite. | Trouvez la source de la fuite et réparez. |

# SCHÉMA DE RACCORDEMENT



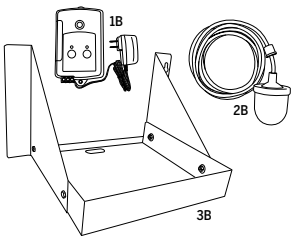
# GMP6-18 PIÈCES

| RÉF. | DESCRIPTION | No DE PIÈCE |
|---|---|---|
| 1 | Pompe | GMP-PUMP |
| 2 | Réservoir | GMP-TANK-6* |
| 2 | Réservoir | GMP-TANK-18** |
| 3 | Couvercle gris | GMP COVER |
| 4 | Bouchon | GMP-LID |
| 5 | Interrupteur avec fiche | GMP DOSER |
| 6 | Soupape de régulation de pression | XACV01275 |
| 7 | Raccord ⅜" MNPT x cannelé | GMP1396C |
| 8 | Raccord ⅜" MNPT x ¼" MNPT | GMP122CB |
| 9 | Valve ⅛" MNPT x ¼" cannelé | GMP1103* |
| 10 | Boyau renforcé noir 4 ½ | XASBH4.5 |
| 11 | Boyau clair ¼" x 3" | GMP36043 |
| 12 | Rondelle | GMPW146** |
| 13 | Vis 1" en acier inoxydable | GMPSCREW-10** |
| 13 | Vis ¾" acier inoxydable | GMPT1112S1* |
| 14 | Manomètre | GMPGAGE2 |
| 15 | Collier de serrage à vis sans fin | GMPCLAMP |
| 16 | Boyau ⅜" ø x 11 ½" | B381001112* |
| 16 | Boyau ⅜" ø x 36" | B3810036** |
| 17 | Tamis | GMP-STRAINER |
| 18 | Raccord cannelé x fileté pour tamis | GMP125-6C |
| 19 | Tuyau ½" ø x 11 7/16" | PVC401212NP* |
| 19 | Tuyau ½" ø x 33 ¼ " | PVC401233NP** |
| 20 | Adaptateur mâle ½ '' | GMP12AM |
| 21 | Obturateur noir 1" | APHP013A |
| 22 | Bouchon ½" MNPT | GMPCAP |
| 23 | Attache ½" | GMPCLAMP2 |
| 24 | Passe-fil | GMP-GROMMET |
| 25 | Joint torique | GMPORING |
| 26 | Rondelle 16 mm | GMPITTWASHER |
| 27 | Attache de nylon 6" | TW6** |
| 28 | Raccord de plastique collé 1" x ¾" | PVC4034M** |




**OPTIONS**

| | | |
|---|---|---|
| 1B+2B | Panneau d'alarme à distance c/a pile 9V | GMPAL |
| 2B | Interrupteur de niveau / contact sec | GMPDC |
| 3B | Support de montage mural | GMP6WMS |




*GMP6 pièce **GMP18 pièce

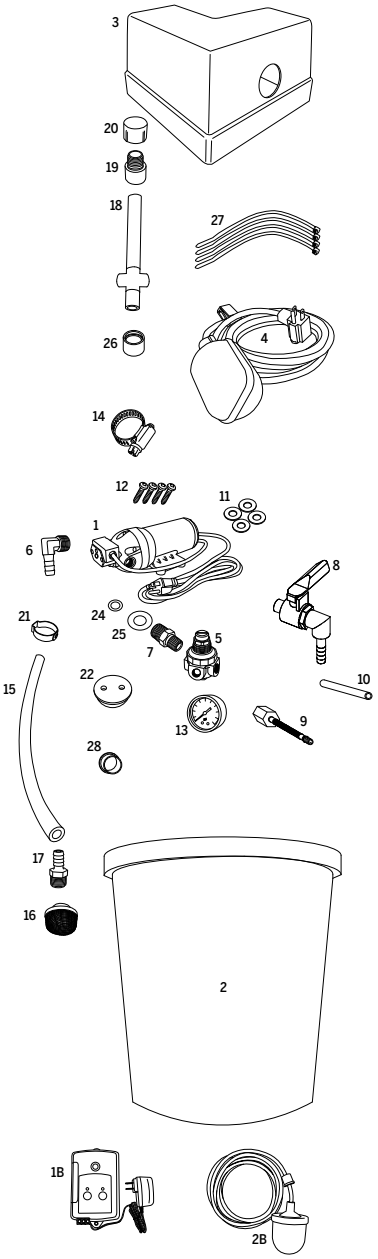
# GMPLC55-LC100 PIÈCES

| RÉF. | DESCRIPTION | No DE PIÈCE |
|---|---|---|
| 1 | Pompe | GMP-PUMP |
| 2 | Réservoir | GMP-TANK-55* |
| 2 | Réservoir | GMP-TANK-100** |
| 3 | Couvercle gris | GMP COVER |
| 4 | Interrupteur avec fiche | GMP DOSER |
| 5 | Soupape de régulation de pression | XACV01275 |
| 6 | Raccord ⅜" MNPT x cannelé | GMP1396C |
| 7 | Raccord ⅜" MNPT x ¼" MNPT | GMP122CB |
| 8 | Valve ⅛" MNPT x ¼" cannelé | GMP1103* |
| 9 | Boyau renforcé noir 4 ½ | XASBH4.5 |
| 10 | Boyau clair ¼" x 3" | GMP36043 |
| 11 | Rondelle | GMPW146* |
| 12 | Vis 1" en acier inoxydable | GMPSCREW-10 |
| 13 | Manomètre | GMPGAGE2 |
| 14 | Collier de serrage à vis sans fin | GMPCLAMP |
| 15 | Boyau ⅜" ø x 46" | B3810046* |
| 15 | Boyau ⅜" ø x 57" | B3810057** |
| 16 | Tamis | GMP-STRAINER |
| 17 | Raccord cannelé x fileté pour tamis | GMP125-6C |
| 18 | Tuyau ½" ø x 42" | PVC4042* |
| 18 | Tuyau ½" ø x 53 ¼ " | PVC405325** |
| 19 | Adaptateur mâle ½ '' | GMP12AM |
| 20 | Bouchon ½" MNPT | GMPCAP |
| 21 | Attache ½" | GMPCLAMP2 |
| 22 | Passe-fil | GMP-GROMMET |
| 24 | Joint torique | GMPORING |
| 25 | Rondelle 16 mm | GMPITTWASHER |
| 26 | Raccord de plastique collé 1" x ¾" | PVC4034M |
| 27 | Attache de nylon 6" | TW6 |
| 28 | Obturateur noir 1" | APHP013A |

**OPTIONS**

| | | |
|---|---|---|
| 1B+2B | Panneau d'alarme à distance c/a pile 9V | GMPAL |
| 2B | Interrupteur de niveau / contact sec | GMPDC |

*GMPLC55 pièce **GMPLC100 pièce



# GARANTIE

## GARANTIE LIMITÉE D'UN AN SUR LES MODÈLES GMP6-GMP18-GMPLC22-GMPLC100 À PARTIR DE LA DATE D'ACHAT OU 6 MOIS APRÈS LA DATE DE FABRICATION.

Les Solutions Calefactio inc. garantit au SEUL acheteur initial que le produit qui lui a été vendu est exempt de tout défaut de fabrication et de matériel et qu'il est conforme aux spécifications publiées par Les Solutions Calefactio inc. La présente garantie n'est valable que si l'installation et l'utilisation du produit respectent des conditions normales d'utilisation et que le produit sert aux fins pour lesquelles il a été conçu, sous réserve des conditions énoncées ci-dessous. Si l'acheteur ne protège pas le produit, s'il ne l'installe et ne l'utilise pas selon les consignes du fabricant, la présente garantie sera frappée de nullité.

Si l'acheteur décèle un défaut de matériel ou remarque une défaillance du produit, cette personne doit immédiatement en aviser l'installateur, le distributeur ou le magasin auprès duquel le produit a été acheté. Les Solutions Calefactio inc. sera ensuite avisée de la réclamation par l'un d'eux. Les Solutions Calefactio inc. n'accepte aucun avis de défaillance d'un produit une fois qu'est écoulée la période garantie. À la demande du fabricant, et avant de tenter de réparer le produit ou une pièce qui en fait partie, il faut retourner le produit ou la pièce rapidement à l'un des entrepôts du fabricant ou à un représentant de service autorisé, selon les indications du fabricant. Le fabricant n'est nullement responsable de la perte du produit en cours de transport ou des dommages subis. De plus, aucune réclamation en vertu de la garantie ne sera acceptée à moins que le produit retourné ne soit dans le même état qu'avant son expédition. Les réclamations liées aux dommages subis pendant le transport relèvent de la seule responsabilité du client et celui-ci doit s'adresser directement à l'entreprise de transport. Les produits réparés ou remplacés seront expédiés aux clients aux conditions de transport du fabricant. Le fabricant garantit les pièces de rechange quatre-vingt-dix (90) jours ou pendant la durée résiduelle da la garantie applicable au produit réparé.

Si la réclamation est fondée, la seule obligation du fabricant en vertu de la présente garantie consiste, à son gré, à réparer ou à remplacer le produit défectueux. Aucun remboursement ne sera accordé. Les Solutions Calefactio inc. se réserve le droit de corriger la défaillance du produit en utilisant des pièces de rechange neuves ou usagées. Les réparations seront exécutées aux frais de Les Solutions Calefactio inc. Les Solutions Calefactio inc. REFUSERA toute demande de remboursement formulée par un client à l'égard des frais engagés pour le retrait ou la réinstallation du produit ou de l'une des pièces du produit. Aucun produit retourné – ni aucune pièce faisant partie du produit – montrant des signes évidents d'une réparation, d'une altération ou de toute autre modification effectuée sans l'autorisation écrite préalable de Les Solutions Calefactio inc. ne sera accepté. Si Les Solutions Calefactio inc. n'est pas en mesure de réparer le produit, elle fournira au client un produit de rechange. Au cours du remplacement des pièces ou du produit lui-même, Les Solutions Calefactio inc. se réserve le droit de modifier la conception, la construction ou les matériaux si elle juge nécessaire de remplacer le produit défectueux par un nouveau modèle équivalent ou de mettre à niveau les pièces d'un produit défectueux.

En vertu des dispositions de la présente garantie, le fabricant ne peut en aucun cas être tenu responsable dans les cas qui suivent :

**1.** Des pertes ou des dommages consécutifs, indirects, accessoires ou particuliers. Lesdits dommages comprennent, mais sans restreindre la portée générale de ce qui suit, les pertes de bénéfices, la perte de capitaux, la perte de revenus ou d'économies, la perte résultant de la non-utilisation du produit ou de l'équipement afférant, le temps d'arrêt, le coût de l'équipement, de lieux ou des services de remplacement, les blessures, les dommages matériels ou les réclamations formulées par des tiers (y compris le client). Dans certaines provinces ou certains États, il est interdit d'exclure les dommages consécutifs ou indirects, la présente disposition ne peut donc pas s'appliquer dans ce cas ;

**2.** Des dommages, des défectuosités ou des défaillances résultant d'une installation ou d'un entretien qui ne respectent pas les consignes imprimées accompagnant le produit ;

**3.** Des défaillances ou des dommages résultant des conditions d'utilisation anormales, d'un accident d'une mauvaise manipulation, d'une négligence ou d'un mauvais usage du produit (soit d'utiliser le produit pour des fins autres que celles pour lesquelles il a été conçu) ;

**4.** Les pertes, les dommages et les frais de main d'œuvre engagés par le client en raison de l'installation de mauvaises pièces ou de pièces défectueuses, de travaux de réparation ou d'entretien inadéquats réalisés par des tiers ou de l'apport non autorisé d'accessoires ou de modifications ;

**5.** Les dommages causés par, entre autres (mais sans restreindre la portée générale de ce qui suit), du sable, des abrasifs, des accumulations de produits chimiques, de la boue, des résidus huileux, de l'acide, de la rouille, une manutention ou une installation inadéquates ;

**6.** Les dommages résultant d'une catastrophe comme un incendie, des rafales, un tremblement de terre ou la foudre ;

**7.** Les pièces, les composants ou les produits qui n'ont pas été fabriqués par Les Solutions Calefactio inc. mais qui ont été utilisés avec le produit qui fait l'objet de la présente vente ;

**8.** Un mauvais usage ou un usage abusif par le client.

Tous les travaux de réparation ou d'entretien que le fabricant exécute pour des défaillances autres que celles énumérées dans la présente garantie seront facturés au tarif habituel de l'équipement, des pièces et du service du fabricant.

Aucun produit, ni aucune pièce, retourné au fabricant sans avoir obtenu une autorisation préalable ne sera accepté.

La présente garantie est la seule garantie du fabricant, toute autre garantie, expresse ou implicite en vertu de la loi ou en fait, y compris mais sans restreindre la portée générale de ce qui suit, les garanties de qualité marchande et d'adaptabilité à un usage particulier sont par la présente expressément exclues. Dans certaines provinces ou certains États, il est interdit de limiter la durée des garanties implicites, il se peut donc que la présente disposition ne s'applique pas dans votre cas. La présente garantie ne s'applique qu'à l'acheteur initial du produit et n'est pas transférable.

À moins d'une modification convenue par écrit entre les deux parties participant à la transaction, la présente entente est réputée être l'entente intégrale et exclusive entre les parties et elle remplace toutes les ententes antérieures, écrites ou verbales,

GMPINST201401-TRI

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CALEFACTIO

# Installation, Operation and Maintenance Manual

**Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage!**

## Table of Contents

*Reference part number listed in chart to locate specific motor information page number.*

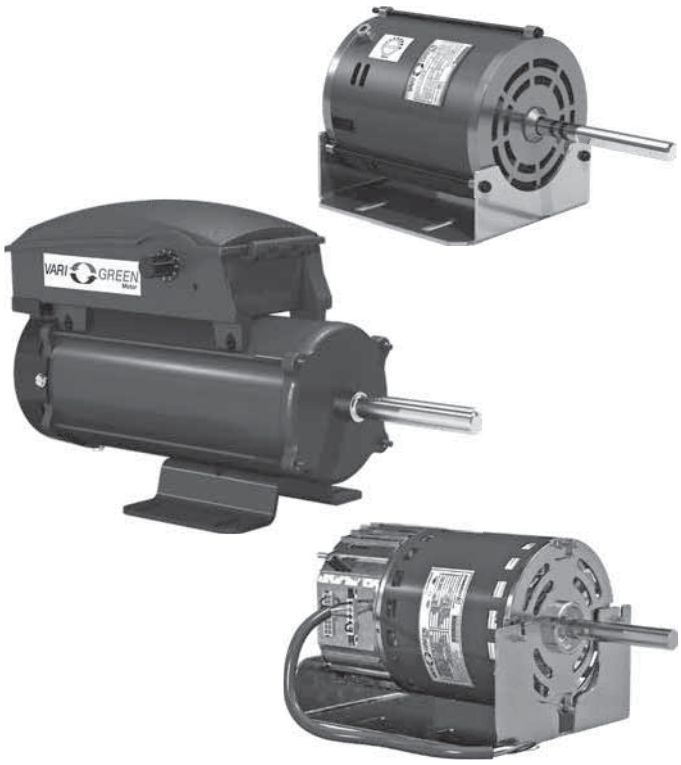
| HP | Voltage | * RPM Range | Encl. | FLA | Control Method | Motor Part No. | Pg. |
|---|---|---|---|---|---|---|---|
| 1/6 | 115 | 300-1725 | TENV | 3.1 | 0-10V Only | 311352 | 2 |
| | | | | 3.1 | Pot Only | 311353 | 2 |
| | | | | 3.4 | Pot/0-10V | 311731 | 3 |
| | | | | | | 312359 | 3 |
| 1/6 | 208-240 | 300-1725 | TENV | 1.6 | Pot/0-10V | 313233 | 3 |
| 1/4 | 115 | 300-1725 | ODP | 3.9 | 0-10V Only | 310107 | 2 |
| | | | | 3.9 | Pot Only | 310108 | 2 |
| | | | | 3.7 | Pot/0-10V | 311377 | 3 |
| 1/4 | 115/ 208-240 | 300-1725 | ODP | 3.3/1.8 | Pot/0-10V | 310175 | 6 |
| 1/4 | 208-240 | 300-1725 | ODP | 2.3 | Pot/0-10V | 313234 | 3 |
| 1/2 | 115 | 300-1725 | ODP | 6.2 | 0-10V Only | 309025 | 2 |
| | | | | 6.2 | Pot Only | 309028 | 2 |
| | | | | 6.7 | Pot/0-10V | 311812 | 3 |
| 1/2 | 115/ 208-240 | 300-1725 | ODP | 6.8/3.5 | Pot/0-10V | 310176 | 6 |
| 1/2 | 208-240 | 300-1725 | ODP | 4.2 | Pot/0-10V | 313235 | 3 |
| 1/2 | 115 | 300-2500 | ODP | 6.5 | 0-10V Only | 310307 | 2 |
| | | | | 6.5 | Pot Only | 310476 | 2 |
| | | | | 6.5 | Pot/0-10V | 312360 | 3 |
| 3/4 | 115 | 300-1725 | ODP | 10.1 | 0-10V Only | 309026 | 2 |
| | | | | 10.1 | Pot Only | 309029 | 2 |
| | | | | 10.6 | Pot/0-10V | 311388 | 3 |
| | | | | | | 312619 | 3 |
| 3/4 | 115/ 208-240 | 300-1725 | ODP | 9.0/4.9 | Pot/0-10V | 310177 | 6 |
| 3/4 | 208-240 | 300-1725 | ODP | 6.6 | Pot/0-10V | 314534 | 3 |
| 3/4 | 115 | 300-2200 | ODP | 11.3 | 0-10V Only | 310306 | 2 |
| | | | | 11.3 | Pot Only | 310475 | 2 |
| | | | | 11.3 | Pot/0-10V | 312361 | 3 |
| 1 | 115 | 300-1725 | ODP | 12.4 | Pot/0-10V | 310359 | 3 |
| | | | | | | 312362 | 3 |
| 1 | 115/ 208-240 | 300-1725 | ODP | 11.4/6.3 | Pot/0-10V | 310178 | 6 |
| 1 | 115/ 208-240 | 300-1725 | TEFC | 12.0/6.0 | Pot/0-10V | 311156 | 4 |
| 1 | 208-240 | 300-1725 | ODP | 8.6 | Pot/0-10V | 314945 | 3 |
| 2 | 208-240 | 300 - 1725 | TEFC | 12.0 | Pot/0-10V | 310420 | 4 |

*Actual maximum RPM may vary. See RPM column in chart on pg. 10 for specific motor and fan combinations.

Controls . . . . . .7-9
Maximum RPM Table. . . . . 10

## Vari-Green® Motor

The Vari-Green Motor is an electronically commutated (EC) motor that uses AC input power and internally converts it to a DC power supply which provides an 80% turndown capability and increased energy savings.




**NOTE**

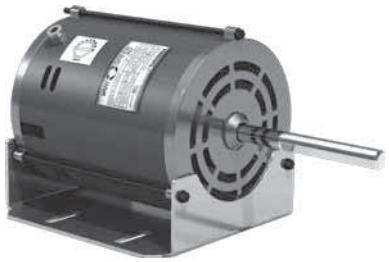
When using a clamp meter to measure input amp draw, the meter must be capable of reading a non-linear current. Erroneous readings will occur otherwise.

**WARNING**

To reduce the risk of fire or electric shock, do not use this motor with any solid-state speed control device.

## Features, Operation, Wiring and Troubleshooting

### Features



**Soft start** – All motors feature soft-start technology which eliminates inrush current at start-up. The motors will reliably start at any speed setting.

**Overload protection** – If the motor becomes overloaded, it will automatically reduce its speed until it is no longer overloaded. This means that the motor will never operate in the "service factor" which is possible with many AC motors.

**Locked rotor protection** – If the motor ever encounters a locked-rotor scenario, the motor will automatically shut itself down. It will try to restart up to 3 times, and if after the 3rd time the motor will still not rotate, the motor will not attempt to start again until power is cycled.

**Thermal protection** – The motors have a one-shot fuse thermal protector. This is meant to protect the motor from a severe temperature rise. With the motor controller's ability to software limit the speed, the fuse is used as a last resort to prevent a fire.

**RPM measurement** – The motors have a small shaft extension on the end of the motor to measure motor RPM with either a contact or optical tachometer.

### Operation and Wiring
**- Potentiometer Dial Only**

| Part Numbers Covered in this Section | | | | |
|---|---|---|---|---|
| 309028 | 309029 | 310108 | 310475 | 310476 |
| 311353 | | | | |

These motors feature a potentiometer dial on the motor for speed adjustment. A small screwdriver can be used to make the speed adjustment. To increase the speed, rotate the dial clockwise. To decrease the speed, rotate the dial counter clockwise.

The motor is pre-wired at the factory and cannot be changed inside the motor. Connect single-phase power at the voltage listed on the nameplate.

These motors cannot be converted to receive a remote control signal – a different motor is needed. Please consult the factory.

### Operation and Wiring
**- 0-10V Input Only**

| Part Numbers Covered in this Section | | | | |
|---|---|---|---|---|
| 309025 | 309026 | 310107 | 310306 | 310307 |
| 311352 | | | | |

These motors will accept a 0-10 VDC control signal for speed control. From 0-1.9V, the motor will be off, and will operate in the 2-10V range. 24 VAC/DC power is also required for operation. The motor will consume 0.7VA at 24 VAC or 25mA at 24 VDC. A factory mounted transformer is available to supply this voltage. See Fig. 1

The motor is pre-wired at the factory and cannot be changed inside the motor. Connect single-phase power at the voltage listed on the nameplate, along with the 0-10 VDC and 24V signal for speed control.

NOTE: The motor will not operate without the proper control voltages.

**Transformer Assembly**

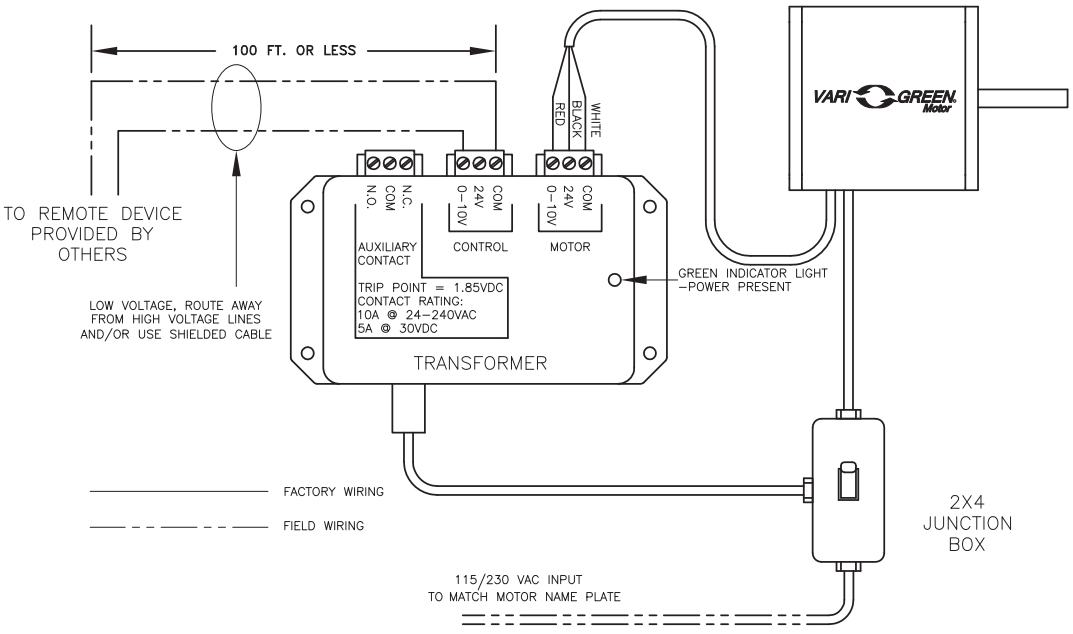



Fig. 1 **0-10 VDC External connection with factory mounted transformer**

## Operation and Wiring

**- Potentiometer Dial and 0-10V Input**

| Part Numbers Covered in this Section | | | | |
|---|---|---|---|---|
| 310359 | 311731 | 311377 | 311388 | 311812 |
| 312359 | 312360 | 312361 | 312362 | 312619 |
| 313233 | 313234 | 313235 | 314534 | 314945 |

These motors have both a potentiometer dial on the motor for speed adjustment AND have the ability to accept a 0-10 VDC signal for remote speed control.

There is a 4 second delay between the application of power and the motor starting.

The motor is pre-wired at the factory and cannot be changed inside the motor. Connect single-phase power at the voltage listed on the nameplate. If remote control is desired, connect the 0-10 VDC and 24V signal for remote speed control.

**Dial on motor** – A small screwdriver can be used to make the speed adjustment. To increase the speed, rotate the dial clockwise. To decrease the speed, rotate the dial counter clockwise. There is no need to connect the control wires.

**0-10 VDC signal** – The dial on the motor must be rotated fully clockwise to achieve the full speed range. If this is not done, the dial will act as a maximum speed limiter.

From 0-1.9V, the motor will be off, and will operate in the 2-10V range. 24 VAC/DC power is also required for operation. The motor will consume 0.7VA at 24 VAC or 25mA at 24 VDC. A factory mounted transformer is available to supply this voltage. See Fig. 1

A low voltage wiring harness is needed to supply the 0-10V signal to the motor. This harness is available from the factory if conversion is necessary.

| Low Voltage Harness Part Numbers | | | |
|---|---|---|---|
| **Type** | **Use with Motor** | **18 in. long** | **36 in. long** |
| 3-pin | 311731, 310359 | 384431 | 384432 |
| 9-pin | 312359, 311377, 311812, 311388, 312360, 312361, 312362, 312619, 313233, 313234, 313235, 314534, 314945 | 384804 | 384805 |

**NOTE**

The 9-pin connector on the motor contains 6 wires. The red, black and white wires are used for the external control signal and the other three are used for factory initialization and programing.

| 0-10V Analog input connection | |
|---|---|
| Red | + 0-10 VDC |
| White | Common* |
| Black | +24 VAC/DC |
| *Common is shared between both 24V power and 0-10V signal. | |
| The impedance of 0-10V circuit is 12KΩ | |

## Troubleshooting

**Motor does not operate**

1. Check all wiring connections to ensure they are correct and secure.
2. Verify that all voltages are present at the motor, including 24V and 0-10 VDC, if applicable.
3. Make sure that the fan wheel will rotate freely and there are no foreign objects in the wheel. If fan wheel does not rotate freely, disconnect power from the motor and adjust the wheel or housing until the wheel can freely rotate. Apply power and the motor should restart.
4. If motor has both the dial on the motor and 0-10 VDC control option, control wiring issues can be tested by disconnecting the control wires from the motor. The motor should then operate using the dial on the motor for speed control.

**Motor will not reach maximum speed**

1. Make sure dial is rotated full clockwise, if applicable.
2. Make sure motor is receiving 10 VDC, if applicable.
3. There are some motor/fan combinations where the motor may not reach nameplate RPM. See Max RPM table on page 10 for the maximum motor speed for your application.

## Factory Mounted Transformer (Fig. 1)

A factory mounted transformer is available to supply 24 VDC power to the motor when the 0-10V signal is by others. This transformer has the capability to power a remote device if desired. The power available to a remote device is 400mA at 24 VDC. If the remote device is powered by a different source, connect the analog output to the 0-10V and COM terminals of the transformer. This will pass the signal through to the motor.

**WARNING**

**Do not connect an external 24V supply to the transformer's control terminal labeled 24V. If the external device providing the 0-10V signal is powered elsewhere, this terminal can remain unused.**

| Part Numbers Covered in this Section | |
|---|---|
| 310420 | 311156 |

## Features

**Speed control** - These motors can be controlled by either a dial on the motor or a 0-10 VDC signal for remote control.

**Soft start** – All motors feature soft-start technology which eliminates inrush current at start-up. The motors will reliably start at any speed setting. There will be up to a 30 second delay between the application of power and the motor starting.

**Overload protection** – If the motor becomes overloaded, it will automatically shut itself down. The maximum programed motor speeds have been selected to prevent this from happening in normal operation.

**Locked rotor protection** – If the motor encounters a locked-rotor scenario, it will automatically shut itself down. It will try to restart up to 3 times, and if after the 3rd time the motor will still not rotate, the motor will not attempt to start again until power is cycled.

**Thermal protection** – The motors have an automatic reset thermal protector. This is meant to protect the motor from a severe temperature rise.

**RPM measurement** – The motor RPM can be measured by removing the cooling fan cover and using a contact or optical tachometer. Be sure to replace the cooling fan cover when finished.

**Reversible rotation** – The motor direction has been pre-set at the factory for the rotation of the fan but can be reversed if necessary.

## Operation and Wiring

These motors can be controlled by either a dial on the motor or a 0-10 VDC signal for remote control. The motor will be supplied from the factory with the correct accessory depending on what was ordered.

**Dial on Motor -** Turn the dial with your fingers to adjust. To increase the speed, rotate the dial clockwise. To decrease the speed, rotate the dial counter clockwise. Turning the dial full CCW will turn the motor off.

**0-10 VDC Signal -** From 0-1.9V, the motor will be off, and will operate in the 2-10V range. This motor does not require 24V power for operation.

| 0-10V Analog input connection | |
|---|---|
| Red | + 0-10 VDC |
| White | Ground |

## Wiring

1. All high and low voltage wiring connections are made inside the motor control box at the factory. Normally, there is no reason to enter the control box of the motor. If there is a need to enter the control box, disconnect power and wait at least five minutes to allow the capacitors to discharge.
2. The motors are factory wired for the ordered voltage. If the factory wired voltage does not match the desired voltage, the voltage can be changed, with exception of the 2HP motor (310420), which is 208-240V only.

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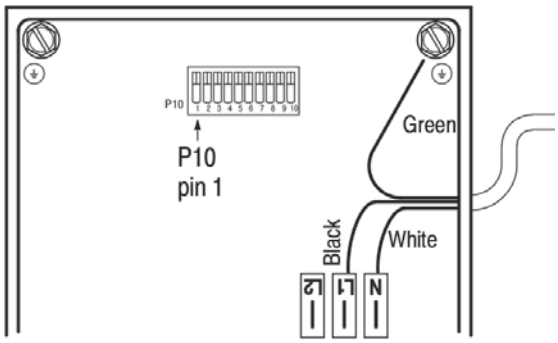
**115V:** Connect 115 VAC to L1, connect Neutral to N. The L2 terminal remains empty. Connect ground to grounding stud.




115V Connection inside control box

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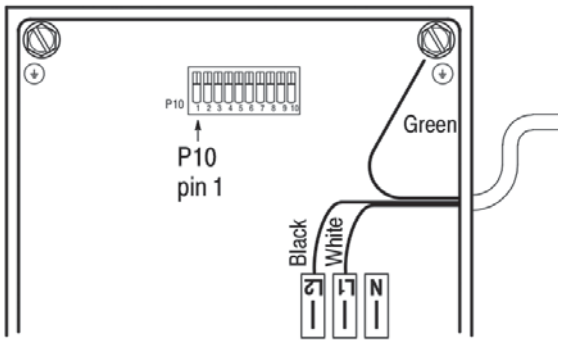
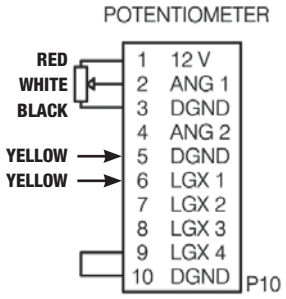
**208-240V -** Connect Line voltage to L1 and L2. The N terminal remains empty. Connect the ground to the grounding stud.



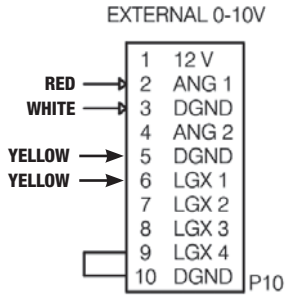

208-240V Connection inside control box

**Dial on motor -** the dial is factory-wired into the low voltage terminal block inside the control box. The wires are connected as shown.




Dial on motor connection inside control box

**0-10 VDC Signal -** a two-wire pigtail is factory-wired into the low voltage terminal block. The wires are connected as shown.

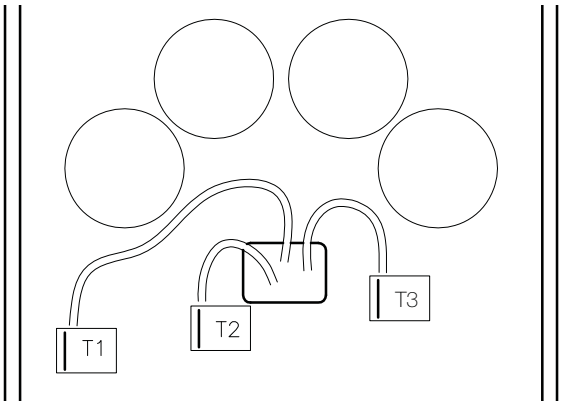



0-10 VDC Signal connection inside control box

If the motor needs to be tested before the 0-10 VDC signal is available, a jumper can be placed between terminals 1 and 2. This will force the motor to run at full speed.

## Motor Rotation

To reverse the rotation of the motor, swap any two of the red, black and blue wires connecting the control board to the motor at terminals T1, T2 and T3. Note that motor warranty is void if motor is rotating in the wrong direction. See fan instruction manual for correct rotation direction.




Rotation selection wires inside control box

## Troubleshooting

These motors have a diagnostic red LED on the circuit board inside the control box, or on the exterior of the control box, that will be solid (not flashing) when power is applied to the motor and the motor is operating normally. The LED may be solid even if the motor is not spinning, such as when power is applied but the motor may be commanded to be off with a 0-1.9V VDC signal.

1. If external LED is not present, to view the status of the LED the control box cover must be removed while power is applied to the motor. If the control box cover is removed while power is applied, extreme care must be taken not to touch any of the components inside the box.

   a. If a fault occurs, the LED will blink a specific number of times to identify the fault that has occurred. The fault indications are as follows:

| Number of Blinks | Indicated Fault |
|---|---|
| 2 | Overcurrent |
| 3 | Overvoltage |
| 4 | Undervoltage |
| 5 | Communication Error |
| 6 | Sync Loss |
| 7 | Spin Fault |
| 8 | Motor overload |
| 9 | Motor Over Temperature |

3. When the LED is blinking, it will consecutively blink from 2 to 9 times, followed by a pause, and repeat the blink sequence. It is best to count the number of flashes 2 or 3 times to ensure accuracy.
4. Under most fault conditions the motor will automatically restart. If a motor overload fault occurs more then 10 times in one hour, the motor will shut down and require a power cycle to reset.
5. If the fault persists, consult the factory.

## Motor does not operate

1. Verify the motor is wired for the correct voltage.
2. Verify that the dial on the motor is properly connected to the control board - or - verify that the 0-10 VDC wires are properly connected to the control board.
3. Verify that the Status LED is solid red.
4. Verify that a jumper is in place between terminals 9 and 10. The motor will not run without this jumper in place.
5. Verify that the two yellow wires coming from the motor are in place on terminals 5 and 6.

| Part Numbers Covered in this Section | | | |
|---|---|---|---|
| 310175 | 310176 | 310177 | 310178 |

## Features

**Speed control** - These motors can be controlled by either the dial on the motor or a 0-10 VDC signal for remote control.

**Soft start** – All motors feature soft-start technology which eliminates inrush current at start-up. The motors will reliably start at any speed setting. There will be a 4 second delay between the application of power and the motor starting.

**Overload protection** – If the motor becomes overloaded, it will automatically reduce its speed until it is no longer overloaded. This prevents the motor from operating in the "service factor" should the motor be misapplied.

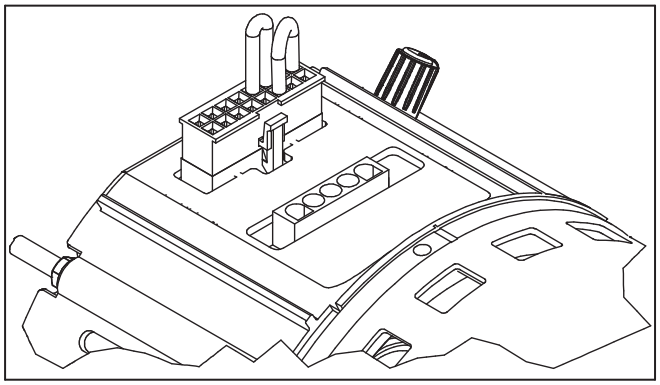
**Locked rotor protection** – If the motor ever encounters a locked-rotor scenario, the motor will automatically shut itself down. It will try to restart up to 3 times, and if after the 3rd time the motor will still not rotate, the motor will not attempt to start again until power is cycled.

**Thermal protection** – The motors have electronic thermal protection. If the motor temperature exceeds its limits, it will slow itself down until the temperatures have dropped.

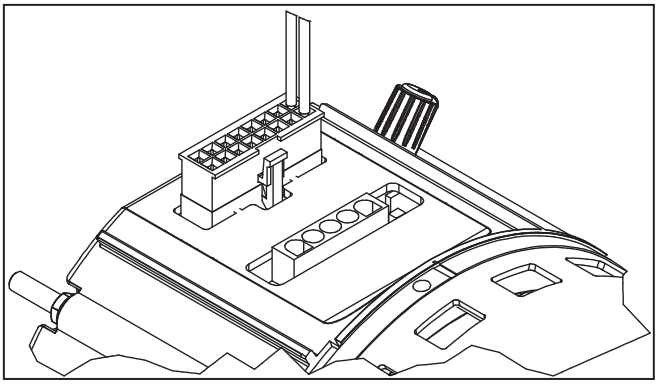
## Operation and Wiring

These motors can be controlled by either the dial on the motor or a 0-10 VDC signal for remote control. The motor will be supplied from the factory with the correct accessory depending on what control option was ordered.

**Dial on Motor -** Turn the dial with your fingers to adjust. To increase the speed, rotate the dial clockwise. To decrease the speed, rotate the dial counter-clockwise. Turning the dial full CCW will turn the motor off. A 16-pin connector with two jumper wires must be installed for the dial to function. (p/n 384962) See image below.



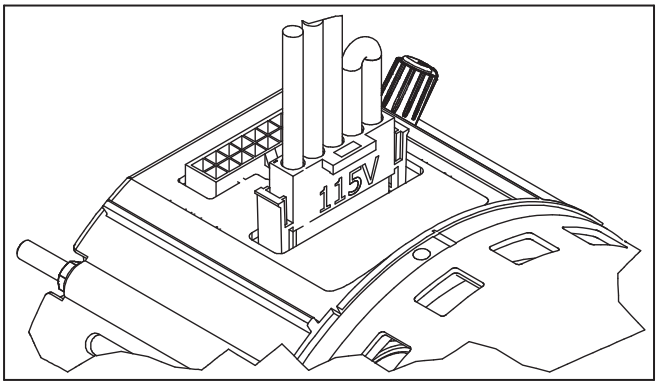
**0-10 VDC Signal -** From 0-1.9V, the motor will be off, and will operate within the 2-10V range. This motor does not require 24V power for operation. For 0-10V operation, a 16-pin connector with two wires connected to pins 8 and 16 is required. (18 in. #384822 • 36 in. #384821)



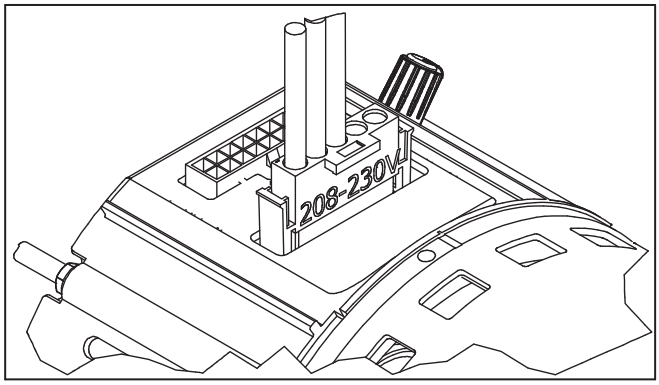
## Wiring

A power cord with a 5-pin connector is required and is shipped with the motor. A different cord assembly is needed depending on the desired voltage:

**115V** - 18 in. #384824 • 36 in. #384823




**208-230V** - 18 in. #384826 • 36 in. #384825

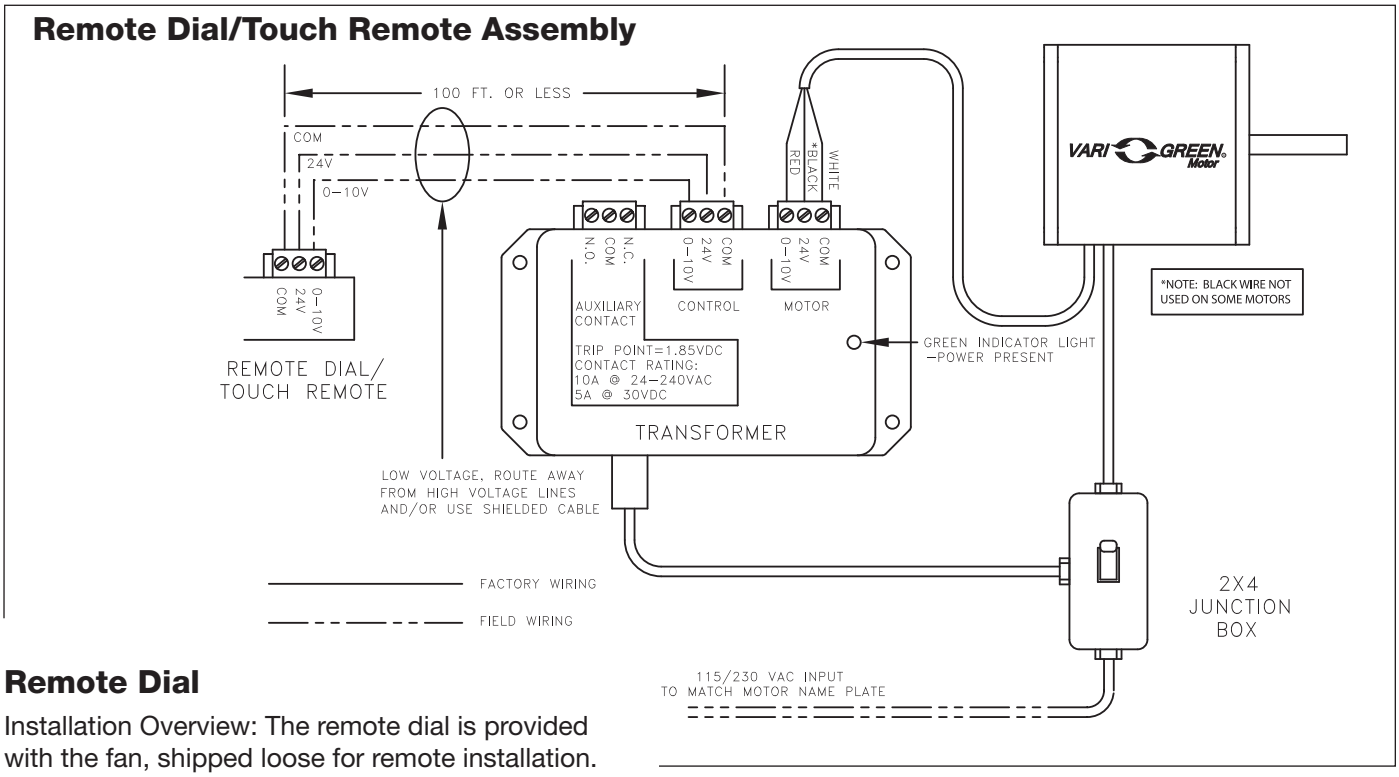


## Controls: Operation, Wiring and Troubleshooting

### Remote Dial/Touch Remote and 2-Speed Control

Other Vari-Green® controls, such as the Constant Pressure and Air Quality families of controls, have their own manual that ship with the controller. They can also be found on Greenheck.com. See table on page 9 for document numbers.

### Remote Dial/Touch Remote Assembly




## Remote Dial

Installation Overview: The remote dial is provided with the fan, shipped loose for remote installation. It also includes a factory mounted 24 VDC transformer.

1. Disconnect power to the fan.
2. Identify where the remote dial will be mounted.
3. Mount a standard single-gang 2x4 junction box.
4. Run a 3-wire control cable from the remote dial to the fan motor compartment. The maximum distance from the fan to the remote dial is 100 feet. If a greater distance is required, signal loss may occur and cause the fan to operate erratically.
5. Connect control cable to transformer mounted inside fan motor compartment. Connect control cable to remote dial.
6. Secure remote dial to 2x4 junction box.

## Touch Remote

Follow installation instructions above. After Power is applied to the system, operate as follows:

1. Touch power button to turn fan on.
2. Touch UP/DOWN arrow to increase/decrease speed.
3. Subsequent touches of the power button will start the countdown timer of 90, 60, 30 or 10 minutes.
4. LED's will turn off after a periods of inactivity.
5. To lock/unlock buttons, hold the UP and DOWN arrows for 3 seconds. When locked, the power button will light up red.

**CAUTION**

**Even though the motor may not be operating, high voltage power may still be present at the motor. Make sure to disconnect power to the fan before servicing.**

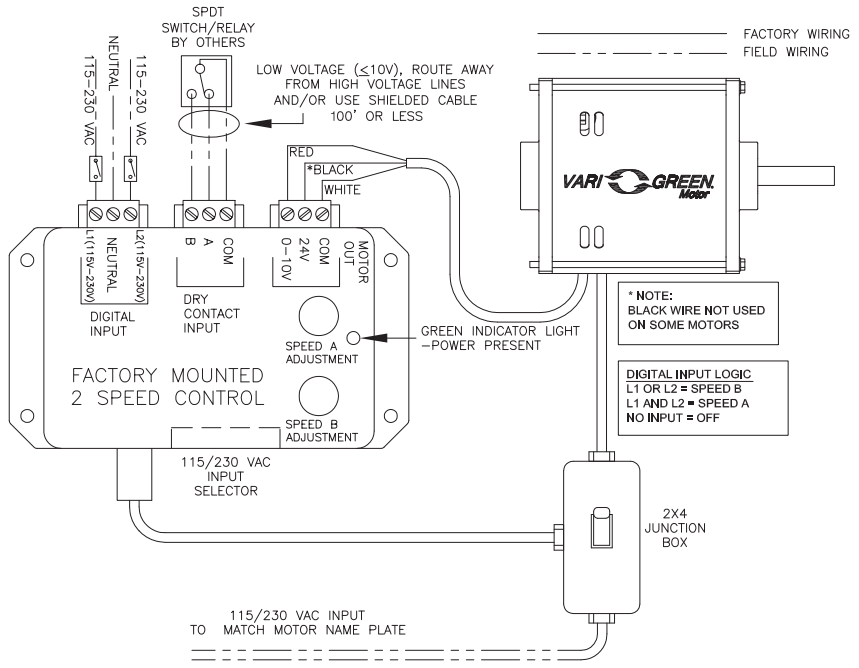
## Troubleshooting - Remote Dial Touch Remote

**Remote Dial does not adjust motor RPM**

1. Check voltage to ensure the motor and transformer are receiving the correct line voltage.
2. Check voltage at the remote dial. 24 VDC should be present across the 24V and COM terminals. 0-10 VDC should be present across the 0-10V and COM terminals.
3. Verify all of the connections at the transformer and make certain that they are secure.
4. Touch remote: Verify that the touch remote is unlocked.

| Terminals | Desired Voltage |
|---|---|
| 24V-COM | 24 VDC Nominal |
| 0-10V-COM | 0-10 VDC (varies with dial position) |

## Two Speed Assembly




## Two Speed

Installation Overview: The two speed control is factory mounted to the fan and may be set to provide any two speeds the application requires. It also includes a 24 VAC transformer which has a dual voltage primary (115/230V), selectable via a switch on the housing near the power cable. The voltage will be factory set to match the motor voltage.

1. A green LED will be illuminated when the 2-speed control is powered.
2. There are two methods of toggling between speed A and speed B:
   a. **Dry contact input** - this utilizes an external switching device such as a relay or SPDT switch to toggle between the two speeds.
      - Connect terminal “A” to “COM” for speed A.
      - Connect terminal “B” to “COM” for speed B.

      If no contact is made between either terminal the motor will be off.
   b. **AC Digital input** - this input allows an AC voltage signal to be fed directly into the 2-speed control to change speeds.
      - Send 115-230V AC to L1 **OR** L2 for speed B.
      - Send 115-230V AC to L1 **AND** L2 for speed A.

      If no voltage is applied to either terminal, the motor will be off.
   c. DO NOT CONNECT BOTH DRY CONTACT AND DIGITAL INPUTS SIMULTANEOUSLY.
3. To test fan operation before the external control devices are installed, a jumper wire can be connected between the COM and A or B terminal on the dry contact input for fan operation.

## Troubleshooting - Two Speed

1. Check all wiring connections to ensure they are correct and secure.
2. Verify AC line voltage is present at the motor and 2-speed control.
3. Verify 24V AC is present at the 24V and COM terminals of the "Motor" terminal block.
4. Measure DC voltage between the 0-10V and COM terminals of the "Motor" terminal block. This voltage should match the dial position of the active dial.
   a. If using dry contact input - ensure contact closure is connecting the proper terminals.
   b. If using AC digital input - disconnect connector from 2-speed control and measure voltage between L1 and Neutral or L2 and Neutral.

## Multiple motors on one control

See the table below for the recommended number of motors to be driven from one controller. Note that the controllers do not have the ability to distinguish between more than one motor, therefore all motors will receive the same control voltage.

| Controls | Maximum Motor Quantity |
|---|---|
| Remote Dial | 4 |
| 2 Speed | 6 |
| Constant Pressure | 4 |
| Temperature/Humidity | 2 |
| VOC | 2 |

## Maintenance

Vari-Green® motors use brushless technology with sealed bearings. No routine maintenance is required other than keeping any debris from accumulating on the motor and controls.

## Other Vari-Green® Control Instruction Manuals

| Description | Document Number |
|---|---|
| Indoor Air Quality - VOC | 475407 |
| Indoor Air Quality - Temperature/Humidity | 475573 |
| Constant Pressure Control | 474766 |

## Motorized Backdraft Damper Control

The available factory mounted transformer (PN 385253) has the ability to signal a motorized back draft damper to open/close as the motor starts/stops.

A N.O./N.C. set of contacts is provided which will change state when above or below a control voltage of 1.85 VDC.

**Contact Rating:**

- 10A @ 24-240 VAC
- 5A @ 30 VDC

**Notes:**

## Maximum RPM Table

This table will show the available motor and fan combinations with the correlating maximum motor RPM for each combination.

| G | Max RPM | Motor HP |
|---|---|---|
| 60-75 | 1725 | 1/6 |
| 80-95 | 1725 | 1/6 |
| 97-99 | 1725 | 1/4 |
| 103 | 1725 | 1/4 |
| 103HP | 1725 | 1/4 |
| | 2500 | 1/2 |
| 123 | 1200 | 1/4 |
| | 1725 | 1/2 |
| 133 | 1150 | 1/4 |
| | 1550 | 1/2 |
| | 1725 | 3/4 |
| 143 | 900 | 1/4 |
| | 1200 | 1/2 |
| | 1300 | 3/4 |
| | 1725 | 1 |
| 143HP | 1500 | 1/4 |
| | 1725 | 1/2 |
| | 2200 | 3/4 |
| 163 | 750 | 3/4 |
| | 1200 | 1 |
| | 1725 | 2 |
| 183 | 900 | 3/4 |
| | 1000 | 1 |
| | 1400 | 2 |

| SE1/SS1 | Max RPM | Motor HP |
|---|---|---|
| 8-440* | 1725 | 1/6 |
| 10-440* | 1725 | 1/6 |
| 12-426 | 1725 | 1/4 |
| 12-432 | 1725 | 1/4 |
| 12-436 | 1725 | 1/4 |
| 14-432 | 1725 | 1/4 |
| 14-436 | 1725 | 1/2 |
| 14-440 | 1725 | 1/2 |
| 16-421 | 1725 | 1/2 |
| 16-426 | 1725 | 1/2 |
| 16-428 | 1725 | 3/4 |
| 16-436 | 1725 | 3/4 |
| 18-424 | 1725 | 3/4 |
| 18-429 | 1725 | 3/4 |
| 20-420 | 1725 | 1 |

***SE1Model Only***

| CUE/CW | Max RPM | Motor HP |
|---|---|---|
| 60-75 | 1725 | 1/6 |
| 80-95 | 1725 | 1/6 |
| 99 | 1725 | 1/4 |
| 101 | 1725 | 1/4 |
| 101HP | 1725 | 1/4 |
| | 2500 | 1/2 |
| 121 | 1400 | 1/4 |
| | 1725 | 1/2 |
| 131 | 1200 | 1/4 |
| | 1450 | 1/2 |
| | 1725 | 3/4 |
| 141 | 1000 | 1/4 |
| | 1300 | 1/2 |
| | 1550 | 3/4 |
| | 1725 | 1 |
| 141HP | 1450 | 1/4 |
| | 1725 | 1/2 |
| | 2200 | 3/4 |
| 161 | 1000 | 1/2 |
| | 1200 | 3/4 |
| | 1300 | 1 |
| | 1725 | 2 |
| 161HP | 1300 | 1/2 |
| | 1650 | 3/4 |
| | 1725 | 1 |
| 180 | 875 | 3/4 |
| | 1000 | 1 |
| | 1400 | 2 |

| LD/LDP | Max RPM | Motor HP |
|---|---|---|
| 80-95 | 1725 | 1/6 |
| 100 | 1725 | 1/4 |
| 120 | 1725 | 1/2 |

| SFD | Max RPM | Motor HP |
|---|---|---|
| 6 | 1725 | 1/4 |
| 7.5 | 1725 | 1/2 |

| SP/CSP | Max RPM | Motor HP |
|---|---|---|
| 510 | 1200 | 1/6 |
| 710 | 1510 | 1/4 |

| SWD | Max RPM | Motor HP |
|---|---|---|
| 7 | 1725 | 1/4 |
| | 2500 | 1/2 |
| 8 | 1725 | 1/4 |
| | 2500 | 1/2 |
| 10 | 1725 | 1/4 |
| | 2200 | 3/4 |
| 13 | 1200 | 1/4 |
| | 1550 | 1/2 |
| | 1725 | 3/4 |
| 15 | 1150 | 1/2 |
| | 1400 | 3/4 |
| | 1725 | 1 |
| 16 | 900 | 3/4 |
| | 1300 | 1 |
| | 1725 | 2 |
| 18 | 850 | 3/4 |
| | 950 | 1 |
| | 1300 | 2 |

| SQ | Max RPM | Motor HP |
|---|---|---|
| 60-75 | 1725 | 1/6 |
| 80-95 | 1725 | 1/6 |
| 97 | 1725 | 1/4 |
| | 2500 | 1/2 |
| 98 | 1725 | 1/4 |
| | 2200 | 3/4 |
| 99 | 1725 | 1/4 |
| | 2200 | 3/4 |
| 100 | 1725 | 1/4 |
| 120 | 1725 | 1/2 |
| 130 | 1725 | 3/4 |
| 130HP | 1250 | 1/4 |
| | 1450 | 1/2 |
| | 1950 | 3/4 |
| 140 | 1500 | 3/4 |
| | 1725 | 1 |
| 140HP | 1100 | 1/2 |
| | 1450 | 3/4 |
| | 1725 | 1 |
| 160 | 1140 | 3/4 |
| | 1300 | 1 |
| | 1725 | 2 |
| 160HP | 850 | 1/2 |
| | 1000 | 3/4 |
| | 1600 | 1 |
| | 1725 | 2 |

## Our Commitment

*As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.*

**Specific Greenheck product warranties can be located on greenheck.com within the product area tabs and listed in the Library under Warranties.**

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at www.amca.org.

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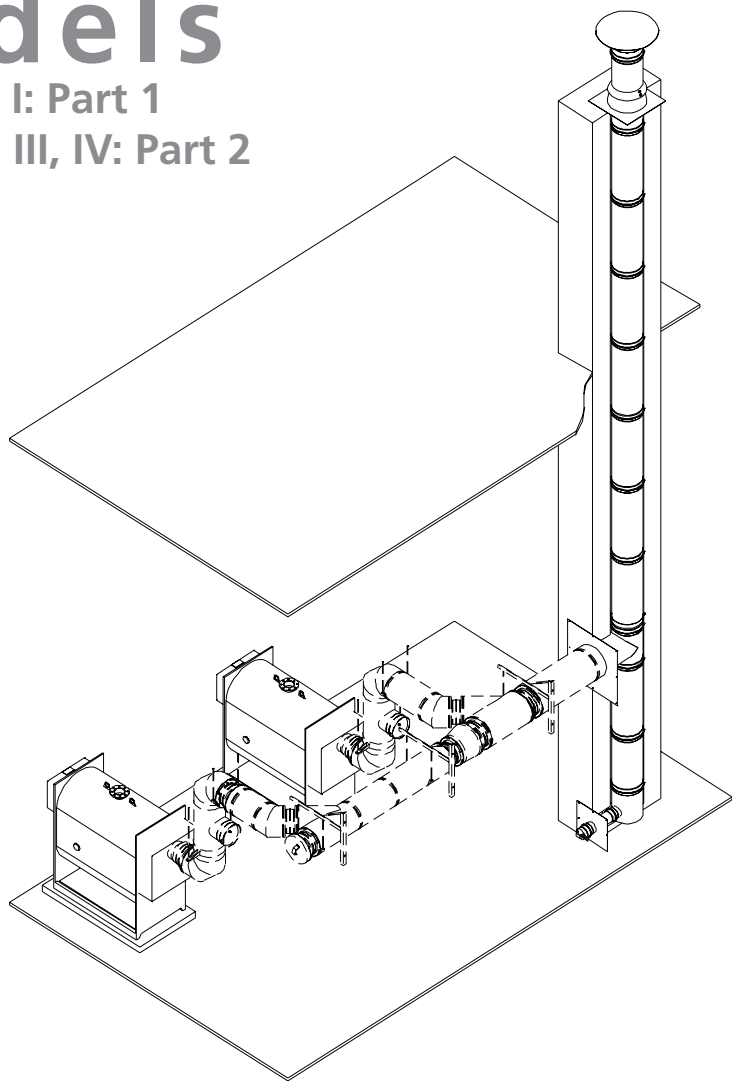
# METALLIC CHIMNEY LINER SYSTEM

## Single Wall Construction Rigid Chimney Liner

## Installation Instructions

# Models

**IPP Cat. I: Part 1**
**HEP Cat I, II, III, IV: Part 2**



c UL us
LISTED
3STS

This symbol shows that Cheminée Lining.E inc. venting systems Models IPP and HEP are Listed in the US and certified for Canada under Underwriters Laboratories inc. file no. MH46608. Tests are made in accordance with UL 1777 standard for Chimney Liners and the Canadian standard for Lining Systems CAN/ULC-S635

**IT IS OF UTMOST IMPORTANCE THAT THIS CHIMNEY BE INSTALLED ONLY IN ACCORDANCE WITH THESE INSTRUCTIONS.**

CHEMINÉE Lining
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**General Notes:**
Use only factory-supplied components. Failure to do so will void the certification and the warranty of this chimney.

**Maintenance Notes:**
Chimney Cleaning: Other than for standard natural gas chimney applications where minimal maintenance is necessary. Keep your chimney clean. Access should be provided for the inspection and cleaning of all sections of the chimney. Have your chimney cleaned by a qualified chimney sweep. If you want to clean the chimney yourself, clean with a nylon or metal chimney brush of the correct size. Do not use a brush that will scratch the stainless steel interior of the chimney.

**WARNING**
**Failure to follow these installation instructions could cause FIRE, CARBON MONOXIDE POISONING, and OR DEATH. If you are unsure of installation requirements, call the phone number listed on the front page of this manual.**

**CHIMNEY SYSTEM MODEL IPP IS SUITABLE FOR POSITIVE PRESSURE APPLICATIONS USE AT MAXIMUM 60 INCH WATER COLUMN AND MODEL HEP AT MAXIMUM 15 INCH WATER COLUMN INTERNAL STATIC PRESSURE AT 570°F.**

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General Notes:

Use only factory-supplied components. Failure to do so will void the certification and the warranty of this chimney.

Maintenance Notes:

Chimney Cleaning: Other than for standard natural gas chimney applications where minimal maintenance is necessary. Keep your chimney clean. Access should be provided for the inspection and cleaning of all sections of the chimney. Have your chimney cleaned by a qualified chimney sweep. If you want to clean the chimney yourself, clean with a nylon or metal chimney brush of the correct size. Do not use a brush that will scratch the stainless steel interior of the chimney.

**WARNING**

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**CHIMNEY SYSTEM MODEL IPP IS SUITABLE FOR POSITIVE PRESSURE APPLICATIONS USE AT MAXIMUM 60 INCH WATER COLUMN AND MODEL HEP AT MAXIMUM 15 INCH WATER COLUMN INTERNAL STATIC PRESSURE AT 570°F.**

# PART 1:
# IPP Category I

## UNDERWRITERS LABORATORIES LISTINGS:

CHEMINEE LINING.E inc. venting systems Models IPP and HEP are Listed by Underwriters Laboratories, inc. (UL) under File MH46608 and Tested in accordance with UL 1777 Chimney Liners and the Canadian Standard for Lining Systems CAN/ULCS635- M91. Listings include the following chimney product categories and diameters.

### UL 1777

| Model | Classification | Diameters |
|---|---|---|
| IPP | Chimney Liners | 6" to 24" I.D. |

### CAN / ULC-S635-M91

| Model | Classification | Diameters |
|---|---|---|
| HEP | Lining systems for existing masonry | 6" to 24" I.D. |

## FEATURES

Models IPP are part of the Industrial Positive Pressure products for industrial and commercial applications. They are prefabricated modular venting systems designed for quick assembly and using a continuous welded joint stainless steel inner wall. Given that all parts have a male and female end, each model part fit into one another, thus eliminating the need for all kinds of adapters. This unique method of coupling provides an incomparable flexibility in selecting models of flues and chimneys. Models IPP are single wall constructions. The high quality of stainless steel inner wall construction using a continuous welded method for the longitudinal joint provides a high strength-to-weight ratio and low friction losses.

## APPLICATION FOR MODELS IPP & HEP CAT 1

### UL 103

**1. Chimney Liners Listing** (Category I, for oil and gas) – Under this category, model IPP liner have been determined suitable for field-installation into new or existing masonry chimneys and used to vent gas-fired and oil-fired appliances in which the maximum continuous flue-gas outlet temperature do not exceed 570°F for oil and 480°F for gas. It also complies with test at 1700°F temperature for 10 minutes.

### CAN/ULC-C959

**1. Standard for Lining Systems for Existing Masonry or Factory-Built Chimneys and Vents (**Class II, for oil and gas) – Under this category, model IPP liner have been determined suitable for installation into existing masonry and used to vent gas-fired and oil-fired appliances in which the maximum continuous flue-gas outlet temperature do not exceed 300°C for oil and 245°C for gas. It also complies with test at 927°C temperature for 10 minutes.

**WARNING**
**NOT FOR USE WITH SOLID-FUEL-FIRED APPLIANCES.**

## SURROUNDINGS/ENCLOSURES

1. In United-States, Models IPP chimney liners are primarily intended to be installed in new or existing masonry chimneys with or without a liner of fire-clay tile, or to be used as a substitute for masonry fire-clay tile flue liners in new chimneys.

2. In Canada, Models IPP chimney liners are primarily intended to be installed in existing masonry chimneys with or without a liner of fire-clay tile, or factory-built chimneys and vents.

3. The minimum brick thickness of the masonry chimney must be of 3"-1/2. Also, the masonry chimney must comply with the National Buildong Code, the Standard for "Design and Construction of Masonry Chimneys and Fireplaces" CAN/CSA A405 and NFPA 211.

4. The heating appliance connected to the chimney liner must not have a flue outlet size larger than the chimney liner area at its smallest point.

5. Rain cap and rain cap with bird screens should be checked for ice formation during low ambient temperature. Consult authority having jurisdiction. Also, it's important to size correctly the venting of low temperature flue products in geographical areas experiencing sustained low ambient temperature.

**CONTACT LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION IN YOUR AREA.**

## SYSTEM SIZING

Complete system sizing and capacity may be obtained from the "Chimney, Gas Vent, and Fireplace Systems" chapter of the ASHRAE Handbook or contact your CHEMINÉE LINING representative. In spite of any sizing guidelines, when sizing exhaust systems, it is most important that the heating appliance, engine or turbine manufacturer's installation instructions be followed. Not following these instructions may result in inadequate chimney performance and/or a violation of the equipment manufacturer's installation requirements.

## PART NUMBERS

These instructions identify major models IPP & HEP parts by part number.

**Example no.1:**
**Number: IPP 48L 12**

| Model | Description | Inside Diameter |
|---|---|---|
| IPP Single Wall | 48″ Pipe Section Length | 12″ |

**Example no.2:**
**Number: HEP 36L 24**

| Model | Description | Inside Diameter |
|---|---|---|
| HEP Single Wall | 36″ Pipe Section Length | 24″ |

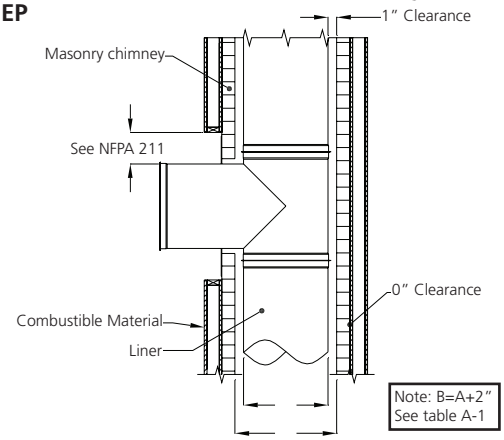
## CLEARANCES

The following table serves to identify the minimum clearances required when installing a liner system in a masonry chimney.

Table A-1. Minimum air space clearance

| Model and diameter "A" | Air space location | |
|---|---|---|
| | Between masonry chimeny exterior and combustible | Between masonry chimeny interior and the liner |
| IPP 6″ to 24″ | 0″ | 1″ |
| ---- | ---- | ---- |

**EX 1: Clearance and dimension of masonry chimney for model IPP/HEP**




**WARNING**
**DO NOT INSTALL ANY TYPE OF INSULATION IN THE REQUIRED CLEARANCE SPACES SURROUNDING THE LINER.**

## CHIMNEY LINER PIPE AND FITTING JOINT ASSEMBLY

All components have a male and a female end. The installation orientation is indicated on the labeling of each pipe section with an arrow. The arrow indicates the direction of the flue (See Fig. A-1). Clean all inner and outer surfaces of male and female ends with an appropriate organic solvent, such as acetone, Mek, or other commercial degreaser.

1.Before fitting the male and female ends in one another, a sealant is applied on the male end, at the gap between the inner band and the inner pipe. (See Fig. A-1 and A-3). Table A-2 for Sealant.

2. After joining the male and female ends together, a layer of sealant is applied inside the V-groove of the Assembly Band (AB) prior to it's installation over the joint (See Fig. A-3). Table A-2 for Sealant.

3. The Assembly Band (AB) (Fig.A-2 and A-3) is installed and clamped in place with the 4 screws (supplied).

4. Where the chimney passes outdoor, a exterior sealant (ES) is applied at the joint of the Storm Collar (SC) and the outer wall of the pipe for weather protection (see Fig.A-4). Table A-2 for sealant.

**CAUTION**
**A. DO NOT ALLOW SCREWS TO PENETRATE THE INNER PIPE. THIS CAN CAUSE CORROSION, GAS LEAKAGE OR EXPANSION FAILURE**
**B. OBSERVE ADEQUATE SAFETY MESURES WHEN USING A DEGREASER.**

**Fig. A-1 - Models IPP & HEP Flue direction**

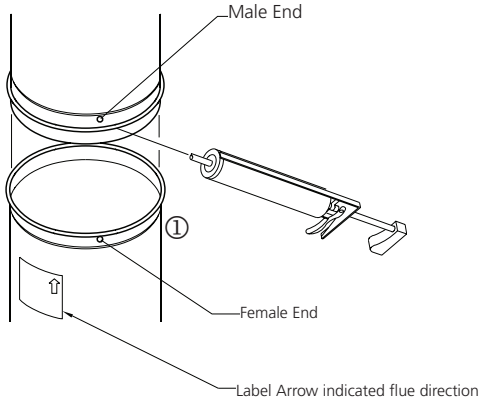



**Table A-2 - Sealant usage**

**Interior Installation**

| Sealant Application | Supplier | Model | Color | Max. Temp. |
|---|---|---|---|---|
| Inner Joints | Adchem | X-Trasil H.T. 4706_3 | red | 500°F |
| alternate | GE | RTV-106 | red | 500°F |
| alternate | Dow Corning | RTV-736 | red | 500°F |

**Exterior Installation**

| Sealant Application | Supplier | Model | Color | Max. Temp. |
|---|---|---|---|---|
| Outer Joints | Adchem | Adsil 4809 | Gray | 375°F |

**Fig. A-2 - Joint components Models IPP & HEP**

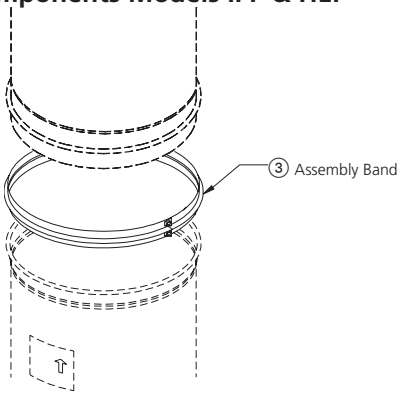


**FIg. A-3 - Assembled Models IPP & HEP**

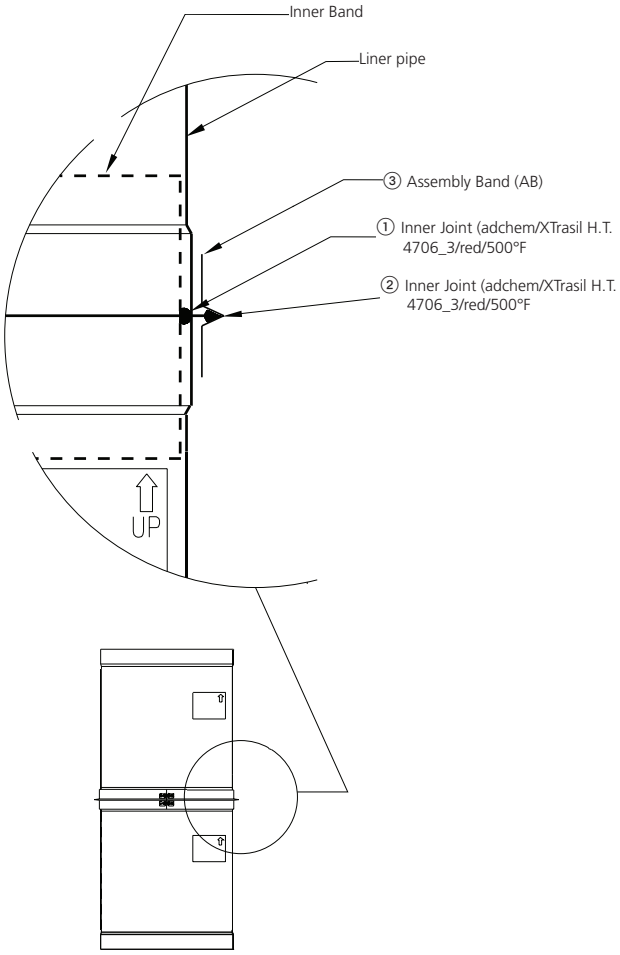
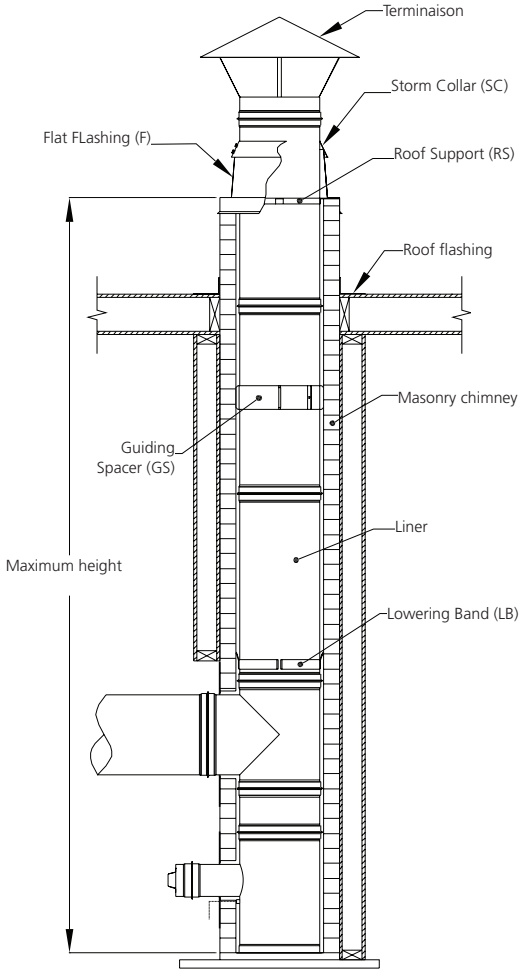



**Fig. A-4 - Maximum Chimney Height and support**




## SUPPORT METHODS AND HIEGHT LIMITS

1. The optimal method to support the liner system is to rest the liner system on a solid foundation and to use a roof support (RF) at the exit of the masonry chimney (Fig.A-4).

2. The maximum heights between the base and to Roof Support (RF) are shown in Table A-3.

**Table A-3 - Maximum Chimney Heigths**

| Inside Diameter (in) | Maximum Height (ft) |
|---|---|
| 6" thru 14" | 90 (27.4 m) |
| 16" thru 24" | 125 (38.1 m) |

**Note: if higher height is needed, please call manufacturer, the engineering team can provide solutions.**

**Note: Use Guiding Spacer (GS) at every 50 feet, See Section C.**

## PIPE WEIGHT

Pipe weight is given in pounds per foot of pipe for each diameter.

**Table A-4 - Pipe weight in lb/ft**

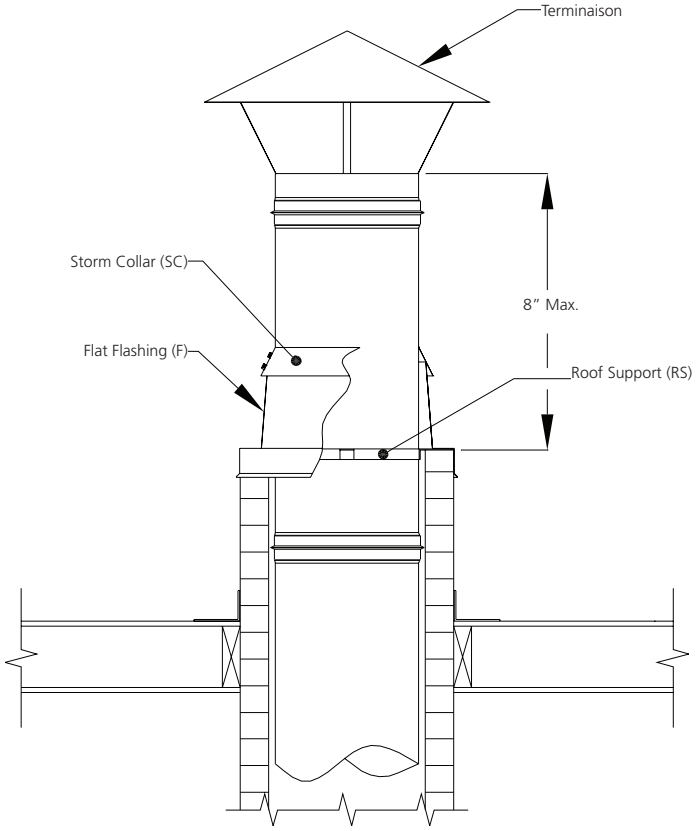
| Inside diameter | IPP Model | HEP Model |
|---|---|---|
| 6 | 3.39 | 2.25 |
| 8 | 4.52 | 2.99 |
| 10 | 5.65 | 3.74 |
| 12 | 6.78 | 4.49 |
| 14 | 7.91 | 5.24 |
| 16 | 9.04 | 5.99 |
| 18 | 10.17 | 6.74 |
| 20 | 11.30 | 7.49 |
| 22 | 12.43 | 8.24 |
| 24 | 13.56 | 8.98 |

# Tees and Adjustable Length

**LINER FREESTANDING HEIGHT**

1. Maximum freestanding height above the masonry chimney is 4 feet (1.2 m). See Fig. A-5.

**Fig. A-5 - Maximum Freestanding Liner Height**

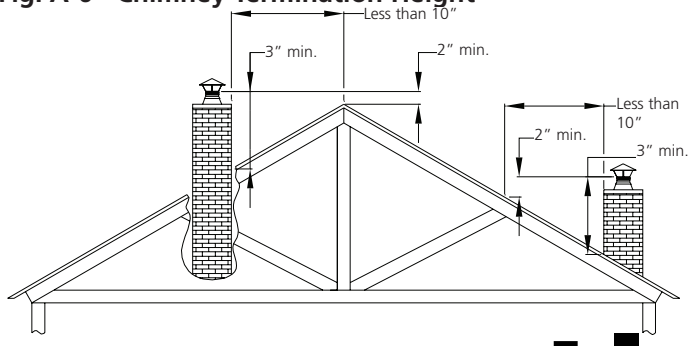



**TERMINAISON HEIGHT**

Chimneys and vents shall terminate above the roof level in accordance with the following requirements (Fig. A-6):

1. Five feet above the roof level or any adjacent flat roof, wall parapet or air intakes, and/or in accordance with the following NFPA 211 requirements.
2. Where chimney terminates at less than 10 feet from any adjacent ridge, wall or parapet, the chimney shall terminate at minimum of 3 feet above the ridge, wall, or parapet.
3. Where chimney terminates at more than 10 feet from ridge, wall, or parapet, a minimum height of 2 feet shall be required above the ridge wall or parapet.

**Fig. A-6 - Chimney Termination Height**



# Tees and Adjustable Length

**90° TEE (T90)**

1. Generally used to connect the horizontal length from an appliance to the vertical length in boiler exhaust systems.

2. There are two types of 90° Tee (T90), one for model IPP and another for HEP model.

3. For model IPP, a removable tee branch is used for easy installation in two steps. First, insert the tee section in the masonry chimney. After, install the tee branch on the tee section with screws (Fig. B-1).

4. Also, a welded tee branch can be used. There are two ways to install this type of 90° Tee (T90). First way is, if the dimension of masonry chimney allows it, insert the tee section with the welded branch in the chimney (Fig. B-2a). Second way is to enlarge the masonry chimney inlet opening (Fig. B-2b) by demolishing the masonry wall and rebuilding it.

5. A 90° Tee (T90) section with a Tee Cap (TC) can be use to facilitate access for inspection and maintenance (Fig. B-1).

**Note: if those configuration can not be used, please call manufacturer, the engineering team can provude solutions.**

**Fig. B-1 - Detachable 90° Tee (DT90) Assembly**

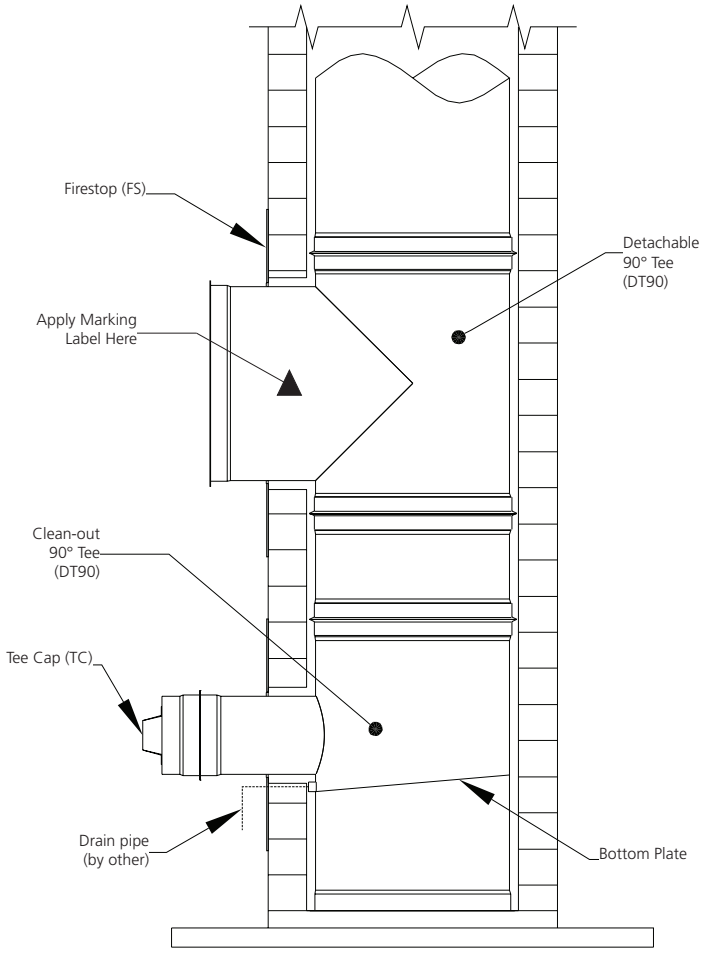



**Fig. B-2a - Welde 90° Tee (T90) Assembly**

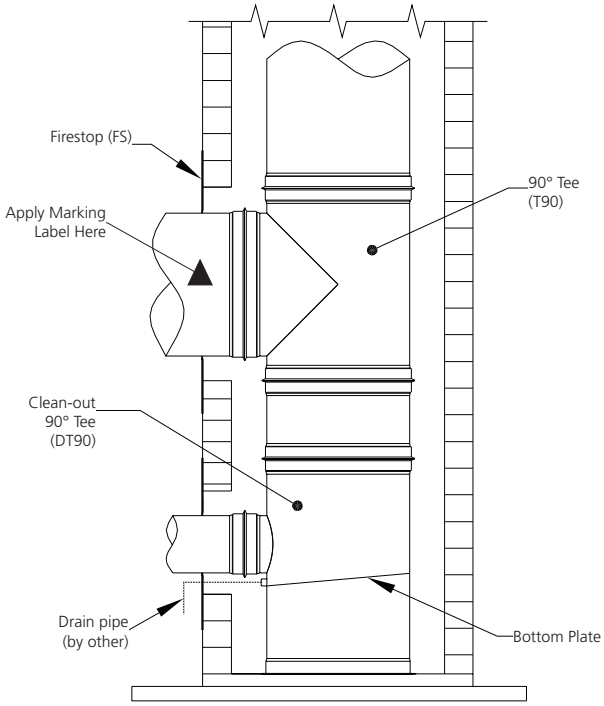
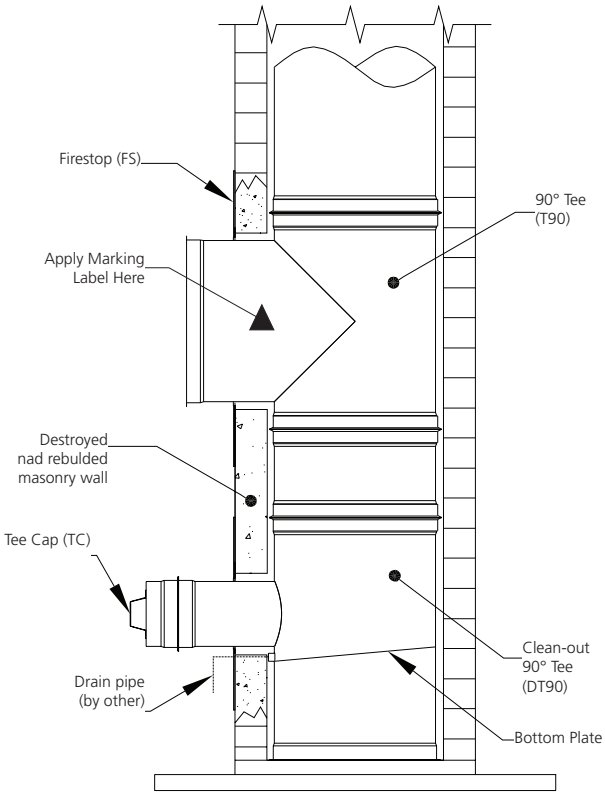


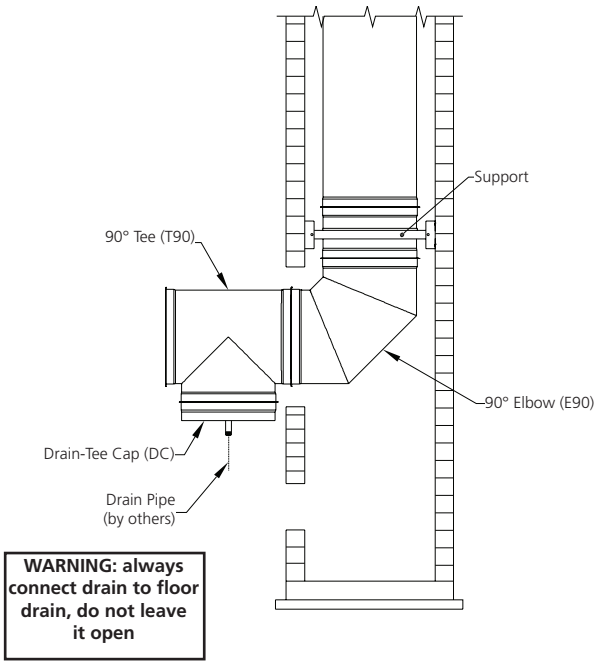

**Fig. B-2b - Welded 90° Tee (T90) Assembly**



## 90° ELBOW (E90)

Another assembly option is to use a 90° ELbow (E90) with a 90° Tee (T90) and Drain-Tee Cap (DC). (See Fig. B-3)

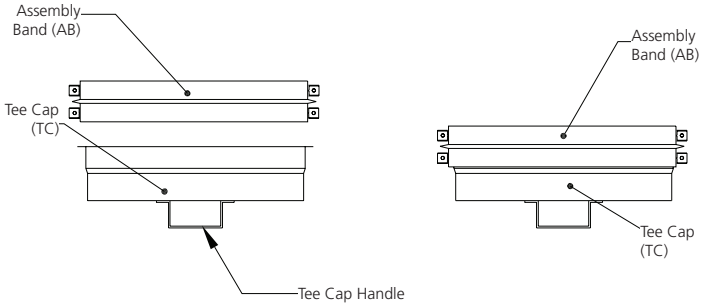
**Fig. B-3 - 90° Elbow (E90) Assembly**




## TEE CAP (TC)

1. Used to block the horizontal opening of the tee, see Fig. B-1. Removable, it facilitates access for inspection and maintenance of the chimney (Fig. B-4).
2. The assembly includes an Assembly Band (AB).
3. Joint assembly between the Tee Cap (TC) and the Tee is done in the same manner as described in Section A Piping and Fitting Assembly.

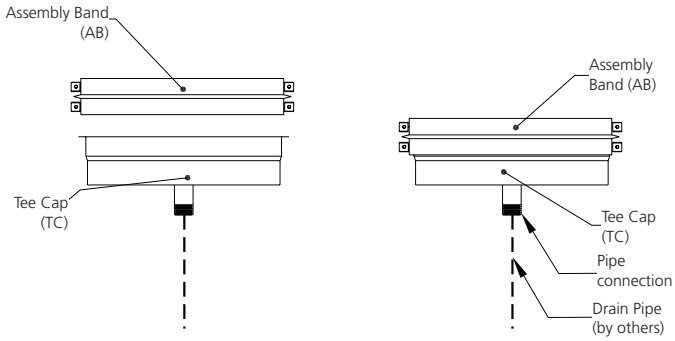
**Fig. B-4 - Tee Cap (TC)**




## DRAIN-TEE CAP (DC)

1. Used in some configurations to block the lower vertical opening of a tee, see Fig. B-3. It serves to collect rainwater that may enter the chimney (Fig. B-5).
2. Removable, it facilitates access for inspection and maintenance of the chimney.
3. To be connected to a drain of 1" diameter-NPT. It is connected to the tee with the joint assembly.
4. Joint assembly between the Drain-Tee Cap (DC) and the tee is done in the same manner as described in Section A Piping and Fitting Assembly.

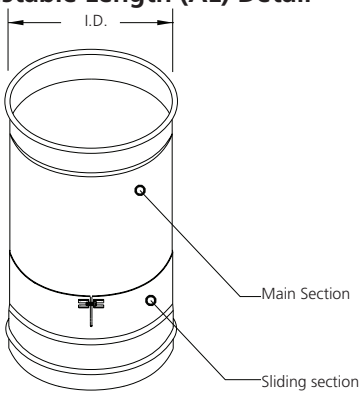
**Fig. B-5 - Drain-Tee Cap (DC)**




## ADJUSTABLE LENGTH (AL)

1. Used in horizontal straight runs of models IPP and HEP, the Adjustable Length (AL) serves two major functions:
   a) To make up for odd lengths of pipe in short runs
   b) To extend the Tee Cap (TC) outside the masonry chimney
2. This part is designed to be adjustable to any needed exact length and it's internal joint must be sealed by working sealant under the seal section, as well as at the joint between the male and the female ends to be closed with the Assembly Band (AB).
3. The adjustable length includes a main section and an outer sliding section that can be secured in the desired length position. Cutting the main section may be required for proper fitting.
4. The sliding section is designed to fit outside the standard main section.
5. Once the final length of the section is set, it is secured using a single clamp and screw. This seal section will prevent the inner section from slipping after the assembly.

**Fig. B-6 - Adjustable Length (AL) Detail**




## SPECIAL PARTS

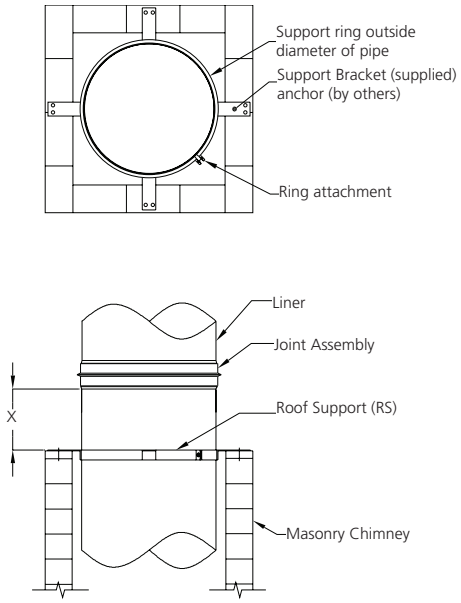
Available when specified are special parts or components used in chimney systems that can be factory-built to accommodate field situations where standard parts cannot be used.

# Structural Support and guiding

## ROOF SUPPORT (RS)

Used to support and guide the portion of the chimney which extend to the masonry chimney. It is attached to the masonry chimney by means of four angles (See Fig. C-1). It maintains a minimum distance between the liner and the masonry chimney.

**Fig. C-1 - Roof Support (RS)**

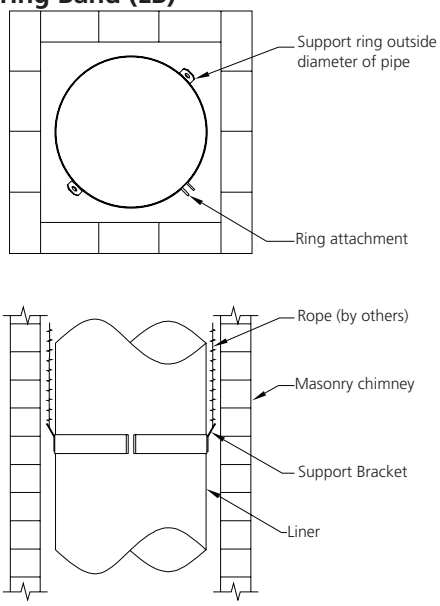



**Keep joint away From support X=6" Min. above and under**

## LOWERING BAND (LB)

Used to insert the liner in the masonry chimney by supporting the liner during the lowering.

**Fig. C-2 - Lowering Band (LB)**

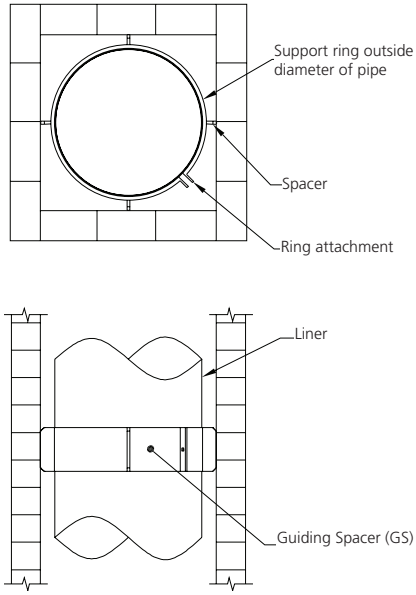



**Note: Must be used with shackles.**

## GUIDING SPACER (GS)

Used to guide the liner every 50 feet and to keep the clearance between the liner and the masonry chimney. Also, it prevents bending of the liner in the masonry chimney and has for effect to increase the maximum height of the liner.

**Fig. C-3 - Guiding Spacer (GS)**

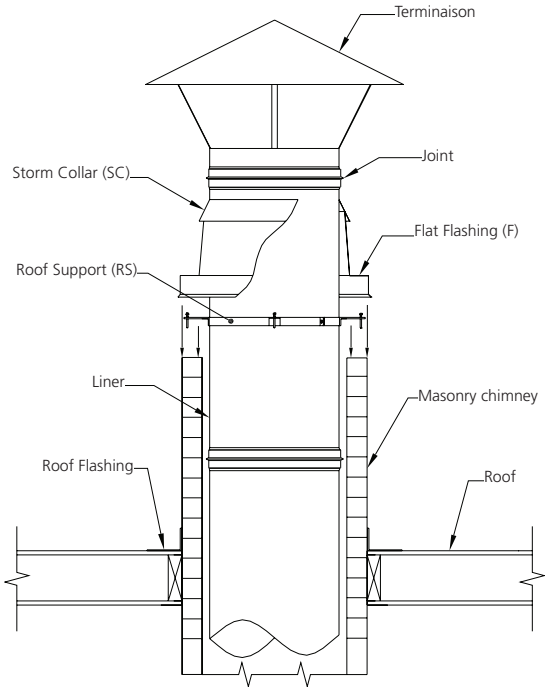



**Note: See Section D Masonry Chimney Top and Wall Penetrations for complete Roof Support (RS) assembly details an use.**

## FLAT FLASHING (F) AND VENTILATED FLASHING (VF) ASSEMBLIES

The Flat Flashing assembly (F) is primarily used for boiler or low temperature exhaust to clause the masonry chimney exit opening. It is design to be installed on a flat masonry chimney top of a minimum height of 3 feet from the roof (See Fig. D-1). For some areas, greater heights may be needed according to local code requirements. The roof framing dimension and the masonry chimney dimension must provide sufficient opening to comply with the minimum clearance from combustibles. (See Table A-1) The Roof Support (RS) is secured to the top of the masonry chimney using two 1/4" masonry screws in each support bracket. The Flat Flashing (F) is then lowered on the top of the masonry chimney and the Storm Collar (SC) secured to the chimney section with the screws supplied. A Ventilated Flashing (VF) option is also available where air circulation between the liner and the masonry chimney is wanted. The Ventilated Flashing (VF) option may serve as a ventilation outlet in small boiler rooms with gravity air supply.

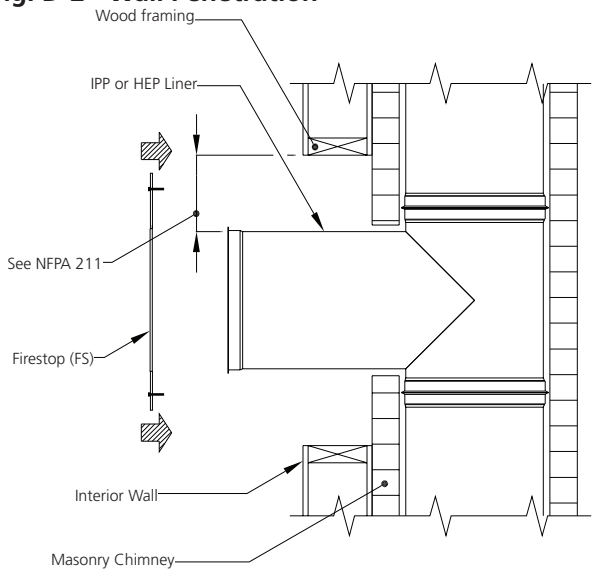
**Fig. D-1 - Masonry Chimney Top Assembly**




## WALL PENETRATION

Where a liner section passes through a wall and a masonry chimney, the combustible material need to be at a minimum clearance from the exterior of the liner to be protected from radiation heat from the liner. See NFPA 211 or local codes for minimum distances to respect (Fig. D-2). Also, used a FireStop (FS) to close the masonry chimney inlet opening.

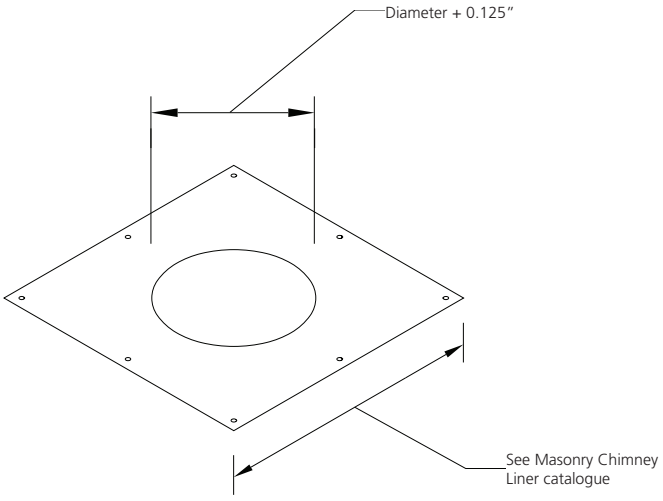
**Fig. D-2 - Wall Penetration**




## FIRESTOP (FS)

Used to close the opening of a masonry chimney where a liner passes through. see Fig. D-3.

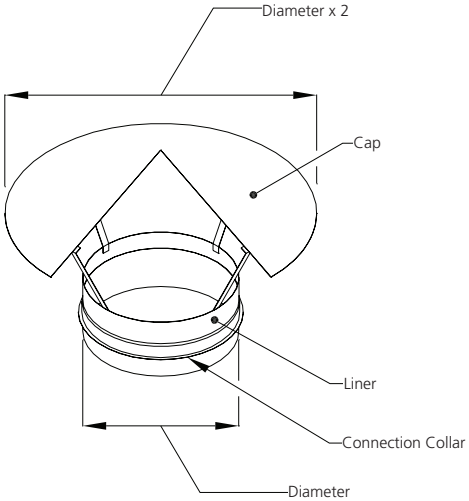
**Fig. D-3 - Firestop (FS) Assembly**



**RAIN CAP (RC)**

Installed at the top of the IPP liner, it prevents entry of rain into the chimney. (See Fig. E-7 for assembly)

**Fig. E-1 - Rain Cap Detil (RC)**

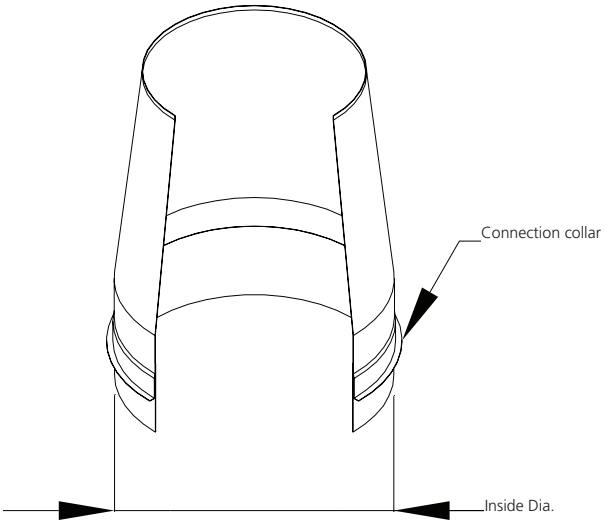



**Note: Do not use with HEP model.**

**EXHAUST CONE (EC)**

Installed at the top the chimney, it improves the draft and increases the speed of escaping gases by 50%. Installation of a drain at the base of the liner is required to collect rainwater. For installation details Exhaust Cone (EC) (See Fig.E-7).

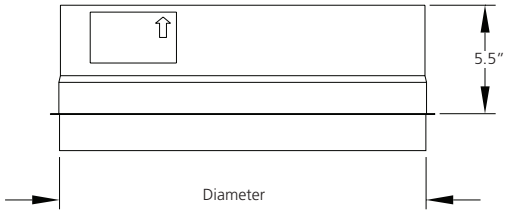
**Fig. E-2 - Exhaust Cone (EC) Detail**




**CLOSURE SECTION (CS)**

Installed at the chimney extremity, the use of a drain at the base of the liner is required to collect any excess rain that may enter the chimney.

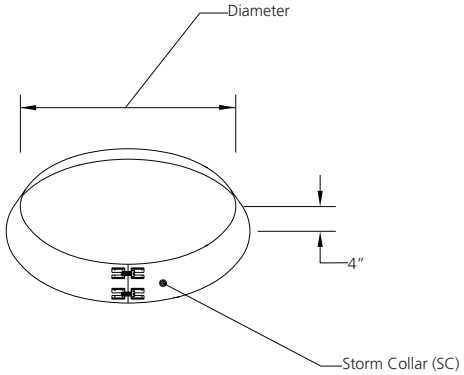
**Fig. E-3 - Closure Section (CS) Detail**




**STORM COLLAR (SC)**

Used for sealing the opening between the chimney and the Flat Flashing (F), the Storm Collar (SC) must be sealed to the chimney with silicone putty. It is supplied with the Flat Flashing (F) roof assembly or Adjustable Flashing (AF) roof assembly.

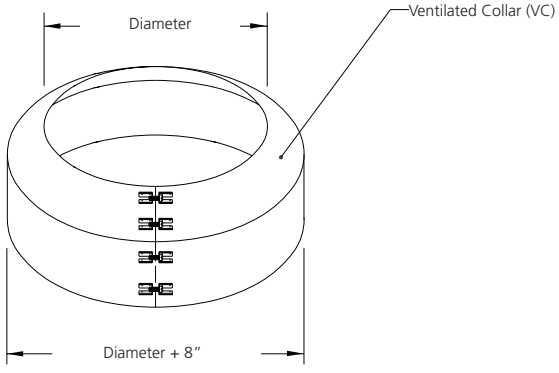
**Fig. E-4 - Sorm Collar (SC) Detail**




**VENTILATED COLLAR (VC)**

Used for sealing the opening between the chimney and Ventilated Flashing (VF), the Ventilated Collar (VC) must be sealed to the chimney with silicone putty. It is supplied with the Ventilated Flashing (VF).

**Fig. E-5 - Ventilated Collar (VC) Detail**



**FAN ADAPTER (FA)**

Installed at the chimney extremity. It is used to connect the chimney to an up-blast exhaust fan.

**Fig. E-6 - Fan Adapter (FA) Detail**

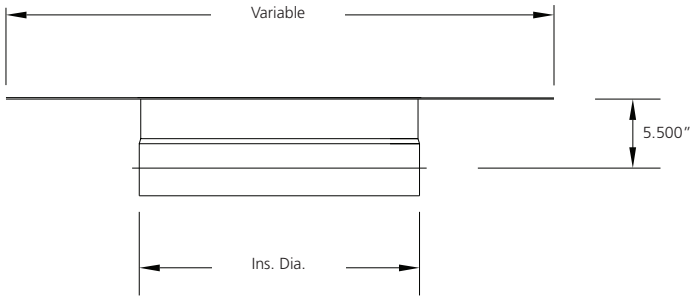



**Fig. E-7a - Typical Installation for Rain Cap (RC)**

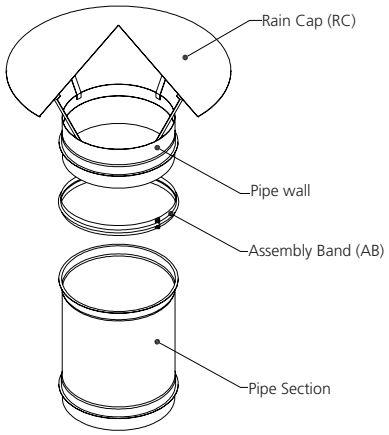
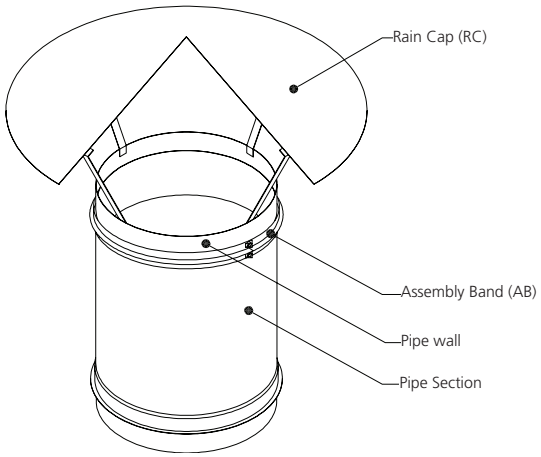



**Fig. E-7b - Finished assembly for Rain Cap (RC)**




**Terminations use and application**

| Termination | Model | Temperature from 0°F to less than 570°F continuous or boiler applications |
|---|---|---|
| Rain Cap | IPP | 6" to 24" diameter |
| Exhaust Cone | IPP and HEP | 6" to 24" diameter |
| Closure Section | IPP and HEP | 6" to 24" diameter |

## CLEANING OF THE MASONRY CHIMNEY

Prior to install, we recommend to check the masonry chimney for cracks, loose, other materials that could inhibit correct installation of the liner and missing bricks or mortar. Also, clean and neutralize the existent masonry chimney.

1. Clean with a water jet all interior surfaces of the masonry chimney in order to remove any residue of combustion and materials releases or not healthy. After cleaning, all surfaces must be solid and healthy.

2. Wash with clean water on air pressure with a mixture of 10% of potassium carbonate all surface interns chimney. Let act at least 12 hours the alkaline solution in order to neutralize the accumulated acid. Rinse with clean water on air pressure.

## OTHER WAY TO INSTALL LINER

1. Joint the access door Tee section with the flue gases 90° Tee (see section B).

2. The use of a lowering band (see section C) and a rope is necessary. The lowering band is to be installed on lower section of the liner above the 90° Tee (T90). Two shackles are to be installed on each side of the lowering band and the rope must be attached to them (Fig. F-1).

3. The first section is lower in the masonry chimney until the edge of the liner is above the top of the chimney. The rope must be blocked to support the liner and another liner section can be added on the first one (Fig. F-1).

4. Continue step 3 until the liner system is resting on the base of the masonry chimney by adding section one by one.

5. Remove the rope and the shackle from the lowering band above the 90° Tee (T90) and leave the lowering band on the liner (Fig. F-2).

**Fig. F-1 - Insertion of Liner in Masonry Chimney**

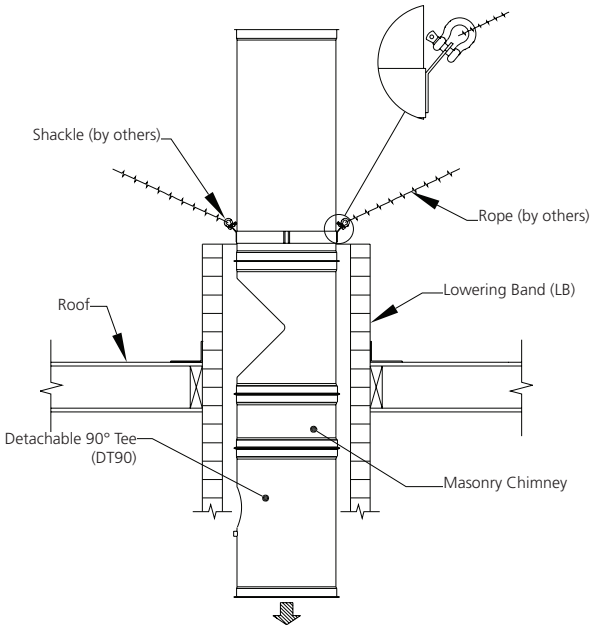
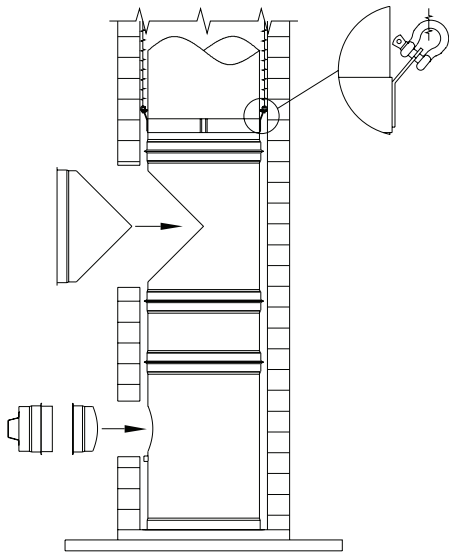



**Fig. F-2 - Tee Branch installation**



6. Install the removable branch on the 90° Tee (T90) with screws (Fig. F-2). Also, install a FireStop (FS) to close the masonry chimney inlet opening.

7. Install the Roof Support (RF), the Flat Flashing (F), the Storm Collar (SC) and a termination section on the top of the masonry chimney (See section D and E).

## INSERTION OF THE HEP LINER

1. If the welded 90° Tee (T90) (see section B) can pass through the masonry chimney, use same steps as model IPP.

2. If the dimensions of the masonry chimney doesn't allowed the 90° Tee (T90) to pass through, the masonry inlet opening must be enlarges to permit the tee section to be install.

3. Joint the clean-out 90° Tee section with the flue gases 90° Tee and inserts the assembly in the masonry chimney by enlarging the inlet opening (Fig. F-3)

**Note: Verify the integrity and the solidity of the masonry chimney prior to demolishing the masonry**

4. For the liner sections above the 90° Tee (T90), the use of a lowering band (see section C) and a rope is necessary. The lowering band is to be installed at the base of the liner section for easy access to remove the rope at the end. Two shackles are to be installed on each side of the lowering band and the rope must be attached to them (Fig. F-4).

5. The section is lower in the masonry chimney until the edge of the liner is above the top of the chimney. The rope must be blocked to support the liner and another liner section can be added on the first one (Fig. F-4).

6. Continue step 2 until the liner system is resting on the top of the 90° Tee (T90) by adding section one by one.

**Fig. F-3 - Installation of Liner Tee Section in Masonry Chimney**

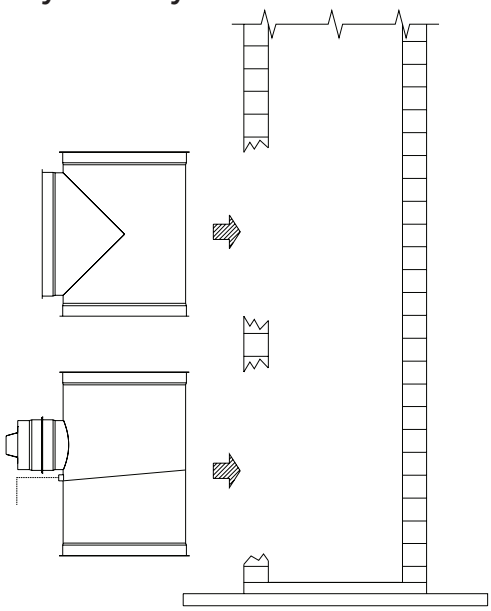
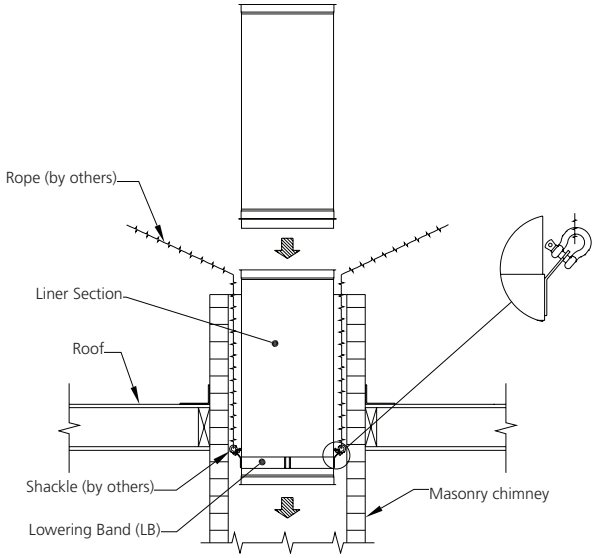


**Fig. F-4 - Lowering or Liner Section in Masonry Chimney**

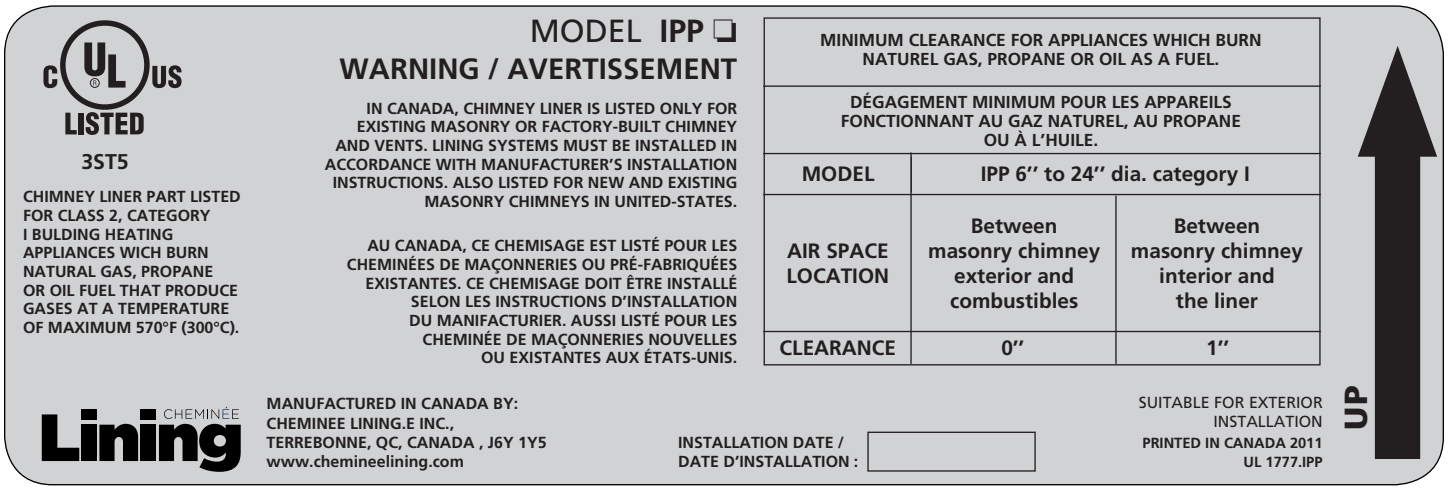



7. Remove the rope and the shackle from the lowering band at the bottom of the liner.

8. Rebuild the masonry chimney wall and install a FireStop (FS) to close the masonry chimney inlet opening.

9. Install the Roof Support (RF), the Flat Flashing (F), the Storm Collar (SC) and a termination section on the top of the masonry chimney (See section D and E).

**Note: If those configurations can not be used, please call manufacturer, the engineering team can provide solutions.**



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3ST5

CHIMNEY LINER PART LISTED FOR CLASS 2, CATEGORY I BULDING HEATING APPLIANCES WICH BURN NATURAL GAS, PROPANE OR OIL FUEL THAT PRODUCE GASES AT A TEMPERATURE OF MAXIMUM 570°F (300°C).

MODEL **IPP** ❑

**WARNING / AVERTISSEMENT**

IN CANADA, CHIMNEY LINER IS LISTED ONLY FOR EXISTING MASONRY OR FACTORY-BUILT CHIMNEY AND VENTS. LINING SYSTEMS MUST BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS. ALSO LISTED FOR NEW AND EXISTING MASONRY CHIMNEYS IN UNITED-STATES.

AU CANADA, CE CHEMISAGE EST LISTÉ POUR LES CHEMINÉES DE MAÇONNERIES OU PRÉ-FABRIQUÉES EXISTANTES. CE CHEMISAGE DOIT ÊTRE INSTALLÉ SELON LES INSTRUCTIONS D'INSTALLATION DU MANIFACTURIER. AUSSI LISTÉ POUR LES CHEMINÉE DE MAÇONNERIES NOUVELLES OU EXISTANTES AUX ÉTATS-UNIS.

| MINIMUM CLEARANCE FOR APPLIANCES WHICH BURN NATUREL GAS, PROPANE OR OIL AS A FUEL. | | |
|---|---|---|
| DÉGAGEMENT MINIMUM POUR LES APPAREILS FONCTIONNANT AU GAZ NATUREL, AU PROPANE OU À L'HUILE. | | |
| MODEL | IPP 6'' to 24'' dia. category I | |
| AIR SPACE LOCATION | Between masonry chimney exterior and combustibles | Between masonry chimney interior and the liner |
| CLEARANCE | 0'' | 1'' |

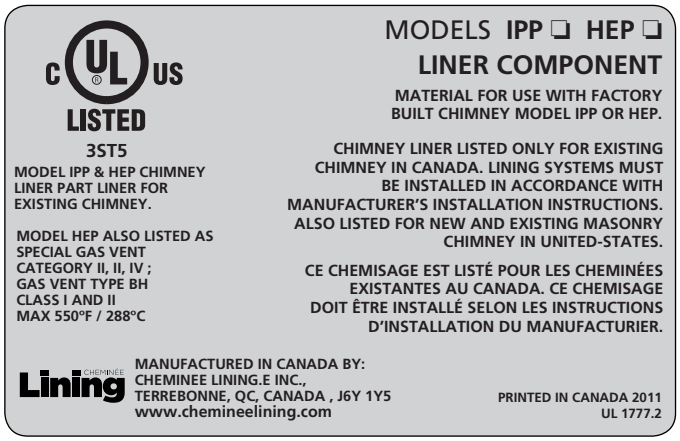
UP

Lining CHEMINÉE

MANUFACTURED IN CANADA BY:
CHEMINEE LINING.E INC.,
TERREBONNE, QC, CANADA , J6Y 1Y5
www.chemineelining.com

INSTALLATION DATE /
DATE D'INSTALLATION :

SUITABLE FOR EXTERIOR INSTALLATION
PRINTED IN CANADA 2011
UL 1777.IPP



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3ST5

MODEL IPP & HEP CHIMNEY LINER PART LINER FOR EXISTING CHIMNEY.

MODEL HEP ALSO LISTED AS SPECIAL GAS VENT CATEGORY II, II, IV ; GAS VENT TYPE BH CLASS I AND II MAX 550°F / 288°C

MODELS **IPP** ❑ **HEP** ❑

**LINER COMPONENT**

MATERIAL FOR USE WITH FACTORY BUILT CHIMNEY MODEL IPP OR HEP.

CHIMNEY LINER LISTED ONLY FOR EXISTING CHIMNEY IN CANADA. LINING SYSTEMS MUST BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS. ALSO LISTED FOR NEW AND EXISTING MASONRY CHIMNEY IN UNITED-STATES.

CE CHEMISAGE EST LISTÉ POUR LES CHEMINÉES EXISTANTES AU CANADA. CE CHEMISAGE DOIT ÊTRE INSTALLÉ SELON LES INSTRUCTIONS D'INSTALLATION DU MANUFACTURIER.

Lining CHEMINÉE

MANUFACTURED IN CANADA BY:
CHEMINEE LINING.E INC.,
TERREBONNE, QC, CANADA , J6Y 1Y5
www.chemineelining.com

PRINTED IN CANADA 2011
UL 1777.2

HEP MODEL
HEP MODEL

# PART 2:
# HEP Category I, II, III, IV

## UNDERWRITERS LABORATORIES LISTINGS:

CHEMINEE LINING.E inc. venting systems Models IPP and HEP are Listed by Underwriters Laboratories, inc. (UL) under File MH46608 and Tested in accordance with UL 1777 Chimney Liners and the Canadian Standard for Lining Systems CAN/ULCS635- M91. Listings include the following chimney product categories and diameters.

### UL 1777

| Model | Classification | Diameters |
|---|---|---|
| IPP | Chimney Liners | 6" to 24" I.D. |

### CAN / ULC-S635-M91

| Model | Classification | Diameters |
|---|---|---|
| HEP | Lining systems for existing masonry | 6" to 24" I.D. |

## FEATURES

Models IPP are part of the Industrial Positive Pressure products for industrial and commercial applications. They are prefabricated modular venting systems designed for quick assembly and using a continuous welded joint stainless steel inner wall. Given that all parts have a male and female end, each model part fit into one another, thus eliminating the need for all kinds of adapters. This unique method of coupling provides an incomparable flexibility in selecting models of flues and chimneys. Models IPP are single wall constructions. The high quality of stainless steel inner wall construction using a continuous welded method for the longitudinal joint provides a high strength-to-weight ratio and low friction losses.

## APPLICATION FOR MODELS IPP & HEP CAT 1

### UL 1777

**1. Chimney Liners Listing** (Category I, for oil and gas) – Under this category, model IPP liner have been determined suitable for field-installation into new or existing masonry chimneys and used to vent gas-fired and oil-fired appliances in which the maximum continuous flue-gas outlet temperature do not exceed 570°F for oil and 480°F for gas. It also complies with test at 1700°F temperature for 10 minutes.

### CAN / ULC-S635-M91

**1. Standard for Lining Systems for Existing Masonry or Factory-Built Chimneys and Vents (**Class II, for oil and gas) – Under this category, model IPP liner have been determined suitable for installation into existing masonry and used to vent gas-fired and oil-fired appliances in which the maximum continuous flue-gas outlet temperature do not exceed 300°C for oil and 245°C for gas. It also complies with test at 927°C temperature for 10 minutes.

**WARNING**
**NOT FOR USE WITH SOLID-FUEL-FIRED APPLIANCES.**

## SURROUNDINGS/ENCLOSURES

1. In United-States, Models IPP chimney liners are primarily intended to be installed in new or existing masonry chimneys with or without a liner of fire-clay tile, or to be used as a substitute for masonry fire-clay tile flue liners in new chimneys.

2. In Canada, Models IPP chimney liners are primarily intended to be installed in existing masonry chimneys with or without a liner of fire-clay tile, or factory-built chimneys and vents.

3. The minimum brick thickness of the masonry chimney must be of 3"-1/2. Also, the masonry chimney must comply with the National Buildong Code, the Standard for "Design and Construction of Masonry Chimneys and Fireplaces" CAN/CSA A405 and NFPA 211.

4. The heating appliance connected to the chimney liner must not have a flue outlet size larger than the chimney liner area at its smallest point.

5. Rain cap and rain cap with bird screens should be checked for ice formation during low ambient temperature. Consult authority having jurisdiction. Also, it's important to size correctly the venting of low temperature flue products in geographical areas experiencing sustained low ambient temperature.

**CONTACT LOCAL BUILDING OR FIRE OFFICIALS ABOUT RESTRICTIONS AND INSTALLATION INSPECTION IN YOUR AREA.**

## SYSTEM SIZING

Complete system sizing and capacity may be obtained from the "Chimney, Gas Vent, and Fireplace Systems" chapter of the ASHRAE Handbook or contact your CHEMINÉE LINING representative. In spite of any sizing guidelines, when sizing exhaust systems, it is most important that the heating appliance, engine or turbine manufacturer's installation instructions be followed. Not following these instructions may result in inadequate chimney performance and/or a violation of the equipment manufacturer's installation requirements.

## PART NUMBERS

These instructions identify major models IPP & HEP parts by part number.

**Example no.1:**

**Number: IPP 48L 12**

| Model | Description | Inside Diameter |
|---|---|---|
| IPP Single Wall | 48″ Pipe Section Length | 12″ |

**Example no.2:**

**Number: HEP 36L 24**

| Model | Description | Inside Diameter |
|---|---|---|
| HEP Single Wall | 36″ Pipe Section Length | 24″ |

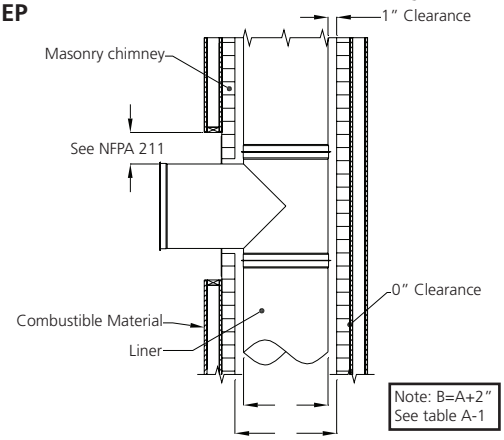
## CLEARANCES

The following table serves to identify the minimum clearances required when installing a liner system in a masonry chimney.

Table A-1. Minimum air space clearance

| Model and diameter "A" | Air space location | |
|---|---|---|
| | Between masonry chimeny exterior and combustible | Between masonry chimeny interior and the liner |
| ---- | ---- | ---- |
| HEP 6″ to 48″ | 0″ | 1″ |

**EX 1: Clearance and dimension of masonry chimney for model IPP/HEP**




**WARNING**
**DO NOT INSTALL ANY TYPE OF INSULATION IN THE REQUIRED CLEARANCE SPACES SURROUNDING THE LINER.**

## CHIMNEY LINER PIPE AND FITTING JOINT ASSEMBLY

All components have a male and a female end. The installation orientation is indicated on the labeling of each pipe section with an arrow. The arrow indicates the direction of the flue (See Fig. A-1). Clean all inner and outer surfaces of male and female ends with an appropriate organic solvent, such as acetone, Mek, or other commercial degreaser.

1.Before fitting the male and female ends in one another, a sealant is applied on the male end, at the gap between the inner band and the inner pipe. (See Fig. A-1 and A-3). Table A-2 for Sealant.

2. After joining the male and female ends together, a layer of sealant is applied inside the V-groove of the Assembly Band (AB) prior to it's installation over the joint (See Fig. A-3). Table A-2 for Sealant.

3. The Assembly Band (AB) (Fig.A-2 and A-3) is installed and clamped in place with the 4 screws (supplied).

4. Where the chimney passes outdoor, a exterior sealant (ES) is applied at the joint of the Storm Collar (SC) and the outer wall of the pipe for weather protection (see Fig.A-4). Table A-2 for sealant.

**CAUTION**
**A. DO NOT ALLOW SCREWS TO PENETRATE THE INNER PIPE. THIS CAN CAUSE CORROSION, GAS LEAKAGE OR EXPANSION FAILURE**
**B. OBSERVE ADEQUATE SAFETY MESURES WHEN USING A DEGREASER.**

**Fig. A-1 - Models IPP & HEP Fleu direction**

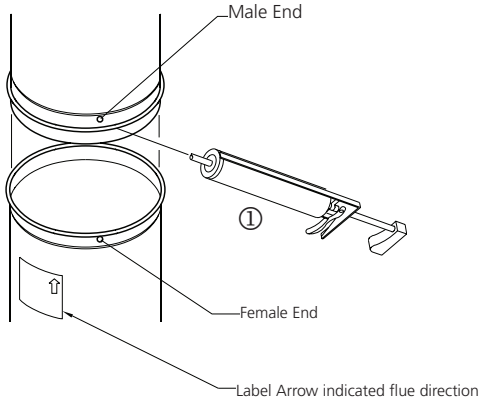



**Table A-2 - Sealant usage**

**Interior Installation**

| Sealant Application | Supplier | Model | Color | Max. Temp. |
|---|---|---|---|---|
| Inner Joints | Adchem | X-Trasil H.T. 4706_3 | red | 500°F |
| alternate | GE | RTV-106 | red | 500°F |
| alternate | Dow Corning | RTV-736 | red | 500°F |

**Exterior Installation**

| Sealant Application | Supplier | Model | Color | Max. Temp. |
|---|---|---|---|---|
| Outer Joints | Adchem | Adsil 4809 | Gray | 375°F |

**Fig. A-2 - Joint components Models IPP & HEP**

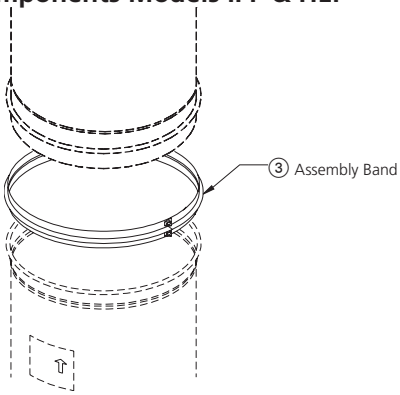


**FIg. A-3 - Assembled Models IPP & HEP**

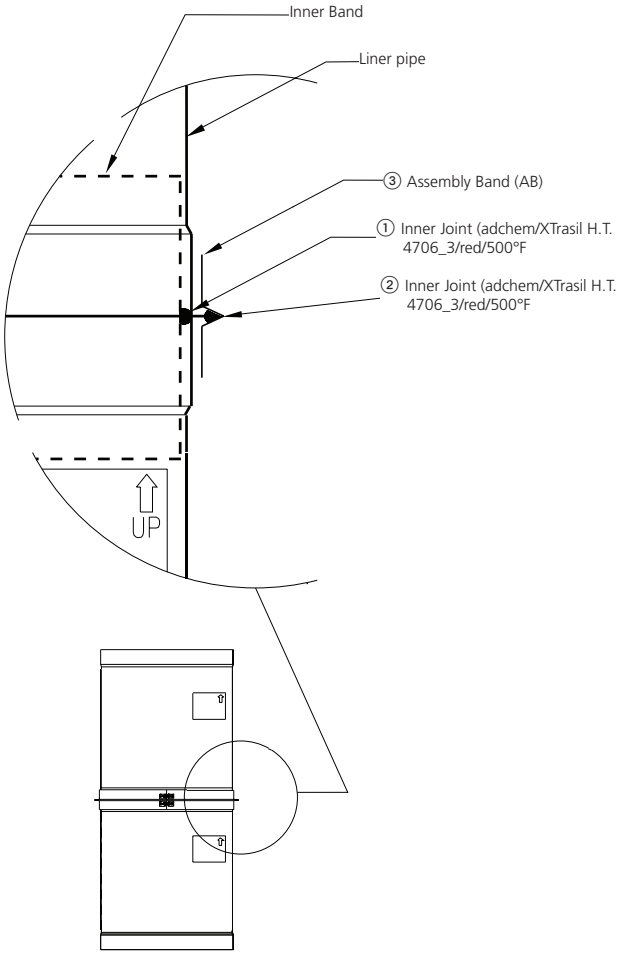
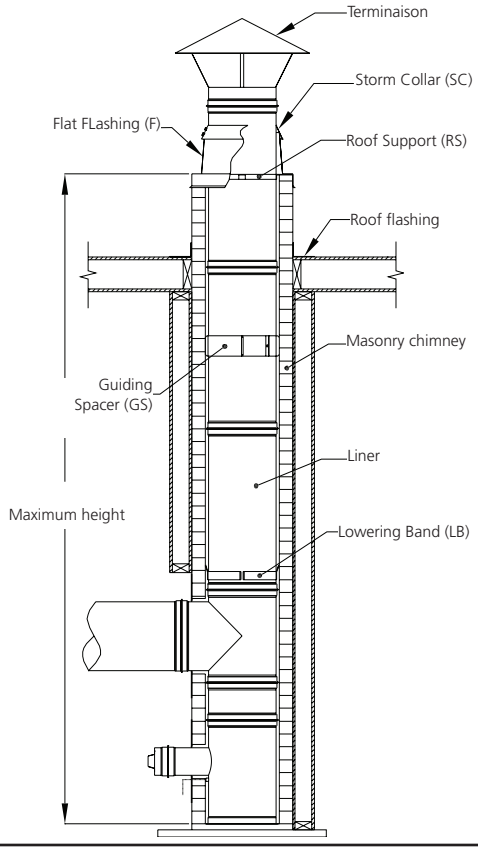



**Fig. A-4 - Maximum Chimney Height and support**




**Note: Use Guiding Spacer (GS) at every 50 feet, See Section C.**

## SUPPORT METHODS AND HIEGHT LIMITS

1. The optimal method to support the liner system is to rest the liner system on a solid foundation and to use a roof support (RF) at the exit of the masonry chimney (Fig.A-4).

2. The maximum heights between the base and to Roof Support (RF) are shown in Table A-3.

**Table A-3 - Maximum Chimney Heigths**

| Inside Diameter (in) | Maximum Height (ft) |
|---|---|
| 6" thru 14" | 90 (27.4 m) |
| 16" thru 48" | 125 (38.1 m) |

**Note: if higher height is needed, please call manufacturer, the engineering team can provide solution.**

## PIPE WEIGHT

Pipe weight is given in pounds per foot of pipe for each diameter.

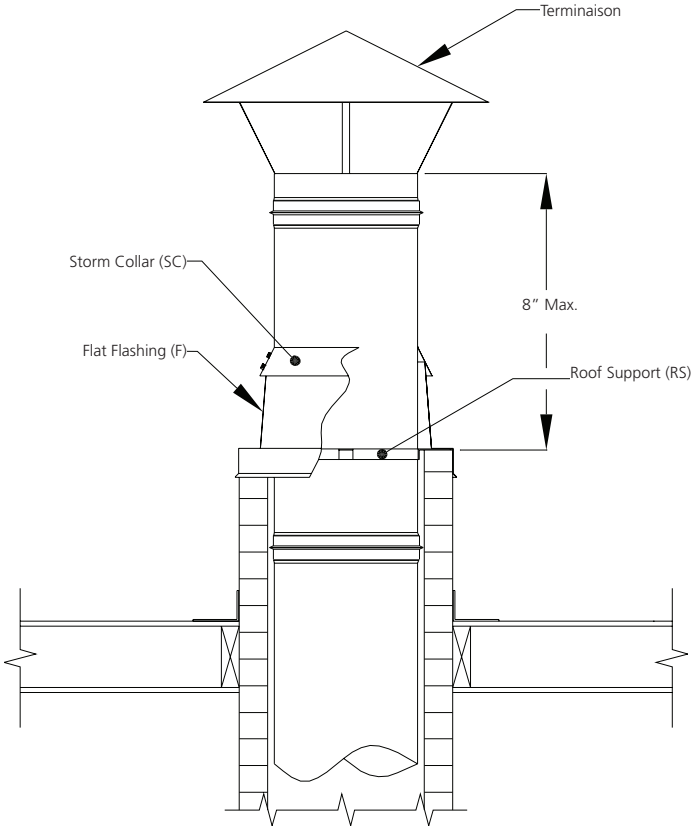
**Table A-4 - Pipe weight in lb/ft**

| Inside diameter | IPP Model | HEP Model |
|---|---|---|
| 6 | 3.39 | 2.25 |
| 8 | 4.52 | 2.99 |
| 10 | 5.65 | 3.74 |
| 12 | 6.78 | 4.49 |
| 14 | 7.91 | 5.24 |
| 16 | 9.04 | 5.99 |
| 18 | 10.17 | 6.74 |
| 20 | 11.30 | 7.49 |
| 22 | 12.43 | 8.24 |
| 24 | 13.56 | 8.98 |
| 26 | - | 9.8 |
| 28 | - | 10.6 |
| 30 | - | 11.3 |
| 32 | - | 12.1 |
| 34 | - | 12.9 |
| 36 | - | 13.6 |
| 38 | - | 14.4 |
| 40 | - | 15.1 |
| 42 | - | 15.9 |
| 44 | - | 16.6 |
| 46 | - | 17.4 |
| 48 | - | 18.1 |

**LINER FREESTANDING HEIGHT**

1. Maximum freestanding height above the masonry chimney is 4 feet (1.2 m). See Fig. A-5.

**Fig. A-5 - Maximum Freestanding Liner Height**

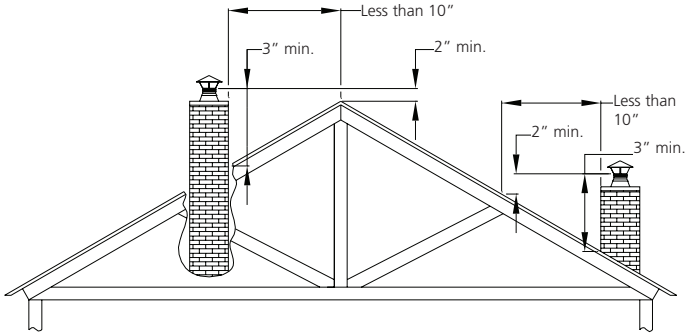



**TERMINAISON HEIGHT**

Chimneys and vents shall terminate above the roof level in accordance with the following requirements (Fig. A-6):

1. Five feet above the roof level or any adjacent flat roof, wall parapet or air intakes, and/or in accordance with the following NFPA 211 requirements.
2. Where chimney terminates at less than 10 feet from any adjacent ridge, wall or parapet, the chimney shall terminate at minimum of 3 feet above the ridge, wall, or parapet.
3. Where chimney terminates at more than 10 feet from ridge, wall, or parapet, a minimum height of 2 feet shall be required above the ridge wall or parapet.

**Fig. A-6 - Chimney Termination Height**



# Tees and Adjustable Length



**90° TEE (T90)**

1. Generally used to connect the horizontal length from an appliance to the vertical length in boiler exhaust systems.

2. There are two types of 90° Tee (T90), one for model IPP and another for HEP model.

3. For model HEP, due to corrosive action of condensing apliances category II and IV, a welded tee branch is necessary. There are two ways to install this type of 90° Tee (T90). First way is, if the dimension of masonry chimney allows it, insert the tee section with the welded branch in the chimney (Fig. B-1). Second way is to enlarge the masonry chimney inlet opening (Fig. B-2) by demolishing the masonry wall and rebuilding it.

4. A 90° Tee (T90) section with a Tee Cap (TC) can be use to facilitate access for inspection and maintenance (Fig. B-1).

**Note: If those configurations can not be used, please call manufacturer, the engineering team can provude solutions.**

**Fig. B-1 - Detachable 90° Tee (DT90) Assembly**

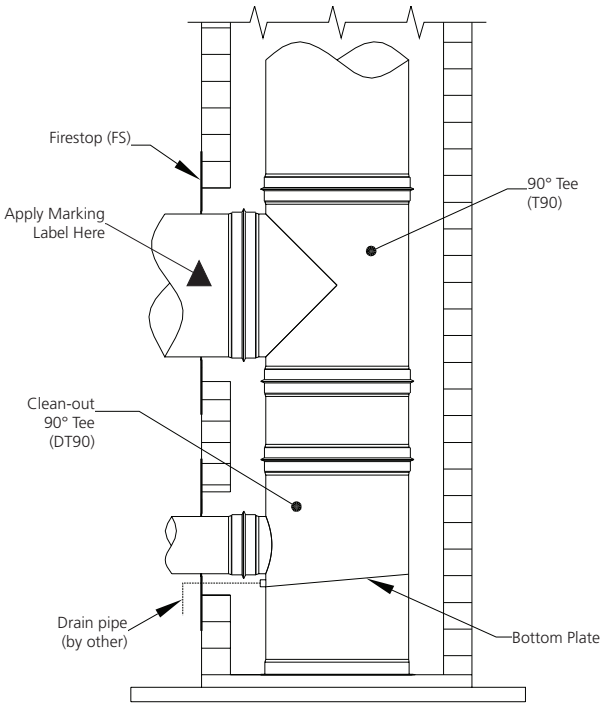
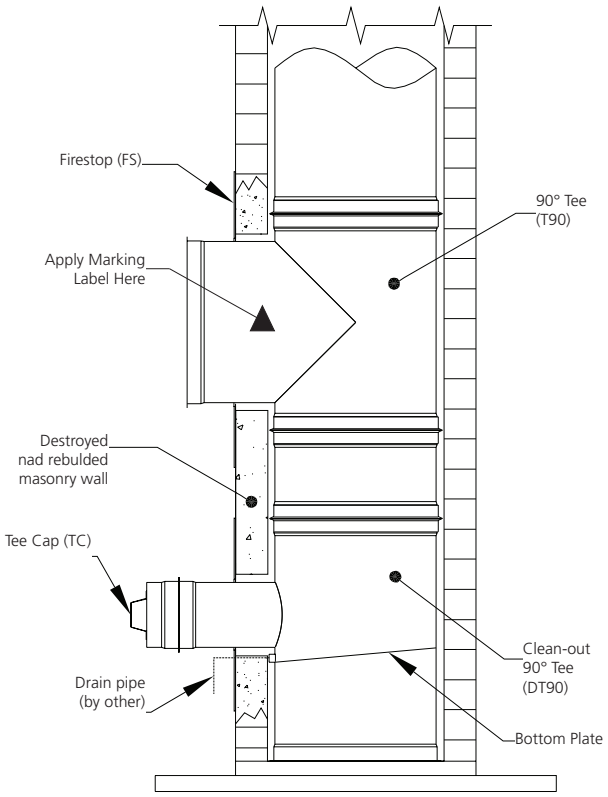



**Fig. B-2a - Welde 90° Tee (T90) Assembly**



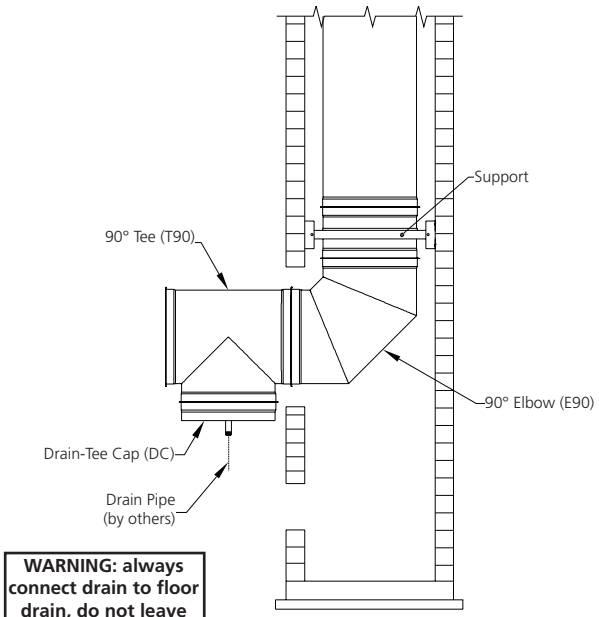
# Tees and Adjustable Length



## 90° ELBOW (E90)

Another assembly option is to use a 90° ELbow (E90) with a 90° Tee (T90) and Drain-Tee Cap (DC). (See Fig. B-3)

**Fig. B-3 - 90° Elbow (E90) Assembly**

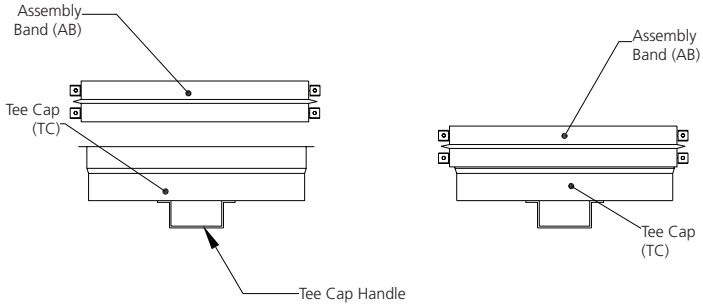



**WARNING: always connect drain to floor drain, do not leave it open**

## TEE CAP (TC)

1. Used to block the horizontal opening of the tee, see Fig. B-1. Removable, it facilitates access for inspection and maintenance of the chimney (Fig. B-4).
2. The assembly includes an Assembly Band (AB).
3. Joint assembly between the Tee Cap (TC) and the Tee is done in the same manner as described in Section A Piping and Fitting Assembly.

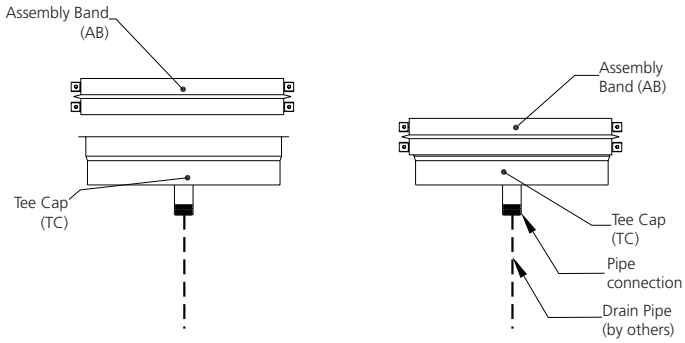
**Fig. B-4 - Tee Cap (TC)**




## DRAIN-TEE CAP (DC)

1. Used in some configurations to block the lower vertical opening of a tee, see Fig. B-3. It serves to collect rainwater that may enter the chimney (Fig. B-5).
2. Removable, it facilitates access for inspection and maintenance of the chimney.
3. To be connected to a drain of 1" diameter-NPT. It is connected to the tee with the joint assembly.
4. Joint assembly between the Drain-Tee Cap (DC) and the tee is done in the same manner as described in Section A Piping and Fitting Assembly.

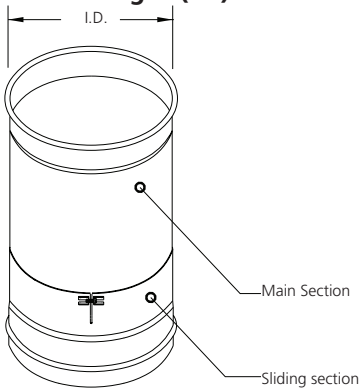
**Fig. B-5 - Drain-Tee Cap (DC)**




## ADJUSTABLE LENGTH (AL)

1. Used in horizontal straight runs of models IPP and HEP, the Adjustable Length (AL) serves two major functions:
   a) To make up for odd lengths of pipe in short runs
   b) To extend the Tee Cap (TC) outside the masonry chimney
2. This part is designed to be adjustable to any needed exact length and it's internal joint must be sealed by working sealant under the seal section, as well as at the joint between the male and the female ends to be closed with the Assembly Band (AB).
3. The adjustable length includes a main section and an outer sliding section that can be secured in the desired length position. Cutting the main section may be required for proper fitting.
4. The sliding section is designed to fit outside the standard main section.
5. Once the final length of the section is set, it is secured using a single clamp and screw. This seal section will prevent the inner section from slipping after the assembly.

**Fig. B-6 - Adjustable Length (AL) Detail**




## SPECIAL PARTS

Available when specified are special parts or components used in chimney systems that can be factory-built to accommodate field situations where standard parts cannot be used.

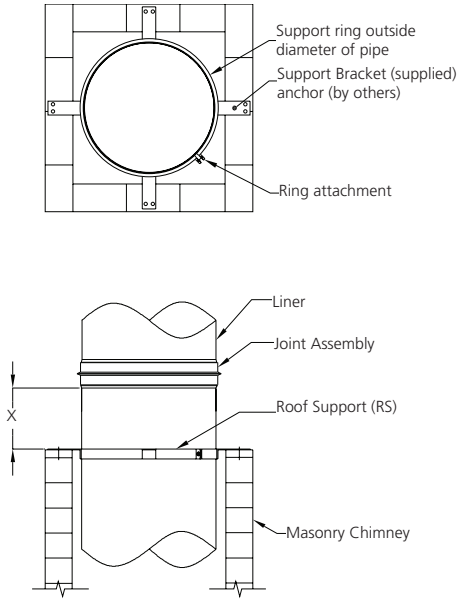
# Structural Support and guiding



## ROOF SUPPORT

Used to support and guide the portion of the chimney which extend to the masonry chimney. It is attached to the masonry chimney by means of four angles (See Fig. C-1). It maintains a minimum distance between the liner and the masonry chimney.

**Fig. C-1 - Roof Support (RS)**

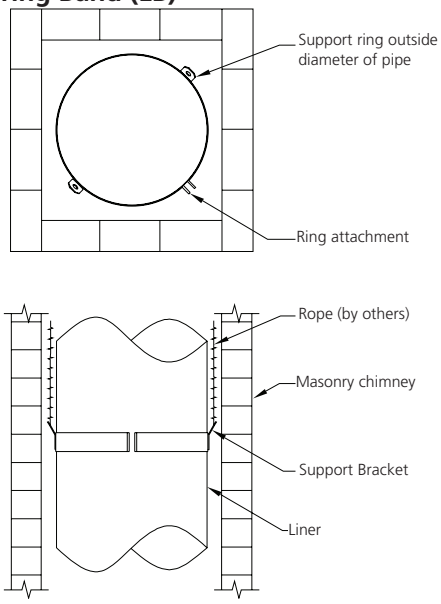



**Keep joint away From support X=6" Min. above and under**

## LOWERING BAND (LB)

Used to insert the liner in the masonry chimney by supporting the liner during the lowering.

**Fig. C-2 - Lowering Band (LB)**

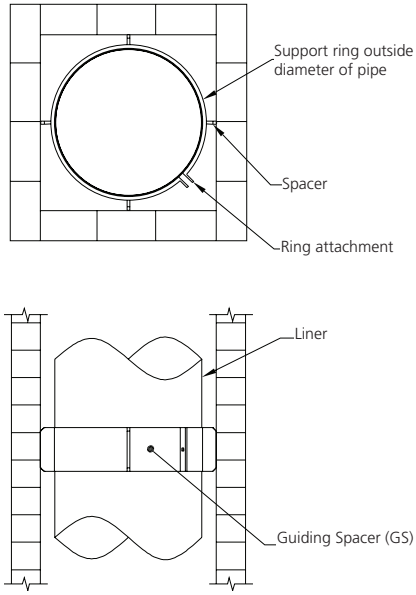



**Note: Must be used with shackles.**

## GUIDING SPACER (GS)

Used to guide the liner every 50 feet and to keep the clearance between the liner and the masonry chimney. Also, it prevents bending of the liner in the masonry chimney and has for effect to increase the maximum height of the liner.

**Fig. C-3 - Guiding Spacer (GS)**




**Note: See Section D Masonry Chimney Top and Wall Penetrations for complete Roof Support (RS) assembly details an use.**

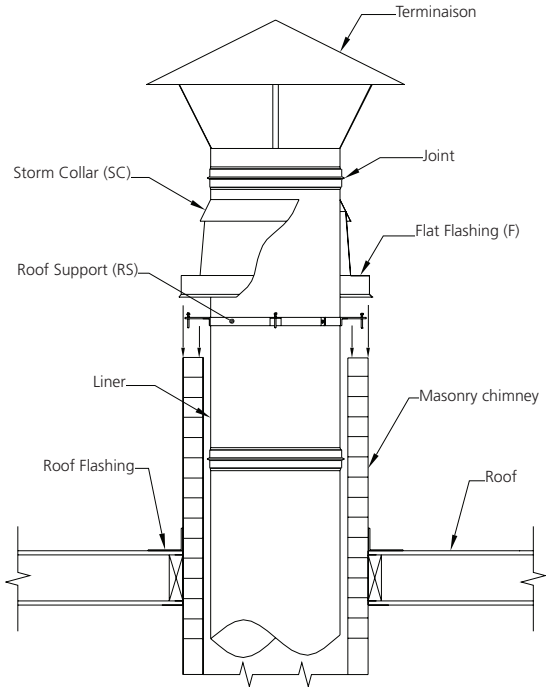
# Masonry Chimney Top and Wall Penetration



## FLAT FLASHING (F) AND VENTILATED FLASHING (VF) ASSEMBLIES

The Flat Flashing assembly (F) is primarily used for boiler or low temperature exhaust to clause the masonry chimney exit opening. It is design to be installed on a flat masonry chimney top of a minimum height of 3 feet from the roof (See Fig. D-1). For some areas, greater heights may be needed according to local code requirements. The roof framing dimension and the masonry chimney dimension must provide sufficient opening to comply with the minimum clearance from combustibles. (See Table A-1) The Roof Support (RS) is secured to the top of the masonry chimney using two 1/4" masonry screws in each support bracket. The Flat Flashing (F) is then lowered on the top of the masonry chimney and the Storm Collar (SC) secured to the chimney section with the screws supplied. A Ventilated Flashing (VF) option is also available where air circulation between the liner and the masonry chimney is wanted. The Ventilated Flashing (VF) option may serve as a ventilation outlet in small boiler rooms with gravity air supply.

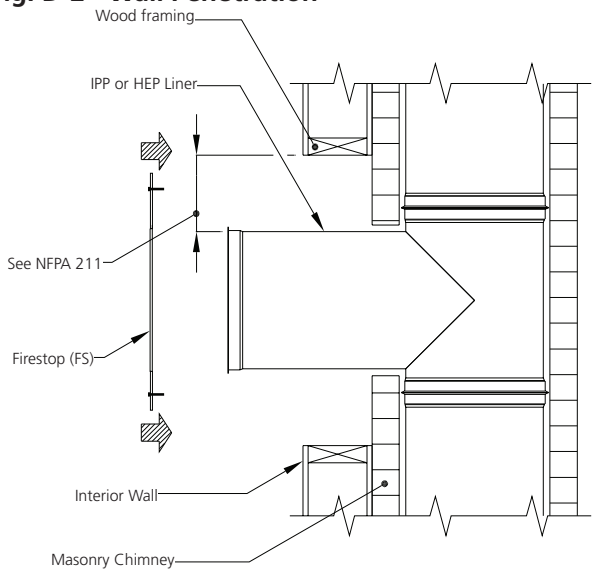
**Fig. D-1 - Masonry Chimney Top Assembly**




## WALL PENETRATION

Where a liner section passes through a wall and a masonry chimney, the combustible material need to be at a minimum clearance from the exterior of the liner to be protected from radiation heat from the liner. See NFPA 211 or local codes for minimum distances to respect (Fig. D-2). Also, used a FireStop (FS) to close the masonry chimney inlet opening.

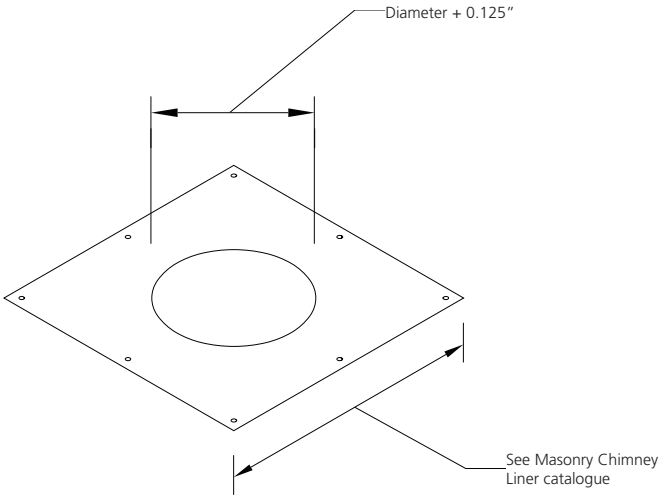
**Fig. D-2 - Wall Penetration**




## FIRESTOP (FS)

Used to close the opening of a masonry chimney where a liner passes through. see Fig. D-3.

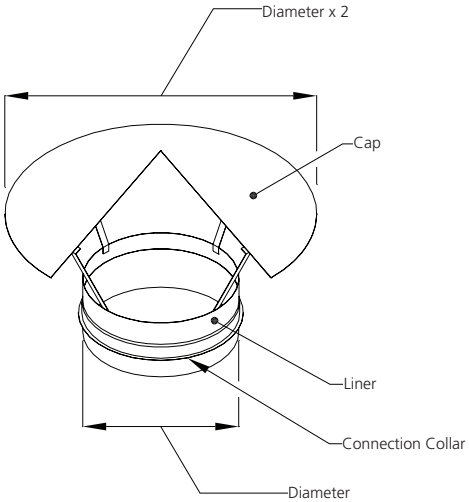
**Fig. D-3 - Firestop (FS) Assembly**



**RAIN CAP (RC)**

Installed at the top of the IPP liner, it prevents entry of rain into the chimney. (See Fig. E-7 for assembly)

**Fig. E-1 - Rain Cap Detil (RC)**

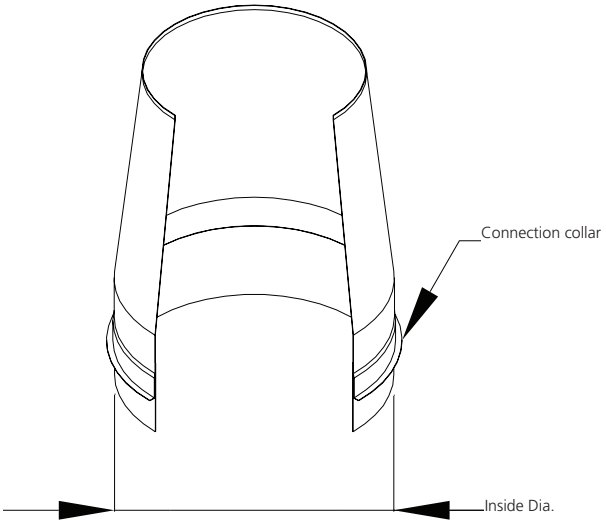



**Note: Do not use with HEP model.**

**EXHAUST CONE (EC)**

Installed at the top the chimney, it improves the draft and increases the speed of escaping gases by 50%. Installation of a drain at the base of the liner is required to collect rainwater. For installation details Exhaust Cone (EC) (See Fig.E-7).

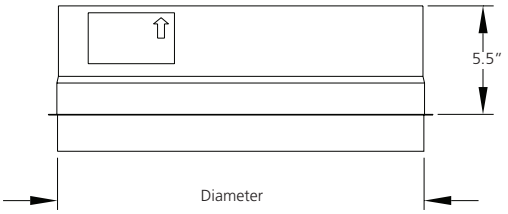
**Fig. E-2 - Exhaust Cone (EC) Detail**




**CLOSURE SECTION (CS)**

Installed at the chimney extremity, the use of a drain at the base of the liner is required to collect any excess rain that may enter the chimney.

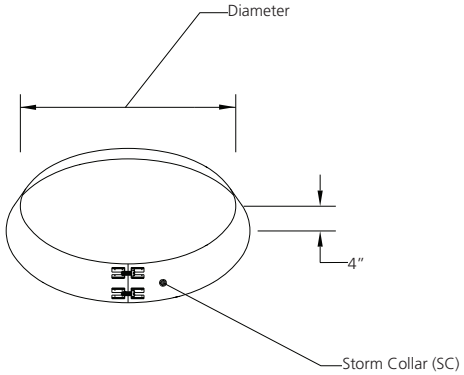
**Fig. E-3 - Closure Section (CS) Detail**




**STORM COLLAR (SC)**

Used for sealing the opening between the chimney and the Flat Flashing (F), the Storm Collar (SC) must be sealed to the chimney with silicone putty. It is supplied with the Flat Flashing (F) roof assembly or Adjustable Flashing (AF) roof assembly.

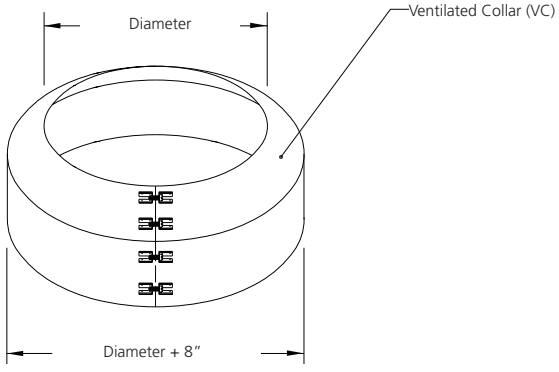
**Fig. E-4 - Sorm Collar (SC) Detail**




**VENTILATED COLLAR (VC)**

Used for sealing the opening between the chimney and Ventilated Flashing (VF), the Ventilated Collar (VC) must be sealed to the chimney with silicone putty. It is supplied with the Ventilated Flashing (VF).

**Fig. E-5 - Ventilated Collar (VC) Detail**



**FAN ADAPTER (FA)**

Installed at the chimney extremity. It is used to connect the chimney to an up-blast exhaust fan.

**Fig. E-6 - Fan Adapter (FA) Detail**

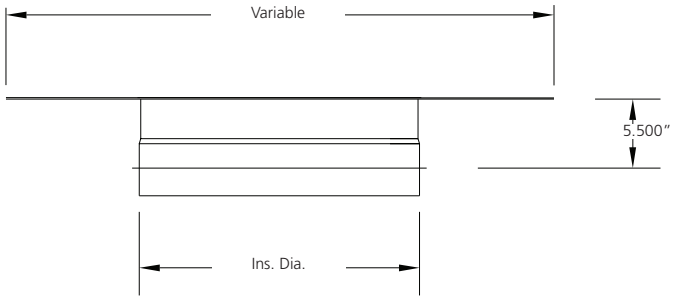



**Fig. E-7a - Typical Installation for Rain Cap (RC)**

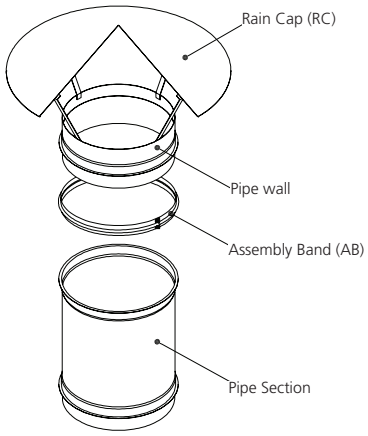
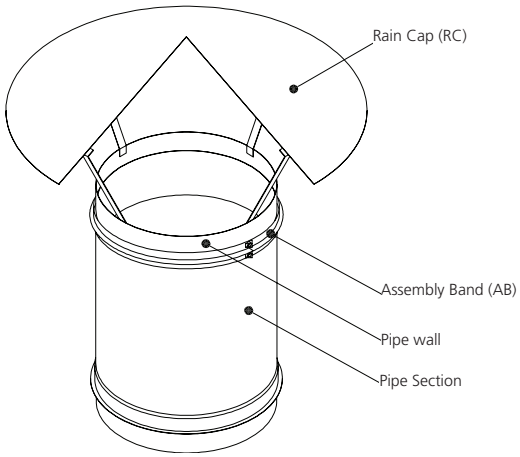



**Fig. E-7b - Finished assembly for Rain Cap (RC)**




**Terminations use and application**

| Termination | Model | Temperature from 0°F to less than 570°F continuous or boiler applications |
|---|---|---|
| Rain Cap | IPP | 6" to 24" diameter |
| Exhaust Cone | IPP and HEP | 6" to 48" diameter |
| Closure Section | IPP and HEP | 6" to 48" diameter |

## CLEANING OF THE MASONRY CHIMNEY

Prior to install, we recommend to check the masonry chimney for cracks, loose, other materials that could inhibit correct installation of the liner and missing bricks or mortar. Also, clean and neutralize the existent masonry chimney.

1. Clean with a water jet all interior surfaces of the masonry chimney in order to remove any residue of combustion and materials releases or not healthy. After cleaning, all surfaces must be solid and healthy.

2. Wash with clean water on air pressure with a mixture of 10% of potassium carbonate all surface interns chimney. Let act at least 12 hours the alkaline solution in order to neutralize the accumulated acid. Rinse with clean water on air pressure.

## INSERTION OF THE HEP LINER

1. If the welded 90° Tee (T90) (see section B) can pass through the masonry chimney, use same steps as model IPP.

2. If the dimensions of the masonry chimney doesn't allowed the 90° Tee (T90) to pass through, the masonry inlet opening must be enlarges to permit the tee section to be install.

3. Joint the clean-out 90° Tee section with the flue gases 90° Tee and inserts the assembly in the masonry chimney by enlarging the inlet opening (Fig. F-1).

**Note: Verify the integrity and the solidity of the masonry chimney prior to demolishing the masonry**

4. For the liner sections above the 90° Tee (T90), the use of a lowering band (see section C) and a rope is necessary. The lowering band is to be installed at the base of the liner section for easy access to remove the rope at the end. Two shackles are to be installed on each side of the lowering band and the rope must be attached to them (Fig. F-2).

5. The section is lower in the masonry chimney until the edge of the liner is above the top of the chimney. The rope must be blocked to support the liner and another liner section can be added on the first one (Fig. F-2).

6. Continue step 2 until the liner system is resting on the top of the 90° Tee (T90) by adding section one by one.

**Fig. F-1 - Installation of HEP Tee section in Masonry Chimney**

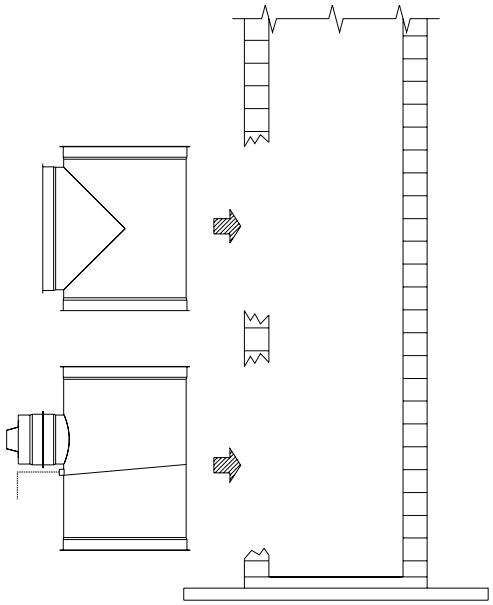
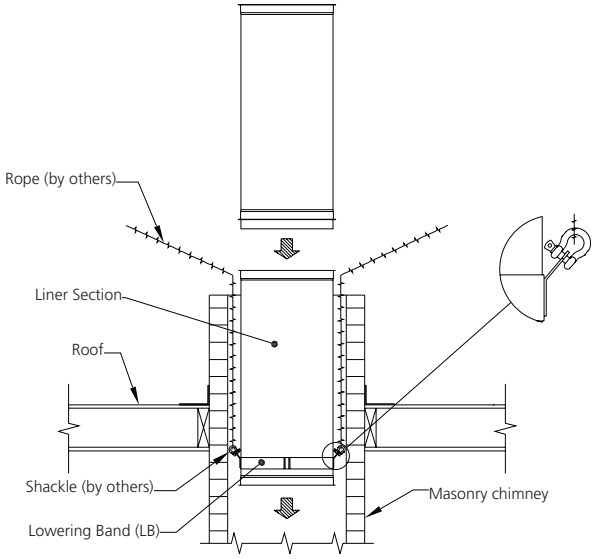


**Fig. F-2 - Lowering of HEP Sections in masonry Chimney**




7. Remove the rope and the shackle from the lowering band at the bottom of the liner.

8. Rebuild the masonry chimney wall and install a Firestop (FS) to close the masonry chimney inlet opening.

9. Install the Roof Support (RF), the Flat Flashing (F), the Storm Collar (SC) and a termination section on the top of the masonry chimney (See section D and E).

**Note: If those configurations can not be used, please call manufacturer, the engineering team can provide solutions.**

c UL us LISTED

**3ST5**

CHIMNEY LINER LISTED FOR APPLIANCES WICH BURN NATURAL GAS, PROPANE OR OIL FUEL THAT PRODUCE GASES AT A TEMPERATURE OF MAX 570°F (300°C).

**28KJ**

ALSO LISTED AS SPECIAL GAS VENT CATEGORY II, II, IV ; GAS VENT TYPE BH CLASS I AND II MAX 550°F / 288°C

CHEMINÉE Lining

MANUFACTURED IN CANADA BY:
CHEMINEE LINING.E INC.,
TERREBONNE, QC, CANADA , J6Y 1Y5
www.chemineelining.com

## MODEL **HEP** ❑

## WARNING / AVERTISSEMENT

IN CANADA, CHIMNEY LINER IS LISTED ONLY FOR EXISTING MASONRY OR FACTORY-BUILT CHIMNEY AND VENTS. LINING SYSTEMS MUST BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS. ALSO LISTED FOR NEW AND EXISTING MASONRY CHIMNEYS IN UNITED-STATES.

AU CANADA, CE CHEMISAGE EST LISTÉ POUR LES CHEMINÉES DE MAÇONNERIES OU PRÉ-FABRIQUÉES EXISTANTES. CE CHEMISAGE DOIT ÊTRE INSTALLÉ SELON LES INSTRUCTIONS D'INSTALLATION DU MANIFACTURIER. AUSSI LISTÉ POUR LES CHEMINÉE DE MAÇONNERIES NOUVELLES OU EXISTANTES AUX ÉTATS-UNIS.

**Minimum clearance to combustible material (in)**

| Used as a Liner | | Used as special gas vent | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter | 6'' to 24'' | Diameter | 6 | 8-10 | 12-14 | 16-20 | 22-24 | 26-28 | 30 | 32 | 34-38 | 40-42 | 44 | 46-48 |
| Between masonry chimney exterior and combustibles | 0'' | Unenclosed vertical | 1,5 | 2 | 3 | 4 | 5 | 6 | 7 | 7 | 8 | 9 | 9 | 10 |
| Between masonry chimney interior and the liner | 1'' | Unenclosed horizontal | 3 | 3 | 4 | 5 | 6 | 6 | 6 | 7 | 7 | 8 | 9 | 9 |

RISK OR CARBON MONOXIDE POISIONNING AND RISK OF FIRE IF IMPROPERLY INSTALLED. FOLLOW ALL CAUTIONS, WARNINGS AND INSTRUCTIONS REGARDING INSTALLATION OF THIS VENT PIPE SYSTEM.
RISQUE D'EMPOISONNEMENT AU MONOXYDE DE CARBONE SI MAL INSTALLÉ. LIRE ATTENTIVEMENT LES INSTRUCTIONS D'INSTALLATION FOURNIES AVEC CE PRODUIT.S

INSTALLATION DATE /
DATE D'INSTALLATION :

SUITABLE FOR EXTERIOR INSTALLATION
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**3ST5**

MODEL IPP & HEP CHIMNEY LINER PART LINER FOR EXISTING CHIMNEY.

MODEL HEP ALSO LISTED AS SPECIAL GAS VENT CATEGORY II, II, IV ; GAS VENT TYPE BH CLASS I AND II MAX 550°F / 288°C

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## MODELS **IPP** ❑ **HEP** ❑

## LINER COMPONENT

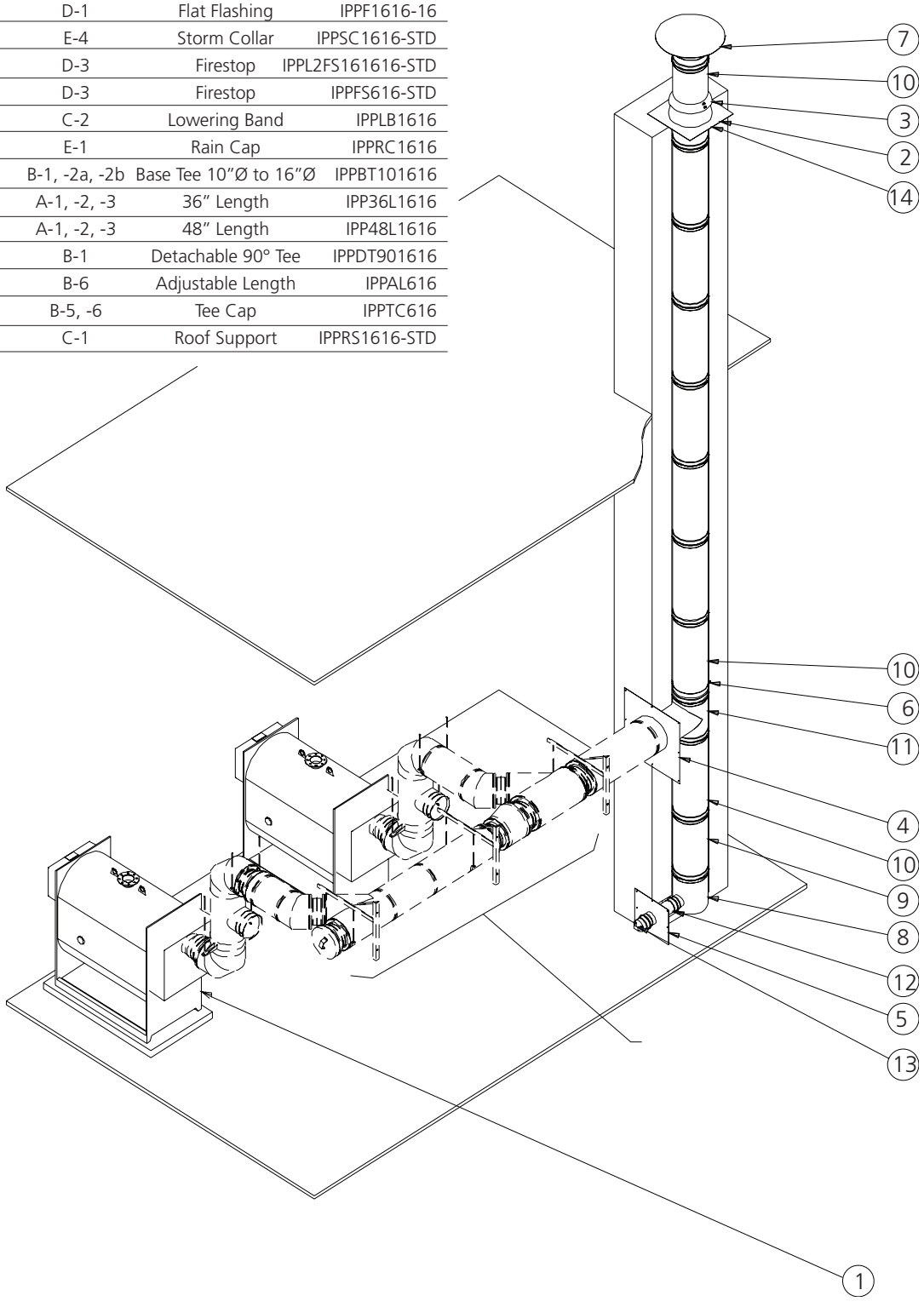
MATERIAL FOR USE WITH FACTORY BUILT CHIMNEY MODEL IPP OR HEP.

CHIMNEY LINER LISTED ONLY FOR EXISTING CHIMNEY IN CANADA. LINING SYSTEMS MUST BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS. ALSO LISTED FOR NEW AND EXISTING MASONRY CHIMNEY IN UNITED-STATES.

CE CHEMISAGE EST LISTÉ POUR LES CHEMINÉES EXISTANTES AU CANADA. CE CHEMISAGE DOIT ÊTRE INSTALLÉ SELON LES INSTRUCTIONS D'INSTALLATION DU MANUFACTURIER.

PRINTED IN CANADA 2011
UL 1777.2

| No. | Section | Page | Fig. | Description | Part no. |
|---|---|---|---|---|---|
| 1 | --- | --- | --- | Appliance | --- |
| 2 | D | 12 | D-1 | Flat Flashing | IPPF1616-16 |
| 3 | E | 13 | E-4 | Storm Collar | IPPSC1616-STD |
| 4 | D | 12 | D-3 | Firestop | IPPL2FS161616-STD |
| 5 | D | 12 | D-3 | Firestop | IPPFS616-STD |
| 6 | C | 11 | C-2 | Lowering Band | IPPLB1616 |
| 7 | E | 13 | E-1 | Rain Cap | IPPRC1616 |
| 8 | B | 9 | B-1, -2a, -2b | Base Tee 10"Ø to 16"Ø | IPPBT101616 |
| 9 | A | 6-7 | A-1, -2, -3 | 36" Length | IPP36L1616 |
| 10 | A | 6-7 | A-1, -2, -3 | 48" Length | IPP48L1616 |
| 11 | B | 9 | B-1 | Detachable 90° Tee | IPPDT901616 |
| 12 | B | 10 | B-6 | Adjustable Length | IPPAL616 |
| 13 | B | 10 | B-5, -6 | Tee Cap | IPPTC616 |
| 14 | C | 11 | C-1 | Roof Support | IPPRS1616-STD |



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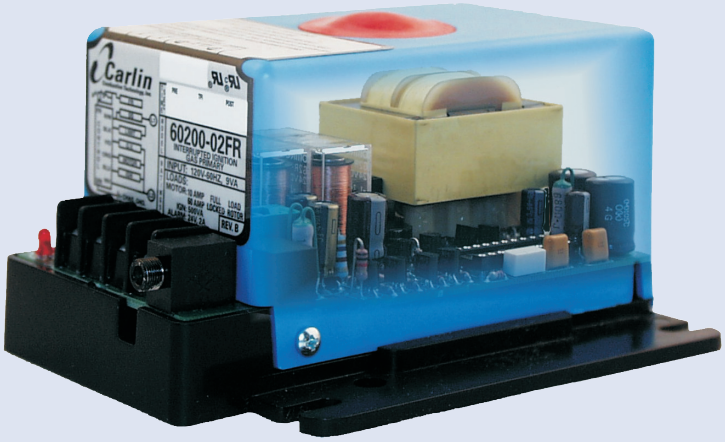
Carlin®
Combustion Technology, Inc.

# MODEL 60200FR
## Flame rod
# Microprocessor Gas primary control

## Data sheet

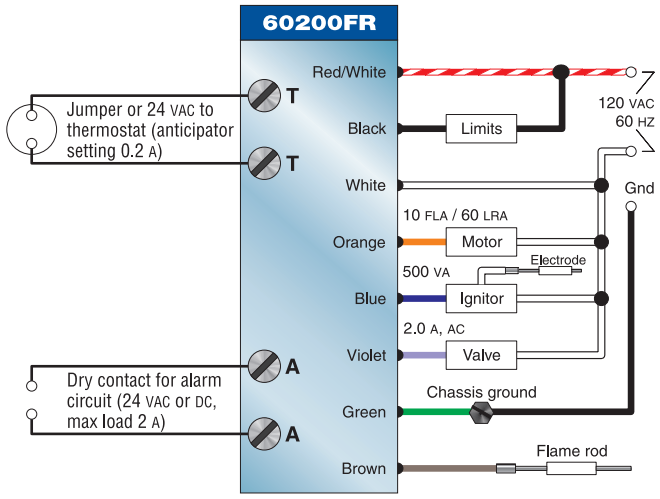



- Interrupted duty ignition
- Recycle on flame failure
  (flame failure lockout version also available)
- Serviceman reset protection
  (Latch-up after three consecutive lockouts (1))
- Diagnostic & flame indicator LED's
- Pre-purge and post-purge
  (contact Carlin for available timings)
- 2-second ignition establishment period
- 4-second TFI (trial for ignition)(other timings available)
  (1.3-second flame failure response time (FFRT))
- Alarm contacts
- Flame signal test jack
- Thermostat/aquastat compatible
- ***SMC*** Technology (2)

| | |
|---|---|
| **Power input** (red/white wire) | 120 VAC, 60 HZ, 9 VA |
| **Limit circuit input** (black wire) | 120 VAC, 60 HZ |
| **Motor load** | 120 VAC, 60 HZ, 10 FLA, 60 LRA |
| **Ignitor load** | 120 VAC, 60 HZ, 500 VA |
| **Valve load** | 120 VAC, 60 HZ, 2.0 A |
| **Alarm contacts** | 24 V, AC/DC, 2.0 A |
| **Operating temperature limits** | +32°F to +140°F |
| **Storage temperature limits** | –40°F to +185°F |
| **Thermostat anticipator current** | 0.2 A, AC |
| **Flame current, minimum** | 0.8 MICROAMP DC |
| **Agencies** | UL/CUL recognized |

(1) **Latch-up** mode shuts down the control after three consecutive lockouts, and requires a special procedure to reset. This ensures the owner will call in a technician to troubleshoot burner problems.

(2) The 60200FR provides two motor relays. Carlin's patented **SMC** technology (*Safety Monitoring Circuit*) monitors the contacts of both motor relays and the gas valve relay. No start-up is allowed if a motor relay contact is found closed when it should be open — or — if the gas valve relay contact shows power when the control starts up. The second motor relay ensures motor shutdown even if the first motor relay fails.




## Installing and wiring

**Warning** — *The 60200FR control must be installed and serviced only by a qualified service technician.*

1. Always disconnect power source before wiring to avoid electrical shock or damage to the control. All wiring must comply with applicable codes and ordinances.
2. Thermostat terminals (T–T) provide a current source. Never apply external power to these terminals under any circumstances.
3. Alarm terminals provide a 24 VAC-rated dry contact, suitable for use with security/fire alarm systems such as Carlin SecureHeat™.

### Mounting

- The control may be mounted on a 4" x 4" junction box in any convenient location on the burner, furnace or wall. The location must not exceed the ambient temperature limit, 140°F.

### Wiring

- Wiring must comply with local and national electrical codes, and in accordance with the wiring diagram above.

### Field checks

1. **Safety timing (TFI) test** — Disconnect flame rod wire from control. Start burner. After the pre-purge period, the control activates ignitor. Control should lockout within TFI timing plus 2 seconds. Replace wire after test.
2. **Flame failure/recycle test** — Start burner. After flame is established (after TFI period), close the gas supply hand valve. This will cause a flame failure sequence as described on the reverse side of this Data sheet. The control should recycle (restart after 65 seconds).
3. If control does not operate as described, check the wiring.

## Start-up & operation

**WARNING** Do not start the burner if the combustion chamber contains residual gas. Allow gas to disperse.

**NOTICE** Per UL requirements, the control will not turn on if the flame rod senses flame during the self-test. If the flame rod senses flame, the green LED turns on. The control will remain in self-test mode until the flame rod no longer senses flame. The amber LED will remain on, but blink off momentarily Ⓐ every 3 to 4 seconds.

**NOTICE** Check 60200FR control label for trial for ignition (TFI), pre-purge and post-purge timings.

ⒶⓇ **Power ON** Open all manual gas line valves. Close the line switch. (If Red LED turns on constant Ⓡ, control is in lockout. See below to reset.)

ⒶⓇ **Self-test 1** The control performs a "boot-up" test to verify internal operation each time power is applied to the red/white wire. About 4 seconds after power application, the amber LED turns on. The test continues for about 6 more seconds. If the test fails, the control turns the amber LED off and repeats this test sequence until successful.

ⒶⓇ **Stand-by** (No call for heat) If Self-test 1 is successful, amber LED turns off and control waits for heat call.

ⒶⓇ **Call for heat** Set thermostat (or limit) to call for heat. Thermostat circuit must be closed and power coming to black wire from limit circuit.

**Self-test 2** The amber LED turns on. For the first 3 to 4 seconds, the control performs a self-test. If the flame rod senses flame, the green LED turns on. The control repeats the self-test until flame is no longer detected (green LED would turn off). During this time, the amber LED will remain on, but blink off momentarily Ⓐ every 3 to 4 seconds. If the control detects motor contacts closed, no start-up is allowed.

ⒶⓇ **Burner on** After the self-test, the amber LED turns off. The ***motor*** starts.

ⒶⓇ **Pre-purge** The ***ignitor*** starts after the pre-purge period. Two seconds later, the ***gas valve*** opens. The 2-second delay (ignition establishment period) helps ensure a stable spark is in place when the gas valve opens (to compensate for sluggish response of some AC ignition transformers).

ⒶⓇ **TFI** After gas valve opens, the flame rod must sense flame within the TFI time limit (trial for ignition). The green LED turns on Ⓖ at the end of the TFI if the flame rod senses flame.

ⒶⓇⒼ **Run** The burner continues firing during call for heat if the flame rod senses flame. Amber and red LED's are off during normal running.

ⒶⓇⒼ **Lockout** If flame rod does not sense flame within the TFI time limit after gas valve activation (TFI), **lockout** occurs. The control turns the red LED on constant, and closes the ***alarm*** contact. Green LED is off.

To **Reset** Push in and hold reset button for 1 second, then release.

ⒶⓇⒼ **Latch-up** If the control locks out **3 times** during a single call for heat, **latch-up** occurs. The control turns on both the amber and red LED's constant. You must use the special procedure below to reset the control after latch-up.

**WARNING** **Reset after latch-up — *Only a qualified service technician should attempt to reset the control after latch-up. The problem that caused the repeated burner problems must be corrected before returning the burner to normal operation.***

ⒶⓇⒼ Push in and hold the reset button for about 10 seconds. The amber and red LED's will begin to flash alternately.

ⒶⓇⒼ After the LED's begin flashing, continue to hold the reset button for about another 20 seconds. The LED's will turn off. Release the reset button and the control will restart. (Releasing the button before the LED's turn off will cause the control to remain in latch-up.)

**NOTICE** The 60200FR control will not reset from lockout or latch-up if power is interrupted.

ⒶⓇ **Flame failure** If the flame rod loses flame signal during operation (after the TFI), the red LED flashes. The ***gas valve*** closes within 2 seconds. The ***motor*** remains on for the motor delay off period, then shuts off. **Recycle**: Control waits for 65 seconds (with red LED flashing), then begins again at **Self-test 2**. Red LED goes off Ⓡ.
**(NOTE**: **Controls with non-recycle feature will lockout on flame failure**. **Model 60200FRN only.)**

ⒶⓇ **Post-purge** Set thermostat (or aquastat) to stop call for heat. The ***gas valve*** will turn off within 2 seconds. The ***motor*** remains on for the post-purge period, then turns off.

ⒶⓇ **Stand-by** Control remains in stand-by mode until limit circuit sends power to the black wire and thermostat circuit closes (call for heat).

## Model 60200 diagnostic LED's

Ⓐ – Amber **OFF** Ⓡ – Red **OFF** Ⓖ – Green **OFF**

Ⓐ – Amber **ON** Ⓡ – Red **ON** Ⓖ – Green **ON**

Ⓐ – Amber **FLASHING** Ⓡ – Red **FLASHING**

Ⓐ – Amber **BLINKING** (blinks off momentarily every 3 to 4 seconds)

## Service & Troubleshooting

### Burner (control) will not come on

ⒶⓇ **No power to control**

- Check line voltage to the control (at least 95 VAC).
- Check all electrical connections.

ⒶⓇ **Control is in lockout**

- Red LED will be on. Press the reset button for 1 second.
- If the control returns immediately to lockout: Use a voltmeter to check power to the gas valve. (Also check the power to the valve after resetting control and attempting another start.) The control may have detected power on the valve relay contact. If the gas valve wire shows 120 vac, check wiring to make sure wiring is correct and there is no external power feed to the valve. Correct wiring if needed. If the voltmeter shows no power to the valve, the circuit may have an internal control problem. Replace the control.

ⒶⓇⒼ **Flame rod sensing flame**

- Amber LED blinks off each 3 to 4 seconds; green LED on. Remove flame rod lead from rod.

  If the amber LED ***remains on*** Ⓐ with a wire detached, the control is defective.

  If amber and green LED's ***go off*** Ⓐ, control is OK, and either the rod is defective or there is a problem with the rod wiring.

To troubleshoot:

- Check flame rod by using an ohmmeter to check resistance from flame rod to ground — should be at least 1 MEGOHM.
- Connect a flame simulator to the control flame rod lead. If green LED turns on, flame rod assembly is defective. Replace assembly.

### Repeated flame failures (Ⓐ Ⓡ *flashing red LED*)

Check for:

- Defective flame rod assembly
- Excessive airflow or draft causing flame to leave burner head — Check for proper air band setting and draft.
- Excessive back pressure causing flame to be erratic — Check appliance and flue for sooting/plugging.

### Control locks out after TFI (Ⓐ Ⓡ *red LED on*)

Check for:

- No gas to burner — Check gas supply and lines. Verify gas pressure is no higher than allowed for gas valve (usually ½ psig maximum).
- Shorted electrode — Inspect for cracked porcelain and replace as needed.
- Poor spark — Check electrode spacing and condition per burner manual. Replace or realign if necessary.
- Airflow too high — Check air band setting.
- Ignitor module defective — Replace if no spark.
- Flame rod defective or shorted to burner chassis.
- Gas valve stuck in closed position. Check wiring connections. Replace as necessary.
- Reversed 120 VAC polarity — Make sure the hot and neutral lines are not reversed at power entrance.

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# INSTALLATION and OPERATING INSTRUCTIONS

**For Use By Qualified Service Technicians Only**

# CARLIN OIL BURNER MODEL 702CRD

## DESCRIPTION

The model 702CRD burner is designed to fire No. 2 fuel oil and is a low-high-low-off (step modulating) high-speed flame retention burner. Oil flow-rate is step-modulated by the use of two oil valves with a dual pressure fuel unit. Combustion air is controlled by a damper motor. Its end-switch energizes the second stage valve as the air shutter approaches the open position.

Model 702CRD is currently for use on H.B. Smith "18" series, Weil-McLain "88" series, and Burnham "V9" series boilers. Other applications should be reviewed with Carlin factory support personnel if questionable.

## ASSEMBLING THE BURNER (TWO-PAK)

1. Remove the air tube and nozzle line assembly from the smaller carton. If nozzles are not installed, see instructions under (4).
2. Remove the main housing assembly from the larger carton.
3. Install air tube assembly in housing using set screws provided. Be sure air tube is fully seated against step in housing.
4. Install and tighten the proper nozzles (Table 3, Page 3) in the adapter. Be careful not to damage the electrode insulators or to bend the wires.

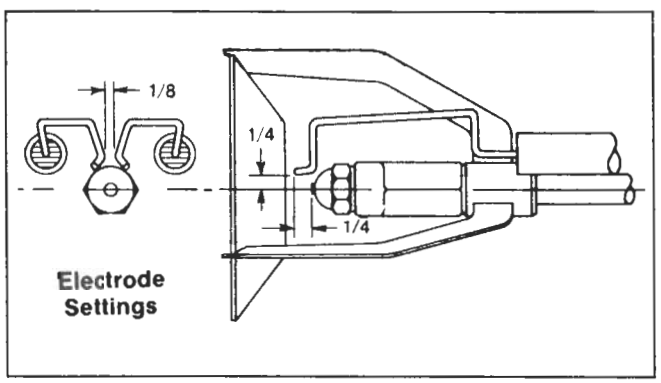
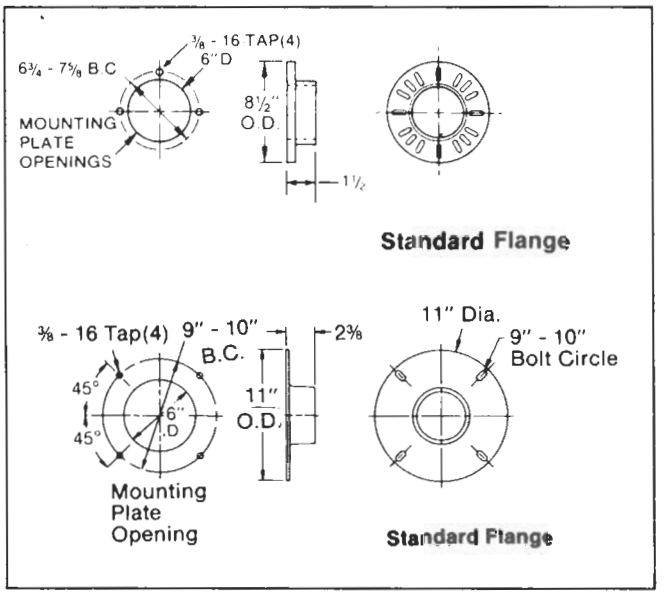



**Figure 1. Electrode Settings**

5. Check the electrode settings (Figure 1).
6. Swing open the transformer, and slide the nozzle line assembly into the air tube. The flame retention ring must be lifted and guided through the throttle ring (a reduced diameter) in the end of the air tube. DO NOT FORCE IT.
7. Fasten the high tension leads to the transformer terminals.
8. Place the nozzle line yoke in the groove in the adjusting screw.
9. Swing the transformer to the closed position.
10. Connect the flared fitting on the copper oil line to the nozzle line and tighten.
11. See sections on Page 4 for adjustments of combustion head and combustion air.

## DIMENSIONS




## VENTILATION

Boiler room areas of commercial buildings of normal construction generally do not allow for sufficient air infiltration. Provision must be made for an outside air supply to the boiler room area. This is required because combustion of oil consumes about 30 cfm of air per 1 gph input. To ensure an adequate air supply, provision must be made for 30 cfm per 1 gph plus 50% additional for draft regulator.

**Example:**

Burner is firing at 6.00 gph. 6 × 30 = 180 cfm. Add 50% = 270 cfm. Install an opening of approximately 30 sq. in. free area per 1 gallon per hour input. When louvers are used, consider the free area half of the total.

**Example:**

Firing 6.00 gph free area = 6 × 30 = 180 sq. in. A louvered opening would be 180 × 2 = 360 sq. in. gross. Fresh air louvers must be above ground level to prevent obstruction by leaves and snow.

## INSTALLING THE BURNER: FLANGE MOUNTED

1. Measure, in the burner opening, the distance from the inside of the combustion chamber to the outside of the mounting plate to find the insertion length of air tube needed. Position flange (Figure 2) with sleeve inside on air tube at a point from end of burner corresponding to this measurement. Tighten set screws to anchor flange. The flange is now located so that the end of the burner will be flush, or almost flush, with the inside of the combustion chamber.
2. Slide the end of the air tube into the opening and secure the flange to the front plate.

## INSTALLING THE BURNER: PEDESTAL MOUNTED

1. Adjust the pedestal (Figure 3) so that the height of the air tube matches the location of the burner opening.
2. Slide the end of the air tube into the opening so that it is flush or nearly flush with the inside of the combustion chamber.
3. From the outside of the unit, seal the space around the air tube with asbestos cement or equivalent.

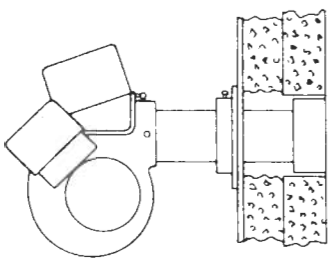


Figure 2. Flange mounted.

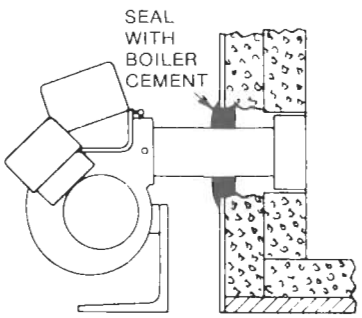



Figure 3. Pedestal mounted.

## FIRING BOILERS WITH COMBUSTION CHAMBERS

The 702CRD burner operates with superior efficiency and cleanliness in properly designed refractory-type combustion chambers (Figure 4). Very wide tolerance to burner adjustments and other variables is found when these chambers are used.

Table 1 shows the recommended minimum inside dimensions for refractory brick, refractory pre-cast and preformed refractory fiber chambers. Due to their quick warm-up properties, the light, insulating-type materials are slightly preferable although these burners show less dependence upon refractory temperature than previous models. Refractory materials in boilers and furnaces should be capable of withstanding 2600° F (1427° C) or higher.

The note accompanying Table 1 provides further details relative to variations in dimensions and geometry.

**TABLE 1.**
**MINIMUM DIMENSIONS RECOMMENDED IN REFRACTORY COMBUSTION CHAMBERS (Inches)**

| High-Fire Oil Delivery Rate GPH @ 300 PSI | Length "L" | Width "W" | Dim. "C" | Suggested Height "H" | Min. Dia. Vertical Cylinder |
|---|---|---|---|---|---|
| 5.95 | 19 | 13.5 | 7.0 | 13 | 17 |
| 6.80 | 23 | 14.5 | 7.0 | 14 | 21 |
| 7.65 | 27 | 15.0 | 7.5 | 15 | 25 |
| 8.50 | 32 | 15.5 | 8.0 | 15 | 30 |
| 9.35 | 34 | 16.0 | 8.0 | 16 | 32 |
| 10.20 | 35 | 16.0 | 8.0 | 16 | 33 |
| 11.05 | 37 | 16.5 | 8.5 | 16 | 35 |
| 11.90 | 48 | 16.5 | 8.5 | 16 | 46 |
| 12.75 | 55 | 16.5 | 8.5 | 16 | 53 |

**Note:** **These are minimum** dimensions and each may be exceeded without much effect.

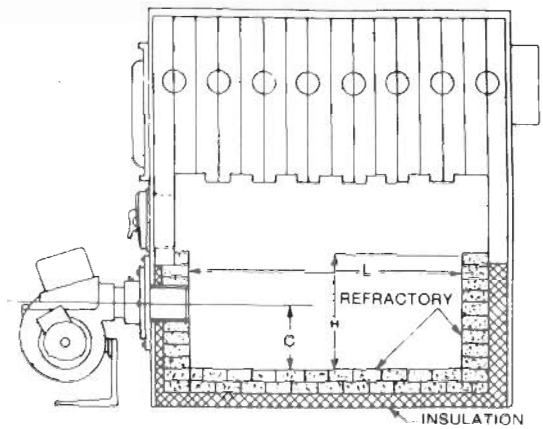



**Figure 4. Brick combustion chamber (side view).**

## FIRING BOILERS WITHOUT REFRACTORY CHAMBERS

Depending upon the geometry of the combustion space, some units perform better than others without refractory (Figures 5 and 6). When the back wall of the unit coincides approximately with the end of the flame, a target of refractory material is usually required.

Table 2 shows minimum dimensions required for good combustion *without* refractory. They may be exceeded without much effect.

**TABLE 2.**
**MINIMUM DIMENSIONS RECOMMENDED IN BOILERS FIRED WITHOUT COMBUSTION CHAMBERS (Inches)**

| High-Fire Oil Delivery Rate GPH @ 300 PSI | "L" With Target | "L" Without Target | Width "W" | Dim. "C" | Dim. "D" |
|---|---|---|---|---|---|
| 5.95 | 19 | 23 | 15.5 | 8.0 | 10.0 |
| 6.80 | 23 | 27 | 16.5 | 8.0 | 10.0 |
| 7.65 | 27 | 32 | 17.0 | 8.5 | 10.5 |
| 8.50 | 32 | 37 | 17.5 | 9.0 | 11.0 |
| 9.35 | 34 | 40 | 18.0 | 9.0 | 11.0 |
| 10.20 | 35 | 41 | 18.0 | 9.0 | 11.0 |
| 11.05 | 37 | 43 | 18.5 | 9.5 | 11.5 |
| 11.90 | 48 | 54 | 18.5 | 9.5 | 11.5 |
| 12.75 | 55 | 61 | 18.5 | 9.5 | 11.5 |

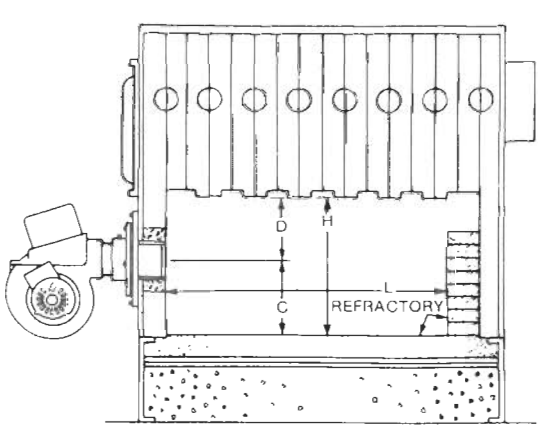



**Figure 5. Wet leg boiler. No combustion chamber (side view).**

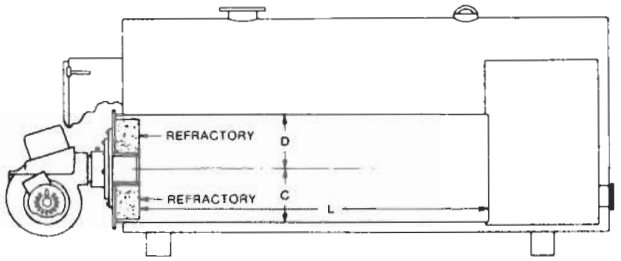



**Figure 6. Scotch Marine boiler. No combustion chamber.**

## OPERATION

1. Call for heat. Burner motor and ignition are energized. Air is in the *low-fire* position. The *low-fire* oil valve admits oil at 100 psi to the nozzle and its spray ignites, burning clean with proper air/fuel ratio.
2. If demand exceeds *low-fire*, the damper motor is energized through a *high-fire* operating control (aquastat, airstat, pressuretrol, or outdoor thermostat). As the damper motor approaches a half open position, the auxiliary end switch energizes the *high-fire* valve on the fuel unit, closing the by-pass port, and increasing the nozzle pressure to 300 psi. Thus the full fire with open air burns clean with high $CO_2$ and high efficiency.
3. As the *high-fire* input begins to exceed the demand of the *high-fire* operator, the operating control de-energizes the damper motor. As the damper motor returns the air shutter to *low-fire*, the auxiliary end switch in the damper motor de-energizes the *high-fire* valve which drops the nozzle pressure to 100 psi.
4. If the demand exceeds *low-fire*, the *high-fire* operating control would again call for more heat as in Step 2 and then Step 3.
5. If, after returning to *low-fire*, the load should drop to below the *low-fire* output, the operating limit would shut off the burner completely.

**It is important that the installation of the oil burner, piping and fittings, safety devices, controls, electrical wiring and equipment be done in accordance with national and/or local regulations of the authorities having jurisdiction over such installation.**

**Table 3.**
**NOZZLE DATA AND COMBUSTION HEAD SETTINGS**

| Nozzle Size | Low Fire Pres.* | Low Fire Rate GPH | Head Setting 'A' (Inch) | Low Fire 'X' Air Open (Inch) | High Fire Pres.** | High Fire Rate |
|---|---|---|---|---|---|---|
| 3.50 | 100 | 3.50 | 0 | 3/8 | 300 | 5.95 |
| 3.75 | 100 | 3.75 | 1/16 | 3/8 | 300 | 6.38 |
| 4.00 | 100 | 4.00 | 1/8 | 3/8 | 300 | 6.80 |
| 4.50 | 100 | 4.50 | 3/16 | 3/8 | 300 | 7.65 |
| 5.00 | 100 | 5.00 | 1/4 | 3/8 | 300 | 8.50 |
| 5.50 | 100 | 5.50 | 5/16 | 3/8 | 300 | 9.35 |
| 6.00 | 100 | 6.00 | 7/16 | 7/16 | 300 | 10.20 |
| 6.50 | 100 | 6.50 | 5/8 | 7/16 | 300 | 11.05 |
| 7.00 | 100 | 7.00 | 7/8 | 1/2 | 300 | 11.90 |
| 7.50 | 100 | 7.50 | 1 1/4 | 1/2 | 300 | 12.75 |

* The "low-fire" pump pressures shown are recommended. If higher low-fire inputs are desired for a given situation, the low-fire pressure can be increased only up to 200 psi. Higher low-fire pressures will require higher low-fire air openings.

** The "high-fire" pressure is set at the factory to 300 psi. This is the maximum UL rating for the fuel unit, so higher pressures are not recommended.

## NOZZLE SPECIFICATIONS

The 60° P Hago nozzle is the standard nozzle and usually provides the best fire. Substitutions are sometimes recommended in specific packaged boilers.

Following is a list of nozzle specifications for packaged boilers presently using the 702CRD burner:

**Burnham Series V907 - V910: 70° B, Delavan**
**Burnham Series V911: 60° PLP Monarch**
**H. B. Smith Series 18: 9-11 Section, 45° P Hago**
**H. B. Smith Series 19: 7-11 Section, 60° P Hago**
**Weil-McLain 488, 488R: 60° PLP Monarch**
**Weil-McLain 588: 70° P Hago.**

Other makes of nozzles may or may not prove satisfactory.

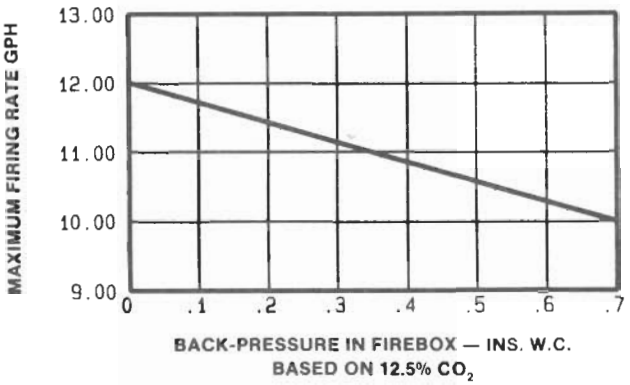
For special applications, other specifications might provide a more desirable pattern.

## FORCED DRAFT FIRING

Due to the back pressure in forced draft units, the maximum firing rate of a burner is reduced. The greater the pressure, the lower the maximum GPH capability becomes. Table 4 shows this. Note that the Table stops at 0.70 inches W.C., the maximum recommended back pressure for the 702CRD burner.

The combustion head settings for forced draft firing would be somewhat greater than those shown in Table 3 which is for zero pressure or natural draft.

**TABLE 4.**
**MAXIMUM FIRING RATES (GPH) — FORCED DRAFT**




## HOW TO ADJUST THE COMBUSTION HEAD

The retention ring position ahead of the throttle ring is adjustable from zero (flush) to 1 1/4 inches (Dimension "A," Figures 7 and 8). Turning the adjusting screw (clockwise) increases the distance "A" ahead. This distance is indicated by lifting the housing cover and reading the scale on the nozzle line across the corners on sides of the channel guiding the nozzle line. Each division is 1/16 inch.

Refer to "A" dimension (Table 3) for corresponding nozzle selection. **Example:** 702CRD burner firing at 6.80 GPH *high-fire* setting, Column "A" reads 1/8-inch.

1. Turn adjusting screw counter clockwise until zero on scale is aligned with rear of housing. ("A" equals zero, see Figure 8.)
2. Now turn adjusting screw clockwise until the 1/8-inch graduation on the scale coincides with rear of housing. Each mark (or line) is 1/16 inch. (See Figure 8.)
3. The retention ring will now be 1/8-inch ahead of the throttle ring. (See "A" dimension, Figure 7.)

CAUTION: Housing cover should be raised slightly when attempting to change retention ring setting ("A" dimension) otherwise scale will be torn or distorted. This can be done by backing out the two hold-down screws 2 to 3 turns, and then lifting cover slightly while adjusting. Be sure to tighten screws after adjusting.

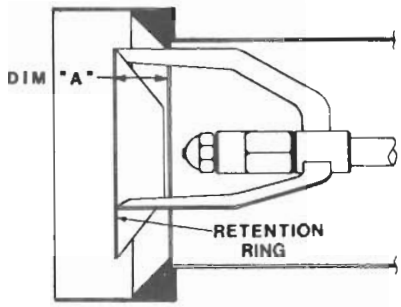



Figure 7. Dimension "A".

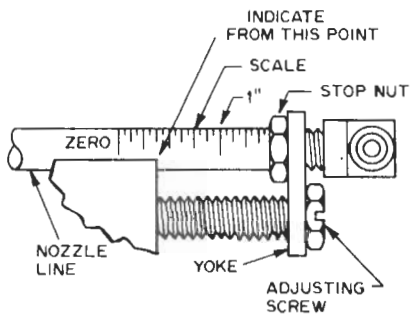



Figure 8. Combustion Head Adjustment.

## COMBUSTION HEAD ADJUSTMENT FOR COMBUSTION AIR

When adjusting the combustion head forward or back, the space around the rim of the retention ring is increased or decreased which increases or decreases the amount of combustion air to correspond with the nozzle sizes used.

Also, by using the specified nozzle, the air fuel ratio for both *low* and *high-fire* are optimized by the automatic damper motor and its associated linkage. **This linkage has been pre-set at the factory and should not be adjusted.** It is set to be in the fully open position when the burner is in *high-fire*.

By adjusting the combustion head for the firing rate delivered by the particular nozzle, the burner should deliver very close to the proper amount of combustion air and $CO_2$. Slight increases or decreases will usually be required depending upon the draft. Normally a draft of 0.02 to 0.04 inches W.C. (negative pressure) is recommended over the fire for natural draft applications.

**Adjust the combustion head only while in high-fire.** The burner is provided with a *low-fire* air shutter adjusting screw. This adjustment limits the amount of shutter closure which thereby increases or decreases the amount of combustion air required for proper burning.

## WIRING FOR LOW-HIGH-LOW STEP MODULATION

In order to take full advantage of the energy savings potential of the 702CRD burner, it should be wired to operate with *low-high-low* cycles. Hence the firing cycle would be much longer by going from *low* to *high* to *low* once or several times before shutting off.

The following examples illustrate wiring for a "Water Boiler" (Figure 9), and a "Steam Boiler" (Figure 10). In each case we have a limit circuit which starts and stops the burner and a *high-fire* control which brings the *high-fire* on and off.

Also, prewired and built into the burner is a manual *high-fire* switch which enables the installer or operator to hold the burner on *low-fire* if so desired.

Refer to the appropriate example for your installation.

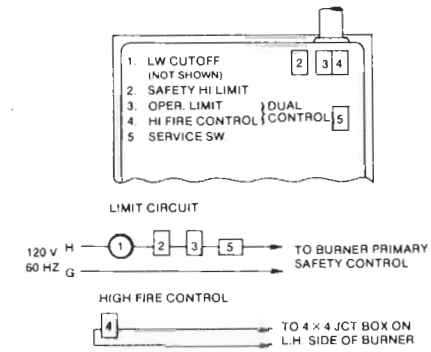



Figure 9. Wiring for Low-High-Low Step Modulation in "Water Boiler".

**Example: Water Boiler**

Operating Range: 170° — 190° F

2. Set Safety Hi Limit: Cut in 200 — Cut out 210
3. Set Operating Limit: Cut in 180 — Cut out 190
4. Set *Hi-Fire* Control: Cut in 170 — Cut out 180

**Operation:**

1. Call for heat; cold start. Burner starts on low and goes to *high-fire*.
2. When the temperature rises to 180° F the burner goes to *low-fire*.
3. If temperature drops to 170° F burner returns to *high-fire*.
4. If temperature rises to 190° F burner shuts off.

NOTE: Since the calibrations on the limit controls are seldom exact, it will be necessary to readjust the settings during operation.

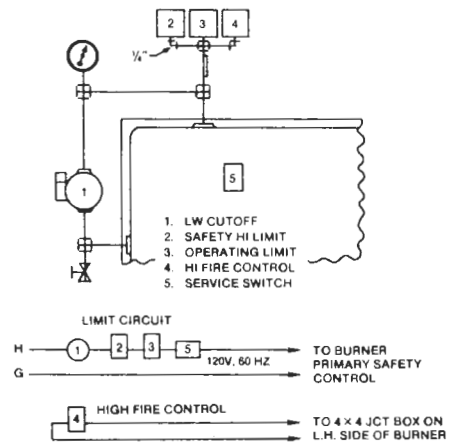



Figure 10. Wiring for Low-High-Low Step Modulation in "Steam Boiler".

**Example: Steam Boiler**

Operating Range: 3 to 6 PSI

2. Set Safety Hi Limit: Cut in 8 PSI — Cut out 10 PSI
3. Set Operating Limit: Cut in 5 PSI — Cut out 6 PSI
4. Set *Hi-Fire* Control: Cut in 3 PSI — Cut out 4 PSI

**Operation:**

1. Call for heat; cold start. Burner starts on low and goes to *high-fire*.
2. When pressure rises to 4 PSI the burner goes to *low-fire*.
3. If pressure drops to 3 PSI burner returns to *high-fire*.
4. If pressure rises to 6 PSI burner shuts off.

NOTE: Since the calibrations on the limit controls are seldom exact, it will be necessary to readjust the settings during operation.

## FUEL UNIT AND OIL LINES

The 702CRD burner is provided with a two-stage dual pressure fuel unit. *Low-fire* operating pressure is 100 psi, adjusted by turning the slotted screw located on top of the solenoid coil on the pump (See Figure 11.) The *high-fire* operating pressure is 300 psi. The high pressure is adjusted by the screw opposite the nozzle port on the pump while the burner is in the *high-fire* mode.

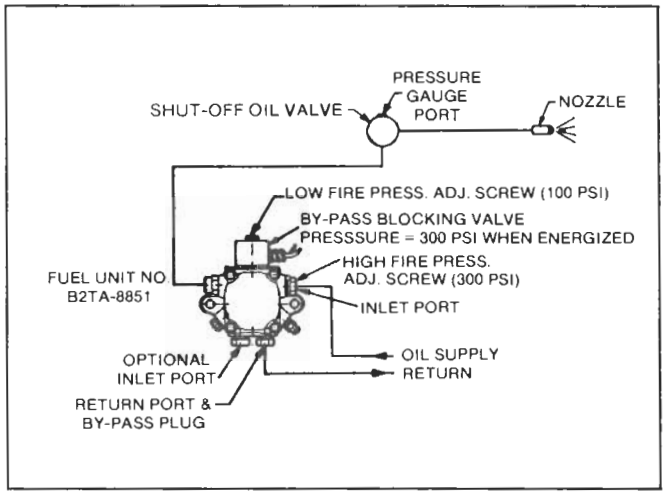



**Figure 11. Two-stage Dual Pressure Fuel Unit.**

A single-pipe system is recommended whenever the bottom of the fuel tank is above the burner or is at the same level as the burner. This includes outdoor fuel tanks that are at such levels. The length of run should not exceed 100 ft. and the vacuum should not exceed 12" mercury. Be sure the by-pass plug has been removed for single-pipe systems.

A two-pipe system is recommended when the fuel tank is below the level of the burner, and the fuel unit must pull (lift) the fuel up to the burner. The vacuum reading should not exceed 12" mercury. For two-pipe installations the by-pass plug must be installed.

Table 5 shows, for the standard two-stage fuel unit, the allowable lift and lengths of 3/8" and 1/2" OD tubing for both suction and return lines in two-pipe systems.

**TABLE 5.**
**TWO-PIPE SYSTEMS**

| Lift (Feet) | Length of Tubing (Feet) | |
|---|---|---|
| | 3/8" OD | 1/2" OD |
| 0 | 41 | 100 |
| 2 | 37 | 100 |
| 4 | 32 | 100 |
| 6 | 28 | 100 |
| 8 | 24 | 96 |
| 10 | 20 | 80 |
| 12 | 16 | 64 |
| 14 | — | 48 |
| 16 | — | 32 |

Be sure that all oil line connections are absolutely air-tight. Check all connections and joints. Flared fittings are recommended. Do not use compression fittings.

Open the air-bleed valve and start the burner. For clean bleed, slip a 3/16" ID hose over the end of the bleed valve and bleed into a container. Continue to bleed for 15 seconds after oil is free of air bubbles. Stop the burner and close the bleed valve.

## LIGHT-OFF AND ADJUSTMENT

Before starting the burner, pre-set the retention ring position for the particular firing rate according to Table 3.

If the fire is a little too rich, move the combustion head forward by increasing dimension "A," Figures 7 and 8. At the lower inputs, a very slight change is usually enough. DO NOT ALTER THE LINKAGE. IT IS PRE-SET AT THE FACTORY.

Adjust draft to 0.02 to 0.04 inches W.C. over the fire for natural draft units.

Run a smoke test. Strive for zero or a trace. Each time further adjustment of retention ring is made, reset the draft to 0.02 to 0.04 inches W.C. over the fire.

Check $CO_2$. This should be 12 to 12½%.

Check for good ignition and clean cut-off. If cut-off continues to be poor, look for air leaks in the suction line, filters or valves and correct them.

For different boiler applications, it is sometimes necessary to have the *high-fire* pull in earlier or later than normal during the swing to achieve a smooth, cleaner transition.

If the swing from *low-fire* to *high-fire* is rough, i.e., bangs or rumbles, or is extremely smoky, the internal end switch of the damper motor is possibly not set correctly. The *high-fire* should pull in when the air shutter **(not the damper arm)** is about half way through its swing.

If the fire is lean all the way to *high-fire*, the *high-fire* valve should be energized earlier. If during the swing, the fire gets very smoky, then cleans up again, the *high-fire* valve should be energized later.

To adjust the damper end switch, remove the damper motor cover. This will expose a white plastic gear with notches. With the burner off, use the end of a small blade screwdriver inserted into one of the notches of the white gear. Turn the gear one notch clockwise if a later pull-in is required, or counter clockwise for an earlier pull-in.

The linkage between the damper motor arm and the air shutter crank is set at the factory and should only need adjustment if the damper motor or damper rod is replaced. With the burner in *high-fire*, there should be minimal play in the connecting rod.

# 1-YEAR LIMITED WARRANTY

## For Commercial Oil Burners Over 3 GPH

The Carlin Company warrants its commercial oil burners to be free from defects in material and workmanship under normal use and service for 12 months from the date of manufacture.

**This warranty does not extend to equipment subjected to misuse, neglect, or accident; nor does this warranty apply unless the product covered by it is properly installed by a qualified, competent technician, who is licensed where state or local codes require, and who is experienced in making such installations, in accordance with NFPA No. 31 of the National Fire Protection Association and in accordance with all applicable local, state and national codes. Equipment that is defective in material or workmanship and within the warranty period will be repaired or replaced as follows:**

1. Motors, fuel units, transformers and other components should be sent for repair or replacement to an authorized service point or distributor of the manufacturer of such components when reasonably available in Customer's locality.

2. Where such local service is not available with respect to the above listed components, or where other components are involved, such defective equipment should be returned, freight prepaid to The Carlin Company. The repaired equipment or replacement will be provided to the Customer freight prepaid by The Carlin Company unless the returned equipment is determined by The Carlin Company to be out of warranty or not to be defective, in which case, it will be returned to the Customer F.O.B., The Carlin Company, Windsor, Connecticut.

3. The Carlin Company is not responsible for any labor cost for removal and replacement of equipment.

4. Equipment that is repaired or replaced will carry the unexpired portion of the original equipment warranty.

5. If inspection by The Carlin Company does not disclose any defect covered by this warranty, the equipment will be repaired or replaced at the expense of Customer, and The Carlin Company's regular charges will apply.

**This warranty is limited to the precise terms set forth above, and provides exclusive remedies expressly in lieu of all other remedies and in particular there shall be excluded the implied warranties of merchantability and fitness for a particular purpose. In no event will The Carlin Company be liable for any incidental or consequential damage of any nature.** The Carlin Company neither assumes nor authorizes any person to assume for The Carlin Company any other liability or obligation in connection with the sale of this equipment. The Carlin Company's liability and Customer's exclusive remedy being limited to repairs or replacement as set forth above.

Carlin®
Combustion Technology, Inc.

# NOTES

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Form No. IO-361A(5M) 5/90

WEIL-McLAIN®

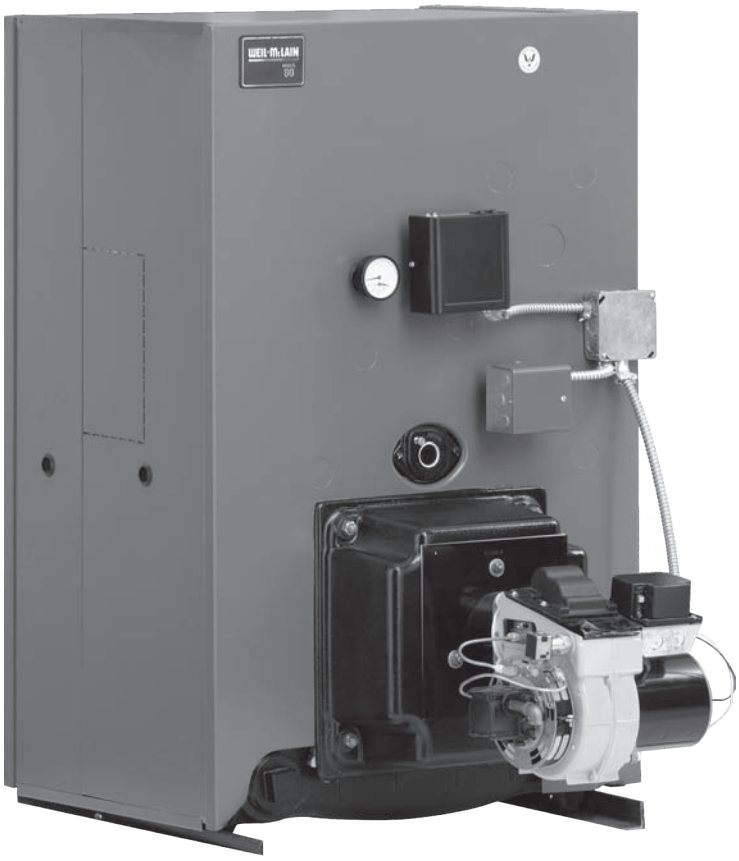
# – 80 –

## Water & Steam Boilers

For Gas, Light Oil, & Gas/Light Oil-Fired Burners

# Boiler Manual

- Installation
- Maintenance
- Startup
- Parts



DESIGN CERTIFIED ®

CERTIFIED ®

**⚠WARNING** This manual must only be used by a qualified heating installer/service technician. Read all instructions before installing. Follow all instructions in proper order. Failure to comply could result in severe personal injury, death or substantial property damage.

***INSTALLER***

- Consider piping and installation when determining boiler location.
- Any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.

***USER***

- This manual is for use only by your qualified heating installer/service technician.
- Boiler and burner must be installed by a qualified service technician.
- We recommend regular service by a qualified service technician, at least annually.

***NOTICE*** When calling or writing about the boiler— Please have the boiler model number from the boiler rating label and the CP number from the boiler jacket.

Part No. 550-141-935/1009

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## Hazard Definitions

The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product.

**⚠ DANGER** Indicates presence of hazards that **will cause severe** personal injury, death or substantial property damage if ignored.

**⚠ WARNING** Indicates presence of hazards that **can cause severe** personal injury, death or substantial property damage if ignored.

**⚠ CAUTION** Indicates presence of hazards that **will or can cause minor** personal injury, death or substantial property damage if ignored.

***NOTICE*** Indicates special instructions on installation, operation or maintenance that are important but not related to personal injury.

**⚠ WARNING** Read all instructions before installing. Failure to follow all instructions in proper order can cause severe personal injury, death or substantial property damage.

**⚠ WARNING** Do not use petroleum-based cleaning or sealing components in boiler system. Severe damage to system components can result, causing substantial property damage.

# 1 Before installing boiler

## Installation must comply with —

- State, provincial and local plumbing, heating and electrical codes.
- Regulations of servicing utilities.
- National codes where applicable.

## Before selecting boiler location

1. Check for nearby connections to:
   a. Fuel supply
   b. Electrical power
   c. System water or steam piping
   d. Venting systems - see page 31
   e. Combustion and ventilation air supply — see "Provide combustion and ventilation air supply openings" on page 4.
2. Check area around boiler. Remove any combustible materials, gasoline and other flammable vapors and liquids.

**⚠WARNING** Failure to keep boiler area clear and free of combustible materials, gasoline and other flammable liquids and vapors can result in severe personal injury, death and substantial property damage.

## Provide clearance around boiler

- Provide minimum clearances to combustible materials:
  1. Single-wall vent pipe – 18 inches.
  2. Double-wall vent pipe – refer to vent pipe manufacturer's recommendations for vent pipe clearances.
  3. Boiler top — 24 inches.
  4. Boiler front — 48 inches.
  5. Boiler flue — 9 inches.
  6. Boiler rear — 9 inches.
  7. Boiler sides — 6 inches.
- Boiler may be installed on combustible flooring.
- See pages 34 and 35 for boiler dimensions.

***NOTICE*** Flue pipe/breeching clearances take precedence over jacket clearances.

- Left side — for cleaning and tankless heater removal – 34 inches.
- Allow sufficient space on remaining sides for cleaning, servicing and burner installation. See burner literature for length and recommended service clearances.

## Lay a foundation, if needed:

Floor construction and condition must be suitable for weight of boiler when filled with water. See page 34 for approximate boiler operating weight.

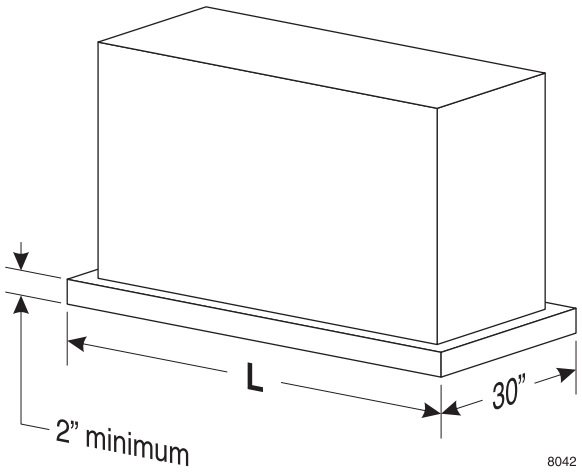
A level concrete or brick foundation (constructed per Table 1 and Figure 1) is required when:

1. A floor could possibly become flooded.
2. Non-level conditions exist.

**Table 1** Boiler foundation (see Figure 1)

| Boiler model number | "L" Length (inches) | Boiler model number | "L" Length (inches) |
|---|---|---|---|
| **380** | 23 | **880** | 58 |
| **480** | 30 | **980** | 65 |
| **580** | 37 | **1080** | 72 |
| **680** | 44 | **1180** | 79 |
| **780** | 51 | **1280** | 86 |

**Figure 1** Boiler foundation



# 1 Before installing boiler (continued)

## Provide combustion and ventilation air openings:

**⚠WARNING** Do not install an exhaust fan in boiler room. Adequate combustion and ventilation air must be provided to assure proper combustion and prevent possibility of flue gas leakage and carbon monoxide emissions, causing severe personal injury or death.

Opening sizes must comply with state, provincial or local codes. In their absence, use the following when boiler is in a confined room:

- Provide two permanent openings in boiler room — one within 12 inches of ceiling, one within 12 inches of floor. Minimum dimension of each opening is 3 inches.
  1. When all air is taken from within building, each opening should be at least one square inch/1,000 Btuh boiler input and freely connect with areas having adequate infiltration from outside.
  2. When all air is taken from outdoors, each opening should connect directly or by ducts from outdoors or crawl or attic spaces that freely connect with outdoors and sized as listed below:
     a. through outside wall or vertical ducts - at least one square inch/4,000 Btuh boiler input.
     b. through horizontal ducts - at least one square inch/2,000 Btuh boiler input.
     c. where ducts are used, they should be same cross-sectional area as free area of openings they are connected to.
     d. compensate for louver, grille or screen blockage when calculating free air openings. Refer to their manufacturer's instructions for size. If unknown, use:
        - wood louvers - 20-25% free air.
        - metal louvers or grilles - 60-75% free air.
        - screens - not less than ¼ inch mesh.

Lock louvers in open position, or interlock with equipment to prove open before boiler operation.

When combustion and ventilation air enters through sidewall openings, ensure openings comply with Figures 2 and 3.

**Figure 2** Combustion and ventilation air openings — Boiler room below grade

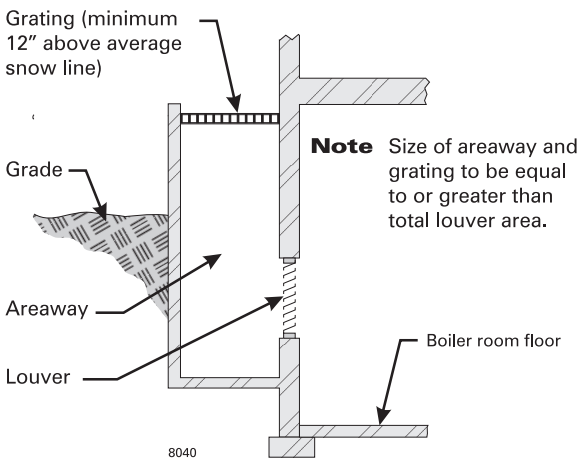
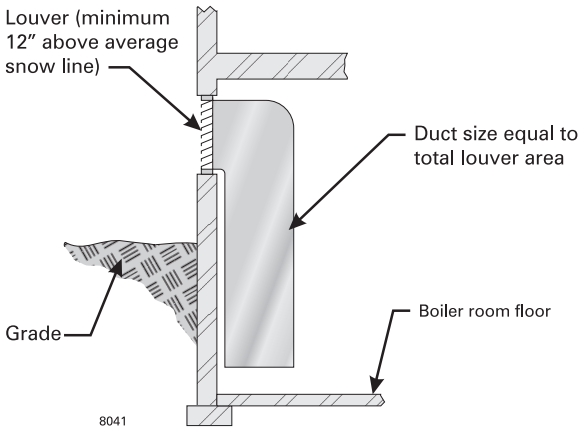



**Figure 3** Combustion and ventilation air openings — Boiler room partially or completely above grade



# 2 Set boiler in place

## For packaged boiler:

1. Remove top jacket panels. Set aside until after boiler is piped.

**⚠WARNING** The boiler contains ceramic fiber and fiberglass materials. Use care when handling these materials per instructions on **page 38** of this manual. Failure to comply could result in severe personal injury.

2. Remove lag screws (2 in front, 2 in rear) from shipping rails.
3. Remove boiler from skid. Cables are already attached to block assembly. See Table 2 for lifting weight.
   - Using crane — hook middle of each cable to eye of crane.
   - Using hoist — hook middle of each cable to hoist. Raise boiler off skid. Use pipe rollers under skid angles to roll boiler.
4. Place boiler in final position. Center boiler on foundation, if used.
5. Level boiler. Shim under skid angles, if necessary.
6. Cut off cables.

**⚠WARNING** Cables are not intended for long-term usage. Cables may corrode inside boiler, weakening their lifting strength. Failure to remove cables can result in severe personal injury, death or substantial property damage.

7. Proceed to "Perform hydrostatic pressure test," page 8.

## For block assembly:

1. Remove lag screws (2 in front, 2 in rear) from shipping rails.
2. Remove boiler from skid. Cables are already attached to block assembly. See Table 2 for lifting weight.
   - Using crane – attach free end of cables to eye of crane.
   - Using hoist – attach free end of cables to hoist. Raise boiler off skid. Use pipe rollers under steel skid angles to roll boiler.
3. Place boiler in final position. Center boiler on foundation, if used.
4. Level boiler. Shim under skid angles, if necessary.
5. Cut off cables.

**⚠WARNING** Cables are not intended for long-term usage. Cables may corrode inside boiler, weakening their lifting strength. Failure to remove cables can result in severe personal injury, death or substantial property damage.

6. Inspect block assembly for disjointed sections. Check gas-tight seal of flue collector hood and cleanout plates.

**⚠WARNING** Gas tight seal must be maintained to prevent possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

   a. Check inside section assembly for any light passing through unsealed areas.
   b. Mark all unsealed areas.
   c. At unsealed areas, check for:
      - damaged gaskets.
      - sealing rope not in place.
      - loose bolts or nuts.
   d. Correct all conditions and repeat step b. If unsealed areas still exist, contact your Weil-McLain distributor or sales office before continuing installation.

7. Proceed to "Perform hydrostatic pressure test," page 8.

**Table 2** Lifting weights

| Boiler model number | Packaged boiler lbs. | Assembled block lbs. |
|---|---|---|
| **380** | 1355 | 1150 |
| **480** | 1615 | 1385 |
| **580** | 1875 | 1620 |
| **680** | 2130 | 1855 |
| **780** | 2390 | 2090 |
| **880** | 2650 | 2325 |
| **980** | 2910 | 2560 |
| **1080** | 3165 | 2795 |
| **1180** | 3425 | 3030 |
| **1280** | 3680 | 3265 |

# 3 Assemble block

**⚠WARNING** Sections are top heavy. Unbolted sections may fall if not supported, resulting in severe personal injury or death.

## Install back refractory blanket

1. Lay back section on floor with ports face up.
2. Apply adhesive to blanket.
3. Press blanket against back target wall as shown in Figure 4.
4. Using knife, cut hole through blanket to expose observation port opening.

## Prepare back section

1. Apply ⅛" continuous bead of sealing rope adhesive in sealing rope grooves. See Figure 4. **Do not get any adhesive on machined port surfaces**.
2. Place ½" sealing rope in groove. Around curves, grasp at 1" intervals and push together. Do not stretch.

**⚠WARNING** Do not pre-cut rope. Gas tight seal must be maintained to prevent possibility of flue gas leakage and carbon monoxide emissions, causing severe personal injury or death.

3. Remove any grit from port machined surfaces with clean rag.

**⚠WARNING** Do not use petroleum-based cleaning or sealing compounds in boiler system. Severe damage to system components can result, causing substantial property damage.

4. Place 7½" and 3½" sealing rings in appropriate port openings. See Figure 4. If sealing ring slips out of groove, stretch ring gently for several seconds, then reposition in groove.
5. Apply continuous bead of silicone sealant no larger than 1/16" around entire outside edge of **outer** machined surface of port. Refer to Figure 5. **Do not apply silicone sealant on, next to or under sealing ring**.

**⚠WARNING** Silicone sealant applied as specified above prevents unburned oil vapors from coming in contact with sealing ring. Vapor contact can damage rings, resulting in severe damage to boiler and substantial property damage.

6. Position section upright on foundation (if used) and screw 3" pipe at least 22" long into 3" return tapping.
7. Place a block under pipe to hold section upright.

**Figure 4** Sealing rope installation

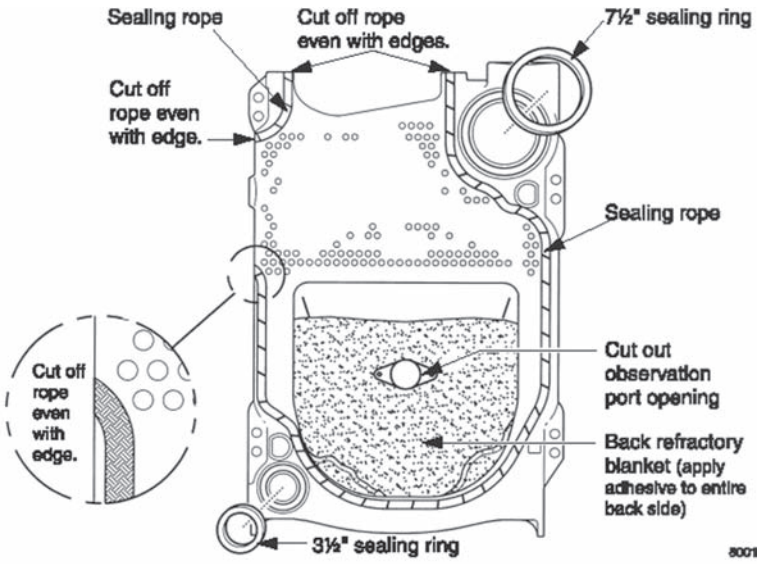
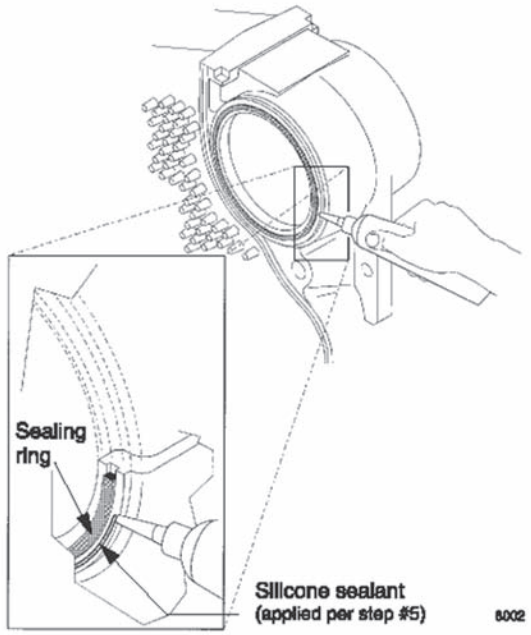



**Figure 5** Silicone sealant



# 3 Assemble block (continued)

## Install intermediate sections

**⚠WARNING** Sections are top heavy. Unbolted sections may fall if not supported, resulting in severe personal injury or death.

1. Remove and discard ⅜" diameter shipping tie rods.
2. Remove grit from port machined surfaces with clean rag.

**⚠WARNING** Do not use petroleum-based cleaning or sealing compounds in boiler system. Severe damage to system components can result, causing substantial property damage.

3. Position intermediate section so aligning lugs fit into sockets of next section. See Figure 6.
4. Install TI (tankless intermediate) and SI (supply intermediate) sections (when used) in order shown in Table 3.
5. Draw sections together until metal-to-metal contact is made around machined port openings (see Figure 6):
   a. Oil threads on 4 draw rods. Install washer and nut on end to be tightened. Use nut only on other end.
   b. Uniformly draw sections together, starting at washer/nut end.

**NOTICE** **Important — Leave an equal amount of thread on each end of the draw rod. This is needed to allow securing the jacket support brackets in place** (see pages 20 and 21).

   c. Draw rods should be torqued to a range of 90 to 100 ft. - lbs. Do not back off draw rods.
   d. Metal-to-metal contact will be achieved around port openings. See Figure 6. If gap occurs, it should be no greater than .032". Check with feeler gauge.
   e. If, for any reason, gap around machined port opening exceeds .032", check for rope extending from rope grooves, dirt on port openings or sockets, or misaligned lugs. If corrections are made and gap still exists, contact your Weil-McLain distributor or sales office before continuing installation.

6. **⚠CAUTION** After erecting first intermediate section, check both sections for plumb. Failure to plumb sections can cause misaligned piping and breeching, possibly resulting in property damage.
7. Repeat steps 1-5 from "Prepare back section," page 6.

## Install bottom refractory blanket on combustion chamber floor inside section block

1. Unroll blanket only to depth of back section and first intermediate section.
2. Spread adhesive on bottom side of blanket.
3. Press blanket into center bottom of sections.
4. Unroll and install blanket per steps 2 and 3 as each intermediate and front section are installed.
5. At front section, cut off blanket 2 ½" from burner opening. Discard unused blanket.

## Prepare remaining sections

1. Follow "Prepare intermediate section" for remaining intermediate and front sections:
   a. Remove any grit from threads inside tapped holes with clean rag.

**Figure 6** Sealing ring installation and port alignment

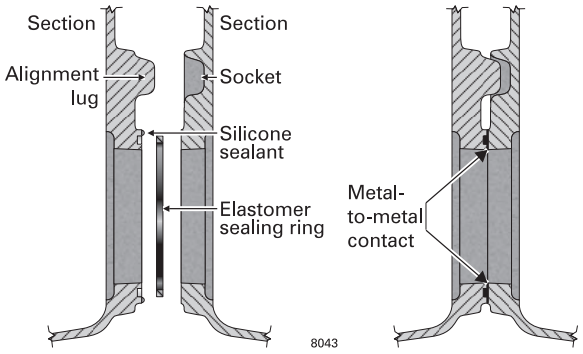



**Table 3** Section arrangement

| Boiler model number | Max. number of heaters | Section arrangement (all heaters must be on left side of boiler) |
|---|---|---|
| 380 W&S | 1 | F–TI–B |
| 480 W&S | 1 | F–TI–I–B |
| 580 W&S | 2 | F–TI–I–TI–B |
| 680 W&S | 2 | F–TI–I–TI–I–B |
| 780 W&S | 2 | F–TI–I–TI–I–I–B |
| 880 W&S | 3 | F–TI–I–TI–I–I–TI–B |
| 980 W&S | 3 | F–TI–I–TI–I–TI–I–I–B |
| 1080 W | 3 | F–TI–I–TI–I–I–TI–I–I–B |
| 1080 S | 3 | F–TI–I–TI–SI–I–TI–I–I–B |
| 1180 W | 4 | F–TI–I–TI–I–I–I–TI–I–TI–B |
| 1180 S | 4 | F–TI–I–TI–I–SI–I–TI–I–TI–B |
| 1280 W | 4 | F–TI–I–TI–I–I–I–I–TI–I–TI–B |
| 1280 S | 4 | F–TI–I–TI–I–SI–I–I–TI–I–TI–B |

W = water / S = steam
F = front / B = back / I = intermediate
TI = tankless intermediate
SI = supply intermediate for steam boilers.
"I" sections can be substituted for "TI" sections.

**⚠WARNING** Do not use petroleum-based cleaning or sealing compounds in boiler system. Severe damage to system components can result, causing substantial property damage.

   b. Check each section for proper sealing rope position before proceeding to next section.

**⚠WARNING** Failure to position sealing rope properly can cause boiler to not seal gas-tight. Gas tight seal prevents possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

## If using tankless heater (TI) sections

1. Install tankless heaters and gaskets or heater cover plates and gaskets. Use ⅜" x ¾" studs, washers and nuts.

# 4 Perform hydrostatic pressure test

## Prepare boiler and test:

1. See pages 28 and 29 for tapping locations. Install:
   a. Boiler drain (not furnished).
   b. Water pressure gauge — for test only. Be sure gauge can handle test pressure — see step 3.
   c. Air vent in upper tapping (K).
2. Plug remaining tappings.

**⚠CAUTION** Do not pressure test with any control installed. Damage to control can occur due to overpressure.

3. Fill boiler. Vent all air. Pressure test at least 10 minutes at a pressure not less than the following:

   **Steam** boiler:

   Between 45 and 55 psig.

   **Water** boiler:

   1½ times maximum allowable working pressure (MAWP) stamped on the boiler nameplate, located on boiler jacket front panel.

***NOTICE*** Do not exceed above test pressures by more than 10 psig.

**⚠WARNING** Do not leave boiler unattended. Cold water fill could expand and cause excessive pressure, resulting in severe personal injury, death or substantial property damage.

4. Check for maintained gauge pressure and leaks. Repair if found.

**⚠WARNING** Leaks must be repaired at once. Failure to do so can damage boiler, resulting in substantial property damage.

**⚠WARNING** Do not use petroleum-based cleaning or sealing compounds in boiler system. Severe damage to system components can result, causing substantial property damage.

5. Drain boiler and remove air vent, boiler drain and gauge. Remove plugs from tappings that will be used for controls and accessories.

# 5 Complete block assembly

## Install burner mounting plate on front section

1. Install four ½" x 4¾" studs to secure burner mounting plate to section:
   a. Thread and lock together two nuts on rounded end of stud. Thread flat end of stud into one of four holes located around opening.
   b. Remove nuts.
   c. Repeat steps a and b for remaining studs.
2. Install burner mounting plate:
   a. Apply ⅛" continuous bead of sealing rope adhesive in groove around opening in section.
   b. Position ½" sealing rope in groove. Overlap ends at least one inch.
   c. Install burner mounting plate. Use ½" washers and nuts.

## Install observation port assemblies on front and back sections:

1. Install front observation port assembly:
   a. Apply ⅛" continuous bead of sealing rope adhesive in groove on observation port.
   b. Position ⅜" sealing rope in groove.
   c. Secure assembly to section. Use 5/16" - 18 x ¾" slotted head screws.
2. Repeat above steps for back observation port assembly.

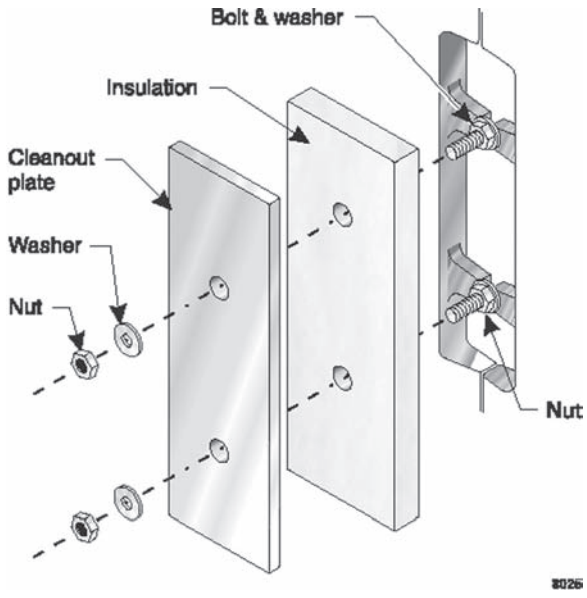
## Install cleanout plates

**⚠WARNING** Cleanout plates must be installed gas-tight to prevent possibility of flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

1. See Figure 7. Position two ¼" x 1¾" carriage bolts in cleanout opening. Secure with washers and nuts.
2. Place blanket insulation piece against cleanout plate.
3. Mount cleanout plate over opening. Secure with nuts and washers.
4. Repeat steps 1 through 3 for remaining cleanout plates.

**⚠WARNING** The boiler contains ceramic fiber and fiberglass materials. Use care when handling these materials per instructions on **page 38** of this manual. Failure to comply could result in severe personal injury.

**Figure 7** Cleanout plate assembly



# 6 Install flue collector

## Flue collector assembly

1. Figure 10, page 11, shows flue collector components and locations. Figure 11, page 13, shows collector hoods for all models. Follow all instructions in this manual to ensure correct installation of the flue collector.
2. Model 80 boilers are available with either rear flue or top flue. Verify that you have the correct components for your application. You can convert a Model 80 from rear to top or top to rear flue using a flue conversion kit, available from your Weil-McLain distributor.

**NOTICE** The flue outlet for top flue models must be located as shown in this manual.

## Install collector hold-down bolts

1. Figure 10, lower left — Install a collector hold-down bolt assembly at each section joint, and on both sides of the boiler section assembly. Set aside the flanged nuts for securing the collector assembly when it is ready.
2. Each hold-down bolt assembly consists of a 5/16" x 2" carriage bolt, flat washer, regular hex nut and a flanged nut as shown.

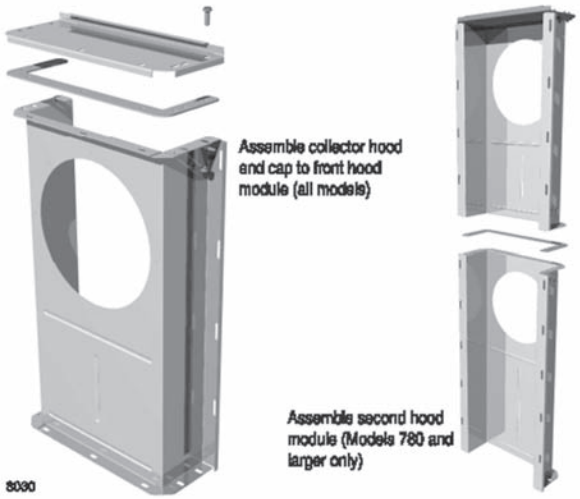
## Prepare flue collector hood assembly

**⚠WARNING** Make sure gaskets are intact, not torn or otherwise damaged. These conditions can cause possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

**⚠WARNING** The boiler contains ceramic fiber and fiberglass materials. Use care when handling these materials per instructions on **page 38** of this manual. Failure to comply could result in severe personal injury.

1. Stand flue collector hood front module (item **4**) on end as in Figure 8, left side.

**Figure 8** Collector hood preparation



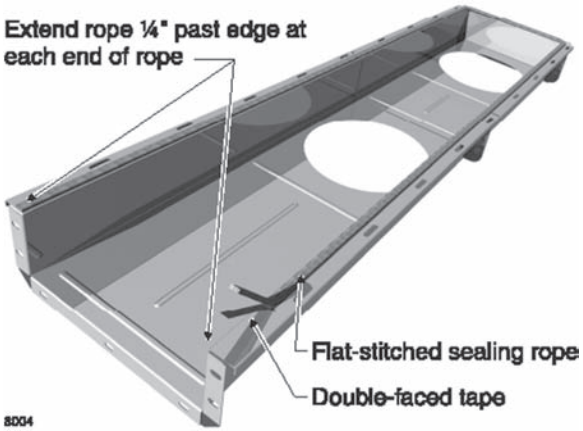

2. Wipe all flanged surfaces with clean rag.
3. Lay flue collector hood gasket (item **2**) on flange.
4. Place flue collector end cap (item **1**) on gasket. Align bolt holes. Secure with seven 5/16" x 5/8" flanged bolts and flanged nuts. **Tighten to between 30 and 35 inch-pounds torque**. (See **WARNING** on page 12, top right column.)
5. For 880 - 1280:
   a. Stand remaining hood module on end, as in Figure 8, right side.
   b. Wipe all flanged surfaces with clean rag.
   c. Lay gasket on flange.
   d. Carefully place open end of first module on top of gasket, aligning flanged surfaces.
   e. Secure with seven 5/16" x 5/8" flanged bolts and flanged nuts. **Tighten to between 30 and 35 inch-pounds torque**. (See WARNING on page 12.)
6. Attach flat-stitched sealing rope to hood assembly. See Figure 9:
   a. Lay hood on floor with flanged side up.
   b. Wipe flanged surface with clean rag to remove dirt and oil.
   c. Apply double-faced tape to flanged surface.
   d. Apply rope to tape beginning on one side of open end of hood, leaving ¼" extending past edge. Bend rope around corners. **DO NOT cut or stretch rope**.

**⚠WARNING** Do not pre-cut rope. All collector hood joints must be sealed gas-tight to prevent possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

   e. Continue around entire flange. At other open end, leave ¼" rope extending past edge of flange. Cut off excess rope.

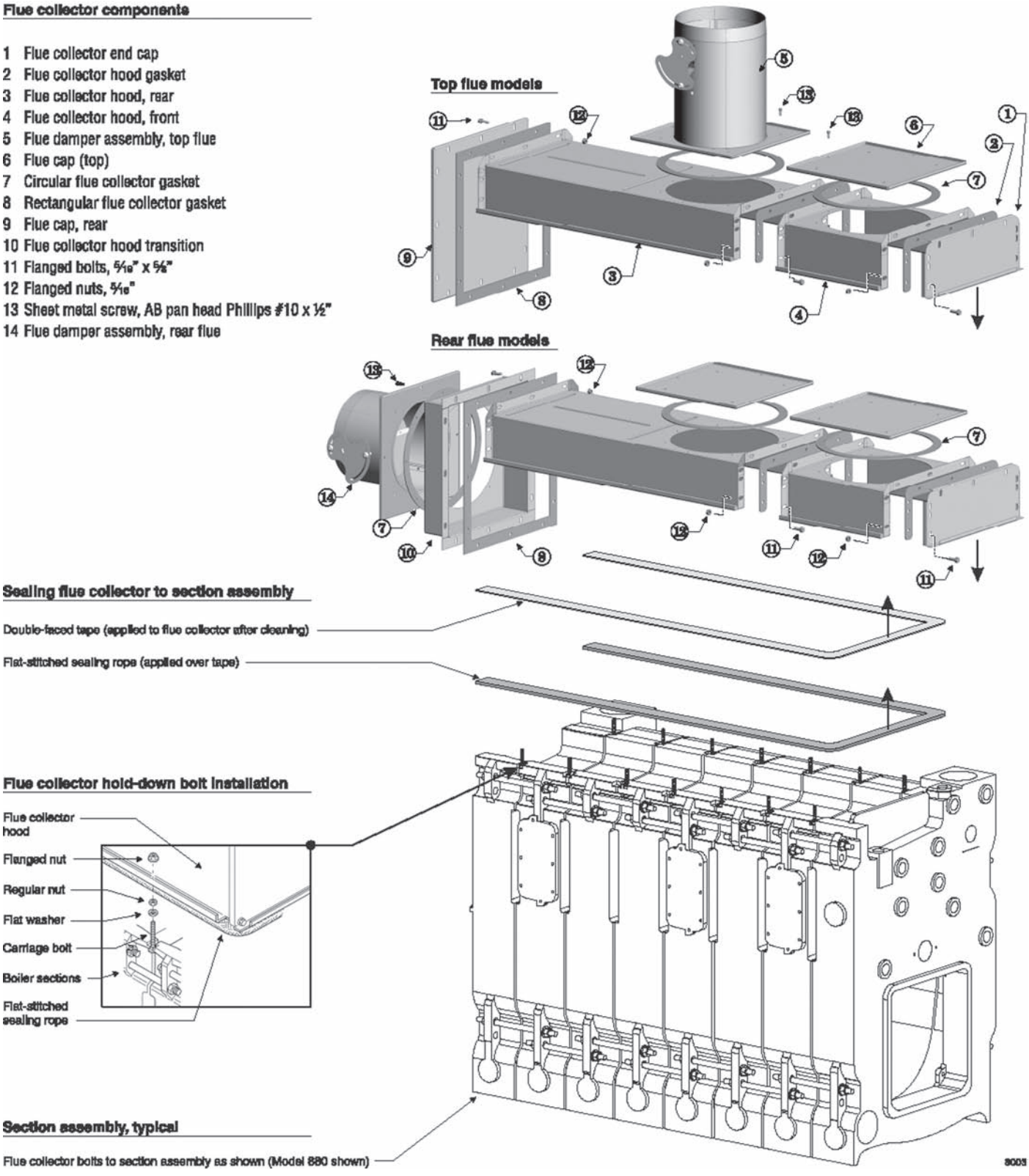
**NOTICE** Double-faced tape serves only to hold sealing rope in place during installation. It will disintegrate over time. If collector hood and sealing rope are removed for any reason, install new tape and new gasket.

**Figure 9** Flue collector sealing rope installation



# 6 Install flue collector (continued)

**Figure 10** Flue collector components, typical (Model 880 collector configurations shown)



# 6 Install flue collector (continued)

## Before installing flue collector

1. See Figure 10, page 11, for general assembly of flue collector components.
2. See Figure 11, page 13 for the placement of flue collector hoods on each model.
3. Prepare mounting holes in boiler rear section.
   a. The boiler rear section has tapped holes for mounting rear flue collector component.
   b. Remove any grit from threads inside tapped holes with clean rag.

## Rear flue boilers only:

1. See Figure 10, page 11 and Figure 11, page 13.
2. Place collector hood transition on rear section:
   a. Wipe item 10, Figure 10, **collector hood transition** flange surfaces with a clean rag.
   b. Apply a few pieces of double-faced tape on the collector hood transition flange.
   c. Place the **collector hood transition gasket** (item 8, Figure 10) on the collector hood transition flange. Align holes in gasket with holes in flange. Press gasket firmly in place.
   d. Position collector hood transition on back of boiler rear section, aligning collector hood transition flange holes with tapped holes in boiler rear section.
   e. Insert a 5/16" x 5/8" flanged bolt through the bottom center hole and finger tighten to hold transition in place.
   f. Install six remaining bolts securing collector hood transition to rear section. **Finger-tighten** only.
3. Place collector hood assembly on sections:
   a. Carefully set collector hood assembly on top of section assembly. Align slotted holes in collector hood flanges with the hold-down bolts in the sections.
   b. Place the collector hood assembly so its rear flange is against the collector hood transition flange gasket.
   c. Thread flanged nuts onto hold-down bolts and **finger-tighten** only.
   d. Insert five 5/16" x 5/8" flanged bolts through holes in collector hood transition and collector hood assembly rear flange. Thread on nuts and **finger-tighten** only.
4. Tighten flue collector bolts and nuts:
   a. Gradually tighten all bolts and nuts on flue collector assembly and boiler. **Tighten to between 30 and 35 inch-pounds torque**. See **WARNING**, upper right.
   b. Alternate locations as you tighten the fasteners to ensure all parts are evenly drawn down, with no gaps or distortion of parts.
5. Install damper and flue caps:
   a. Wipe item 5, Figure 10, **flue damper** flange surface with a clean rag.
   b. Apply a few pieces of double-faced tape to the flue damper flange. Position flue collar gasket on damper and press firmly in place. Align all holes before securing.
   c. Position flue damper assembly against collector hood transition. Insert a #10 x ½" screw through the top center hole. Lightly tighten to hold flue damper in position.
   d. Insert remaining #10 screws into flue damper flange and lightly tighten. Alternate from screw to screw and tighten all screws evenly and securely.
   e. Install flue caps on flue collector top opening(s) using steps 5a through 5d.

**⚠WARNING** DO NOT overtighten bolts in flue collector hood assembly. Gasket material could extrude, causing possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

## Top flue boilers only:

1. See Figure 10, page 11 and Figure 11, page 13.
2. Place rear flue cap on rear section:
   a. Wipe item 9, Figure 10, **rear flue cap** gasket surface with a clean rag.
   b. Apply a few pieces of double-faced tape on the rear flue cap gasket surface.
   c. Place the **rectangular gasket** (item 8, Figure 10) on the flue cap, aligning holes in gasket with holes in rear flue cap. Press firmly in place.
   d. Position rear flue cap on back of boiler rear section, aligning rear flue cap holes with tapped holes in boiler rear section.
   e. Insert a 5/16" x 5/8" flanged bolt through the bottom center hole and finger tighten to hold rear flue cap in place.
   f. Install six remaining bolts securing rear flue cap to rear section. **Finger-tighten** only.
3. Place collector hood assembly on sections:
   a. Carefully set collector hood assembly on top of section assembly. Align slotted holes in collector hood flanges with the hold-down bolts in the sections.
   b. Place the collector hood assembly so its rear flange is against the rear flue cap gasket.
   b. Thread flanged nuts onto hold-down bolts and **finger-tighten** only.
   c. Insert five 5/16" x 5/8" flanged bolts through holes in rear flue cap and collector hood assembly rear flange. Thread on nuts and **finger-tighten** only.
4. Tighten flue collector bolts and nuts:
   a. Gradually tighten all bolts and nuts on flue collector assembly and boiler. **Tighten to between 30 and 35 inch-pounds torque**. See **WARNING**, above.
   b. Alternate locations as you tighten the fasteners to ensure all parts are evenly drawn down, with no gaps or distortion of parts.
5. Install damper and flue caps (see Figure 11, page 13):
   a. Wipe item 5, Figure 10, **flue damper** flange surface and flue collector assembly surfaces with a clean rag.
   b. Position **round gasket** (item 7, Figure 10) on flue collector assembly ***in the flue location shown in Figure 11, page 13***. Align bolt holes.
   c. Place flue damper assembly on gasket. (See NOTICE, below.) Insert #10 x ½" screws through the holes. Alternate from screw to screw and tighten all screws evenly and securely.

***NOTICE*** Model 380 top flue applications — always mount the damper assembly with the damper adjustment plate pointed toward the rear of the boiler as shown in Figure 11. Otherwise, the jacket top panels may be difficult to install.

   e. Install flue cap on remaining top opening (if any) using steps a through c, above.

## After installing flue collector, ALL BOILERS

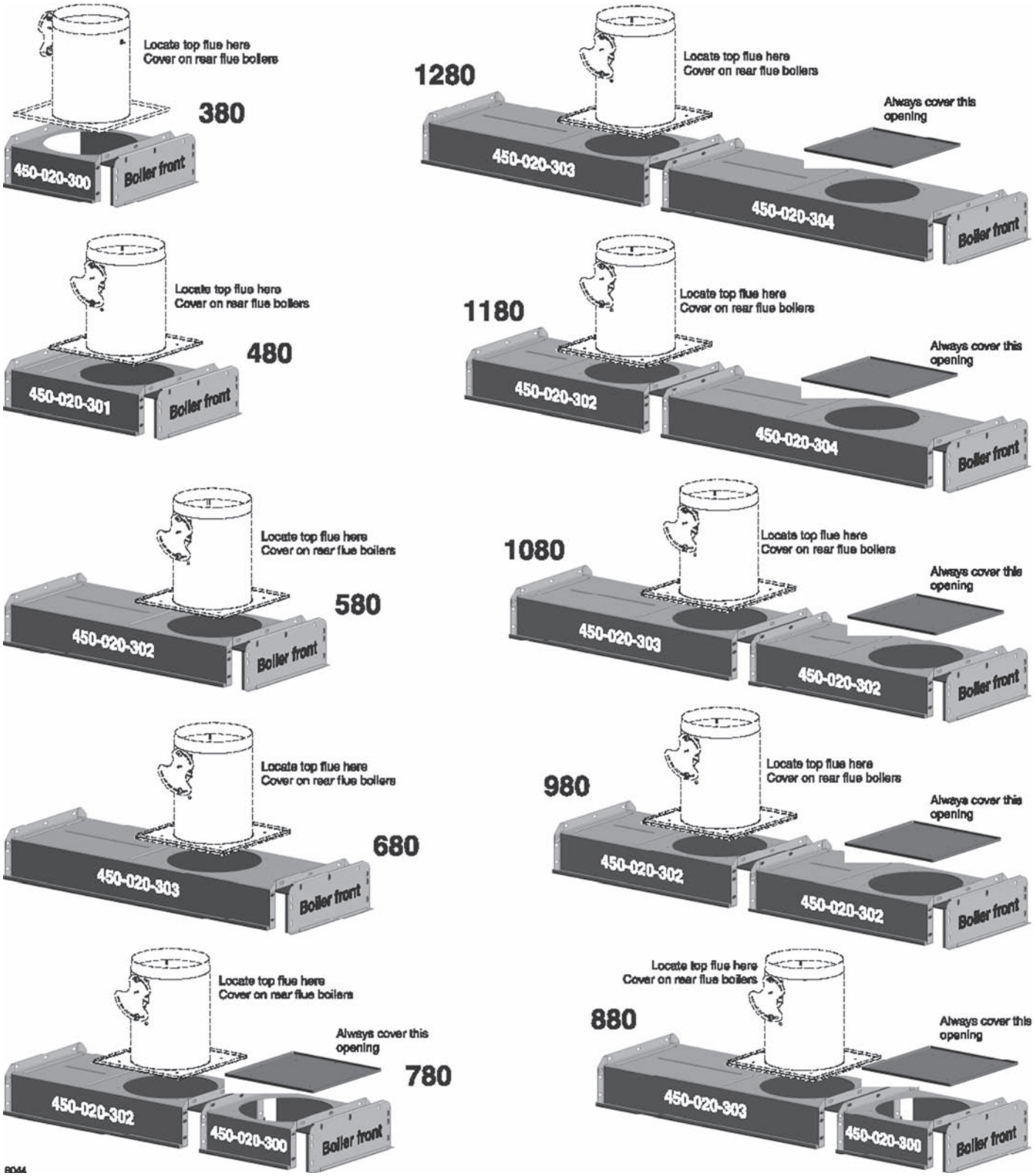
1. Check for gas-tight seal of all flue collector hood components.

**⚠WARNING** All collector hood joints must be sealed gas-tight to prevent possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

   a. Open flue damper. Visually inspect inside section assembly and flue collector assembly for any light passing through unsealed areas.
   b. Mark all unsealed areas.
   c. Check unsealed areas for cause — damaged gaskets, sealing rope not in place, or loose bolts or nuts.
   d. Correct all conditions and repeat inspection procedure.
   e. If unsealed areas cannot be eliminated, discontinue the boiler installation. Contact your Weil-McLain distributor or sales office for assistance.

# 6 Install flue collector (continued)

**Figure 11** Flue collector components by model (see Figure 10, page 11 for flue collector components not shown below)



# 7 Connect water boiler piping

## General water piping information:

- System water supply and return piping should be installed and piping connections attached to boiler before erecting jacket or installing controls.
- Do not pipe in through supply and out through return. This creates reverse water flow through boiler that must not be used.
- When three-way valves are used for temperature modulation, install slow-opening (minimum 10-minute) valves and boiler mixing pump to minimize potential of boiler thermal shock. See W-M Bulletin AE-8402.

## Install piping:

Install piping as shown in Figure 12 for single boilers. For multiple boilers, see Figure 13, page 15.

**⚠CAUTION** Improperly piped systems or undersized piping can contribute to erratic boiler operation and possible boiler or system damage.

1. Connect supply and return piping:
   a. Size according to tables below.
      1) For **unknown flow rates**, size piping per Table below, using 20°F. temperature rise through boiler.
      2) For **known flow rates or higher flow rate** through boiler, size piping per Table below.

**⚠WARNING** Flow at higher rates than shown in Table below for pipe size can damage boiler, causing substantial property damage.

   b. Locate circulator in supply piping.
   c. For return piping, use full diameter pipe for 10 times that diameter before making any reduction. For example, a 4-inch return should not be reduced any closer to boiler return tapping than 40 inches.
   d. Install system blow-off (drain) valve in lowest part of return piping close to boiler. ASME minimum size requirements are shown in Table 6.
2. Install expansion tank:
   a. **Closed type** – connect to 1" tapping "K" (refer to pages 28 and 29). Use 1" N.P.T. piping. Any horizontal piping must pitch up toward tank at least 1 inch per each 5 feet of piping.
   b. **Diaphragm type** – Refer to tank manufacturer's literature for location. Install automatic air vent in "K" tapping.
   c. Connect cold water fill to expansion tank piping. See Figure 12, page 14. Also shown are recommended valves and water meter, when used. Water meter will detect added make-up water, indicating leaks in system.

**Table 4** Recommended minimum pipe sizes when flow rate is not known (see Figure 12)

| Boiler model number | Supply pipe size A | Return pipe size B |
|---|---|---|
| 380 | 2" | 2" |
| 480 | 2½" | 2½" |
| 580 – 680 | 3" | 3" |
| 780 – 1280 | 4" | 4" |

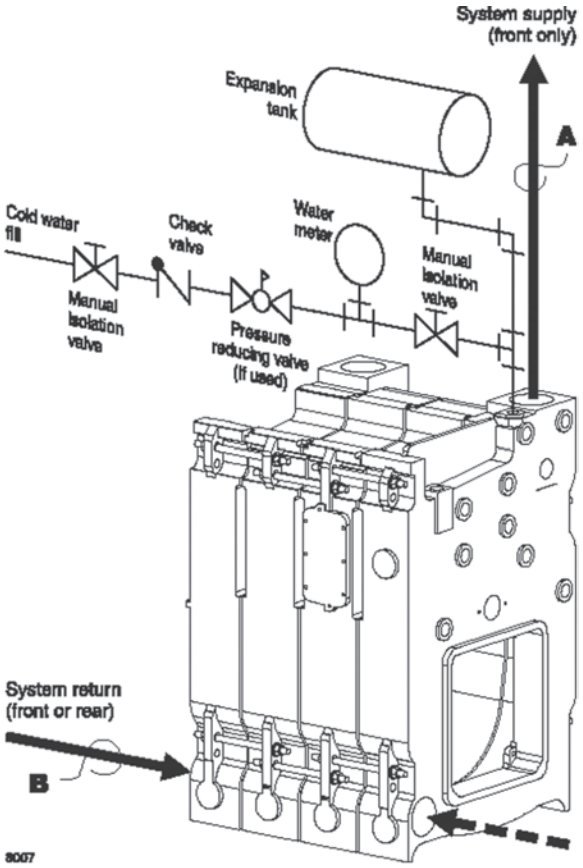
**Table 5** Recommended minimum pipe sizes for known flow rates.

| Water flow rate GPM | Supply pipe size A | Return pipe size B |
|---|---|---|
| Up to 35 | 2" | 2" |
| 36–50 | 2½" | 2½" |
| 51–77 | 3" | 3" |
| 78–142 | 4" | 4" |

**Table 6** ASME drain valve size

| Boiler model number | Valve size |
|---|---|
| 380 – 480 | ¾" |
| 580 – 1180 | 1" |
| 1280 | 1¼" |

**Figure 12** Water boiler piping, typical



# 7 Connect water boiler piping (continued)

3. Piping for multiple boilers (see Figure 13):
   **A** Size secondary boiler pump GPM based on following formulas:

$$\frac{\text{Gross output}}{\text{Temperature rise x 500}} = \text{GPM}$$

**Temperature rise**, *°F = 230°F – Return water temperature*
**Gross output** *is in Btuh.*

Calculate only secondary piping circuit resistance. Boiler resistance will be about equal to three 90 degree elbows of secondary pipe size. Operate each boiler and its secondary pump from a Weil-McLain boiler control panel. **Do not** maintain boiler at predetermined water temperature.

**B** Primary pump GPM and head calculation should not include secondary boiler circuits. Primary pump can operate continuously during heating season.

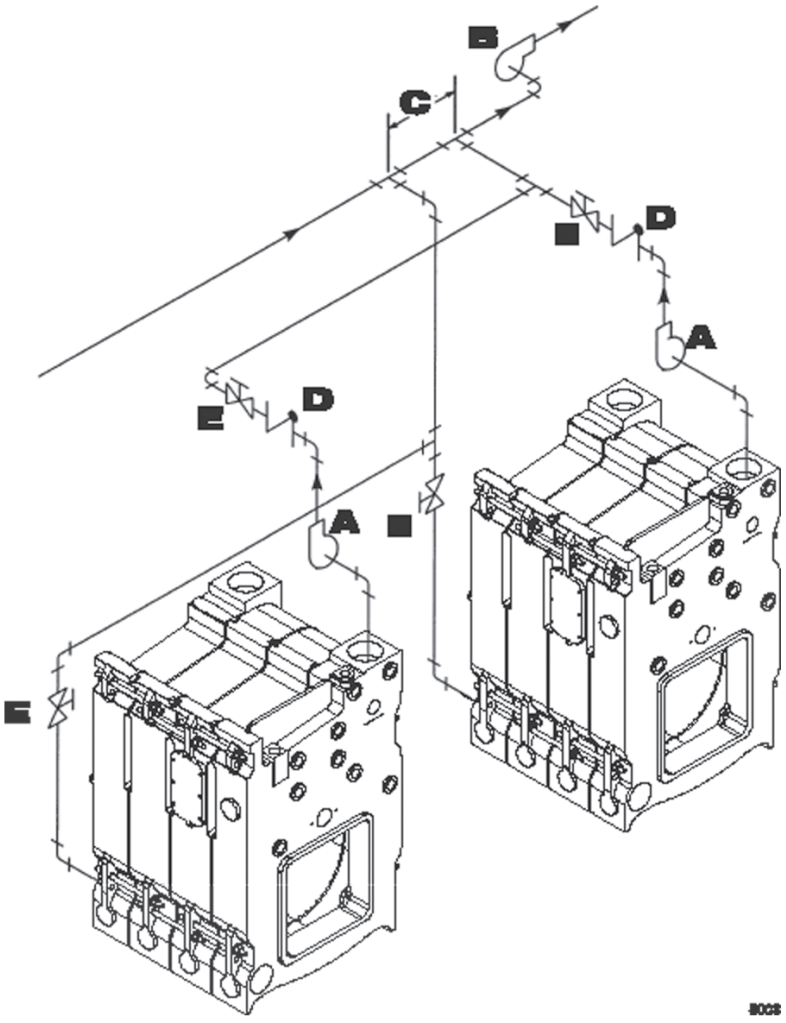
**C** Space 12" maximum or as close as practical.

**D** Check valve.

**E** Hand valve.

Expansion tank(s), relief valves and other accessories are required but not shown.

**Figure 13** Multiple water boiler piping



# 8 Connect steam boiler piping

## General steam piping information:

- Hartford loop piping arrangement and wet return are required for steam boilers. Use the Hartford loop for both pumped-return and gravity-return systems.
- Maintain 24-inch minimum from waterline to bottom of header (56¼" from bottom of section).
- When using condensate receiver, feed pump must be energized by boiler-mounted pump controller. Install piping:

Install piping as shown on pages 16 through 18 for single boilers. See page 19 for additional requirements when piping multiple boilers.

**⚠ CAUTION** Improperly piped systems or undersized piping can contribute to erratic boiler operation and possible boiler or system damage. Piping system must be installed as shown, using pipe sizes shown. Pipe sizes shown are for two-pipe, pumped-return systems. Adjust pipe sizing as needed when connecting to gravity-return systems. Consult local Weil-McLain distributor or sales office before installing alternate piping.

1. Connect supply and return piping:
   a. See Table 7.
      1) Size condensate return piping by pump.
      2) Size gravity condensate return same as equalizer "**J**" pipe size.
   b. Install system drain valve in lowest part of return piping close to boiler. ASME size requirements are shown in Table 6, page 14.
   c. Connect cold water fill piping as shown in Figure 14. Also shown are recommended valves and water meter, if used. Water meter will detect added makeup water, indicating leaks in system.
2. Condensate piping:
   a. Satisfactory operation of any steam heating system depends on adequate return of condensate to maintain steady water level.
   b. Avoid adding excessive amounts of raw make-up water.
   c. Where condensate return is not adequate, a low water cutoff with pump control, condensate receiver, and condensate boiler feed pump should be installed. Refer to page 18, Figure 18 for piping and Table 8 for sizing.
3. Multiple steam boiler piping
   a. See page 19.

**Figure 14** Cold water fill piping

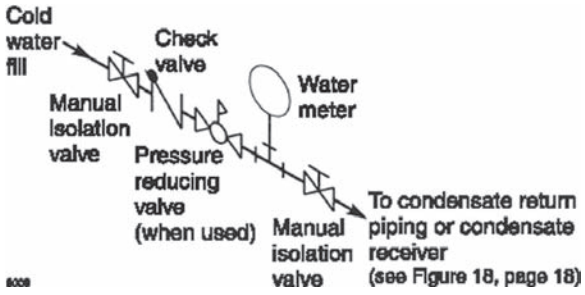



**Table 7** Steam boiler pipe size for typical 2-pipe steam systems

| Figure number | Boiler model number | Riser pipe size Inches Note 1 | | | "H" Header inches Note 2 | "J" Equalizer inches |
|---|---|---|---|---|---|---|
| | | A | B | C | | |
| 15 | 360 | 3 | -- | – | 3 | 2 |
| | 480 | 4 | -- | – | 4 | 2 |
| | 580 | 4 | -- | – | 4 | 2½ |
| 16 | 680 | 3 | 3 | – | 4 | 2½ |
| | 780 | 4 | 4 | – | 4 | 2½ |
| | 880 | 4 | 4 | – | 4 | 3 |
| | 980 | 4 | 4 | – | 6 | 3 |
| 17 | 1080 – 1280 | 4 | 4 | 4 | 6 | 3 |

Notes:
1. Based on ASHRAE Handbook recommendations, allowing ½ oz. pressure drop per 100 feet of pipe for dry return.
2. Based on ASHRAE Handbook recommendations, allowing 2 oz. pressure drop per 100 feet of pipe at 3.5 psig. Maintain minimum 24" height from waterline to header.

# 8 Connect steam boiler piping (continued)

**Figure 15** Model 380 through 580 steam boiler piping — NOTE minimum 24 inches between boiler water line and bottom of header.

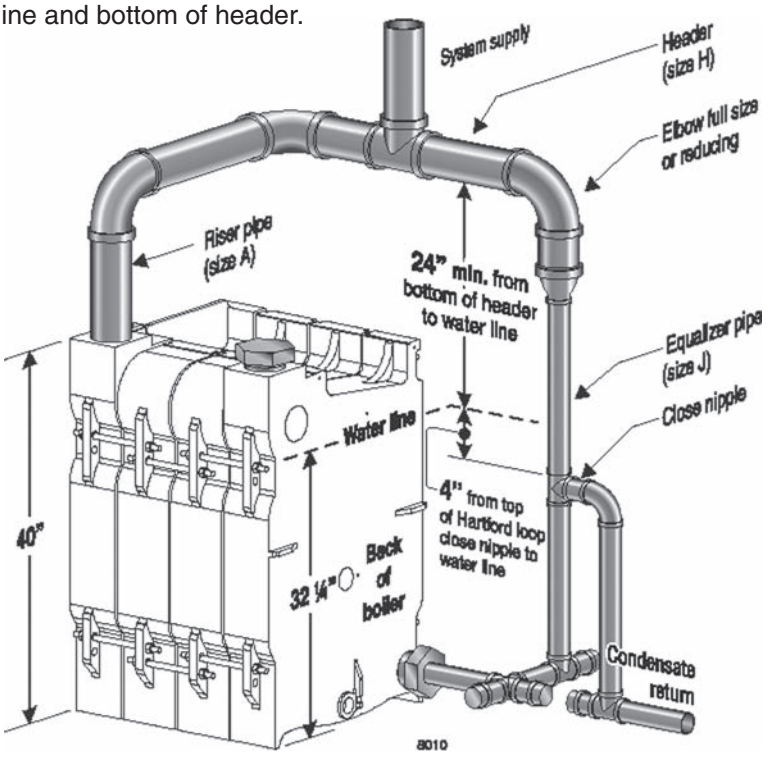
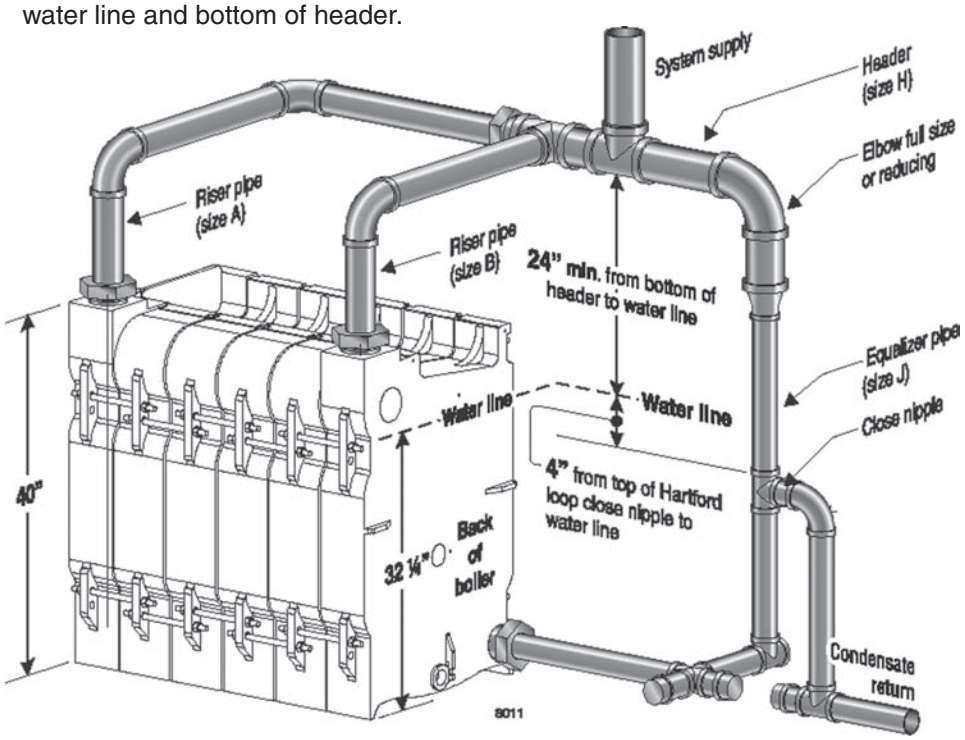



**Figure 16** Model 680 through 980 steam boiler piping — NOTE minimum 24 inches between boiler water line and bottom of header.



# 8 Connect steam boiler piping (continued)

**Figure 17** Model 1080 through 1280 steam boiler piping — NOTE minimum 24 inches between boiler water line and bottom of header.

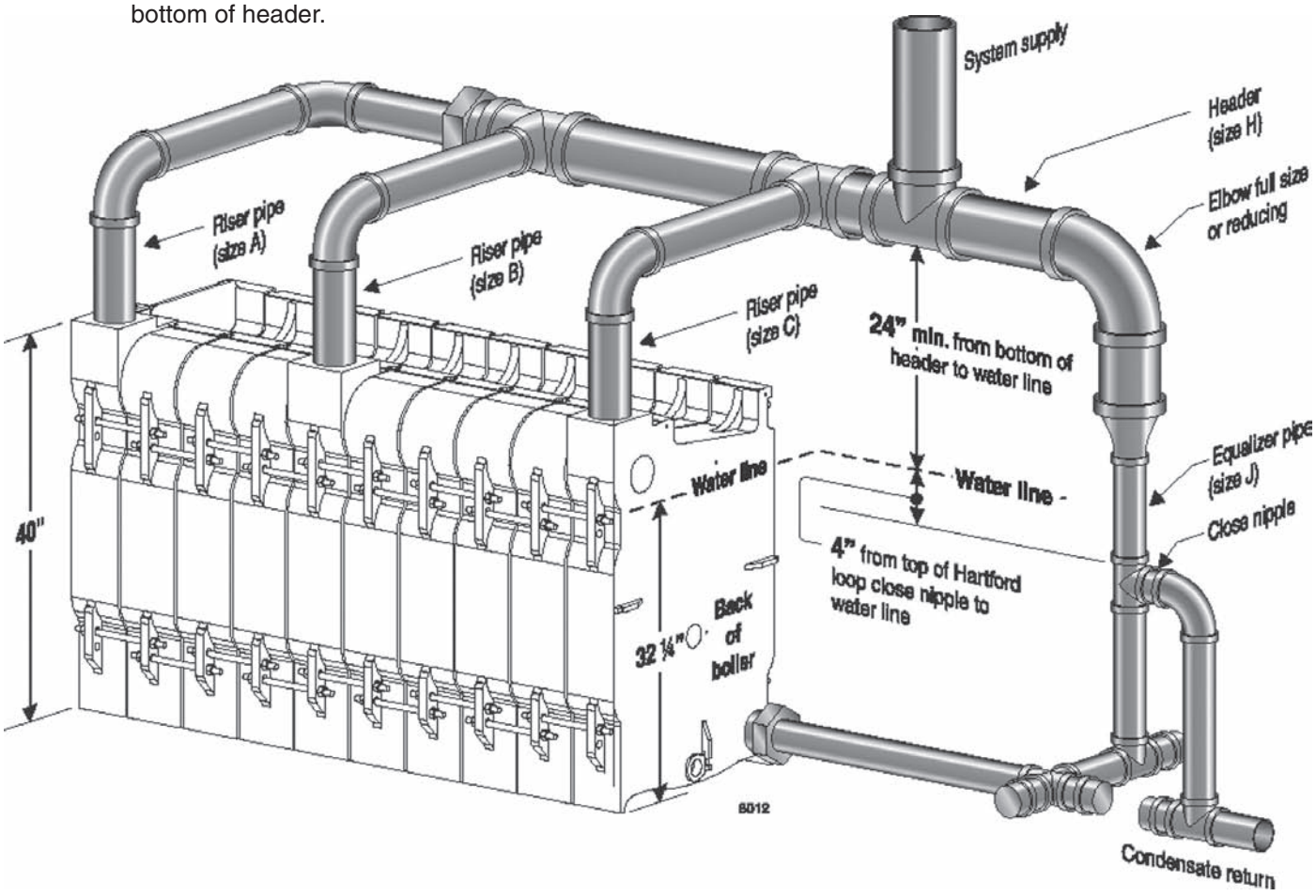



**Figure 18** Condensate piping to boiler

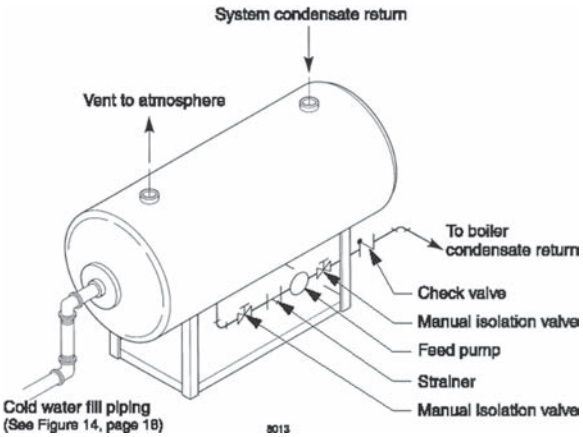


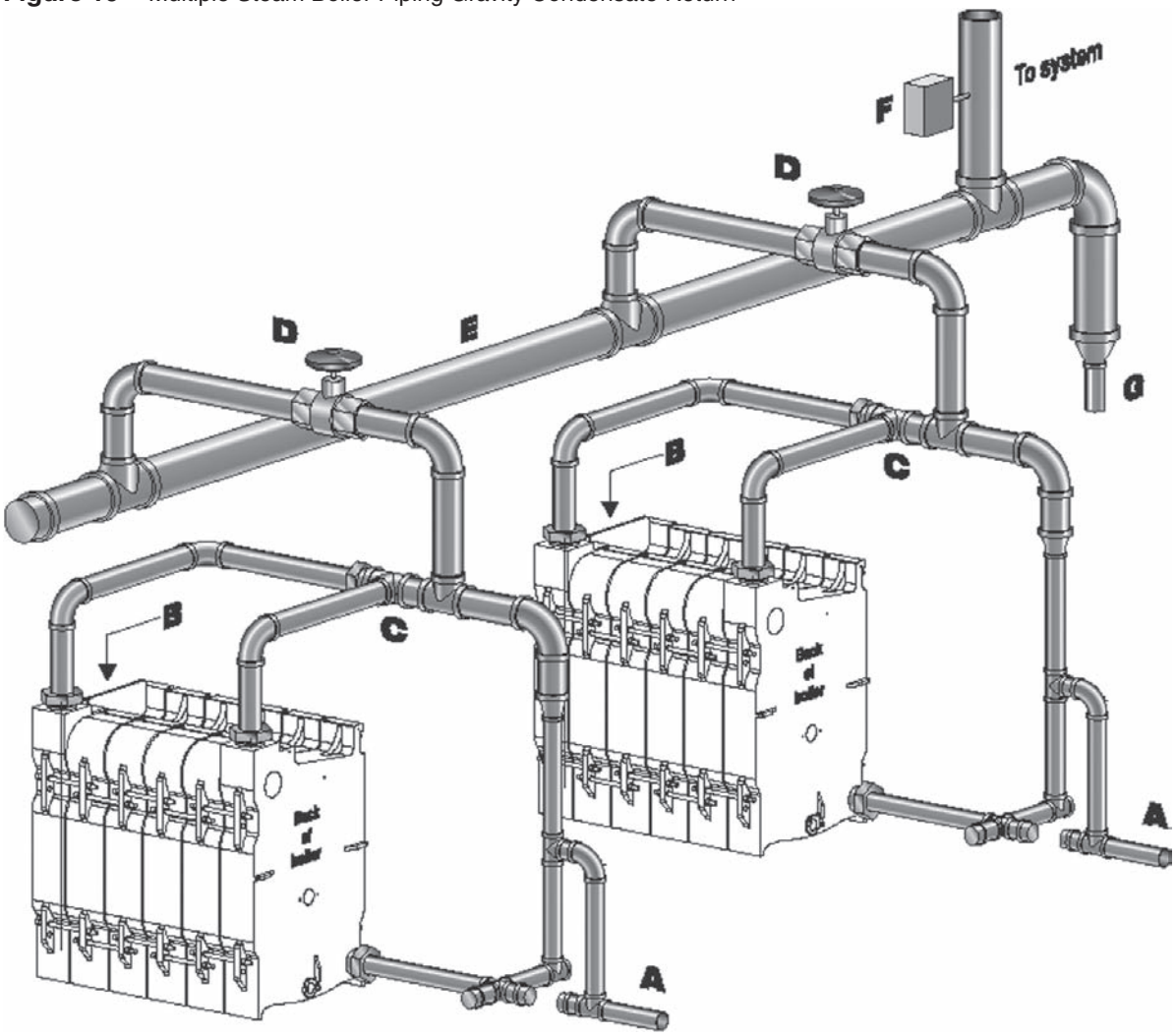

**Table 8** Condensate receiver capacity

| Boiler model number | I=B=R gross output (lbs steam per hour) | Gallons condensate per hour | Minimum condensate receiver capacity (gallons) (Note 1) | | | | Recommended condensate feed pump capacity GPM at 15 PSI |
|---|---|---|---|---|---|---|---|
| | | | 15-minute boiler operation | 30-minute boiler operation | 45-minute boiler operation | 60-minute boiler operation | |
| 380 | 278 | 33 | 11 | 21 | 31 | 41 | 1.2 |
| 480 | 396 | 48 | 15 | 29 | 43 | 58 | 1.6 |
| 580 | 515 | 62 | 19 | 38 | 56 | 75 | 2.1 |
| 680 | 634 | 76 | 23 | 46 | 69 | 92 | 2.6 |
| 780 | 753 | 90 | 28 | 55 | 82 | 109 | 3.1 |
| 880 | 872 | 105 | 32 | 63 | 95 | 126 | 3.5 |
| 980 | 991 | 119 | 36 | 72 | 108 | 143 | 4.0 |
| 1080 | 1110 | 133 | 40 | 80 | 120 | 160 | 4.5 |
| 1180 | 1229 | 148 | 45 | 89 | 133 | 178 | 5.0 |
| 1280 | 1348 | 162 | 49 | 98 | 146 | 195 | 5.4 |

Note 1 — Maximum time to when condensate returns to boiler.

# 8 Connect steam boiler piping (continued)

**Figure 19** Multiple Steam Boiler Piping Gravity Condensate Return




**A** Pipe as shown for gravity return systems, connecting point **A** to the wet gravity return.

For pumped-return systems, install boiler water level control on each boiler with body mark at level indicated in Figure 30 on page 30. Provide at point **A** either:

- Separate feed pumps and check valves for each boiler, or . . .
- Single feed pump, with separate solenoid valve for each boiler.

**B** For pumped-return systems, install a combination float and thermostatic trap on each boiler to prevent flooding of one boiler while other boiler is firing. Install trap in skim tapping (see page 29). Connect traps to condensate receiver.

Gravity-return systems are self-levelling if the wet returns are piped to the common system wet return.

**C** Install boiler piping as shown in this manual (pages 16 through 19).

**D** Install stop valves per ASME code requirements.

For pump-return systems, if using automatic steam valves, use only slow-opening automatic valves. Use a Weil-McLain Boiler Control System (such as a BCP panel) to open each steam valve automatically before firing burner.

**E** Construct common supply drop header with pipe size at least same size as largest boiler header size.

**F** Use:

- A Weil-McLain Boiler Control System (such as a BCP panel) with header-mounted pressure control(s) to sequence boilers, or . . .
- A steam pressure controller.

**G** Install drip line in common supply drop header.

Gravity-return: Pipe drip line to wet return.

Pumped-return: Use combination float and thermostatic trap and drain to condensate receiver.

# 9 Install jacket

## Before installing jacket

1. Packaged boilers
   - Install top jacket panels per instructions in this manual.
2. Non-packaged boilers
   - Follow the instructions in this section to install all jacket panels.
   - Make sure the following are completed before installing jacket:
   - Boiler hydrostatically pressure-tested. See page 8.
   - Plugs for unused tappings installed. See control tapping table, page 28 or 29.
   - Supply and return piping installed. See pages 14 through 19.
   - Cleanout plates, flue collar and flue collector hood installed. See pages 9 through 13.
3. These parts must be on boiler:
   - plugs for unused tappings
   - supply and return piping
   - steam supply header
   - cleanout plates
   - tankless heater(s) (when used)
   - tankless heater cover plate(s) (when used)
   - tankless heater piping (when used)
   - flue damper assembly
   - flue collector hood
   - observation port assemblies
4. These parts may be on boiler:
   - burner mounting plate
   - burner
5. These parts must be off boiler:
   - water or steam gauge
   - limit control
   - low water cutoff
   - gauge glass and gauge glass cocks
   - tri-cocks
   - drain cock

**⚠WARNING** The boiler contains ceramic fiber and fiberglass materials. Use care when handling these materials per instructions on **page 38** of this manual. Failure to comply could result in severe personal injury.

## Remove jacket parts from cartons

1. Locate jacket cartons.
2. Remove jacket parts from cartons as needed. Leave in cartons as long as possible to avoid damage.

## Install support brackets and rails

1. Place upper and lower support brackets over draw rods as shown in Figure 20, page 21.
2. Fasten securely with 5/8" nuts where shown.

***NOTICE*** Models 380, 480, 580, 680 and 780 do not require lower support brackets. Only upper brackets are required.

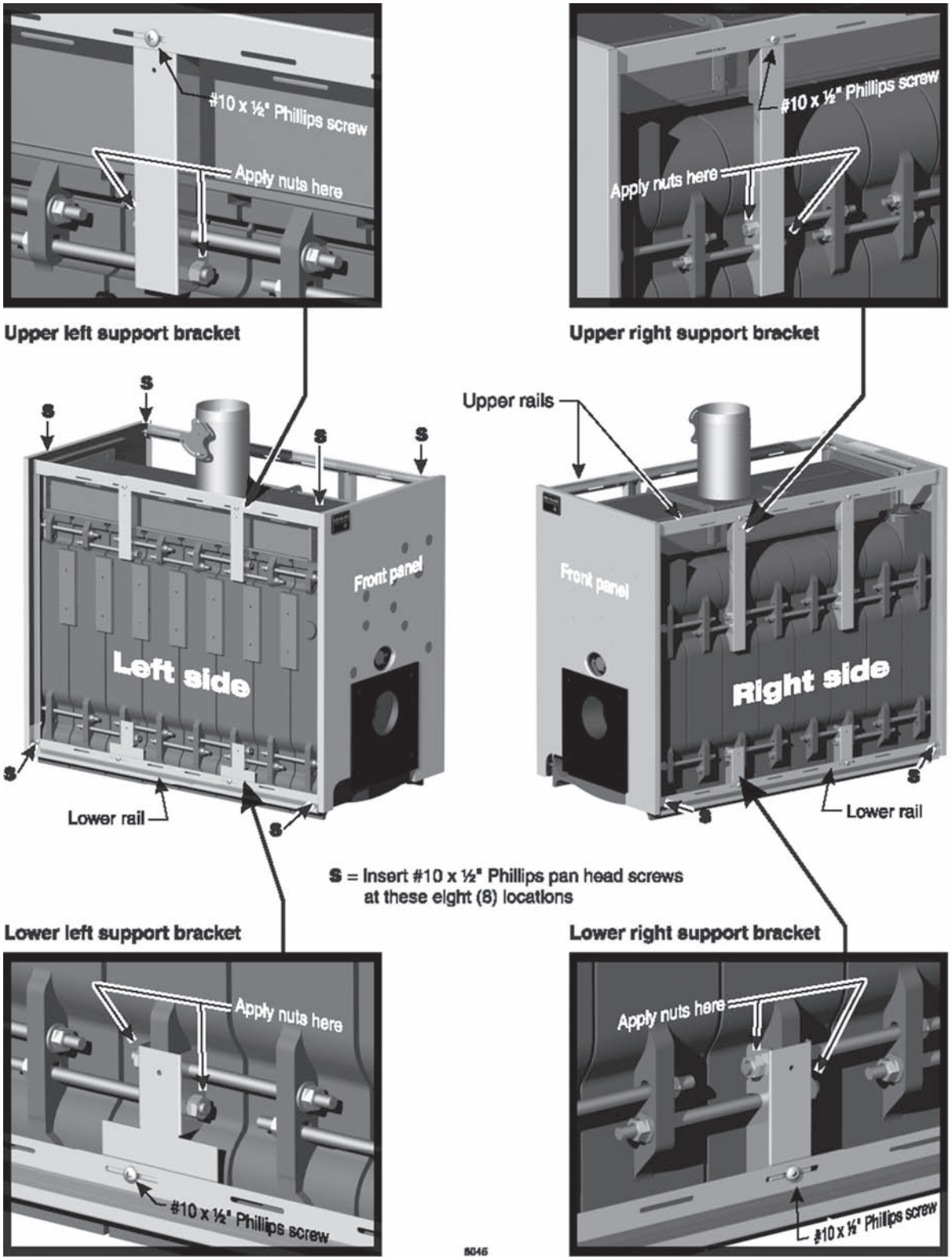
3. Space the brackets along the length of the boiler so there are close to an equal number of sections on either side of the bracket(s).
4. Attach the upper and lower rails on each side of the boiler by securing with #10 x ½" Phillips pan head screws. **DO NOT** tighten the screws more than finger-tight.

## Install jacket front and rear panels

1. Attach the front and rear jacket panels to the upper and lower channels using #10 x ½" Phillips pan head screws, as shown in Figure 20.
2. **Rear flue boilers only** — remove rear jacket panel flue collector transition knockout with tin snips before installing on boiler.

# 9 Install jacket (continued)

**Figure 20** Installing jacket support brackets and rails and jacket front and rear panels



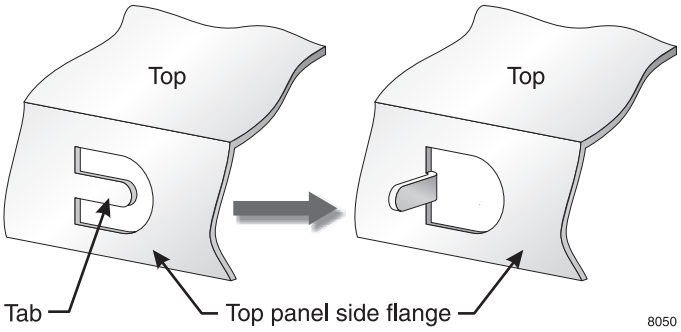
# 9 Install jacket (continued)

## Install jacket side panels

1. Remove jacket side panels from cartons.
2. Insert a plastic plug (provided in jacket cartons) in the 1-inch hole in the center of each of the jacket side panels.
3. Before installing side panels, square up the jacket support rails.
   - Place any of the jacket side panels on the rails as shown in Figure 21.
   - Butt the side panel against the jacket front panel.
   - Push/pull on the upper and lower rails until the fit-up of the side panel, front panel and rails is square.
   - Place a jacket top panel in position against the jacket front panel to ensure the top alignment is square. Adjust the jacket support rails forward or backward if needed for square alignment.
   - Tighten the screws securing the upper and lower rails to the support brackets.
   - Tighten the screws securing the front and back panels to the rails.
4. Apply all jacket side panels in the order shown in Figures 22, 23 or 24.
   - Remove jacket knockouts as required for tankless heaters.
   - Note that panel sequence is not important for boilers not equipped with tankless heater intermediate sections.

## Install jacket top panels

1. Place jacket top panels as shown in Figure 25, page 26.
   - Remove knockouts for riser pipes or flue outlet using tin snips.
2. Fold out tab in top panel side flange next to top flue knockout to prevent top panel from sagging (see below).

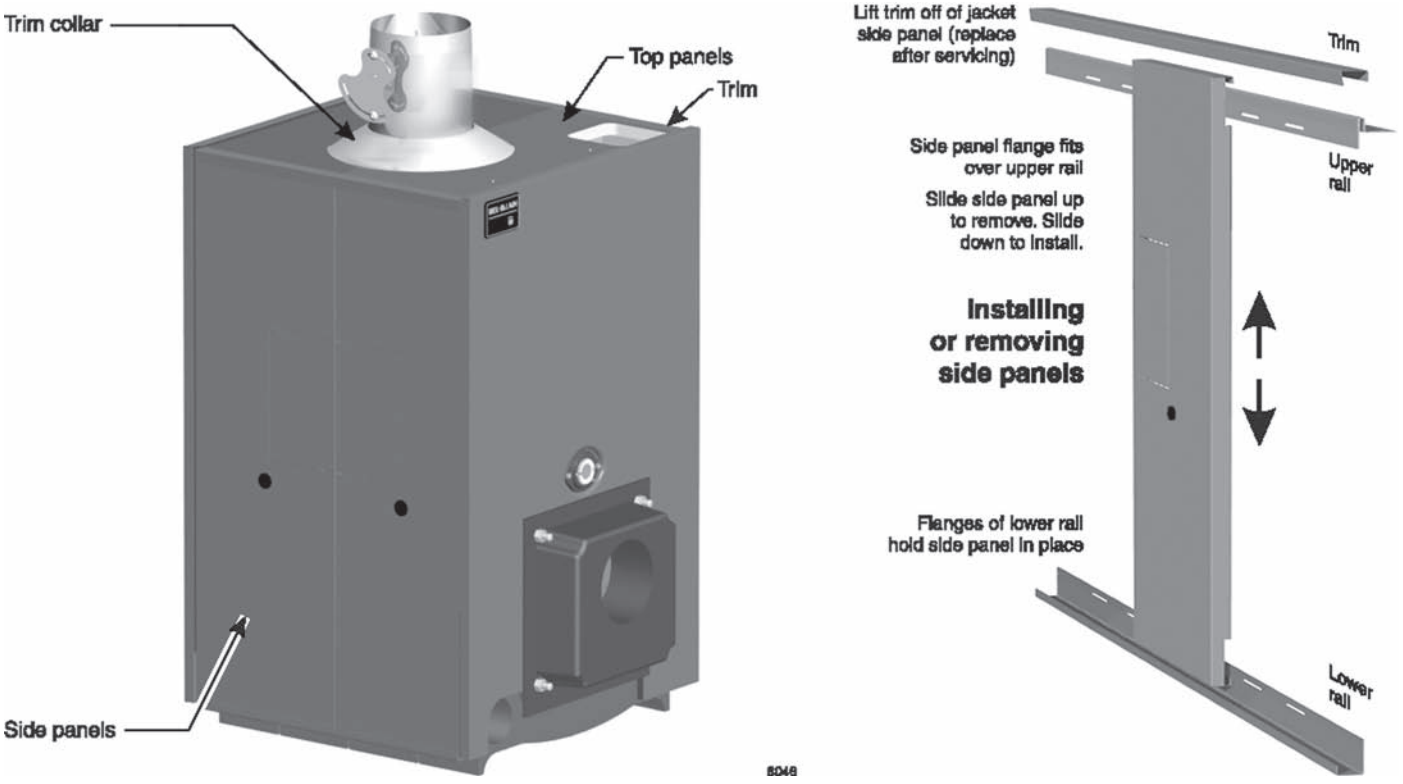



3. Install trim collar around damper assembly on top flue boilers.

## Install jacket trim

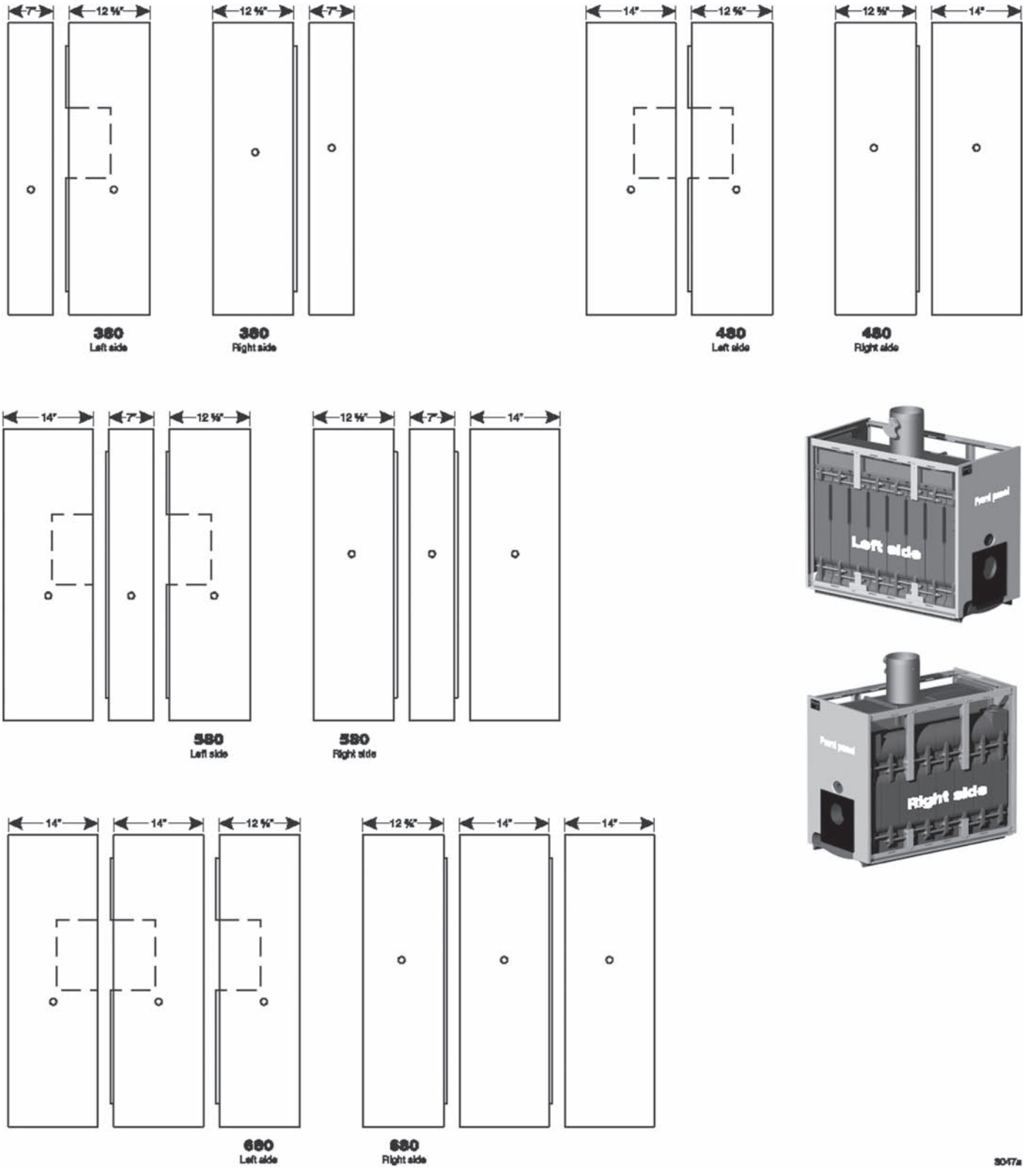
1. Press jacket trim over jacket side panels as shown in Figure 21. Place each jacket trim so the side of the trim with small holes faces toward the boiler.

**Figure 21** Installing (removing) jacket side panels and top panels



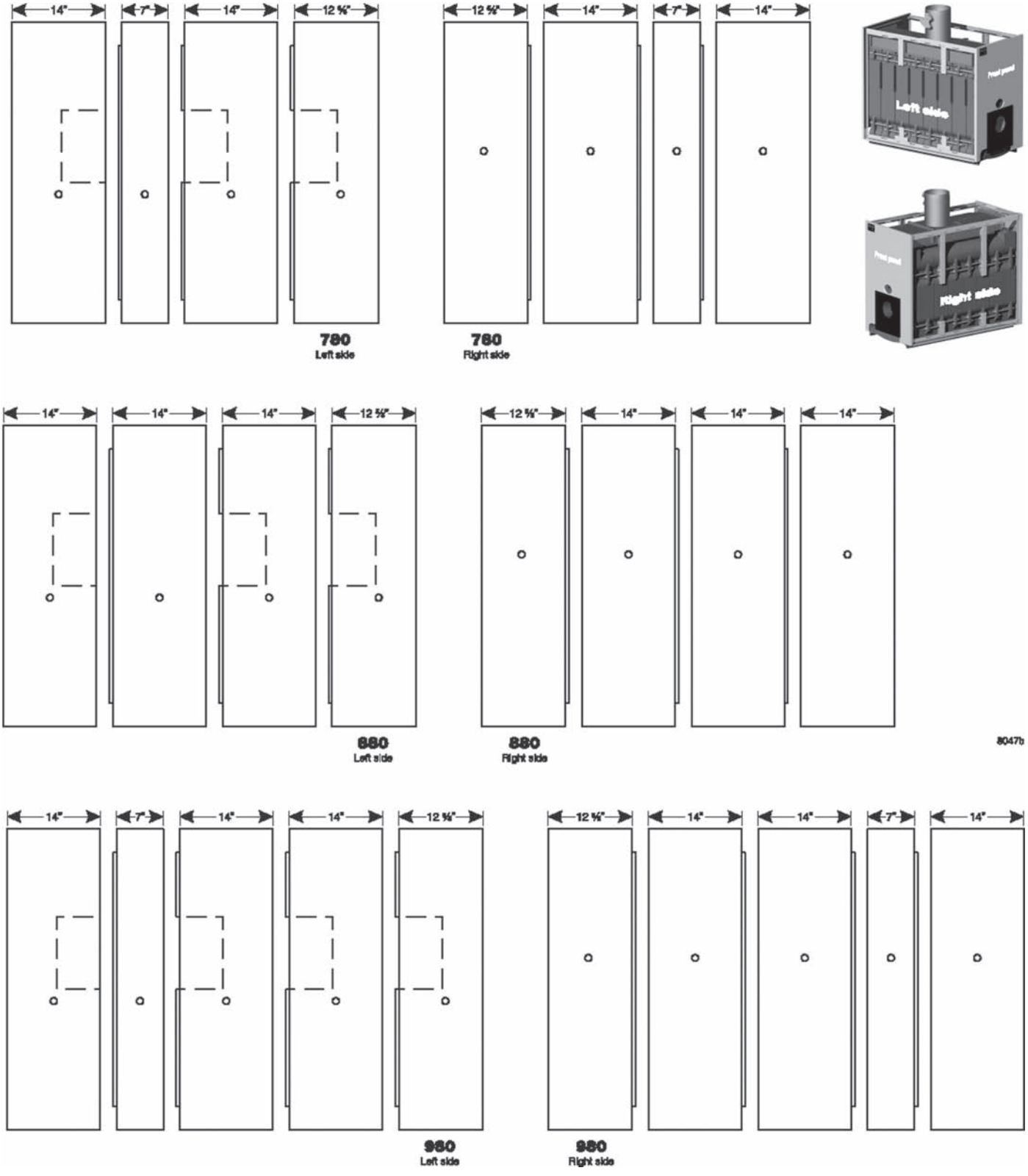
# 9 Install jacket (continued)

**Figure 22** Jacket side panel placement — Models 380, 480, 580 and 680



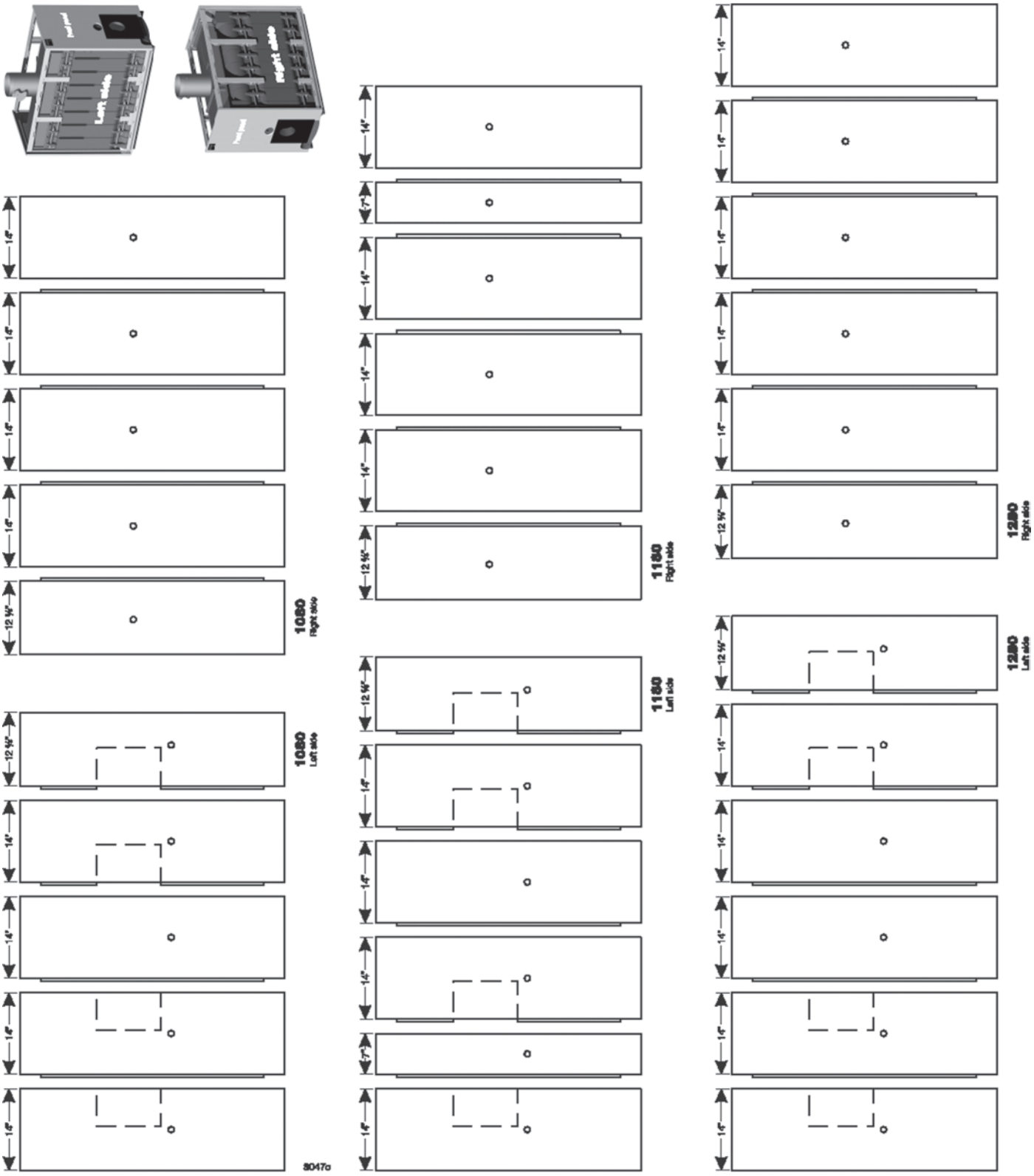
# 9 Install jacket (continued)

**Figure 23** Jacket side panel placement — Models 780, 880 and 980



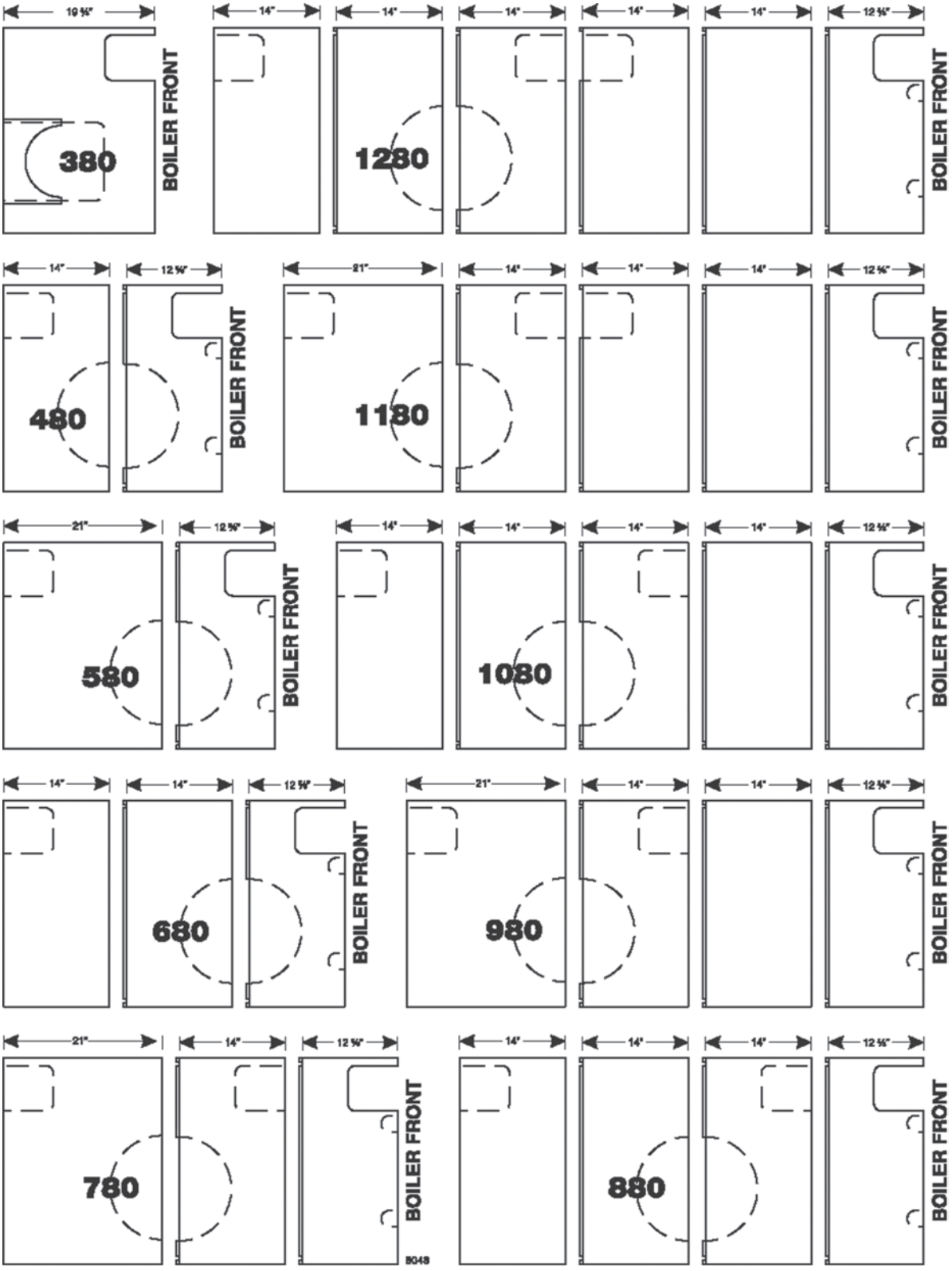
# 9 Install jacket (continued)

**Figure 24** Jacket side panel placement — Models 1080, 1180, and 1280



# 9 Install jacket (continued)

**Figure 25** Jacket top panel placement



# 10 Pipe tankless heaters

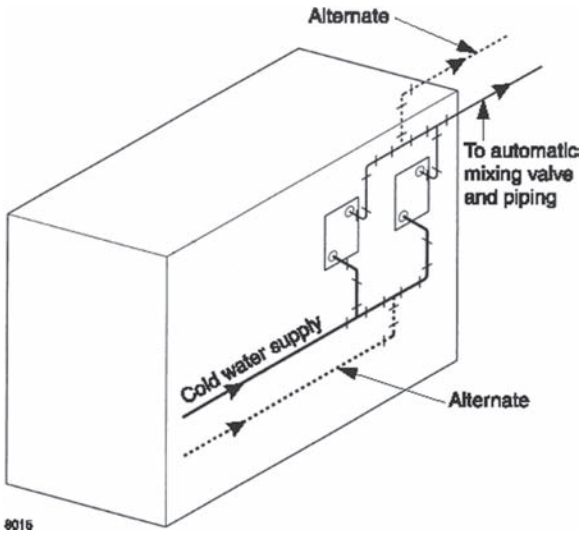
## To pipe tankless heaters:

1. Size piping no smaller than heater inlet and outlet.
2. Automatic mixing valve must be installed. See Figure 26. Follow manufacturer's instructions to install.
3. Flow regulating valve must be installed. Size according to continuous draw of heater. See Table 9. Follow manufacturer's instructions to install.
4. Operating control with small adjustable differential scale is recommended. Install in temperature control tapping in heater plate.
5. Multiple tankless heaters (see Figure 26):
   a. Use cold water supply header with individual risers to each heater. Size header by increasing one pipe size for each additional heater.
   b. Use hot water outlet header with individual risers to each heater. Size header by increasing one pipe size for each additional heater.
   c. Do not pipe multiple heaters in series.
6. In hard water areas, soften cold domestic water supply to heaters to prevent lime build-up.

**Table 9** Tankless Heater Ratings

| Tankless heater model | Continuous draw (no recovery period) GPM | Inlet and outlet tappings |
|---|---|---|
| 78-24 | 6.5 | ¾" |

**Figure 26** Tankless Heater Piping




**⚠ DANGER** **Hot water can scald!**

- Consumer Product Safety Commission and some states recommend domestic hot water temperature of 130°F or less.
- When installing an automatic mixing valve, selection and installation **must** comply with valve manufacturer's recommendations and instructions.
- Water heated to a temperature suitable for clothes washing, dish washing and other sanitizing needs will scald and cause injury.
- Children, elderly, infirm or physically handicapped persons are more likely to be injured by hot water. Never leave them unattended in or near a bathtub, shower or sink. Never allow small children to use a hot water faucet or draw their own bath. If anyone using hot water in the building fits this description, or if state laws or local codes require certain water temperatures at hot water faucets, take special precautions:
  — Install automatic mixing valve set according to those standards.
  — Use lowest practical temperature setting.
  — Check water temperature immediately after first heating cycle and after any adjustment.

# 11 Install water boiler controls

## Install controls:

1. Install furnished controls where shown in Table 10 and Figure 27.

**⚠WARNING** Failure to properly install, pipe and wire boiler controls can result in severe damage to boiler, building and personnel; and is not covered by boiler warranty.

2. Relief valve must be installed with spindle in vertical position. Use fittings provided with boiler. Do not make any other connection in that piping.

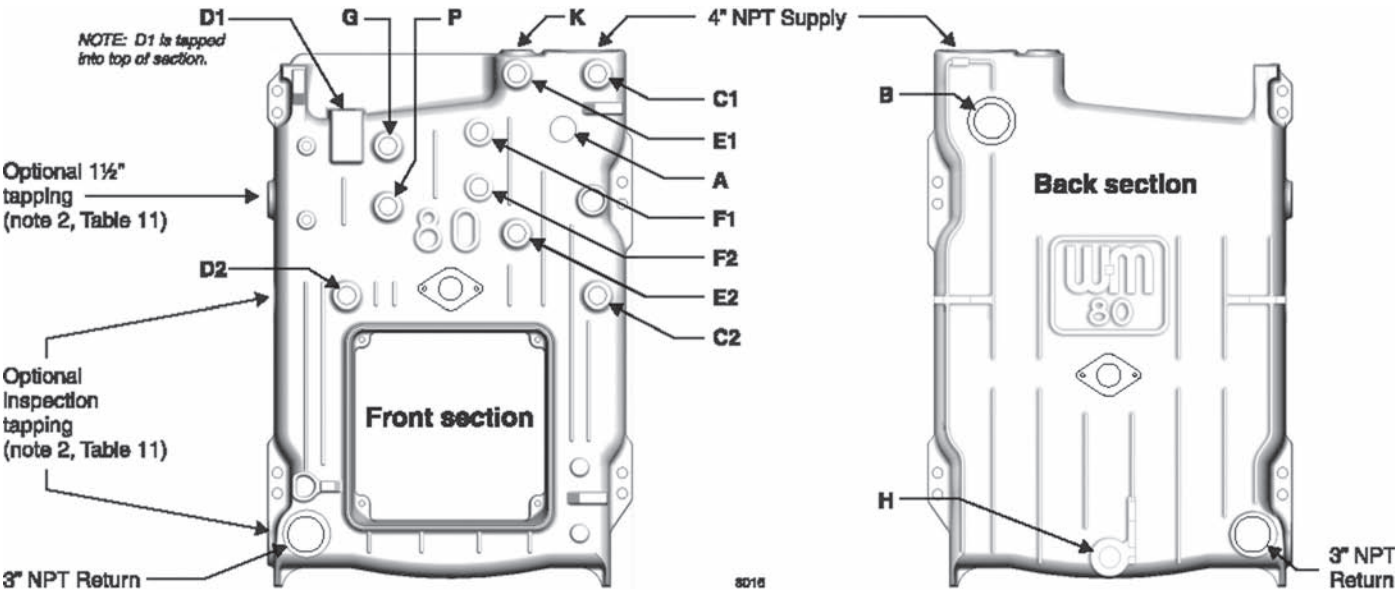
**⚠WARNING** Relief valve discharge line must be piped using rigid material suitable for 375°F, threaded one end, near floor close to drain to eliminate potential of severe burns. Do not pipe to any area where freezing could occur. Do not plug, valve or place any obstruction in discharge line.

3. When installing low water cutoff
   a. Must be installed if boiler is located above radiation level.
   b. May be required on water boilers by certain state, local or territorial codes or insurance companies.
   c. Install low water cutoff designed for water installations where shown in Table 10 and Figure 27.
4. If installation is to comply with ASME installation requirements, an additional high temperature limit is needed. Purchase and install in supply line between boiler and isolation valve or in tapping "**A**."
5. Dual limit control settings:
   - **Low** – set according to design requirements.
   - **High** – at least 20° higher than low limit, 240°F maximum.
6. Install optional controls per control manufacturer's instructions.

**Table 10** Water control tappings (see Figure 27)

| Tapping | Size (NPT) | Water boilers, with water level controls: | | |
|---|---|---|---|---|
| | | Probe-type primary Probe-type secondary | Float-type primary Probe-type secondary | Float-type primary Float-type secondary |
| A | 1½" Note 1 | Combination high/low limit control | | |
| B | 3" | Water relief valve | | |
| C1 | 1" | Firing rate control | Primary water level control | |
| C2 | 1" | Not used | Primary water level control | |
| D1 | 1" | Not used | Not used | Secondary level control |
| D2 | 1" | Not used | Not used | Secondary level control |
| E1 | 1" | Not used | Not used | Not used |
| E2 | 1" | Additional high/low limit control. | | |
| F1 | 1" | Primary level control | Not used | |
| F2 | 1" | Not used | Firing rate control | |
| G | 1" | Pressure-temperature gauge | | |
| H | 1½" | Boiler drain | | |
| K | 1" | Expansion tank piping or automatic air vent | | |
| P | 1" | Secondary level control | | Not used |
| Notes: | 1. 1½" plug provided with boiler. 2. By special request only. | | | |

**Figure 27** Water control locations



# 12 Install steam boiler controls

## Install controls:

1. Install controls where shown in Table 11 and Figure 28.

**⚠WARNING** Failure to properly install, pipe and wire boiler controls can result in severe damage to boiler, building and personnel; and is not covered by boiler warranty.

a. Install steam pressure operating and high limit controls and pressure gauge. See Figure 28,this page, and Figure 29, page 30.
Pressure limit control settings:
- **Low** – set according to design requirements.
- **High** – set at least 2 psi higher than low limit, 15 psi maximum.

b. Relief valve must be installed with spindle in vertical position. Use fittings provided with boiler. Do not make any other connection in that piping.

**⚠WARNING** Pipe relief valve discharge through vertical piping to atmosphere. Use rigid material suitable for 375°F, threaded one end only. Install drain pan elbow to drain condensate. Pipe near floor close to floor drain to eliminate potential of severe burns. Do not pipe to any area where freezing could occur. Do not plug, valve or place any obstruction in discharge line.

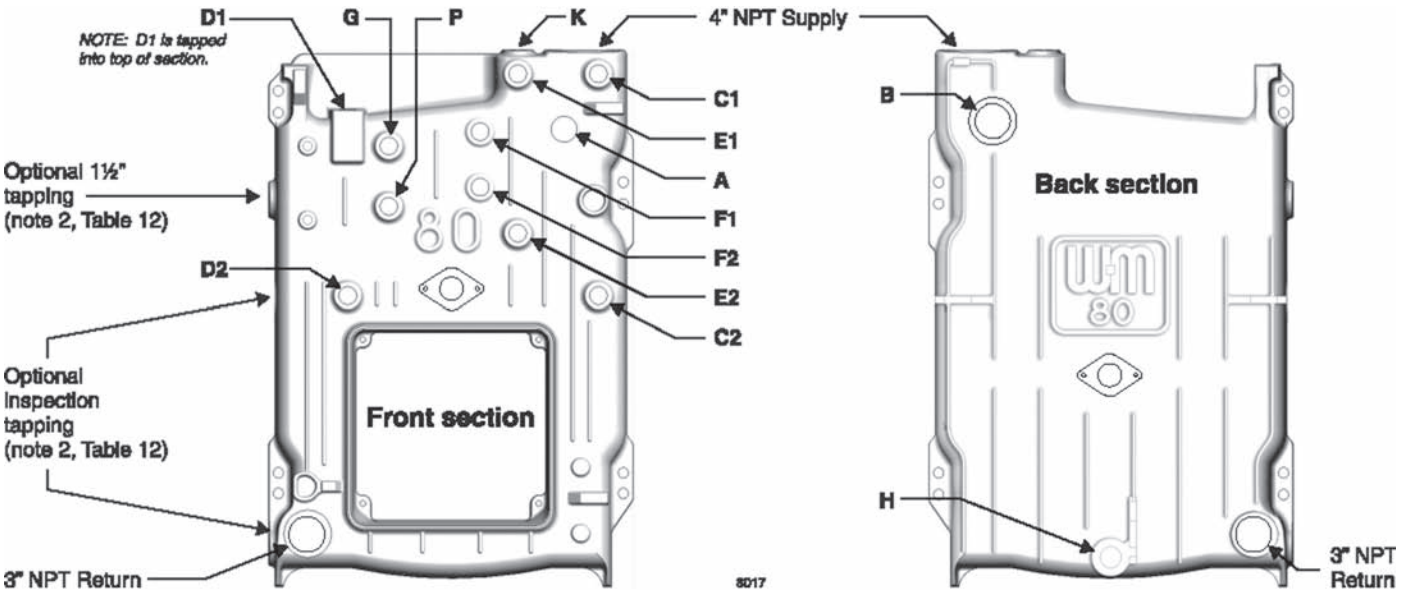
c. Install water level controls and gauge glass as shown in Figure 30 and Table 12, page 30.
   1. Fittings for controls to be furnished by others.
   2. If water level control is not shown in Table 12, page 30, locate casting mark on control and install per manufacturer's instructions.

***NOTICE*** Do not use water level controls with quick hook-up fittings. Nuisance shutdowns will occur.

**Table 11** Steam control tappings (see Figure 28)

| Tapping | Size (NPT) | Steam boilers, with water level controls: | |
|---|---|---|---|
| | | Float-type primary Probe-type secondary | Float-type primary Float-type secondary |
| A | 1½" Note 1 | Skim tapping (Pipe skim piping to side of boiler.) | |
| B | 3" | Steam relief valve | |
| C1 | 1" | Primary water level control | |
| C2 | 1" | Primary water level control | |
| D1 | 1" | Not used | Secondary level control |
| D2 | 1" | Not used | Secondary level control |
| E1 | 1" | Gauge glass | |
| E2 | 1" | Gauge glass | |
| F1 | 1" | Try cock tapping | |
| F2 | 1" | Try cock tapping | |
| G | 1" | Control tree: Limit control, operating control, and pressure gauge | |
| H | 1½" | Boiler drain | |
| K | 1" | Not used | |
| P | 1" | Secondary level control | Not used |
| Notes: | 1. 1½" plug provided with boiler. 2. By special request only. | | |

**Figure 28** Steam control locations



# 12 Install steam boiler controls (continued)

**Figure 29** Steam control siphon and fittings

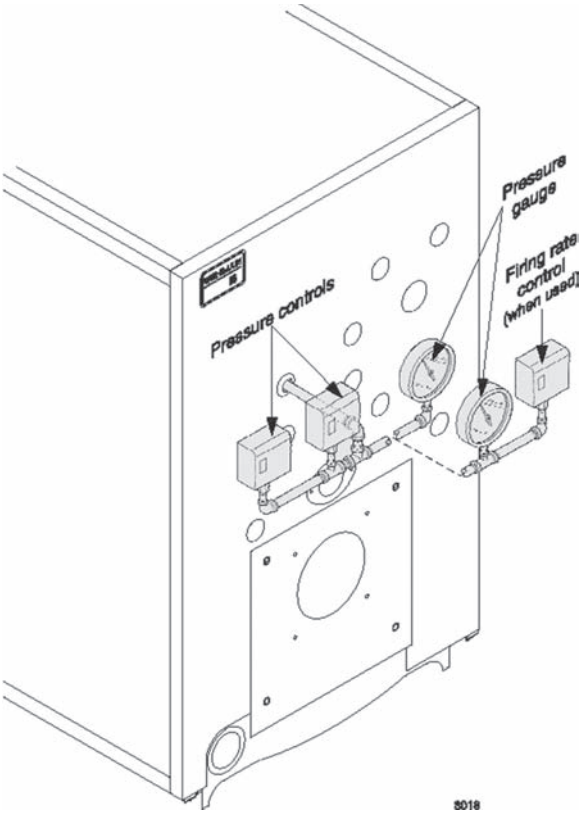
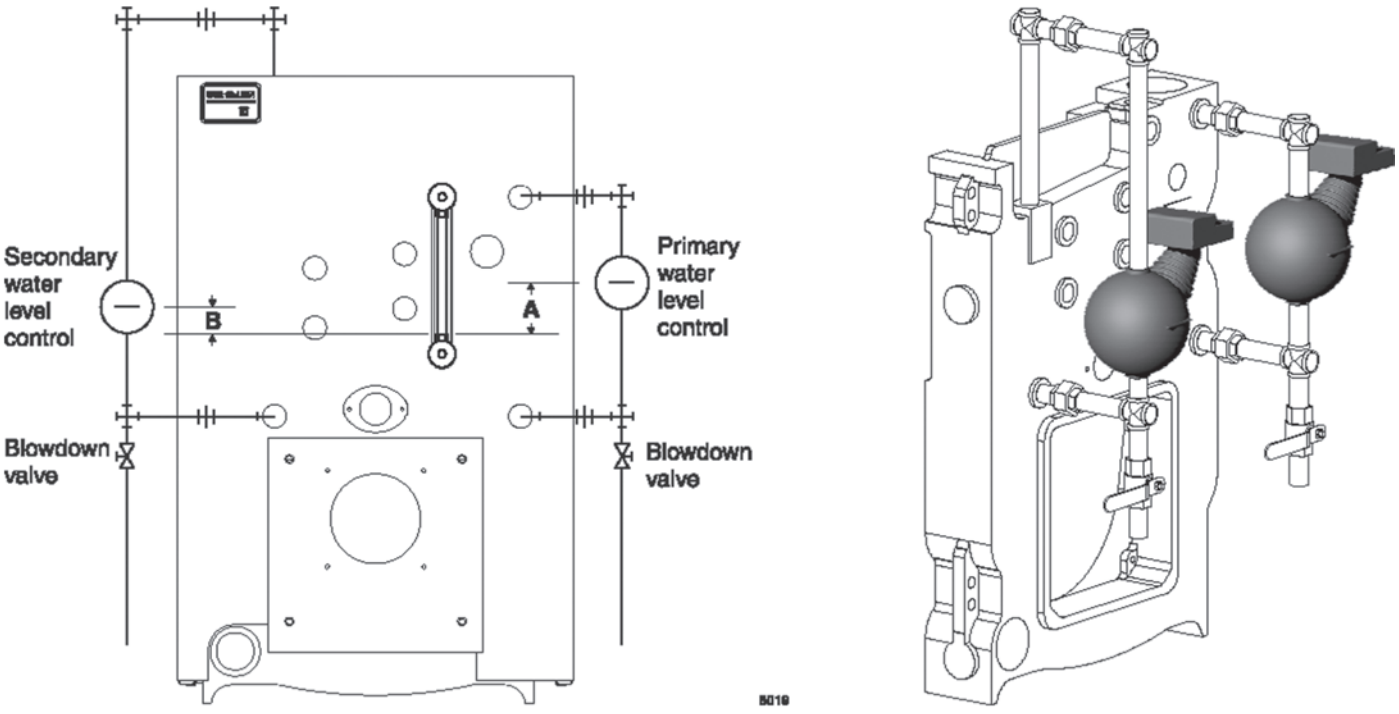



**Table 12** Water level control locations

| Primary water level control | Casting line height above bottom of gauge glass | Back-up water level control | Casting line height above bottom of gauge glass | Back-up (only) probe-type water level control in "P" tapping |
|---|---|---|---|---|
| Note 1 | "A" | Note 1 | "B" | |
| 61, 63 | 1½" | 61, 63 | ½" | MM PS801-120 or Hydrolevel 45-550 |
| 42, 150MD, 157MD (see Notes 2 & 3) | 2⅝" | 61, 63 | ½" | |
| 93, 193 (see Notes 2 & 3) | 1¾" | 61, 63 | ½" | |
| 51-2 & 51-S-2 (see Notes 2 & 3) | 2⅝" | 61, 63 | ½" | |

Notes:
1. Other manufacturer's controls providing similar function may be used, if properly located and selected.
2. Cannot be used as back-up water level controls.
3. When pump control is used with feed water tank, install pump control on boiler and makup water feeder on tank. Use separate low water cutoff on boiler when back-up is needed. Do not install combination low water cutoff and feeder as back-up control on boiler. Feeder will operate before pump control operates.

**Figure 30** Water level control locations (see Table 12)



# 13 Connect breeching and venting systems

## General venting information

- Model 80 boilers operate with positive overfire pressure. Adjust damper assembly (see page 33) during burner start-up to achieve 0.1" W.C. positive pressure at damper sample hole.

## Select type of venting system

### Forced draft

Boiler, breeching and stub vent operate at positive pressure. Entire system must be gas-tight to prevent leaks. Stub vent height must be limited to prevent negative draft with 3-foot minimum stub vent height above roof. See Figures 31 and 32.

### Balanced draft

Boiler operates with positive pressure overfire. Chimney **may** provide excess draft which may require a barometric draft control installed and set to provide minimum draft to maintain 0.1" positive pressure at flue collar. Minimum chimney height above roof is 3 feet. See Figures 33 and 34.

## Construct metal breeching:

- See Table 13 or Table 14 for minimum breeching diameter.
- Select material type and thickness in compliance with local codes.

**⚠WARNING** Conventional flue pipe should not be used as it could leak flue gases and carbon monoxide emissions through seams and joints, resulting in severe personal injury or death.

- Refer to ASHRAE Guide for chimney and breeching calculations and construction and lining.

**⚠WARNING** Long horizontal breechings, excessive number of tees and elbows or other obstructions restricting combustion gas flow can result in possibility of condensation, flue gas leakage and carbon monoxide emissions, causing severe personal injury or death.

**Figure 31**
Stub vent – forced draft — single boiler

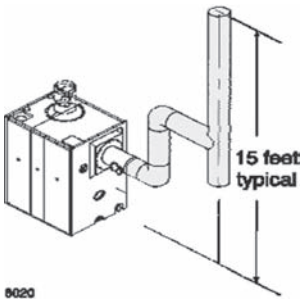



**Figure 32**
Stub vent – forced draft — multiple boilers

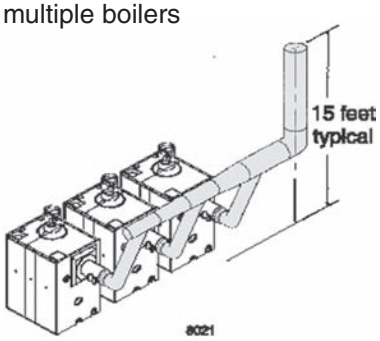



**Figure 33**
Conventional chimney – balanced draft with barometric draft control when required — single boiler

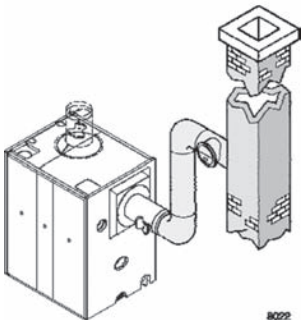



**Figure 34**
Conventional chimney – balanced draft with barometric draft control when required — multiple boilers

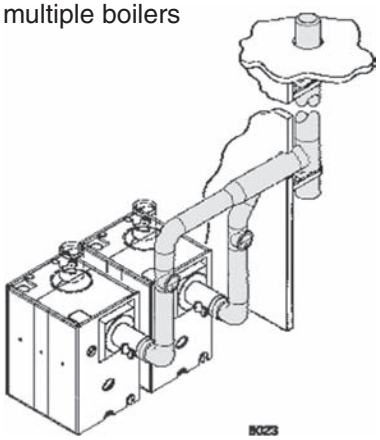



**Table 13** Minimum breeching diameter — forced draft venting

| Boiler model number | I=B=R recommended minimum vent diameter | Flue collar outlet diameter |
|---|---|---|
| | inches | Inches |
| 380 | 6 | 8 |
| 480 | 7 | 8 |
| 580 | 8 | 8 |
| 680 | 8 | 8 |
| 780 | 9 | 10 |
| 880 | 10 | 10 |
| 980 | 10 | 10 |
| 1080 | 10 | 10 |
| 1180 | 10 | 10 |
| 1280 | 12 | 12 |

**Table 14** Minimum breeching diameter — balanced draft venting

| Boiler model number | I=B=R round vent diameter | I=B=R rectangular chimney size | Minimum chimney/ vent height | Flue collar outlet diameter |
|---|---|---|---|---|
| | inches | Inches | feet | inches |
| 380 | 8 | 8 x 12 | 15 | 8 |
| 480 | 10 | 8 x 12 | 15 | 8 |
| 580 | 10 | 12 x 12 | 15 | 8 |
| 680 | 11 | 12 x 16 | 15 | 8 |
| 780 | 12 | 12 x 16 | 15 | 10 |
| 880 | 15 | 12 x 16 | 15 | 10 |
| 980 | 15 | 16 x 16 | 15 | 10 |
| 1080 | 15 | 16 x 16 | 15 | 10 |
| 1180 | 15 | 16 x 16 | 15 | 10 |
| 1280 | 15 | 20 x 16 | 15 | 12 |

# 14 Install burner

### To install burner:

1. Unpack burner.
2. Place gasket around air tube and against burner mounting flange. If sealing rope is used, apply 1/8" continuous bead of rope adhesive around burner mounting flange and apply sealing rope to make gas-tight seal.
3. Mount burner into opening in burner mounting plate.

**⚠ CAUTION** Maintain gas-tight seal between burner mounting flange and plate to prevent damage to air tube.

4. Level burner using burner support brackets where required.
5. Secure with furnished bolts.
6. Retain burner information packet. Keep with boiler.

# 15 Wiring and fuel piping

**⚠ WARNING** Electric shock hazard. Can cause severe personal injury or death if power source is not disconnected before installing or servicing boiler and burner.

### To wire burner and boiler controls:

1. Install all wiring in compliance with:
   - National Electrical Code ANSI/NFPA 70.
   - Any additional national, state, or local codes.
2. Follow burner manual and wiring diagram found in burner information packet.
3. Use 14 ga. wire for operating and safety circuit wiring.
4. Where burner motor voltage differs from control voltage, supply proper voltage to each. Size fused disconnect(s) and conductors per National Electrical Code ANSI/NFPA 70.

### To install gas and/or oil piping:

1. Install all piping in compliance with:
   - Local, state or national codes and regulations.
   - Seperate burner manual provided with burner.
2. Use pipe joint compound (pipe dope) resistant to corrosive action of fuel oil or liquified petroleum gases. Apply sparingly to male threads of pipe joints. Do not use any kind of pipe tape.
3. Oil piping – use flare-type fittings, not compression type.

**⚠ DANGER** Do not use compression or soldered fittings. No safe repair can be made. Severe personal injury, death or substantial property damage will result.

**⚠ WARNING** Propane boilers — see WARNING on page 39 regarding propane gas odorant.

# 16 Make final adjustments

### To fill water boilers:

1. Close manual air vents and drain cocks.
2. Fill to correct system pressure. Correct pressure will vary with each installation.
3. Starting on lowest floor, open air vents one at a time until water squirts out. Close vent. Repeat with remaining vents.
4. Refill boiler to correct pressure.

### To fill steam boilers:

1. Do not fill (except for leakage test) until boiler is ready to be fired.
2. Fill to normal waterline, halfway up gauge glass.
3. Recommend boiler water pH 7.0 to 8.5.

### Adjust burner and damper assembly:

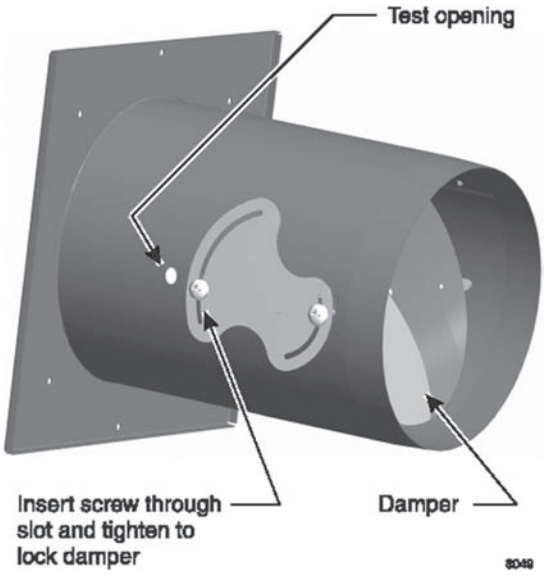
1. Lock open flue transition damper.

**⚠ WARNING** Make final burner adjustments using combustion test equipment to assure proper operation. Do not fire boiler without water. Sections will overheat, damaging boiler and resulting in severe property damage.

2. Refer to burner manual for start-up and service.
3. Let burner advance to high fire. Heat boiler to design conditions.
4. Using combustion test equipment, adjust burner for:
   a. 12% (± ¼%) $CO_2$ for No. 2 fuel oil, 0 smoke.
   b. 9 – 10% $CO_2$ natural gas; CO in flue gas not to exceed 50 ppm (0.01%).
5. Adjust damper assembly (Figure 35, page 33) to ensure 0.1" W.C. positive pressure at test opening. Tighten screws to secure in position. Plug test opening with 3/8" bolt provided with damper assembly.
6. Adjust barometric draft control, when used, to design conditions.
7. Repeat steps 4 through 6. Adjust as required.

# 16 Make final adjustments (continued)

**Figure 35** Flue damper assembly, typical




## Skim steam boilers:

**NOTICE** Clean all newly installed steam boilers to remove oil. Failure to properly clean can result in violent water level fluctuations, water passing into steam mains, or high maintenance costs on strainers, traps and vents. Skim boiler only. Do not clean old piping or leaks can occur.

**⚠WARNING** Do not use petroleum-based cleaning or sealing compounds in boiler system. Severe damage to system components can result, causing substantial property damage.

1. Remove 1½" plug from skim tapping tapping "**A**" – Figure 28, page 29). Provide 1½" skim piping from tapping to floor drain (pipe to side of boiler).
2. Raise waterline to midpoint of skim piping.
3. Fire burner to maintain temperature below steaming rate during skimming process.
4. Feed in water to maintain water level. Cycle burner to prevent rise in steam pressure.
5. Continue skimming until discharge is clear. This may take several hours.
6. Drain boiler. While boiler is warm **but not hot**, flush all interior surfaces under full pressure until drain water runs clear.
7. Remove skim piping. Re-insert plug at boiler skim tapping.
8. Close drain cock. Fill with fresh water to normal water line. Start burner and steam for 15 minutes to remove dissolved gases. Stop burner.
9. Check traps and air vents for proper operation.

## Determine if water treatment is needed (water boilers only):

**⚠WARNING** Do not use petroleum-based cleaning or sealing compounds in boiler system. Severe damage to system components can result, causing substantial property damage.

Continual make-up water will reduce boiler life. Minerals can build up in sections, reducing heat transfer, overheating cast iron and causing section failure.

For unusually hard water areas or low pH conditions (less than 7.0) consult local water treatment company.

## Freeze protection (when used):

1. Use antifreeze especially made for hydronic systems. Inhibited propylene glycol is recommended.

**⚠WARNING** Do not use automotive, ethylene glycol or undiluted antifreeze. Severe personal injury or death can result.

2. 50% solution provides protection to about -30°F.
3. Local codes may require back-flow preventer or actual disconnect from city water supply.
4. Determine quantity according to system water content. Boiler water content is listed on page 34. Percent of solution will affect sizing of heat distribution units, circulator and expansion tank.
5. Follow antifreeze manufacturer's instructions.

## Check boiler for gas-tight seal:

**⚠WARNING** Boiler must be sealed gas-tight to prevent possible flue gas leakage and carbon monoxide emissions, resulting in severe personal injury or death.

1. Remove boiler jacket side and top panels.

**⚠WARNING** The boiler contains ceramic fiber and fiberglass materials. Use care when handling these materials per instructions on **page 38** of this manual. Failure to comply could result in severe personal injury.

2. Start burner. Observe all sealing points and chalk mark any not gas-tight.
3. To seal all chalk-marked areas:
   a. use silicone sealant on section flueways.
   b. check gaskets and sealing rope placement.
4. Reinstall all jacket panels.

# 17 Dimensions and ratings

| Boiler model number | Data | | | | Dimensions (inches) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Supply tappings Qty-size (see Note) | | Return tappings Qty-size (see Note) | | A | B | D | F | H | W | L |
| | Water | Steam | Water | Steam | | | | | | | |
| 380 | 2-4" | 2-4" | 2-3" | 2-3" | 13 1/8 | -- | 8 | 12 7/16 | 13 1/2 | 20 3/8 | 21 5/8 |
| 480 | 2-4" | 2-4" | 2-3" | 2-3" | 20 1/8 | -- | 8 | 13 5/8 | 20 1/2 | 27 3/8 | 28 5/8 |
| 580 | 2-4" | 2-4" | 2-3" | 2-3" | 27 1/8 | -- | 8 | 13 5/8 | 27 1/2 | 34 3/8 | 35 5/8 |
| 680 | 2-4" | 2-4" | 2-3" | 2-3" | 34 1/8 | -- | 8 | 13 5/8 | 34 1/2 | 41 3/8 | 42 5/8 |
| 780 | 2-4" | 2-4" | 2-3" | 2-3" | 41 1/8 | -- | 10 | 27 5/8 | 41 1/2 | 48 3/8 | 49 5/8 |
| 880 | 2-4" | 2-4" | 2-3" | 2-3" | 48 1/8 | -- | 10 | 27 5/8 | 48 1/2 | 55 3/8 | 56 5/8 |
| 980 | 2-4" | 2-4" | 2-3" | 2-3" | 55 1/8 | -- | 10 | 41 5/8 | 55 1/2 | 62 3/8 | 63 5/8 |
| 1080 | 2-4" | 3-4" | 2-3" | 2-3" | 62 1/8 | 27 9/16 | 10 | 41 5/8 | 62 1/2 | 69 3/8 | 70 5/8 |
| 1180 | 2-4" | 3-4" | 2-3" | 2-3" | 69 1/8 | 34 9/16 | 10 | 55 5/8 | 69 1/2 | 76 3/8 | 77 5/8 |
| 1280 | 2-4" | 3-4" | 2-3" | 2-3" | 76 1/8 | 34 9/16 | 12 | 55 5/8 | 76 1/2 | 83 3/8 | 84 5/8 |

Note: Use piping connections shown in Manual, pages 14 through 19.

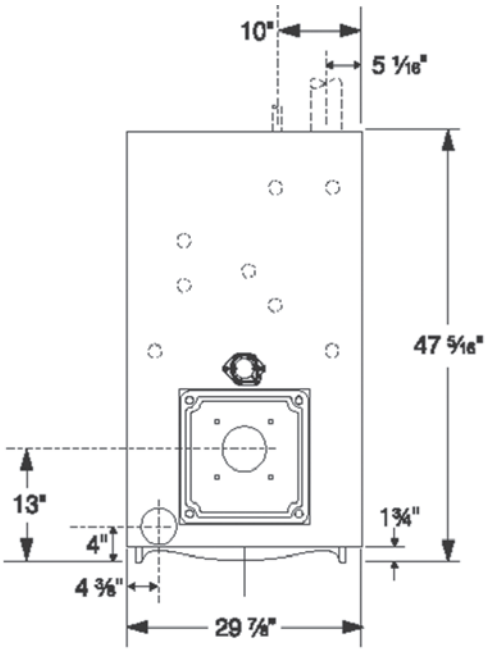
| Boiler model number | I=B=R burner capacity | | Gross I=B=R output | Net I=B=R ratings | | | Boiler H.P. | Net firebox volume | Stack gas volume | Positive pressure in firebox | Flue outlet diameter | Boiler water content (gallons) | | Packaged boiler weight (less water) | Approx. operating weight (with water) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Light oil GPH | Gas MBH | MBH | Steam Sq. Ft | Steam MBH | Water MBH | | Cu. ft | CFM | Inches W.C. | Inches | Water boiler | Steam to waterline | Lbs | Lbs |
| Notes: 1 | 2 | 3, 4 | 5, 6 | | 5 | 5 | | | 7 | 8 | | | | | |
| 380 | 2.40 | 346 | 278 | 867 | 208 | 242 | 8.3 | 2.61 | 139 | 0.28 | 8 | 37.5 | 27.5 | 1058 | 1170 |
| 480 | 3.40 | 491 | 396 | 1238 | 297 | 344 | 11.8 | 3.97 | 198 | 0.28 | 8 | 49.0 | 36.0 | 1203 | 1411 |
| 580 | 4.45 | 639 | 515 | 1608 | 386 | 448 | 15.4 | 5.33 | 259 | 0.28 | 8 | 60.5 | 44.5 | 1448 | 1752 |
| 680 | 5.50 | 787 | 634 | 1983 | 476 | 551 | 18.9 | 6.69 | 320 | 0.27 | 8 | 72.0 | 53.0 | 1843 | 2093 |
| 780 | 6.50 | 935 | 753 | 2354 | 565 | 655 | 22.5 | 8.05 | 378 | 0.27 | 10 | 83.5 | 61.5 | 2088 | 2434 |
| 880 | 7.50 | 1082 | 872 | 2725 | 654 | 758 | 26.0 | 9.41 | 436 | 0.27 | 10 | 95.0 | 70.0 | 2317 | 2774 |
| 980 | 8.50 | 1230 | 991 | 3096 | 743 | 862 | 29.6 | 10.77 | 494 | 0.27 | 10 | 106.5 | 78.5 | 2678 | 3115 |
| 1080 | 9.60 | 1378 | 1110 | 3471 | 833 | 965 | 33.2 | 12.13 | 558 | 0.26 | 10 | 118.0 | 87.0 | 2923 | 3456 |
| 1180 | 10.60 | 1526 | 1229 | 3842 | 922 | 1069 | 36.7 | 13.49 | 616 | 0.26 | 10 | 129.5 | 95.5 | 3068 | 3697 |
| 1280 | 11.60 | 1674 | 1348 | 4242 | 1018 | 1172 | 40.3 | 14.85 | 675 | 0.26 | 12 | 141.0 | 104.0 | 3313 | 4038 |

## Notes

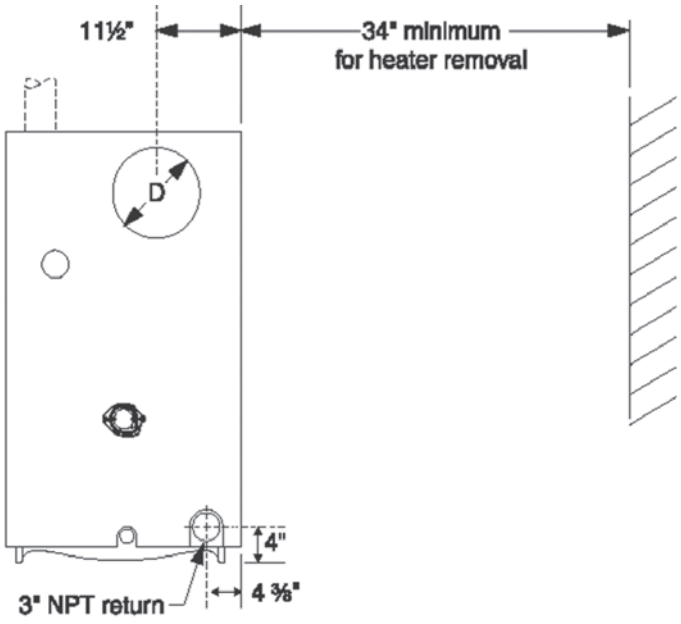
1. Burner input based on maximum of 2,000 feet altitude. For higher altitudes consult local Weil-McLain representative.
2. No. 2 fuel oil Commercial Standard Spec. CS75-56. Heat value of oil — 140,000 Btu/Gal.
3. Consult Weil-McLain Burner Specifications and Data Sheet for gas pressures required.
4. MBH refers to thousands of Btu per hour.
5. Gross I=B=R ratings have been determined under the I=B=R provision forced draft boiler-burner units.
6. Net I=B=R ratings are based on net installed radiation of sufficient quantity for the requirements of the building and nothing need be added for normal piping and pickup. Water ratings are based on a piping and pickup allowance of 1.15. Steam ratings are based on the following allowances: 380 thru 1180 — 1.333; 1280 — 1.321. An additional allowance should be made for gravity hot water systems or for unusual piping and pickup loads. Consult locat Weil-McLain representative.
7. Stack gas volume at outlet temperature.
8. With 0.10" W.C. positive pressure at flue collar.

**NOTICE**: Boiler sections are tested for 80 PSIG working pressure. Water boilers are supplied with 30 PSIG relief valve standard.

# 17 Dimensions and ratings (continued)




FRONT

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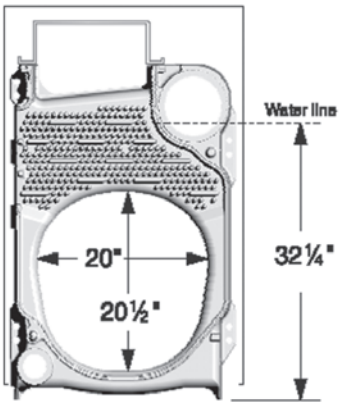
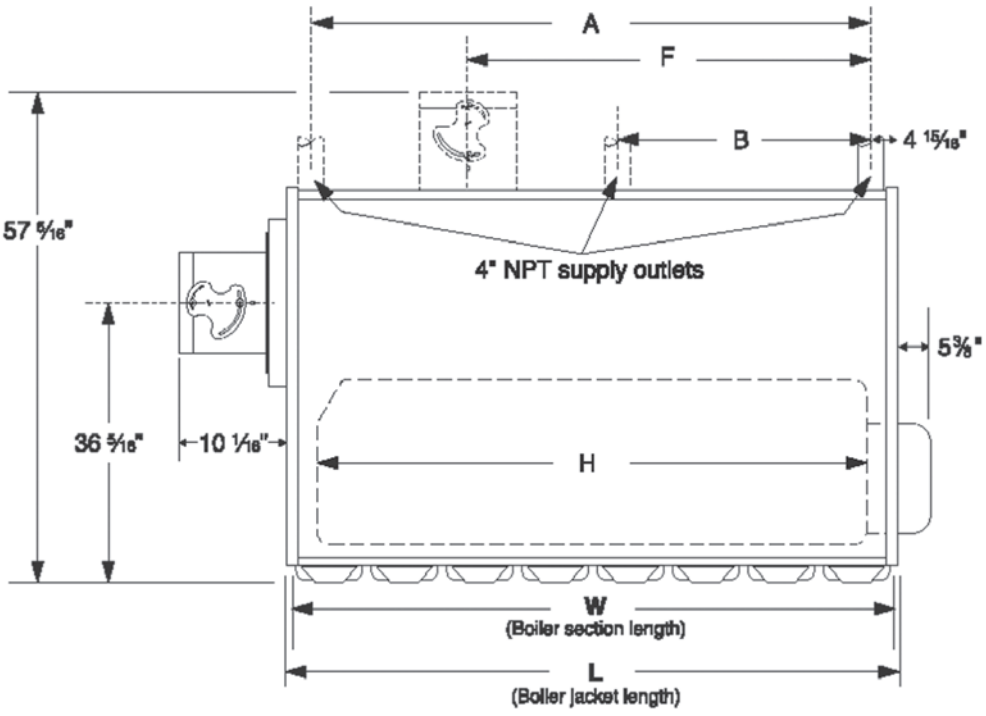



INTERMEDIATE



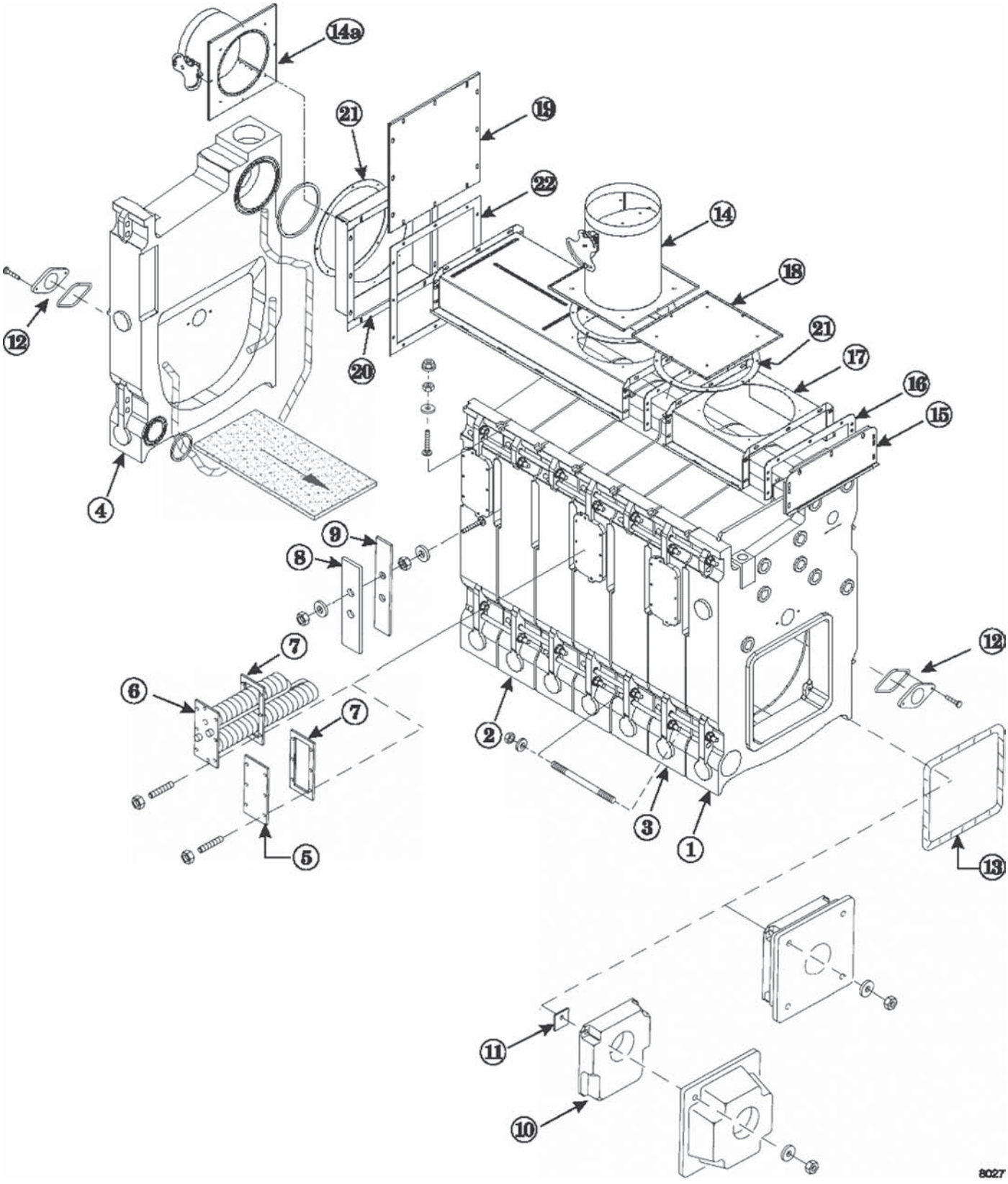

SIDE

8029

# 18 Parts

| Item number | Description | Weil-McLain part number |
|---|---|---|
| 1 | Front section | 315-700-100 |
| 2 | Intermediate section, regular<br>Intermediate section with special side tappings<br>Intermediate section, supply (steam boilers) | 315-700-120<br>315-700-130<br>315-700-150 |
| 3 | Intermediate section, tankless | 315-700-140 |
| 4 | Back section | 315-700-110 |
| not shown | Section assembly kit<br>(includes for one joint: sealing rope, sealing rope adhesive, sealing rings, silicone sealant) | 385-800-205 |
| 5 | Heater cover plate carton<br>(includes: cover plate, gasket, studs, nuts) | 385-700-200 |
| 6 | Tankless heater carton<br>(includes tankless heater, gasket, studs, nuts) | 590-921-917 |
| 7 | Heater gasket | 590-317-550 |
| 8 | Cleanout plate | 450-030-928 |
| 9 | Cleanout plate gasket | 590-317-303 |
| 10 | Burner mounting plate, front refractory<br>4½" burner opening<br>6⅛" burner opening | <br>591-000-070<br>591-000-072 |
| 11 | Refractory retainer clip | 562-650-105 |
| 12 | Observation port assembly<br>(includes: observation port assembly, sealing rope, screws) | 385-600-099 |
| 13 | Sealing rope | 590-735-140 |
| not shown | Combustion chamber kit<br>(includes: back refractory blanket, bottom refractory blanket, adhesive, sealing rope, sealing rope adhesive) | 385-700-220 |
| 14 | Flue damper assembly, top flue boilers<br>8"<br>10"<br>12" | <br>425-800-090<br>425-800-091<br>425-800-092 |
| 14a | Flue damper assembly, rear flue boilers<br>8"<br>10"<br>12" | <br>425-800-096<br>425-800-097<br>425-800-098 |
| not shown | Flue collector hood hardware kit<br>(includes: flue collector hardware plus collector hood gasket kit, below) | 385-800-215 |
| 15 | Flue collector hood end cap | 463-000-003 |
| Not shown | Collector hood gasket kit<br>(includes: (2) flue collector hood gasket, (3) circular collector hood gaskets,<br>(1) rectangular collector hood gasket, flat-stitched sealing rope, double-faced tape) | 385-800-218 |
| 16 | Flue collector hood gasket | Included in gasket kit |
| 17 | Flue collector hoods | 450-020-300<br>450-020-301<br>450-020-302<br>450-020-303<br>450-020-304 |
| 18 | Flue cap | Included with flue damper assembly |
| 19 | Flue cap rear | |
| 20 | Rear flue transition box | |
| 21 | Circular collector hood gasket | Included in gasket kit |
| 22 | Rectangular collector hood gasket | Included in gasket kit |

# 18 Parts (continued)



# Handling ceramic fiber and fiberglass materials

**⚠WARNING** This symbol is used in this addendum to indicate presence of hazards that can cause severe personal injury, death or substantial property damage.

## REMOVAL OF COMBUSTION CHAMBER LINING OR BASE PANELS

**⚠WARNING** The combustion chamber lining or base insulation panels in this product contain ceramic fiber materials. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded, "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1).":

- Avoid breathing dust and contact with skin and eyes.
  - Use NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH web site at http://www.cdc.gov/niosh/homepage.html. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this web site.
  - Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
- Apply enough water to the combustion chamber lining or base insulation to prevent airborne dust.
- Remove combustion chamber lining or base insulation from the boiler and place it in a plastic bag for disposal.
- Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

**NIOSH stated First Aid.**

- Eye: Irrigate immediately
- Breathing: Fresh air.

## REMOVAL OF FIBERGLASS WOOL — OR —

## INSTALLATION OF FIBERGLASS WOOL, COMBUSTION CHAMBER LINING OR BASE PANELS:

**⚠WARNING** This product contains fiberglass jacket insulation and ceramic fiber materials in combustion chamber lining or base panels in gas fired products. Airborne fibers from these materials have been listed by the State of California as a possible cause of cancer through inhalation.

- Avoid breathing dust and contact with skin and eyes.
  - Use NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for fiberglass wool at the time this document was written. Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH web site at http://www.cdc.gov/niosh/homepage.html. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this web site.
  - Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
- Operations such as sawing, blowing, tear out, and spraying may generate airborne fiber concentration requiring additional protection.
- Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

**NIOSH stated First Aid.**

- Eye: Irrigate immediately
- Breathing: Fresh air.

# Propane boilers — propane gas odorant

**⚠WARNING**

Propane boilers only — Your propane supplier mixes an odorant with the propane to make its presence detectable. In some instances, the odorant can fade and the gas may no longer have an odor.

- Propane gas can accumulate at floor level. Smell near the floor for the gas odorant or any unusual odor. If you suspect a leak, do not attempt to light the burner.
- Use caution when attempting to light a propane burner (or pilot burner). This should be done by a qualified service technician, particularly if flame outages (or pilot outages) are common.
- Periodically check the odorant level of your gas.
- Inspect boiler and system at least yearly to make sure all gas piping is leak-tight.
- Consult your propane supplier regarding installation of a gas leak detector. There are some products on the market intended for this purpose. Your supplier may be able to suggest an appropriate device.

WEIL-McLAIN®

Weil-McLain
500 Blaine Street
Michigan City, IN 46360-2388
*http://www.weil-mclain.com*

# Installation, Operation and Maintenance

## Performance Climate Changer™ Air Handlers

Model CSAA

Indoor and Outdoor Units Sizes 3-120

**⚠ SAFETY WARNING**

**Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.**

March 2014

**CLCH-SVX07E-EN**

X-39641152010

# Warnings, Cautions and Notices

**Warnings, Cautions and Notices.** Note that warnings, cautions and notices appear at appropriate intervals throughout this manual. Warnings are provided to alert installing contractors to potential hazards that could result in death or personal injury. Cautions are designed to alert personnel to hazardous situations that could result in personal injury, while notices indicate a situation that could result in equipment or property-damage-only accidents.

Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

Read this manual thoroughly before operating or servicing this unit.

---

**ATTENTION:** Warnings, Cautions, and Notices appear at appropriate sections throughout this literature. Read these carefully:

**⚠WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

**⚠CAUTION** Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.

***NOTICE:*** Indicates a situation that could result in equipment or property-damage only accidents.

---

## Important Environmental Concerns!

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants-including industry replacements for CFCs such as HCFCs and HFCs.

## Responsible Refrigerant Practices!

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified. The Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

**⚠WARNING**

### Proper Field Wiring and Grounding Required!

**All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Failure to follow code could result in death or serious injury.**

**⚠WARNING**

### Personal Protective Equipment (PPE) Required!

**Installing/servicing this unit could result in exposure to electrical, mechanical and chemical hazards.**

- **Before installing/servicing this unit, technicians MUST put on all Personal Protective Equipment (PPE) recommended for the work being undertaken. ALWAYS refer to appropriate MSDS sheets and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate MSDS sheets and OSHA guidelines for information on allowable personal exposure levels, proper respiratory protection and handling recommendations.**
- **If there is a risk of arc or flash, technicians MUST put on all Personal Protective Equipment (PPE) in accordance with NFPA 70E or other country-specific requirements for arc flash protection, PRIOR to servicing the unit.**

**Failure to follow recommendations could result in death or serious injury.**

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## Ultraviolet (UV) Germicidal Irradiation Lights!

The United States Environmental Protection Agency (EPA) believes that molds and bacteria inside buildings have the potential to cause health problems in sensitive individuals. If specified, Trane provides ultraviolet lights (UV-C) as a factory-engineered and installed option in select commercial air handling products for the purpose of reducing microbiological growth (mold and bacteria) within the equipment. When factory provided, polymer materials that are susceptible to deterioration by the UV-C light will be substituted or shielded from direct exposure to the light. In addition, UV-C radiation can damage human tissue, namely eyes and skin. To reduce the potential for inadvertent exposure to the lights by operating and maintenance personnel, electrical interlocks that automatically disconnect power to the lights are provided at all unit entry points to equipment where lights are located.

**⚠ WARNING**

### Equipment Damage From Ultraviolet (UV) Lights!

**Trane does not recommend field installation of ultraviolet lights in its air handling equipment for the intended purpose of improving indoor air quality. High intensity C-band ultraviolet light is known to severely damage polymer (plastic) materials and poses a personal safety risk to anyone exposed to the light without proper personal protective equipment (could cause damage to eyes and skin). Polymer materials commonly found in HVAC equipment that may be susceptible include insulation on electrical wiring, fan belts, thermal insulation, various fasteners and bushings. Degradation of these materials can result in serious damage to the equipment.**

**Trane accepts no responsibility for the performance or operation of our air handling equipment in which ultraviolet devices were installed outside of the Trane factory.**

# Introduction

## Overview of Manual

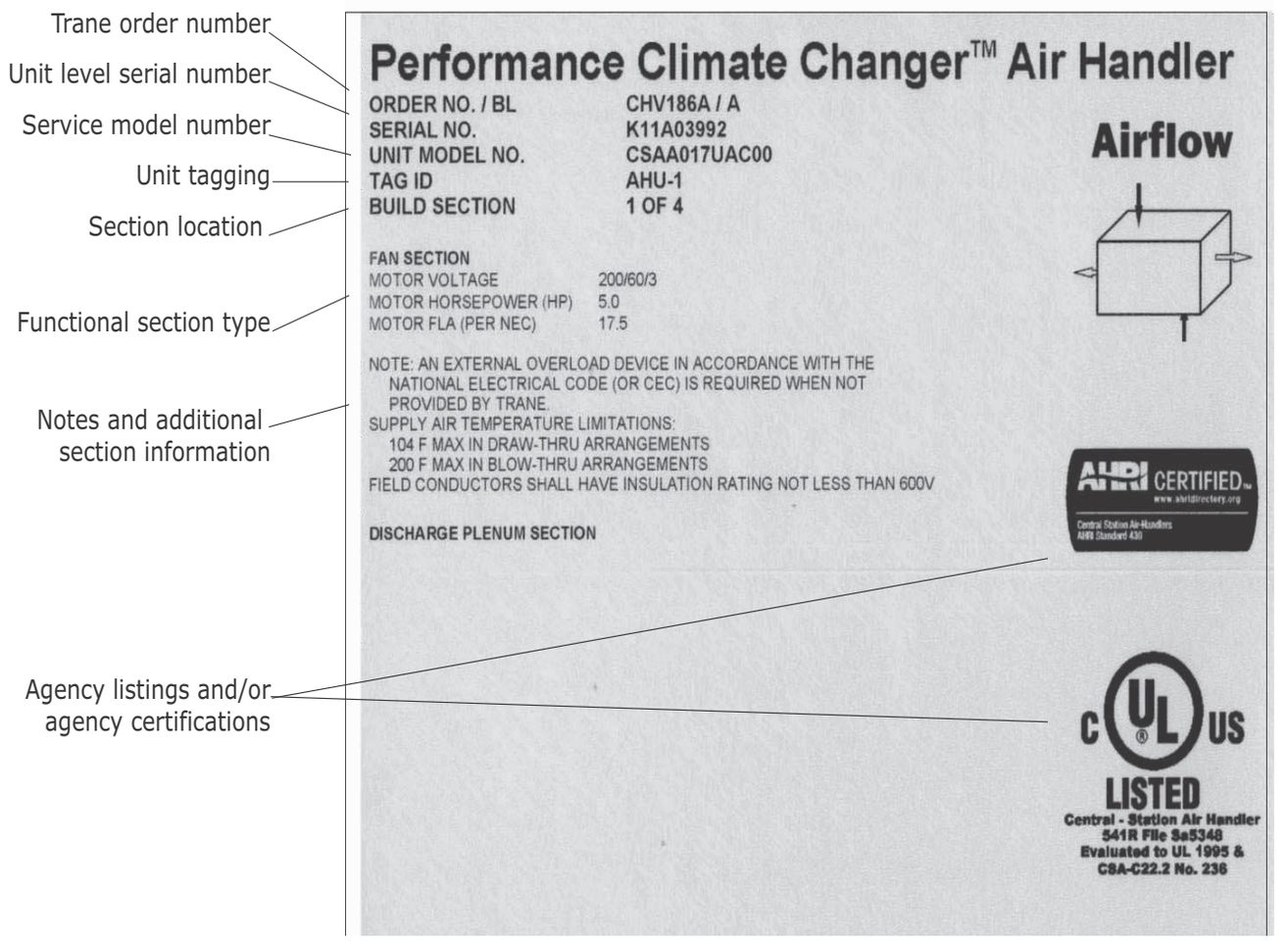
Use this manual to install, startup, operate, and maintain the Performance Climate Changer™ air handler model CSAA. Carefully review the procedures discussed in this manual to minimize installation and startup difficulties.

## Nameplate

Each Performance air handler section includes one or more nameplate/label (see Figure 1), which identifies the type of section and functional components, customer tagging information, the unit serial number, the unit order number, the build-section position for installation, and the unit model number.

*Note: The unit serial number and order number is required when ordering parts or requesting service for a Trane air handler.*

**Figure 1. Performance air handler section nameplate**



# General Information

## Operating Environment

The Performance Climate Changer™ air handler is a central station air handler for indoor and outdoor applications. When considering the placement of the air handler, it is important to consider the operating environment. The acceptable ambient temperature range for unit operation is -40ºF to 140ºF (-40ºC to 60ºC).

For heating applications, a special motor may be required to withstand the higher temperatures. Motors with Class B insulation are acceptable for ambient temperatures up to 104º F, while motors with Class F insulation can withstand ambient temperatures to +140º F (60º C).

*Note: Units with UL approval have a maximum ambient temperature requirement of 104ºF. The customer should provide adequate freeze protection for the coils. See "Routine Maintenance," p. 133 for more information.*

## Unit Description

The Performance Climate Changer air handler is designed for a variety of controlled-air applications. The basic unit consists of a fan, heating and/or cooling coils, filters, and dampers.

Trane air handlers ship as complete assemblies or in sub-assemblies if shipping splits are required. Some assembly is required when the unit ships in subassemblies.

A wide variety of components is available for Trane air handlers, including numerous fan, coil, and filter options, access sections, diffusers, discharge plenums, face-and-bypass sections, UL-approved electric heat sections, humidifiers, mixing boxes, moisture eliminator sections, exhaust dampers, controls, blenders and airflow monitoring stations.

For more information, refer to the following documents, available from your local Trane sales engineer:

- CLCH-PRC022A-EN, Performance Climate Changer™ Air Handler catalog
- CLCH-PRC023A-EN, Performance Climate Changer™ Air Handler dimensions
- CLCH-PRC016-EN, Performance Climate Changer™ Air Handler quick select
- CLCH-SVN05A-EN, Roof Curbs for Performance Climate Changer™ Air Handlers installation instructions
- CLCH-PRG003-EN, Performance Climate Changer™ Air handler guide specifications
- CLCH-SLB017-EN, Performance Climate Changer™ Air Handler sales brochure
- CLCH-SVX08A-EN, Gas Heat in Performance Climate Changer™ Air Handlers installation, operation, and maintenance guide
- COIL-SVX01A-EN, Coils installation, operation, and maintenance guide

### Factory-Mounted Controls

Trane air handlers are available with a wide selection of factory-mounted controls, including controllers, motor starters, and variable frequency drives (VFD).

Most control components are mounted inside the unit. Depending on the system configuration, this may include damper actuators, dirty filter switches, averaging temperature sensors, and low limit switches. VFDs, starters, controllers, control transformers, static pressure transducers, DC power supplies, and customer interface relays will be in enclosures mounted on the inside of the unit.

Small items that cannot be factory-mounted, such as space temperature sensors, outside air temperature sensors, and humidity sensors, will ship inside the control enclosures, or packaged and shipped inside the fan or mixing box section. Larger items are shipped inside the fan section.

*Note: All control valves ship directly to the "ship-to address" from the vendor unless another address is given on the Trane sales order.*

All factory-mounted control systems (controls that are factory-wired to a unit controller or termination strip) ordered without starters or variable-frequency drives (VFDs) are provided with 120 to 24 Vac control transformers mounted and wired in the auxiliary control panel. The customer must provide 120 Vac control power, 50/60 Hz, typically 3 amps for unit sizes 3 to 57 and 5 amps for unit sizes 66 to 100. A dedicated 15-amp circuit is recommended.

Factory-mounted control systems ordered with factory-mounted starters or VFDs are supplied with line to 24 Vac control transformers. No additional power wiring is required.

### Pre-Packaged Solutions for Controls

If the air handler has been selected using one of Trane's pre-packaged solutions options for controls, there are a number of resources available to aid in commissioning and start-up of the unit. These resources include commissioning sheets, graphics and technical application notes. The technical application notes include the control sequencing, Trane Graphic Programming (TGP) and Rover set-up files for the specific unit selected. These resources are available through your local Trane sales office.

For more information on controls, refer to the following manuals:

- Programmable UC600 controllers
  - BAS-SVX45C-EN, Installation, Operation, and Maintenance Tracer UC600 Programmable Controller
  - X39641178-01D, UC600 Installation Instructions
  - X39641191-01A, Installing the Tracer TD7 Display
  - BAS-SVX50C-EN, Tracer TD7 Display for the Tracer UC600 Programmable Controller Installation, Operation, and Maintenance Guide
- TR150 Drives
  - BAS-SVX59A-EN TR150 Design Guide
  - BAS-SVP16A-EN TR150 Programming Guide

## Wiring

**⚠WARNING**

**Proper Field Wiring and Grounding Required!**

**All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Failure to follow code could result in death or serious injury.**

Entrances are generally provided for field-installation of high and low voltage wiring through a pipe/nipple connection in the unit depending on unit configuration with or without factory-mounted controls. Before installation, consider overall unit serviceability and accessibility before mounting, running wires (power), making penetrations, or mounting any components to the cabinet.

Wiring to the air handler must be provided by the installer and must comply with all national and local codes. The fan motor nameplate includes a wiring diagram. If there are any questions concerning the wiring of the motor, write down the information on the motor nameplate and contact your local Trane sales office.

# Pre-Installation

## Receiving and Handling

### Inspection

Upon delivery, thoroughly inspect all components for any shipping damage that may have occurred, and confirm that the shipment is complete. See "Receiving Checklist" section for detailed instructions.

*Note: Delivery cannot be refused. All units are shipped F.O.B. factory. Trane is not responsible for shipping damage.*

### Packaging/Shipping

Performance air handlers ship as a complete unit or in individual sections to be field assembled. Indoor air handler sections are stretch-wrapped or shrink-wrapped before shipping. All factory shipping protection should be removed upon delivery. This wrapping is for transit protection only.

Indoor Performance air handlers ship in subassemblies if the total length of the units exceeds 98 inches or if the total weight exceeds the limits shown in Table 1.

*Note: These limits are based on a four-point lift.*

**Table 1. Shipping length and weight limitations for indoor air handlers**

| Unit Size | Maximum Unit Weight (lb.) | Maximum Unit Length (in) |
|---|---|---|
| 3–31 | <2,500 | 98 |
| 35, 36 | <3,900 | 98 |
| 40, 41 | <4,300 | 98 |
| 50–58 | <5,100 | 98 |
| 66-120 | <8000 | 98 |

Outdoor Performance air handler sections are not wrapped, but openings are covered to comply with LEED EQ Credit 5.

Table 2 outlines weight and length shipping limits for outdoor air handler sections.

**Table 2. Shipping length and weight limitations for outdoor air handlers**

| Unit Size | Minimum Length (in.) | Maximum Length (in.) | Maximum Weight (lb.) |
|---|---|---|---|
| 3–31 | 24.50 | 360.00 | 8,000 |
| 35-58 | 24.50 | 96.00[1] | 12,000 |
| 66-120 | 24.50 | 96.00[1] | 12,000 |

**Notes:** [1]Some specialty sections can be attached to the adjacent section even if this causes length to be greater than 96 inches, up to 118.44 inches.

Smaller components and hardware may be shipped separately, or shipped inside the unit. This hardware is typically packaged in a clear plastic envelope or cardboard box, and can be found inside the fan, mixing box, or access section.

### Identification

Each air handler section includes a nameplate identifying the section type and functional components, customer tagging information, unit serial number, unit order number, the build-section position for installation, and the unit model number. See "Nameplate" on page 4.

### Handling

Air handlers have an integral base frame designed with the necessary number of lift points for safe installation. See "Lifting and Rigging" on page 20.

Indoor air handlers sizes 3-30 are shipped with a shipping skid designed for forklift transport.

### Receiving Checklist

Complete the following checklist immediately after receiving shipment to detect possible shipping damage.

- ☐ Check to ensure that the shipment is complete. Small components may ship inside the unit or ship separately. Check the parts list to ensure all materials are present. If any component is missing, contact your local Trane sales office.
- ☐ Check all units, components, connections, and piping. Check fan wheel for free rotation by spinning manually. Check all doors, latches and hinges. Inspect interior of each unit or section. Inspect coils for damage to fin surface and coil connections. Check for rattles, bent corners, or other visible indications of shipping damage. Tighten loose connections.
- ☐ If a unit is damaged, make specific notations concerning the damage on the freight bill. Do not refuse delivery.
- ☐ Notify the carrier's terminal of the damage immediately by phone and mail. Request an immediate joint inspection of the damage by the carrier and consignee.
- ☐ Notify your Trane sales representative of the damage and arrange for repair. Do not attempt to repair the unit without consulting the Trane representative.
- ☐ Inspect the unit for concealed damage as soon as possible after delivery. Report concealed damage to the freight line. It is the receiver's responsibility to provide reasonable evidence that concealed damage did not occur after delivery. Take photos of damaged material if possible.

  *Note: Concealed damage must be reported within 15 days of receipt.*

# Jobsite Storage

Indoor air handlers and field-installed accessories must be protected from the elements. A controlled indoor environment is recommended for proper storage.

*Note: All factory shipping protection should be removed, This wrapping is for transit protection only.*

The unit controller and all other electrical/electronic components should be stored in conditions of -20°F to 120°F and 5 to 95 percent relative humidity, non-condensing. Electrical components are not moisture-tolerant.

Outdoor units require no special protection for storage prior to installation.

## Outdoor Storage

**NOTICE:**

**Corrosion!**

**Use only canvas tarps to cover air handlers. Plastic tarps can cause condensation to form in and on the equipment, which could result in corrosion damage or wet storage stains.**

Outdoor storage is not recommended for units that will be installed indoors. However, when outdoor storage is necessary, several things must be done to prevent damage:

*Note: Keep the equipment on the original wooden blocks/ skid for protection and ease of handling.*

- Select a well-drained area, preferably a concrete pad or blacktop surface.
- Place the unit on a dry surface or raised off the ground to assure adequate air circulation beneath the unit and to assure no portion of the unit will contact standing water at any time.
- Loosen the belt tension on the drive belts.
- Cover the unit securely with a canvas tarp.
- Do not stack units.
- Do not pile other material on the unit.

## Long-Term Storage

For longer periods of storage, allow proper clearance around the unit to perform periodic inspections and maintenance on the equipment. While the unit is in storage:

- Every two weeks, rotate the fan and motor shaft 30 revolutions by hand. Check for free rotation.
- Every six months, check fan shaft bearings and grease lines. Add grease using a manual grease gun following the lubrications recommendations in “Fan Bearing Lubrication” on page 147.
- Check the motor lubrication; remove and clean grease plugs and check for the presence of moisture in the grease. If moisture is present, remove the motor and send it to an authorized repair shop for bearing inspection/replacement. If no moisture if present, refer to the motor manufacturer’s lubrication recommendation for proper lubrication.

# Site Preparation

- Ensure the installation site can support the total weight of the unit (see “Dimensions and Weights” on page 10 for approximate section weights; refer to the unit submittals for actual weights).
- Allow sufficient space for adequate free air and necessary service access (see “Service Clearances” on page 10). Refer to submittals for specific minimums.
- Allow room for supply and return piping, ductwork, electrical connections, and coil removal.
- Ensure there is adequate height for condensate drain requirements. See “Drain Pan Trapping” on page 93.

*Note: If unit is installed in a mechanical room on a pad, inadequate height may necessitate core-drilling the floor to attain proper trap height. Insufficient height could inhibit condensate drainage and result in flooding the unit and/or equipment room.*

**NOTICE:**

**Microbial Growth!**

**The floor or foundation must be level and the condensate drain at the proper height for proper coil drainage and condensate flow. Standing water and wet surfaces inside the equipment can become an amplification site for microbial growth (mold), which could cause odors and damage to the equipment and building materials.**

- Confirm the roof curb or foundation of the mounting platform is level and large enough to accommodate the unit. Refer to the unit submittals for specific dimensions.
- Provide adequate lighting for maintenance personnel to perform maintenance duties.
- Provide permanent power outlets in close proximity to the unit for installation and maintenance.
- Depending upon job requirements, 120 Vac power may need to be provided for the unit controller. Refer to submittals for more information. A dedicated 15-amp circuit is recommended.
- Wiring for the air handler must be provided by the installer and must comply with all national and local electrical codes.
- If the unit integral base frame ceiling suspension provisions are not used, the installer/contractor must provide a ceiling-suspended mounting frame

designed to support the length, width, and weight of the entire air-handling unit. See "Ceiling Suspension" on page 25 for more information.

- Rooftop curb-mounted units must be sealed tightly to the curb. Use proper sealants and roof-to-curb sealing techniques to prevent water and air leakage. Refer to CLCH-SVN05A-EN Roof Curbs for Performance Climate Changer™ Air Handlers Installation Instructions.

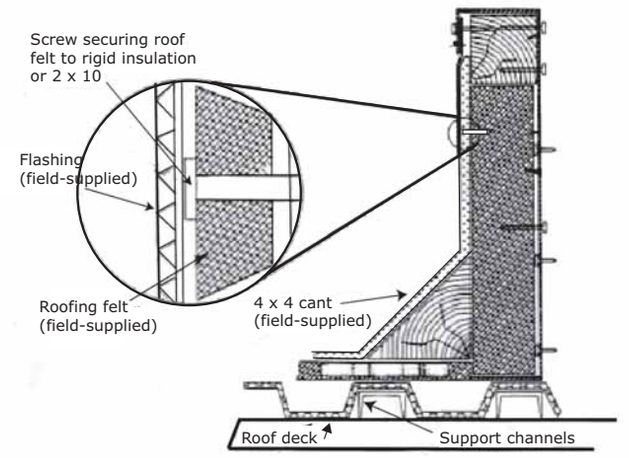
*Note: Preparation of the roof curb or pier mount and roof openings should be completed prior to lifting the unit to the roof.*

# Roof Curb Installation Checklist

See CLCH-SVN05A-EN Roof Curbs for Performance Climate Changer™ Air Handlers Installation Instructions for information on installing roof curbs.

It is recommended that the curb be installed directly on the support members and fastened to the supports using tack welds or other equivalent methods. Properly supported decking should be installed inside the air handler section of the curb when this method is used. See Figure 2.

**Figure 2. Cross section of typical curb installation on new construction**




1. Verify that the roof structure can adequately support the combined weight of the unit and curb assembly.
2. Ensure that the selected installation location provides sufficient service and operational clearances.
3. Remove any twist within the curb due to roof supports and square the curb.
4. Level the curb.
5. Secure the curb to the roof support members.
6. Install 2-inch thick boards or rigid insulation around the curb.
7. Install cant strips around the curb.
8. Bring field supplied roofing felt up to the top of the curb nailing strips. Nail felt into place.
9. Install field supplied flashing under the lip of the curb flanges and over the felt.
10. Apply sealant to the four corners.
11. Caulk all joints between the curb and the roof. Attach the gasket material to the curb's top flanges (entire perimeter) and to the supply and return air duct opening panel flanges.

# Dimensions and Weights

## Service Clearances

A minimum clearance of the section width plus 12 inches on the access door side of the gas heat section is recommended for routine maintenance. This clearance provides enough room to replace the heat exchanger in the event of failure. The section side panels must be removed to access the heat exchanger. Refer to Table 3 for service clearance recommendations for the air handler.

**Figure 3. Service Clearance**

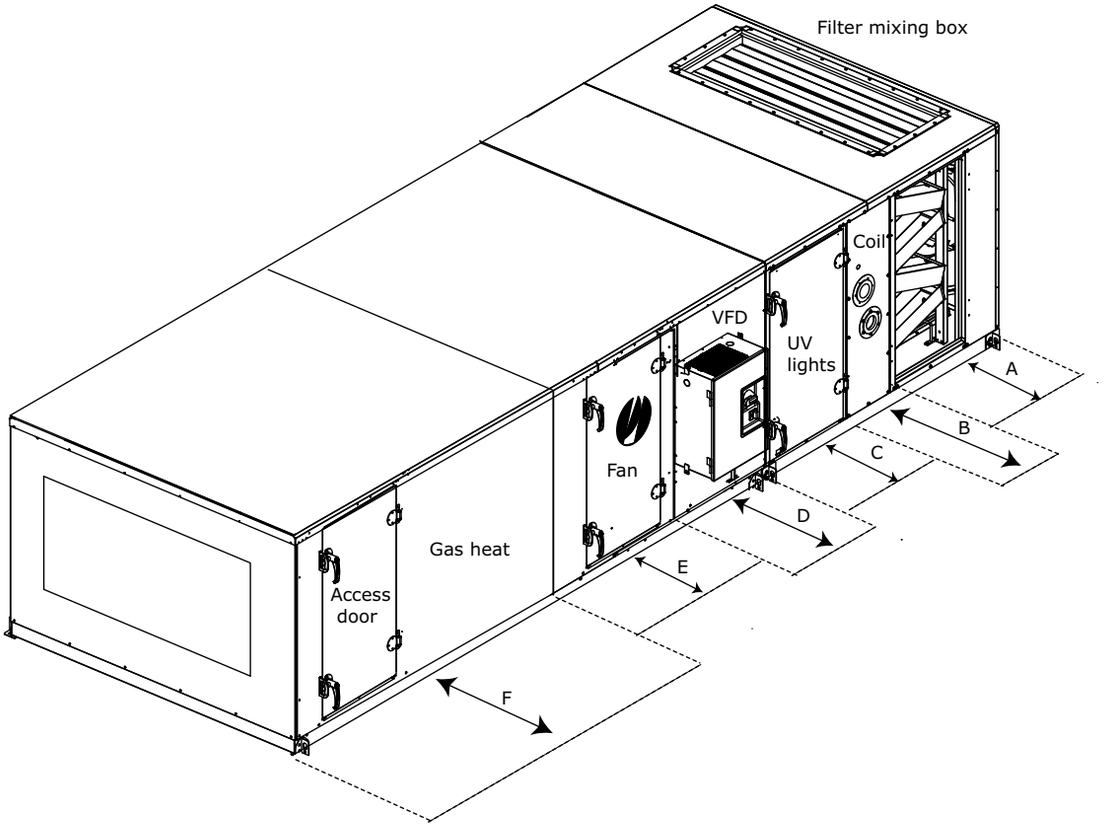



**Table 3. Service clearance dimensions (inches)**

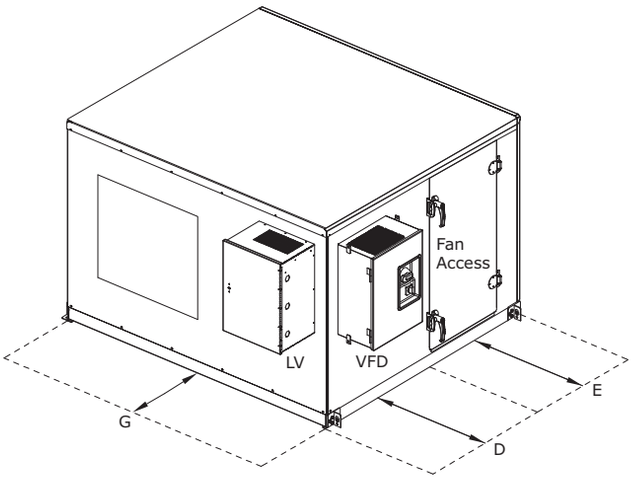
| Component | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 17 | 21 | 22 | 25 | 26 | 30 | 31 | 35 | 36 | 40 | 41 | 50 | 51 | 57 | 58 | 66 | 80 | 100 | 120 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A (filter) | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 52 | 56 | 58 | 58 |
| B (coil) | 48 | 59 | 59 | 66 | 77 | 82 | 87 | 87 | 95 | 77 | 95 | 77 | 109 | 87 | 115 | 96 | 128 | 96 | 141 | 110 | 141 | 110 | 156 | 156 | 170 | 197 |
| C (UV Lights) | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 52 | 56 | 58 | 58 |
| C (Catalytic Air Cleaner) | 43 | 59 | 59 | 63 | 75 | 81 | 83 | 83 | 58 | 75 | 58 | 75 | 83 | 83 | 75 | 59 | 83 | 83 | 83 | 83 | 83 | 83 | 83 | 83 | 75 | 83 |
| D (external starter or VFD or LV box) | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 |
| D (internal starter or VFD) | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 |
| E (fan) | 48 | 48 | 48 | 48 | 51 | 54 | 58 | 61 | 60 | 51 | 66 | 51 | 66 | 58 | 66 | 60 | 70 | 60 | 77 | 66 | 77 | 66 | 93 | 93 | 101 | 101 |
| F (gas heat - Ext Vestibule) | n/a | n/a | 89 | 90 | 108 | 100 | 100 | 105 | 115 | n/a | 115 | n/a | 118 | n/a | 136 | n/a | 140 | n/a | 156 | n/a | 156 | n/a | 170 | 179 | 180 | n/a |
| F (gas heat - Int Vestibule) | n/a | n/a | 56 | 63 | 74 | 79 | 84 | 84 | 92 | n/a | 92 | n/a | 106 | n/a | 112 | n/a | 125 | n/a | 138 | n/a | 138 | n/a | 153 | 153 | 167 | 194 |

### Table 3. Service clearance dimensions (inches)

**Note:** At a minimum, the above clearance dimensions are recommended on one side of the unit for regular service and maintenance. Refer to as-built submittal for locations of items such as filter access doors, coil, piping connections, motor locations, hoods, pipe cabinets, etc. Sufficient clearance must be provided on all sides of unit for removal of access panels, plug panels, or section-to-section attachment brackets. Clearance for starters, VFDs, or other high-voltage devices must be provided per NEC requirements.

**Note:** For specific dimensional and weight information, refer to the unit submittals. The dimensions and weights in this manual are approximate. Trane has a policy of continuous product and product data improvement and reserves the right to change design and specifications without notice.

### Figure 4. Service clearance for control box




### Table 4. Service clearance dimensions (inches) for control box

| HV Component | LV Component | | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 17 | 21 | 22 | 25 | 26 | 30 | 31 | 35 | 36 | 40 | 41 | 50 | 51 | 57 | 58 | 66 | 80 | 100 | 120 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Starter or VFD | None | G | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| 18 point terminal strip | None | G | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| >18 point terminal strip | None | G | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| None | 18 point terminal strip | G | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 |
| None | >18 point terminal strip | G | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |

# Section Dimensions and Weights

**Table 5. Section dimensions (inches) and weights (pounds) - unit sizes 3-30**

| **Nominal airflow** | 1500 | 2000 | 3000 | 4000 | 5000 | 6000 | 7000 | 8500 | 10,500 | 11,000 | 12,500 | 13,000 | 15,000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Airflow at 625 fpm** | 2169 | 3475 | 4338 | 4581 | 6075 | 8331 | 9025 | 11,806 | 13,456 | 13,194 | 16,944 | 18,231 | 19,025 |
| **Unit size** | **3** | **4** | **6** | **8** | **10** | **12** | **14** | **17** | **21** | **22** | **25** | **26** | **30** |
| **Height** - indoor unit | 29.00 | 29.00 | 35.25 | 37.75 | 37.75 | 41.50 | 41.50 | 49.00 | 52.75 | 67.25 | 61.50 | 85.50 | 61.50 |
| **Width** | 31.50 | 44.00 | 44.00 | 50.50 | 61.50 | 66.50 | 72.00 | 72.00 | 80.00 | 61.50 | 80.00 | 61.50 | 93.50 |
| **Height for outdoor unit** includes base drip lip | 36.25 | 36.38 | 42.63 | 45.13 | 45.13 | 49.25 | 49.25 | 56.75 | 60.50 | n/a | 69.25 | n/a | 69.25 |
| **Weight add for outdoor unit** (lbs/in. of unit length) | 1.66 | 1.91 | 1.91 | 2.04 | 2.27 | 2.40 | 2.51 | 2.51 | 2.68 | n/a | 2.68 | n/a | 2.94 |
| **Access or blank** | | | | | | | | | | | | | |
| -Small horizontal | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | 48.05 | 57.43 | 60.55 | 66.67 | 74.92 | 80.55 | 84.67 | 88.41 | 96.28 | 89.63 | 100.65 | 98.73 | 110.78 |
| -Medium horizontal | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 |
| | 59.91 | 71.18 | 75.25 | 82.74 | 92.66 | 99.61 | 104.57 | 109.45 | 119.10 | 111.84 | 124.79 | 123.71 | 136.97 |
| -Extended-medium horizontal | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 |
| | 74.73 | 88.37 | 93.62 | 102.82 | 114.83 | 123.43 | 129.44 | 135.74 | 147.62 | 139.60 | 154.97 | 154.93 | 169.71 |
| -Medium-large horizontal | 24.50 | 24.50 | 24.50 | 26.50 | 26.50 | 26.50 | 26.50 | 24.50 | 24.50 | 26.50 | 24.50 | 26.50 | 24.50 |
| | 121.60 | 107.28 | 113.84 | 132.94 | 148.08 | 159.18 | 166.74 | 164.66 | 178.99 | 170.14 | 188.17 | 189.27 | 205.72 |
| -Large horizontal or turning | 34.00 | 34.00 | 34.00 | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 34.00 | 36.00 | 46.00 | 46.00 | 46.00 |
| | 137.75 | 164.85 | 179.46 | 208.50 | 235.01 | 257.70 | 271.35 | 293.42 | 314.60 | 315.97 | 413.45 | 428.50 | 457.18 |
| -Extra-large horizontal or turning | 36.00 | 41.00 | 41.00 | 44.00 | 42.50 | 42.50 | 42.50 | 44.00 | 50.25 | 50.25 | 56.50 | 56.50 | 56.50 |
| | 143.68 | 188.92 | 205.18 | 240.63 | 263.83 | 288.68 | 303.68 | 335.49 | 407.29 | 395.09 | 476.83 | 494.06 | 525.93 |
| **-Ducted inlet or ducted outlet section** | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | 48.10 | 57.40 | 60.50 | 66.70 | 74.90 | 80.50 | 84.70 | 88.40 | 96.30 | 89.60 | 100.60 | 98.70 | 110.80 |
| **Blender** | 19.00 | 24.50 | 24.50 | 26.50 | 36.00 | 36.00 | 36.00 | 36.00 | 34.00 | 30.500 | 46.00 | 36.00 | 46.00 |
| | 94.86 | 132.71 | 146.30 | 173.34 | 238.64 | 264.12 | 276.73 | 303.71 | 323.59 | 300.15 | 427.13 | 385.06 | 470.25 |
| **Cool Dry Quiet (CDQ) Desiccant Dehumidification** | 52.00 | 52.00 | 52.00 | 52.00 | 55.00 | 58.00 | 58.00 | 58.00 | 56.00 | n/a | 56.00 | n/a | 58.00 |
| | 495.00 | 651.00 | 694.00 | 792.00 | 1011.00 | 1165.00 | 1326.00 | 1390.00 | 1793.00 | | 1876.00 | | 2029.00 |
| **Coils** | | | | | | | | | | | | | |
| -Small horizontal (with 4-row UW) | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | 116.10 | 148.55 | 174.35 | 205.79 | 244.49 | 285.13 | 307.44 | 352.47 | 433.37 | 433.22 | 502.46 | 523.01 | 572.50 |
| -Medium horizontal (with 8-row UW) | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 |
| | 168.65 | 220.23 | 265.58 | 318.97 | 382.53 | 450.07 | 488.32 | 569.79 | 700.27 | 690.67 | 817.63 | 840.58 | 941.48 |
| -Extended-medium horizontal (with 8-row UW) | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 |
| | 185.58 | 239.53 | 286.06 | 341.16 | 406.80 | 476.00 | 516.35 | 599.24 | 737.96 | 721.58 | 858.03 | 878.74 | 985.30 |
| -Medium-large horizontal (with 10-row W) | 24.50 | 24.50 | 24.50 | 26.50 | 26.50 | 26.50 | 26.50 | 24.50 | 24.50 | 26.50 | 24.50 | 26.50 | 24.50 |
| | 270.61 | 359.79 | 433.08 | 554.88 | 656.63 | 777.26 | 884.93 | 1013.57 | 1262.10 | 1175.58 | 1478.66 | 1503.93 | 1503.93 |
| -Large horizontal or vertical (with 10-row W) | 34.00 | 34.00 | 34.00 | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 34.00 | 36.00 | 46.00 | 46.00 | 46.00 |
| | 302.77 | 396.45 | 471.99 | 597.03 | 702.74 | 826.53 | 938.18 | 1081.30 | 1333.70 | 1234.32 | 1652.36 | 1652.73 | 1652.73 |
| **-Electric Heat Coil** | 36.00 | 41.00 | 41.00 | 44.00 | 42.50 | 42.50 | 42.50 | 44.00 | 50.25 | n/a | 46.00 | n/a | 56.50 |
| | 295.00 | 364.00 | 413.00 | 480.00 | 563.00 | 622.00 | 666.00 | 731.00 | 876.00 | | 1012.00 | | 1244.00 |
| **Integral-face-and-bypass coil** | | | | | | | | | | | | | |
| -Less than 4 rows | n/a | 26.50 | 26.50 | 26.50 | 26.50 | 26.50 | 26.50 | 26.50 | 26.50 | 26.50 | 26.50 | 26.50 | 26.50 |
| | n/a | 355.20 | 367.21 | 470.21 | 541.93 | 585.86 | 619.66 | 733.14 | 792.88 | 858.31 | 805.52 | 1047.84 | 940.46 |
| -4 rows | n/a | 43.00 | 43.00 | 43.00 | 43.00 | 43.00 | 43.00 | 43.00 | 43.00 | 43.00 | 43.00 | 43.00 | 43.00 |
| | n/a | 543.54 | 560.74 | 725.48 | 835.34 | 901.70 | 950.23 | 1131.90 | 1216.48 | 1313.83 | 1399.66 | 1613.03 | 1439.40 |

**Table 5. Section dimensions (inches) and weights (pounds) - unit sizes 3-30**

| Unit size | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 17 | 21 | 22 | 25 | 26 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Controls section** (includes largest available VFD) | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 |
| | 184.00 | 208.00 | 253.00 | 272.00 | 295.00 | 315.00 | 327.00 | 350.00 | 428.00 | 419.00 | 453.00 | 464.00 | 487.00 |
| **Diffuser** | 10.00 | 10.00 | 10.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 19.00 | 19.00 | 19.00 |
| | 45.70 | 55.08 | 58.20 | 80.39 | 90.31 | 97.26 | 102.22 | 107.10 | 116.75 | 109.49 | 152.62 | 152.58 | 167.36 |
| **Discharge plenum** | | | | | | | | | | | | | |
| -Horizontal | 34.00 | 34.00 | 34.00 | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 34.00 | 36.00 | 46.00 | 46.00 | 46.00 |
| | 135.40 | 162.50 | 177.11 | 206.15 | 232.66 | 255.35 | 269.00 | 291.07 | 312.25 | 313.62 | 411.10 | 426.15 | 454.83 |
| -Vertical | 36.00 | 41.00 | 41.00 | 44.00 | 42.50 | 42.50 | 42.50 | 44.00 | 50.25 | n/a | 56.50 | n/a | 56.50 |
| | 159.90 | 211.48 | 233.54 | 275.69 | 306.29 | 339.58 | 358.68 | 401.43 | 486.37 | | 570.00 | | 634.27 |
| **Energy Wheel** | n/a | 52.00 | 52.00 | 52.00 | 55.00 | 58.00 | 58.00 | 58.00 | 56.00 | n/a | 56.00 | n/a | 58.00 |
| | | 609.00 | 663.00 | 765.00 | 911.00 | 1085.00 | 1208.00 | 1269.00 | 1484.00 | | 1595.00 | | 1868.00 |
| **Face-and-Bypass Dampers** | | | | | | | | | | | | | |
| -Face-and-bypass | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 |
| | 105.60 | 129.06 | 141.70 | 157.63 | 178.68 | 199.15 | 209.53 | 224.50 | 248.05 | 137.25 | 265.62 | 152.58 | 291.36 |
| -External face-and-bypass | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 22.00 | 19.00 | 27.75 | 19.00 |
| | 122.68 | 155.15 | 167.79 | 190.70 | 219.68 | 241.45 | 255.80 | 270.77 | 300.08 | 153.91 | 317.53 | 207.22 | 353.22 |
| -Internal face-and-bypass or face damper only | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 |
| | 107.95 | 140.46 | 149.91 | 174.82 | 203.43 | 227.60 | 241.91 | 255.18 | 291.55 | 137.25 | 306.62 | 152.58 | 341.36 |
| **Fan** | | | | | | | | | | | | | |
| -Belt-drive plenum fan with motor | 36.00 | 41.00 | 41.00 | 44.00 | 42.50 | 42.50 | 42.50 | 44.00 | 50.25 | n/a | 56.50 | n/a | 56.50 |
| | 397.87 | 538.34 | 631.36 | 682.55 | 875.00 | 951.91 | 1069.39 | 1239.89 | 1443.56 | | 1494.52 | | 1751.34 |
| -Housed FC fan with motor | 36.00 | 41.00 | 41.00 | 44.00 | 42.50 | 42.50 | 42.50 | 44.00 | 50.25 | 50.25 | 56.50 | 56.50 | 56.50 |
| | 368.77 | 449.75 | 544.28 | 589.00 | 721.69 | 882.15 | 904.21 | 1054.64 | 1329.38 | 1295.80 | 1487.55 | 1511.37 | 1710.85 |
| -Housed AF/BC fan with motor | 36.00 | 41.00 | 41.00 | 44.00 | 42.50 | 42.50 | 42.50 | 44.00 | 50.25 | 50.25 | 56.50 | 56.50 | 56.50 |
| | 378.87 | 467.35 | 574.68 | 649.40 | 849.71 | 920.08 | 942.14 | 1098.21 | 1432.10 | 1444.53 | 1572.28 | 1609.10 | 1797.21 |
| -Direct-drive plenum fan with motor | 36.00 | 41.00 | 41.00 | 44.00 | 42.50 | 42.50 | 42.50 | 44.00 | 50.25 | 50.25 | 56.50 | 56.50 | 56.50 |
| | 373.16 | 516.35 | 535.05 | 692.86 | 795.54 | 912.52 | 936.26 | 991.99 | 1380.92 | 1237.09 | 1541.05 | 1600.04 | 1652.91 |
| **Filters** | | | | | | | | | | | | | |
| -Side load 2-in. angled | 24.50 | 24.50 | 24.50 | 26.50 | 26.50 | 26.50 | 26.50 | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 |
| | 134.55 | 163.83 | 175.66 | 202.44 | 225.96 | 251.82 | 265.94 | 314.12 | 347.50 | 348.70 | 403.70 | 418.53 | 454.19 |
| -Side load 4-in. angled | 24.50 | 24.50 | 24.50 | 26.50 | 26.50 | 26.50 | 26.50 | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 |
| | 141.89 | 176.87 | 192.86 | 209.64 | 247.16 | 254.22 | 273.54 | 352.07 | 379.13 | 361.27 | 409.37 | 470.37 | 465.65 |
| -Side load cartridge 12-in. or short bag 18-in. | 24.50 | 24.50 | 24.50 | 26.50 | 26.50 | 26.50 | 26.50 | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 |
| | 125.03 | 159.79 | 176.46 | 220.46 | 234.88 | 284.12 | 303.60 | 335.02 | 365.40 | 342.50 | 439.69 | 440.65 | 479.36 |
| -Side load 2-in. flat | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 |
| | 70.27 | 86.53 | 91.98 | 103.59 | 117.74 | 133.81 | 141.07 | 148.02 | 165.52 | 160.19 | 182.07 | 177.12 | 198.93 |
| -Side load 4-in. flat | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 |
| | 81.56 | 104.62 | 114.08 | 117.09 | 143.40 | 142.66 | 154.67 | 202.82 | 213.64 | 189.17 | 217.75 | 254.10 | 249.73 |
| -Side load 2-in. and 4-in. combination flat | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 |
| | 100.62 | 128.19 | 139.09 | 144.56 | 174.73 | 185.69 | 201.37 | 252.57 | 268.17 | 252.01 | 288.98 | 326.16 | 326.58 |
| -Long bag 30-in. | 36.00 | 41.00 | 41.00 | 44.00 | 42.50 | 42.50 | 42.50 | 44.00 | 50.25 | 50.25 | 46.00 | 40.00 | 46.00 |
| | 159.54 | 203.31 | 223.70 | 269.26 | 289.43 | 330.97 | 349.19 | 382.94 | 461.96 | 395.90 | 488.89 | 462.06 | 523.37 |
| -Front-load HEPA | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 |
| | 240.36 | 262.50 | 346.16 | 368.01 | 407.75 | 439.62 | 452.92 | 569.28 | 692.30 | 595.47 | 750.47 | 837.36 | 822.10 |
| -Front-load cartridge | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 |
| | 215.15 | 237.79 | 285.59 | 310.12 | 341.11 | 386.04 | 399.01 | 470.25 | 525.86 | 468.47 | 580.13 | 552.53 | 651.47 |
| -Front-load short bag | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 |
| | 222.35 | 246.75 | 279.75 | 306.39 | 335.16 | 369.65 | 383.67 | 432.15 | 473.60 | 487.79 | 518.05 | 573.98 | 566.55 |

### Table 5. Section dimensions (inches) and weights (pounds) - unit sizes 3-30

| Unit size | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 17 | 21 | 22 | 25 | 26 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gas heat** | | | | | | | | | | | | | |
| - 200 MBH | n/a | n/a | 57.00<br>752.92 | 57.00<br>797.85 | 59.00<br>852.48 | 57.00<br>912.57 | 57.00<br>937.05 | 60.00<br>1011.83 | 60.00<br>1074.91 | n/a | n/a | n/a | n/a |
| - 300 MBH | n/a | n/a | 73.00<br>901.27 | 73.00<br>953.49 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| - 360 MBH | n/a | n/a | n/a | n/a | 77.00<br>1093.23 | 73.00<br>1131.38 | 68.00<br>1127.89 | 71.00<br>1211.08 | 69.00<br>1264.50 | n/a | 69.00<br>1348.04 | n/a | 66.00<br>1298.88 |
| - 560 MBH | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 71.00<br>1191.99 | 69.00<br>1246.59 | n/a | 65.00<br>1307.47 | n/a | 66.00<br>1441.79 |
| - 700 MBH | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 83.00<br>1479.92 | 75.00<br>1503.43 | n/a | 75.00<br>1599.35 | n/a | 76.00<br>1745.65 |
| - 860 MBH | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 81.00<br>1606.36 | n/a | 81.00<br>1711.24 | n/a | 76.00<br>1804.77 |
| - 1000 MBH | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 87.00<br>1364.25 | n/a | 90.00<br>1497.35 | n/a | 85.00<br>1560.01 |
| **Humidifier** | | | | | | | | | | | | | |
| -Building Steam | 14.00<br>125.00 | 14.00<br>146.00 | 14.00<br>165.00 | 14.00<br>184.00 | 14.00<br>226.00 | 14.00<br>269.00 | 14.00<br>286.00 | 14.00<br>324.00 | 14.00<br>354.00 | 14.00<br>368.00 | 14.00<br>398.00 | 14.00<br>500.00 | 14.00<br>452.00 |
| -Atmospheric Steam | 14.00<br>127.00 | 14.00<br>168.00 | 14.00<br>178.00 | 14.00<br>203.00 | 14.00<br>252.00 | 14.00<br>276.00 | 14.00<br>312.00 | 14.00<br>339.00 | 14.00<br>396.00 | 14.00<br>344.00 | 14.00<br>432.00 | 14.00<br>396.00 | 19.00<br>528.00 |
| **Mixing box** | | | | | | | | | | | | | |
| -with angled filters | 34.00<br>137.75 | 34.00<br>164.85 | 34.00<br>179.46 | 36.00<br>208.50 | 36.00<br>235.01 | 36.00<br>257070 | 36.00<br>271.35 | 36.00<br>293.42 | 34.00<br>314.60 | 36.00<br>315.97 | 46.00<br>413.45 | 46.00<br>428.50 | 46.00<br>457.18 |
| -with front/back Traq and top Traq dampers | 36.00<br>191.06 | 41.00<br>247.07 | 41.00<br>272.06 | 44.00<br>321.58 | 42.50<br>356.08 | 42.50<br>396.49 | 42.50<br>418.78 | 44.00<br>463.57 | 50.25<br>555.65 | 51.00<br>549.18 | 56.50<br>646.61 | n/a | 56.50<br>715.15 |
| -reduced length with side/top/ back/bottom airfoil damper | 23.40<br>131.80 | 23.40<br>158.30 | 23.40<br>177.90 | 23.40<br>202.80 | 23.40<br>231.60 | 23.40<br>257.60 | 28.40<br>298.40 | 28.40<br>328.40 | 28.40<br>370.10 | n/a | 28.40<br>408.10 | n/a | 32.50<br>485.80 |
| **Multizone** | | | | | | | | | | | | | |
| - 3-deck vertical discharge | n/a | n/a | 61.00<br>1125.00 | 61.00<br>1313.00 | 66.00<br>1671.00 | 71.00<br>1899.00 | 71.00<br>2063.00 | 71.00<br>2211.00 | 82.00<br>2757.00 | n/a | 82.00<br>2991.00 | n/a | 82.00<br>3425.00 |
| - 2-deck vertical discharge | n/a | n/a | 61.00<br>763.00 | 61.00<br>899.00 | 66.00<br>1099.00 | 71.00<br>1266.00 | 71.00<br>1380.00 | 71.00<br>1526.00 | 82.00<br>1882.00 | n/a | 82.00<br>2108.00 | n/a | 82.00<br>2413.00 |
| -3-deck horizontal discharge | n/a | n/a | 52.00<br>1031.00 | 52.00<br>1219.00 | 52.00<br>1511.00 | 57.00<br>1729.00 | 57.00<br>1892.00 | 57.00<br>2034.00 | 72.00<br>2603.00 | n/a | 72.00<br>2829.00 | n/a | 72.00<br>3267.00 |
| -2-deck horizontal discharge | n/a | n/a | 52.00<br>701.00 | 52.00<br>832.00 | 52.00<br>982.00 | 57.00<br>1145.00 | 57.00<br>1253.00 | 57.00<br>1396.00 | 72.00<br>1755.00 | n/a | 72.00<br>1975.00 | n/a | 72.00<br>2264.00 |
| **Silencer** | | | | | | | | | | | | | |
| -3 ft | 38.00<br>198.00 | 38.00<br>256.00 | 38.00<br>286.00 | 38.00<br>319.00 | 38.00<br>359.00 | 38.00<br>442.00 | 38.00<br>461.00 | 38.00<br>512.00 | 38.00<br>573.00 | 38.00<br>562.00 | 38.00<br>699.00 | 38.00<br>659.00 | 38.00<br>800.00 |
| -5 ft | 62.00<br>308.00 | 62.00<br>391.00 | 62.00<br>436.00 | 62.00<br>483.00 | 62.00<br>541.00 | 62.00<br>678.00 | 62.00<br>704.00 | 62.00<br>780.00 | 62.00<br>873.00 | 62.00<br>858.00 | 62.00<br>1073.00 | 62.00<br>1005.00 | 62.00<br>1215.00 |
| **Trane Catalytic Air Cleaning System (TCACS)** | 36.00<br>334.73 | 36.00<br>367.14 | 36.00<br>389.21 | 36.00<br>434.66 | 36.00<br>470.05 | 36.00<br>497.59 | 36.00<br>514.12 | 36.00<br>544.30 | 36.00<br>599.38 | 36.00<br>690.80 | 36.00<br>665.11 | 36.00<br>777.83 | 36.00<br>711.12 |
| **UV light** | 14.00<br>76.02 | 14.00<br>93.64 | 14.00<br>98.69 | 14.00<br>120.26 | 14.00<br>135.22 | 14.00<br>146.68 | 14.00<br>155.07 | 14.00<br>162.95 | 14.00<br>179.84 | n/a | 14.00<br>188.71 | n/a | 14.00<br>218.33 |

### Table 5. Section dimensions (inches) and weights (pounds) - unit sizes 3-30

| | Sections below are for outdoor units only | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Unit size** | **3** | **4** | **6** | **8** | **10** | **12** | **14** | **17** | **21** | **22** | **25** | **26** | **30** |
| **Diagonal economizer** | | | | | | | | | | | | | |
| -with airfoil dampers | 46.00 | 49.00 | 50.00 | 48.00 | 53.00 | 53.00 | 57.00 | 52.00 | 63.00 | n/a | 57.00 | n/a | 63.00 |
| | 187.00 | 231.00 | 256.00 | 276.00 | 334.00 | 365.00 | 407.00 | 414.00 | 534.00 | | 548.00 | | 649.00 |
| -with airfoil damper and one side Traq damper | 46.00 | 49.00 | 50.00 | 48.00 | 53.00 | 53.00 | 57.00 | 52.00 | 63.00 | n/a | 57.00 | n/a | 63.00 |
| | 204.00 | 247.00 | 271.00 | 290.00 | 349.00 | 378.00 | 426.00 | 431.00 | 555.00 | | 565.00 | | 689.00 |
| **Exhaust damper section for outdoor unit** | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | n/a | 19.00 | n/a | 19.00 |
| | 93.30 | 113.30 | 124.30 | 140.20 | 159.60 | 176.70 | 186.80 | 204.00 | 229.10 | | 250.50 | | 280.40 |
| **Hoods** | | | | | | | | | | | | | |
| -Back inlet hood with airfoil and Traq dampers | 22.25 | 44.00 | 44.00 | 50.38 | 61.50 | 66.38 | 71.88 | 72.00 | 79.88 | n/a | 79.88 | n/a | 93.38 |
| | 22.00 | 45.00 | 47.00 | 47.00 | 52.00 | 69.00 | 74.00 | 74.00 | 74.00 | | 128.00 | | 166.00 |
| -Side inlet hood with airfoil and Traq dampers | 20.00 | 20.00 | 20.00 | 20.00 | 22.88 | 22.88 | 31.38 | 25.75 | 29.13 | n/a | 25.75 | n/a | 27.88 |
| | 17.00 | 17.00 | 22.00 | 22.00 | 31.00 | 42.00 | 50.00 | 50.00 | 50.00 | | 84.00 | | 96.00 |
| -Exhaust hood with airfoil damper | 20.00 | 20.00 | 20.00 | 20.00 | 22.88 | 22.88 | 31.38 | 25.75 | 29.13 | n/a | 25.75 | n/a | 27.88 |
| | 12.00 | 12.00 | 16.00 | 16.00 | 21.00 | 29.00 | 30.00 | 30.00 | 30.00 | | 59.00 | | 67.00 |
| -Economizer inlet hood | 45.50 | 49.00 | 49.50 | 48.00 | 53.00 | 53.00 | 56.50 | 52.00 | 62.50 | n/a | 57.00 | n/a | 62.50 |
| | 41.00 | 37.00 | 45.00 | 61.00 | 68.00 | 76.00 | 137.00 | 174.00 | 179.00 | | 214.00 | | 224.00 |
| **Pipe cabinet weight** | | | | | | | | | | | | | |
| 15 inches long, 36 inches deep | 104.00 | 104.00 | 116.00 | 120.00 | 120.00 | 127.00 | 127.00 | 141.00 | 148.00 | n/a | 164.00 | n/a | 164.00 |
| 24 inches long, 36 inches deep | 122.00 | 122.00 | 135.00 | 140.00 | 140.00 | 147.00 | 147.00 | 162.00 | 170.00 | n/a | 187.00 | n/a | 187.00 |
| 48 inches long, 36 inches deep | 169.00 | 169.00 | 184.00 | 191.00 | 191.00 | 200.00 | 200.00 | 218.00 | 228.00 | n/a | 249.00 | n/a | 249.00 |
| 96 inches long, 36 inches deep | 263.00 | 263.00 | 284.00 | 293.00 | 293.00 | 305.00 | 305.00 | 331.00 | 343.00 | n/a | 373.00 | n/a | 373.00 |

**Note:** [1]Nominal airflow is based on 500 fpm through a nominal coil (i.e. 500xunit size 8=4000 cfm). [2]Airflow@625 fpm through the flat filter (maximum filter velocity). [3]Height includes standard 2.5-inch base frame for sizes 3-57 and 6-inch base frame for sizes 66-120. [4]Height includes 6-inch base frame for sizes 3-120.[5]Variable lengths available from 14-96 inches. [6]Fan section weights include the heaviest fan with the largest ODP motor available. [7]Nominal length and height shown for discharge plenums. Variable plenum height and length is available from 0.5 to 1.5 of nominal. [8]Access section required with humidifiers for dispersion distance.

### Table 6. Section dimensions (inches) and weights (pounds) - unit sizes 31-120

| **Nominal airflow** | 15,500 | 17,500 | 18,000 | 20,000 | 20,500 | 25,000 | 25,500 | 28,500 | 29,000 | 33,000 | 40,000 | 50,000 | 60,000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Airflow at 625 fpm** | 22,138 | 23,263 | 25,000 | 25,519 | 30,138 | 34,375 | 34,306 | 39,581 | 39,722 | 47,225 | 53,475 | 65,106 | 76,388 |
| **Unit size** | **31** | **35** | **36** | **40** | **41** | **50** | **51** | **57** | **58** | **66** | **80** | **100** | **120** |
| **Height** - indoor unit | 85.50 | 67.25 | 89.00 | 67.25 | 104.00 | 75.75 | 104.00 | 85.50 | 116.25 | 92.50 | 107.50 | 119.75 | 119.75 |
| **Width** | 72.00 | 100.00 | 80.00 | 112.50 | 80.00 | 125.50 | 93.50 | 125.50 | 93.50 | 140.50 | 140.50 | 154.50 | 182.00 |
| **Height for outdoor unit** includes base drip lip | n/a | 75.00 | n/a | 75.00 | n/a | 84.38 | n/a | 94.13 | n/a | 97.63 | 112.63 | 124.88 | 124.88 |
| **Weight add for outdoor unit** (lbs/in. of unit length) | n/a | 3.02 | n/a | 3.28 | n/a | 3.73 | n/a | 6.12 | n/a | 2.57 | 2.57 | 2.80 | 3.25 |
| **Access or blank** | | | | | | | | | | | | | |
| -Small horizontal | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | n/a | n/a | n/a | n/a |
| | 106.61 | 211.11 | 207.98 | 227.92 | 224.38 | 254.69 | 242.54 | 265.35 | 255.92 | | | | |
| -Medium horizontal | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 15.00 | 15.00 | 15.00 | 15.00 |
| | 133.18 | 241.53 | 238.68 | 260.24 | 257.35 | 290.28 | 277.55 | 302.41 | 292.80 | 430.36 | 449.60 | 493.59 | 549.13 |
| -Extended-medium horizontal | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 |
| | 166.39 | 279.57 | 277.04 | 300.64 | 298.56 | 334.76 | 321.32 | 348.74 | 338.89 | 476.36 | 497.88 | 545.85 | 605.56 |
| -Medium-large horizontal | 26.50 | 24.50 | 29.50 | 24.50 | 29.50 | 24.50 | 29.50 | 24.50 | 29.50 | 24.50 | 24.50 | 24.50 | 24.50 |
| | 202.93 | 321.40 | 319.24 | 345.09 | 343.89 | 410.37 | 369.46 | 427.50 | 389.59 | 574.11 | 600.46 | 656.89 | 725.47 |
| -Large horizontal or turning | 46.00 | 48.00 | 46.00 | 48.00 | 46.00 | 48.00 | 46.00 | 48.00 | 46.00 | 49.00 | 54.00 | 60.00 | 60.00 |
| | 467.28 | 514.42 | 509.00 | 557.22 | 561.11 | 639.24 | 615.72 | 682.26 | 661.42 | 907.93 | 1036.33 | 1242.40 | 1387.96 |
| -Extra-large horizontal or turning | n/a | 63.75 | n/a | 63.75 | n/a | 68.50 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | | 624.86 | | 675.12 | | 809.42 | | | | | | | |

### Table 6. Section dimensions (inches) and weights (pounds) - unit sizes 31-120

| Unit size | 31 | 35 | 36 | 40 | 41 | 50 | 51 | 57 | 58 | 66 | 80 | 100 | 120 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **-Ducted inlet or ducted outlet section** | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | 106.60 | 211.10 | 208.00 | 227.90 | 224.40 | 254.70 | 242.50 | 265.30 | 255.90 | 372.90 | 389.30 | 428.30 | 478.60 |
| **Blender** | 40.00 | 48.00 | 48.00 | 48.00 | 48.00 | 48.00 | 54.00 | 48.00 | 48.00 | 49.00 | 54.00 | 60.00 | 60.00 |
| | 449.80 | 540.76 | 495.07 | 593.46 | 616.31 | 675.51 | 656.33 | 731.75 | 718.81 | 970.30 | 1112.23 | 1345.03 | 1567.62 |
| **Cool Dry Quiet (CDQ) Desiccant Dehumidification** | n/a | 56.00 | n/a | 56.00 | n/a | 59.00 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | | 2914.00 | | 3122.00 | | 4224.00 | | | | | | | |
| **Coils** | | | | | | | | | | | | | |
| -Small horizontal (with 4-row UW) | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | n/a | n/a | n/a | n/a |
| | 594.43 | 690.59 | 675.23 | 754.61 | 792.51 | 934.27 | 922.65 | 1044.33 | 1014.74 | | | | |
| -Medium horizontal (with 8-row UW) | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 15.00 | 15.00 | 15.00 | 15.00 |
| | 968.56 | 1094.27 | 1095.29 | 1219.78 | 1290.73 | 1561.92 | 1523.08 | 1759.58 | 1686.19 | 2220.94 | 2558.94 | 3094.04 | 3638.44 |
| -Extended-medium horizontal (with 8-row UW) | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 |
| | 1009.31 | 1148.70 | 1138.74 | 1279.06 | 1337.01 | 1613.56 | 1572.75 | 1813.06 | 1738.19 | 2275.46 | 2615.73 | 3163.21 | 3712.02 |
| -Medium-large horizontal (with 10-row W) | 26.50 | 24.50 | 29.50 | 24.50 | 29.50 | 24.50 | 29.50 | 24.50 | 29.50 | 24.50 | 24.50 | 24.50 | 24.50 |
| | 1737.73 | 1955.08 | 2017.86 | 2216.68 | 2355.51 | 2754.49 | 2791.28 | 3215.01 | 3116.00 | 3876.05 | 4488.82 | 5499.42 | 6713.50 |
| -Large horizontal or vertical (with 10-row W) | 46.00 | 48.00 | 46.00 | 48.00 | 46.00 | 48.00 | 46.00 | 48.00 | 46.00 | n/a | n/a | n/a | n/a |
| | 1896.66 | 2131.70 | 2161.23 | 2401.84 | 2508.26 | 2985.19 | 2955.21 | 3454.40 | 3287.59 | | | | |
| **-Electric Heat Coil** | n/a | 63.75 | n/a | 63.75 | n/a | 68.50 | n/a | 48.00 | n/a | 49.00 | n/a | n/a | n/a |
| | | 1666.00 | | 1825.00 | | 2267.00 | | 2297.00 | | 2857.00 | | | |
| **Integral-face-and-bypass coil** | | | | | | | | | | | | | |
| -Less than 4 rows | 26.50 | 29.50 | 29.50 | 29.50 | 29.50 | 29.50 | 29.50 | 29.50 | 29.50 | 29.50 | 29.50 | 29.50 | 29.50 |
| | 1190.19 | 1129.66 | 1407.86 | 1168.40 | 1449.00 | 1793.80 | 1640.15 | 1956.80 | 1817.25 | 2322.61 | 2378.60 | 2865.77 | 2936.42 |
| -4 rows | 43.00 | 43.00 | 43.00 | 43.00 | 43.00 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | 1836.97 | 1677.52 | 2148.28 | 1720.20 | 2196.84 | | | | | | | | |
| **Controls section** (includes largest available VFD) | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 | 28.50 |
| | 496.00 | 637.00 | 649.00 | 674.00 | 698.00 | 745.00 | 747.00 | 787.00 | 790.00 | 964.00 | 1031.00 | 1146.00 | 1266.00 |
| **Diffuser** | 19.00 | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 | 27.50 | 37.25 | 37.25 | 37.25 |
| | 164.04 | 319.05 | 316.89 | 342.74 | 341.54 | 381.33 | 367.11 | 397.35 | 387.24 | 571.76 | 715.78 | 781.92 | 860.66 |
| **Discharge plenum** | | | | | | | | | | | | | |
| -Horizontal | 46.00 | 48.00 | 46.00 | 48.00 | 46.00 | 48.00 | 46.00 | 48.00 | 46.00 | 49.00 | 54.00 | 60.00 | 60.00 |
| | 464.93 | 627.24 | 621.68 | 677.47 | 682.71 | 772.27 | 745.34 | 821.10 | 798.32 | 1058.35 | 1198.64 | 1423.88 | 1585.80 |
| -Vertical | n/a | 63.75 | n/a | 63.75 | n/a | 68.50 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | | 876.48 | | 949.58 | | 1136.53 | | | | | | | |
| **Energy Wheel** | n/a | 61.00 | n/a | 65.00 | n/a | 65.00 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | | 2403.00 | | 2742.00 | | 3111.00 | | | | | | | |
| **Face-and-Bypass Dampers** | | | | | | | | | | | | | |
| -Face-and-bypass | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 |
| | 164.04 | 473.39 | 274.69 | 556.23 | 296.21 | 630.10 | 318.97 | 714.61 | 336.54 | 888.33 | 973.60 | 1093.88 | 1205.53 |
| -External face-and-bypass | 27.75 | 22.00 | 27.75 | 22.00 | 27.75 | 22.00 | 27.75 | 22.00 | 27.75 | 39.00 | 39.00 | 39.00 | 39.00 |
| | 222.16 | 566.46 | 341.83 | 660.36 | 368.32 | 740.29 | 395.56 | 831.66 | 417.20 | 1256.07 | 1348.84 | 1498.11 | 1643.69 |
| -Internal face-and-bypass or face damper only | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 |
| | 164.04 | 502.53 | 274.69 | 575.62 | 296.21 | 678.20 | 318.97 | 714.61 | 336.54 | 888.33 | 954.26 | 1082.84 | 1194.50 |
| **Fan** | | | | | | | | | | | | | |
| -Belt-drive plenum fan with motor | n/a | 53.50 | n/a | 53.50 | n/a | 57.50 | n/a | 59.50 | n/a | 61.00 | 63.00 | 73.75 | 82.25 |
| | | 2368.54 | | 2740.37 | | 3263.68 | | 3599.82 | | 4062.62 | 4745.62 | 6223.51 | 7341.11 |
| -Housed FC fan with motor | 73.25 | 63.75 | 80.50 | 63.75 | 80.50 | 68.50 | 88.00 | 68.50 | 88.00 | 84.00 | 92.00 | 96.00 | 96.00 |
| | 1832.18 | 2400.18 | 2423.46 | 2603.08 | 2771.01 | 3151.89 | 3312.75 | 3235.63 | 3414.05 | 4201.67 | 4922.58 | 5297.62 | 5600.08 |
| -Housed AF/BC fan with motor | 73.25 | 63.75 | 80.50 | 63.75 | 80.50 | 68.50 | 88.00 | 68.50 | 88.00 | 84.00 | 92.00 | 96.00 | 96.00 |
| | 1979.55 | 2429.71 | 2568.99 | 2695.61 | 2863.54 | 3221.42 | 3382.28 | 3305.16 | 3483.58 | 4311.38 | 5101.29 | 6025.44 | 6891.90 |

**Table 6. Section dimensions (inches) and weights (pounds) - unit sizes 31-120**

| Unit size | 31 | 35 | 36 | 40 | 41 | 50 | 51 | 57 | 58 | 66 | 80 | 100 | 120 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -Direct-drive plenum fan with motor | 73.25 | 63.75 | 80.50 | 63.75 | 80.50 | 68.50 | 88.00 | 68.50 | 88.00 | 84.00 | 92.00 | 96.00 | 96.00 |
| | 1673.71 | 2057.87 | 2804.47 | 2406.73 | 3039.54 | 3469.95 | 4268.88 | 3545.86 | 4349.06 | 4903.24 | 5456.86 | 7176.65 | 7382.51 |
| **Filters** | | | | | | | | | | | | | |
| -Side load 2-in. angled | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 | 27.50 | 24.50 | 27.50 | 24.50 | 27.50 | 27.50 | 27.50 | 27.50 |
| | 469.97 | 593.86 | 562.37 | 649.06 | 652.32 | 770.02 | 688.86 | 797.89 | 777.14 | 989.00 | 1088.02 | 1157.16 | 1282.20 |
| -Side load 4-in. angled | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 | 27.50 | 24.50 | 27.50 | 24.50 | 27.50 | 27.50 | 27.50 | 27.50 |
| | 477.66 | 594.02 | 567.56 | 631.64 | 663.25 | 768.20 | 747.25 | 805.97 | 778.73 | 999.89 | 1105.14 | 1201.91 | 1338.65 |
| -Side load cartridge 12-in. or short bag 18-in. | 24.50 | 24.50 | 24.50 | 24.50 | 24.50 | 27.50 | 24.50 | 27.50 | 24.50 | 27.50 | 27.50 | 27.50 | 27.50 |
| | 487.55 | 681.24 | 637.25 | 668.25 | 762.69 | 878.57 | 874.81 | 934.14 | 980.36 | 1239.99 | 1364.91 | 1746.31 | 1903.54 |
| -Side load 2-in. flat | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 15.00 | 15.00 | 15.00 | 15.00 |
| | 198.17 | 319.66 | 322.85 | 358.18 | 358.29 | 408.69 | 392.33 | 438.52 | 426.12 | 598.12 | 637.02 | 716.56 | 817.63 |
| -Side load 4-in. flat | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 15.00 | 15.00 | 15.00 | 15.00 |
| | 241.97 | 359.20 | 350.39 | 375.13 | 404.69 | 451.33 | 461.82 | 498.71 | 476.21 | 657.87 | 729.15 | 803.46 | 913.90 |
| -Side load 2-in. and 4-in. combination flat | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 |
| | 322.00 | 476.00 | 484.13 | 504.37 | 570.61 | 600.40 | 646.20 | 671.64 | 667.97 | 853.08 | 981.02 | 1078.09 | 1165.92 |
| -Long bag 30-in. | 37.25 | 37.25 | 37.25 | 37.25 | 37.25 | 37.25 | 37.25 | 37.25 | 37.25 | 37.25 | 37.25 | 37.25 | 37.25 |
| | 505.93 | 657.41 | 700.77 | 716.04 | 802.78 | 826.72 | 883.10 | 906.56 | 944.63 | 1094.61 | 1270.51 | 1393.17 | 1549.80 |
| -Front-load HEPA | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 |
| | 874.09 | 985.62 | 1176.01 | 1128.46 | 1267.90 | 1397.21 | 1449.89 | 1520.35 | 1561.45 | 1845.81 | 2141.38 | 2553.97 | 2924.72 |
| -Front-load cartridge | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 |
| | 637.18 | 867.68 | 796.62 | 922.78 | 931.37 | 1093.06 | 1061.94 | 1173.89 | 1168.54 | 1449.48 | 1671.46 | 1923.09 | 2155.95 |
| -Front-load short bag | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 |
| | 622.53 | 750.89 | 778.04 | 799.75 | 885.35 | 917.08 | 968.65 | 979.84 | 1048.59 | 1231.49 | 1365.35 | 1538.95 | 1696.33 |
| **Gas heat** | | | | | | | | | | | | | |
| - 200 MBH | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| - 300 MBH | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| - 360 MBH | n/a | 66.00<br>1402.11 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| - 560 MBH | n/a | 66.00<br>1594.61 | n/a | 64.00<br>1468.07 | n/a | 64.00<br>1853.53 | n/a | 64.00<br>1900.53 | n/a | n/a<br>n/a | n/a<br>n/a | n/a<br>n/a | n/a<br>n/a |
| - 700 MBH | n/a | 73.00<br>1895.19 | n/a | 75.00<br>1804.11 | n/a | 74.00<br>2190.52 | n/a | 74.00<br>2241.91 | n/a | 74.00<br>2490.63 | n/a | n/a | n/a |
| - 860 MBH | n/a | 80.00<br>2046.29 | n/a | 75.00<br>2098.72 | n/a | 74.00<br>2280.52 | n/a | 74.00<br>2331.91 | n/a | 74.00<br>2580.63 | 74.00<br>2198.81 | n/a<br>n/a | n/a<br>n/a |
| - 1000 MBH | n/a | 80.00<br>1723.73 | n/a | 81.00<br>1844.68 | n/a | 77.00<br>2325.57 | n/a | 77.00<br>2082.86 | n/a | 74.00<br>2300.63 | 74.00<br>1918.81 | 84.00<br>3156.04 | 92.00<br>3125.34 |
| - 1250-1750 MBH | n/a | 101.00<br>2540.84 | n/a | 105.00<br>2717.94 | n/a | 106.00<br>3264.84 | n/a | 106.00<br>2942.76 | n/a | 109.00<br>3309.39 | 109.00<br>2949.68 | 92.00<br>3878.54 | 102.00<br>3886.60 |
| - 2000 MBH | n/a | n/a | n/a | | n/a | 114.00<br>3758.71 | n/a | 114.00<br>3430.29 | n/a | 112.00<br>3688.33 | 112.00<br>3320.33 | 109.00<br>4503.52 | 109.00<br>4391.21 |
| -2400 MBH | n/a | n/a | n/a | | n/a | | n/a | n/a | n/a | 118.00<br>3890.31 | 112.00<br>3455.33 | 121.00<br>4715.85 | 119.00<br>4668.51 |
| **Humidifier** | | | | | | | | | | | | | |
| -Building Steam | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 15.00 | 15.00 | 15.00 | 15.00 |
| | 561.00 | 544.00 | 622.00 | 599.00 | 684.00 | 782.00 | 773.00 | 897.00 | 807.00 | 1123.00 | 1215.00 | 1363.00 | 1551.00 |
| -Atmospheric Steam | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 |
| | 471.00 | 581.00 | 508.00 | 665.00 | 570.00 | 724.00 | 683.00 | 803.00 | 742.00 | 977.00 | 1078.00 | 1265.00 | 1492.00 |

### Table 6. Section dimensions (inches) and weights (pounds) - unit sizes 31-120

| Unit size | 31 | 35 | 36 | 40 | 41 | 50 | 51 | 57 | 58 | 66 | 80 | 100 | 120 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mixing box** | | | | | | | | | | | | | |
| -with angled filters | 46.00 | 48.00 | 46.00 | 48.00 | 46.00 | 48.00 | 46.00 | 48.00 | 46.00 | 49.00 | 54.00 | 60.00 | 60.00 |
| | 467.28 | 519.12 | 513.70 | 561.92 | 565.81 | 653.36 | 629.45 | 653.36 | 675.14 | 946.02 | 1077.83 | 1287.99 | 1433.55 |
| -with front/back Traq and top Traq dampers | n/a | 63.75 | n/a | 63.75 | n/a | 68.50 | n/a | 68.50 | n/a | 84.00 | 92.00 | 96.00 | 96.00 |
| | | 966.49 | | 1073.80 | | 1261.78 | | 1365.59 | | 1907.28 | 2151.42 | 2473.12 | 2790.48 |
| -reduced length with side/top/back/bottom airfoil damper | n/a | 35.50 | n/a | 38.50 | n/a | 41.50 | n/a | 41.50 | n/a | 41.50 | 41.50 | 47.00 | 53.00 |
| | | 708.50 | | 795.10 | | 947.60 | | 1022.70 | | 1328.50 | 1453.60 | 1731.30 | 2025.40 |
| **Multizone** | | | | | | | | | | | | | |
| - 3-deck vertical discharge | n/a | 92.00 | n/a | 92.00 | n/a | 96.00 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | | 4263.00 | | 4732.00 | | 5739.00 | | | | | | | |
| - 2-deck vertical discharge | n/a | 92.00 | n/a | 92.00 | n/a | 96.00 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | | 2965.00 | | 3267.00 | | 3986.00 | | | | | | | |
| -3-deck horizontal discharge | n/a | 78.00 | n/a | 78.00 | n/a | 78.00 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | | 4020.00 | | 4471.00 | | 5276.00 | | | | | | | |
| -2-deck horizontal discharge | n/a | 78.00 | n/a | 78.00 | n/a | 78.00 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| | | 2725.00 | | 3006.00 | | 3633.00 | | | | | | | |
| **Silencer** | | | | | | | | | | | | | |
| -3 ft | 38.00 | 38.00 | 38.00 | 38.00 | 38.00 | 38.00 | 38.00 | 38.00 | 38.00 | 38.00 | 38.00 | 38.00 | 38.00 |
| | 826.00 | 918.00 | 951.00 | 974.00 | 1013.00 | 1226.00 | 1142.00 | 1332.00 | 1312.00 | 1573.00 | 1741.00 | 2196.00 | 2555.00 |
| -5 ft | 62.00 | 62.00 | 62.00 | 62.00 | 62.00 | 62.00 | 62.00 | 62.00 | 62.00 | 62.00 | 62.00 | 62.00 | 62.00 |
| | 1272.00 | 1335.00 | 1478.00 | 1439.00 | 1558.00 | 1795.00 | 1759.00 | 1945.00 | 2030.00 | 2313.00 | 2555.00 | 3230.00 | 3786.00 |
| **Trane Catalytic Air Cleaning System (TCACS)** | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 |
| | 825.55 | 881.59 | 916.32 | 935.35 | 945.79 | 1044.28 | 1043.64 | 1148.17 | 1132.38 | 1362.38 | 1451.30 | 1707.27 | 1881.13 |
| **UV light** | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 15.00 | 15.00 | 15.00 | 15.00 |
| | n/a | 325.48 | n/a | 352.71 | n/a | 394.34 | n/a | 419.43 | n/a | 574.52 | 604.11 | 667.60 | 758.72 |
| **Sections below are for outdoor units only** | | | | | | | | | | | | | |
| **Diagonal economizer** | | | | | | | | | | | | | |
| -with airfoil dampers | n/a | 75.00 | n/a | 83.00 | n/a | 72.00 | n/a | 76.00 | n/a | 83.00 | 86.00 | 93.00 | 93.00 |
| | | 931.00 | | 1062.00 | | 1120.00 | | 1223.00 | | 1680.00 | 1851.00 | 2173.00 | 2396.00 |
| -with airfoil damper and one side Traq damper | n/a | 75.00 | n/a | 83.00 | n/a | 72.00 | n/a | 76.00 | n/a | 83.00 | 86.00 | 93.00 | 93.00 |
| | | 973.00 | | 1101.00 | | 1169.00 | | 1266.00 | | 1722.00 | 1920.00 | 2290.00 | 2494.00 |
| **Unit size** | **31** | **35** | **36** | **40** | **41** | **50** | **51** | **57** | **58** | **66** | **80** | **100** | **120** |
| **Exhaust damper section for outdoor unit** | n/a | 24.50 | n/a | 24.50 | n/a | 24.50 | n/a | 22.40 | n/a | 22.40 | 22.40 | 22.40 | 22.40 |
| | | 450.80 | | 489.90 | | 565.60 | | 586.60 | | 755.30 | 820.10 | 935.50 | 1058.30 |
| **Hoods** | | | | | | | | | | | | | |
| -Back inlet hood with airfoil and Traq dampers | n/a | 99.88 | | 112.38 | n/a | 125.38 | n/a | 125.38 | n/a | 126.00 | 140.00 | 140.00 | 167.25 |
| | | 176.00 | n/a | 195.00 | | 230.00 | | 270.00 | | 317.00 | 344.00 | 491.00 | 566.00 |
| -Side inlet hood with airfoil and Traq dampers | n/a | 40.88 | | 40.88 | n/a | 44.75 | n/a | 37.25 | n/a | 37.25 | 37.25 | 43.00 | 48.75 |
| | | 122.00 | n/a | 128.00 | | 161.00 | | 174.00 | | 189.00 | 258.00 | 412.00 | 415.00 |
| -Exhaust hood with airfoil damper | n/a | 40.88 | | 40.88 | n/a | 39.63 | n/a | 37.25 | n/a | 37.25 | 37.25 | 43.00 | 48.75 |
| | | 73.00 | n/a | 77.00 | | 93.00 | | 114.00 | | 129.00 | 174.00 | 206.00 | 221.00 |
| -Economizer inlet hood | n/a | 75.00 | | 83.00 | n/a | 72.00 | n/a | 75.50 | n/a | 83.00 | 86.00 | 93.00 | 93.00 |
| | | 195.00 | n/a | 275.00 | | 358.00 | | 345.00 | | 418.00 | 522.00 | 629.00 | 778.00 |
| **Pipe cabinet weight** | | | | | | | | | | | | | |
| 15 inches long, 36 inches deep | n/a | 175.00 | n/a | 175.00 | n/a | 191.00 | n/a | 209.00 | n/a | 215.00 | 243.00 | 265.00 | 265.00 |
| 24 inches long, 36 inches deep | n/a | 199.00 | n/a | 199.00 | n/a | 216.00 | n/a | 236.00 | n/a | 243.00 | 273.00 | 298.00 | 298.00 |
| 48 inches long, 36 inches deep | n/a | 263.00 | n/a | 263.00 | n/a | 284.00 | n/a | 309.00 | n/a | 317.00 | 354.00 | 385.00 | 385.00 |
| 96 inches long, 36 inches deep | n/a | 392.00 | n/a | 392.00 | n/a | 421.00 | n/a | 454.00 | n/a | 466.00 | 517.00 | 558.00 | 558.00 |

# Fans/Motors

## Starter/VFD Weights

Fan weights do not include starter/VFD weights. Table 7 gives approximate starter/VFD weights.

**Table 7. Approximate starter and VFD weights per horsepower (lbs.)**

| Horsepower | 1 | 1.5 | 2 | 3 | 5 | 7.5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 75 | 100 | 125 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Starter[1] | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 |
| VFD[2] | 123 | 123 | 132 | 124 | 125 | 136 | 151 | 162 | 177 | 197 | 241 | 325 | 332 | 243 | 258 | 294 | 314 |

**Note:** [1]These weights represent the largest available starter. [2]VFD weights include transformer, distribution block, and enclosure.

## Motor Weights

Fan weights provided in this manual include the heaviest ODP (open drip-proof) motor. Approximate motor weights are shown in Table 8.

**Table 8. Approximate motor weights (pounds)**

| Motor Type | Motor RPM | Horsepower 3/4 | 1 | 1-1/2 | 2 | 3 | 5 | 7-1/2 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 75 | 100 | 125 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Energy efficient ODP (EEOP) | 1800 | 24 | 29 | | | | | | | | | | | | | | | | |
| NEMA Premium ODP (HEOP) | 1200 | | 39 | 77 | 91 | 147 | 126 | 249 | 300 | 375 | 443 | 594 | 667 | | | | | | |
| NEMA Premium TEFC (HETC) | 1200 | | 56 | 96 | 109 | 148 | 185 | 310 | 341 | 423 | 481 | 614 | 655 | | | | | | |
| NEMA Premium ODP (HEOP) | 1800 | | 36 | 42 | 47 | 76 | 82 | 118 | 148 | 234 | 263 | 330 | 379 | 488 | 521 | 698 | 808 | 1114 | 1238 |
| NEMA Premium TEFC (HETC) | 1800 | | 47 | 54 | 56 | 91 | 108 | 159 | 185 | 285 | 315 | 452 | 481 | 578 | 670 | 808 | 889 | 1239 | 1466 |
| NEMA Premium ODP (HEOP) | 3600 | | 36 | 36 | 37 | 89 | 104 | 173 | 203 | 267 | 243 | 261 | 407 | | | | | | |
| NEMA Premium TEFC (HETC) | 3600 | | 36 | 53 | 62 | 85 | 103 | 154 | 176 | 287 | 322 | 448 | 496 | | | | | | |

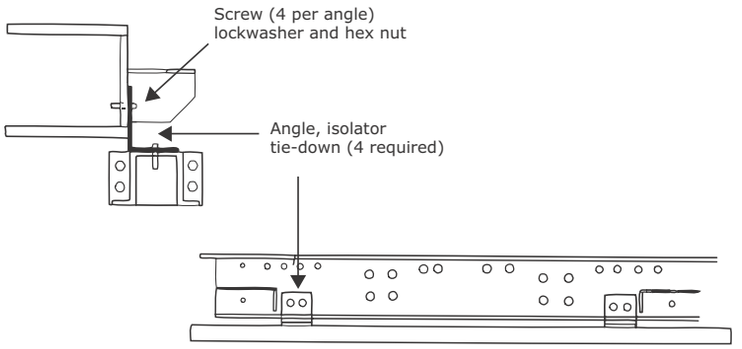
# Installation - Mechanical

## Lifting and Rigging

### Remove Shipping Tie-Downs

Prior to unit placement, remove the shipping tie-downs. See Figure 5.

**Figure 5. Isolator tie-down removal**




- Shipping tie-downs are located at each corner of the isolation base. See Figure 6, Figure 7, Figure 8, and Figure 9.

**Figure 6. Isolator tie-down for unit sizes 3-8**

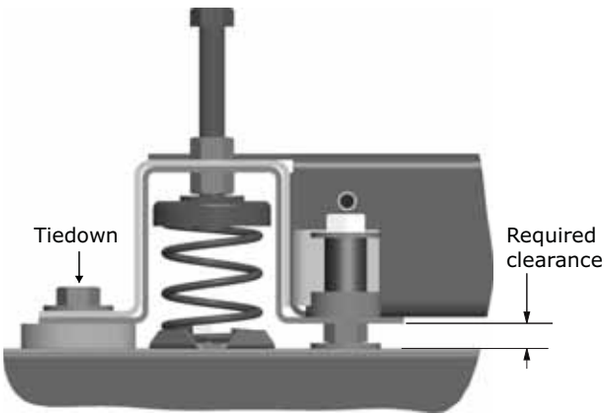



**Figure 7. Isolator tie-down for unit sizes 10-30**

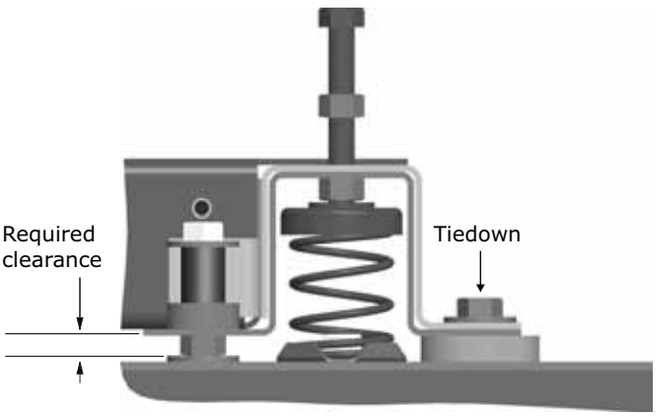



**Figure 8. Isolator tie-down removal for unit sizes 66-120**

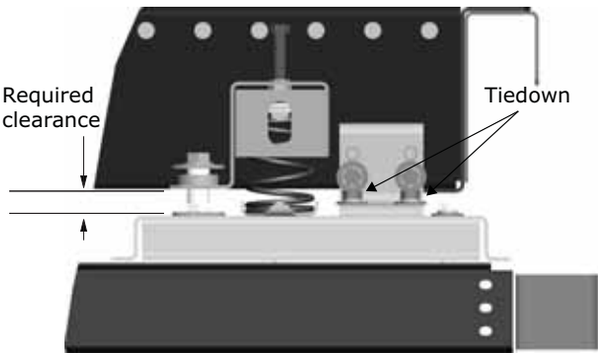
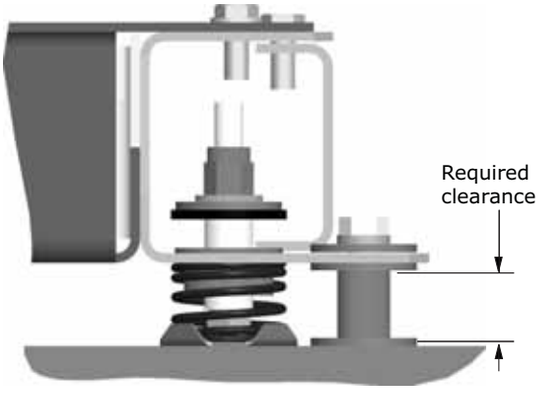
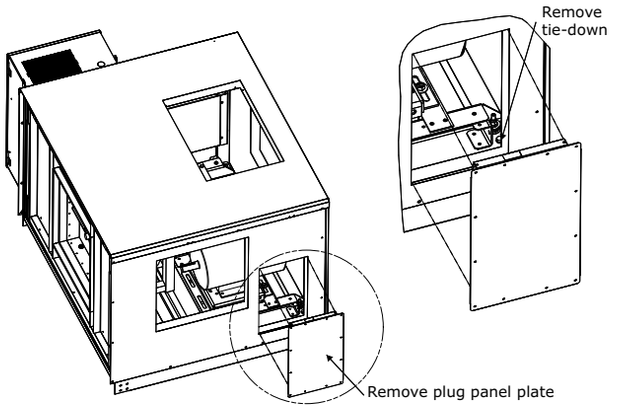



**Figure 9. Belt-drive plenum fan tie down**



- Access for removal of shipping tie-downs for unit sizes 3-30 is available through the fan section access door or opposite drive-side plug panel. See Figure 10.

**Figure 10. Plug panel plate**




- Access for removal of shipping tie-downs for unit sizes 3-30 is available through the fan section access door or opposite drive-side plug panel. See Figure 10.
- Remove the bolt. This will release the isolator and make it possible to remove the pipe or spacer.
- Replace plug panel if applicable.

*Note: For outdoor air handlers, after isolator tie-down is removed, remove the paper backing from the butyl tape around plug panel perimeter prior to replacing plug panel.*

## General Lifting Considerations

**⚠WARNING**

**Risk of Unit Dropping!**

**Always place, assemble, and suspend modules/subassemblies one at a time. Placing, assembling, and/or suspending more than one module/subassembly at a time could result in module/subassemblies dropping and crushing technicians which could result in death, serious injury, or equipment damage.**

**⚠WARNING**

**Improper Unit Lift!**

**Test lift unit approximately 24 inches to verify proper center of gravity lift point. To avoid dropping of unit, reposition lifting point if unit is not level. Failure to properly lift unit could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury and possible equipment or property-only damage.**

:

***NOTICE:***

**Equipment Damage!**

**Keep skid in place until unit is ready to set. Do not move the unit or subassembly without the skid in place as shipped from the factory. Premature skid removal could result in equipment damage.**

Before preparing the unit for lifting, estimate the approximate center of gravity for lifting safety. Because of placement of internal components, the unit weight may be unevenly distributed, with more weight in the coil and fan areas. Approximate unit weights are provided in "Dimensions and Weights" on page 10. Refer to the unit submittals for actual section weights. Test the unit for proper balance before lifting.

For outdoor air handlers, preparation of the roof curb or pier mount and roof openings must be completed before lifting to the roof. See CLCH-SVN04A-EN Roof Curbs for Performance Climate Changer Air Handlers installation instructions for details.

**⚠WARNING**

**Heavy Objects!**

**Ensure that all the lifting equipment used is properly rated for the weight of the unit being lifted. Each of the cables (chains or slings), hooks, and shackles used to lift the unit must be capable of supporting the entire weight of the unit. Lifting cables (chains or slings) may not be of the same length. Adjust as necessary for even unit lift. Other lifting arrangements could cause equipment or property damage. Failure to follow instructions above or properly lift unit could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury.**

Always rig subassemblies or sections as they ship from the factory. Never bolt sections together before rigging.

- Make the loop of the sling parallel to the direction of airflow, if possible.
- When hoisting the unit into position, use the proper rigging method, such as straps, slings, spreader bars, or lifting lugs for protection and safety.
- Use all lifting lugs provided. See Figure 11 and Table 12 and Table 9 for lug hole sizes and location.

**Figure 11. Lifting lugs for low-capacity and high-capacity units**

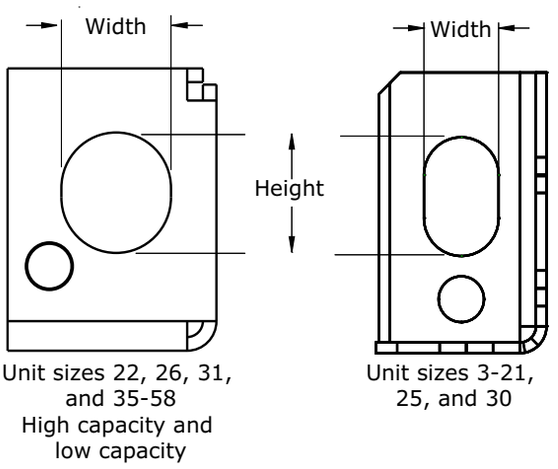



**Figure 12. Lifting lug for pipe cabinets and hoods**

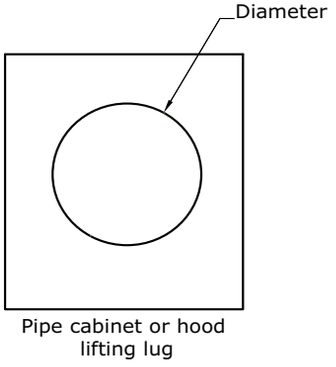



**Figure 13. Lifting lug part numbers**

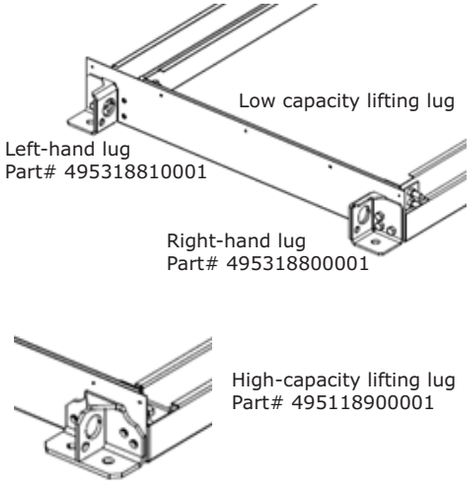
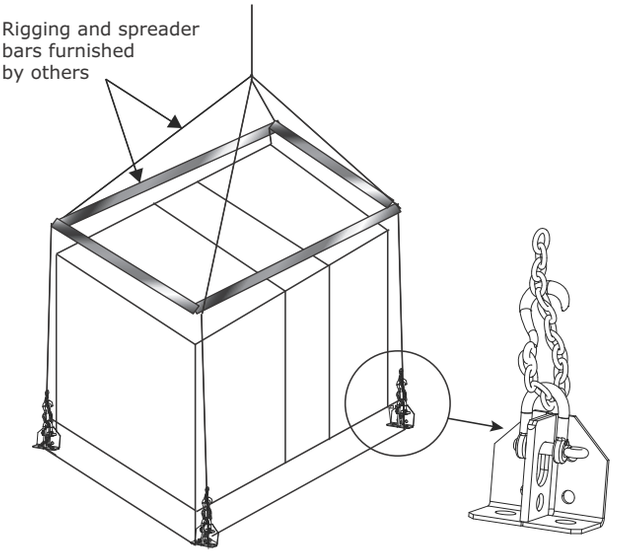



**Table 9. Lug hole dimensions for low-capacity (under 3000 lbs.) and high-capacity (3000 lbs and over) units**

| Section | Location | Unit Size | Width | Height |
|---|---|---|---|---|
| Unit Lug Hole Size | Indoor | 3-21, 25, 30 | 0.88 | 1.38 |
| | Indoor | 22, 26, 31, 35-58 | 1.31 | 1.43 |
| | Indoor | 66-120 | 1.25 | 2.75 |
| | Outdoor | 3-30 | 1.25 | 2.75 |
| Pipe Cabinet | Outdoor | 3-120 | 2.5-in. diameter | |
| Hood | Outdoor | 3-120 | 1-in. diameter | |

- For unit sizes 3 to 120 with integral base frame, use field-provided spreader bars and slings to rig units and subassemblies as shown in Figure 14. The air handler is not designed to be lifted or rigged from the top of the unit.

**Figure 14. Lifting detail for unit sizes 3 to 120**




- For outdoor units, never stack the pipe cabinet or inlet hood on the unit as it is being lifted.
- Do not attach the intake/exhaust hood or pipe cabinet to the unit prior to lifting the unit. Doing so may damage the equipment. Attach the hoods to the unit only after all sections are in place.
- For outdoor air handlers, all shipping supports and crating on the face of the sections must be removed to permit proper fit-up and sealing of the surfaces. Dispose of properly.

## Lifting Hoods and Pipe Cabinets

**⚠ WARNING**

**Risk of Unit Dropping!**

**Always place, assemble, and suspend modules/subassemblies one at a time. Placing, assembling, and/or suspending more than one module/subassembly at a time could result in module/subassemblies dropping and crushing technicians which could result in death, serious injury, or equipment damage.**

**Figure 15. Lifting inlet and exhaust hoods**

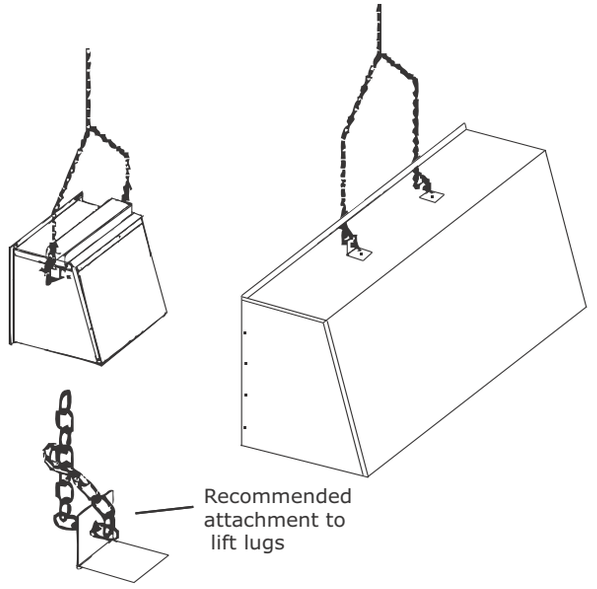
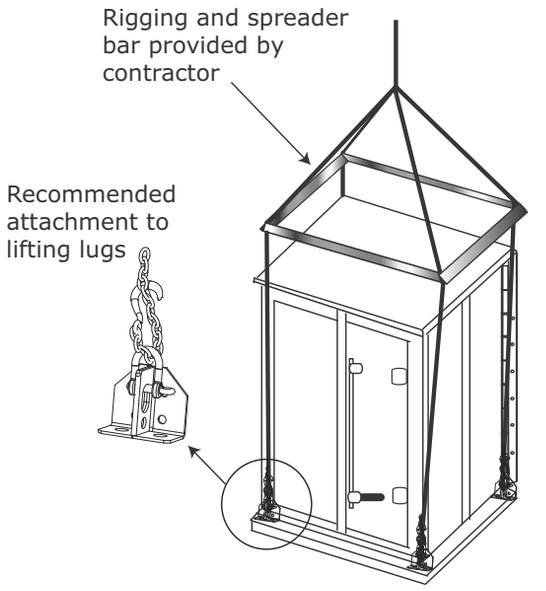



**Figure 16. Lifting pipe cabinets**




## Forklifting Considerations

***NOTICE:***

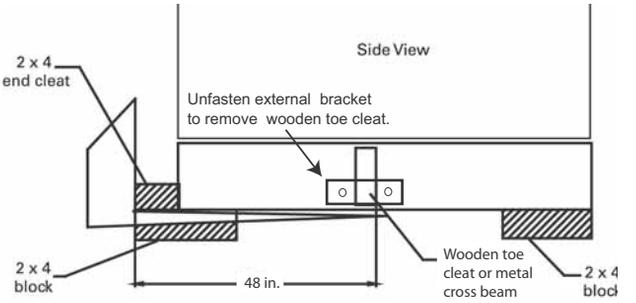
**Equipment Damage!**

**Do not use a fork lift on air handlers or subassemblies larger than size 30. Improper use of fork lifts on units larger than size 30 could result in equipment damage. Trane is not responsible for equipment damage resulting from improper fork lifting practices.**

*Note: Do not use a forklift on outdoor air handlers or indoor air handlers/subassemblies larger than size 30.*

For unit sizes 3-30, a forklift may be used to lift a single section or small subassembly, provided the forks extend under both ends of the base frame, or as indicated in Figure 17. The forks should not contact the bottom of the air handler. Units should only be lifted from the proper end identified by the lifting label on the unit. A lifting crane or other means should be used for larger units where forks cannot extend under both base rails.

**Figure 17. Fork lift points with base rail**



# Unit Placement and Assembly

If the air handler ships in subassemblies or in individual sections, some assembly is required, including:

- Ceiling-suspended indoor unit assembly; see See “Ceiling Suspension” on page 25.
- Section-to-section assembly; see “Section-to-Section Assembly” on page 26.

**⚠WARNING**

**Toxic Fumes!**

**Keep open flame away from unit exterior or interior. Do not weld or use cutting torch on the exterior or interior of the unit. The unit contains polyurethane insulation. Flame could produce toxic gas which could result in death or serious injury.**

:

***NOTICE:***

**Equipment Damage!**

**The internal sections of this unit containing electrical components must not exceed 104º F operating temperature. Internal sections of the unit which do not contain electrical components must not exceed 200º F temperature. Failure to comply with temperature requirements could result in equipment damage.**

## Unit Placement

**⚠WARNING**

**Risk of Unit Dropping!**

**Always place, assemble, and suspend modules/subassemblies one at a time. Placing, assembling, and/or suspending more than one module/subassembly at a time could result in module/subassemblies dropping and crushing technicians which could result in death, serious injury, or equipment damage.**

***NOTICE:***

**Microbial Growth!**

**The floor or foundation must be level and the condensate drain at the proper height for proper coil drainage and condensate flow. Standing water and wet surfaces inside the equipment can become an amplification site for microbial growth (mold), which could cause odors and damage to the equipment and building materials.**

If a unit arrives in sections, then each section must be individually hoisted, set on the housekeeping pad, roof curb, or pier mount and then assembled.

Refer to the unit submittals and unit tagging for correct placement of all sections. If there are any discrepancies between the submittals and the unit tagging, contact your local Trane representative before proceeding.

Following the order of the sections on the unit submittals and tagging, individually place each unassembled section or subassembly in the appropriate installation location.

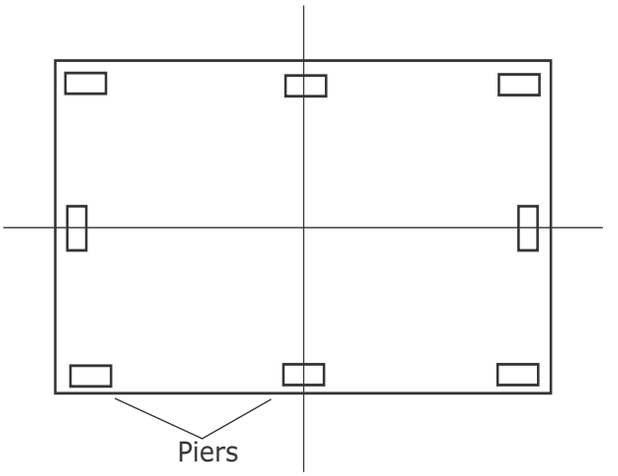
*Note: Prior to placing fan section in the appropriate installation location, verify shipping tie-downs have been removed.*

For outdoor units, the pipe cabinet must also be mounted as an individual section. Refer to “Pipe Cabinet Installation” on page 32 for specific instructions.

When mounting the unit on a roof curb, make sure the gasketing between the roof curb and unit base provides an airtight seal.

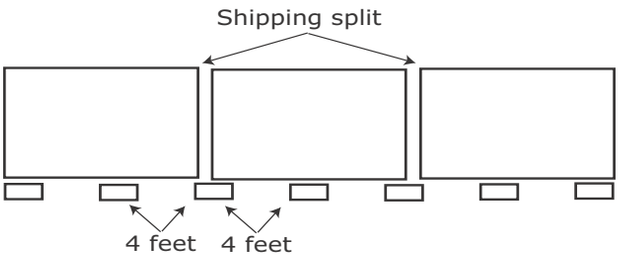
When mounting the unit on a pier mount, locate one pier at each corner as a minimum, directly underneath any shipping split (ensure full support under each side) and then every four feet at equally spaced intervals around the perimeter of the unit. Both the unit and the pipe cabinet should be supported by their base around the entire perimeter. See Figure 18 and Figure 19.

**Figure 18. Piers located in each corner and spaced evenly every four feet**




*Note: Piers beneath shipping splits must be structurally sound to support the weight of the unit.*

**Figure 19. Side view with two shipping splits - locate one pier directly under each shipping split**




*Note: Piers beneath shipping splits must be structurally sound to support the weight of the unit.*

For proper operation, the unit must be installed level (zero tolerance) in both horizontal axes. For vertical discharge units, allow space under the unit for supply air ductwork connections.

## Unit Assembly

*Note: Air handlers often include optional factory-provided casing penetration entry points for field-provided wiring. Consider overall unit serviceability and accessibility before mounting, running wires (power), making cabinet penetrations, or mounting any components to the cabinet.*

See "Component Installation Requirements" on page 47 for special assembly/installation considerations.

### Removing the Shipping Skid

Remove the wooden shipping blocks, wooden toe cleat if there is one, and end cleats prior to lowering unit into final position or installing the unit to the roof curb.

## Ceiling Suspension

**⚠ WARNING**

**Risk of Unit Dropping!**

**Do not use mounting legs for ceiling suspension, external isolation, or unit support during module placement. Mounting legs are designed only to secure the unit to the floor, housekeeping pad, or platform. Improper use of the mounting legs as described above could result in unit dropping and crushing technicians which could result in death or serious injury, and equipment damage.**

*Note: Ceiling suspension is not recommended for units larger than size 57 unless using a field-provided mounting frame.*

### Using a Field-Provided Mounting Frame

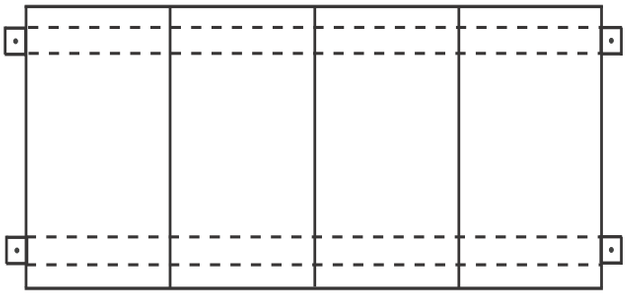
If a field-provided mounting frame is used for ceiling suspension, the installer/contractor must provide a ceiling-suspended mounting frame designed to support the length, width, and weight of the entire air-handling unit. See "Dimensions and Weights" on page 10 for approximate weights.

*Note: It is the building engineer's responsibility to size the structural channels and to provide the appropriate hangers.*

Structural channels in a field-provided frame can be mounted parallel to airflow or perpendicular to airflow:

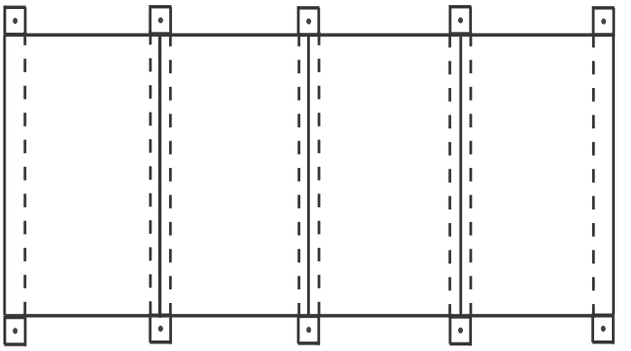
- For parallel-to-airflow channels, size channels based on a four-point load distribution (see Figure 20.

**Figure 20. Typical suspension method-parallel channels**



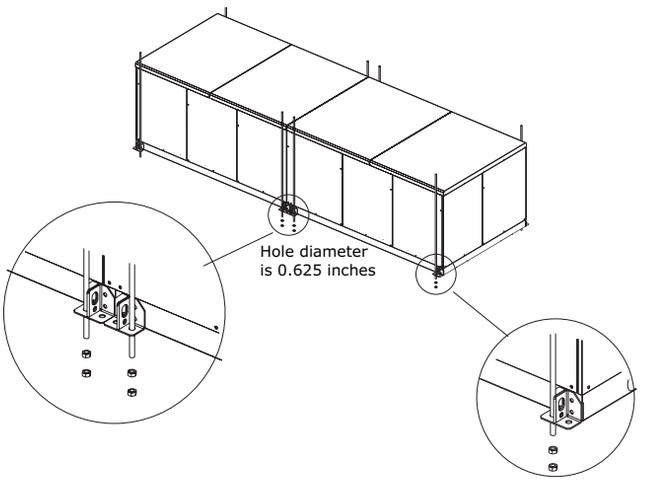
- For perpendicular-to-airflow channels, size channels based on the load distribution of the individual sections and install the channels so that *both ends of every section are supported* (see Figure 21).

**Figure 21. Typical ceiling suspension-perpendicular channels**



## Using Integral Base Frame

**Figure 22. Ceiling suspension for unit sizes 3-57**




If using the factory-provided integral base frame for ceiling suspension, individual sections and/or subassemblies will have base frame shipping splits and base frame lifting lugs. When using the base frame for ceiling suspension:

- Suspend the unit (on both sides of the unit) at each shipping split lug as well as the four corners of the unit (see Figure 22). See Figure 11 and Figure 12 and Table 9 on page 22 for lug hole sizes.
- Bolt shipping splits together.

*The hanger rods must extend through the bottom of the base lug. It is the building engineer's responsibility to provide the appropriate hangers.*

## Shipping Gussets

Prior to pulling the shipping splits together, the shipping gussets (see Figure 23) should be removed to simplify panel removal (except for units required OSHPD certification). If there is enough access after joining the shipping splits, the gussets can be removed after they are joined. The exception to this rule is for size 35-50 stacked units. For these sizes, the gussets should be left in place for the lower level unit unless they are installed in a shipping split that contains a coil. The other exception is when access to install or change out front-loaded filters is restricted or blocked.

Do not mistake the coil structural gusset (see Figure 24) used on unit sizes 66-120 with the shipping gussets.

**Figure 23. Shipping gusset**

**Figure 24. Coil structural gusset**

## Section-to-Section Assembly

Air handlers ship with all necessary assembly hardware and gasket material. The hardware should be packaged in either a clear plastic envelope or cardboard box inside the fan section, access section, or mixing box.

The number of sections to be assembled often makes it necessary to use more than one section to ship the assembly material; therefore, check all sections thoroughly before contacting your Trane sales representative to report missing items.

Sections are joined with gasketing applied to one of the mating surfaces and hardware to bolt the sections together. The gasketing for section-to-section joints is a closed cell foam with adhesive backing.

To assemble the unit:

1. Locate the mounting hardware and gasket material.
2. All shipping supports and crating on the face of the sections must be removed and discarded to permit proper fit-up and sealing of the surfaces. Remove any shipping bolts located on the mounting surfaces of the sections (see Figure 25).
3. Apply the gasketing to one of the mating surfaces; see Figure 25, Figure 26, and Figure 27.

**Figure 25. Section-to-section installation**

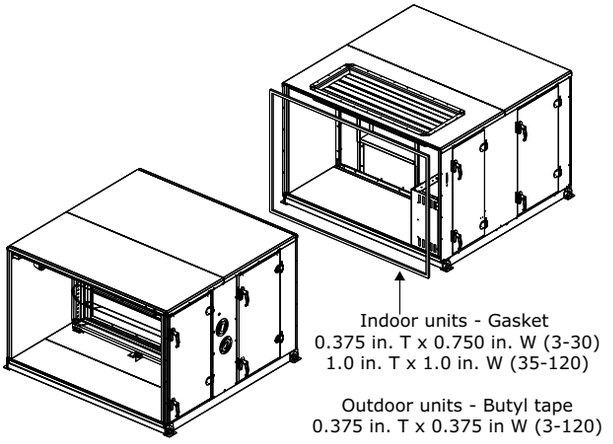
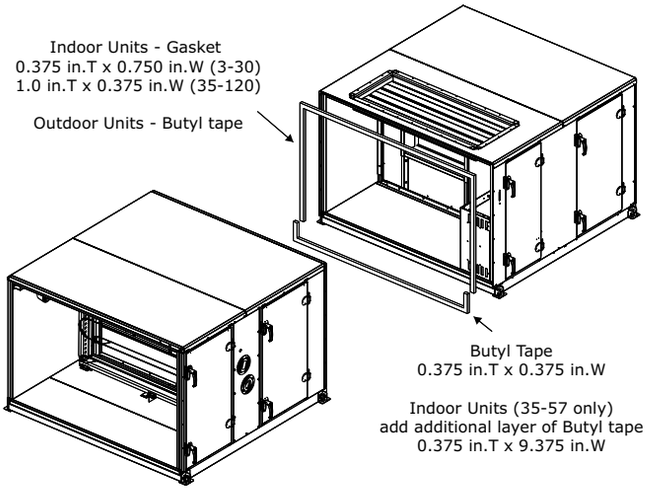



**Figure 26. Coil-section-to-downstream-section bolt up with splash guard**




*Note: Reference the appropriate controller manual for more details on the installation of units with factory-mounted controls.*

**Figure 27. Stacked unit assembly (shown for sizes 3-50)**

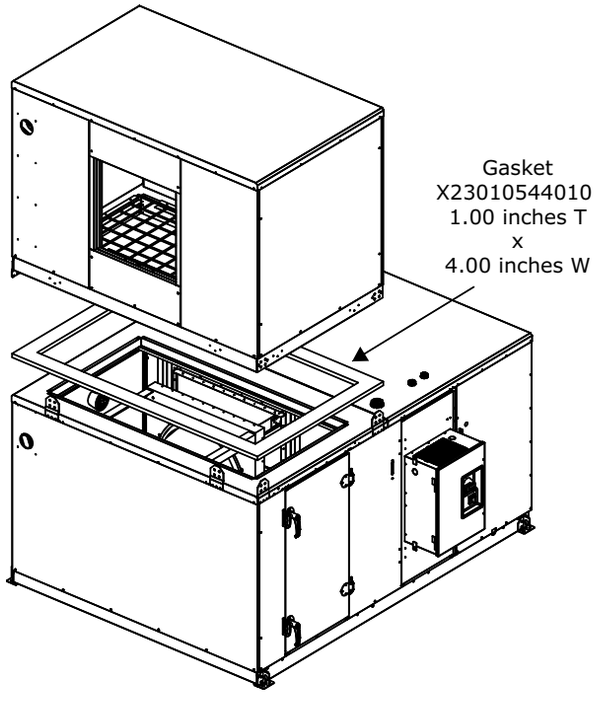
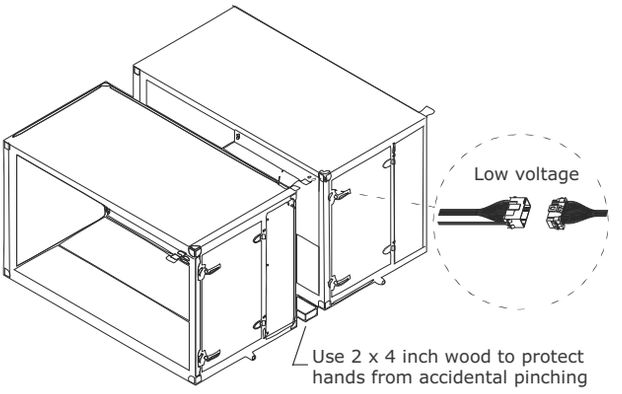
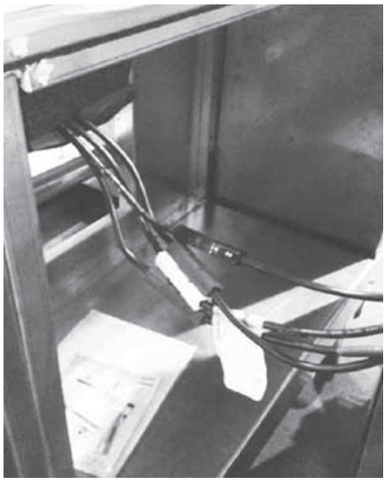



**Figure 28. Horizontal section-to-section low voltage quick connects**



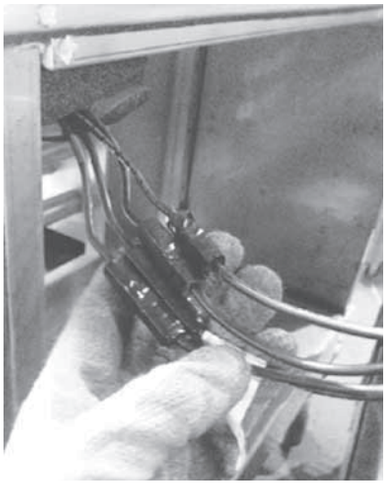

4. If the unit is equipped with factory-mounted controls, move adjacent subassembly within six inches and fasten quick connects where the sections bolt together. See Figure 28 for low voltage. See Figure 29 and Figure 30 for high voltage.

**Figure 29. Horizontal section-to-section high voltage quick connects**



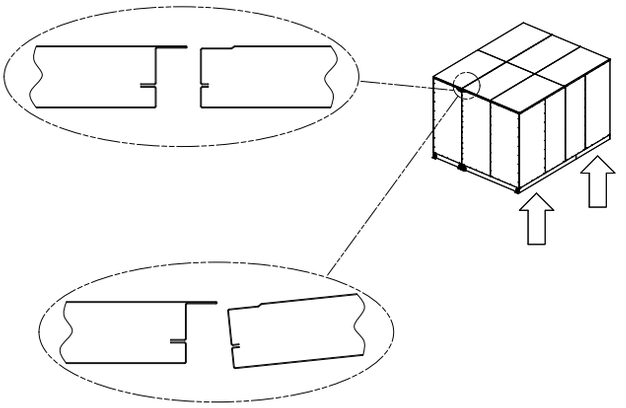
5. Assemble and seat connections per color code.

**Figure 30. Horizontal section-to-section high voltage quick connects**



6. Wrap each connection individually with black electrical tape.
7. Fully wrap the connection with tape.
8. Use a bar clamp to pull adjacent shipping section lifting lugs together.
9. For indoor units sizes 66-120 and for outdoor units size 35-120, a wedge block is provided to aid in pulling and aligning the units together. Attach the wedge blocks to both sides of the units being pulled together, matching the correct wedge block with the correct hole pattern. See Figure 34, p. 29.
10. Verify that the subassembly with the overhang profile on the roof is higher than the mating subassembly. If it is not, raise one end of the subassembly and bring the unit together. See Figure 31.
11. Due to unlevel floor and platforms, the roof may be misaligned as shown in Figure 31. A common solution is to raise one end of the shipping section to clear the hemming before pulling the units together.

**Figure 31. Roof alignment (indoor unit only)**



12. In addition, an adjustment can also be made to the height of the roof of either subassembly. At the center (width-wise) of the unit, measure the height of each adjacent subassembly and verify that the subassembly with the overlap sheet metal is higher than the mating subassembly roof. If it is not, adjust the height of either subassembly by loosening the screws in the vertical channels or component structure and adjust the height of the roof. See Figure 32 and Figure 33).

**Figure 32. Adjust height of roof by adjusting vertical channels**

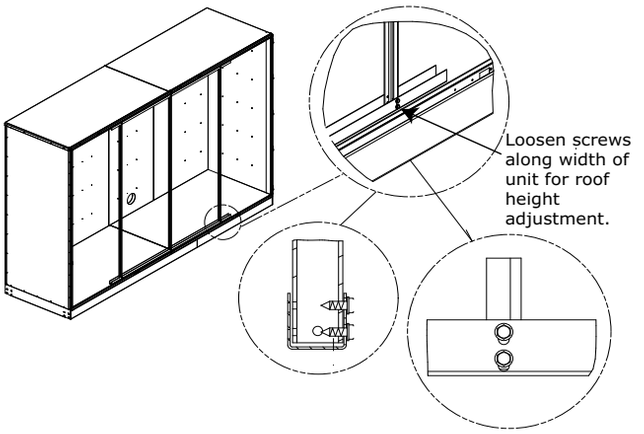
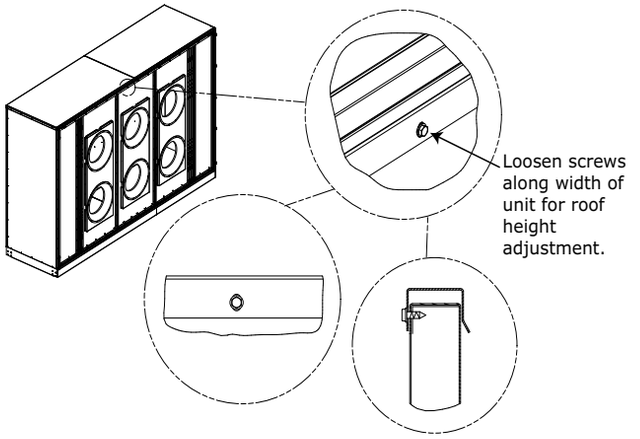
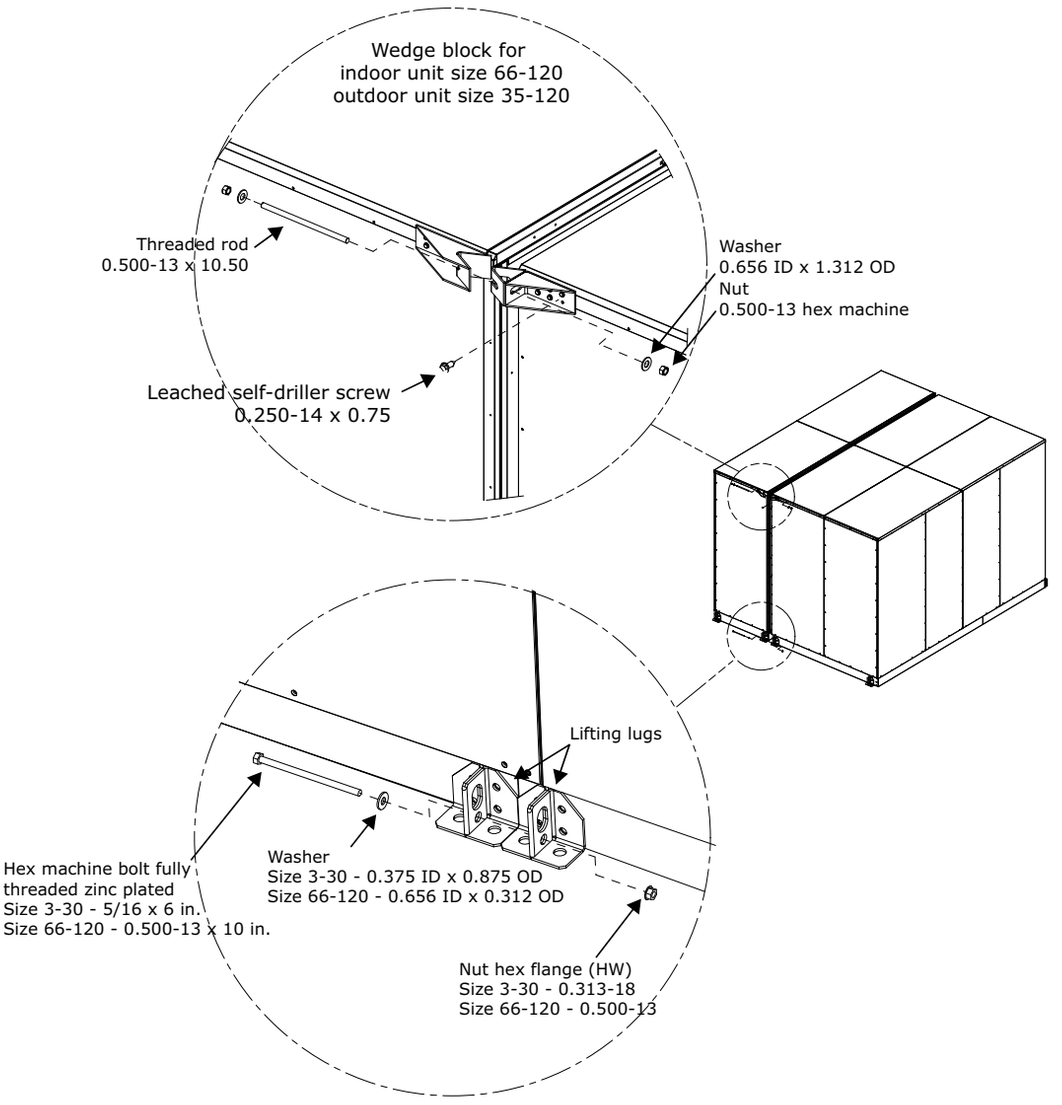


**Figure 33. Adjust height of roof by loosening screws**




13. For unit sizes 3-30, bolt the unit base frames together using 5/16-inch bolts (see Figure 34).
14. For unit sizes 35-120, bolt the unit base frames together using ½-threaded rod (see Figure 34).
15. For sizes 66-120 only, bolt through the wedge blocks using a ½-threaded rod (see Figure 34). Alternate between tightening on the lifting lug bolts and wedge block bolts until the shipping section comes together.
16. Use straps and come-alongs to compress the gasketing and pull the sections together along the height of the unit.

**Figure 34. Base frame split assembly**

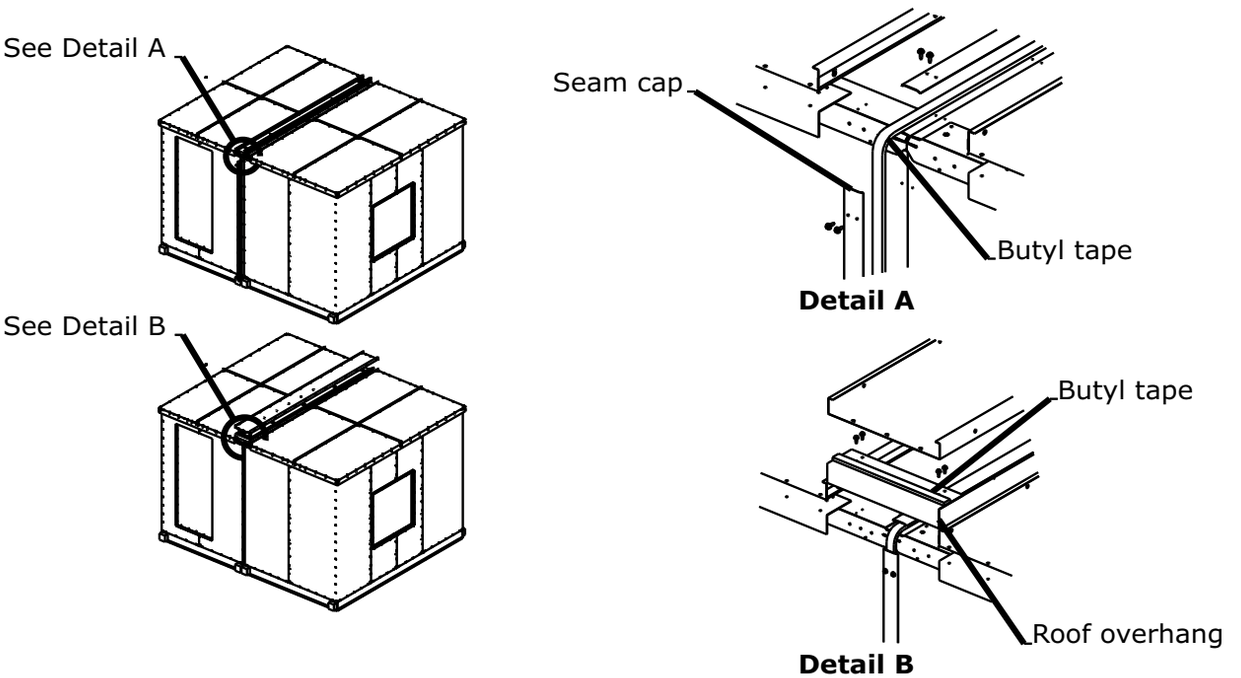


17. Install the section-to-section screws inserting the appropriate screws through the overlapping flanges using a powered impact gun and taking care not to strip the screws. Outdoor air handlers will ship with a seam cap that is to be installed over the section-to-section seams. Factory-supplied butyl tape must be continuously applied over the top and both side seams prior to seam caps being applied.

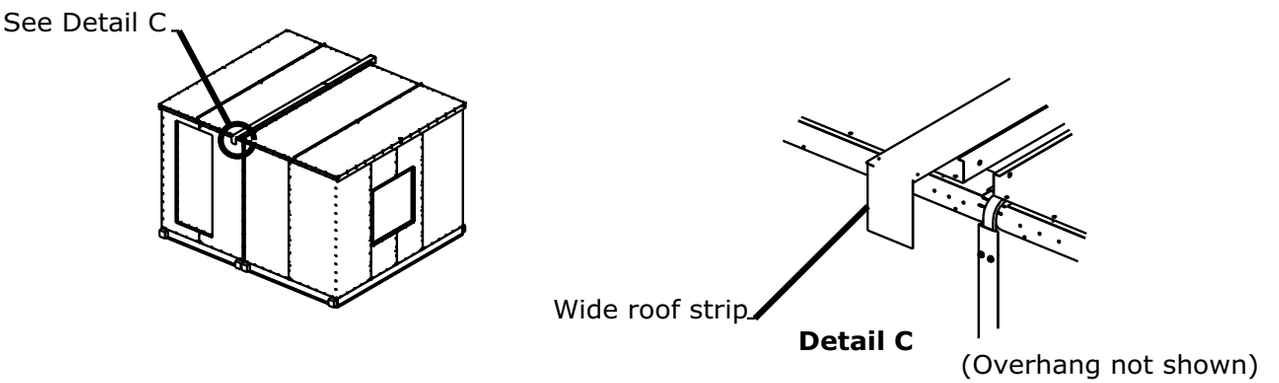
**Figure 35. Section-to-section seam cap installation**

See Figure 35. Detail A and Detail B refer to hurricane units for sizes 3-120. Detail C applies to non-hurricane units size 3-120.

**Detail A and Detail B apply to hurricane units size 3-120 and non-hurricane units size 35-120**

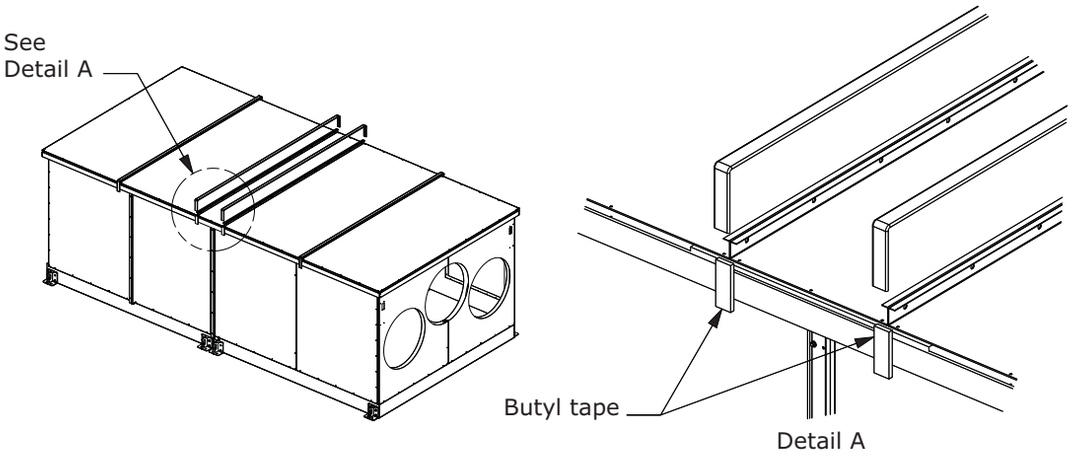



**Detail C applies to non-hurricane units size 3-30**



18. For sizes 3 through 30 hurricane units, and sizes 35 through 120 hurricane and outdoor non-hurricane units, attach roof overhang angle with number 10 screws.
    For sizes 3 through 30 outdoor non-hurricane outdoor units, a wide roof strip is attached.
19. Join outdoor roof panels together at the seams in the direction perpendicular to airflow and secure them in place with 5/16-inch x 3/4-inch bolts and 5/16 lock nuts. Install the roof joint strip to cover the seam between two outdoor roof panels in the perpendicular to airflow direction of. Use 3/8-inch butyl tape to cover the seam between two outdoor roof panels overhang at the side the unit. Bend joint strip over roof panel and use two number 10 sheet metal screws (one in each roof panel) to secure joint strip. Trim the roof joint strip to insure that it does not protrude more than 1/16-inch beyond outdoor roof overhang (see Figure 36).

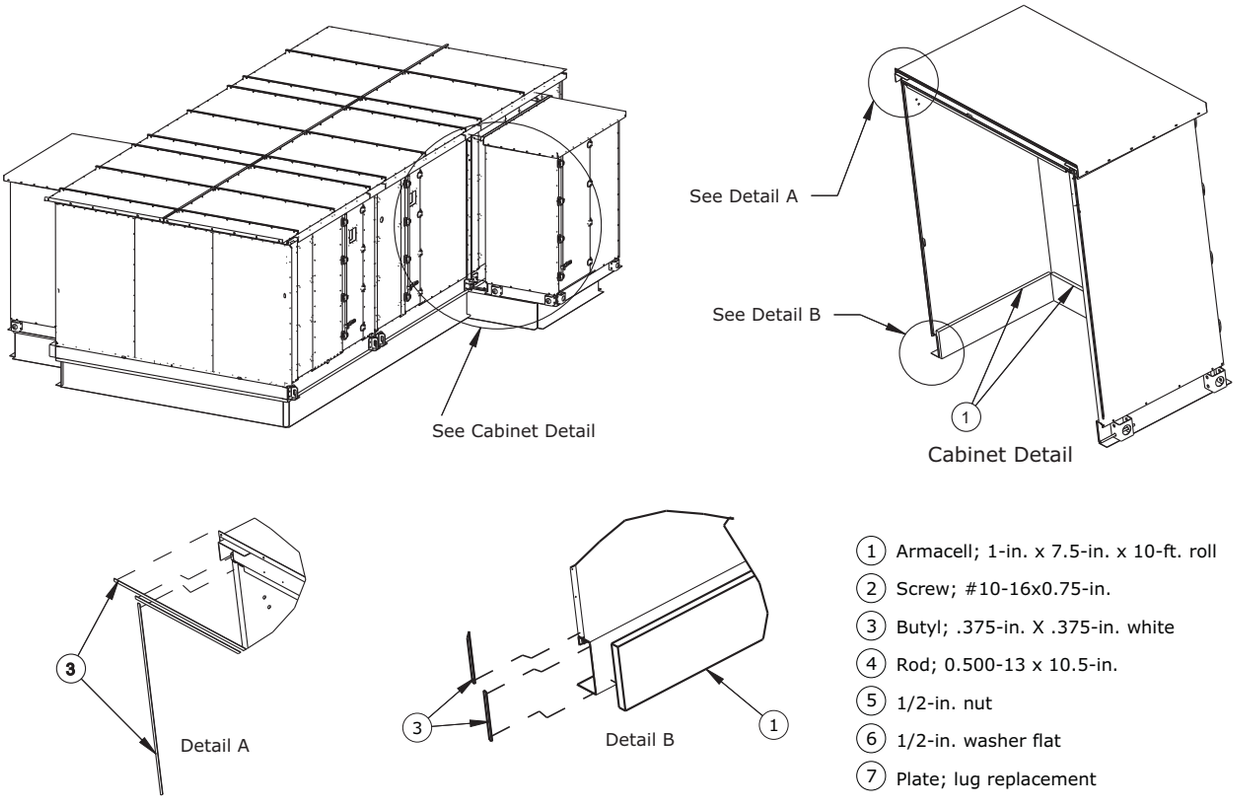
**Figure 36. Join outdoor roof panels at the seams**



# Pipe Cabinet Installation

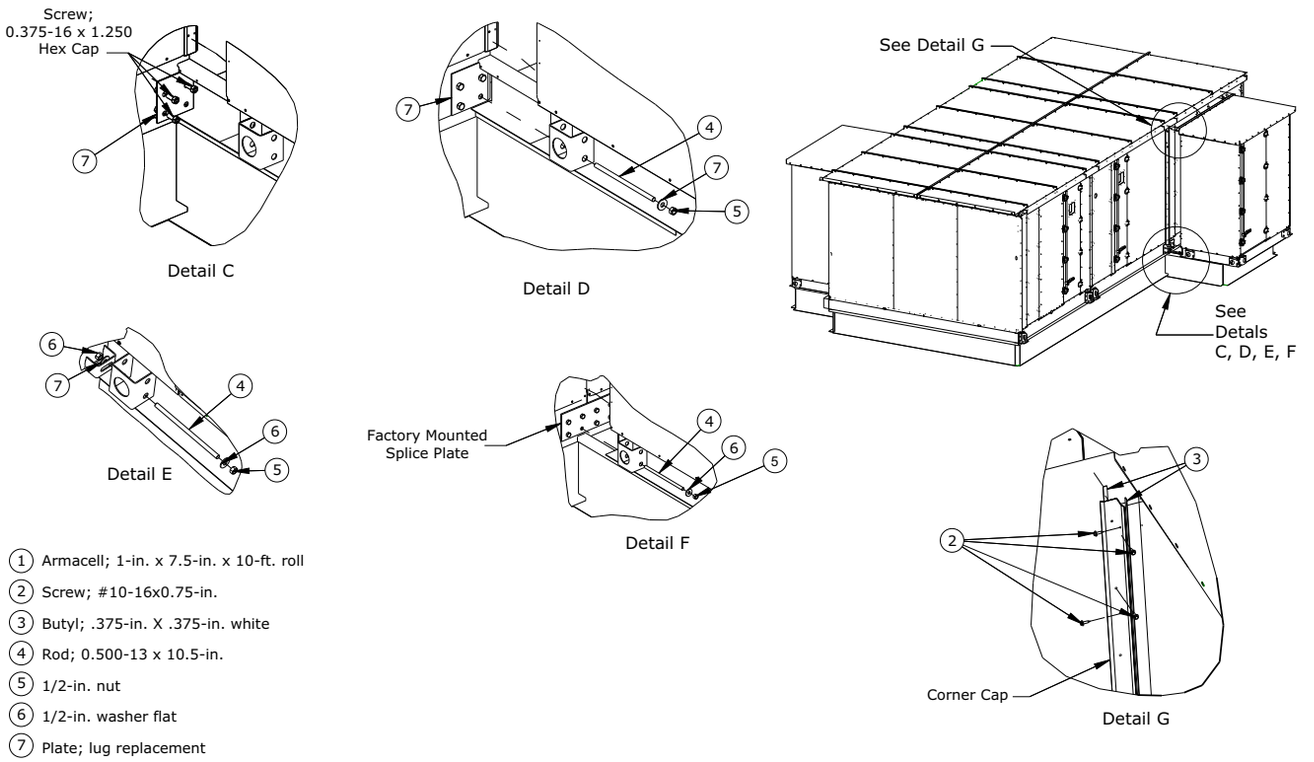
1. After air handler is completely installed and checked to ensure that the unit is level and square, remove cross base member on pipe cabinet base by removing the four bolts and nuts.

**Figure 37. Pipe cabinet installation**




1. Install inside corner cap. See Figure 38 Detail A and Detail B.
2. Install 3/8-inch x 3/8 inch white Butyl tape to unit wall where pipe cabinet roof connects.
3. Lift pipe cabinet roof into place and attach to unit wall with screws. See Figure 38.
2. Add 1-inch x 7.5-inch Armacell® gasketing to inside of baserail and add 3/8-inch x 3/8-inch white Butyl® tape to face of pipe cabinet. See Figure 37.

**Figure 38. Pipe cabinet installation details**




## Pipe Cabinet to be Installed at Shipping Split Joint

1. Remove threaded rod and unit lug that is outside of pipe cabinet.
2. Using three screws from unit lug, install black lug replacement plate in place of unit lug. See Figure 38 Detail C.
3. Lift pipe cabinet into place on roof curb.
4. Slide pipe cabinet into place.
5. Put threaded rod through pipe cabinet lifting lug into weld nut inside baserail to pull the pipe cabinet tight against the unit. See Figure 38 Detail D.

## Pipe Cabinet to be Attached to Unit Base Bracket

1. Lift pipe cabinet into place on roof curb.
2. Slide pipe cabinet into place.
3. Put threaded rod through pipe cabinet lifting lug into welded unit base rail bracket to pull the pipe cabinet tight against the unit. See Figure 38 Detail E.

## Pipe Cabinet to be installed at a Factory Joint

1. Lift pipe cabinet into place on roof curb.
2. Slide pipe cabinet into place.
3. Put threaded rod through pipe cabinet lifting lug into weld nut inside base rail to pull the pipe cabinet tight against the unit. See Figure 38 Detail F.

## Completing Pipe Cabinet Installation

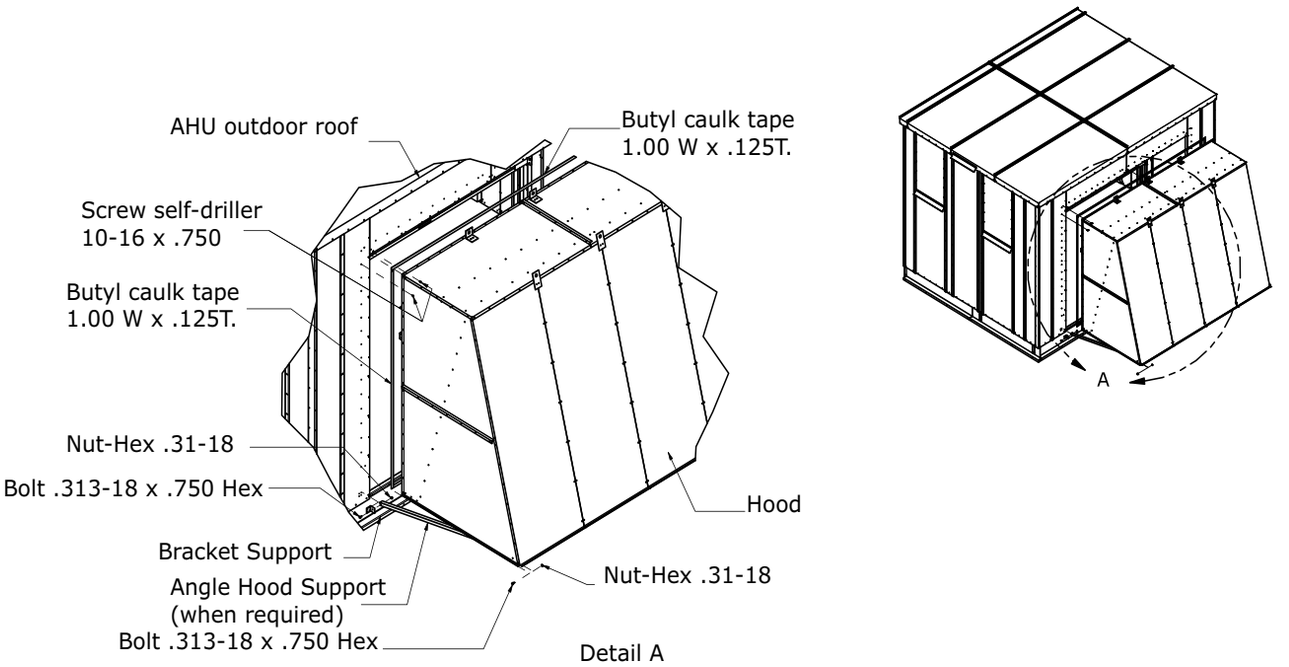
1. Install inside corner cap. See Figure 38.
2. Install 3/8-in. white Butyl tape to unit wall where pipe cabinet roof connects.
3. Lift pipe cabinet roof into place and attach to unit wall with screws. See Figure 38.

# Outdoor Unit Weather Hoods

1. Per the unit drawing determine mounting location of the unit weather hoods.
2. Using the factory provided screws mount the weather hoods to the unit.
3. On larger units, weather hoods may be large enough to require angled down supports. In those cases, the angles are shipped attached to the hood but will need to be connected to the air handler by the installing contractor. See Figure 39.

*Note: It is required that the hoods be sealed to the unit using factory-provided butyl/caulk tape.*

**Figure 39. Hood installation**



# Stacked Outdoor Units

## Assembly hardware

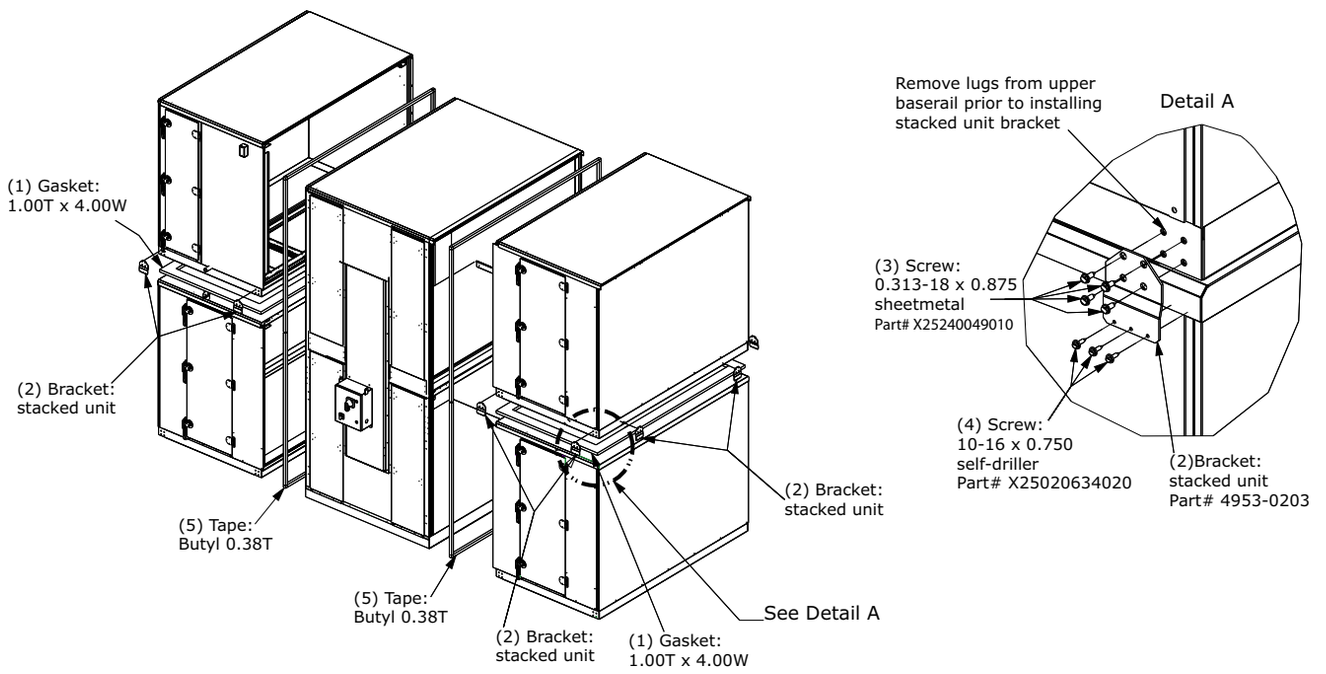
**Table 10. Parts list for outdoor stacked units**

| Item | Description |
|---|---|
| 1 | Gasket: 1.00T x 4.00W |
| 2 | Bracket: Stacked unit |
| 3 | Screw: 0.313-18 x 0.875 sheet metal |
| 4 | Screw: 10-16 x 0.750 self driller |
| 5 | Tape: Butyl 0.38T |
| 6 | Tape: Ribbed Butyl |
| 7 | Plate: Vertical seam cap |
| 8 | Tape: 0.12T x 1.00W, gray Butyl |
| 9 | Guard: perpendicular to airflow flashing |
| 10 | Guard: Energy recovery end cover |
| 11 | Guard: Energy recovery end cover |
| 12 | Guard: Direction of airflow flashing |
| 13 | Guard: Flashing seam cover |
| 14 | Adhesive/sealant: Flex polyurethane |
| 15 | Bracket: Hood support |
| 16 | Angle: Hood support |
| 17 | Screw: 0.250-14 x 0.750 self driller |

## Unit assembly

1. See Figure 40. Apply gasket (Item 1) on top of lower unit. Compress gasketing to ensure a good air seal between upper and lower sections.
2. Place upper unit on lower unit.
3. Remove lifting lugs from top unit and attach stacking brackets (Item 2) to top and bottom units using screws (Item 3 and Item 4). See Detail A in Figure 40. Stacking brackets (Item 2) are to be used on the right and left sides at each shipping split section end and also on front and back of the unit.
4. Apply Butyl tape (Item 5) to one side of the shipping split section.
5. Slide shipping split sections together, pulling tight using lifting lugs and threaded rod on bottom and straps or pipe clamps on top.

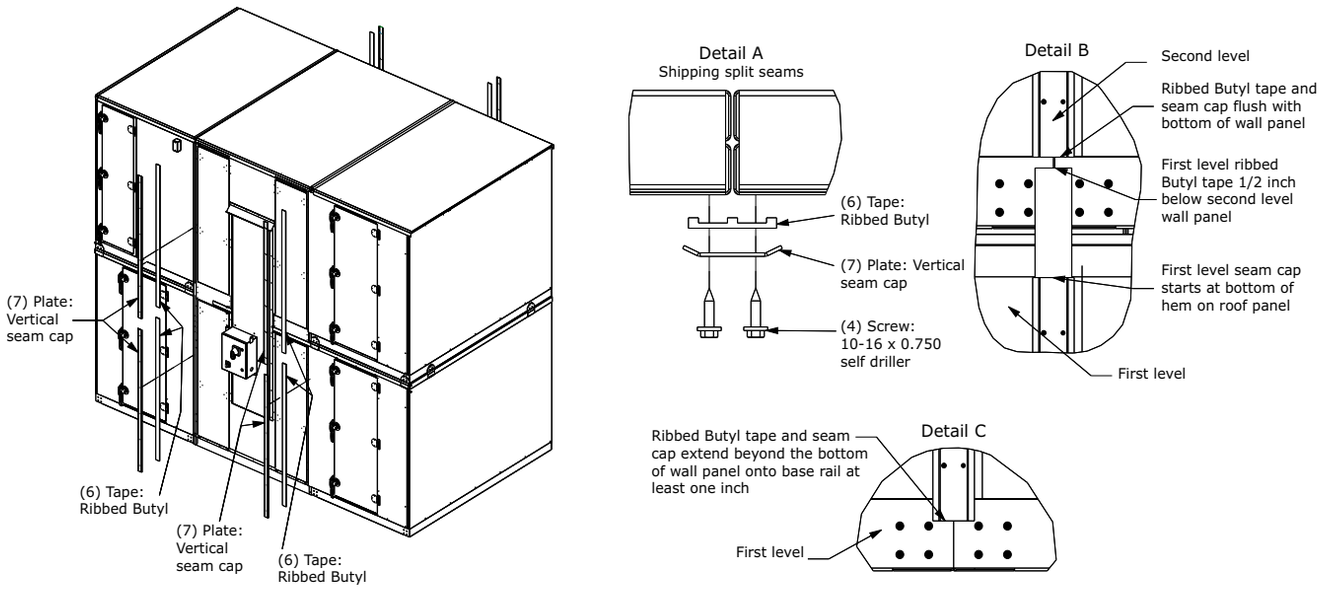
**Figure 40. Stacked unit assembly**



## Vertical Seam Cap Installation

1. See Figure 41. Apply ribbed Butyl tape (Item 6) over all vertical shipping split seams (see Detail A). First level ribbed Butyl tape (Item 6) starts 1/2 inch below second level wall panel (see Detail B), and extends down beyond the bottom of the first level wall panel onto the base rail at least one inch (see Detail C). Second level ribbed Butyl tape (Item 6) starts at bottom of wall panel on second level (see Detail B) and runs up to the top of the second level wall panel.
2. Secure vertical seam cap (Item 7) over ribbed Butyl tape (Item 6) with screws (Item 4) (see Detail A). First level vertical seam cap (Item 7) starts at bottom of hem on roof panels (see Detail B) and extends down onto the base rail at least one inch (see Detail D in Figure 46). Vertical seam cap (Item 7) on second level starts at bottom of wall panel and extends up (see Detail B). Second level vertical seam cap (Item 7) may extend onto the roof panel.

**Figure 41. Vertical seam cap installation**



## Flashing Installation

For additional information, see “Flashing Installation Notes” on page 42.

For hood installations, see “Install flashing and hood” on page 43.

1. See Figure 42. Apply Butyl tape (Item 8) to perpendicular-to-airflow flashing (Item 9) and secure to base rail with screws (Item 4) on front and back of unit (see Detail A in Figure 46).
2. For energy wheel/CDQ wheel, preassemble end covers (Item 10 and Item 11) to direction-of-airflow flashing (Item 12) with screws (Item 4). Apply caulk (Item 14) to create water tight seal (see Detail B in Figure 44).
3. Apply Butyl tape (Item 8) to direction-of-airflow flashing (Item 12) and secure to base rails with screws (Item 4). Start at corners to ensure tight corner seams. Apply caulk (Item 14) to create water-tight seal (see Detail A and Detail C in Figure 45).
4. Install seam covers (Item 13) to all flashing seams (see Detail D in Figure 46).

If second level of unit is shorter than first level, see “Flashing Installation for Stacked Unit With Second Level Shorter Than First” on page 40.

**Figure 42. Flashing installation**

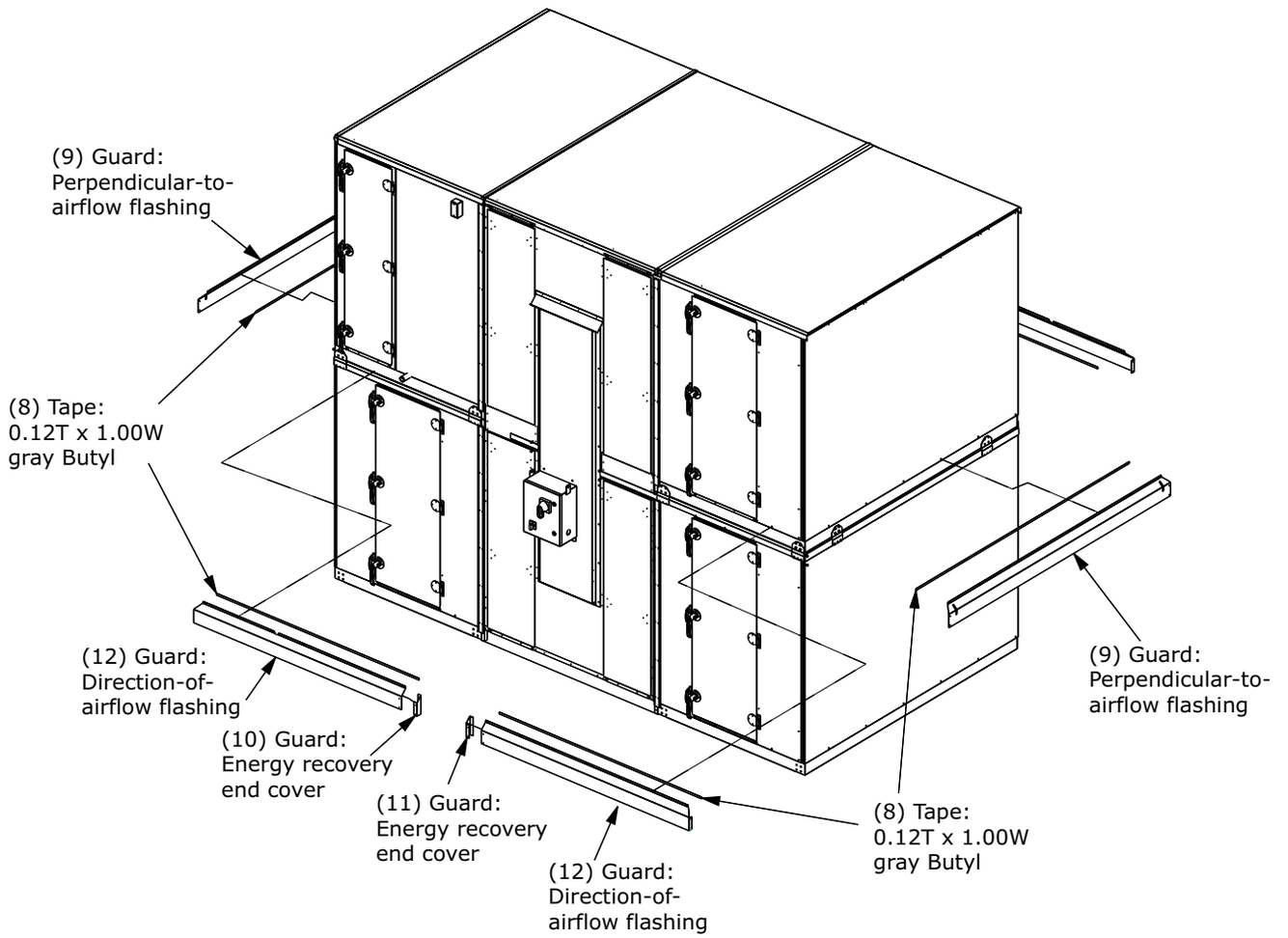


**Figure 43. Flashing installation location**

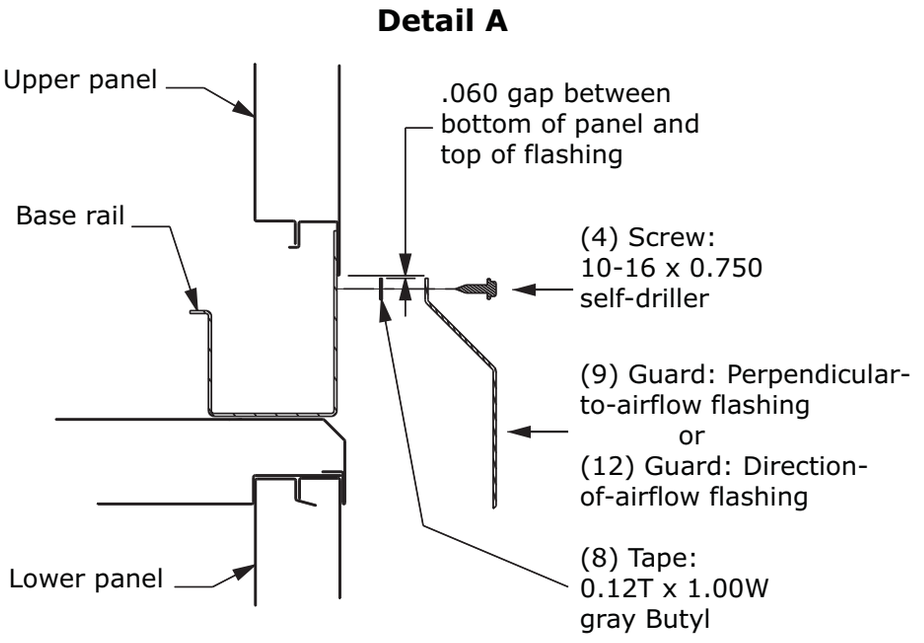



**Figure 44. Flashing end cover installation applied to energy wheels and CDQ sections**

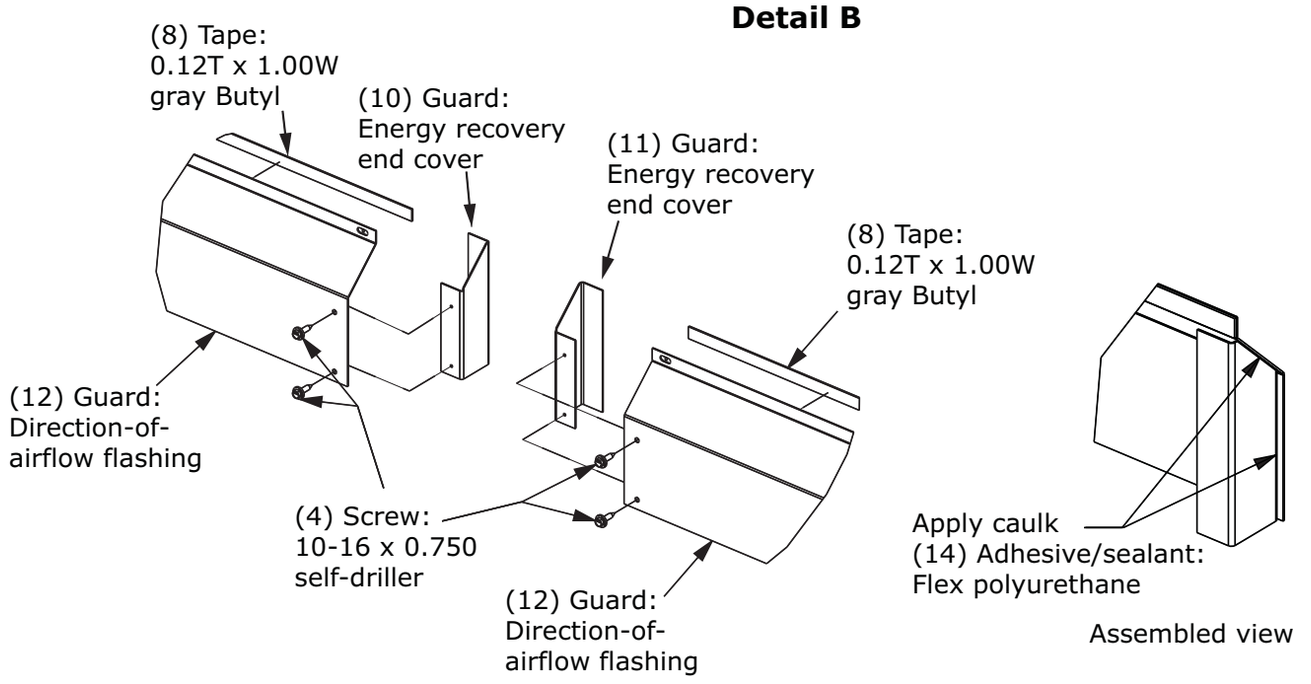


**Figure 45. Flashing for corner seams**

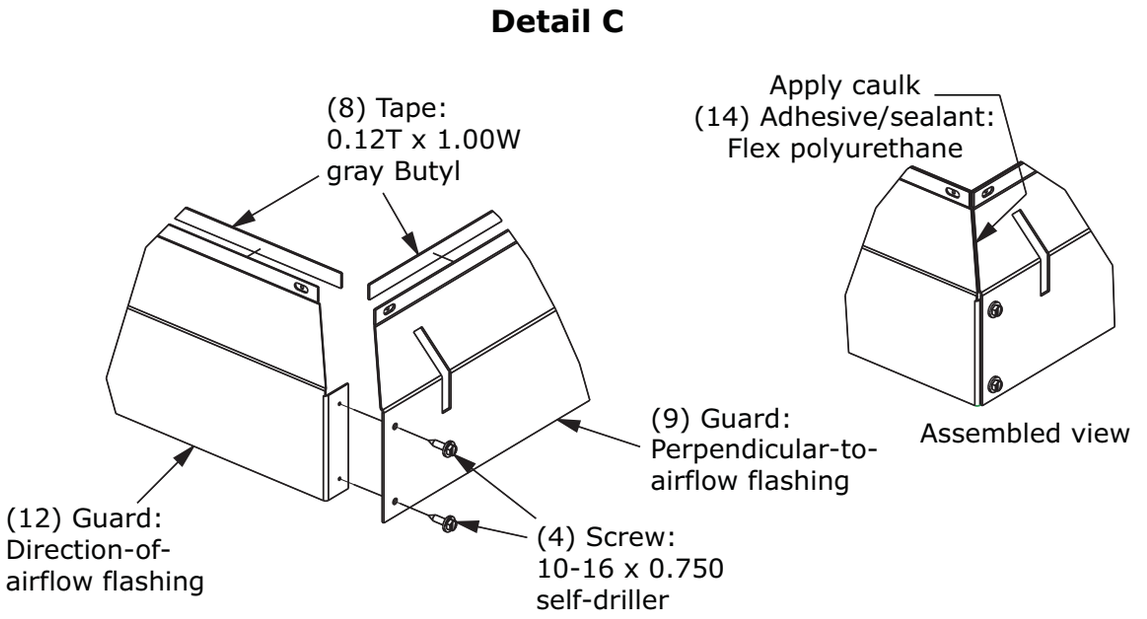
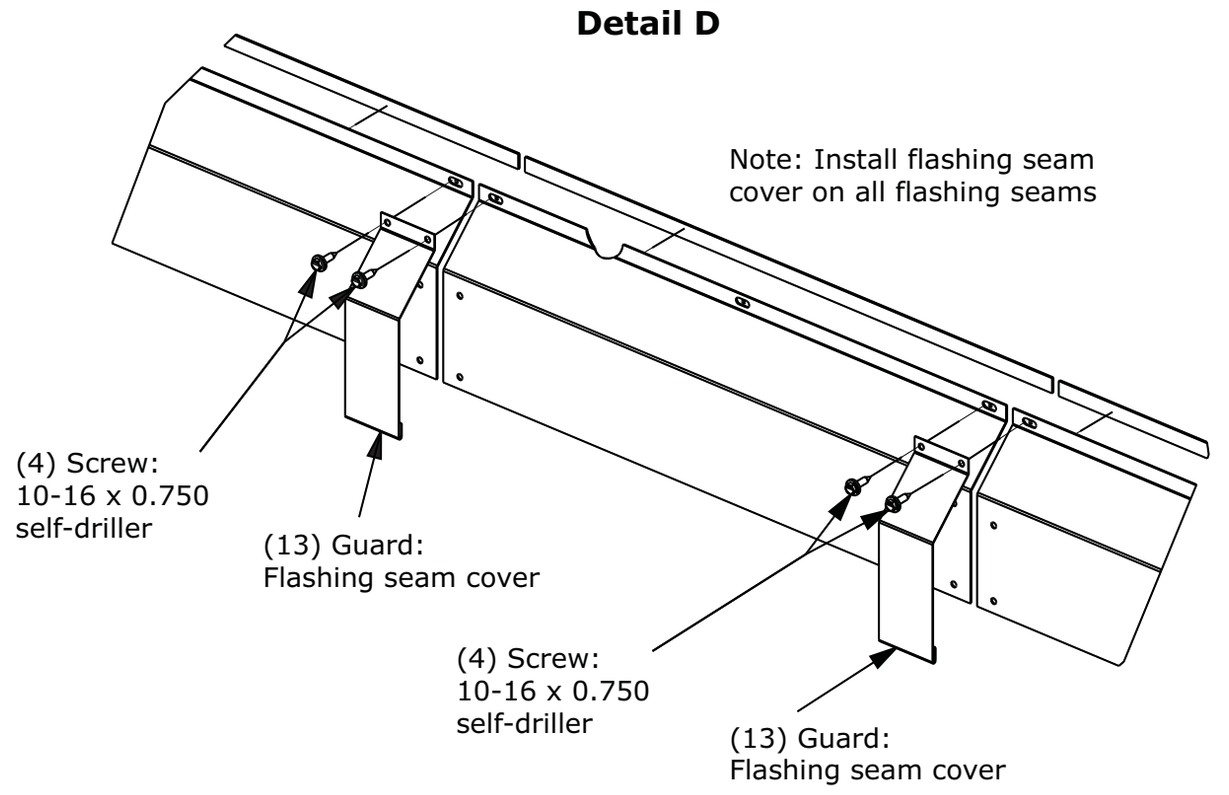


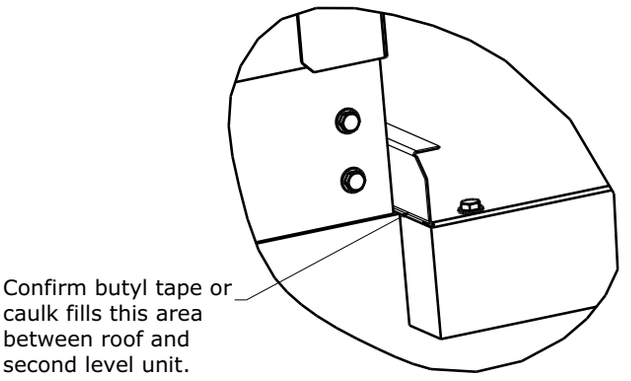

**Figure 46. Flashing seam cover installation**



## Flashing Installation for Stacked Unit With Second Level Shorter Than First

1. Ensure that first level roof section is properly sealed with Butyl tape (item 8) and/or caulk (Item 14) at the ends. See Figure 47.

**Figure 47. Seal first level with caulk or Butyl tape.**

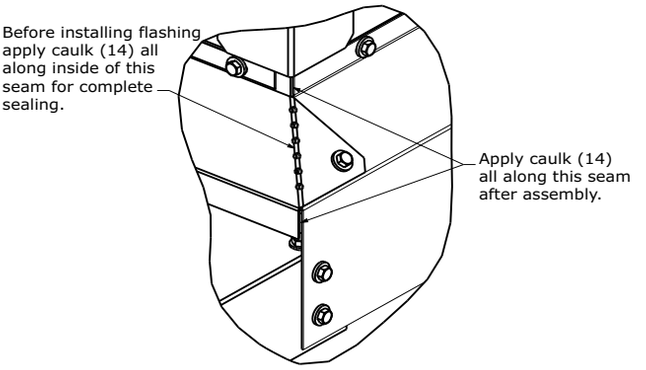



2. Bend end tabs by hand and apply Butyl tape (Item 8) to flashing. See Figure 48.

**Figure 48. Bend end tabs and apply Butyl tape to flashing.**

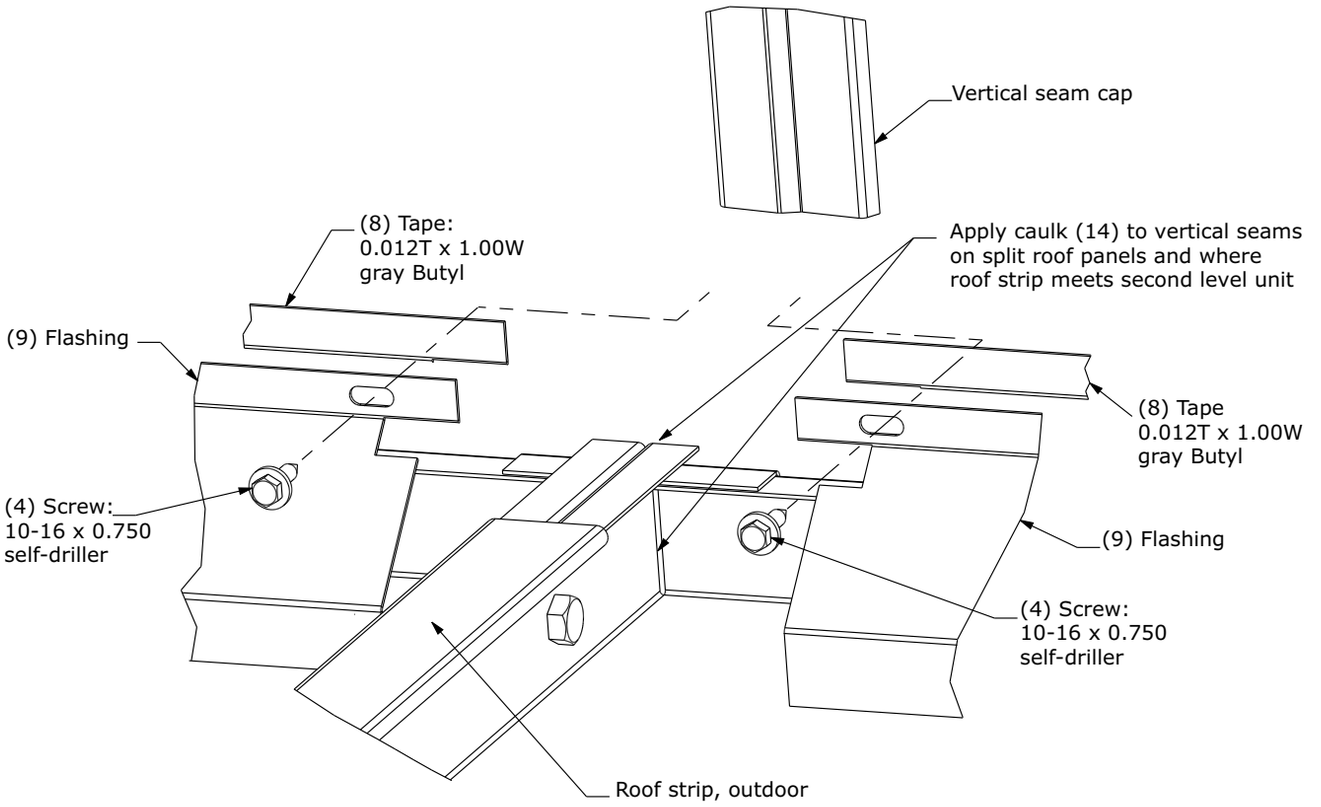
3. Secure to base rail with screws (Item 4).
4. Apply caulk (Item 14) to ensure a water tight seal. See Figure 49.

**Figure 49. Apply caulk to seal.**




5. For unit size 50 with a two piece roof, additional sealing is required in the middle where the first level roof sections meet with second level baserail. Seal vertical flanges of roof with caulk (Item 8) prior to installing flashing. Once flashing is installed, apply caulk (Item 8) to joint, then install direction of airflow roof strip and smooth caulk into crevices to ensure a water tight seal. See Figure 50.

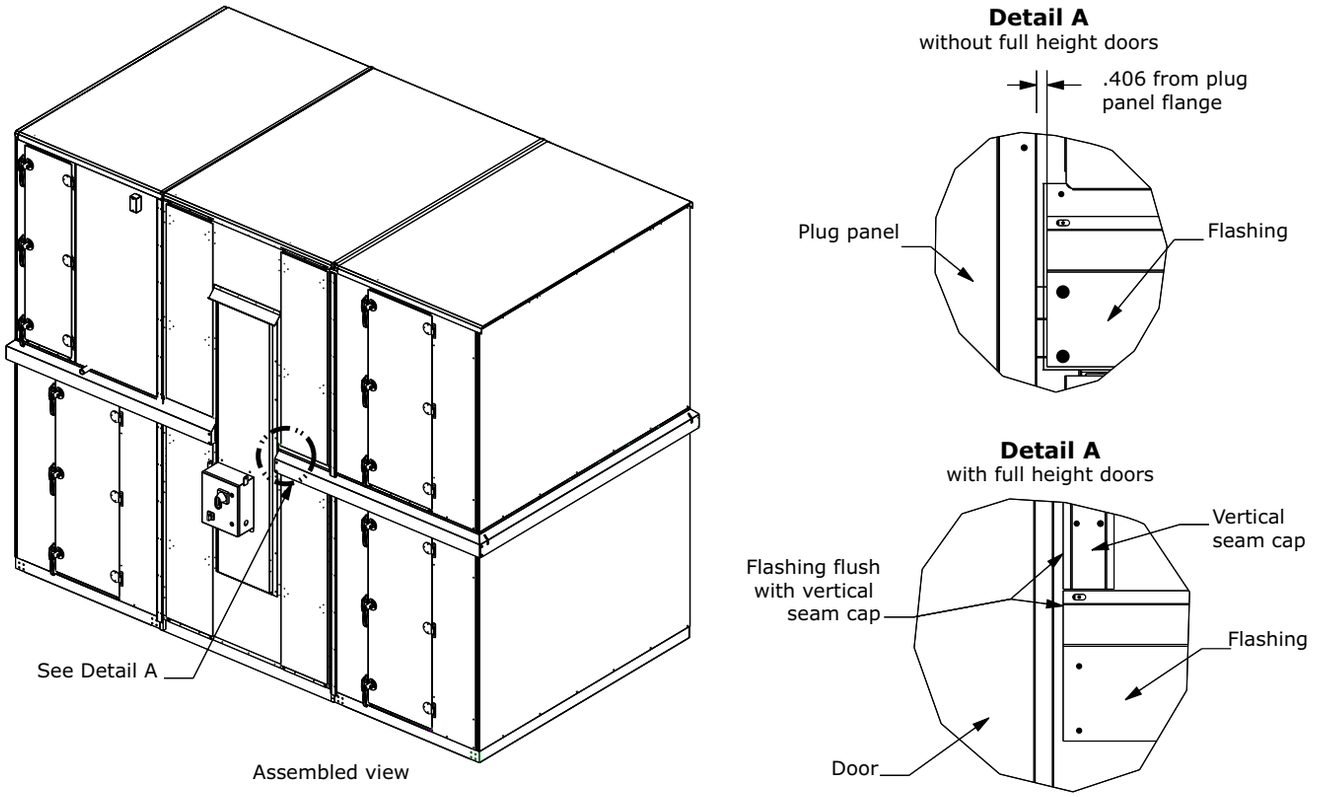
**Figure 50. Flashing installation for perpendicular-to-airflow piece if second level of unit is shorter than first level**



## Flashing Installation Notes

- Side flashing will have locating features:
  - Right side front and back pieces will have two diamonds and a tab. Intermediate right side pieces (if present) will have two diamonds and length of part will match the ship group length and mounting holes will match hole pattern on the unit.
  - Left side front and back pieces will have one diamond and a tab. Intermediate left side pieces (if present) will have one diamond and length of part will match the ship group length and mounting holes will match hole pattern on the unit.
- Flashing runs full length on right/left sides of unit except on access side when an energy recovery section is present. For energy recovery section without full height doors, flashing will extend to removable plug panel. For energy recovery section with full height doors, flashing will be flush with edge of vertical seam caps (see Detail A in Figure 51).
- Flashing runs full length on front/back of unit. Front/back flashing will not have any locating features and will always have mitre (one piece will have two mitres, two pieces will have one mitre).

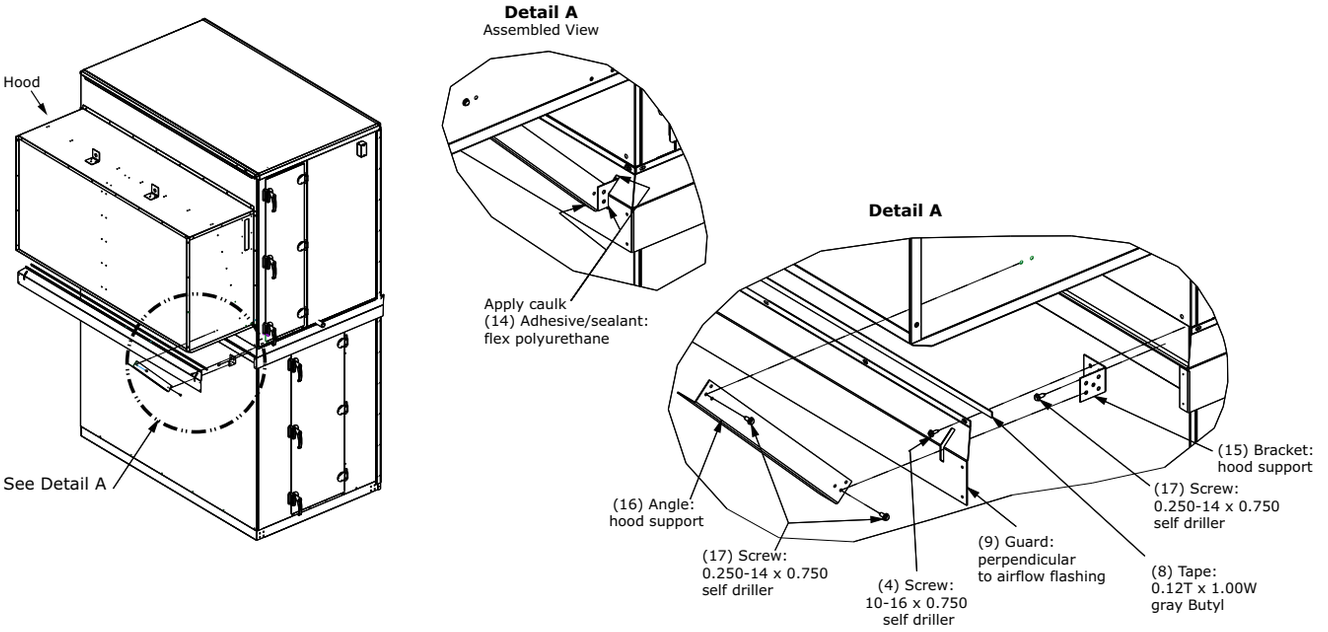
**Figure 51. Side flashing installation**



## Install flashing and hood

1. See Figure 52. Secure two hood support brackets (Item 15) to base rail with screws (Item 17).
2. Apply Butyl tape (Item 8) to flashing (Item 9) and place over hood support brackets (Item 15) using cut in flashing and secure to base rails with screws (Item 4).
3. See “Outdoor Unit Weather Hoods” on page 34 for hood installation instructions.
4. Secure hood support angles (Item 16) to hood support brackets (Item 15) and to the hood side panels with screws (Item 17).
5. Apply caulk (Item 14) around hood support bracket (Item 15), hood support angle (Item 16), and cutout in perpendicular-to-airflow flashing (Item 9) to ensure water-tight seal.

**Figure 52. Stacked unit assembly**



# Indoor Dual-Path SDU/Winterizer Assembly

**⚠ WARNING**

**Heavy Objects!**

**Do not stack air handlers unless factory-designed and factory-approved. When stacking units, factory-designed unit support brackets must be used. Stacking units without factory-approval and without factory-provided support brackets could result in the base unit collapsing under the weight of the top unit which could result in death or serious injury and property damage.**

A dual-path, Split Dehumidification Unit (SDU)/winterizer air handler consists of two units that are stacked together in a draw-thru arrangement that share one supply fan. The unit on the first level (primary unit) is designed to handle the return air and is larger than the unit on the second level (secondary unit), which is designed to handle outside air.

Factory-designed unit support brackets are provided with all factory-approved, dual-path SDUs or winterizer air handlers.

- A horizontal SDU/winterizer dual-path air handler incorporates a horizontal supply fan on the first level with a top opening in the primary unit that aligns with a bottom opening in the secondary unit.
- A vertical SDU/winterizer dual-path air handler incorporates a vertical supply fan on the second level with a back opening that aligns with a front opening in the secondary unit.

To assemble air handlers utilizing factory-approved and factory-provided dissimilar unit sizes for horizontal SDU or winterizer applications, join all similar size shipping sections per “Section-to-Section Assembly” on page 26.

## Horizontal SDU/Winterizer Assembly

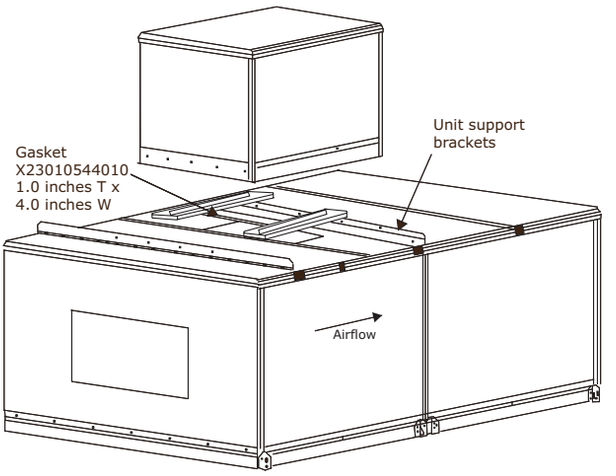
To assemble dissimilar unit sizes for an indoor horizontal SDU/winterizer configuration:

1. Locate the mounting hardware and gasket material.

*Note: Black unit support brackets ship pre-installed on the primary (larger) unit section.*

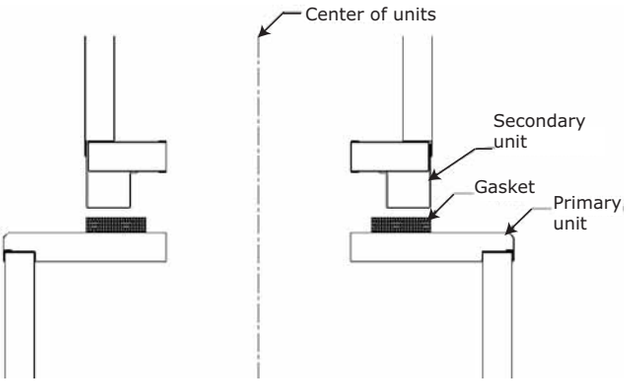
2. Apply gasket in direction of airflow between the black unit support brackets to the roof of the primary unit. See Figure 53. The gasket needs to be placed such that it will be directly under the integral base frame of the secondary (smaller) unit to be stacked on top. The secondary unit will be centered along the width on the primary unit.

**Figure 53. Apply gasket in direction of airflow**



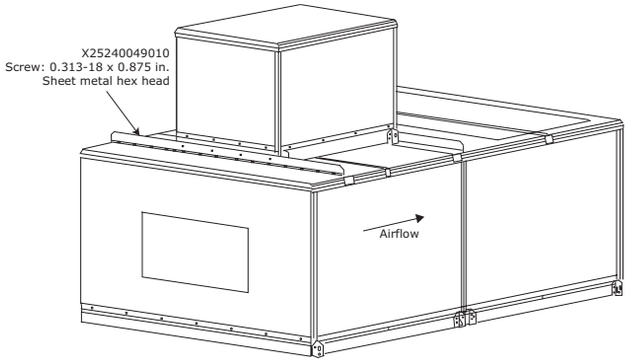

3. If there is an opening in the roof of the primary unit, apply gasket perpendicular to airflow on the roof next to the opening (air entering side only).
4. Lift the secondary unit, following instructions in “General Lifting Considerations” on page 21 (see Figure 14), and place on the black unit support brackets (see Figure 54). The secondary unit must be centered on the primary unit between the black unit support brackets.

**Figure 54. Place secondary unit on black unit support brackets.**



5. Install screws as shown in Figure 55 inserting the appropriate screws using a powered impact gun and taking care not to strip the screws.
6. Remove the secondary unit lifting lugs one at a time and reinstall screws after sections are set in final position.

**Figure 55. Install screws using powered impact gun.**

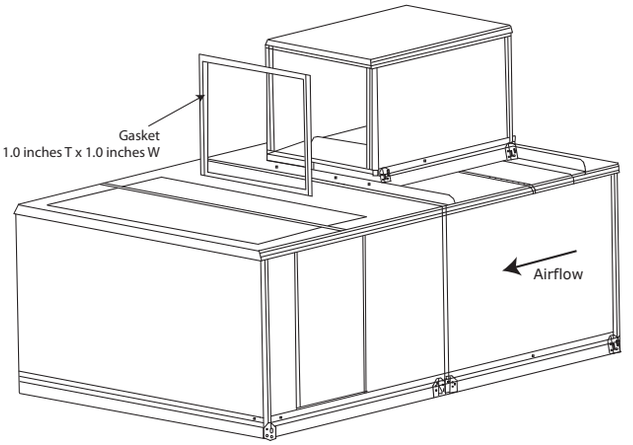



## Vertical SDU/Winterizer Assembly

To assemble dissimilar unit sizes for an indoor vertical SDU/winterizer configuration:

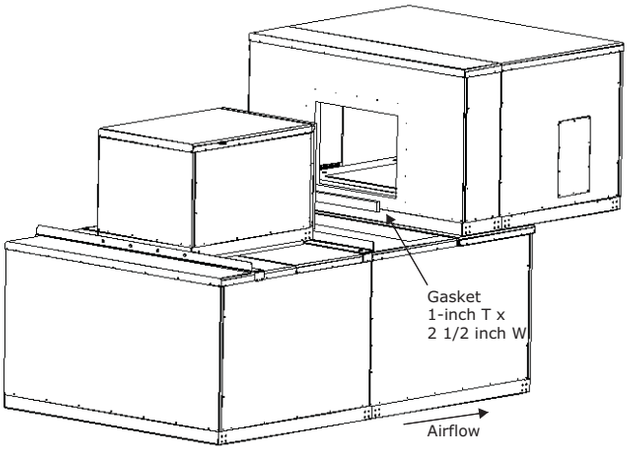
1. Apply gasketing to the mating surface of the secondary unit (see Figure 56).

**Figure 56. Apply gasketing to mating surface of secondary unit**



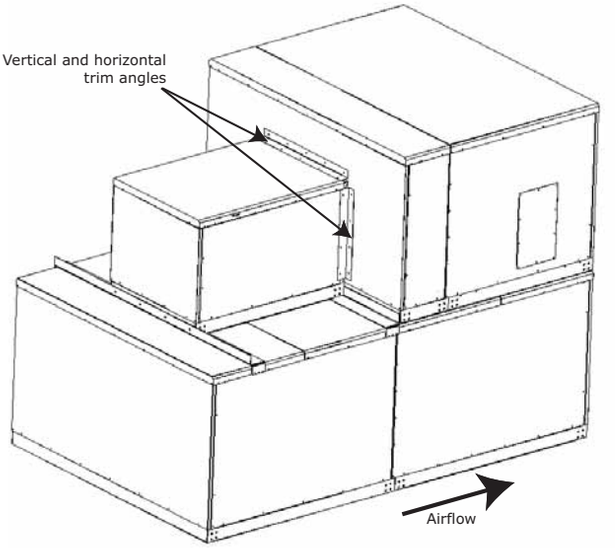

2. Apply gasketing to the mating surface of the primary unit at the bottom of the opening (see Figure 57.

**Figure 57. Apply gasketing to the mating surface of the primary unit.**




3. Lift the secondary unit, follow instructions in “General Lifting Considerations” on page 21 (see Figure 14), and place on the black unit support brackets (see Figure 54, p. 44. The secondary unit must be centered on the primary unit between the black unit support brackets.
4. Install trim angles as shown in Figure 58 inserting the 10-16 x 3/4-inch self-drilling screws using a powered impact gun and taking care not to strip the screws.

**Figure 58. Install trim angles**



# External Raceway Assembly

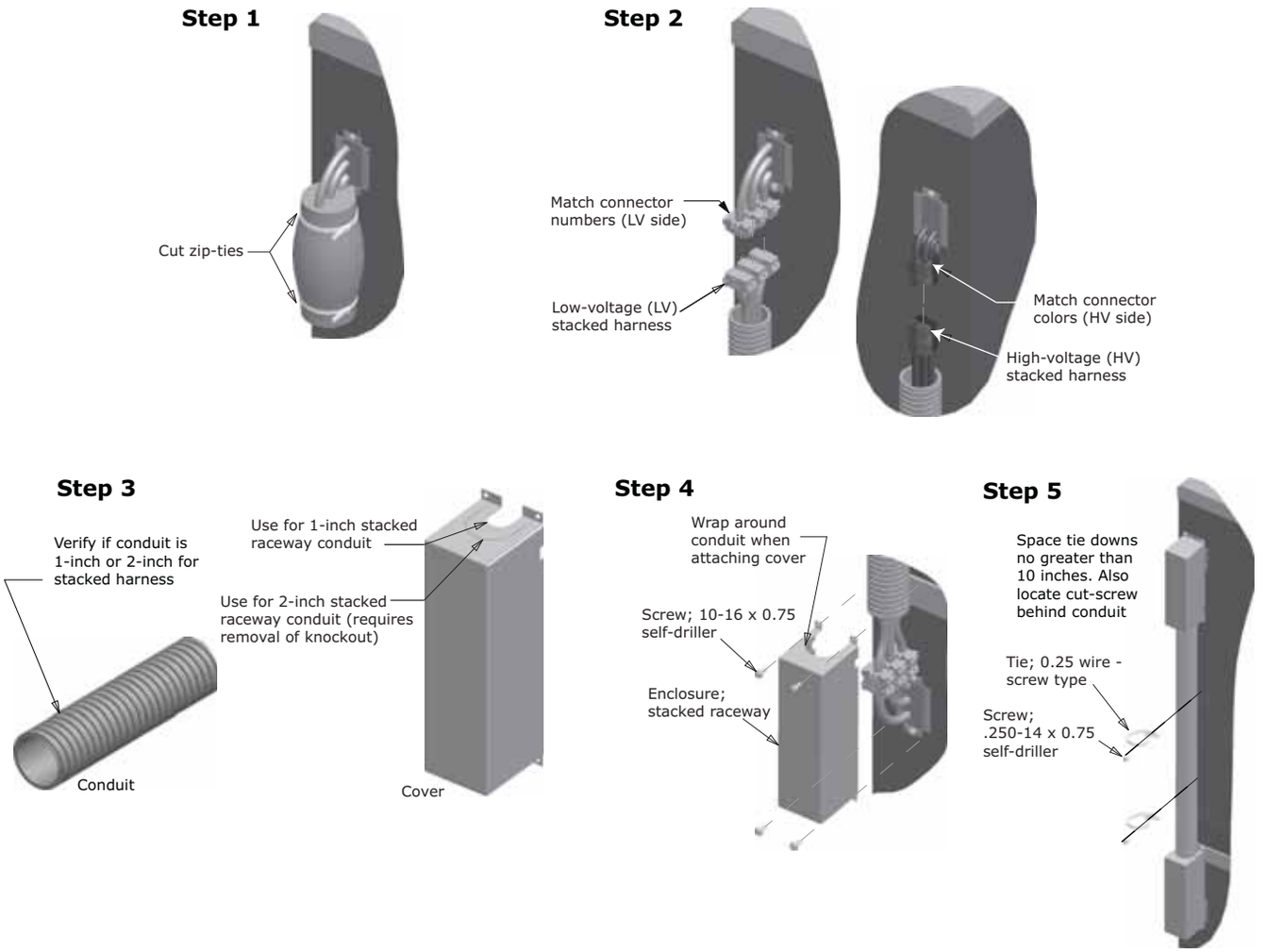
For air handling units with factory-installed power wiring extending from the first level to the second level, wiring must be connected and assembled in a raceway. See Figure 59.

1. Cut zip ties. Remove protective foam cover from connectors.
2. Attach stacked raceway harness connectors, matching connector colors on the high voltage side and connector numbers on the low voltage side.
3. Verify conduit size.
4. Attach covers.
5. Secure conduit.

***Part numbers:***

- Indoor
  - External Raceway Kit: KIT09713
- Outdoor
  - External Raceway Kit - Top: KIT16191
  - External Raceway Kit - Bottom: KIT16192

**Figure 59. External raceway**



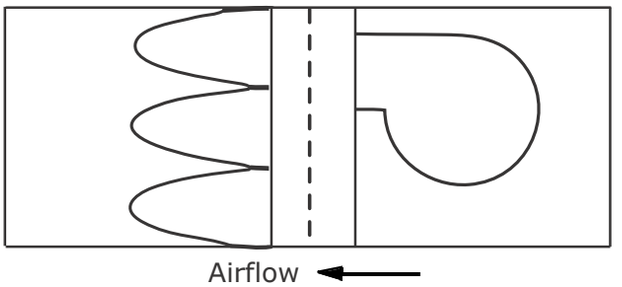
# Component Installation Requirements

The components in the air handler may have installation requirements that could affect the unit's performance.

## Diffuser Section

Diffuser sections are usually placed between a fan and a downstream coil or filter. Because placement is critical to unit performance, verify the correct placement of the diffuser section before assembling the unit (see Figure 60).

**Figure 60. Diffuser placement sizes 3 to 120**




## Filter Section

Bag and cartridge filter sections can be used as a pre-filter section, a final filter section, or both. This use is determined by the filter's placement in relation to the fan.

- A final filter is placed after the fan.
- A pre-filter is placed before the fan.

*Note: Cartridge and bag filters provided by Trane are fitted with a 7/8-inch header that fits in the filter track. If using filters supplied by another manufacturer, filters should be purchased with a 7/8-inch header. In some cases it may be necessary to gasket other manufacturers' filters to ensure a good air seal.*

Filters should be installed when the unit is set. This will protect internal components, such as the heating and cooling coils.

### Final Filter Section

A final filter section should not be bolted directly to the face of a fan section. One or more intermediate sections must be placed between the fan discharge and the filter section.

### Pre-Filter Section

A pre-filter section has no special installation requirements unless placed directly upstream of a plenum fan. In these configurations, ensure a blank section is placed between the fan inlet and the filter section.

Trane recommends the use of disposable pre-filters with high-efficiency filters. Disposable pre-filters slide into the mounting tracks just ahead of the bag/cartridge filters.

### Filter Installation

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

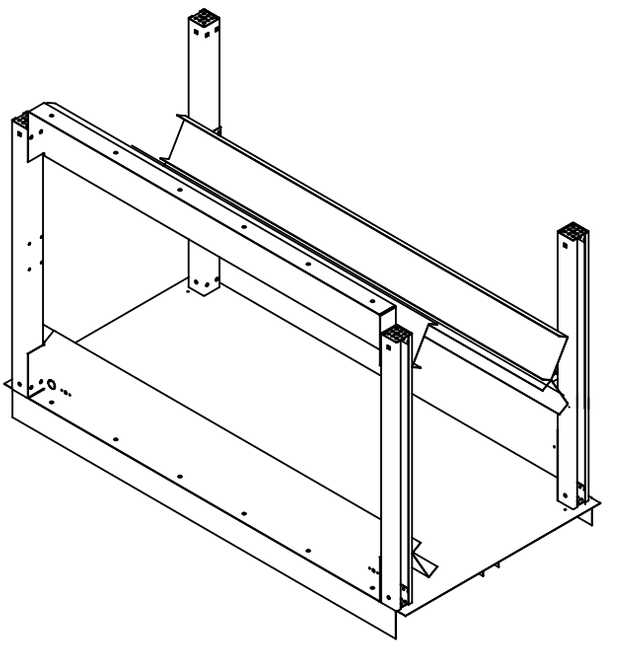
To install filters:

1. Disconnect the power to the unit.
2. Open the filter section access door.
3. Slide the filters into the tracks.

*Note: Bag filters must be installed with the pleats in the vertical plane.*

4. The block-off is permanently installed and will create a seal when the access door is closed.
5. Close the access door slowly to allow any gasketing to compress.

**Figure 61. Filter block-off placement**



## Filter Placement

**Figure 62. 2-inch and 4-inch flat filter placement for unit sizes 3-50 - side loading**

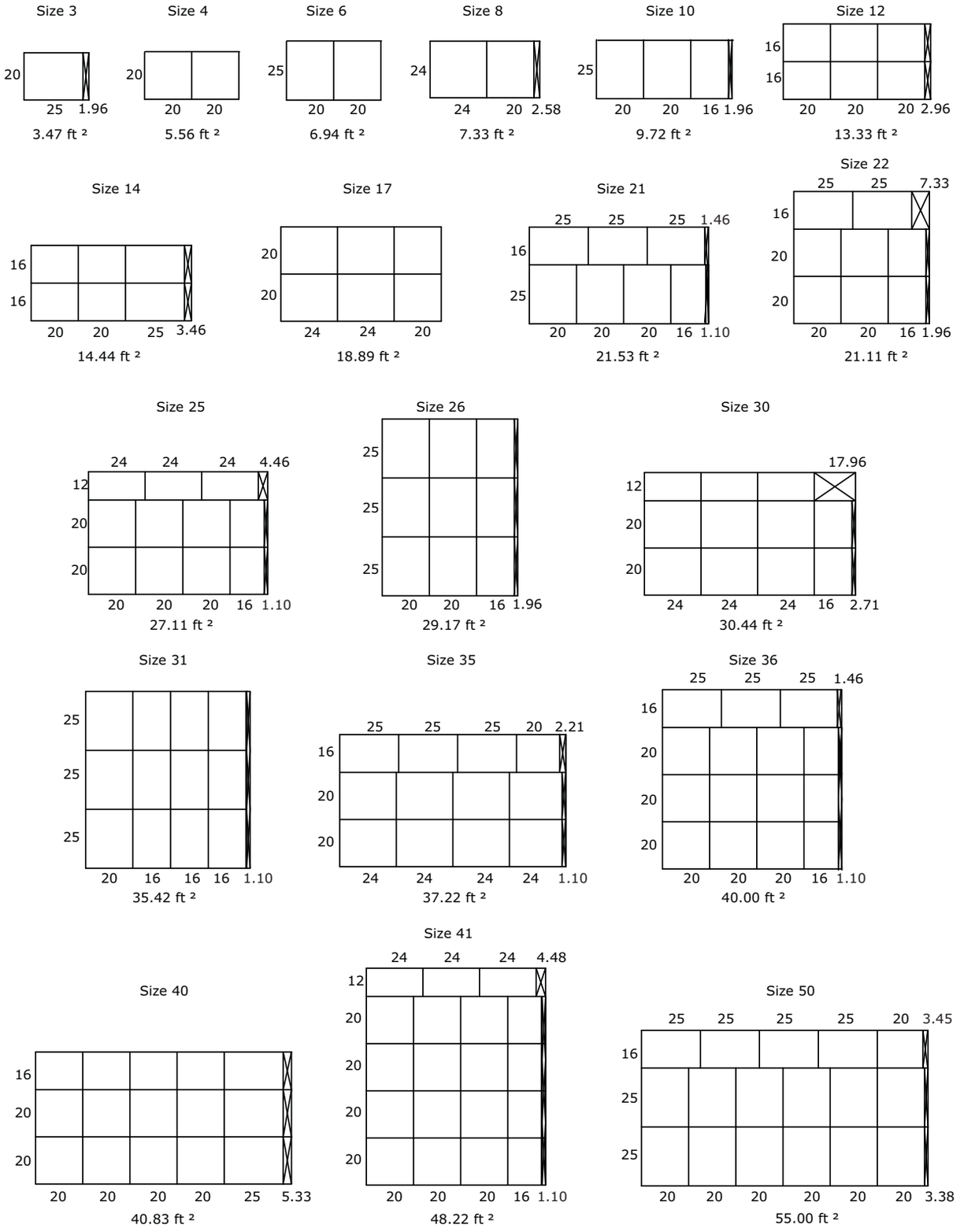
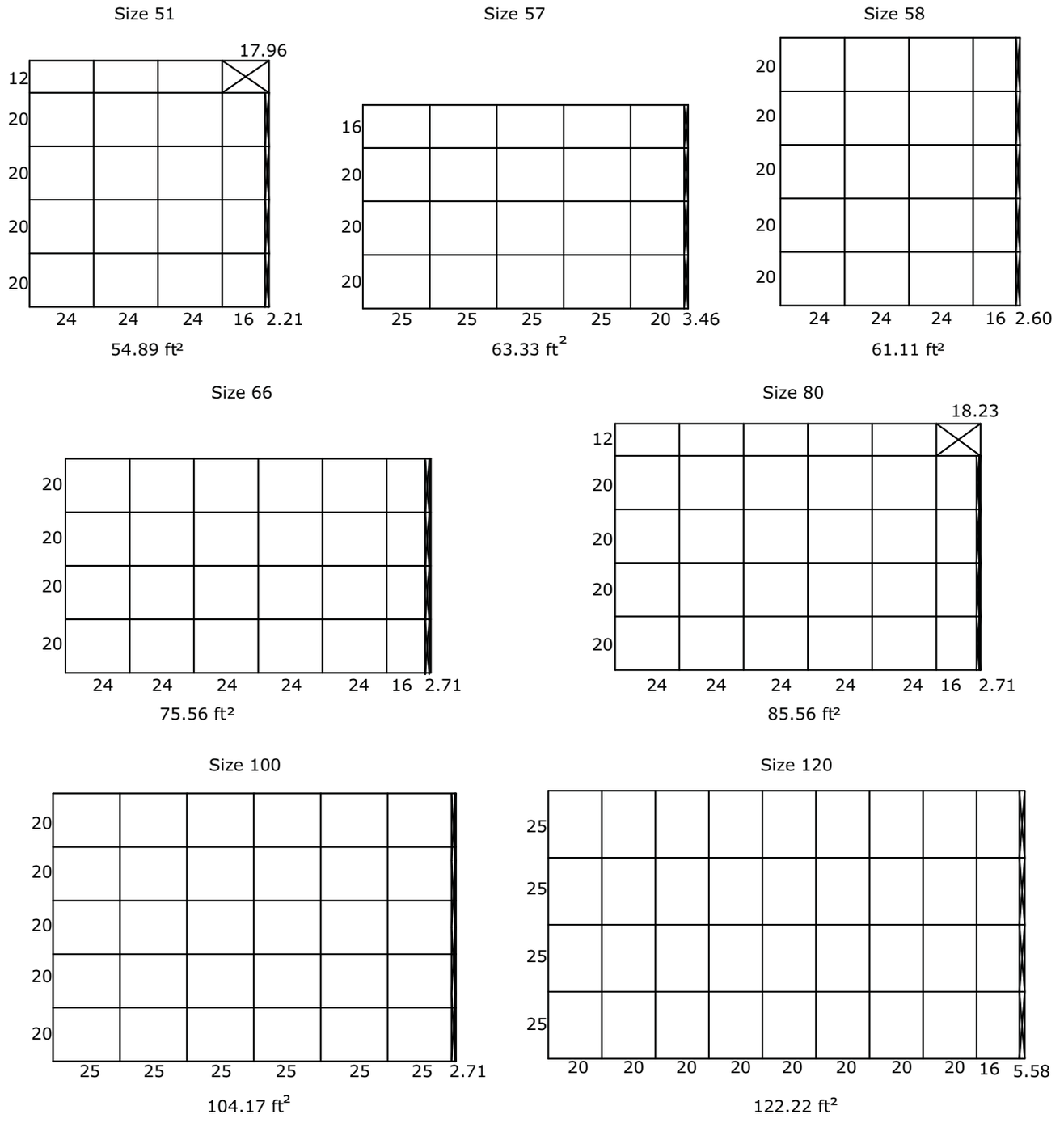


**Figure 63. 2-inch and 4-inch flat filter placement for unit sizes 51-120 - side loading**




Filter racks have a 1.5 ft T x 1.0 ft W gasket (X23010565010) applied to blockoff.

**Figure 64. 2-inch/4-inch combination flat filter placement for unit sizes 3-50 - side loading**

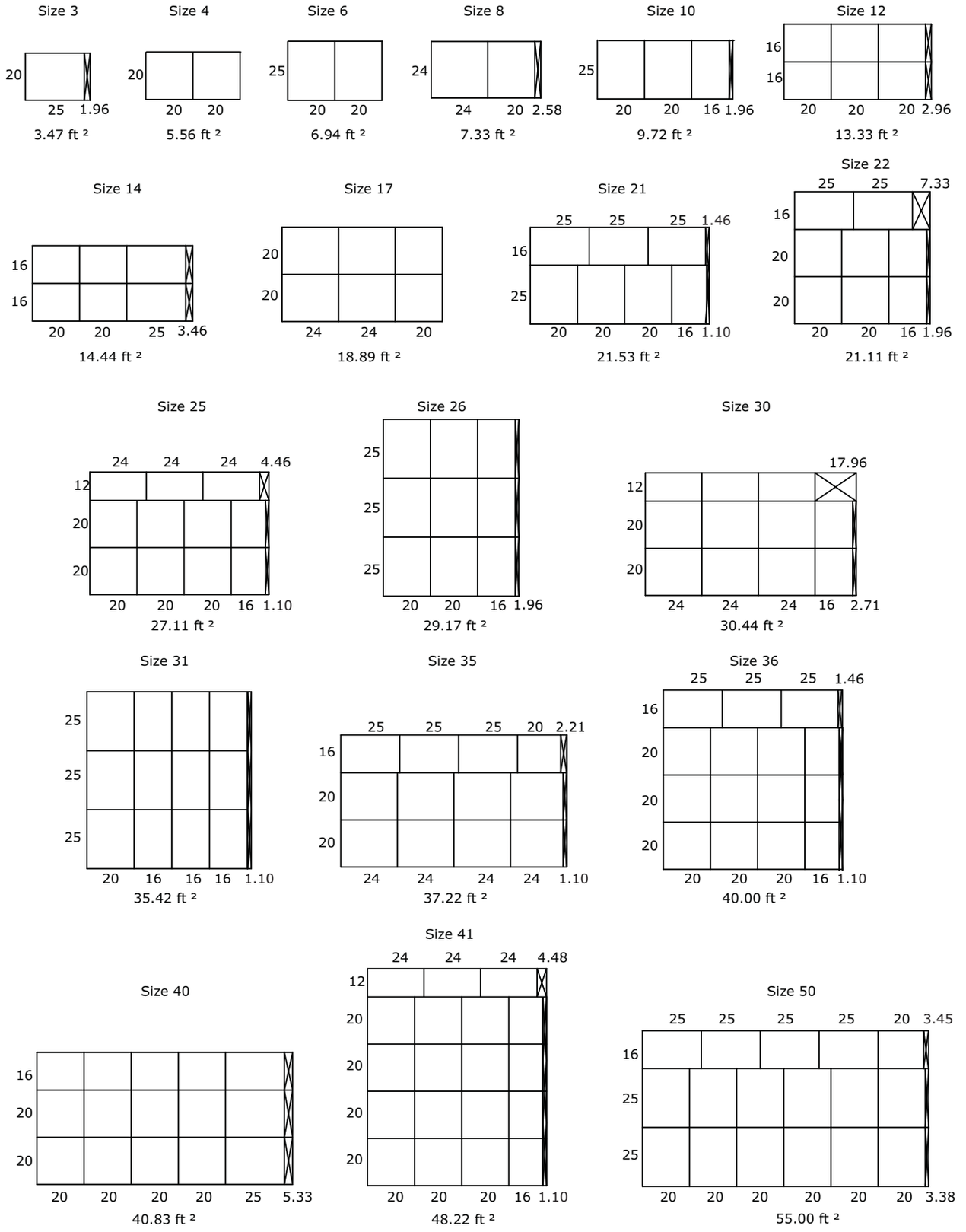
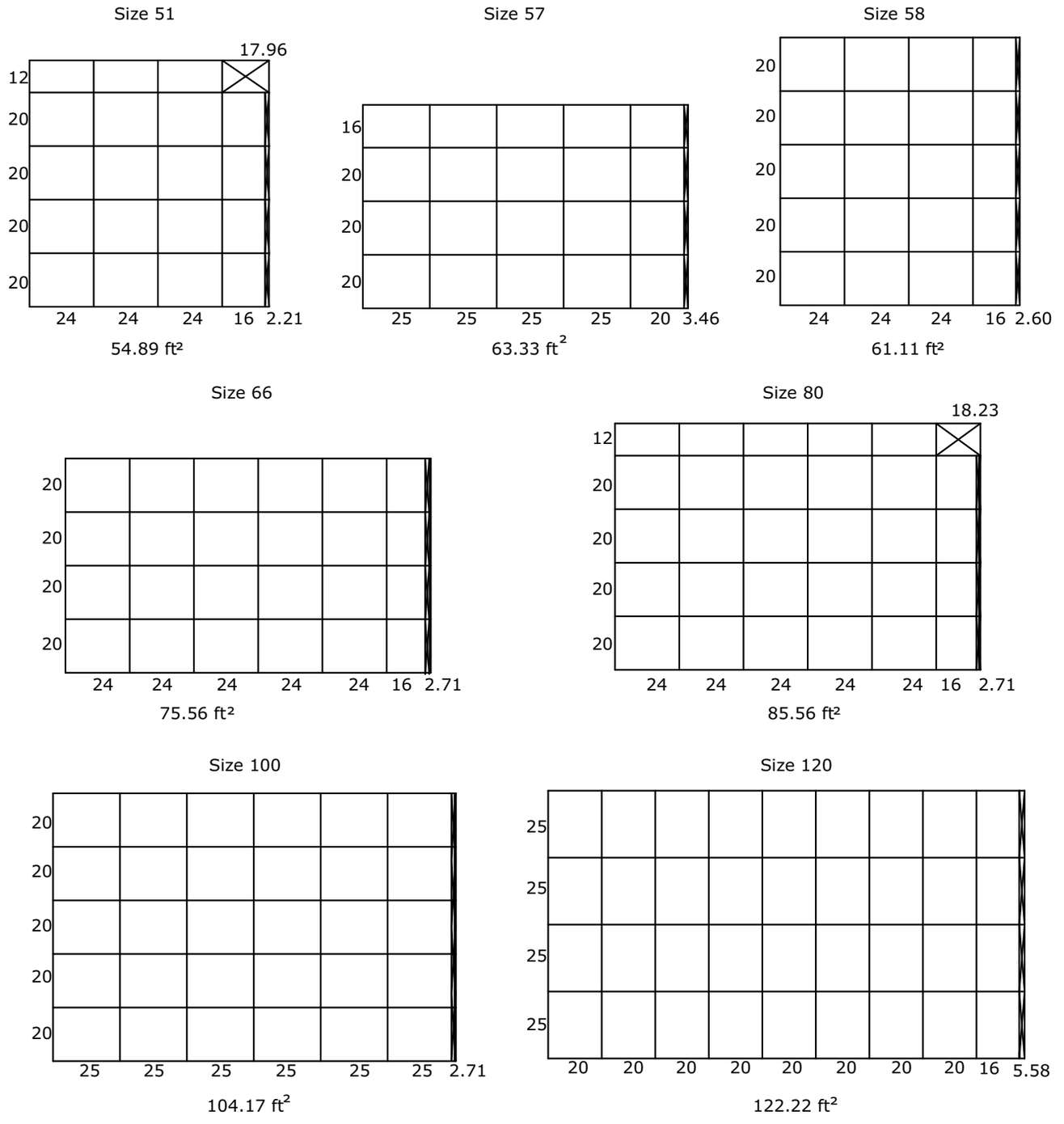


**Figure 65. 2-inch/4-inch combination flat filter placement for unit sizes 51-120 - side loading**




Filter racks have a 1.5 ft T x 1.0 ft W gasket (X23010565010) applied to blockoff.

**Figure 66. 2-inch and 4-inch angled filter placement for unit sizes 3-50 - side loading**

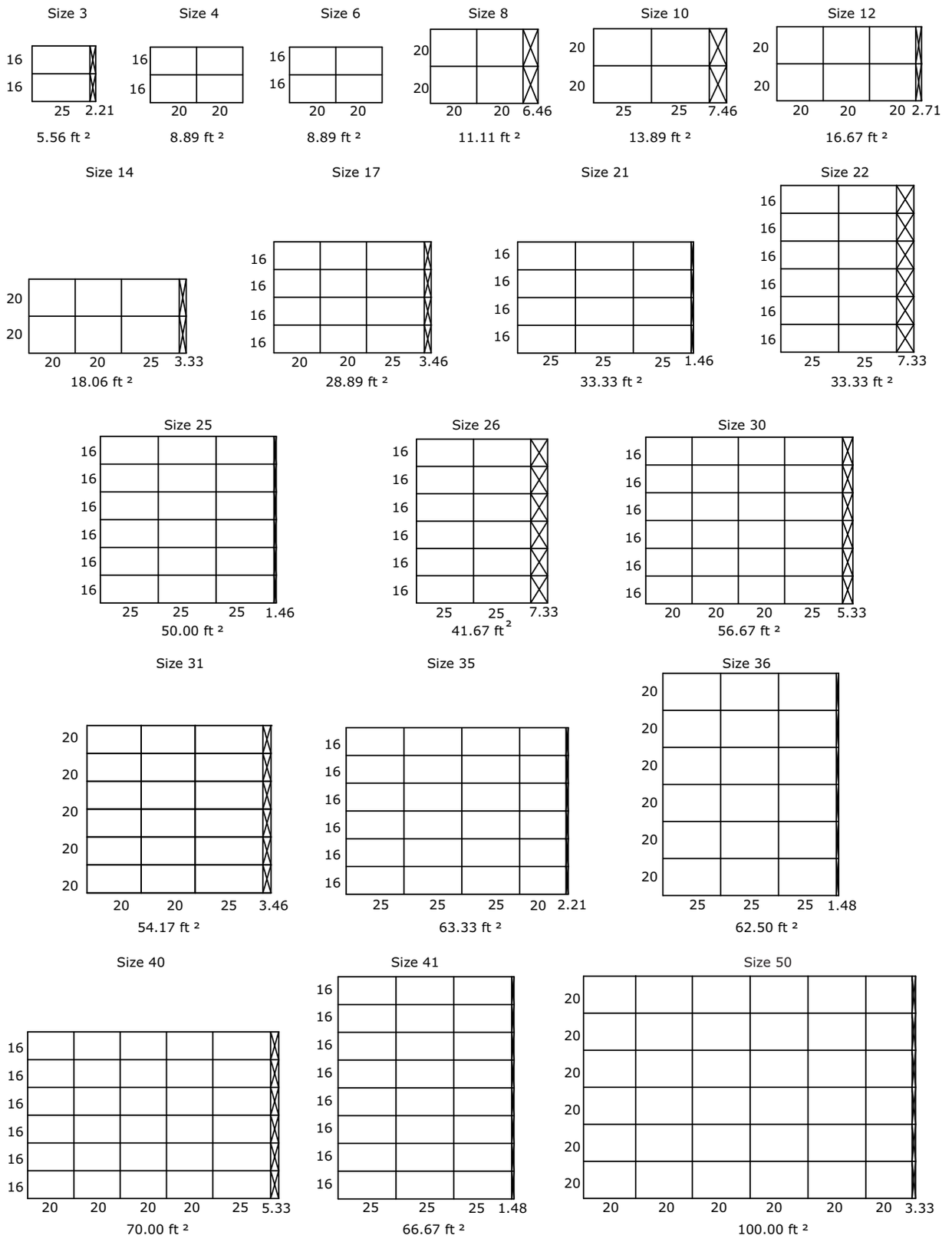
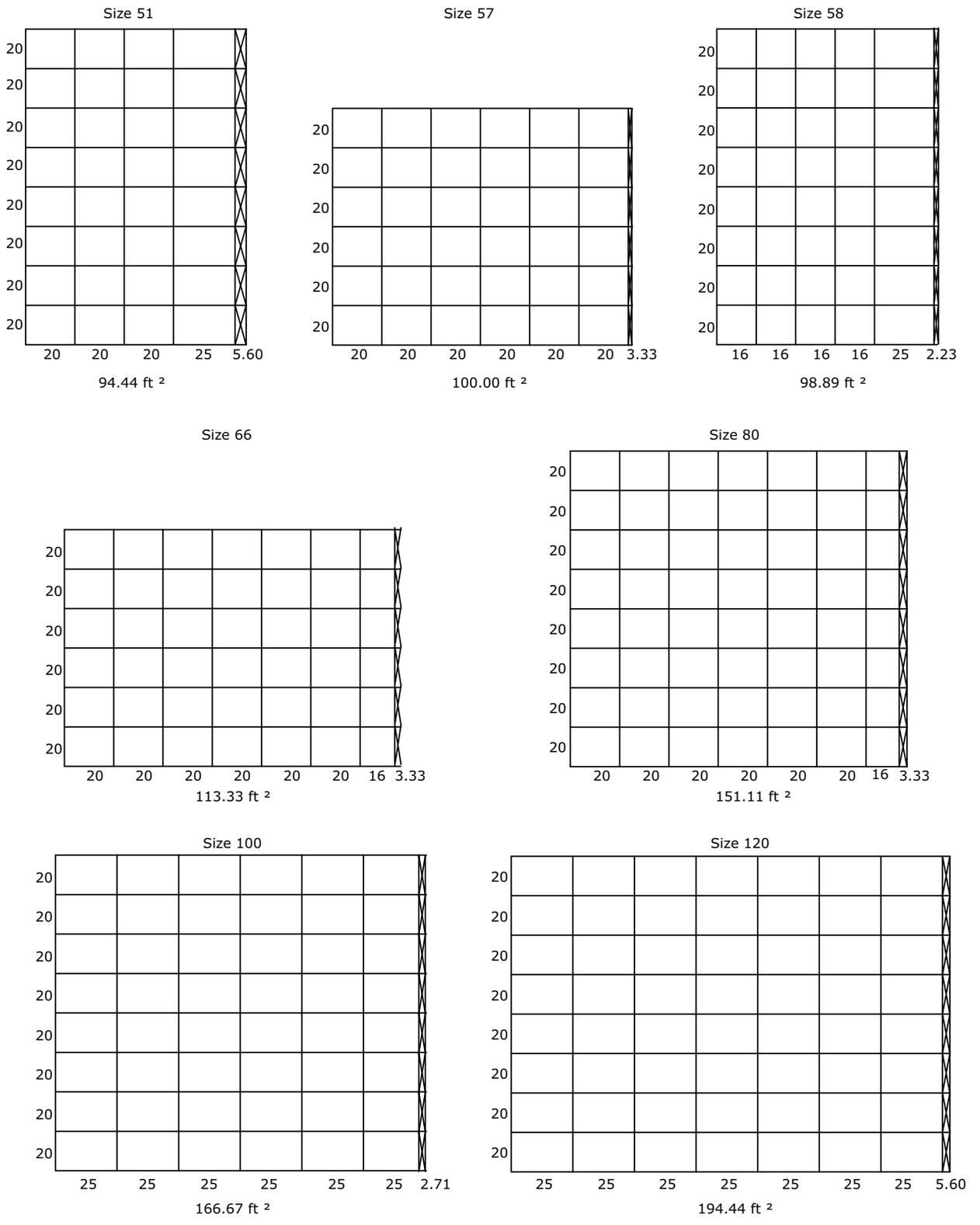


**Figure 67. 2-inch and 4-inch angled filter placement for unit sizes 51-120 - side loading**




Filter racks have a 1.5 ft T x 1.0 ft W gasket (X23010565010) applied to blockoff.

**Figure 68. Long bag filter placement for unit sizes 3-50 - side loading**

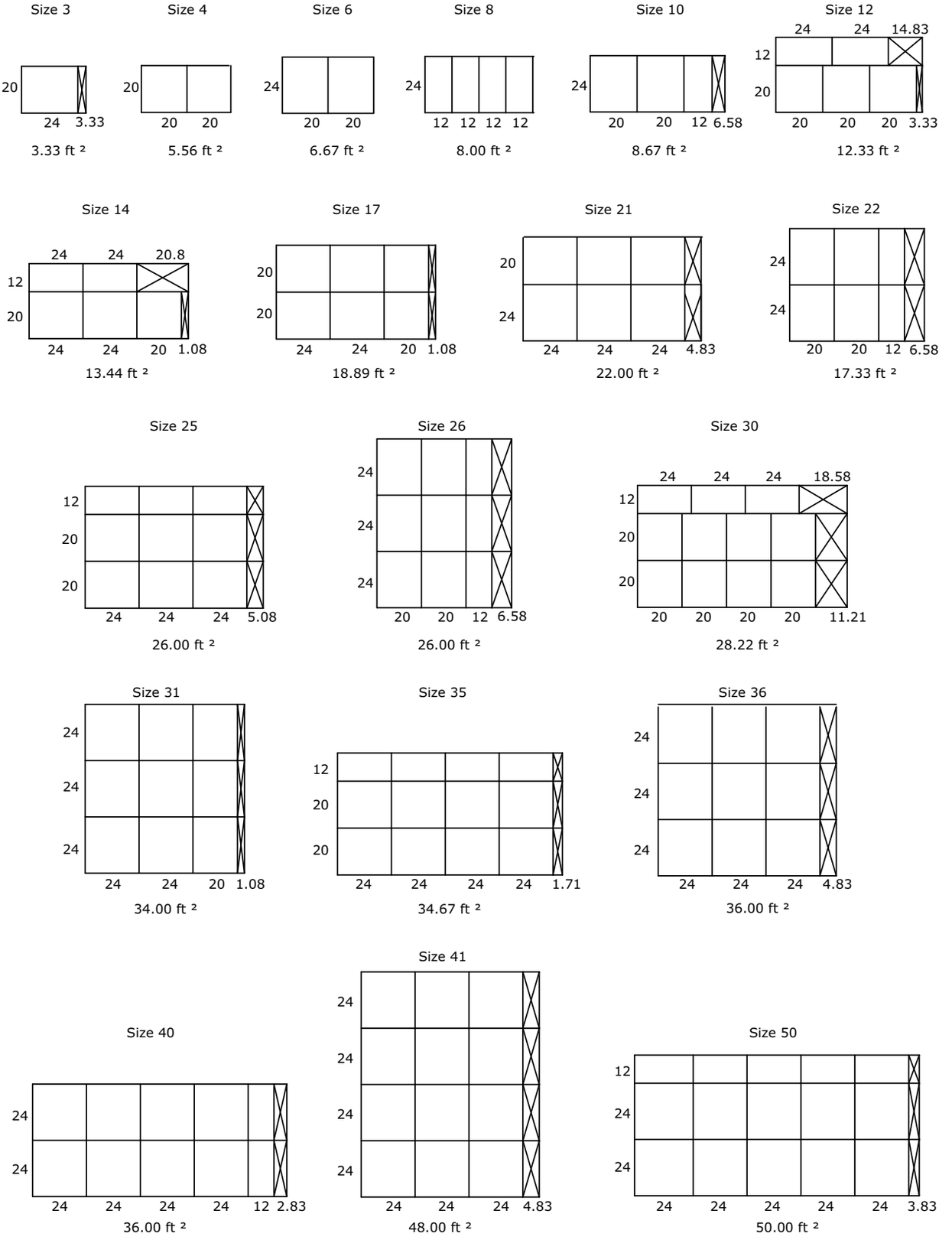
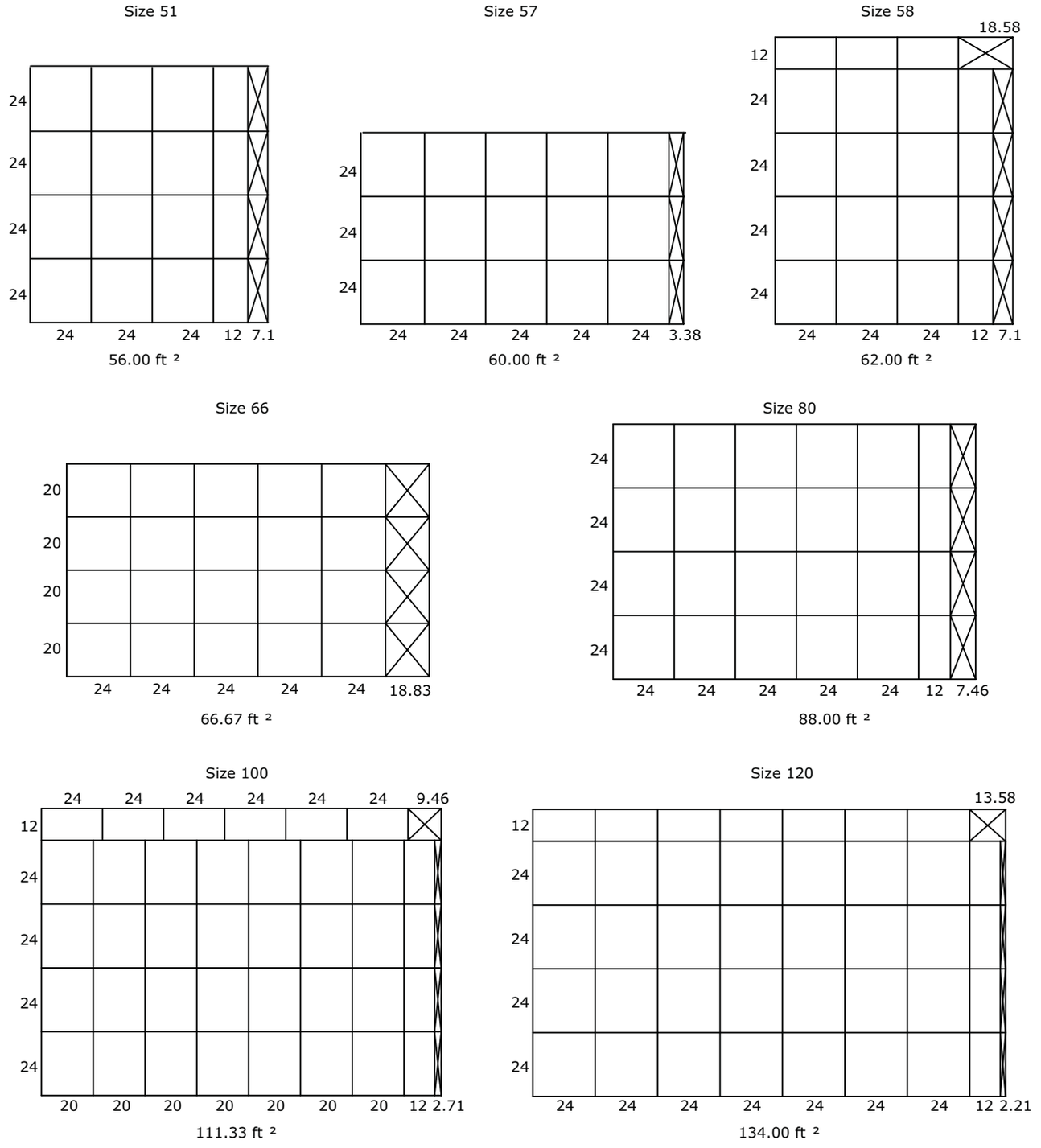


**Figure 69. Long bag filter placement for unit sizes 57-120 - side loading**




Filter racks have a 1.5 ft T x 1.0 ft W gasket (X23010565010) applied to blockoff.

**Figure 70. Short bag filter placement for unit sizes 3-50 - side loading**

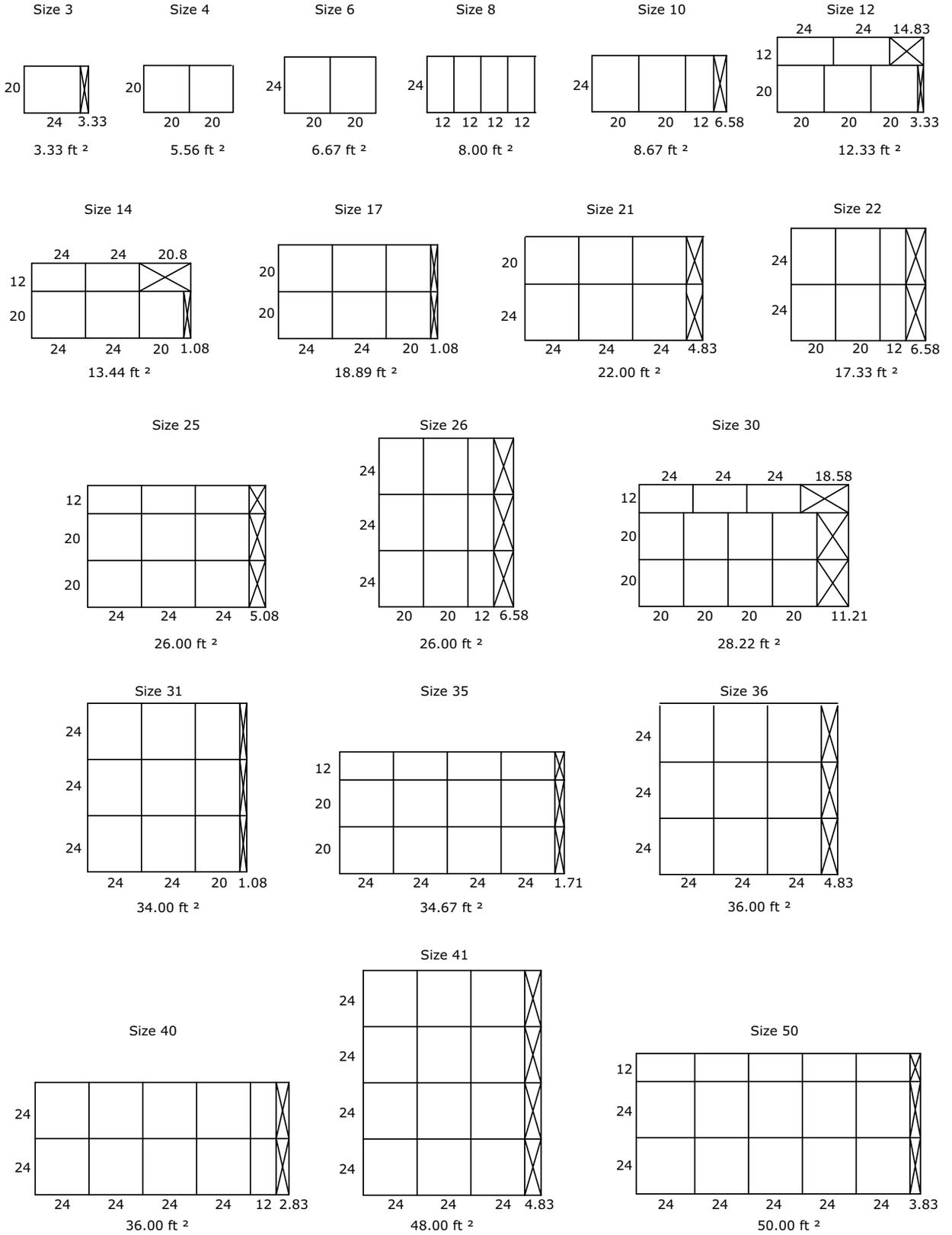
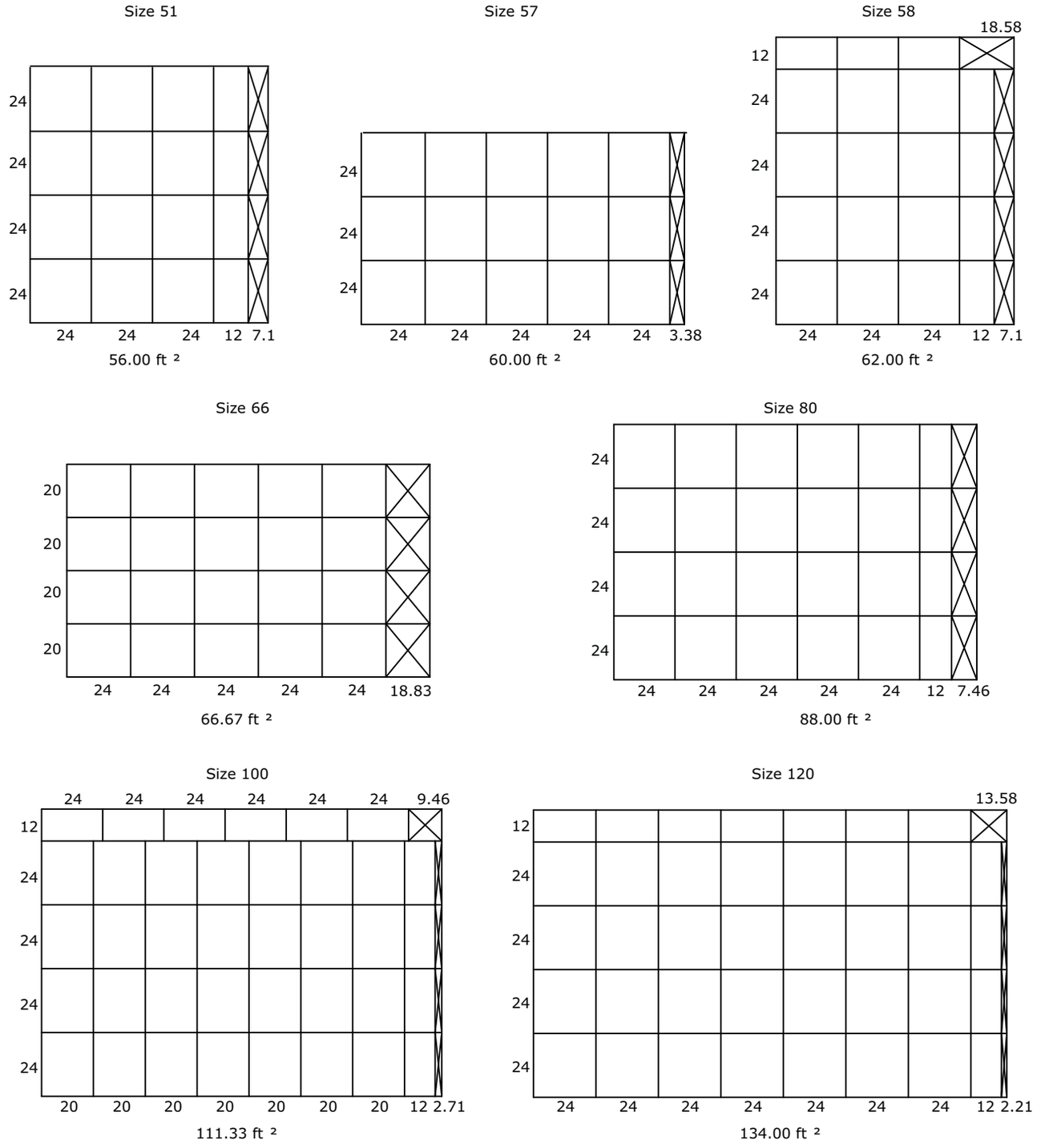


**Figure 71. Short bag filter placement for unit sizes 51-120 - side loading**




Filter racks have a 1.5 ft T x 1.0 ft W gasket (X23010565010) applied to blockoff.

**Figure 72. Cartridge filter placement for unit sizes 3-50 - side loading**

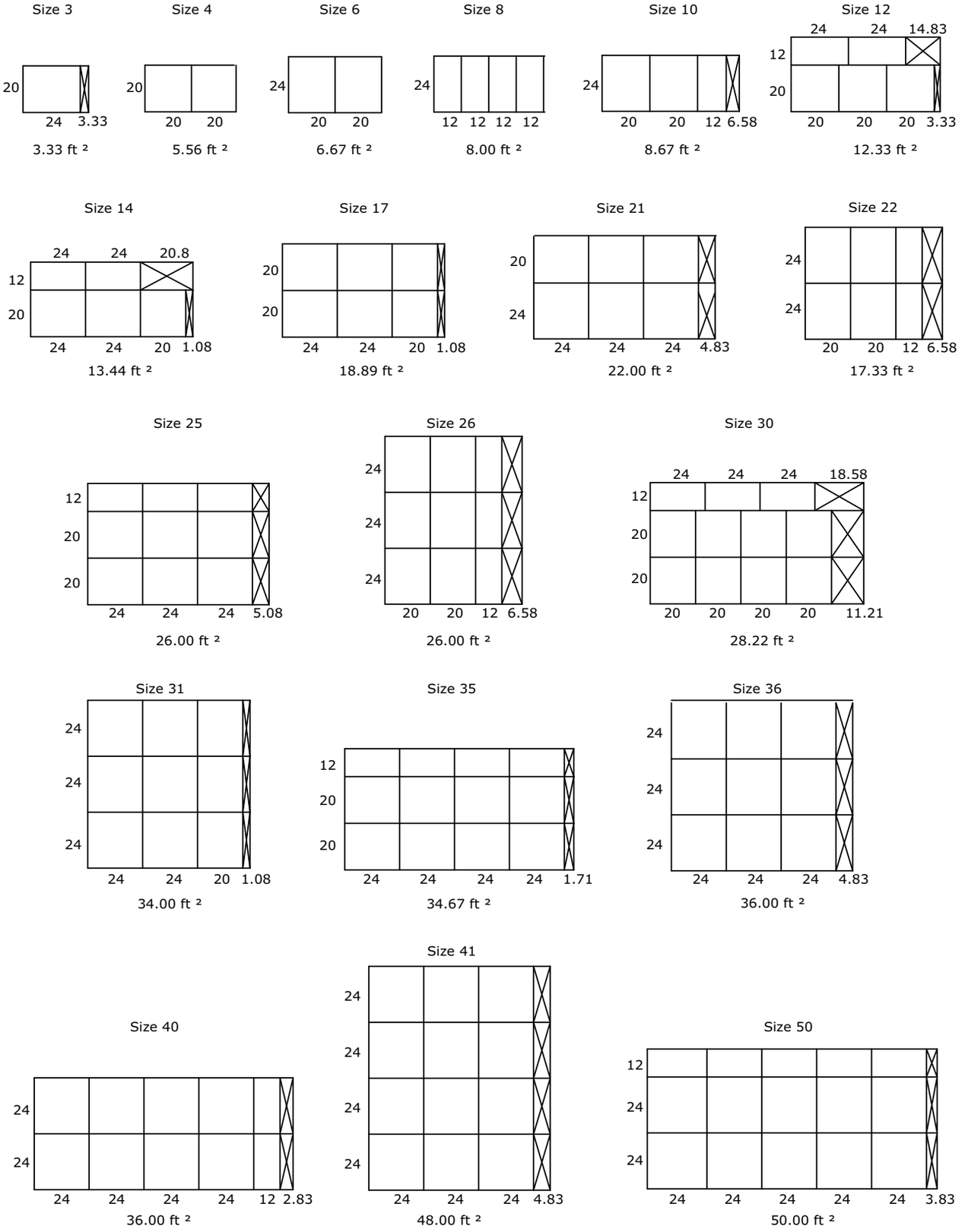
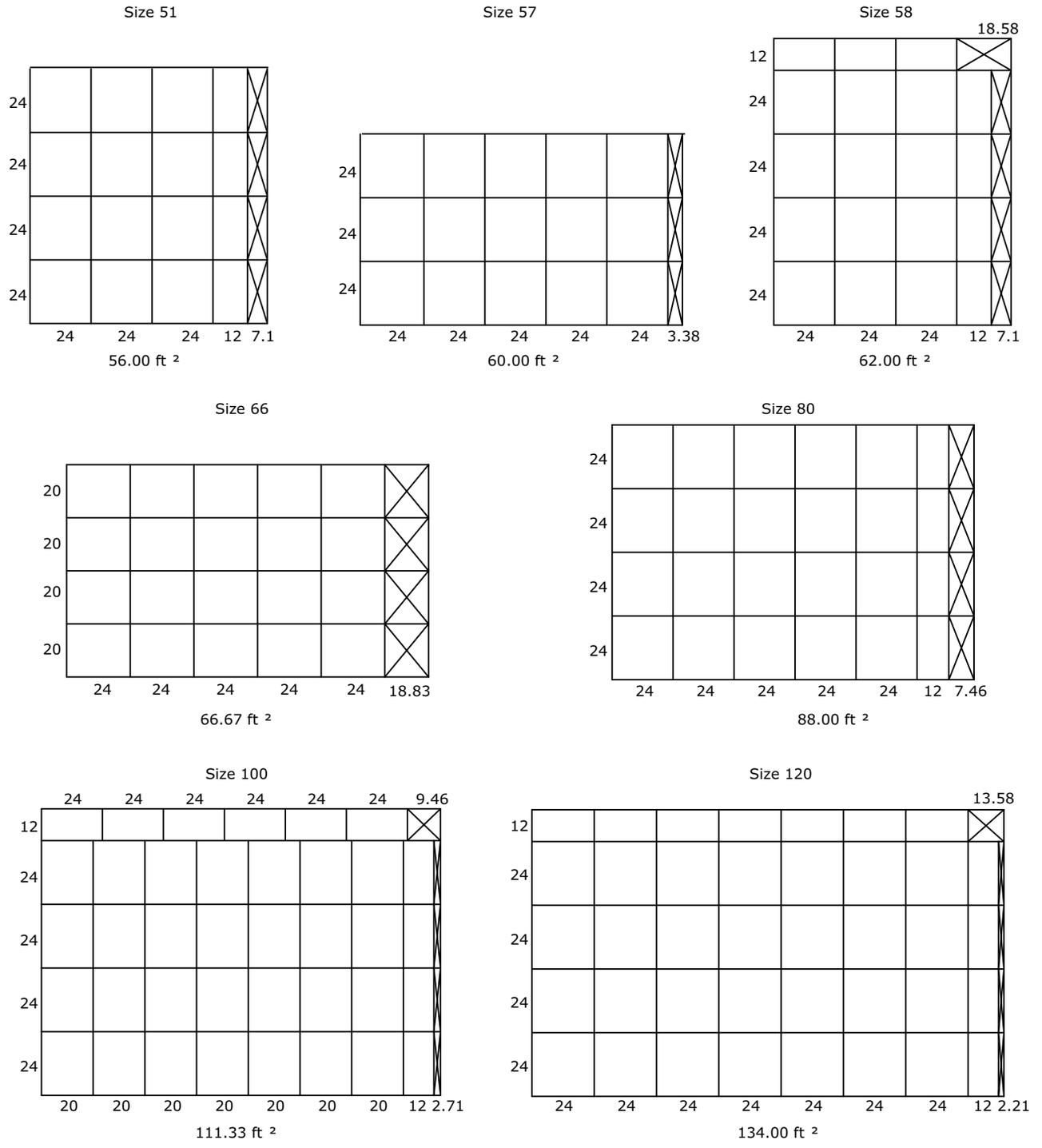


**Figure 73. Cartridge filter placement for unit sizes 51-120 - side loading**




Filter racks have a 1.5 ft T x 1.0 ft W gasket (X23010565010) applied to blockoff.

**Figure 74. Bag and cartridge filter placement for unit sizes 3-50 - front loading**

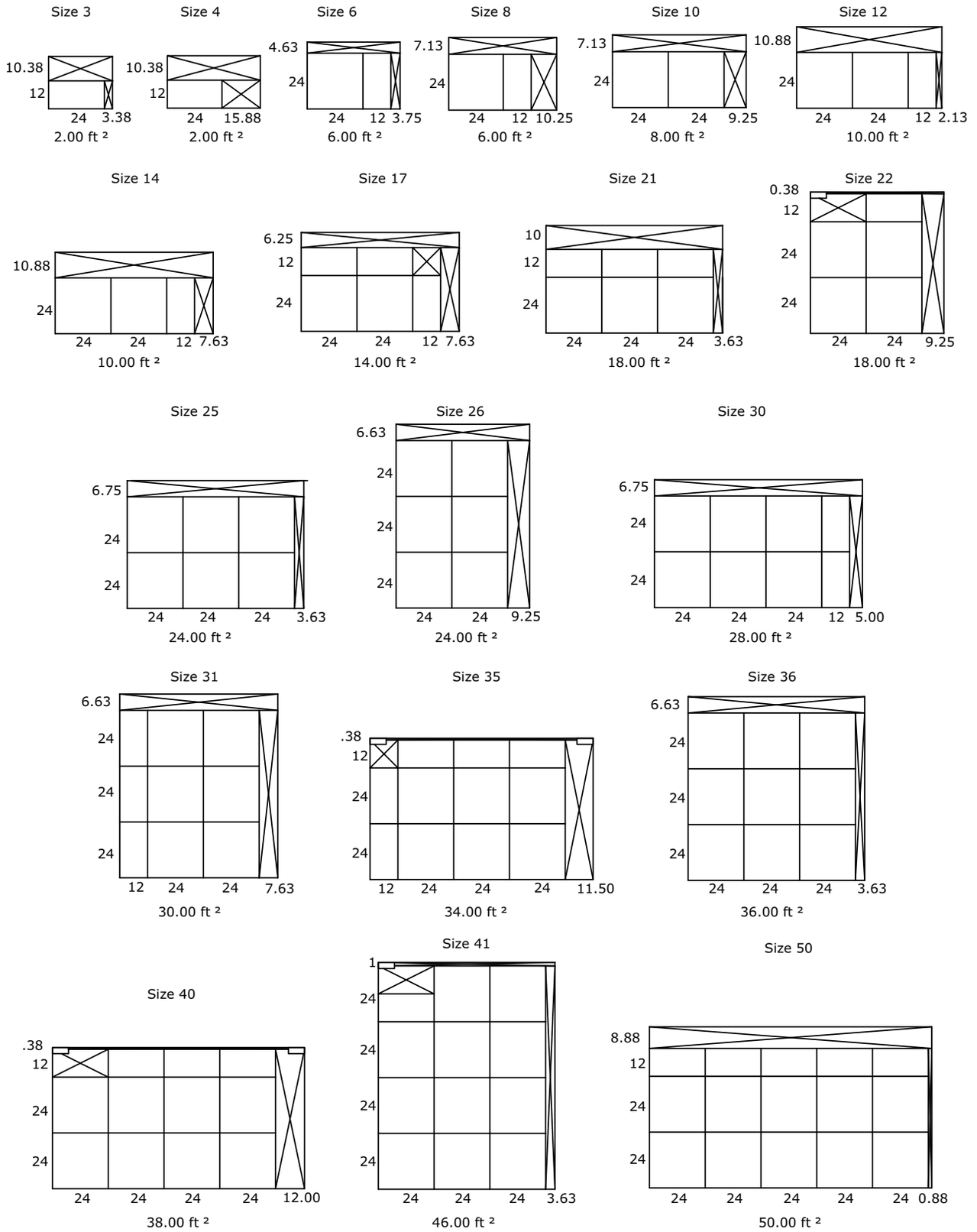
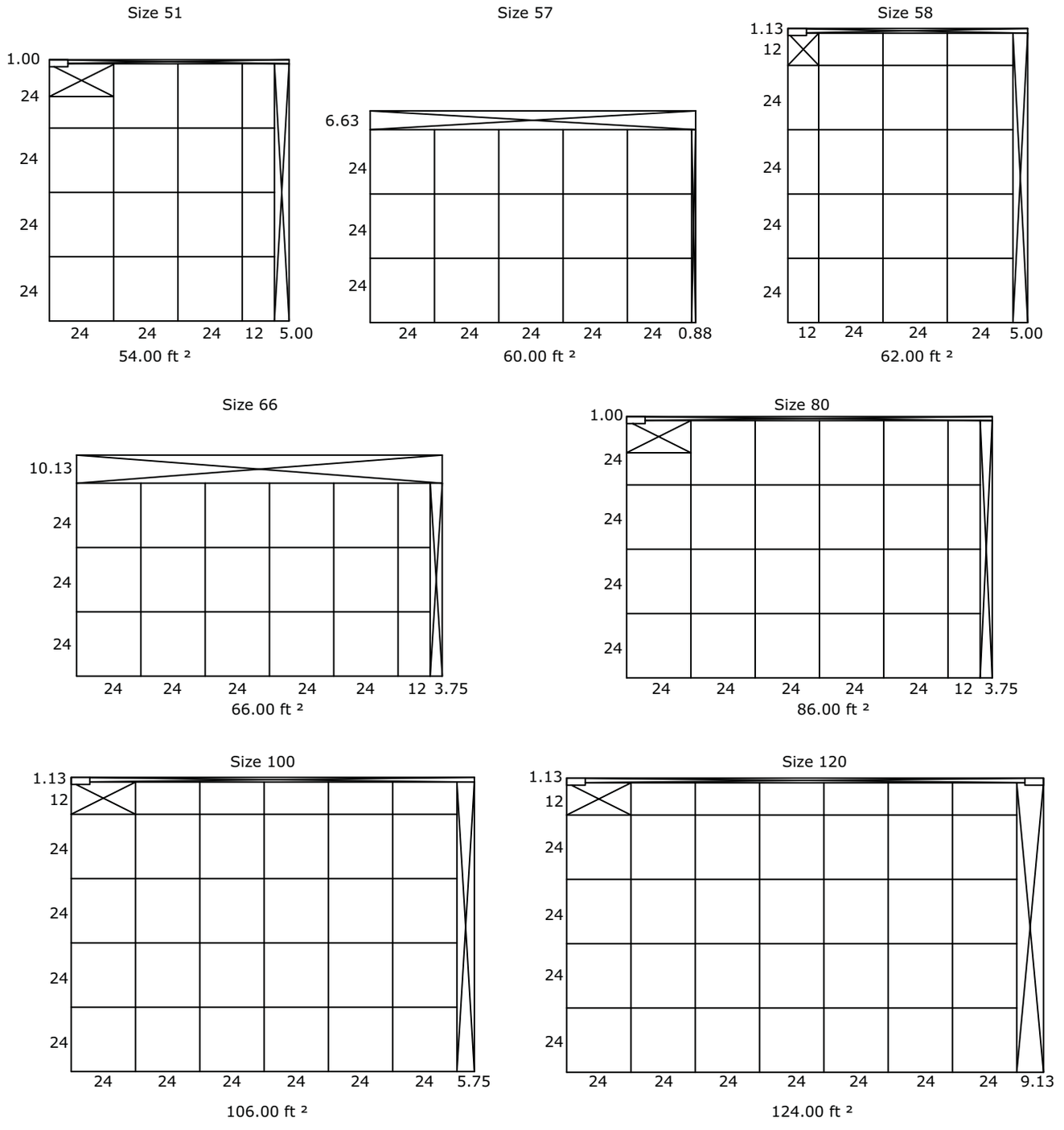


**Figure 75. Bag and cartridge filter placement for unit sizes 51-120 - front loading**




Filter racks have a 1.5 ft T x 1.0 ft W gasket (X23010565010) applied to blockoff.

**Figure 76. HEPA filter placement for unit size 3-50 - front loading**

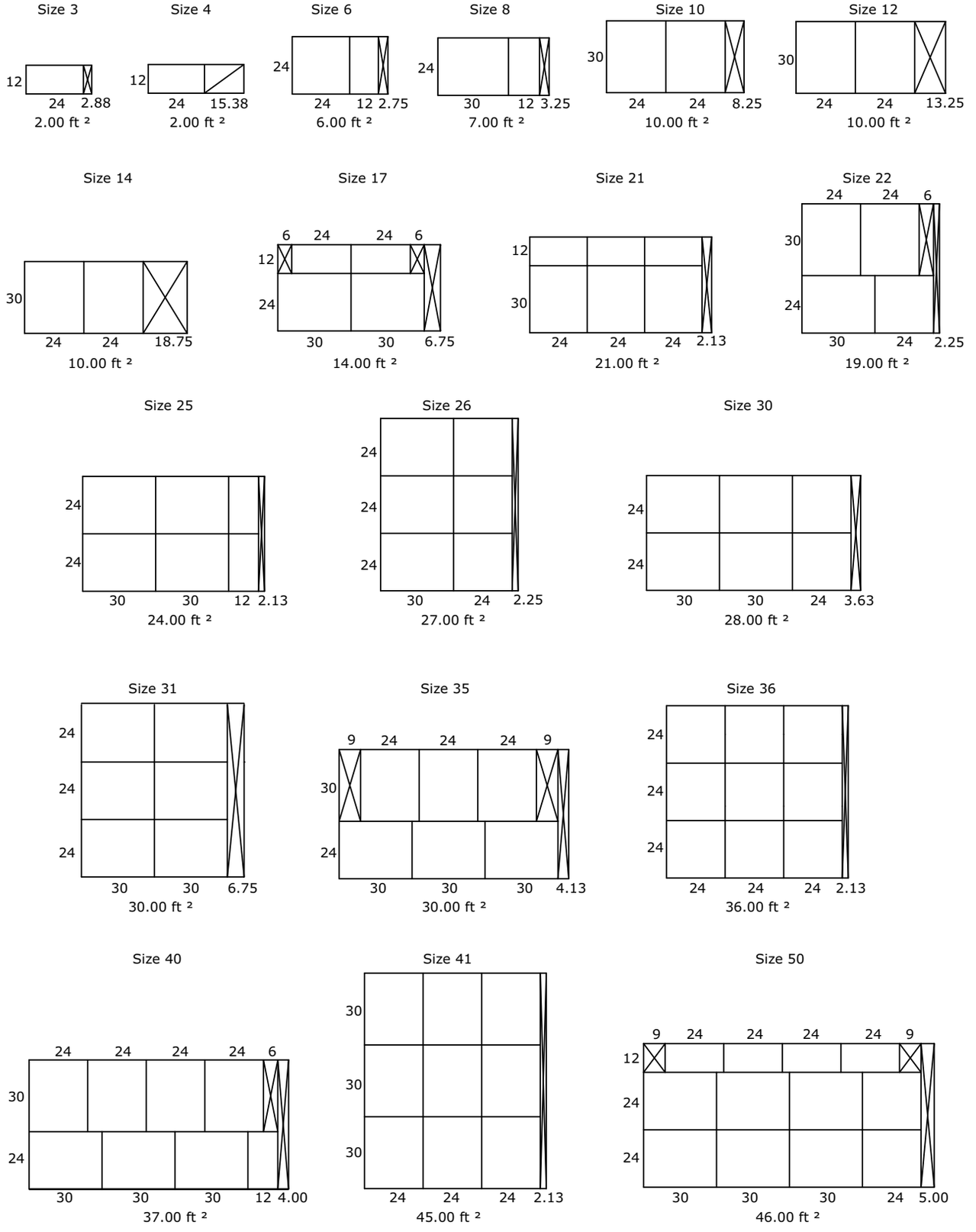
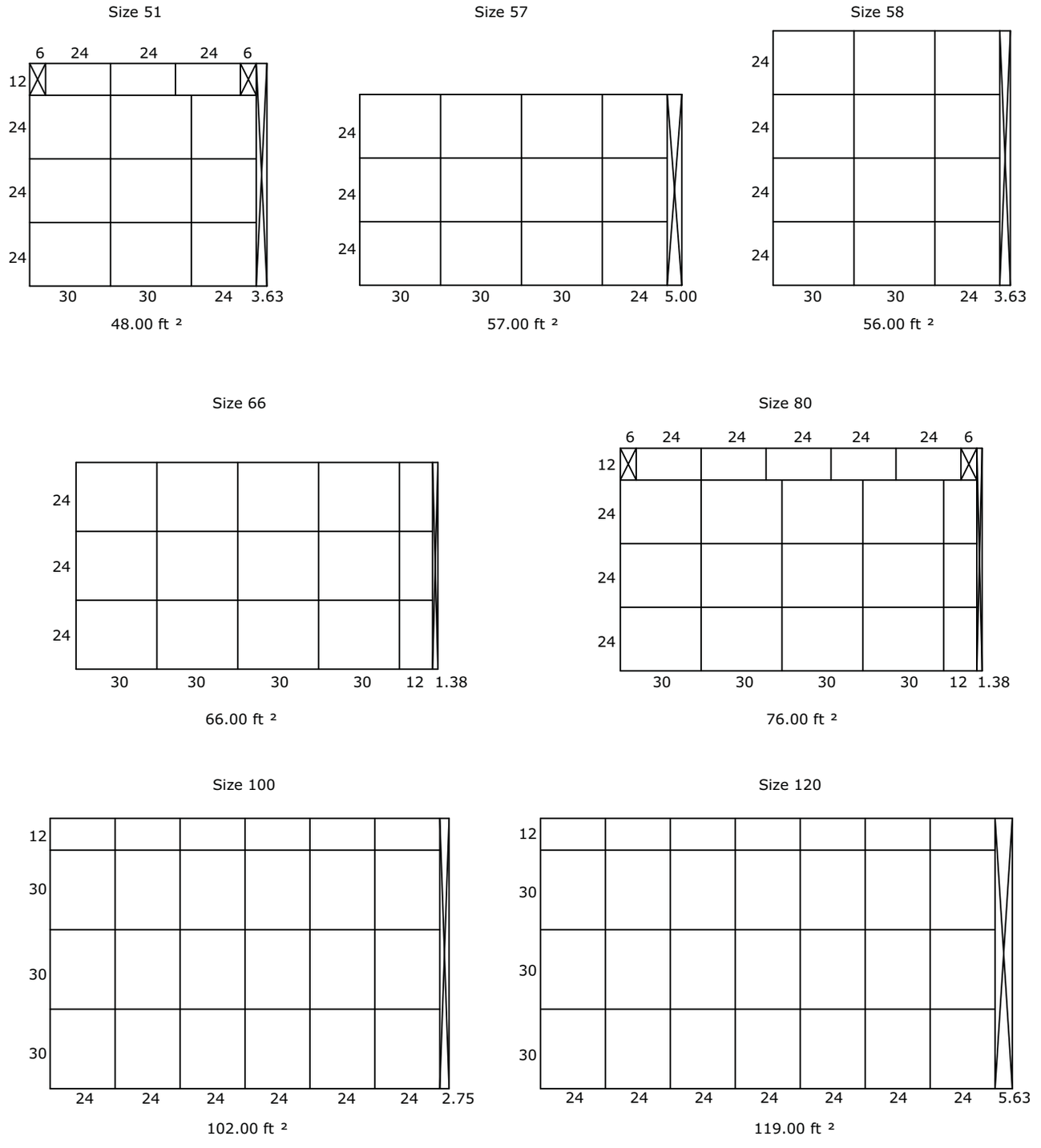


**Figure 77. HEPA filter placement for unit size 57-120 - front loading**




Filter racks have a 1.5 ft T x 1.0 ft W gasket (X23010565010) applied to blockoff.

# Fan Section

The fan section can be configured as either draw-thru or blow-thru. Review the submittals and unit tagging information prior to assembly to determine placement.

**⚠WARNING**

**Hazardous Service Procedures!**

**The maintenance and troubleshooting procedures recommended in this manual could result in exposure to electrical, mechanical or other potential safety hazards. Always refer to the safety warnings provided throughout this manual concerning these procedures. Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks. Failure to follow all of the recommended safety warnings provided, could result in death or serious injury.**

## Fan Isolation

The fan-and-motor assembly is internally isolated. The fan and motor bases are bolted to a minimum of four spring isolators. The isolators are secured to the fan section support base.

Shipping tie-down bolts are bolted adjacent to the isolators between the fan isolation base and the isolator support frame. The shipping tie-downs secure the isolation base to the support assembly to prevent any damage to the fan section during shipment.

*Note: Remove the tie-downs **only** if the factory-provided isolation is to be used.*

## Adjusting the Isolators

Once the shipping tie-downs are removed and the internal isolation is released, it may be necessary to adjust the isolators to achieve the proper operation height of the fan and motor isolation base.

Minimum required clearances are listed in Table 11. To determine the isolator clearances on all unit sizes, measure between the top of the cabinet channel and the bottom of the isolation base channel. See Figure 78, Figure 79, Figure 80, and Figure 81.

**Table 11. Minimum isolator clearances (inches)**

| Unit Size | Fan Type | Required Clearance |
|---|---|---|
| 3–8 | FC, BC, Plenum | 1.0 |
| 10–31 | FC, AF, Plenum | 0.5 |
| 35-58 | FC, AF, Plenum | 0.5 |
| 66-120 | FC, AF, Plenum | 1.0 |

**Figure 78. Isolator adjustment for unit sizes 10-30**

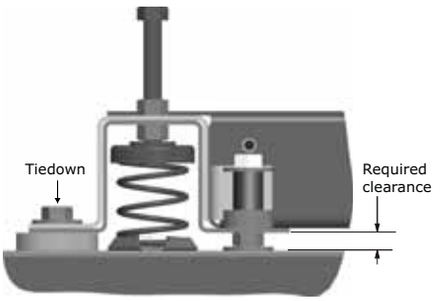



**Figure 79. Isolator adjustment for unit sizes 10-30**

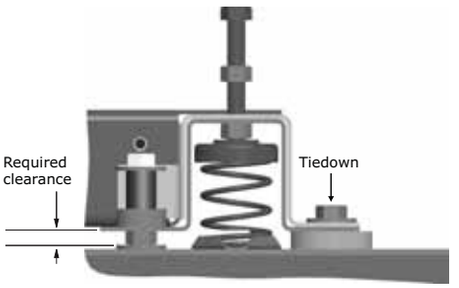



**Figure 80. Isolator adjustment for unit sizes 66-120**

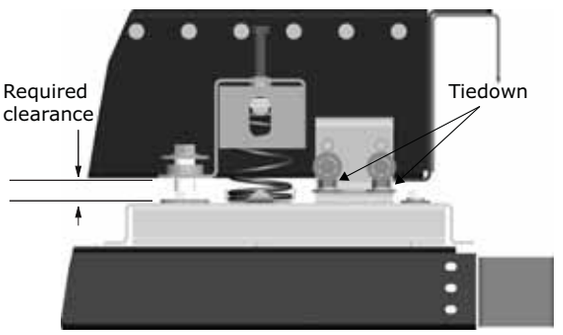
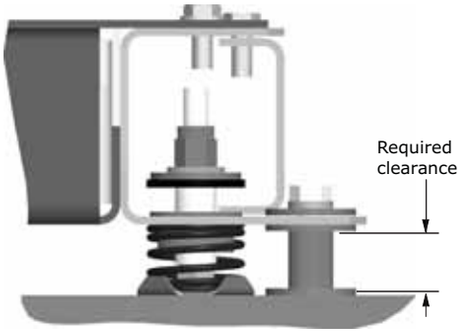



**Figure 81. Belt-drive plenum fan isolator adjustment size 3-8**



# Seismic Application Requirements

Air handling equipment manufactured by Trane is capable of structurally and operationally withstanding the seismic response criteria as required by the International Building Codes (IBC) 2000,2003, 2006, 2009, 2012, and CBC 2007, 2010. Trane has third-party certification for IBC compliance for seismic applications for unit sizes 3-120 and stacked units.

*Note: If seismic isolation has been specified, the following requirements must be adhered to for installation. Failure to follow these instructions would void the warranty.*

## Anchor Requirements

### Single Level Design Break - Size 3-120

Grade to Roof Mounted Non-Isolated

See Table 12.

Steel dunnage/steel curb

3/8-inch diameter ASTM A325 or SAE grade 5 bolts attached to unit base located as noted above or 1-inch long 3/16-inch welds at unit base located as noted above.

**Table 12. Anchor requirements**

| SDS | $I_p$ | z/h | Attachment method | Equipment weight (lbs.) | Seismic Restraint model | Attachment System | |
|---|---|---|---|---|---|---|---|
| | | | | | | Qty per tag | Method |
| 1.483 | 1.5 | 1.0 | Floor mounted (concrete) | 45 psf maximum | Bolt down | 2 per mounting location | Anchor: Hilti HDA-P<br>Dia.: M12 x 125/50<br>Embed.: 4.922 inches<br>Edge: 14-in./8-in. thick<br>Conc.: 3000 psi |
| 0.967 | 1.5 | 1.0 | Floor mounted (concrete) | 45 psf maximum | Bolt down | 2 per mounting location | Anchor: Hilti TZ-CS<br>Dia.: 1/2 inch<br>Embed.: 3.25 inches<br>Edge: 14-in./6-in. thick<br>Conc.: 3000 psi |
| 1.850 | 1.5 | 1.0 | Floor mounted (steel) | 45 psf maximum | Bolt down | 2 per mounting location | Anchor: A325 Bolt<br>Dia.: 1/2 inch<br>Embed.: n/a<br>Edge: n/a<br>Conc.: n/a |
| 1.850 | 1.5 | 1.0 | Floor mounted (welded to steel) | 45 psf maximum | Welded | 1 per mounting location | 6-inch weld length with 1/8-inch weld leg |

**Notes:** Install clips at shipping split corners.
Install clips at shipping splits containing fans or coils at 48 inches maximum on-center spacing.

### Stacked Design Break - Size 3-50

Grade to Roof Mounted (0<=Sds<=1.85) Non-Isolated

4000 psi concrete

- 1/2-inch diameter Hilti Kwik Bolt TZ carbon steel concrete anchors attached to unit base rails
- Install clips at all ship split corners.
- Install clips at ship splits with a stacked section at 36 inches maximum on-center spacing.
- Install clips at single level ship splits containing fans or coils at 48 inches maximum on-center spacing.
- 3 1/4-inch minimum anchor embedment
- 7 1/2-inch minimum distance to the nearest edge
- 6-inch minimum concrete slab thickness

Steel dunnage/steel curb

1/2-inch diameter ASTM A325 or SAE Grade 5 bolts attached to unit base located as noted above or 1-inch long 3/16-inch welds at unit bases located as noted above.

### Ceiling Suspended Units Size 3-30

(0<=Sds<=1.85)

The details for the suspension system, including the steel members used to support the bottom of the unit, will need to be determined by working directly with The VMC Group. They will also help provide information regarding the required external isolation system.

## Anchor Pattern

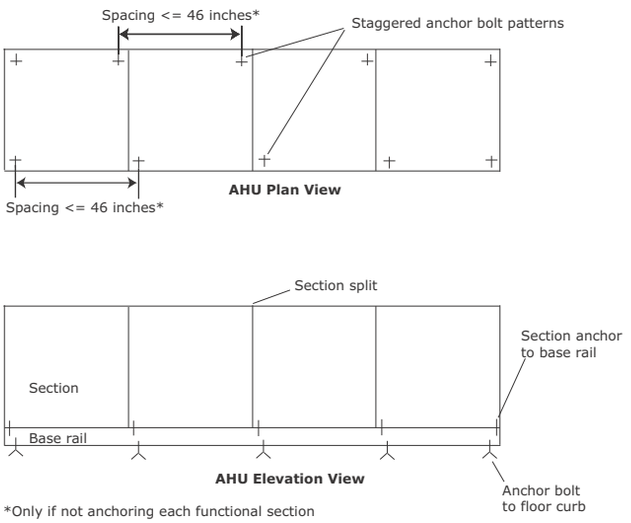
Lifting lugs should be used to anchor the unit at the ends of each shipping split. Per the anchor requirements, additional anchoring may be needed. If so, anchors will be provided and installed on the unit. An example of a seismic anchor is shown in Figure 82.

Anchor selection meets or exceeds IBC 2000,2003, 2006, 2009, 2012, and CBC 2007, 2010 compliance requirements.

Special Inspection per IBC Section 1704 is required on all installations. All anchors listed above must be installed to meet compliance.

**Figure 82. Seismic anchor**

**Figure 83. Seismic anchor pattern**




# Hurricane Application Requirements

## Miami/Dade County Hurricane Certification

Performance Climate Changer air handlers are approved and have has been designed to comply with the High Velocity Hurricane Zone of the Florida Building Code. Notice of compliance and additional product construction details can be found at the Miami-Dade County, Building Code Compliance Office Web site.

The Florida licensed engineer or architect-of-record for the project shall be responsible for the design, sizing, and structural adequacy of the product framework as well as curbing and attachment to the roof, or as accepted by the corresponding building departments.

## Anchoring the Unit

The method shown in Figure 84 through Figure 87 is what is approved and recommended for anchoring the unit to substrate and roof curb. Any deviation to this may require the approval of the local building code enforcement agency.

Unit may be installed onto concrete (3.2 ksi min. compressive strength) or 1/4-inch thick steel (36 ksi min. yield) substrates with anchors through lifting lugs and angle clips attached to first level baserail. Unit may also be installed onto a 36 ksi yield steel curb by others.

**Figure 84. Anchoring size 3-50 units to substrate or roof curb for hurricane applications**

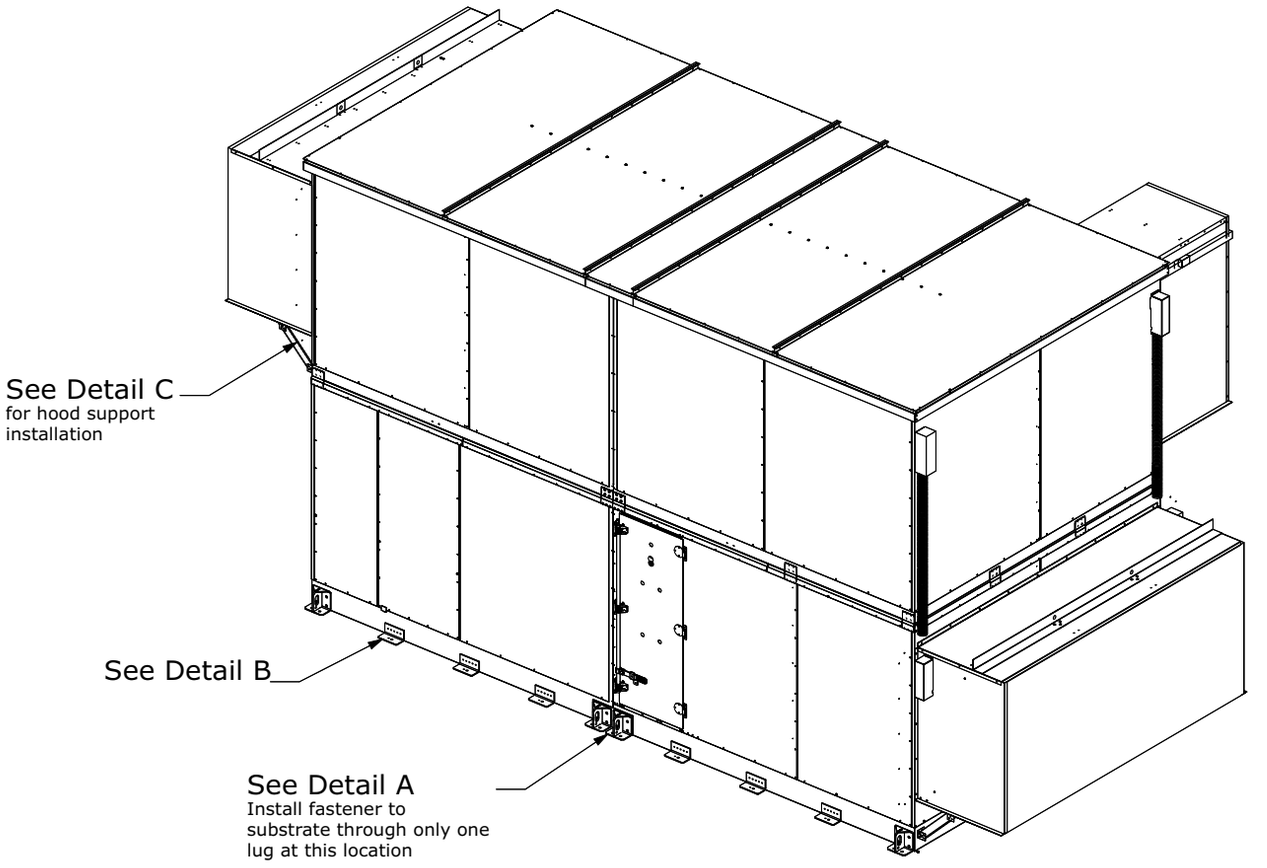


**Figure 85. Anchoring size 57-120 units to substrate or roof curb for hurricane applications**

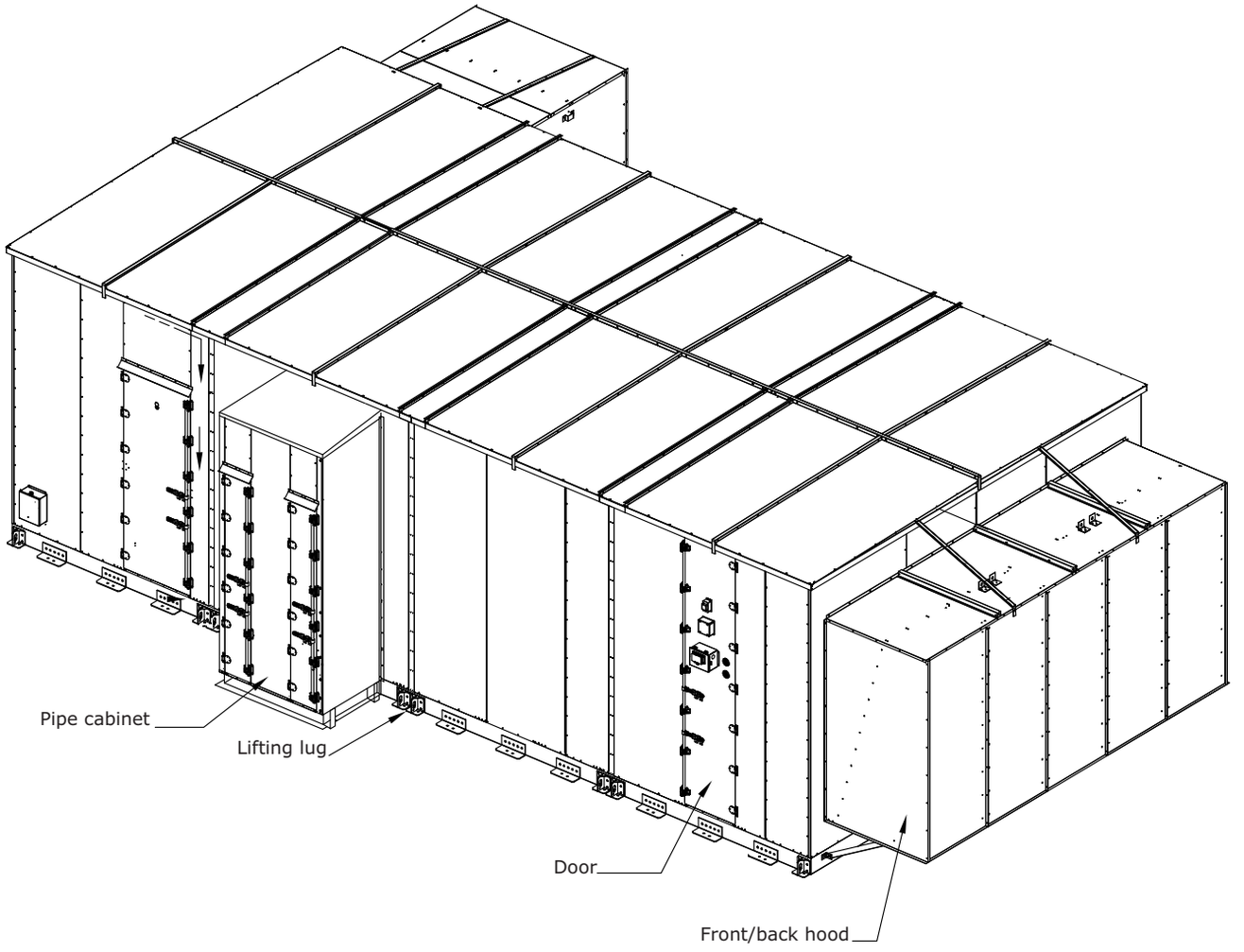


**Figure 86. Anchorage details (see Table 13 for minimums) for hurricane applications**

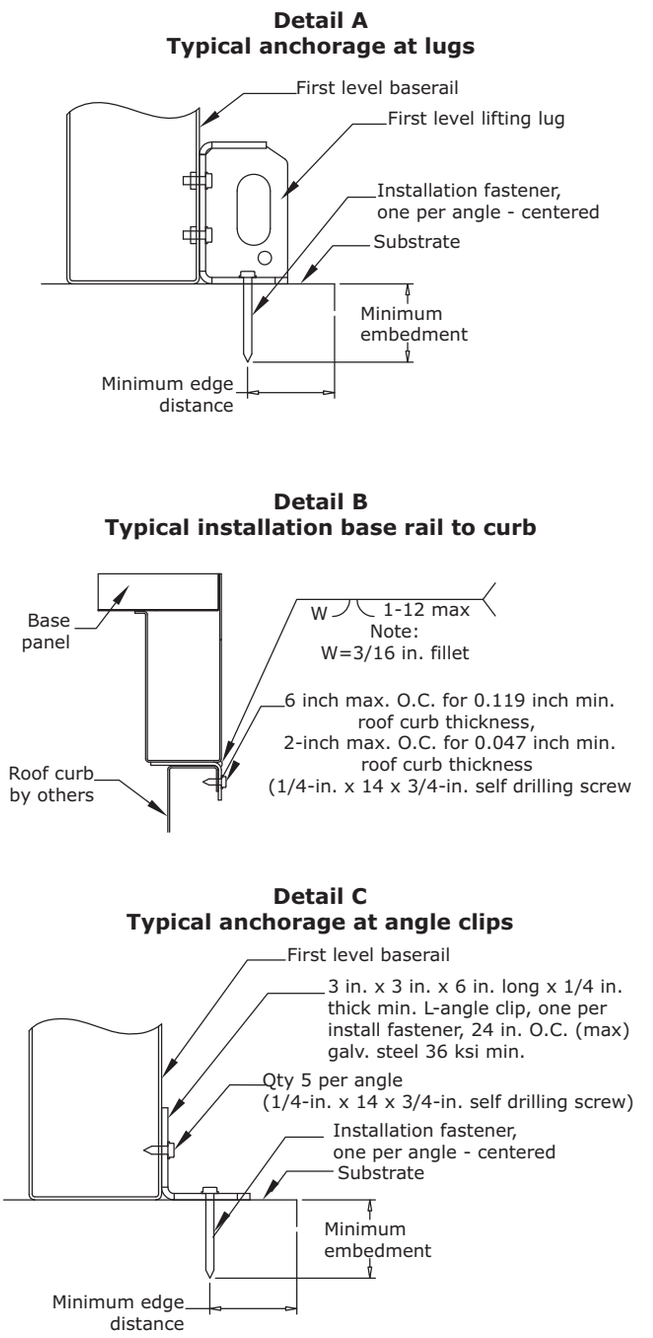



**Table 13. Anchorage installation information for hurricane applications**

| Anchor / substrate | Minimum embedment | Minimum edge distance |
|---|---|---|
| 1/2-inch powers chem-stud threaded rod installed with chem-stud adhesive capsule in 3.2 ksi minimum concrete substrate | 1 1/2 inches | 6 inches |
| 1/2-inch HH F-type thread cutting screw installed in 36 ksi minimum steel 1/4-inch thick minimum (full thread engagement) | 1/4 inch | 1 1/4 inch |

**Figure 87. Approved field penetrations for hurricane applications**

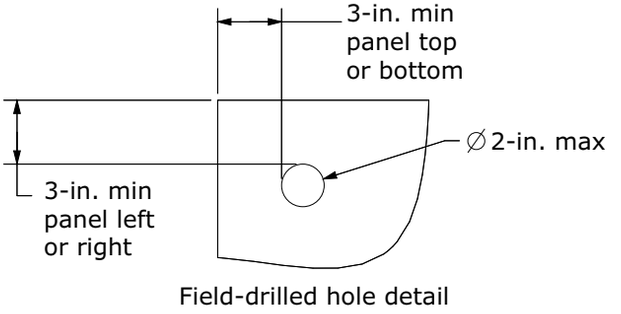


**Figure 88. Hood installation size 3-50 - front and back hoods for hurricane applications**

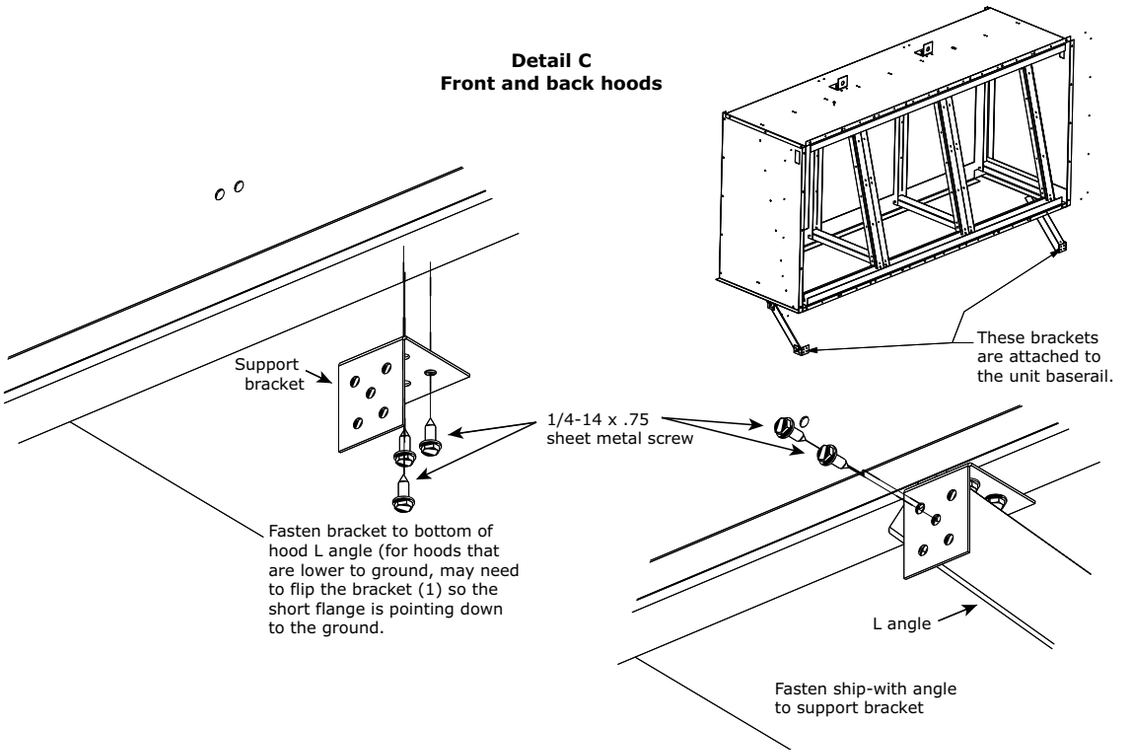
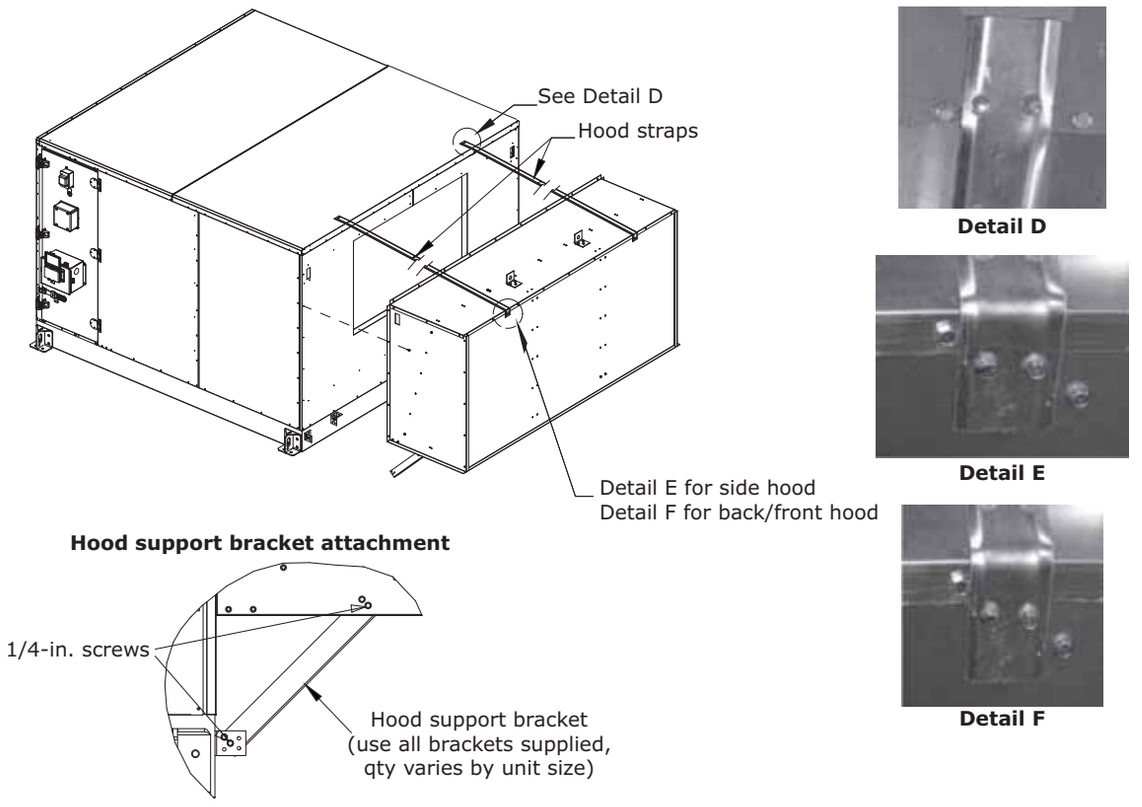
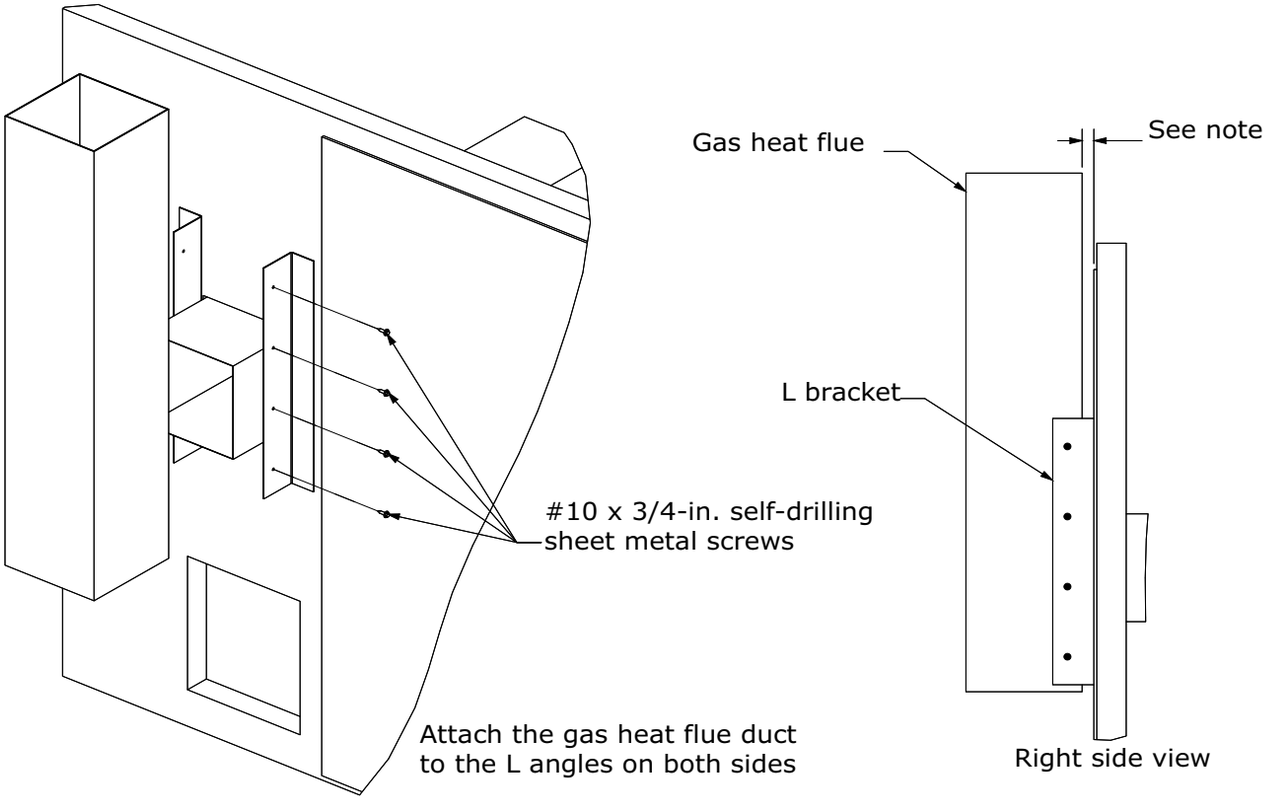



**Figure 89. Hood installation size 57 - 120 for hurricane applications**



## Gas Heat Installation

**Figure 90. Gas heat flue installation for hurricane applications**



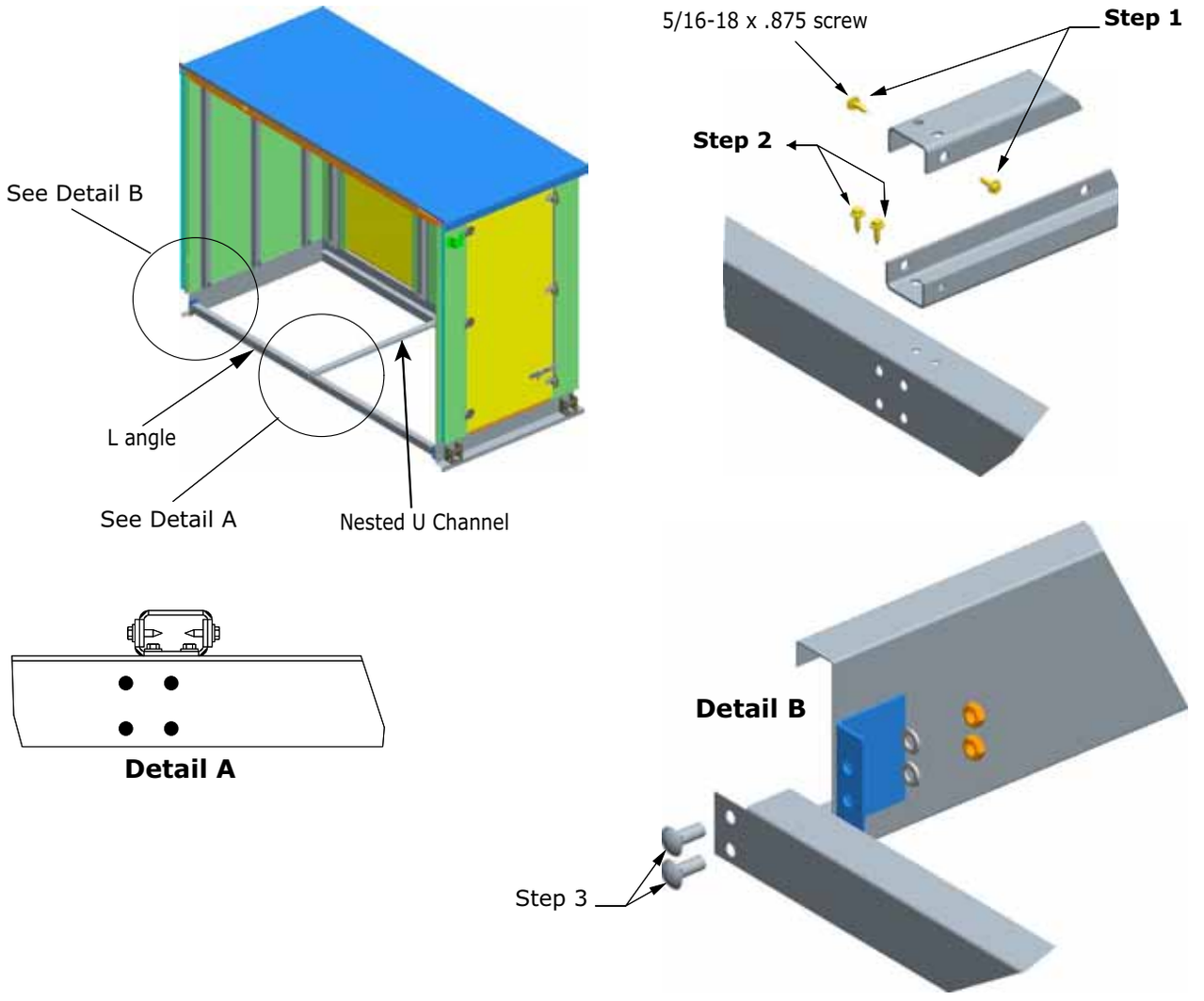

Note:
When installing flue, leave enough clearance to avoid roof's edge and anything above the roof.

## Pipe Cabinet Installation

Nested U channels and L angle have to be removed to install the pipe cabinet to the unit and reinstall per hurricane certification guidelines. See Figure 91.

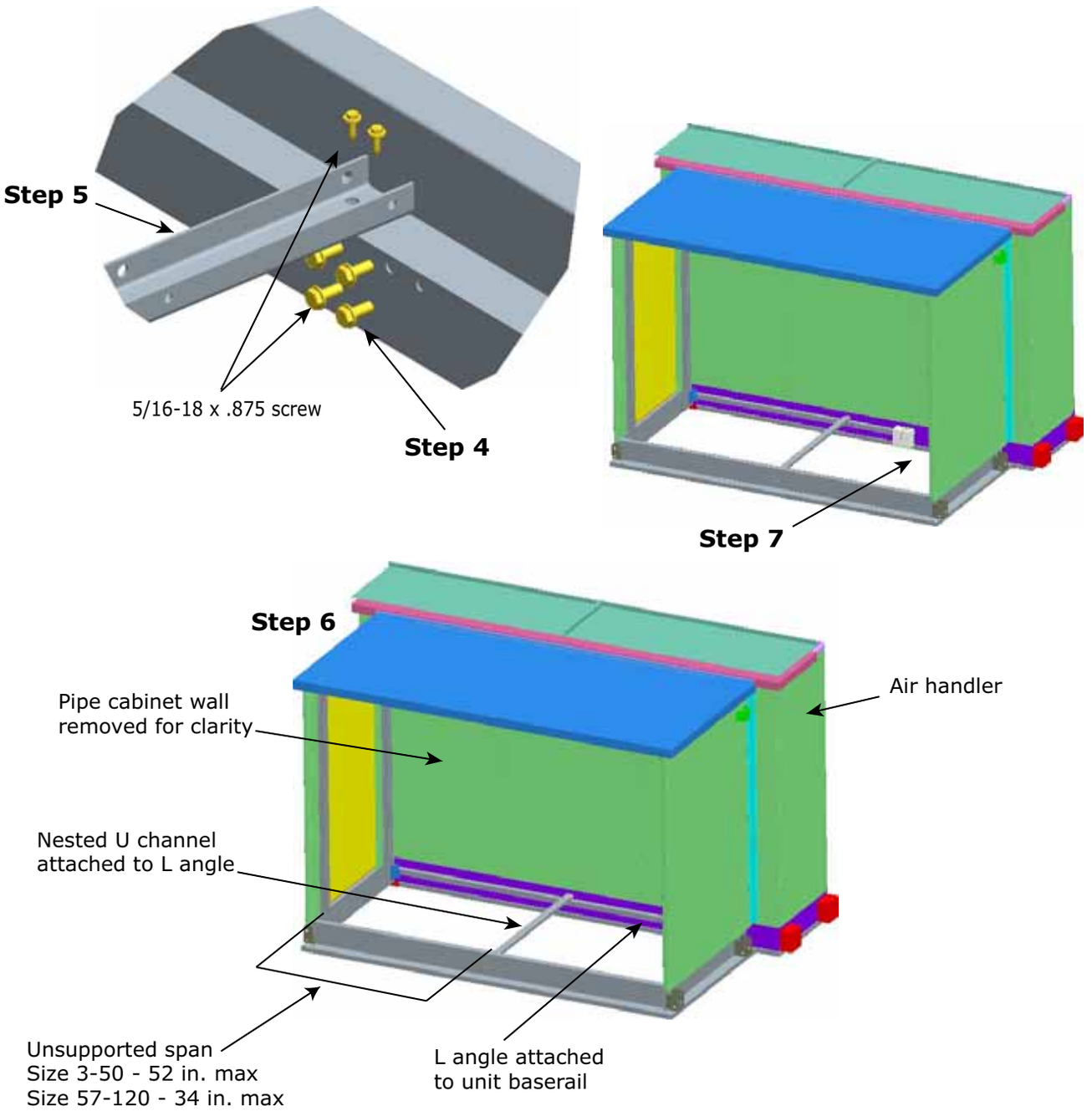
1. Remove the fasteners from the top of the nested U channel.
2. Remove the U channel from the unit base L angle and the pipe cabinet base L angle.
3. Remove the corner fasteners from the pipe cabinet base and the unit base L angle. These fasteners are not required to be put back.

**Figure 91. Pipe cabinet installation for hurricane applications**



4. Attach the unit base L angle from the pipe cabinet to the unit base rail. See Step 4 in Figure 92
5. Attach a U channel to the unit base L angle. Make sure to clear any coil piping. Make sure to attach enough nested U channels to comply to the unsupported span. See Step 5 in Figure 92.
6. Locate the pipe cabinet in place, and reinstall the U channel to the pipe base L angle and reinstall the top U channel to the nest (see Step 1, Figure 91).
7. When the L angle interferes with the unit base rail lifting lugs or splice plate, mark and cut L angle section to clear the component. If excess L angle is not needed for nested U channel, leave it off. See Figure 92.

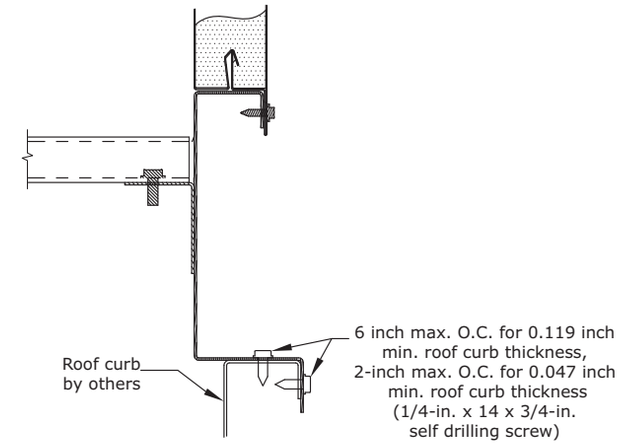
**Figure 92. Pipe cabinet installation for hurricane applications**



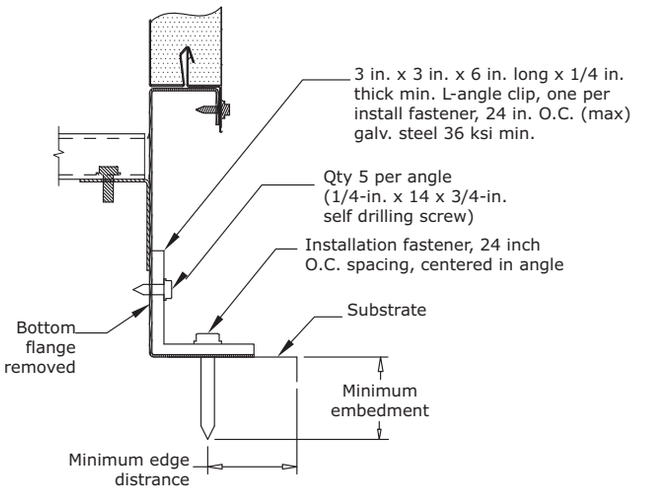
## Pipe Cabinet Anchorage

**Figure 93. Anchorage details for pipe cabinet (see Table 13 for minimums) for hurricane applications**

**Anchorage to Roof Curb**




**Direct Anchorage to Substrate**




## Damper Section

Dampers are factory-installed and adjusted and can be found in mixing box/economizer sections. There are two damper blade configurations available: parallel-blade and opposed-blade.

Traq™ dampers are another type of damper available in mixing box sections. Traq dampers have only one blade configuration - opposed. They have two control applications available - standard Traq dampers and low-flow Traq dampers. Low-flow Traq dampers are always not linked and consist of two damper sets - one set for minimum outside air measurement and one set for economizing. Each will have its own VCM.

The air handler is available with factory-mounted controls or end devices. If the unit is not ordered with controls or end devices, it is the installer's responsibility to provide and install the damper actuators. Size the actuators according to Table 14.

Mixing section and economizer dampers are designed for the damper actuators to be direct coupled and installed in the air stream. If other provisions are required, modifications to the section will be the responsibility of the installing contractor.

## Damper Torque Requirements

**Table 14. Mixing box damper torque requirements (inch pound) at 1-inch w.g. air pressure drop**

| Unit Size | Parallel airfoil damper only | Opposed airfoil damper only | Standard Traq damper only | Low-flow minimum OA Traq damper only | Low-flow econ Traq damper only | Parallel airfoil damper linked to parallel airfoil damper | Opposed airfoil damper linked to opposed airfoil damper | Standard Traq linked to airfoil damper | Standard Traq linked to standard Traq damper |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 9.00 | 6.40 | 18.00 | n/a | n/a | 10.30 | 7.70 | 19.30 | 36.00 |
| 4 | 13.10 | 9.30 | 36.00 | 18.00 | 18.00 | 14.90 | 11.20 | 19.90 | 72.00 |
| 6 | 17.10 | 12.20 | 36.00 | 18.00 | 18.00 | 19.60 | 14.70 | 38.40 | 72.00 |
| 8 | 23.30 | 16.60 | 54.00 | 18.00 | 36.00 | 26.60 | 19.90 | 57.30 | 108.00 |
| 10 | 29.00 | 20.70 | 54.00 | 18.00 | 36.00 | 33.20 | 24.90 | 58.10 | 108.00 |
| 12 | 35.70 | 25.50 | 67.50 | 22.50 | 45.00 | 40.70 | 30.60 | 72.60 | 135.00 |
| 14 | 39.50 | 28.20 | 67.50 | 22.50 | 45.00 | 45.20 | 33.90 | 73.10 | 135.00 |
| 17 | 48.90 | 34.90 | 67.50 | 22.50 | 45.00 | 55.90 | 41.90 | 74.50 | 135.00 |
| 21 | 60.40 | 43.10 | 99.00 | 33.00 | 66.00 | 69.00 | 51.80 | 107.60 | 198.00 |
| 25 | 72.40 | 51.70 | 99.00 | 33.00 | 66.00 | 82.80 | 62.10 | 109.30 | 198.00 |
| 30 | 84.20 | 60.10 | 108.00 | 36.00 | 72.00 | 96.20 | 72.20 | 120.00 | 216.00 |
| 35 | 100.20 | 71.50 | 108.00 | 36.00 | 72.00 | 114.50 | 85.90 | 122.30 | 198.00 |
| 40 | 110.20 | 78.70 | 108.00 | 36.00 | 72.00 | 125.90 | 94.50 | 119.60 | 198.00 |
| 50 | 126.30 | 90.20 | 112.50 | 37.50 | 75.00 | 144.30 | 108.20 | 139.11 | 216.00 |
| 57 | 154.80 | 110.60 | 112.50 | 37.50 | 75.00 | 176.90 | 132.70 | 167.60 | 198.00 |
| 66 | 177.60 | 126.80 | 150.00 | 37.50 | 75.00 | 202.90 | 152.20 | 194.70 | 264.00 |
| 80 | 210.30 | 150.20 | 187.50 | 37.50 | 112.50 | 240.30 | 180.20 | 231.60 | 360.00 |
| 100 | 272.00 | 194.30 | 225.00 | 37.50 | 150.00 | 310.90 | 233.20 | 297.70 | 396.00 |
| 120 | 322.40 | 230.30 | 225.00 | 37.50 | 150.00 | 368.50 | 276.30 | 348.10 | 432.00 |

**Table 15. Air-to-Air Plate Heat Exchanger Bypass Damper**

| Unit size | Damper dia (in) A | Damper dia (in) B | Damper qty | Damper torque (in-lb) | Actuator torque (max) (in-lb) | Actuator qty | Linkage |
|---|---|---|---|---|---|---|---|
| 3 | 25.00 | 24.03 | 1 | 20.90 | 42.00 | 1 | No |
| 4 | 37.50 | 24.03 | 1 | 31.30 | 42.00 | 1 | No |
| 6 | 37.50 | 29.78 | 1 | 38.80 | 180.00 | 1 | No |
| 8 | 44.00 | 29.78 | 1 | 45.50 | 180.00 | 1 | No |
| 10 | 55.00 | 35.53 | 1 | 67.90 | 180.00 | 1 | No |
| 12 | 60.00 | 35.53 | 1 | 74.00 | 180.00 | 1 | No |
| 14 | 65.50 | 35.53 | 1 | 80.80 | 180.00 | 1 | No |
| 17 | 65.50 | 24.03 | 2 | 109.30 | 180.00 | 1 | Yes |
| 21 | 73.50 | 24.03 | 2 | 122.70 | 180.00 | 1 | Yes |
| 25 | 73.50 | 29.78 | 2 | 152.00 | 180.00 | 1 | Yes |
| 30 | 87.00 | 29.78 | 2 | 179.90 | 180.00 | 1 | Yes |
| 35 | 93.50 | 29.78 | 2 | 193.40 | 180.00 | 2 | Yes |
| 40 | 106.00 | 29.78 | 2 | 219.20 | 180.00 | 2 | Yes |

**Table 16. Air-to-Air Plate Heat Exchanger Frost Damper**

| Unit size | A | B | Damper qty | Damper torque (in-lb) | Actuator torque (max) (in-lb) | Actuator qty | Linkage |
|---|---|---|---|---|---|---|---|
| 3 | 25.00 | 13.97 | 1 | 12.10 | 42.00 | 1 | No |
| 4 | 37.50 | 13.97 | 1 | 18.20 | 42.00 | 1 | No |
| 6 | 37.50 | 13.97 | 1 | 18.20 | 42.00 | 1 | No |
| 8 | 44.00 | 13.97 | 1 | 21.30 | 42.00 | 1 | No |
| 10 | 55.00 | 13.97 | 1 | 26.70 | 42.00 | 1 | No |
| 12 | 60.00 | 13.97 | 1 | 29.10 | 42.00 | 1 | No |
| 14 | 65.50 | 13.97 | 1 | 31.80 | 180.00 | 1 | No |
| 17 | 65.50 | 13.97 | 2 | 63.50 | 180.00 | 1 | Yes |
| 21 | 73.50 | 13.97 | 2 | 71.30 | 180.00 | 1 | Yes |
| 25 | 73.50 | 13.97 | 2 | 71.30 | 180.00 | 1 | Yes |
| 30 | 87.00 | 13.97 | 2 | 84.40 | 180.00 | 1 | Yes |
| 35 | 93.50 | 13.97 | 2 | 90.70 | 180.00 | 1 | Yes |
| 40 | 106.00 | 13.97 | 2 | 102.80 | 180.00 | 1 | Yes |
| 50 | 119.00 | 13.97 | 2 | 115.40 | 180.00 | 1 | Yes |

**Table 17. Standard damper to low-flow Traq damper**

| Unit size | Damper dia (in) | Total damper qty | Low flow Traq damper qty | Linked Traq damper torque (in-lb.) | Damper torque (in-lb.) | Actuator torque (max) (in-lb.) | Actuator qty for linked damper | Actuator qty for linked Traq damper | Actuator qty for single low flow Traq damper | Face-to-face linkage | Linkage on face damper | Actuator total qty |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 13.00 | 2 | 1 | 18.00 | 17.15 | 42 | 1 | 1 | 1 | No | No | 3 |
| 8 | 13.00 | 3 | 1 | 36.00 | 23.26 | 42 | 1 | 1 | 1 | No | Yes | 3 |
| 10 | 13.00 | 3 | 1 | 36.00 | 29.03 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 12 | 16.00 | 3 | 1 | 45.00 | 35.65 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 14 | 16.00 | 3 | 1 | 45.00 | 39.54 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 17 | 16.00 | 3 | 1 | 45.00 | 48.89 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 21 | 20.00 | 3 | 1 | 66.00 | 60.39 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 25 | 20.00 | 3 | 1 | 66.00 | 72.43 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 30 | 24.00 | 3 | 1 | 72.00 | 84.19 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 35 | 24.00 | 3 | 1 | 72.00 | 100.16 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 40 | 24.00 | 3 | 1 | 72.00 | 110.19 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 50 | 28.00 | 3 | 1 | 75.00 | 126.29 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 57 | 28.00 | 3 | 1 | 75.00 | 154.80 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 66 | 28.00 | 4 | 1 | 112.50 | 177.56 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 80 | 28.00 | 5 | 1 | 150.00 | 210.27 | 180 | 2 | 1 | 1 | No | Yes | 4 |
| 100 | 28.00 | 6 | 1 | 187.50 | 272.04 | 180 | 2 | 2 | 1 | No | Yes | 5 |
| 120 | 28.00 | 6 | 1 | 187.50 | 322.40 | 180 | 2 | 2 | 1 | No | Yes | 5 |

**Table 18. Standard Traq damper - low flow Traq damper**

| Unit size | Damper dia (in) | Damper qty per face | Damper torque (in-lb.) | Std Traq damper torque (in-lb.) | Linked low flow Traq damper torque (in-lb.) | Actuator torque (max) (in-lb.) | Actuator qty for linked Std Traq Damper | Actuator qty for linked low flow Traq damper | Actuator qty for single low flow Traq damper | Face-to-face linkage | Linkage on face | Total actuator qty |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 13.00 | 2 | 18.0 | 36.0 | 18.00 | 42 | 1 | - | 2 | No | Yes | 3 |
| 8 | 13.00 | 3 | 18.0 | 54.0 | 36.00 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 10 | 13.00 | 3 | 18.0 | 54.0 | 36.00 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 12 | 16.00 | 3 | 22.5 | 67.5 | 45.00 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 14 | 16.00 | 3 | 22.5 | 67.5 | 45.00 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 17 | 16.00 | 3 | 22.5 | 67.5 | 45.00 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 21 | 20.00 | 3 | 33.0 | 99.0 | 66.00 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 25 | 20.00 | 3 | 33.0 | 99.0 | 66.00 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 30 | 24.00 | 3 | 36.0 | 108.0 | 72.00 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 35 | 24.00 | 3 | 36.0 | 108.0 | 72.00 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 40 | 24.00 | 3 | 36.0 | 108.0 | 72.00 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 50 | 28.00 | 3 | 37.5 | 112.5 | 75.00 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 57 | 28.00 | 3 | 37.5 | 112.5 | 75.00 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 66 | 28.00 | 4 | 37.5 | 150.0 | 112.50 | 180 | 1 | 1 | 1 | No | Yes | 3 |
| 80 | 28.00 | 5 | 37.5 | 187.5 | 150.00 | 180 | 2 | 1 | 1 | No | Yes | 4 |
| 100 | 28.00 | 6 | 37.5 | 225.0 | 187.5 | 180 | 2 | 2 | 1 | No | Yes | 5 |
| 120 | 28.00 | 6 | 37.5 | 225.0 | 187.5 | 180 | 2 | 2 | 1 | No | Yes | 5 |

**Table 19. Side Traq damper - standard flow mixing box**

| Unit size | Damper dia (in) | Damper qty | Damper torque (in-lb) | Total torque (in-lb) | Actuator torque (max) (in-lb) | Actuator qty | Face-to-face linkage | Linkage on face |
|---|---|---|---|---|---|---|---|---|
| 3, 4, 6, 8 | 13.00 | 1 | 18.00 | 18.00 | 42.00 | 1 | No | No |
| 10, 12 | 16.00 | 1 | 22.50 | 22.50 | 42.00 | 1 | No | No |
| 14, 17 | 13.00 | 2 | 18.00 | 36.00 | 42.00 | 1 | No | Yes |
| 21, 22, 25, 26 | 16.00 | 2 | 22.50 | 45.00 | 180.00 | 1 | No | Yes |
| 30, 31, 35, 40 | 20.00 | 2 | 33.00 | 66.00 | 180.00 | 1 | No | Yes |
| 36, 41, 50, 57, 66 | 24.00 | 2 | 36.00 | 72.00 | 180.00 | 1 | No | Yes |
| 51, 58, 80 | 28.00 | 2 | 37.50 | 75.00 | 180.00 | 1 | No | Yes |
| 100 | 28.00 | 3 | 37.50 | 112.50 | 180.00 | 1 | No | Yes |
| 120 | 24.00 | 4 | 36.00 | 144.00 | 180.00 | 1 | No | Yes |

**Table 20. Side Traq damper - standard flow diagonal economizer**

| Unit sizes | Damper dia (in) | Damper qty | Damper torque (in-lb.) | Total torque (in-lb.) | Actuator torque (max) (in-lb.) | Actuator qty | Face-to-face linkage | Linkage on face |
|---|---|---|---|---|---|---|---|---|
| 3 | 13.00 | 1 | 18.00 | 18.00 | 42.00 | 1 | No | No |
| 4 | 13.00 | 2 | 18.00 | 36.00 | 42.00 | 2 | No | No |
| 6, 8 | 13.00 | 2 | 18.00 | 36.00 | 42.00 | 1 | No | Yes |
| 10, 12, 14 | 16.00 | 2 | 22.50 | 45.00 | 180.00 | 1 | No | Yes |
| 17 | 13.00 | 4 | 18.00 | 72.00 | 180.00 | 1 | No | Yes |
| 21 | 20.00 | 2 | 33.00 | 66.00 | 180.00 | 1 | No | Yes |
| 25 | 16.00 | 4 | 22.50 | 90.00 | 180.00 | 1 | No | Yes |
| 30 | 20.00 | 3 | 33.00 | 99.00 | 180.00 | 1 | No | Yes |
| 35 | 28.00 | 2 | 37.50 | 37.50 | 42.00 | 2 | No | No |
| 40 | 28.00 | 2 | 37.50 | 75.00 | 180.00 | 1 | No | Yes |
| 50 | 24.00 | 3 | 36.00 | 108.00 | 180.00 | 1 | No | Yes |
| 57 | 24.00 | 4 | 36.00 | 144.00 | 180.00 | 1 | No | Yes |
| 66 | 28.00 | 3 | 37.50 | 112.50 | 180.00 | 1 | No | Yes |
| 80 | 28.00 | 4 | 37.50 | 150.00 | 180.00 | 1 | No | Yes |
| 100, 120 | 28.00 | 5 | 37.50 | 187.50 | 180.00 | 2 | No | Yes |

**Table 21. Single -Side Traq low flow mixing box**

| Unit size | Damper Dia (in) | Damper Qty | Damper Torque (in-lb.) | Low flow Traq Torque (in-lb.) | Remained Traq Torque (in-lb.) | Actuator qty for low flow Traq | Actuator qty for remained damper | Actuator total Qty | Face-to-face Linkage | Linkage on Face |
|---|---|---|---|---|---|---|---|---|---|---|
| 14, 17 | 13.00 | 2 | 18.00 | 18.00 | 18.00 | 1 | 1 | 2 | No | No |
| 21, 22, 25, 26 | 16.00 | 2 | 22.50 | 22.50 | 22.50 | 1 | 1 | 2 | No | No |
| 30, 31, 35, 40 | 20.00 | 2 | 33.00 | 33.00 | 33.00 | 1 | 1 | 2 | No | No |
| 36, 41, 50, 57, 66 | 24.00 | 2 | 36.00 | 36.00 | 36.00 | 1 | 1 | 2 | No | No |
| 51, 58, 80 | 28.00 | 2 | 37.50 | 37.50 | 37.50 | 1 | 1 | 2 | No | No |
| 100 | 28.00 | 3 | 37.50 | 37.50 | 75.00 | 1 | 1 | 2 | No | Yes |
| 120 | 24.00 | 4 | 36.00 | 36.00 | 108.00 | 1 | 1 | 2 | No | Yes |

**Table 22. Dual-side Traq low flow mixing box**

| Unit size | Damper dia (in) | Damper qty | Damper torque (in-lb) | Low-flow Traq torque (in-lb) | Remained Traq torque (in-lb) | Actuator qty for std Traq damper | Actuator qty for low-flow Traq damper | Actuator qty for single low-flow Traq | Actuator total qty | Face-to-face linkage | Linkage on face |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3, 4, 6, 8 | 13.00 | 2 | 18.00 | 18.00 | 18.00 | 1 | - | 1 | 2 | No | No |
| 10, 12 | 16.00 | 2 | 22.50 | 22.50 | 22.50 | 1 | - | 1 | 2 | No | No |
| 14, 17 | 13.00 | 4 | 18.00 | 18.00 | 54.00 | 1 | 1 | 1 | 3 | No | No |
| 21, 22, 25, 26 | 16.00 | 4 | 22.50 | 22.50 | 67.50 | 1 | 1 | 1 | 3 | No | No |
| 30, 31, 35, 40 | 20.00 | 4 | 33.00 | 33.00 | 99.00 | 1 | 1 | 1 | 3 | No | No |
| 36, 41, 50, 57, 66 | 24.00 | 4 | 36.00 | 36.00 | 108.00 | 1 | 1 | 1 | 3 | No | No |
| 51, 58, 80 | 28.00 | 4 | 37.50 | 37.50 | 112.50 | 1 | 1 | 1 | 3 | No | No |
| 100 | 28.00 | 6 | 37.50 | 37.50 | 187.50 | 1 | 1 | 1 | 3 | No | Yes |
| 120 | 24.00 | 8 | 36.00 | 36.00 | 252.00 | 1 | 1 | 1 | 3 | No | Yes |

**Table 23. Side Traq low-flow diagonal economizer**

| Unit size | Damper dia (in) | Damper qty | Damper torque (in-lb.) | Low flow Traq torque (in-lb.) | Remainder Traq torque (in-lb.) | Actuator qty for low flow Traq | Actuator qty for remainder damper | Actuator total qty | Face-to-face linkage | Linkage on face |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 13.00 | 2 | 18.00 | 18.00 | 18.00 | 1 | 1 | 2 | No | No |
| 8 | 13.00 | 2 | 18.00 | 18.00 | 18.00 | 1 | 1 | 2 | No | No |
| 10 | 16.00 | 2 | 22.50 | 22.50 | 22.50 | 1 | 1 | 2 | No | No |
| 12 | 16.00 | 2 | 22.50 | 22.50 | 22.50 | 1 | 1 | 2 | No | No |
| 14 | 16.00 | 2 | 22.50 | 22.50 | 22.50 | 1 | 1 | 2 | No | No |
| 17 | 13.00 | 4 | 18.00 | 18.00 | 54.00 | 1 | 1 | 2 | No | Yes |
| 21 | 20.00 | 2 | 33.00 | 33.00 | 33.00 | 1 | 1 | 2 | No | No |
| 25 | 16.00 | 4 | 22.50 | 22.50 | 67.50 | 1 | 1 | 2 | No | Yes |
| 30 | 20.00 | 3 | 33.00 | 33.00 | 66.00 | 1 | 1 | 2 | No | Yes |
| 35 | 28.00 | 2 | 37.50 | 37.50 | 37.50 | 1 | 1 | 2 | No | No |
| 40 | 28.00 | 2 | 37.50 | 37.50 | 37.50 | 1 | 1 | 2 | No | No |
| 50 | 24.00 | 3 | 36.00 | 36.00 | 72.00 | 1 | 1 | 2 | No | Yes |
| 57 | 24.00 | 4 | 36.00 | 36.00 | 108.00 | 1 | 1 | 2 | No | Yes |
| 66 | 28.00 | 3 | 37.50 | 37.50 | 75.00 | 1 | 1 | 2 | No | Yes |
| 80 | 28.00 | 4 | 37.50 | 37.50 | 112.50 | 1 | 1 | 2 | No | Yes |
| 100 | 28.00 | 5 | 37.50 | 37.50 | 150.00 | 1 | 1 | 2 | No | Yes |
| 120 | 28.00 | 5 | 37.50 | 37.50 | 150.00 | 1 | 1 | 2 | No | Yes |

**Table 24. Side rectangle angle damper - 2000 fpm**

| Unit size | A (in) | B (in) | Damper qty | Torque (in-lb.) | Actuator torque (max) (in-lb.) | Actuator qty | Linkage |
|---|---|---|---|---|---|---|---|
| 3 | 11.25 | 13.97 | 1 | 13.10 | 42.00 | 1 | No |
| 4 | 11.25 | 13.97 | 1 | 13.10 | 42.00 | 1 | No |
| 6 | 15.75 | 13.97 | 1 | 18.30 | 42.00 | 1 | No |
| 8 | 20.25 | 13.97 | 1 | 23.60 | 42.00 | 1 | No |
| 10 | 20.25 | 16.30 | 1 | 27.50 | 42.00 | 1 | No |
| 12 | 27.00 | 16.30 | 1 | 36.70 | 42.00 | 1 | No |
| 14 | 23.25 | 19.72 | 1 | 38.20 | 42.00 | 1 | No |
| 17 | 30.50 | 19.72 | 1 | 50.10 | 180.00 | 1 | No |
| 21 | 36.75 | 19.72 | 1 | 60.40 | 180.00 | 1 | No |
| 25 | 45.75 | 19.72 | 1 | 75.20 | 180.00 | 1 | No |
| 30 | 48.50 | 20.22 | 1 | 81.70 | 180.00 | 1 | No |
| 35 | 45.50 | 25.47 | 1 | 96.60 | 180.00 | 1 | No |
| 40 | 48.00 | 28.35 | 1 | 113.40 | 180.00 | 1 | No |
| 50 | 56.75 | 31.22 | 1 | 147.60 | 180.00 | 1 | No |
| 57 | 65.75 | 31.22 | 1 | 171.10 | 180.00 | 1 | No |
| 66 | 70.50 | 31.22 | 1 | 183.40 | 180.00 | 2 | No |
| 80 | 85.00 | 31.22 | 1 | 221.10 | 180.00 | 2 | No |
| 100 | 95.00 | 36.97 | 1 | 292.70 | 180.00 | 2 | No |
| 120 | 96.00 | 42.72 | 1 | 341.80 | 180.00 | 2 | No |

**Table 25. Side rectangle damper per 1200 fpm - diagonal economizer with OA rectangular dampers**

| Unit size | A (in) | B (in) | Damper qty | Torque (in-lb.) | Actuator torque (max) (in-lb.) | Actuator qty | Linkage |
|---|---|---|---|---|---|---|---|
| 3 | 12.50 | 13.97 | 1 | 14.60 | 42.00 | 1 | No |
| 4 | 13.75 | 19.72 | 1 | 22.60 | 42.00 | 1 | No |
| 6 | 18.75 | 19.72 | 1 | 30.80 | 42.00 | 1 | No |
| 8 | 24.25 | 19.72 | 1 | 39.90 | 42.00 | 1 | No |
| 10 | 23.50 | 25.47 | 1 | 49.90 | 180.00 | 1 | No |
| 12 | 29.00 | 25.47 | 1 | 61.60 | 180.00 | 1 | No |
| 14 | 26.00 | 31.22 | 1 | 67.60 | 180.00 | 1 | No |
| 17 | 32.00 | 31.22 | 1 | 83.30 | 180.00 | 1 | No |
| 21 | 40.00 | 31.22 | 1 | 104.10 | 180.00 | 1 | No |
| 25 | 48.00 | 31.22 | 1 | 124.90 | 180.00 | 1 | No |
| 30 | 47.00 | 36.97 | 1 | 144.80 | 180.00 | 1 | No |
| 35 | 48.00 | 42.72 | 1 | 170.90 | 180.00 | 1 | No |
| 40 | 48.00 | 48.47 | 1 | 193.90 | 180.00 | 2 | No |
| 50 | 57.75 | 48.47 | 1 | 233.30 | 180.00 | 2 | No |
| 57 | 67.50 | 48.47 | 1 | 272.60 | 180.00 | 2 | No |
| 66 | 69.50 | 28.35 | 2 | 277.10 | 180.00 | 2 | Yes |
| 80 | 83.00 | 28.35 | 2 | 330.90 | 180.00 | 2 | Yes |
| 100 | 95.25 | 31.22 | 2 | 418.20 | 180.00 | 3 | Yes |
| 120 | 95.00 | 36.97 | 2 | 493.90 | 180.00 | 3 | Yes |

**Table 26. Short mixing box rectangle damper - top, back or bottom only**

| Unit size | A (in) | B (in) | Damper Qty | Torque (in-lb.) | Actuator Torque (max) (in-lb.) | Actuator qty | Linkage |
|---|---|---|---|---|---|---|---|
| 3 | 13.00 | 8.22 | 1 | 5.20 | 42.00 | 1 | No |
| 4 | 19.75 | 8.22 | 1 | 7.90 | 42.00 | 1 | No |
| 6 | 27.00 | 8.22 | 1 | 10.80 | 42.00 | 1 | No |
| 8 | 35.00 | 8.22 | 1 | 14.00 | 42.00 | 1 | No |
| 10 | 43.75 | 8.22 | 1 | 17.50 | 180.00 | 1 | No |
| 12 | 32.00 | 13.97 | 1 | 21.70 | 180.00 | 1 | No |
| 14 | 60.00 | 8.22 | 1 | 24.00 | 180.00 | 1 | No |
| 17 | 43.50 | 13.97 | 1 | 29.50 | 180.00 | 1 | No |
| 21 | 53.75 | 13.97 | 1 | 36.50 | 180.00 | 1 | No |
| 25 | 64.50 | 13.97 | 1 | 43.80 | 180.00 | 1 | No |
| 30 | 55.00 | 19.72 | 1 | 52.70 | 180.00 | 1 | No |
| 35 | 64.00 | 19.72 | 1 | 61.40 | 180.00 | 1 | No |
| 40 | 56.50 | 25.47 | 1 | 70.00 | 180.00 | 1 | No |
| 50 | 68.00 | 25.47 | 1 | 84.20 | 180.00 | 1 | No |
| 57 | 66.00 | 31.22 | 1 | 100.20 | 180.00 | 1 | No |
| 66 | 58.50 | 19.72 | 2 | 112.20 | 180.00 | 1 | No |
| 80 | 54.25 | 25.47 | 2 | 134.30 | 180.00 | 1 | No |
| 100 | 65.25 | 25.47 | 2 | 161.60 | 180.00 | 1 | No |
| 120 | 66.00 | 31.22 | 2 | 200.30 | 180.00 | 2 | No |

**Table 27. Damper torque per blade (inch-pounds)**

| Unit size | 2 Deck Horizontal | 2 Deck Vertical | 3 Deck dual-actuator Horizontal | 3 Deck dual-actuator Vertical | 3 Deck single-actuator Horizontal | 3 Deck single-actuator Vertical |
|---|---|---|---|---|---|---|
| 6 | 7.10 | 5.50 | 7.50 | 5.80 | 32.50 | 25.00 |
| 8 | 7.10 | 5.50 | 7.50 | 5.80 | 32.50 | 25.00 |
| 10 | 8.00 | 6.20 | 8.60 | 6.60 | 32.50 | 25.00 |
| 12 | 8.00 | 6.20 | 8.60 | 6.60 | 32.50 | 25.00 |
| 14 | 8.00 | 6.20 | 8.60 | 6.60 | 32.50 | 25.00 |
| 17 | 8.00 | 6.20 | 8.60 | 6.60 | 32.50 | 25.00 |
| 21 | 9.90 | 7.50 | 11.50 | 8.70 | 32.50 | 25.00 |
| 25 | 9.90 | 7.50 | 11.50 | 8.70 | 32.50 | 25.00 |
| 30 | 9.90 | 7.50 | 11.50 | 8.70 | 32.50 | 25.00 |
| 35 | 19.80 | 15.20 | 31.50 | 24.40 | 32.50 | 25.00 |
| 40 | 19.80 | 15.20 | 31.50 | 24.40 | 32.50 | 25.00 |
| 50 | 19.80 | 15.20 | 31.50 | 24.40 | 32.50 | 25.00 |

**Table 28. Energy recovery bypass opposed-blade damper**

| Unit size | A (in) | B (in) | Damper qty | Torque (in-lb.) | Actuator Torque (max) (in-lb.) | Actuator qty | Linkage |
|---|---|---|---|---|---|---|---|
| 3 - 8 | 18.00 | 8.22 | 1 | 5.10 | 42.00 | 1 | No |
| 8 - 14 | 32.00 | 8.22 | 1 | 9.10 | 42.00 | 1 | No |
| 10 - 17 | 41.75 | 8.22 | 1 | 11.90 | 42.00 | 1 | No |
| 12 - 21 | 53.50 | 8.22 | 1 | 15.30 | 42.00 | 1 | No |
| 21 - 50 | 52.50 | 13.97 | 1 | 25.50 | 180.00 | 1 | No |
| 17, 21 | 61.50 | 8.22 | 1 | 17.60 | 42.00 | 1 | No |
| 21 - 30 | 66.00 | 8.22 | 1 | 18.80 | 42.00 | 1 | No |
| 25 - 50 | 65.00 | 13.97 | 1 | 31.50 | 180.00 | 1 | No |
| 21 | 70.00 | 8.22 | 1 | 20.00 | 42.00 | 1 | No |
| 35 - 50 | 84.50 | 13.97 | 1 | 41.00 | 180.00 | 1 | No |
| 35 - 50 | 75.00 | 13.97 | 1 | 36.40 | 180.00 | 1 | No |
| 40 - 50 | 102.00 | 13.97 | 1 | 49.50 | 180.00 | 1 | No |
| 50 | 113.00 | 13.97 | 1 | 54.80 | 180.00 | 1 | No |

**Table 29. Exhaust fan damper torque**

| Unit size | A (in) | B (in) | Damper Qty | Torque (in-lb.) | Actuator Torque (max) (in-lb.) | Actuator qty | Linkage |
|---|---|---|---|---|---|---|---|
| 3 | 19.83 | 13.97 | 1 | 13.50 | 42.00 | 1 | No |
| 4 | 32.33 | 13.97 | 1 | 22.00 | 42.00 | 1 | No |
| 6 | 32.33 | 13.97 | 1 | 22.00 | 42.00 | 1 | No |
| 8 | 38.83 | 13.97 | 1 | 26.40 | 180.00 | 1 | No |
| 10 | 49.83 | 13.97 | 1 | 33.80 | 180.00 | 1 | No |
| 12 | 54.83 | 13.97 | 1 | 37.20 | 180.00 | 1 | No |
| 14 | 60.33 | 13.97 | 1 | 41.00 | 180.00 | 1 | No |
| 17 | 60.33 | 13.97 | 1 | 41.00 | 180.00 | 1 | No |
| 21 | 68.33 | 13.97 | 1 | 46.40 | 180.00 | 1 | No |
| 25 | 68.33 | 13.97 | 1 | 46.40 | 180.00 | 1 | No |
| 30 | 81.83 | 13.97 | 1 | 55.60 | 180.00 | 1 | No |
| 35 | 40.88 | 19.72 | 2 | 78.40 | 180.00 | 2 | No |
| 40 | 30.42 | 19.72 | 3 | 87.50 | 180.00 | 3 | No |
| 50 | 34.75 | 19.72 | 3 | 99.90 | 180.00 | 3 | No |
| 57 | 34.75 | 19.72 | 3 | 99.90 | 180.00 | 3 | No |
| 66 | 39.75 | 31.22 | 3 | 181.00 | 180.00 | 3 | No |
| 80 | 38.42 | 31.22 | 3 | 174.90 | 180.00 | 3 | No |
| 100 | 43.09 | 31.22 | 3 | 196.20 | 180.00 | 3 | No |
| 120 | 52.25 | 31.22 | 3 | 237.90 | 180.00 | 3 | No |

**Table 30. Energy recovery recirculation parallel-blade damper**

| Unit size | A (in) | B (in) | Damper qty | Torque (in-lb.) | Actuator torque (max) (in-lb.) | Actuator qty | Linkage |
|---|---|---|---|---|---|---|---|
| 3 | 16.00 | 13.97 | 1 | 10.90 | 42.00 | 1 | No |
| 4 | 28.50 | 13.97 | 1 | 19.40 | 42.00 | 1 | No |
| 6 | 28.50 | 13.97 | 1 | 19.40 | 42.00 | 1 | No |
| 8 | 35.00 | 13.97 | 1 | 23.80 | 42.00 | 1 | No |
| 10 | 46.00 | 13.97 | 1 | 31.20 | 42.00 | 1 | No |
| 12 | 51.00 | 13.97 | 1 | 34.60 | 42.00 | 1 | No |
| 14 | 56.50 | 13.97 | 1 | 38.40 | 180.00 | 1 | No |
| 17 | 56.50 | 13.97 | 1 | 38.40 | 180.00 | 1 | No |
| 21 | 64.50 | 13.97 | 1 | 43.80 | 180.00 | 1 | No |
| 25 | 64.50 | 13.97 | 1 | 43.80 | 180.00 | 1 | No |
| 30 | 78.00 | 13.97 | 1 | 53.00 | 180.00 | 1 | No |
| 35 | 84.50 | 13.97 | 1 | 57.40 | 180.00 | 1 | No |
| 40 | 97.00 | 13.97 | 1 | 65.90 | 180.00 | 1 | No |
| 50 | 110.00 | 13.97 | 1 | 74.70 | 180.00 | 1 | No |

**Table 31. Face damper torque requirements**

| Unit size | A (in) | B (in) | Damper Qty | Torque (in-lb) | Actuator torque (max) (in-lb.) | Actuator Qty |
|---|---|---|---|---|---|---|
| 3 | 23.20 | 19.72 | 1 | 13.80 | 42.00 | 1 |
| 4 | 35.70 | 19.72 | 1 | 21.30 | 42.00 | 1 |
| 6 | 35.70 | 25.47 | 1 | 27.50 | 42.00 | 1 |
| 8 | 42.20 | 25.47 | 1 | 32.50 | 42.00 | 1 |
| 10 | 53.20 | 25.47 | 1 | 40.90 | 42.00 | 1 |
| 12 | 58.20 | 31.22 | 1 | 54.90 | 180.00 | 1 |
| 14 | 63.70 | 31.22 | 1 | 60.10 | 180.00 | 1 |
| 17 | 63.70 | 36.97 | 1 | 71.10 | 180.00 | 1 |
| 21 | 71.70 | 42.72 | 1 | 92.50 | 180.00 | 1 |
| 22 | 50.94 | 54.82 | 1 | 84.36 | 180.00 | 1 |
| 25 | 71.70 | 48.47 | 1 | 105.00 | 180.00 | 1 |
| 26 | 50.94 | 68.19 | 1 | 104.93 | 180.00 | 1 |
| 30 | 85.20 | 48.47 | 1 | 124.70 | 180.00 | 1 |
| 31 | 29.19 | 68.19 | 2 | 120.25 | 180.00 | 1 |
| 35 | 43.44 | 50.94 | 2 | 133.70 | 180.00 | 1 |
| 36 | 33.19 | 73.94 | 2 | 148.26 | 180.00 | 1 |
| 40 | 32.19 | 50.94 | 3 | 148.60 | 180.00 | 1 |
| 41 | 33.19 | 91.19 | 2 | 182.85 | 180.00 | 2 |
| 50 | 36.52 | 62.44 | 3 | 206.70 | 180.00 | 2 |
| 51 | 39.94 | 91.19 | 2 | 220.03 | 180.00 | 2 |
| 57 | 36.52 | 68.19 | 3 | 225.70 | 180.00 | 2 |
| 58 | 39.94 | 102.69 | 2 | 247.78 | 180.00 | 2 |
| 66 | 41.52 | 73.94 | 3 | 278.20 | 180.00 | 2 |
| 80 | 41.52 | 85.44 | 3 | 321.50 | 180.00 | 2 |
| 100 | 46.19 | 99.41 | 3 | 416.10 | 180.00 | 3 |
| 120 | 55.35 | 99.41 | 3 | 498.70 | 180.00 | 3 |

**Table 32. Internal face-and-bypass damper torque requirements**

| Unit size | A (in) | B (in) | Damper Qty | Torque (in-lb) | Actuator torque (max) (in-lb.) | Actuator Qty |
|---|---|---|---|---|---|---|
| 3 | 23.20 | 18.31 | 1 | 12.80 | 42.00 | 1 |
| 4 | 35.70 | 18.31 | 1 | 19.70 | 42.00 | 1 |
| 6 | 35.70 | 19.37 | 1 | 20.90 | 42.00 | 1 |
| 8 | 42.20 | 24.39 | 1 | 31.10 | 42.00 | 1 |
| 10 | 53.20 | 24.39 | 1 | 39.20 | 42.00 | 1 |
| 12 | 58.20 | 31.14 | 1 | 54.80 | 180.00 | 1 |
| 14 | 63.70 | 31.14 | 1 | 59.90 | 180.00 | 1 |
| 17 | 63.70 | 36.61 | 1 | 70.50 | 180.00 | 1 |
| 21 | 71.70 | 42.17 | 1 | 91.30 | 180.00 | 1 |
| 22 | 50.94 | 50.94 | 1 | 78.38 | 180.00 | 1 |
| 25 | 71.70 | 47.80 | 1 | 103.50 | 180.00 | 1 |
| 26 | 50.94 | 68.19 | 1 | 104.93 | 180.00 | 1 |
| 30 | 85.20 | 47.80 | 1 | 123.00 | 180.00 | 1 |
| 31 | 29.19 | 68.19 | 2 | 120.25 | 180.00 | 1 |
| 35 | 43.44 | 50.94 | 2 | 133.70 | 180.00 | 1 |
| 36 | 33.19 | 73.94 | 2 | 148.26 | 180.00 | 1 |
| 40 | 32.19 | 50.94 | 3 | 148.60 | 180.00 | 1 |
| 41 | 33.19 | 85.44 | 2 | 171.32 | 180.00 | 2 |
| 50 | 36.52 | 62.44 | 3 | 206.70 | 180.00 | 2 |
| 51 | 39.94 | 85.44 | 2 | 206.16 | 180.00 | 2 |
| 57 | 36.52 | 68.19 | 3 | 225.70 | 180.00 | 2 |
| 58 | 39.94 | 101.62 | 2 | 245.19 | 180.00 | 2 |
| 66 | 41.52 | 73.94 | 3 | 278.20 | 180.00 | 2 |
| 80 | 41.52 | 85.44 | 3 | 321.50 | 180.00 | 2 |
| 100 | 46.19 | 99.41 | 3 | 416.10 | 180.00 | 3 |
| 120 | 55.35 | 99.41 | 3 | 498.70 | 180.00 | 3 |

**Table 33. External face-and-bypass damper torque requirements**

| Unit size | A (in) | B (in) | Damper Qty | Bypass Torque (in-lb) | Face Torque (in-lb.) | Torque (in-lb) | Actuatortorque (max) (in-lb.) | Actuator Qty |
|---|---|---|---|---|---|---|---|---|
| 3 | 19.83 | 13.97 | 1 | 8.40 | 13.80 | 22.20 | 42.00 | 1 |
| 4 | 32.33 | 13.97 | 1 | 13.60 | 21.30 | 34.90 | 42.00 | 1 |
| 6 | 32.33 | 13.97 | 1 | 13.60 | 27.50 | 41.10 | 42.00 | 1 |
| 8 | 38.83 | 13.97 | 1 | 16.40 | 32.50 | 48.90 | 180.00 | 1 |
| 10 | 49.83 | 13.97 | 1 | 21.00 | 40.90 | 62.00 | 180.00 | 1 |
| 12 | 54.83 | 13.97 | 1 | 23.10 | 54.90 | 78.00 | 180.00 | 1 |
| 14 | 60.33 | 13.97 | 1 | 25.50 | 60.10 | 85.50 | 180.00 | 1 |
| 17 | 60.33 | 13.97 | 1 | 25.50 | 71.10 | 96.60 | 180.00 | 1 |
| 21 | 68.33 | 13.97 | 1 | 28.80 | 92.50 | 121.40 | 180.00 | 1 |
| 22 | 49.83 | 13.97 | 1 | 21.03 | 84.36 | 105.39 | 180.00 | 1 |
| 25 | 68.33 | 13.97 | 1 | 28.80 | 105.00 | 133.80 | 180.00 | 1 |
| 26 | 49.83 | 19.72 | 1 | 29.69 | 104.93 | 134.61 | 180.00 | 1 |
| 30 | 81.83 | 13.97 | 1 | 34.50 | 124.70 | 159.30 | 180.00 | 1 |
| 31 | 60.33 | 19.72 | 1 | 35.94 | 120.25 | 156.19 | 180.00 | 1 |
| 35 | 41.17 | 13.97 | 2 | 34.70 | 133.70 | 168.40 | 180.00 | 1 |
| 36 | 68.33 | 19.72 | 1 | 40.71 | 148.26 | 188.96 | 180.00 | 2 |
| 40 | 27.61 | 13.97 | 3 | 35.00 | 148.6 | 183.50 | 180.00 | 2 |

**Table 33. External face-and-bypass damper torque requirements**

| Unit size | A (in) | B (in) | Damper Qty | Bypass Torque (in-lb) | Face Torque (in-lb.) | Torque (in-lb) | Actuator torque (max) (in-lb.) | Actuator Qty |
|---|---|---|---|---|---|---|---|---|
| 41 | 68.33 | 19.72 | 1 | 40.71 | 182.85 | 223.55 | 180.00 | 2 |
| 50 | 31.94 | 13.97 | 3 | 40.40 | 206.70 | 247.10 | 180.00 | 2 |
| 51 | 81.83 | 19.72 | 1 | 48.75 | 220.03 | 268.78 | 180.00 | 2 |
| 57 | 31.94 | 13.97 | 3 | 40.40 | 225.70 | 266.10 | 180.00 | 2 |
| 58 | 81.83 | 19.72 | 1 | 48.75 | 247.78 | 296.53 | 180.00 | 2 |
| 66 | 36.94 | 25.47 | 3 | 85.30 | 278.20 | 363.50 | 180.00 | 3 |
| 80 | 36.94 | 25.47 | 3 | 85.30 | 321.50 | 406.80 | 180.00 | 3 |
| 100 | 41.61 | 25.47 | 3 | 96.00 | 416.10 | 512.20 | 180.00 | 2 |
| 120 | 50.78 | 25.47 | 3 | 117.20 | 498.70 | 615.90 | 180.00 | 3 |

## Opposed-Blade and Parallel-Blade Damper

Opposed-blade and parallel-blade airfoil dampers in unit sizes 3-120, as well as internal and external face-and-bypass sections, have centered dampers with an internal jack-shaft (see Figure 94, Figure 95 and Figure 96). A 95-degree actuator rotation gives a 90-degree blade travel.

*Note: Damper blades should be checked for proper operation from full open to full closed position before unit start up. Damper blade positioning may have changed due to shipping and handling vibrations.*

**Figure 94. Typical mixing box configurations for unit sizes 3 to 120**

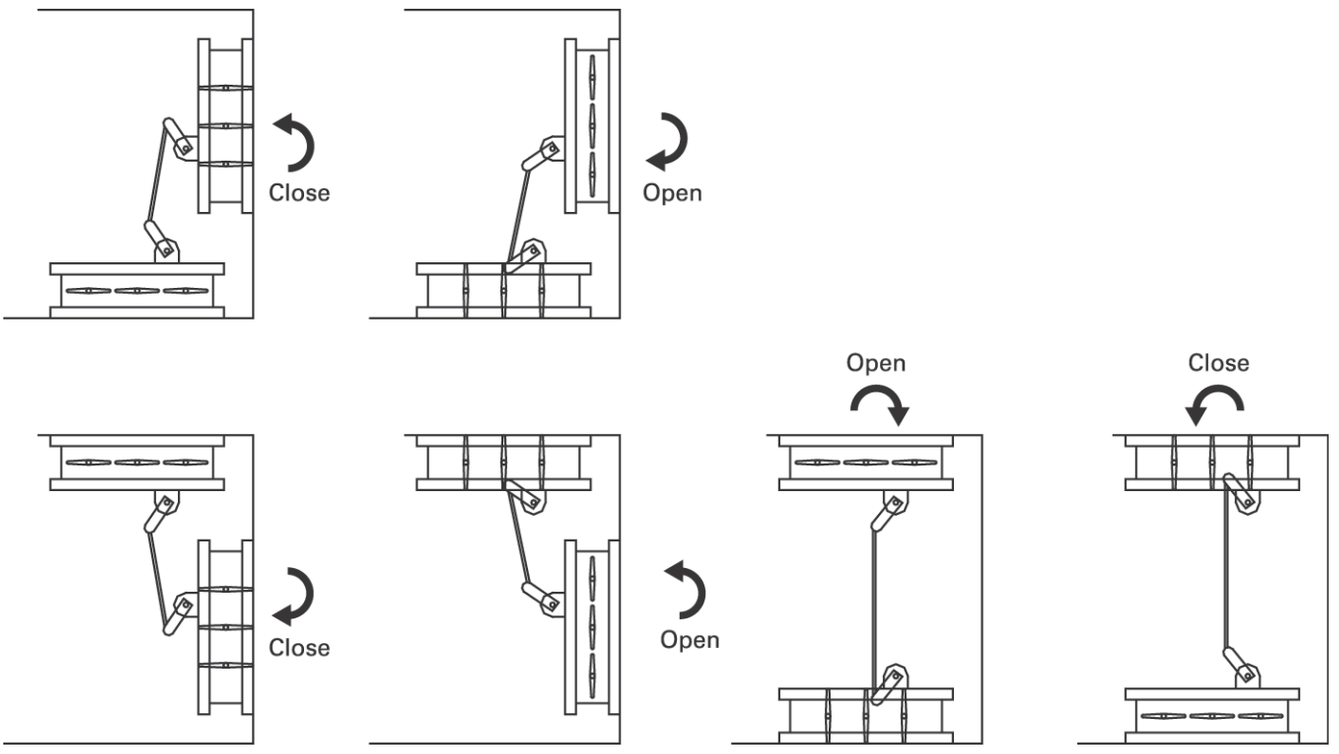


**Figure 95. Typical internal face-and-bypass configuration**

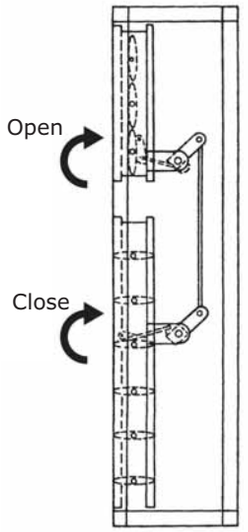
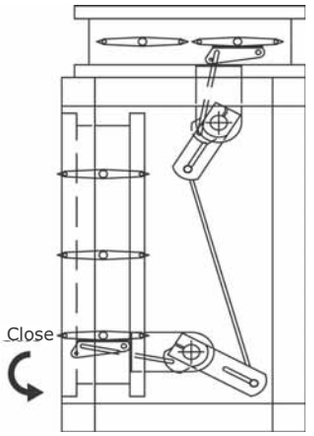



**Figure 96. Typical external face-and-bypass configuration**




# Multizone Modules

Under certain operating conditions, condensation may form on the cold deck portion of the multizone damper section. To prevent this, insulate around the damper rods. Be sure the insulation does not affect damper operation.

## Zone Damper Operators

Zone damper operators are available factory-mounted with factory-mounted controls or as a stand-alone end device. If not factory-provided, the contractor is responsible for providing these operators. In all cases, the damper operator should be connected to the drive rod.

## Adjusting Zone Dampers

Zone dampers should be installed and adjusted prior to making duct connections, assuring proper setup of the damper zones:

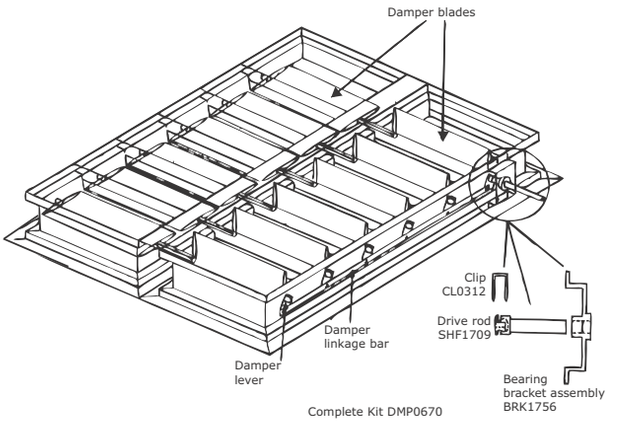
1. Check the damper blades to confirm they are not binding. The blade should rotate 90 degrees.
2. Determine the number of zones required. The zone damper is fitted with a linkage bar that connects all damper zones.
3. Select the number of damper segments required for the first zone.
4. Cut a section out of the damper linkage bar just after the last lever in that zone.

*Note: It may be necessary to remove the damper linkage bar to cut it. To remove the linkage bar pry the "e" rings from the blade axles and remove the bar.*

5. Repeat steps 3 and 4 for the remaining zones.
6. Attach the damper operator drive rod to one blade axle in each zone with the two-deck damper.
7. Use the self-drilling screws provided to mount the bearing bracket assembly (see Figure 97).

*Note: The drive rod kits ship in a separate box, found in the fan module or the cold deck of the multizone module.*

**Figure 97. Setting the zone damper rods and damper linkage**




# Duct Connections

All duct connections to the air handlers should be installed in accordance with the standards of the National Fire Protection Association (NFPA):

- NFPA 90A for installing air conditioning and ventilating systems other than residence type.
- NFPA 90B for residence-type warm air heating and air-conditioning systems.

See unit submittal documentation for additional duct mounting information.

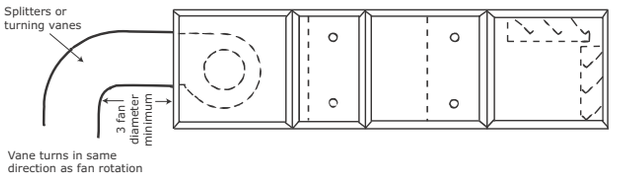
## Fan Discharge Connections

To ensure the highest fan efficiency, duct turns and transitions must be made carefully, minimizing air friction losses and turbulence. Proper ductwork installation, as outlined by such organizations as Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), should be followed closely.

Indoor unit fan sections with rectangular or round openings should have flanged ductwork attached to bottom panel opening. When using lined ducts, the insulation should not obstruct the discharge opening. For plenum fan sections with bell mouth fittings, see "Bell Mouth Discharge Connections" on page 89.

Connections made directly to the discharge opening of a housed fan should have a minimum of three fan diameters of straight duct before any turns or transitions. The ductwork should be the same size as the fan discharge opening. The first turn of the connection should be in the same direction as the fan rotation as shown in Figure 98. The air that the fan discharges into the duct is extremely turbulent and requires some length of duct to stabilize. Abrupt changes in ductwork directly off the fan discharge may adversely affect fan performance and acoustics.

**Figure 98. Typical discharge ductwork recommendations**




## Damper Connections

Standard damper sections include mixing sections, filter mixing sections, face dampers sections, internal face-and-bypass sections, and economizer sections. There are two damper blade configurations available - parallel-blade and opposed-blade. Traq™ dampers are another type of damper available in mixing box sections.

Ductwork attached to the standard damper sections should be sized to fit the opening of the damper. Duct opening dimensions are provided in the submittals. When using lined duct, ensure that the insulation does not obstruct the damper opening (see Figure 99 and Figure 100).

*Note: Damper blades should be checked for proper operation from full-open to full-closed position before unit start up. Damper blade positioning may have changed due to shipping and handling vibrations.*

**Figure 99. Typical section with duct flat/flange connection- uninsulated or externally insulated**

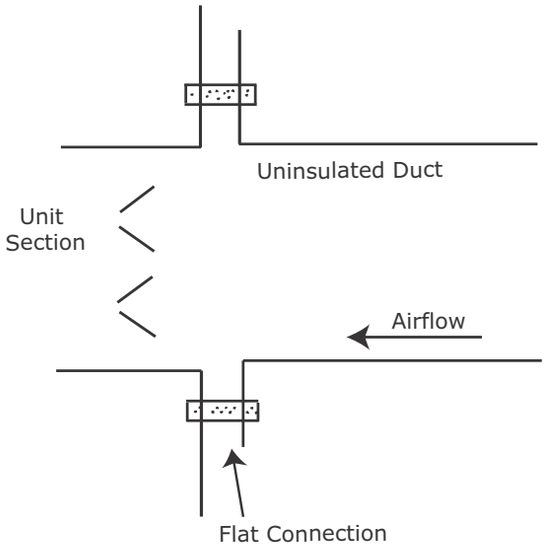
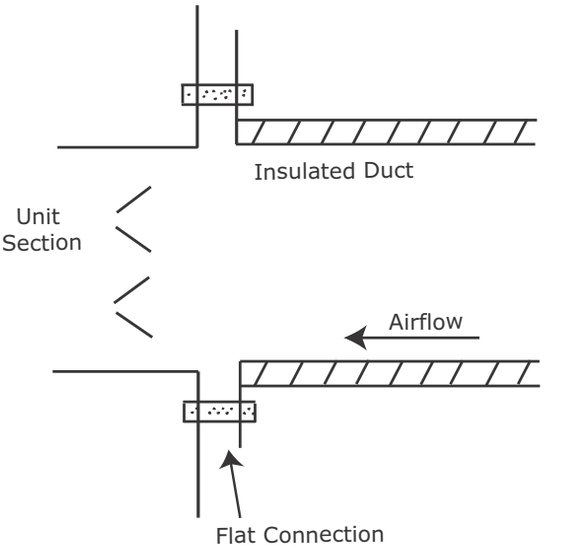



**Figure 100. Typical section with duct flat/flange connection- internally insulated**



## Bottom Opening Duct Installation

1. Install gasket to duct flange to ensure air tight seal.
2. Install duct into place underneath framed opening in unit base per Figure 101. Refer to factory curb layout provided with unit submittals for duct size and location.
3. Bottom of unit base elevation is flush with duct opening in bottom of unit (see Figure 102 and Figure 103).

**Figure 101. Field-supplied duct connection to AHU bottom supply/return air opening**

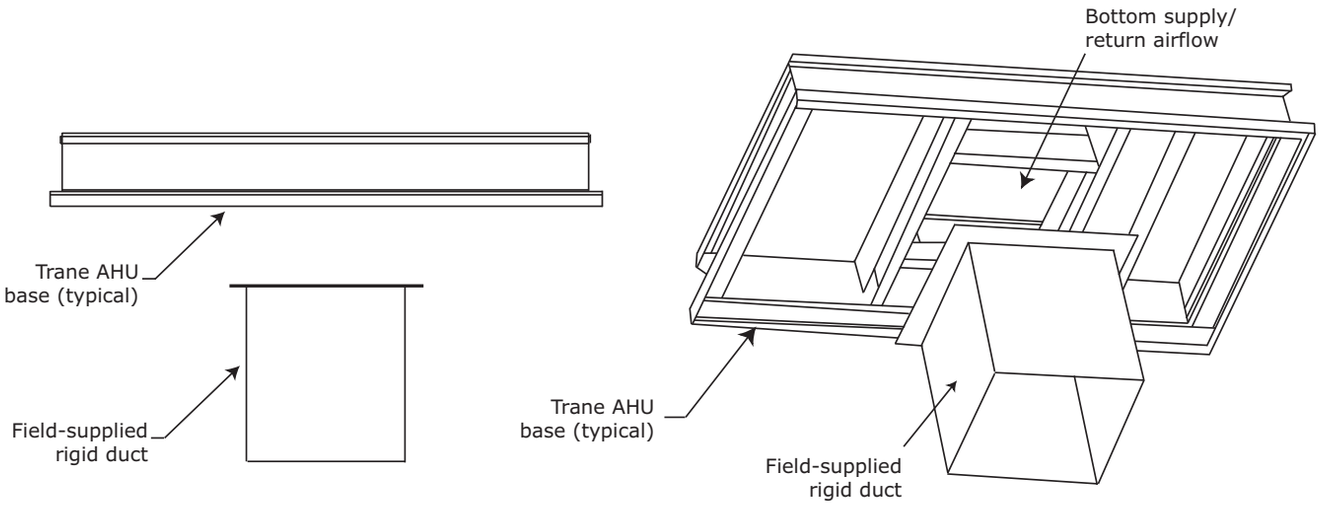



**Figure 102. Field-supplied duct connection details - curb mount for outdoor units**

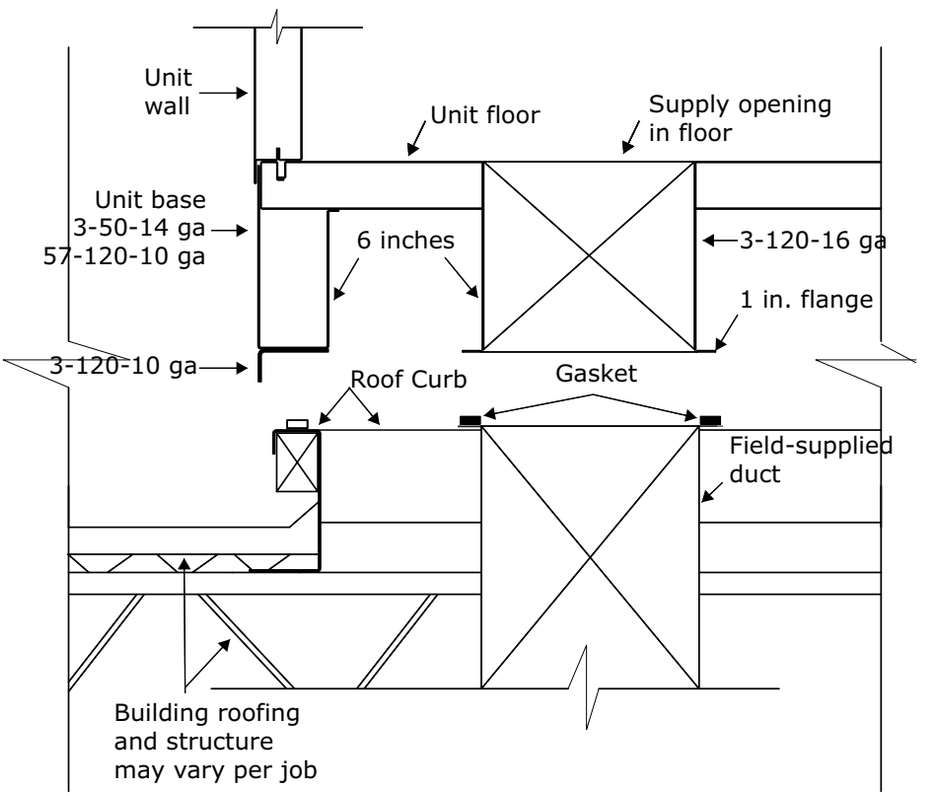
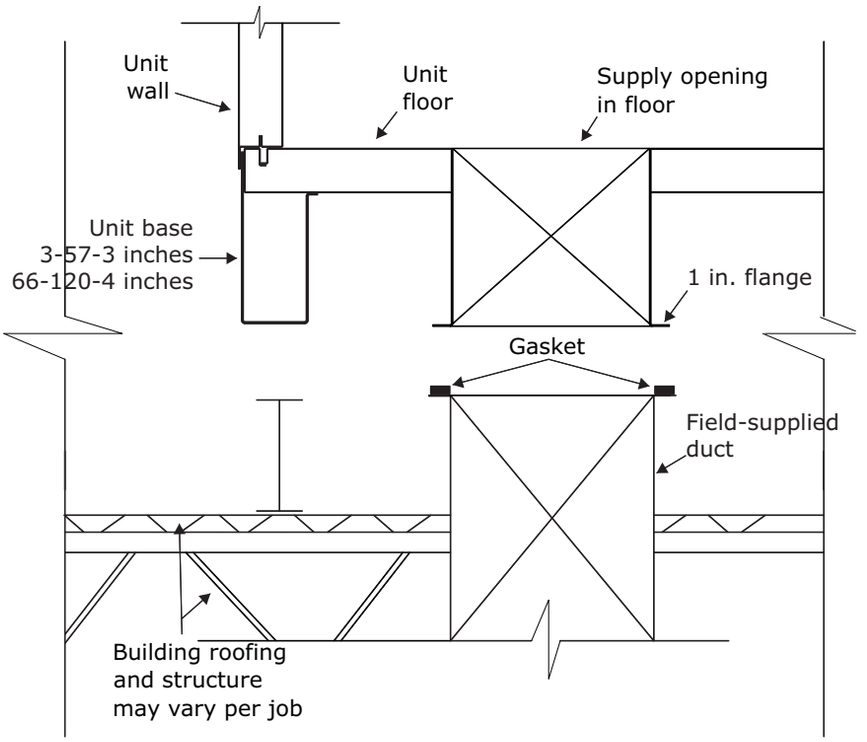


**Figure 103. Field-supplied duct connection details - pier mount for outdoor units**




## Discharge Plenum Connections

Discharge plenum sections are available with or without openings. Sections with rectangular and round openings have a framed opening that can be used to secure the duct to the frames. If the duct is lined, it is important the insulation does not obstruct the opening of the section.

For a discharge plenum with field-cut openings, attach the duct to the side panel.

## Bell Mouth Discharge Connections

Round duct connections to be fastened to plenum fan and discharge plenum sections with bell mouth discharge openings should be sized to attach to the casing or directly to the bell mouth fitting. Attachment to the casing requires the round duct diameter to be sized two inches larger than the nominal bell mouth outlet. An angle ring with a flat flange should be affixed to the round duct to secure the duct to the casing (see Figure 104). Attachment to the bell mouth fitting requires the duct and fitting to be insulated by the installing contractor up to the bell mouth radius to prevent condensation (see Figure 105). The bell mouth fitting extends through the casing by one inch.

**Figure 104. Securing round duct to casing over bell mouth outlet**

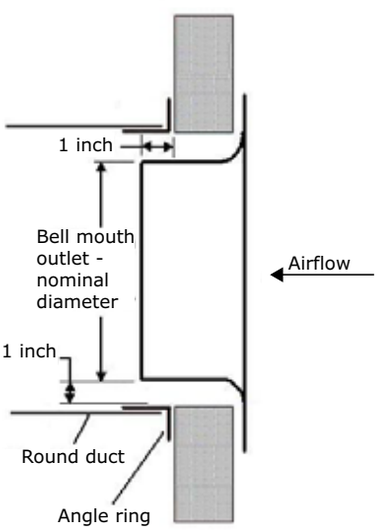
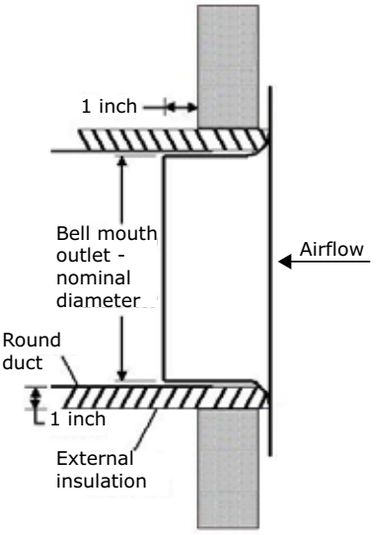



**Figure 105. Securing round duct to bell mouth outlet**

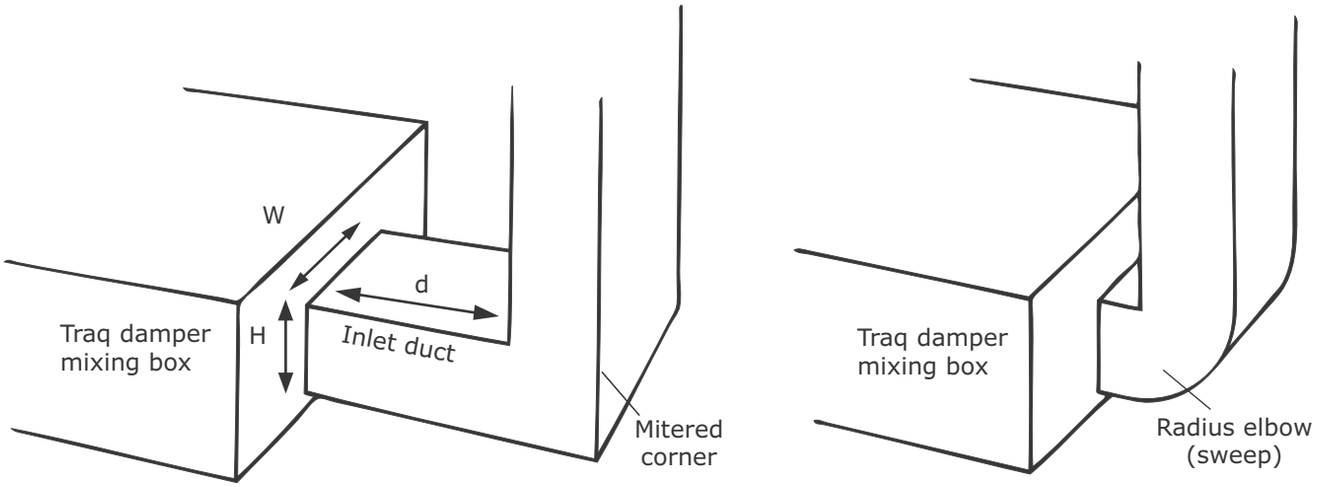



## Traq Damper Connections

Size the duct connections to attach to the specified portion on the face of the mixing box that the duct connection completely covers all of the Traq damper.

For a mitered corner, provide one hydraulic duct diameter between the entering face of the Traq dampers and the duct turn. For a radius elbow, or sweep, place the elbow directly against the face of the Traq dampers (see Figure 106).

**Figure 106. Traq damper duct connections**




$$d = 1 \text{ hydraulic duct diameter} = \frac{2 \times W \times H}{W + H}$$

## External Face-and-Bypass Connections

The external face-and-bypass damper sections will require a field-fabricated duct to direct the bypass air into the appropriate section. Duct sizing recommendations are listed in Table 34.

**Table 34. Recommended bypass duct sizes (inches)**

| Unit size | H | W | L |
|---|---|---|---|
| 3 | 16.00 | 20.00 | 14.00 |
| 4 | 18.00 | 33.00 | 16.00 |
| 6 | 18.00 | 33.00 | 16.00 |
| 8 | 18.00 | 39.00 | 16.00 |
| 10 | 18.00 | 50.00 | 16.00 |
| 12 | 22.00 | 55.00 | 20.00 |
| 14 | 22.00 | 61.00 | 20.00 |
| 17 | 22.00 | 61.00 | 20.00 |
| 21 | 28.00 | 69.00 | 26.00 |
| 22 | 45.00 | 50.50 | 31.13 |
| 25 | 28.00 | 69.00 | 26.00 |
| 26 | 47.00 | 50.50 | 33.13 |
| 30 | 28.00 | 82.00 | 26.00 |
| 31 | 47.00 | 61.00 | 33.13 |
| 35 | 45.00 | 80.00 | 36.00 |
| 36 | 47.50 | 69.00 | 40.13 |
| 40 | 45.00 | 93.00 | 36.00 |
| 41 | 55.50 | 69.00 | 40.13 |
| 50 | 45.00 | 106.00 | 36.00 |
| 51 | 55.50 | 82.00 | 40.13 |
| 57 | 47.00 | 106.00 | 40.00 |
| 58 | 55.50 | 82.00 | 52.13 |
| 66 | 48.00 | 121.00 | 40.00 |
| 80 | 56.00 | 121.00 | 48.00 |
| 100 | 56.00 | 135.00 | 48.00 |
| 120 | 56.00 | 162.00 | 48.00 |

When attaching a bypass duct to a downstream fan section or access section, the section will have a factory-provided opening. (see Figure 107, Figure 108, and Figure 109.)

When bypassing into an access section, remove a panel. It is not necessary to cut an opening.

**Figure 107. External face-and-bypass with duct configuration designed to bypass air into a vertical fan section**

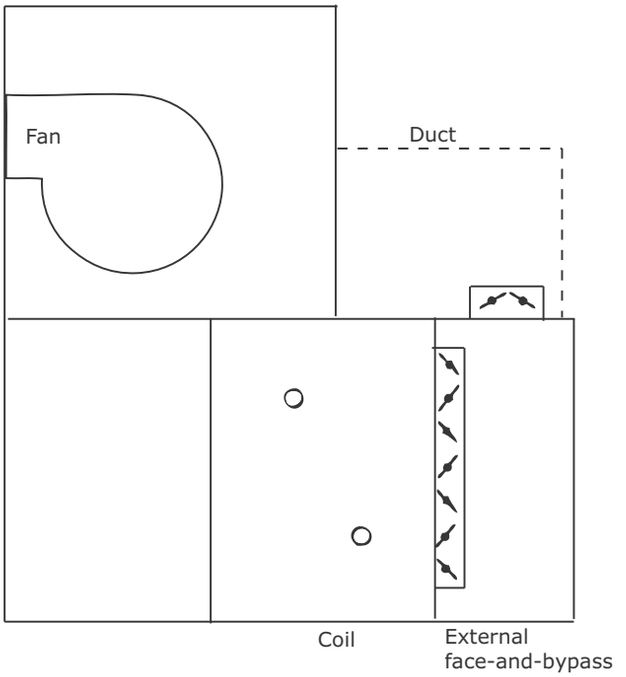



**Figure 108. External face-and-bypass with duct configuration designed to bypass air around one coil**

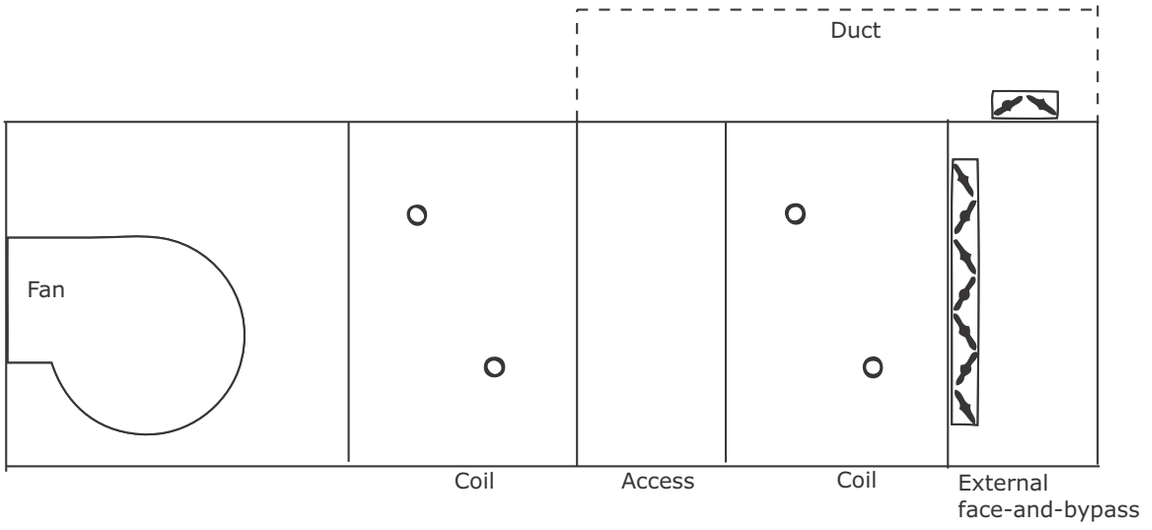
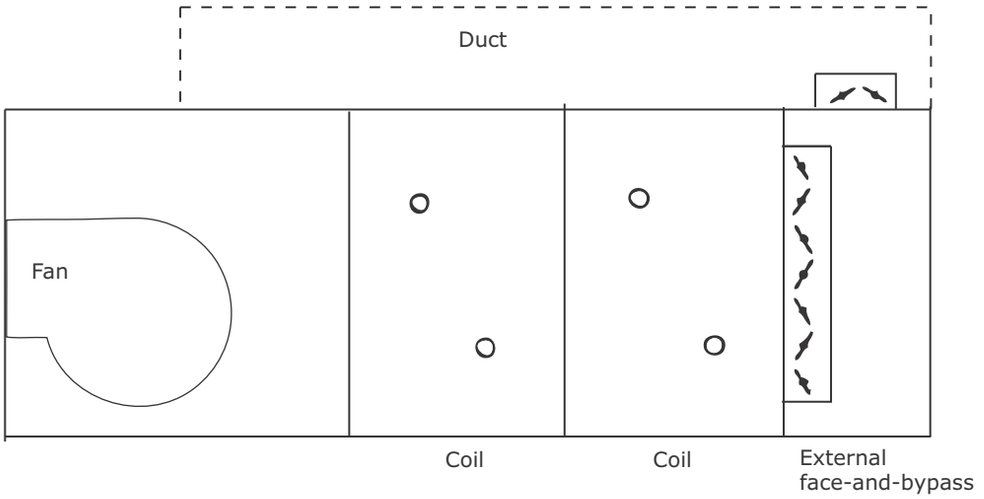


**Figure 109. External face-and-bypass with duct configuration designed to bypass air into a horizontal fan section**




## Other Connections

Access, filter, and other sections may have open inlets with a 2-inch (sizes 3-120) panel frame for connecting the ductwork. If the duct is lined, it is important the insulation does not obstruct the opening of the section.

**Figure 110. Typical duct flat/flange end of unit connection - uninsulated**

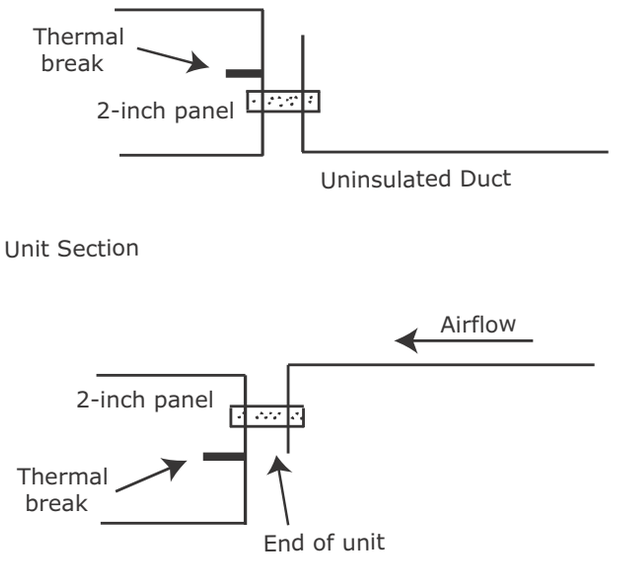
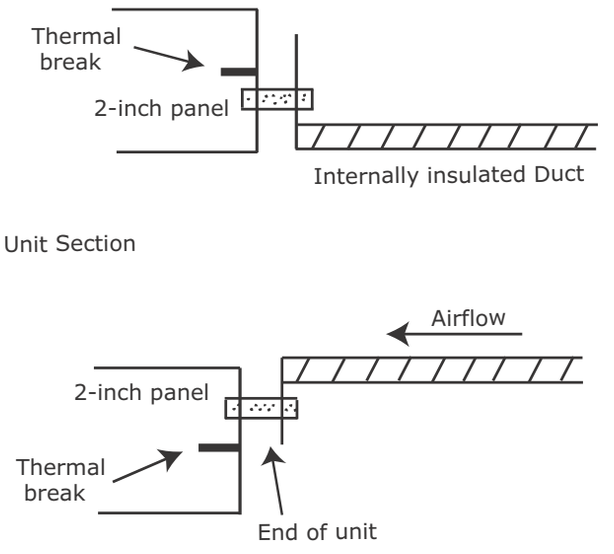



**Figure 111. Typical duct flat/flange end of unit connection - insulated**



# Piping and Connections

**NOTICE:**

**Connection Leaks!**

**Use a backup wrench when attaching piping to coils with copper headers to prevent damage to the coil header. Do not use brass connectors because they distort easily and could cause connection leaks.**

**NOTICE:**

**Over Tightening!**

**Do not use Teflon-based products for any field connections because their high lubricity could allow connections to be over-tightened, resulting in damage to the coil header.**

**NOTICE:**

**Leakage!**

**Properly seal all penetrations in unit casing. Failure to seal penetrations from inner panel to outer panel could result in unconditioned air entering the module, and water infiltrating the insulation, resulting in equipment damage.**

## General Recommendations

Proper installation, piping, and trapping is necessary to ensure satisfactory coil operation and to prevent operational damage:

- Support all piping independently of the coils.
- Provide swing joints or flexible fittings on all connections that are adjacent to heating coils to absorb thermal expansion and contraction strains.
- If the coil was ordered with factory-mounted controls, install the control valves. The valves ship separately.

*Note: The contractor is responsible for supplying the installation hardware.*

- For best results, use a short pipe nipple on the coil headers prior to making any welded flange or welded elbow type connections.
- Extended drain and vent connections are provided as standard on D1 and D2 coils only. If extended drains and vents are required on other water coils, they must be field-installed or ordered as specials from the factory.
- Pipe coils counterflow to airflow.
- When attaching the piping to the coil header, make the connection only tight enough to prevent leaks. Maximum recommended torque is 200 foot-pounds.
- Use pipe sealer on all thread connections.
- After completing the piping connections, seal around pipe from inner panel to outer panel.

## Drain Pan Trapping

**⚠WARNING**

**No Step Surface!**

**Do not walk on the sheet metal drain pan. Walking on the drain pan could cause the supporting metal to collapse, resulting in the operator/technician to fall. Failure to follow this recommendation could result in death or serious injury.**

**NOTICE:**

**Water Damage!**

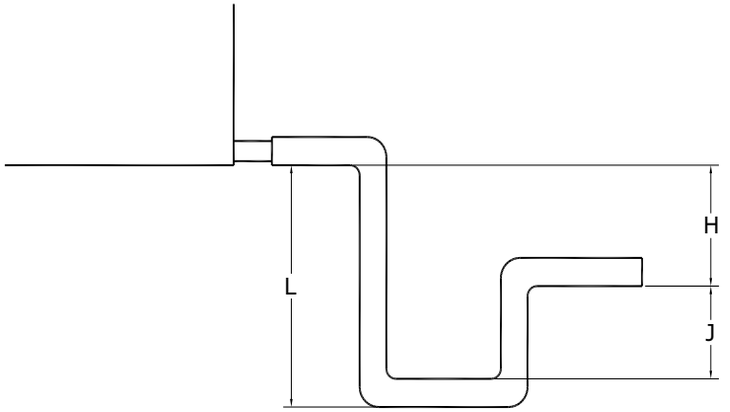
**When more than one section has a drain pain, trap each section individually. Connecting all drains to a common line with only one trap can result in condensate retention and possible water damage to the air handler or adjoining space.**

Threaded condensate drain connections are provided on only one side of the coil section. Pitch the connection lines horizontal or downward toward an open drain. Trane recommends installing a plug to facilitate cleaning of the trap. The drain connection sizes are:

| Unit size | NPT (national pipe thread) external connection |
|---|---|
| 3-31 | 1-inch |
| 35-58 | 1 1/4 inch |
| 66-120 | 1 1/2 inch |

Figure 35 illustrates the proper trapping, piping, and operation of the trap. Use the formula under the figure to determine the correct minimum depth for the condensate trap. If a section has a drain pan for cleaning purposes only, it does not need a trap; however, a cap or shutoff valve should be installed on the drain connection. Only sections handling condensate, such as a cooling coil section or moisture eliminator section, require a trap.

**Table 35. Drain pan trapping for negative and positive pressure applications**




| Drain pan trapping for section under negative pressure | Drain pan trapping for section under positive pressure |
|---|---|
| L = H + J + pipe diameter where:<br>H = 1 inch for each inch of negative pressure plus 1 inch<br>J = 1/2 H | L = H + J + pipe diameter where:<br>H = 1/2 inch (minimum)<br>J = 1/2 inch plus the unit positive static pressure at coil discharge (loaded filters) |

# Steam Coil Piping

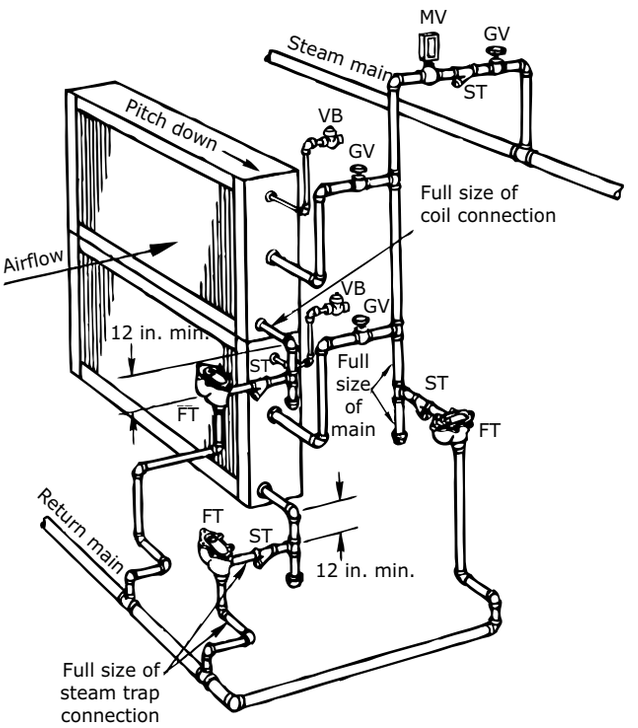
Air handlers fitted with steam coils have labeled holes for piping penetrations. Figure 112 illustrates a typical steam coil piping configuration. See Table 36 for the codes of system components in these figures.

The coil condensate return line must be piped full size of the condensate trap connection, except for a short nipple screwed directly into the coil header's condensate return tapping. Do not bush or reduce the coil return trapping size.

**Table 36. Code of system components for piping figures**

| Code | System component |
|---|---|
| FT | Float and thermostatic steam trap |
| GV | Gate valve |
| OV | Automatic two-position (ON-OFF) control valve |
| VB | Vacuum breaker |
| ST | Strainer |
| AV | Automatic or manual air vent |
| MV | Modulating control valve |

**Figure 112. Typical piping for Type NS steam coils and horizontal tubes for horizontal airflow**



**NOTICE:**

## Breaker Cracking Pressure!

**The 1/2-inch NPT, 15 degree swing check valve vacuum breaker is recommended because other vacuum breakers, such as spring-loaded ball-check breakers, have cracking pressures as high as 1.25 inches Hg (17 inches of water). Vacuum breakers with fitting sizes smaller than 1/2 inch NPT are too small to relieve vacuum quick enough to ensure complete condensate drainage. Other types of swing check valve vacuum breakers are acceptable if the fittings size is not smaller than 1/2-inch NPT and the cracking pressure is not larger than 0.25 inches HG (3.5 inches of water). Failure to follow these instructions could result in equipment damage.**

To prevent coil damage, complete the following recommendations:

- Install a 1/2-inch NPT, 15 degree swing check valve vacuum breaker with cracking pressure of 0.25 inches Hg (3.4 inches water) or lower at the top of the coil. This vacuum breaker should be installed as close to the coil as possible.
- For coil type NS, install the vacuum breaker in the unused condensate return tapping at the top of the coil.
- Vent the vacuum breaker line to atmosphere or connect it into the return main at the discharge side of the steam trap

*Note: Vacuum breaker relief is mandatory when the coil is controlled by a modulating steam supply or automatic two position (ON-OFF) steam supply valve. Vacuum breaker relief is also recommended when face-and-bypass control is used.*

**NOTICE:**

## Coil Condensate!

**Condensate must flow freely from the coil at all times to prevent coil damage from water hammer, unequal thermal stresses, freeze-up and/or corrosion. In all steam coil installations, the condensate return connections must be at the low point of the coil. Failure to follow these instructions could result in equipment damage.**

Proper steam trap installation is necessary for satisfactory coil performance and service life. For steam trap installation:

1. Install the steam trap discharge 12 inches below the condensate return connection. Twelve inches provides sufficient hydrostatic head pressure to overcome trap losses and ensures complete condensate removal.
   a. Use float and thermostatic traps with atmospheric pressure gravity condensate return, with automatic controls, or where the possibility of low-pressure supply steam exists. (Float and thermostatic traps are recommended because of gravity drain and continuous discharge operation.)
   b. Use bucket traps only when the supply steam is not modulated and is 25 psig or higher.

*Note: Trane steam coils require a minimum of 2 psi of pressure to assure even heat distribution.*

2. Trap each coil separately to prevent holding up condensate in one or more of the coils.
3. Install strainers as close as possible to the inlet side of the trap.
4. If installing coils in series airflow, control each coil bank independently with an automatic steam-control valve. Size the traps for each coil using the capacity of the first coil in direction of airflow.
5. Use a modulating valve that has linear flow characteristics to obtain gradual modulation of the coil steam supply.

*Note: Do not modulate systems with overhead or pressurized returns unless the condensate is drained by gravity into a receiver, vented to atmosphere, and returned to the condensate pump.*

6. Pitch all supply and return steam piping down 1 inch for every 10 feet in the direction of the steam or condensate flow.

*Note: Do not drain the steam mains or take-offs through the coils. Drain the mains ahead of the coils through a steam trap to the return line.*

7. Ensure overhead returns have 1 psig of pressure at the steam trap discharge for every 2 feet of elevation for continuous condensate removal.

# Water Coil Piping

Figure 113, and Figure 115 illustrate typical water coil piping configurations.

Type 5A, 5W, D1, W, UW, TT, P,2, P4, and P8 water coils are self-venting only if the water velocity exceeds 1.5 feet per second (fps) in the coil tubes. Type D2, UA, UU, and WD water coils are self-venting only if the water velocity exceeds 2.5 fps in the coil tubes. See the unit submittals for coil water velocity. If the water velocity is below these minimums, vent the coil by one of the following methods:

1. Install an air vent in the top pipe plug tapping of the return header.
2. When the return line rises above the top of the coil, vent from the top of the return header horizontally to the return piping.

*Note: TT coils are designed with larger than normal end tube sheet holes to allow for maximum expansion. Air leakage around tubes should be expected and handled by capping over coil ends or by sealing around tubes with a pliable sealant such as silicone.*

**Figure 113. Typical piping for type 5W one-row water coil**

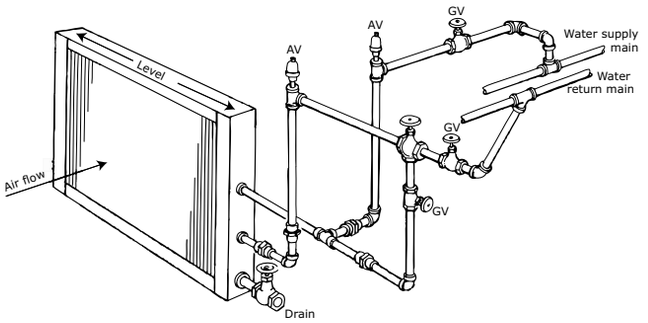



**Figure 114. Typical piping for type 5A, 5W two-row, W 3- to 12-row, WD, D1, and D2 water coils**

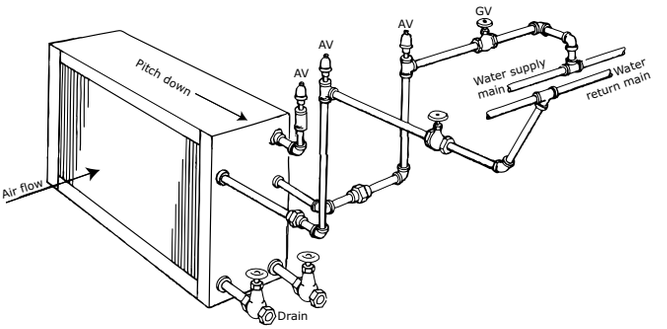
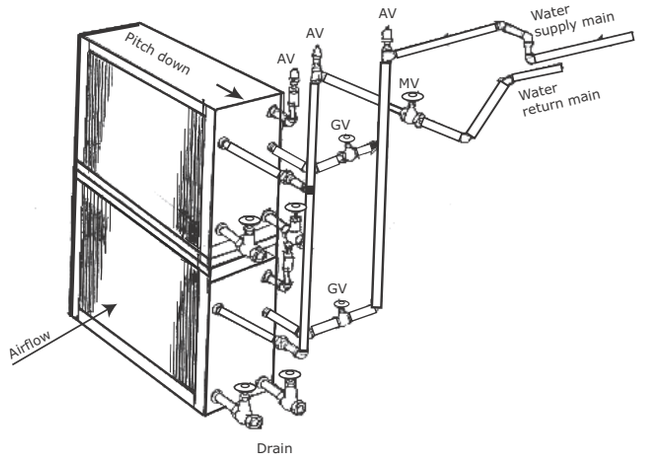



**Figure 115. Typical piping for stacked water coils**

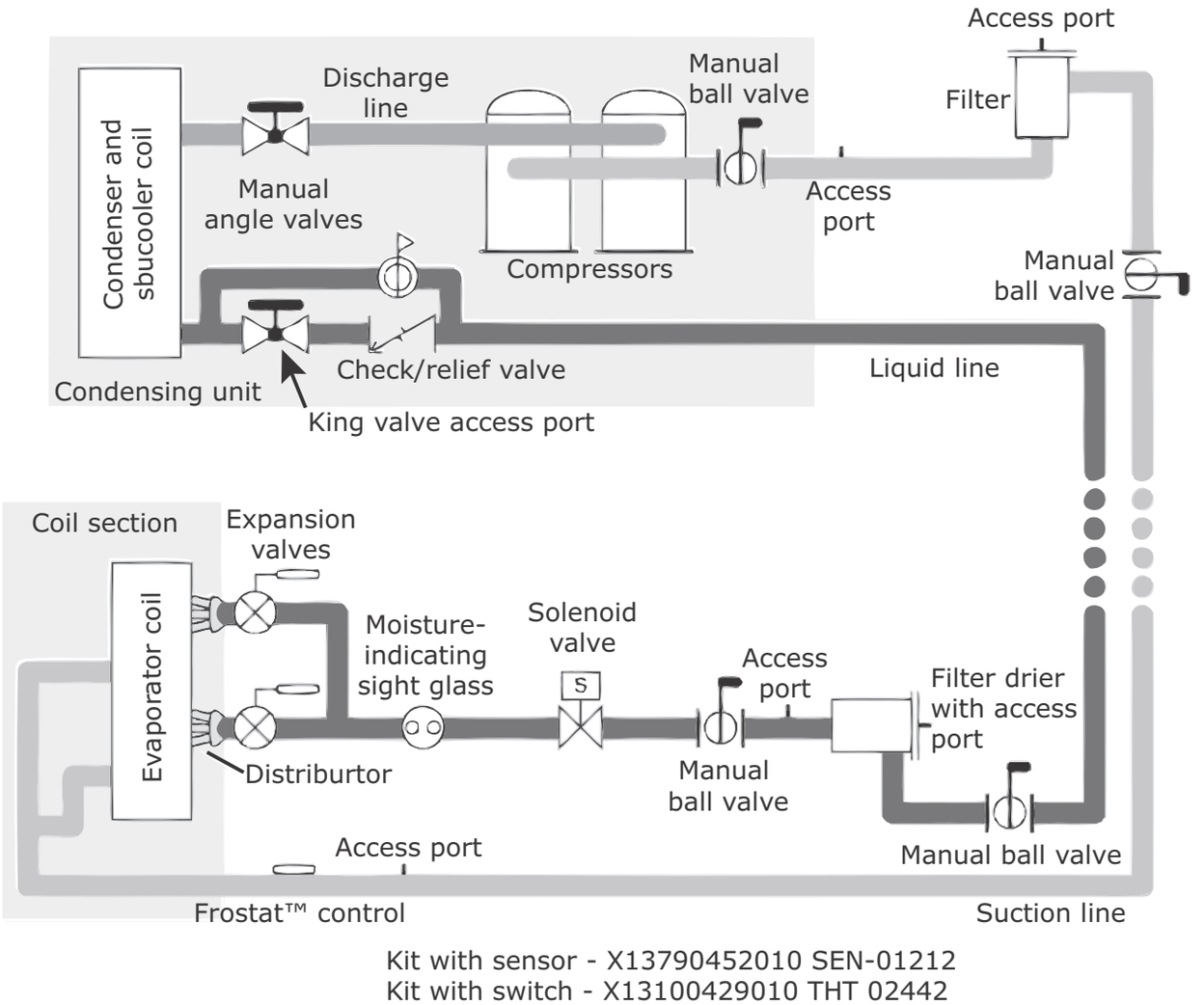


# Refrigerant Coil Piping

*Note: Refer to for information on handling refrigerants.*

Figure 116 illustrates an example of a split-system component arrangement. Use it to determine the proper, relative sequence of the components in the refrigerant lines that connect the condensing unit to an evaporator coil. Refer to "Field-Installed Evaporator Piping Examples," p. 102 for more detailed schematics of evaporator piping.

**Figure 116. Example of placement for split-system components**




Kit with sensor - X13790452010 SEN-01212
Kit with switch - X13100429010 THT 02442

# Liquid Lines

## Line Sizing

Properly sizing the liquid line is critical to a successful split-system application. The selected tube diameter must provide at least 5°F [2.7°C] of subcooling at the expansion valve throughout the operating envelope. Increasing the size of the liquid line will not increase the available subcooling.

## Routing

Install the liquid line with a slight slope in the direction of flow so that it can be routed with the suction line. Minimize tube bends and reducers because these items tend to increase pressure drop and to reduce subcooling at the expansion valve. Liquid line receivers, other than those that are factory-installed, are not recommended.

## Insulation

The liquid line is generally warmer than the surrounding air, so it does not require insulation. In fact, heat loss from the liquid line improves system capacity because it provides additional subcooling. However, if the liquid line is routed through a high-temperature area, such as an attic or a mechanical room, insulation would be required.

## Components

Liquid-line refrigerant components necessary for a successful job include a filter drier, access port, solenoid valve, moisture-indicating sight glass, expansion valve(s), and ball shutoff valves. Figure 116 illustrates the proper sequence for positioning them in the liquid line. Position the components as close to the evaporator as possible.

- *Filter drier.* There is no substitute for cleanliness during system installation. The filter drier prevents residual contaminants, introduced during installation, from entering the expansion valve and solenoid valve.
- *Access port.* The access port allows the unit to be charged with liquid refrigerant and is used to determine subcooling. This port is usually a Schraeder® valve with a core.
- *Solenoid valve.* In split systems, solenoid valves isolate the refrigerant from the evaporator during off cycles; under certain conditions, they may also trim the amount of active evaporator as compressors unload. Generally, the “trim” solenoid valve is unnecessary for VAV comfort-cooling applications, and is only required for constant-volume applications when dehumidification is a concern.
  In split systems with mircochannel heat exchanger condensers (MCHE), solenoid valves isolate the refrigerant from the evaporator during the off cycles. Trim solenoids cannot be used with MCHE.

*Note: Trane condensing units with MCHE no longer employ pump-down, but isolation solenoids are required. The suggested solenoid uses a 120-volt service and requires code-compliant wiring to the condensing unit.*

- *Moisture-indicating sight glass.* Be sure to install one moisture-indicating sight glass in the main liquid line. The only value of the sight glass is its moisture indication ability. Use actual measurements of temperature and pressure—not the sight glass—to determine subcooling and whether the system is properly charged. The moisture indicator/sight glass must be sized to match the size of the liquid line at the thermal expansion valve.

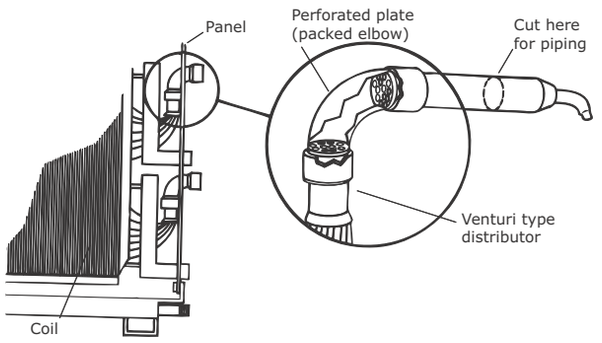
**NOTICE:**

**Valve Damage!**

**Disassemble the thermal expansion valve before completing the brazing connections. If necessary, wrap the valve in a cool, wet cloth while brazing. Failure to protect the valve from high temperatures could result in damage to internal components.**

- *Thermal expansion valve.* The expansion valve is the throttling device that meters the refrigerant into the evaporator coil. Metering too much refrigerant floods the compressor; metering too little elevates the compressor temperature. Choosing the correct size and type of expansion valve is critical to assure it will correctly meter refrigerant into the evaporator coil throughout the entire operating envelope of the system. *Correct refrigerant distribution into the coil requires an expansion valve for each distributor.*
  The thermal expansion valve must be selected for proper size and capacity. The size of the expansion valve should cover the full range of loadings. Check that the valve will successfully operate at the lightest load condition. For improved modulation, choose expansion valves with balanced port construction and external equalization. Cut the process tube and cap assembly from the liquid connection as shown in Figure 117 and install the expansion valve directly to the liquid connections.

**Figure 117. Type F refrigerant coil with packed elbow**




- *Ball shutoff valves.* Adding manual, ball-type shutoff valves upstream and downstream of the filter simplifies replacement of the filter core.

# Suction Lines

## Line sizing

Proper line sizing is required to guarantee the oil returns to the compressor throughout the system's operating envelope. At the same time, the line must be sized so that the pressure drop does not excessively affect capacity or efficiency. To accomplish both objectives, it may be necessary to use two different line diameters: one for the horizontal run and for the vertical drops, and another for the vertical lifts (risers).

## Routing

To prevent residual or condensed refrigerant from "free-flowing" toward the compressor during the off cycle, install the suction line so it slopes by ¼ inch to 1 inch per 10 feet of run toward the evaporator.

When the application includes a suction riser, oil must be forced to travel the height of the riser. Riser traps are unnecessary in the suction line. They will add pressure drop. Double risers must not be used. They not only add pressure drop, but can hold great amounts of oil - oil better used in the compressor.

*Note: If a suction riser is properly sized, oil will return to the compressor regardless of whether a trap is present. If a suction riser is oversized, adding a trap will not restore proper oil entrainment.*

### Avoid Underground Refrigerant Lines

Refrigerant condensation during the off cycle, installation debris inside the line (including condensed ambient moisture), service access, and abrasion/corrosion can quickly impair reliability.

## Insulation

Any heat that transfers from the surrounding air to the cooler suction lines increases the load on the condenser (reducing the system's air-conditioning capacity) and promotes condensate formation. After operating the system and testing all fittings and joints to verify that the system is leak-free, insulate suction lines to prevent heat gain and unwanted condensation.

## Components

Installing the suction line requires field installation of these components: a filter, access port, and a Frostat™ control when the refrigerant coil is used with Trane condensing units. Position them as close to the compressor as possible.

*Note: Placement of the Frostat control is illustrated in Figure 116 on page 97.*

- *Filter.* The suction filter prevents contaminants, introduced during installation, from entering the compressor. For this reason, the suction filter should be the replaceable-core type, *and* a clean core should be installed after the system is cleaned up.
- *Access port.* The access port is used to determine suction pressure. This port is usually a Schraeder valve with a core.
- *Frostat™ coil frost protection.* The Frostat control is the preferred method for protecting evaporator coils from freezing when the refrigerant coil is used with Trane condensing units. It senses the suction-line temperature and temporarily disables mechanical cooling if it detects frost conditions. The control is mechanically attached to the outside of the refrigerant line, near the evaporator, and wired to the unit control panel.
- *Ball shutoff valve.* Adding manual, ball-type shutoff valves upstream and downstream of the filter simplifies replacement of the filter core.

# Expansion Valves

Expansion valves meter refrigerant into the evaporator under controlled conditions. If there is too much refrigerant, the refrigerant will not completely vaporize and the remaining liquid will slug the compressor. If there is too little refrigerant, there may not be enough cooling for the compressor.

Expansion valve requirements vary based on condensing unit design. Consult the product literature for the condensing unit to be used for proper valve selection.

# Hot Gas Bypass

Many years ago, hot gas bypass (HGBP) was successfully added to HVAC systems to correct a number of operational problems. Hoping to avoid such problems altogether, it eventually became common practice for designers to specify hot gas bypass in new systems. Unfortunately, the practice often degraded rather than improved reliability.

Hot gas bypass increases the minimum refrigerant charge; it also inflates the first cost of the system. Besides adding more paths for potential refrigerant leaks, hot gas bypass increases the likelihood of refrigerant distribution problems. Finally, hot gas bypass uses excessive amounts of energy by preventing the compressors from cycling with fluctuating loads.

Trane now has many years of experience in the successful use of equipment *without hot gas bypass* in commercial comfort-cooling applications. To prevent evaporator freeze-up, Trane equipment typically includes Frostat™ coil frost protection.

Like hot gas bypass, the Frostat system protects the coil from freezing, but it does so by turning off compressors when a sensor detects the formation of frost on the evaporator coil. The compressor is released to operate when the coil temperature rises a few degrees above the frost threshold. The Frostat control strategy reduces the overall energy consumption of the system while maintaining system control.

Systems should be designed to avoid HGBP whenever possible. For more information about HGBP, refer to the *Engineers Newsletter*, "Hot Gas Bypass – Blessing or a Curse?" (ADM-APN007-EN).

# Remodel, Retrofit, or Replacement

Inevitably, older condensing units and evaporator systems will need to be replaced or retrofitted. Due to the phase-out of many of these older refrigerants, the major components for those older units or systems may no longer be available. The only option will be to convert the system to R-410A, POE oil, and R-410A components.

When upgrading an existing refrigerant split system due to remodel, retrofit, or replacement, the entire system must be reviewed for compatibility with R-410A and POE oil. Each and every part of the split HVAC system MUST be compatible with the properties of R-410A refrigerant and POE oil. In addition, ensure the existing electrical service is adequate for the product being installed.

**⚠WARNING**

**R-410A Refrigerant under Higher Pressure than R-22!**

**Failure to use proper equipment or components as described below, could result in equipment failing and possibly exploding, which could result in death, serious injury, or equipment damage. The units described in this manual use R-410A refrigerant which operates at higher pressures than R-22. Use ONLY R-410A rated service equipment or components with these units. For specific handling concerns with R-410A, please contact your local Trane representative.**

Every part of an existing split system needs to be analyzed to determine if it can be reused in an R-410A and POE oil system:

- R-22 condensing units will not work with R-410A; they must be replaced.
- Most older evaporator coils were not pressure- and cycle-rated for R-410A pressures. If they weren't, they will need to be replaced. If they were properly pressure-rated for R-410A, existing coils must be modeled to determine if they will meet capacity requirements, are properly circuited, have correctly sized distributor tubes, and employ acceptable distributors and orifices.
- The required R-410A line sizes may be different than the existing line sizes. The lines need to be re-sized and compared to existing lines for reusability.
- Suction lines 2-5/8 OD and smaller of type L copper are suitable for use with R-410A. Suction lines 3-1/8 OD must use type K or thicker wall.
- Discharge lines, liquid lines, heat pump vapor lines, and hot gas bypass lines 1-3/8 OD and smaller of type L copper are suitable for use with R-410A. These same lines sized at 1-5/8 OD or 2-1/8 OD must use type K or thicker wall.
- Expansion valves need to be reselected. Expansion valves are refrigerant specific.
- Any gasket or o-ring should be replaced. Shrinkage of the original seal may occur after an HFC conversion, potentially causing a refrigerant leak. Components commonly affected are Schraeder cores, solenoid valves, ball valves, and flange seals. But *all* external seals in contact with refrigerant should be viewed as potential leak sources after a retrofit.
- All other valves, filters, valve packing, pressure controls, and refrigeration accessories must be researched through their manufacturer for compatibility with the pressures of an R-410A system, and for their compatibility with the newer POE oil.

- For the best performance and operation, the original mineral oil should be removed from the components of the system that are not being replaced. Any component of the system that is suspected of trapping oil (piping, traps, and coil), should be dismantled, drained, and reassembled. After all components have been drained, the amount of residual mineral oil will have a negligible effect on performance and reliability.

**NOTICE:**

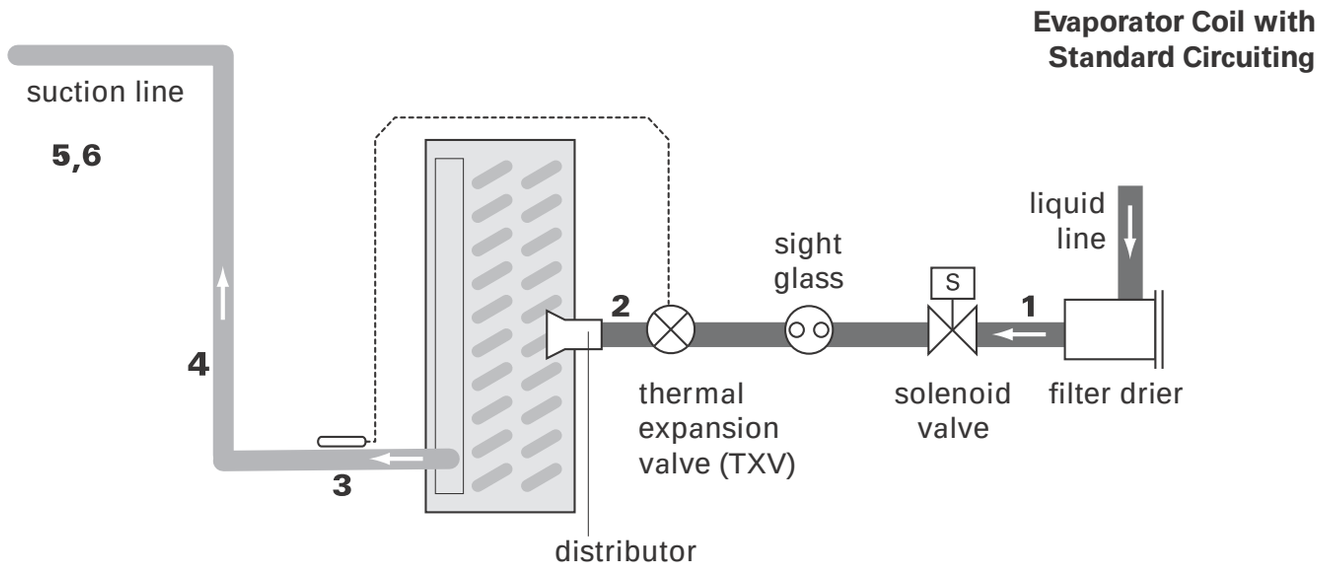
**Compressor Damage!**

**POE oil is hygroscopic – it absorbs water directly from the air. This water is nearly impossible to remove from the compressor oil and can cause compressor failures. For this reason, the system should not be open for longer than necessary, dry nitrogen should flow in the system while brazing, and only new containers of oil should be used for service and maintenance.**

All Codes take precedence over anything written here.

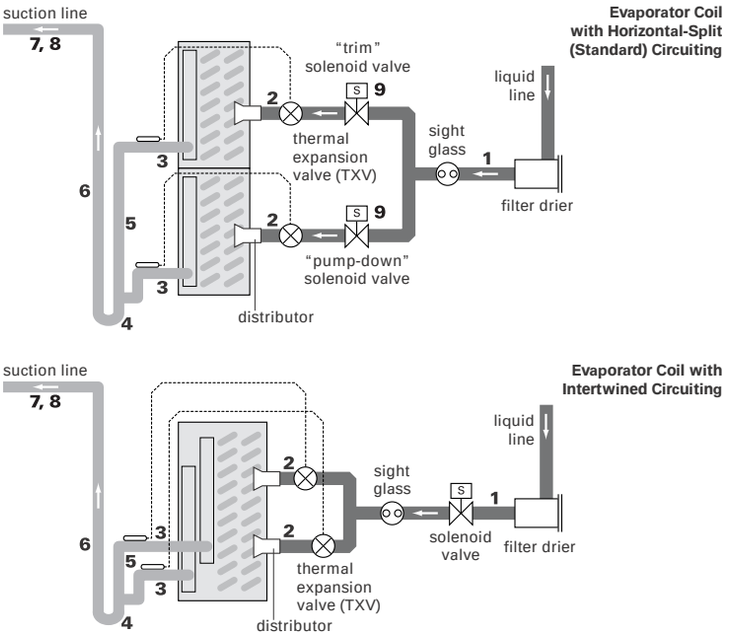
# Field-Installed Evaporator Piping Examples

**Figure 118. Single-circuit condensing unit: evaporator coil with one distributor**




1. Pitch the liquid line slightly—1 inch/10 feet —so that the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.
3. Slightly pitch the outlet line from the suction header toward the suction riser—that is, 1 inch/10 feet in the direction of flow. Use the tube diameter that matches the suction-header connection.
4. Use the tube diameter recommended in the condensing unit application manual for a vertical rise. Ensure that the top of the riser is higher than the evaporator coil.
5. Pitch the suction line slightly—1 inch/10 feet —so the refrigerant drains toward the evaporator.
6. Insulate the suction line.

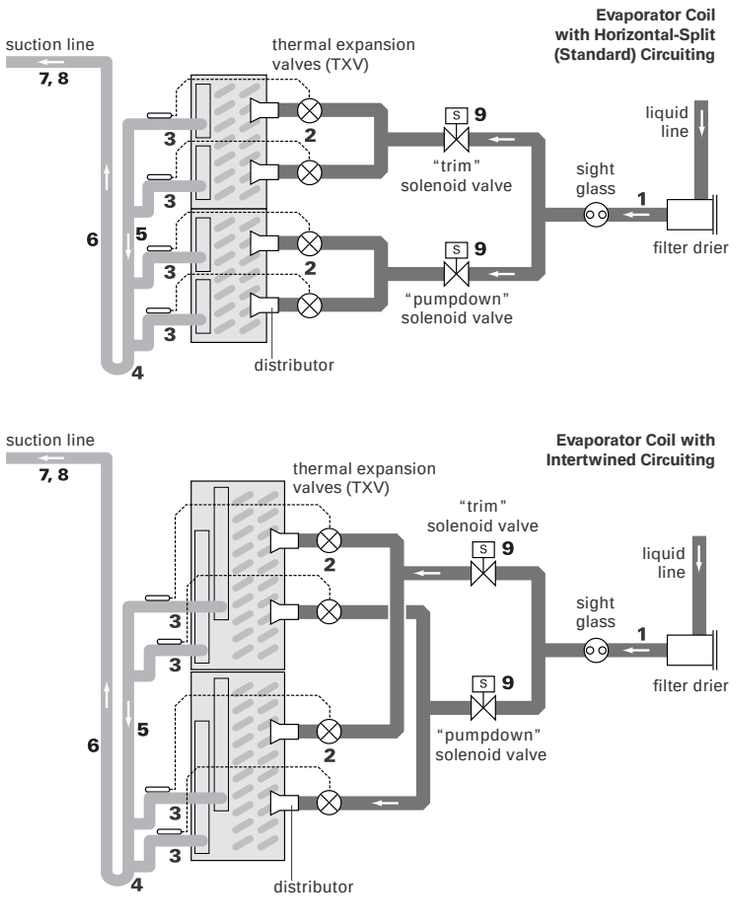
**Figure 119. Single-circuit condensing unit: evaporator coil with two distributors**




1. Pitch the liquid line slightly—1 inch/10 feet —so the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.
3. Slightly pitch the outlet line from the suction header toward the suction riser— 1 inch/10 feet in the direction of flow. Use the tube diameter that matches the suction-header connection. Use a double-elbow configuration to isolate the TXV bulb from other suction headers.
4. This looks like a trap, but is actually due to the requirement that the refrigerant gas leaving the coil flows downward, past the lowest suction-header outlet, before turning upward.
5. Use the "horizontal" tube diameter as specified in the condensing unit application manual.
6. Use the tube diameter recommended for a vertical rise as specified in the condensing unit application manual. Assure the top of the riser is higher than the evaporator coil.
7. Pitch the suction line slightly—1 inch/10 feet — so that the refrigerant drains toward the evaporator.
8. Insulate the suction line.
9. Only use a "trim" solenoid valve for constant-volume, humidity-sensitive applications. For all other applications, install a single solenoid valve (the "pumpdown" solenoid valve) between the liquid-line filter drier and the sight glass.

*Note: Due to reduced coil volume in condensing units with microchannel heat exchanger condenser, do not use trim solenoid valves for these units.*

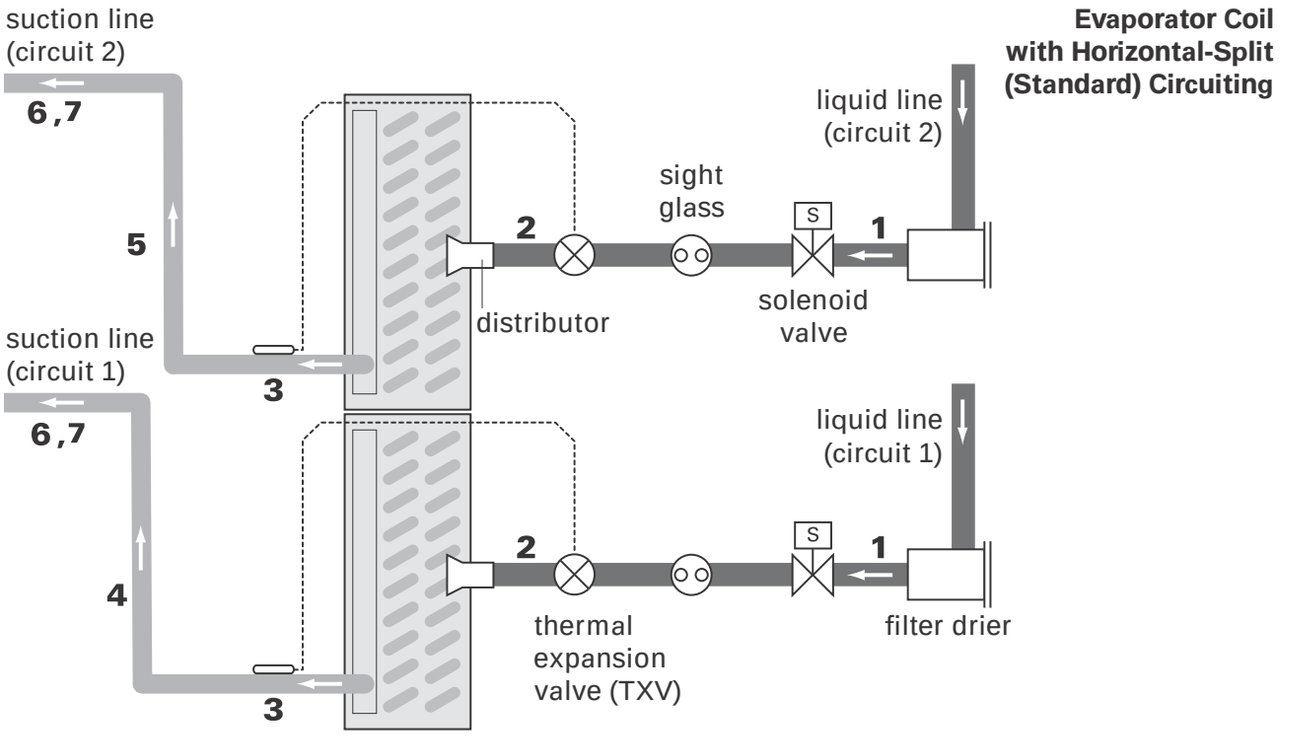
**Figure 120. Single-Circuit Condensing Unit: Evaporator Coil with Four Distributors**




1. Pitch the liquid line slightly—1 inch/10 feet —so that the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.
3. Slightly pitch the outlet line from the suction header toward the suction riser— 1 inch/10 feet in the direction of flow. Use the tube diameter that matches the suction-header connection.
4. This looks like a trap, but is actually due to the requirement that the refrigerant gas leaving the coil flows downward, past the lowest suction-header outlet, before turning upward. Use the double-elbow configuration to isolate the TXV bulb from other suction headers.
5. Use the "horizontal" tube diameter as specified in the condensing unit application manual.
6. Use the tube diameter recommended for a vertical rise as specified in the condensing unit application manual. Ensure that the top of the riser is higher than the evaporator coil.
7. Pitch the suction line slightly—1 inch/10 feet — so that the refrigerant drains toward the evaporator.
8. Insulate the suction line.
9. Only use a "trim" solenoid valve for constant-volume, humidity-sensitive applications. For all other applications, install a single solenoid valve (the "pumpdown" solenoid valve) between the liquid-line filter drier and the sight glass.

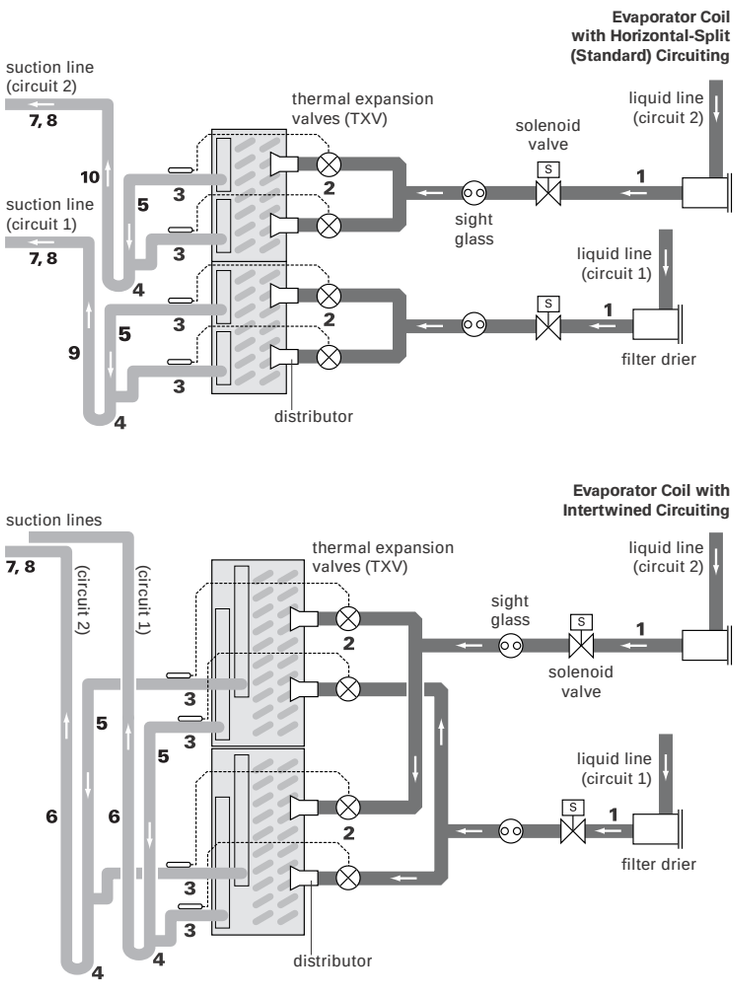
*Note: Due to reduced coil volume in condensing units with microchannel heat exchanger condenser, do not use trim solenoid valves for these units.*

**Figure 121. Dual-circuit condensing unit: evaporator coil with two distributors**



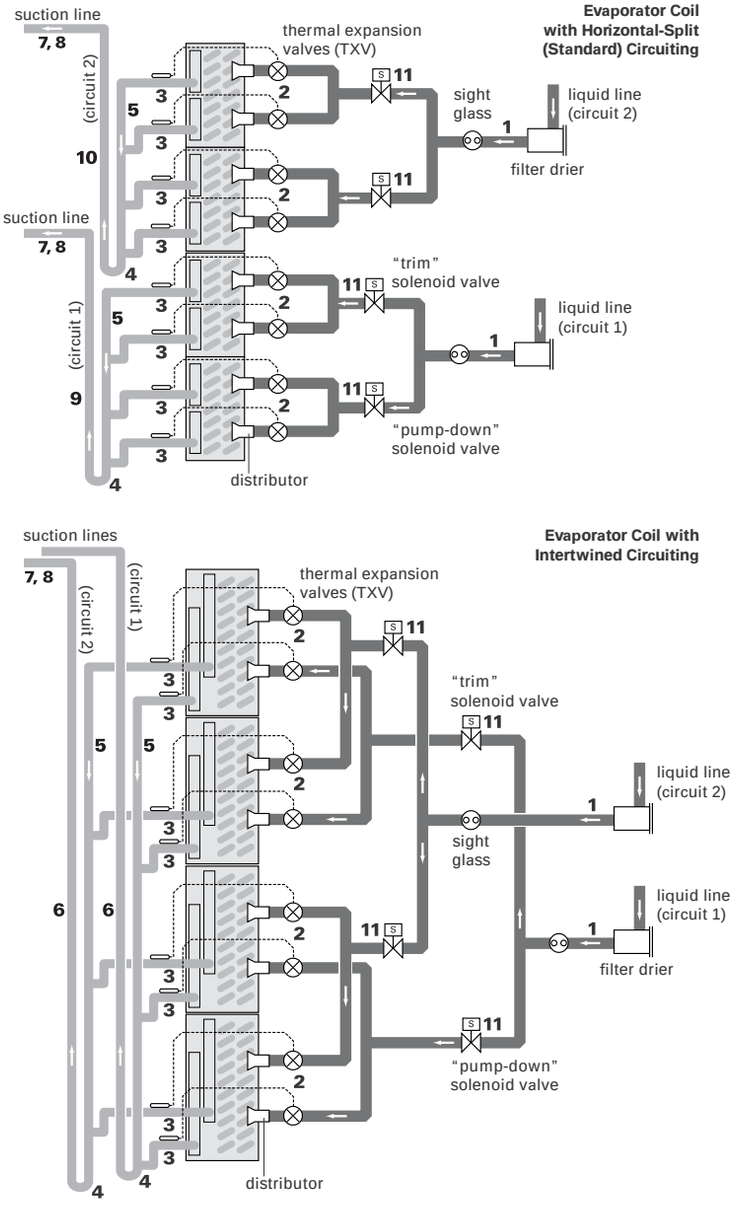

1. Pitch the liquid lines slightly—1 inch/10 feet —so that the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.
3. Slightly pitch the outlet line from the suction header toward the suction riser—1 inch/10 feet in the direction of flow. Use the tube diameter that matches the suction-header connection.
4. The top of the Circuit 1 suction riser must be higher than the bottom evaporator coil. Use the tube diameter recommended for a vertical rise as specified in the condensing unit application manual.
5. The top of the Circuit 2 suction riser must be higher than the top evaporator coil. Use the tube diameter recommended for a vertical rise as specified in the condensing unit application manual.
6. Pitch the suction lines slightly—1 inch/10 feet —so that the refrigerant drains toward the evaporator.
7. Insulate the suction lines.

**Figure 122. Dual-circuit condensing unit: evaporator coil with four distributors**




1. Pitch the liquid line slightly—1 inch/10 feet —so that the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.
3. Slightly pitch the outlet line from the suction header toward the suction riser— 1 inch/10 feet in the direction of flow. Use the tube diameter that matches the suction-header connection.
4. This looks like a trap, but is actually due to the requirement that the refrigerant gas leaving the coil flows downward, past the lowest suction-header outlet, before turning upward. Use the double-elbow configuration to isolate the TXV bulb from other suction headers.
5. Use the “horizontal” tube diameter as specified in the condensing unit application manual.
6. Use the tube diameter recommended for a vertical rise as specified in the condensing unit application manual. Ensure that the top of the riser is higher than the evaporator coil.
7. Pitch the suction line slightly—1 inch/10 feet — so that the refrigerant drains toward the evaporator.
8. Insulate the suction line.
9. The top of the Circuit 1 suction riser must be higher than the bottom evaporator coil. Use the tube diameter recommended for a vertical rise as specified in the condensing unit application manual.
10. The top of the Circuit 2 suction riser must be higher than the top evaporator coil. Use the tube diameter recommended for a vertical rise as specified in the condensing unit application manual.

**Figure 123.Dual-circuit condensing unit: evaporator coil with eight distributors**




1. Pitch the liquid line slightly—1 inch/10 feet —so that the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.
3. Slightly pitch the outlet line from the suction header toward the suction riser— 1 inch/10 feet in the direction of flow. Use the tube diameter that matches the suction-header connection.
4. This looks like a trap, but is actually due to the requirement that the refrigerant gas leaving the coil flows downward, past the lowest suction-header outlet, before turning upward. Use the double-elbow configuration to isolate the TXV bulb from other suction headers.
5. Use the "horizontal" tube diameter as specified in the condensing unit application manual.
6. Use the tube diameter recommended for a vertical rise as specified in the condensing unit application manual. Ensure that the top of the riser is higher than the evaporator coil.
7. Pitch the suction line slightly—1 inch/10 feet — so that the refrigerant drains toward the evaporator.
8. Insulate the suction line.
9. The top of the Circuit 1 suction riser must be higher than the bottom evaporator coil. Use the tube diameter recommended for a vertical rise as specified in the condensing unit application manual.
10. The top of the Circuit 2 suction riser must be higher than the top evaporator coil. Use the tube diameter recommended for a vertical rise as specified in the condensing unit application manual.
11. Only use a "trim" solenoid valve for constant-volume, humidity-sensitive applications. For all other applications, install a single solenoid valve (the "pumpdown" solenoid valve) between the liquid-line filter drier and the sight glass.

*Note: Due to reduced coil volume in condensing units with microchannel heat exchanger condenser, do not use trim solenoid valves for these units.*

# Humidifier Piping and Connections

These instructions cover the piping installation for Trane's building steam humidifier panel and atmospheric steam humidifier panel. The humidifier panel shall arrive installed in the unit air cabinet.

Units with a humidifier panel to be used with building (boiler) steam will also receive the following piping accessories shipped direct from the humidifier vendor to the jobsite address.

- Inverted bucket steam trap (to be used to drip steam supply to control valve)
- Control valve
- In-line Y strainer (to be used prior to the control valve)
- Float and thermostatic steam trap (for condensate drainage of header, two required)

Units with a humidifier panel to be used with atmospheric distribution of steam generated by electric or steam-to-steam humidifiers (steam generating) are not supplied with piping accessories. Piping will be determined by requirement of field-provided steam generator.

All accessories listed above will be on the packing slip. Report any shortages immediately. If accessories have been damaged in transit, notify Trane and file claim with the transportation company. If your order covers more than one package, segregate complete assembly. Equipment tagging will be the same as shown on the packing list.

All piping accessories should be installed in accordance with all applicable building, plumbing, and electrical codes.

Condensate discharged from the humidifier separator/ header is essentially atmospheric pressure. Thus condensate must be discharges to a drain or pumped. On many applications, an attempt to lift condensate even a few inches will lead to potential flooding or spitting problems from the multiple tube bank. Avoid master trapping the two connections to one steam trap. If traps discharge into a common return, install check valves (low opening pressure) on the outlet of each trap.

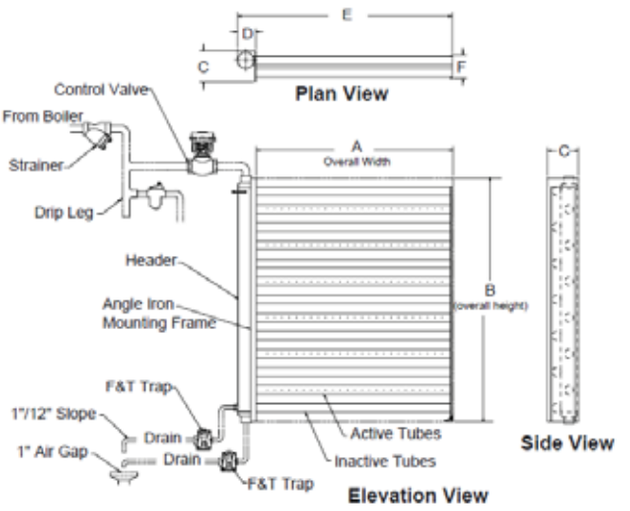
Supplying quality steam (not wet) to the humidifier panel is an important component for proper operation. Care must be taken that the main supply header is dripped sufficiently as well as the runout piping to the control valve and header. The entire system must be designed and hooked up to prevent accumulation of condensate at any point. The following recommendations will help to ensure this.

Use drip legs and traps at all low spots or natural drainage points such as:

- Ahead of risers
- End of mains
- Ahead of expansion joints or bends
- Ahead of valves or regulators

Install drip legs and drain traps even where there are no natural drainage points.

**Figure 124.Building (boiler) steam panel piping**



# Installation - Electrical

**⚠WARNING**

**Hazardous Voltage w/Capacitors!**

**Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.**

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN*

.

***NOTICE:***

**Use Copper Conductors Only!**

**Unit terminals are not designed to accept other types of conductors. Failure to use copper conductors could result in equipment damage.**

Units intended for indoor use are available with starters or variable-frequency drives (VFDs) that are externally mounted in an enclosure or internally mounted in a recessed cabinet. Units intended for outdoor use are only available with internally mounted starters or VFDs. A typical internally mounted VFD is shown in Figure 125. A typical externally mounted VFD is shown in Figure 126.

**Figure 125. Internally mounted VFD**

**Figure 126. Externally mounted VFD**

Typical wiring schematics for VFDs and starters are shown in Figure 132 and Figure 133, respectively. Unit specific wiring schematics are shipped with each unit.

All units with starters or VFDs that have direct-digital controllers (DDCs) are provided with line voltage to 24 Vac power transformers as shown in Figure 127. When provided, the line voltage to 24 Vac transformers are factory wired to the supply fan power feed. All units with factory-mounted controllers, and no starters or VFDs, are provided with 120 Vac to 24 Vac control transformers, as shown in Figure 129, and require a separate 120V field connection. As with starters or VFDs, units intended for indoor use are available with DDCs mounted internally (see Figure 127) or externally (see Figure 128 and Figure 129), while units intended for outdoor use are only available with internally mounted DDCs.

In units with 24Vac LED marine lights, the lights are wired together to a single switch located in the controls interface module. Figure 128 shows a typical mounting of the controls interface module with an externally mounted controller. When DDCs are provided, the lighting circuit is powered from the DDC power feed and does not require a separate power source. When marine lights are provided without DDCs, the lighting circuit requires a separate 120V field connection that powers the lights through a 120V to 24Vac power transformer.

A mounted GFCI receptacle is provided for all units that have DDCs or marine lights. The receptacle is mounted in the controls interface module (see Figure 128) with the unit light switch. The receptacle requires a separate 120V power feed.

**Figure 127. Internal controller**

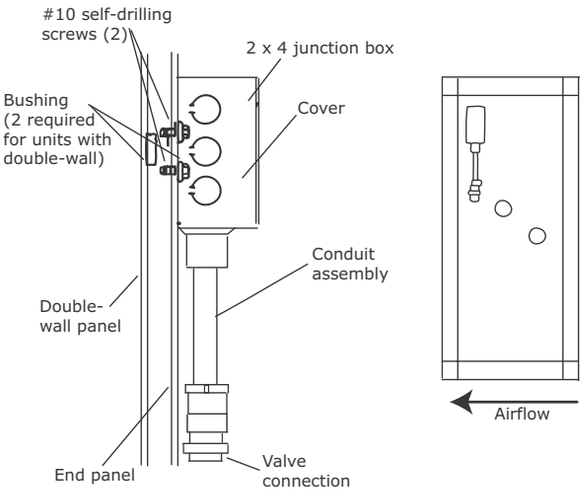
**Figure 128. External mounted controller**

**Figure 129. External controller**

Field installed DDC control devices:

- Install outside-air sensor and space sensor, if ordered.
- Connect control valves, if ordered, to the valve jack provided as part of the unit wiring harness. The valve jack is typically located at the air-leaving side of the coil connection inside the casing panel. For valve junction box mounting and wiring detail, see Figure 130.

**Figure 130. Junction box for valve wiring**

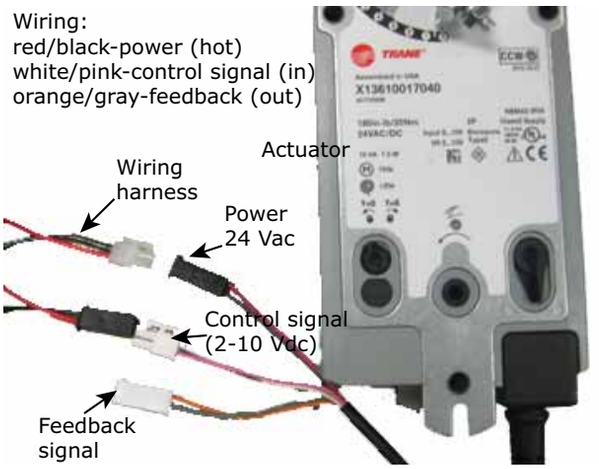



## Quick Connects

The actuators, factory-mounted or field-supplied, are separately wired and controlled by a direct-digital controller or other building logic. Figure 131 illustrates the typical quick connect scheme.

*Note: With units that require splits to be assembled that have high voltage quick connects, use electrical tape to bind the quick connections together to avoid poor connections or intermittent connection from vibrations.*

**Figure 131. Typical quick connects with wiring.**



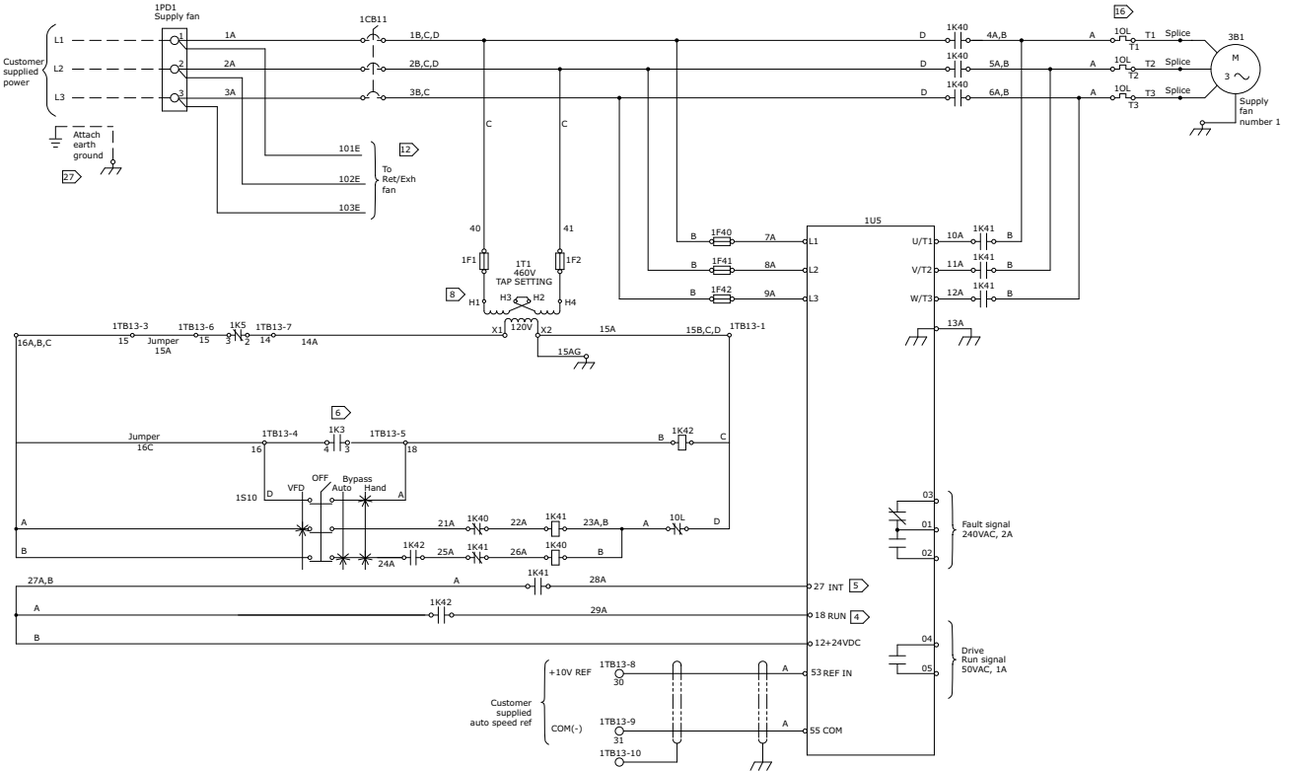

If the unit does not include a factory-mounted starter, wiring to the unit fan motor must be provided by the installer and must comply with all national and local electrical codes. The installer must also furnish a service disconnect switch in compliance with national and local electrical codes.

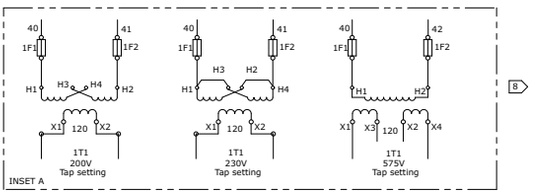
Fan motors require motor overload protective devices that are rated or selected in compliance with the National Electric Code (NEC) or Canadian Electric Code. Specific unit and motor connection diagrams are provided on the starter/VFD if Trane-provided, or refer to the motor nameplate.

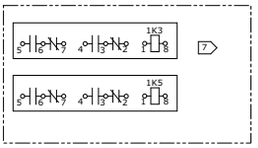
If wiring directly to the motor, a flexible connection at the motor to permit fan belt adjustment should be provided. Fractional horsepower motors may be factory connected to a terminal box on the unit. If this construction is provided, the installer should complete field wiring to this connection box. For a typical high voltage wiring schematic, see Figure 132.

*Note: Properly seal all penetrations in unit casing. Failure to seal penetrations from inner panel to outer panel could result in unconditioned air entering the unit.*

## Figure 132. Typical VFD wiring schematic




| Legend | |
|---|---|
| Device Designation | Description |
| 1CB11 | VFD circuit breaker |
| 1F1,1F2 | Control circuit primary fuse(s) |
| 1F40,1F41,1F42 | AFC fuse(s) |
| 1K3 | Supply fan start/stop relay |
| 1K5 | Supply fan low limit relay |
| 1K40 | Bypass contactor |
| 1K41 | Isolation contactor |
| 1K42 | Run permissive relay |
| 1OL | Overload relay |
| 1S10 | VFD/OFF/Bypass Auto/Bypass hand switch |
| 1T1 | Primary transformer |
| 1PD1 | Supply fan power distribution block |
| 1TB13 | Terminal strip control circuit |
| 1U5 | Drive controller (AFC) |
| 3B1 | Supply fan motor |

| Bussman Class T Drive Fuse Part No. | | | |
|---|---|---|---|
| AFC Fuse | Voltage | HP | Part No. |
| 1F40<br>1F41<br>1F42 | 200/230 | 1,1.5 | JJN-10 |
| | | 2 | JJN-15 |
| | | 3 | JJN-20 |
| | | 5 | JJN-25 |
| | | 7.5 | JJS-30 |
| | | 10 | JJN-50 |
| | | 15 | JJN-60 |
| | | 20 | JJN-80 |
| | | 25,30 | JJN-125 |
| | | 40 | FWH-150B |
| | | 50 | FWH-200B |
| | 460 | 1,1.5 | JJS-6 |
| | | 2,3 | JJS-10 |
| | | 5 | JJS-20 |
| | | 7.5 | JJS-25 |
| | | 10 | JJS-30 |
| | | 15,20 | JJS-40 |
| | | 25 | JJS-50 |
| | | 30 | JJS-60 |
| | | 40 | JJS-80 |
| | | 50 | JJS-100 |
| | | 60 | JJS-125 |
| | | 75 | FWH-150B |
| | | 100 | FWH-200B |
| | | 125 | FWH-250B |
| | 575 | 1,1.5 | JJS-3 |
| | | 2,3 | JJS-6 |
| | | 5,7.5 | JJS-10 |
| | | 10 | JJS-15 |
| | | 15 | JJS-20 |
| | | 20 | JJS-30 |
| | | 25 | JJS-35 |
| | | 30 | JJS-45 |
| | | 40 | JJS-60 |
| | | 50 | JJS-80 |
| | | 60 | JJS-90 |
| | | 75 | JJS-100 |
| | | 100 | FWP-125A |
| | | 125 | FWP-175B |

| Fuse Rating (AMPS) - 600V Class LP-CC Time Delay | | | | |
|---|---|---|---|---|
| Primary Transformer Fuses | | | | |
| Line Voltage | Item | MFR. | MFR. Part NO. | Danfoss NO. |
| 200 | 1F1,1F2 | Bussman | FNQ-R-1.25 | 34046200 |
| 230 | 1F1,1F2 | Bussman | FNQ-R-1.25 | 34046200 |
| 460 | 1F1,1F2 | Bussman | FNQ-R-0.60 | 34046000 |
| 575 | 1F1,1F2 | Bussman | FNQ-R-0.50 | 34053600 |

| Device Prefix Location Code | |
|---|---|
| Area | Location |
| 1 | High voltage panel |
| 2 | Low voltage panel (Unit schematic) |
| 3 | Air handler section |

Notes:

1 Dashed lines indicate recommended field wiring by others. Phantom lines indicate control option. Ref. Control panel schematic for specific detail.

2 All field wiring must be in accordance with the National Electrical Code (NEC), state and local requirements. Other countries applicable national and/or local requirements shall apply. Field conductors shall have insulation rating not less than 600v copper conductors only.

3 The minimum circuit ampacity, the maximum fuse size, and disconnect size are calculated based on the inverter input line currents per article 430-2 of the National Electrical Code.

4 Program terminal 18 as run.

5 Program terminal 27 inv. coasting stop.

6 Closes to run auto mode or bypass auto for option VFD or starter.

7 Relay(s)--contacts: silver-cadmium oxide: 1/6 hp 5 amp @ 120V AC, 1/3 hp 5 amp @240V AC. See 24V schematic diagram for coil connections and actual quantity of transformer relays.

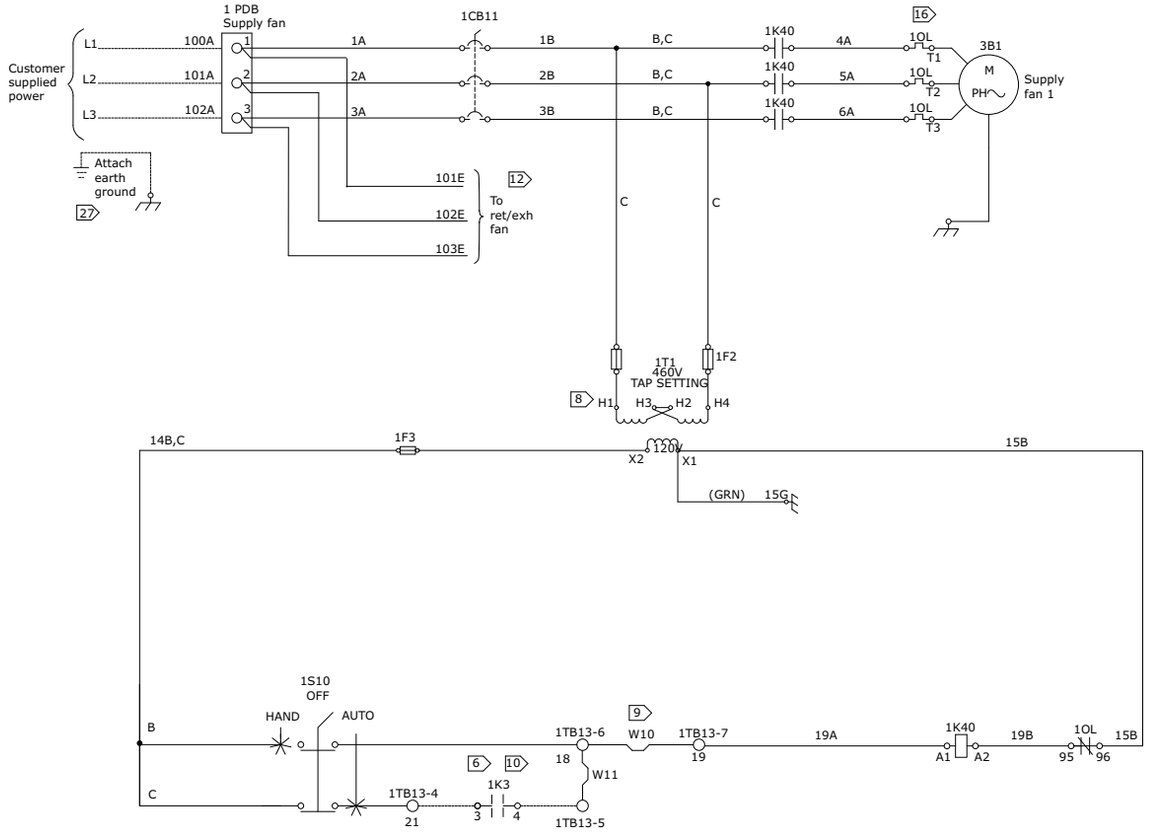
8 Control transformer shown for 460V primary. For 200 or 230V or 575V refer to Inset A.

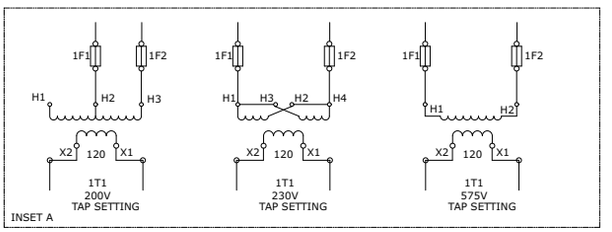
12 If unit has shipping splits wiring will terminate to module at each shipping split.

16 The overload relay trip setting must be adjusted to Correspond with the motor full load current as shown on the motor nameplate.

27 Attach ground or equipment ground.

## Figure 133. Typical starter wiring schematic




| Legend | |
|---|---|
| Device Designation | Description |
| 1CB11 | Starter circuit breaker |
| 1F1,1F2 | Control circuit primary fuse(s) |
| 1F3 | Control circuit secondary fuse |
| 1K3 | Supply fan start/stop relay (field supply) |
| 1K40 | Supply fan starter |
| 1OL | Overload relay |
| 1S10 | Hand/off/auto switch |
| 1T1 | Primary transformer |
| 1PDB | Supply fan power distribution block |
| 1TB13 | Terminal strip control circuit |
| 3B1 | Supply fan motor 1 |

| FUSE RATING (AMPS) - 600V CLASS LP-CC TIME DELAY | | | |
|---|---|---|---|
| PRIMARY TRANSFORMER FUSES | | | |
| LINE VOLTAGE | ITEM | MANUFACTURER | MFR. PART NO. |
| 200 | 1F1,1F2 | FERRAZ-SHAWMUT | ATQR-1 |
| 230 | 1F1,1F2 | FERRAZ-SHAWMUT | ATQR-8/10 |
| 460 | 1F1,1F2 | FERRAZ-SHAWMUT | ATQR-4/10 |
| 575 | 1F1,1F2 | FERRAZ-SHAWMUT | ATQR-3/10 |
| SECONDARY CIRCUIT FUSES | | | |
| LINE VOLTAGE | ITEM | MANUFACTURER | MFR. PART NO. |
| 120 | 1F3 | FERRAZ-SHAWMUT | ATQ-8/10 |

| Device prefix locatoin code | |
|---|---|
| Area | Location |
| 1 | High voltage panel |
| 2 | Low voltage panel (unit schematic) |
| 3 | Air handler section |

Auxillary Contact

1K40 AUX

13 14

Notes:

1 Dashed lines indicate recommended field wiring by others. Phantom lines indicate control option. Ref. Control panel schematic for specific detail.

2 All field wiring must be in accordance with the National Electrical Code (NEC), state and local requirements. Other countries applicable national and/or local requirements shall apply. Field conductors shall have insulation rating not less than 600V copper conductors only.

3 The minimum circuit ampacity, the maximum fuse size, and disconnect size are calculated based on the inverter input line currents per article 430-2 of the National Electrical Code.

6 Closes to run auto mode or bypass auto for option VFD or starter.

8 Control transformer shown for 460V primary. For 200 or 230V or 575V refer to Inset A.

9 Remove jumper and install field safety contact.

10 Field supplied contacts.

12 If unit has shipping splits wiring will terminate to module at each shipping split.

16 The overload relay trip setting must be adjusted to correspond with the motor full load current as shown on the motor nameplate.

27 Attach ground or equipment ground.

**Figure 134. Typical UV light schematic**

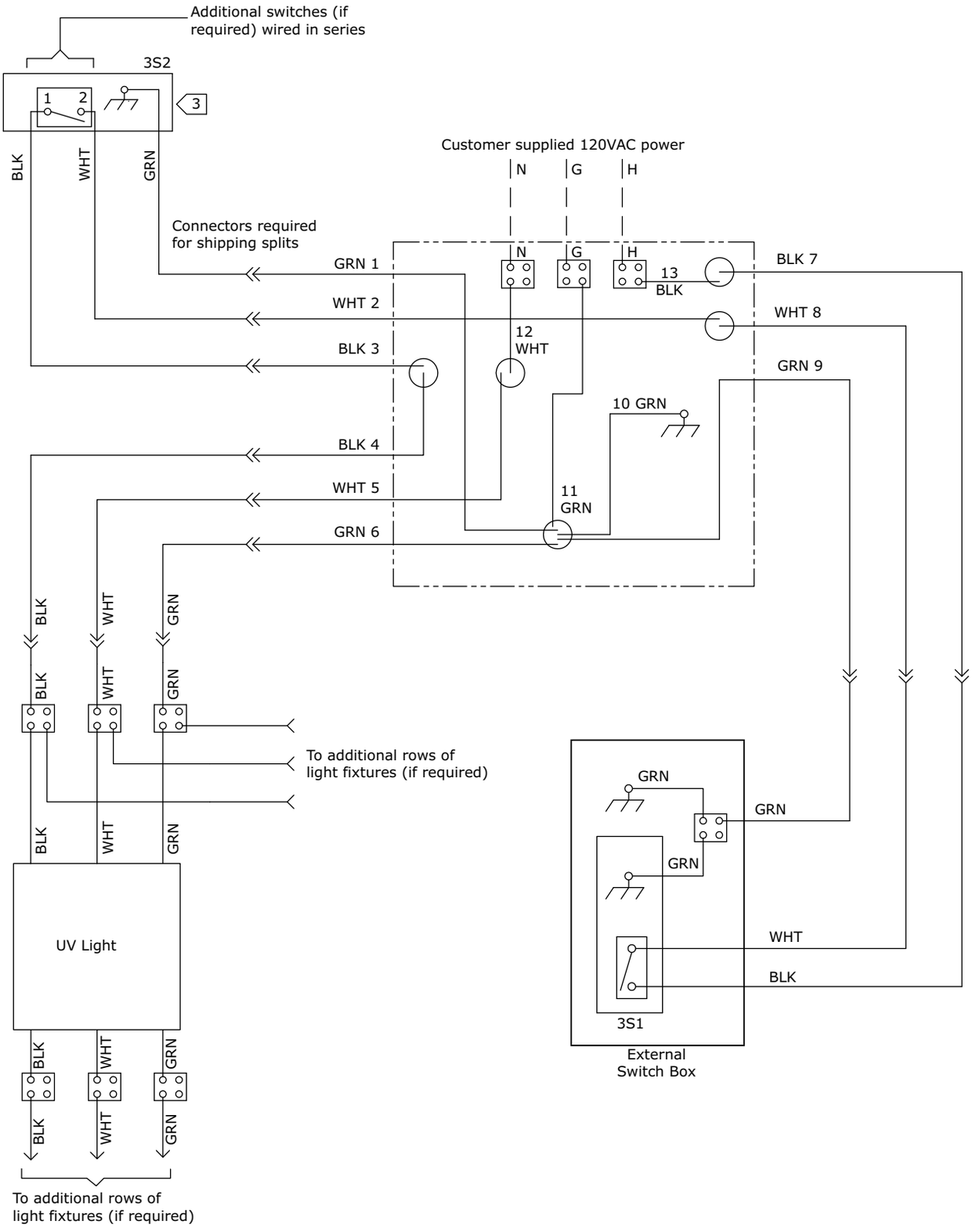
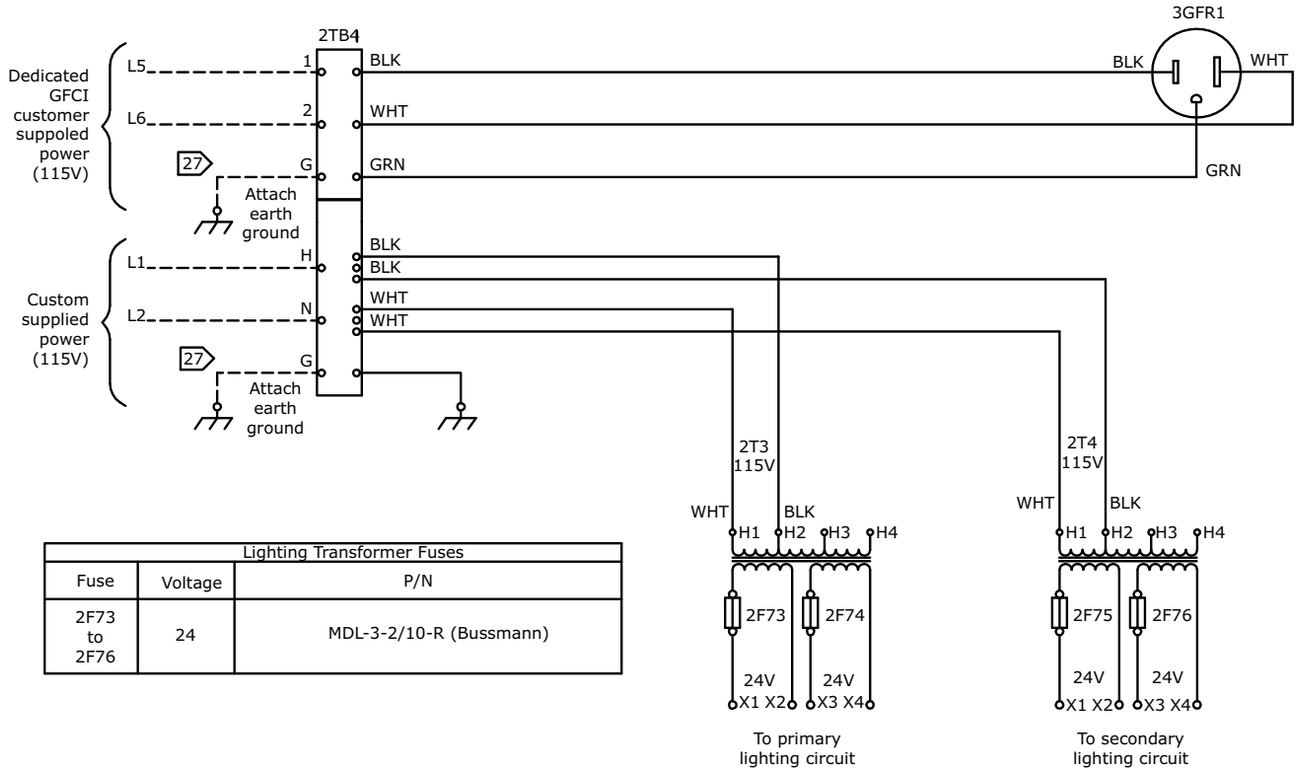


**Figure 135. Schematic for customer-supplied power for GFCI and lights/switch**




| Lighting Transformer Fuses | | |
|---|---|---|
| Fuse | Voltage | P/N |
| 2F73 to 2F76 | 24 | MDL-3-2/10-R (Bussmann) |

| Legend | |
|---|---|
| Device Designation | Description |
| 2TP4 | Terminal block GFCI/lighting circuits |
| 2T3 | Primary lighting transformer |
| 2T4 | Secondary lighting transformer |
| 3GFR1 | Ground fault receptacle |

| Device Prefix Location Code | |
|---|---|
| Area | Location |
| 1 | High voltage panel |
| 2 | Low voltage panel (unit schematic) |
| 3 | Air handler section |

Notes:

1 Dashed lines indicate recommended field wiring by others. Phantom lines indicate control options. Ref. Control panel schematic for specific detail.

2 All field wiring must be in accordance with the National Electrical Code (NEC), state and local requirements. Other countries applicable national and/or local requirements shall apply. Field conductors shall have insulation rating not less than 600V copper conductors only.

3 The minimum circuit ampacity, the maximum fuse size, and disconnect size are calculated based on the inverter input line currents per Article 430-2 of the National Electrical Code.

27 Attach ground or equipment ground.

# Controls Interface

The portable operator display is used for temporary connection to and operation of Trane UC600 controller. With the portable operator display, you can monitor data, change setpoints, monitor alarms, and override points. The portable operator display includes a 10 ft (3 m) cable with connector that is stored in the storage compartment of the carrying bag. The cable cannot be disconnected from the operator display. Keep this document with the portable operator display for access to calibration and cleaning instructions.

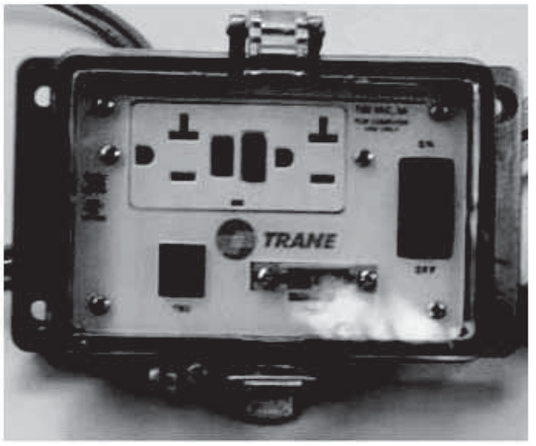
*Note: The portable operator display is not used for timeclock scheduling. To provide scheduling you must use a Tracer Summit system.*

## Connecting the operator display

To connect the portable operator display:

1. Locate the factory-provided service module (see Figure 136).
2. Attach the operator-display cable to the operator-display connector on the service module. The operator display receives power from the controller and turns on automatically when it is connected.

**Figure 136. Service module**




## Setting up the operator display

**NOTICE:**

**Water Damage!**

**To clean the operator display, use a cloth dampened with commercial liquid glass cleaner. Spraying water or cleaner directly on the screen could result in equipment damage.**

This section shows how to calibrate the operator display touch screen and how to adjust the brightness and contrast. To set up the operator display screens and security, see the *Tracer TD7 Display for the Tracer UC600 Programmable Controller Installation, Operation, and Maintenance* guide (BAS-SVX50C-EN).

## Calibrating the operator display

To calibrate the operator display:

1. On the home screen, press Setup. The Setup menu appears.
2. Page down to view the next screen.
3. Press Calibrate Touch Screen. A calibration screen appears.

**NOTICE:**

**Equipment Damage!**

**Do not allow the operator display to come in contact with sharp objects. This could result in equipment damage.**

4. Touch the target using a small, pliable, blunt object, such as a pencil eraser or your finger. Hold until the beeping stops. A second calibration screen appears.
5. Again, touch the target with the object. Hold until the beeping stops. The Advanced Selection screen appears.
6. Press Home. The home screen appears.

## Adjusting brightness and contrast

To adjust the brightness and contrast of the operator display:

1. On the home screen, press Setup. The Setup menu appears.
2. Page down to view the next screen.
3. Press the Adjust Brightness and Contrast buttons. The Brightness and Contrast screen appears.
4. To increase the brightness, press the buttons along the top row, in sequence, from left to right. To decrease the brightness, press the buttons from right to left.

*Note: Contrast adjustment is not available on all computer display models.*

5. To increase the contrast, press the buttons along the bottom row, in sequence, from left to right. To decrease the contrast, press the buttons from right to left.
6. Press Home. The home screen appears.

# External communications port

Units with a factory-provided DDC controller can include a service module (see Figure 136) with an external communications port when purchased. Both the operator display and Rover service tool can be connected without shutting off the unit through the external communications port. Open the cover plate on the service module and plug into the RJ-11 port for the operator display or the RS 485 port for the Rover service tool. This enables continuous operation of the air handler without disruption to the operating conditions of the unit. When servicing of the unit is complete, close the cover plate on the service module to eliminate any air leakage path.

# Start-Up

## Pre-Startup Checklist

Once the air handler has been assembled and installed, attention must be directed to individual components for proper operation. Before operating the unit, complete the pre-startup checklist.

**⚠WARNING**

**Hazardous Voltage w/Capacitors!**

**Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.**

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN*

### General Checks

- Ensure the unit has been installed level.
- Ensure supply-air and return-air ducts have been connected.
- Ensure damper operator motors and connecting linkage have been installed.
- Verify damper operation and linkage alignment.
- Check that air filters are in place and positioned properly.
- Remove any debris from the unit interior.
- Remove all foreign material from the drain pan and check drain pan opening and condensate line for obstructions.
- Close and secure all unit access doors.
- If differential pressure switch is provided on filter rack, adjust per system requirements.
- Inspect electrical connections to the unit and unit controllers.
  - Connections should be clean and secure.
  - Compare the actual wiring with the unit diagrams.
  - Reference the appropriate controller manual for more details about starting units with factory-mounted controls.
- Check piping and valves for leaks. Open or close the valves to check for proper operation. Drain lines should be open.
- Leave this manual with the unit.

### Fan-Related Checks

- If the unit is *not* externally isolated, ensure that the fan isolator tie-down bolts have been removed. See "Fan Isolation" section on page 64 for more information.
- Rotate all fan wheels manually to confirm they turn freely in the proper direction.
- Check fan shaft bearings, fan wheel, and drive sheave set screws for proper torque settings (see Table 40 on page 123.
  - Fan sheaves should be tight and aligned.
- Check fan drive belt tension. See "Tension the Fan Belt" section on page 121.
- Inspect fan motor and bearings for proper lubrication, if necessary. See "Fan Bearing Lubrication," p. 147.

### Coil-Related Checks

:

***NOTICE:***

**Proper Water Treatment!**

**The use of untreated or improperly treated water in coils could result in scaling, erosion, corrosion, algae or slime. It is recommended that the services of a qualified water treatment specialist be engaged to determine what water treatment, if any, is required. Trane assumes no responsibility for equipment failures which result from untreated or improperly treated water, or saline or brackish water.**

- Ensure coil and condensate drain piping connections are complete.
- Check the piping and valves for leaks.
  - Open or close the valves to check operation.
  - The drain lines should be open.
- If unit has a refrigerant coil, ensure that it has been charged and leak-tested according to the instructions provided with the condenser equipment. Adjust the superheat setting.
- Remove all foreign material from the drain pan and check the pan opening and condensate line for obstructions.
- For steam coils, slowly turn the steam on full for at least 10 minutes before opening the fresh air intake on units with fresh air dampers.

## Motor-Related Checks

- Locate installation manual from the motor manufacturer for the specific motor installed. This can be found by contacting the motor manufacturer's representative. The motor manufacturer's recommendations take precedence for all matters related to the start-up and routine maintenance of the motor.
- Check the motor lubrication for moisture and rust.
  - Remove and clean grease plugs to inspect.
  - If moisture is present, consult an authorized repair shop for bearing inspection/replacement. This may require removal and transport of motor.
  - If no moisture is present, refer to the motor manufacturer's lubrication recommendations for proper lubrication.
  - The motor manufacturer may recommend lubricating the motor as part of their routine start-up instructions.
- Check motor winding. An acceptable winding resistance reading is from 6 meg-ohms to infinity. If reading is less than 5 mega-ohms, the winding should be dried out in an oven or by a blower.
- Inspect the entire motor for rust and corrosion.
- Bump-start the unit and confirm the fan wheel rotates properly, as indicated by the rotation arrow located on the fan housing.

*Note: For motor warranty needs, contact your local Trane sales office.*

# Unit Operation

**⚠WARNING**

**Rotating Components!**

**During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks. Failure to follow all safety precautions could result in rotating components cutting and slashing technician which could result in death or serious injury.**

**⚠WARNING**

**Live Electrical Components!**

**During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.**

Before complete start-up, bump-start the unit and confirm the fan wheel rotates properly, as indicated by the rotation arrow located on the fan housing.

After initial startup:

- Calculate the motor voltage imbalance, notifying the power company to correct unacceptable imbalances.
- Periodically check the fan belt tension.

## Calculate Motor Voltage Imbalance

After startup, measure the motor voltage and amperage on all phases to ensure proper operation. The readings should fall within the range given on the motor nameplate. The maximum allowable voltage imbalance is 2 percent.

Voltage imbalance is defined as 100 times the sum of the deviation of the three voltages from the average, divided by twice the average voltage. For example, if the three measured voltages are 221, 230 and 227, the average voltage would be 226 volts. The percent of voltage imbalance is then calculated.

$$\textbf{Voltage imbalance} = \frac{100A}{2 \times AvgVoltage}$$

**where:**

**A = (226-221) + (230-226) + (227-226)**

Voltage imbalance = 2.2% (not acceptable)

In the example, 2.2 percent imbalance is not acceptable and the power company should be notified to correct it.

## VFD Programming Parameters

Units shipped with an optional variable frequency drive (VFD) are preset and run-tested at the Trane factory. If a problem with a VFD occurs, ensure that the programmed parameters listed in Table 38 have been set. If trouble still persist after verifying factory parameters are correct, call Trane Drive Technical Support at 1-877-872-6363. Have the unit serial number from the drive available for the technical support representative. The technician will determine if drive can be repaired or needs to be replaced.

.

**Table 37. Trane TR150 Switching Frequency**

| Horsepower | Voltage | Max KHz | Trane Setting |
|---|---|---|---|
| 0.5 - 15 | 208/230 | 16 | 16 |
| 20-60 | 208/230 | 12 | 12 |
| 0.5 - 30 | 460 | 16 | 16 |
| 40 - 125 | 460 | 12 | 12 |
| 0.5 - 10 | 575 | 12 | 12 |
| 15 - 125 | 575 | 8 | 8 |

**⚠WARNING**

**Hazardous Voltage w/Capacitors!**

**Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.**

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN*

**Table 38. Trane TR150 VFD Programming Parameters**

| Parameter # TR150 | Description | Factory Default | Trane Setting |
|---|---|---|---|
| 0-03 | Region | International | North American |
| 1-03 | Torque Characteristics | Auto Energy Optim. VT | Auto Energy Optim. VT [3]for Belt-Drive Fans<br>Variable Torque [1]for Direct-Drive Fans |
| 1-20 | Motor Power | Depends on unit | Set Based on Motor Nameplate |
| 1-22 | Motor Voltage | Depends on unit | Set Based on Motor Nameplate |
| 1-24 | Motor Current | Depends on unit | Set Based on Motor Nameplate |
| 1-25 | Rated Motor Speed | Depends on unit | Set Based on Motor Nameplate |
| 1-71 | Start Delay | 0.0 Sec | 2 Sec |
| 1-73 | Flying Start | Disabled | Enable |
| 1-90 | Motor Thermal Protection | ETR Trip 1 [4] | ETR Trip 1 [4] |
| 3-02 | Minimum Reference | Application dependant | 0 Hz |
| 3-03 | Maximum Reference | 60Hz | 60 or the Value of Maximum Inverter Frequency (Hz) on nameplate if fan is direct drive. |
| 3-15 | Terminal 53 Analog Input | Analog Input 53 | Analog Input 53 |
| 3-41 | Ramp-up Time | Application dependant | 30 Sec |
| 3-42 | Ramp-down Time | Application dependant | 30 Sec |
| 4-12 | Output Freq Low Limit | Application dependant | 20 Hz |
| 4-14 | Output Freq High Limit | 60 or the Value of Maximum Inverter Frequency (Hz) on nameplate if fan is direct drive. | 60 or the Value of Maximum Inverter Frequency (Hz) on nameplate if fan is direct drive. |
| 4-18 | Current Limit | Application dependant | 110% |
| 4-19 | Max Output Frequency | Application dependant | 65 Hz or 120 Hz for Direct Drive Fan |
| 5-12 | Terminal 27 Digital Input | No Operation | Coast Inverse |
| 5-40 | Function Relay | No Operation | Relay 1 Active No Alarm [160]<br>Relay 2 Active Motor Running [5] |
| 6-14 | Terminal 53 Low Ref Feedback | 0.0 Hz | 20 Hz |
| 6-15 | Terminal 53 High Ref Feedback | Application dependant | 60 or the Value of Maximum Inverter Frequency (Hz) on Nameplate if fan is direct drive. |
| 14-01 | Switching Frequency | 5.0 kHz | Set to Max for HP (see Table 37) |
| 14-20 | Reset Mode | Manual Reset | Automatic Reset x 5 |

## Tension the Fan Belt

**NOTICE:**

**Belt Tension! (2 of 2)**

**Do not over-tension belts. Excessive belt tension will reduce fan and motor bearing life, accelerate belt wear and possibly cause shaft failure. Under tensioning belts is the primary cause of premature belt failure. Belts should not squeal at startup. Recheck belt tension after 8 hours, 24 hours, and 100 hours of operation and monthly thereafter.**

Proper belt tension is required to ensure maximum bearing and drive component life and is based on motor horsepower requirement. A label located on the bearing support on the drive side of the unit lists all drive parts, the proper belt tension, and deflection for that tension for the specific drive (Figure 137).

If the drive is changed from the original, proper belt tension can be estimated using Table 39.

The correct operation tension for a V-belt drive is the lowest tension at which the belts will not slip under the peak load conditions. It may be necessary, however, to increase the tension of some drives to reduce excessive belt flopping or to reduce excessive startup squealing.

**Figure 137. Tension drive belt label**

Browning V-BELT DRIVE KIT 1627373
MODULE 0400

PURCHASE ORD. NUMBER B24597-061 H5D073B A
CUSTOMER'S KIT # H5D073B A-012-0400
MTR HP.= 10.0
FAN RPM = 1458 CD = 9.4 AT 3.00 TRN OPN
TENSION INFO - 3.86 LB., 0.14 IN.
DRIVE'S BELTS - B40
MOTOR SHEAVE - 2VP75X 1 3/8
MOTOR BUSHING - NONE REQUIRED
FAN SHEAVE - 2B5V80
FAN BUSHING - B 1 7/16

Check the fan belt tension at least three times during the first days of operation because there is a rapid decrease in tension until the belt settles in. To measure belt tension, use a belt tensiometer (see Figure 138). Determine actual deflection by depressing one belt with the belt tensiometer and measuring the deflection relative to the other belts or to belt line (see Figure 139). Adjust the belt tension to the correct pounds force and tighten all bolts to the proper torque. See Table 53.

**Figure 138. Belt tensioner**

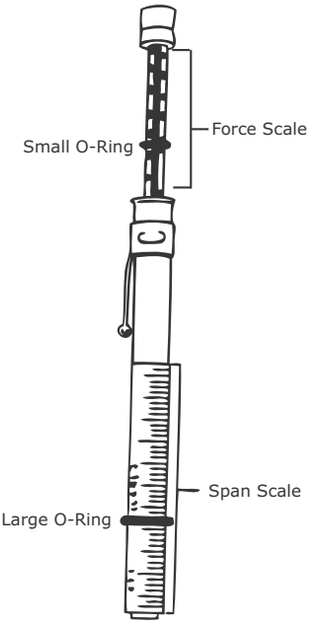



**Figure 139. Belt tension measurement**

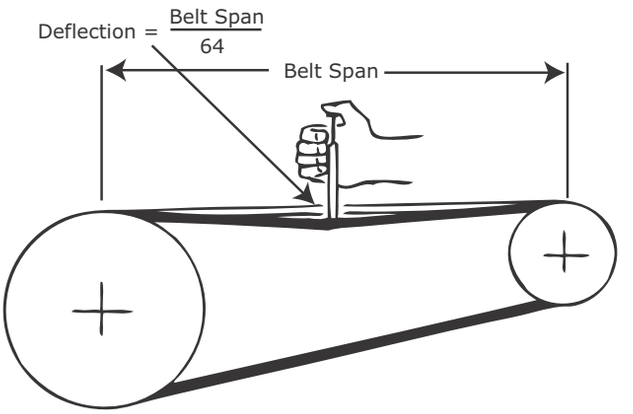


**Table 39. Typical sheave diameter and deflection force**

| Cross section | Smallest sheave diameter range (in.) | Speed (rpm) range | Belt Deflection Force (lbs) | | | |
|---|---|---|---|---|---|---|
| | | | Super gripbelts and unnotched gripbands | | Gripnotch belts and notched gripbands | |
| | | | Used belt | New belt | Used belt | New belt |
| A, AX | 3.0–3.6 | 1,000–2,500 | 3.7 | 5.5 | 4.1 | 6.4 |
| | | 2,501–4,000 | 2.8 | 4.2 | 3.4 | 5.0 |
| | 3.8–4.8 | 1,000–2,500 | 4.5 | 6.8 | 5.0 | 7.4 |
| | | 2,501–4,000 | 3.8 | 5.7 | 4.3 | 6.4 |
| | 5.0–7.0 | 1,000–2,500 | 5.4 | 8.0 | 5.7 | 9.4 |
| | | 2,501–4,000 | 4.7 | 7.0 | 5.1 | 7.6 |
| B, BX | 3.4–4.2 | 860–2,500 | n/a | n/a | 4.9 | 7.2 |
| | | 2,501–4,000 | n/a | n/a | 4.2 | 6.2 |
| | 4.4–5.6 | 860–2,500 | 5.3 | 7.9 | 7.1 | 10.5 |
| | | 2,501–4,000 | 4.5 | 6.7 | 7.1 | 9.1 |
| | 5.8–8.6 | 860–2,500 | 6.3 | 9.4 | 8.5 | 12.6 |
| | | 2,501–4,000 | 6.0 | 8.9 | 7.3 | 10.9 |
| C, CX | 7.0–9.0 | 500–1,740 | 11.5 | 17.0 | 14.7 | 21.8 |
| | | 1,741–3,000 | 9.4 | 13.8 | 11.9 | 17.5 |
| | 9.5–16.0 | 500–1,740 | 14.1 | 21.0 | 15.9 | 23.5 |
| | | 1,741–3,000 | 12.5 | 18.5 | 14.6 | 21.6 |
| D | 12.0–16.0 | 200–850 | 24.9 | 37.0 | n/a | n/a |
| | | 851–1,500 | 21.2 | 31.3 | n/a | n/a |
| | 18.0–20.0 | 200–850 | 30.4 | 45.2 | n/a | n/a |
| | | 851–1,500 | 25.6 | 38.0 | n/a | n/a |
| 3V, 3VX | 2.2–2.4 | 1,000–2,500 | n/a | n/a | 3.3 | 4.9 |
| | | 2,501–4,000 | n/a | n/a | 2.9 | 4.3 |
| | 2.65–3.65 | 1,000–2,500 | 3.6 | 5.1 | 4.2 | 6.2 |
| | | 2,501–4,000 | 3.0 | 4.4 | 3.8 | 5.6 |
| | 4.12–6.90 | 1,000–2,500 | 4.9 | 7.3 | 5.3 | 7.9 |
| | | 2,501–4,000 | 4.4 | 6.6 | 4.9 | 7.3 |
| 5V, 5VX | 4.4–6.7 | 500–1,749 | n/a | n/a | 10.2 | 15.2 |
| | | 1,750–3,000 | n/a | n/a | 8.8 | 13.2 |
| | | 3,001–4,000 | n/a | n/a | 5.6 | 8.5 |
| | 7.1–10.9 | 500–1,749 | 12.7 | 18.9 | 14.8 | 22.1 |
| | | 1,750–3,000 | 11.2 | 16.7 | 13.7 | 20.1 |
| | 11.8–16.0 | 500–1,749 | 15.5 | 23.4 | 17.1 | 25.5 |
| | | 1,750–3,000 | 14.6 | 21.8 | 16.8 | 25.0 |
| 8V | 12.5–17.0 | 200–850 | 33.0 | 49.3 | n/a | n/a |
| | | 851–1,500 | 26.8 | 39.9 | n/a | n/a |
| | 18.0–22.4 | 200–850 | 39.6 | 59.2 | n/a | n/a |
| | | 851–1,500 | 35.3 | 52.7 | n/a | n/a |

## Determine Fan Speed

**⚠ WARNING**

**Live Electrical Components!**

**During installation, testing, servicing and troubleshooting of this product, it may be necessary to measure the speed of rotating components. Have a qualified licensed service individual who has been properly trained in handling exposed rotating components perform these tasks. Failure to follow all safety precautions when exposed to rotating components could result in death or serious injury.**

Fan speed can be determined using a strobe-type tachometer, or revolution counter.

Check unit vibration if the fan speed is changed more than five percent from the original designed speed, or if parts such as shafts, fan wheels, bearings, or other drive components are replaced. Do not exceed the maximum fan speed.

Pay particular attention to any vibration, noise, or overheating of the motor and fan bearings; however, note that bearings may run warm during break in.

## Align Fan and Motor Sheaves

Align the fan and motor sheaves using a straightedge. The straightedge must be long enough to span the distance between the outside edges of the sheaves. When the sheaves are aligned, the straightedge will touch both sheaves at points A through D (see Figure 140) to confirm the shaft is parallel. For uneven width sheaves, place a string in the center groove of both sheaves and pull tight. Adjust the sheaves and tighten the sheave set screws to the proper torque given in Table 40.

## Check Multiple Belts

Tighten the belts slightly and rotate the drive several times.

On multiple belt drives, ensure the force of deflection is approximately the same on each belt by pushing each belt in an equal distance at a point halfway from each sheave (see Figure 140). If this force is not the same for each belt, the motor and fan shaft are not parallel. Realign as required. After realignment, tighten the belts again to the standard belt tensioning specifications. If the force is still not the same for all belts, the belts or sheaves are worn and must be replaced.

**Figure 140. Proper drive alignment**

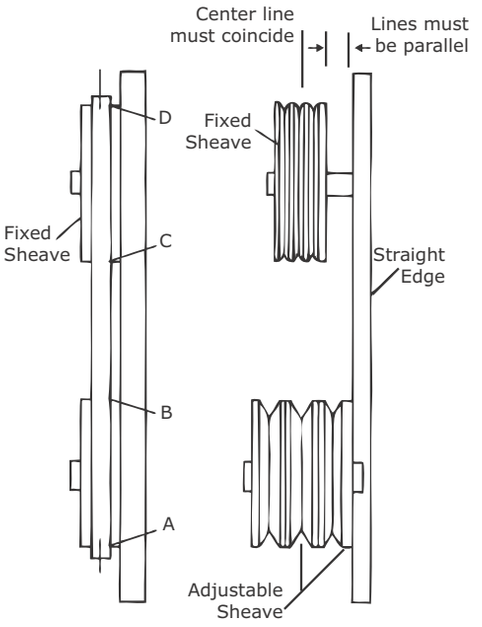



**Table 40. Set screw torque settings (inches)**

| Screw Size | Hex Key | Square Head | Hex Head | Torque (in.-lb.) | Torque (ft.-lb.) |
|---|---|---|---|---|---|
| 1/4 | 1/8 | 3/8 | 7/16 | 66-90 | 5.5-7.5 |
| 5/16 | 5/32 | 1/2 | 1/2 | 126-164 | 10.5-13.7 |
| 3/8 | 3/16 | 9/16 | 9/16 | 228-300 | 19.0-25.0 |
| 7/15 | 7/32 | 5/8 | 5/8 | 348-450 | 29.0-37.5 |
| 1/2 | 1/4 | 3/4 | 3/4 | 504-650 | 42.0-54.2 |
| 5/8 | 5/16 | 15/16 | 15/16 | 1290-1390 | 107.0-116.0 |
| #10 | 3/32 | - | - | 28-40 | 2.3-3.3 |

# Airflow Measuring Systems

## Traq™ Dampers

Traq dampers are low-leak dampers that modulate and measure airflow. Each Traq damper section is supplied with a factory-mounted ventilation control module (VCM) on the interior of the mixing box section. The VCM has an input terminal for power and an output terminal for air velocity (see Figure 141). A direct-digital controller controls the factory-mounted and wired actuators.

**Figure 141. Traq damper terminal connections**

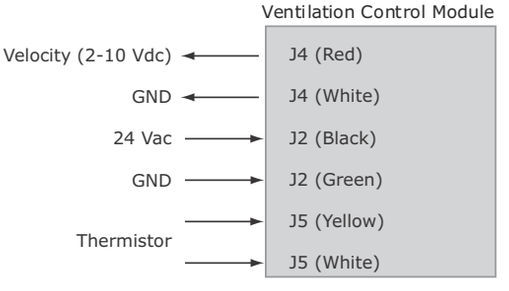
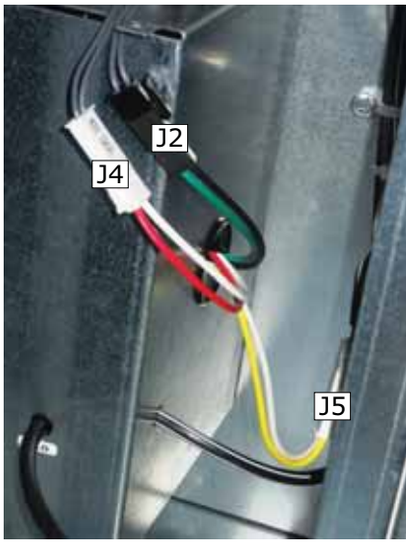


**Figure 142. Traq damper terminal connections**




**VCM (Transducer) Calibration.** The VCM has an auto-zero function that recalibrates the transducer once every minute. When troubleshooting, allow for the recalibration time before making any measurements.

**Input Power.** The only input the VCM needs is the 24 Vac power connected to the J2 plug (green and black wires).

**Output Velocity Signal.** The 2 to 10 Vdc linear output signal from the VCM represents air velocity. This voltage can be converted to represent airflow (cfm or L/s) using the formula below and Table 41.

$$\text{Airflow} = k\ (\text{cfm @ 10V}) \left[\frac{(\text{volts} - 2)}{8}\right]$$

or

$$\text{Airflow} = k\ (\text{L/s @ 10V}) \left[\frac{(\text{volts} - 2)}{8}\right]$$

**For example, if the VCM on a size 30 air handler at sea level (k=1) has a 10-volt signal, it would represent 24,492 cfm (11,559 L/s) through the Traq damper. If the voltage were 6 volts, airflow through the Traq damper would be 12,246 cfm (5779 L/s).**

**Table 41. Altitude adjustment factors**

| Sea level = 1.0 | |
|---|---|
| **Elevation (feet)** | **k** |
| 1000 | 0.982 |
| 2000 | 0.964 |
| 3000 | 0.949 |
| 4000 | 0.930 |
| 5000 | 0.914 |
| 6000 | 0.897 |
| 7000 | 0.876 |
| 8000 | 0.860 |
| 9000 | 0.846 |
| 10,000 | 0.825 |

Table 42. In Table 43 through Figure 50, the cfm at 10Vdc is a calculated value based on area and peak velocity. In certain situations, it can be advantageous to raise the velocity of air through the remaining Traq dampers by closing off one or more dampers in the unit. The cfm at 10Vdc can be recalculated based on the proportion of remaining Traq dampers or by multiplying the remaining area of dampers by peak velocity. Calculations are based on VCM voltage versus airflow at sea level.

**Table 43. Back or top inlet standard Traq damper-air mixing and indoor economizer section**

| Unit Size | Part Number | Traq Damper Size (inches) | Quantity | Peak Velocity (fpm) | Total Area ($ft^2$) | CFM @ 10VDC Peak Velocity | L/s @ 10VDC Peak Velocity |
|---|---|---|---|---|---|---|---|
| 3 | 495100860001 | 13 | 1 | 2475 | 0.92 | 2279 | 1076 |
| 4, 6 | 495100860001 | 13 | 2 | 2475 | 1.84 | 4559 | 2151 |
| 8, 10 | 495100860001 | 13 | 3 | 2475 | 2.76 | 6838 | 3227 |
| 12, 14, 17 | 495100870001 | 16 | 3 | 2475 | 4.19 | 10,365 | 4891 |
| 21, 25 | 495100890001 | 20 | 3 | 2600 | 6.54 | 17,012 | 8028 |
| 22, 26 | 495100870001 | 16 | 4 | 2475 | 5.58 | 13,820 | 6525 |
| 30, 35, 40 | 495100880001 | 24 | 3 | 2600 | 9.42 | 24,492 | 11,558 |
| 31 | 495100890001 | 20 | 4 | 2600 | 8.72 | 22,682 | 10,708 |
| 36, 41 | 495100880001 | 24 | 3 | 2600 | 9.42 | 24,492 | 11,563 |
| 50, 57 | 495100900001 | 28 | 3 | 2600 | 12.83 | 33,358 | 15,742 |
| 51, 58 | 495100900001 | 28 | 3 | 2600 | 12.82 | 33,337 | 15,738 |
| 66 | 495100900001 | 28 | 4 | 2600 | 17.10 | 44,460 | 20,981 |
| 80 | 495100900001 | 28 | 5 | 2600 | 21.38 | 55,588 | 26,232 |
| 100, 120 | 495100900001 | 28 | 6 | 2600 | 25.66 | 66,716 | 31,483 |

**Table 44. Back or top inlet low-flow Traq damper-air mixing and indoor economizer sections**

| Unit Size | Part Number | Traq Damper Size (in) | Damper Type | Qty | Peak Velocity (fpm) | Total Area ($ft^2$) | CFM @ 10VDC Peak Velocity | L/s @ 10VDC Peak Velocity |
|---|---|---|---|---|---|---|---|---|
| 4 | 495100860001 | 13 | Min. Outside Air | 1 | 2475 | 0.92 | 2279 | 1076 |
| 6 | 495100860001 | 13 | Min. Outside Air | 1 | 2475 | 0.92 | 2279 | 1076 |
| 8, 10 | 495100860001 | 13 | Min. Outside Air | 1 | 2475 | 0.92 | 2279 | 1076 |
| 12, 14, 17 | 495100870001 | 16 | Min. Outside Air | 1 | 2475 | 1.40 | 3455 | 1630 |
| 21, 25 | 495100890001 | 20 | Min. Outside Air | 1 | 2600 | 2.18 | 5671 | 2676 |
| 22, 26 | 495100870001 | 16 | Min. Outside Air | 1 | 2475 | 1.40 | 3455 | 1631 |
| 30, 35, 40 | 495100880001 | 24 | Min. Outside Air | 1 | 2600 | 3.14 | 8164 | 3853 |
| 31 | 495100890001 | 20 | Min. Outside Air | 1 | 2600 | 2.18 | 5671 | 2677 |
| 36, 41 | 495100880001 | 24 | Min. Outside Air | 1 | 2600 | 3.14 | 8164 | 3854 |
| 50, 57 | 495100900001 | 28 | Min. Outside Air | 1 | 2600 | 4.27 | 11,112 | 5244 |
| 51, 58 | 495100900001 | 28 | Min. Outside Air | 1 | 2600 | 4.27 | 11,112 | 5246 |
| 66 | 495100900001 | 28 | Min. Outside Air | 1 | 2600 | 4.27 | 11,112 | 5244 |
| 80 | 495100900001 | 28 | Min. Outside Air | 2 | 2600 | 8.54 | 22,224 | 10,488 |
| 100 | 495100900001 | 28 | Min. Outside Air | 2 | 2600 | 8.54 | 22,224 | 10,488 |
| 120 | 495100900001 | 28 | Min. Outside Air | 2 | 2600 | 8.54 | 22,224 | 10,488 |

**Table 45. Mixing box Traq damper inlet - single-side standard flow**

| Unit size | Part number | Traq damper size (in) | Qty | Peak velocity (fpm) | Total area ($ft^2$) | CFM@10VDC peak velocity | L/s@ 10VDC peak velocity |
|---|---|---|---|---|---|---|---|
| 3, 4, 6, 8 | 495100860001 | 13 | 1 | 2475 | 0.92 | 2279 | 1076 |
| 10, 12 | 495100870001 | 16 | 1 | 2475 | 1.40 | 3455 | 1631 |
| 14, 17 | 495100860001 | 13 | 2 | 2475 | 1.84 | 4559 | 2152 |
| 21, 22, 25, 26 | 495100870001 | 16 | 2 | 2475 | 2.79 | 6910 | 3262 |
| 30, 31, 35, 40 | 495100890001 | 20 | 2 | 2600 | 4.36 | 11,341 | 5354 |
| 36, 41, 50, 57, 66 | 495100880001 | 24 | 2 | 2600 | 6.28 | 16,328 | 7708 |
| 51, 58, 80 | 495100900001 | 28 | 2 | 2600 | 8.59 | 22,225 | 10,492 |
| 100 | 495100900001 | 28 | 3 | 2600 | 12.82 | 33,337 | 15,738 |
| 120 | 495100880001 | 24 | 4 | 2600 | 12.56 | 32,656 | 15,417 |

**Table 46. Mixing box Traq damper inlet - single-side low flow**

| Unit size | Part number | Traq damper size (in) | Damper type | Qty | Peak velocity (fpm) | Total area ($ft^2$) | CFM@10VDC peak velocity | L/s@ 10VDC peak velocity |
|---|---|---|---|---|---|---|---|---|
| 14, 17 | 495100860001 | 13 | Min. Outside Air | 1 | 2475 | 0.92 | 2279 | 1076 |
| 21, 22, 25, 26 | 495100870001 | 16 | Min. Outside Air | 1 | 2475 | 1.40 | 3455 | 1631 |
| 30, 31, 35, 40 | 495100890001 | 20 | Min. Outside Air | 1 | 2600 | 2.18 | 5671 | 2677 |
| 36, 41, 50, 57, 66 | 495100880001 | 24 | Min. Outside Air | 1 | 2600 | 3.14 | 8164 | 3854 |
| 51, 58, 80 | 495100900001 | 28 | Min. Outside Air | 1 | 2600 | 4.27 | 11,112 | 5246 |
| 100 | 495100900001 | 28 | Min. Outside Air | 1 | 2600 | 4.27 | 11,112 | 5246 |
| 120 | 495100880001 | 24 | Min. Outside Air | 1 | 2600 | 3.14 | 8164 | 3854 |

**Table 47. Mixing box Traq damper inlet - dual-side standard flow**

| Unit size | Part number | Traq damper size (in) | Qty | Peak velocity (fpm) | Total area ($ft^2$) | CFM@10VDC peak velocity | L/s@ 10VDC peak velocity |
|---|---|---|---|---|---|---|---|
| 3, 4, 6, 8 | 495100860001 | 13 | 2 | 2475 | 1.84 | 4559 | 2152 |
| 10, 12 | 495100870001 | 16 | 2 | 2475 | 2.79 | 6910 | 3262 |
| 14, 17 | 495100860001 | 13 | 4 | 2475 | 3.68 | 9118 | 4305 |
| 21, 22, 25, 26 | 495100870001 | 16 | 4 | 2475 | 5.58 | 13,820 | 6525 |
| 30, 31, 35, 40 | 495100890001 | 20 | 4 | 2600 | 8.72 | 22,682 | 10,708 |
| 36, 41, 50, 57, 66 | 495100880001 | 24 | 4 | 2600 | 12.56 | 32,656 | 15,417 |
| 51, 58, 80 | 495100900001 | 28 | 4 | 2600 | 17.10 | 44,450 | 20,985 |
| 100 | 495100900001 | 28 | 6 | 2600 | 25.64 | 66,674 | 31,477 |
| 120 | 495100880001 | 24 | 8 | 2600 | 25.12 | 65,312 | 30,834 |

**Table 48. Mixing box Traq damper inlet - dual-side low-flow**

| Unit size | Part number | Traq damper size (in) | Damper type | Qty | Peak velocity (fpm) | Total area ($ft^2$) | CFM@10VDC peak velocity | L/s@ 10VDC peak velocity |
|---|---|---|---|---|---|---|---|---|
| 3, 4, 6, 8 | 495100860001 | 13 | Min. Outside Air | 1 | 2475 | 0.92 | 2279 | 1076 |
| 10, 12 | 495100870001 | 16 | Min. Outside Air | 1 | 2475 | 1.40 | 3455 | 1631 |
| 14, 17 | 495100860001 | 13 | Min. Outside Air | 1 | 2475 | 0.92 | 2279 | 1076 |
| 21, 22, 25, 26 | 495100870001 | 16 | Min. Outside Air | 1 | 2475 | 1.40 | 3455 | 1631 |
| 30, 31, 35, 40 | 495100890001 | 20 | Min. Outside Air | 1 | 2600 | 2.18 | 5671 | 2677 |
| 36, 41, 50, 57, 66 | 495100880001 | 24 | Min. Outside Air | 1 | 2600 | 3.14 | 8164 | 3854 |
| 51, 58, 80 | 495100900001 | 28 | Min. Outside Air | 1 | 2600 | 4.27 | 11,112 | 5246 |
| 100 | 495100900001 | 28 | Min. Outside Air | 1 | 2600 | 4.27 | 11,112 | 5246 |
| 120 | 495100880001 | 24 | Min. Outside Air | 1 | 2600 | 3.14 | 8164 | 3854 |

**Table 49. Side inlet standard Traq dampers - diagonal economizer section**

| Unit size | Part number | Traq damper size (in) | Quantity | Peak velocity (fpm) | Total area (ft2) | CFM@10VDC peak velocity | L/s@10VDC peak velocity |
|---|---|---|---|---|---|---|---|
| 3 | 495100860001 | 13 | 1 | 2475 | 0.92 | 2279 | 1076 |
| 4, 6, 8 | 495100860001 | 13 | 2 | 2475 | 1.84 | 4559 | 2151 |
| 10, 12, 14 | 495100870001 | 16 | 2 | 2475 | 2.79 | 6905 | 3259 |
| 17 | 495100860001 | 13 | 4 | 2475 | 3.68 | 9118 | 4303 |
| 21 | 495100890001 | 20 | 2 | 2600 | 4.36 | 11,341 | 5352 |
| 25 | 495100870001 | 16 | 4 | 2475 | 5.58 | 13,820 | 6522 |
| 30 | 495100890001 | 20 | 3 | 2600 | 6.54 | 17,012 | 8028 |
| 35, 40 | 495100900001 | 28 | 2 | 2600 | 8.55 | 22,224 | 10,488 |
| 50 | 495100880001 | 24 | 3 | 2600 | 9.42 | 24,492 | 11,558 |
| 57 | 495100880001 | 24 | 4 | 2600 | 12.56 | 32,656 | 15,410 |
| 66 | 495100900001 | 28 | 3 | 2600 | 12.82 | 33,336 | 15,731 |
| 80 | 495100900001 | 28 | 4 | 2600 | 17.10 | 44,448 | 20,975 |
| 100, 120 | 495100900001 | 28 | 5 | 2600 | 21.37 | 55,561 | 26,219 |

**Table 50. Side inlet low-flow Traq dampers - diagonal economizer section**

| Unit size | Part number | Traq damper size (in) | Damper type | Qty | Peak velocity (fpm) | Total area ($ft^2$) | CFM@10VDC peak velocity | L/s@ 10VDC peak velocity |
|---|---|---|---|---|---|---|---|---|
| 4 | 495100860001 | 13 | Min. Outside Air | 1 | 2475 | 0.92 | 2279 | 1076 |
| 6 | 495100860001 | 13 | Min. Outside Air | 1 | 2475 | 0.92 | 2279 | 1076 |
| 8 | 495100860001 | 13 | Min. Outside Air | 1 | 2475 | 0.92 | 2279 | 1076 |
| 10 | 495100870001 | 16 | Min. Outside Air | 1 | 2475 | 1.40 | 3455 | 1630 |
| 12 | 495100870001 | 16 | Min. Outside Air | 1 | 2475 | 1.40 | 3455 | 1630 |
| 14 | 495100870001 | 16 | Min. Outside Air | 1 | 2475 | 1.40 | 3455 | 1630 |
| 17 | 495100860001 | 13 | Min. Outside Air | 1 | 2475 | 0.92 | 2279 | 1076 |
| 21 | 495100890001 | 20 | Min. Outside Air | 1 | 2600 | 2.18 | 5671 | 2676 |
| 25 | 495100870001 | 16 | Min. Outside Air | 1 | 2600 | 1.40 | 3630 | 1713 |
| 30 | 495100890001 | 20 | Min. Outside Air | 1 | 2600 | 2.18 | 5671 | 2676 |
| 35, 40 | 495100900001 | 28 | Min. Outside Air | 1 | 2600 | 4.27 | 11,112 | 5244 |
| 50 | 495100880001 | 24 | Min. Outside Air | 1 | 2600 | 3.14 | 8164 | 3853 |
| 57 | 495100880001 | 24 | Min. Outside Air | 1 | 2600 | 3.14 | 8164 | 3853 |
| 66 | 495100900001 | 28 | Min. Outside Air | 1 | 2600 | 4.27 | 11,112 | 5244 |
| 80 | 495100900001 | 28 | Min. Outside Air | 1 | 2600 | 4.27 | 11,112 | 5244 |
| 100, 120 | 495100900001 | 28 | Min. Outside Air | 1 | 2600 | 4.27 | 11,112 | 5244 |

Trane utilizes AMCA certification for airflow measuring stations. Trane certifies that the Traq damper herein is licensed to bear the AMCA seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 611 and comply with the requirements of the AMCA Certified Ratings Program.

The certification program provides the engineer and owner assurance that manufacturer-published performance ratings for airflow measurement stations are accurate and repeatable. Trane Traq dampers are certified with the integral ventilation control module which converts differential pressure to an electronic signal for control.

Refer to Performance Climate Changer Air Handler catalog CLCH-PRC015-EN for Traq damper testing and rating information.

## Fan Inlet Airflow Measuring System

A fan inlet airflow measuring system is available on many centrifugal and plenum fans. Each system comes with a differential pressure transmitter. The minimum diameter is connected to the LO port of the transmitter and the reference pressure point is connected to (or actually is) the HI port of the transmitter.

**Figure 143. Fan inlet airflow measuring system**

## Wiring

The transmitter requires 24VDC power on terminals 1 (+) and 2 (ground) of the transmitter. When the airflow measurement system is ordered with a factory-mounted UC600 controller, the 24 VDC power will be supplied.

In the absence of a factory-provided UC600 controller, the installing contractor must ensure the transmitter has 24VDC power.

*Note: Ensure that the transmitter has a separate power source.*

## Transmitter Sizing

The Trane specification requires that the flow meter option have a total accuracy of 5 percent. The total accuracy is a combination of:

- how accurately the flow meter itself is in sensing airflow
- how accurately the transmitter senses the differential pressure
- how accurately the controller translates the signal from the transmitter to a differential pressure.

Selecting the proper transmitter is critical in order to get accurate airflow measurements. How accurately the transmitter senses the differential pressure is dependent on:

- the pressure range selected
- accuracy of the selected transmitter

Trane air handlers use either a 0-20 inch or a 0-40 inch range transmitter as standard. To sufficiently cover VAV turndown on the smallest fans with the above range, a transmitter with an accuracy of 0.25 percent (full scale) is used as standard. If a field-provided transmitter with a lower accuracy is selected, the range should be chosen closer to the actual, maximum pressure differential expected for the application.

The transmitter outputs a signal that represents the differential pressure which is used to calculate airflow. To adequately calculate and display the airflow for the smaller fans, ensure that the analog input is programmed with enough decimal places to sufficiently represent the pressure differential being measured. For instance, Rover should be used to increase the number of decimal places being used (to a maximum of 4) on an MP-580/581 controller in lieu of the default zero.

Note that the adjustment of the “Zero” and “Span” controls on the transmitter itself are not required at time of installation. The transmitter is factory-calibrated to the range selected and cannot be significantly adjusted to “tighten” the range closer to the pressure being read for the given application. The adjustments are primarily provided to account for any drift that may occur over time.

## Transmitter Calibration

The transmitter is factory-calibrated to a specific pressure range with either a 0-20 inch or 0-40 inch w.g. range being used in most cases. To check calibration and to adjust if necessary, consult the transmitter manufacturer or the factory for specific procedures.

The transmitter outputs a linear, 2-10 VDC signal representing a differential pressure measurement. With this measurement, the airflow through the fan can be calculated using the following equation:

$CFM = K * SQRT(DP)$

Where:

CFM = Airflow ($ft^3/min.$) assuming a standard air density of 0.075 $lbm/ft^3$.

K = A constant factor that is unique for each fan. See “Constant Factor K” section on page 129 for more information.

DP = Differential pressure (inches w.g.) being measured by the transmitter.

Significant differences in elevation and/or temperature will affect the density of air. For air at a constant, non-standard density, a field-obtained K factor can be used. Alternatively, the following equation can be used to continuously correct the equation above:

$ACFM = CFM * SQRT(0.075/\rho)$

Where:

ACFM = Actual airflow ($ft^3/min.$) corrected for non-standard air density.

$\rho$ = Density ($lbm/ft^3$) of the air at the inlet to the fan.

*Note: Alternative units, including SI, can be used in place of the IP units above although the K-factor must be converted appropriately.*

## Constant Factor K

The constant factor K is unique for each fan and is primarily a function of the area and other geometric properties of the fan inlet. Pre-engineered factors are available from the factory for fan types where the airflow measurement system is available. See Table 51 for single-fan K factors. For a multiple-fan system, the constant factor K may need to be adjusted depending on how many transmitters are supplied.

**Table 51. Constant K Factors**

| Fan Size (inches) / Type | Fan Class | Fan Name | K-Factor |
|---|---|---|---|
| 9 BC | Class I | 9 BA | 935.00 |
| 9 BC | Class II | 9 BB | 868.20 |
| 10 BC | Class I | 10 BA | 1072.50 |
| 10 BC | Class II | 10 BB | 1072.50 |
| 12 AF | Class I | 12 AA | 2337.50 |
| 12 AF | Class II | 12 AB | 2237.30 |
| 15 AF | Class I | 15 AA | 3873.60 |
| 15 AF | Class II | 15 AB | 3873.60 |
| 18 AF | Class I | 18 AA | 4675.00 |
| 18 AF | Class II | 18 AB | 4675.00 |
| 20 AF | Class I | 20 AA | 5843.70 |
| 20 AF | Class II | 20 AB | 5119.90 |
| 22 AF | Class I | 22 AA | 7513.40 |
| 22 AF | Class II | 22 AB | 6624.10 |
| 25 AF | Class I | 25 AA | 9683.90 |
| 25 AF | Class II | 25 AB | 8891.10 |
| 28 AF | Class I | 28 AA | 12,856.20 |
| 28 AF | Class II | 28 AB | 11,795.00 |
| 32 AF | Class I | 32 AA | 16,295.60 |
| 32 AF | Class II | 32 AB | 16,295.60 |
| 36 AF | Class I | 36 AA | 19,701.70 |
| 36 AF | Class II | 36 AB | 19,367.80 |
| 40 AF[1] | Class I | 40 AA | 23,374.90 |
| 40 AF[2] | Class II | 40 AA | 25,378.40 |
| 40 AF[1] | Class I | 40 AB | 22,974.20 |
| 40 AF[2] | Class II | 40 AB | 25,044.50 |
| 44 AF | Class I | 44 AA | 30,113.00 |
| 44 AF | Class II | 44 AA | 30,113.00 |
| 49 AF | Class I | 49 AB | 37,470.00 |
| 49 AF | Class II | 49 AB | 37,470.00 |
| 20 FC | Class I | 20 FA | 7300.00 |
| 20 FC | Class II | 20 FB | 7203.90 |
| 22 FC | Class I | 22 FA | 9081.90 |
| 22 FC | Class II | 22 FB | 8793.10 |
| 25 FC | Class I | 25 FA | 12,030.00 |
| 25 FC | Class II | 25 FB | 11,700.00 |
| 28 FC | Class I | 28 FA | 14,450.00 |
| 28 FC | Class II | 28 FB | 14,036.00 |

**Note:** [1]To be used for fan rpm < 700 or cfm < 25,500. [2]To be used for fan rpm > 700 or cfm > 25,500.

**Table 51. Constant K Factors**

| Fan Size (inches) / Type | Fan Class | Fan Name | K-Factor |
|---|---|---|---|
| 32 FC | Class I | 32 FA | 20,400.00 |
| 32 FC | Class II | 32 FB | 20,150.00 |
| 36 FC | Class I | 36 FA | 28,049.90 |
| 36 FC | Class II | 36 FB | 27,549.00 |
| 40 FC | Class I | 40 FA | 39,236.40 |
| 40 FC | Class II | 40 FB | 38,067.70 |
| 10 BC belt-drive plenum | Class I or II | 10 PA or 10 PB | 563.00 |
| 11 BC belt-drive plenum | Class I or II | 11PA or 11 PB | 703.00 |
| 12 AF belt-drive plenum | Class I or II | 12PA or 12 PB | 1168.70 |
| 14 AF belt-drive plenum | Class I or II | 14PA or 14 PB | 1536.10 |
| 16 AF belt-drive plenum | Class I or II | 16PA or 16 PB | 1870.00 |
| 18 AF belt-drive plenum | Class I or II | 18PA or 18 PB | 2270.70 |
| 20 AF belt-drive plenum | Class I or II | 20PA or 20 PB | 2905.20 |
| 22 AF belt-drive plenum | Class I or II | 22PA or 22 PB | 3673.20 |
| 25 AF belt-drive plenum | Class I or II | 25PA or 25 PB | 4608.20 |
| 28 AF belt-drive plenum | Class I or II | 28 PA or 28 PB | 6277.80 |
| 32 AF belt-drive plenum | Class I or II | 32 PA or 32 PB | 7847.30 |
| 36 AF belt-drive plenum | Class I or II | 36 PA or 36 PB | 10017.80 |
| 40 AF belt-drive plenum | Class I or II | 40 PA or 40 PB | 13,023.10 |
| 44 AF belt-drive plenum | Class I or II | 44 PA or 44 PB | 14,692.80 |
| 49 AF belt-drive plenum | Class I or II | 49 PA or 49 PB | 18,299.20 |
| 55 AF belt-drive plenum | Class I or II | 55 PA or 55 PB | 23,901.00 |
| 63 AF belt-drive plenum | Class I or II | 63 PA or 63 PB | 31,135.00 |
| 10.50 AF direct-drive plenum | Class II | 10 NF or 10 NW | 630.00 |
| 12 AF direct-drive plenum | Class II | 12 NR or NF | 839.00 |
| 13.50 AF direct-drive plenum | Class II | 13 NR or 13 NF | 952.00 |
| 15 AF direct-drive plenum | Class II | 15 NR or 15 NF | 1139.00 |
| 16 AF direct-drive plenum | Class II | 16 NR or NF | 1361.00 |
| 18 AF direct-drive plenum | Class II | 18 NR or 18 NF | 1673.00 |
| 20 AF direct-drive plenum | Class II | 20 NR or 20 NF | 1942.00 |
| 22 AF direct-drive plenum | Class II | 22 NR, 22 NF, or 22 NW | 2454.00 |
| 24 AF direct-drive plenum | Class II | 24 NR, 24 NF, or 24 NW | 3010.00 |
| 27 AF direct-drive plenum | Class II | 27 NR or 27 NF | 3701.00 |
| 30 AF direct-drive plenum | Class II | 30 NR or 30 NF | 4620.00 |
| 22 AF stacked direct-drive plenum | Class II | 22 SF or 22 SW | 2849.00 |
| 24.50 AF stacked direct-drive plenum | Class II | 24 SF or 24 SW | 4765.00 |

**Note:** (1) to be used for fan rpm < 700 or cfm < 25,500. (2) to be used for fan rpm > 700 or cfm > 25,500

When a single transmitter is supplied in a multiple fan system, one or more fans will be brought back to the transmitter as a manifold and the airflow will represent the total airflow for the system. As a result, the factor should be adjusted as follows:

K = N * K-Factor from Table 51

Where:

K = The final factor to be used for controller programming.

N = The number of active* fans in the system.

*If a fan fails in a multiple fan system where only one transmitter is being supplied, and if the remaining fans will continue to be used, the factor should be reduced accordingly. Additionally, if the inactive fan was included in the manifold back to the transmitter, the tubes from the inactive fan should be temporarily removed and replaced with tubes from an active fan (or simply plugged).

When a transmitter is supplied for each fan, the factor does not need to be adjusted. The resulting airflow will represent single-fan airflow. At the controller level, the individual airflows should be summed to get the total airflow. If a field-provided K-factor is to be used (see below), the measured airflow for the system should be

divided by the number of active fans to get a single-fan K-factor.

Field-obtained factors can provide maximum accuracy. To obtain the factor in the field, measure the differential pressure output from the transmitter while measuring the airflow through the system. Once these two values have been measured, simply solve for K using the following equation:

K = ACFM/SQRT(DP)
Where:
K = Field-provided constant factor.
ACFM = Actual airflow ($ft^3$/min.) being measured at the air density being measured.
DP = Differential pressure (inches w.g.) being measured by the transmitter.

### Maintenance

For a typical HVAC environment - especially with upstream filtration - there should be little to no required maintenance. In extreme cases or for mishaps (bearing grease in the taps for example), the flow meter is easily cleanable. The fan inlet airflow measuring system is extremely simple: a few pressure taps, a few fittings, and some tubing. Although unlikely, if any tap were to get clogged, simply disconnect each side of the transmitter and blast air in a reverse direction through the system.

## Energy Wheel Startup

**⚠WARNING**

**Toxic Hazards with Exhaust Air!**

**Do not use an energy wheel in an application where the exhaust air is contaminated with harmful toxins or biohazards. Using an energy wheel could displace vast quantity of contaminated air which could result in asphyxiation and poisoning. Failure to follow this instruction could result in death or serious injury.**

**⚠WARNING**

**Hazardous Voltage w/Capacitors!**

**Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Verify with an appropriate voltmeter that all capacitors have discharged. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.**

*For additional information regarding the safe discharge of capacitors, see PROD-SVB06A-EN*

**NOTICE:**

**Equipment Damage!**

**Exceeding the recommended airflow can result in damage to equipment. Trane is not responsible for equipment damage resulting from exceeding recommendations.**

Do not exceed the maximum rated airflow for the wheel. The pressure drop across the wheel is not to exceed 1.25 inches w.g.

1. Set diameter seals. See “Seal Adjustment” on page 144.
2. Turn the energy wheel clockwise (as viewed from the pulley side) by hand to verify that the wheel turns freely through its full rotation.
3. Confirm that all wheel segments are fully engaged in the wheel frame and that segment retainers are completely fastened (see Figure 144).
4. With hands and objects away from moving parts, activate the wheel and confirm the wheel rotation. The correct rotation direction is clockwise as viewed from the pulley side.
5. Start and stop the wheel several times to confirm seal adjustment and proper belt tracking on the wheel rim. The correct belt tracking is approximately a quarter inch from the outer edge of the rim (see Figure 145).
6. If the wheel has difficulty starting, turn off the power and inspect for excessive interference between the wheel surface and the four diameter seals. To correct, loosen the diameter seal adjusting screws and back the diameter seals away from the surface of the wheel. Apply power to confirm that the wheel rotates freely. Readjust and tighten the seals according to instructions in “Seal Adjustment” on page 144.
7. Damper actuators (if so equipped): Stroke the actuators to observe full open and full closure of dampers. Adjust the actuator and/or linkage to prevent “over-stroking” so excessive pressure is not placed on the damper at the full open or full closed position.

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**Figure 144. Completely fasten segment retainers**

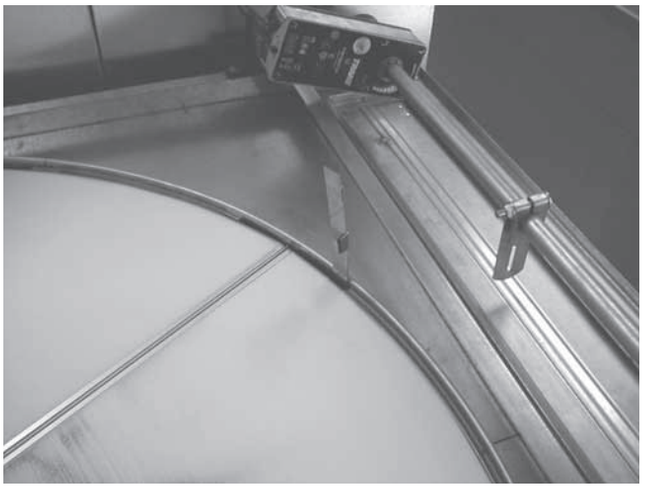


**Figure 145. Confirm proper belt tracking on the wheel rim**

# External Insulating Requirements

The following areas should be specifically addressed, as applicable:

- Supply and return water piping connections
- Supply and return refrigerant piping connections
- Condensate drain lines and connections
- Outdoor-air-intake duct connections
- Discharge duct connections
- Special requirements for low-temperature-air systems

# Routine Maintenance

**⚠WARNING**

**Hazardous Service Procedures!**

**The maintenance and troubleshooting procedures recommended in this manual could result in exposure to electrical, mechanical or other potential safety hazards. Always refer to the safety warnings provided throughout this manual concerning these procedures. Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks. Failure to follow all of the recommended safety warnings provided, could result in death or serious injury.**

**⚠WARNING**

**Rotating Components!**

**The following procedure involves working with rotating components. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Secure rotor to ensure rotor cannot freewheel. Failure to secure rotor or disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.**

## Maintenance Checklist

**Table 52. Maintenance Checklist**

| Frequency | Maintenance |
|---|---|
| **After 48 hours of operation** | For belt-drive fans, the belts have acquired their permanent set. Readjust but do not overtighten. See “Tension the Fan Belt,” p. 121 for more information. |
| **Every week** | Observe unit weekly for any change in running condition and unusual noise. |
| **Every month** | • Clean or replace air filters if clogged or dirty; coat permanent filters with oil after cleaning; change bag filters when pressure drop is 1 in. wg. See “Air Filters” on page 134 for more information.<br>• Belt-drive fans - relubricate fan bearings if necessary. See “Fan Bearing Lubrication” on page 147 for more information.<br>Belt-drive fans - check and adjust fan belt tension.See “Tension the Fan Belt,” p. 121 for more information. |
| **Every three to six months** | • Belt-drive fans - check fan bearing grease line connections. Lines should be tight to the bearings.<br>• Check motor bracket torque. See Table 53, p. 147 for torque requirements.<br>• Belt-drive fans - check bearing bolt torque and bearing setscrew torque. See Table 53, p. 147 for torque requirements.<br>• Belt-drive fans - align fan and motor sheaves. Tighten sheave set screws to the proper torque. See “Align Fan and Motor Sheaves,” p. 123 for more information.<br>• Inspect and clean drain pans. See “Coils” on page 134 for more information.<br>• Tighten electrical connections.<br>• Inspect coils for dirt build-up. See “Coils” on page 134 for more information. |
| **Every year** | • Inspect the unit casing for corrosion. If damage is found, clean and repaint.<br>• Clean the fan wheels and shaft. See “Coils” on page 134 for more information.<br>• Inspect and clean drain pans.<br>• Check damper linkages, set screws, and blade adjustment. Clean, but do not lubricate, the nylon damper rod bushings.<br>• Clean damper operators.<br>• Inspect electrical components and insulation.<br>• Inspect wiring for damage.<br>• Rotate the fan wheel and check for obstructions. The wheel should not rub. Adjust the center if necessary.<br>• Lubricate motor bearings in accordance with motor manufacturer’s recommendations (see “Motor Bearing Lubrication” on page 147 for more information).<br>• Check condition of gasketing and insulation around unit, door and dampers.<br>• Examine flex connections for cracks or leaks. Repair or replace damaged material. |

# Air Filters

**⚠WARNING**

**Rotating Components!**

**The following procedure involves working with rotating components. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Secure rotor to ensure rotor cannot freewheel. Failure to secure rotor or disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.**

## Throwaway Filters

To replace throwaway filters, install new filters with the directional arrows pointing in the direction of airflow.

*Note: Bag and cartridge filters must have an airtight seal to prevent air bypass. If using filters not supplied by Trane, apply foam gasketing to the vertical edges of the filter.*

## Permanent Filters

To clean permanent filters:

1. Disconnect all electrical power to the unit.
2. Wash the filter under a stream of water to remove dirt and lint.
3. Remove oil from the filter with a wash of mild alkali solution.
4. Rinse the filter in clean, hot water and allow to dry.
5. Coat both sides of the filter by immersing or spraying it with Air Maze Filter Kote W or an equivalent.
6. Allow to drain and dry for about 12 hours.
7. Reinstall the filter.

*Note: It may be preferable to keep extra, clean filters to replace the dirty filters to minimize unit downtime for filter maintenance.*

## Cartridge or Bag Filters

To replace cartridge or bag filters:

1. Disconnect all electrical power to the unit.
2. Remove the dirty filters from their installed position.
3. Keeping the new bag filters folded, slide each filter into the filter rack, pushing them tightly against the unit.

*Note: The pleats should be in the vertical position.*

4. If using the optional pre-filters, replace them on the appropriate filter rack.
5. Close and secure the access door.

# Coils

All coils should be kept clean to maintain maximum performance.

## Steam and Water Coils

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

**⚠WARNING**

**Hazardous Chemicals!**

**Coil cleaning agents can be either acidic or highly alkaline and can burn severely if contact with skin occurs. Handle chemical carefully and avoid contact with skin. ALWAYS wear Personal Protective Equipment (PPE) including goggles or face shield, chemical resistant gloves, boots, apron or suit as required. For personal safety refer to the cleaning agent manufacturer's Materials Safety Data Sheet and follow all recommended safe handling practices. Failure to follow all safety instructions could result in death or serious injury.**

To clean steam and water coils:

1. Disconnect all electrical power to the unit.
2. Wearing the appropriate personal protective equipment, use a soft brush to remove loose debris from both sides of the coil.
3. Install a block-off to prevent spray from going through the coil and into a dry section of the unit and/or system ductwork.
4. Mix a high-quality coil cleaning detergent with water according to the manufacturer's instructions.

*Note: If the detergent is strongly alkaline after mixing (PH 8.5 or higher), it must contain an inhibitor. Follow the cleaning solution manufacturer's instructions regarding the use of the product.*

5. Place the mixed solution in a garden pump-up sprayer or high-pressure sprayer. If a high pressure sprayer is to be used:
   - Maintain minimum nozzle spray angle of 15 degrees.
   - Spray perpendicular to the coil face.
   - Keep the nozzle at least 6 inches from the coil.
   - Do *not* exceed 600 psi.

6. Spray the leaving air side of the coil first, then the entering air side.
7. Thoroughly rinse both sides of the coil and the drain pan with cool, clean water.
8. Repeat steps 6 and 7 as necessary.
9. Straighten any coil fins that may have been damaged during the cleaning process.
10. Confirm the drain line is open following the cleaning process.
11. Allow the unit to dry thoroughly before putting it back into service.
12. Replace all panels and parts and restore electrical power to the unit.
13. Be careful any contaminated material does not contact other areas of the unit or building. Properly dispose of all contaminated materials.

## Refrigerant Coils

**⚠WARNING**

**Hazardous Pressures!**

**Coils contain refrigerant under pressure. When cleaning coils, maintain coil cleaning solution temperature under 150°F to avoid excessive pressure in the coil. Failure to follow these safety precautions could result in coil bursting, which could result in death or serious injury.**

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

**⚠WARNING**

**Hazardous Chemicals!**

**Coil cleaning agents can be either acidic or highly alkaline and can burn severely if contact with skin occurs. Handle chemical carefully and avoid contact with skin. ALWAYS wear Personal Protective Equipment (PPE) including goggles or face shield, chemical resistant gloves, boots, apron or suit as required. For personal safety refer to the cleaning agent manufacturer's Materials Safety Data Sheet and follow all recommended safe handling practices. Failure to follow all safety instructions could result in death or serious injury.**

To clean refrigerant coils:

1. Disconnect all electrical power to the unit.
2. Wearing the appropriate personal protective equipment, use a soft brush to remove loose debris from both sides of the coil.
3. Install a block-off to prevent spray from going through the coil and into a dry section of the unit and/or system ductwork.
4. Mix a high-quality coil cleaning detergent with water according to the manufacturer's instructions.

*Note: If the detergent is strongly alkaline after mixing (PH 8.5 or higher), it must contain an inhibitor. Follow the cleaning solution manufacturer's instructions regarding the use of the product.*

5. Place the mixed solution in a garden pump-up sprayer or high-pressure sprayer. If a high pressure sprayer is to be used:
   - Maintain minimum nozzle spray angle of 15 degrees.
   - Spray perpendicular to the coil face.
   - Keep the nozzle at least 6 inches from the coil.
   - Do *not* exceed 600 psi.
6. Spray the leaving air side of the coil first, then the entering air side.
7. Thoroughly rinse both sides of the coil and the drain pan with cool, clean water.
8. Repeat steps 6 and 7 as necessary.
9. Straighten any coil fins damaged during the cleaning process.
10. Confirm the drain line is open following the cleaning process.
11. Allow the unit to dry thoroughly before putting it back into service.
12. Replace all panels and parts and restore electrical power to the unit.
13. Be careful any contaminated material does not contact other areas of the unit or building. Properly dispose of all contaminated materials and cleaning solution.

## Coil Winterization

Water coil winterization procedures consist primarily of draining water from the coil before the heating season. Trane recommends flushing the coil with glycol if coils will be exposed to temperatures below 35 degrees.

**NOTICE:**

**Coil Freeze-up!**

**Drain and vent coils when not in use. Trane recommends glycol protection in all possible freezing applications. Use a glycol approved for use with commercial cooling and heating systems and copper tube coils. Failure to do so could result in equipment damage.**

Install field-fitted drains and vents to permit winterization of coils not in use and to assist in evacuating air from the water system during startup. If draining is questionable because of dirt or scale deposits inside the coil, fill the coil with glycol before the heating season begins.

Individual coil types determine how to properly winterize the coil. To determine the coil type find the "Service Model No of Coil" on the coil section nameplate. The coil type is designated by the second and third digits on that model number. For example, if the model number begins with "DUWB," the coil type is UW; if the model number begins with "DW0B," the coil type is W.

*Note: On many unit sizes, there are multiple coils in the coil section. Be sure to winterize all coils in a given coil section.*

To winterize type D1, D2, WL, LL, UA, UW, UU, W, P2, P4, P8, WD, 5D, and 5W coils:

1. Remove the vent and drain plugs.
2. Blow the coil out as completely as possible with compressed air.
3. Fill and drain the coil several times with full strength glycol so that it mixes thoroughly with the water retained in the coil.
4. Drain the coil out as completely as possible.
5. To ensure no water remains in the coil, do not replace the vent and drain plugs until the coils are put back into service.

*Note: Use care in removing header plugs from Type P2, P4, and P8 coils. Over-torquing may result in twisted tubes.*

## Moisture Purge Cycle

By it's very nature, any HVAC unit with a cooling coil serves as a dehumidifier, reducing the surrounding air's ability to hold water vapor as its temperature falls. This normally doesn't present a problem when the unit is running. However, when the fan stops, water vapor condenses on the cold metal surfaces inside the air handler and remains there until the air warms sufficiently to re-evaporate it. This damp, dark environment—though temporary—can encourage the growth of mold, mildew, and other microbial contaminants.

Providing a moisture purge cycle 15 to 30 minutes after shutdown disperses the cold, humid air inside the air-handling system more evenly throughout the building. This four-step cycle:

- Closes the outdoor air dampers.
- Turns off the cooling coil.
- Opens any variable-air-volume terminals connected to the air handler.
- Operates the supply fan for 10 to 15 minutes.

Air movement discourages water condensation and hastens re-evaporation of any condensate that does happen to form. This simple preventative measure effectively combats microbial growth and curbs moisture-related deterioration of air-handling components.

## Cleaning Non-Porous Surfaces

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

If microbial growth on a non-porous insulating surface (closed cell insulation or sheet metal surface) is observed:

1. Disconnect all electrical power to the unit.
2. Wearing the appropriate personal protective equipment, use a brush for sheet metal surfaces or a soft sponge on a foil face or closed cell foam surface to mechanically remove the microbial growth.

*Note: Be careful not to damage the non-porous surface of the insulation.*

3. Install a block-off to prevent spray from going into a dry section of the unit and/or system ductwork.
4. Thoroughly clean the contaminated area(s) with an EPA-approved sanitizer specifically designed for HVAC use.
5. Rinse the affected surfaces thoroughly with fresh water and a fresh sponge to prevent potential corrosion of the drain pan and drain line

6. Repeat steps 4 and 5 as necessary.
7. Confirm the drain line is open following the cleaning process.
8. Allow the unit to dry thoroughly before putting it back into service.
9. Replace all panels and parts and restore electrical power to the unit.
10. Be careful any contaminated material does not contact other areas of the unit or building. Properly dispose of all contaminated materials and cleaning solution.

### Cleaning Porous Surfaces

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

To clean a porous insulating surface (fiberglass insulation):

1. Disconnect all electrical power to the unit.
2. Wearing the appropriate personal protective equipment, use a vacuum device with a HEPA filter (99.97 percent efficient at 0.3 micron particles) to remove the accumulated dirt and organic matter.

*Note: Be careful not to tear the insulation surface or edges.*

3. Confirm the drain line is open following the cleaning process.
4. Allow the unit to dry thoroughly before putting it back into service.
5. Replace all panels and parts and restore electrical power to the unit.
6. Be careful any contaminated material does not contact other areas of the unit or building. Properly dispose of all contaminated materials and cleaning solution.

## Drain Pans

**⚠WARNING**

**Hazardous Chemicals!**

**Coil cleaning agents can be either acidic or highly alkaline and can burn severely if contact with skin occurs. Handle chemical carefully and avoid contact with skin. ALWAYS wear Personal Protective Equipment (PPE) including goggles or face shield, chemical resistant gloves, boots, apron or suit as required. For personal safety refer to the cleaning agent manufacturer's Materials Safety Data Sheet and follow all recommended safe handling practices. Failure to follow all safety instructions could result in death or serious injury.**

**⚠WARNING**

**No Step Surface!**

**Do not walk on the sheet metal drain pan. Walking on the drain pan could cause the supporting metal to collapse, resulting in the operator/technician to fall. Failure to follow this recommendation could result in death or serious injury.**

The condensate drain pan and drain line must be checked to assure the condensate drains as designed. This inspection should occur a minimum of every six months or more often as dictated by operating experience.

If evidence of standing water or condensate overflow exists, identify and remedy the cause immediately. Refer to "Troubleshooting" on page 149 for possible causes and solutions.

To clean drain pans:

1. Disconnect all electrical power to the unit.
2. Wearing the appropriate personal protective equipment, remove any standing water.
3. Scrape solid matter off of the drain pan.
4. Vacuum the drain pan with a vacuum device that uses high-efficiency particulate arrestance (HEPA) filters with a minimum efficiency of 99.97 percent at 0.3 micron particle size.
5. Thoroughly clean any contaminated area(s) with a mild bleach and water solution or an EPA-approved sanitizer specifically designed for HVAC use.
6. Immediately rinse the affected surfaces thoroughly with fresh water and a fresh sponge to prevent potential corrosion of metal surfaces.
7. Allow the unit to dry completely before putting it back into service.

8. Be careful any contaminated material does not contact other areas of the unit or building. Properly dispose of all contaminated materials and cleaning solution.

# CDQ Desiccant Wheels

Please reference CDQ-SVX01A-EN Installation Operation Maintenance manual for instructions.

# Energy Wheels

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

***NOTICE:***

**Equipment Damage!**

**Do not use acid based cleaners, aromatic solvents, steam or temperatures in excess of 170°F to prevent damage to internal components. Trane assumes no responsibility for equipment damage caused by cleaning solutions or steam.**

### Cleaning Frequency

In reasonably clean office or school buildings, cleaning with coil cleaner solution may not be required for several years. If the energy wheel is exposed to air streams containing, for example, high levels of occupant tobacco smoke, cooking facility exhaust air, or oil-based aerosols found in machine shop areas, annual cleaning may be required to remove these contaminants and restore performance.

### Segment Removal (for wheel cfm 900-15,000)

For unit sizes 3 to 8, the energy wheel module is equipped with only *one* access panel and the entire energy wheel cassette slides out through the door for maintenance. For unit sizes 10 to 50, the energy wheel module is equipped with *four* access doors and the wheel segments are removable. Wheel segments are secured to the wheel frame by a segment retainer, which pivots on the wheel rim and is held in place by a segment retaining catch.

1. Disconnect all electrical power.
2. Unlock the two segment retainer brackets, one on each side of the selected segment opening (see Figure 146).

***NOTICE:***

**Reduced Airflow!**

**Accumulated dirt and debris may result in reduced airflow and/or increased pressure drop across the energy wheel. Increased pressure drop can result in permanent damage to the energy wheel. Trane is not responsible for equipment-only-damage caused by debris.**

### Cleaning the Energy Wheel

Disconnect all electrical power, then use a vacuum or brush to remove accumulated material from the face of the wheel. Examine the energy wheel monthly for material build-up on the wheel.

If more aggressive cleaning is needed, segment removal may be required.

1. Wash the segments or the wheel in a five-percent solution of non-acid-base coil cleaner (part no. CHM00021 at your local Trane parts center) or in a alkaline detergent and warm water.
2. Soak the segments in the solution until grease, oil, and tar deposits are loosened.
3. Before removing the cleaner, rapidly run your fingers across the surface of the segments to separate the polymer strips for better cleaning actions.
4. Rinse the dirty solution from the segments and remove excess water before re-installing the segments in the wheel. Note that some permanent staining of the desiccant may remain but is not harmful to performance.

High maintenance applications like these may benefit from keeping a spare set of clean segments on hand. This allows for rapid change-out of clean segments with minimal downtime. The dirty segments can then be cleaned at a convenient time.

### Segment Removal/Replacement

3. Remove the segment from the wheel frame. It may be necessary to *gently* pry the segment out of the wheel with a screwdriver.
4. Pull the segment up and out of the wheel frame (see Figure 147).
5. Close any open segment retainers prior to rotating the wheel. Failure to close any retainer may damage the retainer, seals, or segments.
6. Slowly rotate the wheel by hand 180 degrees and repeat the process to remove the second segment.
7. Rotate the wheel 90 degrees by hand and remove the third segment.

8. Rotate the wheel 180 degrees by hand and remove the fourth segment. Rotating the wheel in this manner keeps the wheel balanced while removing the segments.
9. Continue this procedure to remove all the segments.

## Segment Replacement (for wheel cfm 900-15,000)

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

1. Disconnect all electrical power.
2. Unlock the two segment retainers, one for each side of the selected segment opening (see Figure 146).
3. With the embedded stiffener facing the motor side, insert the nose of the segment between the hub plates (see Figure 148).
4. Holding the segment by the two outer corners, press the segment toward the center of the wheel and inward against the spoke flanges. If hand pressure does not fully seat the segment, insert the flat tip of a screwdriver between the wheel rim and outer corners of the segment and apply downward force while guiding the segment into place.
5. Close and latch each segment retainer under the segment retaining catch.
6. Slowly rotate the wheel 180 degrees by hand. Install the second segment opposite the first for counterbalance.
7. Rotate the two installed segments 90 degrees by hand to balance the wheel while the third segment is installed.
8. Rotate the wheel 180 degrees by hand to install the fourth segment opposite the third.
9. Repeat this sequence with the remaining four segments.

Replacing the segments with a spare set can be accomplished more quickly. Remove the dirty segment, replace it with a clean segment, then move to the next segment. The 180/90/180-degree rotation procedure is not necessary.

**Figure 146. Unlock the segment retainers**

**Figure 147. Pull the segment up and out of the wheel frame to remove**

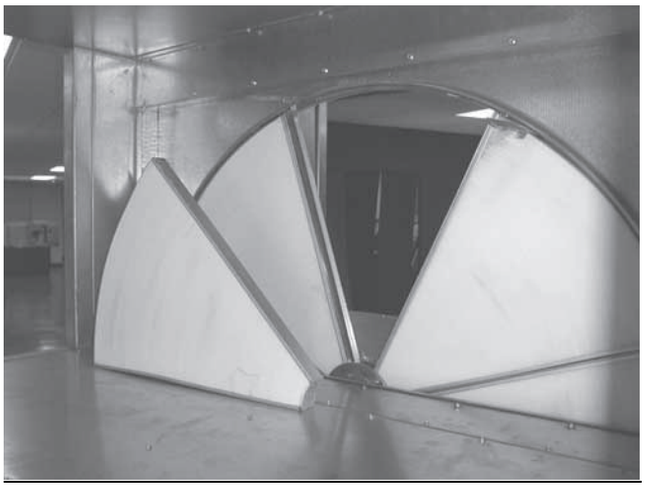


**Figure 148. Insert nose of segment between hub plates to install**

## Segment Removal (for wheel cfm 17,500 and higher)

For energy wheel applications requiring 17,500 cfm and higher, wheel segments with satellite sections are used (see Figure 149).

## Removal Procedure for Outer Segments

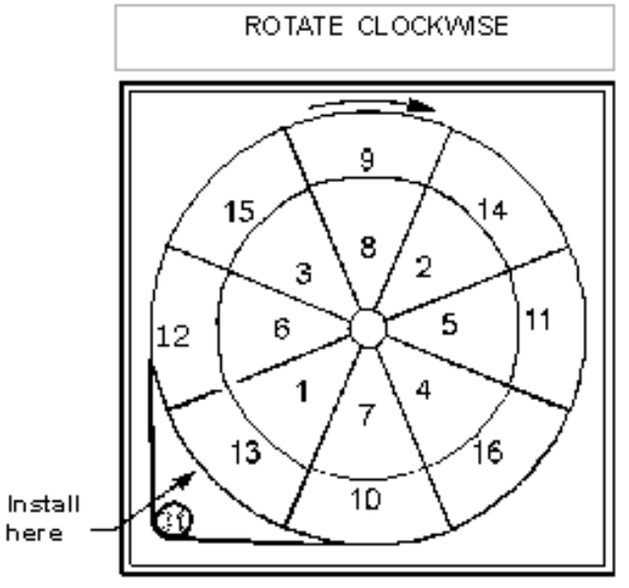
**⚠ WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

*Note: Install and remove all segments at location indicated by arrow in Figure 149.*

**Figure 149. Install and remove segments in the order shown**




1. Disconnect all electrical power.
2. Align outer segment with wheel drive pulley. Secure pulley and belt with vise grip to prevent rotation (see Figure 150).

**Figure 150. Secure pulley and belt with vise grip to prevent wheel rotation.**

## Removal Procedure for Inner Segments

Remove inner segments in the order shown in Figure 149 as follows:

1. Align inner segment with wheel drive pulley. Secure pulley and belt with vise grip to prevent rotation (see Figure 150).
2. Support segment with one hand while removing 1/4-20 flat head retaining screw in hub with 5/32 inch Allen wrench.
3. With weight of segment resting on lower spoke, carefully slide segment out from between hub plates.
4. Being careful to balance segment on lower spoke with one hand, grasp nose of segment with other hand and remove from wheel.
5. Reinsert 1/4-20 screws in segment nose bracket to avoid loss.
6. Remove vise grip. Repeat steps 1 through 5 for each segment in the order shown in Figure 149.

3. Insert flat tipped screwdriver between rim and segment retainer latch. Rotate screwdriver to release latch from under catch.
4. Rotate latch 90 degrees from rim. Remove forked segment retainers.
5. Insert screwdriver tip between corners of segment and spoke. Gently pry ends of segment part way out. Grasp one end of segment and lift straight out.
6. Remove vise grip. Repeat steps 1 through 5 for each segment in the order shown in Figure 149.

## Segment Replacement (for wheel cfm 17,500 and higher)

### Installation Procedure for Inner Segments

*Note: Note: Install and remove all segments at location indicated by arrow in Figure 149.*

1. Rotate the wheel clockwise to align the center of a spoke opening with the pulley. Secure pulley and belt with vise grip to prevent wheel rotation (see Figure 150).
2. Remove 1/4-20 flat head screw from segment nose bracket.
3. Center and rest segment on lower spoke. Slide segment on spoke until nose bracket contacts stop in hub plate. Insert screw and tighten until screw is firmly seated (see Figure 151).
4. Holding wheel to prevent rotation, remove vise grip. Rotate wheel clockwise to install segments in the order shown in Figure 149.
5. Secure pulley. Repeat steps 2 through 4 until all inner segments are installed.

### Installation Procedure for Outer Segments

1. Align segment opening with pulley. Secure pulley and belt with vise grip to prevent rotation (see Figure 150).
2. Rotate outer segment retainer latch, located at end of spokes, 90 degrees from rim and remove two forked outer segment retainers.
3. Install outer segment by starting lower end in position and pressing straight in against four corners. Sharp rap with heel of hand will assist entry when needed (see Figure 152). Note: Only reinstall segment retainer between adjacent installed segments.
4. Rotate both retainer latches to closed position to prevent interference with bearing support beam while rotating wheel by hand.
5. Repeat steps 1 through 4 in the order shown in Figure 149until all outer segments are in place. Make certain all retainer latches are latched in place under catch

.

**Figure 151. Slide segment on spoke until contacts stop in hub plate.**

**Figure 152. Install outer segment by starting lower end in position and pressing straight in**

## Cleaning the Energy Wheel Motor

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

Disconnect all electrical power, then use a vacuum cleaner and brush to remove accumulated material from the energy wheel motor. The use of spray aerosol cleaners is not recommended. Examine the motor monthly for debris accumulation.

## Cleaning the Module

1. Disconnect all electrical power.
2. Use a vacuum cleaner to remove dust and debris from the module surfaces.
3. If needed, use a detergent solution to remove grease, oil, or other stubborn deposits from module surfaces. Follow the manufacturer's instructions regarding use of the product.
4. Rinse any cleaning product thoroughly from the module walls. The use of a water stream from a garden hose or high pressure washer is *not* recommended. Saturation of the wall panel insulation with potential microbial growth or damage to the energy wheel could occur.
5. Examine the module monthly for material build-up on the wall surfaces.

## Bearing and Motor Lubrication

The wheel drive motor and wheel support shaft bearings are permanently lubricated and no further lubrication is necessary.

## Energy Wheel Drive Belt Adjustment

The drive belt is a urethane stretch belt designed to provide constant tension throughout the life of the belt. No periodic adjustment is required. Inspect the belt annually for proper tracking and tension. A properly tensioned belt will turn the wheel immediately, with no visible slippage, when power is applied.

## Bearing/Drive Belt Replacement

### For sizes 10 to 50

Bearing removal on the pulley side of the wheel is required to remove and replace the drive belt for unit sizes 10 to 50. Bearing removal is discussed first in this procedure.

1. Disconnect all electrical power.
2. Obtain access to the pulley side bearing access plate.
3. Remove the two bearing access plate retaining screws and the access plate.
4. Using a hexagonal wrench, loosen the set screw in the bearing locking collar.
5. Using a light hammer and a drift placed in the drift pin hole in the collar, tap the collar in the opposite direction of wheel rotation to unlock it.
6. Remove the collar.
7. Using a socket wrench with an extension, remove the two nuts that secure the bearing housing to the bearing support beam.
8. Slide the bearing from the shaft. Note that slight hand pressure against the wheel rim will lift the weight of wheel from the inner race of the bearing to assist in its removal and installation. The use of a bearing puller may be required.
9. Using a wrench, remove the diameter seal retaining screws or hub seal retaining screws and remove the diameter seals or hub seals from the bearing beam. See Figure 153 for an exploded view of the shaft, bearings, belt, etc.

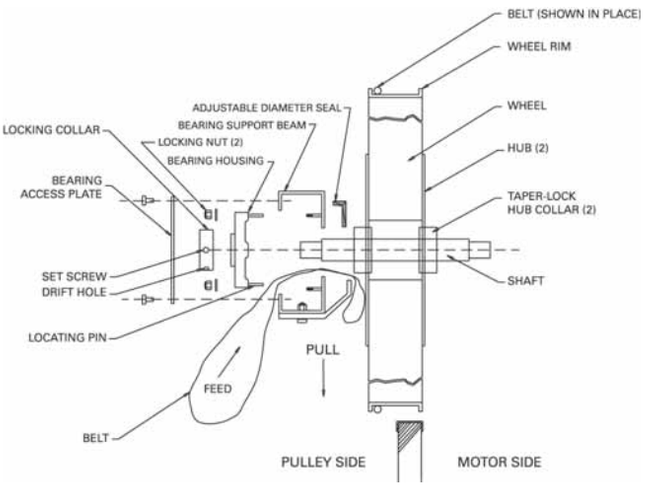
## Energy Wheel Service and Repair

**⚠CAUTION**

**Sharp Edges!**

**The service procedure described in this document involves working around sharp edges. To avoid being cut, technicians MUST put on all necessary Personal Protective Equipment (PPE), including gloves and arm guards. Failure to follow recommendations could result in minor to moderate injury.**

**Figure 153. For belt replacement, loop the trailing end of the belt over the shaft (shown with diameter seals removed).**




10. Remove the old belt. Form a small loop of belt and pass it through the hole in the bearing support beam.
11. Grasp the belt at the wheel hub and pull the entire belt down.
12. Loop the trailing end of the belt over the shaft. Figure 153 shows the belt partially through the opening.

13. Re-install the bearing onto the wheel shaft, being careful to engage the two locating pins into the holes in the bearing support beam.
14. Secure the bearing with two self-locking nuts.
15. Install the belt around the wheel and pulley according to the instructions provided with the belt.
16. Re-install the diameter seals or hub seal and tighten the retaining screws.
17. Adjust the seals according to the procedure in "Seal Adjustment" on page 144.
18. Rotate the wheel in a clockwise direction to confirm that it rotates freely with slight drag on seals.

## For sizes 3 to 8

Bearing removal is not required on slide-out cassettes, unit sizes 3 to 8. These belts may be replaced by temporarily dismounting and rotating the pulley side bearing beam to allow the new belt to be installed on the wheel rim.

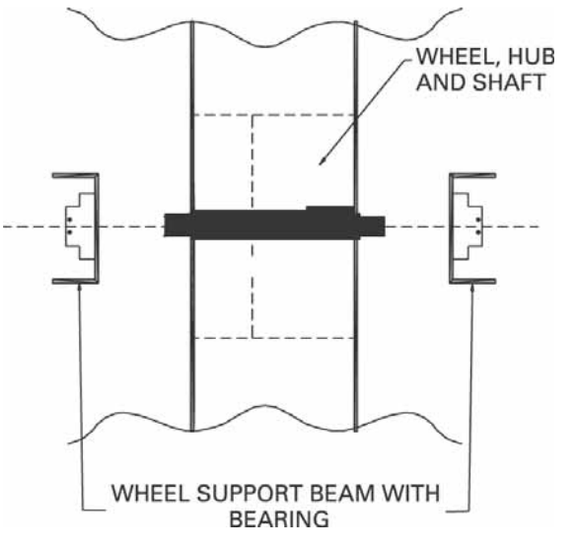
1. Disconnect electrical power to the energy wheel.
2. Remove the access panel.
3. Disconnect all controls wiring.
4. Slide the entire cassette assembly out of the module.
5. Loosen the two set screws on the wheel support beam bearings, one on each side of wheel.
6. Remove the belt from the pulley and temporarily position it around the rim.
7. Remove the pulley side wheel support beam with the bearing.
8. Pull the wheel with the shaft straight out of the motor side wheel support beam and bearing (see Figure 154). Do not disassemble the bearings from the beam unless they require replacement. Handle the wheel with care to avoid distorting the wheel

## Seal Adjustment

1. Loosen the diameter seal adjustment screws and back the seals away from the wheel surface (see Figure 155).
19. Re-install the bearing locking collar.
20. Rotate the collar by hand in the direction of wheel rotation.
21. Lock the collar in position by tapping the drift pin hole with a hammer and drift.
22. Secure the collar in position by tightening the set screw.
23. Re-install the bearing access cover.
24. Apply power to the wheel and ensure that the wheel rotates freely without interference.

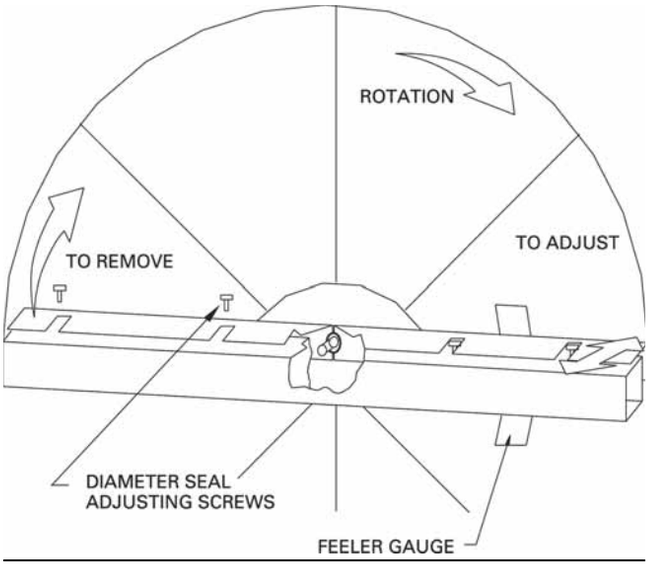
.

**Figure 154. Unit sizes 3 to 8 bearing assembly**




9. Reverse the removal procedure to re-install. Check to ensure that the wheel remains in the center of the seal plate opening.

**Figure 155. To adjust seal, loosen screws, back seals away from wheel surface. Seal seen from bottom section.**




1. Rotate the wheel clockwise until two opposing spokes are hidden behind the bearing support beam.
2. Using a folded piece of paper as a feeler gauge, position the paper between the wheel surface and the diameter seals.
3. Adjust the seals toward the wheel surface until slight friction on the paper feeler gauge is felt when the gauge is moved along the length of the spoke.
4. Check the adjustment through a full rotation of the wheel.
5. Retighten the adjusting screws and recheck the clearance with the paper feeler gauge.

### Drive Motor and Pulley Replacement

**⚠WARNING**

**Hazardous Voltage!**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.**

1. Disconnect all electrical power.
2. Remove the belt from the pulley and temporarily position it around the wheel rim.
3. Measure and record the distance from the inner edge of the pulley to the mounting wall.
4. Loosen the set screw in the wheel drive pulley using an Allen wrench and remove the pulley from the motor drive shaft.
5. While supporting the weight of the drive motor in one hand, loosen and remove the four mounting bolts.
6. Install a replacement motor with the hardware kit supplied.
7. Install the pulley and adjust it to the distance recorded in the previous step.
8. Tighten the set screw to the drive shaft.
9. Stretch the belt over the pulley and engage it in the groove.

## Fans

**⚠WARNING**

**Rotating Components!**

**The following procedure involves working with rotating components. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Secure rotor to ensure rotor cannot freewheel. Failure to secure rotor or disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury.**

### Inspecting and Cleaning Fans

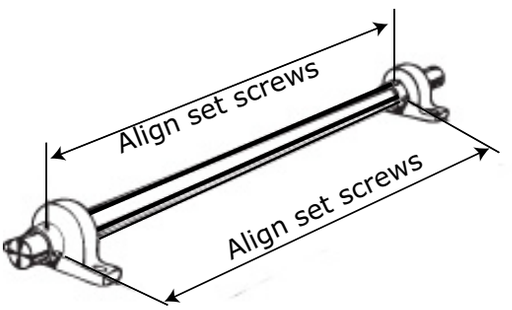
Fan sections of air handlers should be inspected every six months at a minimum or more frequently if operating experience dictates. If evidence of microbial growth (mold) is found, identify and remedy the cause immediately. Refer to “Troubleshooting” on page 149 for possible causes and solutions. To clean the fan section:

1. Disconnect all electrical power to the unit.
2. Wearing the appropriate personal protective equipment, remove any contamination.
3. Vacuum the section with a vacuum device that uses high-efficiency particulate arrestance (HEPA) filters with a minimum efficiency of 99.97 percent at 0.3 micron particle size.
4. Thoroughly clean any contaminated area(s) with a mild bleach and water solution or an EPA-approved sanitizer specifically designed for HVAC use.
5. Immediately rinse the affected surfaces thoroughly with fresh water and a fresh sponge to prevent potential corrosion of metal surfaces.
6. Allow the unit to dry completely before putting it back into service.
7. Be careful any contaminated material does not contact other areas of the unit or building. Properly dispose of all contaminated materials and cleaning solution.

### Bearing Set Screw Alignment

Align bearing set screws for belt-drive fans as illustrated in Figure 156. See Table 40 for set screw torque measurements.

**Figure 156. Alignment**



## Torque Requirements

Refer to Table 53 for minimum torque of motor mounting and bearings bolts. Refer to Table 40, p. 123 for minimum setscrew torque.

**Table 53. Minimum hex head bolt torque in lb.-ft. (Grade 5 bolts)**

| Size (inches) | Thread Designation | Minimum Torque |
|---|---|---|
| 1/4-20 | UNC | 6 |
| 1/4-28 | UNF | 7 |
| 65/16-18 | UNC | 14 |
| 5/16-24 | UNF | 16 |
| 3/8-16 | UNC | 24 |
| 3/8-24 | UNF | 28 |
| 7/16-14 | UNC | 42 |
| 7/16-20 | UNF | 45 |
| 1/2-13 | UNC | 69 |
| 1/2-20 | UNF | 83 |
| 9/16-12 | UNC | 99 |
| 9/16-18 | UNF | 118 |
| 5/8-11 | UNC | 150 |
| 5/8-18 | UNF | 176 |
| 3/4-10 | UNC | 254 |
| 3/4-16 | UNF | 301 |
| 7/8-9 | UNC | 358 |
| 7/8-14 | UNF | 422 |
| 1-8 | UNC | 500 |
| 1-14 | UNF | 602 |

**Note:** Soft metric conversions are not acceptable for screw and hex sizes.

## Fan Bearing Lubrication

**NOTICE:**

**Bearing Failure!**

**Do not mix greases with different bases within the bearing. Mixing grease within the bearing could result in premature bearing failure.**

For belt-drive fans, the grease used in electric motor bearings is usually not compatible with the grease used in fan bearings. Never mix the two grease types! See Table 54 for compatible greases and Table 55 for maximum grease capacity.

*Note: Lubricate the motor bearing according to the motor manufacturer's recommendations and use the manufacturer-recommended grease. See "Motor Bearing Lubrication" on page 147.*

**Table 54. Compatible Greases**

| Type |
|---|
| Texaco Multi Fak 2 |
| Shell Alvania 2 |
| Mobil 532 |
| Chevron Dura-Lith 2 |
| Exxon Beacon |
| Keystone 84H |

**Table 55. Fan bearing maximum grease capacity**

| Shaft size (inches) | Capacity (fluid ounce) |
|---|---|
| 1/2 - 3/4 | 1/7 |
| 7/8 - 1 3/16 | 3/8 |
| 1 1/4 - 1 1/2 | 5/8 |
| 1 11/16 - 1 15/16 | 7/8 |
| 2 - 2 7/16 | 1 1/4 |
| 2 1/2 - 2 15/16 | 2 |

- Fan bearings without lubrication lines are sealed bearings. Re-lubrication is not required.
- Fan bearings equipped with lubrication lines should be lubricated with a lithium-based grease that conforms to NLGI No. 2 for consistency.

## Motor Bearing Lubrication

Obtain an operation and maintenance manual from the motor manufacturer for the specific motor installed. The motor manufacturer's recommendations take precedence for all matters related to the start-up and routine maintenance of the motor.

Motor grease fittings have been removed from factory-installed motors in compliance with UL regulations. Motor bearings require periodic maintenance throughout their life. Many different styles of motors come as standard selections, so please obtain the motor IOM and use the manufacturer-recommended grease.

## Fan Motor Inspection

Inspect fan motors periodically for excessive vibration or temperature. Operating conditions will vary the frequency of inspection and lubrication. Motor lubrication instructions are on the motor tag or nameplate. If for some reason these instructions are not available, contact the motor manufacturer. Some motor manufacturers may not provide oil tubes on motors with permanently sealed bearings.

# Ultraviolet (UV) Light Maintenance

The intensity of the ultraviolet energy emitted from the ultraviolet bulbs is dependent on the cleanliness and age of the bulb. The surface of the bulb should be kept as clean as possible for optimum intensity. Depending on the filtration level of the HVAC system and the general hygiene of the building, periodic cleaning may be necessary. Before attempting any maintenance procedures, always follow all warnings and cautions as detailed in this maintenance section.

**⚠WARNING**

**Hazardous Voltage and Exposure to Ultraviolet Radiation!**

**This product contains components that emit high-intensity ultraviolet (UV-C) radiation which can be harmful to unprotected eyes and skin. To avoid injury, disconnect all electrical power, including remote disconnects, and make sure the UV lights are off before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to disconnect power before servicing could result in burns or electrocution which could result in death or serious injury.**

**⚠WARNING**

**Hazardous Mercury Vapors!**

**If large numbers of UV bulbs are broken, an appropriate respirator, as described in OSHA 1910.134, MUST be worn to prevent inhalation of mercury vapors. Mercury vapors are toxic and inhaling them could result in poisoning and suffocation. Failure to follow this recommendation could result in death or serious injury.**

## Cleaning the Bulbs

*Note: If bulbs are found to be broken, see the proper warning and cautions below regarding broken bulbs and hazardous vapors.*

1. Disconnect all electrical power to the unit and the ultraviolet bulbs.
2. Wearing soft cloth gloves and safety glasses, use two hands and firmly grasp the bulb at each end.
3. Rotate the bulb 90 degrees in either direction and move bulb away from the fixture and out of unit.
4. Wipe down each bulb with a clean cloth and alcohol. Avoid touching the bulb with bare hands as skin oils can accelerate future glass soiling and degrade the bulb performance.
5. Wearing soft cloth gloves and safety glasses, install lamp by grasping each non-glass end with the thumb and index fingers. Carefully push lamp ends into previously mounted lamp clamps.
6. Attach the loom to the lamp by firmly pushing the four-port connector onto the four pins on the lamp end.

*Note: Connection must be snug to avoid potential arcing.*

## Replacing the Bulbs

Ultraviolet bulbs should be replaced annually if operated continuously or after 9,000 hours of use if operated intermittently. Replacement bulbs must be the specific size and wattage as originally supplied from the factory.

*Note: Although the lights may continue to generate a characteristic blue glow beyond 9,000 operating hours, the ultraviolet radiation emitted by the bulbs degrades over time and will no longer provide the intended benefit.*

1. Disconnect power to the HVAC unit and the ultraviolet bulbs. SEE WARNING ABOVE.
2. Before installation, lamps should be cleaned using 99 percent isopropyl alcohol and a lint free cloth.

*Note: Note: If Teflon coated 'EncapsuLamp™ is used, it is not necessary to clean the surface.*

3. Wearing soft cloth gloves and safety glasses, install lamp by grasping each non-glass end with the thumb and index fingers. Carefully push lamp ends into previously mounted lamp clamps.
4. Attach the loom to the lamp by firmly pushing the four-port connector onto the four pins on the lamp end.

*Note: Connection must be snug to avoid potential arcing.*

5. If broken bulbs are found or if you are required to dispose of used bulbs, the proper warning and cautions must be followed.

**⚠CAUTION**

**Broken Glass!**

**Bulbs are fragile and can be easily broken. To avoid getting cut, always use cloth gloves and eye protection when handling, cleaning or replacing these bulbs. Bulbs may break if dropped or handled improperly. Refer to the MSDS sheet from the bulb manufacturer for additional safety information. Failure to handle bulbs properly could result in minor to moderate injury.**

## Disposal of Bulbs

UV bulbs, like fluorescent bulbs, contain mercury, which is a regulated hazardous waste. The disposal requirements for hazardous wastes are determined by local, state and federal guidelines. Check all regulations before disposing of bulbs to assure you have met all requirements.

Refer to the MSDS sheet from the bulb manufacturer for additional disposal, handling and safety information.

After replacing bulbs, close and latch all unit panels and reenergize power to the lights.

# Troubleshooting

This section is intended to be used as a diagnostic aid only. For detailed repair procedures, contact your local Trane service representative.

**⚠ WARNING**

**Hazardous Service Procedures!**

**The maintenance and troubleshooting procedures recommended in this manual could result in exposure to electrical, mechanical or other potential safety hazards. Always refer to the safety warnings provided throughout this manual concerning these procedures. Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks. Failure to follow all of the recommended safety warnings provided, could result in death or serious injury.**

**Table 56. Air handler troubleshooting recommendations**

| Symptom | Probable Cause | Recommended Action |
|---|---|---|
| Bearing is excessively hot | First start after relubrication (Grease distribution) | Allow machine to cool down and restart. |
| | Over-lubrication | Clean surface of grease and purge. |
| | Over tensioned belts | Adjust belt tension. |
| | No lubricant | Apply lubricant. Check bearings for damage. |
| | Misaligned bearing | Correct alignment. Check shaft level. |
| Motor fails to start | Blown fuse or open circuit breaker | Replace fuse or reset circuit breaker. |
| | Overload trip | Check and reset overload. |
| | Improper wiring or connections | Check wiring with diagram supplied on unit. |
| | Improper current supply | Compare actual supply power with motor nameplate recommendations. Contact power company for adjustments. |
| | Mechanical failure | Check that motor and drive rotate freely. Check bearing lubricant. |
| Motor stalls | Open phase | Check line for an open phase. |
| | Overloaded motor | Reduce load or replace with larger motor. |
| | Low line voltage | Check across AC line. Correct voltage if possible. |
| Excessive vibration | Poor alignment | Align bearing set screws (see Table 40, p. 123). Loosen and retighten bearing set screws. |
| | Shipping spacers not removed | Remove shipping spacers and/or bolts (see "Fan Isolation," page 64). |
| | Over tensioned belts | Adjust belt tension. |
| | Misaligned drive | Align drive. |
| Motor runs and then dies down | Partial loss of line voltage | Check for loose connections. Determine adequacy of main power supply. |
| | Starter shorts when motor warms up | Replace starter. |
| Motor does not come up to speed | Low voltage at motor terminals | Check across AC line and correct voltage loss if possible. |
| | Line wiring to motor too small | Replace with larger sized wiring. |
| Motor overheats | Overloaded motor | Reduce load or replace with a larger motor. |
| | Motor fan is clogged with dirt preventing proper ventilation | Remove fan cover, clean fan and replace cover. |
| Excessive motor noise | Motor mounting bolts loose | Tighten motor mounting bolts. |
| | Rigid coupling connections | Replace with flexible connections. |
| | Worn motor bearings | Replace bearings and seals. |
| | Fan rubbing on fan cover | Remove interference in motor fan housing. |
| Rapid motor bearing wear | Excessive overhung load due to overtensioned drive | Check belt tension and overhung load. |
| | Excessive overhung load due to a small diameter motor sheave | Replace sheave with larger one. |
| Loose fan belt | Motor is poorly positioned | Adjust belt tension. |
| | Worn or damaged belt | Replace belt or belt set. Check sheave alignment. |
| | Worn sheaves | Replace sheaves. |

**Table 56. Air handler troubleshooting recommendations**

| Symptom | Probable Cause | Recommended Action |
|---|---|---|
| Short belt life | Worn sheaves | Replace sheaves. |
| | Misaligned belt | Realign drive with MVP sheave set at mean pitch diameter. |
| | Grease or oil on belts | Check for leaky bearings. Clean belts and sheaves. |
| | Belt slipping | Improper belt tension. Adjust tension. |
| | Belts rubbing | Remove obstruction or realign drive for clearance. |
| Bearing noise | Poor alignment | Loosen bearing set screws and realign (see "Align Fan and Motor Sheaves," page 123) |
| | Failed bearing | Replace bearing. |
| | Inadequate lubrication | Replace bearing. |
| Low water coil capacity | Incorrect airflow | Check fan operating condition. |
| | Incorrect water flow | Inspect the water pumps and valves for proper operation and check the lines for obstructions. |
| | Incorrect water temperature | Adjust the chiller or boiler to provide the proper water temperature. |
| | Coil is piped incorrectly | Verify coil piping (see "Piping and Connections," page 93). |
| | Dirty fin surface | Clean the fin surface (see the "Coils" section on page 134). |
| | Incorrect glycol mixture | Verify glycol mixture and adjust if necessary. |
| Low refrigerant coil capacity | Incorrect airflow | Check fan operating condition. |
| | Expansion valve is not operating properly or is sized incorrectly | Check sensing bulb temperature.<br>Verify valve operation.<br>Verify proper valve size. |
| | Incorrect refrigerant charge | Verify refrigerant charge and adjust if necessary. |
| | Condensing unit failure | Verify condensing unit operation. |
| | Coil is piped incorrectly | Verify coil piping (see "Piping and Connections," page 93.) |
| | Clogged refrigerant line filter | Change filter core. |
| | Failure of suction/liquid line components | Verify component operation |
| | Dirty fin surface | Clean the fin surface (see the "Coils" section on page 134).<br>Do not use steam to clean refrigerant coils. |
| | Fin frosting | Verify defrost cycle operation.<br>Verify frostat operation.<br>Verify refrigerant charge. |
| Low steam coil capacity | Incorrect airflow | Check fan operating condition. |
| | Coil is piped incorrectly | Verify coil piping (see "Piping and Connections," page 93). |
| | Incorrect steam pressure | Verify steam pressure and adjust if necessary. |
| | Excessive steam superheat | Check steam superheat.<br>Steam superheat should not exceed 50ºF. |
| | Failure of steam line/condensate return components | Verify component operation |
| | Boiler failure | Verify boiler operation |
| | Dirty fin surface | Clean the fin surface (see the "Coils" section on page 134). |
| Drain pan is overflowing | Plugged Drain Line | Clean drain line |
| | Unit not level | Level unit |
| | Improper trap design | Design trap per unit installation instructions |
| Standing water in drain pan | Improper trap design | Design trap per unit installation instructions |
| | Unit not level | Level unit |
| | Plugged drain line | Clean drain line |
| Wet interior | Coil face velocity too high | Reduce fan speed |
| | Improper trap design | Design trap per unit installation instructions |
| | Drain pan leaks/overflows | Repair leaks |
| | Condensation on surfaces | Insulate surfaces |
| Excess dirt in unit | Missing filters | Replace filters |
| | Filter bypass | Reduce filter bypass by ensuring all blockoffs are in place. |
| Microbial growth (mold) inside air handler | Standing water in drain pan | See "Standing water in drain pan" above |

**Table 56. Air handler troubleshooting recommendations**

| Symptom | Probable Cause | Recommended Action |
|---|---|---|
| Energy wheel will not rotate | Motor is not running | The fuse or circuit breaker may be blown or open. Check the breaker/fuse box and replace. |
| | | There may be a loss of incoming power. Attempt to trace the power loss back to its source and correct. |
| | | The motor may have failed. Check for power at the motor terminals. If present, disconnect the belt from the motor pulley and see if the motor runs without a load. If it still doesn't run, replace the motor. |
| | | The motor may have failed because it is connected to a variable frequency drive. Disconnect the VFD and run the motor on 60 Hz power only. |
| | Excessive friction at the seals | Re-adjust the diameter seals. See "Seal Adjustment" on page 144. |
| | Energy wheel frame or spokes are bent or warped | Inspect the wheel, locate the bent section, and straighten the section or replace the frame. |
| | During winter operation, excessive frost/ice forms in the heat transfer media | Disconnect power to the wheel motor, adjust outside air dampers shut and let the wheel thaw. After the initial section thaws, rotate the wheel 90 degrees by hand until the "new" section rotates into the warm exhaust air stream. Continue this procedure until the wheel is completely thawed. |
| | Drive belt is broken | Inspect visually. Replace the drive belt. |
| | Wheel main shaft bearing is seized | Replace the seized bearing. |
| Loss of energy wheel capacity | Wheel is not rotating | See above |
| | Wheel is rotating too slowly | Belt is stretched, slipping. Replace the belt. |
| | | Ice forms on the wheel; thaw per above. |
| | | Seized bearing on the main shaft; replace the bearing. |
| | | Excessive friction in seals; adjust. |
| | Energy transfer surface is contaminated | Clean the energy transfer surfaces. Consider purchasing a second set of energy transfer segments for continuous operation while cleaning. |
| | | Replace the energy transfer segments if they are severely contaminated and cannot be cleaned. Consider adding a contaminate filter before (upstream) the energy wheel. |
| | Frost/ice forms on heat transfer surfaces | Thaw the wheel surfaces per procedure above. Consider adding outside air preheat. |
| Worn diameter seals in energy wheel | Maximum wheel pressure drop exceeded | Adjust wheel airflow so that the pressure drop across the wheel is less than 1.25 inches wg. |
| | Seal adjusted too tight | Adjust seals. See "Seal Adjustment" on page 144. |
| UV light fails | Ballast fails to energize light. | Disconnect high voltage leads (green, white, and black connectors) from the ballast enclosure. Wait for three minutes, this will reset the end-of-light circuitry and then reconnect. |
| | End of life. | Replace bulb. See "Replacing the Bulbs" on page 148. |

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Honeywell

# T775A/B/M Series 2000 Electronic Stand-Alone Controllers

**INSTALLATION INSTRUCTIONS**

## PRODUCT DESCRIPTION

The T775 electronic stand-alone controllers are the next generation of commercial and agricultural controls capable of remote sensing of temperature and providing switched and/or proportional outputs to various types of loads.

Five models have analog (modulating) outputs for actuator and motor control, and NEMA-4 weatherproof enclosures are available for wet environments.

***IMPORTANT***

*Each T775A/B/M controller is an operating control, not a limit or safety control. If used in applications requiring safety or limit controls, a separate safety or limit control device is required.*

**Table 1. T775A/B/M Controller Configurations.**

| Controller Model[a] | Description | Replaces | SPDT Relay Outputs | Analog (Mod) Outputs[b] | Floating Outputs[c] | Sensor Inputs | Nbr of Sensors Included | Enclosure |
|---|---|---|---|---|---|---|---|---|
| T775A2009 | Standard | T775A1001 | 1 | None | None | 1 | 1 | NEMA 1 |
| T775B2016 | Standard | N/A | 2 | None | 1 | 2 | 1 | NEMA 4X |
| T775B2024 | Standard | T775C1009 T775D1008 | 4 | None | 2 | 2 | 1 | NEMA 4X |
| T775B2032 | Standard | T775A1019 T775B1000 | 2 | None | 1 | 2 | 1 | NEMA 1 |
| T775B2040 | Standard | T775A1027 T775A1035 T775B1018 T775B1026 T775B1042 | 4 | None | 2 | 2 | 1 | NEMA 1 |
| T775M2006 | Modulating | N/A | None | 2 | N/A | 2 | 1 | NEMA 1 |
| T775M2014 | Modulating | T775G1005 T775G1013 T775G1021 T775G1039 | 4 | 2 | N/A | 2[d] | 1 | NEMA 4X |
| T775M2022 | Modulating | N/A | 2 | 2 | N/A | 2[d] | 1 | NEMA 4X |
| T775M2030 | Modulating | T775E1114 T775F1022 T775F1055 T775F1089 | 4 | 2 | N/A | 2[d] | 1 | NEMA 1 |
| T775M2048 | Modulating | T775E1015 T775E1023 T775E1056 T775E1064 T775E1098 | 2 | 2 | N/A | 2[d] | 1 | NEMA 1 |

[a] All models include a digital input for use with the disable or setback option.

[b] The modulating (analog) outputs are 4-20 mA, 0-10 Vdc, 2-10 Vdc, or Series 90 selectable.

[c] Each floating output eliminates two SPDT relays.

[d] These models can support a high/low modulating limit at Sensor B for temperature control at Sensor A.

62-0254-13

## Temperature Sensors[a]

The controller accepts 1,097 Ohms PTC at 77°F (25°C):

- 50021579-001 – Standard sensor (included with all models except NEMA 4X models)
- T775-SENS-STRAP– Strap on sensor with wiring box
- T775-SENS-WR – Water resistant with 5 foot leads (included with NEMA 4X models)
- T775-SENS-WT – Watertight with 6 foot lead
- T775-SENS-OAT – Outdoor air temperature sensor
- C7031B2005 – 6 inch duct mount with wiring box
- C7031D2003 – 5 inch immersion sensor with wiring box (use immersion well; P/N 50001774-001)
- C7031J2009 – 12 foot duct averaging sensor with wiring box
- C7046D1008 – 8 inch duct probe with mounting flange
- C7100D1001 – 12 inch fast response, duct averaging sensor with flange
- C7130B1009 – Room mount sensor

[a] See form 62-0265 - *Temperature Sensors for the T775 Series 2000 Stand-alone Controller*

## Accessories

- 107324A – Bulb Holder, duct insertion
- 107408 – Heat Conductive Compound, 4 ounce
- 50001774-001 – Immersion Well, stainless steel 304, 1/2 in. threading.

## Product Changes

Below are the changes to T775A/B/M models starting with Series 3 (March 2009). Series 3 can be identified by the sideways 3 after the part number on the device label.

1. Modulating high and low limit now both function in either the heat or the cool mode.
2. MIN ON added.
3. SYNC added.
4. Differential and throttling range increased to 300°F.
5. Setpoint and Enable options added to the DI options.
6. HIDE option added to MOD1 and MOD2 (to hide them on the home screen).

## Controller Dimensions

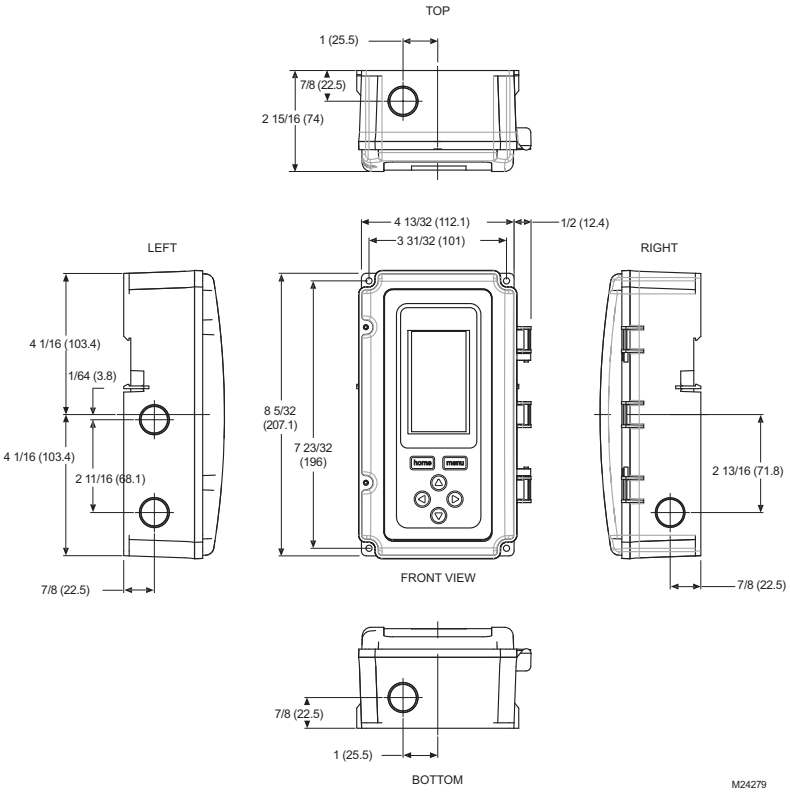



**Fig. 1. T775A/B/M Dimensions in inches (mm).**

# BEFORE INSTALLATION

Review the “SPECIFICATIONS” on page 35 before installing the controller.

## When Installing This Product

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check ratings given in instructions and on the product to ensure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

# INSTALLATION AND SETUP

The following installation procedures are typically performed in the order listed:

1. Mounting — See “MOUNTING” below.
2. Wiring — See “WIRING” on this page.
3. Checkout — See page 11.
4. Programming — See page 14.
5. Scheduling (optional) — See page 30.

Additional topics are:
- Temperature sensor calibration begins on page 11.
- Interface overview begins on page 12.
- Setup (for advanced options) begins on page 17.
- Summary menu begins on page 34.
- Troubleshooting begins on page 34.

# MOUNTING

This section describes the mounting procedures for the controller and temperature sensor(s).

## Controller Mounting

***IMPORTANT***

*Avoid mounting in areas where acid fumes or other deteriorating vapors can attack the metal parts of the controller circuit board, or in areas where escaping gas or other explosive vapors are present.*

***IMPORTANT***

*The controller must be mounted in a position that allows clearance for wiring, servicing, and removal.*

Use a screwdriver to pry out only the knockouts that you will use.

If mounting on DIN rail, be sure to remove the knockouts before mounting. See “Controller Wiring” on page 5 and Fig. 7 on page 6 for recommended knockout usage and locations. If you do not use an opened knockout be sure to cover it.

Mount the controller on any convenient interior location using the four mounting holes provided on the back of the enclosure using #6 or #8 screws (screws are not provided and must be obtained separately). Use controller dimensions in Fig. 1 on page 2 as a guide.

The controller may be mounted in any orientation. However, mounting in the orientation shown in Fig. 1 on page 2 permits proper viewing of the LCD display and use of the keypad.

### NEMA 4 Enclosure Mounting

For models with NEMA 4 enclosures, ensure that waterproof wire/conduit fittings are used at the knockouts for all wiring attachments. Refer to Fig. 7 on page 6 for knockout locations.

***IMPORTANT***

*For NEMA 4 enclosures, be sure to cover and seal all unused open knockouts.*

## Temperature Sensor(s) Mounting and Location

Temperature sensors may be located up to 1,000 feet (304 m) from the T775A/B/M controller. Refer to Table 3 on page 11 for calibration guidelines.

The sensors may be mounted on a wall or panel for sensing space temperature, strapped to a pipe or inserted in an immersion well (see Fig. 2) for hot or cold water sensing, or taped to a standard cap or bulb holder for duct air sensing. To prevent moisture or condensation entering the sensor through the lead wire holes, mount the sensor with the lead wires exiting the bottom of the sensor.

NOTES:
1. The included sensor is not designed for very wet applications. For immersion applications, an immersion well is used.
2. Heat conductive compound must be used in immersion wells.
3. Refer to the list of temperature sensors on page 2 for this type of installation

.

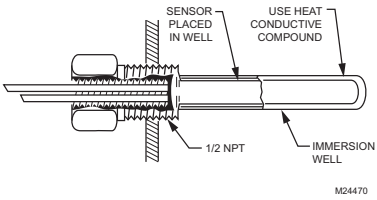



**Fig. 2. Sensor Inserted in Immersion Well.**

**NOTE: Multiple sensors may be parallel-series wired to sense average temperatures in large spaces. Refer to Fig. 3 on page 4.**

# WIRING

All wiring must comply with applicable electrical codes and ordinances, or as specified on installation wiring diagrams. Controller wiring is terminated to the screw terminal blocks located inside the device.

The remainder of this section describes the temperature sensor wiring and the T775A/B/M controller wiring.

## Wiring Connections Access

To access the wiring connections, remove the two screws on the left side of the enclosure and gently swing open the top. Be careful to not stress the ribbon cables that connect the keypad and LCD display to the controller circuit board.

## Temperature Sensor Wiring

**CAUTION**

**Electrical Shock Hazard.**
**Can short equipment circuitry.**
Make sure that metal tube of sensor does not short against T terminals in wall-mounted case.

***IMPORTANT***

*Poor wiring practices can cause erratic readings from the sensor. Avoid the following to ensure proper operation:*

- *Do not route the temperature sensor wiring with building power wiring.*
- *Do not locate the temperature sensor wiring next to control contactors.*
- *Do not locate the temperature sensor wiring near electrical motors.*
- *Do not locate the temperature sensor wiring near welding equipment.*
- *Make sure good mechanical connections are made to both the sensor and the controller.*
- *Do not mount the sensor with the lead wire end pointing up in an area where condensation can occur.*

*If any of the above conditions cannot be avoided, use shielded cable.*

**NOTE: Each T775 controller must be wired to its own sensor(s). However, a benefit of the T775 controller's accuracy is that there is no more than a 2° F (-7° C) differential between any two T775 controllers.**

## Multiple Parallel Sensors

Multiple sensors can be parallel-series wired to sense average temperatures in large spaces. To maintain control accuracy, the number of sensors to be parallel-series wired must be of the $n^2$ power (for example, 4, 9, 16, etc.). Refer to Fig. 3

.

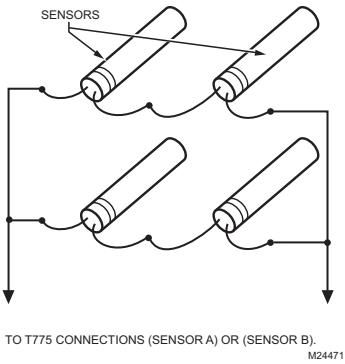



**Fig. 3. Parallel-Series Wiring of Sensors.**

## Temperature Sensor Wire Type and Size

Temperature sensors use standard AWG 18/2 unshielded wire. For cable runs greater than 25 feet or where electrical interference may be a problem, shielded cable is recommended (See Fig. 4).

Refer to "Temperature Sensor Calibration" on page 11 for wire size selection where cable runs are longer than 25 feet.

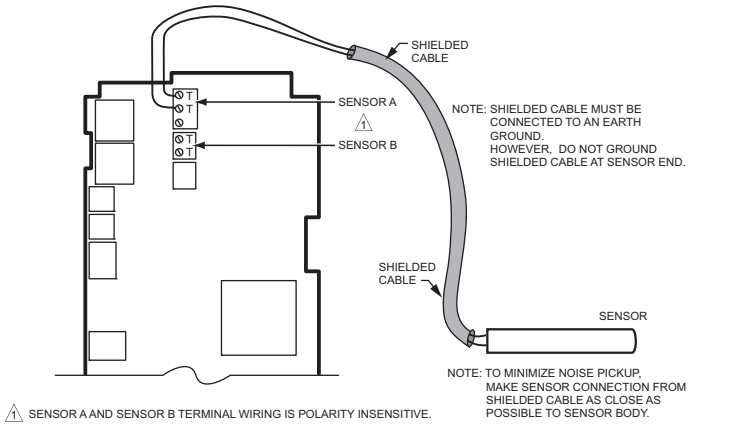



**Fig. 4. Sensor Wiring — Showing Shielded Cable Connection to Sensor A.**

## Controller Wiring

**WARNING**

**Electrical Shock Hazard.**
**Can cause severe injury, death or property damage.**
Disconnect power supply before beginning wiring, or making wiring connections, to prevent electrical shock or equipment damage.

**CAUTION**

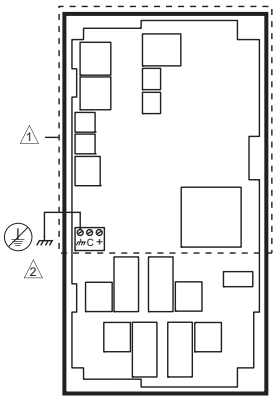
**Do not use 24 Vac power to power any external loads if 120 Vac or 240 Vac is used to power the T775A/B/M controller.**

**CAUTION**

**A separate earth ground is required.**
Equipment damage can result if the earth ground is not connected. See Fig. 5 and Table 2 on page 6.

**CAUTION**

**Equipment Damage Hazard.**
**Electrostatic discharge can short equipment circuitry.**
Ensure that you are properly grounded before handling the unit




1 NO HIGH VOLTAGE. CLASS 2 WIRING ONLY.

2 EARTH GROUND TERMINAL MUST BE CONNECTED TO CONDUIT CLAMP LOCALLY.

M24296

**Fig. 5. Earth Ground.**

***IMPORTANT***

*Poor wiring practices can cause erratic readings from the sensor. To ensure proper operation, ensure that good mechanical connections are made to both the sensor and the controller.*

***IMPORTANT***

*When wiring the input power, only one source of power can be applied to the T775A/B/M controller (24 Vac or 120 Vac or 240 Vac).*

See Fig. 7 on page 6 for locating the appropriate power input, remote sensors input, low voltage, contact closure, and load output terminals.

Access to the terminals can be gained through standard conduit knockouts (A through E in Fig. 7 on page 6) located around the perimeter of the enclosure:

- Knockouts A and B should be used only for sensor and low-voltage wiring.
- Knockouts C, D, and E can be used to gain access to the load relay output terminals and 120/240 Vac power wiring.

### Controller Wiring Method

Wire the sensors and outputs, then wire the power connection.

Each terminal can accommodate the following gauges of wire:

- Single wire – from 14 AWG to 22 AWG solid or stranded
- Multiple wires – up to two 22 AWG stranded

For 24, 120, or 240 Vac power connections:

- Single wire – from 14 to 18 AWG solid or stranded

Prepare wiring for the terminal blocks, as follows:

1. Strip 1/2 in. (13 mm) insulation from the conductor.
2. Cut a single wire to 3/16 in. (5 mm). Insert the wire in the required terminal location and tighten the screw.
3. If two or more wires are being inserted into one terminal location, twist the wires together a minimum of three turns before inserting them to ensure proper electrical contact.
4. Cut the twisted end of the wires to 3/16 in. (5 mm) before inserting them into the terminal and tightening the screw.
5. Pull on each wire in all terminals to check for good mechanical connection

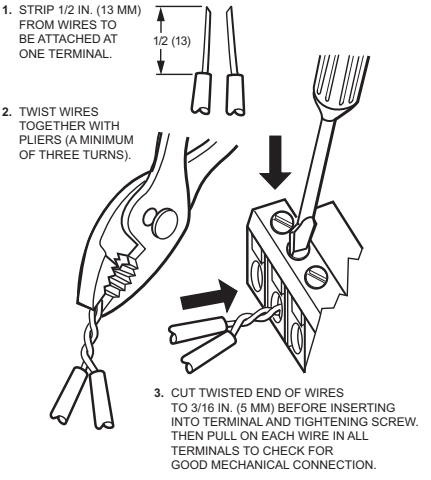
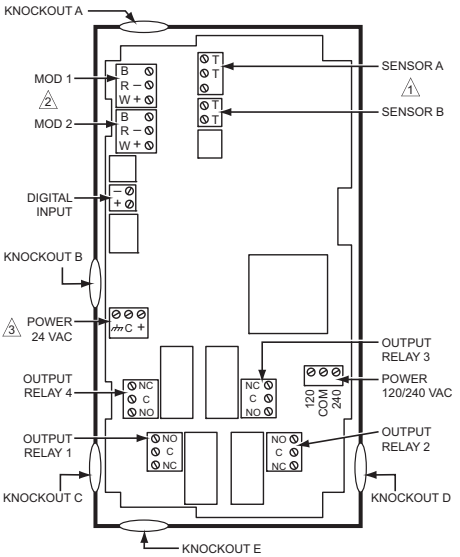



**Fig. 6. Attaching Two or More Wires at Terminal Blocks.**

## Controller Wiring Details

The wiring connection terminals are shown in Fig. 7 and are described in Table 2.

See Fig. 8 – 22 beginning on page 6 for typical T775A/B/M wiring applications.




1 SENSORS A AND B USE THE TWO TT CONNECTIONS AND ARE POLARITY INSENSITIVE.

2 FOR MOD 1 AND MOD 2 CURRENT (mA) OR VOLTAGE (VDC) OUTPUT, USE SIGNAL (+) & COMMON (-).
FOR MOD 1 AND MOD 2 SERIES 90 OUTPUT, USE W, R, & B.

3 A SEPARATE EARTH GROUND IS REQUIRED FOR ANY POWER SOURCE (24, 120, OR 240 VAC). M24474

**Fig. 7. T775A/B/M Terminal and Feature Locations.**

**NOTE: Refer to Table 1 on page 1 for the specific configuration of sensors and outputs supported by the model you are installing.**

**NOTE: For NEMA 4 enclosures, use waterproof fittings for wiring/conduit connections at knockouts.**

**Table 2. Description of Wiring Terminal Connections.**

| Connection | Terminal Label | Description |
|---|---|---|
| **Sensors** | | |
| Sensor A | T T | Temperature Sensor; polarity insensitive |
| Sensor B | | |
| **Outputs** | | |
| Relay 1<br>Relay 2<br>Relay 3<br>Relay 4 | NO<br>COM<br>NC | 120-240 Vac Relay Output |
| Mod 1 | + - (Vdc or mA) | Modulating Output |
| Mod 2 | W R B (Series 90)[a] | |

**Table 2. Description of Wiring Terminal Connections. (Continued)**

| Connection | Terminal Label | Description |
|---|---|---|
| **Input** | | |
| DI | + - | Digital Input (dry contact) |
| **24 Vac Power** | | |
| 24V + | + | 24 Vac Hot |
| Common | C | 24 Vac Common |
| Ground | ⏚ | Earth Ground[b] |
| **120 or 240 Vac Power** | | |
| 120 Vac | 120 | 120 Vac Power |
| Common | COM | Common |
| 240 Vac | 240 | 240 Vac Power |

[a] For Series 90 connections, you must insert a 340 Ohm resistor across terminals R and W. Refer to Fig. 19 on page 9. The resistor is included with the controller.

[b] A separate earth ground is required for all installations regardless of the power source (24, 120, or 240 Vac). Refer to Fig. 5 on page 5.

# WIRING APPLICATIONS (EXAMPLES)

Fig. 8 – 22 illustrate typical controller wiring for various applications.

**NOTE: The electronic Series 90 output provided with modulating T775 models can not drive electro-mechanical slidewire devices like older Series 3 modulating meters (prior to Series 6), V9055s, and S984s.**

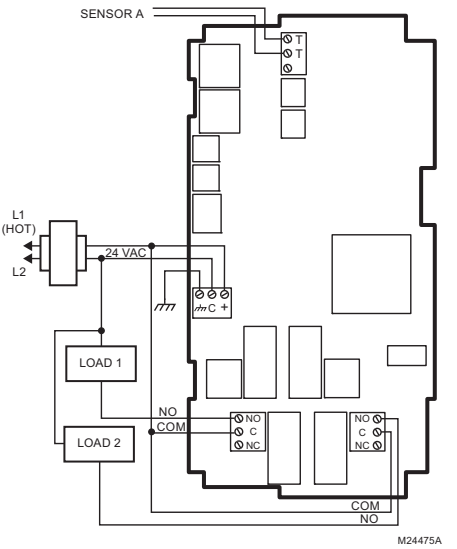



**Fig. 8. Wiring for Two-Stage Control – 24 Vac Input and 24 Vac Load.**

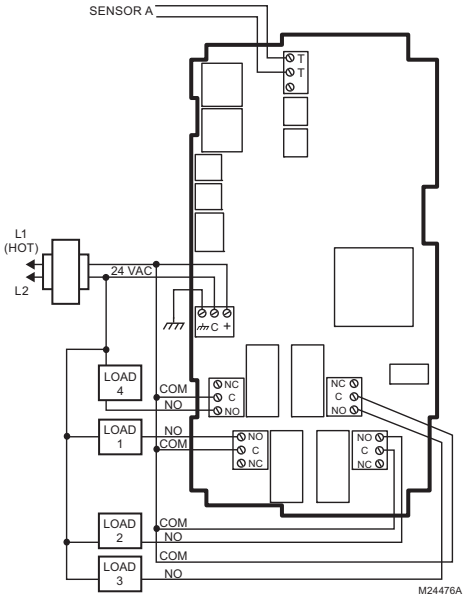



**Fig. 9. Wiring for Four-Stage Control – 24 Vac Input and 24 Vac Load.**

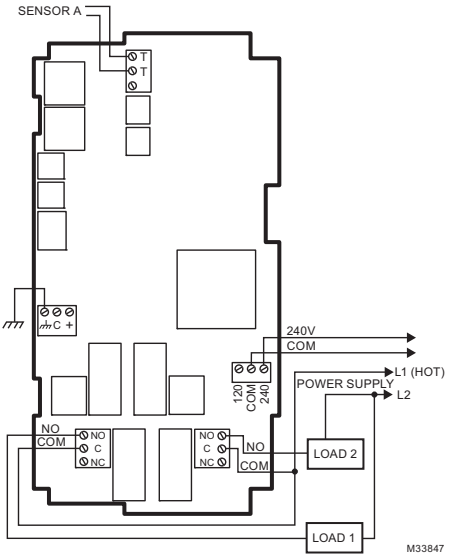



**Fig. 11. Wiring for Two-Stage Control with 240 Vac.**

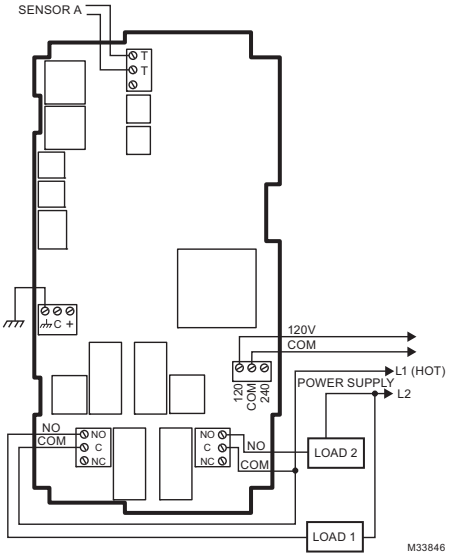



**Fig. 10. Wiring for Two-Stage Control with 120 Vac (120 Vac Input and 120 Vac Load Shown).**

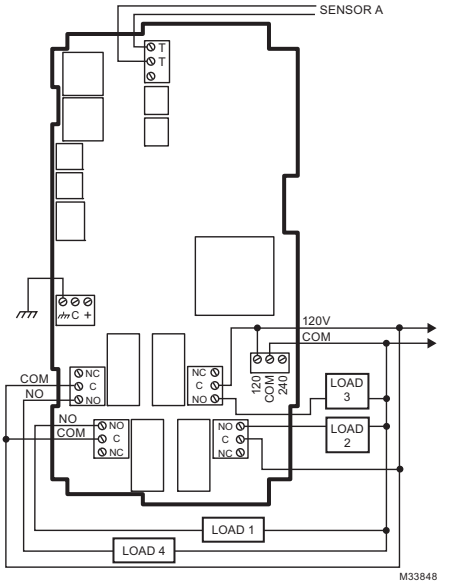



**Fig. 12. Wiring for Four-Stage Control with 120 Vac (120 Vac Input and 120 Vac Load Shown).**

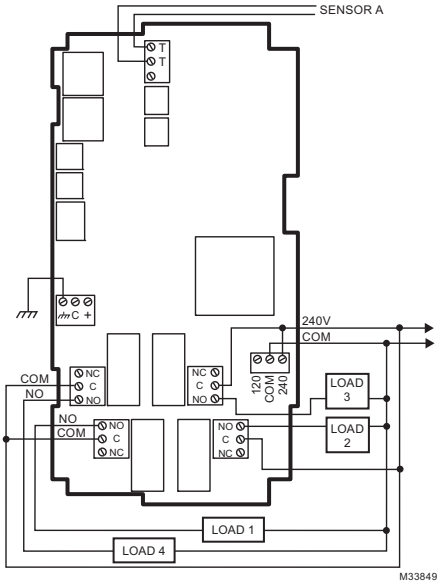
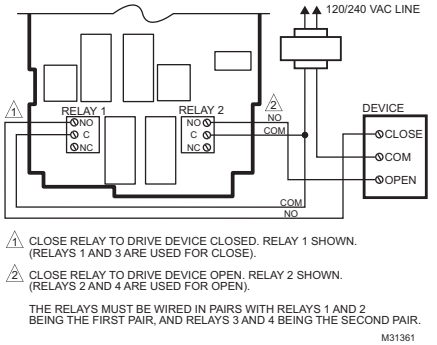



**Fig. 13. Wiring for Four-Stage Control with 240 Vac.**




1 CLOSE RELAY TO DRIVE DEVICE CLOSED. RELAY 1 SHOWN. (RELAYS 1 AND 3 ARE USED FOR CLOSE).

2 CLOSE RELAY TO DRIVE DEVICE OPEN. RELAY 2 SHOWN. (RELAYS 2 AND 4 ARE USED FOR OPEN).

THE RELAYS MUST BE WIRED IN PAIRS WITH RELAYS 1 AND 2 BEING THE FIRST PAIR, AND RELAYS 3 AND 4 BEING THE SECOND PAIR.

M31361

**Fig. 14. Wiring for Floating Output (Relay 1 and Relay 2 Pair Shown)**

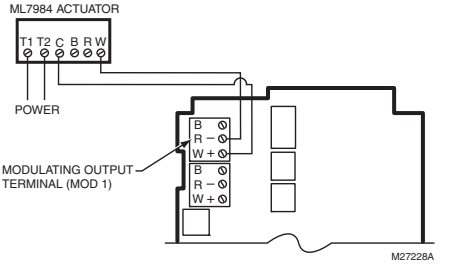



**Fig. 15. Wiring for ML7984 Valve Actuator (Using 4 to 20 mA Signal)**

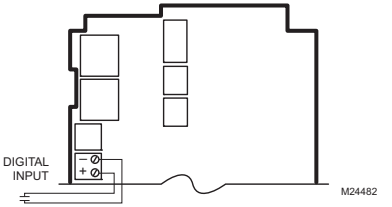



**Fig. 16. Wiring for Digital Input (Dry Contact).**

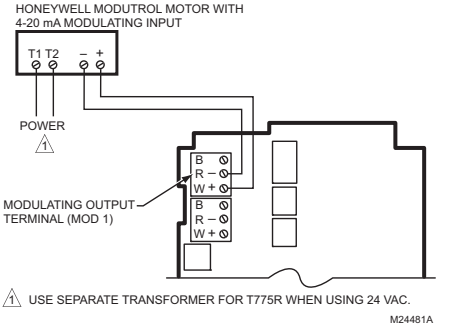



**Fig. 17. Wiring for Mod Motor or Direct Coupled Actuator with 4 to 20 mA Control Input**

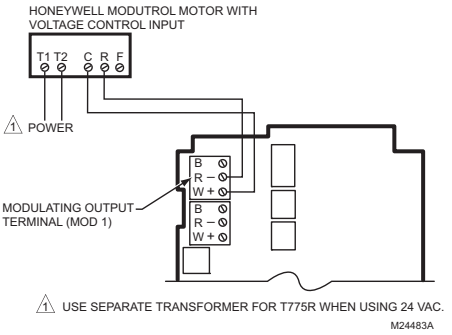



**Fig. 18. Wiring for Mod Motor or Direct Coupled Actuator with 0 to 10 Vdc Control Input**

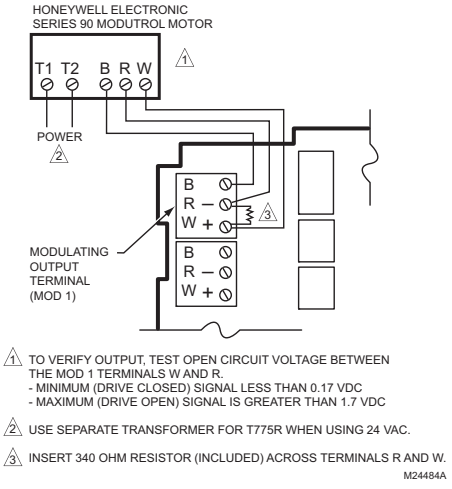



**Fig. 19. Wiring for Series 90 Modutrol Motor Control**

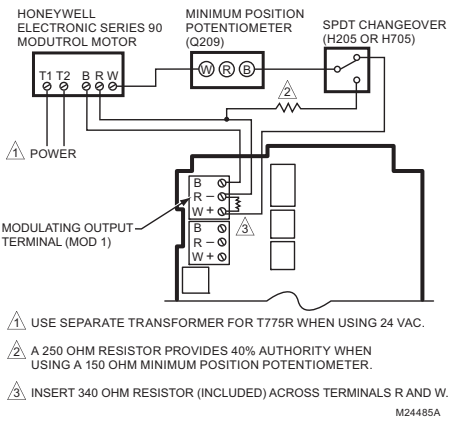
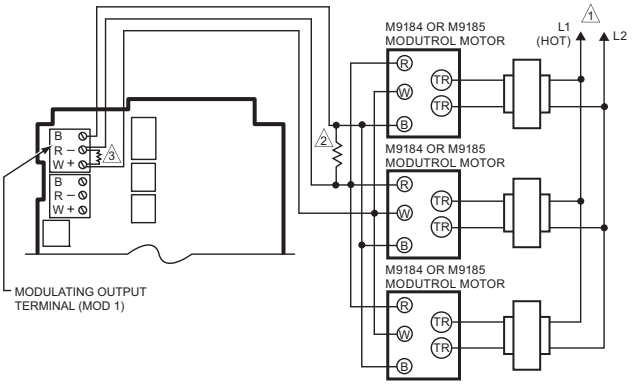



**Fig. 20. Wiring for Changeover Relay and Minimum Position Potentiometer Used with Series 90 Modutrol Motors.**




1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

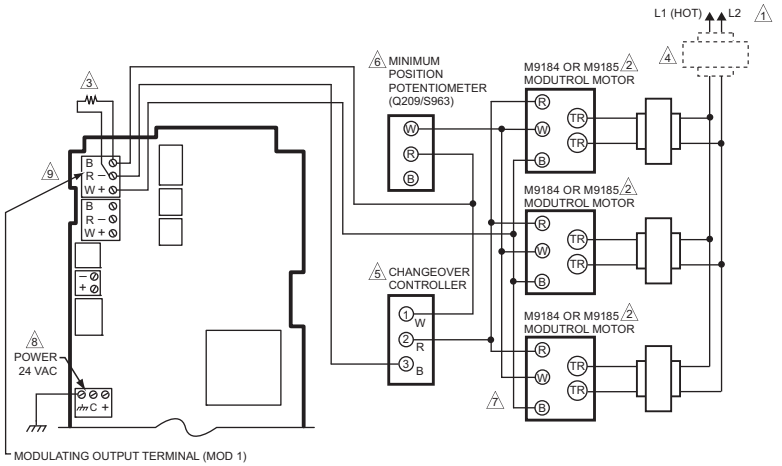
2 USE A 1300 OHM RESISTOR FOR TWO MOTORS, 910 OHM RESISTOR FOR THREE MOTORS. THE 407EAU RESISTOR KIT, WHICH IS SHIPPED WITH THE M9184 AND M9185 MOTORS, INCLUDES BOTH RESISTORS.

3 INSERT 340 OHM RESISTOR (INCLUDED) ACROSS TERMINALS R AND W.

M24486

**Fig. 21. Wiring for Three Series 90 Modutrol Motors**

.




1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 UP TO SIX SIMILAR MOTORS CAN BE CONNECTED IN UNISON.

3 USE RESISTOR BETWEEN R AND B ON THE MOD 1 TERMINAL: 1300 OHMS FOR TWO MOTORS; 910 OHMS FOR THREE MOTORS (4074EAU KIT).

4 IF COMMON TRANSFORMER IS USED, ALL MOTORS MUST BE IN PHASE. CONNECT THE SAME TRANSFORMER LEAD TO T1 ON EACH MOTOR, CONNECT THE OTHER TRANSFORMER LEAD TO T2 ON EACH MOTOR.

5 USE TEMPERATURE CONTROLLER SUCH AS H205 OR H705, OR T675A FOR CHANGEOVER CONTROL.

6 AUTHORITY OF MINIMUM POSITION POTENTIOMETER, IF USED, INCREASES WITH THE NUMBER OF MOTORS IN PARALLEL. WITH ONE MOTOR, 50% STROKE; WITH TWO MOTORS, 100% STROKE; WITH THREE MOTORS, 100% STROKE WITH 1/3 OF FULL POTENTIOMETER ROTATION.

7 REVERSING THE B AND W TERMINALS ON ONE OR MORE MOTORS WILL NOT AFFECT CONTROL PERFORMANCE ON THE OTHER MOTORS. THE SYSTEM CAN BE CONFIGURED TO HAVE SOME MOTORS BE REVERSE ACTING AND OTHER MOTORS BE DIRECT ACTING.

8 USE SEPARATE TRANSFORMER FOR T775 WHEN POWERING FROM 24 VAC.

9 THE SYSTEM IS SHOWN CONNECTED FOR COOLING. FOR HEATING, REVERSE THE W AND B LEADS OF THE MODULATING OUTPUT ON THE T775 CONTROLLER.

M24487

**Fig. 22. Wiring for Unison Control of M9184 or M9185 Modutrol IV Motor Using One Minimum Position Potentiometer for All Motors.**

# CHECKOUT

Inspect all wiring connections at the controller terminals, and verify compliance with the installation wiring diagrams.

## ⚠ WARNING

**Electrical Shock Hazard.**
**Can cause severe injury, death or property damage.**
Disconnect power supply before beginning wiring or making wiring connections, to prevent electrical shock or equipment damage.

If any wiring changes are required, *first* be sure to remove power from the controller *before* starting work. Pay particular attention to verifying the power connection (24, 120, or 240 Vac).

After the controller is installed and wired, apply power.

## Power Loss

The date and time settings are retained for 24 hours after a power outage. After a power loss of more than 24 hours, the date and time settings may need to be reentered. All other settings are stored permanently.

## Temperature Sensor Calibration

As wire length increases, resistance increases and thus the temperature reading increases. If necessary, calibrate the sensor input by reducing the value by the amount shown in the Table 3. For example, a wire run with 18 gauge wire of 1,000 feet, requires a calibration offset of -6.0° F (-21° C).

***IMPORTANT***

*If the calibration value in the table exceeds the controller's calibration limits of +/-10° F (+/-6° C), you must use a heavier gauge wire.*

*For example, with a wire run of 1,000 feet you must use 20 AWG wire or heavier in order to calibrate for wire loss within the limits of the controller.*

See "2.2.2.2. CALIBRATE (the sensor)" on page 18 for the instructions to enter the calibration value.

**Table 3. Temperature Sensor Calibration for Resistance Loss Due to Wire Length.**

| AWG Rating | mΩ/ft | Temperature Offset in °F (Foot)[a] | | |
|---|---|---|---|---|
| | | 200 ft | 500 ft | 1,000 ft |
| 14 | 2.5 | 0.46 | 1.14 | 2.28 |
| 16 | 4.0 | 0.72 | 1.82 | 3.64 |
| 18 | 6.4 | 1.16 | 2.90 | 5.82 |
| 20 | 10.2 | 1.86 | 4.64 | 9.28 |
| 22 | 16.1 | 2.92 | 7.32 | 14.64 |

| AWG Rating | mΩ/m | Temperature Offset in °C (Meter)[a] | | |
|---|---|---|---|---|
| | | 100 m | 200 m | 300 m |
| 14 | 8.3 | 0.44 | 0.86 | 1.30 |
| 16 | 13.2 | 0.68 | 1.38 | 2.06 |
| 18 | 21.0 | 1.10 | 2.18 | 3.28 |
| 20 | 33.5 | 1.74 | 3.48 | 5.22 |
| 22 | 52.8 | 2.74 | 5.48 | 8.22 |

[a] This is the distance from the controller to the sensor (already accounts for round trip distance).

Fig. 23 shows how sensor resistance varies with temperature for a sensor having a positive temperature coefficient (PTC) of 2.1 Ohms per degree F (3.85 Ohms per degree C)

.

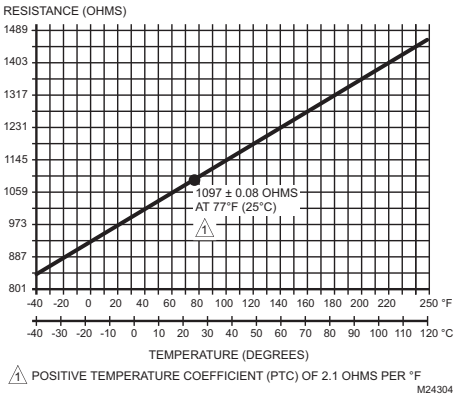



**Fig. 23. Sensor Resistance vs. Temperature.**

# INTERFACE OVERVIEW

The T775A/B/M controllers use an LCD panel and 6-button keypad to provide status information and permit user input of the programming, setup, and scheduling parameters.

The following figure describes the display areas of the LCD and the keypad

.

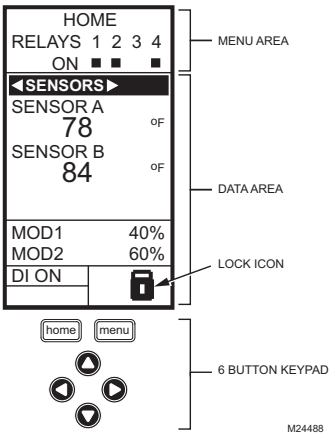



**Fig. 24. LCD Display - Home Screen And Keypad.**

**Menu Area** – On the home screen, the LCD displays the configured relays and whether they are active. In Program, Setup or Schedule mode, the LCD displays the current menu selection and its order within the menu hierarchy.

**Data Area** – On the home screen, the LCD displays the sensors and outputs status. In Setup or Program mode, the LCD displays menu choices, parameter selections, and data values.

**Lock Icon** – The icon indicates the **MENU** button is locked and prevents access to the Setup and Program menus.

**NOTE: Pressing and holding the HOME and MENU buttons simultaneously for five seconds locks/unlocks the MENU button.**

**6-Button Keypad** – The keypad is used to access the menus and enter values (See "Using the LCD Panel Interface").

# Using the LCD Panel Interface

The 6-button keypad is used to move through the menus and enter or change parameter values.

## Home Button

Pressing the **HOME** button at any time exits the current Programming or Setup display screen and returns to the home screen as shown in Fig. 24 and Fig. 25.

## Menu Button

- Pressing the **MENU** button always displays the Program menu. If you are in Setup mode, you exit setup and return to the Program menu.
- **Pressing and holding the MENU button for five seconds leaves the current screen and displays the Setup menu.**

## Left and Right Arrow Buttons (◀ and ▶)

Use these buttons to move backward (◀) and forward (▶) through the Program and Setup menus.

## Up and Down Arrow Buttons (▲ and ▼)

Use these buttons to move your selection up and down through a menu or list.

- When the desired item is highlighted, you press the ▶ arrow button to display that item's content.
- When a value is displayed (e.g. 70° F), the up and down arrows increase and decrease the value.

**NOTE: Once you select an item from a list or enter a value, pressing the ◀ or ▶ or HOME button accepts your selection or value and stores it in the controller's memory.**

# Home Screen

In the normal run state, the LCD home screen displays the current sensed temperatures, the modulating outputs status, the active status of the output relays, and error and status codes.

Active relays are indicated by the small black square (■) just below the relay number. Fig. 25 shows the home screen with relays 1, 2, and 4 energized.

Pressing the ◀ and ▶ buttons from the home screen cycles through each modulating output that is paired with the sensor it controls and the active output relays

.

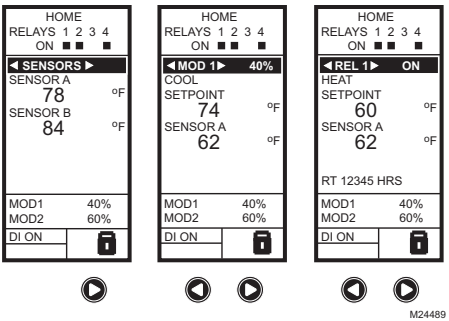



**Fig. 25. LCD Display - Home Screen Displaying Sensors, Active Relays, and Mod Outputs.**

**NOTE: The modulating output home screen and the relay home screen do not dynamically update the active relay status, sensor values, and modulating output percentages. The information is a snapshot taken when you press the ◀ or ▶ button to display the screen.**

***IMPORTANT***

*After four minutes of inactivity (no buttons pressed), the LCD display reverts to the home screen display.*

# Accessing the Menus

Menus are used for programming, scheduling, viewing the summary settings, and setup of advanced options.

## Programming, Scheduling, and Summary Menus

To access these menus from the home screen, press the **MENU** button (See Fig. 26)

.

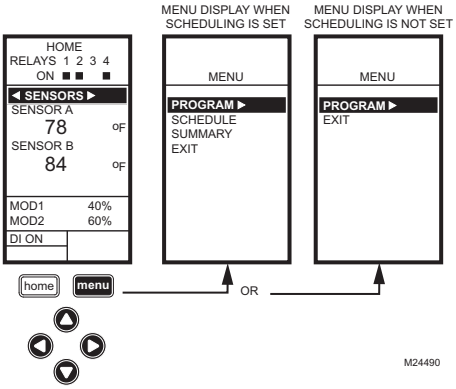



**Fig. 26. Menus.**

Depending on whether scheduling is enabled or not, the LCD displays one of two menus as shown in Fig. 26. Scheduling is enabled from the Setup menu's Output settings (See "2.3.3.1. USE SCHED" on page 25).

## Setup Menu

To access the Setup menu, press and hold the **MENU** button for five seconds (Refer to Fig. 27).

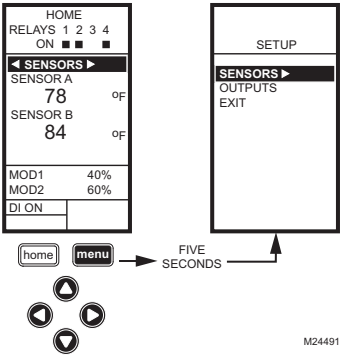



**Fig. 27. Setup Menu.**

## Using the Menus

When you are working with the menus, use the:

- **Left arrow button ( ◀ ) to scroll backward through the menus •Right arrow button** ( ▶ ) to select the highlighted menu item and display its content
- **Up and Down arrow buttons** ( ▲ and ▼ ) to scroll up and down through a list of items or to increase or decrease the value of a displayed parameter

**NOTE: If you press the HOME button or there is no keypad activity for four minutes, you exit Program mode and return to the home screen.**

**If you press the MENU button, you exit and return to the menu.**

# 1. PROGRAMMING

The controller must be programmed before being placed into service.

***IMPORTANT***

*During programming, the controller is live at all times. For example, the contacts may open and close when adjusting the setpoint.*

The Programming process uses a hierarchical menu structure that is easy to use. You press the ◀ and ▶ arrow buttons to move forward and backward through the menus.

NOTES:

1. The controller interface is intuitive. You may find that you do not need the following procedure instructions to program the controller. You may want to use this procedure simply as a reference to locate the particular option or parameter of interest.
2. The menus can display only those relays that are defined in Setup (See "2.3.2. NBR OF RELAYS" on page 24). For example, if you configure only two relays, then only two relays display on the appropriate menus.
3. If you press the **HOME** button or there is no keypad activity for four minutes, you exit Program mode and return to the home screen.
4. If you press the **MENU** button, you exit Program mode and return to the menu.

## Setpoint and Differential

The following describes the relationship between setpoint and differential for heating and cooling. These settings are programmed for each output relay.

### Heating Mode Setpoint and Differential

In heating mode, the differential is below the setpoint. The relay de-energizes when the temperature rises to the setpoint. As the temperature drops to the setpoint minus the differential, the relay energizes.

### Cooling Mode Setpoint and Differential

In cooling mode, the differential is above the setpoint. The relay de-energizes when the temperature falls to the setpoint. As the temperature rises to the setpoint plus the differential, the relay energizes.

## Setpoint High Limit

You can set a single irreversible setpoint high limit maximum value, which is applied to all outputs.

Adjust the setpoint (at any output) to the desired maximum setpoint. Then, simultaneously press the **home,** ◀ , and ▶ buttons and continue to press all three buttons for five seconds to set the setpoint high limit maximum to this value.

**NOTE: You must press all three buttons at exactly the same time for this action to occur.**

***IMPORTANT***

1. *This action sets the maximum setpoint value of **all** outputs to the setpoint high limit maximum.*
2. *Setting the high limit setpoint maximum is **irreversible**. If you perform the action inadvertently gently and this setpoint adversely affects the control of your system, you must replace the controller.*

## Programming the T775A/B/M Controller

To program the controller, perform the following procedures in the order listed:

1. Enter Program mode — see "1.1. Entering Program Mode"
2. Program the Outputs — see "1.2. Program Menu for Outputs"

When programming is complete, you may continue with "3. SCHEDULING" on page 30 or, for advanced options, continue with "2. SETUP (ADVANCED OPTIONS)" on page 17.

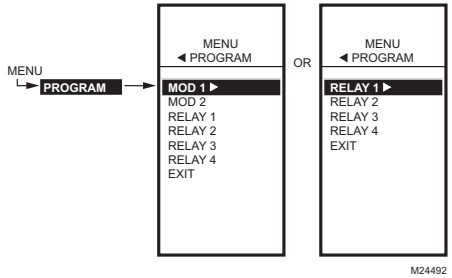



**Fig. 28. Program Menu.**

### 1.1. Entering Program Mode

Press the **MENU** button, then select PROGRAM and press the ▶ button to view the Program menu.

Fig. 28 shows the Program menus for controllers with and without Modulating Outputs.

**NOTE: Modulating outputs are not available on the T775A and T775B controller models.**

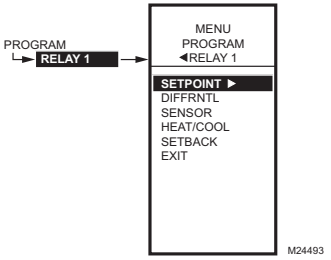



**Fig. 29. Program Menu Outputs.**

## 1.2. Program Menu for Outputs

Press the **MENU** button, select PROGRAM, then select RELAY 1 (or MOD 1) to view the parameters. Fig. 29 shows RELAY 1.

**NOTE: For MOD 1 and 2, THROT RNG replaces DIFFRNTL.**

**NOTE: The Setback parameter displays only if scheduling is enabled (See Fig. 57 on page 24) or the DI Option is set to Setback. (See Fig. 60 on page 26).**

Continue with "1.2.1. SETPOINT".

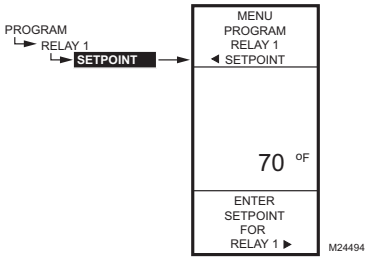



**Fig. 30. Program - Setpoint.**

## 1.2.1. SETPOINT

1. From the menu, use the ▲ and ▼ buttons to highlight SETPOINT.
2. Press the ► button to display the setpoint value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired setpoint temperature.
   Default: 70° F (21° C)
   Range: -40° to 248° F (-40° to 120° C)
4. Press the ► button to accept the setpoint temperature and display the next option.

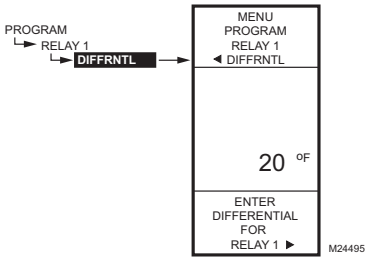



**Fig. 31. Program - Differential or Throttling Range.**

## 1.2.2. DIFFERENTIAL or THROTTLING RANGE

Differential is used for Relay outputs and Throttling Range is used for Modulating outputs.

1. From the menu, use the ▲ and ▼ buttons to highlight THROT RNG or DIFFERNTL.
2. Press the ► button to display the throttling range value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired value.
   Default: 20° F (-7° C)
   Range: 1° to 300° F (1° to 149° C).
4. Press the ► button to accept the value and display the next option.

In heating mode, the Differential is below the setpoint. The relay de-energizes when the temperature rises to the setpoint. As the temperature drops to the setpoint minus the Differential, the relay energizes.

In cooling mode, the Differential is above the setpoint. The relay de-energizes when the temperature falls to the setpoint. As the temperature rises to the setpoint plus the Differential, the relay energizes.

The Throttling Range brackets the setpoint setting, e.g., if the setpoint is 72°F (22° C) and the throttling range is 10° F (-12° C), then the effective throttling temperature range is 67° to 77° F (19° to 25° C). This applies to both modulating outputs and floating outputs.

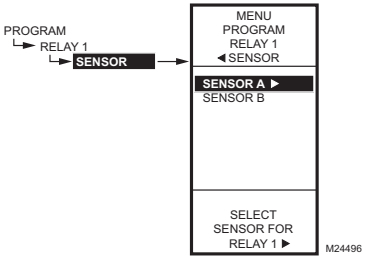



**Fig. 32. Program - Sensor.**

## 1.2.3. SENSOR

1. From the menu, use the ▲ and ▼ buttons to highlight SENSOR.
2. Press the ► button to display the sensor selections.
3. Use the ▲ and ▼ buttons to select Sensor A or B.
4. Press the ► button to accept the highlighted sensor and display the next option.

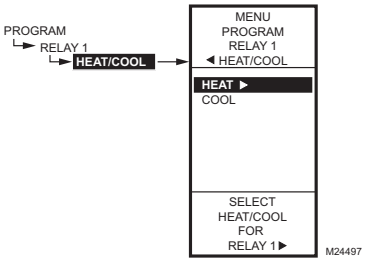



**Fig. 33. Program - Heat/Cool.**

## 1.2.4. HEAT/COOL

1. From the menu, use the ▲ and ▼ buttons to highlight HEAT/COOL.
   Default: HEAT
2. Press the ► button to display the heat and cool selections.
3. Use the ▲ and ▼ buttons to select Heat or Cool.
4. Press the ► button to accept the highlighted selection and display the next option.

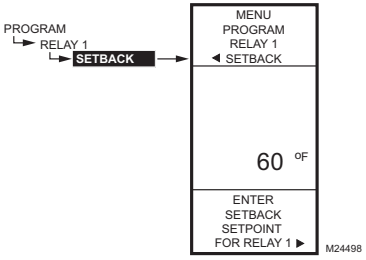



**Fig. 34. Program - Setback.**

## 1.2.5. SETBACK

The Setback temperature option displays if scheduling is enabled (See Fig. 57 on page 24) or the DI Option is set to Setback. (See Fig. 60 on page 26).

This is the desired setpoint temperature that you want to use during setback mode for this output. For example, if your setpoint is 70° F (21° C) and you want the temperature to drop 10° F during setback mode, enter 60° F (16° C) as the setpoint for this output.

1. From the menu, use the ▲ and ▼ buttons to highlight SETBACK.
2. Use the ▲ and ▼ buttons to increase/decrease the desired setpoint temperature.
   Default: 60° F (16° C)
   Range: -40° to 248° F (-40° to 120° C)
3. Press the ► button to accept the value and display the menu.

## 1.2.6. Program Next Output (Mod or Relay)

For the next output (Mod or Relay), select the desired output from the Program menu (Refer to Fig. 28 on page 14).

Go to “1.2.1. SETPOINT” on page 15 to program the next output.

When you finish programming the outputs, continue with “1.2.7. Exiting Program Mode” on page 17.

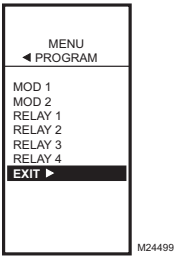



**Fig. 35. Program - Exit.**

### 1.2.7. Exiting Program Mode

Press the **HOME** button to leave programming mode and return to the home screen.

This completes the programming procedure.

# 2.SETUP (ADVANCED OPTIONS)

Setup provides the ability to change the factory default settings for the temperature sensors and outputs, to enable/disable reset control, and to enable/disable scheduling.

**NOTE: The controller interface is intuitive. You may find that you do not need the following setup instructions for the sensors and outputs. You may want to use this procedure simply as a reference to locate the particular option or parameter of interest.**

NOTES:

1. If you press the **HOME** button or there is no keypad activity for four minutes, you exit Setup mode and return to the home screen.
2. If you press the **MENU** button, you exit Setup mode and return to the menu.

## Setup Procedure

The Setup process uses a hierarchical menu structure that is easy to use. You press the ◄ and ► arrow buttons to move forward and backward through the menus.

**NOTE: The menus can display only those relays that are defined in Setup (see "2.3.2. NBR OF RELAYS" on page 24). For example, if you configure only two relays, then only two relays display on the appropriate menus.**

Once in Setup mode, you use the —

- **Left arrow button ( ◄ )** to scroll backward through the Setup menus
- **Right arrow button** ( ► ) to select the highlighted menu item and display its content
- **Up and Down arrow buttons** ( ▲ and ▼ ) to scroll up and down through a list of items or to increase or decrease the value of a displayed setup parameter

To change the controller's sensors and output setup parameters, perform the following procedures in the order listed:

1. Enter Setup mode — see "2.1. Entering Setup Mode"
2. Setup Sensors — see "2.2. Setting up the Sensors"
3. Setup Outputs — see "2.3. Setting up the Outputs" on page 21
4. Exit Setup Mode — see "2.4. EXIT Setup Mode" on page 30

### 2.1. Entering Setup Mode

To enter Setup mode, press and hold the **MENU** button for five seconds to display the Setup menu. Refer to Fig. 27 on page 13.

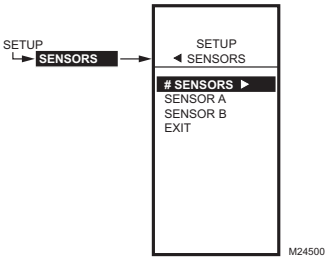



**Fig. 36. Setup - Sensors Menu.**

### 2.2. Setting up the Sensors

1. From the Setup menu, use the ▲ and ▼ buttons to highlight SENSORS.
2. Press the ► button to display the Sensors menu.

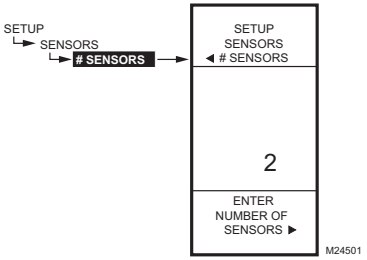



**Fig. 37. Setup - Sensors - Number of Sensors.**

## 2.2.1. Number of SENSORS

The value entered here determines the number of sensors displayed on the home screen.

1. From the Sensors menu, highlight # SENSORS then press the ► button to display the number of sensors.
2. Use the ▲ and ▼ buttons to enter the number of sensors (1 or 2).
   Default: 2
3. Press the ► button to accept the value and display the SENSOR A selection.

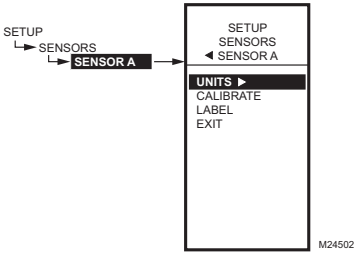



**Fig. 38. Setup - Sensors - Sensor A Menu.**

## 2.2.2. SENSOR A

1. From the Sensors menu, highlight SENSOR A.
2. Press the ► button to display the Sensor A selections.

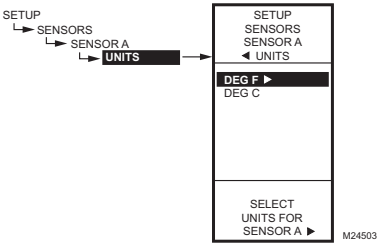



**Fig. 39. Setup - Sensors - Sensor A - Units.**

### 2.2.2.1. UNITS (° F or ° C)

***IMPORTANT***

*This is a global change and affects the unit values for all temperature parameters on all displays.*

*The UNITS screen displays only for Sensor A.*

1. From the Sensor A selections, use the ▲ and ▼ buttons to highlight UNITS.
2. Press the ► button to display the temperature units.
3. Use the ▲ and ▼ buttons to highlight F or C.
   Default: F (Fahrenheit)
4. Press the ► button to accept the units and return to the Sensor A selections.

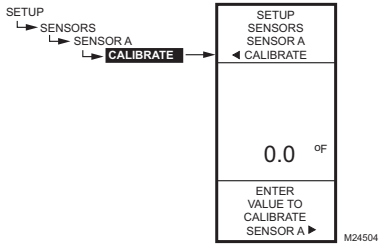



**Fig. 40. Setup - Sensors - Sensor A - Calibrate.**

### 2.2.2.2. CALIBRATE (the sensor)

Ensure that the wire size calibration value is within the limits. See “Temperature Sensor Calibration” on page 11.

1. From the Sensor A selections, use the ▲ and ▼ buttons to highlight CALIBRATE.
2. Press the ► button to display the calibration degree value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired calibration degrees.
   Default: 0.0
   Range: +/-10° F (+/-6° C)
4. Press the ► button to accept the value and return to the Sensor A selections.

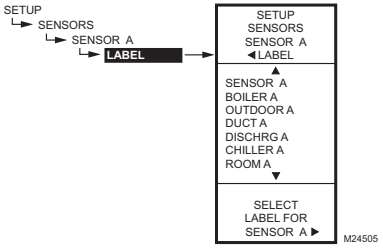



**Fig. 41. Setup - Sensors - Sensor A - Label.**

### 2.2.2.3. LABEL (the sensor input)

For a sensor already labeled, the display positions to and highlights that label.

1. From the Sensor A selections, use the ▲ and ▼ buttons to highlight LABEL.
2. Press the ► button to display the label list.
3. Use the ▲ and ▼ buttons to scroll through list and highlight the desired label.
   You may need to scroll up or down to view all possible labels.
4. Use the ► button to accept the highlighted label and exit the list.

**NOTE: The label names in list order are: Sensor, Boiler, Outdoor, Duct, Dischrg, Chiller, Room, Supply, Return, and Animals.**

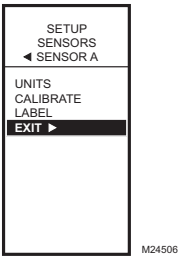



**Fig. 42. Setup - Sensors - Sensor A - Exit.**

### 2.2.2.4. Exit Sensor A Setup

Press the ◄ button to exit Sensor A selections and return to the Sensors menu.
or
Use the ▲ and ▼ buttons to highlight EXIT and press the ► button.

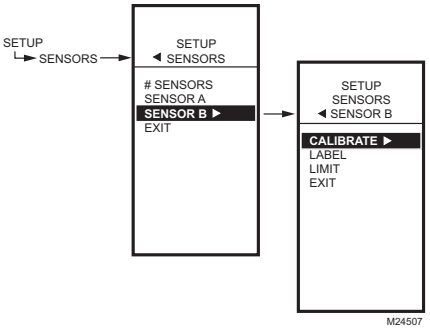



**Fig. 43. Setup - Sensors - Sensor B Menu.**

### 2.2.3. SENSOR B

For the T775M2030 and T775M2048 models only, which have a High/Low modulating temperature limit, the LIMIT item displays on the Sensor B menu.

1. From the Sensors menu, use the ▼ button to highlight SENSOR B.
2. Press the ► button to display the Sensor B menu.

### 2.2.3.1. CALIBRATE

Setting the calibration value is accomplished the same way as the Sensor A. See “2.2.2.2. CALIBRATE (the sensor)” on page 18.

### 2.2.3.2. LABEL

Setting the label is accomplished the same way as the Sensor A. See “2.2.2.3. LABEL (the sensor input)” on page 19.

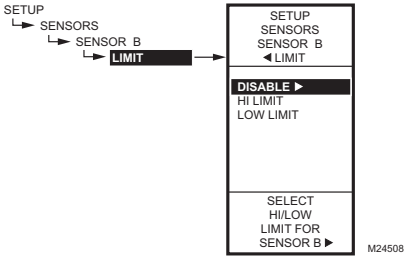



**Fig. 44. Setup - Sensors - Sensor B - Limit.**

## 2.2.4. LIMIT (Sensor B only)

For the T775M2030 and T775M2048 models only, the LIMIT item displays on the Sensor B menu.

**NOTE: The LIMIT option acts *only* on Modulating Output 1.**

1. From the Sensors menu, use the ▼ button to highlight SENSOR B.
2. Press the ► button to display the Sensor B menu.
3. Use the ▲ and ▼ buttons to select the LIMIT item.
4. Use the ► button to display the Limit selections.
5. Use the ▲ and ▼ buttons to select the desired limit, (Disable, Hi Limit, or Low Limit).
   Default: Disable
6. Press the ► button to accept the value and return to the Sensor B menu.

When you select Hi Limit or Low Limit, the Sensor B menu changes and adds the Hi/Low Limit and Throttling Range items.

If you are setting a Hi or Low Limit, continue with "2.2.4.1. HI LIMIT or LOW LIMIT (Sensor B only)".

If you selected Disable for the Limit value, continue with "2.3. Setting up the Outputs" on page 21.

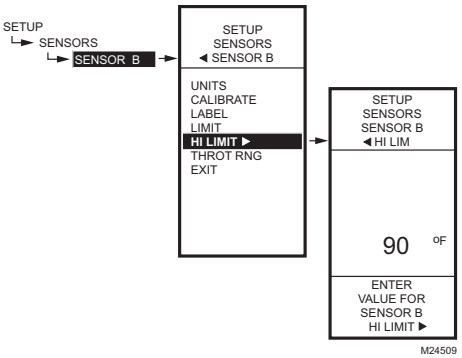



**Fig. 45. Setup - Sensors - Sensor B - Hi/Low Limit (showing Hi Limit).**

## 2.2.4.1. HI LIMIT or LOW LIMIT (Sensor B only)

Fig. 45 shows the High Limit, but the process is the same for setting the Low Limit.

Sensor B can be assigned a high/low limit, so that as you are controlling temperature at Sensor A, the control adjusts its modulating output to prevent exceeding the user-entered limit for Sensor B.

1. From the Sensor B menu, use the ▼ button to highlight HI LIMIT or LOW LIMIT.
2. Press the ► button display the LIMIT value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired Limit value.
4. Press the ► button to accept the value and return to the Limit menu.

The high and low limit action will work in either the heat or the cool mode as follows:

- When the low limit is used in the heat mode, the MOD1 output *increases* to prevent reaching the low limit at sensor B.
- When the high limit is used in the heat mode, the MOD1 output *decreases* to prevent reaching the hi limit at sensor B.
- When the low limit is used in the cool mode, the MOD1 output *decreases* to prevent reaching the low limit at sensor B.
- When the high limit is used in the cool mode, the MOD1 output *increases* to prevent reaching hi limit at sensor B.

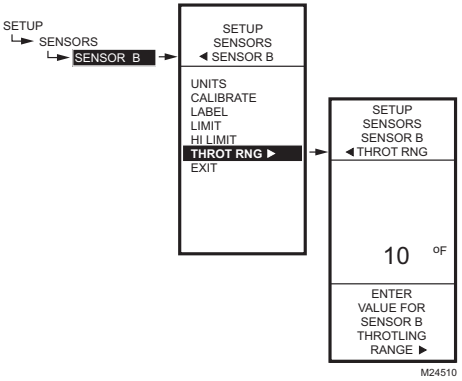



**Fig. 46. Setup - Sensors - Sensor B - Throttling Range.**

## 2.2.4.2. THROTTLING RANGE (Sensor B only)

The throttling range for the modulating high or low limit positions the setpoint at the end of the throttling range. For example, with a high limit at Sensor B of 200°F and a throttling range of 10°F, the modulating output controlling Sensor A begins to throttle back at 190°F (88°C), and fully closes at 200°F (93°C). Conversely, the throttling range for the low limit begins above the setpoint in the same manner.

1. From the Limit menu, use the ▼ button to highlight THROT RNG.
2. Use the ▲ and ▼ buttons to increase/decrease the desired value for the Throttling Range.
   Default = 0
3. Press the ► button to accept the value and return to the Limit menu.
4. Press the ◄ button to exit the Limit menu.
5. Press the ◄ button to exit the Sensors menu and return to the Setup menu.

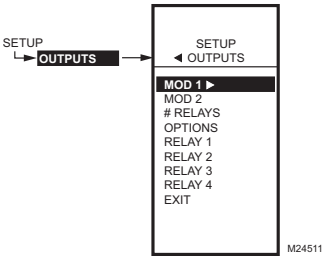



**Fig. 47. Setup - Outputs Menu.**

## 2.3. Setting up the Outputs

1. From the Setup menu, use the ▲ and ▼ buttons to highlight OUTPUTS.
2. Press the ► button to display the Outputs menu.

**NOTE: The menus (e.g. the Outputs menu shown here) can display only those relays that are defined in Setup (see "2.3.2. NBR OF RELAYS" on page 24). For example, if you configure only two relays, then only two relays display on the appropriate menus.**

The following procedures set up each modulating output and relay output.

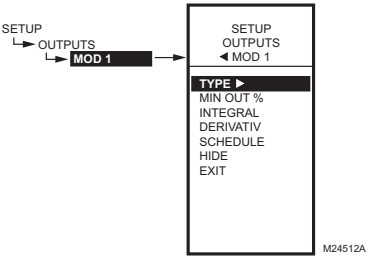



**Fig. 48. Setup - Outputs - Modulating Output Menu.**

## 2.3.1. Setting up the Modulating Outputs

1. From the Output menu, use the ▲ and ▼ buttons to highlight the desired modulating output (MOD 1 or MOD 2).
2. Press the ► button to display the selected MOD menu.

**NOTE: Modulating outputs are not available on the T775A and T775B controller models. If you are setting up one of these controllers, skip to "2.3.2. NBR OF RELAYS" on page 24.**

Use the remaining procedures, beginning with "2.3.1.1. TYPE (of output signal)" on page 22, to set up each modulating output. If you have two modulating outputs, repeat these procedures for each modulating output.

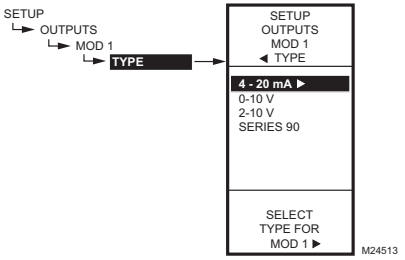



**Fig. 49. Setup - Outputs - Mod Out - Type.**

## 2.3.1.1. TYPE (of output signal)

1. From the Mod menu, use the ▲ and ▼ buttons to highlight TYPE.
2. Press the ► button to display the Type selections.
3. Use the ▲ and ▼ buttons to highlight the desired output type.
   Default: 4-20 mA
4. Press the ► button to accept the selected type and return to the Mod menu.

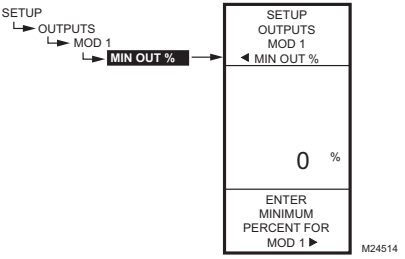



**Fig. 50. Setup - Outputs - Mod Out - Minimum Output Percentage.**

## 2.3.1.2. MIN OUT %

The minimum output % prevents the output from dropping below the value entered. This value can be useful to maintain minimum damper position.

Using the time clock or digital input to disable the output forces the output to 0%.

1. From the Mod menu, use the ▲ and ▼ buttons to highlight MIN OUT %.
2. Press the ► button to display the Min Out %.
3. Use the ▲ and ▼ buttons to increase/decrease the desired value from 0% to 100% in 1% increments.
   Default: 0%
   Range: 0 to 100%
4. Press the ► button to accept the percentage and return to the Mod menu.

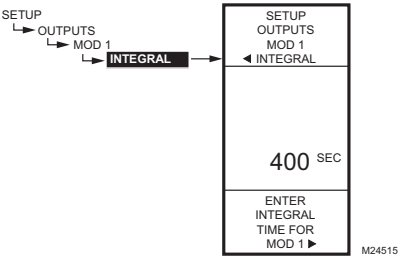



**Fig. 51. Setup - Outputs - Mod Out - Integral.**

## 2.3.1.3. INTEGRAL

1. From the Mod menu, use the ▲ and ▼ buttons to highlight INTEGRAL.
2. Press the ► button to display the Integral seconds.
3. Use the ▲ and ▼ buttons to increase/decrease the value from 0 to 3,600 in 10 second increments.
   Default: 400 seconds
   Range: 0 to 3,600 seconds
4. Press the ► button to accept the seconds and return to the Mod menu.

NOTES:

1. The Integral time is factory set for 400 seconds. This is a good middle range and should satisfy many applications. The integral time can be increased for applications where sensed response is slow, and can be decreased for applications where sensed response is fast (e.g. discharge air control).

2. As a starting point, an optimal integral time for discharge air typically ranges from 12 to 200 seconds. An optimal integral time for room control typically ranges from 60 to 2,500 seconds. The purpose of integral action is to reduce or eliminate the offset from setpoint during steady state control that is often seen in proportional only control.

3. Keep in mind that control is most sensitive to throttling range. Adjust the throttling range first before any adjustment to integral time. Adjust throttling range to be as wide as possible to start since this will provide the most stable control. Remember that the integral will eliminate the steady state error so you do not need to have a small throttling range to have accurate control. (Integral action allows for controlling to a setpoint even with a wide throttling range).

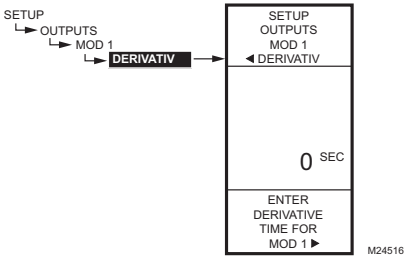



**Fig. 52. Setup - Outputs - Mod Out - Derivative.**

## 2.3.1.4. DERIVATIVE

The Derivative default value is factory set to zero (no derivative control). It is strongly recommended that the derivative remain at zero (0) unless you have a very good reason to adjust it. Derivative control is not needed in the vast majority of HVAC applications.

1. From the Mod menu, use the ▲ and ▼ buttons to highlight DERIVATIV.
2. Press the ► button to display the Derivative seconds.
3. Use the ▲ and ▼ buttons to increase/decrease the value.
   Default: 0 (zero)
   Range: 0 to 3,600 seconds
4. Press the ► button to accept the seconds and return to the Mod menu.

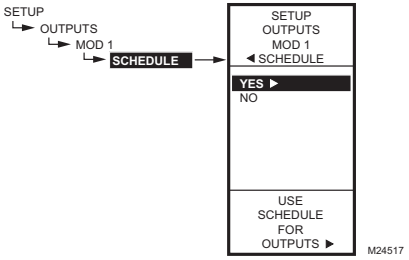



**Fig. 53. Setup - Outputs - Mod Out - Schedule.**

## 2.3.1.5. SCHEDULE

The Schedule option displays only if the USE SCHED parameter is set to Yes (See “2.3.3.1. USE SCHED” on page 25).

1. From the Mod menu, use the ▲ and ▼ buttons to highlight SCHEDULE.
2. Use the ▲ and ▼ buttons to highlight YES or NO.
   Default: YES
3. Press the ► button to accept the selection and return to the Mod menu.

Each output can be set up to follow or ignore the built in scheduler. To disable the scheduler for all outputs, see “2.3.3.1. USE SCHED” on page 25.

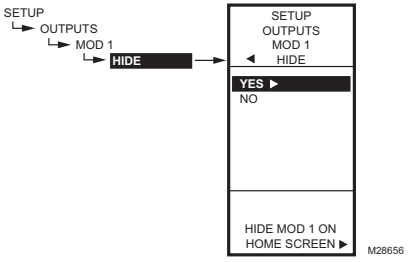



**Fig. 54. Setup - Outputs - Mod 1/2 - Hide.**

## 2.3.1.6. HIDE

The Hide option is used to prevent the MOD 1 and MOD 2 outputs from displaying on the Home screen.

1. From the Mod menu, use the ▲ and ▼ buttons to highlight HIDE.
2. Use the ▲ and ▼ buttons to highlight YES or NO.
   Default: YES
3. Press the ► button to accept the selection and return to the Mod menu.

**NOTE: The MOD1 and MOD2 outputs are still active even when hidden from the Home screen.**

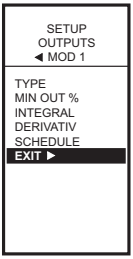



**Fig. 55. Setup - Outputs - Mod Out - Exit.**

## 2.3.1.7. EXIT

Press the ◄ button (or highlight EXIT and press the ► button) to exit the Mod menu and return to the Outputs menu.

If you have a second modulating output to configure, go to “2.3.1. Setting up the Modulating Outputs” on page 21.

If you are finished setting up the modulating outputs, continue with “2.3.2. NBR OF RELAYS”.

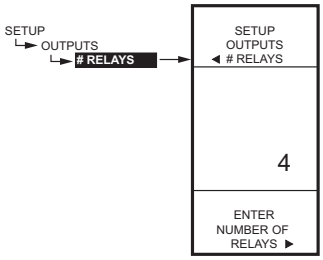



**Fig. 56. Setup - Outputs - Number of Relays.**

## 2.3.2. NBR OF RELAYS

1. From the Outputs menu, use the ▲ and ▼ buttons to highlight # RELAYS.
2. Press the ► button to display the number of relays.
3. Use the ▲ and ▼ buttons to display the number from 1 to 4 depending on the model. (See notes below.)
4. Press the ► button to accept the value and display the Outputs menu.

NOTES:

1. The T775A/B/M models have the following outputs available:
   T775A20191 relay output
   T775B2016up to 2 relay outputs
   T775B2024up to 4 relay outputs
   T775B2032up to 2 relay outputs
   T775B2040up to 4 relay outputs
   T775M2006no relay outputs
   T775M2014up to 4 relay outputs
2. The number of relay outputs entered here determines how many relays display on the home screen.

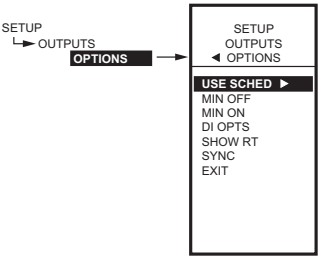



**Fig. 57. Setup - Outputs - Options Menu.**

## 2.3.3. OPTIONS

1. From the Outputs menu, use the ▲ and ▼ buttons to highlight OPTIONS.
2. Press the ► button to display the Options menu.

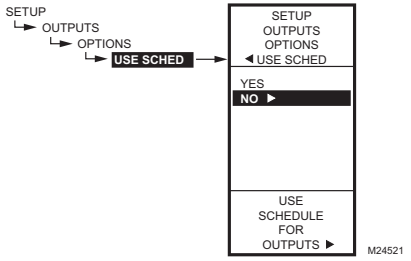



**Fig. 58. Setup - Outputs - Options - Schedule.**

## 2.3.3.1. USE SCHED

1. Press the ▶ button to display the schedule selections.
2. Use the ▲ and ▼ buttons to highlight YES or NO.
   Default: NO
3. Press the ▶ button to accept the value and display the MIN OFF option.

Selecting NO disables scheduling for **all** outputs.

Selecting YES enables scheduling for **all** outputs. When YES is selected, all individual outputs default to follow the schedule. However, each individual output can be removed from scheduling as desired.

With Scheduling enabled, when you return to Program mode, the new option for Scheduling displays. You can press the home key and then the menu key to view the Schedule options in the menu.

See “2.3.1.5. SCHEDULE” on page 23.

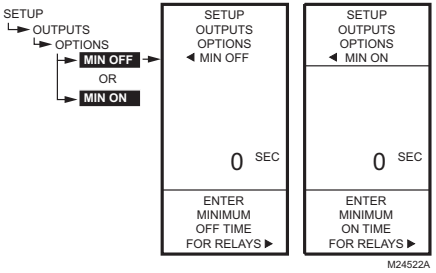



**Fig. 59. Setup - Outputs - Options - Min Off/On Time.**

## 2.3.3.2. MIN OFF or MIN ON

This is the minimum number of seconds of “off time” or “on time” for **all** relays.

1. Press the ▶ button to display the Min Off/On value.
2. Use the ▲ and ▼ buttons to increase/decrease the desired number of seconds from 0 to 990 seconds in 10 second increments.
   Default: 0 (zero)
   Range: 0 to 990 seconds
3. Press the ▶ button to accept the seconds and display the DI OPTIONS.

NOTES:

1. The minimum OFF or ON time applies to **all** relay outputs.
2. When minimum OFF or ON time is active, relays waiting to be energized display a flashing square underneath the relay number on the home screen.
3. If the minimum OFF time is not equal to zero (0), the minimum OFF time activates at power-up. To manually override, press the ◄ button at any time.

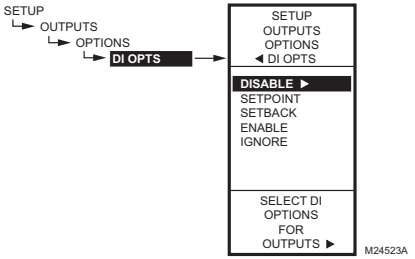



**Fig. 60. Setup - Outputs - Options - DI Options.**

## 2.3.3.3. DI OPTIONS (digital input options)

The DI Option you select applies to **all** outputs. This option overrides any Setpoint/Setback values entered in the Schedule.

1. Press the ► button to display the DI Option selections.
2. Use the ▲ and ▼ buttons to highlight DISABLE, SETBACK, or IGNORE.
   Default: DISABLE
3. Press the ► button to accept the value and display the SHOW RT option.

When the digital input (DI) closes, all outputs follow the DI option value (Disable, Setback, or Ignore):

- **DISABLE** disables the outputs; relays return to de-energized state and Mod outputs return to 0% output.
- **SETPOINT** forces the control to the setpoint temperature.
- **SETBACK** enables a setback temperature value to be programmed for each output and forces the control to the setback temperature.
  — To program the Setback temperature, see Fig. 34 on page 16.
- **ENABLE** energizes all relays and MOD outputs to 100%. Use this option carefully.
- **IGNORE** causes the digital input to have no effect on the Relay or Mod outputs.

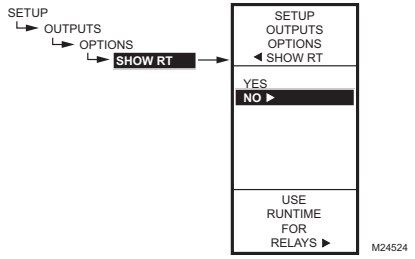



**Fig. 61. Setup - Outputs - Options - Show Runtime.**

## 2.3.3.4. SHOW RT (show run time hours)

1. Press the ► button to display the Show RT values.
2. Use the ▲ and ▼ buttons to select YES or NO.
   Default: YES
3. Press the ► button to accept the value and return to the Options menu.

Selecting YES shows the RT (run time) hours for **each** relay on the home screen displays.

**NOTE: Run times can be reset to zero for each individual relay. You must do this for each relay that you want to reset to zero. See "2.3.4.3. RESET RT (run time hours)" on page 29.**

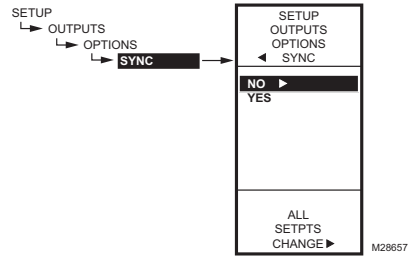



**Fig. 62. Setup - Outputs - Options - Sync.**

## 2.3.3.5. SYNC (synchronize setpoint changes)

1. Press the ► button to display the Sync values.
2. Use the ▲ and ▼ buttons to select YES or NO.
   Default: NO
3. Press the ► button to accept the value and return to the Options menu.

Depending on the model, selecting YES causes all setpoints for all relays and MODs to sync to any change to:

- Relay 1 for models without MOD outputs
- MOD1 for models with MOD outputs

For example, assume the MOD1 setpoint is 110°F, MOD2 is 115°F, and Relay 1 is 120°F. With SYNC=YES, when the MOD1 setpoint is adjusted to 112°F (increase 2°F), then MOD2 and all other relay setpoints increase by 2°F. Thus the MOD2 setpoint is now 117°F and the relay 1 setpoint is 122°F.

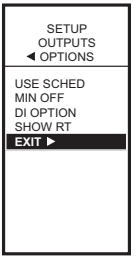



**Fig. 63. Setup - Outputs - Options - Exit.**

## 2.3.3.6. Exit Options Setup

Press the ◄ button (or highlight EXIT and press the ► button) to exit and return to the Outputs menu.

Continue with “2.3.4. Setting up the Relays”

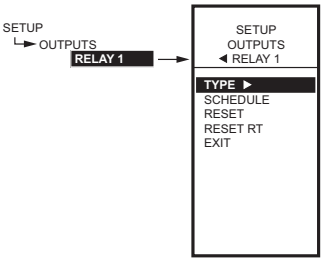



**Fig. 64. Setup - Outputs - Relay Menu.**

## 2.3.4. Setting up the Relays

1. From the Outputs menu, use the ▲ and ▼ buttons to highlight the desired relay (1-4 depending on model).
2. Press the ► button to display the selected relay menu.

The TYPE selection shown in Fig. 64 displays only for Relay 1 and Relay 3.

Continue with the remainder of section 3.4 to setup the relay outputs.

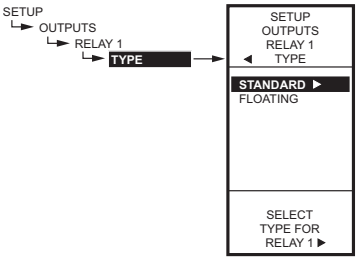



**Fig. 65. Setup - Outputs - Relay - Type.**

## 2.3.4.1. TYPE (standard or floating)

The Floating option is only available on the T775B2016, T775B2024, T775B2032, and T775B2040 models.

For these models, this selection displays only for Relay 1 and/or Relay 3.

1. Press the ► button to display the Type values.
2. Use the ▲ and ▼ buttons to select STANDARD OR FLOATING.
   Default: STANDARD (not floating)
3. Press the ► button to accept the value and return to the Relay menu.

If you select FLOATING, the relays are paired (1-2 or 3-4) and are setup together. Continue with “2.3.4.1.1. Floating Relay Menu”.

If you select STANDARD, go to “2.3.4.2. SCHEDULE” on page 29.

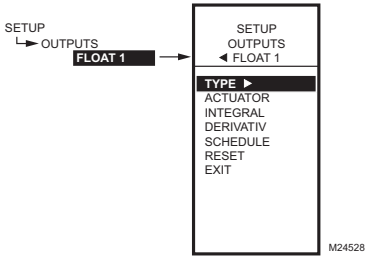



**Fig. 66. Setup - Outputs - Floating Relay - Menu.**

## 2.3.4.1.1. Floating Relay Menu

The Floating option is only available on the T775B2016, T775B2024, T775B2032, and T775B2040 models.

When Relay 1 or Relay 3 is setup as floating, relays are paired and the Float 1 or Float 2 menu displays with the selections shown in Fig. 66.

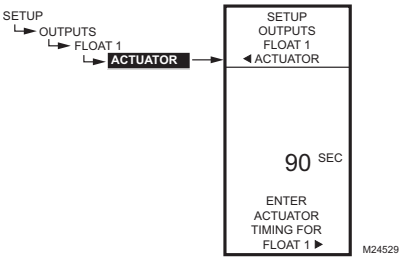



**Fig. 67. Setup - Outputs - Floating Relay - Actuator.**

### 2.3.4.1.1.1. ACTUATOR (floating relay only)

The Actuator option displays only on the T775B2016, T775B2024, T775B2032, and T775B2040 models when the Type option = Floating.

1. From the menu, use the ▲ and ▼ buttons to highlight ACTUATOR.
2. Press the ► button to display the actuator value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired number of seconds.
   Default: 90 seconds
   Range: 0 to 3,600 seconds)
4. Press the ► button to accept the value and display the INTEGRAL option.

The actuator run time is defined as the time needed to move the actuator from the fully closed to fully open position and visa versa.

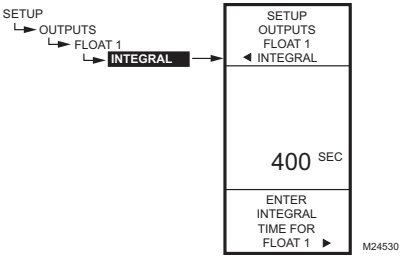



**Fig. 68. Setup - Outputs - Floating Relay - Integral.**

### 2.3.4.1.1.2. INTEGRAL (modulating/floating relay only)

The Actuator option displays only on the T775B2016, T775B2024, T775B2032, and T775B2040 models when the Type option = Floating.

1. From the menu, use the ▲ and ▼ buttons to highlight INTEGRAL.
2. Press the ► button to display the actuator value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired number of seconds.
   Default: 400 seconds
   Range: 0 to 3,600 seconds)
4. Press the ► button to accept the value and display the DERIVATIV option.

See Integral NOTES on page 22 for additional information about setting the Integral time.

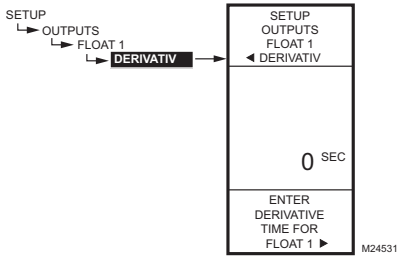



**Fig. 69. Setup - Outputs - Floating Relay - Derivative.**

## 2.3.4.1.1.3. DERIVATIVE (modulating/floating relay only)

The Derivative option displays only on the T775B2016, T775B2024, T775B2032, and T775B2040 models when the Type option = Floating.

1. From the menu, use the ▲ and ▼ buttons to highlight DERIVATIV.
2. Press the ► button to display the actuator value.
3. Use the ▲ and ▼ buttons to increase/decrease the desired number of seconds.
   Default: 0 seconds
   Range: 0 to 3,600 seconds)
4. Press the ► button to accept the value and display the SCHEDULE option.

Continue with "2.3.4.2. SCHEDULE" for the remaining relay selections.

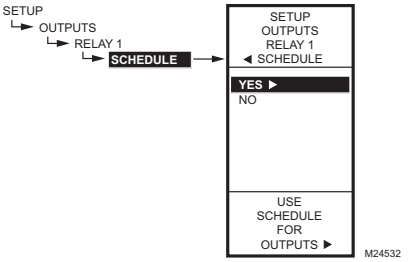



**Fig. 70. Setup - Outputs - Relay - Schedule.**

## 2.3.4.2. SCHEDULE

This selection displays only if "Use Sched = YES" is selected during the Output Options setup (see "2.3.3.1. USE SCHED" on page 25). When selected, individual outputs default to follow the schedule.

1. Press the ► button to display the Schedule values.
2. Use the ▲ and ▼ buttons to select YES or NO.
   Default: YES
3. Press the ► button to accept the value and return to the Relay menu.

An individual output can be selected to be controlled or not controlled by the schedule.

If NO is selected, the Setback selection does not appear in the Program menu for this output.

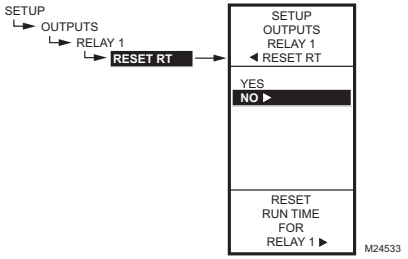



**Fig. 71. Setup - Outputs - Relay - Reset Runtime.**

## 2.3.4.3. RESET RT (run time hours)

This selection displays only if "Show RT = YES" is selected during Output Options setup (see "2.3.3.4. SHOW RT (show run time hours)" on page 26).

1. From the Relay menu, press the ► button to display the Reset RT values.
2. Use the ▲ and ▼ buttons to select YES or NO.
   Default: NO
3. Press the ► button to accept the value and return to the Relay menu.

Selecting YES immediately resets the output run time hours to zero for this output. When you subsequently return to this screen, the RESET RT defaults to NO.

**NOTE: Run times can be reset to zero for each individual relay. You must do this for each relay that you want to reset to zero.**

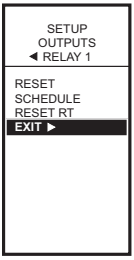



**Fig. 72. Setup - Outputs - Relay - Exit.**

## 2.4. EXIT Setup Mode

Press the ◄ button to exit the selected relay set up and return to the Outputs menu.

To setup the next relay output go to "2.3.4. Setting up the Relays" on page 27.

If you are finished setting up the relay outputs, press the **HOME** button to exit Setup mode and return to the home screen display.

This completes the Setup procedure.

# 3. SCHEDULING

Scheduling provides the ability to set daily temperature settings for up to two events per day. Typically, these are the daytime (setpoint) and the nighttime (setback) settings.

***IMPORTANT***

*To enable Scheduling, you must first enter Setup mode (press and hold the **MENU** button for 5 seconds), select OUTPUTS, select OPTIONS, select USE SCHED, and then select YES. (See "2.3.3.1. USE SCHED" on page 25).*

***IMPORTANT***

*To properly account for Daylight Saving time, be sure to set the Date **before** setting the Time. See "3.2.2. SET DATE" on page 31.*

**NOTE: Each output is independently configurable to follow the schedule or not. For modulating outputs, See "2.3.1.5. SCHEDULE" on page 23. For relay outputs, see "2.3.4.2. SCHEDULE" on page 29.**

**NOTE: The controller interface is intuitive. You may find that you do not need the following scheduling instructions. You may want to use this procedure simply as a reference to locate the particular option or parameter of interest.**

NOTES:

1. If you press the **HOME** button or there is no keypad activity for four minutes, you exit Scheduling mode and return to the home screen.
2. If you press the **MENU** button, you exit Scheduling mode and return to the menu.

To create or change a schedule, you use the —

- **Left arrow button** ( ◄ ) to scroll backward through the Schedule menus
- **Right arrow button** ( ► ) to select the highlighted menu item and display its content
- **Up and Down arrow buttons** ( ▲ and ▼ ) to scroll up and down through a list of items or to increase or decrease the value of a displayed schedule parameter

## Creating a Schedule

To create a schedule, perform the following in the order listed:

1. Enable Scheduling in Setup mode - See *"2.3.3.1. USE SCHED" on page 25*
2. Enter Schedule mode — See "3.1. Entering Schedule Mode"
3. Set the Schedule Options — See "3.2. OPTIONS"
4. Set Individual Schedules — begin with "3.3. Setting Individual Schedules" on page 32
5. Exit Schedule Mode — See "3.4. Exiting Scheduling Mode" on page 33

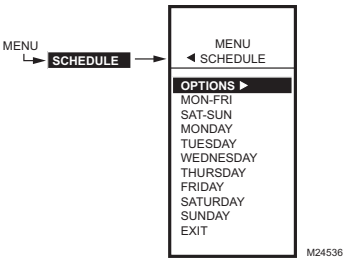



**Fig. 73. Schedule - Menu.**

## 3.1. Entering Schedule Mode

Press the **MENU** button, then select SCHEDULE and press the ► button to view the Schedule menu.

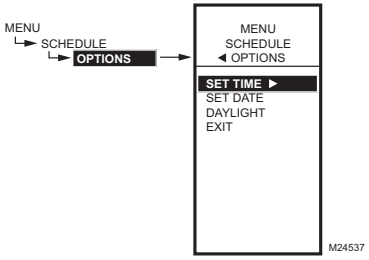



**Fig. 74. Schedule - Options Menu.**

## 3.2. OPTIONS

1. From the Schedule menu, use the ▲ and ▼ buttons to highlight OPTIONS.
2. Press the ► button to display the Options menu.

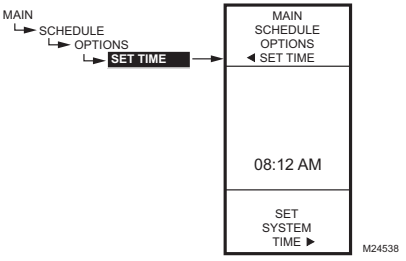



**Fig. 75. Schedule - Options - System Time.**

## 3.2.1. SET TIME

Setting the system time is required to enable the controller to follow daylight saving time.

***IMPORTANT***

*Set the Date **before** setting the Time. See "3.2.2. SET DATE".*

1. From the Options menu, use the ▲ and ▼ buttons to highlight SET TIME.
2. Press the ► button to display the current system time setting.
3. Use the ► button to cycle between the hour, minute, and AM/PM values.
4. Use the ▲ and ▼ buttons to increase/decrease the desired value for the hour, minute, and AM/PM.
5. Press the ◄ button to accept the Time and return to the Options menu.

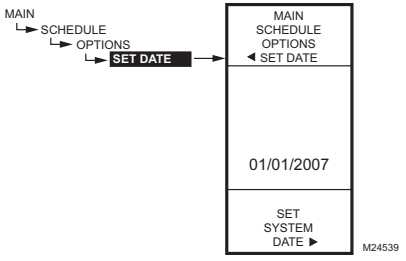



**Fig. 76. Schedule - Options - System Date.**

## 3.2.2. SET DATE

Setting the system date is required to enable the controller to follow daylight saving time.

***IMPORTANT***

*To properly account for Daylight Saving time, be sure to set the Date **before** setting the Time.*

1. From the Options menu, use the ▲ and ▼ buttons to highlight SET DATE.
2. Press the ► button to display the current system date setting.
3. Use the ► button to cycle between the month, day, and year values.
4. Use the ▲ and ▼ buttons to increase/decrease the desired value for the month, day, and year.
5. Press the ◄ button to accept the Date and return to the Options menu.

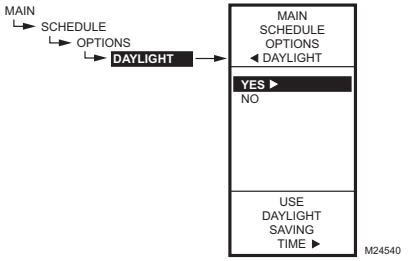



**Fig. 77. Schedule - Options - Daylight Saving Time.**

### 3.2.3. DAYLIGHT (daylight saving time)

1. From the Options menu, use the ▲ and ▼ buttons to highlight DAYLIGHT.
2. Press the ► button to display the current system setting for daylight saving time.
3. Use the ▲ and ▼ buttons to select YES or NO. Default: YES
4. Press the ► button to accept the value and return to the Options menu.
5. From the Options menu, use the Use the ▲ and ▼ buttons to highlight EXIT.
6. Press the ► button to return to the Schedule menu.

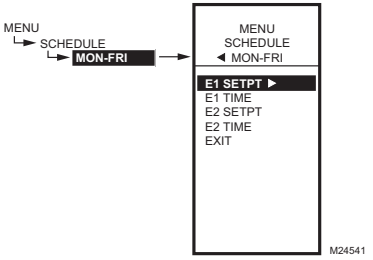



**Fig. 78. Schedule Event Menu (Showing MON-FRI).**

## 3.3. Setting Individual Schedules

As shown in the Schedule menu (Fig. 73 on page 30), schedules can be set for the following time periods:

- Monday through Friday
- Saturday and Sunday
- Individual days of the week

1. From the Schedule menu, use the ▲ and ▼ buttons to highlight the desired time period.
2. Press the ► button to display the Schedule menu for the selected time period.

For each selected time period, the schedule event (E1 and E2) parameters are exactly the same as shown in Fig. 78.

**SCHEDULING EXAMPLE**

Setting the schedule is independent of the temperature settings for the relay outputs. The following illustrates a weekly schedule for daytime (setpoint) and night time (setback) use and shows the factory default settings:

**Table 4. Mon-Fri Schedule Defaults**

| DAY | EVENT | SETPT ACTION | TIME |
|---|---|---|---|
| Mon-Fri | Event 1 (E1) | Setpoint | 6:00 AM [a] |
| Mon-Fri | Event 2 (E2) | Setback | 6:00 PM [b] |
| Sat-Sun | Not used; remains in Setback from Mon-Fri E2 settings | | |

[a] Setpoint time span is 6:00 AM until 5:59 PM because setback starts at 6:00 PM.

[b] Setback time span is 6:00PM until 5:59 AM because setpoint starts at 6:00 AM.

To set a schedule, continue with “3.3.1. E1 SETPT (setpoint for event 1)”.

The following figures show the MON-FRI menu, but the menu selections are the same for any time period.

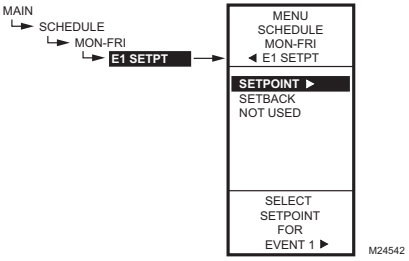



**Fig. 79. Schedule - Event 1 Setpoint.**

### 3.3.1. E1 SETPT (setpoint for event 1)

1. From the selected time period menu, use the ▲ and ▼ buttons to highlight E1 SETPT.
2. Press the ► button to display the setpoint options.
3. Use the ▲ and ▼ buttons to highlight the desired option.
4. Press the ► button to accept the value and return to the selected time period menu.

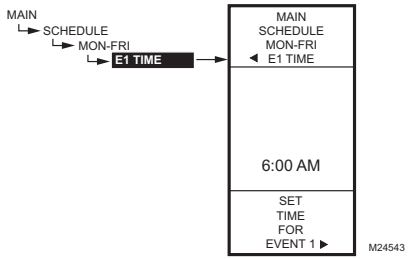



**Fig. 80. Schedule - Event 1 Time.**

### 3.3.2. E1 TIME (time for event 1)

1. From the selected time period menu, use the ▲ and ▼ buttons to highlight E1 TIME.
2. Press the ► button to display the current time setting for event 1.
3. Use the ► button to cycle between the hour, minute, and AM/PM values.
4. Use the ▲ and ▼ buttons to increase/decrease the desired value for the hour, minute, and AM/PM.
5. Press the ◄ button to accept the time and return to the selected time period menu.

### 3.3.3. E2 SETPOINT (setpoint for event 2)

Creating the setpoint for event 2 is accomplished the same way as the first event. See“3.3.1. E1 SETPT (setpoint for event 1)” on page 33.

### 3.3.4. E2 TIME (time for event 2)

Creating the time for event 2 is accomplished the same way as the first event. See “3.3.2. E1 TIME (time for event 1)” above.

### 3.3.5. EXIT (exit from selected time period settings)

After entering the time for event 2, use the ◄ button to exit the schedule time period and return to the Schedule menu (Fig. 73 on page 30) to select a different time period.

When you finish scheduling the time periods, continue with “3.4. Exiting Scheduling Mode”.

## 3.4. Exiting Scheduling Mode

Press the **HOME** button to exit the Schedule menu and return to the home screen display.

This completes the Scheduling procedure.

# SUMMARY MENU

The Summary menu provides the ability to view the schedule (E1 and E2 times) for each relay for each day of the week.

**NOTE: Scheduling must be enabled for the Summary menu to display. Enabling the schedule is determined in the Setup process for the Output Options (see "2.3.3.1. USE SCHED" on page 25).**

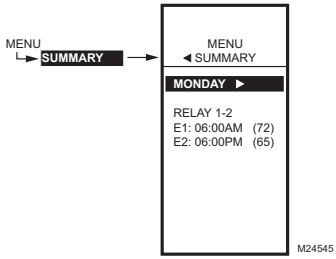



**Fig. 81. Summary Example - Monday Settings.**

For each relay, the Summary display indicates the time and temperature (in parenthesis) for each of the two scheduled events E1 and E2.

1. Press the **MENU** button to view the menu.
2. Use the ▲ and ▼ buttons to highlight SUMMARY.
3. Press the ► button to display the Summary settings.
4. Use the ► button to scroll forward through each day of the week (Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday).
5. While viewing a specific day, use the ▲ and ▼ buttons to cycle through the individual relay schedules for that day.

When finished, press the home key to return to the home display screen.

# TROUBLESHOOTING

## Power Loss

The date and time settings are retained for 24 hours after a power outage. After a power loss of more than 24 hours, the date and time settings may need to be reentered. All other settings are stored permanently.

## Errors and Diagnostics

The controller provides an error message and diagnostic status as described below.

### Error Message

There is a two-character error code that displays in response to controller software problems:

**EE**

**EEPROM Failure** — The values read back from the EEPROM are not the same as written into the EEPROM. This error cannot be field repaired. Replace the device.

### Diagnostic Messages

There are two diagnostic messages that can display in response to sensor problems. The diagnostic codes that can flash on the display are:

**– –**

**Sensor Open or Shorted** — Two dashes display when a sensor (typically temperature) is open or shorted. An open circuit is considered anything greater than 1570 ohms (greater than 300F), shorted anything less than 770 ohms (less than -73F). Whichever stages are operating with this sensor cease to control (meaning relays go to OFF and proportional outputs go to zero percent).

This message can also mean that the sensor is programmed, but not physically connected.

**-60°** or **270° F** (-51° or 132° C) Blinking

**Temperature Out of Range** — The temperature display blinks when the sensed temperature range is outside of the display range, below -60° F (-51° C) or above 270° F (132° C). The displayed value remains at that displayed limit and control continues. Controller continues to function unless an open or shorted state is detected.

#### Blinking relay status

**Relay Minimum Off Time is Active** — On the home screen, each relay's indicator (■) blinks while the relay's minimum off time is active.

# SPECIFICATIONS

**Power:** 24, 120, or 240 Vac; 50/60 Hz;
A separate earth ground is required for any power source.

**Power Consumption:**
- 8 VA maximum at 60 Hz
- 10 VA maximum at 50 Hz

**Operating & Storage Temperature Ambient Rating:**
- -40° to 125° F (-40° to 52° C) @ 50 Hz
- -40° to 140° F (-40° to 60° C) @ 60 Hz

**Relative Humidity:** 5% to 95% non-condensing

**Relay Contact Output Ratings (N.O. and N.C.):**
- 1/2 hp; 9.8 AFL, 58.8 ALR @ 120 Vac
- 1/2 hp; 4.9 AFL, 29.4 ALR @ 240 Vac
- 125 VA pilot duty @ 120/240 Vac
- 10A @ 24 Vac (resistive)

**Modulating Outputs:**
- 0-10 Vdc; drive a minimum of 2,000 Ohms
- 2-10 Vdc; drive a minimum of 2,000 Ohms
- 4-20 mA; drive a maximum of 600 Ohms
- Electronic Series 90
- Floating

# DOC

## Emissions Compliance

EN 55022: 2006
CISPR 22: 2006
VCCI V-3/2006.04
ICES-003, Issue 4: 2004
FCC PART 15 SUBPART B Class B Limit

## Immunity Compliance

EN 61000-6-1: 2001 covering
EN 61000-4-2: 1995 + A1: 1998 + A2: 2001
EN 61000-4-3: 2002
EN 61000-4-4: 2004
EN 61000-4-5: 1995 + A1: 2001
EN 61000-4-6: 1996 + A1: 2001
EN 61000-4-8: 1993 + A1: 2001
EN 61000-4-11 2nd Ed.: 2004

## Safety Compliance

UL 60730-1 for US and Canada

## FCC Compliance Statement:

This equipment has been tested and found to comply with limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television equipment reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
— Reorient or relocate the receiving antenna
— Move the equipment away from the receiver
— Plug the equipment into an outlet on a circuit different from that to which the receiver is connected
— Consult the dealer or an experienced radio/television technician for additional suggestions

You are cautioned that any change or modifications to the equipment not expressly approve by the party responsible for compliance could void Your authority to operate such equipment.

This device complies with Part 15 of the FCC Rules. Operation is subjected to the following two conditions 1) this device may not cause harmful interference and 2) this device must accept any interference received, including interference that may cause undesired operation.

By using this Honeywell literature, you agree that Honeywell will have no liability for any damages arising out of your use or modification to, the literature. You will defend and indemnify Honeywell, its affiliates and subsidiaries, from and against any liability, cost, or damages, including attorneys' fees, arising out of, or resulting from, any modification to the literature by you.

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62-0254—13 M.S. Rev. 10-12
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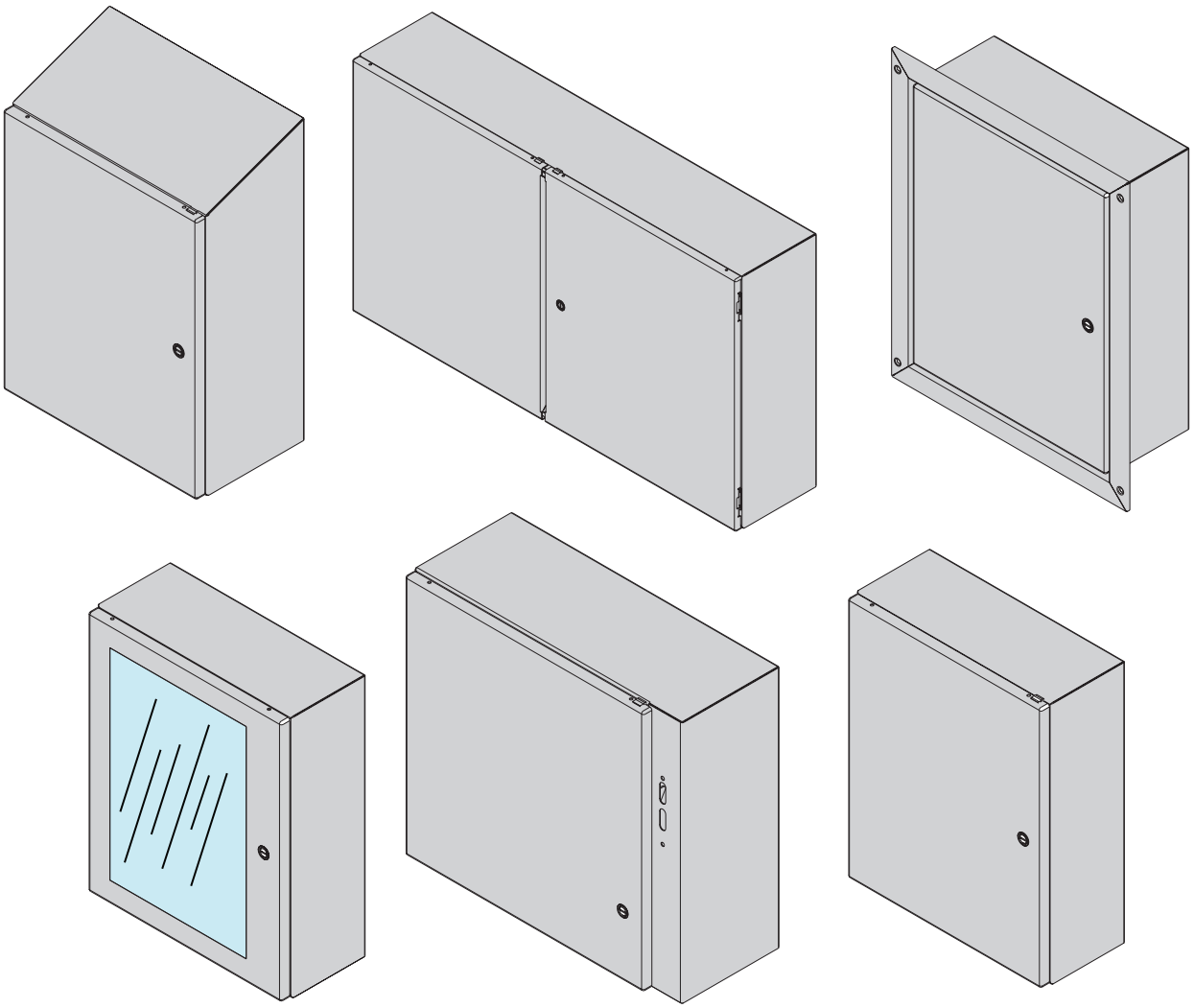
# CONCEPT™

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| | | |
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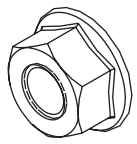
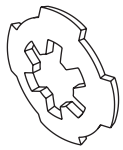
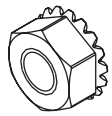
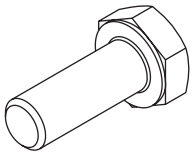
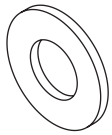
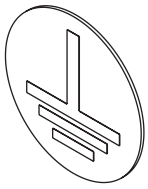
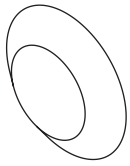
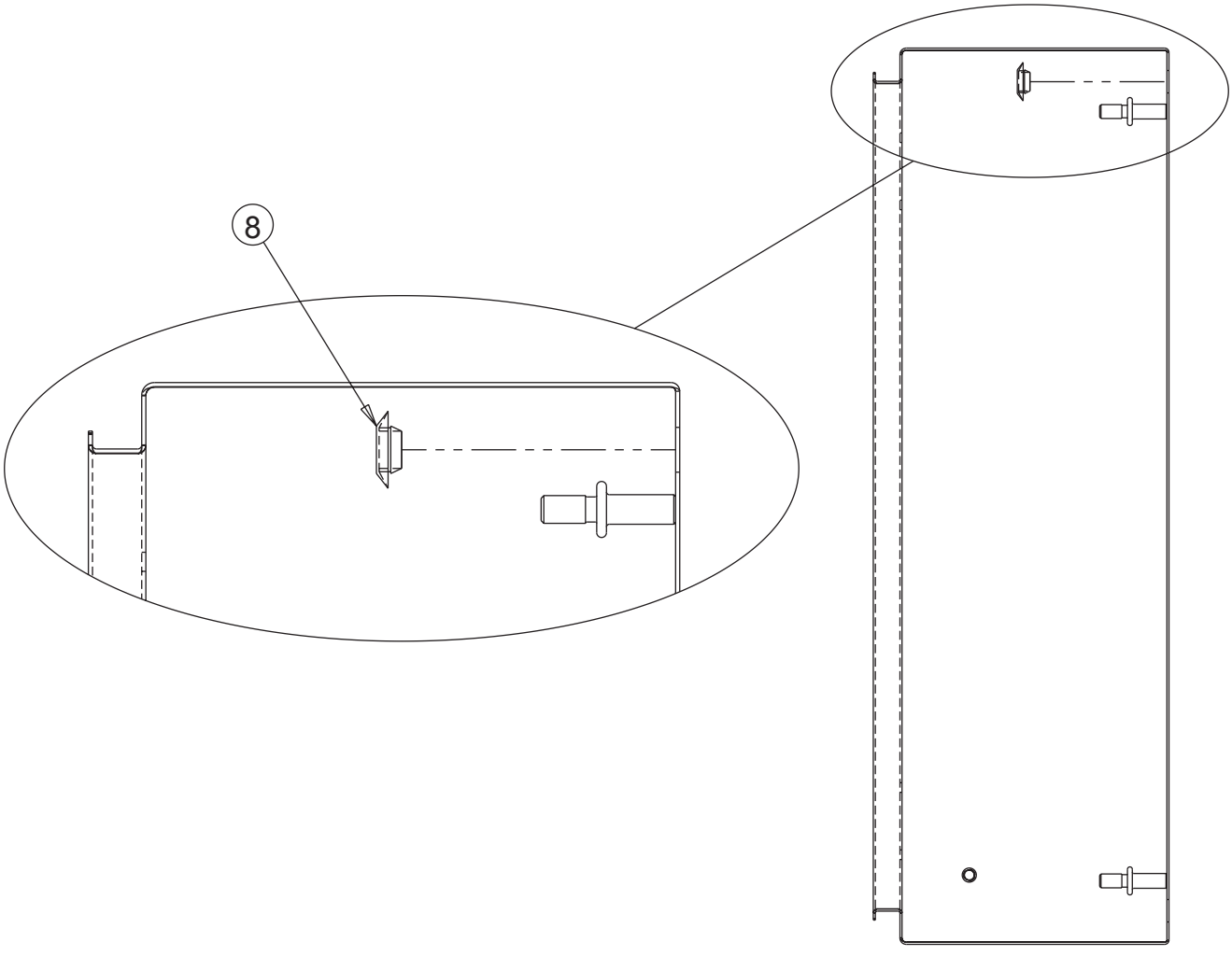
| 1 M8X1.25  (4x) (8x) | 2 3/8  (1x) | 3 M6X1  (6x) |
| 4 M6X1  (2x) | 5 3/8 (4x) | 6 3/8  (4x) |
| 7  (2x) | 8 1/2  (4x) | 9 (0x) |





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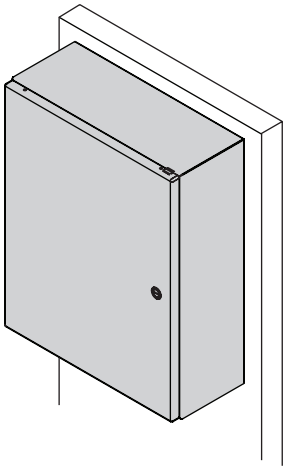

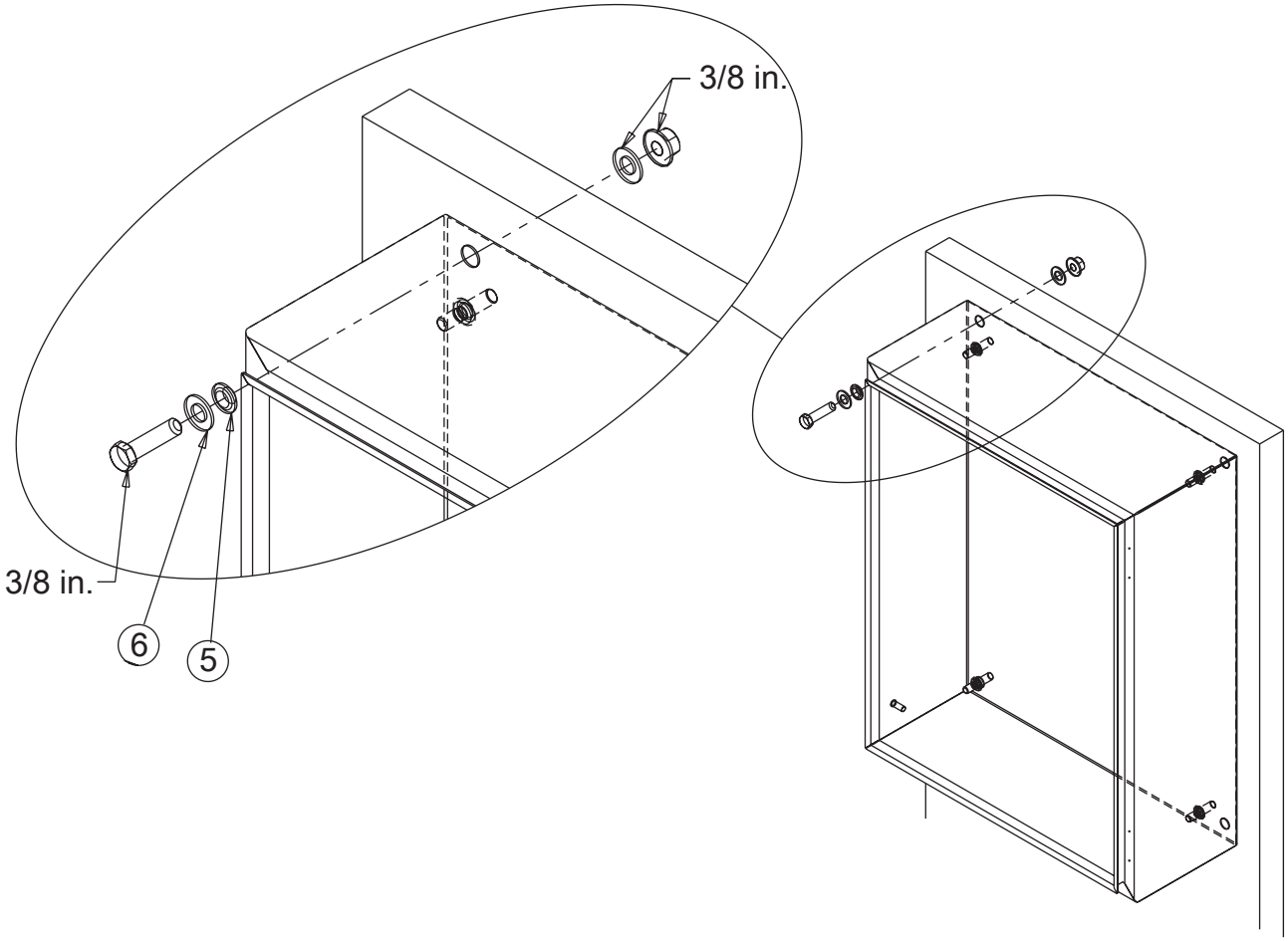



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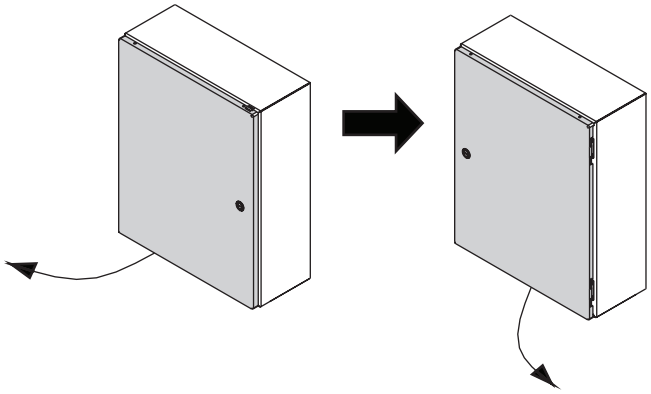

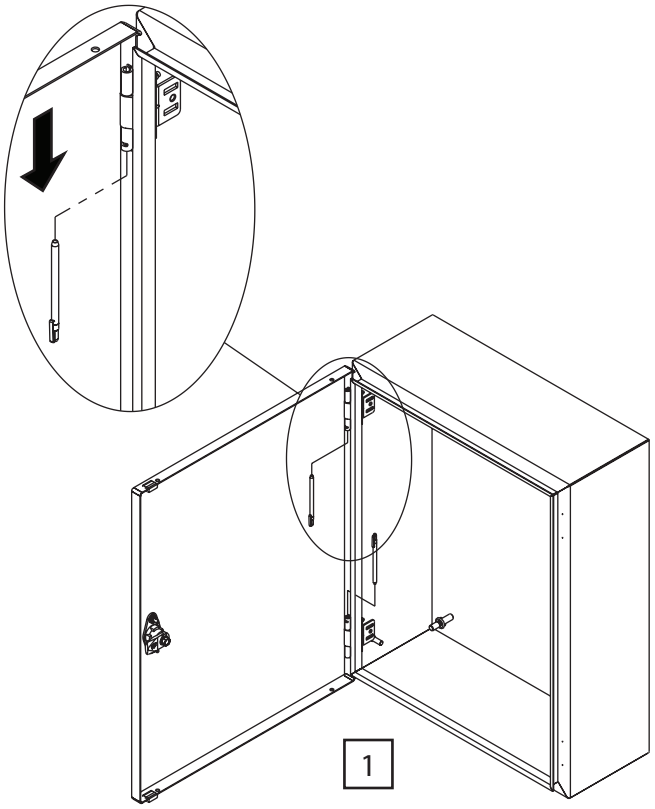


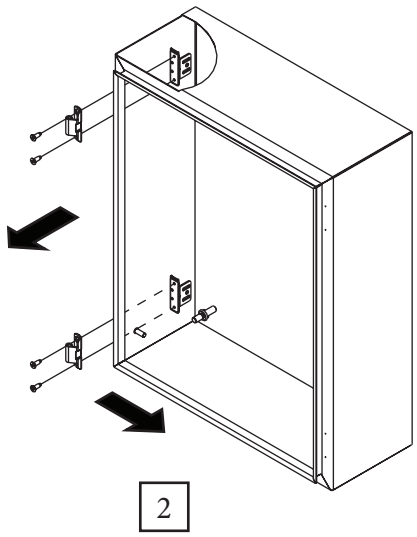


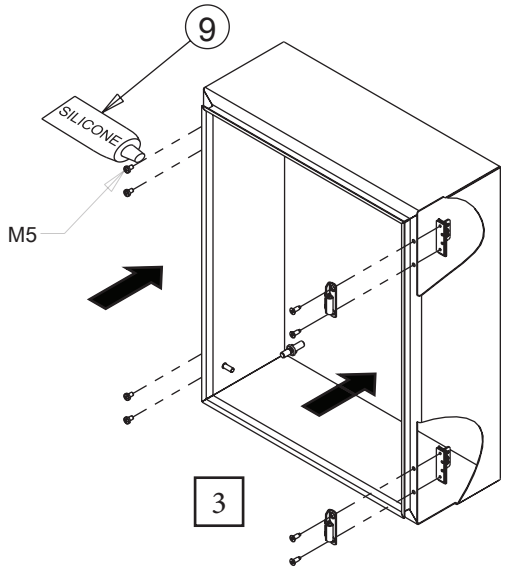


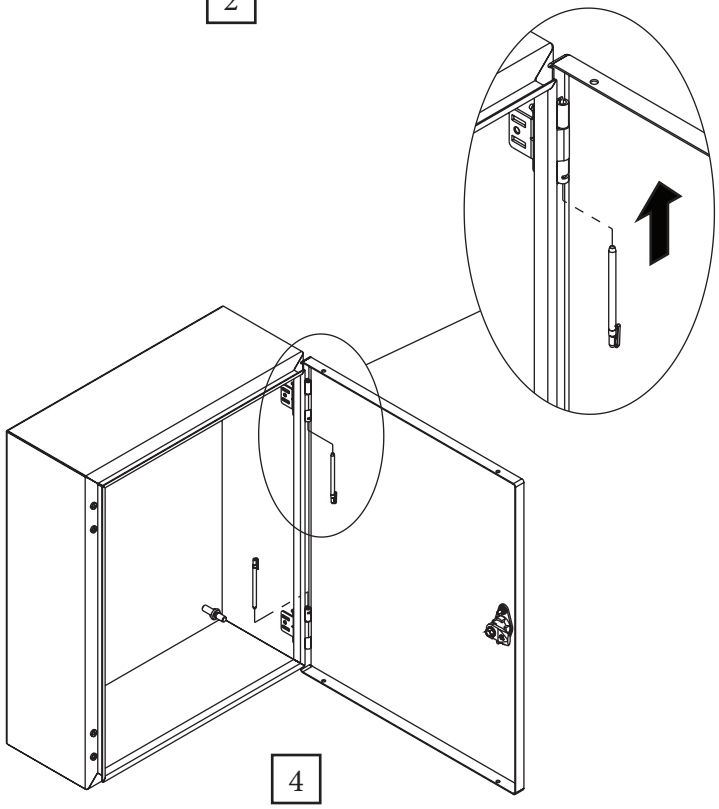



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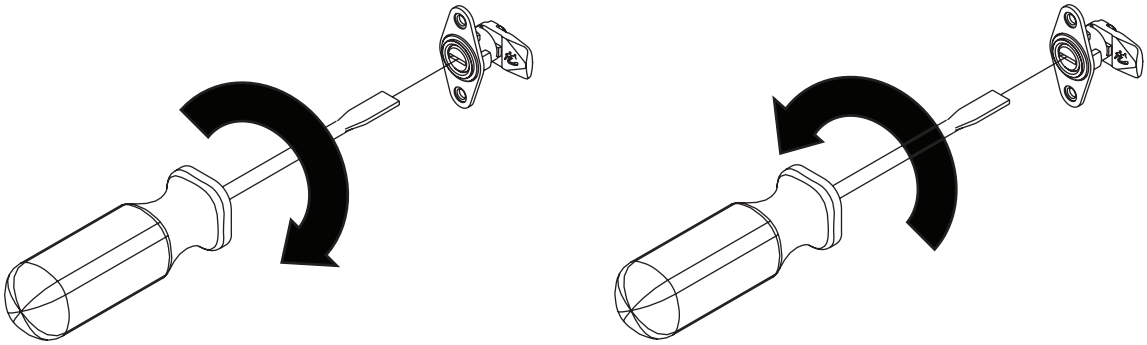

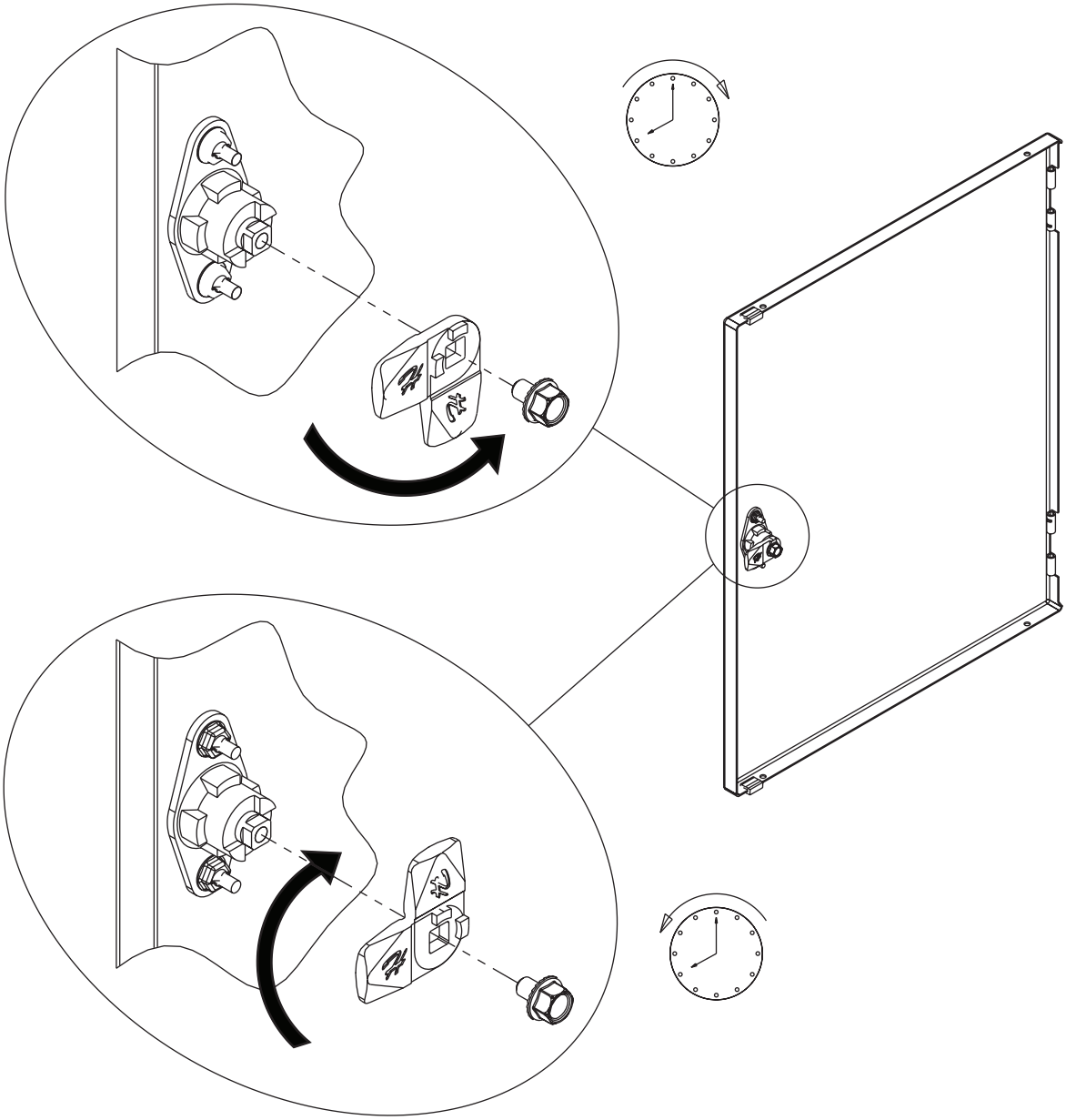


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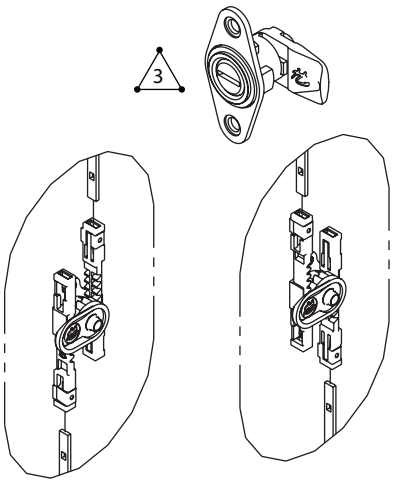


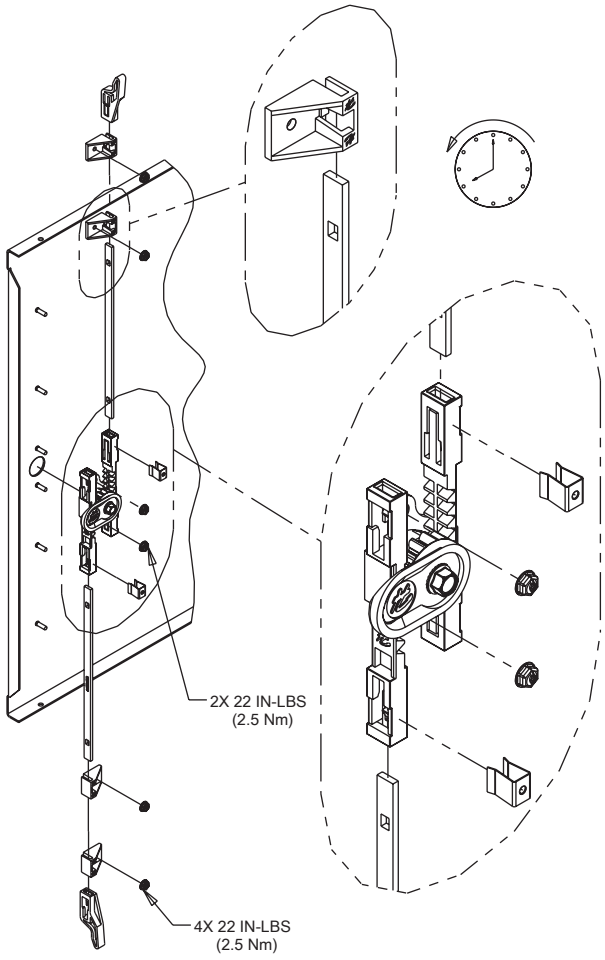


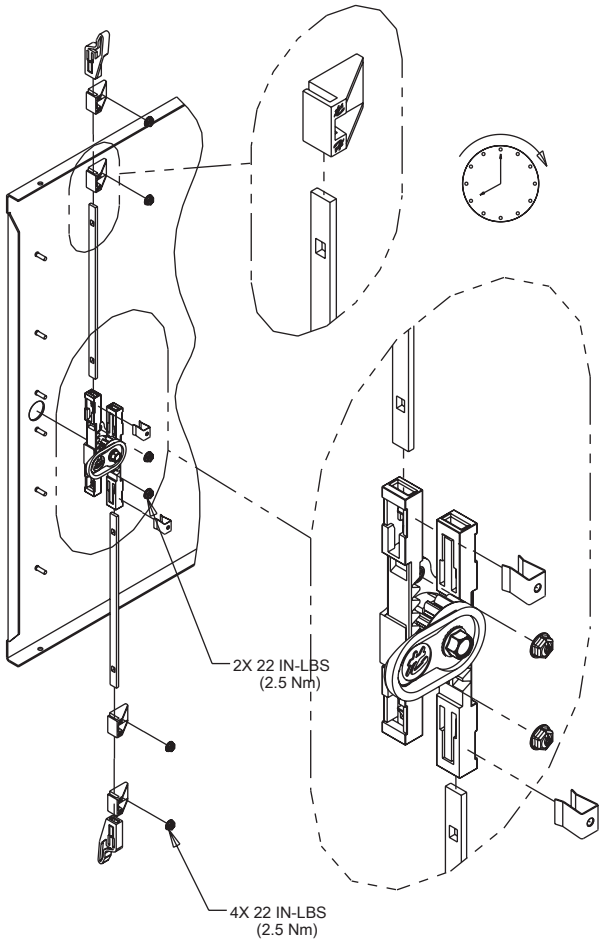



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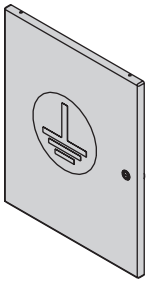

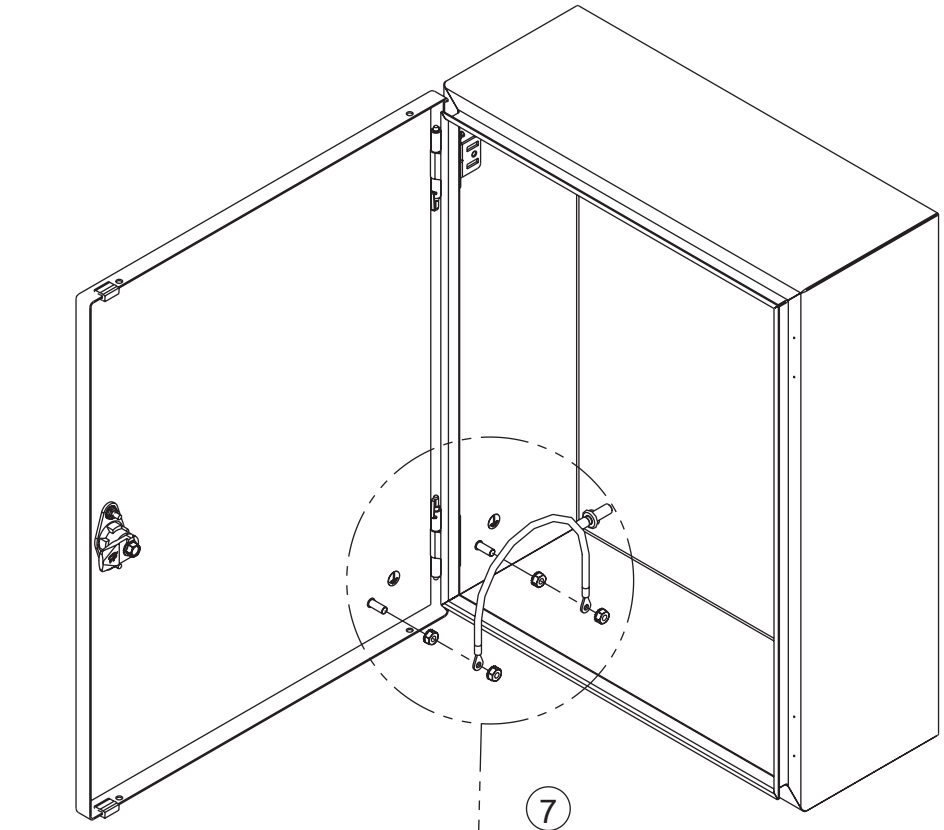

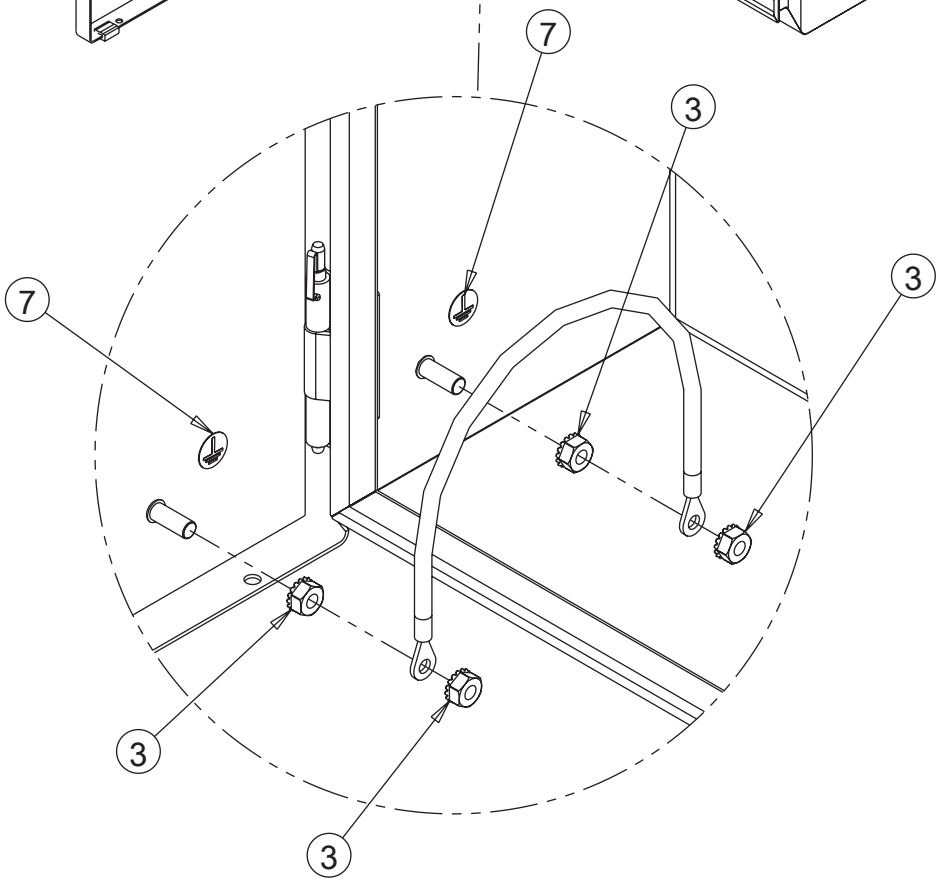



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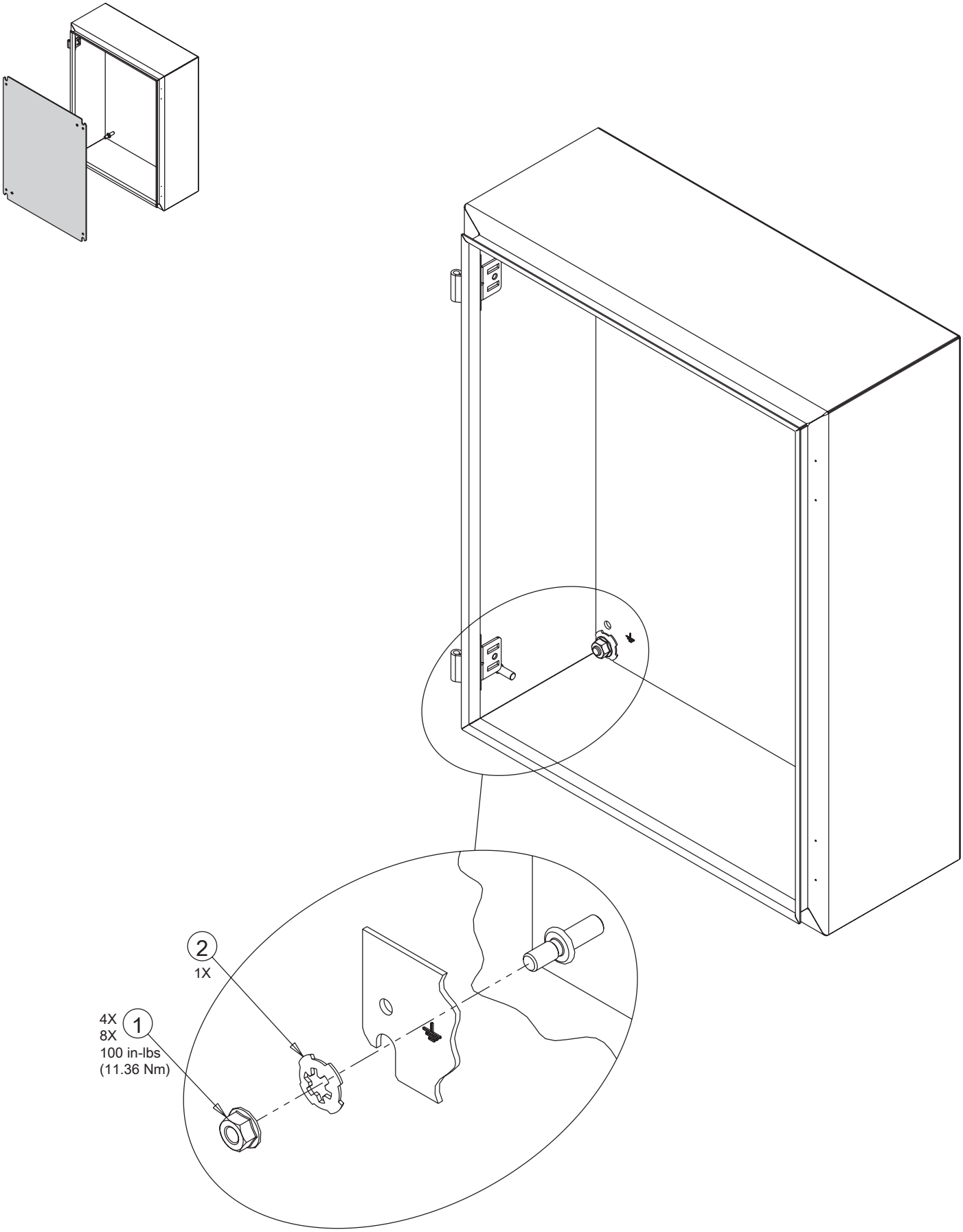



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*Installation Instructions*

# 1769 Compact I/O Communication Bus Expansion Cables

(Cat. No. 1769-CRR1, -CRR3, -CLL1, -CLL3, -CRL1, -CRL3)

**Inside ...**


For More Information ..... 2
Hazardous Location Considerations ..... 3
Environnements dangereux ..... 4
Overview ..... 4
Cable Types and Lengths ..... 5
System Configurations ..... 6
Installation ..... 7


Publication 1769-IN014B-EN-P - May 2002

## For More Information

| For | Refer to this Document | Pub. No. |
|---|---|---|
| Information on how to install and use your 1769-ADN Adapter | Compact™ I/O 1769-ADN DeviceNet Adapter Installation Instructions | 1769-IN001 |
| Installation guides for 1769 Discrete Compact I/O module 1769-IA8I | Compact 1769-IA8I Individually Isolated 120V ac Input Module | 1769-IN012 |
| Installation guides for 1769 Discrete Compact I/O module 1769-IA16 | Compact 1769-IA16 120V ac Input Module Installation Instructions | 1769-IN006 |
| Installation guides for 1769 Discrete Compact I/O module 1769-OW8 | Compact 1769-OW8 AC/DC Relay Output Module Installation Instructions | 1769-IN051 |
| Installation guides for 1769 Discrete Compact I/O module 1769-OW8I | Compact 1769-OW8I Individually Isolated AC/DC Relay Output Module | 1769-IN053 |
| Installation guides for 1769 Discrete Compact I/O module 1769-IQ16 | Compact 1769-IQ16 24V dc Sink/Source Input Module Installation Instructions | 1769-IN007 |
| Installation guides for 1769 Discrete Compact I/O module 1769-OB16 | Compact 1769-OB16 Solid State 24V dc Source Output Module Installation Instructions | 1769-IN054 |
| Installation guides for 1769 Discrete Compact I/O module 1769-OB16P | Compact 1769-OB16P Solid State 24V dc Source Output Module Installation Instructions | 1769-IN052 |
| Installation guides for 1769 Discrete Compact I/O module 1769-OA8 | Compact 1769-OA8 100 to 240V ac Solid State Output Module Installation Instructions | 1769-IN055 |
| Installation guides for 1769 Discrete Compact I/O module 1769-OV16 | Compact 1769-OV16 Solid State 24V dc Sink Output Module Installation Instructions | 1769-IN056 |
| Installation guides for 1769 Discrete Compact I/O module 1769-IQ6XOW4 | Compact 1769-IQ6XOW4 24V dc Sink/Source Input AC/DC Relay Output Module Installation Instructions | 1769-IN050 |
| Installation guides for 1769 Discrete Compact I/O module 1769-IM12 | Compact 1769-IM12 240V ac Input Module Installation Instructions | 1769-IN011 |
| Installation guides for 1769 Analog Compact I/O module 1769-IF4 | Compact 1769-IF4 Analog Input Module Installation Instructions | 1769-IN048 |
| Installation guides for 1769 Analog Compact I/O module 1769-OF2 | Compact 1769-OF2 Analog Output Module Installation Instructions | 1769-IN049 |
| Installation guides for 1769 Analog Compact I/O module 1769-IF4XOF2 * For Series B DeviceNet adapters only | Compact 1769-IF4XOF2 Combination Analog Module Installation Instructions | 1769-IN057 |
| Information on how to install and use your 1769-IF4XOF2 module | Compact 1769-IF4XOF2 8-Bit Low-Resolution Analog I/O Combination Module User Manual | 1769-UM008 |
| Installation guides for 1769 High Speed Counter module 1769-HSC * For Series B DeviceNet adapters only | Compact 1769-HSC High Speed Counter Module Installation Instructions | 1769-IN030 |
| Installation guides for 1769 Thermocouple/mV module 1769-IT6 | Compact 1769-IT6 Thermocouple/mV Input Module Installation Instructions | 1769-IN026 |

| For | Refer to this Document | Pub. No. |
|---|---|---|
| Information on how to install and use your 1769-IT6 module | Compact 1769-IT6 Thermocouple/mV Input Module User Manual | 1769-UM004 |
| Installation guides for 1769 RTD/resistance module 1769-IR6 | Compact 1769-IR6 RTD/Resistance Input Module Installation Instructions | 1769-IN027 |
| Information on how to install and use your 1769-IR6 module | Compact 1769-IR6 RTD/Resistance Input Module User Manual | 1769-UM005 |
| Installation guides for 1769 power supplies | Compact 1769 Expansion I/O Power Supplies Installation Instructions | 1769-IN028 |
| Installation guides for 1769 cables | Compact I/O Communication Bus Expansion Cables Installation Instructions | 1769-IN014 |
| Installation guides for 1769 end caps and terminators | Compact I/O End Caps/Terminators Installation Instructions | 1769-IN015 |

If you would like a manual, you can:

- download a free electronic version from the internet: **www.ab.com/micrologix** or **www.theautomationbookstore.com**
- purchase a printed manual by:

– contacting your local distributor or Rockwell Automation representative
– visiting **www.theautomationbookstore.com** and placing your order
– calling `1.800.963.9548` (USA/Canada) or `001.330.725.1574` (Outside USA/Canada)

## Hazardous Location Considerations

This product must be installed in an enclosure. This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following ATTENTION statement applies to use in hazardous locations.

**ATTENTION**

EXPLOSION HAZARD

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace components or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
- Do not connect or disconnect components unless power has been switched off or the area is known to be non-hazardous.
- All wiring must comply with N.E.C. article 501-4(b).

## Environnements dangereux

Cet équipement est conçu pour être utilisé dans des environnements de Classe 1, Division 2, Groupes A, B, C, D ou non dangereux. La mise en garde suivante s'applique à une utilisation dans des environnements dangereux.

**ATTENTION**

DANGER D'EXPLOSION

- La substitution de composants peut rendre cet équipement impropre à une utilisation en environnement de Classe 1, Division 2.
- Ne pas remplacer de composants ou déconnecter l'équipement sans s'être assuré que l'alimentation est coupée.
- Ne pas connecter ou déconnecter des composants sans s'être assuré que l'alimentation est coupée.
- Ce produit doit être installé dans une armoire.

## Overview

The 1769-CLLx, -CRRx, and -CRLx cables extend the 1769 bus communication lines. A maximum of two cables can be used in a 1769 system, allowing for three groups or banks of I/O modules. Each bank requires its own power supply. See System Configurations on page 6.

**TIP**

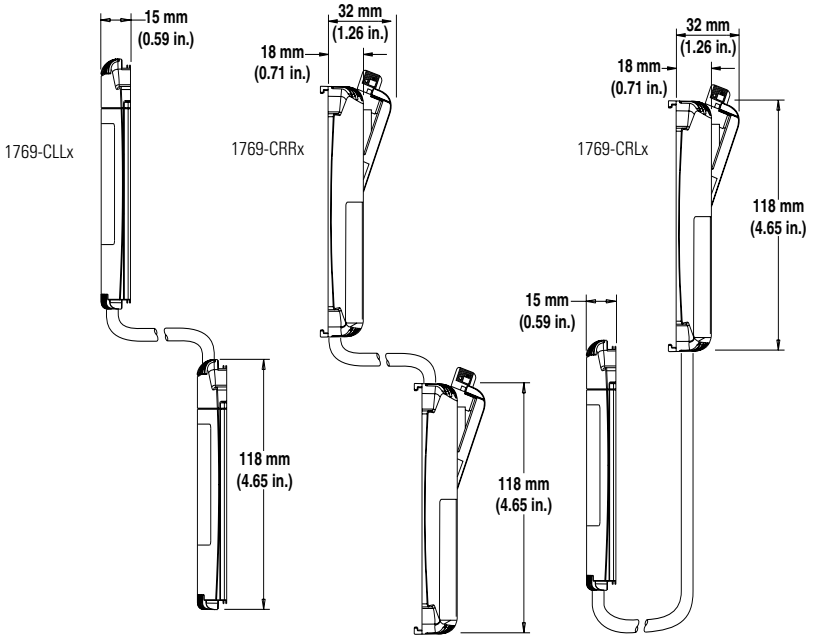
- Some controllers do not support three I/O banks. Refer to your controller's manual for details.
- Some controllers provide power to the I/O bank. Refer to your controller's manual for details.

# Cable Types and Lengths

**Table 1**

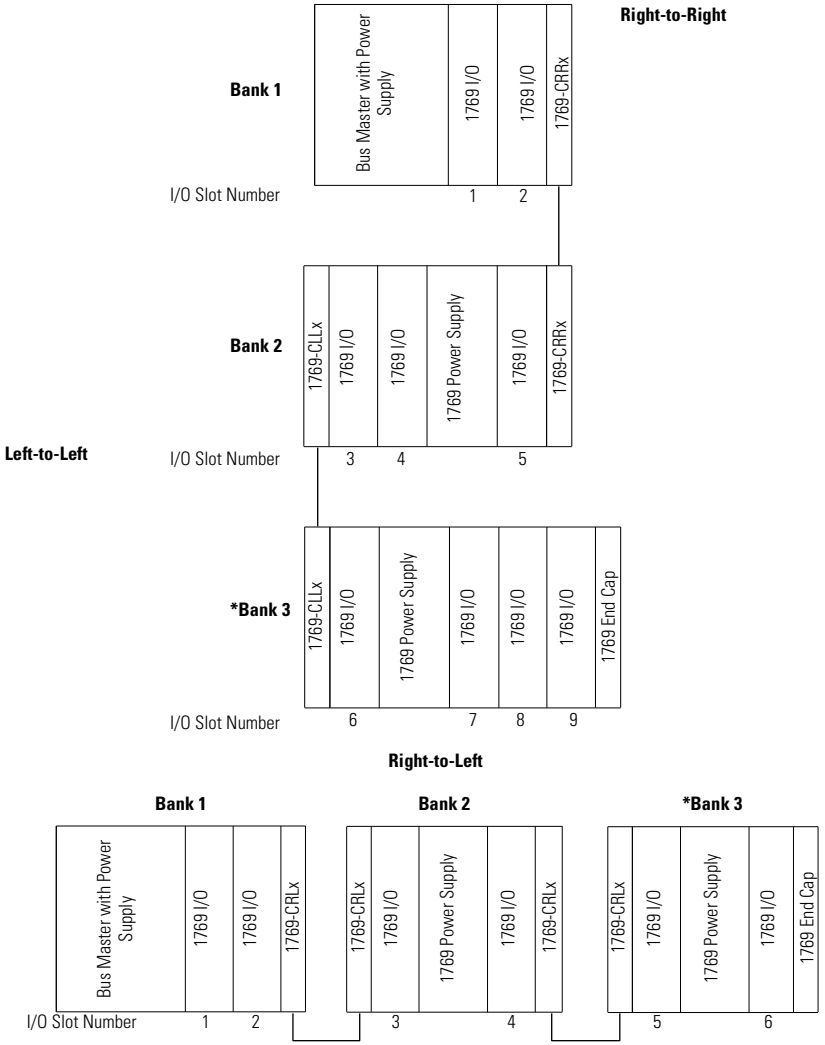
| Catalog Number | Cable Type | Length[1] |
|---|---|---|
| 1769-CLL1 | Left bank-to-left bank expansion | 1 ft. (305 mm) |
| 1769-CLL3 | Left bank-to-left bank expansion | 3.28 ft. (1 m) |
| 1769-CRR1 | Right bank-to-right bank expansion | 1 ft. (305 mm) |
| 1769-CRR3 | Right bank-to-right bank expansion | 3.28 ft. (1 m) |
| 1769-CRL1 | Right bank-to-left bank expansion | 1 ft. (305 mm) |
| 1769-CRL3 | Right bank-to-left bank expansion | 3.28 ft. (1 m) |

(1) Approximate cable length is measured from end-to-end of the cable only.



## System Configurations

The following illustration show examples of two valid system setups.




**TIP**

- When configuring your system using a MicroLogix 1500 controller, only one expansion cable, one expansion power supply, and a maximum of eight I/O modules may be used allowing for two banks of I/O modules (maximum). * An adapter allows three banks and 30 modules maximum.

# Installation

## Prevent Electrostatic Discharge

**ATTENTION**

Electrostatic discharge can damage integrated circuits or semiconductors if you touch bus connector pins or the terminal block. Follow these guidelines when handling 1769 Compact I/O components:

- Touch a grounded object to discharge static potential.
- Wear an approved wrist-strap grounding device.
- Do not touch the bus connector or connector pins.
- Do not touch circuit components inside the module.
- If available, use a static-safe workstation.
- When not in use, keep cables in static shield packaging.

## Remove Power

**ATTENTION**

Remove power before making or breaking cable connections. When you remove or insert a cable connector with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

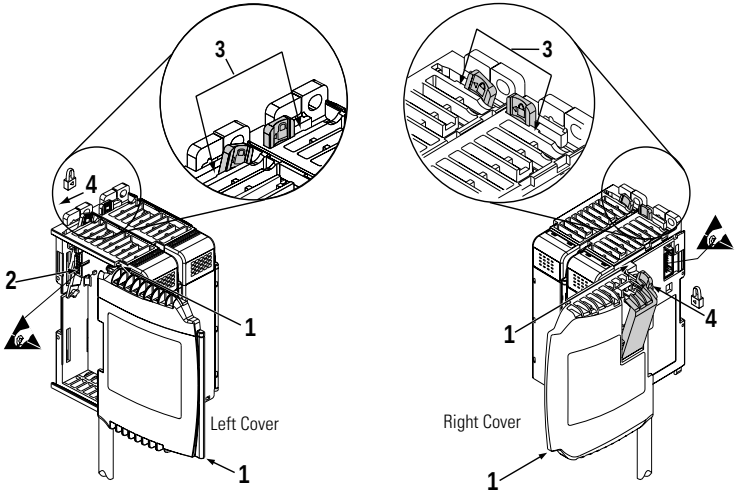
- sending an erroneous signal to your system's field devices, causing unintended machine motion
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.

## Attaching Cables

**TIP**

- A maximum of two expansion cables may be used in a 1769 system.
- Each I/O bank requires its own power supply. The 1769 cables extend the 1769 communication bus, but do not extend bus power.




1. Disconnect power
2. Check bus lever position.

   Left cover: Make sure the bus lever (4) on the left-most I/O module is in the unlocked (fully right) position.

   Right cover: Make sure the bus lever (4) on the right cover is in the unlocked (fully right) position.
3. Use the upper and lower tongue-and-groove slots (1) to secure the cable cover to the module.
4. Move the cable cover back along the tongue-and-groove slots until the bus connectors (2) line up with each other.

5. If necessary, push the bus lever back slightly to clear the bus locking tab (3). Use your fingers or a small screwdriver.

6. To allow communication between the module and the cable connector, move the bus lever firmly to the left (4) until it clicks. Ensure that it is locked firmly in place.

**ATTENTION**

When attaching cables, it is very important that the bus connectors are securely locked together to ensure proper electrical connection.

**Specifications**

| | |
|---|---|
| Approximate Shipping Weight (with carton) | 3-foot cables: 350 g (0.77lbs.)<br>1-foot cables: 300 g (0.66 lbs.) |
| Storage Temperature | -40°C to +85°C (-40°F to +185°F) |
| Operating Temperature | 0°C to +60°C (32°F to +140°F) |
| Operating Humidity | 5% to 95% non-condensing |
| Operating Altitude | 2000 meters (6561 feet) |
| Vibration | Operating: 10 to 500 Hz, 5G, 0.030 inches maximum peak-to-peak<br>Relay Operation: 2G |
| Shock | Operating: 30G panel mounted (20G DIN rail mounted)<br>Relay Operation: 7.5G panel mounted (5G DIN rail mounted)<br>Non-Operating: 40G panel mounted (30G DIN rail mounted) |
| Agency Certification | C-UL certified (under CSA C22.2 No. 142)<br>UL 508 listed<br>CE compliant for all applicable directives |
| Hazardous Environment Class | Class I, Division 2, Hazardous Location, Groups A, B, C, D<br>(UL 1604, C-UL under CSA C22.2 No. 213) |

## Notes:

## Notes:

# Notes:

**www.rockwellautomation.com**

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*Installation Instructions*

# Compact I/O End Caps/Terminators

## Catalog Numbers 1769-ECL, 1769-ECR


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## About the End Caps/Terminators

The 1769 controllers, such as the 1769-L32E, require end caps. A 1769-ECR right end cap or 1769-ECL left end cap terminates the end of the communication bus. Use this guide to install either end cap.

# Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

| | |
|---|---|
| **WARNING** | Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss. |
| **IMPORTANT** | Identifies information that is critical for successful application and understanding of the product. |
| **ATTENTION** | Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard and recognize the consequences. |
| **SHOCK HAZARD** | Labels may be on or inside the equipment (for example, drive or motor) to alert people that dangerous voltage may be present. |
| **BURN HAZARD** | Labels may be on or inside the equipment (for example, drive or motor) to alert people that surfaces may reach dangerous temperatures. |

## Environment and Enclosure

**ATTENTION**

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2000 meters (6562 ft) without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA, V2, V1, V0 (or equivalent) if non-metallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see:

- Industrial Automation Wiring and Grounding Guidelines, for additional installation requirements, Allen-Bradley publication 1770-4.1.
- NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure.

## Prevent Electrostatic Discharge

**ATTENTION**

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

# North American Hazardous Location Approval

| **The following information applies when operating this equipment in hazardous locations.** | **Informations sur l'utilisation de cet équipement en environnements dangereux.** |
|---|---|
| Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation. | Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation. |

| **WARNING** | **EXPLOSION HAZARD -** | **AVERTISSEMENT** | **RISQUE D'EXPLOSION –** |
|---|---|---|---|
| | • Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous. Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.<br>• Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.<br>• Substitution of components may impair suitability for Class I, Division 2.<br>• If this product contains batteries, they must only be changed in an area known to be nonhazardous. | | • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement.<br>• Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit.<br>• La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2.<br>• S'assurer que l'environnement est classé non dangereux avant de changer les piles. |

# European Hazardous Location Approval - 1769-ECR Only

**European Zone 2 Certification (The following applies when the product bears the Ex or EEx Marking)**

This equipment is intended for use in potentially explosive atmospheres as defined by European Union Directive 94/9/EC and has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of Category 3 equipment intended for use in potentially explosive atmospheres, given in Annex II to this Directive.

Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-15 and EN 60079-0.

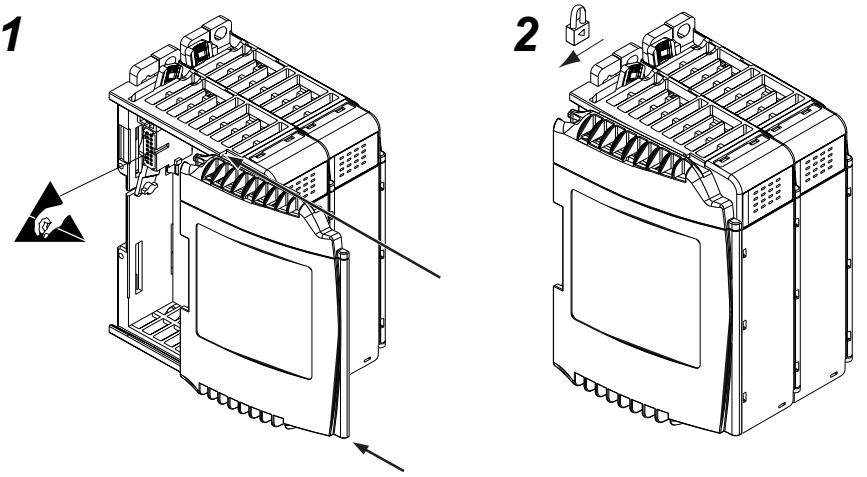
**WARNING**

- This equipment must be installed in an enclosure providing at least IP54 protection when applied in Zone 2 environments.
- This equipment shall be used within its specified ratings defined by Allen-Bradley.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.

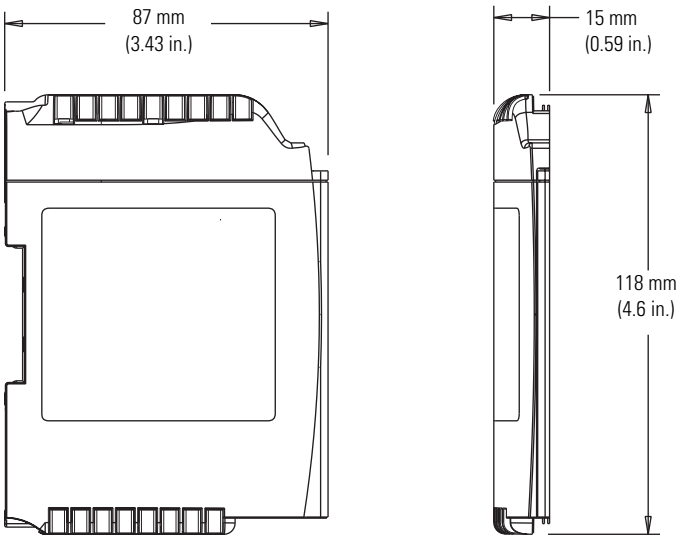
**ATTENTION**

This equipment is not resistant to sunlight or other sources of UV radiation.

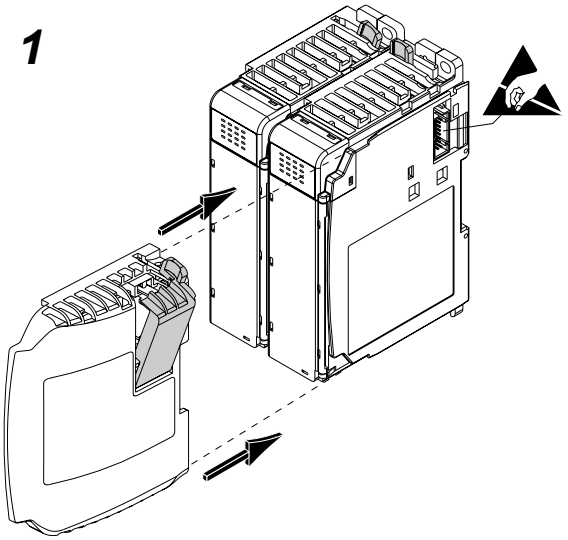
## 1769-ECL Left End Cap

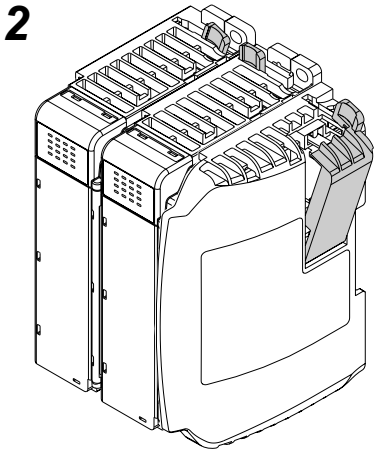


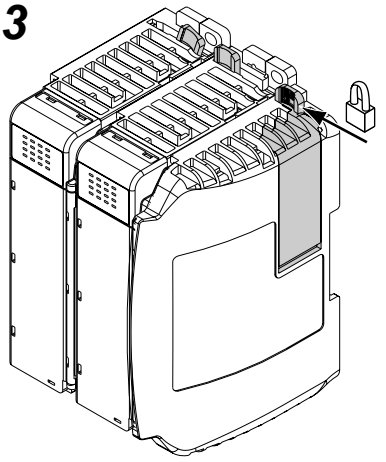

### 1769-ECL Dimensions



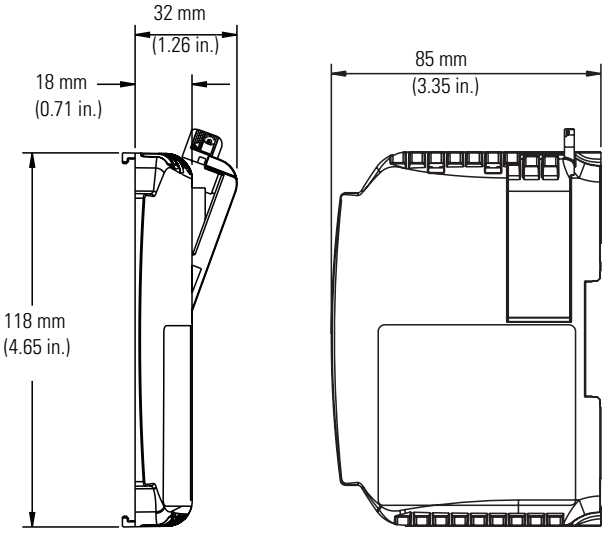
## 1769-ECR Right End Cap



## 1769-ECR Dimensions



# Specifications

## 1769-ECL, 1769-ECR - Technical Specifications

| Attribute | 1769-ECL | 1769-ECR |
|---|---|---|
| Bus current draw, max | 5 mA at 5V DC | |
| Operating altitude | 2000 m (6562 ft) | |
| North American temp code | T3C | |
| IEC temp code | N/A | T4 |
| Shipping weight, approx | 130 g (0.286 lb) | |
| Enclosure type rating | None (open style) | |

## 1769-ECL, 1769-ECR - Environmental Specifications

| Attribute | 1769-ECL | 1769-ECR |
|---|---|---|
| Operating temperature<br>IEC 60068-2-1 (Test Ad, Operating Cold)<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat)<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock) | 0…60 °C (32…140 °F) | |
| Nonoperating temperature<br>IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold)<br>IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat)<br>IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock) | -40…85 °C (-40…185 °F) | |
| Relative humidity | 5…95% noncondensing | |
| Vibration<br>IEC 60068-2-6 (Test Fc, Operating) | 5 g @ 10…500 Hz | |
| Operating shock<br>IEC 60068-2-27 (Test Ea, Unpackaged Shock) | DIN rail mount: 20 g; Panel mount: 30 g | |
| Nonoperating shock<br>IEC 60068-2-27 (Test Ea, Unpackaged Shock) | DIN rail mount: 30 g; Panel mount: 40 g | |

## 1769-ECL, 1769-ECR - Environmental Specifications

| Attribute | 1769-ECL | 1769-ECR |
|---|---|---|
| Emissions<br>CISPR 11 | Group 1, Class A | |
| ESD immunity<br>IEC 61000-4-2 | 8 kV air discharges | |
| Radiated RF immunity<br>IEC 61000-4-3 | 10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz<br>10V/m with 200 Hz 50%Pulse 100% AM at 900 MHz | |

## 1769-ECL, 1769-ECR - Certifications[1]

| Certifications[2] | 1769-ECL | 1769-ECR |
|---|---|---|
| c-UL-us | UL Listed for Class I, Division 2 Group A, B, C, D Hazardous Locations, certified for U.S. and Canada. See UL File E10314 | |
| CE | European Union 2004/108/EC EMC Directive, compliant with:<br>• EN 61000-6-2; Industrial Immunity<br>• EN 61000-6-4; Industrial Emissions | |
| C-Tick | Australian Radio Communications Act, compliant with:<br>• AS/NZS CISPR 11; Industrial Emissions | |
| Ex | N/A | European Union 94/9/EC ATEX Directive, compliant with:<br>• EN 60079-15; Potentially Explosive Atmospheres, Protection “n” (II 3 G Ex nA IIC T4 X)<br>• EN 60079-0; General Requirements (Zone 2) |

(1) When product is marked.

(2) See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

## Notes:

# Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://support.rockwellautomation.com, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://support.rockwellautomation.com.

## Installation Assistance

If you experience a problem within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your product up and running.

| | |
|---|---|
| United States | 1.440.646.3434 Monday – Friday, 8 a.m. – 5 p.m. EST |
| Outside United States | Please contact your local Rockwell Automation representative for any technical support issues. |

## New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

| | |
|---|---|
| United States | Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor in order to complete the return process. |
| Outside United States | Please contact your local Rockwell Automation representative for return procedure. |

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*Installation Instructions*

# Compact I/O Expansion Power Supplies

## Catalog Numbers 1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4


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## About the Power Supplies

Compact I/O power supplies provide 120/240V AC and 24V DC power to modules, which can be placed to the left or the right side of the 1769 power supply. As many as eight I/O modules can be placed on each side of the power supply.

# Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

| | |
|---|---|
| **WARNING** | Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss. |
| **IMPORTANT** | Identifies information that is critical for successful application and understanding of the product. |
| **ATTENTION** | Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard and recognize the consequences. |
| **SHOCK HAZARD** | Labels may be on or inside the equipment (for example, drive or motor) to alert people that dangerous voltage may be present. |
| **BURN HAZARD** | Labels may be on or inside the equipment (for example, drive or motor) to alert people that surfaces may reach dangerous temperatures. |

## Environment and Enclosure

**ATTENTION**

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2000 meters (6562 ft) without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA, V2, V1, V0 (or equivalent) if non-metallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see:

- Industrial Automation Wiring and Grounding Guidelines, for additional installation requirements, Allen-Bradley publication 1770-4.1.
- NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure.

## Prevent Electrostatic Discharge

**ATTENTION**

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

## North American Hazardous Location Approval

| The following information applies when operating this equipment in hazardous locations: | Informations sur l'utilisation de cet équipement en environnements dangereux: |
|---|---|
| Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation. | Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation. |

| WARNING | EXPLOSION HAZARD - | AVERTISSEMENT | RISQUE D'EXPLOSION – |
|---|---|---|---|
| | • Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.<br>• Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.<br>• Substitution of components may impair suitability for Class I, Division 2.<br>• If this product contains batteries, they must only be changed in an area known to be nonhazardous. | | • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement.<br>• Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit.<br>• La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2.<br>• S'assurer que l'environnement est classé non dangereux avant de changer les piles. |

## Install Safety Circuits

**WARNING**

Explosion Hazard - Do not connect or disconnect connectors while circuit is live.

Circuits that are installed on the machine for safety reasons, like overtravel limit switches, stop push buttons, and interlocks, should always be hard-wired directly to the master control relay. These devices must be wired in series so that when any one device opens, the master control relay is de-energized, thereby removing power to the machine.

**ATTENTION**

Never alter these circuits to defeat their function. Serious injury or machine damage could result.

# European Hazardous Location Approval

## 1769-PB2, 1769-PB4 Only

**European Zone 2 Certification (The following applies when the product bears the Ex or EEx Marking)**

This equipment is intended for use in potentially explosive atmospheres as defined by European Union Directive 94/9/EC and has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of Category 3 equipment intended for use in potentially explosive atmospheres, given in Annex II to this Directive.

Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-15 and EN 60079-0.

**WARNING**

- This equipment must be installed in an enclosure providing at least IP54 protection when applied in Zone 2 environments.
- This equipment shall be used within its specified ratings defined by Allen-Bradley.
- Provisions shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 40% when applied in Zone 2 environments.
- This equipment must be used only with ATEX certified backplanes.
- Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.

**ATTENTION**

This equipment is not resistant to sunlight or other sources of UV radiation.

## Before You Begin

There are some points about power distribution that you should know.

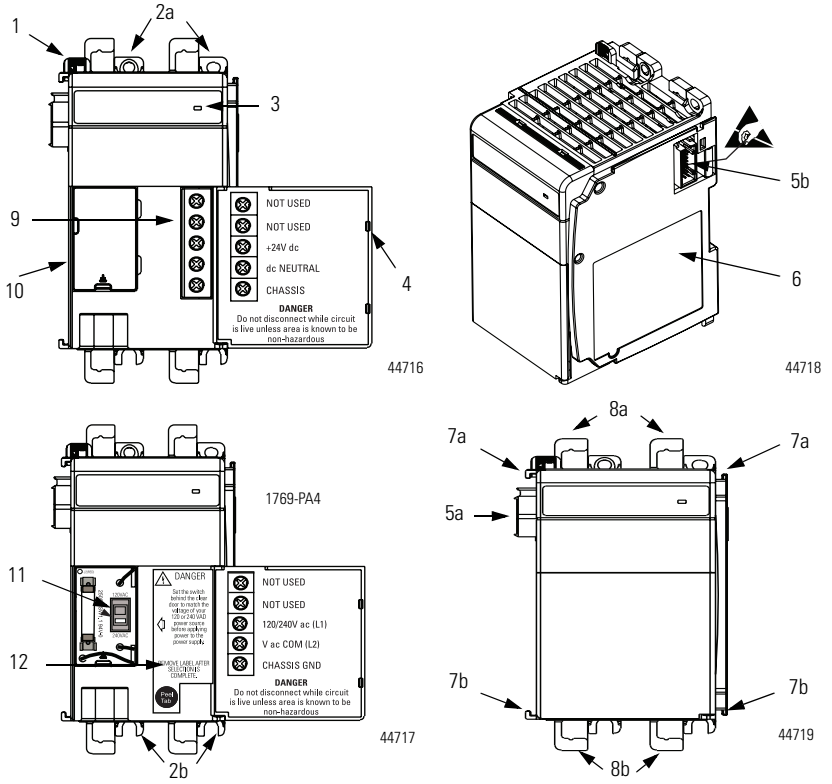
- The master control relay must be able to inhibit all machine motion by removing power to the machine I/O devices when the relay is de-energized. We recommend that the controller remains powered even when the master control relay is de-energized.
- If you are using a DC power supply, interrupt the load side rather than the AC line power. This avoids the additional delay of power supply turn-off. The DC power supply should be powered directly from the fused secondary of the transformer. Power to the DC input and output circuits should be connected through a set of master control relay contacts.

### Perform Periodic Tests of Master Control Relay Circuit

Any part can fail, including the switches in a master control relay circuit. The failure of one of these switches would most likely cause an open circuit, which would be a safe power-off failure. However, if one of these switches shorts out, it no longer provides any safety protection. These switches should be tested periodically to assure they will stop machine motion when needed.

## Parts Illustration of a Power Supply

The sample illustrations of a 1769-PA4 power supply let you review the various components that comprise a power supply, which is attached to a DIN rail.




| Item | Description |
|---|---|
| 1 | Bus lever (with locking function) |
| 2a | Upper panel mounting tabs |
| 2b | Lower panel mounting tabs |
| 3 | Status Indicator |
| 4 | Power supply door with terminal identification label |
| 5a | Movable bus connector with female pins |
| 5b | Stationary bus connector with male pins |
| 6 | Nameplate label |

| Item | Description |
|---|---|
| 7a | Upper tongue-and-groove slots |
| 7b | Lower tongue-and-groove slots |
| 8a | Upper DIN rail latches |
| 8b | Lower DIN rail latches |
| 9 | Terminal block with finger-safe cover |
| 10 | Fuse housing cover for replaceable fuse |
| 11 | 120V AC or 240V AC line input power selector switch (PA4 only) |
| 12 | Removable selector switch label (PA4 only) |

## Install an I/O Expansion Power Supply

Compact I/O Expansion Power Supplies are suitable for use in an industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments (Pollution degree 2[1]) and to circuits not exceeding Over Voltage Category II[2] (IEC 60664-1).[3]

## Disconnect the Power

**WARNING**

Remove power before removing or inserting this power supply from the 1769 I/O system. When you remove or insert a power supply with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine motion.
- causing an explosion in a hazardous environment.

Electrical arcing causes excessive wear to contacts on both the power supply and its mating connector. Worn contacts may create electrical resistance.

(1) Pollution Degree 2 is an environment where, normally, only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation shall be expected.

(2) Over Voltage Category II is the load level section of the electrical distribution system. At this level transient voltages are controlled and do not exceed the impulse voltage capability of the product's insulation.

(3) Pollution Degree 2 and Over Voltage Category II are International Electrotechnical Commission (IEC) designations.

## Assemble the System

1769 Compact I/O power supplies distribute power from either side of the power supply.

**EXAMPLE** A 2 amp at 5V DC power supply (1769-PA2, 1769-PB2) can provide 1 amp to the right side of the power supply and 1 amp to the left. A 4 amp at 5V DC power supply (1769-PA4, 1769-PB4) can provide 2 amps to the right side of the power supply and 2 amps to the left.

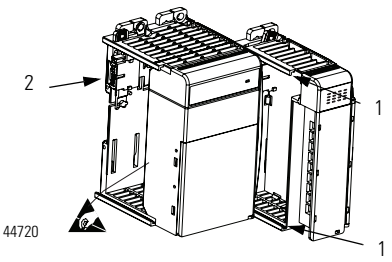
The maximum amount of current the system supports in both directions is:

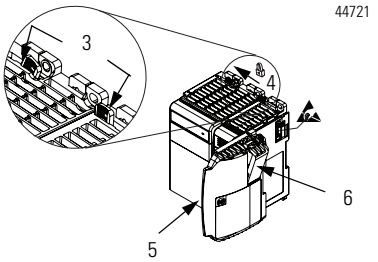
- 1769-PA2, 1769-PB2: 2 amps at 5V DC; 1 amp at 24V DC.
- 1769-PA4, 1769-PB4: 4 amps at 5V DC; 2 amps at 24V DC.

**IMPORTANT** The maximum amount of current that can be distributed from either side of any 1769 power supply is 2 amps at 5V DC and 1 amp at 24V DC.

This is a limit of the 1769 Compact I/O Bus.

The power supply can be attached to an adjacent I/O module **before** or **after** mounting.




| Item | Description |
|---|---|
| 1 | Upper and lower tongue-and-groove slots |
| 2 | Bus connectors |
| 3 | Positioning tab |
| 4 | Direction of the bus lever of the power supply to the I/O modules |
| 5 | End cap terminator |
| 6 | End cap bus terminator |

Follow these steps to assemble the Compact I/O system.

1. Disconnect your line power.

   The power supply does not support removal or insertion of modules under power.

**WARNING**

If you connect or disconnect wiring while the field-side power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

2. Check that the bus lever of the power supply to be installed is in the unlocked (fully right) position.
3. Use the upper and lower tongue-and-groove slots to secure the power supply to an I/O module.
4. Move the power supply back along the tongue-and-groove slots until the bus connectors line up with each other.
5. Push the bus lever back slightly to clear the positioning tab.

   Use your fingers or a small screwdriver.
6. To allow communication between the controller and the I/O, move the bus lever of the power supply and its adjacent I/O modules fully to the left until it clicks.

   Make sure it is locked firmly in place.

**ATTENTION**

When attaching expansion I/O power supplies, it is very important that the bus connectors are securely locked together to ensure proper electrical connection.

7. Attach an end cap terminator to the last I/O module in the system by using the tongue-and-groove slots as before.
8. Lock the end cap bus terminator.

**IMPORTANT**

A 1769-ECR or 1769-ECL right or left end cap (respectively) must be used to terminate the end of the serial communication bus.

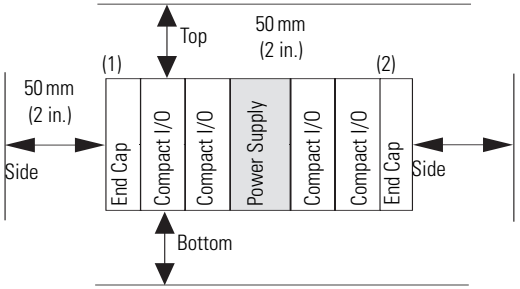
# Mount an I/O Expansion Power Supply

**ATTENTION**

During panel or DIN rail mounting of all devices, be sure that all debris (for example, metal chips, wire strands) is kept from falling into the module. Debris that falls into the module could cause damage on power up.

## Minimum Spacing

Maintain spacing from enclosure walls, wireways, adjacent equipment, and so forth. Allow 50 mm (2 in.) of space on all sides for adequate ventilation.




| Item | Description |
|---|---|
| 1 | This could be an end cap, controller, adapter, or expansion cable depending on your system configuration. |
| 2 | This could be an end cap or expansion cable depending on your system configuration. |

## Prevent Excessive Heat

For most applications, normal convective cooling keeps the system within the specified operating range. Verify that the specified temperature range is maintained. Proper spacing of components within an enclosure is usually sufficient for heat dissipation.

In some applications, a substantial amount of heat is produced by other equipment inside or outside the enclosure. In this case, place blower fans inside the enclosure to assist in air circulation and to reduce hot spots near the system.

Additional cooling provisions might be necessary when high ambient temperatures are encountered.

**TIP** Do not bring in unfiltered outside air. Place the Compact I/O system in an enclosure to protect it from a corrosive atmosphere. Harmful contaminants or dirt could cause improper operation or damage to components. In extreme cases, you may need to use air conditioning to protect against heat build-up within the enclosure.

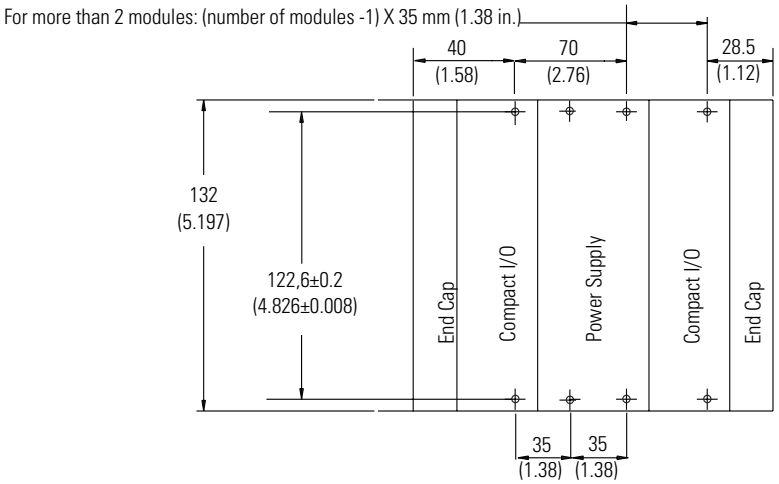
## Mount the Panel

Mount the power supply to a panel by using four screws per module. Use M4 or #8 panhead screws. Mounting screws are required on each power supply panel mounting tab.

**ATTENTION**

This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the power supply's mounting tabs or DIN rail (if used) are not required unless the mounting surface cannot be grounded. Refer to Industrial Automation Wiring and Grounding Guidelines, Allen-Bradley publication 1770-4.1, for additional information.

### *Panel Mounting Using the Dimensional Template*




Note: All dimensions are in mm (in.). Hole spacing tolerance: ±0.4 mm (0.016 in.)

## Mount a Power Supply on a DIN Rail

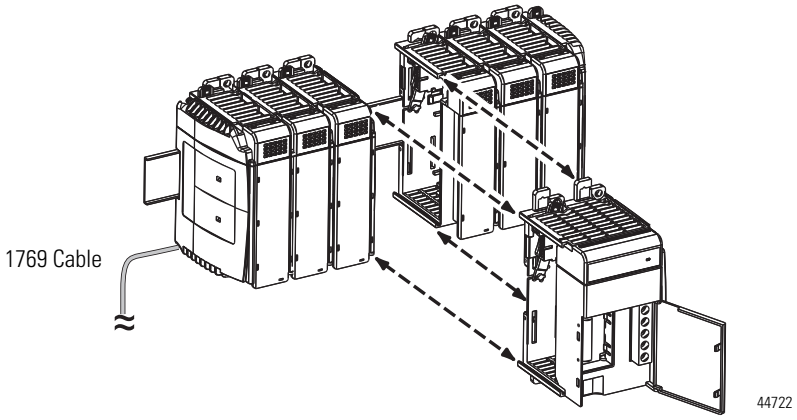
The power supply can be mounted using the following DIN rails:

- 35 x 7.5 mm (EN 50 022 - 35 x 7.5)
- 35 x 15 mm (EN 50 022 - 35 x 15)

1. Before mounting a power supply or module on a DIN rail, close the DIN rail latches.

2. Press the DIN rail mounting area of the module against the DIN rail.

   The latches will momentarily open and lock into place. The following illustration shows a power supply being attached to the I/O modules in a DIN rail mounted Compact I/O system.



## Verify Your System Power

Your system power budget is a consideration when using 1769 power supplies. This determines the power that is being provided to the I/O modules. Refer to Calculate System Power Requirements in the Compact I/O Selection Guide, publication 1769-SG002-EN-P, for the power budget calculation worksheet.

**TIP** The total number of I/O modules cannot exceed 16 on a single bank with a maximum of 8 I/O modules on either side of the power supply.

When configuring your system using a MicroLogix 1500 controller, only one expansion cable, one expansion power supply and a total of eight I/O modules may be used in a maximum of two banks of I/O modules. The expansion power supply cannot be directly connected to the MicroLogix 1500 controller.

1. After you have reviewed the amount of current consumed by your system, verify that your power supply has adequate capacity for its bank of I/O modules.

   See page 25 for graphs.

2. To do so, compare the current graphs to your totals for the following:
   - total 5V DC
   - total 24V DC
   - total 24V DC sensor power (1769-PA2 only)

3. If your power supply load is at or above the limits of the allowable ranges shown in the graphs, you must add an additional I/O bank.

   See Connect the Power Supplies for additional information.

**IMPORTANT** An additional I/O bank must include its own power supply.

An end cap/terminator (1769-ECR or 1769-ECL) must also be used if the I/O bank is the last in the system.

# Power Considerations

The following sections explain power considerations for the Compact I/O system.

## Disconnect the Main Power

**WARNING**

Explosion Hazard - Do not replace components or disconnect equipment unless power has been switched off.

If you connect or disconnect wiring while the field-side power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

Install the main power disconnect switch where operators and maintenance personnel have quick and easy access to it. Besides disconnecting electrical power, de-energize all other sources of power (pneumatic and hydraulic) before you begin working on a machine or process controlled by a controller.

## Isolation Transformer Usage

You may want to use an isolation transformer in the AC line. This type of transformer provides isolation from your power distribution system to reduce electrical noise and is often used as a step down transformer to reduce line voltage. Any transformer used with the Compact I/O system must have a sufficient power rating for its load. The power rating is expressed in volt-amperes (VA). See Schematic (Using IEC Symbols) for an example of circuits using isolation transformers.

## Power Supply Inrush

During powerup, the power supply allows a brief inrush current to charge internal capacitors. Many power lines and control transformers can supply inrush current for a brief time. If the power source cannot supply this inrush current, the source voltage may sag momentarily.

The only effect of limited inrush current and voltage sag on the system is that the power supply capacitors charge more slowly. However, the effect of a voltage sag on other equipment should be considered. For example, a deep voltage sag may reset a computer connected to the same power source. The following considerations determine whether the power source must be required to supply high inrush current:

- Power-up sequence of devices in a system
- Amount of the power source voltage sag if the inrush current cannot be supplied
- Effect of voltage sag on other equipment in the system

If the entire system is powered up at the same time, a brief sag in the power source voltage typically will not affect any equipment.

## Loss of Power Source

The power supply is designed to withstand brief power losses without affecting the operation of the system. The time the system is operational during power loss is called "program scan hold-up time after loss of power." The duration of the power supply hold-up time depends on the type and state of the I/O, but is typically between 5 milliseconds…10 seconds. When the duration of power loss reaches this limit, the power supply signals the processor that it can no longer provide adequate DC power to the system. This is referred to as a power supply shutdown. The processor then performs an orderly shutdown of the controller.

## Input States on Power Down

The power supply hold-up time is generally longer than the turn-on and turn-off times of the inputs. Because of this, the input state change from 'On' to 'Off' that occurs when power is removed may be recorded by the processor before the power supply shuts down the system. Understanding this concept is important. The user program should be written to take this effect into account.

## Other Types of Line Conditions

Occasionally the power source to the system can be temporarily interrupted. It is also possible that the voltage level may drop substantially below the normal line voltage range for a period of time. Both of these conditions are considered to be a loss of power for the system.

## User Power Overcurrent Condition

The power supply shuts down in the event of an overcurrent condition. All outputs latch off and remain off until you remove the overcurrent and cycle power. Reload the user program following a power supply shutdown.

**ATTENTION**

To avoid unexpected operation due to 24V DC user power shutdown (1769-PA2 only), monitor the 24V DC user output with a 24V DC input channel.

## Use a Master Control Relay

A hard-wired master control relay (MCR) provides a reliable means for emergency machine shutdown. Since the master control relay allows the placement of several emergency-stop switches in different locations, its installation is important from a safety standpoint. Overtravel limit switches or mushroom-head push buttons are wired in series so that when any of them opens, the master control relay is de-energized. This removes power to input and output device circuits.

**ATTENTION**

Never alter these circuits to defeat their function since serious injury and/or machine damage could result.

**TIP**

- If you are using an external DC power supply, interrupt the DC output side rather than the AC line side of the supply to avoid the additional delay of power supply turn off.
- The AC line of the DC output power supply should be fused.
- Connect a set of master control relays in series with the DC power supplying the input and output circuits.

Place the main power disconnect switch where operators and maintenance personnel have quick and easy access to it. If you mount a disconnect switch inside the enclosure, place the switch operating handle on the outside of the enclosure, so that you can disconnect power without opening the enclosure.

Whenever any of the emergency-stop switches are opened, power to input and output devices should be removed.

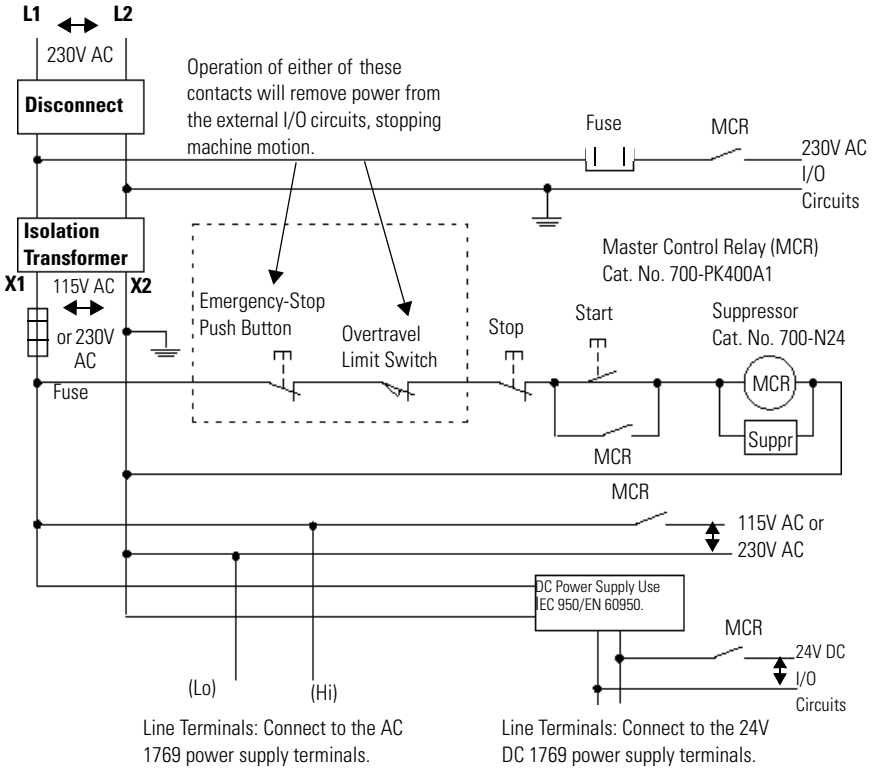
When you use the master control relay to remove power from the external I/O circuits, power continues to be provided to the system's power supply so that diagnostic indicators on the processor can still be observed.

The master control relay is not a substitute for a disconnect to the system. It is intended for any situation where the operator must quickly de-energize only I/O devices. When inspecting or installing terminal connections, replacing output fuses, or working on equipment within the enclosure, use the disconnect to shut off power to the rest of the system.

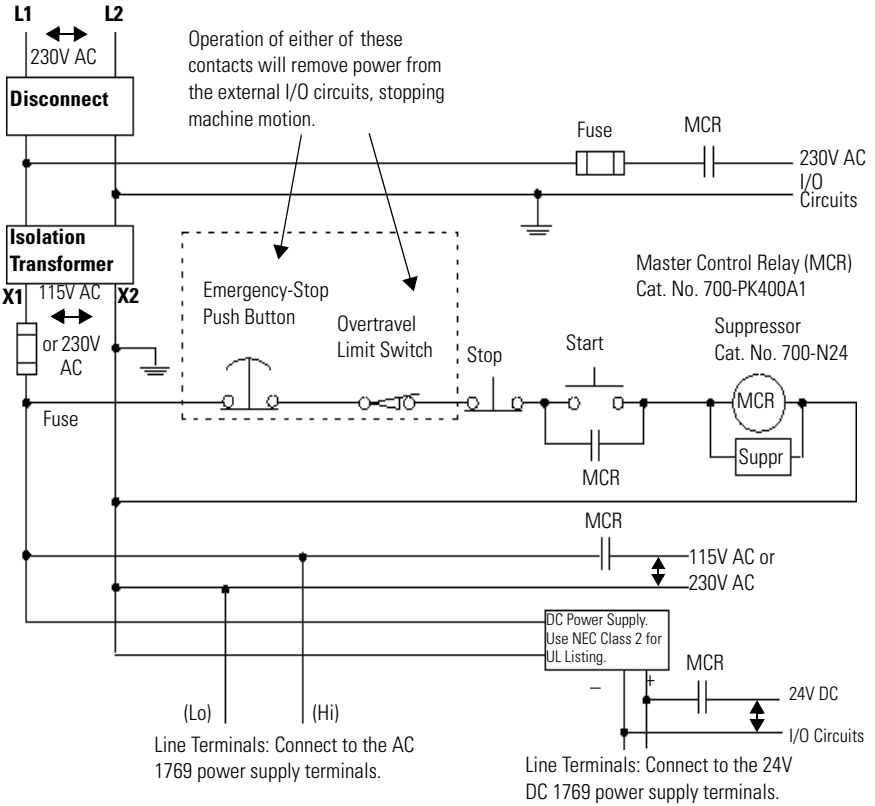
**TIP**

Do not control the master control relay with the Compact I/O system. Provide the operator with the safety of a direct connection between an emergency-stop switch and the master control relay.

## Schematic (Using IEC Symbols)



## Schematic (Using ANSI/CSA Symbols)



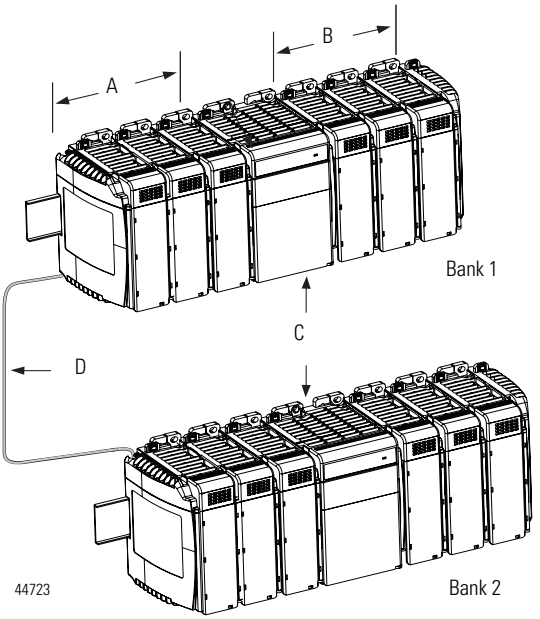

## Connect the Power Supplies

Compact I/O system architecture and the power supply design support connection of I/O on either side of the power supply. Each I/O bank requires its own power supply.

To connect 2 I/O banks, attach a 1769 expansion I/O cable to a power supply or I/O module as shown in the Power Supply Connection illustration. Up to 8 I/O modules can be connected on either side (A or B in the illustration) of the power supply for a maximum of 16 modules per bank.

Each 1769 I/O module has a power supply distance rating, with a maximum value of eight. Refer to the specific 1769 I/O module's installation instructions for more information.

## Power Supply Connection




| Item | Description |
|---|---|
| A - B | The maximum amount of bus current that can be distributed on the 1769 bus (on **either side** of the power supply, A or B) is:<br>• 2 amps at 5V DC (assume supported by power supply)<br>• 1 amp at 24V DC (assume supported by power supply) |
| C | Expansion I/O power supplies |
| D | I/O communication expansion cable |

**IMPORTANT** To use a 1769 expansion I/O power supply with a controller that has an embedded power supply (for example, MicroLogix 1500), you must use a 1769 expansion I/O cable. Do not directly attach the expansion power supply to a controller that has an embedded power supply.

# Connect Field Wires

The following instructions explain how to wire your power supply.

## Ground the Power Supply

**ATTENTION**

This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the power supply's mounting tabs or DIN rail (if used) are not required unless the mounting surface cannot be grounded. Refer to Industrial Automation Wiring and Grounding Guidelines, Allen-Bradley publication 1770-4.1, for additional information.

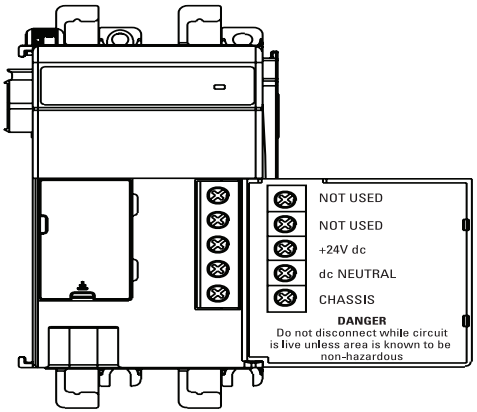
## Wire the Power Supply

1. **1769-PA4 only** - Set the V AC line input power switch behind the clear door to match your 120V or 240V AC power source as directed by the **DANGER** label on the power supply.

   The switch is shipped from the factory in the 240V AC position. Remove the selector switch label that covers the connectors after setting the proper power switch.

2. Connect the ground screw of the power supply to the nearest ground or ground bus.

   Use a 2.5 $mm^2$ (14 AWG) wire and keep the leads as short as possible.

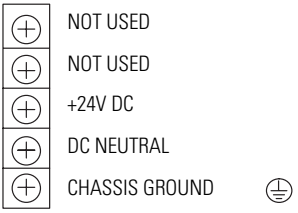



**TIP**

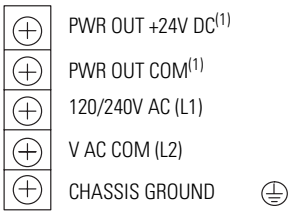
This ⏚ symbol denotes a protective earth ground terminal that provides a low impedance path between electrical circuits and earth for safety purposes and provides noise immunity improvement. This connection must be made for safety purposes.

3. Connect incoming power to the power supply terminals as indicated below.

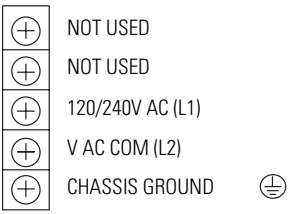
**Catalog Number 1769-PB2, 1769-PB4**




**Catalog Number 1769-PA2**




**Catalog Number 1769-PA4**




**ATTENTION**

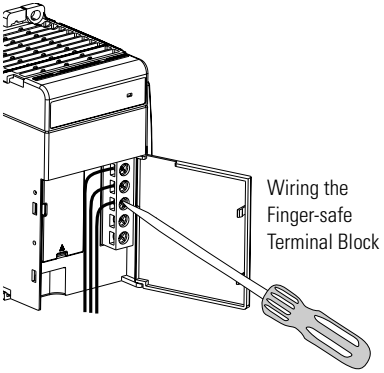
Turn off incoming power before connecting or disconnecting wires. Failure to do so could cause injury to personnel and/or damage to equipment.

(1) 24V DC user power for sensors or other special 24V DC I/O devices

## Wire the Finger-safe Terminal Block

When wiring the terminal block, keep the finger-safe cover in place.

1. Loosen the terminal screws to be wired.



Wiring the Finger-safe Terminal Block

2. Route the wire under the terminal pressure plate.

   You can use the bare wire or a spade lug. The terminals will accept a 6.35 mm (0.25 in.) spade lug.

**TIP** The terminal screws are non-captive. Therefore, it is possible to use a ring lug [maximum 1/4-inch o.d. with a 0.139-inch minimum i.d. (M3.5)] with the module.

3. Tighten the terminal screw making sure the pressure plate secures the wire.

   Recommended torque when tightening terminal screws is 1.27 N•m (11.24 lb•in).

**TIP** If you need to remove the finger-safe cover, insert a screwdriver into one of the square wiring holes and gently pry the cover off. If you wire the terminal block with the finger-safe cover removed, you will not be able to put it back on the terminal block because the wires will be in the way.

## Wire Size and Terminal Screw Torque

Each terminal accepts as many as two wires with the following restrictions.

| Wire Type | | Wire Size | Terminal Screw Torque |
|---|---|---|---|
| Solid | Cu-90 °C (194 °F) | 2.5 $mm^2$ (14 AWG) | 1.27 N•m (11.24 lb•in) |

## Replace the Fuse

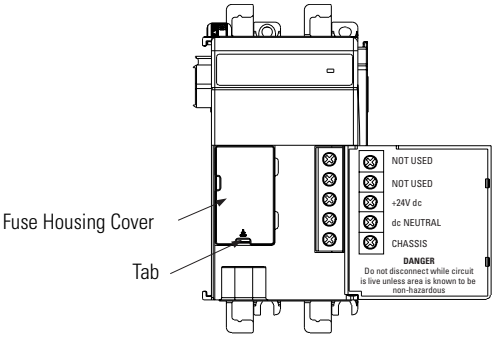
**ATTENTION**

Never install, remove, or wire power supplies unless power has been switched off.

Follow these steps to replace a blown fuse.

1. Remove Compact I/O system power to correct conditions causing the short circuit.
2. Place a slotted screwdriver under the tab to remove the fuse housing cover.
3. Use a fuse puller or similar device to remove the fuse.

   Use care so that the printed circuit board and surrounding electronics are not damaged.




4. Replace the front access fuse by centering the replacement fuse over the fuse clip and pressing down.

   See Specifications for information on the front access fuse.

   If you use a tool to press the fuse in place, apply pressure to only the metal end caps, not to the center of the fuse.

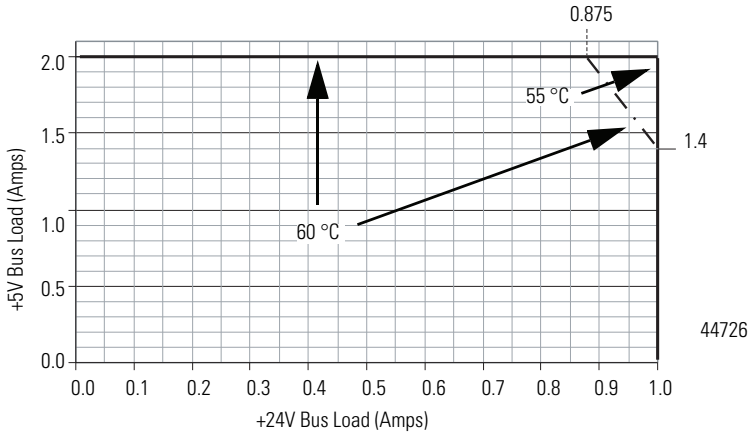
5. Replace the fuse housing cover.
6. Restore Compact I/O system power.

## Temperature Derating

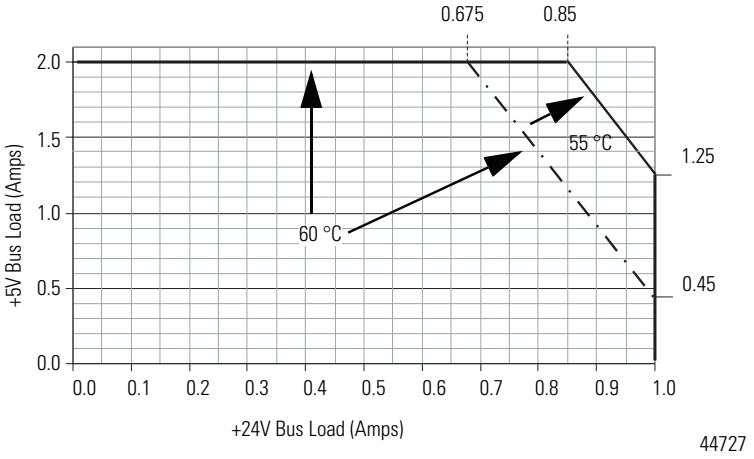
The following graphs indicate how much current can be drawn from the power supply at the indicated case temperature without damaging it.

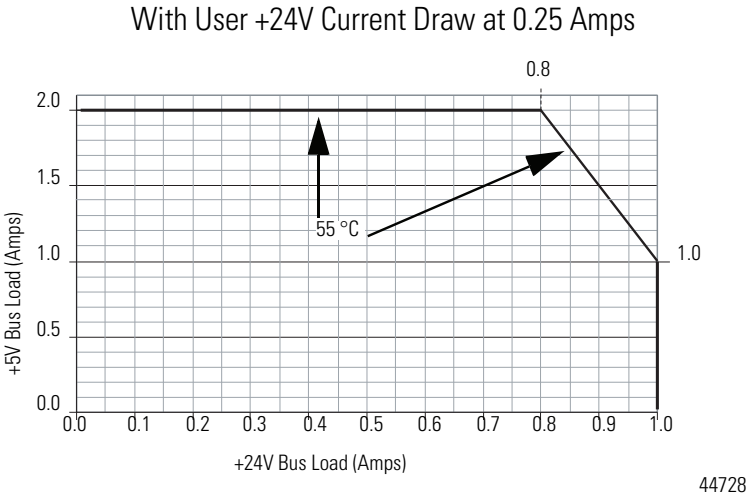
### 1769-PA2 Output Derating

With User +24V Current Draw at 0 Amps

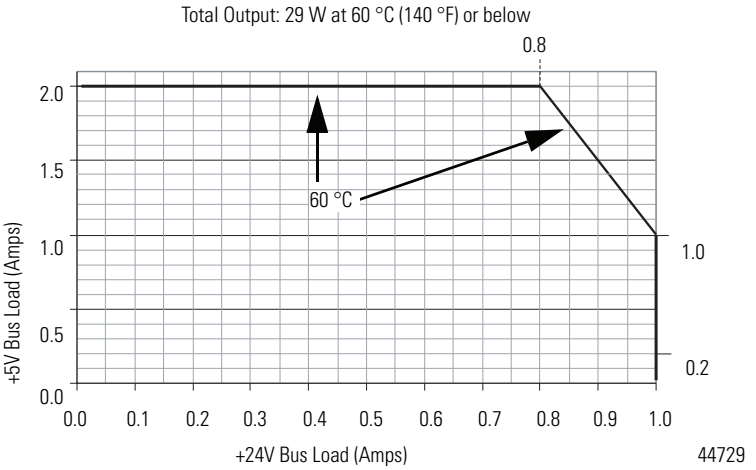



With User +24V Current Draw at 0.2 Amps

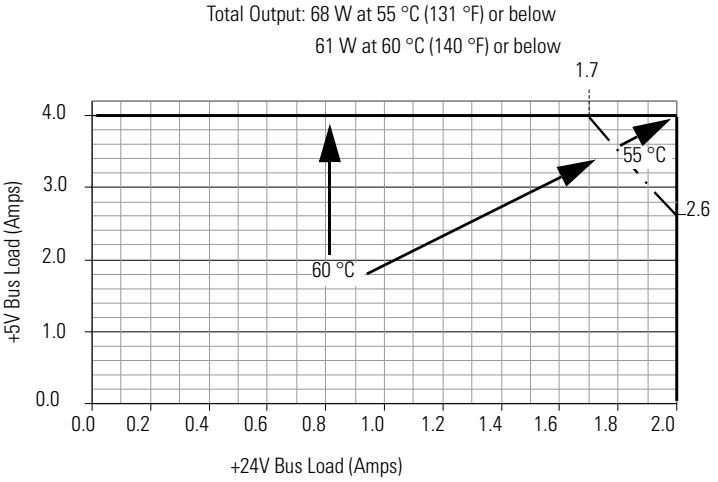




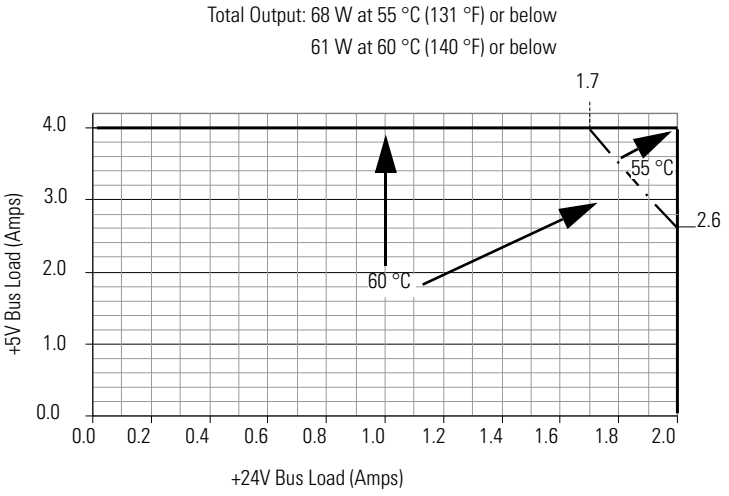

## 1769-PB2 Output Derating



## 1769-PA4 Output Derating



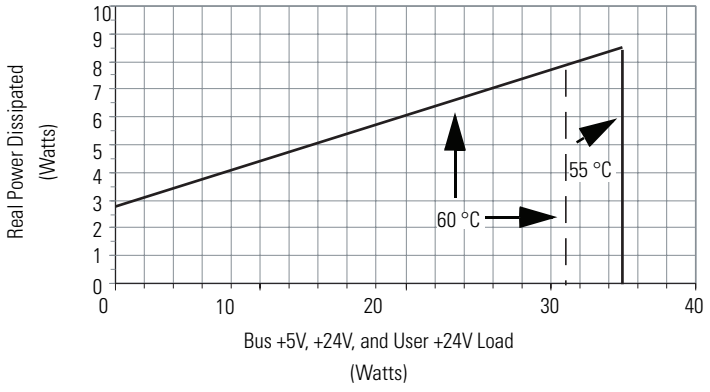

## 1769-PB4 Output Derating



# Power Dissipation

The following graphs indicate the real electrical power dissipation of the power supply in function of the electrical load.

## 1769-PA2 Real Power Dissipation

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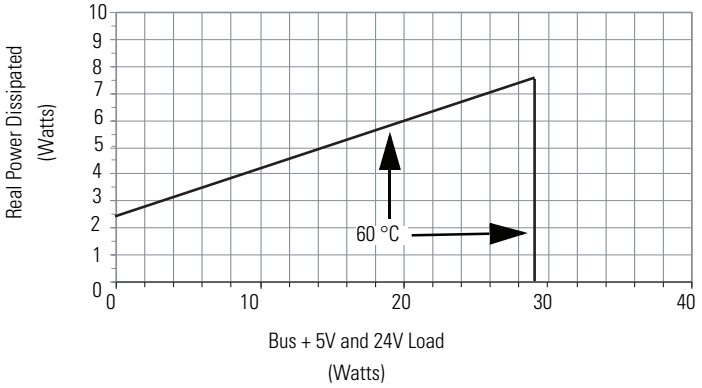
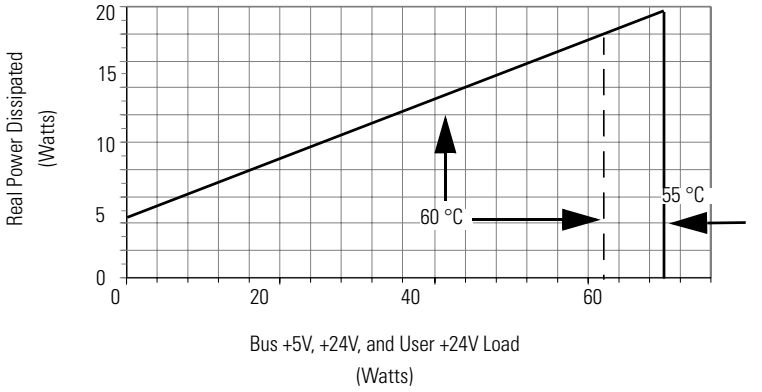
## 1769-PB2 Real Power Dissipation

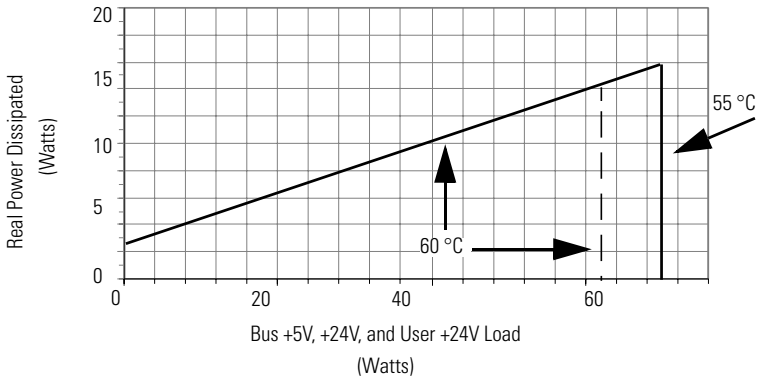



44731

## 1769-PA4 Real Power Dissipation




## 1769-PB4 Real Power Dissipation



# Specifications

### 1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4 - Technical Specifications

| Attribute | 1769-PA2 | 1769-PB2 | 1769-PA4 | 1769-PB4 |
|---|---|---|---|---|
| Input voltage range | 85…265V AC | 19.2…31.2V DC | 85…132V AC or 170…265V AC, switch selectable | 19.2…32V DC |
| Input frequency range | 47…63 Hz | N/A | 47…63 Hz | N/A |
| Power supply distance rating(1) | 8 (8 I/O modules can be connected on either side of the power supply for a maximum of 16 modules.) | | | |
| Operating altitude | 2000 m (6562 ft) | | | |
| Isolation voltage | 265V (continuous), Reinforced Insulation Type (IEC Class 1 grounding required)<br>Routine tested at 2596V DC for 1s, AC Power Input to System and AC Power Input to 24V DC User Power | 75V (continuous), Reinforced Insulation Type (IEC Class 1 grounding required)<br>Routine tested at 1697V DC for 1s, DC Power Input to System | 265V (continuous), Reinforced Insulation Type (IEC Class 1 grounding required)<br>Routine tested at 2596V DC for 1s, AC Power Input to System | 75V (continuous), Reinforced Insulation Type (IEC Class 1 grounding required)<br>Routine tested at 1697V DC for 1s, DC Power Input to System |
| Power consumption | 100 VA @ 120V AC<br>130 VA @ 240V AC | 50 VA @ 24V DC | 200 VA @ 120V AC<br>240 VA @ 240V AC | 100 VA @ 24V DC |
| Power dissipation | 8 W @ 60 °C | 7.5 W @ 60 °C | 18 W @ 60 °C | 14.5 W @ 60 °C |
| Current capacity at 5V | 2.0 A | 2.0 A | 4.0 A | 4.0 A |
| Current capacity at 24V | 0.8 A | 0.8 A | 2.0 A | 2.0 A |
| Inrush current, max | 25 A @ 132V AC | 30 A @ 31.2V DC | 25 A @ 132V AC | 30 A @ 31.2V DC |
| Fuse type | Wickmann 19195-3.15A Littelfuse 02183.15MXP | Wickmann 19193-6.3A Littelfuse 021706.3MXP | Wickmann 19195-3.15A Littelfuse 02183.15MXP | Wickmann 19193-6.3A Littelfuse 021706.3MXP |
| Dimensions (HxWxD), approx. | 118 x 70 x 87 mm (4.65 x 2.76 x 3.43 in.) height including mounting tabs is 138 mm (5.43 in.) | | | |
| Shipping weight, approx | 525 g (1.16 lb) | | 630 g (1.39 lb) | |
| Wiring category(2) | 1 on power ports | 2 on power ports | 1 on power ports | 2 on power ports |

## 1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4 - Technical Specifications

| Attribute | 1769-PA2 | 1769-PB2 | 1769-PA4 | 1769-PB4 |
|---|---|---|---|---|
| Wire size | 2.5 $mm^2$ (14 AWG) solid copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (3/64 in.) insulation max | | | |
| North American temp code | T3C | | | |
| IEC temp code | N/A | T4 | N/A | T4 |
| Enclosure type rating | None (open style) | | | |

(1) When configuring your system using a MicroLogix 1500 controller, only one expansion cable, one expansion power supply and a total of eight I/O modules may be used in a maximum of two banks of I/O modules. The expansion power supply cannot be directly connected to the MicroLogix 1500 controller.

(2) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

## 1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4 - Environmental Specifications

| Attribute | 1769-PA2 | 1769-PB2 | 1769-PA4 | 1769-PB4 |
|---|---|---|---|---|
| Operating temperature<br>IEC 60068-2-1 (Test Ad, Operating Cold<br>IEC 60068-2-2 (Test Bd, Operating Dry Heat)<br>IEC 60068-2-14 (Test Nb, Operating Thermal Shock) | 0…60 °C (32…140 °F) | | | |
| Nonoperating temperature<br>IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold)<br>IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat)<br>IEC 60068-2-14 (Test Na, Unpackaged Thermal Shock) | -40…85 °C (-40…185 °F) | | | |
| Relative humidity<br>IEC 60068-2-30 (Test Db, Unpackaged Damp Heat) | 5…95% noncondensing | | | |

### 1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4 - Environmental Specifications

| Attribute | 1769-PA2 | 1769-PB2 | 1769-PA4 | 1769-PB4 |
|---|---|---|---|---|
| Vibration<br>IEC 60068-2-6 (Test Fc, Operating) | 5 g @ 10…500 Hz | | | |
| Operating shock<br>IEC 60068-2-27 (Test Ea, Unpackaged Shock) | DIN rail mount: 20 g; Panel Mount 30 g | | | |
| Nonoperating shock<br>IEC 60068-2-27 (Test Ea, Unpackaged Shock) | DIN rail mount: 30 g; Panel Mount 40 g | | | |
| Emissions<br>CISPR 11 | Group 1, Class A | | | |
| ESD immunity<br>IEC61000-4-2 | 4 kV contact, 8 kV air discharges | | | |
| Radiated RF immunity<br>IEC61000-4-3 | 10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz<br>3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM at 900 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM at 1890 MHz | 10V/m with 1 kHz sine-wave 80%AM from 80…2000 MHz<br>10V/m with 200 Hz 50% Pulse 100%AM at 900 MHz | 10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz<br>3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM at 900 MHz<br>10V/m with 200 Hz 50% Pulse 100% AM at 1890 MHz | 10V/m with 1 kHz sine-wave 80%AM from 80…2000 MHz<br>10V/m with 200 Hz 50% Pulse 100%AM at 900 MHz |
| EFT/B immunity<br>IEC 61000-4-4 | ±2 kV at 5 kHz on AC power ports<br>±2 kV at 5 kHz on 24V DC PWR OUT ports | ±2 kV at 5 kHz on DC power ports | ±2 kV at 5 kHz on AC power ports | ±2 kV at 5 kHz on DC power ports |
| Surge transient immunity<br>IEC61000-4-5 | ±2 kV line-line (DM) and ±4 kV line-earth (CM) on AC power ports<br>±500V line-line (DM) and ±500V line-earth (CM) on 24V DC PWR OUT ports | ±500V line-line (DM) and ±500V line-earth (CM) on DC power ports | ±2 kV line-line (DM) and ±4 kV line-earth (CM) on AC power ports | ±500V line-line (DM) and ±500V line-earth (CM) on DC power ports |

### 1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4 - Environmental Specifications

| Attribute | 1769-PA2 | 1769-PB2 | 1769-PA4 | 1769-PB4 |
|---|---|---|---|---|
| Conducted RF Immunity IEC61000-4-6 | 10V rms with 1kHz sine-wave 80% AM from 150 kHz...80 MHz | | | |
| Voltage Variation IEC 61000-4-11 | 30% dips for 1 period at 0° and 180° on AC supply ports<br>60% dips for 5 and 50 periods on AC supply ports<br>±10% fluctuations for 15 min on AC supply ports<br>>95% interruptions for 250 periods on AC supply ports | N/A | 30% dips for 1 period at 0° and 180° on AC supply ports<br>60% dips for 5 and 50 periods on AC supply ports<br>±10% fluctuations for 15 min on AC supply ports<br>>95% interruptions for 250 periods on AC supply ports | N/A |

### 1769-PB2, 1769-PB4 - Certifications[1]

| Certifications[2] | Value |
|---|---|
| c-UL-us | UL Listed for Class 1, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E10314 |
| CE | European Union 2004/108/EC EMC Directive, compliant with:<br>• EN 61000-6-2; Industrial Immunity<br>• EN 61000-6-4; Industrial Emissions |
| C-Tick | Australian Radio Communications Act, compliant with:<br>• AS/NZS CISPR 11; Industrial Emissions |
| Ex | European Union 94/9/EC ATEX Directive, compliant with:<br>• EN 60079-15; Potentially Explosive Atmospheres, Protection "n" (II 3 G Ex nA IIC T4 X)<br>• EN 60079-0; General Requirements (Zone 2) |

(1) When product is marked.

(2) See the Product Certification link at http:// www.ab.com for Declarations of Conformity, Certificates, and other certification details.

### 1769-PA2, 1769-PA4 - Certifications[1]

| Certifications[2] | Value |
|---|---|
| c-UL-us | UL Listed for Class 1, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E10314 |

### 1769-PA2, 1769-PA4 - Certifications[1]

| Certifications[2] | Value |
|---|---|
| CE | European Union 2004/108/EC EMC Directive, compliant with:<br>• EN 61000-6-2; Industrial Immunity<br>• EN 61000-6-4; Industrial Emissions |
| C-Tick | Australian Radio Communications Act, compliant with:<br>• AS/NZS CISPR 11; Industrial Emissions |

(1) When product is marked.

(2) See the Production Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

## Certifications Compatibility with MicroLogix 1500

To use the 1769 expansion I/O power supply with the MicroLogix 1500 processor, the processor (catalog number 1764-LSP or 1764-LRP) must be series A, revision C, Firmware Revision Number (FRN) 3 or higher. You can check the firmware revision by looking at the processor nameplate.

Status file bit S:59 (Operating System Firmware Revision Number)

If your processor is at an older revision, you must upgrade the operating system. On the Internet, go to http://www.ab.com/programmablecontrol/plc/micrologix/downloads.html to download the firmware upgrade.

## Additional Resources

These documents contain additional information concerning related Rockwell Automation products.

| Resource | Description |
|---|---|
| 1769-ADN Adapter User Manual, publication 1769-UM001 | A more detailed description of how to install and use a 1769-ADN DeviceNet Adapter Module |
| Compact 1769 Analog I/O User Manual, publication 1769-UM002 | A more detailed description of how to install and use Compact Analog I/O |
| CompactLogix System User Manual, publication 1769-UM007 | A more detailed description of how to install and use your CompactLogix controller |
| MicroLogix 1500 Programmable Controllers User Manual, publication 1764-UM001 | A more detailed description of how to install and use your Compact I/O with the MicroLogix 1500 programmable controller |
| CompactLogix Controllers Selection Guide, publication 1769-SG001 | A more detailed description of the 1769 CompactLogix controllers |
| Compact I/O Selection Guide, publication 1769-SG002 | A more detailed description of the 1769 I/O modules available with the Compact I/O system |
| Compact I/O Communication Bus Expansion Cables Installation Instructions, publication 1769-IN014 | Information on installing and using Compact I/O Communication Bus Expansion Cables |
| Compact I/O End Caps/Terminators, publication 1769-IN015 | Information on installing and using Compact 1769-ECL, 1769-ECR End Cap/Terminators |
| Industrial Automation Wiring and Grounding Guidelines, publication 1770-IN041 | More information on proper wiring and grounding techniques |

# Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.support.rockwellautomation.com, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.support.rockwellautomation.com.

## Installation Assistance

If you experience a problem within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your product up and running.

| | |
|---|---|
| United States | 1.440.646.3434 Monday – Friday, 8 a.m. – 5 p.m. EST |
| Outside United States | Please contact your local Rockwell Automation representative for any technical support issues. |

## New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

| | |
|---|---|
| United States | Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor in order to complete the return process. |
| Outside United States | Please contact your local Rockwell Automation representative for return procedure. |

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COLUMBIAN TecTank

# LIQUID STORAGE ERECTION MANUAL

HYDROTEC™ PETROTEC™

PAR0360 Rev 02/2010

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## INTRODUCTION

This Erection Manual, provided by Columbian TecTank (CTT), is to be used as a supplement to information furnished on CTT's erection drawing and should be read carefully before beginning erection. It should be used in conjunction with the drawings, with both being reviewed periodically throughout erection. The intentions of this manual are to teach the inexperienced crew and to aid the experienced tank erector.

**NO ONE** should attempt to erect a tank manufactured by Columbian TecTank without a Certified CTT Tank Erector or without a CTT Technical Supervisor.

**If you have questions or comments, contact Columbian TecTank's Field Service Department:**

- **For shipments from Kansas City, KS - Telephone 913/621-3700 or Fax 913/621-2145**
- **For shipments from Parsons, KS – Telephone 620/421-0200 or Fax 620/421-9122**

This manual contains instructions for erecting CTT Liquid Storage Tanks.

Review the following data prior to starting any work:

1. This Erection Manual
2. Erection drawings for the tank being erected
3. Accessories included for this tank
4. Check list issued covering the tank being erected

## PLANNING THE ERECTION WORK

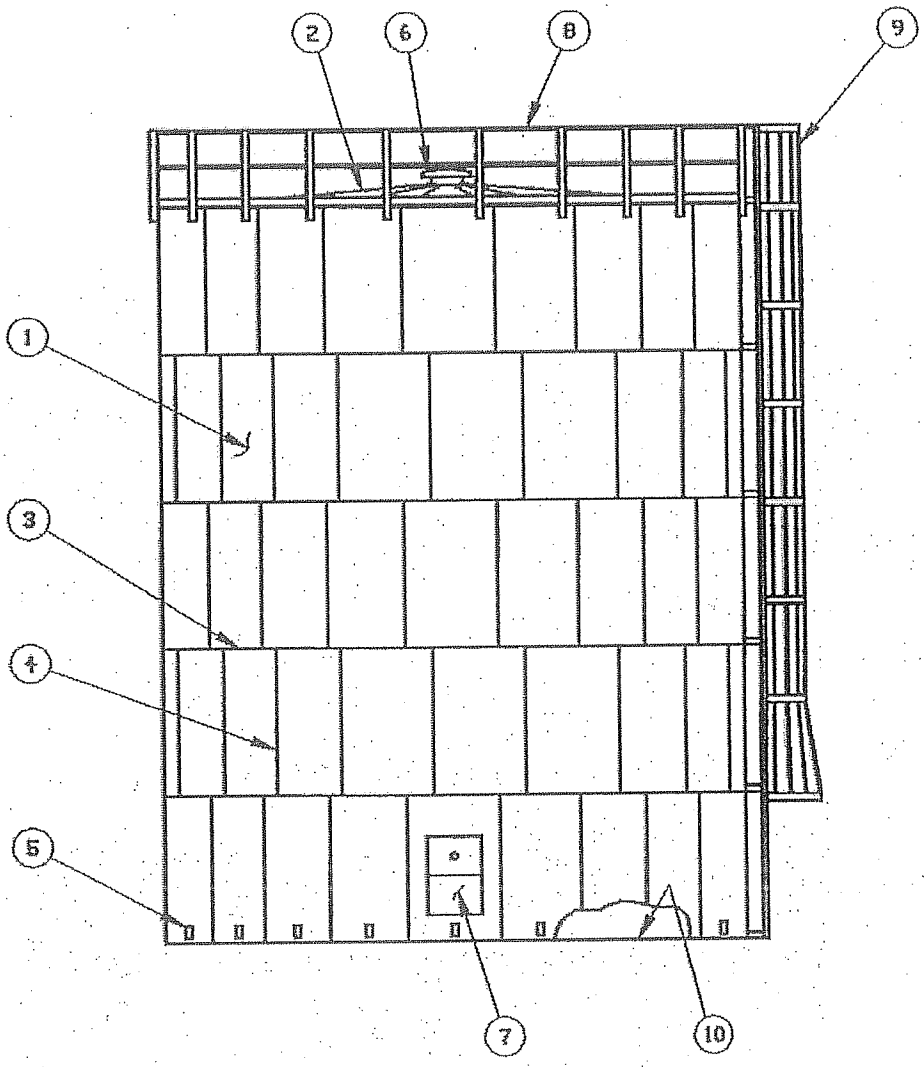
Building Codes – In many areas and municipalities, building codes place limitations and restrictions on structures, such as bolted steel tanks. For this reason, it is the responsibility of the purchaser to comply with such codes. Prior to beginning an installation you should (a) examine local statues to assure that the installation is within building code limitation; and (b) obtain any required building permits.

Natural Disturbances – A partially erected tank is subject to damage by excessive winds or other types of natural disturbances. Tank should be braced or guyed against such damage.

Insurance – The purchaser must maintain proper insurance coverage, including damage caused by natural disturbances during erection, as **Columbian TecTank does not assume liability for damage caused by these conditions.**

SECTION I

GENERAL DESCRIPTIONS




1. CYLINDER STAVE SHEETS
2. CIRCULAR DECK SHEETS
3. CHIME
4. VERTICAL SEAMS
5. ANCHOR BOLTS SADDLE
6. 20" CENTER DOME WITH COVER
7. 24" FLUSH CLEANOUT
8. DECK GUARDRAIL
9. LADDER WITH CAGE
10. CIRCULAR BOTTOM SHEETS

TYPICAL BOLTED STEEL TANK

FIGURE 1

## 1. TANK COMPONENTS

All bolted steel Columbian TecTank's consist of prefabricated cylindrical shells, circular decks, and bottoms. A broad range of capacities is achieved by varying heights and diameters. The following list of components is typical of Columbian TecTank and can be viewed in Figure 1. Familiarizing yourself with the terminology of each item will aid in understanding the reminder of this manual and identifying parts in the field.

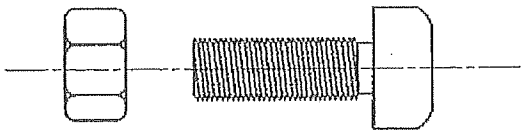
Staves (No. 1) are bolted together at vertical seams to form stave rings. Each ring is designed to support the load imposed by its contents plus loads transferred to if from the rings above. Thus, stave thickness is increased from least in the top ring to greatest in the bottom ring of the tank.

The shell is formed by bolting stave rings together at the chime (No. 3) to develop the required height. The bottom ring of shell can be equipped with a flush cleanout (No. 7), which provides access to the tank for easy cleaning. Plain rings complete the shell. Bolt-on nozzles can be installed as required for filling and draining tank contents. Bottom (No. 10) is joined together at radial seams to form circular floor. The center portion of the floor utilizes a center plate, and on larger diameter tanks an adapter ring is also added. For a cone bottom, the center plate may be replaced with a recessed sump. (See Section VI for more information regarding bottoms.)

Decks are formed similar to bottoms and are available in either self-supporting or supported by a center pole or ladder (see Section VIII).

## 2. HARDWARE, GASKETS AND SEALANTS

A variety of fasteners and gaskets are used on tanks. The following pages (Figures 2 through 5) list the varieties and show a detail of each. The type used on each tank will be identified according to customer specifications.

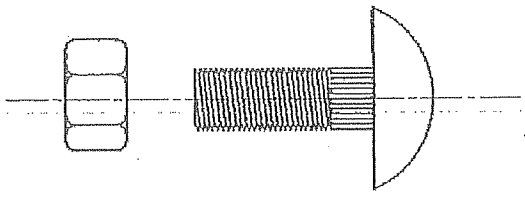


Square-head tank bolt

Size – ½" – 13

Lengths 1"– 1-1/4", 1-1/2", 1-3/4" & 2"

Finish - Hot dip galvanized
- Mechanically galvanized



Round-head, encapsulated ribbed bolt

Size - ½" – 13

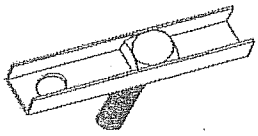
Lengths – 1-1/4", 1-1/2" & 2"

Finish – Mechanically galvanized
Plain or plastic encapsulated head

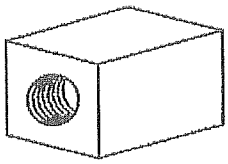
TYPICAL BOLTS

FIGURE 2

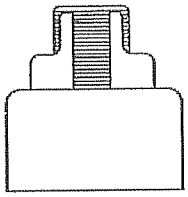
Fasteners for liquid tanks are round head ribbed neck bolts with or without plastic encapsulation on the bolt heads. Steel-backed neoprene washers or two-piece washers are used on all bottom floor bolts and stave vertical seams. Flat washers are placed under nuts on all chime bolts and deck bolts. Most accessories bolted to the floor and sidewall will use one of these sealing washers. In some cases a "bolt channel" with a square head bolt may be used. (Figure 3A) Internal floor bolts may have an Encapsulated Nut (Figure 3B) or a TecCap (Figure 3C). Hot dip galvanized tanks will not use flat washers. Refer to the erection drawings for the particular details of your tank.



BOLT CHANNEL
FIGURE 3A



ENCAPSULATED NUT
FIGURE 3B



TECCAP
FIGURE 3C

## STANDARD GASKETS AND SEALANT

Special sealants are used at specific locations where gaskets alone are not sufficient to seal the tank.

Sealant is shipped in cartridges. A caulking gun is required for the application of this sealant.

Strip Gasket is furnished in rolls and must be cut to length as required during erection. When splices are necessary, lap joints are required with a bead of sealant applied along joint. For one row staves the gasket is one row wide for two row staves the gasket is furnished in a two row wide gasket and for the three row staves the gasket is furnished in two row wide for the inner two rows (next to the offset) and a one row gasket for the outside row viewing the tank from the exterior.

Circular Gaskets for domes, collars, etc., are furnished in one piece or are in several pieces, which join to form rings.

Chime Lap Gaskets are supplied for lap areas of tank parts, as shown in Figure 4. A "light" gasket (4A) is used in tank thickness from 12-gauge to 3/16" plate. The "heavy gasket" is used in 7/32" and ¼" staves. The "step" gasket is used in 5/16" plate staves. Refer to the erection drawings for the proper lap gasket.

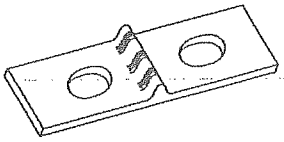


FIGURE 4A – LIGHT

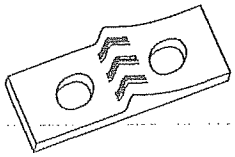
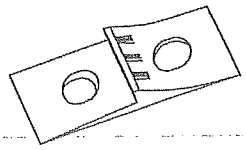


FIGURE 4B – HEAVY

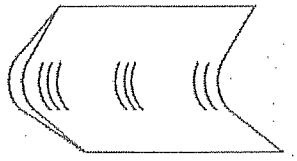


4C – STEP

CHIME LAP GASKETS

FIGURE 4

Radii Fillet Gaskets are supplied in 1-3/4", 3-3/4" or 5-3/4" lengths for placement on staves (Figure 5). One-row vertical seams require gaskets to be 1-3/4" long; two-row vertical seams utilize 3-3/4" lengths; and three-row seams require 5-3/4" lengths. Radii fillet gaskets are furnished in two thickness, light and heavy. The light is used in all thickness from 12-gauge to 7/32". The heavy gasket is used in stave thickness of ¼" and 5/16".



RADII FILLET GASKET
FIGURE 5

**IMPORTANT**
**All Columbian TecTank parts are marked with part numbers, which corresponds to part numbers shown on erection drawings. During erection, check all parts against part numbers shown on erection drawings**

3. DRAWINGS

A complete set of erection drawings is prepared for each tank order. Copies of drawings are forwarded to the customer.

**IMPORTANT**
**All drawings used for erection should be the latest**

**A typical set of drawings would include:**

ERECTION DETAIL PRINT (key drawing in the set) the bill of materials listing all parts and part numbers, the location of accessories, and ring orientation are on this print.

STANDARD DETAIL PRINT shows miscellaneous details, tank elevations, and bolt schedule indicating which bolts should be used in various locations. Observe this schedule closely to ensure against using the wrong bolts, which could result in disassembling and rebuilding the tank at erector's cost.

VARIOUS ACCESSORY DRAWINGS will also be sent showing assembly and installation details for particular accessories furnished with the tank, such as ladder, perimeter guardrail, crossover, et cetera.

## 4. BOLT TIGHTENING

**Material Thickness:** Columbian TecTank uses various steel thicknesses from 5/16" plate to 12-gauge for the major components of a tank. Each different thickness will require different tightening pressures to close the seams.

**Type of Hardware:** Torque required will vary depending on the type of coating used on the hardware.

**Straightness and Levelness of Steel:** Due to normal mill tolerances, it is not uncommon for some deviation to appear along a tank seam. This deviation can change the torque required to achieve proper gasket compression.

In view of the foregoing variables, it is impossible to assign torque values to tank bolts that will always ensure a proper gasket seal. Experience shows that a proper seal is made when the bolt has been tightened enough to compress the gasket until it moves. Watching the gasket in lap joints while tightening the bolt easily verifies this. A set torque may not always compress the gasket properly. Bolts that are too tight will damage the gasket.

If a torque value is required, or if bolts in a multiple-row seam are to be checked, it is suggested that a torque wrench be used after the gasket has been compressed, as explained previously. This will establish a reference point for that seam which should be fairly representative for the entire ring. However, because of variables already mentioned, it would not be uncommon to see a variance of ± 25% in torque values.

One-piece neoprene-backed steel washers should be tightened until they flatten. It is not uncommon to spin off part of the neoprene washer for a proper seal; their purpose is to seal the threads of a bolt. Two-piece washers, consisting of a square shoulder "O" ring and a formed (cup) washer should be tightened to compress the washer against the "O" ring. The "O" ring should not protrude form the washer.

Plastic encapsulated bolts should be tightened until the raised ring on bottom of plastic cap is flattened. To ensure this is happening, a few bolts should be tightened and checked before tightening all bolts.

## SECTION II

## JOB PREPARATION

1. **INSURANCE REQUIREMENTS**
   The customer must secure the proper amount of insurance coverage, including all risk or builder's risk coverage. The tank contractor must have adequate liability and workmen's compensation coverage.

2. **TOOLS AND EQUIPMENT**
   Listed below are tools necessary to erect a bolted tank.

### MINIMUM EQUIPMENT REQUIREMENT

| EQUIPMENT NAME | QUANTITY |
|---|---|
| Scaffolding Bracket | One bracket per stave |
| Scaffold Planks | Two planks per bracket for 1 ring |
| Gin Pole | One (Figure 8) |
| Power Air Tugger or Crane | One |
| Snatch Block Double Pulley (if not using tugger or crane) | Two, minimum |
| Inside Hooked Drive-out ladder | One (Figure 7) |
| Impact Wench, ½ Drive, 450 ft./lb/ (Ingersall Rand Model 231) | Two, minimum |
| Air Compressor – 100 CFM min. without air tugger - 185 CFM with air tugger | One |
| Drift Pins | Six |
| Spiral Tapered Reamers, 9/16" | Two |
| Sealant Guns | Two |
| 32 oz. Ball Peen Hammer | Two |
| ¾" Combination Wrench | Six |
| ½" Drive, ¾" Impact Socket | Six |
| 12" Crescent Wrench | Two |
| 16" Crescent Wrench | Two |
| Handrail | One per bracket for one ring |
| Midrail | One per bracket for one ring |
| Handrail Post | One per bracket for one ring |
| Transit | One |
| Cutting Torch / Plasma Torch | One |
| Welding machine | One |
| Full-body Safety Harness with two lanyards | One per person on scaffolding |
| Tank Construction Ladders | As required |

**ERECTION TOOLS AND EQUIPMENT**
All standard connections are bolted. A small tank can be assembled with ordinary hand tools. However, for larger tanks, or for tanks in quantity, substantial savings can be realized by using specific tank equipment.

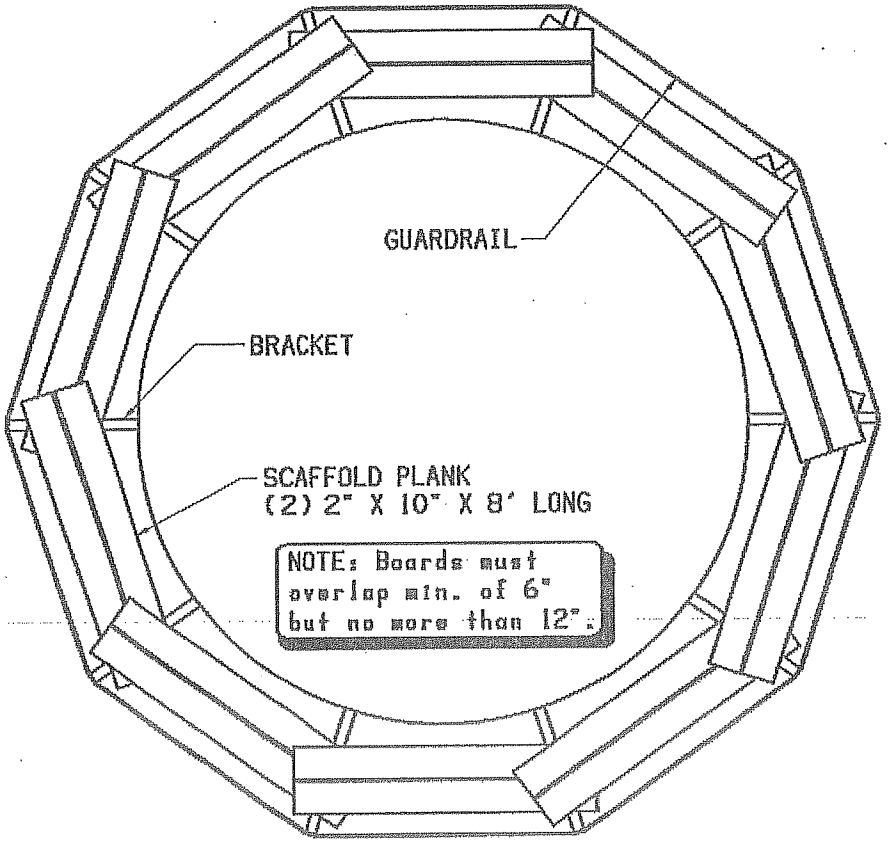
An average tank (15' diameter x 24' high) will have over 4,000 bolted connections. All but a small fraction of these will be 1/2" diameter. Power-driven **IMPACT WRENCHES**, with capacities for 1/2" diameter bolts, will reduce erection time considerably.

Several **DRIFT PINS** are required to align the holes during erection. Most crews prefer pins 16 to 18 inches long. Tapered pry bars can serve the purpose when long pins are not available. Care should be taken not to elongate the hole by applying too much pressure to the drift pin.

Exterior **SCAFFOLDING** similar to that shown in Figure 6 is required. Scaffold planks should have a minimum length of 8 feet.

The number of **SCAFFOLD PLANKS** required is determined by crew practice. The minimum quantity is enough to encircle tank at one level, or two planks for every stave in one ring of staves, plus a few extra. Scaffolding is moved from ring to ring as work progresses. Some crews prefer to leave all scaffolding in place until the shell and deck are complete, thus requiring two planks for every stave in the tank. Scaffold planks are supported by **SCAFFOLDING BRACKETS** similar to those shown in Figure 7. Normally, the brackets consist of 2-1/2" X 2-1/2" X 1/4" steel angles, and spacing between mounting points is 28 inches. Accommodation for safety line uprights must be provided; the bracket shown will receive a tubular upright, which fits over the 6-inch long plank-retaining rod at its end. Any plank-retaining device should have a minimum height of twice the scaffold plank thickness. Safety line upright must be 42 inches in height, measured from top of scaffolding board. Common practice is to leave all scaffolding brackets in place until shell and deck are complete. This requires one bracket for each stave in tank. Boards must be secured.

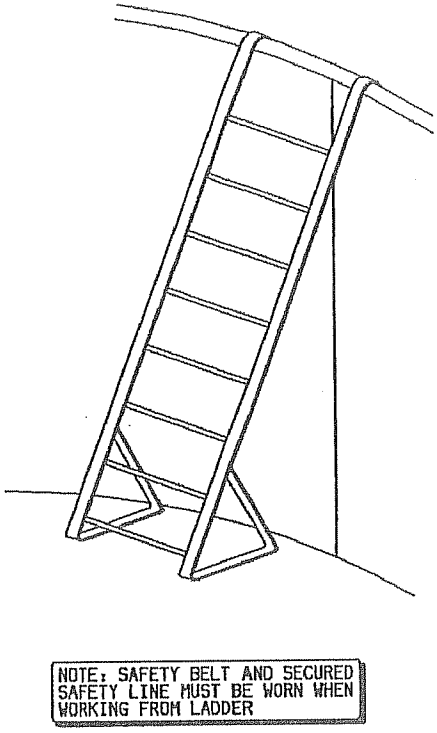
**IMPORTANT**
**Scaffold planks require excellent lumber, stress-graded at 2,000 pounds or better.**
**MUST CONFORM TO OSHA STANDARDS**




SCAFFOLDING

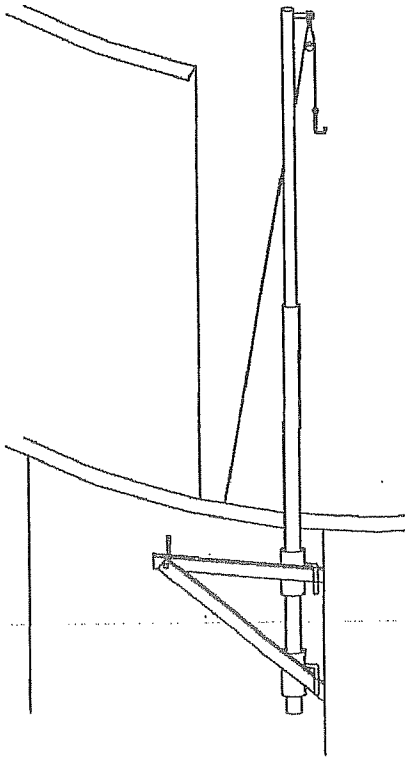
FIGURE 6

If interior scaffolding is not used, a **HOOKED DRIVE-OUT LADDER** similar to the one shown in Figure 7 is required during erection. Overall length of ladder is approximately 10 feet. Points, which bear on the shell, should be insulated to protect the interior finish of tank. Hoisting equipment is required which is capable of lifting components weighing as much as 1,000 pounds. A variety of devices can be used, but GIN POLES similar to the one shown in Figure 8 are most common. Made of steel pipe or tubing, they are supported from scaffolding brackets and extend well above the top of ring under construction. Tank shell must be protected from gin pole bearing points.




DRIVE OUT LADDER

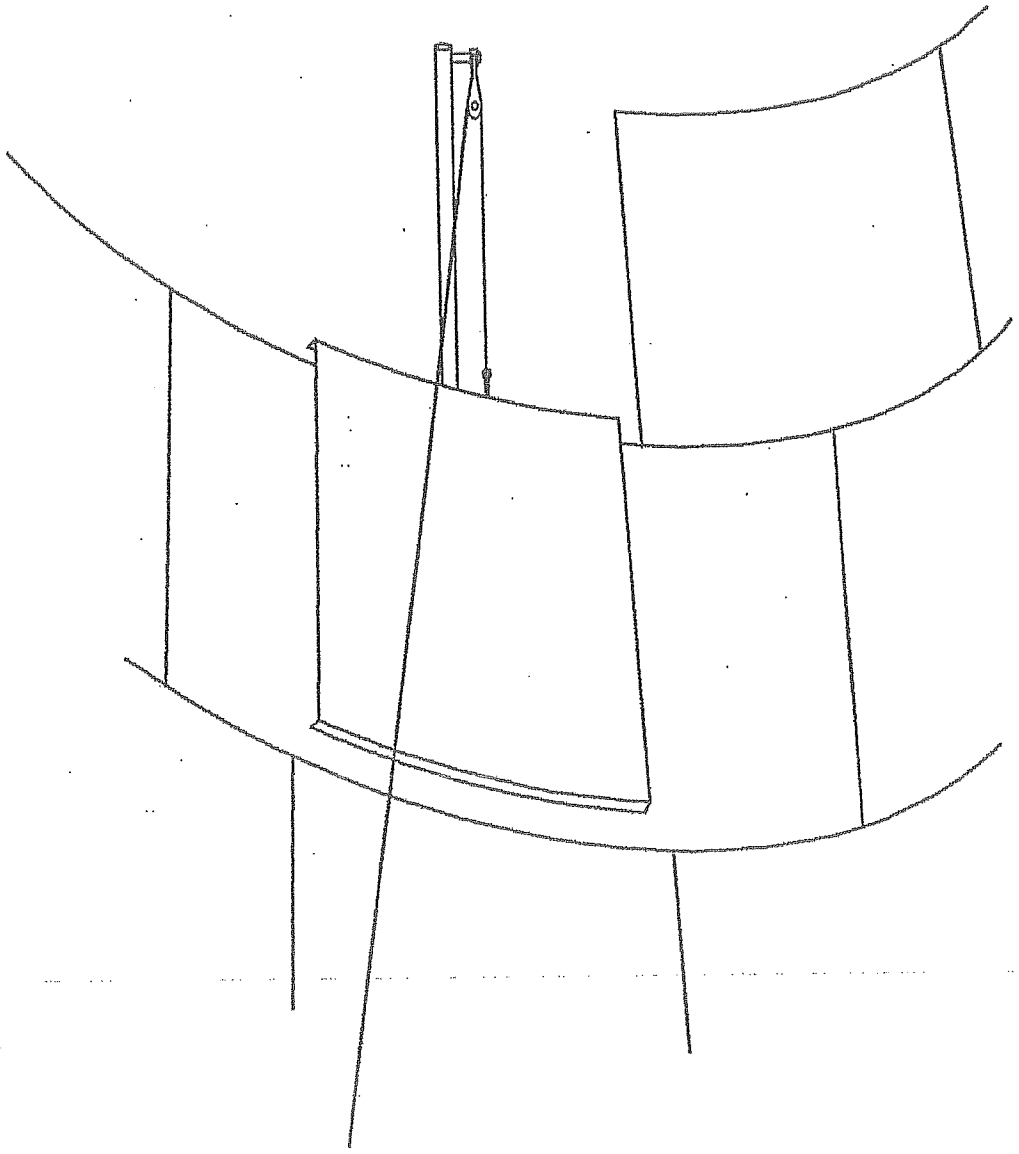
FIGURE 7



GIN POLE

FIGURE 8

The **GIN POLE** should be set so tank components can be lifted from the inside (Figure 9). Staves, deck, and bottom sections are shipped in banded bundles if galvanized, or in special racks that protects the coating of painted tanks. Racking is done to protect the coating. **EXTREME CARE SHOULD BE TAKEN NOT TO SCRATCH COATED PARTS DURING ERECTION.**



LIFTING STAVE WITH GIN POLE

FIGURE 9

The sequence of erection is bottom - shell - deck; therefore, parts should be located in order of use. Smaller accessories and those items shipped in cartons and packages are best stored indoors where they are not subject to weather and pilferage. If indoor storage is not available, platforms and tarpaulins are required. All paint and sealant should be stored in a dry area in a temperature range of 55°F - 75°F.

**IMPORTANT**
**HANDLE COMPONENTS WITH CARE PROTECT THE COATING**

Note: A partially erected tank is subject to damage from excessive winds. Partially erected tanks should be guyed if excessive winds are eminent. Uncompleted stave rings and/or first "starter rings" should be guyed to prevent damage from wind.

**IMPORTANT**
**DO NOT ATTEMPT TO ERECT A TANK IN HIGH WINDS**

3. SAFETY

The erection contractor is responsible for conforming to all requirements set forth in the standards of the Williams-Stieger Occupational Safety and Health Act (OSHA), as well as state or local OSHA requirements, or, when erected outside the U.S.A., any similar rules and country requirements for erections outside of the United States.

Hazards inherent in tank construction can be eliminated by the sincere and constant effort of all concerned. Some precautionary measures are listed below.

- **GOOD HOUSEKEEPING** is essential. Work areas should be clear of obstructions and debris at all times.
- **HARD HATS** must be worn by all personnel while in the construction area
- **SAFETY GLASSES** with side shields are required.
- **SCAFFOLD PLANKS** should be marked for identification and used for the intended purpose only. Inspect regularly.
- **GUARDRAILS AND/OR TOE PLATES** must be used on all scaffolds and platforms.
- **HOISTING EQUIPMENT**, rigging, ropes and cables should be adequate and inspected regularly.
- **ELECTRICAL EQUIPMENT**, including portable tools, should be adequately grounded.
- **LADDERS** should be safe and properly fastened and set when in use. Inspect regularly.
- **SAFETY HARNESS AND SHOCK ABSORBING LANYARDS** must be worn by personnel when working above ground

## SECTION III

## SITE AND FOUNDATIONS

### 1. GENERAL INFORMATION

**IMPORTANT NOTICE TO INSTALLER**

Prior to commencement of any work, foundation must be checked for:

1. Proper radius of anchor bolts.
2. Anchor bolt spacing and height.
3. Number of anchor bolts.
4. Tank centerlines.
5. Foundation level ± 1/4" within any 30' circumference.
6. A center column pad for tanks with a center column.

Tank with base setting ring:

1. Have owner or engineer mark center point of tank.
2. Check radius of base setting ring; should be ± 1/16 inch.
3. Using a transit or other surveying instrument to check levelness to ±1/16 inch.
4. Check base setting ring for plumb (vertical level) ± 1/16 inch.

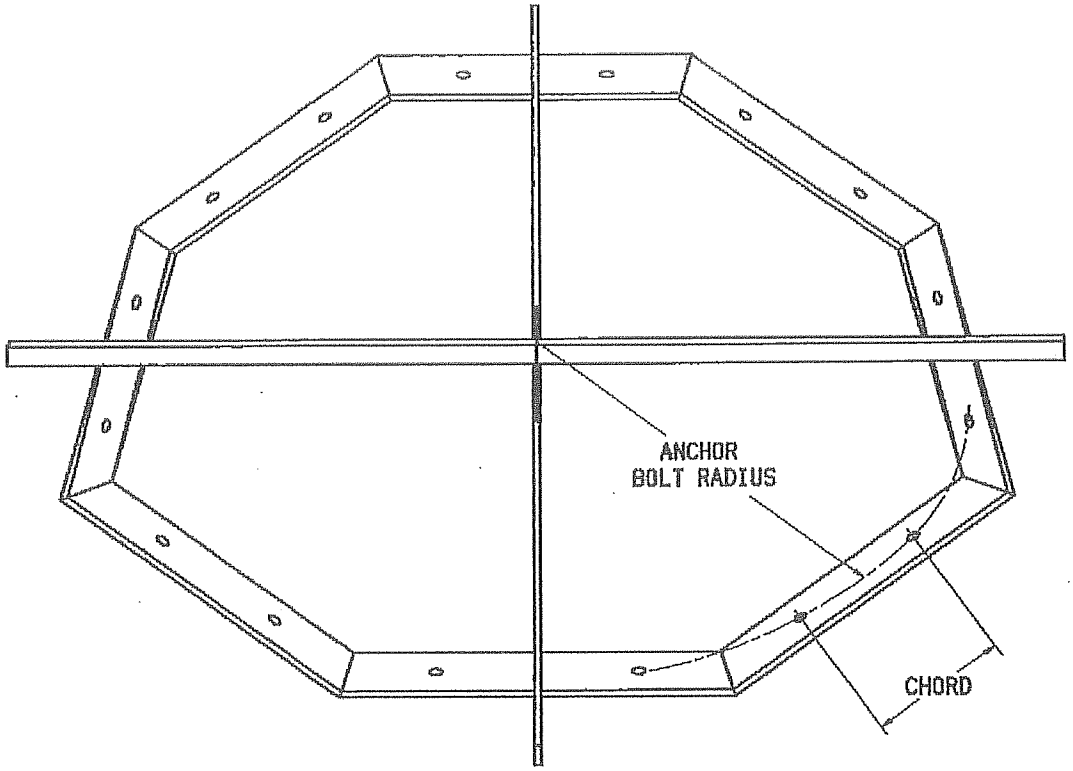
Tanks on sand or gravel fill should be ± ¼". If foundation is not correct, stop all work and contact CTT at Kansas City, KS 913/621-3700 or Parsons, KS 620/421-0200, for assistance is resolving problems.

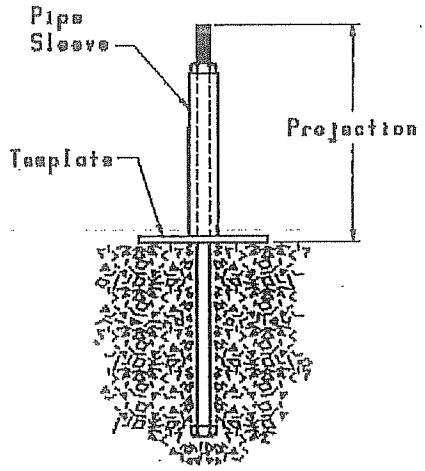
**Foundation Types And Specifications:**
CTT recommends that all foundation designs be completed by local engineers familiar with codes and conditions of the specific area of erection, and in accordance with the latest edition of AWWA-D103.

**Typical Foundation for Unanchored Tanks:**
A typical foundation would consist of the use of foundation grade bands. The grade bands are larger than the tank diameter and are filled with compacted crushed rock and/or sand. Grade bands must be level and form a true diameter. Compact fill must be level to provide an adequate surface for erecting the tank. A barrier, such as roofing tarpaper or plastic, is used on top of the fill. This is to prevent surface moisture from coming in contact with the tank.

Rigidly supported templates, as shown in Figure 10 must be used to maintain proper anchor bolt location during foundation construction.

**CAUTION**
**DO NOT ATTEMPT TO ANCHOR TANKS BY DRILLING HARDENED CONCRETE. ANCHOR BOLTS MUST BE SET BEFORE POURING CONCRETE.**




ANCHOR BOLT TEMPLATE

FIGURE 10

**Liquid Storage Tanks requiring Base Setting Ring**
Several methods can be used to support the base setting ring. It is important to ensure that base ring is level, plumb, and at the proper radius.

PROCEDURE

1. It is recommended that the foundation be poured in two pours.

2. The first pour is the footing with the ½" x 30" threaded rods properly placed. There are two sets of rods per stave provided. This pour must have a construction joint properly placed on the top of the footing to receive the second pour.

3. Once the footing is poured and cured, place the stave support angles on the threaded rods. These support angles must be level plus or minus 1/16". This is what sets the elevation of the tank.

4. Assembly the setting ring as described in Section V part 1 and 2 and Section VII and as shown in figure 11.

5. After leveling and rounding tank, the base ring is welded to the support angle, which is bolted to the threaded rods. The base ring must be supported so that it cannot move while pouring the finish grade. The ring must be plumb to plus or minus 1/16".

6. A radius board is recommended to check and ensure that tank is rounded to the proper diameter. (It is recommended that top and bottom of the staves be checked.) Radius must be plus or minus 1/16"

7. The second pour should be a continuous monolithic pour.

8. Install the C.I.M. bonding agent and membrane material furnished by CTT per the manufactures specifications.

**Figure 11 details typical method of base ring installation**

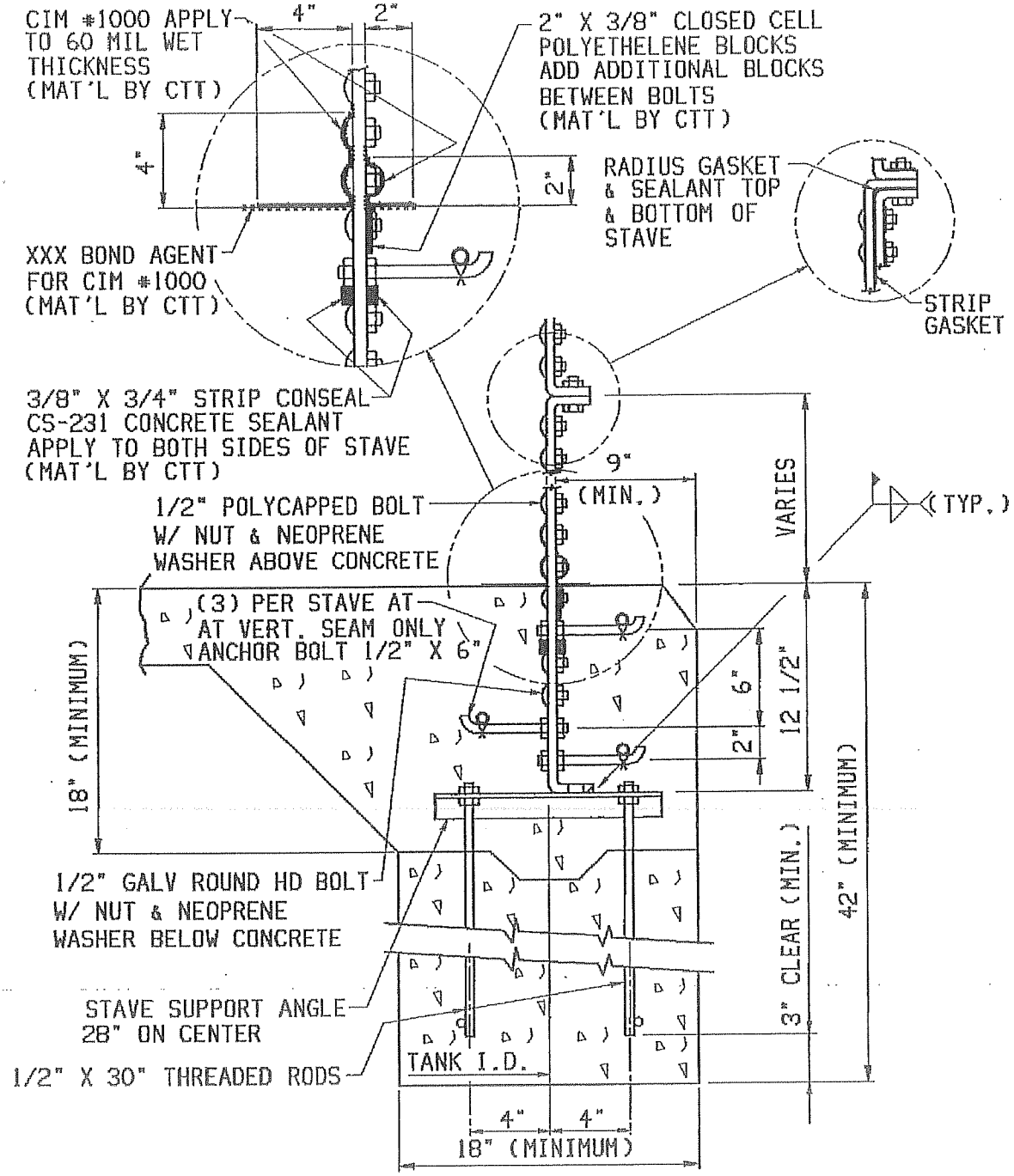
NOTE: Tank erection of the tank cannot be performed until the setting ring has been installed, this includes the C.I.M. material has been installed and cured. This work is to be done by the foundation contractor. CTT can supply on site technical support for assembly of the ring. CTT cannot accept responsibility for the proper placement of the concrete or C.I.M. materials. Please contact your sales representative for information and pricing.

C.I.M. is a high solids, two-component, liquid, cold-applied, chemical-resistant asphalt extended urethane elastomer that cures to a durable abrasion resistant film. It forms a flexible, impermeable barrier to water and most aqueous agents.

The National Sanitation Foundation has approved C.I.M. for direct contact with potable water.

For more information concerning this product contact:

C.I.M. Industries, Inc.
94 Grove Street
Peterborough, NH 03458
TEL: 800/543-3458
603/924-9481
FAX: 603/924-9482




BASE RING SETTING DETAIL

FIGURE 11

## SECTION IV

## UNLOADING AND STORAGE

### 1. UNLOADING MATERIALS

Columbian TecTank's materials are shipped by trucks or by container. A forklift and or a crane will be required to unload materials. If shipped by container, transportation from docks may be necessary. All tanks staves will be shipped in special racks designed to protect the parts. An angle or pipe spreader bar (Figure 12) will be needed to unload racks. The spreader bar should be bolted across the top of stave rack and lifted from both ends of bar. Do not lift from end rack angles or from bottom with forklift, this may result in damage to staves. Extreme care should be taken to protect coating at all times during unloading and erection.

### 2. INVENTORIES AND INSPECTION

While unloading materials, careful inspection of each component should be made; the consignee on the carrier's Bill of Lading should note any damages to parts, or to coatings on parts. Part numbers and location of damage should be added in the description of the part. Inventory of each item should also be taken at this time, and any losses or shortages are to be noted on Bill of Lading. Each shipment is carefully checked at the factory. If a shortage should occur, Columbian TecTank must be notified immediately to ensure the part will reach the site as soon as possible. Please contact the Field Service Department regarding any problems:

- **For shipments from Kansas City, KS - Telephone 913/621-3700 or Fax 913/621-2145**
- **For shipments from Parsons, KS – Telephone 620/421-0200 or Fax 620/421-9122**

To aid in determining whether there is a shortage or loss, and to help avoid costly delays, always check material received against packing list of Bill or Materials sent with the load as well as against the Bill of Materials listed on each drawing.

### 3. STORAGE

Carefully plan ahead for storage of materials. If possible, all materials should be unloaded near the foundation and stored to eliminate any moisture from contacting the coated surface. Deck and hopper sheets should be elevated on one side so water can drain off. The materials should be either stored inside or covered for protection if they are to be stored for more than a few days. To prevent pilferage and possible weather damage, all boxes containing hardware and small parts should be store inside, or carried to and from jobsite by the crew. Columbian TecTank cannot be responsible for theft of materials from jobsite or items damaged due to weather exposure.

## IMPORTANT SHIPPING NOTICE

THIS SHIPMENT HAS BEEN CAREFULLY CHECKED AND PACKED. UPON ARRIVAL, PLEASE LIST ANY VISIBLE DAMAGE OR SHORTAGE ON CARRIER'S DELIVERY ORDERS. COLUMBIAN TECTANK IS NOT RESPONSIBLE FOR PARTS LOST OR DAMAGED IN TRANSIT. CONSIGNEE MUST NOTIFY COLUMBIAN TECTANK OF ANY SHIPPING DISCREPANCIES IMMEDIATELY UPON DELIVERY.

* * *

Any discrepancies not reported to the Field Service department of Columbian TecTank within seven days of delivery will be handled entirely at consignee's expense.

- **For shipments from Kansas City, KS - Telephone 913/621-3700 or Fax 913/621-2145**
- **For shipments from Parsons, KS – Telephone 620/421-0200 or Fax 620/421-9122**

* * *

Columbian TecTank is not responsible for any charges or expenses due to delays, shortages, errors in shipment, or incorrect fabrication of parts.

* * *

Columbian TecTank MUST approve any field rework of parts, and/or back charges, in advance.

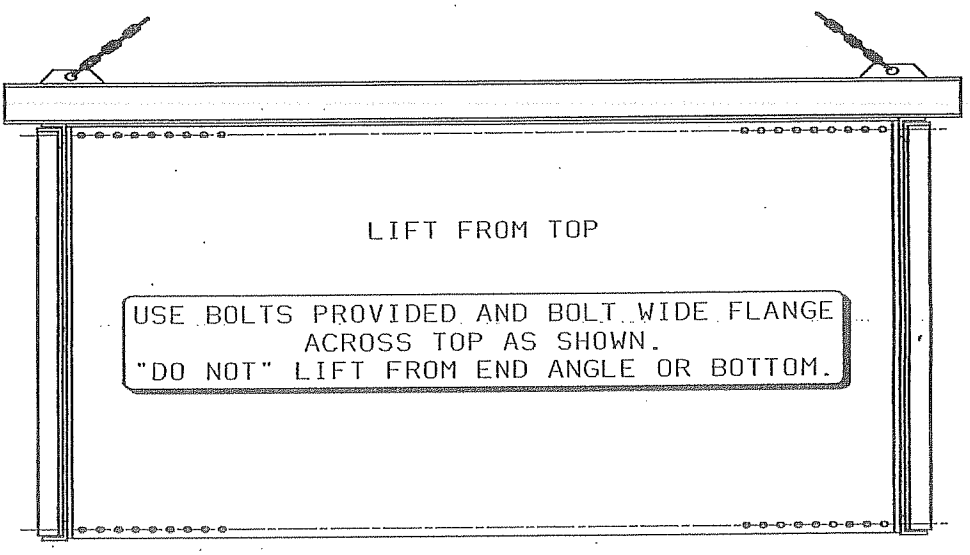
* * *

## FIELD STACKING OF PARTS

TANK PARTS MUST BE POSITIONED TO PREVENT WATER ENTRAPMENT.

PARTS BOLTED OR BANDED TOGETHER FOR SHIPPING MUST BE SEPARATED WITH SPACERS TO PREVENT MOISTURE FROM ACCUMULATING BETWEEN PARTS.

## INSTRUCTIONS FOR UNLOADING STAVES WHEN IN RACKS




LIFTING STAVE RACKS

FIGURE 12

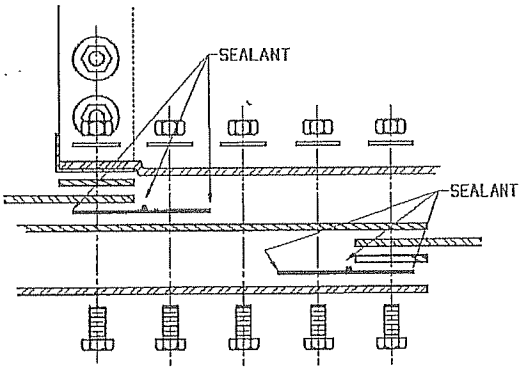
## SECTION V

## TANK PREPARATION

### 1. INSTALLATION OF GASKET

Before erection, most components of tank should have gasketing installed first. Some gasketing will be applied as the tank is built. All radial bottom, deck and stave vertical seams can be prepared in advance.

See Section I, Part 2, (page 3), which lists and describes each type of gasket used in tanks. During erection, chime lap gaskets are used at all joints where three sections of steel meet. The purpose of this gasket is to fill the small void created by the lap (Figure 13).




CHIME LAP GASKET PLACEMENT

FIGURE 13

During erection, radius gasket will also be used at the corners of each sidewall sheet (staves) in tank. On tanks with one row of bolts in vertical seams of sidewall, gasket will be cut 1-3/4" long; tanks with two rows, 3-3/4" long; three rows, 5-3/4" long. Gasket should be installed so it will follow curve of sheet at the corner and under strip gasket installed on vertical seam.

Strip gasket is used at every joint in tank, as well as all vertical and radial seams, and can be installed before tank is erected. It will be installed on all chime seams as tank is being built. Four important points to remember during erection are:

1. No area should have a metal-to-metal connection
2. Chime laps should be used at all laps, and a small amount of sealant (about the size of a dime) should be placed at ends of chime lap gasket and at bump on gasket.
3. Radius gasket should be used in all corners of sidewall sheets (staves) and a small bead of sealant placed in the center.
4. Strip gasket will be used on every single component in tank unless a precut round gasket is provided. Whenever a gasket needs to be spliced or laps over another gasket, a bead of sealant should be run across each end or side of lap and should lap at least two bolts.

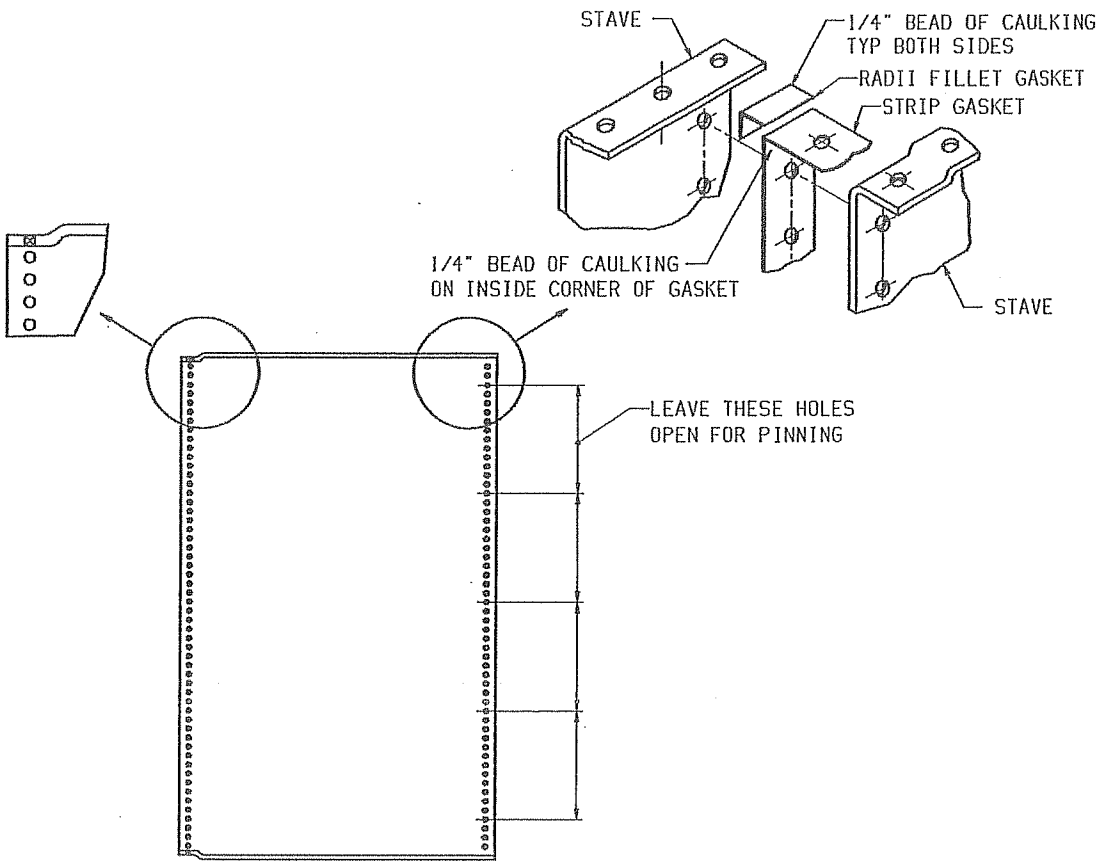
### 2. PREPARING COMPONENTS

When preparing components for erection, refer to the "Standard Detail Print" to find proper bolts used for each component. Several different types of bolts are used in most tanks, as described in Section 1. To prepare stave components, cover every hole in seam with strip gasket, including the hole in the chime at each end, even if all holes don't have a bolt installed. When cutting strip gasket for the vertical seam being prepared, always cut gasket one hole longer than necessary to cover all holes in seam. Note: This gasket is supplied in 100' rolls and must be cut as needed. Do not splice this gasket.

This provides extra gasket to hold onto if it becomes necessary to straighten gasket during erection. Install gasket on straight side of sheet. One side of sheet has an offset corner on it. (See Figure 14) All bolts can be installed in these parts using pre-punched 100' long rolls of gasketing supplied.

Horizontal seams on all components (chime seams) will be prepared during erection after the circle that forms the tank has been completed. It may be necessary to splice this gasket.

The following section describes the process used to prepare each type of component. Carefully note location of bolts and which holes are left open.




STAVE GASKET AND BOLT PREPARATION

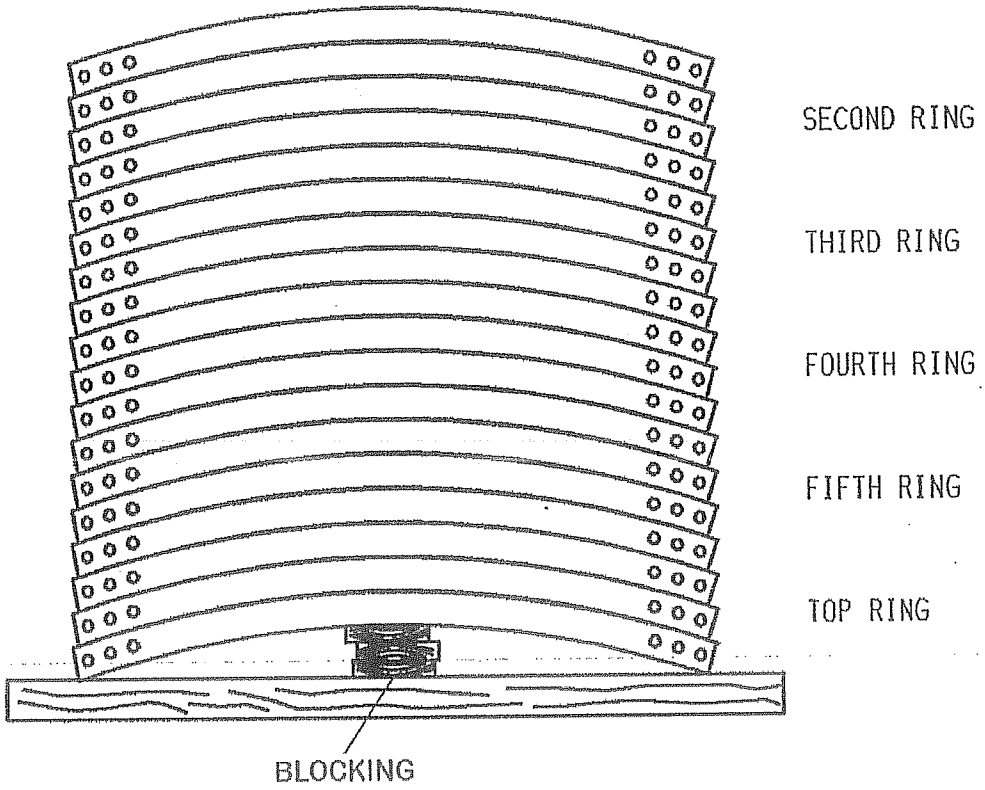
FIGURE 14

## 3. STACKING MATERIALS FOR ERECTION

After gasketing and bolts have been installed and bottom has been assembled, use of a gin pole necessitates stacking materials inside of tank for erection. A tarp, carpet or heavy cardboard should be laid on the floor to protect the finish. All stave sections can be stacked in the center of the tank as shown in Figure 15. On large diameter tanks, two or more stacks may be necessary.

The first ring should be laid out around the bottom of the tank, outside the foundation. After the first ring is erected, but before the last sheet is installed, the second ring should be set up along interior walls, leaving seams in first ring open for easy access. The **TOP RING** should be carried in next and stacked near the center of the tank, since it will be the last ring erected, followed by the second from the top, etc., working up.

Rafter and decks can also be staked inside, but enough space for a safe work area should be left open at all times. Accessories and deck segments can be left outside.




STAVES STACKED FOR ERECTION

FIGURE 15

## SECTION VI

## BOTTOM ASSEMBLY

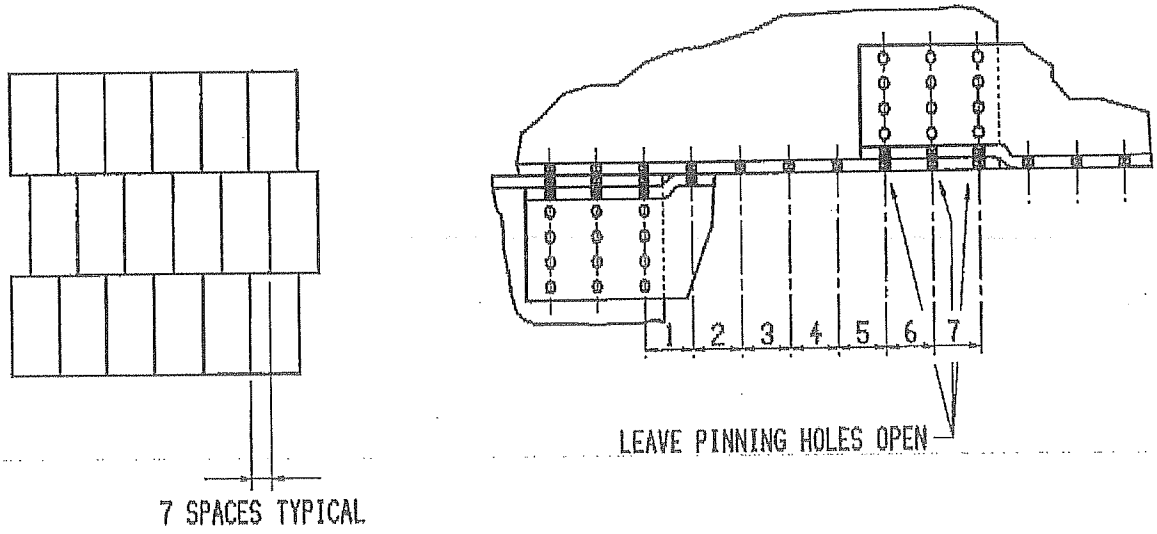
### 1. GENERAL INFORMATION:

Before beginning assembly of bottom, check foundation to ensure it is level. If not, problems may develop when assembling remainder of tank. To orient bottom, rings, decks, and accessories in proper locations, a qualified person should mark location of all openings and accessories in tank or mark 0°, 90°, 180° and 270° on foundation.

To find proper orientation for each of the above items, refer to Erection Drawings. (The vertical seam offset spacing for the bottom each ring and floor can be found in the lower left-hand corner of the main erection drawing or on the flat layout of the tank if applicable.)

**ORIENTATION MUST BE CORRECT.**

The correct way to count spacing for tank is shown in Figure 16. The drawings show spacing from the interior. The detail below shows the spacing from the exterior. Typically there are 29 spaces in tanks less than 29' in diameter and 28 spaces in tank 29' diameter and larger. You must remember this when taking the interior view spacing from the interior to the exterior.



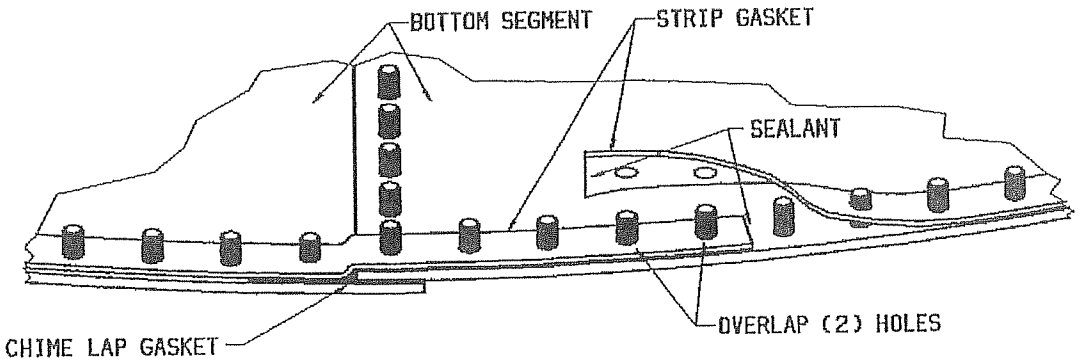

CHIME SPACING DETAIL

EXTERIOR VIEW

FIGURE 16

2. BOTTOM ASSEMBLY – 9' DIAMETER TANK

The 9' diameter tank bottom is supplied in two half sections. To install this bottom, select proper bolts from nut and bolt chart for seam of bottom sections. Care should be taken because several bolts will be used for center support ladder, if applicable. After selecting proper bolts, lay bolt channel along seam, insert bolts, and press strip gasketing over bolts extending through bottom section. Make certain bolt channel does not extend past holes on each end and that strip gasket extends one hole over each side. Next, position bottom section that has been gasketed in the desired position. Lay other half over prepared section. Install neoprene-backed steel washers and nuts. Tighten bottom until strip gasket is compressed and starts to move. Chime lap gaskets are required where bottom halves join at the chime, (Figure 17).




OVERLAPPING THE GASKET

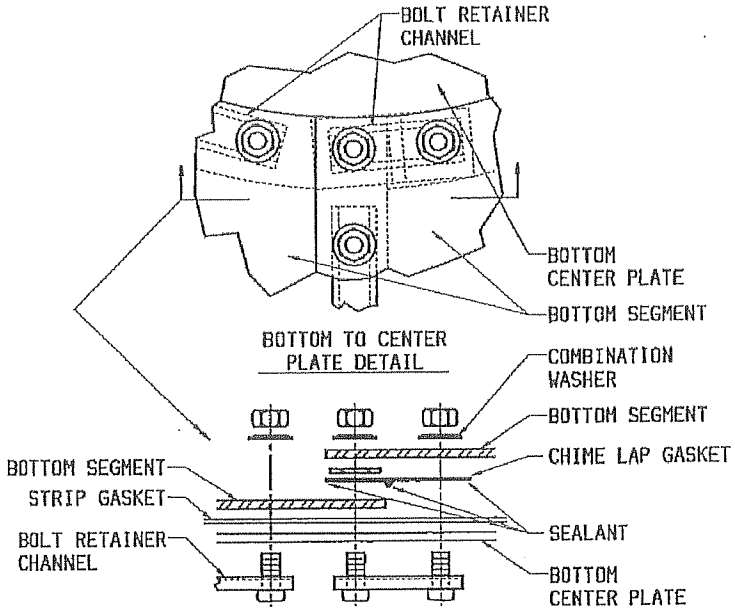
FIGURE 17

3. 12' DIAMETER – 32' DIAMETER TANKS – 1-PIECE SEGMENTS

These tanks incorporate the use of a center plate and pie-shaped segments which, when assembled, form the bottom of tank. Before bottom is assembled a barrier should be installed per previous instructions under "Foundations". Located center point and mark diameter of center plate to help maintain the starting point.

The bottom center plate gasket is furnished in a round circular gasket, except in 26' thru 32' diameter tanks where strip gasket is used to seal the center plate. As this gasket is placed around, it will pucker but will pull down after assembly. Select proper bolt length from nut and bolt chart. Special length bolt channel is used to keep the bolt head from turning. Once center plate is gasketed, bottom pie-shaped segments are prepared. Gasket both sides of the first bottom segment to be assembled. Select proper bolt length and bolt channel; install all bolts through bolt channel, segment, and finally the strip gasket. Bolts should be in bolt channel as far as possible. Bolt channel must not cover first or last hole in sheet. Strip gasket must extend past first and last holes.

Assemble in a counterclockwise direction, install gasket on leading side of remaining segments, leaving last sheet un-gasketed. Care must be taken to ensure NO foreign objects are caught between strip gasket and bottom sheets. (Figure 18)

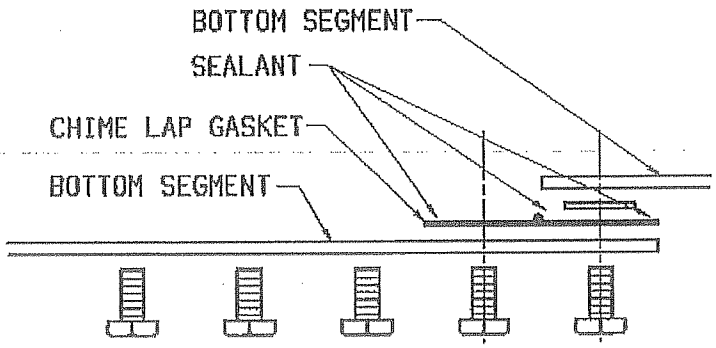



CHIME LAP DETAIL – BOTTOM LAP TO CENTER PLATE

FIGURE 18

It is recommended that 1" x 4" board be placed under seam of bottom segment being assembled to stop bolts from being pushed down. This board can then be moved from seam to seam during assembly.

Next, install segment that has been gasketed on both sides, Chime lap gasket will be placed step side down (Figure 18) with sealant placed alongside the segment prior to chime lap being set down. On the outside end of segment, place a chime lap gasket step side up under radial strip gasket, (Figure 19). Place the last bottom segment onto prepared seam. Install combination washers and nuts on all bolts. **DO NOT TIGHTEN ANY BOLTS UNTIL ENTIRE BOTTOM IS ERECTED.** Continue in a counterclockwise manner until entire bottom is completed.

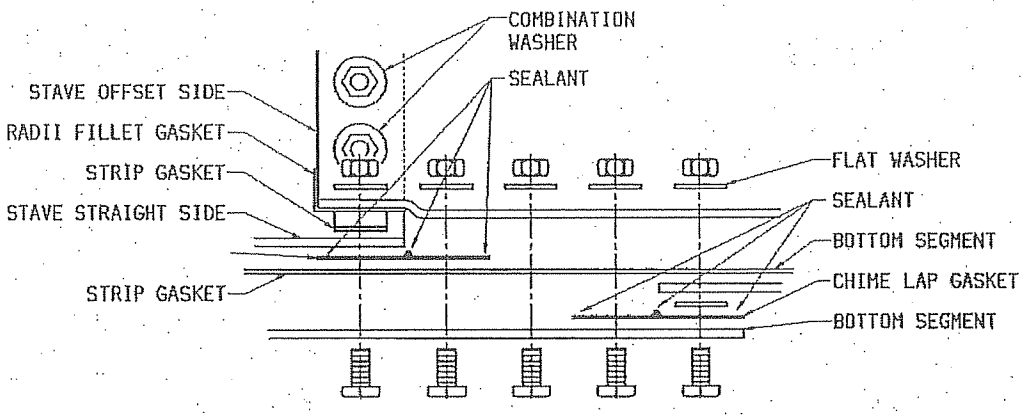



BOTTOM LAP AT CHIME

FIGURE 19

Tighten bottom down. Bottom will be considered tight when movement is noticed in strip gasket. Be certain bolt heads are securely inside of the bolt channel. Check to ensure all protruding bolt lengths are approximately the same height. Be careful not to break bolts, as it will be difficult to replace them.

After bottom is completed, prepare bottom chime for stave erection. Select proper bolt size and place bolt, head side down, up through chime. Press strip gasket down over bolts. Strip gasket should be used in sufficient lengths to minimize laps. When strip gasket is spliced, two-hole lap is to be used. Gasket must be cut through the hole and lapped at least one hole each way (Figure 17). A bead of sealant must be placed at both ends of strip gasket. Also, run bead of sealant across the step of chime lap at bottom chime lap, (Figure 20). Place all bolts in except for the hole in which the stave vertical seam will connect. Bottom is now complete and ready for stave wall connection.




CHIME LAP DETAIL – BOTTOM AT LAP

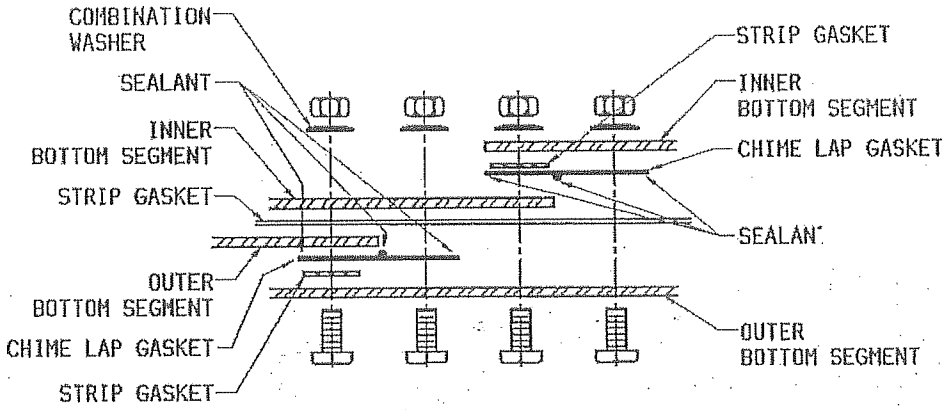
FIGURE 20

## 4. ASSEMBLY OF MULTI-PIECE BOTTOM – 38' DIAMETER AND LARGER

Erection of these large diameter tank bottoms is similar to smaller one-piece tanks. Inner, intermediate segments (if applicable), and then outer bottom segments are erected as bottom proceeds around. First sheet is to be gasket on both sides – inner and outer. It will be necessary to modify the bolt channel for both pieces in order to gasket both sides. This can be accomplished by using a hacksaw CTT furnishes bolt channel for short side of inner sheet and long side of outer sheet. To gasket both sides, it will be necessary to cut off the piece supplied for long side of outer to fit right-hand side of first bottom pieces.

Center plates for these tanks are similar to center plates for smaller tanks. The center plate for 55' diameter starts with a smaller center plate as before, but has a two-piece adapter plate, which has a top and bottom orientation. Refer to Figures 17, 18, 19, 20, 21, and 22 for gasket placements.

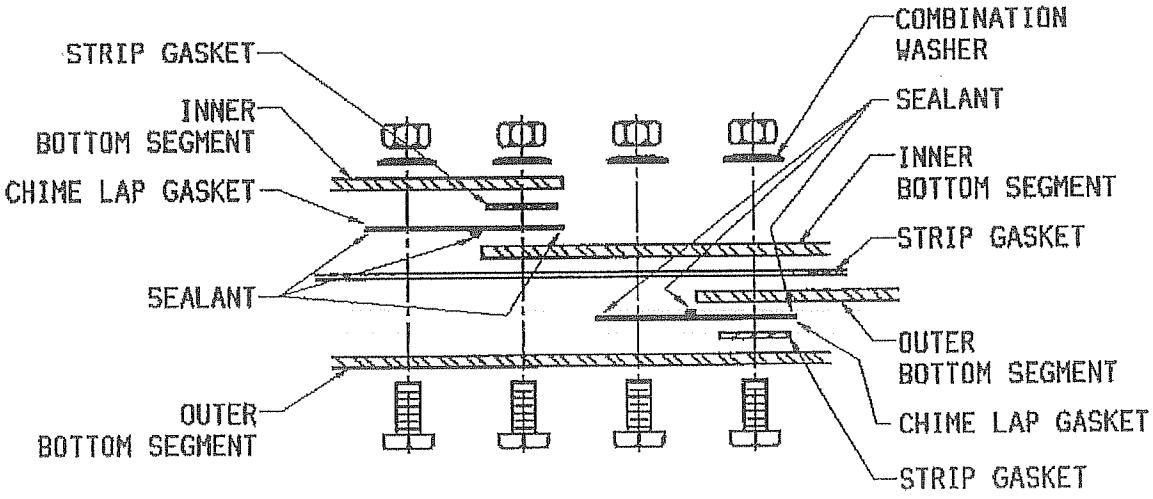
All bottoms are erected starting with the center plate and working out.




Note: Bolt Channel Omitted For Clarity

INNER TO OUTER BOTTOM DETAIL

FIGURE 21




Note: Bolt Channel Omitted For Clarity

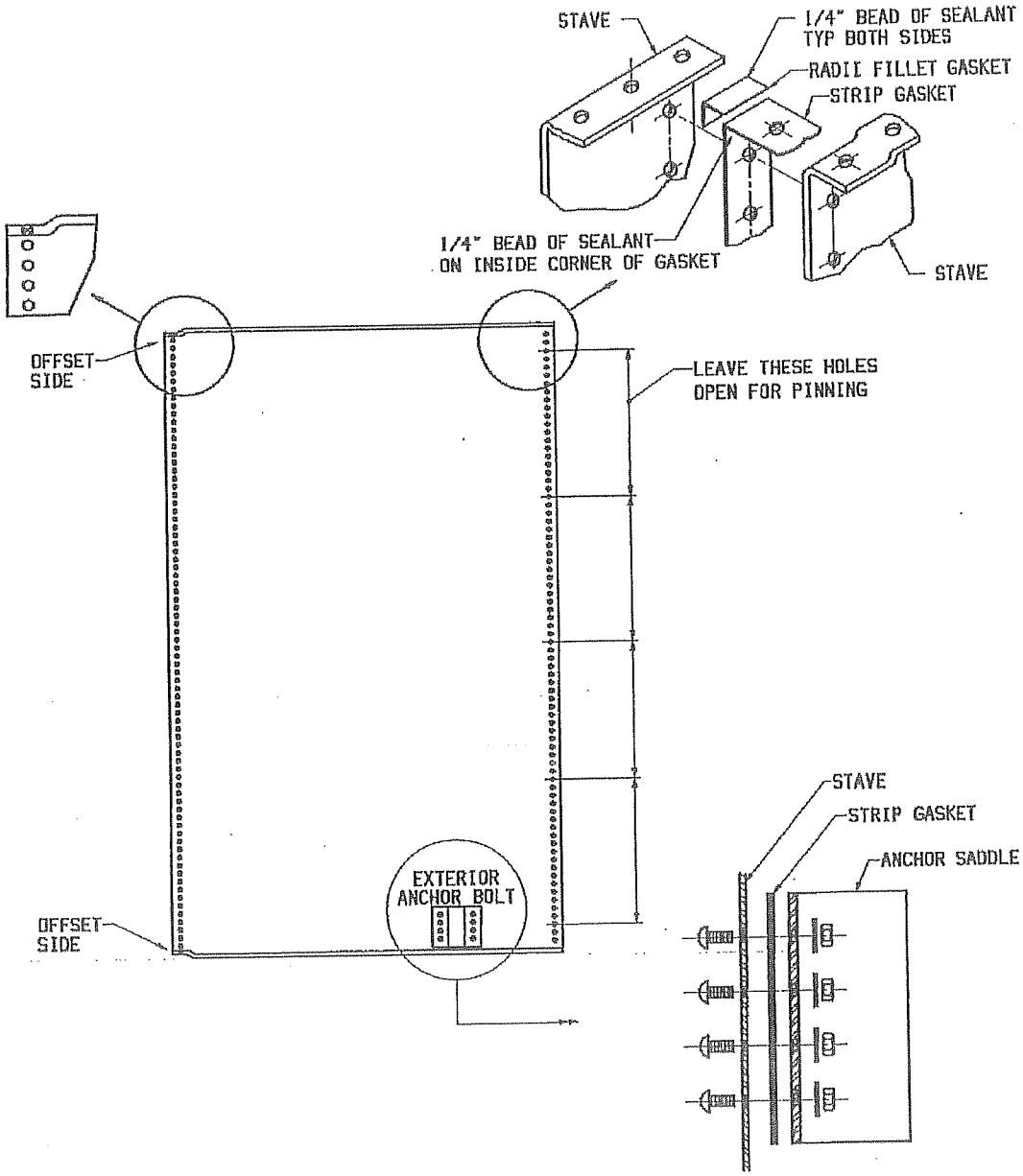
BOTTOM ASSEMBLY 55'

FIGURE 22

## SECTION VII

## SHELL ASSEMBLY

1. FIRST RING
   Figure 23 shows a typical bottom ring of staves, which has been prepared for erection.




BOTTOM RING STAVE PREPARATION

FIGURE 23

Strip gasket is attached to one vertical edge of each stave as shown. Note that gasket is located on outer face of stave at edge, which does not have chime offsets, and it extends at least one hole beyond chimes at top and bottom. Vertical seam bolts are inserted from inside stave and are forced through slightly undersized holes in gasket, thereby retaining both bolts and gasket during erection. Leave five holes open for pinning as shown.

**NOTE: Depending on type of hardware furnished, certain other preparations must be made in installing bolts in the vertical seam. A bolt retainer channel is used if square head bolts are supplied. The bolt must be firmly pushed into this channel.**

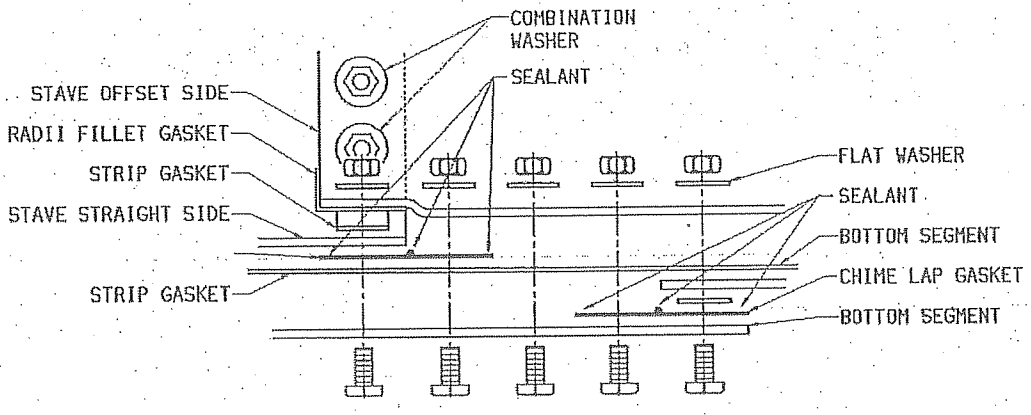
Apply a bead a sealant beneath strip gasket at both seam corners and install a strip of radii fillet gasket. A second bead of sealant is required over the radii fillet gasket. Push strip gasket against sealant and fillet gasket. This will help to ensure a leak-free joint, (Figure 22). Radii fillet gasket must extend beyond both edges of the staves.

Some tanks will require anchor saddles. A short piece of strip gasket is used to seal saddle to stave, (Figure 23).

Some tanks will have two or three rows of vertical bolts. Gasket the other seams, just as on the one-row vertical, making sure the radii fillet gasket extend beyond each edge. For reference: one-row vertical – approximately 1 ¾" of fillet gaskets, two-row vertical – 3 ¾", and three-row vertical of – 5 ¾" of gasket.

Set up first stave. Begin with either the cleanout stave or manway stave. Proper location of first stave will ensure the remaining staves are located correctly. **REFER TO ERECTION DRAWING FOR PROPER ORIENTATION.** Note: Vertical seam joint should not line up with bottom lap joint, as this will create problems in trying to seal the tank.

Work stave chime holes down over chime bolts. Remember, chime bolts were left out where stave laps are to join. If applicable, place flat washers on bolts and spin nuts on all bottom chime bolts, but **DO NOT TIGHTEN**. Slip a mounded chime lap gasket under right-hand chime with smooth side down and shoulder towards lap. **DO THIS ON EVERY STAVE** (Figure 20).




INSTALLING FIRST RING ON BOTTOM

EXTERIOR VIEW

FIGURE 20

To set second stave, place to the right of the first stave, building the ring counterclockwise. Run a pin through lower left lap hole and right lap of first stave. The left-hand side should have a pin placed in an empty vertical seam so it may be lifted and the stave positioned to set down on bottom chime bolts. Chime bolts must to be set first. Next, push up first bolt to right of lap hole and place a nut, or a washer if required, working around to the right nutting up the chime bolts but leaving them loose.

To fit up first vertical seam, place a pin in an open vertical seam hole. Pull straight down.

Direct a worker on the inside of tank to tap a bolt out through stave under the pine. Install nut on this bolt. Reach up to make next open hole and repeat process to the top of stave. **NOTE: MAKE CERTAIN GASKET IS IN PLACE AT UPPER END OF STAVE WHILE PINNING VERTICAL SEAM.**

Next, tighten catch bolts. Drive out remaining bolts in seam and add any bolts left out for pinning. Install combination washers and nuts on all vertical seams. If bolt channel is used, be certain all bolt heads are firmly in the channel. Proceed erecting to the right, counterclockwise around tank. Steady the staves until three or four are in place. On a windy day, wire them.

Before installing the last two staves, remaining stave rings should be stacked in interior of tank. Care must be used so that coating is not damaged and radius of staves is not distorted. Top ring should be stacked first, then the next ring down. Proper blocking must be used to support the stave. Staves should be stacked concave side down, (see Figure 15). Multiple stacks may be used to avoid excessive height and weight.

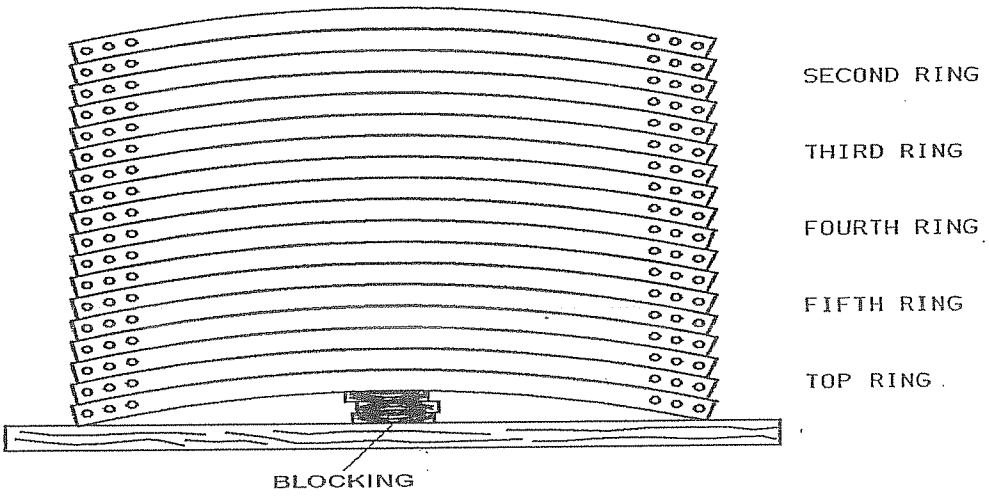



FIGURE 15

Other major components, such as deck sheets, can be stacked. Sequence of erection is bottom, shell, and deck stacks should be located in order of use. Place boards beneath all stacks to provide enough support to avoid distortion. Smaller accessories, and items shipped in cartons and packages, are best stored indoors where they are not subject to weather and pilferage.

If indoor storage is not available, a secure area with platforms and tarpaulins is recommended.

Complete the erection of first ring. Free left-hand end of bottom chime of first stave placed. Back off several chime bolts and wedge the gap open with a pin or nut. **Note: Install and remove the wedge carefully. A sharp edge of a pry bar can damage the tank gasketing.** Slip right-hand lower corner of final stave into this gap from inside the tank. (Install a chime catch bolt or two.) Work bolts into place in right-hand vertical seam of this last stave. Work left-hand vertical seam bolts in last. This is opposite from the way other staves were set. Remember to pull the wedge from chime gap. Use same procedure for finishing all remaining stave rings.

NOTE: DO NOT ATTEMPT TO ERECT A TANK IN HIGH WINDS. IN MODERATE WINDS, GUY STAVES TO PREVENT DAMAGE TO UNCOMPLETED STAVE RINGS.

Tighten all chime and vertical seam bolts, making certain all bolts are tight and a washer is under each nut. Staves should be tightened to the point where gasket begins to move under compression. Refer to "**Bolt Tightening** on page 5."

HANDLE COMPONENTS WITH CARE - PROTECT THE COATING

After first ring is tightened, attach an erection bracket, usually at third and seventeenth holes from top chime – one per stave. Place scaffolding planks and guardrail in place. See Figure 24

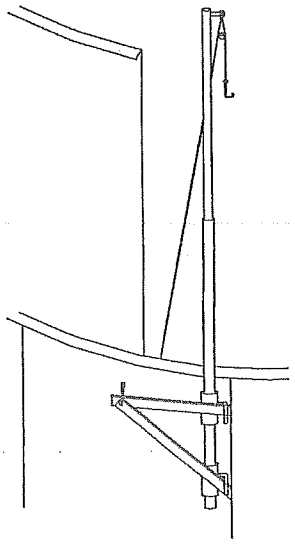
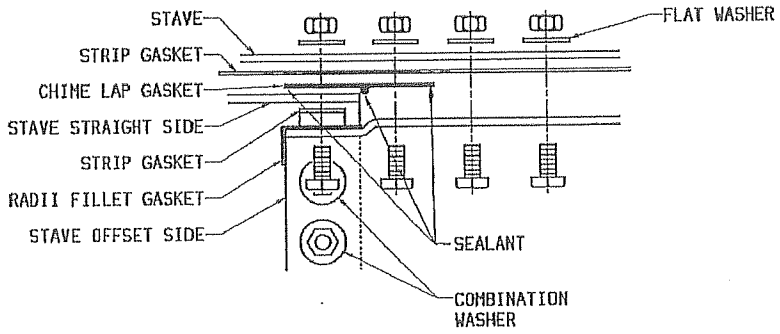


FIGURE 24

2. SECOND RING AND ABOVE
    1. Prepare top of first stave chime ring in same manner as the bottom, except either ream or "drift" out offset lap hole so a bolt will fit. Chime lap gasket must be installed per Figure 25. Push all bolts up through chime and strip gasket, leaving out second stave ring lap bolts, refer to erection drawing for spacing.




CHIME LAP DETAIL – TOP OF STAVE

FIGURE 25

    2. Shell erection proceeds on second ring as in first; except it will be necessary for stave-up worker to work catch bolts in place by himself until three or four staves are set. Then, the drive-out worker will be able to work off the drive-out ladder, (see Figure 7), page 8.

    3. Reminder of tank is erected in the same manner. NOTE: Always complete each ring before starting a new ring, and then if any vertical seam bolts need replacing, they can be easily reached. Lift sheets into place by using the gin pole. (See Figure 9), page 9

    4. Follow the erection drawings to determine proper spacing between vertical seams.

TOUCH-UP PAINTING NOTE:

It will be advantageous to repair all scratches in each stave rings as they are completed. The worker on inside ladder can accomplish this easily. Be certain to follow recommended touch-up procedures in back of this manual.

3. ASSEMBLING THE TOP RING OF STAVES:
    1. The stave sheets for the top ring are assembled in exactly the same manner as the staves sheets on the second ring, (Exception see steps 4 & 5).

    2. One important point to remember is that the first stave sheet of the top ring should be installed so that it straddles a vertical seam on the ring below. Follow erection drawings to determine proper spacing. Once again, be careful to use the right length bolts and the proper radius gasket.

    3. After the last ring is erected, install a gasket around the top edge of the tank, making certain to apply adequate sealant and chime lap gaskets at all offset joints on vertical seams (Figure 37).

    4. For tank with the diameter of 29' and larger it is necessary to modify the bolt retainer channels (if furnished) on the last ring of staves to accommodate the rafter hanger brackets. To do this simply cut 10" off the bolt retainer channel before applying gasket materials to the stave sheets.

5. Next, position the rafter hanger brackets as shown on Figures 26 & 27, depending on whether the tank has single, double or triple-row bolt holes. All brackets should be mounted in the same direction as illustrated.

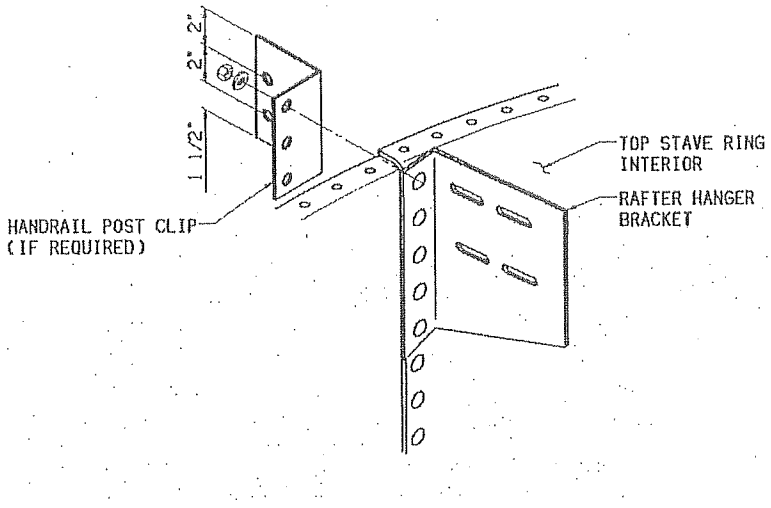



FIGURE 26

Figure 26 shows the proper mounting of the rafter hanger bracket on a stave sheet with single row punching. The view is from the interior of the sheet. (Applicable only for tanks 29' diameter and larger.)

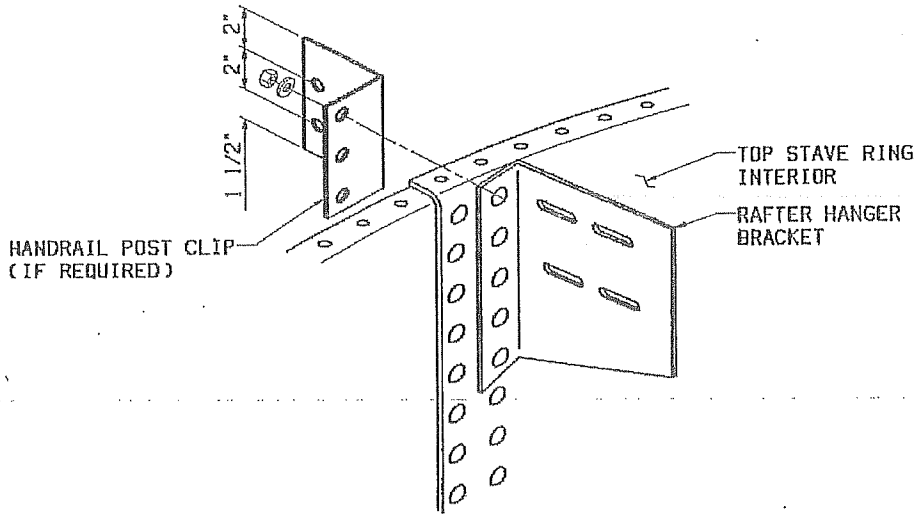



FIGURE 27

Figure 27 shows the proper mounting of the rafter hanger bracket on a stave sheet with double row punching. The view is from the interior of the sheet. (Applicable only for tanks 29' diameter and larger.)

## SUMMARY – SHELL ERECTION

- Place radii fillet gaskets in place.
- Gasket vertical seams of each bottom ring stave overlapping chime with the extra hole of gasketing.
- Lay staves around bottom section, concave side up. Make certain the chime offsets are at the left.
- In placement of staves, be certain all precut openings, such as a cleanout on manway are in their desired location.
- Set first stave in place making certain that vertical seams of this and all other staves do not overlap the segment seams of the bottom panel.
- Bolt bottom chimes to bottom panel.
- Set second stave in place with a chime lap gasket where the stave chimes are overlapped. These chime lap gaskets at the bottom of staves will be placed with the smooth side down.
- Align holes of all staves by using a drift pin.
- Insert bolts in holes from inside of tank to join the staves. Run nuts on bolts but do not tighten until ring is complete.
- Make certain gasket does not get out of line with holes in stave.
- Proceed with construction to the right counterclockwise, in the above manner to complete first ring of staves.
- Place center pole. Rafters and inside ladder, as applicable, inside of tank before last stave of first ring is in place.
- When installing the last stave of first ring, loosen several chime bolts on first stave so chimes of first and last stave may be lapped easily.
- Tighten all chime bolts. Stop tightening when gasket edge begins to move to prevent breaking the gasket.
- Lean gasketed second ring of staves against inside of tank. Be careful not to damage the coating.
- Raise first stave of second ring into place, setting spacing of vertical seams (shown on drawings) to the vertical seams of first ring.
- Erection should not be attempted in high winds.
- If tank has a third ring of staves or more, scaffolding must be built to install it.
- Prepare staves with gasketing and raise into place as in second ring, et cetera.

## SECTION VIII

## DECK SUPPORT SYSTEM INSTALLATION

### TANKS UP TO AND INCLUDING 21' 6-1/2" DIAMETER (CENTER LADDER TYPE)

1. For tanks with diameters up to and including 21' 6-1/2" a deck support system consisting of a manhole dome a center support ladder (may be provided). The dome is supported by the ladder and the deck sections and is later attached to the dome. (Figures 28, 29, 30, 31 & 32)

2. The first step is to assemble the ladder, which consists of angle side rails and shorter angle crosspieces that serve as steps. Bolt the side rails and steps together as shown in the erection drawings.

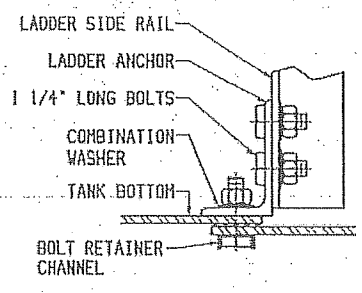
3. The manhole dome must be exactly the right distance from the bottom of the tank. For this reason, it will be necessary for you to refer to the erection drawings to get the correct measurement (from the tank bottom to the lower hole of the ladder side rail) for the tank you are erecting.

4. After the ladder has been assembled, install bolts and strip gasket on the dome skirt. Insert the bolts for the dome from the under-side of the dome through the skirt and the gasket, in that order.

5. Bolt the ladder to the manhole dome and raise the assembly into position, then bolt it to the bottom of tank as shown in Figure 28 & 32. The ladder and dome may be supported temporarily with Guy wires or rope until the first deck section is bolted in place.

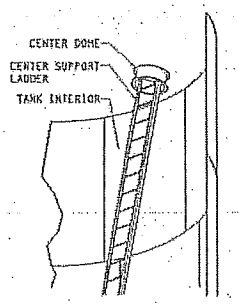
6. You are now ready to prepare the deck sections as shown in Figure 33, page 34.

7. Rather than using guy wires or ropes as explained above, some erectors prefer another method. Place the center support assembly inside the tank and lean it against one side (Figure 29). Be careful not to scratch coated parts. Support the first deck section on the top edge of the last ring (Figure 30). Insert one bolt through the perimeter of the deck section and the chime. Insert another bolt through the inner edge of the deck section and the dome. Swing the center support to the center of the tank, pivoting the deck section on the perimeter bolt (Figure 30). Insert another bolt along the perimeter to stabilize this assembly temporarily. Bolt the center support to the bottom of the tank (Figure 28). Finally, bolt the deck section in place on the chime.



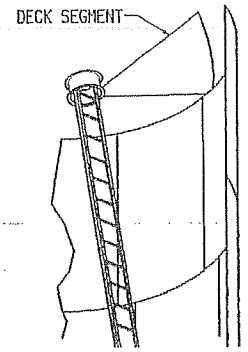

CENTER LADDER ATTACHMENT

FIGURE 28



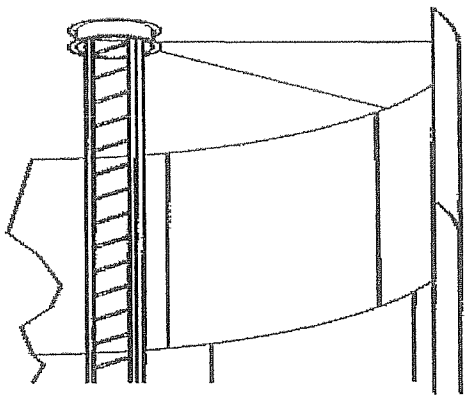

CENTER SUPPORT

FIGURE 29



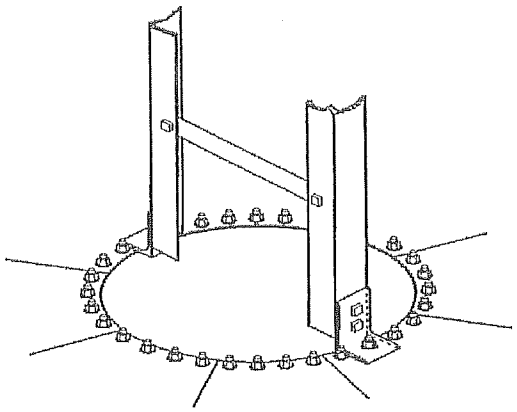

CENTER SUPPORT W/DECK

FIGURE 30



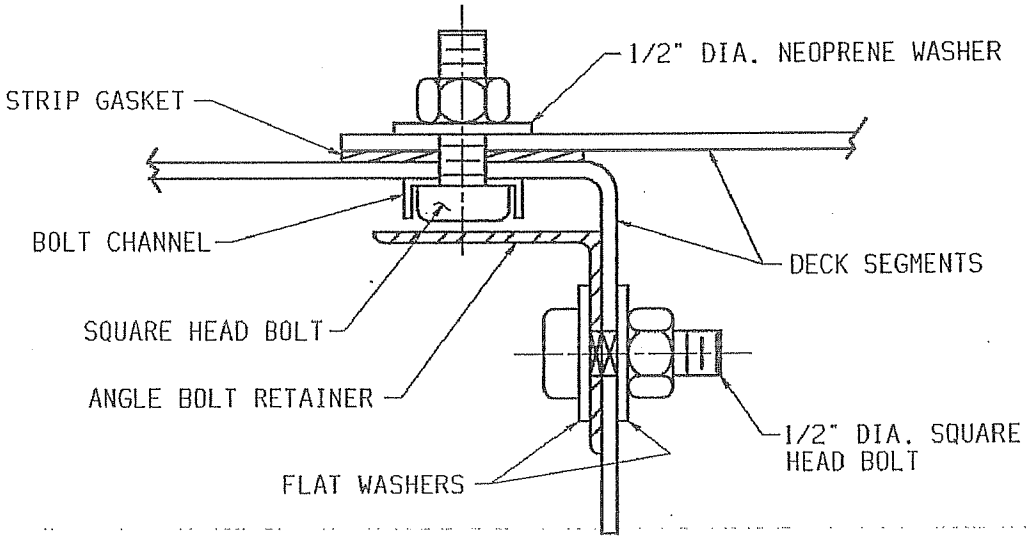
CENTER SUPPORT W/DECK TO STAVE

FIGURE 31



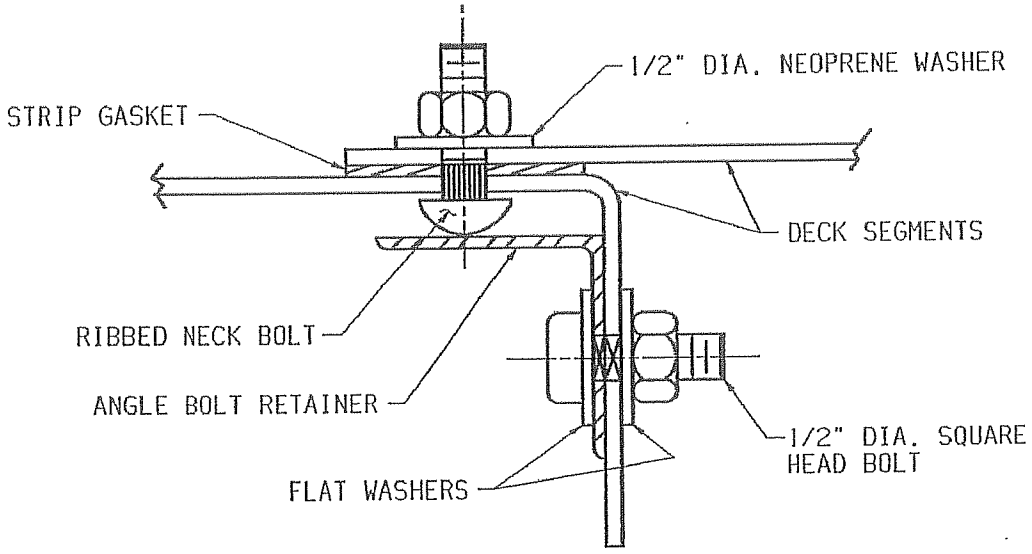
CENTER LADDER ATTACHED TO BOTTOM

FIGURE 32




FLANGED DECK ASSEMBLY WITH SQUARE HEAD BOLTS

FIGURE 33A




FLANGED DECK ASSEMBLY WITH RIBBED NECK BOLTS

FIGURE 33B

**TANKS UP TO AND INCLUDING 26' DIAMETER:**
For tanks with a diameter of 26', Columbian furnishes a deck support system consisting of a dome and beam assembly. Parallel beams support the dome and the deck sections are later attached to the dome assembly.

1. The first step is to assemble the beam support. This assembly consists of channels, splice plates, gusset plates, brace angles, brace clips, and chime hangers. See Figure 34 for the proper parts arrangement. Assemble the parts, insert bolts and tighten all of them except the chime hanger bolts.

2. Install column dome support to center dome using the appropriate bolts, nuts and washers, bolt this to the support structure. Place the appropriate dome gasket on the lower flange. (Note: The top flange will always be 28-holes.) Push the bolt up through the flange and gasket inserting a bolt in every hole. Install the 28-hole dome gasket to the top flange in the same manner as the lower flange. Figure 34

3. Mount the dome assembly to the beam assembly. Raise the complete dome and beam assembly to the top of the tank and position it in the center in such a way that the chime hanger brackets straddle vertical seam laps. Note: Use two chime lap gaskets at each hanger as shown to the erection drawings and Figure 34.

4. Temporarily bolt the hanger brackets in place. You are now ready to prepare the deck sections as shown in figure 33.

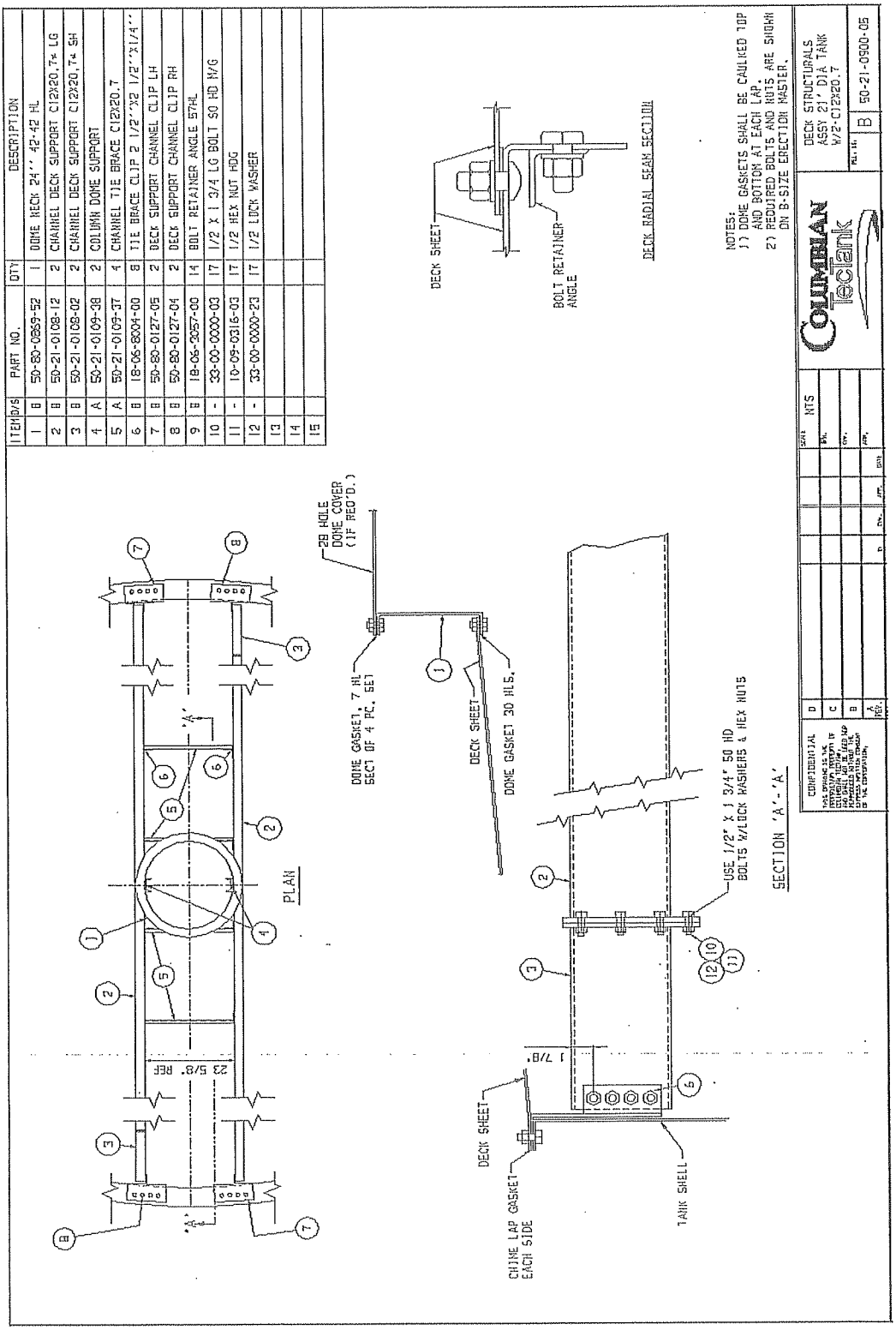
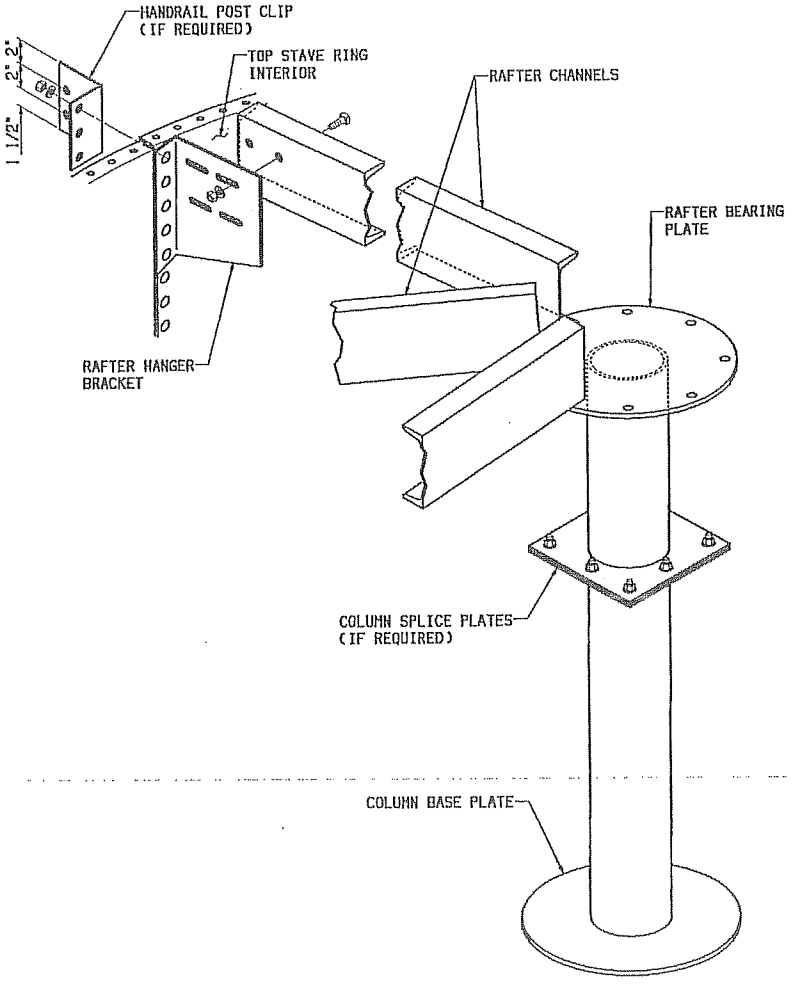

ITEM
QTY/S
PART NO.
QTY
DESCRIPTION
1 B 50-80-0869-52 1 DOME NECK 24'' 42-42 HL
2 B 50-21-0108-12 2 CHANNEL DECK SUPPORT C12X20.7# LG
3 B 50-21-0108-02 2 CHANNEL DECK SUPPORT C12X20.7# SH
4 A 50-21-0109-38 2 COLUMN DOME SUPPORT
5 A 50-21-0109-37 4 CHANNEL TIE BRACE C12X20.7
6 B 18-06-8004-00 8 TIE BRACE CLIP 2 1/2''X2 1/2''X1/4''
7 B 50-80-0127-05 2 DECK SUPPORT CHANNEL CLIP LH
8 B 50-80-0127-04 2 DECK SUPPORT CHANNEL CLIP RH
9 B 18-06-3057-00 14 BOLT RETAINER ANGLE 57HL
10 - 33-00-0000-03 17 1/2 X 1 3/4 LG BOLT SQ HD M/G
11 - 10-09-0316-03 17 1/2 HEX NUT HDG
12 - 33-00-0000-23 17 1/2 LOCK WASHER
PLAN
23 5/8" REF
'A'
'A'
28 HOLE DOME COVER (IF REQ'D.)
DOME GASKET, 7 HL SECT OF 4 PC. SET
DECK SHEET
DOME GASKET 30 HLS.
USE 1/2" X 1 3/4" SQ HD BOLTS W/LOCK WASHERS & HEX NUTS
1 7/8"
DECK SHEET
CHINE LAP GASKET EACH SIDE
TANK SHELL
SECTION 'A'-'A'
DECK SHEET
BOLT RETAINER ANGLE
DECK RADIAL SEAM SECTION
NOTES:
1) DOME GASKETS SHALL BE CAULKED TOP AND BOTTOM AT EACH LAP.
2) REQUIRED BOLTS AND NUTS ARE SHOWN ON B-SIZE ERECTION MASTER.
CONFIDENTIAL
SCALE NTS
COLUMBIAN Tectank
DECK STRUCTURALS
ASSY 21' DIA TANK
W/2-C12X20.7
REV. NO. B
50-21-0900-05

FIGURE 34

## TANKS UP TO AND INCLUDING 29' DIAMETER

For tanks with a diameter of 29' and larger, Columbian furnishes a deck support system consisting of a pre-fabricated pipe support column and rafter bearing plate and full-length rafter channels. See Figure 35 for proper parts arrangement:

1. The first step is to assemble the pipe support columns with the rafter bearing plate. Tighten all bolts.
2. Raise the complete support assembly and position it at the exact center of the bottom of the tank. Secure the support assembly in position with guy wires or ropes attached to the sides of the tank.
3. Raise one rafter and loosely bolt it in position. (It may be necessary to rotate the center column slightly to align the hole in the rafter bearing plate with the hole in the rafter.
4. Raise another rafter and place it to the right of the first. This will orient the rafter bearing plate for the other rafters.
5. Working to the right (counter-clockwise), position the other rafters and loosely bolt them in position. After this is done, check the tank for roundness and for binding of the rafters.




ASSEMBLY AND INSTALLATION OF THE DECK SUPPORT

SYSTEM FOR TANKS 29' DIAMETER & LARGER

FIGURE 35

## SECTION IX

## DECK ASSEMBLY

1. FLANGED DECK SHEETS (Figure 33)
   Flanged deck sheets are prepared for installation as shown in Figure 33A and 33B. Square head bolts are passed through bolt channel and then the deck sheet, and forced through the strip gasket. Bolt retainer angles are attached to deck flanges as shown using one bolt every two feet. Orientation of flanged deck sheets will vary. Refer to erection drawings for point at which installation should begin. Place first deck sheet in position with flange on the left from center tank-- the narrow end of sheet fitting over bolts in bottom flange of center dome, the wide end fitting over bolts in top chime. Install washers and nuts on enough bolts to secure sheet.

   The second deck sheet will be erected counterclockwise, fitting over bolts in dome flange and top chime, and also over bolts in left hand radial seam of first sheet. Before positioning second deck sheet, install chime lap gaskets at dome flange and top chime as shown in Figure 35. Apply a bead of sealant across top of each chime lap gasket. After positioning second deck sheet, run washers and nuts on all bolts except those in the left hand radial seam. **DO NOT TIGHTEN.**

   Installation proceeds in a counterclockwise direction. To install last deck sheet, loosen first sheet and raise its right edge. Position last deck sheet, install chime lap gaskets, and lap first deck sheet over it.

   Tighten the deck after all sheets are in place. Once tighten, apply a generous bead of sealant all around center dome bottom flange, forcing it into notch between inner edge of deck sheets and center dome wall.

   Manholes, ventilators and similar deck accessories may be attached to deck sheets on the ground. Guardrails, ladder extensions and crossovers are added after deck is complete. Refer to accessory drawings for assembly and attachment details.

2. CHANNEL RAFTER DECK ASSEMBLY (FIGURE 34)
   The first deck segment is prepared for installation as shown in Figure 36 with the exception of the last sheet, which will lie on top of the first and next to the last sheet.

   Washers and nuts may be put on as deck is installed but must not be tightened until entire deck is complete. Completion of deck sheets will leave an opening in the center. Two adapter plates are used to make opening for the center dome.

   These two plates should be installed one at a time. **DO NOT TIGHTEN BOLTS UNTIL BOTH SECTIONS ARE INSTALLED.** Bolt channel is furnished to back up bolts. It is not uncommon to pull out and push in this adaptor plate in order to assemble this unit. After all bolts, washers and nuts are installed, pull out adaptor ring so that it concaves up. Now all bolts in deck can be tightened. Center dome or cover can now be installed.

3. ASSEMBLY OF MULTI-PIECE DECKS
   **INSTALL GASKET AND BOLTS ON GROUND.** Decks consist of pie-shaped segments around a center plate. They are to be placed with laps "shingled" so water will drain off. Place outer segments under inner segments (on big decks having two or more rows of segments) and inner segments under center plate. Gasket the starting segment of deck on both sides the same way as the bottom starting segment, using bolt head retaining channels and catch bolts.

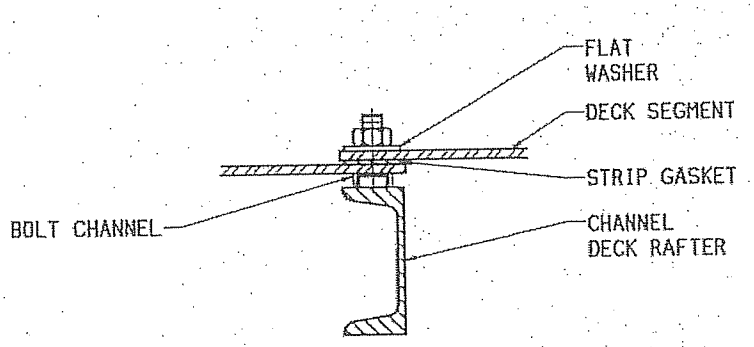
   Raise gasketed deck sheets at one side of tank, placing them as they are raised. Determine where deck accessories should be located and place deck sheets accordingly.

WARNING – DO NOT STACK MANY DECK SHEETS AT ONE PLACE ON DECK RAFTERS. THE HEAVY WEIGHT MAY RESULT IN COLLAPSE.

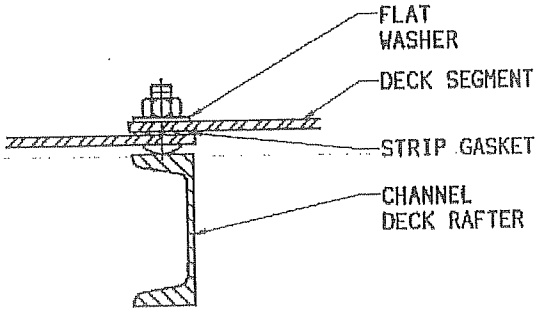
Rafters will then hold the bolt heads. On the inner ends of the deck segments there are no provisions to support the bolts through the deck sheets. To keep the bolts in place while installing inner deck segments or center plate, a thin board can be placed across the rafters under the bolts. Once the inner segments or center plate has been installed, the boards must be removed.

REMEMBER, CENTER PLATE FITS OVER INNER ROW OF DECK SEGMENTS AND INNER ROW OF DECK SEGMENTS FITS OVER OUTER ROW OF DECK SEGMENTS. DO NOT TIGHTEN ANY DECK BOLTS UNTIL ALL DECK PIECES ARE IN PLACE.

**Touch up all deck sheets while they are on the ground. Bolts in deck sheets will be held in place by the gasket.**




CHANNEL RAFTER ASSEMBLY WITH
SQUARE HEAD BOLTS AND BOLT CHANNEL




CHANNEL RAFTER ASSEMBLY WITH
ROUND HEAD BOLTS

FIGURE 36

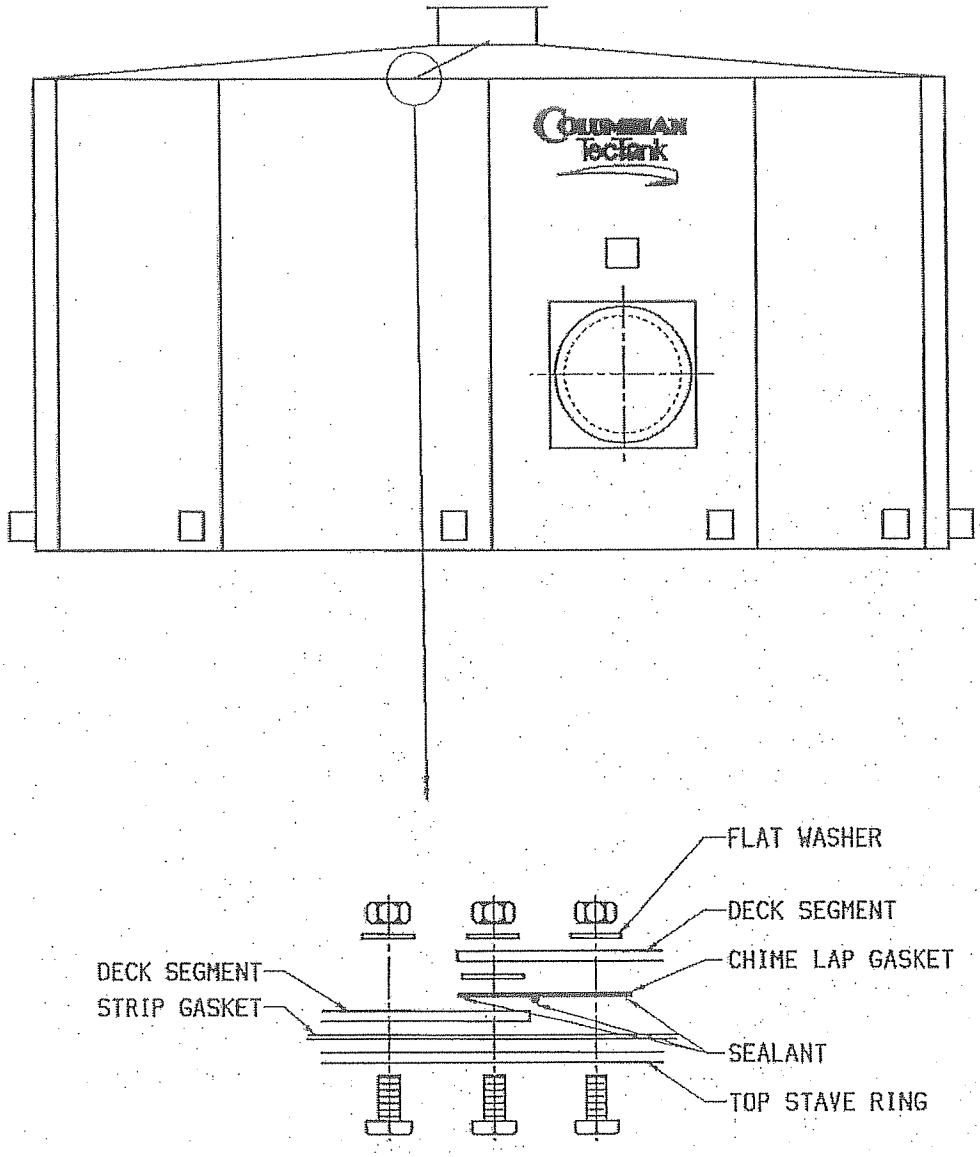

FLAT WASHER
DECK SEGMENT
CHIME LAP GASKET
DECK SEGMENT
STRIP GASKET
SEALANT
TOP STAVE RING

FIGURE 37

## SECTION X

## ACCESSORIES

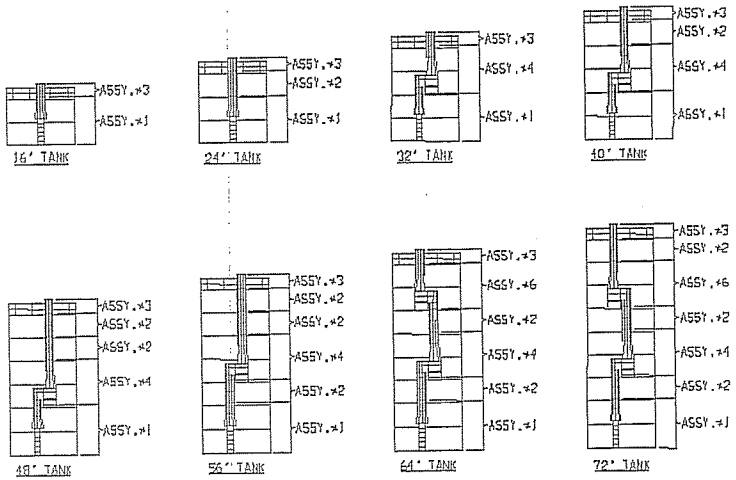
### GENERAL INFORMATION

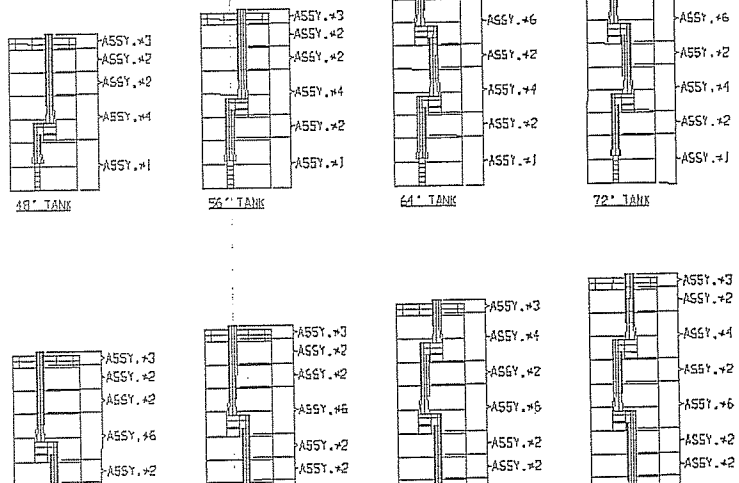
Accessories will vary from tank to tank depending on the customer's needs. The following pages describe those that are commonly used.

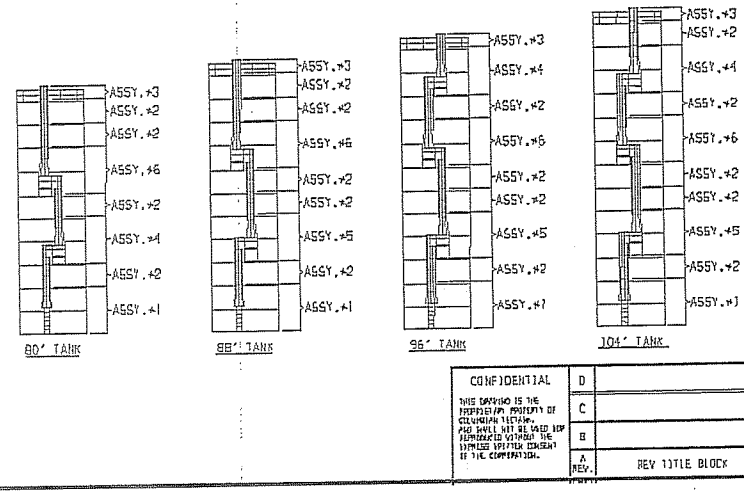
Accessories are normally installed after the tank has been completed. If instructions for installation of each item are not included with the package, a print can be found in the set of erection drawings.

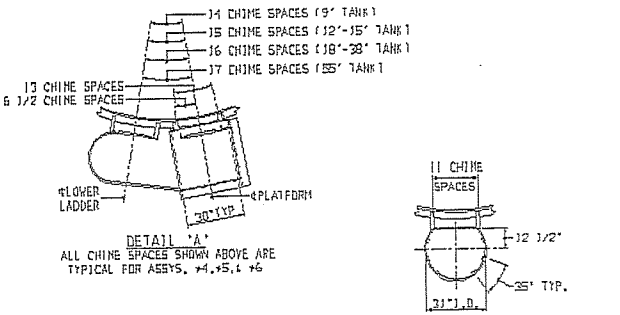
### ACCESSORIES DESCRIPTION:

1. Standard Ladder Erection Drawing, 2 pages
2. Perimeter Guardrail for 15' Diameter Tank
3. Ventilator Assembly



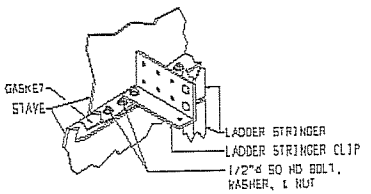




DETAIL 'A'
ALL CHIME SPACES SHOWN ABOVE ARE TYPICAL FOR ASSYS. #4,#5,& #6




DETAIL 'B'
ALL CHIME SPACES SHOWN ABOVE ARE TYPICAL FOR ASSYS. #1,#2,& #3




TYP. LADDER STRINGER CLIP CONNECTION TO STAVE

NOTES:
1) FOR LOCATION OF LADDER, SEE PERIMETER HANDRAIL ERECTION DRAWING.
2) ALL BOLTED CONNECTIONS ARE TO BE MADE SO THE BOLT HEAD IS TOWARD THE ACCESS SIDE OF THE LADDER, SAFETY CAGE, OR PLATFORM.
3) USE 3/8" DIA. BOLTS FOR LADDER AND HOOP CONNECTIONS.
USE 5/16" DIA. BOLTS FOR CAGE BAR TO HOOP CONNECTIONS.
USE 1/2" DIA. BOLTS FOR LANDING PLATFORM.
4) CHIME SPACES ARE DEFINED AS THE 2" SPACE BETWEEN THE BOLT HOLES LOCATED AT TANK CHIME. (SEE DETAILS 'A' AND 'B')
5) REFER TO DWG. 50-B3-0000-00, SHT. 2 OF 2, FOR INDIVIDUAL ASSEMBLIES.

SHEET 1 OF 2

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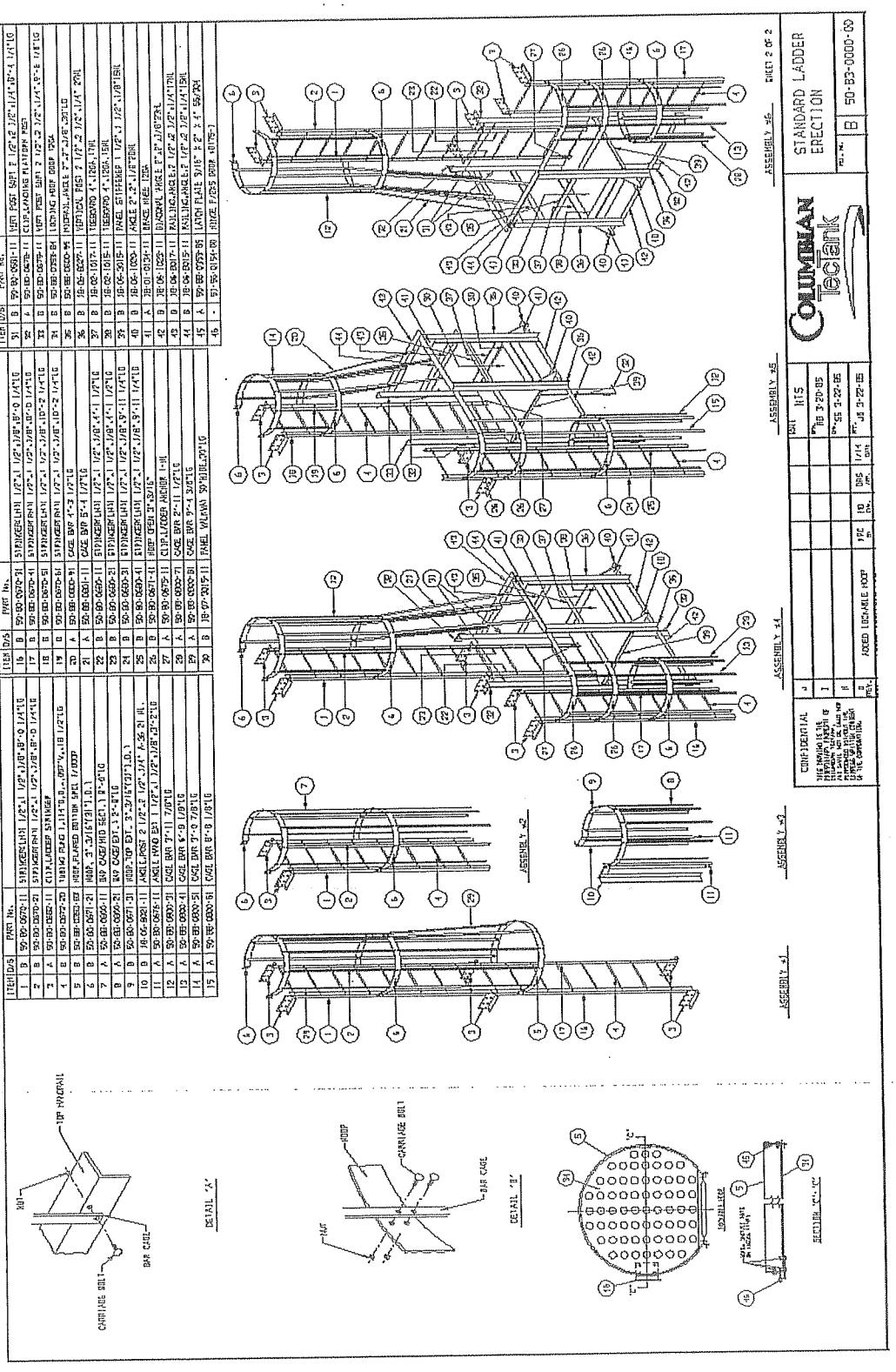
| REV. | | BY | CHK | APP. | DATE |
|---|---|---|---|---|---|
| D | | | | | |
| C | | | | | |
| B | | | | | |
| A | REV TITLE BLOCK | KRC | MB | DRS | 1/24 |

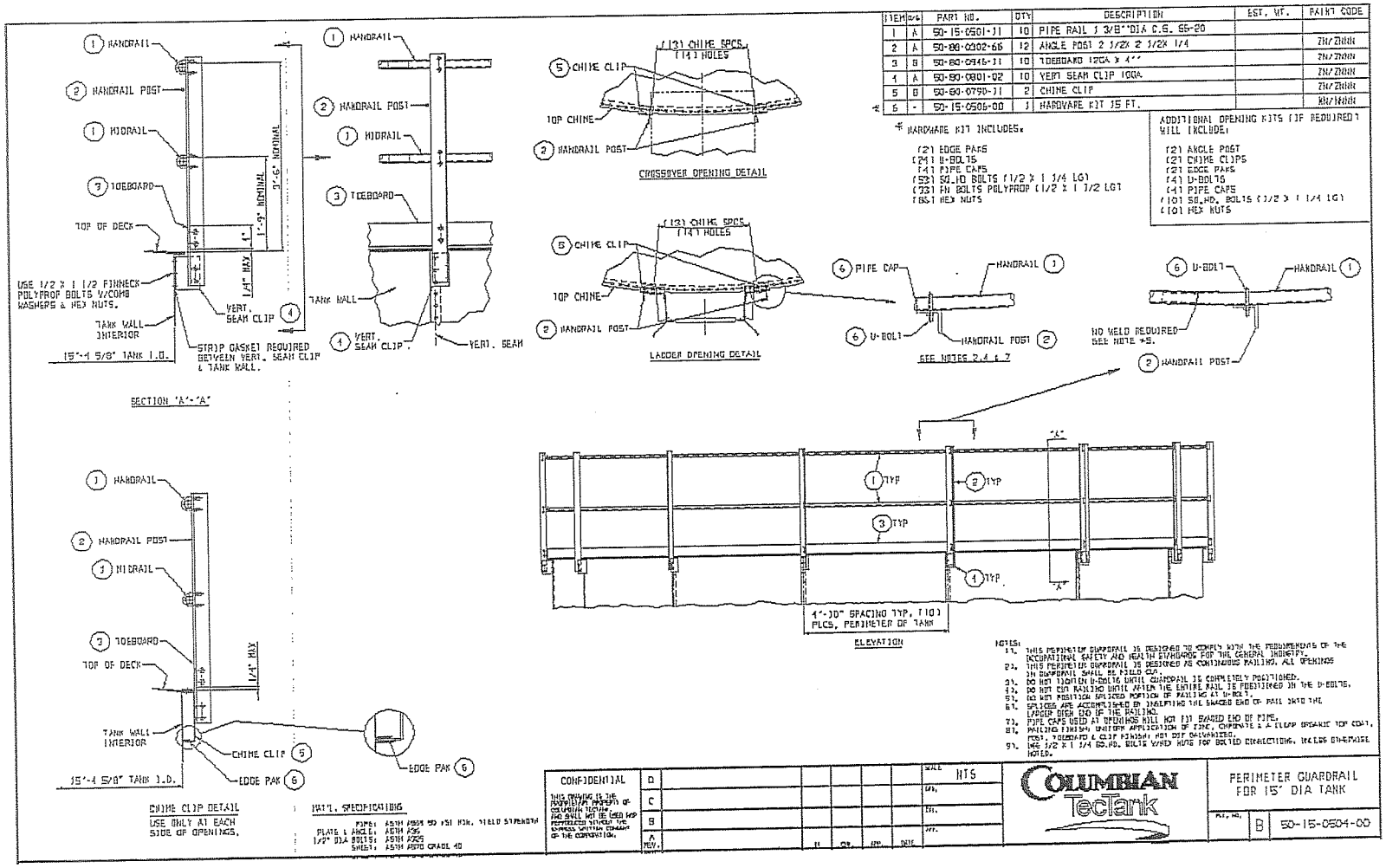
SCALE: NTS
DRN: KJ 10-16-90
CHK: S.S. 1/9/91
APP: R.H. 1/9/91

COLUMBIAN TecTank

STANDARD LADDER ERECTION

REV. NO. B | 50-B3-0000-00


STANDARD LADDER ERECTION
COLUMBIAN TeleTank
50-B3-0000-00
ASSEMBLY #1
ASSEMBLY #2
ASSEMBLY #3
ASSEMBLY #4
ASSEMBLY #5
ASSEMBLY #6
DETAIL "A"
DETAIL "B"
DETAIL "C"
SECTION "C"-"C"
CONFIDENTIAL




| ITEM | GR | PART NO. | QTY | DESCRIPTION | EST. WT. | PAINT CODE |
|---|---|---|---|---|---|---|
| 1 | A | 50-15-0501-11 | 10 | PIPE RAIL 1 3/8" DIA C.S. SS-20 | | |
| 2 | A | 50-80-0302-66 | 12 | ANGLE POST 2 1/2" X 2 1/2" X 1/4 | | ZN/ZNNN |
| 3 | B | 50-80-0946-11 | 10 | TOEBOARD 12GA X 4" | | ZN/ZNNN |
| 4 | A | 50-90-0801-02 | 10 | VERT SEAM CLIP 10GA. | | ZN/ZNNN |
| 5 | B | 50-90-0790-11 | 2 | CHIME CLIP | | ZN/ZNNN |
| 6 | - | 50-15-0506-00 | 1 | HARDWARE KIT 15 FT. | | NN/NNNN |

* HARDWARE KIT INCLUDES:
(2) EDGE PANS
(24) U-BOLTS
(4) PIPE CAPS
(52) SQ.HD BOLTS (1/2 X 1 1/4 LG)
(23) FH BOLTS POLYPROP (1/2 X 1 1/2 LG)
(65) HEX NUTS

ADDITIONAL OPENING KITS (IF REQUIRED) WILL INCLUDE:
(2) ANGLE POST
(2) CHIME CLIPS
(2) EDGE PANS
(4) U-BOLTS
(4) PIPE CAPS
(10) SQ.HD. BOLTS (1/2 X 1 1/4 LG)
(10) HEX NUTS

NOTES:
1. THIS PERIMETER GUARDRAIL IS DESIGNED TO COMPLY WITH THE REQUIREMENTS OF THE OCCUPATIONAL SAFETY AND HEALTH STANDARDS FOR THE GENERAL INDUSTRY.
2. THIS PERIMETER GUARDRAIL IS DESIGNED AS CONTINUOUS RAILING. ALL OPENINGS IN GUARDRAIL SHALL BE FIELD CUT.
3. DO NOT TIGHTEN U-BOLTS UNTIL GUARDRAIL IS COMPLETELY POSITIONED.
4. DO NOT CUT RAILING UNTIL AFTER THE ENTIRE RAIL IS POSITIONED IN THE U-BOLTS.
5. DO NOT POSITION SPLICED PORTION OF RAILING AT U-BOLT.
6. SPLICES ARE ACCOMPLISHED BY INSERTING THE SMALLER END OF RAIL INTO THE LARGER OPEN END OF THE RAILING.
7. PIPE CAPS USED AT OPENINGS WILL NOT FIT SMALL END OF PIPE.
8. PAINTING FINISH: UNIFORM APPLICATION OF ZINC, EPOXY & A TOUGH ORGANIC TOP COAT.
9. POST, TOEBOARD & CLIP FINISH: HOT DIP GALVANIZED.
10. USE 1/2 X 1 1/4 SQ.HD. BOLTS WHEN NUTS FOR BOLTED CONNECTIONS, INCLUDE ON-PLANE NUTS.

MATL. SPECIFICATIONS
PIPE: ASTM A595 50 KSI MIN. YIELD STRENGTH
PLATE & ANGLE: ASTM A36
1/2" DIA BOLTS: ASTM A325
SHEET: ASTM A570 GRADE 40

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|---|---|---|---|---|---|
| D | | | | | |
| C | | | | | |
| B | | | | | |
| A | | | | | |

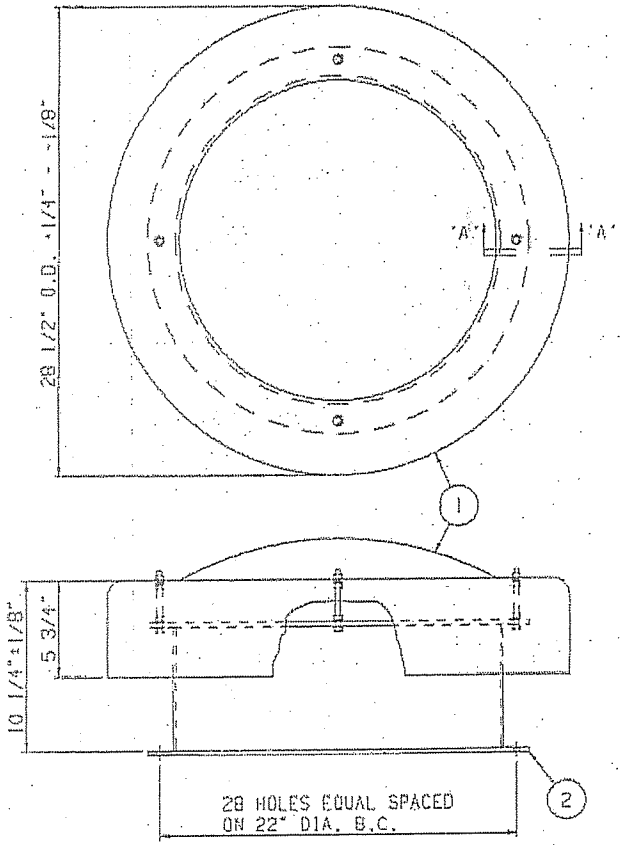
SCALE: NTS
DR.
EN.
APP.

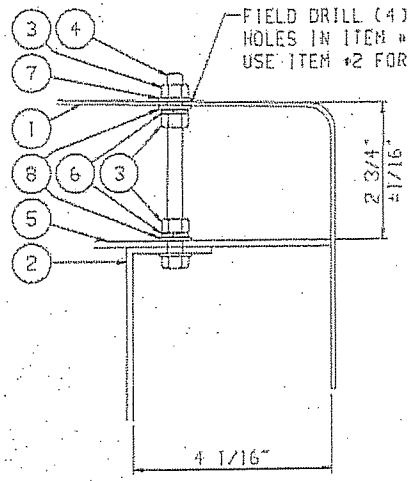
COLUMBIAN TecTank

PERIMETER GUARDRAIL FOR 15' DIA TANK

PART NO. B 50-15-0504-00

| ITEM | D/S | PART NO. | QTY | DESCRIPTION |
|---|---|---|---|---|
| 1 | C | 50-80-0306-10 | 1 | CAP VENTILATOR ALUM 16GA |
| 2 | B | 50-80-0304-10 | 1 | DOME NECK HALF 28 HOLE |
| 3 | - | 03-01-0111-17 | 12 | NUT 5/16"HEX |
| 4 | A | 51-06-0311-00 | 4 | BOLT 5/16"DIA X 3"LG |
| 5 | A | 50-80-0307-15 | 1 | SCREEN VENT 23GA HDG |
| 6 | - | 03-15-0131-17 | 8 | WASHERS SPRING LOCK 5/16" |
| 7 | - | 51-10-0184-00 | 4 | WASHER NEOPRENE/STEEL COMP |
| 8 | - | 03-15-0611-17 | 12 | WASHER 5/16"FLAT |




SECTION "A"-"A"

FOR .83 SQ. FT. FREE VENTING AREA
NOTE: ALL DIMENSIONS IN INCHES.
SHIP ALL PARTS LOOSE. TO
BE FIELD ASSEMBLED.

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SCALE NTS
DRN.
CHK.
APP.

COLUMBIAN Tectank

VENTILATOR ASSEMBLY
FOR DECK
28 HOLE

PCL. NO. A 50-80-0305-10

## Section XI

## Completion

1. **TANK CLEANING**
   After tank erection has been completed, the bottom, sidewall and deck should be cleaned of all mud, dirt and foreign objects, including all reamer shavings.

2. **COATING TOUCH-UP**
   Touch-up should be held to a minimum. Care should be taken at all times to protect the finish. Excessive damage to coating may necessitate replacing damaged parts at erectors expenses.

   The Appendix lists touch-up procedures for each type of coating used by CTT. (Refer to erection drawings or sales order to identify the particular type of coating used on tank.)

   Should it become necessary to repair a part due to damage during erection, the following procedures should be observed.

   Interior surface is generally an epoxy coating requiring a two-component mix. Remember, the pot life after mixing is limited, usually four to eight hours depending on the temperature. Touch-up work must be performed in accordance with the coating application procedures.

> **IMPORTANT**
> **APPLICATION OF COATINGS BELOW 50°F IS NOT RECOMMENDED UNLESS IT IS PERFORMED BY AN CTT TRAINED CONTRACTOR OR UNDER CTT SUPERVISION**

   Cold weather application procedures and cure schedules are available upon request.

   All single component and unmixed catalyzed touch-up left over after the repair work is completed should be stored and utilized in the tank's preventive maintenance program.

   **Interior Coating Repair:**
   1. The damaged area must be cleaned of all dirt and rust.
   2. Damaged surface should be prepared to bare metal, surrounding edges should be feathered to ensure a good bond.
   3. Touch-up must be applied in accordance to manufacturer's instructions.
   4. Area to be repaired should be coated immediately after surface preparation to ensure that oxidation does not occur.
   5. All interior edges should be checked to ensure that proper coating is intact.
   6. Coating must be allowed to dry before tank can be placed in service.

   **Exterior Coating Repair:**
   The exterior of the tank may have several layers of various coatings, such as epoxy primer and acrylic enamel topcoat. Touch-up requirements are the same as the interior. Touch-up is supplied for all layers of coatings.

3. LEAK REPAIR

Since bolted tanks have seams and connections, it is not uncommon to have a few leaks when the tank is completed. However, this can be held to a minimum by taking a few extra precautions before the tank is exterior spray tested.

- Care should be taken during erection to ensure that gasketing has been installed correctly in all seams.
- Sealant must be applied at all gasket splices, chime laps, and stave corner radii.
- All bolts should be double-checked to see that washers and nuts have been installed and tightened.
- Center plates and adaptor rings on the deck should be checked to ensure a tight fit.
- On tanks greater than 32' in diameter, the multi-piece deck laps (where inner and outer sheets join), the center plate and the adaptor ring should be checked and caulked.
- A visual check for daylight at all vertical (chime) seams and all deck seam is helpful.

4. HOW TO STOP LEAKS

- Check all leaks first which are highest on the tank. What appears to be a leak near the bottom may be drainage from a leak higher up.
- Look carefully for the source of the leak since it may follow a groove for some distance before it can be easily seen.
- Carefully tighten bolts next to leak. Do not tighten too much. A vigorous person can squeeze the gasket out of a seam, making it necessary to replace the whole strip of gasket. Stop tightening when gasket begins to compress. To tighten evenly, work back and forth from one bolt to another.
- In some cases, leaks are caused by humps in the steel plates halfway between bolts. Often the most effective way to stop a leak of this type is to tap the steel around the leak gently with a ball peen hammer.
- To stop a leak along the thread of a bolt, remove the nut, replace the combination washer, leaving the rubber already embedded around the bolt intact and run the nut back on.

## SECTION XII

## PREVENTIVE MAINTENANCE

### 1. NEW INSTALLATIONS

Prior to installation crew leaving the jobsite, the owner should inspect the work for conformance to plans and specifications and all items found in error should be corrected. The coatings of the tank should be inspected for damage and repaired in accordance with the coating manufacturer's instructions. Final testing consists of filling the tank with water during which any leaks that have been identified shall be repaired.

### 2. FIRST-YEAR INSPECTION

During the first year of installation, the owner should, on a quarterly basis, inspect the exterior of the tank coatings that require additional touch-up work or areas where leaks have occurred. Repairs should be completed by the owner immediately to eliminate damage from occurring to the tank around the affected areas.

### 3. FOLLOW-UP INSPECTIONS

Thereafter, an overall interior and exterior inspection of the tank should be performed annually to evaluate damage or problems that may have occurred. The inspection should include any signs of corrosion, product leakage, coating damage, equipment functions and any other item related directly or indirectly with the performance of the tanks and safety features of them. All corrective action should be completed immediately after a problem is identified to assure irreversible damage does not occur.

Monthly inspections of filling and venting systems should be made to assure damage does not occur to the tank from plugged or inoperative equipment. Owner must insure that the tank is properly ventilated at all times.

Inspections can be utilized by the owner's own personnel. If this is not feasible, or the severity of the problem warrants the need, an experienced tank technician can be hired through Columbian TecTank's Field Service Department:

- **For shipments from Kansas City, KS - Telephone 913/621-3700 or Fax 913/621-2145**
- **For shipments from Parsons, KS – Telephone 620/421-0200 or Fax 620/421-9122**

SECTION XIII

FIELD TOUCH-UP PROCEDURES

ENGINEERING DATA Columbian TecTank
5400 Kansas Avenue P.O. Box 2907 Kansas City, KS 66110-2907 913-621-3700 Fax 913-621-2145
2101 S. 21st Street P.O. Box 996 Parsons, KS 67357 620-421-0200 Fax 620-421-9122

**DESCRIPTION:** TRICO BOND 478 TOUCH-UP PROCEDURES

Prepared by: PBV No. 1 of 2 Date: 8/00

Base (920Y-927): 1 pint in quart can, Curing Agent (920-C-129): 1/4 pint can
Flash Point: 81°F Flash Point: 23°F

## A. SURFACE PREPARATION

1. Surface to be repaired must be dry and free of rust, oil, grease, or other surface soils. Remove oils with solvent followed by detergent wash and clear water rinse. Wash water-soluble soils with detergent wash and clear water rinse.
2. **Surface must be roughened.** Small areas should be sanded with 80 - 100-grit sandpaper or wire-brushed. All damaged coating must be removed and the edges of existing coating must be roughened (feathered) to ensure good adhesion of touch-up to existing coating. Large areas must be sandblasted to SP-10 (Near-White Metal Blast). Keep areas to be touched-up as small as possible.
3. After preparation, blow off loose dust prior to coating.
4. Apply touch-up within eight hours following surface prep to avoid possibility of flash rust formation on cleaned surface. Do not leave overnight.

## B. MIXING

**Caution: Proper mixing of field touch-up coating is important for good application. Insufficient mixing may result in improper cure.**

1. Thoroughly stir base component to incorporate all settled pigment. Then completely mix one part curing agent with four parts base component. Allow to sit 30 minutes after mixing before using.
2. Do not mix more than will be used during pot life. Pot life is 4 hours maximum at 70 - 90°F or 2 hours maximum at 90 - 100°F.
3. Lack of thorough mixing will yield improper cure.

## C. APPLICATION

**Caution: Do not apply at temperatures below 50°F. Surface temperature must be at least 5°F above the dew point of the surrounding air.**

1. Coating may be brushed or spray applied. **Brushing is suggested for small area touch-up.**
2. To spray adjust viscosity with MEK (up to 10% by volume).
3. DFT desired: 12 mils (20 mils wet). Feather out to zero at the edge of the roughened area. **Will not bond to cured coating without roughening surface.**
4. Recoating should be done within 24 hours at temperatures of 65 - 100°F to avoid roughening the surface again. Recoating can be done as soon as desired, provided it does not damage or lift previous coats, normally when dry to touch.
5. Dry-to-touch time is approximately one hour. Can be placed in service after seven days at 70°F metal temperature.

ENGINEERING DATA Columbian TecTank
5400 Kansas Avenue P.O. Box 2907 Kansas City, KS 66110-2907 913-621-3700 Fax 913-621-2145
2101 S. 21st Street P.O. Box 996 Parsons, KS 67357 620-421-0200 Fax 620-421-9122

DESCRIPTION: TRICO BOND 478 TOUCH-UP PROCEDURES

Prepared by: PBV No. 2 of 2 Date: 8/00

D. COMMENTS

Following these procedures will yield a touched-up area with properties very close to the original Trico Bond 478. The touch-up is supplied in partially filled containers (base component) to ensure proper mixing proportions. Surface preparation then becomes the major factor to ensure coating integrity.

E. CURE TESTING

1. Apply touch-up to undamaged area following above procedures for testing.
2. Wrap cloth saturated with MEK around index finger and rub test area back and forth in a stroke 3 – 4 inches long, using moderate pressure.
3. Count each backward stroke, approximately one count every two seconds. Resaturate the cloth at 50 counts.
4. Coating is cured if 100 counts does not soften film. A small amount of color transfer to the cloth is allowed.

F. SAFETY

**For industrial use only**

1. **Warning! Flammable – flash point 23°F. Causes burn. Overexposure may cause allergic respiratory and skin reaction. Effects may be permanent. Vapor and spray mist harmful. Causes irritation. Contains amine compound and organic solvent.** Keep away from heat, sparks, and flame. Vapors may cause flash fire. Keep containers closed when not in use. Use with adequate ventilation. Do not breathe vapors or spray mist. Wear an appropriate, properly fitted respirator (NIOSH/MSHA approved) while exposed. An air - line respirator (TC 19C NIOSH/MSHA) is recommended. A vapor/particulate respirator (TC 23C NIOSH/MSHA) may be appropriate where airborne monitoring demonstrates vapor levels below ten times the applicable exposure limits. Follow respirator manufacturer's directions for respirator use. Do not get in eyes, on skin, or on clothing. Wash thoroughly after handling.
2. **First Aid:** If affected by inhalation of vapor or spray mist, remove to fresh air. If breathing difficulty persists or occurs later, get medical attention and have label information available. In case of eye contact, flush immediately with plenty of water for 15 minutes and get medical attention; for skin, wash thoroughly with soap and water. If swallowed, get medical attention.
3. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain damage and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal.
4. The contents of this package may be blended with other components before use. Any mixture of components will have hazards of all components. Before opening the packages, read all warning labels and follow all precautions.
5. For further safety information, refer to a Material Safety Data Sheet for this product. If unavailable, contact Technical Coatings Company, North & 25th Avenues, Melrose Park, IL 60160 (708/343-6000).

KEEP OUT OF REACH OF CHILDREN

ENGINEERING DATA Columbian TecTank
5400 Kansas Avenue P.O. Box 2907 Kansas City, KS 66110-2907 913-621-3700 Fax 913-621-2145
2101 S. 21st Street P.O. Box 996 Parsons, KS 67357 620-421-0200 Fax 620-421-9122

DESCRIPTION: TRICO BOND 478 LOW TEMPERATURE TOUCH-UP PROCEDURES

Prepared by: PBV No. 1 of 1 Date: 12/00

**NO CURE BELOW 50°F**

## A. SURFACE PREPARATION

1. Surface preparation for low temperature is even more important than normal.
2. Surface to be repaired must be dry and free of rust, oil, grease, or other surface soils. Remove oils with solvent followed by detergent wash and clear water rinse. Wash water-soluble soils with detergent wash and clear water rinse.
3. **Surface must be roughened.** Small areas should be sanded with 80 – 100 grit sandpaper or wire-brushed. All damaged coating must be removed and the edges of the existing coating must be roughened (feathered) to ensure good adhesion of touch-up to existing coating. Large areas must be sandblasted to SP-10 (Near-White Metal Blast). Keep areas to be touched-up as small as possible.
4. After preparation, blow off loose dust prior to coating.
5. Apply touch-up within eight hours following surface prep to avoid possibility of flash rust formation on cleaned surface. Do not leave overnight.

## B. SAFETY, MIXING, APPLICATION

See individual sheets for specific information.

## C. CURING

1. Touch-ups will take short-term exposure to temperatures below 50°F, but curing will not start until 50°F is reached.
2. **Materials can be force-cured by the application of heat from heat lamps, blowers, etc. Due to variations in other factors, the following cure schedules are only a guide and should not be considered exact.** Temperatures shown refer to the metal, not air temperature.

| APPROXIMATE CURE TIMES | |
|---|---|
| Metal Temperature | Trico Bond 478 |
| 50°F | 15 Days |
| 65°F | 9 Days |
| 80°F | 7 Days |
| 100°F | 64 Hours |
| 120°F | 16 Hours |
| 140°F | 4 Hours |
| 170°F | 2 Hours |
| 200°F | 1 Hour |
| Max. Cure Temp. | 400°F |

ENGINEERING DATA **Columbian TecTank**
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2101 S. 21st Street P.O. Box 996 Parsons, KS 67357 620-421-0200 Fax 620-421-9122

DESCRIPTION: ACRYLIC ENAMEL TOPCOAT (868 SERIES) TOUCH-UP PROCEDURE

Prepared by: PBV No. 1 of 2 Date: 8/00

Flash Point: 81°F

## A. SURFACE PREPARATION

1. Surface to be repaired must be dry and free of rust, oil, grease, or other surface soils. Remove oils with solvent followed by detergent wash and clear water rinse. Wash water-soluble soils with detergent wash and clear water rinse.
2. **Do not apply over bare steel.** Make sure proper primer has been applied, cured, and sanded before applying acrylic enamel.
3. **Surface must be roughened.** Small areas should be sanded with 80-100 grit sandpaper or wire-brushed. All damaged coating must be removed and the edges of existing coating must be roughened (feathered) to ensure good adhesion of paint to existing coating. Keep areas to be touched-up as small as possible.
4. After preparation, blow off loose dust and wipe down with xylene prior to coating.

## B. MIXING

**Caution:** Proper mixing of field touch-up coating is important for good application. Insufficient mixing may result in poor color match.

1. To brush: Apply as received. A small amount (2 – 4 ounces per gallon) of SC-100, xylene, or toluene may be added to improve brushing and replace evaporated solvent.
2. To spray: Mix touch-up with thinner as required. Recommended thinners are:

| METAL TEMPERATURE | THINNER |
|---|---|
| 50 – 65°F | Toluene |
| 65 – 80°F | Xylene |
| 80 - 100°F | SC-100 |

## C. APPLICATION

1. Do not apply at temperatures below 50°F. Surface temperature must be at least 5°F above the dew point of the surrounding air.
2. Coating may be brushed or spray applied. **Brushing is suggested for small area touch-up only.**
3. Apply a full coat covering the primed area as well as the roughened coating. DFT desired: 1 mil (2.5 mils wet). Second coat may be required – apply within 30 minutes.
4. Dry-to-touch time approximately 30 minutes depending on temperature.

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5400 Kansas Avenue P.O. Box 2907 Kansas City, KS 66110-2907 913-621-3700 Fax 913-621-2145
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DESCRIPTION: ACRYLIC ENAMEL TOPCOAT (868 SERIES) TOUCH-UP PROCEDURE

Prepared by: PBV No. 2 of 2 Date: 8/00

D. SAFETY

For industrial use only

1. **Warning! Flammable – flash point 81°F. Overexposure may cause allergic respiratory and skin reaction. Effects may be permanent. Vapor and spray mist harmful. Causes irritation. Contains organic solvent.** Keep away from heat, sparks, and flame. Vapors may cause flash fire. Keep containers closed when not in use. Use with adequate ventilation. Do not breathe vapors or spray mist. Wear an appropriate, properly fitted respirator (NIOSH/MSHA approved) while exposed. An air-line respirator (TC 19C NIOSH/MSHA) is recommended. A vapor/particulate respirator (TC 23C NIOSH/MSHA) may be appropriate where airborne monitoring demonstrates vapor levels below ten times the applicable exposure limits. Follow respirator manufacturer's directions for respirator use. Do not get in eyes, on skin, or on clothing. Wash thoroughly after handling.
2. **First Aid:** If affected by inhalation of vapor or spray mist, remove to fresh air. If breathing difficulty persists or occurs later, get medical attention and have label information available. In case of eye contact, flush immediately with plenty of water for 15 minutes and get medical attention; for skin, wash thoroughly with soap and water. If swallowed, get medical attention.
3. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain damage and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal.
4. The contents of this package may be blended with other components before use. Any mixture of components will have the hazards of all components. Before opening the packages, read all warning labels and follow all procedures.
5. For further safety information, refer to a Material Safety Data Sheet for this product. If unavailable, contact Technical Coatings Company, North & 25th Avenues, Melrose Park, IL 60160 (708/343-6000).

KEEP OUT OF REACH OF CHILDREN

ENGINEERING DATA **Columbian TecTank**
5400 Kansas Avenue P.O. Box 2907 Kansas City, KS 66110-2907 913-621-3700 Fax 913-621-2145
2101 S. 21st Street P.O. Box 996 Parsons, KS 67357 620-421-0200 Fax 620-421-9122

DESCRIPTION: ACROTHANE ACRYLIC URETHANE TOPCOAT (975 SERIES)
TOUCH-UP PROCEDURE

Prepared by: PBV No. 1 of 2 Date: 8/00

Base (975 Series): 1 pint in 1 quart can Curing Agent (700-C-505): 1/4 pint can
Flash Point: 41°F Flash Point: 81°F

## A. SURFACE PREPARATION

1. Surface to be repaired must be dry and free of rust, oil, grease, or other surface soils. Remove oils with solvent followed by detergent wash and clear water rinse. Wash water-soluble soils with detergent wash and clear water rinse.
2. **Do not apply over bare steel.** Make sure proper primer has been applied, cured, and sanded before applying Acrothane.
3. Surface to be repaired must be roughened. Small areas should be sanded with 80-100 grit sandpaper or wire-brushed. All damaged coating must be removed and the edges of existing coating must be roughened (feathered) to ensure good adhesion of paint to existing coating. Keep areas to be touched-up as small as possible.
4. After preparation, blow off loose dust and wipe down with xylene prior to coating.

## B. MIXING

**Caution:** Proper mixing of field touch-up coating is important for good application. Insufficient mixing may result in poor color match and improper cure.

1. Thoroughly stir base component to incorporate all settled pigment. Then completely mix one-part curing agent (1/4 pint can) into four parts base (half-filled quart can). Allow to sit 5 minutes after mixing before using.
2. Do not mix more than will be used during pot life. Pot life is 6 hours at 75°F (less at higher temperatures).
3. Lack of thorough mixing will yield improper cure.

## C. APPLICATION

1. Do not **apply at temperatures below 50°F. Surface temperature must be at least 5°F above the dew point of the surrounding air.**
2. Coating may be brushed or spray applied. **Brushing is suggested for small area touch-up only.**
3. To spray, blend up to 1 part xylene or MEK reducer with 4 parts mixed Acrothane.
4. Apply a full coat covering primed area as well as the roughened coating. DFT desired: 2 mils (4 mils wet).
5. Dry-to-touch time approximately 90 minutes depending on temperature.

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**DESCRIPTION:** ACROTHANE ACRYLIC URETHANE TOPCOAT (975 SERIES)
TOUCH-UP PROCEDURE

Prepared by: PBV No. 2 of 2 Date: 8/00

D. SAFETY

For industrial use only

1. **Warning! Flammable – flash point 81°F. Overexposure may cause allergic respiratory and skin reaction. Effects may be permanent. Vapor and spray mist harmful. Causes irritation. Contains aliphatic polyisocyanate, hexamethylene diisocyanate, and organic solvent. Individuals with lung or breathing problems or prior reaction to isocyanates must not be exposed to vapors or spray mist.** Keep away from heat, sparks, and flame. Vapors may cause flash fire. Keep containers closed when not in use. Use with adequate ventilation. Do not breathe vapors or spray mist. Wear an appropriate, properly fitted respirator (NIOSH/MSHA approved) while exposed. An air-line respirator (TC 19C NIOSH/MSHA) is recommended. A vapor/particulate respirator (TC 23C NIOSH/MSHA) may be appropriate where airborne monitoring demonstrates vapor levels below ten times the applicable exposure limits. Follow respirator manufacturer's directions for respirator use. Do not get in eyes, on skin, or on clothing. Wash thoroughly after handling.
2. **First Aid:** If affected by inhalation of vapor or spray mist, remove to fresh air. If breathing difficulty persists or occurs later, get medical attention and have label information available. In case of eye contact, flush immediately with plenty of water for 15 minutes and get medical attention; for skin, wash thoroughly with soap and water. If swallowed, get medical attention.
3. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain damage and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal.
4. The contents of this package may be blended with other components before use. Any mixture of components will have hazards of all components. Before opening the packages, read all warning labels and follow all precautions.
5. For further safety information, refer to a Material Safety Data Sheet for this product. If unavailable, contact Technical Coatings Company, North & 25th Avenues, Melrose Park, IL 60160 (708/343-6000).

KEEP OUT OF REACH OF CHILDREN

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2101 S. 21st Street P.O. Box 996 Parsons, KS 67357 620-421-0200 Fax 620-421-9122

DESCRIPTION: 8Z REINFORCED INORGANIC ZINC PRIMER (302-K-0250)
TOUCH-UP PROCEDURE

Prepared by: PBV No. 1 of 2 Date: 8/00

Base (302-B-0250) Converter (302-C-0910)
Flash Point: 80°F Flash Point: 80°F

## A. SURFACE PREPARATION

1. Surface to be repaired must be dry and free of rust, oil, grease, or other surface soils. Remove oils with solvent followed by detergent wash and clear water rinse. Wash water-soluble soils with detergent wash and clear water rinse.
2. **Surface must be roughened.** Small areas should be sanded with 80-100 grit sandpaper or wire-brushed. All damaged coating must be removed and the edges of existing coating must be roughened (feathered) to ensure good adhesion of paint to existing coating. Large areas must be sandblasted to SP-10 (Near-White Metal Blast) or better with 1-1/2 mils minimum profile. Keep areas to be touched-up as small as possible.
3. After preparation, blow off loose dust prior to coating.
4. Apply touch-up within eight hours following surface prep to avoid possibility of flash rust formation on cleaned surface. Do not leave overnight.

## B. MIXING

**Caution: Proper mixing of field touch-up coating is important for good application. Insufficient mixing may result in improper cure.**

1. 8Z primer is supplied in two short-filled containers: Base Liquid containing zinc powder, and Converter. Use mechanical agitation for proper mixing. Agitate base component well, then slowly pour in converter and continue agitation until thoroughly mixed. Mix complete units whenever possible.
2. Do not mix more than will be used during pot life. Pot life is 8 hours at 75°F (less at higher temperatures).
3. Keep mixed material under constant agitation for 20 minutes before thinning and application. Prior to application, strain mixed material through 30 – 60 mesh screen or other suitable filtration device. Keep material under constant agitation while in use.
4. Lack of thorough mixing will yield improper cure.

## C. APPLICATION

1. Do not apply at temperatures below 50°F or if temperature is expected to drop below 50°F within 24 hours of application. Surface temperature must be at least 5°F above the dew point of the surrounding air.
2. Coating may be brushed or spray applied. **Brushing is suggested for small area touch-up only.**
3. Apply a full coat covering the bare area as well as the roughened coating. DFT desired: 2-1/2 mils (5-1/2 mils wet).

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2101 S. 21st Street P.O. Box 996 Parsons, KS 67357 620-421-0200 Fax 620-421-9122

DESCRIPTION: 8Z REINFORCED INORGANIC ZINC PRIMER (302-K-0250)
TOUCH-UP PROCEDURE

Prepared by: PBV No. 2 of 2 Date: 8/00

C. APPLICATION (Cont.)

4. When spraying, apply in one wet coat overlapping each pass 25% – 50%.
5. Allow to dry at least 2 hours at 80°F before top coating. (Lower temperatures will take longer.)
6. Thinning is normally not needed; however, at lower temperatures up to 10% thinner (xylene or a mixture of 1 part xylene and 1 part butanol) can be added.
7. **Clean up with xylene or xylene plus butanol.**

D. SAFETY

**For industrial use only**

1. **Warning! Flammable – flash point 80°F. Overexposure may cause allergic respiratory and skin reaction. Effects may be permanent. Vapor and spray mist harmful. Causes irritation. Contains polymeric amido amine, butyl alcohol, ethyl benzene, and methyl amyl ketone.** Keep away from heat, sparks, and flame. Vapors may cause flash fire. Keep containers closed when not in use. Use with adequate ventilation. Do not breathe vapors or spray mist. Wear an appropriate, properly fitted respirator (NIOSH/MSHA approved) while exposed. An air-line respirator (TC 19C NIOSH/MSHA) is recommended. A vapor/particulate respirator (TC 23C NIOSH/MSHA) may be appropriate where airborne monitoring demonstrates vapor levels below ten times the applicable exposure limits. Follow respirator manufacturer's directions for respirator use. Do not get in eyes, on skin, or on clothing. Wash thoroughly after handling.
2. **First Aid:** If affected by inhalation of vapor or spray mist, remove to fresh air. If breathing difficulty persists or occurs later, get medical attention and have label information available. In case of eye contact, flush immediately with plenty of water for 15 minutes and get medical attention; for skin, wash thoroughly with soap and water. If swallowed, get medical attention. **Do not induce vomiting.**
3. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain damage and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal.
4. The contents of this package may be blended with other components before use. Any mixture of components will have hazards of all components. Before opening the packages, read all warning labels and follow all precautions.
5. For further safety information, refer to a Material Safety Data Sheet for this product. If unavailable, contact Devoe Coatings Company, 4000 Dupont Circle, Louisville, KY 40207, (502/897-9861).

KEEP OUT OF REACH OF CHILDREN

ENGINEERING DATA **Columbian TecTank**
5400 Kansas Avenue P.O. Box 2907 Kansas City, KS 66110-2907 913-621-3700 Fax 913-621-2145
2101 S. 21st Street P.O. Box 996 Parsons, KS 67357 620-421-0200 Fax 620-421-9122

DESCRIPTION: SYSTEM 3 AND SYSTEM 4 TOUCH-UP PROCEDURE

Prepared by: PBV No. 1 of 1 Date: 8/00

**System 3 and System 4 touch-up consist of:**

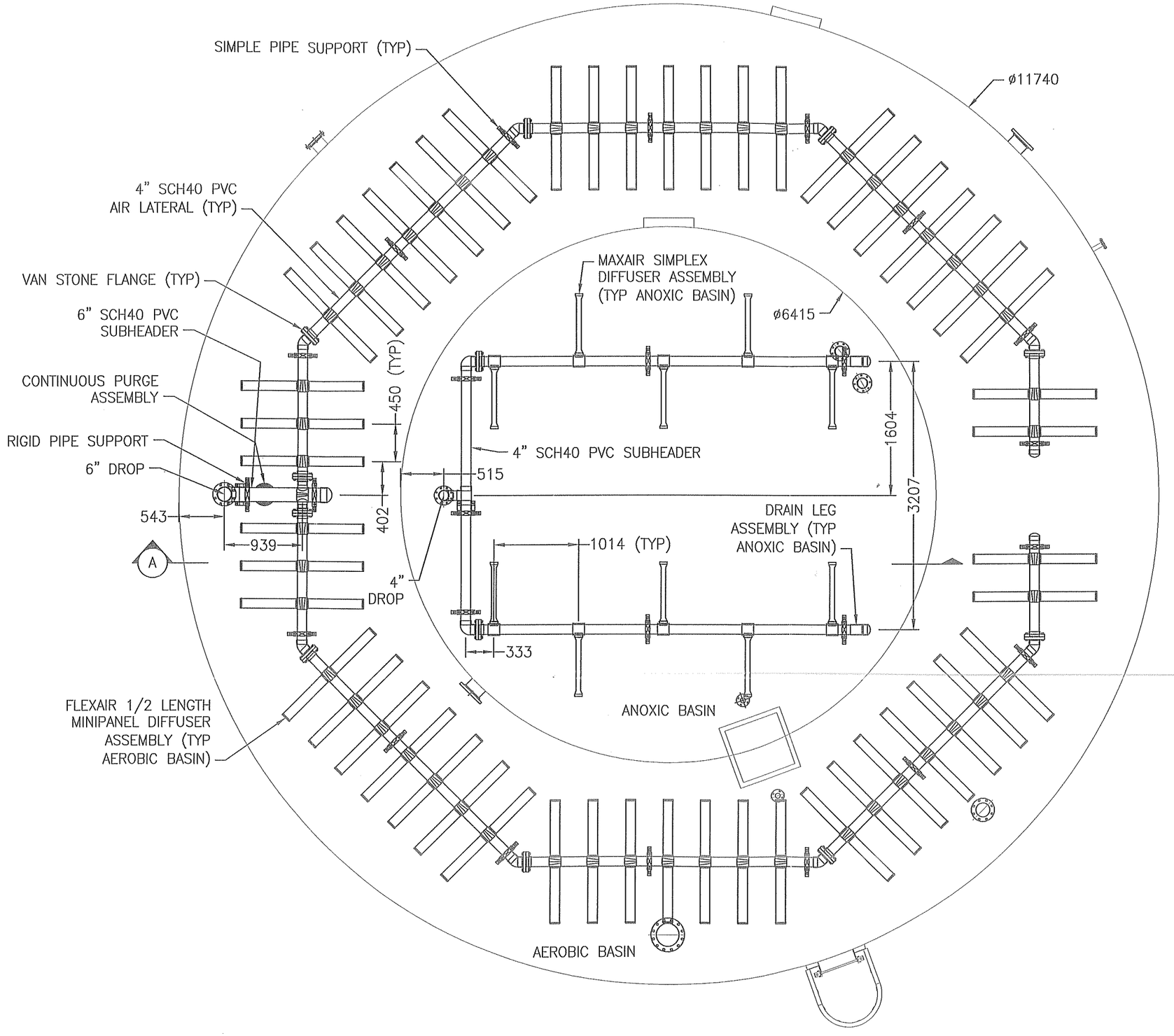
Base coat of 2-1/2 mils DFT of 8Z reinforced inorganic zinc primer (302-K-0250)

**Plus**

Intermediate coat of 4 mils DFT of Copoxy polyamide epoxy

**Plus**

Topcoat of 1-1/2 mils DFT of Acrothane acrylic urethane (975 series)




REVISION HISTORY

| REV | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| A | INITIAL RELEASE | 4/19/13 | MAP |
| B | CHANGE ANOXIC DROP SIZE | 5/3/13 | MAP |

NOTES:

1. AERATION–MIXING BY EDI FLEXAIR 1/2 LENGTH MINIPANEL DIFFUSER ASSEMBLIES & MAXAIR SIMPLEX DIFFUSER ASSEMBLIES.

2. AEROBIC BASIN
   LIQUID DEPTH IS 3.90 M.
   DIFFUSER DEPTH IS 3.65 M.

   ANOXIC BASIN
   LIQUID DEPTH IS 4.20 M
   DIFFUSER DEPTH IS 4.00 M.

3. AIR LATERALS ARE 4" SCH40 PVC.

4. TOTAL= 52 FLEXAIR 1/2 LENGTH MINIPANEL DIFFUSER ASSEMBLIES & 10 MAXAIR SIMPLEX DIFFUSER ASSEMBLIES.

5. SEE SHEET 2 FOR PIPE SUPPORT LAYOUT.

6. SEE SHEET 3 FOR SECTION VIEW.

PROJECT NAME
PANGNIRTUNG, NUNAVUT

PROJECT DESCRIPTION
LAYOUT
EDI FLEXAIR® AERATION-MIXING SYSTEM

| FOR: | BY: | DATE: | SCALE: |
|---|---|---|---|
| MAP | TSP | 4/18/13 | 1:50 |

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5601 Paris Road
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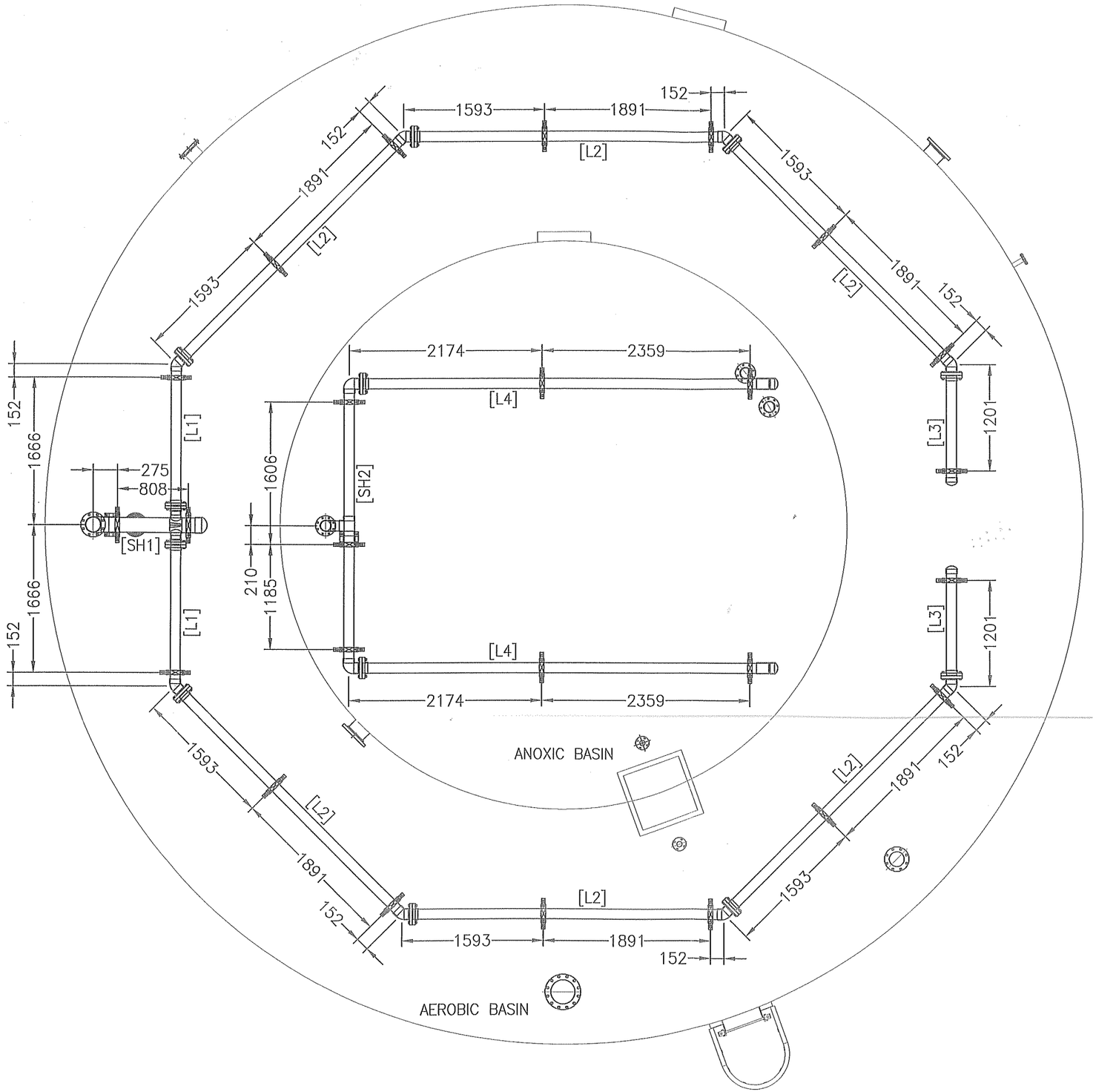
| PROJECT NUMBER | SHEET NUMBER | DWG NUMBER |
|---|---|---|
| 20876 | 1 OF 3 | 109386 |

REVISION HISTORY

| REV | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| A | INITIAL RELEASE | 4/19/13 | MAP |
| B | CHANGE ANOXIC DROP SIZE | 5/3/13 | MAP |




PROJECT NAME
PANGNIRTUNG, NUNAVUT

PROJECT DESCRIPTION
PIPE SUPPORT LAYOUT
EDI FLEXAIR® AERATION-MIXING SYSTEM

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| 20876 | 2 OF 3 | 109386 |

REVISION HISTORY

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| A | INITIAL RELEASE | 4/19/13 | MAP |
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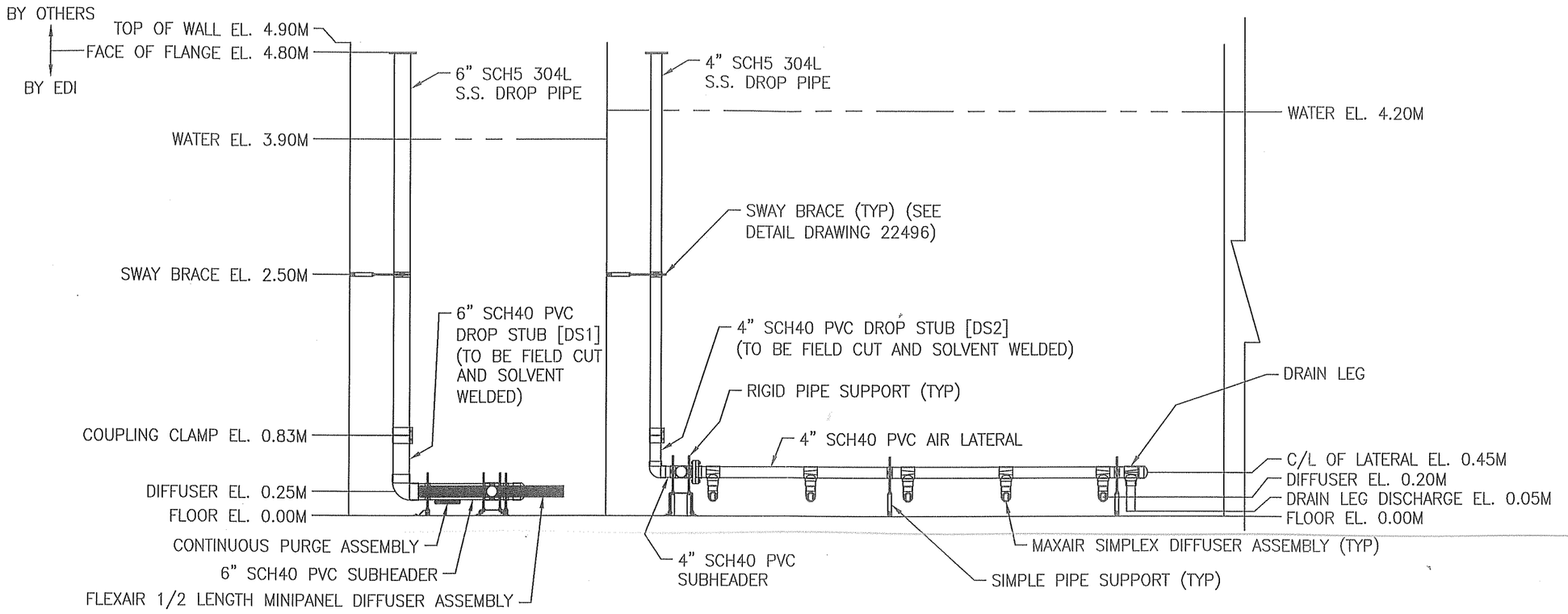


A SECTION

PROJECT NAME
PANGNIRTUNG, NUNAVUT

PROJECT DESCRIPTION
SECTION VIEW
EDI FLEXAIR® AERATION-MIXING SYSTEM

| FOR: | BY: | DATE: | SCALE: |
|---|---|---|---|
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| PROJECT NUMBER | SHEET NUMBER | DWG NUMBER |
|---|---|---|
| 20876 | 3 OF 3 | 109386 |

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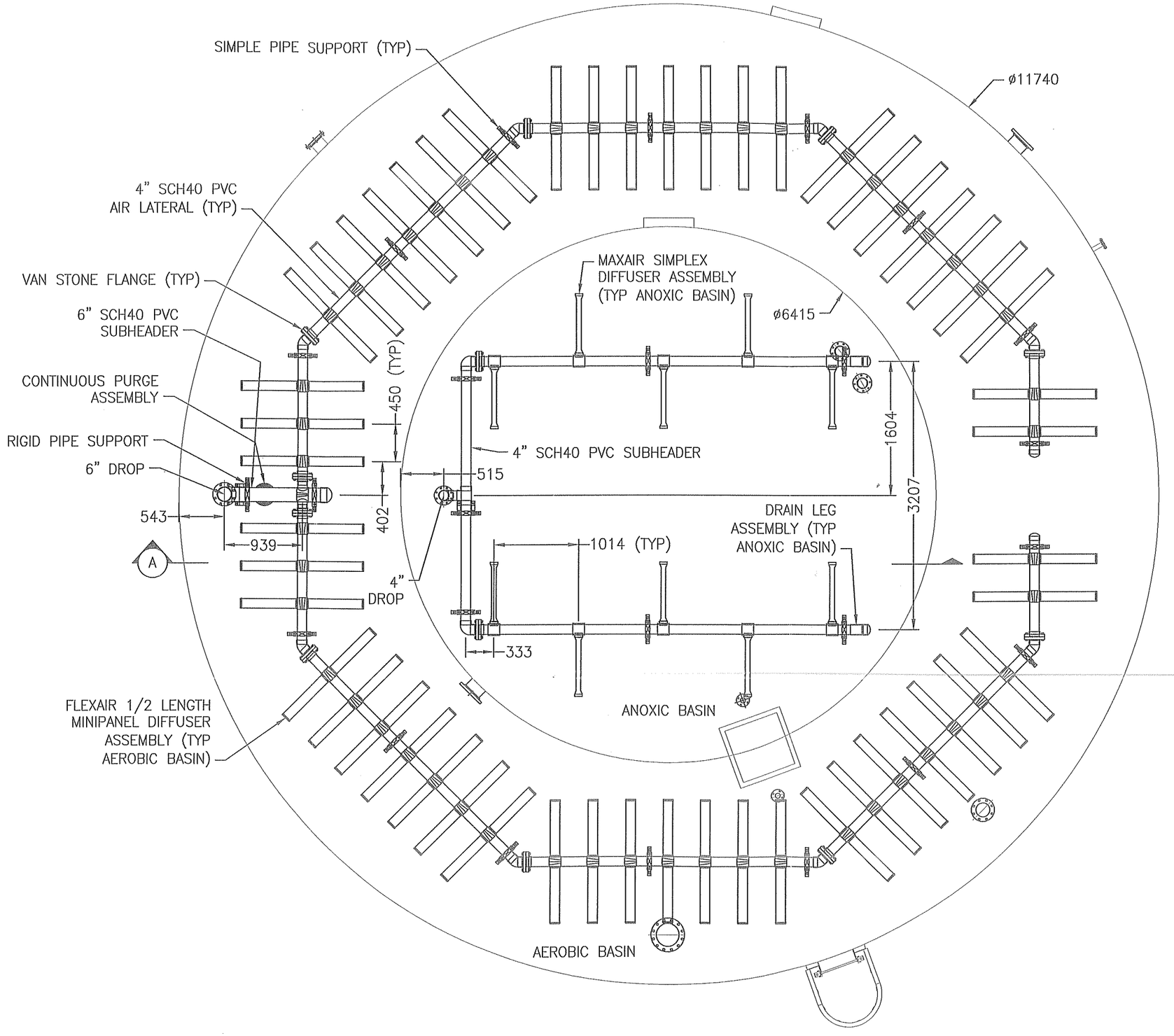


REVISION HISTORY

| REV | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| A | INITIAL RELEASE | 4/19/13 | MAP |
| B | CHANGE ANOXIC DROP SIZE | 5/3/13 | MAP |

NOTES:

1. AERATION–MIXING BY EDI FLEXAIR 1/2 LENGTH MINIPANEL DIFFUSER ASSEMBLIES & MAXAIR SIMPLEX DIFFUSER ASSEMBLIES.

2. AEROBIC BASIN
   LIQUID DEPTH IS 3.90 M.
   DIFFUSER DEPTH IS 3.65 M.

   ANOXIC BASIN
   LIQUID DEPTH IS 4.20 M
   DIFFUSER DEPTH IS 4.00 M.

3. AIR LATERALS ARE 4" SCH40 PVC.

4. TOTAL= 52 FLEXAIR 1/2 LENGTH MINIPANEL DIFFUSER ASSEMBLIES & 10 MAXAIR SIMPLEX DIFFUSER ASSEMBLIES.

5. SEE SHEET 2 FOR PIPE SUPPORT LAYOUT.

6. SEE SHEET 3 FOR SECTION VIEW.

PROJECT NAME
PANGNIRTUNG, NUNAVUT

PROJECT DESCRIPTION
LAYOUT
EDI FLEXAIR® AERATION-MIXING SYSTEM

| FOR: | BY: | DATE: | SCALE: |
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| 20876 | 1 OF 3 | 109386 |

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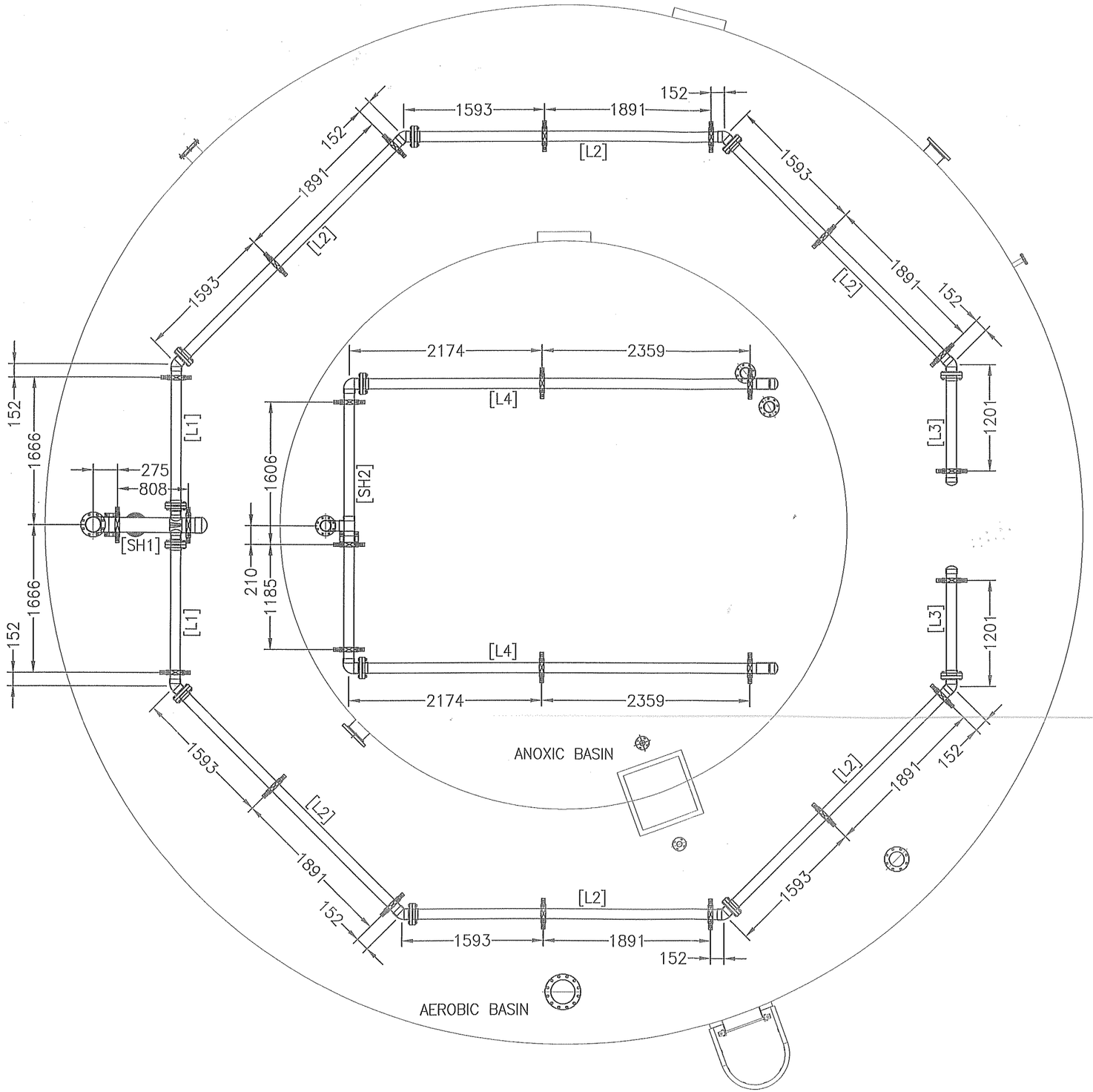


PROJECT NAME
PANGNIRTUNG, NUNAVUT

PROJECT DESCRIPTION
PIPE SUPPORT LAYOUT
EDI FLEXAIR® AERATION-MIXING SYSTEM

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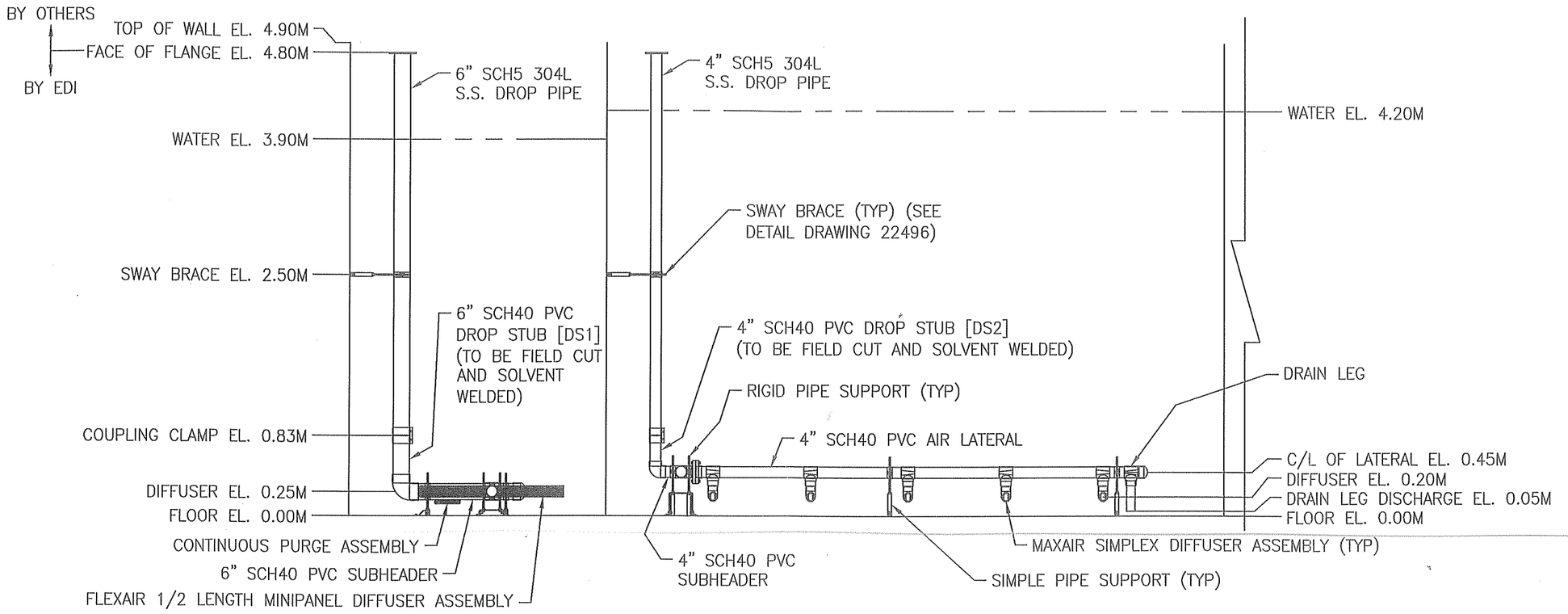
| 20876 | 2 OF 3 | 109386 |

REVISION HISTORY

| REV | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| A | INITIAL RELEASE | 4/19/13 | MAP |
| B | CHANGE ANOXIC DROP SIZE | 5/3/13 | MAP |




A SECTION

PROJECT NAME
PANGNIRTUNG, NUNAVUT

PROJECT DESCRIPTION
SECTION VIEW
EDI FLEXAIR® AERATION-MIXING SYSTEM

| FOR: | BY: | DATE: | SCALE: |
|---|---|---|---|
| MAP | TSP | 4/18/13 | 1:50 |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| 20876 | 3 OF 3 | 109386 |

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# EDI Aeration/Mixing Equipment Installation, Operation, & Maintenance Manual

For:

# Fixed Grid System with FlexAir® MiniPanel™ Diffusers

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*Revised: February 3, 2012*

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PRODUCT SPECIFICATION SHEET

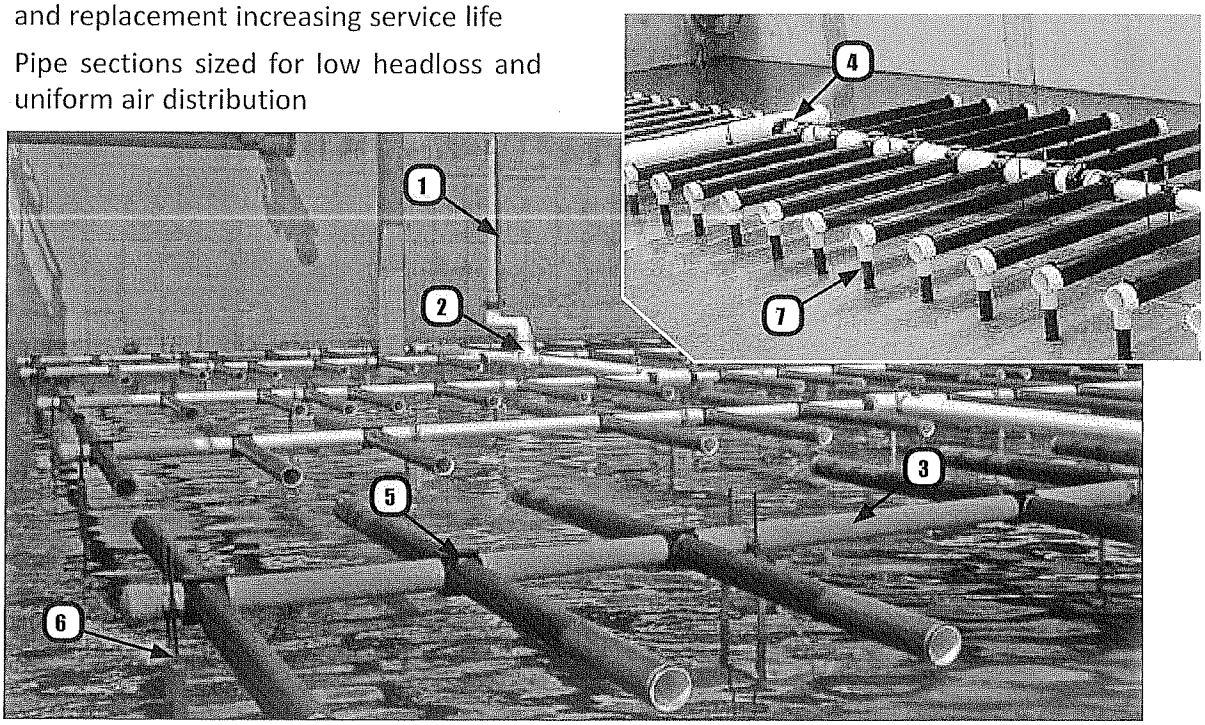
# Fixed Grid Piping System

## with EDI Tube and Panel Diffuser

### Engineered Components Designed for Unmatched System Reliability and Operating Performance

- Permanently anchored to reactor floor; stainless steel supports standard
- Accommodates variable water level applications
- Stainless steel drop pipe and rigid PVC header and lateral standard for maximum value; alternate materials (ABS, CPVC, and Stainless Steel) and wall thicknesses available for heat, chemical resistance, or when maximum durability is desired
- Factory manufactured components with fixed mechanical connections for ease of installation
- Uses no slip joints that are subject to wear and replacement increasing service life
- Pipe sections sized for low headloss and uniform air distribution
- No size constraint on drops and headers, 3" thru 8" and 90 mm thru 160 mm for distribution laterals
- Available with all EDI tubular and panel diffusers

1. Drop Pipe
2. Header Section
3. Air Distribution Laterals
4. Field Joint; Solvent Welded Coupling or Flange Connection
5. Air Distribution Orifice
6. Adjustable Pipe Support
7. Adjustable Diffuser Support (optional)



# PRODUCT SPECIFICATION SHEET

EDI Fixed Grid Piping Systems are ideal for conventional tank applications where access to the reactor for installation and system maintenance is available. The system is engineered for maximum long term economic value and reliability, and is based on design methodologies and system components specifically developed to meet customers needs and customized for each application. The foundational principles used to design each system include the following:

The airflow requirement for each pipe section is evaluated and the appropriate pipe size is selected for low headloss. This helps ensure uniform air release between diffusers and a low system operating pressure. There is no size limit on drop and header sections. Distribution laterals are available from 3" to 8" and 90 mm to 160 mm.

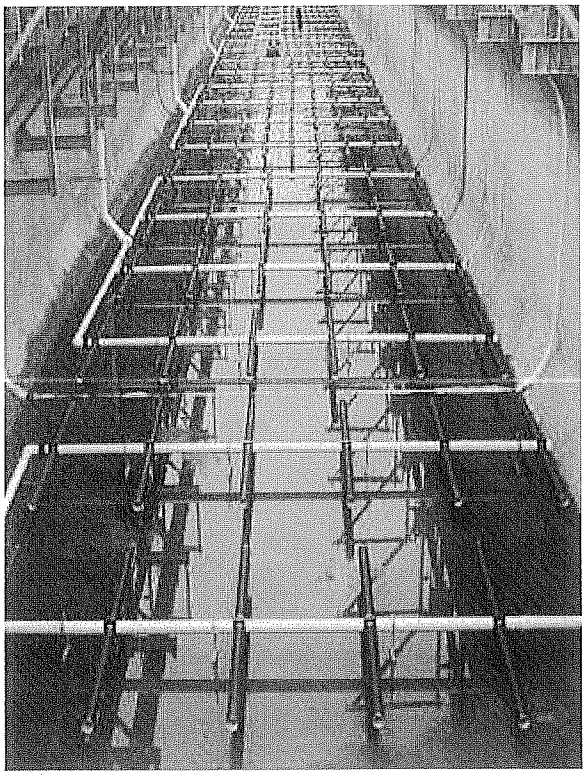
The material of construction is reviewed. Rigid PVC is most common and offers high value for most applications. Alternate materials including ABS, CPVC, Stainless Steel, and thicker wall sections are available to match specific application requirements.

Third, pipe supports are applied based on the mechanical strength of the selected piping components. Pipe supports are designed to allow unrestricted movement due to thermal expansion. This design philosophy allows fixed joints to be used throughout the system. This eliminates maintenance issues common with slip joints. Supports also restrain axial rotation. This is important for tube systems were torsional loads are possible. Spacing for supports is based on the deflection criteria and structural capabilities of the pipe section at worse case field conditions. Supports are typically fabricated of stainless steel. Where extreme external loads are anticipated or alternate materials of constuction are desired, the optional SuperStrut™ diffuser support is available.

All pipe sections are evaluated for condensate collection and purge requirements. Systems will feature either a self-purging device that is integral to the aeration grid or manual purge at the top of the drop pipe.

EDI Tube Diffuser Fixed Grid Piping Systems feature the FlexAir® Magnum™, and MiniPanel™ diffuser for energy efficiency and low maintenance. The MaxAir™, coarse bubble diffuser option is also available when energy efficiency is not a significant concern.

For additional information on an EDI Fixed Grid Piping System with tube or panel options, or any EDI product, visit our website: www.wastewater.com or contact a local EDI representative.



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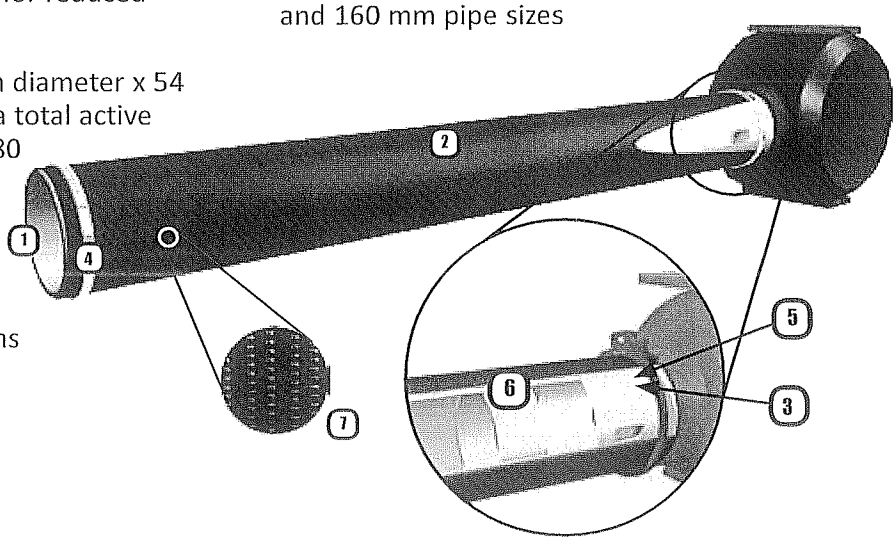
**PRODUCT SPECIFICATION SHEET**

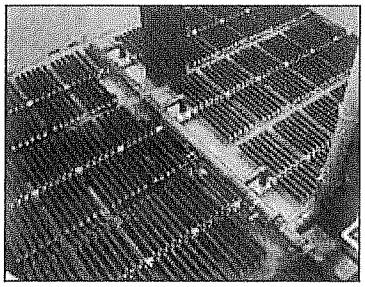
# EDI FlexAir® MiniPanel™ Diffuser

## Fine Pore Flexible Membrane Technology

### High Oxygen Transfer Efficiency for Maximum Customer Value

- Highest horizontal projected diffuser area for maximum OTE performance
- Efficient geometry supports high density installations of over 65% floor coverage
- Precision die cut openings for high oxygen transfer, uniform air release, and low operating pressure
- Nano Pore™ and Micro Pore™ perforation options available for engineered OTE and operating pressure requirements
- Advanced technology premium quality membranes available in EPDM, urethane, or special polymer blends, plus BioShield™ and BioCide™ technologies for reduced fouling and maintenance
- Nominal 4.75 inch (121 mm diameter x 54 inch (1359 mm) length for a total active membrane area equal to 380 $in^2$ (0.245 $m^2$)
- Integral triple check valve design prevents entry of liquid/solids into piping. Ideal for on / off applications
- Resistant to fouling and plugging for low maintenance
- ABS and PVC construction for maximum chemical, temperature, and UV resistance
- Spectrum™ Saddle Mount provides maximum mechanical integrity, ease of installation and maintenance, and ability to relocate or add diffusers for process modifications
- Non-buoyant design for reduced stress on mounting connection
- Spectrum™ Saddle Mount mounts on any pipe material (PVC, ABS, CPVC, SS, etc.)
- Available in 4 inch, 6 inch, 8 inch and 110 mm and 160 mm pipe sizes



1. Membrane Support Tube
2. Flexible Membrane Media featuring Top-Half Only Perforation
3. Check Valve Feature with non-Perforated Membrane Area
4. Membrane Clamp
5. Air Distribution Orifices
6. Internal End Plug
7. Die Cut Perforations

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*aeration for life™*

# PRODUCT SPECIFICATION SHEET

EDI FlexAir® MiniPanel™ diffuser is a unique fine pore, flexible membrane diffuser that provides superior operational flexibility and oxygen transfer efficiency compared to other membrane or rigid fine pore (ceramic) diffusers.

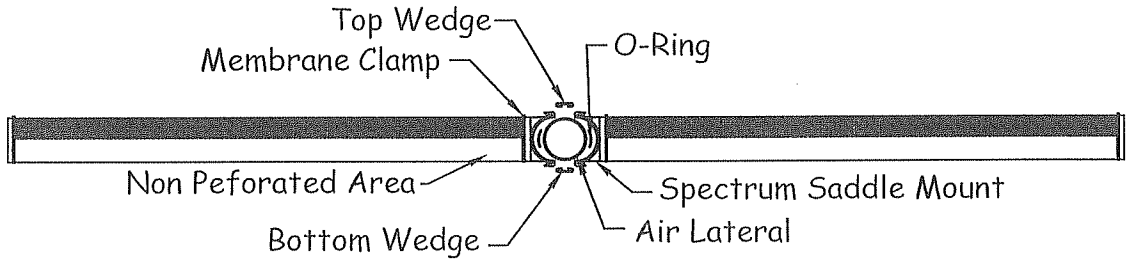
The MiniPanel diffuser features an exclusive top-half only perforation design. This design produces optimum oxygen transfer efficiency performance. A full 380 $in^2$ (0.245 $m^2$) of perforated area is provided with a single MiniPanel diffuser (760 $in^2$ (0.490 $m^2$) per diffuser assembly). The geometry of the diffuser supports high diffuser density applications over 65% floor coverage when the highest oxygen transfer efficiency is desired.

Unique to the FlexAir product is the ability to configure the diffuser for the objectives of the application. The MiniPanel diffuser may be configured with a micro pore, or nano pore membrane for optimized OTE and operating pressure performance. All FlexAir diffusers are configured with premium quality membranes that are engineered by the Membrane Technologies division at EDI. Alternate membrane materials and perforation patterns are available for non-standard industrial or municipal applications.

An integral triple check valve feature prevents the backflow of liquid into the diffuser and piping. The FlexAir MiniPanel diffuser is ideally suited for on/off applications and requires minimal maintenance for long-term performance.

The FlexAir MiniPanel diffuser is constructed of PVC or ABS for maximum chemical resistance and mechanical durability. ABS construction is recommended for high temperature applications or where cold temperature durability is required.

The FlexAir MiniPanel diffuser is exclusively available with the Spectrum Saddle Mount for maximum mechanical durability and ease of installation and maintenance. Unique to the Spectrum Saddle Mount is the ability to relocate or add diffusers to match process demands. This feature allows the aeration system to be reconfigured to match the specific oxygen demand or air handling requirements of the process. This is particularly beneficial in BNR applications were tight dissolved oxygen control is paramount. System expansions are also easily accommodated with this feature.




| Diffuser Type | Design Airflow | | Overall Length | | Active Surface Area | | Dry Weight | | Net Operating Buoyancy | |
|---|---|---|---|---|---|---|---|---|---|---|
| | scfm | $m^3_N/h$ | in | mm | $ft^2$ | $m^2$ | lb | kg | lb | kg |
| Nanopore | 0-30 | 0-48 | 117.0 | 2970.0 | 5.28 | 0.491 | 22.0 | 9.8 | 6.5 | 3.0 |
| Micropore | 0-50 | 0-79 | 117.0 | 2970.0 | 5.28 | 0.491 | 22.0 | 9.8 | 6.5 | 3.0 |

- Optimum oxygen transfer efficiency is achieved when operating in the middle to low end of the airflow range. The approximate operating pressure of the diffuser at the mid-range is 13 to 16 inches (3.2-4.0 kPa).
- Operating the unit at the high end of the range will result in reduced performance and increased operating pressure. Use the maximum airflow value for short term operations such as peak loads or system maintenance.

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For System Information:
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# Storage Instructions

## Receiving Inspection

*r.2011-10-12*

(FOB EDI only) Shipments shall be inspected for damage upon receipt. The recipient/receiver is responsible for all damages. EDI offers to act on behalf of the recipient / receiver in filing a claim for damage incurred during shipment. To file a claim against the freight company, a damage report must be submitted to EDI within 24 hours of delivery.

(FOB Jobsite only) Shipments shall be inspected for damage upon receipt. Any damages observed upon receipt must be reported to EDI within 24 hours of delivery. EDI will repair or replace damaged goods when notified within this notification period.

(Ex-Works only) Shipments shall be inspected for damage upon receipt. The recipient/receiver is responsible for all damages. To file a claim against the freight company, file a damage report directly with the shipping company.

A full inventory of shipped components shall be completed within 14 days of the receipt of shipment. Any deficiencies in the shipment that are clearly deemed to be the result of EDI will be reconciled by EDI when notified within this time period.

## Pre-Installation Storage Requirements for Plastic Piping

*r.2011-10-12*

PVC, CPVC and ABS piping components may be stored outdoors provided the ambient air temperature is below 140°F (60°C).

Pipe sections are furnished with end caps to minimize the entry of foreign materials (dirt, debris, etc.) into the pipe. Any foreign materials that are allowed to contaminate the pipe will need to be removed from the system prior to installation and start-up.

Piping shall be stored on a flat surface to avoid damaging the pipe sections.

If the pipe components are to be stored for more than 6 months, pipe sections are to be shaded from sunlight.

Accessories such as pipe supports, fasteners, etc., packaged in original boxes are to be protected from excessive moisture and rain. Outdoor storage is acceptable provided the ambient air temperature is below 140°F (60°C).

Small items should be stored in a secure location to avoid misplacement and theft.

## Pre-Installation Storage Requirements for a Flexible Membrane System

*r.2011-10-12*

Diffuser components packaged in original crates and/or cardboard boxes may be stored outdoors provided the ambient air temperature is below 100°F (40°C). In the case of components that are received in cardboard packaging, these packages must be protected against excessive moisture and rain to maintain package integrity.

If the ambient air temperature exceeds 100°F (40°C), then containers shall be shaded or stored indoors in which the ambient air temperature does not exceed 125°F (52°C).

Storage of diffuser membrane components shall be limited to one year.

## Post-Installation Storage Requirements for a Flexible Membrane System

*r.2011-10-12*

When the reactor is drained and the aeration system is exposed for a short period of time (less than 4 to 6 weeks), the system shall be protected from foreign objects including but not limited to paint or weld splatter, falling objects, etc.

- If the ambient air temperature is above 100°F (40°C), the system should be shaded to protect the system from UV light and excessive heat. A gray fabric tarp is recommended to shade the aeration components. The gray fabric tarp is to be suspended above the aeration system by approximately 6" (150 mm) to prevent damage to the system.
- **Note: Do not use any form of plastic to cover the aeration components. Plastic can create a hotter environment and/or fuse to the surface of the diffusers.**

When the aeration system is to be idle for an extended period time (greater than 4 to 6 weeks), the system should be submerged in approximately 4 feet of clean water provided the ambient air temperature is greater than 32°F (0°C).

- If the ambient air temperature is below 32°F (0°C), the water level may need to be increased so that the ice layer does not contact the aeration system.
- When reactivating a system where ice exists, operate the system at a minimum airflow to avoid movement of ice and maintain this airflow condition until the ice is no longer present.
- The water level should never be lowered if ice is present. The weight of the ice may damage the system.

When the aeration system is to be idle for an extended period time (greater than 4 to 6 weeks) and the units are going to be removed and stored, then the following storage conditions would apply.

- If the ambient air temperature is going to be less than 100°F (40°C), then a fabric tarp is recommended to cover the equipment.
- If the ambient air temperature exceeds 100°F (40°C), then the equipment shall be shaded or stored indoors in which the ambient air temperature does not exceed 125°F (52°C).

# Installation Instructions

## Air Piping Installation

*r.2011-10-13*

The Contractor is to confirm that the air piping is clean during fabrication of laterals and should swab out any debris found in the pipe **before** installing the diffuser units. Dirt and debris may clog the diffuser unit requiring an extended start-up procedure and **MAY** require the Contractor to remove and replace diffuser unit at Contractor's expense. If piping requires further cleaning before diffuser installation, Contractor may elect to perform water flush or air purge procedures described at the conclusion of this section. **NOTE**: If this procedure is performed, do so before installing the diffusers.

Transition from the drop pipe to the air lateral piping is made by a stainless steel coupling clamp provided by EDI. The aeration system typically features a drop stub designed to be field cut to length and solvent welded to the air laterals by Contractor. The pipes must be aligned vertically prior to installing the coupling clamp or the clamp may leak. The clamp has limited ability to seal misaligned piping. Also, the gap between the drop pipe and drop stub shall be less than 0.25"(6.5 mm) to ensure proper sealing of the coupling clamp.

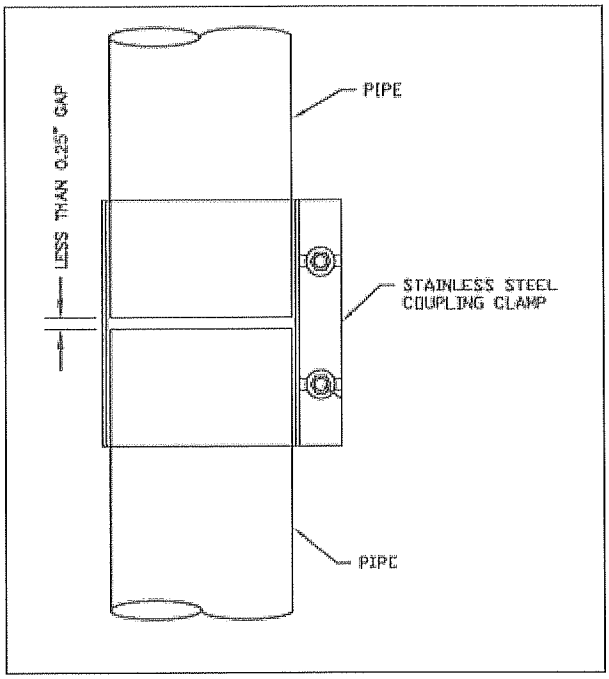
Assemble the aeration piping per the EDI layout drawing. Start with the drop pipe section to ensure proper drop pipe alignment. Pipe supports should be partially assembled with the bottom pipe strap, then placed under the drop pipe section for support. Pipe support assembly instructions are in the following section. See the EDI layout drawing for pipe support locations. Do not install the anchor bolts until the final alignment is established for the complete aeration grid. The remaining air lateral piping shall be installed using this same method. All piping segments will be labeled with a sequence number that indicates that segment's position in the lateral run. Additionally, EDI will provide an arrow on the lateral piping. This arrow indicates the direction of airflow in the lateral segment. All arrows should point away from the header toward the lateral end at final installation.

## Stainless Steel Coupling Clamp Installation

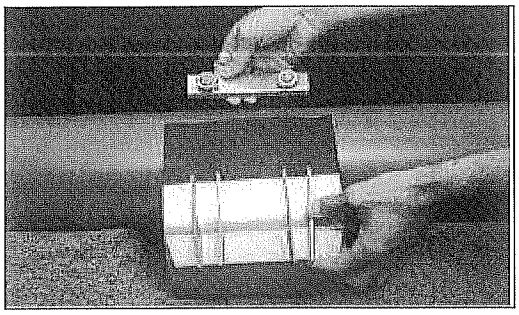
*r.2011-02-29*

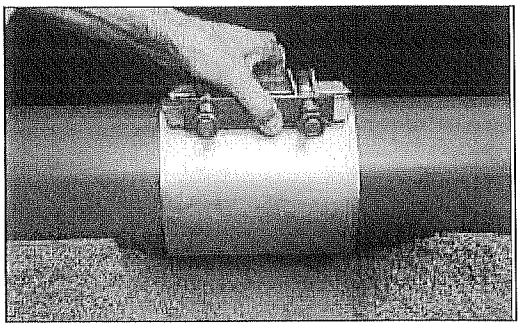
The stainless steel coupling clamp is provided by EDI to make the proper transition between two sections of pipe.

1) Make sure the pipe is clean. Remove any dirt or debris that would interfere with the complete sealing of the gasket around the pipe. Lubricate both the pipe and clamp gasket with soapy water. Do not use oil base pipe lubricant.
2) Ensure that the pipes are properly aligned prior to installing the clamp or the clamp may leak. If the clamp is to be installed on vertical pipe the pipes must be aligned vertically before installing the clamp. The clamp has limited ability to seal misaligned piping. Also, the gap between the two pipes shall be less than 0.25"(6.5 mm) to ensure proper sealing of the coupling clamp.

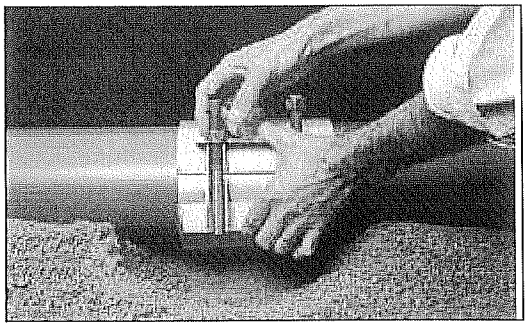


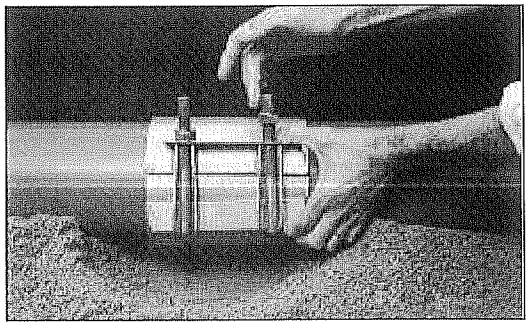

3) Place a reference mark on the pipe at a measured distance from the center of the pipe ends. This presents a visual mark to center the coupling clamp over the pipe transition.
4) Center the clamp over the two pipes. Loosen nuts to top of studs and wrap clamp around the pipe snapping the washer plate over the receiver bar.



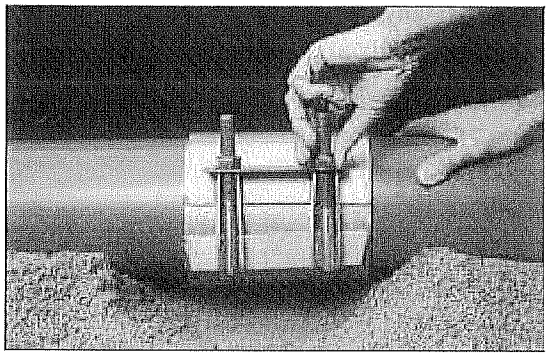


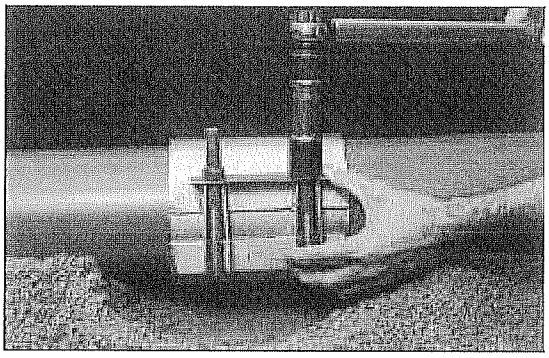
5) Squeeze the clamp together, finger tighten the nuts down, and rotate clamp toward the threaded end of the studs to smooth out the gasket.





6) Torque nuts sufficiently to stop leaks. Recommended torque is 70 ft. lbs. for 2" through 8" coupling clamps and 85 ft. lbs. for 10" – 12" coupling clamps. Correct torque indicated by slight deformation of washer plate and nylon washers. Caution! Thin Wall Pipes may require less torque and may deform if over tightened.





## Van Stone Flange Installation

*r.2011-10-13*

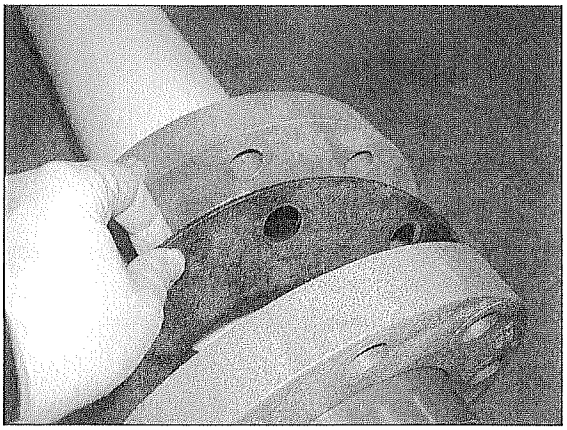
Lateral piping is connected with Van Stone flanges and supported by partially assembled pipe supports.

Gaskets and stainless steel fasteners are provided by EDI for flanged connections. Recommended bolt-tightening torques are indicated in torque table on Flange Installation Detail Drawing.

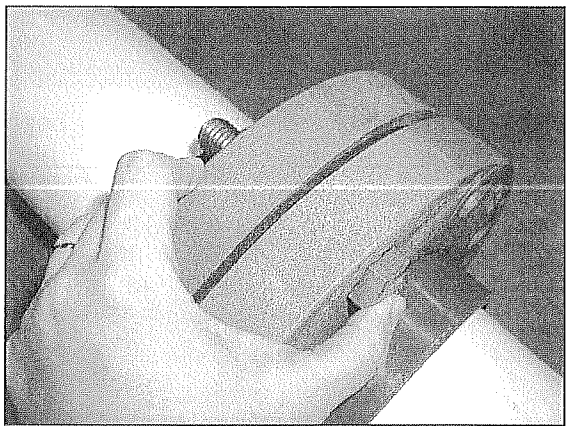
An industrial grade anti-seize lubricant MUST be used on stainless steel bolt threads to prevent galling. Contractor will be responsible for replacement of all damaged items resulting from not using anti-seize lubricant.

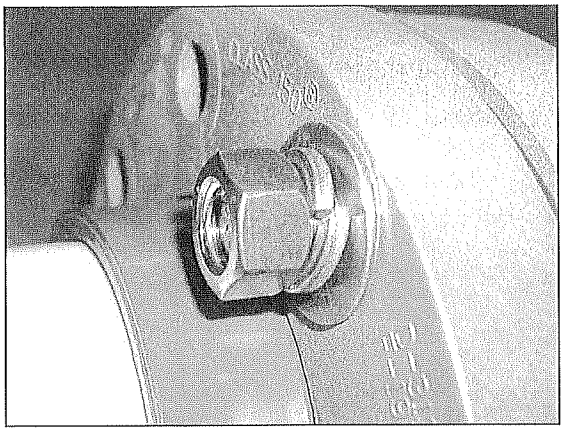
1) Lay out sections of pipe to be joined in order, making sure orifices are in correct orientation to install diffusers as shown on layout drawing. EDI provides flow arrows and labels on pipe corresponding to labels on layout drawing.

2) Rotate loose ring of flange to align the bolt holes with gasket and mating flange to be connected.

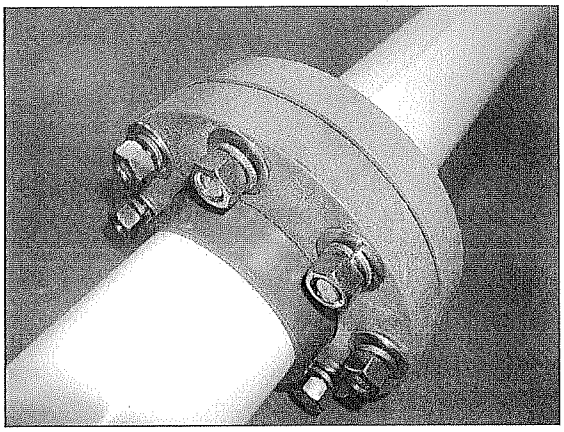


3) Place S.S. bolt through bolt hole in first flange, gasket, and hole in second flange. Place flat washer onto bolt, then lockwasher, then thread S.S. nut LOOSELY onto bolt to complete bolt assembly (do not tighten at this time).





4) Repeat for remaining bolt assemblies around flange.



5) When all bolt assemblies have been correctly positioned, tighten nuts according to torque table on Flange Installation Detail Drawing. Bolt assemblies MUST be tightened in the torque sequence shown on Flange Installation Detail Drawing. For best results, tighten in 5-ft.lb. (6.8 N-m) increments.

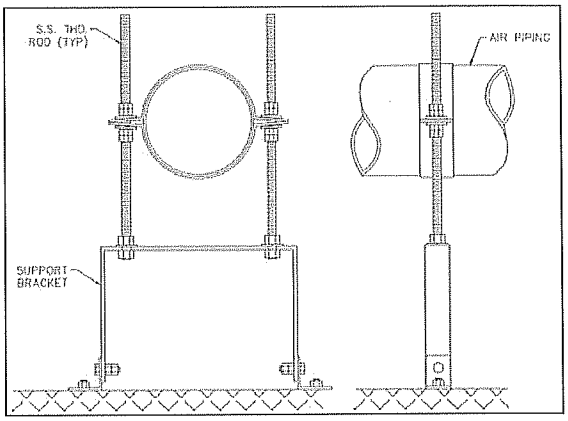
6) As lateral sections are assembled, maintain correct alignment of the air outlets on the lateral so that diffusers will be level when installed.

If the specifications require the system to be pressure or leak tested, all openings are to be plugged before the system is tested. EDI recommends not exceeding 10 psi (69 kPa) during pressure or leak testing.

## Rigid & Simple Pipe Support Installation Instructions

*r.2011-11-15*

Air laterals are anchored to the basin floor by stainless steel (SS) pipe support assemblies. Depending on project specific forces and/or turbulence anticipated in the basin, EDI may include additional support features. Please review all details shown in the EDI construction drawings to ensure all features are properly installed.

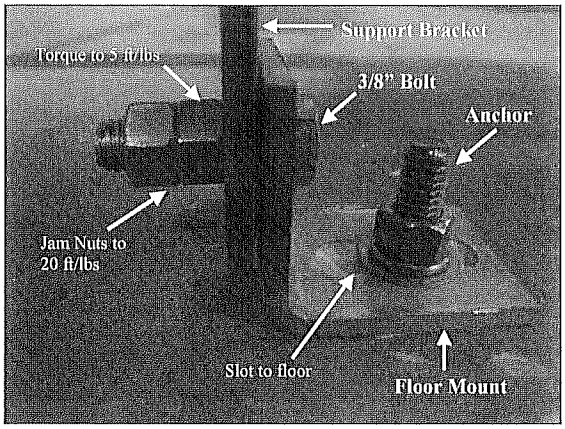



**Note: A simple support is shown above. A rigid support is a simple support plus secondary stabilizer legs to prevent pivoting. See EDI layout drawings for rigid support locations.**

To maintain proper clearance for the diffuser mount, EDI recommends a minimum distance of four inches between any outlet hole and a pipe strap. When a support must be relocated due to the support clearance indicated, shorten rather than lengthen the support spacing. See EDI layout drawing for proper pipe support spacing and locations.

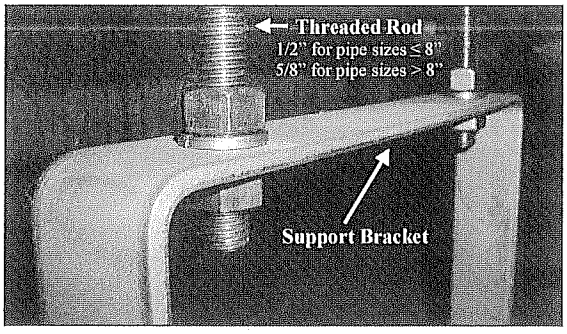
1) Connect floor mount to support bracket with one SS bolt and double SS nuts (see following photo). The slotted side of the floor mount is against the floor when properly assembled. Rest the double nuts against the support bracket and lock against each other. Torque values must be adhered to unless specified otherwise. Floor mount must

allow pivoting of the support. Repeat for other leg of pipe support.




| Required Bolt/Nut Torque Values | |
|---|---|
| Bolt Sizes | Torque |
| 3/8 in.(9.5 mm) | 20 ft-lb (27 N-m) |
| 1/2 in. (13 mm) | 45 ft-lb (61 N-m) |
| 5/8 in. (16 mm) | 90 ft-lb (122 N-m) |

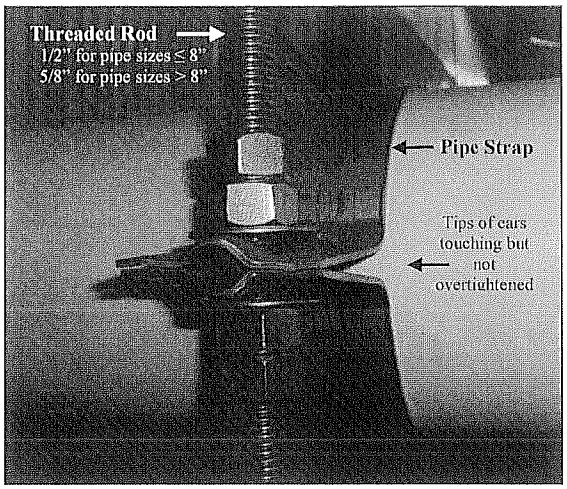
2) In the following order, place one nut and one lock washer onto threaded rod approximately 1" (25.4mm) from bottom. Thread bottom nut to secure rod. Repeat for second S.S. threaded rod (see following photo).




3) Place two SS nuts followed by one SS flat washer on the upper end of both SS threaded rods. Then place the bottom SS pipe strap onto the threaded rods.

4) Set the air piping on the bottom pipe strap and adjust the vertical height to the elevation indicated on EDI layout drawing. Sufficient amounts of threaded rod are provided on pipe supports to adjust the elevation of the piping. Pipe supports incorporate a ± 2" (51 mm) allowance for variations in the basin floor.

5) Place the top SS pipe strap onto threaded rods around the air piping. Install one SS flat washer followed by two SS nuts to upper end of rod over the top pipe strap.

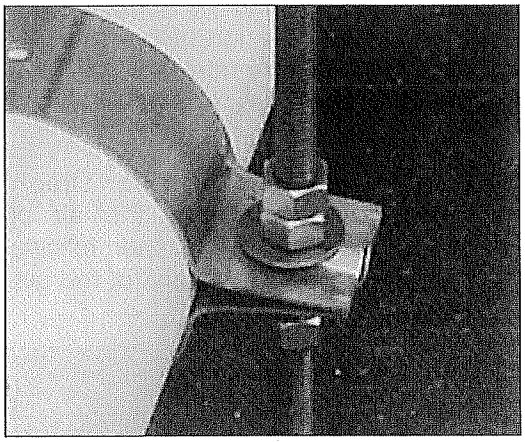


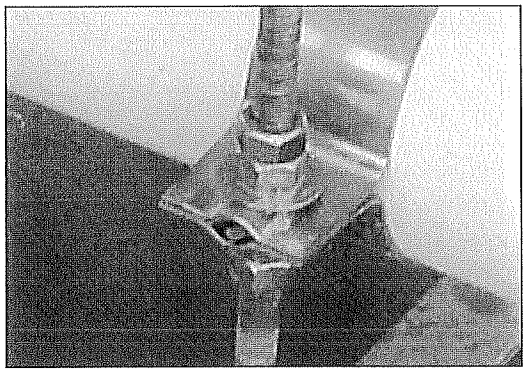

6) **Pipe straps shall be tightened until the ends of the straps touch (see photo above).** Equally tighten both sides until the tips of the upper and lower pipe straps touch on both sides. The straps must be aligned when tightened. Misalignment of the straps will hinder proper operation of the strap through the full range of motion the straps are designed to provide. It takes less than 1ft-lb to reach this position. Care should be taken to not over tighten the straps, as this can cause irreversible damage.

7) Thread the jam nut down to the first hex nut.

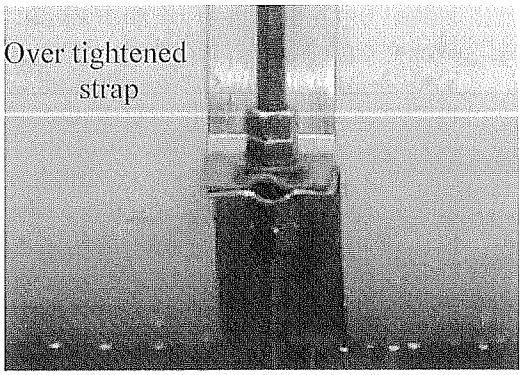
8) While securing the first hex nut, jam the second nut to the proper torque value indicated on the table above.

Example of properly tightened straps:

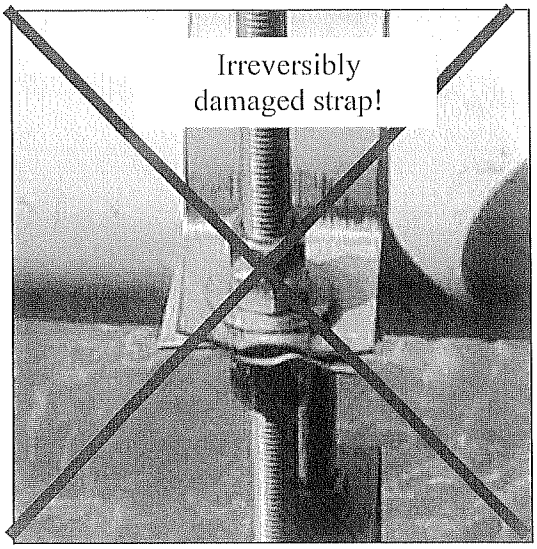




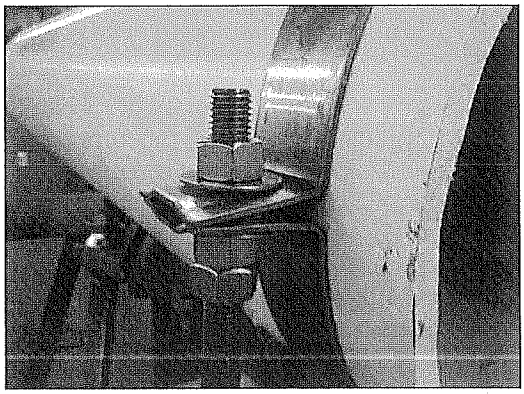
In the photo below, the hex nut must be loosened until the ends of the strap are just touching and aligned.



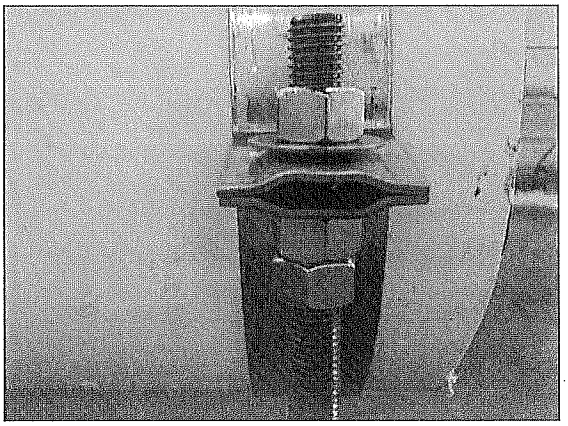

Warning! If the strap ends do not return to their original shape when the hex nut is loosened then the straps must be replaced. Bending the ends of the strap down is not an acceptable repair as this condition is an indication that the center of the strap has been crushed.




9) On pipe diameters greater than 8" the pipe strap design is different and the following instructions apply for proper installation.



10) **Pipe straps shall be tightened until the ends of the straps touch (see photos below).** Equally tighten both sides until the tips of the upper and lower pipe straps touch on both sides. The straps must be aligned when tightened. Misalignment of the straps will hinder proper operation of the strap through the full range of motion the straps are designed to provide. Care should be taken to not over tighten the straps, as this can deform both the strap and the pipe. Deforming the pipe places high stress levels on the pipe and which can result in premature pipe failure



11) Thread the jam nut down to the first hex nut.

12) While securing the first hex nut jam the second nut to the proper torque value indicated on the table above.

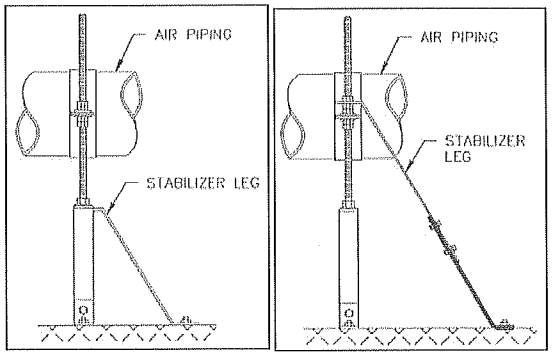
13) Assembled pipe supports MUST be vertical.

14) When each of the above steps has been completed, each floor mount must be secured to the basin floor by an anchor bolt, 3/8" flat washer, lock washer, and nut. Note: When installing anchors, drill the hole perpendicular to the work surface. To assure full holding power, do not ream the hole or allow the drill to wobble. Then clean the hole to ensure proper performance.

### Rigid Stabilizer Legs

Rigid stabilizer legs are featured on all fixed grid aeration systems anchored to the basin floor. Rigid stabilizer legs are utilized to prevent rotation and established a fixed point for downstream expansion and contraction. Each rigid support identified on the EDI layout drawings will feature **two stabilizer legs per support** (one **on** each threaded rod).

Rigid stabilizer legs may be connected at the support bracket or at the pipe strap (see both examples below) depending on the calculated thrust for each specific project. See EDI detail drawings for specific stabilizer arrangement and assembly instructions.



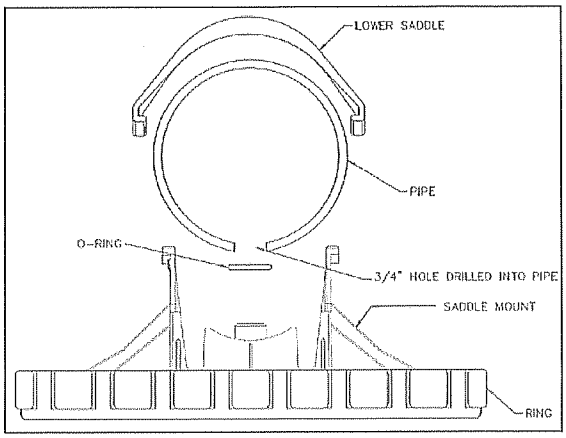

**Note: Rigid stabilizer legs shall be positioned upstream of the support so they are in tension as the piping grid expands forward.**

### Leveling of Air Piping

Air distribution through the aeration system is a function of the relative elevation of the individual aeration units and the leveling tolerance of the air supply piping. As a guideline, EDI recommends that air piping not vary in elevation by more than 1/2" (13mm). Excessive variation in pipe elevation may result in poor air distribution during normal operation.

## Installation of the Bottom-Mounted Continuous Flow Purge Assembly

*r.2012-02-06*



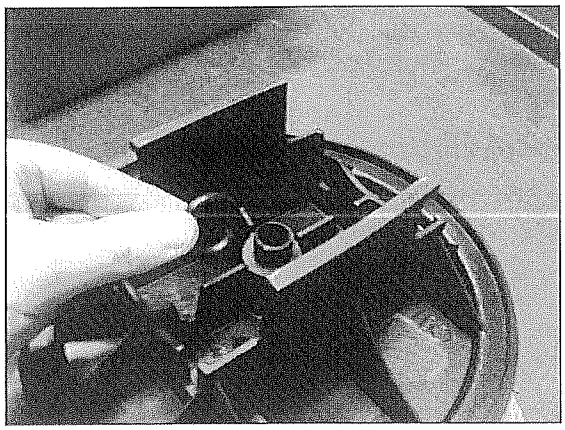
A continuous flow purge assembly has been provided to remove accumulated condensation from the EDI aeration system.

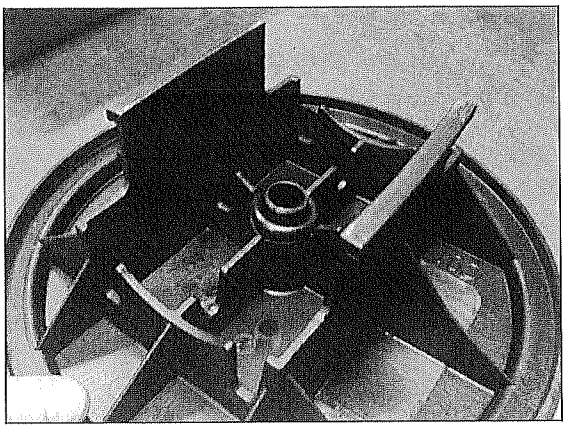
The contractor is to install the continuous purge as detailed below:

1) The diffuser unit is factory-mounted to the saddle. Other materials/tools required for installation include: lower saddle, O-ring, and rubber mallet (rubber mallet not included).

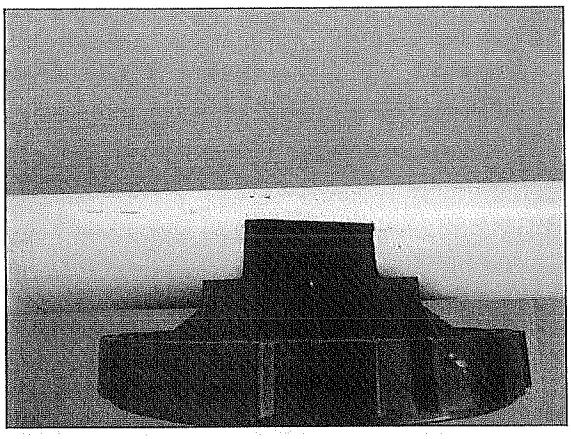
2) Prior to installation, ensure that all air piping is clean and free of debris. When blower assemblies, header piping, air laterals, and all units are properly installed, system is ready for start-up. Refer to "Start-Up Instructions" for details.

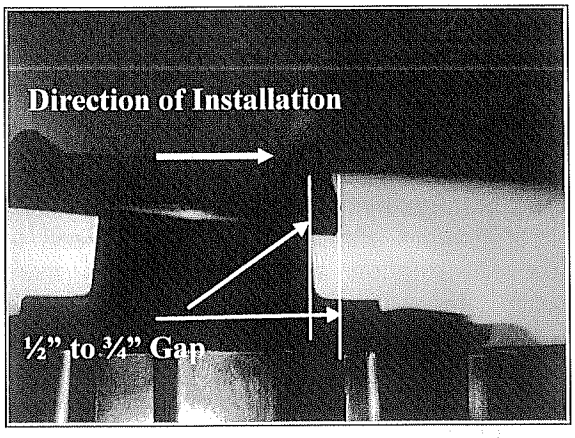
3) Install O-ring over the inlet air stub on the diffuser saddle prior to installing the diffuser on lateral. DO NOT PRE-INSTALL O-RING. DO NOT USE ANY MASTIC OR OTHER ADHESIVE. Note: O-ring must be able to move to seal when pressure is applied.





4) Place the diffuser on the piping with the inlet air stub engaged in the orifice hole in the piping.






5) Follow the arrow that has been molded into the lower saddle for direction of installation. Install the lower saddle. Tighten the lower saddle until the Click-Loc teeth are engaged. Note: Do not use metallic mallets or hammers as they

may crack or shatter the lower saddle or damage the unit. When properly tightened, the diffuser assembly should be level and resist rotation.

6) **Tighten lower saddle to approximately ½" to ¾" (12 mm to 19 mm) beyond upper saddle. This will engage all 3 locking teeth on the upper saddle. See picture above.**

### Tightening Disc Diffuser Retaining Ring

If it is necessary to tighten the disc diffuser retaining ring on diffuser units that are already installed onto lateral piping or support tubing the following procedures should be followed.

1) Ensure that the unit is secured tightly to the piping with the lower saddle.
2) While holding the base of the unit firmly in place:
3) Remove the retaining ring.
4) Apply clean water to lubricate the membrane sealing ring.
5) Replace the retaining ring.
6) Tighten the retaining ring until it makes contact with the membrane, then tighten as tightly as possible by hand.

This degree of tightening will provide positive seal without any difficulties in installing or maintaining operation of the product. Note: It is very important to keep the diffuser base from rotating on the piping during the removal and reinstallation of the disc diffuser retaining ring.

Install the continuous flow purge assemblies in the locations shown on the EDI layout drawings (typically at the end of each lateral run).

## Optional Water Flush and Air Purge Cleaning of Piping

*r.2011-10-12*

These instructions cover the general procedure that may be used to clean the piping in a fine or medium bubble diffuser system prior to diffuser installation. Special pipe cleaning requirements outlined in the Engineer's specifications, contract documents, or instructions offered by EDI shall be supplementary to or take precedence over the general instructions outlined below.

### Water Flush Cleaning

1) Water flush cleaning is the recommended method to clean assembled piping systems where pipe segments are too long for manual cleaning. This procedure can be used in conjunction with air purge cleaning and is recommended when fine debris is not removed prior to assembly of piping. When both water flush and air purge are used, the water flush procedure should be implemented first.
2) To water-flush the system, connect a water supply to the air header or make individual connections to each lateral. If flush water is piped to the header, it is imperative that the header be valved or stubbed such that water does not flood the blowers.
3) Clean water must be used. It is not necessary to use potable water, but the flush water must be free of silt or debris.
4) Flush header assembly prior to water flushing the laterals. To flush the header, fill it with water and open the end lateral to create a flush velocity in the header of at least two feet per second.
5) Next, the laterals are to be individually flushed at a recommended velocity of five to six feet per second. Opening one isolation valve will produce a significant flushing action in the lateral as water is pumped through the header. One or two drilled air outlet holes should be uncapped to allow water and debris to be flushed out of the piping.
6) The cleaning procedure in the previous step should be completed for each of the laterals. This is done by sequentially

opening and closing the isolation valves on the individual laterals.

7) As an alternative to using the main header/lateral flush procedure, the individual laterals may be cleaned independently of the main header. For this operation, the laterals are disconnected from the main header and cleaned individually.

### Air Purge Cleaning

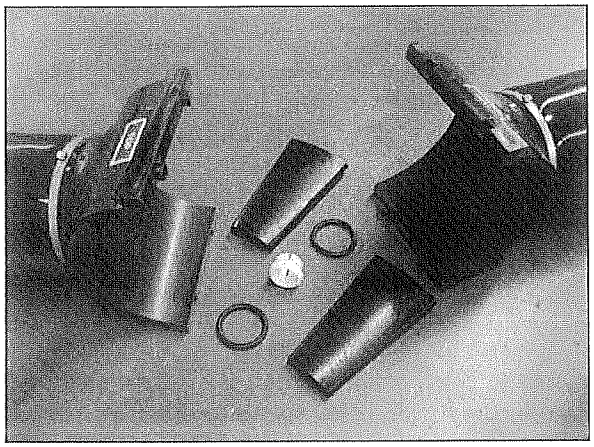
1) Remove weights and cap from the pressure relief valve during initial start-up of the system. This prevents potential damage to the blowers from blocked valves or obstructions in piping system. Cap and weights can be added back to the pressure relief valve as necessary to provide proper operating pressure capability.
2) NOTE: When a blow-off valve is provided for the blower system, it may be operated in lieu of using the pressure relief valve procedure listed above.
3) Open all lateral valves prior to start-up of the blowers. Provide an opening at the end of the air laterals to allow air and foreign materials to be discharged from the system. The opening may be made at the end of the air lateral by leaving the end cap off of the lateral or by removing two orifice/outlet plugs at the end of the lateral.
4) In order to increase the velocity of air through the header and air laterals, it may be desirable to operate at maximum blower capacity. In addition, it may be necessary to close some of the lateral throttling valves to achieve a high velocity through the balance of the laterals that are open to the atmosphere. A high velocity is required in order to blow out any accumulated foreign materials.
5) As laterals are consecutively cleaned, the isolation valves are operated in a manner that allows the remaining laterals to be cleaned by an air purge.
6) Upon completion of the air purge, the blowers are shut down and the laterals are capped. Diffuser units are installed on the laterals and all isolation valves are opened prior to filling the basin with water.
7) If only an air purge is used to clean the piping, the basins are now ready to be filled with water to check the operation of the diffuser units.

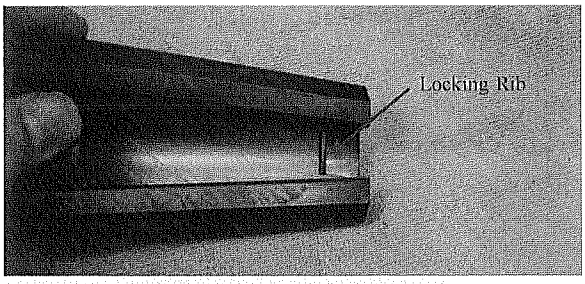
## Installation Instructions for FlexAir® SDM Diffuser Units with locking rib on wedge.

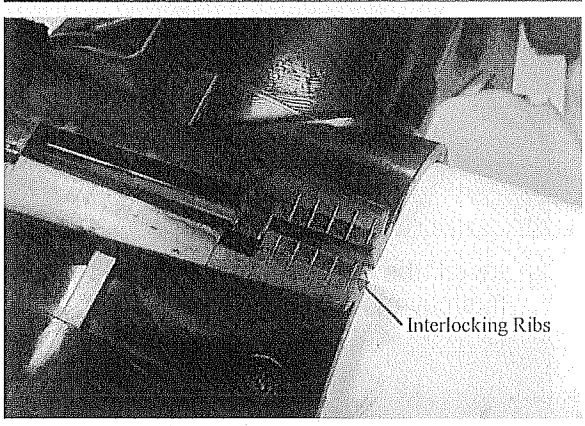
*r.2011-11-02*

**Each duplex diffuser assembly consists of:**

- One "Male" diffuser that has protruding alignment pins, a red "TOP" sticker applied near the wedge ramp, and wedge retaining ribs at small end of ramp.
- One "Female" diffuser that has alignment slots, a red "TOP" sticker applied near the wedge ramp, and wedge retaining ribs at small end of ramp.
- Two wedges with locking rib.
- Two o-rings.
- One alignment plug





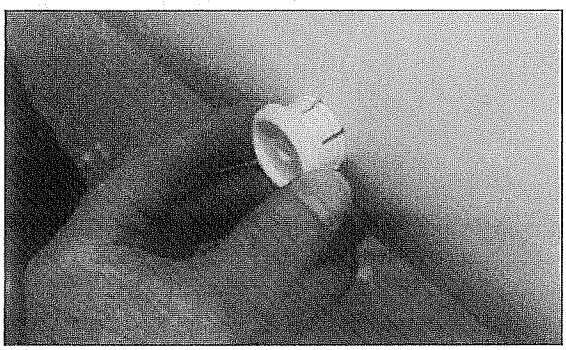




Other standard materials/tools required for installation include:

- Non-metallic mallet (not included by EDI).
- Bubble/laser level (not included by EDI).

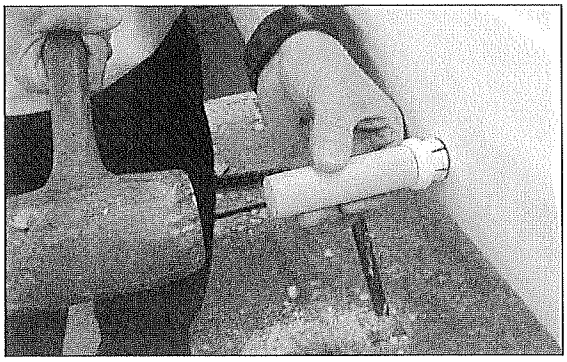
**Preparation for installing diffusers on air lateral piping:**

1) Insure that the air laterals are installed with the orifice holes horizontal.
2) Locate the 1.0 inch holes in the lateral and place the alignment plug up to and centered on the hole. Only one plug is required per pair of diffusers.



**Note:** The lateral will have two different sized holes. The smaller hole is the air flow orifice for one side of the duplex diffuser and the larger hole is for the alignment plug.

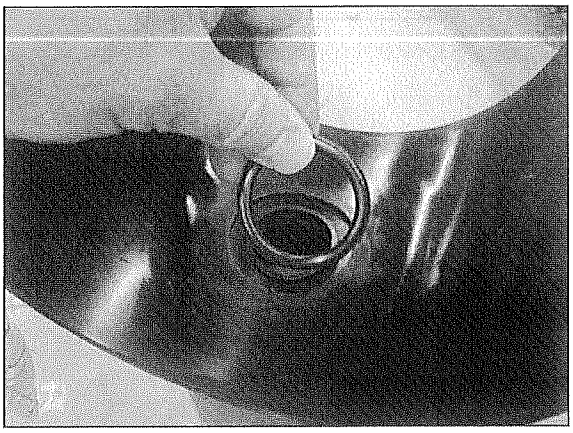
3) Tap the plug into the lateral using a soft blow hammer and a short piece of 1.0 inch diameter dowel (provided by EDI).



4) Ensure that the plug is correctly seated and was not damaged during the installation. Replace any plug if damage occurred.

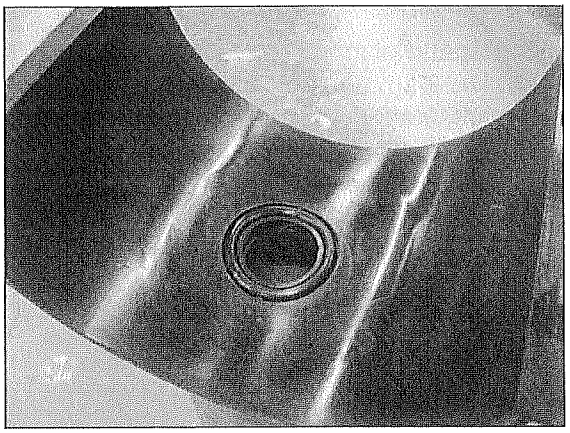
**Installing of diffusers on air lateral piping:**

5) Install O-ring immediately before saddle is to be installed on lateral. The o-ring is placed in the internal groove. DO NOT USE ANY MASTIC OR OTHER ADHESIVE.



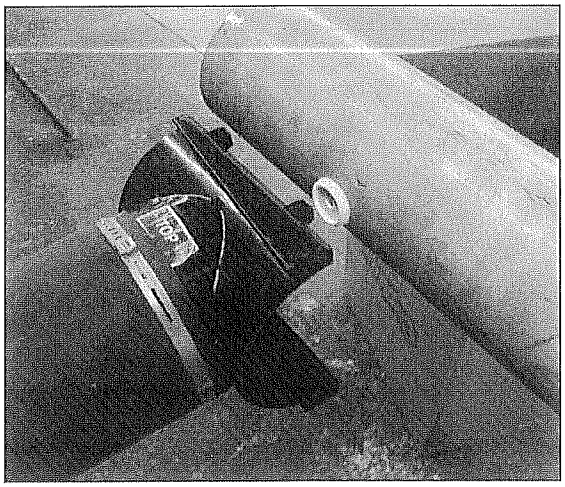
6) There are retaining bumps to hold the o-ring in place during installation. **Note:** The o-ring must be able to move to seal when pressure is applied. **Note:** During cold weather installation, below 40°F

(4°C), it is advisable to keep the o-rings warm. One method is to place the o-rings in a bucket of warm water.

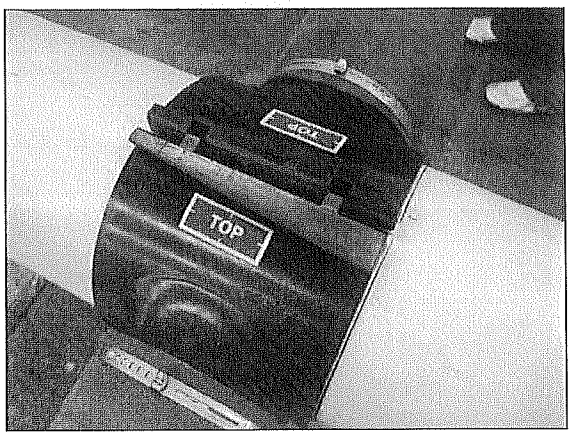


7) Position the diffuser unit in the proper orientation (see table below) while positioning the alignment plug to the center hole in the saddle. The plug fits into the saddle.

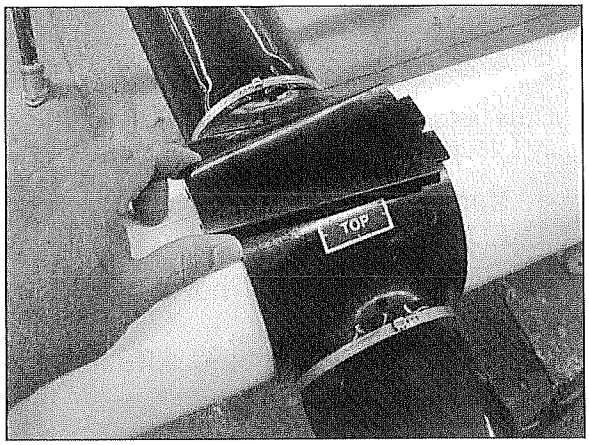
| Unit Type | Perforation | Ear of Clamp | RED "TOP" Sticker |
|---|---|---|---|
| MiniPanel | On Top | On Top | On Top |



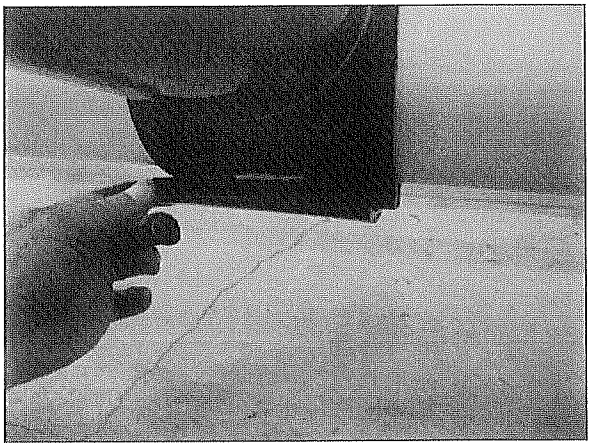

8) **Note:** Ensure that the saddles' alignment pins mate properly when installing the opposing saddle before sliding on the wedges. The red "TOP" stickers should face up.



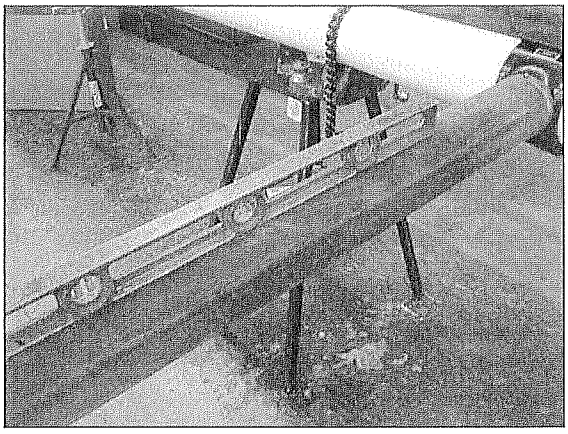

9) Install the top wedge ¾ inch from being flush by hand.



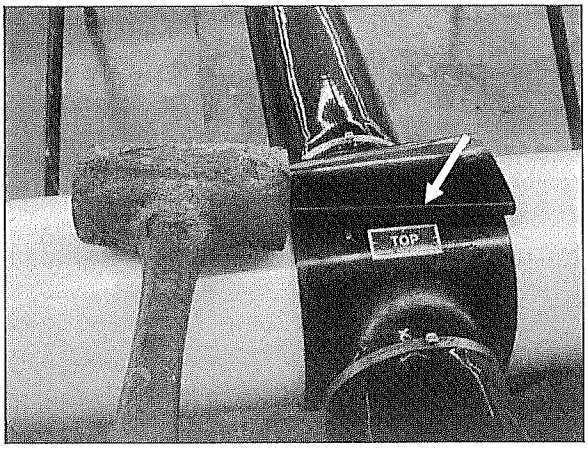

10) Install the bottom wedge hand tight- approximately 3/4 inch (19mm) from being flush with the saddle.



11) Ensure that the diffuser assembly is in the correct location, level, and that each diffuser arm is in line with the rest of the diffusers on the shared lateral.



12) Tighten the top wedge and bottom wedge **EQUALLY** with a non-metallic mallet or rubber faced hammer. When properly tightened, each diffuser should be level and resist rotation. **Note:** Metal mallets or hammers may crack or shatter the wedge assembly or damage the unit. Do not use metal hammers directly. **Note:** Extra care is needed during cold weather installation, below 40°F (4°C). Plastic components become brittle and may fracture with excessive impact force.




13) Ensure that wedges are driven on as equally as possible while maintaining level on the diffusers. **The wedges should be flush with that saddle when complete.** Over-tightening wedges can cause irreversible damage to the diffuser saddle.

**NOTE: Diffusers must be protected from the sun. Long term exposure to direct summer sunlight can cause failure. Diffusers need to either be protected from the sun or heat by covering them with clean water or shade over the basin.**

# Start-Up Instructions

## General Aeration/Mixing Systems Start-Up Instructions

*r.2012-07-13*

These instructions cover the general start-up requirements for the aeration system. Special start-up requirements outlined in the Engineer's specifications, contract documents, or instructions offered by EDI shall be supplementary to or take precedence over these general instructions.

An overview of start-up procedures is related below:

1) Confirm that piping and diffusers are level by filling the basin with water until the diffusers are 1" to 2" under water. Diffuser elevation tolerance should be within the approved tolerance for the respective diffusers. Adjust supports or diffusers as required.
   a. Fixed Grid Disc System less than ±1/4"
   b. Fixed Grid StreamLine System less than ±1/4"
   c. Fixed Grid Magnum System less than ±1/2"
   d. Fixed Grid MiniPanel System less than ±1/2"
   e. Fixed Grid MaxAir System less than ±1/2"
   f. Floating Lateral System less than ±1/2"
   g. Submerged Lateral System less than ±1.0"
2) Activate the blower and introduce air to the aeration system. Take note not to exceed the airflow capacity of the system (see headloss calculations provided in the submittals). At 50% design air capacity, check piping and diffusers for obvious leaks, and repair as required. Open any manual purge valves to expel water that may be in the piping. Close the purge valves once all water has been expelled.
3) Check for minor leaks by completing the following steps. Turn the airflow down to very minimal release. If the system employs separate drop valves, each grid can be checked separately by throttling the valve the valve one at a time. Again, take care not to exceed airflow capacities in neighboring aeration grids when reducing airflow by this method.

   The airflow will not be uniform at this low level. This is acceptable, as this test is only used to check for small leaks that are not visible with the design amount of airflow. Check for any observed leaks and repair as required.

   Leaks commonly occur due to:

   a. missing or misaligned o-ring
   b. torn membranes
   c. loose disc retainer ring

   Directions for fixing these items can be found in the "Corrective Maintenance" section of this manual.

   NOTE: Polyurethane membranes (if supplied) may exhibit small leaks at the ends of the membranes at initial start-up. This is normal and can be expected until the membranes are submerged for a period of time. These small leaks will stop once the membranes are wetted for a period of time, especially for polyurethane membranes (up to 2-4 weeks). This is also true for uniformity of ceramic media (if supplied).

   Reopen the valve as inspection is completed to each aeration grid, and repeat procedure for the next grid.
4) Once all deficiencies have been corrected, maintain air to the system

and continue filling the basin until the design depth is reached.

### Blower Components

See the blower installation and start-up instructions to assure all blower components are mounted properly and ready for operation. When EDI provides the blower assemblies, detailed installation and start-up instructions are provided in the blower submittal package.

Blower components should be fully installed and fully serviced prior to making final electrical connections and starting up the aeration system.

Precautions should be taken throughout system installation to minimize the discharge of airborne particles to the aeration system. As a minimum, an air inlet filter should be installed and operated during blower servicing procedures. EDI recommends a filter efficiency of 93% of 10-microns. Any solvents used to clean blower should be bypassed from the aeration piping. The discharge of airborne particulate matter or solvent into aeration piping may result in damage to diffuser membranes.

Upon completion of blower manufacturer's recommended service, the subsequent start-up procedures may be followed.

### General Air Piping

Contractor is to confirm the cleanliness of the air piping. If existing header piping is used, the air purge or water flush cleaning procedure is recommended prior to installation of diffuser units to remove any internal debris that may have accumulated in the header piping. Inspect air piping and diffuser connections for loose fittings or damaged pipe. Damaged piping sections and connections should be repaired prior to commencing system operations.

### Initial System Start-Up

To start the system, completely open all valves in the air supply system, including blower shut-off valves, header valves and lateral isolation/throttling valves. This instruction assumes that uniform water level is present in all aerated basins served by a common blower. If varying water levels are present, basins with lower water levels will need to have the valve to that basin throttled back to avoid improper air distribution. Failure to completely open all valves may result in over-pressuring blower unit, release of pressure relief valve, motor overload, or poor air distribution in aeration system with the potential of exceeding airflow capacity to diffuser units and damaging the diffuser membranes.

Once valve positions have been confirmed, blower unit may be started. EDI does not recommend starting multiple blower units at initial system start-up. Subsequent blowers should be brought on-line after the system has equalized and uniform diffuser activity is observed throughout the system.

Use blower manufacturer's recommended start-up procedures. EDI recommends that initial pressure surge be reduced through PRV or blow-off valve.

Start-up procedures should follow the basic guidelines as listed below:

1) When starting initial blower, the PRV or blow-off valve should be used to reduce the start-up pressure surge. This is accomplished by removing weights and the cap from the PRV or by opening the blow-off valve.
2) When the basin has been filled, note the operating pressure at the blowers. The pressure relief valve should be adjusted to free-flow at approximately 1 psig above the normal operating pressure of the system.
3) To confirm the PRV operates, partially close blower shut-off valve until PRV releases air. Reopen the shut-off valve to confirm that PRV will reseat. If required, readjust the PRV to the recommended setting per instructions in the Blower IOM manual.

4) To properly assess the airflow distribution on the aeration system, the blower system must be operating at the design operating point. On dual blower systems, design airflow is typically achieved by operating one blower at 100%. On three-blower systems, design airflow is typically based on operating two blowers at 100%.

5) Airflow distribution adjustment between laterals should not be conducted until the full operating depth is obtained and the blower system has been in operation for several days. Small adjustments may be made to the isolation/throttling valves on the laterals receiving the most air. System balancing should be completed on an incremental basis. Changes in airflow distribution may require 2-8 hours to fully stabilize when fine-tuning a system. In addition, in situations where multiple basins are employed and varying water levels exist, adjustments of lateral valves will be required to maintain air distribution in the tanks.

EDI recommends that the system Operator contact EDI at 573-474-9456 prior to making any adjustments to the airflow distribution.

# Safety Considerations

## Safety Considerations

*r.2011-10-13*

The diffused aeration system supplied on this project has no moving parts and poses little to no risk of injury to operations staff. However, routine maintenance may expose personnel to potential hazards. EDI has listed below potential hazards and recommended precautions when maintenance procedures are required for the aeration components.

### Tanks at Full Liquid Depth

Hazards:

1) Turbulent liquid action.

Precautions:

1) Provide access to emergency throw rope or life ring.
2) Use "buddy system" during maintenance activities.

### Tanks Empty

Hazards:

1) Falling into tank.
2) Objects falling onto maintenance personnel in the tank.
3) Slippery floor.

Precautions:

1) Avoid access ways without railings.
2) Provide emergency exit/access.
3) Appropriate personal safety equipment

### Maintenance of Diffuser Units: Tanks Empty

Hazards:

1) Personnel falling into tank.
2) Objects falling in the tank.
3) Slippery basin floor.

Precautions:

1) Avoid access ways without railings.
2) Provide emergency exits/access.
3) Appropriate personal safety equipment.

### Maintenance of Diffuser Units: Tanks Full

Hazards:

1) Dropping hardware
2) Personnel falling into tank.

Precautions:

1) Assure proper winch operation before securing cable to drop assembly.
2) Use buddy system and follow standard safety procedures.

### Personal Protection Measures

Wastewater has a potential for health hazards because it may carry disease producing organisms and a variety of chemical wastes. It is important to employ good personal hygiene practices to prevent oral and skin contact with wastewater. The following is a list of methods to prevent direct contact entry of pathogenic organisms:

1) Wash hands frequently with soap and water after contacting wastewater, visiting restrooms, before eating, drinking, or smoking; and at the end of jobsite visit. When soap and water are not available use anti-bacterial hand wash specifically formulated for use when soap and water is not convenient.
2) Promptly treat cuts and abrasions using appropriate first aid measures.

3) Handle sharp items with extra care to prevent accidental injuries.
4) Clean contaminated tools after use.
5) Follow good common sense and exercise extra caution whenever there is contact with contaminated water or sludge.
6) Never touch face, mouth, eyes, ears, or nose while working with wastewater or sludge.

### Personal Protective Equipment

1) Wear heavy-duty gloves (or double gloving) and boots that are waterproof and puncture resistant. Wear gloves whenever practical when there is contact with wastewater or sludge.
2) When practical, use thin disposable latex gloves for light work. Use reinforced rubber gloves for heavy activities. Discard gloves that become torn and try not to submerge hand below top of glove during service activities. When it is not feasible to use gloves while installing or inspecting equipment, make sure to follow personal hygiene practice listed above.
3) Wear goggles in the presence of heavy aerosols, dust, or when splashing of wastewater might occur.
4) Wear protective clothing; if possible, shower and change clothes before leaving plant site. If work clothes are washed at home, separate from the family wash and use chlorine bleach.

### Confined Space Hazard

1) Verify the designation of the tank before entering. If it is defined as a confined space follow plant directives for entry. Generally a confined space is defined as having limited or restricted means of entry or exit; is large enough for an employee to enter and perform assigned work; and is not designed for continuous worker occupancy. Typical confined spaces are silos, digesters, boilers, vaults, sewers, pipelines, pump pits, ducts and compartments.
2) Wastewater tanks or basins can also be confined spaces and contain potential hazards. Flammable, explosive, toxic, or other hazardous substances or the absence of sufficient oxygen could cause injury, acute illness, disability, or death. Particular care should be exercised to assure NO hydrogen sulfide, chlorine or other heavier than air gases have not accumulated in the basins or tanks. DO NOT ENTER ANY CONFINED SPACE until your supervisor has verified that proper safety precautions have been met. Do not enter a confined space without someone else present on the outside and do not enter a confined space without proper rescue equipment outside the confined space. Every confined space entry has a unique set of hazards, but atmospheric monitoring and proper entrance procedures can minimize the hazards entry personnel typically encounter.

# Operation Instructions

## Description of the Aeration-Mixing System

*r.2011-10-13*

The aeration-mixing system employs a main air header and valved lateral piping system to distribute air throughout the basin. EDI normally designs the aeration system piping to provide uniform air distribution without adjustment to the isolation/throttling valves on the laterals. However, these valves are typically provided for direct control of airflow distribution on large aeration systems or for process control. Airflow distribution will be reviewed at the time of start-up by an EDI field service representative. If process demands dictate a revised airflow distribution pattern, contact EDI for guidance on modification to the system.

### Normal Operation of the Aeration System

The following procedures should be followed on a regular basis to assure consistent and satisfactory performance of the aeration-mixing system.

The air rate to the system may be adjusted to maintain the desired dissolved oxygen levels in the basin. When adjusting the airflow rate, the diffusers should be operated within the normal operating range of the diffuser. Excessive airflow rates will result in high pressure drops across the diffuser and reduced oxygen transfer performance. Low airflow rates may result in incomplete utilization of the diffuser membrane and reduced air distribution.

The aeration-mixing system is designed to provide uniform aeration. Positive dissolved oxygen concentrations should be present throughout the entire system during normal operation. A dissolved oxygen profile analysis may be used to confirm the performance of the aeration system. Typically, the dissolved oxygen levels are measured at the inlet, the outlet, and the midpoint locations of each basin to determine the aeration system performance. In regulating the system airflow to control dissolved oxygen levels, the diffuser units should be operated within their minimum and maximum airflow limits.

In applications where water level variations may exist between aeration basins supplied by a single blower, the isolation valves may need to be adjusted to maintain adequate airflow distribution. This normally requires valving back the air to the basin with the reduced water level. NOTE: It is important to confirm the operating airflow range of the diffuser units before valving back any isolation valve. Damage could result to the aeration diffuser if airflow is above the recommendations noted in the Headloss Calculations. Please consult EDI Engineering Department to confirm operating procedure before adjusting any aeration isolation/throttling valve.

### Normal Operation of the Blower System

The Aeration-Mixing System normally utilizes a centrifugal or positive displacement (PD) blower system consisting of one or more blower units for normal operation plus one on-line spare unit. All blower units including the spare unit must be operated on a regular basis to maintain their proper working condition. EDI recommends that blower units be operated sequentially with idle blower units brought on-line weekly. EDI does not recommend the simultaneous operation of on-line and spare blowers for an extended period. This operating condition may deliver airflows exceeding the air capacity of the diffuser units.

All blower components should be serviced on a regular basis. For additional information concerning proper blower operation, service requirements or service intervals, reference the Blower Operation and Maintenance manual.

### Shutdown Conditions

If air service is interrupted at any time, it should be restored as soon as possible. When restarting positive displacement blower units, the start-up pressure surge should be reduced by down-weighting the pressure relief valve (PRV) or operating the blow-off valve. Once the blower is operational, reset the PRV or slowly close the blow-off valve over a five- to ten-minute period. The PRV must be set properly to prevent overloading of the blower system. Operate manual water purge devices if provided. If the PRV releases air for an extended period of time, the relief setting should be checked.

When diffusers are installed in basins or lagoons and are not going to be in operation for an extended time (4 to 6 weeks), the diffusers should be covered with approximately 4 feet of water.

- In the summer, this protects the diffusers from excessive heat and provides UV protection.
- In winter, EDI recommends that the diffusers be covered with a sufficient amount of water so that if ice forms there is always a minimum liquid clearance that measures approximately 4 feet between the bottom of the formed ice and the diffuser system. This water buffer will keep the ice and its possible damaging effects away from the diffuser system.

Furthermore, the system may be idle or remain active during this period. If the aeration system will be active, operate the system at a minimum air flow so as to avoid movement of ice.

The water level in the basin/lagoon should never be lowered if there is ice present. The weight of the ice or breaking into pieces will invariably cause severe damage to membranes and/or piping.

Slowly starting up the aeration system will aid in the melting of the formed ice. This is to be done with great caution as not to exert any undo forces on piping or equipment that penetrates or is entrapped in the ice surface, and to avoid damage from ice movement as blocks of ice become free to move.

If the basin is to be idle for a prolonged time period, the basin should be drained and cleaned. NOTE: Maintain the minimum airflow to the system during the drain-down procedure. For maximum protection of the aeration system, refill the basin to completely submerge the aeration system. This provides thermal protection in the event of severe cold or hot weather conditions.

Contact EDI for additional operation and maintenance information if it is necessary to decrease the system airflow during cold weather.

### Operation of the Diffuser Unit

The diffuser unit has no moving parts and requires very little maintenance for long-term operation. EDI recommends that the air supply to the diffusers be maintained at all times for optimum performance. The airflow to the diffuser units must be kept within the ranges noted in the Headloss Calculations to maintain the structural and operating characteristics of the diffuser membrane. Continuous application of high airflows, greater than denoted for normal operation, may result in physical damage to the diffuser membrane. NOTE: Use caution when adjusting several lateral throttling valves in the same piping system. This procedure can result in elevated airflows in sections of the basin, exceeding the maximum allowable airflow to each diffuser unit.

## Normal Operation of the Continuous Flow Purge Assembly

*r.2011-10-13*

Condensation will accumulate in the subheader and lateral piping due to the cooling of the air

when it reaches the EDI aeration system. EDI has provided a continuous flow purge assembly to remove this accumulation from the pipe while the system is in operation. This purge assembly is designed to operate on a continual basis thus eliminating the need for manual operation. The condensation in the piping will exit directly through the perforated membrane on the purge assembly. A regulatory orifice is factory installed in the purge assembly to ensure proper flow of the purge (2 scfm or .056 $m^3$/min.). The size of the regulatory orifice is calculated based on the design airflow of the aeration system.

# Preventive Maintenance

## Maintenance Schedule

*r.2011-10-13*

EDI recommends accessing the FlexAir aeration system on a regular basis (annually) to visually inspect the overall system and clean the membranes to remove any accumulated foulants. This activity is beneficial to the Owner, as a reduction in the uniformity of air release or an increase in backpressure will impact the power use. The FlexAir aeration system is designed to allow the system to be accessed by dropping the water level in the basin being serviced. **Note: to prevent solids from entering the system, it is important to keep the air flowing through the system until the water level has dropped below the lateral piping**. The air to the basin being serviced should be turned off after the water has dropped below the lateral piping and diffusers to prevent the possibility of excessive airflows to the units or damage to the blower unit. The following items may be helpful in servicing the FlexAir aeration system during periodic inspections or maintenance procedures:

- Ladder to access the de-watered basin
- Protective gloves and clothing
- Crimping or nipper pliers
- Long-handled soft bristle brush for cleaning assembly for observation
- Spare FlexAir membranes and crimping clamps

### FlexAir Aeration System Inspection

All system components should be inspected for general wear or damage. This includes but is not limited to:

- Pipe supports including anchor bolts, pipe straps and fasteners.
- Pipe connection including fasteners, shifts in alignment of pipes and joints.
- Diffuser assembly including position, membrane integrity, membrane clamps, etc.
- Purge assembly components including all connections, anchor points, and wear at any contact points.

Any worn or damaged components need to be repaired or replaced. Please contact EDI for assistance in identifying a root cause and solution.

### In Situ Cleaning of Membrane

Typically rubber membrane diffuser units will require cleaning because of two common types of surface build-up: biological and inorganic scaling. The recommended cleaning procedures for both types of build-up are detailed below:

Biological build-up is a moss-like growth. The recommended cleaning procedure is to physically dislodge the growth either by gently brushing the substance off with a soft plastic bristle brush or by using low-pressure hosing. Care should be taken not to abrade the membrane surface during the cleaning procedure.

Inorganic scaling is a granular mineral-like precipitate that can form on the membrane surface. If brushing and hosing the diffuser membrane do not remove the scaling, contact EDI for further instructions.

### Membrane Protection

The diffuser membranes should be protected from chemicals that may be harmful to the material. If using a cleaning aid or other substance on or around the membranes, please contact EDI for chemical compatibility.

Good air filtration is required with all FlexAir units. The blower system should be equipped with inlet filters having a performance efficiency of 93% removal of 10-micron particles to prevent clogging of the diffuser membrane. Follow blower manufacturer's recommendations regarding care and maintenance of inlet filters.

# Corrective Maintenance

## Troubleshooting

*r.2011-10-18*

The FlexAir aeration system requires very little maintenance for long-term operation. Periodic visual inspection of the system should allow the Operator to determine if the system is performing at optimum levels. For example, diffuser unit elevation variations greater than the design tolerance (refer to Headloss Calculations) will reduce the uniformity of air distribution in the system. In addition, operating airflows below the design condition will also reduce the uniformity of air distribution. If operating conditions warrant airflow rates below the design condition, contact EDI for additional operational guidelines.

Below are symptoms and procedures to follow if inspection of the aeration system reveals abnormal operating characteristics:

**Large volume of air in localized area.**

Possible Cause:

1) Air leak in aeration piping.
2) Diffuser membrane damaged or missing.

Procedure:

1) Access area in question. Inspect joints for evidence of breakage.
2) Inspect diffuser units for membrane damage. Repair as required.

**Decreased diffuser activity and increased back pressure noted at blower.**

Possible Cause:

1) Diffusers becoming fouled or deformed.
2) Reduced blower discharge air volume.
3) Restriction in air header.

Procedure:

1) Access diffusers and inspect for external or internal fouling or deformation.
2) Confirm blower operating point and rpm reading.
3) Confirm isolation valve position on header and drops.

**Dissolved oxygen profile not satisfactory throughout basin.**

Possible Cause:

1) Increased loading to system.
2) Reduced blower discharge air volume.
3) Improper distribution of air in system.
4) Air leak in system.
5) Excessive foulant accumulated on diffuser.

Procedure:

1) Confirm loading to system.
2) Confirm blower operations.
3) & 4) See items 1 and 2 above.
5) Access diffusers and inspect for external fouling.

## Replacing FlexAir Diffuser Membranes

*r.2011-10-18*

If it becomes necessary to replace rubber membranes, the guidelines below should be followed:

1) Remove the stainless steel (S.S.) crimping clamps. This is easily accomplished by bending back the small tab on the clamp with a crimping tool or screwdriver. The operator should not attempt to snip or cut the ear of the clamp because S.S. material is very strong and excessive force is required to shear the material.

2) Gently pull the rubber membrane off the support to avoid breaking or damaging the support.
3) Gently install new membrane ensuring the non-perforated area is installed centered over the air discharge holes.
4) S.S. crimping clamps should be fully compressed with outside edge of the clamp located 1/4" (6mm) from the edge of the membrane. For EPDM membranes, the ear of clamp shall be placed on top of unit. For PU membranes, the ear of clamp shall be placed 45-degrees from the top of unit.

## Replacing Saddle Mounted Diffuser Assembly

*r.2011-10-18*

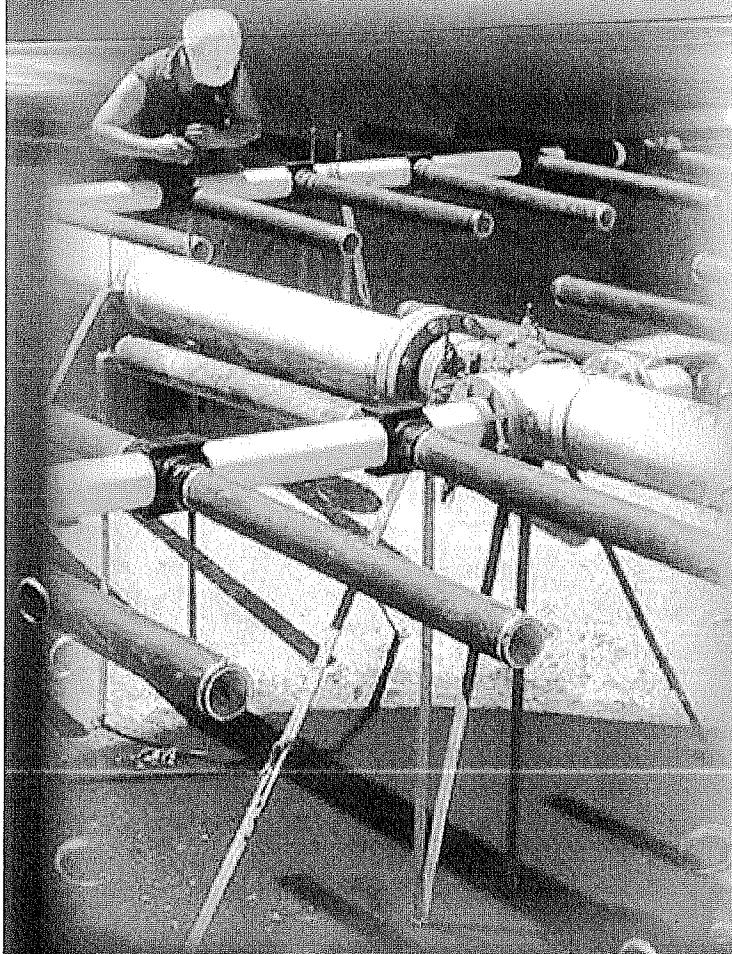
If it becomes necessary to remove an entire diffuser assembly, the general procedures outlined below should be followed:

1) Use a rubber or plastic mallet to remove sliding wedges from the saddle body.
2) Remove the saddle body from the lateral piping. Be careful not to damage the lateral near the predrilled holes. The Spectrum diffuser mount forms a tight seal to the lateral with compressed O-rings. Heavy scratches in the lateral near the O-rings could break the pressure seal.
3) Re-install the diffuser assembly by following the Installation Instructions.
4) NOTE: A properly installed wedge may not be flush with the saddle body due to manufacturing tolerances. Use of a non-rubber mallet may crack or shatter wedge assembly. As the diffuser mount tightens, the diffuser assembly may rotate and it would then become necessary to realign in the original, marked position.

Questions regarding the aeration-mixing system operation, maintenance, etc. should be forwarded to Environmental Dynamics International, 5601 Paris Road, Columbia, Missouri 65202. +1(573)474-9456.

# AerationWorks™

## Global Maintenance & Installation Services



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*"The EDI Aeration Works division provides experts in the installation and maintenance of any aeration system, including supervision and/or the skilled labor pool to perform the actual service"*

- Chuck Tharp, PE
Chairman • Environmental Dynamics Inc.

**Aeration Works maintains special equipment, tools and skilled crews for installation and service on any aeration construction or maintenance project.**

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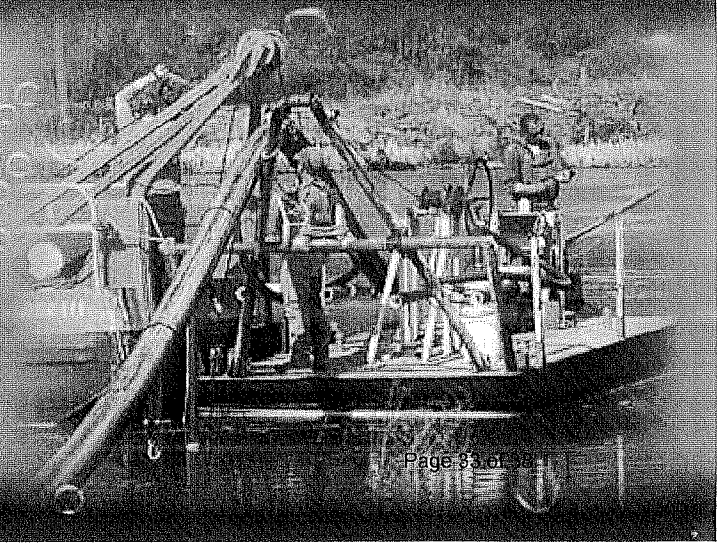

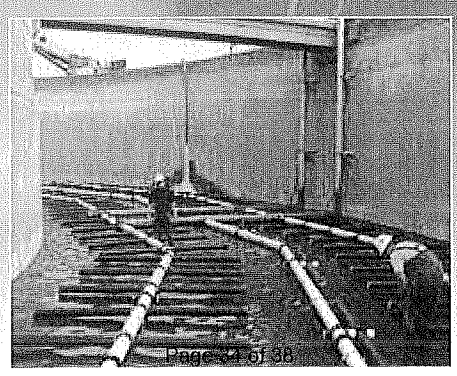

**EDI Aeration Works personnel have the experience and knowledge to handle unique systems and offers a cost effective alternative for installation and maintenance of your aeration system.**

AerationWorks™

Global Maintenance & Installation Services

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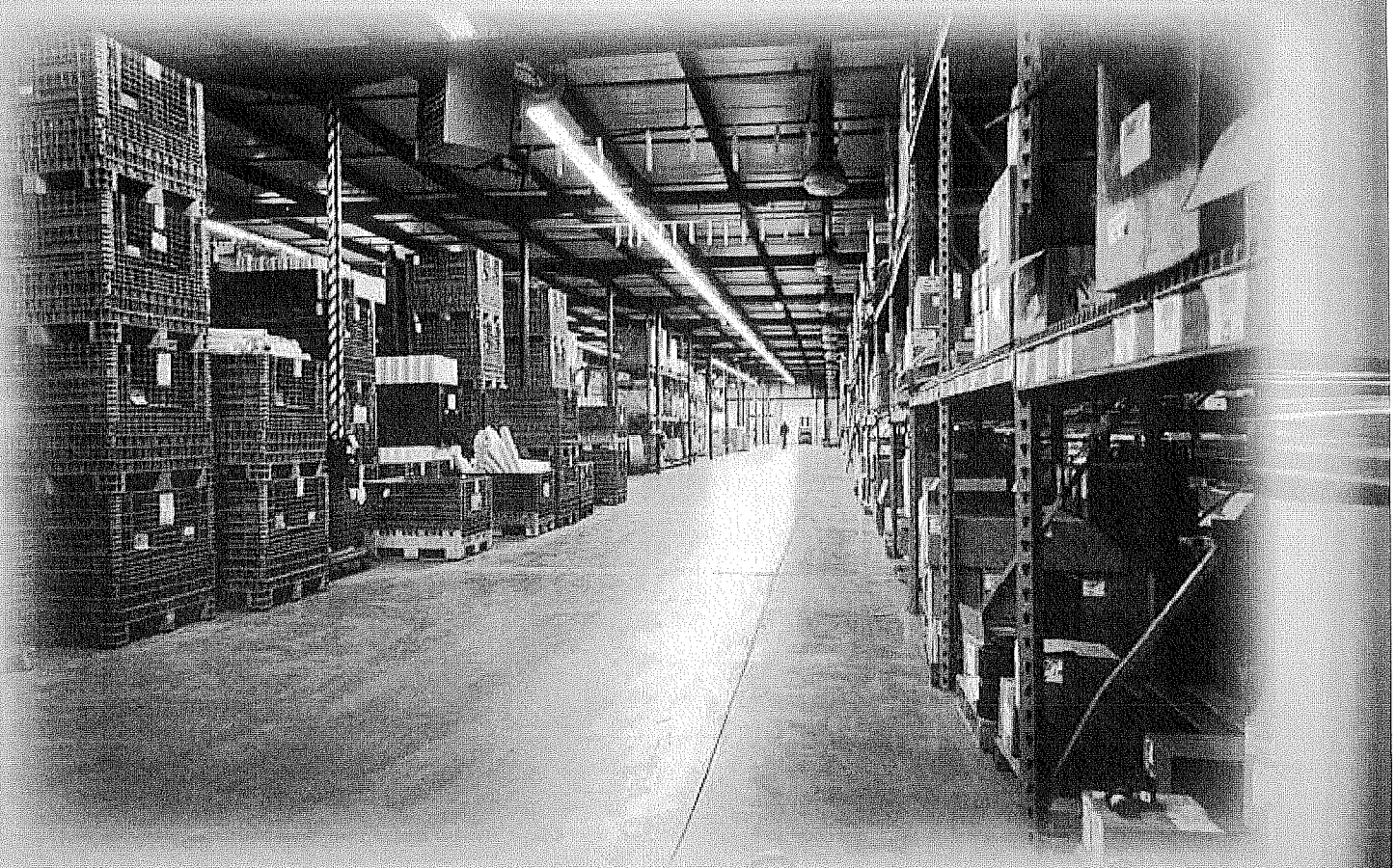
**info@aerationworks.com**

# diffuser express®

**Diffuser Express®** is committed to excellence in supplying diffusers, replacement membranes, and specialty diffuser items across all brands for new and existing water and wastewater treatment applications.

Diffuser Express offers replacement parts for nearly all types of disc, tube, and panel diffusers for most manufacturer's. Significant resources have been invested in developing and engineering diffuser membrane compounds and products to fit every need. The advanced technology required to produce premium quality membranes incorporated in all EDI diffusers is the result of years of intensive investment, research, engineering, and product refinement. In developing and controlling the total membrane product from compounding through extrusion and perforation, EDI and Diffuser Express (DX) are able to offer high efficiency products that require less energy to operate and last longer in the field, which results in reduced operation and maintenance costs.

Diffuser Express delivers a stream of technology advances using EDI's quality products with "express" service and competitive pricing. - Randall C. Chann, President/CEO - EDI



Diffuser Express offers a warehouse of disc, tube, and panel diffuser products to meet the needs of your specific application. EDI diffusers employ the latest technology available in membrane diffusers. These diffusers are designed for use in new installations or as replacements for existing systems. Conversion kits are available for upgrading your system from coarse bubble to fine bubble and from ceramic to more efficient flexible membranes. Specialty items include diffuser mounting options, stainless steel membrane clamps, crimping tools, as well as many other commodity items and accessories.

Diffuser Express is committed to providing quality products with superior customer service. Visit our website at www.diffuserexpress.com to view an existing catlaog or make your purchase online. Contact Diffuser Express at 573-474-9456 to incorporate our quality products into your treatment application.

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Columbia, MO 65202 • USA

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# Environmental Dynamics International

# Service Department

## Quality In-House & On-Site Customer Service

EDI provides Field & Customer Service directly from its worldwide headquarters located in Columbia, Missouri, while maintaining Authorized Field Service offices around the globe.

**Services may include visits made by an Authorized EDI Service Representative to a project site and may provide any or all of the following:**

Train on-site personnel in the proper installation and assembly of all EDI equipment.

Inspect installation to provide verification of general conformance to EDI specifications and requirements.

Provide startup services to ensure that the equipment is operating satisfactorily after installation.

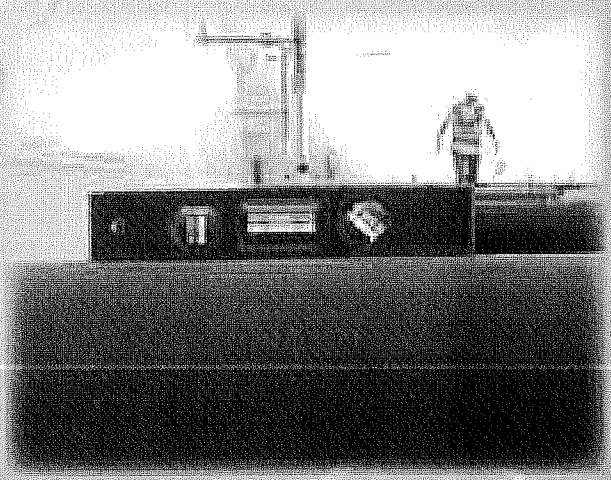
Train plant Owners/Operators in long term operation and maintenance procedures for the EDI equipment that has been installed.

Provide troubleshooting investigation or inspection when requested by the customer, with regards to EDI equipment installation

In addition to the highest quality products and services, EDI is pleased to offer superior Customer & Field Services. EDI strives to provide these services in the most convenient and cost effective manner to ensure the greatest benefit to its customers. EDI is able to provide these services directly with its Service personnel located within the EDI Headquarters in Columbia, Missouri, as well as maintaining localized Authorized Field Services offices Worldwide.

EDI highly recommends the purchase of field service with any EDI system purchase.

***Our experience has shown that an inspection provided by an Authorized EDI Field Service Representative can eliminate potential costs incurred by the customer from failures due to preventable installation errors.***



In order to allow reasonable scheduling and to ensure an EDI representative is available, at least a three week notice is needed when requesting service.

Should you have any questions regarding EDI Field Services or if you would like to request a quote, please feel free to contact the EDI Service Manager, Ms. April Heywood at 573-474-9456. As always, EDI provides telephone and email support at any time at no additional charge.

Environmental Dynamics International

**Service Department**

5601 Paris Road • Columbia, MO 65202 • USA

+1 877.EDI.AIR8 (334-2478)

service@wastewater.com

www.Wastewater.com

# EDI Aeration/Mixing Equipment Installation, Operation, & Maintenance Manual

For:

# Fixed Grid System with PVC MaxAir™ Diffusers

**Environmental Dynamics International**
5601 Paris Road
Columbia, MO 65202
PH: 573.474.9456
FAX: 573.474.6988

Revised: February 3, 2012

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PRODUCT SPECIFICATION SHEET

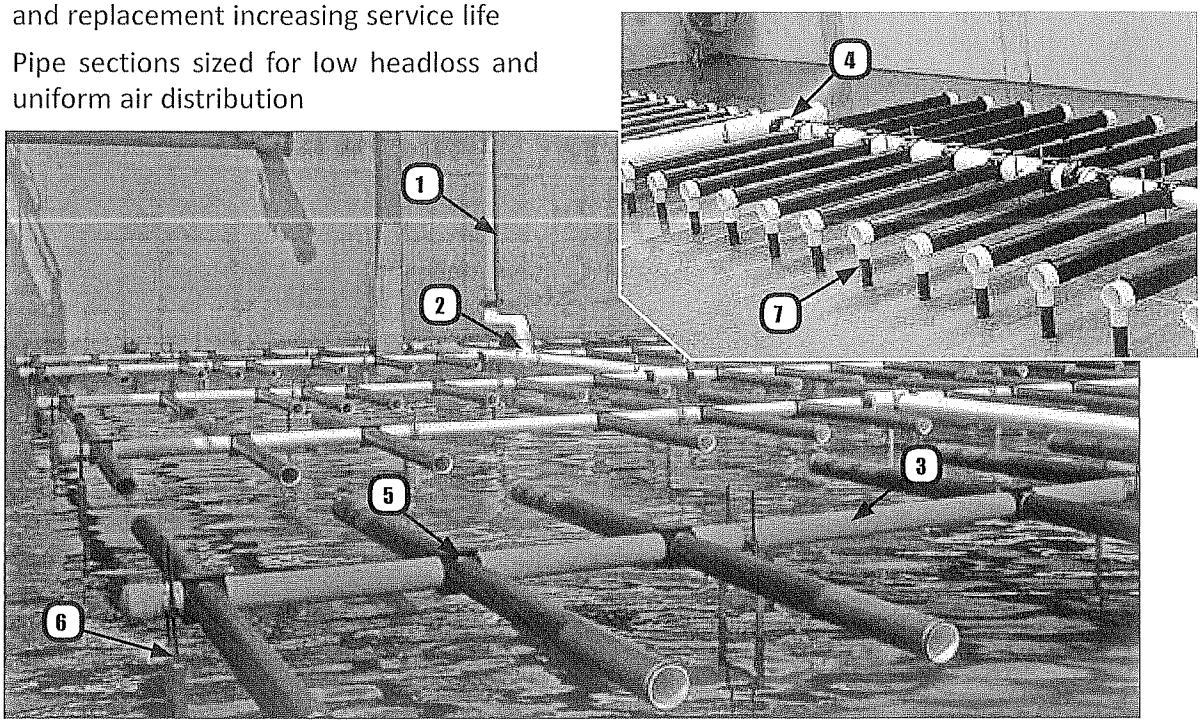
# Fixed Grid Piping System

## with EDI Tube and Panel Diffuser

### Engineered Components Designed for Unmatched System Reliability and Operating Performance

- Permanently anchored to reactor floor; stainless steel supports standard
- Accommodates variable water level applications
- Stainless steel drop pipe and rigid PVC header and lateral standard for maximum value; alternate materials (ABS, CPVC, and Stainless Steel) and wall thicknesses available for heat, chemical resistance, or when maximum durability is desired
- Factory manufactured components with fixed mechanical connections for ease of installation
- Uses no slip joints that are subject to wear and replacement increasing service life
- Pipe sections sized for low headloss and uniform air distribution
- No size constraint on drops and headers, 3" thru 8" and 90 mm thru 160 mm for distribution laterals
- Available with all EDI tubular and panel diffusers

1. Drop Pipe
2. Header Section
3. Air Distribution Laterals
4. Field Joint; Solvent Welded Coupling or Flange Connection
5. Air Distribution Orifice
6. Adjustable Pipe Support
7. Adjustable Diffuser Support (optional)



# PRODUCT SPECIFICATION SHEET

EDI Fixed Grid Piping Systems are ideal for conventional tank applications where access to the reactor for installation and system maintenance is available. The system is engineered for maximum long term economic value and reliability, and is based on design methodologies and system components specifically developed to meet customers needs and customized for each application. The foundational principles used to design each system include the following:

The airflow requirement for each pipe section is evaluated and the appropriate pipe size is selected for low headloss. This helps ensure uniform air release between diffusers and a low system operating pressure. There is no size limit on drop and header sections. Distribution laterals are available from 3" to 8" and 90 mm to 160 mm.

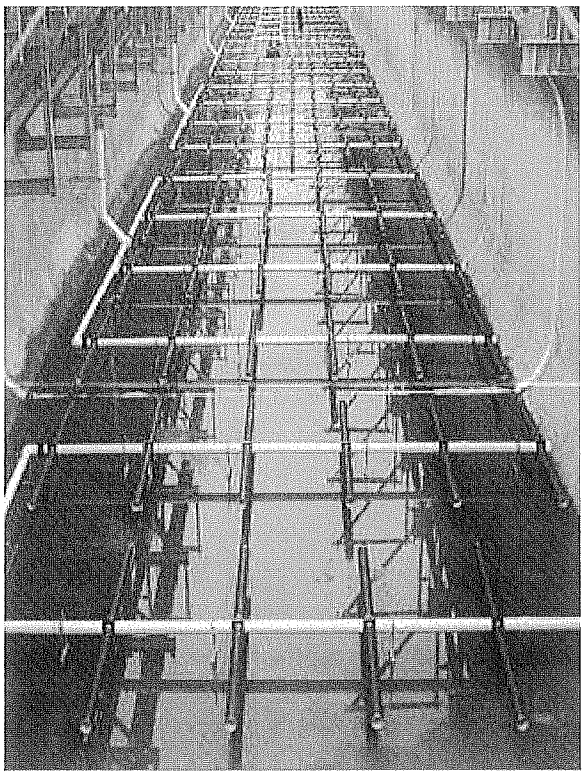
The material of construction is reviewed. Rigid PVC is most common and offers high value for most applications. Alternate materials including ABS, CPVC, Stainless Steel, and thicker wall sections are available to match specific application requirements.

Third, pipe supports are applied based on the mechanical strength of the selected piping components. Pipe supports are designed to allow unrestricted movement due to thermal expansion. This design philosophy allows fixed joints to be used throughout the system. This eliminates maintenance issues common with slip joints. Supports also restrain axial rotation. This is important for tube systems were torsional loads are possible. Spacing for supports is based on the deflection criteria and structural capabilities of the pipe section at worse case field conditions. Supports are typically fabricated of stainless steel. Where extreme external loads are anticipated or alternate materials of constuction are desired, the optional SuperStrut™ diffuser support is available.

All pipe sections are evaluated for condensate collection and purge requirements. Systems will feature either a self-purging device that is integral to the aeration grid or manual purge at the top of the drop pipe.

EDI Tube Diffuser Fixed Grid Piping Systems feature the FlexAir® Magnum™, and MiniPanel™ diffuser for energy efficiency and low maintenance. The MaxAir™, coarse bubble diffuser option is also available when energy efficiency is not a significant concern.

For additional information on an EDI Fixed Grid Piping System with tube or panel options, or any EDI product, visit our website: www.wastewater.com or contact a local EDI representative.



**Environmental Dynamics International**
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For Parts Information:
*parts@wastewater.com*
www.diffuserexpress.com

For System Information:
*systems@wastewater.com*
www.wastewater.com

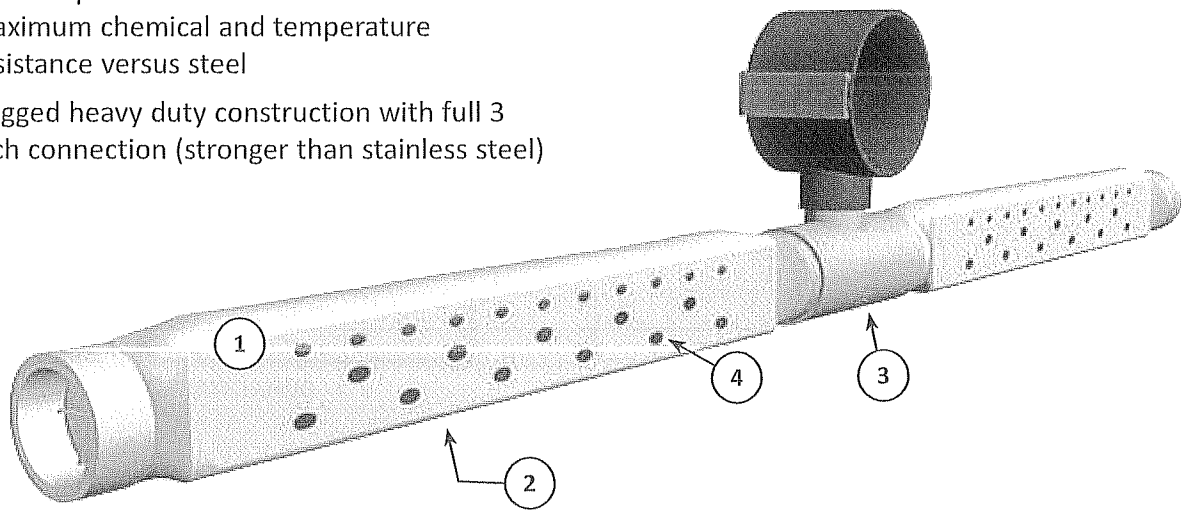
PRODUCT SPECIFICATION SHEET

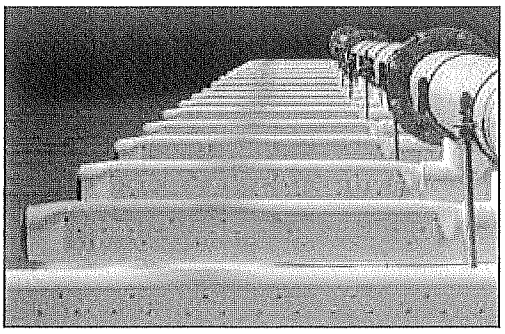
# EDI MaxAir™ PVC Diffuser

## with Spectrum™ Saddle Mount

**MaxAir coarse bubble diffuser offers proven design and is ideal for both mixing and aeration applications**

- Inverted air chamber design for uniform air release over a wide airflow range
- Full 48 inch air release perimeter
- High airflow capacity
- Available in 24 inch length
- Clog resistant self-purge design
- Standard open bottom and optional deflector bottom designs available
- PVC or optional CPVC construction for maximum chemical and temperature resistance versus steel
- Rugged heavy duty construction with full 3 inch connection (stronger than stainless steel)
- Patented Spectrum™ diffuser mount for maximum strength and ease of installation on any pipe material
- Spectrum diffuser mount available for 3 to 8 inch pipe (110 mm & 160 mm also available)
- Simplex or duplex configuration
- Standard sizes IN STOCK for immediate shipment



1. Diffuser Body
2. Standard Open Bottom
3. Full 3 inch Diameter Mount
4. Multi-Level Air Metering Orifices

# PRODUCT SPECIFICATION SHEET

EDI MaxAir™ diffuser provides broad band, coarse bubble aeration for maximum mixing efficiency. The unit is available in 24 inch standard length. The 24 inch diffuser unit provides a full 48 inch air release perimeter. Air release uniformity and mixing efficiency features multi-level air metering orifice design. This provides full utilization over the entire operating range of the unit.

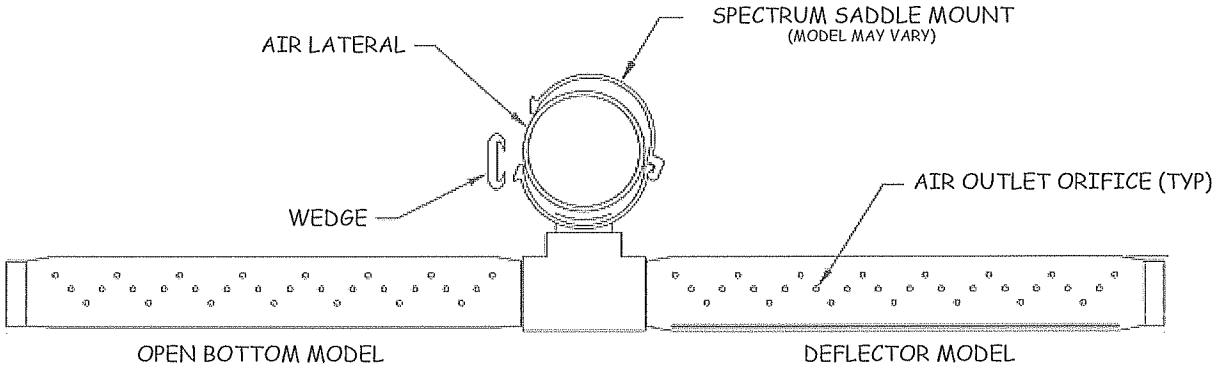
MaxAir diffusers are ideal for the most demanding aeration and mixing applications including flow equalization, channel aeration, aerobic digesters, industrial, and mixing and scouring applications including RBC, MBR, IFAS, and MBBR.

Air distribution is achieved with fixed orifices positioned on three levels. As the air flow to the diffuser increases, the number of active orifices increases thereby minimizing the pressure required for increased airflow.

The standard unit features an open bottom The diffuser may be operated under a wide range of applications including intermittent applications. Optional deflector bottom design provides a mechanism to preclude entry of large particles into the diffuser and piping components.

The MaxAir diffuser is designed for long service life. All components are PVC or optional high temperature CVPC. Diffuser body attaches to air piping using a Spectrum Diffuser Mount with full 3-inch connection.

MaxAir diffusers feature the patented Spectrum™ Diffuser Mount. This unique mounting system clamps to the outside surface of the air supply pipe and may be installed on any pipe material. Saddle mounts are available from 3 inch through 8 inch pipe sizes, plus 110 mm and 160 mm metric sizes.




| Diffuser Type | Design Airflow | | Diffuser Length | | Orifice Size | | Dry Weight | | Net Operating Buoyancy | |
|---|---|---|---|---|---|---|---|---|---|---|
| | scfm | $m^3_N/h$ | in | mm | $ft^2$ | $m^2$ | lb | kg | lb | kg |
| Simplex | 0-50 | 0-79 | 32.0 | 813 | Orifice engineered appropriately for each project. | | 6.0 | 2.7 | 11 | 4.9 |
| Duplex | 0-100 | 0-158 | 64.0 | 1630 | | | 11 | 5.0 | 17 | 7.7 |

- Optimum oxygen transfer efficiency is achieved when operating in the middle to low end of the airflow range. The approximate operating pressure of the diffuser at the mid-range is 2-4 inches (0.5-1.0 kPa).

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For System Information:
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www.wastewater.com

# Storage Instructions

## Receiving Inspection

(FOB EDI only) Shipments shall be inspected for damage upon receipt. The recipient/receiver is responsible for all damages. EDI offers to act on behalf of the recipient / receiver in filing a claim for damage incurred during shipment. To file a claim against the freight company, a damage report must be submitted to EDI within 24 hours of delivery.

(FOB Jobsite only) Shipments shall be inspected for damage upon receipt. Any damages observed upon receipt must be reported to EDI within 24 hours of delivery. EDI will repair or replace damaged goods when notified within this notification period.

(Ex-Works only) Shipments shall be inspected for damage upon receipt. The recipient/receiver is responsible for all damages. To file a claim against the freight company, file a damage report directly with the shipping company.

A full inventory of shipped components shall be completed within 14 days of the receipt of shipment. Any deficiencies in the shipment that are clearly deemed to be the result of EDI will be reconciled by EDI when notified within this time period.

## Pre-Installation Storage Requirements for Plastic Piping

PVC, CPVC and ABS piping components may be stored outdoors provided the ambient air temperature is below 140°F (60°C).

Pipe sections are furnished with end caps to minimize the entry of foreign materials (dirt, debris, etc.) into the pipe. Any foreign materials that are allowed to contaminate the pipe will need to be removed from the system prior to installation and start-up.

Piping shall be stored on a flat surface to avoid damaging the pipe sections.

If the pipe components are to be stored for more than 6 months, pipe sections are to be shaded from sunlight.

Accessories such as pipe supports, fasteners, etc., packaged in original boxes are to be protected from excessive moisture and rain. Outdoor storage is acceptable provided the ambient air temperature is below 140°F (60°C).

Small items should be stored in a secure location to avoid misplacement and theft.

## Pre-Installation Storage Requirements for a Coarse Bubble System

Components may be stored outdoors provided the ambient air temperature is below 140°F (60°C).

## Post-Installation Storage Requirements for a Coarse Bubble System

When the reactor is drained and the aeration system is exposed for a short period of time (less than 6 months), the system shall be protected from foreign objects including but not limited to paint or weld splatter, falling objects, etc.

- If the ambient air temperature is above 140°F (60°C), the system should be shaded to protect the system from UV light and excessive heat. A gray fabric tarp is recommended to shade the aeration components. The gray fabric tarp is to be suspended above the aeration system by approximately 6" (150 mm) to prevent damage to the system.
- **Note: Do not use any form of plastic to cover the aeration components. Plastic can create a hotter environment and/or fuse to the surface of the diffusers.**

When the aeration system is to be idle for an extended period time (greater than 6 months), the system should be submerged in approximately 4 feet of clean water provided the ambient air temperature is greater than 32°F (0°C).

- If the ambient air temperature is below 32°F (0°C), the water level may need to be increased so that the ice layer does not contact the aeration system.
- When reactivating a system where ice exists, operate the system at a minimum airflow to avoid movement of ice and maintain this airflow condition until the ice is no longer present.
- The water level should never be lowered if ice is present. The weight of the ice may damage the system.

When the aeration system is to be idle for an extended period time (greater than 6 months) and the units are going to be removed and stored, then the following storage conditions would apply.

- If the ambient air temperature is going to be less than 100°F (40°C), then a fabric tarp is recommended to cover the equipment.
- If the ambient air temperature exceeds 100°F (40°C), then the equipment shall be shaded or stored indoors in which the ambient air temperature does not exceed 125°F (52°C).

# Installation Instructions

## Air Piping Installation

The Contractor is to confirm that the air piping is clean during fabrication of laterals and should swab out any debris found in the pipe **before** installing the diffuser units. Dirt and debris may clog the diffuser unit requiring an extended start-up procedure and **MAY** require the Contractor to remove and replace diffuser unit at Contractor's expense. If piping requires further cleaning before diffuser installation, Contractor may elect to perform water flush or air purge procedures described at the conclusion of this section. **NOTE**: If this procedure is performed, do so before installing the diffusers.

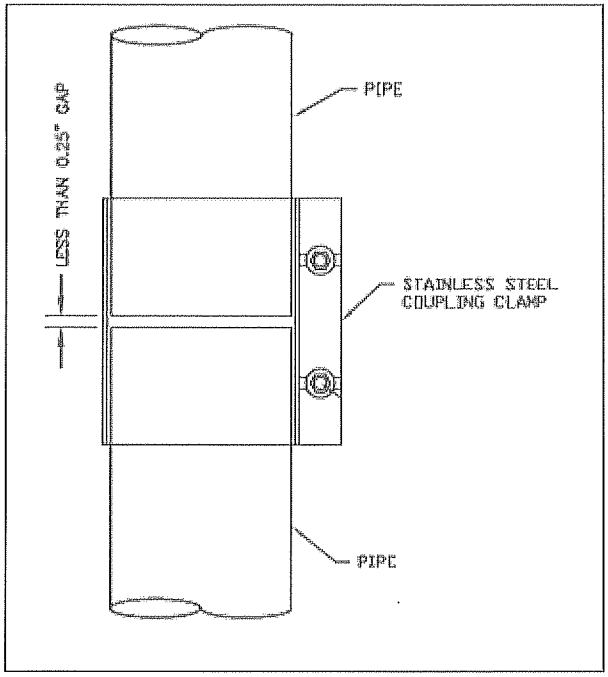
Transition from the drop pipe to the air lateral piping is made by a stainless steel coupling clamp provided by EDI. The aeration system typically features a drop stub designed to be field cut to length and solvent welded to the air laterals by Contractor. The pipes must be aligned vertically prior to installing the coupling clamp or the clamp may leak. The clamp has limited ability to seal misaligned piping. Also, the gap between the drop pipe and drop stub shall be less than 0.25"(6.5 mm) to ensure proper sealing of the coupling clamp.

Assemble the aeration piping per the EDI layout drawing. Start with the drop pipe section to ensure proper drop pipe alignment. Pipe supports should be partially assembled with the bottom pipe strap, then placed under the drop pipe section for support. Pipe support assembly instructions are in the following section. See the EDI layout drawing for pipe support locations. Do not install the anchor bolts until the final alignment is established for the complete aeration grid. The remaining air lateral piping shall be installed using this same method. All piping segments will be labeled with a sequence number that indicates that segment's position in the lateral run. Additionally, EDI will provide an arrow on the lateral piping. This arrow indicates the direction of airflow in the lateral segment. All arrows should point away from the header toward the lateral end at final installation.

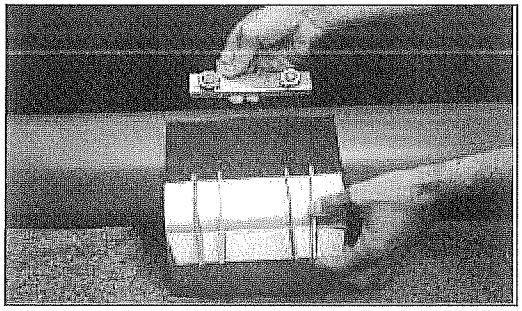
## Stainless Steel Coupling Clamp Installation

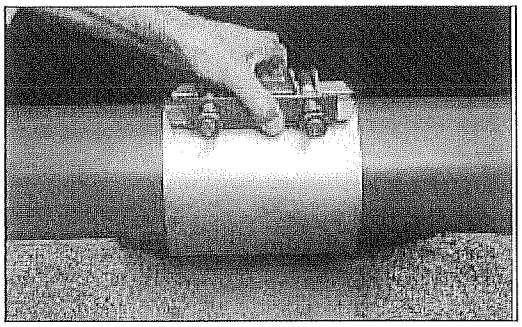
The stainless steel coupling clamp is provided by EDI to make the proper transition between two sections of pipe.

1) Make sure the pipe is clean. Remove any dirt or debris that would interfere with the complete sealing of the gasket around the pipe. Lubricate both the pipe and clamp gasket with soapy water. Do not use oil base pipe lubricant.
2) Ensure that the pipes are properly aligned prior to installing the clamp or the clamp may leak. If the clamp is to be installed on vertical pipe the pipes must be aligned vertically before installing the clamp. The clamp has limited ability to seal misaligned piping. Also, the gap between the two pipes shall be less than 0.25"(6.5 mm) to ensure proper sealing of the coupling clamp.

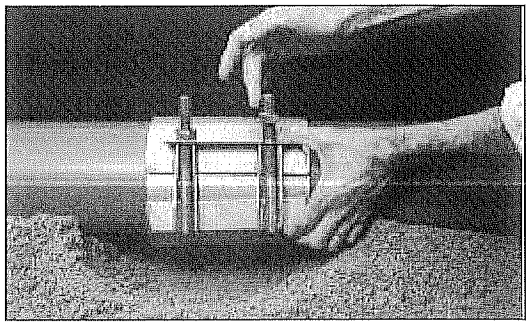



3) Place a reference mark on the pipe at a measured distance from the center of the pipe ends. This presents a visual mark to center the coupling clamp over the pipe transition.
4) Center the clamp over the two pipes. Loosen nuts to top of studs and wrap clamp around the pipe snapping the washer plate over the receiver bar.

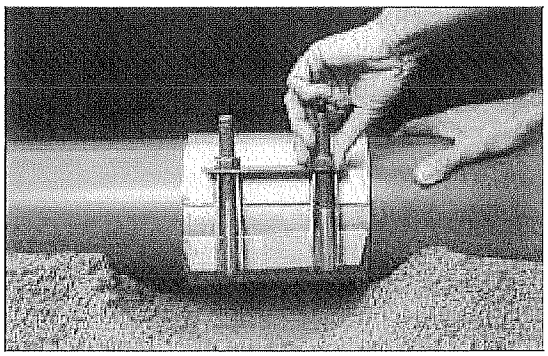


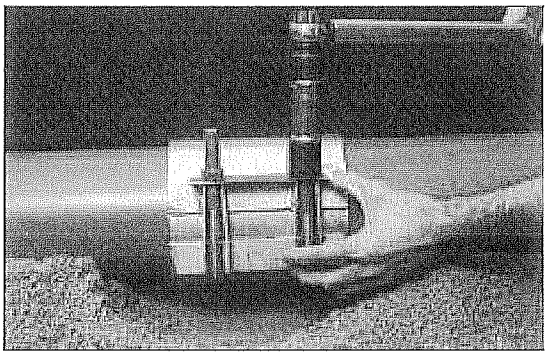


5) Squeeze the clamp together, finger tighten the nuts down, and rotate clamp toward the threaded end of the studs to smooth out the gasket.



6) Torque nuts sufficiently to stop leaks. Recommended torque is 70 ft. lbs. for 2" through 8" coupling clamps and 85 ft. lbs. for 10" – 12" coupling clamps. Correct torque indicated by slight deformation of washer plate and nylon washers. Caution! Thin Wall Pipes may require less torque and may deform if over tightened.





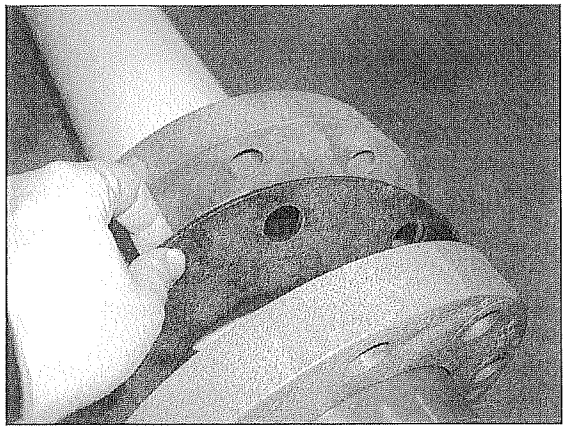
### Van Stone Flange Installation

Lateral piping is connected with Van Stone flanges and supported by partially assembled pipe supports.

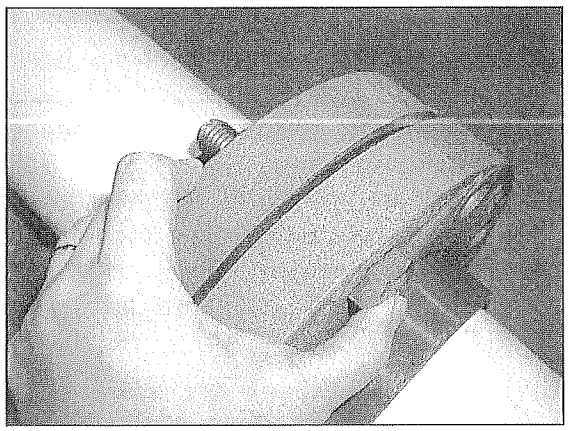
Gaskets and stainless steel fasteners are provided by EDI for flanged connections. Recommended bolt-tightening torques are indicated in torque table on Flange Installation Detail Drawing.

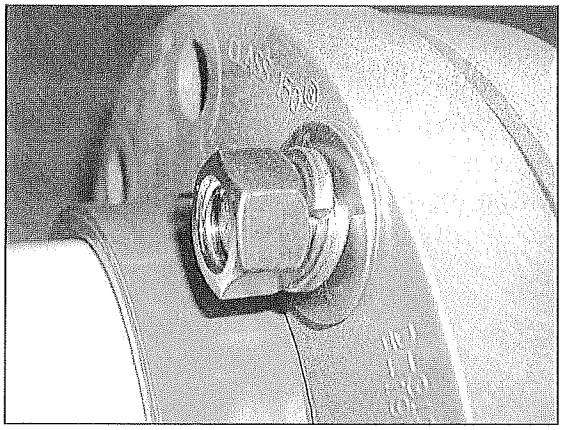
An industrial grade anti-seize lubricant MUST be used on stainless steel bolt threads to prevent galling. Contractor will be responsible for replacement of all damaged items resulting from not using anti-seize lubricant.

1) Lay out sections of pipe to be joined in order, making sure orifices are in correct orientation to install diffusers as shown on layout drawing. EDI provides flow arrows and labels on pipe corresponding to labels on layout drawing.
2) Rotate loose ring of flange to align the bolt holes with gasket and mating flange to be connected.

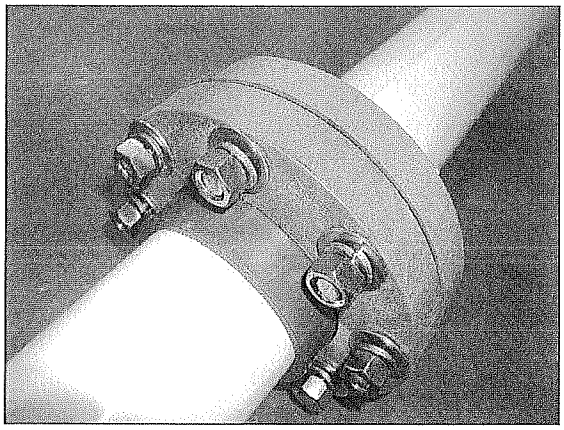


3) Place S.S. bolt through bolt hole in first flange, gasket, and hole in second flange. Place flat washer onto bolt, then lockwasher, then thread S.S. nut LOOSELY onto bolt to complete bolt assembly (do not tighten at this time).





4) Repeat for remaining bolt assemblies around flange.



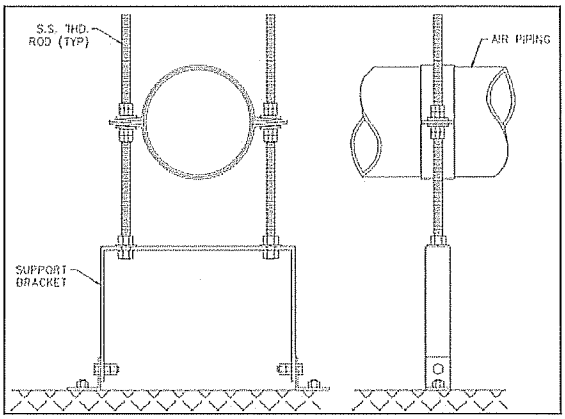
5) When all bolt assemblies have been correctly positioned, tighten nuts according to torque table on Flange Installation Detail Drawing. Bolt assemblies MUST be tightened in the torque sequence shown on Flange Installation Detail Drawing. For best results, tighten in 5-ft.lb. (6.8 N-m) increments.

6) As lateral sections are assembled, maintain correct alignment of the air outlets on the lateral so that diffusers will be level when installed.

If the specifications require the system to be pressure or leak tested, all openings are to be plugged before the system is tested. EDI recommends not exceeding 10 psi (69 kPa) during pressure or leak testing.

## Rigid & Simple Pipe Support Installation Instructions

Air laterals are anchored to the basin floor by stainless steel (SS) pipe support assemblies. Depending on project specific forces and/or turbulence anticipated in the basin, EDI may include additional support features. Please review all details shown in the EDI construction drawings to ensure all features are properly installed.

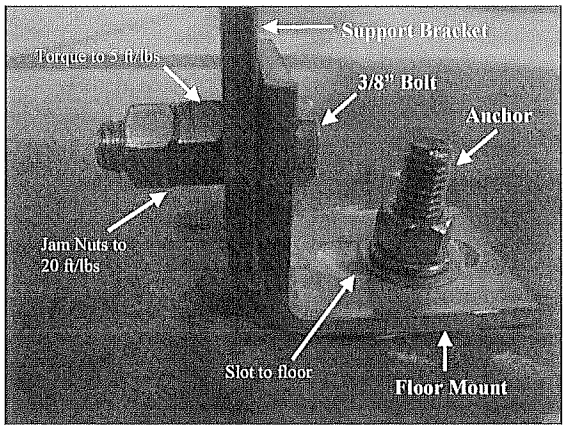



**Note: A simple support is shown above. A rigid support is a simple support plus secondary stabilizer legs to prevent pivoting. See EDI layout drawings for rigid support locations.**

To maintain proper clearance for the diffuser mount, EDI recommends a minimum distance of four inches between any outlet hole and a pipe strap. When a support must be relocated due to the support clearance indicated, shorten rather than lengthen the support spacing. See EDI layout drawing for proper pipe support spacing and locations.

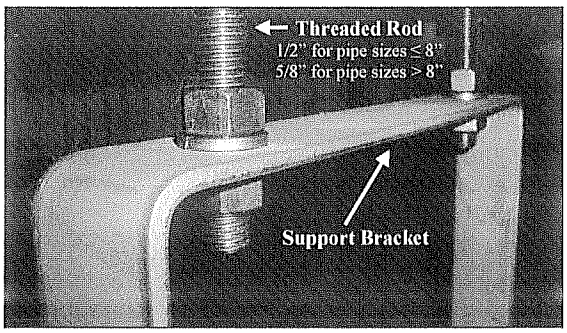
1) Connect floor mount to support bracket with one SS bolt and double SS nuts (see following photo). The

slotted side of the floor mount is against the floor when properly assembled. Rest the double nuts against the support bracket and lock against each other. Torque values must be adhered to unless specified otherwise. Floor mount must allow pivoting of the support. Repeat for other leg of pipe support.




| Required Bolt/Nut Torque Values | |
|---|---|
| Bolt Sizes | Torque |
| 3/8 in.(9.5 mm) | 20 ft-lb (27 N-m) |
| 1/2 in. (13 mm) | 45 ft-lb (61 N-m) |
| 5/8 in. (16 mm) | 90 ft-lb (122 N-m) |

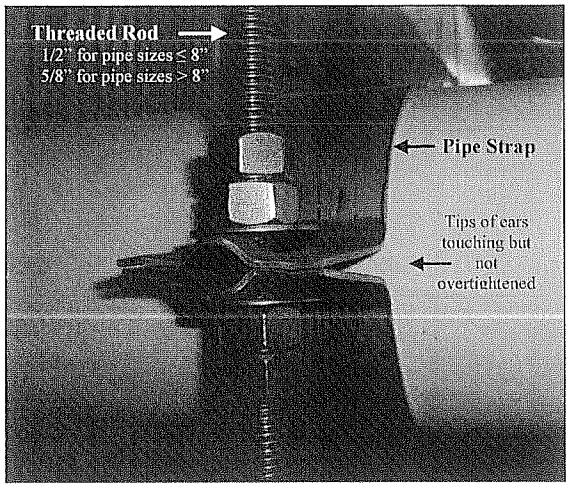
2) In the following order, place one nut and one lock washer onto threaded rod approximately 1" (25.4mm) from bottom. Thread bottom nut to secure rod. Repeat for second S.S. threaded rod (see following photo).




3) Place two SS nuts followed by one SS flat washer on the upper end of both SS threaded rods. Then place the bottom SS pipe strap onto the threaded rods.

4) Set the air piping on the bottom pipe strap and adjust the vertical height to the elevation indicated on EDI layout drawing. Sufficient amounts of threaded rod are provided on pipe supports to adjust the elevation of the piping. Pipe supports incorporate a ± 2" (51 mm) allowance for variations in the basin floor.

5) Place the top SS pipe strap onto threaded rods around the air piping. Install one SS flat washer followed by two SS nuts to upper end of rod over the top pipe strap.



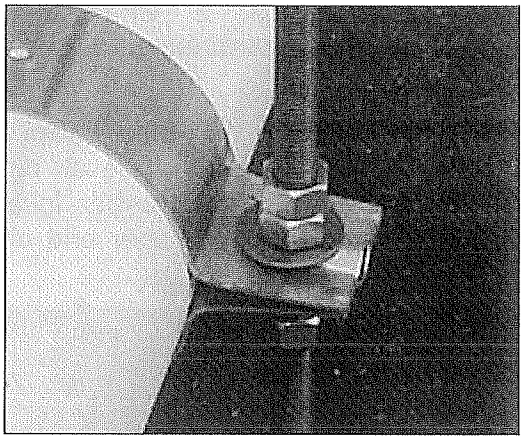

6) **Pipe straps shall be tightened until the ends of the straps touch (see photo above).** Equally tighten both sides until the tips of the upper and lower pipe straps touch on both sides. The straps must be aligned when tightened. Misalignment of the straps will hinder proper operation of the strap through the full range of motion the straps are designed to provide. It takes less than 1ft-lb to

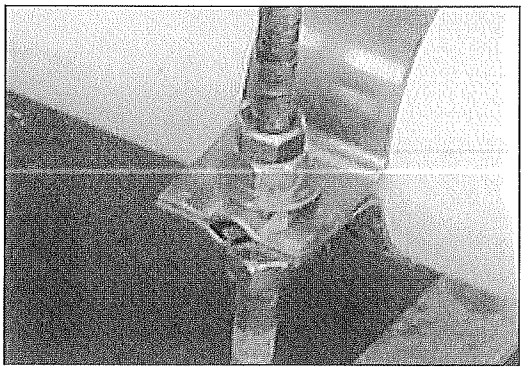
reach this position. Care should be taken to not over tighten the straps, as this can cause irreversible damage.

7) Thread the jam nut down to the first hex nut.

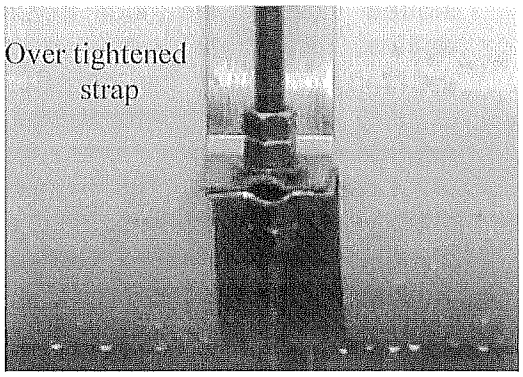
8) While securing the first hex nut, jam the second nut to the proper torque value indicated on the table above.

Example of properly tightened straps:

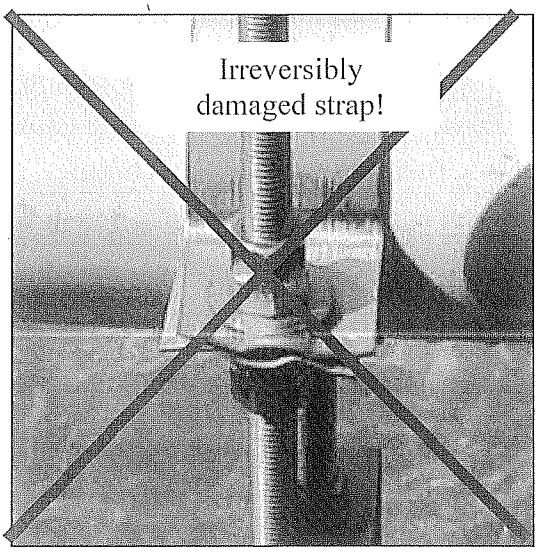




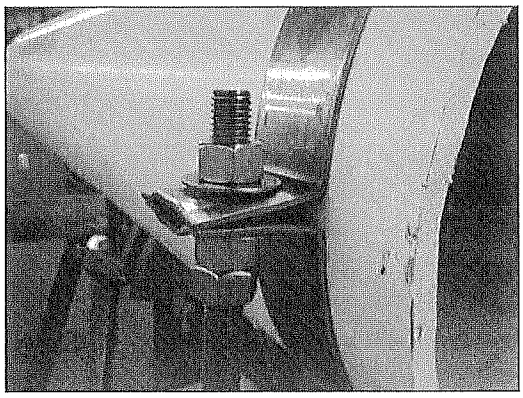
In the photo below, the hex nut must be loosened until the ends of the strap are just touching and aligned.



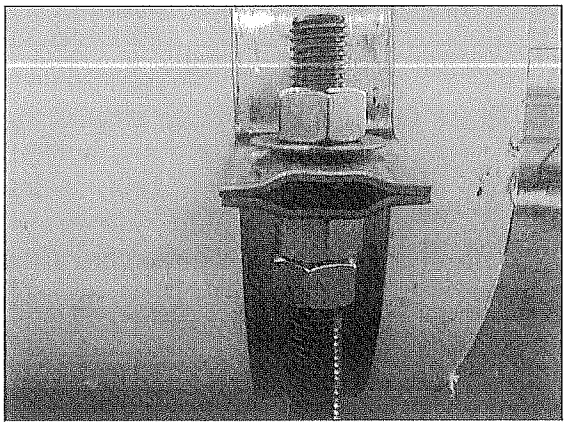

Warning! If the strap ends do not return to their original shape when the hex nut is loosened then the straps must be replaced. Bending the ends of the strap down is not an acceptable repair as this condition is an indication that the center of the strap has been crushed.




9) On pipe diameters greater than 8" the pipe strap design is different and the following instructions apply for proper installation.



10) **Pipe straps shall be tightened until the ends of the straps touch (see photos below).** Equally tighten both sides until the tips of the upper and lower pipe straps touch on both sides. The straps must be aligned when tightened. Misalignment of the straps will hinder proper operation of the strap through the full range of motion the straps are designed to provide. Care should be taken to not over tighten the straps, as this can deform both the strap and the pipe. Deforming the pipe places high stress levels on the pipe and which can result in premature pipe failure



11) Thread the jam nut down to the first hex nut.

12) While securing the first hex nut jam the second nut to the proper torque value indicated on the table above.

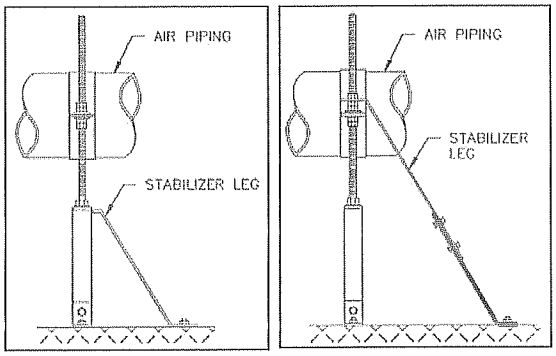
13) Assembled pipe supports MUST be vertical.

14) When each of the above steps has been completed, each floor mount must be secured to the basin floor by an anchor bolt, 3/8" flat washer, lock washer, and nut. Note: When installing anchors, drill the hole perpendicular to the work surface. To assure full holding power, do not ream the hole or allow the drill to wobble. Then clean the hole to ensure proper performance.

### Rigid Stabilizer Legs

Rigid stabilizer legs are featured on all fixed grid aeration systems anchored to the basin floor. Rigid stabilizer legs are utilized to prevent rotation and established a fixed point for downstream expansion and contraction. Each rigid support identified on the EDI layout drawings will feature **two stabilizer legs per support** (one on each threaded rod).

Rigid stabilizer legs may be connected at the support bracket or at the pipe strap (see both examples below) depending on the calculated thrust for each specific project. See EDI detail drawings for specific stabilizer arrangement and assembly instructions.



**Note: Rigid stabilizer legs shall be positioned upstream of the support so they are in tension as the piping grid expands forward.**

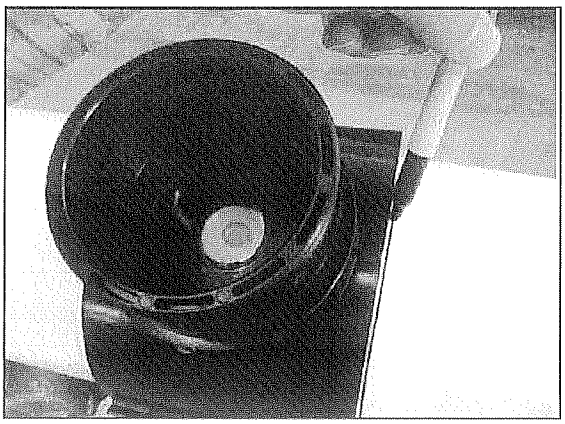
## Leveling of Air Piping

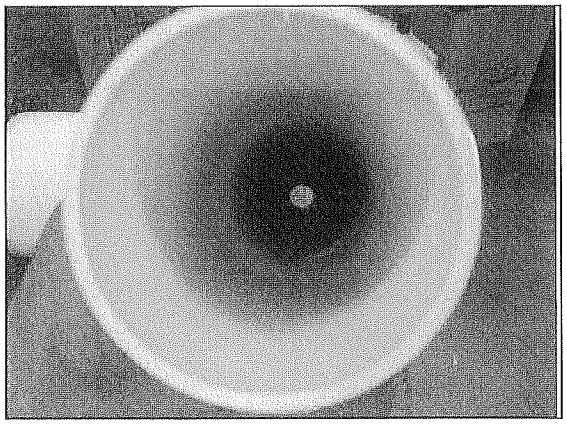
Air distribution through the aeration system is a function of the relative elevation of the individual aeration units and the leveling tolerance of the air supply piping. As a guideline, EDI recommends that air piping not vary in elevation by more than 1/2" (13mm). Excessive variation in pipe elevation may result in poor air distribution during normal operation.

## Installation Instructions for SDM Saddle Drain Leg

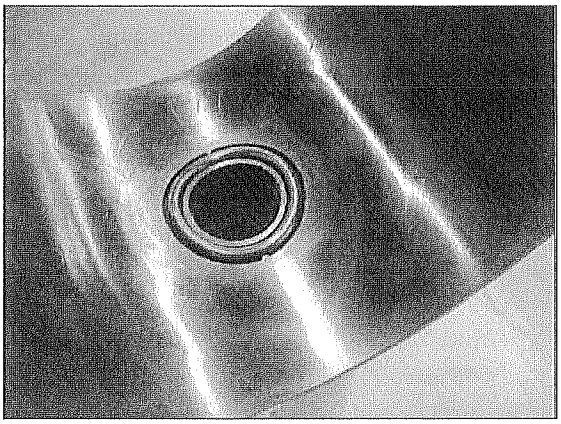
To prevent damage during shipment, EDI provides the SDM saddle Drain Leg for field mounting. The drain leg is factory-mounted on half of a SDM saddle. Other materials/tools required for installation include: SDM blank saddle, two locking wedges, o-ring and rubber mallet.

The lateral piping has the outlet drain hole predrilled at the factory. Pipe surface must be smooth, clean, and free of all grease and dirt.

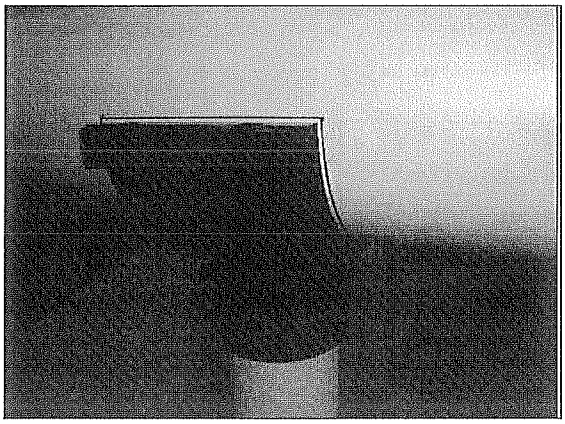




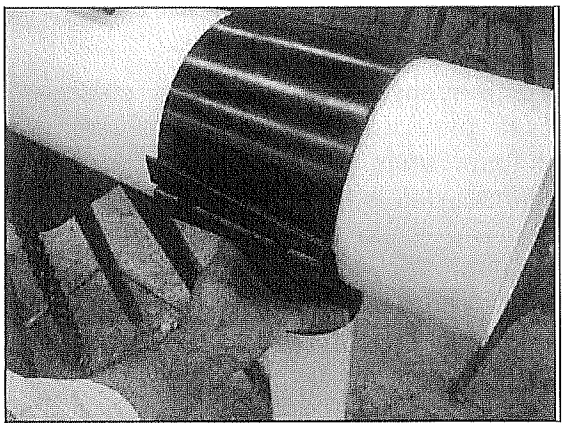
1) The position of the drain leg on the lateral piping is to be marked using an EDI alignment saddle (provided) or the drain leg itself. Place the outlet hole of the saddle centered on the drilled outlet hole in the lateral and mark the lateral around all edges of the saddle. When the drain leg saddle is placed on the lateral, the marks on the lateral indicate the proper orientation of the saddle over the outlet hole. NOTE: The outlet opening on the saddle is 1-1/2" in diameter and is larger than the 1-1/4"hole in the lateral. (The photo shows the outlet hole rotated up for clarity). The outlet hole should be on the bottom of the lateral.
2) Place o-ring in the groove around the saddle outlet. Don't use any solvent or adhesives- there are o-ring retaining bumps to help hold the o-ring in place during installation. The o-ring must be able to move to seal when pressure is applied.

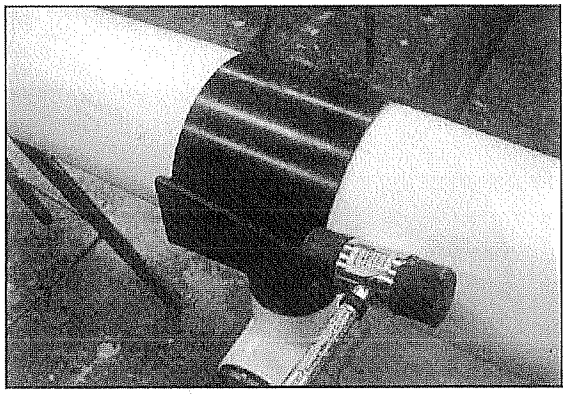


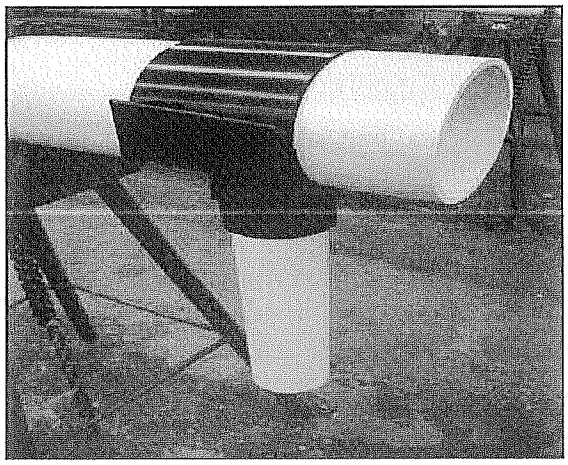
3) Fasten the unit around the drilled lateral at the position marked. The top blank SDM saddle should interlock with the pins of the lower SDM saddle.



4) Push the wedges onto the saddle by hand until tight – about 1/4 inch from flush. Make sure that the drain leg is vertical. Tighten the wedges until the unit resists rotation of 15 pounds force at the end of the unit. Use a rubber or soft face hammer to tighten the wedges. NOTE: Use of a non-rubber mallet may crack or shatter the wedge assembly.





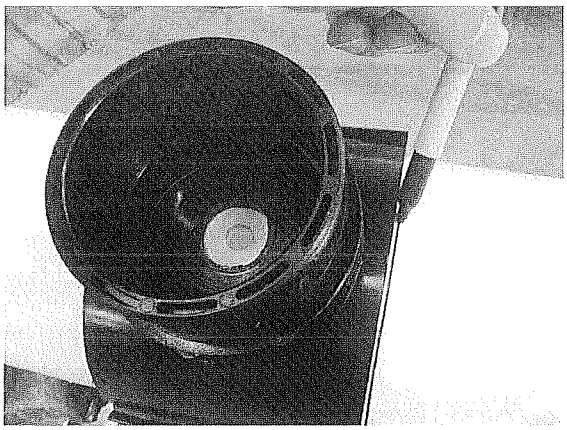


Note: Prior to installation, ensure that all air piping is clean and free of debris. When blower assemblies, header piping, air laterals, and all units are properly installed, system is ready for start-up. Refer to "Start-Up Instructions" for details.

## Installation Instructions for PVC MaxAir Diffuser Units

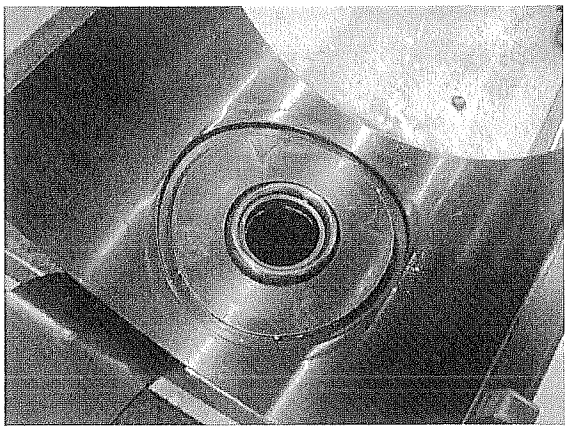
To prevent damage during shipment, EDI provides the SDM saddle and diffuser units for field mounting. The diffuser unit is factory-mounted to half of a SDM saddle. Other materials/tools required for installation include: SDM blank saddle, two locking wedges, o-ring and rubber mallet.

The lateral piping has outlet holes predrilled at the factory. Pipe surface must be smooth, clean, and free of all grease and dirt.

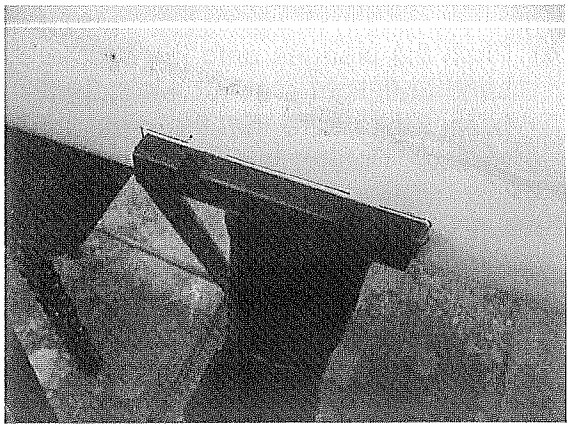


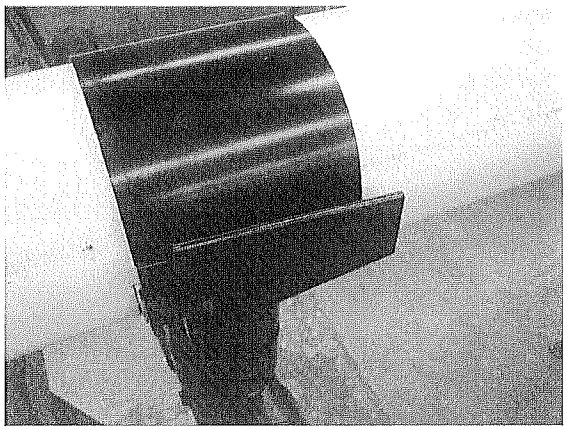
5) The position of each diffuser mount on the lateral piping is to be marked using a EDI alignment saddle (provided). Place the outlet hole in the saddle centered on the drilled outlet hole in the lateral and mark the lateral around each corner of the alignment tool or saddle base. When the diffuser assembly is placed over the outlet hole, the marks on the lateral indicate the proper orientation of the saddle over the outlet hole. NOTE: The outlet opening on the saddle is 1-1/2" in diameter and significantly larger than the outlet on the lateral. This dimensional difference allows the diffuser assembly to be adjusted relative to the lateral for proper leveling. (The photo shows the outlet hole on top for clarity). The outlet hole should be on the bottom of the lateral.

6) Place O-ring in groove under saddle outlet. Don't use any solvent or adhesives- there are o-ring retaining bumps to help hold the o-ring in place during installation. The O-ring must be able to move to seal when pressure is applied.

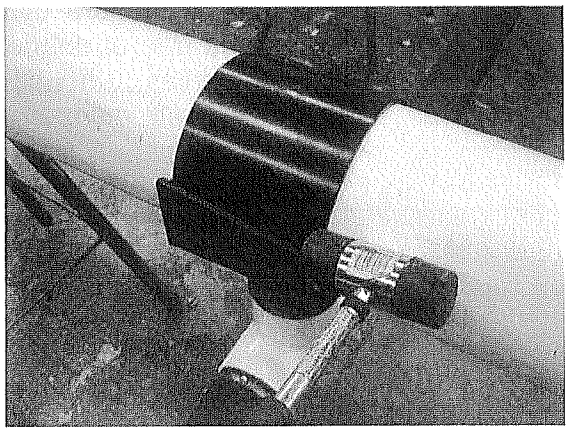


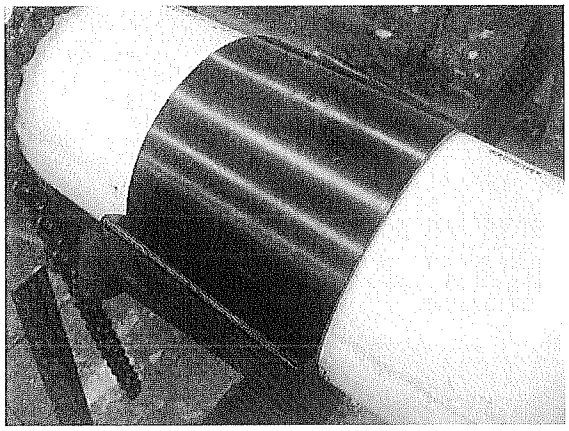
7) Fasten the unit around the drilled lateral at the position marked. The top blank SDM saddle should interlock with the pins of the lower SDM saddle.



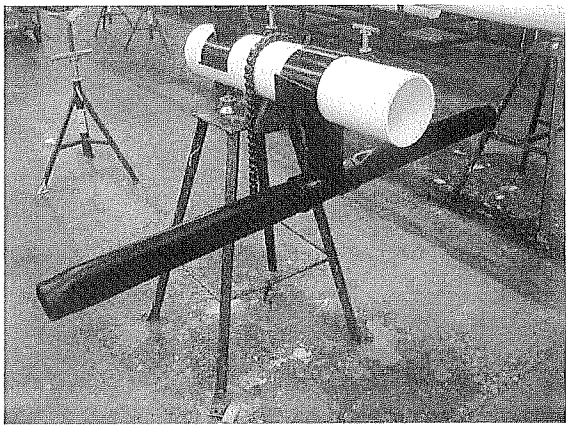


8) Push the wedges onto the saddle by hand until tight. With the wedge installed hand-tight, level the unit by placing a level on the MaxAir unit. Tighten the wedges until the unit resists rotation of 15 pounds (7 kg) force at the end of the unit. Use a rubber or soft face hammer to tighten the wedges. NOTE: Use of a non-rubber mallet may crack or shatter wedge assembly. As the diffuser mount tightens, the diffuser assembly may rotate and it would then become necessary to realign in the original, marked position.





Diffuser units are to be leveled to ± 1/2" (13 mm) from a common elevation. This is normally accomplished by adjusting the lateral elevations at each S.S. pipe support assembly and by adjusting the orientation or rotation of the diffuser mount assembly. The basin water level, transit or laser may be utilized to establish the proper pipe elevations.



Note: Prior to installation, ensure that all air piping is clean and free of debris. When blower assemblies, header piping, air laterals, and all units are properly installed, system is ready for start-up. Refer to "Start-Up Instructions" for details.

# Start-Up Instructions

## General Aeration/Mixing Systems Start-Up Instructions

These instructions cover the general start-up requirements for the aeration system. Special start-up requirements outlined in the Engineer's specifications, contract documents, or instructions offered by EDI shall be supplementary to or take precedence over these general instructions.

An overview of start-up procedures is related below:

1) Confirm that piping and diffusers are level by filling the basin with water until the diffusers are 1" to 2" under water. Adjust supports or diffusers as required.
2) Activate the blower and introduce air to the aeration system. Check piping and diffusers for leaks, and repair if required. Open any manual purge valves to expel water that may be in the piping. Close the purge valves prior to placing the system into full service.
3) NOTE: Diffuser membranes may exhibit small leaks at the ends of the membranes at initial start-up. This is normal and can be expected until the membranes are submerged for a period of time. This is also true for uniformity of ceramic media. These small leaks will stop once the membranes are wetted for a period of time, especially for polyurethane membranes (up to 2-4 weeks). This allows the polymer to become less rigid, improve uniformity, and allow the specific clamping mechanism to seal the membrane to the support tube/holder.
4) While maintaining air to the system, continue filling the basin until the design depth is reached.

### Blower Components

See the blower installation and start-up instructions to assure all blower components are mounted properly and ready for operation. When EDI provides the blower assemblies, detailed installation and start-up instructions are provided in the blower submittal package.

Blower components should be fully installed and fully serviced prior to making final electrical connections and starting up the aeration system.

Precautions should be taken throughout system installation to minimize the discharge of airborne particles to the aeration system. As a minimum, an air inlet filter should be installed and operated during blower servicing procedures. EDI recommends a filter efficiency of 93% of 10-microns. Any solvents used to clean blower should be bypassed from the aeration piping. The discharge of airborne particulate matter or solvent into aeration piping may result in damage to diffuser membranes.

Upon completion of blower manufacturer's recommended service, the subsequent start-up procedures may be followed.

### General Air Piping

Contractor is to confirm the cleanliness of the air piping. If existing header piping is used, the air purge or water flush cleaning procedure is recommended prior to installation of diffuser units to remove any internal

debris that may have accumulated in the header piping. Inspect air piping and diffuser connections for loose fittings or damaged pipe. Damaged piping sections and connections should be repaired prior to commencing system operations.

### Initial System Start-Up

To start the system, completely open all valves in the air supply system, including blower shut-off valves, header valves and lateral isolation/throttling valves. This instruction assumes that uniform water level is present in all aerated basins served by a single blower. If varying water levels are present, basins with lower water levels will need to have the valve throttled back to avoid improper air distribution. Failure to completely open all valves may result in over-pressuring blower unit, release of pressure relief valve, motor overload, or poor air distribution in aeration system with the potential of overpressuring diffuser units and damaging the diffuser membranes.

Once valve positions have been confirmed, blower unit may be started. EDI does not recommend starting multiple blower units at initial system start-up. Subsequent blowers should be brought on-line after the system has equalized and uniform diffuser activity is observed throughout the system.

Use blower manufacturer's recommended start-up procedures. EDI recommends that initial pressure surge be reduced through PRV or blow-off valve.

Start-up procedures should follow the basic guidelines as listed below:

1) When starting initial blower, the PRV or blow-off valve should be used to reduce the start-up pressure surge. This is accomplished by removing weights and the cap from the PRV or by opening the blow-off valve.
2) When the basin has been filled, note the operating pressure at the blowers. The pressure relief valve should be adjusted to free-flow at approximately 1 psig above the normal operating pressure of the system.
3) To confirm the PRV operates, partially close blower shut-off valve until PRV releases air. Reopen the shut-off valve to confirm that PRV will reseat. If required, readjust the PRV to the recommended setting per instructions in the Blower IOM manual.
4) To properly assess the airflow distribution on the aeration system, the blower system must be operating at the design operating point. On dual blower systems, design airflow is typically achieved by operating one blower at 100%. On three-blower systems, design airflow is typically based on operating two blowers at 100%.
5) Airflow distribution adjustment between laterals should not be conducted until the full operating depth is obtained and the blower system has been in operation for several days. Small adjustments may be made to the isolation/throttling valves on the laterals receiving the most air. System balancing should be completed on an incremental basis. Changes in airflow distribution may require 2-8 hours to fully stabilize when fine-tuning a system. In addition, in situations where multiple basins are employed and varying water levels exist, adjustments of

lateral valves will be required to maintain air distribution in the tanks.

6) For units using membrane clamps, the clamp may become loose during shipment. If a small leak in the clamp area is noticed during the wet check, a simple tightening of the clamp should eliminate the leak.

EDI recommends that the system Operator contact EDI at 573-474-9456 prior to making any adjustments to the airflow distribution.

# Safety Considerations

The diffused aeration system supplied on this project has no moving parts and poses little to no risk of injury to operations staff. However, routine maintenance may expose personnel to potential hazards. EDI has listed below potential hazards and recommended precautions when maintenance procedures are required for the aeration components.

### Tanks at Full Liquid Depth

Hazards:

1) Turbulent liquid action.

Precautions:

1) Provide access to emergency throw rope or life ring.
2) Use "buddy system" during maintenance activities.

### Tanks Empty

Hazards:

1) Falling into tank.
2) Objects falling onto maintenance personnel in the tank.
3) Slippery floor.

Precautions:

1) Avoid access ways without railings.
2) Provide emergency exit/access.
3) Appropriate personal safety equipment

### Maintenance of Diffuser Units: Tanks Empty

Hazards:

1) Personnel falling into tank.
2) Objects falling in the tank.
3) Slippery basin floor.

Precautions:

1) Avoid access ways without railings.
2) Provide emergency exits/access.
3) Appropriate personal safety equipment.

### Maintenance of Diffuser Units: Tanks Full

Hazards:

1) Dropping hardware
2) Personnel falling into tank.

Precautions:

1) Assure proper winch operation before securing cable to drop assembly.
2) Use buddy system and follow standard safety procedures.

### Personal Protection Measures

Wastewater has a potential for health hazards because it may carry disease producing organisms and a variety of chemical wastes. It is important to employ good personal hygiene practices to prevent oral and skin contact with wastewater. The following is a list of methods to prevent direct contact entry of pathogenic organisms:

1) Wash hands frequently with soap and water after contacting wastewater, visiting restrooms, before eating, drinking, or smoking;

and at the end of jobsite visit. When soap and water are not available use anti-bacterial hand wash specifically formulated for use when soap and water is not convenient.

2) Promptly treat cuts and abrasions using appropriate first aid measures.
3) Handle sharp items with extra care to prevent accidental injuries.
4) Clean contaminated tools after use.
5) Follow good common sense and exercise extra caution whenever there is contact with contaminated water or sludge.
6) Never touch face, mouth, eyes, ears, or nose while working with wastewater or sludge.

**Personal Protective Equipment**

1) Wear heavy-duty gloves (or double gloving) and boots that are waterproof and puncture resistant. Wear gloves whenever practical when there is contact with wastewater or sludge.
2) When practical, use thin disposable latex gloves for light work. Use reinforced rubber gloves for heavy activities. Discard gloves that become torn and try not to submerge hand below top of glove during service activities. When it is not feasible to use gloves while installing or inspecting equipment, make sure to follow personal hygiene practice listed above.
3) Wear goggles in the presence of heavy aerosols, dust, or when splashing of wastewater might occur.
4) Wear protective clothing; if possible, shower and change clothes before leaving plant site. If work clothes are washed at home, separate from the family wash and use chlorine bleach.

**Confined Space Hazard**

1) Verify the designation of the tank before entering. If it is defined as a confined space follow plant directives for entry. Generally a confined space is defined as having limited or restricted means of entry or exit; is large enough for an employee to enter and perform assigned work; and is not designed for continuous worker occupancy. Typical confined spaces are silos, digesters, boilers, vaults, sewers, pipelines, pump pits, ducts and compartments.
2) Wastewater tanks or basins can also be confined spaces and contain potential hazards. Flammable, explosive, toxic, or other hazardous substances or the absence of sufficient oxygen could cause injury, acute illness, disability, or death. Particular care should be exercised to assure NO hydrogen sulfide, chlorine or other heavier than air gases have not accumulated in the basins or tanks. DO NOT ENTER ANY CONFINED SPACE until your supervisor has verified that proper safety precautions have been met. Do not enter a confined space without someone else present on the outside and do not enter a confined space without proper rescue equipment outside the confined space. Every confined space entry has a unique set of hazards, but atmospheric monitoring and proper entrance procedures can minimize the hazards entry personnel typically encounter.

# Operation Instructions

## Description of the Aeration-Mixing System

The aeration-mixing system employs a main air header and valved lateral piping system to distribute air throughout the basin. EDI normally designs the aeration system piping to provide uniform air distribution without adjustment to the isolation/throttling valves on the laterals. However, these valves are typically provided for direct control of airflow distribution on large aeration systems or for process control. Airflow distribution will be reviewed at the time of start-up by an EDI field service representative. If process demands dictate a revised airflow distribution pattern, contact EDI for guidance on modification to the system.

## Normal Operation of the Aeration System

The following procedures should be followed on a regular basis to assure consistent and satisfactory performance of the aeration-mixing system.

The air rate to the system may be adjusted to maintain the desired dissolved oxygen levels in the basin. When adjusting the airflow rate, the diffusers should be operated within the normal operating range of the diffuser. Excessive airflow rates will result in high pressure drops across the diffuser and reduced oxygen transfer performance. Low airflow rates may result in incomplete utilization of the diffuser membrane and reduced air distribution.

The aeration-mixing system is designed to provide uniform aeration. Positive dissolved oxygen concentrations should be present throughout the entire system during normal operation. A dissolved oxygen profile analysis may be used to confirm the performance of the aeration system. Typically, the dissolved oxygen levels are measured at the inlet, the outlet, and the midpoint locations of each basin to determine the aeration system performance. In regulating the system airflow to control dissolved oxygen levels, the diffuser units should be operated within their minimum and maximum airflow limits.

In applications where water level variations may exist between aeration basins supplied by a single blower, the isolation valves may need to be adjusted to maintain adequate airflow distribution. This normally requires valving back the air to the basin with the reduced water level. NOTE: It is important to confirm the operating airflow range of the diffuser units before valving back any isolation valve. Damage could result to the aeration diffuser if airflow is above the recommendations noted in the Headloss Calculations. Please consult EDI Engineering Department to confirm operating procedure before adjusting any aeration isolation/throttling valve.

## Normal Operation of the Blower System

The Aeration-Mixing System normally utilizes a centrifugal or positive displacement (PD) blower system consisting of one or more blower units for normal operation plus one on-line spare unit. All blower units including the spare unit must be operated on a regular basis to maintain their proper working condition. EDI recommends that blower units be operated

sequentially with idle blower units brought on-line weekly. EDI does not recommend the simultaneous operation of on-line and spare blowers for an extended period. This operating condition may deliver airflows exceeding the air capacity of the diffuser units.

All blower components should be serviced on a regular basis. For additional information concerning proper blower operation, service requirements or service intervals, reference the Blower Operation and Maintenance manual.

### Shutdown Conditions

If air service is interrupted at any time, it should be restored as soon as possible. When restarting positive displacement blower units, the start-up pressure surge should be reduced by down-weighting the pressure relief valve (PRV) or operating the blow-off valve. Once the blower is operational, reset the PRV or slowly close the blow-off valve over a five- to ten-minute period. The PRV must be set properly to prevent overloading of the blower system. Operate manual water purge devices if provided. If the PRV releases air for an extended period of time, the relief setting should be checked.

When diffusers are installed in basins or lagoons and are not going to be in operation for an extended time (4 to 6 weeks), the diffusers should be covered with approximately 4 feet of water.

- In the summer, this protects the diffusers from excessive heat and provides UV protection.
- In winter, EDI recommends that the diffusers be covered with a sufficient amount of water so that if ice forms there is always a minimum liquid clearance that measures approximately 4 feet between the bottom of the formed ice and the diffuser system. This water buffer will keep the ice and its possible damaging effects away from the diffuser system.

Furthermore, the system may be idle or remain active during this period. If the aeration system will be active, operate the system at a minimum air flow so as to avoid movement of ice.

The water level in the basin/lagoon should never be lowered if there is ice present. The weight of the ice or breaking into pieces will invariably cause severe damage to membranes and/or piping.

Slowly starting up the aeration system will aid in the melting of the formed ice. This is to be done with great caution as not to exert any undo forces on piping or equipment that penetrates or is entrapped in the ice surface, and to avoid damage from ice movement as blocks of ice become free to move.

If the basin is to be idle for a prolonged time period, the basin should be drained and cleaned. NOTE: Maintain the minimum airflow to the system during the drain-down procedure. For maximum protection of the aeration system, refill the basin to completely submerge the aeration system. This provides thermal protection in the event of severe cold or hot weather conditions.

Contact EDI for additional operation and maintenance information if it is necessary to decrease the system airflow during cold weather.

### Operation of the Diffuser Unit

The diffuser unit has no moving parts and requires very little maintenance for long-term operation. EDI recommends

that the air supply to the diffusers be maintained at all times for optimum performance. The airflow to the diffuser units must be kept within the ranges noted in the Headloss Calculations to maintain the structural and operating characteristics of the diffuser membrane. Continuous application of high airflows, greater than denoted for normal operation, may result in physical damage to the diffuser membrane. NOTE: Use caution when adjusting several lateral throttling valves in the same piping system. This procedure can result in elevated airflows in sections of the basin, exceeding the maximum allowable airflow to each diffuser unit.

# Preventive Maintenance

## Maintenance Schedule

The EDI MaxAir unit is a coarse bubble aeration device that requires minimal maintenance. With proper operation and maintenance, the MaxAir diffuser will provide years of long-term performance.

EDI recommends that the MaxAir units be inspected during normal basin drain-down periods. The MaxAir aeration system is designed to allow the diffuser units to be accessed by dropping the water level in the basin being serviced. The air to the basin being serviced should be adjusted to maintain the recommended minimum airflow rate to the diffusers until the basin is completely drained down.

## MaxAir Aeration System Inspection

All system components should be inspected for general wear or damage. This includes but is not limited to:

- Pipe supports including anchor bolts, pipe straps and fasteners.
- Pipe connection including fasteners, shifts in alignment of pipes and joints.
- Diffuser assembly including position, diffuser integrity, etc.
- Purge assembly components (if applicable) including all connections, anchor points, and wear at any contact points.

Any worn or damaged components need to be repaired or replaced. Please contact EDI for assistance in identifying a root cause and solution.

## In Situ Cleaning of Membrane

If it becomes necessary to remove loose surface deposits on the MaxAir unit, a low-pressure hosing method is effective. The length of time required to remove deposits is dependent on the type of surface foulant, water pressure, distance from unit, etc. Typically, 5 to 10 seconds are required per unit.

Manual Cleaning: Remove any significant accumulation of attached debris. Minor surface deposits need not be removed for operating performance.

## Diffuser Protection

Good air filtration is recommended for both the aeration system and blower system. Typically, roughing filters with a nominal efficiency of 93% removal of 10-micron particles are recommended. Follow blower manufacturer's recommendations regarding care and maintenance of inlet filters.

A minor degree of surface deposits or slime will build up on the diffuser units over time. This material typically does not impact the operation of the diffuser. In applications where a large amount of stringy material exists, a significant amount of debris may accumulate on the unit. This material should be removed on a regular basis to avoid mechanical damage to the diffuser unit.

# Corrective Maintenance

## Troubleshooting

The MaxAir aeration system requires very little maintenance for long-term operation. Periodic visual inspection of the system should allow the Operator to determine if the system is performing at optimum levels. For example, diffuser unit elevation variations greater than the design tolerance, typically ± 1/2" (13mm) will reduce the uniformity of air distribution in the system. In addition, operating airflows below the design condition will also reduce the uniformity of air distribution. If operating conditions warrant airflow rates below the design condition, contact EDI for additional operational guidelines.

Below are symptoms and procedures to follow if inspection of the aeration system reveals abnormal operation:

**Large volume of air in localized area.**

Possible Cause:

1) Air leak in aeration piping.

Procedure:

1) Access area in question. Inspect joints for evidence of breakage.

**Decreased diffuser activity and increased back pressure noted at blower.**

Possible Cause:

1) Diffusers becoming fouled.
2) Reduced blower discharge air volume.
3) Restriction in air header.

Procedure:

1) Access diffusers and inspect for external or internal fouling.
2) Confirm blower operating point and rpm reading.
3) Confirm isolation valve position on header and drops.

**Dissolved oxygen profile not satisfactory throughout basin.**

Possible Cause:

1) Increased loading to system.
2) Reduced blower discharge air volume.
3) Improper distribution of air in system.
4) Air leak in system.

Procedure:

1) Confirm loading to system.
2) Confirm blower operations.
3) & 4) See items 1 and 2 above.

## Replacing Saddle Mounted Diffuser Assembly

If it becomes necessary to remove an entire diffuser assembly, the general procedures outlined below should be followed:

1) Use a rubber or plastic mallet to remove sliding wedges from the saddle body.
2) Remove the saddle body from the lateral piping. Be careful not to damage the lateral near the predrilled holes. The Spectrum diffuser mount forms a tight seal to the lateral with compressed O-rings. Heavy scratches in the lateral near the O-rings could break the pressure seal.
3) Re-install the diffuser assembly by following the Installation Instructions.

4) NOTE: A properly installed wedge may not be flush with the saddle body due to manufacturing tolerances. Use of a non-rubber mallet may crack or shatter wedge assembly. As the diffuser mount tightens, the diffuser assembly may rotate and it would then become necessary to realign in the original, marked position.

Questions regarding the aeration-mixing system operation, maintenance, etc. should be forwarded to Environmental Dynamics International, 5601 Paris Road, Columbia, Missouri 65202. (573) 474-9456.

# diffuser express®

**Diffuser Express®** is committed to excellence in supplying diffusers, replacement membranes, and specialty diffuser items across all brands for new and existing water and wastewater treatment applications.

Diffuser Express offers replacement parts for nearly all types of disc, tube, and panel diffusers for most manufacturer's. Significant resources have been invested in developing and engineering diffuser membrane compounds and products to fit every need. The advanced technology required to produce premium quality membranes incorporated in all EDI diffusers is the result of years of intensive investment, research, engineering, and product refinement. In developing and controlling the total membrane product from compounding through extrusion and perforation, EDI and Diffuser Express (DX) are able to offer high efficiency products that require less energy to operate and last longer in the field, which results in reduced operation and maintenance costs.

Diffuser Express delivers a stream of technology advances using EDI's quality products with "express" service and competitive pricing. - Randall C. Chann, President/CEO - EDI

Diffuser Express offers a warehouse of disc, tube, and panel diffuser products to meet the needs of your specific application. EDI diffusers employ the latest technology available in membrane diffusers. These diffusers are designed for use in new installations or as replacements for existing systems. Conversion kits are available for upgrading your system from coarse bubble to fine bubble and from ceramic to more efficient flexible membranes. Specialty items include diffuser mounting options, stainless steel membrane clamps, crimping tools, as well as many other commodity items and accessories.

Diffuser Express is committed to providing quality products with superior customer service. Visit our website at www.diffuserexpress.com to view an existing catlaog or make your purchase online. Contact Diffuser Express at 573-474-9456 to incorporate our quality products into your treatment application.

diffuser express

5601 Paris Road
Columbia, MO 65202 • USA

+1 877.EDI.AIR8 (334-2478)
parts@diffuserexpress.com

# Environmental Dynamics International

# Service Department

## Quality In-House & On-Site Customer Service

EDI provides Field & Customer Service directly from its worldwide headquarters located in Columbia, Missouri, while maintaining Authorized Field Service offices around the globe.

**Services may include visits made by an Authorized EDI Service Representative to a project site and may provide any or all of the following:**

Train on-site personnel in the proper installation and assembly of all EDI equipment.

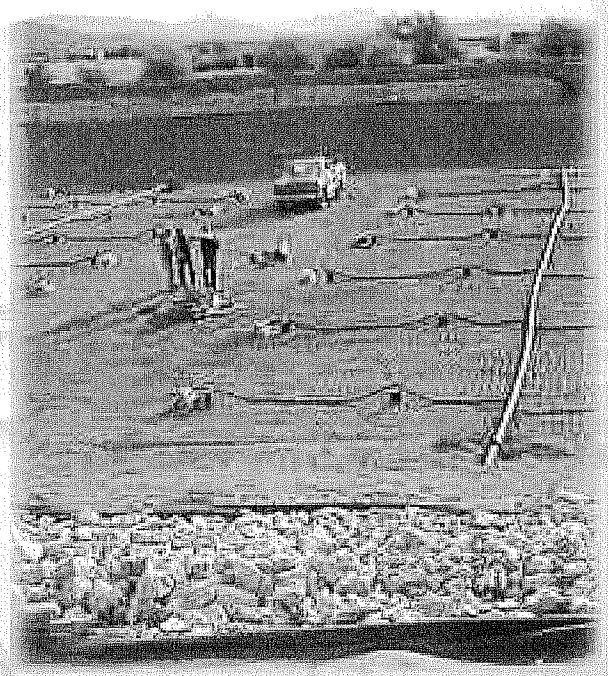
Inspect installation to provide verification of general conformance to EDI specifications and requirements.

Provide startup services to ensure that the equipment is operating satisfactorily after installation.

Train plant Owners/Operators in long term operation and maintenance procedures for the EDI equipment that has been installed.

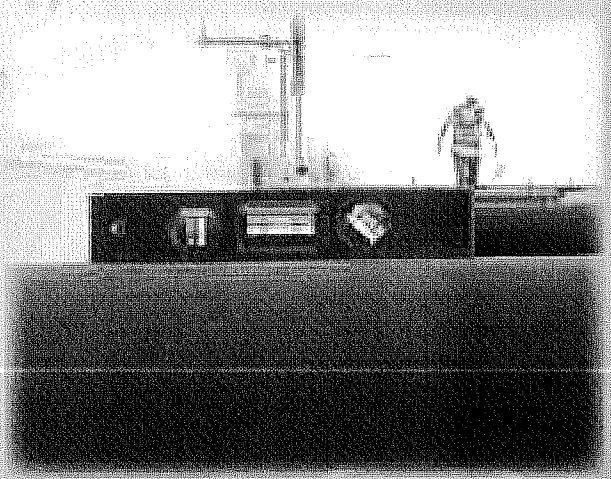
Provide troubleshooting investigation or inspection when requested by the customer, with regards to EDI equipment installation

In addition to the highest quality products and services, EDI is pleased to offer superior Customer & Field Services. EDI strives to provide these services in the most convenient and cost effective manner to ensure the greatest benefit to its customers. EDI is able to provide these services directly with its Service personnel located within the EDI Headquarters in Columbia, Missouri, as well as maintaining localized Authorized Field Services offices Worldwide.



EDI highly recommends the purchase of field service with any EDI system purchase.

***Our experience has shown that an inspection provided by an Authorized EDI Field Service Representative can eliminate potential costs incurred by the customer from failures due to preventable installation errors.***



In order to allow reasonable scheduling and to ensure an EDI representative is available, at least a three week notice is needed when requesting service.

Should you have any questions regarding EDI Field Services or if you would like to request a quote, please feel free to contact the EDI Service Manager, Ms. April Heywood at 573-474-9456. As always, EDI provides telephone and email support at any time at no additional charge.

Environmental Dynamics International

**Service Department**

5601 Paris Road • Columbia, MO 65202 • USA

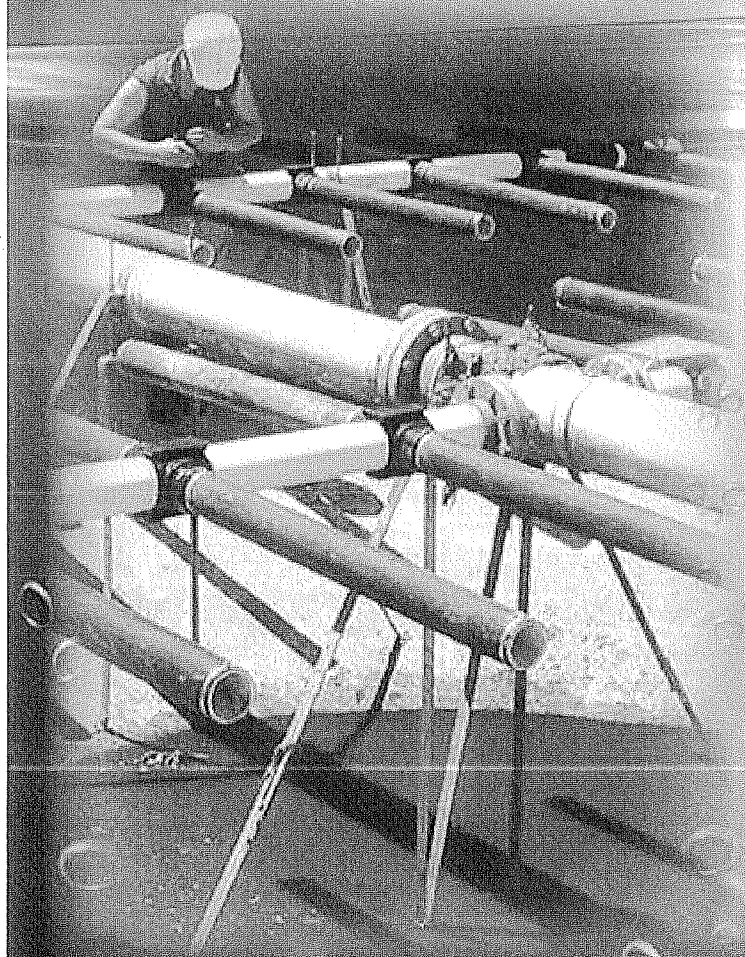
+1.877.EDI.AIR8 (334-2478)

service@wastewater.com

www.Wastewater.com

# AerationWorks™

## Global Maintenance & Installation Services



## *Customer Support Services*

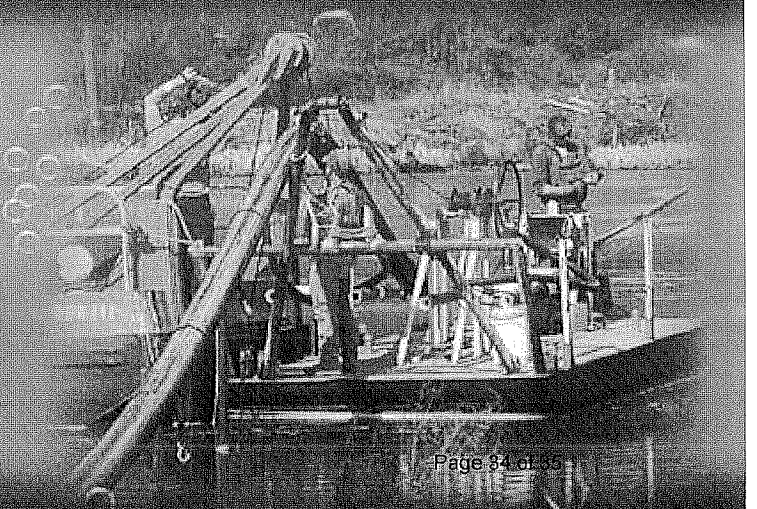
- **Install New Aeration Systems**
- **Maintain or Refurbish Existing Aeration Systems**
- **Develop and Implement Long-Term Maintenance Programs**
- **Service and Support for all Brands of Aeration Systems**

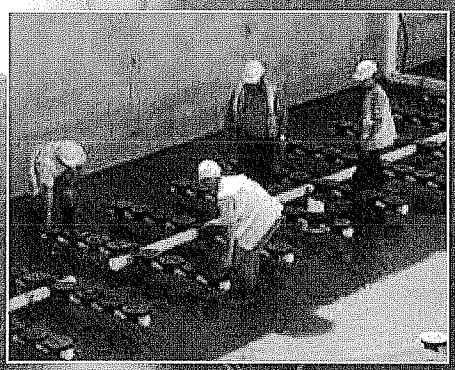
*"The EDI Aeration Works division provides experts in the installation and maintenance of any aeration system, including supervision and/or the skilled labor pool to perform the actual service"*

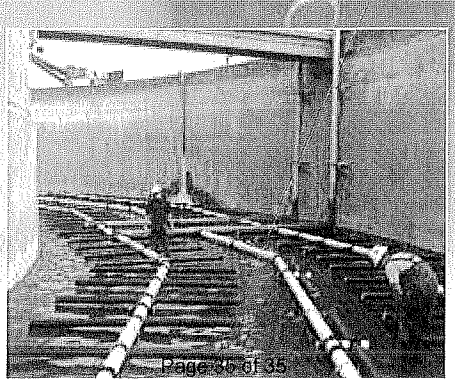
- Chuck Tharp, PE
Chairman • Environmental Dynamics Inc.

**Aeration Works maintains special equipment, tools and skilled crews for installation and service on any aeration construction or maintenance project.**

**Contractors, owners and operating companies can better utilize their own personnel, equipment and resources by enlisting the support of the EDI Aeration Works Division.**







**EDI Aeration Works personnel have the experience and knowledge to handle unique systems and offers a cost effective alternative for installation and maintenance of your aeration system.**

AerationWorks™

Global Maintenance & Installation Services

5601 Paris Road • Columbia, MO 65202 • USA

**+1 877.EDI.AIR8 (334-2478)**

**info@aerationworks.com**

DeltaBlower 5 Generation

ENGLISH

# Operating- and installation instructions
# Positive displacement blower unit

AERZEN

AERZENER MASCHINENFABRIK GMBH

| G4-006 L EN | |
|---|---|
| 174 676 000 | 05-2011 |

Die INFO-Seite ist vor der Inbetriebnahme durchzulesen.
Dort evtl. vermerkte Hinweise und Änderungen sind durchzuführen.

Read the INFORMATION sheet prior to commissioning.
Possible notes and changes indicated herein are to be effected.

La page INFO est à lire avant la mise en route.
Y apporter éventuellement des annotations et modifications.

De INFO-Bladzijde moet voor de inbedrijfname worden doorgelezen.
Daar eventueel opgeschreven aanwijzingen en modificaties moeten worden uitgevoerd.

Prima della messa in esercizio leggere la pagina INFO, ed eseguire eventuali istruzioni o modifiche indicate.

Antes de proceder a la puesta en marcha, leer detenidamente la página informativa y cumplir eventuales indicaciones y modificaciones indicadas en la misma.

A página de informações deve ser lida antes da colocação em funcionamento. As eventuais indicações e alterações aí mencionadas devem ser respeitadas.

INFO-siden skal læses igennem inden idriftsættelsen. Evt. anvisninger og ændringer der står dér skal gennemføres.

Les INFO-siden før igangsetting. Anvisninger og endringer som står oppført der, skal utføres.

Läs igenom INFO-sidan före idrifttagning. Eventuellt angivna anvisningar eller förändringar skall genomföras.

Pidätämme oikeuden painovirheisiin, erehdyksiin sekä teknisiin muutoksiin..

***Druckfehler, Irrtümer sowie technische Änderungen sind vorbehalten.***

***We are not liable for misprints, errors, and we reserve the right to make technical changes.***

***Sous réserve de fautes d'impression, d'erreurs et de modifications techniques.***

***Drukfouten, vergissingen en technische wijzigingen voorbehouden.***

***Salvo error u omisión. Reservado el derecho a realizar modificaciones técnicas.***

***Salvo errori di stampa, incorrettezze e modifiche tecniche.***

***Reservamo-nos o direito a erros de impressão, enganos e alterações técnicas.***

***Der tages forbehold for trykfejl, fejl og tekniske ændringer.***

***Med forbehold om trykkfeil, feiltagelser og tekniske endringer.***

***Tryckfel, övriga fel samt tekniska förändringar förbehålles.***

***INFO-sivu on luettava ennen käyttöönottoa. Siellä ilmoitetut mahdolliset muutokset tai lisäykset on otettava huomioon***

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Aerzener Maschinenfabrik
Abteilung Technische Dokumentation
Technische Illustration & Redaktion
H.Nickel Techniczter/Autor

# Konformitätserklärung für Maschinen gemäß Maschinenrichtlinie 2006/42/EG

**Declaration of conformity** for machines in accordance with Machine Directive 2006/42/EC

**Déclaration de conformité** pour machines selon la directive Machines 2006/42/CE

CE

**Die Konformitätserklärung für diese Drehkolbenmaschine wird von den technischen Angaben im Kapitel „Leistungsdaten“ ergänzt. Die dort erwähnten Angaben identifizieren das Produkt und sind in Verbindung mit dieser Konformitätserklärung zu verwenden.**
**The declaration of conformity for the rotary piston machine supplimented by the technical specification in the chapter „Performance data“. The data mentioned there identify the product and must be used in association with this declaration of conformity.**
**La déclaration de conformité de cette machine à pistons rotatifs est complétée par les indications techniques du chapitre « Caractéristiques de puissance ». Les indications qui y sont données identifient le produit et sont à mettre en relation avec la présente déclaration de conformité.**

*DEUTSCH* *Originalkonformitätserklärung*

Hiermit erklärt der Hersteller: **Aerzener Maschinenfabrik GmbH, Reherweg 28, D-31855 Aerzen**
dass die Maschine konform ist mit den Bestimmungen der folgenden Richtlinien:
Maschinenrichtlinie 2006/42/EG
Elektromagnetische Verträglichkeit 2004/108/EG.
Druckgeräterichtlinie 97/23/EG
Die Schutzziele der Niederspannungsrichtlinie wurden gemäß Anhang I, Nr. 1.5.1 der Maschinenrichtlinie eingehalten.
Die Konformitätserklärung bezieht sich auf den vom Hersteller in Verkehr gebrachten originalen Maschinenzustand.
Bei nachträglich durchgeführten Veränderungen und/oder nachträglich vorgenommenen Eingriffen erlischt diese Konformitätserklärung.
Die zur Maschine gehörenden speziellen technischen Unterlagen nach Anhang VII Teil A wurden erstellt.
Dokumentationsverantwortlicher: Herr Irtel Aerzen, 28-06-2011

*ENGLISH* *Translation of the original declaration of conformity*

The manufacturer: **Aerzener Maschinenfabrik GmbH, Reherweg 28, D-31855 Aerzen**
hereby declares that the machine conforms to the provisions of the following directives:
Machine Directive 2006/42/EC.
Electromagnetic Compatibility 2004/108/EC.
Pressure Equipment Directive 97/23 EC
The safety objectives of the Low Voltage Directive have been complied with according to Appendix I, No. 1.5.1 of the Machine Directive.
The declaration of conformity refers to the machine in its original state as marketed by the manufacturer.
Any changes introduced subsequently and/or interventions carried out subsequently will void this declaration of conformity.
The special technical documents for the machine in accordance with Appendix VII Part A have been created.
Responsible for documentation: Mr. Irtel Aerzen, 28-06-2011

*FRANÇAIS* *Traduction de la déclaration de conformité d‘origine*

Le fabricant : **Aerzener Maschinenfabrik GmbH, Reherweg 28, D-31855 Aerzen**
déclare par la présente que la machine est conforme aux dispositions des directives suivantes :
Directive Machines 2006/42/CE
Compatibilité électromagnétique 2004/108/CE
Directive Équipements sous pression 97/23/CE
Les objectifs de protection de la directive Basse tension ont été respectés conformément à l‘annexe I, n° 1.5.1 de la directive Machines.
La présente déclaration de conformité se rapporte à l‘état d‘origine de la machine tel que mis en circulation par le fabricant.
Cette déclaration de conformité est rendue caduque par toute modification et/ou intervention ultérieure.
La documentation technique pertinente pour la quasi-machine a été constituée conformément à l‘annexe VII partie A.
Responsable de la documentation : Monsieur Irtel Aerzen, 28-06-2011

i.V. (Herr Irtel)

Leiter Techn. Abteilung
Head of the dept.
Directeur technique

Unterschrift des Herstellers
Signature of the manufacturer
Signature du constructeur



**Diese Konformitätserklärung ist mit dem Inkrafttreten der Maschinenrichtlinie 2006/42/EG ab dem 29-12-2009 gültig.**
This declaration of conformity applies when the Machine Directive 2006/42/EC comes into force on 29-12-2009.
Cette déclaration de conformité est valable à partir du 29/12/2009 avec l‘entrée en vigueur de la directive Machines 2006/42/CE.

**Conformiteitsverklaring** voor machines conform machinerichtlijn 2006/42/EG
**Declaración de conformidad** para máquinas, de conformidad con la Directiva de Máquinas 2006/42/CE
**Dichiarazione di conformità** per macchine secondo la Direttiva macchine 2006/42/CE

CE

**De conformiteitsverklaring voor deze roterende zuigercompressor wordt aangevuld door de technische informatie in het hoofdstuk „Specificaties“.**
**Aan de hand van de daar vermelde informatie wordt het product geïdentificeerd en de informatie moet in combinatie met deze conformiteitsverklaring toegepast worden.**
**La declaración de conformidad para esta máquina de émbolos giratorios es complementada por los datos técnicos que se encuentran en el capítulo “Datos de potencia”.**
**Los datos ahí indicados identifican al producto y se deberán utilizar conjuntamente con esta declaración de conformidad.**
**La Dichiarazione di conformità per la presente macchina a pistoni rotanti è integrata dai dati tecnici riportati nel capitolo „Dati di prestazione“**
**Le informazioni incluse in quel capitolo identificano il prodotto e devono essere utilizzate insieme alla presente Dichiarazione di conformità.**

*NEDERLANDS* *Vertaling van de originele conformiteitsverklaring*
Hierbij verklaart de fabrikant: **Aerzener Maschinenfabrik GmbH, Reherweg 28, D-31855 Aerzen**
dat de machine voldoet aan de bepalingen van de volgende richtlijnen:
machinerichtlijn 2006/42/EG
elektromagnetische compatibiliteit 2004/108/EG.
richtlijn drukapparatuur 97/23/EG
De doelstellingen voor veiligheid van de laagspanningsrichtlijn zijn conform bijlage I, nr. 1.5.1 van de machinerichtlijn nageleefd.
De conformiteitsverklaring heeft betrekking op de originele machinetoestand die door de fabrikant in omloop is gebracht.
Bij veranderingen en/of ingrepen die naderhand uitgevoerd zijn, komt deze conformiteitsverklaring te vervallen.
De speciale, bij de machine horende, technische documentatie conform bijlage VII deel A is opgesteld.
Verantwoordelijk voor de documentatie: de heer Irtel Aerzen, 28-06-2011

*ESPAÑOL* *Traducción de la declaración de conformidad original*
Por la presente, el fabricante: **Aerzener Maschinenfabrik GmbH, Reherweg 28, D-31855 Aerzen**
declara, que la máquina cumple con las disposiciones de las siguientes directivas:
Directiva de Máquinas 2006/42/CE
Compatibilidad Electromagnética 2004/108/CE
Directiva de Equipos a Presión 97/23/CE
Los objetivos en materia de seguridad establecidos en la Directiva de Bajo Voltaje se han aplicado según el anexo I, núm. 1.5.1 de la Directiva de Máquinas.
La declaración de conformidad se refiere al estado original de la máquina que el fabricante comercializa.
En el caso de realizar modificaciones y/u operaciones posteriores, la declaración perderá toda validez.
La documentación técnica correspondiente a la máquina, de conformidad con el anexo VII, parte A ha sido elaborada.
Responsable de la documentación: Sr. Irtel Aerzen, 28-06-2011

*ITALIANO* *Traduzione della dichiarazione di conformità originale*
Con la presente dichiarazione il produttore:**Aerzener Maschinenfabrik GmbH, Reherweg 28, D-31855 Aerzen**
dichiara che la macchina è conforme alle disposizioni delle seguenti direttive:
Direttiva macchine 2006/42/CE
Compatibilità elettromagnetica 2004/108/CE
Direttiva sulle attrezzature a pressione (PED) 97/23/CE
Gli obiettivi di sicurezza della Direttiva bassa tensione sono stati rispettati secondo l’allegato I, n. 1.5.1 della Direttiva macchine.
La dichiarazione di conformità si riferisce allo stato della macchina originale messa in circolazione dal produttore.
In caso di modifiche eseguite successivamente e/o di interventi eseguiti in un secondo momento, decade l’obbligo della dichiarazione.
È stata predisposta la documentazione tecnica speciale relativa alla macchina secondo l’Allegato VII Parte A.
Responsabile della documentazione: Sig. Irtel Aerzen, 28-06-2011

i.V. (Herr Irtel)

Hoofd technische afdeling
Director Dpto. Técnico
Responsabile reparto tecnico

Handtekening van de fabrikant
Firma del fabricante
Firma del fornitore



Deze conformiteitsverklaring is geldig bij de inwerkingtreding van de machinerichtlijn 2006/42/EG vanaf 29-12-2009.
Esta declaración de conformidad obtendrá validez con la entrada en vigor de la Directiva de Máquinas 2006/42/CE, a partir del 29.12.2009.
Con l'entrata in vigore della Direttiva macchine 2006/42/CE la presente Dichiarazione di conformità è valida a partire dal 29-12-2009.

## Ersatzteile, *spare parts, pièces dé tachée, onderdelen, repuestos, pezzi di ricambio*

**- AERZENER MASCHINENFABRIK -**

**Ersatz- und Zubehörteile**
Es wird darauf hingewiesen, dass nicht von uns gelieferte Originalteile und Zubehör auch nicht von uns geprüft und freigegeben sind. Der Einbau oder Anbau sowie die Verwendung solcher Produkte kann daher unter Umständen konstruktive vorgegebene Eigenschaften der Anlagen beeinflussen. Für Schäden, die durch Verwendung von nicht Originalteilen und Zubehör entstehen, ist jede Haftung des Herstellers ausgeschlossen.

**Spare parts and accessories**
We draw your attention to the fact that original parts and accessories not supplied by us are also not inspected and released by us. Therefore, the installation and application of such products might influence under certain circumstances constructively stipulated properties of the plants. Consequential damages due to application of non-original parts and accessories release the manufacturer from any warranty and liability.

**Accessoires et pièces de rechange**
Nous attirons votre attention sur le fait que les accessoires et pièces d'origine n'étant pas de notre fourniture ne peuvent être controlés et pris en considératoin lors d'une réclamation. L'intégration ou le montage ainsi que l'utilisation de telles pièces peut influencer sous certaines conditions les caractéristiques et performances de la machine. Pour tout dommage causé du fait de pièces n'étant pas d'origine ou de montage erroné, nous déclinons toute responsabilité.

**Reservedelen en toebehoren**
Er wordt uitdrukkelijk op gewezen dat niet door ons geleverde originele delen en toebehoren ook niet door ons getest en vrijgegeven zijn. De in of aanbouw alsmede de toepassing van zulke producten kan derhalve onder zekere omstandigheden constructief gegeven eigenschappen van de installatie beïnvloeden. Voor schaden, die door gebruik van niet originele delen en accessoires ontstaan, is iedere aansprakelijkheid jegens de fabrikant uitgesloten.

**Ricambi ed accessori**
Devono essere utilizzati solo parti e ricambi originali in quanto verificati dal costruttore della macchina. Il montaggio o l'impiego di prodotti non originali può, in certe circostanze, provocare un cattivo funzionamento dell'impianto. Danni causati dall'impiego di parti e/o ricambi non originali esonerano il produttore da ogni responsabilità e garanzia.

**Piezas de repuesto y accesorios**
Indicamos expresamente, que aquellos repuestos y/o accesorios no suministrados por nosotros no están comprobados ni homologados por Aerzen. Su montaje, así como su utilización pueden tener incidencia en las características prefijadas de la instalación. Por lo tanto no asumimos garantía ni responsabilidad alguna sobre éstas piezas y de los eventuales daños posteriores y/o alteraciones de las calidades y prestaciones de origen. Para daños originados por la utilización de piezas y accesorios no originales, se excluye cualquier responsabilidad por parte del fabricante.

# Aerzener Maschinenfabrik

## Leistungsdaten

***Performance data***

Delta Blower 5 Generation

# Aerzener Maschinenfabrik

## Ersatzteilliste / *spare parts list*

Delta Blower 5 Generation

| | | | |
|---|---|---|---|
| **Auftrags-Nr.** *order no.* | | **Typ** *type* | |
| **Fabrik-Nr.** *serial no.* | | **Kundenbestell-Nr.** *Customer's order no.* | |
| **Lieferanschrift** *Dispatch address* | | | |
| **Rechnungsan-schrift** *Invoice address* | | | |

| Pos. | | Stückzahl / *quantity* | Pos. | | Stückzahl / *quantity* |
|---|---|---|---|---|---|
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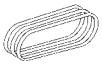
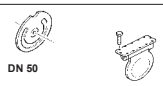
| 2142 |  | | 7211 | | |
| 0612 |   | | 2141 | | |
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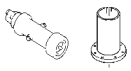
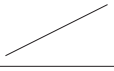
| 4420 |  | | 8310 | | |
| 6520 | | | 8311 |  | |
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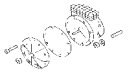
| 5310 |  | | 6880-6881 | | |

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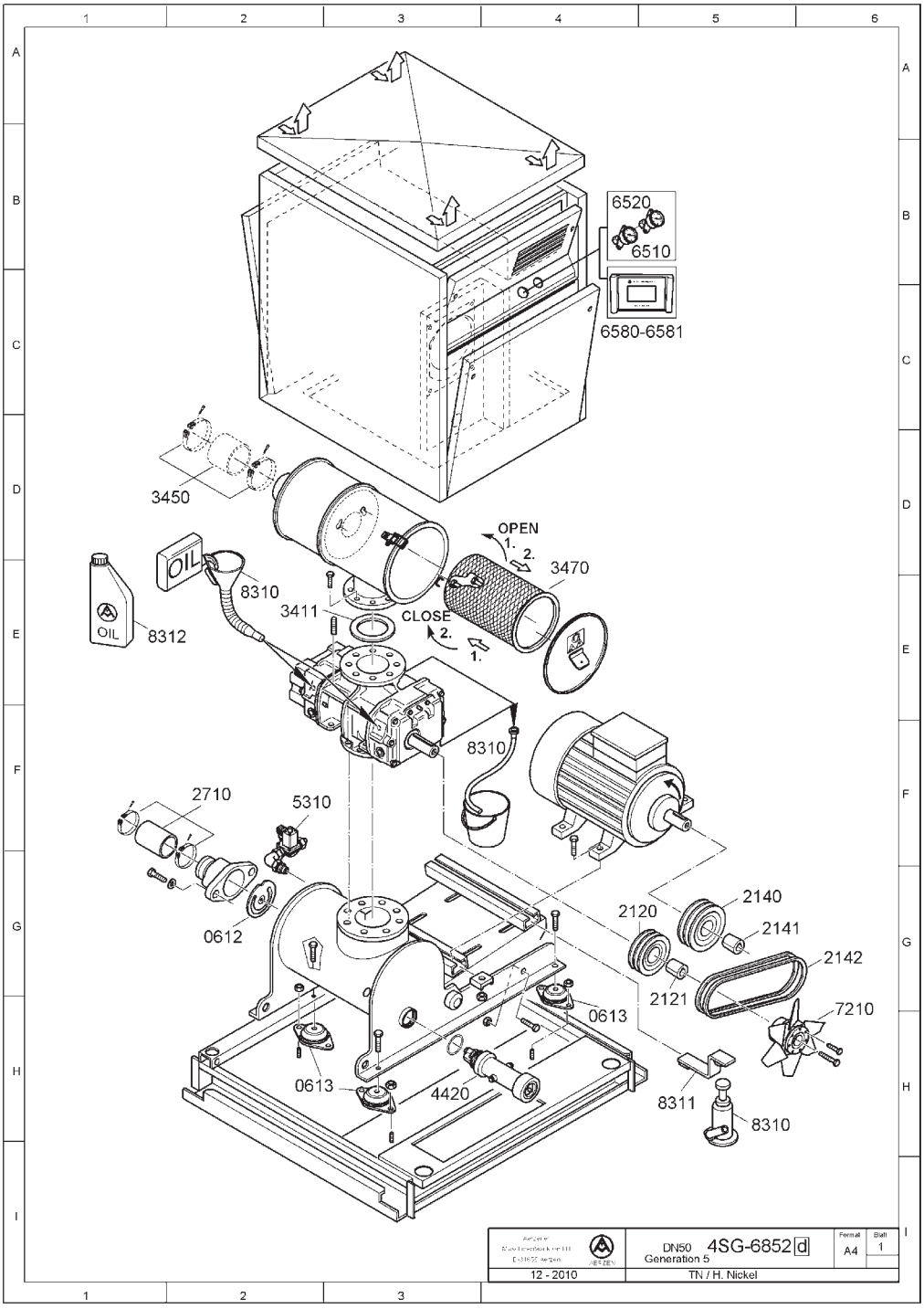
**Abruf unter (++49) 0 51 54 81 192**
***Please send your ordering to the Aerzen representation / -company responsible for your country.***
***Fax polling ++49 (0) 515481192***

ENGLISH

Aerzener Maschinenfabrik
Abteilung Technische Dokumentation / TN
Technische Illustration & Redaktion
H.Nickel Technischer Autor

# DELTA BLOWER

## Verschleißteilzeichnung / *Wearing parts drawing*




**Diese Abbildung ist eine Beispiel-Darstellung und dient der Ersatzteilbestellung.**
**Abweichungen zu der ausgelieferten Maschine sind möglich.**
**Detaillierte Informationen enthält die auftragsbezogene Zeichnung.**

This figure is an example-presentation and serves for spare part order.
Deviations to the machine supplied are possible.
The drawing gives detail information according to the order number.

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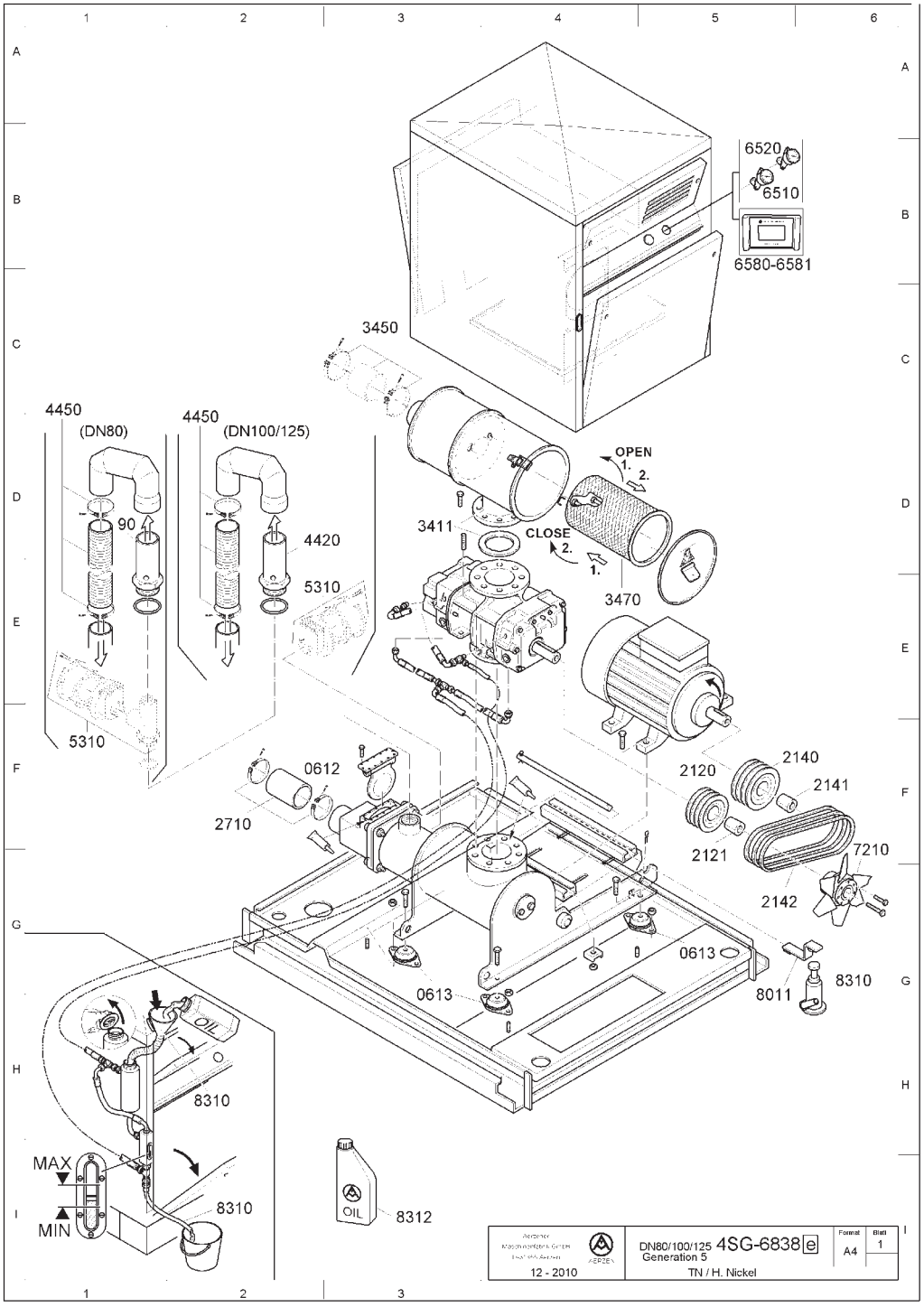
## Verschleißteilzeichnung / *Wearing parts drawing*

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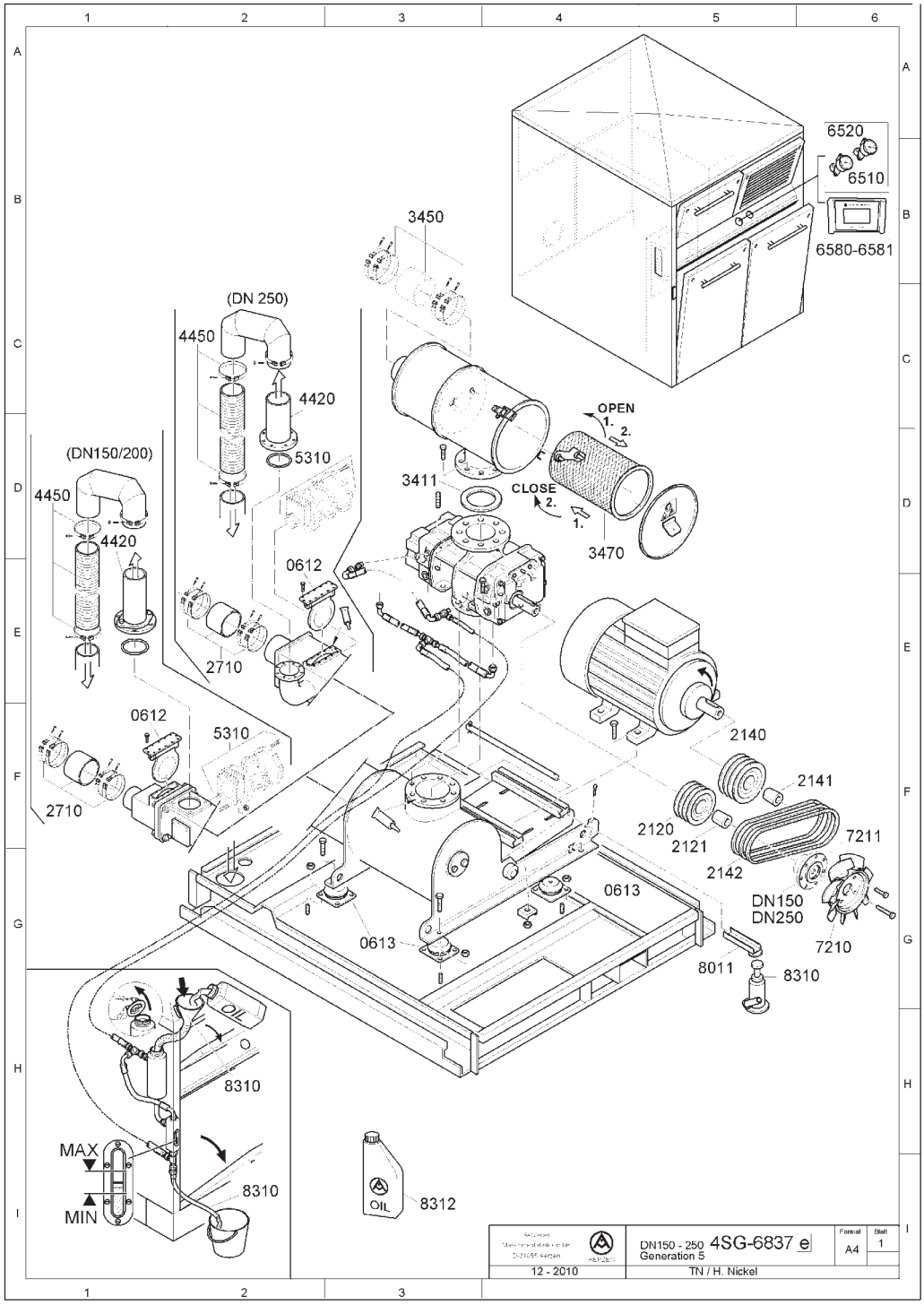


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# Suitability/General information

The German version of these instructions is the “Original instructions”.
Any version in a language other than German is a “Translation of the original instructions”.

Aerzener rotary piston machines are suitable for the oil-free conveying and compression of air and, if specially modified versions are used, various other types of gas.

The technical performance limits must be observed if perfect operation of the equipment is to be ensured in the long term.
The performance limits specified in the order confirmation apply.

The intake temperature $t_1$ specified on the order confirmation serves as the installation site ambient temperature.

Non-observance of the technical performance limits or the safety information shall absolve Aerzener Maschinenfabrik of its warranty obligations and its liability to pay damages or compensation as a result of any consequential damage. The same shall apply to defects that can be traced back to recommended inspections not being performed correctly or on time.

The vibration behaviour of blowers and compressors with mounted belt pulleys or couplings is largely determined by the balance quality of the pistons/rotors as well as the balance of the driving elements.
At Aerzener Maschinenfabrik, the piston/rotor driving shafts are balanced using the „half-key balancing“ technique.
The belt pulleys/couplings must be used in accordance with the requirements of balancing type „H“.

The maintenance intervals according to these operating instructions must be followed and carried out properly. Complying with the maintenance specifications will ensure that the machine retains its value and will also promote operational reliability.

Delta Blower generation 5

# Construction, function

**Unit:**
The standard unit is delivered with mounted accessories, ready to operate.
However, the following additional work must be carried out:

- Connect the delivery pipes.
- Check the oil level.
- Adjust the level, if necessary.
- Install the electrical connection.
- Install special accessories which are supplied separately, if necessary.

**Service package:**
An Aerzen service package is available for the delta blower unit. It includes auxiliary equipment and material for filling with oil and lifting the hinged motor mounting plate, for example.

**Generation 5/Initial quantity of operating oil:**
With few exceptions, „fifth generation“ series units are supplied with an initial quantity of operating oil. The lubricating oil is stored in suitable containers located inside the acoustic hood/on the unit. Please take note of the machine type specifications on the lubricating oil container. The initial oil supplied is the exact quantity required by the blower. This means that the oil container may not be completely full. Please observe the machine‘s oil filling quantity and check the level using the markings on the sight glasses found either on the blower and on the acoustic hood, as appropriate.
Please retain the lubricating oil container until the first oil change so that it can be used for catching and collecting the waste oil.

**Motor connection:**
Electrical installation has to be performed by an authorised electrical fitter. The terminal diagram for the motor can be found in the cover of the terminal box as well as in the accompanying documentation.
Connect the motor and control circuit voltage to a common, stable network to ensure that the locking of the power contactor will be disabled if the power supply fails. Avoid voltage fluctuations and dips.
Alternative: Install an electronic monitoring relay in parallel with the driving motor which will disable the locking of the power contactor if the power supply fails.
A restart should only be possible after a complete machine standstill.

Prerequisites for operating rotary piston machines with asynchronous electric motors on a 3-phase AC supply network**:**
The machine should only be used on stable three-phase supply networks.
The voltage and frequency limits must be observed.
These are specified in EN 60034-1.
Voltage fluctuations/dips beyond the tolerance zone can seriously damage all elements that make up the drive system, e.g. couplings, V-belts, V-belt pulleys, shafts, etc... .
If excessive voltage fluctuations arise in the system,
Aerzener Maschinenfabrik recommends the following measures in order to prevent the blower, compressor or motor from sustaining damage:
- Use suitable protective equipment that will shut down the motor and safeguard it against an automatic restart when inadmissible operating data are detected. Observe also EN 60034-1 and EN 60 204-1.

**Base support:**
The base support is a torsion-stable, cylindrical container that serves as both an absorption-agent-free discharge silencer and as a foundation for the installation of a blower with intake silencer, belt drive, belt guard, hinged motor mounting plate and connection housing. The base support rests on flexible machinery mountings and is to be placed on an even, non-sloping foundation.
A pressure valve appropriate to the size of the blower is also mounted on the base support to protect the blower against overload.

**Filter silencer:**
This silencer is a combination of intake-side silencer and intake filter.
The filter material is easy to access and, therefore, easy to replace.
The degree of contamination/the specifications in the maintenance schedule determine when the filter material is to be replaced.

**Connection housing:**
The connection housing contains a non-return valve that prevents the blower from running in reverse after shut-down.
Additionally, a device for no-load start can be mounted on the connection housing.
A pressure valve appropriate to the size of the blower is also mounted on this housing to protect the blower against overload.
Connect the discharge-side piping to the housing via a rubber sleeve or a compensator.

**Function:**
Aerzen positive displacement blowers are twin-shaft rotating piston machines whose pistons turn against each other uniformly. Timing gears guarantee contact-free running of the rotary pistons. The direction of rotation determines the blower‘s direction of flow, which means there is a discharge-side and an intake-side flange. During operation the conveying medium flows through the intake flange into the housing and is forced into the conveying chambers, which are formed by the pistons and the blower cylinder, towards the discharge side.

Pulsation is reduced by means of interference (patented).
The conveying chamber (cylinder) is sealed from the oil chambers (housing cover and gear case) by piston ring labyrinth seals and the driving shaft is sealed by means of one or two radial seal rings.
If the oil level is too high, oil can penetrate the conveying chamber in an uncontrolled manner.
The compression process creates compression heat. The heat is partly released into the surrounding air via the outer surfaces of the blower and the delivery pipes.
Outer surfaces and delivery pipes reach temperatures which can cause unprotected skin to burn.

**Erst lesen - dann bedienen!**

***Read first, then operate !***

# Due Care to Be Taken Before and During Operation

**CAUTION !** **Identifies all hazardous situations**

**WARNING !** **Indicates direct risk to personnel**

Upon arrival/receipt, the rotary piston machine must be checked against the delivery and order documentation to make sure it has not been damaged during transit and is complete.

Work safety regulations, safety information and operating instructions must all be complied with.

Read the **INFORMATION SHEET** prior to commissioning. Any notes or changes stated on it must be observed.

The tasks described below must only be carried out by qualified personnel who are familiar with the operation of the machine and its components, and have been instructed in the relevant safety information.

This rotary piston machine conforms to European safety regulations. Nevertheless, residual technical risks, which could endanger persons and property, may remain. To prevent this, operators must take note of the following safety information:

**Assembly of the unit**

- Keep the flange connections sealed during installation.
- The ingress of dirt, burring, sputtering, liquids or similar must be avoided.
- Remove the seals and covers on the flanges just before the ducting connection.
- The rotary piston machine can otherwise be blocked or sustain serious damage.

**Information about operating data**

- The machine must be used appropriately and in compliance with the regulations, and within its performance limits.
- The sound pressure level may deviate from that stated in the operating data, depending on the operating state. A sound pressure level in excess of 85 dB(A) may therefore occur for a short period of time.

**Information about general operation**

- The general safety and industrial accident prevention regulations set down by law must be taken into account in addition to the information in the operating instructions.
- The user has an obligation to only operate the machine in perfect, original condition and when it is safe to operate.
- The rotary piston machine is equipped with electrical energy in order to avoid any hazards that may be caused by electricity.
- Only trained electrical technicians may work on current-carrying components.
- Any possibly dangerous electrostatic charging must be avoided and/or enable the discharge of electrical charges with the support of devices.
- A suitable earthing system must be equipped to protect against possible damage caused by lightning strikes.
- For operation, the unit must be equipped with one or more **EMERGENCY BREAK** control units. The **EMERGENCY BREAK** function must be available and ready for operation at all times, independent of the type of operation.

- It must be ensured that a stopped positive displacement machine cannot be moved from the rest position without operating the start function, no matter what the cause!
- Damaged rotary piston machines or machines that are not in perfect working order must be replaced immediately.
- Any operation that impairs machine safety is prohibited.
- The supplier documentation provided with the accessories and the general safety regulations must also be observed.
- The unit contains rotating components. If their protective equipment, according to the version of the unit, e.g. the acoustic hood, belt guard, coupling guard etc., are not observed or are not used appropriately, there is a
- **risk of injury !**
- Protective equipment such as the belt guard/coupling guard, blower guard, hood elements, electrical safety elements, pressure valves, motor protection/EMERGENCY OFF etc., must not be removed or its operational safety restricted whilst the machine is in operation. ***Risk of injury !***
- Do not operate when electrical, mechanical or hydraulic connections are defective missing or are not correctly connected.
- It is expressly prohibited to operate the rotary piston machine without the appropriate protective equipment or safety devices.
- It is expressly prohibited to remove or modify any protective equipment located on the rotary piston machine, divert it from its intended use, or attach third-party protective equipment.
- Do not operate the unit if protective equipment such as the belt or coupling guard, acoustic hood elements, pressure valve, etc., is defective or missing.
- When carrying out work on the unit, the drive motor must be securely disconnected from its power supply.
- Never look into or touch the discharge opening/side of the pressure valve!
- There is a **risk of injury** from decompressing gas escaping at a high speed when the pressure valve is drained. Residual pieces of contaminants, dust particles etc. may escape along with this.
- Screwed connections should only be retightened while the machine is in a depressurised state or is shut down.
- The machine must only be used in stable three-phase supply networks. Voltage fluctuations/dips beyond the tolerance zone can seriously damage all elements that make up the drive system, e.g. couplings, V-belts, V-belt pulleys, shafts, etc. The operator must use oil of a suitable quality, conforming to the Aerzener lubricating oil specifications.
- Observe the safety, operating and maintenance information of the drive motor manufacturer!

**Safety instructions for commissioning**

- These operating instructions must be read and understand before commissioning the machine.
- Commissioning must only be carried out by persons with the relevant knowledge and skills.
- Before switching on the machine, ensure you are familiar with all protection, operation and monitoring elements by referring to these instructions.
- Before commissioning, the unit must be equipped with a command system with which the machine can be shut down according to the hazard potential in order to return the machine to a safe state.
- The energy supply to the drive motor must be disconnected as soon as the machine is shut down. If this is not possible, the operating state “Shut down” must be monitored and maintained.
- Check that the intake side is clean before commissioning.

- Any evidence of dirt, dust or foreign matter must be removed from the intake area.
- Compliance with the maintenance schedule is absolutely mandatory.

**Qualification of operators**

- Each person dealing with the installation, operation, maintenance and repair of this unit must have read and understood the operating instructions.
- The unit must only be operated by trained and authorised personnel.
- Personnel must be trained according to the operating instructions.
- Responsibility for operation must be precisely defined in order to prevent any unclear
- designation of responsibilities.
- Operators must be proficient, instructed and appointed to the work.
- Only trained and authorised electrical technicians may work on current-carrying components. The unit must be disconnected from the power supply. Fuses must be disconnected.

**Safety instructions in relation to prevailing residual risks**

- The warning and information signs on the machine must be observed.
- They provide important information about potential sources of danger.
- Check that the machine is not damaged in any way before commissioning.
- Do not operate the unit if electrical connections are damaged, defective or not properly connected.
- Do not operate the machine with exposed and accessible inlet or discharge sockets, for the following reasons: Rotary piston machines are positive displacement machines which present a risk of injury in the area around the conveying chamber.
- Only suitable tools that correspond to the respective standards and design of the bolts, nuts and screwed connections must be used.
- When using cleaning agents and sprays, there is a risk of poisoning from inhalation, and a risk of burning from coming into contact with them.
- Please refer to the material safety data sheets for the operating materials used.
- Avoid skin contact with or the swallowing of the lubricant. ***Risk of poisoning !*** Wear protective gloves.
- Used lubricants are extremely harmful to the environment and can contain noxious materials.
- Lubricants must be stored and disposed of properly and in an environmentally-friendly manner.
- The appropriately fitted rotary piston machines must be used for conveying oxygen. A lubricant especially suited for operating with oxygen must be used.
- Disregarding these warnings is a ***risk of fire and explosion !***
- Rotary piston machines with separate speed monitoring are equipped with a contact plate on the drive shaft.
- This contact plate rises above the diameter of the belt pulley and reaches operating speed.
- Disregarding the separating protective equipment is a ***risk of shearing !***

**Warning signs for hazardous operations**

- Repairs and modifications to the unit must only be carried out in a professional manner. If you have any problems, please contact Aerzener After-Sales Service for assistance.
- Before carrying out any retrofitting, servicing or maintenance work that requires the removal of protective equipmen, the power supply must be disconnected and the machine secured to prevent it starting up.
- When replacing and cleaning the filter material (if present)
- dust particles and fibres may be released into the ambient air. Do not breathe in these materials. These materials must not reach the unprotected intake area of

the rotary piston machine.
- Lubricating and control oil pipes should only be retightened or opened while the machine is in a depressurised state.
- Depressurise conveying ducts before attempting to remove them.
- When conveying technical gases, conveying ducts must be rinsed with a neutral gas before disassembly.
- Note the oil temperature when changing the oil. The oil temperature must rise above 60°C. If it is above 60°C, there is a ***risk of burns !***

**Personal protective measures**
- Conveying ducts or components on the discharge side must not be touched without adequate protection. The ducts and components can reach temperatures in excess of 70°C.
- ***Risk of burns !***
- If the acoustic hood is open or missing, there is ***risk of burns*** when the housing surface becomes hot as a result of operation.
- Protective gloves and clothing must be worn.
- Close-fitting clothing is required due to the presence of rotating components.
- ***Risk of injury !***
- Ear protection must be worn during machine operation.

**Information about the installation site**
- It is the operator‘s responsibility to use and operate the machine in accordance with its intended use taking into account the local conditions.
- The machine must only be operated in a suitable, well-ventilated installation site. The installation site must be free from excessive dust, acids, steam and explosive or flammable gases.
- The installation site must be arranged to avoid risks as a result of the ambient air, the medium to be convyed or oxygen deficiency.
- The installation site must be arranged so that the commissioning of the rotary piston machine does not impose a risk of overheating, fire and/or explosion.
- The protective equipment provides protection against injury and must not be modified or bypassed.
- When using diesel or petrol drive motors, there is a ***risk of poisoning*** if there is insufficient room ventilation. The installation site must be sufficiently ventilated. The motor manufacturer’s operating instructions must also be observed

**Information on operation with an acoustic hood**
- The acoustic hood is a structural safety component.
- During operation with an acoustic hood, all hood elements are to be closed before starting operation and are only to be opened after the motor has been shut down and the fuses removed or switched off.
- The acoustic hood prevents the risk of injury from rotating and hot components.
- If the acoustic hood is opened while the machine is operating,
- there is a ***risk of injury***.
- When installing and assembling the unit, no sparks or glowing objects caused by, e.g. welding or separating, are allowed to enter the foam in the acoustic hood. ***Risk of fire ! Risk of glowing embers !***
- Fire regulations must be adhered to for all “hot work operations” close to the unit.
- **CAUTION !**
- When commissioning, sparks, glowing or other fire-causing objects could be taken in from the intake airflow and, fanned by the acoustic hood ventilator, set the foam alight.
- ***Risk of fire !***
- No welding or separating is to be done on the acoustic hood as sparks or sputtering caused by the applied thermal energy could set the foam alight.

- ***Risk of fire ! Risk of glowing embers !***
- Depending on the size and increased fire protection regulations, a flame retardant foam would be applied according to the order.

**Information about the event of damage**

- If the unit produces an abnormal and/or unusual sound, the machine must be shut down immediately using the **EMERGENCY BREAK** function.
- The energy supply to the drive motor must be disconnected.
- If the unit is blocked, the energy supply to the drive motor must be immediately disconnected.
- The cause of malfunction must be determined.
- Aerzener Service can be quickly at hand and provide expert troubleshooting for you.
- The unit must not be taken into operation until it is properly functioning.

**Information about operating the pneumatic conveyer/air-separation systems**

- When using the positive displacement machine for pneumatic conveying or in air-separation systems with alternating air-separation columns, pressure surges must not occur when switching between different delivery lines. Pressure surges can be prevented by making the switching process for the ¬intake-side and discharge-side valves take at least five seconds. This pre-accelerates the gas column in the pipework and prevents damage¬ to the positive displacement machine caused by sudden acceleration of the gas. The distance between the switchover valve and the intake-side flange must be at least ¬10 x DN, where DN = nominal diameter of the pipework. This safety note applies to both pressure and vacuum ¬mode.

## *Inadmissible operating methods*

- Installation on uneven and / slanting foundations.
- Securing transport devices to the acoustic hood, e.g. using eye bolts in the accoustic hood element, winding ropes without expansion braces etc.
- Non-observance of operating data.
- Non-observance of maintenance intervals.
- Incorrect direction of rotation.
- Switching on - during run-down.
- - during reverse rotation.
- Inadmissible increase in pressure.
- Remaining under or exceeding maximum rotational speed.
- Exceeding the maximum temperature.
- Pole change to lower rotational speed before motor has come to a standstill.
- Operating without a properly connected fault indicator / control is not permited. Risk of total machine damage!
- Operation without assemblies or with damaged assemblies which serve for the protection of persons and machine.
- Overfilling the maximum oil level.
- Operation without oil.

**“Reasonably foreseeable misuse” that can result from easily forseeable human behaviour:**

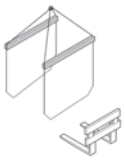
- Operating the machine without having filled the lubricant.
- Operating the machine with too much lubricant.
- Operating the machine with reduced intake performance, e.g. due to a soiled intake filter, starting strainer etc.
- Assembly and commissioning of the rotary piston machine with intake-side and/or discharge-side flange sealers, protection covers or similar.
- Insufficient ventilation at the installation site, no insulated lines.
- Open fire or sparks created by welding, separating or similar in direct proximity to the unit. Risk of fire!
- Operating the machine without an isolated protective device, open belt or coupling drive.
- Risk of injury from rotating components!
- Taking out the transport securing pin under the hinged motor support during operation.
- Only applicable for belt drive machines.

**Foreseeable incorrect operation or use**

- Dust contaminants should be removed before entry into the blower. In particular, substances which can settle in the conveying chamber or the rotors can jeopardise the operational reliability of the machine.
- The same applies to the compression of resublimating gases containing solid particles, which can separate from the gas phase and deposit in the machine. Resublimation in the blower must be prevented via suitable process control (pressure, partial pressure, temperature and speed etc.).

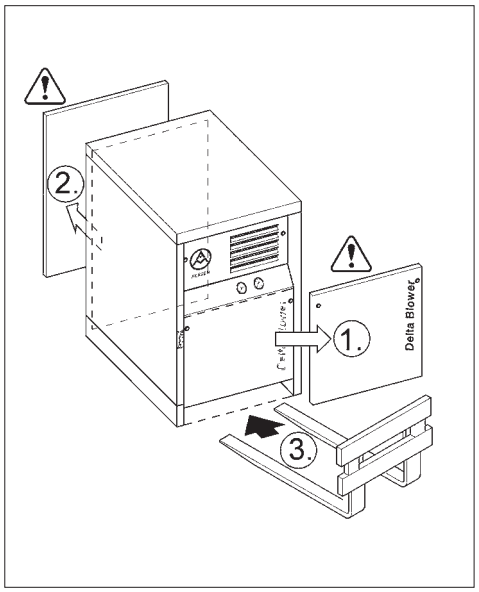
# Transport/Installation/Assembly

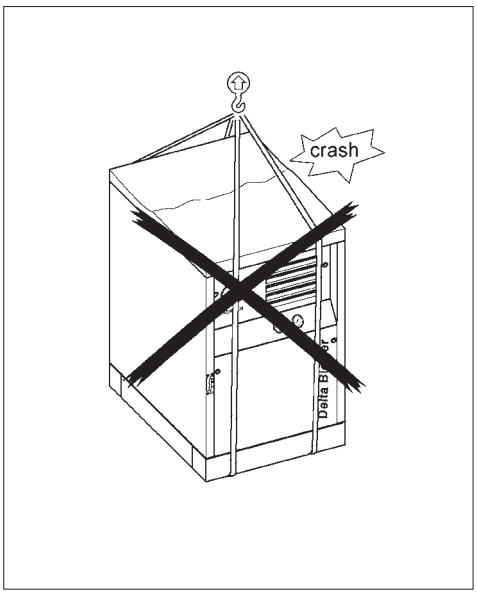
## Transport



When transporting the machine, the following key points must be observed:

- For transportation purposes, the hinged motor support on the belt-driven unit must be fixed in position using transport securing screws or rods. The V-belts must be removed from the belt pulleys.
  Also refer to the chapter „Attaching/Replacing V-belts“.
- Do not expose the unit to impact loads.
- Transport the unit using a crane, fork-lift truck, lift trolley or similar.
- Only suspend the unit as shown in the sketch.
- Use suitable expansion braces that are appropriate for the load concerned. Failure to do so could result in damage or crushing.
- The hoist, cables and chains etc. must be designed for the load concerned.
- Units without an acoustic hood are transported by attaching transport aids either to three or four clevis type eyelets (hinged motor support/base frame) or underneath the transport blocks.
- The hoist must be arranged in accordance with the machine‘s centre of gravity.
- The hoist must not be able to exert any forces on the machine that could result in damage.
- It must be ensured that inadvertent dislocations and harzards due to insufficient stability do not occur during transport and installation of the unit.



## Storage

- Prior to delivery, rotary piston machines are treated and packaged to allow for a 12-month storage period.
- If they are to remain in storage following this 12-month period, they will need to be retreated and the machine will need to be repacked appropriately; see storage and mothballing guidelines TN0 1175... .
- While the units are in storage, ensure that they are correctly preserved and pakkaged and, if necessary, that they undergo nitrogen replenishment in accordance with TN01175. They must be checked every six weeks.
- You must eliminate any adverse influences immediately in order to ensure ongoing preservation.
- Intermediate storage must be in dry, clean rooms that are free of vibrations.
- In the case of belt-driven machines, the V-belts should be slackened during storage.
- During storage, no sealing plugs or plastic caps should be removed from bore holes, flanges, etc. The purpose of these is to prevent any foreign bodies from entering the machine.
- The oil chambers have been sufficiently preserved for one year.
- If the machine needs to be stored for longer than 24 months, the entire scope of supply must undergo a general inspection by Aerzener trained personnel.
- If special packaging is to be used, e.g. for transportation by sea, etc.,
- specific storage and mothballing guidelines laid down by Aerzener Maschinenfabrik must be observed.

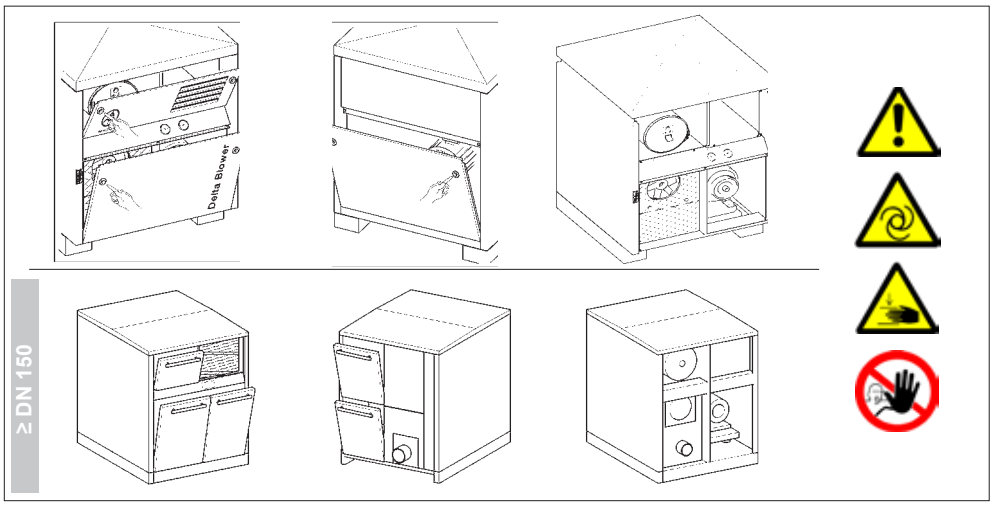
- If the machine is to be stored or if the unit is intended to be taken out of operation for longer than six weeks, the conveying chamber, piston/rotor and bare parts must be preserved.

## Installation/Assembly



During installation/assembly the following points must be observed:

- The relevant acoustic hood elements must be opened for installation and mounting purposes.



**Required ground properties**

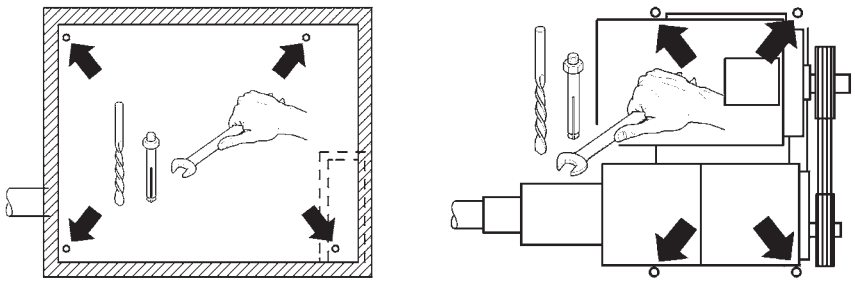
- The unit must be installed on a stable, even foundation that does not vibrate or incline.
- It is *not permitted* to monitor the unit hollow or on lamellar foundations. Risk of deformation of the acoustic hood substructure!
- The foundation, e.g. cement floor, should have a recommended surface pressure resistance of 30 - 40 N/mm2.

- The following foundation tolerances must be observed:

| **Flatness tolerance for finished screed acc. to DIN 18202** | | | | | |
|---|---|---|---|---|---|
| ← m → | **Distance between measuring points in m** | | | | |
| | 0,1 | 1 | 4 | 10 | > 15 |
| **Dimension tolerance in mm** | 2 | 4 | 10 | 12 | 15 |

| **Angular tolerance acc. to DIN 18202** | | | | | | |
|---|---|---|---|---|---|---|
| ← m → | **Distance between measuring points in m** | | | | | |
| | under 1 | over 1 under 3 | over 3 under 6 | over 6 under 15 | over 15 under 30 | over 30 |
| **Dimension tolerance of horizontally tilted surfaces in mm** | ± 6 | ± 8 | ± 12 | ± 16 | ± 20 | ± 30 |

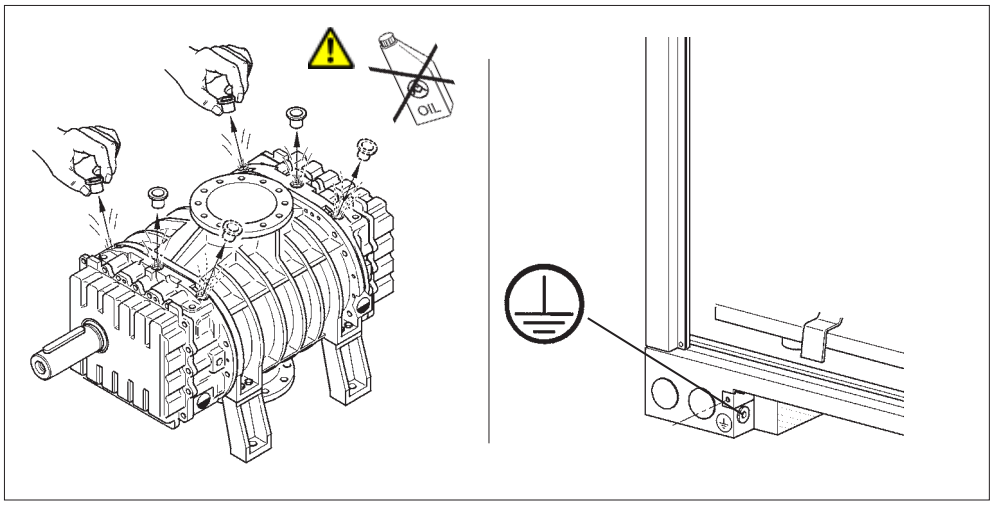
- Depending on the foundation used, it is recommended that you correctly drill and dowel four mounting holes and screw the unit into these so that it is safe to operate.
  One armature screw per machine foot/mounting hole is sufficient for this purpose.



Remove all packaging material. If your machine features an acoustic hood, ensure that the inlet and exhaust air louvre profiles can be accessed.

- Ensure that the installation site is adequately ventilated.
- The following standard installation conditions must be maintained:
  Ambient temperature : -10°C to 40°C
  Rel. air humidity : 0% to 80%
  Chemical-free atmosphere
- Check that the rotary piston machine can run freely. Sluggishness indicates distortion or foreign bodies.

- For the purpose of conveying air, the plastic plugs must be removed from the condensation holes on the blower. This enables a small amount of warm air to escape in order to clear the condensation holes.
  For the purpose of conveying „industrial gases“, the condensation holes must remain sealed.
  If the material to be conveyed has a tendency to produce condensation, then the condensate should be discharged by means of collecting basins or residual gas pipelines, or by temporarily opening the lower holes (depending on the application).
  CAUTION! Hot gas or condensate can escape through the holes !




- To prevent the units acquiring an electrostatic charge, the motor, acoustic hood and base frame must be earthed via the connections provided.
- Fasten the piping on the discharge side and the piping on the intake side separately to ensure a stable connection.
- A flexible sleeve or compensator must be used for the connection to the pipeline system.
- There must be no forces and/or moments acting on the flange or connections.
- This is necessary to ensure an optimal design for the drive unit.
- Take noise protection into consideration. Ducting and foundations may be induced to produce natural vibrations and the associated sound emissions.
- If you are planning the system in-house, the safety information, maintenance information and technical documentation provided by your component suppliers must also be followed!

**Check the oil level prior to commissioning and correct if necessary.**

**Leveling/Alignment: DELTA BLOWER Generation 5**

The **Delta Blower Generation 5** unit must be carefully aligned and positioned horizontally and, where necessary, placed underneath the fastening systems for the base.

1. The **base alignment** for the unit must be done using a spirit level.

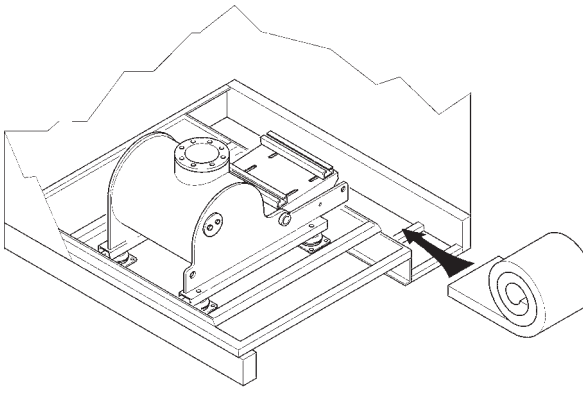
2. **Check the oil level at the blowing stage**
   The oil level is to be checked on the sight glasses of the blower stage.
   The sight glasses must together display an identical medium oil level between minimum and maximum.
   Also refer to chapter “Lubricant Change”.

3. **Leveling the substructure:**
   If varying oil levels occur, shims must be placed under the unit to correct the base alignment.
   The alignment plates provided with the service package should be used to shim the unit.
   The magnitude of any misalignment affects operation safety.

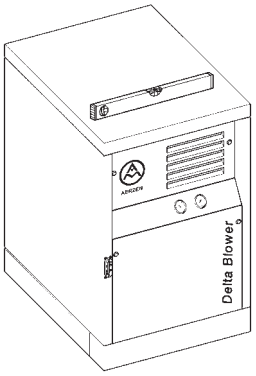
   **CAUTION! If the unit is installed with a tilt, this will result in irreparable damage to the machine caused by the uneven oil level.**

**Version with acoustic hood**

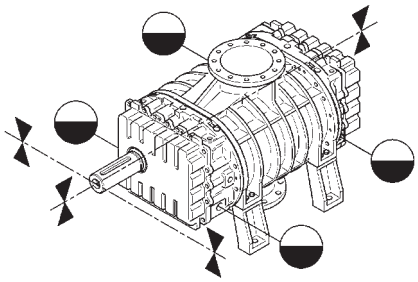
- The insulation strips for the exhaust must be installed in the exhaust duct if they are included separately in the delivery.
- Depending on the acoustic hood version, a foam mat is provided as part of the delivery; this must be rolled out according to the instructions and placed in the acoustic hood.



1. **Base alignment**

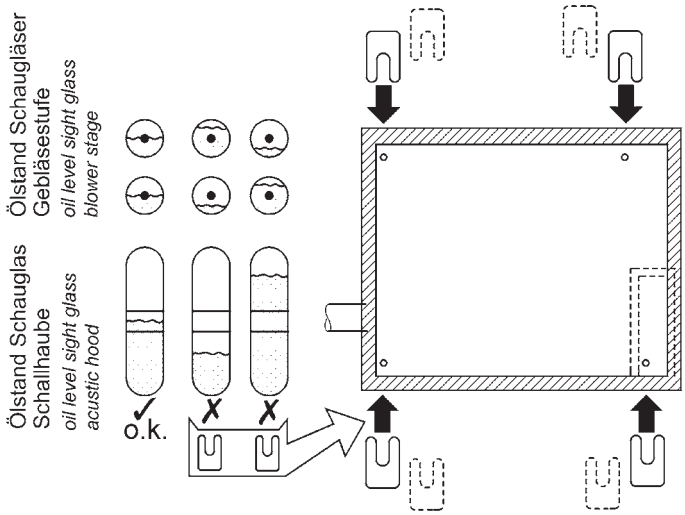



2. **Check the oil level at the blowing stage**



3. **Level the substructure**

**Oil level sight glass blowing stage**




**Oil level sight glass acoustic hood**

# Driving motor

**Observe the Aerzen operating instructions when using driving motors with an Aerzen type plate.**

## Motor connection

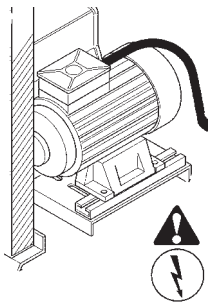
- Connect and operate the driving motor in accordance with the manufacturer‘s operating and connection instructions.
- Electric motor connection: Refer to the type plate, the inside of the terminal box or the information attached to the motor housing for technical data relating to the motor. **Observe the motor operating manual,** supplied separately.
- You must ensure that the nominal electrical data is complied with during operation.
- Only authorised electrical fitters may perform the connection.
- Observe the tightening torques of the terminal screws.
- Install connecting cables for the electric motor so that the cables cannot be damaged. The small movements of the hinged motor support must be taken into account for the belt-driven version. The following instructions must be observed: Motor cable installation for belt-driven units.
- Generation 5: If your unit has an acoustic hood, it may be necessary to remove the intake console and the acoustic hood cover to connect the motor, depending on the size and output of the unit.
- Electricians must observe all applicable regulations when connecting the motor.
- EN 60204-1 must be observed.
- Secure all connections against accidental loosening.
- The connecting hardware must be suitable for the cross-section and type of the connecting leads.
- Cables, leads and connections must not be subjected to excessive bending and tensile forces.
- Install the connecting cables via a stayed cable bridge to prevent the terminal box being subjected to forces or stress.
- Install cables and leads in such a way that they cannot sustain any external damage.
- Avoid contact with the machine, excessive friction and excessive radiant heat.
- The cable and lead sheathing must be resistant to normal wear which is to be expected due to the movement of the hinged motor mounting plate and the effects of contaminants in the atmosphere.
- Fine-core cable is recommended for the connecting leads.
- Connect the motor and control circuit voltage to a common, stable network to ensure that the locking of the power contactor will be disabled if the power supply fails. Avoid voltage fluctuations and dips.
- Prerequisites for operating positive displacement machines with electric induction motors in a three-phase AC supply system:
  Only use the machine in a stable three-phase supply system. Observe the voltage and frequency limits specified in EN 60034-1.
  Voltage fluctuations/dips beyond the accepted tolerances can lead to serious damage to all drive system elements, such as couplings, V-belts, V-belt pulleys, shafts, gear wheels, etc.
  If excessive voltage fluctuations arise in the system,
  Aerzener Maschinenfabrik recommends the following in order to prevent the blower, compressor or motor from sustaining damage:
  - Use suitable protective equipment that will shut the motor down and safeguard it against an automatic restart if impermissible operating data is detected. Observe also EN 60034-1 and EN 60 204-1.

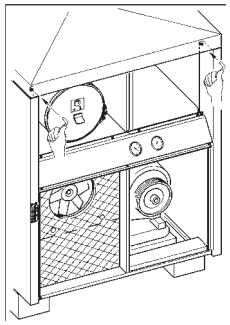
## Motor assembly performed by the customer

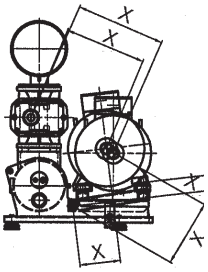
- If the motor is to be assembled by the customer, sufficient motor cooling must be ensured.
- Observe the specifications and paperwork provided by the motor manufacturer.
- Observe and comply with the centre distances and clearances to the positive displacement machine specified by Aerzener Maschinenfabrik.
- Observe the maximum permissible motor weight.
- Install and align the motor in line with the drive.
  Place shims underneath the motor, if necessary. The magnitude of any misalignment affects the service life of the drive elements.

## Permissible starting frequencies of the driving motors

- Up to 160 kW = 6 starts per hour
- From 200 kW = 3 cold starts or 2 warm starts per hour
- Refer to the paperwork provided by the motor manufacturer for further specifications and information.







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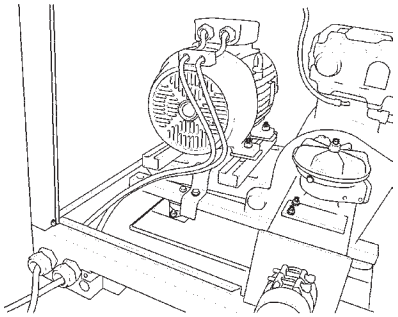
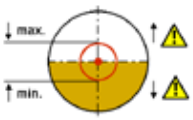


| Kabel<br>*cable* | Kunststoffkabel<br>*plastic-instulated cable* | |
|---|---|---|
| | Uo = 0,6 kV | Uo > 0,6 kV |
| einadrig<br>*single core* | 15 x d | 15 x d |
| mehradrig<br>*multi core* | 12 x d | 15 x d |

# Commissioning

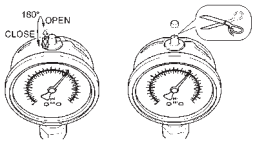
1. The blower unit is to be set up and installed in accordance with these instructions.

2. **Initial commissioning**
   Fill unit with lube oil, if not filled ex factory.
   Check lube oil level and correct if necessary.
   Check oil filler screw and drain valve for correct seating and leakage.
   Check the fan of the acoustic hood ventilation for free and smooth movement.
   If necessary, the blower cover is to be readjusted, to guarantee contactless running!

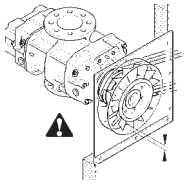


Oil level sight glass on blower stage

Oil level sight glass on the acoustic hood, Generation 5, ≥ DN 80



Pressure gauge bleeding

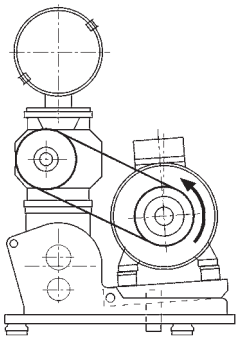

Fan cover, acoustic hood design

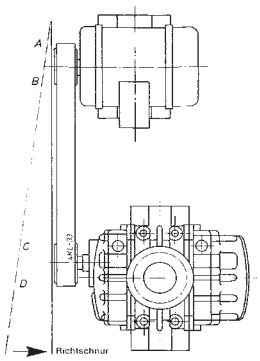
3. Observe commissioning instructions and lubricating intervals of drive motor manufacturer!

4. Depending on design, cut off rubber nipple on the upper side of the pressure gauge (if fitted) or turn bleeder flap to OPEN.

5. Set the maintenance indicator, if present, to „ZERO“.

6. Check rotational direction.
   See also red directional plate on the blower.
   There must be no V-belts on the motor pulley for this.
   Remove the axial locking bolt between belt pulley and the motor housing, if fitted.
   Start drive motor briefly / approx. 1 – 2 seconds.
   See also the instructions of the supplier of electrical components or plant manufacturer!
   ATTENTION! Incorrect rotational direction destroys the blower.
   From the viewing position the blower turns left on the drive shaft.
   The rotational direction of drive motor and blower must be identical.


Direction of rotation



Example: Check the alignment of the V-belt pulleys

7. When rotational direction is correct:
   Remove the transport securing bolt on the hinged motor support plate.
   Check the alignment of the belt pulleys.
   Lift the hinged motor support plate with the aid of a hydraulic lifter.
   Install the V-belts.
   Relieve the hinged motor support plate / remove the hydraulic lifter.
   The weight of the motor automatically tensions the V-belts.
   Close the openings on the motor drive shaft in the belt guard with the pre-i nstalled, adjustable protective covers.
   Push the protective covers up to a maximum of 10 mm toward the motor drive shaft and secure.

8. Connect the pipes to the operational unit.

9. Labels with safety instructions must be legible and safety devices tested.

10. Open valves on the system side. The machine can be started.

11. Switch on drive motor!
    Switch off after approx. 20 seconds and monitor blower for ease of run-down.
    If the pressure relief valve blows, shut the system down immediately and remove the cause.

12. Switch on again.
    Check EMERGENCY-OFF switch / EMERGENCY STOP command switch unit to make sure it is working!

13. The unit is now ready for operation.

## Switch off / shutdown

- Switch off is effected via the power switch on the motor.
- To shut the unit down completely the fuses must be removed after the blower has come to a standstill. The valves on the conveying pipes must be closed. Avoid possible entry of condensate into the blower stage.
- In case of a shutdown for more than six weeks the conveying chamber is to be preserved and the blower turned regularly by hand to avoid damage due to stand-still. Observe also the TN01175 regulations governing storage and preservation.

In case of danger:
Press EMERGENCY - OFF button. For details refer to the instructions of the supplier of electrical components or the plant manufacturer.

## Frequency converter operation

- If the electric motor is driven by frequency converters, we strongly recommend using an engine throttle and power choke. These are specifically designed for the frequency converter and filter dangerous harmonics from the drive current. Damage to the motor winding can be prevented by improving the electromagnetic compatability of the system and reducing reactions of the frequency converter in the current.
- The electrical and mechanical characteristics of the drive motor are to be taken into account.
- The minimum frequency must always be fixed. This frequency must never fall below the fixed minimum during operation.
- The maximum frequency is to be set by taking into account the maximum rotational speed of the motor and the maximum speed of the blower / compressor.
- The run-up time of the drive motor from standstill up to minimum speed may be 3 to 6 seconds.
- The frequency converter must be designed with a constant load moment for operation with a working machine.
- Rotational speeds must no fall below minimum nor exceed maximum.
- The highest admissible voltage increase speed of the motor converter is 1200 V/ µs.
- When exceeding the value, e.g. due to excessively long cables, frequency converter type… etc. a motor throttle / motor filter coil to match the frequency converter is to be used.
- If these components are not used, this can lead to damage of the motor isolation and to a motor breakdown.
- The maximum rotational changeover speed on positive displacement blowers / screw compressors, after run-up to minimum speed, amounts to 1 Hz per second for upward and downward control time.
- Minimum frequency = 20 Hz // maximum frequency = 50 Hz results in a control time of 30 seconds from minimum to maximum.
- The maximum current limit of the motor must not be exceeded. Observe the soecificationa on the motor name plate.
- To prevent operational faults the function “Interception circuit” must not be parameterised in the control of the frequency converter. When the frequency converter is switched off, a restart should only be possible after a complete standstill of the blower or compressor.

Only applies to screw compressors

- At a speeds below 50% the oil pressure sinks to approximately 0.6 bar (ü). To enable the machine to run at speeds up to 25% the ain oil pressure switch, setting value of 1.8 bar (ü), is bridged with a threshold switch.
  A further switch, setting value of 0.5 bar (ü), is installed for oil pressure safety.

## Operation with pole-changing motor

Between a changeover of motor speed

- from a high to a low speed, the motor must have reached zero rotational speed each time.
- from a low to a high speed, changeover can take place instantaneously.

10

# Maintenance

Maintenance is to ensure that all functions are maintained or that they can be restored after a breakdown.

Maintenance includes specifications about inspection, service and repairs.

Maintenance includes instructions for trained and qualified personnel.

If anything is unclear consult Aerzener customer service.

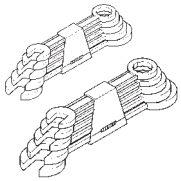
During inquiries please state:
- order and serial number
- prevailing faults / malfunctions as accurately as possible
- steps taken to rectify faults.

Is the machine sent back to the supplier, the following measures are to be carried out:
- Completely drain oil, otherwise it is transport of hazardous goods.
- Treat bare components with preservative.
- Seal flange with blind cover.
- Seal open connections.
- Also observe instructions in chapter “Transport”.

## Inspections / inspection schedule

10.1

A general inspection should be carried out by a service technician from Aerzener after 3 years or 20,000 operating hours.
This includes the preventive maintenance of wearing and replacement parts such as bearings, seal, etc.
We recommend maintaining a stock of replacement and wearing parts to avoid or reduce waiting times and downtimes.



# Maintenance schedule



**Whenever work is carried out on the positive displacement machine, it must be switched off and isolated from the mains electricity supply.
Failure to follow this instruction could result in injury or damage!
Various steps should be taken to achieve a long service life and provide the optimum operating conditions. These include carrying out the maintenance work specified in this table at the intervals specified here.**

| DELTA BLOWER / G5 Overpressure mode | Maintenance intervals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **We recommend carrying out the maintenance work on the positive displacement machine at the specified intervals. The operating hours represent average operating conditions. The actual service life of the equipment may vary depending on environmental conditions and operating data. If you think this situation applies to you, please contact Aerzener Maschinenfabrik.** | **After the first 3 op. hrs** | **After the first 25 op. hrs** | **After the first 500 op. hrs** | **Weekly** | **After every subsequent 2000 op. hours or every 3 months** | **After every subsequent 4000 op. hours or every 6 months** | **After every subsequent 8000 op. hours or every year** | **After every subsequent 16,000 op. hours or after every subsequent 2 years** | **After every subsequent 20,000 op. hours or after every subsequent 3 years** |
| **Check fixing screws and screwed connections**<br>• Re-tighten once the machine has cooled down, if possible | • | | | | | | | | |
| **Starting strainer,** if fitted<br>• Check; can be removed if dirt is no longer being accumulated | | | • | | | | | | |
| **Intake filter**<br>• Check level of filter contamination and, if necessary, replace filter cartridge, max. -45 mbar<br>• Replace filter cartridge | | | | • | <br>○ | | <br>• | | |
| **Check and clean inlet/exhaust openings**<br>• of acoustic hood | | | | | | • | | | |
| **V-belts**<br>• Check condition; replace if necessary<br>• Replace | | • | | | | • | | <br>• | |
| **Belt pulley alignment**<br>• Check; correct if necessary | | • | | | | | | • | |
| **Pressure valve**<br>• Check function | • | | | | ○ | • | | | |
| **Oil level**<br>• Check; correct if necessary | • | • | | • | | | | | |
| **Lubricating oil**<br>• Replace<br>• Replace, with final compression temperatures above 140°C | | | •<br>• | | | <br>• | • | | |
| **Lubricating grease,** only with gas-tight shaft seal<br>• Replace<br>• Replace if Aerzener special rotary piston oil is used and with a final compression temperature above 140°C<br>• Replace if ISO VG 220 is used and the oil has a pronounced dark discolouration | | | •<br>•<br>• | | | •<br><br>• | • | | |
| **Drive shaft seal**<br>**(when conveying toxic / inflammable gases)**<br>• Replace | | | | | | | <br>• | | |
| **Non-return valve**<br>• Check for wear and leaks, replace if necessary | | | | | | | ○ | • | |
| **Flexible pipe connection,** if fitted<br>pressure side/suction<br>• Check for leaks, replace if necessary | | | | | | | | <br>• | |
| **Hydraulic, pneumatic and measurement lines,** if fitted<br>• Check for leaks, replace if necessary<br>• Recommendation: Replace every 6 years | | | | | | | | | <br>• |
| ○ **Halving of or reduction in maintenance intervals (*recommendation*)** | **Under difficult operating conditions such as:<br>- ambient temperatures in excess of 30°C throughout the year<br>- high level of dust etc.** | | | | | | | | |
| **Main inspection / maintenance (*recommendation*)**<br>• Check/replace spare and wearing parts<br>• Check entire machine | | | | | | | | | <br>• |
| **Drive motor**<br>• Perform maintenance<br>• Observe deadlines for re-lubrication | **Please observe the maintenance intervals and maintenance specifications of the motor manufacturer!<br>With Aerzener motors, the Aerzener operating and maintenance instructions must be followed.** | | | | | | | | |

**Arrange for the positive displacement machine to undergo a complete check by the Aerzener Service department at the specified intervals
Or: Take out a maintenance contract with Aerzener Maschinenfabrik.
If you maintain your machine regularly and properly, Aerzener Maschinenfabrik will guarantee maximum reliability for your application.**

# Lubricating oil specification for rotary piston blowers

Additives and viscosity class are the defining factors in selecting types of lubricating oil.
The following oils, which are of the correct viscosity and contain appropriate additives, are to be used in accordance with the relevant operating conditions.

**1. General requirements for lubricating oil properties**

Kinematic viscosity at operating oil temperature : 10 - 13 cSt ($mm^2/s$)
Kinematic viscosity at -10°C : ≤ 3500 cSt ($mm^2/s$)

**Minimum oil additive properties**

- EP wearing protection additives for use in roller bearing gearboxes
- Oxidation stability up to 110°C oil sump temperature,
  at continuous oil temperatures above 120°C = oxidation stability up to 220°C oil sump temperature
- Foam suppressor
- Detergents for solution of deposits
- Neutrality compared with sealing materials made of fluoro-propylene-methyl (Viton).
- Neutrality compared with single-component resin primers
- Adequate shear stability

* Ambient temperature = Temperature in the immediate environment of the machine all year round.

**2. Single or double-shift operation / intermittent operation**

| | | |
|---|---|---|
| Intake temperature stage | : | Up to 50°C |
| Final compression temperature | : | Up to 140°C |
| Ambient temperature* | : | No restriction |
| Lubricant to be used | : | **Aerzener special rotary piston oil**, Order no.: 160 754 or 160 755 |

This lubricating oil is used for the initial filling for standard application conditions.

**3. Continuous operation / 24 hours per day**

| | | |
|---|---|---|
| Intake temperature stage | : | Up to 50°C |
| Final compression temperature | : | Up to 140°C |
| Ambient temperature* | : | No restriction |
| Lubricant to be used | : | **Aerzener special rotary piston oil**, Order no.: 160 754 or 160 755 |

or

**ISO VG 150**
Fully synthetic (PAO) poly-alpha-olefin, gearbox or compressor oil
Example : MOBIL SHC 629

**4. Operation at final compression temperatures above 140°C**

| | | |
|---|---|---|
| Continuous oil temperature | : | 120°C to 140°C or |
| Final compression temperature | : | Above 140°C |
| Lubricant to be used | : | **ISO VG 220**<br>Synthetic lubricating oil with a polyglycol base oil.<br>Example: ESSO Glycolube 220<br>ARAL Degol GS 220 |
| Note | : | Oil change intervals are to be halved in case of significant, dark oil discolouration. |



**5. Lubricating oils in the foodstuffs and pharmaceutical industry**

For rotary piston blowers it is possible to use lubricating oils that have approval as per the specification USDA H1.
Experience in operation is only available with the following lubricating oil. Aerzener Maschinenfabrik cannot approve any other oils.
It is recommended to perform an oil analysis in agreement with the oil manufacturer after 1000 operating hours.

| | | |
|---|---|---|
| Final compression temperature | : | Up to 120°C |
| Continuous oil temperature | : | Up to 100°C |
| Lubricant to be used | : | **ISO VG 100**<br>Klüber oil 4UH1-100 N |

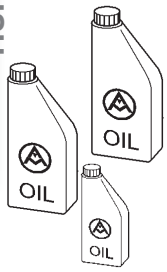
| | | |
|---|---|---|
| Final compression temperature | : | Above 120°C |
| Continuous oil temperature | : | Above 100°C |
| Lubricant to be used | : | **ISO VG 220**<br>Klüber oil 4UH1-220 N |

**Changing to other oil types**

- The Aerzener special rotary piston oil and PAO oils are completely consolute. When switching from one type of oil to another, there are no special measures to be taken into account. However, in order to maintain the useful properties of the new oil type, the oil to be changed should be completely drained and a single intermediate oil change undertaken after an operating period of 100 hours. Only the same oil should be used for refilling.
- Polyglycol-based oils cannot be mixed with Aerzener special rotary piston oil or PAO oils. In case of doubt, the oil chambers are to be opened and flushed.
- Oils based on perfluorinated polyethers, e.g. Fomblin, cannot be mixed with either Aerzener special rotary piston oil or with PAO, or with polyglycol oils. To change the oil the machine must be completely dismantled and the entire oil system through cleaned of all residue. A flushing run prior to commissioning is recommended.

# Lube oil quantities






**Total oil quantity,**
**in approximate litres / oil level up to middle of gauge glass on the blower stage**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| GM 3S | 0.55 l | | GM 4S | 0.55 l | | GM 7L | 0.55 l |
| GM 10S | 0.86 l | | GM 15L | 0.86 l | | GM 25S | 1.2 l |
| GM 30L | 1.20 l | | GM 35S | 3.00 l | | GM 50L | 3.50 l |
| GM 60S | 6.50 l | | GM 80L | 6.50 l | | GM 90S | 11.50 l |
| GM 130L | 11.50 l | | GM 150S | 11.00 l | | GM 220L | 11.00 l |
| GM 240S | 17.50 l | | GM 315L | 17.50 l | | GM 400L | 22.00 l |

**Total oil quantity /**
**only applies to generation 5 units with acoustic hood**
**in approximate litres / oil level up to mark on the gauge glass of the acoustic hood**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| GM 3S | 0.55 l | | GM 4S | 1.00 l | | GM 7L | 1.00 l |
| GM 10S | 1.40 l | | GM 15L | 1.40 l | | GM 25S | 1.75 l |
| GM 30L | 1.75 l | | GM 35S | 3.75 l | | GM 50L | 4.50 l |
| GM 60S | 7.50 l | | GM 80L | 7.50 l | | GM 90S | 12.50 l |
| | | | | | | | |
| | | | | | | | |

**Generation 5 units with acoustic hood**

**NOTE:** The lubricating oil volume specification is a guide value. The display in the oil sight glasses of the blower or the display in the oil sight glass of the acoustic hood are crucial for determining the oil fill volume.

# Change of lubricant on the drive shaft

> Only on drive shaft of gas-tight design <

Changing lubrication on a gas-tight drive shaft is carried out by means of re-lubrication on the drive shaft.

- Depending on the sealing method, a lube oil or grease block is used.
- If an oiler is used the oil level is to be checked weekly and topped up if necessary. The maximum oil level should be in the middle of the oiler.
- If a grease bush or grease nipple is used, the grease quantities listed below, according to the intervals listed in the maintenance schedule, are to be used for re-greasing.
- Please note!
  The grease is to be pressed in / changed several operating hours before the lube oil change. In this way the used, excess grease reaches the oil chamber of the blower and can then be drained together with the lube oil.
- Once the grease has been pressed in, the cover for the compression lubricator must be turned back into place by one rotation. The volume of grease pressed in may therefore expand if heated. Please ensure that this rotation is observed once the grease has been pressed in and add it to the necessary number of rotations.

**Grease specifications**

- When using lube oils according to Aerzener lube oil specifications, *except polyglycol oils*, grease type KHC-2P-30 is used.
- Filled at factory: **KLÜBER PETAMO GHY 133 N**

- When using polyglycol oil according to Aerzener lube oil specification, grease type **MPG2K-40** is used

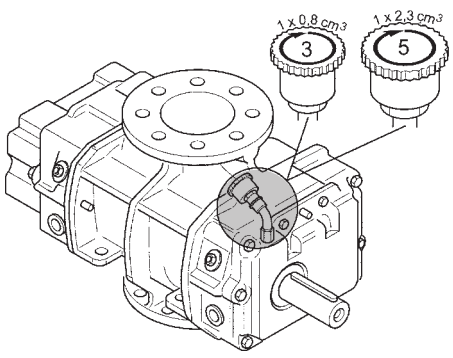
**KLÜBER SYNTHESO PROBA 270**

- Mixing of different greases is to be avoided.
- Re-lubrication is admissible only with the same grease.
- If these greases are not available, they are to be removed completely and replaced with other greases according to KHC-2P-30 or MPG2K-40.
- Observe sealing consistency with Viton.

**Re-lubrication quantities**

| | | |
|---|---|---|
| Type | GM 3S - GM 30L | ≈ 5 cm³ |
| | GM 35S - GM 130L | ≈ 10 cm³ |
| | GM 150S - GM 400L | ≈ 20 cm³ |
| Profile | 10 - 12 | ≈ 5 cm³ |
| | 13 - 15 | ≈ 10 cm³ |
| | 16 - 18 | ≈ 20 cm³ |
| | 19 - 21 | ≈ 40 cm³ |

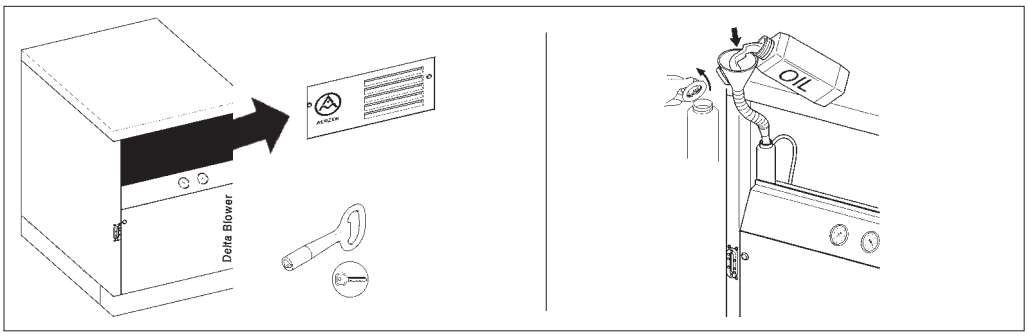
Oiler
Grease nipples
Grease bush

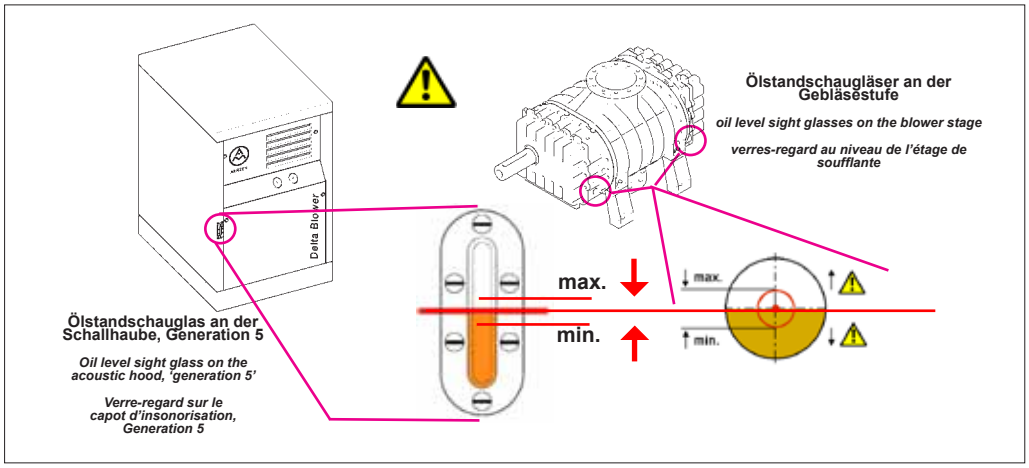


# Changing lubricant

## Filling with oil/Design *with acoustic hood*

- The drain valve must be closed; check that it is properly seated.
- Open the oil reservoir.
- Please note that the bleed line for the oil system ends at the oil filling container. Depending on the level in the oil reservoir, this line must not be closed.
- Use a suitable funnel to fill with oil.
  Please ensure that the oil has a temperature of at least 20°C.
- The filling process should be carried out in stages; observe the capacity of the filling container.
- First fill with approximately ¾ of the specified oil quantity.
- After a brief interval (5 - 10 minutes approx.), the oil level adjusts itself in the oil system and the oil chambers.
- Use the sight glasses on the blower stage and the acoustic hood to check the oil level and, if necessary, to correct it in line with the relevant marks.
  The oil level is correct if it is between the minimum and maximum marks.
  Check and, if necessary, adjust the oil level after the first three operating hours, the first 25 operating hours and then at weekly intervals.
  The oil level can be checked via the acoustic hood sight glass during blower operation.

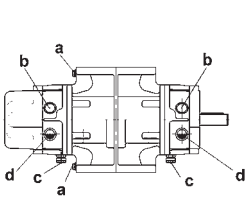


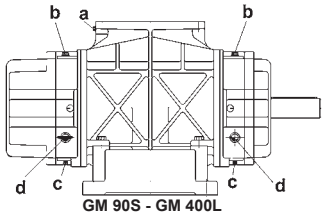

-

- **Filling with oil/**Design ***without acoustic hood***

- Drainage valves must be closed; check that they are properly seated.
- Open the oil flaps.
- The specified oil quantity is to be divided proportionately between both oil chambers according to the oil level indicator. The oil level is correct if it is at the centre of the sight glass;
  observe the maximum and minimum marks.
- Use a suitable funnel to fill with oil. Please ensure that the oil has a temperature of at least 20°C.
- The filling process should be carried out in stages.
- First fill with approximately ¾ of the specified oil quantity.
- After a brief interval the oil level adjusts itself in the oil chambers.
- Now check the oil level and, if necessary, correct it in line with the mark on the sight glass. The oil level may fluctuate between the minimum and maximum marks. Check and, if necessary, adjust the oil level after the first three operating hours, the first 25 operating hours and then at weekly intervals.

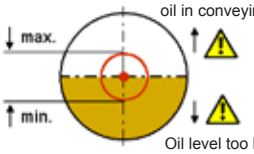



GM 3S - GM 80L




GM 90S - GM 400L

a Connection for measuring instruments
b Oil filler c Oil drainage / drain valve
d Oil level




Oil level too high, oil in conveying

Oil level too low, mechanical damage to bearings and gear wheels

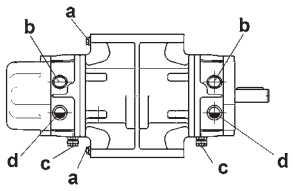
Oil level during machine standstill

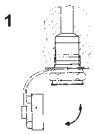
## 10.6 Draining oil

The initial operating oil container can be used as a catch pan.
The waste oil can be properly collected in this container and disposed of in an environmentally-friendly manner at an appropriate collecting station.
Please observe the container‘s capacity.

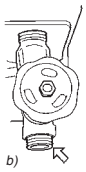
a) *b)* Screw the cap (1) and threaded plug (1) off the drain valve.
If the cap (1) and threaded plug (1) are too tight, hold the valve tightly with an open-jaw wrench and loosen position (1) with a second wrench.
a) Screw on the hose supplied.
a) The drain valve opens automatically.
a) Position the end of the hose in a catch pan.
*b)* Open the manual valve; drain the waste oil into a container.
a) *b)* Dispose of waste oil properly.
a) Remove the hose from the drain valve.
*b)* Close the manual valve; screw the threaded plug (1) in whilst holding the valve tight.
a) Screw the cap (1) onto the drain valve until it is hand-tight.
a) *b)* If the entire drain valve becomes loose or detached from the thread, it must be replaced by a new valve and seal.

Please observe the oil temperature when changing the oil. The oil temperature must not exceed 60°C, due to the thermal load capacity of the „drain hose“.
If the oil temperature is above 60°C, there is a risk of burns.



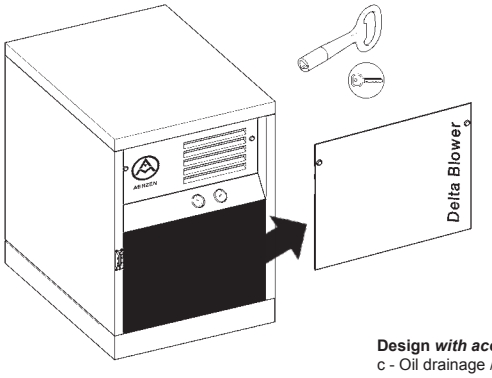



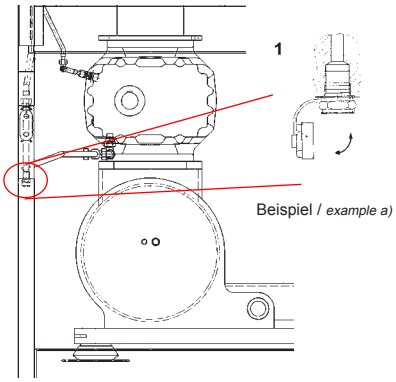

Beispiel / *example a)*



*b)*

**Design *without acoustic hood***
c - Oil drainage / drain valve




Beispiel / *example a)*

**Design *with acoustic hood***
c - Oil drainage / drain valve

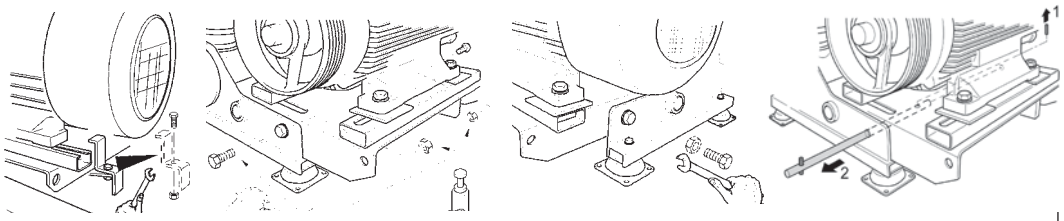
# V-belts

## Instructions for fitting / changing V-belts

Whenever work is carried out on the belt drive, the machine must be taken out of operation and correctly isolated from the mains supply.
The machine must be prevented from starting up/being operated.
**Caution: The belt drive and the hinged motor support plate can sever and/or crush body parts.**

- Open the acoustic hood and / or belt safety guard.
- Remove the protective guard from the positive displacement machine pulley, if fitted, and only on the version with an acoustic hood.
- Remove the protective cover / plastic plate from the belt guard of the motor pulley, only on the version with a belt guard.
- The transport lock must be removed when a belt is fitted for the first time.
  Please observe the information relating to this on the installation drawing.
- Depending on the size of the motor, the hinged motor support plate must be lifted manually or with the aid of the hydraulic jack kit supplied until the belts can be fitted or replaced.
- While lifting the hinged motor support plate, props should be placed underneath in stages to prevent possible accidents.
- On a version with a transport locking rod, the rod must be placed in the recess on the base support as the hinged motor support plate is lifted.
  The rod is used as a stop for the hinged motor support plate.
  The hydraulic jack can then be placed on props to achieve a larger stroke at the hinged support plate.
- The V-belts are only to be replaced in sets.
- The number of belts can differ from the number of grooves in the belt pulleys.
- The motor base plate must be fully lowered once the belts have been fitted.
- The belt drive is tensioned automatically by the weight of the motor.
- In the case of a model with a motor base plate support, detailed supplementary instructions 4PG-701... must be observed.
- Fit the belt safety guard and protective covers correctly and / or close the acoustic hood.
- On the version with a belt guard, the distance between the motor drive shaft and the plastic cover is a maximum of 10 mm.

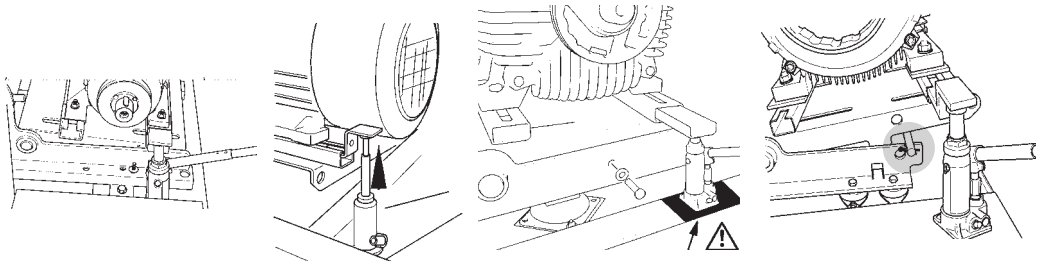
**Disassembly drawing of various transport brackets**

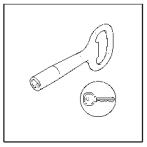



**Lifting of various hinged motor support plates**

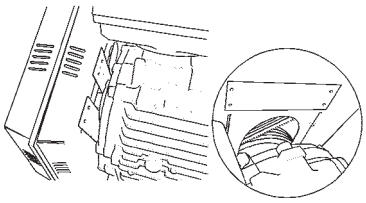
ATTENTION!

Chock hinged motor support plate during lifting.

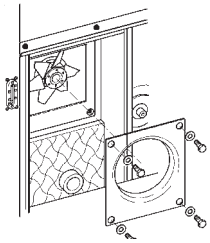


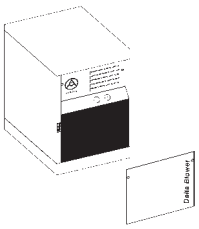


**Motor shaft cover**



**Fan cover**





## Belt drive

- **CAUTION!** It is particularly important to ensure that only genuine replacement and spare parts are used in the belt drive or parts that are recommended and approved by Aerzener Maschinenfabrik.

**V-belts**

- The V-belts to be fitted as replacements must only come from one manufacturer and from one production batch. Otherwise varying belt tensions can occur which can result in uneven running and premature wear.

**Belt pulley**

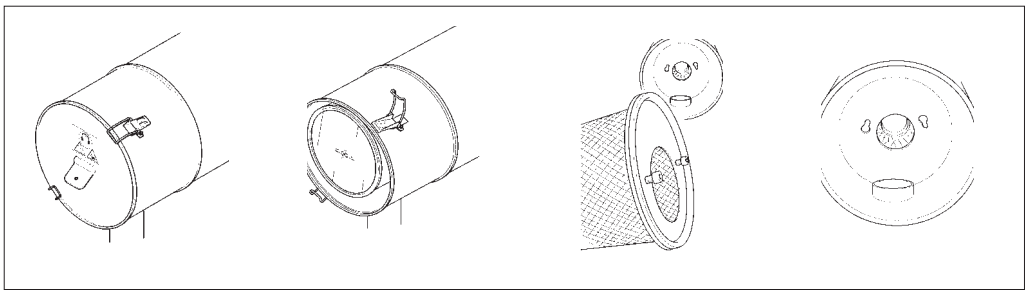
- The belt pulleys are generally fitted and aligned in the factory.
  The alignment should be checked during scheduled maintenance and after replacement of a pulley or pulleys.
- If the customer fits the pulleys, the basic alignment of the two pulleys must be carried out using, for example, a straight-edge.
  CAUTION! Take note of the pulley widths and groove ridges and select where to position the straight-edge accordingly.
- The fine alignment is carried out using optical alignment instruments. The final alignment must be coordinated taking note of the pulley profile.

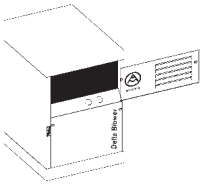
- The maximum permitted belt pulley offset is 0.5 mm.
  The more accurate the alignment, the longer the service life of the belt drive.

- Belt pulleys may only be replaced by trained specialist personnel.
- The belt pulleys must be suitable for the peripheral speed encountered. Danger of snapping!
- Check that the belt pulleys are correctly fitted and firmly seated.
- Comply with the fitting instructions of the belt pulley manufacturer and of Aerzener Maschinenfabrik.

# Intake filter / starting strainer

- Remove the cap locks and then remove the maintenance cover.
- Loosen filter element by “turning left” and remove.
- Replace filter element.
- Insert filter element and tighten by “turning to the right”, observe correct position of insertion groove.
- Correctly install maintenance cover.

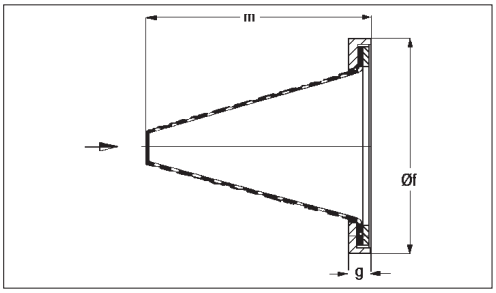




## Starting strainer

- In case of intake from a closed piping system, a starting strainer or a filter housing is to be installed upstream of the machine‘s intake side. Depending on design / order, this is included in the scope of supply.
- This protects the machine against contamination and from foreign particles that are carried into the intake flow.
- The resistance of the starting strainer / filter element is to be monitored.
- The maximum resistance of 45 – mbar must not be exceeded.
- If the strainer remains clean after approximately 500 operating hours, it can be dismantled and replaced by the supplied adjusting ring.
- The filter element is to be checked or replaced according to the respective specifications of the ‘intake filter’ in the maintenance plan.
- The starting strainer consists of fine-meshed gauze with mash size of 0.5 mm with a perforated sheet according to DIN 24041 R 6.3-8.

| DN | Øf | m | g |
|---|---|---|---|
| 125 | 180 | 250 | 15 |
| 150 | 212 | 265 | 15 |
| 200 | 268 | 280 | 15 |
| 250 | 325 | 220 | 15 |
| 300 | 375 | 200 | 15 |
| 350 | 435 | 460 | 15 |
| 400 | 485 | 342 | 15 |



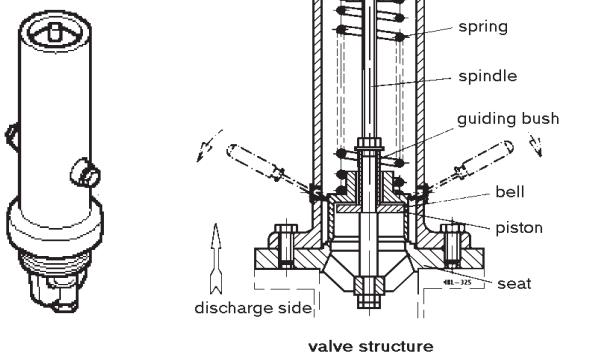
# Checking function of pressure valve

**ATTENTION!**

- The valve is not a control component and is not to be used as such.
- Observe operating instructions G4-002…for pressure valves!
- The unit must be properly shut down for all work carried out on the valve.

**R2“ // DN 50 // R3“ // DN 80 // DN 125**
- The mobility of the valve is to be checked during machine shutdown.
- The valve bell is to be lifted with the aid of two screw drivers.
- *The valve must open correctly.*

**DN 150 // DN 200 // DN 300**
- The mobility of the valve is to be checked during machine shutdown.
- The valve is to be lifted by actuating the lever.
- The valve must open correctly.
- 
- The screwdriver is then to be removed or the aeration device is to be disengaged.
- *A properly functioning valve closes correctly.*
- The valve can be used with temperatures up to 150° C.

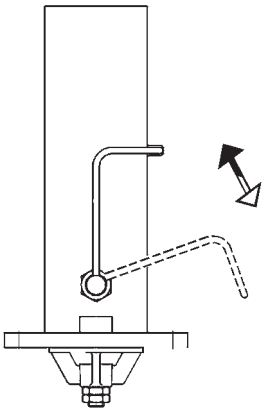


R2" / R3"




valve structure

DN 50 // DN 80 // DN 125



DN 150 // DN 200 // DN 300

# EMERGENCY STOP / shutting down the positive displacement machine

The Delta Blower and Delta Screw series are built and delivered with and without a power cabinet, depending on the order and the model.



**Delta Blower / Delta Screw with power cabinet**
The power cabinet is designed according to DIN EN 60204-1.
According to DIN EN 60204-1, an EMERGENCY STOP command control switch must be installed in the power cabinet on the machine by the customer, depending on model or version.

**Delta Blower / Delta Screw without power cabinet**
On this model, the power supply lines are fed from the customer‘s existing power cabinet, through a cable entry hole in the acoustic hood to the electric motor where it is connected inside the terminal box.
An EMERGENCY STOP command switch unit must be installed in the customer‘s existing power cabinet according to DIN EN 60204-1.
In this case, no emergency stop command unit is installed on the machine at the factory.

The customer must install a power circuit breaker system,
Requirements according to EN 60204-1.
This must contain an electrical overload protection unit, an On/Off command unit and an EMERGENCY STOP command device.
Further EMERGENCY STOP devices must be installed if necessary at the discretion of the user.
The performance specifications of the electrical installation must be designed for the motor operating data, voltage, current and frequency etc. .

**Protective equipment / machine model with acoustic hood**
The acoustic hood is an essential product-safety component of the unit.
Operating the unit without the acoustic hood installed or with the hood open is illegal - this will result in risk of damage, injury or death!
The acoustic hood doors must therefore be locked with special locks.
The key to the acoustic hood doors must therefore be stored so that only qualified personnel who are trained in machine safety and instructed in how to use the operating instructions have access to the interior of the unit.
The key is part of the safety concept and must be stored so that access is only available to authorised personnel.

# Accessories

1. **Acoustic hood for unit**
2. **Start-up relief**
3. **Maintenance indicator for monitoring filter contamination**
4. Aerzener „AERtronic“ control
   Please also refer to the AER*tronic* operating manual.
5. Thermometer for display of discharge temperature
6. Pressure gauge for monitoring intake and discharge pressure
7. Accessories (V-belts, intake filter, oil etc.)

In addition to the standard scope of delivery also the above-mentioned accessories can be requested from Aerzen after-sales service, where spare parts can also be ordered.
The descriptions for special accessories printed in bold letters are listed as follows.
The instructions of accessory manufacturers which are supplied separately are to be observed.

**Accessory no. 1: acoustic hood**

- The acoustic hood is made of powder-coated steel plate.
- It is force ventilated by a fan mounted on the blower shaft.
- Acoustic hoods for units up to a nominal width of 250 are generally delivered completely assembled. For acoustic hoods in disassembled segmental design, an installation manual is available.
- For all work on the acoustic hood the unit is to be shut down and the drive disconnected from the power supply.
- The acoustic hood also serves as belt guard. When the unit is running the doors are to be locked with the enclosed wrench. The locked door is then to be checked. The key is to be kept in a safe place. Only authorized persons are to have access.
- All maintenance work on the unit must only be carried out during machine standstill and after opening of the acoustic hood doors.
- The hinges, if installed, are to be lubricated at regular intervals in accordance with the installation conditions.
- In order to protect the units from electrostatic charging, earthing cables are to be connected at the ground straps of the base frame and the acoustic hood.
- Ensure that the safety labels fixed to the acoustic hood are clearly visible.

**Intake from piping**

- Regarding the intake from piping the corresponding perforated sheets are to be “cracked out” of the acoustic hood element, the foamed material in the diameter of the intake piping is to be cut out and removed. Feed the connection piping through the openings. Depending on design and size, adjusting plates are to be installed on the piping passage.
- Piping cross sections on acoustic hoods with a higher acoustic rating are to be closed with adjusting plates.

**Accessory no. 2: Start-up relief / AEROMAT**

- The start-up relief is installed on units that are driven by electric motors with star/delta drive. It enables blowers or compressors to start in an unloaded condition against the existing network supply pressure.
- For all work on the acoustic hood the unit is to be shut down and the drive disconnected from the power supply.
- A start-up relief is not necessary for frequency converter drives.
- Following setting, the start-up relief works maintenance-free.
- Should the start-up relief not close after correct adjustment, the nozzle (5, see sectional drawing) is to be cleaned with compressed air.

**Attention!**

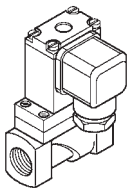
The start-up relief does not serve for regulating the operating data!
If the start-up relief is within the acoustic hood, an adjustment is to be carried out step by step during machine standstill. Then the drive motor is to be started anew by paying attention to the starting frequency and checking the closing time.
**For safety reasons all adjusting work within the acoustic hood must only be carried out when the motor is switched off!**

## Start-up relief DN 50 / DN 80

A solenoid valve at DN 50 / 80 offers the possibility to start in relieved condition.
If voltage is applied the valve closes.

**“Star-delta connection”:**

The valve must close only after the change from “star to delta“.
Pole change: In case of “Star-double-star start-up” the solenoid valve is to be connected so that it opens prior to switchover to high speed and closes after high speed has been reached.



Technische-Standard-Daten
*technical standard data*
stromlos offen
*open at zero current*
220V - 240V
50 Hz
IP 65
8 W

## Start-up relief DN 80-400

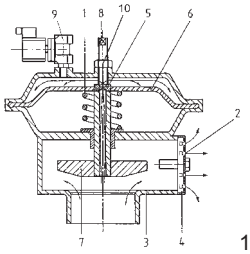
**Setting for star/delta start-up**

The necessary closing time is to be set as follows:

- Depending on design of the unit, on the acoustic hoods the outlet silencer is to be disassembled.
- The maximum closing time is set ex factory.
- The start-up relief must only completely close after switchover from star to delta and after nominal speed has been reached.
- The closing process can be noticed acoustically and visually, see discharge pressure gauge.
- Adjust setting, if necessary, to obtain optimum closing time:
- The closing time is to be set by loosening the counternut (10) and moving the spindle (8):
  - Spindle (8) clockwise — Closing time is reduced
  - Spindle (8) anti-clockwise — Closing time is increased
- Following the adjustment, tighten the counternut (10).
- Following the adjustment, all loosened and disassembled component parts are to be fastened properly.

**Setting pole change**

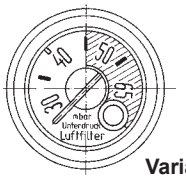
- The start-up relief is to be set to operate with “lower speed“ and according to the above-named sequence for star/delta start-up.
- In case of pole-changing motors the closing time is to be set in the lower speed range as long as possible, so that in case of higher speed an acceptably long closing period can be still obtained.
- If this is not possible due to the high conveying quantity, or is high speed started from the low speed of the “Star-double-star start-up”, an additional solenoid valve is used.
- The solenoid valve (9) keeps the start-up relief open to atmosphere at direct “high speed“ run-up.
- In case of “Star-double-star start-up” the solenoid valve is to be connected so that it opens prior to switchover to high speed and closes after high speed has been reached.



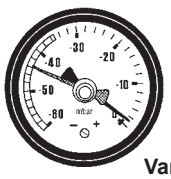
1 Spring
2 Blow-off opening
3 Housing
4 Protection grid
5 Hollow spindle with nozzle
6 Diaphragm
7 Valve
8 Spindle
9 Solenoid valve
10 Counternut

DN 80 - 400
*Technical standard data*
*Close at zero current*
230V
50 Hz
IP 65
8 W

**Accessory no. 3: Maintenance indicator**




**Variation a)**




**Variation b)**

The cleaning intervals depend on the degree of contamination in the intake air.
Observe the maintenance plan!
The maintenance indicator displays the degree of contamination of the intake filter.

**Variation a)**

- The contamination of the filter is displayed via the indicator of the maintenance unit.
- At -45 mbar / red field the intake filter is to be replaced.
- After replacement of the filter the indicator is to be reset to its starting position by pressing the reset button.

**Variation b)**

- The contamination of the filter is displayed by means of the red trailing indicator of the maintenance unit.
- A zero point adjustment is to be carried out on the unit prior to the initial operation. Pull out the front plug and turn the set screw by means of a screwdriver. Observe “+ and -” designations!
- The red trailing indicator is to be re-positioned between 0 to -10mbar prior to initial operation and after every filter change.
- As contamination increases, the red trailing indicator is pulled along by the black indicator and remains on the maximum prevailing intake pressure.
- The filter element is to be replaced when the trailing indicator reaches the **red sector** of the scale.
- The trailing indicator is to be re-positioned between 0 to -10mbar after the filter has been replaced.

## Malfunction / Possible cause / Remedy

**Repairs on positive displacement blowers must be carried out only by authorized and qualified personnel. Improper repairs can lead to considerable damage for the user / persons.**

| Malfunction<br>Faults<br>What to do, when . . ? | Possible<br>Causes . .. | Remedy . . . |
|---|---|---|
| ... abnormal running noises occur? | • Belt not properly aligned<br>• Bearing damage<br>• Rotary pistons contact each other or in the conveying chamber<br>• Pistons contact due to contamination<br>• Foreign particles in gear wheels<br>• Shaft deflection | • Check and adjust if necessary<br>• Exchange bearings<br>• Check clearance adjustment/check for cracks<br>• Clean conveying chamber<br>• Check wheels, clean, exchange if necessary<br>• Measure deflection, change rotary piston if necessary |
| ... the blower gets too hot? | • Intake filter contaminated<br>• Ambient temperature too high<br>• Hood slots clogged<br>• Ventilator defective<br>• Oil level or viscosity too high<br>• Rotary piston clearances too large<br>• Overloaded | • Replace filter<br>• Ensure sufficient room ventilation inlet-/exhaust air<br>• Clean ventilation slots<br>• Replace ventilator<br>• Correct oil level, observe viscosity<br>• Replace damaged components<br>• Check and observe operating data |
| ... oil appears in conveying medium? | • Oil level too high<br>• Worn seals | • Adjust oil level<br>• Replace seals |
| ... the intake volume is too low? | • Starting strainer or intake filter contaminated<br>• Leaky piping<br>• Incorrect dimensioning of blower<br>• Damaged rotary piston / cylinder | • Clean or replace<br>• Seal piping<br>• Check design<br>• Replace damaged components |
| ... motor requires too much power? | • Operating data differ from order data<br>• Mechanical blower or motor damage<br>• Motor voltage drop | • Check and observe operating data<br>• Replace damaged components<br>• Adjust power, refer to motor instructions |
| | | |

| Malfunction Faults What to do, when . . ? | Possible Causes . .. | Remedy . . . |
|---|---|---|
| ... the side of belt vibrates? | • V-belt is worn<br>• Belt not properly aligned | • Replace belt<br>• Check and correct if necessary |
| ... the blower runs in reverse direction after shutdown? | • Non-return valve defective or leaky | • Replace valve |
| ... machine damage occurs due to faulty electrical connection? | • Motor and control system are connected to two different networks | • Connect motor and control voltage to one supply network<br>• Alternative: Installation of a power monitoring relay |
| After the correction of each malfunction, the following is to be checked:<br>• Freedom of movement of the machine<br>• Non-contact turning<br>• Lube oil level<br>• Proper function and connection<br>• Adherence to safety and warning instructions | | |
| | | |

# Spare parts - overview

For effective and durable use of the rotary piston machine, there follows a list of components necessary for maintenance, an inspection or a repair.
The components are grouped by expected life into three spare part versions.



**1.) Maintenance**
- Shaft sealing ring(s)
- Inner ring, shaft sleeve, bush
- Sealing rings and screw plugs, drain valves for oil drain
- V-belt / wearing parts on coupling
- Air filter element
- Lubricating oil, oil filter element

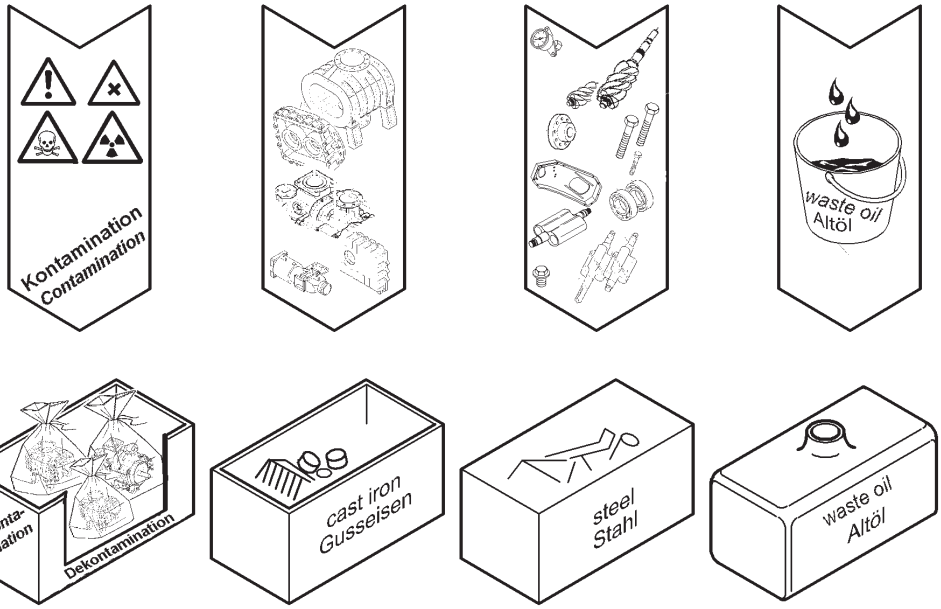
**2.) Inspection**
- Components from point 1.)
- Bearing and sealing components
- for compressor plus the adjustable bearing cover including the related minor items

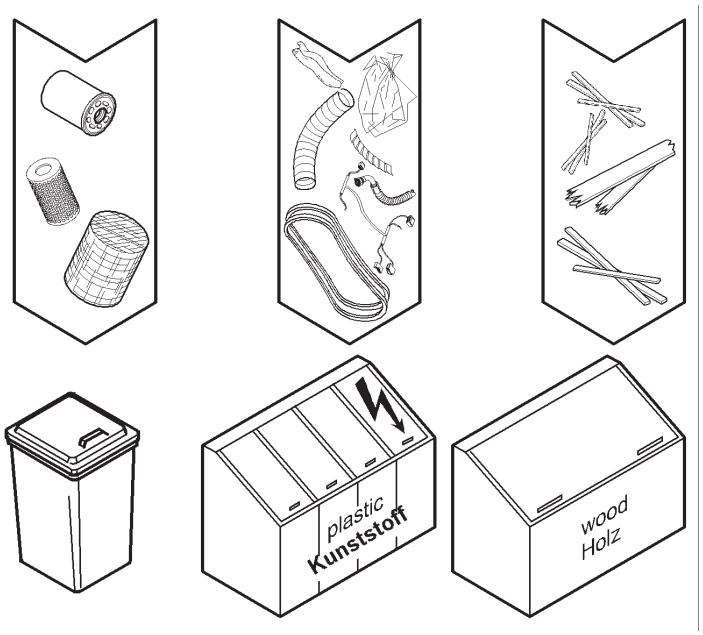
**3.) Repair**
- Components from point 1.) and 2.)
- Rotor pair / rotary piston pair
- Timing gear wheels
- for compressor plus the torsion shaft and the oil pump

**Spare parts and accessories**
It is specifically highlighted that original parts and accessories not supplied by us have also not been tested or approved by us.
Therefore, installing or mounting and using any such products could, under certain circumstances, degrade the stipulated system characteristics. The manufacturer shall assume no liability whatsoever for damage caused by the use of non-genuine parts or accessories.

# Recycling / Disposal

- All waste products are to be disposed of or treated not harmful to the environment.
- Used lubricants are to be disposed of properly.
- Contaminated components and auxiliary material are to be packed and decontaminated.



# INFO - SEITE

***Information sheet***
***Info - bladzijde***

***Page infos***
***PaginaInformativa***



06-2009

Gegenüber Darstellungen und Angaben dieser Betriebsanleitung sind technische Änderungen,
die zur Verbesserung der Drehkolbenmaschinen notwendig werden, vorbehalten.
This operating- and installation manual is subject to engineering changes necessary for the compressor advancement.
Nous nous réservons le droit dans les instructions de service procéder à toutes modifications techniques utiles visant à améliorer la qualité des compresseurs.
Wat de betrft de tekeningen en gegevens in deze bedienings- en opstellings-hanleiding verbetering van de schroefcompressor noodzakelijk worden, voorbehouden.
Nos reservamos el derecho de efectuar, frente a las representaciones e indicaciones de esta
instrucciones de montage servicio modificaciones técnicas necesarias para perfeccionar.
Rispetto all'illustrazione ed alle indicazioni di questa Istruzioni di Esercizio ci si riserva quelle modifiche tecniche che sono necessarie per migliorare i compressori.

Technische Dokumentation

Technical Documentation

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**Aerzen im Internet**
**www.aerzener.com**

# Drehkolben-Gebläsestufe

## Einbau-, Montage- und Bedienungsanleitung

## Rotary piston blower stage

Installation, assembly and operating instructions

## Etage surpresseur à pistons rotatifs

Instructions de montage et d'utilisation

## Draaizuigerblowerblok

Inbouw-, montage- en gebruikshandleiding

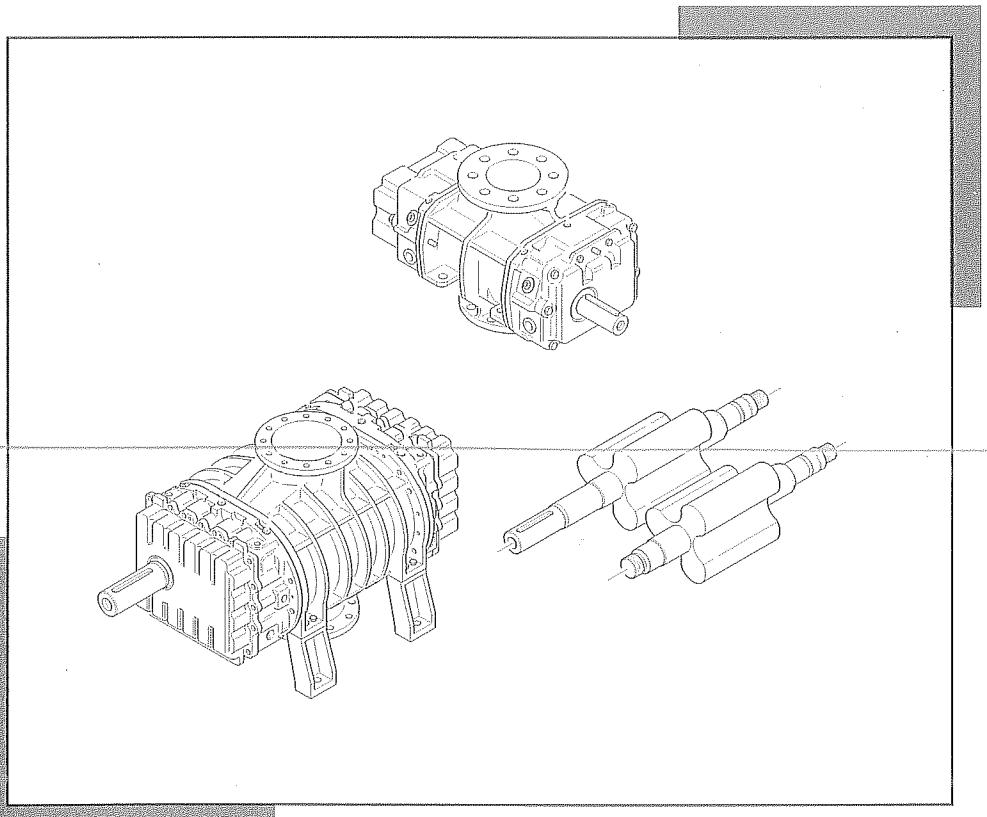
## Soplante de émbolos rotativos

Instrucciones de montaje, instalación y operación

## Soffiante a pistoni rotanti

Istruzioni per l'installazione, il montaggio e l'uso

DEUTSCH ENGLISH FRANÇAIS NEDERLANDS ESPAÑOL ITALIANO



AERZEN

AERZENER MASCHINENFABRIK GMBH

G4-001 N XT

ENGLISH

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# Suitability/General information

The German version of these instructions is the "Original instructions".
Any version in a language other than German is a "Translation of the original instructions".

Aerzener rotary piston machines are suitable for the oil-free conveying and compression of air and, if specially modified versions are used, various other types of gas.

The technical performance limits must be observed if perfect operation of the equipment is to be ensured in the long term.
The performance limits specified in the order confirmation apply.

The intake temperature $t_1$ specified on the order confirmation serves as the installation site ambient temperature.

Non-observance of the technical performance limits or the safety information shall absolve Aerzener Maschinenfabrik of its warranty obligations and its liability to pay damages or compensation as a result of any consequential damage. The same shall apply to defects that can be traced back to recommended inspections not being performed correctly or on time.

The vibration behaviour of blowers and compressors with mounted belt pulleys or couplings is largely determined by the balance quality of the pistons/rotors as well as the balance of the driving elements.
At Aerzener Maschinenfabrik, the piston/rotor driving shafts are balanced using the „half-key balancing" technique.
The belt pulleys/couplings must be used in accordance with the requirements of balancing type „H".

The maintenance intervals according to these operating instructions must be followed and carried out properly. Complying with the maintenance specifications will ensure that the machine retains its value and will also promote operational reliability.

# Construction, function

**Blower stage:**
The blower stage is supplied as a fully assembled unit.
The following additional work must be carried out:
- Correct installation/assembly in the relevant unit/system
- Connect the conveying piping.
- Check lubricating oil level.
- Adjust level, if necessary.
- Install driving elements, ensuring that safety devices are in place!
- Install special accessories which are supplied separately, if necessary.

**Service package:**
An Aerzener service package is available for the blower stage. Depending on the option selected, this includes auxiliary equipment and material, e.g. for filling with oil, draining oil, etc.

**Motor connection:**
Electrical installation of the driving motor must only be carried out by an authorised electrical fitter.
The motor and control voltage must be connected to a stable common network and the power contactor unlocked in the event of an interruption of circuit. Voltage fluctuations and dips must be avoided.
Alternative: An electronic monitoring relay must be installed parallel to the driving motor so that the power contactor can be unlocked in the event of an interruption of circuit.
A restart should only be possible once the machine has come to a complete halt.

Requirements for operating rotary piston machines with asynchronous electric motors on a 3-phase AC system:
The machine should only be used on stable three-phase systems.
The voltage and frequency limits must be observed. These are specified in EN 60034-1.
Voltage fluctuations/dips beyond the tolerance zone can seriously damage all the elements that make up the drive system, e.g. couplings, V-belts, V-belt pulleys, shafts, gear wheels, etc. .
If the supply system is subject to significant voltage fluctuations.
Aerzener Maschinenfabrik recommends the following measures to avoid damaging the blower, compressor or motor:
- Use a suitable protective device that will shut down the motor and definitely prevent an automatic restart when impermissible operating data is detected. Please also observe EN 60034-1 and EN 60 204-1 in this respect.

**Unit/System:**
The blower stage must be installed/assembled in a unit/system in the correct way so that it is safe to operate.
No forces or moments that could distort the blower housing are permitted to act on the flange.
A distortion-resistant form of assembly/installation must be ensured.
The blower stage must be installed flat (without any slopes).
Operational safety/reliability will be affected in accordance with the extent of any misalignment.
We recommend that you install a pressure valve in the piping on the discharge side to protect the blower against overload. No shut-off valves must be installed between the pressure valve and blower stage.

With a suction pressure version, we recommend that you install a suction valve in the piping on the intake side. No shut-off valves must be installed between the suction valve and blower stage.
Suitable valves are available from Aerzener Maschinenfabrik.
The valves are not intended to control the operating data!

**Filter silencer/Starting strainer**
A filter (or in the case of intake from a pipeline, a starting strainer) should be used to ensure the blower stage's operational reliability.
We recommend that you use an Aerzener intake silencer. This silencer is a combination of intake-side silencer and intake filter. The filter element is easily exchanged due to its easy access.
The degree of contamination or the specifications in the maintenance schedule determine when the filter element is to be replaced.

**Accessories:**
A non-return valve is required on the discharge side to prevent the blower from running in reverse after shutdown.
Additionally, a start-up relief can be installed on the discharge side.
This provides relief from any existing discharge pressure during start-up.
With a suction pressure version, various components must be used accordingly.
All accessory components are available from Aerzener Maschinenfabrik.

**Function:**
Aerzener rotary piston blowers are dual-shaft rotary piston machines whose pistons turn uniformly against each other. Timing gear wheels guarantee contact-free running of the rotary pistons. The rotational direction determines the conveying direction of the blower, which means there is a discharge-side and intake-side flange. During operation, the medium to be conveyed flows through the intake flange into the housing. From there, it is forced through the conveying chambers (consisting of the pistons and the blower cylinder) to the discharge side.

Pulsation decrease on the basis of interference (patented).
The conveying chamber (cylinder) is sealed against the oil chambers (casing cover and gear case) by square piston ring labyrinth seals and the driving shaft is sealed by means of one or two radial seal rings.
If the oil level is too high, oil can penetrate into the conveying chamber in an uncontrolled manner.
Compression heat arises during the compression process. Some of the heat is dissipated via the outer surfaces of the blower and conveying piping into the ambient air.
Outer surfaces and conveying piping reach temperatures that can result in burns to exposed skin.

Erst lesen -
dann bedienen!

ENGLISH

*Read first,*
*then operate !*

**Hinweis:**
Angaben zur Schallhaube können je nach Aggregat- / Anlagenausführung variieren. Instruktionen des Anlagenbauers beachten !

*Note:*
*Details concerning acoustic hood can vary depending on unit-/plant design.*
*Pay attention to instructions of plant manufacturer!*

*Remarque:*
*Les indications concernant capot d'insonorisation peuvent varier selon exécution du groupe / de l'usine.*
*Les instructions du constructeur de l'usine sont à observer.*

# Due Care to Be Taken Before and During Operation

**CAUTION !** **Identifies all hazardous situations**

**WARNING !** **Indicates direct risk to personnel**

Upon arrival/receipt, the rotary piston machine must be checked against the delivery and order documentation to make sure it has not been damaged during transit and is complete.

Work safety regulations, safety information and operating instructions must all be complied with.

Read the **INFORMATION SHEET** prior to commissioning. Any notes or changes stated on it must be observed.

The tasks described below must only be carried out by qualified personnel who are familiar with the operation of the machine and its components, and have been instructed in the relevant safety information.

This rotary piston machine conforms to European safety regulations. Nevertheless, residual technical risks, which could endanger persons and property, may remain. To prevent this, operators must take note of the following safety information:

## Assembly of the unit

- Keep the flange connections sealed during installation.
- The ingress of dirt, burring, sputtering, liquids or similar must be avoided.
- Remove the seals and covers on the flanges just before the ducting connection.
- The rotary piston machine can otherwise be blocked or sustain serious damage.

## Information about operating data

- The machine must be used appropriately and in compliance with the regulations, and within its performance limits.
- The sound pressure level may deviate from that stated in the operating data, depending on the operating state. A sound pressure level in excess of 85 dB(A) may therefore occur for a short period of time.

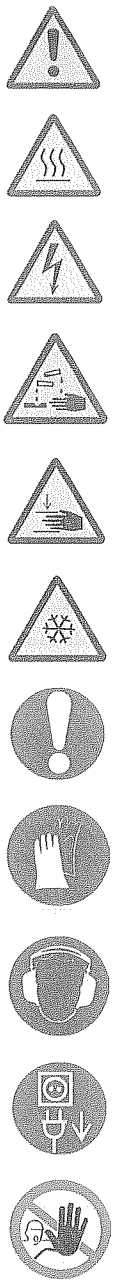
## Information about general operation

- The general safety and industrial accident prevention regulations set down by law must be taken into account in addition to the information in the operating instructions.
- The user has an obligation to only operate the machine in perfect, original condition and when it is safe to operate.
- The rotary piston machine is equipped with electrical energy in order to avoid any hazards that may be caused by electricity.
- Only trained electrical technicians may work on current-carrying components.
- Any possibly dangerous electrostatic charging must be avoided and/or enable the discharge of electrical charges with the support of devices.
- A suitable earthing system must be equipped to protect against possible damage caused by lightning strikes.
- For operation, the unit must be equipped with one or more **EMERGENCY BREAK** control units. The **EMERGENCY BREAK** function must be available and ready for operation at all times, independent of the type of operation.

- It must be ensured that a stopped positive displacement machine cannot be moved from the rest position without operating the start function, no matter what the cause!
- Damaged rotary piston machines or machines that are not in perfect working order must be replaced immediately.
- Any operation that impairs machine safety is prohibited.
- The supplier documentation provided with the accessories and the general safety regulations must also be observed.
- The unit contains rotating components. If their protective equipment, according to the version of the unit, e.g. the acoustic hood, belt guard, coupling guard etc., are not observed or are not used appropriately, there is a
- **risk of injury !**
- Protective equipment such as the belt guard/coupling guard, blower guard, hood elements, electrical safety elements, pressure valves, motor protection/EMERGENCY OFF etc., must not be removed or its operational safety restricted whilst the machine is in operation. ***Risk of injury !***
- Do not operate when electrical, mechanical or hydraulic connections are defective missing or are not correctly connected.
- It is expressly prohibited to operate the rotary piston machine without the appropriate protective equipment or safety devices.
- It is expressly prohibited to remove or modify any protective equipment located on the rotary piston machine, divert it from its intended use, or attach third-party protective equipment.
- Do not operate the unit if protective equipment such as the belt or coupling guard, acoustic hood elements, pressure valve, etc., is defective or missing.
- When carrying out work on the unit, the drive motor must be securely disconnected from its power supply.
- Never look into or touch the discharge opening/side of the pressure valve!
- There is a **risk of injury** from decompressing gas escaping at a high speed when the pressure valve is drained. Residual pieces of contaminants, dust particles etc. may escape along with this.
- Screwed connections should only be retightened while the machine is in a depressurised state or is shut down.
- The machine must only be used in stable three-phase supply networks. Voltage fluctuations/dips beyond the tolerance zone can seriously damage all elements that make up the drive system, e.g. couplings, V-belts, V-belt pulleys, shafts, etc. The operator must use oil of a suitable quality, conforming to the Aerzener lubricating oil specifications.
- Observe the safety, operating and maintenance information of the drive motor manufacturer!

**Safety instructions for commissioning**

- These operating instructions must be read and understand before commissioning the machine.
- Commissioning must only be carried out by persons with the relevant knowledge and skills.
- Before switching on the machine, ensure you are familiar with all protection, operation and monitoring elements by referring to these instructions.
- Before commissioning, the unit must be equipped with a command system with which the machine can be shut down according to the hazard potential in order to return the machine to a safe state.
- The energy supply to the drive motor must be disconnected as soon as the machine is shut down. If this is not possible, the operating state “Shut down” must be monitored and maintained.
- Check that the intake side is clean before commissioning.

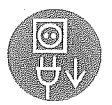


- Any evidence of dirt, dust or foreign matter must be removed from the intake area.
- Compliance with the maintenance schedule is absolutely mandatory.

**Qualification of operators**

- Each person dealing with the installation, operation, maintenance and repair of this unit must have read and understood the operating instructions.
- The unit must only be operated by trained and authorised personnel.
- Personnel must be trained according to the operating instructions.
- Responsibility for operation must be precisely defined in order to prevent any unclear
- designation of responsibilities.
- Operators must be proficient, instructed and appointed to the work.
- Only trained and authorised electrical technicians may work on current-carrying components. The unit must be disconnected from the power supply. Fuses must be disconnected.

**Safety instructions in relation to prevailing residual risks**



- The warning and information signs on the machine must be observed.
- They provide important information about potential sources of danger.
- Check that the machine is not damaged in any way before commissioning.
- Do not operate the unit if electrical connections are damaged, defective or not properly connected.
- Do not operate the machine with exposed and accessible inlet or discharge sockets, for the following reasons: Rotary piston machines are positive displacement machines which present a risk of injury in the area around the conveying chamber.
- Only suitable tools that correspond to the respective standards and design of the bolts, nuts and screwed connections must be used.
- When using cleaning agents and sprays, there is a risk of poisoning from inhalation, and a risk of burning from coming into contact with them.
- Please refer to the material safety data sheets for the operating materials used.
- Avoid skin contact with or the swallowing of the lubricant. ***Risk of poisoning !*** Wear protective gloves.
- Used lubricants are extremely harmful to the environment and can contain noxious materials.
- Lubricants must be stored and disposed of properly and in an environmentally-friendly manner.
- The appropriately fitted rotary piston machines must be used for conveying oxygen. A lubricant especially suited for operating with oxygen must be used.
- Disregarding these warnings is a ***risk of fire and explosion !***
- Rotary piston machines with separate speed monitoring are equipped with a contact plate on the drive shaft.
- This contact plate rises above the diameter of the belt pulley and reaches operating speed.
- Disregarding the separating protective equipment is a ***risk of shearing !***

**Warning signs for hazardous operations**

- Repairs and modifications to the unit must only be carried out in a professional manner. If you have any problems, please contact Aerzener After-Sales Service for assistance.
- Before carrying out any retrofitting, servicing or maintenance work that requires the removal of protective equipmen, the power supply must be disconnected and the machine secured to prevent it starting up.
- When replacing and cleaning the filter material (if present)
- dust particles and fibres may be released into the ambient air. Do not breathe in these materials. These materials must not reach the unprotected intake area of

the rotary piston machine.

- Lubricating and control oil pipes should only be retightened or opened while the machine is in a depressurised state.
- Depressurise conveying ducts before attempting to remove them.
- When conveying technical gases, conveying ducts must be rinsed with a neutral gas before disassembly.
- Note the oil temperature when changing the oil. The oil temperature must not rise above 60°C. If it is above 60°C, there is a ***risk of burns !***

**Personal protective measures**

- Conveying ducts or components on the discharge side must not be touched without adequate protection. The ducts and components can reach temperatures in excess of 70°C.
- ***Risk of burns !***
- If the acoustic hood is open or missing, there is ***risk of burns*** when the housing surface becomes hot as a result of operation.
- Protective gloves and clothing must be worn.
- Close-fitting clothing is required due to the presence of rotating components.
- ***Risk of injury !***
- Ear protection must be worn during machine operation.

**Information about the installation site**

- It is the operator's responsibility to use and operate the machine in accordance with its intended use taking into account the local conditions.
- The machine must only be operated in a suitable, well-ventilated installation site. The installation site must be free from excessive dust, acids, steam and explosive or flammable gases.
- The installation site must be arranged to avoid risks as a result of the ambient air, the medium to be convyed or oxygen deficiency.
- The installation site must be arranged so that the commissioning of the rotary piston machine does not impose a risk of overheating, fire and/or explosion.
- The protective equipment provides protection against injury and must not be modified or bypassed.
- When using diesel or petrol drive motors, there is a ***risk of poisoning*** if there is insufficient room ventilation. The installation site must be sufficiently ventilated. The motor manufacturer's operating instructions must also be observed

**Information on operation with an acoustic hood**

- The acoustic hood is a structural safety component.
- During operation with an acoustic hood, all hood elements are to be closed before starting operation and are only to be opened after the motor has been shut down and the fuses removed or switched off.
- The acoustic hood prevents the risk of injury from rotating and hot components.
- If the acoustic hood is opened while the machine is operating,
- there is a ***risk of injury***.
- When installing and assembling the unit, no sparks or glowing objects caused by, e.g. welding or separating, are allowed to enter the foam in the acoustic hood. ***Risk of fire ! Risk of glowing embers !***
- Fire regulations must be adhered to for all "hot work operations" close to the unit.
- **CAUTION !**
- When commissioning, sparks, glowing or other fire-causing objects could be taken in from the intake airflow and, fanned by the acoustic hood ventilator, set the foam alight.
- ***Risk of fire !***
- No welding or separating is to be done on the acoustic hood as sparks or sputtering caused by the applied thermal energy could set the foam alight.

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- *Risk of fire ! Risk of glowing embers !*
- Depending on the size and increased fire protection regulations, a flame retardant foam would be applied according to the order.

**Information about the event of damage**

- If the unit produces an abnormal and/or unusual sound, the machine must be shut down immediately using the **EMERGENCY BREAK** function.
- The energy supply to the drive motor must be disconnected.
- If the unit is blocked, the energy supply to the drive motor must be immediately disconnected.
- The cause of malfunction must be determined.
- Aerzener Service can be quickly at hand and provide expert troubleshooting for you.
- The unit must not be taken into operation until it is properly functioning.

**Information about operating the pneumatic conveyer/air-separation systems**

- When using the positive displacement machine for pneumatic conveying or in air-separation systems with alternating air-separation columns, pressure surges must not occur when switching between different delivery lines. Pressure surges can be prevented by making the switching process for the ¬intake-side and discharge-side valves take at least five seconds. This pre-accelerates the gas column in the pipework and prevents damage¬ to the positive displacement machine caused by sudden acceleration of the gas. The distance between the switchover valve and the intake-side flange must be at least ¬10 x DN, where DN = nominal diameter of the pipework. This safety note applies to both pressure and vacuum ¬mode.

## Inadmissible operating methods

- Installation on uneven and / slanting foundations.
- Securing transport devices to the acoustic hood, e.g. using eye bolts in the accoustic hood element, winding ropes without expansion braces etc.
- Non-observance of operating data.
- Non-observance of maintenance intervals.
- Incorrect direction of rotation.
- Switching on - during run-down.
- - during reverse rotation.
- Inadmissible increase in pressure.
- Remaining under or exceeding maximum rotational speed.
- Exceeding the maximum temperature.
- Pole change to lower rotational speed before motor has come to a standstill.
- Operating without a properly connected fault indicator / control is not permited. Risk of total machine damage!
- Operation without assemblies or with damaged assemblies which serve for the protection of persons and machine.
- Overfilling the maximum oil level.
- Operation without oil.

**"Reasonably foreseeable misuse" that can result from easily forseeable human behaviour:**

- Operating the machine without having filled the lubricant.
- Operating the machine with too much lubricant.
- Operating the machine with reduced intake performance, e.g. due to a soiled intake filter, starting strainer etc.
- Assembly and commissioning of the rotary piston machine with intake-side and/or discharge-side flange sealers, protection covers or similar.
- Insufficient ventilation at the installation site, no insulated lines.
- Open fire or sparks created by welding, separating or similar in direct proximity to the unit. Risk of fire!
- Operating the machine without an isolated protective device, open belt or coupling drive.
- Risk of injury from rotating components!
- Taking out the transport securing pin under the hinged motor support during operation.
- Only applicable for belt drive machines.

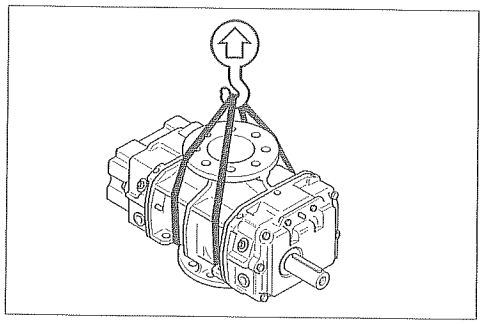
**Foreseeable incorrect operation or use**

- Dust contaminants should be removed before entry into the blower. In particular, substances which can settle in the conveying chamber or the rotors can jeopardise the operational reliability of the machine.
- The same applies to the compression of resublimating gases containing solid particles, which can separate from the gas phase and deposit in the machine. Resublimation in the blower must be prevented via suitable process control (pressure, partial pressure, temperature and speed etc.).

# Transport / Installation / Assembly

When transporting the machine, the following key points must be observed:

- Do not expose the blower to impact loads.
- Transport the blower using a crane, fork-lift truck, lift trolley or similar.
- Only suspend the blower as shown in the sketch.
- Use suitable hoisting gear that is appropriate for the load concerned. Failure to observe this point could result in damage or injury!
- The hoist, cable, chains, etc. must be designed for the load concerned.
- The hoist must be arranged in accordance with the machine's centre of gravity.
- The hoist must not be able to exert any forces on the machine that could result in damage.
- It must be ensured that inadvertent dislocations and harzards due to insufficient stability do not occur during transport and installation of the rotary piston machine.



## Storage

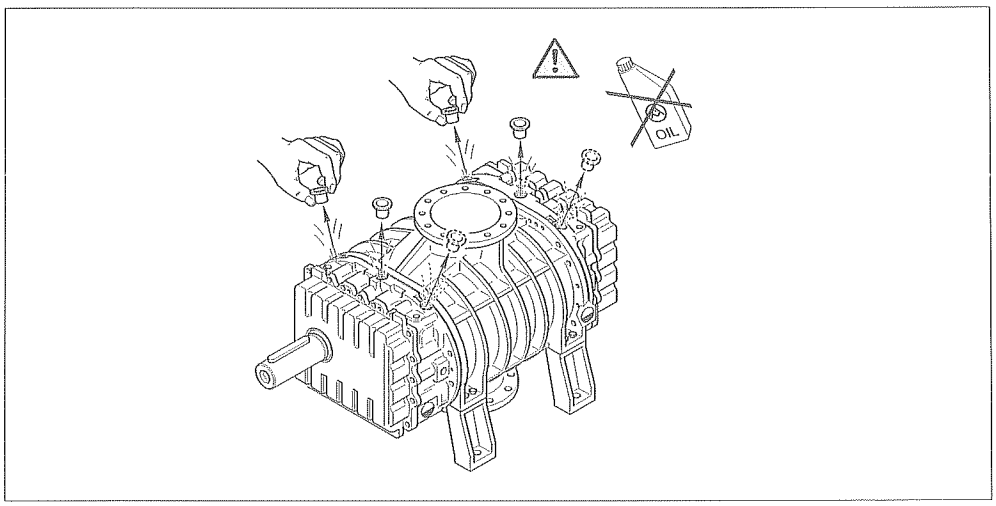
- Prior to delivery, rotary piston machines are treated and packaged to allow for a 12-month storage period.If they are to remain in storage following this 12-month period, they will need to be retreated and the machine will need to be repacked appropriately.
- See storage and mothballing guidelines TN0 1175... .
- Whilst the units are in storage, please ensure that they are correctly preserved, packaged and if necessary that they undergo nitrogen replenishment in accordance with TN0 1175. They must be checked every six weeks.
- You must eliminate any adverse influences immediately to ensure ongoing preservation of the units.
- During storage, no sealing plugs or plastic caps should be removed from bore holes, flanges, etc. The purpose of these is to prevent any foreign bodies from entering the machine.
- The oil chambers have been sufficiently preserved for one year.
- If the machine needs to be stored for longer than 24 months, the entire scope of supply must undergo a general inspection by Aerzener trained personnel.
- If special packaging is to be used, e.g. for transportation by sea, etc., specific storage and mothballing guidelines laid down by Aerzener Maschinenfabrik must be observed.

- If the machine is to be stored or if the unit is intended to be taken out of operation for longer than six weeks, the conveying chamber, piston/rotor and bare parts must be preserved.

## Installation/Assembly

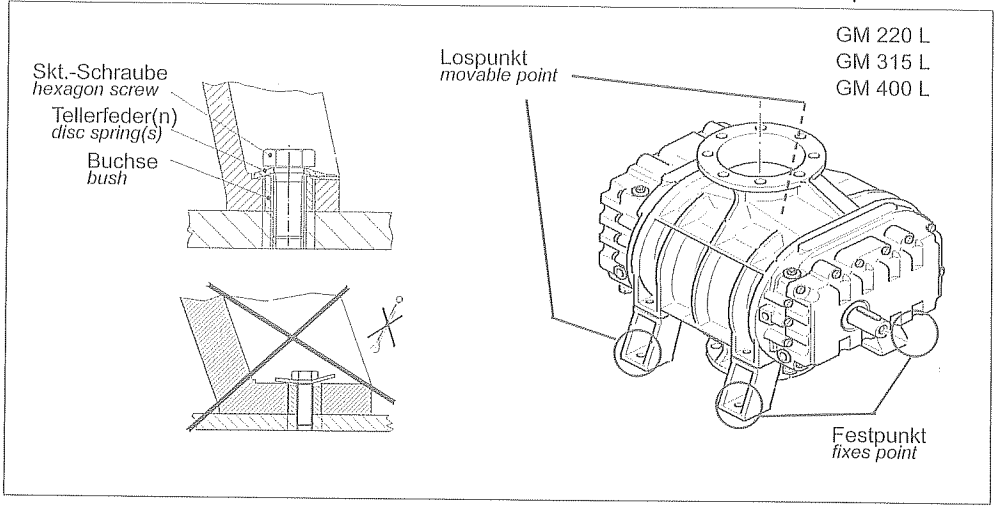
During installation the following points must be observed:

- The blower must be installed on an a foundation, base and connections that are even, non-vibrating and slope-free.
- CAUTION! If the blower is installed with a tilt, this will result in irreparable damage to the machine due to the uneven oil level.
  The machine's operational safety/reliability and service life will be affected in accordance with the extent of any misalignment.
- Remove all packaging material. If your machine features an acoustic hood, ensure that the inlet and exhaust air louver profiles can be accessed.
- Ensure that the installation site is adequately ventilated.
- The following standard installation conditions must be observed:
  Ambient temperature : -10°C to 40°C
  Rel. air humidity : 0% to 80%
  Atmosphere free of chemicals
- Check that the rotary piston machine can run easily. Sluggishness indicates the presence of distortion or foreign bodies.
- For the purpose of conveying air, the plastic plugs must be removed from the condensation holes on the blower. This enables a small amount of warm air to escape in order to clear the condensation holes.
  For the purpose of conveying „industrial gases", the condensation holes must remain sealed.
  If the medium to be conveyed has a tendency to produce condensation, then the condensate should be discharged by means of collecting basins or residual gas pipelines or by temporarily opening the lower holes (depending on the application).
  CAUTION! Hot gas or condensate can escape through the holes!




- To avoid electrostatic charging of the units, the motor, acoustic hood and base frame must be earthed via the relevant connections.
- Fasten the piping on the discharge side and the piping on the intake side separately to ensure a stable connection.
- No forces and/or moments are permitted to act on the flange and connections.
- Check that the blower can run easily prior to installation.
  Sluggishness indicates the presence of foreign bodies inside the conveying chamber.
- Remember to remove the sealing covers from the intake-side and discharge-side flanges prior to installation!

- There must be no distortion of the blower as a result of alignment or tightening operations.
- Assemble the blower fixing screws in the correct manner.
  - Please observe the foot assembly drawing 139 006.
  - According to drawing 139 006, the length of the bush should be determined within the context of assembly.
  - The screw, disc spring and bush must be tightened as far as the stop.




**Height equalisation when installing GM blower with fitted machine feet**

- When installing a GM blower stage with fitted machine feet there is a difference in height between the lower blower flange surface and the machine foot surface.
- This height difference must be determined during installation and equalised by means of suitable shims.

- Determine the equalisation dimension as follows:
- Locate the blower on the flange with a new flange seal and tighten all the flange bolts.
- Measure and record the gap between all four blower feet and the base surfaces. Then loosen the flange bolts again.
- Insert shims in the appropriate thickness between the blower feet and the base surfaces.
- Required shim thickness = existing gap + 0.1 mm.
- The blower feet should stand almost entirely flush on the shims.
- Tighten the flange and foot bolts. Check after approx. 50 hours' operation and retighten if necessary.

- Check that the blower can run easily following installation.
  Sluggishness indicates the presence of foreign bodies inside the conveying chamber or
  distortion.
- Take noise protection into consideration. Piping and foundations may be stimulated into producing natural vibrations along with the inevitable sound emissions.
- If you are planning the system in-house, the safety information, maintenance information and technical documentation provided by your component suppliers must also be observed.

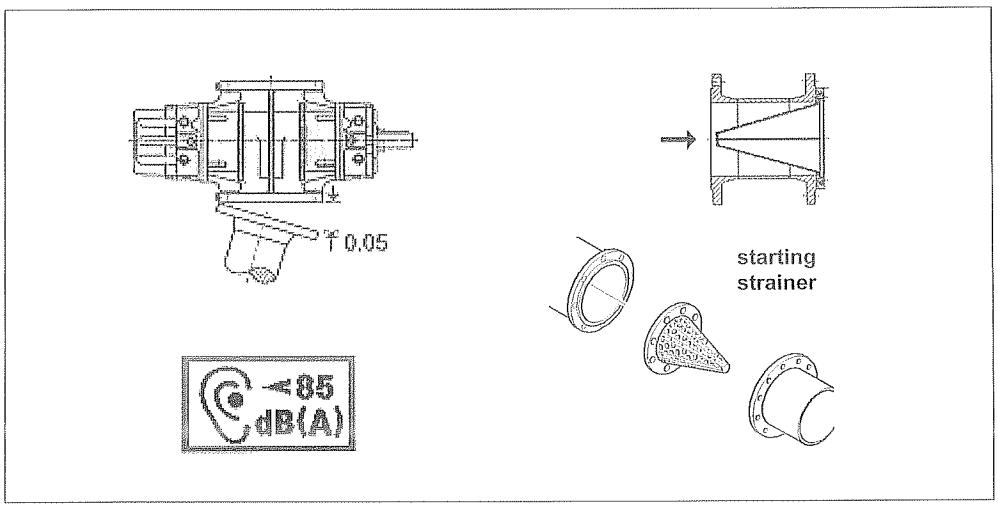
**Check oil level prior to commissioning and correct if necessary.**

## Piping

- When installing the piping on the intake side, ensure that it is clean.
  Foreign bodies and dirt will damage the blower.
- Any piping that is to be connected must be carefully cleaned and must be free from foreign bodies.
- Piping on the intake side must be supported/propped up.
  No forces and/or moments are permitted to act on the blower housing.
- A starting strainer should be installed for the first 500 operating hours to prevent damage as a result of impurities.
  Install the starting strainer together with a seal on the intake side.
- Prior to tightening, the piping and seals must sit on the blower housing flange without any stresses.
- The maximum distance in the sealing surface area is 0.05 mm on one side.
- Once it has been tightened, the blower stage should be able to rotate easily without any resistance.
- Please note that piping and foundations may be stimulated into producing vibrations and sound emissions when the blower is in operation.
- Therefore, insulation and soundproofing measures should be taken into account right from the planning stage.
- If you are planning a system in-house and/or plan to install the blower stage yourself, the safety information and technical documentation provided by your component suppliers should also be observed.

### Coolant connections for oil cooling (special accessories)

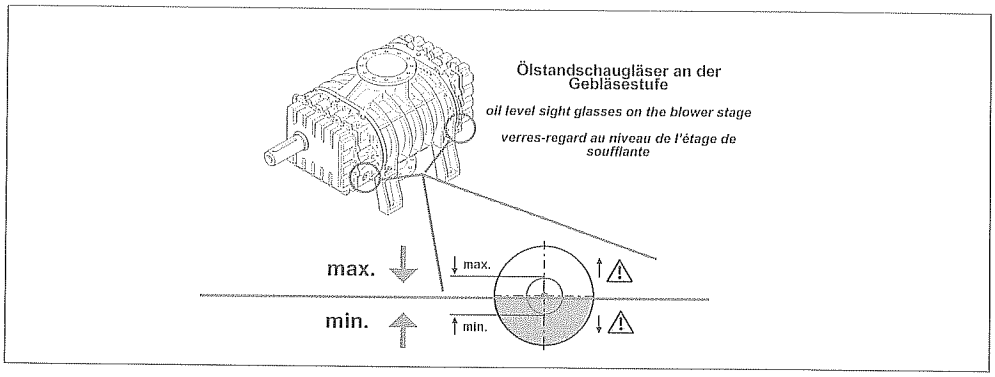
- Install shut-off valves in the feed piping.
- The coolant must flow through the refrigerating chambers from bottom to top.
- A flow indicator should be installed in order to monitor water throughput.
- A drain valve must be provided for the purpose of emptying the cooling system completely.
- Caution! Risk of frost in the case of winter operation.



# Commissioning

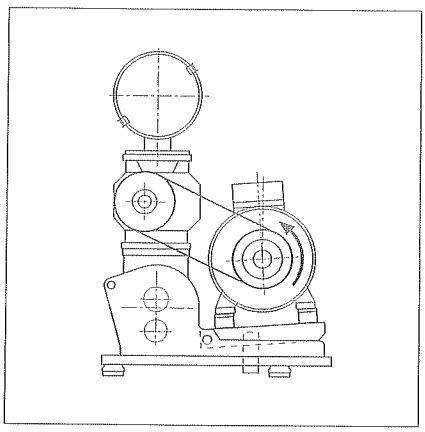
1. Install and assemble the blower stage in accordance with these instructions.
   Assemble the driving elements correctly.
   CAUTION! Do not establish *any* connection with the driving motor yet.

2. **On first commissioning**
   top up lubricating oil on empty machines.
   Check lubricating oil level and correct if necessary.
   Check that the oil filling plug and the drain valve are seated securely and do not leak.




3. Observe the commissioning instructions and lubrication intervals provided by the driving motor manufacturer.
   Observe the requirements for operating rotary piston machines with asynchronous electric motors on a 3-phase AC system. See under Construction and function.

4. Check the direction of rotation.
   See also the red direction plate on the blower.
   There must not be any V-belts on the motor pulley/the drive coupling between the blower and motor must not be connected.
   Briefly start the driving motor (approx. 1 - 2 seconds).
   See also the instructions provided by the electronics supplier/system manufacturer.
   CAUTION! The blower will be destroyed if it is operated in the wrong direction.
   The blower's direction of rotation must match that of the driving motor.



5. With the correct direction of rotation:
   The alignment of the belt pulleys/drive coupling should be checked.
   The V-belts should be attached/the drive coupling should be connected using connecting elements.
   Tension the V-belts. Observe the specifications regarding the belt tensioning force.

6. Ensure that protective equipment is in place for the belt drive/drive coupling.

7. Safety information stickers must be legible and protective equipment must have been checked.

8. Open the slide on the system side. Operation can now start.

9. Switch the driving motor on.
   Switch it off after approx. 20 seconds and monitor the blower to ensure it coasts down smoothly.
   If the pressure valve blows off, switch the blower off immediately and remove the cause.

10. Switch on again.
    Check the EMERGENCY STOP switch.

11. The unit is now ready for operation.

## Switch off / shutdown

- Switch off is effected via the power switch on the motor.
- To shut the unit down completely the fuses must be removed after the blower has come to a standstill. The valves on the conveying pipes must be closed. Avoid possible entry of condensate into the blower stage.
- In case of a shutdown for more than six weeks the conveying chamber is to be preserved and the blower turned regularly by hand to avoid damage due to stand-still. Observe also the TN01175 regulations governing storage and preservation.

In case of danger:
Press EMERGENCY - OFF button. For details refer to the instructions of the supplier of electrical components or the plant manufacturer.

## Frequency converter operation

- If the electric motor is driven by frequency converters, we strongly recommend using an engine throttle and power choke. These are specifically designed for the frequency converter and filter dangerous harmonics from the drive current. Damage to the motor winding can be prevented by improving the electromagnetic compatability of the system and reducing reactions of the frequency converter in the current.
- The electrical and mechanical characteristics of the drive motor are to be taken into account.
- The minimum frequency must always be fixed. This frequency must never fall below the fixed minimum during operation.
- The maximum frequency is to be set by taking into account the maximum rotational speed of the motor and the maximum speed of the blower / compressor.
- The run-up time of the drive motor from standstill up to minimum speed may be 3 to 6 seconds.
- The frequency converter must be designed with a constant load moment for operation with a working machine.
- Rotational speeds must no fall below minimum nor exceed maximum.
- The highest admissible voltage increase speed of the motor converter is 1200 V/ µs.
- When exceeding the value, e.g. due to excessively long cables, frequency converter type… etc. a motor throttle / motor filter coil to match the frequency converter is to be used.
- If these components are not used, this can lead to damage of the motor isolation and to a motor breakdown.
- The maximum rotational changeover speed on positive displacement blowers / screw compressors, after run-up to minimum speed, amounts to 1 Hz per second for upward and downward control time.
- Minimum frequency = 20 Hz // maximum frequency = 50 Hz results in a control time of 30 seconds from minimum to maximum.
- The maximum current limit of the motor must not be exceeded. Observe the soecificationa on the motor name plate.
- To prevent operational faults the function “Interception circuit” must not be parameterised in the control of the frequency converter. When the frequency converter is switched off, a restart should only be possible after a complete standstill of the blower or compressor.

Only applies to screw compressors

- At a speeds below 50% the oil pressure sinks to approximately 0.6 bar (ü). To enable the machine to run at speeds up to 25% the ain oil pressure switch, setting value of 1.8 bar (ü), is bridged with a threshold switch.
  A further switch, setting value of 0.5 bar (ü), is installed for oil pressure safety.

## Operation with pole-changing motor

Between a changeover of motor speed

- from a high to a low speed, the motor must have reached zero rotational speed each time.
- from a low to a high speed, changeover can take place instantaneously.

9

# Maintenance

Maintenance is to ensure that all functions are maintained or that they can be restored after a breakdown.

Maintenance includes specifications about inspection, service and repairs.

Maintenance includes instructions for trained and qualified personnel.

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If anything is unclear consult Aerzener customer service.

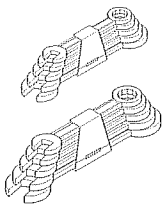
During inquiries please state:
- order and serial number
- prevailing faults / malfunctions as accurately as possible
- steps taken to rectify faults.

Is the machine sent back to the supplier, the following measures are to be carried out:
- Completely drain oil, otherwise it is transport of hazardous goods.
- Treat bare components with preservative.
- Seal flange with blind cover.
- Seal open connections.
- Also observe instructions in chapter “Transport”.

## Inspections / inspection schedule

9.1

A general inspection should be carried out by a service technician from Aerzener after 3 years or 20,000 operating hours.
This includes the preventive maintenance of wearing and replacement parts such as bearings, seal, etc.
We recommend maintaining a stock of replacement and wearing parts to avoid or reduce waiting times and downtimes.



# Maintenance schedule



Whenever work is carried out on the positive displacement machine, it must be switched off and isolated from the mains electricity supply.
Failure to follow this instruction could result in injury or damage!
Various steps should be taken to achieve a long service life and provide the optimum operating conditions. These include carrying out the maintenance work specified in this table at the intervals specified here.

| 3 flg. Stufe / blower stage | Maintenance intervals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **We recommend carrying out the maintenance work on the positive displacement machine at the specified intervals. The operating hours represent average operating conditions. The actual service life of the equipment may vary depending on environmental conditions and operating data. If you think this situation applies to you, please contact Aerzener Maschinenfabrik.** | After the first 3 op. hrs | After the first 25 op. hrs | After the first 500 op. hrs | Weekly | After every subsequent 2000 op. hours or every 3 months | After every subsequent 4000 op. hours or every 6 months | After every subsequent 8000 op. hours or every year | After every subsequent 16,000 op. hours or after every subsequent 2 years | After every subsequent 20,000 op. hours or after every subsequent 3 years |
| **Check fixing screws and screwed connections**<br>• Re-tighten once the machine has cooled down, if possible | • | | | | | | | | |
| **Starting strainer,** if fitted<br>• Check; can be removed if dirt is no longer being accumulated | | | • | | | | | | |
| **Intake filter** (part of the unit)<br>• Check level of filter contamination and, if necessary, replace filter cartridge, max. -45 mbar<br>• Replace filter cartridge | | | | • | ○ | | • | | |
| **Check and clean inlet/exhaust openings** (part of the unit)<br>• of acoustic hood | | | | | | • | | | |
| **V-belts** (part of the unit)<br>• Check condition; replace if necessary<br>• Replace | | • | | | | • | | • | |
| **Belt pulley alignment** (part of the unit)<br>• Check; correct if necessary | | • | | | | | | • | |
| **Pressure valve** (part of the unit)<br>• Check function | • | | | | ○ | • | | | |
| **Oil level**<br>• Check; correct if necessary | • | • | | • | | | | | |
| **Lubricating oil**<br>• Replace<br>• Replace, with final compression temperatures above 140°C | | | •<br>• | | | •<br>• | • | | |
| **Lubricating grease,** only with gas-tight shaft seal<br>• Replace<br>• Replace if Aerzener special rotary piston oil is used and with a final compression temperature above 140°C<br>• Replace if ISO VG 220 is used and the oil has a pronounced dark discolouration | | | •<br>•<br>• | | | •<br>•<br>• | • | | |
| **Drive shaft seal**<br>(when conveying toxic / inflammable gases)<br>• Replace | | | | | | | • | | |
| **Non-return valve** (part of the unit)<br>• Check for wear and leaks, replace if necessary | | | | | | | ○ | • | |
| **Flexible pipe connection,** (part of the unit), if fitted<br>pressure side/suction<br>• Check for leaks, replace if necessary | | | | | | | | • | |
| **Hydraulic, pneumatic and measurement lines,**<br>(part of the unit), if fitted<br>• Check for leaks, replace if necessary<br>• Recommendation: Replace every 6 years | | | | | | | | | •<br>• |
| ○ **Halving of or reduction in maintenance intervals** ***(recommendation)*** | Under difficult operating conditions such as:<br>- ambient temperatures in excess of 30°C throughout the year<br>- high level of dust etc. | | | | | | | | |
| **Main inspection / maintenance** ***(recommendation)***<br>• Check/replace spare and wearing parts<br>• Check entire machine | | | | | | | | | •<br>• |
| **Drive motor**<br>• Perform maintenance<br>• Observe deadlines for re-lubrication | Please observe the maintenance intervals and maintenance specifications of the motor manufacturer!<br>With Aerzener motors, the Aerzener operating and maintenance instructions must be followed. | | | | | | | | |

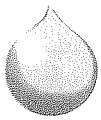
Arrange for the positive displacement machine to undergo a complete check by the Aerzener Service department at the specified intervals
Or: Take out a maintenance contract with Aerzener Maschinenfabrik.
If you maintain your machine regularly and properly, Aerzener Maschinenfabrik will guarantee maximum reliability for your application.

ENGLISH

# Lubricating oil specification for rotary piston blowers

Additives and viscosity class are the defining factors in selecting types of lubricating oil.
The following oils, which are of the correct viscosity and contain appropriate additives, are to be used in accordance with the relevant operating conditions.





## 1. General requirements for lubricating oil properties

Kinematic viscosity at operating oil temperature : 10 - 13 cSt ($mm^2/s$)
Kinematic viscosity at -10°C : ≤ 3500 cSt ($mm^2/s$)

**Minimum oil additive properties**

- EP wearing protection additives for use in roller bearing gearboxes
- Oxidation stability up to 110°C oil sump temperature,
  at continuous oil temperatures above 120°C = oxidation stability up to 220°C oil sump temperature
- Foam suppressor
- Detergents for solution of deposits
- Neutrality compared with sealing materials made of fluoro-propylene-methyl (Viton).
- Neutrality compared with single-component resin primers
- Adequate shear stability

* Ambient temperature = Temperature in the immediate environment of the machine all year round.

## 2. Single or double-shift operation / intermittent operation

| | | |
|---|---|---|
| Intake temperature stage | : | Up to 50°C |
| Final compression temperature | : | Up to 140°C |
| Ambient temperature* | : | No restriction |
| Lubricant to be used | : | **Aerzener special rotary piston oil,** Order no.: 160 754 or 160 755 |

This lubricating oil is used for the initial filling for standard application conditions.

## 3. Continuous operation / 24 hours per day

| | | |
|---|---|---|
| Intake temperature stage | : | Up to 50°C |
| Final compression temperature | : | Up to 140°C |
| Ambient temperature* | : | No restriction |
| Lubricant to be used | : | **Aerzener special rotary piston oil,** Order no.: 160 754 or 160 755 |

or

**ISO VG 150**
Fully synthetic (PAO) poly-alpha-olefin, gearbox or compressor oil
Example : MOBIL SHC 629

**4. Operation at final compression temperatures above 140°C**

| | | |
|---|---|---|
| Continuous oil temperature | : | 120°C to 140°C or |
| Final compression temperature | : | Above 140°C |
| Lubricant to be used | : | **ISO VG 220**<br>Synthetic lubricating oil with a polyglycol base oil.<br>Example: ESSO Glycolube 220<br>ARAL Degol GS 220 |
| Note | : | Oil change intervals are to be halved in case of significant, dark oil discolouration. |



**5. Lubricating oils in the foodstuffs and pharmaceutical industry**

For rotary piston blowers it is possible to use lubricating oils that have approval as per the specification USDA H1.
Experience in operation is only available with the following lubricating oil. Aerzener Maschinenfabrik cannot approve any other oils.
It is recommended to perform an oil analysis in agreement with the oil manufacturer after 1000 operating hours.

| | | |
|---|---|---|
| Final compression temperature | : | Up to 120°C |
| Continuous oil temperature | : | Up to 100°C |
| Lubricant to be used | : | **ISO VG 100**<br>Klüber oil 4UH1-100 N |

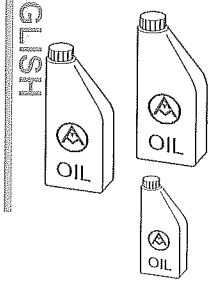
| | | |
|---|---|---|
| Final compression temperature | : | Above 120°C |
| Continuous oil temperature | : | Above 100°C |
| Lubricant to be used | : | **ISO VG 220**<br>Klüber oil 4UH1-220 N |

**Changing to other oil types**

- The Aerzener special rotary piston oil and PAO oils are completely consolute. When switching from one type of oil to another, there are no special measures to be taken into account. However, in order to maintain the useful properties of the new oil type, the oil to be changed should be completely drained and a single intermediate oil change undertaken after an operating period of 100 hours. Only the same oil should be used for refilling.
- Polyglycol-based oils cannot be mixed with Aerzener special rotary piston oil or PAO oils. In case of doubt, the oil chambers are to be opened and flushed.
- Oils based on perfluorinated polyethers, e.g. Fomblin, cannot be mixed with either Aerzener special rotary piston oil or with PAO, or with polyglycol oils. To change the oil the machine must be completely dismantled and the entire oil system through cleaned of all residue. A flushing run prior to commissioning is recommended.

# Lube oil quantities






**Total oil quantity,**
in approximate litres / oil level up to middle of gauge glass on the blower stage

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| GM 3S | 0.55 l | | GM 4S | 0.55 l | | GM 7L | 0.55 l |
| GM 10S | 0.86 l | | GM 15L | 0.86 l | | GM 25S | 1.2 l |
| GM 30L | 1.20 l | | GM 35S | 3.00 l | | GM 50L | 3.50 l |
| GM 60S | 6.50 l | | GM 80L | 6.50 l | | GM 90S | 11.50 l |
| GM 130L | 11.50 l | | GM 150S | 11.00 l | | GM 220L | 11.00 l |
| GM 240S | 17.50 l | | GM 315L | 17.50 l | | GM 400L | 22.00 l |

**Total oil quantity /**
**only applies to generation 5 units with acoustic hood**
in approximate litres / oil level up to mark on the gauge glass of the acoustic hood

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| GM 3S | 0.55 l | | GM 4S | 1.00 l | | GM 7L | 1.00 l |
| GM 10S | 1.40 l | | GM 15L | 1.40 l | | GM 25S | 1.75 l |
| GM 30L | 1.75 l | | GM 35S | 3.75 l | | GM 50L | 4.50 l |
| GM 60S | 7.50 l | | GM 80L | 7.50 l | | GM 90S | 12.50 l |
| | | | | | | | |
| | | | | | | | |

Generation 5 units with acoustic hood

**NOTE:** The lubricating oil volume specification is a guide value. The display in the oil sight glasses of the blower or the display in the oil sight glass of the acoustic hood are crucial for determining the oil fill volume.

# Change of lubricant on the drive shaft

> Only on drive shaft of gas-tight design <

Changing lubrication on a gas-tight drive shaft is carried out by means of re-lubrication on the drive shaft.

- Depending on the sealing method, a lube oil or grease block is used.
- If an oiler is used the oil level is to be checked weekly and topped up if necessary. The maximum oil level should be in the middle of the oiler.
- If a grease bush or grease nipple is used, the grease quantities listed below, according to the intervals listed in the maintenance schedule, are to be used for re-greasing.
- Please note!
  The grease is to be pressed in / changed several operating hours before the lube oil change. In this way the used, excess grease reaches the oil chamber of the blower and can then be drained together with the lube oil.
- Once the grease has been pressed in, the cover for the compression lubricator must be turned back into place by one rotation. The volume of grease pressed in may therefore expand if heated. Please ensure that this rotation is observed once the grease has been pressed in and add it to the necessary number of rotations.

## Grease specifications

- When using lube oils according to Aerzener lube oil specifications, *except polyglycol oils*, grease type KHC-2P-30 is used.
- Filled at factory: **KLÜBER PETAMO GHY 133 N**

- When using polyglycol oil according to Aerzener lube oil specification, grease type **MPG2K-40** is used

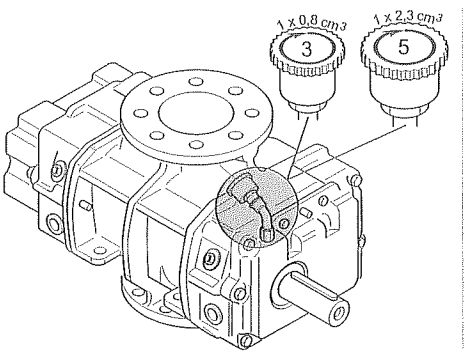
  **KLÜBER SYNTHESO PROBA 270**

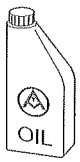
- Mixing of different greases is to be avoided.
- Re-lubrication is admissible only with the same grease.
- If these greases are not available, they are to be removed completely and replaced with other greases according to KHC-2P-30 or MPG2K-40.
- Observe sealing consistency with Viton.

## Re-lubrication quantities

| | | |
|---|---|---|
| Type | GM 3S - GM 30L | ≈ 5 cm³ |
| | GM 35S - GM 130L | ≈ 10 cm³ |
| | GM 150S - GM 400L | ≈ 20 cm³ |
| Profile | 10 - 12 | ≈ 5 cm³ |
| | 13 - 15 | ≈ 10 cm³ |
| | 16 - 18 | ≈ 20 cm³ |
| | 19 - 21 | ≈ 40 cm³ |

Oiler
Grease nipples
Grease bush

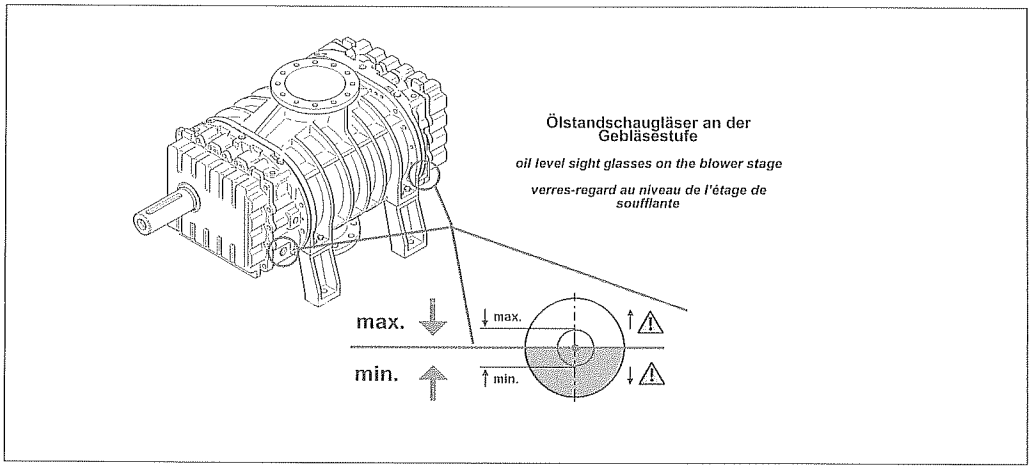


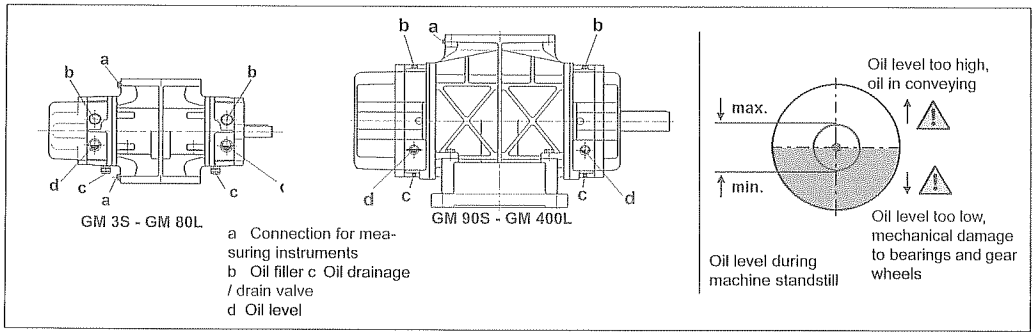



# Lubricant change

## Filling up oil

- Drainage valves must be closed/check for proper seating.
- Open oil reservoir.
- The specified oil quantity must be divided proportionately between both oil chambers according to the oil level indicator. Correct oil level = middle of sight glass,
  observe maximum and minimum markings.
- It is very important that each of the oil chambers is filled and drained separately and that they are checked using the relevant sight glasses.
- Fill oil with a suitable funnel. Please ensure that the oil temperature is at least 20°C.
- The filling process should be carried out in stages.
- First fill with approximately ¾ of the specified oil quantity.
- After a brief interval, the oil level adjusts itself in the oil chambers.
- The oil level should now be checked and adjusted in line with the markings on the sight glass. Oil level can move between the minimum and maximum marks. The oil level should be checked after the first 3 and 25 operating hours and then at weekly intervals, and adjusted if necessary.



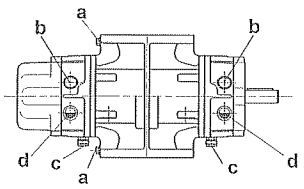



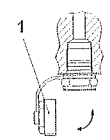
## • Draining oil

The initial operating oil container can be used as a collecting container.
The waste oil can be collected in this container in the proper manner and disposed of in an environmentally-friendly way at an appropriate collecting station.
Please observe capacity.

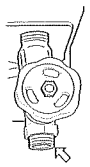
a) *b)* Unscrew cap (1), threaded plug (1) from the drain valve.
If the cap (1) and threaded plug (1) have been screwed in too tight, hold the valve firmly with an
open-jaw wrench and loosen position (1) with a second wrench.
a) Screw on the hose, which is supplied.
a) The drain valve opens automatically.
a) Position the end of the hose in a collecting container.
*b)* Open manual valve, drain the waste oil into a container.
a) *b)* The waste oil must be disposed of in the proper manner.
a) Remove the hose from the drain valve
*b)* Close manual valve, screw in threaded plug (1) while gripping the valve firmly.
a) Screw cap (1) hand-tight onto drain valve.
a) *b)* If the drain valve becomes loose or completely detached in the thread, it must be replaced together with a new seal.

Observe oil temperature when changing the oil. The oil temperature must not exceed 60°C, due to the thermal load capacity of the "drain hose".
If the oil temperature exceeds 60°C there is a risk of burns.




Beispiel / *example a)*



*b)*

Design ***without acoustic hood***
c - Oil drainage / drain valve

## Drive,belt drives, couplings

- Before installing the driving elements, clean the shaft journals to remove the preserving oil.
- Gently break off (debur) any sharp edges on the drive shaft, coupling or belt pulley.
- Push the coupling/belt pulley onto the shaft journal using a fixture, threaded rod...
- In the case of belt pulleys with Taper Lock bushes, refer to the manufacturer's assembly instructions.
- The fixture, threaded rod ... must be screwed into the metric tapped centre hole on the driving shaft.
- The driving elements must*NOT* be driven onto the shaft journal with a hammer. This would risk damaging the blower bearings.
- Following assembly and alignment, the belt pulley/coupling half must be secured to prevent axial displacement.
- At Aerzener Maschinenfabrik, the piston/rotor driving shafts are balanced using the „half-key balancing" technique. The belt pulleys/couplings must be used in accordance with the requirements of balancing type „H".

## Notes on V-belts, V-belt pulleys, V-belt tensioning

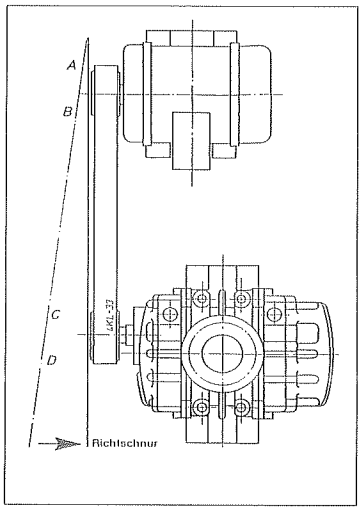
Whenever work is carried out on the belt drive, the machine must be taken out of operation and correctly isolated from the mains supply.
Measures must be implemented to prevent the machine from starting up/being operated.
**Caution: The belt drive is potentially dangerous and can sever and/or crush body parts.**

### Changing V-belts

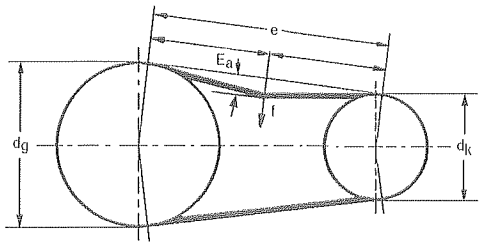
V-belt replacement/life depends on the unit version and on the operating conditions. Please refer to the information provided by the unit manufacturer.

### V-belt pulley alignment

The belt pulleys should be aligned as precisely as possible with the aid of a standard or gauge.
The life of the driving elements will be affected in accordance with the extent of any misalignment.
The standard/gauge must make contact with the belt pulleys at points A, B, C and D.




| Machine type | Min. belt pulley Ø (mm) | Max. belt pulley width (mm) |
|---|---|---|
| GM 3S/4S/7L | 160 | 70 |
| GM 10S/15L | 165 | 85 |
| GM 25S/30L | 140 | 115 |
| GM 35S/50L | 170 | 115 |
| GM 60S/80L | 230 | 150 |
| GM 90S/130L | 360 | 180 |
| GM 150S/220L | 425 | 225 |
| GM 240S/315L | / | / |
| GM 400L | / | / |
| Minimum perm. belt pulley diameter and maximum perm. belt pulley width for the relevant frame size | | |




e = Distance between pulley centres
E = Depth of indentation per 100 mm distance between pulley centres
$E_a$ = Strand depth of indentation
f = Test force

$$E_a = \frac{E \cdot e}{100}$$

| Profile | Test force f per V-belt (daN) | Diameter $d_k$ (mm) | Depth of indentation E (mm) per 100 mm Strand length on initial assembly | Depth of indentation E (mm) per 100 mm Strand length during operation after run-in |
|---|---|---|---|---|
| SPZ/3V<br>XPZ/3VX | 2.5 | ≥ 56 - 71<br>> 71 - 90<br>> 90 - 125<br>> 125 | 2.20<br>1.95<br>1.50<br>1.20 | 2.45<br>2.20<br>2.00<br>1.70 |
| SPA<br>XPA | 5.0 | ≥ 71 - 100<br>> 100 - 140<br>> 140 - 200<br>> 200 | 2.80<br>2.50<br>2.20<br>2.15 | 3.20<br>2.85<br>2.55<br>2.40 |
| SPB/5V<br>XPB/5VX | 7.5 | ≥ 112 - 160<br>> 160 - 224<br>> 224 - 355<br>> 355 | 2.40<br>2.10<br>1.70<br>1.40 | 3.00<br>2.65<br>2.22<br>1.90 |
| SPC<br>XPC | 12.5 | ≥ 180 - 250<br>> 250 - 355<br>> 355 - 560<br>> 560 | 2.30<br>1.90<br>1.65<br>1.60 | 2.65<br>2.30<br>1.90<br>1.70 |

1. Specifying the test force **f** from the table on the basis of the V-belt profile used.
2. Determine the smallest pulley diameter $d_k$ on the drive and take the corresponding depth of indentation**E** from the table.
3. Using the formula, the depth of indentation $E_a$ should be calculated with the available distance between pulley centres **e**
4. The test force **f** must be applied to the V-belts in the middle of the distance between pulley centres **e** and must act vertically in relation to the strand. Pretension the drive until the calculated depth of indentation $E_a$ is achieved.

Pretensioning calculation
Example: Profile = SPZ; $d_k$ = 100 mm; e = 380 mm; f = 2.5 daN; E = 2.00 mm; $E_a$ = 7.6 mm

**Check the tension of the V-belt after an operating time of approx. 30 minutes. The belts may need to be retightened depending on the tensioning unit. Subsequent checks are to be made in accordance with the maintenance schedule.**

## Drive coupling/alignment notes

Whenever work is carried out on the drive coupling, the machine must be taken out of operation
and correctly isolated from the mains supply.
Measures must be implemented to prevent the machine from starting up/being operated.
**Caution: The coupling is potentially dangerous and can sever and/or crush body parts.**

### Changing the coupling elements

Driving element replacement/life depends on the unit version and on the operating conditions. Please refer to the information provided by the unit manufacturer.

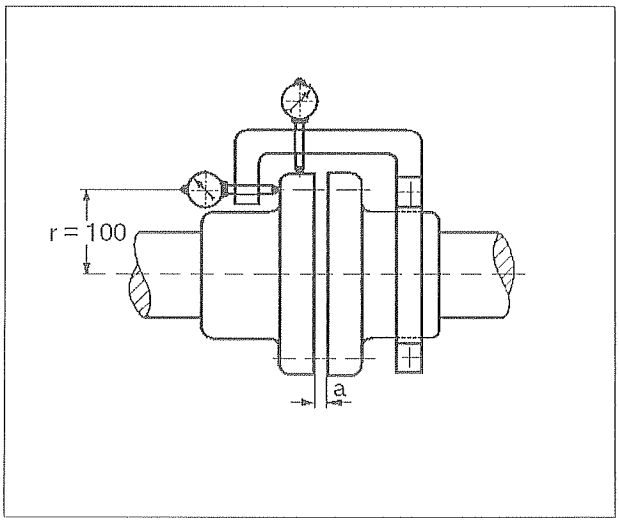
### Coupling alignment

Use dial gauges/hairline squares for alignment purposes.
The life of the driving elements will be affected in accordance with the extent of any misalignment.
Use dial gauges/hairline squares to check the axial and radial run-out.
The coupling must be pushed onto the driving shaft in the correct way so that it provides full bearing support.

Coupling running tolerances:

Radial : max. 0.05 mm parallel shaft misalignment/0.1 mm on turnover
Axial : max. 0.05 mm on turnover

- Dimensions apply to a distance r = 100 mm from the centre of the shaft.
- In the case of other distances, the tolerances will need to be adapted accord ingly.



# Accessories

1. Filter silencer
2. Service indicator for monitoring filter soiling
3. Starting strainer
4. Pressure gauge for monitoring the intake and discharge pressure
5. Pressure valve
6. Discharge silencer
7. Pressure switch
8. Non-return valve
9. Start-up relief
10. Acoustic hood
11. Thermometer for indicating the discharge temperature
12. Compensators
13. Driving motor
14. Maintenance accessories (V-belts, intake filter, oil, etc.)

The scope of supply can be expanded to include the accessories listed above. For enquiries and orders, simply contact the Aerzener After-Sales Service department (also responsible for spare parts).

# Malfunction / Possible cause / Remedy

**Repairs on positive displacement blowers must be carried out only by authorized and qualified personnel. Improper repairs can lead to considerable damage for the user / persons.**

| Malfunction<br>Faults<br>What to do, when . . ? | Possible Causes . .. | Remedy . . . |
|---|---|---|
| ... abnormal running noises occur? | • Belt not properly aligned<br>• Bearing damage<br>• Rotary pistons contact each other or in the conveying chamber<br>• Pistons contact due to contamination<br>• Foreign particles in gear wheels<br>• Shaft deflection | • Check and adjust if necessary<br>• Exchange bearings<br>• Check clearance adjustment/check for cracks<br>• Clean conveying chamber<br>• Check wheels, clean, exchange if necessary<br>• Measure deflection, change rotary piston if necessary |
| ... the blower gets too hot? | • Intake filter contaminated<br>• Ambient temperature too high<br>• Hood slots clogged<br>• Ventilator defective<br>• Oil level or viscosity too high<br>• Rotary piston clearances too large<br>• Overloaded | • Replace filter<br>• Ensure sufficient room ventilation inlet-/exhaust air<br>• Clean ventilation slots<br>• Replace ventilator<br>• Correct oil level, observe viscosity<br>• Replace damaged components<br>• Check and observe operating data |
| ... oil appears in conveying medium? | • Oil level too high<br>• Worn seals | • Adjust oil level<br>• Replace seals |
| ... the intake volume is too low? | • Anfahrsieb bzw. Ansaugfilter verschmutz<br>• undichte Leitungen<br>• Gebläse falsch dimensioniert<br>• beschädigte(r) Drehkolben / Zylinder | • reinigen ggf. ersetzen<br>• Leitungen abdichten<br>• Auslegung prüfen<br>• beschädigte Bauteile austauschen |
| ... motor requires too much power? | • Operating data differ from order data<br>• Mechanical blower or motor damage<br>• Motor voltage drop | • Check and observe operating data<br>• Replace damaged components<br>• Adjust power, refer to motor instructions |
| | | |

| Malfunction<br>Faults<br>What to do, when . . ? | Possible<br>Causes . .. | Remedy . . . |
|---|---|---|
| ... the side of belt vibrates? | • V-belt is worn<br>• Belt not properly aligned | • Replace belt<br>• Check and correct if necessary |
| ... the blower runs in reverse direction after shutdown? | • Non-return valve defective or leaky | • Replace valve |
| ... machine damage occurs due to faulty electrical connection? | • Motor and control system are connected to two different networks | • Connect motor and control voltage to one supply network<br>• Alternative: Installation of a power monitoring relay |
| After the correction of each malfunction, the following is to be checked:<br>• Freedom of movement of the machine<br>• Non-contact turning<br>• Lube oil level<br>• Proper function and connection<br>• Adherence to safety and warning instructions | | |
| | | |

# Spare parts - overview

For effective and durable use of the rotary piston machine, there follows a list of components necessary for maintenance, an inspection or a repair.
The components are grouped by expected life into three spare part versions.



**1.) Maintenance**
- Shaft sealing ring(s)
- Inner ring, shaft sleeve, bush
- Sealing rings and screw plugs, drain valves for oil drain
- V-belt / wearing parts on coupling
- Air filter element
- Lubricating oil, oil filter element

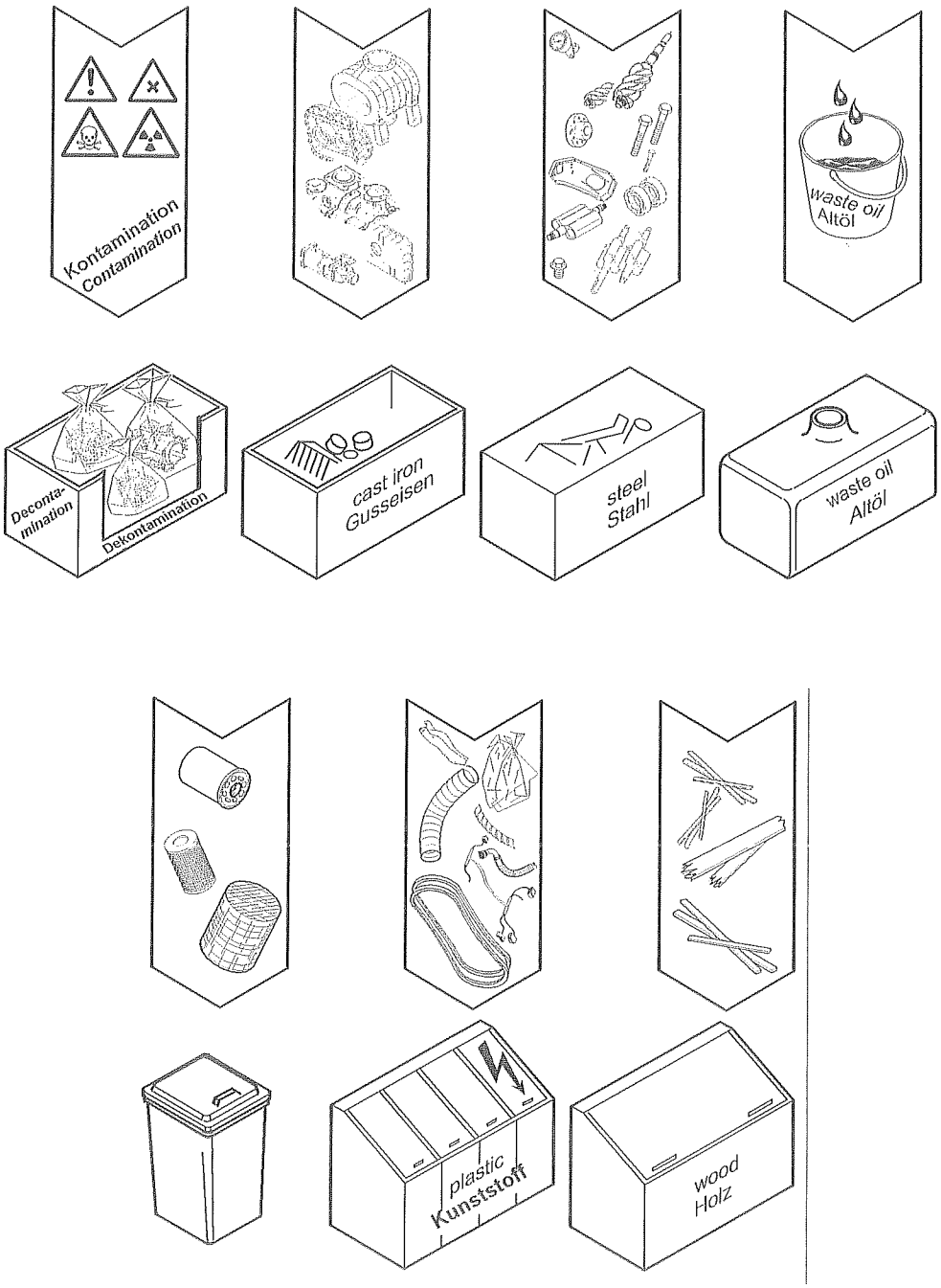
**2.) Inspection**
- Components from point 1.)
- Bearing and sealing components
- for compressor plus the adjustable bearing cover including the related minor items

**3.) Repair**
- Components from point 1.) and 2.)
- Rotor pair / rotary piston pair
- Timing gear wheels
- for compressor plus the torsion shaft and the oil pump

**Spare parts and accessories**
It is specifically highlighted that original parts and accessories not supplied by us have also not been tested or approved by us.
Therefore, installing or mounting and using any such products could, under certain circumstances, degrade the stipulated system characteristics. The manufacturer shall assume no liability whatsoever for damage caused by the use of non-genuine parts or accessories.

# Recycling / Disposal

- All waste products are to be disposed of or treated not harmful to the environment.
- Used lubricants are to be disposed of properly.
- Contaminated components and auxiliary material are to be packed and decontaminated.



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DEUTSCH

ENGLISH

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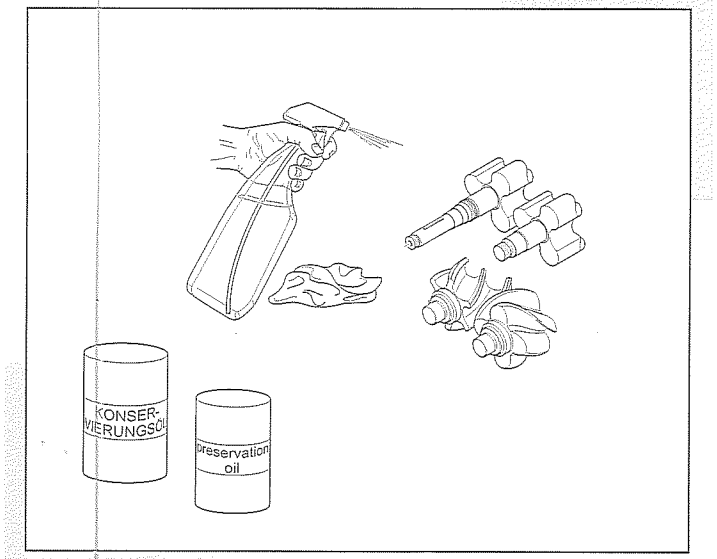
# Lagerungs- und Konservierungsvorschrift

## *Storage- and preservation regulations*

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Werknorm Works Standard

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## 1. General

Under preservation the treatment against corrosion is meant. It is applied for all Aerzen product ranges and corresponding spare parts. We distinguish between

- External preservation and
- Internal preservation

The preservation refers to the external coating, the protection treatment of metallic polished parts as well as preservation of conveying- and oil chambers against corrosion.
The scope of the preservation measures depends on the storage period until commissioning, the bearing co and special customer requests.
In tropical climates a preservation and packing according to the local conditions is necessary.
Also in case of longer operation breaks (more than 6 months) special preservation measures are required fo products. Spare part deliveries are also subject to a preservation at site.
Initial preservation is carried out in factory of manufacturer according to appropriate quality stipulations and b on contractual agreements. Upon non-observation of the guidelines and measures included in the works sta Aerzener Maschinenfabrik is not liable for possible corrosion damages and resulting subsequent damages.

## 2. External preservation

The standard finish of Aerzen machines consists of a corrosion protection primer on alkyd resin basis for me undergrounds, especially for the industrial range in connection with alkyd resin cover coating. For the extend corrosion protection a special finish is offered, based on a combination of a 2-component base-and intermed coating of epoxy resin – micaceous iron ore and a polyurethane cover coating. Please also refer to informati for colour paints A3-010. For the design of the external preservation the following Aerzen quality regulations QH00402, QH00403, QH00510, QH00550.
All external metallic polished surfaces such as socket flanges, shaft journals and installation surfaces are pro corrosion protection agent TECTYL 506 EH .

## 3. Internal preservation

The conveying- and oil chambers of Aerzen products are preserved upon delivery according to application c For the corresponding preservation agents please refer to chart (chapter 8). If not stated differently the conve chamber is preserved by means of BIO CHEM Food Tech Oil, the oil chambers are provided with a preserva ISO VG 46 or 68 (e.g. Delta Lube 06 or Mobil SHC 626 ).
The BIO CHEM Food Tech Oil used is biodegradable and does not harm the groundwater.
A standard preservation up to 12 months is sufficient provided a proper storage is ensured.
In case of longer storage periods a corresponding long-time preservation and special packing is provided as under point 6.3. In general all Aerzen products are supplied without oil filling.
All connection orifices are sealed with plastic flap.
The internal preservation is determined in the corresponding inspection regulations of the products.

## 3.1 Filling of conveying chambers with nitrogen

Alternatively the machines can be filled with nitrogen. For this all orifices, such as intake- and pressure flang neutral chambers need to be closed.
The nitrogen pressure needs to be at approx. 0,5 bar and must be observed.

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## 4. Packing and storage

The preservation measures at site are designed for a limited period of time (up to 12 months) under special storage conditions according to Aerzen quality regulations resp. customer's request.

For the storage a dry, shock-proof and clean room is to be provided. Extreme temperature fluctuations and water penetration (e.g. by rain) are to be avoided.

The machines must not be exposed to shock load. If a shock-free storage cannot be guaranteed, the rotors are to be rotated 2 – 3 times every 6 – 8 weeks.

If the products are stored longer than agreed or under other conditions, additional measures are necessary, in order to ensure a sufficient corrosion protection.

The efficiency of the preservation measures depends on packing, the storage conditions as well as storage period. In order to prepare the necessary preservation measures the customer is asked to provide a climate specification.

If the customer requires a preservation for a longer period of time (more than 12 months), the machines, units, accessories etc. are wrapped in VPI-paper and welded in PVC-foil.

In case of storage longer than 12 months and in case of storage in tropical climates, prior to welding the packing is provided with drying agent (VPI-powder in gauze bags) in corresponding quantity as per climate zone. A high-quality packing with sufficient drying agent as well as a storage in air-conditioned chambers with small air humidity has positive effect on corrosion protection. The design of packing is stipulated in Aerzen quality regulation QH00409.

## 5. Preservation of spare parts

All spare parts being supplied are provided with a preservation. Under normal conditions this preservation is designed at site for a corrosion protection of 12 months.

- Upon storage of spare parts up to 1 year the parts are preserved with BIO-CHEM Food Tech Oil.
- Upon storage of spare parts up to 5 years the parts are preserved with TECTYL 506.
- In case of special preservation of spare parts being stored longer than 5 years the parts are preserved with TECTYL 506, wrapped in VPI-paper and welded in PVC-foil. Prior to welding VPI-powder in gauze bags is attached to the packing as drying agent. If no appropriate room is available resp. the period of storage exceeds the indicated durability of preservation, the preservation is to be checked at corresponding intervals (from beginning of the storage) and if necessary – it is to be renewed accordingly.

In case of appropriate storage places and storage period longer than 1 year, the preservation needs to be checked in 2-months intervals.
The measures for preservation of spare parts refer to the required storage period. They are determined in Aerzen quality regulations QH00441.

## 6. Measures for corrosion protection during storage

### 6.1 General

The measures as described in the following paragraphs are to be understood as general guidelines for certain events. In case of doubt we recommend to agree the measures with Aerzener Maschinenfabrik.
If in the course of controls or maintenances corrosion damages are found, the nearest Aerzen service station is to be informed.



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### 6.2 Damaged packing

Through damaged packing humidity and detrimental environmental influences may act directly onto the produ temperature fluctuations humidity may penetrate to the inside of the machine more frequently.

Measures:

- Drying of the machine, if necessary
- Check and if necessary replacement of the applied quantity of drying agent
- Check and if necessary repair of the preservation of the polished points
- Repair or replacement of the packing. Remove old PVC sheeting and weld the machine again in PVC of the same value together with drying agents.
- External check of the packing at regular intervals. Observe control intervals of the drying agents depe climatic zones.

### 6.3 Exceeding of storage period

If the machines are stored for a longer period than 12 months after delivery (standard), the preservation must repeated. After a storage period of more than 2 years at site the manufacturer generally should have an inspe the entire scope of supply carried out by the Aerzen specialized staff.

Measures:

- Preserving the conveying chamber by spraying through the intake socket of the machine with corresp preservation oil
- Preserving the oil chambers by spraying through the oil supply and oil drain screws with correspondi preservation oil or alternatively short-term filling and draining the oil chambers
- Preserving again the external polished surfaces
- Check of the plug caps on the connection orifices
- Check and restoration of the packing

### 6.4 Preservation after opening of packing

Immediately after opening the packing additional preservation measures become necessary, to guarantee a s corrosion protection for the product.
Measures:

- Check of the connection orifices. Plug caps must not be removed
- Protect the product as good as possible by suitable measures (chapter 4) against water and detrimer environmental influences. If the machine is covered by tarpaulins, these are to be arranged if possibl certain distance to the machine.
- Check the preservation of the external polished surfaces.

### 6.5 Steps to be taken prior to installation of the machine into a unit or a plant

- Check of the intake- and discharge-sided connection orifices for possible damages
- Check of conveying chamber for possible damages
- Check of all connections/screwings for damage and function
- Check of all external polished surfaces for corrosion

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### 6.6 Steps to be taken after installation of the machine into a unit or a plant until commissioning

- Close the intake and discharge side of the machine with blind flange
- Perhaps nitrogen filling of the conveying chambers after contacting the Aerzen After Sales Service
- Check preservation of conveying chamber and if necessary repeat this
- Preservation of oil chambers in case of longer operation stops
- In case of a standstill of more than 6 weeks the conveying chamber is to be preserved and the rotors are to be turned manually, to avoid standstill damages

### 6.7 Steps to be taken prior to commissioning

Prior to commissioning of the machine it must be sure, that the preservations were removed. In case of non-compatibility with the conveying medium the conveying chamber is washed with a degreasant and blown dry with compressed air. Otherwise the conveying chamber does not need to be cleaned. During commissioning the preservation oil is loosened by compression heat and thrown out.
The preservation oil can remain in the oil chambers. Without cleaning the chambers the corresponding oil, in accordance with the operating manual, can be filled up.

- Information based on operating manual !
- Check conveying- and oil chambers for corrosion
- Remove purgings (intake- and discharge side) possibly installed
- Turn rotors manually

### 7. Product specification for corrosion protection agent

- TECTYL 506 EH, Fa. Valvoline, Hamburg, => preservation agent
- Valvoline 150, Fa. Valvoline, Hamburg, => Special solvent for TECTYL 506
- BIO CHEM Food Tech Oil, Fa. CB Chemie, Gütersloh, => corrosion protection oil
- BALLISTOL, Fa. F.W. Klever, Aham, => corrosion protection oil
- FOMBLIN YL-VAC 25/6, Fa. Solvay Solexis, Seligenstadt, => corrosion protection oil
- FOMBLIN Y 45, Fa. Solvay Solexis, Seligenstadt, =>corrosion protection oil
- BRANOGEL, Fa. Brangs & Heinrich, Hannover, => drying agent
- BRANOROST, Fa. Brangs & Heinrich, Hannover, => corrosion protection paper
- BP Aircol HV 100, => Vacuum pump oil
- BP Visco 5000 C 5W-40 => Lubricating oil
- Delta Lube 06, => Lubricating oil
- Mobil SHC 626,=> Lubricating oil
- Shell Morlina 10,=> Hydraulic oil
- RARUS 425, Fa. MOBIL, Hamburg, => Compressor oil
- RENISO SYNTH 68, Fa. Fuchs DEA, Mannheim, => Refrigerator oil
- COEX-Flat film VCI 3000, Fa. Safe Pack, Bad Salzuflen => corrosion inhibiting film
- COEX-foamed material band VCI 150, Fa. Safe Pack, Bad Salzuflen => corrosion protect. Band



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### 8. Charts for preservation measures referring to the product

### 8.1 Blowers (Gas meters)

| Preservation measure | Delta Blower | GM... GL... | GR... GQ... | Oxygen blowers stan-dard | Oxygen blowers HV | Pre-inlet blowers | Vacuum blowers stan-dard | Oil- and grease free blowers (variation 087) | HV canned motor drive | Speci blowe |
|---|---|---|---|---|---|---|---|---|---|---|
| External polished surfaces TECTYL 506 | | x | x | | | x | | | | |
| External polished surfaces VCI film | | | | | | | | x | x | |
| External polished surfaces – except the socket flanges Fomblin Y 45 | | | | x | x | | | | | |
| External polished surfaces BIO CHEM Food Tech Oil | | | | | | | x | | | |
| Internal preservation / conveying chamber BIO CHEM Food Tech Oil | x | x | x | | | x | | | | |
| Internal preservation / conveying chamber Fomblin YL-VAC 25/6 | | | | | | | | | | |
| Internal preservation VCI-foam | | | | | | | | x | x | |
| Internal preservation Nitrogen-filling | | | | x | x | | | | | |
| Internal preservation / conveying chamber None | | | | x | x | | x | | | |
| Seal ring housing BP Aircol HV 100 | | | | | | x | | | | |
| Oil chambers BP Aircol HV 100 | | | | | | | x | | x | |
| Oil chambers Mobil SHC 626 | x | x | x | | | x | | | | |
| Oil chambers Fomblin YL-VAC 25/6 | | | | | x | | | x | | |
| Oil chambers Fomblin Y 45 | | | | x | | | | | | |
| Oil chambers Shell Morlina 10 | | | | | | | | | | |
| Preservation referring to the order | | | | | | | | | | x |
| Quality prescription | QP00001, QP00276 | QP00001, QP00276 | QP00144 | QP00209, QH00428 | QP00209 | QP00192 | QP00209 | QP00209 | QP00209 | Special test instruction |

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## 8.2 Compressors

| Preservation measure | VM... VML... VMT... | VMX... | VMY... Process refrigeration | VMY... semiherm. refrigeration | VR... | DELTA Screw | DELTA-Hybrid | Special Compressors |
|---|---|---|---|---|---|---|---|---|
| External polished surfaces TECTYL 506 | x | x | x | | x | | | |
| Internal preservation / conveying chamber BIO CHEM Food Tech Oil | x | | | | x | x | x | |
| Internal preservation / conveying chamber Mobil Rarus 425 | | x | x | | | | | |
| Internal preservation / oil chamber Mobil SHC 626 | | | | | x | | | |
| Internal preservation / conveying chamber None | | | | | | | | |
| Internal preservation Nitrogen-filling | | | x | x | | | | |
| Internal preservation / Oil chambers Delta Lube 06 | x | | | | | x | x | |
| Oil chambers FUCHS RENISO SYNTH 68 | | | | x | | | | |
| Preservation referring to the order | | | | | | | | x |
| Quality prescription | QP00179, QP00228 | QP00092 | QP00138 | QH00541 | Special test instruction | QP00228 | QH00561 | Special test instruction |



# INFO - SEITE

*Information sheet* *Page infos*
*Info - bladzijde* *PaginaInformativa*

Gegenüber Darstellungen und Angaben dieser Betriebsanleitung sind technische Änderungen,
die zur Verbesserung der Drehkolbenmaschinen notwendig werden, vorbehalten.
This operating- and installation manual is subject to engineering changes necessary for the compressor advancement.
Nous nous réservons le droit dans les instructions de service procéder à toutes modifications techniques utiles visant à améliorer la qualité des compresseurs.
Wat de betrft de tekeningen en gegevens in deze bedienings- en opstellings-handleiding verbetering van de schroefcompressor noodzakelijk worden, voorbehouden.
Nos reservamos el derecho de efectuar, frente a las representaciones e indicaciones de esta
instrucciones de montage servicio modificaciones técnicas necesarias para perfeccionar.
Rispetto all'illustrazione ed alle indicazioni di questa Istruzioni di Esercizio ci si riserva quelle modifiche tecniche che sono necessarie per migliorare i compressori.

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Technische Dokumentation

Technical Documentation

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recycled 50/50 chlorfrei

# Bedienungsanleitung für Aerzener Druckventile

## Gefahrenanalyse
## Ausrüstungsteile mit Sicherheitsfunktion

R2“ // DN 50 // R3“ // DN 80 // DN 125 // DN 150 // DN 200 // DN 300

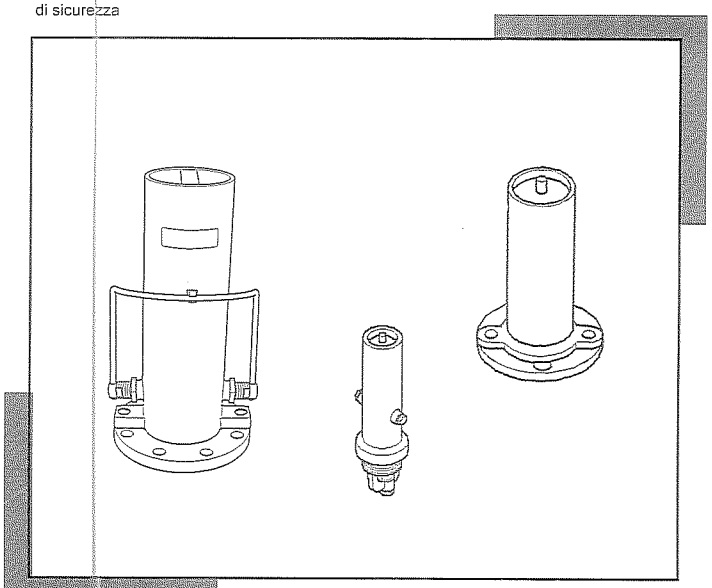
**Instructions de service des soupapes de compression Aerzener**
Analyse des dangers
Pièces d'équipement de sécurité

**Manual de instrucciones para válvulas de presión Aerzener**
Análisis de peligros
Piezas con función de seguridad

**Istruzioni per l'uso delle valvole a pressione Aerzener**
Analisi dei pericoli
Elementi di equipaggiamento con funzione di sicurezza

**Operating instructions of Aerzener valves**
Danger analysis
Part of equipment with safety function

**Handleiding voor Aerzener drukventielen**
Gevarenanalyse
Uitrustingsonderdelen met veiligheidsfunctie



AERZE

AERZENER MASCHINENFABR

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| 4. | Inadmissible operation methods | 3 |
| 5. | Operation / Use | 3 - 4 |
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## 1. Suitability / General advice

The pressure valves are high-quality safety facilities, which are to be treated carefully. An improper, coarse use will lead to an impairment of the function or even to complete failure / damage of the valve.
The pressure valves protect the blowers from excessive pressure load and its consequences.
Stake only for air and neutral gases.
The opening pressure of the valve is set by the manufacturer to 50 mbar above the operating pressure as standard.

## 2. Construction / Function

When exceeding the differential pressure by more than 50 mbar above the operating pressure the valve opens and carries off the conveying medium to the ambience or into a collecting pipe.
The blower is thus protected from overload.
Guide bushing, bell and pistons are made of resistant material.

## 3. Care to be taken before and during operation

ATTENTION ! Draws the attention to all dangerous situations
WARNING ! Points to direct risks of persons.

- Read the INFO-sheet prior to commissioning. Possible notes and changes indicated herein are to be effected.

- **ATTENTION !** The valve is not a control instrument and must not be applied as such.
- Upon modification of the performance data the pressure valve is to be adjusted by a service technician of the manufacturer anew.
  If this is not observed the conformity lapses.
- The manufacturer does not assume any liability when a pressure valve is not applied properly.
- In order to prevent corrosion and deposits of dirt,the valve is to be checked for its function acc. to chapter 5 / „operation and use" .
- The valve is to be mounted to an even flange at tension-free condition.
- The protection cylinder must neither be removed nor be locked.
- At a distance of 20 cm no facilities / components may prevent or reduce the escaping air flow.
- No additional components may be mounted at the valve.
- With open valve, during operation hot gas escapes.
  *Risk of burns !*
- In case of open valve, all parts of the body must stay away from the gas flow.
  *Risk of injury !*
- The escaping gas flow may entrain foreign particles.
  *Risk of injury for the eyes !*
  Protective glasses are to be worn near the valve !
- Housing surfaces reach conveying discharge temperatures.
  *Risk of burns !* Safety gloves are to be worn if necessary.

## 4. INADMISSIBLE OPERATION METHODS

- Inadmissible pressure increase
- Exceeding the maximum application limits
- Use as regulating valve
- Coarse treatment
- Constricting or locking the protection cylinder
- Change of set pressure
- All kinds of assemblies on the valve

## 5. Operation / Use

- **ATTENTION!**
  The valve is not a control component and is not to be used as such.
- Before carrying out work on the valve the unit is to be properly shut down.

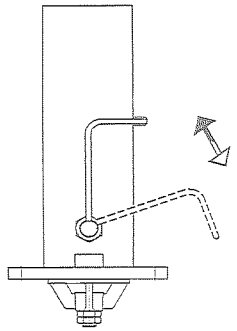
**R2" // DN 50 // R3" // DN 80 // DN 125**

- A mobility check is to be carried out on the valve during machine standstill.
  The valve cup is to be aerated with the use of two screwdrivers.
  —> The valve must open correctly.

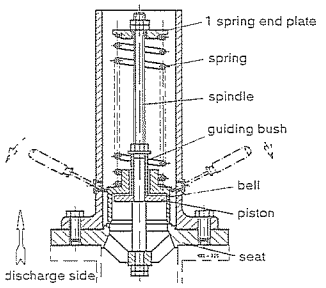
**DN 150 // DN 200 // DN 300**

- A mobility check is to be carried out on the valve during machine standstill.
  The valve is to be aerated by actuating the stirrup.
  —> The valve must open correctly.

- The screwdriver is then to be removed or the aeration device is to be disengaged.
  —> A properly functioning valve closes correctly.
- The valve can be used with temperatures up to 200° C.



DN 150 // DN 200 // DN 300




valve structure

R2" // DN 50 // DN 80 // DN 125

| Valve sizes | Explanation acc. to * | Mounting direction |
|---|---|---|
| R2" // DN 50 // R3" | category I, module A | as you like |
| DN 80 // DN 125<br>DN 150 // DN 200<br>DN 300 | category II, module A1 | vertical |

* Acc. to pressure device guideline, appendix II (conformity evaluation diagrams) an accessory with safety function for specific devices may be allocated to the same category as the device to be protected. Therefore, application may only be carried out when the device to be protected remains within the stated category.

Valves conforming to Category II , Module A1 according to EC Pressure Equipment Directive 97/23/EC are not freely available and must be used only for specific Aerzener machines in applications up to Category II.

## 6. Application limits

- max. overpressure 1.5 bar(g) = valve setting pressure 1.55 bar(g)
- maximum temperature 200°C
- neutral,clean, non-corrosive gases

## 7. Maintenance intervals

| whatever occurs earlier | Check function of pressure valve | |
|---|---|---|
| after each 1000 oper.h. | X | |
| after each ½ year | X | with clean ambient air |
| after each 1 month | X | with dust-containing ambient air |

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GEI-M1031-B

GE Energy

# Motor Installation and Maintenance Instructions

## Horizontal AC Small Industrial Motors

**NEMA 143-326 Frame**
**Totally Enclosed Fan Cooled**
**Severe Duty, Energy Saver**
**Models – 5KSxxxSTExxx**

2012/08/24

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# I. GENERAL INFORMATION

## A. How to Properly use this Instruction Manual

This manual has been written to assist the user with proper procedures when handling, installing, operating and maintaining the equipment. All of the safety warnings and instructions in this book must be followed to prevent injury to personnel.

The installation and maintenance manual must be kept for future reference during installation, operation and maintenance.

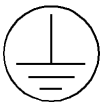
## B. Safety Symbol Legend

Below is a safety symbol table that identifies the safety symbols that appear in this manual and on the equipment.

The use of a lightning bolt within an arrowhead symbol, enclosed in a yellow triangle, indicates warning of dangerous electrical voltage that could cause an electric shock to a person.

The use of an exclamation point within a yellow triangle indicates to the user that important installation operating and maintenance instructions must be followed.

**WARNING:** Indicates a procedure or condition that, if not strictly observed, could result in personal injuries or death.



This symbol identifies any terminal which is intended for connection to an external grounding conductor for protection against electric shock in case of a fault.

The use of a small case "i" enclosed in a square indicates a general note.

**CAUTION:** Indicates a procedure or condition that, if not strictly observed, could result in minor injuries to personnel.

# I. GENERAL INFORMATION (cont'd)

## C. Safe Motor Operation

**WARNINGS**: **High voltage and rotating parts can cause serious or fatal injuries. Qualified personnel should perform installation, operation and maintenance of electrical machinery. For equipment covered by this instruction book, it is important to observe safety precautions to protect personnel from possible injury. Be sure to keep the installation and maintenance information for future reference. All warnings and cautions must be followed.**

**Installation**

- **Avoid contact with energized circuits and rotating parts.**
- **Avoid bypassing or rendering inoperative any safeguards or protective devices.**
- **Avoid use of automatic-reset thermal protection where unexpected starting of equipment might be hazardous to personnel.**
- **Avoid contact with capacitors until safe discharge procedures have been followed.**
- **Be sure the shaft key is captive before the motor is energized.**
- **Avoid long exposure in close proximity to machinery with high noise levels.**
- **Use proper care and procedures in handling, lifting, operating and maintaining the equipment.**
- **Use proper protective gear when handling, lifting, installing, operating and maintaining the equipment.**
- **If eyebolts are used for lifting motors, they must be securely tightened, and the direction of the lift must not exceed a 15° angle with the shank of the eyebolt. Do not use eyebolts in an ambient below 0°F. At lower temperature, the eyebolt could fail resulting in injury to personnel and/or damage to equipment. Drop-forged eyebolts per American Society of Testing Materials A489 or equivalent must be used.**
- **Do not use the shaft as a means for lifting.**
- **Do not lift both the motor and driven equipment with the motor lifting means.**
- **Do not stand on or place objects on the motor.**

**Maintenance**

**Safe maintenance practices performed by qualified personnel are imperative. Before starting maintenance procedures, be positive that:**

- **Equipment connected to the shaft will not cause mechanical rotation.**
- **Main motor windings and all accessory devices associated with the work area are disconnected from electrical power sources.**
- **The motor has been given time to cool.**

**Failure to properly ground the frame of the motor can cause serious injury to personnel. Grounding should be in accordance with the National Electrical Code and consistent with sound practice.**

**These instructions do not purport to cover all details in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes the matter should be referred to the General Electric Company.**

**This document contains proprietary information of General Electric Company, USA and is furnished to its customer solely to assist that customer in the installation, testing, operating and/or maintenance of the equipment described. This document shall not be reproduced in whole or in part, nor shall its contents be disclosed to any third party without the written approval of GE Energy.**

## II. RECEIVING, STORAGE, HANDLING AND UNPACKING

A. Receiving

Each shipment should be carefully inspected upon arrival. Any damage should be reported promptly to the carrier and a claim filed. The nearest GE sales office can provide additional guidance.

B. Storage

If the machine will not be put into service immediately, certain precautions should be taken to protect the machine while in storage. It is recommended that the machine be placed under cover in a clean, dry location.

During storage, windings should be protected from excessive moisture by some safe and reliable method of heating, such as space heaters, to keep the temperature of the windings a few degrees above the temperature of the surrounding air. It is recommended that the machine be inspected at periodic intervals, the windings meggered, and a log kept of pertinent data. (Refer to Operation section.) Any significant drop in insulation resistance should be investigated.

Precautions are taken by the factory to guard against corrosion. The machined parts are coated to prevent rust during shipment. If the equipment is to be stored, examine the parts carefully for rust and moisture and re-coat where necessary.

Grease-lubricated machines have the bearings greased at the factory with the cavity approximately 50% full.

Rotate the shaft of all two-bearing machines 10-20 revolutions at two-month intervals.

C. Handling

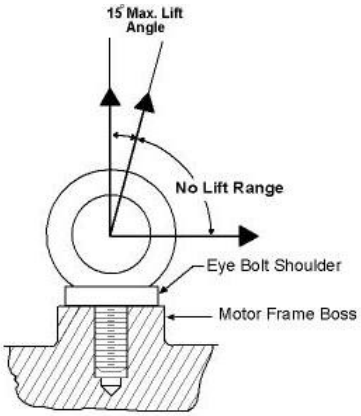
**The lifting lugs or eyebolts on the motor are designed for handling only the motor. They are not to be used to lift the motor plus additional equipment such as pumps, compressors, or other driven equipment. In the case of assemblies on a common base, the lugs or eyebolts provided on the motor are not to be used to lift the assembly and base. The assembly should be lifted by a sling around the base or by other lifting means provided on the base. In the case of unbalanced loads (such as couplings or other attachments), additional slings, or other effective means should be used to prevent tipping. Failure to observe these precautions may result in damage to the equipment, injury to personnel, or both.**

Before lifting the motor, ensure that the eyebolt shoulder is completely seated against the motor frame boss. Eyebolt should only be tightened by hand.

The angle of lift must not exceed a 15° angle with the shank of the eyebolt.

## II. RECEIVING, STORAGE, HANDLING AND UNPACKING (cont'd)

C. Handling (cont'd)




D. Unpacking

If the machine or machine parts have been exposed to low temperatures, unpack it only after it has reached the temperature of the room in which it will be unpacked or located condensation will occur.

E. Description of Labels and Nameplates

Motor rating and identification data are furnished on labels and nameplates. Labels provide basic motor characteristics. Nameplates provide a permanent record of motor characteristics, plant identification and date of manufacture.

F. Model and Serial Numbers

As discussed in section E, every motor that is manufactured by GE is provided with a model and serial number which is permanently marked on the motor nameplate and shipping pack. These numbers identify basic motor characteristics and pertinent data. When contacting a GE Service Shop or representative, please refer to the model and serial number.

## III. INSTALLATION

| | |
|---|---|
| Warning | **Coupling, belt and chain guards should be installed as needed to protect against accidental contact with moving parts. Machines accessible to personnel should be further guarded by screening, guard rails, etc., to prevent them from coming in contact with the equipment.** |
| **Failure to observe these precautions may result in injury to personnel.** | |

A. Location
1. Standard enclosed motors are used where they are exposed to dirt, moisture, and most outdoor conditions.
2. Severe-duty enclosed motors are used in highly corrosive or excessively moist areas.

B. Mounting

Mount motors securely on a firm, flat base. If necessary, grout in larger motors. Motors can be mounted per the chart shown. For vertical mounting, check with GE a representative for recommendations.

| NEMA Mounting | Direct Coupled | Belted |
|---|---|---|
| F1 | X | X |
| F2 | x | x |
| W1 | X | X |
| W2 | X | X |
| W3 | X | X |
| W4 | X | X |
| W5 | X | N/A |
| W6 | X | N/A |
| W7 | X | N/A |
| W8 | X | N/A |
| W9 | X | N/A |
| C1 | X | X |
| C2 | X | x |

X-allowed N/A – Not Allowed

| | |
|---|---|
| Caution | **Motors are shipped with drain plugs in a bag.**<br>**Do not install the drain plugs in the frame if an IP44 enclosure is required.**<br>**Install the drain plugs in the frame if IP54 enclosure is required.** |

C. Alignment
1. Direct Coupling

Align motors accurately. For direct drive, use flexible couplings if possible. For drive recommendations, consult drive or equipment manufacturers or GE.
Accurate mechanical alignment is essential for successful operation.

For base assembly and motor mounting, the bolts must be carefully tightened to prevent changes in alignment and possible damage to the equipment. It is recommended that a washer be used under each nut or bolt head to get a secure hold on the motor feet. As an alternative, flanged nuts or bolts may be used.
Use bolts that are a minimum Grade 5 or ISO 8.8. See Table 2. The recommended tightening torques for SAE (Grade 5) bolts, or ISO 8.8 bolts are in Table 3.

## III. INSTALLATION (cont'd)

C. Alignment (cont'd)

1. Direct Coupling (cont'd)

Table 2: Bolt Grade Designations

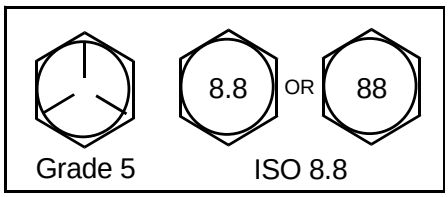



Table 3: Mounting Bolt Torques

| Bolt Size | | Recommended Torque in Ft-Lb (N-M) | | | |
|---|---|---|---|---|---|
| Inch | (Metric) | Minimum | | Maximum | |
| 1/4 | (M6) | 7 | (9) | 11 | (15) |
| 5/16 | (M8) | 14 | (19) | 21 | (28) |
| 3/8 | (M10) | 25 | (34) | 37 | (50) |
| ½ | (M12) | 60 | (81) | 90 | (122) |
| 5/8 | (M16) | 120 | (163) | 180 | (244) |
| 3/4 | (M20) | 210 | (285) | 320 | (433) |

For hardware that is less than SAE Grade 5, use 50% of the above recommended tightening torques. There are no ID marks on bolts that are less than SAE Grade 5.

2. End-Play Adjustment

The axial position of the motor frame with respect to the load is important. The bearings furnished with these motors are not designed to take any external axial thrust load unless specifically requested by the purchaser.

3. Belt Drive

The application of pulleys, sheaves, sprockets and gears on motor shafts are shown in NEMA MG1-14.07. For more information on allowable sheave sizes, refer to the AC Motor Selection and Application Guide, GET-6812.

Align the sheaves carefully to avoid axial thrust on the bearings. Belt tension should just prevent slippage when the motor is running at full load. Excessive belt tension causes unnecessary load on the bearings. This may be especially true on high-inertia loads where belts may be tightened to prevent squealing and slipping during acceleration. On drives of this type, the belts should be allowed to slip during acceleration to prevent the possibility of overloading the motor bearings. Refer to Table 4 for V-Belt sheave diameter information.

| | |
|---|---|
| *Warning* | **The belt speed should not exceed 6,000 feet per minute unless otherwise recommended by the manufacturer of the belt and sheave.** |

## III. INSTALLATION (cont'd)

### C. Alignment (cont'd)

**Table 4**
**V-Belt Sheave Diameters (Minimum in Inches)**

| Horsepower Synchronous Speed (RPM) | | | | Conventional* A, B, C, D, E Pitch Diameter | NarrowΔ 3V, 5V, 8V Outside Diameter |
|---|---|---|---|---|---|
| 3600 | 1800 | 1200 | 900 | | |
| 1.5 | 1 | .75 | .50 | 2.2 | 2.2 |
| 2 – 3 | 1.5 – 2 | 1 | .75 | 2.4 | 2.4 |
| — | 3 | 1.5 | 1 | 2.4 | 2.4 |
| — | — | 2 | 1.5 | 2.4 | 2.4 |
| 5 | — | — | — | 2.6 | 2.4 |
| 7.5 – 10.0 | 5 – 7.5 | 3 – 5 | 2 – 3 | 3.0 | 3.0 |
| — | 10 | 7.5 | 5 | 3.8 | 3.8 |
| 15 | 15 | 10 | 7.5 | 4.4 | 4.4 |
| 20 – 25 | 20 | 15 | 10 | 4.6 | 4.4 |
| — | 25 | | — | 5.0 | 4.4 |
| — | 30 | 20 | 15 | 5.4 | 5.2 |
| — | 40 | 25 | 20 | 6.0 | 6.0 |
| — | 50 | 30 - 40 | 25 - 30 | 6.8 | 6.8 |

* Maximum sheave width = 2(N-W) – ¼" where N-W is the approximate usable shaft length.
Δ Maximum sheave width = N-W.
(Reference table taken from NEMA MG1-Part 14.)

### D. Power Supply and Connections

#### 1. Wiring and Grounding

| | |
|---|---|
| Warning | **Where unexpected starting can be dangerous to personnel, do not use automatic reset protection.** |

| | |
|---|---|
| Warning | **Motor and control wiring, overload protection, and grounding should be in accordance with the National Electrical Code and consistent with sound local practices. Failure to observe these precautions may result in damage to the equipment, injury to personnel, or both.** |

Stator winding connections should be made as shown on the connection diagram on the motor.
The motor frame should be grounded by attaching a ground strap from a known ground point to the bronze-grounding bolt in the conduit box or on motor frame.

Terminal board kits are available upon request. If a terminal board is required see KS TEFC Value Line catalog.
Before the conduit box cover is closed be sure that:

a. All terminal box connections are fixed tightly.
b. The minimum air distances are met.
c. The interior of the terminal box is clean and free from foreign materials.
d. Cable openings not used should be closed and the closing screws should be fixed tightly.
e. The gasket in the terminal box cover should be clean and tightly sealed to the cover.
f. The condition of all gaskets should be in accordance with protective regulations.

## III. INSTALLATION (cont'd)

D. Power Supply and Connections (cont'd)

2. Allowable Voltage and Frequency
The power supply must agree with the nameplate voltage and frequency. The motors will operate (but with characteristics somewhat different from nameplate values) on line voltages within ±10% of nameplate value and frequency within ±5%, and a combined variation not to exceed ±10%.
Motors identified as "usable at 200V" will not operate full loads on line voltages below 190V. Motors will not meet NEMA MG-1 performance standards (including efficiency) when operated at 200V.

3. Position of the Conduit Box
When mounting conditions permit, the conduit box may be rotated so that entrance can be made upward, downward, or from either side.

## IV. OPERATION

A. Prior to Starting

| | |
|---|---|
| *Warning* | **If the motor has been stored in a damp location, dry it out thoroughly before operating. Before energizing the motor for the first time or after an extended shut down, it is advisable to check Insulation Resistance, power supply and mechanical freedom of the motor.** |

B. Insulation Resistance

| | |
|---|---|
| *Warning* | **Before measuring insulation resistance, the machine must be at standstill and all windings to be tested must be electrically connected to the frame and to ground for a time sufficient to remove all residual electrostatic charge. Failure to observe these precautions may result in injury to personnel, damage to the equipment or both.** |

In accordance with established standards, the recommended minimum insulation resistance for the stator winding when measured with a 500 volt DC direct indicating ohmmeter with self-contained power supply (megger), is as follows:

$R_S = 5\ M\Omega$

$R_S$ is the recommended minimum insulation resistance in megohms at 40°C of the entire stator winding obtained by applying direct potential to the entire winding for one minute.

See IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machines, Publication No. 43, for more complete information. If the insulation resistance is lower than this value, it is advisable to eliminate the moisture in one of the following ways:

## IV. OPERATION (cont'd)

B. Insulation Resistance (cont'd)

1. Dry the part in an air circulating oven with the air surrounding the part at 110°C, (-15°C/+5°C) until the part has been above 90°C for at least four hours. Then the air temperature may be raised to 150°C, -15°C/+5°C.
   Continue to heat until the insulation resistance is constant for a one-half hour period.

2. Enclose the motor with a canvas or similar covering, leaving a hole at the top for moisture to escape. Insert heating units or lamps and leave them on until the insulation resistance is constant for a one-half hour period.

3. With the rotor locked mechanically, and using approximately 10% of rated voltage, pass a current through the stator windings. Increase the current gradually until the winding temperature reaches 90°C. Do not exceed this temperature. Maintain a temperature of 90°C until the insulation resistance becomes constant for a one-half hour period.

C. Steps Prior to Initial Start

| | |
|---|---|
| *Warning* | ***Be sure that the motor is not running and the power supply is disconnected.*** |

1. Do not flush out anti-friction bearings. The bearing grease supplied is sufficient for initial operation.

2. Whenever possible, examine the machine for loose objects or debris which may have accumulated and remove any foreign material.

3. If possible, turn the rotor by hand to be sure that it rotates freely.

4. Check all connections with the connection diagram. Check all accessible factory made connections for tightness to make sure none has become loose during shipment.

5. When the driven machine is likely to be damaged by the wrong direction of rotation, it is best to uncouple the drive from its load during the initial start and make certain that it rotates in the correct direction. If it is necessary to change rotation, interchange any two line/supply leads.

## IV. OPERATION (cont'd)

D. Initial Start

1. After inspecting the machine carefully, make the initial start by following the regular sequence of starting operations in the control instructions.

2. At initial start, the rate of rise of the bearing temperature is more indicative of trouble than total temperature. When starting a machine for the first time, the bearing temperature should be observed for a minimum of two hours. If at any time the rate of temperature rise exceeds 2°C/minute, shut down the machine immediately and make an investigation of lineup conditions, and if necessary, the bearing assembly.

3. Check motor operation under load for an initial period of at least one hour to observe whether any unusual noise or hot spots develop.

4. In the event of excessive vibration or unusual noise, disconnect the machine from the load and check the mounting and alignment.

5. Space heaters (when supplied) should be de-energized during motor operation.

6. Check the operating current against the nameplate value. Do not exceed the value of nameplate amperes times service factor (if any) under steady continuous load.

208 Volt system: When a 230/460 Volt motor with a nameplate which states "usable at 200V, _Hp, _Amps, 1.0SF" is operated on a 208 Volt system, the motor slip will increase approximately 30% and the motor locked-rotor, pull-up and breakdown torque values will be reduced by approximately 20% to 30%. Therefore, it should be determined by the user that the motor will start and accelerate the connected load without injurious heating and that the breakdown torque is adequate for the application.

E. Jogging and Repeat Starts

| | |
|---|---|
| ***Caution*** | **Repeated starts and/or jogs of induction motors greatly reduce the life of the winding insulation. The heat produced by each acceleration or jog is much more than dissipated by the motor under full load. If it is necessary to repeatedly start or jog a motor, it is advisable to check the application with the local GE sales office.** |

F. Heating

Use a thermometer or thermocouple to determine temperature. If there is any doubt about the safe operating temperature, take the temperature of the part in question and confer with the nearest GE sales office. Give full details, including all nameplate information.

Overheating of the machine may be caused by improper ventilation, excessive ambient temperature, dirty conditions, and excessive current due to overload or unbalanced a-c voltage.

# V. MAINTENANCE

| | |
|---|---|
| Warning | **Before initiating maintenance procedures, disconnect all power sources to the machine and any accessories. For machines equipped with surge capacitors do not handle the capacitor until discharged by a conductor simultaneously touching all terminals and leads, including ground. This discharge conductor should be insulated for handling.** |
| **Replace all normal grounding connections prior to operating.** | |
| **Failure to observe these precautions may result in injury to personnel.** | |

| | |
|---|---|
| i | **Warranty may be voided if internal maintenance or repairs are not performed by a GE authorized service shop.** |

A. General Cleanliness

Inspect the motor at regular intervals, depending on service. Keep the motor clean and the ventilation openings clear.

In addition to the daily observation of the overall condition, it is recommended that a general inspection routine be set up to periodically check the following items:

1. General Cleanliness
2. Insulation and Windings
3. Lubrication and Bearings

The interior and exterior of the machine should be kept free from dirt, oil, grease and conducting dust. Oily vapor, paper, or textile dusts may build up and block off ventilation. Any of these contaminants can lead to early motor failure.

B. Insulation and Windings

1. General

To obtain long life and satisfactory operation of insulated windings, they should be kept clean from dirt, oil, metal particles, and other contaminants. A variety of satisfactory and acceptable methods are available for keeping equipment clean. The choice of method will depend greatly on time, availability of equipment, and on the insulation system. However, vacuum and/or compressed air cleaning with nonmetallic hose tips should precede cleaning with water and detergent or solvents. Tight adhering dirt will require agitation by gentle brushing or wiping.

| | |
|---|---|
| Warning | **To prevent injury to eyes and respiratory organs, safety glasses and suitable ventilation or other protective equipment should be used.** |

2. Vacuum and Compressed Air Cleaning

Compressed air should be used to remove loose dirt and dust from air passages such as air ducts. Suction should be used to remove dirt and dust particles from windings to avoid driving particles into the windings and damaging the coils.

| | |
|---|---|
| Caution | **Care must be taken to make sure that the air supply is dry and that excessive air pressure is not used.** |
| **Generally a pressure of not more than 30 psi is recommended.** | |

| | |
|---|---|
| Warning | **Operator must not use compressed air to remove dirt or dust from his person or clothing.** |

## V. MAINTENANCE (cont'd)

B. Insulation and Windings (cont'd)

3. Cleaning with Water and Detergent

This method is very effective in cleaning windings when used with a low-pressure steam jenny (maximum steam flow 30 psi and 90°C).

| | |
|---|---|
| Caution | **To minimize possible damage to varnish and insulation, a fairly neutral non-conducting detergent should be used.** |

If a steam jenny is not available, the cleaning solution may be applied with warm water by a spray gun. After the cleaning operation, the windings should be rinsed with water or low-pressure steam.

It is advisable to dry the windings. Refer to Insulation Resistance section for instructions on how to proceed.

4. Cleaning with Solvents

| | |
|---|---|
| Warning | **Many cleaning fluids are flammable and/or toxic. To prevent injury to personnel and property, care should be taken to avoid flames, sparks, etc. Safety glasses should be used and contact with the skin should be avoided. The area should be well ventilated or protective equipment should be used.** |

Although cleaning with water and detergent is the preferred method, solvent cleaning may be used when heat drying facilities are not available.

Mineral spirits are recommended for use as the cleaning solvent. Solvent cleaning of silicone-insulated windings, leads, and space heaters is not recommended.

| | |
|---|---|
| Warning | ***Mineral spirits should be used only in a well-ventilated area that is free from open flames. Avoid prolonged exposure to vapor. Failure to observe these precautions may result in injury to personnel.*** |

Windings cleaned with solvent should be dried thoroughly by circulation of dry air before voltage is applied.

5. Revarnishing Windings

After several cleanings with water and detergent, it may be necessary to revarnish the windings. This varnish is available from the General Electric Company or a GE Authorized Service Shop.

C. Lubrication and Bearings

1. Anti-Friction Bearing Relubrication and Maintenance

The grease used as a lubricant in grease-lubricated anti-friction ball bearings loses its lubricating ability over a period of time. For a given bearing construction and assembly, the lubricating ability of a grease with age depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates, and the severity of operating conditions. As a result, it is not possible to accurately predetermine when new grease must be added. Good results can be obtained if the general recommendations stated in this instruction book are followed.

## V. MAINTENANCE (cont'd)

C. Lubrication and Bearings (cont'd)

The primary function of grease is to supply the essential lubricating oil from the sponge-like reservoir of its soap structure. Grease-lubricated anti-friction ball bearings consume only a small amount of lubricant. This lubricant must always be present to avoid rapid wear and bearing failure. However, excessive or too frequent lubrication may damage the motor.

Ball bearing motors are adequately lubricated at the factory. Motors with grease fittings should be relubricated in accordance with these instructions to provide maximum bearing life.

To obtain optimum results, Chevron SRI-2 grease (or a compatible, polyurea based grease) should be used for relubrication, unless special grease is specified on the motor nameplate. Regreasing frequency should be in accordance with the table below. If in doubt, contact GE. The procedure below must be followed for safe and effective regreasing.

2. Recommended Regreasing Procedure and Frequency

| | |
|---|---|
| ***Warning*** | **Relubrication should be performed with the motor stationary and disconnected from the power source. Extreme caution must be exercised to avoid contact with rotating parts or electrical wiring if the motor must be relubricated while running. Failure to observe these precautions may result in damage to the equipment, injury to personnel, or both.** |

a. Run the motor until warm.
b. Stop the motor and disconnect it from the power supply.
c. Clean dirt and debris from around the inlet lubrication fitting and the grease relief plug.
d. Clear the opening and relief tube of hardened grease. This may be accomplished with a twisted wire brush or sturdy pipe cleaner.
e. While the motor is still warm, add grease with a hand-operated grease gun until grease has been added to about 50-65% of the grease cavity volume listed below:

| Bearing Size on Motor Nameplate | Regreasing Cavity size (oz) |
|---|---|
| 6211 | 3.5 |
| 6212 | 3.9 |
| 6213 | 5.6 |
| 6312 | 8.7 |

A standard 10,000 psi, 16-ounce grease gun delivers approximately 0.04 oz. of grease with each pump, and a 24-ounce gun delivers approximately 0.06 oz. of grease.

f. Restart the motor, and resume operation.

| | |
|---|---|
| ***Caution*** | **Failure to observe the foregoing instructions for regreasing may result in grease leakage and/or bearing damage. To avoid damage to equipment, bearings and grease must be free of dirt.** |

## V. MAINTENANCE (cont'd)

C. Lubrication and Bearings (cont'd)

2. Recommended Regreasing Procedure and Frequency (cont'd)

| Recommended Regreasing Frequency | | | |
|---|---|---|---|
| Type of Service | Typical Examples | HP Range | Lubrication Interval (Years) Horizontal Mount |
| Easy | Valves, door openers, portable floor sanders, motor operating infrequently (one hour per day) | 50 – 100<br>200 – 350 | 4<br>3 |
| Standard | Machine tools, air conditioning apparatus, conveyors (one or two shifts), garage compressors, refrigeration machinery, oil well pumps, water pumps, wood working machinery | 50 – 100<br>200 – 350 | 1.5<br>1 |
| Severe | Motor for fans, machine tools, M-G sets, etc. (that run 24 hours a day, 365 days a year), coal and mining machinery, motors subject to severe vibration, steel mill machinery | 50 – 100<br>200 – 350 | 9 mo.<br>6 mo. |
| Very Severe | Dirty, vibrating applications, where end of shaft is hot (pumps and fans), high ambient temperature | 50 – 100<br>200 – 350 | 4 mo.<br>3 mo. |

Because this method of greasing anti-friction bearings tends to purge the housing of used grease over a period of time, removal of all grease should be required infrequently. A GE authorized Service Shop can clean the bearing cavity and replace the bearings and grease when the motor is removed from service for maintenance or reconditioning.

D. Anti-Friction Bearing Maintenance

1. Removal

Even though high-quality design and workmanship are incorporated in a bearing, it sometimes becomes necessary to remove the bearing for maintenance.

| | |
|---|---|
| *Caution* | **Care must be taken to avoid scratching or nicking the critical surfaces of the balls or rollers.** |

| | |
|---|---|
| *Caution* | **Extreme care is required in the disassembly of a machine for bearing removal. In addition, the shaft bearing seat and the bearing itself must be protected during and after disassembly operations.** |

a. Remove bolts securing fan cover.
b. Remove the snap ring that secures the fan to the shaft extension.
c. Remove the fan from the shaft extension by employing a gear puller.
d. If the motor has bearing caps, remove the hex head bearing cap screws, adjacent to the motor hub, which hold the bearing caps (both ends).
e. Remove the hex head bolts on the outer flange of the end-shields, which hold the end shields on the frame.
f. Carefully pull out the rotor, being careful not to damage any of the windings or machined surfaces.
g. If it is desirable to reuse the bearing, apply a bearing puller to the inner ring.

## V. MAINTENANCE (cont'd)

D. Anti-Friction Bearing Maintenance (cont'd)

2. Reassembly

| | |
|---|---|
| Warning | **To prevent injury to eyes, safety glasses should be used.** |

Cleanliness is important when working with bearings. Before reassembling a bearing, all bearing and machined surfaces should be thoroughly cleaned with suitable solvent. Examine the machined fits of the end-shield, bearing housing, slinger, and grease cap for burrs. It is important that these surfaces be smooth.

Reassembly of the bearing should be performed in the following manner:

a. Inspect the bearing housing and related parts for foreign material. Clean if necessary.
b. The machined fits and critical surfaces of the end-shield, bearing housing, bearing cap and bearings should be free of all nicks, scratches or burrs. If any polishing is done, care should be taken to avoid a deposit of metal dust in and around the bearing assembly.
c. The internal surface of the bearing housing should be coated with a thin film of the recommended grease. The shaft and bearing cap should also receive a very light coating of the recommended grease. These precautions, although not absolutely essential, will guard against corrosion of the critical surfaces.
d. Heat the bearing in oil to a temperature between 50°C and 125°C (122°F to 257°F) and place it on the shaft. Hold it against the shaft shoulder until the bearing cools.
e. Mount drive end end-shield. If an outer bearing cap was supplied, mount the outer bearing cap to the shaft. Refer to Table 5 for bolt torque requirements. (Motor frame sizes 143 to 286 do not have bearing caps).
f. Mount the opposite drive end end-shield to the stator frame. Refer to Table 6 for recommended bolt torques.
g. Insert the rotor into the stator with appropriate tools. Carefully insert the rotor shaft thru the opposite drive end end-shield.
h. Assemble the outer bearing cap at the opposite drive end if bearing cap was supplied. Replace the shaft slinger.
i. Assemble the fan, snap-ring, grease pipes, and fan cover.
j. Mount the drive end end shield to the stator frame. Refer to Table 7 for motor shaft endplay.

**Table 5: Bearing Cap Bolt Torque**

| Frame Size | Bolt Size | Minimum Torque – Ft-Lb (N-M) | Maximum Torque – Ft-Lb (N-M) |
|---|---|---|---|
| 143-286 | Not Applicable | Not Applicable | Not Applicable |
| 324-326 | M8 | 14 (19) | 18.7 (25) |

**Table 6: End Shield Bolt Torque**

| Frame Size | Bolt Size | Minimum Torque – Ft-Lb (N-M) | Maximum Torque – Ft-Lb (N-M) |
|---|---|---|---|
| 143-145 | M8 | 8.7 (11.7) | 12.3 (16.6) |
| 182-184 | M10 | 14 (19) | 18.7 (25) |
| 213-215 | M10 | 5.7 (7.74) | 7.6 (10.3) |
| 254-286 | M12 | 49.3 (66.8) | 65.8 (89.2) |
| 324-326 | M12 | 49.3 (66.8) | 65.8 (89.2) |

## V. MAINTENANCE (cont'd)

D. Anti-Friction Bearing Maintenance (cont'd)

2. Reassembly (cont'd)

| Table 7: Motor Endplay Ranges | | |
|---|---|---|
| | Shaft Endplay (Inches) | |
| Frame Size | Minimum | Maximum |
| 140/180 | 0.020 | 0.045 |
| 210/250 | 0.031 | 0.057 |
| 280 | 0.039 | 0.065 |
| 320 | None (Locked Bearings) | |

## VI. OPERATIONAL DIFFICULTIES

Some operating difficulties may occur, and their causes are given in the following chart and should be corrected as soon as possible.

### TROUBLE SHOOTING CHART

| Affected Parts | Difficulty | What to Check |
|---|---|---|
| Windings | Overheating | • Calibration of measuring instrument<br>• Excessive current<br>• Unbalanced AC current<br>• Improper or restricted ventilation<br>• Excessive ambient temperature<br>• Short circuited coil or windings<br>• Dirty windings<br>• Unbalanced voltage |
| Bearings | Overheating | • Calibration of measuring instrument<br>• Rough journal<br>• Misalignment<br>• Excessive end thrust or radial loading<br>• Shaft currents<br>• Excessive or insufficient grease<br>• Worn out or dirty grease |
| Motor | Excessive Vibration | • Unbalance<br>• Misalignment<br>• Improper or settled foundation<br>• Non-uniform air gap<br>• Rubbing parts<br>• Bent shaft<br>• Unbalanced stator current<br>• Damaged bearing |
| Insulation | Low Insulation Resistance or Insulation Failure | • Moisture, dirt, metal particles, oil, or other contaminants on the insulated windings<br>• Wrong voltage<br>• Excessive temperature<br>• Voltage surges<br>• Mechanical damage<br>• Excessive vibration with resultant mechanical damage |

## VII. FAILURE

**Warning**

**An extreme overload or electrical failure may result in heating or arcing which can cause the insulation to give off noxious fumes. All power should be removed from the motor circuit as a precaution even though the circuit has overload protection. Personnel should not approach the motor until adequate ventilation of the area has purged the air of fumes. When covers of a motor are removed after a failure, care should be observed to avoid breathing fumes from inside the motor. Preferably, time should be allowed for the motor or to cool before attempting any examination or repair.**
**Failure to observe these precautions may result in injury to personnel.**

**Warning**

**Water should not be applied to any electrically energized equipment because electric shock could result in serious or fatal injury. In case of fire, disconnect all power and use a carbon dioxide extinguisher to quench the flame.**
**Before operating any motor after a suspected failure, it should be inspected for damage.**

## VIII. REPAIR

Repairs should be made only by qualified personnel using the materials and processes for which the motor was designed. To protect the warranty during the warranty period, all repairs must be made in a GE Service Shop or GE approved repair facility. Many repairs can be easily performed with only assembly operations if GE replacement parts are available. If major repairs are undertaken (such as rewinding a stator), proper facilities should be available and suitable precautions observed.

**Warning**

**When burning off old insulation materials or when welding near insulation during re-winding, adequate ventilation must be provided to avoid exposing personnel to noxious fumes. Combustion of exhaust must be complete and adequately vented to the outside atmosphere in compliance with acceptable standards.**

**Exposure of personnel to air-borne inorganic fibers must be avoided by adequate ventilation or by wetting the remaining insulation components following the burning off of the organic materials.**

**Failure to observe these precautions may result in injury to personnel.**

## IX. RENEWAL PARTS

The use of only GE renewal parts is recommended. When ordering, specify the model number and serial number of the motor (complete nameplate data is desirable). Specify quantity and describe the part.

For information and service, refer to the nearest GE Sales Office or GE Authorized Service Shop

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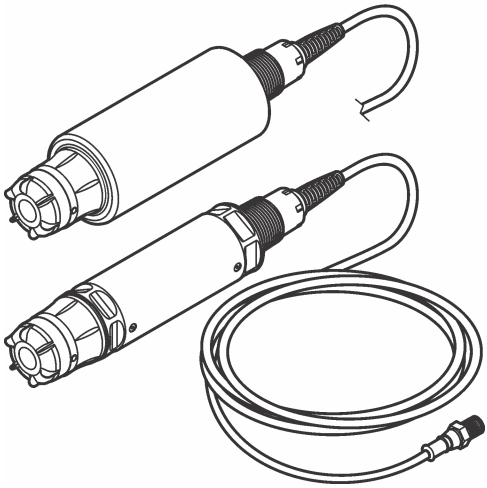
DOC023.97.80170

# LDO Sensor

12/2012, Edition 3



**USER MANUAL**
**MANUEL D'UTILISATION**
**MANUAL DEL USUARIO**
**MANUAL DO USUÁRIO**
用户手册
ユーザーマニュアル
사용 설명서
**คู่มือผู้ใช้**

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# Specifications

Specifications are subject to change without notice.

| Specification | Details |
|---|---|
| Wetted materials | Standard Probe, Standard Class 1-Div 2 Probe<br>• CPVC, sensor end and cable end<br>• Polyurethane, over-molding on cable end and cable jacket<br>• 316 stainless steel body and screws<br>• Viton, O-ring<br>• Noryl, nut on the cable end |
| | Standard Seawater Probe, Seawater Class 1-Div 2 Probe<br>• CPVC, sensor end and cable end<br>• Polyurethane, over-molding on cable end and cable jacket<br>• PVC seawater body<br>• Seawater epoxy sealant<br>• Noryl, nut on the cable end |
| IP classification | IP68 |
| Wetted materials (sensor cap) | Acrylic |
| Measurement range (dissolved oxygen) | 0 to 20 ppm (0 to 20 mg/L) |
| | 0 to 200% saturation |
| Measurement accuracy (dissolved oxygen) | Below 5 ppm: ± 0.1 ppm |
| | Above 5 ppm: ± 0.2 ppm |
| Repeatability (dissolved oxygen) | 0.1 ppm (mg/L) |
| Response time (dissolved oxygen) | $T_{90}$<40 seconds |
| | $T_{95}$<60 seconds |
| Resolution, sensor (dissolved oxygen) | 0.01 ppm (mg/L); 0.1% saturation. |
| Measurement range (temperature) | 0 to 50 °C (32 to 122 °F) |
| Measurement accuracy (temperature) | ± 0.2 °C (± 0.36 °F) |
| Interferences | No interferences from the following: $H_2S$, pH, $K^+$, $Na^+$, $Mg^{2+}$, $Ca^{2+}$, $NH_4^+$, $Al^{3+}$, $Pb^{2+}$, $Cd^{2+}$, $Zn^{2+}$, Cr (total), $Fe^{2+}$, $Fe^{3+}$, $Mn^{2+}$, $Cu^{2+}$, $Ni^{2+}$, $Co^{2+}$, $CN^-$, $NO_3^-$, $SO_4^{2-}$, $S^{2-}$, $PO_4^{3-}$, $Cl^-$, Anion Active Tensides, Crude Oils, $Cl_2$ < 4 ppm |
| Storage temperature | –20 to 70 °C (–4 to 158 °F) |
| Maximum temperature | 0 to 50 ºC (32 to 122 °F) |

| Specification | Details |
|---|---|
| Hazardous location classification (9020000-C1D2 sensor only) | Class I Division 2, Groups A–D, T4 / Class I, Zone 2 Group 2C, T4<br>***Note:*** *This product does not fulfill the requirements of the 94/9/EC Directive (ATEX Directive).* |
| Certifications (9020000-C1D2 sensor only) | ETL listed to ANSI/ISA, CSA and FM standards for use in hazardous location.<br>***Note:*** *This product does not fulfill the requirements of the 94/9/EC Directive (ATEX Directive).* |
| Minimum flow rate | Not required |
| Calibration/verification | Air calibration: One point, 100% water-saturated air |
| | Sample calibration: Comparison with standard instrument |
| Probe immersion depth and pressure limits | Pressure Limits at 34 m (112 ft.), 345 kPa (50 psi) maximum; accuracy may not be maintained at this depth |
| Sensor cable | 10 m (30 ft) integral cable with quick disconnect plug (all sensor types)<br>Up to 100 m possible with extension cables (non-Class I, Division 2 sensor types only)<br>Up to 1000 m with junction box (non-Class I, Division 2 sensor types only) |
| Probe weight | 1.0 kg (2 lb, 3 oz) |
| Probe dimensions | Standard probe (diameter x length): 49.53 x 255.27 mm (1.95 x 10.05 in.) |
| | Seawater probe (diameter x length): 60.45 x 255.27 mm (2.38 x 10.05 in.) |
| Power requirements | 12 VDC, 0.25 A, 3 W |
| Warranty | Probe: 3 years against manufacturing defects |
| | Sensor cap: 2 years against manufacturing defects |

## General information

In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual. The manufacturer reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

### Safety information

**NOTICE**

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

### Use of hazard information

**⚠ DANGER**

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

| ⚠ WARNING |
| --- |
| Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury. |

| ⚠ CAUTION |
| --- |
| Indicates a potentially hazardous situation that may result in minor or moderate injury. |

| NOTICE |
| --- |
| Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis. |

## Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

| | |
| --- | --- |
| | This is the safety alert symbol. Obey all safety messages that follow this symbol to avoid potential injury. If on the instrument, refer to the instruction manual for operation or safety information. |
| | This symbol indicates the presence of a light source that may have the potential to cause minor eye injury. Obey all messages that follow this symbol to avoid potential eye injury. |
| | This symbol indicates the presence of devices sensitive to Electro-static Discharge (ESD) and indicated that care must be taken to prevent damage with the equipment. |
| | Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user.<br>***Note:*** *For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.* |

## Certification

**Canadian Radio Interference-Causing Equipment Regulation, IECS-003, Class A**:

Supporting test records reside with the manufacturer.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numèrique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

**FCC Part 15, Class "A" Limits**

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction

manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

1. Disconnect the equipment from its power source to verify that it is or is not the source of the interference.
2. If the equipment is connected to the same outlet as the device experiencing interference, connect the equipment to a different outlet.
3. Move the equipment away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

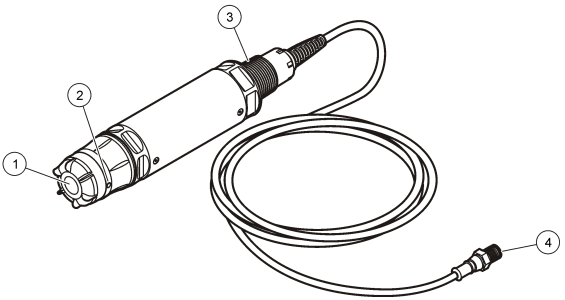
## Product overview

| ⚠ DANGER | |
|---|---|
| | Chemical or biological hazards. If this instrument is used to monitor a treatment process and/or chemical feed system for which there are regulatory limits and monitoring requirements related to public health, public safety, food or beverage manufacture or processing, it is the responsibility of the user of this instrument to know and abide by any applicable regulation and to have sufficient and appropriate mechanisms in place for compliance with applicable regulations in the event of malfunction of the instrument. |

This sensor is designed to work with a controller for data collection and operation. The sensor can be used with several controllers. Refer to the controller-specific user manual for more information.

The primary applications for this sensor are municipal and industrial wastewater applications. LDO sensor technology does not consume oxygen, and can measure DO concentration in low or no-flow applications. Refer to Figure 1.

**Figure 1 LDO sensor**

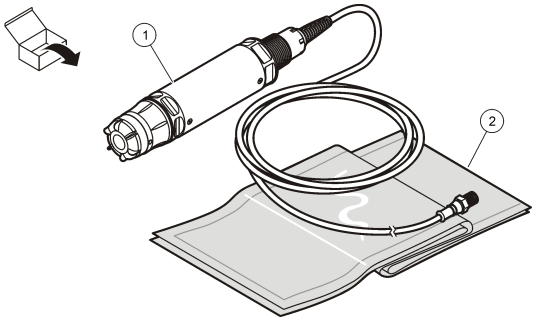



| | |
|---|---|
| **1** Sensor cap | **3** 1-inch NPT |
| **2** Temperature sensor | **4** Connector, quick-connect (standard) |

## LDO Sensor component list

Make sure that all components shown in Figure 2 have been received. If any items are missing or damaged, contact the manufacturer or a sales representative immediately. Refer to Figure 2.

**Figure 2 Sensor component list**




| | |
|---|---|
| **1** LDO sensor[1] | **2** Calibration bags (2x) |

[1] Included user manual is not shown.

# Installation

**⚠ WARNING**

Personal injury hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

## Validate the sensor type

**⚠ DANGER**

Explosion hazard. Connect only peripheral components that are clearly marked as certified for Class 1, Division 2 Hazardous Locations.

**NOTICE**

The hazardous location certified version of this product does not fulfill the requirements of the 94/9/EC Directive (ATEX Directive).

1. Go to the connector end of the cable.
2. Read the label on the connector end of the cable. For hazardous location certified sensors, the label will show "Rated: Class 1 Division 2".
3. Examine the connector.
   - Hazardous location certified sensors have a safety lock connector. Refer to Figure 3 on page 8.
   - Sensors that are not certified for hazardous locations have a quick-connect connector, without a safety lock.

## Connect the sensor in a hazardous location

**⚠ DANGER**

Explosion hazard. This equipment is suitable for use in non-hazardous locations or Class 1, Division 2, Groups A, B, C, D Hazardous Locations with specified sensors and options when installed per the Hazardous Location Installation Control Drawing. Always refer to the Control Drawing and applicable electrical code regulations for proper installation instructions.

**⚠ DANGER**

Explosion hazard. Do not connect or disconnect electrical components or circuits to the equipment unless power has been removed or the area is known to be non-hazardous.

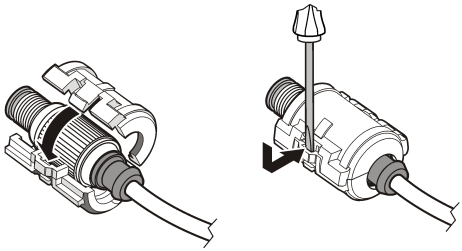
**NOTICE**

Use only a hazardous location certified sensor and cable lock in hazardous locations. The hazardous location certified version of this product does not fulfill the requirements of the 94/9/EC Directive (ATEX Directive).

For more information, refer to Validate the sensor type on page 7 .

1. Remove the connector cap from the controller. Keep the connector cap to seal the connector opening when the sensor is removed.
2. Connect the sensor to the controller. Refer to the controller manual for more information.
3. Close the safety lock over the connector.
4. To remove the connector safety lock, use a small flat screwdriver. Refer to Figure 3.

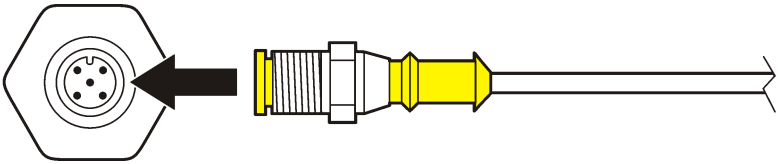
**Figure 3 Connector safety lock**



## Connect the sensor in a non-hazardous location

Refer to Figure 4 to connect an LDO sensor to an sc controller. Refer to the specific sc controller manual for hard-wiring instructions.

**Figure 4 Connect the LDO sensor (non-hazardous location sensor shown)**



After the sensor is attached, scan for the sensor. Refer to Install the sensor on page 8.

## Install the sensor

There are two options to install the sensor:

- Connect the sensor while power to the controller is off. The controller will look for and install new sensors when it is turned on.
- Connect the sensor while power to the controller is on. Use the Scan Devices command to install the new sensor:

| Option | Description |
|---|---|
| **sc200 controller** | Go to MENU>TEST/MAINT>SCAN DEVICE |

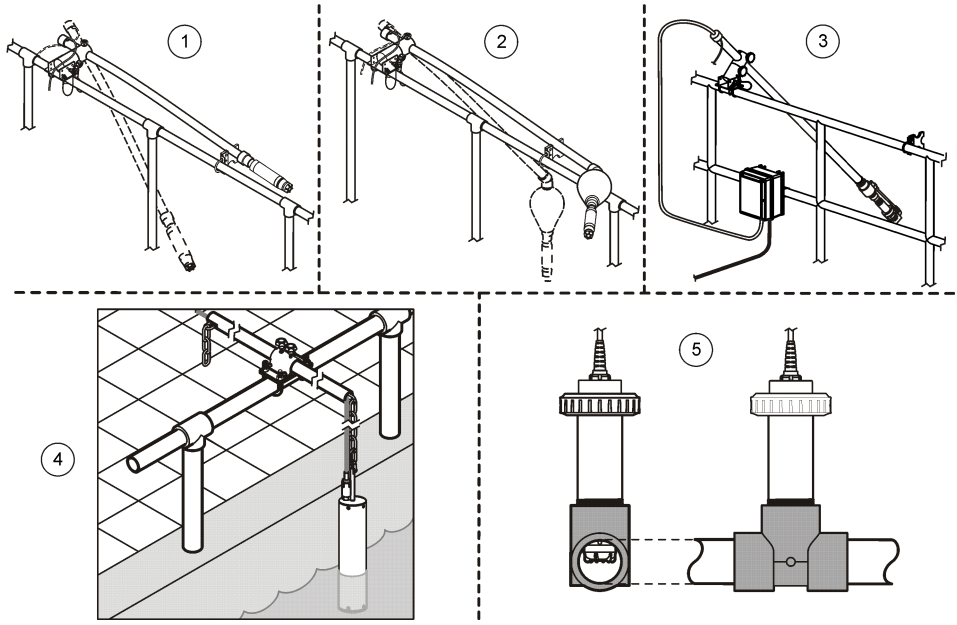
| Option | Description |
|---|---|
| **sc100 controller** | Go to MENU>TEST/MAINT>SCAN SENSORS |
| **sc1000 controller** | Go to MENU>SYSTEM SETUP>DEVICE MANAGEMENT>SCANNING FOR NEW DEVICES |

Refer to Connect the sensor in a non-hazardous location on page 8 for digital sensor connection.

## Sensor installation options

The installation and accessory options available for the LDO sensor are supplied with installation instructions in the hardware kit. Figure 5 shows several installation options. To order installation hardware, refer to Replacement parts and accessories on page 17.

**Figure 5 Installation options**




| | |
|---|---|
| **1** Rail mount | **4** Chain mount |
| **2** Float mount | **5** Union mount (not seawater probe compatible) |
| **3** Air blast system mount (not seawater probe compatible) | |

# Operation

## User navigation

Refer to the controller documentation for keypad description and navigation information.

## Configure the sensor

Use the Configure menu to enter identification information for the sensor and to change options for data handling and storage.

For information about sensor installation, refer to Install the sensor on page 8.

Make sure that all of the Configuration menu values are correct for the application.

1. Go to MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE.
2. Select an option, ENTER. The list of available options is shown in the table below.

| Option | Description |
|---|---|
| EDIT NAME | Changes the name that corresponds to the sensor on the top of the measure screen. The name is limited to 10 characters in any combination of letters, numbers, spaces or punctuation. |
| SET UNITS | TEMP–Sets the temperature units to °C (default) or °F. |
| | MEASURE–Set the measurement units in mg/L, ppm or % . |
| | ALT/PRESS–Set the altitude in m or ft, or set the atmospheric pressure units in mmHg or torr. (Default value = 0 ft) |
| ALT/PRESS | Enter the value of the altitude or atmospheric pressure. This value must be accurate to complete % saturation measurements and calibration in air. (Default = 0 ft). |
| SALINITY | Enter the salinity value. Salinity range: 0.00 to 250.00 parts per thousand (‰). Refer to Enter a salinity correction value on page 11 for more information. (Default value = 0) |
| SIGNAL AVERAGE | Set the time interval to average signal in seconds |
| CLEAN INTRVL | Set the time interval for manual sensor cleaning in days (Default value = 0 days. A value of 0 days disables the clean interval.) |
| RESET CLN INTRVL | Set the time interval to the last saved clean interval |
| LOG SETUP | Sets the time interval for data storage in the data log—0.5, 1, 2, 5, 10, 15 (default), 30, 60 minutes. |
| SET DEFAULTS | Restores the configurable default values for the sensor. Does not change the setting for slope or offset. |

## Enter the atmospheric pressure value

The factory setting for atmospheric (air) pressure is 0 ft, or sea level. To change the default value, use the steps in this procedure. The adjustment for air pressure is entered as either elevation or as pressure units (preferred).

***Note:*** *Accurate air pressure is critical for saturated air calibration (*Calibration with air on page 12*). Use only absolute pressure, not adjusted. If the absolute air pressure is not known, use the correct elevation for the location.*

1. Go to MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>SET UNITS>AIR PRESS/ALT UNITS.
2. Select **one** of the unit options listed:

| Option | Description |
|---|---|
| **ft** | Feet—unit of measure for elevation |
| **m** | Meters—metric unit of measure for elevation |
| **mmHg** | Millimeters of mercury—metric unit of measure for absolute air pressure |
| **torr** | Unit of measure for absolute air pressure |

3. Confirm the selection. The value entry screen will show the selected units.
4. Enter the value, then confirm.

## Enter a salinity correction value

Dissolved oxygen measurements in saline samples can show an apparent DO value that is very different from the actual DO value. To correct for the influence of dissolved salts in a sample, enter a salinity correction factor.

***Note:*** *If the presence or amount of salinity in the process is unknown, consult with the treatment facility engineering staff.*

1. Use a conductivity meter to measure the conductivity of the sample in mS/cm at a reference temperature of 20 °C (68 °F).
2. Use Table 1 to estimate the salinity correction factor in parts per thousand (‰) saturation.

   ***Note:*** *The chloride ion concentration, in g/kg is equal to the chlorinity of the sample. Salinity is calculated with the formula: Salinity = 1.80655 × chlorinity.*

   Salinity can be calculated with the relationship in section 2520 B of *Standard Methods for the Examination of Water and Wastewater*.[*],
3. Go to MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>SALINITY.
4. Enter the salinity correction factor and confirm.

**Table 1 Salinity saturation (‰) per conductivity value (mS/cm)**

| mS/cm | ‰ | mS/cm | ‰ | mS/cm | ‰ | mS/cm | ‰ |
|---|---|---|---|---|---|---|---|
| 5 | 3 | 16 | 10 | 27 | 18 | 38 | 27 |
| 6 | 4 | 17 | 11 | 28 | 19 | 39 | 28 |
| 7 | 4 | 18 | 12 | 29 | 20 | 40 | 29 |
| 8 | 5 | 19 | 13 | 30 | 21 | 42 | 30 |
| 9 | 6 | 20 | 13 | 31 | 22 | 44 | 32 |
| 10 | 6 | 21 | 14 | 32 | 22 | 46 | 33 |
| 11 | 7 | 22 | 15 | 33 | 23 | 48 | 35 |
| 12 | 8 | 23 | 15 | 34 | 24 | 50 | 37 |
| 13 | 8 | 24 | 17 | 35 | 25 | 52 | 38 |
| 14 | 9 | 25 | 17 | 36 | 25 | 54 | 40 |
| 15 | 10 | 26 | 18 | 37 | 26 | | |

## Configure linear output on the controller

Linear outputs send probe data back to the facility PLC, SCADA or other data collection system.

1. Go to the controller output setup menu.

| Option | Description |
|---|---|
| **sc200** | Go to MENU>SETTINGS>sc200 SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION. |

[*] *Standard Methods for the Examiniation of Water and Wastewater*, 20th Edition. Editors Lenore S. Clesceri, Arnold E. Greenberg and Andrew D. Eaton, p. 2-48-2-29 (1998). The relationship between Chlorinity and Oxygen Solubitity is provided in the same reference in 4500-O:I p. 4-131.

| Option | Description |
|---|---|
| **sc100** | Go to MENU>SYSTEM SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION. |
| **sc1000** | Go to MENU>SYSTEM SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION. |

2. Set the function for the controller.

| Option | Description |
|---|---|
| **sc200** | LINEAR |
| **sc100** | LINEAR CONTROL (Default value) |
| **sc1000** | LINEAR CONTROL (Default value) |

### Modbus registers

A list of Modbus registers is available for network communication. Refer to www.hach.com or www.hach-lange.com for more information.

## Calibration for measurements

The sensor is calibrated to specification at the factory. The manufacturer does not recommend calibration unless periodically required by regulatory agencies. If calibration is required, let the sensor come to equilibrium with the process before calibration. Do not calibrate the sensor at setup.

Table 2 shows options for calibration.

**Table 2 Calibration options**

| Option | Description |
|---|---|
| AIR CAL | Recommended calibration method. This calibration modifies the slope. |
| SAMPLE CAL | Calibration by comparison with a hand-held DO meter . This calibration modifies the offset. |
| RESET DFLT CAL | Resets the calibration gain (slope) and offset to the factory default: default gain=1.0; default offset=0.0 |

### Calibration with air

**User notes:**

- Make sure that calibration bag has water inside.
- Make sure that the seal between the calibration bag and the sensor body is tight.
- Make sure that the sensor is dry when it is calibrated.
- Make sure the air pressure/elevation setting is accurate for the calibration location.
- Allow enough time for the sensor temperature to stabilize to the temperature of the calibration bag location. A large difference in temperature between the process and the calibration location can take up to 15 minutes to stabilize.

1. Remove the sensor from the process. Use a wet cloth to clean the sensor.
2. Put the entire sensor in a calibration bag with 25-50 mL of water. Make sure that the sensor cap is not in contact with the water inside the calibration bag and that no water drops are on the sensor cap (Figure 6).
3. Use a rubber band, tie or hand to create a tight seal around the sensor body.
4. Let the instrument stabilize for 15 minutes before calibration. Keep the calibration bag out of direct sunlight during stablization.
5. Make sure that the current absolute air pressure or elevation is configured correctly. Refer to Enter the atmospheric pressure value on page 10.

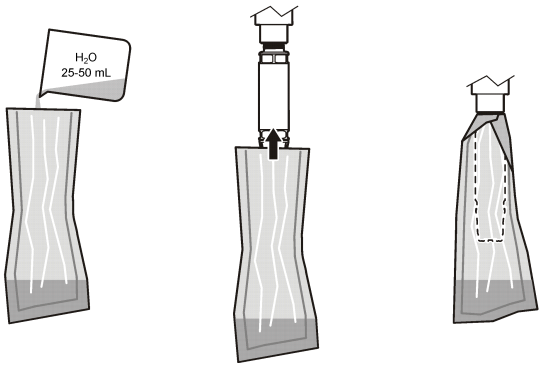
   ***Note:*** *The manufacturer recommends the use of absolute or actual air pressure as a best practice.*

6. Go to MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>AIR CAL.
7. Select the option for the output signal during calibration:

| Option | Description |
|---|---|
| **Active** | The instrument sends the current measured output value during the calibration procedure. |
| **Hold** | The sensor output value is held at the current measured value during the calibration procedure. |
| **Transfer** | A preset value is sent during calibration. Refer to the controller user manual to change the preset value. |

8. The controller will show "Move the probe to bag". Allow the value to stabilize. Push ENTER to accept the stable value. Alternately, let the calibration continue until the display shows "Complete".
9. When the sensor is calibrated, put the sensor into the process. Push ENTER.

**Figure 6 Air calibration procedure**




If the value does not stabilize, the display will show "Unable to Calibrate" followed by an error message. Table 3 shows the error message and resolution for calibration problems.

**Table 3 Air calibration error messages**

| Message | Description | Resolution |
|---|---|---|
| Cal fail, gain high | The calculated gain value is too high. | Repeat the calibration. |
| Cal fail, gain low | The calculated gain value is too low. | Repeat the calibration. |
| Cal fail, unstable | The value did not stabilize in the maximum allowed calibration time. | Repeat the calibration. |

## Sample CAL - calibration by comparison

This calibration method uses an alternate sensor attached to a hand-held meter.

1. Put the alternate sensor into the process. Put the second sensor as close as possible to the first sensor.
2. Wait for the DO value to stabilize .
3. On the controller for the first sensor, go to MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>SAMPLE CAL.
4. Select the option for the output signal during calibration:

| Option | Description |
|---|---|
| **Active** | The instrument sends the current measured output value during the calibration procedure. |

| Option | Description |
|---|---|
| **Hold** | The sensor output value is held at the current measured value during the calibration procedure. |
| **Transfer** | A preset value is sent during calibration. Refer to the controller user manual to change the preset value. |

5. The controller will show:
   - "Press ENTER when stabilized"
   - The current dissolved oxygen measurement
   - The current temperature measurement
6. When the measurement is stable, push ENTER. The display will show an entry screen.

   ***Note:*** *The measurement will usually stabilize in 2 to 3 minutes.*

If the value does not stabilize, the display will show "Unable to Calibrate" followed by an error message. Table 4 shows the error message and resolution for calibration problems.

**Table 4 Sample cal error messages**

| Message | Description | Resolution |
|---|---|---|
| Cal fail, offset high | The calculated offset value is too high. | Repeat the calibration. |
| Cal fail, offset low | The calculated offset value is too low. | Repeat the calibration. |
| Cal fail, unstable | The value did not stabilize in the maximum allowed calibration time. | Repeat the calibration. |

## Exit the calibration procedure

1. During calibration, push the BACK key. Three options are shown:

| Option | Description |
|---|---|
| **ABORT** | Stop the calibration. A new calibration must start from the beginning. |
| **BACK TO CAL** | Return to the current calibration. |
| **LEAVE** | Exit the calibration temporarily. Access to other menus is allowed while the calibration continues in the background. A calibration for a second sensor (if present) can be started. To return to the calibration, push the MENU key and select Sensor Setup, [Select Sensor]. |

2. Select one of the options. Confirm.

## Reset calibration defaults

Calibration settings can be reset to the factory defaults. Gain and offset values are set to 1.0 and 0.0, respectively.

1. Go to MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>RESET CAL DEFLT.
2. The display will show a confirmation message. Confirm to reset the sensor to the factory default calibration curve.

# Maintenance

**⚠ DANGER**

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

**⚠ DANGER**

**Explosion hazard.** Do not connect or disconnect electrical components or circuits to the equipment unless power has been switched off or the area is known to be non-hazardous.

**⚠ DANGER**

**Explosion hazard**. Substitution of components may impair suitability for Class 1, Division 2. Do not replace any component unless power has been switched off and the area is known to be non-hazardous.

***NOTICE***

The hazardous location certified version of this product does not fulfill the requirements of the 94/9/EC Directive (ATEX Directive).

## Maintenance schedule

The maintenance schedule shows minimum intervals for regular maintenance tasks. Perform maintenance tasks more frequently for applications that cause electrode fouling.
***Note:*** *Do not disassemble the probe for maintenance or cleaning.*

| Maintenance task | Recommended minimum frequency |
|---|---|
| Clean the sensor | 90 days |
| Inspect the sensor for damage | 90 days |
| Calibrate the sensor | As recommended by regulatory agencies |

## Clean the sensor

Clean the exterior of the sensor with a soft, wet cloth.
***Note:*** *If the sensor cap must be removed for cleaning, do not expose the interior of the cap to direct sunlight for extended periods of time.*

## Set or change the clean interval

Application conditions may need shorter or longer durations between manual sensor cleanings. The default clean interval is 0 days. To change the interval, refer to the steps in this procedure.

1. Go to MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>CLEAN INTRVL.
2. Change the shown value as needed. Confirm the change.
   - To turn off the clean interval, set the value to '0'.

## Change the sensor cap

**⚠ WARNING**

Potential explosion hazard. The sensor setup cap is not rated for hazardous location use.

Replacement sensor caps and setup caps are shipped with installation instructions. Refer to the included instructions to change the cap.

For best performance and accuracy, replace the sensor cap:

- Every two years
- When routine inspection shows significant erosion of the sensor cap

# Troubleshooting

## Diagnostic and test menu

The diagnostic and test menu shows current and historical information about the LDO sensor. To access the diagnostic and test menu, go to MENU>SENSOR SETUP>[Select Sensor]>DIAG/TEST.

Refer to Table 5.

**Table 5 DIAG/TEST menu**

| Option | Description |
|---|---|
| SENSOR INFO | SOFTWARE VERS—Shows the installed software version |
| | BOOT VERSION—Shows the installed boot version |
| | DRIVER VERS—Shows the installed software driver version |
| LOT CODE | Shows the sensor cap manufacturing lot |
| SERIAL NUMBER | Sensor serial number |
| GAIN CORR | Adjust the calibration gain value. |
| | Range: 0.50 to 2.00 |
| OFFSET CORR | Adjust the calibration offset value (mg/L or ppm). |
| | Range: –3.00 to +3.00 |
| PHASE DIAG | Shows the phase for total, red and blue wavelengths. Updates once per second. |
| AMPL DIAG | Shows the amplitude for red and blue wavelengths. Updates once per second. |
| DAYS TO CLEAN | Shows the number of days until the next scheduled manual cleaning. |
| SENSOR LIFE | Shows the number of days until the next scheduled sensor cap replacement |

## Error list

If an error occurs, the reading on the measurement screen flashes. Output behavior is determined by controller settings. Refer to the controller manual for details.
To show the current sensor errors, go to MENU>DIAGNOSTICS>[Select Sensor]>ERROR LIST. Refer to Table 6.

**Table 6 Error list for the LDO sensor**

| Error | Possible cause | Resolution |
|---|---|---|
| RED AMPL LOW (Value is below 0.01)<br>OR<br>BLUE AMPL LOW (Value is below 0.01) | The sensor cap is not installed, or is not installed correctly. | Remove the sensor cap and install it again. |
| | The light path is blocked in the sensor cap. | Inspect the inside of the sensor cap and lens. |
| | The sensor is not operating correctly. | Make sure that the LED is flashing. Contact the manufacturer. |

## Warning list

When the warning icon flashes (sc100 and sc200) or when the screen turns yellow (sc1000), a message is shown on the bottom of the measurement screen. On the sc1000, the screen turns

yellow to show a warning. To show the current sensor warnings, go to MENU> DIAGNOSTICS>[Select Sensor]>WARNING LIST. Refer to Table 7.

**Table 7 Sensor warning list**

| Warning | Definition | Resolution |
|---|---|---|
| EE SETUP ERR | Storage is corrupt. The values have been set to the factory default. | Contact technical support. |
| EE RSRVD ERR | | |
| TEMP < 0 C | The process temperature is below 0 °C (32 °F) | Increase the process temperature or stop use until the process temperature is in the sensor specification range. |
| TEMP > 50 C | The process temperature is above 50 °C (120 °F) | Decrease the process temperature or stop use until the process temperature is in the sensor specification range. |
| RED AMPL LOW | Value falls below 0.03 | Refer to Table 6 on page 16 . |
| RED AMPL HIGH | Value is greater than 0.35 | Call technical support. |
| BLUE AMPL LOW | Value is below 0.03 | Refer to Table 6 on page 16. |
| BLUE AMPL HIGH | Value is greater than 0.35 | Call technical support. |
| CAP CODE FAULT | The sensor cap code has become corrupt. The code has been reset automatically to the default cap and lot codes. | Complete the sensor setup cap procedure. If no setup cap is available for the sensor cap, call technical support. |

## Event list

The Event list keeps a log of changes to how data is recorded by the sensor. To show sensor events, go to MENU>DIAGNOSTICS>[Select Sensor]>EVENT LIST.
Refer to Table 8.

**Table 8 Event list for the sensor**

| Event | Description |
|---|---|
| ALT/PRESSURE UNIT CHANGE | Atmospheric pressure or altitude units have changed. |
| ALT/PRESSURE CHANGE | The value for altitude or atmospheric pressure has changed. |
| TEMP UNIT CHANGE | The units for temperature have changed. |
| MEAS UNIT CHANGE | A new unit of measurement has changed. |
| SALINITY CHANGE | The value for salinity has changed. |
| SET DEFAULT | Sensor settings have been reset to the default values. |
| SENSOR SETUP CHANGE | The sensor setup has changed. |
| CLEAN INTERVAL TIMER CHANGE | The time between sensor cleaning has changed. |
| SENSOR CAP LIFE TIMER CHANGE | The time between sensor cap replacements has changed. |

# Replacement parts and accessories

Use only replacement parts approved by the manufacturer. Use of non-approved parts may cause personal injury, damage to the instrument or equipment malfunction.

## Replacement items

| Description | Item no. (US / EU) |
|---|---|
| LDO Probe, with one sensor cap and 2 calibration bags | 9020000 / LXV416.99.20001 |
| LDO Probe for seawater, with one sensor cap and two calibration bags | 9020000-SW / — |
| LDO Probe for seawater hazardous locations, with one sensor cap and two calibration bags | 9020000-C1D2-SW / — |
| LDO Probe for hazardous locations, with one sensor cap and 2 calibration bags | 9020000-C1D2 / — |
| Sensor cap, replacement (includes the sensor setup cap, which is not rated for use in Class 1, Division 2 hazardous locations) | 9021100 / 9021150 |

## Accessories

| Description | Item no. (US / EU) |
|---|---|
| Sensor cable lock for hazardous locations | 6139900 / — |
| Cable, sensor extension, Class 1, Division 2 Hazardous Location, 1 m (3.3 ft) | 6122402 / — |
| Cable, sensor extension, Class 1, Division 2 Hazardous Location, 7m (23 ft) | 5796002 / — |
| Cable, sensor extension, Class 1, Division 2 Hazardous Location, 15 m (49.21 ft) | 5796102 / — |
| Cable, sensor extension, Class 1, Division 2 Hazardous Location, 31 m (101.71 ft) | 5796202 / — |
| High output air blast cleaning system, 115 V (not rated for use in hazardous locations) | 6860000 / 6860003.99.0001 |
| High output air blast cleaning system, 230 V (not ATEX rated for use in hazardous locations) | 6860100 / 6860103.99.0001 |
| Calibration bag (1x) | 5796600 / 5796600 |
| Cable, sensor extension, non-hazardous location, 7.7 m (25 ft)[1] | US: 5796000, 7.7 m (25 ft) |
| | EU: LZX849, 10 m (33 ft) |
| Hardware kit for pipe mount (PVC) | 9253000 / LZY714.99.21810 |
| Hardware kit for float mount (PVC) | 9253100 / LZX914.99.42200 |
| Hardware kit for air blast mount | 9253500 / LZY812 |
| Hardware kit for chain mount (stainless steel) | — / LZX914.99.11200 |
| Hardware kit for union mount | 9257000 / 9257000 |
| HQd meter with LDO rugged probe (not rated for use in hazardous locations) | 8505200 / HQ40D.99.310.000 |

[1] 15 m (49 ft) and 30 m (98 ft) also available

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# Caractéristiques

Les caractéristiques techniques peuvent être modifiées sans préavis.

| Caractéristique | Détails |
|---|---|
| Matériaux immergés | Sonde standard, sonde standard classe 1 division 2<br>• CPVC, extrémité du capteur et extrémité du câble<br>• Polyuréthanne, surmoulage de l'extrémité du câble et de la gaine de câble<br>• Corps et vis en acier inoxydable 316<br>• Viton, joint torique<br>• Noryl, écrou sur l'extrémité du câble |
| | Sonde standard pour eau de mer, sonde pour eau de mer classe 1 division 2<br>• CPVC, extrémité du capteur et extrémité du câble<br>• Polyuréthanne, surmoulage de l'extrémité du câble et de la gaine de câble<br>• Corps en PVC pour eau de mer<br>• Matériau d'étanchéité époxy pour eau de mer<br>• Noryl, écrou sur l'extrémité du câble |
| Classification IP | IP68 |
| Matériaux immergés (Capsule de sonde) | Acrylique |
| Plage de mesure (oxygène dissous) | 0 à 20 ppm (0 à 20 mg/l) |
| | 0 à 200 % de saturation |
| Précision des mesures (oxygène dissous) | En dessous de 5 ppm : ± 0,1 ppm |
| | Au-dessus de 5 ppm : ± 0,2 ppm |
| Répétabilité (oxygène dissous) | 0,1 ppm (mg/l) |
| Temps de réponse (oxygène dissous) | $T_{90}$<40 secondes |
| | $T_{95}$<60 secondes |
| Résolution, capteur (oxygène dissous) | 0,01 ppm (mg/l) ; 0,1 % de saturation |
| Plage de mesure (température) | 0 à 50 °C |
| Précision des mesures (température) | ± 0,2 °C |
| Interférences | Les éléments suivants ne causent aucune interférence : $H_2S$, pH, $K^+$, $Na^+$, $Mg^{2+}$, $Ca^{2+}$, $NH_4^+$, $Al^{3+}$, $Pb^{2+}$, $Cd^{2+}$, $Zn^{2+}$, Cr (total), $Fe^{2+}$, $Fe^{3+}$, $Mn^{2+}$, $Cu^{2+}$, $Ni^{2+}$, $Co^{2+}$, $CN^-$, $NO_3^-$, $SO_4^{2-}$, $S^{2-}$, $PO_4^{3-}$, $Cl^-$, surfactants anioniques actifs, pétrole, $Cl_2$ < 4 ppm |

| Caractéristique | Détails |
|---|---|
| Température de stockage | -20 à 70 °C |
| Température maximale | 0 à 50 °C |
| Classification pour zone dangereuse (capteur 9020000-C1D2 uniquement) | Classe I Division 2, Groupes A–D, T4 / Classe I, Zone 2 Groupe 2C, T4<br>***Remarque :*** *ce produit n'est pas conforme à la norme 94/9/EC (norme ATEX).* |
| Certifications (capteur 9020000-C1D2 uniquement) | Certifié conforme aux normes ANSI/ISA, CSA et FM par l'ETL pour une utilisation en environnement dangereux.<br>***Remarque :*** *ce produit n'est pas conforme à la norme 94/9/EC (norme ATEX).* |
| Débit minimal | Non requis |
| Etalonnage/vérification | Etalonnage à l'air : un point, air saturé d'eau à 100 % |
| | Etalonnage par échantillon : comparaison avec un instrument de référence (2) |
| Profondeur d'immersion et limites de pression de la sonde | Limites de pression à 34 m, 345 kPa maximum ; il est possible que la précision ne soit plus assurée à cette profondeur |
| Câble du capteur | Câble intégral de 10 m avec connecteur rapide (tous les types de capteur)<br>Extension possible jusqu'à 100 m à l'aide de câbles supplémentaires (uniquement les types de capteur non-classe I, Division 2)<br>Extension possible jusqu'à 1 000 m à l'aide d'une boîte de raccordement (uniquement les types de capteur non-classe I, Division 2) |
| Poids de la sonde | 1 kg |
| Dimensions de la sonde | Sonde standard (diamètre x longueur) : 49,53 x 255,27 mm |
| | Sonde pour eau de mer (diamètre x longueur) : 60,45 x 255,27 mm |
| Alimentation requise | 12 V CC, 0,25 A, 3 W |
| Garantie | Sonde : 3 ans de couverture des défauts de fabrication |
| | Capsule (2) du capteur : 2 ans de couverture des défauts de fabrication |

## Généralités

En aucun cas le constructeur ne saurait être responsable des dommages directs, indirects, spéciaux, accessoires ou consécutifs résultant d'un défaut ou d'une omission dans ce manuel. Le constructeur se réserve le droit d'apporter des modifications à ce manuel et aux produits décrits à tout moment, sans avertissement ni obligation. Les éditions révisées se trouvent sur le site Internet du fabricant.

## Consignes de sécurité

**AVIS**

Le fabricant décline toute responsabilité quant aux dégâts liés à une application ou un usage inappropriés de ce produit, y compris, sans toutefois s'y limiter, des dommages directs ou indirects, ainsi que des dommages consécutifs, et rejette toute responsabilité quant à ces dommages dans la mesure où la loi applicable le permet. L'utilisateur est seul responsable de la vérification des risques d'application critiques et de la mise en place de mécanismes de protection des processus en cas de défaillance de l'équipement.

Veuillez lire l'ensemble du manuel avant le déballage, la configuration ou la mise en fonctionnement de cet appareil. Respectez toutes les déclarations de prudence et d'attention. Le non-respect de cette procédure peut conduire à des blessures graves de l'opérateur ou à des dégâts sur le matériel.

Assurez-vous que la protection fournie avec cet appareil n'est pas défaillante. N'utilisez ni n'installez cet appareil d'une façon différente de celle décrite dans ce manuel.

## Interprétation des indications de risques

**⚠ DANGER**

Indique une situation de danger potentiel ou imminent qui, si elle n'est pas évitée, entraîne des blessures graves, voire mortelles.

**⚠ AVERTISSEMENT**

Indique une situation de danger potentiel ou imminent qui, si elle n'est pas évitée, peut entraîner des blessures graves, voire mortelles.

**⚠ ATTENTION**

Indique une situation de danger potentiel qui peut entraîner des blessures mineures ou légères.

***AVIS***

Indique une situation qui, si elle n'est pas évitée, peut occasionner l'endommagement du matériel. Informations nécessitant une attention particulière.

## Etiquettes de mise en garde

Lisez toutes les informations et toutes les étiquettes apposées sur l'appareil. Des personnes peuvent se blesser et le matériel peut être endommagé si ces instructions ne sont pas respectées. Un symbole sur l'appareil est référencé dans le manuel et accompagné d'une déclaration de mise en garde.

| | |
|---|---|
| | Ceci est le symbole d'alerte de sécurité. Se conformer à tous les messages de sécurité qui suivent ce symbole afin d'éviter tout risque de blessure. S'ils sont apposés sur l'appareil, se référer au manuel d'utilisation pour connaître le fonctionnement ou les informations de sécurité. |
| | Ce symbole signale la présence d'une source lumineuse entraînant un risque de détérioration légère de la vue. Veillez à vous conformer à tous les messages de sécurité qui suivent ce symbole afin d'éviter une potentielle détérioration de votre vue. |
| | Ce symbole indique la présence de dispositifs sensibles aux décharges électrostatiques (ESD) et indique que des précautions doivent être prises pour éviter les dommages avec l'équipement. |
| | En Europe, depuis le 12 août 2005, les appareils électriques comportant ce symbole ne doivent pas être jetés avec les autres déchets. Conformément à la réglementation nationale et européenne (Directive 2002/96/CE), les appareils électriques doivent désormais être, à la fin de leur service, renvoyés par les utilisateurs au fabricant, qui se chargera de les éliminer à ses frais. ***Remarque :*** *Pour le retour à des fins de recyclage, veuillez contacter le fabricant ou le fournisseur d'équipement pour obtenir les instructions sur la façon de renvoyer l'équipement usagé, les accessoires électriques fournis par le fabricant, et tous les articles auxiliaires pour une mise au rebut appropriée.* |

## Certification

**Règlement canadien sur les équipements causant des interférences radio, IECS-003, Classe A**:

Les données d'essai correspondantes sont conservées chez le constructeur.

Cet appareil numérique de classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Cet appareil numérique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

**FCC part 15, limites de classe A :**

Les données d'essai correspondantes sont conservées chez le constructeur. L'appareil est conforme à la partie 15 de la règlementation FCC. Le fonctionnement est soumis aux conditions suivantes :

1. Cet équipement ne peut pas causer d'interférence nuisible.

2. Cet équipement doit accepter toutes les interférences reçues, y compris celles qui pourraient entraîner un fonctionnement inattendu.

Les modifications de cet équipement qui n'ont pas été expressément approuvées par le responsable de la conformité aux limites pourraient annuler l'autorité dont l'utilisateur dispose pour utiliser cet équipement. Cet équipement a été testé et déclaré conforme aux limites définies pour les appareils numériques de classe A, conformément à la section 15 de la réglementation FCC. Ces limites ont pour but de fournir une protection raisonnable contre les interférences néfastes lorsque l'équipement fonctionne dans un environnement commercial. Cet équipement génère, utilise et peut irradier l'énergie des fréquences radio et, s'il n'est pas installé ou utilisé conformément au mode d'emploi, il peut entraîner des interférences dangereuses pour les communications radio. Le fonctionnement de cet équipement dans une zone résidentielle risque de causer des interférences nuisibles, dans ce cas l'utilisateur doit corriger les interférences à ses frais Les techniques ci-dessous peuvent permettre de réduire les problèmes d'interférences :

1. Débrancher l'équipement de la prise de courant pour vérifier s'il est ou non la source des perturbations
2. Si l'équipement est branché sur le même circuit de prises que l'appareil qui subit des interférences, branchez l'équipement sur un circuit différent.
3. Éloigner l'équipement du dispositif qui reçoit l'interférence.
4. Repositionner l'antenne de réception du périphérique qui reçoit les interférences.
5. Essayer plusieurs des techniques ci-dessus à la fois.

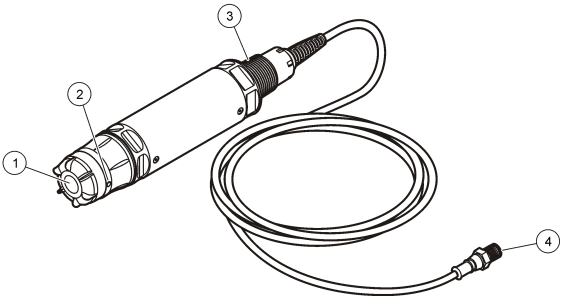
## Présentation du produit

| ⚠ DANGER | |
|---|---|
| | Dangers chimiques ou biologiques. Si cet instrument est utilisé pour la surveillance d'un procédé de traitement et/ou d'un système de dosage de réactifs chimiques auxquels s'appliquent des limites réglementaires et des normes de surveillance motivées par des préoccupations de santé et de sécurité publiques ou de fabrication et de transformation d'aliments ou de boissons, il est de la responsabilité de l'utilisateur de cet instrument qu'il connaisse et applique les normes en vigueur et qu'il ait à sa disposition suffisamment de mécanismes pour s'assurer du bon respect de ces normes dans l'éventualité d'un dysfonctionnement de l'appareil. |

Ce capteur est conçu pour fonctionner avec un contrôleur assurant la collecte de données et le fonctionnement. Il est possible d'utiliser le capteur avec plusieurs transmetteurs. Pour plus d'informations, reportez-vous au manuel d'utilisation du transmetteur.

Ce capteur est essentiellement conçu pour le traitement municipal ou industriel des eaux usées. La technologie de capteur LDO ne consomme pas d'oxygène et permet de mesurer la concentration d'oxygène dissous pour un débit faible ou nul. Voir la Figure 1.

**Figure 1 Capteur LDO**

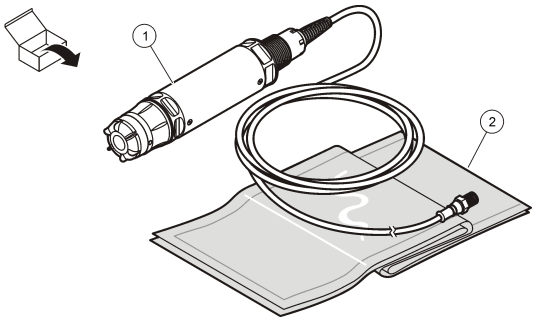



| | |
|---|---|
| **1** Capsule de sonde | **3** Filetage 1 pouce NPT (2) |
| **2** Capteur de température | **4** Connecteur, connexion rapide (standard) |

## Liste des composants du capteur LDO

Assurez-vous d'avoir bien reçu tous les composants illustrés dans la Figure 2. Si des éléments manquent ou sont endommagés, contactez immédiatement le fabricant ou un représentant commercial. Voir la Figure 2.

**Figure 2 Liste des composants du capteur**




| | |
|---|---|
| **1** Capteur LDO[1] | **2** Sachets d'étalonnage (2) |

[1] Le manuel fourni n'est pas représenté.

# Installation

**⚠ AVERTISSEMENT**

Risque de blessures corporelles Seul le personnel qualifié est autorisé à entreprendre les opérations décrites dans cette section du manuel.

## Validation du type de capteur

**⚠ DANGER**

Risque d'explosion. Ne branchez que des composants périphériques clairement indiqués comme certifiés pour usage en endroits dangereux de Classe 1, Division 2.

***AVIS***

La version de ce produit certifiée pour les environnements dangereux n'est pas conforme à la norme 94/9/EC (norme ATEX).

1. Saisissez l'extrémité du câble comportant le connecteur.
2. Lisez l'étiquette placée à cette extrémité du câble. Sur les capteurs certifiés pour une utilisation en environnement dangereux, l'étiquette affiche « Certifié : Classe 1 Division 2 ».
3. Examinez le connecteur.

   - Les capteurs certifiés pour une utilisation en environnement dangereux comportent un connecteur avec verrouillage de sécurité. Voir la Figure 3 à la page 24.
   - Les capteurs non certifiés pour une utilisation en environnement dangereux comportent une prise de déconnexion rapide, sans verrouillage de sécurité.

## Connexion du capteur dans un environnement dangereux

**⚠ DANGER**

Risque d'explosion. Cet équipement convient à une utilisation au sein d'environnements non dangereux ou au sein d'environnements dangereux Classe 1, Division 2, Groupes A, B, C et D avec capteurs et options spécifiées installées selon la fiche technique relative à l'installation au sein d'environnements dangereux. Reportez-vous toujours aux instructions de la fiche technique et des réglementations en vigueur en matière de normes électriques pour une installation conforme.

**⚠ DANGER**

Risque d'explosion Ne branchez ni ne débranchez aucun composant électrique ou circuit sur l'équipement avant de vous être assuré que l'alimentation a été coupée et que l'emplacement est sécurisé.

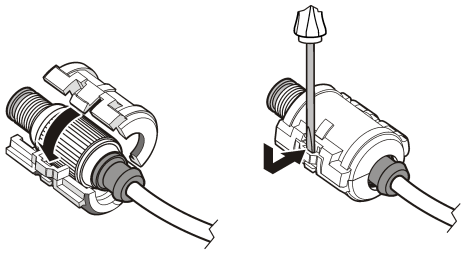
**AVIS**

Dans un environnement dangereux, utilisez uniquement un capteur certifié pour ce type d'environnement et un verrou de câble. La version de ce produit certifiée pour les environnements dangereux n'est pas conforme à la norme 94/9/EC (norme ATEX).

Pour plus de renseignements, référez-vous à la section Validation du type de capteur à la page 23 .

1. Retirez le bouchon (2) du connecteur du transmetteur. Conservez le bouchon (2) du connecteur afin de protéger l'ouverture du connecteur une fois le capteur retiré.
2. Connectez le capteur au transmetteur. Pour plus d'informations, reportez-vous au manuel du transmetteur.
3. Verrouillez le dispositif de sécurité du connecteur.
4. Pour retirer le verrouillage de sécurité du connecteur, utilisez un petit tournevis plat. Voir la Figure 3.

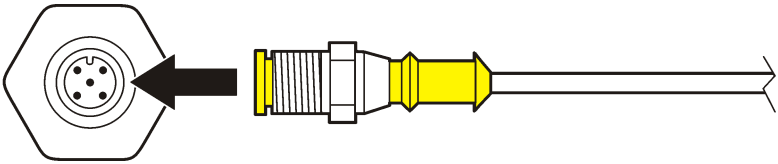
**Figure 3 Verrouillage de sécurité du connecteur**



## Connexion du capteur dans un environnement non dangereux

Voir la Figure 4 pour la connexion d'un capteur LDO à un transmetteur sc. Pour les instructions relatives au câblage, reportez-vous au manuel du transmetteur sc.

**Figure 4 Connexion du capteur LDO (illustration correspondant à un capteur pour environnement non dangereux)**



Une fois le capteur fixé, détectez-le à l'aide du logiciel. Voir la section Installation du capteur à la page 25.

## Installation du capteur

Deux méthodes permettent d'installer le capteur :

- Connectez le capteur lorsque le transmetteur est hors tension. Une fois sous tension, le transmetteur recherche et installe tout nouveau capteur.
- Connectez le capteur lorsque le transmetteur est sous tension. Installez le nouveau capteur à l'aide de la commande Scan Devices (Rechercher les périphériques) :

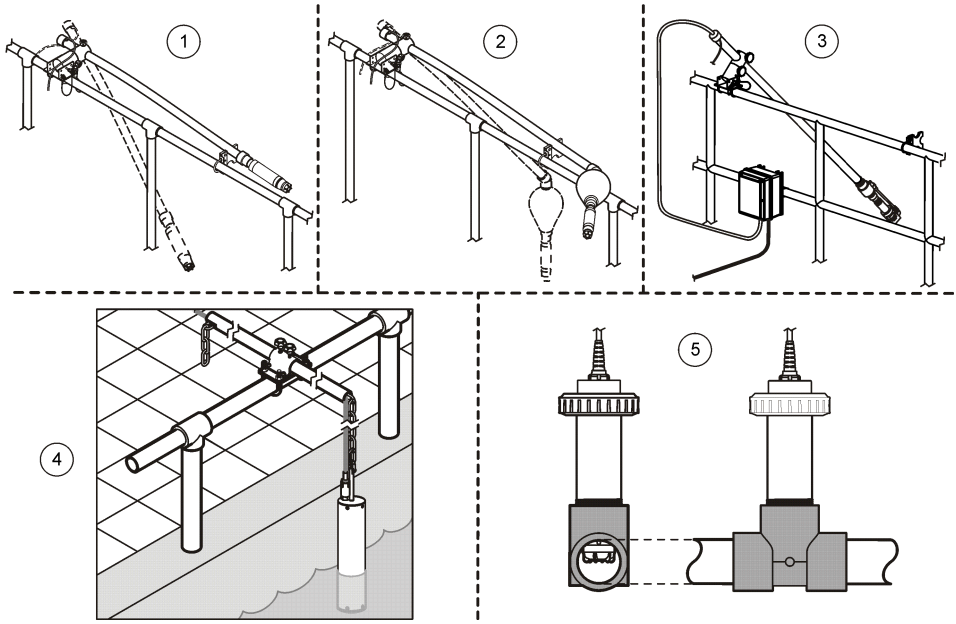
| Option | Description |
|---|---|
| **Transmetteur sc200** | Sélectionnez MENU>TEST/MAINT>RECHERCHE CAPTEUR |
| **Transmetteur sc100** | Sélectionnez MENU>TEST/MAINT>RECHERCHE CAPTEUR |
| **Transmetteur sc1000** | Sélectionnez MENU>SYSTEM SETUP (CONFIG SYSTEME)>CONTROLE APPAREILS>RECHERCHE NOUVEAUX APPAREILS |

Pour plus d'informations sur la connexion d'un capteur numérique, voir la section Connexion du capteur dans un environnement non dangereux à la page 24.

## Options d'installation du capteur

Les options d'installation et les accessoires du capteur LDO sont fournies avec les instructions nécessaires dans le kit de fixation. La Figure 5 présente plusieurs options d'installation. Pour commander du matériel d'installation, voir la section Pièces de rechange et accessoires à la page 35.

**Figure 5 Options d'installation**




| | |
|---|---|
| **1** Montage sur rail | **4** Montage sur chaîne |
| **2** Montage sur flotteur | **5** Montage raccord union (non compatible avec sonde pour eau de mer) |
| **3** Montage sur système de soufflage d'air (non compatible avec sonde pour eau de mer) | |

# Fonctionnement

## Navigation utilisateur

Consultez la documentation du transmetteur pour une description du clavier et des informations de navigation.

## Configuration du capteur

Utiliser le menu Configurer pour entrer les informations d'identification du capteur et modifier les options de gestion et stockage de données.

Pour plus d'informations sur l'installation du capteur, voir Installation du capteur à la page 25.

Assurez-vous que toutes les valeurs du menu de configuration sont appropriées à l'utilisation de l'appareil.

1. Sélectionnez MENU>SENSOR SETUP (CONFIG CAPTEUR)>[Sélectionnez le capteur]>CONFIGURE (CONFIGURER).
2. Sélectionnez une option, puis appuyez sur ENTER (ENTREE). Le tableau ci-dessous présente les options disponibles.

| Option | Description |
|---|---|
| EDITER NOM | Modifie le nom correspondant au capteur en haut de l'écran de mesure. Le nom est limité à 10 caractères avec n'importe quelle combinaison de lettres, chiffres, espaces ou ponctuation. |
| DEFINITION UNITES | TEMP : règle les unités de température en °C (par défaut) ou °F. |
| | MEASURE (MESURE) : règle les unités de mesure en mg/l, ppm ou %. |
| | ALT/PRESS : règle l'altitude en mètres ou en pieds ou les unités de pression atmosphérique en mmHg ou torr. (Valeur par défaut = 0 pied.) |
| ALT/PRESS | Saisissez la valeur d'altitude ou de pression atmosphérique. Il est nécessaire que cette valeur soit précise afin d'effectuer les mesures de saturation en pourcentage et l'étalonnage dans l'air. (Valeur par défaut = 0 pied.) |
| SALINITE | Saisissez la valeur de salinité. Plage de salinité : 0 à 250 parties par milliers (‰). Pour en savoir plus, reportez-vous à la section Saisie d'une valeur de correction de la salinité à la page 27. (Valeur par défaut = 0 pied.) |
| MOYENNE SIGNAL | Définissez l'intervalle de temps pour la moyenne du signal en secondes. |
| INTERVALLE NETTOYAGE | Définissez l'intervalle de temps pour le nettoyage manuel du capteur en jours. (Valeur par défaut = 0 jour. Une valeur de 0 jour désactive l'intervalle de nettoyage.) |
| RAZ INT NETTOY | Définissez le dernier intervalle de nettoyage enregistré comme intervalle de temps. |
| PROGRAMMATION HISTORIQUE | Définit l'intervalle de temps pour l'enregistrement des données dans le journal des données ; 0,5, 1, 2, 5, 10, 15 (par défaut), 30, 60 minutes. |
| VALEURS PAR DEFAUT | Restaure les valeurs par défaut des options de configuration du capteur. Les réglages de pente et de décalage ne sont pas affectés. |

## Saisie de la valeur de pression atmosphérique

Le réglage par défaut pour la pression atmosphérique (de l'air) est 0 pied, soit le niveau de la mer. Pour modifier la valeur par défaut, procédez comme suit. Il est possible d'ajuster la pression d'air à l'aide d'une valeur d'altitude ou d'unités de pression (recommandée).

***Remarque :*** *la précision de la valeur de pression d'air est essentielle à l'étalonnage de la saturation de l'air (Étalonnage à l'air à la page 29). Utilisez toujours la valeur de pression absolue, et non la valeur ajustée. Si vous ne connaissez pas la valeur de pression d'air absolue, utilisez l'altitude exacte de l'endroit où se trouve le capteur.*

1. Sélectionnez MENU>SENSOR SETUP (CONFIG CAPTEUR)>[Sélectionnez le capteur]>CONFIGURE (CONFIGURER)>SET UNITS (DEF UNITES)>AIR PRESS (PRESSION)/ALT UNITS (UNIT ALT).
2. Sélectionnez **une** des unités suivantes :

| Option | Description |
|---|---|
| **ft** | Pied (foot) : unité de mesure anglo-saxonne de l'altitude |
| **m** | Mètre : unité de mesure de l'altitude |
| **mmHg** | Millimètres de mercure : unité de mesure de la pression d'air absolue |
| **torr** | Unité de mesure de pression d'air absolue |

3. Confirmez la sélection. L'écran de saisie de valeur affiche les unités sélectionnées.
4. Saisissez la valeur et confirmez.

## Saisie d'une valeur de correction de la salinité

Il est possible que la valeur DO affichée par les mesures d'oxygène dissous des échantillons salins soit très différente de la valeur DO réelle. Pour compenser l'effet des sels dissous dans un échantillon, saisissez un facteur de correction de la salinité.
***Remarque :*** *Si vous n'êtes pas certain du taux de salinité du fluide, renseignez-vous auprès des ingénieurs du site de traitement.*

1. A l'aide d'un conductimètre, mesurez la conductivité de l'échantillon en mS/cm à la température de référence de 20 °C.
2. Aidez-vous du Tableau 1 pour estimer le facteur de correction de la salinité en fonction de la saturation en parties par millier (‰).

   ***Remarque :*** *La concentration en ion chlorure, exprimée en g/kg, indique la chlorinité de l'échantillon. Le taux de salinité est calculé selon la formule suivante : salinité = 1,80655 x chlorinité.*

   Il est possible de calculer le taux de salinité à l'aide de la relation établie dans la section 2520 B du document *Standard Methods for the Examination of Water and Wastewater*.[*],
3. Sélectionnez MENU>SENSOR SETUP (CONFIG CAPTEUR)>[Sélectionnez le capteur]>CONFIGURE (CONFIGURER)>SALINITY (SALINITE).
4. Saisissez le facteur de salinité et confirmez votre saisie.

[*] *Standard Methods for the Examiniation of Water and Wastewater*, 20e édition. Editeurs : Lenore S. Clesceri, Arnold E. Greenberg et Andrew D. Eaton, p. 2-48-2-29 (1998). Le rapport entre chlorinité et solubilité de l'oxygène est fourni dans ce même document à la section 4500-O:I p. 4-131.

**Tableau 1 Saturation de salinité (‰) en fonction de la valeur de conductivité (mS/cm)**

| mS/cm | ‰ | | mS/cm | ‰ | | mS/cm | ‰ | | mS/cm | ‰ |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 3 | | 16 | 10 | | 27 | 18 | | 38 | 27 |
| 6 | 4 | | 17 | 11 | | 28 | 19 | | 39 | 28 |
| 7 | 4 | | 18 | 12 | | 29 | 20 | | 40 | 29 |
| 8 | 5 | | 19 | 13 | | 30 | 21 | | 42 | 30 |
| 9 | 6 | | 20 | 13 | | 31 | 22 | | 44 | 32 |
| 10 | 6 | | 21 | 14 | | 32 | 22 | | 46 | 33 |
| 11 | 7 | | 22 | 15 | | 33 | 23 | | 48 | 35 |
| 12 | 8 | | 23 | 15 | | 34 | 24 | | 50 | 37 |
| 13 | 8 | | 24 | 17 | | 35 | 25 | | 52 | 38 |
| 14 | 9 | | 25 | 17 | | 36 | 25 | | 54 | 40 |
| 15 | 10 | | 26 | 18 | | 37 | 26 | | | |

## Configuration de la sortie courant (2) du transmetteur

Les sorties linéaires envoient les données de la sonde au système centralisé (automate, supervision ou autre) de l'installation.

1. Ouvrez le menu de configuration de sortie du transmetteur.

| Option | Description |
|---|---|
| **sc200** | Sélectionnez MENU>SETTINGS (REGLAGES)>sc200 SETUP (CONFIG sc200)>PROGRAMMATION SORTIE>[Sélectionnez la sortie]>MODE. |
| **sc100** | Sélectionnez MENU>SYSTEM SETUP (CONFIG SYSTEME)>PROGRAMMATION SORTIE>[Sélectionnez la sortie]>MODE. |
| **sc1000** | Sélectionnez MENU>SYSTEM SETUP (CONFIG SYSTEME)>PROGRAMMATION SORTIE>[Sélectionnez la sortie]>MODE. |

2. Définissez la fonction du transmetteur.

| Option | Description |
|---|---|
| **sc200** | LINEAIRE |
| **sc100** | LINEAIRE (valeur par défaut) |
| **sc1000** | LINEAIRE (valeur par défaut) |

## Registres Modbus

Une liste de registres Modbus est disponible pour la communication réseau. Consulter www.hach.com ou www.hach-lange.com pour plus d'informations.

# Etalonnage

Le capteur est étalonné en usine conformément aux spécifications. Le fabricant recommande de procéder à l'étalonnage à la fréquence préconisée par les organismes de contrôle. Si l'étalonnage est nécessaire, assurez-vous du fonctionnement stabilisé (2) du capteur avant de procéder à l'étalonnage. Ne procédez pas à l'étalonnage du capteur lors de son installation.

Le Tableau 2 présente les options d'étalonnage.

**Tableau 2 Options d'étalonnage**

| Option | Description |
|---|---|
| ETALONNAGE A L'AIR | Méthode d'étalonnage recommandée. Cet étalonnage modifie la pente. |
| ETALONNAGE PROCESS | Etalonnage par comparaison avec un appareil de mesure d'oxygène dissous portable. Cet étalonnage modifie le décalage. |
| RAZ DEF ETAL | Rétablit les valeurs de gain d'étalonnage (pente) et de décalage par défaut ; gain par défaut = 1,0, décalage par défaut = 0,0 |

## Étalonnage à l'air

**Remarques à l'intention de l'utilisateur :**

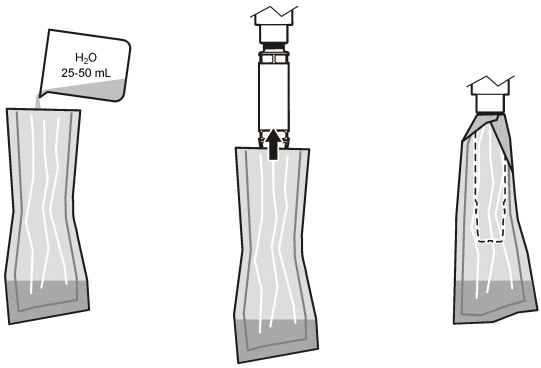
- Assurez-vous que le sachet utilisé pour l'étalonnage contient bien de l'eau.
- Assurez-vous que le joint placé entre le sachet d'étalonnage et le corps du capteur est bien serré.
- Avant de procéder à l'étalonnage, assurez-vous que le capteur est bien sec.
- Assurez-vous que le réglage de pression d'air et d'altitude est approprié à l'emplacement choisi pour effectuer l'étalonnage.
- Attendez que la température du capteur corresponde à la température de l'emplacement du sachet d'étalonnage. Jusqu'à 15 minutes peuvent être nécessaires pour réduire un écart de température important entre le fluide traité et l'emplacement choisi pour l'étalonnage.

1. Sortez le capteur du fluide traité. Nettoyez le capteur à l'aide d'un chiffon humide.
2. Placez l'intégralité du capteur dans un sachet d'étalonnage contenant 25 à 50 ml d'eau. Veillez à ce que la capsule du capteur n'entre pas en contact avec l'eau du sachet d'étalonnage et ne comporte aucune goutte d'eau (Figure 6).
3. Resserrez le sac autour du corps du capteur à l'aide d'un ruban adhésif, d'une ficelle ou de votre main.
4. Avant de procéder à l'étalonnage, laissez le capteur se stabiliser pendant 15 minutes. Pendant la stabilisation, conservez le sachet d'étalonnage à l'abri du soleil.
5. Assurez-vous que le réglage actuel absolu de pression d'air ou d'altitude est correctement configuré. Voir Saisie de la valeur de pression atmosphérique à la page 26.

   ***Remarque :*** *le fabricant recommande l'utilisation de la valeur de pression d'air réelle ou absolue.*
6. Sélectionnez MENU>SENSOR SETUP (CONFIG CAPTEUR)>[Sélectionnez le capteur]>CALIBRATE (ETALONNER)>AIR CAL (ETAL AIR).
7. Sélectionnez l'option de sortie du signal pendant l'étalonnage :

   | Option | Description |
   |---|---|
   | **Actif** | L'instrument envoie la valeur de sortie mesurée pendant la procédure d'étalonnage. |
   | **Mémorisation** | La valeur de sortie du capteur est maintenue à la dernière valeur mesurée pendant la procédure d'étalonnage. |
   | **Transfert** | Une valeur prédéfinie est fournie pendant l'étalonnage. Consultez le manuel d'utilisation du transmetteur pour changer la valeur prédéfinie. |
8. Le transmetteur affiche le message « Placer le capteur dans l'air ». Attendez que la valeur se stabilise. Appuyez sur ENTER (ENTREE) pour accepter la valeur stable. Vous pouvez également attendre que l'écran affiche « Complete » (Terminé).
9. Une fois le capteur étalonné, placez-le dans le fluide traité. Appuyez sur ENTER (ENTREE).

**Figure 6 Procédure d'étalonnage à l'air**




Si la valeur ne se stabilise pas, l'écran affiche un message d'erreur précédé de la mention « Unable to Calibrate » (Etalonnage impossible). Le Tableau 3 présente les messages d'erreur et les résolutions des problèmes d'étalonnage.

**Tableau 3 Messages relatifs à l'étalonnage à l'air**

| Message | Description | Résolution |
|---|---|---|
| Cal fail, gain high (Echec étal., gain élevé) | La valeur de gain calculée est trop élevée. | Procédez à nouveau à l'étalonnage. |
| Cal fail, gain low (Echec étal., gain faible) | La valeur de gain calculée est trop faible. | Procédez à nouveau à l'étalonnage. |
| Cal fail, unstable (Echec étal., instable) | La valeur ne s'est pas stabilisée dans le délai maximal d'étalonnage. | Procédez à nouveau à l'étalonnage. |

## Etalonnage Process : étalonnage par comparaison

Cette méthode d'étalonnage nécessite un autre capteur connecté à un appareil de mesure portable.

1. Plongez cet autre capteur dans le fluide. Placez le second capteur aussi près que possible du premier.
2. Attendez la stabilisation de la valeur O2 dissous (1).
3. Sur le transmetteur du capteur à calibrer, sélectionnez MENU>CONFIG CAPTEUR>[Sélectionnez le capteur]>ETALONNAGE>PROCESS.
4. Sélectionnez l'option de sortie du signal pendant l'étalonnage :

| Option | Description |
|---|---|
| **Actif** | L'instrument envoie la valeur de sortie mesurée pendant la procédure d'étalonnage. |
| **Mémorisation** | La valeur de sortie du capteur est maintenue à la dernière valeur mesurée pendant la procédure d'étalonnage. |
| **Transfert** | Une valeur prédéfinie est fournie pendant l'étalonnage. Consultez le manuel d'utilisation du transmetteur pour changer la valeur prédéfinie. |

5. Le transmetteur affiche les éléments suivants :
   - « Press ENTER when stabilized » (Appuyez sur ENTREE une fois la valeur stabilisée)
   - La mesure d'oxygène dissous actuelle
   - La mesure de température actuelle
6. Une fois la mesure stable, appuyez sur ENTER (ENTREE). Un écran de saisie s'affiche.

***Remarque :*** *la mesure se stabilise en général au bout de 2 ou 3 minutes.*

Si la valeur ne se stabilise pas, l'écran affiche un message d'erreur précédé de la mention « Unable to Calibrate » (Etalonnage impossible). Le Tableau 4 présente les messages d'erreur et les résolutions des problèmes d'étalonnage.

**Tableau 4 Messages d'erreur d'étalonnage par échantillon**

| Message | Description | Résolution |
|---|---|---|
| Cal fail, offset high (Echec étal., décalage élevé) | La valeur de décalage calculée est trop élevée. | Procédez à nouveau à l'étalonnage. |
| Cal fail, offset low (Echec étal., décalage faible) | La valeur de décalage calculée est trop faible. | Procédez à nouveau à l'étalonnage. |
| Cal fail, unstable (Echec étal., instable) | La valeur ne s'est pas stabilisée dans le délai maximal d'étalonnage. | Procédez à nouveau à l'étalonnage. |

## Quitter la procédure d'étalonnage

1. Pendant l'étalonnage, appuyez sur la touche BACK (RETOUR). Trois options apparaissent :

| Option | Description |
|---|---|
| **ANNULER** | Arrête l'étalonnage. Un nouvel étalonnage devra repartir du début. |
| **RETOUR ETALON.** | Permet de reprendre l'étalonnage en cours. |
| **ECHAPPER** | Quitte temporairement l'étalonnage. L'étalonnage se poursuit en arrière-plan, permettant l'accès à d'autres menus. Il est possible de démarrer un étalonnage pour un deuxième capteur (le cas échéant). Pour revenir à l'étalonnage, appuyez sur la touche MENU et sélectionnez Sensor Setup (Config capteur), [Sélectionnez le capteur]. |

2. Sélectionnez une des options. Validez.

## Réinitialisation des valeurs d'étalonnage par défaut

Il est possible de réinitialiser les réglages d'étalonnage à l'aide des valeurs par défaut. Les valeurs de gain et de décalage sont alors définies sur 1 et 0, respectivement.

1. Sélectionnez MENU>CONFIG CAPTEUR>CONFIGURATION
2. Un message de confirmation s'affiche. Confirmez la réinitialisation du capteur à l'aide de la courbe d'étalonnage par défaut.

# Maintenance

**⚠ DANGER**

Dangers multiples. Seul le personnel qualifié doit effectuer les tâches détaillées dans cette section du document.

**⚠ DANGER**

**Risque d'explosion** Ne branchez ni ne débranchez aucun composant électrique ou circuit sur l'équipement avant de vous être assuré que l'alimentation a été coupée et que l'emplacement est sécurisé.

**⚠ DANGER**

**Risque d'explosion** Tout changement de composant est susceptible d'avoir une incidence sur la conformité Classe 1, Division 2. Ne remplacez jamais un composant avant de vous être assuré que l'alimentation a été coupée et que l'emplacement est sécurisé.

| AVIS |
| --- |
| La version de ce produit certifiée pour les environnements dangereux n'est pas conforme à la norme 94/9/EC (norme ATEX). |

## Calendrier de maintenance

Le calendrier de maintenance indique la fréquence minimum des tâches de maintenance régulières. Effectuer les opérations d'entretien plus fréquemment avec des applications entraînant une contamination de l'électrode.
***Remarque :*** *ne démontez pas la sonde pour la maintenance ou le nettoyage.*

| Tâche de maintenance | Fréquence minimum recommandée |
| --- | --- |
| Nettoyage du capteur | 90 jours |
| Inspection du capteur | 90 jours |
| Etalonnage du capteur | Conformément aux recommandations des organismes de contrôle |

## Nettoyage du capteur

Nettoyez la surface du capteur à l'aide d'un chiffon doux humide.
***Remarque :*** *S'il est nécessaire de retirer la capsule du capteur lors du nettoyage, évitez d'exposer l'intérieur de la capsule aux rayons du soleil pendant une période prolongée.*

## Définition ou modification de l'intervalle de nettoyage

L'intervalle adéquat entre les nettoyages manuels du capteur peut varier en fonction des conditions d'utilisation. L'intervalle de nettoyage par défaut est de 0 jour. Pour modifier l'intervalle, procédez comme suit.

1. Sélectionnez MENU>SENSOR SETUP (CONFIG CAPTEUR)>[Sélectionnez le capteur]>CONFIGURE (CONFIGURER)>INT NETTOYAGE.
2. Modifiez la valeur affichée. Confirmez la modification.

   - Pour désactiver l'intervalle de nettoyage, définissez 0 comme valeur.

## Remplacement du capuchon du capteur

| ⚠ AVERTISSEMENT | |
| --- | --- |
| | Risque d'explosion. Le capuchon de configuration du capteur n'est pas certifié pour une utilisation en environnement dangereux. |

Des instructions d'installation sont fournies avec les capuchons de configuration et les capuchons de capteur de rechange. Pour remplacer le capuchon, reportez-vous aux instructions fournies.

Pour bénéficier de performances et d'une précision optimales, remplacez le capuchon du capteur :

- Tous les deux ans ;
- Lorsque l'inspection de routine révèle une forte érosion du capuchon du capteur.

# Dépannage

## Menu de diagnostic et test

Le menu de diagnostic et de test affiche les informations actuelles et consignées relatives au capteur LDO.
Pour accéder au menu de diagnostic et de test, sélectionnez MENU>SENSOR SETUP (CONFIG CAPTEUR)>[Sélectionnez le capteur]>DIAG/TEST.

Voir le Tableau 5.

**Tableau 5 Menu DIAG/TEST**

| Option | Description |
|---|---|
| INFO CAPTEUR | VER LOGICIEL : affiche la version du logiciel installé. |
| | VER CODE DEM : affiche la version du code de démarrage installé. |
| | DRIVER VERSION (VER PILOTE) : affiche la version du pilote logiciel installé. |
| LOT CODE (CODE LOT) | Affiche le lot de fabrication du capuchon du capteur |
| SERIAL NUMBER (NUMERO DE SERIE) | Numéro de série du capteur |
| GAIN CORR (COEF GAIN) | Permet d'ajuster la valeur de gain d'étalonnage. |
| | Plage : 0,5 à 2 |
| OFFSET CORR (CORR DECALAGE) | Permet d'ajuster la valeur de décalage d'étalonnage (mg/l ou ppm). |
| | Plage : -3 à 3 |
| PHASE DIAG (DIAG PHASE) | Affiche la phase des longueurs d'onde bleue, rouge et totale. Mise à jour chaque seconde. |
| AMPL DIAG (DIAG AMPL) | Affiche l'amplitude des longueurs d'onde bleue et rouge. Mise à jour chaque seconde. |
| JRS AV NETTOY | Affiche le nombre de jours avant le prochain nettoyage manuel programmé. |
| DUREE CAPTEUR | Affiche le nombre de jours avant le prochain remplacement de capuchon du capteur programmé. |

## Liste d’erreurs

En cas d'erreur, la mesure affichée clignote. Le comportement de sortie est déterminé par les réglages du transmetteur. Pour plus d'informations, reportez-vous au manuel du transmetteur. Pour afficher les erreurs actuellement détectées sur le capteur, sélectionnez MENU>DIAGNOSTICS>[Sélectionnez le capteur]>ERROR LIST (LISTE ERREURS) Voir le Tableau 6.

**Tableau 6 Liste d'erreurs du capteur LDO**

| Erreur | Cause possible | Résolution |
|---|---|---|
| RED AMPL LOW (AMPL RGE FAIB) (Valeur inférieure à 0,01)<br>OU<br>BLUE AMPL LOW (AMPL BL FAIB) (Valeur inférieure à 0,01) | Le capuchon du capteur n'est pas installé ou ne l'est pas correctement. | Retirez le capuchon du capteur, puis replacez-le. |
| | La trajectoire de la lumière est bloquée dans le capuchon du capteur. | Inspectez la lentille et l'intérieur du capuchon du capteur. |
| | Le capteur ne fonctionne pas correctement. | Assurez-vous que le voyant clignote. Contactez le fabricant. |

## Liste d’avertissements

Lorsque l'icône d'avertissement clignote (sc100 et sc200) ou lorsque l'écran devient jaune (sc1000), un message s'affiche en bas de l'écran. Sur le transmetteur sc1000, l'écran devient jaune lorsqu'un avertissement est affiché. Pour afficher les avertissements actuellement émis par le capteur,

sélectionnez MENU>DIAGNOSTICS>[Sélectionnez le capteur]>WARNING LIST (LISTE AVERTISSEMENTS) Voir le Tableau 7.

**Tableau 7 Liste d'avertissements du capteur**

| Avertissement | Définition | Résolution |
|---|---|---|
| EE SETUP ERR (ERR CONFIG EE) | Le stockage est corrompu. Les valeurs par défaut ont été rétablies. | Contactez l'assistance technique. |
| EE RSRVD ERR (ERR ENR EE) | | |
| TEMP < 0 C (TEMP < 0 °C) | La température du fluide est inférieure à 0 °C | Augmentez la température du fluide ou cessez son utilisation jusqu'à ce que sa température soit comprise dans la plage des spécifications du capteur. |
| TEMP > 50 C (TEMP > 50 °C) | La température du fluide est supérieure à 50 °C | Diminuez la température du fluide ou cessez son utilisation jusqu'à ce que sa température soit comprise dans la plage des spécifications du capteur. |
| RED AMPL LOW (AMPL RGE FAIB) | La valeur est inférieure à 0,03 | Voir le Tableau 6 à la page 33. |
| RED AMPL HIGH (AMPL RGE ELEV) | La valeur est supérieure à 0,35 | Appelez l'assistance technique. |
| BLUE AMPL LOW (AMPL BL FAIB) | La valeur est inférieure à 0,03 | Voir le Tableau 6 à la page 33. |
| BLUE AMPL HIGH (AMPL BL ELEV) | La valeur est supérieure à 0,35 | Appelez l'assistance technique. |
| CAP CODE FAULT (ERR CODE CAP) | Le code du capuchon du capteur est corrompu. Le code a été automatiquement réinitialisé à l'aide des codes de lot et de capuchon par défaut. | Suivez les instructions relatives au capuchon de configuration du capteur. Si aucun capuchon de configuration n'est disponible pour le capuchon du capteur, contactez l'assistance technique. |

## Liste d'événements

La liste d'événements consigne les modifications apportées au mode d'enregistrement des données par le capteur. Pour afficher les événements relatifs au capteur, sélectionnez MENU>DIAGNOSTICS>[Sélectionnez le capteur]>EVENT LIST (LISTE EVENEMENTS). Voir le Tableau 8.

**Tableau 8 Liste d'événements du capteur**

| Evénement | Description |
|---|---|
| ALT/PRESSURE UNIT CHANGE (MODIF UNIT PRESSION/ALT) | Les unités de pression atmosphérique ou d'altitude ont été modifiées. |
| ALT/PRESSURE CHANGE (MODIF PRESSION/ALT) | La valeur de pression atmosphérique ou d'altitude a été modifiée. |
| TEMP UNIT CHANGE (MODIF UNIT TEMP) | Les unités de température ont été modifiées. |
| MEAS UNIT CHANGE (MODIF UNIT MES) | Une nouvelle unité de mesure a été introduite. |
| SALINITY CHANGE (MODIF SALINITE) | La valeur de salinité a été modifiée. |
| SET DEFAULT (DEF VAL PR DFT) | Les valeurs par défaut des réglages du capteur ont été rétablies. |

**Tableau 8 Liste d'événements du capteur (suite)**

| Evénement | Description |
|---|---|
| SENSOR SETUP CHANGE (MODIF CONFIG CAPTEUR) | La configuration du capteur a été modifiée. |
| CLEAN INTERVAL TIMER CHANGE (MODIF INT NETTOYAGE) | L'intervalle entre deux nettoyages du capteur a été modifié. |
| SENSOR CAP LIFE TIMER CHANGE (MODIF DUREE CAP) | L'intervalle entre deux remplacements du capuchon du capteur a été modifié. |

## Pièces de rechange et accessoires

Utiliser uniquement des pièces de rechange approuvées par le fabricant. L'utilisation de pièces non approuvées comporte un risque de blessure, d'endommagement de l'appareil ou de panne d'équipement.

### Eléments de rechange

| Description | Référence article (U.S.A. / U.E.) |
|---|---|
| Sonde LDO avec capsule de capteur et 2 sachets d'étalonnage | 9020000 / LXV416.99.20001 |
| Sonde LDO pour eau de mer avec capsule de capteur et deux sachets d'étalonnage | 9020000-SW / — |
| Sonde LDO pour zone dangereuse avec eau de mer, avec capsule de capteur et deux sachets d'étalonnage | 9020000-C1D2-SW / — |
| Sonde LDO pour zone dangereuse avec capsule de capteur et 2 sachets d'étalonnage | 9020000-C1D2 / — |
| Capsule du capteur de rechange (inclut la capsule de configuration du capteur non certifié pour zone dangereuse de classe 1, division 2) | 9021100 / 9021150 |

### Accessoires

| Description | Référence article (U.S.A. / U.E.) |
|---|---|
| Verrou de câble du capteur pour environnements dangereux | 6139900 / — |
| Câble, extension de capteur, zone dangereuse de classe 1, division 2, 1 m | 6122402 / — |
| Câble, extension de capteur, zone dangereuse de classe 1, division 2, 7 m | 5796002 / — |
| Câble, extension de capteur, zone dangereuse de classe 1, division 2, 15 m | 5796102 / — |
| Câble, extension de capteur, zone dangereuse de classe 1, division 2, 31 m | 5796202 / — |
| Système de nettoyage par soufflage d'air haut rendement, 115 V (non certifié pour utilisation en environnement dangereux) | 6860000 / 6860003.99.0001 |
| Système de nettoyage par soufflage d'air haut rendement, 230 V (non certifié ATEX pour utilisation en environnement dangereux) | 6860100 / 6860103.99.0001 |
| Sachet d'étalonnage (1) | 5796600 / 5796600 |
| Câble, extension du capteur, environnement non dangereux, 7,7 m[1] | U.S.A. : 5796000, 7,7 m |
| | U.E. : LZX849, 10 m |
| Kit de montage tube d'immersion (PVC) | 9253000 / LZY714.99.21810 |
| Kit de montage sur flotteur (PVC) | 9253100 / LZX914.99.42200 |
| Kit de montage pour soufflage d'air | 9253500 / LZY812 |
| Kit de montage chaîne d'immersion (acier inoxydable) | — / LZX914.99.11200 |

| Description | Référence article (U.S.A. / U.E.) |
|---|---|
| Kit de montage raccord union | 9257000 / 9257000 |
| Appareil de mesure HQd avec sonde LDO terrain (non certifiée pour utilisation en environnement dangereux) | 8505200 / HQ40D.99.310.000 |

[1] Câbles de 15 m et 30 m également disponibles.

# Contenido


Especificaciones en la página 37

Información general en la página 38

Descripción general del producto en la página 40

Instalación en la página 41

Calibración de las mediciones en la página 47

Funcionamiento en la página 44

Mantenimiento en la página 50

Solución de problemas en la página 52

Piezas de repuesto y accesorios en la página 54


# Especificaciones

Las especificaciones están sujetas a cambios sin previo aviso.

| Especificación | Detalles |
|---|---|
| Materiales impregnados | Sonda estándar, sonda estándar Clase 1-Div 2<br>• CPVC, extremo del sensor y extremo del cable<br>• Poliuretano, doble moldura en el extremo y el revestimiento del cable<br>• Cuerpo y tornillos de acero inoxidable 316<br>• Viton, junta tórica<br>• Noryl, tuerca en el extremo del cable |
| | Sonda estándar para agua de mar, sonda para agua de mar Clase 1-Div 2<br>• CPVC, extremo del sensor y extremo del cable<br>• Poliuretano, doble moldura en el extremo y el revestimiento del cable<br>• Cuerpo de PVC para agua de mar<br>• Sellado de epoxi para agua de mar<br>• Noryl, tuerca en el extremo del cable |
| Clasificación IP | IP68 |
| Materiales húmedos (Tapa del sensor) | Acrílico |
| Intervalo de medición (oxígeno disuelto) | De 0 a 20 ppm (de 0 a 20 mg/l) |
| | Del 0 al 200% de saturación |
| Precisión de la medición (oxígeno disuelto) | Por debajo de 5 ppm: ± 0,1 ppm |
| | Por encima de 5 ppm: ± 0,2 ppm |
| Repetibilidad (oxígeno disuelto) | 0,1 ppm (mg/l) |
| Tiempo de respuesta (oxígeno disuelto) | $T_{90}$<40 segundos |
| | $T_{95}$<60 segundos |
| Resolución, sensor (oxígeno disuelto) | 0,01 ppm (mg/l); 0,1% de saturación. |
| Intervalo de medición (temperatura) | 0 a 50 °C (32 a 122 °F) |
| Precisión de la medición (temperatura) | ± 0,2 °C (± 0,36 °F) |
| Interferencias | No existen interferencias de los siguientes elementos: $H_2S$, pH, $K^+$, $Na^+$, $Mg^{2+}$, $Ca^{2+}$, $NH_4^+$, $Al^{3+}$, $Pb^{2+}$, $Cd^{2+}$, $Zn^{2+}$, Cr (total), $Fe^{2+}$, $Fe^{3+}$, $Mn^{2+}$, $Cu^{2+}$, $Ni^{2+}$, $Co^{2+}$, $CN^-$, $NO_3^-$, $SO_4^{2-}$, $S^{2-}$, $PO_4^{3-}$, $Cl^-$, tensioactivos de aniones, aceites crudos, $Cl_2$ < 4 ppm |
| Temperatura de almacenamiento | De –20 a 70 °C (de –4 a 158 °F) |

| Especificación | Detalles |
|---|---|
| Temperatura máxima | 0 a 50 ºC (32 a 122 °F) |
| Clasificación de ubicaciones peligrosas (solo sensor 9020000-C1D2) | Clase I, Division 2, Grupos A–D, T4/Clase I, Zona 2 Grupo 2C, T4<br>***Nota:*** *Este producto no cumple los requisitos de la Directiva 94/9/EC (Directiva ATEX).* |
| Certificaciones (solo sensor 9020000-C1D2) | ETL se recoge en las normativas ANSI/ISA, CSA y FM para su uso en entornos peligrosos.<br>***Nota:*** *Este producto no cumple los requisitos de la Directiva 94/9/EC (Directiva ATEX).* |
| Caudal mínimo | No se requiere. |
| Calibración/verificación | Calibración del aire: un punto, aire con una saturación de agua del 100% |
| | Calibración de la muestra: comparación con el instrumento estándar |
| Profundidad de inmersión y límites de presión de la sonda | Límites de presión a 34 m (112 pies), 345 kPa (50 psi) como máximo; es posible que no se mantenga la precisión a esta profundidad. |
| Cable del sensor | Cable integral de 10 m (30 pies) con interruptor de desconexión rápida (todos los tipos de sensores)<br>Hasta 100 m mediante cables de extensión (sólo los tipos de sensores que no pertenecen a la Clase I, División 2)<br>Hasta 1.000 m con caja de empalmes (sólo los tipos de sensores que no pertenecen a la Clase I, División 2) |
| Peso de la sonda | 1,0 kg (2 libras, 3 onzas) |
| Dimensiones de la sonda | Sonda estándar (diámetro x longitud): 49,53 x 255,27 mm (1,95 x 10,05 pulg) |
| | Sonda para agua de mar (diámetro x longitud): 60,45 x 255,27 mm (2,38 x 10,05 pulg) |
| Requisitos de alimentación | 12 VDC, 0,25 A, 3 W |
| Garantía | Sonda: 3 años por defectos de fabricación |
| | Cápsula del sensor: 2 años por defectos de fabricación |

## Información general

En ningún caso el fabricante será responsable de ningún daño directo, indirecto, especial, accidental o resultante de un defecto u omisión en este manual. El fabricante se reserva el derecho a modificar este manual y los productos que describen en cualquier momento, sin aviso ni obligación. Las ediciones revisadas se encuentran en la página web del fabricante.

### Información de seguridad

| AVISO |
|---|
| El fabricante no es responsable de los daños provocados por un mal uso o aplicación incorrecta del producto. Entre estos daños se incluyen, sin limitación, los daños directos y accidentales. El usuario sólo es responsable de identificar los riesgos críticos de aplicación y de instalar adecuadamente los mecanismos para proteger los procesos en caso de que el equipo no funcione correctamente. |

Lea todo el manual antes de desembalar, instalar o trabajar con este equipo. Ponga atención a todas las advertencias y avisos de peligro. El no hacerlo puede provocar heridas graves al usuario o daños al equipo.

Asegúrese de que la protección proporcionada por el equipo no está dañada. No utilice ni instale este equipo de manera distinta a lo especificado en este manual.

## Uso de la información sobre riesgos

**⚠ PELIGRO**

Indica una situación potencial o de riesgo inminente que, de no evitarse, provocará la muerte o lesiones graves.

**⚠ ADVERTENCIA**

Indica una situación potencial o inminentemente peligrosa que, de no evitarse, podría provocar la muerte o lesiones graves.

**⚠ PRECAUCIÓN**

Indica una situación potencialmente peligrosa que podría provocar una lesión menor o moderada.

***AVISO***

Indica una situación que, si no se evita, puede provocar daños en el instrumento. Información que requiere especial énfasis.

## Etiquetas de precaución

Lea todas las etiquetas y rótulos adheridos al instrumento. En caso contrario, podrían producirse heridas personales o daños en el instrumento. El símbolo que aparezca en el instrumento se comentará en el manual con una declaración de precaución.

| | |
|---|---|
| | Este es un símbolo de alerta de seguridad. Obedezca todos los mensajes de seguridad que se muestran junto con este símbolo para evitar posibles lesiones. Si se encuentran sobre el instrumento, consulte el manual de instrucciones para obtener información de funcionamiento o seguridad. |
| | Este símbolo indica la presencia de una fuente de luz que podría provocar lesiones oculares leves. Obedezca todos los mensajes que se muestran a continuación de este símbolo para evitar posibles lesiones oculares. |
| | Este símbolo indica la presencia de dispositivos susceptibles a descargas electrostáticas. Asimismo, indica que se debe tener cuidado para evitar que el equipo sufra daño. |
| | El equipo eléctrico marcado con este símbolo no se podrá desechar por medio de los sistemas europeos públicos de eliminación después del 12 de agosto de 2005. De acuerdo con las regulaciones locales y nacionales europeas (Directiva UE 2002/96/EC), ahora los usuarios de equipos eléctricos en Europa deben devolver los equipos viejos o que hayan alcanzado el término de su vida útil al fabricante para su eliminación sin cargo para el usuario.<br>***Nota:*** *Para devolver equipos para su reciclaje, póngase en contacto con el fabricante o distribuidor para así obtener instrucciones acerca de cómo devolverlos y desecharlos correctamente. Esto es aplicable a equipos que hayan alcanzado el término de su vida útil, accesorios eléctricos suministrados por el fabricante o distribuidor y todo elemento auxiliar.* |

## Certificación

**Reglamentación canadiense sobre equipos que provocan interferencia, IECS-003, Clase A**

Registros de pruebas de control del fabricante.

Este aparato digital de clase A cumple con todos los requerimientos de las reglamentaciones canadienses para equipos que producen interferencias.

Cet appareil numèrique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

**FCC Parte 15, Límites Clase "A"**

Registros de pruebas de control del fabricante. Este dispositivo cumple con la Parte 15 de las normas de la FCC estadounidense. Su operación está sujeta a las siguientes dos condiciones:

1. El equipo no puede causar interferencias perjudiciales.

2. Este equipo debe aceptar cualquier interferencia recibida, incluyendo las interferencias que pueden causar un funcionamiento no deseado.

Los cambios o modificaciones a este equipo que no hayan sido aprobados por la parte responsable podrían anular el permiso del usuario para operar el equipo. Este equipo ha sido probado y encontrado que cumple con los límites para un dispositivo digital Clase A, de acuerdo con la Parte 15 de las Reglas FCC. Estos límites están diseñados para proporcionar una protección razonable contra las interferencias perjudiciales cuando el equipo está operando en un entorno comercial. Este equipo genera, utiliza y puede irradiar energía de radio frecuencia, y si no es instalado y utilizado de acuerdo con el manual de instrucciones, puede causar una interferencia dañina a las radio comunicaciones. La operación de este equipo en un área residencial es probable que produzca interferencia dañina, en cuyo caso el usuario será requerido para corregir la interferencia bajo su propio cargo. Pueden utilizarse las siguientes técnicas para reducir los problemas de interferencia:

1. Desconecte el equipo de su fuente de alimentación para verificar si éste es o no la fuente de la interferencia.
2. Si el equipo está conectado a la misma toma eléctrica que el dispositivo que experimenta la interferencia, conecte el equipo a otra toma eléctrica.
3. Aleje el equipo del dispositivo que está recibiendo la interferencia.
4. Cambie la posición de la antena del dispositivo que recibe la interferencia.
5. Trate combinaciones de las opciones descritas.

## Descripción general del producto

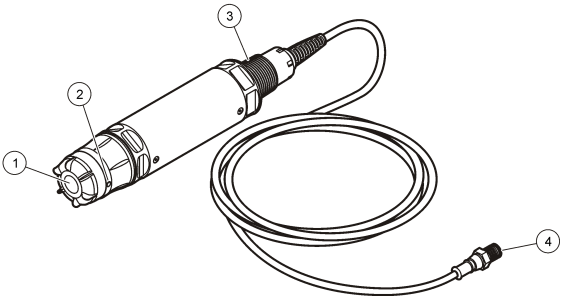
**⚠ PELIGRO**

Peligro químico o biológico. Si este instrumento se usa para controlar un proceso de tratamiento y/o un sistema de suministro químico para el que existan límites normativos y requisitos de control relacionados con la salud pública, la seguridad pública, la fabricación o procesamiento de alimentos o bebidas, es responsabilidad del usuario de este instrumento conocer y cumplir toda normativa aplicable y disponer de mecanismos adecuados y suficientes que satisfagan las normativas vigentes en caso de mal funcionamiento del equipo.

Este sensor está diseñado para trabajar con un controlador para la recolección de datos y operación. El sensor puede utilizarse con varios controladores. Para obtener más información, consulte el manual de usuario específico del sensor.

Las aplicaciones principales de este sensor son aplicaciones de aguas residuales industriales y municipales. La tecnología del sensor LDO no consume oxígeno y puede medir la concentración de oxígeno disuelto en aplicaciones sin flujo o con flujo bajo. Consulte la Figura 1.

**Figura 1 Sensor LDO**

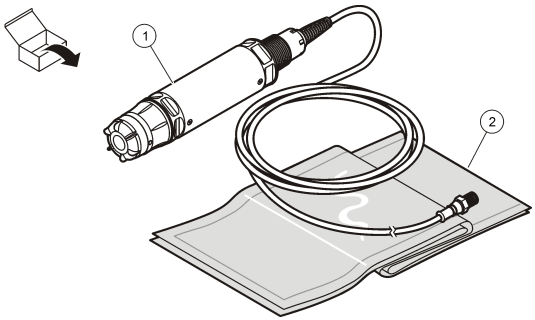



| | |
|---|---|
| **1** Tapa del sensor | **3** NPT de 1 pulgada |
| **2** Sensor de temperatura | **4** Conector, conexión rápida (estándar) |

## Lista de componentes del sensor LDO

Asegúrese de haber recibido todos los componentes que se muestran en la Figura 2. Si faltan elementos o están dañados, póngase en contacto con el fabricante o el representante de ventas inmediatamente. Consulte la Figura 2.

**Figura 2 Lista de componentes del sensor**




| | |
|---|---|
| **1** Sensor LDO [1] | **2** Bolsas de calibración (2x) |

[1] El manual del usuario incluido no se muestra.

# Instalación

**⚠ ADVERTENCIA**

Peligro de lesión personal. Las tareas descritas en esta sección del manual solo deben ser realizadas por personal cualificado.

## Validación del tipo de sensor

**⚠ PELIGRO**

Peligro de explosión. Sólo debe conectar componentes periféricos que estén claramente etiquetados con el certificado para ubicaciones peligrosas de Clase 1, División 2.

**AVISO**

La versión con certificación para ubicaciones peligrosas de este producto no cumple los requisitos de la Directiva 94/9/EC (Directiva ATEX).

1. Vaya al extremo del conector del cable.
2. Lea la etiqueta del extremo del conector del cable. En las etiquetas de los sensores con certificación para ubicaciones peligrosas, se leerá: "Rated: Class 1 Division 2" (Evaluado: Clase 1, División 2).
3. Examine el conector.

   - Los sensores con certificados para ubicaciones peligrosas disponen de un conector de bloqueo de seguridad. Consulte la Figura 3 en la página 42.
   - Los sensores que no cuentan con certificados para ubicaciones peligrosas tienen un conector de conexión rápida sin un bloqueo de seguridad.

## Conexión del sensor en una ubicación peligrosa

**⚠ PELIGRO**

Peligro de explosión. Este equipo se puede usar en lugares no peligrosos o en los lugares peligrosos de los grupos A, B, C y D de Clase 1, División 2 si se utiliza con sensores y equipos opcionales específicos instalados de acuerdo a los planos de control para la instalación en lugares peligrosos. Consulte siempre los planos de control y las regulaciones del código eléctrico para llevar a cabo una instalación apropiada.

**⚠ PELIGRO**

Peligro de explosión. Evite conectar o desconectar componentes o circuitos eléctricos sin antes desconectar la alimentación eléctrica, a menos que se sepa que esa parte del equipo no presenta riesgos.

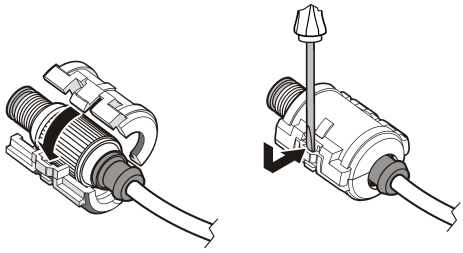
**AVISO**

En ubicaciones peligrosas, utilice únicamente un sensor y un conector de cables que cuenten con una certificación para ubicaciones peligrosas. La versión con certificación para ubicaciones peligrosas de este producto no cumple los requisitos de la Directiva 94/9/EC (Directiva ATEX).

Para disponer de más información, consulte Validación del tipo de sensor en la página 41.

1. Retire la cápsula del conector del controlador. Conserve la cápsula del conector para sellar la apertura del conector cuando se retire el sensor.
2. Conecte el sensor al controlador. Para obtener más información, consulte el manual del controlador.
3. Cierre la cerradura de seguridad en el conector.
4. Para retirar la cerradura de seguridad del conector, utilice un destornillador plano pequeño. Consulte la Figura 3.

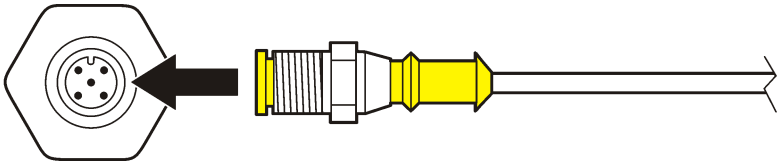
**Figura 3 Cerradura de seguridad del conector**



## Conexión del sensor en una ubicación no peligrosa

Consulte Figura 4 para conectar un sensor LDO a un controlador sc. Para obtener las instrucciones de conexión, consulte el manual específico del controlador sc.

**Figura 4 Conexión del sensor LDO (se muestra un sensor para ubicaciones no peligrosas)**



Cuando haya conectado el sensor, realice una exploración del sensor. Consulte la Instalación del sensor en la página 43.

## Instalación del sensor

Existen dos opciones para instalar el sensor:

- Conectar el sensor mientras la alimentación eléctrica del controlador está desactivada. El controlador buscará e instalará los sensores nuevos cuando se active.
- Conectar el sensor mientras la alimentación eléctrica del controlador está activada. Utilice el comando Scan Devices (Dispositivos de exploración) para instalar el sensor nuevo:

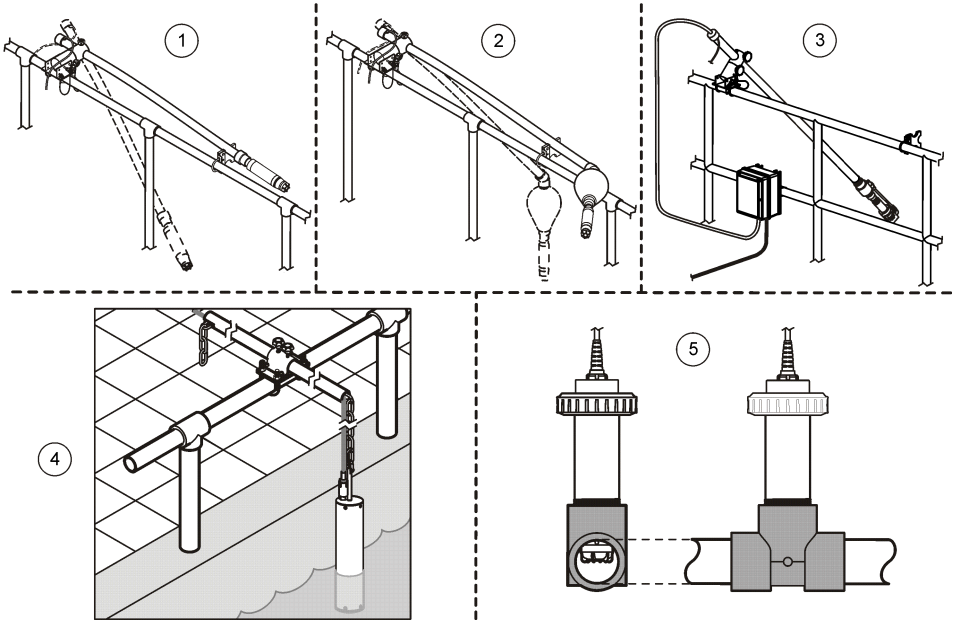
| Opción | Descripción |
|---|---|
| **Controlador sc200** | Vaya a MENU>TEST/MAINT>SCAN DEVICE (MENÚ>PRUEBA/MANTENIMIENTO>DISPOSITIVO DE EXPLORACIÓN). |
| **Controlador sc100** | Vaya a MENU>TEST/MAINT>SCAN SENSORS (MENÚ>PRUEBA/MANTENIMIENTO>SENSORES DE EXPLORACIÓN). |
| **Controlador sc1000** | Vaya a MENU>SYSTEM SETUP>DEVICE MANAGEMENT>SCANNING FOR NEW DEVICES (MENÚ>CONFIGURACIÓN DEL SISTEMA>GESTIÓN DE DISPOSITIVOS>EXPLORACIÓN DE DISPOSITIVOS NUEVOS). |

Para obtener información sobre la conexión del sensor digital, consulte Conexión del sensor en una ubicación no peligrosa en la página 42 .

## Opciones de instalación del sensor

Las opciones de instalación y de accesorios disponibles para el sensor LDO se suministran con las instrucciones de instalación del kit de hardware. En la Figura 5 se muestran varias opciones de instalación. Para pedir hardware de instalación, consulte Piezas de repuesto y accesorios en la página 54.

**Figura 5 Opciones de instalación**




| | |
|---|---|
| **1** Montaje en barra | **4** Montaje con cadenas |
| **2** Montaje flotante | **5** Montaje de unión (no compatible con la sonda para agua de mar) |
| **3** Montaje con el sistema de ráfagas de aire (no compatible con la sonda para agua de mar) | |

# Funcionamiento

## Desplazamiento del usuario

Consulte la documentación del controlador para ver la descripción del teclado e información sobre cómo desplazarse.

## Configuración del sensor

Utilice el menú Configurar para introducir la información de identificación del sensor y para cambiar las opciones para el manejo y almacenamiento de datos.

Para obtener más información sobre la instalación del sensor, consulte Instalación del sensor en la página 43.

Asegúrese de que todos los valores del menú Configuration (Configuración) son correctos para la aplicación.

1. Vaya a MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE (MENÚ>CONFIGURACIÓN DEL SENSOR>[Seleccione el sensor]>CONFIGURAR).
2. Seleccione una opción y, a continuación, pulse ENTER (Intro). A continuación, se enumeran las opciones disponibles en una tabla.

| Opción | Descripción |
|---|---|
| EDIT NAME (EDITAR NOMBRE) | Cambia el nombre que corresponde al sensor en la parte superior de la pantalla de medición. El nombre puede contener hasta 10 caracteres en cualquier combinación de letras, números, espacios o signos de puntuación. |
| SET UNITS (ESTABLECER UNIDADES) | TEMP (TEMPERATURA): establezce las unidades de temperatura en °C (predeterminado) o en °F. |
| | MEASURE (MEDIR): establezce las unidades de las mediciones en mg/l, ppm o %. |
| | ALT/PRESS (ALTITUD/PRESIÓN): establezca la altitud en m o pies y las unidades de presión atmosférica en mmHg o torr. (Valor predeterminado = 0 pies) |
| ALT/PRESS (ALTITUD/PRESIÓN) | Introduzca el valor de la altitud o presión atmosférica. Este valor debe ser preciso para completar la calibración y las mediciones de la saturación en % del aire. (Predeterminado = 0 pies). |
| SALINITY (SALINIDAD) | Introduzca el valor de salinidad. Intervalo de salinidad: de 0,00 a 250,000 partes por mil (‰). Consulte Introducción de un valor de corrección de salinidad en la página 46 para obtener más información. (Valor predeterminado = 0). |
| SIGNAL AVERAGE (PROMEDIO SEÑAL) | Configure el intervalo de tiempo al promedio de señal en segundos. |
| CLEAN INTRVL (INTERV. LIMPIEZA) | Establezca el intervalo de tiempo para la limpieza manual del sensor en días. (Valor predeterminado = 0 días. Un valor de 0 días desactiva el intervalo de limpieza). |
| RESET CLN INTRVL (RESTABLECER INTERV. LIMPIEZA) | Establezca el intervalo de tiempo al último intervalo de limpieza guardado. |
| LOG SETUP (CONFIG. REGISTRO) | Establece el intervalo de tiempo del almacenamiento de datos en el registro de datos: 0,5, 1, 2, 5, 10, 15 (predeterminado), 30 y 60 minutos. |
| SET DEFAULTS (ESTABLECER VAL. PREDET.) | Restablece los valores predeterminados configurables para el sensor. No modifique los ajustes para la pendiente o el desvío. |

## Introducción de la unidad de presión atmosférica

La configuración de fábrica de la presión atmosférica (aire) es de 0 pies o del nivel del mar. Para cambiar el valor predeterminado, siga los pasos de este procedimiento. El ajuste de la presión del aire se introduce como unidades de elevación o de presión (preferido).

***Nota:*** *La precisión de la presión del aire es fundamental para calibrar el aire saturado (Calibración con aire en la página 48). Utilice únicamente presión absoluta, no ajustada. Si se desconoce la presión absoluta del aire, utilice la elevación correcta para la ubicación.*

1. Vaya a MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>SET UNITS>AIR PRESS/ALT UNITS (MENÚ>CONFIGURACIÓN DEL SENSOR>[Seleccione el sensor]>CONFIGURAR>CONFIGURAR UNIDADES>UNIDADES ALTITUD/PRESIÓN DEL AIRE).
2. Seleccione **una** de las opciones de unidades que se enumeran:

| Opción | Descripción |
|---|---|
| **pies** | Pie: unidad de medida para la elevación |
| **m** | Metros: unidad métrica de medición de la elevación |
| **mmHg** | Milímetros de mercurio: unidad métrica de medición de la presión absoluta del aire |
| **torr** | Unidad de medición de la presión absoluta del aire |

3. Confirme la selección. La pantalla de introducción del valor le mostrará las unidades seleccionadas.
4. Introduzca el valor y, a continuación, confírmelo.

## Introducción de un valor de corrección de salinidad

Las mediciones de oxígeno disuelto en muestras de salino pueden mostrar un valor aparente del oxígeno disuelto muy diferente del valor actual de oxígeno disuelto. Para corregir la influencia de sales disueltas en una muestra, introduzca un factor de corrección de salinidad.
***Nota:*** *Si se desconoce la presencia o la cantidad de salinidad del proceso, póngase en contacto con el personal de ingeniería del centro de tratamiento.*

1. Utilice un medidor de conductividad para medir la conductividad de la muestra en mS/cm a una temperatura de referencia de 20 °C (68 °F).
2. Utilice la Tabla 1 para calcular el factor de corrección de salinidad en una saturación en partes por mil (‰).

   ***Nota:*** *La concentración de iones cloruro, en g/kg, equivale a la clorinidad de la muestra. La salinidad se calcula con la fórmula: Salinidad = 1,80655 × clorinidad.*

   La salinidad puede calcularse con la relación de la sección 2520 B de *Standard Methods for the Examination of Water and Wastewater* (Métodos estándar para la evaluación de las aguas y las aguas residuales).[*],
3. Vaya a MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>SALINITY (MENÚ>CONFIGURACIÓN DEL SENSOR>[Seleccione el sensor]>CONFIGURAR>SALINIDAD).
4. Introduzca el factor de corrección de salinidad y confírmelo.

**Tabla 1 Saturación de la salinidad (‰) por valor de conductividad (mS/cm)**

| mS/cm | ‰ | | mS/cm | ‰ | | mS/cm | ‰ | | mS/cm | ‰ |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 3 | | 16 | 10 | | 27 | 18 | | 38 | 27 |
| 6 | 4 | | 17 | 11 | | 28 | 19 | | 39 | 28 |
| 7 | 4 | | 18 | 12 | | 29 | 20 | | 40 | 29 |
| 8 | 5 | | 19 | 13 | | 30 | 21 | | 42 | 30 |
| 9 | 6 | | 20 | 13 | | 31 | 22 | | 44 | 32 |
| 10 | 6 | | 21 | 14 | | 32 | 22 | | 46 | 33 |
| 11 | 7 | | 22 | 15 | | 33 | 23 | | 48 | 35 |
| 12 | 8 | | 23 | 15 | | 34 | 24 | | 50 | 37 |
| 13 | 8 | | 24 | 17 | | 35 | 25 | | 52 | 38 |
| 14 | 9 | | 25 | 17 | | 36 | 25 | | 54 | 40 |
| 15 | 10 | | 26 | 18 | | 37 | 26 | | | |

[*] *Standard Methods for the Examiniation of Water and Wastewater*, Edición 20.º. Editores: Lenore S. Clesceri, Arnold E. Greenberg y Andrew D. Eaton, pág. 2-48-2-29 (1998). La relación entre la clorinidad y la solubilidad del oxígeno se proporciona en la misma obra de referencia, en 4500-O:I, pág. 4-131.

### Configure la salida lineal en el controlador.

Las salidas lineales devuelven los datos de la sonda a los sistemas PLC y SCADA o a otros sistemas de recopilación de datos.

1. Vaya al menú de configuración de salidas del controlador.

| Opción | Descripción |
|---|---|
| **sc200** | Vaya a MENU>SETTINGS>sc200 SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION (MENÚ>AJUSTES<CONFIGURACIÓN DE sc200>CONFIGURACIÓN DE SALIDA>[Seleccione la salida]>CONFIGURAR FUNCIÓN). |
| **sc100** | Vaya a MENU>SYSTEM SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION (MENÚ>CONFIGURACIÓN DEL SISTEMA>CONFIGURACIÓN DE SALIDA>[Seleccione la salida]>CONFIGURAR FUNCIÓN). |
| **sc1000** | Vaya a MENU>SYSTEM SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION (MENÚ>CONFIGURACIÓN DEL SISTEMA>CONFIGURACIÓN DE SALIDA>[Seleccione la salida]>CONFIGURAR FUNCIÓN). |

2. Configure la función para el controlador.

| Opción | Descripción |
|---|---|
| **sc200** | LINEAL |
| **sc100** | LINEAR CONTROL (CONTROL LINEAL) (valor predeterminado) |
| **sc1000** | LINEAR CONTROL (CONTROL LINEAL) (valor predeterminado) |

### Registros de Modbus

Está disponible una lista de registros Modbus para comunicación en red. Consulte www.hach.com o www.hach-lange.com para obtener más información.

## Calibración de las mediciones

El sensor se calibra en fábrica de acuerdo con las especificaciones. El fabricante no recomienda que se calibre a menos que las agencias de regulación soliciten calibraciones periódicas. En caso que se requiera una calibración, deje que el sensor se equilibre con el proceso antes de calibrarlo. No calibre el sensor durante la configuración.

En la Tabla 2 se muestran las opciones de calibración.

**Tabla 2 Opciones de calibración**

| Opción | Descripción |
|---|---|
| AIR CAL (CAL. AIRE) | Método de calibración recomendado. Esta calibración modifica la pendiente. |
| SAMPLE CAL (CAL. MUESTRA) | Calibración por comparación con un medidor manual de oxígeno disuelto. Esta calibración modifica el desvío. |
| RESET DFLT CAL (RESTABLECER CAL. PREDET.) | Restablece la ganancia (pendiente) y el desvío de la calibración a los valores predeterminados de fábrica: ganancia predeterminada = 1,0; desvío predeterminado = 0,0 |

## Calibración con aire

**Notas para el usuario:**

- Asegúrese de que la bolsa de calibración contiene agua en el interior.
- Asegúrese de que el sellado entre la bolsa de calibración y el cuerpo del sensor es hermético.
- Asegúrese de que el sensor está seco cuando lo vaya a calibrar.
- Asegúrese de que los ajustes de la elevación y la presión del aire son adecuados para el lugar de calibración.
- Deje tiempo suficiente para que la temperatura del sensor se estabilice con la temperatura del lugar de la bolsa de calibración. Si existe una gran diferencia entre la temperatura del proceso y la temperatura del lugar de calibración, es posible que el sensor tarde en estabilizarse hasta 15 minutos.

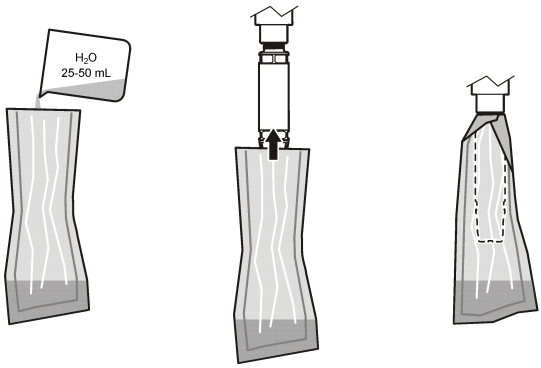
1. Retire el sensor del proceso. Utilice un paño húmedo para limpiar el sensor.
2. Ponga el sensor en su conjunto en una bolsa de calibración con unos 25 o 50 ml de agua. Asegúrese de que la cápsula del sensor no entra en contacto con el agua del interior de la bolsa de calibración y que no caen gotas de agua en la cápsula del sensor (Figura 6).
3. Utilice una correa o lazo de goma o la mano para crear un sellado hermético alrededor del cuerpo del sensor.
4. Deje que el instrumento se estabilice durante 15 minutos antes de calibrarlo. Evite que la bolsa de calibración entre en contacto directo con la luz solar durante la calibración.
5. Asegúrese de que la elevación o la presión absoluta del aire actual estén configuradas correctamente. Consulte la Introducción de la unidad de presión atmosférica en la página 45.

   ***Nota:*** *El fabricante recomienda el uso de una presión real o absoluta del aire como buena práctica.*
6. Vaya a MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>AIR CAL (MENÚ>CONFIGURACIÓN DEL SENSOR>[Seleccione el sensor]>CALIBRAR>CAL. AIRE).
7. Seleccione la opción de la señal de salida durante la calibración:

| Opción | Descripción |
|---|---|
| **Activa** | Durante el proceso de calibración el instrumento envía el valor de medición actual de salida. |
| **Hold (Retenido)** | Durante el proceso de calibración el valor de salida del sensor se mantiene en el valor de medición actual. |
| **Transfer (Transferencia)** | Durante el proceso de calibración se envía un valor predeterminado. Consulte el manual del usuario del controlador para cambiar el valor predeterminado. |

8. El controlador mostrará el mensaje "Move the probe to bag" (Mover sonda). Deje que el valor se estabilice. Pulse ENTER (Intro) para aceptar el valor estable. A su vez, deje que la calibración continúe hasta que se muestre el mensaje "Complete" (Finalizado).
9. Cuando se haya calibrado el sensor, póngalo en proceso. Pulse ENTER (Intro).

**Figura 6 Procedimiento de calibración del aire**




Si el valor no se estabiliza, en la pantalla se mostrará el mensaje "Unable to Calibrate" (No se puede calibrar), seguido de un mensaje de error. En la Tabla 3 se muestran los mensajes de error y las soluciones para los problemas de calibración.

**Tabla 3 Mensajes de error de la calibración del aire**

| Mensaje | Descripción | Resolución |
|---|---|---|
| Cal fail, gain high (Error de calibración, ganancia elevada) | El valor de ganancia calculado es demasiado elevado. | Repita la calibración. |
| Cal fail, gain low (Error de calibración, ganancia baja) | El valor de ganancia calculado es demasiado bajo. | Repita la calibración. |
| Cal fail, unstable (Error de calibración, inestable) | El valor no se estabilizó en el tiempo máximo de calibración permitido. | Repita la calibración. |

## Calibración de la muestra: calibración por comparación

El método de calibración utiliza un sensor alternativo conectado a un medidor manual.

1. Ponga en funcionamiento el sensor alternativo. Coloque el segundo sensor lo más próximo posible al primer sensor.
2. Espere a que el valor de oxígeno disuelto se estabilice.
3. En el controlador del primer sensor, vaya a MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>SAMPLE CAL (MENÚ>CONFIGURACIÓN DEL SENSOR>[Seleccione el sensor]>CALIBRAR>CAL. MUESTRA).
4. Seleccione la opción de la señal de salida durante la calibración:

| Opción | Descripción |
|---|---|
| **Activa** | Durante el proceso de calibración el instrumento envía el valor de medición actual de salida. |
| **Hold (Retenido)** | Durante el proceso de calibración el valor de salida del sensor se mantiene en el valor de medición actual. |
| **Transfer (Transferencia)** | Durante el proceso de calibración se envía un valor predeterminado. Consulte el manual del usuario del controlador para cambiar el valor predeterminado. |

5. En el controlador se mostrará:
   - "Press ENTER when stabilized" (Pulse INTRO cuando se estabilice)
   - La medición actual de oxígeno disuelto

- La medición actual de la temperatura

6. Cuando la medición sea estable, pulse INTRO. Se visualizará una pantalla de entrada.

   ***Nota:*** *Normalmente, la medición se tarda en estabilizarse entre 2 y 3 minutos.*

Si el valor no se estabiliza, en la pantalla se mostrará el mensaje "Unable to Calibrate" (No se puede calibrar), seguido de un mensaje de error. En la Tabla 4 se muestran los mensajes de error y las soluciones para los problemas de calibración.

**Tabla 4 Mensajes de error de la calibración de muestra**

| Mensaje | Descripción | Resolución |
|---|---|---|
| Cal fail, offset high (Error de calibración, desvío elevado) | El valor calculado de desvío es demasiado elevado. | Repita la calibración. |
| Cal fail, offset low (Error de calibración, desvío bajo) | El valor calculado de desvío es demasiado bajo. | Repita la calibración. |
| Cal fail, unstable (Error de calibración, instable) | El valor no se estabilizó en el tiempo máximo de calibración permitido. | Repita la calibración. |

## Salida del proceso de calibración

1. Durante la calibración, pulse la tecla BACK (Atrás). Aparecerán tres opciones:

| Opción | Descripción |
|---|---|
| **ABORT (ABORTAR)** | Detiene el proceso de calibración. Se deberá comenzar con una nueva calibración desde el principio. |
| **VOLVER A CAL** | Vuelve a la calibración actual. |
| **LEAVE (ABANDONAR)** | Sale del proceso de calibración provisoriamente. Se puede acceder a otros menús mientras continúa la calibración. Se puede iniciar la calibración de un segundo sensor (en caso que lo hubiera). Para volver al proceso de calibración, pulse la tecla MENU (MENÚ) y seleccione Sensor Setup (Configuración del sensor), [seleccione el sensor]. |

2. Seleccione una de las opciones. Confirme.

## Restablecimiento de los valores predeterminados de la calibración

La configuración de la calibración puede restablecerse con los valores predeterminados de fábrica. Los valores de ganancia y desvío se establecen al 1,0 y al 0,0, respectivamente.

1. Vaya a MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>RESET CAL DEFLT (MENÚ>CONFIGURACIÓN DEL SENSOR>[Seleccione el sensor]>CALIBRAR>RESTABLECER CONFIGURACIÓN PREDETERMINADA DE LA CALIBRACIÓN).
2. En la pantalla se mostrará un mensaje de confirmación. Confirme que desea restablecer el sensor con la curva de calibración predeterminada de fábrica.

# Mantenimiento

**⚠ PELIGRO**

Peligros diversos. Sólo el personal cualificado debe realizar las tareas descritas en esta sección del documento.

**⚠ PELIGRO**

**Peligro de explosión.** Evite conectar o desconectar componentes o circuitos eléctricos sin antes desconectar la alimentación eléctrica, a menos que se sepa que esa porción del equipo no presenta riesgos.

**⚠ PELIGRO**

**Riesgo de explosión**. Es posible que la sustitución de algún componente perjudique a la conformidad con la Clase 1, División 2. Evite conectar o desconectar ningún componente sin antes desconectar la alimentación eléctrica, a menos que se sepa que esa zona no presenta riesgos.

***AVISO***

La versión con certificación para ubicaciones peligrosas de este producto no cumple los requisitos de la Directiva 94/9/EC (Directiva ATEX).

## Cronograma de mantenimiento

En el cronograma de mantenimiento se muestran los intervalos mínimos de las tareas periódicas de mantenimiento. En las aplicaciones donde el electrodo se ensucia, realice las tareas de mantenimiento con mayor frecuencia.
***Nota:*** *No desmonte la sonda para su mantenimiento o limpieza.*

| Tarea de mantenimiento | Frecuencia mínima recomendada |
|---|---|
| Limpiar el sensor | 90 días |
| Inspección del sensor en busca de daños | 90 días |
| Calibración del sensor | Según lo recomendado por su sistema de control de calidad o entes regulatorios locales |

## Limpiar el sensor

Limpie la parte exterior del sensor con un paño suave y húmedo.
***Nota:*** *Si debe retirar la cápsula del sensor para limpiarla, no exponga directamente la parte interior de la cápsula a la luz solar durante un período de tiempo prolongado.*

## Configuración y cambio del intervalo de limpieza

En función de las condiciones de la aplicación del sensor, los intervalos de tiempo que transcurren entre las limpiezas del sensor manual pueden ser menores o mayores. El intervalo de limpieza predeterminado es de 0 días. Para cambiar el intervalo, consulte los pasos de este procedimiento.

1. Vaya a MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>CLEAN INTRVL (MENÚ>CONFIGURACIÓN DEL SENSOR>[Seleccione el sensor]>CONFIGURAR>INTERV. LIMPIEZA).
2. Cambie el valor mostrado según sea necesario. Confirme el cambio.
   - Para desactivar el intervalo de limpieza, establezca el valor en "0".

## Sustitución de la cápsula del sensor

**⚠ ADVERTENCIA**

Posible riesgo de explosión. La cápsula de configuración del sensor no se ha evaluado para ser utilizada en ubicaciones peligrosas.

Junto con las instrucciones de instalación se suministran cápsulas para el sensor y cápsulas de configuración de repuesto. Para cambiar la cápsula, consulte las instrucciones suministradas.

Para obtener un rendimiento y una precisión mejores, sustituya la cápsula del sensor:

- Cada dos años
- Cuando en las inspecciones periódicas se detecte una erosión importante en la cápsula del sensor.

# Solución de problemas

## Menú de prueba y diagnóstico

En el menú de prueba y diagnóstico se muestra la información actual e histórica relativa al sensor LDO.
Para acceder al menú de prueba y diagnóstico, vaya a MENU>SENSOR SETUP>[Select Sensor]>DIAG/TEST (MENÚ>CONFIGURACIÓN DEL SENSOR>[Seleccione el sensor]>DIAGNÓSTICO/PRUEBA).

Consulte la Tabla 5.

**Tabla 5 Menú DIAG/PRUEBA**

| Opción | Descripción |
|---|---|
| SENSOR INFO (INFORMACIÓN SENSOR) | SOFTWARE VERS (VERSIÓN SOFTWARE): muestra la versión del software instalada. |
| | BOOT VERSION (VERSIÓN ARRANQUE ): muestra la versión del arranque instalada. |
| | DRIVER VERS (VERSIÓN CONTROLADOR): muestra la versión del controlador instalada. |
| LOT CODE (CÓDIGO LOTE) | Muestra el lote de fabricación de la cápsula del sensor. |
| SERIAL NUMBER (NÚMERO DE SERIE) | Número de serie del sensor |
| GAIN CORR (CORR. GANANCIA) | Ajusta el valor de ganancia de la calibración. |
| | Intervalo: de 0,50 a 2,00 |
| OFFSET CORR (CORR. NIVELACIÓN) | Ajusta el valor de desvío de la calibración (mg/l o ppm). |
| | Intervalo: de -3,00 a +3,00 |
| PHASE DIAG (FASE DEL DIAGNÓSTICO) | Muestra la fase de las longitudes de onda totales, rojas y azules. Actualiza una por segundo. |
| AMPL DIAG (AMPLITUD DEL DIAGNÓSTICO) | Muestra la amplitud de las longitudes de onda rojas y azules. Actualiza una por segundo. |
| DAYS TO CLEAN (DÍAS PARA LA LIMPIEZA) | Muestra el número de días que quedan hasta la próxima limpieza manual programada. |
| SENSOR LIFE (DURACIÓN DEL SENSOR) | Muestra el número de días que quedan hasta la próxima sustitución programada de la cápsula del sensor. |

## Lista de errores

Si se produce un error, la lectura de la pantalla de medición se iluminará. Los ajustes del controlador determinan la conducta de la salida. Para obtener información detallada, consulte el manual del controlador.

Para mostrar los errores actuales del sensor, vaya a MENU>DIAGNOSTICS>[Select Sensor]>ERROR LIST (MENÚ>DIAGNÓSTICO>[Seleccione el sensor]>LISTA DE ERRORES). Consulte la Tabla 6.

**Tabla 6 Lista de errores del sensor LDO**

| Error | Posible causa | Resolución |
|---|---|---|
| RED AMPL LOW (Value is below 0.01) (AMPLITUD ROJA BAJA [El valor se encuentra por debajo de 0,01])<br>O BIEN<br>BLUE AMPL LOW (Value is below 0.01) (AMPLITUD AZUL BAJA [El valor se encuentra por debajo de 0,01]) | La cápsula del sensor no está instalada o no se ha instalado correctamente. | Retire la cápsula del sensor y vuélvala a instalar. |
| | El recorrido de la luz se ha bloqueado en la cápsula del sensor. | Inspeccione el interior de la cápsula y de la lente del sensor. |
| | El sensor no funciona correctamente. | Asegúrese de que el LED se ilumina. Póngase en contacto con el fabricante. |

## Lista de advertencias

Cuando el icono de advertencia se ilumina (sc100 y sc200) o cuando el color de la pantalla cambia a amarillo (sc1000), aparece un mensaje en la parte inferior de la pantalla de medición. En el sc1000, el color de la pantalla se cambia a amarillo para mostrar una advertencia. Para mostrar las advertencias actuales del sensor, vaya a MENU>DIAGNOSTICS>[Select Sensor]>ERROR LIST (MENÚ>DIAGNÓSTICO>[Seleccione el sensor]>LISTA DE ERRORES). Consulte la Tabla 7.

**Tabla 7 Lista de advertencias del sensor**

| Advertencia | Definición | Resolución |
|---|---|---|
| EE SETUP ERR (ERR. CONFIG. EE) | El almacenamiento se ha dañado. Los valores se han establecido a los valores predeterminados de fábrica. | Póngase en contacto con la asistencia técnica. |
| EE RSRVD ERR (ERR. RSRVD EE) | | |
| TEMP < 0 C | La temperatura del proceso se encuentra por debajo de 0 °C (32 °F). | Aumente la temperatura del proceso o deténgalo hasta que la temperatura se encuentre dentro del intervalo del sensor indicado en las especificaciones. |
| TEMP < 50 C | La temperatura del proceso se encuentra por encima de 50 °C (120 °F). | Disminuya la temperatura del proceso o deténgalo hasta que la temperatura se encuentre dentro del intervalo del sensor indicado en las especificaciones. |
| RED AMPL LOW (AMPLITUD ROJA BAJA) | El valor cae por debajo de 0,03. | Consulte Tabla 6 en la página 53 . |
| RED AMPL HIGH (AMPLITUD ROJA ELEVADA) | El valor es superior a 0,35. | Póngase en contacto con la asistencia técnica. |
| BLUE AMPL LOW (AMPLITUD AZUL BAJA) | El valor se encuentra por debajo de 0,03. | Consulte la Tabla 6 en la página 53. |
| BLUE AMPL HIGH (AMPLITUD AZUL ELEVADA) | El valor es superior a 0,35. | Póngase en contacto con la asistencia técnica. |
| CAP CODE FAULT (ERROR DE CÓDIGO DE LA CÁPSULA) | El código de la cápsula del sensor se ha dañado. Se ha restablecido automáticamente el código con los códigos predeterminados del lote y la cápsula. | Finalice el procedimiento de la cápsula de configuración del sensor. Si no hay ninguna cápsula de configuración disponible para la cápsula del sensor, póngase en contacto con la asistencia técnica. |

## Lista de eventos

La lista de eventos guarda un registro de los cambios en la forma en la que el sensor registra los datos. Para mostrar los eventos del sensor, vaya a MENU>DIAGNOSTICS>[Select Sensor]>EVENT LIST (MENÚ>DIAGNÓSTICO>[Seleccione el sensor]>LISTA DE EVENTOS).
Consulte la Tabla 8.

**Tabla 8 Lista de eventos del sensor**

| Evento | Descripción |
|---|---|
| ALT/PRESSURE UNIT CHANGE (CAMBIO UNIDAD ALTITUD/PRESIÓN) | Se han modificado las unidades de la presión atmosférica o de la altitud. |
| ALT/PRESSURE CHANGE (CAMBIO EN LA ALTITUD/PRESIÓN) | Se ha modificado el valor de la altitud o de la presión atmosférica. |
| TEMP UNIT CHANGE (CAMBIO EN LA UNIDAD DE TEMPERATURA) | Se han modificado las unidades de la temperatura. |
| MEAS UNIT CHANGE (CAMBIO EN LAS UNIDADES DE MEDICIÓN) | Se ha modificado una unidad nueva de medición. |
| SALINITY CHANGE (CAMBIO EN LA SALINIDAD) | Se ha modificado el valor de salinidad. |
| SET DEFAULT (ESTABLECER VAL. PREDET.) | Se ha restablecido la configuración del sensor a los valores predeterminados. |
| SENSOR SETUP CHANGE (CAMBIO EN LA CONFIGURACIÓN DEL SENSOR) | Se ha modificado la configuración del sensor. |
| CLEAN INTERVAL TIMER CHANGE (CAMBIO EN EL TEMPORIZADOR DEL INTERVALO DE LIMPIEZA) | Se ha modificado el intervalo de tiempo que transcurre entre las limpiezas del sensor. |
| SENSOR CAP LIFE TIMER CHANGE (CAMBIO EN EL TEMPORIZADOR DE LA DURACIÓN DE LA CÁPSULA DEL SENSOR) | Se ha modificado el intervalo de tiempo que transcurre entre las sustituciones de la cápsula del sensor. |

# Piezas de repuesto y accesorios

Utilice únicamente piezas de repuesto aprobadas por el fabricante. El uso de piezas no aprobadas puede causar lesiones personales, daños al instrumento o un mal funcionamiento del equipo.

### Repuestos

| Descripción | Referencia (EE. UU./UE) |
|---|---|
| Sonda LDO, con una cápsula para el sensor y 2 bolsas de calibración | 9020000 / LXV416.99.20001 |
| Sonda LDO para agua de mar, con una cápsula para el sensor y dos bolsas de calibración | 9020000-SW / — |
| Sonda LDO para agua de mar en ubicaciones peligrosas, con una cápsula para el sensor y dos bolsas de calibración | 9020000-C1D2-SW / — |
| Sonda LDO para ubicaciones peligrosas, con una cápsula para el sensor y 2 bolsas de calibración | 9020000-C1D2 / — |
| Cápsula para el sensor, repuesto (incluye la cápsula de configuración del sensor que no se ha evaluado para su uso en ubicaciones peligrosas de Clase 1, División 2) | 9021100 / 9021150 |

## Accesorios

| Descripción | Referencia (EE. UU./UE) |
|---|---|
| Bloqueo del cable del sensor para ubicaciones peligrosas | 6139900 / — |
| Cable, extensión del sensor, Clase 1, División 2, ubicaciones peligrosas, 1 m (3,3 pies) | 6122402 / — |
| Cable, extensión del sensor, Clase 1, División 2, ubicaciones peligrosas, 7 m (23 pies) | 5796002 / — |
| Cable, extensión del sensor, Clase 1, División 2, ubicaciones peligrosas, 15 m (49,21 pies) | 5796102 / — |
| Cable, extensión del sensor, Clase 1, División 2, ubicaciones peligrosas, 31 m (101,71 pies) | 5796202 / — |
| Sistema de limpieza con ráfagas de aire de la salida elevada, 115 V (no se ha evaluado para su uso en ubicaciones peligrosas) | 6860000 / 6860003.99.0001 |
| Sistema de limpieza con ráfagas de aire de la salida elevada, 230 V (no se ha evaluado según la Directiva ATEX para su uso en ubicaciones peligrosas) | 6860100 / 6860103.99.0001 |
| Bolsa de calibración (1x) | 5796600 / 5796600 |
| Cable, extensión del sensor, ubicación no peligrosa, 7,7 m (25 pies)[1] | EE. UU.: 5796000, 7,7 m (25 pies) |
| | UE: LZX849, 10 m (33 pies) |
| Kit de hardware para montaje con conducto (PVC) | 9253000 / LZY714.99.21810 |
| Kit de hardware para montaje flotante (PVC) | 9253100 / LZX914.99.42200 |
| Kit de hardware para montaje con ráfagas de aire | 9253500 / LZY812 |
| Kit de hardware para montaje con cadenas (acero inoxidable) | — / LZX914.99.11200 |
| Kit de hardware para montaje de empalme | 9257000 / 9257000 |
| Medidor HQd con sonda reforzada LDO (no se ha evaluado su uso en ubicaciones peligrosas) | 8505200 / HQ40D.99.310.000 |

[1] También disponible con 15 m (49 pies) y 30 m (98 pies)

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# Especificações

As especificações estão sujeitas a alterações sem aviso prévio.

| Especificação | Detalhes |
|---|---|
| Materiais molhados | Sonda padrão, Sonda de Classe padrão 1, Divisão 2<br>• CPVC, extremidade do sensor e extremidade do cabo<br>• Poliuretano, supermoldagem na extremidade do cabo e suporte do cabo<br>• 316 parafusos e corpo em aço inoxidável<br>• Viton, O-ring<br>• Porca noryl na extremidade do cabo |
| | Sonda padrão para aguá do mar, Sonda para água do mar, Classe 1, Divisão 2<br>• CPVC, extremidade do sensor e extremidade do cabo<br>• Poliuretano, supermoldagem na extremidade do cabo e suporte do cabo<br>• Corpo em PVC para água do mar<br>• Selador epóxi para água do mar<br>• Porca noryl na extremidade do cabo |
| Classificação de IP | IP68 |
| Materiais em contato com líquido (Cap do Sensor) | Acrílico |
| Intervalo de medição (oxigênio dissolvido) | 0 a 22 ppm (0 a 20 mg/L) |
| | Saturação de 0 a 200% |
| Precisão de medição (oxigênio dissolvido) | Abaixo de 5 ppm: ± 0,1 ppm |
| | Acima de 5 ppm: ± 0,2 ppm |
| Repetibilidade (oxigênio dissolvido) | 0,1 ppm (mg/L) |
| Tempo de resposta (oxigênio dissolvido) | $T_{90}$<40 segundos |
| | $T_{95}$<60 segundos |
| Resolução, sensor (oxigênio dissolvido) | 0,01 ppm (mg/L); 0,1% de saturação. |
| Faixa de medição (temperatura) | 0 a 50°C (32 a 122°F) |
| Precisão de medida (temperatura) | ± 0,2 °C (±0,36 °F) |
| Interferente | Nenhuma interferência de: $H_2S$, pH, $K^+$, $Na^+$, $Mg^{2+}$, $Ca^{2+}$, $NH_4^+$, $Al^{3+}$, $Pb^{2+}$, $Cd^{2+}$, $Zn^{2+}$, Cr (total), $Fe^{2+}$, $Fe^{3+}$, $Mn^{2+}$, $Cu^{2+}$, $Ni^{2+}$, $Co^{2+}$, $CN^-$, $NO_3^-$, $SO_4^{2-}$, $S^{2-}$, $PO_4^{3-}$, $Cl^-$, Ânion tenso-ativo, Petróleo bruto, $Cl_2$ < 4 ppm |

| Especificação | Detalhes |
|---|---|
| Temperatura de armazenamento | –20 a 70°C (-4 a 158°F) |
| Temperatura máxima | 0 a 50°C (32°F a 122°F) |
| Classificação para local perigoso (apenas para sensor 9020000-C1D2) | Classe I, Divisão 2, Grupos A-D, T4 / Classe I, Zona 2 Grupo 2C, T4<br>***Observação:*** *Este produto não preenche os requisitos da Diretiva 94/9/EC (Diretiva ATEX).* |
| Certificações (apenas para sensor 9020000-C1D2) | ETL listado em padrões ANSI/ISA, CSA e FM para uso em local perigoso.<br>***Observação:*** *Este produto não preenche os requisitos da Diretiva 94/9/EC (Diretiva ATEX).* |
| Taxa de vazão mínima | Não obrigatória |
| Calibração/verificação | Calibração do ar: um ponto, 100% de ar saturado por água |
| | Exemplo de calibração: comparação com instrumento padrão |
| Profundidade de imersão da sonda e limites de pressão | Limites de pressão em 34 m (112 pés), 345 kPa (50 psi) - máximo; a precisão pode não ser mantida nesta profundidade |
| Cabo do sensor | Cabo integral com 10 m (30 pés) e plugue de desconexão rápida (todos os tipos de sensor)<br>Possibilidade de até 100 m com cabos de extensão (somente tipos de sensores que não sejam Classe I, Divisão 2)<br>Até 1.000 m com caixa de junção (somente tipos sensores que não sejam Classe I, Divisão 2) |
| Peso da sonda | 1.0 kg (2 lb, 3 oz) |
| Dimensões da sonda | Sonda padrão (diâmetro x comprimento): 49,53 x 255,27 mm (1,95 x 10,05 pol.) |
| | Sonda para água do mar (diâmetro x comprimento): 60,45 x 255,27 mm (2,38 x 10,05 pol.) |
| Alimentação elétrica | 12 VDC, 0,25 A, 3 W |
| Garantia | Sonda: 3 anos para defeitos de fabricação |
| | Cap do Sensor: 2 anos para defeitos de fabricação |

## Informações gerais

Em hipótese alguma o fabricante será responsável por danos diretos, indiretos, especiais, incidentais ou consequenciais resultantes de qualquer defeito ou omissão neste manual. O fabricante reserva-se o direito de fazer alterações neste manual e nos produtos aqui descritos a qualquer momento, sem aviso ou obrigação. As edições revisadas podem ser encontradas no site do fabricante.

## Informações de segurança

**AVISO**

O fabricante não é responsável por quaisquer danos devido ao uso ou aplicação incorreta deste produto, incluindo, sem limitação, danos diretos, acidentais ou consequenciais, e se isenta desses danos à extensão total permitida pela lei aplicável. O usuário é unicamente responsável por identificar riscos críticos de aplicação e por instalar os mecanismos apropriados para proteger os processos durante um possível mau funcionamento do equipamento.

Leia todo o manual antes de tirar da embalagem, montar ou operar esse equipamento. Preste atenção a todas as declarações de perigo e cuidado. Caso contrário, o operador poderá sofrer ferimentos graves ou o equipamento poderá ser danificado.

Certifique-se de que a proteção oferecida por este equipamento não seja afetada. Não use nem instale este equipamento de nenhuma outra forma além da especificada neste manual.

## Uso de informações de risco

**⚠ PERIGO**

Indica uma situação potencial ou iminentemente perigosa que, se não for evitada, resultará em morte ou lesão grave.

**⚠ ADVERTÊNCIA**

Indica uma situação potencialmente perigosa que, se não for evitada, pode resultar em morte ou ferimento grave.

**⚠ CUIDADO**

Indica uma situação potencialmente perigosa que pode resultar em ferimento leve a moderado.

***AVISO***

Indica uma situação que, se não evitada, pode causar danos ao instrumento. Informações que necessitam de uma ênfase especial.

## Avisos de precaução

Leia todas as etiquetas e rótulos fixados no instrumento. Caso não sejam observadas, podem ocorrer lesões pessoais ou danos ao instrumento. Um símbolo no instrumento tem sua referência no manual com uma medida preventiva.

| | |
|---|---|
| | Este é o símbolo de alerta de segurança. Acate todas as mensagens de segurança que seguem este símbolo a fim de evitar lesões potenciais. Se o símbolo estiver no instrumento, consulte o manual de instruções para obter informações sobre a operação ou segurança. |
| | Este símbolo indica a presença de uma fonte de luz com potencial de causar lesões oculares leves. Acate todas as mensagens de segurança que seguem este símbolo a fim de evitar possíveis lesões. |
| | Este símbolo identifica a presença de dispositivos sensíveis a Descargas eletrostáticas (ESD) e indica que deve-se tomar cuidado para evitar dano ao equipamento. |
| | Os equipamentos elétricos marcados com este símbolo não podem ser descartados em sistemas de descarte (lixo) públicos europeus após 12 de agosto de 2005. Em conformidade com as regulamentações nacionais e locais européias (Diretiva UE 2002/96/EC), os usuários de equipamentos elétricos devem devolver seus equipamentos usados para o fabricante para descarte, sem ônus para o usuário.<br>***Observação:*** *Para o envio de equipamento para reciclagem, entre em contato com o fabricante ou fornecedor do equipamento para obter instruções sobre o envio de sucata de equipamento, acessórios elétricos fornecidos pelo fabricante e todos os itens auxiliares para um descarte adequado.* |

## Certificação

**Canadian Radio Interference-Causing Equipment Regulation (Regulamentação para equipamentos de rádio causadores de interferência do Canadá), IECS-003, Classe A**:

Os registros de testes de comprovação encontram-se com o fabricante.

Este aparelho digital Classe A atende a todos os requisitos de regulamentações canadenses sobre equipamentos que causam interferências.

Cet appareil numèrique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

**FCC parte 15, limites Classe "A"**

Os registros de testes de comprovação encontram-se com o fabricante. O dispositivo está em conformidade com a Parte 15 das Regras da FCC. A operação está sujeita às seguintes condições:

1. O equipamento não deve causar interferência prejudicial.
2. O equipamento deve aceitar todas as interferências recebidas, inclusive interferências que podem causar funcionamento indesejado.

Alterações ou modificações a este equipamento não aprovadas expressamente pela parte responsável pela conformidade podem anular a autoridade do usuário de operar o equipamento. Este equipamento foi testado e está em conformidade com os limites de dispositivo digital Classe A, de acordo com a Parte 15 das Regras da FCC. Esses limites foram estabelecidos para proporcionar uma razoável proteção contra interferências nocivas quando o equipamento for operado em ambientes comerciais. Este equipamento gera, utiliza e pode irradiar energia de rádiofrequência e, se não instalado e usado de acordo com o manual de instruções, pode causar interferências prejudiciais às comunicações de rádio. É provável que o funcionamento deste equipamento em área residencial possa causar interferência indesejada, caso em que o usuário será solicitado a corrigir a interferência por conta própria. As seguintes técnicas podem ser usadas para reduzir problemas de interferência:

1. Desconecte o equipamento de sua fonte de alimentação para verificar se ele é ou não a origem da interferência.
2. Se o equipamento está conectado à mesma tomada do dispositivo que está sofrendo interferência, conecte o equipamento a uma tomada diferente.
3. Afaste o equipamento do dispositivo que estiver recebendo a interferência.
4. Reposicione a antena de recebimento do dispositivo que está sofrendo interferência.
5. Tente algumas combinações das opções acima.

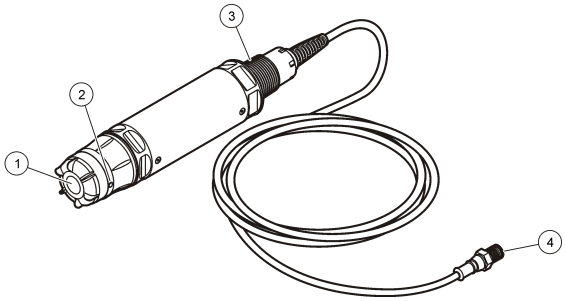
## Visão geral do produto

| ⚠ PERIGO | |
|---|---|
| | Riscos químicos ou biológicos. Se esse instrumento for usado para monitorar um processo de tratamento e/ou sistema de alimentação química para o qual existam limites de regulamentação e requisitos de monitoramento relacionados à saúde pública, à produção ou ao processamento de alimentos ou bebidas, é responsabilidade do usuário deste instrumento conhecer e cumprir as regulamentações aplicáveis e ter mecanismos suficientes e apropriados para obter conformidade com as regulamentações aplicáveis no caso de mau funcionamento do instrumento. |

Este sensor foi projetado para funcionar com um controlador para a operação e armazenamento de dados. O sensor pode ser usado com vários controladores. Consulte o manual do usuário do sensor para obter mais informações.

As principais aplicações deste sensor são Estações de Tratamento de Efluentes Industriais e Companhias de Saneamento. A tecnologia do sensor LDO não consome oxigênio e pode medir a concentração de DO em aplicações com baixas vazões ou sem vazão. Consulte a Figura 1.

**Figura 1 LDO**

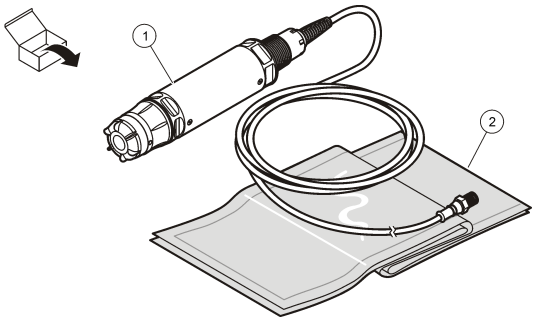



| | |
|---|---|
| **1** Cap do Sensor | **3** NPT de 1 polegada |
| **2** Sensor de temperatura | **4** Conector, conexão rápida (padrão) |

## Lista de componentes do sensor LDO

Certifique-se de que todos os componentes foram recebidos.Figura 2 Se houver itens ausentes ou danificados, entre em contato imediatamente com o fabricante ou com um representante de vendas. Consulte a Figura 2.

**Figura 2 Lista de componentes do sensor**




| | |
|---|---|
| **1** LDO [1] | **2** Bolsas de calibração (2x) |

[1] O manual do usuário incluído não é exibido.

# Instalação

**⚠ ADVERTÊNCIA**

Risco de lesão corporal. Somente pessoal qualificado deve realizar as tarefas descritas nesta seção do manual.

## Validar o tipo de sensor

**⚠ PERIGO**

Risco de explosão. Conecte apenas componentes periféricos claramente marcados como certificados como Locais de Perigo Classe 1, Divisão 2.

***AVISO***

A versão certificada deste produto para locais perigosos não corresponde aos requisitos da Diretiva 94/9/EC (Diretiva ATEX).

1. Vá até a extremidade do conector do cabo.
2. Leia o rótulo da extremidade do conector do cabo. Para sensores certificados para locais perigosos, a etiqueta deve ter o texto "Classificação: Classe 1, Divisão 2".
3. Examine o conector.

   - Sensores certificados para locais perigosos têm um conector com trava de segurança. Consulte a Figura 3 na página 61.
   - Os sensores que não são certificados para locais perigosos têm conector com conexão rápida, sem trava de segurança.

## Conecte o sensor em um local não perigoso

**⚠ PERIGO**

Perigo de explosão. Este equipamento é adequado para uso em locais seguros ou de Classe 1, Divisão 2, Grupos A, B, C e D com sensores e opções especificados quando instalado em locais perigosos de Classe 1, Divisão 2, Grupos A, B, C e D. Consulte sempre o desenho de controle e os códigos de normas elétricas para instruções de instalação apropriadas.

**⚠ PERIGO**

Risco de explosão. Não conecte nem desconecte componentes ou circuitos elétricos para e do equipamento, ao menos que a energia tenha sido desligada ou a área esteja completamente segura.

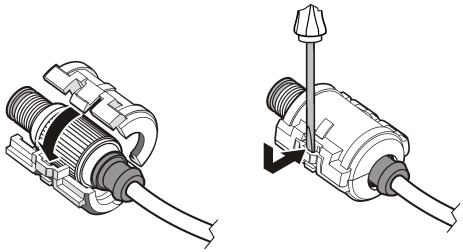
**AVISO**

Use apenas sensores e trava do cabo certificados para locais perigosos. A versão certificada deste produto para locais perigosos não corresponde aos requisitos da Diretiva 94/9/EC (Diretiva ATEX).

Para obter mais informações, consulte Validar o tipo de sensor na página 60 .

1. Remova a cap do conector do controlador. Mantenha a cap do conector para vedar a abertura do conector quando o sensor for removido.
2. Conecte o do sensor ao controlador. Consulte o manual do controlador para obter mais informações.
3. Alinhe a trava de segurança no conector.
4. Para remover a trava de segurança do conector, Consulte a Figura 3.

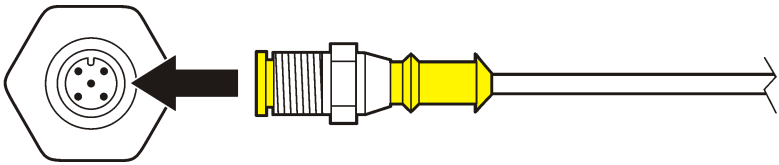
**Figura 3 Trava de segurança do conector.**



## Conecte o sensor em um local não perigoso

Consulte a Figura 4 para conectar um sensor LDO a um controlador sc. Consulte o manual específico do controlador sc para obter instruções sobre cabeamento.

**Figura 4 Conecte o sensor LDO (sensor para local não perigoso)**



Depois que o sensor for encaixado, procure o sensor. Consulte a Instalar o sensor na página 61.

## Instalar o sensor

Há duas opções para instalar o sensor:

- Conecte o sensor enquanto a energia para o controlador estiver desligada. O controlador procurará e instalará novos sensores quando for ligado.
- Conecte o sensor enquanto a energia para o controlador estiver ligada. Use o comando Scan Devices (Procurar dispositivos) para instalar o novo sensor:

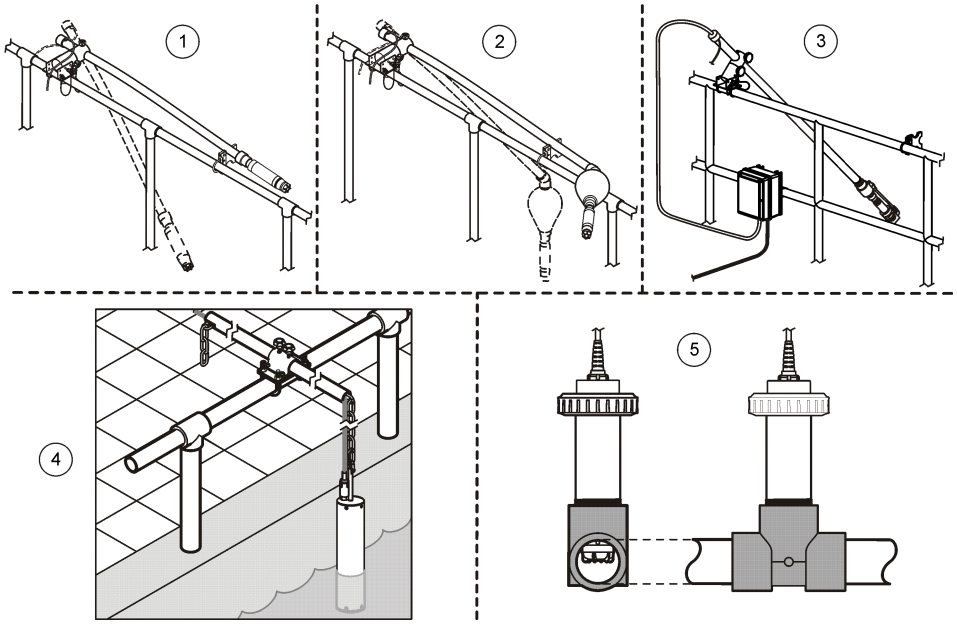
| Opção | Descrição |
|---|---|
| **Controlador sc200** | Vá para MENU>TEST/MAINT>SCAN DEVICE (MENU>TESTE/MANUT>PROCURAR DISPOSITIVO) |
| **Controlador sc100** | Vá para MENU>TEST/MAINT>SCAN DEVICE (MENU>TESTE/MANUT>PROCURAR SENSORES) |
| **Controlador sc1000** | Vá para MENU>SYSTEM SETUP>DEVICE MANAGEMENT>SCANNING FOR NEW DEVICES (MENU>CONFIGURAÇÃO DO SISTEMA>GERENCIAMENTO DE DISPOSITIVOS>PROCURANDO NOVOS DISPOSITIVOS) |

Consulte Conecte o sensor em um local não perigoso na página 61 para obter a conexão do sensor digital.

## Opções de instalação do sensor

As opções de instalação e acessórios disponíveis para o sensor LDO são fornecidas com as instruções de instalação no kit de montagens. O Figura 5 mostra diversas opções de instalação. Para solicitar as peças do kit de montagens, consulte o Peças e acessórios de reposição na página 72.

**Figura 5 Opções de instalação**




| | |
|---|---|
| **1** de montagem em trilho | **4** de montagem em corrente |
| **2** Montagem flutuante | **5** Montagem por união (incompatível com sondas para água do mar) |
| **3** Montagem do sistema de jato de ar (incompatível com sondas para água do mar) | |

# Operação

## Navegação do usuário

Consulte a documentação do controlador para obter uma descrição do teclado e informações de navegação.

## Configurar o sensor

Use o menu Configure (Configurar) para digitar as informações de identificação do sensor, e para alterar as opções de armazenamento e manuseio dos dados.

Para obter informações sobre a instalação do sensor, consulte Instalar o sensor na página 61.

Confira se todos os valores do menu Configuração estão corretos para a aplicação.

1. Vá para MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE (MENU>CONFIGURAÇÃO DO SENSOR>[Selecione Sensor]>CONFIGURAR).
2. Selecione uma opção, pressione ENTER. A lista de opções disponíveis é mostrada na tabela abaixo.

| Opção | Descrição |
|---|---|
| EDIT NAME (Editar nome) | Altera o nome que corresponde ao sensor no topo da tela de medição. O nome é limitado a 10 caracteres com qualquer combinação de letras, números, espaços ou pontuação. |
| SET UNITS (DEFINIR UNIDADES) | Define a unidade de temperatura para °C (padrão) ou °F. |
| | MEASURE (MEDIDA) - Define as unidades de medida em mg/L, ppm ou %. |
| | ALT/PRESS - Define a altitude em m ou pés, ou defina as unidades de pressão atmosférica em mmHg ou torr. (Valor padrão = 0 pé) |
| ALT/PRESS (Altitude/pressão) | Insira o valor da altitude ou pressão atmosférica. Este valor deve ser preciso para completar as medidas de saturação em % e a calibração no ar. (Padrão = 0 pé). |
| SALINITY (Salinidade) | Insira o valor de salinidade. Intervalo de salinidade: 0,00 a 250,00 partes por milhar (‰). Consulte a seção Inserir valor de correção de salinidade. na página 64 para obter mais informações. (Valor padrão> 0) |
| Média de sinal | Ajuste o intervalo de tempo para a média de sinal em segundos |
| CLEAN INTRVL (INTERVALO DE LIMPEZA) | Ajuste o intervalo de tempo para a limpeza manual do sensor em dias (Valor padrão = 0 dia. Um valor de 0 dia desativa o intervalo de limpeza). |
| RESET CLN INTRVL (REDEFINIR INTERVALO DE LIMPEZA) | Ajuste o intervalo de tempo ao último intervalo de limpeza salvo |
| LOG SETUP (Configuração do registrador) | Define o intervalo de tempo para armazenamento de dados no registros dos dados—0.5, segundos, 1, 2, 5, 10, 15 (padrão), 30, 60 minutos. |
| SET DEFAULTS | Restaura os valores padrão configuráveis do sensor. Não altera o ajuste de inclinação ou deslocamento. |

## Insira o valor de pressão atmosférica

A configuração de fábrica para pressão (de ar) atmosférica é O pés ou no nível do mar. Para alterar o valor padrão, utilize as etapas nesse procedimento. O ajuste para pressão de ar é inserido como elevação ou como unidades de pressão (preferido).

***Observação:*** *A pressão de ar precisa é essencial para calibração de ar saturado (*Calibração com ar na página 66*). Utilize apenas pressão absoluta, não ajustada. Se a pressão absoluta do ar for desconhecida, utilize a elevação correta para o local.*

1. Vá para MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>SET UNITS>AIR PRESS/ALT UNITS (MENU>CONFIGURAÇÃO DO SENSOR>[Selecione Sensor]>CONFIGURAR>DEFINIR UNIDADES>PRESSÃO AR/UNIDADES ALT.
2. Selecione **um** das opções de unidade listadas:

| Opção | Descrição |
|---|---|
| **ft** | Pés - unidade de medida para elevação |
| **m** | Metros - unidade métrica para medir elevação |
| **mmHg** | Milímetros de mercúrio - unidade métrica para medir pressão absoluta do ar |
| **torr** | Unidade de medida para pressão absoluta do ar |

3. Confirme a seleção. A tela de entrada de valor exibirá as unidades selecionadas.
4. Insira o valor de e confirme.

## Inserir valor de correção de salinidade.

As medidas de oxigênio dissolvido em amostras salinas podem exibir um valor aparente de DO que é bem diferente do valor real do DO. Para corrigir a influência de sais dissolvidos na amostra, insira o fator de correção de salinidade.

***Observação:*** *Se a presença ou a quantidade de salinidade no processo for desconhecido, consulte a equipe de engenharia da unidade de tratamento.*

1. Utilize o medidor de condutividade para medir a condutividade da amostra em mS/cm na temperatura de referência de 20 °C (68 °F).
2. Utilize Tabela 1 para estimar o fator de correção de salinidade em partes por milhar (‰) de saturação.

   ***Observação:*** *A concentração de íon cloreto em g/kg é igual à clorinidade da amostra. A salinidade é calculada com a seguinte fórmula: Salinidade = 1.80655 × clorinidade.*

   A salinidade pode ser calculada por meio da relação na seção 2520 B de *Método Padrão para Análise de Água e Água servida*.[*],
3. Vá para MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>SALINITY (MENU>CONFIGURAÇÃO DO SENSOR>[Selecione Sensor]>CONFIGURAR>SALINIDADE.
4. Insira o fator de correção de salinidade e confirme.

[*] *Standard Methods for the Examiniation of Water and Wastewater*, 20th Edition. Editors Lenore S. Clesceri, Arnold E. Greenberg and Andrew D. Eaton, p. 2-48-2-29 (1998). A relação entre Clorinidade e Solubilidade do oxigênio é fornecida na mesma referência em 4500-O:I p. 4-131.

**Tabela 1 Saturação de salinidade (‰) por valor de condutividade (mS/cm)**

| mS/cm | ‰ | | mS/cm | ‰ | | mS/cm | ‰ | | mS/cm | ‰ |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 3 | | 16 | 10 | | 27 | 18 | | 38 | 27 |
| 6 | 4 | | 17 | 11 | | 28 | 19 | | 39 | 28 |
| 7 | 4 | | 18 | 12 | | 29 | 20 | | 40 | 29 |
| 8 | 5 | | 19 | 13 | | 30 | 21 | | 42 | 30 |
| 9 | 6 | | 20 | 13 | | 31 | 22 | | 44 | 32 |
| 10 | 6 | | 21 | 14 | | 32 | 22 | | 46 | 33 |
| 11 | 7 | | 22 | 15 | | 33 | 23 | | 48 | 35 |
| 12 | 8 | | 23 | 15 | | 34 | 24 | | 50 | 37 |
| 13 | 8 | | 24 | 17 | | 35 | 25 | | 52 | 38 |
| 14 | 9 | | 25 | 17 | | 36 | 25 | | 54 | 40 |
| 15 | 10 | | 26 | 18 | | 37 | 26 | | | |

## Configurar a saída linear do controlador

As saídas lineares enviam dados da sonda para o PLC, SCADA ou outro sistema de coleta de dados da instalação.

1. Vá até o menu de configuração de saída do controlador.

| Opção | Descrição |
|---|---|
| **sc200** | Vá para MENU>SETTINGS>sc200 SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION (MENU>CONFIGURAÇÕES>CONFIGURAÇÃO de sc200>CONFIGURAÇÃO DA SAÍDA>[Selecione a Saída]>DEFINIR FUNÇÃO). |
| **sc100** | Vá para MENU>SYSTEM SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION (MENU>CONFIGURAÇÃO DO SISTEMA>CONFIGURAÇÃO DA SAÍDA>[Selecione a Saída]>DEFINIR FUNÇÃO). |
| **sc1000** | Vá para MENU>SYSTEM SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION (MENU>CONFIGURAÇÃO DO SISTEMA>CONFIGURAÇÃO DA SAÍDA>[Selecione a Saída]>DEFINIR FUNÇÃO). |

2. Ajuste a função do controlador.

| Opção | Descrição |
|---|---|
| **sc200** | LINEAR |
| **sc100** | CONTROLE LINEAR (valor padrão) |
| **sc1000** | CONTROLE LINEAR (valor padrão) |

## Registradores Modbus

Uma lista de registradores Modbus está disponível para comunicação em rede. Visite www.hach.com ou www.hach-lange.com para obter mais informações.

# Calibração para medições

O sensor está calibrado com as especificações de fábrica. O fabricante não recomenda a calibração a não ser que seja periodicamente solicitada pelas agências de regulamentação. Se a calibação for necessária, permita que o sensor chegue ao ponto de equilíbrio com o processo antes da calibração. Não faça a calibração do sensor na configuração.

Tabela 2 mostra opções para calibração.

**Tabela 2 Opções de calibração**

| Opção | Descrição |
|---|---|
| AIR CAL (CALIBRAÇÃO DE AR) | Método de calibração recomendado. Essa calibração modifica a inclinação. |
| SAMPLE CAL (1 CAL. AMOSTRA) | Calibração por comparação com um medidor de DO portátil. Essa calibração modifica o deslocamento. |
| RESET DFLT CAL (RECONFIGURAR CALIBRAÇÃO PADRÃO) | Reconfigura o ganho de calibração (inclinação) e o deslocamento aos padrões de fábrica: ganho padrão=1,0; deslocamento padrão=0,0 |

## Calibração com ar

**Notas para o usuário:**

- Confira se a bolsa de calibração contém água.
- Confira se a vedação entre a bolsa de calibração e o corpo do sensor está firme.
- Confira se o sensor fica seco quando calibrado.
- Confira se a configuração de pressão/elevação do ar é precisa para o local de calibração.
- Aguarde o tempo suficiente para que a temperatura do sensor se estabilize à temperatura do local da bolsa de calibração. Uma diferença grande de temperatura entre o processo e o local da calibração pode determinar um tempo de estabilização de até 15 minutos.

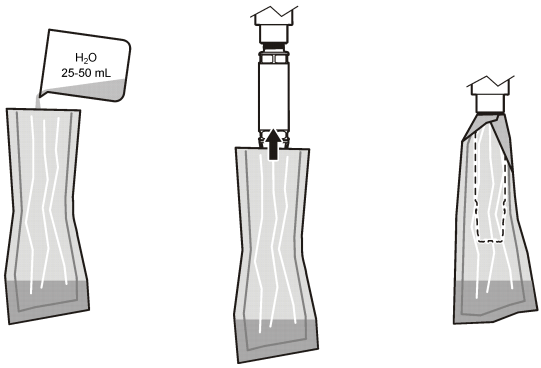
1. Remova o sensor do processo. Use um pano molhado para limpar o sensor.
2. Coloque todo o sensor em uma bolsa de calibração com 25 a 50 ml de água. Confira se a cap do sensor não está em contato com a água da bolsa de calibração e se não há gotas de água na cap do sensor (Figura 6).
3. Utilize uma faixa de borracha, abraçadeira ou a mão para criar uma vedação firme ao redor do corpo do sensor.
4. Antes da calibração, aguarde 15 minutos para a estabilização do instrumento. Mantenha a bolsa de calibração longe da luz solar direta durante a estabilização.
5. Confira se a pressão absoluta ou elevação do ar está configurada corretamente. Consulte a Insira o valor de pressão atmosférica na página 63.

   ***Observação:*** *O fabricante recomenda o uso de pressão do ar absoluta ou real como melhor prática.*
6. Vá para MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>AIR CAL (MENU>CONFIGURAÇÃO DO SENSOR>[Selecione o sensor]>CALIBRAR>CALIBRAÇÃO NO AR).
7. Selecione a opção para o sinal de saída durante a calibração:

| Opção | Descrição |
|---|---|
| **Ativo** | O instrumento envia para a saída o valor medido atual durante o procedimento de calibração. |
| **Espera** | O valor de saída é mantido no valor medido no início do processo de calibração. |
| **Transferir** | Um valor de saída pré-definido é enviado para a saída durante a calibração. Consulte o manual do usuário par alterar o valor pré-definido |

8. O controlador mostrará "Move the probe to bag" ("Mover a sonda para bolsa"). Aguarde o valor se estabilizar. Pressione ENTER para aceitar o valor estável. Como alternativa, aguarde a calibração continuar até a exibição de "Complete" ("Completo").
9. Quando o sensor for calibrado, coloque-o no processo. Pressione ENTER.

**Figura 6 Procedimento de calibração por ar**




Se o valor não for estabilizado, o visor mostrará "Unable to Calibrate" ("Não é possível calibrar") e uma mensagem de erro. Tabela 3 mostra a mensagem de erro e a resolução para os problemas de calibração.

**Tabela 3 Mensagens de erro de calibração de ar**

| Mensagem | Descrição | Resolução |
|---|---|---|
| Cal fail, gain high (Falha na calibração, ganho alto) | O valor de ganho calculado é muito alto. | Repita a calibração. |
| Cal fail, gain low (Falha na calibração, ganho baixo) | O valor de ganho calculado é muito baixo. | Repita a calibração. |
| Cal fail, unstable (Falha na calibração, instável) | O valor não foi estabilizado no tempo máximo de calibração permitido. | Repita a calibração. |

## Sample CAL (CAL de amostra) - calibração por comparação

Esse método de calibração usa um sensor opcional anexado a um medidor portátil.

1. Coloque o sensor opcional no processo. Coloque o segundo sensor o mais próximo possível do primeiro.
2. Aguarde até que o valor estabilize.
3. No controlador do primeiro sensor, vá para MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>SAMPLE CAL (MENU>CONFIGURAÇÃO DO SENSOR>[Selecione o sensor]>CALIBRAR>CAL. DE AMOSTRA).
4. Selecione a opção para o sinal de saída durante a calibração:

| Opção | Descrição |
|---|---|
| **Ativo** | O instrumento envia para a saída o valor medido atual durante o procedimento de calibração. |
| **Espera** | O valor de saída é mantido no valor medido no início do processo de calibração. |
| **Transferir** | Um valor de saída pré-definido é enviado para a saída durante a calibração. Consulte o manual do usuário par alterar o valor pré-definido |

5. O mostrador exibirá:
   - Pressione ENTER quando estabilizado
   - A medição atual de oxigênio dissolvido
   - A medição atual da temperatura
6. Quando a medição estiver estável, pressione ENTER. O visor mostrará uma tela de entrada.

***Observação:*** *A medição normalmente se estabiliza dentro de 2 a 3 minutos.*

Se o valor não for estabilizado, o visor mostrará "Unable to Calibrate" ("Não é possível calibrar") e uma mensagem de erro. Tabela 4 mostra a mensagem de erro e a resolução para os problemas de calibração.

**Tabela 4 Mensagens de erro de calibração de amostra**

| Mensagem | Descrição | Resolução |
|---|---|---|
| Cal fail, offset high (Falha na calibração, deslocamento alto) | O valor de deslocamento calculado é muito alto. | Repita a calibração. |
| Cal fail, offset low (Falha na calibração, deslocamento baixo) | O valor de deslocamento calculado é muito baixo. | Repita a calibração. |
| Cal fail, unstable (Falha na calibração, instável) | O valor não foi estabilizado no tempo máximo de calibração permitido. | Repita a calibração. |

## Sair temporariamente da calibração

1. Durante a calibração pressione a tecla BACK (VOLTAR). São exibidas três opções:

| Opção | Descrição |
|---|---|
| **ABORT (ANULAR)** | Interrompe a calibração. Uma nova calibração precisa ser reiniciada. |
| **BACK TO CAL (Voltar à calibração)** | Retornar à calibração. |
| **LEAVE (Deixar a calibragem)** | Sair temporariamente da calibração. O acesso a outros menus é permitido enquanto a calibração prossegue em segundo plano. Uma calibração para um segundo sensor (se presente) pode ser iniciada. Para retornar à calibração, pressione a tecla MENU e selecione Sensor Setup (Configuração do sensor), [Select Sensor] (Selecionar sensor). |

2. Selecionar uma das opções de saída. Confirme.

## Restaurar a calibração para os valores padrão

As configurações de calibração podem ser restauradas aos padrões de fábrica. Os valores de ganho e deslocamento são definidos como 1,0 e 0,0, respectivamente.

1. Vá para MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>RESET CAL DEFLT (MENU>CONFIGURAÇÃO DO SENSOR>[Selecione o sensor]>CALIBRAR>REDEFINIR CALIBRAÇÃO PADRÃO).
2. O visor mostrará uma mensagem de confirmação. Confirme para redefinir a curva de calibração do sensor ao padrão de fábrica.

# Manutenção

**⚠ PERIGO**

Vários perigos. Somente pessoal qualificado deve realizar as tarefas descritas nesta seção do manual.

**⚠ PERIGO**

**Perigo de explosão.** Não conecte nem desconecte componentes ou circuitos elétricos para e do equipamento, ao menos que a energia tenha sido desligada ou a área esteja completamente segura.

**⚠ PERIGO**

**Perigo de explosão**. A substituição de componentes pode prejudicar a compatibilidade da Classe 1, Divisão 2. Não substitua nenhum componente, ao menos que esse tenha sido desligado ou que a área esteja completamente segura.

***AVISO***

A versão certificada deste produto para locais perigosos não corresponde aos requisitos da Diretiva 94/9/EC (Diretiva ATEX).

## Rotina de manutenção

O programa de manutenção mostra os tempos mínimos para as tarefas de manutenção regulares. Efetue as tarefas de manutenção com mais freqüência para aplicações que causam sujeira no elétrodo.

***Observação:*** *Não desmonte o instrumento para manutenção ou serviço.*

| Tarefa de manutenção | Frequência mínima recomendada |
|---|---|
| Limpar o sensor | 90 dias |
| Verificar se há danos no sensor | 90 dias |
| Calibrar o sensor | Conforme recomendação do órgão regulamentar |

## Limpar o sensor

Limpe a parte externa do sensor com um pano macio e úmido.

***Observação:*** *Se a cap do sensor precisar ser removida para limpeza, não exponha o interior da cap à luz direta do sol por um longo período de tempo.*

## Definir ou alterar o intervalo de limpeza

As condições da aplicação podem exigir intervalos mais curtos ou mais longos entre as limpezas manuais do sensor. O intervalo de limpeza padrão é de 0 dias. Para alterar o intervalo, consulte as etapas neste procedimento.

1. Vá para MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>CLEAN INTRVL (MENU>CONFIGURAÇÃO DO SENSOR>[Selecione o sensor]>CONFIGURAR>INTERVALO DE LIMPEZA).
2. Altere o valor mostrado, conforme necessário. Confirme a alteração.
   - Para desativar o intervalo de limpeza, defina o valor como '0'.

## Troque a cap do sensor

**⚠ ADVERTÊNCIA**

Risco potencial de explosão. A cap de configuração do sensor não está classificada para uso em locais perigosos.

Caps sobressalentes e de configuração são enviadas juntamente com as instruções de instalação. Consulte as instruções incluídas para trocar a cap.

Para um melhor desempenho e precisão, substitua a cap do sensor:

- A cada dois anos
- Quando a inspeção de rotina mostra erosão significativa na cap do sensor

# Solução de problemas

## Menu de teste e diagnóstico

O menu de teste e diagnóstico mostra as informações atuais e históricas sobre o analisador de cloro.
Para acessar o menu de diagnóstico e de teste, vá para MENU>SENSOR SETUP>[Select Sensor]>DIAG/TEST (MENU>CONFIGURAÇÃO DO SENSOR>[Selecione o sensor]>DIAG/TESTE.

Consulte a Tabela 5.

**Tabela 5 Menu DIAG/TEST (Diagnóstico/teste)**

| Opção | Descrição |
|---|---|
| INFORMAÇÕES DO SENSOR | VERSÃO DO SOFTWARE - Exibe a versão instalada do software |
| | VERSÃO DE INICIALIZAÇÃO - Exibe a versão de inicialização instalada |
| | VERSÃO DO DRIVER - Exibe a versão do driver instalada |
| LOT CODE (CÓDIGO DO LOTE) | Exibe o lote de fabricação na cap do sensor |
| SERIAL NUMBER (NÚMERO DE SÉRIE): | Número de série do sensor |
| GAIN CORR (CORREÇÃO DO GANHO) | Ajustar o valor de ganho da calibração. |
| | Intervalo de 0.50 a 2.00 |
| OFFSET CORR | Ajustar o valor de deslocamento da calibração (mg/L ou ppm). |
| | Intervalo de 3.00 a 3.00 |
| PHASE DIAG (DIAG DA FASE) | Exibe a fase para cumprimento de onda total, vermelho e azul. Atualiza uma vez por segundo |
| AMPL DIAG (DIAG AMPL) | Exibe a amplitude para cumprimento de onda vermelho e azul. Atualiza uma vez por segundo |
| DAYS TO CLEAN (DIAS PARA LIMPEZA) | Exibe os dias até a próxima programação de limpeza manual. |
| SENSOR LIFE (VIDA ÚTIL DO SENSOR) | Exibe os dias até a próxima programação de reposição da cap do sensor. |

## Lista de erro

Se ocorrer um erro, a leitura na tela de medidas piscará. O comportamento da saída é determinado pelas configurações do controlador. Consulte o manual do controlador para obter mais informações.
Para mostrar os erros atuais do sensor, vá para MENU>DIAGNOSTICS>[Select Sensor]>ERROR LIST (MENU>DIAGNÓSTICOS>[Selecione o sensor]>LISTA DE ERROS). Consulte a Tabela 6.

**Tabela 6 Lista de erros do sensor**

| Error (Erro) | Causa possível | Resolução |
|---|---|---|
| RED AMPL LOW (AMPL VERM BAIXO - Valor abaixo de 0,01)<br>Ou<br>BLUE AMPL LOW (AMPL AZUL BAIXO - Valor abaixo de 0,01) | The sensor cap is not installed, or is not installed correctly. | Remova a cap do sensor e instale-a novamente. |
| | O percurso da luz está bloqueado na cap do sensor. | Inspecione a parte interna da cap do sensor e a lente. |
| | O sensor não está funcionando corretamente. | Verifique se o LED está piscando. Entre em contato com o fabricante. |

## Lista de aviso

Quando o ícone de advertência piscar (sc100 e sc200) ou a tela ficar amarela (sc1000), uma mensagem será mostrada na parte inferior da tela de medição. Para sc1000, a tela ficará amarela para mostrar a advertência. Para mostrar as advertências atuais do sensor, vá para MENU>DIAGNOSTICS>[Select Sensor]>WARNING LIST (MENU>DIAGNÓSTICOS>[Selecione o sensor]>LISTA DE ADVERTÊNCIAS). Consulte a Tabela 7.

**Tabela 7 Lista de advertências do sensor**

| Advertência | Definição | Resolução |
|---|---|---|
| EE SETUP ERR (ERRO DE CONFIGURAÇÃO DE EE) | O armazenamento está corrompido. Os valores foram definidos para o padrão de fábrica. | Entre em contato com o suporte técnico. |
| ERRO EE RSRVD | | |
| TEMP < 0 C (TEMPERATURA < 0 ºC) | A temperatura de processamento está abaixo de 0 °C (32 °F) | Aumente a temperatura de processamento ou interrompa o uso até que a temperatura de processamento esteja dentro do intervalo de especificação do sensor. |
| TEMP > 50 C (TEMPERATURA > 50 ºC) | A temperatura de processamento está acima de 50 °C (120 °F) | Diminua a temperatura de processamento ou interrompa o uso até que a temperatura de processamento esteja dentro do intervalo de especificação do sensor. |
| RED AMPL LOW (AMPL VERM BAIXO) | Valor fica abaixo de 0,03 | Consulte a Tabela 6 na página 70. |
| RED AMPL HIGH (AMPL VERM ALTO) | Valor é maior que 0,35 | Contate o suporte técnico. |
| BLUE AMPL LOW (AMPL AZUL BAIXO) | Valor abaixo de 0,03 | Consulte a Tabela 6 na página 70. |
| BLUE AMPL HIGH (AMPL AZUL ALTO) | Valor é maior que 0,35 | Contate o suporte técnico. |
| CAP CODE FAULT (FALHA DO CÓDIGO DA CAP) | O código da cap do sensor foi corrompido. O código foi redefinido automaticamente para os códigos padrão da cap e do lote. | Conclua o procedimento da cap de configuração do sensor. Se nenhuma cap de configuração estiver disponível para a cap do sensor, contate o suporte técnico. |

## Lista de eventos

A Lista de eventos mantém um registro das alterações na forma como os dados são registrados pelo sensor. Para mostrar os eventos do sensor, vá para (MENU>DIAGNÓSTICOS>[Selecione o sensor]>LISTA DE EVENTOS).
Consulte a Tabela 8.

**Tabela 8 Lista de eventos do sensor**

| Evento | Descrição |
|---|---|
| ALT/PRESSURE UNIT CHANGE (ALTERAÇÃO DA UNIDADE DE ALTITUDE/PRESSÃO) | As unidades de pressão atmosférica ou de altitude foram alteradas. |
| ALT/PRESSURE CHANGE (ALTERAÇÃO DA ALTITUDE/PRESSÃO) | O valor da altitude ou da pressão atmosférica foi alterado. |
| TEMP UNIT CHANGE (ALTERAÇÃO DE UNIDADE DE TEMPERATURA) | As unidades de temperatura foram alteradas. |
| MEAS UNIT CHANGE (ALTERAÇÃO DA UNIDADE DE MEDIDA) | Uma nova unidade de medida foi alterada. |

**Tabela 8 Lista de eventos do sensor (continuação)**

| Evento | Descrição |
|---|---|
| SALINITY CHANGE (ALTERAÇÃO DE SALINIDADE) | O valor de salinidade foi alterado. |
| SET DEFAULT (DEFINIR PARA PADRÃO) | As configurações do sensor foram redefinidas para os valores padrão. |
| SENSOR SETUP CHANGE (ALTERAÇÃO DA CONFIGURAÇÃO DO SENSOR) | A configuração do sensor foi alterada. |
| CLEAN INTERVAL TIMER CHANGE (ALTERAÇÃO DO TEMPORIZADOR DO INTERVALO DE LIMPEZA) | O tempo entre as limpezas do sensor foi alterado. |
| SENSOR CAP LIFE TIMER CHANGE (ALTERAÇÃO NO TEMPORIZADOR DE VIDA ÚTIL DA CAP DO SENSOR) | O tempo entre as substituições da cap do sensor foi alterado. |

## Peças e acessórios de reposição

Utilize apenas as peças de substituição aprovadas pelo fabricante. O uso de peças não aprovadas pode causar lesões pessoais, danos ao instrumento ou mau funcionamento do equipamento.

### Itens de reposição

| Descrição | Nº de item (EUA / UE) |
|---|---|
| Sonda LDO, com cap de sensor e 2 bolsas de calibração | LXV416.99.20001416.99.20001 |
| Sonda LDO para água do mar, com cap de sensor e duas bolsas de calibração | 9020000-SW / — |
| Sonda LDO para locais perigosos com água do mar, com cap de sensor e duas bolsas de calibração | 9020000-C1D2-SW / — |
| Sonda LDO para locais perigosos, com cap de sensor e 2 bolsas de calibração | 9020000-C1D2 / — |
| Cap do Sensor, substituição (inclui a cap de configuração do sensor, que não é classificada para uso em locais perigosos de Classe 1, Divisão 2) | 9021100 / 9021150 |

### Acessórios

| Descrição | Nº de item (EUA / UE) |
|---|---|
| Trava do cabo do sensor para locais perigosos | 6139900 / — |
| Cabo, extensão do sensor, Classe 1, Locais perigosos da Divisão 2, 1 m (3,3 pés) | 6122402 / — |
| Cabo, extensão do sensor, Classe 1, Locais perigosos da Divisão 2, 7 m (23 pés) | 5796002 / — |
| Cabo, extensão do sensor, Classe 1, Locais perigosos da Divisão 2, 15 m (49,21 pés) | 5796102 / — |
| Cabo, extensão do sensor, Classe 1, Locais perigosos da Divisão 2, 31 m (101,71 pés) | 5796202 / — |
| Sistema de limpeza jato de ar de alto rendimento, 115 volts (não classificado para uso em locais perigosos) | 6860000 / 6860003.99.0001 |
| Sistema de limpeza com jato de ar de alto rendimento, 230 volts (não classificado pela ATEX para uso em locais perigosos) | 6860100 / 6860103.99.0001 |
| Bolsa de calibração (1x) | 5796600 / 5796600 |

| Descrição | Nº de item (EUA / UE) |
|---|---|
| Cabo, extensão do sensor, local não perigoso, 7,7 m (25 pés)[1] | EUA: 5796000, 7,7 metros (25 pés) |
| | UE: LZX849, 10 m (33 pés) |
| Kit de hardware para montagem de tubulação (PVC) | LZY714.99.21810714.99.21810 |
| Kit de hardware para montagem de flutuante (PVC) | LZX914.99.42200914.99.42200 |
| Kit de hardware para montagem do jato de ar | 9253500 / LZY812 |
| Kit de hardware para montagem em corrente (aço inoxidável) | — / LZX914.99.11200 |
| Kit de hardware para montagem por união | 9257000 / 9257000 |
| Medidor HQd com sonda resistente LDO (não classificada para uso em locais perigosos) | 8505200 / HQ40D.99.310.000 |

[1] 15 metros (49 pés) e 30 metros (98 pés) também disponíveis

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# 规格

产品规格如有变化，恕不另行通知。

| 规格 | 详细信息 |
|---|---|
| 过流材料 | 标准探头，标准 Class 1-Div 2 探头<br>• CPVC，传感器末端和电缆末端<br>• 聚氨酯，电缆末端和电缆管套二次成型<br>• 316 不锈钢机身和螺钉<br>• 氟橡胶，O 形环<br>• 改性聚苯醚，电缆末端螺母 |
| | 标准海水探头，海水 Class 1-Div 2 探头<br>• CPVC，传感器末端和电缆末端<br>• 聚氨酯，电缆末端和电缆管套二次成型<br>• PVC 海水探头机身<br>• 海水环氧密封剂<br>• 改性聚苯醚，电缆末端螺母 |
| IP 分类 | IP68 |
| 电极材料（传感器盖帽 ） | 丙烯酸 |
| 测量范围（溶解氧） | 0 至 20 ppm（0 至 20 mg/L） |
| | 0 至 200% 饱和度 |
| 测量精度（溶解氧） | 低于 5 ppm：± 0.1 ppm |
| | 高于 5 ppm：± 0.2 ppm |
| 可重复性（溶解氧） | 0.1 ppm (mg/L) |
| 响应时间（溶解氧） | $T_{90}$ < 40 秒 |
| | $T_{95}$ < 60 秒 |
| 溶液，传感器（溶解氧） | 0.01 ppm (mg/L)；0.1% 饱和度。 |
| 测量范围（温度） | 0 到 50 °C（32 到 122 °F） |
| 测量精度（温度） | ± 0.2 °C (±0.36 °F) |
| 干扰 | 不存在干扰的包括： $H_2S$, pH, $K^+$, $Na^+$, $Mg^{2+}$, $Ca^{2+}$, $NH_4^+$, $Al^{3+}$, $Pb^{2+}$, $Cd^{2+}$, $Zn^{2+}$, Cr (total), $Fe^{2+}$, $Fe^{3+}$, $Mn^{2+}$, $Cu^{2+}$, $Ni^{2+}$, $Co^{2+}$, $CN^-$, $NO_3^-$, $SO_4^{2-}$, $S^{2-}$, $PO_4^{3-}$, $Cl^-$, 阴离子活性剂，原油， $Cl_2$ < 4 ppm |
| 存储温度 | –20 至 70 °C (–4 至 158 °F) |
| 最高温度 | 0 至 50 ºC（32 至 122 °F） |

| 规格 | 详细信息 |
| --- | --- |
| 危险场所分类（仅适用于 9020000-C1D2 传感器） | 类别 I，第 2 子类，组 A-D，T4/ 类别 I，第 2 区，组 2C，T4<br>*注：* *本产品不符合 94/9/EC 标准 （ATEX 标准）的要求。* |
| 认证（仅适用于 9020000-C1D2 传感器） | ETL 列入 ANSI/ISA、CSA 和 FM 标准，适于用危险场所。<br>*注：* *本产品不符合 94/9/EC 标准 （ATEX 标准）的要求。* |
| 最小流率 | 不需要 |
| 校准/检定 | 空气校准：一点，100% 的水饱和气体 |
| | 样本校准：与标准仪器进行比较 |
| 探头浸入深度和压力限值 | 34 m (112 ft.)时的最大压力限值为 345 kPa (50 psi)；在此深度可能无法保持精确度 |
| 传感器线 | 10 m (30 ft) 整体电缆，带快速断开型插头（所有传感器类型）<br>加延长电缆最高可达 100 m（仅限非类别 I，第 2 子类的传感器类型）<br>使用接线盒最长可达 1000 m（仅限非类别 I，第 2 子类的传感器类型） |
| 探头重量 | 1.0 kg (2 lb, 3 oz) |
| 探头尺寸 | 标准探头（直径 x 长度）：49.53 x 255.27 mm (1.95 x 10.05 in.) |
| | 海水探头（直径 x 长度）：60.45 x 255.27 mm (2.38 x 10.05 in.) |
| 电源要求 | 12 VDC, 0.25 A, 3 W |
| 保修 | 探头：制造缺陷保修 3 年 |
| | 传感器盖帽：制造缺陷保修 2 年 |

## 基本信息

对于因本手册中的任何不足或遗漏造成的直接、间接、特别、附带或结果性损失，制造商概不负责。制造商保留随时更改本手册和手册中描述的产品的权利，如有更改恕不另行通知或承担有关责任。修订版可在制造商的网站上找到。

## 安全信息

**注意**

对于误用和滥用造成的产品损坏，制造商概不负责，包括但不限于：直接、附带和间接的损坏，并且对于适用法律允许的最大程度的损坏也不承担任何责任。用户唯一的责任是识别重大应用风险和安装适当的系统，以在设备可能出现故障时保护流程。

请在拆开本设备包装、安装或使用本设备前，完整阅读本手册。特别要注意所有的危险警告和注意事项。否则，可能会对操作者造成严重的人身伤害，或者对设备造成损坏。

确保设备提供的保护没有受损。请勿以本手册指定方式之外的其它方式使用或安装本设备。

## 危险信息使用

**⚠ 危险**

表示潜在的或紧急的危险情况，如果不加以避免，将会导致死亡或严重伤害。

**⚠ 警告**

表示潜在或非常危险的情形，如不避免，可能导致严重的人身伤亡。

**⚠ 警告**

表示潜在的危险情形，可能导致一定程度的人身伤害。

| *注意* |
| --- |
| 表明如不加以避免则会导致仪器损坏的情况。需要特别强调的信息。 |

## 警告标签

请阅读贴在仪器上的所有标签和标记。如未遵照这些安全标签的指示操作，则可能造成人身伤害或仪器损坏。仪器上的符号在手册中提述为警告说明。

| | |
| --- | --- |
| | 这是安全警报标志。请遵守此标志后面的所有安全信息，以避免可能造成的伤害。如果仪器上有此标志，则请参见仪器手册，了解操作或安全信息。 |
| | 此标志指示存在可能造成眼部轻度损伤的光源。请遵守此标志后面的所有信息，以避免可能造成的眼部损伤。 |
| | 此标志指示存在静电释放 （ESD） 敏感的设备，且必须小心以避免设备损坏。 |
| | 使用此符号标记的电气设备在 2005 年 8 月 12 日后，不能通过欧洲公共垃圾系统进行处理。为遵守欧洲地区和国家法规（欧盟指令 2002/96/EC），欧洲电气设备使用者现在必须将废弃或到期的设备送还制造商进行处理，使用者不必支付任何费用。<br>***注：*** *如果退回产品是为了进行再循环，请联系设备生产商或供应商，索取如何退回使用寿命到期的设备、生产商提供的电源附件以及所有辅助部件的说明，以便进行适当处理。* |

## 认证

**加拿大无线电干扰产生设备法规（Canadian Radio Interference-Causing Equipment Regulation），IECS-003，A 类：**

制造商支持测试记录留存。

此 A 类数字设备符合加拿大干扰产生设备法规的所有要求。

Cet appareil numèrique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

**FCC 第 15 部分，“A”类限制**

制造商支持测试记录留存。该设备符合 FCC 规定第 15 部分的要求。设备操作满足以下两个条件：

1. 本设备不会造成有害干扰。
2. 本设备必须接受任何接收到的干扰，包括可能导致意外操作的干扰。

若未经负责出具符合声明的一方明确同意擅自对本设备进行改动或改装，可能会导致取消用户操作该设备的权限。本设备已经过测试，符合 FCC 规定第 15 部分中确定的 A 类数字设备限制。这些限制专门提供当设备在商业环境下工作时针对有害干扰的合理保护。该设备产生、使用和放射无线电射频能量，如果不按照说明手册的要求对其进行安装和使用，可能会对无线电通讯造成有害干扰。本设备在居民区工作时可能会产生有害干扰，这种情况下用户须自行承担费用消除这种干扰。以下方法可用于减少干扰问题：

1. 断开设备的电源，以便确证它是干扰源与否。
2. 如果设备与遭受干扰的仪器连接到相同的插座，将设备连接到其他插座。
3. 将设备从接受干扰的仪器边上移开。
4. 重新定位受干扰仪器的接收天线。
5. 同时尝试以上多项措施。

## 产品概述

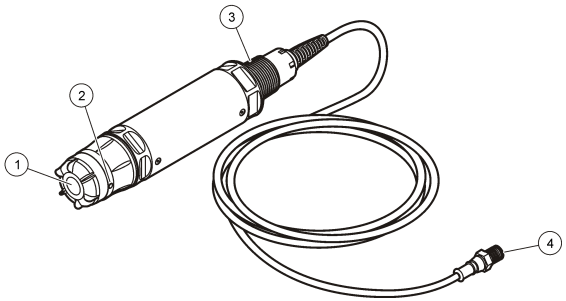
**⚠ 危险**

化学或生物危害。如果该仪器用于监测处理过程和/或监测有法规限制以及有与公众健康、公众安全、食品或饮料制造或加工相关监测要求的化学药物添加系统时，仪器的使用者有责任了解并遵守所有适用的法规，并且要建立适当的机制，确保在仪器发生故障的时候也不会违法这些法规。

此传感器旨在配合控制器使用，用于数据收集和操作。传感器可与多个控制器一同使用。请参阅控制器专用用户手册，了解详细信息。

该传感器主要应用于城市和工业废水的处理领域。LDO 传感器技术不会产生氧消耗，并且可测量低压或无流量应用下溶解氧的浓度。请参阅图 1。

**图 1 LDO 传感器**

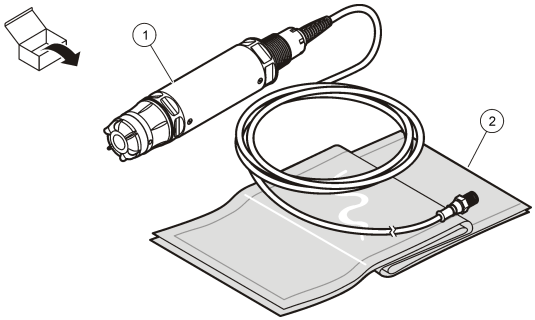



| | |
|---|---|
| **1** 传感器盖帽 | **3** 1 英寸 NPT |
| **2** 温度传感器 | **4** 连接器，快速连接（标准） |

## LDO 传感器组件列表

确保已收到图 2 中列出的所有组件。如有任何物品丢失或损坏，请立即联系制造商或销售代表。请参阅图 2。

**图 2 传感器组件列表**




| | |
|---|---|
| **1** LDO 传感器[1] | **2** 校准包（2 个） |

[1] 未显示随附的用户手册。

# 安装

**⚠ 警告**

存在人身伤害危险。只有合格的专业人员，才能从事手册此处所述的工作。

## 验证传感器类型

**⚠ 危险**

爆炸危险。仅连接明确标明为类别 1，第 2 子类危险场所的周边设备。

***注意***

经过认证的适用于危险场所的本产品型号不符合 94/9/EC 标准 （ATEX 标准）的要求。

1. 进入电缆连接器端。
2. 阅读电缆连接器端的标签。针对经认证可用于危险场所的传感器，标签上将显示“额定：类别 I，第 2 子类”。
3. 检查连接器。
   - 经认证可用于危险场所的传感器带有安全锁连接器。请参阅图 3 第 79。
   - 不适用于危险场所的传感器带有快速连接连接器，但没有安全锁。

## 在危险场所连接传感器

**⚠ 危险**

爆炸危险。本设备适用于非危险场所，或者当根据危险场所安装控制图进行安装时，适用于类别 1，第 2 子类，组 A、B、C、D 危险场所（配有指定的传感器和选配件）。请始终参阅控制图和相应的电气法规，了解有关正确安装的说明。

**⚠ 危险**

爆炸危险。除非已关闭电源或确认未处于危险区域，否则不得连接或断开设备的电气元件或电路。

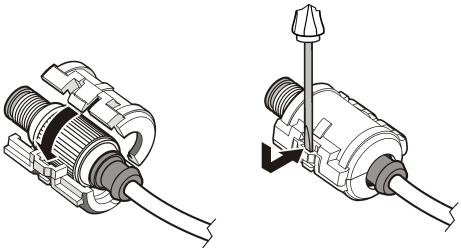
***注意***

在危险场所仅使用经过认证的危险场所适用的传感器和线缆锁。经过认证的适用于危险场所的本产品型号不符合 94/9/EC 标准 （ATEX 标准）的要求。

更多信息请参见验证传感器类型 第 78。

1. 从控制器上取下连接器帽。拆下传感器时，保持连接器帽将连接器开口封起。
2. 将传感器连接到控制器。请参考控制器手册，了解详细信息。
3. 锁定连接器上的安全锁。
4. 要卸下连接器安全锁，请使用小号平头螺丝刀。请参阅图 3。

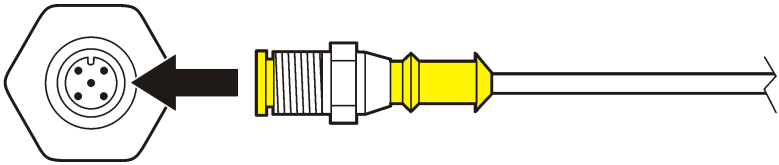
**图 3 连接器安全锁**



## 在非危险场所连接传感器

参阅图 4，将 LDO 传感器连接至 sc 控制器。有关硬接线说明，请参阅专门的 sc 控制器手册。

**图 4 连接 LDO 传感器（所示为非危险场所适用的传感器）**



连接传感器后，扫描传感器。请参阅安装传感器 第 79。

## 安装传感器

安装传感器有两种方式：

- 断开控制器电源时连接传感器。控制器开启后，将寻找并安装新的传感器。
- 接通控制器电源时连接传感器。使用 Scan Devices（扫描设备）命令安装新的传感器：

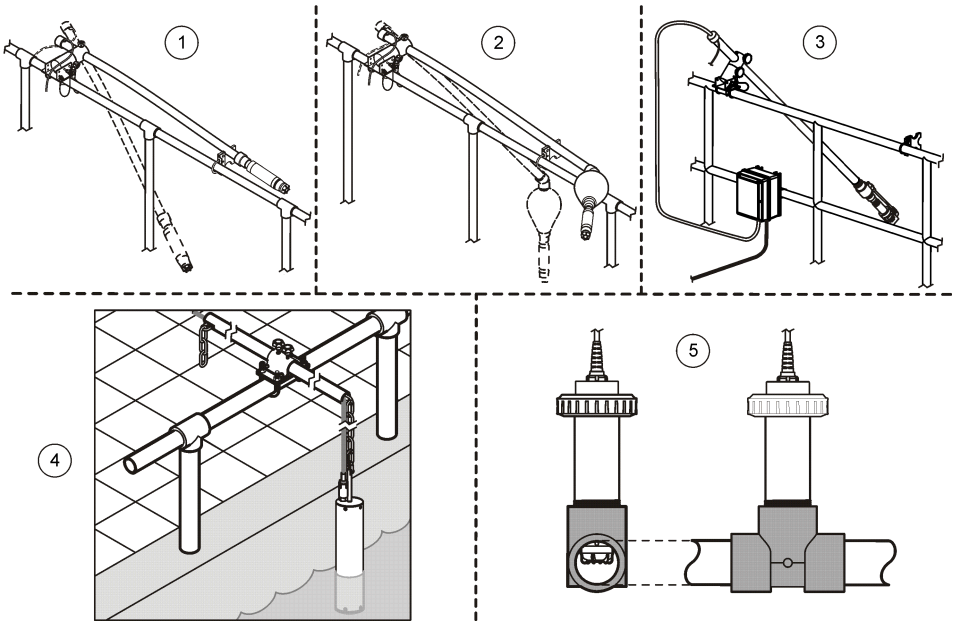
| 选项 | 说明 |
|---|---|
| **sc200 控制器** | 进入“MENU（菜单）>TEST/MAINT（测试/维护）>SCAN DEVICE（扫描设备）” |
| **sc100 控制器** | 进入“MENU（菜单）>TEST/MAINT（测试/维护）>SCAN SENSORS（扫描传感器）” |
| **sc1000 控制器** | 进入“MENU（菜单）>SYSTEM SETUP（系统设置）>DEVICE MANAGEMENT（设备管理）>SCANNING FOR NEW DEVICES（扫描新设备）” |

有关数字传感器连接，请参阅在非危险场所连接传感器 第 79。

## 传感器安装选项

LDO 传感器的安装和附件选项包含在硬件工具箱的安装说明中。图 5 显示多个安装选项。要订购安装硬件，请参阅 更换零件与附件 第 88。

**图 5 安装选项**




| | |
|---|---|
| **1** 导轨式安装 | **4** 链式安装 |
| **2** 浮点式安装 | **5** 管接式安装（不兼容海水探头） |
| **3** 鼓风系统安装（不兼容海水探头） | |

# 操作

## 用户导航

有关键盘说明和导航信息，请参阅控制器文档。

## 配置传感器

使用“Configure（配置）”菜单输入传感器的识别信息，或更改数据处理和存储的选项。

参阅 安装传感器 第 79，了解传感器安装信息。

确保应用的所有配置菜单值均正确。

1. 进入“MENU（菜单）>SENSOR SETUP（传感器设置）>[Select Sensor]（选择传感器）>CONFIGURE（配置）”。
2. 选择选项，然后按“ENTER（输入）。可供选项列表如下表所示。

| 选项 | 说明 |
| --- | --- |
| EDIT NAME（编辑名称） | 更改测量屏幕顶端上传感器对应的名称。名称限于字母、数字、空格或标点任何组合的 10 个字符。 |
| SET UNITS（设置单位） | TEMP（温度） - 将温度单位设置为 °C（默认值）或 °F。 |
| | MEASURE（测量） - 将测量单位设置为 mg/L、ppm 或 %。 |
| | ALT/PRESS（海拔/压力） - 将海拔单位设置为 m 或者 ft，或者将气压单位设置为 mmHg 或者 torr。（默认值 = 0 ft） |
| ALT/PRESS（海拔/压力） | 输入海拔或气压值该值必须准确以便完成 % 饱和度测量和空气校准。（默认值 = 0 ft）。 |
| SALINITY（盐度） | 输入盐度值。盐度范围：每一千为 0.00 至 250.00 （‰）。有关详细信息，请参考 输入盐度修正值 第 81。（默认值 = 0） |
| SIGNAL AVERAGE（信号平均） | 将信号平均的时间间隔设置为秒 |
| CLEAN INTRVL（清洗间隔） | 将手动清洗传感器的时间间隔设置为天（默认值 = 0 天。值为 0 天时，清洗间隔无效。） |
| RESET CLN INTRVL（重置清洗间隔） | 将时间间隔设置为最后一次保存的清洗间隔 |
| LOG SETUP（日志设置） | 设置数据日志中数据存储的时间间隔 - 0.5 分钟、1 分钟、2 分钟、5 分钟、10 分钟、15 分钟（默认值）、30 分钟和 60 分钟。 |
| SET DEFAULTS（设置默认值） | 恢复传感器配置默认值。切勿更改斜度或偏移量的设置。 |

## 输入气压值

工厂设置的气压为 0 ft，或海平面压力。要更改默认值，请采用本程序中的步骤。输入的调整气压为海拔或压力单位（优先使用）。

***注：*** *准确的气压对饱和空气校准至关重要（空气校准 第 83）。仅使用绝对压力，而非调整后的压力。如果绝对气压未知，请选择正确的海拔。*

1. 进入“MENU（菜单）>SENSOR SETUP（传感器设置）>[Select Sensor]（选择传感器）>CONFIGURE（配置）>SET UNITS（设置单位）>AIR PRESS（气压）/ALT UNITS（海拔单位）”。
2. 选择所列单位选项中的**一项**：

| 选项 | 说明 |
| --- | --- |
| **ft** | 英尺 - 海拔测量单位 |
| **m** | 米 - 海拔测量公制单位 |
| **mmHg** | 毫米汞柱 - 绝对气压测量公制单位 |
| **torr** | 绝对气压测量单位 |

3. 确认选项。值输入屏幕将显示所选的单位。
4. 输入值，然后确认。

## 输入盐度修正值

盐水样本中溶解氧的测量结果可能与实际的溶解氧的值有很大的不同。为了纠正样本中溶解盐的影响，应输入盐度修正系数。

***注：*** *如果过程溶液中的盐度值未知，请咨询处理部门的技术人员。*

1. 使用电导仪测量基准温度（20 °C 或者 68 °F）下样本的电导率，单位为 mS/cm。
2. 使用 表 1 估计千分率 （‰） 的盐度修正系数。

   ***注：*** *氯离子浓度等于样本中的含氯量，单位为 g/Kg。盐度的计算公式为：盐度 = 1.80655 × 含氯量。*

盐度可根据*水和废水检查的标准方法*中的 2520 B 部分计算。*,

3. 进入“MENU（菜单）>SENSOR SETUP（传感器设置）>[Select Sensor]（选择传感器）>CONFIGURE（配置）>SALINITY（盐度）”。
4. 输入盐度修正系数并确认。

**表 1 根据电导率值 (mS/cm) 测得的盐度饱和度 (‰)。**

| mS/cm | ‰ | mS/cm | ‰ | mS/cm | ‰ | mS/cm | ‰ |
|---|---|---|---|---|---|---|---|
| 5 | 3 | 16 | 10 | 27 | 18 | 38 | 27 |
| 6 | 4 | 17 | 11 | 28 | 19 | 39 | 28 |
| 7 | 4 | 18 | 12 | 29 | 20 | 40 | 29 |
| 8 | 5 | 19 | 13 | 30 | 21 | 42 | 30 |
| 9 | 6 | 20 | 13 | 31 | 22 | 44 | 32 |
| 10 | 6 | 21 | 14 | 32 | 22 | 46 | 33 |
| 11 | 7 | 22 | 15 | 33 | 23 | 48 | 35 |
| 12 | 8 | 23 | 15 | 34 | 24 | 50 | 37 |
| 13 | 8 | 24 | 17 | 35 | 25 | 52 | 38 |
| 14 | 9 | 25 | 17 | 36 | 25 | 54 | 40 |
| 15 | 10 | 26 | 18 | 37 | 26 | | |

## 为控制器配置线性输出

线性输出将探头数据发送回设备 PLC、SCADA 或其它数据收集系统。

1. 进入控制器输出设置菜单。

| 选项 | 说明 |
|---|---|
| **sc200** | 进入“MENU（菜单）>SETTINGS（设置）>sc200 SETUP（sc200 设置）>OUTPUT SETUP（输出设置）>[Select Output]（选择输出）>SET FUNCTION（设置功能）”。 |
| **sc100** | 进入“MENU（菜单）>SYSTEM SETUP（系统设置）>OUTPUT SETUP（输出设置）>[Select Output]（选择输出）>SET FUNCTION（设置功能）”。 |
| **sc1000** | 进入“MENU（菜单）>SYSTEM SETUP（系统设置）>OUTPUT SETUP（输出设置）>[Select Output]（选择输出）>SET FUNCTION（设置功能）”。 |

2. 设置控制器功能。

| 选项 | 说明 |
|---|---|
| **sc200** | 线性 |
| **sc100** | 线性控制（默认值） |
| **sc1000** | 线性控制（默认值） |

## Modbus 寄存器

Modbus 寄存器列表可供网络通信使用。有关详情，请访问 www.hach.com 或 www.hach-lange.com。

* *水和废水检查的标准方法*，第 20 版。编者 Lenore S. Clesceri、Arnold E. Greenberg 和 Andrew D. Eaton，2-48-2-29 页，（1998 年出版）。在同一文献中也说明了含氯量和氧溶解度的关系，4500-O:I，4-131 页。

# 测量校准

此传感器已校准至出厂规格。制造商并不建议校准，除非监管机构要求定期校准。如要求校准，则校准前应让传感器与过程溶液达到平衡。设置时切勿校准传感器。

表 2 列出了校准选项

**表 2 校准选项**

| 选项 | 说明 |
|---|---|
| AIR CAL（空气校准） | 建议的校准方法。这类校准会改变斜度。 |
| SAMPLE CAL（样品校准） | 通过与手持型溶氧仪对比进行校准。这类校准会改变偏差。 |
| 重置偏转校准值 | 将校准增益（斜度）和偏差重置为工厂默认值：默认增益=1.0；默认偏差=0.0 |

## 空气校准

**用户注意事项：**

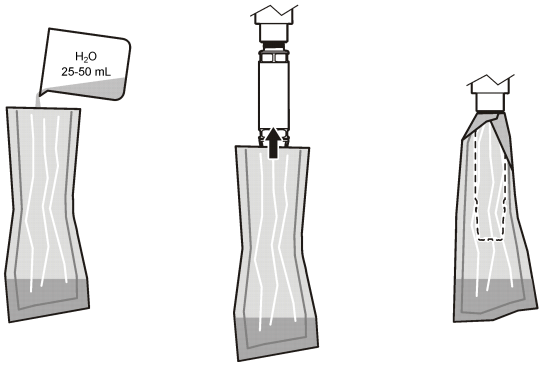
- 确保校准包内有水。
- 确保校准包和传感器机体之间密封牢固。
- 校准时，确保传感器干燥。
- 确保校准地点空气压力和高度设置准确。
- 留出足够的时间使传感器温度稳定在校准包所处位置的温度。可能需要 15 分钟才能消除过程溶液和校准地点之间较大温差。

1. 从过程溶液中取出传感器。使用湿抹布清洁传感器。
2. 将整个传感器置于盛有 25 - 50 毫升水的校准包中。确保传感器盖帽未接触校准包中的水，并且盖帽上没有水珠（图 6）。
3. 用橡皮筋、绑带或徒手将传感器牢固密封。
4. 校准前让仪器稳定 15 分钟。仪器稳定期间，应避免校准包受到阳光直射。
5. 确保当前绝对气压或高度配置正确。请参阅输入气压值 第 81。

   ***注：*** *制造商建议将使用绝对或实际气压作为最佳使用方法。*
6. 进入 MENU（菜单）>SENSOR SETUP（传感器设置）>[Select Sensor]（选择传感器）>CALIBRATE（校准）>AIR CAL（空气校准）。
7. 在校准过程中选择输出信号的选项：

   | 选项 | 说明 |
   |---|---|
   | **ACTIVE（有效）** | 仪器在校准过程中发送当前测量的输出值。 |
   | **Hold（保持）** | 传感器输出值在校准过程中保持为当前测量值。 |
   | **Transfer（转换）** | 在校准过程中发送预设值。要更改预设值，请参阅控制器用户手册。 |
8. 控制器将显示“将探头移至校准包”。等待数值稳定。按 ENTER（输入）接受该稳定值。或者，持续校准直至显示屏显示“完成”。
9. 校准完成后，将传感器放入过程溶液中。按“Enter（输入）”。

**图 6 空气校准程序**




如果值未稳定，显示屏将显示“无法校准”并提供错误信息。表 3 显示错误信息和解决校准问题的方案。

**表 3 空气校准错误信息**

| 信息 | 说明 | 解决方案 |
|---|---|---|
| 校准失败，增益值高 | 校准增益值过高。 | 重复校准。 |
| 校准失败，增益值低 | 校准增益值过低。 | 重复校准。 |
| 校准失败，不稳定 | 在允许的最长校准时间内值未稳定。 | 重复校准。 |

## 样本校准 - 通过比较进行校准

此校准方法使用连接到手持式仪表的备用传感器。

1. 将备用传感器放入过程溶液中。使第二个传感器尽可能接近第一个传感器。
2. 等待溶解氧的值稳定。
3. 在第一个传感器的控制器上，进入“MENU（菜单）>SENSOR SETUP（传感器设置）>[Select Sensor]（选择传感器）>CALIBRATE（校准）>SAMPLE CAL（样本校准）”。
4. 在校准过程中选择输出信号的选项：

| 选项 | 说明 |
|---|---|
| **ACTIVE（有效）** | 仪器在校准过程中发送当前测量的输出值。 |
| **Hold（保持）** | 传感器输出值在校准过程中保持为当前测量值。 |
| **Transfer（转换）** | 在校准过程中发送预设值。要更改预设值，请参阅控制器用户手册。 |

5. 控制器将显示：
   - “稳定后请按 ENTER（确认）”
   - 测量当前溶解氧
   - 测量当前温度
6. 测量值稳定后，按“ENTER（输入）”。显示屏将显示进入屏幕。

   ***注：*** *测量值通常在 2 至 3 分钟内稳定。*

如果值未稳定，显示屏将显示“无法校准”并提供错误信息。表 4 显示错误信息和解决校准问题的方案。

表 4 样本校准错误信息

| 信息 | 说明 | 溶液 |
|---|---|---|
| 校准失败，偏差高 | 校准偏差值过高。 | 重复校准。 |
| 校准失败，偏差低 | 校准偏差值过低。 | 重复校准。 |
| 校准失败，不稳定 | 在允许的最长校准时间内值未稳定。 | 重复校准。 |

## 退出校准程序

1. 校准期间，按下“BACK（退回）”键。将显示三个选项：

| 选项 | 说明 |
|---|---|
| **ABORT（中止）** | 停止校准。新校准必须从头开始。 |
| **BACK TO CAL（后退到校准）** | 返回至当前校准。 |
| **LEAVE（离开）** | 暂时退出校准。校准在后台继续时，可访问其他菜单。可开始另一个传感器（如有）的校准。要返回到校准，按 MENU（菜单）键，然后选择 Sensor Setup（传感器设置）、[Select Sensor]（选择传感器）。 |

2. 选择一个选项。确认。

## 重设校准默认值

将校准设置重置为工厂默认值。将增益和偏差分别设为 1.0 和 0.0。

1. 进入“MENU（菜单）>SENSOR SETUP（传感器设置）>[Select Sensor]（选择传感器）>CALIBRATE（校准）>RESET CAL DEFLT（重设校准默认值）”。
2. 显示屏将显示确认信息。确认以将传感器重设为工厂默认校准曲线。

# 维护

**⚠ 危险**

多种危险。只有合规的专业人员才能从事文档中本部分所述的任务。

**⚠ 危险**

**爆炸危险。** 除非已关闭电源或确认未处于危险区域，否则不得连接或断开设备的电气组件或电路。

**⚠ 危险**

**爆炸危险。**替换组件可能降低对类别 1，第 2 子类危险场所的适宜性。不要更换任何组件，除非已关闭电源并确认未处于危险区域。

***注意***

经过认证的适用于危险场所的本产品型号不符合 94/9/EC 标准 （ATEX 标准）的要求。

## 维护计划

维护计划显示例行维护任务的最短间隔。对于会造成电极污损的应用，应更加频繁地执行维护任务。

***注：*** *请勿拆卸探头进行维护或清洗。*

| 维护任务 | 建议的最小维护频率 |
|---|---|
| 清洗传感器 | 90 天 |
| 检查传感器是否损坏 | 90 天 |
| 校准传感器 | 根据管制机构的建议进行校准 |

## 清洗传感器

使用柔软的湿布清洗传感器的外部。
***注：*** *如果必须移去传感器盖帽进行清洁，切勿将盖帽内部过长时间直接置于阳光下。*

## 设置或更改清洗间隔

应用条件可能需要按更短或更长的间隔手动清洗传感器。默认清洗时间间隔为 0 天。要更改时间间隔，请参阅本程序中的步骤。

1. 进入“MENU（菜单）>SENSOR SETUP（传感器设置）>[Select Sensor]（选择传感器）>CONFIGURE（配置）>CLEAN INTRVL（清洗间隔）”。
2. 如有需要，更改所列值。确认更改。
   - 要关闭清洗间隔，将值设为“0”。

## 更换传感器盖帽

| ⚠ 警告 | |
|---|---|
| | 可能存在爆炸危险。传感器设置盖帽不适用于危险区域。 |

替代传感器盖帽和设置盖帽随安装说明一起发运。参阅随附的说明更换盖帽。
为了达到最佳性能和准确性，按以下说明更换传感器盖帽：

- 每两年更换一次
- 例行检查发现传感器盖帽出现严重腐蚀时

# 故障排除

## 诊断和测试菜单

诊断和测试菜单显示有关 LDO 传感器的当前和历史记录信息。
要访问诊断和测试菜单，进入“MENU（菜单）>SENSOR SETUP（传感器设置）>[Select Sensor]（选择传感器）>DIAG/TEST（诊断/测试）”。

请参阅表 5。

**表 5 诊断/测试菜单**

| 选项 | 说明 |
|---|---|
| SENSOR INFO（传感器信息） | SOFTWARE VERS（软件版本） - 显示安装的软件版本 |
| | BOOT VERSION（引导版本） - 显示安装的引导版本 |
| | DRIVER VERS（驱动程序版本） - 显示安装的驱动程序版本 |
| LOT CODE（批号） | 显示传感器盖帽生产批号 |
| SERIAL NUMBER（序列号） | 传感器序列号 |

**表 5 诊断/测试菜单 （续）**

| 选项 | 说明 |
|---|---|
| GAIN CORR（增益校正） | 调整校准增益值。 |
| | 范围：0.50 至 2.00 |
| OFFSET CORR（偏差校正） | 调整校准偏差值（mg/L 或 ppm）。 |
| | 范围：–3.00 至 +3.00 |
| PHASE DIAG（相位诊断） | 显示全部、红色和蓝色波长的相位。每秒更新一次。 |
| AMPL DIAG（放大器诊断） | 显示红色和蓝色波长的振幅。每秒更新一次。 |
| DAYS TO CLEAN（清洗间隔） | 显示直至下一次手动清洗的天数。 |
| SENSOR LIFE（传感器寿命） | 显示直至下一次传感器盖帽更换的天数 |

## 错误列表

如果出现错误，测量屏幕上的读数将闪烁。控制器设置决定输出行为。请参阅控制器手册，了解详细信息。

要显示当前传感器错误，请进入“MENU（菜单）>DIAGNOSTICS（诊断）>[Select Sensor]（选择传感器）>ERROR LIST（错误列表）”。请参阅表 6。

**表 6 LDO 传感器错误列表**

| 错误 | 可能的原因 | 解决方案 |
|---|---|---|
| 红色振幅低（值低于 0.01）<br>或者<br>蓝色振幅低（值低于 0.01） | 传感器盖帽未安装或安装不正确。 | 卸下传感器盖帽并重新安装。 |
| | 传感器盖帽内的光通路受阻。 | 检查传感器盖帽内部和透镜。 |
| | 传感器未正确运行。 | 确保 LED 闪烁。联系制造商。 |

## 警告列表

当警告图标闪烁（sc100 和 sc200）或屏幕变成黄色（sc1000）时，一条信息将显示在测量屏幕底部。在 sc1000 上，屏幕变成黄色表示警告。要显示当前传感器警告，进入“MENU（菜单）> DIAGNOSTICS（诊断）>[Select Sensor]（选择传感器）>WARNING LIST（警告列表）”。请参阅表 7。

**表 7 传感器警告列表**

| 警告 | 定义 | 溶液 |
|---|---|---|
| EE SETUP ERR（EE 设置错误） | 存储出错。值已设置为出厂默认值。 | 请联系技术支持部门。 |
| EE RSRVD ERR（EE RSRVD 错误） | | |
| TEMP < 0 C（温度低于 0 °C） | 过程溶液温度低于 0 °C (32 °F) | 增加过程溶液温度或停止使用，直到过程溶液温度达到传感器规定的范围。 |
| TEMP > 50 C（温度大于 50 °C） | 过程溶液温度高于 50 °C (120 °F) | 降低过程溶液温度或停止使用，直到过程溶液温度达到传感器规定的范围。 |
| RED AMPL LOW（红色振幅低） | 值下降到 0.03 以下 | 请参阅表 6 第 87。 |
| RED AMPL HIGH（红色振幅高） | 值大于 0.35 | 请致电技术支持部门。 |
| BLUE AMPL LOW（蓝色振幅低） | 值低于 0.03 | 请参阅表 6 第 87。 |

**表 7 传感器警告列表 （续）**

| 警告 | 定义 | 溶液 |
|---|---|---|
| BLUE AMPL HIGH（蓝色振幅高） | 值大于 0.35 | 请致电技术支持部门。 |
| CAP CODE FAULT（盖帽代码错误） | 传感器盖帽代码出错。代码已自动重设为默认盖帽代码和批号。 | 完成传感器设置盖帽程序。如果传感器盖帽没有可用的设置盖帽，请致电技术支持部门。 |

## 事件列表

事件列表以日志的形式保留了传感器记录数据方式的改变。要显示传感器事件，进入“MENU（菜单）>DIAGNOSTICS（诊断）>[Select Sensor]（选择传感器）>EVENT LIST（事件列表）”。请参阅表 8。

**表 8 传感器事件列表**

| 事件 | 说明 |
|---|---|
| ALT/PRESSURE UNIT CHANGE（海拔/压力单位变更） | 气压或海拔单位发生变更。 |
| ALT/PRESSURE CHANGE（海拔/气压变更） | 海拔值或气压值发生变更。 |
| TEMP UNIT CHANGE（温度单位变更） | 温度单位发生变更。 |
| MEAS UNIT CHANGE（测量单位变更） | 新的测量单位发生变更。 |
| SALINITY CHANGE（盐度变化） | 盐度值发生变化。 |
| SET DEFAULT（设置默认值） | 传感器设置已重置为默认值。 |
| SENSOR SETUP CHANGE（传感器设置变更） | 传感器设置发生变更。 |
| CLEAN INTERVAL TIMER CHANGE（清洗间隔计时器变更） | 传感器清洗时间发生变更。 |
| SENSOR CAP LIFE TIMER CHANGE（传感器盖帽寿命计时器变更） | 传感器盖帽更换时间发生变更。 |

# 更换零件与附件

请仅使用经制造商批准的更换部件。使用未经批准的部件可能造成人身伤害、仪器损坏或设备故障。

### 备换物品

| 说明 | 物品编号（美国/欧盟） |
|---|---|
| LDO 探头，带 1 个传感器盖帽和 2 个校准包 | 9020000 / LXV416.99.20001 |
| 用于在海水中使用的 LDO 探头，带 1 个传感器盖帽和 2 个校准包 | 9020000-SW / — |
| 用于海水危险场所的 LDO 探头，带 1 个传感器盖帽和 2 个校准包 | 9020000-C1D2-SW / — |
| 用于危险场所的 LDO 探头，带 1 个传感器盖帽和 2 个校准包 | 9020000-C1D2 / — |
| 传感器盖帽，更换（包括传感器设置盖帽，不适合在 1 类第 2 子类危险场所使用） | 9021100 / 9021150 |

### 配件

| 说明 | 物品编号（美国/欧盟） |
|---|---|
| 适用于危险场所的传感器线缆锁 | 6139900 / — |
| 电缆，传感器延伸线，类别 1，第 2 子类危险场所，1 m (3.3 ft) | 6122402 / — |
| 电缆，传感器延伸线，类别 1，第 2 子类危险场所，7m (23 ft) | 5796002 / — |
| 电缆，传感器延伸线，类别 1，第 2 子类危险场所，15 m (49.21 ft) | 5796102 / — |

| 说明 | 物品编号（美国/欧盟） |
| --- | --- |
| 电缆，传感器延伸线，类别 1，第 2 子类危险场所，31 m (101.71 ft) | 5796202 / — |
| 高输出空气清洗系统，115 V（不适用于危险场所） | 6860000 / 6860003.99.0001 |
| 高输出空气清洗系统，230 V（根据 ATEX，不适用于危险场所） | 6860100 / 6860103.99.0001 |
| 校准包 （1x） | 5796600 / 5796600 |
| 电缆，传感器延伸线，非危险场所，7.7 m (25 ft)[1] | 美国：5796000，7.7 m (25 ft) |
| | 欧盟：LZX849，10 m (33 ft) |
| 管式安装的硬件工具箱 （PVC） | 9253000 / LZY714.99.21810 |
| 浮点式安装的硬件工具箱 （PVC） | 9253100 / LZX914.99.42200 |
| 鼓风式安装的硬件工具箱 | 9253500 / LZY812 |
| 链式安装的硬件工具箱（不锈钢） | — / LZX914.99.11200 |
| 联合安装的硬件工具箱 | 9257000 / 9257000 |
| 具有 LDO 耐用探头的 HQd 仪表（不适用于危险场所） | 8505200 / HQ40D.99.310.000 |

[1] 15 m (49 ft) 和 30 m (98 ft) 也适用

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# 仕様

この仕様は予告なく変更されることがあります。

| 項目 | 仕様 |
|---|---|
| 接液面の材質 | 標準プローブ、標準 Class 1-Div 2 プローブ<br>• CPVC、センサ端およびケーブル端<br>• ポリウレタン、ケーブル端のオーバーモールド部およびケーブルジャケット<br>• 316 ステンレススチールの本体とねじ<br>• バイトン、O リング<br>• ノリル、ケーブル端のナット |
| | 標準海水用プローブ、海水用 Class 1-Div 2 プローブ<br>• CPVC、センサ端およびケーブル端<br>• ポリウレタン、ケーブル端のオーバーモールド部およびケーブルジャケット<br>• PVC 海水用本体<br>• 海水用エポキシシーラント<br>• ノリル、ケーブル端のナット |
| IP 等級 | IP68 |
| 接液面の材質 (センサキャップ) | アクリル |
| 測定範囲 (溶存酸素) | 0 ～ 20 ppm (0 ～ 20 mg/L) |
| | 0 ～ 200 % |
| 測定精度 (溶存酸素) | 5 ppm 未満: ± 0.1 ppm |
| | 5 ppm 以上: ± 0.2 ppm |
| 繰り返し精度 (溶存酸素) | 0.1 ppm (mg/L) |
| 応答時間 (溶存酸素) | $T_{90}$<40 秒 |
| | $T_{95}$<60 秒 |
| 分解能、センサ (溶存酸素) | 0.01 ppm (mg/L)、0.1% 飽和 |
| 温度測定範囲 | 0 ～ 50 ℃ |
| 測定精度 (温度) | ± 0.2°C |
| 妨害物質 | 次の物質について妨害を受けないことを確認: $H_2S$、pH, $K^+$、$Na^+$、$Mg^{2+}$、$Ca^{2+}$、$NH_4^+$、$Al^{3+}$、$Pb^{2+}$、$Cd^{2+}$、$Zn^{2+}$、Cr (全)、$Fe^{2+}$、$Fe^{3+}$、$Mn^{2+}$、$Cu^{2+}$、$Ni^{2+}$、$Co^{2+}$、$CN^-$、$NO_3^-$、$SO_4^{2-}$、$S^{2-}$、$PO_4^{3-}$、$Cl^-$、陰イオン界面活性剤、原油、$Cl_2$ < 4 ppm |
| 保管温度 | -20 ～ 70 °C |

| 項目 | 仕様 |
|---|---|
| 最大温度 | 0 ～ 50 °C |
| 危険区域対応分類 (9020000-C1D2 センサのみ) | Class I Division 2、Groups A - D、T4 / Class I、Zone 2 Group 2C、T4<br>***注:*** *本製品は、94/9/EC 指令 (ATEX 指令) の要件は満たしていません。* |
| 認証 (9020000-C1D2 センサのみ) | 危険区域での使用に関する ANSI/ISA、CSA、FM 規格に準じた ETL 認証取得済み。<br>***注:*** *本製品は、94/9/EC 指令 (ATEX 指令) の要件は満たしていません。* |
| 最小流量 | 不要 |
| 校正/検証 | 空気中校正: 1 点、100 % 水蒸気飽和空気 |
| | 試料校正: 標準装置との比較 |
| 最大プローブ浸漬深さ/圧力 | 圧力上限 (34 m の場合)、最大 345 kPa (50 psi)。この深度では確度が保持されない可能性があります |
| センサケーブル | 10 m の統合ケーブル、クイック分離プラグ付き (すべてのセンサタイプ)<br>延長ケーブルを使用して最大 100 m まで延長可能 (非 Class I, Division 2 センサタイプのみ)<br>接続ボックスを使用して最大 1000 m まで延長可能 (非 Class I, Division 2 センサタイプのみ) |
| プローブ重量 | 1.0 kg |
| プローブの寸法 | 標準プローブ (直径 x 長さ): 49.53 x 255.27 mm |
| | 海水用プローブ (直径 x 長さ): 60.45 x 255.27 mm |
| 電源 | 12 VDC、0.25 A、3 W |
| 保証 | プローブ: 製造上の欠陥に対して 3 年間 |
| | センサキャップ: 製造上の欠陥に対して 2 年間 |

## 総合情報

いかなる場合も、製造元は、例えそのような損害が生じる可能性について報告を受けていたとしても、本マニュアルに含まれるいかなる瑕疵または脱落から生じる直接的、間接的、特定、付随的または結果的に生じる損害に関して責を負いません。製造元は、通知または義務なしに、随時本マニュアルおよび製品において、その記載を変更する権利を留保します。改訂版は、製造元の Web サイト上にあります。

## 安全情報

| *告知* |
|---|
| メーカーは、本製品の目的外使用または誤用に起因する直接損害、偶発的損害、結果的損害を含むあらゆる損害に対して、適用法で認められている範囲で一切責任を負わないものとします。ユーザーは、適用に伴う危険性を特定したり、装置が誤作動した場合にプロセスを保護するための適切な機構を設けることに関して、全責任を負うものとします。 |

この機器の開梱、設定または操作を行う前に、このマニュアルをすべてよく読んでください。危険および注意の注意事項に注意を払ってください。これを怠ると、オペレータが重傷を負う可能性、あるいは機器が損傷を受ける可能性があります。

本装置に備わっている保護機能が故障していないことを確認します。本マニュアルで指定されている以外の方法で本装置を使用または設置しないでください。

## 危険情報の使用

**⚠ 危険**

回避しなければ死亡または重傷につながる、潜在的または切迫した危険な状況を示します。

**⚠ 警告**

避けない場合、死亡事故や負傷が起こるかも知れない危険な状況を示します。

**⚠ 注意**

軽傷または中傷事故の原因となる可能性のある危険な状況を示しています。

***告知***

回避しなければ、装置の損傷を引き起こす可能性のある状況を示します。 特に注意を要する情報。

## 使用上の注意ラベル

測定器上に貼付されたラベルや注意書きを全てお読みください。これを怠ると、人身傷害や装置の損傷につながるおそれがあります。測定器に記載されたシンボルは、使用上の注意と共にマニュアルを参照してください。

| | |
|---|---|
| | これは安全警報シンボルです。潜在的な障害を避けるためにこのシンボルのすべて安全メッセージに従ってください。 装置上では、作業または安全情報に関しては取り扱い説明書を参照してください。 |
| | このシンボルは、軽微な眼に障害を引き起こす可能性がある光源が存在することを示します。眼の障害を回避するように、このシンボルに伴われているすべてメッセージに従ってください。 |
| | このシンボルは静電気放電 (ESD) に敏感なデバイスがあることを示しています。このため、機器の破損を防止する措置をとることが必要です。 |
| | このシンボルが表示された電気機器は、欧州廃棄システムにより 2005 年 8 月 12 日以降の廃棄処分が禁じられています。欧州地域規制および国内規制 (EU 指令 2002/96/EC) に従い、欧州の電気機器ユーザーは古くなったまたは使い切った機器をメーカーに無償返却する必要があります。<br>***注:*** *リサイクル用にご返却になる場合には、機器メーカーまたは供給者にご連絡の上、使い切った機器、メーカー供給による電気アクセサリーおよび予備品を適切に処分するための返却方法をご確認ください。* |

## 取得認証

**カナダの障害発生機器規則、IECS-003、クラス A**:

テスト記録のサポートはメーカーにあります。

このクラス A デジタル装置はカナダの障害発生機器規則の要件をすべて満たします。

Cet appareil numèrique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

**FCC PART 15、クラス 「A」 限度値**

テスト記録のサポートはメーカーにあります。この機器は FCC 規則のパート 15 に準拠します。運転は以下の条件を前提としています:

1. この装置が有害な干渉の原因とならないこと。
2. この装置が望ましくない動作の原因となる可能性のあるいかなる干渉にも対応しなければなりません。

これらの規格への準拠に責任を持つ当事者による明示的承認を伴わなずにこの装置に対する改変または改造を行うと、ユーザーはこの機器を使用する権限を失う可能性があります。 この装置は、FCC 規則のパート 15 に従って、クラス A のデジタル機器の制限に準拠することが試験によって確認され

ています。これらの制限は、この機器が商用の環境で使用されたときに、有害な干渉から適切に保護することを目的に設定されています。この機器は、無線周波数エネルギーを生成および使用するもので、取り扱い説明書に従って取り付けおよび使用しない場合にはそれを放射する場合があり、無線通信に対して有害な干渉を発生させる可能性があります。住宅地域における本装置の使用は有害な電波妨害を引き起こすことがあり、その場合ユーザーは自己負担で電波妨害の問題を解決する必要があります。以下の手法が干渉の問題を軽減するために使用可能です。

1. 装置から電源を取り外して、電源が干渉源かどうかを確認します。
2. 装置が干渉を受けている装置と同じコンセントに接続されている場合は、装置を別のコンセントに接続してください。
3. 妨害を受けている装置から本装置を離します。
4. 干渉を受けるデバイスの受信アンテナの位置を変更します。
5. 上記の手法を組み合わせてみます。

## 製品概要

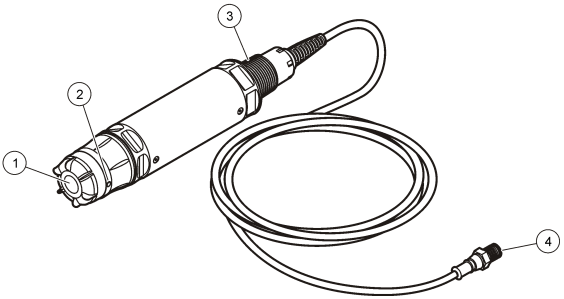
**⚠ 危険**

化学的および生物学的な危険。この装置の用途が処理工程や薬液注入システムの監視であり、それらに対して公衆衛生、公衆安全、食品/飲料の製造/加工に関する規制や監視要件が存在する場合、この装置の使用者には、該当するすべての規制を把握して遵守する責任、および装置の異常時に関する当該規制に従って十分かつ適切な措置を講じる責任があります。

このセンサはデータ収集と操作のために変換器と接続するように設計されています。センサは、複数の変換器で使用できます。詳細は、変換器固有のユーザーマニュアルを参照してください。

このセンサの主な用途は、公共および産業廃水用途です。LDO センサ技術は、酸素を消費せず、低流量または流速なしの条件で DO 濃度を測定できます。図 1 を参照してください。

**図 1 LDO センサ**

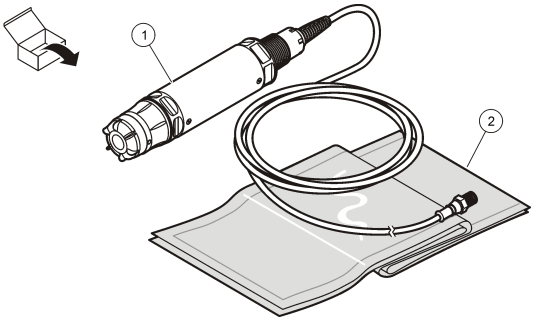



| | |
|---|---|
| **1** センサキャップ | **3** 1 インチ NPT |
| **2** 温度センサ | **4** コネクタ、クイックコネクト (標準) |

## LDO センサコンポーネントのリスト

図 2 に示しているすべてのコンポーネントがあることを確認します。コンポーネントが不足していたり損傷していたりした場合は、直ちに HACH 販売代理店にお問い合わせください。図 2 を参照してください。

**図 2 センサコンポーネントのリスト**




| | |
|---|---|
| **1** LDO センサ[1] | **2** 校正バッグ (2 袋) |

[1] 付属のユーザーマニュアルは図示していません。

## 設置

**⚠ 警告**

人体損傷の危険。マニュアルのこのセクションに記載されている作業は、必ず資格のある要員が行う必要があります。

### センサタイプの確認

**⚠ 危険**

爆発の危険。Class 1、Division 2 危険区域での使用の認可を受けた周辺装置にのみ接続してください。

***告知***

本製品の危険区域での使用の認可を受けたバージョンは、94/9/EC 指令 (ATEX 指令) の要件を満たしません。

1. ケーブルのコネクタ端を手に取ります。
2. ケーブルのコネクタ端に付いているラベルを確認します。危険区域での使用の認可を受けたセンサの場合、ラベルには「Rated: Class 1 Division 2 (Class 1 Division 2 対応)」と表示されています。
3. コネクタを確認します。
   - 危険区域での使用の認可を受けたセンサには、安全ロックコネクタが付いています。図 3 ページの 95 を参照してください。
   - 危険区域での使用の認可を受けていないセンサには、クイックコネクトコネクタが付いていて、安全ロックは付いていません。

## 危険区域でのセンサの接続

**⚠ 危険**

爆発の危険。この装置は、危険区域以外の場所、または Class 1、Division 2、Groups A、B、C 、D の危険区域で、危険区域での設置管理図面に従って設置された場合、指定のセンサとオプションと共に使用するのに適しています。設置の際は、管理図面と該当する電気法規を必ず参照してください。

**⚠ 危険**

爆発の危険。電源が切り離され、作業区域が安全であることが確実である場合以外は、電子部品の取り付けと取り外し、また電子回路の接続と切断は行わないでください。

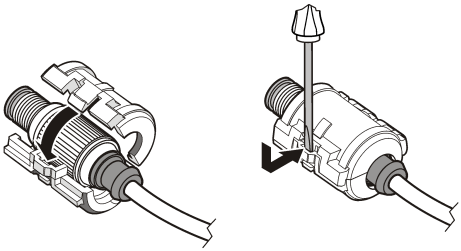
***告知***

危険区域では、必ず危険区域での使用の認可を受けたセンサおよびケーブルロックを使用してください。本製品の危険区域での使用の認可を受けたバージョンは、94/9/EC 指令 (ATEX 指令) の要件を満たしません。

詳細はセンサタイプの確認 ページの 94 を参照してください。

1. コネクタキャップを変換器から外します。センサを取り外したときにコネクタの開口部をふさぐことができるように、コネクタキャップは保管しておきます。
2. センサを変換器に接続します。詳細は、変換器の取扱説明書を参照してください。
3. コネクタを覆うようにして安全ロックを閉じます。
4. コネクタの安全ロックを取り外すには、小さなマイナスドライバーを使用します。図 3 を参照してください。

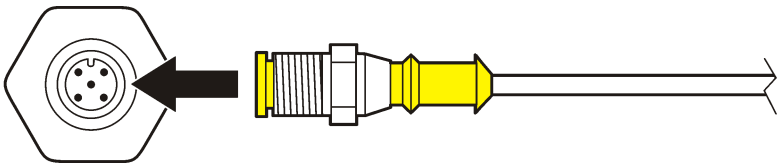
**図 3 コネクタの安全ロック**



## 非危険区域でのセンサの接続

LDO センサを変換器に接続する方法については 図 4 を参照してください。結線方法については、変換器のマニュアルを参照してください。

**図 4 LDO センサの接続 (非危険区域でのセンサの図)**



センサを取り付けた後に、センサをスキャンします。センサの取り付け ページの 95 を参照してください。

## センサの取り付け

次の 2 つの方法でセンサを設置できます。

- 変換器の電源がオフの状態でセンサを接続する。変換器の電源がオンになったときに、変換器は新しいセンサを検索し、それをインストールします。
- 変換器の電源がオンの状態でセンサを接続する。Scan Devices (デバイスのスキャン) コマンドを使用して、新しいセンサをインストールします。

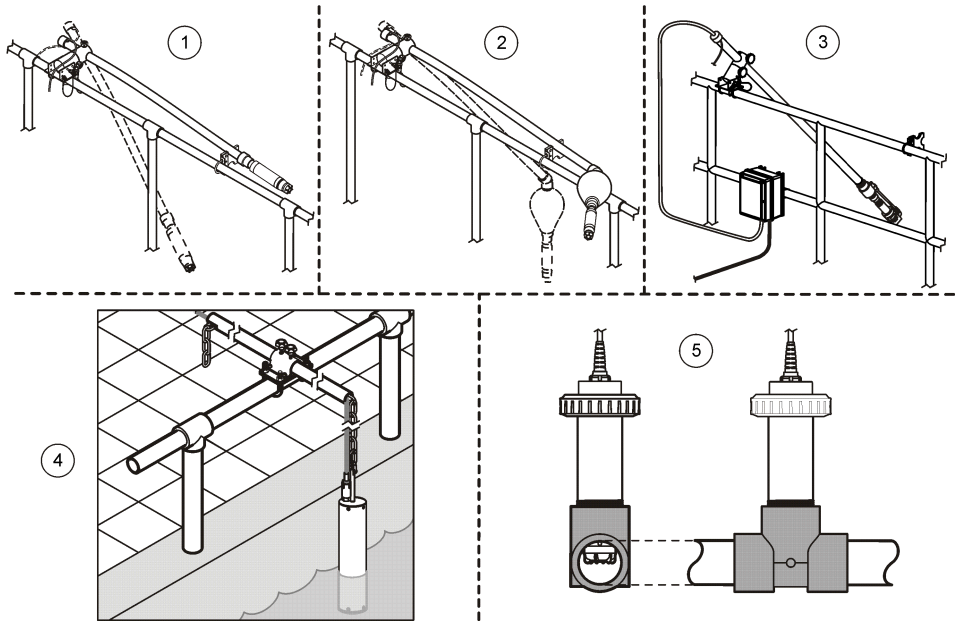
| オプション | 説明 |
|---|---|
| **sc200 変換器** | [MENU (メニュー)] >[TEST/MAINT (テスト/メンテナンス)] > [SCAN DEVICE (デバイスのスキャン)] に進みます |
| **sc100 変換器** | [MENU (メニュー)] >[TEST/MAINT (テスト/メンテナンス)] > [SCAN SENSORS (センサスキャン)] に進みます |
| **sc1000 変換器** | [MENU (メニュー)] >[SYSTEM SETUP (システム設定)] > [DEVICE MANAGEMENT (デバイス管理)] > [SCANNING FOR NEW DEVICES (新しいデバイスのスキャン)] に進みます |

デジタルセンサの接続方法については、非危険区域でのセンサの接続 ページの 95 を参照してください。

## センサ設置オプション

LDO センサ用の設置およびアクセサリオプションには、ハードウェアキットに取扱説明書が付属されています。図 5 に、いくつかの設置オプションを示します。ハードウェアを設置する方法については、交換部品とアクセサリ ページの 106 を参照してください。

**図 5 設置オプション**




| | |
|---|---|
| **1** レール取り付け | **4** チェーン取り付け |
| **2** フロート式 | **5** ユニオン式 (海水用プローブには対応していません) |
| **3** 空気洗浄式 (海水用プローブには対応していません) | |

# 操作

## ユーザーナビゲーション

キーパッドの説明とナビゲーション情報は変換器の説明書を参照してください。

## センサの設定

設定メニューを使って、センサの識別情報を入力し、また、データ処理と保存に関するオプションを変更します。

センサの設置方法については、センサの取り付け ページの 95 を参照してください。

設定メニューのすべての値が、用途に適した正しい値であることを確認してください。

1. [MENU (メニュー)] > [SENSOR SETUP (センサの設定)] > [<センサを選択>] > [CONFIGURE (設定)] に進みます。
2. オプションを選択して、ENTER を押します。選択可能なオプションのリストを以下の表に示します。

| オプション | 説明 |
|---|---|
| EDIT NAME (名前の編集) | 測定画面の上部に表示されるセンサの名前を変更します。名前は 10 文字以内で指定でき、文字、数字、スペース、句読点を組み合わせることができます。 |
| SET UNITS (単位の設定) | TEMP (温度) - 単位を °C (デフォルト) または °F に設定します。 |
| | MEASURE (測定) - 測定単位を mg/L、ppm、または % に設定します。 |
| | ALT/PRESS (高度/圧力) - 高度をメートルまたはフィート単位で設定するか、気圧の単位を mmHg または torr 単位で設定します。(デフォルト値 = 0 フィート) |
| ALT/PRESS (高度/圧力) | 高度または気圧の値を入力します。% 飽和測定と空気中校正を実行するには、この値が正確でなければなりません。(デフォルト = 0 フィート)。 |
| SALINITY (塩分) | 塩度値を入力します。塩度範囲: 0.00 ～ 250.00 ppt (‰、千分率)。詳細は、塩分補正値の入力 ページの 98 を参照してください。(デフォルト値 = 0) |
| SIGNAL AVERAGE (信号の平均化) | 信号を平均化する時間を秒単位で設定します |
| CLEAN INTRVL (洗浄間隔) | 手動でのセンサ洗浄間隔を日単位で設定します。 (デフォルト値 = 0 日。値が 0 日の場合、洗浄間隔は無効になります) |
| RESET CLN INTRVL (洗浄間隔リセット) | 間隔を前回保存した洗浄間隔に設定します |
| LOG SETUP (ログの設定) | データログへのデータ保存の時間間隔を設定します。0.5、1、2、5、10、15 (デフォルト)、30、60 分 |
| SET DEFAULTS (デフォルトに設定) | センサの設定可能なデフォルト値を復元します。スロープまたはオフセットの設定は変更されません。 |

## 気圧値の入力

工場出荷時には、気圧は 0 メートル、つまり海水位に設定されています。デフォルト値を変更するには、以下の方法で行います。気圧の調整は、高度または気圧 (推奨) のいずれかとして入力します。

***注:*** *気圧を正確に設定することは、飽和空気で校正する際に重要です (空気で校正 ページの 100)。絶対気圧のみを使用してください。調整気圧は使用しないでください。絶対気圧が不明な場合は、測定場所の正しい高度を使用します。*

1. [MENU (メニュー)] > [SENSOR SETUP (センサの設定)] > [<センサを選択>] > [CONFIGURE (設定)] > [SET UNITS (単位の設定)] > [AIR PRESS/ALT UNITS (気圧/高度の単位)] に進みます。
2. 表示される**いずれかの**単位オプションを選択します。

| オプション | 説明 |
|---|---|
| **フィート** | Feet (フィート) - 高度の測定単位 |
| **m** | Meters (メートル) - 高度の測定単位 (メートル) |
| **mmHg** | 水銀柱ミリメートル - 絶対気圧の測定単位 (メートル) |
| **torr** | 絶対気圧の測定単位 |

3. 選択を確認します。選択した単位が値入力画面に表示されます。
4. 値を入力して、確定します。

## 塩分補正値の入力

塩分試料中の溶存酸素測定では、実際の DO 値とは非常に異なる見掛けの DO 値が示されることがあります。試料中の溶解塩の影響を補正するには、塩分補正係数を入力します。
***注:*** *プロセス中に塩分が存在するかどうか、または塩分の量が不明な場合は、処理施設の技術スタッフにお問い合わせください。*

1. 導電率計を使用して、20 °C の基準温度で、試料の導電率を mS/cm 単位で測定します。
2. 表 1 を使用して、塩分補正係数を ppt (‰、千分率) 飽和度を見積もります。

   ***注:*** *塩素イオン濃度 (g/kg 単位) は、試料の塩素量と等価です。塩度は、次の式で計算します:、塩分 = 1.80655 × 塩素量。*

   塩分は、*Standard Methods for the Examination of Water and Wastewater (水および廃水に関する標準検査法)* のセクション 2520 B に記載されている関係式を使って計算できます。[*]、
3. [MENU (メニュー)] > [SENSOR SETUP (センサの設定)] > [<センサを選択>] > [CONFIGURE (設定)] > [SALINITY (塩分)] に進みます。
4. 塩分補正係数を入力して、確定します。

[*] *Standard Methods for the Examiniation of Water and Wastewater*, 20th Edition. (水および廃水に関する標準検査法、第 20 版)編集者: Lenore S. Clesceri、Arnold E. Greenberg、Andrew D. Eaton。2-48-2-29 ページ (1998)塩素量と酸素溶解度は、同じ参考文献の 4500-O:I、4-131 ページに記載されています。

表 1 導電率値 (mS/cm) あたりの塩分飽和度 (‰)

| mS/cm | ‰ | mS/cm | ‰ | mS/cm | ‰ | mS/cm | ‰ |
|---|---|---|---|---|---|---|---|
| 5 | 3 | 16 | 10 | 27 | 18 | 38 | 27 |
| 6 | 4 | 17 | 11 | 28 | 19 | 39 | 28 |
| 7 | 4 | 18 | 12 | 29 | 20 | 40 | 29 |
| 8 | 5 | 19 | 13 | 30 | 21 | 42 | 30 |
| 9 | 6 | 20 | 13 | 31 | 22 | 44 | 32 |
| 10 | 6 | 21 | 14 | 32 | 22 | 46 | 33 |
| 11 | 7 | 22 | 15 | 33 | 23 | 48 | 35 |
| 12 | 8 | 23 | 15 | 34 | 24 | 50 | 37 |
| 13 | 8 | 24 | 17 | 35 | 25 | 52 | 38 |
| 14 | 9 | 25 | 17 | 36 | 25 | 54 | 40 |
| 15 | 10 | 26 | 18 | 37 | 26 | | |

## 変換器のリニア出力の設定

リニア出力は、プローブデータを施設の PLC、SCADA またはその他のデータ収集システムに送信します。

1. 変換器の出力設定メニューに進みます。

| オプション | 説明 |
|---|---|
| **sc200** | [MENU (メニュー)] > [SETTINGS (設定)] > [sc200 SETUP (sc200 の設定)] > OUTPUT SETUP (出力の設定)] > [<出力を選択>] > [SET FUNCTION (機能設定)] に進みます。 |
| **sc100** | [MENU (メニュー)] > [SYSTEM SETUP (システム設定)] > [<出力を選択>] > [SET FUNCTION (機能設定)] に進みます。 |
| **sc1000** | [MENU (メニュー)] > [SYSTEM SETUP (システム設定)] > [<出力を選択>] > [SET FUNCTION (機能設定)] に進みます。 |

2. 変換器の機能を設定します。

| オプション | 説明 |
|---|---|
| **sc200** | LINEAR (リニア) |
| **sc100** | LINEAR CONTROL (リニア制御: デフォルト値) |
| **sc1000** | LINEAR CONTROL (リニア制御: デフォルト値) |

## Modbus レジスタ

ネットワーク通信用に Modbus レジスタのリストを用意しています。詳細は www.hach.com または www.hach-lange.com をご覧ください。

## 測定のための校正

センサは工場で仕様に合わせて校正されています。規制機関によって定期的な校正が義務付けられている場合を除き、校正することは推奨しません。校正が必要な場合は、校正する前にセンサをプロセスと平衡状態にしてください。設定時にセンサを校正しないでください。

表 2 に、校正のオプションを示します。

表 2 校正オプション

| オプション | 説明 |
|---|---|
| AIR CAL (空気中校正開始) | 推奨される校正方法です。この校正ではスロープが変わります。 |
| SAMPLE CAL (試料校正) | ハンドヘルド DO メーターとの比較による校正。この校正ではオフセットが変わります。 |
| RESET DFLT CAL (デフォルトの校正にリセット) | 校正ゲイン (スロープ) とオフセットを工場出荷時のデフォルトに戻します。デフォルトのゲイン=1.0、デフォルトのオフセット=0.0 |

## 空気で校正

**注意事項:**

- 校正バッグ内に水が含まれていることを確認してください。
- 校正バッグとセンサ本体間が完全に密閉されていることを確認してください。
- センサを校正するときには、センサが乾いていることを確認してください。
- 気圧/高度が、校正を実施する場所に合わせて正確に設定されていることを確認してください。
- センサの温度が、校正バッグのある場所の温度で安定するまで、十分な時間放置してください。プロセスと校正場所の温度差が大きい場合、温度が安定するまで最大 15 分かかります。

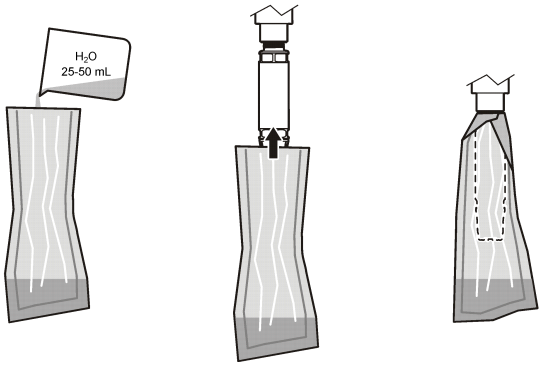
1. センサをプロセスから外します。湿った布を使用してセンサを清掃します。
2. センサ全体を、25 ～ 50 mL の水が入った校正バッグに入れます。センサのキャップが校正バッグ内の水に接触しないようにしてください。また、センサのキャップに水滴が付かないようにしてください (図 6)。
3. 輪ゴム、結束バンド、または手で、センサ本体の周囲を完全に密閉します。
4. 校正を開始する前に、装置を 15 分間放置して安定させます。安定させている間は、校正バッグが直射日光に当たらないようにしてください。
5. 現在の絶対気圧または高度が正しく設定されていることを確認します。気圧値の入力 ページの 97 を参照してください。

   ***注:*** *有用な結果を得るためにも、絶対気圧計または実気圧を使用することをお勧めします。*
6. [MENU (メニュー)] > [<センサを選択>] > [CALIBRATE (校正)] > AIR CAL (空気中校正開始)] に進みます。
7. 校正時の出力信号のオプションを選択します。

| オプション | 説明 |
|---|---|
| **アクティブ** | 校正手順時に、装置は現在の測定出力値を送信します。 |
| **ホールド** | 校正手順時に、センサの出力値が現在の測定値に保持されます。 |
| **転送** | 校正時に、プリセットされている値が送信されます。プリセット値の変更については、変換器のユーザーマニュアルを参照してください。 |

8. 変換器に「Move the probe to bag (プローブをバッグへ移動してください)」と表示されます。値が安定するまで待ちます。ENTER を押して、安定した値を受け入れます。または、ディスプレイに「Complete (完了)」と表示されるまで校正を続けます。
9. センサが校正されたら、センサをプロセスに入れます。ENTER を押します。

**図 6 空気中校正手順**




値が安定しない場合、ディスプレイに「Unable to Calibrate (校正できません)」というメッセージに続けてエラーメッセージが表示されます。表 3 に校正の問題に関するエラーメッセージと解決方法を示します。

**表 3 空気中校正時のエラーメッセージ**

| メッセージ | 説明 | 解決方法 |
|---|---|---|
| Cal fail, gain high (校正失敗、ゲイン高) | ゲイン値が高すぎます。 | 再校正します。 |
| Cal fail, gain low (校正失敗、ゲイン低) | ゲイン値が低すぎます。 | 再校正します。 |
| Cal fail, unstable (校正失敗、不安定) | 校正時間内に値が安定しませんでした。 | 再校正します。 |

## Sample CAL (試料校正) - 比較による校正

この校正方法は、ハンドヘルド測定器に取り付けられた別のセンサを使用して行います。

1. 別のセンサをプロセスに入れます。最初のセンサに可能な限り近い位置に 2 番目のセンサを入れます。
2. DO 値が安定するのを待ちます。
3. 最初のセンサの変換器で、[MENU (メニュー)] > [SENSOR SETUP (センサの設定)] > [<センサを選択>] > [CALIBRATE (校正)] > [SAMPLE CAL (試料校正)] に進みます。
4. 校正時の出力信号のオプションを選択します。

| オプション | 説明 |
|---|---|
| **アクティブ** | 校正手順時に、装置は現在の測定出力値を送信します。 |
| **ホールド** | 校正手順時に、センサの出力値が現在の測定値に保持されます。 |
| **転送** | 校正時に、プリセットされている値が送信されます。プリセット値の変更については、変換器のユーザーマニュアルを参照してください。 |

5. 次の情報が変換器に表示されます。
   - 「Press ENTER when stabilized (安定したら ENTER を押してください)」
   - 現在の溶存酸素測定値
   - 現在の温度測定値
6. 測定値が安定したら、ENTER を押します。ディスプレイに入力画面が表示されます。
   ***注:*** *通常、測定値は 2 ～ 3 分で安定します。*

値が安定しない場合、ディスプレイに「Unable to Calibrate (校正できません)」というメッセージに続けてエラーメッセージが表示されます。表 4 に校正の問題に関するエラーメッセージと解決方法を示します。

**表 4 試料校正エラーメッセージ**

| メッセージ | 説明 | 解決方法 |
|---|---|---|
| Cal fail, offset high (校正失敗、オフセット高) | オフセット値が高すぎます。 | 再校正します。 |
| Cal fail, offset low (校正失敗、オフセット低) | オフセット値が低すぎます。 | 再校正します。 |
| Cal fail, unstable (校正失敗、不安定) | 校正時間内に値が安定しませんでした。 | 再校正します。 |

## 校正手順の終了

1. 校正中に、BACK キーを押します。3 つのオプションが表示されます:

| オプション | 説明 |
|---|---|
| **ABORT (中止)** | 校正を停止します。最初から新しい校正を開始しなければなりません。 |
| **BACK TO CAL(校正に戻る)** | 現在の校正に戻ります。 |
| **LEAVE (校正中断)** | 一時的に校正を終了します。校正をバックグラウンドで続行しながら、他のメニューにアクセスすることができます。2 番目のセンサ(接続されている場合)の校正を開始できます。校正に戻るには、MENU キーを押して、[SENSOR SETUP (センサの設定)] を選択し、センサを選択します。 |

2. いずれかのオプションを選択します。確定します。

## デフォルトの校正値へのリセット

校正設定を工場出荷時のデフォルトにリセットすることができます。ゲイン値とオフセット値は、それぞれ 1.0 と 0.0 に設定されます。

1. [MENU (メニュー)] > [SENSOR SETUP (センサの設定)] > [<センサを選択>] > [CALIBRATE (校正)] > [RESET CAL DEFLT (校正をデフォルト値にリセット)]
2. ディスプレイに確認メッセージが表示されます。確定して、センサを工場出荷時のデフォルトの校正曲線にリセットします。

# メンテナンス

**⚠ 危険**

複合的な危険。本書のこのセクションに記載されている作業は、必ず資格のある要員が行う必要があります。

**⚠ 危険**

**爆発の危険。**電源が切断され、作業区域が安全であることが確実な場合以外は、電子部品の取り付けと取り外し、また電子回路の接続と切断は行わないでください。

**⚠ 危険**

**爆発の危険。**部品を代用すると Class 1、Division 2 への適合性が損なわれる可能性があります。電源が切断され、作業区域が安全であることが確実な場合以外は、部品の交換はしないでください。

***告知***

本製品の危険区域での使用の認可を受けたバージョンは、94/9/EC 指令 (ATEX 指令) の要件を満たしません。

## メンテナンススケジュール

メンテナンススケジュールは、定期メンテナンスに関する最小頻度を示します。電極の汚染の可能性があるアプリケーションの場合はもっと頻繁にメンテナンスを実施してください。
***注:*** *メンテナンスまたは清掃のためにプローブを分解しないでください。*

| メンテナンスタスク | 推奨最小頻度 |
|---|---|
| センサの清掃 | 90 日 |
| センサに損傷がないか検査 | 90 日 |
| センサの校正 | 機関で定めた頻度 |

## センサの洗浄

柔らかい湿った布でセンサの外側を清掃します。
***注:*** *清掃時にセンサキャップを取り外す必要がある場合は、キャップの内側を長時間直射日光に曝さないでください。*

## 洗浄間隔の設定または変更

用途の状態によっては、手動でのセンサ洗浄間隔を短くまたは長くしなければならないことがあります。デフォルトの洗浄間隔は 0 日です。間隔を変更するには、次の手順に従います。

1. [MENU (メニュー)] > [SENSOR SETUP (センサの設定)] > [<センサを選択>] > [CONFIGURE (設定)] > [CLEAN INTRVL (洗浄間隔)] に進みます。
2. 必要に応じて表示された値を変更します。変更内容を確定します。
   - 洗浄間隔をオフにするには、値を 0 に設定します。

## センサキャップの交換

| ⚠ 警告 | |
|---|---|
| | 爆発の危険の可能性があります。センサ設定キャップは、危険区域での使用に対応していません。 |

交換用のセンサキャップと設定キャップには、取扱説明書が付属しています。キャップの交換方法については、付属の取扱説明書を参照してください。

最高の性能と精度を得るためにも、次の場合はセンサキャップを交換してください。

- 2 年毎
- 日常点検でセンサキャップが激しく腐食していることが認められた場合

# トラブルシューティング

## 診断/テスト・メニュー

診断/テストメニューには、LDO センサの現在の情報と履歴情報が表示されます。
診断/テストメニューにアクセスするには、[MENU (メニュー)] > [SENSOR SETUP (センサ設定)] > [<センサを選択>] > [DIAG/TEST (診断/テスト)] に進みます。

表 5 を参照してください。

**表 5 [DIAG/TEST (診断/テスト)] メニュー**

| オプション | 説明 |
|---|---|
| SENSOR INFO (センサ情報) | SOFTWARE VERS (ソフトウェアバージョン) - インストールされているソフトウェアバージョンが表示されます |
| | BOOT VERSION (ブートバージョン) - インストールされているブートバージョンが表示されます |
| | DRIVER VERS (ドライバーバージョン) - インストールされているドライバーバージョンが表示されます |
| LOT CODE (ロットコード) | センサキャップの製造ロットを示します |
| SERIAL NUMBER (シリアル番号) | センサのシリアル番号 |
| GAIN CORR (ゲイン補正) | 校正ゲイン値を調整します。 |
| | 範囲: 0.50 ～ 2.00 |
| OFFSET CORR (修正オフセット) | 校正オフセット値を調整します (mg/L または ppm)。 |
| | 範囲: -3.00 ～ +3.00 |
| PHASE DIAG (フェーズの診断) | 両波長、赤色波長、および青色波長のフェーズを示します。1 秒ごとに更新されます。 |
| AMPL DIAG (振幅の診断) | 赤色波長および青色波長の振幅を示します。1 秒ごとに更新されます。 |
| DAYS TO CLEAN (洗浄までの日数) | 次回予定されている手動洗浄までの日数を示します。 |
| SENSOR LIFE (センサ寿命) | 次回予定されているセンサキャップ交換までの日数を示します。 |

## エラーリスト

エラーが発生した場合は、測定画面の読み取り値が点滅します。出力動作は、変換器の設定によって決まります。詳細は、変換器の取扱説明書を参照してください。
現在のセンサエラーを表示するには、[MENU (メニュー)] > [DIAGNOSTICS (診断)] > [<センサを選択>] > [ERROR LIST (エラーリスト)] に進みます。表 6 を参照してください。

**表 6 LDO センサのエラーリスト**

| エラー | 考えられる原因 | 解決方法 |
|---|---|---|
| RED AMPL LOW (赤色 振幅 低) (値が 0.01 未満)<br>または<br>BLUE AMPL LOW (青色 振幅 低) (値が 0.01 未満) | センサキャップが取り付けられていません。または正しく取り付けられていません。 | センサキャップを外して、取り付け直してください。 |
| | センサキャップで光路が遮られています。 | センサキャップとレンズの内側を検査してください。 |
| | センサが正しく動作していません。 | LED が点滅していることを確認してください。メーカーにお問い合わせください。 |

## 警告リスト

警告アイコンが点滅した場合 (sc100 および sc200)、または画面が黄色に変わった場合 (sc1000)、測定画面の下部にメッセージが表示されます。sc1000 では、画面が黄色に変わって警告状態であるこ

とが示されます。センサの現在の警告を表示するには、[MENU (メニュー)] > [DIAGNOSTICS (診断)] > [<センサを選択>] > [WARNING LIST (警告リスト)] に進みます。表 7 を参照してください。

**表 7 センサの警告リスト**

| Warning(警告) | 定義 | 解決方法 |
|---|---|---|
| EE SETUP ERR (EE 設定エラー) | 保存されているデータが破損しました。値は工場出荷時のデフォルトに設定されました。 | 技術サポートにお問い合わせください. |
| EE RSRVD ERR | | |
| TEMP < 0 ℃(温度 < 0 ℃) | プロセス温度が 0 °C 未満です。 | プロセス温度を上げるか、プロセス温度がセンサの仕様範囲になるまで使用を停止します。 |
| TEMP > 50 ℃(温度 > 50 ℃) | プロセス温度が 50 °C を超えています。 | プロセス温度を下げるか、プロセス温度がセンサの仕様範囲になるまで使用を停止します。 |
| RED AMPL LOW (赤色 振幅 低) | 値が 0.03 未満です。 | 表 6 ページの 104 を参照してください。 |
| RED AMPL HIGH (赤色 振幅 高) | 値が 0.35 を超えています。 | 技術サポートにお問い合わせください。 |
| BLUE AMPL LOW (青色 振幅 低) | 値が 0.03 未満です。 | 表 6 ページの 104 を参照してください。 |
| BLUE AMPL HIGH (青色 振幅 高) | 値が 0.35 を超えています。 | 技術サポートにお問い合わせください。 |
| キャップコードエラー | センサキャップコードが破損しました。コードは、自動的にデフォルトのキャップおよびロットコードにリセットされました。 | センサ設定キャップ手順を実行します。センサキャップで使用可能な設定キャップがない場合は、技術サポートにお問い合わせください。 |

## イベントリスト

イベントリストには、データの記録方法に関する変更ログが保存されます。センサイベントを表示するには、[MENU (メニュー)] > [DIAGNOSTICS (診断)] > [<センサを選択>] > [EVENT LIST (イベントリスト)] に進みます。
表 8 を参照してください。

**表 8 センサのイベントリスト**

| イベント | 説明 |
|---|---|
| ALT/PRESSURE UNIT CHANGE (高度/気圧の単位の変更) | 気圧または高度の単位が変更されました。 |
| ALT/PRESSURE CHANGE (高度/気圧の変更) | 高度または気圧の値が変更されました。 |
| TEMP UNIT CHANGE (温度の単位の変更) | 温度の単位が変更されました。 |
| MEAS UNIT CHANGE (測定単位の変更) | 新しい測定単位が変更されました。 |
| SALINITY CHANGE (塩分の変更) | 塩分の値が変更されました。 |
| SET DEFAULT (デフォルトに設定) | センサの設定がデフォルト値にリセットされました。 |
| SENSOR SETUP CHANGE (センサの設定の変更) | センサの設定が変更されました。 |
| CLEAN INTERVAL TIMER CHANGE (洗浄間隔の変更) | センサの洗浄間隔が変更されました。 |
| SENSOR CAP LIFE TIMER CHANGE (センサキャップの寿命の変更) | センサキャップの交換間隔が変更されました。 |

# 交換部品とアクセサリ

メーカーが承認した交換部品のみを使用してください。未承認の部品を使用すると、負傷、装置の破損、または装置の誤作動を招く危険性があります。

### 交換品目

| 説明 | アイテム番号(米国/ヨーロッパ) |
|---|---|
| LDO プローブ、センサキャップ x 1、校正バッグ x 2 | 9020000 / LXV416.99.20001 |
| 海水用 LDO プローブ、センサキャップ x 1、校正バッグ x 2 | 9020000-SW / — |
| 海水危険区域用 LDO プローブ、センサキャップ x 1、校正バッグ x 2 | 9020000-C1D2-SW / — |
| 危険区域用 LDO プローブ、センサキャップ x 1、校正バッグ x 2 | 9020000-C1D2 / — |
| センサキャップ、交換用 (Class 1, Division 2 危険区域での使用に未対応のセンサ設定キャップ付属) | 9021100 / 9021150 |

### アクセサリ

| 説明 | アイテム番号(米国/ヨーロッパ) |
|---|---|
| 危険区域用センサケーブルロック | 6139900 / — |
| ケーブル、センサ延長用、Class 1, Division 2 危険区域用、1 m | 6122402 / — |
| ケーブル、センサ延長用、Class 1, Division 2 危険区域用、7 m | 5796002 / — |
| ケーブル、センサ延長用、Class 1, Division 2 危険区域用、15 m | 5796102 / — |
| ケーブル、センサ延長用、Class 1, Division 2 危険区域用、31 m | 5796202 / — |
| 高出力空気洗浄システム、115 V (危険区域での使用に未対応) | 6860000 / 6860003.99.0001 |
| 高出力空気洗浄システム、230 V (ATEX 非準拠、危険区域での使用に未対応) | 6860100 / 6860103.99.0001 |
| 校正バッグ (1 袋) | 5796600 / 5796600 |
| ケーブル、センサ延長用、非危険区域用、7.7 m[1] | 米国: 5796000、7.7 m |
| | ヨーロッパ: LZX849、10 m |
| パイプ取り付け用ハードウェアキット (PVC) | 9253000 / LZY714.99.21810 |
| フロート取り付け用ハードウェアキット (PVC) | 9253100 / LZX914.99.42200 |
| 空気洗浄器ハードウェアキット | 9253500 / LZY812 |
| チェーン取り付け用ハードウェアキット (ステンレススチール) | — / LZX914.99.11200 |
| ユニオン取り付け用ハードウェアキット | 9257000 / 9257000 |
| HQd 測定器、堅牢型 LDO プローブ (危険区域での使用に未対応) | 8505200 / HQ40D.99.310.000 |

[1] 15 m および 30 m タイプも用意

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# 사양

사양은 사전 예고 없이 변경될 수 있습니다.

| 사양 | 세부 사항 |
|---|---|
| 습식 재질 | 표준 프로브, 표준 Class 1-Div 2 프로브<br>• CPVC, 센서 단부 및 케이블 단부<br>• 폴리우레탄, 케이블 단부 및 케이블 재킷에 오버몰딩<br>• 316 스테인리스 스틸 본체 및 나사<br>• Viton, 오링<br>• Noryl, 케이블 단부 위 너트 |
| | 표준 해수 프로브, 해수 Class 1-Div 2 프로브<br>• CPVC, 센서 단부 및 케이블 단부<br>• 폴리우레탄, 케이블 단부 및 케이블 재킷에 오버몰딩<br>• PVC 해수 본체<br>• 해수 에폭시 실런트<br>• Noryl, 케이블 단부 위 너트 |
| IP 등급 | IP68 |
| 침수 재질(센서 캡) | 아크릴릭 |
| 측정 범위(용존 산소량) | 0-20 ppm(0-20 mg/L) |
| | 0-200% 포화도 |
| 측정 정도(용존 산소량) | 5 ppm ± 0.1 ppm 미만 |
| | 5 ppm ± 0.2 ppm 초과 |
| 반복성(용존 산소량) | 0.1 ppm(mg/L) |
| 반응 시간(용존 산소량) | $T_{90}$<40 초 |
| | $T_{95}$<60 초 |
| 분해능, 센서(용존 산소량) | 0.01 ppm(mg/L), 0.1% 포화도. |
| 측정 범위(온도) | 0-50°C(32-122°F) |
| 측정 정도(온도) | ± 0.2°C(±0.36°F) |
| 방해물질들 | 다음 물질로 인한 방해가 없음: $H_2S$, pH, $K^+$, $Na^+$, $Mg^{2+}$, $Ca^{2+}$, $NH_4^+$, $Al^{3+}$, $Pb^{2+}$, $Cd^{2+}$, $Zn^{2+}$, Cr (total), $Fe^{2+}$, $Fe^{3+}$, $Mn^{2+}$, $Cu^{2+}$, $Ni^{2+}$, $Co^{2+}$, $CN^-$, $NO_3^-$, $SO_4^{2-}$, $S^{2-}$, $PO_4^{3-}$, $Cl^-$, 음이온 계면활성제, 원유, $Cl_2$ < 4 ppm |
| 보관 온도 | –20-70 °C(–4-158 °F) |
| 최대 온도 | 0-50 °C(32-122 °F) |

| 사양 | 세부 사항 |
|---|---|
| 위험 지역 분류(9020000-C1D2 센서 전용) | Class I, Division 2, Group A–D, T4 / Class I, Zone 2 Group 2C, T4<br>***참고:*** *이 제품은 94/9/EC 지침(ATEX 지침)의 요구 사항을 충족하지 않습니다.* |
| 분류(9020000-C1D2 전용) | 위험 지역에서 사용을 위해 ANSI/ISA, CSA 및 FM 표준에 따라 ETL 리스팅.<br>***참고:*** *이 제품은 94/9/EC 지침(ATEX 지침)의 요구 사항을 충족하지 않습니다.* |
| 최소 유동 속도 | 필요하지 않음 |
| 교정/검사 | 공기 교정: 1 포인트, 100% 물 포화 공기 |
| | 시료 교정: 표준 장비와 비교 |
| 프로브 침수 깊이 및 압력 한계 | 최대 34 m(112ft.), 345kPa(50psi)의 압력 한계. 그러나 이 깊이에서는 정확도가 떨어질 수 있음 |
| 센서 케이블 | 퀵 커넥트 플러그 포함 10 m(30 ft) 통합 케이블(모든 센서 유형)<br>연장 케이블 사용으로 최대 100 m 가능(non-Class I, Division 2 센서 유형만 해당)<br>접속함 사용으로 최대 1000m(non-Class I, Division 2 센서 유형만 해당) |
| 프로브 중량 | 1.0 kg(2 lb, 3 oz) |
| 프로브 치수 | 표준 프로브(직경 x 길이): 49.53 x 255.27 mm(1.95 x 10.05 in.) |
| | 해수 프로브(직경 x 길이): 60.45 x 255.27 mm(2.38 x 10.05 in.) |
| 전원 요구 사항 | 12 VDC, 0.25 A, 3 W |
| 보증 | 프로브: 제조 결함 3 년 |
| | 센서 캡: : 제조 결함 2 년 |

## 일반 정보

제조업체는 본 설명서에 존재하는 오류나 누락에 의해 발생하는 직접, 간접, 특수, 우발적 또는 결과적 손해에 대해 어떠한 경우에도 책임을 지지 않습니다. 제조업체는 본 설명서와 여기에 설명된 제품을 언제라도 통지나 추가적 책임 없이 변경할 수 있습니다. 개정본은 제조업체 웹 사이트에서 확인할 수 있습니다.

## 안전 정보

**주의사항**

제조사는 본 제품의 잘못된 적용 또는 잘못된 사용으로 인한 직접, 우발적 또는 간접적 손해에 국한하지 않는 모든 손해에 대한 어떠한 책임도 지지않으며, 관계 법령이 최대한 허용하는 손해에 관한 면책이 있습니다. 사용자는 사용상 중대한 위험을 인지하고 장비 오작동이 발생할 경우에 대비하여 적절한 보호 장치를 설치하여야 합니다.

장치 포장을 풀거나 설치하거나 작동하기 전에 본 설명서를 모두 읽으십시오. 모든 위험 및 주의사항 설명에 유의하시기 바랍니다. 이를 지키지 않으면 사용자가 중상을 입거나 장치가 손상될 수 있습니다.

본 장치의 보호 기능이 손상되지 않도록 본 설명서에서 설명하는 방법이 아닌 다른 방법으로 본 장치를 사용하거나 설치하지 마십시오.

## 위험 정보 표시

**⚠ 위 험**

방지하지 않을 경우 사망 또는 심각한 부상이 일어나는 잠재적 또는 즉각적 위험 상황을 의미합니다.

**⚠ 경 고**

피하지 않을 경우에 사망이나 심각한 부상을 유발할 수 있는 잠재적 위험이나 긴급한 위험 상황을 나타냅니다.

**⚠ 주 의**

경미하거나 심하지 않은 부상을 초래할 수 있는 잠재적으로 위험한 상황을 경고합니다.

***주 의 사 항***

피하지 않으면 기기에 손상을 일으킬 수 있는 상황을 나타냅니다. 특별히 강조할 필요가 있는 정보.

## 주의 경고

본 장치에 부착된 표기들을 참조하시기 바랍니다. 표시된 지침을 따르지 않으면 부상이나 기기 손상이 발생할 수 있습니다. 장비에 있는 심볼은 주의사항에 대한 설명과 함께 설명서에서 참조합니다.

| | |
|---|---|
| | 이는 안전 경고 심볼입니다. 잠재적인 부상 위험을 방지할 수 있도록 이 기호를 따라 모든 안전 메시지를 준수하십시오. 기기에 안전 기호가 부착되어 있는 경우 작동 및 안전 정보에 대해서는 작동 설명서를 참조하십시오. |
| | 본 심볼은 경한 눈 부상을 초래할 수 있는 광원이 있음을 나타냅니다. 눈 부상 위험을 방지할 수 있도록 본 심볼에 이어지는 모든 메시지를 준수하십시오. |
| | 본 심볼은 전자기 방출(ESD)에 민감한 장치가 있으므로 장치 손상을 방지하기 위해 세심한 주의가 필요함을 나타냅니다. |
| | 본 기호가 부착된 전기 장비는 2005 년 8 월 12 일 이후 유럽 공공 처리 시스템에 의해 처분될 수도 있습니다. 유럽 지역 및 국가 규정(EU 지침 2002/96/EC)에 따라 유럽 전기 장비 사용자는 구형 또는 수명이 끝난 장비를 제조업체에 무료 조건으로 반환하도록 합니다.<br>***참고:*** *재활용을 위해 반환하려면 장비 제조업체나 공급업체에 문의하여 수명이 다한 장비, 제조업체에서 받은 전기 부품 및 모든 보조 물품을 올바른 방법으로 폐기하기 위한 반환 방법을 확인하십시오.* |

## 인증

**캐나다 무선 간섭 유발 장치 규정, IECS-003, 등급 A**:

보조 테스트 기록은 제조업체가 제공합니다.

본 등급 A 디지털 장치는 캐나다 간섭 유발 장치 규제의 모든 요구조건을 만족합니다.

Cet appareil numèrique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

**FCC Part 15, Class "A" 제한**

보조 테스트 기록은 제조업체가 제공합니다. 본 장치는 FCC 규칙, Part 15 를 준수합니다. 본 장치는 다음 조건에 따라 작동해야 합니다.

1. 유해한 간섭을 일으키지 않아야 합니다.
2. 바람직하지 않은 작동을 유발할 수 있는 간섭을 포함하여 수신되는 모든 간섭에도 정상적으로 작동해야 합니다.

본 장치의 준수 책임이 있는 측이 명시적으로 허용하지 않은 변경 또는 수정을 가하는 경우 해당 사용자의 장치 작동 권한이 무효화될 수 있습니다. 본 장치는 FCC 규칙, Part 15 에 의거하여 등급 A 디지털 장치 제한 규정을 준수합니다. 이러한 제한은 상업 지역에서 장치를 작동할 때 유해한 간섭으로부터 적절하게 보호하기 위하여 제정되었습니다. 본 장치는 무선 주파수 에너지를 생성 및 사용하며 방출할 수 있고 사용 설명서에 따라 설치하고 사용하지 않을 경우 무선 통신에 해로운 간섭을 일으킬 수 있습니다. 주거 지역에서 본 장치를 사용하면 해로운 간섭을 일으킬 수 있으며, 이 경우 사용자는 자비를 들여 간섭 문제를 해결해야 합니다. 다음과 같은 방법으로 간섭 문제를 줄일 수 있습니다.

1. 장치를 전원에서 분리하여 장치가 간섭의 원인인지 여부를 확인합니다.
2. 장치가 간섭을 받는 장치와 동일한 콘센트에 연결된 경우, 장치를 다른 콘센트에 연결해보십시오.
3. 장치를 간섭을 받는 장치로부터 멀리 떨어트려 놓으십시오.
4. 간섭을 받는 장치의 안테나 위치를 바꿔보십시오.

**5.** 위의 방법들을 함께 이용해보십시오.

## 제품 소개

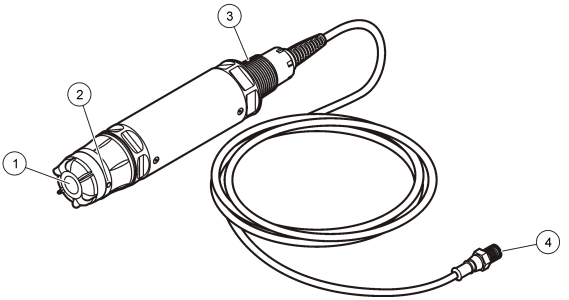
**⚠ 위 험**

화학적 또는 생물학적 위험 존재. 본 장비를 공중 위생, 공중 안전, 식음료 제조 또는 가공에 관련한 시행령 및 감시 규정 목적으로 처리공정이나 약품 주입 시스템을 감시하기 위하여 사용하는 경우, 이 장비에 적용되는 모든 규정을 이해하고 준수하며, 장비가 오작동하는 경우 해당 규정에 따라 충분하고 합당한 메커니즘을 보유하는 것은 사용자의 책임입니다.

본 센서는 컨트롤러와 함께 사용하여 데이터를 수집하고 작업을 수행하도록 설계되었습니다. 센서는 여러 컨트롤러와 함께 사용할 수 있습니다. 자세한 내용은 해당 컨트롤러 사용 설명서를 참조하십시오.

이 센서의 주요 용도는 도시 및 산업 폐수용입니다. LDO 센서 기술은 산소를 소비하지 않으며, 유동이 적거나 없는 환경에서도 DO 농도를 측정할 수 있습니다. 그림 1 을(를) 참조하십시오.

**그림 1 LDO 센서**

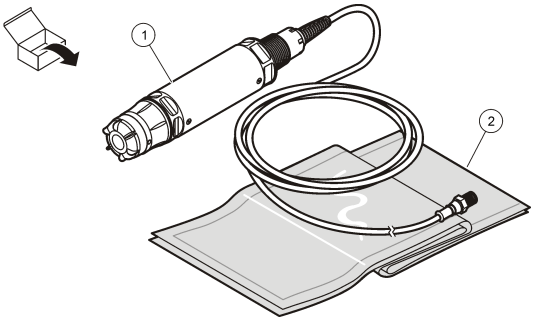



| | |
|---|---|
| **1** 센서 캡 | **3** 1 인치 NPT |
| **2** 온도 센서 | **4** 커넥터, 퀵 커넥트(기본) |

## LDO 센서 구성 부품 목록

그림 2 에 표시된 구성 부품을 모두 받았는지 확인하십시오. 품목이 누락되었거나 손상된 경우에는 제조업체 또는 판매 담당자에게 즉시 연락하십시오. 그림 2 을(를) 참조하십시오.

**그림 2 센서 구성 부품 목록**




| | |
|---|---|
| **1** LDO 센서[1] | **2** 교정 백(2 개) |

[1] 동봉되는 사용 설명서는 표시되어 있지 않습니다.

# 설치

**⚠ 경 고**

신체 부상 위험. 해당 전문요원이 지침서에 의거하여 다룹니다.

## 센서 유형 확인

**⚠ 위 험**

폭발 위험. Class 1, Division 2 위험 지역에 대해 인증된 것으로 명시된 주변 구성 부품만 연결하십시오.

***주 의 사 항***

이 제품의 위험 지역 인증 버전은 94/9/EC 지침(ATEX 지침)의 요구 사항을 충족하지 않습니다.

1. 케이블의 커넥터 단부로 이동합니다.
2. 케이블의 커넥터 단부에서 라벨을 읽습니다. 위험 지역 인증 센서의 경우, 라벨에 "등급: Class 1 Division 2"가 표시됩니다.
3. 커넥터를 검사합니다.
   - 위험 지역 인증 센서는 안전 잠금 장치 커넥터를 사용합니다. 그림 3 페이지의 112 을(를) 참조하십시오.
   - 위험 지역 미인증 센서는 안전 잠금 장치가 없는 퀵 커넥트 커넥터를 사용합니다.

## 위험 지역에서 센서 연결

**⚠ 위 험**

폭발 위험 이 장비는 위험 지역 설치 컨트롤 도면에 따라 설치한 경우, 특정 센서 및 옵션을 사용하여 비위험 지역 또는 Class 1, Division 2, Group A, B, C, D 위험 지역에서 사용하기에 적합합니다. 컨트롤 도면과 해당하는 전기 코드 규정을 참조하여 올바른 설치 지침을 항상 확인하십시오.

**⚠ 위 험**

폭발 위험. 장비의 전원을 차단했거나 현재 지역이 위험하지 않은 지역으로 확인된 경우에만 전기 부품 또는 회로를 장비에 연결하거나 분리하십시오.

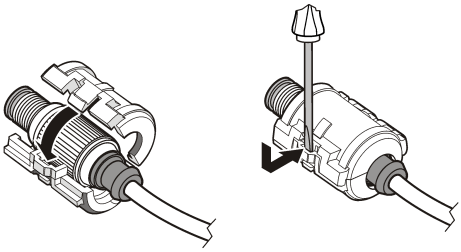
***주 의 사 항***

위험 지역에서는 위험 지역 인증 센서 및 케이블 잠금 장치만 사용하십시오. 이 제품의 위험 지역 인증 버전은 94/9/EC 지침(ATEX 지침)의 요구 사항을 충족하지 않습니다.

자세한 내용은 센서 유형 확인 페이지의 111 을(를) 참조하십시오.

1. 컨트롤러에서 커넥터 마개를 분리합니다. 센서가 분리되었을 때 커넥터 마개를 유지하여 커넥터 구멍을 밀폐합니다.
2. 센서를 컨트롤러에 연결합니다. 자세한 내용은 컨트롤러 설명서를 참조하십시오.
3. 안전 잠금 장치를 커넥터 위에 덮습니다.
4. 커넥터 안전 잠금 장치를 제거하려면, 작은 일자 드라이버를 사용합니다. 그림 3 을(를) 참조하십시오.

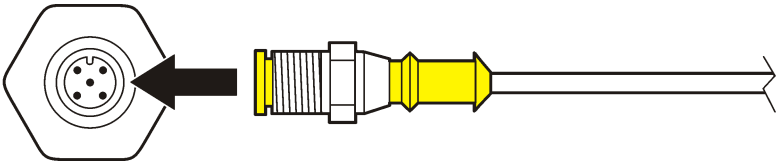
**그림 3 커넥터 안전 잠금 장치**



## 비위험 지역에서 센서 연결

LDO 센서를 sc 컨트롤러에 연결하려면 그림 4 을(를) 참조하십시오. 배선 지침은 해당 sc 컨트롤러 설명서를 참조하십시오.

**그림 4 LDO 센서 연결(그림은 비위험 지역 센서)**



센서를 부착한 후, 센서를 검색합니다. 센서 설치 페이지의 112 을(를) 참조하십시오.

## 센서 설치

센서 설치에는 다음의 두 옵션이 있습니다.

- 컨트롤러 전원을 끈 상태에서 센서를 연결합니다. 컨트롤러 전원을 켜면 컨트롤러가 새 센서를 검색하여 설치합니다.
- 컨트롤러 전원을 켠 상태에서 센서를 연결합니다. Scan Devices(장치 검색) 명령을 사용하여 새 센서를 설치합니다.

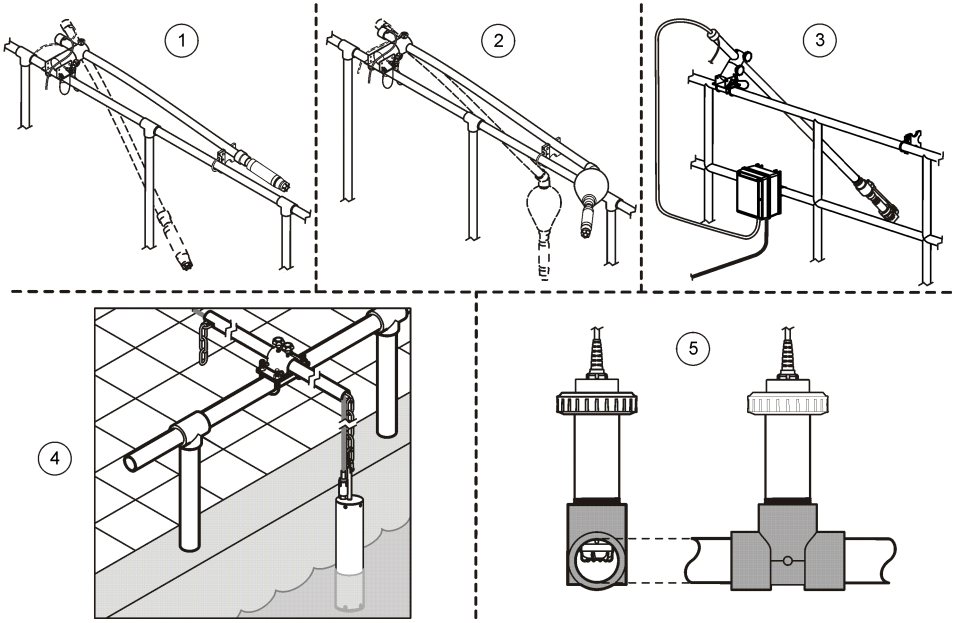
| 옵션 | 설명 |
|---|---|
| **sc200 컨트롤러** | MENU(메뉴)>TEST(테스트)/MAINT(유지관리)>SCAN DEVICE(장치 검색)로 이동합니다. |
| **sc100 컨트롤러** | MENU(메뉴)>TEST(테스트)/MAINT(유지관리)>SCAN SENSORS(센서 검색)로 이동합니다. |
| **sc1000 컨트롤러** | MENU(메뉴)>SYSTEM SETUP(시스템 설정)>DEVICE MANAGEMENT(장치 관리)>SCANNING FOR NEW DEVICES(새 장치 검색)로 이동합니다. |

디지털 센서 연결은 비위험 지역에서 센서 연결 페이지의 112 을(를) 참조하십시오.

## 센서 설치 옵션

LDO 센서용으로 사용 가능한 설치 및 액세서리 옵션은 하드웨어 키트 내 설치 지침과 함께 제공됩니다. 그림 5 에는 여러 설치 옵션이 나와 있습니다. 설치 하드웨어를 주문하려면, 교체 부품 및 부속품 페이지의 121 을(를) 참조하십시오.

그림 5 설치 옵션




| | |
|---|---|
| **1** 레일 장착 | **4** 체인 장착 |
| **2** 플로트 장착 | **5** 유니온 마운트(해수 프로브와 호환 안됨) |
| **3** 공기 분사 시스템 장착 (해수 프로브와 호환 안됨) | |

# 작동

## 사용자 탐색

키패드 설명 및 탐색 정보에 대해서는 콘트롤러 설명서를 참조하십시오.

## 센서 구성

구성 메뉴를 사용하여 센서의 ID 정보를 입력하고 데이터 처리와 보관을 위한 옵션을 변경합니다.
센서 설치에 대한 자세한 내용은 센서 설치 페이지의 112 을(를) 참조하십시오.
구성 메뉴의 모든 값이 용도에 맞게 정확한지 확인하십시오.

1. MENU(메뉴)>SENSOR SETUP(센서 설정)>[센서 선택]>CONFIGURE(구성)로 이동합니다.
2. 옵션을 선택하고 ENTER 키를 누릅니다. 아래 표에는 선택 가능한 옵션의 목록이 나와 있습니다.

| 옵션 | 설명 |
|---|---|
| 이름 편집하기 | 측정 화면 상단에서 센서에 해당하는 이름을 변경합니다. 이름은 문자, 숫자, 공백 또는 문장 부호를 조합하여 10 자로 제한됩니다. |
| SET UNITS(단위 설정) | TEMP(온도)–온도 단위를 °C(기본값) 또는 °F 로 설정합니다. |
| | MEASURE(측정)–측정 단위를 mg/L, ppm 또는 %로 설정합니다. |
| | ALT/PRESS(고도/압력)–고도를 m 또는 ft 로 설정하거나, 기압 단위를 mmHg 또는 torr 로 설정합니다. (기본값 = 0 ft) |

| 옵션 | 설명 |
|---|---|
| 고도/압력 | 고도 또는 기압 값을 입력합니다. % 포화도 측정 및 공기 교정을 완료하려면 이 값이 정확해야 합니다. (기본값 = 0 ft). |
| 염도 | 염도 값을 입력합니다. 염도 범위: 0.00-250.00 ‰. 자세한 내용은 염도 보정 값 입력 페이지의 114 을(를) 참조하십시오. (기본값 = 0) |
| SIGNAL AVERAGE(신호 평균) | 신호를 평균할 시간 간격(초)을 설정합니다. |
| CLEAN INTRVL(세척 주기) | 수동 센서 세척을 위한 시간 간격(일)을 설정합니다. (기본값 = 0 일. 값이 0 이면 세척 주기가 비활성화됩니다.) |
| RESET CLN INTRVL(세척 주기 재설정) | 시간 간격을 마지막으로 저장된 세척 주기로 설정합니다. |
| 로그 설정 | 데이터 로그에 데이터를 저장하기 위한 시간 간격을 설정합니다. 0.5, 1, 2, 5, 10, 15(기본값), 30, 60 분 |
| 기본값 설정 | 센서에 대해 구성 가능한 기본값을 복원합니다. 기울기 또는 오프셋 설정은 변경되지 않습니다. |

## 기압 값 입력

기압의 출고 시 설정은 0 ft 또는 해수면입니다. 기본값을 변경하려면, 이 절차의 단계를 사용하십시오. 기압 조정치는 고도 또는 압력 단위(권장)로 입력합니다.

***참고:*** *정확한 기압은 포화 공기 교정에 중요합니다(공기를 사용한 교정 페이지의 116). 조정되지 않은 절대 기압만 사용하십시오. 절대 기압이 알려지지 않은 경우 해당 지역의 정확한 고도를 사용합니다.*

1. MENU(메뉴)>SENSOR SETUP(센서 설정)>[센서 선택]>CONFIGURE(구성)>SET UNITS(단위 설정)>AIR PRESS/ALT UNITS(압력/고도 단위)로 이동합니다.
2. 나열된 단위 옵션 중 **하나**를 선택합니다.

| 옵션 | 설명 |
|---|---|
| **ft** | 피트—고도 측정 단위 |
| **m** | 미터—고도 측정 단위 |
| **mmHg** | 밀리미터 수은주—절대 기압 측정 단위 |
| **torr** | 절대 압력 측정 단위 |

3. 선택을 확인합니다. 값 입력 화면에 선택한 단위가 표시됩니다.
4. 값을 입력하고 확인합니다.

## 염도 보정 값 입력

염수 시료의 용존 산소량 측정치는 실제 DO 값과 매우 다른 표면적인 DO 값을 보여줄 수 있습니다. 시료에 용해된 염분의 영향을 보정하려면, 염도 보정 계수를 입력합니다.

***참고:*** *공정 내 염분의 존재 또는 양이 밝혀지지 않은 경우, 처리 시설 엔지니어링 직원에 문의하십시오.*

1. 전도도계를 사용하여 기준 온도인 20 °C(68 °F)에서 시료의 전도도(mS/cm)를 측정합니다.
2. 표 1 을 사용하여 염도 보정 계수를 천분율(‰) 포화도 단위로 추정합니다.

   ***참고:*** *염소 이온 농도(g/kg)는 시료의 염소량과 동일합니다. 염도는 다음 공식에 따라 계산합니다. 염도 = 1.80655 × 염소량.*

   염도는 *Standard Methods for the Examination of Water and Wastewater(상하수도 표준 실험법)*의 섹션 2520 B 에 수록된 관계를 사용하여 계산할 수 있습니다.*,

* *Standard Methods for the Examiniation of Water and Wastewater*, 20th Edition. Editors Lenore S. Clesceri, Arnold E. Greenberg and Andrew D. Eaton, p. 2-48-2-29 (1998). 염소량과 산소 용해도 간의 관계는 동 참고문헌의 4500-O:I, 4-131 페이지에 제시되어 있습니다.

3. MENU(메뉴)>SENSOR SETUP(센서 설정)>[센서 선택]>CONFIGURE(구성)>SALINITY(염도)로 이동합니다.
4. 염도 보정 계수를 입력하고 확인합니다.

**표 1 전도도(mS/cm)별 염분 포화도(‰)**

| mS/cm | ‰ | mS/cm | ‰ | mS/cm | ‰ | mS/cm | ‰ |
|---|---|---|---|---|---|---|---|
| 5 | 3 | 16 | 10 | 27 | 18 | 38 | 27 |
| 6 | 4 | 17 | 11 | 28 | 19 | 39 | 28 |
| 7 | 4 | 18 | 12 | 29 | 20 | 40 | 29 |
| 8 | 5 | 19 | 13 | 30 | 21 | 42 | 30 |
| 9 | 6 | 20 | 13 | 31 | 22 | 44 | 32 |
| 10 | 6 | 21 | 14 | 32 | 22 | 46 | 33 |
| 11 | 7 | 22 | 15 | 33 | 23 | 48 | 35 |
| 12 | 8 | 23 | 15 | 34 | 24 | 50 | 37 |
| 13 | 8 | 24 | 17 | 35 | 25 | 52 | 38 |
| 14 | 9 | 25 | 17 | 36 | 25 | 54 | 40 |
| 15 | 10 | 26 | 18 | 37 | 26 | | |

## 컨트롤러에서 선형 출력 구성

선형 출력은 프로브 데이터를 PLC, SCADA 또는 기타 데이터 수집 시스템으로 전송합니다.

1. 컨트롤러 출력 설정 메뉴로 이동합니다.

| 옵션 | 설명 |
|---|---|
| **sc200** | MENU(메뉴)>SETTINGS(설정)>sc200 SETUP(sc200 설정)>OUTPUT SETUP(출력 설정)>[출력 선택]>SET FUNCTION(기능 설정)으로 이동합니다. |
| **sc100** | MENU(메뉴)>SYSTEM SETUP(시스템 설정)>OUTPUT SETUP(출력 설정)>[출력 선택]>SET FUNCTION(기능 설정)으로 이동합니다. |
| **sc1000** | MENU(메뉴)>SYSTEM SETUP(시스템 설정)>OUTPUT SETUP(출력 설정)>[출력 선택]>SET FUNCTION(기능 설정)으로 이동합니다. |

2. 컨트롤러의 기능을 설정합니다.

| 옵션 | 설명 |
|---|---|
| **sc200** | 선형 |
| **sc100** | LINEAR CONTROL(선형 컨트롤) (기본값) |
| **sc1000** | LINEAR CONTROL(선형 컨트롤) (기본값) |

## Modbus 레지스터

Modbus 레지스터 목록을 네트워크 통신에 사용할 수 있습니다. 자세한 내용은 www.hach.com 또는 www.hach-lange.com 을 참조하십시오.

# 측정을 위한 교정

센서는 규격에 맞게 교정된 후 출고됩니다. 규제 기관에서 요구하는 정기 교정 이외에는 교정을 권장하지 않습니다. 교정이 필요할 경우, 교정 전에 센서가 공정에 맞게 평형을 이루도록 만드십시오. 설정 시 센서를 교정하지 마십시오.

표 2 에는 교정 옵션이 나와 있습니다.

**표 2 교정 옵션**

| 옵션 | 설명 |
|---|---|
| AIR CAL(공기 교정) | 권장되는 교정 방법. 이 교정에 의해 기울기가 수정됩니다. |
| SAMPLE CAL | 휴대형 DO 미터와의 비교를 통한 교정. 이 교정에 의해 오프셋이 수정됩니다. |
| RESET DFLT CAL(기본 교정 재설정) | 교정 게인(기울기) 및 오프셋을 출고 기본값으로 재설정합니다(기본 게인=1.0, 기본 오프셋=0.0). |

## 공기를 사용한 교정

**사용자 주의 사항:**

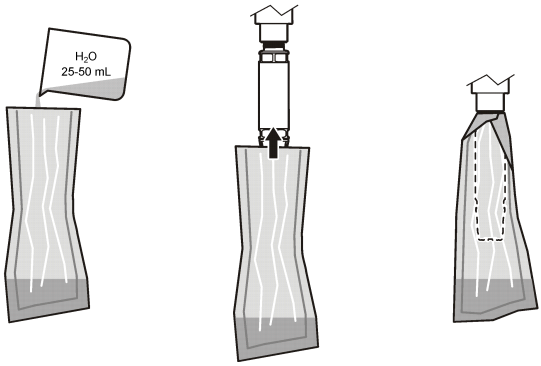
- 교정 백에 물이 들어 있는지 확인하십시오.
- 교정 백과 센서 본체 사이의 씰이 밀착되었는지 확인하십시오.
- 교정 시 센서가 건조한 상태인지 확인하십시오.
- 기압/고도 설정이 교정 위치에 맞게 정확한지 확인하십시오.
- 센서 온도가 교정 백 위치의 온도로 안정될 때까지 충분히 기다리십시오. 공정과 교정 위치 사이에 온도 차이가 클 경우 안정화에 최대 15 분이 걸릴 수 있습니다.

1. 공정에서 센서를 분리합니다. 젖은 천을 사용하여 센서를 청소합니다.
2. 전체 센서를 25-50 mL 의 물이 들어 있는 교정 백 안에 넣습니다. 센서 캡이 교정 백 안의 물에 닿지 않고 물방울이 센서 캡 위에 떨어지지 않아야 합니다(그림 6).
3. 고무줄 등이나 손을 사용하여 센서 본체 주위를 단단히 감습니다.
4. 교정 전에 장비를 15 분간 안정시킵니다. 안정화 기간 동안 교정 백에 직사 광선이 비추지 않도록 하십시오.
5. 현재의 절대 기압 또는 고도가 올바로 구성되었는지 확인합니다. 기압 값 입력 페이지의 114 을(를) 참조하십시오.

   ***참고:*** *절대 압력 또는 실제 압력을 모범 관행으로 권장합니다.*
6. MENU(메뉴)>SENSOR SETUP(센서 설정)>[센서 선택]>CALIBRATE(교정)>AIR CAL(공기 교정)로 이동합니다.
7. 교정 중의 출력 신호 옵션을 선택합니다.

   | 옵션 | 설명 |
   |---|---|
   | **활성** | 교정 절차 중에 현재 측정한 출력 값이 전송됩니다. |
   | **대기** | 센서 출력 값이 교정 절차 중에 현재 측정한 값으로 유지됩니다. |
   | **전송** | 교정 중에 사전 설정 값이 전송됩니다. 사전 설정 값을 변경하려면 컨트롤러의 사용 설명서를 참조하십시오. |
8. 컨트롤러에 "Move the probe to bag(백으로 프로브 이동)"이 표시됩니다. 값이 안정화될 때까지 기다립니다. ENTER 를 눌러 안정된 값을 수락합니다. 또는, 디스플레이에 "Complete(완료)"가 표시될 때까지 교정을 계속합니다.
9. 센서가 교정되면 센서를 공정에 넣습니다. ENTER 를 누릅니다.

**그림 6 공기 교정 절차**




값이 안정되지 않을 경우, 디스플레이에 "Unable to Calibrate(교정할 수 없음)"와 오류 메시지가 차례로 표시됩니다. 표 3 에는 교정 문제에 대한 오류 메시지 및 해결 방법이 나와 있습니다.

**표 3 공기 교정 오류 메시지**

| 메시지 | 설명 | 해결 방법 |
|---|---|---|
| Cal fail, gain high(교정 실패, 게인이 너무 높음) | 계산된 게인 값이 너무 높습니다. | 교정을 반복하십시오. |
| Cal fail, gain low(교정 실패, 게인이 너무 낮음) | 계산된 게인 값이 너무 낮습니다. | 교정을 반복하십시오. |
| Cal fail, unstable(교정 실패, 안정되지 않음) | 최대 허용 교정 시간 내에 값이 안정되지 않았습니다. | 교정을 반복하십시오. |

## 시료 교정 - 비교를 통한 교정

이 교정 방법은 휴대형 미터에 부착된 대체 센서를 사용합니다.

1. 대체 센서를 공정에 넣습니다. 2 차 센서를 1 차 센서와 최대한 가까이 놓습니다.
2. DO 값이 안정될 때까지 기다립니다.
3. 1 차 센서용 컨트롤러에서, MENU(메뉴)>SENSOR SETUP(센서 설정)>[센서 선택]>CALIBRATE(교정)>SAMPLE CAL(시료 교정)으로 이동합니다.
4. 교정 중의 출력 신호 옵션을 선택합니다.

| 옵션 | 설명 |
|---|---|
| **활성** | 교정 절차 중에 현재 측정한 출력 값이 전송됩니다. |
| **대기** | 센서 출력 값이 교정 절차 중에 현재 측정한 값으로 유지됩니다. |
| **전송** | 교정 중에 사전 설정 값이 전송됩니다. 사전 설정 값을 변경하려면 컨트롤러의 사용 설명서를 참조하십시오. |

5. 디스플레이에 다음이 표시됩니다.
   - "Press ENTER when stabilized(안정화되면 ENTER 를 누르십시오)"
   - 현재 용존 산소량 측정치
   - 현재 온도 측정치
6. 측정치가 안정적이면 Enter 를 누릅니다. 디스플레이에 입력 화면이 나타납니다.

   ***참고:*** *측정치는 보통 2-3 분 안에 안정됩니다.*

값이 안정되지 않을 경우, 디스플레이에 "Unable to Calibrate(교정할 수 없음)"와 오류 메시지가 차례로 표시됩니다. 표 4 에는 교정 문제에 대한 오류 메시지 및 해결 방법이 나와 있습니다.

**표 4 시료 측정 오류 메시지**

| 메시지 | 설명 | 해결 방법 |
|---|---|---|
| Cal fail, offset high(교정 실패, 오프셋 높음) | 계산된 오프셋 값이 너무 높습니다. | 교정을 반복하십시오. |
| Cal fail, offset low(교정 실패, 오프셋 낮음) | 계산된 오프셋 값이 너무 낮습니다. | 교정을 반복하십시오. |
| Cal fail, unstable(교정 실패, 안정되지 않음) | 최대 허용 교정 시간 내에 값이 안정되지 않았습니다. | 교정을 반복하십시오. |

## 교정 절차 종료

1. 교정 도중 BACK(뒤로) 키를 누릅니다. 세 가지 옵션이 표시됩니다.

| 옵션 | 설명 |
|---|---|
| **ABORT(취소)** | 교정을 중단합니다. 새 교정을 처음부터 시작해야 합니다. |
| **교정으로 가기** | 현재 교정으로 돌아갑니다. |
| **LEAVE(나가기)** | 교정을 일시적으로 종료합니다. 배경에서 교정이 계속되는 동안 다른 메뉴에 액세스할 수 있습니다. 보조 센서(있는 경우)에 대한 교정을 시작할 수 있습니다. 교정으로 돌아가려면 MENU 키를 누르고 센서 설정, [센서 선택]을 선택합니다. |

2. 옵션 중 하나를 선택합니다. 확인합니다.

## 교정 기본값 재설정

교정 설정은 출고 기본값으로 재설정할 수 있습니다. 게인 및 오프셋 값이 각각 1.0 과 0.0 으로 설정됩니다.

1. MENU(메뉴)>SENSOR SETUP(센서 설정)>[센서 선택]>CALIBRATE(교정)>RESET CAL DEFLT(교정 기본값 재설정)로 이동합니다.
2. 디스플레이에 확인 메시지가 표시됩니다. 센서를 출고 기본값 교정 곡선으로 재설정하려면 확인합니다.

# 유지관리

**⚠ 위 험**

여러 가지 위험이 존재합니다. 해당 전문가가 본 문서에 의거하여 작업을 수행해야 합니다.

**⚠ 위 험**

**폭발 위험.**반드시 비위험 지역에서 전원을 끈 후에 전기 부품 또는 회로를 장치에 연결하거나 분리하십시오.

**⚠ 위 험**

**폭발 위험**. 부품을 교체할 경우, Class 1, Division 2 의 적합성이 침해될 수 있습니다. 반드시 비위험 지역에서 전원을 끈 후에 부품을 교체하십시오.

***주 의 사 항***

이 제품의 위험 지역 인증 버전은 94/9/EC 지침(ATEX 지침)의 요구 사항을 충족하지 않습니다.

## 유지 보수 일정

유지관리 일정은 주기적 유지관리 작업을 위한 최소 주기를 나타냅니다. 전극이 쉽게 오염되는 환경에서는 유지관리 작업을 더 자주 수행하십시오.
***참고:*** *유지관리 또는 세척을 위해 프로브를 분해하지 마십시오.*

| 유지관리 작업 | 권장 최소 빈도 |
|---|---|
| 센서 세척 | 90 일 |
| 센서 손상 검사 | 90 일 |
| 센서 교정 | 규제 기관의 권고사항에 따름 |

## 센서 세척

젖은 부드러운 천으로 센서의 외부를 청소합니다.
***참고:*** *청소를 위해 센서 캡을 분리할 경우, 캡 내부를 장시간 직사 광선에 노출시키지 마십시오.*

## 세척 주기 설정 또는 변경

환경 조건에 따라 더 길거나 짧은 수동 센서 세척 주기가 필요할 수 있습니다. 기본 세척 주기는 0 일입니다. 주기를 변경하려면, 이 절차의 단계를 참조하십시오.

1. MENU(메뉴)>SENSOR SETUP(센서 설정)>[센서 선택]>CONFIGURE(구성)>CLEAN INTRVL(세척 주기)로 이동합니다.
2. 필요에 따라 표시된 값을 변경합니다. 변경 내용을 확인합니다.
   - 세척 주기를 끄려면 값을 '0'으로 설정합니다.

## 센서 캡 교환

| ⚠ 경 고 | |
|---|---|
| | 폭발 위험. 센서 설정 캡은 위험 지역 사용 등급이 아닙니다. |

교체용 센서 캡 및 설정 캡은 설치 지침과 함께 발송됩니다. 캡을 교환하려면 동봉된 지침을 참조하십시오.

최상의 성능 및 정확도를 위해 다음의 경우 센서를 교체합니다.

- 2 년마다
- 정기 검사에서 센서 캡의 현저한 부식이 발견된 경우

# 문제 해결

## 진단 및 테스트 메뉴

진단 및 테스트 메뉴에는 LDO 센서에 대한 현재 및 기록 정보가 표시됩니다.
진단 및 테스트 메뉴에 액세스하려면 MENU(메뉴)>SENSOR SETUP(센서 설정)>[센서 선택]>DIAG/TEST(진단/테스트)로 이동합니다.

표 5 을(를) 참조하십시오.

**표 5 진단/테스트 메뉴**

| 옵션 | 설명 |
|---|---|
| SENSOR INFO(센서 정보) | SOFTWARE VERS(소프트웨어 버전)—설치된 소프트웨어 버전을 표시합니다. |
| | BOOT VERSION(부팅 버전)—설치된 부팅 버전을 표시합니다. |
| | DRIVER VERS(드라이버 버전)—설치된 드라이버 버전을 표시합니다. |
| LOT CODE(로트 코드) | 센서 캡 제조 로트를 표시합니다. |
| SERIAL NUMBER(일련 번호) | 센서 일련 번호 |
| 채널 GAIN 정정 | 교정 게인 값을 조정합니다. |
| | 범위: 0.50-2.00 |
| 오프셋 수정 | 교정 오프셋 값((mg/L 또는 ppm))을 조정합니다. |
| | 범위: -3.00-+3.00 |
| PHASE DIAG(위상 진단) | 전체, 적색 및 청색 파장의 위상을 표시합니다. 1 초마다 업데이트됩니다. |
| AMPL DIAG(진폭 진단) | 전체, 적색 및 청색 파장의 진폭을 표시합니다. 1 초마다 업데이트됩니다. |
| DAYS TO CLEAN(세척할 남은 일 수) | 다음에 예정된 수동 세척 시까지 남은 일 수를 표시합니다. |
| SENSOR LIFE(센서 수명) | 다음에 예정된 캡 교체 시까지 남은 일 수를 표시합니다. |

## 오류 목록

오류가 발생할 경우 측정 화면에서 값이 점멸합니다. 출력 동작은 컨트롤러 설정에 의해 결정됩니다. 자세한 내용은 컨트롤러 설명서를 참조하십시오.
현재의 센서 오류를 표시하려면 MENU(메뉴)>DIAGNOSTICS(진단)>[센서 선택]>ERROR LIST(오류 목록)으로 이동합니다. 표 6 을(를) 참조하십시오.

**표 6 LDO 센서 오류 목록**

| 오류 | 발생 원인 | 해결 방법 |
|---|---|---|
| RED AMPL LOW(적색 진폭 낮음) (값이 0.01 미만)<br>또는<br>BLUE AMPL LOW(청색 진폭 낮음) (값이 0.01 미만) | 센서 캡이 설치되지 않았거나 올바로 설치되지 않았습니다. | 센서 캡을 분리했다 다시 설치하십시오. |
| | 센서 캡에서 광 경로가 막혔습니다. | 센서 캡 밀 렌즈의 안쪽을 검사하십시오. |
| | 센서가 올바로 작동하지 않습니다. | LED 가 점멸하는지 확인하십시오. 제조업체에 문의하십시오. |

## 경고 목록

경고 아이콘이 점멸할 경우(sc100 및 sc200) 또는 화면이 노란색으로 바뀔 경우(sc1000), 측정 화면 하단에 메시지가 표시된 것입니다. sc1000 에서는 경고가 표시될 경우 화면이 노란색으로 바뀝니다. 현

재의 센서 경고를 표시하려면 MENU(메뉴)> DIAGNOSTICS(진단)>[센서 선택]>WARNING LIST(경고 목록)으로 이동합니다. 표 7 을(를) 참조하십시오.

**표 7 센서 경고 목록**

| 경고 | 정의 | 해결 방법 |
|---|---|---|
| EE SETUP ERR(설정 오류) | 저장장치가 손상되었습니다. 값이 출고 기본값으로 설정되었습니다. | 기술 지원부에 문의하십시오. |
| EE RSRVD ERR(예약 오류) | | |
| TEMP < 0 C(온도 0 °C 미만) | 공정 온도가 0 °C(32 °F) 미만입니다. | 공정 온도를 높이거나 공정 온도가 센서 사양 범위 안에 들어갈 때까지 사용을 중단합니다. |
| TEMP > 50 C(온도 50 °C 초과) | 공정 온도가 50 °C(120 °F)를 초과합니다. | 공정 온도를 낮추거나 공정 온도가 센서 사양 범위 안에 들어갈 때까지 사용을 중단합니다. |
| RED AMPL LOW(적색 진폭 낮음) | 값이 0.03 미만으로 떨어졌습니다. | 표 6 페이지의 120 을(를) 참조하십시오. |
| RED AMPL HIGH(적색 진폭 높음) | 값이 0.35 를 초과했습니다. | 기술 지원 부서로 연락하십시오. |
| BLUE AMPL LOW(청색 진폭 낮음) | 값이 0.03 미만입니다. | 표 6 페이지의 120 을(를) 참조하십시오. |
| BLUE AMPL HIGH(청색 진폭 높음) | 값이 0.35 를 초과했습니다. | 기술 지원 부서로 연락하십시오. |
| CAP CODE FAULT(캡 코드 결함) | 센서 캡 코드가 손상되었습니다. 코드가 자동으로 기본 캡 및 로트 코드로 재설정되었습니다. | 센서 설정 캡 절차를 완료하십시오. 센서 캡에 대해 사용 가능한 설정 캡이 없을 경우 기술 지원 부서로 연락하십시오. |

## 이벤트 목록

이벤트 목록은 센서가 데이터를 기록하는 방식의 변경 내용을 로깅합니다. 센서 이벤트를 표시하려면 MENU(메뉴)>DIAGNOSTICS(진단)>[센서 선택]>EVENT LIST(이벤트 목록)으로 이동합니다. 표 8 을(를) 참조하십시오.

**표 8 센서 이벤트 목록**

| 이벤트 | 설명 |
|---|---|
| ALT/PRESSURE UNIT CHANGE(고도/압력 단위 변경) | 기압 또는 고도 단위가 변경되었습니다. |
| ALT/PRESSURE CHANGE(고도/압력 변경) | 고도 또는 기압 값이 변경되었습니다. |
| TEMP UNIT CHANGE(온도 단위 변경) | 온도 단위가 변경되었습니다. |
| MEAS UNIT CHANGE(측정 단위 변경) | 새 측정 단위가 변경되었습니다. |
| SALINITY CHANGE(염도 변경) | 염도 값이 변경되었습니다. |
| SET DEFAULT(기본값 설정) | 센서 설정이 기본값으로 재설정되었습니다. |
| SENSOR SETUP CHANGE(센서 설정 변경) | 센서 설정이 변경되었습니다. |
| CLEAN INTERVAL TIMER CHANGE(세척 주기 타이머 변경) | 센서 세척 주기가 변경되었습니다. |
| SENSOR CAP LIFE TIMER CHANGE(센서 캡 수명 타이머 변경) | 센서 캡 교체 주기가 변경되었습니다. |

# 교체 부품 및 부속품

제조업체로부터 승인된 교체 부품만 사용하십시오. 승인되지 않은 부품을 사용하면 부상, 기기 손상 또는 장비 오작동이 발생할 수 있습니다.

## 교체 품목

| 설명 | 품목 번호 (US / EU) |
|---|---|
| LDO 프로브, 센서 캡 1 개 및 교정 백 2 개 포함 | 9020000 / LXV416.99.20001 |
| 해수용 LDO 프로브, 센서 캡 1 개, 교정 백 2 개 포함 | 9020000-SW / — |
| 해수 위험 지역용 LDO 프로브, 센서 캡 1 개, 교정 백 2 개 포함 | 9020000-C1D2-SW / — |
| 위험 지역용 LDO 프로브, 센서 캡 1 개 및 교정 백 2 개 포함 | 9020000-C1D2 / — |
| 센서 캡, 교체용(Class 1, Division 2 위험 지역 사용 등급이 아닌 센서 설정 캡 포함) | 9021100 / 9021150 |

## 부속품

| 설명 | 품목 번호 (US / EU) |
|---|---|
| 위험 지역용 센서 케이블 잠금 장치 | 6139900 / — |
| 케이블, 센서 연장, Class 1, Division 2 위험 지역, 1 m(3.3 ft) | 6122402 / — |
| 케이블, 센서 연장, Class 1, Division 2 위험 지역, 7 m(23 ft) | 5796102 / — |
| 케이블, 센서 연장, Class 1, Division 2 위험 지역, 15 m(49.21 ft) | 5796102 / — |
| 케이블, 센서 연장, Class 1, Division 2 위험 지역, 31 m(101.71 ft) | 5796202 / — |
| 고출력 공기 분사 세척 시스템, 115 V(위험 지역 사용 등급이 아님) | 6860000 / 6860003.99.0001 |
| 고출력 공기 분사 세척 시스템, 230 V(위험 지역 사용 ATEX 등급이 아님) | 6860100 / 6860103.99.0001 |
| 교정 백(1 개) | 5796600 / 5796600 |
| 케이블, 센서 연장, 비위험 지역, 7.7 m(25 ft)[1] | US: 5796000, 7.7 m(25 ft) |
| | EU: LZX849, 10 m(33 ft) |
| 파이프 장착용 하드웨어 키트(PVC) | 9253000 / LZY714.99.21810 |
| 플로트 장착용 하드웨어 키트(PVC) | 9253100 / LZX914.99.42200 |
| 공기 분사 장착용 하드웨어 키트 | 9253500 / LZY812 |
| 체인 장착용 하드웨어 키트(스테인리스 스틸) | — / LZX914.99.11200 |
| 유니언 장착용 하드웨어 키트 | 9257000 / 9257000 |
| LDO 고강도 프로브 포함 HQd 미터(위험 지역 사용 등급 아님) | 8505200 / HQ40D.99.310.000 |

[1] 15 m(49 ft) 및 30 m(98 ft)도 사용 가능

# สารบัญ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## รายละเอียดทางเทคนิค

รายละเอียดทางเทคนิคอาจเปลี่ยนแปลงได้โดยไม่ต้องแจ้งให้ทราบล่วงหน้า

| รายละเอียดทางเทคนิค | รายละเอียด |
|---|---|
| วัสดุเปียก (wetted) | โพรบมาตรฐาน Class โพรบมาตรฐาน 1-Div 2<br>• CPVC ปลายเซ็นเซอร์และปลายสายเคเบิล<br>• โพลียูรีเทน หลอมทับบนปลายสายเคเบิลและปลอกหุ้มสายเคเบิล<br>• 316 บอดี้โลหะสแตนเลสและสกรู<br>• ไวตอน โอริง<br>• โนริล น็อตบนปลายสายเคเบิล |
| | โพรบน้ำทะเลมาตรฐาน โพรบน้ำทะเล Class 1-Div 2<br>• CPVC ปลายเซ็นเซอร์และปลายสายเคเบิล<br>• โพลียูรีเทน หลอมทับบนปลายสายเคเบิลและปลอกหุ้มสายเคเบิล<br>• บอดี้น้ำทะเล PVC<br>• ซีลน้ำทะเลอีพ็อกซี่<br>• โนริล น็อตบนปลายสายเคเบิล |
| การจัดประเภท IP | IP68 |
| วัสดุเปียก (wetted) (ฝาเซ็นเซอร์) | อะคริลิค |
| ช่วงการวัด (ออกซิเจนที่ละลายน้ำ) | 0 ถึง 20 ppm (0 ถึง 20 mg/L) |
| | จุดอิ่มตัว 0 ถึง 200% |
| ความแม่นยำในการวัด (ออกซิเจนที่ละลายน้ำ) | ต่ำกว่า 5 ppm: ± 0.1 ppm |
| | สูงกว่า 5 ppm: ± 0.2 ppm |
| อัตราการทำซ้ำ (ออกซิเจนที่ละลายน้ำ) | 0.1 ppm (mg/L) |
| เวลาการตอบสนอง (ออกซิเจนที่ละลายน้ำ) | $T_{90}$<40 วินาที |
| | $T_{95}$<60 วินาที |
| ความละเอียด เซ็นเซอร์ (ออกซิเจนที่ละลายน้ำ) | 0.01 ppm (mg/L); จุดอิ่มตัว 0.1% |
| ช่วงการวัด (อุณหภูมิ) | 0 ถึง 50 °C (32 ถึง 122 °F) |
| ความแม่นยำในการวัด (อุณหภูมิ) | ± 0.2 °C (± 0.36 °F) |
| สิ่งรบกวนในการวัด | ไม่มีการแทรกแซงจากรายการต่อไปนี้: $H_2S$, pH, $K^+$, $Na^+$, $Mg^{2+}$, $Ca^{2+}$, $NH_4^+$, $Al^{3+}$, $Pb^{2+}$, $Cd^{2+}$, $Zn^{2+}$, Cr (total), $Fe^{2+}$, $Fe^{3+}$, $Mn^{2+}$, $Cu^{2+}$, $Ni^{2+}$, $Co^{2+}$, $CN^-$, $NO_3^-$, $SO_4^{2-}$, $S^{2-}$, $PO_4^{3-}$, $Cl^-$, Anion Active Tensides, น้ำมันดิบ, $Cl_2$ < 4 ppm |

| รายละเอียดทางเทคนิค | รายละเอียด |
|---|---|
| อุณหภูมิสำหรับจัดเก็บ | –20 ถึง 70 °C (–4 ถึง 158 °F) |
| อุณหภูมิสูงสุด | 0 ถึง 50 °C (32 ถึง 122 °F) |
| การจัดประเภทสถานที่อันตราย (เซ็นเซอร์ 9020000-C1D2 เท่านั้น) | Class I Division 2, Groups A–D, T4 / Class I, Zone 2 Group 2C, T4<br>***บันทึก:*** *ผลิตภัณฑ์นี้ไม่เป็นไปตามข้อกำหนดของ 94/9/EC Directive (ATEX Directive)* |
| การรับรอง (เซ็นเซอร์ 9020000-C1D2 เท่านั้น) | อยู่ในรายการ ETL ของมาตรฐาน ANSI/ISA, CSA และ FM สำหรับการใช้งานในสถานที่อันตราย<br>***บันทึก:*** *ผลิตภัณฑ์นี้ไม่เป็นไปตามข้อกำหนดของ 94/9/EC Directive (ATEX Directive)* |
| อัตราการไหลขั้นต่ำ | ไม่จำเป็น |
| การปรับเทียบ/การตรวจสอบ | การปรับเทียบอากาศ: หนึ่งจุด อากาศที่มีน้ำอิ่มตัว 100% |
| | การปรับเทียบตัวอย่าง: เปรียบเทียบกับอุปกรณ์มาตรฐาน |
| ความลึกในการจุ่มโพรบและขีดจำกัดแรงดัน | จำกัดแรงดันที่ 34 ม. (112 ฟุต), สูงสุด 345 kPa (50 psi); อาจไม่สามารถคงความแม่นยำได้ในความลึกเท่านี้ |
| สายเคเบิลเซ็นเซอร์ | สายเคเบิล 10 ม. (30 ฟุต) พร้อมปลั๊กแบบควิกคอนเนค (สำหรับเซ็นเซอร์ทุกประเภท)<br>สามารถต่อสายเคเบิลขยายได้สูงสุดไม่เกิน 100 ม. (เฉพาะประเภทเซ็นเซอร์แบบ non-Class I, Division 2)<br>สามารถต่อจังก์ชันบ็อกซ์ได้สูงสุดไม่เกิน 1000 ม. (เฉพาะประเภทเซ็นเซอร์แบบ non-Class I, Division 2) |
| น้ำหนักของโพรบ | 1.0 กก. (2 ปอนด์ 3 ออนซ์) |
| ขนาดของโพรบ | โพรบมาตรฐาน (เส้นผ่าศูนย์กลาง x ความยาว): 49.53 x 255.27 มม. (1.95 x 10.05 นิ้ว) |
| | โพรบมาตรฐานน้ำทะเล (เส้นผ่าศูนย์กลาง x ความยาว): 60.45 x 255.27 มม. (2.38 x 10.05 นิ้ว) |
| ระบบไฟฟ้า | 12 VDC, 0.25 A, 3 W |
| การรับประกัน | โพรบ: 3 ปี สำหรับข้อผิดพลาดจากการผลิต |
| | ฝาเซ็นเซอร์: 2 ปี สำหรับข้อผิดพลาดจากการผลิต |

## ข้อมูลทั่วไป

ผู้ผลิตไม่มีส่วนรับผิดชอบใด ๆ ต่อความเสียหายโดยตรง โดยอ้อม ความเสียพิเศษ ความเสียหายจากอุบัติการณ์หรือความเสียหายอันเป็นผลต่อเนื่องเนื่องจากข้อบกพร่องหรือการละเว้นข้อมูลใด ๆ ของคู่มือชุดนี้ ผู้ผลิตสงวนสิทธิ์ในการแก้ไขคู่มือและเปลี่ยนแปลงผลิตภัณฑ์ที่อ้างถึงได้โดยไม่ต้องแจ้งให้ทราบ ข้อมูลฉบับแก้ไขจะมีจัดไว้ให้ในเว็บไซต์ของผู้ผลิต

### ข้อมูลเพื่อความปลอดภัย

***หมายเหตุ***

ผู้ผลิตจะไม่รับผิดชอบต่อความเสียหายใดๆ ที่เกิดจากการนำผลิตภัณฑ์ไปใช้หรือการใช้งานที่ผิดวัตถุประสงค์ รวมถึง แต่ไม่จำกัดเพียงความเสียหายทางตรง ความเสียหายที่ไม่ได้ตั้งใจ และความเสียหายที่ต่อเนื่องตามมา และขอปฏิเสธในการรับผิดชอบต่อความเสียหายเหล่านี้ในระดับสูงสุดเท่าที่กฎหมายที่เกี่ยวข้องจะอนุญาต ผู้ใช้เป็นผู้รับผิดชอบแต่เพียงผู้เดียวในการระบุถึงความเสี่ยงในการนำไปใช้งานที่สำคัญ และการติดตั้งกลไกที่เหมาะสมเพื่อป้องกันกระบวนการต่างๆ ที่เป็นไปได้ในกรณีอุปกรณ์ทำงานผิดพลาด

กรุณาอ่านคู่มือฉบับนี้โดยละเอียดก่อนเปิดกล่อง ติดตั้งหรือใช้งานอุปกรณ์นี้ ศึกษาอันตรายและข้อควรระวังต่าง ๆ ที่แจ้งให้ทราบให้ครบถ้วน หากไม่ปฏิบัติตามอาจทำให้เกิดการบาดเจ็บร้ายแรงต่อผู้ใช้หรือเกิดความเสียหายต่ออุปกรณ์

ตรวจดูว่าชิ้นส่วนป้องกันของอุปกรณ์ไม่มีความเสียหาย ห้ามใช้หรือติดตั้งอุปกรณ์ในลักษณะอื่นใดนอกจากที่ระบุไว้ในคู่มือนี้

## การใช้ข้อมูลแจ้งเตือนเกี่ยวกับอันตราย

**⚠ อันตราย**

ระบุอันตรายที่อาจเกิดขึ้น ซึ่งหากไม่หลีกเลี่ยง อาจทำให้เสียชีวิตหรือได้รับบาดเจ็บร้ายแรงได้

**⚠ คำเตือน**

ระบุอันตรายที่อาจเกิดขึ้น ซึ่งหากไม่หลีกเลี่ยง อาจทำให้เสียชีวิตหรือได้รับบาดเจ็บร้ายแรงได้

**⚠ ข้อควรระวัง**

ระบุอันตรายที่อาจเกิดขึ้นซึ่งอาจทำให้เกิดการบาดเจ็บเล็กน้อยถึงปานกลาง

***หมายเหตุ***

ข้อควรทราบระบุกรณีที่หากไม่หลีกเลี่ยง อาจทำให้อุปกรณ์ได้รับความเสียหายได้ ข้อมูลที่ต้องมีการเน้นย้ำเป็นพิเศษ

## ฉลากระบุข้อควรระวัง

อ่านฉลากและป้ายระบุทั้งหมดที่จัดมาพร้อมกับอุปกรณ์ อาจเกิดการบาดเจ็บหรือความเสียหายต่ออุปกรณ์หากไม่ปฏิบัติตาม คู่มืออ้างอิงสัญลักษณ์ที่ตัวอุปกรณ์พร้อมข้อความเพื่อเฝ้าระวังเบื้องต้น

| | |
|---|---|
| | นี่เป็นสัญลักษณ์แจ้งเตือนเพื่อความปลอดภัย ปฏิบัติตามข้อความแจ้งเพื่อความปลอดภัยที่ระบุต่อจากสัญลักษณ์นี้เพื่อหลีกเลี่ยงการบาดเจ็บ ดูคู่มือเพื่อรับทราบข้อมูลการใช้งานและข้อมูลด้านความปลอดภัยสำหรับอุปกรณ์ |
| | สัญลักษณ์นี้ระบุถึงแหล่งแสงสว่างที่มีแนวโน้มในการทำให้เกิดอันตรายระดับไม่ร้ายแรงกับดวงตา ปฏิบัติตามข้อความทั้งหมดที่อยู่ถัดจากสัญลักษณ์นี้เพื่อหลีกเลี่ยงการบาดเจ็บบริเวณดวงตา |
| | สัญลักษณ์นี้ใช้เพื่อแจ้งว่าอุปกรณ์ไวต่อไฟฟ้าสถิต (ESD) และจะต้องใช้ความระมัดระวังเพื่อป้องกันความเสียหายต่ออุปกรณ์ |
| | อุปกรณ์อิเล็กทรอนิกส์ที่มีเครื่องหมายนี้ไม่สามารถทิ้งแบบขยะปกติในเขตยุโรป ตามหลักเกณฑ์ที่ประกาศใช้หลังจากวันที่ 12 สิงหาคม 2005 หากไม่ปฏิบัติตามข้อบังคับในเขตยุโรปหรือในพื้นที่ (EU Directive 2002/96/EC) ผู้ใช้อุปกรณ์ไฟฟ้าในยุโรปจะต้องส่งคืนผลิตภัณฑ์เก่าหรือที่หมดอายุการใช้งานแล้วให้แก่ผู้ผลิตเพื่อกำจัดทิ้งตามความเหมาะสมโดยผู้ใช้ไม่ต้องเสียค่าใช้จ่ายใด ๆ<br>***บันทึก:*** *ในกรณีการส่งคืนเพื่อรีไซเคิล กรุณาติดต่อผู้ผลิตอุปกรณ์หรือซัพพลายเออร์เพื่อรับทราบคำแนะนำในการส่งคืนอุปกรณ์ที่หมดอายุ อุปกรณ์ไฟฟ้าที่ผู้ผลิตจัดหาให้ หรืออุปกรณ์เสริมใด ๆ เพื่อให้มีการกำจัดอย่างถูกวิธี* |

## การรับรอง

**หลักเกณฑ์เกี่ยวกับอุปกรณ์ที่ทำให้เกิดสัญญาณรบกวนของแคนาดา IECS-003, Class A**

รองรับข้อมูลการทดสอบของผู้ผลิต

อุปกรณ์ดิจิตอล Class A นี้ได้มาตรฐานตามเงื่อนไขภายใต้หลักเกณฑ์เกี่ยวกับอุปกรณ์ที่ทำให้เกิดสัญญาณรบกวนของแคนาดา

Cet appareil numèrique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

**FCC Part 15, Class "A" Limits**

รองรับข้อมูลการทดสอบของผู้ผลิต อุปกรณ์ได้มาตรฐานตาม Part 15 ของ FCC Rules การใช้งานจะต้องอยู่ภายใต้เงื่อนไขดังต่อไปนี้:

1. อุปกรณ์จะต้องไม่ทำให้เกิดอันตรายจากสัญญาณรบกวน
2. อุปกรณ์จะต้องสามารถทนรับสัญญาณรบกวนที่ได้รับ รวมทั้งสัญญาณรบกวนอื่น ๆ ที่อาจทำให้การทำงานไม่เป็นไปตามที่คาดหวัง

การเปลี่ยนแปลงหรือปรับแต่งอุปกรณ์นี้ซึ่งไม่ได้รับรับการรับรองโดยผู้เกี่ยวข้องเพื่อควบคุมมาตรฐาน อาจทำให้ผู้ใช้เสียสิทธิ์ในการใช้งานอุปกรณ์ อุปกรณ์นี้ผ่านการทดสอบและพบว่าได้มาตรฐานตามข้อจำกัดสำหรับอุปกรณ์ดิจิตอล Class A ภายใต้ Part 15 ของ FCC Rules ข้อจำกัดนี้กำหนดขึ้นเพื่อเป็นการป้องกันสัญญาณรบกวนที่เป็นอันตรายเมื่อมีการใช้งานอุปกรณ์ในเชิงพาณิชย์ อุปกรณ์นี้ทำให้เกิด

ใช้ และสามารถแพร่คลื่นความถี่วิทยุ และหากมีการติดตั้งและใช้งานไม่เป็นไปตามคู่มือการใช้งาน อาจทำให้เกิดสัญญาณรบกวนที่เป็นอันตรายต่อการสื่อสารทางวิทยุ การทำงานของอุปกรณ์ในที่พักอาศัยอาจทำให้เกิดสัญญาณรบกวนที่เป็นอันตราย ซึ่งในกรณีนี้ผู้ใช้จะต้องแก้ไขปัญหาสัญญาณรบกวนด้วยตัวเอง สามารถใช้เทคนิคต่อไปนี้เพื่อลดปัญหาจากสัญญาณรบกวน:

1. ปลดอุปกรณ์จากแหล่งจ่ายไฟเพื่อยืนยันว่าอุปกรณ์เป็นสาเหตุของสัญญาณรบกวนหรือไม่
2. หากต่ออุปกรณ์เข้ากับเต้ารับไฟฟ้าเดียวกันกับอุปกรณ์ที่มีปัญหาสัญญาณรบกวน ให้ต่ออุปกรณ์กับเต้ารับไฟฟ้าอื่น
3. ย้ายอุปกรณ์ออกห่างจากอุปกรณ์ที่ได้รับสัญญาณรบกวน
4. ปรับตำแหน่งสายอากาศสำหรับอุปกรณ์ที่ได้รับสัญญาณรบกวน
5. ลองดำเนินการตามวิธีการต่าง ๆ ข้างต้น

## ภาพรวมผลิตภัณฑ์

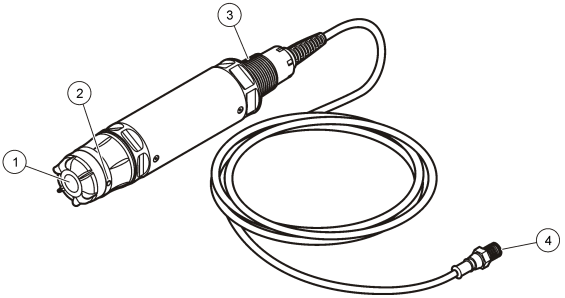
**⚠ อันตราย**

อันตรายจากสารเคมีหรืออันตรายทางชีวภาพ หากอุปกรณ์นี้ถูกใช้งานในการตรวจสอบกระบวนการทรีตเมนต์ และ/หรือระบบฟีดส์สารเคมี ซึ่งมีขีดจำกัดตามกฎข้อบังคับและมีข้อกำหนดในการตรวจสอบ ซึ่งเกี่ยวข้องกับด้านสาธารณสุข ความปลอดภัยของสาธารณะ การผลิตหรือกระบวนการต่างๆ ของเครื่องดื่มหรืออาหาร ถือเป็นความรับผิดชอบของผู้ใช้อุปกรณ์นี้ ในการรับทราบและปฏิบัติตามกฎข้อบังคับที่เกี่ยวข้อง รวมถึงการมีกลไกที่เหมาะสมและเพียงพอไว้รองรับ เพื่อให้เป็นไปตามกฎข้อบังคับที่เกี่ยวข้องในกรณีที่อุปกรณ์ทำงานผิดพลาด

เซ็นเซอร์ออกแบบมาให้สามารถใช้งานร่วมกับคอนโทรเลอร์เพื่อเก็บข้อมูลและเพื่อการประมวลผล สามารถใช้เซ็นเซอร์นี้ได้กับคอนโทรเลอร์สองถึงสามชุด โปรดดูคู่มือคอนโทรเลอร์เฉพาะสำหรับข้อมูลเพิ่มเติม

การใช้งานหลักสำหรับเซ็นเซอร์นี้คือการใช้กับน้ำเสียในเขตเทศบาลหรืออุตสาหกรรม เทคโนโลยีเซ็นเซอร์ LDO จะไม่ใช้ค่าออกซิเจน และสามารถวัดความเข้มข้นของ DO ได้ในลักษณะที่มีการไหลต่ำหรือไม่มีเลย โปรดดูรายละเอียดใน รูปที่ 1

**รูปที่ 1 เซ็นเซอร์ LDO**

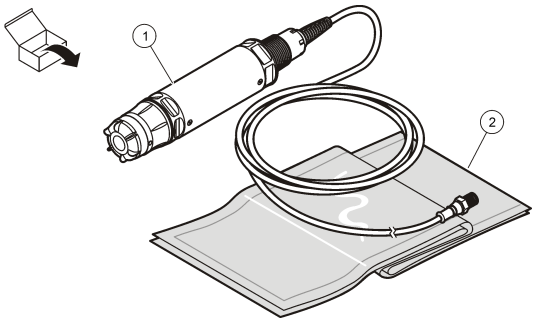



| | |
|---|---|
| **1** ฝาเซ็นเซอร์ | **3** NPT 1-นิ้ว |
| **2** เซ็นเซอร์อุณหภูมิ | **4** คอนเนคเตอร์ ควิก-คอนเนค (มาตรฐาน) |

## รายการส่วนประกอบเซ็นเซอร์ LDO

ตรวจสอบให้แน่ใจว่าได้รับส่วนประกอบทั้งหมดที่แสดงใน รูปที่ 2 หากพบว่าชิ้นส่วนใดสูญหายหรือชำรุด โปรดติดต่อผู้ผลิตหรือพนักงานขายทันที โปรดดูรายละเอียดใน รูปที่ 2

**รูปที่ 2 รายการส่วนประกอบเซ็นเซอร์**




| | |
|---|---|
| **1** เซ็นเซอร์ LDO [1] | **2** ถุงสำหรับปรับเทียบ (2 ชิ้น) |

[1] ไม่ได้แสดงคู่มือผู้ใช้ที่ให้ไปพร้อมกัน

## การติดตั้ง

**⚠ คำเตือน**

อาจทำให้เกิดการบาดเจ็บได้ บุคลากรผู้เชี่ยวชาญเท่านั้นที่ควรดำเนินการตามขั้นตอนที่ระบุในคู่มือส่วนนี้

### ตรวจสอบประเภทเซ็นเซอร์

**⚠ อันตราย**

อันตรายจากการระเบิด เชื่อมต่อเฉพาะส่วนประกอบในการต่อพ่วงที่มีการทำเครื่องหมายอย่างชัดเจน ว่าได้รับอนุญาตให้ใช้ในสถานที่อันตราย Class 1 Division 2

**หมายเหตุ**

ผลิตภัณฑ์นี้ในเวอร์ชันที่ผ่านการรับรองสำหรับสถานที่อันตราย ไม่เป็นไปตามข้อกำหนดของ 94/9/EC Directive (ATEX Directive)

1. ไปที่ส่วนปลายคอนเนคเตอร์ของสายเคเบิล
2. อ่านป้ายบนปลายคอนเนคเตอร์ของสายเคเบิล สำหรับเซ็นเซอร์ที่ผ่านการรับรองการใช้งานในสถานที่อันตราย ป้ายจะเขียนว่า "Rated: Class 1 Division 2"
3. ตรวจสอบคอนเนคเตอร์

   - เซ็นเซอร์ที่ผ่านการรับรองการใช้งานในสถานที่อันตรายจะมีคอนเนคเตอร์ล็อคนิรภัย โปรดดูรายละเอียดใน รูปที่ 3 ในหน้า 128
   - เซ็นเซอร์ที่ไม่ผ่านการรับรองการใช้งานในสถานที่อันตราย จะมีควิกคอนเนคคอนเนคเตอร์ แต่ไม่มีล็อคนิรภัย

### เชื่อมต่อเซ็นเซอร์ในสถานที่อันตราย

**⚠ อันตราย**

อันตรายจากการระเบิด อุปกรณ์นี้เหมาะสมสำหรับการใช้ในพื้นที่ปลอดภัย หรือพื้นที่อันตราย Class 1, Division 2, Groups A, B, C, D พร้อมกับเซ็นเซอร์ที่กำหนดและอุปกรณ์เสริมตามเอกสารควบคุมการติดตั้งในพื้นที่อันตราย โปรดปฏิบัติตามเอกสารควบคุมและข้อกำหนด Electrical Code เพื่อการติดตั้งอย่างเหมาะสมเสมอ

**⚠ อันตราย**

อันตรายจากการระเบิด ห้ามเชื่อมต่อหรือถอดส่วนประกอบอิเล็กทรอนิกส์หรือวงจรกับอุปกรณ์ จนกว่าจะตัดพลังงานหรือมั่นใจว่าในบริเวณนั้นปลอดภัย

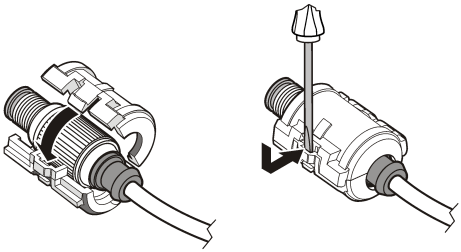
***หมายเหตุ***

ใช้เฉพาะเซ็นเซอร์ที่ผ่านการรับรองสำหรับสถานที่อันตราย และเคเบิลล็อคในสถานที่อันตราย ผลิตภัณฑ์นี้ในเวอร์ชันที่ผ่านการรับรองสำหรับสถานที่อันตรายไม่เป็นไปตามข้อกำหนดของ 94/9/EC Directive (ATEX Directive)

สำหรับข้อมูลเพิ่มเติม โปรดดูที่ ตรวจสอบประเภทเซ็นเซอร์ ในหน้า 127

1. ถอดฝาคอนเนคเตอร์ออกจากคอนโทรเลอร์ ทิ้งให้ฝาคอนเนคเตอร์ปิดช่องว่างของคอนเนคเตอร์ในขณะที่ถอดเซ็นเซอร์ออกไป
2. ต่อเซ็นเซอร์เข้ากับคอนโทรเลอร์ โปรดดูคู่มือคอนโทรเลอร์สำหรับข้อมูลเพิ่มเติม
3. ปิดล็อคนิรภัยไว้บนคอนเนคเตอร์
4. หากต้องการถอดล็อคนิรภัยคอนเนคเตอร์ ให้ใช้ไขควงปากแบนขนาดเล็ก โปรดดูรายละเอียดใน รูปที่ 3

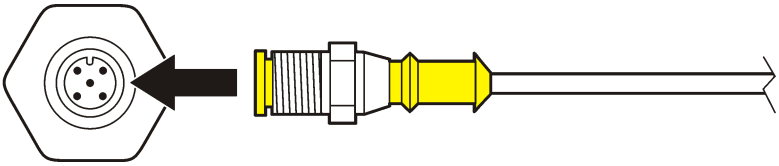
**รูปที่ 3 ล็อคนิรภัยคอนเนคเตอร์**



## เชื่อมต่อเซ็นเซอร์ในสถานที่ไม่อันตราย

โปรดดูที่ รูปที่ 4 สำหรับการเชื่อมต่อเซ็นเซอร์ LDO กับคอนโทรเลอร์ SC โปรดดูคู่มือเฉพาะของคอนโทรเลอร์ SC สำหรับคำแนะนำในการต่อสายไฟ

**รูปที่ 4 เชื่อมต่อเซ็นเซอร์ LDO (ในสถานที่ปลอดภัย)**



หลังจากติดตั้งเซ็นเซอร์แล้ว ให้สแกนหาเซ็นเซอร์ โปรดดูรายละเอียดใน ติดตั้งเซ็นเซอร์ ในหน้า 128

## ติดตั้งเซ็นเซอร์

มีอยู่สองตัวเลือกในการติดตั้งเซ็นเซอร์:

- เชื่อมต่อเซ็นเซอร์ในขณะที่ปิดสวิตช์คอนโทรเลอร์ไว้ คอนโทรเลอร์จะค้นหาและติดตั้งเซ็นเซอร์ใหม่หลังจากที่เปิดเครื่อง
- เชื่อมต่อเซ็นเซอร์ในขณะที่เปิดสวิตช์คอนโทรเลอร์ไว้ ใช้คำสั่ง Scan Device ในการติดตั้งเซ็นเซอร์ใหม่:

| ตัวเลือก | คำอธิบาย |
|---|---|
| **SC200 คอนโทรเลอร์** | ไปที่ MENU>TEST/MAINT>SCAN DEVICE |

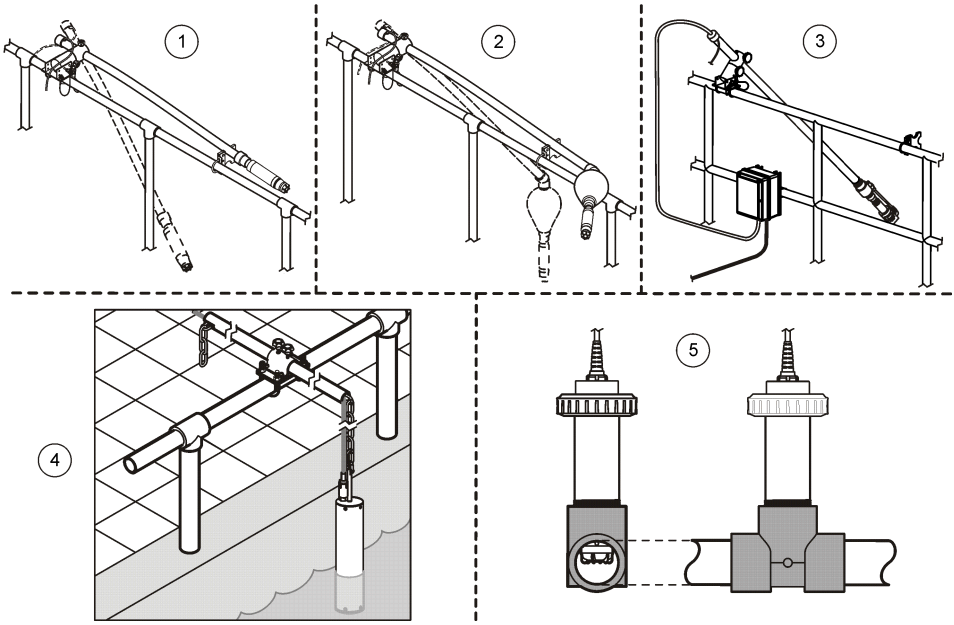
| ตัวเลือก | คำอธิบาย |
|---|---|
| **SC100** คอลโทรเลอร์ | ไปที่ MENU>TEST/MAINT>SCAN SENSORS |
| **SC1000** คอลโทรเลอร์ | ไปที่ MENU>SYSTEM SETUP>DEVICE MANAGEMENT>SCANNING FOR NEW DEVICES |

โปรดดูที่ เชื่อมต่อเซ็นเซอร์ในสถานที่ไม่อันตราย ในหน้า 128 สำหรับการเชื่อมต่อดิจิตอลเซ็นเซอร์

## ตัวเลือกในการติดตั้งเซ็นเซอร์

ชุดอุปกรณ์การติดตั้งในรูปแบบต่างๆ สำหรับเซ็นเซอร์ LDO นี้มีจำหน่ายแล้วซึ่งจะมีให้ไปพร้อมกับคำแนะนำการติดตั้งในชุดอุปกรณ์ รูปที่ 5 แสดงสองถึงสามตัวเลือกในการติดตั้ง หากต้องการสั่งซื้ออุปกรณ์การติดตั้ง โปรดดูที่ อะไหล่ทดแทนและอุปกรณ์เสริม ในหน้า 138

**รูปที่ 5 ตัวเลือกการติดตั้ง**




| | |
|---|---|
| **1** ติดตั้งบนราง | **4** ติดตั้งบนโซ่ |
| **2** ติดตั้งแบบลอย | **5** ติดตั้งแบบยูเนียน (ไม่สามารถใช้งานร่วมกับโพรบน้ำทะเล) |
| **3** ติดตั้งแบบระบบแอร์บลาสต์ (ไม่สามารถใช้งานร่วมกับโพรบน้ำทะเล) | |

## การทำงาน

## การไล่เนื้อหาสำหรับผู้ใช้

ดูเอกสารกำกับชุดควบคุมเพื่อดูคำอธิบายเกี่ยวกับแป้นกดและข้อมูลการไล่เนื้อหาต่าง ๆ

## กำหนดค่าเซ็นเซอร์

ใช้เมนู Configure เพื่อป้อนค่าสำหรับเซ็นเซอร์และเพื่อเปลี่ยนแปลงตัวเลือกสำหรับจัดการและจัดเก็บข้อมูล

สำหรับข้อมูลเกี่ยวกับการติดตั้งเซ็นเซอร์ โปรดดู ติดตั้งเซ็นเซอร์ ในหน้า 128

ตรวจสอบให้แน่ใจว่าค่าต่างๆ ในเมนู Configure นั้นถูกต้องสำหรับการนำไปใช้

1. ไปที่ MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE
2. เลือกตัวเลือก และกด ENTER รายการตัวเลือกที่พร้อมใช้งานจะปรากฏในตารางด้านล่าง

| ตัวเลือก | คำอธิบาย |
|---|---|
| EDIT NAME | เปลี่ยนชื่อที่ตรงกับเซ็นเซอร์ที่ด้านบนของหน้าจอตรวจวัด ชื่อจำกัดความยาวไว้ที่ 10 ตัวอักษรโดยสามารถใช้ตัวอักษร ตัวเลข ช่องว่างหรือเครื่องหมายวรรคตอน |
| SET UNITS | TEMP–กำหนดหน่วยอุณหภูมิเป็น °C (ค่าเริ่มต้น) หรือ °F |
| | MEASURE–กำหนดหน่วยการวัดเป็น mg/L, ppm หรือ % |
| | ALT/PRESS–ตั้งค่าความสูงในหน่วย m หรือ ft หรือตั้งค่าหน่วยแรงดันสภาพแวดล้อมเป็น mmHg หรือ torr (ค่าเริ่มต้น = 0 ft) |
| ALT/PRESS | ป้อนค่าความสูงหรือแรงดันสภาพแวดล้อม ค่านี้จะต้องแม่นยำตามการวัด % จุดอิ่มตัว และการปรับเทียบในอากาศ (ค่าเริ่มต้น = 0 ft) |
| SALINITY | ป้อนค่าความเค็ม ช่วงค่าความเค็ม: 0.00 ถึง 250.00 ส่วนต่อหนึ่งพัน (‰) โปรดดูที่ ป้อนค่าแก้ไขค่าความเค็ม ในหน้า 131 สำหรับข้อมูลเพิ่มเติม (ค่าเริ่มต้น = 0) |
| SIGNAL AVERAGE | กำหนดค่าช่วงของค่าเฉลี่ยสัญญาณโดยหน่วยเป็นวินาที |
| CLEAN INTRVL | กำหนดช่วงเวลาสำหรับการทำความสะอาดเซ็นเซอร์ด้วยตัวเอง โดยหน่วยเป็นวัน (ค่าเริ่มต้น = 0 วัน ค่า 0 วัน จะปิดการทำงานของช่วงเวลาการทำความสะอาด) |
| RESET CLN INTRVL | กำหนดช่วงเวลาสำหรับช่วงการทำความสะอาดที่บันทึกไว้ล่าสุด |
| LOG SETUP | กำหนดช่วงเวลาสำหรับจัดเก็บข้อมูลในบันทึกข้อมูล-0.5,1, 2, 5, 10, 15 (ค่าเริ่มต้น) 30, 60 นาที |
| SET DEFAULTS | คืนค่าทั้งหมดที่กำหนดได้สำหรับเซ็นเซอร์เป็นค่าเริ่มต้น จะไม่เปลี่ยนแปลงการตั้งค่าความชันหรือออฟเซ็ต |

## การป้อนค่าแรงดันสภาพแวดล้อม

การตั้งค่าจากโรงงานของแรงดัน (อากาศ) สภาพแวดล้อมคือ 0 ft หรือระดับน้ำทะเล หากต้องการเปลี่ยนค่าเริ่มต้น ให้ใช้ขั้นตอนต่างๆ ในกระบวนการนี้ การปรับแต่งค่าแรงดันอากาศจะป้อนในหน่วยระดับความสูงหรือแรงดัน (แนะนำ)

***บันทึก:*** *แรงดันอากาศที่แม่นยำเป็นสิ่งจำเป็นสำหรับการปรับเทียบอากาศที่จุดอิ่มตัว (ปรับเทียบด้วยอากาศ ในหน้า 132) ใช้เฉพาะแรงดันสัมบูรณ์เท่านั้น ไม่ต้องปรับแต่ง หากไม่ทราบแรงดันอากาศสัมบูรณ์ ให้ใช้ระดับความสูงที่ถูกต้องสำหรับสถานที่*

1. ไปที่ MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>SET UNITS>AIR PRESS/ALT UNITS
2. เลือก **หนึ่ง** ในตัวเลือกหน่วยในรายการ:

| ตัวเลือก | คำอธิบาย |
|---|---|
| **ft** | ฟุต—หน่วยวัดระดับความสูง |
| **m** | เมตร—หน่วยวัดแบบเมตริกของระดับความสูง |
| **mmHg** | มิลลิเมตรปรอท—หน่วยวัดแบบเมตริกของค่าแรงดันอากาศสัมบูรณ์ |
| **torr** | หน่วยวัดค่าแรงดันอากาศสัมบูรณ์ |

3. ยืนยันการเลือก หน้าจอป้อนค่าจะแสดงหน่วยที่เลือก
4. ป้อนค่า จากนั้น ENTER เพื่อยืนยัน

## ป้อนค่าแก้ไขค่าความเค็ม

การวัดออกซิเจนที่ละลายในตัวอย่างน้ำเกลือ สามารถแสดงค่า DO ได้อย่างชัดเจน ซึ่งจะมีความแตกต่างจากค่า DO จริงเป็นอย่างมาก หากต้องการแก้ไขอิทธิพลของเกลือที่ละลายในตัวอย่าง ให้ป้อนปัจจัยการแก้ไขค่าความเค็ม

***บันทึก:*** *ไม่ทราบปริมาณของค่าความเค็มในกระบวนการ ให้ติดต่อทีมงานฝ่ายวิศวกรรมสาขาทรีตเมนต์*

1. ใช้มิเตอร์วัดค่าการนำไฟฟ้าเพื่อวัดการนำไฟฟ้าในตัวอย่าง ด้วยหน่วย mS/cm ที่อุณหภูมิอ้างอิง 20 °C (68 °F)
2. ใช้ ตาราง 1 ในการประมาณค่าปัจจัยการแก้ไขค่าความเค็มที่จุดอิ่มตัวส่วนต่อพัน (‰)

   ***บันทึก:*** *ค่าความเข้มข้นของอิออนคลอไรด์ ในหน่วย g/kg จะเทียบเท่ากับค่าคลอรีนในตัวอย่าง ค่าความเค็มจะถูกคำนวณด้วยสูตร: ค่าความเค็ม = 1.80655 x ค่าคลอรีน*

   สามารถคำนวณค่าความเค็มได้ด้วยความสัมพันธ์ในส่วน 2520 B ของ *Standard Methods for the Examination of Water and Wastewater* (วิธีการมาตรฐานในการตรวจสอบน้ำและน้ำเสีย)*,
3. ไปที่ MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>SALINITY
4. ป้อนค่าปัจจัยการแก้ไขค่าความเค็มและยืนยัน

**ตาราง 1 จุดอิ่มตัวค่าความเค็ม (‰) ต่อค่าการนำไฟฟ้า (mS/cm)**

| mS/cm | ‰ | mS/cm | ‰ | mS/cm | ‰ | mS/cm | ‰ |
|---|---|---|---|---|---|---|---|
| 5 | 3 | 16 | 10 | 27 | 18 | 38 | 27 |
| 6 | 4 | 17 | 11 | 28 | 19 | 39 | 28 |
| 7 | 4 | 18 | 12 | 29 | 20 | 40 | 29 |
| 8 | 5 | 19 | 13 | 30 | 21 | 42 | 30 |
| 9 | 6 | 20 | 13 | 31 | 22 | 44 | 32 |
| 10 | 6 | 21 | 14 | 32 | 22 | 46 | 33 |
| 11 | 7 | 22 | 15 | 33 | 23 | 48 | 35 |
| 12 | 8 | 23 | 15 | 34 | 24 | 50 | 37 |
| 13 | 8 | 24 | 17 | 35 | 25 | 52 | 38 |
| 14 | 9 | 25 | 17 | 36 | 25 | 54 | 40 |
| 15 | 10 | 26 | 18 | 37 | 26 | | |

## กำหนดค่าลิเนียร์เอาต์พุตบนคอนโทรเลอร์

ลิเนียร์เอาต์พุตจะส่งข้อมูลโพรบกลับไปยังอุปกรณ์ PLC, SCADA หรือระบบเก็บรวบรวมข้อมูลอื่นๆ

1. ไปที่เมนูการตั้งค่าเอาต์พุตคอนโทรเลอร์

| ตัวเลือก | คำอธิบาย |
|---|---|
| **sc200** | ไปที่ MENU>SETTINGS>sc200 SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION |

* *Standard Methods for the Examiniation of Water and Wastewater* (วิธีการมาตรฐานในการตรวจสอบน้ำและน้ำเสีย) ฉบับที่ 20 Editors Lenore S. Clesceri, Arnold E. Greenberg and Andrew D. Eaton, p. 2-48-2-29 (1998). ความสัมพันธ์ระหว่างค่าคลอรีนและค่าออกซิเจนโซลูบิทีที จะอยู่ในช่วงอ้างอิงเดียวกันใน 4500-O:I p. 4-131

| ตัวเลือก | คำอธิบาย |
|---|---|
| **sc100** | ไปที่ MENU>SYSTEM SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION |
| **sc1000** | ไปที่ MENU>SYSTEM SETUP>OUTPUT SETUP>[Select Output]>SET FUNCTION |

2. ตั้งค่าฟังก์ชันสำหรับคอนโทรเลอร์

| ตัวเลือก | คำอธิบาย |
|---|---|
| **sc200** | LINEAR |
| **sc100** | LINEAR CONTROL (ค่าเริ่มต้น) |
| **sc1000** | LINEAR CONTROL (ค่าเริ่มต้น) |

## MODBUS รีจีสเตอร์

รายการรีจีสเตอร์ Modbus สำหรับการเชื่อมต่อเครือข่าย ดูข้อมูลเพิ่มเติมใน www.hach.com หรือ www.hach-lange.com

## การปรับเทียบสำหรับการตรวจวัด

เซ็นเซอร์จะได้รับการปรับเทียบตามข้อมูลจำเพาะจากที่โรงงาน ผู้ผลิตไม่แนะนำให้ทำการปรับเทียบ ยกเว้นเป็นข้อกำหนดตามระยะเวลาของเจ้าหน้าที่ด้านกฎข้อบังคับ หากต้องทำการปรับเทียบ ให้เซ็นเซอร์อยู่ในสภาวะสมดุลก่อนดำเนินการปรับเทียบ ห้ามปรับเทียบเซ็นเซอร์ในขณะตั้งค่า

ตาราง 2แสดงตัวเลือกในการปรับเทียบ

**ตาราง 2 ตัวเลือกการปรับเทียบ**

| ตัวเลือก | คำอธิบาย |
|---|---|
| AIR CAL | วิธีการปรับเทียบที่แนะนำ การปรับเทียบนี้จะแก้ไขค่าความชัน |
| SAMPLE CAL | การปรับเทียบโดยการเปรียบเทียบกับมิเตอร์ DO แบบมือถือ การปรับเทียบนี้จะแก้ไขค่าออฟเซ็ต |
| RESET DFLT CAL | รีเซ็ตค่า Gain (ความชัน) และออฟเซ็ตเป็นค่าเริ่มต้นโรงงาน: ค่าเริ่มต้นเกน=1.0 ค่าเริ่มต้นออฟเซ็ต=0.0 |

### ปรับเทียบด้วยอากาศ

**หมายเหตุสำหรับผู้ใช้:**

- ตรวจสอบให้แน่ใจว่าถุงสำหรับปรับเทียบมีน้ำอยู่ข้างใน
- ตรวจสอบให้แน่ใจว่าระหว่างถุงสำหรับปรับเทียบและตัวเซ็นเซอร์นั้นมีซีลที่แน่นหนา
- ตรวจสอบให้แน่ใจว่าเซ็นเซอร์แห้งอยู่ในขณะที่ทำการปรับเทียบ
- ตรวจสอบให้แน่ใจว่าการตั้งค่าแรงดันอากาศ/ระดับความสูงนั้นตรงกับสถานที่ที่ทำการปรับเทียบ
- รอเวลาให้อุณหภูมิของเซ็นเซอร์ปรับตัวให้คงที่ตามอุณหภูมิของสถานที่ของถุงสำหรับปรับเทียบ หากมีอุณหภูมิแตกต่างกันมากระหว่างกระบวนการทำงานและสถานที่ที่ทำการปรับเทียบ อาจต้องใช้เวลาถึง 15 นาทีในการปรับตัวให้คงที่

1. นำเซ็นเซอร์ออกจากจุดวัด ใช้ผ้าเปียกในการทำความสะอาดเซ็นเซอร์
2. ใส่เซ็นเซอร์ทั้งอันลงในถุงสำหรับปรับเทียบที่มีน้ำในปริมาณ 25-50 mL ตรวจสอบให้แน่ใจว่าฝาเซ็นเซอร์ไม่สัมผัสกับน้ำภายในถุงสำหรับปรับเทียบ และไม่มีหยดน้ำติดอยู่บนฝาเซ็นเซอร์ (รูปที่ 6)
3. หรือใช้ยางวง เส้นด้าย หรือมือในการสร้างซีลที่แน่นหนารอบๆ ตัวเซ็นเซอร์
4. ปล่อยให้อุปกรณ์ปรับตัวให้คงที่เป็นเวลา 15 นาที ก่อนทำการปรับเทียบ อย่าให้ถุงสำหรับปรับเทียบสัมผัสถูกแสงแดดในระหว่างการปรับเทียบ
5. ตรวจสอบให้แน่ใจว่ามีการกำหนดค่าแรงดันอากาศหรือระดับความสูงสัมบูรณ์ในปัจจุบันอย่างถูกต้อง โปรดดูรายละเอียดใน การป้อนค่าแรงดันสภาพแวดล้อม ในหน้า 130

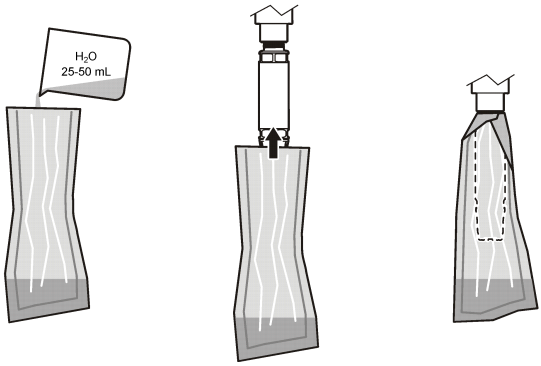
   ***บันทึก:*** *ผู้ผลิตแนะนำให้ใช้ค่าสัมบูรณ์หรือค่าแรงดันอากาศจริงเป็นวิธีปฏิบัติที่ดีที่สุด*
6. ไปที่ MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>AIR CAL

7. เลือกตัวเลือกสำหรับเอาต์พุตระหว่างการปรับเทียบ:

| ตัวเลือก | คำอธิบาย |
|---|---|
| **Active** | อุปกรณ์จะส่งค่ากระแสที่ตรวจวัดได้ระหว่างขั้นตอนการปรับเทียบ |
| **Hold** | กระแสเอาต์พุตของเซ็นเซอร์จะคงค้างไว้สำหรับค่าตรวจวัดระหว่างขั้นตอนการปรับเทียบ |
| **Transfer** | ค่าพรีเซ็ตจะถูกส่งในระหว่างการปรับเทียบ ดูวิธีการเปลี่ยนแปลงปรับตั้งเบื้องต้นจากคู่มือผู้ใช้คอนโทรเลอร์ |

8. คอนโทรเลอร์จะแสดง "Move the probe to bag" (นำโพรบไปไว้ที่ถุง) ปล่อยทิ้งไว้จนกว่าค่าจะคงที่ กด ENTER เพื่อยอมรับค่าที่คงที่แล้ว หรือ ปล่อยให้การปรับเทียบดำเนินการต่อไปจนกว่าหน้าจอจะแสดงข้อความ "Complete" (เสร็จสิ้น)
9. เมื่อปรับเทียบเซ็นเซอร์แล้ว ให้นำเซ็นเซอร์ไปติดตั้งตามเดิม กดปุ่ม ENTER

**รูปที่ 6 ขั้นตอนการปรับเทียบอากาศ**




หากค่ายังไม่คงที่ หน้าจอจะแสดงข้อความ "Unable to Calibrate" (ไม่สามารถปรับเทียบได้) ตามด้วยข้อความแสดงข้อผิดพลาด ตาราง 3 จะแสดงข้อความแสดงข้อผิดพลาดและวิธีแก้ปัญหาสำหรับปัญหาการปรับเทียบ

**ตาราง 3 ข้อความแสดงข้อผิดพลาดการปรับเทียบอากาศ**

| ข้อความ | คำอธิบาย | ความละเอียด |
|---|---|---|
| Cal fail, gain high | ค่า Gain ที่คำนวณได้สูงเกินไป | ทำซ้ำขั้นตอนการปรับเทียบ |
| Cal fail, gain low | ค่า Gain ที่คำนวณได้ต่ำเกินไป | ทำซ้ำขั้นตอนการปรับเทียบ |
| Cal fail, unstable | ค่าไม่คงที่ภายในเวลาการปรับเทียบสูงสุดที่กำหนดไว้ | ทำซ้ำขั้นตอนการปรับเทียบ |

## Sample CAL - ปรับเทียบจากการเปรียบเทียบ

วิธีการปรับเทียบนี้จะใช้เซ็นเซอร์อีกตัวหนึ่งที่ติดกับมิเตอร์แบบมือถือ

1. วางเซ็นเซอร์อีกตัวเข้าสู่กระบวนการ วางเซ็นเซอร์ที่สองไว้ใกล้กับเซ็นเซอร์แรกให้มากที่สุด
2. คอยจนว่าค่า DO จะคงที่
3. บนคอนโทรเลอร์ของเซ็นเซอร์แรก ไปที่ MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>SAMPLE CAL
4. เลือกตัวเลือกสำหรับเอาต์พุตระหว่างการปรับเทียบ:

| ตัวเลือก | คำอธิบาย |
|---|---|
| **Active** | อุปกรณ์จะส่งค่ากระแสที่ตรวจวัดได้ระหว่างขั้นตอนการปรับเทียบ |

| ตัวเลือก | คำอธิบาย |
|---|---|
| **Hold** | กระแสเอาต์พุตของเซ็นเซอร์จะคงค้างไว้สำหรับค่าตรวจวัดระหว่างขั้นตอนการปรับเทียบ |
| **Transfer** | ค่าพริเซ็ตจะถูกส่งในระหว่างการปรับเทียบ ดูวิธีการเปลี่ยนแปลงปรับตั้งเบื้องต้นจากคู่มือผู้ใช้คอนโทรเลอร์ |

5. คอนโทรเลอร์จะแสดงข้อความ:
   - "Press ENTER when stabilized" (กด ENTER เมื่อค่าคงที่แล้ว)
   - จะถูกวัดค่าออกซิเจนที่ละลายในปัจจุบัน
   - จะถูกวัดอุณหภูมิในปัจจุบัน
6. เมื่อการวัดคงที่ ให้กด ENTER หน้าจอจะแสดงหน้าจอป้อนค่า
   *__บันทึก:__ โดยปกติการวัดจะใช้เวลา 2 ถึง 3 นาทีก่อนที่จะคงที่*

หากค่ายังไม่คงที่ หน้าจอจะแสดงข้อความ "Unable to Calibrate" (ไม่สามารถปรับเทียบได้) ตามด้วยข้อความแสดงข้อผิดพลาด ตาราง 4 จะแสดงข้อความแสดงข้อผิดพลาดและวิธีแก้ปัญหาสำหรับปัญหาการปรับเทียบ

**ตาราง 4 ข้อความแสดงข้อผิดพลาดของ Sample cal**

| ข้อความ | คำอธิบาย | ความละเอียด |
|---|---|---|
| Cal fail, offset high | ค่าออฟเซ็ตที่คำนวณได้สูงเกินไป | ทำซ้ำขั้นตอนการปรับเทียบ |
| Cal fail, offset low | ค่าออฟเซ็ตที่คำนวณได้ต่ำเกินไป | ทำซ้ำขั้นตอนการปรับเทียบ |
| Cal fail, unstable | ค่าไม่คงที่ภายในเวลาการปรับเทียบสูงสุดที่กำหนดไว้ | ทำซ้ำขั้นตอนการปรับเทียบ |

## ออกจากขั้นตอนการปรับเทียบ

1. ในระหว่างการปรับเทียบ กดปุ่ม BACK ตัวเลือกสามตัวเลือกจะปรากฏขึ้น:

| ตัวเลือก | คำอธิบาย |
|---|---|
| **ABORT** | หยุดการปรับเทียบ เริ่มการปรับเทียบใหม่ทั้งหมด |
| **BACK TO CAL** | กลับไปที่การปรับเทียบปัจจุบัน |
| **LEAVE** | ออกจากการปรับเทียบชั่วคราว สามารถเข้าถึงเมนูอื่นได้ในระหว่างที่ดำเนินการปรับเทียบบนหน้าจอพื้นหลัง จะสามารถเริ่มการปรับเทียบสำหรับเซ็นเซอร์ตัวที่สอง (ถ้ามีอยู่) กลับไปที่การปรับเทียบโดยกดปุ่ม เมนู จากนั้นเลือก ติดตั้งเซ็นเซอร์ [Select Sensor] |

2. เลือกหนึ่งในตัวเลือก ยืนยัน

## รีเซ็ตค่าเริ่มต้นการปรับเทียบ

สามารถรีเซ็ตการตั้งค่าการปรับเทียบกลับเป็นค่าเริ่มต้นจากโรงงานได้ ค่า Gain และออฟเซ็ตจะถูกตั้งค่าเป็น 1.0 และ 0.0 ตามลำดับ

1. ไปที่ MENU>SENSOR SETUP>[Select Sensor]>CALIBRATE>RESET CAL DEFLT
2. หน้าจอจะแสดงข้อความยืนยัน ยืนยันเพื่อทำการรีเซ็ตเซ็นเซอร์กลับเป็นเคิร์ฟการปรับเทียบเริ่มต้นจากโรงงาน

## การดูแลรักษา

| ⚠ อันตราย | |
|---|---|
| | อันตรายจากการแยกชิ้นส่วน บุคลากรผู้เชี่ยวชาญเท่านั้นที่ควรดำเนินการตามขั้นตอนที่ระบุในเอกสารส่วนนี้ |

**⚠ อันตราย**

**อันตรายจากการระเบิด**ห้ามเชื่อมต่อหรือถอดส่วนประกอบอิเล็กทรอนิกส์หรือวงจรกับอุปกรณ์ จนกว่าจะปิดอุปกรณ์และหรือมั่นใจว่าในบริเวณนั้นปลอดภัย

**⚠ อันตราย**

**อันตรายจากการระเบิด** การใช้ส่วนประกอบอื่นทดแทน อาจส่งผลต่อความเหมาะสมตามมาตรฐาน Class 1, Division 2 ห้ามทำการเปลี่ยนส่วนประกอบใดๆ จนกว่าจะปิดอุปกรณ์และมั่นใจว่าในบริเวณนั้นไม่เป็นอันตราย

***หมายเหตุ***

ผลิตภัณฑ์นี้ในเวอร์ชันที่ผ่านการรับรองสำหรับสถานที่อันตราย ไม่เป็นไปตามข้อกำหนดของ 94/9/EC Directive (ATEX Directive)

## กำหนดการดูแลรักษา

กำหนดการดูแลรักษาแสดงช่วงเวลาขั้นต่ำสำหรับการดูแลรักษาตามปกติ ดำเนินการดูแลรักษาอุปกรณ์ให้บ่อยครั้งขึ้นในกรณีที่มีการใช้งานที่อาจทำให้ขั้วไฟฟ้าสึกกร่อน

***บันทึก:*** *ห้ามถอดแยกชิ้นส่วนโพรบในการดูแลรักษาหรือทำความสะอาด*

| การดูแลรักษา | ความถี่ขั้นต่ำที่แนะนำ |
|---|---|
| ทำความสะอาดเซ็นเซอร์ | 90 วัน |
| ตรวจสอบเซ็นเซอร์ว่าเสียหายหรือไม่ | 90 วัน |
| ปรับเทียบเซ็นเซอร์ | ตามที่ตัวแทนด้านกฎข้อบังคับแนะนำ |

## ทำความสะอาดเซ็นเซอร์

ทำความสะอาดภายนอกของเซ็นเซอร์ด้วยผ้าที่นุ่มและแห้ง

***บันทึก:*** *หากต้องถอดฝาเซ็นเซอร์ก่อนการทำความสะอาด ห้ามให้ด้านในของฝาสัมผัสถูกแสงแดดโดยตรงเป็นเวลานาน*

## ตั้งค่าหรือเปลี่ยนแปลงช่วงเวลาการทำความสะอาด

สภาพการใช้งานอาจทำให้ต้องทำความสะอาดเซ็นเซอร์ด้วยตัวเองเร็วขึ้นหรือช้าลง ช่วงการทำความสะอาดเริ่มต้นคือ 0 วัน หากต้องการเปลี่ยนแปลงช่วง โปรดดูที่ขั้นตอนต่างๆ ในกระบวนการนี้

1. ไปที่ MENU>SENSOR SETUP>[Select Sensor]>CONFIGURE>CLEAN INTRVL
2. เปลี่ยนค่าที่แสดงตามต้องการ ยืนยันการเปลี่ยนแปลง
   - หากต้องการปิดช่วงการทำความสะอาด ให้ตั้งค่าเป็น '0'

## เปลี่ยนฝาเซ็นเซอร์

**⚠ คำเตือน**

อาจมีอันตรายจากการระเบิด ฝาตั้งค่าเซ็นเซอร์ไม่ได้ผ่านการตรวจสอบสำหรับการใช้งานในสถานที่ที่มีอันตราย

ฝาเซ็นเซอร์สำรองและฝาตั้งค่าจะถูกส่งไปพร้อมกับคู่มือการติดตั้ง โปรดดูคำแนะนำที่ให้ไปกันสำหรับวิธีการเปลี่ยนฝา

เพื่อประสิทธิภาพและความแม่นยำสูงสุด ควรเปลี่ยนฝาเซ็นเซอร์:

- ทุกๆ สองปี
- เมื่อการตรวจสอบประจำรอบตรวจพบว่าฝาเซ็นเซอร์สึกกร่อนอย่างเห็นได้ชัด

## การแก้ไขปัญหา

### เมนูวินิจฉัยและทดสอบ

เมนูวินิจฉัยและทดสอบจะแสดงข้อมูลปัจจุบันและข้อมูลในอดีตของเซ็นเซอร์ LDO
ในการเข้าถึงเมนูวินิจฉัยและทดสอบ ให้ไปที่ MENU>SENSOR SETUP>[Select Sensor]>DIAG/TEST

โปรดดูรายละเอียดใน ตาราง 5

**ตาราง 5 เมนู DIAG/TEST**

| ตัวเลือก | คำอธิบาย |
|---|---|
| SENSOR INFO | SOFTWARE VERS—แสดงเวอร์ชันของซอฟต์แวร์ที่ติดตั้ง |
| | BOOT VERSION—แสดงเวอร์ชันของ Boot ที่ติดตั้ง |
| | DRIVER VERS—แสดงเวอร์ชันของไดรเวอร์ที่ติดตั้ง |
| LOT CODE | แสดงล็อตการผลิตของฝาเซ็นเซอร์ |
| SERIAL NUMBER | หมายเลขซีเรียลของเซ็นเซอร์ |
| GAIN CORR | ปรับแต่งค่า Gain สำหรับการปรับเทียบ |
| | ช่วง: 0.50 ถึง 2.00 |
| OFFSET CORR | ปรับแต่งค่าออฟเซ็ตสำหรับการปรับเทียบ (mg/L หรือ ppm) |
| | ช่วง: –3.00 ถึง +3.00 |
| PHASE DIAG | แสดงเฟสสำหรับความยาวคลื่นรวม สีแดง และสีน้ำเงิน อัปเดตครั้งละหนึ่งวินาที |
| AMPL DIAG | แสดงแอมพลิจูดสำหรับความยาวคลื่นสีแดงและสีน้ำเงิน อัปเดตครั้งละหนึ่งวินาที |
| DAYS TO CLEAN | แสดงจำนวนวันก่อนครบกำหนดการถัดไปสำหรับการทำความสะอาดด้วยตัวเอง |
| SENSOR LIFE | แสดงจำนวนวันก่อนครบกำหนดการถัดไปสำหรับการเปลี่ยนฝาเซ็นเซอร์ |

### รายการข้อผิดพลาด

หากเกิดข้อผิดพลาดขึ้น ค่าบนหน้าจอการวัดจะกะพริบ ลักษณะการทำงานของเอาต์พุตจะขึ้นอยู่กับการตั้งค่าคอนโทรเลอร์ โปรดดูคู่มือคอนโทรเลอร์สำหรับรายละเอียด
หากต้องการแสดงข้อผิดพลาดของเซ็นเซอร์ในปัจจุบัน ไปที่ MENU>DIAGNOSTICS>[Select Sensor]>ERROR LIST
โปรดดูรายละเอียดใน ตาราง 6

**ตาราง 6 รายการข้อผิดพลาดสำหรับเซ็นเซอร์ LDO**

| ข้อผิดพลาด | สาเหตุที่เป็นไปได้ | ความละเอียด |
|---|---|---|
| RED AMPL LOW (ค่าต่ำกว่า 0.01)<br>หรือ<br>BLUE AMPL LOW (ค่าต่ำกว่า 0.01) | ไม่ได้ติดตั้งฝาเซ็นเซอร์ หรือติดตั้งไม่ถูกต้อง | ถอดฝาเซ็นเซอร์ออกแล้วติดตั้งใหม่อีกครั้ง |
| | ทางเดินของแสงในฝาเซ็นเซอร์ถูกบัง | ตรวจสอบด้านในของฝาเซ็นเซอร์และเลนส์ |
| | เซ็นเซอร์ทำงานไม่ถูกต้อง | ตรวจสอบให้แน่ใจว่าไฟ LED กะพริบอยู่ ติดต่อผู้ผลิต |

## รายการแจ้งเตือน

เมื่อไอคอนเตือนกะพริบ (sc100 และ sc200) หรือเมื่อหน้าจอกลายเป็นสีเหลือง (sc1000) จะมีข้อความปรากฏขึ้นที่ด้านล่างสุดของหน้าจอการวัด บน sc1000 หน้าจอจะกลายเป็นสีเหลืองเพื่อแสดงการเตือน หากต้องการแสดงการเตือนของเซ็นเซอร์ในปัจจุบัน ไปที่ MENU> DIAGNOSTICS>[Select Sensor]>WARNING LIST โปรดดูรายละเอียดใน ตาราง 7

**ตาราง 7 รายการการเตือนของเซ็นเซอร์**

| คำเตือน | คำอธิบาย | ความละเอียด |
|---|---|---|
| EE SETUP ERR | ที่จัดเก็บเสียหาย ค่าจะถูกตั้งกลับเป็นค่าเริ่มต้นจากโรงงาน | ติดต่อฝ่ายให้บริการทางเทคนิค |
| EE RSRVD ERR | | |
| TEMP < 0 C | อุณหภูมิกระบวนการต่ำกว่า 0 °C (32 °F) | เพิ่มอุณหภูมิกระบวนการ หรือหยุดการใช้งานจนกว่าอุณหภูมิกระบวนการจะอยู่ภายในช่วงตามข้อมูลจำเพาะของเซ็นเซอร์ |
| TEMP > 50 C | อุณหภูมิกระบวนการสูงกว่า 50 °C (120 °F) | ลดอุณหภูมิกระบวนการ หรือหยุดการใช้งานจนกว่าอุณหภูมิกระบวนการจะอยู่ภายในช่วงตามข้อมูลจำเพาะของเซ็นเซอร์ |
| RED AMPL LOW | ค่าต่ำกว่า 0.03 | โปรดดูรายละเอียดใน ตาราง 6 ในหน้า 136 |
| RED AMPL HIGH | ค่าสูงกว่า 0.03 | ติดต่อฝ่ายให้บริการทางเทคนิค |
| BLUE AMPL LOW | ค่าต่ำกว่า 0.03 | โปรดดูรายละเอียดใน ตาราง 6 ในหน้า 136 |
| BLUE AMPL HIGH | ค่าสูงกว่า 0.03 | ติดต่อฝ่ายให้บริการทางเทคนิค |
| CAP CODE FAULT | รหัสฝาเซ็นเซอร์เสียหาย รหัสถูกรีเซ็ตโดยอัตโนมัติกลับเป็นรหัสเริ่มต้นของฝาและล็อต | ดำเนินการตามขั้นตอนของฝาตั้งค่าเซ็นเซอร์ หากไม่มีฝาตั้งค่าสำหรับฝาเซ็นเซอร์ โปรดติดต่อฝ่ายสนับสนุนด้านเทคนิค |

## รายการเหตุการณ์

รายการเหตุการณ์จะเก็บบันทึกการเปลี่ยนแปลงข้อมูลต่างๆ ของเซ็นเซอร์ หากต้องการแสดงเหตุการณ์เซ็นเซอร์ ไปที่ MENU>DIAGNOSTICS>[Select Sensor]>EVENT LIST
โปรดดูรายละเอียดใน ตาราง 8

**ตาราง 8 รายการเหตุการณ์สำหรับเซ็นเซอร์**

| เหตุการณ์ | คำอธิบาย |
|---|---|
| ALT/PRESSURE UNIT CHANGE | แรงดันสภาพแวดล้อมหรือหน่วยอัลติจูดเปลี่ยนแปลงไป |
| ALT/PRESSURE CHANGE | ค่าอัลติจูดหรือแรงดันสภาพแวดล้อมเปลี่ยนแปลงไป |
| TEMP UNIT CHANGE | หน่วยของอุณหภูมิเปลี่ยนแปลงไป |
| MEAS UNIT CHANGE | หน่วยการวัดใหม่เปลี่ยนแปลงไป |
| SALINITY CHANGE | ค่าความเค็มเปลี่ยนแปลงไป |
| SET DEFAULT | การตั้งค่าเซ็นเซอร์ถูกรีเซ็ตเป็นค่าเริ่มต้น |
| SENSOR SETUP CHANGE | การตั้งค่าเซ็นเซอร์เปลี่ยนแปลงไป |
| CLEAN INTERVAL TIMER CHANGE | เวลาระหว่างการทำความสะอาดเซ็นเซอร์เปลี่ยนแปลงไป |
| SENSOR CAP LIFE TIMER CHANGE | เวลาระหว่างการเปลี่ยนฝาเซ็นเซอร์เปลี่ยนแปลงไป |

## อะไหล่ทดแทนและอุปกรณ์เสริม

ใช้อะไหล่ทดแทนที่ได้รับการรับรองโดยผู้ผลิตเท่านั้น การใช้อะไหล่ที่ไม่ได้รับการรับรองอาจทำให้เกิดการบาดเจ็บของบุคคล ความเสียหายของเครื่องมือ หรือการทำงานผิดพลาดของอุปกรณ์

**รายการอะไหล่ทดแทน**

| คำอธิบาย | รหัสสินค้า (US / EU) |
|---|---|
| โพรบ LDO พร้อมหนึ่งฝาเซ็นเซอร์ และ 2 ถุงสำหรับปรับเทียบ | 9020000 / LXV416.99.20001 |
| โพรบ LDO สำหรับน้ำทะเล พร้อมหนึ่งฝาเซ็นเซอร์และสองถุงสำหรับปรับเทียบ | 9020000-SW / — |
| โพรบ LDO สำหรับน้ำทะเล สถานที่อันตราย พร้อมหนึ่งฝาเซ็นเซอร์และสองถุงสำหรับปรับเทียบ | 9020000-C1D2-SW / — |
| โพรบ LDO สำหรับสถานที่อันตราย พร้อมหนึ่งฝาเซ็นเซอร์และ 2 ถุงสำหรับปรับเทียบ | 9020000-C1D2 / — |
| ฝาเซ็นเซอร์ สำรอง (มีฝาตั้งค่าเซ็นเซอร์ ซึ่งไม่ผ่านการทดสอบสำหรับการใช้งานในสถานที่อันตราย Class 1 Division 2) | 9021100 / 9021150 |

**อุปกรณ์เสริม**

| คำอธิบาย | รหัสสินค้า (US / EU) |
|---|---|
| เซ็นเซอร์เคเบิลล็อคสำหรับสถานที่อันตราย | 6139900 / — |
| สายเคเบิล, ส่วนขยายเซ็นเซอร์, Class 1, Division 2 สถานที่อันตราย, 1 ม. (3.3 ฟุต) | 6122402 / — |
| สายเคเบิล, ส่วนขยายเซ็นเซอร์, Class 1, Division 2 สถานที่อันตราย, 7 ม. (23 ฟุต) | 5796002 / — |
| สายเคเบิล, ส่วนขยายเซ็นเซอร์, Class 1, Division 2 สถานที่อันตราย, 15 ม. (49.21 ฟุต) | 5796102 / — |
| สายเคเบิล, ส่วนขยายเซ็นเซอร์, Class 1, Division 2 สถานที่อันตราย, 31 ม. (101.71 ฟุต) | 5796202 / — |
| ระบบทำความสะอาดด้วยการเป่าอากาศเอาต์พุตสูง 115 V (ไม่ผ่านการทดสอบสำหรับการใช้งานในสถานที่อันตราย) | 6860000 / 6860003.99.0001 |
| ระบบทำความสะอาดแบบแอร์บลาสต์เอาต์พุตสูง 230 V (ไม่ผ่านการทดสอบ ATEX สำหรับการใช้งานในสถานที่อันตราย) | 6860100 / 6860103.99.0001 |
| ถุงสำหรับการปรับเทียบ (1 ชิ้น) | 5796600 / 5796600 |
| สายเคเบิล, ส่วนขยายเซ็นเซอร์, สถานที่ไม่อันตราย, 7.7 ม. (25 ฟุต)[1] | US: 5796000, 7.7 ม. (25 ฟุต) |
| | EU: LZX849, 10 ม. (33 ฟุต) |
| ชุดอุปกรณ์สำหรับติดตั้งบนท่อ (PVC) | 9253000 / LZY714.99.21810 |
| ชุดอุปกรณ์สำหรับติดตั้งแบบลอย (PVC) | 9253100 / LZX914.99.42200 |
| ชุดอุปกรณ์สำหรับติดตั้งแบบแอร์บลาสต์ | 9253500 / LZY812 |
| ชุดติดตั้งอุปกรณ์สำหรับติดตั้งบนโซ่ (สแตนเลสสตีล) | — / LZX914.99.11200 |
| ชุดอุปกรณ์สำหรับติดตั้งแบบยูเนียน | 9257000 / 9257000 |
| มิเตอร์ HQd พร้อมโพรบ LDO แบบทนทาน (ไม่ผ่านการทดสอบสำหรับการใช้งานในสถานที่อันตราย) | 8505200 / HQ40D.99.310.000 |

[1] มีความยาว 15 ม. (49 ฟุต) และ 30 ม. (98 ฟุต) ด้วย

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# ELMRIDGE®

## Jet Apparatus

## Liqui-Jet® Solids Eductors (Gravity Feed)

### INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS

### INSTALLATION

ELMRIDGE Liqui-Jet Solids Eductors for Gravity Feed applications should be installed in a near horizontal orientation with the Eductor suction port pointing upwards. Supply and discharge piping including bends, elbows etc., should be minimized in order to prevent head losses within the system. Supply piping should be of a size sufficient to provide the design volume of motive liquid at the specified pressure, and suction and discharge pipe sizes should not be less than those required to fit the eductor. All process piping should be leak-free. Note that the discharge of the eductor must be flooded in order for the unit to operate properly. It may be required to add a restriction downstream of the discharge of the eductor (ie. an elbow etc.).

### OPERATION

Liqui-Jet Solids eductors are self-priming and have no moving parts. Operation, therefore, involves only making the necessary Motive liquid stream and Suction material available under the proper conditions. In most cases, the eductor has excess Motive and Suction flow capacity. It is therefore necessary to control these flows if a specific ratio of Motive flow to Suction flow is required. Open the valve on the inlet side of the eductor until the proper motive flowrate is achieved. Then open the valve (if applicable), on the suction side of the eductor as required to achieve suction flow. Both inlet and suction valves (if applicable), will have to be adjusted until the proper flowrates are observed. If an ELMRIDGE Washdown Hopper is used on the Suction of the eductor, the washdown nozzles are included to provide the washdown flowrate as required for the design operation. If it is desired to reduce the washdown flowrate, the washdown water can be throttled as required. It is generally good practice to incorporate check valves on the Eductor to prevent backflow through the Suction port at shutdown, or if a blockage occurs downstream of the Eductor.

### MAINTENANCE

Since Liqui-Jet eductors have no moving parts, very little maintenance is required. The following items should be considered standard practice whenever a visual inspection is possible:

i) Check that all threaded fittings (or flange nuts and bolts), connecting the eductor to Motive, Suction and Discharge lines are torqued to the proper values. If threaded connections or flange nuts and bolts have been tack welded to prevent disengagement, check that all welds are secure.

ii) Visually check the orifice of the Eductor nozzle and the throat of the venturi diffuser for signs of wear. Orifice and throat wear can dramatically change the conditions under which flow must be controlled.

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marathon@mfsl.ca

# O&M Manual

*MFS Project # 13-11640*

## Pangnirtung WTP Upgrade
## *Waste Sludge Pump Skid & Polymer Injection System*

Bishop Water Technologies
P.O. Box 669
110-B Bonnechere St.W
Eganville, ON
K0J 1T0

PO# KB122

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# DATASHEET/EQUIPMENT LIST

MFS JOB REFERENCE NUMBER: **13-11640**
(Please reference this number on all correspondence)

**Re:** Pangnirtung WTP Upgrade
-Waste Sludge Pump Skid
-Polymer Injection System

## EQUIPMENT:

(1) MCD Waste Sludge Pump Skid. Including:

- (1) Enviroflex L65 peristaltic hose pump (Tag: 70-WSP-01). Featuring:
  - 65mm, 11,672 L/h max. flow
  - 27.4 rpm max. speed
  - Max. suction pressure: 0.95 Bar
  - Max. discharge pressure: 4.12 Bar
  - Natual rubber hose
  - 316 Stainless steel flanged connections
  - Fixed speed gearbox c/w 3/60/575V electric motor
- 3" PVC suction/discharge headers. Including:
  - 3" ANSI inlet flanged connection c/w 3" PVC/EPDM isolation ball valve (Tag: 70-V-07)
  - 3" ANSI outlet flanged connection
  - (1) 18.9 L capacity inlet stabilizer (Required as per pump manufacturer). Featuring:
    - Aluminum construction
    - Buna-N bladder
    - 3" ANSI class 150 inlet flange
    - 3" PVC/EPDM inlet isolation ball valve
  - (1) 3-1/2" Suction pressure gauge (Tag: 70-PG-01) c/w diaphragm seal and 1-1/2" PVC/EPDM isolation ball valve (Tag: 70-V-08)
  - (1) 3-1/2" Discharge pressure gauge (Tag: 70-PG-02) c/w diaphragm seal and 1-1/2" PVC/EPDM isolation ball valve (Tag: 70-V-09)
  - (1) 18.9 L capacity discharge pulsation dampener (Tag: 70-PD-01). Featuring:
    - Aluminum construction

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        - Buna-N bladder
        - 3" ANSI class 150 inlet flange
        - Chargeable type
        - 3" PVC/EPDM inlet isolation ball valve
    - (1) 3" PVC/EPDM discharge isolation ball valve (Tag: 70-V-10)
    - (1) Inlet port for activated polymer injection
    - (1) 3" PVC flanged inline static mixer (Tag: 70-MIX-02)
    - (3) 1/2" PVC/EPDM drain/sample port isolation valves (Tag: 70-V-11, 12 & 13)
- (1) Allen-Bradley Powerflex40, 7.5hp, 3/60/575V variable frequency drive (Tag: 70-SC-01). Input power by others
- (1) 3" ABB magnetic type flow meter (Tag: 70-FE/FIT-01) c/w integral transmitter
- (1) Shelf spare Allen-Bradley Powerflex40, 7.5hp, 3/60/575V variable frequency drive
- (1) Shelf spare Enviroflex L65 complete pump with gearbox and motor
- (1) Shelf spare Enviroflex L65 pump natural rubber hose
- (4) 5L Envirolube roller lubricant
- Recommended spare parts as per Enviroflex pump manufacturer:
    - (4) Hose clips
    - (1) Front cover door seal
    - (2) Hose connector
    - (2) Roller
- All assembled and fasten to an epoxy coated mild steel construction supporting frame with stainless steel hardware

(1) MCD VEPAS-20-V-B Liquid Polymer Injection System. Including:

- (1) Epoxy coated mild steel equipment mounting frame
- (1) MCD neat polymer peristaltic metering pump (Tag: 70-PFP-01). Featuring:
    - Integrated and programmable speed control
    - Manual or automatic (4-20mA) variable flow adjustment between 0.95 and 9.5 L/hr
    - 1/60/120V power through polymer system control panel
- (1) MCD non-mechanical polymer activator
- (1) 3/4" static mixer (Tag: 70-MIX-01)
- (1) Water inlet pressure regulator (Tag: 70-V-18)

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- (1) Water solenoid control valve (Tag: 70-V-17)
- (1) Water inlet pressure transmitter (Tag: 70-PT/PE-01)
- (1) Activated polymer pressure gauge c/w diaphragm seal (Tag: 70-PG-03)
- (1) Neat polymer rigid suction wand c/w foot valve (Tag: 70-V-16) and flexible hose
- (1) Shelf spare MCD neat polymer peristaltic metering pump c/w (2) spare hose
- Necessary PVC schedule 80 pipe and fittings for a complete system
- All mounted on a thermoplastic board and/or epoxy coated mild steel frame

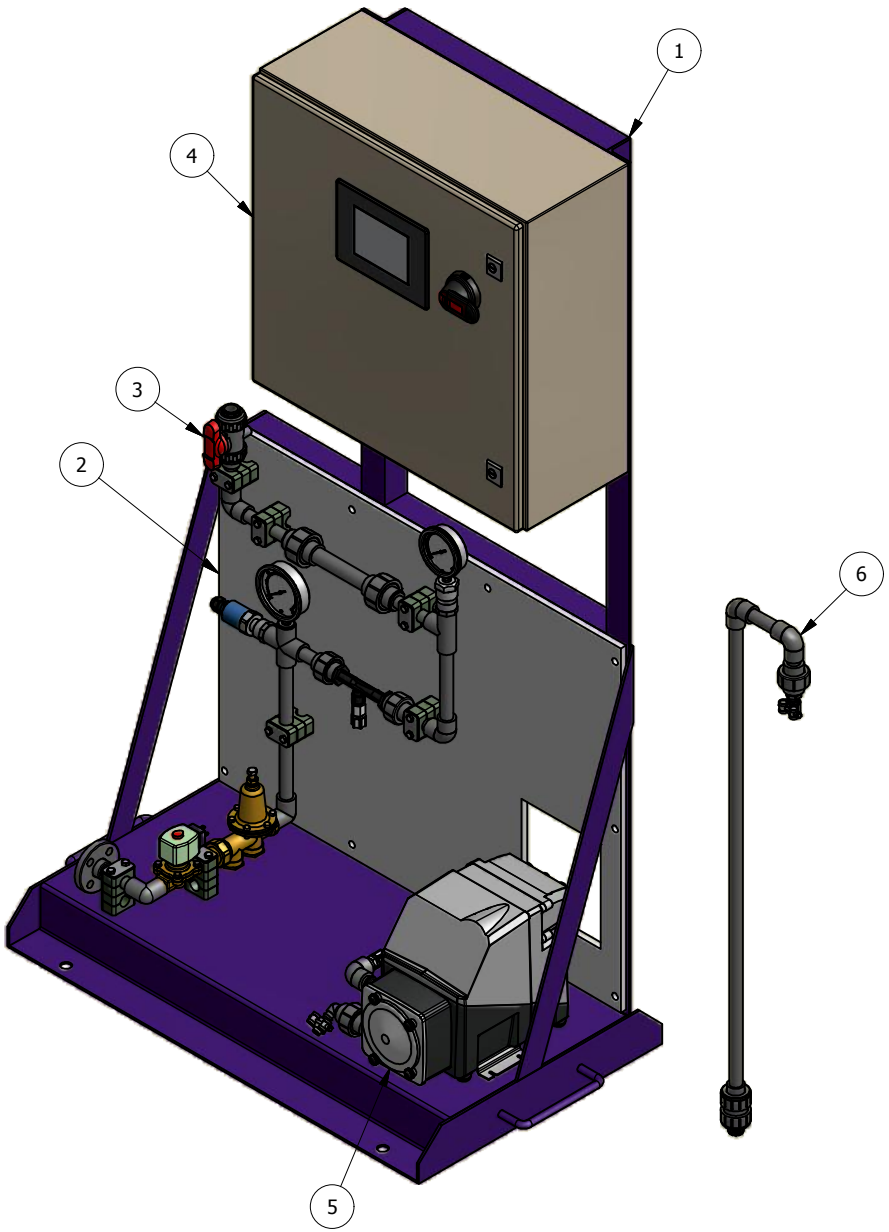
(1) MCD VEPAS Custom Control Panel. Including:

- Painted mild steel NEMA4 enclosure
- 1/60/120VAC power input (By others)
- Allen-Bradley CompactLogix L33ER PLC and approriate I/O cards
- Cmore 6" color touch HMI
- Necessary electrical components, terminal blocks, fusing, etc for a complete system
- CSA or QPS approval

(1) Radio Frequency Type Geo Bag Level Sensor (Tag: 70-LS-04). Featuring:

- 24VDC power (From polymer control panel)
- 316 Stainless steel probe
- Standard 10” long
- Field adjustable
- Wired to polymer control panel to shut down automatic process when geo bag is full

| Parts List | | | |
|---|---|---|---|
| ITEM | PART NUMBER | DESCRIPTION | ITEM QTY |
| 1 | 13-11640PA1000A | Supporting Frame | 1 |
| 2 | 13-11640PA0001P | Plate | 1 |
| 3 | 13-11640PA2000A | Polymer Activation Header | 1 |
| 4 | 13-11640PA4000A | Control Panel | 1 |
| 5 | 13-11640PA3000A | Metering Pump Assembly | 1 |
| 6 | 13-11640PA5000A | Rigid Suction Wand | 1 |




Isometric View
SCALE 1 : 12

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Project:
Pangnirtung
WTP Upgrades

Drawing:
VEPAS-20 Polymer Activation System
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 1 of 5 | 13-11640 | 13-11640PA0000A |

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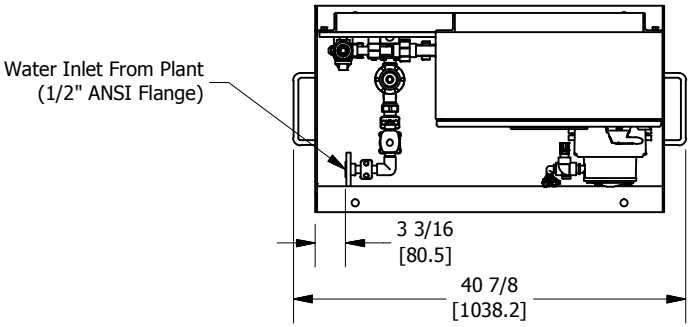
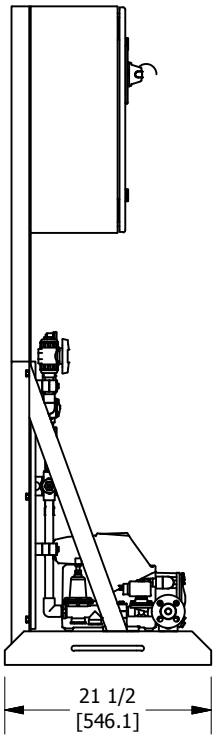
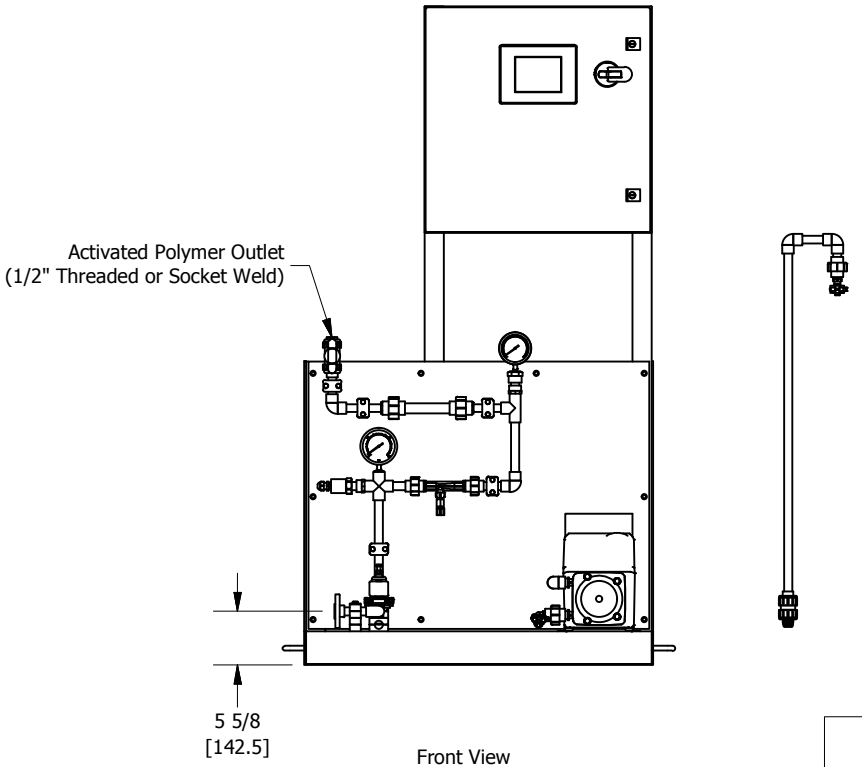
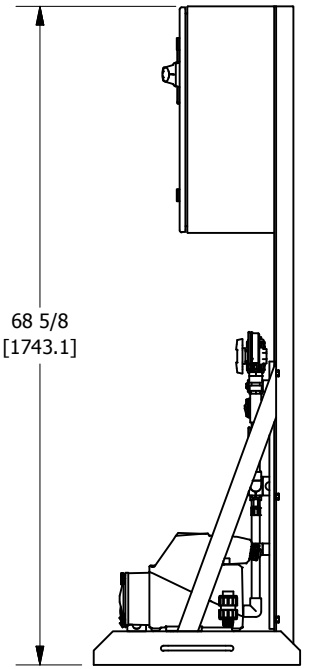



Front View
SCALE 1 : 20



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Project:
Pangnirtung
WTP Upgrades

Drawing:
VEPAS-20 Polymer Activation System
General Dimensions

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 2 of 5 | 13-11640 | 13-11640PA0000A |

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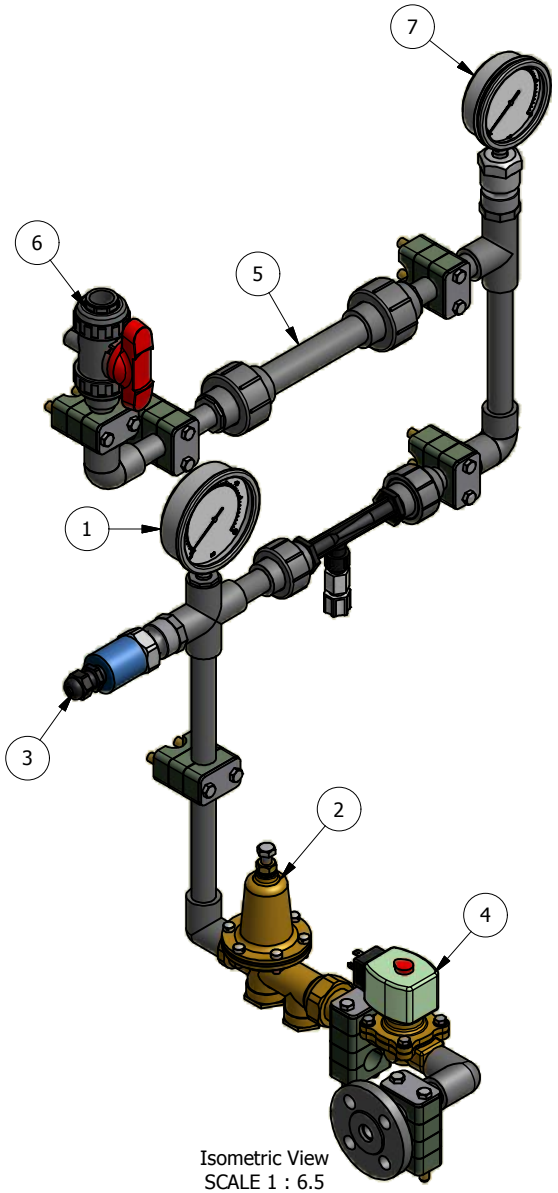
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 122122 | 304/316 | Pressure Gauge; 0-60 Psi; 4" Liquid Filled Dial; 1/4" Bottom Mount | 1 |
| 2 | 147010 | Bronze/SS/EPDM | Pressure Reducing Valve; 1/2"; Adjustable 25-75 psi | 1 |
| 3 | 150718 | 304/Ceramic/Viton | Pressure Transmitter; 1/2" MNPT/1/4" FNPT; 4-20mA Output; 0-150 psi; DIN Connector | 1 |
| 4 | 145030 | Brass | Solenoid Operated Valve; 1/2"; NC; 24VDC; NEMA 4X Coil; DIN Connection | 1 |
| 5 | 151634 | PVC | Static Mixer; 3/4"; 4 Mixing Elements; Plain Ends | 1 |
| 6 | 115157 | PVC/EPDM | Valve; True-Union Ball; 1/2"; Soc x Thd | 1 |
| 7 | 122306 | 316L/304/316 | Diaphragm Seal; Mini; 1/2" MNPT Process c/w Pressure Gauge; 0-60 Psi; 3.5" Dial; Liquid Filled | 1 |




Isometric View
SCALE 1 : 6.5

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Project:
Pangnirtung
WTP Upgrades

Drawing:
VEPAS-20 Polymer Activation Header
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 3 of 5 | 13-11640 | 13-11640PA2000A |

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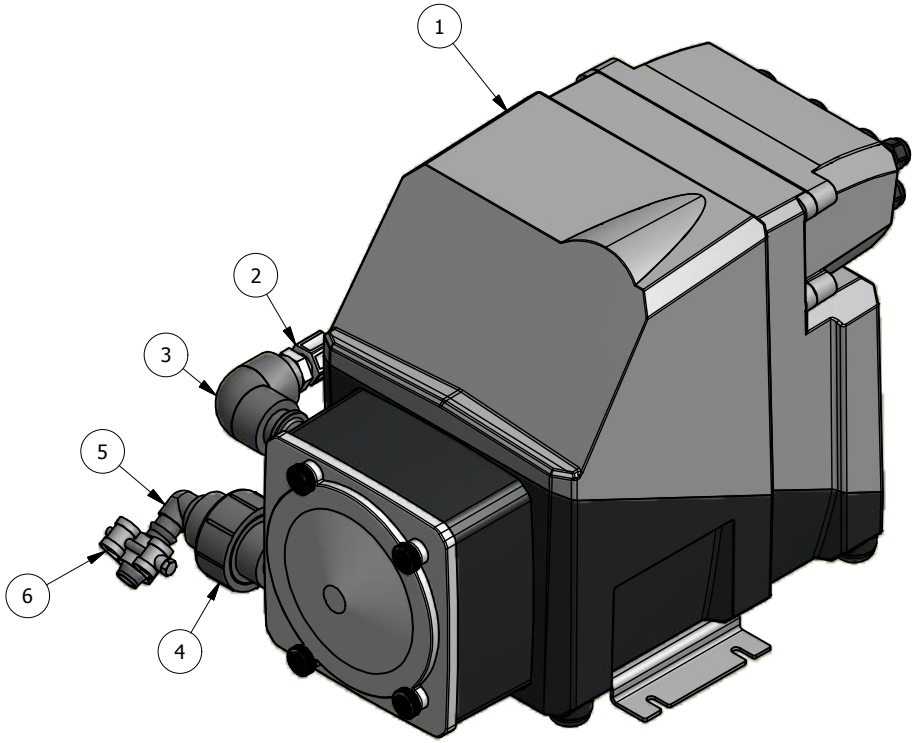
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 143012 | Varies | Peristaltic Metering Pump; A2V Series; 0.04 to 4 GPH | 1 |
| 2 | 111020 | PP | Connector, Male; 3/8" Tube x 1/2" MPT | 1 |
| 3 | 301122 | PVC | Elbow; 90°; 1/2"; Sch 80; Fipt x Fipt | 1 |
| 4 | 309046 | PVC/Viton | Union; 1/2"; Fipt | 1 |
| 5 | 31320 | PVC | Hose Adapter; 90 Deg. Elbow; 1/2"; Mipt x Insert | 1 |
| 6 | 151760 | 304 | Clamp; T-Bolt; 20-22 mm | 1 |




ISOMETRIC VIEW
SCALE 1/4

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Project:
Pangnirtung
WTP Upgrades

Drawing:
VEPAS-20 Polymer Metering Pump Assy
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 4 of 5 | 13-11640 | 13-11640PA3000A |

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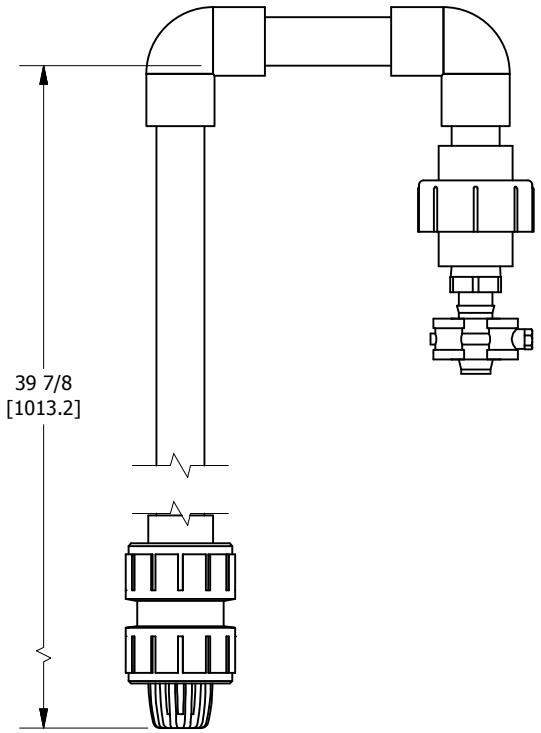
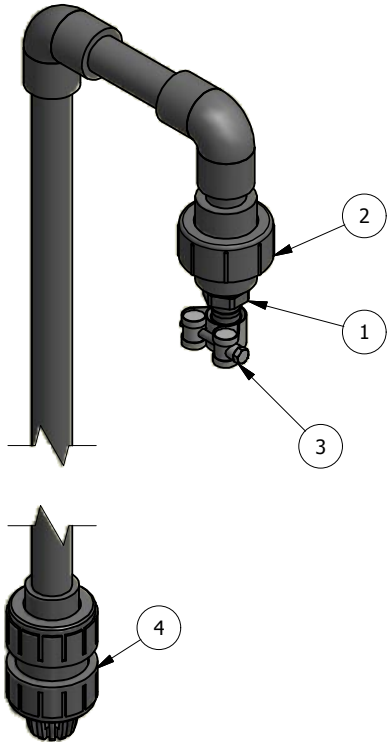
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 313100 | PVC | Hose Adapter; 1/2"; Mipt x Insert | 1 |
| 2 | 309090 | PVC/Viton | Union; 1/2"; Soc x Fipt | 1 |
| 3 | 151760 | 304 | Clamp; T-Bolt; 20-22 mm | 1 |
| 4 | 115800 | PVC/EPDM | Valve; True Union Foot; 1/2"; Soc | 1 |




Side View
SCALE 0.3 : 1




Isometric View
SCALE 1 : 4

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Rigid Suction Wand
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 5 of 5 | 13-11640 | 13-11640PA5000A |

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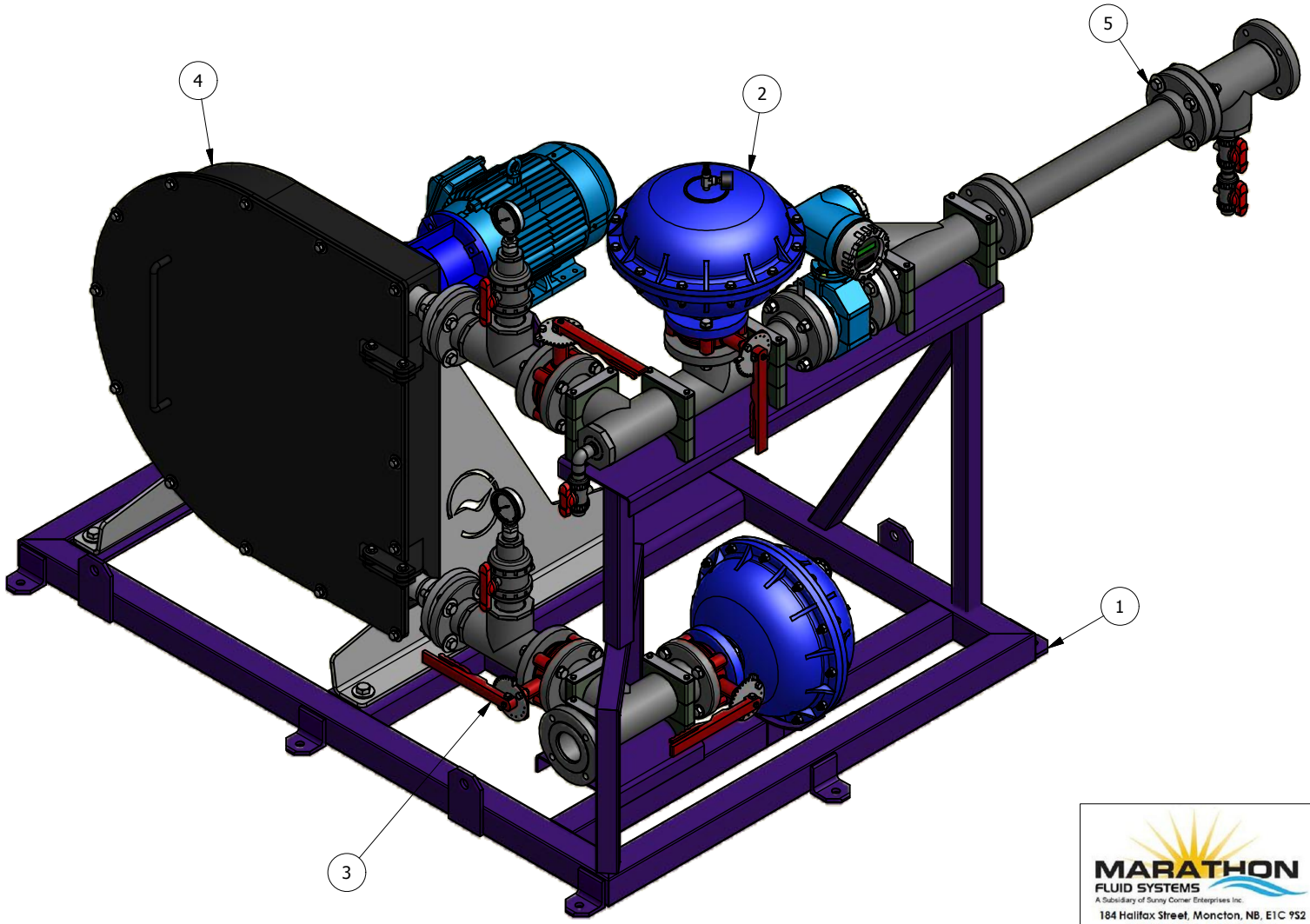
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 13-11640WS1000A | Epoxy Coated Steel | Equipment Mounting Frame | 1 |
| 2 | 13-11640WS2000A | Vareis | Discharge Header | 1 |
| 3 | 13-11640WS3000A | Varies | Suction Header | 1 |
| 4 | 143018 | Varies | Peristaltic; Pump; 2-1/2"; 55 GPM; Right Facing Connections c/w Gearbox & 7.5hp; 3/60/575V; TEFC Motor | 1 |
| 5 | 13-11640WS4000A | Varies | Static Mixer/Sampling Header | 1 |




Isometric View
SCALE 1 : 15

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Waste Sludge Feed System
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 1 of 8 | 13-11640 | 13-11640WS0000A |

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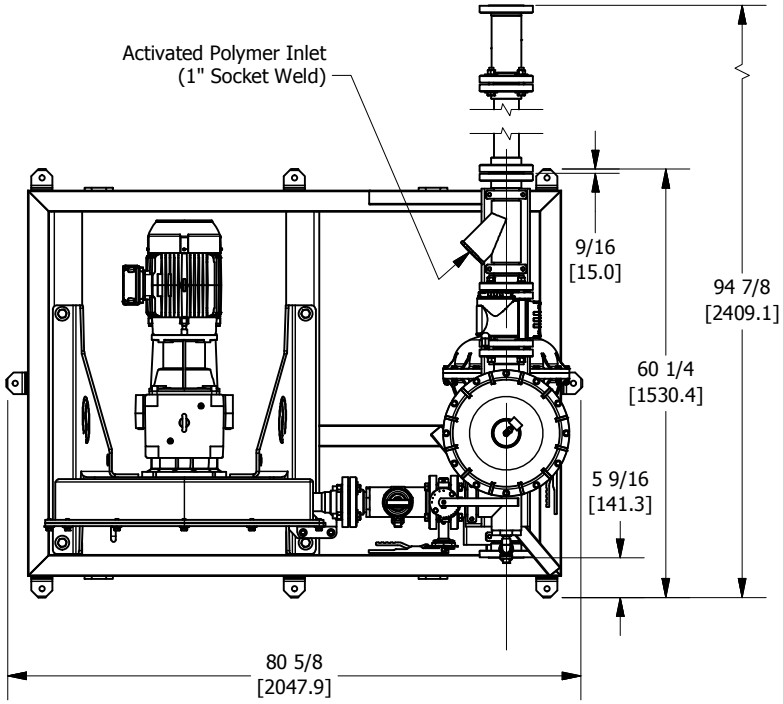
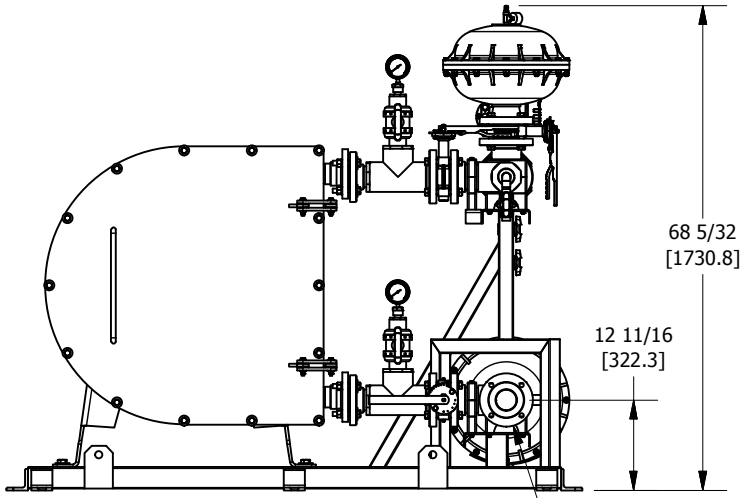
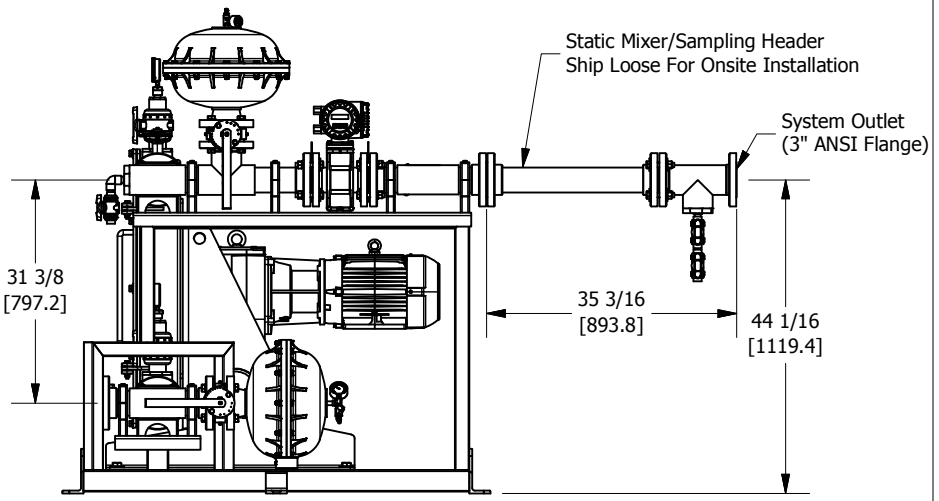



Front View
SCALE 1 : 27

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Waste Sludge Feed System
General Dimensions

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 2 of 8 | 13-11640 | 13-11640WS0000A |

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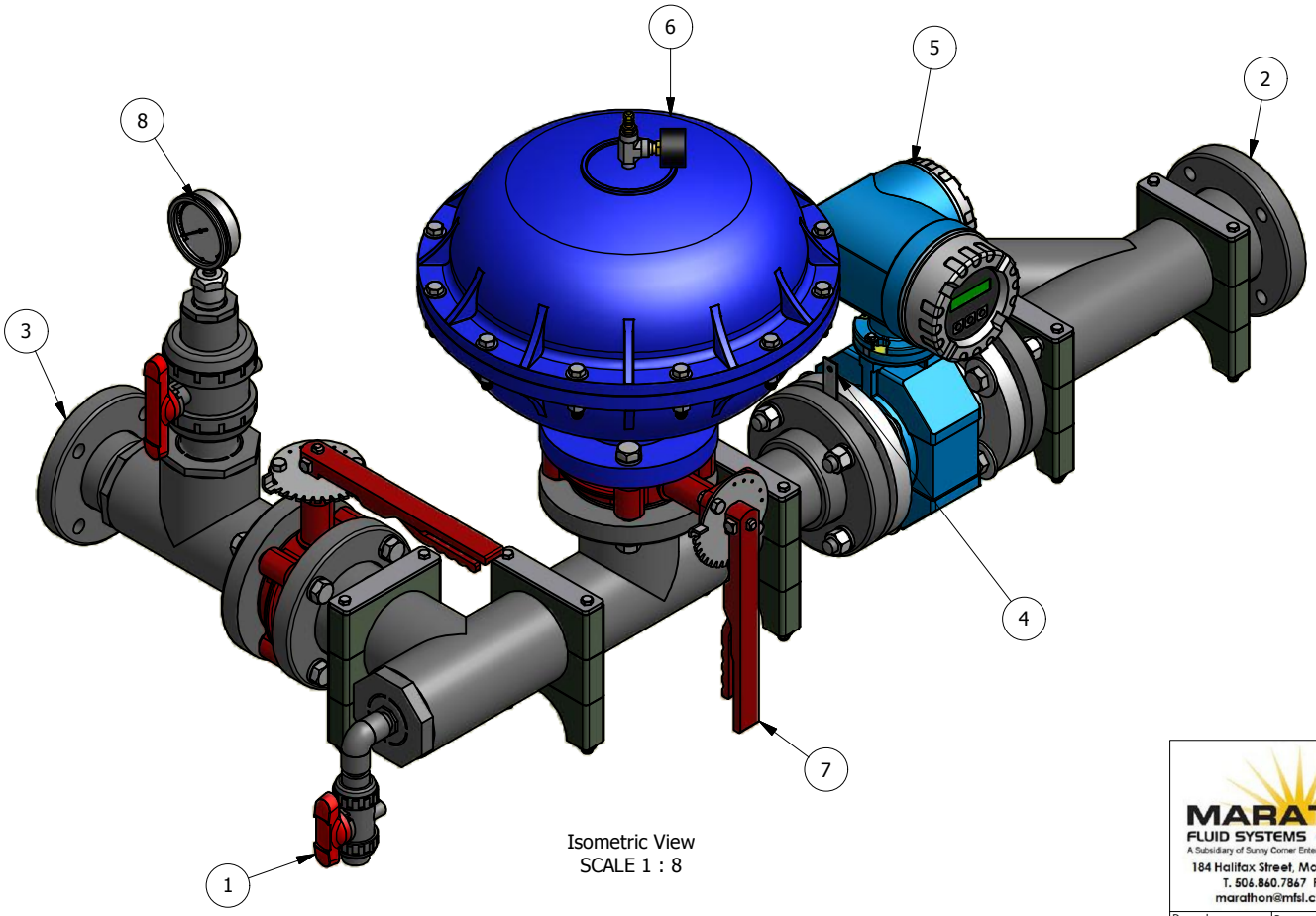
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 13-11640WS2200A | Varies | Discharge Header; Dampener Sub-Assembly | 1 |
| 2 | 13-11640WS2300A | Varies | Discharge Header; Polymer Injection Sub-Assembly | 1 |
| 3 | 13-11640WS2100A | Varies | Discharge Header; Pressure Gauge Sub-Assembly | 1 |
| 5 | 147442 | 316L/316L/Polyurethane | Flow Meter; Magnetic; DN80; 3"; Compact Display; 3" ANSI Flanges; 15' Cable | 1 |
| 6 | 124013 | Al/Al/Buna-N | Pulsation Dampener; 1155 Cu.In; 3" ANSI Flange | 1 |
| 7 | 150613 | CI/316/316/EPDM | Valve; Butterfly; Lug Style; 3"; Series 31 c/w Lever Lock Handle | 2 |
| 8 | 122306 | 316L/304/316 | Diaphragm Seal; Mini; 1/2" MNPT Process c/w Pressure Gauge; 0-60 Psi; 3.5" Dial; Liquid Filled | 1 |




Isometric View
SCALE 1 : 8

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Discharge Header
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 3 of 8 | 13-11640 | 13-11640WS2000A |

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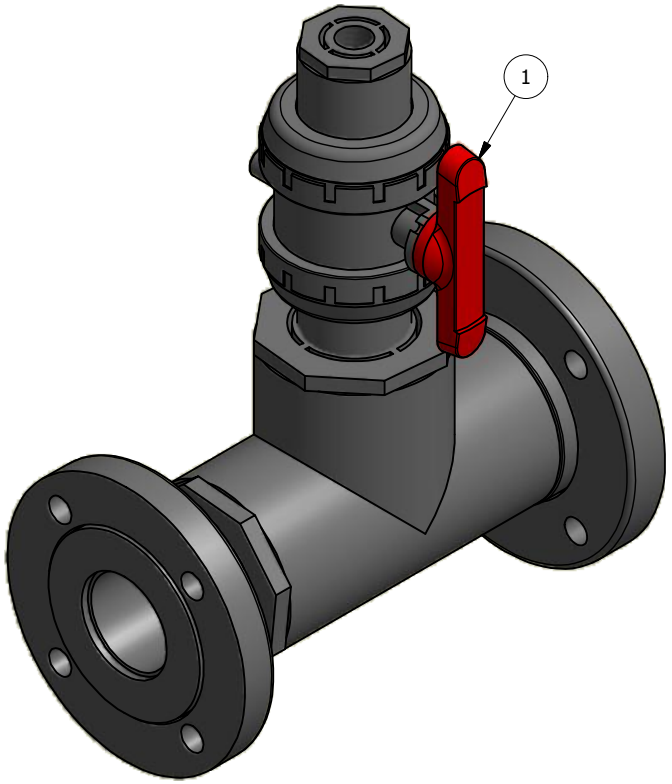
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 115153 | PVC/EPDM | Valve; True-Union Ball; 1-1/2"; Soc x Soc | 1 |




Isometric View
SCALE 1 : 4

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Discharge Header; Pressure Gauge Sub-Ass'y
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 4 of 8 | 13-11640 | 13-11640WS2100A |

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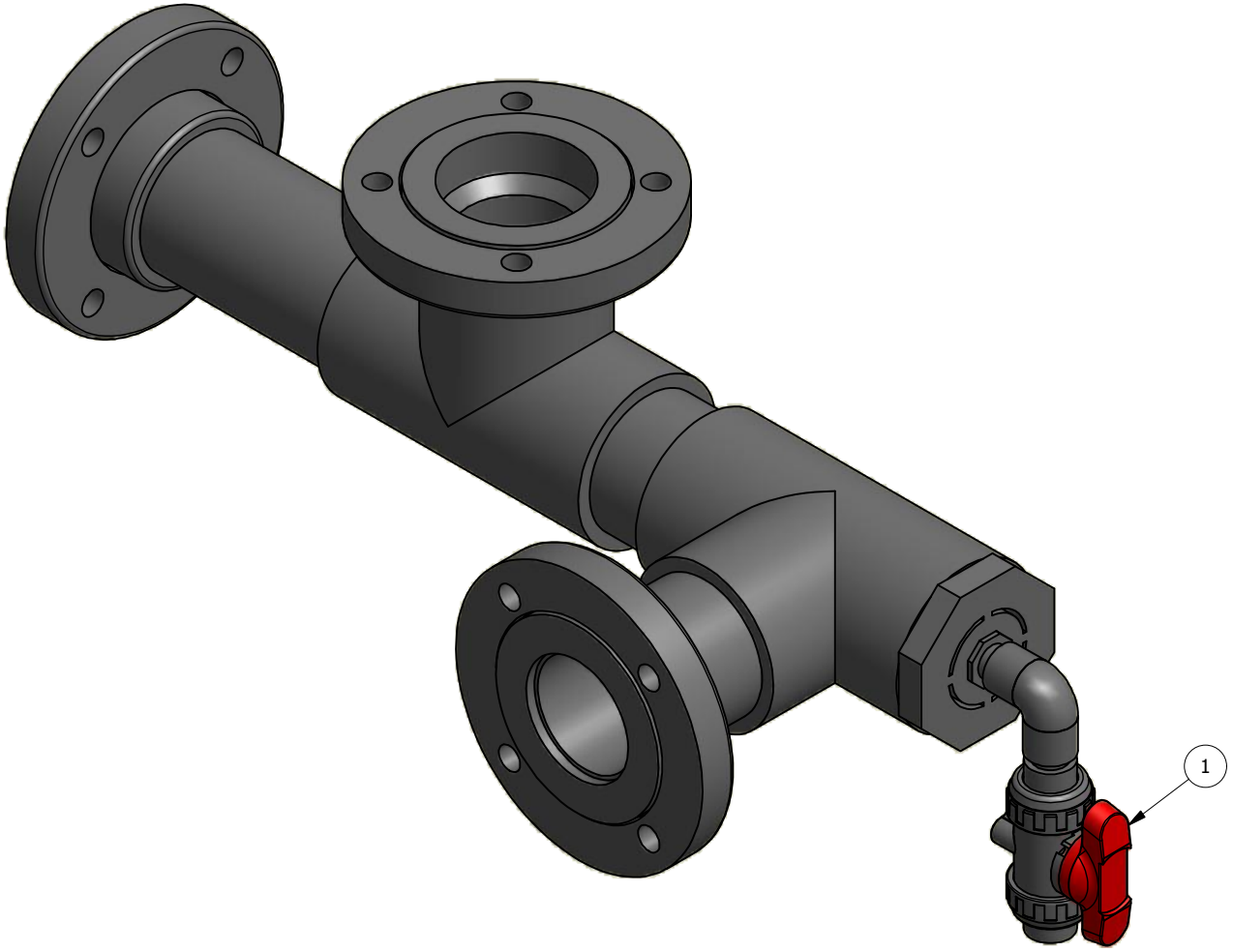
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 115149 | PVC/EPDM | Valve; True-Union Ball; 1/2"; Soc x Soc | 1 |




Isometric View
SCALE 1 : 4

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Discharge Header; Dampener Sub-Ass'y
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 13, 2014 | 5 of 8 | 13-11640 | 13-11640WS2200A |

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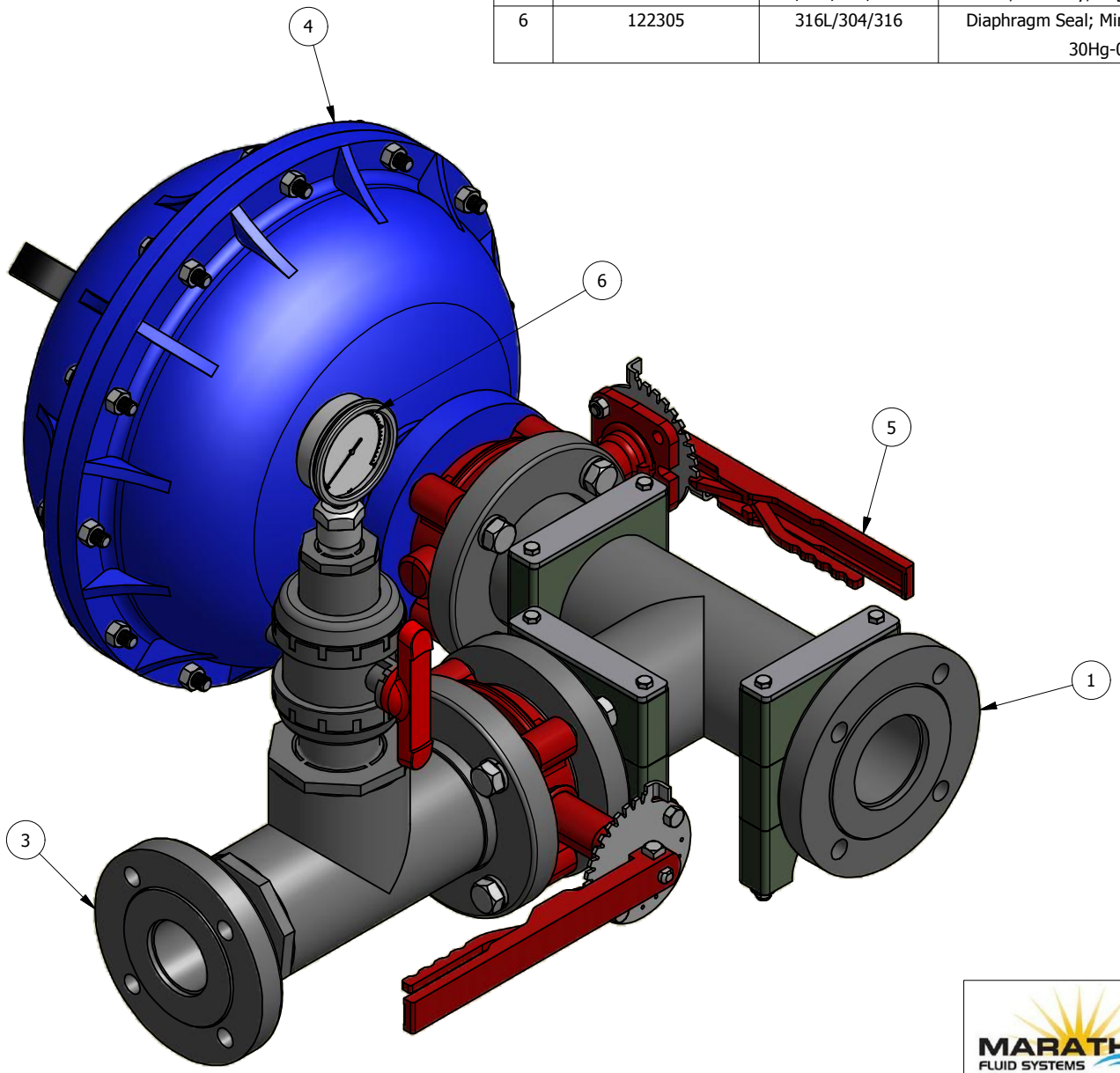
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 13-11640WS3100A | Varies | Suction Header; Stabilizer/Inlet Sub-Assembly | 1 |
| 3 | 13-11640WS2100A | Varies | Discharge Header; Pressure Gauge Sub-Assembly | 1 |
| 4 | 124012 | Al/Al/Buna-N | Inlet Stabilizer; 1155 Cu.In; 3" ANSI Flange | 1 |
| 5 | 150613 | CI/316/316/EPDM | Valve; Butterfly; Lug Style; 3"; Series 31 c/w Lever Lock Handle | 2 |
| 6 | 122305 | 316L/304/316 | Diaphragm Seal; Mini; 1/2" MNPT Process c/w Pressure Gauge; 30Hg-0-60 Psi; 3.5" Dial; Liquid Filled | 1 |




Isometric View
SCALE 1 : 5

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Suction Header
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 6 of 8 | 13-11640 | 13-11640WS3000A |

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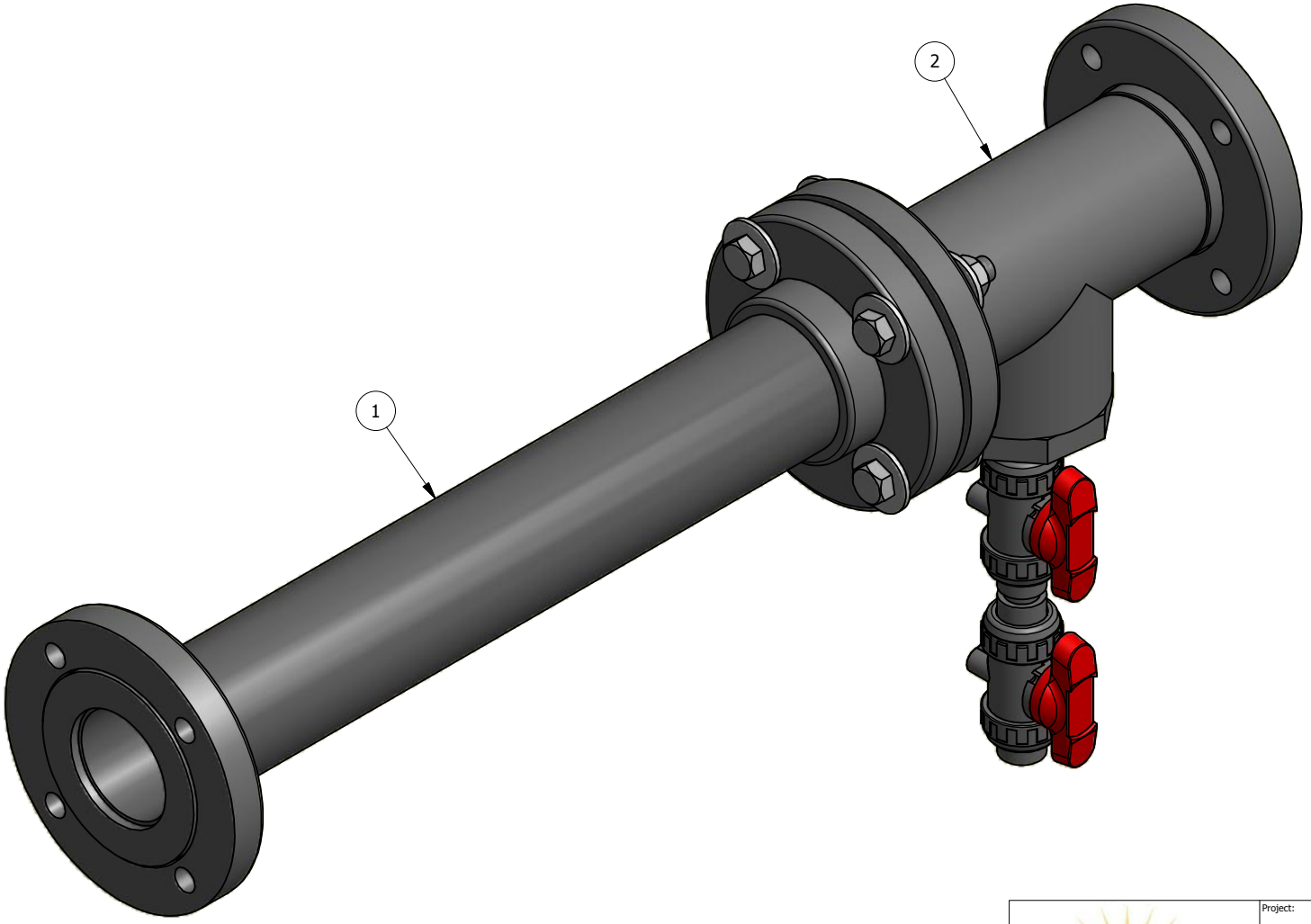
# This Assembly Ship Loose For Onsite Installation (To Be Supported Onsite)

| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 151635 | PVC | Static Mixer; 3"; 6 Mixing Elements; ANSI Flanged Ends | 1 |
| 2 | 13-11640WS4200A | Varies | Discharge Header; Sampling Sub-Assembly | 1 |
| 3 | 205351 | 18.8 | Bolt; Hex; 5/8"-11 x 3-1/2" | 4 |
| 4 | 206011 | 18.8 | Washer; Flat; 5/8" | 8 |
| 5 | 205836 | 18.8 | Nut; Nylon Lock; 5/8"-11 | 4 |




Isometric View
SCALE 1 : 4

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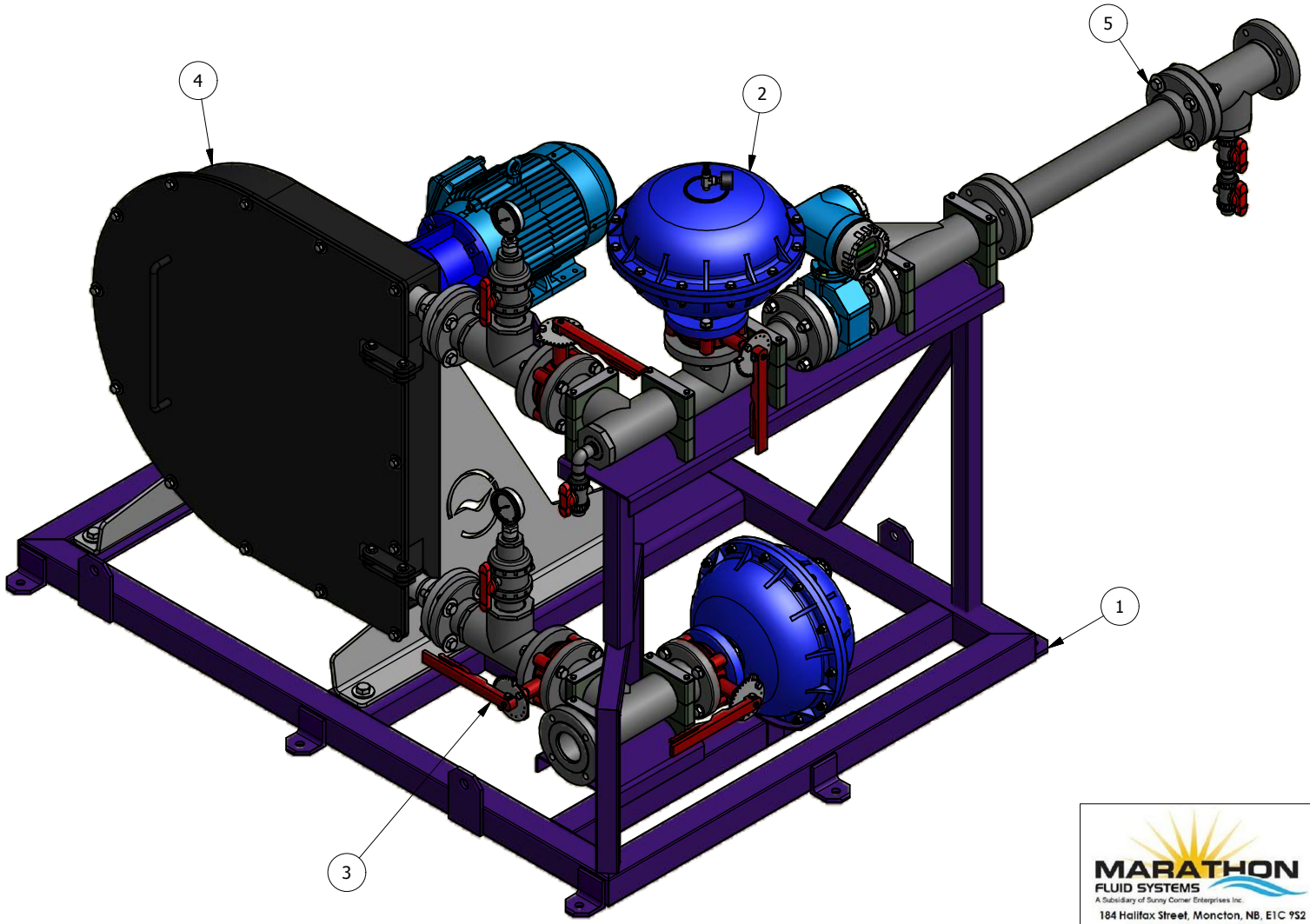
Project:
Pangnirtung
WTP Upgrades

Drawing:
Static Mixer/Sampling Header
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 13, 2014 | 7 of 8 | 13-11640 | 13-11640WS4000A |

Drawing is property of Marathon Fluid Systems and shall not be used by another party unless authorized

| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 13-11640WS1000A | Epoxy Coated Steel | Equipment Mounting Frame | 1 |
| 2 | 13-11640WS2000A | Vareis | Discharge Header | 1 |
| 3 | 13-11640WS3000A | Varies | Suction Header | 1 |
| 4 | 143018 | Varies | Peristaltic; Pump; 2-1/2"; 55 GPM; Right Facing Connections c/w Gearbox & 7.5hp; 3/60/575V; TEFC Motor | 1 |
| 5 | 13-11640WS4000A | Varies | Static Mixer/Sampling Header | 1 |




Isometric View
SCALE 1 : 15

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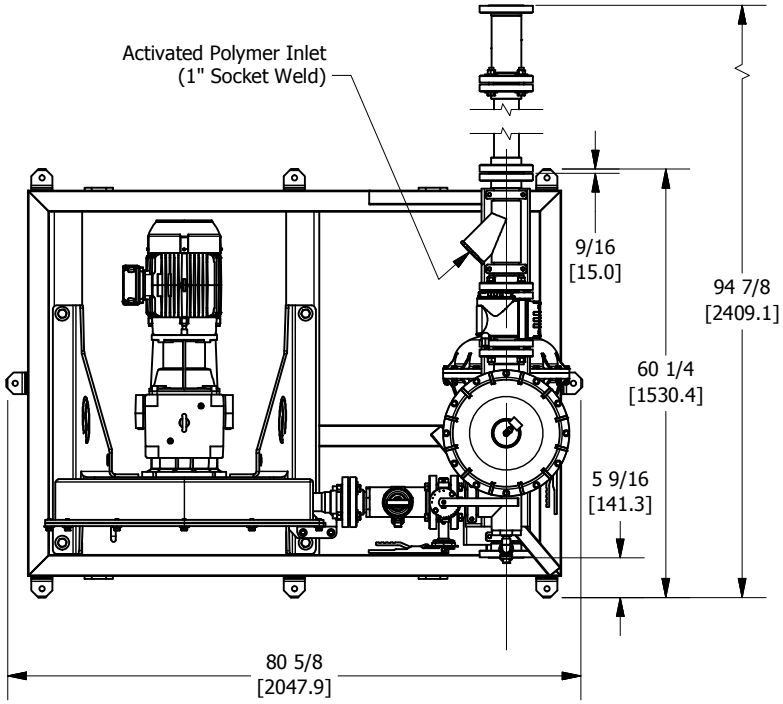
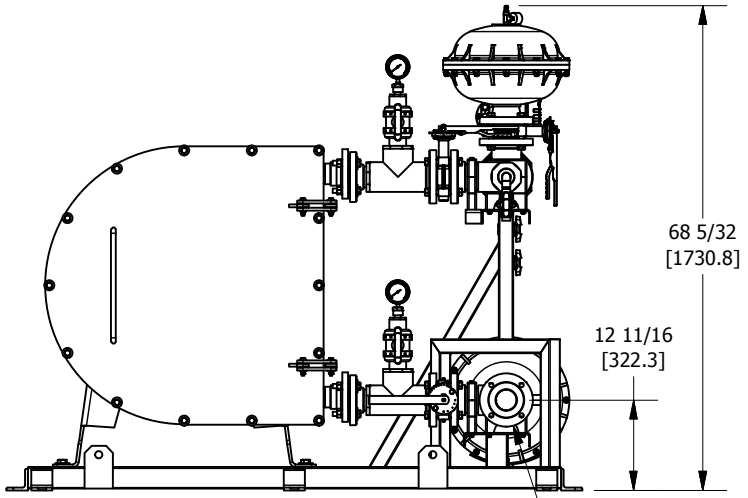
Project:
Pangnirtung
WTP Upgrades

Drawing:
Waste Sludge Feed System
General Representation

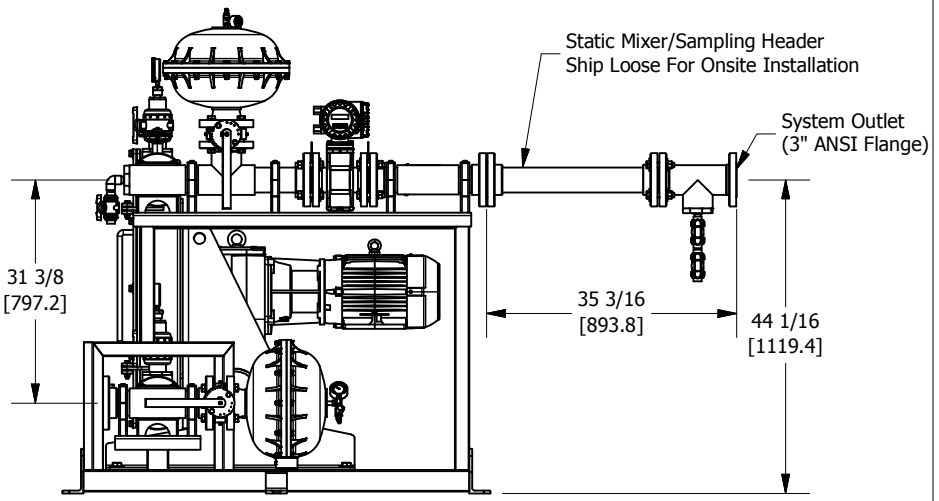
| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 1 of 8 | 13-11640 | 13-11640WS0000A |

Drawing is property of Marathon Fluid Systems and shall not be used by another party unless authorized




Front View
SCALE 1 : 27

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Waste Sludge Feed System
General Dimensions

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 2 of 8 | 13-11640 | 13-11640WS0000A |

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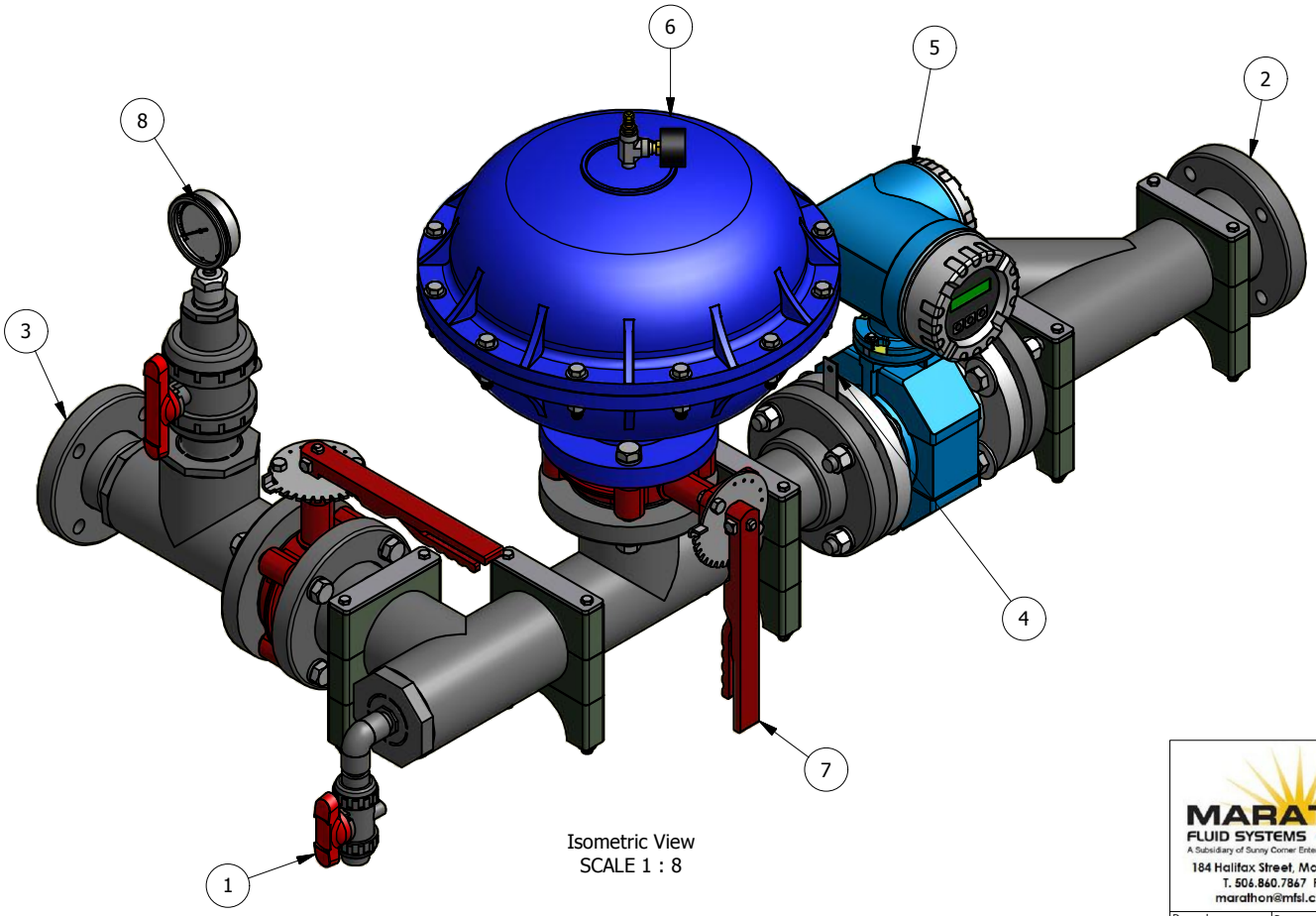
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 13-11640WS2200A | Varies | Discharge Header; Dampener Sub-Assembly | 1 |
| 2 | 13-11640WS2300A | Varies | Discharge Header; Polymer Injection Sub-Assembly | 1 |
| 3 | 13-11640WS2100A | Varies | Discharge Header; Pressure Gauge Sub-Assembly | 1 |
| 5 | 147442 | 316L/316L/Polyurethane | Flow Meter; Magnetic; DN80; 3"; Compact Display; 3" ANSI Flanges; 15' Cable | 1 |
| 6 | 124013 | Al/Al/Buna-N | Pulsation Dampener; 1155 Cu.In; 3" ANSI Flange | 1 |
| 7 | 150613 | CI/316/316/EPDM | Valve; Butterfly; Lug Style; 3"; Series 31 c/w Lever Lock Handle | 2 |
| 8 | 122125 | 316L/304/316 | Diaphragm Seal; Mini; 1/2" MNPT Process c/w Pressure Gauge; 0-60 Psi; 3.5" Dial; Liquid Filled | 1 |




Isometric View
SCALE 1 : 8

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Discharge Header
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 3 of 8 | 13-11640 | 13-11640WS2000A |

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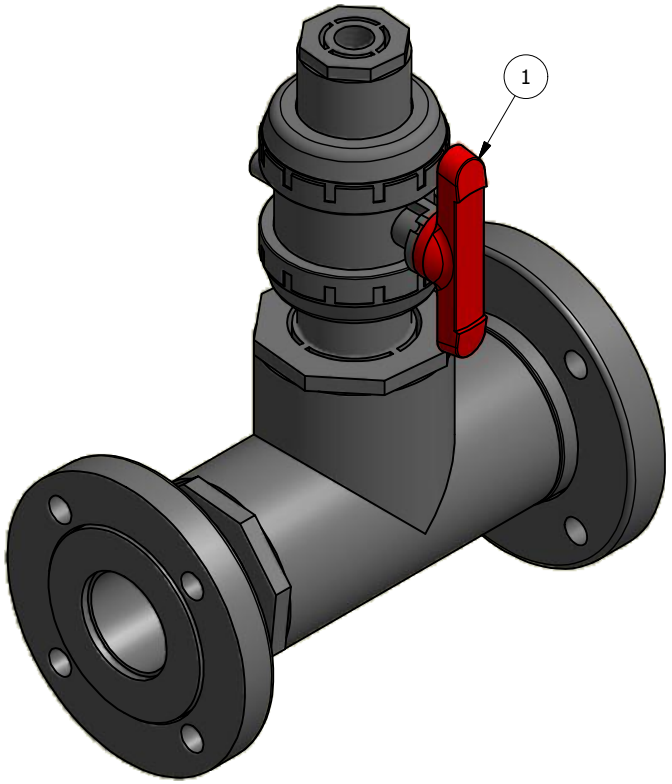
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 115153 | PVC/EPDM | Valve; True-Union Ball; 1-1/2"; Soc x Soc | 1 |




Isometric View
SCALE 1 : 4

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Discharge Header; Pressure Gauge Sub-Ass'y
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 4 of 8 | 13-11640 | 13-11640WS2100A |

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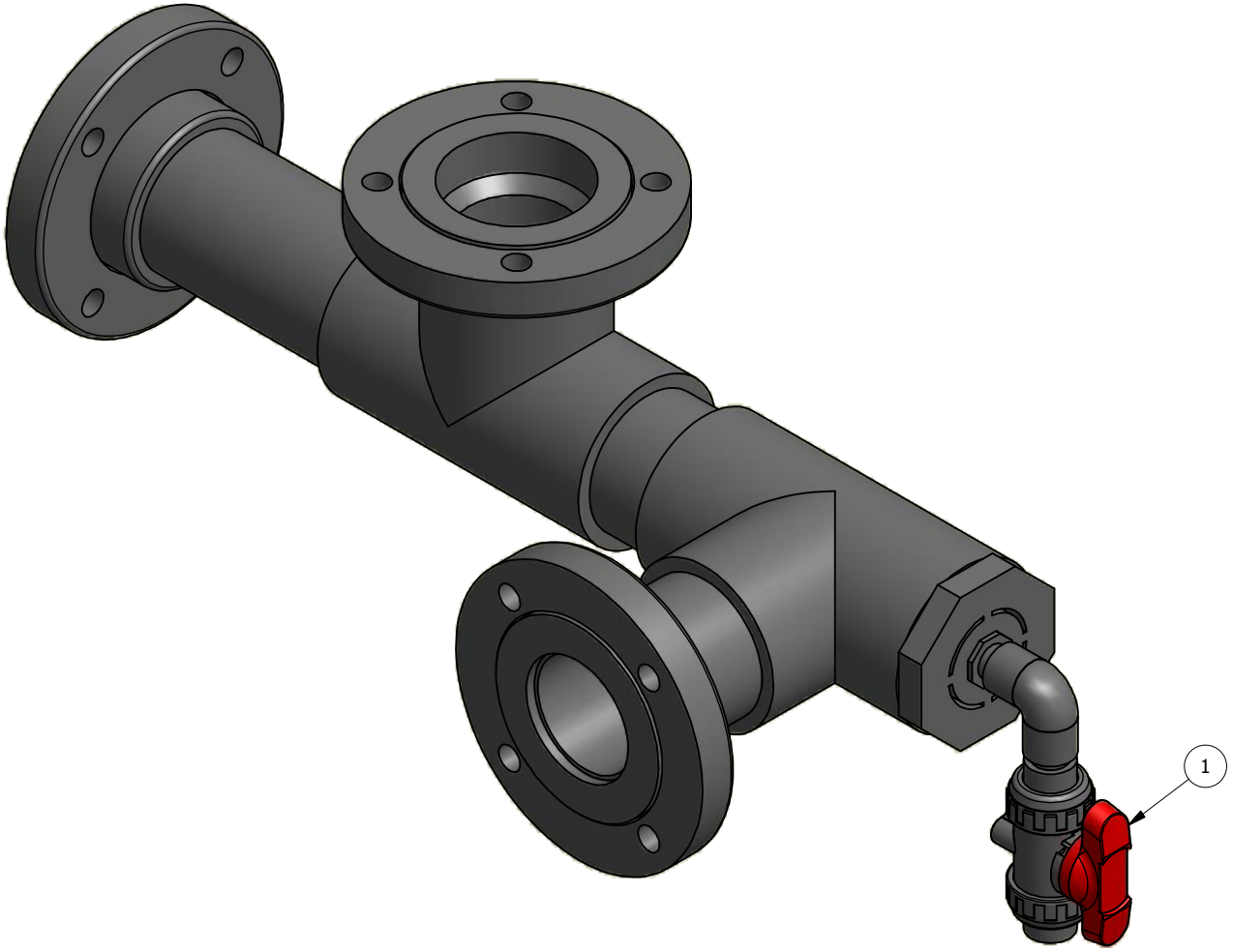
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 115149 | PVC/EPDM | Valve; True-Union Ball; 1/2"; Soc x Soc | 1 |




Isometric View
SCALE 1 : 4

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Discharge Header; Dampener Sub-Ass'y
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 13, 2014 | 5 of 8 | 13-11640 | 13-11640WS2200A |

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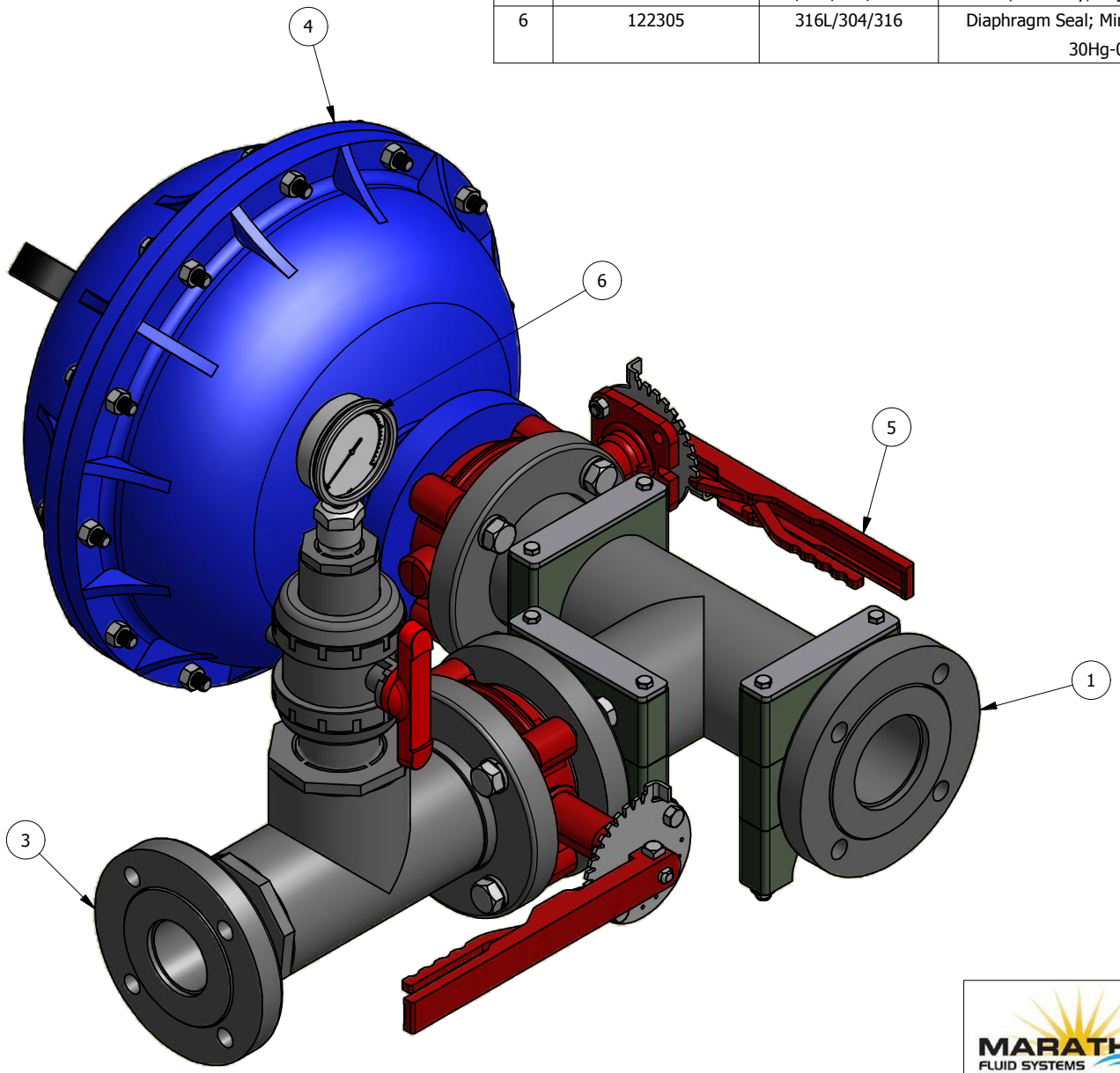
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 13-11640WS3100A | Varies | Suction Header; Stabilizer/Inlet Sub-Assembly | 1 |
| 3 | 13-11640WS2100A | Varies | Discharge Header; Pressure Gauge Sub-Assembly | 1 |
| 4 | 124012 | Al/Al/Buna-N | Inlet Stabilizer; 1155 Cu.In; 3" ANSI Flange | 1 |
| 5 | 150613 | CI/316/316/EPDM | Valve; Butterfly; Lug Style; 3"; Series 31 c/w Lever Lock Handle | 2 |
| 6 | 122305 | 316L/304/316 | Diaphragm Seal; Mini; 1/2" MNPT Process c/w Pressure Gauge; 30Hg-0-60 Psi; 3.5" Dial; Liquid Filled | 1 |




Isometric View
SCALE 1 : 5

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Suction Header
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 12, 2014 | 6 of 8 | 13-11640 | 13-11640WS3000A |

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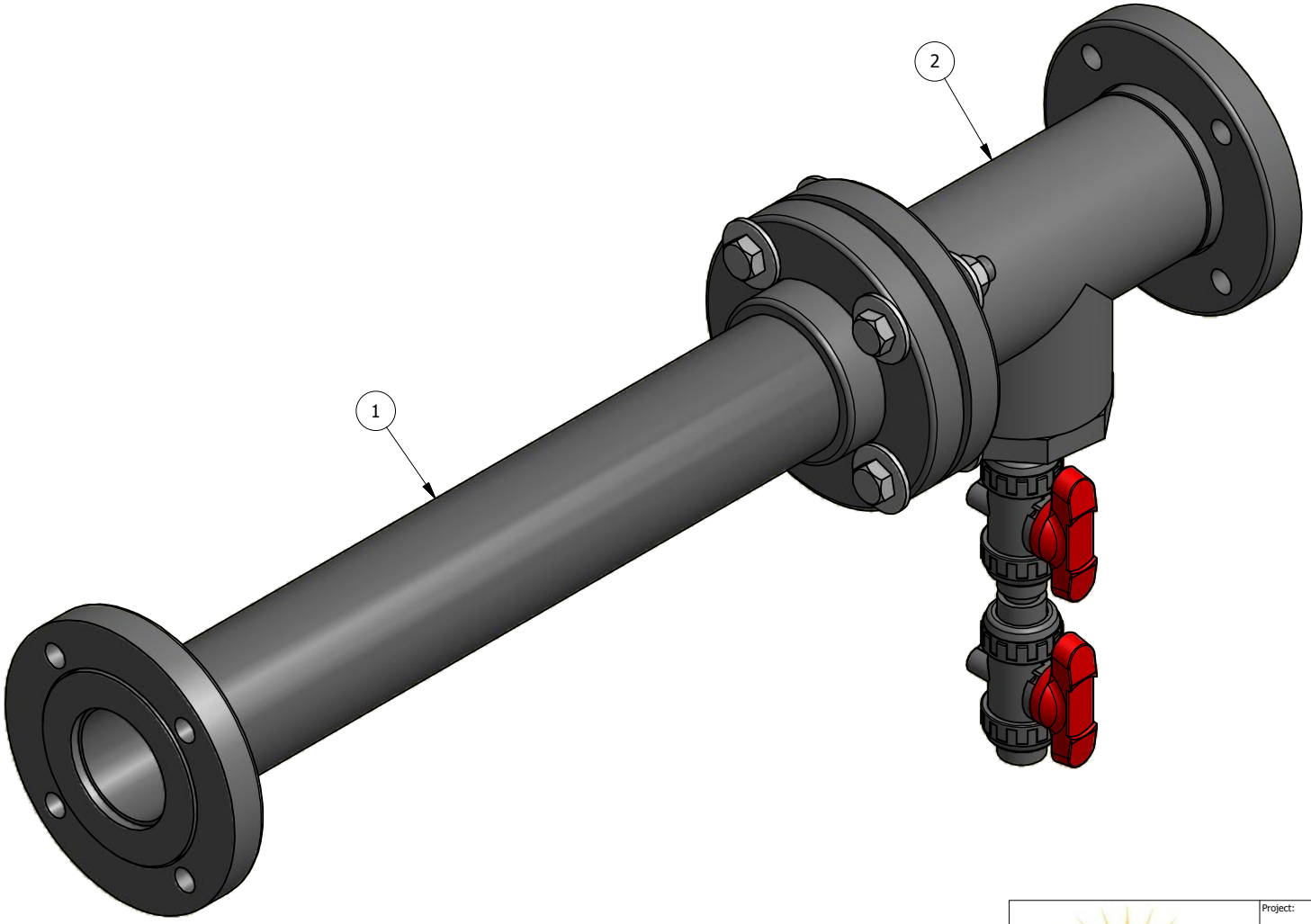
# This Assembly Ship Loose For Onsite Installation (To Be Supported Onsite)

| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 151635 | PVC | Static Mixer; 3"; 6 Mixing Elements; ANSI Flanged Ends | 1 |
| 2 | 13-11640WS4200A | Varies | Discharge Header; Sampling Sub-Assembly | 1 |
| 3 | 205351 | 18.8 | Bolt; Hex; 5/8"-11 x 3-1/2" | 4 |
| 4 | 206011 | 18.8 | Washer; Flat; 5/8" | 8 |
| 5 | 205836 | 18.8 | Nut; Nylon Lock; 5/8"-11 | 4 |




Isometric View
SCALE 1 : 4

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Static Mixer/Sampling Header
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 13, 2014 | 7 of 8 | 13-11640 | 13-11640WS4000A |

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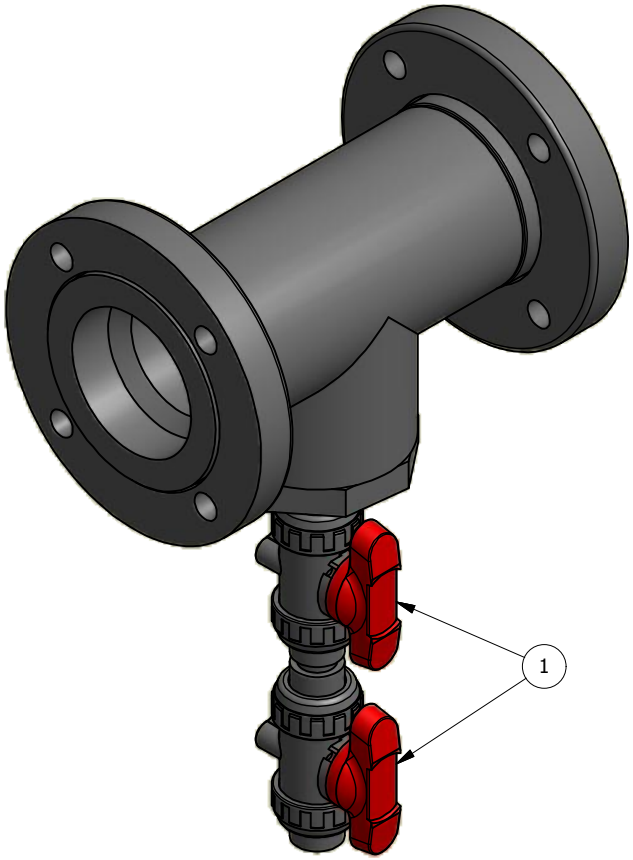
| Parts List | | | | |
|---|---|---|---|---|
| ITEM | PART NUMBER | Material | DESCRIPTION | ITEM QTY |
| 1 | 115149 | PVC/EPDM | Valve; True-Union Ball; 1/2"; Soc x Soc | 2 |




Isometric View
SCALE 1 : 4

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Project:
Pangnirtung
WTP Upgrades

Drawing:
Discharge Header; Sampling Sub-Ass'y
General Representation

| Drawn by: | Rev: | Date: | Sheet: | Job No: | Drw No: |
|---|---|---|---|---|---|
| J. Mallet | 0 | Feb 13, 2014 | 8 of 8 | 13-11640 | 13-11640WS4200A |

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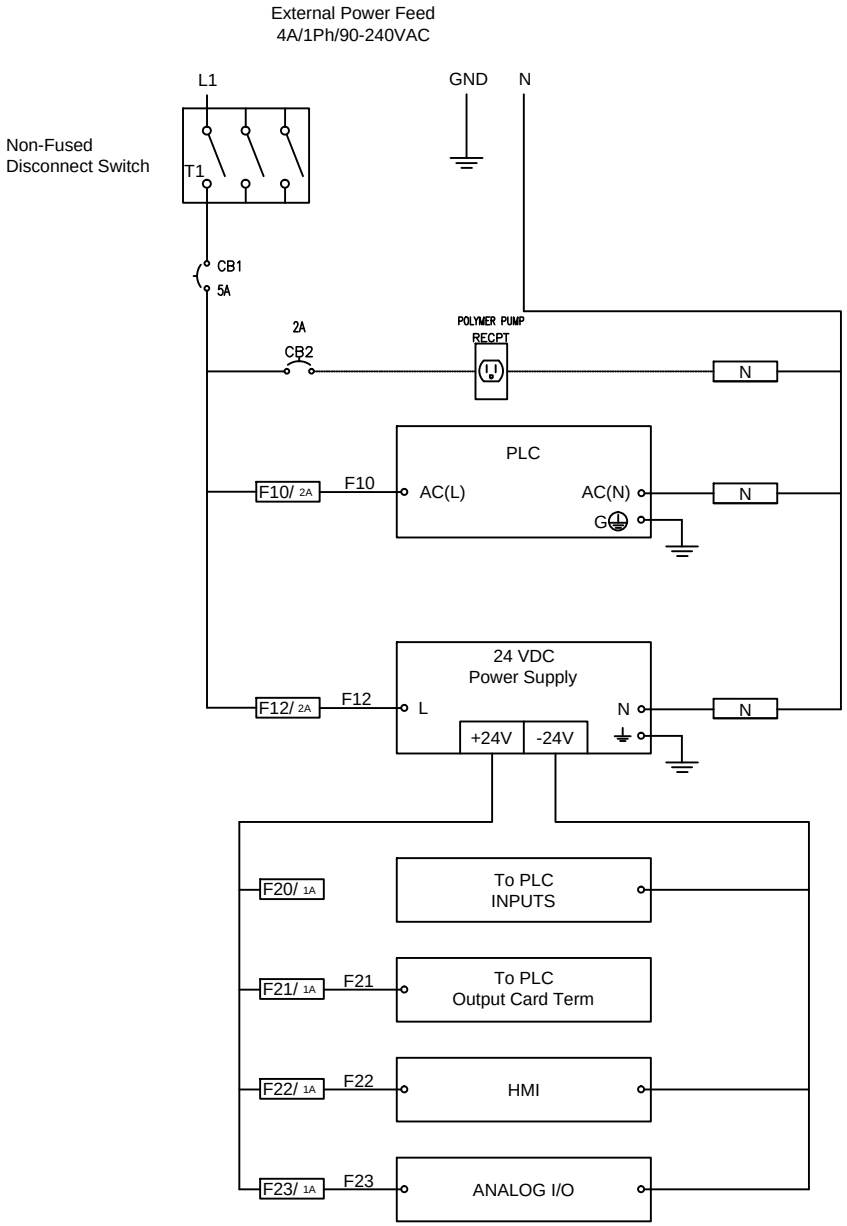


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Fax.506-458-2124

Automation Division of
Liteco

| NO. | DATE | REVISION | BY |
|---|---|---|---|
| 02 | 08/11/2014 | AS BUILT | DC |
| 01 | 07/30/14 | AS BUILT | MH |
| 00 | 07/23/14 | AS BUILT | MH |
| 1 | 07/15/14 | REMOVED RELAY | MH |
| A | 07/08/13 | APPROVAL | MH |

DWG TITLE

*MARATHON FLUID SYSTEMS*
*PLC PANEL*

*POWER DISTRIBUTION*

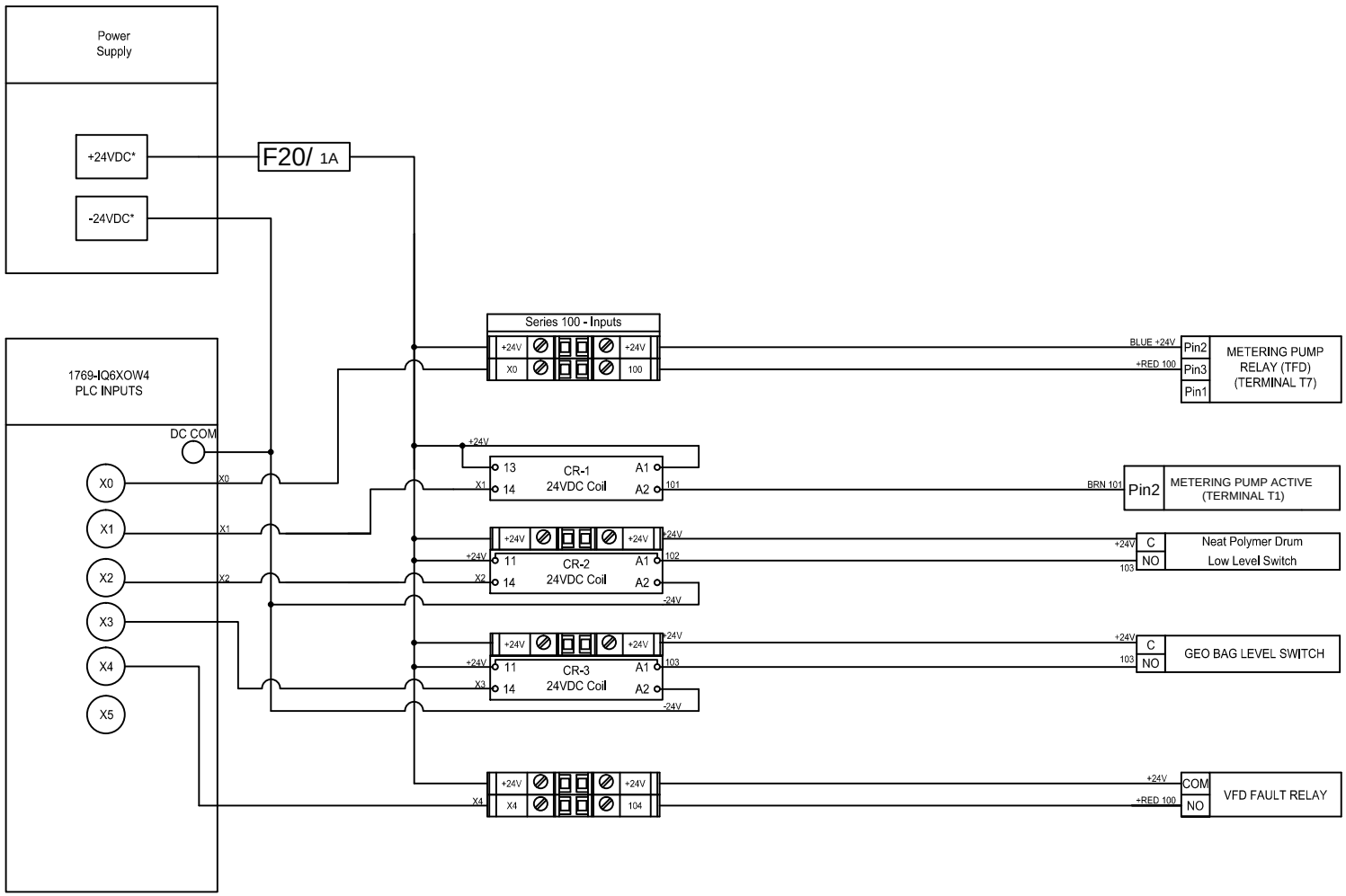
| ENGINEER | CHECKED BY |
|---|---|
| | *MH* |
| JOB NO | DRAWN BY |
| *814018* | *MH* |
| SCALE | DATE |
| NTS | 02/17/14 |

DWG NO

*E1*

DRAWING STATUS

*AS BUILT*

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| 02 | 08/11/2014 | AS BUILT | DC |
| 01 | 07/30/14 | AS BUILT | MH |
| 00 | 07/23/14 | AS BUILT | MH |
| 1 | 07/15/14 | CONSTRUCTION | MH |
| A | 02/18/14 | APRROVAL | MH |

DWG TITLE

*MARATHON FLUID SYSTEMS*
*PLC PANEL*

*INPUTS*

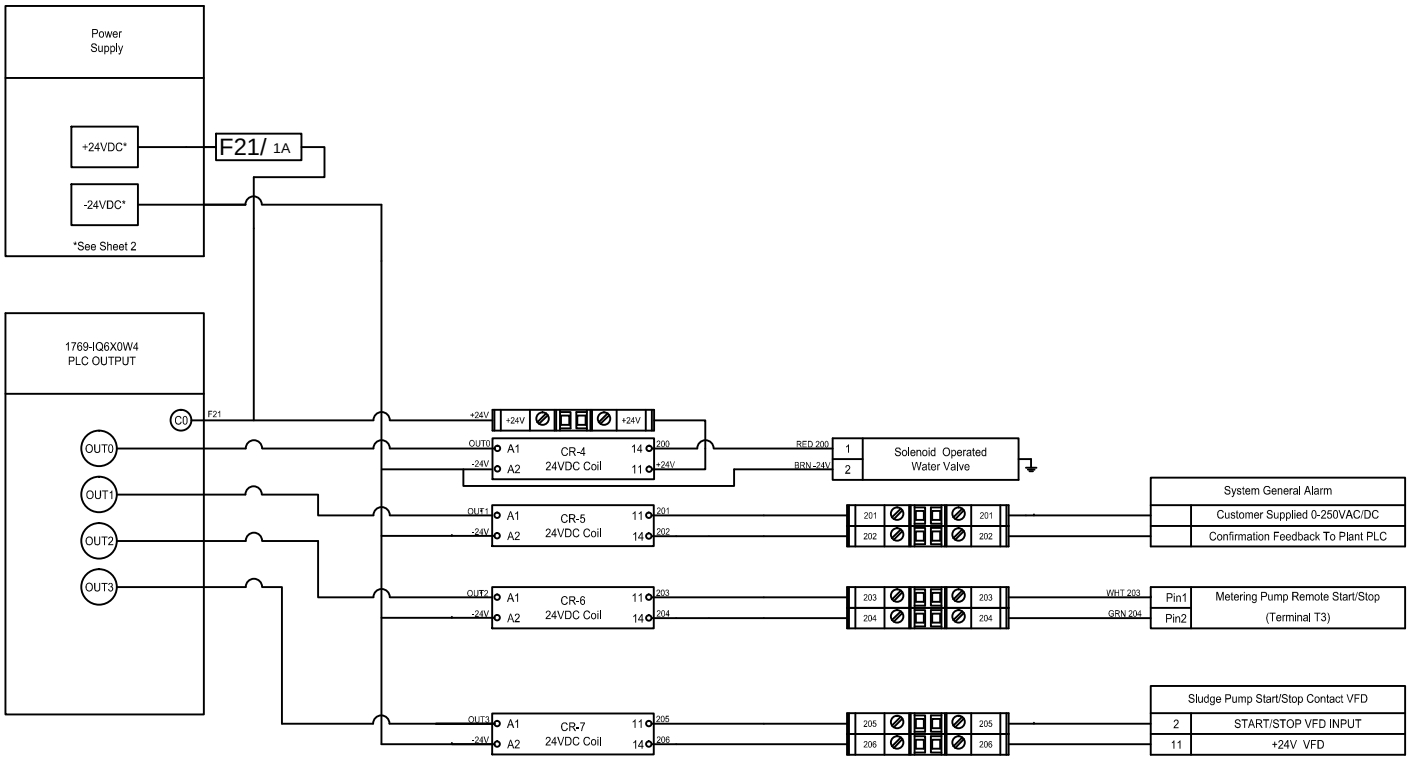
| | |
|---|---|
| ENGINEER | CHECKED BY *MH* |
| JOB NO *814018* | DRAWN BY *MH* |
| SCALE NTS | DATE 02/18/14 |

DWG NO

*E2*

DRAWING STATUS

*AS BUILT*

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|---|---|---|---|
| 01 | 07/30/14 | AS BUILT | MH |
| 00 | 07/23/14 | AS BUILT | MH |
| 1 | 07/15/14 | CONSTRUCTION | MH |
| C | 02/18/14 | VFD TERM CHANGE | MH |
| B | 2/18/14 | LABEL CHANGES | MH |
| A | 02/18/14 | APRROVAL | MH |

DWG TITLE

*MARATHON FLUID SYSTEMS*
*PLC PANEL*

*RELAY OUTPUTS*

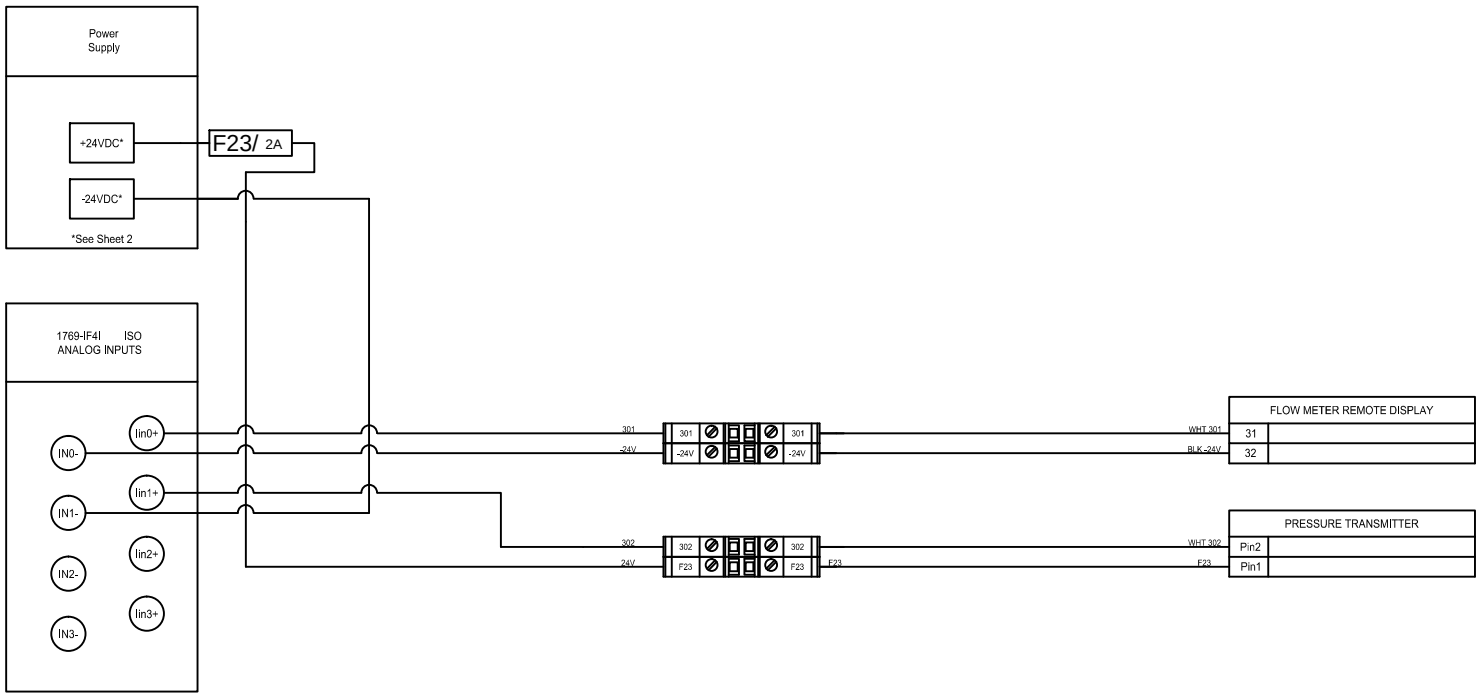
| ENGINEER | CHECKED BY |
|---|---|
| | *MH* |
| JOB NO | DRAWN BY |
| *814018* | *MH* |
| SCALE | DATE |
| NTS | 02/18/14 |

DWG NO

*E3*

DRAWING STATUS

*AS BUILT*

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| 01 | 07/30/14 | AS BUILT | MH |
| 00 | 07/23/14 | AS BUILT | MH |
| 1 | 07/15/14 | CONSTRUCTION | MH |
| A | 02/18/14 | APPROVAL | MH |

DWG TITLE

*MARATHON FLUID SYSTEMS*
*PLC PANEL*

*ANALOG INPUTS*

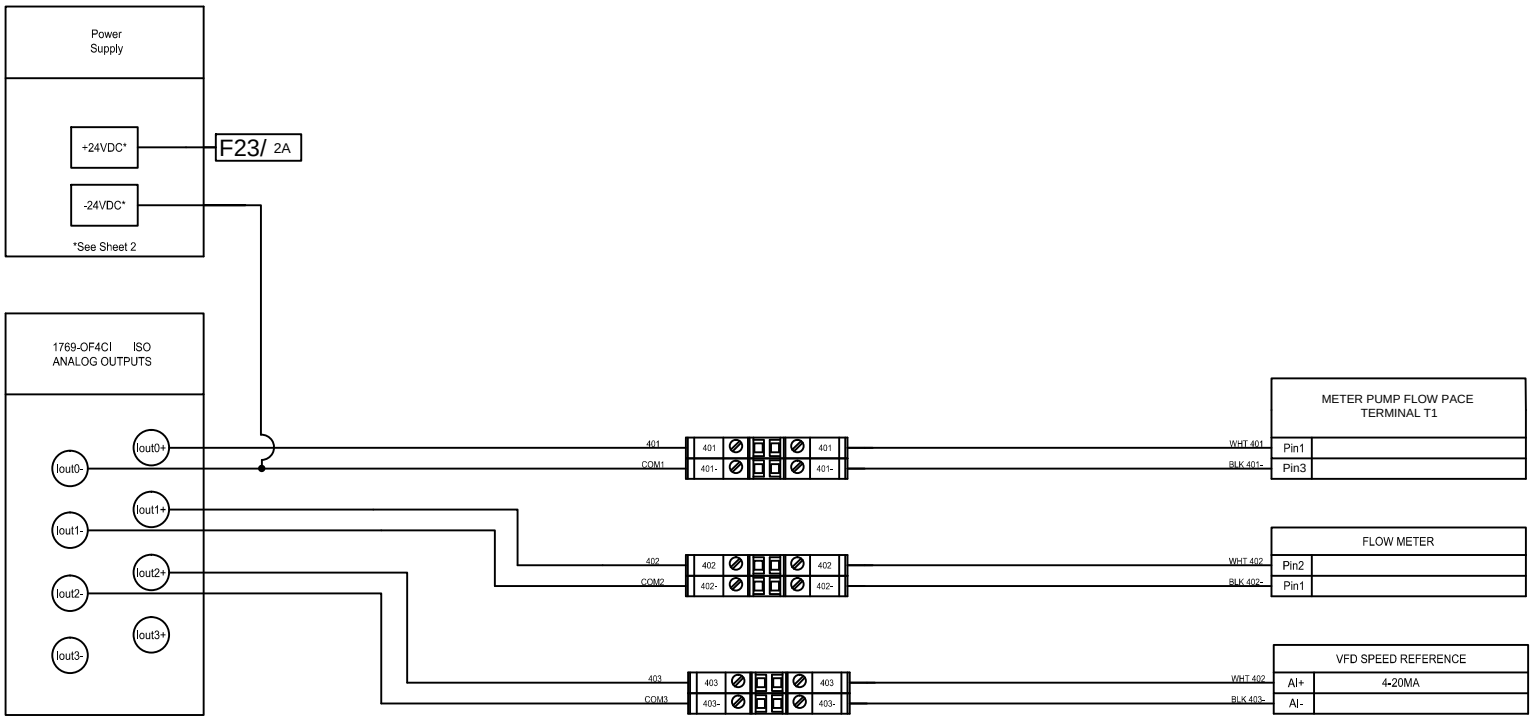
| ENGINEER | CHECKED BY |
|---|---|
| | *MH* |
| JOB NO | DRAWN BY |
| *814018* | *MH* |
| SCALE | DATE |
| NTS | 02/18/14 |

DWG NO

*E4*

DRAWING STATUS

*AS BUILT*

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| 02 | 08/11/2014 | AS BUILT | DC |
| 01 | 07/30/14 | AS BUILT | MH |
| 00 | 07/23/14 | AS BUILT | MH |
| 1 | 07/15/14 | CONSTRUCTION | MH |
| A | 02/18/14 | APPROVAL | MH |

DWG TITLE

*MARATHON FLUID SYSTEMS*
*PLC PANEL*

*ANALOG OUTPUTS*

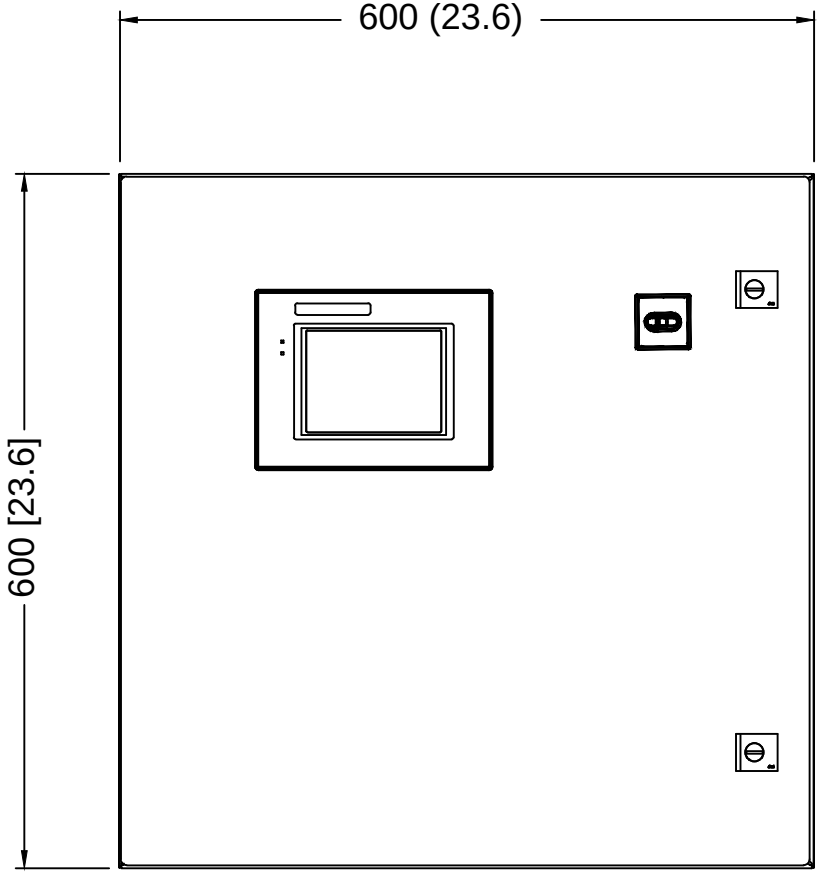
| ENGINEER | CHECKED BY |
|---|---|
| | *MH* |
| JOB NO | DRAWN BY |
| *814018* | *MH* |
| SCALE | DATE |
| NTS | 02/18/14 |

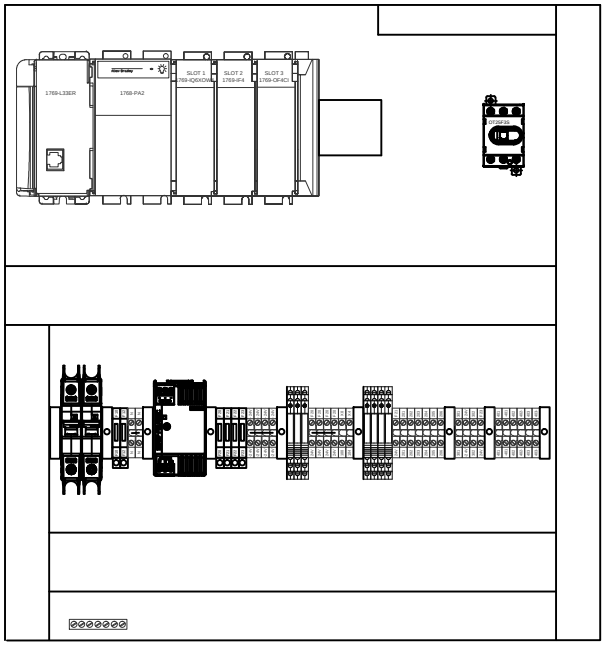
DWG NO

*E5*

DRAWING STATUS

*AS BUILT*



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| NO. | DATE | REVISION | BY |
|---|---|---|---|
| 02 | 08/11/2014 | AS BUILT | DC |
| 01 | AS BUILT | 07/30/14 | MH |
| 00 | 07/23/14 | AS BUILT | MH |

DWG TITLE

*MARATHON FLUID SYSTEMS*
*PLC PANEL*

*LAYOUT*

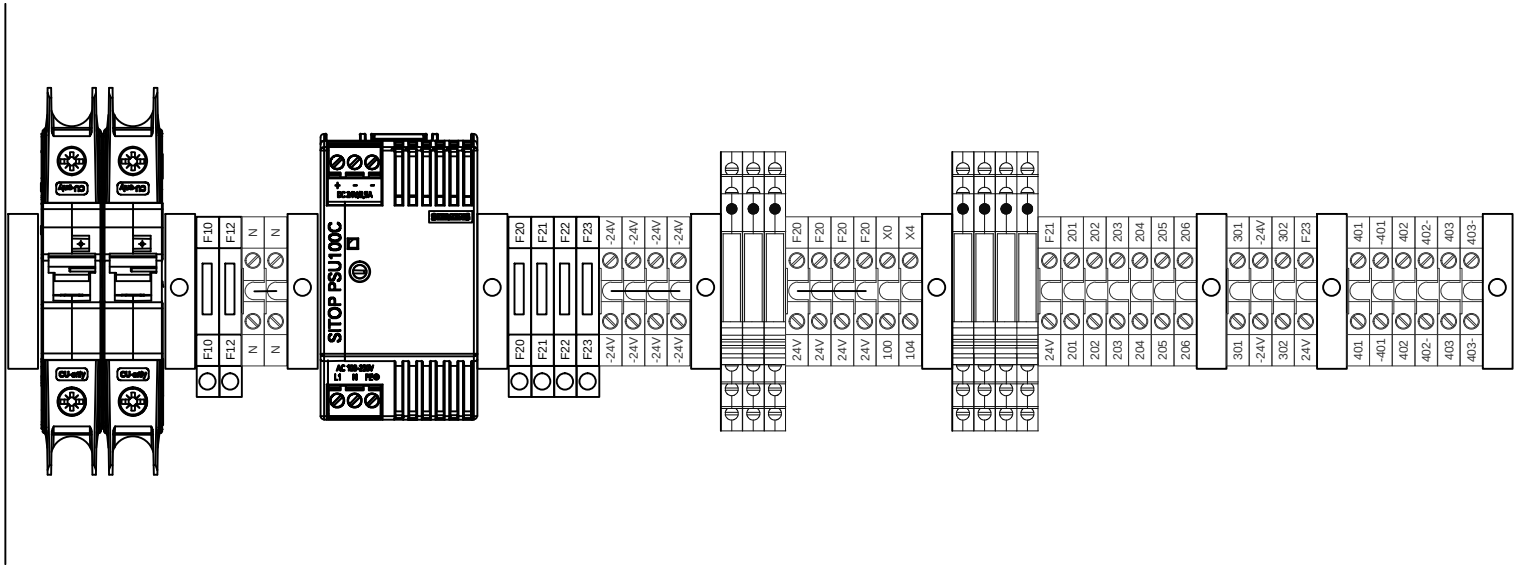
| ENGINEER | CHECKED BY |
|---|---|
| | *MH* |
| JOB NO | DRAWN BY |
| *814018* | *MH* |
| SCALE | DATE |
| NTS | 02/18/14 |

DWG NO

*E6*

DRAWING STATUS

*AS BUILT*

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| 02 | 08/11/2014 | AS BUILT | DC |
| 01 | AS BUILT | 07/30/14 | MH |
| 00 | 07/23/14 | AS BUILT | MH |

DWG TITLE

*MARATHON FLUID SYSTEMS*
*PLC PANEL*

*TERMINAL STRIP*

| ENGINEER | CHECKED BY |
|---|---|
| | *MH* |
| JOB NO | DRAWN BY |
| *814018* | *MH* |
| SCALE | DATE |
| NTS | 02/18/14 |

DWG NO

*E7*

DRAWING STATUS

*AS BUILT*

| Vendor: | Part number | Description | Qty |
|---|---|---|---|
| | | | |
| ALLEN BRADLEY | 1769-L33ER | PROCESSOR | 1 |
| ALLEN BRADLEY | 1768-PA2 | 2.5A POWER SUPPLY CPU | 1 |
| ALLEN BRADLEY | 1769-IQ6XOW4 | DIGITAL I/O CARD | 1 |
| ALLEN BRADLEY | 1769-IF4 | ANALOG INOT CARD | 1 |
| ALLEN BRADLEY | 1769-OF4CI | ANALOG OUTPUT CARD | 1 |
| ALLEN BRADLEY | 1769-ECR | ENC CAP | 1 |
| ALLEN BRADLEY | 22BE9P9N104 | 7.5HP 600V POWER FLEX 40 VFD | 2 |
| ALLEN BRADLEY | 22-JBAC | CONDUIT BOX | 2 |
| | | | |
| AUTOMATION DIRECT | EA9-T6CL | 6IN TOUCH SCREEN | 1 |
| MISC | ETHERNET | CABLE | 1 |
| | | | |
| SIEMENS | 6EP1332-5BA00 | POWER SUPPLY 60W 2.5A 24VDC | 1 |
| | | | |
| A.B.B. | OT163P | DOOR MOUNT DISCONNECT | 1 |
| | | | |
| WEIDMULLER | 9926251005 | 5A BREAKER | 1 |
| WEIDMULLER | 9926251002 | 2A BREAKER | 1 |
| WEIDMULLER | 6720005422 | RECEPTACLE | 1 |
| | | | |
| RITTAL | 8018963 | WM242410NC | 1 |
| RITTAL | 2508200 | MOUNTING FEET | 1 |
| | | | |
| MERSEN | GGM1 | 1A CONTROL FUSES | 4 |
| MERSEN | GGM2 | 2A CONTROL FUSES | 3 |
| | | | |
| PHEONIX CONTACT | 3046100 | 250V AC FUSE HOLDER | 3 |
| PHEONIX CONTACT | 3046090 | 24V FUSE HOLDER | 4 |
| PHEONIX CONTACT | 0800886 | END STOP | 6 |
| PHEONIX CONTACT | 3044102 | UT4 TERMINALS | 20 |
| PHEONIX CONTACT | 3022276 | SPACERS | 3 |
| PHEONIX CONTACT | 2966171 | 24VDC RELAY | 6 |
| PHEONIX CONTACT | 2966634 | ELECTRONIC 24VDC RELAY | 1 |
| PHEONIX CONTACT | 3030365 | 10 POLE JUMPER FBS 10-6 | 2 |
| | | | |

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*PLC PANEL*

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| SCALE | DATE |
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DRAWING STATUS

*AS BUILT*

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FLUID SYSTEMS
Subsidiary of Sunny Corner Enterprises Inc.

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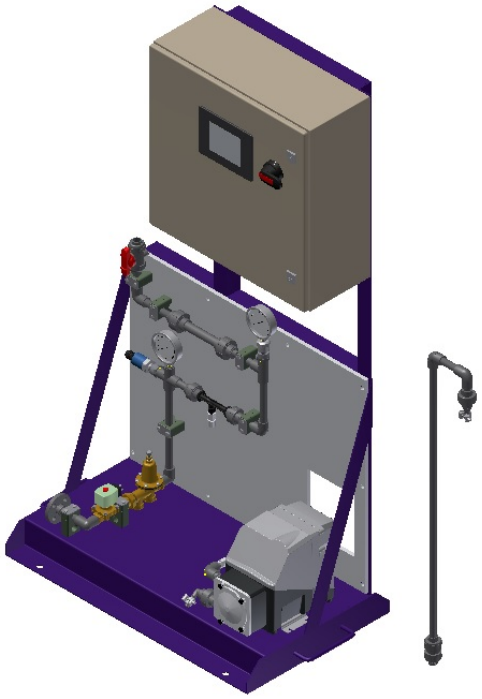
# OPERATION MANUAL

## Pangnirtung WTP Upgrade
## Sludge Dewatering System
## ***Polymer Activation System Control Panel***



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# 1 INSTALLATION

Move the system at the desired position while ensuring enough space is available around the equipment for proper operation and maintenance. Using shims, level the equipment and use anchor bolts to secure the equipment in place.

# 2 START-UP

## 2.1 ELECTRICAL WIRING

Prior to start-up, the main power supply and system I/O's needs to be wired on site by a certified electrician to ensure that all relevant codes and regulations are followed. Wiring diagrams are included in the control panel and in the O&M manual.

## 2.2 MECHANICAL CONNECTIONS

The required on-site mechanical connections include the water inlet (1/2", Class 150 flange) and the system outlet (1/2" Socket weld or threaded).

# 3 BASIS OF OPERATION

The operator will have the choice to operate the system in "Automatic" or "Manual" mode via the local touch screen interface.

When the "automatic process" will be switched to "On" via the touch screen interface, the metering pump, water solenoid valve and sludge pump (if enabled) will operate automatically based on the signal from the sludge flow meter. The water solenoid valve will open first, followed the metering pump and the sludge pump (if enabled). The metering pump running speed will adjust itself based on the sludge flow rate and user defined system set point.

The system will detect low and high sludge flows, metering pump motor failure, metering pump tube failure, flow meter failure, low and high water pressure, neat polymer drum empty (if equipped) and other specific alarms/failures. Any of these alarms will close the "general alarm" contact and will send the alarm to the plant PLC via dry contact.

The operator will have the option to manually operate the equipment via the local touch screen interface to convey initial testing or troubleshooting only. He will be able to locally activate the following:

- Water solenoid valve On/Off
- Metering pump On/Off and speed
- Sludge pump On/Off (if enabled)

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The operator will be able to adjust the following parameters locally using the touch screen interface:

- Neat polymer concentration
- System set point (ml of neat polymer per L of sludge)
- Flow meter set-points
- Flow meter and pressure transmitter analog scaling
- Alarms delays
- HMI contrast
- Operational mode (Local or Remote)
- Pressure transmitter status (Enable/Disable)
- Sludge pump control (Enable/Disable)

## 4 CONTROL PANEL

This control panel, designed for this specific application, will allow the operator to automatically make consistent polymer activation with a fixed water and variable neat polymer rate & sludge rate. Based on the operator's inputs, the system will start/stop the metering pump, open/close the water valve, start/stop the sludge pump (if enable) and monitor the sludge flow rate. It will also monitor the various alarms while providing dry contact feedback for: "General Alarm". This control panel allows the system to be operated in manual or automatic mode.

### 4.1 HMI OVERVIEW

The control panel is digitally operated from a touch screen located on the control system's front panel.

### 4.2 DESCRIPTION AND FUNCTIONNALITY OF SCREENS

When the main disconnect switch is in the "ON" position, the first screen that will appear will be the "Welcome Screen" with the contact phone number shown in figure 1. By touching the screen, the operator will advance to the "System Information Screen" (figure 2). Touching the screen again will bring the "Main Menu Screen" (figure 3) where he will be able to choose to operate the system in automatic mode or in manual mode, to acknowledge the alarms, to access the alarm history, to access the options or to access the

setup menu. Touching the top title bar of any screen will automatically exit the current screen and display the "Main Menu Screen" (figure 2) or previous screen.

*Figure 1: Marathon Custom Designs Information Screen*

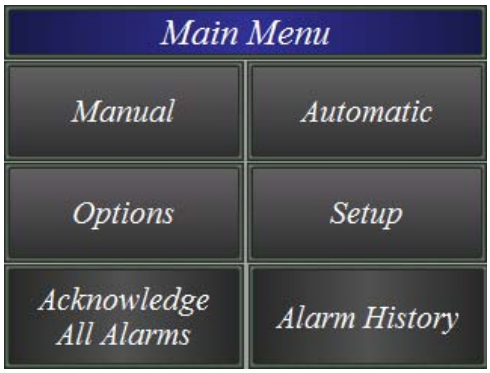


*Figure 2: Main Menu Screen*

### *4.2.1 MANUAL OPERATION*

From the "Main Menu Screen" (figure 2), the "Manual Operation Screen" (figure 3) can be access by pressing the "Manual" button. This mode allows the operator to manually operate the sludge pump (if enable), add some water and turn on the metering pump in the desired order. This mode is to be used to convey initial testing of the various components or to troubleshoot the system.

The speed of the metering pump can be changed by pressing the "Polymer Pump Speed" button to access the keypad screen. The metering pump speed shown will be the percentage of the maximum speed of the pump (based on pump calibration). For example, if the speed is set at 30%, the metering pump will output approximately 75.9

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ml/min (based on the factory 253 ml/min capacity). ***Exiting the "Manual Operation Screen" will stop any component running in manual.***

The "Manual Operation Screen" below shows a "Water Pump Disabled" text. In the event where the polymer system would be equipped with a water booster pump, this feature could be enabled and would allow the operator to manually turn ON/OFF the water booster pump. This current system does not have a water booster pump therefore this feature is not available.

***For further explanation on the sludge pump control feature, refer to section 4.2.3: Options.***

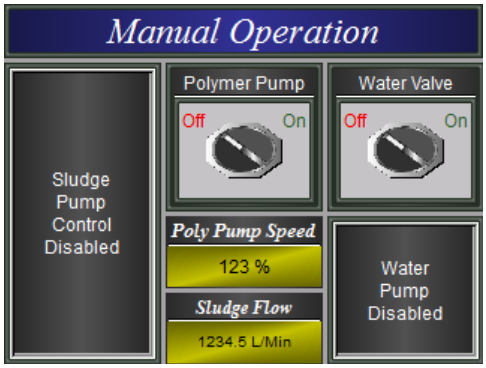


*Figure 3: Manual Operation Screen*

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### *4.2.2 AUTOMATIC OPERATION*

Returning back to the "Main Menu Screen", the "Automatic Operation Screen" (figure 4) can be access by pressing the "Automatic" button. In automatic, the system will operate as per described in section 3 - Basis of Operation.

Pressing the "Automatic" toggle button will activate or deactivate the "Automatic Process", if the system is in local operation mode (control mode set to local).

Based on timers and operation, the different status indicators will be displayed to indicate if the components are running.

In the "Automatic Operation Screen" (figure 4) the sludge flow, sludge pump speed, inlet pressure, metering pump speed and system set points are shown. Those values are based on the operator inputs in the setup pages.

The sludge pump speed will only be displayed if the operator enables the sludge pump control feature from the option screen. This will allow him to run the sludge pump at a desired fixed speed during the dewatering process.

**The controller is designed to be operated locally by the operator or automatically by the plant PLC (if equipped). The system will be mainly operated automatically in local mode by the operator. In order for the system to be controlled by the SCADA, the "Control Mode" needs to be set to "Remote" and the operator needs to put the system in automatic from the HMI. To operate the system in automatic locally, the operator needs to make sure the "Control Mode" is set to "Local". See section 4.2.3 to change the "Control Mode" from "Remote" to "Local" or vice versa.**

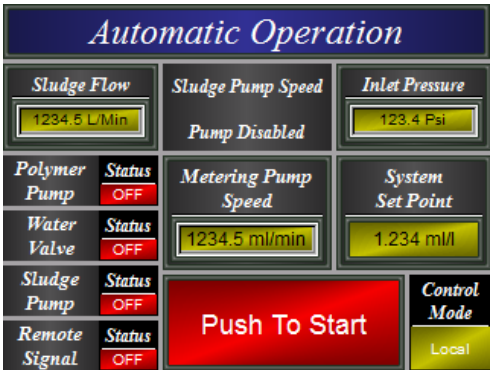


*Figure 4: Automatic Operation Screen*

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*4.2.3 OPTIONS*

From the "Main Menu Screen" (figure 2), the "Options Screen" (figure 5) can be access by pressing the "Options" button. The operator will be prompt to enter a password to access the options (8826). This screen allows the operator to change the "Control Mode", which dictates how the automatic operation is enabled/disabled. A control mode of "Remote" means that the plant PLC has the remote control on enabling/disabling the automatic feature. A control mode of "Local" means that the operator has the local control on enabling/disabling the automatic feature.

The inlet pressure transmitter can also be disabled in the event of a transmitter failure. This will allow the operator to still operate the system in automatic mode while maintenance is done.

The system has been equipped with an enable/disable feature for the sludge pump control as this equipment might be controlled externally from this control panel. This panel has provision for a dry contact output and analog output to control the sludge pump. In the event the sludge pump is controlled externally from this panel, the "Sludge Pump Control" needs to be set to "Disabled". Under this mode, the control panel will not have any control on the sludge pump start/stop, but will start/standby the automatic process based on the sludge flow, providing the system automatic mode has been "activated". In other words, the SCADA does not need to control the polymer system. Only by starting/stopping the sludge pump, the polymer system will start or stay in standby mode until flow is present.

If this feature is set to "Enabled", the operator (or SCADA) needs to start/stop the automatic process as this control panel will have the control over the start/stop of the sludge pump. This could be described as a "batch" process.

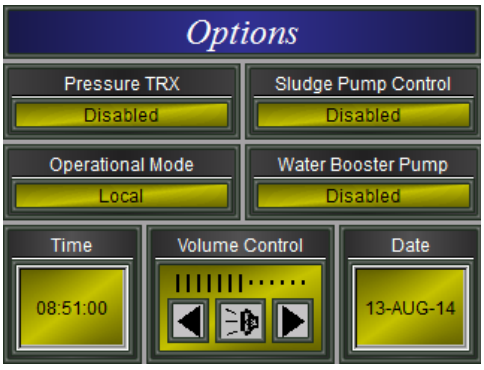


*Figure 5: Options Screen*

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*4.2.4 SETUP*

Selecting the "Setup" button from the "Main Menu Screen" will display a security code screen. The "Setup screens" are password protected (7867) to prevent unauthorized people to make changes to the system's settings. In the event where the client does not requested password protected screens, the security code screen will not be displayed. Pressing the "Setup Sub-Menus" button shown in figure 6 will allow the operator to navigate through the different setup pages without entering the password each time.

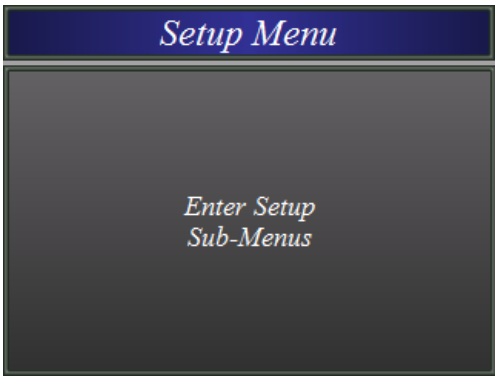


*Figure 6: Setup Main Menu Screen*

In the "Setup Sub Menus Screen" (figure 7) the operator can access the various setup pages by pressing the appropriate button.

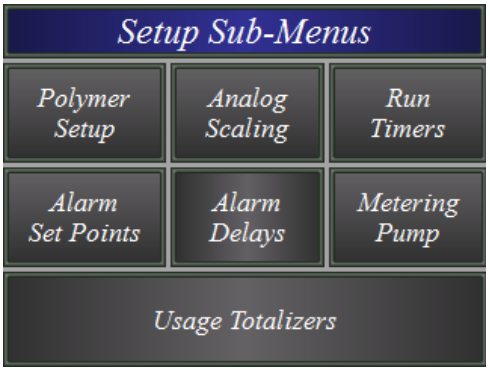


*Figure 7: Setup Sub Menus Screen*

*4.2.4.1 Polymer Setup*

In the "Polymer Setup Screen" (figure 8), the operator can change the neat polymer and system set point by pressing the appropriate box, which will display a keypad to enter the desired numbers.

Once the system set point has been entered, the PLC will do calculations to determine the amount of neat polymer to be added to the sludge. If the calculated value is higher than the metering pump capacity, an alarm will occur advising the operator of the situation. In order to correct this, either the sludge flow or system set point needs to be lowered.

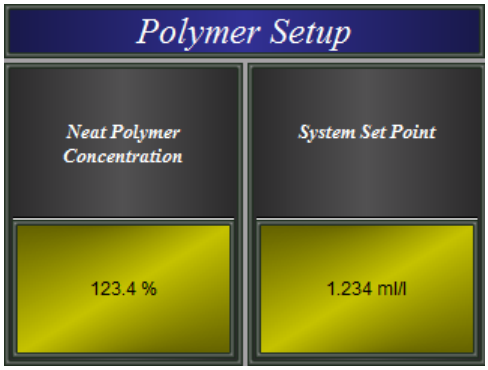


*Figure 8: Polymer Setup Screen*

#### 4.2.4.2 *Analog Scaling*

Pressing the top title bar of the page will bring back the "Setup Sub Menus Screen" where the operator can select the other setup screens.

Selecting the "Analog Scaling" will display another screen, shown in figure 9. This has been set based on the scaling of flow meter and pressure transmitter used. The scaling should never be changed except if the flow meter scaling gets changed to a different value. The flow meter scaling as been set to a random value, which should be more than the sludge pump capacity. If not, this number needs to be increased as well as the set point in the E+H transmitter. For alarming purpose, ensure the scaling is at least 10 LPM more than the maximum process flow.

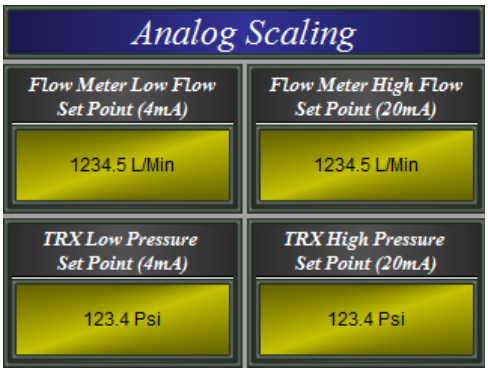


*Figure 9: Analog Scaling Screen*

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*4.2.4.3* *Alarm Set Points*

The "Alarm Set Points Screen" (figure 10) allows the operator to change the set points where the system will react to a "Low Flow/Pressure" or a "High Flow/Pressure" alarm.

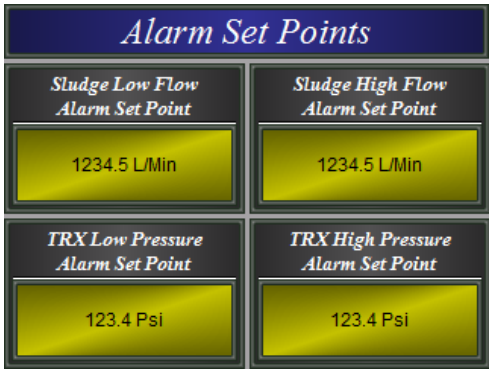


*Figure 10: Alarm Set-Points Screen*

*4.2.4.4* *Alarm Delays*

The "Alarm Delays Screen" (figure 11) shows the delays required before the PLC triggers the appropriate alarms. This is to ensure the alarm has been fully detected and to prevent false alarms. The delay between the start/stop of the components can also be adjusted. This is just to give some time to the system to react and to prevent the start/stop of all the components at the same time. ***The metering pump motor alarm delay should always be at least 3 seconds more than the metering pump tube failure detection.***

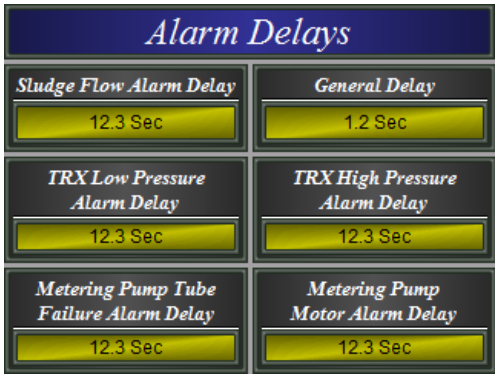


*Figure 11: Alarm Delays Setup Screen*

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*4.2.4.5* *Run Timers*

The "Run Timers Screen" (figure 12) shows the run time of the water valve, metering pump and sludge pump. The time displays are in hours and can be "reset" individually by pressing the appropriate "Reset" button. To prevent unwanted resets, the "Reset" buttons needs to be pressed for a minimum of 1 second in order to reset the timers.

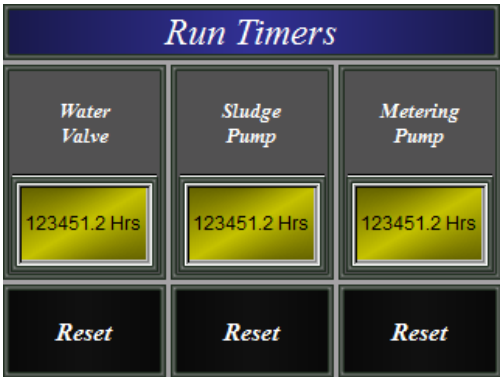


*Figure 12: Run Timers Screen*

*4.2.4.6* *Metering Pump Setup*

By pressing the "Metering Pump Setup" button, the "Metering Pump Setup Screen" (figure 13) will be displayed and will allow the operator to input the calibrated value of the metering pump in millilitre a minute. It is really crucial that the pump is calibrated at 100% speed and then, the value is entered below in order for the PLC to make proper polymer injection based on sludge flow and system set point. To fully ensure the pump capacity is linear, a second calibration at 50% speed needs to be performed. This second value should be very close to half of the first value (at 100%).

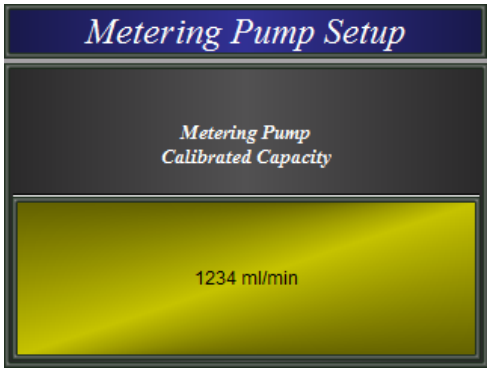


*Figure 13: Metering Pump Setup Screen*

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#### 4.2.4.7 *Usage Totalizers*

By pressing the "Usage Totalizers" button, the "Usage Totalizer Screen" (figure 14) will be displayed and will allow the operator to see the sludge and neat polymer usage. These counters can be reset, but to prevent unwanted resets, the "Reset" buttons needs to be pressed for at least 1 second in order to reset the counters.

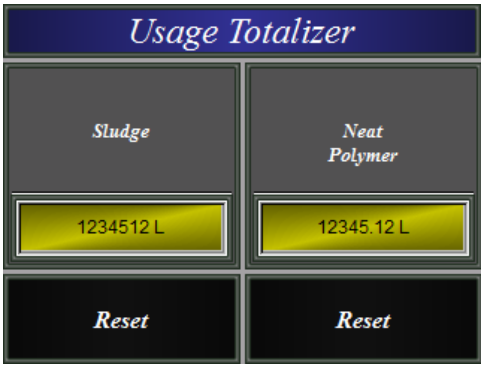


*Figure 14: Usage Totalizers Screen*

### 4.2.5 *ALARMS*

This control system will detect predefined alarms. Each time there is an alarm detected, the PLC will close the "General Alarm" dry contact. All alarms can be cleared by pressing the screen once. If multiple alarms occur at the same time, the alarms can be acknowledged by pressing the "Acknowledge All Alarms" button on the "Main Menu Screen" (figure 2).

#### 4.2.5.1 *High Water Pressure Alarm*

When the water pressure reaches the predefined "System High Pressure Alarm Set point", the control system will stop all equipment, close the "General Alarm" contact and display the "High Water Pressure Alarm Screen" (figure 15) in a flashing red color. If the alarm persists, the operator should investigate the issue and make corrections. This alarm would occur if someone closed the 1/2" isolation valve on the discharge of the polymer system or if there is a blockage in the discharge line/sludge line.

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*Figure 15: High Water Pressure Alarm Screen*

*4.2.5.2* *Low Water Pressure Alarm*

When the water pressure reaches the predefined "Low Water Pressure Alarm Set point", the control system will stop all equipment, close the "General Alarm" contact and display the "Low Water Pressure Alarm Screen" (figure 16) in a flashing red color. This alarm would occur if there is an issue with the water supply or if there is a leakage in the system inlet piping.

*Figure 16: Low Water Flow Alarm Screen*

*4.2.5.3* *High Sludge Flow Alarm*

When the sludge flow rate reaches the predefined "High Sludge Flow Alarm Set point", the control system will stop all equipment, close the "General Alarm" contact and display the "High Sludge Flow Alarm Screen" (figure 17) in a flashing red color.

*Figure 17: High Sludge Flow Alarm Screen*

*4.2.5.4* *Low Sludge Flow Alarm*

When the sludge flow rate reaches the predefined "Low Sludge Flow Alarm Set point", the control system will stop all equipment, close the "General Alarm" contact and display the "Low Sludge Flow Alarm Screen" (figure 18) in a flashing red color. This alarm could be related to a sludge pump issue/failure, to a broken sludge line or sludge blockage within the sludge line.

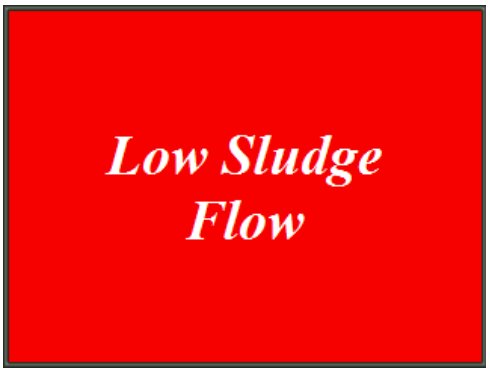


*Figure 18: Low Sludge Flow Alarm Screen*

*4.2.5.5* *Flow Meter Failure/Open Circuit Alarm*

If the flow meter fails to send a signal to the PLC or the cable gets unplugged/cut, the control system will stop all equipment, close the "General Alarm" contact and display the "Flow Meter Failure/Open Circuit Alarm Screen" (figure 19) in a flashing red color. If the alarm persists, the operator should check if the wiring is intact and inspect the flow meter. If the flow meter detects an internal failure, the E+H flow meter remote display will send a 20mA value to the control panel. This situation would trigger this

alarm as well. If this happens, the operator should check the E+H remote display for any fault message.

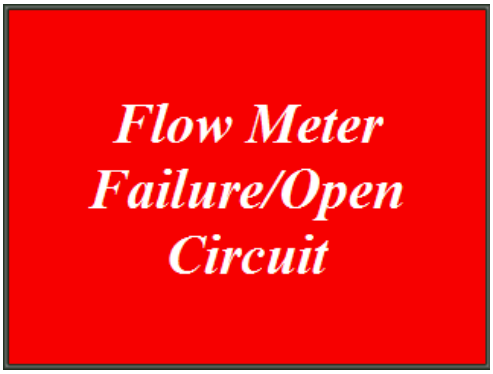


*Figure 19: Flow Meter Failure/Open Circuit Alarm Screen*

*4.2.5.6* *Metering Pump Capacity Exceeded Alarm*

This PLC makes constant calculations to determine the appropriate neat polymer amount to inject based on multiple variables, including the metering pump maximum capacity. In the case where the amount of neat polymer to be injected is higher than the pump capacity, the control system will stop all equipment, close the "General Alarm" contact and display the "Metering Pump Capacity Exceeded Alarm Screen" (figure 20) in a flashing red color. The operator needs to either lower the sludge flow or lower the system set point.

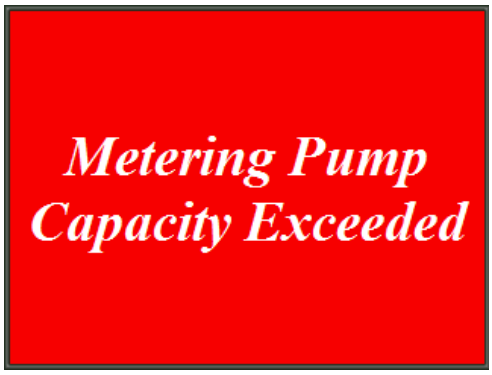


*Figure 20: Metering Pump Capacity Exceeded Alarm Screen*

*4.2.5.7* *Metering Pump Motor Failure/Stopped Alarm*

The metering pump is equipped with a contact confirming if the motor is running or not. If the PLC does not receive this signal when the pump is suppose to run, the control

system will stop all equipment, close the "General Alarm" contact and display the "Metering Pump Motor Failure/Stopped Alarm Screen" (figure 21) in a flashing red color. In order to accept signal from the PLC, the metering pump needs to be in "Standby" mode. Failure to put the pump in standby will make the PLC display this alarm. **Refer to section 5 on how to ensure the pump is properly setup.** If the pump is correctly setup and the alarm occurs, the operator should check if the pump runs by manually changing the setting on the pump itself.

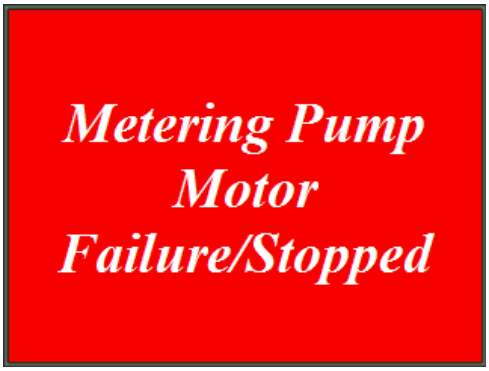


*Figure 21: Metering Pump Motor Failure/Stopped Alarm Screen*

#### *4.2.5.8 Metering Pump Tube Failure*

The metering pump is equipped with a feature that detects if the tube is ruptured. In the event of a tube failure, the control system will stop all equipment, close the "General Alarm" contact and display the "Metering Pump Tube Failure Alarm Screen" (figure 22) in a flashing red color. In case of tube failure alarm, the operator should inspect the pump tube to detect any rupture and change the tube.

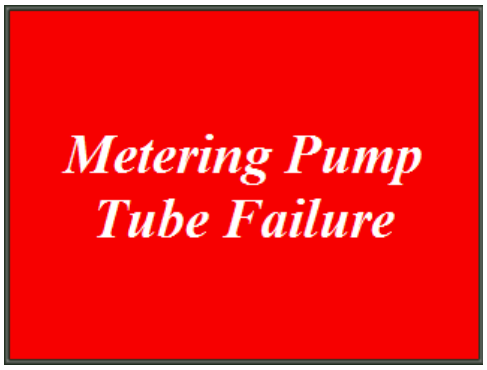


*Figure 22: Metering Pump Tube Failure Alarm Screen*

*4.2.5.9* *Neat Polymer Chemical Drum Empty Alarm*

This control panel has been equipped with a relay detecting the signal coming from the SCADA system or from a level switch in the event of an empty polymer drum. Upon reception of this signal, the control system will stop all equipment, close the "General Alarm" contact and display the "Neat Polymer Chemical Drum Empty Alarm Screen" (figure 23) in a flashing red color.

*Figure 23: Neat Polymer Chemical Drum Empty Alarm Screen*

*4.2.5.10* *Water Valve Close And Water Pump In Manual Alarm*

Under manual operation of the water booster pump, the system will monitor if the water valve opens once the water booster pump starts. If the operator hasn't open the valve after a certain delay, the control system will stop all equipment, close the "General Alarm" contact and display the "Water Valve Close And Water Pump In Manual Alarm Screen" (figure 24) in a flashing red color.

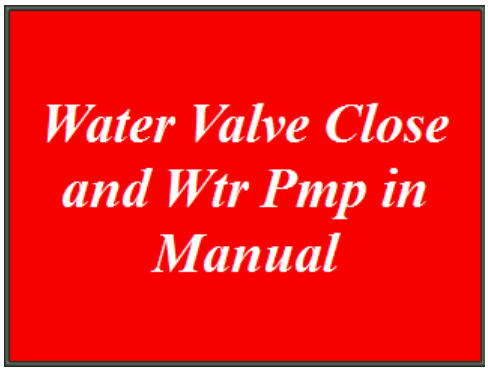


*Figure 24: Water Valve Close & Waster Pump On Alarm Screen*

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*4.2.5.11* *Water Pump Motor Protector O/L Trip/OFF Failure*

The water pump motor starter has a motor circuit protector, which detects any overload on the motor. In the event of an overload or the circuit protector being in the OFF position, the control system will stop all equipment, close the “General Alarm” contact and display the “Water Pump Motor Protector O/L Trip/OFF Alarm Screen” (figure 25) in a flashing red color. The motor circuit controller, inside the control panel, should be inspected for proper operation.

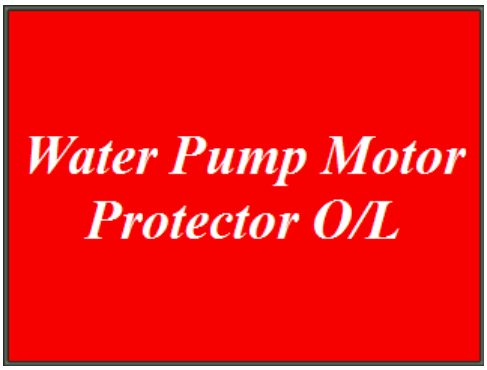


*Figure 25: Water Pump Motor O/L Protector Alarm Screen*

*4.2.5.12* *Water Pump Motor Contactor Failure*

An auxiliary contact is used on the water pump motor contactor to confirm it's activated. In the case where the motor contactor is asked to start, but the PLC doesn't receive the signal, the control system will stop all equipment, close the “General Alarm” contact and display the “Water Pump Motor Contactor Failure Alarm Screen” (figure 26) in a flashing red color. The motor contactor, inside the control panel, should be inspected for proper operation.

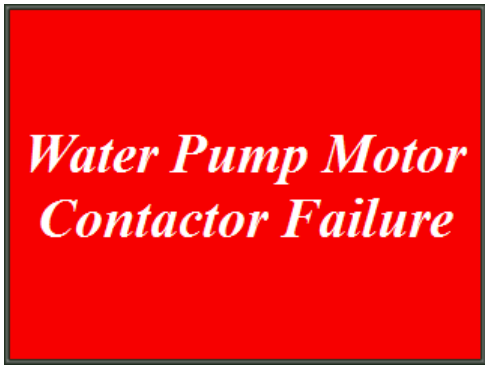


*Figure 26: Water Pump Contactor Failure Alarm Screen*

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*4.2.5.13* *Pressure TRX Failure/Open Circuit Alarm*

If the pressure transmitter fails to send a signal to the PLC or the cable gets unplugged/cut, the control system will stop all equipment, close the "General Alarm" contact and display the "Pressure TRX Failure/Open Circuit Alarm Screen" (figure 27) in a flashing red color. If the alarm persists, the operator should check if the wiring is intact and inspect the pressure transmitter.

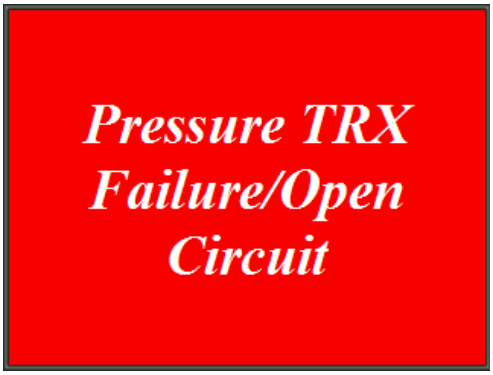


*Figure 27: Pressure TRX Failure/Open Circuit Alarm Screen*

*4.2.5.14* *Sludge Pump VFD Fault Alarm*

If there is a fault with the VFD, the VFD will send a signal which will display the "Sludge Pump VFD Fault" (figure 28) in flashing red color. The VFD should be verified to determine the cause of the fault.

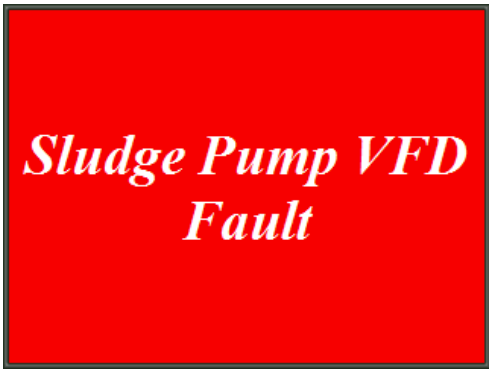


*Figure 28: Sludge Pump VFD Fault Alarm Screen*

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*4.2.5.15* *Geo Bag Full Alarm*

When the geo bag is full, the sensor will send a signal which will cause the "Geo Bag Full" (figure 29) alarm to be displayed. This will cause a system reset and the operator will have to re-start the automatic operation after replacing the geo bag. If the alarm is activated when the bag in not full, the geo bag level sensor should be verified.

*Figure 29: Geo Bag Full Alarm Screen*

## 5 METERING PUMP SETUP

To change the operating mode of the pump:

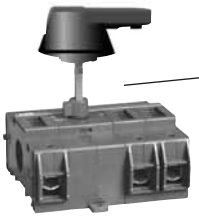
- Press the SELECT RUN MODE button repeatedly until mode 2 (4-20 mA Input) is displayed.

To enable/disable (Standby/Stop) the pump:

- If "OFF" is displayed on the screen, press the START button to show "STDY" on the screen.
- If "STDY" is displayed on the screen, press the STOP button to show "OFF" on the screen.

# Complete switches
## Non-fusible disconnect switches
## 16A – 2000A, 600V, 3 pole①

Each kit includes:
- 1 three pole① switch
- 1 handle
- 1 shaft



Kit

### Complete switches, base & DIN rail mounted, selector handles

| CSA general purpose amp rating | CSA standard C22.2 No. | Maximum horsepower rating | | | | | | Complete switches catalog number | List price |
|---|---|---|---|---|---|---|---|---|---|
| | | Single phase | | Three phase | | | | | |
| | | 120V | 240V | 200V – 208V | 240V | 480V | 600V | | |
| 16 | 14 | 1 | 2 | 3 | 5 | 10 | 10 | OT16F3S | |
| 25 | 14 | 1.5 | 3 | 7.5 | 7.5 | 15 | 20 | OT25F3S | |
| 40 | 14 | 2 | 5 | 10 | 10 | 20 | 25 | OT40F3S | |
| 60 | 14 | 2 | 7.5 | 15 | 15 | 30 | 30 | OT63F3S | |
| 80 | 14 | 2 | 10 | 20 | 20 | 40 | 40 | OT80F3S | |
| 30 | 4 | 2 | 5 | 10 | 10 | 20 | 30 | OT30F3S | |
| 60 | 4 | 3 | 7.5 | 20 | 20 | 40 | 40 | OT60F3S | |
| 100 | 4 | 5 | 15 | 25 | 30 | 50 | 50 | OT100F3S | |

### Complete switches, base & DIN rail mounted, pistol handles③

| CSA general purpose amp rating | CSA standard C22.2 No. | Maximum horsepower rating | | | | | | Complete switches catalog number | List price |
|---|---|---|---|---|---|---|---|---|---|
| | | Single phase | | Three phase | | | | | |
| | | 120V | 240V | 200V – 208V | 240V | 480V | 600V | | |
| 16 | 14 | 1 | 2 | 3 | 5 | 10 | 10 | OT16F3P | |
| 25 | 14 | 1.5 | 3 | 7.5 | 7.5 | 15 | 20 | OT25F3P | |
| 40 | 14 | 2 | 5 | 10 | 10 | 20 | 25 | OT40F3P | |
| 60 | 14 | 2 | 7.5 | 15 | 15 | 30 | 30 | OT63F3P | |
| 80 | 14 | 2 | 10 | 20 | 20 | 40 | 40 | OT80F3P | |
| 30 | 4 | 2 | 5 | 10 | 10 | 20 | 30 | OT30F3P | |
| 60 | 4 | 3 | 7.5 | 20 | 20 | 40 | 40 | OT60F3P | |
| 100 | 4 | 5 | 15 | 25 | 30 | 50 | 50 | OT100F3P | |
| 125 | 4 | 7.5 | 20 | 30 | 40 | 75 | 100 | OT160E3P | |
| 200 | 4 | — | 40 | 60 | 75 | 150 | 200 | OT200U03P③ | |
| 400 | 4 | — | — | 100 | 125 | 250 | 350 | OT400U03P③ | |
| 600 | 4 | — | — | 150 | 200 | 400 | 500 | OT600U03P③ | |
| 800 | 4 | — | — | 200 | 250 | 500 | 500 | OT800U03P③ | |
| 1200 | 4 | — | — | — | — | — | — | OT1200U03P③ | |
| 1600 | 4 | — | — | — | — | — | — | OETL-NF1600P③ | |
| 2000 | 4 | — | — | — | — | — | — | OETL-NF2000P③④ | |

### Complete switches, door mounted

| CSA general purpose amp rating | CSA standard C22.2 No. | Maximum horsepower rating | | | | | | Complete switches catalog number | List price |
|---|---|---|---|---|---|---|---|---|---|
| | | Single phase | | Three phase | | | | | |
| | | 120V | 240V | 200V – 208V | 240V | 480V | 600V | | |
| 16 | 14 | 1 | 2 | 3 | 5 | 10 | 10 | OT16FT3S | |
| 25 | 14 | 1.5 | 3 | 7.5 | 7.5 | 15 | 20 | OT25FT3S | |
| 40 | 14 | 2 | 5 | 10 | 10 | 20 | 25 | OT40FT3S | |
| 60 | 14 | 2 | 7.5 | 15 | 15 | 30 | 30 | OT63FT3S | |
| 80 | 14 | 2 | 10 | 20 | 20 | 40 | 40 | OT80FT3S | |
| 30 | 4 | 2 | 5 | 10 | 10 | 20 | 30 | OT30FT3S | |
| 60 | 4 | 3 | 7.5 | 20 | 20 | 40 | 40 | OT60FT3S | |
| 100 | 4 | 5 | 15 | 25 | 30 | 50 | 50 | OT100FT3S | |
| 30 | 4 | 2 | 5 | 10 | 10 | 20 | 30 | OT30FT3P | |
| 60 | 4 | 3 | 7.5 | 20 | 20 | 40 | 40 | OT60FT3P | |
| 100 | 4 | 5 | 15 | 25 | 30 | 50 | 50 | OT100FT3P | |
| 125 | 4 | 7.5 | 20 | 30 | 40 | 75 | 100 | OT160ET3 | |

①Four poles are available — please refer to accessories page.
②Shaft is not required with door mounted switch, except OT160ET3.
③Terminal lug kit are sold separately, see accessories page 1.21.
④Maximum operating voltage 480V.

*General information : 1.1 – 1.7* *Complete Non-fusible switches: 1.8 – 1.9* *Components: 1.10 – 1.26* *Technical information: 1.28– 1.35* *Dimensions: 1.36 – 1.53*

# Bulletin 1489 Circuit Breakers

Selection Guide

Allen-Bradley

LISTEN. THINK. SOLVE.®

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Rockwell Automation

## Bulletin 1489-A Circuit Breakers

- Energy-limiting design — protects downstream components better than conventional breakers during short circuits
- Field-mountable options for selective applications
- IP2x Finger-Protection (Front)
- North America certifications: UL 489, CSA C22.2 No. 5
- International standards: CE Marked, and IEC (VDE) standards for worldwide acceptance
- Ratings: UL/CSA — max. 480Y/277V AC – up to 14 kA interrupt rating;
  IEC — max. 240/415V AC – 15 000 A interrupt rating
- 48V DC rating, 96V DC — 2-pole series
- A positively trip-free mechanism (breaker operation cannot be defeated by holding the handle in the ON position)
- Trip curves: C and D
- Time delay (D Characteristic) for high inrush currents during inductive start-ups such as motors, transformers and power supplies
- Superior shock and vibration resistance capabilities — helps to prevent nuisance tripping
- Mounts on DIN Rail
- Wire connect, line and load (reversible)
- Optional terminals for ring lug terminals

## Table of Contents

Specifications..... 13
Description..... 3
Product Selection..... 9
Approximate Dimensions..... 14

## Standards Compliance

UL 489
CSA C22.2 No. 5
EN/IEC 60947-2

## Certifications

UL Listed
CSA Certified
CE Marked
VDE Certified

## Industrial Circuit Breakers for North American Applications

The Bulletin 1489-A line includes:

- UL 489, CSA C22.2 No. 5
- 240V AC 0.5...40 A
- 480V/277V AC 0.5...32 A
- Miniature Circuit Breaker for EN/IEC Applications EN/IEC 60947-2
  415V AC 0.5...40 A
- SWD (0.5...20 A) Switching Duty for fluorescent lighting applications
- HACR
- 1-pole 48V DC 0.5…40 A
- 2-pole (series) 96V DC 0.5…40 A
- 48V DC 0.5…40 A

## Description

Bulletin 1489-A Circuit Breakers for Branch Circuit protection are available in 1-, 2-, and 3-pole construction and are rated 0.5...40 A at 240V AC and 0.5...32 A at 480Y/277V AC for North American applications (UL 489 and CSA C22.2 No. 5). The circuit breakers also have a 1-pole 48V DC, 2-pole (series) 96V DC rating. For EN\IEC applications the products are rated 415V AC, 48V AC 0.5...40 A.

## Thermal Magnetic Circuit Breakers

The Bulletin 1489-A Thermal Magnetic Circuit Breakers are general-purpose devices suitable for the majority of industrial, inverse time circuit breaker applications.

They combine thermal and magnetic trip actions and provide accurate overload and short-circuit protection for conductors and connected equipment.

### Circuit Breaker Application Information

Selection of a Bulletin 1489 circuit breaker with appropriate circuit protection includes consideration of:

- Circuit Voltage
- Circuit Frequency
- Available Short Circuit Current
- Continuous Current Rating
- Application Considerations
- Special Operating Conditions

The following discussion is based upon National Electric Code and UL requirements. Similar considerations are appropriate for Canadian applications.

## Features

- Designed manufactured and listed to UL 489 (CSA 22.2 No. 5)
- Thermal-magnetic protection
- All ratings are HACR rated
- up to 14 kA Interrupting rating
- Finger–safe design (front)
- DIN Rail mounting
- Line and load wire connections
- Optional ring terminal connections (convertible)

### Circuit Voltage

The Bulletin 1489-A circuit breakers are rated by voltage class. Applications should not exceed the listed voltage and current range (see Table 1).

### Circuit Frequency

The Bulletin 1489-A circuit breakers may be applied to frequencies of 50 Hz and 60 Hz without derating. For applications above 60 Hz, contact Rockwell Automation with specific application information for the derating of the circuit breakers.

### Available Short Circuit Current

The Bulletin 1489-A circuit breakers should only be applied in those applications in which the available short-circuit (or fault) current is less than or equal to 10 kA...14 kA (US/Canada) and 15 kA (IEC).

## Table 1. Voltage and Current Ranges

| Region | Max. Voltage | Current Range [A] |
|---|---|---|
| EN/IEC Regions | 415V AC | 0.5...40 |
| | 48V DC | 0.5...40 |
| North America (UL 489 & CSA C22.2 No. 5) | 240V AC | 0.5...40 |
| | 480Y/277V AC | 0.5...32 |
| | 1-pole 48V DC | 0.5...40 |
| | 2-pole 96V DC | 0.5...40 |

## Continuous Current Rating

Standard current ratings are: 0.5, 1, 1.5, 2, 3, 4, 5, 6, 7, 8, 10, 15, 16, 20, 25, 30, 32, 35, and 40 A.

The Bulletin 1489-A circuit breakers are rated in RMS amperes at a 40 °C (104 °F) ambient temperature per the UL 489 (CSA 22.2 No. 5) standard. This temperature is generally used as the average temperature within an industrial enclosure. If a circuit breaker is applied in a temperature that exceeds the 40 °C (104 °F) ambient, then the circuit breaker should be derated. For IEC 60 947-2 standard, the products carry an ambient rating of 30 °C. Follow standard IEC application considerations for temperature rating in different ambient temperatures.

The characteristic trip curves are shown on page 7. The trip bands shown for each breaker represent current tripping limits for a circuit breaker and are within the limits established by UL. For a specific current at 40 °C (104 °F), a circuit breaker will open ("clear the circuit") automatically at some total time that will be within the "Minimum" and "Maximum" time shown on the curves. For example, page 7 shows that a one-pole, 15 A, Bulletin 1489-A circuit breaker trips in not less than 10 s and not more than 120 s on a 30 A current. Because the UL standard defines this time spread, users should not specify exact tripping time. The lower current portion of the curves (upper left) depict the time to trip due to thermal action and reflect overload protection of the wire and connect load. The higher current portion of the curves (lower right) depicts the trip due to magnetic action of the circuit breaker and reflects protection due to short circuit level currents.

## Application Considerations

*The following is a discussion of application considerations related to North American applications. When applying product to IEC regional requirements, follow IEC practices and guidelines.*

The selection of a specific ampere rating for a specific application is dependent on the type of load and duty cycle and is governed by the National Electric Code (Canadian Electric Code) and UL/CSA. In general, the codes require that overcurrent protection is at the current supply and at points where wire sizes are reduced. In addition, the codes state that conductors be protected according to their current carrying capacity. There are specific situations that require application consideration, such as motor circuit, and guidelines for the selection for transformer protection.

The Bulletin 1489-A circuit breakers are “non 100 percent rated” as defined by UL 489, para 7.1.4.2. As such, the circuit breaker's rating should be loaded to no more than 80% if used with continuous loads.

Line and load may be reversed. The Bulletin 1489 circuit breaker may be bottom fed.

**Branch Circuits:**

Bulletin 1489-A circuit breakers may be used to protect branch circuits. A branch circuit is the wiring portion of a system extending beyond the final overcurrent device protecting the circuit.

Guidelines established in NEC, CEC, UL, and CSA should be used to determine the specific device. For example:

1) Motor Branch Circuit

Bulletin 1489-A circuit breakers are not horsepower rated because they are able to safely interrupt currents far in excess of the locked rotor value for a selected motor. This ability is recognized in the codes and standards and is also established by the UL and CSA tests described in UL 489 and CSA C22.2 No. 5 standards.

The size of a Bulletin 1489 circuit breaker should be determined following the guidelines for an Inverse Time Circuit Breaker.

References: NEC 430.51 and UL 489. Also see CEC and appropriate Canadian Standards.

2) Transformer Protection

Bulletin 1489-A circuit breakers may be used for transformer protection following the guidelines established.

References: NEC 450 and UL 489. Also see CEC and appropriate Canadian Standards.

3) Heater Load, Lighting, and Other Load Protection

Bulletin 1489-A circuit breakers may be used for protection of heater loads, lighting loads, and other loads following the guidelines established.

References: NEC Article 31 and UL 508A. Also see CEC and appropriate Canadian Standards.

**Coordinated Overcurrent Protection**

Where an orderly shutdown is required to minimize the hazards to personnel and equipment, a system of coordination based upon the faulted or overloaded circuit is isolated by selective operation of only the overcurrent protective device closest to the overcurrent condition. The user should select devices that meet this requirement.

References: NEC 240.12. Also see CEC.

**HACR Rating**

Bulletin 1489-A Circuit Breakers are rated as Heating, Air Conditioning and Refrigeration circuit breakers as defined by UL 489, paragraph 6.7 and may used in this type of application.

**SWD Rating**

The Bulletin 1489 breakers (0.5 … 20 A) are rated as SWD and as such may be applied to switch fluorescent lighting loads up to their current and voltage maximum.

**Current Limiting**

Bulletin 1489-A Circuit Breakers are rated as current limiting circuit breakers as defined by UL 489, paragraph 8.6.

The Bulletin 1489-A line features the ability to achieve short circuit interruptions far more effectively than conventional breakers. In conventional circuit breakers, the short circuit interruption time required is approximately one or two half cycles of an AC sine wave. When the contacts open, the resulting arc continues to burn until the current level passes through zero. The arc may re-ignite because of the insufficient width of the contact gap. The current that flows until the arc is extinguished produces a heating effect proportional to the $I^2t$ value (let-through-energy) of the fault current.

The Bulletin 1489-A device is designed to substantially reduce the amount of let-through-current and the resulting let-through-energy that can damage protected components. The Bulletin 1489 has the ability to interrupt short circuit current within the first half cycle of the fault. Limiting let-through current and energy will protect against the harmful effects of overcurrent and is focused primarily on avoiding the following:

- Excessive Heat
- Mechanical Damage

Both of these factors are proportional to the square of the current. Thermal energy is proportional to the square of the RMS value and magnetic forces are proportional to the square of the peak value. The most effective way to provide protection is to substantially limit let-through-energy. This provides the following advantages

- Far less damage at the location of the short circuit.
- Fast electric separation of a faulty unit from the system, especially power supplies connected in parallel that are switched off when the voltage of the power bus drops below a certain level.
- Far less wear on the miniature circuit breaker itself. This means more safe interruptions.
- Better protection of all components in the short circuit path.
- Far wider range of selective action when used with an upstream protective device. (No nuisance shut downs from feeder line interruptions, causing a blackout in all connected branches.)

The following values are applicable to the whole product range with frequency of 50/60 Hz.

The values were derived from worst case V AC testing of:

D trip 40 A, 240V AC @ 10 kA

D trip 32 A, 480Y/277V AC @ 10 kA

D trip 20 A, 480Y/277V AC @ 14 kA

Current-Limiting at 240V / 10 kA1p, 2p, 3p $I^2t$ = 43 $kA^2s$ and Ipeak = 6.2 kA

Current-Limiting at 480Y/277V / 10 kA 1p, 2p, 3p $I^2t$ = 60 $kA^2s$ and Ipeak = 6.2 kA

Current-Limiting at 480Y/277V / 14 kA 1p, 2p, 3p $I^2t$ = 65 $kA^2s$ and Ipeak = 7.5 kA

## Bulletin 1489-A Ambient Temperature Derating

The standard tripping characteristic for Bulletin 1489-A is Type C. Type C has a magnetic trip activated at 5…10 times the rated current of the circuit breaker. The reference temperature for the thermal tripping characteristics is 40 °C. The Type C characteristic will suit most applications.

In rare occurrences when the Type C characteristic does not fully meet the application, the following additional magnetic trip characteristic is available:

Type D allows for transients approximately twice as high as the standard Type C.

Use the following table and graph to determine the current rating for the breaker if the ambient is significantly different than 40 °C.

### Bulletin 1489-A Ambient Temperature Derating Calibration Temperature 40º C (UL) Application below 0º C is for non-condensing atmosphere❄

| Device Marked Current Rating [A] @ 40 °C | Ambient Temperature (°C) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -25 | -20 | -10 | 0 | 10 | 20 | 30 | 35 | **40** | 45 | 50 | 55 |
| 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.5 | 0.5 | 0.5 | **0.50** | 0.5 | 0.5 | 0.5 |
| 1.0 | 1.3 | 1.2 | 1.2 | 1.2 | 1.1 | 1.1 | 1.0 | 1.0 | **1.0** | 1.0 | 1.0 | 0.9 |
| 1.5 | 1.9 | 1.9 | 1.8 | 1.7 | 1.7 | 1.6 | 1.6 | 1.5 | **1.5** | 1.5 | 1.4 | 1.4 |
| 2.0 | 2.5 | 2.5 | 2.4 | 2.3 | 2.2 | 2.2 | 2.1 | 2.0 | **2.0** | 2.0 | 1.9 | 1.9 |
| 3.0 | 3.8 | 3.7 | 3.6 | 3.5 | 3.4 | 3.2 | 3.1 | 3.1 | **3.0** | 2.9 | 2.9 | 2.8 |
| 4.0 | 5.0 | 5.0 | 4.8 | 4.6 | 4.5 | 4.3 | 4.2 | 4.1 | **4.0** | 3.9 | 3.8 | 3.8 |
| 5.0 | 6.3 | 6.2 | 6.0 | 5.8 | 5.6 | 5.4 | 5.2 | 5.1 | **5.0** | 4.9 | 4.8 | 4.7 |
| 6.0 | 7.5 | 7.4 | 7.2 | 7.0 | 6.7 | 6.5 | 6.2 | 6.1 | **6.0** | 5.9 | 5.8 | 5.6 |
| 7.0 | 8.8 | 8.7 | 8.4 | 8.1 | 7.8 | 7.6 | 7.3 | 7.1 | **7.0** | 6.9 | 6.7 | 6.6 |
| 8.0 | 10.0 | 9.9 | 9.6 | 9.3 | 9.0 | 8.6 | 8.3 | 8.2 | **8.0** | 7.8 | 7.7 | 7.5 |
| 10.0 | 12.6 | 12.4 | 12.0 | 11.6 | 11.2 | 10.8 | 10.4 | 10.2 | **10** | 9.8 | 9.6 | 9.4 |
| 13.0 | 16.3 | 16.1 | 15.6 | 15.1 | 14.6 | 14.0 | 13.5 | 13.3 | **13** | 12.7 | 12.5 | 12.2 |
| 15.0 | 18.8 | 18.6 | 18.0 | 17.4 | 16.8 | 16.2 | 15.6 | 15.3 | **15** | 14.7 | 14.4 | 14.1 |
| 16.0 | 20.1 | 19.8 | 19.2 | 18.6 | 17.9 | 17.3 | 16.6 | 16.3 | **16** | 15.7 | 15.4 | 15.0 |
| 20.0 | 25.1 | 24.8 | 24.0 | 23.2 | 22.4 | 21.6 | 20.8 | 20.4 | **20** | 19.6 | 19.2 | 18.8 |
| 25.0 | 31.4 | 31.0 | 30.0 | 29.0 | 28.0 | 27.0 | 26.0 | 25.5 | **25** | 24.5 | 24.0 | 23.5 |
| 30.0 | 37.7 | 37.2 | 36.0 | 34.8 | 33.6 | 32.4 | 31.2 | 30.6 | **30** | 29.4 | 28.8 | 28.2 |
| 32.0 | 40.2 | 39.7 | 38.4 | 37.1 | 35.8 | 34.6 | 33.3 | 32.6 | **32** | 31.4 | 30.7 | 30.1 |
| 40.0 | 43.9 | 43.4 | 42.0 | 40.6 | 39.2 | 37.8 | 36.4 | 35.7 | **35** | 34.3 | 33.6 | 32.9 |

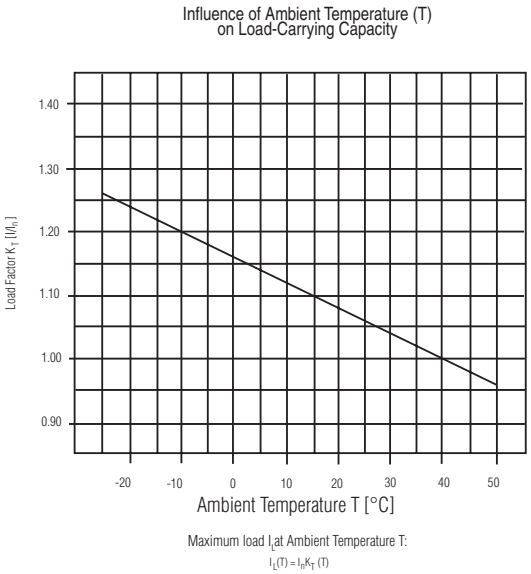
❄ Care should be taken for application below 0 °C. These devcies are not certified to operate correctly in the presence of ice.

All other specifications for standard Bulletin 1489-A products remain unchanged.

The ambient temperature derating applies to applications of the device as an IEC Miniature Circuit Breaker (MCB), following 60 947-2 and as Circuit Breaker to UL489/CSA 22.2 No 5..

Ambient temperature refers to the free air temperature in contact with the 1489 device

**Ambient Temperature Graph**




***The 1489-A circuit breaker can function over a wide temperature range (-30°...+60 °C). Operation in ambient temperatures below 0 °C is based on a non condensing atmosphere (no ice). Use the graph above or contact your local Rockwell Automation sales office or Allen-Bradley distributor to determine the correction factor based upon ambient***

**Terminals**

Standard wire (cable) connection

The standard configuration of the Bulletin 1489-A is with terminals suitable for connection of stranded copper wire of the wire size #18 … 8 AWG (1.0 … 10 $mm^2$). Strip length for the termination is 0.5 in. (12 mm). Terminals are shipped in the open position for ease of installation.

**Optional Ring Termination**

For the Bulletin 1489-A circuit breakers, an optional terminal configuration (suffix R) is available for use with a ring terminal. This configuration is shipped so that the terminal screw may be unscrewed and withdrawn for the insertion of the ring terminal at proper connection point. The screw is then retightened to provide proper wire termination.

This unique terminal may be field converted to open the wire termination to allow standard wire termination of the converted terminal.

**Bus Bars**

For the Bulletin 1489-A circuit breakers, UL Recognized bus bars and UL Listed feeder terminals are available for group connection of circuit breakers. They are available in 1-, 2-, and 3- pole configurations for connection of multiple circuit breakers.

**Lock-out Attachment**

A sturdy lock-out attachment may be added to a circuit breaker. This lock-out may be padlocked so that the circuit breaker is locked in the off position.

**Shunt Trip**

A shunt trip may be added to a circuit breaker to allow the device to be tripped from a remote source. One version is for tripping voltages of 12…110V AC (12…60V DC) and another for tripping voltages of 110…415V AC (110…230V DC).

**Auxiliary Contacts**

An auxiliary contact module may be added to a circuit breaker to provide pilot duty contacts to indicate the position of circuit breaker, off or on. This contact changes state when the circuit breaker is operated either manually or electrically.

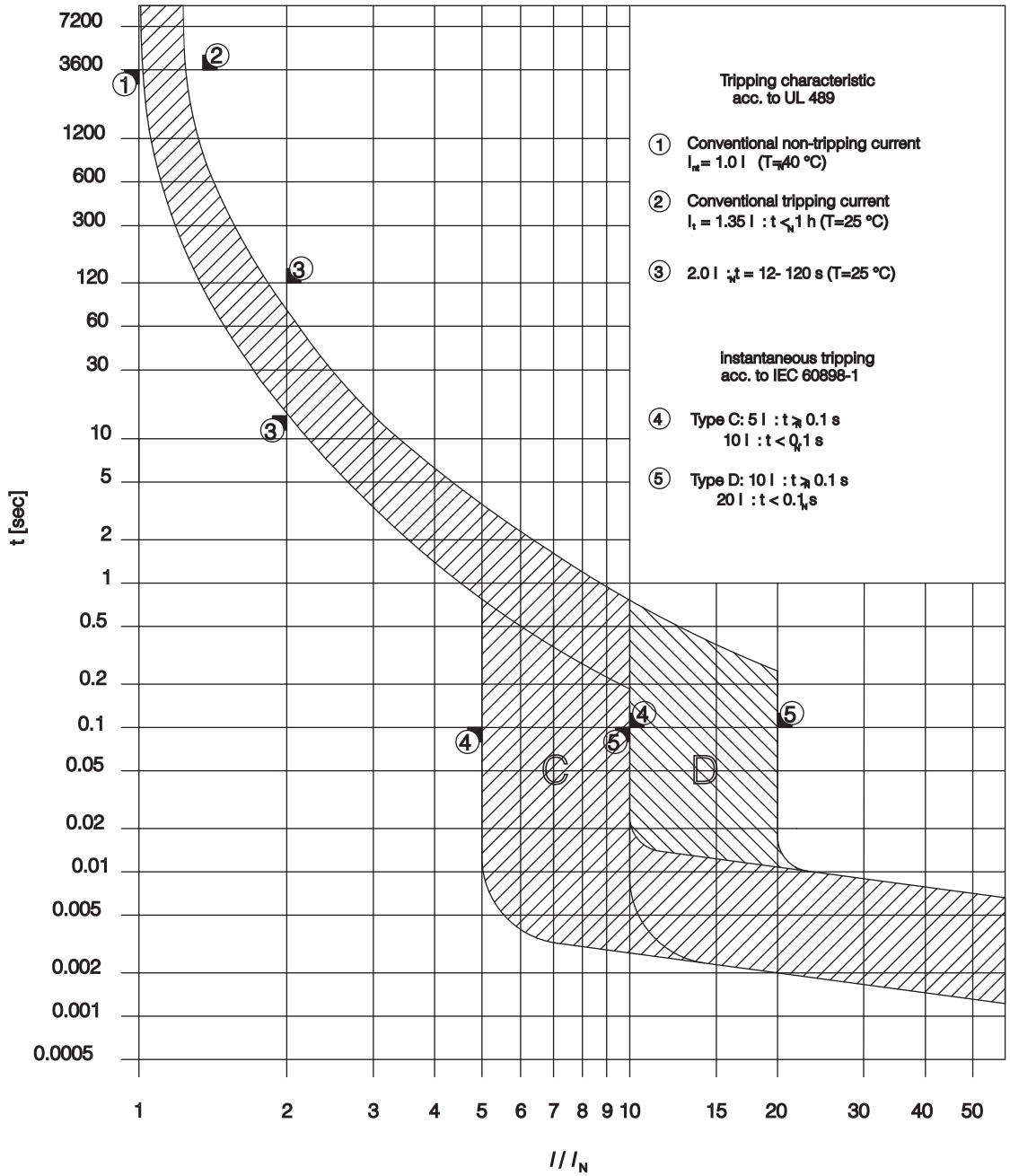
**Signal Contacts**

A signal/auxiliary contact module may be added to a circuit breaker to provide auxiliary contact information off and on and signal contact pilot duty contacts. With signal contacts, the contacts change state only when the circuit breaker changes state from On to Off because of an electrical operation. The module contains one signal contact, form C contact (N.O. and N.C contact with common) and one auxiliary contact (N.O. and N.C contact with common).

# Time-Current Characteristic Bulletin 1489

## Type C and D

## Ambient Temperature 40 °C



## Bulletin 1489 Cat. No. Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid catalog number.

| 1489 - | A | 1 | C | 005 | R |
|---|---|---|---|---|---|
| | *a* | *b* | *c* | *d* | *e* |

### *a*

| Body Style | |
|---|---|
| Code | Description |
| A | Standard configuration, AC Device |
| D | Standard configuration, DC Device |

### *b*

| Poles | |
|---|---|
| Code | Description |
| 1 | 1-Pole |
| 2 | 2-Pole |
| 3 | 3-Pole |

### *c*

| Trip Curve | |
|---|---|
| Code | Trip Curve |
| B | Trip Curve B |
| C | Trip Curve C |
| D | Trip Curve D |

### *d*

| Rated Current ($I_n$) | |
|---|---|
| Code | Current [A] |
| 005 | 0.5 |
| 010 | 1 |
| 015 | 1.5 |
| 020 | 2 |
| 030 | 3 |
| 040 | 4 |
| 050 | 5 |
| 060 | 6 |
| 070 | 7 |
| 080 | 8 |
| 100 | 10 |
| 130 | 13 |
| 150 | 15 |
| 160 | 16 |
| 200 | 20 |
| 250 | 25 |
| 300 | 30 |
| 320 | 32 |
| 350 | 35 |
| 400 | 40 |

### *e*

| Factory Modifications | |
|---|---|
| Code | Description |
| blank | Standard Terminal |
| R | Ring Terminal |

## Product Selection

### Bulletin 1489-A AC Miniature Circuit Breakers

### Bulletin 1489 1-Pole AC Miniature Circuit Breakers

| No. of Poles | EN/IEC Maximum Voltage | Trip Curve | UL/CSA Max. Volt. | Rated Current [A] | Standard Wire Configuration Cat. No. | Ring Terminal Configuration Cat. No. |
|---|---|---|---|---|---|---|
| 1 | 415V AC, 48V DC | C | 277V AC, 48V DC | 0.5 | **1489-A1C005** | **1489-A1C005R** |
| | | | | 1 | **1489-A1C010** | **1489-A1C010R** |
| | | | | 1.5 | **1489-A1C015** | **1489-A1C015R** |
| | | | | 2 | 1489-A1C020 | **1489-A1C020R** |
| | | | | 3 | **1489-A1C030** | **1489-A1C030R** |
| | | | | 4 | 1489-A1C040 | **1489-A1C040R** |
| | | | | 5 | **1489-A1C050** | **1489-A1C050R** |
| | | | | 6 | 1489-A1C060 | **1489-A1C060R** |
| | | | | 7 | **1489-A1C070** | **1489-A1C070R** |
| | | | | 8 | **1489-A1C080** | **1489-A1C080R** |
| | | | | 10 | 1489-A1C100 | **1489-A1C100R** |
| | | | | 13 | **1489-A1C130** | **1489-A1C130R** |
| | | | | 15 | **1489-A1C150** | **1489-A1C150R** |
| | | | | 16 | 1489-A1C160 | **1489-A1C160R** |
| | | | | 20 | **1489-A1C200** | **1489-A1C200R** |
| | | | | 25 | **1489-A1C250** | **1489-A1C250R** |
| | | | | 30 | **1489-A1C300** | **1489-A1C300R** |
| | | | | 32 | **1489-A1C320** | **1489-A1C320R** |
| | | | 240V AC, 48V DC | 35 | **1489-A1C350** | **1489-A1C350R** |
| | | | | 40 | **1489-A1C400** | **1489-A1C400R** |
| | | D | 277V AC, 48V DC | 0.5 | **1489-A1D005** | **1489-A1D005R** |
| | | | | 1 | **1489-A1D010** | **1489-A1D010R** |
| | | | | 1.5 | **1489-A1D015** | **1489-A1D015R** |
| | | | | 2 | **1489-A1D020** | **1489-A1D020R** |
| | | | | 3 | **1489-A1D030** | **1489-A1D030R** |
| | | | | 4 | **1489-A1D040** | **1489-A1D040R** |
| | | | | 5 | **1489-A1D050** | **1489-A1D050R** |
| | | | | 6 | **1489-A1D060** | **1489-A1D060R** |
| | | | | 7 | **1489-A1D070** | **1489-A1D070R** |
| | | | | 8 | **1489-A1D080** | **1489-A1D080R** |
| | | | | 10 | **1489-A1D100** | **1489-A1D100R** |
| | | | | 13 | **1489-A1D130** | **1489-A1D130R** |
| | | | | 15 | **1489-A1D150** | **1489-A1D150R** |
| | | | | 16 | **1489-A1D160** | **1489-A1D160R** |
| | | | | 20 | **1489-A1D200** | **1489-A1D200R** |
| | | | | 25 | **1489-A1D250** | **1489-A1D250R** |
| | | | | 30 | **1489-A1D300** | **1489-A1D300R** |
| | | | | 32 | **1489-A1D320** | **1489-A1D320R** |
| | | | 240V AC, 48V DC | 35 | **1489-A1D350** | **1489-A1D350R** |
| | | | | 40 | **1489-A1D400** | **1489-A1D400R** |

## Bulletin 1489-A 2-Pole AC Miniature Circuit Breakers

| No. of Poles | EN/IEC Maximum Voltage | Trip Curve | UL/CSA Max. Volt. | Rated Current [A] | Standard Wire Terminal Cat. No. | Ring Terminal Configuration Cat. No. |
|---|---|---|---|---|---|---|
| 2 | 415V AC | C | 480Y/277V AC, 96V DC | 0.5 | **1489-A2C005** | **1489-A2C005** |
| | | | | 1 | **1489-A2C010** | **1489-A2C010R** |
| | | | | 1.5 | **1489-A2C015** | **1489-A2C015R** |
| | | | | 2 | 1489-A2C020 | **1489-A2C020R** |
| | | | | 3 | **1489-A2C030** | **1489-A2C030R** |
| | | | | 4 | 1489-A2C040 | **1489-A2C040R** |
| | | | | 5 | **1489-A2C050** | **1489-A2C050R** |
| | | | | 6 | 1489-A2C060 | **1489-A2C060R** |
| | | | | 7 | **1489-A2C070** | **1489-A2C070R** |
| | | | | 8 | **1489-A2C080** | **1489-A2C080R** |
| | | | | 10 | 1489-A2C100 | **1489-A2C100R** |
| | | | | 13 | **1489-A2C130** | **1489-A2C130R** |
| | | | | 15 | **1489-A2C150** | **1489-A2C150R** |
| | | | | 16 | 1489-A2C160 | **1489-A2C160R** |
| | | | | 20 | **1489-A2C200** | **1489-A2C200R** |
| | | | | 25 | **1489-A2C250** | **1489-A2C250R** |
| | | | | 30 | **1489-A2C300** | **1489-A2C300R** |
| | | | | 32 | **1489-A2C320** | **1489-A2C320R** |
| | | | 240V AC, 96V DC | 35 | **1489-A2C350** | **1489-A2C350R** |
| | | | | 40 | **1489-A2C400** | **1489-A2C400R** |
| | | D | 480Y/277V AC, 96V DC | 0.5 | **1489-A2D005** | **1489-A2D005R** |
| | | | | 1 | **1489-A2D010** | **1489-A2D010R** |
| | | | | 1.5 | **1489-A2D015** | **1489-A2D015R** |
| | | | | 2 | **1489-A2D020** | **1489-A2D020R** |
| | | | | 3 | **1489-A2D030** | **1489-A2D030R** |
| | | | | 4 | **1489-A2D040** | **1489-A2D040R** |
| | | | | 5 | **1489-A2D050** | **1489-A2D050R** |
| | | | | 6 | **1489-A2D060** | **1489-A2D060R** |
| | | | | 7 | **1489-A2D070** | **1489-A2D070R** |
| | | | | 8 | **1489-A2D080** | **1489-A2D080R** |
| | | | | 10 | **1489-A2D100** | **1489-A2D100R** |
| | | | | 13 | **1489-A2D130** | **1489-A2D130R** |
| | | | | 15 | **1489-A2D150** | **1489-A2D150R** |
| | | | | 16 | **1489-A2D160** | **1489-A2D160R** |
| | | | | 20 | **1489-A2D200** | **1489-A2D200R** |
| | | | | 25 | **1489-A2D250** | **1489-A2D250R** |
| | | | | 30 | **1489-A2D300** | **1489-A2D300R** |
| | | | | 32 | **1489-A2D320** | **1489-A2D320R** |
| | | | 240V AC, 96V DC | 35 | **1489-A2D350** | **1489-A2D350R** |
| | | | | 40 | **1489-A2D400** | **1489-A2D400R** |

User Manual

Allen-Bradley

# CompactLogix 5370 Controllers

Catalog Numbers 1769-L16ER-BB1B, 1769-L18ER-BB1B, 1769-L18ERM-BB1B, 1769-L24ER-QB1B, 1769-L24ER-QBFC1B, 1769-L27ERM-QBFC1B, 1769-L30ER, 1769-L30ER-NSE, 1769-L30ERM, 1769-L33ER, 1769-L33ERM, 1769-L36ERM

## Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation® sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

| | |
|---|---|
| | **WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss. |
| | **ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence. |
| | **SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present. |
| | **BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures. |
| **IMPORTANT** | Identifies information that is critical for successful application and understanding of the product. |

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This manual contains new and updated information. Changes throughout this revision are marked by change bars, as shown to the right of this paragraph.

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This manual describes the necessary tasks to install, configure, program, and operate a CompactLogix 5370 controller. This manual is intended for automation engineers and control system developers.

CompactLogix 5370 controllers are designed to provide solution for small and medium-sized applications.

## Studio 5000 Environment

The Studio 5000™ Engineering and Design Environment combines engineering and design elements into a common environment. The first element in the Studio 5000 environment is the Logix Designer application. The Logix Designer application is the rebranding of RSLogix™ 5000 software and will continue to be the product to program Logix5000™ controllers for discrete, process, batch, motion, safety, and drive-based solutions.

The Studio 5000 environment is the foundation for the future of Rockwell Automation engineering design tools and capabilities. It is the one place for design engineers to develop all the elements of their control system.

## Additional Resources

These documents contain additional information that may assist you when using Rockwell Automation products.

| Resource | Description |
|---|---|
| CompactLogix Selection Guide, publication 1769-SG001 | Describes information about products used in a CompactLogix control system to assist you in designing a control solution. |
| CompactLogix Controllers Specifications Technical Data, publication 1769-TD005 | Provides CompactLogix controller specifications. |
| CompactLogix 5370 L1 Controllers Quick Start, publication IASIMP-QS024 | Describes basic tasks to design, install and start a CompactLogix 5370 L1 control system. |
| CompactLogix 5370 L2 Controllers Quick Start, publication IASIMP-QS025 | Describes basic tasks to design, install and start a CompactLogix 5370 L1 control system. |
| CompactLogix 5370 L3 Controllers Quick Start, publication IASIMP-QS023 | Describes basic tasks to design, install and start a CompactLogix 5370 L3 control system. |
| Integrated Architecture and CIP Sync Configuration Application Technique, publication IA-AT003 | Describes CIP Sync technology and how to synchronize clocks in the Rockwell Automation Integrated Architecture™ system. |
| CIP Motion Configuration and Startup User Manual, publication MOTION-UM003 | Describes basic tasks you can use to quickly and easily understand how best to create an Integrated Motion over an EtherNet/IP network control solution. |
| Kinetix 350 Single-axis EtherNet/IP Servo Drive User Manual, publication 2097-UM002 | Describes how to install, use and troubleshoot Kinetix® 350 drives. |
| PowerFlex 755 Drive Embedded EtherNet/IP Adapter User Manual, publication 750COM-UM001 | Describes how to install, use and troubleshoot PowerFlex® 755 drives. |
| Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002 | Describes how to install, use and troubleshoot Kinetix 6500 drives. |
| Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001 | Describes how to create and edit a program, communicate with and configure modules. |
| Ethernet Design Considerations Reference Manual, publication ENET-RM002 | Describes the following concepts that you should consider when designing a control system that includes an EtherNet/IP network:<br>• EtherNet/IP overview<br>• Ethernet infrastructure<br>• EtherNet/IP protocol |
| Logix5000 Controllers Execution Time and Memory Use Reference Manual, publication 1756-RM087 | Details how to estimate the execution time and memory use of the controller's logic. |
| Logix5000 Controllers General Instruction Set Reference Manual, publication 1756-RM003 | Details how to program the controller for sequential applications. |
| Logix5000 Controllers Process Control/Drives Instruction Set Reference Manual, publication 1756-RM006 | Details how to program the controller for process or drives applications. |
| Logix5000 Controllers Motion Instructions Reference Manual, publication MOTION-RM002 | Details how to program the controllers for motion applications. |
| CIP Motion Configuration and Start-up User Manual, publication MOTION-UM003 | Describes how to configure an Integrated Motion over EtherNet/IP motion application and to start up that motion solution in a Logix5000 control system. |
| Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1 | Provides general guidelines for installing a Rockwell Automation industrial system. |
| Product Certifications website, http://www.ab.com | Provides declarations of conformity, certificates, and other certification details. |

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

# Install the CompactLogix 5370 L1 Controller


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| Install the Secure Digital Card | 20 |
| Install the System | 22 |
| Connect to the Controller via a USB Cable | 31 |
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**ATTENTION: Environment and Enclosure**

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR 11. Without appropriate precautions, there may be difficulties with electromagnetic compatibility in residential and other environments due to conducted and radiated disturbances.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA, V2, V1, V0 (or equivalent) if nonmetallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see the following:

- Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1, for additional installation requirements
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by enclosures

## North American Hazardous Location Approval

| | |
|---|---|
| The following information applies when operating this equipment in hazardous locations. | Informations sur l'utilisation de cet équipement en environnements dangereux. |
| Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation. | Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation. |
| **WARNING:** EXPLOSION HAZARD -<br>• Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.<br>• Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.<br>• Substitution of components may impair suitability for Class I, Division 2.<br>• If this product contains batteries, they must only be changed in an area known to be nonhazardous. | **AVERTISSEMENT:** RISQUE D'EXPLOSION –<br>• Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement.<br>• Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit.<br>• La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2.<br>• S'assurer que l'environnement est classé non dangereux avant de changer les piles. |

## European Hazardous Location Approval

**The following applies when the product bears the Ex Marking.**

This equipment is intended for use in potentially explosive atmospheres as defined by European Union Directive 94/9/EC and has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of Category 3 equipment intended for use in Zone 2 potentially explosive atmospheres, given in Annex II to this Directive.

Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-15 and EN 60079-0.

**ATTENTION:** This equipment is not resistant to sunlight or other sources of UV radiation.

**WARNING:**

- This equipment must be installed in an enclosure providing at least IP54 protection when applied in Zone 2 environments.
- This equipment shall be used within its specified ratings defined by Rockwell Automation.
- Provision shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 40% when applied in Zone 2 environments.
- Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.
- Enclosure must be marked with the following: "Warning - Do not open when energized." After installation of equipment into the enclosure, access to termination compartments shall be dimensioned so that conductors can be readily connected.

### ATTENTION: Prevent Electrostatic Discharge

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

## Before You Begin

Consider the following before installing a CompactLogix 5370 L1 controller:

**ATTENTION:** If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

- The control system includes the controller, an embedded power supply, and embedded I/O points.
- The embedded power supply is a 24V DC nominal, non-isolated power supply with an input range of 10...28.8V DC. You wire the embedded power supply via a removable connector.
- You must use a dedicated external Class 2/SELV-approved power supply to provide power to the system, according to the application's needs and within the controller's operating voltage range.

  The external power supply that provides power to the controller's embedded power supply cannot be used to provide power to any other components or devices in the application.
- The controller has sixteen embedded digital input points and sixteen embedded digital output points. You wire the input and output points via a removable connector.
- The controller supports the use of 1734 POINT I/O™ modules on the POINTBus™ backplane as local expansion modules.

**IMPORTANT** We strongly recommend that you use the latest series and firmware revision for all 1734 POINT I/O modules in the local expansion slots to make sure your application will operate as expected.

The following table lists local expansion module support by controller catalog number.

**Table 1 - Local Expansion Module Support for CompactLogix 5370 L1 Controllers**

| Cat. No. | 1734 POINT I/O Modules Supported, max |
|---|---|
| 1769-L16ER-BB1B | 6 |
| 1769-L18ER-BB1B | 8 |
| 1769-L18ERM-BB1B | |

- You can use up to the maximum number of 1734 POINT I/O modules with the CompactLogix 5370 L1 controllers listed in Table 1, as long as the total current drawn by the embedded I/O and local expansion modules does not exceed the available POINTBus backplane current of 1 A and/or field power current of 3 A.

  Depending on your application's configuration, you can use one of the following devices to make additional POINTBus backplane current and/or field power current available:

  – **1734-EP24DC POINT I/O Expansion Power Supply** - An expansion power supply is installed between embedded I/O modules and local expansion modules or between local expansion modules.

    The expansion power supply breaks the available POINTBus backplane current between the modules to its left and right. With the expansion power supply installed, the modules to its left can draw up to 1 A of POINTBus backplane current and the modules to its right can draw as much current as that provided by the expansion power supply.

    Additionally, the expansion power supply breaks the available field power current between the modules to its left and right With the expansion power supply installed, the modules to its left can draw up to 3 A of field power current and the modules to its right can draw as much field power current as allowed by the expansion power supply.

    For more information on the 1734-EP24DC expansion power supply, see the POINT I/O 24V DC Expansion Power Supply Installation Instructions, publication 1734-IN058.

  – **1734-FPD POINT I/O Field Power Distributor Module** - A field power distributor module can also be installed between embedded I/O modules and local expansion modules or between local expansion modules.

    The field power distributor module breaks the available field power current between the modules to its left and right. With the field power distributor module installed, the modules to its left can draw up 3 A of field power current, and the modules to its right can draw as much field power current as allowed by the field power distributor.

    For more information on the 1734-FPD POINT I/O Field Power Distributor module, see the POINT I/O Field Power Distributor Module Installation Instructions, publication 1734-IN059.

**IMPORTANT** Remember, the field power distributor module only changes the level of field power current available in the system. It does not affect the level of POINTBus backplane current available.

**ATTENTION:** Do not discard the end cap. Use this end cap to cover the exposed interconnections on the last mounting base on the DIN rail. Failure to do so could result in equipment damage or injury from electric shock.

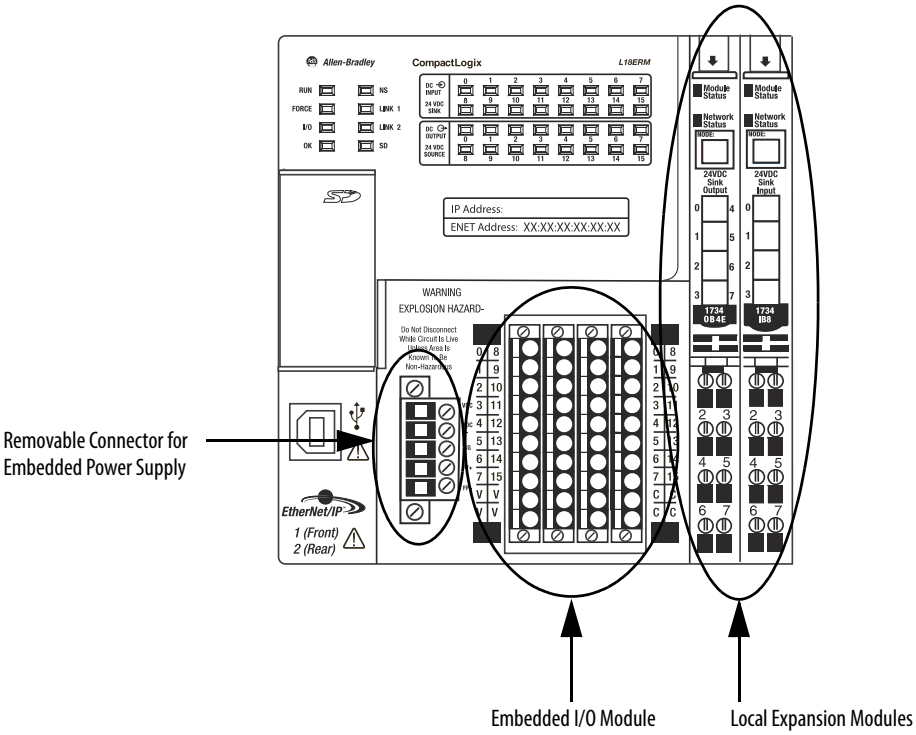
For more information on how to terminate the end of your system, see page 25.

- 1734 POINT I/O modules support removal and insertion under power.

**WARNING:** If you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

The following graphic shows a CompactLogix 5370 L1 controller with local expansion modules installed.



### CompactLogix 5370 L1 Controller Parts

These parts are included in the box when you order your controller:

- Controller - Specific catalog number varies by order
- 1784-SD1 Secure Digital (SD) card with 1 GB of memory storage

  A 1784-SD2 SD card with 2 GB of memory storage, or additional 1784-SD1 SD cards, are also available if you need additional memory.

  **IMPORTANT** The life expectancy of flash media is strongly dependent on the number of write cycles that are performed. Flash media use wear leveling but users should avoid frequent writes.

  Avoiding frequent writes is particularly important when logging data. We recommend that you log data to a buffer in your controller's memory and limit the number of times data is written to removable media.

- An end cap protective covering that slides onto the right side of the CompactLogix 5370 L1 control system.

## Installation Summary

To install a CompactLogix 5370 L1 controller, follow these steps.

1. Install the Secure Digital Card.
2. Install the System.
3. Connect to the Controller via a USB Cable.
4. Connect the Controller to an EtherNet/IP Network.

## Install the Secure Digital Card

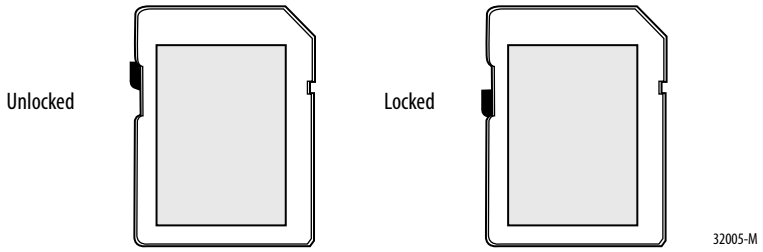
The CompactLogix 5370 L1 controller is shipped from the factory with the 1784-SD1 **SD card installed**.

Complete these steps to re-install an SD card that has been removed from the controller back into the controller or if installing a new SD card into the controller.

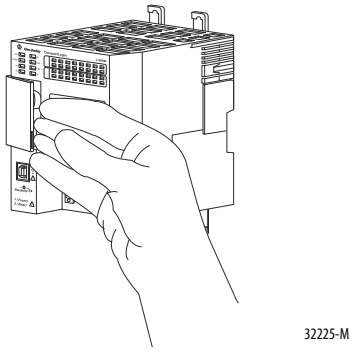
**WARNING:** When you insert or remove the SD card while power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

1. Verify that the SD card is locked or unlocked according to your preference. Consider these when deciding to lock the card before installation:
   - If the card is unlocked, the controller can write data to it or read data from it.
   - If the card is locked, the controller can only read data from it and you may experience issues when updating the firmware on your controller




2. Open the door for the SD card.

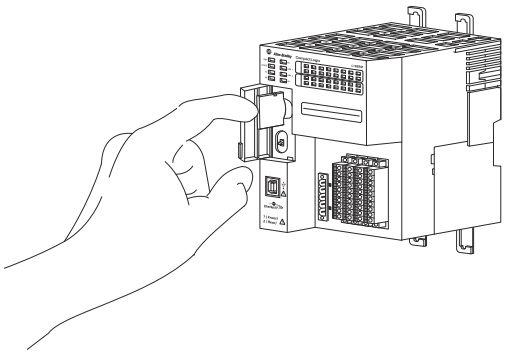


3. Insert the SD card into the SD card slot.

   You can install the SD card in one orientation only. The beveled corner should be at the top.

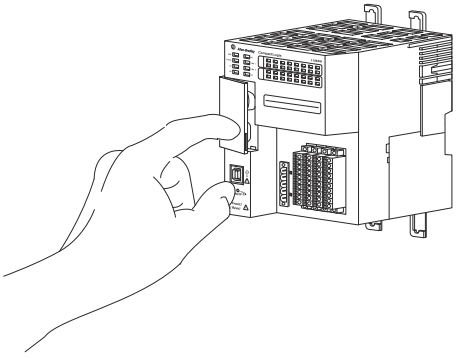
   If you feel resistance when inserting the SD card, pull it out and change the orientation.

4. Gently press the card until it clicks into place.



32226-M

5. Close the SD card door.



32227-M

We recommend you keep the SD card door closed during normal system operation. For more information on using the SD card, see Use a Secure Digital Card on page 301.

## Install the System

Complete the following steps to install the CompactLogix 5370 L1 control system.

- Mount the System
- Ground the System
- Install the Controller
- Connect Power to the Controller

### Mount the System

You mount a CompactLogix 5370 L1 control system on a DIN rail. Before you complete the steps required to installing the system, install a DIN rail.

**WARNING:** When used in a Class I, Division 2, hazardous location, this equipment must be mounted in a suitable enclosure with proper wiring method that complies with the governing electrical codes.

Before you mount a CompactLogix 5370 L1 control system, consider the following requirements:

- Available DIN Rails
- Minimum Spacing
- System Dimensions

*Available DIN Rails*

**ATTENTION:** This product is grounded through the DIN rail to chassis ground. Use zinc-plated yellow-chromate steel DIN rail to assure proper grounding. The use of other DIN rail materials (for example, aluminum or plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding. Secure DIN rail to mounting surface approximately every 200 mm (7.8 in.) and use end-anchors appropriately.

You can mount the CompactLogix 5370 L1 controller on the following DIN rails:

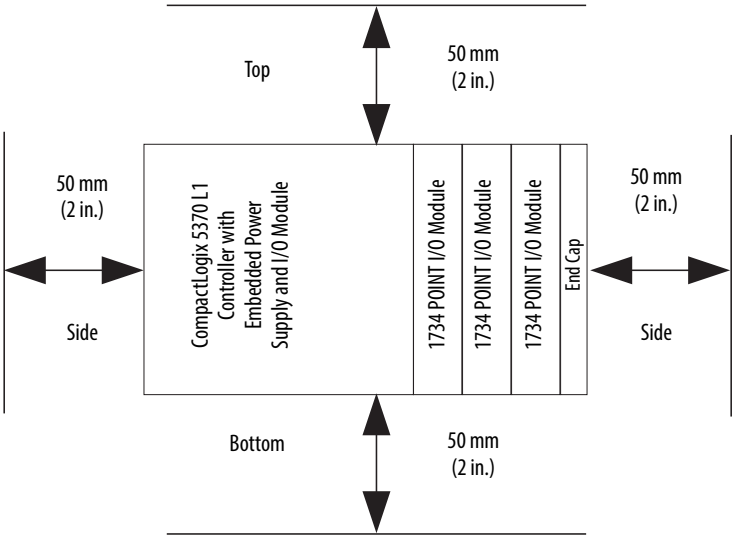
- EN 50 022 - 35 x 7.5 mm (1.38 x 0.30 in.)
- EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.)

**IMPORTANT** You must install bumpers on the back of your CompactLogix 5370 L1 controller before mounting it on the EN 50022 - 35 x 15 mm (1.38 x 0.59 in.) DIN rail.

For more information about the required bumper (PN-83094), contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

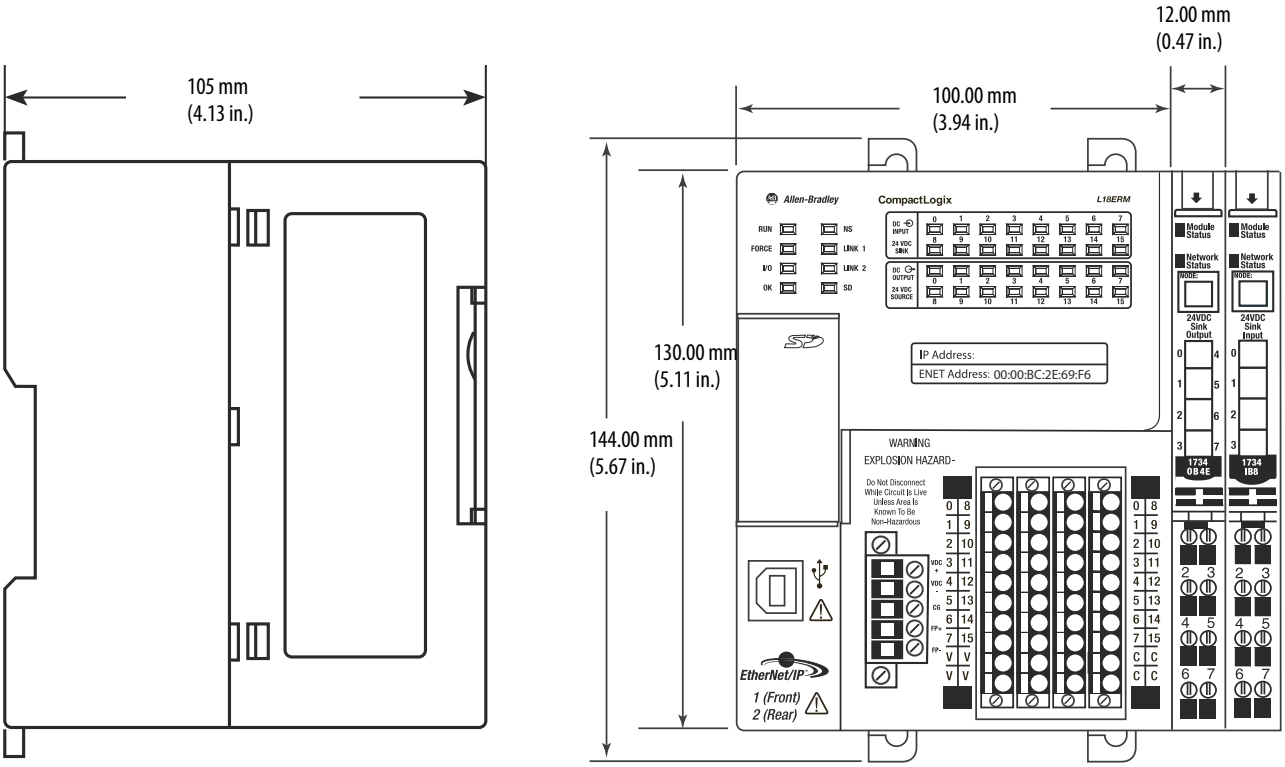
### *Minimum Spacing*

Maintain spacing from enclosure walls, wireways, and adjacent equipment. Allow 50 mm (2 in.) of space on all sides, as shown. This provides ventilation and electrical isolation.




### *System Dimensions*

This graphic shows the system dimensions.



## Ground the System

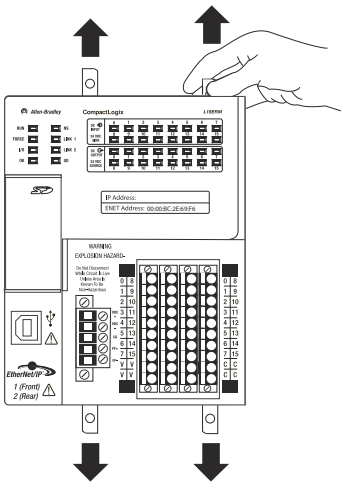
**ATTENTION:** This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the power supply's mounting tabs or DIN rail (if used) are not required unless the mounting surface cannot be grounded.

Refer to Industrial Automation Wiring and Grounding Guidelines, Rockwell Automation publication 1770-4.1, for additional information.

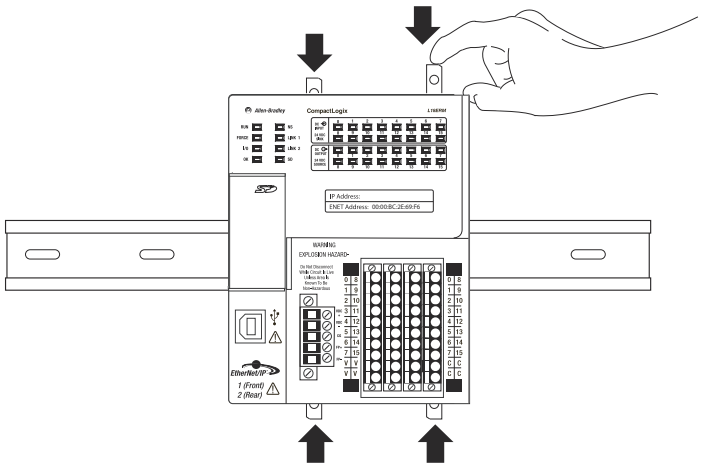
## Install the Controller

Complete these steps to install the controller.

1. Pull locking tabs out.

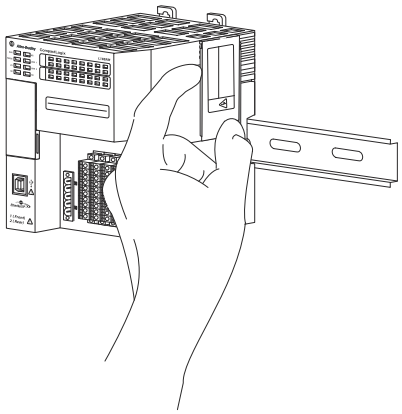


2. Slide the controller into position on the DIN rail and push the locking tabs in.



3. If you are not using local expansion modules, use the tongue-and-groove slots on the right side of the controller to slide a protective covering onto the controller. The protective cover ships with the controller.

   The covering covers the exposed interconnections on the right side of the controller. Failure to use a protective covering could result in equipment damage or injury from electric shock.



   If you are using local expansion modules, see Local Expansion Modules on page 152 for more information on installing them in a CompactLogix 5370 L1 control system.

## Connect Power to the Controller

**IMPORTANT** This section describes how to power the controller via the VDC+ and VDC- terminals.

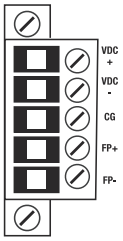
Connections to the VDC+ and VDC- terminals **do not** provide power to input or output devices connected to the controller's embedded I/O modules or local expansion modules.

For more information on how to provide power to input or output devices that are connected to the controller's embedded I/O modules and local expansion modules, see page 140.

You must connect a dedicated Class 2/SELV-listed external power supply to the controller's embedded power supply. The external power supply converts 115/230V AC power to 24V DC or other application-required DC voltage that is within the controller's operating range.

**WARNING:** Do not connect directly to line voltage. Line voltage must be supplied by a suitable, approved isolating transformer or power supply having short circuit capacity not exceeding 100 VA maximum or equivalent.

Power is connected to the controller via a removable connector that is connected to the front of the controller. The following graphic shows the connector.




**IMPORTANT** The CG terminal on the removable connector connects to the DIN rail via a grounding clip on the back of the controller. The controller is grounded once it is installed on a DIN rail as described in Mount the System on page 22.

You **should not** make any connections to the CG terminal.

Consider these points before completing the steps in this section:

- This section describes how to connect an external 24V DC power source to the CompactLogix 5370 L1 controller.

  For information on how to provide power to input and output devices connected to the controller's embedded I/O modules and local expansion modules via the removable connector, see page 140.

- You must use an external power supply that is Class 2 or SELV-listed.

- The external power supply that provides power to the CompactLogix 5370 L1 controller must be dedicated to powering the controller.

- You must use a separate, dedicated external 24V DC power source to connect power to other terminals on the removable connector and devices in the system, for example, the FP+ terminal or a bar code scanner, respectively.

- Use a power source that most effectively meets your application needs. That is, calculate your application's power requirements before choosing a power source to avoid using a power source that far exceeds your application requirements.

- The external 24V DC power source connected to the VDC+ and VDC- terminals on the removable connector must reside in the same enclosure as the CompactLogix 5370 L1 controller.

- This section assumes that any DIN rail you use has been grounded following Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1

- The CompactLogix 5370 L1 controller's embedded power supply provides power to the controller and POINTBus backplane. It does not provide field-side power to the embedded I/O or local expansion modules.

- Not all Class 2/SELV-listed power supplies are certified for use in all applications, for example, use in both nonhazardous and hazardous environments.

  Before installing an external power supply, consult all specification and certification information to verify that you are using an acceptable external power supply.

- For example purposes, this section describes how to use a 1606-XLP50E, NEC Class 2 switched-mode power supply. The exact steps for other external power supplies might vary from those described here.

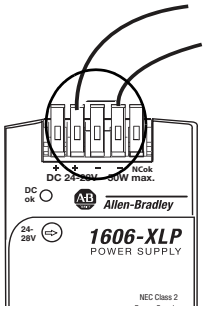
Complete these steps to connect power to the CompactLogix 5370 L1 controller.

1. Verify that the external 24V DC power source is not powered.
2. Mount the external 24V DC power source on a DIN rail.

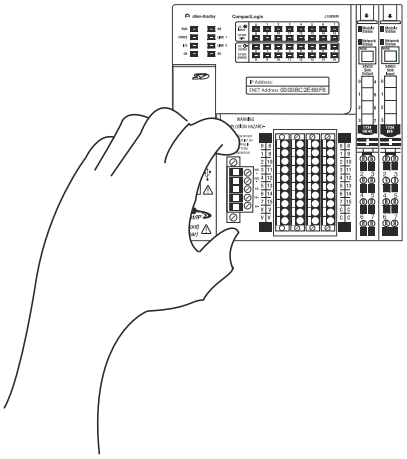
   The external 24V DC power source can be installed on the same DIN rail as the controller or a separate DIN rail.

3. Connect wires to the appropriate 24V DC+ and 24V DC- connections on the external 24V DC power source.

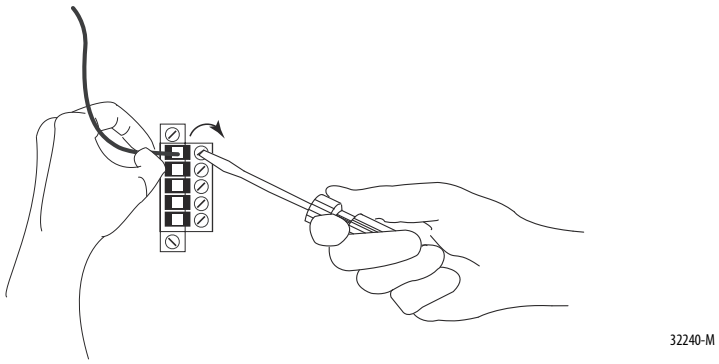
**WARNING:** If you connect or disconnect wiring while the field-side power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.



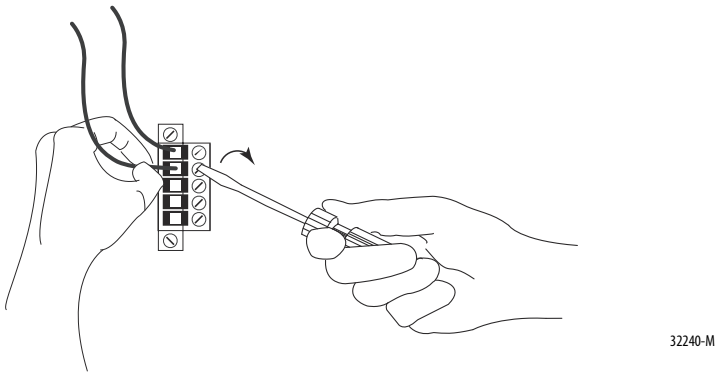

4. Pull the removable connector off of the CompactLogix 5370 L1 controller.



5. Connect the wire connected to the 24V DC+ terminal on the external 24V DC power source to the VDC+ terminal, that is, the top terminal, on the removable connector.




6. Connect the wire connected to the 24V DC- terminal on the external 24V DC power source to the VDC- terminal, that is, the terminal that is second from the top, on the removable connector.

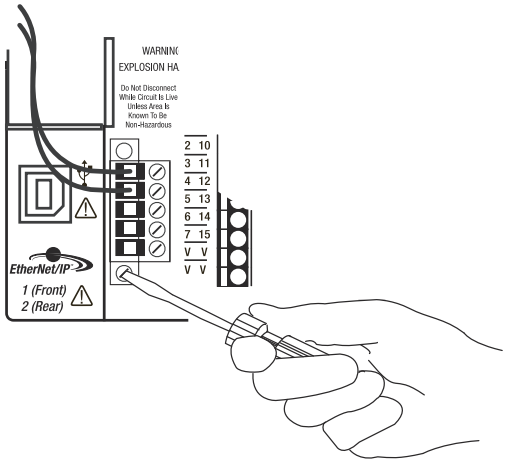



**IMPORTANT** If your application requires a power control device, for example, a switch or relay, between the external 24V DC power source and the CompactLogix 5370 L1 controller to control when the controller is powered, you must install the power control device at the VDC+ terminal on the removable connector.

If you install the power control device at the VDC- terminal, the CompactLogix 5370 L1 controller may not power up or power down properly.

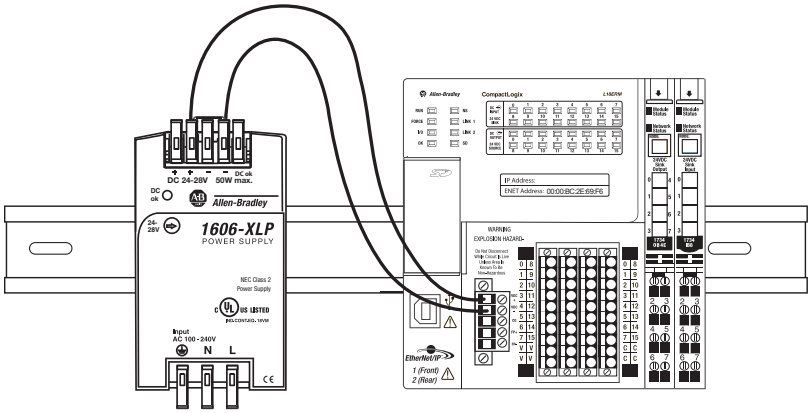
7. Plug the removable connector back into the controller.

**8.** Secure the removable connector in place.




**9.** Turn power on to the external 24V DC power source.

The following graphic shows an external 24V DC power source connected to a CompactLogix 5370 L1 controller.



## Connect to the Controller via a USB Cable

The controller has a USB port that uses a Type B receptacle. The port is USB 2.0-compatible and operates at 12 Mbps.

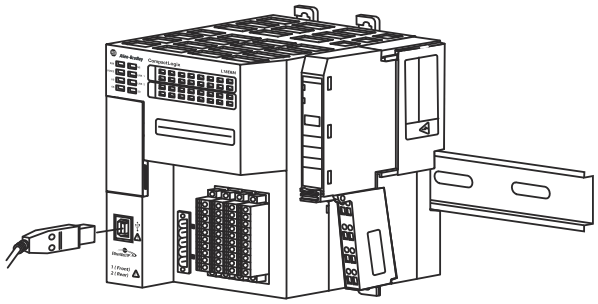
Use a USB cable to connect your computer to the USB port. With this connection, you can upgrade firmware and download programs to the controller directly from your computer.

**ATTENTION:** The USB port is intended for temporary local programming purposes only and not intended for permanent connection.

The USB cable is not to exceed 3.0 m (9.84 ft) and must not contain hubs.

**WARNING:** Do not use the USB port in hazardous locations.

Plug the USB cable into the CompactLogix 5370 L1 controller.



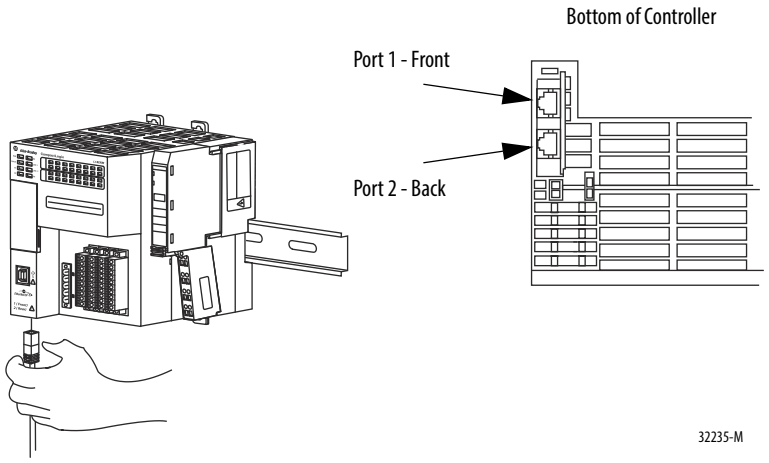
32234-M

## Connect the Controller to an EtherNet/IP Network

**WARNING:** If you connect or disconnect the communications cable with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

Connect the RJ45 connector of the Ethernet cable to one of the Ethernet ports on the controller. The ports are on the bottom of the controller.




**IMPORTANT** This example shows how to connect the controller to the network through one port. Depending on your application's network topology, you might connect both ports of the controller to the EtherNet/IP network.

For more information on EtherNet/IP network topologies, see page 120.

### Connecting to Different EtherNet/IP Network Topologies

CompactLogix 5370 L1 controllers have embedded switch technology and two EtherNet/IP ports that let you use it in various EtherNet/IP network topologies:

- Device-level ring network topology - Both ports on the controller are connected to the network.
- Linear network topology - Both ports on the controller are connected to the network.
- Star network topology - One port on the controller is connected to the network.

There are specific connection and configuration requirements for each EtherNet/IP network topology.

For more information, see EtherNet/IP Network Topologies on page 120.

# Install the CompactLogix 5370 L2 Controller


| Topic | Page |
|---|---|
| Before You Begin | 36 |
| Install the Secure Digital Card | 39 |
| Install the System | 41 |
| Connect to the Controller via a USB Cable | 52 |
| Connect the Controller to an EtherNet/IP Network | 53 |

**ATTENTION: Environment and Enclosure**

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR 11. Without appropriate precautions, there may be difficulties with electromagnetic compatibility in residential and other environments due to conducted and radiated disturbances.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA, V2, V1, V0 (or equivalent) if nonmetallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see the following:

- Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1, for additional installation requirements
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by enclosures

## North American Hazardous Location Approval

| | |
|---|---|
| The following information applies when operating this equipment in hazardous locations. | Informations sur l'utilisation de cet équipement en environnements dangereux. |
| Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation. | Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation. |
| **WARNING:** EXPLOSION HAZARD -<br>• Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.<br>• Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.<br>• Substitution of components may impair suitability for Class I, Division 2.<br>• If this product contains batteries, they must only be changed in an area known to be nonhazardous. | **AVERTISSEMENT:** RISQUE D'EXPLOSION –<br>• Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement.<br>• Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit.<br>• La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2.<br>• S'assurer que l'environnement est classé non dangereux avant de changer les piles. |

## European Hazardous Location Approval

**The following applies when the product bears the Ex Marking.**

This equipment is intended for use in potentially explosive atmospheres as defined by European Union Directive 94/9/EC and has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of Category 3 equipment intended for use in Zone 2 potentially explosive atmospheres, given in Annex II to this Directive.

Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-15 and EN 60079-0.

**ATTENTION:** This equipment is not resistant to sunlight or other sources of UV radiation.

**WARNING:**

- This equipment must be installed in an enclosure providing at least IP54 protection when applied in Zone 2 environments.
- This equipment shall be used within its specified ratings defined by Rockwell Automation.
- Provision shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 40% when applied in Zone 2 environments.
- Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.
- Enclosure must be marked with the following: "Warning - Do not open when energized." After installation of equipment into the enclosure, access to termination compartments shall be dimensioned so that conductors can be readily connected.

### ATTENTION: Prevent Electrostatic Discharge

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

## Before You Begin

Consider the following before installing a CompactLogix 5370 L2 controller:

- The control system includes a controller, an embedded power supply, embedded I/O points, and a 1769-ECR right end cap.
- The embedded power supply is a 24V DC input, isolated power supply.
- You must connect an external Class 2 or SELV-approved power supply to provide 24V DC power to the system.

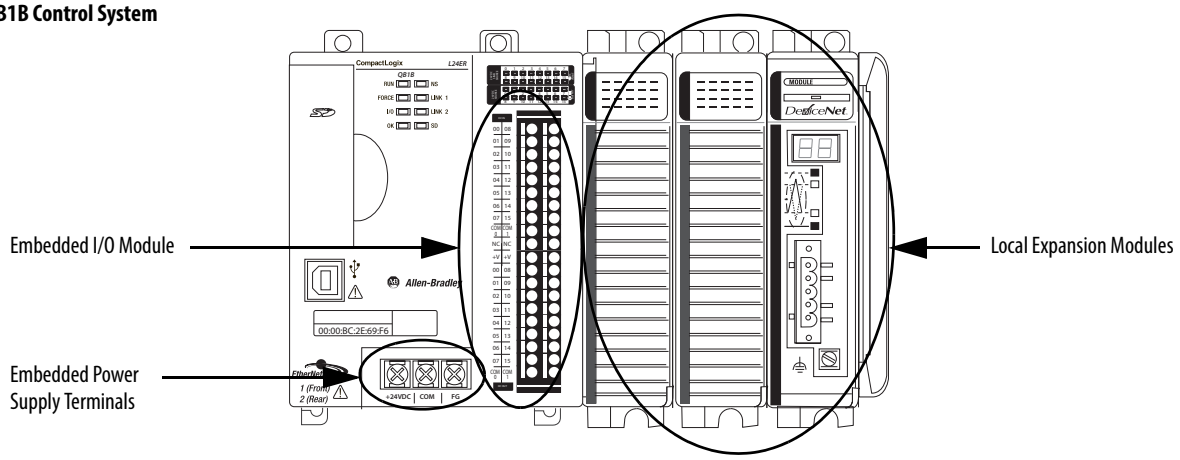
  For example, you can use a 1606-XLSDNET4, standard switched-mode power supply, as shown in this chapter.
- The controllers have embedded I/O points. You wire the input and output points via a removable connector.
- The controller supports the use of up to four Compact I/O™ modules on the local 1769 CompactBus backplane as local expansion modules.

  For more information on using **embedded I/O** points and **local expansion modules**, see Chapter 8, Use I/O Modules with CompactLogix 5370 L2 Controllers on page 179.
- You must terminate the end of the CompactBus via a 1769-ECR right end cap as shown in step 6 on page 47.
- You cannot remove nor install Compact I/O modules while the controller is powered.

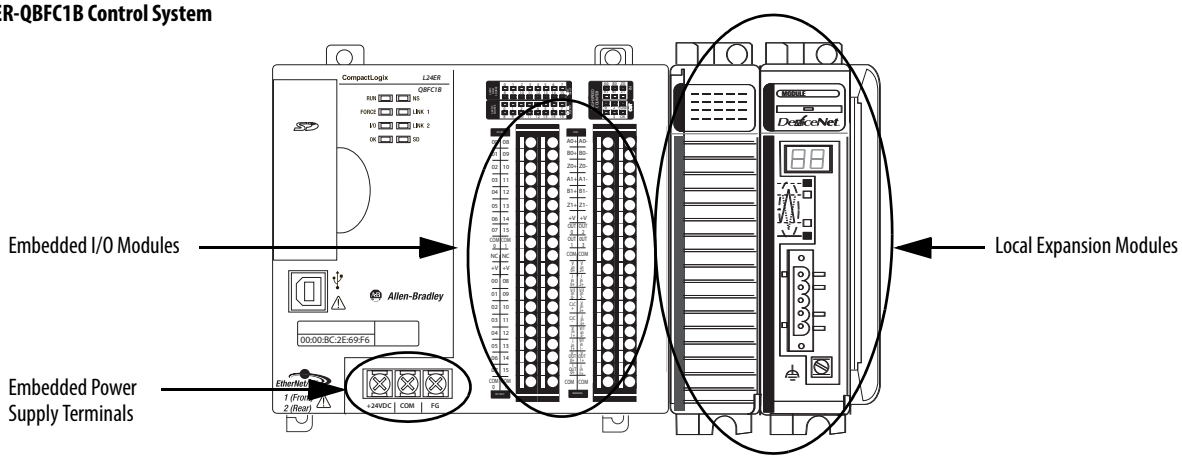
**ATTENTION:** CompactLogix 5370 L2 control systems do not support removal and insertion under power (RIUP). Removing a 1769 Compact I/O module or end cap will generate a controller fault and may also result in damage to system components.

The following graphic shows CompactLogix 5370 L2 controllers with local expansion modules installed.

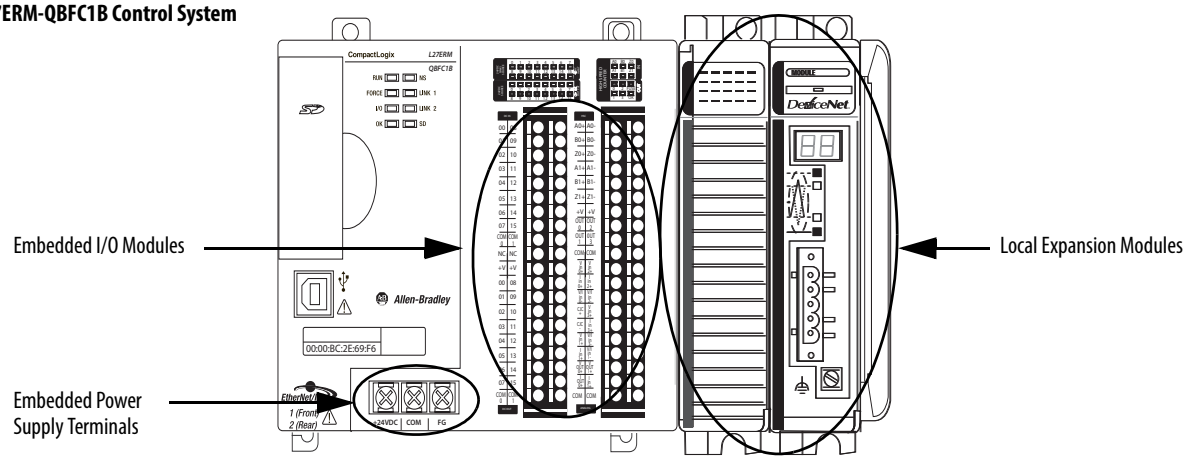
**1769-L24ER-QB1B Control System**




**1769-L24ER-QBFC1B Control System**




**1769-L27ERM-QBFC1B Control System**



### CompactLogix 5370 L2 Controller Parts

These parts are included in the box when you order your controller:

- Controller - Specific catalog number varies by order
- 1769-ECR Compact I/O End Cap/Terminator
- 1784-SD1 Secure Digital (SD) card with 1 GB of memory storage

  A 1784-SD2 SD card with 2 GB of memory storage, or additional 1784-SD1 SD cards, are also available if you need additional memory.

| | |
|---|---|
| **IMPORTANT** | The life expectancy of flash media is strongly dependent on the number of write cycles that are performed. Flash media use wear leveling but users should avoid frequent writes.<br>Avoiding frequent writes is particularly important when logging data. We recommend that you log data to a buffer in your controller's memory and limit the number of times data is written to removable media. |

## Installation Summary

To install a CompactLogix 5370 L2 controller, follow these steps.

1. Install the Secure Digital Card.
2. Install the System.
3. Connect to the Controller via a USB Cable.
4. Connect the Controller to an EtherNet/IP Network.

## Install the Secure Digital Card

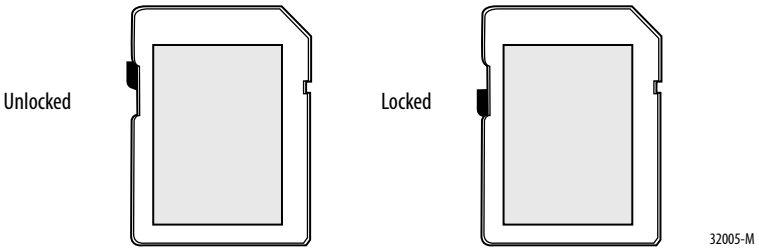
The CompactLogix 5370 L2 controller is shipped from the factory with the 1784-SD1 **SD card installed**.

Complete these steps to re-install an SD card that has been removed from the controller back into the controller or if installing a new SD card into the controller.

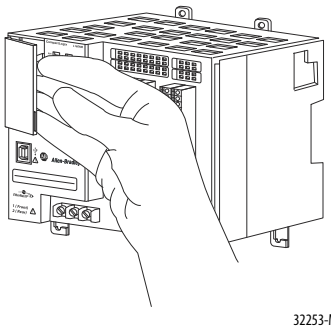
**WARNING:** When you insert or remove the SD card while power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

1. Verify that the SD card is locked or unlocked according to your preference. Consider these when deciding to lock the card before installation:
   - If the card is unlocked, the controller can write data to it or read data from it.
   - If the card is locked, the controller can only read data from it and you may experience issues when updating the firmware on your controller




2. Open the door for the SD card.

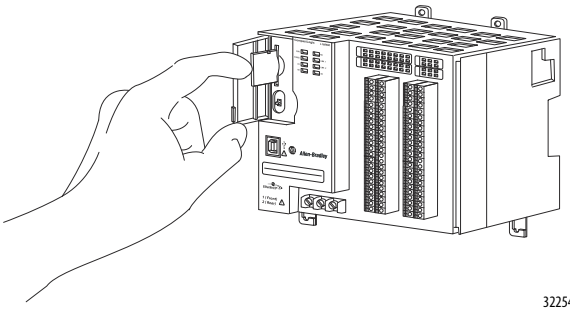


3. Insert the SD card into the SD card slot.

   You can install the SD card in one orientation only. The beveled corner should be at the bottom.

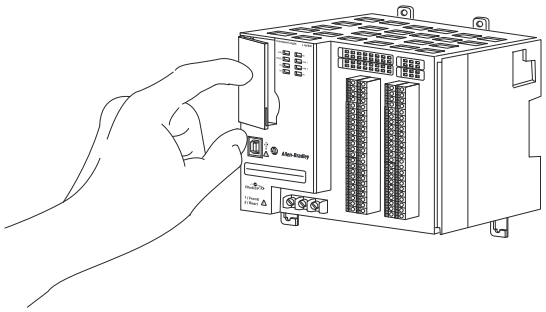
   If you feel resistance when inserting the SD card, pull it out and change the orientation.

4. Gently press the card until it clicks into place.



32254-M

5. Close the SD card door.



32255-M

We recommend you keep the SD card door closed during normal system operation. For more information on using the SD card, see Use a Secure Digital Card on page 301.

# Install the System

Complete the following tasks to install the CompactLogix 5370 L2 control system:

- Mount the System
- Ground the System
- Install the Controller
- Connect Power to the Control System

## Mount the System

You can mount a CompactLogix 5370 L2 control system on a DIN rail or a panel.

**WARNING:** When used in a Class I, Division 2, hazardous location, this equipment must be mounted in a suitable enclosure with proper wiring method that complies with the governing electrical codes.

Before you mount a CompactLogix 5370 L2 control system, consider the following requirements:

- Available DIN Rails
- Minimum Spacing
- System Dimensions

*Available DIN Rails*

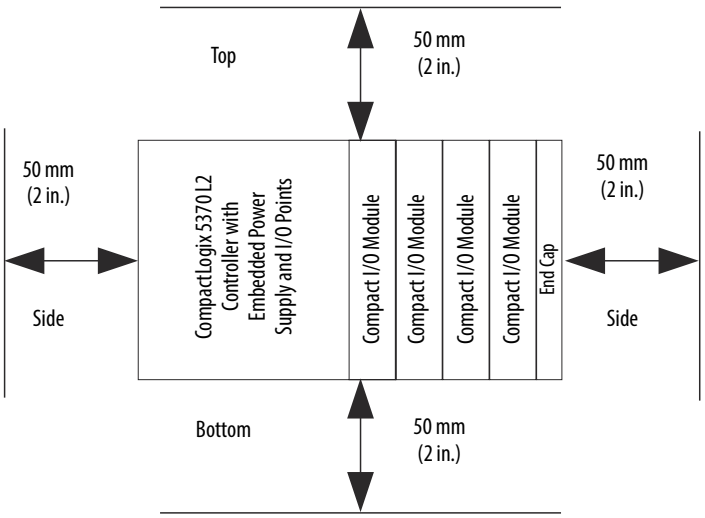
**ATTENTION:** This product is grounded through the DIN rail to chassis ground. Use zinc-plated yellow-chromate steel DIN rail to assure proper grounding. The use of other DIN rail materials (for example, aluminum or plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding. Secure DIN rail to mounting surface approximately every 200 mm (7.8 in.) and use end-anchors appropriately.

You can mount the CompactLogix 5370 L2 controller on the following DIN rails:

- EN 50 022 - 35 x 7.5 mm (1.38 x 0.30 in.)
- EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.)

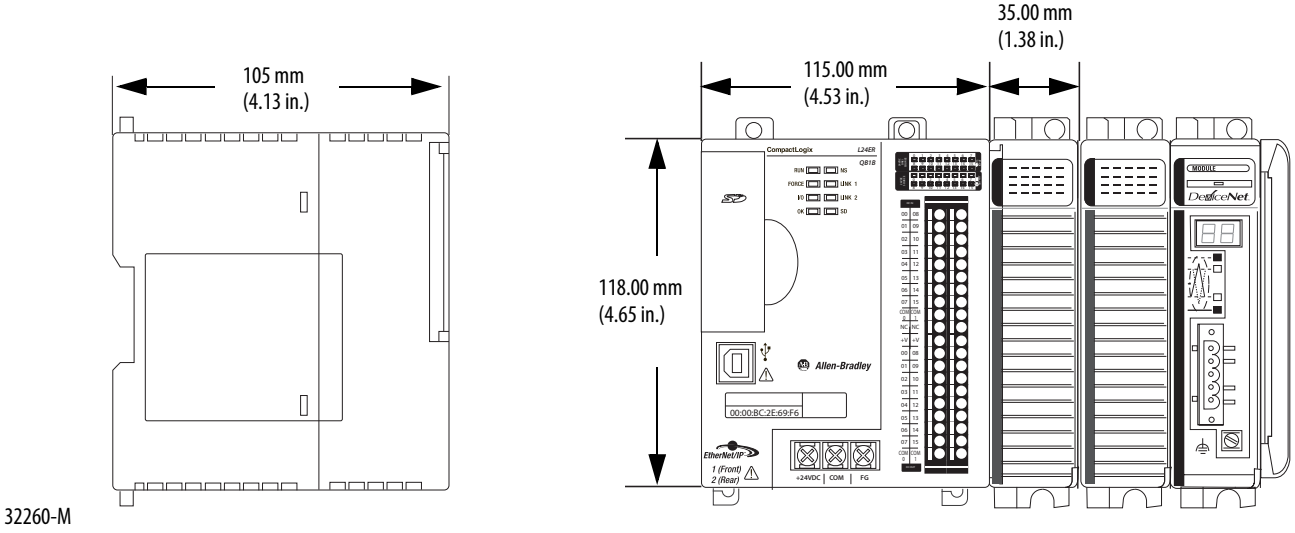
### *Minimum Spacing*

Maintain spacing from enclosure walls, wireways, and adjacent equipment. Allow 50 mm (2 in.) of space on all sides, as shown. This provides ventilation and electrical isolation.



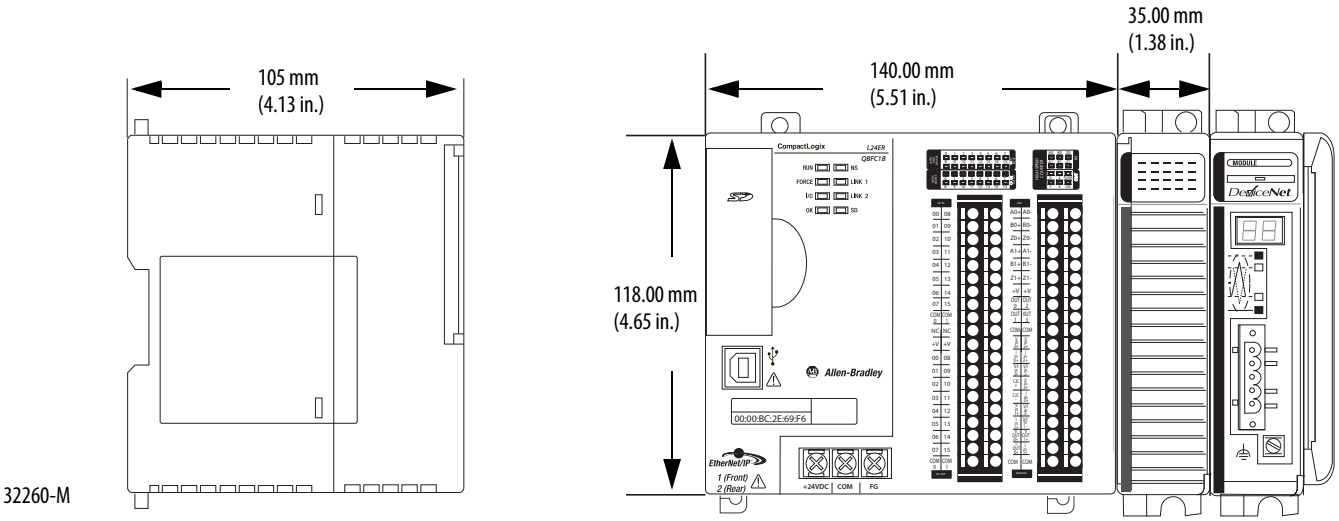

### *System Dimensions*

This graphic shows the system dimensions for the 1769-L24ER-QB1B controller.

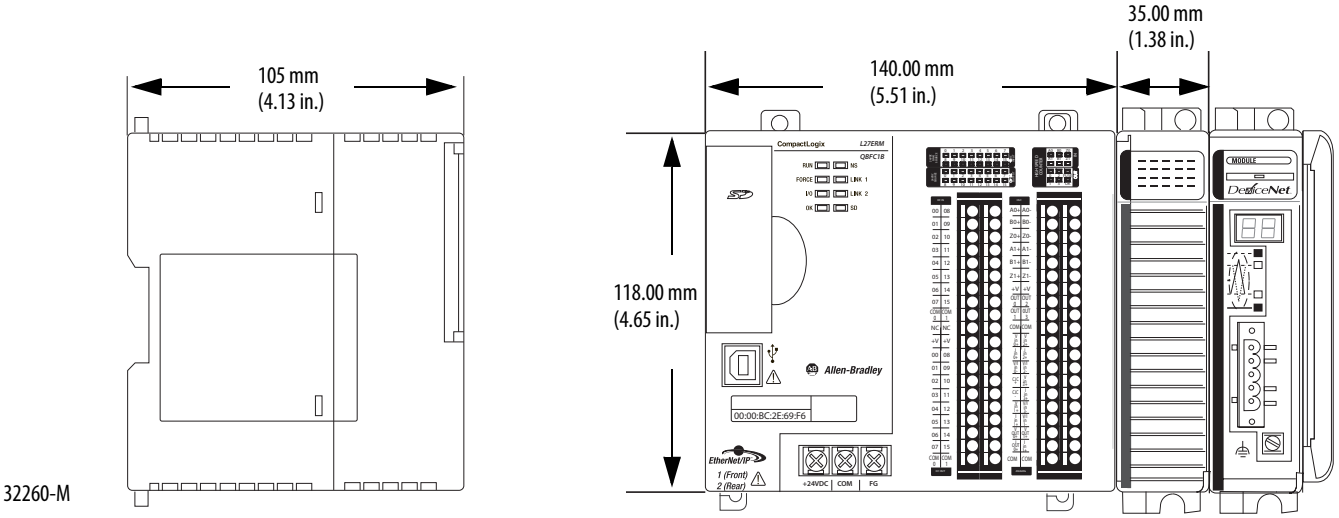



32260-M

This graphic shows the system dimensions for the 1769-L24ER-QBFC1B controller.




This graphic shows the system dimensions for the 1769-L27ERM-QBFC1B controller.



### *Mount the Controller on a Panel*

Use two M4 or #8 panhead screws to mount the controller. Mounting screws are required on every module. Use this procedure to use the assembled modules as a template for drilling holes in the panel.

**IMPORTANT** Due to module mounting hole tolerance, it is important to follow these procedures.

1. On a clean work surface, assemble no more than three modules.
2. Using the assembled modules as a template, carefully mark the center of all module-mounting holes on the panel.
3. Return the assembled modules to the clean work surface, including any previously mounted modules.
4. Drill and tap the mounting holes for the recommended M4 or #8 screw.
5. Place the modules back on the panel and check for proper hole alignment.

   **TIP** The grounding plate, that is, where you install the mounting screws, grounds the module when it is panel-mounted.

6. Use the mounting screws to attach the modules to the panel.

   **TIP** If you are mounting more modules, mount only the last one of this group and put the others aside. This reduces remounting time when you are drilling and tapping the next group of modules.

7. Repeat steps 1…6 for any remaining modules.

*Mount the Controller on the DIN Rail*

You can mount the controller on the following DIN rails:

- EN 50 022 - 35 x 7.5 mm (1.38 x 0.30 in.)
- EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.)

**ATTENTION:** This product is grounded through the DIN rail to chassis ground. Use zinc plated yellow-chromate steel DIN rail to assure proper grounding. The use of other DIN rail materials (for example, aluminum or plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding. Secure DIN rail to mounting surface approximately every 200 mm (7.8 in.) and use end-anchors appropriately.

1. Hook the DIN rail latch at the top of the back of the controller on the DIN rail.
2. Swing the controller downward until it touches the DIN rail and press the controller against the DIN rail until it clicks in place.

## Ground the System

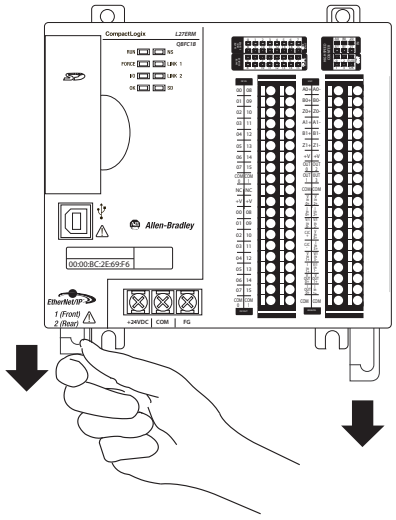
**ATTENTION:** This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the power supply's mounting tabs or DIN rail (if used) are not required unless the mounting surface cannot be grounded.

Refer to Industrial Automation Wiring and Grounding Guidelines, Rockwell Automation publication 1770-4.1, for additional information.

## Install the Controller

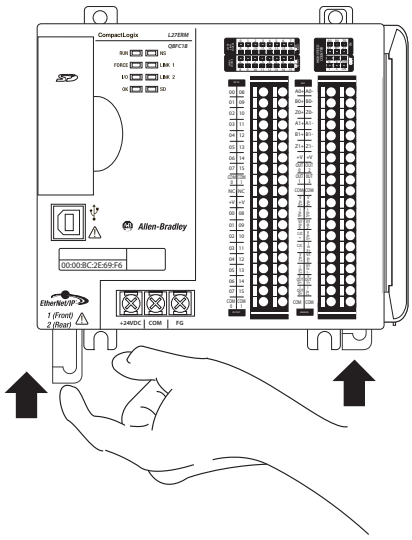
Complete these steps to install the controller.

1. Pull the bottom locking tabs out.




32256-M

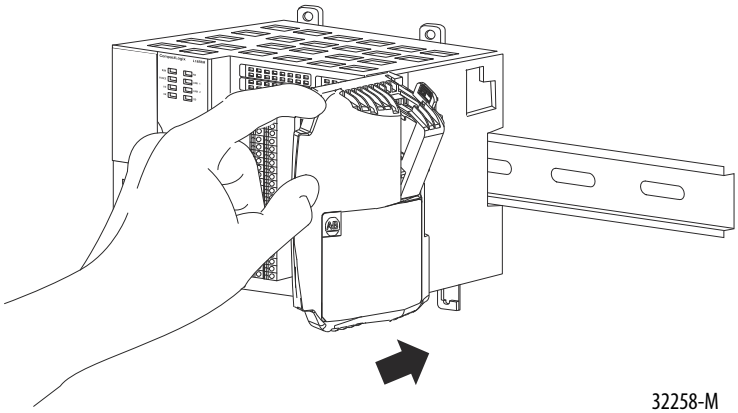
2. Hook the top of the controller on the DIN rail.
3. Swing it downward until the controller is flush against the DIN rail and push it down against the DIN rail.
4. Push the controller against the DIN rail.
5. Push the locking tabs in.




32257-M

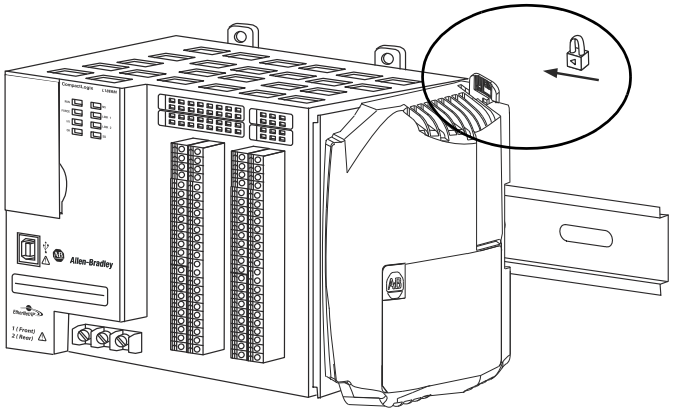
6. If you are not using local expansion modules, slide the 1769-ECR end cap onto the right side of the controller.

| | |
|---|---|
| **IMPORTANT** | You must install an end cap onto the right side of the CompactLogix 5370 L2 controller system either at the end of the controller or at the end of any local expansion modules that may be installed onto the controller.<br>The covering covers the exposed interconnections on the right side of the controller. Failure to use a protective covering could result in equipment damage or injury from electric shock. |



32258-M

7. Push the end cap locking mechanism to the right to lock it onto the controller.




32267-M

If you are using local expansion modules, see Local Expansion Modules - Optional on page 210 for more information on installing them in a CompactLogix 5370 L2 control system.

## Connect Power to the Control System

You must connect an external Class 2 or SELV-listed power supply to the controller's embedded power supply. The external power supply converts 115/230V AC power to 24V DC.

**WARNING:** Do not connect directly to line voltage. Line voltage must be supplied by a suitable, approved isolating transformer or power supply having short circuit capacity not exceeding 100 VA maximum or equivalent.

Consider these points before completing the steps in this section:

- This section describes how to connect power to the CompactLogix 5370 L2 controller's embedded power supply only.

  For information on how to wire the embedded I/O module available on CompactLogix 5370 L2 controllers, see Embedded I/O Modules on page 180.

- An external power supply must reside in the same enclosure as the CompactLogix 5370 L2 controller.

  If the external power supply and controller are located in separate enclosures, an electrical arc can occur when power is applied.

- Not all Class 2 or SELV-listed power supplies are certified for use in all applications, for example, use in both nonhazardous and hazardous environments.

  Before installing an external power supply, consult all specification and certification information to verify that you are using an acceptable external power supply.

- This section describes how to wire terminals +24VDC and COM on the CompactLogix 5370 L2 controller. They are the only terminals you wire to power the CompactLogix 5370 L2 control system.

  You should only use the FG terminal as appropriate when connecting a field device to the controller.

For example purposes, this section uses a 1606-XLDNET4, standard switched-mode power supply.

**IMPORTANT** The 1606-XLDNET4 power supply is not certified for use in all applications, for example, you cannot use it in hazardous locations. Read the points in Connect Power to the Control System on page 48 before choosing the external power supply for your application.

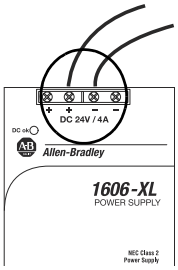
Complete these steps to connect power to the CompactLogix 5370 L2 control system.

1. Verify that the external 24V DC power source is not powered.
2. Mount the external 24V DC power source on a DIN rail.

   The external 24V DC power source can be installed on the same DIN rail as the controller or a separate DIN rail.

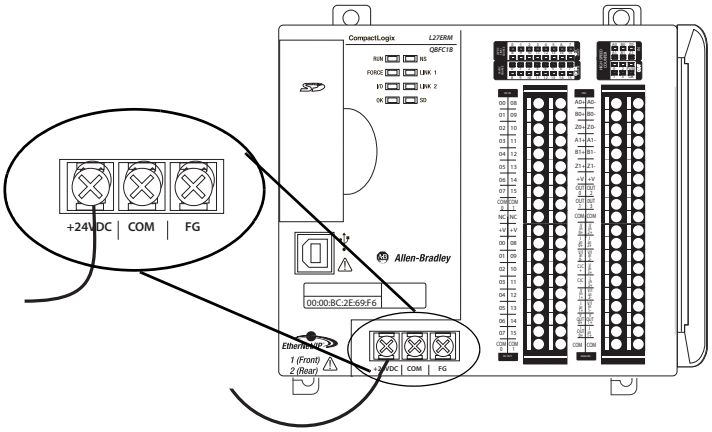
3. Connect wires to the appropriate 24V DC+ and 24V DC- connections on the external 24V DC power source.

**WARNING:** If you connect or disconnect wiring while the field-side power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

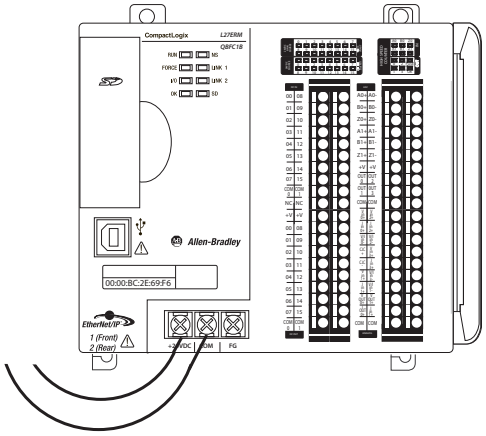



4. Strip 8 mm (0.31 in) insulation from the end of the wire that you will connect to the +24VDC terminal on the controller.

5. Connect the wire from the 24V DC+ terminal on the external 24V DC power source to the +24VDC terminal on the controller.



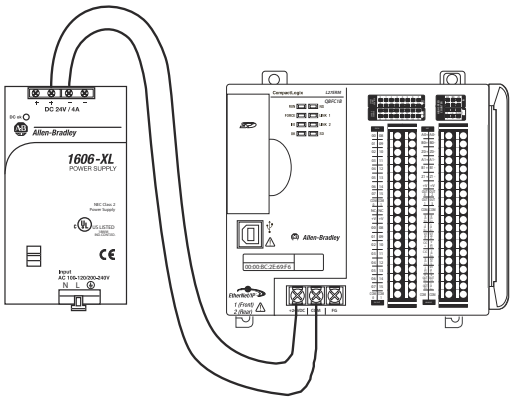

6. Strip 8 mm (0.31 in) insulation from the end of the wire that you will connect to the COM terminal on the controller.
7. Connect the wire from the 24V DC- terminal on the external 24V DC power source to the COM terminal on the controller.




**IMPORTANT** If your application requires a power control device, for example, a switch or relay, between the external power supply and the CompactLogix 5370 L2 controller's embedded power supply to control when the controller is powered, you must install the power control device at the +24VDC terminal on the controller.

If you install the power control device at the COM terminal, the CompactLogix 5370 L2 controller may not power up or power down properly.

The following graphic shows an external 24V DC power source connected to a CompactLogix 5370 L2 controller.




**IMPORTANT** When you remove power from the CompactLogix 5370 L2 controller to cycle power, the controller's OK status indicator remains lit briefly as the controller passes through its shutdown sequence.

Do not reapply power from the external power supply to the CompactLogix 5370 L2 controller's embedded power supply until after the controller's OK status indicator is off.

## Connect to the Controller via a USB Cable

The controller has a USB port that uses a Type B receptacle. The port is USB 2.0-compatible and operates at 12 Mbps.

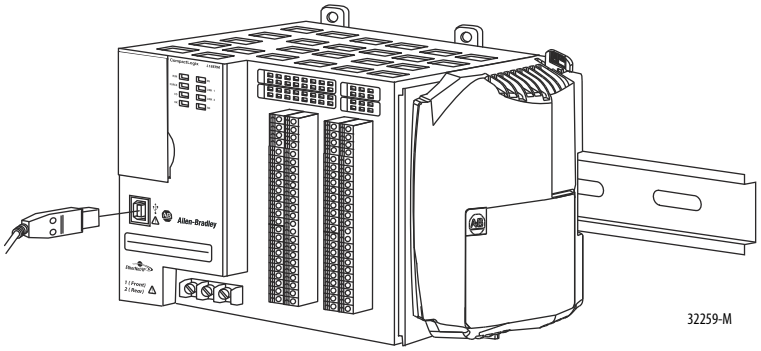
Use a USB cable to connect your computer to the USB port. With this connection, you can upgrade firmware and download programs to the controller directly from your computer.

**ATTENTION:** The USB port is intended for temporary local programming purposes only and not intended for permanent connection.

The USB cable is not to exceed 3.0 m (9.84 ft) and must not contain hubs.

**WARNING:** Do not use the USB port in hazardous locations.

Plug the USB cable into the CompactLogix 5370 L2 controller.



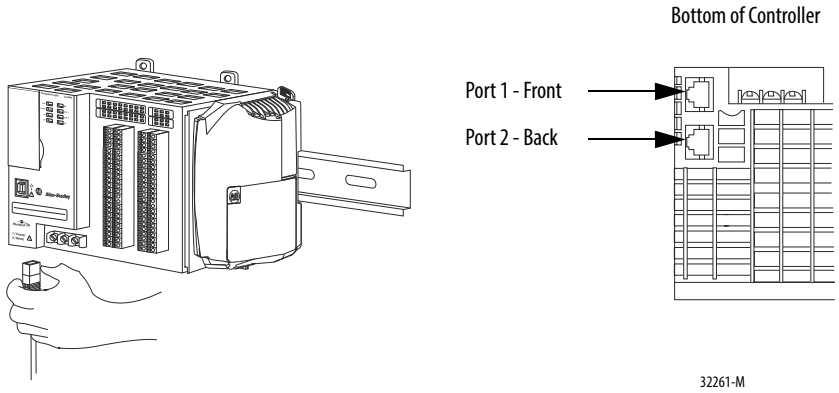
## Connect the Controller to an EtherNet/IP Network

**WARNING:** If you connect or disconnect the communication cable with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

Connect the RJ45 connector of the Ethernet cable to one of the Ethernet ports on the controller. The ports are on the bottom of the controller.

**ATTENTION:** Do not plug a DH-485 network cable or a NAP cable into the Ethernet port. Undesirable behavior and/or damage to the port may result.




**IMPORTANT** This example shows how to connect the controller to the network through one port. Depending on your application's network topology, you might connect both ports of the controller to the EtherNet/IP network.

For more information on EtherNet/IP network topologies, see page 120.

### Connecting to Different EtherNet/IP Network Topologies

CompactLogix 5370 L2 controllers have embedded switch technology and two EtherNet/IP ports that let you use it in various EtherNet/IP network topologies:

- Device-level ring network topology - Both ports on the controller are connected to the network.
- Linear network topology - Both ports on the controller are connected to the network.
- Star network topology - One port on the controller is connected to the network.

There are specific connection and configuration requirements for each EtherNet/IP network topology.

For more information, see EtherNet/IP Network Topologies on page 120.

## Notes:

# Install the CompactLogix 5370 L3 Controller


| Topic | Page |
|---|---|
| Before You Begin | 58 |
| Install the Secure Digital Card | 61 |
| Install the System | 63 |
| Connect to the Controller via a USB Cable | 72 |
| Connect the Controller to an EtherNet/IP Network | 73 |

**ATTENTION: Environment and Enclosure**

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR 11. Without appropriate precautions, there may be difficulties with electromagnetic compatibility in residential and other environments due to conducted and radiated disturbances.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA, V2, V1, V0 (or equivalent) if nonmetallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see the following:

- Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1, for additional installation requirements
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by enclosures

## North American Hazardous Location Approval

| | |
|---|---|
| The following information applies when operating this equipment in hazardous locations. | Informations sur l'utilisation de cet équipement en environnements dangereux. |
| Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation. | Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation. |
| **WARNING:** EXPLOSION HAZARD -<br>• Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.<br>• Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.<br>• Substitution of components may impair suitability for Class I, Division 2.<br>• If this product contains batteries, they must only be changed in an area known to be nonhazardous. | **AVERTISSEMENT:** RISQUE D'EXPLOSION –<br>• Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement.<br>• Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit.<br>• La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2.<br>• S'assurer que l'environnement est classé non dangereux avant de changer les piles. |

## European Hazardous Location Approval

**The following applies when the product bears the Ex Marking.**

This equipment is intended for use in potentially explosive atmospheres as defined by European Union Directive 94/9/EC and has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of Category 3 equipment intended for use in Zone 2 potentially explosive atmospheres, given in Annex II to this Directive.

Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-15 and EN 60079-0.

**ATTENTION:** This equipment is not resistant to sunlight or other sources of UV radiation.

**WARNING:**

- This equipment must be installed in an enclosure providing at least IP54 protection when applied in Zone 2 environments.
- This equipment shall be used within its specified ratings defined by Rockwell Automation.
- Provision shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 40% when applied in Zone 2 environments.
- Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.
- Enclosure must be marked with the following: "Warning - Do not open when energized." After installation of equipment into the enclosure, access to termination compartments shall be dimensioned so that conductors can be readily connected.

### ATTENTION: Prevent Electrostatic Discharge

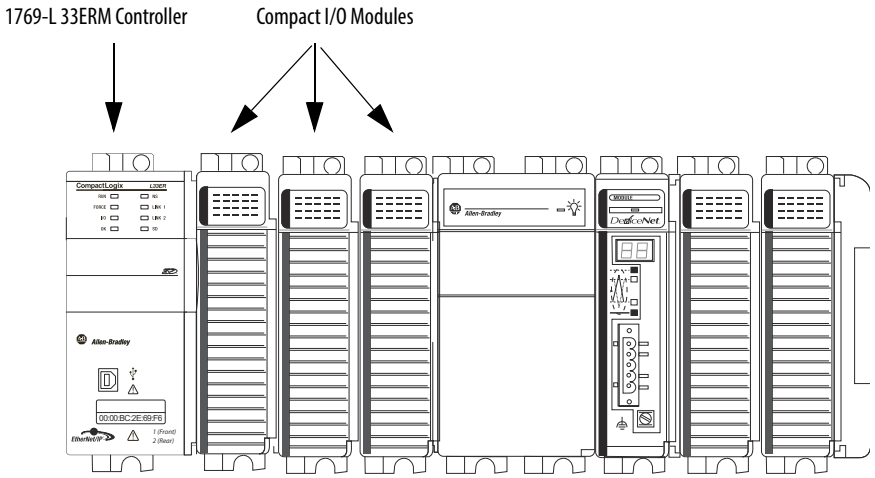
This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

## Before You Begin

Consider the following when planning your CompactLogix 5370 L3 control system:

- The controller is always the leftmost device in the system.
- Only one controller can be used on a local 1769 CompactBus. The controller supports the local bank and up to two more additional banks.
- The controller has a power supply distance rating of four. This rating means the controller must be within four slots of the power supply, that is, you can install as many as three modules between the power supply and the controller, as shown below.




- The controllers support this many local expansion modules across multiple I/O banks.

| Cat. No. | Local Expansion Modules Supported, max |
|---|---|
| 1769- L30ER<br>1769-L30ERM<br>1769-L30ER-NSE | 8 |
| 1769-L33ER<br>1769-L33ERM | 16 |
| 1769-L36ERM | 30 |

- Each I/O bank requires its own power supply.

- You must terminate the end of the last bank in a CompactLogix 5370 L3 control system. Depending on your system design, you may need to terminate a bank at the left or right end of the bank.

  A 1769-EC*x* end cap is required to terminate the end of the last bank in the control system.

  For example, if a CompactLogix 5370 L3 control system uses a single bank, you must use a 1769-ECR right end cap to terminate the right end of the bank.

  For graphics of CompactLogix 5370 L3 control systems that use a single bank or multiple banks, see Mount the System on page 66.

**ATTENTION:** The CompactLogix 5370 L3 control systems do not support removal and insertion under power (RIUP). These events will occur while the CompactLogix system is under power:

- Any break in the connection between the power supply and the controller, for example, removing the power supply, controller, or an I/O module, may subject the logic circuitry to transient conditions above the normal design thresholds and may result in damage to system components or unexpected behavior.
- Removing an end cap or an I/O module faults the controller and may also result in damage to system components.

### CompactLogix 5370 L3 Controller Parts

These parts are included in the box when you order your controller:

- Controller - Specific catalog number varies by order
- 1769-ECR Compact I/O End Cap/Terminator
- 1784-SD1 Secure Digital (SD) card with 1 GB of memory storage

  A 1784-SD2 SD card with 2 GB of memory storage, or additional 1784-SD1 SD cards, are also available if you need additional memory.

| | |
|---|---|
| **IMPORTANT** | The life expectancy of flash media is strongly dependent on the number of write cycles that are performed. Flash media controllers use wear leveling but users should avoid frequent writes.<br>Avoiding frequent writes is particularly important when logging data. We recommend that you log data to a buffer in your controller's memory and limit the number of times data is written to removable media. |

## Installation Summary

To install a CompactLogix 5370 L3 controller, follow these steps.

- Install the Secure Digital Card
- Install the System
- Connect to the Controller via a USB Cable.
- Connect the Controller to an EtherNet/IP Network.

## Install the Secure Digital Card

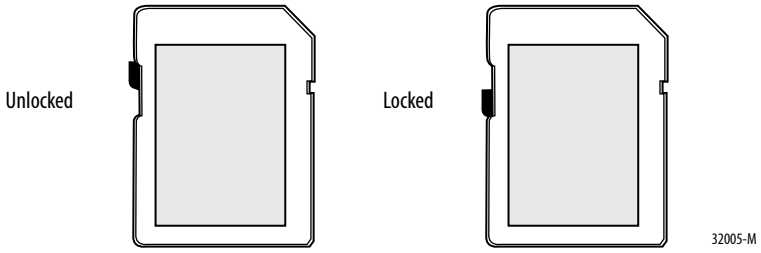
The CompactLogix 5370 L3 **controllers ship** from the factory with the 1784-SD1 **SD card installed**.

Complete these steps to re-install an SD card that has been removed from the controller back into the controller or if installing a new SD card into the controller.

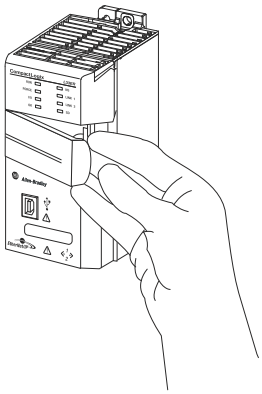
**WARNING:** When you insert or remove the Secure Digital (SD) Card while power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

1. Verify that the SD card is locked or unlocked according to your preference. Consider these when deciding to lock the card before installation:
   - If the card is unlocked, the controller can write data to it or read data from it.
   - If the card is locked, the controller can only read data from it and you may experience issues when updating the firmware on your controller.




2. Open the door for the SD card.

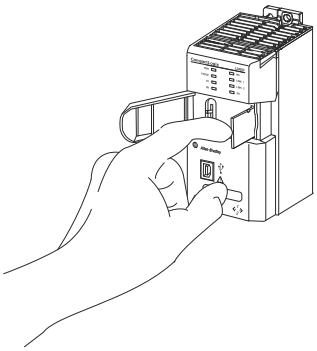


3. Insert the SD card into the SD card slot.

   You can install the SD card in one orientation only. The beveled corner should be at the top. An orientation logo is printed on the card.

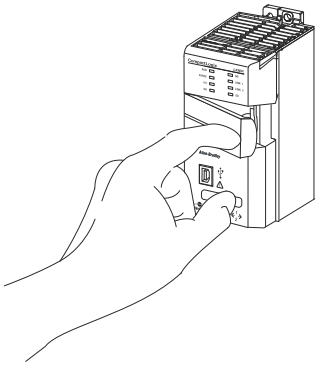
   If you feel resistance when inserting the SD card, pull it out and change the orientation.

4. Gently press the card until it clicks into place.



32164-M

5. Close the SD card door.



32165-M

We recommend you keep the SD card door closed during normal system operation. For more information on using the SD card, see Use a Secure Digital Card on page 301.

# Install the System

Complete the following steps to install the CompactLogix 5370 L3 control system.

- Assemble the System
- Mount the System
- Ground the System
- Connect Power to the Control System

## Assemble the System

You can attach an adjacent Compact I/O module or 1769 Compact I/O power supply to a CompactLogix 5370 L3 controller before or after mounting. For mounting instructions, see Ground the System on page 69 or Mount the Controller on a Panel on page 70.

**ATTENTION:** Do not remove or replace this module while power is applied. Interruption of the backplane can result in unintentional operation or machine motion.

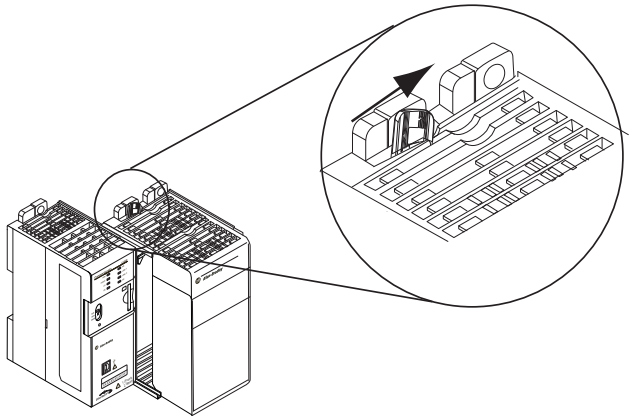
**WARNING:** Remove power before removing or inserting this module. If you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

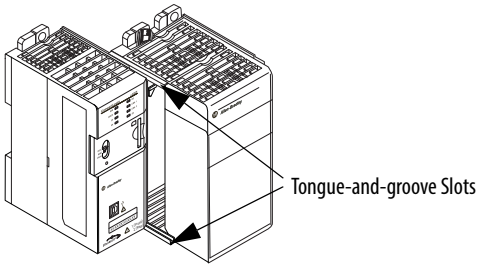
This section describes how to assemble a local bank.

Complete these steps to install the controller. This example describes how to attach a 1769 Compact I/O power supply to the controller.

1. Verify line power is disconnected.
2. Make sure that the bus lever of the 1769 Compact I/O power supply is in the unlocked position, that is, leaning to the right.

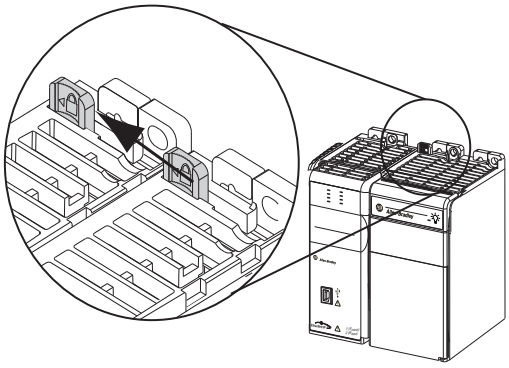


3. Use the upper and lower tongue-and-groove slots to secure the controller and power supply together.




4. Move the power supply back along the tongue-and-groove slots until the bus connectors line up with each other.
5. Use your fingers or a small screwdriver to push the power supply's bus lever back slightly to clear the positioning tab.

6. Move the power supply's bus lever fully to the left until it clicks; making sure it locks.



7. If your system does not use any local expansion modules, use the tongue-and-groove slots described earlier to attach a 1769-ECR Compact I/O end cap terminator to the last module in the system.

| | |
|---|---|
| **IMPORTANT** | You must install an end cap onto the right side of the CompactLogix 5370 L2 controller system either at the end of the controller or at the end of any local expansion modules that may be installed onto the controller.<br>The covering covers the exposed interconnections on the right side of the controller. Failure to use a protective covering could result in equipment damage or injury from electric shock. |

8. Wire the 1769 Compact I/O power supply according to the directions in the Compact I/O Expansion Power Supplies installation instructions, publication 1769-IN028.

   If you are using local expansion modules, see Local Expansion Modules on page 238.

## Mount the System

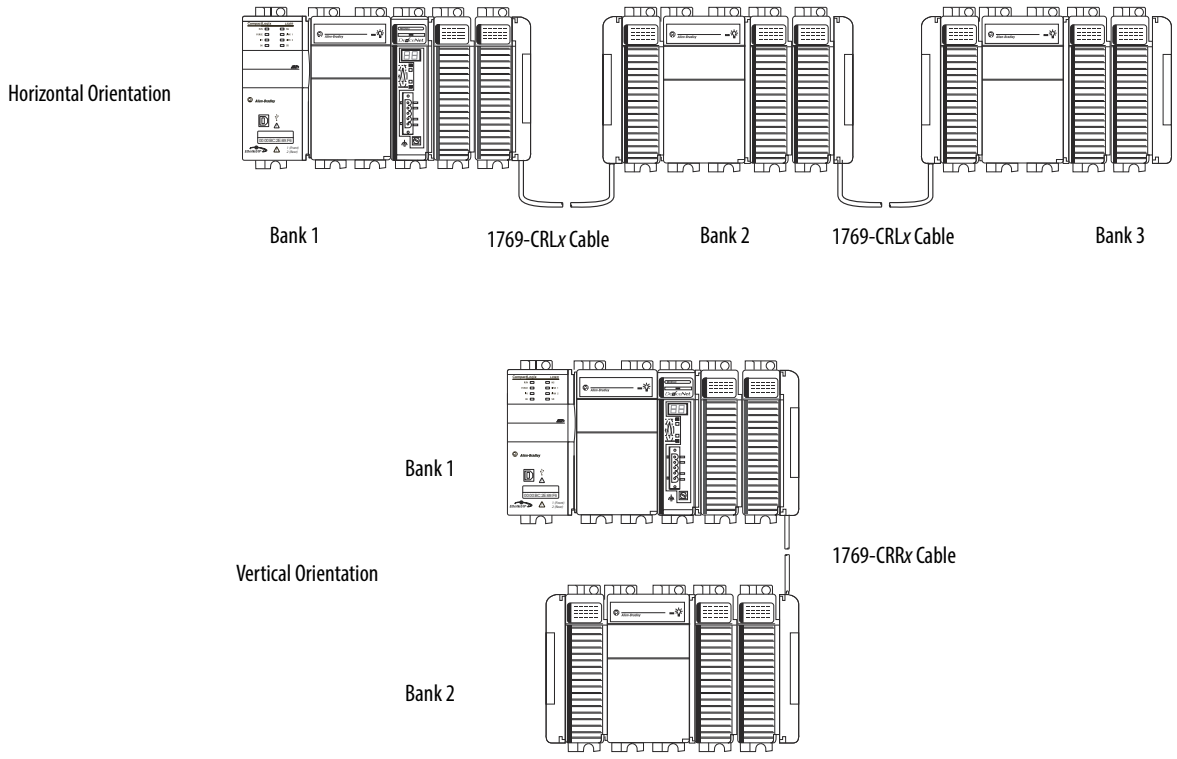
You can mount a CompactLogix 5370 L3 control system on a DIN rail or on a panel.

**ATTENTION:** During panel or DIN rail mounting of all devices, be sure that all debris (such as metal chips or wire strands) is kept from falling into the controller. Debris that falls into the controller could cause damage while the controller is energized.

A CompactLogix 5370 L3 control system must be mounted so that the modules are horizontal to each other. If you separate modules into multiple banks, the banks can be vertical or horizontal to each other.

The following example shows example systems with local expansion modules included.

**Figure 1 - Example CompactLogix 5370 L3 Control Systems**

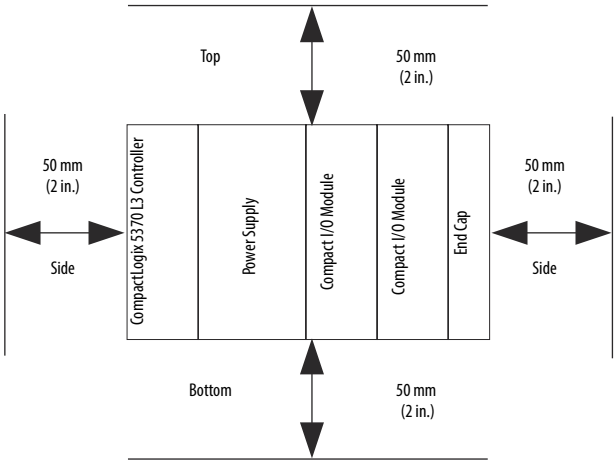


Before you mount a CompactLogix 5370 L3 control system, consider the following:

- Minimum Spacing
- System Dimensions
- Power Supply Distance Rating

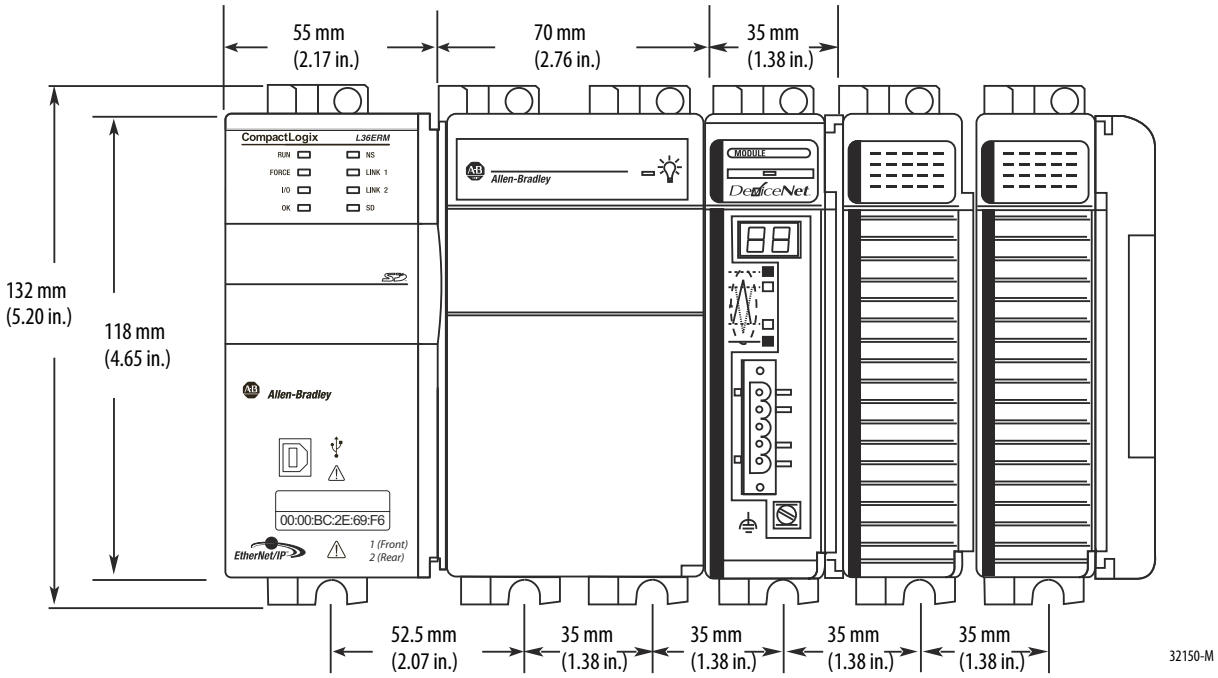
### *Minimum Spacing*

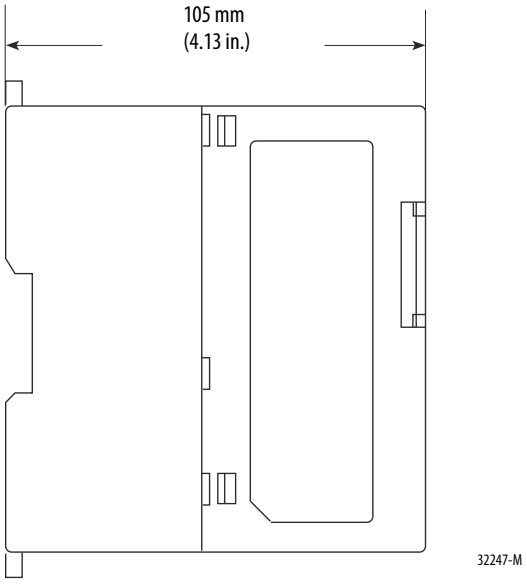
Maintain spacing from enclosure walls, wireways, and adjacent equipment. Allow 50 mm (2 in.) of space on all sides, as shown. This provides ventilation and electrical isolation.



### *System Dimensions*

This graphic shows the system dimensions.



*Power Supply Distance Rating*

CompactLogix 5370 L3 controllers, Compact I/O modules, and the Compact I/O 1769-SDN DeviceNet scanner module have power supply distance ratings. Power supply distance ratings determine how many slots in a bank that a device can be from the power supply.

For example, a product with a power supply distance rating of four can only have up to three slots between it and the power supply.

| Device | Power Supply Distance Rating |
|---|---|
| CompactLogix 5370 L3 controller<br>1769 Compact I/O DeviceNet scanner | 4 |
| Compact I/O module | 4…8, depending on module<br>For more information about the power supply distance rating for a Compact I/O module, see CompactLogix Selection Guide, publication 1769-SG001 |

CompactLogix 5370 L3 controllers must be the leftmost device in the control system, and the system only allows up to three modules between the controller and the power supply. Power supply distance ratings are more critical for other modules that might be installed with the CompactLogix 5370 L3 control system:

- For more information on considering a 1769-SDN scanner module's power supply distance rating when designing a CompactLogix 5370 L3 control system, see Power Supply Distance Rating on page 134.
- For more information on considering a Compact I/O module's power supply distance rating when designing a CompactLogix 5370 L3 control system, see Power Supply Distance Rating on page 250.

## Ground the System

**ATTENTION:** This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the power supply's mounting tabs or DIN rail (if used) are not required unless the mounting surface cannot be grounded.

Refer to Industrial Automation Wiring and Grounding Guidelines, Rockwell Automation publication 1770-4.1, for additional information.

For more information, refer to the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

### *Mount the Controller on a Panel*

Use two M4 or #8 panhead screws to mount the controller. Mounting screws are required on every module. Use this procedure to use the assembled modules as a template for drilling holes in the panel.

**IMPORTANT** Due to module mounting hole tolerance, it is important to follow these procedures.

1. On a clean work surface, assemble no more than three modules.
2. Using the assembled modules as a template, carefully mark the center of all module-mounting holes on the panel.
3. Return the assembled modules to the clean work surface, including any previously mounted modules.
4. Drill and tap the mounting holes for the recommended M4 or #8 screw.
5. Place the modules back on the panel and check for proper hole alignment.

   **TIP** The grounding plate, that is, where you install the mounting screws, grounds the module when it is panel-mounted.

6. Use the mounting screws to attach the modules to the panel.

   **TIP** If you are mounting more modules, mount only the last one of this group and put the others aside. This reduces remounting time when you are drilling and tapping the next group of modules.

7. Repeat steps 1…6 for any remaining modules.

*Mount the Controller on the DIN Rail*

You can mount the controller on the following DIN rails:

- EN 50 022 - 35 x 7.5 mm (1.38 x 0.30 in.)
- EN 50 022 - 35 x 15 mm (1.38 x 0.59 in.)

**ATTENTION:** This product is grounded through the DIN rail to chassis ground. Use zinc plated yellow-chromate steel DIN rail to assure proper grounding. The use of other DIN rail materials (for example, aluminum or plastic) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding. Secure DIN rail to mounting surface approximately every 200 mm (7.8 in.) and use end-anchors appropriately.

1. Before mounting the controller on a DIN rail, close the controller's DIN rail latches.
2. Press the DIN rail mounting area of the controller against the DIN rail.

   The latches momentarily open and lock into place.

## Connect Power to the Control System

Connect power to the CompactLogix 5370 L3 control system based on 1769 Compact I/O power supply your application uses. For more information on connecting power to your CompactLogix 5370 L3 control system, see the Compact I/O Expansion Power Supplies Installation Instructions, publication 1769-IN028.

## Connect to the Controller via a USB Cable

The controller has a USB port that uses a Type B receptacle. The port is USB 2.0-compatible and operates at 12 Mbps.

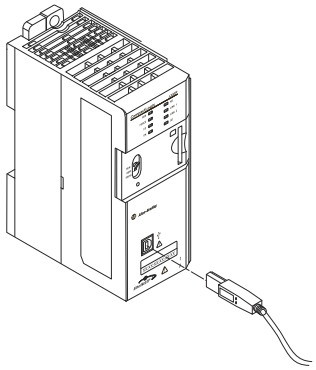
Use a USB cable to connect your computer to the USB port. With this connection, you can upgrade firmware and download programs to the controller directly from your computer.

**ATTENTION:** The USB port is intended for temporary local programming purposes only and not intended for permanent connection.

The USB cable is not to exceed 3.0 m (9.84 ft) and must not contain hubs.

**WARNING:** Do not use the USB port in hazardous locations.

Plug the USB cable into the CompactLogix 5370 L3 controller as shown.



32152-M

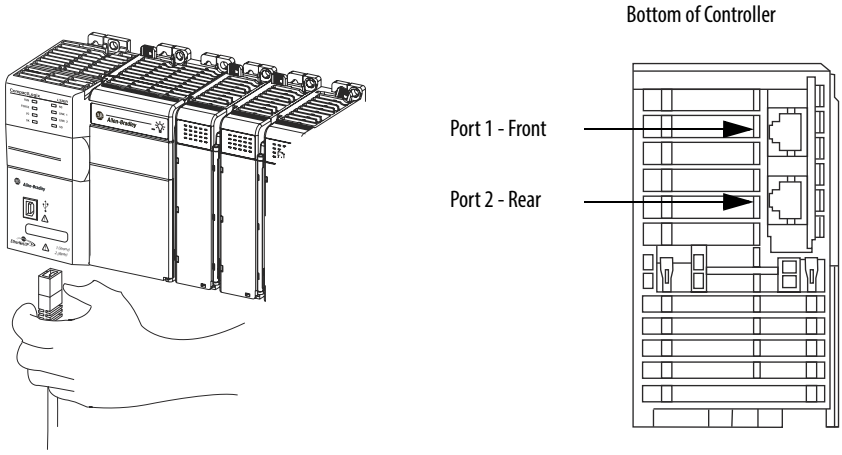
## Connect the Controller to an EtherNet/IP Network

**WARNING:** If you connect or disconnect the communications cable with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

Connect the RJ45 connector of the Ethernet cable to one of the Ethernet ports on the controller. The ports are on the bottom of the controller.

**ATTENTION:** Do not plug a DH-485 network cable or a NAP cable into the Ethernet port. Undesirable behavior and/or damage to the port may result.




**IMPORTANT** This example shows how to connect the controller to the network through one port. Depending on your application's EtherNet network topology, you might connect both ports of the controller to the EtherNet/IP network.

For more information on EtherNet/IP network topologies, see page 120.

## Connecting to Different EtherNet/IP Network Topologies

The CompactLogix 5370 L3 controllers have embedded switch technology and two EtherNet/IP ports that let you to use it in different EtherNet/IP network topologies:

- Device-level Ring network topology - Both ports on the controller are connected to the network with requirements about how the connections are made.
- Linear network topology - Both ports on the controller are connected to the network with requirements about how the connections are made.
- Star network topology - One port on the controller is connected to the network.

For more information, see EtherNet/IP Network Topologies on page 120.

# Complete Software Tasks Required at CompactLogix 5370 Controller Installation


| Topic | Page |
|---|---|
| Set a Controller's IP Address | 77 |
| Change a Controller's IP Address | 89 |
| Load the Controller Firmware | 93 |
| Select the Controller's Operating Mode | 103 |


To complete the tasks described in this chapter, you must have the software described in the following table installed on your computer.

| Software | Required Version |
|---|---|
| RSLinx® Classic | 2.59.00 or later(1) |
| RSLogix 5000 | 20.*xx.xx* - For CompactLogix 5370 controllers using firmware revision 20.*xxx*. |
| Studio 5000 environment | 21.00.00 or later - For CompactLogix 5370 controllers using firmware revision 21.000 or later. |
| BOOTP-DHCP server | Most current version is installed with RSLinx Classic software installation |
| ControlFLASH™ | Installed with the installation of either of the following:<br>• RSLogix 5000 software, version 20.*xx.xx*<br>• Studio 5000 environment, version 21.00.00 or later |

(1) CompactLogix 5370 L2 controllers require RSLinx Classic software, version 2.59.01 or later.

CompactLogix 5370 controllers require a network Internet Protocol (IP) address to operate on an EtherNet/IP network.

The IP address uniquely identifies the controller. The IP address is in the form *xxx.xxx.xxx.xxx* where each *xxx* is a number from 000…254 with some exceptions for reserved values. These numbers are **examples** of reserved values you cannot use:

- 000.*xxx.xxx.xxx*
- 127.*xxx.xxx.xxx*
- 224 to 255.*xxx.xxx.xxx*

Some other specific values are reserved based on an application-by-application basis.

Depending on system conditions, you may need to complete one of these tasks:

- **Set** the IP address for a controller that does not have one assigned.
- **Change** the IP address for a controller that already has an IP address assigned to it.

| **IMPORTANT** | CompactLogix 5370 controllers have two EtherNet/IP ports to connect to an EtherNet/IP network. The ports carry the same network traffic as part of the controller's embedded switch. However, the controller uses only one IP address. |
|---|---|

## Set a Controller's IP Address

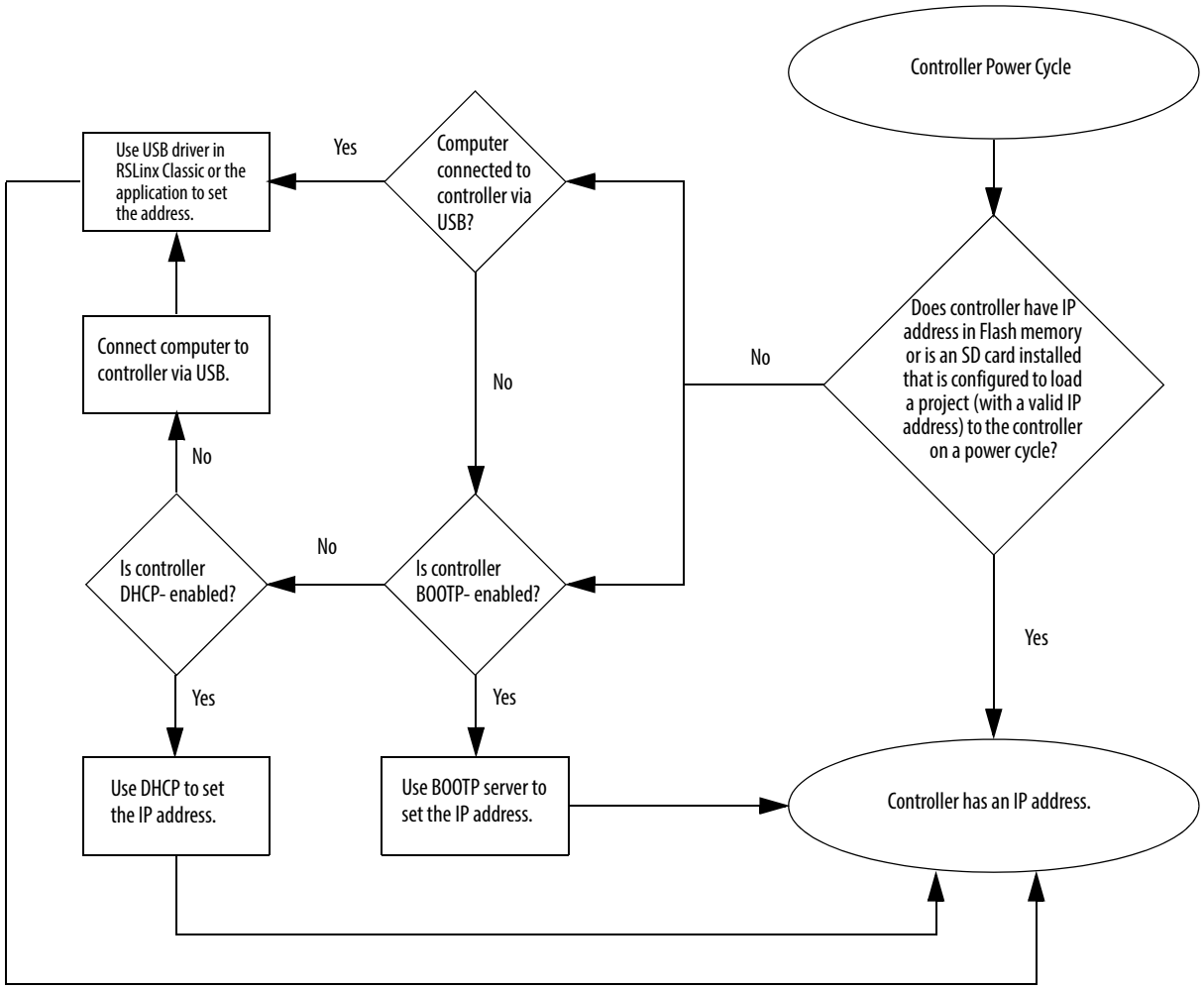
You must set a CompactLogix 5370 controller's IP address when the controller powers up for the first time, that is, when commissioning the controller for the first time. You are not required to set an IP address each time power is cycled to the controller.

You can use these tools to **set** a CompactLogix 5370 controller's IP address:

- Bootstrap Protocol (BOOTP) server
- Dynamic Host Configuration Protocol (DHCP) server
- RSLinx Classic software
- Logix Designer application
- SD card

**IMPORTANT** Each tool has connection requirements to set the controller's IP address via that tool. For example, your computer must be connected to the controller via a USB cable to set the controller's initial IP address with RSLinx Classic software or the application.

This graphic describes how to set your CompactLogix 5370 controller's IP address on a power cycle during initial installation or after operation has begun.



## Use the BOOTP Server to Set the Controller's IP Address

Bootstrap Protocol (BOOTP) is a protocol that allows the controller to communicate with a BOOTP server. The server can be used to assign an IP address. You can use the BOOTP server to set an IP address for your CompactLogix 5370 controller.

Consider these points when using the BOOTP server:

- The BOOTP server is installed automatically when you install RSLinx Classic or RSLogix 5000 software on your computer. The BOOTP server sets an IP address and other Transmission Control Protocol (TCP) parameters.
- A CompactLogix 5370 controller ships from the factory without an IP address and BOOTP-enabled.
- This section describes how to use a BOOTP/DHCP server offered by Rockwell Automation. If you use a different BOOTP/DHCP server, contact your network administrator to verify you are using it correctly.
- To use the BOOTP server, your computer and the controller must be connected to the same EtherNet/IP network.
- If the controller is BOOTP-disabled, you cannot use the BOOTP server to set the IP address.

There are two conditions in which the CompactLogix 5370 controllers use the BOOTP servers to set the controller's IP address:

- **Initial powerup** - Because the CompactLogix 5370 controller ships with BOOTP-enabled, when it is first powered up, the controller sends a request for an IP address on the EtherNet/IP network. You can use the BOOTP server to set the IP address, as described later in this section.
- **Powerup after controller operation has begun** - When controller power is cycled after operation has begun, the BOOTP/DHCP server sets the IP address if either of these conditions exists:
  - Controller is BOOTP-enabled - You set the IP address manually with the BOOTP server.
  - Controller is DHCP-enabled - The IP address is set automatically via the DHCP server.

Access the BOOTP/DHCP utility from one of these locations:

- Start>Programs>Rockwell Software>BOOTP-DHCP Server

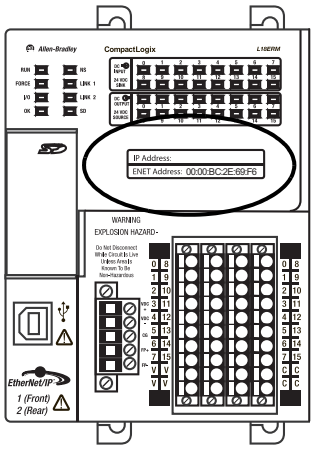
  If you have not installed the utility, you can download and install it from http://www.ab.com/networks/ethernet/bootp.html.

- Tools directory on the programming software installation CD

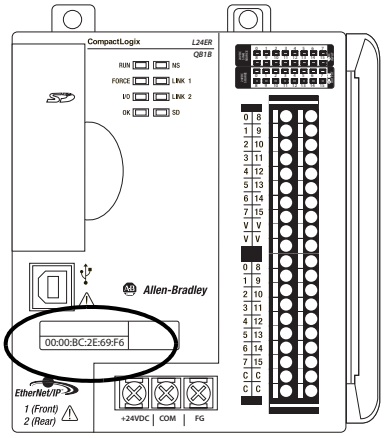
**IMPORTANT** Before you start the BOOTP/DHCP utility, make sure you have the controller's hardware (MAC) address. The hardware address is on the front of the controller and uses an address in a format similar to the following:

00:00:BC:2E:69:F6

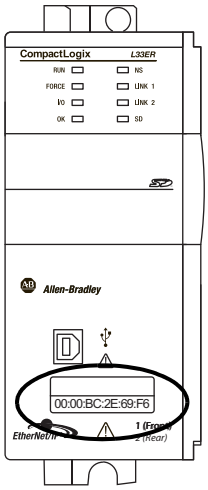
1769-L18ERM-BB1B Controller




1769-L24ER-QB1B Controller

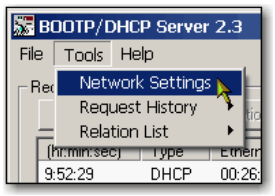



1769-L33ER Controller

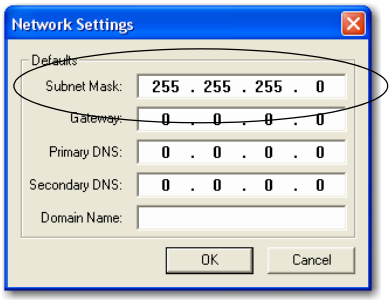


Complete these steps to set the controller's IP address with the BOOTP/DHCP server.

1. Choose Start>Programs>Rockwell Software>BOOTP/DHCP Server>BOOTP/DHCP Server.
2. From the Tools menu, choose Network Settings.




3. Type the Subnet Mask of the network.

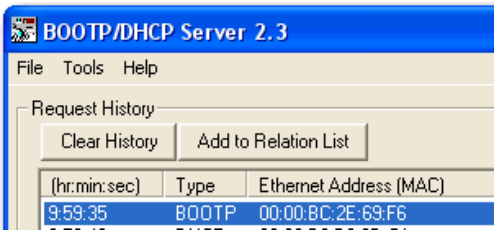



The Gateway address, Primary and/or Secondary DNS address, and Domain Name fields are optional.

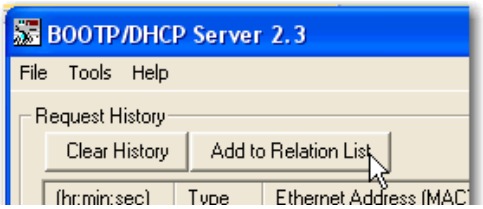
4. Click OK.

The Request History panel appears with the hardware addresses of all devices issuing BOOTP or DHCP requests.

5. Select the line with the same MAC address as your controller.

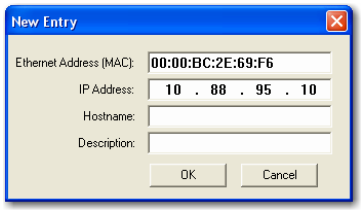


6. Click Add to Relation List.

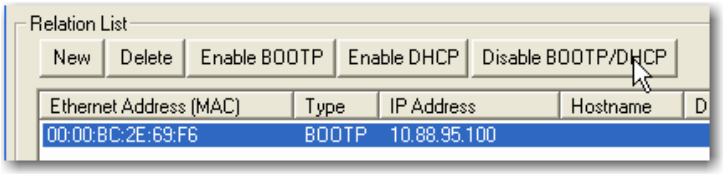



The New Entry dialog box appears.

7. Type an IP Address, Hostname, and Description for the controller.




8. Click OK.
9. To permanently assign this configuration to the controller, wait for the controller to appear in the Relation List panel and select it.
10. Click Disable BOOTP/DHCP.




When power is cycled, the controller uses the assigned configuration and does not issue a BOOTP request.

| **IMPORTANT** | If you do not click Disable BOOTP/DHCP, on a power cycle, the host controller clears the current IP configuration and begins sending BOOTP requests again. |
|---|---|

## Use the DHCP Server to Set the Controller's IP Address

Dynamic Host Configuration Protocol (DHCP) server automatically assigns IP addresses to client stations logging onto a TCP/IP network. DHCP is based on BOOTP and maintains some backward compatibility. The main difference is that BOOTP allows for manual configuration (static), while DHCP allows for both static and dynamic allocation of network addresses and configurations to newly attached controllers.

Be cautious when using the DHCP server to configure a controller. A BOOTP client, such as the CompactLogix 5370 controllers, can start from a DHCP server only if the DHCP server is specifically written to also handle BOOTP queries. This is specific to the DHCP server used. Consult your system administrator to see if a DHCP server supports BOOTP commands and manual IP allocation.

**ATTENTION:** The CompactLogix 5370 controllers should be assigned a fixed network address. The IP address of this controller should not be dynamically provided.

Failure to observe this precaution may result in unintended machine motion or loss of process control.

If you use the Rockwell Automation BOOTP or DHCP server in an uplinked subnet where a DHCP server exists, a controller may get an address from the enterprise server before the Rockwell Automation utility even sees the controller. You might have to disconnect from the uplink to set the address and configure the controller to retain its static address before reconnecting to the uplink.

## Use RSLinx Classic Software to Set the Controller's IP Address

You can use RSLinx Classic software to set the CompactLogix 5370 controller's IP address.

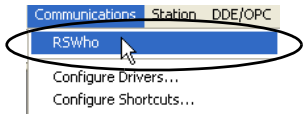
**IMPORTANT** To set the IP address, that is, assign an IP address to a controller that does not have one, for a CompactLogix 5370 controller via RSLinx Classic software, you must be connected to your controller via the USB port.

Complete these steps to set the controller's IP address with RSLinx Classic software.

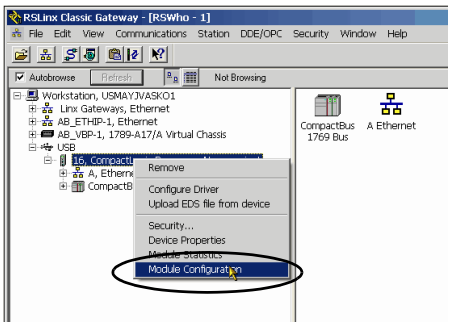
**IMPORTANT** These steps show a 1769-L36ERM controller. The same steps apply to other CompactLogix 5370 controllers with slight variations in screens.

1. Make sure a USB cable is connected to your computer and the controller.
2. Start RSLinx Classic software.

   After several seconds, an RSWho dialog box should appear.
3. If no RSWho dialog box appears, from the Communications pull-down menu, choose RSWho.




   The RSWho dialog box appears and includes the USB driver.
4. Navigate to the USB network.
5. Right-click the controller and choose Module Configuration.

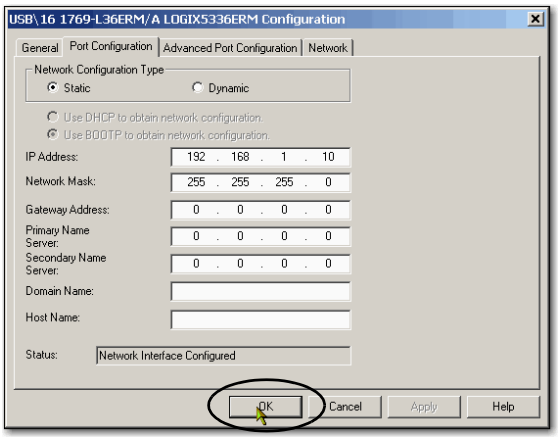



   The Module Configuration dialog box appears.

6. Click the Port Configuration tab.
7. For Network Configuration Type, click Static to permanently assign this configuration to the port.

| **IMPORTANT** | If you click Dynamic, on a power cycle, the controller clears the current IP configuration and resumes sending BOOTP requests or DHCP requests, depending on the controller configuration. |
|---|---|

8. Type the new IP address and Network Mask




9. Click OK.

As with all configuration changes, if desired, make sure you are using the SD card in a way that it will not overwrite the IP address at the next controller power cycle.

For more information on using the SD card, see Chapter 12, Use a Secure Digital Card on page 301.

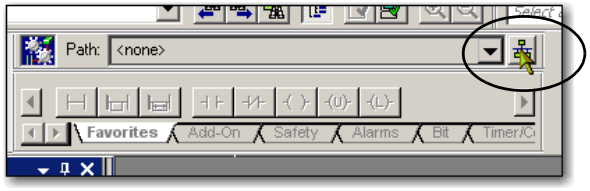
## Use Logix Designer Application to Set the Controller's IP Address

You can use Logix Designer application to set a CompactLogix 5370 controller's IP address. To set the IP address via the application, you must be connected to your controller via the USB port.

Complete these steps to set the controller's IP address.

**IMPORTANT** These steps show a 1769-L18ERMBB1B controller. The same steps apply to other CompactLogix 5370 controllers with slight variations in screens.

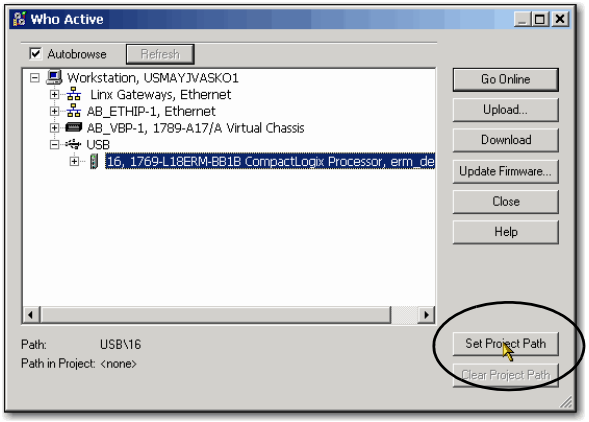
1. Start the application.
2. Set the Project Path.
   a. Click RSWho.



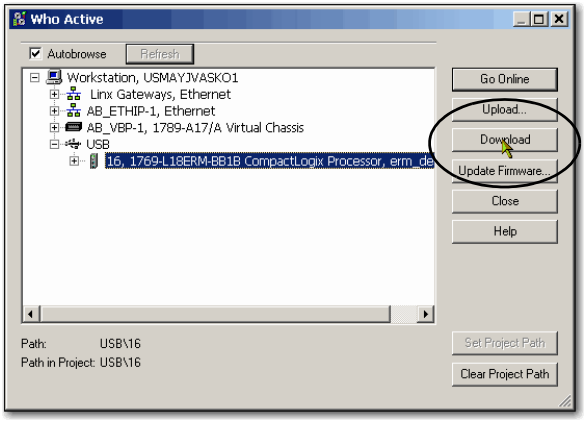

   The RSWho dialog box appears.

   b. Navigate over the USB network and select the CompactLogix 5370 controller.

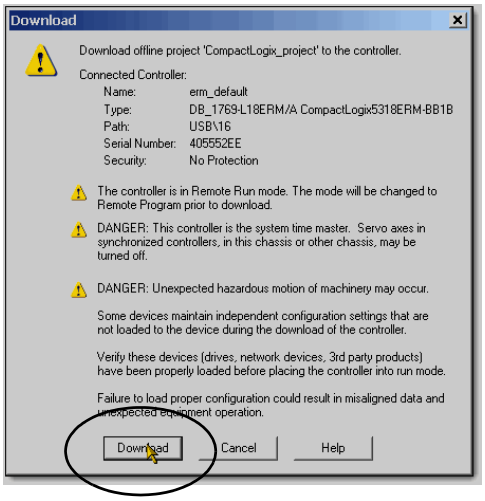
   c. Click Set Project Path.



3. Click Download.

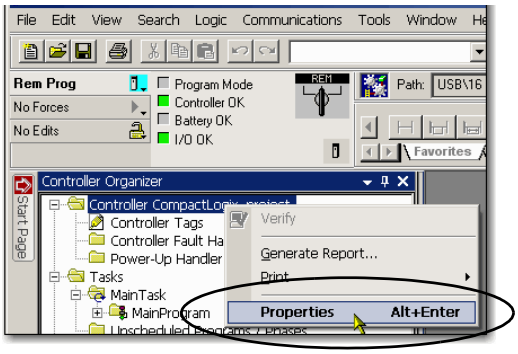



4. Click Download again.



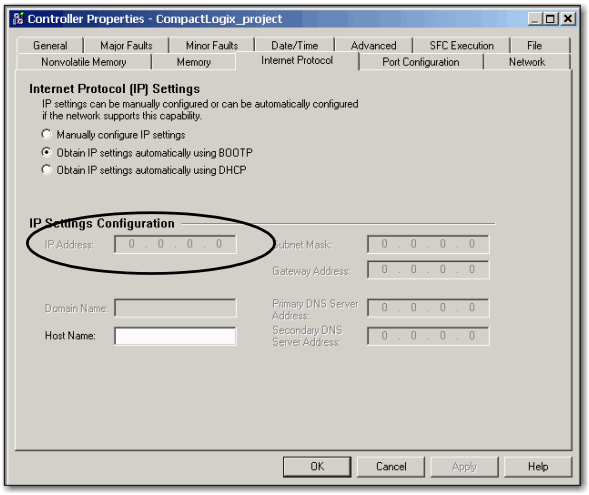

The new project is downloaded to the controller and the project goes online, in either Remote Program or Program mode.

5. Right-click the controller name and choose Properties.

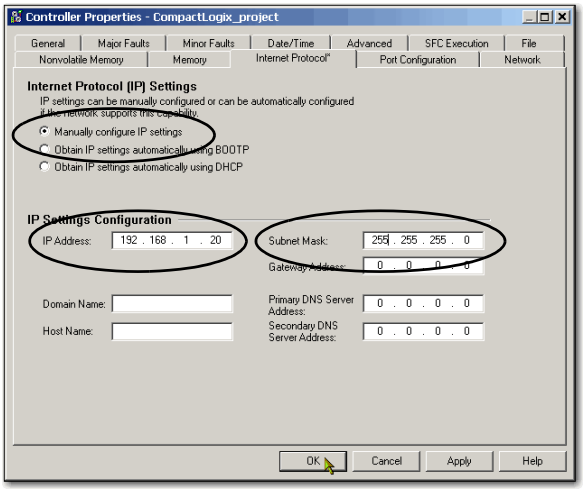


6. On the Controller Properties dialog box, click the Internet Protocol tab.

   The IP Settings Configuration values show the controller has no IP address assigned to it.




7. Click Manually configure IP settings.
8. Enter desired IP address and other configuration information and click OK.




9. When prompted to confirm the IP address setting, click Yes.

The controller now uses the newly-set IP address.

## Use the SD Card to Set the Controller's IP Address

You can use an SD card to set the IP address for a CompactLogix 5370 controller. Using the SD card to set the IP address eliminates the need for software to complete this task.

| | |
|---|---|
| **IMPORTANT** | Setting the IP address from an SD card does not require software during the power-up process. However, you must have previously saved the project to the SD card.<br>The option to set a CompactLogix 5370 controller's IP address via an SD card at power-up is only one part of loading an entire project to the controller from the SD card.<br>Use this option carefully. For example, the SD card may contain a desirable IP address as part of an undesirable project, for example, a project that is older than the project currently used on the controller. |

These requirements apply when using the SD card to set the IP address on a CompactLogix 5370 controller:

- A project must already be stored on the SD card.
- The project stored on the SD card is configured with the Load Image parameter set to On Power Up.

For more information on using the SD card, see Chapter 12, Use a Secure Digital Card on page 301.

## Change a Controller's IP Address

You may need to **change** a CompactLogix 5370 controller's IP address after system operation has begun. In this case, the controller already has a valid IP address assigned to it but you need to change that IP address.

You can use these tools to change a controller's IP address:

- RSLinx Classic software
- Logix Designer application
- SD card

**IMPORTANT** You **cannot** use any of these tools to **change** a controller's IP address:

- Bootstrap Protocol (BOOTP) server
- Dynamic Host Configuration Protocol (DHCP) server

Consider these factors when you determine how to change the controller's IP address:

- Network isolation from, or integration into, the plant/enterprise network
- Network size - For large, isolated networks, it might be more convenient and safer to use a BOOTP/DHCP server rather than RSLogix 5000 or RSLinx Classic software. A BOOTP/DHCP server limits the possibility of assigning duplicate IP addresses.

  However, you can use the BOOTP/DHCP server only to **set** the controller's IP address and not to change it. If you decide to change the controller's IP address and want to use a BOOTP/DHCP server so as to limit the possibility of assigning duplicate IP addresses, you must first clear the IP address.

  After clearing the IP address, use the steps described at Use the BOOTP Server to Set the Controller's IP Address on page 78 or Use the DHCP Server to Set the Controller's IP Address on page 82 to set the controller's IP address.
- Company policies and procedures dealing with plant floor network installation and maintenance
- Level of involvement by IT personnel in plant-floor network installation and maintenance
- Type of training offered to control engineers and maintenance personnel

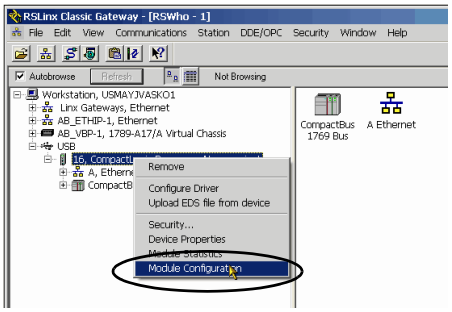
## Change the Network IP Address with RSLinx Classic Software

**IMPORTANT** The steps in Use RSLinx Classic Software to Set the Controller's IP Address on page 83 describe how to assign an IP address for a CompactLogix 5370 controller that does not have a valid IP address.

The steps in this section describe how to change the IP address on a CompactLogix 5370 controller that already has a valid IP address assigned to it.

The graphics in this section show how to change the IP address for a 1769-L36ERM controller. The same steps apply to other CompactLogix 5370 controllers with slight variations in screens.

1. Right-click the controller and choose Module Configuration.

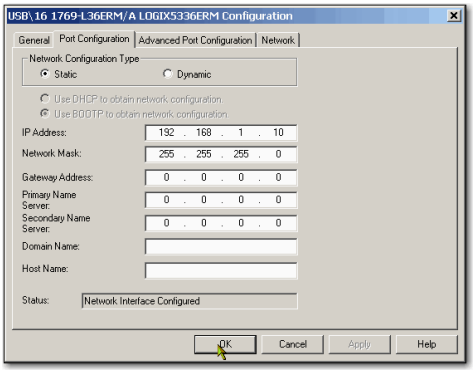



2. Click the Port Configuration tab when the Module Configuration dialog box appears.

   The controller has a valid IP address and Network Configuration Type.

3. Type a new IP address and make any other desired changes.
4. To permanently assign this configuration to the controller, click Static in the Network Configuration Type section of the dialog box.

**IMPORTANT** If you click Dynamic, on a power cycle, the controller clears the current IP configuration and resumes sending BOOTP or DHCP requests, depending on the controller configuration.




5. Click OK.

## Change the Network IP Address with Logix Designer Application

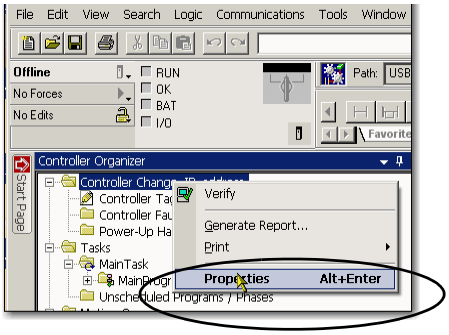
**IMPORTANT** The steps in Use Logix Designer Application to Set the Controller's IP Address on page 85 describe how to **assign an IP address** for a CompactLogix 5370 controller that does not have a valid IP address.

The steps in this section describe how to **change the IP address** on a CompactLogix 5370 controller that already has a valid IP address assigned to it.

You can change a CompactLogix 5370 controller's IP address via Logix Designer application over a USB or EtherNet/IP network connection.

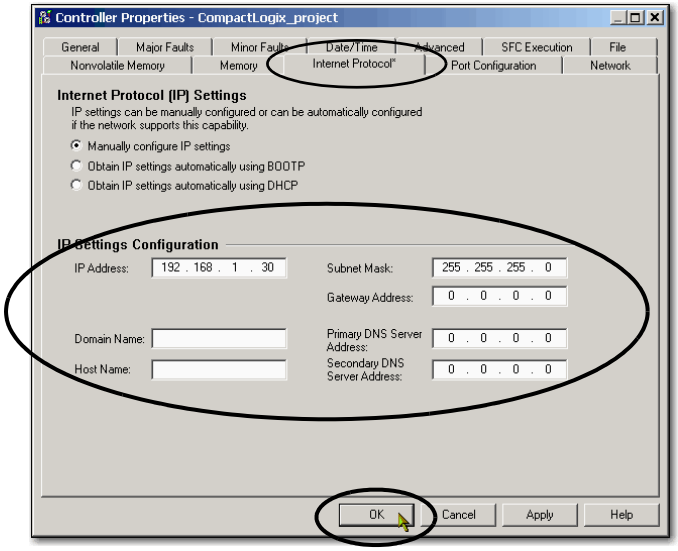
The graphics in this section show how to change the IP address for a 1769-L18ERM-BB1B controller over a USB connection. The same steps apply to other CompactLogix 5370 controllers with slight variations in screens.

1. Verify that your computer is connected to the controller.
2. Verify that your project is online.
3. Right-click the controller name and choose Properties.




You could also right-click the Ethernet node in the I/O Configuration section and choose Properties. The Controller Properties dialog box appears on the Internet Protocol tab.

4. Change the controller's IP address.
5. Make other changes where necessary.




6. Click OK.

## Change the Network IP Address with an SD Card

You can use an SD card to change the IP address for a CompactLogix 5370 controller when controller power is cycled. Using the SD card to change the IP address eliminates the need for software to complete this task.

| **IMPORTANT** | Setting the IP address from an SD card does not require software during the power-up process. However, you must have previously saved the project to the SD card. |
|---|---|

These requirements apply when using the SD card to change the IP address on a CompactLogix 5370 controller:

- A project is stored on the SD card.
- The project stored on the SD card includes a different IP address for the CompactLogix 5370 controller than the IP address currently in use on the physical controller housing the SD card.
- The project stored on the SD card is configured with the Load Image parameter set to On Power Up.
- Power is cycled to the controller with the SD card installed.

For more information on using the SD card, see Chapter 12, Use a Secure Digital Card on page 301.

## Load the Controller Firmware

You must download the current firmware before you can use the CompactLogix 5370 controller.

**IMPORTANT** Do not interrupt a firmware upgrade while it is in process. Doing so may cause the CompactLogix 5370 controller's firmware revision to revert to its out-of-the-box revision level, that is, 1.*xxx*.

To load firmware, you can use any of the following:

- ControlFLASH utility that installs with Logix Designer application
- AutoFlash that launches through the application when you download a project and the controller does not have the matching firmware revision
- SD card (catalog numbers 1784-SD1 or 1784-SD2) with an image already stored to the card

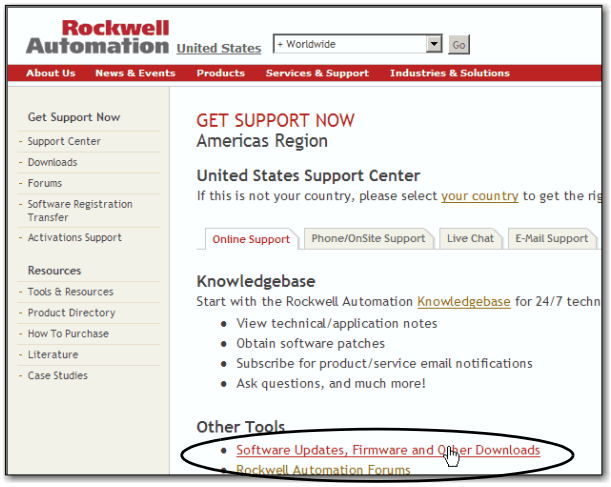
If you use the ControlFLASH or AutoFlash utilities, you need an EtherNet/IP network or USB connection to the controller.

**IMPORTANT** Be aware that the controller firmware revision loaded via the ControlFLASH utility or the AutoFlash option may be overwritten after future controller power cycles if the conditions described in Use the Secure Digital Card to Load Firmware on page 102 exist.

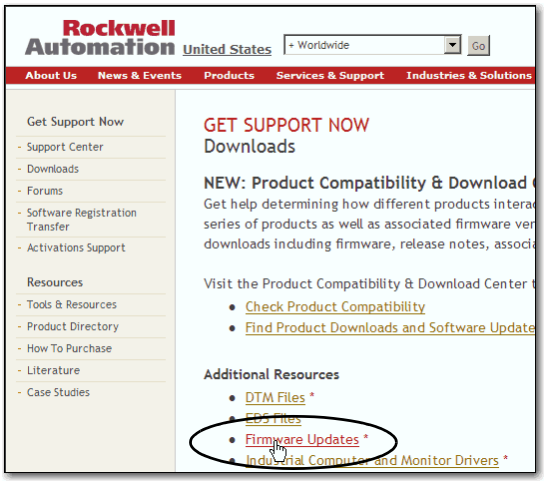
The firmware is available with the application or you can download it from the support website. Go to http://www.rockwellautomation.com/support.

Complete these steps to download firmware from the support website.

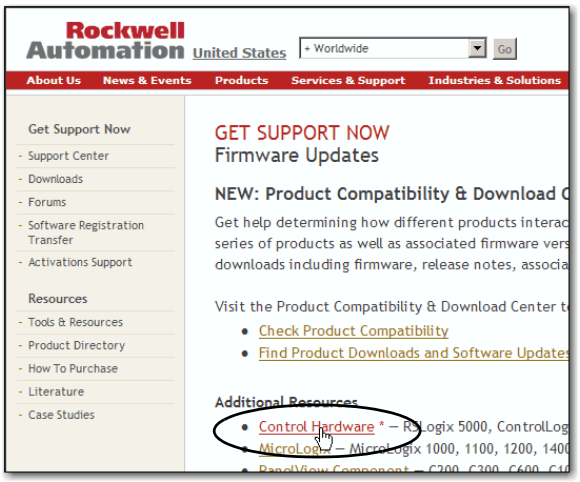
1. On the Rockwell Automation Support Page, click Software Updates, Firmware and Other Downloads under the Other Tools heading.



2. Click Firmware Updates.




3. Click Control Hardware.




4. Select the desired firmware revision.
5. Download the firmware zip file.

## Use the ControlFLASH Utility to Load Firmware

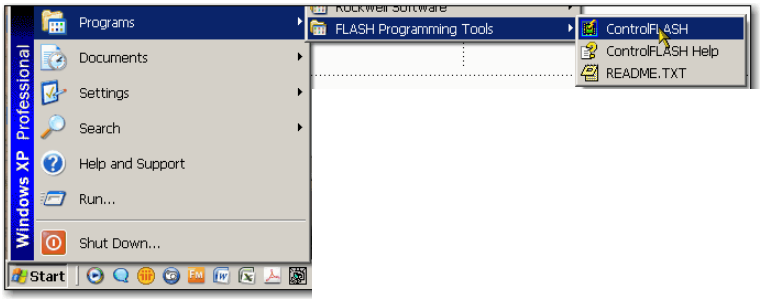
You can use the ControlFLASH utility to load firmware through a USB or EtherNet/IP network connection. We recommend the following when you load firmware via the ControlFLASH utility:

- Use a USB connection to load the firmware.
- Remove the SD card, if one is installed in the controller.

Complete these steps to use the ControlFLASH utility to load firmware.

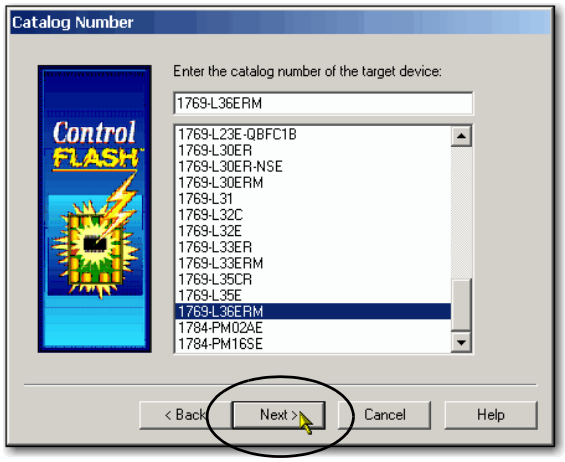
**IMPORTANT** These steps show a 1769-L36ERM controller. The same steps apply to other CompactLogix 5370 controllers with slight variations in screens.

1. Verify that a connection exists between your computer and the CompactLogix 5370 controller.
2. Choose Start>Programs>FLASH Programming Tools>ControlFLASH.

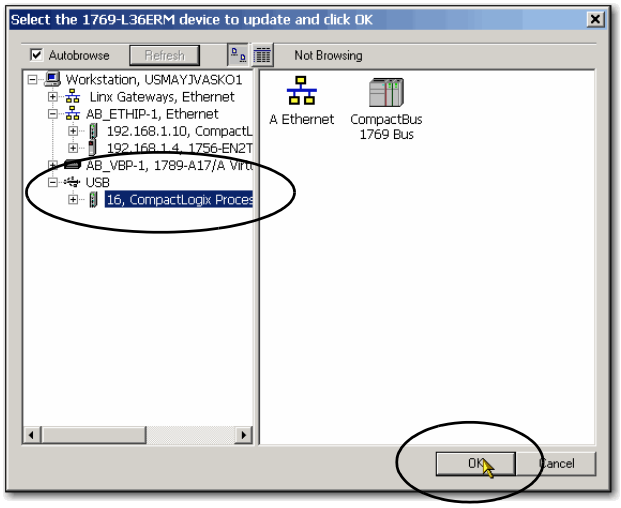



3. When the Welcome dialog box appears, click Next.

4. Choose the appropriate controller catalog number and click Next.

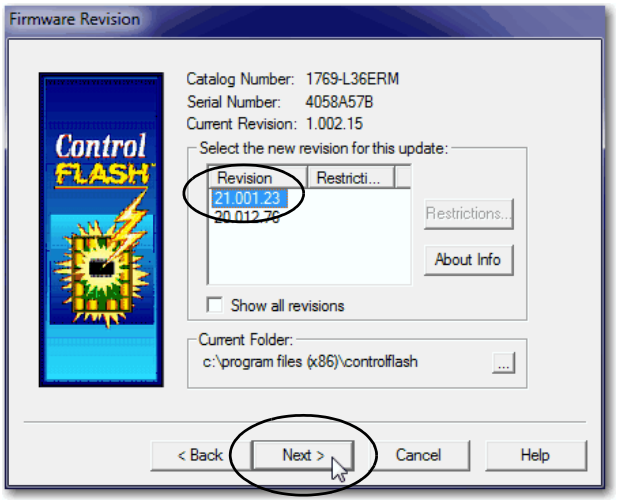



5. Expand the network until you see the controller.
6. Choose the controller at the first instance in which it appears, as shown below, and click OK.

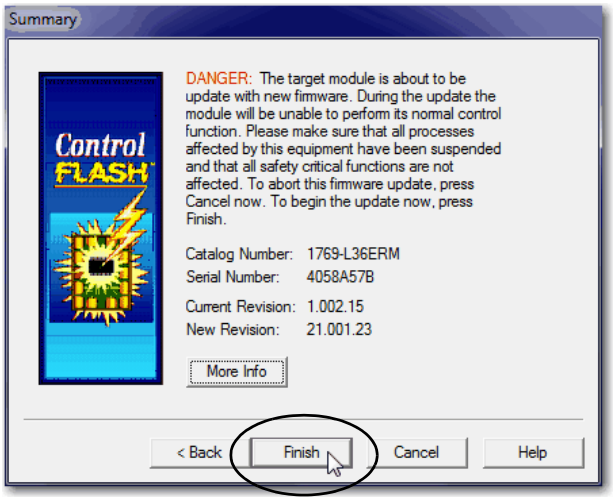


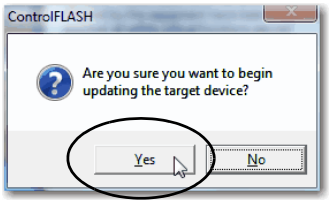

**IMPORTANT** If you expand the controller, that is, expand the network beyond the first instance in which it appears on the left side of the screen, you may experience issue when performing the firmware update.

7. Choose the revision level to which you want to update the controller and click Next.

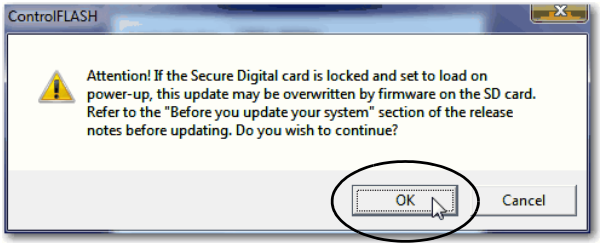



8. To start the update of the controller, click Finish and then click Yes.

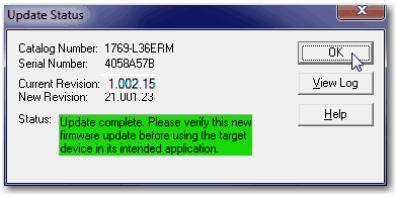


Before the firmware upgrade begins, you see the following dialog box. Take the appropriate action for your application. In this example, the upgrade continues when OK is clicked.




After the controller is updated, the status dialog box displays the message Update complete.




9. Click OK.
10. To close the ControlFLASH utility, click Cancel and then click Yes.

*Automatic Upgrade for CompactLogix 5370 L1 Embedded I/O Module*

**IMPORTANT** This section applies to CompactLogix 5370 L1 controllers only.

After the controller firmware upgrade process is complete, the controller may execute a firmware upgrade for its embedded I/O module.

Remember these points regarding the automatic firmware upgrade for the embedded I/O module:

- The firmware upgrade occurs on the embedded I/O module only, not the local expansion modules.

  If you need to update the firmware revision on any 1734 POINT I/O modules that will be used as local expansion modules, you must do so before installing them in the CompactLogix 5370 L1 control system.

- The firmware upgrade on the embedded I/O module occurs automatically. No user action is required.

- The upgrade process make take up to a few minutes to complete.

- During the firmware upgrade process, the controller's OK status indicator remains in a flashing red state.

- Do not cycle power to the controller while the firmware upgrade for embedded I/O module is taking place.

## Use AutoFlash to Load Firmware

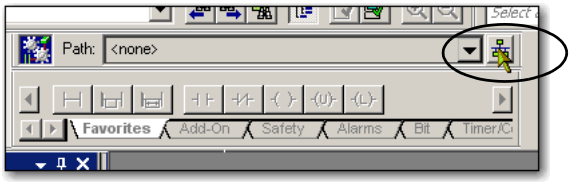
You can use AutoFlash to load firmware through a USB or EtherNet/IP network connection.

Let the upgrade complete without interruption.If you interrupt a firmware upgrade that is in process, you are alerted that an error has occurred. In this case, cycle power to the controller. The firmware revision level reverts to the 1.*xxx* revision level and you can begin the upgrade process again.

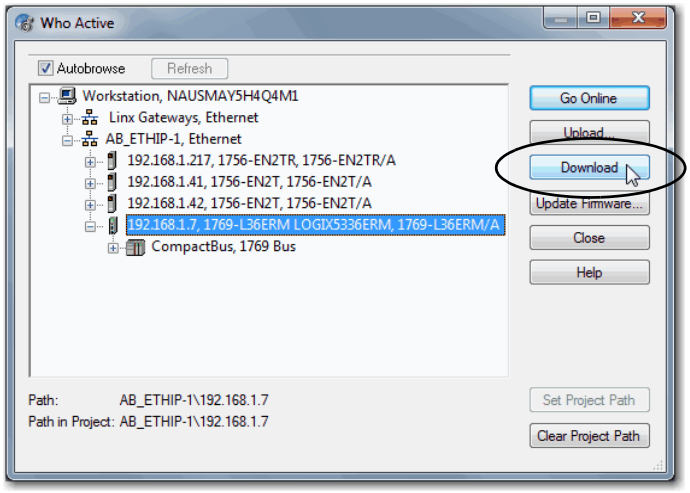
Complete these steps to use the AutoFlash utility to load firmware.

**IMPORTANT** These steps show a 1769-L36ERM controller. The same steps apply to other CompactLogix 5370 controllers with slight variations in screens.

1. Make sure the appropriate network connection is made and your network driver is configured in RSLinx Classic software.
2. Create a controller project.
3. Click RSWho to specify the controller path.



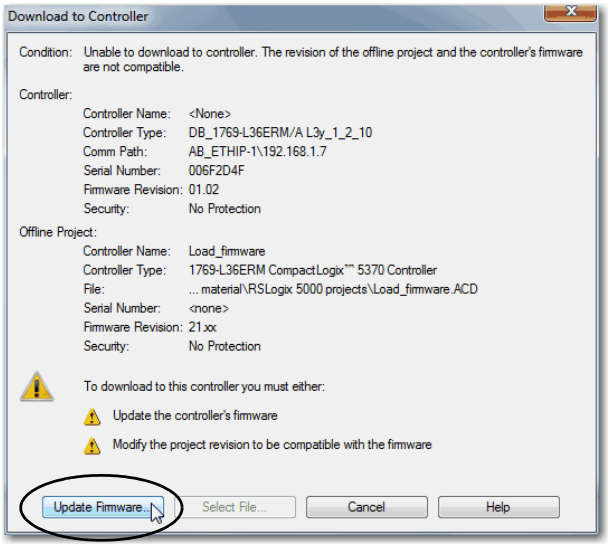

4. Select your controller and click Download.



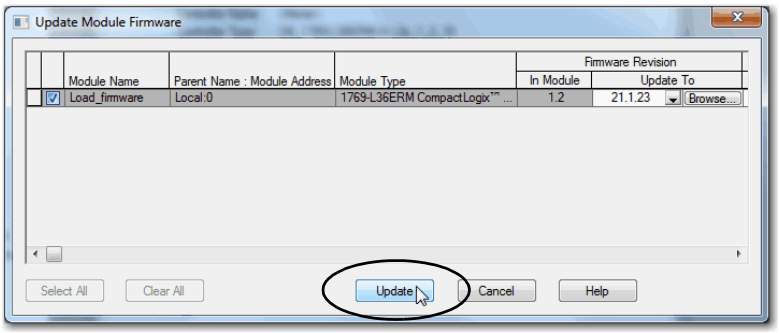

You may also choose to click Update Firmware to complete this process. If you do so, skip to step step 6.

A dialog box appears indicating that the project revision and controller firmware revision are different.

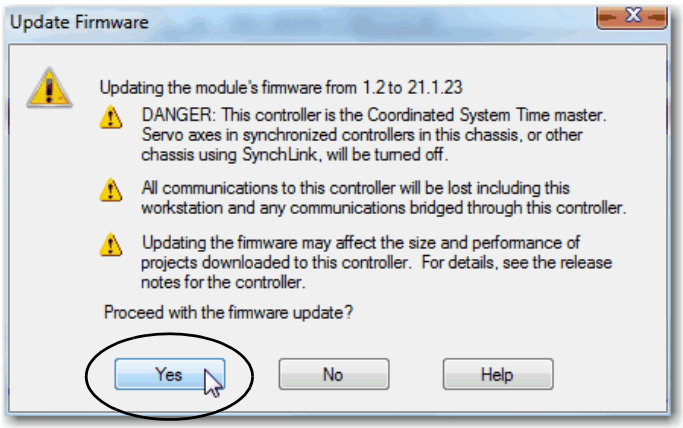
5. Click Update Firmware.




6. Use the checkbox and pull-down menu to choose your controller and firmware revision.
7. Click Update.



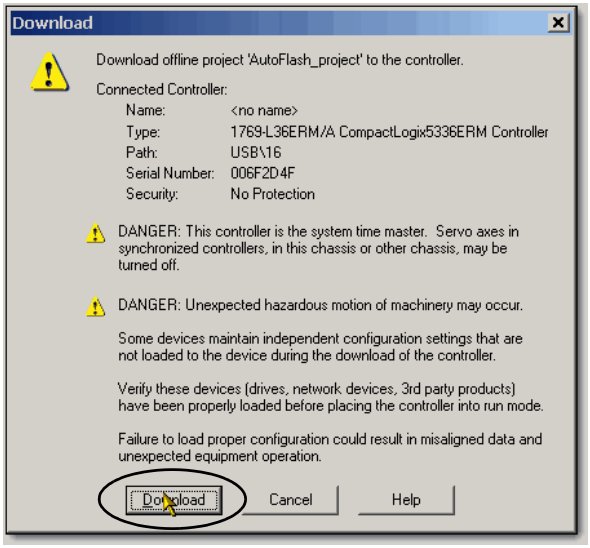

8. When the Update Firmware dialog box appears, click Yes.



Before the firmware upgrade begins, you may be warned about your controller missing its SD card. Take the appropriate action, typically clicking OK.

The firmware upgrade begins.

9. When the firmware upgrade is complete, the Download dialog box appears and you may continue by downloading your project to the controller.




## Use the Secure Digital Card to Load Firmware

You can use an installed SD card to load firmware on a CompactLogix 5370 controller. Using the SD card to load firmware eliminates the need for software to complete this task.

Your application requires the following to load firmware from an SD card at power-up:

- You must have saved the project to the SD card before the power cycle.
- The firmware revision in the project stored on the SD card is different from the firmware revision on the CompactLogix 5370 controller.

For more information on using the SD card, see Chapter 12, Use a Secure Digital Card on page 301.

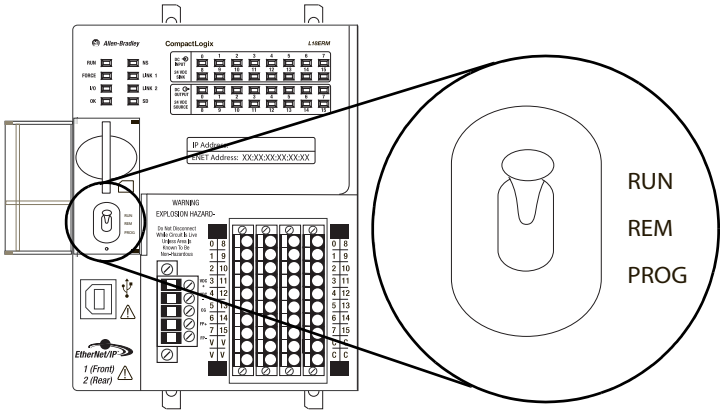
## Select the Controller's Operating Mode

CompactLogix 5370 controllers have slightly different front designs and mode switch placements.

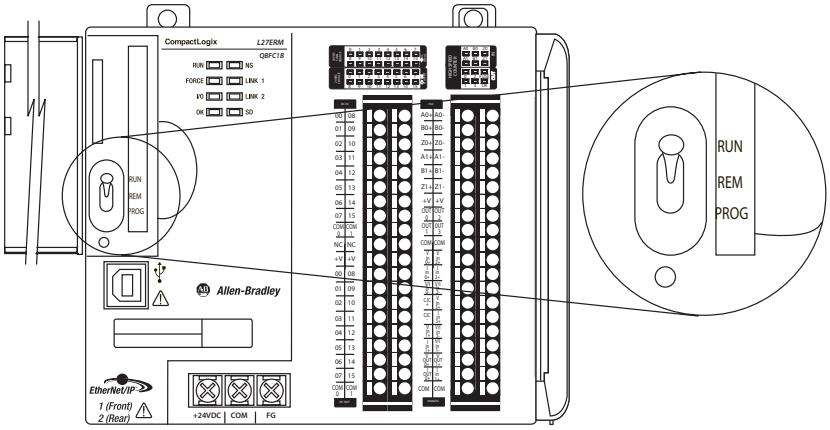
**WARNING:** When you change switch settings while power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

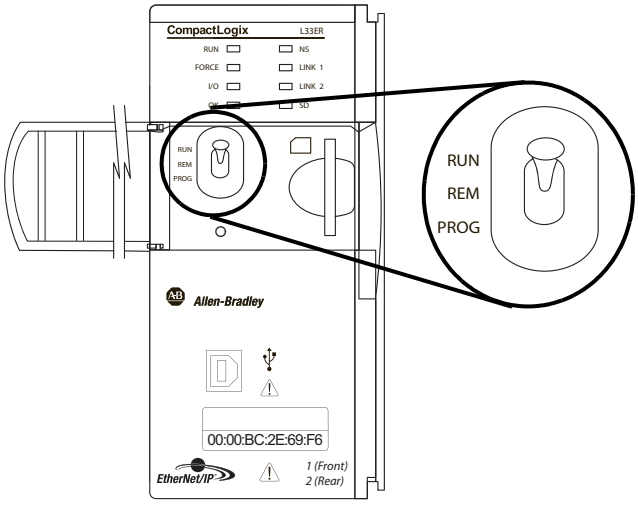
This graphic shows the mode switch on a CompactLogix 5370 L1 controller.




This graphic shows the mode switch on a CompactLogix 5370 L2 controller.



This graphic shows the mode switch on a CompactLogix 5370 L3 controller.




Use the controller's mode switch to set the CompactLogix 5370 controller's operating mode.

| Mode Switch Position | Description |
|---|---|
| Run | You can perform these tasks:<br>• Upload projects.<br>• Run the program and enable outputs.<br>You cannot perform these tasks:<br>• Update controller firmware.<br>• Create or delete tasks, programs, or routines.<br>• Create or delete tags or edit online.<br>• Import a program to the controller.<br>• Change the controller's port configuration, advanced port configuration, nor network configuration settings.<br>• Change controller configuration parameters directly set for operation on a device-level ring (DLR) network topology. |
| Prog | You can perform these tasks:<br>• Update controller firmware.<br>• Disable outputs.<br>• Upload/download projects.<br>• Create, modify, and delete tasks, programs, or routines.<br>• Change the controller's port configuration, advanced port configuration, nor network configuration settings.<br>You cannot perform these tasks:<br>• Use the controller to execute (scan) tasks. |

| Mode Switch Position | Description | |
|---|---|---|
| Rem | You can perform these tasks:<br>• Upload/download projects.<br>• Change the controller's port configuration, advanced port configuration, nor network configuration settings.<br>• Change between Remote Program, Remote Test, and Remote Run modes through the application. | |
| | Remote Run | • The controller executes (scans) tasks.<br>• Enable outputs.<br>• Edit online. |
| | Remote Program | • Update controller firmware.<br>• Disable outputs.<br>• Create, modify, and delete tasks, programs or routines.<br>• Download projects.<br>• Edit online.<br>• The controller does not execute (scan) tasks. |
| | Remote Test | • Execute tasks with outputs disabled.<br>• Edit online. |

## Notes:

# CompactLogix 5370 Controllers Overview


| Topic | Page |
|---|---|
| CompactLogix 5370 Control System Components | 108 |
| Controller Functionality | 109 |
| Example System Configurations | 111 |


The CompactLogix 5370 controllers offer state-of-the-art control, communication, and I/O elements in a distributed control package. This product family includes these CompactLogix 5370 controllers:

- 1769-L16ER-BB1B
- 1769-L18ER-BB1B
- 1769-L18ERM-BB1B
- 1769-L24ER-QB1B
- 1769-L24ER-QBFC1B
- 1769-L27ERM-QBFC1B
- 1769-L30ER
- 1769-L30ERM
- 1769-L30ER-NSE
- 1769-L33ER
- 1769-L33ERM
- 1769-L36ERM

Among the features the CompactLogix 5370 controllers support are dual EtherNet/IP ports on each controller and support for Integrated Motion over an EtherNet/IP network on some CompactLogix 5370 controllers.

For a complete description of the CompactLogix 5370 control system components and functionality, see Table 2 and Table 3, respectively.

# CompactLogix 5370 Control System Components

Table 2 describes components a CompactLogix 5370 controller uses in a typical control system.

**Table 2 - CompactLogix 5370 Control System Components**

| System Component | Product Family | | |
|---|---|---|---|
| | **CompactLogix 5370 L1 Controllers** | **CompactLogix 5370 L2 Controllers** | **CompactLogix 5370 L3 Controllers** |
| Controller | One of the controllers documented in this publication | | |
| Power supply | External power supply connected to the controller's embedded 24V DC nominal input, nonisolated power supply. The power supply has a 10…28.8 input range. | External power supply connected to the controller's embedded 24V DC Input, isolated power supply | One of the following 1769 Compact I/O power supplies:<br>• 1769-PA2<br>• 1769-PB2<br>• 1769-PA4<br>• 1769-PB4 |
| Communication networks components | Any of the following:<br>• EtherNet/IP network via built-in EtherNet/IP network ports<br>• USB connection for programming and firmware upgrades only | Any of the following:<br>• EtherNet/IP network via built-in EtherNet/IP network ports<br>• DeviceNet network via a 1769-SDN module<br>• USB connection for programming and firmware upgrades only | |
| Software | • One of the following:<br>– RSLogix 5000 software, version 20.*xx.xx*, - For CompactLogix 5370 controllers using firmware revision 20.*xxx*<br>– Logix Designer application, version 21.00.00 or later, - For CompactLogix 5370 controllers using firmware revision 21.000 or later<br>• RSLinx Classic software, version 2.59.*xx* or later<br>• RSNetWorx™ for DeviceNet software, version 11.00.00 or later<br>**IMPORTANT**: This software is not used with CompactLogix 5370 L1 controllers because they do not offer DeviceNet connectivity. | | |
| Secure Digital (SD) card for external nonvolatile memory | • 1784-SD1 card - Ships with CompactLogix 5370 controller and offers 1 GB of memory<br>• 1784-SD2 card - Available for separate purchase and offers 2 GB of memory | | |
| I/O modules | • 16 embedded 24V DC digital input points - The nominal input voltage is 24V DC but the operating range is 10…28.8V DC.<br>• 16 embedded 24V DC digital output points - The nominal input voltage is 24V DC but the operating range is 10…28.8V DC.<br>• Local expansion modules- 1734 POINT I/O modules<br>• Distributed I/O - Multiple I/O module product lines over an EtherNet/IP network | • 16 embedded 24V DC digital input points<br>• 16 embedded 24V DC digital output points<br>• 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers only<br>– Four embedded high-speed counters<br>– Four embedded universal analog input points<br>– Two embedded analog output points<br>• Local expansion modules- 1769 Compact I/O modules<br>• Distributed I/O - Multiple I/O module product lines over DeviceNet and EtherNet/IP networks | • Local expansion modules- 1769 Compact I/O modules<br>• Distributed I/O - Multiple I/O module product lines over DeviceNet and EtherNet/IP networks |
| Reset button | If held in during controller powerup, it will clear the user program from the controller's internal memory. | | |

## Controller Functionality

Table 3 describes functionality available with CompactLogix 5370 controllers.

**Table 3 - CompactLogix 5370 Controller Functionality**

| Cat. No. | Controller Tasks Supported | Programs Supported Per Task | Internal Energy Storage Solution | EtherNet/IP Network Topology Support | Power Supply Distance Rating | On-board User Memory Size | Local I/O Module Support |
|---|---|---|---|---|---|---|---|
| 1769-L16ER-BB1B | 32 | 100 | Yes - Eliminating the need for a battery | Support the following topologies:<br>• Device-level ring (DLR)<br>• Linear<br>• Traditional star | NA | 384 KB | As many as six 1734 POINT I/O modules(2) |
| 1769-L18ER-BB1B | | | | | | 512 KB | As many as eight 1734 POINT I/O modules(2) |
| 1769-L18ERM-BB1B | | | | | | | |
| 1769-L24ER-QB1B | | | | | See footnote below(1) | 768 KB | As many as four Compact I/O modules |
| 1769-L24ER-QBFC1B | | | | | | | |
| 1769-L27ERM-QBFC1B | | | | | | 1 MB | |
| 1769-L30ER | | | | | 4 | 1 MB | As many as eight Compact I/O modules |
| 1769-L30ER-NSE | | | | | | | |
| 1769-L30ERM | | | | | | | |
| 1769-L33ER | | | | | | 2 MB | As many as 16 Compact I/O modules |
| 1769-L33ERM | | | | | | | |
| 1769-L36ERM | | | | | | 3 MB | As many as 30 Compact I/O modules |

(1) CompactLogix 5370 L2 controllers have an embedded power supply. Therefore, you do not need to consider power supply distance rating when installing the controller. The Compact I/O modules used as local expansion modules in a CompactLogix 5370 L2 control systems operate on a CompactBus and do have a power supply distance rating you must consider when installing those modules. For more information on power supply distance rating with respect to using Compact I/O modules in a CompactLogix 5370 L2 control system, see page 134 and page 216.

(2) **IMPORTANT**: You can use up to the maximum number of 1734 POINT I/O modules with the CompactLogix 5370 L1 controllers listed in Table 1, as long as the total current drawn by the modules does not exceed the available POINTBus backplane current of 1 A. If you need to use more local expansion modules than the POINTBus backplane current supports, you can install a 1734-EP24DC POINT I/O expansion power supply between local expansion modules to increase the POINTBus backplane power and meet your system requirements.

Additionally, you can use the **1769-L30ER-NSE** controller only in applications that require the installed controller deplete its residual stored energy to specific levels before transporting it into or out of your application.

**WARNING:** If your application requires the 1769-L30ER-NSE controller to deplete its residual stored energy to 40 µJ or fewer before you transport it into or out of the application, complete these steps before you remove the controller.

1. Turn off power to the chassis.

   After you turn off power, the controller's OK status indicator transitions from Green to Solid Red to OFF.

2. Wait **at least 15 minutes** for the residual stored energy to decrease to 40 µJ or fewer before you remove the controller.

There is no visual indication of when the 15 minutes has expired. **You must track that time period**.

Some applications that require the installed controller deplete its residual stored energy to specific levels before transporting it into or out of your application. This may include other devices that also require a wait time before removing them. See those products' documentation for more information.

## Support for Integrated Motion over an EtherNet/IP Network

The following CompactLogix 5370 controllers support Integrated Motion over an EtherNet/IP network:

- 1769-L18ERM-BB1B
- 1769-L27ERM-QBFC1B
- 1769-L30ERM
- 1769-L33ERM
- 1769-L36ERM

For more information on using CompactLogix 5370 controllers in applications that require Integrated Motion over an EtherNet/IP network, see Chapter 11, Develop Integrated Motion over an EtherNet/IP Network Applications on page 289.

# Example System Configurations

CompactLogix 5370 controllers support the following networks:

- EtherNet/IP network - All CompactLogix 5370 controllers
- DeviceNet network - CompactLogix 5370 L2 and L3 controllers only

## EtherNet/IP Network

**IMPORTANT** Figure 4 and figure 2 show CompactLogix 5370 controllers used in a DLR network topology on an EtherNet/IP network. You can also use CompactLogix 5370 controllers in linear or star EtherNet/IP network topologies.

For more information on the other EtherNet/IP network topologies, see Communicate over Networks on page 115.

Some of the CompactLogix 5370 controllers support Integrated Motion over an EtherNet/IP network, if desired. For more information on using Integrated Motion over an EtherNet/IP network, see Chapter 11, Develop Integrated Motion over an EtherNet/IP Network Applications on page 289.

Figure 2 shows an example EtherNet/IP system configuration for a 1769-L18ERM-BB1B controller.

**Figure 2 - Example 1769-L18ERM-BB1B Control System Configuration on an EtherNet/IP Network**

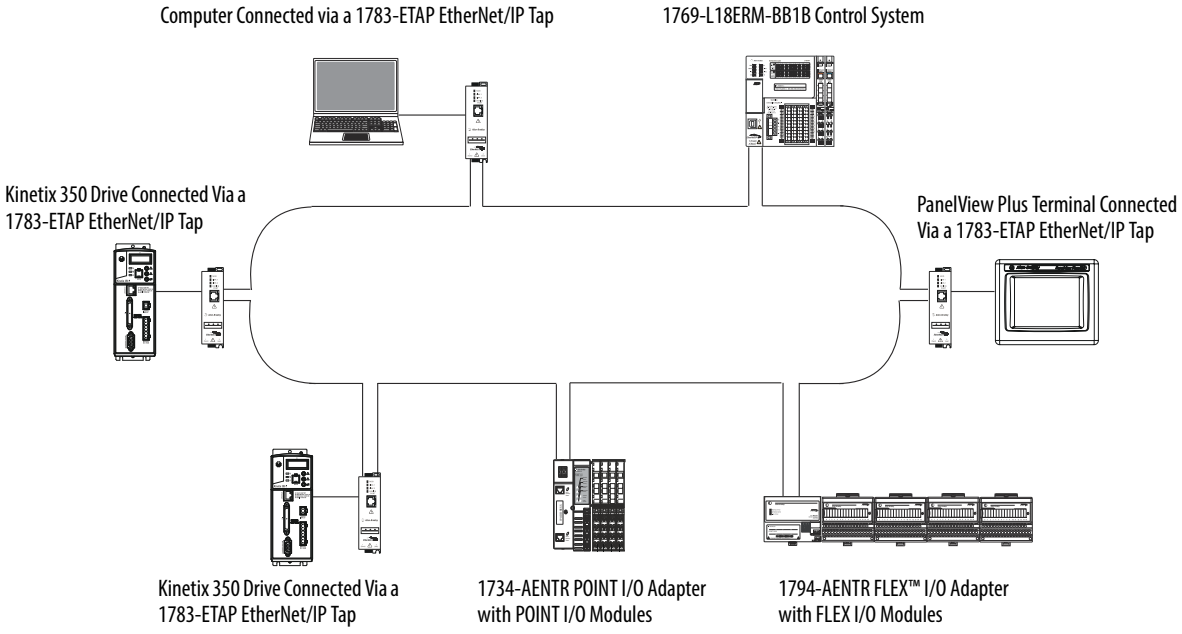


Figure 2 shows an example EtherNet/IP system configuration for a 1769-L27ERM-QBFC1B controller.

**Figure 3 - Example 1769-L27ERM-QBFC1B Control System Configuration on an EtherNet/IP Network**

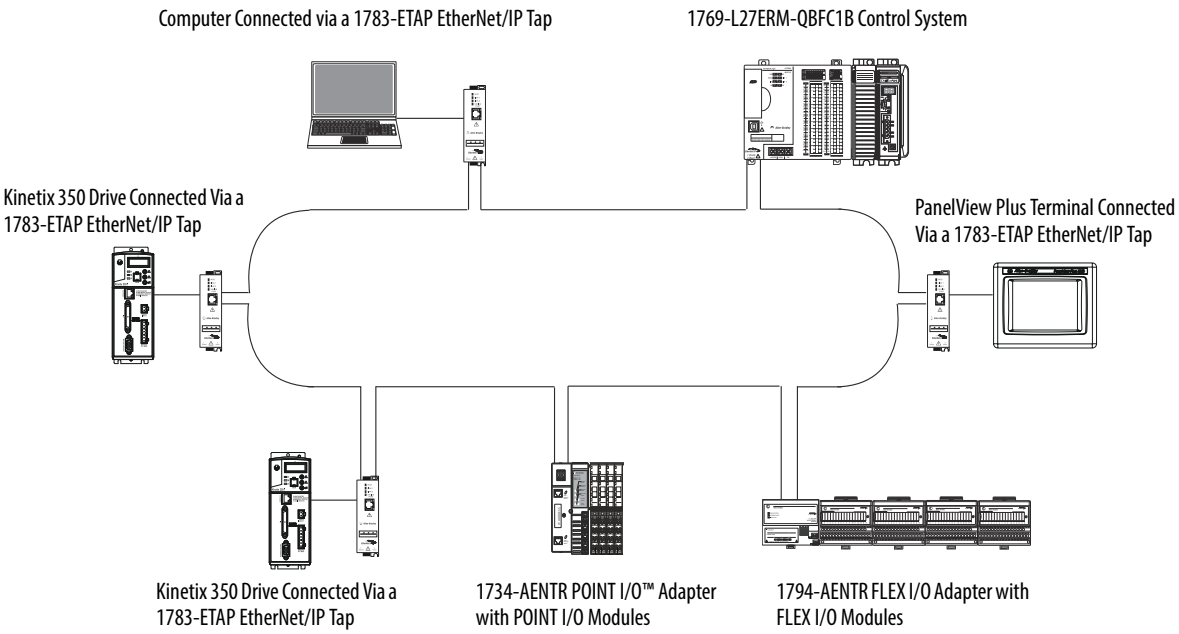
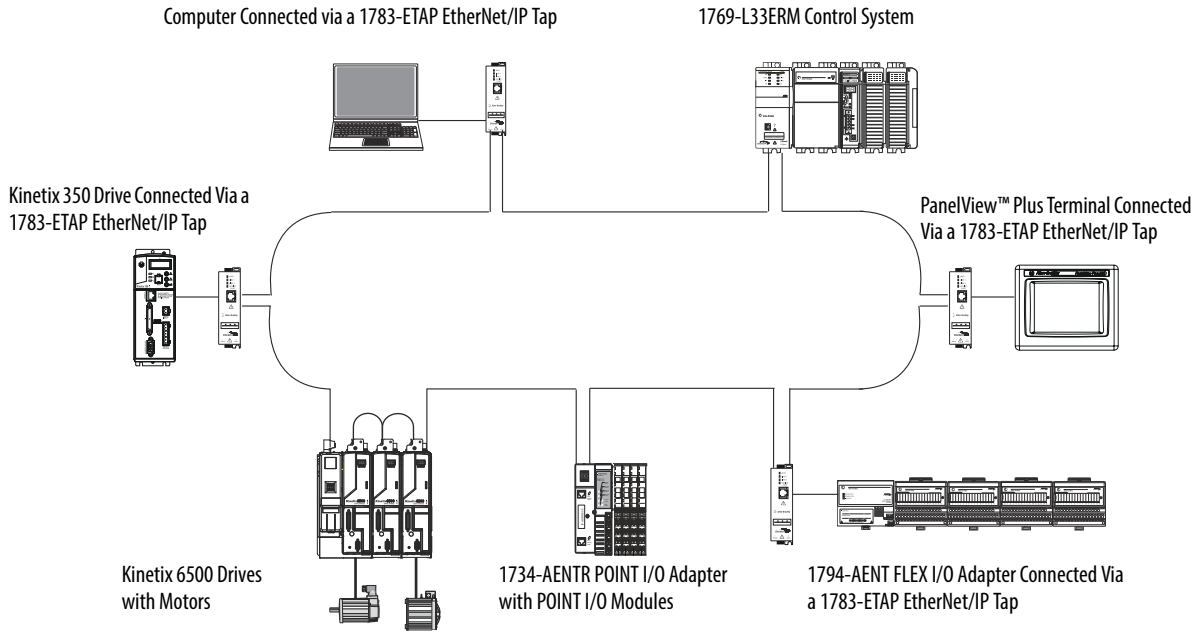



Figure 4 shows an example EtherNet/IP system configuration for a 1769-L33ERM controller.

**Figure 4 - Example 1769-L33ERM Control System Configuration on an EtherNet/IP Network**



## DeviceNet Network

**IMPORTANT** CompactLogix 5370 L2 and L3 controllers can send messages to devices on the DeviceNet network; however, these **controllers cannot receive** messages from those devices on the DeviceNet network.

Figure 6 shows an example DeviceNet system configuration for a CompactLogix 1769-L24ER-QB1B controller.

**Figure 5 - Example 1769-L24ER-QB1B Control System Configuration on a DeviceNet Network**

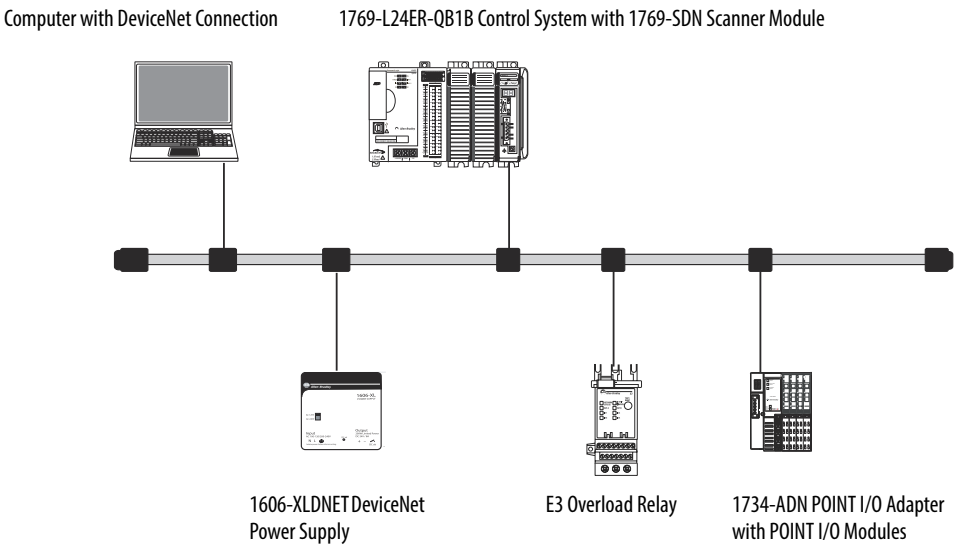
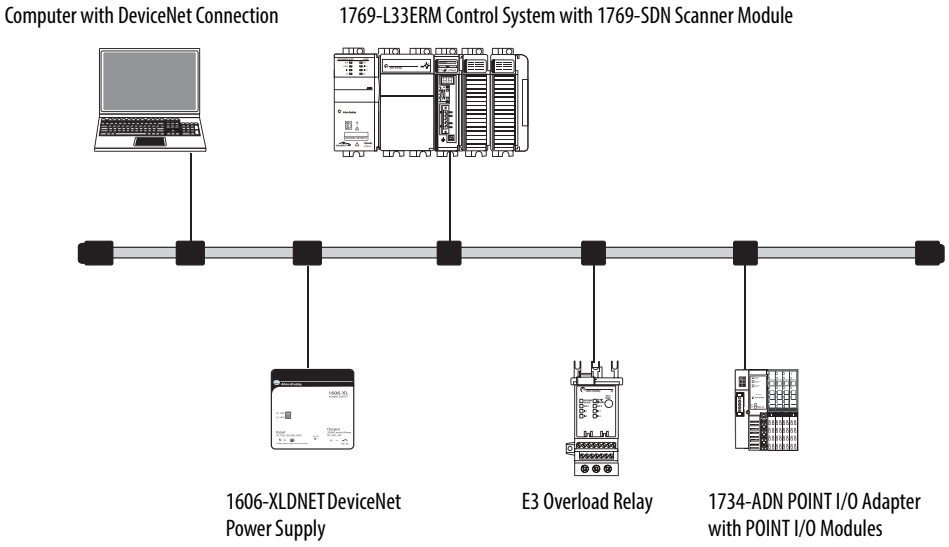



Figure 6 shows an example DeviceNet system configuration for a CompactLogix 1769-L33ERM controller.

**Figure 6 - Example 1769-L33ERM Control System Configuration on a DeviceNet Network**




For more information on using the CompactLogix 5370 L2 or L3 controllers on DeviceNet networks, see Communicate over Networks on page 115.

## Notes:

# Communicate over Networks


| Topic | Page |
|---|---|
| EtherNet/IP Network Communication | 116 |
| DeviceNet Network Communication | 131 |


All CompactLogix 5370 controllers support these tasks over an **EtherNet/IP network**:

- Control distributed I/O
- Send/receive messages to/from other devices on the same network or another network
- Produce/consume (interlock) data between controllers
- Socket interface

CompactLogix 5370 L2 and L3 controllers support these tasks over a **DeviceNet network**:

- Control distributed I/O
- Send messages to devices on the same network; the controller cannot receive messages from other devices on the network.

All CompactLogix 5370 controllers also support temporary connections from your computer via a USB connection.

# EtherNet/IP Network Communication

The EtherNet/IP network offers a full suite of control, configuration and data collection services by layering the Common Industrial Protocol (CIP) over the standard Internet protocols, such as TCP/IP and UDP. This combination of well-accepted standards provides the capability required to both support information data exchange and control applications.

In addition to conventional communication over the EtherNet/IP network, the CompactLogix 5370 controllers use socket interface transactions to communicate with Ethernet devices that do not support the EtherNet/IP application protocol.

For more information on socket interface transactions, see Socket Interface with CompactLogix 5370 Controllers on page 126.

## Available Software

You use the software listed in the following table with a CompactLogix 5370 controller on an EtherNet/IP network.

| Software | Required Version | Functions | Required |
|---|---|---|---|
| RSLogix 5000 | Version 20.*xx.xx* - For CompactLogix 5370 controllers using firmware revision 20.*xxx*. | • Configure the CompactLogix project.<br>• Define EtherNet/IP communication.<br>• Change IP address for devices on network, including the CompactLogix 5370 controller. | Yes |
| Studio 5000 environment | Version 21.00.00 or later - For CompactLogix 5370 controllers using firmware revision 21.000 or later. | | |
| RSLinx Classic | Version 2.59 or later | • Assign or change IP addresses to devices on an EtherNet/IP network.<br>• Configure communication devices.<br>• Provide diagnostics.<br>• Establish communication between devices. | |
| BOOTP/DHCP utility | Most current version is installed with RSLinx Classic software installation | Assign IP addresses to devices on an EtherNet/IP network. | No |

## EtherNet/IP Network Functionality on CompactLogix 5370 Controllers

The CompactLogix 5370 controllers offer this EtherNet/IP network functionality:

- Dual built-in EtherNet/IP network ports
- Support for the following EtherNet/IP network topologies:
  - Device-level Ring Network Topology
  - Linear Network Topology
  - Star Network Topology
- Support for CIP Sync technology
- Support for Integrated Motion over an EtherNet/IP network - Only the following controllers support this functionality:
  - 1769-L18ERM-BB1B
  - 1769-L27ERM-QBFC1B
  - 1769-L30ERM
  - 1769-L33ERM
  - 1769-L36ERM
- Socket interface to communicate with Ethernet devices that do not support the EtherNet/IP application protocol
- Duplicate IP address detection
- Unicast and multicast communication
- Support messaging, produced/consumed tags, HMI, and distributed I/O
- Interface via RJ45, twisted-pair cables
- Support half/full-duplex 10 Mbps or 100 Mbps operation
- Support standard switches
- No network scheduling required
- No routing tables required

## Nodes on an EtherNet/IP Network

When configuring your CompactLogix 5370 control system, you must account for the number of Ethernet nodes you include in the I/O configuration section of your project. CompactLogix 5370 controllers have limits on the number of nodes they support in the I/O configuration section.

Table 4 lists the Ethernet node limits for CompactLogix controllers.

**Table 4 - CompactLogix 5370 Controller Ethernet Node Guidelines**

| Cat. No. | Ethernet Nodes Supported |
|---|---|
| 1769-L16ER-BB1B | 4 |
| 1769-L18ER-BB1B | 8 |
| 1769-L18ERM-BB1B | |
| 1769-L24ER-QB1B | 8 |
| 1769-L24ER-QBFC1B | |
| 1769-L27ERM-QBFC1B | 16 |
| 1769-L30ER | 16 |
| 1769-L30ERM | |
| 1769-L30ER-NSE | |
| 1769-L33ER | 32 |
| 1769-L33ERM | |
| 1769-L36ERM | 48 |

**IMPORTANT** While CompactLogix 5370 controllers offer the option of using Ethernet node count to effectively and efficiently design a control system, the controllers do have connection limits on an EtherNet/IP network.

For more information on how to design EtherNet/IP network use in your CompactLogix 5370 control system, see these resources:

- The EtherNet/IP Capacity Tool available at http://www.rockwellautomation.com/solutions/integratedarchitecture/resources3.html#enetpredict.

  The EtherNet/IP Capacity Tool helps you in the initial layout of your EtherNet/IP network.

- Ethernet Design Considerations Reference Manual, publication ENET-RM002

- Appendix B, Connections over an EtherNet/IP Network on page 313.

### *Devices Included in the Node Count*

Any devices you add directly to the local Ethernet I/O configuration are counted toward the controller's node limitation. The following are example devices that are added to the I/O configuration section in your project and must be counted:

- Remote communication adapters
- I/O modules directly connected to the EtherNet/IP network, for example the 1732E-IB16M12R ArmorBlock® EtherNet/IP module
- Motion devices, such as drives
- Remote controllers
- HMI devices that are included in the I/O configuration section, for example, PanelView Plus terminals
- Linking devices, such as the 1788-EN2DN, Ethernet-to-DeviceNet linking device
- Third-party devices that are directed connected to the EtherNet/IP network

### *Devices Excluded from the Node Count*

When considering a CompactLogix 5370 controller's Ethernet node limitation, you do not count Ethernet devices that exist on the EtherNet/IP network but are not added to the I/O configuration section of the project.

The following devices are **not added** to the I/O configuration section in your project and are **not counted** among the total number of nodes:

- Computer
- HMI that are not added to the I/O configuration section, for example, PanelView Plus terminals
- MSG instructions
- Devices the CompactLogix 5370 controllers use a socket interface to communicate with.

  For example, the following devices require communication via a socket interface:
  - Modbus TCP/IP device
  - Bar code scanners

## EtherNet/IP Network Topologies

CompactLogix 5370 controllers support these EtherNet/IP network types:

- Device-level Ring Network Topology
- Linear Network Topology
- Star Network Topology

Each of these EtherNet/IP network topologies support applications that use Integrated Motion over an EtherNet/IP network, if required.

### *Device-level Ring Network Topology*

A DLR network topology is a single-fault tolerant ring network intended for the interconnection of automation devices. A DLR network is comprised of Supervisor (Active and Backup) nodes and Ring nodes.

DLR network topologies automatically convert to linear network topologies when a fault is detected. The conversion to the new network topology maintains communication of data on the network. The fault condition is typically easily detected and corrected.

CompactLogix 5370 controllers connect directly to a DLR network topology, that is, without requiring a 1783-ETAP tap to connect to the network. The controllers can function in any of the roles on a DLR network topology, that is, active supervisor node, backup supervisor node or ring node.

**IMPORTANT** The topology graphics shown in this section are examples of applications that use DLR network topologies only.

We recommend you exercise caution if you consider designing an application that includes connecting a DLR topology with a linear or star network topology.

For more information on using a DLR network topology, see the EtherNet/IP Embedded Switch Technology Application Guide, publication ENET-AP005.

Figure 7 shows an example 1769-L18ERM-BB1B control system using a DLR network topology.

**Figure 7 - Example 1769-L18ERM-BB1B Control System Using DLR Network Topology**

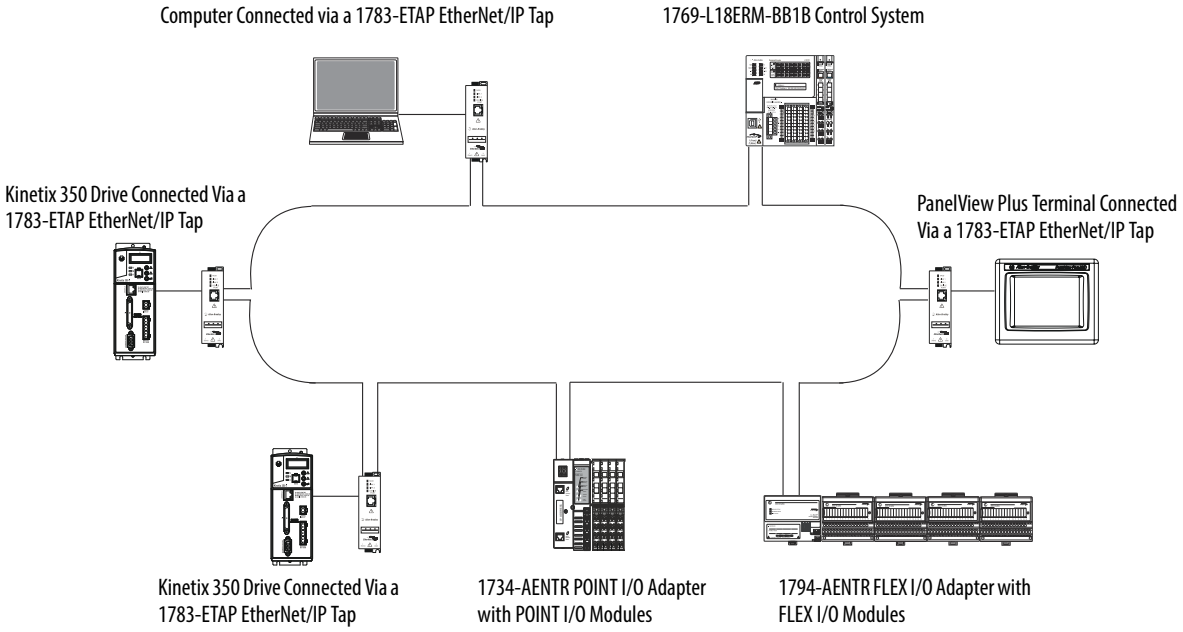



Figure 8 shows an example 1769-L27ERM-QBFC1B control system using a DLR network topology.

**Figure 8 - Example 1769-L27ERM-QBFC1B Control System Using DLR Network Topology**

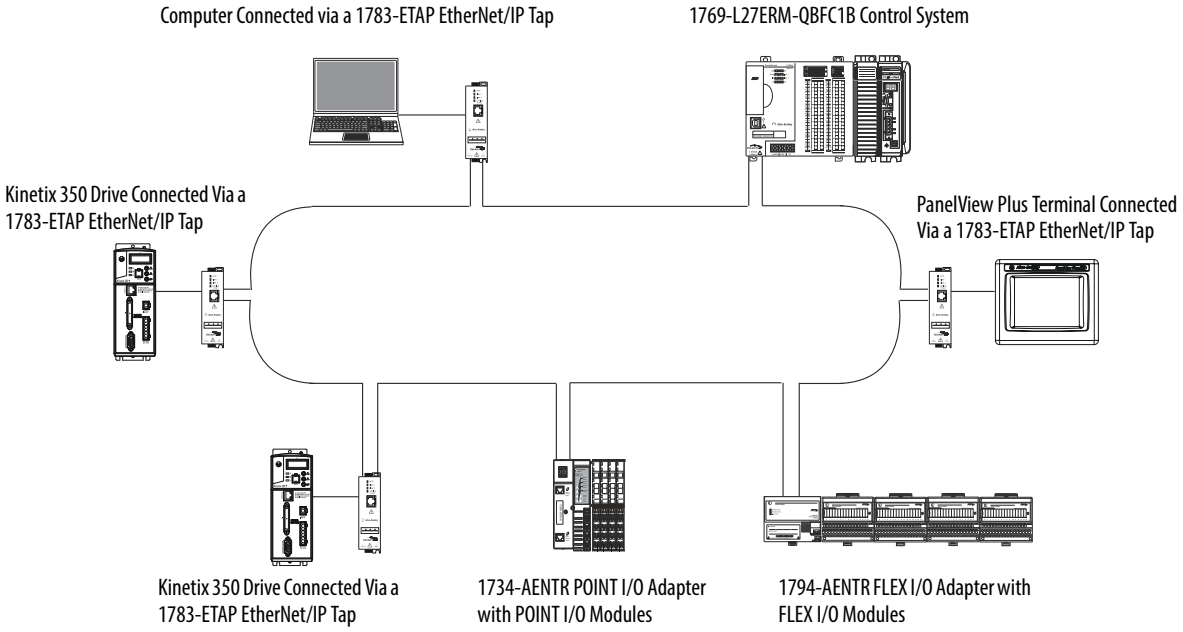
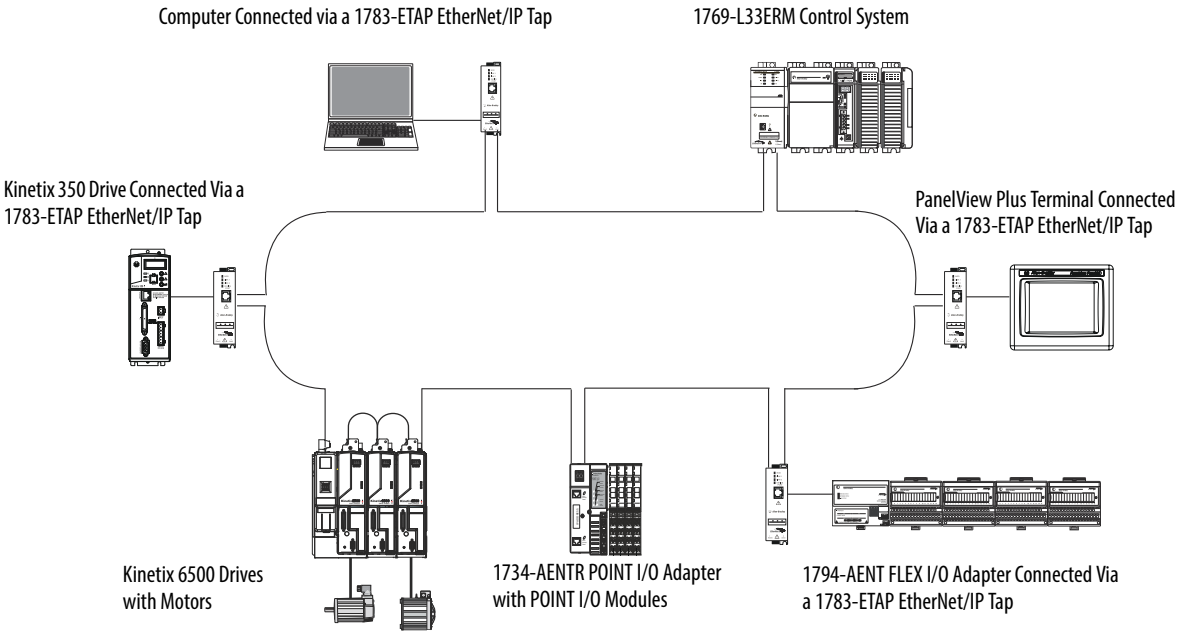


Figure 9 shows an example 1769-L33ERM control system using a DLR network topology.

**Figure 9 - Example 1769-L33ERM Control System Using a DLR Network Topology**



*Linear Network Topology*

A linear network topology is a collection of devices that are daisy-chained together across an EtherNet/IP network. Devices capable of connecting to a linear network topology use embedded switch technology to eliminate any need for a separate switch, as required in Star network topologies.

Figure 10 shows an example 1769-L18ERM-BB1B control system using a linear network topology.

**Figure 10 - Example 1769-L18ERM-BB1B Control System Using a Linear Network Topology**

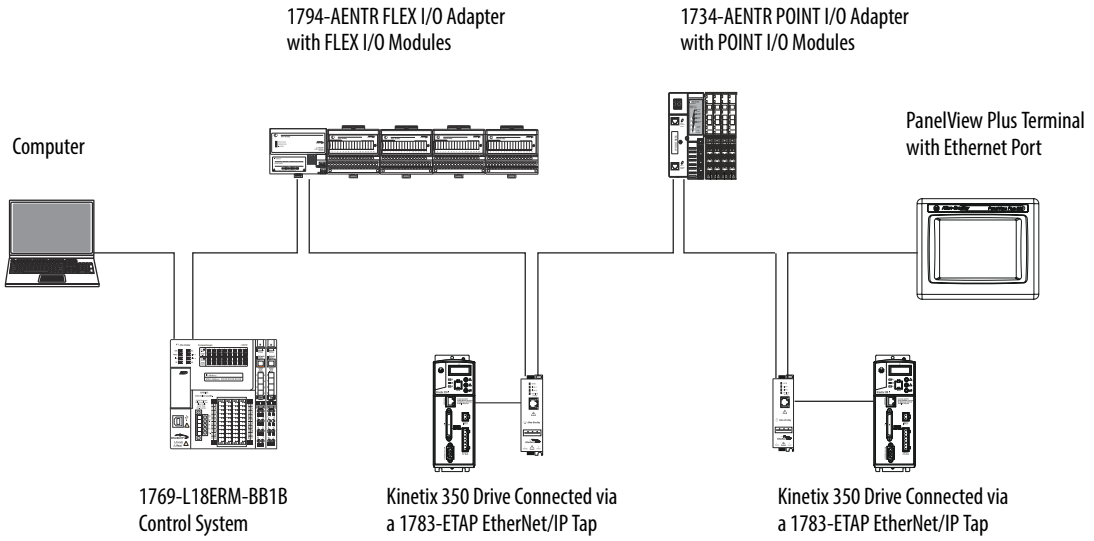



Figure 11 shows an example 1769-L24ER-QB1B control system using a linear network topology.

**Figure 11 - Example 1769-L24ER-QB1B Control System Using a Linear Network Topology**

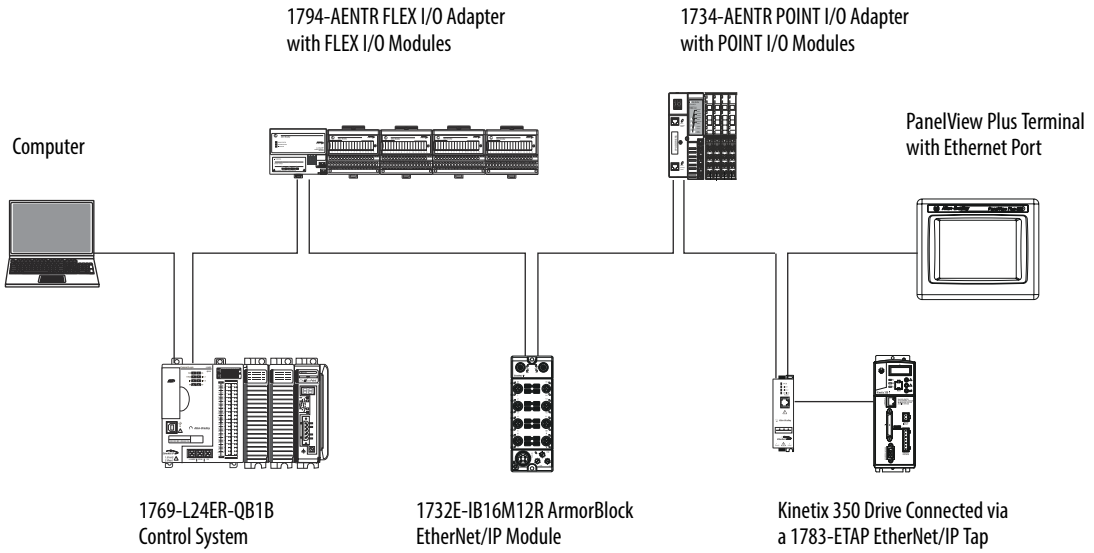
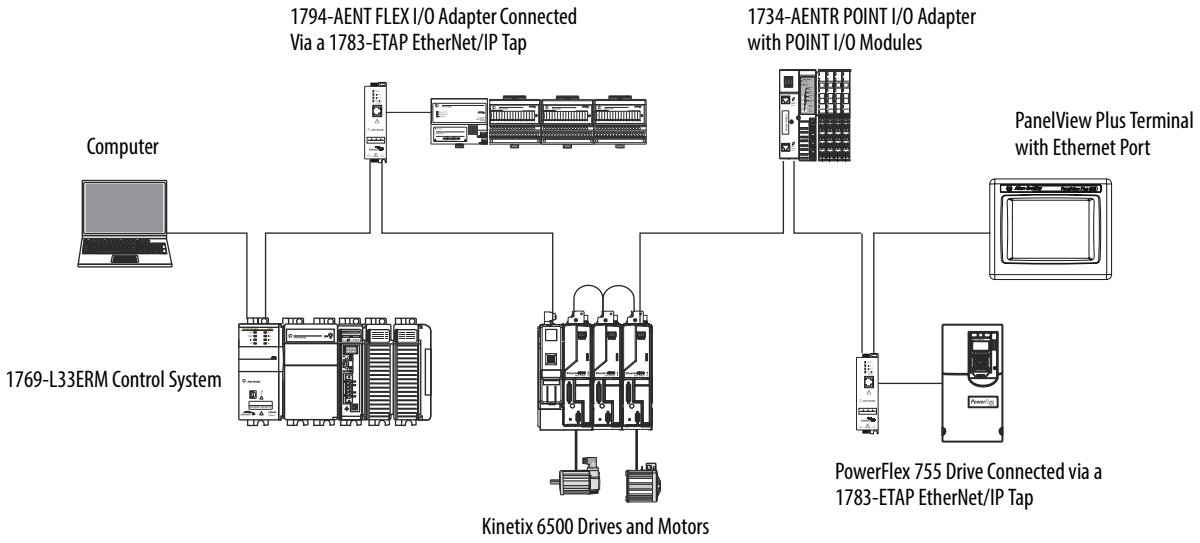


Figure 12 shows an example 1769-L33ERM control system using a linear network topology.

**Figure 12 - Example 1769-L33ERM Control System Using a Linear Network Topology**




*Star Network Topology*

A star network topology is a traditional EtherNet/IP network that includes multiple devices connected to each other via an Ethernet switch.

Figure 13 show a 1769-L18ERM-BB1B control system using a star topology.

**Figure 13 - Example1769-L18ERM-BB1B Control System Using a Star Network Topology**

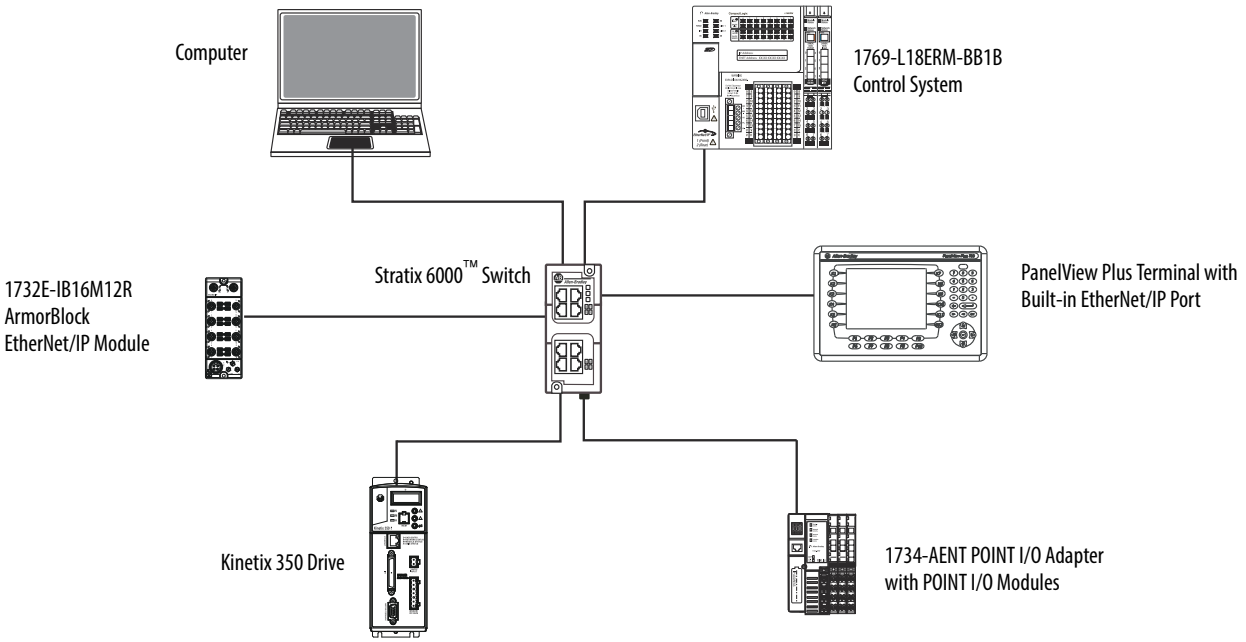


Figure 14 show a 1769-L27ERM-QBFC1B control system using a star topology.

**Figure 14 - Example 1769-L27ERM-QBFC1B Control System Using a Star Network Topology**

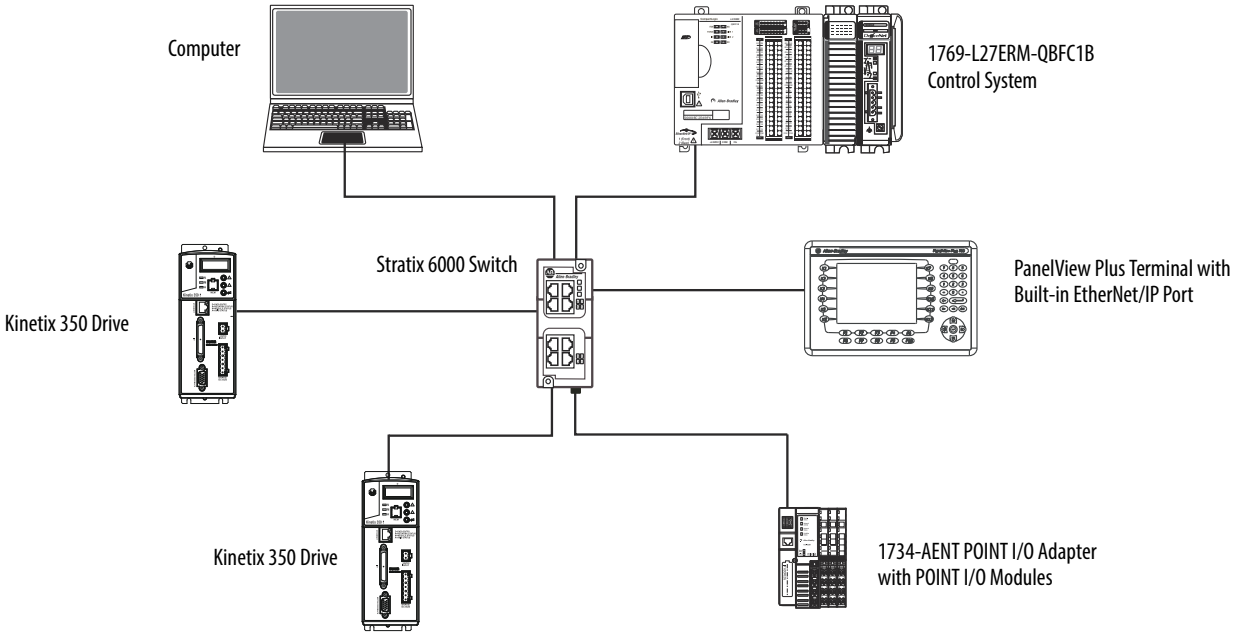
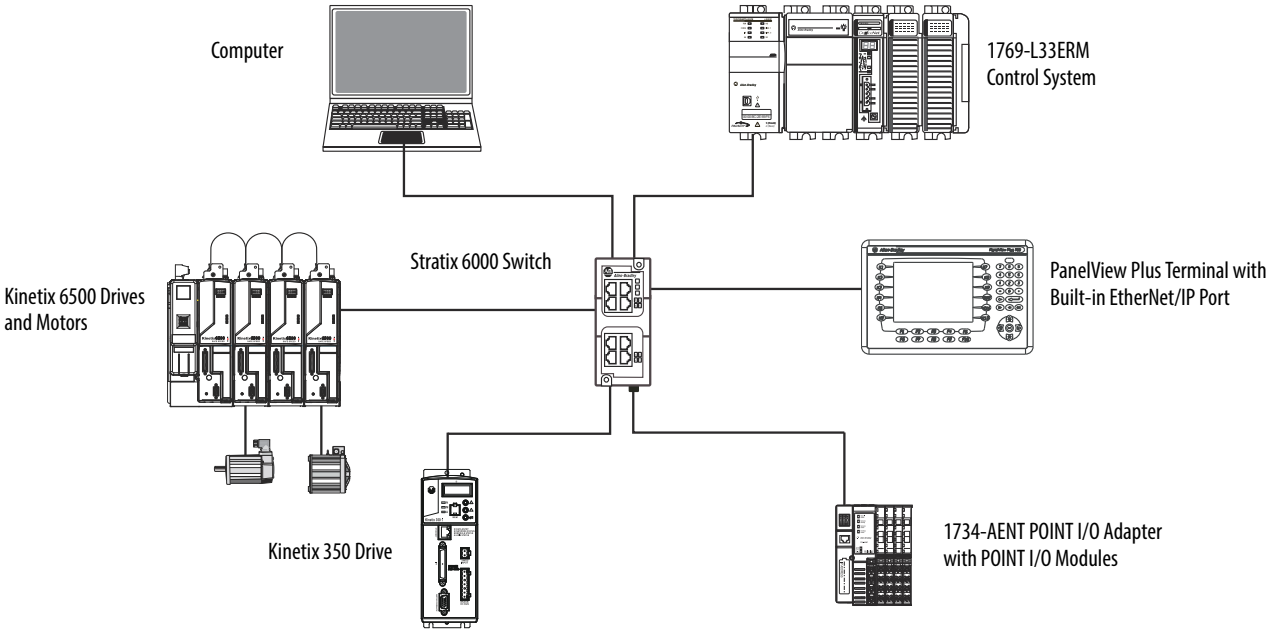



Figure 15 shows an example 1769-L33ERM control system using a star topology.

**Figure 15 - Example 1769-L33ERM Control System Using a Star Network Topology**



## Socket Interface with CompactLogix 5370 Controllers

The CompactLogix 5370 controller can use socket interfaces to communicate with Ethernet devices that do not support the EtherNet/IP application protocol.

Examples of devices that do not support the EtherNet/IP application protocol but might be used in a CompactLogix 5370 controller application include the following:

- Modbus TCP/IP device
- Bar code scanners
- RFID readers

The socket interface is implemented via the Socket Object. CompactLogix 5370 controllers communicate with the Socket Object via MSG instructions. All CompactLogix 5370 controllers must use unconnected MSG instructions with socket interfaces.

The Socket Object services lets the controller perform these actions:

- Open connections
- Accept incoming connections
- Send data
- Receive data

To communicate with another device, you must understand the other device's application protocol. The CompactLogix 5370 controller has no application protocol knowledge. The controller makes the socket services available to its program.

### *Number and Type of Sockets*

The CompactLogix 5370 controllers support up to 32 socket instances. Each instance can be one of these types:

- UDP socket - Sends and receives UDP datagrams.
- TCP client socket - The Logix5000 program initiates the connection.
- TCP server socket - Another device initiates the connection to the Logix5000 program.
- TCP listen socket - Listens on a specified port number for incoming connections.

The options available for UDP and TCP send and receive services are described in this table.

| Type | Communication | Send (Write) | Receive (Read) |
|---|---|---|---|
| UDP | Unicast | Yes | Yes |
| | Multicast | Yes | Yes |
| | Broadcast | Yes | Yes |
| TCP | Unicast | Yes | Yes |
| | Multicast | N/A | N/A |
| | Broadcast | N/A | N/A |

You must have a listen socket for each TCP port number that accepts connections. Multiple TCP server sockets can share a listen socket if the connections are made to the same port number.

You can partition the available socket instances between UDP and TCP sockets in these ways:

- Use all instances for client TCP connections.
- Use one instance to listen for incoming TCP connections and then accept the remaining connections from other devices.
- Perform both TCP client and server operations.
- Perform both TCP and UDP operations.

These socket services are available.

| Socket Service | Socket Instance |
|---|---|
| SocketCreate | Server or client |
| OpenConnection | Client |
| AcceptConnection | • If you issue an AcceptConnection service, the instance is listen type.<br>• If the AcceptConnection service returns an instance as a result of an incoming connection request, the socket instance is server type |
| ReadSocket | Server or client |
| WriteSocket | |
| DeleteSocket | |
| DeleteAllSockets | |
| ClearLog | |
| JoinMulticastAddress | |
| DropMulticastAddress | |

Once you open a connection on a client socket instance, you cannot use the same socket instance to accept incoming connections. Similarly, if you accept connections on a socket instance, you cannot then use the instance to open outgoing connections. This behavior is consistent with standard socket API behavior.

*Message Instructions to Use Socket Services*

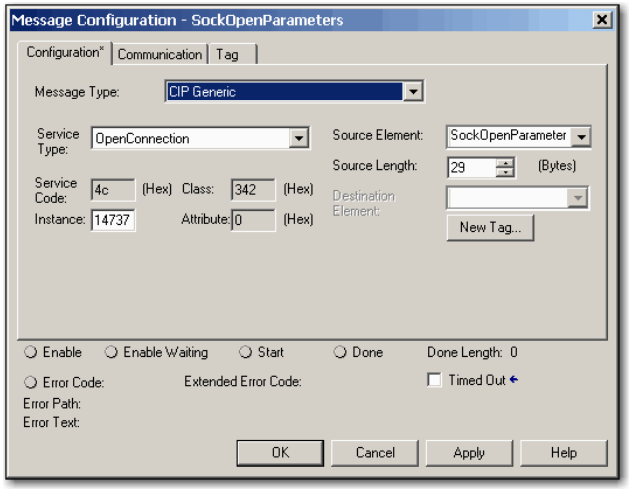
**IMPORTANT** This section describes only one of the socket service available with your CompactLogix 5370 controller.

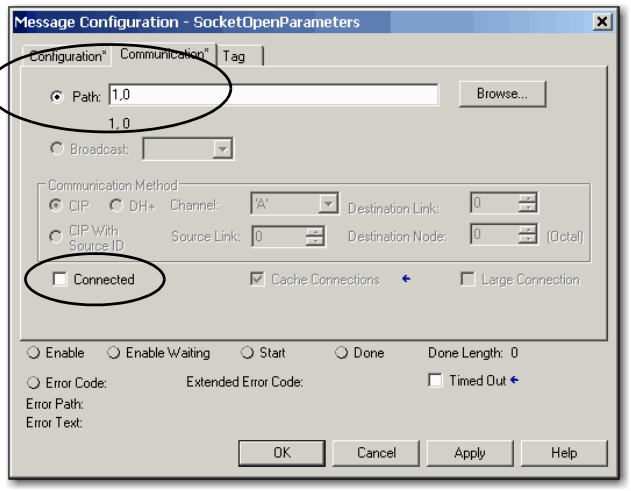
For more information on all socket services, see the EtherNet/IP Socket Interface Application Technique, publication ENET-AT002.

In the CompactLogix 5370 controller program, use a CIP Generic MSG instruction to request socket services.

The following example graphics show the Configuration and Communication tabs for a MSG instruction that uses the OpenConnection service type. The parameter values for this MSG type are defined Table 5.

**IMPORTANT** Before you can configure the MSG instruction, you must create a user-defined data type (UDT) that is available in the Source Element parameter. See MSG Source Element for more information on how to create a UDT.




**IMPORTANT**: Keep the following in mind when using sockets with CompactLogix 5370 controllers:

- A significant difference between CompactLogix 5370 controllers and other Logix5000 controllers is the communication path. CompactLogix 5370 controllers do not require a separate EtherNet/IP network communication module, for example, a 1756-EN2T module. In the case of the CompactLogix 5370 controllers, the MSG is sent to the controller itself using the path '1,0'.
- All CompactLogix 5370 controllers must use **unconnected** MSG instructions for socket servers. When you configure a message for a CompactLogix 5370 controller, make sure the Connected checkbox on the Message Configuration dialog box is cleared.

**Table 5 - Parameter Values for OpenConnection Service**

| Configuration Parameter | Description |
|---|---|
| MSG Type | CIP Generic |
| Service Type | OpenConnection |
| Service Code | 4c |
| Class | 342 |
| Instance | from CreateSocket |
| Attribute | 0 |
| Source Element | Application specific |
| Source Length | |

## MSG Source Element

You must also create a user-defined data type (UDT) to use this service. This example graphic shows the UDT screen. The parameter values for this MSG type are defined in Table 6 on page 130.

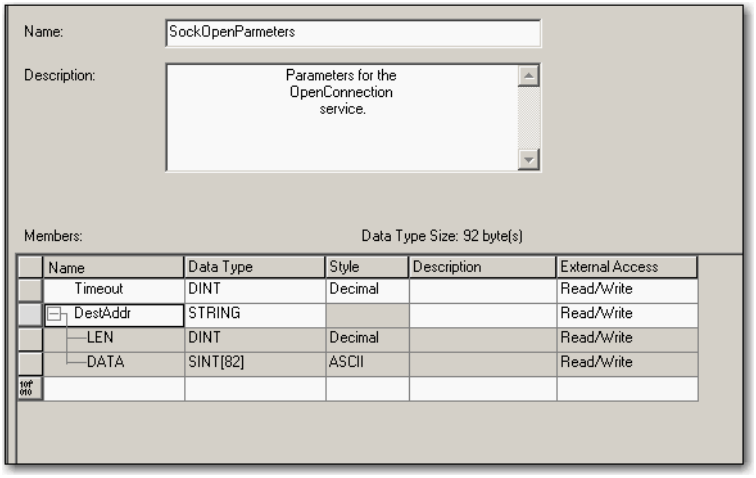


**Table 6 - Parameter Values for OpenConnection Service**

| Configuration Parameter | Element | Description |
|---|---|---|
| Timeout | DINT | Specify the timeout in milliseconds. |
| DestAddr | STRING | Specify an array of characters (maximum of 64) to define the destination of the connection. Specify either of these:<br>• Hostname?port=xxx<br>• IPAddr?port=xxx<br>For example, to specify an IP address, enter 10.88.81.10?port=2813 |
| .LEN | DINT | The length of the destination address. |
| .DATA | SINT array | The array containing the destination address. |

For more information on socket interface, see the following:

- EtherNet/IP Socket Interface Application Technique, publication ENET-AT002
- Rockwell Automation Sample Code Library at http://samplecode.rockwellautomation.com/

## Quality of Service (QoS) and I/O Module Connections

CompactLogix 5370 controllers support Quality of Service (QoS) technology. QoS lets the controller prioritize EtherNet/IP network traffic. By default, the CompactLogix 5370 controllers are QoS-enabled.

Some EtherNet/IP devices do not support QoS technology unless the device's firmware is upgraded to a required minimum firmware revision level. For example, the ControlLogix® 1756-ENBT communication module must use firmware revision 4.005 or later to support QoS technology.

To make sure communication between CompactLogix 5370 controllers and I/O modules are maintained, verify that the EtherNet/IP devices use the products' minimum firmware revision level required to support QoS technology.

For more information on EtherNet/IP devices' minimum firmware revision levels to support QoS technology, see Rockwell Automation Knowledgebase Tech Note 66325. The document is available at http://www.rockwellautomation.com/knowledgebase/.

# DeviceNet Network Communication

The CompactLogix 5370 L2 and L3 controllers communicate with other devices over the DeviceNet network via a Compact I/O 1769-SDN DeviceNet scanner module. The DeviceNet network uses the Common Industrial Protocol (CIP) to provide the control, configuration, and data collection capabilities for industrial devices.

**IMPORTANT** This section applies to applications using CompactLogix 5370 L2 and L3 controllers only.

CompactLogix 5370 L1 controllers do not operate on DeviceNet networks.

## Available Software

The software applications listed in this table are **required** when using a CompactLogix 5370 L2 or L3 controller on a DeviceNet network.

| Software | Required Version | Functions |
|---|---|---|
| RSLogix 5000 | 20.*xx*.*xx* - For CompactLogix 5370 controllers using firmware revision 20.*xxx*. | Configure the CompactLogix project |
| Studio 5000 environment | 21.00.00 or later - For CompactLogix 5370 controllers using firmware revision 21.000 or later. | |
| RSLinx Classic | 2.59.00 or later(1), (2) | • Configure communication devices<br>• Provide diagnostics<br>• Establish communication between devices |
| RSNetWorx for DeviceNet | One of the following:<br>• 11.00.00 or later if used with RSLogix 5000 software, version 20.xx.xx<br>• 21.00.00 or later if used with RSLogix 5000 software, version 21.00.00 or later | • Configure DeviceNet devices<br>• Define the scanlist for the DeviceNet network |

(1) CompactLogix 5370 L2 controllers require RSLinx Classic software, version 2.59.01 or later.

(2) We recommend that you use RSLinx Classic software, version 3.51.00 or later, with Studio 5000 environment, version 21.00.00 or later.

Figure 16 shows an example 1769-L27ERM-QBFC1B control system using a DeviceNet network.

**Figure 16 - Example 1769-L24ER-QB1B Control System Using a DeviceNet Network**

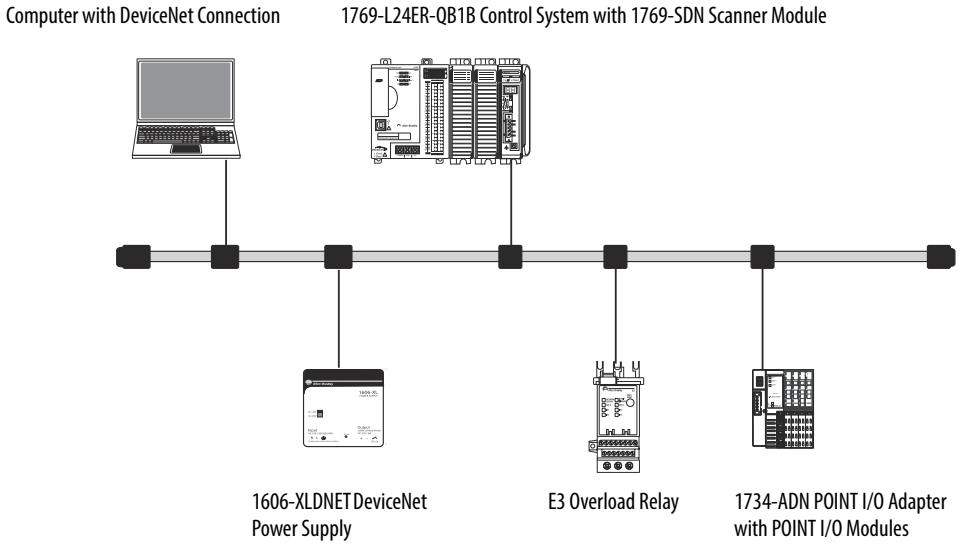
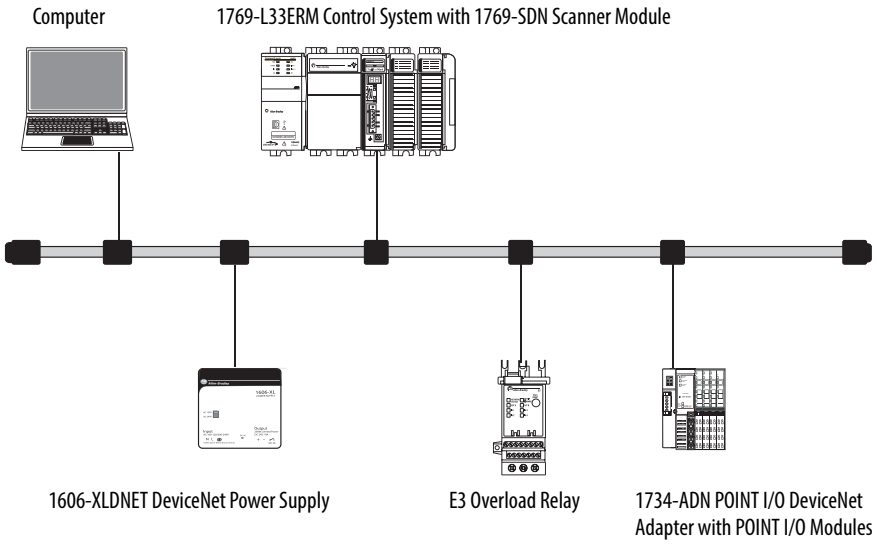



Figure 17 shows an example 1769-L33ERM using a DeviceNet network.

**Figure 17 - Example 1769-L33ERM Control System Using a DeviceNet Network**



## Compact I/O 1769-SDN DeviceNet Scanner Module

You connect a CompactLogix 5370 L2 or L3 controller to a DeviceNet network via a Compact I/O 1769-SDN DeviceNet scanner module.

Before installing the scanner module, consider the following:

- You can connect the scanner module to an adjacent controller, power supply, or I/O module.
- You must account for these two requirements jointly:
  - **Power Supply Distance Rating** - Described on **page 134**
  - **Current Capacity in CompactLogix 5370 L3 Control Systems** - Described on page 138
- The scanner module, as a master, can own up to 63 slave I/O nodes.
- The scanner module can simultaneously be a master and be a slave owned by another DeviceNet master.

The scanner module has this functionality:

- Supports messaging to devices, not controller to controller
- Supports control-level network to device-level network for programming, configuration, control or data collection
- Supports back up your CompactLogix 5370 L2 or L3 controller on the DeviceNet network

  For more information on using the 1769-SDN to back up your CompactLogix 5370 L2 or L3 controller, see the 1769-SDN DeviceNet Scanner Module User Manual, publication 1769-UM009.
- Shares a common application layer with EtherNet/IP networks
- Offers diagnostics for improved data collection and fault detection

## Power Supply Distance Rating

CompactLogix 5370 L2 and L3 control systems allow you to install 1769-SDN scanner modules as local expansion modules. The 1769-SDN scanner module has a power supply distance rating that you must consider before install it.

Power supply distance rating is the number of slots a 1769-SDN scanner module can be installed away from the power supply. The 1769-SDN scanner module has a power supply distance rating of four. Therefore, your CompactLogix 5370 L2 or L3 control system can include up to three modules between the 1769-SDN scanner module and the power supply.

Using the 1769-SDN scanner module's power supply distance rating as a design consideration differs by CompactLogix L2 controller catalog number.

### *CompactLogix 5370 L2 Control Systems*

In a CompactLogix 5370 L2 control system, you can install a 1769-SDN scanner module on the right side of the control system. The controller has an embedded power supply preventing the installation of 1769-SDN scanner modules between the controller and the power supply.

Additionally, the controller has embedded I/O modules that prevent installation of the 1769-SDN scanner module directly to the right of the embedded power supply. CompactLogix 5370 L2 control systems have one or two embedded I/O modules as described below:

- 1769-L24ER-QB1B controller - One embedded I/O module
- 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers - Two embedded I/O modules

While the embedded I/O modules are not considered local expansion modules, you still must include each embedded I/O module in the module slot count when determining where to install the 1769-SDN scanner module as a local expansion module.

The farthest local expansion module slot where you can install the 1769-SDN scanner module in a CompactLogix 5370 L2 control system is module slot number two or three as determined by the controller catalog number used in the control system.

Table 7 describes the farthest local expansion module slot where you can install a 1769-SDN scanner module and meet its power supply distance rating requirement.

**Table 7 - Example CompactLogix 5370 L2 Control Systems with a 1769-SDN Scanner Module**

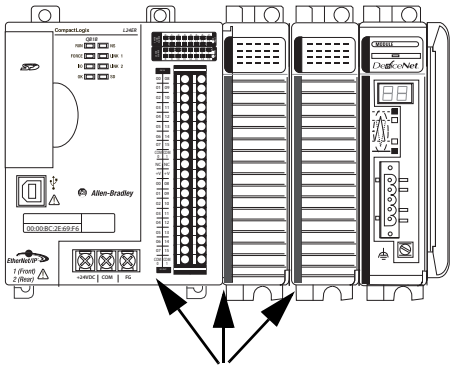
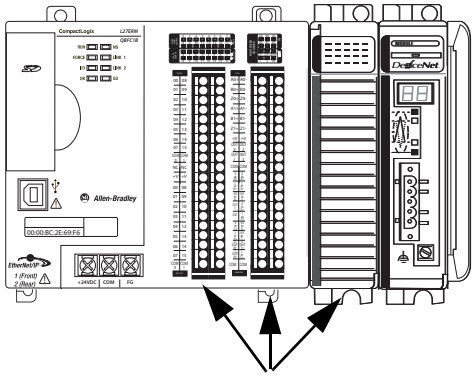
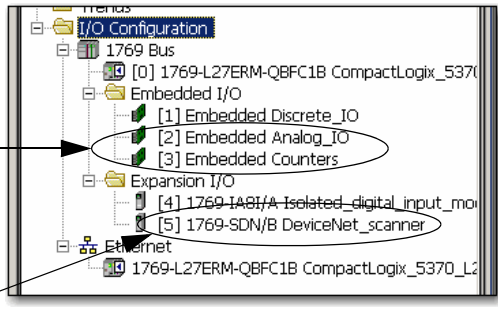
| Controller Cat. No. | Number of Embedded I/O Modules | 1769-SDN Scanner Module Power Supply Distance Rating Calculation Impact |
|---|---|---|
| 1769-L24ER-QB1B | 1 | The embedded I/O module is the first module in the module count. At its maximum power supply distance rating, the 1769-SDN scanner module can be installed in slot 3 of the local expansion modules, as shown below.<br>  <br>Three modules between the power supply and the 1769-SDN scanner module.<br>With this controller catalog number, you can only install up to two local expansion modules between the controller and the 1769-SDN scanner module. |

**Table 7 - Example CompactLogix 5370 L2 Control Systems with a 1769-SDN Scanner Module**

| Controller Cat. No. | Number of Embedded I/O Modules | 1769-SDN Scanner Module Power Supply Distance Rating Calculation Impact |
|---|---|---|
| 1769-L24ER-QBFC1B<br>1769-L27ERM-QBFC1B | 2 | The embedded I/O modules are the first two modules in the module count. At its maximum power supply distance rating, the 1769-SDN scanner module can be installed in slot 2 of the local expansion modules, as shown below.<br>  <br>Three modules between the power supply and the 1769-SDN scanner module.<br>With this controller catalog number, you can only install one local expansion modules between the controller and the 1769-SDN scanner module.<br><br>**IMPORTANT** When counting I/O modules to determine the 1769-SDN scanner module placement in a 1769-L24ER-QBFC1B or 1769-L27ERM-QBFC1B control system, the embedded I/O module appearance is different between the physical appearance and the modules' appearance the application.<br>The physical appearance is shown above. The second module is two rows of termination points below a single set of status indicators.<br>In the application, the second embedded I/O module appears as two modules in the Controller Organizer each with their own slot number, that is [2] and [3].<br>When the 1769-SDN scanner module is installed in the farthest local expansion module slot possible, that is the fourth module in the control system, it appears with a [5] designation in the Controller Organizer, as shown below.<br>Modules [2] and [3] are shown separately but are considered a single module when counting modules to meet power supply distance rating requirements.<br>  <br>1769-SDN scanner module is shown as module [5] in this location but considered the fourth module when counting modules to meet power supply distance rating requirements. |

*CompactLogix 5370 L3 Control Systems*

CompactLogix 5370 L3 control systems do not have embedded I/O modules. You begin counting local expansion slots with the first Compact I/O module installed next to the power supply when determining where to install a 1769-SDN scanner and meet its power supply distance rating.

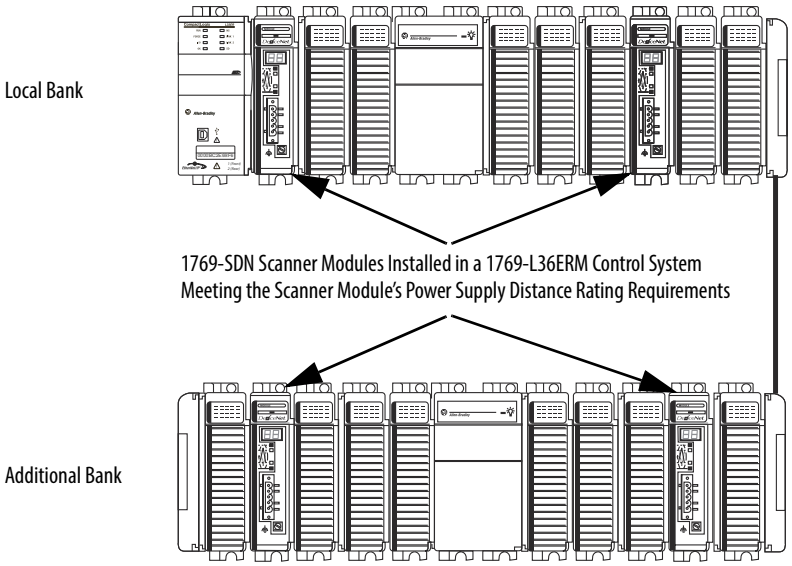
In CompactLogix 5370 L3 control systems, you can install 1769-SDN scanner modules to the left or right side of the power supply. You can also use both local and additional banks in a CompactLogix 5370 L3 control systems, with each allowing the inclusion of a 1769-SDN scanner module.

In the local bank, the controller must be the leftmost device in the system and you can only install up to three modules between the controller and the power supply. Therefore, any 1769-SDN scanner modules that are installed to the left of the power supply in the local bank, are in a module slot that meets the module's power supply distance rating requirements.

CompactLogix 5370 L3 control systems also support the use of additional banks for the system's local expansion modules. Every additional bank requires a 1769 Compact I/O power supply. The bank can be designed with local expansion modules on either side of the power supply.

In this case, you must install the 1769-SDN scanner module with no more three Compact I/O modules between the scanner module and the power, regardless of whether the modules are installed to the left or right of the power supply.

This graphic shows 1769-SDN scanner modules installed in a 1769-L36ERM control system and meeting the module's power supply distance rating.




1769-SDN Scanner Modules Installed in a 1769-L36ERM Control System
Meeting the Scanner Module's Power Supply Distance Rating Requirements

## Current Capacity in CompactLogix 5370 L3 Control Systems

In a local or additional bank, the modules installed on either side of the power supply cannot draw more current than the power supply can supply. This requirement partially dictates module placement on the bank.

For example, if a bank uses a 1769-PA2 Compact I/O power supply, each side of the bank has a current capacity of 1A at 5 V DC and 0.4A at 24 V DC. Because a 1769-SDN scanner module has a current draw of 440 mA at 5 V DC and 0 mA at 24 V DC, you can only install up to two scanner modules on each side of the power supply in the bank in this case.

For more information on 1769 Compact I/O power supply maximum current capacity and calculations you can use to design the modules used in local or additional banks, see Calculate System Power Consumption on page 244.

# Use I/O Modules with CompactLogix 5370 L1 Controllers

This chapter explains how to use I/O modules in a CompactLogix 5370 L1 control system.


| Topic | Page |
|---|---|
| Select I/O Modules | 139 |
| Validate I/O Layout | 156 |
| Use the Event Task | 161 |
| Configure I/O | 165 |
| Electronic Keying | 167 |
| Configure Distributed I/O Modules on an EtherNet/IP Network | 173 |
| Monitor I/O Modules | 176 |


## Select I/O Modules

CompactLogix 5370 L1 control systems offer these I/O module options:

- Embedded I/O Modules
- Local Expansion Modules
- Distributed I/O Modules over an EtherNet/IP Network

## Connect Power to I/O Devices Connected to a CompactLogix 5730 L1 Control System

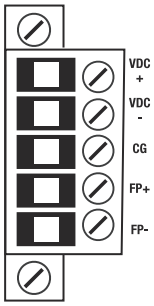
Section Connect Power to the Controller on page 26 describes how to connect a dedicated, Class 2/SELV-listed external 24V DC power source to the VDC+ and VDC- terminals on the removable connector shown below. Those connections provide power to only the system-side of the embedded I/O and local expansion I/O modules.

You must connect a separate external power source to the FP+ and FP- terminals on the controller's removable connector to power the field-side circuitry of the embedded I/O modules and the local expansion modules.

That is, power connections to the FP+ and FP- terminals provides power to input and output devices connected to the controller's embedded I/O modules or local expansion modules. For example, input or output devices, such as a bar code scanner.

The controller's embedded I/O and local expansion modules' field-side power is 24V DC nominally with an input range of 10...28.8V DC.

The following graphic shows the removable connector.




**IMPORTANT** The CG terminal on the removable connector connects to the DIN rail via a grounding clip on the back of the controller. The controller is grounded once it is installed on a DIN rail as described in Mount the System on page 22.

You should not make any connections to the CG terminal.

Consider these points before completing the steps in this section:

- This section describes how to connect a 24V DC power source to power input or output devices connected to the CompactLogix 5370 L1 controller's embedded I/O or local expansion modules via FP+ and FP- terminals.

  For information on how to connect 24V DC power to the CompactLogix 5370 L1 controller and the POINTBus backplane via VDC+ and VDC- terminals on the removable connector, see page 26.

- The external 24V DC power source that is connected to the FP+ and FP- terminals **must be separate** from the power source dedicated to powering the controller via the VDC+ and VDC- terminals.

- You can use the external 24V DC power source that provides power to the FP+ and FP- terminals to power other components or devices in the application.

- The external 24V DC power source that provides power to the FP+ and FP- terminals can be installed on the same DIN rail as the external 24V DC power source that provides power to the VDC+ and VDC- terminals or you can install the external 24V DC power sources on separate DIN rails.

- Use a power source that most effectively meets your application needs. That is, calculate your application's power requirements before choosing a power source to avoid using a power source that far exceeds your application requirements.

- This section assumes that any DIN rail you use has been grounded following Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1

- For example purposes, this section describes how to use a 1606-XLE80E, Class 2 switched-mode power supply with the FP+ and FP- terminals. The exact steps for other external power supplies might vary from those described here.

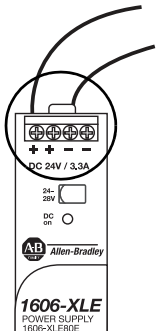
Complete these steps to connect power to the CompactLogix 5370 L1 controller.

1. Verify that the separate external 24V DC power source powering the CompactLogix 5370 L1 controller is not powered.
2. Verify that the external 24V DC power source that will be connected to the FP+ and FP- terminals is not powered.
3. Mount the external power supply that will connect to the FP+ and FP- terminals on a DIN rail.

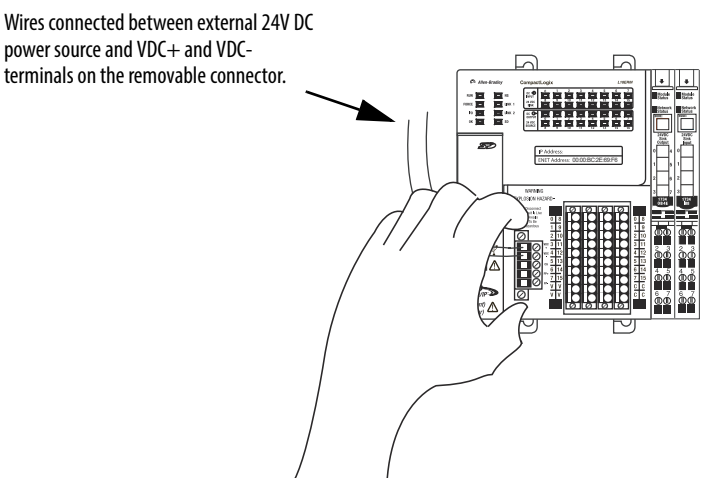
   The external power supply can be installed on the same DIN rail as the controller or a separate DIN rail.

4. Connect wires to the appropriate + and - connections on the external 24V DC power source.

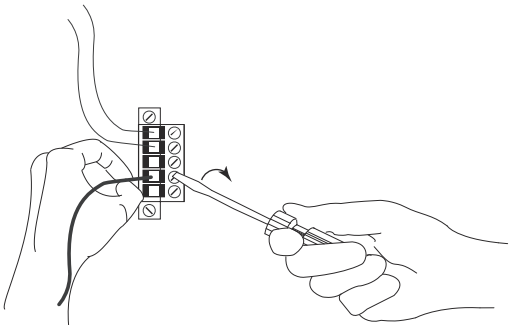
**WARNING:** If you connect or disconnect wiring while the field-side power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.



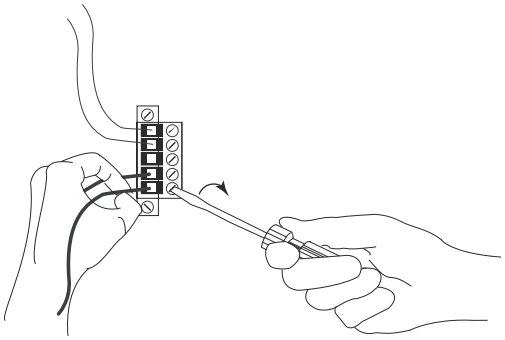

5. Pull the removable connector off of the CompactLogix 5370 L1 controller.



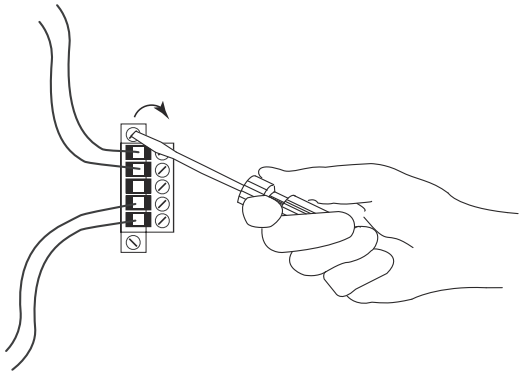
6. Connect the wire connected to the + terminal on the external 24V DC power source to the FP+ terminal, that is, the fourth terminal from the top, on the removable connector.



7. Connect the wire connected to the - terminal on the external 24V DC power source to the FP- terminal, that is the fifth terminal from the top, on the removable connector.



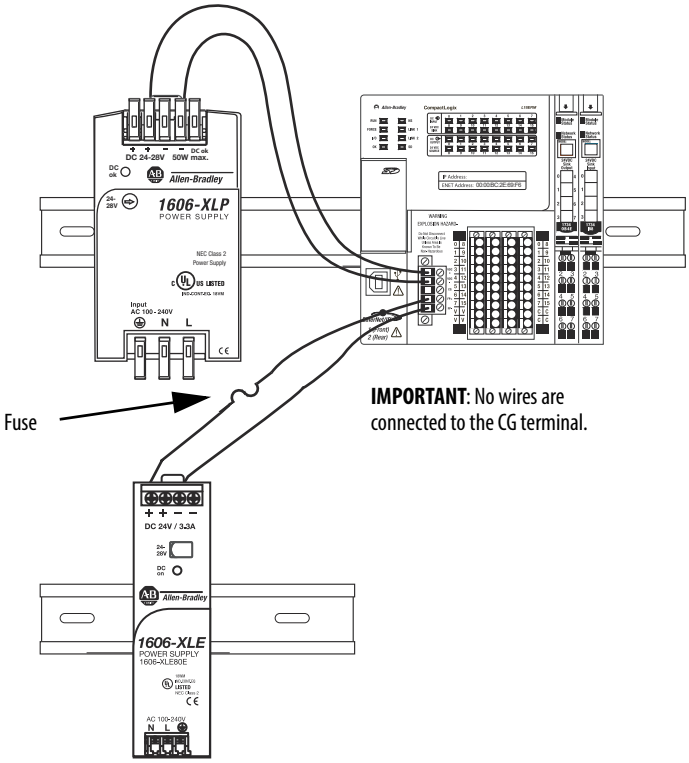
8. Plug the removable connector into the controller.
9. Secure the removable connector in place.



10. Turn power on to the separate external 24V DC power source connected to the removable connector's VDC+ and VDC- terminals.
11. Turn power on to the external 24V DC power source connected to the removable connector's FP+ and FP- terminals.

The following graphic shows separate external 24V DC power supplies connected to the VDC+/VDC- and FP+/FP- terminals on the removable connector, respectively.

**IMPORTANT** We recommend that you put a user-replaceable fuse with overcurrent protection of 4…6 A @ 52.5…68.25 $A^2t$ in line between the incoming power and the FP+ terminal.

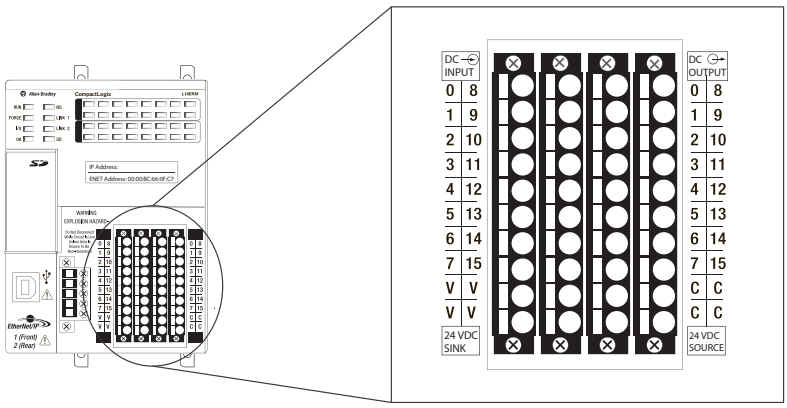


## Embedded I/O Modules

In addition to the embedded power supply, CompactLogix 5370 L1 controllers provide an embedded I/O module with these points:

- Sixteen sinking 24V DC digital input points
- Sixteen sourcing 24V DC digital output points

The following diagram shows the wiring terminals on the embedded I/O module.




Consider the following when connecting input or output devices to your CompactLogix 5370 L1 controller's embedded I/O modules:

- You must connect an external 24V DC power source to the FP+ and FP- terminals on the controller's removable connector to power input and output devices connected to the controller's embedded I/O modules.

  The controller's embedded I/O modules' field-side power is 24V DC nominally with an input range of 10...28.8V DC.

  For more information on how to connect an external power source to the FP+ and FP- terminals, see page 140.

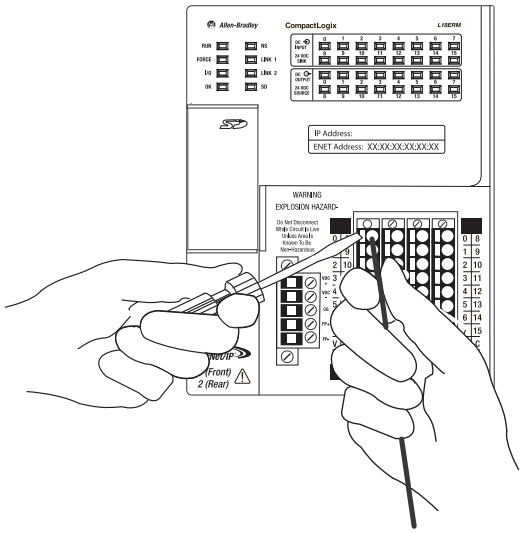
- The I/O points' available RPI range is 1.0 ms…750.0 ms and can be changed by 0.5 ms increments. The default setting is 20 ms.

**IMPORTANT**

- If you attempt to use an RPI value that is not valid, the application automatically rounds the value down to the closest 0.5 ms increment when you apply the change.
  For example, if you set the RPI = 1.75 ms, when you click Apply or OK, the value is rounded down to 1.5 ms and then applied.
- The RPI value for embedded I/O module is intended to establish a specific time interval at which data is transmitted. However, the actual time interval of data transmission may be affected by the configuration of your CompactLogix 5370 L1 control system.
  For more information, see Estimate Requested Packet Interval on page 158.

Complete these steps to wire the input and output points on the CompactLogix 5370 L1 controller.

1. Verify that the control system is not powered.
2. Use a small screwdriver to push on the spring release clip and insert the wire.




3. With the wire in place, pull the screwdriver off the spring release clip.
4. Repeat step 2 for all embedded I/O wires needed in your application.

To remove a wire from the removable connector, complete these steps.

1. Verify that the control system is not powered.
2. Use a small screwdriver to push on the spring release clip and pull the wire out.

### *Embedded Input Points*

The embedded input points on the CompactLogix 5370 L1 controllers support 2-wire and 3-wire input devices. You can wire the input devices to be powered in either of the following methods:

- Using an **external power supply**, as shown in Figure 18 - In this case, you can monitor the input devices even if field power is interrupted, for example, by the MCR.

  This method is required if you need to continue reading data from the input devices when the embedded output terminals are disabled, for example, output power is interrupted by the use of a Master Control Relay (MCR).

- Using the **V terminal** on the embedded I/O module, as shown in Figure 19 - In this case, you cannot monitor the input devices even if field power is interrupted, for example, by the MCR.

Figure 18 shows examples of how to power 2-wire and 3-wire input devices in your application.

**IMPORTANT** When using Figure 18, use the following guidelines:

- With this wiring configuration, you can monitor the input devices even if field power is interrupted, for example, by the MCR. The FP- connection must be maintained as a reference for inputs to function.
- With this wiring configuration, the controller does not protect field-side devices from overcurrent draw conditions.

  We recommend that you put a user-replaceable fuse with overcurrent protection of 4…6 A in line between the incoming power and the FP+ terminal.
- You must use a separate, dedicated Class 2 power supply for the CompactLogix 5370 L1 controller and a separate power supply for the embedded I/O module.
- Design your application so that power consumption does not exceed the power supply ratings.
- The graphic below is a wiring example that complies with the North American Electrical Code (NEC) standard for isolation between system and field power.
- The FP+ terminal on the removable connector is the voltage connection.
- The FP- terminal on the removable connector is the common connection.
- The MCR must be closed for the removable connector to provide power to the embedded I/O module.

**Figure 18 - CompactLogix 5370 L1 Controllers with Input Devices Powered by External Power Supplies**

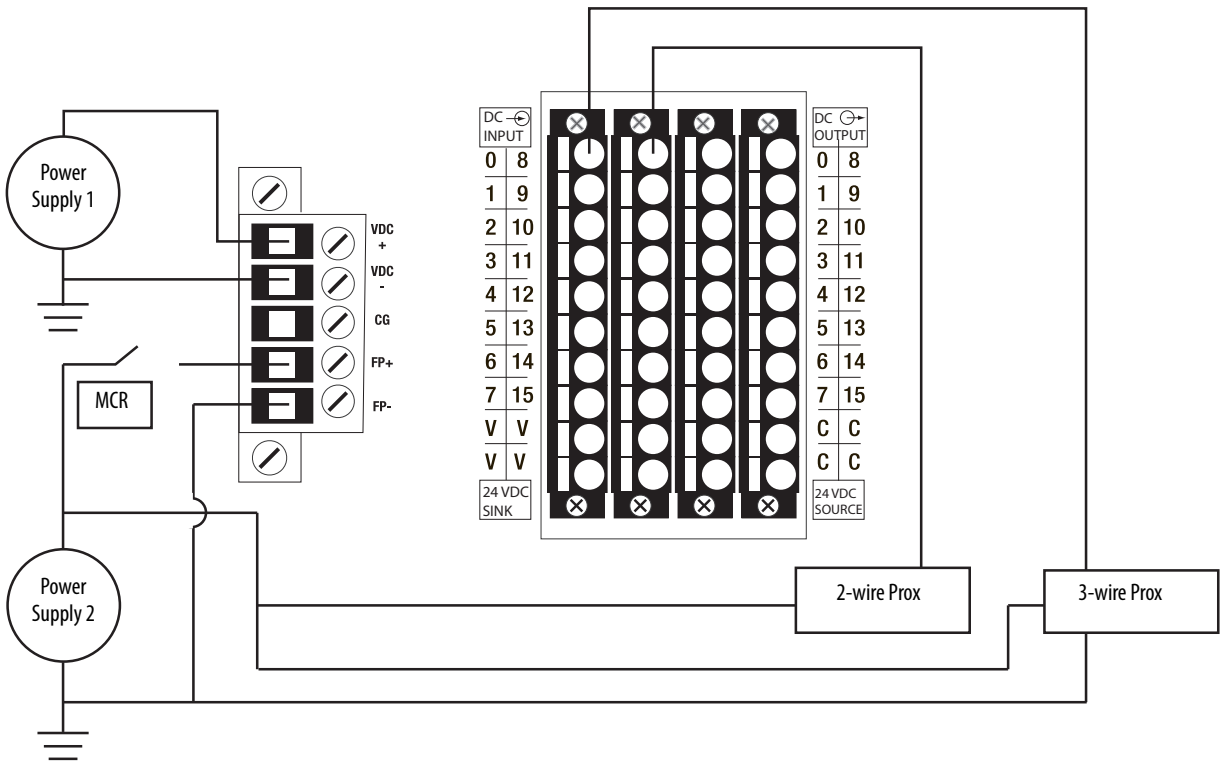


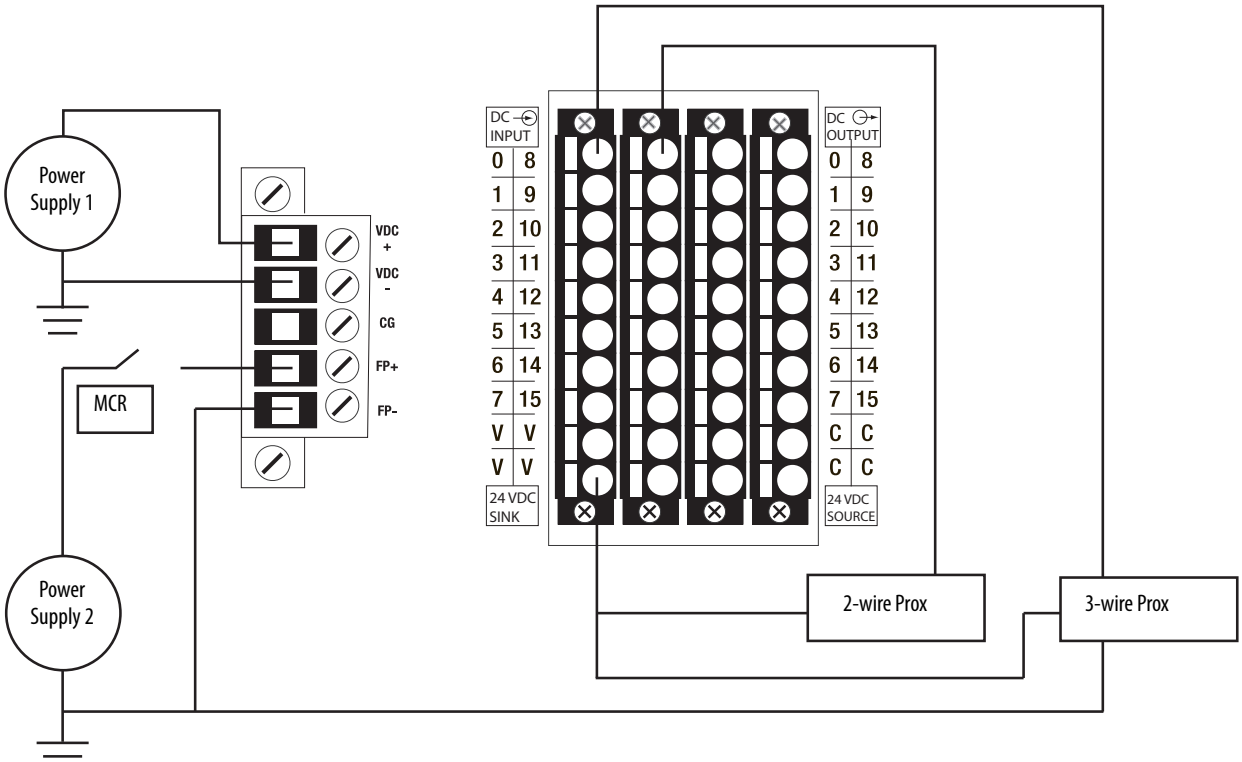
Figure 19 shows examples of how to power 2-wire and 3-wire input devices in your application with connections to a V terminal.

**IMPORTANT** When using Figure 19, use the following guidelines:

- With this wiring configuration, the input devices lose power if the removable connector does not power the embedded I/O modules.
- With this wiring configuration, the controller does not protect field-side devices from overcurrent draw conditions.

  We recommend that you put a user-replaceable fuse with overcurrent protection of 4…6 A in line between the incoming power and the FP+ terminal.
- You must use a separate, dedicated Class 2 power supply for the CompactLogix 5370 L1 controller and a separate power supply for the embedded I/O module.
- Design your application so that power consumption does not exceed the power supply ratings.
- The graphic below is a wiring example that complies with the North American Electrical Code (NEC) standard for isolation between system and field power.
- The FP+ terminal on the removable connector is the Voltage connection.
- The FP- terminal on the removable connector is the Common connection.
- The MCR must be closed for the removable connector to provide power to the embedded I/O module.

**Figure 19 - CompactLogix 5370 L1 Controllers with Input Devices Powered by a V Terminal on Embedded I/O Module**



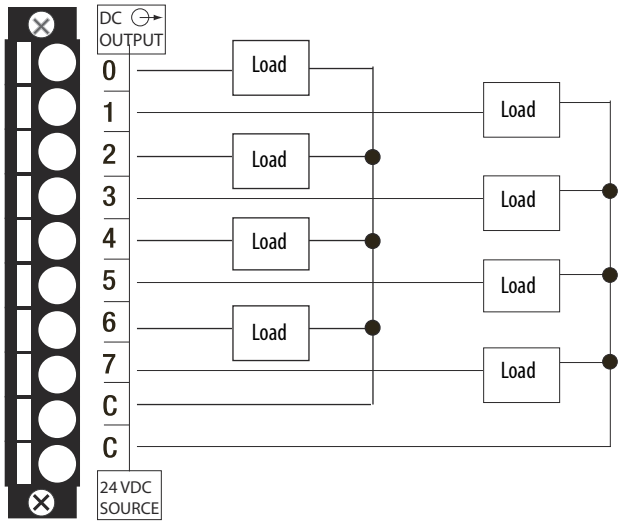
### *Embedded Output Points*

The embedded output points on the CompactLogix 5370 L1 controllers support 2-wire systems. The controller's embedded power supply powers the embedded output points over the POINTBus backplane.

The following graphic shows examples of how to connect 2-wire systems to embedded output points 0...7. The same wiring connections can be used with output points 8...15.

**IMPORTANT** Do not exceed the per point output current rating or total output module current rating.

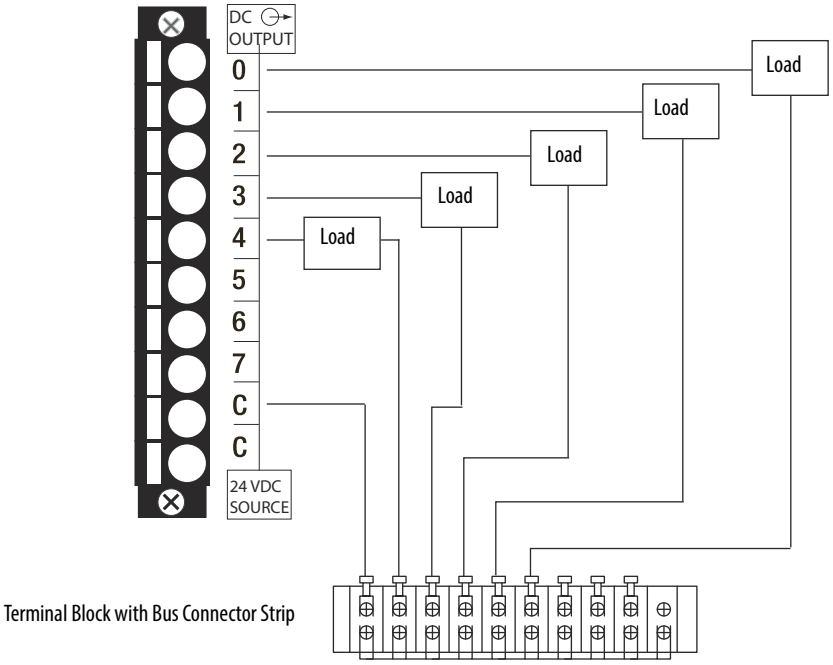
**Figure 20 - CompactLogix 5370 L1 Controllers Embedded Digital Output Point Wiring Diagram**



The following graphic shows an example of how to connect 2-wire systems to embedded output points 0...4 and use an external terminal block with a bus connector strip.

**IMPORTANT** Do not exceed the per point output current rating or total output module current rating.

**Figure 21 - CompactLogix 5370 L1 Controllers Embedded Digital Output Point Wiring Diagram**



## Local Expansion Modules

CompactLogix 5370 L1 controllers support the use of 1734 POINT I/O modules as local expansion modules along the POINTBus backplane.

**IMPORTANT** For a full description of how to use 1734 POINT I/O modules, see the POINT I/O Digital and Analog Modules and POINTBlock I/O Modules, publication 1734-UM001.

Consider the following when using local expansion modules:

- The controllers support this many local expansion modules.

  **Table 8 - Maximum 1734 POINT I/O Modules Available as Local Expansion Modules**

  | Cat. No. | Local 1734 POINT I/O Modules Supported, max |
  |---|---|
  | 1769-L16ER-BB1B | 6 |
  | 1769-L18ER-BB1B | 8 |
  | 1769-L18ERM-BB1B | |

- You can use up to the maximum number of 1734 POINT I/O modules with the CompactLogix 5370 L1 controllers listed in Table 8, as long as the total current drawn by the embedded I/O and local expansion modules does not exceed the available POINTBus backplane current of 1 A and/or field power current of 3 A.

  Depending on your application's configuration, you can use one of the following devices to make additional POINTBus backplane current and/or field power current available:

  – **1734-EP24DC POINT I/O Expansion Power Supply** - An expansion power supply is installed between embedded I/O modules and local expansion modules or between local expansion modules.

    The expansion power supply breaks the available POINTBus backplane current between the modules to its left and right. With the expansion power supply installed, the modules to its left can draw up to 1 A of POINTBus backplane current and the modules to its right can draw as much current as that provided by the expansion power supply.

    Additionally, the expansion power supply breaks the available field power current between the modules to its left and right With the expansion power supply installed, the modules to its left can draw up to 3 A of field power current and the modules to its right can draw as much field power current as allowed by the expansion power supply.

    For more information on the 1734-EP24DC expansion power supply, see the POINT I/O 24V DC Expansion Power Supply Installation Instructions, publication 1734-IN058.

– **1734-FPD POINT I/O Field Power Distributor Module** - A field power distributor module can also be installed between embedded I/O modules and local expansion modules or between local expansion modules.

The field power distributor module breaks the available field power current between the modules to its left and right. With the field power distributor module installed, the modules to its left can draw up 3 A of field power current, and the modules to its right can draw as much field power current as allowed by the field power distributor.

For more information on the 1734-FPD POINT I/O Field Power Distributor module, see the POINT I/O Field Power Distributor Module Installation Instructions, publication 1734-IN059.

**IMPORTANT** Remember, the field power distributor module only changes the level of field power current available in the system. It does not affect the level of POINTBus backplane current available.

- You must connect an external 24V DC power source to the FP+ and FP- terminals on the controller's removable connector to provide power to input and output devices connected to the local expansion modules.

**IMPORTANT** We recommend that you put a user-replaceable fuse with overcurrent protection of 4…6 A in line between the incoming power and the FP terminals.

The controller's local expansion modules' field-side power requirement is 24V DC nominally with an input range of 10...28.8V DC.

For more information on how to connect a power source to the FP+ and FP- terminals, see page 140.

- We **recommend** that you make sure all of the 1734 POINT I/O modules that you intend as local expansion modules are upgraded to the most current firmware revision before installing them in a CompactLogix 5370 L1 control system.

- Each local expansion module's available RPI range is 1.0…750.0 ms and can be changed by 0.5 ms increments. The default setting is module-dependent.

  You can configure specific RPI values for each local expansion module in your control system. However, the complete I/O configuration has an impact on the rate at which data is actually transmitted in a CompactLogix 5370 L1 control system. For more information, see Estimate Requested Packet Interval on page 158.

- Before installing a 1734 POINT I/O module into a CompactLogix 5370 L1 control system, make sure the I/O module is set to Autobaud. 1734 POINT I/O modules are set to Autobaud by default.

  If you need to return a 1734 POINT I/O module to Autobaud, see the POINT I/O Digital and Analog Modules and POINTBlock I/O Modules, publication 1734-UM001.

- When possible, use specialty 1734 POINT I/O modules to meet unique application requirements.

- Make sure that there are no empty slots between the controller and local expansion modules or between local expansion modules.

- The Expansion I/O parameter in the controller's project must match the number of local expansion modules installed in the system exactly or the controller will not establish connections to the local expansion modules.

- You must use a 1734-232ASC, firmware revision 4.001 or later, to access an RS-232 network in your CompactLogix 5370 L1 controller application.

## Distributed I/O Modules over an EtherNet/IP Network

You can include distributed I/O modules over an EtherNet/IP network in your CompactLogix 5370 L1 control system.

Consider the following when using distributed I/O modules over an EtherNet/IP network:

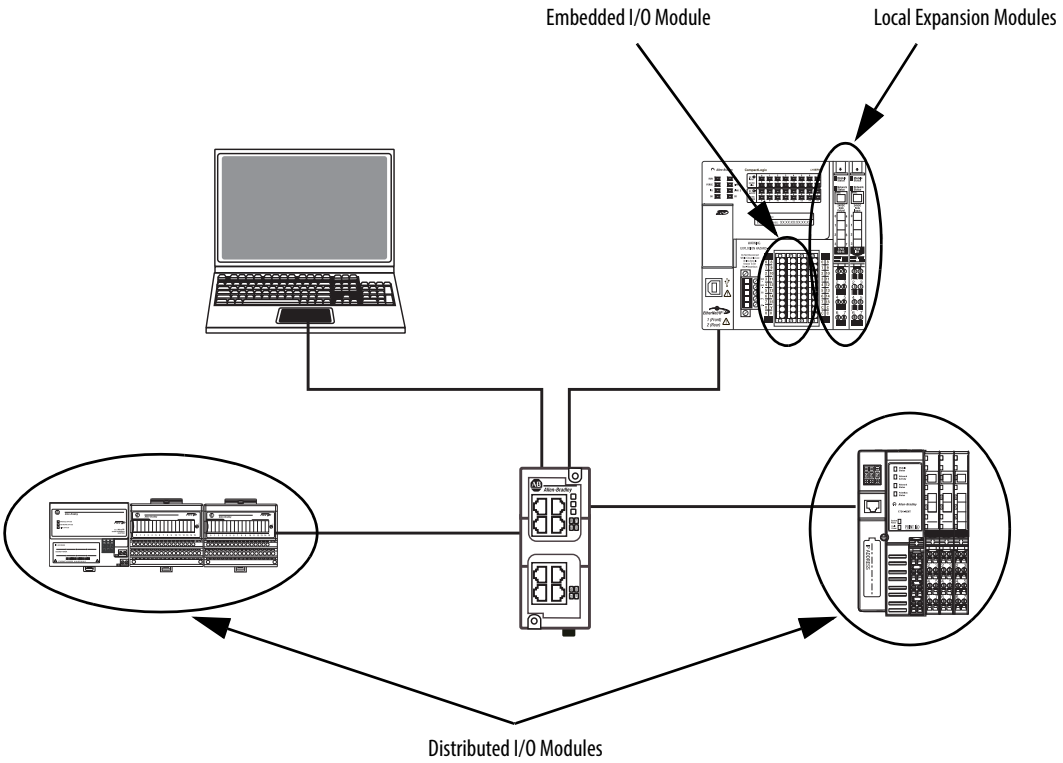
- Each remote EtherNet/IP adapter included in the system must be counted toward the controller's maximum number of EtherNet/IP nodes.

  For more information on maximum number of EtherNet/IP nodes, see Nodes on an EtherNet/IP Network on page 118.

- The configurable RPI settings vary depending on which distributed I/O modules are used in the system.

- For information on adding distributed I/O modules to your CompactLogix 5370 L1 control system, see Configure Distributed I/O Modules on an EtherNet/IP Network on page 173.

The following graphic shows a CompactLogix 5370 L1 control system that uses all three I/O module options.



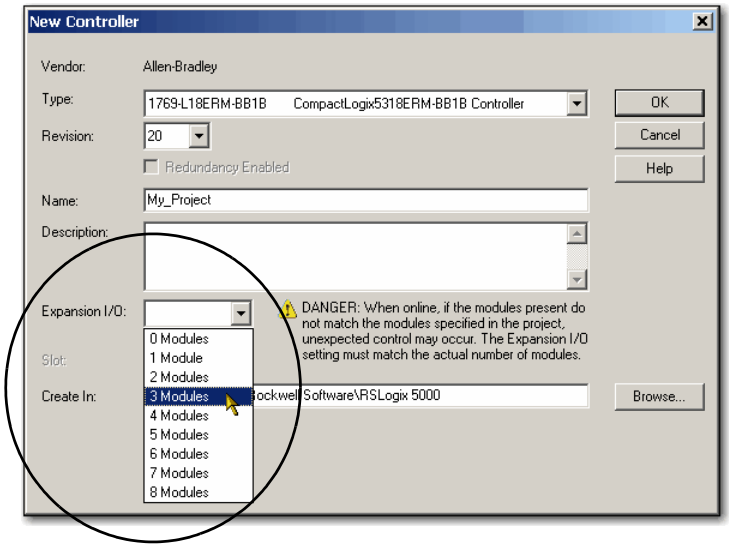
## Validate I/O Layout

You must validate the layout of 1734 POINT I/O modules in your CompactLogix 5370 L1 control system. Consider these points when validating I/O layout placement:

- Set the Number of Local Expansion Modules
- Empty Slots and Removal and Insertion Under Power Situations
- Estimate Requested Packet Interval
- Module Faults Related to RPI Estimates
- Physical Placement of I/O Modules

### Set the Number of Local Expansion Modules

You must specify the number of local expansion modules to be used in a CompactLogix 5370 L1 control system when creating a new project, as shown below, or when the number of local expansion modules is changed.




Each time the controller is powered up, it compares the number of local expansion modules present on the POINTBus backplane to the Expansion I/O value. The controller does not allow any I/O connections until the number of local expansion modules present equals the Expansion I/O value.

## Empty Slots and Removal and Insertion Under Power Situations

The POINT I/O system cannot detect an empty terminal base. For this reason, there are numerous situations in which you can potentially configure a system that is unusable or one that exercises unintended control.

Follow these rules for I/O system configuration and RIUP of I/O modules.

**IMPORTANT** 1734 POINT I/O modules support RIUP in CompactLogix 5370 L1 control systems.

- A correct I/O system does not have any empty terminal bases. If necessary, you can use a 1734-ARM POINT I/O Address Reserve module to temporarily replace a 1734 POINT I/O module in a CompactLogix 5370 control system.
- After you cycle power, the controller only allows I/O connections if the number of local expansion modules present on POINTBus matches the value used for the Expansion I/O parameter in the project.
- If a 1734 POINT I/O module is removed under power, the operation of the other I/O modules is not disrupted.
- When you remove an I/O module that has an active connection from the controller, the controller I/O status indicator flashes green to indicate the condition.

  **IMPORTANT** If you enabled the 'Major Fault On Controller If Connection Fails While in Run Mode' parameter when configuring the module in the RSLogix 5000 project, removal of the module causes the controller to transition to a major fault condition.

- If more than one contiguous module is removed under power, connections to all modules in the contiguous missing module set are disallowed until all modules are replaced. The controller cannot detect an empty base. Therefore, it does not know the physical positioning of the modules until all of the missing modules are replaced.
- If a module separating two sets of contiguous missing modules is removed, the two sets merge into a single set. All of the modules must be replaced before connections are permitted to any module in the set.

- If modules of different types are removed and returned to the wrong locations, attempts to connect to these modules fail during verification of Electronic Keying.

| **IMPORTANT** | If Electronic Keying is set to Disable Keying, no verification of electronic keying occurs and unintended control might occur. |
|---|---|

- If modules of the same type are removed and returned to the wrong locations, they accept connections from the controller and reconfigure with the correct data once they pass their electronic keying check.

## Estimate Requested Packet Interval

The requested packet interval (RPI) defines the frequency at which the controller sends data to and receives data from I/O modules. You set an RPI rate for each I/O module in your system.

The CompactLogix 5370 L1 controllers always attempt to scan an I/O module at the configured RPI rate. For individual I/O modules, a Module RPI Overlap minor fault occurs if there are enough I/O modules with RPI rates set too fast that they cannot all be serviced in the allotted interval.

The specific configuration parameters for a system determine the impact on actual RPI rates. These configuration factors can impact the effective scan frequency for any individual module:

- Rates at which other 1734 POINT I/O modules' RPI rates are set
- Number of other 1734 POINT I/O modules in the system
- Types of other 1734 POINT I/O modules in the system
- Application user task priorities

In general, follow these guidelines when setting the RPI rates in a CompactLogix 5370 L1 control system:

- For **digital** I/O modules:
  - 1...2 modules can be scanned in 2 ms.
  - 3...4 modules can be scanned in 4 ms.
  - 5...8 modules can be scanned in 8 ms.

| **IMPORTANT** | When considering digital I/O modules, remember that they can be the embedded I/O module on the controller or 1734 POINT I/O modules used as Local Expansion Modules. Therefore, the consideration for using two modules can be the embedded I/O module and a 1734 POINT I/O module or two 1734 POINT I/O modules. |
|---|---|

- For **specialty and analog** I/O modules (except 1734-485ASC modules):
  - 1 module can be scanned at 20ms.
  - For each additional module add 20ms.

  For example, if a CompactLogix 5370 L1 control system uses two analog modules, the module can be scanned in 40 ms.

- For **1734-485ASC** modules, the sum total data size for all ASC modules determines the RPI rates:
  - For total data size less than 20 bytes, each module can be scanned in 20 ms.
  - For data size greater than 20 bytes, use the size value as the RPI.

  For example, if the total data size is 40 bytes, each ASC module can be scanned in 40 ms.

You are not required to set individual 1734 POINT I/O modules' RPI values to the values listed above. For example, if your application scans one or two modules, you do not have to use RPI rates of 2 ms. Remember, though, that higher RPI rates result in scanning the data less frequently.

The RPI shows how quickly modules can be scanned, not how quickly an application can use the data. The RPI is asynchronous to the program scan. Other factors, such as program execution duration, affect I/O throughput.

## Module Faults Related to RPI Estimates

When following the guidelines described on page 158, most CompactLogix 5370 L1 control systems operate as expected.

Some systems that follow the guidelines may experience minor faults described in the following table.

| Name | Fault Information | Condition In Which Fault Occurs |
|---|---|---|
| Module RPI Overlap | (Type 03) I/O fault<br>(Code 94) Module RPI overlap detected<br>Module Slot = *x*, where *x* is the slot number of the I/O module in the I/O Configuration section | This fault is logged when an I/O module's current RPI update overlaps with its previous RPI update. The Minor Faults tab in the Controller Properties dialog box indicates which module's RPI is overlapping.<br>If multiple I/O modules experience the fault, the application indicates the fault occurred on the first such I/O module. Typically, it is an I/O module with a lower RPI rate and/or an I/O module with large input/output data sizes. For example, the 1734-232ASC and 1734-485ASC modules use large input/output data sizes.<br>Once the fault is cleared from the first I/O module, the application indicates the next module experiencing the fault.This pattern continues until the fault is cleared from all affected I/O modules.<br>To avoid this fault, set the I/O modules' RPI rate to a higher numerical value. |

## Calculate System Power Consumption

An embedded 24V DC nominal, non-isolated power supply with an input range of 10...28.8V DC powers the CompactLogix 5370 L1 control system.

The embedded power supply provides 1 A @ 5V DC to the POINTBus backplane to power all system components, including local expansion modules, that is 1734 POINT I/O modules, in most system configurations.

In some circumstances, you might configure a system that requires more current than the system's embedded power supply provides. This type of configuration results from using a combination of local expansion modules that, when combined with current consumption of the rest of the system, exceeds 1 A @ 5V DC.

In this case, you can take any of the following actions to make sure your system configuration has enough power:

- Insert a 1734-EP24DC POINT I/O expansion power supply between local expansion modules to increase the POINTBus backplane power.
- Insert a 1734-FPD POINT I/O Field Potential Distribution module between local expansion modules to renew field power or change the field power from DC to AC, that is, separate DC I/O modules from AC I/O modules on the same POINTBus.

| **IMPORTANT** | The 1734-FPD POINT I/O Field Power Distributor is required if the devices connected to the local expansion modules consume more than 3 A. |
|---|---|

## Physical Placement of I/O Modules

Before you physically install the I/O modules, you must assemble, mount, and ground the system as described in Chapter 1, Install the CompactLogix 5370 L1 Controller on page 13.

## Use the Event Task

The CompactLogix 5370 L1 controllers support the use of an Event task with their embedded input points. You can configure embedded input point terminals to trigger an Event task if a change of state (COS) occurs.

**IMPORTANT** When using the Event task with the CompactLogix 5370 L1 controllers, consider these points:

- You can use the Event task only with Logix Designer application, version 21.00.00 and later.
- You can use the Event task only with the controller's embedded input points. You cannot use the Event task with input points in the local expansion modules, for example, a 1734-IB4 module.
- You can use the Event task only if the input point has an input data state change.
- An event is recognized only when it maintains the same state for at least the duration of the input filter time specified.
- Configure the Event task at a rate that prevents task overlap conditions.
- Configure the Event task at a rate that is likely to succeed.

  A 2 ms signal width is the minimum pulse width that can be used at which the Event task always succeeds.

You can configure more than one embedded input point to trigger an Event task. However, we recommend you enable COS for only one point. If you enable COS for multiple points, a task overlap of the Event task can occur.

You can configure an Event task to trigger if either of these events occur:

- A specific event occurs on a single point on an input module.
- A trigger event does not occur in a specific time interval.

You configure whether the task updates output modules at the end of the task. After the task executes, it does not execute again until the event occurs again. Each Event task requires a specific trigger.

The following table describes the triggers for an Event task available in a CompactLogix 5370 L1 control system.

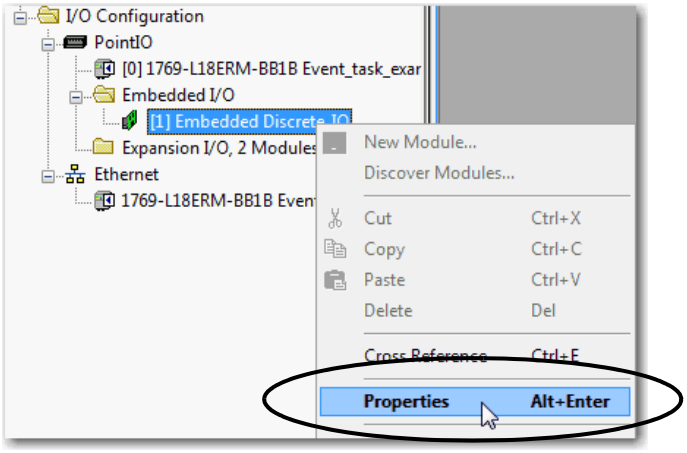
| Trigger | Description |
|---|---|
| Input Data State Change | The input point triggers the Event task based on the change of state (COS) configuration for the point. The COS configuration is set on the Module Definition dialog box. |
| Consumed Tag | Only one consumed tag can trigger a specific Event task. Use an Immediate Output (IOT) instruction in the producing controller to signal the production of new data. |
| Axis Registration 1 or 2 | A registration input triggers the Event task. |
| Axis Watch | A watch position triggers the Event task. |
| Motion Group Execution | The coarse update period for the motion group triggers the execution of both the motion planner and the Event task. Because the motion planner interrupts all other tasks, it executes first. |
| EVENT Instruction | Multiple EVENT instructions can trigger the same task. |

For more information on Event tasks, see the following publications:

- Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001
- Using Event Tasks with Logix5000 Controllers, publication LOGIX-WP003

Complete the following steps to configure the Event task.

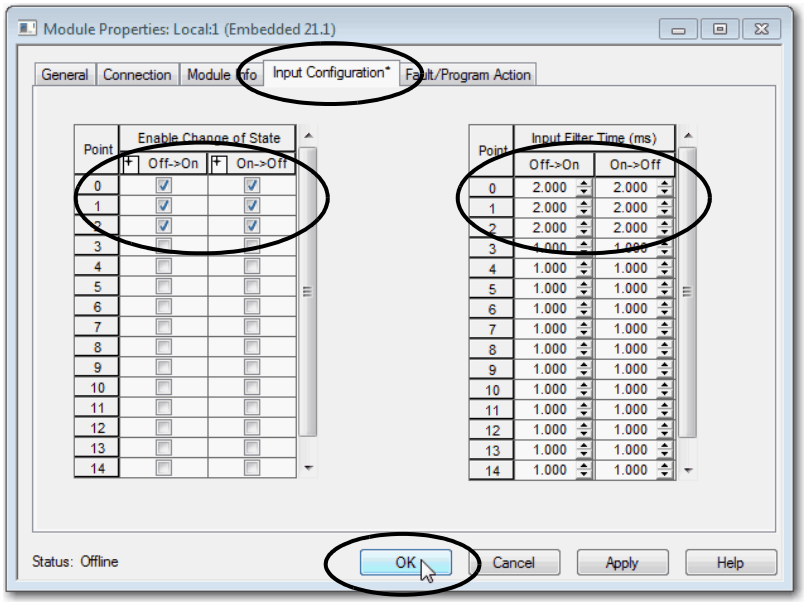
1. Open the project.
2. Right-click Embedded Discrete_IO and choose Properties.



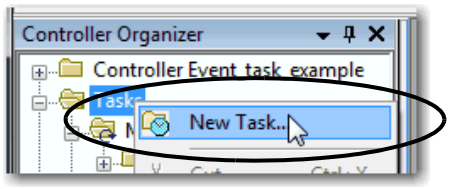
3. On the Module Properties dialog box, complete the following steps.
   a. Click the Input Configuration tab.
   b. Enable COS for the digital input points on which a state change, that is, Off to On or On to Off, triggers the Event task.
   c. Set the desired input filter time for each COS-enabled input point.

| **IMPORTANT** | An event is recognized only when it maintains the same state for at least the duration of the input filter time specified. |
|---|---|

   d. Click OK.



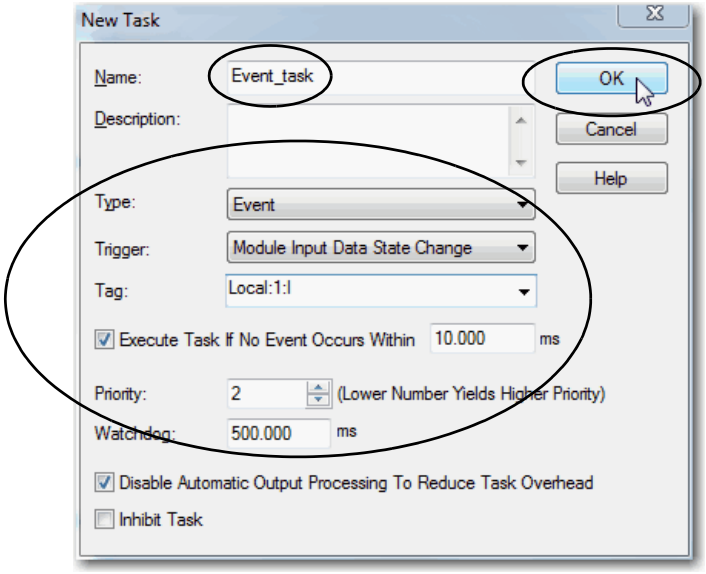

4. Right-click Tasks and choose New Task.



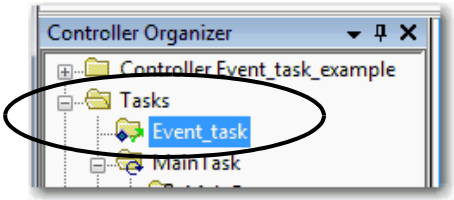
5. On the New Task dialog box, complete the following steps.
   a. Name the task.
   b. Change the task type to Event.
   c. Choose the trigger.
   d. Select the tag.
   e. If desired, set a time so the Event task executes if no event occurs with the value.

      On the following example dialog box, the time is 10 ms. If no event occurs for 10 ms, the Event tasks executes.
   f. Set the task priority.

      The default Event task priority level is 10. For more information about Event tasks, see Using Event Tasks with Logix5000 Controllers white paper, LOGIX-WP003.
   g. Make additional desired configuration changes.
   h. Click OK.



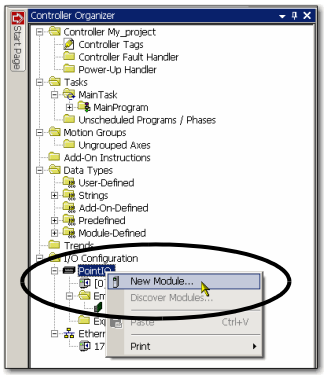

The new Event task appears in the Controller Organizer.



## Configure I/O

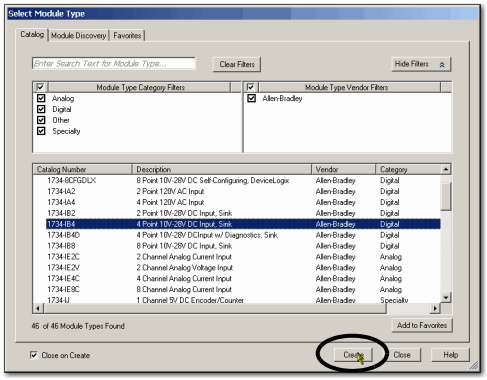
Complete these steps to add a 1734 POINT I/O module to your CompactLogix 5370 L1 control system.

1. Right-click PointIO and choose New Module.



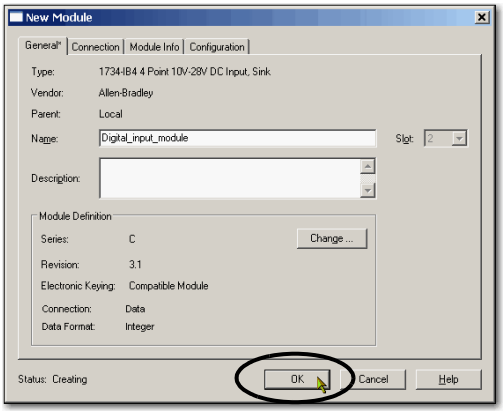

You can also right-click Expansion I/O.

2. Select the desired I/O module and click Create.




The New Module dialog box appears.

3. Configure the new I/O module as necessary and click OK.



## Common Configuration Parameters

While the configuration options vary from module to module, there are some common options you typically configure when using 1734 POINT I/O modules in a CompactLogix 5370 L1 control system, as described in Table 9.

**Table 9 - Common Configuration Parameters**

| Configuration Option | Description |
|---|---|
| Requested packet interval (RPI) | The RPI specifies the interval at which data is transmitted or received over a connection. For POINTBus backplane local expansion modules, data is transmitted to the controller at the RPI.<br>When scanned on the local bus or over an EtherNet/IP network, I/O modules are scanned at the RPI specified in the module configuration. Typically, you configure an RPI in milliseconds (ms).<br>• For local expansion modules, the range is 1.0…750 ms and the RPI must be configured in 0.5 ms increments. That is, you cannot set the RPI to a value of 2.3 ms. It must be 2.0 or 2.5.<br>• For remote I/O modules over an EtherNet/IP network, the range is 2.0…750 ms and the RPI must be configured in 1.0 ms increments. That is, you cannot set the RPI to a value of 2.3 ms. It must be 2.0 or 3.0. |
| Module definition | Set of configuration parameters that affects data transmission between the controller and the I/O module. The parameters include the following:<br>• Series - Module's hardware series.<br>• Revision - Major and minor firmware revision levels used on the module.<br>• Electronic keying - See page 167.<br>• Connection - Type of connection between the controller writing the configuration and the I/O module, such as Output.<br>• Data format - Type of data transferred between the controller and I/O module and what tags are generated when the configuration is complete. |
| Major Fault on Controller If Connection Fails While in Run Mode | This option determines how the controller is affected if the connection to an I/O module fails in Run mode or if the controller is unable to establish a connection to the module. You can configure the project so that a connection failure causes a major fault on the controller or not. The default setting is for the option to be disabled.<br>For example, if this option is enabled and an I/O module is removed while in Run mode, a major fault occurs on the controller. The default setting for the embedded I/O module is that this option is enabled. The default setting for local expansion modules is that this option is disabled. |

## I/O Connections

A CompactLogix 5370 L1 control system uses connections to transmit I/O data. Table 10 describes the connection types.

**IMPORTANT** You can only use direct connections with the local expansion modules in a CompactLogix 5370 L1 control system.

**Table 10 - I/O Module Connections**

| Connection | Description |
|---|---|
| Direct | A direct connection is a real-time, data-transfer link between the controller and an I/O module. The controller maintains and monitors the connection. Any break in the connection, such as a module fault, causes the controller to set fault status bits in the data area associated with the module.<br>Typically, analog I/O modules, diagnostic I/O modules, and specialty modules require direct connections. |
| Rack-optimized | Rack-optimized connections are not available with local expansion modules used in CompactLogix 5370 L1 control systems.For digital I/O modules, you can select rack-optimized connections.<br>This option is used with distributed I/O modules and the Rack Optimization connection selection is made when configuring the remote adapter. For example, if you want to use a rack-optimized connection with digital I/O modules in a remote 1734 POINT I/O system, you configure the 1734-AENT(R) module to use a connection type of Rack Optimization.<br>A rack-optimized connection consolidates connection usage between the controller and all of the digital I/O modules in a remote chassis or on a single DIN rail. Rather than having individual, direct connections for each I/O module, there is one connection for the entire rack (or DIN rail). |

## Electronic Keying

The electronic keying feature automatically compares the expected module, as shown in the I/O Configuration tree, to the physical module before I/O communication begins. You can use electronic keying to help prevent communication to a module that does not match the type and revision expected.

For each module in the I/O Configuration tree, the user-selected keying option determines if, and how, an electronic keying check is performed. Typically, three keying options are available:

- Exact Match
- Compatible Keying
- Disabled Keying

You must carefully consider the benefits and implications of each keying option when selecting between them. For some specific module types, fewer options are available.

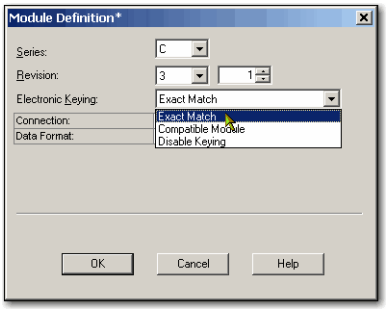
Electronic keying is based on a set of attributes unique to each product revision. When a Logix5000 controller begins communicating with a module, this set of keying attributes is considered.

**Table 11 - Keying Attributes**

| Attribute | Description |
|---|---|
| Vendor | The manufacturer of the module, for example, Rockwell Automation/Allen-Bradley. |
| Product Type | The general type of the module, for example, communication adapter, AC drive, or digital I/O. |
| Product Code | The specific type of module, generally represented by its catalog number, for example, 1734-OB4E. |
| Major Revision | A number that represents the functional capabilities and data exchange formats of the module. Typically, although not always, a later, that is higher, Major Revision supports at least all of the data formats supported by an earlier, that is lower, Major Revision of the same catalog number and, possibly, additional ones. |
| Minor Revision | A number that indicates the module's specific firmware revision. Minor Revisions typically do not impact data compatibility but may indicate performance or behavior improvement. |

You can find revision information on the General tab of a module's Properties dialog box.

**Figure 22 - General Tab**




**IMPORTANT** Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

## Exact Match

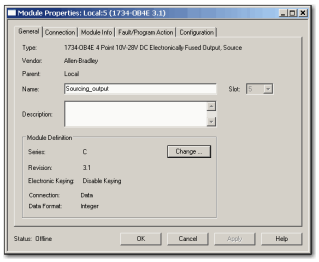
Exact Match keying requires all keying attributes, that is, Vendor, Product Type, Product Code (catalog number), Major Revision, and Minor Revision, of the physical module and the module created in the software to match precisely to establish communication. If any attribute does not match precisely, I/O communication is not permitted with the module or with modules connected through it, as in the case of a communication module.

Use Exact Match keying when you need the system to verify that the module revisions in use are exactly as specified in the project, such as for use in highly-regulated industries. Exact Match keying is also necessary to enable Automatic Firmware Update for the module via the Firmware Supervisor feature from a Logix5000 controller.

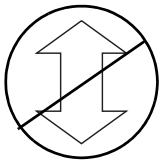
**EXAMPLE** In this scenario, **Exact Match keying prevents I/O communication**.

The module configuration is for a 1734-OB4E module with module revision 3.1. The physical module is a 1734-OB4E module with module revision 3.2. In this case, communication is prevented because the Minor Revision of the module does not match precisely.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1734-OB4E
Major Revision = 3
**Minor Revision = 1**

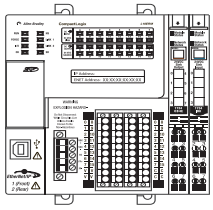



Communication is prevented.



Physical Module

Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1734-OB4E
Major Revision = 3
**Minor Revision = 2**



**IMPORTANT** Changing electronic keying selections online may cause the I/O Communication connection to the module to be disrupted and may result in a loss of data.

## Compatible Keying

Compatible Keying indicates that the module determines whether to accept or reject communication. Different module families, communication adapters, and module types implement the compatibility check differently based on the family capabilities and on prior knowledge of compatible products. Release notes for individual modules indicate the specific compatibility details.

Compatible Keying is the default setting. Compatible Keying allows the physical module to accept the key of the module configured in the software, provided that the configured module is one the physical module is capable of emulating. The exact level of emulation required is product and revision specific.

With Compatible Keying, you can replace a module of a certain Major Revision with one of the same catalog number and the same or later, that is higher, Major Revision. In some cases, the selection makes it possible to use a replacement that is a different catalog number than the original.

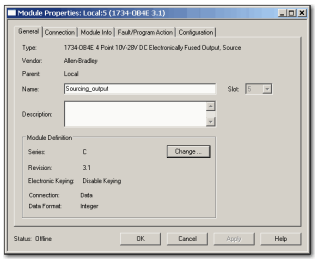
When a module is created, the module developers consider the module's development history to implement capabilities that emulate those of the previous module. However, the developers cannot know future developments. Because of this, when a system is configured, we recommend that you configure your module using the earliest, that is, lowest, revision of the physical module that you believe will be used in the system. By doing this, you can avoid the case of a physical module rejecting the keying request because it is an earlier revision than the one configured in the software.

**EXAMPLE**

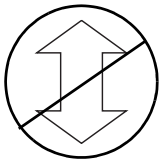
In this scenario, **Compatible Keying prevents I/O communication**:

The module configuration is for a 1734-OB4E module with module revision 3.3. The physical module is a 1734-OB4E module with module revision 3.2. In this case, communication is prevented because the minor revision of the module is lower than expected and may not be compatible with 3.3.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1734-OB4E
Major Revision = 3
**Minor Revision = 3**

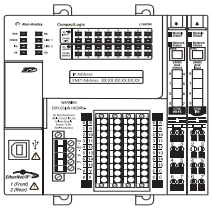



Communication is prevented.



Physical Module

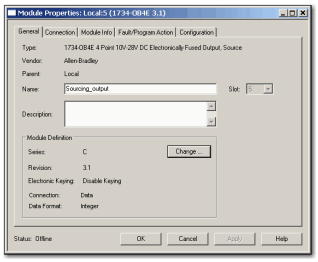
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1734-OB4E
Major Revision = 3
**Minor Revision = 2**



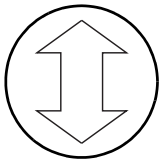
**EXAMPLE** In this scenario, **Compatible Keying allows I/O communication**:

The module configuration is for a 1734-OB4E module with module revision 1.2. The physical module is a 1734-OB4E module with module revision 3.2. In this case, communication is allowed because the major revision of the physical module is higher than expected and the module determines that it is compatible with the prior major revision.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1734-OB4E
Major Revision = 1
**Minor Revision = 2**

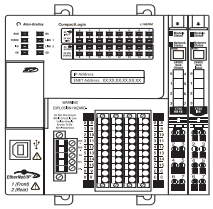



Communication is allowed.



Physical Module

Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1734-OB4E
Major Revision = 3
**Minor Revision = 2**



**IMPORTANT** Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

## Disabled Keying

Disabled Keying indicates the keying attributes are not considered when attempting to communicate with a module. Other attributes, such as data size and format, are considered and must be acceptable before I/O communication is established. With Disabled Keying, I/O communication may occur with a module other than the type specified in the I/O Configuration tree with unpredictable results. We generally do not recommend using Disabled Keying.

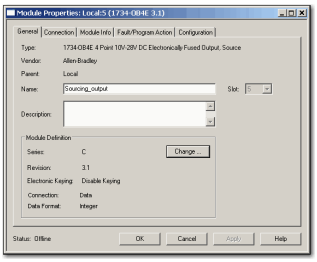
**ATTENTION:** Be extremely cautious when using Disabled Keying; if used incorrectly, this option can lead to personal injury or death, property damage, or economic loss.

If you use Disabled Keying, you must take full responsibility for understanding whether the module being used can fulfill the functional requirements of the application.

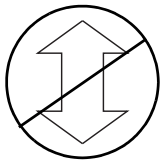
**EXAMPLE** In this scenario, **Disable Keying prevents I/O communication**:

The module configuration is for a 1734-OB4E digital output module. The physical module is a 1734-IT2I thermocouple input module. In this case, communication is prevented because the analog module rejects the data formats that the digital module configuration requests.

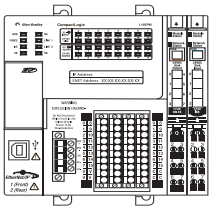
Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1734-OB4E
Major Revision = 1
**Minor Revision = 2**




Communication is prevented.



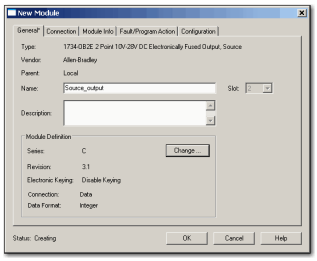
Physical Module
Vendor = Allen-Bradley
Product Type = Digital Thermocouple input module
Catalog Number = 1734-IT2I
Major Revision = 3
**Minor Revision = 2**



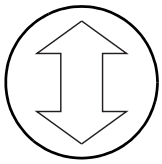
**EXAMPLE** In this scenario, **Disable Keying allows I/O communication**:

The module configuration is for a 1734-OB2E module. The physical module is a 1734-OB4E module. In this case, communication is allowed because the two digital modules share common data formats.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1734-OB2E
Major Revision = 1
**Minor Revision = 2**

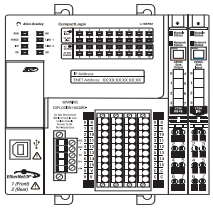



Communication is allowed.



Physical Module

Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1734-OB4E
Major Revision = 3
**Minor Revision = 2**



**IMPORTANT** Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

## Configure Distributed I/O Modules on an EtherNet/IP Network

Your CompactLogix 5370 L1 control system can use distributed I/O modules on an EtherNet/IP network.

**IMPORTANT**

When adding distributed I/O modules, remember to count the remote Ethernet adapter to remain within the maximum number of EtherNet/IP network nodes limitation for your specific controller.

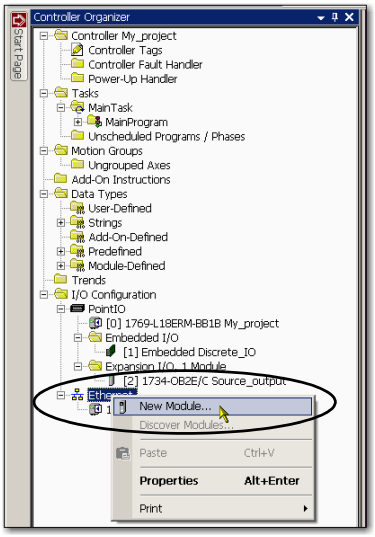
The distributed I/O modules connected to the controller via the remote Ethernet adapter are not counted toward the maximum Ethernet node limit for the controller.

For example, a 1769-L16ER-BB1B controller supports up to four Ethernet nodes. You can add up to four remote Ethernet adapters to the I/O Configuration section because each remote adapter counts against the node count. However, you can add as many remote I/O modules to the adapter's chassis as necessary. Remote I/O modules do not count against the node count.

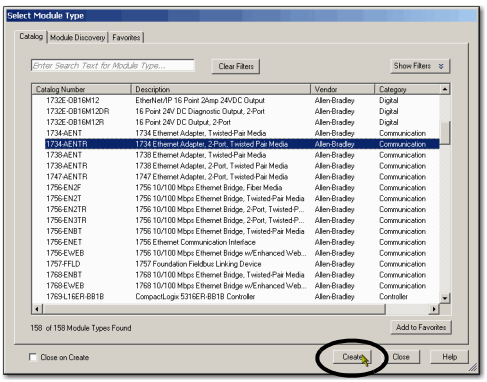
For more information on node limitations, see Nodes on an EtherNet/IP Network on page 118.

Complete these steps to configure distributed I/O modules on an EtherNet/IP network.

1. Right-click Ethernet and choose New Module.

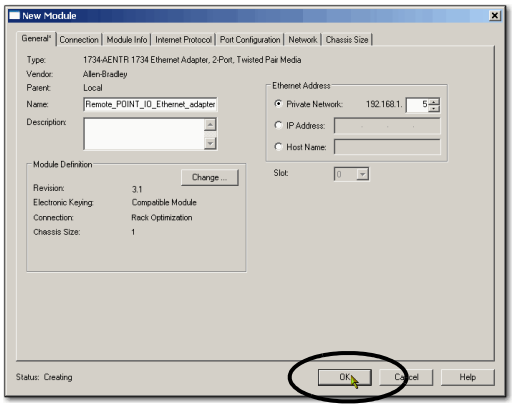


2. Select the desired Ethernet adapter and click Create.

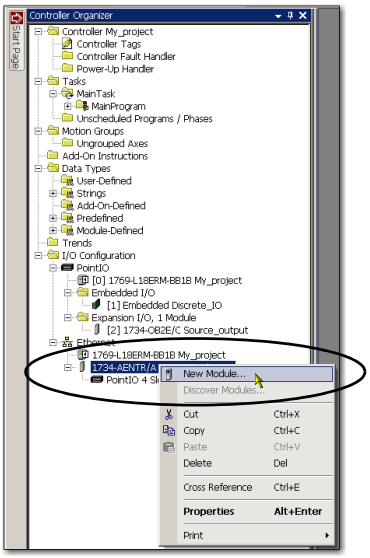



The New Module dialog box appears.

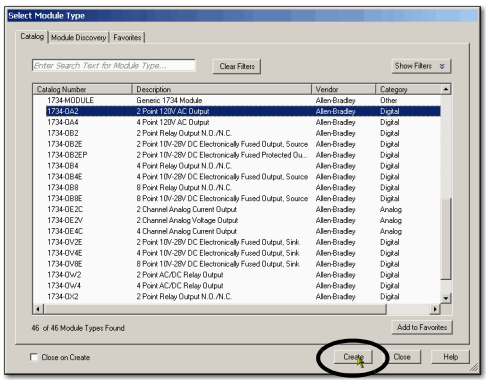
3. Configure the new Ethernet adapter as necessary and click OK.




4. Right-click the new adapter and choose New Module.

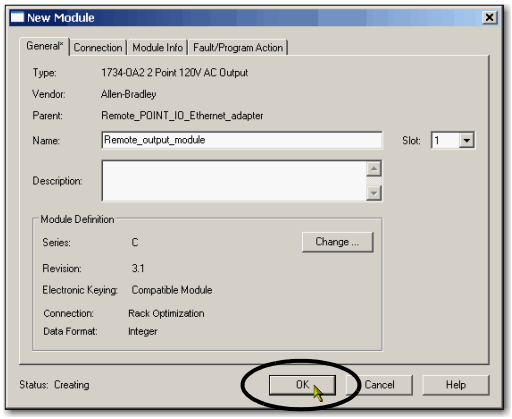


5. Select the desired I/O module and click Create.



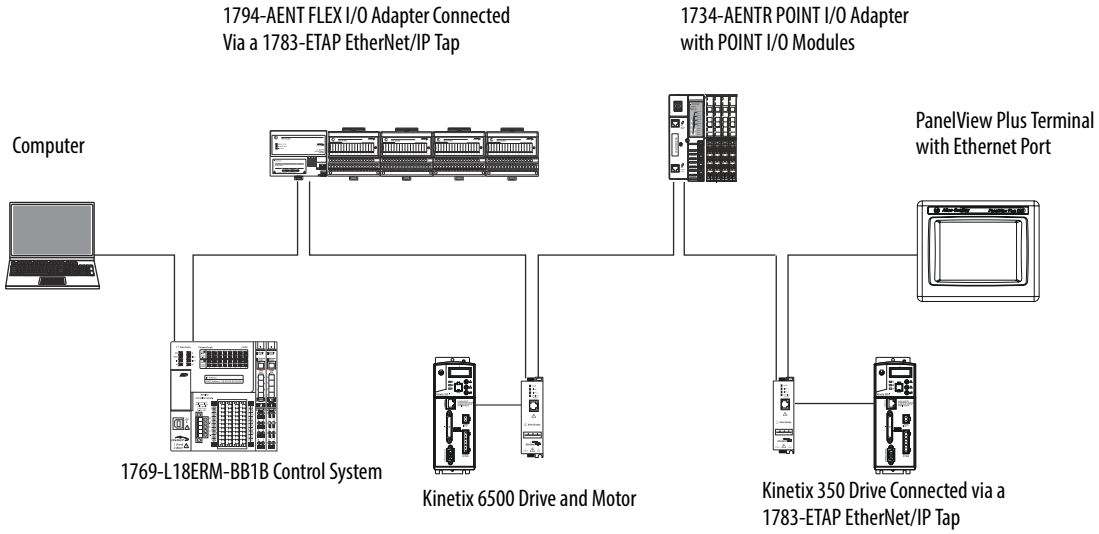

The New Module dialog box appears.

6. Configure the new I/O module as necessary and click OK.




7. Repeat these steps to add all of the desired distributed I/O modules to the project.

The following graphic is an example of a 1769-L18ERM-BB1B control system that uses distributed I/O modules over an EtherNet/IP network.

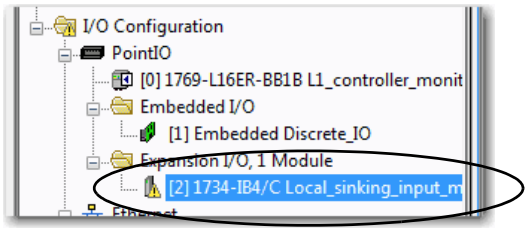


## Monitor I/O Modules

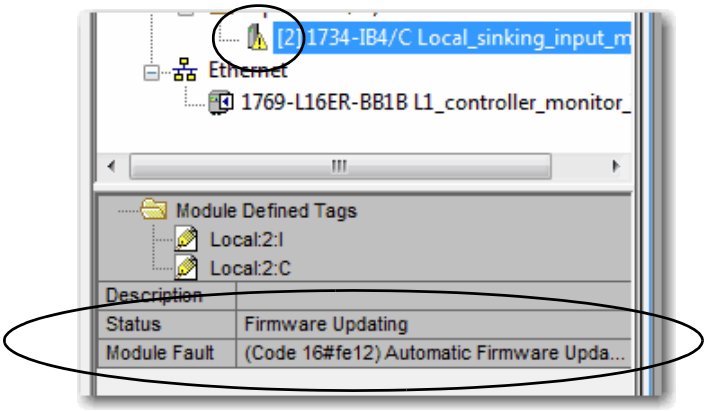
With CompactLogix 5370 L1 controllers, you can use the following options to monitor I/O modules:

- Quick View Pane below the Controller Organizer
- Connection tab in the Module Properties dialog box
- Programming logic to monitor fault data so you can take appropriate action.

When a fault occurs on an I/O module, a yellow triangle on the module's appearance in the Controller Organizer alerts you to the fault.

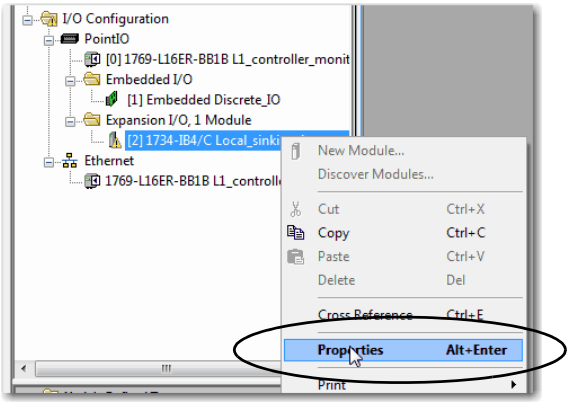



The following graphic shows the **Quick View Pane** indicating the type of fault.

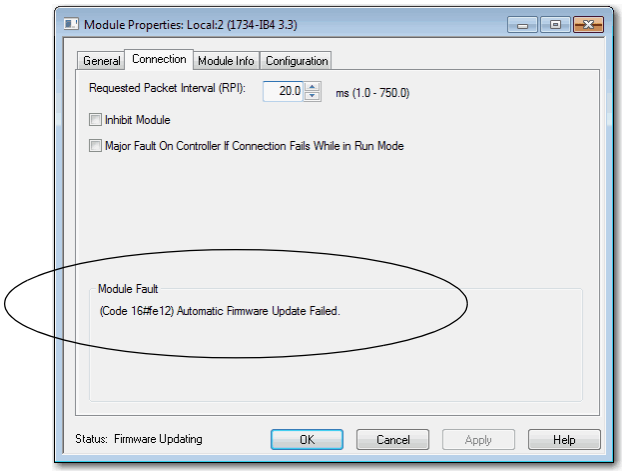


To see the fault description on the **Connection tab** in Module Properties dialog box, complete these steps.

1. In the I/O Configuration, right-click the faulted I/O module and choose Properties.




2. Click the Connection tab and use the fault description, in the Module Fault section, to diagnose the issue.




3. Click OK to close the dialog box and remedy the issue.

## Bus Off Detection and Recovery

When the POINTBus backplane experiences a bus off condition, the CompactLogix 5370 L1 controller indicates this condition via a BUS OFF minor fault (Type 03, Code 01). When this fault occurs, the connections between the controller and I/O modules are broken.

Complete these steps to identify the source of the BUS OFF minor fault.

1. Make sure the number of local expansion modules in the project matches the number of modules physically installed in the system.
2. Make sure all mounting bases are locked and I/O modules are securely installed on mounting bases.
3. Make sure all 1734 POINT I/O modules are configured to use the Autobaud rate.

| | |
|---|---|
| **IMPORTANT** | You cannot change a 1734 POINT I/O module's Autobaud setting when the module is installed in a CompactLogix 5370 L1 control system.<br>If you need to return a 1734 POINT I/O module to Autobaud, see the POINT I/O Digital and Analog Modules and POINTBlock I/O Modules, publication 1734-UM001. |

If these steps do not remedy the fault condition, contact Rockwell Automation technical support.

# Use I/O Modules with CompactLogix 5370 L2 Controllers

This chapter explains how to use I/O modules in a CompactLogix 5370 L2 control system.


| Topic | Page |
|---|---|
| Select I/O Modules | 179 |
| Embedded Analog I/O Modules Data Arrays | 199 |
| Validate I/O Layout | 213 |
| Configure Local I/O Modules | 219 |
| Electronic Keying | 222 |
| Configure Distributed I/O Modules on an EtherNet/IP Network | 229 |
| Monitor I/O Modules | 234 |


## Select I/O Modules

CompactLogix 5370 L2 control systems offer these I/O module options:

- Embedded I/O Modules
- Local Expansion Modules - Optional
- Distributed I/O Modules over an EtherNet/IP Network

## Embedded I/O Modules

CompactLogix 5370 L2 controllers provide embedded I/O modules. The number and type of points is determined by catalog number. The following table describes what embedded I/O modules are supported by CompactLogix 5370 L2 controllers.

| Cat. No. | Sourcing 24V DC Digital Input Points | Sinking 24V DC Digital Output Points | High-speed Counters | High-speed Counter Output Points | Universal Analog Input Points | Analog Output Points |
|---|---|---|---|---|---|---|
| 1769-L24ER-QB1B | 16 | 16 | - | - | - | - |
| 1769-L24ER-QBFC1B | | | 4 | 4 | 4 | 2 |
| 1769-L27ERM-QBFC1B | | | | | | |

**IMPORTANT** Remember the following when using the embedded I/O modules on CompactLogix 5370 L2 controllers:

- 1769-L24ER-QB1B controller - The digital input points and digital output points are located on a single embedded I/O module. Therefore, the 1769-L24ER-QB1B controller is considered to have one embedded I/O module.
- 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers - The digital input points and digital output points are located on a single embedded I/O module. The high-speed counter input output points, universal analog input points, and analog output points are located on another single embedded I/O module. Therefore, the 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers are considered to have two embedded I/O modules.

You configure an RPI rate for the embedded I/O modules to establish specific time intervals at which data is transmitted between the controller and each embedded I/O point. The embedded I/O points' available RPI range is 0.5…750.0 ms and can be changed by 0.5 ms increments. The default setting is 20 ms.

**IMPORTANT**

- If you attempt to use an RPI value that is not valid, the application automatically rounds the value down to the closest 0.5 ms increment when you apply the change.
  For example, if you set the RPI = 1.75 ms, when you click Apply or OK, the value is rounded down to 1.5 ms and then applied.
- The RPI value for an embedded I/O module is intended to establish a specific time interval at which data is transmitted. However, the actual time interval of data transmission may be affected by the configuration of your CompactLogix 5370 L2 control system.
  For more information, see Estimate Requested Packet Interval on page 213.

### *Embedded Digital I/O Points*

The embedded digital I/O module on CompactLogix 5370 L2 contains sixteen 24V DC sinking inputs and sixteen 24V DC sourcing outputs. The inputs can be configured to use digital filtering by input group. Filter times can be specified for both OFF to ON and ON to OFF.

Group 0 is used to configure inputs 0...7. Group 1 is used to configure inputs 8...15. The default filter time for each group is 8 ms. You can the filter times to 0.0 ms, 0.1 ms, 0.5 ms, 1.0 ms, 2.0 ms, and 4.0 ms, as shown in this graphic.

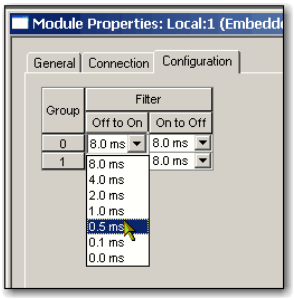



Figure 23 shows the CompactLogix 5370 L2 controllers' embedded digital I/O points.

**IMPORTANT** Figure 23 shows the embedded digital I/O points on the 1769-L24ER-QB1B controller. The embedded digital I/O points on the 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers are organized and wired the same.

**Figure 23 - CompactLogix 5370 L2 Controllers Embedded Digital I/O Module Wiring Termination Points**

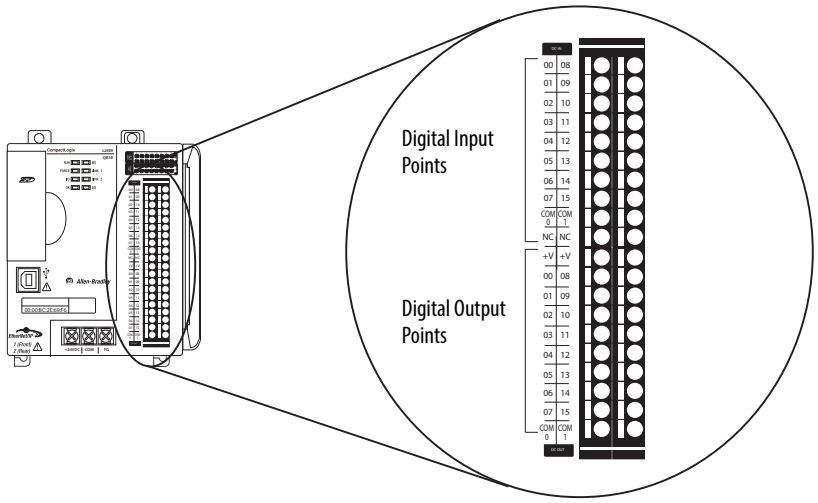


Figure 24 shows an example wiring diagram for the embedded digital input points.

**Figure 24 - CompactLogix 5370 L2 Controllers Embedded Digital Input Point Wiring Diagram**

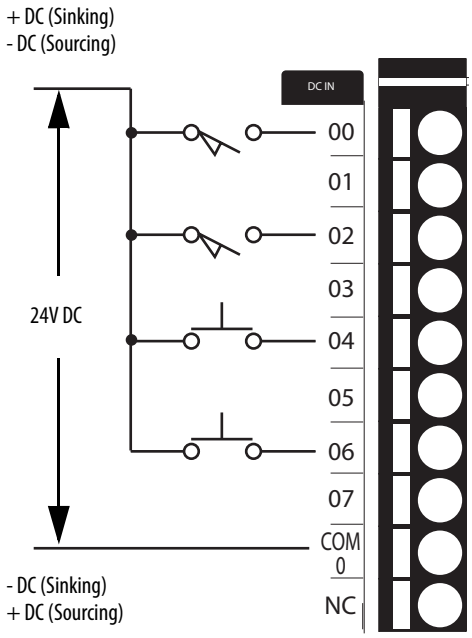
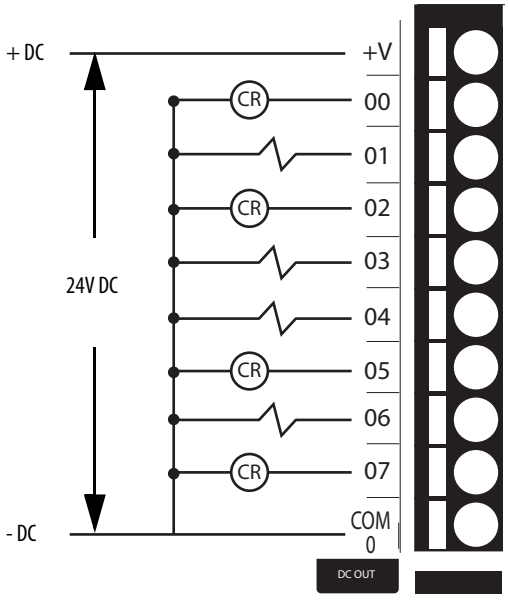



Figure 25 shows an example wiring diagram for the embedded digital output points.

**Figure 25 - CompactLogix 5370 L2 Controllers Embedded Digital Output Point Wiring Diagram**



*Embedded Analog I/O Points*

**IMPORTANT** The embedded analog I/O points are available on the 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers only.

The 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers support four embedded universal analog inputs that can function as differential or single-ended inputs and two embedded standard analog outputs that can function as single-ended outputs. The inputs and outputs are considered channels. Each channel configuration offers multiple configuration options.

Table 12 lists the available embedded analog input channel types and ranges for the channel type. The configuration choices are made on the Input Configuration tab of the Module Properties dialog box, as shown in the table.

**Table 12 - Input Types**

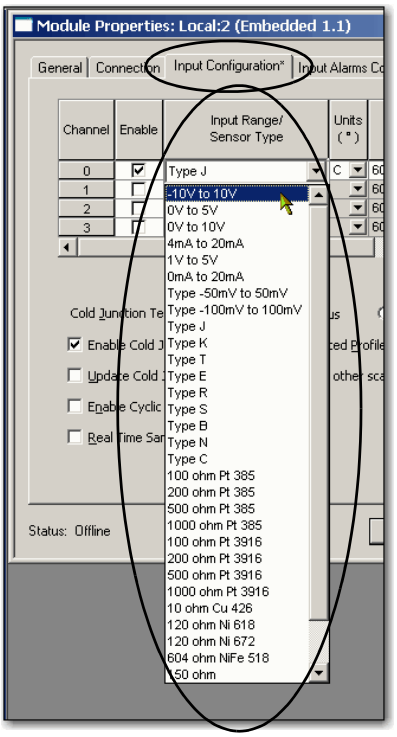
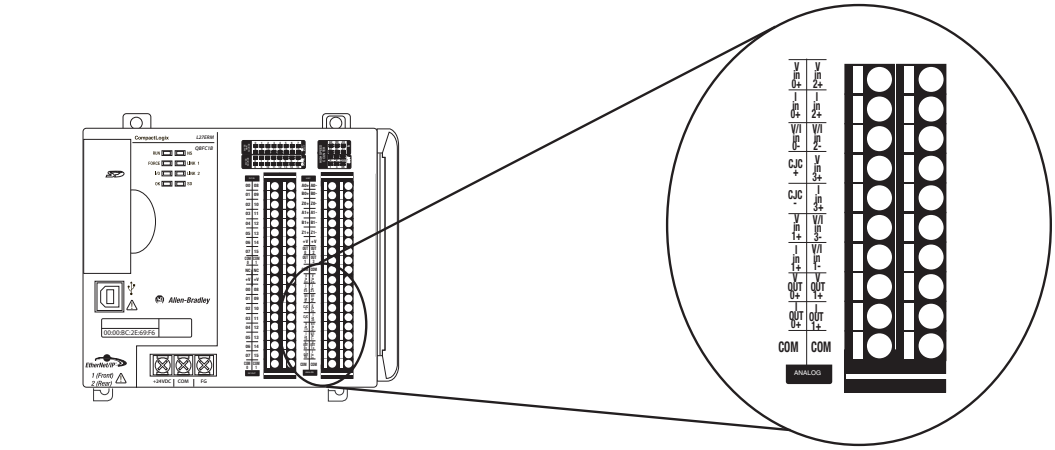
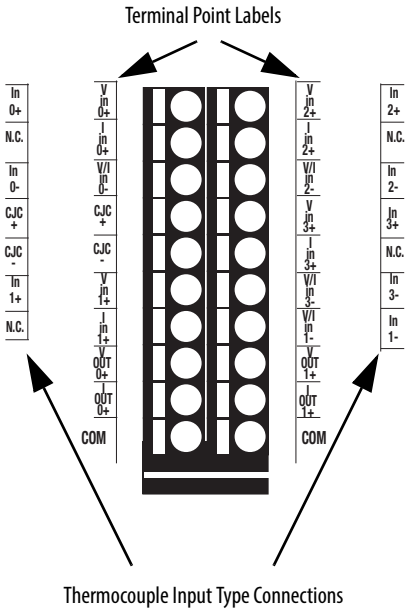
| Input Type | Input Ranges | Project Configuration |
|---|---|---|
| Voltage | • Type -50 mV…50 mV<br>• Type -100 mV…100 mV<br>• 0…5V<br>• 1…5V<br>• 0…10V<br>• -10V…10V |  |
| Current | • 0…20 mA<br>• 4…20 mA | |
| Thermocouple | • J<br>• K at 1370…1372 °C (2498…2501.6 °F)<br>• K at -200…1370 °C (-328…2498 °F)<br>• T<br>• E<br>• S and R at 0…1768 °C (32…3214.4 °F)<br>• S and R at -50…0 °C (-58…32 °F)<br>• B at 300…1820 °C (572…3308 °F)<br>• B at 250…300 °C (482…572 °F)<br>• N<br>• C | |
| RTD | • 100 Ω Platinum 385<br>• 200 Ω Platinum 385<br>• 500 Ω Platinum 385<br>• 1000 Ω Platinum 385<br>• 100 Ω Platinum 3916<br>• 200 Ω Platinum 3916<br>• 500 Ω Platinum 3916<br>• 1000 Ω Platinum 3916<br>• 10 Ω Copper 426<br>• 120 Ω Nickel 618<br>• 120 Ω Nickel 672<br>• 604 Ω Nickel-Iron 518 | |
| Resistance | • 0…150 Ω<br>• 0…500 Ω<br>• 0…1000 Ω<br>• 0…3000 Ω | |

Figure 26 shows the embedded analog I/O points and how each termination point is used with different analog input types.

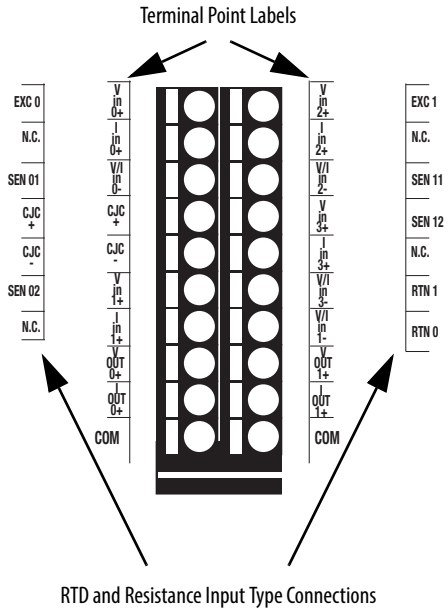
**IMPORTANT** Figure 26 shows the embedded analog I/O points on the 1769-L27ERM-QBFC1B controller. The embedded analog I/O points on the 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers are organized and wired the same.

**Figure 26 - 1769-L27ERM-QBFC1B Controller Embedded Analog I/O Wiring Termination Points**



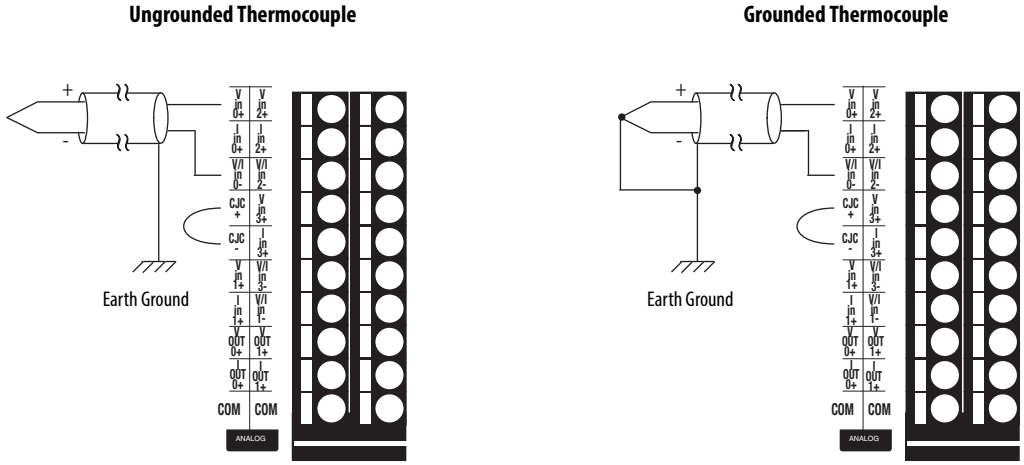

Thermocouple Input Type Connections




RTD and Resistance Input Type Connections

Figure 27 shows an example of ungrounded and grounded thermocouple wiring diagrams on a 1769-L27ERM-QBFC1B controller.

**Figure 27 - 1769-L27ERM-QBFC1B Controller Thermocouple Wiring Diagrams**




**IMPORTANT**: You must order Cold Junction Connectors, catalog number 1769-CJC, separately from the CompactLogix 5370 L2 controllers.

Figure 28 shows an example of devices with differential connections wired to the embedded analog inputs on a 1769-L27ERM-QBFC1B controller when it is operating with voltage or current input types.

**Figure 28 - 1769-L27ERM-QBFC1B Controller Differential Connections Diagrams**

**IMPORTANT**: For both input types, we recommend that you use Belden #8761or equivalent cable.

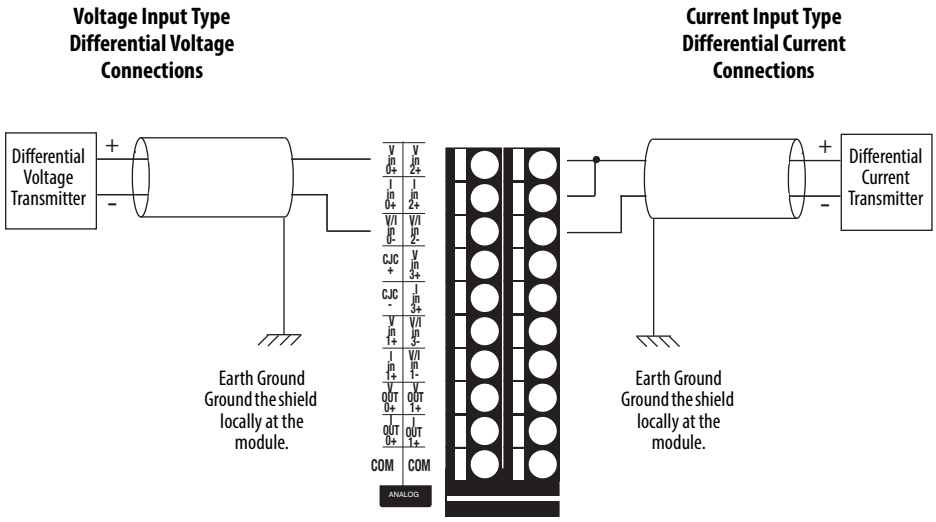
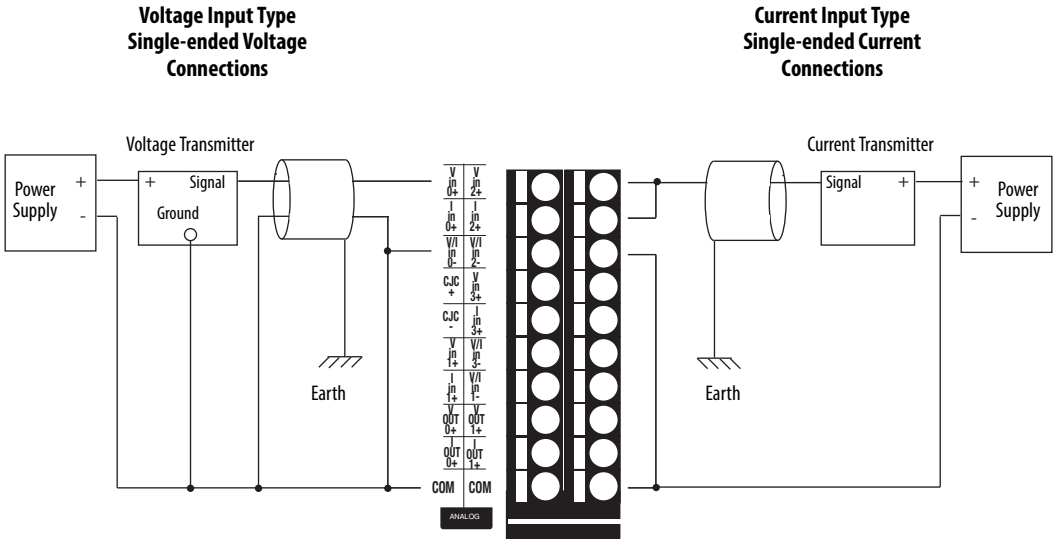


Figure 29 shows an example of devices with single-ended connections wired to the embedded analog inputs on a 1769-L27ERM-QBFC1B controller when it is operating with voltage or current input types.

**Figure 29 - 1769-L27ERM-QBFC1B Controller Single-ended Connections Wiring Diagrams**



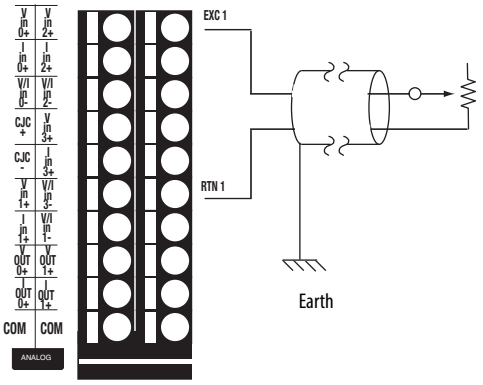

**IMPORTANT**: For single-ended connections, remember the following:

- For both input types, we recommend that you use Belden #8761or equivalent cable.
- The mV ranges with the Voltage input type do not support single-ended encoder wiring.
- All commons are electrically tied together in the controller.
- If multiple power supplies are used, the commons must have the same reference.

Figure 30 shows an example of 2-wire, 3-wire, and 4-wire RTD/Resistance wiring diagrams on a 1769-L27ERM-QBFC1B controller.

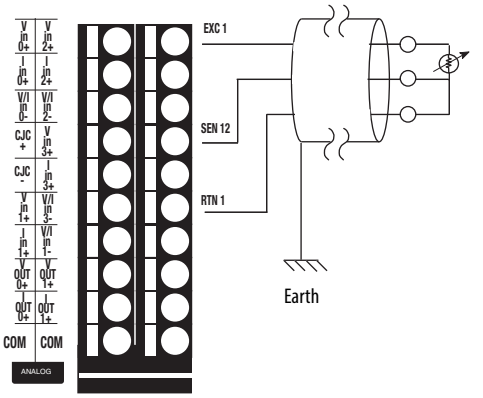
**Figure 30 - 1769-L27ERM-QBFC1B RTD/Resistance Wiring Diagrams**

2-wire Device Wiring Diagram




**IMPORTANT**: For all wiring diagrams, we recommend that you use Belden #83503 or 9533 cable.

3-wire Device Wiring Diagram




4-wire Device Wiring Diagram

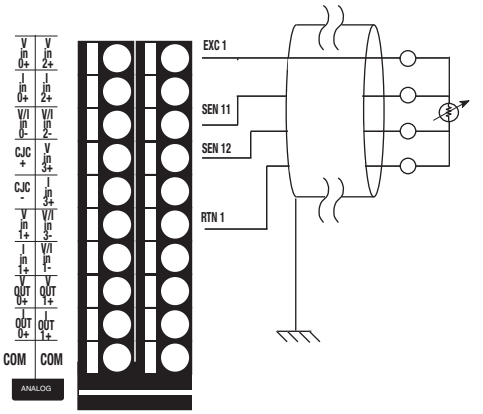


Table 13 lists the available embedded analog output channel types and ranges for the channel type. The configuration choices are made on the Output Configuration tab of the Module Properties dialog box, as shown in the table.

**Table 13 - Output Types**

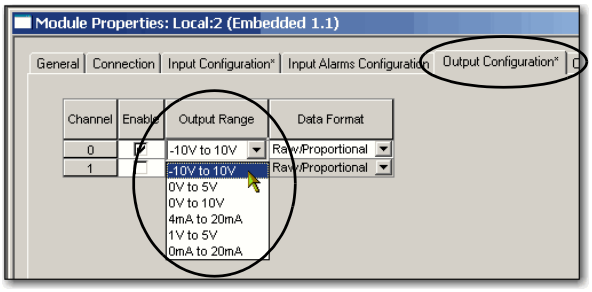
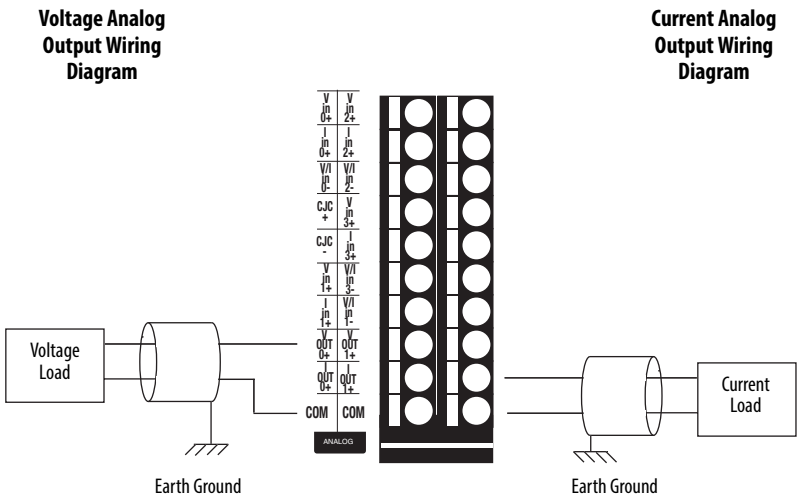
| Output Type | Output Ranges | Project Configuration |
|---|---|---|
| Voltage | • -10…10V<br>• 0…5V<br>• 0…10V<br>• 1…5V |  |
| Current | • 4…20 mA<br>• 0…20 mA | |



Figure 31 shows an example of wiring input devices to the analog output points on the 1769-L27ERM-QBFC1B controller when it is operating in voltage or current mode.

**Figure 31 - 1769-L27ERM-QBFC1B Controller Analog Output Wiring Diagrams**



*Embedded High-speed Counters*

**IMPORTANT** The embedded high-speed counters are available on the 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers only.

The 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers support four embedded high-speed counters. Each counter is a differential input. Therefore, two input terminals are required for a single counter. For example, the A0+ and A0- terminals are required for counter A0.

Each counter uses differential inputs that are compatible with standard differential-line driver output devices as well as single-ended devices. Figure 32 shows the embedded high-speed counter input points.

**IMPORTANT** Figure 32 shows the embedded high-speed counters on the 1769-L27ER-QB1B controller. The embedded high-speed counter points on the 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers are organized and wired the same.

**Figure 32 - 1769-L27ERM-QBFC1B Controller Embedded High-speed Counter Wiring Termination Points**

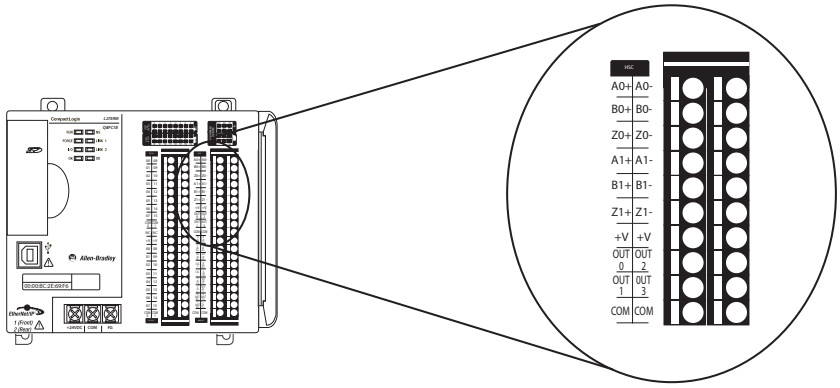


Figure 33 shows an example of a differential encoder wired to the embedded high-speed counter inputs on a 1769-L27ERM-QBFC1B controller.

**Figure 33 - 1769-L27ERM-QBFC1B Controller Differential Encoder with High-speed Counter Input Wiring Diagram**

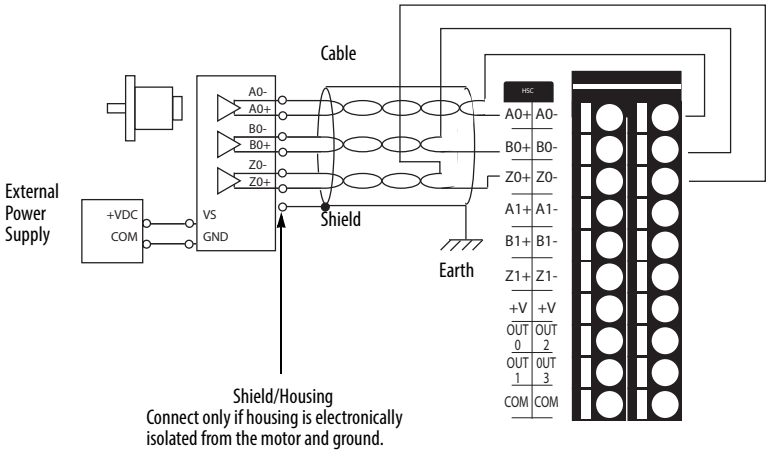
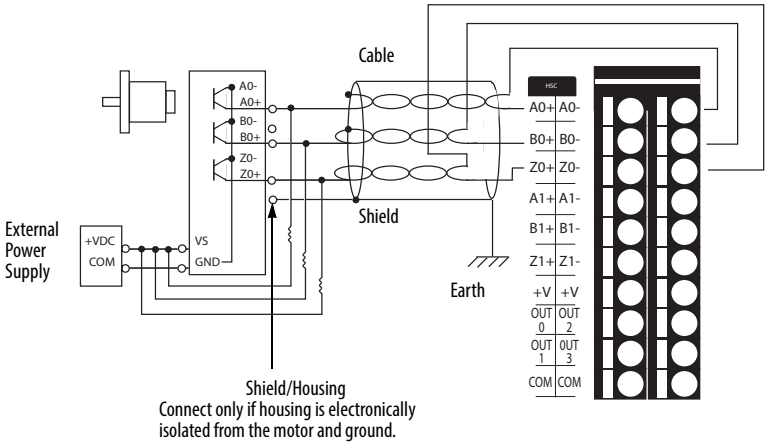



Figure 34 shows an example of a single-ended encoder wired to the embedded high-speed counter inputs on a 1769-L27ERM-QBFC1B controller.

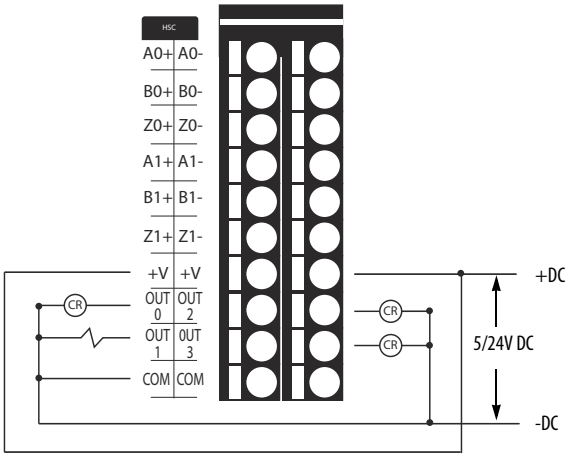
**Figure 34 - 1769-L27ERM-QBFC1B Controller Single-ended Encoder with High-speed Counter Input Wiring Diagram**



The embedded high-speed counter also supports four output points. Figure 35 shows a wiring diagram for the embedded high-speed counter output points.

**IMPORTANT** Figure 35 shows the embedded high-speed counter output points on the 1769-L27ER-QB1B controller. The embedded high-speed counter points on the 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers are organized and wired the same.

**Figure 35 - 1769-L27ERM-QBFC1B Controller Embedded High-speed Counter Output Wiring Diagram**

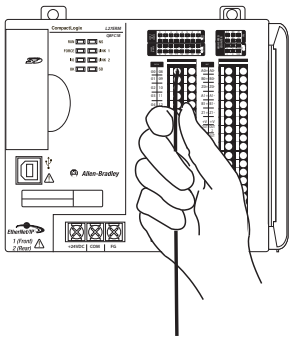



*Wiring the Embedded I/O Modules*

Complete these steps to wire the input and output points on the CompactLogix 5370 L2 controller.

1. Verify that the control system is not powered.
2. Strip 10 mm (0.39 in) insulation from the end of the wire.
3. Push the wire into the connector hole until it is securely place.

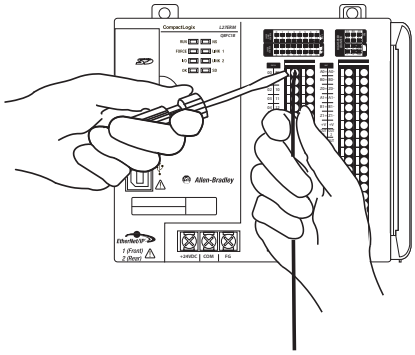
   If your wire is too thin to push into the connector hole for secure placement, we recommend that you connect the wire to a ferrule and then insert it into the connector hole.



4. Repeat step 3 for all embedded I/O wires needed in your application.

To remove a wire from the removable connector, complete these steps.

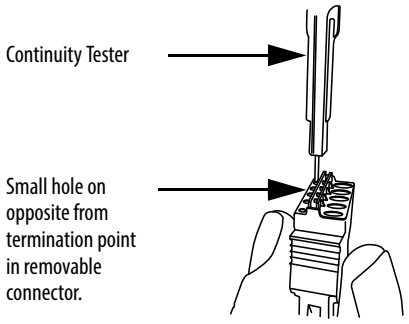
1. Verify that the control system is not powered.
2. Use a small screwdriver to push on the spring release clip and pull the wire out.



If any issues arise with a removable connector and you suspect a connection point may no longer be functioning as a complete circuit, you can use a continuity tester to determine if the connection point is operating correctly, that is, the connection point is a complete circuit.

The indication mechanism, for example, a light illuminating on the tester, varies by specific continuity tester. The example graphic below shows a continuity tester with a single connection point. In this case, if the circuit is operating correctly, the indicator light turns on.

Insert a continuity tester into the suspected I/O connection point as shown in the following graphic.



# Determine Embedded Module Update Time

**IMPORTANT** This section applies to the 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B because only those controllers have and embedded universal analog input points.

The module update time is the time required for the module to sample and convert the input signals of all enabled analog input channels and provide the resulting data values to the controller.

The module update time is calculated by adding the update times for each enabled analog input channel on the module. Each channel update time calculation is the result of several configuration choices described in the following section.

## Channel Update Times

The channel update time for an enabled analog input channel is determined by some combination of the following times:

- Channel Input Type and Filter Frequency Selection Update Time - Required for channel update time calculation
- Cold Junction Compensation Update Times - Optional for channel update time calculation time
- Open Circuit Detection Update Time - Optional for channel update time calculation time

### *Channel Input Type and Filter Frequency Selection Update Time*

When you enable an embedded analog input channel, you must select an input type and a filter frequency for that input. The selections made determine the value that is required when calculating channel update time.

**IMPORTANT** Each channel input type has multiple ranges or types. For example, a voltage input type can use one of six voltage ranges, as listed in Table 12 on page 183. Regardless of which voltage range the channel uses, the channel update time remains the same. For more information, see Table 14.

Table 14 shows the channel update times for each channel input type and filter frequency selection.

**Table 14 - Channel Update Times**

| | Channel Update Times Based on Input Type Selection | |
|---|---|---|
| **Filter Frequency Selection(1)** | **Voltage, Current or Thermocouple Input Type** | **Resistance or RTD Input Type** |
| 10 Hz | 307 ms | 614 ms |
| 50 Hz | 67 ms | 134 ms |
| 60 Hz | 57 ms | 114 ms |
| 250 Hz | 19 ms | 38 ms |
| 500 Hz | 13 ms | 26 ms |
| 1 kHz | 11 ms | 22 ms |

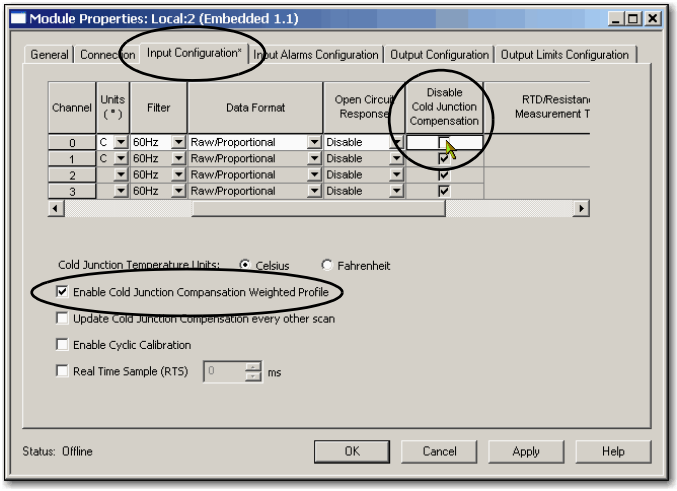
(1) Filter frequency selections are made on the Input Configuration tab of the Module Properties dialog box.

### *Cold Junction Compensation Update Times*

When you use any of the thermocouple input types on your embedded analog input, you might need to account for additional voltage at the junction of the thermocouple field wires and the input point. Additional voltage can alter the input signal on that point and, therefore, affect that channel's update time.

The process of accounting for increased voltage at an input point using a thermocouple type input is cold junction compensation (CJC). You enable CJC for a given channel on the Input Configuration tab of the Module Configuration dialog box, as shown below.

By default, CJC is disabled. You must clear the Disable Cold Junction Compensation checkbox to use CJC for a given channel.




You are not required to enable CJC for a channel using the thermocouple input type. If you enable CJC and select Update Cold Junction Compensation every other scan, an additional update time exists on the channel. This additional update time increases the overall channel update time.

The CJC update time is determined by the filter frequency selection for the channel. Table 15 shows the CJC update times based on filter frequency selections.

**Table 15 - Channel Update Times**

| Filter Frequency Selection(1) | CJC Update Time |
|---|---|
| 10 Hz | 614 ms |
| 50 Hz | 134 ms |
| 60 Hz | 114 ms |
| 250 Hz | 38 ms |
| 500 Hz | 26 ms |
| 1 kHz | 22 ms |

(1) Filter frequency selections are made on the Input Configuration tab of the Module Properties dialog box.

**IMPORTANT** Keep the following in mind when calculating the CJC update time:

- If multiple input channels are configured to use a thermocouple input type and a different filter value is selected for each, the CJC update time is determined by the filter frequency selection with the slowest update time.

  For example, if one input channel uses a thermocouple input with a 50 Hz filter frequency and another input channel uses a thermocouple input with a 60 Hz filter frequency, the CJC channel update time is 134 ms.
- The CJC update time that increases overall module update time is only used once regardless of the number of input channels on a module that have CJC enabled to scan every other scan.

  In other words, if your module uses a filter frequency selection of 250 Hz and includes three channels with CJC enabled to scan every other scan, you only add one instances of CJC update time to the overall equation. Instead of including 38 ms for each channel, you include 38 ms once.

### *Open Circuit Detection Update Time*

Open circuit detection is used to verify that the field wiring is physically connected to the embedded analog input point. If this feature is enabled and field wiring is disconnected from the input, the application alerts you to the condition and an open wire bit is set in the project's tags for the respective input channel.

Open circuit detection can be enabled or disabled on any channel input type with the exception of an input channel configured to use the 0...20 mA input range. The configuration selection is made on the Input Configuration tab on the Module Properties dialog box, as shown in the following graphic. The configuration choice, that is, enabled or disabled, is the result of selecting an Open Circuit Response for the channel.

To disable open circuit detection, choosing Disable. To enable open circuit detection, choose any of the other four options.

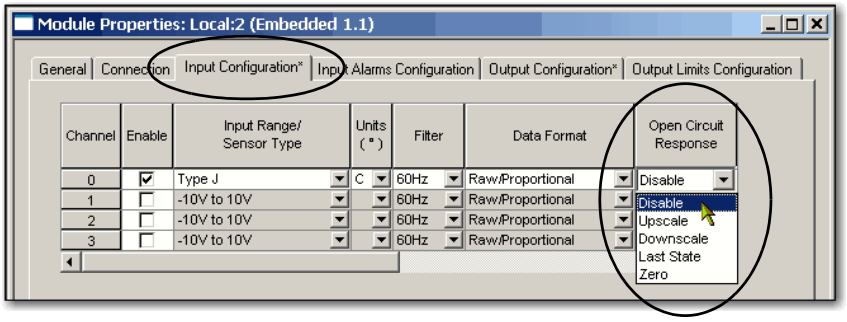



Table 16 describes the module response associated with each enable selection.

**Table 16 - Open Circuit Detection Response Definitions**

| Response Option | Definition |
|---|---|
| Upscale | Sets the input data value to full upper scale value of channel data word. The full-scale value is determined by the selected input type and data format. |
| Downscale | Sets the input data value to full lower scale value of channel data word. The low scale value is determined by the selected input type and data format. |
| Last State | Sets the input data value to the last input value prior to the detection of the open-circuit. |
| Zero | Sets the input data value to 0 to force the channel data word to 0. |

When you enable open circuit detection for an input channel, an additional update time is used to calculate the overall channel type. The **increase** in channel update time is **11 ms** for each channel that enables open circuit detection response.

Table 17 lists example module update times based on specific channel configurations.

**Table 17 - Example Module Update Times**

| Example Enabled Analog Input Channel Configuration | Channel Update Time Calculations | Module Update Time |
|---|---|---|
| • Channel 0:<br>– Input type = Current<br>– Filter Frequency Selection = 60 Hz | 57 ms | 57 ms |
| • Channel 0:<br>– Input type = Current<br>– Filter Frequency Selection = 60 Hz<br>• Channel 1:<br>– Input type = RTD<br>– Filter Frequency Selection = 60 Hz | Channel 0 update time + Channel 1 update time<br>57 ms + 114 ms | 171 ms |
| • Channel 0:<br>– Input type = Voltage<br>– Filter Frequency Selection = 60 Hz<br>– Open Circuit Detection = Enabled<br>• Channel 1:<br>– Input type = RTD<br>– Filter Frequency Selection = 10 Hz | Channel 0 update time + Channel 1 update time<br>(57 ms + 11 ms) + 614 ms | 682 ms |
| • Channel 0:<br>– Input type = Voltage<br>– Filter Frequency Selection = 50 Hz<br>• Channel 1:<br>– Input type = RTD<br>– Filter Frequency Selection = 10 Hz<br>– Open Circuit Detection = Enabled<br>• Channel 2<br>– Input type = Thermocouple<br>– Filter Frequency Selection = 60 Hz<br>– CJC = Enabled<br>– Open Circuit Detection = Enabled<br>• Channel 3:<br>– Input type = Thermocouple<br>– Filter Frequency Selection = 500 Hz<br>– CJC = Enabled<br>– Open Circuit Detection = Enabled | Channel 0 update time + Channel 1 update time + Channel 2 update time + Channel 3 update time + CJC Update Time<br>67 ms + (614 ms + 11 ms) + (57 ms + 11 ms) + (13 ms + 11 ms) + 114 ms | 898 ms |

## Embedded Analog I/O Modules Data Arrays

The section describes the data table structures for the embedded analog I/O modules on the CompactLogix 5370 L2 controllers. The embedded analog I/O modules have arrays for the following data:

- Input data
- Output data
- Configuration data

You can access the data via the tags in the application.

**IMPORTANT** The analog I/O modules data structures apply to the 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers only.

The 1769-L24ER-QB1B controller does not have an embedded analog I/O module.

### Input Array

The embedded analog I/O module's input data array contains eleven words as described in Table 18. This array is read-only and the default value for all bits is 0.

**Table 18 - CompactLogix 5370 L2 Controllers' Embedded Analog I/O Module's Input Data Array**

| | Bit | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Word** | **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| 0 | S | Analog Read (Input) Data Value Channel 0 | | | | | | | | | | | | | | |
| 1 | S | Analog Read (Input) Data Value Channel 1 | | | | | | | | | | | | | | |
| 2 | S | Analog Read (Input) Data Value Channel 2 | | | | | | | | | | | | | | |
| 3 | S | Analog Read (Input) Data Value Channel 3 | | | | | | | | | | | | | | |
| 4 | Nu | Timestamp Value | | | | | | | | | | | | | | |
| 5 | Nu | UI4 | OI4 | OC4 | OC3 | OC2 | OC1 | OC0 | Nu | | | SI4 | SI3 | SI2 | SI1 | SI0 |
| 6 | LI3 | HI3 | UI3 | OI3 | LI2 | HI2 | UI2 | OI2 | LI1 | HI1 | UI1 | OI1 | LI0 | HI0 | UI0 | OI0 |
| 7 | S | Cold Junction Compensation Value | | | | | | | | | | | | | | |
| 8 | S | Output Data Loopback/Echo Channel 0 | | | | | | | | | | | | | | |
| 9 | S | Output Data Loopback/Echo Channel 1 | | | | | | | | | | | | | | |
| 10 | Nu | | U01 | O01 | Nu | | U00 | O00 | Nu | | | | | | S01 | S00 |

**Table 18 - CompactLogix 5370 L2 Controllers' Embedded Analog I/O Module's Input Data Array**

| | | Bit | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Word** | | **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| Where: | Analog Read (Input) Data Value Channel x is the data read from the field device connected to the channel. | | | | | | | | | | | | | | | | |
| | Timestamp Value is the timestamp of when data was received at the corresponding channel. | | | | | | | | | | | | | | | | |
| | Cold Junction Compensation value is the converted CJC data The data is calculated in the following manner:<br>• If the CJC is open, the converted value is 25 °C (77 °F).<br>• If the CJC is not opened and the Update CJC sensor every other scan option is disabled, the converted value is 25 °C (77 °F).<br>• If the CJC is not opened and the Update CJC sensor every other scan option is enabled, the converted value is the measured temperature. | | | | | | | | | | | | | | | | |
| | S | Sign bit | | | | | | | | | | | | | | | |
| | Nu | Bit not used | | | | | | | | | | | | | | | |
| | SI*x* | General status bit for an input channel. Bits 0…3 are for input channels. Bit 4 is for CJC. If the bit is 0, the channel is operating normally. If the bit is 1, a fault has occurred on the channel. | | | | | | | | | | | | | | | |
| | OI*x* | Overrange alarm bit for an input channel.<br>0 = Channel is operating normally<br>1 = Input signal is over normal range. | | | | | | | | | | | | | | | |
| | UI*x* | Underrange alarm bit for an input channel.<br>0 = Channel is operating normally<br>1 = For bits 0…3, that is, input channels, the input signal is under the normal range. For bit 4, that is, channel using the thermocouple/mV, RTD/Resistance input type, the input value equals the minimum value of the range. | | | | | | | | | | | | | | | |
| | HI*x* | High alarm bit for an input channel 0.<br>0 = Channel is operating normally<br>1 = Input signal is above the user-defined range | | | | | | | | | | | | | | | |
| | LI*x* | Low alarm bit for an input channel 0.<br>0 = Channel is operating normally<br>1 = Input signal is below the user-defined range. | | | | | | | | | | | | | | | |
| | OCx | Open circuit detection bit.<br>0 = Channel is not experiencing an open circuit condition<br>1 = Channel is experiencing an open circuit condition | | | | | | | | | | | | | | | |
| | SO*x* | General status bit for output channel 0 or 1.<br>0 = Channel operating normally<br>1 = A fault has occurred on the channel | | | | | | | | | | | | | | | |
| | OO*x* | Overrange alarm bit for output channel 0 or 1.<br>0 = Channel is operating normally<br>1 = Output signal is over the normal range | | | | | | | | | | | | | | | |
| | UO*x* | Underrange alarm bit for output channel 0 or 1.<br>0 = Channel is operating normally<br>1 = Output signal is below the normal range | | | | | | | | | | | | | | | |

## Output Array

The embedded analog I/O module's output image array contains four words as described in Table 19. This array is write-only and the default value for all bits is 0.

**Table 19 - CompactLogix 5370 L2 Controllers' Embedded Analog I/O Module's Output Data Array**

| | Bit | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Word** | **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| 0 | S | Analog Output Data Value Channel 0 | | | | | | | | | | | | | | |
| 1 | S | Analog Output Data Value Channel 1 | | | | | | | | | | | | | | |
| 2 | Nu | | | | | | | | CL I3 | CH I3 | CL I2 | CH I2 | CL I1 | CH I1 | CL I0 | CH I0 |
| 3 | Nu | | | | | | | | | | | | CL O1 | CH O1 | CL O0 | CH O0 |

| Where: | | |
|---|---|---|
| | Analog Output Data Value Channel x is the data written to the channel. | |
| | S | Sign bit |
| | Nu | Bit not used |
| | CH I*x* | Use this bit to cancel High Process Alarm Latch functionality for an input.<br>0 = Do not cancel<br>1 = Cancel the alarm latch |
| | CL I*x* | Use this bit to cancel Low Process Alarm Latch functionality for an input.<br>0 = Do not cancel<br>1 = Cancel the alarm latch |
| | CH O*x* | Use this bit to cancel High Process Alarm Latch functionality for an output.<br>0 = Do not cancel<br>1 = Cancel the alarm latch |
| | CL O*x* | Use this bit to cancel Low Process Alarm Latch functionality for an output.<br>0 = Do not cancel<br>1 = Cancel the alarm latch |

## Configuration Array

The embedded analog I/O module's configuration image array contains 43 words as described in Table 20.

**Table 20 - CompactLogix 5370 L2 Controllers Embedded Analog I/O Module's Configuration Image Array**

| Word | Bit | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Real Time Sample Value | | | | | | | | | | | | | | | |
| 1 | ETS | Nu | | | | | | | | | | | | | | |
| 2 | EC | Nu | | | | EA | AL | EI | EO | Open Circuit Ch0 | | 0V Adj | Filter Setting ChI0 | | | |
| 3 | Wire & CLCD | | TU ChIo | Nu | | Inpt Dta Fm ChI0 | | | Nu | | | Inpt Tp/RngeSel ChI0 | | | | |
| 4 | S | Process Alarm High Data Value Universal Input Channel 0 | | | | | | | | | | | | | | |
| 5 | S | Process Alarm Low Data Value Universal Input Channel 0 | | | | | | | | | | | | | | |
| 6 | S | Alarm Dead Band Value Universal Input Channel 0 | | | | | | | | | | | | | | |
| 7 | Nu | | | | | | | | | | | | | | | |
| 8 | EC | Nu | | | | EA | AL | EI | EO | Open Circuit ChI 1 | | 0V Adj | Filter Setting ChI1 | | | |
| 9 | Nu | | TU ChI1 | Nu | | Inpt Dta Fm ChI1 | | | Nu | | | Inpt Tp/RngeSel ChI1 | | | | |
| 10 | S | Process Alarm High Data Value Universal Input Channel 1 | | | | | | | | | | | | | | |
| 11 | S | Process Alarm Low Data Value Universal Input Channel 1 | | | | | | | | | | | | | | |
| 12 | S | Alarm Dead Band Value Universal Input Channel 1 | | | | | | | | | | | | | | |
| 13 | Nu | | | | | | | | | | | | | | | |
| 14 | EC | Nu | | | | EA | AL | EI | EO | Open Circuit ChI 2 | | 0V Adj | Filter Setting ChI2 | | | |
| 15 | Wire & CLCD | | TU ChI1 | Nu | | Inpt Dta Fm ChI2 | | | Nu | | | Inpt Tp/RngeSel ChI2 | | | | |
| 16 | S | Process Alarm High Data Value Universal Input Channel 2 | | | | | | | | | | | | | | |
| 17 | S | Process Alarm Low Data Value Universal Input Channel 2 | | | | | | | | | | | | | | |
| 18 | S | Alarm Dead Band Value Universal Input Channel 2 | | | | | | | | | | | | | | |
| 19 | Nu | | | | | | | | | | | | | | | |
| 20 | EC | Nu | | | | EA | AL | EI | EO | Open Circuit ChI 3 | | 0V Adj | Filter Setting ChI3 | | | |
| 21 | Nu | | TU ChI1 | Nu | | Inpt Dta Fm ChI3 | | | Nu | | | Inpt Tp/RngeSel ChI3 | | | | |
| 22 | S | Process Alarm High Data Value Universal Input Channel 3 | | | | | | | | | | | | | | |
| 23 | S | Process Alarm Low Data Value Universal Input Channel 3 | | | | | | | | | | | | | | |
| 24 | S | Alarm Dead Band Value Universal Input Channel 3 | | | | | | | | | | | | | | |
| 25 | Nu | | | | | | | | | | | | | | | |
| 26 | CJC Ses | Cycle Calib | Nu | CJC WP | Nu | | | | | | | | | | | TU CJC |
| 27 | Nu | | | | | | | | | | | | | | | |
| 28 | EC | NU | | | | | | | EHI | ELI | LC | ER | FM | PM | Nu | PFE |
| 29 | Nu | | | | | Outpt Fm ChI0 | | | Nu | | | | Outpt Tp/RngeSel Ch0 | | | |
| 30 | S | Fault Value Channel 0 | | | | | | | | | | | | | | |
| 31 | S | Program (Idle) Value Channel 0 | | | | | | | | | | | | | | |
| 32 | S | Clamp High Data Value Channel 0 | | | | | | | | | | | | | | |
| 33 | S | Clamp Low Data Value Channel 0 | | | | | | | | | | | | | | |

**Table 20 - CompactLogix 5370 L2 Controllers Embedded Analog I/O Module's Configuration Image Array**

| Word | Bit | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 34 | S | Ramp Rate Channel 0 | | | | | | | | | | | | | | |
| 35 | Nu | | | | | | | | | | | | | | | |
| 36 | EC | Nu | | | | | | | EHI | ELI | LC | ER | FM | PM | Nu | PFE |
| 37 | Nu | | | | | Outpt Fm Chl1 | | | Nu | | | | Outpt Tp/RngeSel Chl1 | | | |
| 38 | S | Fault Value Channel 1 | | | | | | | | | | | | | | |
| 39 | S | Program (Idle) Value Channel 1 | | | | | | | | | | | | | | |
| 40 | S | Clamp High Data Value Channel 1 | | | | | | | | | | | | | | |
| 41 | S | Clamp Low Data Value Channel 1 | | | | | | | | | | | | | | |
| 42 | S | Ramp Rate Channel 1 | | | | | | | | | | | | | | |

Where:

| | |
|---|---|
| EC | Use to enable or disable a channel. Each channel can be individually enabled.<br>0 = Disable<br>1 = Enable |
| Inpt Dta FM CHI*x* | Use this bit to select the form in which the analog data is returned to the controller and used in the control program. |
| EA | Use this bit to enable or disable a channel's process alarms.<br>0 = Disable<br>1 = Enable |
| AL | Use this bit to enable or disable alarm latching on a channel's process alarm.<br>0 = No latch<br>1 = Latch |
| EI | Use this bit to enable or disable interrupts on a channel's process alarms.<br>0 = Disable<br>1 = Enable |
| EO | Use this bit to enable or disable Open Circuit functionality on a channel.<br>0 = Disable<br>1 = Enable |
| Open Circuit Ch*x* | Use to set the Open Circuit Response for a channel.<br>0 = Upscale<br>1 = Downscale<br>2 = Last State<br>3 = Zero |
| 0V adjust | CJC is performed by default by taking the CJC sensor temperature value for a given channel, converting that to a thermocouple voltage, and adding that voltage from the measured value prior to converting to a user value. If this bit is set for a given channel, the signal value is directly converted to a user value (No cold junction compensation performed). |
| Wire & CLCD | Use to set the wire mode. The mode is determined by the combination of values in bits 14 and 15, as listed in the following table. |

| Bit 15 Value | Bit 14 Value | Mode |
|---|---|---|
| 0 | 0 | 3-wire and cycle lead compensation - Enable |
| 0 | 1 | 3-wire and cycle lead compensation - Disable |
| 1 | 0 | 2-wire (No lead compensation) |
| 1 | 1 | 4-wire (No lead compensation) |

| | |
|---|---|
| TU Ch*x* | Use to set the temperature units.<br>0 = Degrees Celsius<br>1 = Degrees Fahrenheit |

**Table 20 - CompactLogix 5370 L2 Controllers Embedded Analog I/O Module's Configuration Image Array**

| Word | | Bit | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Where (cont.) | Inpt Dta Fm Chl*x* | Use these bits to select the form the analog input data is presented to the controller and then used by the controller. This value is determined by the combination of multiple selections in specific words and bits.<br>For more information on what selections determine the input data form that is used, see Table 22 on page 207. | | | | | | | | | | | | | | | |
| | Inpt Tp / Rnge Sel Chl*x* | Use these bits to select the input type and operating range for a channel. For more information on what selections determine the input type and operating range for a channel, see Table 23 on page 207. | | | | | | | | | | | | | | | |
| | Filter Setting Ch*x* | Use these bits to select the filter setting for a channel. For more information on what selections determine the filter settings for a channel, see Table 21 on page 206. | | | | | | | | | | | | | | | |
| | Process Alarm High Data Value Channel *x* | Use to configure the Process Alarm High value for a channel. Configuration is done using words 4, 10, 16, and 22 to set the Alarm High value. | | | | | | | | | | | | | | | |
| | Process Alarm Low Data Value Channel *x* | Use to configure the Process Alarm Low value for a channel. Configuration is done using words 5, 11, 17, and 23 to set the Low High value. | | | | | | | | | | | | | | | |
| | Alarm Dead Band Data Value Channel *x* | Use to configure the Alarm Deadband value for a channel. Configuration is done using words 6, 12, 18, and 24 to set the deadband alarm value. | | | | | | | | | | | | | | | |
| | ETS | Use to enable or disable the timestamping function on the module.<br>0 = Disable<br>1 = Enable | | | | | | | | | | | | | | | |
| | Real Time Stamp Value | Use to set the Real Time Sample value. The available range = 0…5000 ms. | | | | | | | | | | | | | | | |
| | Update CJCCompensationEn | Use this bit to enable or disable a CJC sensor.<br>• If enabled, the CJC is read once every other module scan, and its value updated in the CJC status word. This value is also used for thermocouple cold junction compensation.<br>• If disabled, the CJC sensor value is not acquired, and the CJC temperature is fixed at 25 °C (77 °F) for all channels. The CJC will also be fixed at 25 °C (77 °F) for all channels if it is determined to be broken (short or open circuit).<br>0 = Disable<br>1 = Enable | | | | | | | | | | | | | | | |
| | Cycle Calib | Use this bit to enable Cycle Calibration.<br>• If enabled, the module's internal calibration occurs once every 5 minutes.<br>• If disabled, the module's internal calibration occurs only once at power on/ reset.<br>Cycle Calibration allows the module to readjust for environmental changes such as variations in temperature. However, the module throughput is slightly reduced during the calibration operation.<br>0 = Disable<br>1 = Enable | | | | | | | | | | | | | | | |

**Table 20 - CompactLogix 5370 L2 Controllers Embedded Analog I/O Module's Configuration Image Array**

| Word | Bit | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Where (cont.) | CJC WP | Use this bit to enable or disable the CJC Weighted Profile.<br>• If enabled, the CJC temperature for each channel is scaled by multiplying the single CJC reading by a predefined scale factor derived from lab measurements of each terminal block pin's stable temperature. In this condition, all channel data is overridden with that channel's CJC temperature.<br>• If disabled, the single CJC reading is applied directly to all channels. If the CJC sensors are installed in a remote terminal block, the weighted profile must be disabled. In this condition, channel data is presented in the input table as normal.<br>0 = Disable<br>1 = Enable | | | | | | | | | | | | | | |
| | PFE | Use this bit to select whether data from the Program/Idle m ode or the Fault Enable mode is applied.<br>0 = Program/Idle mode data applied<br>1 = Fault mode data applied | | | | | | | | | | | | | | |
| | ER | Use this bit to enable or disable ramping for each channel.<br>0 = Disable<br>1 = Enable | | | | | | | | | | | | | | |
| | EHI | Use this bit to enable or disable the output channel interrupt function when a High Clamp alarm is set.<br>0 = Disable<br>1 = Enable | | | | | | | | | | | | | | |
| | ELI | Use this bit to enable or disable the output channel interrupt function when a Low Clamp alarm is set.<br>0 = Disable<br>1 = Enable | | | | | | | | | | | | | | |
| | PM | Use this bit to set data a channel uses when it is in Program/Idle mode.<br>0 = Hold Last State value<br>1 = User-defined value | | | | | | | | | | | | | | |
| | FM | Use this bit to set data a channel uses when it is in Fault mode.<br>0 = Hold Last State value<br>1 = User-defined value | | | | | | | | | | | | | | |
| | LC | Use this bit to enable or disable latch functionality when Low/High clamp and Under/Over range alarm conditions exist on a channel.<br>0 = Disable<br>1 = Enable | | | | | | | | | | | | | | |
| | Outpt Dta Fm Ch*x* | Use these bits to select the form the analog output data is presented to the controller and then used by the controller. This value is determined by the combination of multiple selections in specific words and bits.<br>For more information on what selections determine the output data form that is used, see Table 24 on page 209. | | | | | | | | | | | | | | |
| | Outpt Tp / Rnge Sel Ch*x* | Use these bits to select the output type and operating range for a channel. For more information on what selections determine the input type and operating range for a channel, see Table 25 on page 209. | | | | | | | | | | | | | | |
| | Fault Value Channel *x* | Use this bit to configure the Fault mode value for a channel. | | | | | | | | | | | | | | |
| | Program (Idle) Value Channel *x* | Use this bit to configure the Program/Idle mode value for a channel. | | | | | | | | | | | | | | |

**Table 20 - CompactLogix 5370 L2 Controllers Embedded Analog I/O Module's Configuration Image Array**

| Word | Bit | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Where (cont.) | Clamp High Data Value Channel *x* | Use this bit to configure the Clamp High data value for a channel. | | | | | | | | | | | | | | |
| | Clamp Low Data Value Channel *x* | Use this bit to configure the Clamp Low data value for a channel. | | | | | | | | | | | | | | |
| | Ramp Rate Channel *x* | Use this bit to set the Ramp Rate value for a channel. | | | | | | | | | | | | | | |

### *Input Filter Selections*

Table 21 lists the bit value combinations you can use to select a filter setting for a channel. You use bits 0...3 in words 2, 8, 14, and 20 to make this selection.

**Table 21 - Input Filter Selections**

| Filter Value | Bit Settings (Words 3, 9, 15, and 21) | | | |
|---|---|---|---|---|
| | Bit 03 | Bit 02 | Bit 01 | Bit 00 |
| 60 Hz | 0 | 0 | 0 | 0 |
| 50 Hz | 0 | 0 | 0 | 1 |
| 10 Hz | 0 | 0 | 1 | |
| 250 Hz | 0 | 0 | 1 | 1 |
| 500 Hz | 0 | 1 | 0 | 0 |
| 1 kHz | 0 | 1 | 0 | 1 |
| Spare(1) | Values 6…15 | | | |

(1) An attempt to write a non-valid (any Spare value) or Not Used bit configuration into the Input Filter Response Select field will cause a Module Configuration Error (contained in the Mod_Condition Array).

### *Analog Input Data Format*

Table 22 lists the bit value combinations you can use to select the output data format for analog data that is sent to the controller for a channel. You use bits 8...10 in words 3, 9, 15, and 21 to make this selection.

**Table 22 - Analog Input Data Format**

| Analog Output Data Format | Bit Settings (Words 3, 9, 15, and 21) | | |
|---|---|---|---|
| | Bit 10 | Bit 09 | Bit 08 |
| Raw/Proportional Data | 0 | 0 | 0 |
| Engineering Units | 0 | 0 | 1 |
| Engineering Units x 10 | 0 | 1 | 0 |
| Scaled for PID | 0 | 1 | 1 |
| Percent Range | 1 | 0 | 0 |
| Spare(1) | Values 5…7 | | |

(1) An attempt to write a non-valid (any Spare value) bit configuration into the Input/Output Data Format Select field will cause a Module Configuration Error (contained in Mod_Condition Array). All bits shown as 0 above shall always be set to 0.

### *Analog Input Type and Operating Range*

Table 23 lists the bit value combinations you can use to select the input type and operating range for a channel. You use bits 0...5 in words 3, 9, 15, 21, 29, and 37 to make the selections.

**Table 23 - Analog Input Type and Operating Range**

| Input Type and Normal Operating Range | Bit Settings (Words 3, 9, 15, and 21) | | | | | |
|---|---|---|---|---|---|---|
| | Bit 05 | Bit 04 | Bit 03 | Bit 02 | Bit | Bit 00 |
| -10…10V DC | 0 | 0 | 0 | 0 | 0 | 0 |
| 0…5V DC | 0 | 0 | 0 | 0 | 0 | 1 |
| 0…10V DC | 0 | 0 | 0 | 0 | 1 | 0 |
| 4…20 mA | 0 | 0 | 0 | 0 | 1 | 1 |
| 1…5V DC | 0 | 0 | 0 | 1 | 0 | 0 |
| 0…20 mA | 0 | 0 | 0 | 1 | 0 | 1 |
| -50 mV…50 mv | 0 | 0 | 0 | 1 | 1 | 0 |
| -100 mV…100 mV | 0 | 0 | 0 | 1 | 1 | 1 |
| Thermocouple J | 0 | 0 | 1 | 0 | 0 | 0 |
| Thermocouple K | 0 | 0 | 1 | 0 | 0 | 1 |
| Thermocouple T | 0 | 0 | 1 | 0 | 1 | 0 |
| Thermocouple E | 0 | 0 | 1 | 0 | 1 | 1 |
| Thermocouple R | 0 | 0 | 1 | 1 | 0 | 0 |
| Thermocouple S | 0 | 0 | 1 | 1 | 0 | 1 |
| Thermocouple B | 0 | 0 | 1 | 1 | 1 | 0 |
| Thermocouple N | 0 | 0 | 1 | 1 | 1 | 1 |

**Table 23 - Analog Input Type and Operating Range**

| Input Type and Normal Operating Range | Bit Settings (Words 3, 9, 15, and 21) | | | | | |
|---|---|---|---|---|---|---|
| | Bit 05 | Bit 04 | Bit 03 | Bit 02 | Bit | Bit 00 |
| Thermocouple C | 0 | 1 | 0 | 0 | 0 | 0 |
| 100 Ω PT 385 | 0 | 1 | 0 | 0 | 0 | 1 |
| 200 Ω PT 385 | 0 | 1 | 0 | 0 | 1 | 0 |
| 500 Ω PT 385 | 0 | 1 | 0 | 0 | 1 | 1 |
| 1000 Ω PT 385 | 0 | 1 | 0 | 1 | 0 | 0 |
| 100 Ω PT 3916 | 0 | 1 | 0 | 1 | 0 | 1 |
| 200 Ω PT 3916 | 0 | 1 | 0 | 1 | 1 | 0 |
| 500 Ω PT 3916 | 0 | 1 | 0 | 1 | 1 | 1 |
| 1000 Ω PT 3916 | 0 | 1 | 1 | 0 | 0 | 0 |
| 10 Ω CU 426 | 0 | 1 | 1 | 0 | 0 | 1 |
| 120 Ω Ni 618 | 0 | 1 | 1 | 0 | 1 | 0 |
| 120 Ω Ni 672 | 0 | 1 | 1 | 0 | 1 | 1 |
| 604 Ω NiFe 518 | 0 | 1 | 1 | 1 | 0 | 0 |
| 150 Ω | 0 | 1 | 1 | 1 | 0 | 1 |
| 500 Ω | 0 | 1 | 1 | 1 | 1 | 0 |
| 1000 Ω | 0 | 1 | 1 | 1 | 1 | 1 |
| 3000 Ω | 1 | 0 | 0 | 0 | 0 | 0 |

### *Analog Output Data Format*

Table 24 lists the bit value combinations you can use to select the output data format for analog data that is sent to the controller for a channel. You use bits 8...10 in words 29 and 37 to make this selection.

**Table 24 - Analog Output Data Format**

| Analog Output Data Format | Bit Settings (Words 29 and 37) | | |
|---|---|---|---|
| | Bit 10 | Bit 09 | Bit 08 |
| Raw/Proportional Data | 0 | 0 | 0 |
| Engineering Units | 0 | 0 | 1 |
| Scaled for PID | 0 | 1 | 0 |
| Percent Range | 0 | 1 | 1 |
| Spare(1) | Values 4…7 | | |

(1) An attempt to write a non-valid (any Spare value) bit configuration into the Input/Output Data Format Select field will cause a Module Configuration Error (contained in Mod_Condition Array). All bits shown as 0

### *Analog Output Type and Operating Range*

Table 25 lists the bit value combinations you can use to select the input type and operating range for a channel. You use bits 0...5 in words 29 and 37 to make the selections.

**Table 25 - Analog Output Type and Operating Range**

| Output Type and Normal Operating Range | Bit Settings (Words 29 and 37) | | | | | |
|---|---|---|---|---|---|---|
| | Bit 05 | Bit 04 | Bit 03 | Bit 02 | Bit | Bit 00 |
| -10…10V DC | 0 | 0 | 0 | 0 | 0 | 0 |
| 0…5V DC | 0 | 0 | 0 | 0 | 0 | 1 |
| 0…10V DC | 0 | 0 | 0 | 0 | 1 | 0 |
| 4…20 mA | 0 | 0 | 0 | 0 | 1 | 1 |
| 1…5V DC | 0 | 0 | 0 | 1 | 0 | 0 |
| 0…20 mA | 0 | 0 | 0 | 1 | 0 | 1 |

## Local Expansion Modules - Optional

CompactLogix 5370 L2 control systems support the use of Compact I/O modules as local expansion modules along a CompactBus backplane:

- The controllers support up to four Compact I/O modules as local expansion modules.
- When possible, use specialty Compact I/O modules to meet unique application requirements.
- Consider using a 1492 wiring system for each I/O module as an alternative to the terminal block that comes with the module.
- Use 1492 PanelConnect™ modules and cables if you are connecting input modules to sensors.
- Install local expansion modules in the same local bank as the CompactLogix 5370 L2 controller.

### *Install Local Expansion Modules*

Complete these steps to install local expansion modules in your CompactLogix 5370 L2 control system.

1. Attach the Compact I/O modules as described in these publications:
   - Compact I/O Modules Installation Instructions, publication 1769-IN088
   - Compact I/O DeviceNet Scanner Module Installation Instructions, publication 1769-IN060
2. Use the tongue-and-groove slots to attach a 1769-ECR Compact I/O end cap terminator to the last module in the system.
3. Move the end cap terminator's bus lever fully to the left until it clicks to lock the end cap bus terminator.

### *Wire Local Expansion Modules*

Wire each Compact I/O module used as a local expansion module according to the technical documentation for that module.

## Distributed I/O Modules over an EtherNet/IP Network

You can include distributed I/O modules over an EtherNet/IP network in your CompactLogix 5370 L2 control system.

Consider the following when using distributed I/O modules over an EtherNet/IP network:

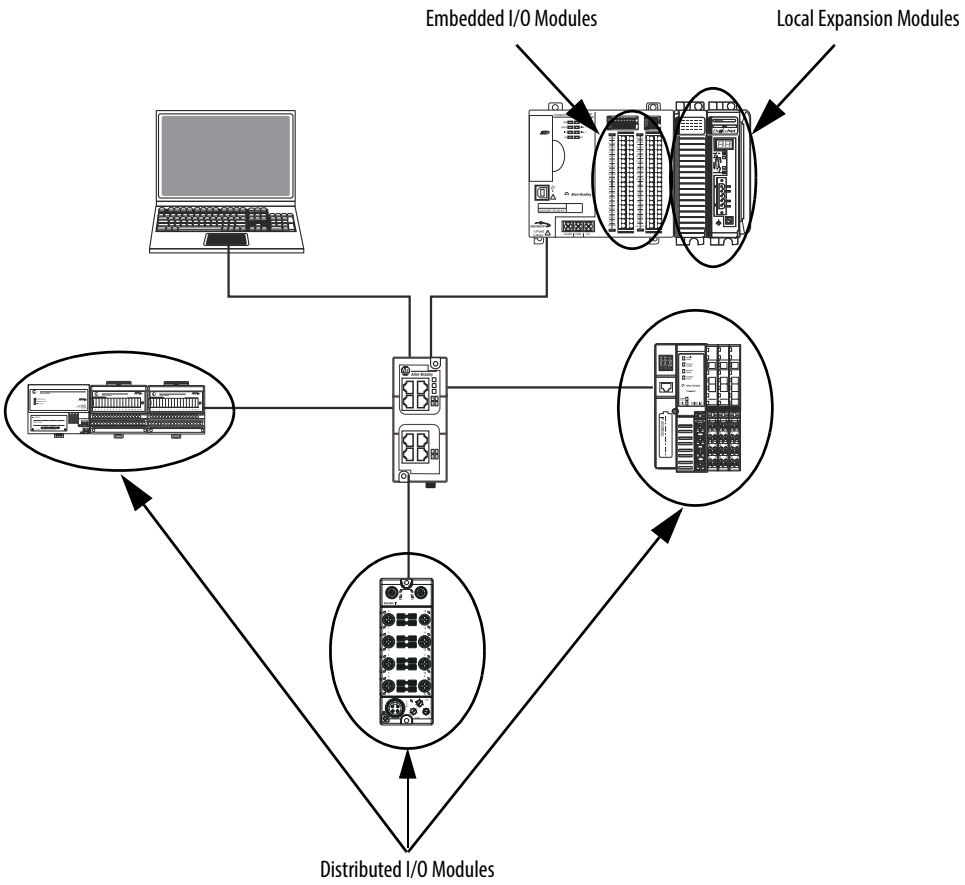
- Each remote EtherNet/IP adapter included in the system must be counted toward the controller's maximum number of EtherNet/IP nodes.

  For more information on maximum number of EtherNet/IP nodes, see Nodes on an EtherNet/IP Network on page 118.

- The configurable RPI settings vary depending on which distributed I/O modules are used in the system.

- For information on adding distributed I/O modules to your CompactLogix 5370 L2 control system, see Configure Distributed I/O Modules on a DeviceNet Network on page 232.

The following graphic shows a CompactLogix 5370 L2 control system on an EtherNet/IP network that uses all three I/O module options.



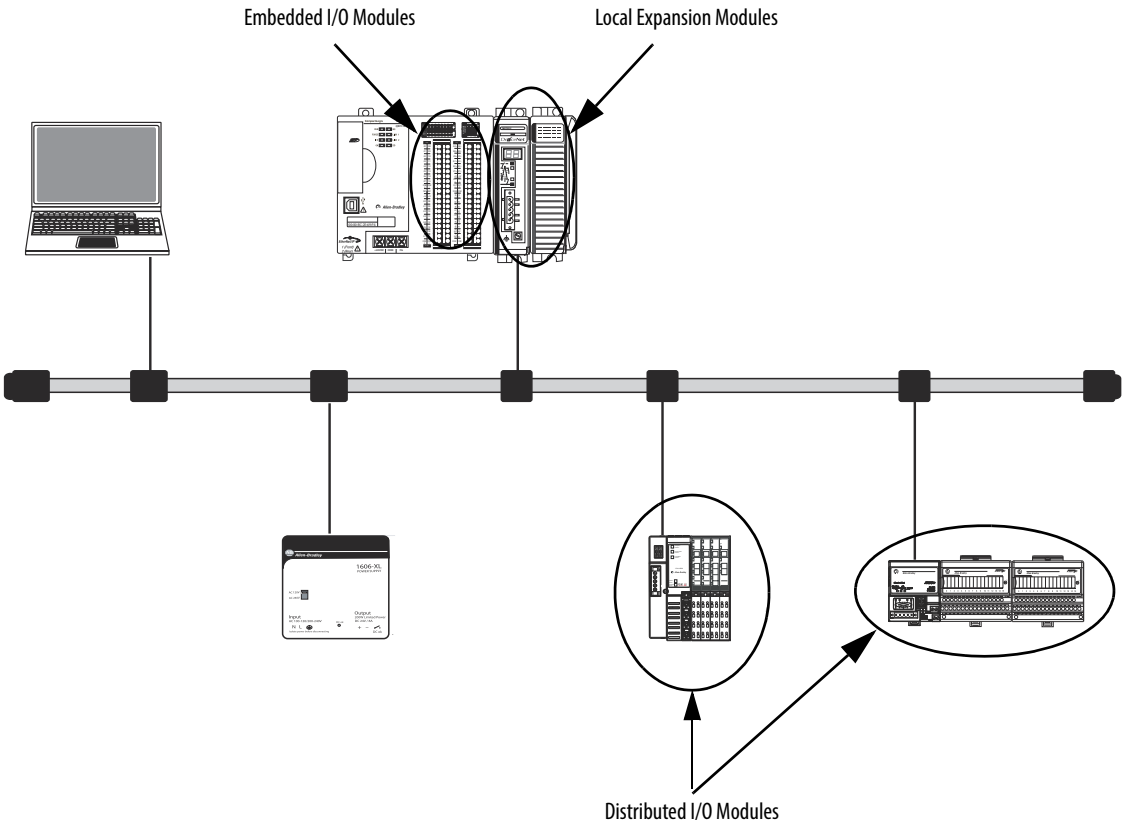
## Distributed I/O Modules over a DeviceNet Network

You can include distributed I/O modules over a DeviceNet network in your CompactLogix 5370 L2 control system.

You must use the following to use distributed I/O modules over a DeviceNet network in your CompactLogix 5370 L2 control system:

- Logix Designer application or RSLogix 5000 software - For more information, see Configure Distributed I/O Modules on an EtherNet/IP Network on page 229.
- RSNetWorx for DeviceNet software - For more information, see Configure Distributed I/O Modules on a DeviceNet Network on page 232.

The following graphic shows a CompactLogix 5370 L2 control system on a DeviceNet network that uses all three I/O module options.



# Validate I/O Layout

You must validate the layout of I/O modules in your CompactLogix 5370 L2 control system. Consider these points when validating I/O layout placement:

- Estimate Requested Packet Interval
- Module Fault Related to RPI Estimates
- System Power Availability
- Power Supply Distance Rating

## Estimate Requested Packet Interval

The requested packet interval (RPI) defines the frequency at which the controller sends data to and receives data from I/O modules. You set an RPI rate for each I/O module in your system, including embedded I/O modules, local expansion modules or distributed I/O modules over an EtherNet/IP network.

The CompactLogix 5370 L2 controllers always attempt to scan an I/O module at the configured RPI rate. The controller scans distributed I/O modules at the configured RPI rates.

With embedded I/O modules and local expansion modules, however, some specific system configuration parameters determine the actual rate at which the controller scans the modules. That is, the controller may be configured to scan an I/O module at one rate but actually scan the module at a different rate.

For individual I/O modules, a Module RPI Overlap minor fault occurs if there is at least one I/O module that cannot be serviced within its RPI time.

The specific configuration parameters for a system determine the impact on actual RPI rates. These configuration factors can impact the effective scan frequency for any individual embedded or local expansion module:

- Rates at which embedded I/O modules' RPI values are set
- Number of embedded I/O modules used in the system
- Types of embedded I/O modules used in the system
- Rates at which Compact I/O modules' RPI values are set
- Number of Compact I/O modules in the system
- Types of Compact I/O modules in the system
- Application user task priorities

Table 26 describes RPI rate guidelines.

**Table 26 - Requested Packet Interval Guidelines**

| Type of Module | Guidelines |
|---|---|
| Digital and analog (any mix) | The following guidelines apply:<br>• 1…2 modules can be scanned in 0.5 ms.<br>• 3…4 modules can be scanned in 1 ms.<br>• 5…6 modules can be scanned in 2 ms.<br>• Some input modules have a fixed 8 ms filter, so selecting a faster RPI has no effect. |
| Specialty | The following conditions apply:<br>• For every full-sized 1769-SDN module in the system, increase every other module's RPI by 2 ms.<br>• For every 1769-HSC module in the system, increase every other module's RPI by 1 ms.<br>• For every full-sized 1769-ASCII module system, increase every other module's RPI by 1 ms.<br>• For every 1769-SM2 module in the system, increase every other module's RPI by 2 ms.<br>For example, if the system includes four I/O modules configured with an RPI = 1 ms and you add a 1769-SDN module to the system, you should increase the RPI value for all four other I/O modules by 2 ms. Therefore, when the 1769-SDN module is added to the system the four other I/O modules should use an RPI = 3 ms.<br>If, in the same system, you add a second 1769-SDN module, the four other I/O modules' RPI value should be increased to 5 ms. |

**IMPORTANT** When considering the number of I/O modules, remember that they can be the embedded I/O modules on the controller or Compact I/O modules used as local expansion modules.

Therefore, the consideration for using modules can be any of the following system configurations:

- Embedded I/O modules only
- Compact I/O modules only
- Some combination of embedded I/O modules and Compact I/O modules

You can set individual Compact I/O modules' RPI rates higher than those listed in Table 26. The RPI shows how quickly modules can be scanned, not how quickly an application can use the data. The RPI is asynchronous to the program scan. Other factors, such as program execution duration, affect I/O throughput.

## Module Fault Related to RPI Estimates

When following the guidelines described in Table 26, most CompactLogix 5370 L2 control systems operate as expected. Some systems that follow the guidelines may experience a Module RPI Overlap minor fault described in the following table.

| Name | Fault Information | Condition in Which Fault Occurs |
|---|---|---|
| Module RPI Overlap | (Type 03) I/O fault<br>(Code 94) Module RPI overlap detected<br>Module Slot = *x*, where *x* is the slot number of the I/O module in the I/O Configuration section | This fault is logged when an I/O module's current RPI update overlaps with its previous RPI update. The Minor Faults tab in the Controller Properties dialog box indicates which module's RPI is overlapping.<br>If multiple I/O modules experience the fault, the application indicates the fault occurred on the first such I/O module. Typically, it is an I/O module with a large Input/Output array sizes. Example modules that use large Input/Output array sizes include the 1769-SDN and 1769-HSC modules. In these cases, we recommend you adjust the module's RPI to eliminate the fault.<br>Once the fault is cleared from the first I/O module, the application indicates the next module experiencing the fault.This pattern continues until the fault is cleared from all affected I/O modules.<br>To avoid this fault, set the I/O modules' RPI rate to higher numerical values. We recommend you use an RPI value that is not a common multiple of other module RPI values, such as 2.5 ms, 5.5 ms, or 7 ms:<br>• We recommend you do not run CompactLogix 5370 L2 control systems with Module RPI Overlap faults.<br>• A system that experiences many Module RPI Overlap faults may not operate optimally because I/O data is not sampled at the expected rate determined by RPI settings.<br>• When the project is downloaded or an I/O module's RPI value is adjusted, it is expected to have a minor fault. Faults under these conditions are transitionary. Clear the fault and wait for the fault to reappear before adjusting the RPI value or the task priorities. |

## System Power Availability

An embedded 24V DC Input, nonisolated power supply powers all components in a CompactLogix 5370 L2 control system.

The embedded power supply provides the following power to the CompactBus:

- 1769-L24ER-QB1B controller:
  - 1.54 A @ 5V DC
  - 0.95 mA @ 24V DC
- 1769-L24ER-QBFC and 1769-L27ERM-QBFC1B controllers:
  - 1 A @ 5V DC
  - 0.8 mA @ 24V DC

The embedded power supply can power any combination of controller, embedded I/O modules and local expansion modules used in your application.

## Power Supply Distance Rating

In a CompactLogix 5370 L2 control system, you can install Compact I/O modules on as local expansion modules to the right of the controller system. Compact I/O modules each have a power supply distance rating that you must consider before you install them.

Power supply distance rating is the number of slots a Compact I/O module can be installed away from the power supply. If a Compact I/O modules has a distance rating of three, you can include up to two modules between the Compact I/O module and the power supply.

Additionally, the controller has embedded I/O modules that prevent installation of a Compact I/O module directly to the right of the embedded power supply. CompactLogix 5370 L2 control systems have embedded I/O modules in the controller. CompactLogix 5370 L2 control systems have one or two embedded I/O modules as described below:

- 1769-L24ER-QB1B controller - One embedded I/O module
- 1769-L24ER-QBFC1B and 1769-L27ERM-QBFC1B controllers - Two embedded I/O modules

While the embedded I/O modules are not considered local expansion modules, you still must include each embedded I/O module in the module slot count when determining where to install Compact I/O module as a local expansion module.

Because CompactLogix 5370 L2 control systems allow only up to four local expansion modules in the system, you can install most Compact I/O modules in any local expansion module slot. Some Compact I/O modules have power supply distance ratings that affect where you can install them in the CompactLogix 5370 L2 control system.

For example, the 1769-ASCII Compact ASCII and 1769-HSC Compact high-speed counter modules each have a power supply distance rating of four. The farthest local expansion module slot where you can install either of these modules in a CompactLogix 5370 L2 control system is module slot number two or three as determined by the controller catalog number used in the control system.

Table 27 describes the farthest local expansion module slot where you can install a 1769-HSC high-speed counter module and meet its power supply distance rating requirement.

**Table 27 - Example CompactLogix 5370 L2 Control Systems with a 1769-HSC High-speed Counter Module**

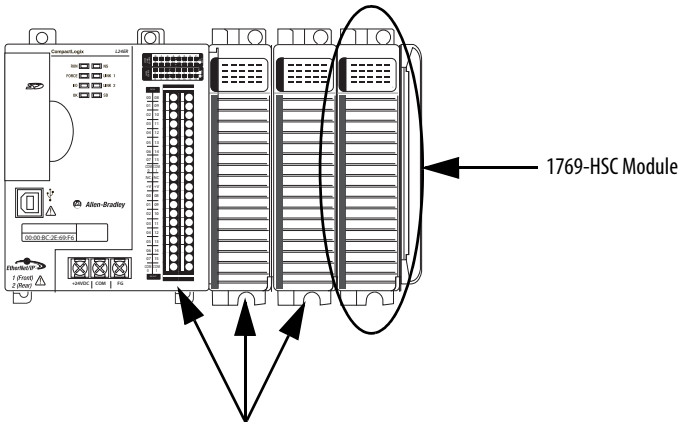
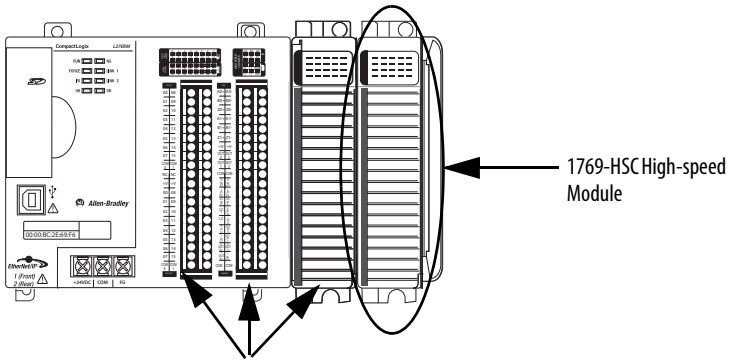
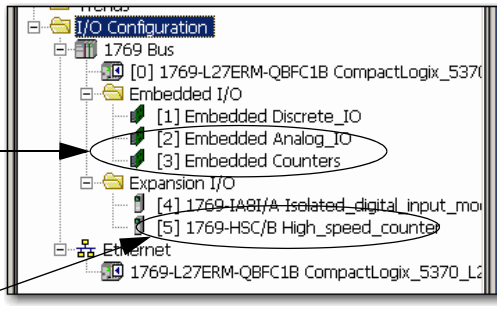
| Controller Cat. No. | Number of Embedded I/O Modules | 1769-HSC High-speed Counter Module Power Supply Distance Rating Calculation Impact |
|---|---|---|
| 1769-L24ER-QB1B | 1 | The embedded I/O module is the first module in the module count. At its maximum power supply distance rating, the 1769-HSC high-speed counter module can be installed in slot 3 of the local expansion modules, as shown below.<br>  <br><br>Three modules between the power supply and the 1769-HSC high-speed counter module. With this controller catalog number, you can only install up to two local expansion modules between the controller and the 1769-HSC high-speed counter module. |

**Table 27 - Example CompactLogix 5370 L2 Control Systems with a 1769-HSC High-speed Counter Module**

| Controller Cat. No. | Number of Embedded I/O Modules | 1769-HSC High-speed Counter Module Power Supply Distance Rating Calculation Impact |
|---|---|---|
| 1769-L24ER-QBFC1B<br>1769-L27ERM-QBFC1B | 2 | The embedded I/O modules are the first two modules in the module count. At its maximum power supply distance rating, the 1769-HSC high-speed counter module can be installed in slot 2 of the local expansion modules, as shown below.<br>  <br><br>Three modules between the power supply and the 1769-HSC high-speed counter module. With this controller catalog number, you can only install one local expansion modules between the controller and the 1769-HSC high-speed counter.<br><br>**IMPORTANT** When counting I/O modules to determine the 1769-HSC high-speed counter module placement in a 1769-L24ER-QBFC1B or 1769-L27ERM-QBFC1B control system, the embedded I/O module appearance is different between the physical appearance and the modules' appearance in the application.<br><br>The physical appearance is a shown above. The second module is two rows of termination points below a single set of status indicators.<br><br>In the application, the second embedded I/O module appears as two modules in the Controller Organizer each with their own slot number, that is [2] and [3].<br><br>When the 1769-HSC high-speed counter module is installed in the farthest local expansion module slot possible, that is the fourth module in the system, it appears with a [5] designation in the Controller Organizer, as shown below.<br><br>Modules [2] and [3] are shown separately but are considered a single module when counting modules to meet power supply distance rating requirements.<br>  <br><br>1769-HSC high-speed counter module is shown as module [5] in this location but considered the fourth module when counting modules to meet power supply distance rating requirements. |

For more information about the power supply distance rating for a Compact I/O module, see CompactLogix Selection Guide, publication 1769-SG001.

## Configure Local I/O Modules

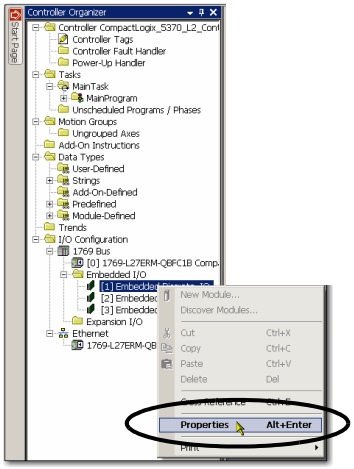
You can configure either of these types of local I/O modules in your RSLogix 5000 project:

- Configure Embedded I/O Modules
- Configure Local Expansion Modules

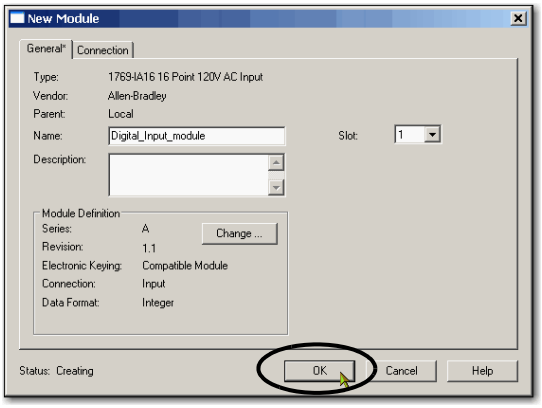
### Configure Embedded I/O Modules

Embedded I/O modules are automatically created in the I/O Configuration portion of the Controller Organizer. Complete these steps to configure an embedded I/O module in your CompactLogix 5370 L2 control system.

1. Right-click the embedded I/O module and choose Properties.




2. Click the appropriate tab, make the necessary changes, and click OK.

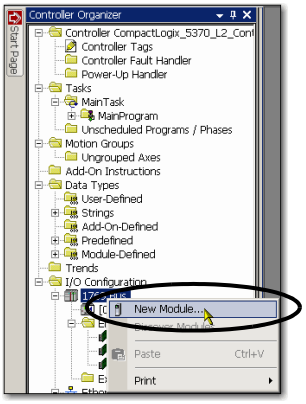



**IMPORTANT** You can also use the tags to configure the CompactLogix 5370 L2 controllers' embedded I/O modules. When attempting to use the tags to make analog I/O module selections in the input, output and configuration data arrays, the options are complicated.

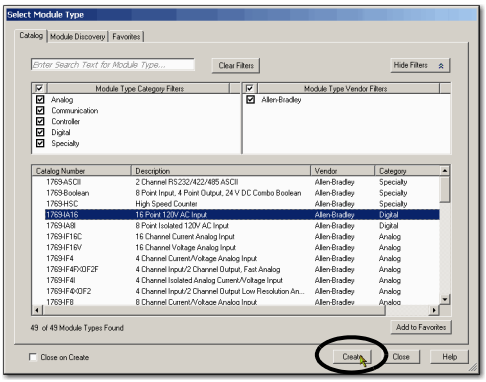
## Configure Local Expansion Modules

Complete these steps to add a Compact I/O module to your CompactLogix 5370 L2 control system and configure it.

1. Right-click the 1769 Bus and choose New Module.

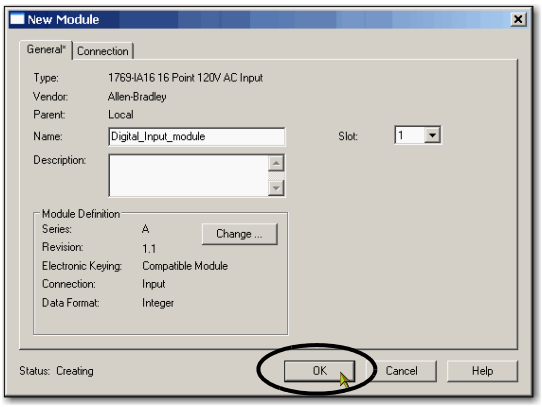



2. Select the desired I/O module and click Create.




The New Module dialog box appears.

3. Configure the new I/O module as necessary and click OK.




## Common Configuration Parameters

While the configuration options vary from module to module, there are some common options you typically configure when using Compact I/O modules in a CompactLogix 5370 L2 control system, as described in Table 28.

**Table 28 - Common Configuration Parameters**

| Configuration Option | Description |
|---|---|
| Requested packet interval (RPI) | The RPI specifies the interval at which data is transmitted or received over a connection. For 1769 Compact Local I/O modules, data is transmitted to the controller at the RPI.<br>When scanned on the local bus or over an EtherNet/IP network, input modules are scanned at the RPI specified in the module configuration. Typically, you configure an RPI in milliseconds (ms). For I/O modules, the range is 0.5…750 ms.<br>When scanned over a DeviceNet network via a 1769-SDN scanner module in the CompactLogix 5370 L2 control system, distributed input modules are scanned at the rate supported by the DeviceNet adapter module connecting the input modules to the network. For example, if your system includes a remote system of 1734 POINT I/O modules on a DeviceNet network, the 1769-SDN scanner module can only scan the distributed 1734 POINT I/O modules as quickly as the 1734-ADN DeviceNet adapter can transmit the data. |
| Module definition | Set of configuration parameters that affect data transmission between the controller and the I/O module. The parameters include the following:<br>• Series - Module's hardware series.<br>• Revision - Major and minor firmware revision levels used on the module.<br>• Electronic keying - See page 222.<br>• Connection - Type of connection between the controller writing the configuration and the I/O module, such as Output.<br>• Data format - Type of data transferred between the controller and I/O module and what tags are generated when the configuration is complete. |
| Module Fault on Controller If Connection Fails While in Run Mode | This option determines how the controller is affected if the connection to an I/O module fails in Run mode. You can configure the project so that a connection failure causes a major fault on the controller or not.<br>The default setting is for the option to be enable, that is, if the connection to an I/O module fails in Run mode, a major fault will occur on the controller. |

## I/O Connections

**IMPORTANT** You can only use direct connections with the local expansion modules in a CompactLogix 5370 L2 control system.

A Logix5000 system uses connections to transmit I/O data, as described in Table 29.

**Table 29 - I/O Module Connections**

| Connection | Description |
|---|---|
| Direct | A direct connection is a real-time, data-transfer link between the controller and an I/O module. The controller maintains and monitors the connection. Any break in the connection, such as a module fault, causes the controller to set fault status bits in the data area associated with the module.<br>Typically, analog I/O modules, diagnostic I/O modules, and specialty modules require direct connections. |
| Rack-optimized | For digital I/O modules, you can select rack-optimized communication.<br>This option is used with distributed I/O modules and the Rack Optimization connection selection is made when configuring the remote adapter. For example, if your CompactLogix 5370 L2 control system includes distributed digital I/O modules over an EtherNet/IP and you want to use a rack-optimized connection with those digital I/O modules, you must configure the distributed digital I/O modules' EtherNet/IP adapter to use a connection type of Rack Optimization.<br>A rack-optimized connection consolidates connection usage between the controller and all the digital I/O modules in a remote chassis or on a single DIN rail. Rather than having individual, direct connections for each I/O module, there is one connection for the entire rack (or DIN rail). |

# Electronic Keying

The electronic keying feature automatically compares the expected module, as shown in the I/O Configuration tree, to the physical module before I/O communication begins. You can use electronic keying to help prevent communication to a module that does not match the type and revision expected.

For each module in the I/O Configuration tree, the user-selected keying option determines if, and how, an electronic keying check is performed. Typically, three keying options are available:

- Exact Match
- Compatible Keying
- Disable Keying

You must carefully consider the benefits and implications of each keying option when selecting between them. For some specific module types, fewer options are available.

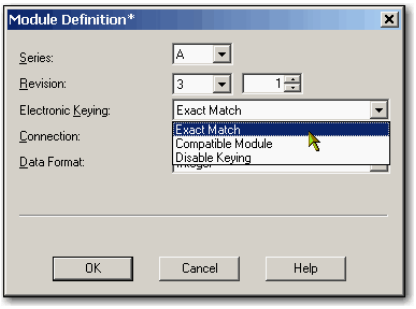
Electronic keying is based on a set of attributes unique to each product revision. When a Logix5000 controller begins communicating with a module, this set of keying attributes is considered.

**Table 30 - Keying Attributes**

| Attribute | Description |
|---|---|
| Vendor | The manufacturer of the module, for example, Rockwell Automation/Allen-Bradley. |
| Product Type | The general type of the module, for example, communication adapter, AC drive, or digital I/O. |
| Product Code | The specific type of module, generally represented by its catalog number, for example, 1769-OB32. |
| Major Revision | A number that represents the functional capabilities and data exchange formats of the module. Typically, although not always, a later, that is higher, Major Revision supports at least all of the data formats supported by an earlier, that is lower, Major Revision of the same catalog number and, possibly, additional ones. |
| Minor Revision | A number that indicates the module's specific firmware revision. Minor Revisions typically do not impact data compatibility but may indicate performance or behavior improvement. |

You can find revision information on the General tab of a module's Properties dialog box.

**Figure 36 - General Tab**




**IMPORTANT** Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

## Exact Match

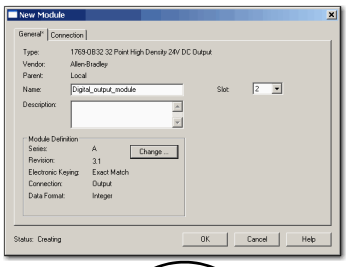
Exact Match keying requires all keying attributes, that is, Vendor, Product Type, Product Code (catalog number), Major Revision, and Minor Revision, of the physical module and the module created in the software to match precisely to establish communication. If any attribute does not match precisely, I/O communication is not permitted with the module or with modules connected through it, as in the case of a communication module.

Use Exact Match keying when you need the system to verify that the module revisions in use are exactly as specified in the project, such as for use in highly-regulated industries. Exact Match keying is also necessary to enable Automatic Firmware Update for the module via the Firmware Supervisor feature from a Logix5000 controller.

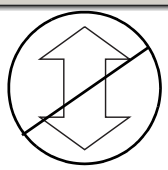
**EXAMPLE** In this scenario, **Exact Match keying prevents I/O communication**.

The module configuration is for a 1769-0B32 module with module revision 3.1. The physical module is a 1769-0B32 module with module revision 3.2. In this case, communication is prevented because the Minor Revision of the module does not match precisely.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-0B32
Major Revision = 3
**Minor Revision = 1**

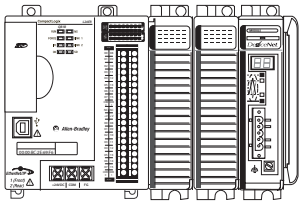



Communication is prevented.



Physical Module

Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-0B32
Major Revision = 3
**Minor Revision = 2**



**IMPORTANT** Changing electronic keying selections online may cause the I/O Communication connection to the module to be disrupted and may result in a loss of data.

## Compatible Keying

Compatible Keying indicates that the module determines whether to accept or reject communication. Different module families, communication adapters, and module types implement the compatibility check differently based on the family capabilities and on prior knowledge of compatible products. Release notes for individual modules indicate the specific compatibility details.

Compatible Keying is the default setting. Compatible Keying allows the physical module to accept the key of the module configured in the software, provided that the configured module is one the physical module is capable of emulating. The exact level of emulation required is product and revision specific.

With Compatible Keying, you can replace a module of a certain Major Revision with one of the same catalog number and the same or later, that is higher, Major Revision. In some cases, the selection makes it possible to use a replacement that is a different catalog number than the original.

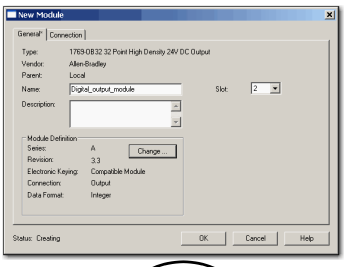
When a module is created, the module developers consider the module's development history to implement capabilities that emulate those of the previous module. However, the developers cannot know future developments. Because of this, when a system is configured, we recommend that you configure your module using the earliest, that is, lowest, revision of the physical module that you believe will be used in the system. By doing this, you can avoid the case of a physical module rejecting the keying request because it is an earlier revision than the one configured in the software.

**EXAMPLE**

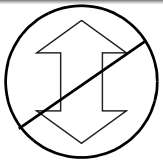
In this scenario, **Compatible Keying prevents I/O communication**:

The module configuration is for a 1769-OB32 module with module revision 3.3. The physical module is a 1769-OB32 module with module revision 3.2. In this case, communication is prevented because the minor revision of the module is lower than expected and may not be compatible with 3.3.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OB32
Major Revision = 3
**Minor Revision = 3**

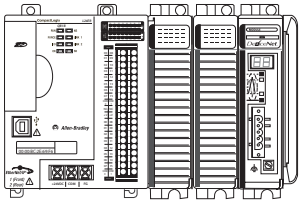



Communication is prevented.



Physical Module

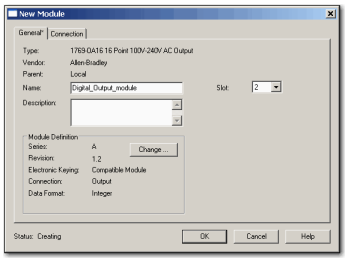
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OB32
Major Revision = 3
**Minor Revision = 2**



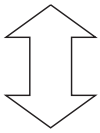
**EXAMPLE** In this scenario, **Compatible Keying allows I/O communication**:

The module configuration is for a 1769-OA16 module with module revision 1.2. The physical module is a 1769-OA16 module with module revision 3.2. In this case, communication is allowed because the major revision of the physical module is higher than expected and the module determines that it is compatible with the prior major revision.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OA16
**Major Revision = 1**
**Minor Revision = 2**

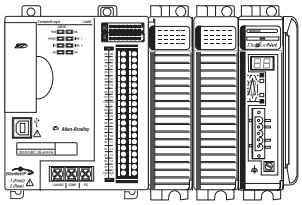



Communication is allowed.



Physical Module

Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OA16
**Major Revision = 3**
**Minor Revision = 2**



**IMPORTANT** Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

## Disabled Keying

Disabled Keying indicates the keying attributes are not considered when attempting to communicate with a module. Other attributes, such as data size and format, are considered and must be acceptable before I/O communication is established. With Disabled Keying, I/O communication may occur with a module other than the type specified in the I/O Configuration tree with unpredictable results. We generally do not recommend using Disabled Keying.

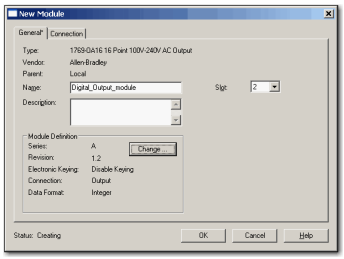
**ATTENTION:** Be extremely cautious when using Disabled Keying; if used incorrectly, this option can lead to personal injury or death, property damage, or economic loss.

If you use Disabled Keying, you must take full responsibility for understanding whether the module being used can fulfill the functional requirements of the application.

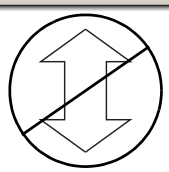
**EXAMPLE** In this scenario, **Disable Keying prevents I/O communication**:

The module configuration is for a 1769-OA16 digital output module. The physical module is a 1769-IT6 analog input module. In this case, communication is prevented because the analog module rejects the data formats that the digital module configuration requests.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
**Catalog Number = 1769-OA16**
Major Revision = 1
Minor Revision = 2

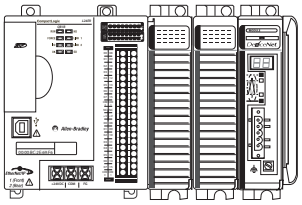



Communication is prevented.



Physical Module

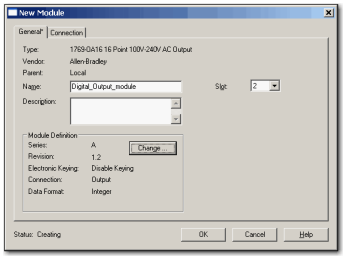
Vendor = Allen-Bradley
Product Type = Digital Output Module
**Catalog Number = 1769-IT6**
Major Revision = 3
Minor Revision = 2



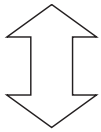
**EXAMPLE** In this scenario, **Disable Keying allows I/O communication**:

The module configuration is for a 1769-OA16 module. The physical module is a 1769-OB16 module. In this case, communication is allowed because the two digital modules share common data formats.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OA16
Major Revision = 1
Minor Revision = 2

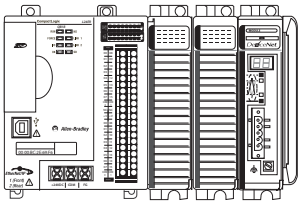



Communication is allowed.



Physical Module

Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OB16
Major Revision = 3
Minor Revision = 2



**IMPORTANT** Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

## Configure Distributed I/O Modules on an EtherNet/IP Network

Your CompactLogix 5370 L2 control system can use distributed I/O modules on an EtherNet/IP network.

**IMPORTANT** When adding distributed I/O modules, remember to count the remote Ethernet adapter to remain within the maximum number of EtherNet/IP network nodes limitation for your specific controller.

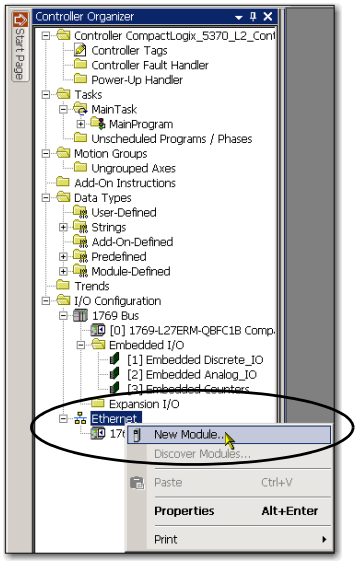
The distributed I/O modules connected to the controller via the remote Ethernet adapter are not counted toward the maximum Ethernet node limit for the controller.

For example, a 1769-L27ERM-QBFC1B controller supports up to 16 Ethernet nodes. You can add up to 16 remote Ethernet adapters to the I/O Configuration section because each remote adapter counts against the node count. However, you can add as many remote I/O modules to the adapter's chassis as necessary. Remote I/O modules do not count against the node count.

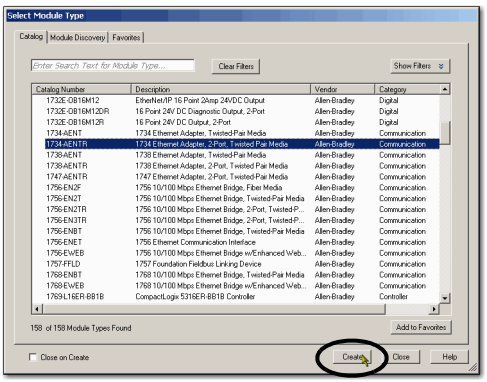
For more information on node limitations, see Nodes on an EtherNet/IP Network on page 118.

Complete these steps to configure distributed I/O modules on an EtherNet/IP network.

1. Right-click Ethernet and choose New Module.

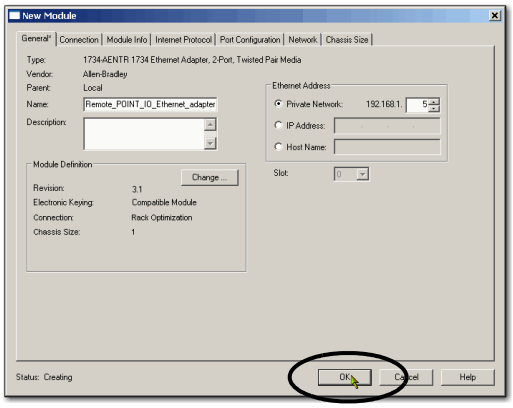


2. Select the desired Ethernet adapter and click Create.

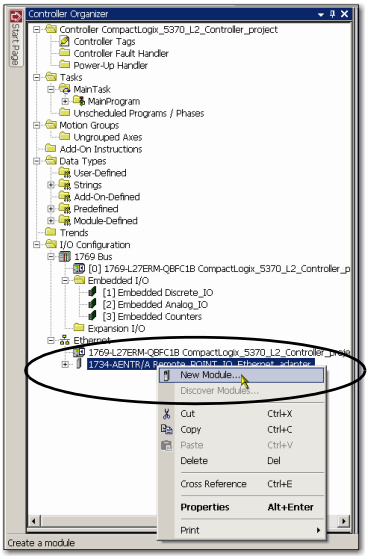



The New Module dialog box appears.

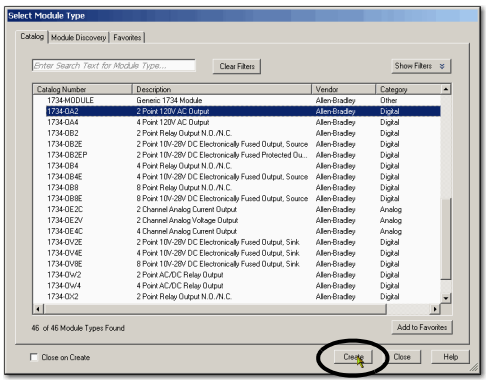
3. Configure the new Ethernet adapter as necessary and click OK.




4. Right-click the new adapter and choose New Module.

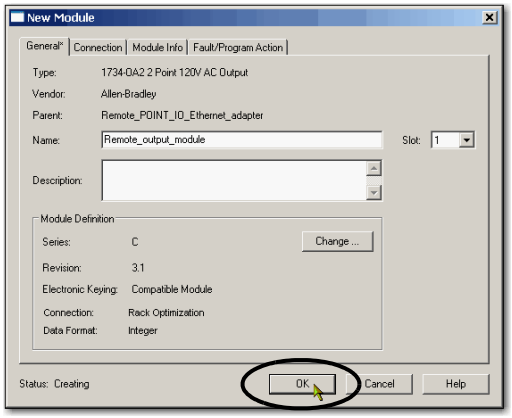


5. Select the desired I/O module and click Create.



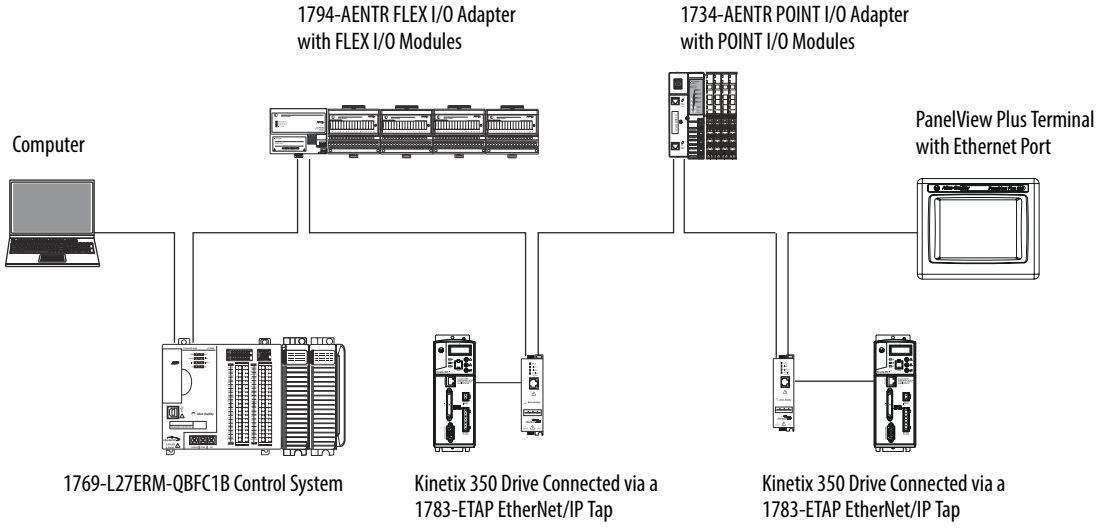

The New Module dialog box appears.

6. Configure the new I/O module as necessary and click OK.




7. Repeat these steps to add all of the desired distributed I/O modules.

The following graphic is an example of a 1769-L27ERM-QBFC1B control system that uses distributed I/O modules over an EtherNet/IP network.

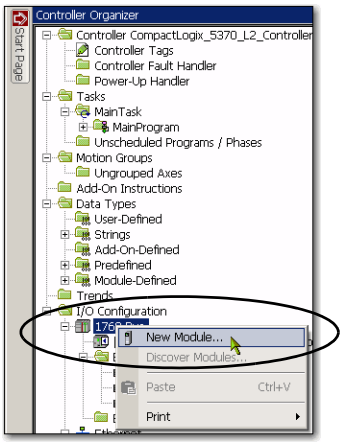


## Configure Distributed I/O Modules on a DeviceNet Network

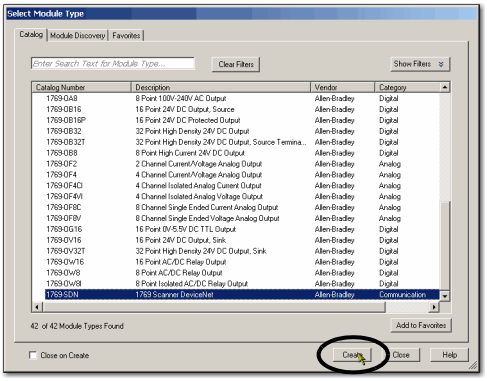
Your CompactLogix 5370 L2 control system can use distributed I/O modules on a DeviceNet network.

Complete these steps to configure distributed I/O modules on a DeviceNet network.

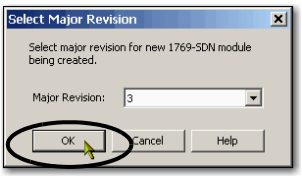
1. If you have not done so already, install a 1769-SDN Compact I/O DeviceNet scanner module into the local bank of your CompactLogix 5370 L2 control system.
2. Right-click 1769 Bus and choose New Module.




3. Select the 1769-SDN scanner module and click Create.

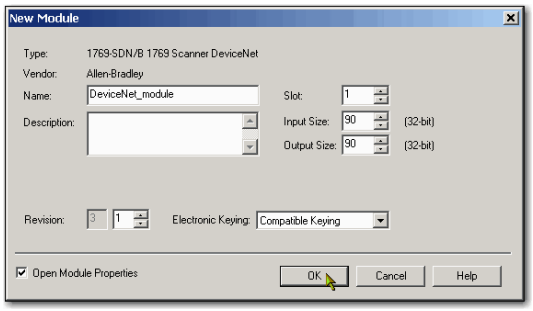



4. Choose a Major Revision and click OK.



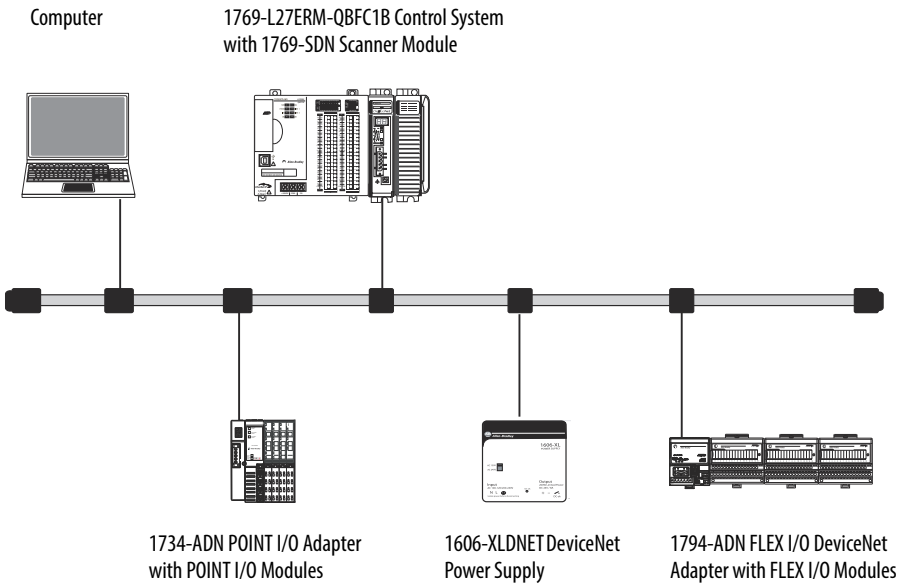

The New Module dialog box appears.

5. Configure the new 1769-SDN scanner module as necessary and click OK.




6. Use RSNetWorx for DeviceNet software to define the scanlist in the 1769-SDN scanner module to communicate data between the devices and the controller through the scanner module.

The following graphic is an example of a 1769-L27ERM-QBFC1B control system that uses distributed I/O modules on a DeviceNet network.

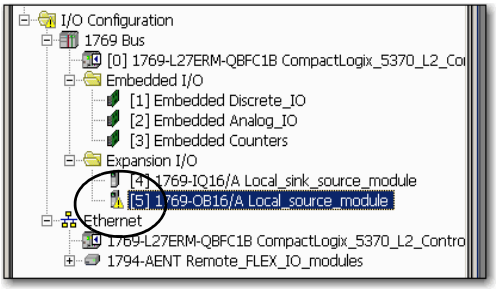


## Monitor I/O Modules

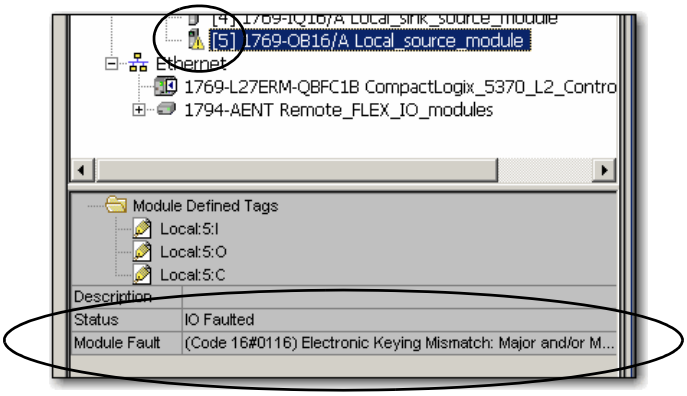
With CompactLogix 5370 L2 controllers, you can use the following options to monitor I/O modules:

- Quick View Pane below the Controller Organizer
- Connection tab in the Module Properties dialog box
- Programming logic to monitor fault data so you can take appropriate action.

When a fault occurs on an I/O module, a yellow triangle on the module's appearance in the Controller Organizer alerts you to the fault, as shown below.

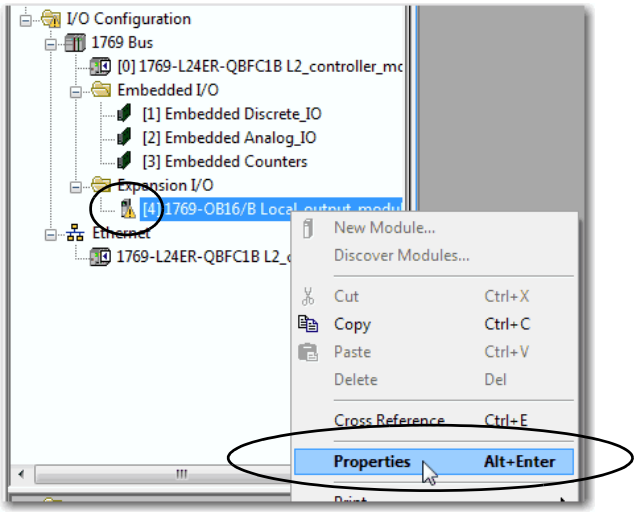



The following graphic shows the **Quick View Pane** indicating the type of fault.

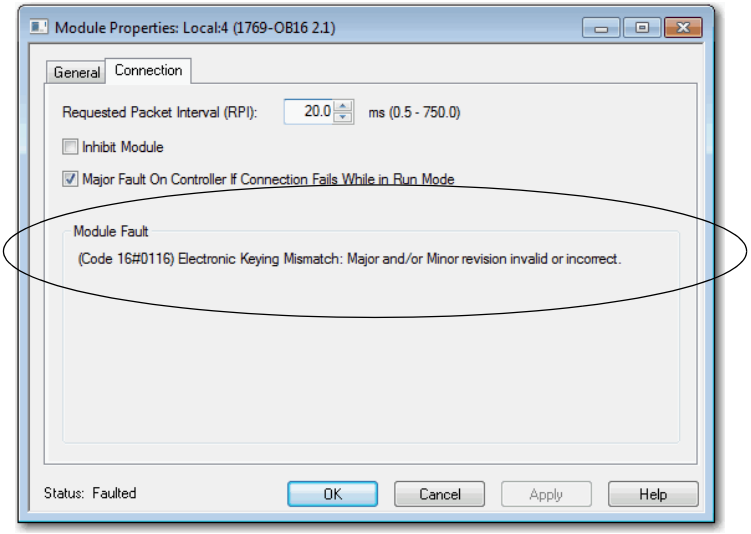


To see the fault description on the **Connection tab** in Module Properties dialog box, complete these steps.

1. In the I/O Configuration, right-click the faulted I/O module and choose Properties.




2. Click the Connection tab and use the fault description, in the Module Fault section, to diagnose the issue.




3. Click OK to close the dialog box and remedy the issue.

## End-cap Detection and Module Faults

End-cap detection is performed through the last module on a 1769 Bus. If that module experiences a fault such that it cannot communicate on the 1769 Bus, the following events occur:

- End-cap detection fails
- Controller faults

# Use I/O Modules with CompactLogix 5370 L3 Controllers

This chapter explains how to use Compact I/O modules in a CompactLogix 5370 L3 control system.


| Topic | Page |
|---|---|
| Select I/O Modules | 237 |
| Validate I/O Layout | 242 |
| Configure I/O | 252 |
| Electronic Keying | 254 |
| Configure Distributed I/O Modules on an EtherNet/IP Network | 260 |
| Configure Distributed I/O Modules on a DeviceNet Network | 263 |
| Monitor I/O Modules | 265 |


## Select I/O Modules

CompactLogix 5370 L3 control systems offer these I/O module options:

- Local Expansion Modules
- Distributed I/O Modules over an EtherNet/IP Network
- Configure Distributed I/O Modules on a DeviceNet Network

## Local Expansion Modules

CompactLogix 5370 L3 control systems support the use of Compact I/O modules as local expansion modules along a CompactBus backplane.

Consider the following when using local expansion modules:

- The controllers support this many local Compact I/O modules across up to three I/O banks, that is, the local bank and two additional banks.

| Cat. No. | Local Expansion Modules Supported, max |
|---|---|
| 1769- L30ER<br>1769-L30ERM<br>1769-L30ER-NSE | 8 |
| 1769-L33ER<br>1769-L33ERM | 16 |
| 1769-L36ERM | 30 |

- When possible, use specialty Compact I/O modules to meet unique application requirements.
- Consider using a 1492 wiring system for each I/O module as an alternative to the terminal block that comes with the module.
- Use 1492 PanelConnect™ modules and cables if you are connecting input modules to sensors.

### *Install Local Expansion Modules*

Complete these steps to install local expansion modules in your CompactLogix 5370 L3 control system:

1. Attach the 1769 Compact communication or I/O modules as described in these publications:
   - Compact I/O Modules Installation Instructions, publication 1769-IN088
   - Compact I/O DeviceNet Scanner Module Installation Instructions, publication 1769-IN060
2. If your system uses a **local bank** only, complete these steps.
   a. Use the tongue-and-groove slots to attach a 1769-ECR Compact I/O end cap terminator to the last module in the system.
   b. Move the end cap terminator's bus lever fully to the left until it clicks to lock the end cap bus terminator.

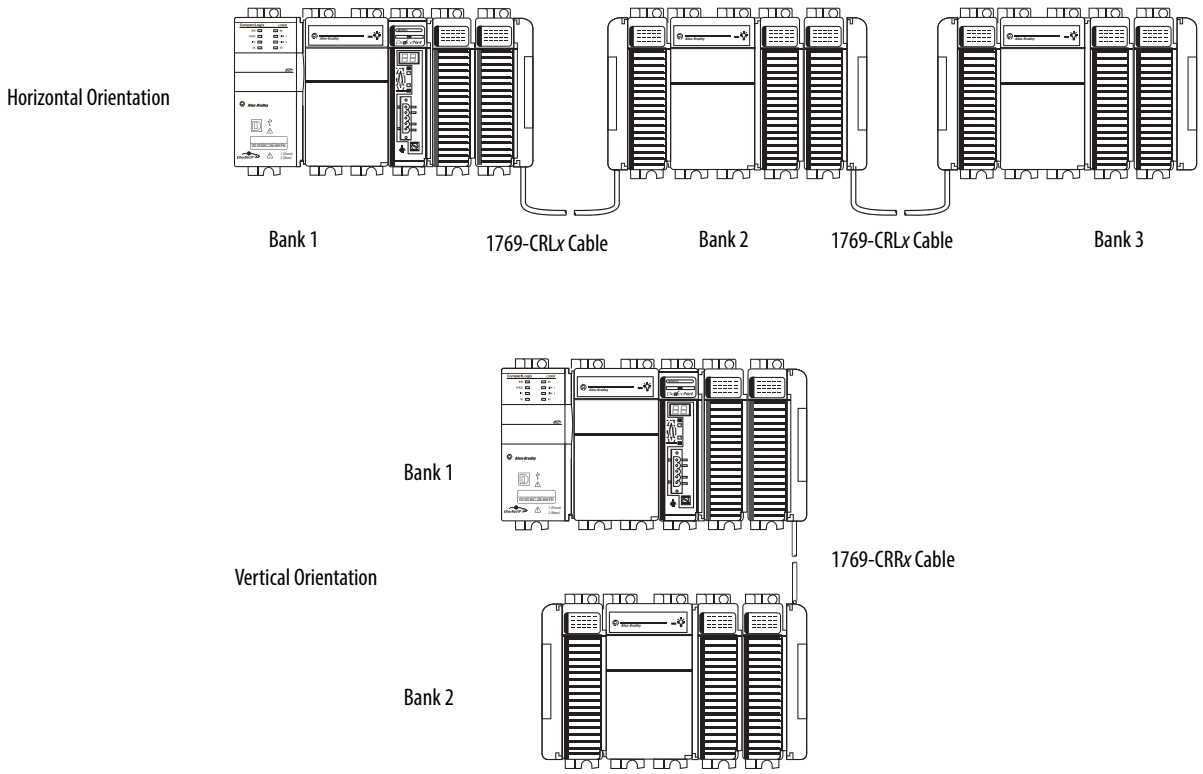
3. If you system uses **additional banks**, follow these steps.
   a. Install a 1769-CR*x* Compact I/O communication bus expansion cable at the right end of the **local bank**.
   b. Connect the appropriate 1769-CR*x* cable to the additional bank as necessary.

      That is, the expansion cable installed at the end of the local bank is determined by how you connect to the first additional bank—on the right or left side of the bank. See Figure 37 on page 239 for examples of how to connect a local bank to additional banks.
   c. Complete the installation of the remaining banks in your system.

| **IMPORTANT** | Make sure you install an end cap at the end of the last bank in your system. |
|---|---|

The following example shows example systems with local expansion modules included.

**Figure 37 - Example CompactLogix 5370 L3 Control Systems**




### *Wire Local Expansion Modules*

Wire each Compact I/O module used as a local expansion module according to the technical documentation for that module.

## Distributed I/O Modules over an EtherNet/IP Network

You can include distributed I/O modules over an EtherNet/IP network in your CompactLogix 5370 control system. Consider the following when using distributed I/O modules over an EtherNet/IP network:

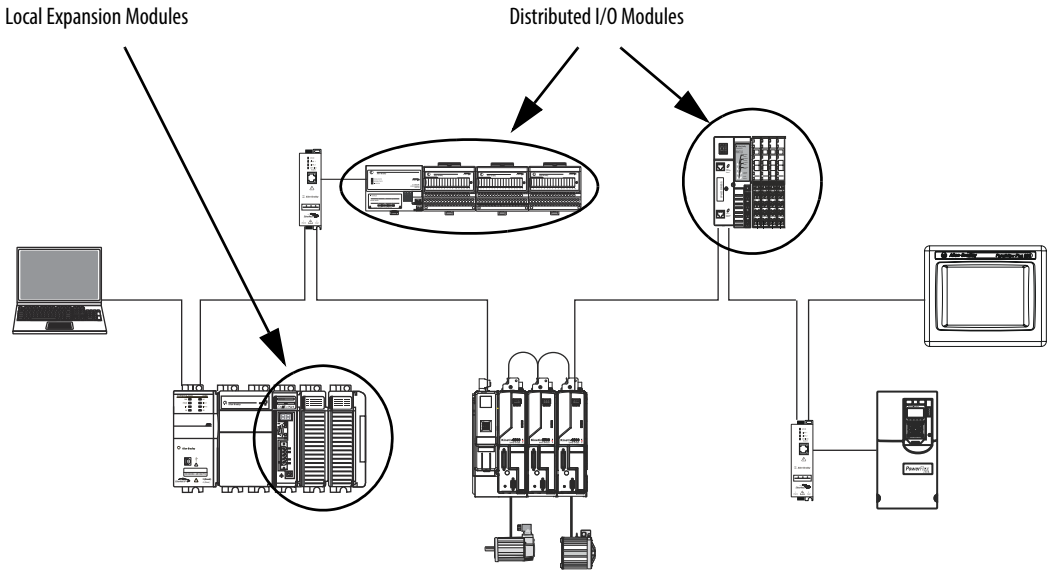
- Each remote EtherNet/IP adapter included in the system must be counted toward the controller's maximum number of EtherNet/IP nodes.

  For more information on maximum number of EtherNet/IP nodes, see Nodes on an EtherNet/IP Network on page 118.

- The configurable RPI settings vary depending on which distributed I/O modules are used in the system.

- For information on adding distributed I/O modules to your CompactLogix 5370 control system, see Configure Distributed I/O Modules on a DeviceNet Network on page 263.

The following graphic shows an example 1769-L33ERM control system that uses local expansion modules and distributed I/O modules over an EtherNet/IP network.



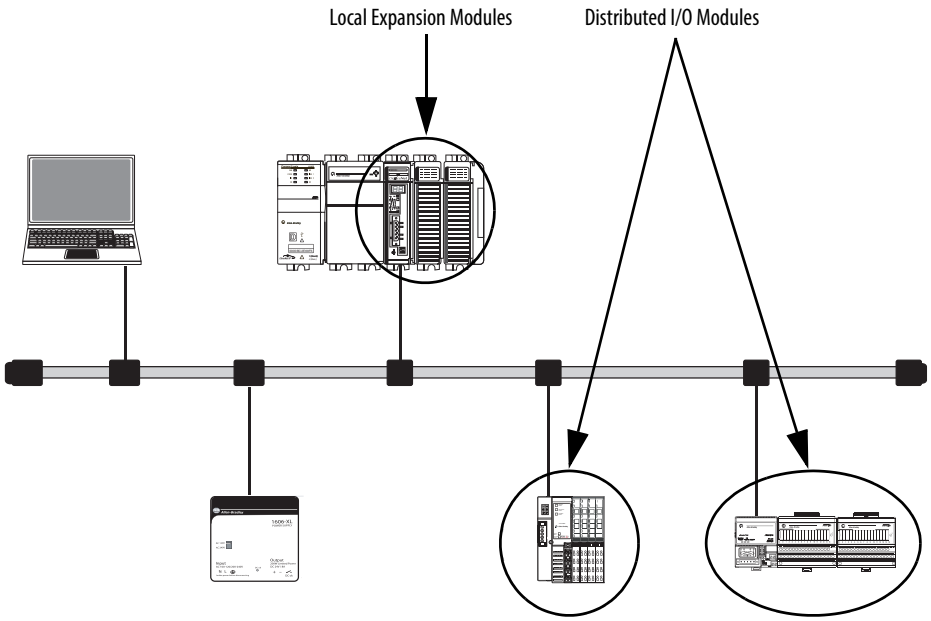
## Distributed I/O Modules over a DeviceNet Network

You can include distributed I/O modules over a DeviceNet network in your CompactLogix 5370 L3 control system. Consider the following when using distributed I/O modules over a DeviceNet network:

You must use the following to use distributed I/O modules over a DeviceNet network in your CompactLogix 5370 L3 control system:

- Logix Designer application or RSLogix 5000 software - For more information, see Configure Distributed I/O Modules on an EtherNet/IP Network on page 260.
- RSNetWorx for DeviceNet software - For more information, see DeviceNet Network Communication on page 131.

The following graphic shows an example 1769-L33ERM control system that uses local expansion modules and distributed I/O modules over a DeviceNet network.



## Validate I/O Layout

After you have selected your I/O modules, you must validate the system you want to design. Consider these points when validating I/O layout placement:

- Estimate Requested Packet Interval
- Module Fault Related to RPI Estimates
- Calculate System Power Consumption
- Power Supply Distance Rating
- Physical Placement of I/O Modules

### Estimate Requested Packet Interval

The requested packet interval (RPI) defines the frequency at which the controller sends data to and receives data from I/O modules. You set an RPI rate for each I/O module in your system.

The CompactLogix 5370 L3 controllers always attempt to scan an I/O module at the configured RPI rate. For individual I/O modules, a Module RPI Overlap minor fault occurs if there is at least one I/O module which cannot be serviced within its RPI time.

The specific configuration parameters for a system determine the impact on actual RPI rates. These configuration factors can impact the effective scan frequency for any individual module:

- Rates at which other Compact I/O modules' RPI rates are set
- Number of other Compact I/O modules in the system
- Types of other Compact I/O modules in the system
- Application user task priorities

Table 31 describes RPI rate guidelines.

**Table 31 - Requested Packet Interval Guidelines**

| Type of Module | Guidelines |
|---|---|
| Digital and analog (any mix) | The following guidelines apply:<br>• 1…2 modules can be scanned in 0.5 ms.<br>• 3…4 modules can be scanned in 1 ms.<br>• 5…30 modules can be scanned in 2 ms.<br>• Some input modules have a fixed 8 ms filter, so selecting a faster RPI has no effect. |
| Specialty | The following conditions apply:<br>• For every full-sized 1769-SDN module in the system, increase every other module's RPI by 2 ms.<br>• For every 1769-HSC module in the system, increase every other module's RPI by 1 ms.<br>• For every full-sized 1769-ASCII module system, increase every other module's RPI by 1 ms.<br>• For every 1769-SM2 module in the system, increase every other module's RPI by 2 ms.<br>For example, if there are four digital I/O modules in the system configured with an RPI = 1 ms and a 1769-SDN module is added to the system, you should increase the RPI value for all four digital I/O modules by 2 ms. Therefore, when the 1769-SDN module is added to the system the four digital I/O modules should use an RPI = 3 ms.<br>If, in the same system, you add a second 1769-SDN module, the four digital I/O modules' RPI value should be increased to 5 ms. |

You can set individual Compact I/O modules' RPI rates higher than those listed in Table 31. The RPI shows how quickly modules can be scanned, not how quickly an application can use the data. The RPI is asynchronous to the program scan. Other factors, such as program execution duration, affect I/O throughput.

## Module Fault Related to RPI Estimates

When following the guidelines described in Table 31, most CompactLogix 5370 L3 control systems operate as expected. Some systems that follow the guidelines may experience a Module RPI Overlap minor fault as described in the following table.

| Name | Fault Information | Condition In Which Fault Occurs |
|---|---|---|
| Module RPI Overlap | (Type 03) I/O fault<br>(Code 94) Module RPI overlap detected<br>Module Slot = *x*, where *x* is the slot number of the I/O module in the I/O Configuration section | This fault is logged when an I/O module's current RPI update overlaps with its previous RPI update. The Minor Faults tab in the Controller Properties dialog box indicates which module's RPI is overlapping.<br>If multiple I/O modules experience the fault, the application indicates the fault occurred on the first such I/O module. Typically, it is an I/O module with a large Input/Output array sizes. Example modules that use large Input/Output array sizes include the 1769-SDN and 1769-HSC modules. In these cases, we recommend you adjust the module's RPI to eliminate the fault.<br>Once the fault is cleared from the first I/O module, the application indicates the next module experiencing the fault.This pattern continues until the fault is cleared from all affected I/O modules.<br>To avoid this fault, set the I/O modules' RPI rate to higher numerical values. We recommend you use an RPI value that is not a common multiple of other module RPI values, such as 2.5 ms, 5.5 ms or 7 ms.<br>• We recommend you do not run CompactLogix 5370 L3 control systems with Module RPI Overlap faults.<br>• A system that experiences many Module RPI Overlap faults may not operate optimally because I/O data is not sampled at the expected rate determined by RPI settings.<br>• When the project is downloaded or an I/O module's RPI value is adjusted, it is expected to have a minor fault. Faults under these conditions are transitionary. Clear the fault and wait for the fault to reappear before adjusting the RPI value or the task priorities. |

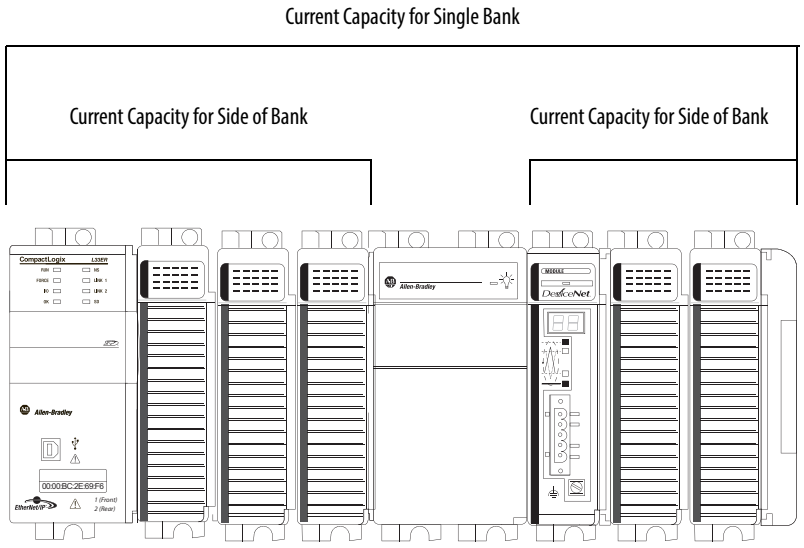
## Calculate System Power Consumption

The 1769 Compact I/O power supplies provide power to CompactLogix local and additional banks. The power provided is measured in current capacity.

Consider these points when designing your CompactLogix 5370 L3 control system banks:‘

- 1769 Compact I/O power supplies have two maximum current capacity requirements that affect how you design and configure a single bank.

  The following are the maximum current capacity requirements:
  - Maximum current capacity for a single bank
  - Maximum current capacity for each side of the power supply




- The maximum current capacity requirements vary by the power supply used in the bank.

| Power Supply Cat. No. | Current Capacity, max for Single Bank | Current Capacity, max for Each Side of Bank(1) |
|---|---|---|
| 1769-PA2 | 2 A at 5V DC and 0.8 A at 24V DC | 1 A at 5V DC and 0.4 A at 24V DC |
| 1769-PB2 | | |
| 1769-PA4 | 4 A at 5V DC and 2 A at 24V DC | 2 A at 5V DC and 1 A at 24V DC |
| 1769-PB4 | | |

(1) Specification for banks with devices on both left and right sides of the power supply.

*Calculate Power Consumption in Single Bank*

**IMPORTANT** A single bank, requires the CompactLogix 5370 L3 controllers to reside in the leftmost slot. At minimum, you must calculate the controller's power consumption on the left side of the power supply.

If additional modules are exist on the left side of the power supply, you must calculate the power consumption for those modules as well.

If additional modules are installed to the right of the power supply, you must calculate the power consumption for that side separately.

Use this table to calculate power consumption in a single bank.

**Table 32 - Module Power Consumption Calculation for a Local Bank**

| Side of Power Supply | Device Cat. No. | Number of Modules(3) | Module Current Requirements | | Calculated Current = (Number of Modules) x (Module Current Requirements) | |
|---|---|---|---|---|---|---|
| | | | at 5V DC (in mA) | at 24V DC (in mA) | at 5V DC (in mA) | at 24V DC (in mA) |
| Left - Required | 1769-L30ER<br>1769-L30ERM<br>1769-L30ER-NSE<br>1769-L33ER<br>1769-L33ERM<br>1769-L36ERM | 1 | 500 | 225 | 500 | 225 |
| Left - Optional | I/O Module-specific | Up to 3 | Module-specific | Module-specific | | |
| | | | | **Total Current Required**(2): | | |
| Right | I/O Module-specific<br>**IMPORTANT**: Insert a separate row in this calculation for each I/O module. | Up to 8 | Module-specific | Module-specific | | |
| | | | | **Total Current Required**(2): | | |
| | | | | **Total Current Required for Single Bank if Modules Are Installed on Both Sides of the Power Supply**(1): | | |

(1) This number must not exceed the power supply current capacity for the bank.

(2) This number must not exceed the power supply current capacity for this side of the bank.

(3) In the local bank, you can only install up to three modules to the left of the power supply because the CompactLogix 5370 L3 controllers have a power supply distance rating of four and must be within four slots of the Compact I/O power supply. On the right side of the power supply in the local bank and both sides of the power supply in additional banks, you can install up to eight modules if power supply distance ratings for the modules validate the system design.

*Calculate Power Consumption in an Additional Bank*

**IMPORTANT** In additional banks, you can install I/O modules to the left side, right side or both sides of the power supply.

The system design determines how to use the table below.

Use this table to calculate power consumption in an additional bank.

**Table 33 - Module Power Consumption Calculation for an Additional Bank**

| Side of Power Supply | Device Cat. No. | Number of Modules(3) | Module Current Requirements | | Calculated Current = (Number of Modules) x (Module Current Requirements) | |
|---|---|---|---|---|---|---|
| | | | at 5V DC (in mA) | at 24V DC (in mA) | at 5V DC (in mA) | at 24V DC (in mA) |
| Left - Optional in an additional bank | I/O Modules<br>**IMPORTANT**: Insert a separate row in this calculation for each I/O module. | Up to 8 | Module-specific | Module-specific | | |
| | | | | **Total Current Required**(2): | | |
| Right - Optional in a single bank | I/O Modules<br>**IMPORTANT**: Insert a separate row for each I/O module. | Up to 8 | Module-specific | Module-specific | | |
| | | | | **Total Current Required**(2): | | |
| | | | | **Total Current Required for Bank if Modules Are Installed on Both Sides of the Power Supply**(1): | | |

(1) This number must not exceed the power supply current capacity for the bank.

(2) This number must not exceed the power supply current capacity for this side of the bank.

(3) You can install up to eight modules in additional banks if the power supply distance ratings for the modules validate the system design.

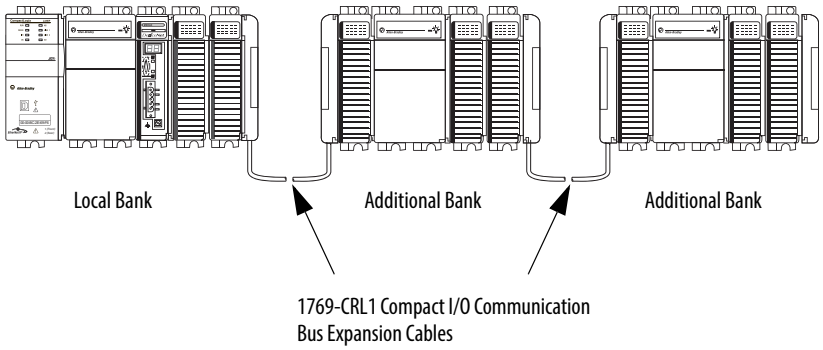
## Physical Placement of I/O Modules

Depending on the controller catalog number, CompactLogix 5370 L3 controllers support between eight and thirty I/O modules. For more information on specific catalog numbers, see Local Expansion Modules on page 238.

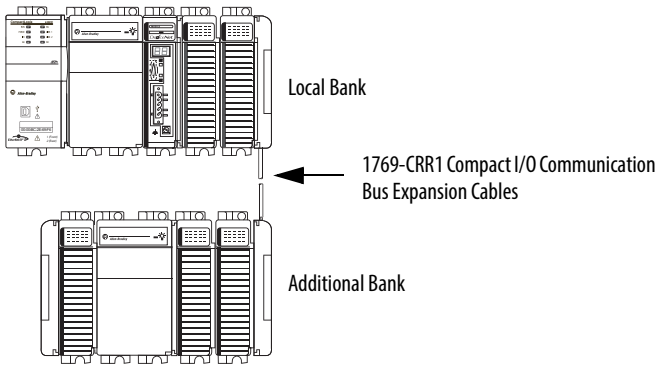
Consider these factors when determining the physical placement of the I/O modules:

- You can install I/O modules in local and additional banks.
- You can install I/O modules to the left and right of the power supply.
- When a system requires more than one bank, you can install the additional banks horizontally or vertically, as shown in this graphic.

Horizontal Orientation




Vertical Orientation




- Each I/O module also has a power supply distance rating and specific maximum current draw. Considered jointly, distance ratings and current draw determine where I/O modules can be placed in a bank and what configuration of modules may be installed in the bank.

  For more information on power supply distance ratings, see Power Supply Distance Rating on page 69. For more information on system power consumption, see Calculate System Power Consumption on page 244.

### *Local Bank*

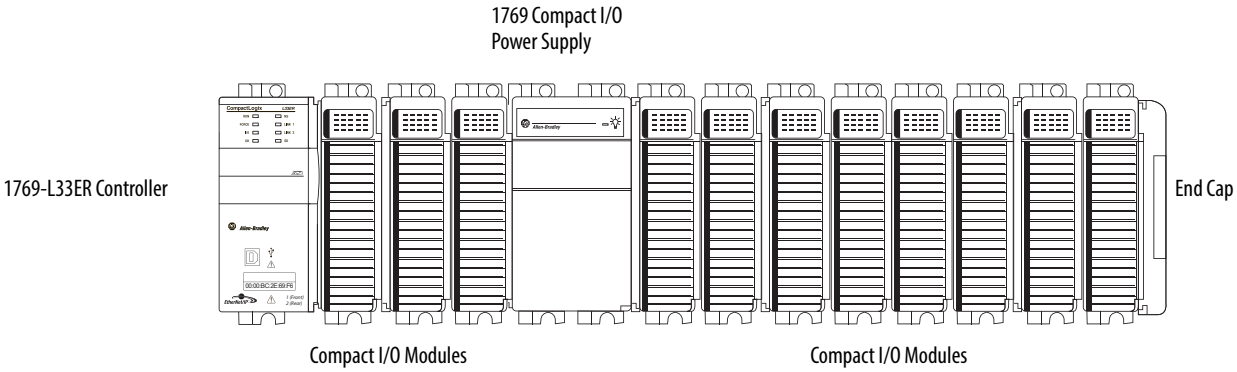
To validate the local bank design, confirm the design meets these requirements:

- The controller is the leftmost device in the local bank.
- No more than three modules are installed between the controller and the left side of the power supply.
- No more than eight modules are installed to the right of the power supply.
- The modules' power consumption on each side of the power supply does not exceed the power supply's capacity for that side.
- The total power consumption by all modules in the bank does not exceed the power supply's capacity for the entire bank.
- Modules are installed such that all power supply distance rating and system power consumption requirements are met.

  For example, the 1769-SDN scanner module has a power supply distance rating of four. If the design includes the installation of a 1769-SDN scanner with greater than three modules between it and the power supply, the design is invalid.

**IMPORTANT** With respect to power supply distance ratings, if you install a module that violates its power supply distance rating specification, the system may appear to operate normally for a period of time but could experience operational issues over time, such as I/O faults.

The example graphic below shows a local bank.



### *Additional Banks*

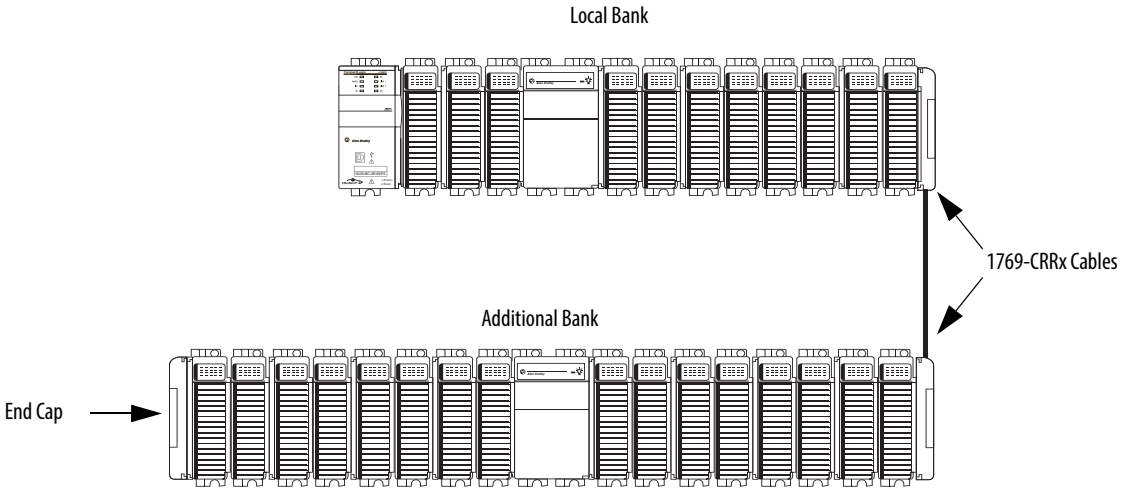
If your application calls for twelve or more I/O modules, at minimum, you must install the modules in multiple banks additional banks. The number of additional banks is determined by the specific conditions of each application.

Once the local bank design is validated, you must validate the design for any additional banks. To validate additional bank designs, confirm the design meets these requirements:

- Compact I/O communication bus expansion cables are used properly.

  **TIP** Compact I/O expansion cables have the same dimensions as the end caps regardless of whether they are installed at the right or left side of the communication bus.

- No more than eight modules are installed on either side of the power supply.
- The modules' power consumption on each side of the power supply does not exceed the power supply's capacity for that side.
- Modules are installed such that all power supply distance rating requirements are met.
- End caps are installed properly, as shown below.



## Power Supply Distance Rating

CompactLogix 5370 L3 control systems do not have embedded I/O modules. You begin counting local expansion slots with the first Compact I/O module installed next to the power supply when determining where to install a Compact I/O module and meet its power supply distance rating.

In CompactLogix 5370 L3 control systems, you can install Compact I/O modules to the left or right side of the power supply. You can also use both local and additional banks in CompactLogix 5370 L3 control systems, with each allowing the inclusion of Compact I/O modules.

### *Local Bank*

In the local bank, the controller must be the leftmost device in the system and you can only install up to three modules between the controller and the power supply. Therefore, any Compact I/O modules that are installed to the left of the power supply in the local bank, are in a module slot that meets the module's power supply distance rating requirements.

### *Additional Banks*

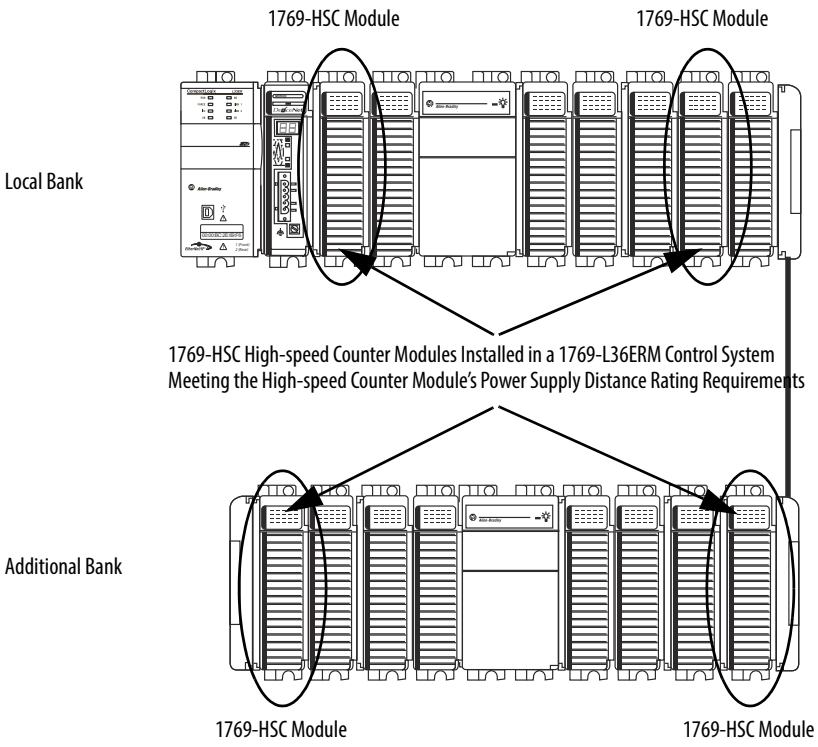
CompactLogix 5370 L3 control systems also support the use of additional banks for the system's local expansion modules. Every additional bank requires a 1769 Compact I/O power supply. The bank can be designed with local expansion modules on either side of the power supply.

Most Compact I/O modules have power supply distance rating values that allow you to install them in any slot on either side of the power supply in additional banks. Some Compact I/O modules have power supply distance ratings that affect where you can install them in the CompactLogix 5370 L3 control system.

For example, the 1769-ASCII Compact ASCII and 1769-HSC Compact high-speed counter modules each have a power supply distance rating of four. These modules can be installed in local expansion module slots one through three.

In this case, you must install the 1769-ASCII module and 1769-HSC high-speed counter module with no more three Compact I/O modules between the module and the power, regardless of whether the modules are installed to the left or right of the power supply.

This graphic shows 1769-HSC high-speed counter modules installed in a 1769-L36ERM control system and meeting the module's power supply distance rating.



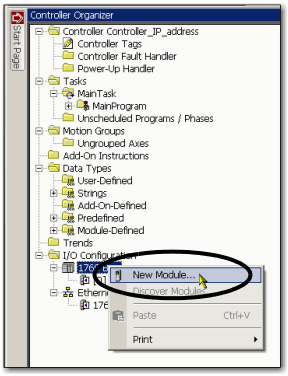

**IMPORTANT** The previous table shows example systems with 1769-HSC high-speed counter modules in each control system because it has a power supply distance rating of four and cannot be installed as far from the Compact I/O power supply. Most Compact I/O modules have power supply distance ratings that allow you to install them anywhere in the local expansion slots of a CompactLogix 5370 L2 control system.

For more information about the power supply distance rating for a Compact I/O module, see CompactLogix Selection Guide, publication 1769-SG001.

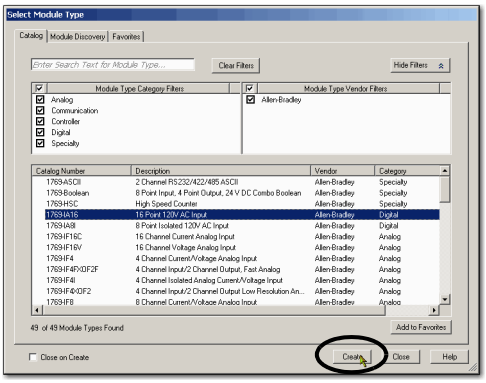
## Configure I/O

Complete these steps to add a Compact I/O module to your CompactLogix 5370 L3 control system and configure it.

1. Right-click the 1769 Bus and choose New Module.

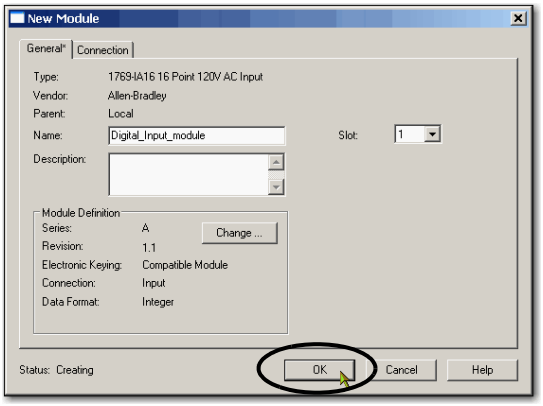



2. Select the desired I/O module and click Create.




The New Module dialog box appears.

3. Configure the new I/O module as necessary and click OK.



## Common Configuration Parameters

While the configuration options vary from module to module, there are some common options you typically configure when using Compact I/O modules in a CompactLogix 5370 L3 control system, as described in Table 34.

**Table 34 - Common Configuration Parameters**

| Configuration Option | Description |
|---|---|
| Requested packet interval (RPI) | The RPI specifies the interval at which data is transmitted or received over a connection. For 1769 Compact Local I/O modules, data is transmitted to the controller at the RPI.<br>When scanned on the local bus or over an EtherNet/IP network, input modules are scanned at the RPI specified in the module configuration. Typically, you configure an RPI in milliseconds (ms). For I/O modules, the range is 0.5…750 ms.<br>When scanned over a DeviceNet network, distributed input modules are scanned at the rate supported by the DeviceNet adapter module connecting the input modules to the network. For example, the scan rate for distributed 1734 POINT I/O over DeviceNet can occur only as quickly as the 1734-ADN DeviceNet adapter can transmit the data. |
| Module definition | Set of configuration parameters that affect data transmission between the controller and the I/O module. The parameters include the following:<br>• Series - Module's hardware series.<br>• Revision - Major and minor firmware revision levels used on the module.<br>• Electronic keying - See page 254.<br>• Connection - Type of connection between the controller writing the configuration and the I/O module, such as Output.<br>• Data format - Type of data transferred between the controller and I/O module and what tags are generated when the configuration is complete. |
| Module Fault on Controller If Connection Fails While in Run Mode | This option determines how the controller is affected if the connection to an I/O module fails in Run mode. You can configure the project so that a connection failure causes a major fault on the controller or not.<br>The default setting is for the option to be enable, that is, if the connection to an I/O module fails in Run mode, a major fault will occur on the controller. |

## I/O Connections

A Logix5000 system uses connections to transmit I/O data, as described in Table 35.

**Table 35 - I/O Module Connections**

| Connection | Description |
|---|---|
| Direct | A direct connection is a real-time, data-transfer link between the controller and an I/O module. The controller maintains and monitors the connection. Any break in the connection, such as a module fault, causes the controller to set fault status bits in the data area associated with the module.<br>Typically, analog I/O modules, diagnostic I/O modules, and specialty modules require direct connections. |
| Rack-optimized | For digital I/O modules, you can select rack-optimized communication.<br>This option is used with distributed I/O modules and the Rack Optimization connection selection is made when configuring the remote adapter. For example, if you want to use a rack-optimized connection with digital I/O modules in a remote 1734 POINT I/O system, you configure the 1734-AENT(R) module to use a connection type of Rack Optimization.<br>A rack-optimized connection consolidates connection usage between the controller and all the digital I/O modules in a remote chassis or on a single DIN rail. Rather than having individual, direct connections for each I/O module, there is one connection for the entire rack (or DIN rail). |

## Electronic Keying

The electronic keying feature automatically compares the expected module, as shown in the I/O Configuration tree, to the physical module before I/O communication begins. You can use electronic keying to help prevent communication to a module that does not match the type and revision expected.

For each module in the I/O Configuration tree, the user-selected keying option determines if, and how, an electronic keying check is performed. Typically, three keying options are available:

- Exact Match
- Compatible Keying
- Disable Keying

You must carefully consider the benefits and implications of each keying option when selecting between them. For some specific module types, fewer options are available.

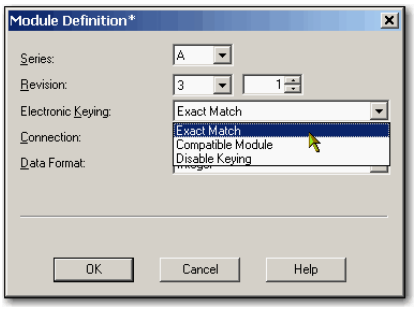
Electronic keying is based on a set of attributes unique to each product revision. When a Logix5000 controller begins communicating with a module, this set of keying attributes is considered.

**Table 36 - Keying Attributes**

| Attribute | Description |
|---|---|
| Vendor | The manufacturer of the module, for example, Rockwell Automation/Allen-Bradley. |
| Product Type | The general type of the module, for example, communication adapter, AC drive, or digital I/O. |
| Product Code | The specific type of module, generally represented by its catalog number, for example, 1769-OB32. |
| Major Revision | A number that represents the functional capabilities and data exchange formats of the module. Typically, although not always, a later, that is higher, Major Revision supports at least all of the data formats supported by an earlier, that is lower, Major Revision of the same catalog number and, possibly, additional ones. |
| Minor Revision | A number that indicates the module's specific firmware revision. Minor Revisions typically do not impact data compatibility but may indicate performance or behavior improvement. |

You can find revision information on the General tab of a module's Properties dialog box.

**Figure 38 - General Tab**




**IMPORTANT** Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

## Exact Match

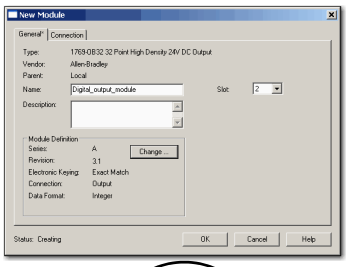
Exact Match keying requires all keying attributes, that is, Vendor, Product Type, Product Code (catalog number), Major Revision, and Minor Revision, of the physical module and the module created in the software to match precisely to establish communication. If any attribute does not match precisely, I/O communication is not permitted with the module or with modules connected through it, as in the case of a communication module.

Use Exact Match keying when you need the system to verify that the module revisions in use are exactly as specified in the project, such as for use in highly-regulated industries. Exact Match keying is also necessary to enable Automatic Firmware Update for the module via the Firmware Supervisor feature from a Logix5000 controller.

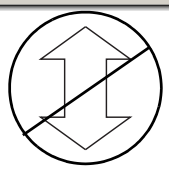
**EXAMPLE** In this scenario, **Exact Match keying prevents I/O communication**.

The module configuration is for a 1769-OB32 module with module revision 3.1. The physical module is a 1769-OB32 module with module revision 3.2. In this case, communication is prevented because the Minor Revision of the module does not match precisely.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OB32
Major Revision = 3
**Minor Revision = 1**

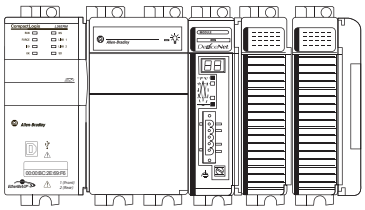



Communication is prevented.



Physical Module

Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OB32
Major Revision = 3
**Minor Revision = 2**



**IMPORTANT** Changing electronic keying selections online may cause the I/O Communication connection to the module to be disrupted and may result in a loss of data.

## Compatible Keying

Compatible Keying indicates that the module determines whether to accept or reject communication. Different module families, communication adapters, and module types implement the compatibility check differently based on the family capabilities and on prior knowledge of compatible products. Release notes for individual modules indicate the specific compatibility details.

Compatible Keying is the default setting. Compatible Keying allows the physical module to accept the key of the module configured in the software, provided that the configured module is one the physical module is capable of emulating. The exact level of emulation required is product and revision specific.

With Compatible Keying, you can replace a module of a certain Major Revision with one of the same catalog number and the same or later, that is higher, Major Revision. In some cases, the selection makes it possible to use a replacement that is a different catalog number than the original.

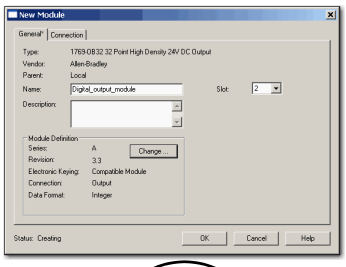
When a module is created, the module developers consider the module's development history to implement capabilities that emulate those of the previous module. However, the developers cannot know future developments. Because of this, when a system is configured, we recommend that you configure your module using the earliest, that is, lowest, revision of the physical module that you believe will be used in the system. By doing this, you can avoid the case of a physical module rejecting the keying request because it is an earlier revision than the one configured in the software.

**EXAMPLE**

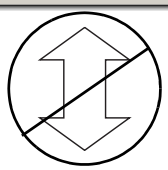
In this scenario, **Compatible Keying prevents I/O communication**:

The module configuration is for a 1769-OB32 module with module revision 3.3. The physical module is a 1769-OB32 module with module revision 3.2. In this case, communication is prevented because the minor revision of the module is lower than expected and may not be compatible with 3.3.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OB32
Major Revision = 3
**Minor Revision = 3**

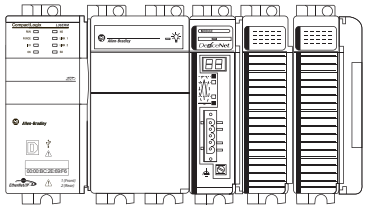



Communication is prevented.



Physical Module

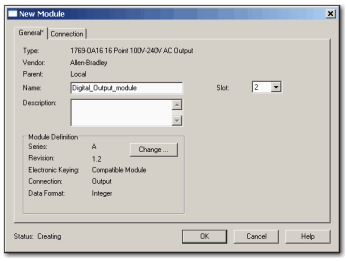
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OB32
Major Revision = 3
**Minor Revision = 2**



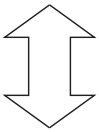
**EXAMPLE** In this scenario, **Compatible Keying allows I/O communication**:

The module configuration is for a 1769-OA16 module with module revision 1.2. The physical module is a 1769-OA16 module with module revision 3.2. In this case, communication is allowed because the major revision of the physical module is higher than expected and the module determines that it is compatible with the prior major revision.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OA16
**Major Revision = 1**
**Minor Revision = 2**

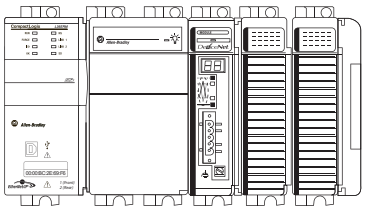



Communication is allowed.



Physical Module

Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OA16
**Major Revision = 3**
**Minor Revision = 2**



**IMPORTANT** Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

## Disabled Keying

Disabled Keying indicates the keying attributes are not considered when attempting to communicate with a module. Other attributes, such as data size and format, are considered and must be acceptable before I/O communication is established. With Disabled Keying, I/O communication may occur with a module other than the type specified in the I/O Configuration tree with unpredictable results. We generally do not recommend using Disabled Keying.

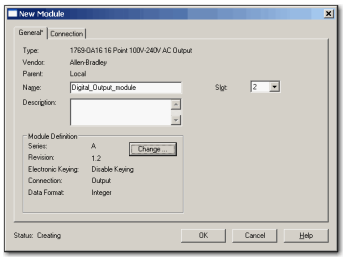
**ATTENTION:** Be extremely cautious when using Disabled Keying; if used incorrectly, this option can lead to personal injury or death, property damage, or economic loss.

If you use Disabled Keying, you must take full responsibility for understanding whether the module being used can fulfill the functional requirements of the application.

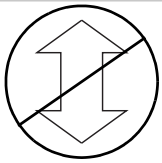
**EXAMPLE** In this scenario, **Disable Keying prevents I/O communication**:

The module configuration is for a 1769-OA16 digital output module. The physical module is a 1769-IT6 analog input module. In this case, communication is prevented because the analog module rejects the data formats that the digital module configuration requests.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
**Catalog Number = 1769-OA16**
Major Revision = 1
Minor Revision = 2

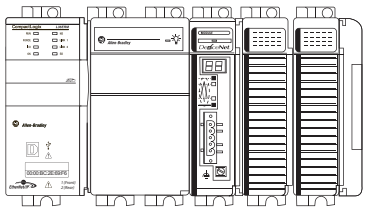



Communication is prevented.



Physical Module

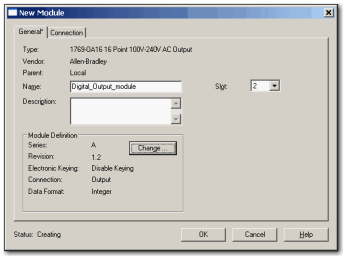
Vendor = Allen-Bradley
Product Type = Digital Output Module
**Catalog Number = 1769-IT6**
Major Revision = 3
Minor Revision = 2



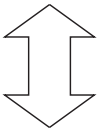
**EXAMPLE** In this scenario, **Disable Keying allows I/O communication**:

The module configuration is for a 1769-OA16 module. The physical module is a 1769-OB16 module. In this case, communication is allowed because the two digital modules share common data formats.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OA16
Major Revision = 1
Minor Revision = 2

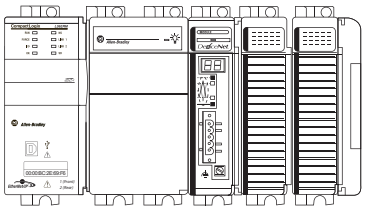



Communication is allowed.



Physical Module

Vendor = Allen-Bradley
Product Type = Digital Output Module
Catalog Number = 1769-OB16
Major Revision = 3
Minor Revision = 2



**IMPORTANT** Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

# Configure Distributed I/O Modules on an EtherNet/IP Network

Your CompactLogix 5370 L3 control system can use distributed I/O modules on an EtherNet/IP network.

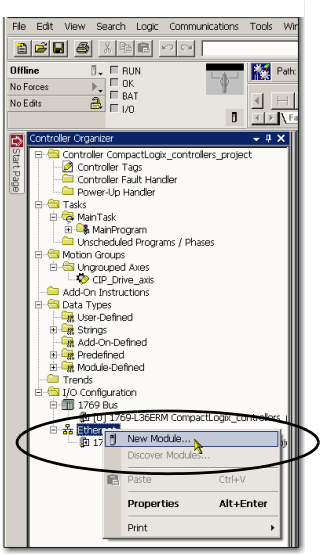
**IMPORTANT** When adding distributed I/O modules, remember to count the remote Ethernet adapter to remain within the maximum number of EtherNet/IP network nodes limitation for your specific controller.

The remote I/O modules connected to the controller via the Ethernet adapter are not counted toward the maximum Ethernet node limit for the controller.

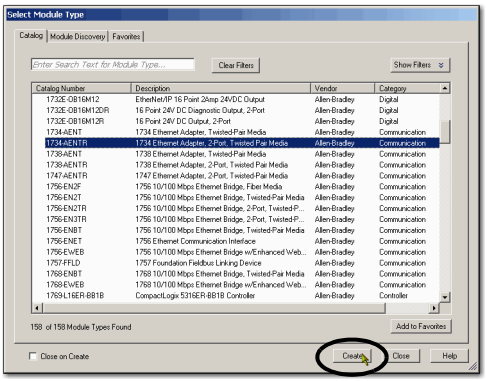
For more information on node limitations, see Nodes on an EtherNet/IP Network on page 118.

Complete these steps to configure distributed I/O modules on an EtherNet/IP network.

1. Right-click Ethernet and choose New Module.

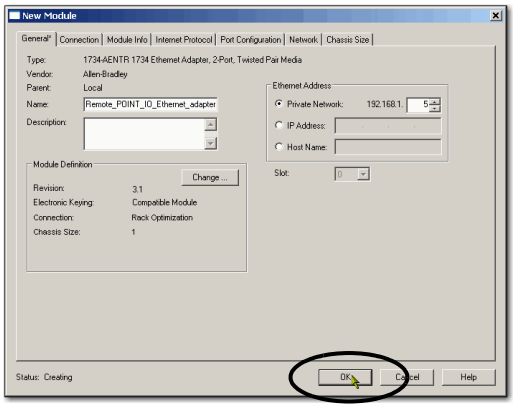



2. Select the desired Ethernet adapter and click Create.

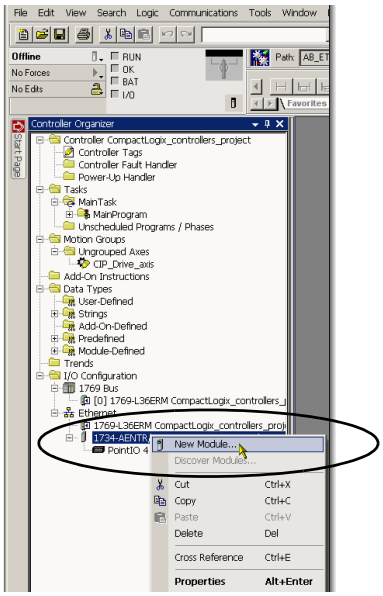



The New Module dialog box appears.

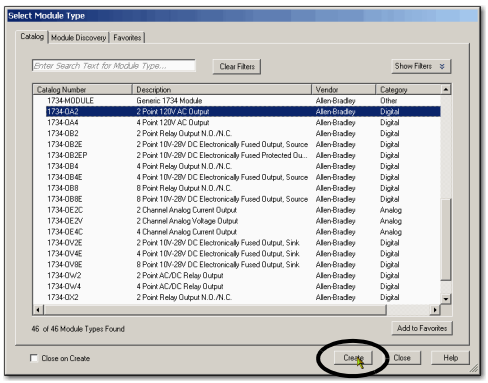
3. Configure the new Ethernet adapter as necessary and click OK.




4. Right-click the new adapter and choose New Module.

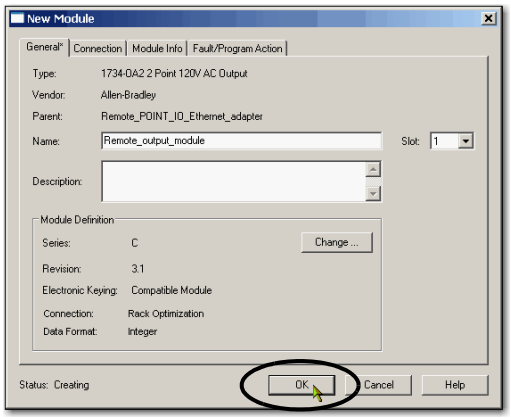



5. Select the desired I/O module and click Create.



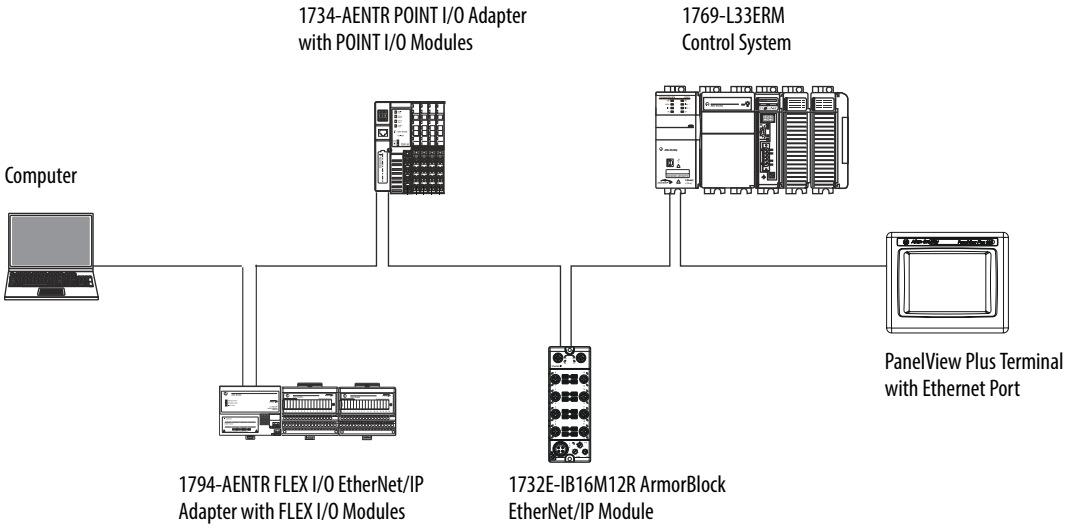

The New Module dialog box appears.

6. Configure the new I/O module as necessary and click OK.




7. Repeat these steps to add all the desired distributed I/O modules.

The following graphic is an example of a 1769-L33ERM control system that uses distributed I/O modules over an EtherNet/IP network.

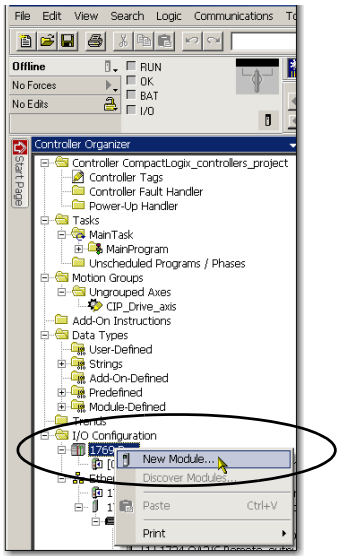


## Configure Distributed I/O Modules on a DeviceNet Network

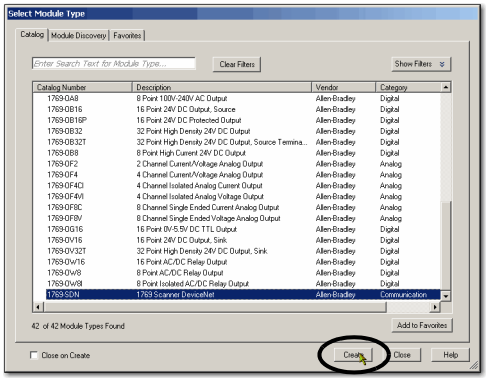
Your CompactLogix 5370 L3 control system can use distributed I/O modules on a DeviceNet network.

Complete these steps to configure distributed I/O modules on a DeviceNet network.

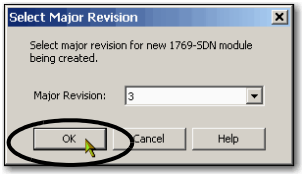
1. If you have not done so already, install a 1769-SDN Compact I/O DeviceNet scanner module into the local bank of your CompactLogix CompactLogix 5370 L3 control system.
2. Right-click 1769 Bus and choose New Module.




3. Select the 1769-SDN scanner module and click Create.

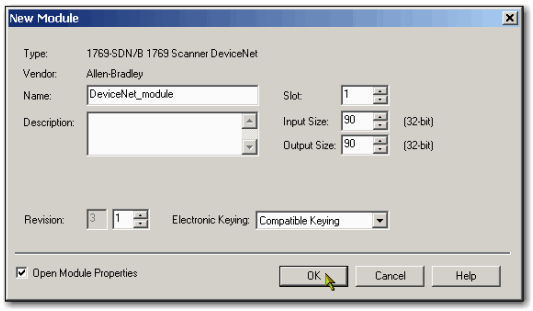



4. Choose a Major Revision and click OK.



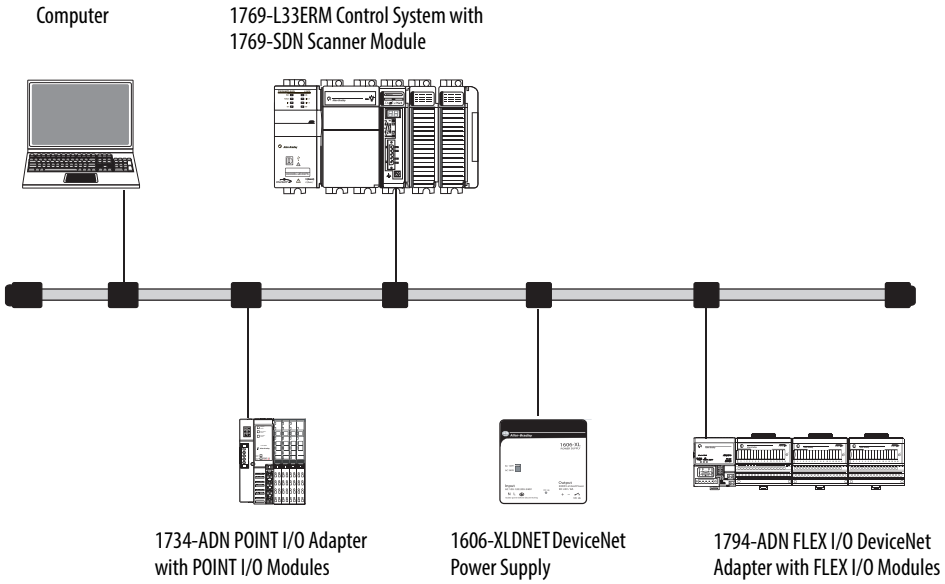

The New Module dialog box appears.

5. Configure the new 1769-SDN scanner module as necessary and click OK.




6. Use RSNetWorx for DeviceNet software to define the scanlist in the 1769-SDN scanner module to communicate data between the devices and the controller through the scanner module.

The following graphic is an example of a 1769-L33ERM control system that uses distributed I/O modules on a DeviceNet network.

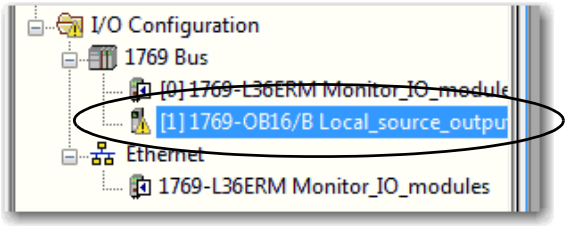


## Monitor I/O Modules

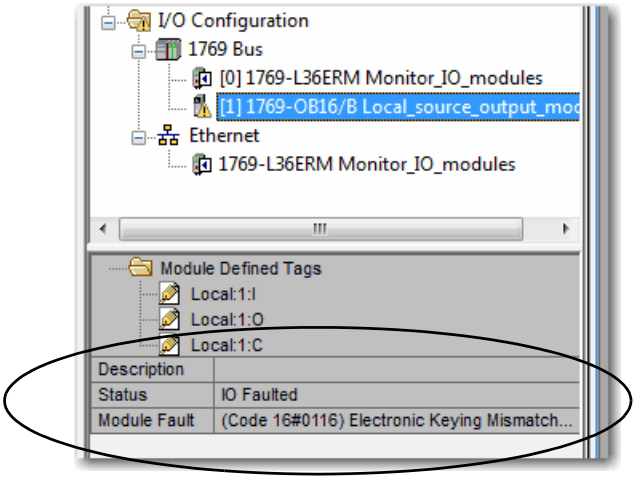
With CompactLogix 5370 L3 controllers, you can monitor I/O modules in the following ways:

- Quick View Pane below the Controller Organizer
- Connection tab in the Module Properties dialog box
- Programming logic to monitor fault data so you can take appropriate action.

When a fault occurs on an I/O module, a yellow triangle on the module's appearance in the Controller Organizer alerts you to the fault.

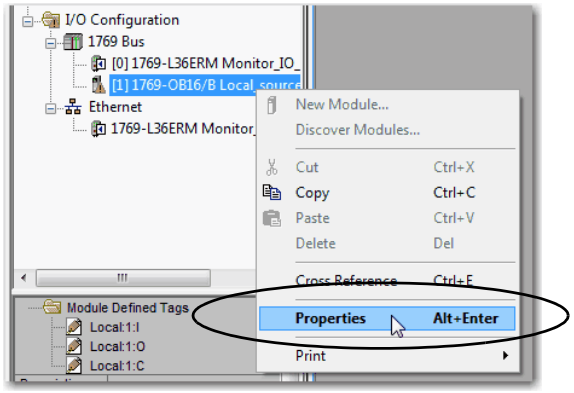



The following graphic shows the **Quick View Pane** indicating the type of fault.

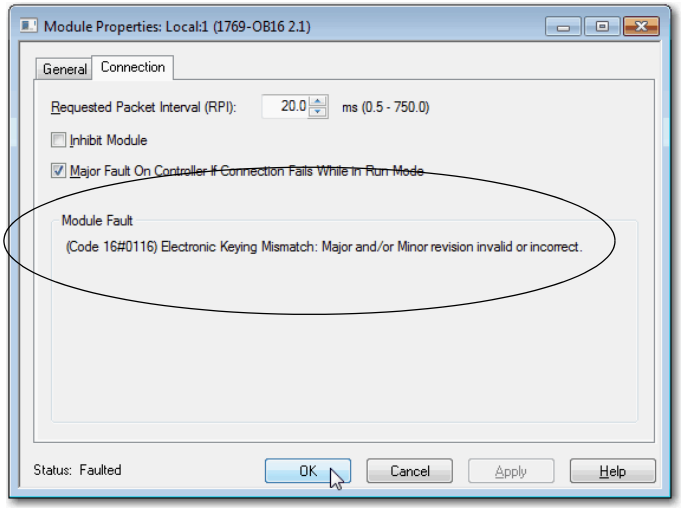


To see the fault description on the **Connection tab** in Module Properties dialog box, complete these steps.

1. In the I/O Configuration, right-click the faulted I/O module and choose Properties.




2. Click the Connection tab and use the fault description, in the Module Fault section, to diagnose the issue.




3. Click OK to close the dialog box and remedy the issue.

## End-cap Detection and Module Faults

End-cap detection is performed through the last module on a 1769 Bus. If that module experiences a fault such that it cannot communicate on the 1769 Bus, the following events occur:

- End-cap detection fails
- Controller faults

# Develop Applications


| Topic | Page |
|---|---|
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| Tasks | 268 |
| Programs | 272 |
| Routines | 274 |
| Tags | 275 |
| Programming Languages | 278 |
| Add-On Instructions | 279 |
| Monitoring Controller Status | 280 |
| Monitoring I/O Connections | 281 |
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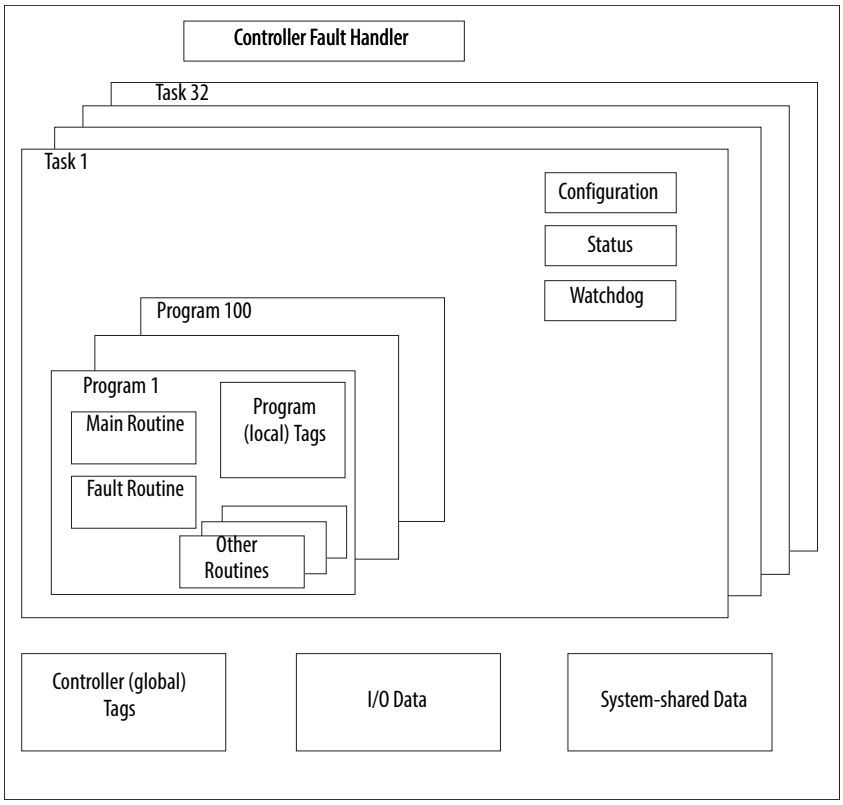
## Elements of a Control Application

A control application is comprised of several elements that require planning for efficient application execution. Application elements include the following:

- Tasks
- Programs
- Routines
- Tags

**Figure 39 - Elements of a Control Program**




## Tasks

A Logix5000 controller lets you use multiple tasks to schedule and prioritize the execution of your programs based on specific criteria. This multitasking allocates the controller's processing time among the different operations in your application:

- The controller executes only one task at a time.
- One task can interrupt another's execution and take control.
- In any given task, multiple programs may be used. However, only one program executes at a time.

**Figure 40 - Task in a Control Application**

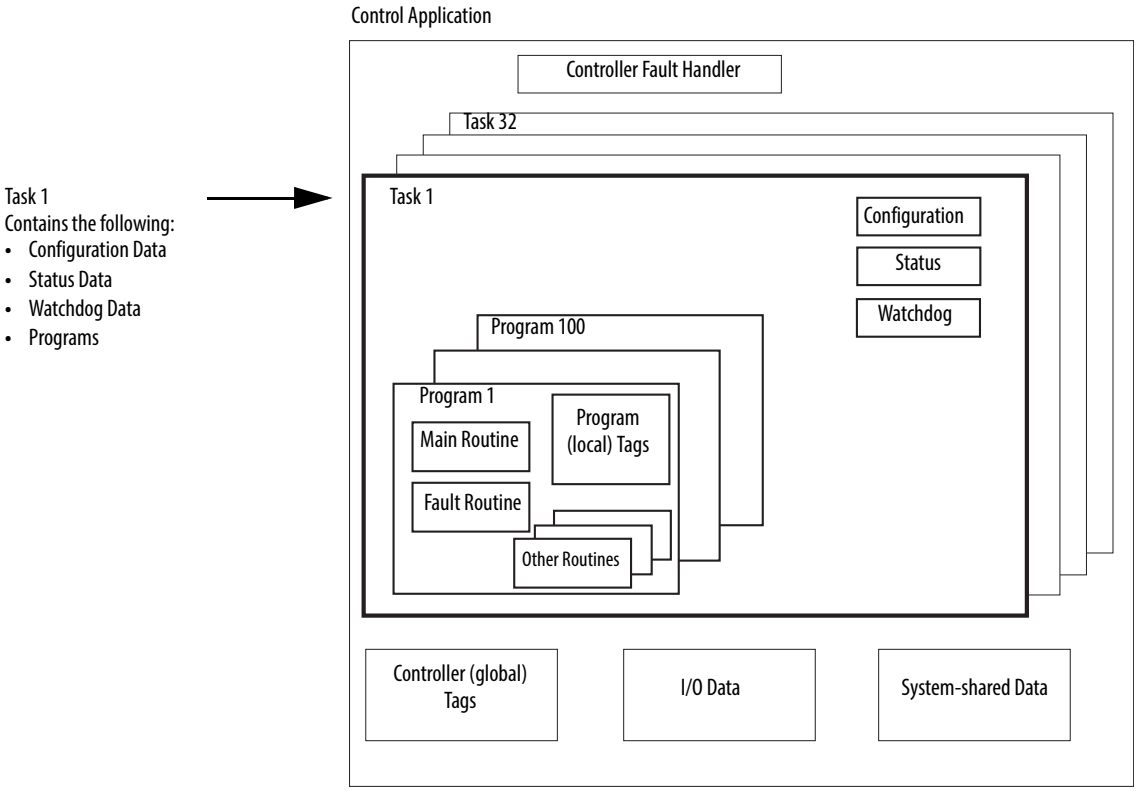
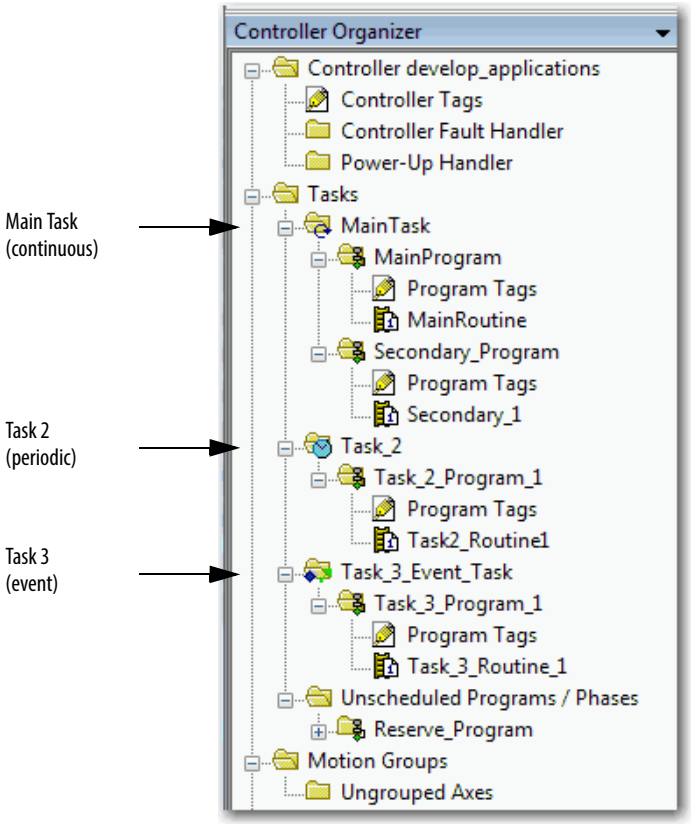
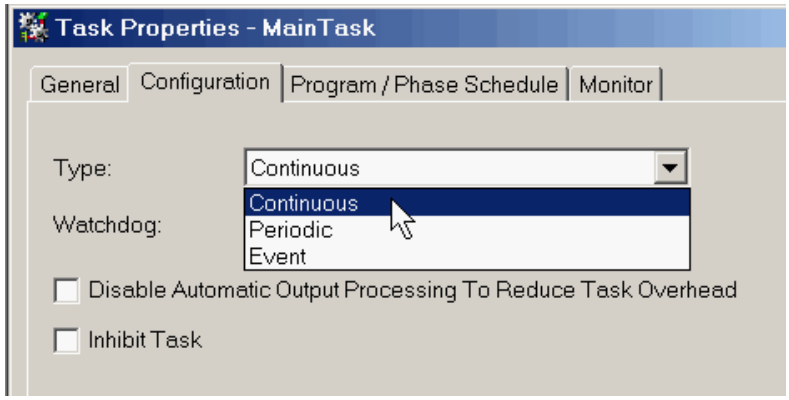



**Figure 41 - Tasks in Application**



A task provides scheduling and priority information for a set of one or more programs. Configure tasks as continuous, periodic, or event by using the Task Properties dialog box.

**Figure 42 - Configuring the Task Type**




This table explains the types of tasks you can configure.

**Table 37 - Task Types and Execution Frequency**

| Task Type | Task Execution | Description |
|---|---|---|
| Continuous | All of the time | The continuous task runs in the background. Any CPU time not allocated to other operations (such as motion, communication, and other tasks) is used to execute the programs in the continuous task:<br>• The continuous task runs constantly. When the continuous task completes a full scan, it restarts immediately.<br>• A project does not require a continuous task. If used, there can be only one continuous task. |
| Periodic | • At a set interval, such as every 100 ms<br>• Multiple times in the scan of your other logic | A periodic task performs a function at a specific interval:<br>• Whenever the time for the periodic task expires, the task interrupts any lower priority tasks, executes once, and then returns control to where the previous task left off.<br>• You can configure the time period from 0.1...2,000,000.00 ms. The default is 10 ms. It is also controller and configuration dependent.<br>• The performance of a periodic task depends on the type of Logix5000 controller and on the logic in the task.<br>• The periodic task processes I/O data for CompactLogix, FlexLogix, DriveLogix, and SoftLogix controllers with the following considerations:<br>– For CompactLogix, FlexLogix, and DriveLogix controllers, operates at priority 6<br>– For SoftLogix controllers, operates at Windows priority 16 (Idle)<br>– Higher-priority tasks take precedence over the I/O task and can impact processing<br>– Executes at the fastest RPI you have scheduled for the system<br>– Executes for as long as it takes to scan the configured I/O modules |
| Event | Immediately when an event occurs | An Event task performs a function only when a specific event (trigger) occurs. The trigger for the Event task can be the following:<br>• A consumed tag trigger<br>• An EVENT instruction<br>• An axis trigger<br>• A motion event trigger<br>• Module input data state change<br>**IMPORTANT**: With Logix Designer application, version 21.00.00 or later, you can use this trigger with 1756 ControlLogix, 1789 SoftLogix, and CompactLogix 5370 L1 applications. |

The CompactLogix controller supports up to 32 tasks, only one of which can be continuous.

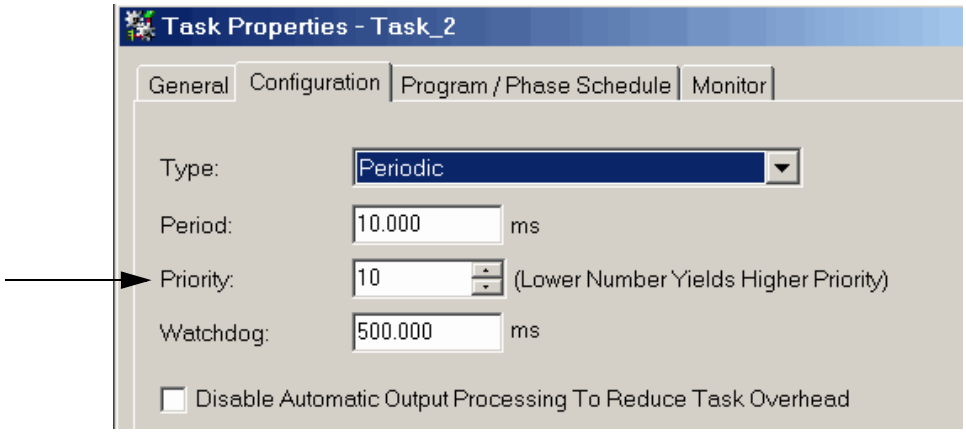
A task can have up to 100 separate Programs per task, each with its own executable routines and program-scoped tags. Once a task is triggered (activated), all of the programs assigned to the task execute in the order in which they are grouped. Programs can appear only once in the Controller Organizer and cannot be shared by multiple tasks.

## Task Priority

Each task in the controller has a priority level. The operating system uses the priority level to determine which task to execute when multiple tasks are triggered. A higher priority task will interrupt any lower priority task. The continuous task has the lowest priority and is always interrupted by a periodic or event task.

You can configure periodic tasks to execute from the lowest priority of 15 up to the highest priority of 1. Configure the task priority using the Task Properties dialog box.

**Figure 43 - Configure Task Priority**



## Programs

The controller operating system is a preemptive multitasking system that is IEC 1131-3 compliant. This system provides the following:

- Programs to group data and logic
- Routines to encapsulate executable code written in a single programming language

Each program contains the following:

- Program tags
- A main executable routine
- Other routines
- An optional fault routine

**Figure 44 - Program in a Control Application**

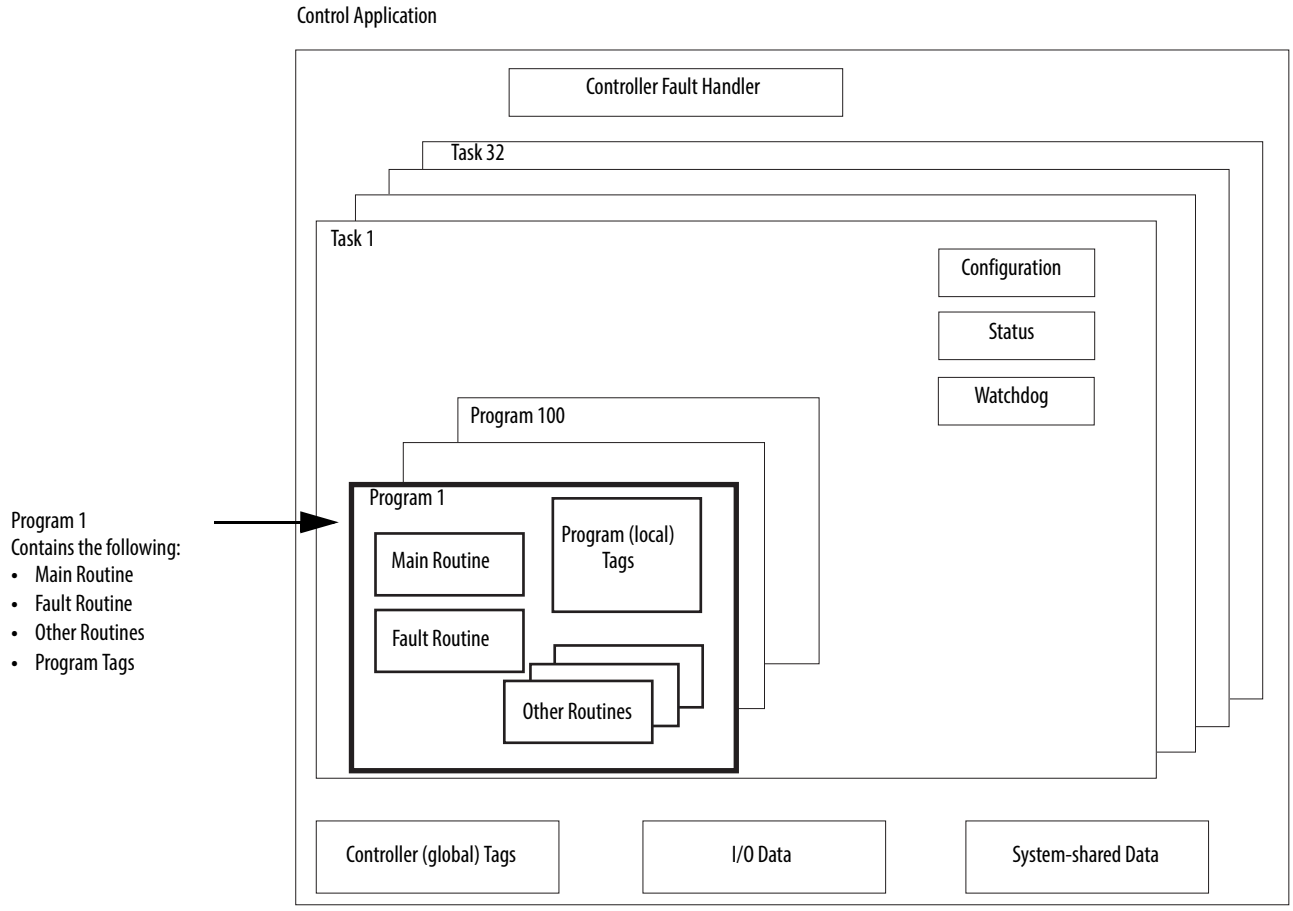
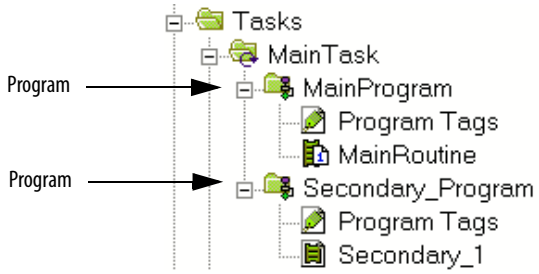



**Figure 45 - Programs in Application**



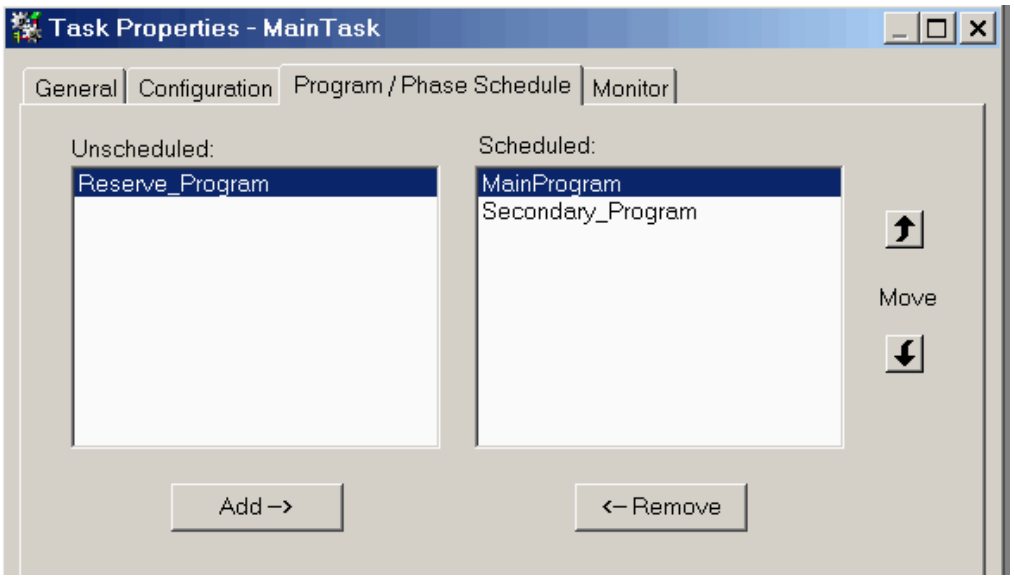
## Scheduled and Unscheduled Programs

The scheduled programs in a task execute to completion from first to last. Programs that aren't attached to any task show up as unscheduled programs.

Unscheduled programs in a task are downloaded to the controller with the entire project. The controller verifies unscheduled programs but does not execute them.

You must schedule a program in a task before the controller can scan the program. To schedule an unscheduled program, use the Program/Phase Schedule tab of the Task Properties dialog box.

**Figure 46 - Scheduling an Unscheduled Program**



## Routines

A routine is a set of logic instructions in a single programming language, such as Ladder Diagram (ladder logic). Routines provide the executable code for the project in a controller. A routine is similar to a program file or subroutine in a PLC or SLC™ processor.

Each program has a main routine. This is the first routine to execute when the controller triggers the associated task and calls the associated program. Use logic, such as the Jump to Subroutine (JSR) instruction, to call other routines.

You can also specify an optional program fault routine. The controller executes this routine if it encounters an instruction-execution fault in any of the routines in the associated program.

**Figure 47 - Routines in a Control Application**

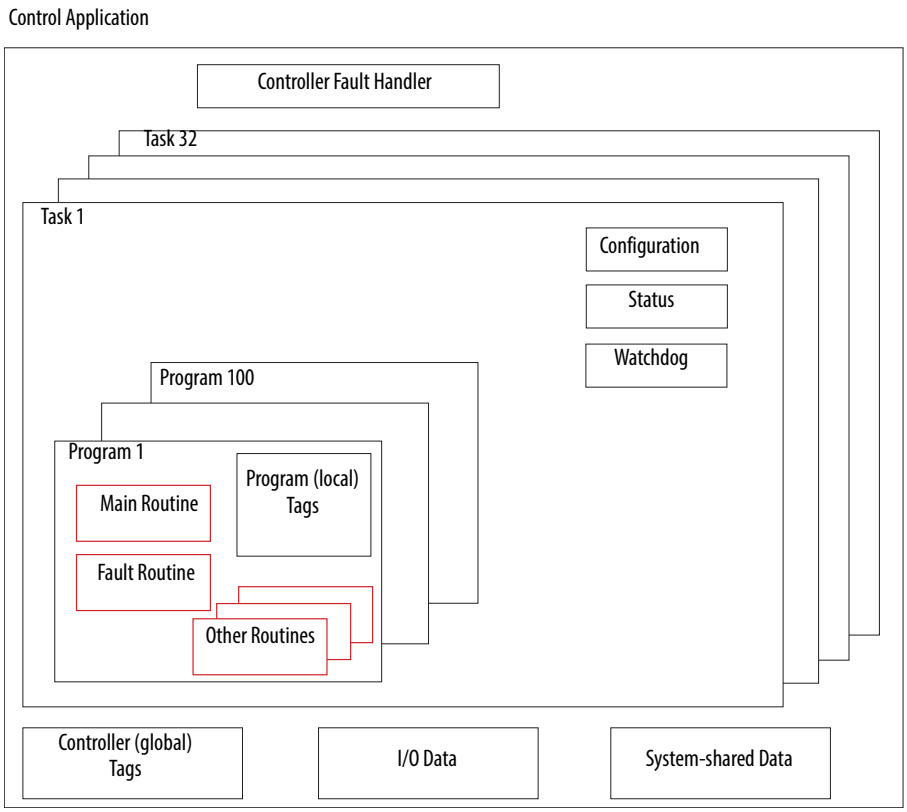
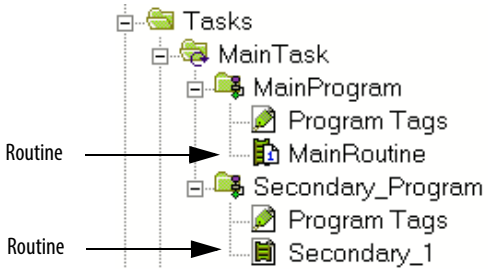



**Figure 48 - Routines in Application**



# Tags

With a Logix5000 controller, you use a tag (alphanumeric name) to address data (variables). In Logix5000 controllers, there is no fixed, numeric format. For example, as shown below, you can use the tag name **north_tank_mix** instead of a numeric format, such as N7:0.0.

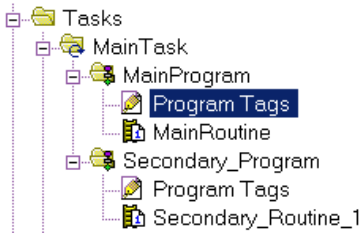
The tag name itself identifies the data. This lets you do the following:

- Organize your data to mirror your machinery.
- Document your application as you develop it.

This example shows data tags created in the scope of the Main Program of the controller.

**Figure 49 - Tags Example**

**Controller Organizer - Main Program Tags**




**Program Tags Window - Main Program Tags**

Scope: MainProgram Show: All Tags

| Name | Alias For | Base Tag | Data Type |
|---|---|---|---|
| north_tank_mix | | | BOOL |
| north_tank_pressure | | | REAL |
| north_tank_temp | | | REAL |
| ⊞ one_shots | | | DINT |
| ⊞ recipe | | | TANK[3] |
| ⊞ recipe_number | | | DINT |
| replace_bit | | | BOOL |
| ⊞ running_hours | | | COUNTER |
| ⊞ running_seconds | | | TIMER |
| start | | | BOOL |
| stop | | | BOOL |
| | | | |

Analog I/O Device
Integer Value
Storage Bit
Counter
Timer
Digital I/O Device

There are several guidelines for creating and configuring program tags for optimal task and program execution. For more information, see the Logix5000 Controllers and I/O Tag Data Programming Manual, publication 1756-PM004.

## Extended Properties

The Extended Properties feature lets you define additional information, such as limits, engineering units, or state identifiers, for various components within your controller project.

| Component | Extended Properties |
|---|---|
| Tag | In the Tag Editor, add extended properties to a tag. |
| User-defined data type | In the Data Type Editor, add extended properties to data types. |
| Add-On Instructions | In the properties associated with the Add-On Instruction definition, add extended properties to Add-On Instructions. |

Pass-through behavior is the ability to assign extended properties at a higher level of a structure or Add-On Instruction and have that extended property automatically available for all members. Pass-through behavior is available for descriptions, state identifiers, and engineering units and is user configurable. Configure pass-through behavior on the Project tab of the Controller Properties dialog box. If you choose not to show pass-through properties, then only extended properties that have been configured for a given component are displayed.

Pass-through behavior is **not** available for limits. When an instance of a tag is created, if limits are associated with the data type, the instance is copied.

You need to know which tags have limits associated with them as there is no indication in the tag browser that extended properties are defined for a tag. If, however, you try to use extended properties that have not been defined for a tag, the editors show a visual indication and the routine does not verify.

## Access Extended Properties in Logic

You can access limits defined on tags by using the .@Min and .@Max syntax:

- You cannot write to extended properties values in logic.
- To use extended tag properties in an Add-On Instruction, you must pass them in as input operands to the Add-On Instruction.
- Aliases to tags that have extended properties cannot access the extended properties in logic.
- Limits can be configured for input and output parameters in Add-On Instructions. However, limits cannot be defined on an InOut parameter of an Add-On Instruction.
- Limits cannot be accessed inside Add-On Instruction logic. Limits are for use by HMI applications only.

If an array tag is using indirect addressing to access limits in logic, the following conditions apply:

- If the array tag has limits configured, the extended properties are applied to any array element that does not explicitly have that particular extended property configured. For example, if the array tag MyArray has Max configured to 100, then any element of the array that does not have Max configured inherits the value of 100 when being used in logic. However, it will not be visible to you that the value inherited from MyArray is configured in the tag properties.
- At least one array element must have a limit configured for indirectly referenced array logic to verify. For example, if MyArray[x].@Max is being used in logic, at least one array element of MyArray[] must have Max extended property configured if Max is not configured by MyArray.
- Under the following circumstances a data type default value is used:
  - Array is accessed programmatically with indirect reference.
  - Array tag does not have the extended property configured.
  - A member of an array does not have the extended property configured.

  For example, for an array of SINT type, when max limit is called in logic for a member, the value 127 will be used.

If an array element is directly accessed, the element has to have the extended property defined. If not, verification will fail.

## Programming Languages

The CompactLogix controller supports these programming languages, both online and offline.

**Table 38 - CompactLogix Controller Programming Languages**

| Language | Is best-used in programs with |
|---|---|
| Relay ladder | Continuous or parallel execution of multiple operations (not sequenced) |
| | Boolean or bit-based operations |
| | Complex logical operations |
| | Message and communication processing |
| | Machine interlocking |
| | Operations that service or maintenance personnel may have to interpret in order to troubleshoot the machine or process |
| Function block diagram | Continuous process and drive control |
| | Loop control |
| | Calculations in circuit flow |
| Sequential function chart (SFC) | High-level management of multiple operations |
| | Repetitive sequence of operations |
| | Batch process |
| | Motion control using structured text |
| | State machine operations |
| Structured text | Complex mathematical operations |
| | Specialized array or table loop processing |
| | ASCII string handling or protocol processing |

For information about programming in these languages, see the Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001.

## Add-On Instructions

You can design and configure sets of commonly used instructions to increase project consistency. Similar to the built-in instructions contained in Logix5000 controllers, these instructions you create are called Add-On Instructions. Add-On Instructions reuse common control algorithms. With them, you can do the following:

- Ease maintenance by animating logic for a single instance.
- Protect intellectual property with Source Protection.
- Reduce documentation development time.

You can use Add-On Instructions across multiple projects. You can define your instructions, obtain them from somebody else, or copy them from another project.

This table explains some of the capabilities and advantages of use Add-On Instructions.

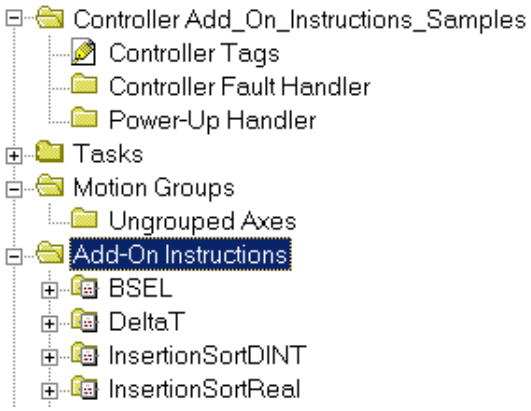
**Table 39 - Add-On Instruction Capabilities**

| Capability | Description |
|---|---|
| Save Time | With Add-On Instructions, you can combine your most commonly used logic into sets of reusable instructions. You save time when you create instructions for your projects and then share them with others. Add-On Instructions increase project consistency because commonly used algorithms all work in the same manner, regardless of who implements the project. |
| Use Standard Editors | You create Add-On Instructions by using one of three editors:<br>• Relay Ladder<br>• Function Block Diagram<br>• Structured Text<br>Once you have created instructions, you can use them in any editor. |
| Export Add-On Instructions | You can export Add-On Instructions to other projects as well as copy and paste them from one project to another. Give each instruction a unique name so that you don't accidentally overwrite another instruction of the same name. |
| Use Context Views | Context views let you visualize an instruction's logic for a specific instant, simplifying online troubleshooting of your Add-On Instructions. Each instruction contains a revision, a change history, and an auto-generated help page. |
| Create Custom Help | When you create an instruction, you enter information for the description fields in dialogs, information that becomes what is known as Custom Help. Custom Help makes it easier for you to get the help you need when implementing the instructions. |
| Apply Source Protection | As the creator of Add-On Instructions, you can limit users of your instructions to read-only access, or you can bar access to the internal logic or local parameters used by the instructions. This source protection lets you prevent unwanted changes to your instructions and protects your intellectual property. |

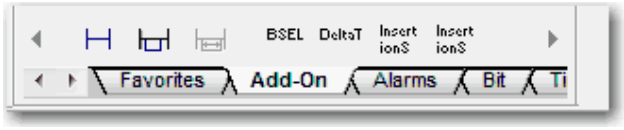
Once defined in a project, Add-On Instructions behave similarly to the built-in instructions in Logix5000 controllers. They appear on the instruction tool bar for easy access, as do internal instructions.

**Figure 50 - Add-On Instructions**

**Controller Organizer**




**Instruction Toolbar**



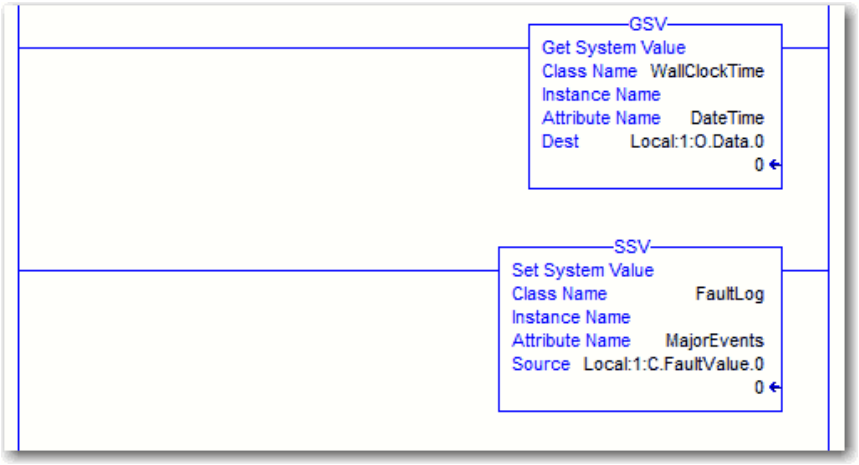

For more information about using Add-On Instructions, see the Add-On Instructions Programming Manual, publication 1756-PM010.

## Monitoring Controller Status

The CompactLogix controller uses Get System Value (GSV) and Set System Value (SSV) instructions to get and set (change) controller data. The controller stores system data in objects. There is no status file, as in the PLC-5® processor.

The GSV instruction retrieves the specified information and places it in the destination. The SSV instruction sets the specified attribute with data from the source. Both instructions are available from the Input/Output tab of the Instruction tool bar.

**Figure 51 - GSV and SSV Instructions for Monitoring**



When you add a GSV/SSV instruction to the program, the valid object classes, object names, and attribute names for each instruction are displayed. For the GSV instruction, you can get values for all the available attributes. For the SSV instruction, only those attributes you are allowed to set are displayed.

Some object types appear repeatedly, so you may have to specify the object name. For example, there can be several tasks in your application. Each task has its own Task object that you access by the task name.

There are several objects and attributes that you can use the GSV and SSV instructions to monitor and set the system. For more information about GSV instructions, SSV instructions, objects, and attributes see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

## Monitoring I/O Connections

If communication with a device in the controller's I/O configuration does not occur in an application-specific period of time, the communication times out and the controller produces warnings.

The minimum timeout period that, once expired without communication, causes a timeout is 100 ms. The timeout period may be greater, depending on the application's RPI. For example, if your application uses the default RPI = 20 ms, the timeout period is 160 ms.

For more information on how to determine the time for your application, see Rockwell Automation Knowledgebase Tech Note 38535. The document is available at http://www.rockwellautomation.com/knowledgebase/.

When a timeout does occur, the controller produces these warnings:

- An I/O fault status code is indicated on the status display of the CompactLogix 5370 controller.
- The I/O status indicator on the front of the CompactLogix 5370 controller flashes green.
- A ⚠ shows over the I/O configuration folder and over the devices that have timed out.
- A module fault code is produced, which you can access via the following:
  - The Module Properties dialog box
  - A GSV instruction

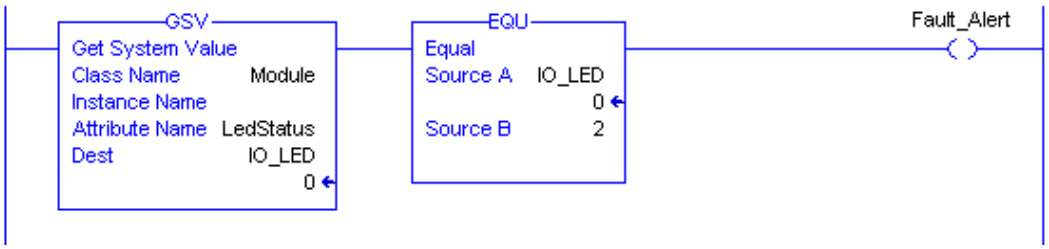
For more information about I/O faults, see the Major, Minor, and I/O Faults Programming Manual, publication 1756-PM014.

## Determine if I/O Communication has Timed Out

This example could be used with the CompactLogix 5370 controllers:

- The GSV instruction gets the status of the I/O status indicator (via the LEDStatus attribute of the Module object) and stores it in the IO_LED tag.
- IO_LED is a DINT tag that stores the status of the I/O status indicator or status display on the front of the controller.
- If IO_LED equals 2, than at least one I/O connection has been lost and the Fault_Alert is set.

**Figure 52 - GSV Used to Identify I/O Timeout**




For more information about attributes available with the Module object, see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

## Determine if I/O Communication to a Specific I/O Module has Timed Out

If communication times out with a device (module) in the I/O configuration of the controller, the controller produces a fault code and fault information for the module. You can use GSV instructions to get fault code and information via the FaultCode and FaultInfo attributes of the Module object.

For more information about attributes available with the Module object, see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

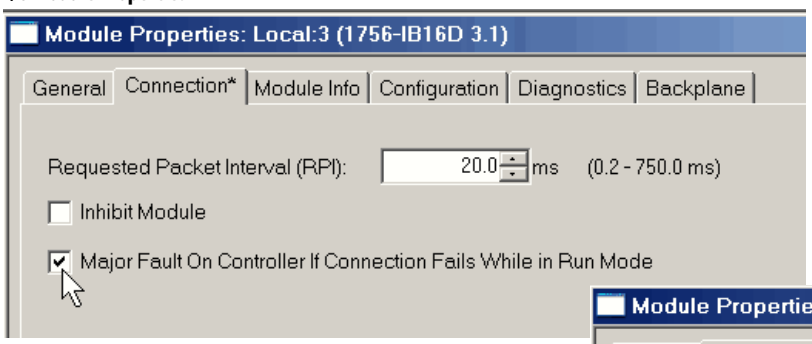
## Interrupt the Execution of Logic and Execute the Fault Handler

Depending on your application, you might want an I/O connection error to cause the Controller Fault Handler to execute. To do so, set the module property that causes a major fault to result from an I/O connection error. The major fault then causes the execution of the Controller Fault Handler.

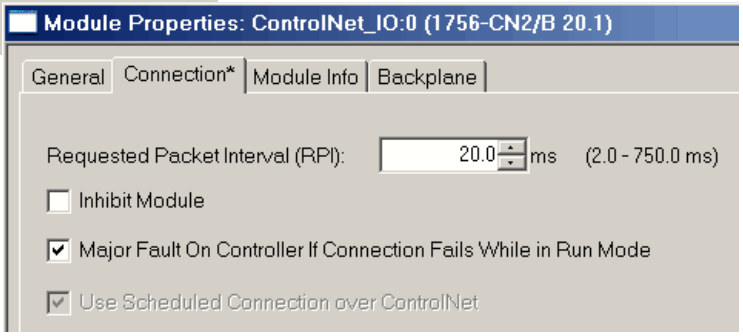
First, develop a routine in the Controller Fault Handler that can respond to I/O connection faults. Then, in the Module Properties dialog box of the I/O module or parent communication module, check Major Fault On Controller If Connection Fails While in Run Mode.

**Figure 53 - I/O Connection Fault Causes Major Fault**

**I/O Module Properties**




**Parent Communication Module Properties**




For more information about programming the Controller Fault Handler, see the Major, Minor, and I/O Faults Programming Manual, publication 1756-PM014.

## System Overhead Time Slice

The controller communicates with other devices at either a specified rate (scheduled) or when there is processing time available to service the communication.

The system overhead time slice specifies the percentage of time a controller devotes to service communication. If you have a continuous task, the System Overhead Time Slice entered in the Advanced tab of the Controller Properties dialog box specifies continuous task/service communication ratio. However, if there is no continuous task, the overhead time slice has no affect.

The table shows the ratio between the continuous task and service communication at various system overhead time slices.

**Table 40 - Ratio between Continuous Task and Service Communication**

| At this time slice | The continuous task runs | Service communication occurs for up to |
|---|---|---|
| 10% | 9 ms | 1 ms |
| 20% | 4 ms | 1 ms |
| 25% | 3 ms | 1 ms |
| 33% | 2 ms | 1 ms |
| 50% | 1 ms | 1 ms |
| 66% | 1 ms | 2 ms |
| 75% | 1 ms | 3 ms |
| 80% | 1 ms | 4 ms |
| 90% | 1 ms | 9 ms |

As shown in Table 40, if the system overhead time slice is less than or equal to 50%, the duration stays fixed at 1 ms. The same applies for 66% and higher, except there are multiple 1 ms intervals. For example, at 66% there are two 1 ms intervals of consecutive time and at 90% there are nine 1 ms intervals of consecutive time.

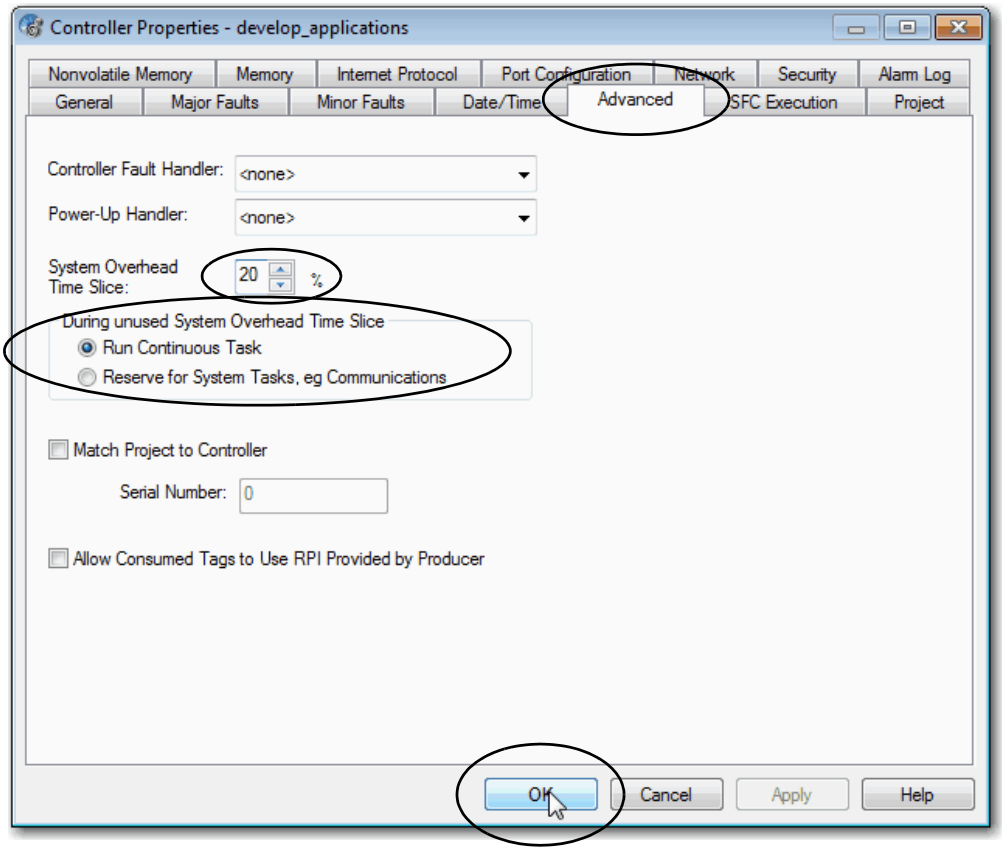
## Configure the System Overhead Time Slice

To configure the system overhead time slice, perform this procedure.

1. In the Controller Organizer, right-click the controller and choose Properties.

   The Controller Properties dialog box appears.

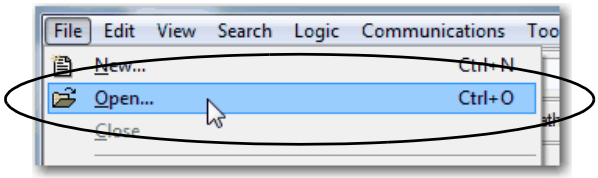
2. Click the Advanced tab.
3. Enter a numeric value in the System Overhead Time Slice box.
4. Use either Run Continuous Task (default) or Reserve for System Tasks.
   - Click Run Continue Task when there is no communication or background tasks to process; controller immediately returns to the continuous task.
   - Click Reserve for System Task to allocates the entire 1 ms of the system overhead time slice whether the controller has communication or background tasks to perform before returning back to the continuous task. This lets you simulate a communication load on the controller during design and programming before HMIs, controller to controller messaging, and so forth, are set up.
5. Click OK.



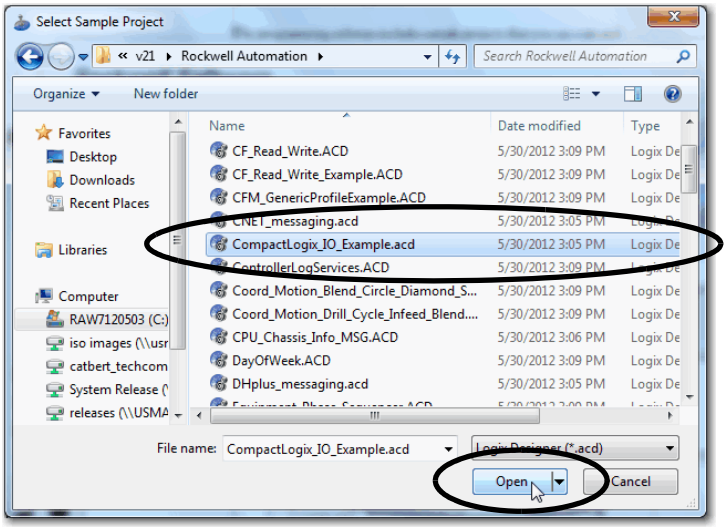
## Sample Controller Projects

The application includes sample projects that you can copy and modify to fit your application. To access the sample projects, complete these steps.

1. From the File menu, choose Open.




2. Browse to the sample projects list and select a sample project.
3. Click Open.



## Additional Resources

These documents contain additional information concerning products from Rockwell Automation.

| Resource | Description |
|---|---|
| Logix5000 Controllers and I/O Tag Data Programming Manual, publication 1756-PM004 | Explains procedures for using and organizing I/O data tags. |
| Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001 | Guides all user levels in developing projects for Logix5000 controllers and provides links to individual guides for information on topics such as import/export, messages, security, and programming in different languages. |
| Add-On Instructions Programming Manual, publication 1756-PM010 | Explains Add-On Instructions and how to use them. |
| Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003 | Provides details about instructions for programming a Logix5000 controller. |
| Major, Minor, and I/O Faults Programming Manual, publication 1756-PM014 | Explains major, minor, and I/O faults as well as the Controller Fault Handler. |
| Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094 | Provides advanced users with guidelines for system optimization and with system information to guide system design choices. |
| Logix5000 Controllers Execution Time and Memory Use Reference Manual, publication 1756-RM087 | Assists in estimating the memory use and execution time of programmed logic and in selecting among different programming options. |

You can view or download publications at http://www.rockwellautomation.com/literature. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

## Notes:

# Develop Integrated Motion over an EtherNet/IP Network Applications


| Topic | Page |
|---|---|
| Motion Axes Support | 290 |
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| Time Synchronization | 292 |
| Configure Integrated Motion on the EtherNet/IP Network | 293 |
| Scalability in Applications Using Integrated Motion on EtherNet/IP Networks | 297 |


Some of the CompactLogix 5370 controllers support Integrated Motion over an EtherNet/IP network, a motion solution on a standard, unmodified EtherNet/IP network with simple design or configuration compared to traditional motion applications.

**IMPORTANT** These CompactLogix 5370 controllers support Integrated Motion over an EtherNet/IP network:

- 1769-L18ERM-BB1B controller
- 1769-L27ERM-QBFC1B controller
- 1769-L30ERM controller
- 1769-L33ERM controller
- 1769-L36ERM controller

Integrated Motion on EtherNet/IP applications use the following:

- Standard EtherNet/IP network
- High performance drives, including the following:
  - Kinetix 350 drives
  - Kinetix 6500 drives
  - PowerFlex 755 drives
- Standard infrastructure components
- Programming software

For a complete description of how to use a CompactLogix 5370 controller in an application that uses Integrated Motion over an EtherNet/IP network, see the CIP Motion Configuration and Startup User Manual, publication MOTION-UM003.

## Motion Axes Support

The 1769-L18ERM-BB1B, 1769-L27ERM-QBFC1B, 1769-L30ERM, 1769-L33ERM, and 1769-L36ERM controllers support these axes:

- AXIS_VIRTUAL
- AXIS_CIP_DRIVE

### AXIS_VIRTUAL Axis

The AXIS_VIRTUAL axis is an internal axis representation that is not associated with any physical drives. That is, you can configure the axis but it does not cause any physical motion in your system.

### AXIS_CIP_DRIVE Axis

The AXIS_CIP_DRIVE axis is a motion axis used with physical drives to cause physical motion in your system as determined by your application.

*Configuration Types*

When adding an axis to your project, you must associate the axis to a drive. Among other configuration parameters, you must select a configuration type. The axis configuration type is also considered the drive configuration type.

For example, an AXIS_CIP_DRIVE axis may use a Position Loop configuration and be associated with a Kinetix 350 drive. The axis is considered a Position Loop-configured axis and the associated drive is considered a Position Loop-configured drive.

The following drives support these configuration types:

- Kinetix 350 and Kinetix 6500 drives
  - Position loop
  - Velocity loop
  - Torque loop
- PowerFlex 755 drive
  - Position loop
  - Velocity loop
  - Torque loop
  - Frequency control

# Maximum Number of Position Loop-configured Drives

The CompactLogix 5370 controllers support a maximum number of EtherNet/IP nodes in a project. Any device added to the local Ethernet node in the I/O configuration is counted toward the controller's node limitation. For more information, see Nodes on an EtherNet/IP Network on page 118.

Drives are counted among the number of nodes in the I/O Configuration section of an RSLogix 5000 project. If you use the maximum number of drives that a 1769-L18ERM-BB1B, 1769-L27ERM-QBFC1B, 1769-L30ERM, 1769-L33ERM, or 1769-L36ERM controller supports in a single system, you cannot add other EtherNet/IP devices to that project.

## Position Loop-configured Drive Limits

Among the maximum number drives supported by the controllers, there is a maximum number of Position Loop-configured drives supported in the controller's project.

For example, the 1769-L30ERM controller supports a maximum of four Position Loop-configured drives.

Table 41 lists motion-related specification information for the controllers that support Integrated Motion over an EtherNet/IP network.

**Table 41 - CompactLogix 5370 Controllers Supporting Integrated Motion on the EtherNet/IP Network**

| Controller Type | Drive Types Supported | Number of Drives Supported, max | Number of Position Loop-configured Drives Supported, max |
|---|---|---|---|
| 1769-L18ERM-BB1B | Kinetix 350<br>Kinetix 6500<br>PowerFlex 755 | 8 | 2 |
| 1769-L27ERM-QBFC1B | | 16 | 4 |
| 1769-L30ERM | | 16 | 4 |
| 1769-L33ERM | | 32 | 8 |
| 1769-L36ERM | | 48 | 16 |

If your solution requires more than 16 Position Loop-configured drives, consider using the ControlLogix platform. The ControlLogix platform allows up to 100 Position Loop-configured drives.

## Time Synchronization

Integrated Motion over an EtherNet/IP network requires Time Synchronization, also known as CIP Sync. CIP Sync provides accurate real-time (real-world time) or Coordinated Universal Time (UTC) synchronization of CompactLogix 5370 controllers and devices connected over an EtherNet/IP network.

CIP Sync is a time-synchronization protocol that can be applied to various applications. This chapter focuses on using the protocol in applications with Integrated Motion over an EtherNet/IP network.

In a CompactLogix system, the following devices are CIP Sync-capable:

- All CompactLogix 5370 controllers - Required

**IMPORTANT** While all CompactLogix 5370 controllers are CIP Sync-capable, not all of the controllers support Integrated Motion over an EtherNet/IP network.

A controller must be CIP Sync-capable and synchronized with other devices on the EtherNet/IP network to support Integrated Motion over an EtherNet/IP network. However, the condition of being CIP Sync-capable does not exclusively qualify a CompactLogix 5370 controller to support Integrated Motion over an EtherNet/IP network.

Table 41 on page 291 lists the CompactLogix 5370 controllers that support Integrated Motion over an EtherNet/IP network.

All controllers and communication modules must have time synchronization enabled to participate in CIP Sync.

CIP Sync requires that devices in the system function in the following roles:

- Grandmaster, also known as the coordinated system time (CST) master - Sets time for entire system and passes the time to a Master
- Master - Sets time for its backplane
- Slave - Uses time set by Master

## Configure Integrated Motion on the EtherNet/IP Network

To use Integrated Motion on the EtherNet/IP network, complete these steps.

**IMPORTANT** These steps show a 1769-L36ERM controller. The same steps apply to other CompactLogix 5370 controllers that support Integrated Motion over an EtherNet/IP network with slight variations in screens.

1. Enable Time Synchronization.
2. Add a Drive.

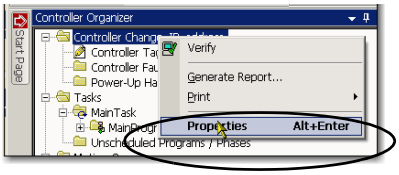
**IMPORTANT** This section assumes you have previously created a project for your 1769-L36ERM controller. If you have not, do so before continuing.

### Enable Time Synchronization

Configuring Integrated Motion on the EtherNet/IP network begins with enabling time synchronization in a CompactLogix 5370 controller.

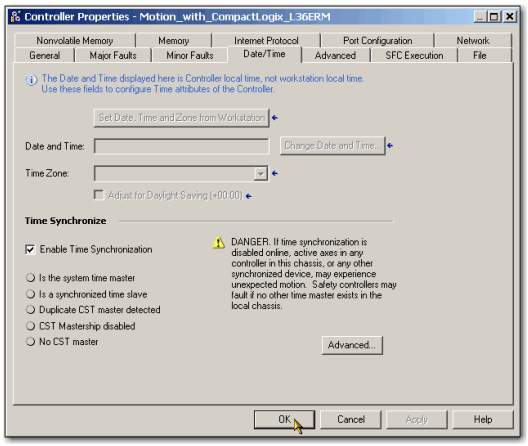
To enable Time Synchronization on a CompactLogix 5370 controller, complete these steps.

1. In the Controller Organizer, right-click your controller and choose Properties.




   The Controller Properties dialog box appears.
2. Click the Date/Time tab.
3. Click Enable Time Synchronization.

4. Click OK.



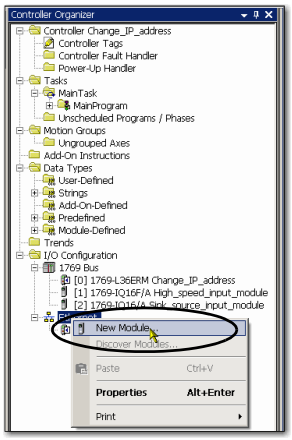

## Add a Drive

You can use these drives only in an application that uses Integrated Motion over an EtherNet/IP network:

- Kinetix 350 drive
- Kinetix 6500 drive
- PowerFlex 755 AC drive

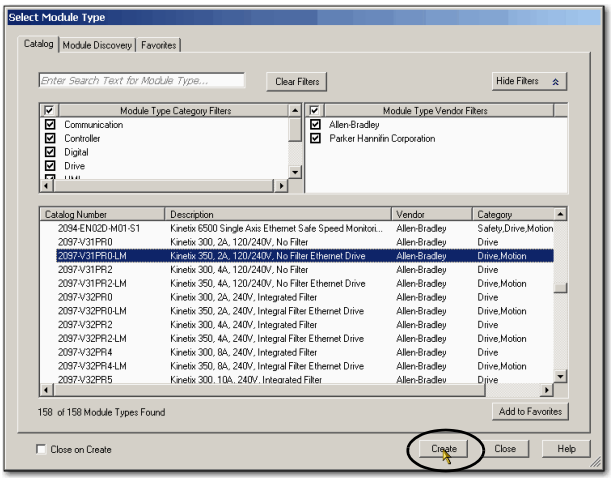
**IMPORTANT** These steps show a Kinetix 350 drive in a 1769-L36ERM control system. The same steps apply to other CompactLogix 5370 controllers that support Integrated Motion over an EtherNet/IP network with slight variations in screens.

1. In the I/O configuration tree, right-click the Ethernet network and choose New Module.




The Select Module Type dialog box appears.

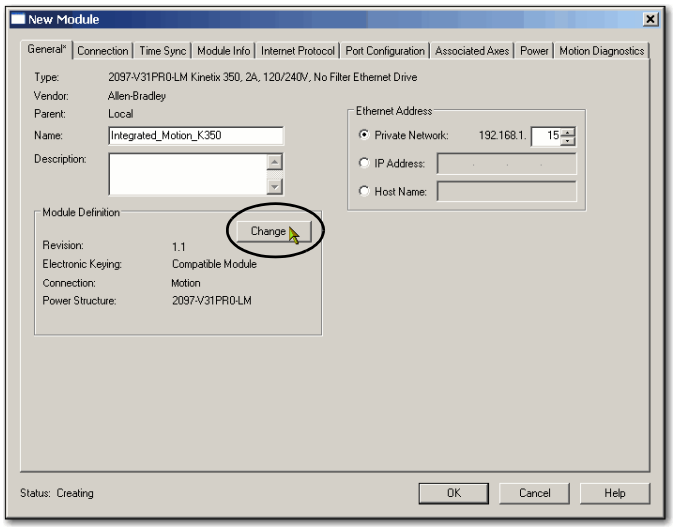
2. Select the desired drive and click Create.




The New Module dialog box appears.

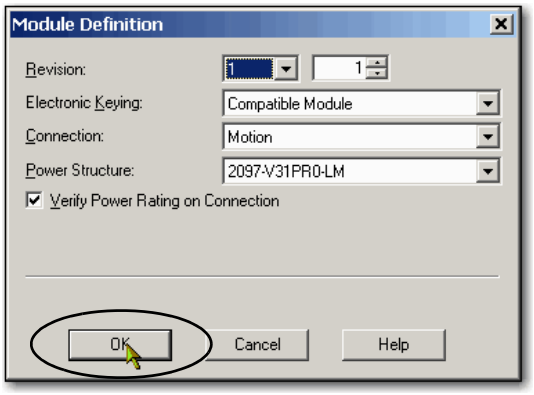
3. Type a name for the module.
4. Type a description, if desired.
5. Assign an EtherNet/IP address.

For information on setting the IP addresses, see the publications for each drive type listed on page 12.



6. If you need to change the configuration for any of the following parameters, click Change in the Module Definition area:
   - Revision
   - Electronic Keying
   - Connection
   - Power Structure
   - Verify Power Rating on Connection

   The Module dialog box appears.




7. Make the desired changes and click OK.
8. Click OK to create the drive in your project.
9. Add other components required by your project.

# Scalability in Applications Using Integrated Motion on EtherNet/IP Networks

CompactLogix 5370 controllers offer varying levels of flexibility and scalability to operate in control systems using Integrated Motion on EtherNet/IP networks.

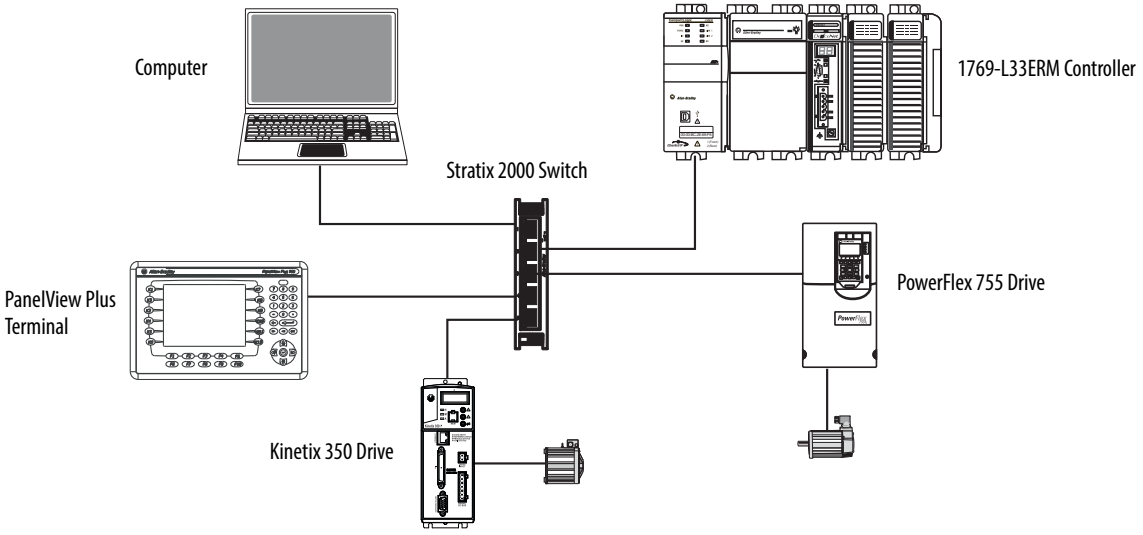
## 1769-L30ERM, 1769-L33ERM, and 1769-L36ERM Controllers

You can use the following controllers in control systems requiring simpler configuration and complex configuration of Integrated Motion on EtherNet/IP networks parameters:

- 1769-L30ERM
- 1769-L33ERM
- 1769-L36ERM

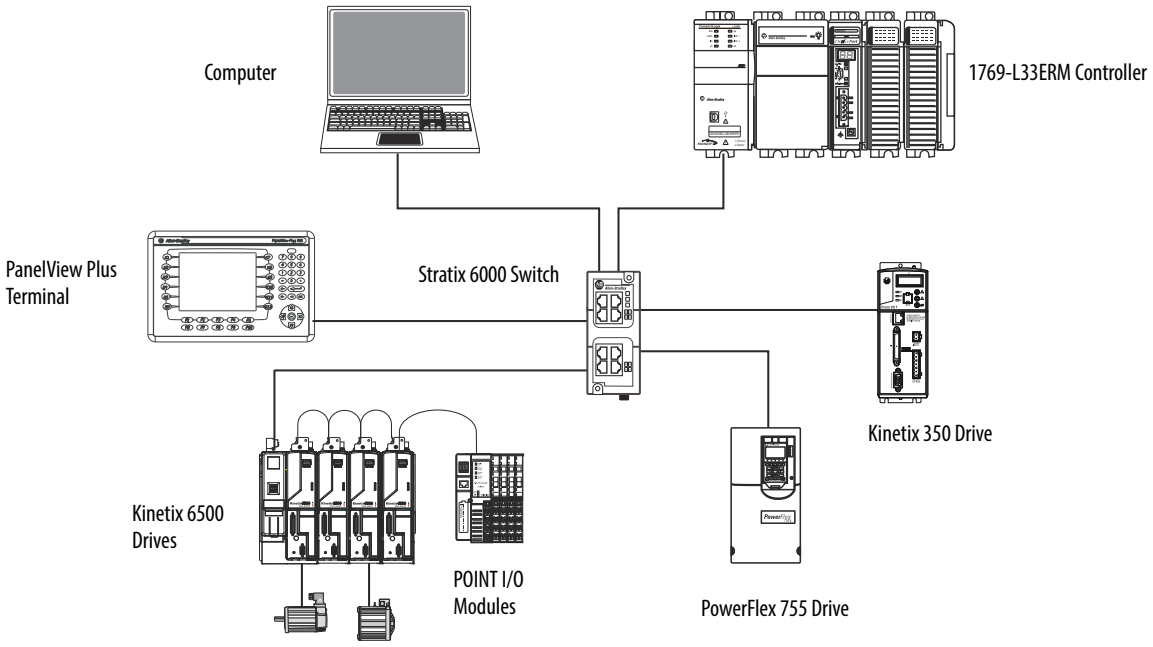
### *Control Systems Requiring Simple Configuration*

Relatively simple control systems that use Integrated Motion over an EtherNet/IP network often include unmanaged switches, such as a Stratix 2000™ switch, and Kinetix 350 drives, as shown in this example.



### *Control Systems Requiring Complex Configuration*

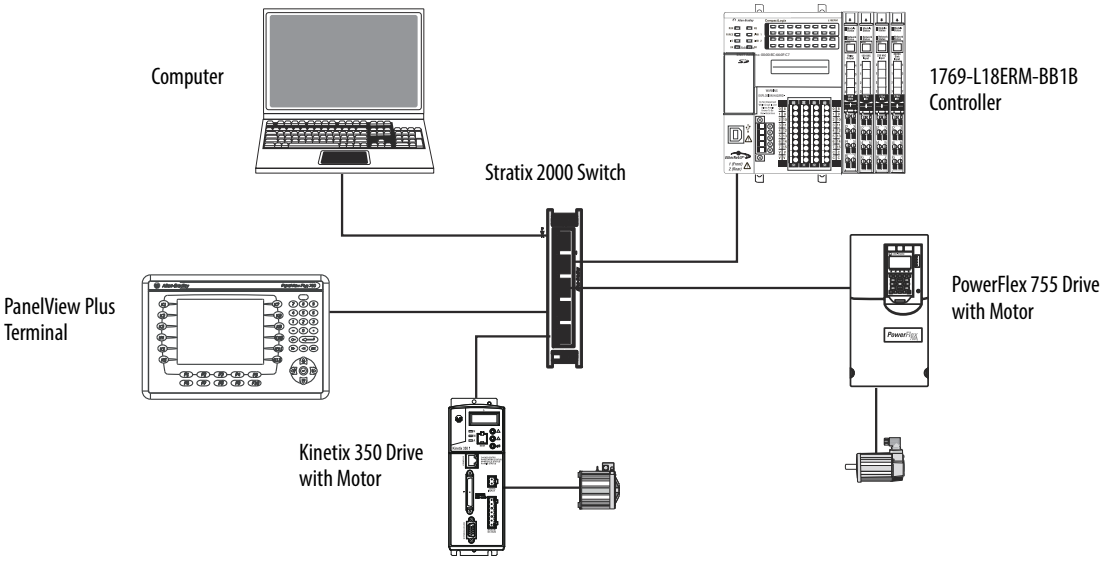
Complex control systems that use Integrated Motion over an EtherNet/IP network often include managed switches, such as a Stratix 6000 switch, and Kinetix 6500 and PowerFlex 755 drives, as shown in this example.



## 1769-L18ERM-BB1B Controller

The 1769-L18ERM-BB1B controller is typically used in control systems requiring simpler configuration with respect to using Integrated Motion over an EtherNet/IP network.

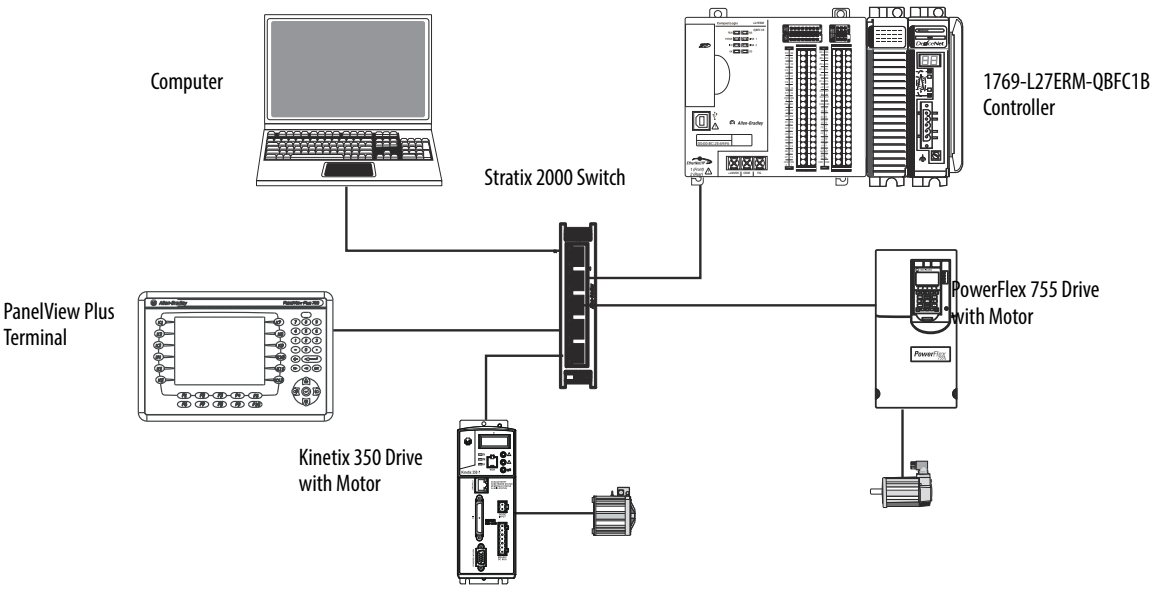
The simpler control system often includes unmanaged switches, such a Stratix 2000 switch, and Kinetix 350 drives, as shown in this example.



## 1769-L27ERM-QBFC1B Controller

The 1769-L27ERM-QBFC1B controller is typically used in control systems requiring simpler configuration with respect to using Integrated Motion over an EtherNet/IP network.

The simpler control system often includes unmanaged switches, such a Stratix 2000 switch, and Kinetix 350 drives, as shown in this example.




For more information on Integrated Motion over an EtherNet/IP network, see the publications listed on page 12.

# Use a Secure Digital Card

This chapter describes the primary tasks required to store a project on an SD card or load a project from an SD card to the CompactLogix 5370 controller.


| Topic | Page |
|---|---|
| Store or Load a Project with the Secure Digital Card | 303 |
| Store a Project | 304 |
| Load a Project | 307 |


**IMPORTANT** The life expectancy of flash media is strongly dependent on the number of write cycles that are performed. Flash media uses wear leveling but users should avoid frequent writes.

Avoiding frequent writes is particularly important when logging data. We recommend that you log data to a buffer in your controller's memory and limit the number of times data is written to removable media.

CompactLogix 5370 controllers support nonvolatile storage through the following SD cards:

- 1784-SD1 - Ships with CompactLogix 5370 controller and offers 1 GB of memory. You can order additional 1784-SD1 cards if desired.
- 1784-SD2 cards - Available for separate purchase and offer 2 GB of memory.

For information on how to install or remove an SD card from a CompactLogix 5370 controller, see Install the Secure Digital Card on page 61.

**IMPORTANT**

We recommend that you leave the SD card installed in the controller and the card unlocked. The SD card saves extended diagnostic information you can send to Rockwell Automation that provides enhanced diagnostics of your application and firmware revision should circumstances require this data.

This section briefly describes how to use the SD card when installed in a CompactLogix 5370 controller, that is, how to store a project from the controller to the SD card and how to load a project from the SD card to the controller.

However, you may need to complete other tasks using the SD card, such as the following:

- Change the image that is loaded from the card
- Check for a load that was completed
- Clear an image from the memory card
- Store an empty image
- Change load parameters
- Read/write application data to the card

For more detailed information about using an SD card, see the Logix5000 Controllers Nonvolatile Memory Card Programming Manual, publication 1756-PM017.

## Store or Load a Project with the Secure Digital Card

There are several options for when to load the project back into the CompactLogix 5370 controller's user memory (RAM). The option used is determined by the controller configuration.

The following table describes the conditions in which a project is loaded from as described in the following table.

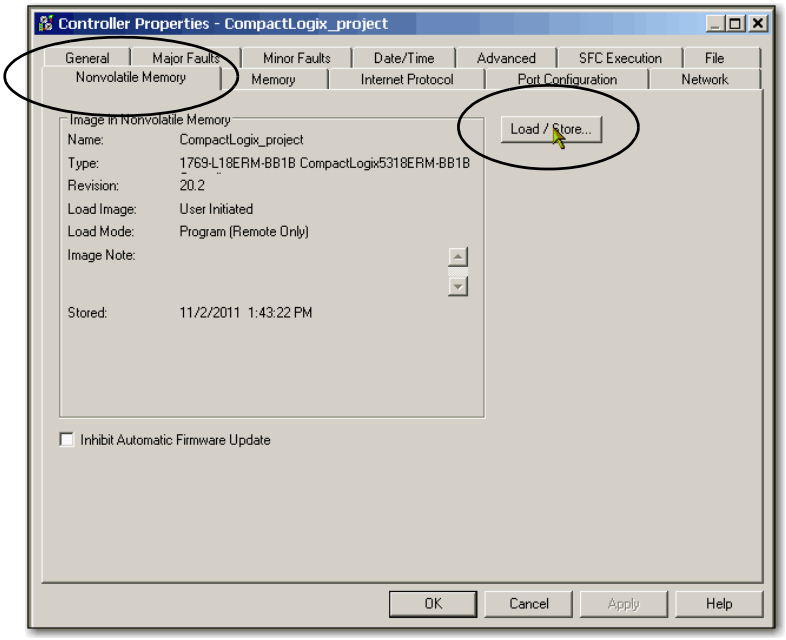
| Condition to Load Project From an SD Card into Controller RAM | Required Setting in Controller Configuration | Notes |
|---|---|---|
| Controller power-up | On Power Up | • During a power cycle, you lose any online changes and tag values you have not stored on the memory card.<br>• A load from a memory card may also change the firmware of the controller.<br>• For more information, see the Logix5000 Controllers Nonvolatile Memory Card Programming Manual, publication 1756-PM017.<br>• You can always use the application to load the project. |
| No project in the controller and you power-up the controller | On Corrupt Memory | • During a power cycle, you lose any online changes and tag values you have not stored on the memory card.<br>• A load from a memory card may also change the firmware of the controller.<br>• For more information, see the Logix5000 Controllers Nonvolatile Memory Card Programming Manual, publication 1756-PM017.<br>• You can always use the application to load the project. |
| Only through application | User Initiated | You lose any online changes and tag values you have not stored on the memory card. |

## Store a Project

Follow these steps to store a project. These steps show a 1769-L18ERM-BB1B controller. The same steps apply for other CompactLogix 5370 controllers.

1. Go online with the controller.
2. Put the controller in Program mode, that is, Remote Program or Program.
3. On the Online tool bar, click the controller properties icon.

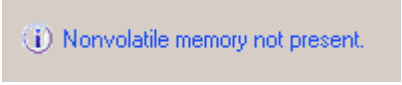
4. Click the Nonvolatile Memory tab.
5. Click Load/Store.



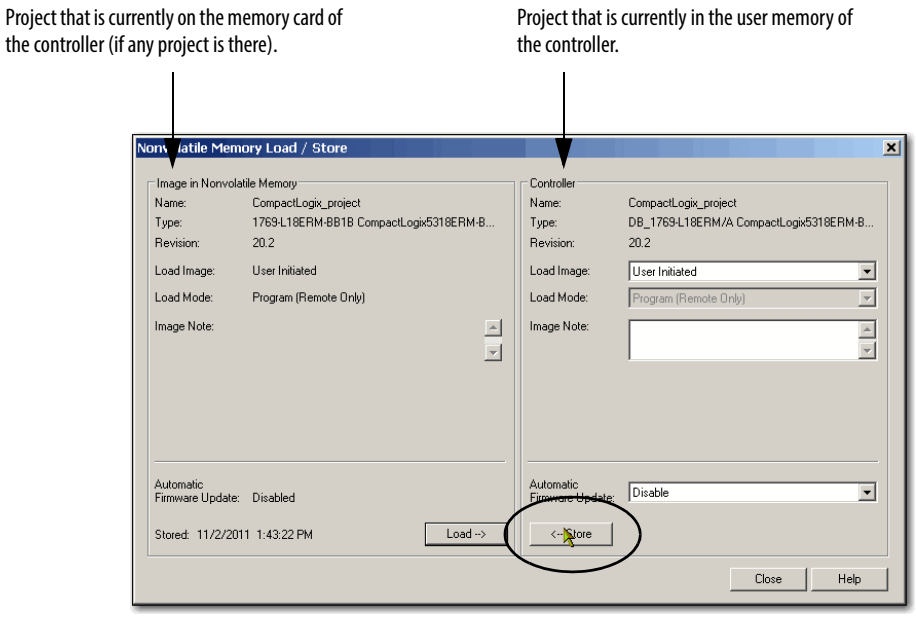

**TIP** If Load/Store is dimmed (unavailable), verify the following:

- You have specified the correct communication path and are online with the controller.
- The memory card is installed.

If the memory card is not installed, the missing card is indicated by a message in the lower-left corner of the Nonvolatile Memory tab as shown here.



6. Choose under what conditions to load the project into the user memory of the controller.




If you choose On Power Up or On Corrupt Memory, you must also choose the mode you want the controller to go to after the load:

- Remote Program
- Remote Run

7. In the Automatic Firmware Update box, use the default (disable) or choose the appropriate firmware supervisor option.

| **IMPORTANT** | The Firmware Supervisor option is not used to upgrade the controller firmware. |
|---|---|

8. Click <- Store.

| **IMPORTANT** | Store is not active if a SD card is locked. |
|---|---|

A dialog box asks you to confirm the store.

9. To store the project, click Yes.
10. Click OK.

After you click Store, the project is saved to the SD card as indicated by the controller status indicators. These conditions may exist:

- While the **store is in progress**, the following occurs:
  - The OK indicator is flashing green.
  - The SD indicator is flashing green.
  - A dialog box indicates the store is in progress.
- When the **store is complete**, the following occurs:
  - The controller resets itself.

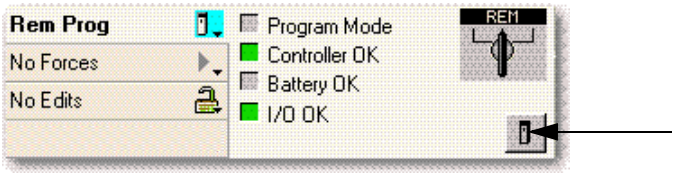
    When the controller is resetting itself, the status indicators execute a sequence of state changes, for example, a brief period of time with the OK status indicator in the solid red state. Wait for the controller to complete the sequence.
  - After the controller fully resets itself, the OK indicator is solid green.
  - The SD indicator is off.

**IMPORTANT** Allow the store to complete without interruption. If you interrupt the store, data corruption or loss may occur.

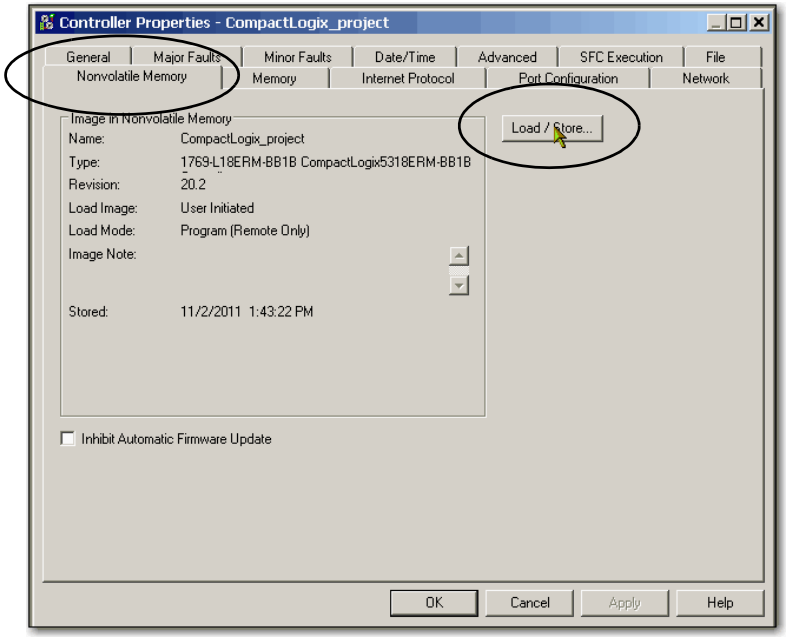
## Load a Project

Follow these steps to use the application to load the project from an SD card. These steps show a 1769-L18ERM-BB1B controller. The same steps apply for other CompactLogix 5370 controllers.

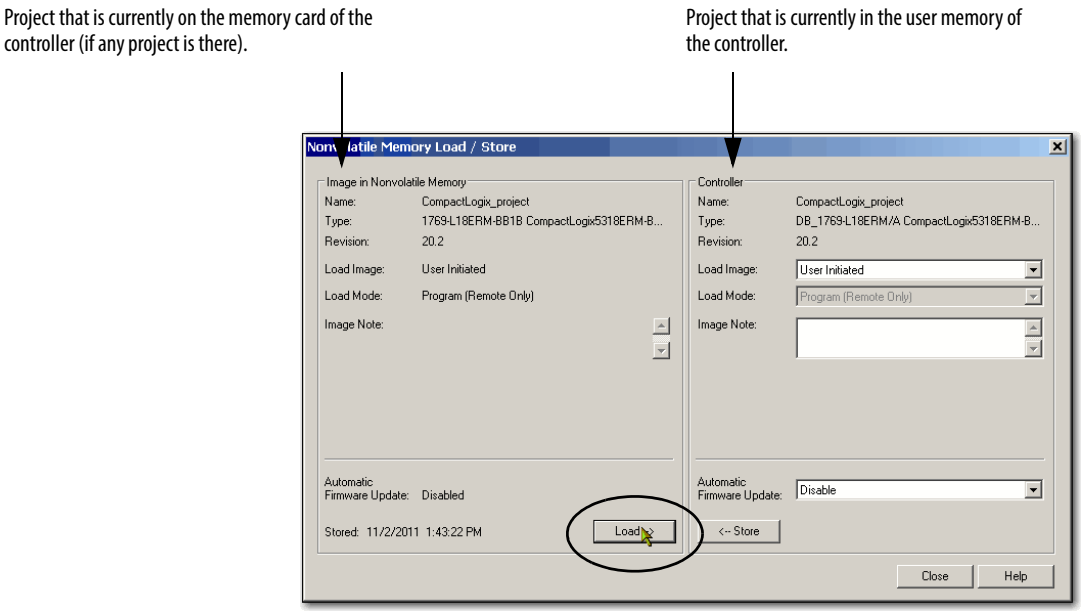
1. Go online with the controller.
2. Put the controller in Program mode, that is, Remote Program or Program.
3. On the Online tool bar, click the controller properties icon.




4. Click the Nonvolatile Memory tab.
5. Click Load/Store.



6. Click Load.




A dialog box prompts you to confirm the load.

7. To load the project, click Yes.
8. Click OK.

After you click Load, the project is loaded into the controller as indicated by the controller status indicators. These conditions may exist:

- While the **load is in progress**, the following occurs:
  - The controller resets itself.

    When the controller is resetting itself, the status indicators execute a sequence of state changes, for example, a brief period of time with the OK status indicator in the solid red state. Wait for the controller to complete the sequence.
  - After the controller fully resets itself, the OK indicator is solid green.
  - The SD indicator is off.

# Status Indicators

This section explains how to interpret the status indicators on your CompactLogix 5370 controllers. All controllers use the status indicators described in the following table.

| Status Indicator | Description |
|---|---|
| RUN | Indicates the controller's operating mode. |
| FORCE | Indicates the force state. |
| I/O | Indicates the current state of communication between the controller and I/O modules. |
| OK | Indicates the controller's state. |
| NS | Indicates the EtherNet/IP network status with regard to the controller operating on the network. |
| LINK 1 | Indicates the controller's EtherNet/IP link status for port 1. |
| LINK 2 | Indicates the controller's EtherNet/IP link status for port 2. |
| SD | Indicates if there is currently activity on the SD card. |

## Use the CompactLogix 5370 Controllers Status Indicators

The following graphic shows the controller status indicators for all of the CompactLogix 5370 controllers.

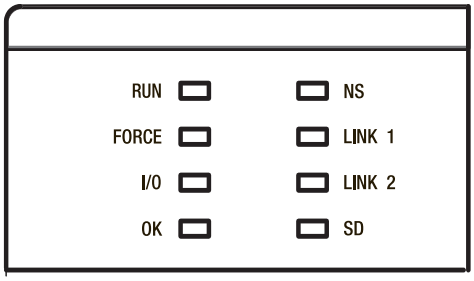



**Table 42 - Controller Mode (RUN) Status Indicator**

| Status | Description |
|---|---|
| Off | The controller is in Program or Test mode. |
| Green | The controller is in Run mode. |

**Table 43 - Force State (FORCE) Status Indicator**

| Status | Description |
|---|---|
| Off | No tags contain I/O force values. I/O forces are inactive (disabled). |
| Yellow | I/O forces are active (enabled). I/O force values may or may not exist. |
| Flashing yellow | One or more input or output addresses have been forced to an On or Off condition, but the forces have not been enabled. |

**Table 44 - I/O State (I/O) Status Indicator**

| Status | Description |
|---|---|
| Off | One of the following conditions exists:<br>• There are no devices in the I/O configuration of the controller. - Only applies to CompactLogix 5370 L3 controllers.<br>• The controller does not contain a project. |
| Green | The controller is communicating with all of the devices in its I/O configuration. |
| Flashing green | One or more devices in the I/O configuration of the controller are not responding. |
| Flashing red | One of the following conditions exists:<br>• The controller is not communicating with any devices.<br>• A fault has occurred on the controller. - CompactLogix 5370 L1 and L2 controllers only. |

**Table 45 - Controller Status (OK) Status Indicator**

| Status | Description |
|---|---|
| Off | No power is applied. |
| Green | The controller is OK. |
| Flashing green | The controller is storing a project to or loading a project from the SD card. |
| Red | The controller detected a nonrecoverable major fault and cleared the project from memory. |
| Flashing red | One of the following:<br>• The controller requires a firmware update.<br>• A major recoverable fault occurred on the controller.<br>• A nonrecoverable major fault occurred on the controller and cleared the program from memory.<br>• A controller firmware update is in process.<br>• An embedded I/O module firmware update is in process. - CompactLogix 5370 L1 controllers only. |
| Dim green to red | Save to Flash at power-down. |

**Table 46 - Ethernet Network Status (NS) Status Indicator**

| Status | Description |
|---|---|
| Off | The port is not initialized; it does not have an IP address and is operating in BOOTP or DHCP mode. |
| Green | The port has an IP address and CIP connections are established. |
| Flashing green | The port has an IP address, but no CIP connections are established. |
| Red | The port has detected that the assigned IP address is already in use. |
| Flashing red/green | The port is performing its power-up self test. |

**Table 47 - Ethernet Link Status (LINK 1/LINK 2) Status Indicator**

| Status | Description |
|---|---|
| Off | One of the following conditions exists:<br>• No link.<br>• Port administratively disabled.<br>• Port disabled because rapid ring fault condition was detected (LINK2). |
| Green | One of the following conditions exists:<br>• A 100 Mbps link (half- or full-duplex) exists, no activity.<br>• A 10 Mbps link (half- or full-duplex) exists, no activity.<br>• Ring network is operating normally and the controller is the active supervisor.<br>• Ring network has encountered a rare partial network fault and the controller is the active supervisor. |
| Flashing green | One of the following conditions exists:<br>• A 100 Mbps link exists and there is activity.<br>• A 10 Mbps link exists and there is activity. |

**Table 48 - SD Card Activity (SD) Status Indicator**

| Status | Description |
|---|---|
| Off | There is no activity to the SD card. |
| Flashing green | The controller is reading from or writing to the SD card. |
| Flashing red | The SD card does not have a valid file system. |

## Notes:

# Connections over an EtherNet/IP Network

**IMPORTANT** Before using this section, first use the information at Nodes on an EtherNet/IP Network on page 118 when designing and configuring your CompactLogix 5370 control system.

For more information on how to best design EtherNet/IP network use in your CompactLogix 5370 control system, see these resources:

- The EtherNet/IP Capacity Tool available at http://www.rockwellautomation.com/solutions/integratedarchitecture/resources3.html#enetpredict.

  The EtherNet/IP Capacity Tool helps you in the initial layout of your EtherNet/IP network.

- Ethernet Design Considerations Reference Manual, publication ENET-RM002

CompactLogix 5370 controllers use connections to manage communication on the EtherNet/IP network. A connection is a point-to-point communication mechanism used to transfer data between a transmitter and a receiver. Connections can be logical or physical.

You indirectly determine the number of connections the controller uses by configuring the controller to communicate with other devices in the system. Connections are allocations of resources that provide more reliable communication between devices than unconnected messages.

All EtherNet/IP connections are unscheduled. An unscheduled connection is a message transfer between controllers that is triggered by the requested packet interval (RPI) or the program, such as a MSG instruction. Unscheduled messaging lets you send and receive data when needed.

This table list specific information for CompactLogix 5370 controllers.

**Table 49 - CompactLogix 5370 Controller EtherNet/IP Network Port Specifications**

| Cat. No. | Connections | | | CIP Unconnected Messages (backplane + Ethernet) | Packet Rate Capacity (packets/second)(1) | | SNMP Support (password required) | Media Support | Produced/Consumed Tags | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Controller | TCP | CIP | | I/O | HMI/MSG | | | Number of Multicast Tags, max(2) | Unicast Available |
| 1769-L16ER-BB1B | 256 | 120 | 256 | 256 | 6000 @ 500 bytes/ packet | 400 messages/s @ 20% comm. timeslice | Yes | Twisted Pair | 32 multicast produced tags 128 unicast produced tags | Yes |
| 1769-L18ER-BB1B | | | | | | | | | | |
| 1769-L18ERM-BB1B | | | | | | | | | | |
| 1769-L24ER-QB1B | | | | | | | | | | |
| 1769-L24ER-QBFC1B | | | | | | | | | | |
| 1769-L27ERM-QBFC1B | | | | | | | | | | |
| 1769-L30ER | | | | | | | | | | |
| 1769-L30ERM | | | | | | | | | | |
| 1769-L30ER-NSE | | | | | | | | | | |
| 1769-L33ER | | | | | | | | | | |
| 1769-L33ERM | | | | | | | | | | |
| 1769-L36ERM | | | | | | | | | | |

(1) Total packet rate capacity = I/O Produced Tag, max + HMI/MSG, max. Packet rates will vary depending on packet size. For more detailed specifications, see the capacity section of the EDS file for the specific catalog number.

(2) These are the maximum numbers of CIP I/O connections.

# History of Changes

## Changes to the Manual

With the availability of new controllers, modules, applications, and programming software features, this manual has been revised to include updated information. This appendix briefly summarizes changes that have been made with previous revisions of this manual.

**IMPORTANT** This appendix does not list the changes that have been implemented with this revision of the publication.

For a list of changes made in this revision of the publication, see Summary of Changes on page 3.

Reference this appendix if you need information to determine what changes have been made across multiple revisions. This may be especially useful if you are deciding to upgrade your hardware or software based on information added with previous revisions of this manual.

This table lists the publication revision, publication date, and changes made with the revision.

**Table 50 - History of Changes**

| Publication Revision and Date | Topic |
|---|---|
| 1769-UM021C-EN-P, May 2012 | Added the description of CompactLogix 5370 L2 controllers, including the following content:<br>• Installing the controller<br>• Control system components<br>• Controller functionality<br>• Example system configurations on an EtherNet/IP network<br>• Example system configurations on a DeviceNet network<br>• Using I/O modules with the controller 169<br>• Motion support with the 1769-L27ERM-QBFC1B controller<br>• EtherNet/IP network connection specifications |
| 1769-UM021B-EN-P, February 2012 | Removed the descriptions of the I/O Event Task and its use with the CompactLogix 5370 L1 controllers.<br><br>In RSLogix 5000 software, version 20.*xx.xx*, you can configure the I/O Event Task for your CompactLogix 5370 L1 controller's project. However, the task will never be triggered because the functionality has been disabled in the controller. |

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## Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support, you can find technical manuals, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools. You can also visit our Knowledgebase at http://www.rockwellautomation.com/knowledgebase for FAQs, technical information, support chat and forums, software updates, and to sign up for product notification updates.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect$^{SM}$ support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

### Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

| | |
|---|---|
| United States or Canada | 1.440.646.3434 |
| Outside United States or Canada | Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative. |

### New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

| | |
|---|---|
| United States | Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process. |
| Outside United States | Please contact your local Rockwell Automation representative for the return procedure. |

## Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

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Allen-Bradley

# PowerFlex® 40

# Adjustable Frequency AC Drive

***FRN 1.xx - 6.xx***

**User Manual**

Rockwell Automation

## Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at **http://www.rockwellautomation.com/literature**) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary we use notes to make you aware of safety considerations.

**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

**Important:** Identifies information that is critical for successful application and understanding of the product.

**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:

- identify a hazard
- avoid the hazard
- recognize the consequences

**Shock Hazard** labels may be located on or inside the equipment (e.g., drive or motor) to alert people that dangerous voltage may be present.

**Burn Hazard** labels may be located on or inside the equipment (e.g., drive or motor) to alert people that surfaces may be at dangerous temperatures.

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The information below summarizes the changes to the PowerFlex 40 *User Manual* since the August 2008 release.

## Manual Updates

| Description of New or Updated Information | Page(s) |
|---|---|
| Minimum Enclosure Volume column and new footnotes added. | 1-9, A-2 |
| Drive, Fuse & Circuit Breaker Ratings topic updated. | A-1 |
| Electronic Motor Overload Protection description updated. | A-4 |

The information below summarizes the changes to the PowerFlex 40 *User Manual* since the April 2008 release.

## Manual Updates

| Description of New or Updated Information | Page(s) |
|---|---|
| Description of A056 revised. | 3-17 |
| Description of A059/A062 revised. | 3-19 |
| Fault description for F3 revised. | 4-3 |
| A table row for electrical specifications added. | A-4 |
| Graphic for the “Network Wiring” section revised. | C-1 |
| Second last paragraph in the “Network Wiring” section revised. | C-2 |
| Text in the “Writing (06) Logic Command Data” section revised. | C-4 |
| Frequency source for logic command 001 of bits 14, 13, and 12 corrected. | C-4 |
| Text in the “Writing (06) Reference” section revised. | C-5 |

## Parameter Updates

The following parameters have been updated with firmware version 6.xx.

| Parameter | Number | Description | Page |
|---|---|---|---|
| [Relay Out Sel] | A055 | Function of option 20, ParamControl, changed.<br>Option 24, MsgControl, added. | 3-16 |
| [Relay Out Sel] | A058, A061 | Function of option 20, ParamControl, changed.<br>Option 24, MsgControl, added. | 3-18 |

The information below summarizes the changes to the PowerFlex 40 *User Manual* since the January 2007 release.

## Manual Updates

| Description of New or Updated Information | Page(s) |
|---|---|
| Input description and attention text for Multiple Digital Input Connection example corrected. | 1-22 |
| New method of changing speed reference for IP66, NEMA/UL Type 4X rated drives described. | 2-2 |
| Description for Up Arrow and Down Arrow keys revised. | 2-4 |
| Fault description for F3 revised. | 4-3 |
| Graphic for the “Network Wiring” section revised. | C-1 |
| Descriptions for bits 6, 7, and 15 of register address 8192 (Logic Command) updated. | C-4 |
| New information on reading register address 8192 added. | C-4 |
| New information on reading register address 8193 added. | C-5 |
| Graphic for the “Connecting an RS-485 Network” section corrected. | D-4 |
| New method for inverting sign of PID error added. | F-6 |

## New Parameter

The following parameter has been added with firmware version 5.xx.

| Parameter | Number | Description | Page |
|---|---|---|---|
| [PID Invert Error] | A167 | New | 3-44 |

## Parameter Updates

The following parameters have been updated with firmware version 5.xx.

| Parameter | Number | Description | Page |
|---|---|---|---|
| [Control Source] | d012 | Options 7 and 8 added. | 3-5 |
| [Start Source] | P036 | Description revised for option 6. | 3-10 |
| [Relay Out Sel] | A055 | Description revised for option 20. | 3-16 |
| [Relay Out Level] | A056 | Description revised. | 3-17 |
| [Opto Outx Sel] | A058, A061 | Description revised for option 20. | 3-18 |
| [Opto Outx Level] | A059, A062 | Description revised. | 3-19 |
| [Internal Freq] | A069 | Default value for IP66, NEMA/ UL Type 4X drives is 0.0 Hz. Default value for IP20 rated drives is 60.0 Hz. | 3-22 |
| [PID Trim Hi] | A130 | Description revised. | 3-38 |
| [PID Trim Lo] | A131 | Description revised. | 3-38 |

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Manual Conventions . . . . . P-2
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# Overview

The purpose of this manual is to provide you with the basic information needed to install, start-up and troubleshoot the PowerFlex 40 Adjustable Frequency AC Drive.


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| Who Should Use this Manual? | P-1 |
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| Manual Conventions | P-2 |
| Drive Frame Sizes | P-2 |
| General Precautions | P-3 |
| Catalog Number Explanation | P-4 |


## Who Should Use this Manual?

This manual is intended for qualified personnel. You must be able to program and operate Adjustable Frequency AC Drive devices. In addition, you must have an understanding of the parameter settings and functions.

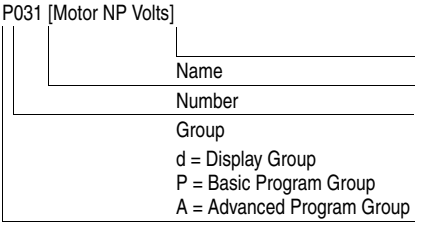
## Reference Materials

The following manuals are recommended for general drive information:

| Title | Publication | Available Online at … |
|---|---|---|
| Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives | DRIVES-IN001… | **www.rockwellautomation.com/literature** |
| Preventive Maintenance of Industrial Control and Drive System Equipment | DRIVES-TD001… | |
| Safety Guidelines for the Application, Installation and Maintenance of Solid State Control | SGI-1.1 | |
| A Global Reference Guide for Reading Schematic Diagrams | 100-2.10 | |
| Guarding Against Electrostatic Damage | 8000-4.5.2 | |

## Manual Conventions

- In this manual we refer to the PowerFlex 40 Adjustable Frequency AC Drive as; drive, PowerFlex 40 or PowerFlex 40 Drive.
- Parameter numbers and names are shown in this format:




- The following words are used throughout the manual to describe an action:

| Word | Meaning |
|---|---|
| Can | Possible, able to do something |
| Cannot | Not possible, not able to do something |
| May | Permitted, allowed |
| Must | Unavoidable, you must do this |
| Shall | Required and necessary |
| Should | Recommended |
| Should Not | Not Recommended |

## Drive Frame Sizes

Similar PowerFlex 40 drive sizes are grouped into frame sizes to simplify spare parts ordering, dimensioning, etc. A cross reference of drive catalog numbers and their respective frame sizes is provided in Appendix B.

## General Precautions

**ATTENTION:** The drive contains high voltage capacitors which take time to discharge after removal of mains supply. Before working on drive, ensure isolation of mains supply from line inputs [R, S, T (L1, L2, L3)]. Wait three minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death.

Darkened display LEDs is not an indication that capacitors have discharged to safe voltage levels.

**ATTENTION:** Only qualified personnel familiar with adjustable frequency AC drives and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

**ATTENTION:** This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference A-B publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.

**ATTENTION:** An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

**ATTENTION:** The bus regulator function is extremely useful for preventing nuisance overvoltage faults resulting from aggressive decelerations, overhauling loads, and eccentric loads. However, it can also cause either of the following two conditions to occur.
1. Fast positive changes in input voltage or imbalanced input voltages can cause uncommanded positive speed changes;
2. Actual deceleration times can be longer than commanded deceleration times
However, a “Stall Fault” is generated if the drive remains in this state for 1 minute. If this condition is unacceptable, the bus regulator must be disabled (see parameter A117). In addition, installing a properly sized dynamic brake resistor will provide equal or better performance in most cases.

## Catalog Number Explanation

| 1-3 | 4 | 5 | 6-8 | 9 | 10 | 11 | 12 (1) | 13-14 |
|---|---|---|---|---|---|---|---|---|
| **22B** | **-** | **A** | **1P5** | **N** | **1** | **1** | **4** | **AA** |
| Drive | Dash | Voltage Rating | Rating | Enclosure | HIM | Emission Class | Type | Optional |

| Code | |
|---|---|
| 22B | PowerFlex 40 |

| Code | Version |
|---|---|
| 3 | No Brake IGBT |
| 4 | Standard |

| Code | Rating |
|---|---|
| 0 | Not Filtered |
| 1 | Filtered |

| Code | Voltage | Ph. |
|---|---|---|
| V | 120V AC | 1 |
| A | 240V AC | 1 |
| B | 240V AC | 3 |
| D | 480V AC | 3 |
| E | 600V AC | 3 |

| Code | Interface Module |
|---|---|
| 1 | Fixed Keypad |

| Code | Purpose |
|---|---|
| AA thru ZZ | Reserved for custom firmware |

| Code | Enclosure |
|---|---|
| N | Panel Mount - IP20, NEMA/UL Type Open |
| C | Panel Mount - IP66, NEMA/UL Type 4X |
| F | Flange Mount - IP20, NEMA/UL Type Open |
| H | Replacement Plate Drive - IP20, NEMA/UL Type Open - *Contact factory for ordering information.* |

Output Current @ 100-120V 50/60 Hz Input

| Code | Amps | kW (HP) |
|---|---|---|
| 2P3 | 2.3 | 0.4 (0.5) |
| 5P0 | 5.0 | 0.75 (1.0) |
| 6P0 | 6.0 | 1.1 (1.5) |

Output Current @ 200-240V 50/60 Hz Input

| Code | Amps | kW (HP) |
|---|---|---|
| 2P3 | 2.3 | 0.4 (0.5) |
| 5P0 | 5.0 | 0.75 (1.0) |
| 8P0 | 8.0 | 1.5 (2.0) |
| 012 | 12 | 2.2 (3.0) |
| 017 | 17.5 | 3.7 (5.0) |
| 024 | 24 | 5.5 (7.5) |
| 033 | 33 | 7.5 (10) |

Output Current @ 380-480V 50/60 Hz Input

| Code | Amps | kW (HP) |
|---|---|---|
| 1P4 | 1.4 | 0.4 (0.5) |
| 2P3 | 2.3 | 0.75 (1.0) |
| 4P0 | 4.0 | 1.5 (2.0) |
| 6P0 | 6.0 | 2.2 (3.0) |
| 010 | 10.5 | 4.0 (5.0) |
| 012 | 12 | 5.5 (7.5) |
| 017 | 17 | 7.5 (10) |
| 024 | 24 | 11 (15) |

Output Current @ 500-600V 50/60 Hz Input

| Code | Amps | kW (HP) |
|---|---|---|
| 1P7 | 1.7 | 0.75 (1.0) |
| 3P0 | 3.0 | 1.5 (2.0) |
| 4P2 | 4.2 | 2.2 (3.0) |
| 6P6 | 6.6 | 4.0 (5.0) |
| 9P9 | 9.9 | 5.5 (7.5) |
| 012 | 12.2 | 7.5 (10) |
| 019 | 19 | 11 (15) |

(1) Position 12 of the Catalog Number now indicates drive type. All PowerFlex 40 drives are equipped with RS485 communication.

Additional accessories, options and adapters are available. See Appendix B for details.

# Installation/Wiring

This chapter provides information on mounting and wiring the PowerFlex 40 Drive.


| For information on... | See page |
|---|---|
| Opening the Cover | 1-1 |
| Mounting Considerations | 1-3 |
| AC Supply Source Considerations | 1-5 |
| General Grounding Requirements | 1-7 |

| For information on... | See page |
|---|---|
| Fuses and Circuit Breakers | 1-8 |
| Power Wiring | 1-10 |
| I/O Wiring Recommendations | 1-14 |
| EMC Instructions | 1-25 |

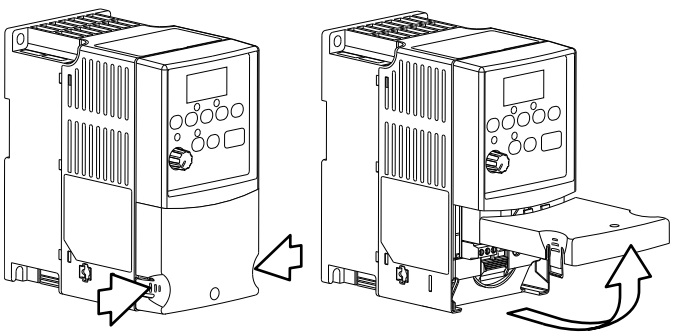

Most start-up difficulties are the result of incorrect wiring. Every precaution must be taken to assure that the wiring is done as instructed. All items must be read and understood before the actual installation begins.

**ATTENTION:** The following information is merely a guide for proper installation. Rockwell Automation, Inc. cannot assume responsibility for the compliance or the noncompliance to any code, national, local or otherwise for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.

## Opening the Cover

### IP20, NEMA/UL Type Open

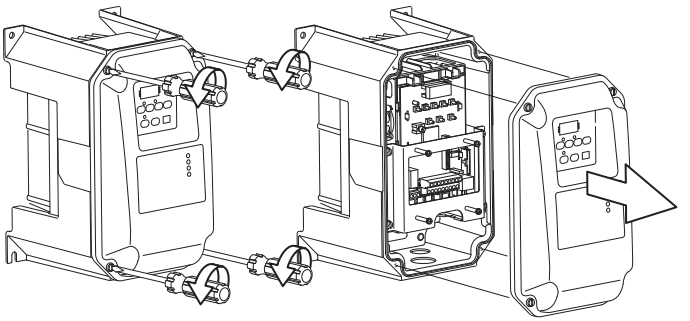
1. Press and hold in the tabs on each side of the cover.
2. Pull the cover out and up to release.



### IP66, NEMA/UL Type 4X

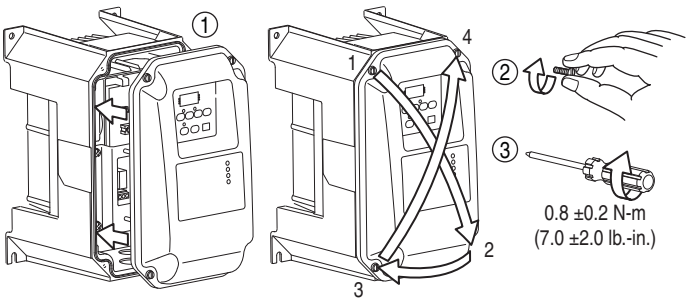
**ATTENTION:** To avoid an electric shock hazard, ensure isolation of mains supply from line inputs [R, S, T (L1, L2, L3)] and wait three minutes for capacitors to discharge before removing the external cover. Once the cover is removed, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the DC– and DC+ terminals on the Power Terminal Block (refer to page 1-13 for Power Terminal descriptions). The voltage must be zero.

1. Loosen the four captive cover screws.
2. Pull cover straight off chassis.



IP66, NEMA/UL Type 4X Cover Installation

1. Squarely align the cover on the chassis.
2. Lightly tighten the four captive cover screws.
3. Torque the cover screws using an alternating pattern.



## Mounting Considerations

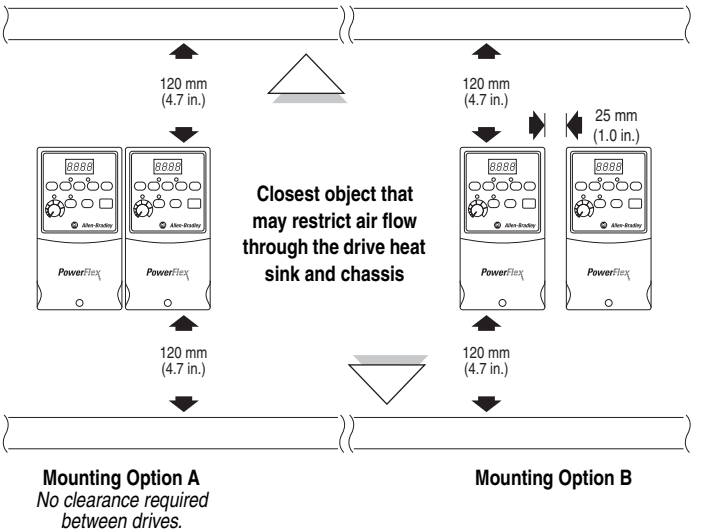
- Mount the drive upright on a flat, vertical and level surface.

| Frame | Screw Size | Screw Torque | DIN Rail |
|---|---|---|---|
| B | M4 (#8-32) | 1.56-1.96 N-m (14-17 lb.-in.) | 35 mm |
| C | M5 (#10-24) | 2.45-2.94 N-m (22-26 lb.-in.) | – |
| B (IP66, Type 4X) | M6 (#12-24) | 3.95-4.75 N-m (35-42 lb.-in.) | – |

- Protect the cooling fan by avoiding dust or metallic particles.
- Do not expose to a corrosive atmosphere.
- Protect from moisture and direct sunlight.

### Minimum Mounting Clearances

Refer to Appendix B for mounting dimensions.




### Ambient Operating Temperatures

**Table 1.A Enclosure and Clearance Requirements**

| Ambient Temperature | | Enclosure Rating | Minimum Mounting Clearances |
|---|---|---|---|
| Minimum | Maximum | | |
| -10°C (14°F) | 40°C (104°F) | IP20, NEMA/UL Type Open | Use Mounting Option A |
| | | IP66, NEMA/UL Type 4X | Use Mounting Option A |
| | | IP30, NEMA/UL Type 1(1) | Use Mounting Option B |
| | 50°C (122°F) | IP20, NEMA/UL Type Open | Use Mounting Option B |

(1) Rating requires installation of the PowerFlex 40 IP30, NEMA/UL Type 1 option kit.

### Debris Protection

A plastic top panel is included with the drive. Install the panel to prevent debris from falling through the vents of the drive housing during installation. Remove the panel for IP20, NEMA/UL Type Open applications.

### Storage

- Store within an ambient temperature range of -40° to +85°C.
- Store within a relative humidity range of 0% to 95%, non-condensing.
- Do not expose to a corrosive atmosphere.

# AC Supply Source Considerations

## Ungrounded Distribution Systems

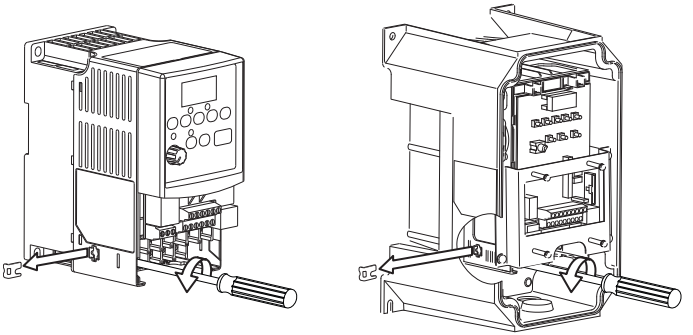
**ATTENTION:** PowerFlex 40 drives contain protective MOVs that are referenced to ground. These devices must be disconnected if the drive is installed on an ungrounded or resistive grounded distribution system.

### Disconnecting MOVs

To prevent drive damage, the MOVs connected to ground shall be disconnected if the drive is installed on an ungrounded distribution system where the line-to-ground voltages on any phase could exceed 125% of the nominal line-to-line voltage. To disconnect these devices, remove the jumper shown in the Figures 1.1 and 1.2.

1. Turn the screw counterclockwise to loosen.
2. Pull the jumper completely out of the drive chassis.
3. Tighten the screw to keep it in place.

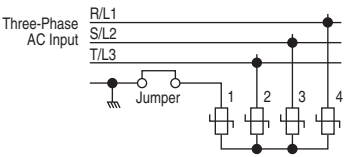
**Figure 1.1 Jumper Location (Typical)**



**IP20, NEMA/UL Type Open** **IP66, NEMA/UL Type 4X**

**Important:** Tighten screw after jumper removal.

**Figure 1.2 Phase to Ground MOV Removal**



## Input Power Conditioning

The drive is suitable for direct connection to input power within the rated voltage of the drive (see Appendix A). Listed in Table 1.B are certain input power conditions which may cause component damage or reduction in product life. If any of the conditions exist, as described in Table 1.B, install one of the devices listed under the heading *Corrective Action* on the line side of the drive.

**Important:** Only one device per branch circuit is required. It should be mounted closest to the branch and sized to handle the total current of the branch circuit.

**Table 1.B Input Power Conditions**

| Input Power Condition | Corrective Action |
|---|---|
| Low Line Impedance (less than 1% line reactance) | • Install Line Reactor(2)<br>• or Isolation Transformer<br>• or Bus Inductor – 5.5 & 11 kW (7.5 & 15 HP) drives only |
| Greater than 120 kVA supply transformer | |
| Line has power factor correction capacitors | • Install Line Reactor<br>• or Isolation Transformer |
| Line has frequent power interruptions | |
| Line has intermittent noise spikes in excess of 6000V (lightning) | |
| Phase to ground voltage exceeds 125% of normal line to line voltage | • Remove MOV jumper to ground.<br>• or Install Isolation Transformer with grounded secondary if necessary. |
| Ungrounded distribution system | |
| 240V open delta configuration (stinger leg)(1) | • Install Line Reactor |

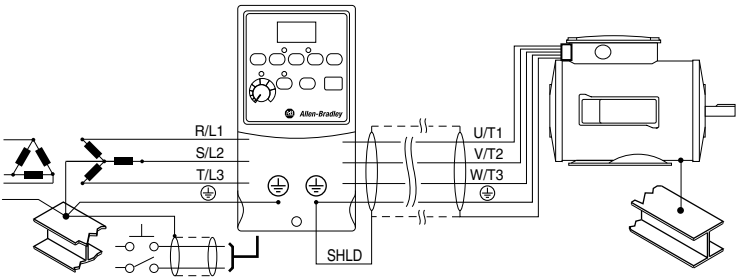
(1) For drives applied on an open delta with a middle phase grounded neutral system, the phase opposite the phase that is tapped in the middle to the neutral or earth is referred to as the “stinger leg,” “high leg,” “red leg,” etc. This leg should be identified throughout the system with red or orange tape on the wire at each connection point. The stinger leg should be connected to the center Phase B on the reactor. Refer to Table B.D for specific line reactor part numbers.

(2) Refer to Appendix B for accessory ordering information.

## General Grounding Requirements

The drive Safety Ground - ⏚ (PE) must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be periodically checked.

**Figure 1.3 Typical Grounding**




### Ground Fault Monitoring

If a system ground fault monitor (RCD) is to be used, only Type B (adjustable) devices should be used to avoid nuisance tripping.

### Safety Ground - ⏚ (PE)

This is the safety ground for the drive that is required by code. One of these points must be connected to adjacent building steel (girder, joist), a floor ground rod or bus bar. Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

### Motor Ground

The motor ground must be connected to one of the ground terminals on the drive.

### Shield Termination - SHLD

Either of the safety ground terminals located on the power terminal block provides a grounding point for the motor cable shield. The **motor cable** shield connected to one of these terminals (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal. The conduit box option may be used with a cable clamp for a grounding point for the cable shield.

When shielded cable is used for **control and signal wiring**, the shield should be grounded at the source end only, not at the drive end.

### RFI Filter Grounding

Using single phase drives with integral filter, or an external filter with any drive rating, may result in relatively high ground leakage currents. Therefore, the **filter must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded** (bonded) to the building power distribution ground. Ensure that the incoming supply neutral is solidly connected (bonded) to the same building power distribution ground. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. Some local codes may require redundant ground connections. The integrity of all connections should be periodically checked.

## Fuses and Circuit Breakers

The PowerFlex 40 does not provide branch short circuit protection. This product should be installed with either input fuses or an input circuit breaker. National and local industrial safety regulations and/or electrical codes may determine additional requirements for these installations.

**ATTENTION:** To guard against personal injury and/or equipment damage caused by improper fusing or circuit breaker selection, use only the recommended line fuses/circuit breakers specified in this section.

### Fusing

The PowerFlex 40 has been UL tested and approved for use with input fuses. The ratings in the table that follows are the minimum recommended values for use with each drive rating. The devices listed in this table are provided to serve as a guide.

### Bulletin 140M (Self-Protected Combination Controller)/UL489 Circuit Breakers

When using Bulletin 140M or UL489 rated circuit breakers, the guidelines listed below must be followed in order to meet the NEC requirements for branch circuit protection.

- Bulletin 140M can be used in single and group motor applications.
- Bulletin 140M can be used up stream from the drive **without** the need for fuses.

**Table 1.C Minimum Recommended Branch Circuit Protective Devices**

| Voltage Rating | Drive Rating *kW (HP)* | Fuse Rating[1] *Amps* | 140M Motor Protectors[2] [3] *Catalog No.* | Recommended MCS Contactors *Catalog No.* | Min. Enclosure Volume[4] *Inches$^3$* |
|---|---|---|---|---|---|
| 120V AC – 1-Phase | 0.4 (0.5) | 15 | 140M-C2E-C16 | 100-C12 | 1655 |
| | 0.75 (1.0) | 35 | 140M-D8E-C20 | 100-C23 | 1655 |
| | 1.1 (1.5) | 40 | 140M-F8E-C32 | 100-C37 | 1655 |
| 240V AC – 1-Phase | 0.4 (0.5) | 10 | 140M-C2E-B63 | 100-C09 | 1655 |
| | 0.75 (1.0) | 20 | 140M-C2E-C16 | 100-C12 | 1655 |
| | 1.5 (2.0) | 30 | 140M-D8E-C20 | 100-C23 | 1655 |
| | 2.2 (3.0) | 40 | 140M-F8E-C32 | 100-C37 | 2069 |
| 240V AC – 3-Phase | 0.4 (0.5) | 6 | 140M-C2E-B40 | 100-C07 | 1655 |
| | 0.75 (1.0) | 10 | 140M-C2E-C10 | 100-C09 | 1655 |
| | 1.5 (2.0) | 15 | 140M-C2E-C16 | 100-C12 | 1655 |
| | 2.2 (3.0) | 25 | 140M-C2E-C16 | 100-C23 | 1655 |
| | 3.7 (5.0) | 30 | 140M-F8E-C25 | 100-C23 | 1655 |
| | 5.5 (7.5) | 40 | 140M-F8E-C32 | 100-C37 | 2069 |
| | 7.5 (10.0) | 60 | 140M-G8E-C45 | 100-C60 | 2069 |
| 480V AC – 3-Phase | 0.4 (0.5) | 3 | 140M-C2E-B25 | 100-C07 | 1655 |
| | 0.75 (1.0) | 6 | 140M-C2E-B40 | 100-C07 | 1655 |
| | 1.5 (2.0) | 10 | 140M-C2E-B63 | 100-C09 | 1655 |
| | 2.2 (3.0) | 15 | 140M-C2E-C10 | 100-C09 | 1655 |
| | 4.0 (5.0) | 20 | 140M-C2E-C16 | 100-C23 | 1655 |
| | 5.5 (7.5) | 25 | 140M-D8E-C20 | 100-C23 | 2069 |
| | 7.5 (10.0) | 30 | 140M-D8E-C20 | 100-C23 | 2069 |
| | 11 (15) | 50 | 140M-F8E-C32 | 100-C43 | 2069 |
| 600V AC – 3-Phase | 0.75 (1.0) | 6 | 140M-C2E-B25 | 100-C09 | 1655 |
| | 1.5 (2.0) | 6 | 140M-C2E-B40 | 100-C09 | 1655 |
| | 2.2 (3.0) | 10 | 140M-D8E-B63 | 100-C09 | 1655 |
| | 4.0 (5.0) | 15 | 140M-D8E-C10 | 100-C09 | 1655 |
| | 5.5 (7.5) | 20 | 140M-D8E-C16 | 100-C16 | 2069 |
| | 7.5 (10.0) | 25 | 140M-D8E-C16 | 100-C23 | 2069 |
| | 11 (15) | 40 | 140M-F8E-C25 | 100-C30 | 2069 |

(1) Recommended Fuse Type: UL Class J, CC, T or Type BS88; 600V (550V) or equivalent.

(2) The AIC ratings of the Bulletin 140M Motor Protector Circuit Breakers may vary. See Bulletin 140M Motor Protection Circuit Breakers Application Ratings.

(3) Manual Self-Protected (Type E) Combination Motor Controller, UL listed for 208 Wye or Delta, 240 Wye or Delta, 480Y/277 or 600Y/347. Not UL listed for use on 480V or 600V Delta/Delta, corner ground, or high-resistance ground systems.

(4) When using a Manual Self-Protected (Type E) Combination Motor Controller, the drive must be installed in a ventilated or non-ventilated enclosure with the minimum volume specified in this column. Application specific thermal considerations may require a larger enclosure.

## Power Wiring

**ATTENTION:** National Codes and standards (NEC, VDE, BSI, etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

**ATTENTION:** To avoid a possible shock hazard caused by induced voltages, unused wires in the conduit must be grounded at both ends. For the same reason, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled. This will help minimize the possible shock hazard from “cross coupled” power leads.

### Motor Cable Types Acceptable for 200-600 Volt Installations

A variety of cable types are acceptable for drive installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits. As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (32.8 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than 15 mils (0.4 mm/0.015 in.). Do not route more than three sets of motor leads in a single conduit to minimize “cross talk”. If more than three drive/motor connections per conduit are required, shielded cable must be used.
UL installations in 50°C ambient must use 600V, 75°C or 90°C wire.
UL installations in 40°C ambient should use 600V, 75°C or 90°C wire.
Use copper wire only. Wire gauge requirements and recommendations are based on 75 degree C. Do not reduce wire gauge when using higher temperature wire.

#### Unshielded

THHN, THWN or similar wire is acceptable for drive installation in dry environments provided adequate free air space and/or conduit fill rates limits are provided. **Do not use THHN or similarly coated wire in wet areas**. Any wire chosen must have a minimum insulation thickness of 15 mils and should not have large variations in insulation concentricity.

#### Shielded/Armored Cable

Shielded cable contains all of the general benefits of multi-conductor cable with the added benefit of a copper braided shield that can contain much of the noise generated by a typical AC Drive. Strong consideration for shielded cable should be given in installations with sensitive equipment such as weigh scales, capacitive proximity switches and other devices that may be affected by electrical noise in the distribution system. Applications with large numbers of drives in a similar location, imposed EMC regulations or a high degree of communications / networking are also good candidates for shielded cable.

Shielded cable may also help reduce shaft voltage and induced bearing currents for some applications. In addition, the increased impedance of shielded cable may help extend the distance that the motor can be located from the drive without the addition of motor protective devices such as terminator networks. Refer to Reflected Wave in "Wiring and Grounding Guidelines for PWM AC Drives," publication DRIVES-IN001A-EN-P.

Consideration should be given to all of the general specifications dictated by the environment of the installation, including temperature, flexibility, moisture characteristics and chemical resistance. In addition, a braided shield should be included and be specified by the cable manufacturer as having coverage of at least 75%. An additional foil shield can greatly improve noise containment.

A good example of recommended cable is Belden® 295xx (xx determines gauge). This cable has four (4) XLPE insulated conductors with a 100% coverage foil and an 85% coverage copper braided shield (with drain wire) surrounded by a PVC jacket.

Other types of shielded cable are available, but the selection of these types may limit the allowable cable length. Particularly, some of the newer cables twist 4 conductors of THHN wire and wrap them tightly with a foil shield. This construction can greatly increase the cable charging current required and reduce the overall drive performance. Unless specified in the individual distance tables as tested with the drive, these cables are not recommended and their performance against the lead length limits supplied is not known.

**Recommended Shielded Wire**

| Location | Rating/Type | Description |
|---|---|---|
| Standard (Option 1) | 600V, 90°C (194°F) XHHW2/RHW-2 Anixter B209500-B209507, Belden 29501-29507, or equivalent | • Four tinned copper conductors with XLPE insulation.<br>• Copper braid/aluminum foil combination shield and tinned copper drain wire.<br>• PVC jacket. |
| Standard (Option 2) | Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter OLF-7xxxxx or equivalent | • Three tinned copper conductors with XLPE insulation.<br>• 5 mil single helical copper tape (25% overlap min.) with three bare copper grounds in contact with shield.<br>• PVC jacket. |
| Class I & II; Division I & II | Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter 7V-7xxxx-3G or equivalent | • Three bare copper conductors with XLPE insulation and impervious corrugated continuously welded aluminum armor.<br>• Black sunlight resistant PVC jacket overall.<br>• Three copper grounds on #10 AWG and smaller. |

## Reflected Wave Protection

The drive should be installed as close to the motor as possible. Installations with long motor cables may require the addition of external devices to limit voltage reflections at the motor (reflected wave phenomena). See Table 1.D for recommendations.

The reflected wave data applies to all frequencies 2 to 16 kHz.

For 240V ratings, reflected wave effects do not need to be considered.

**Table 1.D Maximum Cable Length Recommendations**

| Reflected Wave | | |
|---|---|---|
| **380-480V Ratings** | **Motor Insulation Rating** | **Motor Cable Only**(1) |
| | 1000 Vp-p | 15 meters (49 feet) |
| | 1200 Vp-p | 40 meters (131 feet) |
| | 1600 Vp-p | 170 meters (558 feet) |

(1) Longer cable lengths can be achieved by installing devices on the output of the drive. Consult factory for recommendations.

## Output Disconnect

The drive is intended to be commanded by control input signals that will start and stop the motor. A device that routinely disconnects then reapplies output power to the motor for the purpose of starting and stopping the motor should not be used. If it is necessary to disconnect power to the motor with the drive outputting power, an auxiliary contact should be used to simultaneously disable drive control run commands.

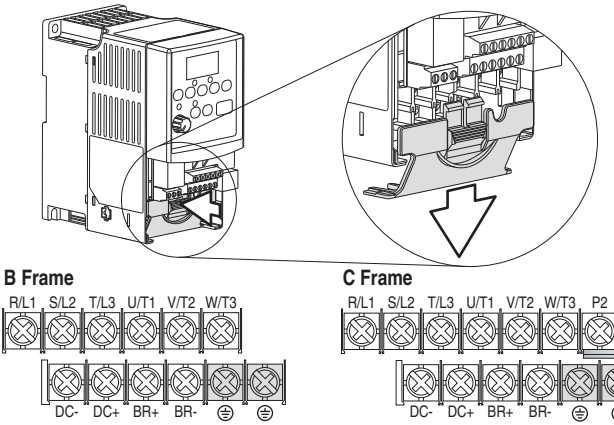
## Power Terminal Block

The power terminal block is covered by a finger guard. To remove:

1. Press in and hold the locking tab.
2. Slide finger guard down and out.

Replace the finger guard when wiring is complete.

**Figure 1.4 Power Terminal Block (Typical)**




| Terminal (1) | Description |
|---|---|
| R/L1, S/L2 | 1-Phase Input |
| R/L1, S/L2, T/L3 | 3-Phase Input |
| U/T1 | To Motor U/T1 |
| V/T2 | To Motor V/T2 = Switch any two motor leads to change forward direction. |
| W/T3 | To Motor W/T3 |
| P2, P1 | DC Bus Inductor Connection (C Frame drives only.)<br>The C Frame drive is shipped with a jumper between Terminals P2 and P1. Remove this jumper only when a DC Bus Inductor will be connected. Drive will not power up without a jumper or inductor connected. |
| DC+, DC- | DC Bus Connection |
| BR+, BR- | Dynamic Brake Resistor Connection |
| ⏚ | Safety Ground - PE |

(1) **Important:** Terminal screws may become loose during shipment. Ensure that all terminal screws are tightened to the recommended torque before applying power to the drive.

**Table 1.E Power Terminal Block Specifications**

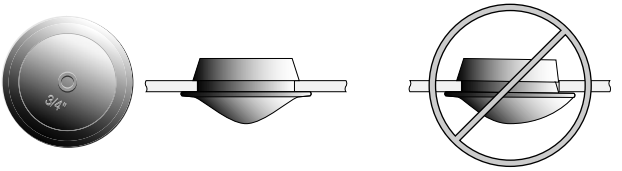
| Frame | Maximum Wire Size(1) | Minimum Wire Size(1) | Torque |
|---|---|---|---|
| B | 5.3 $mm^2$ (10 AWG) | 1.3 $mm^2$ (16 AWG) | 1.7-2.2 N-m (16-19 lb.-in.) |
| C | 8.4 $mm^2$ (8 AWG) | 1.3 $mm^2$ (16 AWG) | 2.9-3.7 N-m (26-33 lb.-in.) |

(1) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

## IP66, NEMA/UL Type 4X Installations

Use the plugs supplied with IP66, NEMA/UL Type 4X rated drives to seal unused holes in the conduit entry plate.

**Important:** Completely seat the plug inner rim for the best seal.



## I/O Wiring Recommendations

### Motor Start/Stop Precautions

**ATTENTION:** A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If used, the input device must not exceed one operation per minute or drive damage can occur.

**ATTENTION:** The drive start/stop control circuitry includes solid-state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. When the AC line is removed, there will be a loss of any inherent regenerative braking effect that might be present - the motor will coast to a stop. An auxiliary braking method may be required.

Important points to remember about I/O wiring:

- Always use copper wire.
- Wire with an insulation rating of 600V or greater is recommended.
- Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

**Important:** I/O terminals labeled “Common” are not referenced to the safety ground (PE) terminal and are designed to greatly reduce common mode interference.

**ATTENTION:** Driving the 4-20mA analog input from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.

## Control Wire Types

**Table 1.F Recommended Control and Signal Wire**(1)

| Wire Type(s)(2) | Description | Minimum Insulation Rating |
|---|---|---|
| Belden 8760/9460 (or equiv.) | 0.8 $mm^2$ (18 AWG), twisted pair, 100% shield with drain. | 300V 60 degrees C (140 degrees F) |
| Belden 8770 (or equiv.) | 0.8 $mm^2$ (18 AWG), 3 conductor, shielded for remote pot only. | |

(1) If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

(2) Stranded or solid wire.

## I/O Terminal Block

**Table 1.G I/O Terminal Block Specifications**

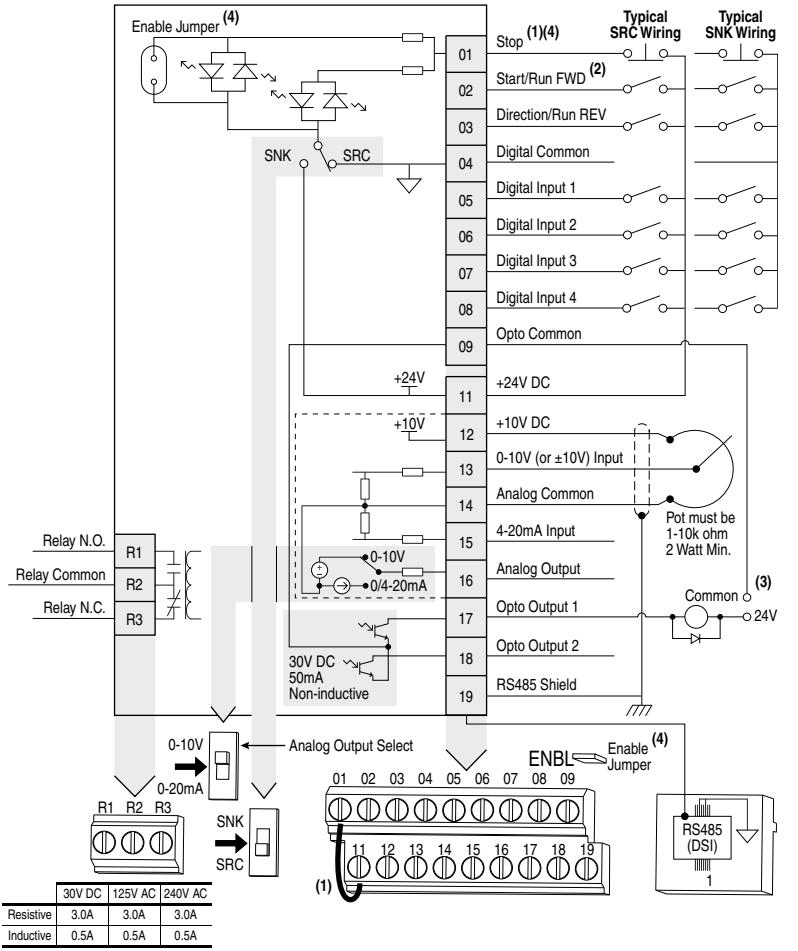
| Frame | Maximum Wire Size (3) | Minimum Wire Size (3) | Torque |
|---|---|---|---|
| B & C | 1.3 $mm^2$ (16 AWG) | 0.2 $mm^2$ (24 AWG) | 0.5-0.8 N-m (4.4-7 lb.-in.) |

(3) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

## Maximum Control Wire Recommendations

Do not exceed control wiring length of 30 meters (100 feet). Control signal cable length is highly dependent on electrical environment and installation practices. To improve noise immunity, the I/O terminal block Common must be connected to ground terminal/protective earth. If using the RS485 (DSI) port, I/O Terminal 16 should also be connected to ground terminal/protective earth.

**Figure 1.5 Control Wiring Block Diagram**




| | 30V DC | 125V AC | 240V AC |
|---|---|---|---|
| Resistive | 3.0A | 3.0A | 3.0A |
| Inductive | 0.5A | 0.5A | 0.5A |

(1) **Important:** I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set to "3-Wire" or "Momt FWD/REV" control. In three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode]. All other stop sources are controlled by P037 [Stop Mode].

| P036 [Start Source] | Stop | I/O Terminal 01 Stop |
|---|---|---|
| Keypad | Per P037 | Coast |
| 3-Wire | Per P037 | Per P037(4) |
| 2-Wire | Per P037 | Coast |
| Momt FWD/REV | Per P037 | Per P037(4) |
| RS485 Port | Per P037 | Coast |

**Important:** The drive is shipped with a jumper installed between I/O Terminals 01 and 11. Remove this jumper when using I/O Terminal 01 as a stop or enable input.

(2) Two wire control shown. For three wire control use a momentary input on I/O Terminal 02 to command a start. Use a maintained input for I/O Terminal 03 to change direction.

(3) When using an opto output with an inductive load such as a relay, install a recovery diode parallel to the relay as shown, to prevent damage to the output.

(4) When the ENBL enable jumper is removed, I/O Terminal 01 will always act as a hardware enable, causing a coast to stop without software interpretation.

**Table 1.H Control I/O Terminal Designations**

| No. | Signal | Default | Description | Param. |
|---|---|---|---|---|
| R1 | Relay N.O. | Fault | Normally open contact for output relay. | A055 |
| R2 | Relay Common | – | Common for output relay. | |
| R3 | Relay N.C. | Fault | Normally closed contact for output relay. | A055 |

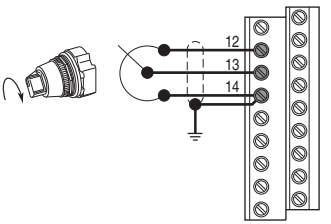
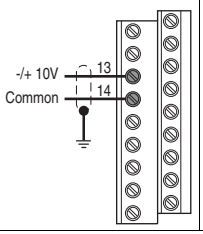
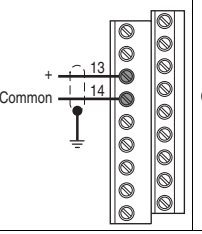
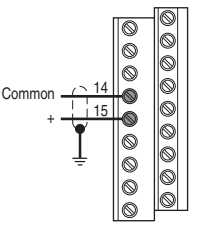
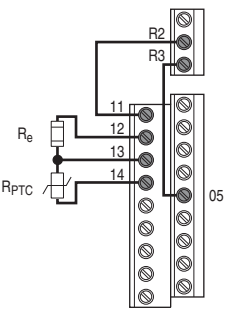
| | | |
|---|---|---|
| Analog Output Select DIP Switch | 0-10V | Sets analog output to either voltage or current. Setting must match A065 [Analog Out Sel]. |
| Sink/Source DIP Switch | Source (SRC) | Inputs can be wired as Sink (SNK) or Source (SRC) via DIP Switch setting. |

| | | | | |
|---|---|---|---|---|
| 01 | Stop (1) | Coast | The factory installed jumper or a normally closed input must be present for the drive to start. | P036 (1) |
| 02 | Start/Run FWD | Not Active | Command comes from the integral keypad by default. To disable reverse operation, see A095 [Reverse Disable]. | P036, P037 |
| 03 | Direction/Run REV | Not Active | | P036, P037, A095 |
| 04 | Digital Common | – | For digital inputs. Electronically isolated with digital inputs from analog I/O and opto outputs. | |
| 05 | Digital Input 1 | Preset Freq | Program with A051 [Digital In1 Sel]. | A051 |
| 06 | Digital Input 2 | Preset Freq | Program with A052 [Digital In2 Sel]. | A052 |
| 07 | Digital Input 3 | Local | Program with A053 [Digital In3 Sel]. | A053 |
| 08 | Digital Input 4 | Jog Forward | Program with A054 [Digital In4 Sel]. | A054 |
| 09 | Opto Common | – | For opto-coupled outputs. Electronically isolated with opto outputs from analog I/O and digital inputs. | |
| 11 | +24V DC | – | Referenced to Digital Common.<br>Drive supplied power for digital inputs.<br>Maximum output current is 100mA. | |
| 12 | +10V DC | – | Referenced to Analog Common.<br>Drive supplied power for 0-10V external potentiometer.<br>Maximum output current is 15mA. | P038 |
| 13 | ±10V In (2) | Not Active | For external 0-10V (unipolar) or ±10V (bipolar) input supply (input impedance = 100k ohm) or potentiometer wiper. | P038, A051-A054, A123, A132 |
| 14 | Analog Common | – | For 0-10V In or 4-20mA In. Electronically isolated with analog inputs and outputs from digital I/O and opto outputs. | |
| 15 | 4-20mA In (2) | Not Active | For external 4-20mA input supply (input impedance = 250 ohm). | P038, A051-A054, A132 |
| 16 | Analog Output | OutFreq 0-10 | The default analog output is 0-10V. To covert to a current value, change the Analog Output Select DIP Switch to 0-20mA. Program with A065 [Analog Out Sel]. Max analog value can be scaled with A066 [Analog Out High].<br>Maximum Load: 4-20mA = 525 ohm (10.5V)<br>0-10V = 1k ohm (10mA) | A065, A066 |
| 17 | Opto Output 1 | MotorRunning | Program with A058 [Opto Out1 Sel] | A058, A059, A064 |
| 18 | Opto Output 2 | At Frequency | Program with A061 [Opto Out2 Sel] | A061, A062, A064 |
| 19 | RS485 (DSI) Shield | – | Terminal should be connected to safety ground - PE when using the RS485 (DSI) communications port. | |

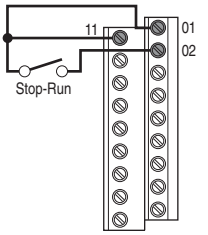
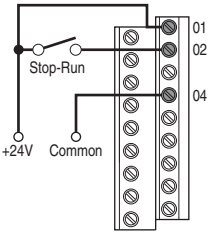
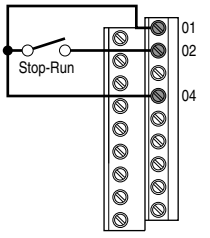
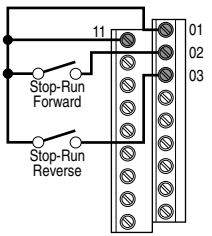
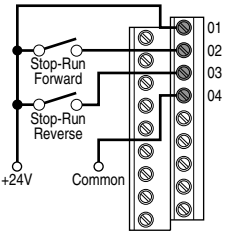
(1) See Footnotes (1) and (4) on page 1-16.

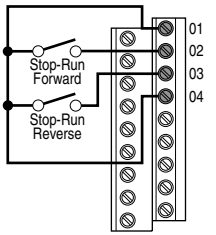
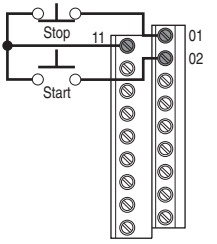
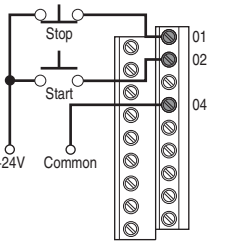
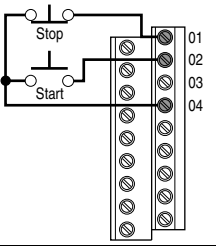
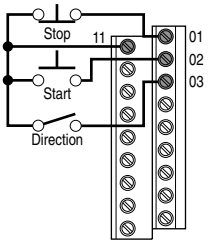
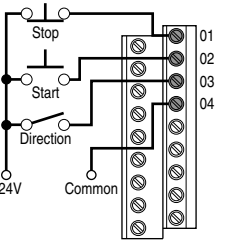
(2) 0-10V In and 4-20mA In are distinct input channels and may be connected simultaneously. Inputs may be used independently for speed control or jointly when operating in PID mode.

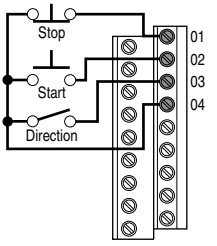
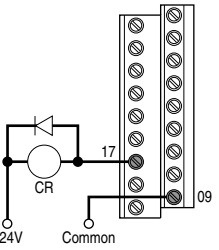
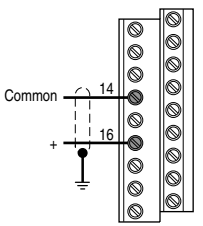
## I/O Wiring Examples

<table>
<tr><th>Input/Output</th><th colspan="3">Connection Example</th></tr>
<tr><td rowspan="2">Potentiometer<br>1-10k Ohm Pot. Recommended<br>(2 Watt minimum)</td><td colspan="3">P038 [Speed Reference] = 2 “0-10V Input”</td></tr>
<tr><td colspan="3"> 
</td></tr>
<tr><td rowspan="2">Analog Input<br>0 to +10V, 100k ohm impedance<br>4-20 mA, 250 ohm impedance</td><td>Bipolar<br>P038 [Speed Reference] = 2 “0-10V Input” and A123 [10V Bipolar Enbl] = 1 “Bi-Polar In”</td><td>Unipolar (Voltage)<br>P038 [Speed Reference] = 2 “0-10V Input”</td><td>Unipolar (Current)<br>P038 [Speed Reference] = 3 “4-20mA Input”</td></tr>
<tr><td> 
</td><td> 
</td><td> 
</td></tr>
<tr><td>Analog Input, PTC<br>For Drive Fault</td><td colspan="3">Wire the PTC and External Resistor (typically matched to the PTC Hot Resistance) to I/O Terminals 12, 13, 14.<br>Wire R2/R3 Relay Output (SRC) to I/O Terminals 5 & 11.<br>A051 [Digital In1 Sel] = 3 “Aux Fault”<br>A055 [Relay Out Sel] = 10 “Above Anlg V”<br>A056 [Relay Out Level] = % Voltage Trip</td></tr>
<tr><td></td><td colspan="3"> 

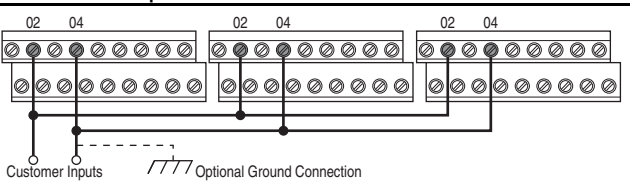
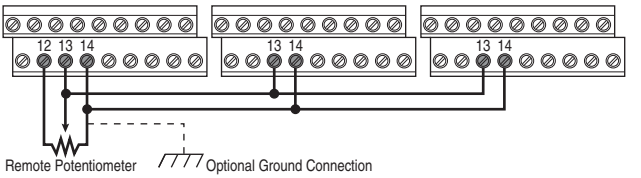
$$V_{Trip} = \frac{R_{PTC\ (hot)}}{R_{PTC\ (hot)} + R_e} \times 100$$</td></tr>
</table>

<table>
<tr><th>Input/Output</th><th colspan="2">Connection Example</th></tr>
<tr><td rowspan="2">2 Wire SRC Control - Non-Reversing<br>P036 [Start Source] = 2, 3 or 4<br>Input must be active for the drive to run. When input is opened, the drive will stop as specified by P037 [Stop Mode].<br>If desired, a User Supplied 24V DC power source can be used. Refer to the “External Supply (SRC)” example.</td><td>Internal Supply (SRC)<br> 
</td><td>External Supply (SRC)<br> 
<br>Each digital input draws 6 mA.</td></tr>
<tr><td colspan="2">2 Wire SNK Control - Non-Reversing</td><td>Internal Supply (SNK)<br> 
</td></tr>
<tr><td rowspan="2">2 Wire SRC Control - Run FWD/Run REV<br>P036 [Start Source] = 2, 3 or 4<br>Input must be active for the drive to run. When input is opened, the drive will stop as specified by P037 [Stop Mode].<br>If both Run Forward and Run Reverse inputs are closed at the same time, an undetermined state could occur.</td><td>Internal Supply (SRC)<br> 
</td><td>External Supply (SRC)<br> 
<br>Each digital input draws 6 mA.</td></tr>
</table>

<table>
<tr><th>Input/Output</th><th colspan="2">Connection Example</th></tr>
<tr><td>2 Wire SNK Control - Run FWD/Run REV</td><td colspan="2">Internal Supply (SNK)<br> 
</td></tr>
<tr><td>3 Wire SRC Control - Non-Reversing<br>P036 [Start Source] = 1<br>A momentary input will start the drive. A stop input to I/O Terminal 01 will stop the drive as specified by P037 [Stop Mode].</td><td>Internal Supply (SRC)<br> 
</td><td>External Supply (SRC)<br> 
<br>Each digital input draws 6 mA.</td></tr>
<tr><td>3 Wire SNK Control - Non-Reversing</td><td colspan="2">Internal Supply (SNK)<br> 
</td></tr>
<tr><td>3 Wire SRC Control - Reversing<br>P036 [Start Source] = 1<br>A momentary input will start the drive. A stop input to I/O Terminal 01 will stop the drive as specified by P037 [Stop Mode]. I/O Terminal 03 determines direction.</td><td>Internal Supply (SRC)<br> 
</td><td>External Supply (SRC)<br> 
<br>Each digital input draws 6 mA.</td></tr>
</table>

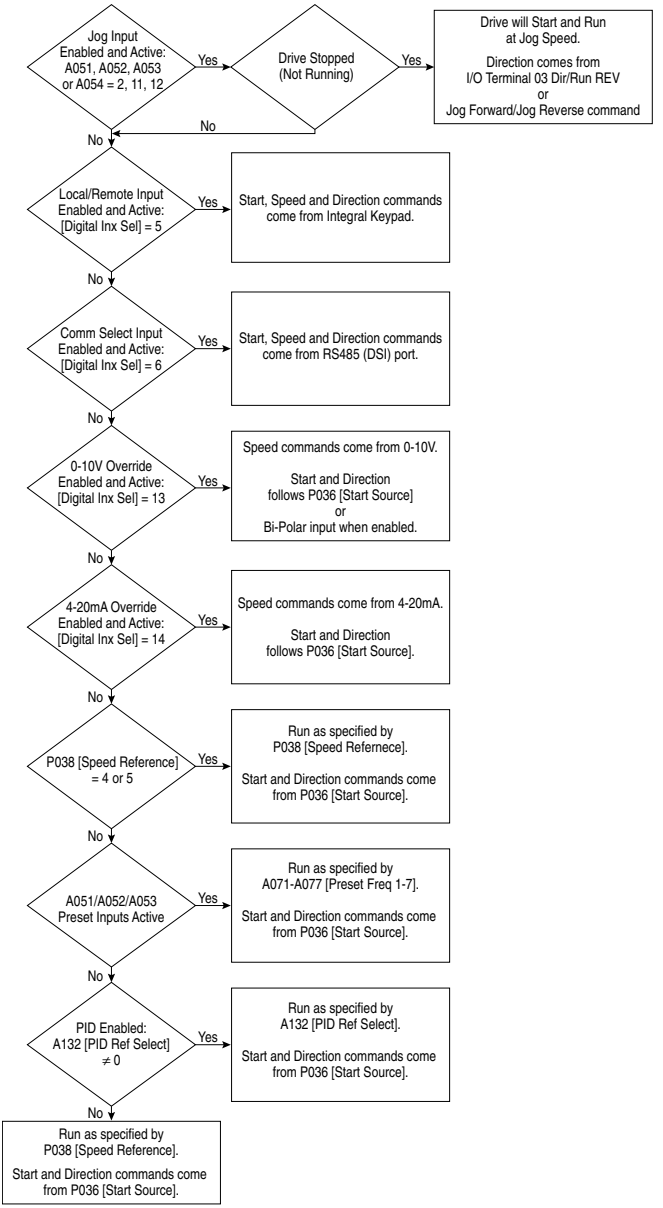
| Input/Output | Connection Example |
|---|---|
| **3 Wire SNK Control - Reversing** | Internal Supply (SNK)<br>  |
| **Opto Output (1 & 2)**<br>A058 [Opto Out1 Sel] determines Opto-Output 1 (I/O Terminal 17) operation.<br>A061 [Opto Out2 Sel] determines Opto-Output 2 (I/O Terminal 18) operation.<br>When using Opto-Output with an inductive load such as a relay, install a recovery diode parallel to the relay as shown, to prevent damage to the output. | Opto-Output 1<br>  <br>Each Opto-Output is rated 30V DC 50 mA (Non-inductive). |
| **Analog Output**<br>A065 [Analog Out Sel] determines analog output type and drive conditions.<br>0-10V,<br>1k ohm minimum<br><br>0-20mA/4-20mA,<br>525 ohm maximum | A065 [Analog Out Sel] = 0 through 14<br>The Analog Output Select DIP Switch must be set to match the analog output signal mode set in A065 [Analog Out Sel].<br>  |

## Typical Multiple Drive Connection Examples

| Input/Output | Connection Example |
|---|---|
| **Multiple Digital Input Connections**<br>Customer Inputs can be wired per External Supply (SRC) examples on 1-19 and 1-20. |  <br>When connecting a single input such as Run, Stop, Reverse or Preset Speeds to multiple drives, it is important to connect I/O Terminal 04 common together for all drives. If they are to be tied into another common (such as earth ground or separate apparatus ground) only one point of the daisy chain of I/O Terminal 04 should be connected.<br><br>**ATTENTION:** Digital inputs on multiple drives should **not** be tied together when using SNK (Internal Supply) mode. In SNK mode, if power is removed from one drive, inadvertent operation of other drives that share the same I/O Common connection may occur. |
| **Multiple Analog Connections** |  <br>When connecting a single potentiometer to multiple drives it is important to connect I/O Terminal 14 common together for all drives. I/O Terminal 14 common and I/O Terminal 13 (potentiometer wiper) should be daisy-chained to each drive. All drives must be powered up for the analog signal to be read correctly. |

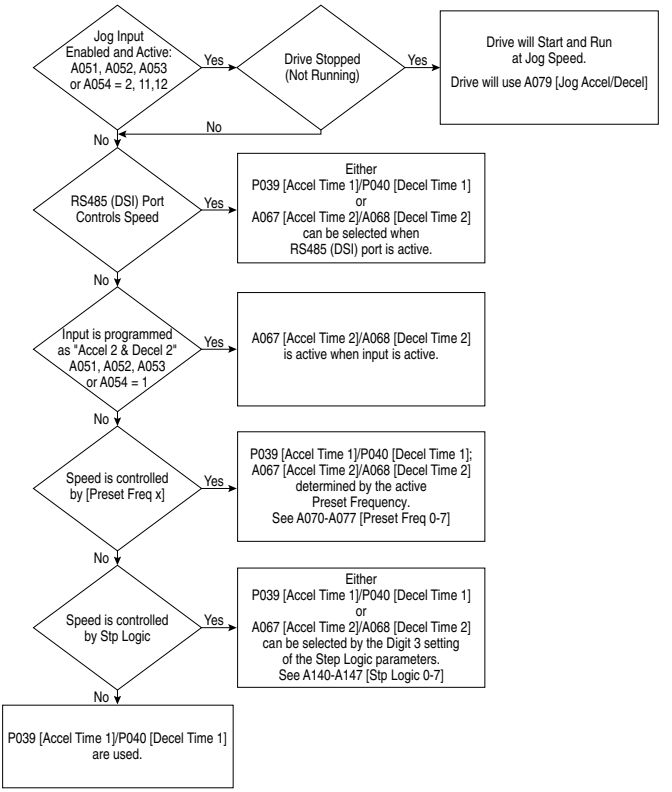
## Start and Speed Reference Control

The drive speed command can be obtained from a number of different sources. The source is normally determined by P038 [Speed Reference]. However, when A051 - A054 [Digital Inx Sel] is set to option 2, 4, 5, 6, 11, 12, 13, 14, 15 and the digital input is active, or if A132 is not set to option 0, the speed reference commanded by P038 [Speed Reference] will be overridden. See the chart below for the override priority.



## Accel/Decel Selection

The Accel/Decel rate can be obtained by a variety of methods. The default rate is determined by P039 [Accel Time 1] and P040 [Decel Time 1]. Alternative Accel/Decel rates can be made through digital inputs, RS485 (DSI) communications and/or parameters. See the chart below for the override priority.



## EMC Instructions

### CE Conformity

Conformity with the Low Voltage (LV) Directive and Electromagnetic Compatibility (EMC) Directive has been demonstrated using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. PowerFlex Drives comply with the EN standards listed below when installed according to the User Manual.

CE Declarations of Conformity are available online at:
**http://www.ab.com/certification/ce/docs**.

### Low Voltage Directive (73/23/EEC)

- EN50178 Electronic equipment for use in power installations

### EMC Directive (89/336/EEC)

- EN61800-3 Adjustable speed electrical power drive systems Part 3: EMC product standard including specific test methods.

### General Notes

- If the plastic top panel is removed or the optional conduit box is not installed, the drive must be installed in an enclosure with side openings less than 12.5 mm (0.5 in.) and top openings less than 1.0 mm (0.04 in.) to maintain compliance with the LV Directive.
- The motor cable should be kept as short as possible in order to avoid electromagnetic emission as well as capacitive currents.
- Use of line filters in ungrounded systems is not recommended.
- Conformity of the drive with CE EMC requirements does not guarantee an entire machine installation complies with CE EMC requirements. Many factors can influence total machine/installation compliance.

## Essential Requirements for CE Compliance

Conditions 1-3 listed below **must be** satisfied for PowerFlex drives to meet the requirements of **EN61800-3**.

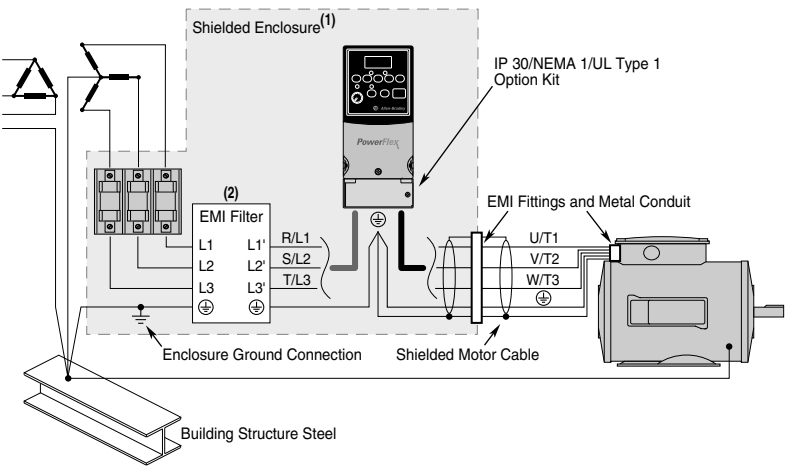
1. Grounding as described in Figure 1.6. Refer to page 1-8 for additional grounding recommendations.
2. Output power, control (I/O) and signal wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit or equivalent attenuation.
3. Allowable cable length in Table 1.I is not exceeded.

**Table 1.I Allowable Cable Length**

| Filter Type | EN61800-3 First Environment Restricted Distribution or Second Environment (2) | EN61800-3 First Environment Unrestricted Distribution (3) |
|---|---|---|
| Integral | 10 meters (33 feet) | 1 meter (3 feet) |
| External - S Type(1) | 10 meters (33 feet) | 1 meter (3 feet) |
| External - L Type(1) | 100 meters (328 feet) | 5 meters (16 feet) |

(1) Refer to Appendix B for details on optional external filters.
(2) Equivalent to EN55011 Class A.
(3) Equivalent to EN55011 Class B.

**Figure 1.6 Connections and Grounding**




(1) First Environment Unrestricted Distribution installations require a shielded enclosure. Keep wire length as short as possible between the enclosure entry point and the EMI filter.
(2) Integral EMI filters are available on 240V, 1-Phase drives.

### EN61000-3-2

- 0.75 kW (1 HP) 240V 1-Phase and 3-Phase drives and 0.37 kW (0.5 HP) 240V 1-Phase drives are suitable for installation on a private low voltage power network. Installations on a public low voltage power network may require additional external harmonic mitigation.
- Other drive ratings meet the current harmonic requirements of EN61000-3-2 without additional external mitigation.

**Notes:**

# Start Up

This chapter describes how to start up the PowerFlex 40 Drive. To simplify drive setup, the most commonly programmed parameters are organized in a single Basic Program Group.

**Important:** Read the *General Precautions* section before proceeding.

**ATTENTION:** Power must be applied to the drive to perform the following start-up procedures. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, **Do Not Proceed**. **Remove All Power** including user supplied control voltages. User supplied voltages may exist even when main AC power is not applied to the drive. Correct the malfunction before continuing.

## Prepare For Drive Start-Up

### Before Applying Power to the Drive

❑ **1.** Confirm that all inputs are connected to the correct terminals and are secure.

❑ **2.** Verify that AC line power at the disconnect device is within the rated value of the drive.

❑ **3.** Verify that any digital control power is 24 volts.

❑ **4.** Verify that the Sink (SNK)/Source (SRC) Setup DIP Switch is set to match your control wiring scheme. See Figure 1.5 on page 1-16 for location.

**Important:** The default control scheme is Source (SRC). The Stop terminal is jumpered (I/O Terminals 01 and 11) to allow starting from the keypad. If the control scheme is changed to Sink (SNK), the jumper must be removed from I/O Terminals 01 and 11 and installed between I/O Terminals 01 and 04.

❑ **5.** Verify that the Stop input is present or the drive will not start.

**Important:** If I/O Terminal 01 is used as a stop input, the jumper between I/O Terminals 01 and 11 must be removed.

### Applying Power to the Drive

❑ **6.** Apply AC power and control voltages to the drive.

❑ **7.** Familiarize yourself with the integral keypad features (see page 2-4) before setting any Program Group parameters.

If a fault appears on power up, refer to Fault Descriptions on page 4-3 for an explanation of the fault code.

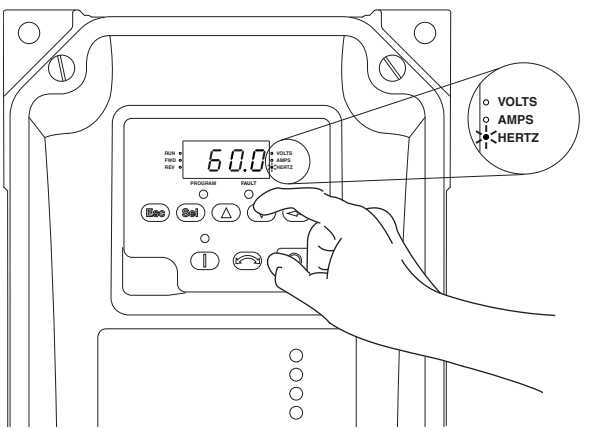
### Start, Stop, Direction and Speed Control

Factory default parameter values allow the drive to be controlled from the integral keypad. No programming is required to start, stop, change direction and control speed directly from the integral keypad.

**Important:** To disable reverse operation, see A095 [Reverse Disable].

### Changing the Speed Reference of an IP66, NEMA/UL Type 4X rated drive

When a Display Group parameter, for example, d001 [Output Freq] is displayed, and P038 [Speed Ref] is set to A069 [Internal Freq], you can change the internal frequency using the Up Arrow and Down Arrow keys.




When the internal frequency is being adjusted, its value is displayed and the Hertz LED flashes. Any changes are saved immediately. The display then returns to the Display Group parameter previously shown.

**TIP:** By default, the speed reference of an IP66, NEMA/UL Type 4X rated drive is set to the internal frequency, A069 [Internal Freq].

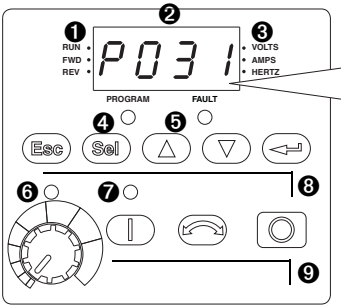
**TIP:** You can also change the speed reference by editing the parameter A069 [Internal Freq] in program mode. For details on how to enter the program mode, see Viewing and Editing Parameters on page 2-5.

Note: The default value of A069 [Internal Freq] is 0 Hz. For IP20 rated PowerFlex 40 drives, the default value of this parameter is 60 Hz.

### Variable Torque Fan/Pump Applications

For improved motor tuning performance when using a premium efficient motor on a variable torque load, set A084 [Boost Select] to option 2 “35.0, VT”.

## Integral Keypad




| Menu | Description |
|---|---|
| d | **Display Group (View Only)**<br>Consists of commonly viewed drive operating conditions. |
| P | **Basic Program Group**<br>Consists of most commonly used programmable functions. |
| A | **Advanced Program Group**<br>Consists of remaining programmable functions. |
| F | **Fault Designator**<br>Consists of list of codes for specific fault conditions. Displayed only when fault is present. |

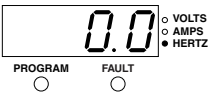
| No. | LED | LED State | Description |
|---|---|---|---|
| ❶ | Run/Direction Status | Steady Red | Indicates drive is running and commanded motor direction. |
| | | Flashing Red | Drive has been commanded to change direction. Indicates actual motor direction while decelerating to zero. |
| ❷ | Alphanumeric Display | Steady Red | Indicates parameter number, parameter value, or fault code. |
| | | Flashing Red | Single digit flashing indicates that digit can be edited.<br>All digits flashing indicates a fault condition. |
| ❸ | Displayed Units | Steady Red | Indicates the units of the parameter value being displayed. |
| ❹ | Program Status | Steady Red | Indicates parameter value can be changed. |
| ❺ | Fault Status | Flashing Red | Indicates drive is faulted. |
| ❻ | Pot Status | Steady Green | Indicates potentiometer on Integral Keypad is active.(1) |
| ❼ | Start Key Status | Steady Green | Indicates Start key on Integral Keypad is active.<br>The Reverse key is also active unless disabled by A095 [Reverse Disable]. |

| No. | Key | Name | Description |
|---|---|---|---|
| ❽ | Esc | Escape | Back one step in programming menu.<br>Cancel a change to a parameter value and exit Program Mode. |
| | Sel | Select | Advance one step in programming menu.<br>Select a digit when viewing parameter value. |
| | △ ▽ | Up Arrow<br>Down Arrow | Scroll through groups and parameters.<br>Increase/decrease the value of a flashing digit.<br>Used to adjust internal frequency of IP66, NEMA/UL Type 4X rated drives *only* when a Display Group parameter is shown and P038 [Speed Reference] is set to internal frequency, A069 [Internal Freq]. |
| | ↵ | Enter | Advance one step in programming menu.<br>Save a change to a parameter value. |
| ❾ | | Potentiometer(1) | Used to control speed of drive. Default is active.<br>Controlled by parameter P038 [Speed Reference]. |
| | | Start | Used to start the drive. Default is active.<br>Controlled by parameter P036 [Start Source]. |
| | | Reverse | Used to reverse direction of the drive. Default is active.<br>Controlled by parameters P036 [Start Source] and A095 [Reverse Disable]. |
| | | Stop | Used to stop the drive or clear a fault.<br>This key is always active.<br>Controlled by parameter P037 [Stop Mode]. |

(1) IP66, NEMA/UL Type 4X rated drives are not equipped with a potentiometer.

## Viewing and Editing Parameters

The last user-selected Display Group parameter is saved when power is removed and is displayed by default when power is reapplied.
The following is an example of basic integral keypad and display functions. This example provides basic navigation instructions and illustrates how to program the first Program Group parameter.

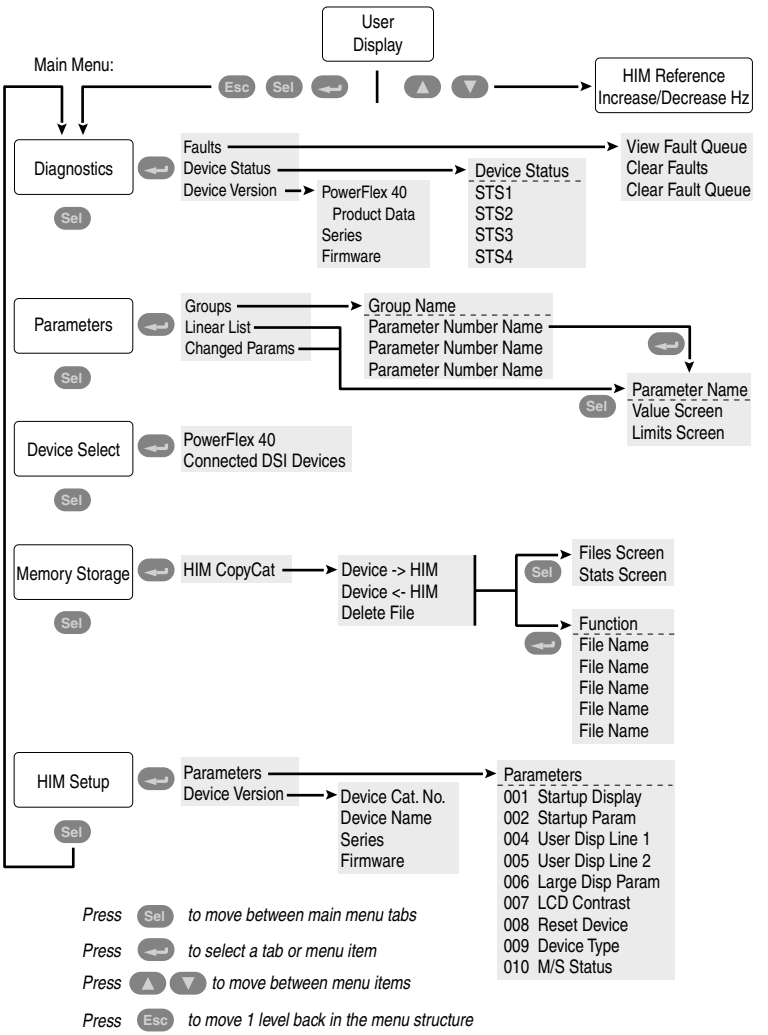
| Step | Key(s) | Example Displays |
|---|---|---|
| 1. When power is applied, the last user-selected Display Group parameter number is briefly displayed with flashing characters. The display then defaults to that parameter's current value. (Example shows the value of d001 [Output Freq] with the drive stopped.) | |   |
| 2. Press Esc once to display the Display Group parameter number shown on power-up. The parameter number will flash. | Esc | |
| 3. Press Esc again to enter the group menu. The group menu letter will flash. | Esc | |
| 4. Press the Up Arrow or Down Arrow to scroll through the group menu (d, P and A). | ▲ or ▼ | |
| 5. Press Enter or Sel to enter a group. The right digit of the last viewed parameter in that group will flash. | ↵ or Sel | |
| 6. Press the Up Arrow or Down Arrow to scroll through the parameters that are in the group. | ▲ or ▼ | |
| 7. Press Enter or Sel to view the value of a parameter. If you do not want to edit the value, press Esc to return to the parameter number. | ↵ or Sel | |
| 8. Press Enter or Sel to enter program mode to edit the parameter value. The right digit will flash and the Program LED will illuminate if the parameter can be edited. | ↵ or Sel | |
| 9. Press the Up Arrow or Down Arrow to change the parameter value. If desired, press Sel to move from digit to digit or bit to bit. The digit or bit that you can change will flash. | ▲ or ▼ | |
| 10. Press Esc to cancel a change. The digit will stop flashing, the previous value is restored and the Program LED will turn off.<br>Or<br>Press Enter to save a change. The digit will stop flashing and the Program LED will turn off. | Esc<br>↵ | |
| 11. Press Esc to return to the parameter list. Continue to press Esc to back out of the programming menu.<br>If pressing Esc does not change the display, then d001 [Output Frequency] is displayed. Press Enter or Sel to enter the group menu. | Esc | |

The Basic Program Group (page 3-9) contains the most commonly changed parameters.

## Remote HIM Menu Structure

The Menu Structure below can be accessed through the following Human Interface Module options:

| HIM Option | Catalog Number |
|---|---|
| Remote Panel Mount Small, LCD Display | 22-HIM-C2S |
| Remote Handheld, LCD Display | 22-HIM-A3 |



### Diagnostics Menu

When a fault trips the drive, use this menu to access detailed data about the drive.

| Option | Description |
|---|---|
| Faults | View fault queue or fault information, clear faults or clear fault queue. |
| Device Status | View status information about the drive or peripheral. |
| Device Version | View the firmware version and hardware series of components. |

### Parameters Menu

Use this menu to access drive parameters. Parameters can be displayed in groups, in a linear list, or only those changed from their defaults.

### Device Select Menu

Use this menu to access the drive or peripheral that the drive is to access.

### Memory Storage Menu

Drive data can be saved to, or recalled from HIM sets.
*HIM sets* are files stored in permanent nonvolatile HIM memory.

| Option | Description |
|---|---|
| HIM Copycat<br>Device -> HIM<br>Device <- HIM | Save data to a HIM set or load data from a HIM set to active drive memory. A maximum of 5 HIM set can be stored. |
| Delete File | Delete a HIM set. |

### HIM Setup Menu

The HIM and drive have features that you can customize.

| Option | Description |
|---|---|
| Parameters | Access parameters in HIM to set display options. |
| Device Version | View HIM version, hardware series and firmware version |

**Notes:**

# Programming and Parameters

Chapter 3 provides a complete listing and description of the PowerFlex 40 parameters. Parameters are programmed (viewed/edited) using the integral keypad. As an alternative, programming can also be performed using DriveExplorer™ or DriveExecutive™ software, a personal computer and a serial converter module. Refer to Appendix B for catalog numbers.


| For information on... | See page... |
|---|---|
| About Parameters | 3-1 |
| Parameter Organization | 3-2 |
| Basic Program Group | 3-9 |
| Advanced Program Group | 3-14 |
| Parameter Cross Reference – by Name | 3-45 |


## About Parameters

To configure a drive to operate in a specific way, drive parameters may have to be set. Three types of parameters exist:

- **ENUM**
  ENUM parameters allow a selection from 2 or more items. Each item is represented by a number.
- **Numeric Parameters**
  These parameters have a single numerical value (i.e. 0.1 Volts).
- **Bit Parameters**
  Bit parameters have four individual bits associated with features or conditions. If the bit is 0, the feature is off or the condition is false. If the bit is 1, the feature is on or the condition is true.

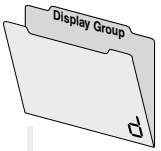
Some parameters are marked as follows.

= Stop drive before changing this parameter.

= 32 bit parameter. Parameters marked 32 bit will have two parameter numbers when using RS485 communications and programming software.

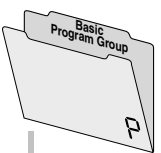
## Parameter Organization

Refer to page 3-45 for an alphabetical listing of parameters.



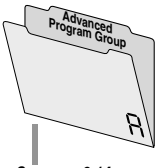

*See page 3-3*

| | |
|---|---|
| Output Freq | d001 |
| Commanded Freq | d002 |
| Output Current | d003 |
| Output Voltage | d004 |
| DC Bus Voltage | d005 |
| Drive Status | d006 |
| Fault 1 Code | d007 |
| Fault 2 Code | d008 |
| Fault 3 Code | d009 |
| Process Display | d010 |
| Control Source | d012 |
| Contrl In Status | d013 |
| Dig In Status | d014 |
| Comm Status | d015 |
| Control SW Ver | d016 |
| Drive Type | d017 |
| Elapsed Run Time | d018 |
| Testpoint Data | d019 |
| Analog In 0-10V | d020 |
| Analog In 4-20mA | d021 |
| Output Power | d022 |
| Output Power Fctr | d023 |
| Drive Temp | d024 |
| Counter Status | d025 |
| Timer Status | d026 |
| Stp Logic Status | d028 |
| Torque Current | d029 |




*See page 3-9*

| | |
|---|---|
| Motor NP Volts | P031 |
| Motor NP Hertz | P032 |
| Motor OL Current | P033 |
| Minimum Freq | P034 |
| Maximum Freq | P035 |
| Start Source | P036 |
| Stop Mode | P037 |
| Speed Reference | P038 |
| Accel Time 1 | P039 |
| Decel Time 1 | P040 |
| Reset To Defalts | P041 |
| Voltage Class | P042 |
| Motor OL Ret | P043 |




*See page 3-14*

| | |
|---|---|
| Digital In1 Sel | A051 |
| Digital In2 Sel | A052 |
| Digital In3 Sel | A053 |
| Digital In4 Sel | A054 |
| Relay Out Sel | A055 |
| Relay Out Level | A056 |
| Opto Out1 Sel | A058 |
| Opto Out1 Level | A059 |
| Opto Out2 Sel | A061 |
| Opto Out2 Level | A062 |
| Opto Out Logic | A064 |
| Analog Out Sel | A065 |
| Analog Out High | A066 |
| Accel Time 2 | A067 |
| Decel Time 2 | A068 |
| Internal Freq | A069 |
| Preset Freq 0 | A070 |
| Preset Freq 1 | A071 |
| Preset Freq 2 | A072 |
| Preset Freq 3 | A073 |
| Preset Freq 4 | A074 |
| Preset Freq 5 | A075 |
| Preset Freq 6 | A076 |
| Preset Freq 7 | A077 |
| Jog Frequency | A078 |
| Jog Accel/Decel | A079 |
| DC Brake Time | A080 |
| DC Brake Level | A081 |
| DB Resistor Sel | A082 |
| S Curve % | A083 |
| Boost Select | A084 |
| Start Boost | A085 |
| Break Voltage | A086 |
| Break Frequency | A087 |
| Maximum Voltage | A088 |
| Current Limit 1 | A089 |
| Motor OL Select | A090 |
| PWM Frequency | A091 |
| Auto Rstrt Tries | A092 |
| Auto Rstrt Delay | A093 |
| Start At PowerUp | A094 |
| Reverse Disable | A095 |
| Flying Start En | A096 |
| Compensation | A097 |
| SW Current Trip | A098 |
| Process Factor | A099 |
| Fault Clear | A100 |
| Program Lock | A101 |
| Testpoint Sel | A102 |
| Comm Data Rate | A103 |
| Comm Node Addr | A104 |
| Comm Loss Action | A105 |

*See page 3-14*

| | |
|---|---|
| Comm Loss Time | A106 |
| Comm Format | A107 |
| Language | A108 |
| Anlg Out Setpt | A109 |
| Anlg In 0-10V Lo | A110 |
| Anlg In 0-10V Hi | A111 |
| Anlg In4-20mA Lo | A112 |
| Anlg In4-20mA Hi | A113 |
| Slip Hertz @ FLA | A114 |
| Process Time Lo | A115 |
| Process Time Hi | A116 |
| Bus Reg Mode | A117 |
| Current Limit 2 | A118 |
| Skip Frequency | A119 |
| Skip Freq Band | A120 |
| Stall Fault Time | A121 |
| Analog In Loss | A122 |
| 10V Bipolar Enbl | A123 |
| Var PWM Disable | A124 |
| Torque Perf Mode | A125 |
| Motor NP FLA | A126 |
| Autotune | A127 |
| IR Voltage Drop | A128 |
| Flux Current Ref | A129 |
| PID Trim Hi | A130 |
| PID Trim Lo | A131 |
| PID Ref Sel | A132 |
| PID Feedback Sel | A133 |
| PID Prop Gain | A134 |
| PID Integ Time | A135 |
| PID Diff Rate | A136 |
| PID Setpoint | A137 |
| PID Deadband | A138 |
| PID Preload | A139 |
| Stp Logic 0 | A140 |
| Stp Logic 1 | A141 |
| Stp Logic 2 | A142 |
| Stp Logic 3 | A143 |
| Stp Logic 4 | A144 |
| Stp Logic 5 | A145 |
| Stp Logic 6 | A146 |
| Stp Logic 7 | A147 |
| Stp Logic Time 0 | A150 |
| Stp Logic Time 1 | A151 |
| Stp Logic Time 2 | A152 |
| Stp Logic Time 3 | A153 |
| Stp Logic Time 4 | A154 |
| Stp Logic Time 5 | A155 |
| Stp Logic Time 6 | A156 |
| Stp Logic Time 7 | A157 |
| EM Brk Off Delay | A160 |
| EM Brk On Delay | A161 |
| MOP Reset Sel | A162 |
| DB Threshold | A163 |
| Comm Write Mode | A164 |
| Anlg Loss Delay | A165 |
| Analog In Filter | A166 |
| PID Invert Error | A167 |

## Display Group

### d001 [Output Freq]

Related Parameter(s): d002, d010, P034, P035, P038

Output frequency present at T1, T2 & T3 (U, V & W).

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0.0/P035 [Maximum Freq] |
| | Display: | 0.1 Hz |

### d002 [Commanded Freq]

Related Parameter(s): d001, d013, P034, P035, P038

Value of the active frequency command. Displays the commanded frequency even if the drive is not running.

**Important:** The frequency command can come from a number of sources. Refer to Start and Speed Reference Control on page 1-23 for details.

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0.0/P035 [Maximum Freq] |
| | Display: | 0.1 Hz |

### d003 [Output Current]

The output current present at T1, T2 & T3 (U, V & W).

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0.00/(Drive Rated Amps × 2) |
| | Display: | 0.01 Amps |

### d004 [Output Voltage]

Related Parameter(s): P031, A084, A088

Output voltage present at terminals T1, T2 & T3 (U, V & W).

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0/Drive Rated Volts |
| | Display: | 1 VAC |

### d005 [DC Bus Voltage]

Present DC bus voltage level.

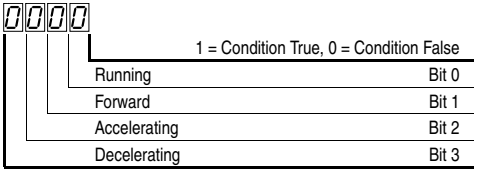
| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | Based on Drive Rating |
| | Display: | 1 VDC |

## Display Group *(continued)*

### d006 [Drive Status]

Related Parameter(s): A095

Present operating condition of the drive.




| Values | Default: | Read Only |
|---|---|---|
| | Min/Max: | 0/1 |
| | Display: | 1 |

### d007 [Fault 1 Code]
### d008 [Fault 2 Code]
### d009 [Fault 3 Code]

A code that represents a drive fault. The codes will appear in these parameters in the order they occur (d007 [Fault 1 Code] = the most recent fault). Repetitive faults will only be recorded once.

Refer to Chapter 4 for fault code descriptions.

| Values | Default: | Read Only |
|---|---|---|
| | Min/Max: | F2/F122 |
| | Display: | F1 |

### d010 [Process Display]

Related Parameter(s): d001, A099

32 bit parameter.

The output frequency scaled by A099 [Process Factor].

Output Freq x Process Factor = Process Display

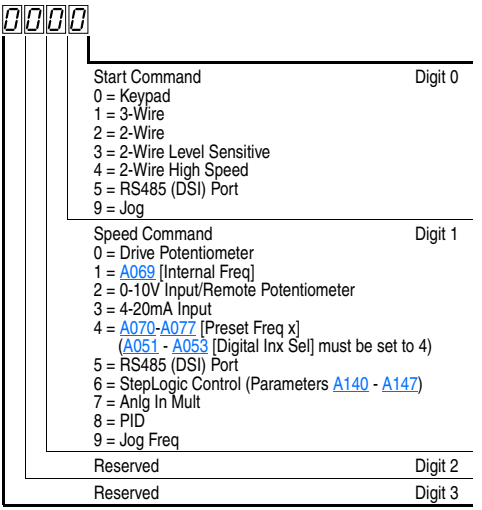
| Values | Default: | Read Only |
|---|---|---|
| | Min/Max: | 0.00/9999 |
| | Display: | 0.01 – 1 |

## Display Group *(continued)*

### d012 [Control Source]

Related Parameter(s): P036, P038, A051-A054

Displays the active source of the Start Command and Speed Command which are normally defined by the settings of P036 [Start Source] and P038 [Speed Reference] but may be overridden by digital inputs. Refer to the flowcharts on pages 1-23 and 1-24 for details.



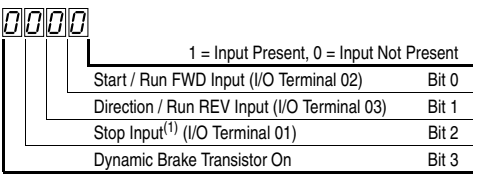

| Values | Default: | Read Only |
|---|---|---|
| | Min/Max: | 0/9 |
| | Display: | 1 |

### d013 [Contrl In Status]

Related Parameter(s): d002, P034, P035

Status of the control terminal block control inputs.

**Important:** Actual control commands may come from a source other than the control terminal block.




(1) The stop input must be present in order to start the drive.
When this bit is a 1 the drive can be started.
When this bit is a 0 the drive will stop.

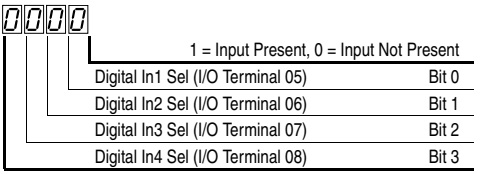
| Values | Default: | Read Only |
|---|---|---|
| | Min/Max: | 0/1 |
| | Display: | 1 |

## Display Group *(continued)*

### d014 [Dig In Status]

Related Parameter(s): A051-A054

Status of the control terminal block digital inputs.

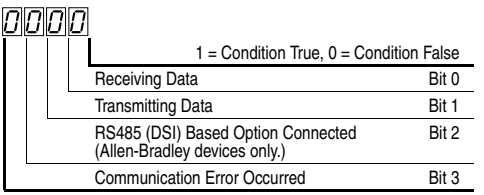



| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0/1 |
| | Display: | 1 |

### d015 [Comm Status]

Related Parameter(s): A103-A107

Status of the communications ports.




| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0/1 |
| | Display: | 1 |

### d016 [Control SW Ver]

Main Control Board software version.

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 1.00/99.99 |
| | Display: | 0.01 |

### d017 [Drive Type]

Used by Rockwell Automation field service personnel.

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 1001/9999 |
| | Display: | 1 |

## Display Group *(continued)*

### d018 [Elapsed Run Time]

Accumulated time drive is outputting power. Time is displayed in 10 hour increments.

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0/9999 Hrs |
| | Display: | 1 = 10 Hrs |

### d019 [Testpoint Data]

Related Parameter(s): A102

The present value of the function selected in A102 [Testpoint Sel].

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0/FFFF |
| | Display: | 1 Hex |

### d020 [Analog In 0-10V]

Related Parameter(s): A110, A111

The present value of the voltage at I/O Terminal 13 (100.0% = 10 volts).

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0.0/100.0% |
| | Display: | 0.1% |

### d021 [Analog In 4-20mA]

Related Parameter(s): A112, A113

The present value of the current at I/O Terminal 15 (0.0% = 4mA, 100.0% = 20mA).

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0.0/100.0% |
| | Display: | 0.1% |

### d022 [Output Power]

Output power present at T1, T2 & T3 (U, V & W).

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0.00/(Drive Rated Power × 2) |
| | Display: | 0.01 kW |

### d023 [Output Powr Fctr]

The angle in electrical degrees between motor voltage and motor current.

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0.0/180.0 deg |
| | Display: | 0.1 deg |

## Display Group *(continued)*

### d024 [Drive Temp]

Present operating temperature of the drive power section.

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0/120 degC |
| | Display: | 1 degC |

### d025 [Counter Status]

The current value of the counter when counter is enabled.

| | | |
|---|---|---|
| **Values** | Default: | Read only |
| | Min/Max: | 0/9999 |
| | Display: | 1 |

### d026 [Timer Status]

32 bit parameter.

The current value of the timer when timer is enabled.

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0.0/9999 Secs |
| | Display: | 0.1 Secs |

### d028 [Stp Logic Status]

When P038 [Speed Reference] is set to 6 “Stp Logic”, this parameter will display the current step of the StepLogic profile as defined by parameters A140-A147 [Stp Logic x].

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0/7 |
| | Display: | 1 |

### d029 [Torque Current]

The current value of the motor torque current.

| | | |
|---|---|---|
| **Values** | Default: | Read Only |
| | Min/Max: | 0.00/(Drive Rated Amps × 2) |
| | Display: | 0.01 Amps |

## Basic Program Group

### P031 [Motor NP Volts]

Related Parameter(s): d004, A084, A085, A086, A087

Stop drive before changing this parameter.

Set to the motor nameplate rated volts.

| | | |
|---|---|---|
| **Values** | Default: | Based on Drive Rating |
| | Min/Max: | 20/Drive Rated Volts |
| | Display: | 1 VAC |

### P032 [Motor NP Hertz]

Related Parameter(s): A084, A085, A086, A087, A090

Stop drive before changing this parameter.

Set to the motor nameplate rated frequency.

| | | |
|---|---|---|
| **Values** | Default: | 60 Hz |
| | Min/Max: | 15/400 Hz |
| | Display: | 1 Hz |

### P033 [Motor OL Current]

Related Parameter(s): A055, A058, A061, A089, A090, A098, A114, A118

Set to the maximum allowable motor current.

The drive will fault on an F7 Motor Overload if the value of this parameter is exceeded by 150% for 60 seconds.

| | | |
|---|---|---|
| **Values** | Default: | Based on Drive Rating |
| | Min/Max: | 0.0/(Drive Rated Amps × 2) |
| | Display: | 0.1 Amps |

### P034 [Minimum Freq]

Related Parameter(s): d001, d002, d013, P035, A085, A086, A087, A110, A112

Sets the lowest frequency the drive will output continuously.

| | | |
|---|---|---|
| **Values** | Default: | 0.0 Hz |
| | Min/Max: | 0.0/400.0 Hz |
| | Display: | 0.1 Hz |

### P035 [Maximum Freq]

Related Parameter(s): d001, d002, d013, P034, A065, A078, A085, A086, A087, A111, A113

Stop drive before changing this parameter.

Sets the highest frequency the drive will output.

| | | |
|---|---|---|
| **Values** | Default: | 60 Hz |
| | Min/Max: | 0/400 Hz |
| | Display: | 1 Hz |

## Basic Program Group *(continued)*

### P036 [Start Source]

Related Parameter(s): d012, P037

Stop drive before changing this parameter.

Sets the control scheme used to start the drive.

Refer to Start and Speed Reference Control on page 1-23 for details about how other drive settings can override the setting of this parameter.

**Important:** For all settings except option 3, the drive must receive a leading edge from the start input for the drive to start after a stop input, loss of power or fault condition.

| | | | |
|---|---|---|---|
| **Options** | **0** | "Keypad" (Default) | • Integral keypad controls drive operation.<br>• I/O Terminal 1 "Stop" = coast to stop.<br>• When active, the Reverse key is also active unless disabled by A095 [Reverse Disable]. |
| | **1** | "3-Wire" | I/O Terminal 1 "Stop" = stop according to the value set in P037 [Stop Mode]. |
| | **2** | "2-Wire" | I/O Terminal 1 "Stop" = coast to stop. |
| | **3** | "2-W Lvl Sens" | Drive will restart after a "Stop" command when:<br>• Stop is removed<br>and<br>• Start is held active |

**ATTENTION:** Hazard of injury exists due to unintended operation. When P036 [Start Source] is set to option 3, and the Run input is maintained, the Run inputs do not need to be toggled after a Stop input for the drive to run again. A Stop function is provided only when the Stop input is active (open).

| | | | |
|---|---|---|---|
| | **4** | "2-W Hi Speed" | **Important:** There is greater potential voltage on the output terminals when using this option.<br>• Outputs are kept in a ready-to-run state. The drive will respond to a "Start" command within 10 ms.<br>• I/O Terminal 1 "Stop" = coast to stop. |
| | **5** | "Comm Port" | • Remote communications. Refer to Appendix C for details.<br>• I/O Terminal 1 "Stop" = coast to stop. |
| | **6** | "Momt FWD/REV" | • Drive will start after a momentary input from either the Run FWD Input (I/O Terminal 02) or the Run REV Input (I/O Terminal 03).<br>• I/O Terminal 1 "Stop" = coast to stop. |

## Basic Program Group *(continued)*

### P037 [Stop Mode]

Related Parameter(s): P036, A080, A081, A082, A105, A160

Active stop mode for all stop sources [e.g. keypad, run forward (I/O Terminal 02), run reverse (I/O Terminal 03), RS485 port] except as noted below.

**Important:** I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set for "3-Wire" control. When in three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode].

#### Hardware Enable Circuitry

By default, I/O Terminal 01 is a coast to stop input. The status of the input is interpreted by drive software. If the application requires the drive to be disabled without software interpretation, a "dedicated" hardware enable configuration can be utilized. This is accomplished by removing the ENBL enable jumper on the control board. In this case, the drive will always coast to a stop regardless of the settings of P036 [Start Source] and P037 [Stop Mode].

| | | | |
|---|---|---|---|
| **Options** | **0** | "Ramp, CF"(1) (Default) | Ramp to Stop. "Stop" command clears active fault. |
| | **1** | "Coast, CF"(1) | Coast to Stop. "Stop" command clears active fault. |
| | **2** | "DC Brake, CF"(1) | DC Injection Braking Stop. "Stop" command clears active fault. |
| | **3** | "DCBrkAuto,CF"(1) | DC Injection Braking Stop with Auto Shutoff.<br>• Standard DC Injection Braking for value set in A080 [DC Brake Time].<br>OR<br>• Drive shuts off if the drive detects that the motor is stopped.<br>"Stop" command clears active fault. |
| | **4** | "Ramp" | Ramp to Stop. |
| | **5** | "Coast" | Coast to Stop. |
| | **6** | "DC Brake" | DC Injection Braking Stop. |
| | **7** | "DC BrakeAuto" | DC Injection Braking Stop with Auto Shutoff.<br>• Standard DC Injection Braking for value set in A080 [DC Brake Time].<br>OR<br>• Drive shuts off if current limit is exceeded. |
| | **8** | "Ramp+EM B,CF" | Ramp to Stop with EM Brake Control. "Stop" Command clears active fault. |
| | **9** | "Ramp+EM Brk" | Ramp to Stop with EM Brake Control. |

(1) Stop input also clears active fault.

## Basic Program Group *(continued)*

**P038 [Speed Reference]** Related Parameter(s): d001, d002, d012, d020, d021, P039, P040, A051-A054, A069, A070-A077, A110-A113, A123, A132, A140-A147, A150-A157

Sets the source of the speed reference to the drive.

The drive speed command can be obtained from a number of different sources. The source is normally determined by P038 [Speed Reference]. However, when A051 - A054 [Digital Inx Sel] is set to option 2, 4, 5, 6, 11, 12, 13, 14, 15 and the digital input is active, or if A132 [PID Ref Sel] is not set to option 0, the speed reference commanded by P038 [Speed Reference] will be overridden. Refer to the flowchart on page 1-23 for more information on speed reference control priority.

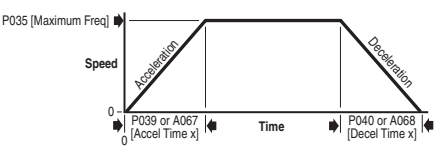
| | | | |
|---|---|---|---|
| **Options** | **0** | "Drive Pot" (Default) | Frequency command from the potentiometer on the integral keypad.<br>**Important:** This option is not available with IP66, NEMA/UL Type 4X rated drives. Internal frequency command comes from A069 [Internal Freq]. |
| | **1** | "InternalFreq" (IP66, NEMA/UL Type 4X Default) | Internal frequency command from A069 [Internal Freq]. Must be set when using MOP function. |
| | **2** | "0-10V Input" | External frequency command from the 0-10V or ±10V analog input or remote potentiometer. |
| | **3** | "4-20mA Input" | External frequency command from the 4-20mA analog input. |
| | **4** | "Preset Freq" | External frequency command as defined by A070 - A077 [Preset Freq x] when A051 - A054 [Digital Inx Sel] are programmed as "Preset Frequencies" and the digital inputs are active. |
| | **5** | "Comm Port" | External frequency command from the communications port. Refer to Appendix C for details. |
| | **6** | "Stp Logic" | External frequency command as defined by A070 - A077 [Preset Freq x] and A140 - A147 [Stp Logic x]. |
| | **7** | "Anlg In Mult" | External frequency command as defined by the product of the analog inputs (shown in d020 [Analog In 0-10V] and d021 [Analog In 4-20mA]).<br>[Analog In 0-10V] × [Analog In 4-20mA] = Speed Command<br>Example: 100% × 50% = 50% |

**P039 [Accel Time 1]** Related Parameter(s): P038, P040, A051-A054, A067, A070-A077, A140-A147

Sets the rate of acceleration for all speed increases.

$$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$$

| | | |
|---|---|---|
| **Values** | Default: | 10.0 Secs |
| | Min/Max: | 0.0/600.0 Secs |
| | Display: | 0.1 Secs |



# Basic Program Group *(continued)*

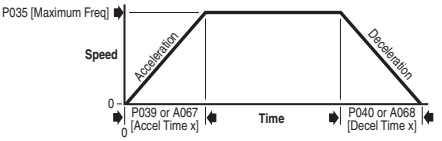
## P040 [Decel Time 1]

Related Parameter(s): P038, P039, A051-A054, A068, A070-A077, A140-A147

Sets the rate of deceleration for all speed decreases.

$$\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$$

| | | |
|---|---|---|
| **Values** | Default: | 10.0 Secs |
| | Min/Max: | 0.1/600.0 Secs |
| | Display: | 0.1 Secs |




## P041 [Reset To Defalts]

Stop drive before changing this parameter.

Resets all parameter values to factory defaults.

| | | | |
|---|---|---|---|
| **Options** | **0** | "Ready/Idle" (Default) | |
| | **1** | "Factory Rset" | • After the reset function is complete, this parameter will set itself back to "0".<br>• Causes an F48 Params Defaulted fault. |

## P042 [Voltage Class]

Stop drive before changing this parameter.

Sets the voltage class of 600V drives.

| | | | |
|---|---|---|---|
| **Options** | **2** | "Low Voltage" | 480V |
| | **3** | "High Voltage" (Default) | 600V |

## P043 [Motor OL Ret]

Related Parameter(s): P033

Enables/disables the Motor Overload Retention function. When Enabled, the value held in the motor overload counter is saved at power-down and restored at power-up. A change to this parameter setting resets the counter.

| | | |
|---|---|---|
| **Options** | **0** | "Disabled" (Default) |
| | **1** | "Enabled" |

## Advanced Program Group

**A051 [Digital In1 Sel]**
(I/O Terminal 05)
**A052 [Digital In2 Sel]**
(I/O Terminal 06)
**A053 [Digital In3 Sel]**
(I/O Terminal 07)
**A054 [Digital In4 Sel]**
(I/O Terminal 08)

Related Parameter(s): d012, d014, P038, P039, P040, A067, A068, A070-A077, A078, A079, A118, A140-A147

Stop drive before changing this parameter.

Selects the function for the digital inputs. Refer to the flowchart on page 1-23 for more information on speed reference control priority.

| | | | |
|---|---|---|---|
| **Options** | **0** | "Not Used" | Terminal has no function but can be read over network communications via d014 [Dig In Status]. |
| | **1** | "Acc & Dec 2" | • When active, A067 [Accel Time 2] and A068 [Decel Time 2] are used for all ramp rates except Jog.<br>• Can only be tied to one input.<br>Refer to the flowchart on page 1-24 for more information on Accel/Decel selection. |
| | **2** | "Jog" | • When input is present, drive accelerates according to the value set in A079 [Jog Accel/Decel] and ramps to the value set in A078 [Jog Frequency].<br>• When input is removed, drive ramps to a stop according to the value set in A079 [Jog Accel/Decel].<br>• A valid "Start" command will override this input. |
| | **3** | "Aux Fault" | When enabled, an F2 Auxiliary Input fault will occur when the input is removed. |
| | **4** | "Preset Freq" (A051 & A052 Default) | Refer to A070 - A077 [Preset Freq x].<br>**Important:** Digital Inputs have priority for frequency control when programmed as Preset Speed and are active. Refer to the flowchart on page 1-23 for more information on speed reference control priority. |
| | **5** | "Local" (A053 Default) | When active, sets integral keypad as start source and potentiometer on the integral keypad as speed source.<br>**Important:** Speed source for IP66, NEMA/UL Type 4X rated drives comes from A069 [Internal Freq]. |
| | **6** | "Comm Port" | • When active, sets communications device as default start/speed command source.<br>• Can only be tied to one input. |
| | **7** | "Clear Fault" | When active, clears an active fault. |
| | **8** | "RampStop,CF" | Causes drive to immediately ramp to a stop regardless of how P037 [Stop Mode] is set. |
| | **9** | "CoastStop,CF" | Causes drive to immediately coast to a stop regardless of how P037 [Stop Mode] is set. |
| | **10** | "DCInjStop,CF" | Causes drive to immediately begin a DC Injection stop regardless of how P037 [Stop Mode] is set. |
| | **11** | "Jog Forward" (A054 Default) | Drive accelerates to A078 [Jog Frequency] according to A079 [Jog Accel/Decel] and ramps to stop when input becomes inactive. A valid start will override this command. |
| | **12** | "Jog Reverse" | Drive accelerates to A078 [Jog Frequency] according to A079 [Jog Accel/Decel] and ramps to stop when input becomes inactive. A valid start will override this command. |

| | | |
|---|---|---|
| **A051 - A054 Options** (Cont.) | **13** "10V In Ctrl" | Selects 0-10V or ±10V control as the frequency reference. Start source is not changed. |
| | **14** "20mA In Ctrl" | Selects 4-20mA control as the frequency reference. Start source is not changed. |
| | **15** "PID Disable" | Disables PID function. Drive uses the next valid non-PID speed reference. |
| | **16** "MOP Up" | Increases the value of A069 [Internal Freq] at the current Accel rate if P038 [Speed Reference] is set to 1 "InternalFreq".<br>For IP20 rated drives, the default for A069 is 60.0 Hz.<br>For IP66, NEMA/UL Type 4X drives, the default for A069 is 0.0 Hz. |
| | **17** "MOP Down" | Decreases the value of A069 [Internal Freq] at the current Decel rate if P038 [Speed Reference] is set to 1 "InternalFreq".<br>For IP20 rated drives, the default for A069 is 60.0 Hz.<br>For IP66, NEMA/UL Type 4X drives, the default for A069 is 0.0 Hz. |
| | **18** "Timer Start" | Clears and starts the timer function. May be used to control the relay or opto outputs. |
| | **19** "Counter In" | Starts the counter function. May be used to control the relay or opto outputs. |
| | **20** "Reset Timer" | Clears the active timer. |
| | **21** "Reset Countr" | Clears the active counter. |
| | **22** "Rset Tim&Cnt" | Clears the active timer and counter. |
| | **23** "Logic In1" | Logic function input number 1. May be used to control the relay or opto outputs (see parameters A055, A058, A061 Options 11-14). May be used in conjunction with StepLogic parameters A140 - A147 [Stp Logic x]. |
| | **24** "Logic In2" | Logic function input number 2. May be used to control the relay or opto outputs (see parameters A055, A058, A061 Options 11-14). May be used in conjunction with StepLogic parameters A140 - A147 [Stp Logic x]. |
| | **25** "Current Lmt2" | When active, A118 [Current Limit 2] determines the drive current limit level. |
| | **26** "Anlg Invert" | Inverts the scaling of the analog input levels set in A110 [Anlg In 0-10V Lo] and A111 [Anlg In 0-10V Hi] or A112 [Anlg In4-20mA Lo] and A113 [Anlg In4-20mA Hi]. |
| | **27** "EM Brk Rlse" | If EM brake function is enabled, this input releases the brake. |

**ATTENTION:** If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used.

## Advanced Program Group *(continued)*

### A055 [Relay Out Sel]

Related Parameter(s): P033, A056, A092, A140-A147, A150-A157, A160, A161

Sets the condition that changes the state of the output relay contacts.

| Options | | | |
|---|---|---|---|
| | **0** | "Ready/Fault" (Default) | Relay changes state when power is applied. This indicates that the drive is ready for operation. Relay returns drive to shelf state when power is removed or a fault occurs. |
| | **1** | "At Frequency" | Drive reaches commanded frequency. |
| | **2** | "MotorRunning" | Motor is receiving power from the drive. |
| | **3** | "Reverse" | Drive is commanded to run in reverse direction. |
| | **4** | "Motor OverId" | Motor overload condition exists. |
| | **5** | "Ramp Reg" | Ramp regulator is modifying the programmed accel/decel times to avoid an overcurrent or overvoltage fault from occurring. |
| | **6** | "Above Freq" | • Drive exceeds the frequency (Hz) value set in A056 [Relay Out Level].<br>• Use A056 to set threshold. |
| | **7** | "Above Cur" | • Drive exceeds the current (% Amps) value set in A056 [Relay Out Level].<br>• Use A056 to set threshold.<br>**Important:** Value for A056 [Relay Out Level] must be entered in percent of drive rated output current. |
| | **8** | "Above DCVolt" | • Drive exceeds the DC bus voltage value set in A056 [Relay Out Level].<br>• Use A056 to set threshold. |
| | **9** | "Retries Exst" | Value set in A092 [Auto Rstrt Tries] is exceeded. |
| | **10** | "Above Anlg V" | • Analog input voltage (I/O Terminal 13) exceeds the value set in A056 [Relay Out Level].<br>• Do not use if A123 [10V Bipolar Enbl] is set to 1 "Bi-Polar In".<br>• This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 13) is wired to a PTC and external resistor.<br>• Use A056 to set threshold. |
| | **11** | "Logic In 1" | An input is programmed as "Logic In 1" and is active. |
| | **12** | "Logic In 2" | An input is programmed as "Logic In 2" and is active. |
| | **13** | "Logic 1 & 2" | Both Logic inputs are programmed and active. |
| | **14** | "Logic 1 or 2" | One or both Logic inputs are programmed and one or both is active. |
| | **15** | "StpLogic Out" | Drive enters StepLogic step with Digit 3 of Command Word (A140 - A147) set to enable StepLogic output. |
| | **16** | "Timer Out" | • Timer has reached value set in A056 [Relay Out Level].<br>• Use A056 to set threshold. |
| | **17** | "Counter Out" | • Counter has reached value set in A056 [Relay Out Level].<br>• Use A056 to set threshold. |
| | **18** | "Above PF Ang" | • Power Factor angle has exceeded the value set in A056 [Relay Out Level].<br>• Use A056 to set threshold. |

| | | |
|---|---|---|
| **A055 Options** (Cont.) | **19** "Anlg In Loss" | Analog input loss has occurred. Program A122 [Analog In Loss] for desired action when input loss occurs. |
| | **20** "ParamControl" | Prior to FRN 4.01, this option enables the output to be controlled over network communications by writing to A056 [Relay Out Level]. (0 = Off, 1 = On.)<br>With FRN 4.01 and later, the logic command word bit 15 has full control of A056. See Writing (06) Logic Command Data on page C-4. |
| | **21** "NonRec Fault" | • Value set in A092 [Auto Rstrt Tries] is exceeded.<br>• A092 [Auto Rstrt Tries] in not enabled.<br>• A Non-resettable fault has occurred. |
| | **22** "EM Brk Cntrl" | EM brake is energized. Program A160 [EM Brk Off Delay] and A161 [EM Brk On Delay] for desired action. |
| | **23** "Above Fcmd" | The current commanded frequency exceeds the value set in A056 [Relay Out Level]. |
| | **24** "MsgControl" | With FRN 4.01 and later, this option enables the output to be controlled over network communications by writing to A056 [Relay Out Level]. (0 = Off, 1 = On.) |

## A056 [Relay Out Level]

Related Parameter(s): A055

32 32 bit parameter.

Sets the trip point for the digital output relay if the value of A055 [Relay Out Sel] is 6, 7, 8, 10, 16, 17, 18 or 20.

With FRN 4.01 and later, when the value of A055 is set to 20, the logic command word bit 15 has full control of A056.

| A055 Setting | A056 Min/Max |
|---|---|
| 6 | 0/400 Hz |
| 7 | 0/180% |
| 8 | 0/815 Volts |
| 10 | 0/100% |
| 16 | 0.1/9999 Secs |
| 17 | 1/9999 Counts |
| 18 | 1/180 degs |
| 20 | 0/1 |
| 23 | 0/400 Hz |

| | | |
|---|---|---|
| **Values** | Default: | 0.0 |
| | Min/Max: | 0.0/9999 |
| | Display: | 0.1 |

## Advanced Program Group *(continued)*

**A058 [Opto Out1 Sel]**
**A061 [Opto Out2 Sel]**

Related Parameter(s): P033, A059, A062, A092, A122, A123, A160, A161, A140-A147, A150-A157

Determines the operation of the programmable opto outputs.

| | | | |
|---|---|---|---|
| **Options** | **0** | "Ready/Fault" | Opto outputs are active when power is applied. This indicates that the drive is ready for operation. Opto outputs are inactive when power is removed or a fault occurs. |
| | **1** | "At Frequency" (A061 Default) | Drive reaches commanded frequency. |
| | **2** | "MotorRunning" (A058 Default) | Motor is receiving power from the drive. |
| | **3** | "Reverse" | Drive is commanded to run in reverse direction. |
| | **4** | "Motor OverId" | Motor overload condition exists. |
| | **5** | "Ramp Reg" | Ramp regulator is modifying the programmed accel/decel times to avoid an overcurrent or overvoltage fault from occurring. |
| | **6** | "Above Freq" | • Drive exceeds the frequency (Hz) value set in A059 or A062 [Opto Outx Level].<br>• Use A059 or A062 to set threshold. |
| | **7** | "Above Cur" | • Drive exceeds the current (% Amps) value set in A059 or A062 [Opto Outx Level].<br>• Use A059 or A062 to set threshold.<br>**Important:** Value for A059 or A062 [Opto Outx Level] must be entered in percent of drive rated output current. |
| | **8** | "Above DCVolt" | • Drive exceeds the DC bus voltage value set in A059 or A062 [Opto Outx Level].<br>• Use A059 or A062 to set threshold. |
| | **9** | "Retries Exst" | Value set in A092 [Auto Rstrt Tries] is exceeded. |
| | **10** | "Above Anlg V" | • Analog input voltage (I/O Terminal 13) exceeds the value set in A059 or A062 [Opto Outx Level].<br>• Do not use if A123 [10V Bipolar Enbl] is set to 1 "Bi-Polar In".<br>• This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 13) is wired to a PTC and external resistor.<br>• Use A059 or A062 to set threshold. |
| | **11** | "Logic In 1" | An input is programmed as "Logic In 1" and is active. |
| | **12** | "Logic In 2" | An input is programmed as "Logic In 2" and is active. |
| | **13** | "Logic 1 & 2" | Both Logic inputs are programmed and active. |
| | **14** | "Logic 1 or 2" | One or both Logic inputs are programmed and one or both is active. |
| | **15** | "StpLogic Out" | Drive enters StepLogic step with Digit 3 of Command Word (A140 - A147) set to enable StepLogic output. |
| | **16** | "Timer Out" | • Timer has reached value set in A059 or A062 [Opto Outx Level].<br>• Use A059 or A062 to set threshold. |
| | **17** | "Counter Out" | • Counter has reached value set in A059 or A062 [Opto Outx Level].<br>• Use A059 or A062 to set threshold. |

| | | |
|---|---|---|
| **A058, A061 Options** (Cont.) | **18** "Above PF Ang" | • Power Factor angle has exceeded the value set in A059 or A062 [Opto Outx Level].<br>• Use A059 or A062 to set threshold. |
| | **19** "Anlg In Loss" | Analog input loss has occurred. Program A122 [Analog In Loss] for desired action when input loss occurs. |
| | **20** "ParamControl" | Prior to FRN 4.01, this option enables the output to be controlled over network communications by writing to A059 or A062 [Opto Outx Level]. (0 = Off, 1 = On.)<br>With FRN 4.01 and later:<br>Setting this option for A058 means the logic command word bit 6 has full control of A059.<br>Setting this option for A059 means the logic command word bit 7 has full control of A062.<br>See Writing (06) Logic Command Data on page C-4. |
| | **21** "NonRec Fault" | • Value set in A092 [Auto Rstrt Tries] is exceeded.<br>• A092 [Auto Rstrt Tries] in not enabled.<br>• A Non-resettable fault has occurred. |
| | **22** "EM Brk Cntrl" | EM brake is energized. Program A160 [EM Brk Off Delay] and A161 [EM Brk On Delay] for desired action. |
| | **23** "Above Fcmd" | The current commanded frequency exceeds the value set in A059 or A062 [Opto Outx Level]. |
| | **24** "MsgControl" | With FRN 4.01 and later:<br>Enables the output to be controlled over the network communications by writing to A059 or A062 [Opto Outx Level]. (0 = Off, 1 = On.) |

## A059 [Opto Out1 Level]
## A062 [Opto Out2 Level]

Related Parameter(s): A058, A061

32 bit parameter.

Determines the on/off point for the opto outputs when A058 or A061 [Opto Outx Sel] is set to option 6, 7, 8, 10, 16, 17, 18 or 20.

With FRN 4.01 and later, when the value of A058 is set to 20, the logic command word bit 6 has full control of A059 and when the value of A061 is set to 20, bit 7 has full control of A062.

| A058 & A061 Setting | A059 & A062 Min/Max |
|---|---|
| 6 | 0/400 Hz |
| 7 | 0/180% |
| 8 | 0/815 Volts |
| 10 | 0/100% |
| 16 | 0.1/9999 Secs |
| 17 | 1/9999 Counts |
| 18 | 1/180 degs |
| 20 | 0/1 |
| 23 | 0/400 Hz |

| | | |
|---|---|---|
| **Values** | Default: | 0.0 |
| | Min/Max: | 0.0/9999 |
| | Display: | 0.1 |

# Advanced Program Group *(continued)*

## A064 [Opto Out Logic]

Determines the logic (Normally Open/NO or Normally Closed/NC) of the opto outputs.

| A064 Option | Opto Out1 Logic | Opto Out2 Logic |
|---|---|---|
| 0 | NO (Normally Open) | NO (Normally Open) |
| 1 | NC (Normally Closed) | NO (Normally Open) |
| 2 | NO (Normally Open) | NC (Normally Closed) |
| 3 | NC (Normally Closed) | NC (Normally Closed) |

| | | |
|---|---|---|
| **Values** | Default: | 0 |
| | Min/Max: | 0/3 |
| | Display: | 1 |

## A065 [Analog Out Sel]

Related Parameter(s): P035, A066

Sets the analog output signal mode (0-10V, 0-20mA, or 4-20mA). The output is used to provide a signal that is proportional to several drive conditions.

| Option | Output Range | Minimum Output Value | Maximum Output Value A066 [Analog Out High] | DIP Switch Position | Related Parameter |
|---|---|---|---|---|---|
| 0 “OutFreq 0-10” | 0-10V | 0V = 0 Hz | P035 [Maximum Freq] | 0-10V | d001 |
| 1 “OutCurr 0-10” | 0-10V | 0V = 0 Amps | 200% Drive Rated Output Current | 0-10V | d003 |
| 2 “OutVolt 0-10” | 0-10V | 0V = 0 Volts | 120% Drive Rated Output Volts | 0-10V | d004 |
| 3 “OutPowr 0-10” | 0-10V | 0V = 0 kW | 200% Drive Rated Power | 0-10V | d022 |
| 4 “TstData 0-10” | 0-10V | 0V = 0000 | 65535 (Hex FFFF) | 0-10V | d019 |
| 5 “OutFreq 0-20” | 0-20mA | 0 mA = 0 Hz | P035 [Maximum Freq] | 0-20mA | d001 |
| 6 “OutCurr 0-20” | 0-20mA | 0 mA = 0 Amps | 200% Drive Rated Output Current | 0-20mA | d003 |
| 7 “OutVolt 0-20” | 0-20mA | 0 mA = 0 Volts | 120% Drive Rated Output Volts | 0-20mA | d004 |
| 8 “OutPowr 0-20” | 0-20mA | 0 mA = 0 kW | 200% Drive Rated Power | 0-20mA | d022 |
| 9 “TstData 0-20” | 0-20mA | 0 mA = 0000 | 65535 (Hex FFFF) | 0-20mA | d019 |
| 10 “OutFreq 4-20” | 4-20mA | 4 mA = 0 Hz | P035 [Maximum Freq] | 0-20mA | d001 |
| 11 “OutCurr 4-20” | 4-20mA | 4 mA = 0 Amps | 200% Drive Rated Output Current | 0-20mA | d003 |
| 12 “OutVolt 4-20” | 4-20mA | 4 mA = 0 Volts | 120% Drive Rated Output Volts | 0-20mA | d004 |
| 13 “OutPowr 4-20” | 4-20mA | 4 mA = 0 kW | 200% Drive Rated Power | 0-20mA | d022 |
| 14 “TstData 4-20” | 4-20mA | 4 mA = 0000 | 65535 (Hex FFFF) | 0-20mA | d019 |
| 15 “OutTorq 0-10” | 0-10V | 0V = 0 Amps | 200% Drive Rated FLA | 0-10V | d029 |
| 16 “OutTorq 0-20” | 0-20 mA | 0 mA = 0 Amps | 200% Drive Rated FLA | 0-20 mA | d029 |
| 17 “OutTorq 4-20” | 4-20 mA | 4 mA = 0 Amps | 200% Drive Rated FLA | 0-20 mA | d029 |
| 18 “Setpnt 0-10” | 0-10V | 0V = 0% | 100.0% Setpoint Setting | 0-10V | A109 |
| 19 “Setpnt 0-20” | 0-20 mA | 0 mA = 0% | 100.0% Setpoint Setting | 0-20 mA | A109 |
| 20 “Setpnt 4-20” | 4-20 mA | 4 mA = 0% | 100.0% Setpoint Setting | 0-20 mA | A109 |
| 21 “MinFreq 0-10” | 0-10V | 0V = Min. Freq | P035 [Maximum Freq] | 0-10V | d001 |
| 22 “MinFreq 0-20” | 0-20 mA | 0 mA = Min. Freq | P035 [Maximum Freq] | 0-20 mA | d001 |
| 23 “MinFreq 4-20” | 4-20 mA | 4 mA = Min. Freq | P035 [Maximum Freq] | 0-20 mA | d001 |

| | | |
|---|---|---|
| **Values** | Default: | 0 |
| | Min/Max: | 0/23 |
| | Display: | 1 |

# Advanced Program Group *(continued)*

## A066 [Analog Out High]

Related Parameter(s): A065

Scales the Maximum Output Value for the A065 [Analog Out Sel] source setting.

Examples:

| A066 Setting | A065 Setting | A065 Max. Output Value |
|---|---|---|
| 50% | 1 “OutCurr 0-10” | 5V for 200% Drive Rated Output Current |
| 90% | 8 “OutPowr 0-20” | 18mA for 200% Drive Rated Power |

| | | |
|---|---|---|
| **Values** | Default: | 100% |
| | Min/Max: | 0/800% |
| | Display: | 1% |

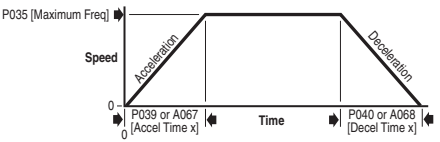
## A067 [Accel Time 2]

Related Parameter(s): P039, A051-A054, A070-A077, A140-A147

When active, sets the rate of acceleration for all speed increases except jog. Refer to the flowchart on page 1-24 for details.

$$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$$

| | | |
|---|---|---|
| **Values** | Default: | 20.0 Secs |
| | Min/Max: | 0.0/600.0 Secs |
| | Display: | 0.1 Secs |



## Advanced Program Group *(continued)*

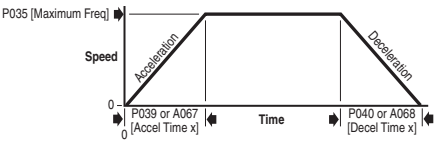
### A068 [Decel Time 2]

Related Parameter(s): P040, A051-A054, A070-A077, A140-A147

When active, sets the rate of deceleration for all speed decreases except jog. Refer to the flowchart on page 1-24 for details.

$$\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$$

| | | |
|---|---|---|
| **Values** | Default: | 20.0 Secs |
| | Min/Max: | 0.1/600.0 Secs |
| | Display: | 0.1 Secs |




### A069 [Internal Freq]

Related Parameter(s): P038, A162

Provides the frequency command to the drive when P038 [Speed Reference] is set to 1 “Internal Freq”. When enabled, this parameter will change the frequency command in “real time” using the integral keypad Up Arrow or Down Arrow when in program mode.

**Important:** Once the desired command frequency is reached, the Enter key must be pressed to store this value to EEPROM memory. If the ESC key is used before the Enter key, the frequency will return to the original value following the normal accel/decel curve.

If A051 - A054 [Digital Inx Sel] is set to 16 “MOP Up” or 17 “MOP Down” this parameter acts as the MOP frequency reference.

| | | |
|---|---|---|
| **Values** | Default: | 60.0 Hz for IP20 rated drives<br>0.0 Hz for IP66, NEMA/UL Type 4X drives |
| | Min/Max: | 0.0/400.0 Hz |
| | Display: | 0.1 Hz |

## Advanced Program Group *(continued)*

### A070 [Preset Freq 0](1)
### A071 [Preset Freq 1]
### A072 [Preset Freq 2]
### A073 [Preset Freq 3]
### A074 [Preset Freq 4]
### A075 [Preset Freq 5]
### A076 [Preset Freq 6]
### A077 [Preset Freq 7]

Related Parameter(s): P038, P039, P040, A051-A053, A067, A068, A140-A147, A150-A157

| | | |
|---|---|---|
| **Values** | A070 Default:(1) | 0.0 Hz |
| | A071 Default: | 5.0 Hz |
| | A072 Default: | 10.0 Hz |
| | A073 Default: | 20.0 Hz |
| | A074 Default: | 30.0 Hz |
| | A075 Default: | 40.0 Hz |
| | A076 Default: | 50.0 Hz |
| | A077 Default: | 60.0 Hz |
| | Min/Max: | 0.0/400.0 Hz |
| | Display: | 0.1 Hz |

Provides a fixed frequency command value when A051 - A053 [Digital Inx Sel] is set to 4 “Preset Frequencies”.

An active preset input will override speed command as shown in the flowchart on page 1-23.

(1) To activate A070 [Preset Freq 0] set P038 [Speed Reference] to option 4 “Preset Freq 0-3”.

| Input State of Digital In 1 (I/O Terminal 05 when A051 = 4) | Input State of Digital In 2 (I/O Terminal 06 when A052 = 4) | Input State of Digital In 3 (I/O Terminal 07 when A053 = 4) | Frequency Source | Accel / Decel Parameter Used(2) |
|---|---|---|---|---|
| 0 | 0 | 0 | A070 [Preset Freq 0] | [Accel Time 1] / [Decel Time 1] |
| 1 | 0 | 0 | A071 [Preset Freq 1] | [Accel Time 1] / [Decel Time 1] |
| 0 | 1 | 0 | A072 [Preset Freq 2] | [Accel Time 2] / [Decel Time 2] |
| 1 | 1 | 0 | A073 [Preset Freq 3] | [Accel Time 2] / [Decel Time 2] |
| 0 | 0 | 1 | A074 [Preset Freq 4] | [Accel Time 1] / [Decel Time 1] |
| 1 | 0 | 1 | A075 [Preset Freq 5] | [Accel Time 1] / [Decel Time 1] |
| 0 | 1 | 1 | A076 [Preset Freq 6] | [Accel Time 2] / [Decel Time 2] |
| 1 | 1 | 1 | A077 [Preset Freq 7] | [Accel Time 2] / [Decel Time 2] |

(2) When a Digital Input is set to “Accel 2 & Decel 2”, and the input is active, that input overrides the settings in this table.

### A078 [Jog Frequency]

Related Parameter(s): P035, A051-A054, A079

Sets the output frequency when a jog command is issued.

| | | |
|---|---|---|
| **Values** | Default: | 10.0 Hz |
| | Min/Max: | 0.0/[Maximum Freq] |
| | Display: | 0.1 Hz |

# Advanced Program Group *(continued)*

## A079 [Jog Accel/Decel]

Related Parameter(s): A078, A051-A054

Sets the acceleration and deceleration time when a jog command is issued.

| | | |
|---|---|---|
| **Values** | Default: | 10.0 Secs |
| | Min/Max: | 0.1/600.0 Secs |
| | Display: | 0.1 Secs |

## A080 [DC Brake Time]

Related Parameter(s): P037, A081

Sets the length of time that DC brake current is "injected" into the motor. Refer to parameter A081 [DC Brake Level].

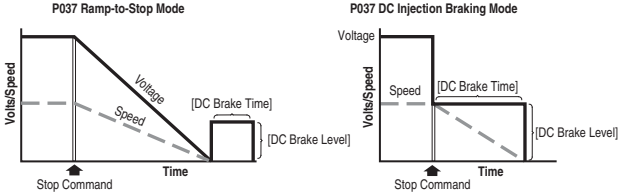
| | | |
|---|---|---|
| **Values** | Default: | 0.0 Secs |
| | Min/Max: | 0.0/99.9 Secs (A setting of 99.9 = Continuous) |
| | Display: | 0.1 Secs |

## A081 [DC Brake Level]

Related Parameter(s): P037, A080

Defines the maximum DC brake current, in amps, applied to the motor when P037 [Stop Mode] is set to either "Ramp" or "DC Brake".

| | | |
|---|---|---|
| **Values** | Default: | Drive Rated Amps × 0.05 |
| | Min/Max: | 0.0/(Drive Rated Amps × 1.8) |
| | Display: | 0.1 Amps |




**ATTENTION:** If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used.

**ATTENTION:** This feature should not be used with synchronous or permanent magnet motors. Motors may be demagnetized during braking.

# Advanced Program Group *(continued)*

## A082 [DB Resistor Sel]

Related Parameter(s): P037

Stop drive before changing this parameter.

Enables/disables external dynamic braking.

| Setting | Min/Max |
|---|---|
| 0 | "Disabled" |
| 1 | "Normal RA Res" (5% Duty Cycle) – Refer to Table B.C on page B-2. |
| 2 | "NoProtection" (100% Duty Cycle) |
| 3-99 | "x%Duty Cycle" Limited (3% – 99% of Duty Cycle) |

The drive is able to provide full braking indefinitely. Braking power is limited by the external DB resistor. When this parameter is set to 1 "Normal RA Res" and an appropriate resistor is used (see selection Table B.C), the drive provides calculated resistor overload protection. However, the drive cannot protect against a brake IGBT failure.

**ATTENTION:** A risk of fire exists if external braking resistors are not protected. The external resistor package must be self-protected from over temperature or the protective circuit shown in Figure B.9 on page B-13, or equivalent, must be supplied.

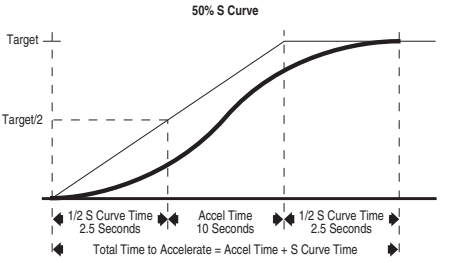
| | | |
|---|---|---|
| **Values** | Default: | 0 |
| | Min/Max: | 0/99 |
| | Display: | 1 |

## A083 [S Curve %]

Sets the percentage of acceleration or deceleration time that is applied to the ramp as S Curve. Time is added, 1/2 at the beginning and 1/2 at the end of the ramp.

| | | |
|---|---|---|
| **Values** | Default: | 0% (Disabled) |
| | Min/Max: | 0/100% |
| | Display: | 1% |

**Example:**
Accel Time = 10 Seconds
S Curve Setting = 50%
S Curve Time = 10 × 0.5 = 5 Seconds
Total Time = 10 + 5 = 15 Seconds



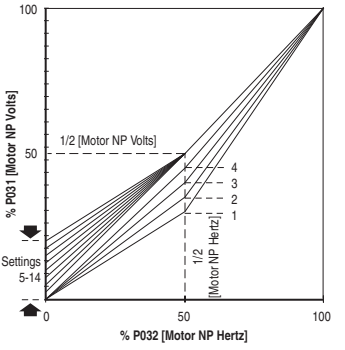
## Advanced Program Group *(continued)*

### A084 [Boost Select]

Related Parameter(s): d004, P031, P032, A085, A086, A087, A125

Sets the boost voltage (% of P031 [Motor NP Volts]) and redefines the Volts per Hz curve.
Active when A125 [Torque Perf Mode] = 0 "V/Hz".
Drive may add additional voltage unless Option 5 is selected.

| Options | | | |
|---|---|---|---|
| | **0** | "Custom V/Hz" | |
| | **1** | "30.0, VT" | Variable Torque (Typical fan/pump curves.) |
| | **2** | "35.0, VT" | |
| | **3** | "40.0, VT" | |
| | **4** | "45.0, VT" | |
| | **5** | "0.0 no IR" | Constant Torque |
| | **6** | "0.0" | |
| | **7** | "2.5, CT" [Default for 4.0, 5.5, 7.5 & 11 kW (5.0, 7.5, 10 & 15 HP) Drives] | |
| | **8** | "5.0, CT" (Default) | |
| | **9** | "7.5, CT" | |
| | **10** | "10.0, CT" | |
| | **11** | "12.5, CT" | |
| | **12** | "15.0, CT" | |
| | **13** | "17.5, CT" | |
| | **14** | "20.0, CT" | |



## Advanced Program Group *(continued)*

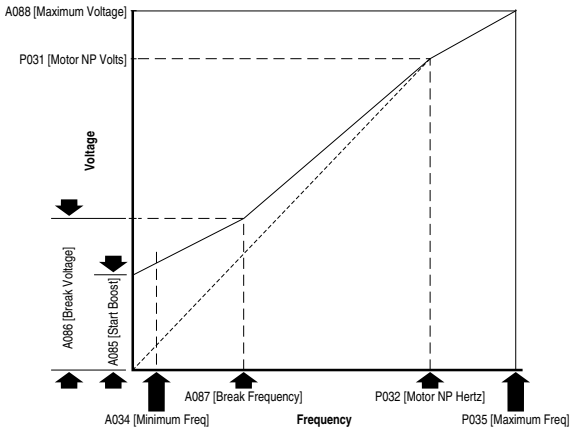
### A085 [Start Boost]

Related Parameter(s): P031, P032, P034, P035, A084, A086, A087, A088, A125

Sets the boost voltage (% of P031 [Motor NP Volts]) and redefines the Volts per Hz curve when A084 [Boost Select] = 0 “Custom V/Hz” and A125 [Torque Perf Mode] = 0 “V/Hz”.

Drive may add additional voltage unless Option 5 is selected.

| | | |
|---|---|---|
| **Values** | Default: | 2.5% |
| | Min/Max: | 0.0/25.0% |
| | Display: | 0.1% |




### A086 [Break Voltage]

Related Parameter(s): P031, P032, P034, P035, A084, A085, A087, A088, A125

Sets the frequency where break voltage is applied when A084 [Boost Select] = 0 “Custom V/Hz” and A125 [Torque Perf Mode] = 0 “V/Hz”

| | | |
|---|---|---|
| **Values** | Default: | 25.0% |
| | Min/Max: | 0.0/100.0% |
| | Display: | 0.1% |

### A087 [Break Frequency]

Related Parameter(s): P031, P032, P034, P035, A084, A085, A086, A088, A125

Sets the frequency where break frequency is applied when A084 [Boost Select] = 0 “Custom V/Hz” and A125 [Torque Perf Mode] = 0 “V/Hz”

| | | |
|---|---|---|
| **Values** | Default: | 15.0 Hz |
| | Min/Max: | 0.0/400.0 Hz |
| | Display: | 0.1 Hz |

# Advanced Program Group *(continued)*

## A088 [Maximum Voltage]

Related Parameter(s): d004, A085, A086, A087

Sets the highest voltage the drive will output.

| | | |
|---|---|---|
| **Values** | Default: | Drive Rated Volts |
| | Min/Max: | 20/Drive Rated Volts |
| | Display: | 1 VAC |

## A089 [Current Limit 1]

Related Parameter(s): P033, A118

Maximum output current allowed before current limiting occurs.

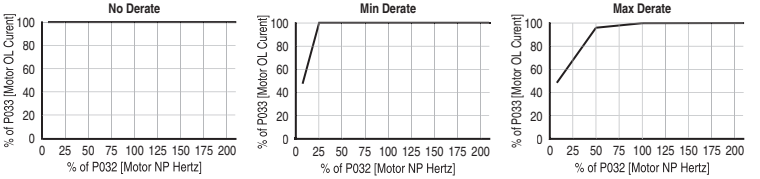
| | | |
|---|---|---|
| **Values** | Default: | Drive Rated Amps × 1.5 |
| | Min/Max: | 0.1/Drive Rated Amps × 1.8 |
| | Display: | 0.1 Amps |

## A090 [Motor OL Select]

Related Parameter(s): P032, P033

Drive provides Class 10 motor overload protection. Settings 0-2 select the derating factor for the $I^2t$ overload function.

| | | |
|---|---|---|
| **Options** | **0** | "No Derate" (Default) |
| | **1** | "Min Derate" |
| | **2** | "Max Derate" |



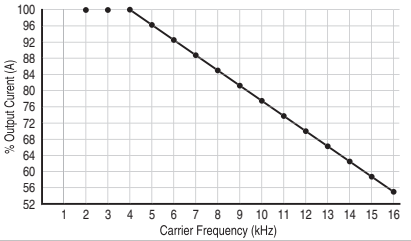

## A091 [PWM Frequency]

Related Parameter(s): A124

Sets the carrier frequency for the PWM output waveform. The chart below provides derating guidelines based on the PWM frequency setting.

**Important:** Ignoring derating guidelines can cause reduced drive performance.

| | | |
|---|---|---|
| **Values** | Default: | 4.0 kHz |
| | Min/Max: | 2.0/16.0 kHz |
| | Display: | 0.1 kHz |



# Advanced Program Group *(continued)*

## A092 [Auto Rstrt Tries]

Related Parameter(s): A055, A058, A061, A093

Sets the maximum number of times the drive attempts to reset a fault and restart.

**Clear a Type 1 fault and restart the drive.**

1. Set A092 [Auto Rstrt Tries] to a value other than "0".
2. Set A093 [Auto Rstrt Delay] to a value other than "0".

**Clear an OverVoltage, UnderVoltage or Heatsink OvrTmp fault without restarting the drive.**

1. Set A092 [Auto Rstrt Tries] to a value other than "0".
2. Set A093 [Auto Rstrt Delay] to "0".

**ATTENTION:** Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

| | | |
|---|---|---|
| **Values** | Default: | 0 |
| | Min/Max: | 0/9 |
| | Display: | 1 |

## A093 [Auto Rstrt Delay]

Related Parameter(s): A092

Sets the time between restart attempts when A092 [Auto Rstrt Tries] is set to a value other than zero.

| | | |
|---|---|---|
| **Values** | Default: | 1.0 Secs |
| | Min/Max: | 0.0/300.0 Secs |
| | Display: | 0.1 Secs |

## A094 [Start At PowerUp]

Stop drive before changing this parameter.

Enables/disables a feature that allows a Start or Run command to automatically cause the drive to resume running at commanded speed after drive input power is restored. Requires a digital input configured for Run or Start and a valid start contact.

This parameter will not function if parameter P036 [Start Source] is set to 4 "2-W High Speed".

**ATTENTION:** Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

| | | |
|---|---|---|
| **Options** | **0** | "Disabled" (Default) |
| | **1** | "Enabled" |

## Advanced Program Group *(continued)*

### A095 [Reverse Disable]

Related Parameter(s): d006

Stop drive before changing this parameter.

Enables/disables the function that allows the direction of motor rotation to be changed. The reverse command may come from a digital command, the keypad or a serial command. All reverse inputs including two-wire Run Reverse will be ignored with reverse disabled.

| | | |
|---|---|---|
| **Options** | **0** | "Rev Enabled" (Default) |
| | **1** | "Rev Disabled" |

### A096 [Flying Start En]

Sets the condition that allows the drive to reconnect to a spinning motor at actual RPM.

| | | |
|---|---|---|
| **Options** | **0** | "Disabled" (Default) |
| | **1** | "Enabled" |

### A097 [Compensation]

Enables/disables correction options that may improve problems with motor instability.

| | | | |
|---|---|---|---|
| **Options** | **0** | "Disabled" | |
| | **1** | "Electrical" (Default) | Some drive/motor combinations have inherent instabilities which are exhibited as non-sinusodial motor currents. This setting attempts to correct this condition. |
| | **2** | "Mechanical" | Some motor/load combinations have mechanical resonances which can be excited by the drive current regulator. This setting slows down the current regulator response and attempts to correct this condition. |
| | **3** | "Both" | |

### A098 [SW Current Trip]

Related Parameter(s): P033

Enables/disables a software instantaneous (within 100 ms) current trip.

| | | |
|---|---|---|
| **Values** | Default: | 0.0 (Disabled) |
| | Min/Max: | 0.0/(Drive Rated Amps × 2) |
| | Display: | 0.1 Amps |

### A099 [Process Factor]

Related Parameter(s): d010

Scales the output frequency value displayed by d010 [Process Display].

Output Freq x Process Factor = Process Display

| | | |
|---|---|---|
| **Values** | Default: | 30.0 |
| | Min/Max: | 0.1/999.9 |
| | Display: | 0.1 |

# Advanced Program Group *(continued)*

## A100 [Fault Clear]

Stop drive before changing this parameter.

Resets a fault and clears the fault queue. Used primarily to clear a fault over network communications.

| | | | |
|---|---|---|---|
| **Options** | **0** | "Ready/Idle" (Default) | |
| | **1** | "Reset Fault" | |
| | **2** | "Clear Buffer" | (Parameters d007-d009 [Fault x Code]) |

## A101 [Program Lock]

Protects parameters against change by unauthorized personnel.

| | | |
|---|---|---|
| **Options** | **0** | "Unlocked" (Default) |
| | **1** | "Locked" |

## A102 [Testpoint Sel]

Related Parameter(s): d019

Used by Rockwell Automation field service personnel.

| | | |
|---|---|---|
| **Values** | Default: | 400 |
| | Min/Max: | 0/FFFF |
| | Display: | 1 Hex |

## A103 [Comm Data Rate]

Related Parameter(s): d015

Sets the serial port rate for the RS485 (DSI) port.

**Important:** Power to drive must be cycled before any changes will affect drive operation.

| | | |
|---|---|---|
| **Options** | **0** | "1200" |
| | **1** | "2400" |
| | **2** | "4800" |
| | **3** | "9600" (Default) |
| | **4** | "19.2K" |
| | **5** | "38.4K" |

## A104 [Comm Node Addr]

Related Parameter(s): d015

Sets the drive node address for the RS485 (DSI) port if using a network connection.

**Important:** Power to drive must be cycled before any changes will affect drive operation.

| | | |
|---|---|---|
| **Values** | Default: | 100 |
| | Min/Max: | 1/247 |
| | Display: | 1 |

## Advanced Program Group *(continued)*

### A105 [Comm Loss Action]

Related Parameter(s): d015, P037, A106

Selects the drive's response to a loss of the communication connection or excessive communication errors.

| | | | |
|---|---|---|---|
| **Options** | **0** | "Fault" (Default) | Drive will fault on an F81 Comm Loss and coast to stop. |
| | **1** | "Coast Stop" | Stops drive via coast to stop. |
| | **2** | "Stop" | Stops drive via P037 [Stop Mode] setting. |
| | **3** | "Continu Last" | Drive continues operating at communication commanded speed saved in RAM. |

### A106 [Comm Loss Time]

Related Parameter(s): d015, A105

Sets the time that the drive will remain in communication loss before implementing the option selected in A105 [Comm Loss Action].

| | | |
|---|---|---|
| **Values** | Default: | 5.0 Secs |
| | Min/Max: | 0.1/60.0 Secs |
| | Display: | 0.1 Secs |

### A107 [Comm Format]

Related Parameter(s): d015

Selects the protocol (RTU only), data bits (8 data bits only), parity (None, Even, Odd), and stop bits (1 stop bit only) used by the RS485 port on the drive.

Refer to Appendix C for details on using the drive communication features.

**Important:** Power to drive must be cycled before any changes will affect drive operation.

| | | |
|---|---|---|
| **Options** | **0** | "RTU 8-N-1" (Default) |
| | **1** | "RTU 8-E-1" |
| | **2** | "RTU 8-O-1" |
| | **3** | "RTU 8-N-2" |
| | **4** | "RTU 8-E-2" |
| | **5** | "RTU 8-O-2" |

### A108 [Language]

Selects the language displayed by the remote communications option.

| | | |
|---|---|---|
| **Options** | **1** | "English" (Default) |
| | **2** | "Français" |
| | **3** | "Español" |
| | **4** | "Italiano" |
| | **5** | "Deutsch" |
| | **6** | "Reserved" |
| | **7** | "Português" |
| | **8** | "Reserved" |
| | **9** | "Reserved" |
| | **10** | "Nederlands" |

## Advanced Program Group *(continued)*

### A109 [Anlg Out Setpt]

Related Parameter(s): A065

When A065 [Analog Out Sel] is set to option 18, 19 or 20, this parameter sets the percentage of analog output desired.

| | | |
|---|---|---|
| **Values** | Default: | 0.0% |
| | Min/Max: | 0.0/100.0% |
| | Display: | 0.1% |

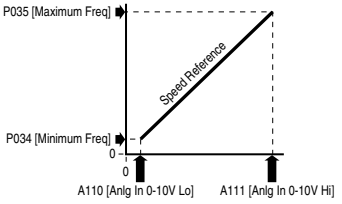
### A110 [Anlg In 0-10V Lo]

Related Parameter(s): d020, P034, P038, A122

Sets the analog input level that corresponds to P034 [Minimum Freq] if a 0-10V input is used by P038 [Speed Reference].

Analog inversion can be accomplished by setting this value larger than A111 [Anlg In 0-10V Hi].

| | | |
|---|---|---|
| **Values** | Default: | 0.0% |
| | Min/Max: | 0.0/100.0% |
| | Display: | 0.1% |




### A111 [Anlg In 0-10V Hi]

Related Parameter(s): d020, P035, P038, A122, A123

Sets the analog input level that corresponds to P035 [Maximum Freq] if a 0-10V input is used by P038 [Speed Reference].

Analog inversion can be accomplished by setting this value smaller than A110 [Anlg In 0-10V Lo].

| | | |
|---|---|---|
| **Values** | Default: | 100.0% |
| | Min/Max: | 0.0/100.0% |
| | Display: | 0.1% |

### A112 [Anlg In4-20mA Lo]

Related Parameter(s): d021, P034, P038

Sets the analog input level that corresponds to P034 [Minimum Freq] if a 4-20mA input is used by P038 [Speed Reference].

Analog inversion can be accomplished by setting this value larger than A113 [Anlg In4-20mA Hi].

| | | |
|---|---|---|
| **Values** | Default: | 0.0% |
| | Min/Max: | 0.0/100.0% |
| | Display: | 0.1% |

## Advanced Program Group *(continued)*

### A113 [Anlg In4-20mA Hi]

Related Parameter(s): d021, P035, P038

Sets the analog input level that corresponds to P035 [Maximum Freq] if a 4-20mA input is used by P038 [Speed Reference].

Analog inversion can be accomplished by setting this value smaller than A112 [Anlg In4-20mA Lo].

| | | |
|---|---|---|
| **Values** | Default: | 100.0% |
| | Min/Max: | 0.0/100.0% |
| | Display: | 0.1% |

### A114 [Slip Hertz @ FLA]

Related Parameter(s): P033

Compensates for the inherent slip in an induction motor. This frequency is added to the commanded output frequency based on motor current.

| | | |
|---|---|---|
| **Values** | Default: | 2.0 Hz |
| | Min/Max: | 0.0/10.0 Hz |
| | Display: | 0.1 Hz |

### A115 [Process Time Lo]

Related Parameter(s): d010, P034

Scales the time value when the drive is running at P034 [Minimum Freq]. When set to a value other than zero, d010 [Process Display] indicates the duration of the process.

| | | |
|---|---|---|
| **Values** | Default: | 0.00 |
| | Min/Max: | 0.00/99.99 |
| | Display: | 0.01 |

### A116 [Process Time Hi]

Related Parameter(s): d010, P035

Scales the time value when the drive is running at P035 [Maximum Freq]. When set to a value other than zero, d010 [Process Display] indicates the duration of the process.

| | | |
|---|---|---|
| **Values** | Default: | 0.00 |
| | Min/Max: | 0.00/99.99 |
| | Display: | 0.01 |

### A117 [Bus Reg Mode]

Controls the operation of the drive voltage regulation, which is normally operational at decel or when the bus voltage rises.

Refer to the Attention statement on page P-3 for important information on bus regulation.

| | | |
|---|---|---|
| **Options** | **0** | "Disabled" |
| | **1** | "Enabled" (Default) |

### A118 [Current Limit 2]

Related Parameter(s): P033, A051-A054, A089

Maximum output current allowed before current limiting occurs. This parameter is only active if A051 - A054 [Digital Inx Sel] is set to 25 "Current Lmt2" and is active.

| | | |
|---|---|---|
| **Values** | Default: | Drive Rated Amps × 1.5 |
| | Min/Max: | 0.1/(Drive Rated Amps × 1.8) |
| | Display: | 0.1 Amps |

## Advanced Program Group *(continued)*

### A119 [Skip Frequency]

Related Parameter(s): A120

Sets the frequency at which the drive will not operate.

A setting of 0 disables this parameter.

| | | |
|---|---|---|
| **Values** | Default: | 0 Hz |
| | Min/Max: | 0/400 Hz |
| | Display: | 1 Hz |

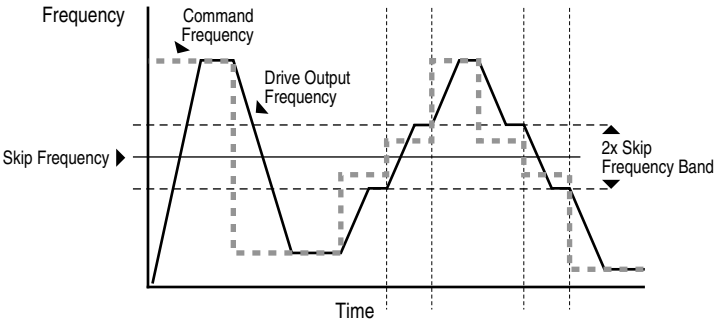
### A120 [Skip Freq Band]

Related Parameter(s): A119

Determines the bandwidth around A119 [Skip Frequency]. A120 [Skip Frequency Band] is split applying 1/2 above and 1/2 below the actual skip frequency.

A setting of 0.0 disables this parameter.

| | | |
|---|---|---|
| **Values** | Default: | 0.0 Hz |
| | Min/Max: | 0.0/30.0 Hz |
| | Display: | 0.1 Hz |




### A121 [Stall Fault Time]

Sets the time that the drive will remain in stall mode before a fault is issued.

| | | |
|---|---|---|
| **Options** | **0** | "60 Seconds" (Default) |
| | **1** | "120 Seconds" |
| | **2** | "240 Seconds" |
| | **3** | "360 Seconds" |
| | **4** | "480 Seconds" |
| | **5** | "Flt Disabled" |

## Advanced Program Group *(continued)*

### A122 [Analog In Loss]

Related Parameter(s): A110, A111, A132

Selects drive action when an input signal loss is detected. Signal loss is defined as an analog signal less than 1V or 2mA. The signal loss event ends and normal operation resumes when the input signal level is greater than or equal to 1.5V or 3mA. If using a 0-10V analog input, set A110 [Anlg In 0-10V Lo] to a minimum of 20% (i.e. 2 volts).

| | | | |
|---|---|---|---|
| **Options** | **0** | "Disabled" (Default) | |
| | **1** | "Fault (F29)" | F29 Analog Input Loss |
| | **2** | "Stop" | Uses P037 [Stop Mode] |
| | **3** | "Zero Ref" | Drive runs at zero speed reference. |
| | **4** | "Min Freq Ref" | Drive runs at minimum frequency. |
| | **5** | "Max Freq Ref" | Drive runs at maximum frequency. |
| | **6** | "Int Freq Ref" | Drive runs at internal frequency. |

### A123 [10V Bipolar Enbl]

Related Parameter(s): P038, A111

Enables/disables bipolar control. In bipolar mode direction is commanded by the sign of the reference.

| | | | |
|---|---|---|---|
| **Options** | **0** | "Uni-Polar In" (Default) | 0 to 10V only |
| | **1** | "Bi-Polar In" | ±10V |

### A124 [Var PWM Disable]

Related Parameter(s): A091

Stop drive before changing this parameter.

Enables/disables a feature that varies the carrier frequency for the PWM output waveform defined by A091 [PWM Frequency].

Disabling this feature when low frequency conditions exist may result in IGBT stress and nuisance tripping.

| | | |
|---|---|---|
| **Options** | **0** | "Enabled" (Default) |
| | **1** | "Disabled" |

### A125 [Torque Perf Mode]

Related Parameter(s): A084, A085, A086, A087, A127

Stop drive before changing this parameter.

Enables/disables sensorless vector control operation.

| | | |
|---|---|---|
| **Options** | **0** | "V/Hz" |
| | **1** | "Sensrls Vect" (Default) |

### A126 [Motor NP FLA]

Related Parameter(s): A127

Set to the motor nameplate rated full load amps.

| | | |
|---|---|---|
| **Values** | Default: | Drive Rated Amps |
| | Min/Max: | 0.1/(Drive Rated Amps × 2) |
| | Display: | 0.1 Amps |

## Advanced Program Group *(continued)*

### A127 [Autotune]

Related Parameter(s): A125, A126, A128, A129

Stop drive before changing this parameter.

Provides an automatic method for setting A128 [IR Voltage Drop] and A129 [Flux Current Ref], which affect sensorless vector performance. Parameter A126 [Motor NP FLA] must be set to the motor nameplate full load amps before running the Autotune procedure.

| | | |
|---|---|---|
| **Options** | **0** | "Ready/Idle" (Default) |
| | **1** | "Static Tune" |
| | **2** | "Rotate Tune" |

"Ready" (0) = Parameter returns to this setting following a "Static Tune" or "Rotate Tune."

"Static Tune" (1) = A temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of A128 [IR Voltage Drop]. A start command is required following initiation of this setting. The parameter returns to "Ready" (0) following the test, at which time another start transition is required operate the drive in normal mode. Used when motor cannot be uncoupled from the load.

"Rotate Tune" (2) = A temporary command that initiates a "Static Tune" followed by a rotational test for the best possible automatic setting of A129 [Flux Current Ref]. A start command is required following initiation of this setting. The parameter returns to "Ready" (0) following the test, at which time another start transition is required to operate the drive in normal mode. **Important:** Used when motor is uncoupled from the load. Results may not be valid if a load is coupled to the motor during this procedure.

**ATTENTION:** Rotation of the motor in an undesired direction can occur during this procedure. To guard against possible injury and/or equipment damage, it is recommended that the motor be disconnected from the load before proceeding.

If the Autotune routine fails, an F80 SVC Autotune fault is displayed.

### A128 [IR Voltage Drop]

Related Parameter(s): A127

Value of volts dropped across the resistance of the motor stator.

| | | |
|---|---|---|
| **Values** | Default: | Based on Drive Rating |
| | Min/Max: | 0.0/230.0 VAC |
| | Display: | 0.1 VAC |

### A129 [Flux Current Ref]

Related Parameter(s): A127

Value of amps for full motor flux.

| | | |
|---|---|---|
| **Values** | Default: | Based on Drive Rating |
| | Min/Max: | 0.00/[Motor NP FLA] |
| | Display: | 0.01 Amps |

# Advanced Program Group *(continued)*

## A130 [PID Trim Hi]

Sets the maximum positive value that is added to the speed reference when PID trim is used.

| | | |
|---|---|---|
| **Values** | Default: | 60.0 |
| | Min/Max: | 0.0/400.0 |
| | Display: | 0.1 |

## A131 [PID Trim Lo]

Sets the maximum positive value that is subtracted from the PID reference when PID trim is used.

| | | |
|---|---|---|
| **Values** | Default: | 0.0 |
| | Min/Max: | 0.0/400.0 |
| | Display: | 0.1 |

## A132 [PID Ref Sel]

Related Parameter(s): P038, A122

Stop drive before changing this parameter.

Enables/disables PID mode and selects the source of the PID reference. Refer to Appendix F for details.

| | | |
|---|---|---|
| **Options** | **0** | "PID Disabled" (Default) |
| | **1** | "PID Setpoint" |
| | **2** | "0-10V Input" |
| | **3** | "4-20mA Input" |
| | **4** | "Comm Port" |
| | **5** | "Setpnt, Trim" |
| | **6** | "0-10V, Trim" |
| | **7** | "4-20mA, Trim" |
| | **8** | "Comm, Trim" |

## A133 [PID Feedback Sel]

Select the source of the PID feedback. Refer to Appendix F for details.

| | | | |
|---|---|---|---|
| **Options** | **0** | "0-10V Input" (Default) | The PID will not function with a bipolar input. Negative voltages are treated as 0 volts. |
| | **1** | "4-20mA Input" | |
| | **2** | "Comm Port" | |

## A134 [PID Prop Gain]

Sets the value for the PID proportional component when the PID mode is enabled by A132 [PID Ref Sel].

| | | |
|---|---|---|
| **Values** | Default: | 0.01 |
| | Min/Max: | 0.00/99.99 |
| | Display: | 0.01 |

## Advanced Program Group *(continued)*

### A135 [PID Integ Time]

Sets the value for the PID integral component when the PID mode is enabled by A132 [PID Ref Sel].

| | | |
|---|---|---|
| **Values** | Default: | 0.1 Secs |
| | Min/Max: | 0.0/999.9 Secs |
| | Display: | 0.1 Secs |

### A136 [PID Diff Rate]

Sets the value for the PID differential component when the PID mode is enabled by A132 [PID Ref Sel].

| | | |
|---|---|---|
| **Values** | Default: | 0.01 (1/Secs) |
| | Min/Max: | 0.00/99.99 (1/Secs) |
| | Display: | 0.01 (1/Secs) |

### A137 [PID Setpoint]

Provides an internal fixed value for process setpoint when the PID mode is enabled by A132 [PID Ref Sel].

| | | |
|---|---|---|
| **Values** | Default: | 0.0% |
| | Min/Max: | 0.0/100.0% |
| | Display: | 0.1% |

### A138 [PID Deadband]

Sets the lower limit of the PID output.

| | | |
|---|---|---|
| **Values** | Default: | 0.0% |
| | Min/Max: | 0.0/10.0% |
| | Display: | 0.1% |

### A139 [PID Preload]

Sets the value used to preload the integral component on start or enable.

| | | |
|---|---|---|
| **Values** | Default: | 0.0 Hz |
| | Min/Max: | 0.0/400.0 Hz |
| | Display: | 0.1 Hz |

## Advanced Program Group *(continued)*

**A140 [Stp Logic 0]**
**A141 [Stp Logic 1]**
**A142 [Stp Logic 2]**
**A143 [Stp Logic 3]**
**A144 [Stp Logic 4]**
**A145 [Stp Logic 5]**
**A146 [Stp Logic 6]**
**A147 [Stp Logic 7]**

Related Parameter(s): P038, P039, P040, A051-A054, A055, A058, A061, A067, A068, A070-A077, A150-A157

Stop drive before changing this parameter.

| | | |
|---|---|---|
| **Values** | Default: | 00F1 |
| | Min/Max: | 0001/bAFF |
| | Display: | 4 Digits |

Parameters A140-A147 are only active if P038 [Speed Reference] is set to 6 “Stp Logic”.

These parameters can be used to create a custom profile of frequency commands. Each “step” can be based on time, status of a Logic input or a combination of time and the status of a Logic input.

Digits 0-3 for each [Stp Logic x] parameter must be programmed according to the desired profile.

A Logic input is established by setting a digital input, parameters A051 - A054 [Digital Inx Sel], to 23 “Logic In1” and/or 24 “Logic In2”.

A time interval between steps can be programmed using parameters A150 - A157 [Stp Logic Time x]. See the table below for related parameters.

The speed for any step is programmed using parameters A070 - A077 [Preset Freq x].

| StepLogic Parameter (Active when P038 = 6 “Stp Logic”) | Related Preset Frequency Parameter (Can be activated independent of StepLogic Parameters) | Related StepLogic Time Parameter (Active when A140-A147 Digit 0 or 1 are set to 1, b, C, d or E) |
|---|---|---|
| A140 [Stp Logic 0] | A070 [Preset Freq 0] | A150 [Stp Logic Time 0] |
| A141 [Stp Logic 1] | A071 [Preset Freq 1] | A151 [Stp Logic Time 1] |
| A142 [Stp Logic 2] | A072 [Preset Freq 2] | A152 [Stp Logic Time 2] |
| A143 [Stp Logic 3] | A073 [Preset Freq 3] | A153 [Stp Logic Time 3] |
| A144 [Stp Logic 4] | A074 [Preset Freq 4] | A154 [Stp Logic Time 4] |
| A145 [Stp Logic 5] | A075 [Preset Freq 5] | A155 [Stp Logic Time 5] |
| A146 [Stp Logic 6] | A076 [Preset Freq 6] | A156 [Stp Logic Time 6] |
| A147 [Stp Logic 7] | A077 [Preset Freq 7] | A157 [Stp Logic Time 7] |

**How StepLogic Works**
The StepLogic sequence begins with a valid start command. A normal sequence always begins with A140 [Stp Logic 0].

**Digit 0: Logic For Next Step**
This digit defines the logic for the next step. When the condition is met the program advances to the next step. Step 0 follows Step 7. Example: Digit 0 is set 3. When “Logic In2” becomes active, the program advances to the next step.

**Digit 1: Logic to Jump to a Different Step**
For all settings other than F, when the condition is met, the program overrides Digit 0 and jumps to the step defined by Digit 2.

**Digit 2: Different Step to Jump**
When the condition for Digit 1 is met, the Digit 2 setting determines the next step or to end the program.

**Digit 3: Step Settings**

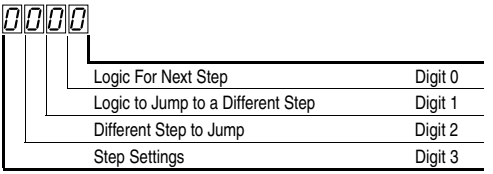
This digit defines what accel/decel profile the speed command will follow and the direction of the command for the current step. In addition, if a relay or opto output (parameters A055, A058 and A061) is set to 15 “StpLogic Out”, this parameter can control the status of that output.

Any StepLogic parameter can be programmed to control a relay or opto output, but you can not control different outputs based on the condition of different StepLogic commands.

**StepLogic Settings**

The logic for each function is determined by the four digits for each StepLogic parameter. The following is a listing of the available settings for each digit.

Refer to Appendix E for details.




**Digit 3 Settings**

| Required Setting | Accel/Decel Param. Used | StepLogic Output State | Commanded Direction |
|---|---|---|---|
| 0 | Accel/Decel 1 | Off | FWD |
| 1 | Accel/Decel 1 | Off | REV |
| 2 | Accel/Decel 1 | Off | No Output |
| 3 | Accel/Decel 1 | On | FWD |
| 4 | Accel/Decel 1 | On | REV |
| 5 | Accel/Decel 1 | On | No Output |
| 6 | Accel/Decel 2 | Off | FWD |
| 7 | Accel/Decel 2 | Off | REV |
| 8 | Accel/Decel 2 | Off | No Output |
| 9 | Accel/Decel 2 | On | FWD |
| A | Accel/Decel 2 | On | REV |
| b | Accel/Decel 2 | On | No Output |

**Digit 2 Settings**

0 = Jump to Step 0
1 = Jump to Step 1
2 = Jump to Step 2
3 = Jump to Step 3
4 = Jump to Step 4
5 = Jump to Step 5
6 = Jump to Step 6
7 = Jump to Step 7
8 = End Program (Normal Stop)
9 = End Program (Coast to Stop)
A = End Program and Fault (F2)

**Digit 1 and Digit 0 Settings**

0 = Skip Step (Jump Immediately)
1 = Step Based on [Stp Logic Time x]
2 = Step if “Logic In1” is Active
3 = Step if “Logic In2” is Active
4 = Step if “Logic In1” is Not Active
5 = Step if “Logic In2” is Not Active
6 = Step if either “Logic In1” or “Logic In2” is Active
7 = Step if both “Logic In1” and “Logic In2” is Active
8 = Step if neither “Logic In1” or “Logic In2” is Active
9 = Step if “Logic In1” is Active and “Logic In2” is Not Active
A = Step if “Logic In2” is Active and “Logic In1” is Not Active
b = Step after [Stp Logic Time x] and “Logic In1” is Active
C = Step after [Stp Logic Time x] and “Logic In2” is Active
d = Step after [Stp Logic Time x] and “Logic In1” is Not Active
E = Step after [Stp Logic Time x] and “Logic In2” is Not Active
F = Do Not Step/Ignore Digit 2 Settings

## Advanced Program Group *(continued)*

**A150 [Stp Logic Time 0]**
**A151 [Stp Logic Time 1]**
**A152 [Stp Logic Time 2]**
**A153 [Stp Logic Time 3]**
**A154 [Stp Logic Time 4]**
**A155 [Stp Logic Time 5]**
**A156 [Stp Logic Time 6]**
**A157 [Stp Logic Time 7]**

Related Parameter(s): P038, A055, A058, A061, A070-A077, A140-A147

Sets the time to remain in each step if the corresponding StpLogic command word is set to "Step after Time".

| | | |
|---|---|---|
| **Values** | Default: | 30.0 Secs |
| | Min/Max: | 0.0/999.9 Secs |
| | Display: | 0.1 Secs |

**A160 [EM Brk Off Delay]**

Related Parameter(s): P037

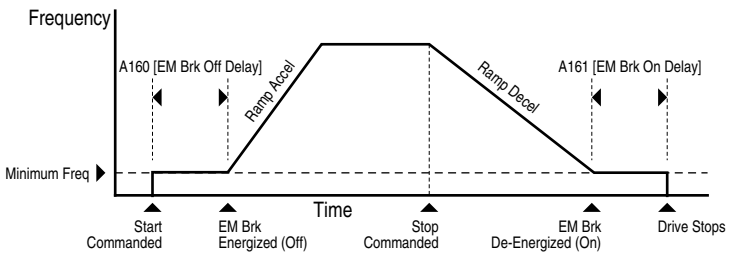
Sets the time the drive remains at minimum frequency before the relay or an opto output is energized and the drive ramps to the commanded frequency.

The relay or opto output is typically connected to a user-supplied electromechanical brake coil relay.

Set P037 [Stop Mode] to 8 "Ramp+EM B,CF" or 9 "Ramp+EM Brk" to enable the electromechanical brake option.

Set A055 [Relay Out Sel], A058 or A061 [Opto Outx Sel] to 22 "EM Brk Cntrl" to control brake operation.

| | | |
|---|---|---|
| **Values** | Default: | 2.00 Secs |
| | Min/Max: | 0.01/10.00 Secs |
| | Display: | 0.01 Secs |



## Advanced Program Group *(continued)*

### A161 [EM Brk On Delay]

Related Parameter(s): P037

Sets the time the drive remains at minimum frequency before the relay or an opto output is de-energizing and the drive stops.

The relay or opto output is typically connected to a user-supplied electromechanical brake coil relay.

Set P037 [Stop Mode] to 8 “Ramp+EM B,CF” or 9 “Ramp+EM Brk” to enable the electromechanical brake option.

Set A055 [Relay Out Sel], A058 or A061 [Opto Outx Sel] to 22 “EM Brk Cntrl” to control brake operation.

| | | |
|---|---|---|
| **Values** | Default: | 2.00 Secs |
| | Min/Max: | 0.01/10.00 Secs |
| | Display: | 0.01 Secs |

### A162 [MOP Reset Sel]

Related Parameter(s): A069

Set the drive to save the current MOP reference command.

| | | | |
|---|---|---|---|
| **Options** | **0** | “Zero MOP Ref” | This option clamps A069 [Internal Freq] at 0.0 Hz when the drive is not running. |
| | **1** | “Save MOP Ref” (Default) | Reference is saved in A069 [Internal Freq]. |

### A163 [DB Threshold]

Related Parameter(s): P037, A080, A081, A082

Sets the DC bus Voltage Threshold for Dynamic Brake operation. If the DC bus voltage falls below the value set in this parameter, the Dynamic Brake will not turn on. Lower values will make the Dynamic Braking function more responsive but may result in nuisance Dynamic Brake activation.

| | | |
|---|---|---|
| **Values** | Default | 100.0% |
| | Min/Max: | 0.0/110.0% |
| | Display: | 0.0% |

**ATTENTION:** Equipment damage may result if this parameter is set a value that causes the dynamic braking resistor to dissipate excessive power. Parameter settings less than 100% should be carefully evaluated to ensure that the dynamic brake resistor’s wattage rating is not exceeded. In general, values less than 90% are not needed. This parameter’s setting is especially important if parameter A082 [DB Resistor Sel] is set to 2 “No Protection”.

# Advanced Program Group *(continued)*

## A164 [Comm Write Mode]

Determines whether parameter changes made over communication port are saved and stored in Non-Volatile Storage (NVS) or RAM only. If they are stored in RAM, the values will be lost at power-down.

| | | |
|---|---|---|
| **Options** | **0** | "Save" (Default) |
| | **1** | "RAM Only" |

**ATTENTION:** Risk of equipment damage exists. If a controller is programmed to write parameter data to Non-Volatile Storage (NVS) frequently, the NVS will quickly exceed its life cycle and cause the drive to malfunction. Do not create a program that frequently uses configurable outputs to write parameter data to NVS unless A164 [Comm Write Mode] is set to option 1.

## A165 [Anlg Loss Delay]

Related Parameter(s): A122

Sets the length of time after power-up during which the drive will not detect an analog signal loss. The drive response to an analog signal loss is set in A122 [Analog In Loss].

| | | |
|---|---|---|
| **Values** | Default: | 0.0 Secs |
| | Min/Max: | 0.0/20.0 Secs |
| | Display: | 0.1 Secs |

## A166 [Analog In Filter]

Sets level of additional filtering of the analog input signals. A higher number increases filtering and decreases bandwidth. Each setting doubles the applied filtering (1 = 2x filter, 2 = 4x filter, etc...). No additional filtering is applied when set to "0".

| | | |
|---|---|---|
| **Values** | Default: | 0 |
| | Min/Max: | 0/14 |
| | Display: | 1 |

## A167 [PID Invert Error]

When set to "Inverted", changes the sign of the PID error. This causes an increase in the drive output frequency with PID Feedback greater than PID Setpoint, and a decrease in drive output frequency with PID Feedback less than PID Setpoint.

| | | |
|---|---|---|
| **Options** | **0** | "Not Inverted" (Default) |
| | **1** | "Inverted" |

# Parameter Cross Reference – by Name

| Parameter Name | No. | Group |
|---|---|---|
| 10V Bipolar Enbl | A123 | Advanced Program |
| Accel Time 1 | P039 | Basic Program |
| Accel Time 2 | A067 | Advanced Program |
| Analog In 0-10V | d020 | Display |
| Analog In 4-20mA | d021 | Display |
| Analog In Filter | A166 | Advanced Program |
| Analog In Loss | A122 | Advanced Program |
| Analog Out High | A066 | Advanced Program |
| Analog Out Sel | A065 | Advanced Program |
| Anlg In 0-10V Hi | A111 | Advanced Program |
| Anlg In 0-10V Lo | A110 | Advanced Program |
| Anlg In4-20mA Hi | A113 | Advanced Program |
| Anlg In4-20mA Lo | A112 | Advanced Program |
| Anlg Loss Delay | A166 | Advanced Program |
| Anlg Out Setpt | A109 | Advanced Program |
| Auto Rstrt Delay | A093 | Advanced Program |
| Auto Rstrt Tries | A092 | Advanced Program |
| Autotune | A127 | Advanced Program |
| Boost Select | A084 | Advanced Program |
| Break Frequency | A087 | Advanced Program |
| Break Voltage | A086 | Advanced Program |
| Bus Reg Mode | A117 | Advanced Program |
| Comm Data Rate | A103 | Advanced Program |
| Comm Format | A107 | Advanced Program |
| Comm Loss Action | A105 | Advanced Program |
| Comm Loss Time | A106 | Advanced Program |
| Comm Node Addr | A104 | Advanced Program |
| Comm Status | d015 | Display |
| Comm Write Mode | A164 | Advanced Program |
| Commanded Freq | d002 | Display |
| Compensation | A097 | Advanced Program |
| Contrl In Status | d013 | Display |
| Control Source | d012 | Display |
| Control SW Ver | d016 | Display |
| Counter Status | d025 | Display |
| Current Limit x | A089, A118 | Advanced Program |
| DB Resistor Sel | A082 | Advanced Program |
| DB Threshold | A163 | Advanced Program |
| DC Brake Level | A081 | Advanced Program |
| DC Brake Time | A080 | Advanced Program |
| DC Bus Voltage | d005 | Display |
| Decel Time 1 | P040 | Basic Program |
| Decel Time 2 | A068 | Advanced Program |
| Dig In Status | d014 | Display |
| Digital Inx Sel | A051-A054 | Advanced Program |
| Drive Status | d006 | Display |
| Drive Temp | d024 | Display |
| Drive Type | d017 | Display |
| Elapsed Run Time | d018 | Display |
| EM Brk Off Delay | A160 | Advanced Program |
| EM Brk On Delay | A161 | Advanced Program |
| Fault Clear | A100 | Advanced Program |
| Fault x Code | d007-d009 | Display |
| Flux Current Ref | A129 | Advanced Program |
| Flying Start En | A096 | Advanced Program |
| Internal Freq | A069 | Advanced Program |
| IR Voltage Drop | A128 | Advanced Program |
| Jog Accel/Decel | A079 | Advanced Program |
| Jog Frequency | A078 | Advanced Program |
| Language | A108 | Advanced Program |
| Maximum Freq | P035 | Basic Program |
| Maximum Voltage | A088 | Advanced Program |
| Minimum Freq | P034 | Basic Program |
| MOP Reset Sel | A162 | Advanced Program |
| Motor NP FLA | A126 | Advanced Program |
| Motor NP Hertz | P032 | Basic Program |
| Motor NP Volts | P031 | Basic Program |
| Motor OL Current | P033 | Basic Program |
| Motor OL Ret | P043 | Basic Program |
| Motor OL Select | A090 | Advanced Program |
| Opto Out Logic | A064 | Advanced Program |
| Opto Outx Level | A059, A062 | Advanced Program |
| Opto Outx Sel | A058, A061 | Advanced Program |
| Output Current | d003 | Display |
| Output Freq | d001 | Display |
| Output Power | d022 | Display |
| Output Powr Fctr | d023 | Display |
| Output Voltage | d004 | Display |
| PID Deadband | A138 | Advanced Program |
| PID Diff Rate | A136 | Advanced Program |
| PID Feedback Sel | A133 | Advanced Program |
| PID Integ Time | A135 | Advanced Program |
| PID Invert Error | A167 | Advanced Program |
| PID Preload | A139 | Advanced Program |
| PID Prop Gain | A134 | Advanced Program |
| PID Ref Sel | A132 | Advanced Program |
| PID Setpoint | A137 | Advanced Program |
| PID Trim Hi | A130 | Advanced Program |
| PID Trim Lo | A131 | Advanced Program |
| Preset Freq x | A070-A077 | Advanced Program |
| Process Display | d010 | Display |
| Process Factor | A099 | Advanced Program |
| Process Time Hi | A116 | Advanced Program |
| Process Time Lo | A115 | Advanced Program |
| Program Lock | A101 | Advanced Program |
| PWM Frequency | A091 | Advanced Program |
| Relay Out Level | A056 | Advanced Program |
| Relay Out Sel | A055 | Advanced Program |
| Reset To Defalts | P041 | Basic Program |
| Reverse Disable | A095 | Advanced Program |
| S Curve % | A083 | Advanced Program |
| Skip Freq Band | A120 | Advanced Program |
| Skip Frequency | A119 | Advanced Program |
| Slip Hertz @ FLA | A114 | Advanced Program |
| Stp Logic Status | d028 | Display |
| Stp Logic x | A140-A147 | Advanced Program |
| Stp Logic Time x | A150-A157 | Advanced Program |
| Speed Reference | P038 | Basic Program |
| Stall Fault Time | A121 | Advanced Program |
| Start At PowerUp | A094 | Advanced Program |
| Start Boost | A085 | Advanced Program |
| Start Source | P036 | Basic Program |
| Stop Mode | P037 | Basic Program |
| SW Current Trip | A098 | Advanced Program |

| Parameter Name | No. | Group |
|---|---|---|
| Testpoint Data | d019 | Display |
| Testpoint Sel | A102 | Advanced Program |
| Timer Status | d026 | Display |
| Torque Current | d029 | Display |
| Torque Perf Mode | A125 | Advanced Program |
| Var PWM Disable | A124 | Advanced Program |
| Voltage Class | P042 | Basic Program |

# Troubleshooting

Chapter 4 provides information to guide you in troubleshooting the PowerFlex 40 drive. Included is a listing and description of drive faults (with possible solutions, when applicable).


| For information on... | See page... | For information on... | See page... |
|---|---|---|---|
| Drive Status | 4-1 | Fault Descriptions | 4-3 |
| Faults | 4-1 | Common Symptoms and Corrective Actions | 4-5 |


## Drive Status

The condition or state of your drive is constantly monitored. Any changes will be indicated through the integral keypad.

### LED Indications

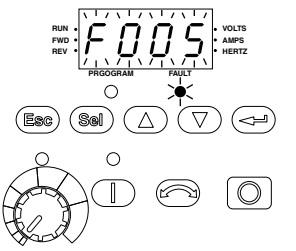
See page 2-4 for information on drive status indicators and controls.

## Faults

A fault is a condition that stops the drive. There are two fault types.

| Type | Fault Description | |
|---|---|---|
| ① | Auto-Reset/Run | When this type of fault occurs, and A092 [Auto Rstrt Tries] is set to a value greater than "0," a user-configurable timer, A093 [Auto Rstrt Delay], begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted. |
| ② | Non-Resetable | This type of fault may require drive or motor repair, or is caused by wiring or programing errors. The cause of the fault must be corrected before the fault can be cleared. |

## Fault Indication

| Condition | Display |
|---|---|
| **Drive is indicating a fault.**<br>The integral keypad provides visual notification of a fault condition by displaying the following.<br>• Flashing fault number<br>• Flashing fault indicator<br>Press the Escape key to regain control of the integral keypad. |  |

## Manually Clearing Faults

| Step | Key(s) |
|---|---|
| 1. Press Esc to acknowledge the fault. The fault information will be removed so that you can use the integral keypad.<br>Access d007 [Fault 1 Code] to view the most recent fault information.<br>2. Address the condition that caused the fault.<br>The cause must be corrected before the fault can be cleared.<br>See Table 4.A.<br>3. After corrective action has been taken, clear the fault by one of these methods.<br>• Press Stop if P037 [Stop Mode] is set to a value between “0” and “3”.<br>• Cycle drive power.<br>• Set A100 [Fault Clear] to “1” or “2”.<br>• Cycle digital input if A051-A054 [Digital Inx Sel] is set to option 7 “Clear Fault”. | <br> |

## Automatically Clearing Faults

| Option / Step |
|---|
| **Clear a Type 1 fault and restart the drive.**<br>1. Set A092 [Auto Rstrt Tries] to a value other than “0”.<br>2. Set A093 [Auto Rstrt Delay] to a value other than “0”. |
| **Clear an OverVoltage, UnderVoltage or Heatsink OvrTmp fault without restarting the drive.**<br>1. Set A092 [Auto Rstrt Tries] to a value other than “0”.<br>2. Set A093 [Auto Rstrt Delay] to “0”. |

## Auto Restart (Reset/Run)

The Auto Restart feature provides the ability for the drive to automatically perform a fault reset followed by a start attempt without user or application intervention. This allows remote or “unattended” operation. Only certain faults are allowed to be reset. Certain faults (Type 2) that indicate possible drive component malfunction are not resettable.

Caution should be used when enabling this feature, since the drive will attempt to issue its own start command based on user selected programming.

## Fault Descriptions

**Table 4.A Fault Types, Descriptions and Actions**

| No. | Fault | Type[1] | Description | Action |
|---|---|---|---|---|
| F2 | Auxiliary Input | ① | Auxiliary input interlock is open. | 1. Check remote wiring.<br>2. Verify communications programming for intentional fault. |
| F3 | Power Loss | ② | Excessive DC Bus voltage ripple. | 1. Monitor the incoming line for phase loss or line imbalance.<br>2. Check input line fuse. |
| F4 | UnderVoltage | ① | DC bus voltage fell below the minimum value. | Monitor the incoming AC line for low voltage or line power interruption. |
| F5 | OverVoltage | ① | DC bus voltage exceeded maximum value. | Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option. |
| F6 | Motor Stalled | ① | Drive is unable to accelerate motor. | Increase P039 - A067 [Accel Time x] or reduce load so drive output current does not exceed the current set by parameter A089 [Current Limit 1]. |
| F7 | Motor Overload | ① | Internal electronic overload trip. | 1. An excessive motor load exists. Reduce load so drive output current does not exceed the current set by parameter P033 [Motor OL Current].<br>2. Verify A084 [Boost Select] setting |
| F8 | Heatsink OvrTmp | ① | Heatsink temperature exceeds a predefined value. | 1. Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40°C (104°F) for IP30, NEMA UL Type 1 installations or 50°C (122°F) for IP20/Open type installations.<br>2. Check fan. |
| F12 | HW OverCurrent | ② | The drive output current has exceeded the hardware current limit. | Check programming. Check for excess load, improper A084 [Boost Select] setting, DC brake volts set too high or other causes of excess current. |
| F13 | Ground Fault | ② | A current path to earth ground has been detected at one or more of the drive output terminals. | Check the motor and external wiring to the drive output terminals for a grounded condition. |
| F29 | Analog Input Loss | ① | An analog input is configured to fault on signal loss. A signal loss has occurred.<br>Configure with A122 [Analog In Loss]. | 1. Check parameters.<br>2. Check for broken/loose connections at inputs. |

(1) See page 4-1 for a description of fault types.

| No. | Fault | Type(1) | Description | Action |
|---|---|---|---|---|
| F33 | Auto Rstrt Tries | ② | Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of A092 [Auto Rstrt Tries]. | Correct the cause of the fault and manually clear. |
| F38 | Phase U to Gnd | ② | A phase to ground fault has been detected between the drive and motor in this phase. | 1. Check the wiring between the drive and motor.<br>2. Check motor for grounded phase.<br>3. Replace drive if fault cannot be cleared. |
| F39 | Phase V to Gnd | | | |
| F40 | Phase W to Gnd | | | |
| F41 | Phase UV Short | ② | Excessive current has been detected between these two output terminals. | 1. Check the motor and drive output terminal wiring for a shorted condition.<br>2. Replace drive if fault cannot be cleared. |
| F42 | Phase UW Short | | | |
| F43 | Phase VW Short | | | |
| F48 | Params Defaulted | | The drive was commanded to write default values to EEPROM. | 1. Clear the fault or cycle power to the drive.<br>2. Program the drive parameters as needed. |
| F63 | SW OverCurrent | ① | Programmed A098 [SW Current Trip] has been exceeded. | Check load requirements and A098 [SW Current Trip] setting. |
| F64 | Drive Overload | ② | Drive rating of 150% for 1 minute or 200% for 3 seconds has been exceeded. | Reduce load or extend Accel Time. |
| F70 | Power Unit | ② | Failure has been detected in the drive power section. | 1. Cycle power.<br>2. Replace drive if fault cannot be cleared. |
| F71 | Net Loss | | The communication network has faulted. | 1. Cycle power.<br>2. Check communications cabling.<br>3. Check network adapter setting.<br>4. Check external network status. |
| F80 | SVC Autotune | | The autotune function was either cancelled by the user or failed. | Restart procedure. |
| F81 | Comm Loss | ② | RS485 (DSI) port stopped communicating. | 1. If adapter was not intentionally disconnected, check wiring to the port. Replace wiring, port expander, adapters or complete drive as required.<br>2. Check connection.<br>3. An adapter was intentionally disconnected.<br>4. Turn off using A105 [Comm Loss Action]. |

| No. | Fault | Type(1) | Description | Action |
|---|---|---|---|---|
| F100 | Parameter Checksum | ② | The checksum read from the board does not match the checksum calculated. | Set P041 [Reset To Defalts] to option 1 “Reset Defaults”. |
| F122 | I/O Board Fail | ② | Failure has been detected in the drive control and I/O section. | 1. Cycle power.<br>2. Replace drive if fault cannot be cleared. |

(1) See page 4-1 for a description of fault types.

## Common Symptoms and Corrective Actions

**Motor does not Start.**

| Cause(s) | Indication | Corrective Action |
|---|---|---|
| No output voltage to the motor. | None | Check the power circuit.<br>• Check the supply voltage.<br>• Check all fuses and disconnects.<br>Check the motor.<br>• Verify that the motor is connected properly.<br>Check the control input signals.<br>• Verify that a Start signal is present. If 2-Wire control is used, verify that either the Run Forward or Run Reverse signal is active, but not both.<br>• Verify that I/O Terminal 01 is active.<br>• Verify that P036 [Start Source] matches your configuration.<br>• Verify that A095 [Reverse Disable] is not prohibiting movement. |
| Improper boost setting at initial start-up. | None | Set A084 [Boost Select] to option 2 “35.0, VT”. |
| Drive is Faulted | Flashing red status light | Clear fault.<br>• Press Stop<br>• Cycle power<br>• Set A100 [Fault Clear] to option 1 “Clear Faults”.<br>• Cycle digital input if A051 - A054 [Digital Inx Sel] is set to option 7 “Clear Fault”. |

**Drive does not Start from Start or Run Inputs wired to the terminal block.**

| Cause(s) | Indication | Corrective Action |
|---|---|---|
| Drive is Faulted | Flashing red status light | Clear fault.<br>• Press Stop<br>• Cycle power<br>• Set A100 [Fault Clear] to option 1 “Clear Faults”.<br>• Cycle digital input if A051 - A054 [Digital Inx Sel] is set to option 7 “Clear Fault”. |
| Incorrect programming.<br>• P036 [Start Source] is set to option 0 “Keypad” or option 5 “RS485 (DSI) Port”.<br>• A051 - A054 [Digital Inx Sel] is set to option 5 “Local” and the input is active. | None | Check parameter settings. |
| Incorrect input wiring.<br>See 1-18 for wiring examples.<br>• 2 wire control requires Run Forward, Run Reverse or Jog input.<br>• 3 wire control requires Start and Stop inputs<br>• Stop input is always required. | None | Wire inputs correctly and/or install jumper. |
| Incorrect Sink/Source DIP switch setting. | None | Set switch to match wiring scheme. |

**Drive does not Start from Integral Keypad.**

| Cause(s) | Indication | Corrective Action |
|---|---|---|
| Integral keypad is not enabled. | Green LED above Start key is not illuminated. | • Set parameter P036 [Start Source] to option 0 “Keypad”.<br>• Set parameter A051 - A054 [Digital Inx Sel] to option 5 “Local” and activate the input. |
| I/O Terminal 01 “Stop” input is not present. | None | Wire inputs correctly and/or install jumper. |

**Drive does not respond to changes in speed command.**

| Cause(s) | Indication | Corrective Action |
|---|---|---|
| No value is coming from the source of the command. | The drive “Run” indicator is lit and output is 0 Hz. | • Check d012 [Control Source] for correct source.<br>• If the source is an analog input, check wiring and use a meter to check for presence of signal.<br>• Check d002 [Commanded Freq] to verify correct command. |
| Incorrect reference source is being selected via remote device or digital inputs. | None | • Check d012 [Control Source] for correct source.<br>• Check d014 [Dig In Status] to see if inputs are selecting an alternate source. Verify settings for A051 - A054 [Digital Inx Sel].<br>• Check P038 [Speed Reference] for the source of the speed reference. Reprogram as necessary.<br>• Review the Speed Reference Control chart on page 1-23. |

**Motor and/or drive will not accelerate to commanded speed.**

| Cause(s) | Indication | Corrective Action |
|---|---|---|
| Acceleration time is excessive. | None | Reprogram P039 [Accel Time 1] or A067 [Accel Time 2]. |
| Excess load or short acceleration times force the drive into current limit, slowing or stopping acceleration. | None | Compare d003 [Output Current] with A089 [Current Limit 1].<br>Remove excess load or reprogram P039 [Accel Time 1] or A067 [Accel Time 2].<br>Check for improper A084 [Boost Select] setting. |
| Speed command source or value is not as expected. | None | Verify d002 [Commanded Freq].<br>Check d012 [Control Source] for the proper Speed Command. |
| Programming is preventing the drive output from exceeding limiting values. | None | Check P035 [Maximum Freq] to insure that speed is not limited by programming. |
| Torque performance does not match motor characteristics. | None | Set motor nameplate full load amps in parameter A126 [Motor NP FLA].<br>Perform A127 [Autotune] “Static Tune” or “Rotate Tune” procedure.<br>Set A125 [Torque Perf Mode] to option 0 “V/Hz”. |

**Motor operation is unstable.**

| Cause(s) | Indication | Corrective Action |
|---|---|---|
| Motor data was incorrectly entered. | None | 1. Correctly enter motor nameplate data into P031, P032 and P033.<br>2. Enable A097 [Compensation].<br>3. Use A084 [Boost Select] to reduce boost level. |

**Drive will not reverse motor direction.**

| Cause(s) | Indication | Corrective Action |
|---|---|---|
| Digital input is not selected for reversing control. | None | Check [Digital Inx Sel] (See page 3-14). Choose correct input and program for reversing mode. |
| Digital input is incorrectly wired. | None | Check input wiring. (See page 1-17) |
| Motor wiring is improperly phased for reverse. | None | Switch two motor leads. |
| Reverse is disabled. | None | Check A095 [Reverse Disable]. |

**Drive does not power up.**

| Cause(s) | Indication | Corrective Action |
|---|---|---|
| No input power to drive. | None | Check the power circuit.<br>• Check the supply voltage.<br>• Check all fuses and disconnects. |
| Jumper between I/O Terminals P2 and P1 not installed and/or DC Bus Inductor not connected. | None | Install jumper or connect DC Bus Inductor. |

# Supplemental Drive Information


| For information on... | See page... |
|---|---|
| Drive, Fuse & Circuit Breaker Ratings | A-1 |
| Specifications | A-2 |


## Drive, Fuse & Circuit Breaker Ratings

The tables on the following pages provide recommended AC line input fuse and circuit breaker information. See Fusing and Circuit Breakers below for UL and IEC requirements. Sizes listed are the recommended sizes based on 40 °C (104 °F) and the U.S. N.E.C. Other country, state or local codes may require different ratings.

### Fusing

The recommended fuse types are listed below. If available current ratings do not match those listed in the tables provided, choose the next higher fuse rating.

- IEC – BS88 (British Standard) Parts 1 & 2[(1)], EN60269-1, Parts 1 & 2, type gG or equivalent should be used.
- UL – UL Class CC, T or J must be used.[(2)]

### Circuit Breakers

The "non-fuse" listings in the following tables include inverse time circuit breakers, instantaneous trip circuit breakers (motor circuit protectors) and 140M self-protected combination motor controllers. If one of these is chosen as the desired protection method, the following requirements apply:

- IEC – Both types of circuit breakers and 140M self-protected combination motor controllers are acceptable for IEC installations.
- UL – Only inverse time circuit breakers and the specified 140M self-protected combination motor controllers are acceptable for UL installations.

(1) Typical designations include, but may not be limited to the following; Parts 1 & 2: AC, AD, BC, BD, CD, DD, ED, EFS, EF, FF, FG, GF, GG, GH.

(2) Typical designations include; Type CC - KTK-R, FNQ-R
Type J - JKS, LPJ
Type T - JJS, JJN

# Specifications

| Drive Ratings | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Catalog Number[1] | Output Ratings | | Input Ratings | | | Branch Circuit Protection | | | |
| | kW (HP) | Amps | Voltage Range | kVA | Amps | Fuses | 140M Motor Protectors[3] [4] | Contactors | Min. Enclosure Volume[5] (in.$^3$) |
| **100 - 120V AC (±10%) – 1-Phase Input, 0 - 230V 3-Phase Output** | | | | | | | | | |
| 22B-V2P3x104 | 0.4 (0.5) | 2.3 | 90-132 | 1.15 | 9.0 | 15 | 140M-C2E-C16 | 100-C12 | 1655 |
| 22B-V5P0x104 | 0.75 (1.0) | 5.0 | 90-132 | 2.45 | 20.3 | 35 | 140M-D8E-C20 | 100-C23 | 1655 |
| 22B-V6P0x104 | 1.1 (1.5) | 6.0 | 90-132 | 3.0 | 24.0 | 40 | 140M-F8E-C32 | 100-C37 | 1655 |
| **200 - 240V AC (±10%) – 1-Phase[2] Input, 0 - 230V 3-Phase Output** | | | | | | | | | |
| 22B-A2P3x104 | 0.4 (0.5) | 2.3 | 180-264 | 1.15 | 6.0 | 10 | 140M-C2E-B63 | 100-C09 | 1655 |
| 22B-A5P0x104 | 0.75 (1.0) | 5.0 | 180-264 | 2.45 | 12.0 | 20 | 140M-C2E-C16 | 100-C12 | 1655 |
| 22B-A8P0x104 | 1.5 (2.0) | 8.0 | 180-264 | 4.0 | 18.0 | 30 | 140M-D8E-C20 | 100-C23 | 1655 |
| 22B-A012x104 | 2.2 (3.0) | 12.0 | 180-264 | 5.5 | 25.0 | 40 | 140M-F8E-C32 | 100-C37 | 2069 |
| **200 - 240V AC (±10%) – 3-Phase Input, 0 - 230V 3-Phase Output** | | | | | | | | | |
| 22B-B2P3x104 | 0.4 (0.5) | 2.3 | 180-264 | 1.15 | 2.5 | 6 | 140M-C2E-B40 | 100-C07 | 1655 |
| 22B-B5P0x104 | 0.75 (1.0) | 5.0 | 180-264 | 2.45 | 5.7 | 10 | 140M-C2E-C10 | 100-C09 | 1655 |
| 22B-B8P0x104 | 1.5 (2.0) | 8.0 | 180-264 | 4.0 | 9.5 | 15 | 140M-C2E-C16 | 100-C12 | 1655 |
| 22B-B012x104 | 2.2 (3.0) | 12.0 | 180-264 | 5.5 | 15.5 | 25 | 140M-C2E-C16 | 100-C23 | 1655 |
| 22B-B017x104 | 3.7 (5.0) | 17.5 | 180-264 | 8.6 | 21.0 | 30 | 140M-F8E-C25 | 100-C23 | 1655 |
| 22B-B024x104 | 5.5 (7.5) | 24.0 | 180-264 | 11.8 | 26.1 | 40 | 140M-F8E-C32 | 100-C37 | 2069 |
| 22B-B033x104 | 7.5 (10.0) | 33.0 | 180-264 | 16.3 | 34.6 | 60 | 140M-G8E-C45 | 100-C60 | 2069 |
| **380 - 480V AC (±10%) – 3-Phase Input, 0 - 460V 3-Phase Output** | | | | | | | | | |
| 22B-D1P4x104 | 0.4 (0.5) | 1.4 | 342-528 | 1.4 | 1.8 | 3 | 140M-C2E-B25 | 100-C07 | 1655 |
| 22B-D2P3x104 | 0.75 (1.0) | 2.3 | 342-528 | 2.3 | 3.2 | 6 | 140M-C2E-B40 | 100-C07 | 1655 |
| 22B-D4P0x104 | 1.5 (2.0) | 4.0 | 342-528 | 4.0 | 5.7 | 10 | 140M-C2E-B63 | 100-C09 | 1655 |
| 22B-D6P0x104 | 2.2 (3.0) | 6.0 | 342-528 | 5.9 | 7.5 | 15 | 140M-C2E-C10 | 100-C09 | 1655 |
| 22B-D010x104 | 4.0 (5.0) | 10.5 | 342-528 | 10.3 | 13.0 | 20 | 140M-C2E-C16 | 100-C23 | 1655 |
| 22B-D012x104 | 5.5 (7.5) | 12.0 | 342-528 | 11.8 | 14.2 | 25 | 140M-D8E-C20 | 100-C23 | 2069 |
| 22B-D017x104 | 7.5 (10.0) | 17.0 | 342-528 | 16.8 | 18.4 | 30 | 140M-D8E-C20 | 100-C23 | 2069 |
| 22B-D024x104 | 11.0 (15.0) | 24.0 | 342-528 | 23.4 | 26.0 | 50 | 140M-F8E-C32 | 100-C43 | 2069 |
| **460 - 600V AC (±10%) – 3-Phase Input, 0 - 575V 3-Phase Output** | | | | | | | | | |
| 22B-E1P7x104 | 0.75 (1.0) | 1.7 | 414-660 | 2.1 | 2.3 | 6 | 140M-C2E-B25 | 100-C09 | 1655 |
| 22B-E3P0x104 | 1.5 (2.0) | 3.0 | 414-660 | 3.65 | 3.8 | 6 | 140M-C2E-B40 | 100-C09 | 1655 |
| 22B-E4P2x104 | 2.2 (3.0) | 4.2 | 414-660 | 5.2 | 5.3 | 10 | 140M-D8E-B63 | 100-C09 | 1655 |
| 22B-E6P6x104 | 4.0 (5.0) | 6.6 | 414-660 | 8.1 | 8.3 | 15 | 140M-D8E-C10 | 100-C09 | 1655 |
| 22B-E9P9x104 | 5.5 (7.5) | 9.9 | 414-660 | 12.1 | 11.2 | 20 | 140M-D8E-C16 | 100-C16 | 2069 |
| 22B-E012x104 | 7.5 (10.0) | 12.2 | 414-660 | 14.9 | 13.7 | 25 | 140M-D8E-C16 | 100-C23 | 2069 |
| 22B-E019x104 | 11.0 (15.0) | 19.0 | 414-660 | 23.1 | 24.1 | 40 | 140M-F8E-C25 | 100-C30 | 2069 |

(1) In the Catalog Numbers listed "x" represents enclosure type. Specifications are valid for all enclosure types. IP66, NEMA/UL Type 4X drive ratings are only available as Frame B drives. Refer to Table B.B.

(2) 200-240V AC - 1-Phase drives are also available with an integral EMC filter. Catalog suffix changes from N104 to N114. Filter option is not available for IP66, NEMA/UL Type 4X rated drives.

(3) The AIC ratings of the Bulletin 140M Motor Protector Circuit Breakers may vary. See Bulletin 140M Motor Protection Circuit Breakers Application Ratings.

(4) Manual Self-Protected (Type E) Combination Motor Controller, UL listed for 208 Wye or Delta, 240 Wye or Delta, 480Y/277 or 600Y/347. Not UL listed for use on 480V or 600V Delta/Delta, corner ground, or high-resistance ground systems.

(5) When using a Manual Self-Protected (Type E) Combination Motor Controller, the drive must be installed in a ventilated or non-ventilated enclosure with the minimum volume specified in this column. Application specific thermal considerations may require a larger enclosure.

**Input/Output Ratings**

*Output Frequency:* 0-400 Hz (Programmable)
*Efficiency:* 97.5% (Typical)

**Approvals**

UL508C CSA 22.2
EMC Directive 89/336
LV: EN 50178, EN 60204
EMC: EN 61800-3, EN 50081-1, EN 50082-2

**Digital Control Inputs (Input Current = 6mA)**

| SRC (Source) Mode: | SNK (Sink) Mode: |
|---|---|
| 18-24V = ON | 0-6V = ON |
| 0-6V = OFF | 18-24V = OFF |

**Analog Control Inputs**

*4-20mA Analog:* 250 ohm input impedance
*0-10V DC Analog:* 100k ohm input impedance
*External Pot:* 1-10k ohms, 2 Watt minimum

**Control Output**

| *Programmable Output (form C relay)* | *Opto Outputs* | *Analog Outputs (10 bit)* |
|---|---|---|
| Resistive Rating: 3.0A at 30V DC, 3.0A at 125V AC, 3.0A at 240V AC | 30V DC, 50mA | 0-10V, 1k ohm Min. |
| Inductive Rating: 0.5A at 30V DC, 0.5A at 125V AC, 0.5A at 240V AC | Non-inductive | 4-20mA, 525 ohm Max. |

**Fuses and Circuit Breakers**

*Recommended Fuse Type:* UL Class J, CC, T or Type BS88; 600V (550V) or equivalent.
*Recommended Circuit Breakers:* HMCP circuit breakers or equivalent.

**Protective Features**

*Motor Protection:* $I^2t$ overload protection - 150% for 60 Secs, 200% for 3 Secs (Provides Class 10 protection)

*Overcurrent:* 200% hardware limit, 300% instantaneous fault

*Over Voltage:* 100-120V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 150V AC incoming line)
200-240V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 290V AC incoming line)
380-460V AC Input – Trip occurs at 810V DC bus voltage (equivalent to 575V AC incoming line)
460-600V AC Input – Trip occurs at 1005V DC bus voltage (equivalent to 711V AC incoming line)

*Under Voltage:* 100-120V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 75V AC incoming line)
200-240V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 150V AC incoming line)
380-480V AC Input – Trip occurs at 390V DC bus voltage (equivalent to 275V AC incoming line)
460-600V AC Input – If P042 = 3 "High Voltage" trip occurs at 487V DC bus voltage (344V AC incoming line);
If P042 = 2 "Low Voltage" trip occurs at 390V DC bus voltage (275V AC incoming line)

*Control Ride Through:* Minimum ride through is 0.5 Secs - typical value 2 Secs

*Faultless Power Ride Through:* 100 milliseconds

**Dynamic Braking**

Internal brake IGBT included with all ratings except when no brake is specified.
Refer to Appendix B for DB resistor ordering information.

| Category | Specification | |
|---|---|---|
| **Environment** | Altitude: | 1000 m (3300 ft) max. without derating |
| | Maximum Surrounding Air Temperature without derating: | |
| | IP20, NEMA/UL Type Open: | –10 to 50° C (14 to 122° F) |
| | IP30, NEMA/UL Type 1: | –10 to 40° C (14 to 104° F) |
| | Flange Mount: | Heatsink: –10 to 40° C (14 to 104° F)<br>Drive: –10 to 50° C (14 to 122° F) |
| | IP66, NEMA/UL Type 4X: | –10 to 40° C (14 to 104° F) |
| | Cooling Method | |
| | Convection: | 0.4 kW (0.5 HP) drives |
| | Fan: | All other drive ratings and 0.4 kW (0.5 HP) 1-Phase drives with Integral “S Type” EMC Filter |
| | Storage Temperature: | –40 to 85 degrees C (–40 to 185 degrees F) |
| | Atmosphere: | **Important:** Drive **must** **not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere. |
| | Relative Humidity: | 0 to 95% non-condensing |
| | Shock (operating): | 15G peak for 11ms duration (±1.0ms) |
| | Vibration (operating): | 1G peak, 5 to 2000 Hz |
| **Control** | Carrier Frequency | 2-16 kHz. Drive rating based on 4 kHz. |
| | Frequency Accuracy | |
| | Digital Input: | Within ±0.05% of set output frequency. |
| | Analog Input: | Within 0.5% of maximum output frequency, 10-Bit resolution |
| | Analog Output: | ±2% of full scale, 10-Bit resolution |
| | Speed Regulation - Open Loop with Slip Compensation: | ±1% of base speed across a 60:1 speed range. |
| | Stop Modes: | Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S Curve. |
| | Accel/Decel: | Two independently programmable accel and decel times. Each time may be programmed from 0 - 600 seconds in 0.1 second increments. |
| | Intermittent Overload: | 150% Overload capability for up to 1 minute<br>200% Overload capability for up to 3 seconds |
| | Electronic Motor Overload Protection: | Provides class 10 motor overload protection according to NEC article 430 and motor over-temperature protection according to NEC article 430.126 (A) (2). UL 508C File 29572. |
| **Electrical** | Voltage Tolerance: | 100-120V ±10%<br>200-240V ±10%<br>380-480V ±10%<br>460-600V ±10% |
| | Frequency Tolerance: | 48-63 Hz |
| | Input Phases: | Three-phase input provides full rating. Single-phase operation provides 35% rated current. |
| | Displacement Power Factor: | 0.98 across entire speed range |
| | Maximum Short Circuit Rating: | 100,000 Amps Symmetrical |
| | Actual Short Circuit Rating: | Determined by AIC Rating of installed fuse/circuit breaker |
| | Transistor Type: | Insulated Gate Bipolar Transistor (IGBT) |

**PowerFlex 40 Estimated Watts Loss (Rated Load, Speed & PWM)**

| Voltage | kW (HP) | External Watts | Internal Watts | Total Watts Loss |
|---|---|---|---|---|
| **100–120V** | 0.4 (0.5) | 22 | 18 | 40 |
| | 0.75 (1.0) | 40 | 20 | 60 |
| | 1.1 (1.5) | 58 | 22 | 80 |
| **200–240V** | 0.4 (0.5) | 22 | 18 | 40 |
| | 0.75 (1.0) | 40 | 20 | 60 |
| | 1.1 (2.0) | 63 | 22 | 85 |
| | 2.2 (3.0) | 100 | 25 | 125 |
| | 3.7 (5.0) | 150 | 30 | 180 |
| | 5.5 (7.5) | 200 | 35 | 235 |
| | 7.5 (10) | 265 | 40 | 305 |
| **380–480V** | 0.4 (0.5) | 17 | 18 | 35 |
| | 0.75 (1.0) | 30 | 20 | 50 |
| | 1.1 (2.0) | 48 | 22 | 70 |
| | 2.2 (3.0) | 75 | 25 | 100 |
| | 3.7 (5.0) | 135 | 25 | 160 |
| | 5.5 (7.5) | 140 | 35 | 175 |
| | 7.5 (10) | 175 | 35 | 210 |
| | 11 (15) | 260 | 40 | 300 |
| **460–600V** | 0.75 (1.0) | 30 | 20 | 50 |
| | 1.5 (2.0) | 48 | 22 | 70 |
| | 2.2 (3.0) | 75 | 25 | 100 |
| | 4.0 (5.0) | 135 | 25 | 160 |
| | 5.5 (7.5) | 140 | 35 | 175 |
| | 7.5 (10) | 175 | 35 | 210 |
| | 11 (15) | 260 | 40 | 300 |

**Notes:**

# Accessories and Dimensions

## Product Selection

**Table B.A Catalog Number Description**

| 22B | - | A | 1P5 | N | 1 | 1 | 4 |
|---|---|---|---|---|---|---|---|
| Drive | | Voltage Rating | Rating | Enclosure | HIM | Emission Class | Type |

**Table B.B PowerFlex 40 Drives**

| Drive Ratings | | | | IP20, NEMA/UL Type Open | | IP20 Flange Mount[1] | IP66, NEMA/UL Type 4X |
|---|---|---|---|---|---|---|---|
| Input Voltage | kW | HP | Output Current | Catalog Number | Frame Size | Catalog Number | Catalog Number |
| 120V 50/60 Hz 1-Phase No Filter | 0.4 | 0.5 | 2.3A | 22B-V2P3N104 | B | 22B-V2P3F104 | 22B-V2P3C104 |
| | 0.75 | 1.0 | 5.0A | 22B-V5P0N104 | B | 22B-V5P0F104 | 22B-V5P0C104 |
| | 1.1 | 1.5 | 6.0A | 22B-V6P0N104 | B | 22B-V6P0F104 | 22B-V6P0C104 |
| 240V 50/60 Hz 1-Phase With Integral "S Type" EMC Filter | 0.4 | 0.5 | 2.3A | 22B-A2P3N114 | B | – | – |
| | 0.75 | 1.0 | 5.0A | 22B-A5P0N114 | B | – | – |
| | 1.5 | 2.0 | 8.0A | 22B-A8P0N114 | B | – | – |
| | 2.2 | 3.0 | 12.0A | 22B-A012N114 | C | – | – |
| 240V 50/60 Hz 1-Phase No Filter | 0.4 | 0.5 | 2.3A | 22B-A2P3N104 | B | 22B-A2P3F104 | 22B-A2P3C104 |
| | 0.75 | 1.0 | 5.0A | 22B-A5P0N104 | B | 22B-A5P0F104 | 22B-A5P0C104 |
| | 1.5 | 2.0 | 8.0A | 22B-A8P0N104 | B | 22B-A8P0F104 | 22B-A8P0C104 |
| | 2.2 | 3.0 | 12.0A | 22B-A012N104 | C | 22B-A012F104 | – |
| 240V 50/60 Hz 3-Phase No Filter | 0.4 | 0.5 | 2.3A | 22B-B2P3N104 | B | 22B-B2P3F104 | 22B-B2P3C104 |
| | 0.75 | 1.0 | 5.0A | 22B-B5P0N104 | B | 22B-B5P0F104 | 22B-B5P0C104 |
| | 1.5 | 2.0 | 8.0A | 22B-B8P0N104 | B | 22B-B8P0F104 | 22B-B8P0C104 |
| | 2.2 | 3.0 | 12.0A | 22B-B012N104 | B | 22B-B012F104 | 22B-B012C104 |
| | 3.7 | 5.0 | 17.5A | 22B-B017N104 | B | 22B-B017F104 | 22B-B017C104 |
| | 5.5 | 7.5 | 24.0A | 22B-B024N104 | C | 22B-B024F104 | – |
| | 7.5 | 10.0 | 33.0A | 22B-B033N104 | C | 22B-B033F104 | – |
| 480V 50/60 Hz 3-Phase No Filter | 0.4 | 0.5 | 1.4A | 22B-D1P4N104 | B | 22B-D1P4F104 | 22B-D1P4C104 |
| | 0.75 | 1.0 | 2.3A | 22B-D2P3N104 | B | 22B-D2P3F104 | 22B-D2P3C104 |
| | 1.5 | 2.0 | 4.0A | 22B-D4P0N104 | B | 22B-D4P0F104 | 22B-D4P0C104 |
| | 2.2 | 3.0 | 6.0A | 22B-D6P0N104 | B | 22B-D6P0F104 | 22B-D6P0C104 |
| | 4.0 | 5.0 | 10.5A | 22B-D010N104 | B | 22B-D010F104 | 22B-D010C104 |
| | 5.5 | 7.5 | 12.0A | 22B-D012N104 | C | 22B-D012F104 | – |
| | 7.5 | 10.0 | 17.0A | 22B-D017N104 | C | 22B-D017F104 | – |
| | 11.0 | 15.0 | 24.0A | 22B-D024N104 | C | 22B-D024F104 [2] | – |
| 600V 50/60 Hz 3-Phase No Filter | 0.75 | 1.0 | 1.7A | 22B-E1P7N104 | B | 22B-E1P7F104 | 22B-E1P7C104 |
| | 1.5 | 2.0 | 3.0A | 22B-E3P0N104 | B | 22B-E3P0F104 | 22B-E3P0C104 |
| | 2.2 | 3.0 | 4.2A | 22B-E4P2N104 | B | 22B-E4P2F104 | 22B-E4P2C104 |
| | 4.0 | 5.0 | 6.6A | 22B-E6P6N104 | B | 22B-E6P6F104 | 22B-E6P6C104 |
| | 5.5 | 7.5 | 9.9A | 22B-E9P9N104 | C | 22B-E9P9F104 | – |
| | 7.5 | 10.0 | 12.0A | 22B-E012N104 | C | 22B-E012F104 | – |
| | 11.0 | 15.0 | 19.0A | 22B-E019N104 | C | 22B-E019F104 | – |

(1) Meets IP40/54/65 (NEMA 1/12/4/4X) when installed in an enclosure of like rating.

(2) Requires use of external DC Bus Inductor or AC Line Reactor. See Table B.E for details.

**Table B.C Dynamic Brake Modules**

| Drive Ratings | | | | |
|---|---|---|---|---|
| **Input Voltage** | **kW** | **HP** | **Minimum Resistance Ω** | **Catalog Number (1) (2)** |
| 120V 50/60 Hz 1-Phase | 0.4 | 0.5 | 48 | AK-R2-091P500 |
| | 0.75 | 1.0 | 48 | AK-R2-091P500 |
| | 1.1 | 1.5 | 48 | AK-R2-091P500 |
| 240V 50/60 Hz 1-Phase | 0.4 | 0.5 | 48 | AK-R2-091P500 |
| | 0.75 | 1.0 | 48 | AK-R2-091P500 |
| | 1.5 | 2.0 | 48 | AK-R2-091P500 |
| | 2.2 | 3.0 | 32 | AK-R2-047P500 |
| 240V 50/60 Hz 3-Phase | 0.4 | 0.5 | 48 | AK-R2-091P500 |
| | 0.75 | 1.0 | 48 | AK-R2-091P500 |
| | 1.5 | 2.0 | 48 | AK-R2-091P500 |
| | 2.2 | 3.0 | 32 | AK-R2-047P500 |
| | 3.7 | 5.0 | 19 | AK-R2-047P500 |
| | 5.5 | 7.5 | 13 | AK-R2-030P1K2 |
| | 7.5 | 10.0 | 10 | AK-R2-030P1K2 |
| 480V 50/60 Hz 3-Phase | 0.4 | 0.5 | 97 | AK-R2-360P500 |
| | 0.75 | 1.0 | 97 | AK-R2-360P500 |
| | 1.5 | 2.0 | 97 | AK-R2-360P500 |
| | 2.2 | 3.0 | 97 | AK-R2-120P1K2 |
| | 4.0 | 5.0 | 77 | AK-R2-120P1K2 |
| | 5.5 | 7.5 | 55 | AK-R2-120P1K2 |
| | 7.5 | 10.0 | 39 | AK-R2-120P1K2 |
| | 11.0 | 15.0 | 24 | AK-R2-120P1K2 (3) |
| 600V 50/60 Hz 3-Phase | 0.75 | 1.0 | 120 | AK-R2-360P500 |
| | 1.5 | 2.0 | 120 | AK-R2-360P500 |
| | 2.2 | 3.0 | 82 | AK-R2-120P1K2 |
| | 4.0 | 5.0 | 82 | AK-R2-120P1K2 |
| | 5.5 | 7.5 | 51 | AK-R2-120P1K2 |
| | 7.5 | 10.0 | 51 | AK-R2-120P1K2 |
| | 11.0 | 15.0 | 51 | AK-R2-120P1K2 (3) |

(1) The resistors listed in this tables are rated for 5% duty cycle.

(2) Use of Rockwell resistors is always recommended. The resistors listed have been carefully selected for optimizing performance in a variety of applications. Alternative resistors may be used, however care must be taken when making a selection. Refer to the P*owerFlex Dynamic Braking Resistor Calculator*, publication PFLEX-AT001.

(3) Requires two resistors wired in parallel.

**Table B.D Bulletin 1321-3R Series Line Reactors**

| Input Voltage | kW | HP | Fundamental Amps | Maximum Continuous Amps | Inductance mh | Watts Loss | Catalog Number (1) |
|---|---|---|---|---|---|---|---|
| 240V 50/60 Hz 3-Phase | 0.4 | 0.5 | 4 | 6 | 12.0 | 21 W | 1321-3R4-D |
| | 0.75 | 1.0 | 8 | 12 | 3.0 | 29 W | 1321-3R8-B |
| | 1.5 | 2.0 | 8 | 12 | 1.5 | 19.5 W | 1321-3R8-A |
| | 2.2 | 3.0 | 12 | 18 | 1.25 | 26 W | 1321-3R12-A |
| | 3.7 | 5.0 | 18 | 27 | 0.8 | 36 W | 1321-3R18-A |
| | 5.5 | 7.5 | 25 | 37.5 | 0.5 | 48 W | 1321-3R25-A |
| | 7.5 | 10.0 | 35 | 52.5 | 0.4 | 49 W | 1321-3R35-A |
| 480V 50/60 Hz 3-Phase | 0.4 | 0.5 | 2 | 3 | 20.0 | 11.3 W | 1321-3R2-B |
| | 0.75 | 1.0 | 4 | 6 | 9.0 | 20 W | 1321-3R4-C |
| | 1.5 | 2.0 | 4 | 6 | 6.5 | 20 W | 1321-3R4-B |
| | 2.2 | 3.0 | 8 | 12 | 5.0 | 25.3 W | 1321-3R8-C |
| | 4.0 | 5.0 | 12 | 18 | 2.5 | 31 W | 1321-3R12-B |
| | 5.5 | 7.5 | 12 | 18 | 2.5 | 31 W | 1321-3R12-B |
| | 7.5 | 10.0 | 18 | 27 | 1.5 | 43 W | 1321-3R18-B |
| | 11.0 | 15.0 | 25 | 37.5 | 1.2 | 52 W | 1321-3R25-B |
| 600V 50/60 Hz 3-Phase | 0.75 | 1.0 | 2 | 3 | 20.0 | 11.3 W | 1321-3R2-B |
| | 1.5 | 2.0 | 4 | 6 | 6.5 | 20 W | 1321-3R4-B |
| | 2.2 | 3.0 | 4 | 6 | 6.5 | 20 W | 1321-3R4-B |
| | 4.0 | 5.0 | 8 | 12 | 5.0 | 25.3 W | 1321-3R8-C |
| | 5.5 | 7.5 | 12 | 18 | 2.5 | 31 W | 1321-3R12-B |
| | 7.5 | 10.0 | 12 | 18 | 2.5 | 31 W | 1321-3R12-B |
| | 11.0 | 15.0 | 18 | 27 | 1.5 | 43 W | 1321-3R18-B |

(1) Catalog numbers listed are for 3% impedance open style units. NEMA Type 1 and 5% impedance reactor types are also available. Refer to publication 1321-TD001….

**Table B.E DC Bus Inductors**

| Input Voltage | kW | HP | Amps | Inductance mh | MTE Catalog Number (2) |
|---|---|---|---|---|---|
| 240V 50/60 Hz 3-Phase | 5.5 | 7.5 | 32 | 0.85 | 32RB001 |
| | 7.5 | 10.0 | 40 | 0.5 | 40RB001 |
| 480V 50/60 Hz 3-Phase | 5.5 | 7.5 | 18 | 3.75 | 18RB004 |
| | 7.5 | 10.0 | 25 | 4.0 | 25RB005 |
| | 11.0 | 15.0 | 32 | 2.68 | 32RB003 |
| 600V 50/60 Hz 3-Phase | 5.5 | 7.5 | 12 | 6.0 | 12RB004 |
| | 7.5 | 10.0 | 18 | 6.0 | 18RB005 |
| | 11.0 | 15.0 | 25 | 4.0 | 25RB005 |

(2) Use MTE RB Series or equivalent inductors.

**Table B.F EMC Line Filters**

| Drive Ratings | | | S Type Filter Catalog Number (1) | L Type Filter Catalog Number (4) |
|---|---|---|---|---|
| Input Voltage | kW | HP | | |
| 120V 50/60 Hz 1-Phase | 0.4 | 0.5 | – | 22-RF018-BL |
| | 0.75 | 1.0 | – | 22-RF018-BL |
| | 1.1 | 1.5 | – | 22-RF018-BL |
| 240V 50/60 Hz 1-Phase | 0.4 | 0.5 | (2) | 22-RF018-BL |
| | 0.75 | 1.0 | (2) | 22-RF018-BL |
| | 1.5 | 2.0 | (2) | 22-RF018-BL |
| | 2.2 | 3.0 | (2) | 22-RF025-CL |
| 240V 50/60 Hz 3-Phase | 0.4 | 0.5 | 22-RF021-BS(3) | 22-RF021-BL |
| | 0.75 | 1.0 | 22-RF021-BS(3) | 22-RF021-BL |
| | 1.5 | 2.0 | 22-RF021-BS(3) | 22-RF021-BL |
| | 2.2 | 3.0 | 22-RF021-BS(3) | 22-RF021-BL |
| | 3.7 | 5.0 | 22-RF021-BS(3) | 22-RF021-BL |
| | 5.5 | 7.5 | 22-RF034-CS | 22-RF034-CL |
| | 7.5 | 10.0 | 22-RF034-CS | 22-RF034-CL |
| 480V 50/60 Hz 3-Phase | 0.4 | 0.5 | 22-RF012-BS | 22-RF012-BL |
| | 0.75 | 1.0 | 22-RF012-BS | 22-RF012-BL |
| | 1.5 | 2.0 | 22-RF012-BS | 22-RF012-BL |
| | 2.2 | 3.0 | 22-RF012-BS | 22-RF012-BL |
| | 4.0 | 5.0 | 22-RF012-BS | 22-RF012-BL |
| | 5.5 | 7.5 | 22-RF018-CS | 22-RF018-CL |
| | 7.5 | 10.0 | 22-RF018-CS | 22-RF018-CL |
| | 11.0 | 15.0 | 22-RF026-CS | 22-RF026-CL |
| 600V 50/60 Hz 3-Phase | 0.75 | 1.0 | – | 22-RF8P0-BL |
| | 1.5 | 2.0 | – | 22-RF8P0-BL |
| | 2.2 | 3.0 | – | 22-RF8P0-BL |
| | 4.0 | 5.0 | – | 22-RF8P0-BL |
| | 5.5 | 7.5 | – | 22-RF015-CL |
| | 7.5 | 10.0 | – | 22-RF015-CL |
| | 11.0 | 15.0 | – | 22-RF024-CL |

(1) This filter is suitable for use with a cable length of at least 10 meters (33 feet) for Class A and 1 meter for Class B environments.

(2) These ratings can be ordered with internal “S Type” filters. Refer to the Catalog Number explanation on page P-4 and Table B.B for details.

(3) Filter must be Series B or later.

(4) This filter is suitable for use with a cable length of at least 100 meters for Class A and 5 meters for Class B environments.

**Table B.G Human Interface Module (HIM) Option Kits and Accessories**

| Item | Description | Catalog Number |
|---|---|---|
| LCD Display, Remote Panel Mount | Digital speed control<br>CopyCat capable<br>IP66 (NEMA Type 4X/12) indoor use only<br>Includes 2.9 meter cable | 22-HIM-C2S |
| LCD Display, Remote Panel Mount | Digital speed control<br>CopyCat capable<br>IP66 (NEMA Type 4X/12) indoor use only<br>Includes 2.9 meter cable | 22-HIM-C2 |
| LCD Display, Remote Handheld | Digital speed control<br>Full numeric keypad<br>CopyCat capable<br>IP30 (NEMA Type 1)<br>Includes 1.0 meter cable<br>Panel mount with optional Bezel Kit | 22-HIM-A3 |
| Bezel Kit | Panel mount for LCD Display, Remote Handheld unit, IP30 (NEMA Type 1) | 22-HIM-B1 |
| DSI HIM Cable<br>(DSI HIM to RJ45 cable) | 1.0 Meter (3.3 Feet)<br>2.9 Meter (9.51 Feet) | 22-HIM-H10<br>22-HIM-H30 |

**Table B.H IP30/NEMA 1/UL Type 1 Kit**

| Item | Description | Drive Frame | Catalog Number |
|---|---|---|---|
| IP30/NEMA 1/UL Type 1 Kit | Field installed kit. Converts drive to IP30/ NEMA 1/UL Type 1 enclosure. Includes conduit box with mounting screws and plastic top panel. | B | 22-JBAB |
| | | C | 22-JBAC |
| IP30/NEMA 1/UL Type 1 Kit for Communication Option | Field installed kit. Converts drive to IP30/ NEMA 1/UL Type 1 enclosure. Includes communication option conduit box with mounting screws and plastic top panel. | B | 22-JBCB |
| | | C | 22-JBCC |

**Table B.I Communication Option Kits and Accessories**

| Item | Description | Catalog Number |
|---|---|---|
| Communication Adapters | Embedded communication options for use with the PowerFlex 4-Class drives.<br>Requires a Communication Adapter Cover (IP20, NEMA/UL Type 1 only. Ordered Separately)<br>BACnet®<br>ControlNet™<br>DeviceNet™<br>EtherNet/IP™<br>LonWorks®<br>PROFIBUS™ DP | <br><br><br>22-COMM-B<br>22-COMM-C<br>22-COMM-D<br>22-COMM-E<br>22-COMM-L<br>22-COMM-P |
| External DSI™ Communications Kit | External mounting kit for 22-COMM communication options | 22-XCOMM-DC-BASE |
| External Comms Power Supply | Optional 100-240V AC Power Supply for External DSI Communications Kit. | 20-XCOMM-AC-PS1 |
| Compact I/O Module | Three channel. | 1769-SM2 |
| Communication Adapter Cover | Cover that houses the DeviceNet Communication Adapter (IP20, NEMA/UL Type 1 only)<br>B Frame Drive<br>C Frame Drive | <br>22B-CCB<br>22B-CCC |
| Serial Converter Module (RS485 to RS232) | Provides serial communication via DF1 protocol for use with DriveExplorer and DriveExecutive software. Includes:<br>DSI to RS232 serial converter (1)<br>1203-SFC serial cable (1)<br>22-RJ45CBL-C20 cable (1)<br>DriveExplorer Lite CD (1) | 22-SCM-232 |
| DSI Cable | 2.0 meter RJ45 to RJ45 cable, male to male connectors. | 22-RJ45CBL-C20 |
| Serial Cable | 2.0 meter serial cable with a locking low profile connector to connect to the serial converter and a 9-pin sub-miniature D female connector to connect to a computer. | 1203-SFC |
| Null Cable Converter | For use when connecting the serial converter to DriveExplorer on a handheld PC. | 1203-SNM |
| Splitter Cable | RJ45 one to two port splitter cable | AK-U0-RJ45-SC1 |
| Terminating Resistors | RJ45 120 Ohm resistors (2 pieces) | AK-U0-RJ45-TR1 |
| Terminal Block | RJ45 Two position terminal block (5 pieces) | AK-U0-RJ45-TB2P |
| DriveExplorer Software (CD-ROM) Version 3.01 or later | Windows based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communication adapters online.<br>Compatibility:<br>Windows 95, 98, ME, NT 4.0 (Service Pack 3 or later), 2000, XP and CE[1] | 9306-4EXP01ENE |
| DriveExecutive software (CD-ROM) Version 1.01 or later | Windows based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communication adapters online and offline.<br>Compatibility:<br>Windows 98, ME, NT 4.0 (Service Pack 3 or later), 2000 and XP | 9303-4DTE01ENE |

(1) See www.ab.com/drives/driveexplorer.htm for supported devices.

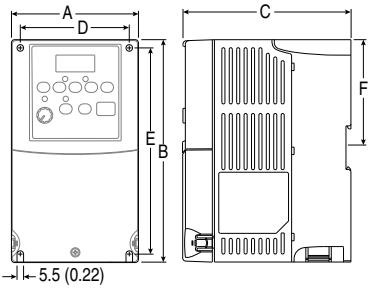
## Product Dimensions

**Table B.J PowerFlex 40 Frames** – Ratings are in kW and (HP)

| Frame | 120V AC – 1-Phase | 240V AC – 1-Phase | 240V AC – 3-Phase | 480V AC – 3-Phase | 600V AC – 3-Phase |
|---|---|---|---|---|---|
| B | 0.4 (0.5)<br>0.75 (1.0)<br>1.1 (1.5) | 0.4 (0.5)<br>0.75 (1.0)<br>1.5 (2.0) | 0.4 (0.5) 2.2 (3.0)<br>0.75 (1.0) 3.7 (5.0)<br>1.5 (2.0) | 0.4 (0.5) 2.2 (3.0)<br>0.75 (1.0) 4.0 (5.0)<br>1.5 (2.0) | 0.75 (1.0) 2.2 (3.0)<br>1.5 (2.0) 4.0 (5.0) |
| C[1] | | 2.2 (3.0) | 5.5 (7.5)<br>7.5 (10.0) | 5.5 (7.5) 11.0 (15.0)<br>7.5 (10.0) | 5.5 (7.5) 11.0 (15.0)<br>7.5 (10.0) |

(1) IP66, NEMA/UL Type 4X rated drives are not availble in Frame C drive ratings.

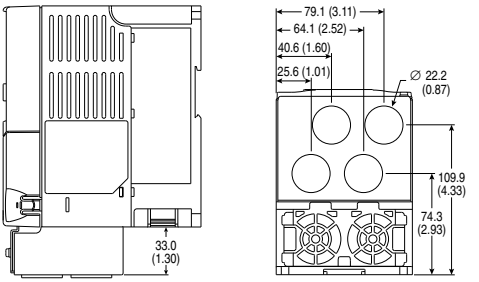
**Figure B.1 IP20, NEMA/UL Type Open**



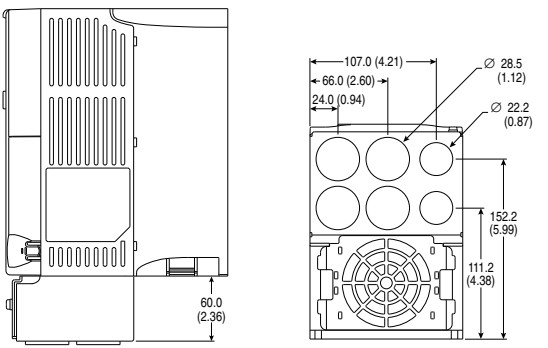

Dimensions are in millimeters and (inches).
Weights are in kilograms and (pounds).

| Frame | A | B | C | D | E | F | Ship Weight |
|---|---|---|---|---|---|---|---|
| B | 100 (3.94) | 180 (7.09) | 136 (5.35) | 87 (3.43) | 168 (6.61) | 87.4 (3.44) | 2.2 (4.9) |
| C | 130 (5.1) | 260 (10.2) | 180 (7.1) | 116 (4.57) | 246 (9.7) | – | 4.3 (9.5) |

**Figure B.2 IP30, NEMA/UL Type 1 Option Kit without Communication Option**

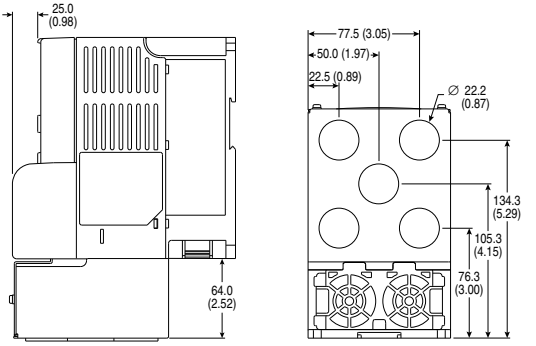



**Frame B - 22-JBAB**

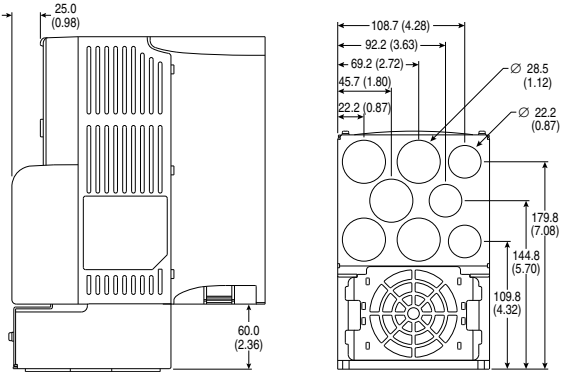



**Frame C - 22-JBAC**

**Figure B.3 IP30, NEMA/UL Type 1 Option Kit with Communication Option** – Dimensions are in millimeters and (inches)

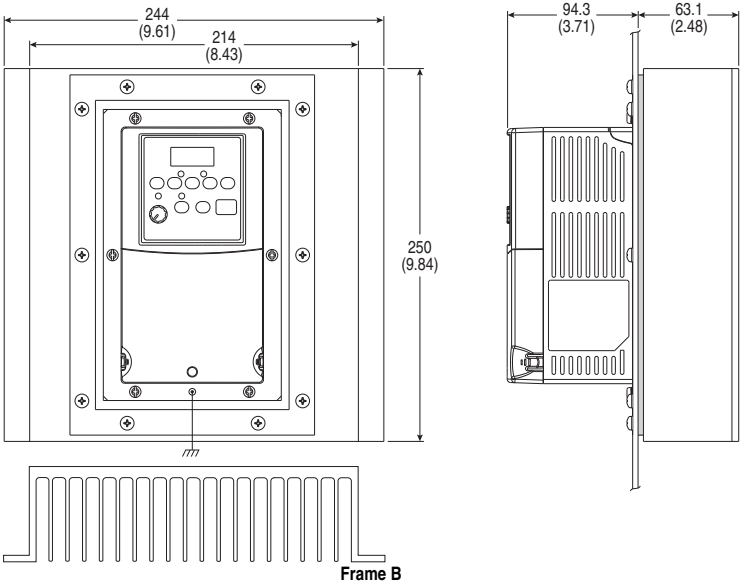



**Frame B - 22-JBCB**

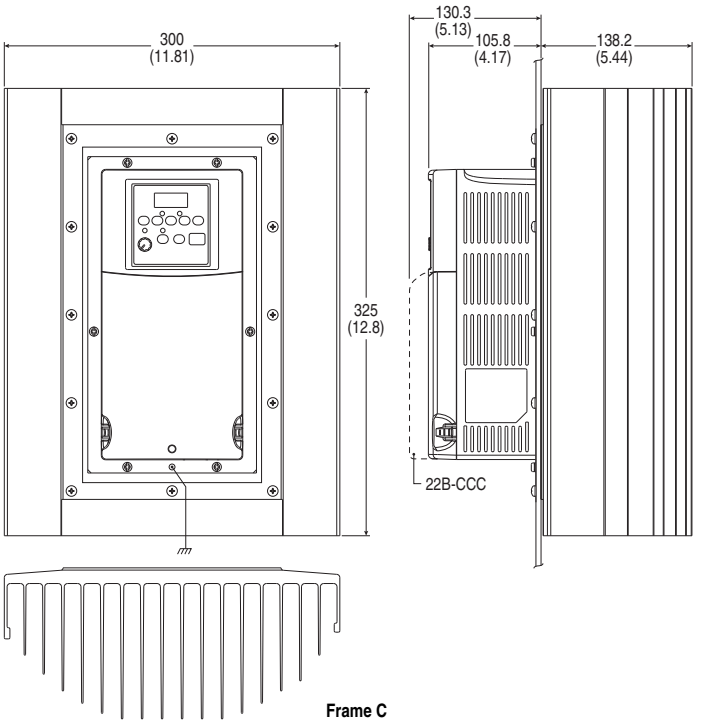



**Frame C - 22-JBCC**

**Figure B.4 PowerFlex 40 Flange Mount Drives** – Dimensions are in millimeters and (inches)

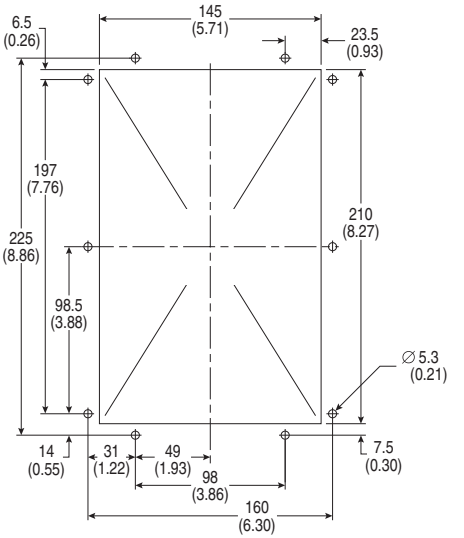



**Frame B**

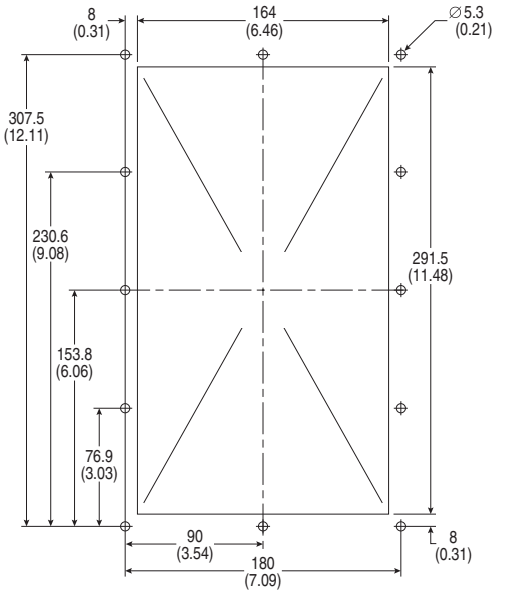



**Frame C**

**Figure B.5 PowerFlex 40 Flange Mount Cutout Dimensions** – Dimensions are in millimeters and (inches)

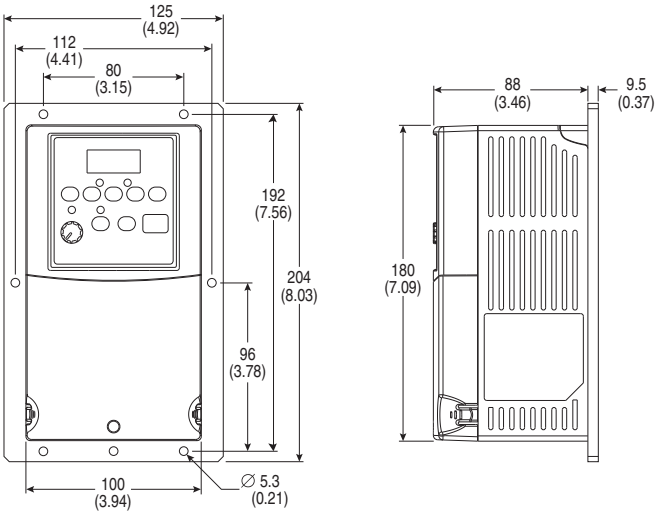



**Frame B**

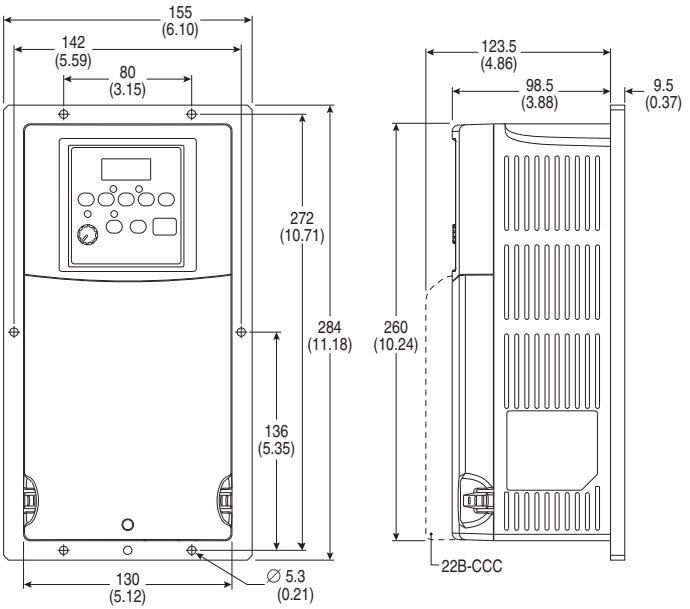



**Frame C**

**Figure B.6 PowerFlex 40 Replacement Plate Drive Dimensions** – Dimensions are in millimeters and (inches)

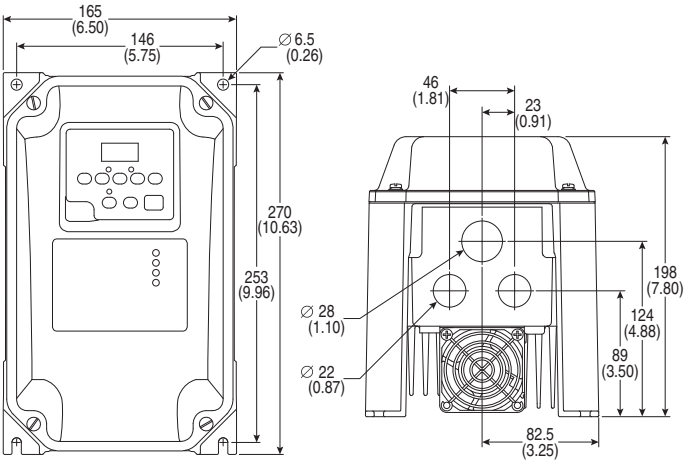



**Frame B**



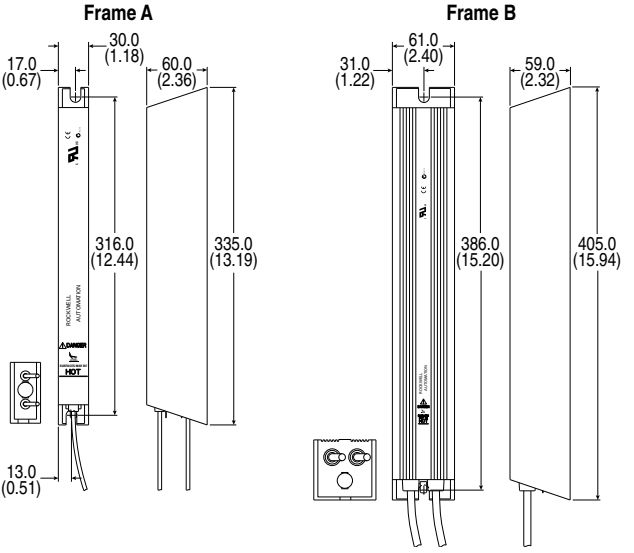

**Frame C**

**Figure B.7 IP66, NEMA Type/UL Type 4X** – Dimensions are in millimeters and (inches) Weights are in kilograms and (pounds).




| Weight |
|---|
| 5.2 (11.5) |

**Figure B.8 Dynamic Brake Modules** – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).




| Frame | Catalog Number | Weight |
|---|---|---|
| A | AK-R2-091P500, AK-R2-047P500, AK-R2-360P500 | 1.1 (2.5) |
| B | AK-R2-030P1K2, AK-R2-120P1K2 | 2.7 (6) |

**Figure B.9 Recommended External Brake Resistor Circuitry**

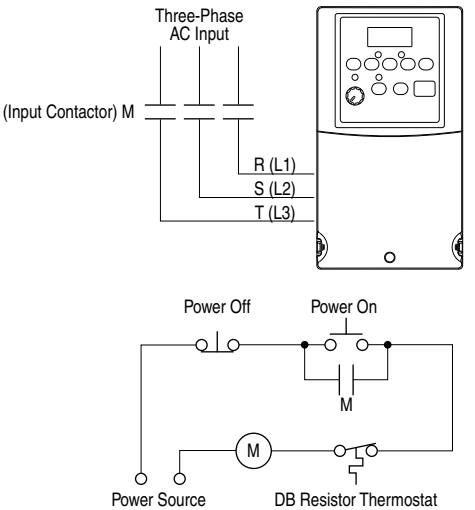
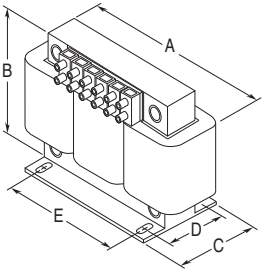


**Figure B.10 Bulletin 1321-3R Series Line Reactors** – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).




| Catalog Number | A | B | C | D | E | Weight |
|---|---|---|---|---|---|---|
| 1321-3R2-A | 112 (4.40) | 104 (4.10) | 70 (2.75) | 50 (1.98) | 37 (1.44) | 1.8 (4) |
| 1321-3R2-B | 112 (4.40) | 104 (4.10) | 70 (2.75) | 50 (1.98) | 37 (1.44) | 1.8 (4) |
| 1321-3R4-A | 112 (4.40) | 104 (4.10) | 76 (3.00) | 50 (1.98) | 37 (1.44) | 1.8 (4) |
| 1321-3R4-B | 112 (4.40) | 104 (4.10) | 76 (3.00) | 50 (1.98) | 37 (1.44) | 1.8 (4) |
| 1321-3R4-C | 112 (4.40) | 104 (4.10) | 86 (3.38) | 60 (2.35) | 37 (1.44) | 2.3 (5) |
| 1321-3R4-D | 112 (4.40) | 104 (4.10) | 92 (3.62) | 66 (2.60) | 37 (1.44) | 2.7 (6) |
| 1321-3R8-A | 152 (6.00) | 127 (5.00) | 76 (3.00) | 53 (2.10) | 51 (2.00) | 3.1 (7) |
| 1321-3R8-B | 152 (6.00) | 127 (5.00) | 76 (3.00) | 53 (2.10) | 51 (2.00) | 3.6 (8) |
| 1321-3R8-C | 152 (6.00) | 127 (5.00) | 85 (3.35) | 63 (2.48) | 51 (2.00) | 4.9 (11) |
| 1321-3R12-A | 152 (6.00) | 127 (5.00) | 76 (3.00) | 53 (2.10) | 51 (2.00) | 4.1 (9) |
| 1321-3R12-B | 152 (6.00) | 127 (5.00) | 76 (3.00) | 53 (2.10) | 51 (2.00) | 4.5 (10) |
| 1321-3R18-A | 152 (6.00) | 133 (5.25) | 79 (3.10) | 54 (2.13) | 51 (2.00) | 4.1 (9) |
| 1321-3R18-B | 152 (6.00) | 133 (5.25) | 86 (3.40) | 63 (2.48) | 51 (2.00) | 5.4 (12) |
| 1321-3R25-A | 183 (7.20) | 146 (5.76) | 85 (3.35) | 60 (2.35) | 76 (3.00) | 4.9 (11) |
| 1321-3R35-A | 193 (7.60) | 146 (5.76) | 91 (3.60) | 66 (2.60) | 76 (3.00) | 6.3 (14) |

**Figure B.11 Frame B EMC Line Filters** – Dimensions are in millimeters and (inches)
Catalog Numbers: 22-RF8P0-BL, 22-RF012-BS, -BL (Series B); 22-RF018-BS; 22-RF021-BS, -BL

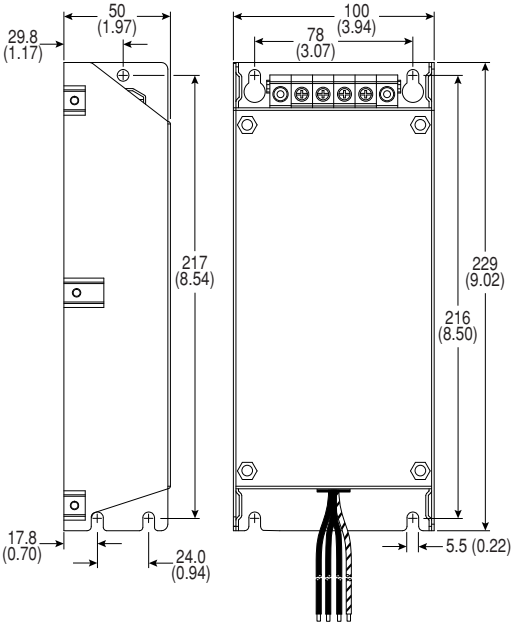


**Figure B.12 Frame C EMC Line Filters** – Dimensions are in millimeters and (inches)
Catalog Numbers: 22-RF018-CS, -CL; 22-RF025-CL; 22-RF026-CS, -CL; 22-RF034-CS, -CL

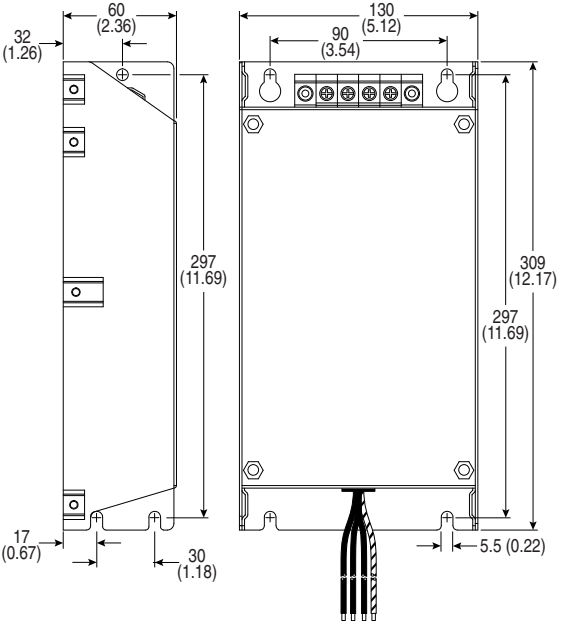
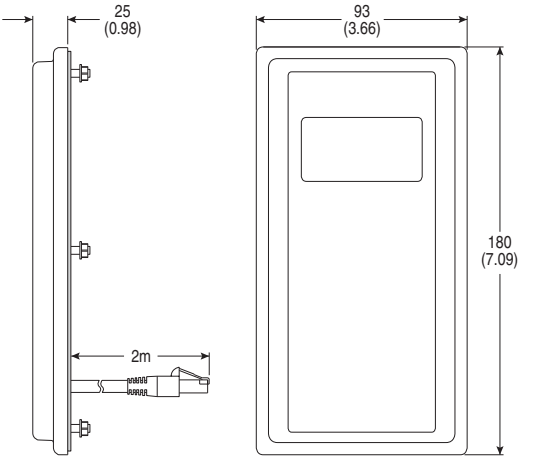


**Figure B.13 Remote (Panel Mount) Small HIM** – Dimensions are in millimeters and (inches) Catalog Number: 22-HIM-C2S



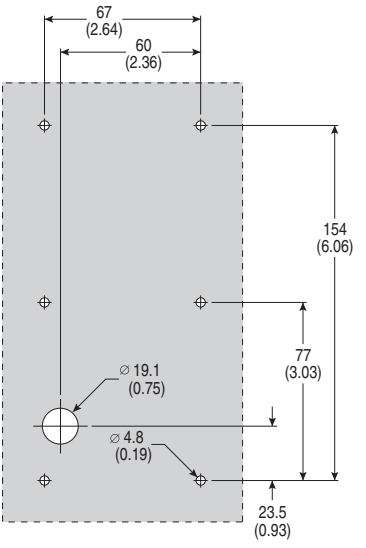
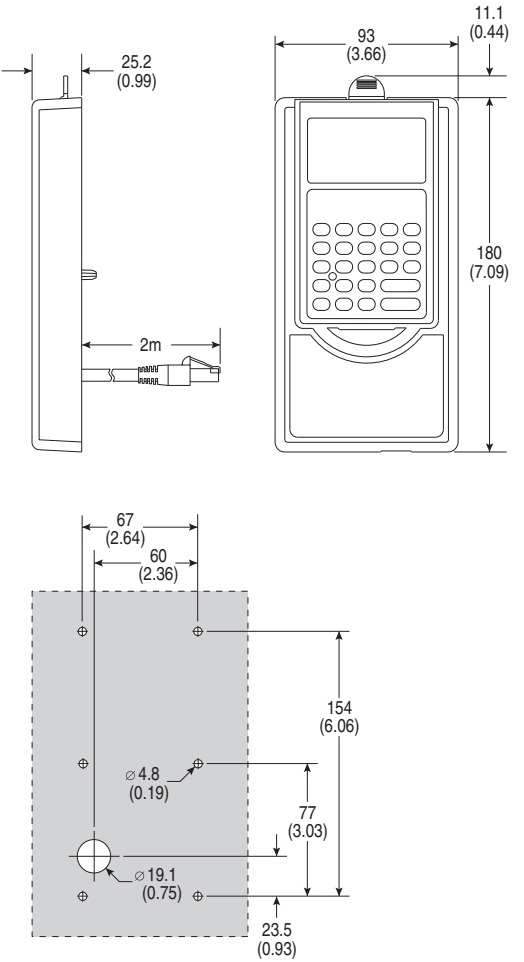
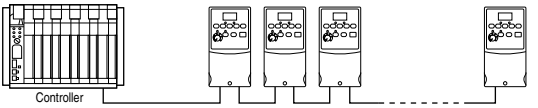



**Figure B.14 NEMA Type 1 Bezel** – Dimensions are in millimeters and (inches)
Catalog Number: 22-HIM-B1



# RS485 (DSI) Protocol

PowerFlex 40 drives support the RS485 (DSI) protocol to allow efficient operation with Rockwell Automation peripherals. In addition, some Modbus functions are supported to allow simple networking. PowerFlex 40 drives can be multi-dropped on an RS485 network using Modbus protocol in RTU mode.

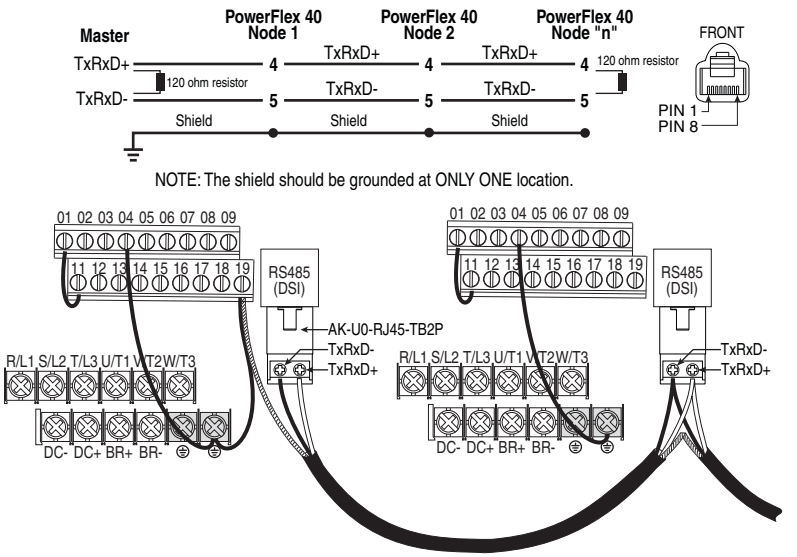



For information regarding DeviceNet or other communication protocols, refer to the appropriate user manual.

## Network Wiring

Network wiring consists of a shielded 2-conductor cable that is daisy-chained from node to node.

**Figure C.1 Network Wiring Diagram**



Only pins 4 and 5 on the RJ45 plug should be wired. The other pins on the PowerFlex 40 RJ45 socket must not be connected because they contain power, etc. for other Rockwell Automation peripheral devices.

Wiring terminations on the master controller will vary depending on the master controller used and “TxRxD+” and “TxRxD-” are shown for illustration purposes only. Refer to the master controller’s user manual for network terminations. Note that there is no standard for the “+” and “-” wires, and consequently Modbus device manufacturers interpret them differently. If you have problems with initially establishing communications, try swapping the two network wires at the master controller.

Standard RS485 wiring practices apply.

- Termination resistors need to be applied at each end of the network cable.
- RS485 repeaters may need to be used for long cable runs, or if greater than 32 nodes are needed on the network.
- Network wiring should be separated from power wires by at least 0.3 meters (1 foot).
- Network wiring should only cross power wires at a right angle.

I/O Terminal 19 on the PowerFlex 40 is connected to the metal shield around the RJ45 connector. It is recommended to ground this terminal (there are two PE terminals on the drive). See Table 1.H for more information.

Network Common is internally tied to I/O Terminal 04 (Digital Common). Tying I/O Terminal 04 to PE ground may improve noise immunity in some applications.

## Parameter Configuration

The following PowerFlex 40 parameters are used to configure the drive to operate on a network.

| Parameter | Details | Reference |
|---|---|---|
| P036 [Start Source] | Set to 5 "RS485 (DSI) Port" if Start is controlled from the network. | Page 3-10 |
| P038 [Speed Reference] | Set to 5 "RS485 (DSI) Port" if the Speed Reference is controlled from the network. | Page 3-12 |
| A103 [Comm Data Rate] | Sets the data rate for the RS485 (DSI) Port. All nodes on the network must be set to the same data rate. | Page 3-31 |
| A104 [Comm Node Addr] | Sets the node address for the drive on the network. Each device on the network requires a unique node address. | Page 3-31 |
| A105 [Comm Loss Action] | Selects the drive's response to communication problems. | Page 3-32 |
| A106 [Comm Loss Time] | Sets the time that the drive will remain in communication loss before the drive implements A105 [Comm Loss Action]. | Page 3-32 |
| A107 [Comm Format] | Sets the transmission mode, data bits, parity and stop bits for the RS485 (DSI) Port. All nodes on the network must be set to the same setting. | Page 3-32 |

## Supported Modbus Function Codes

The peripheral interface (DSI) used on PowerFlex 40 drives supports some of the Modbus function codes.

| Modbus Function Code (Decimal) | Command |
|---|---|
| 03 | Read Holding Registers |
| 06 | Preset (Write) Single Register |
| 16 (10 Hexadecimal) | Preset (Write) Multiple Registers |

**Important:** Modbus devices can be 0-based (registers are numbered starting at 0) or 1-based (registers are numbered starting at 1). Depending on the Modbus Master used, the register addresses listed on the following pages may need to be offset by +1. For example, Logic Command may be register address 8192 for some master devices (e.g. ProSoft 3150-MCM SLC Modbus scanner) and 8193 for others (e.g. PanelViews).

## Writing (06) Logic Command Data

The PowerFlex 40 drive can be controlled via the network by sending Function Code 06 writes to register address 8192 (Logic Command). P036 [Start Source] must be set to 5 “RS485 (DSI) Port” in order to accept the commands.

In addition to being written, register address 8192 can be read using Function Code 03.

| Logic Command | | |
|---|---|---|
| **Address (Decimal)** | **Bit(s)** | **Description** |
| 8192 | 0 | 1 = Stop, 0 = Not Stop |
| | 1 | 1 = Start, 0 = Not Start |
| | 2 | 1 = Jog, 0 = No Jog |
| | 3 | 1 = Clear Faults, 0 = Not Clear Faults |
| | 5,4 | 00 = No Command |
| | | 01 = Forward Command |
| | | 10 = Reverse Command |
| | | 11 = No Command |
| | 6 | Not Used in FRN 3.03 and earlier.<br>In FRN 4.01 and later, activates Opto Output 1.<br>Note: This bit controls the output when the value of parameter A058 is set to 20. |
| | 7 | Not Used in FRN 3.03 and earlier.<br>In FRN 4.01 and later, activates Opto Output 2.<br>Note: This bit controls the output when the value of parameter A061 is set to 20. |
| | 9,8 | 00 = No Command |
| | | 01 = Accel Rate 1 Enable |
| | | 10 = Accel Rate 2 Enable |
| | | 11 = Hold Accel Rate Selected |
| | 11,10 | 00 = No Command |
| | | 01 = Decel Rate 1 Enable |
| | | 10 = Decel Rate 2 Enable |
| | | 11 = Hold Decel Rate Selected |
| | 14,13,12 | 000 = No Command |
| | | 001 = Freq. Source = P038 [Speed Reference] |
| | | 010 = Freq. Source = A069 [Internal Freq] |
| | | 011 = Freq. Source = Comms (Addr 8193) |
| | | 100 = A070 [Preset Freq 0] |
| | | 101 = A071 [Preset Freq 1] |
| | | 110 = A072 [Preset Freq 2] |
| | | 111 = A073 [Preset Freq 3] |
| | 15 | Not Used in FRN 3.03 and earlier.<br>In FRN 4.01 and later, activates C-form relay.<br>Note: This bit controls the output when the value of parameter A055 is set to 20. |

## Writing (06) Reference

The Speed Reference to a PowerFlex 40 drive can be controlled via the network by sending Function Code 06 writes to register address 8193 (Reference). P038 [Speed Reference] must be set to 5 “RS485 (DSI) Port” in order to accept the Speed Reference.

In addition to being written, register address 8193 can be read using Function Code 03.

| Reference | |
|---|---|
| **Address (Decimal)** | **Description** |
| 8193 | A decimal value entered as xxx.x where the decimal point is fixed. For example, a decimal “100” equals 10.0 Hz and “543” equals 54.3 Hz. |

## Reading (03) Logic Status Data

The PowerFlex 40 Logic Status data can be read via the network by sending Function Code 03 reads to register address 8448 (Logic Status).

| Logic Status | | |
|---|---|---|
| **Address (Decimal)** | **Bit(s)** | **Description** |
| 8448 | 0 | 1 = Ready, 0 = Not Ready |
| | 1 | 1 = Active (Running), 0 = Not Active |
| | 2 | 1 = Cmd Forward, 0 = Cmd Reverse |
| | 3 | 1 = Rotating Forward, 0 = Rotating Reverse |
| | 4 | 1 = Accelerating, 0 = Not Accelerating |
| | 5 | 1 = Decelerating, 0 = Not Decelerating |
| | 6 | 1 = Alarm, 0 = No Alarm |
| | 7 | 1 = Faulted, 0 = Not Faulted |
| | 8 | 1 = At Reference, 0 = Not At Reference |
| | 9 | 1 = Reference Controlled by Comm |
| | 10 | 1 = Operation Cmd Controlled by Comm |
| | 11 | 1 = Parameters have been locked |
| | 12 | Digital Input 1 Status |
| | 13 | Digital Input 2 Status |
| | 14 | Digital Input 3 Status(1) |
| | 15 | Digital Input 4 Status(1) |

(1) This status is available only with firmware revision FRN 2.xx and higher.

## Reading (03) Feedback

The Feedback (Output Frequency) from the PowerFlex 40 drive can be read via the network by sending Function Code 03 reads to register address 8451 (Feedback).

| Feedback[2] | |
|---|---|
| **Address (Decimal)** | **Description** |
| 8451 | A xxx.x decimal value where the decimal point is fixed. For example, a decimal "123" equals 12.3 Hz and "300" equals 30.0 Hz. |

(2) Returns the same data as Reading (03) Parameter d001 [Output Freq].

## Reading (03) Drive Error Codes

The PowerFlex 40 Error Code data can be read via the network by sending Function Code 03 reads to register address 8449 (Drive Error Codes).

| Logic Status | | |
|---|---|---|
| **Address (Decimal)** | **Value (Decimal)** | **Description** |
| 8449 | 0 | No Fault |
| | 2 | Auxiliary Input |
| | 3 | Power Loss |
| | 4 | Undervoltage |
| | 5 | Overvoltage |
| | 6 | Motor Stalled |
| | 7 | Motor Overload |
| | 8 | Heatsink Overtemperature |
| | 12 | HW Overcurrent (300%) |
| | 13 | Ground Fault |
| | 29 | Analog Input Loss |
| | 33 | Auto Restart Tries |
| | 38 | Phase U to Ground Short |
| | 39 | Phase V to Ground Short |
| | 40 | Phase W to Ground Short |
| | 41 | Phase UV Short |
| | 42 | Phase UW Short |
| | 43 | Phase VW Short |
| | 63 | Software Overcurrent |
| | 64 | Drive Overload |
| | 70 | Power Unit Fail |
| | 80 | AutoTune Fail |
| | 81 | Communication Loss |
| | 100 | Parameter Checksum Error |
| | 122 | I/O Board Fail |

## Reading (03) and Writing (06) Drive Parameters

To access drive parameters, the Modbus register address equals the parameter number. For example, a decimal “1” is used to address Parameter d001 [Output Freq] and decimal “39” is used to address Parameter P039 [Accel Time 1].

## Additional Information

Refer to **http://www.ab.com/drives/** for additional information.

**Notes:**

# RJ45 DSI Splitter Cable

The PowerFlex 40 drive provides a RJ45 port to allow the connection of a single peripheral device. The RJ45 DSI Splitter Cable can be used to connect a second DSI peripheral device to the drive.

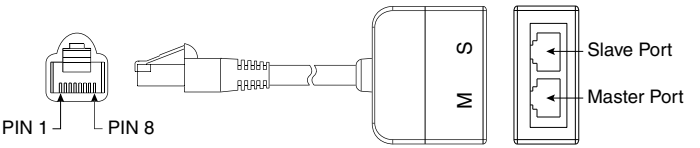
## Connectivity Guidelines

**ATTENTION:** Risk of injury or equipment damage exists. The peripherals may not perform as intended if these Connectivity Guidelines are not followed. Precautions should be taken to follow these Connectivity Guidelines.

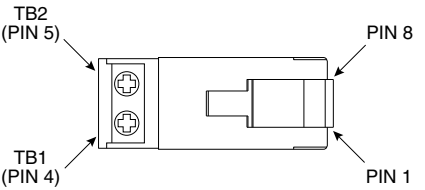
- Two peripherals maximum can be attached to a drive.
- If a single peripheral is used, it must be connected to the Master port (M) on the splitter and configured for “Auto” (default) or “Master.” Parameter 9 [Device Type] on the DSI / MDI keypads and Parameter 1 [Adapter Cfg] on the Serial Converter are used to select the type (Auto / Master / Slave).
- **Do not use the RJ45 Splitter Cable with a drive that has an internal network communication adapter installed.** Since only one additional peripheral can be added, the second peripheral can be connected directly to the RJ45 port on the drive. The internal Comm is always the Master, therefore the external peripheral must be configured as “Auto” (for temporary connections) or “Slave” (for permanent connections).
- If two peripherals will be powered up at the same time, one must be configured as the “Master” and connected to the Master port (M) and the other must be connected as the “Slave” and connected to the Slave port (S).

## DSI Cable Accessories

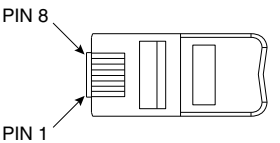
**RJ45 Splitter Cable** – Catalog Number: AK-U0-RJ45-SC1



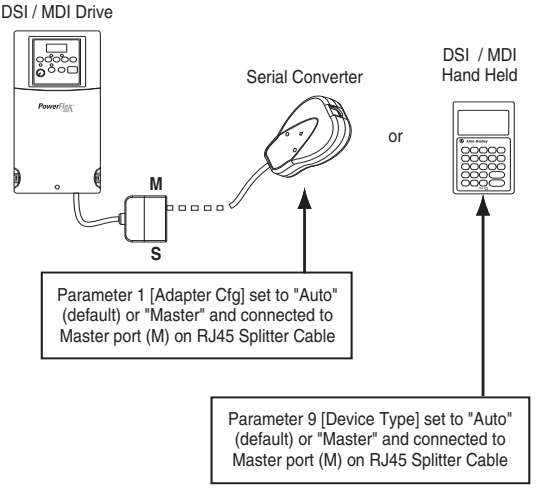

**RJ45 Two-Position Terminal Block Adapter** –
Catalog Number: AK-U0-RJ45-TB2P



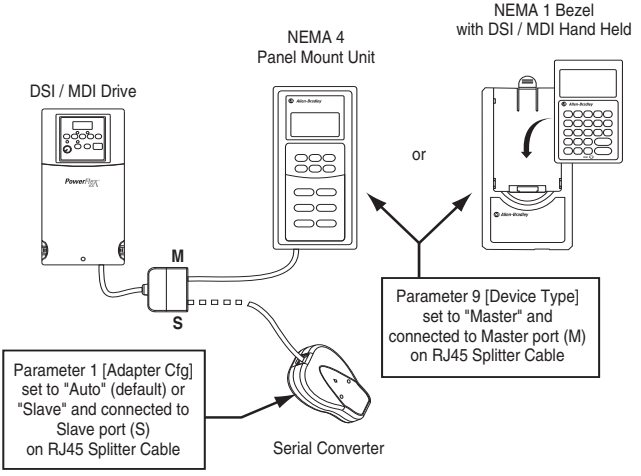

**RJ45 Adapter with Integrated Termination Resistor** –
Catalog Number: AK-U0-RJ45-TR1



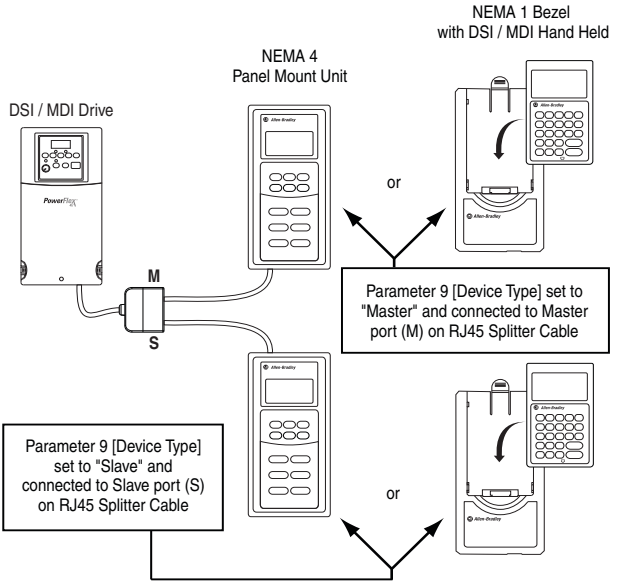
## Connecting One Temporary Peripheral



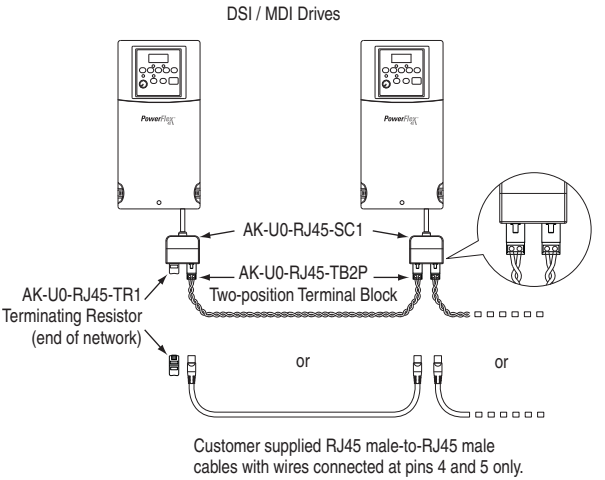

## Connecting One Temporary Peripheral and One Permanent Peripheral



## Connecting Two Permanent Peripherals




## Connecting an RS-485 Network




Both the Master (M) and Slave (S) ports on the RJ45 Splitter Cable operate as standard RS-485 ports in this configuration.

# StepLogic™, Basic Logic and Timer/Counter Functions

Four PowerFlex 40 logic functions provide the capability to program simple logic functions without a separate controller.

- StepLogic Function

  Steps through up to eight preset speeds based on programmed logic. Programmed logic can include conditions that need to be met from digital inputs programmed as “Logic In1” and “Logic In2” before stepping from one preset speed to the next. A timer is available for each of the eight steps and is used to program a time delay before stepping from one preset speed to the next. The status of a digital output can also be controlled based on the step being executed.

- Basic Logic Function

  Up to two digital inputs can be programmed as “Logic In1” and/or “Logic In2”. A digital output can be programmed to change state based on the condition of one or both inputs based on basic logic functions such as AND, OR, NOR. The basic logic functions can be used with or without StepLogic.

- Timer Function

  A digital input can be programmed for “Timer Start”. A digital output can be programmed as a “Timer Out” with an output level programmed to the desired time. When the timer reaches the time programmed into the output level the output will change state. The timer can be reset via a digital input programmed as “Reset Timer”.

- Counter Function

  A digital input can be programmed for “Counter In”. A digital output can be programmed as “Counter Out” with an output level programmed to the desired number of counts. When the counter reaches the count programmed into the output level the output will change state. The counter can be reset via a digital input programmed as “Reset Counter”.

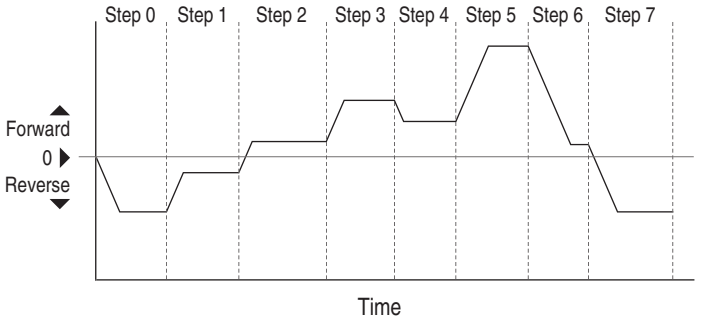
## StepLogic Using Timed Steps

To activate this function, set parameter P038 [Speed Reference] to 6 “Stp Logic”. Three parameters are used to configure the logic, speed reference and time for each step.

- Logic is defined using parameters A140-A147 [Stp Logic x].
- Preset Speeds are set with parameters A070-A077 [Preset Freq x].
- Time of operation for each step is set with parameters A150-A157 [Stp Logic Time x].

The direction of motor rotation can be forward or reverse.

**Figure E.1 Using Timed Steps**




### StepLogic Sequence

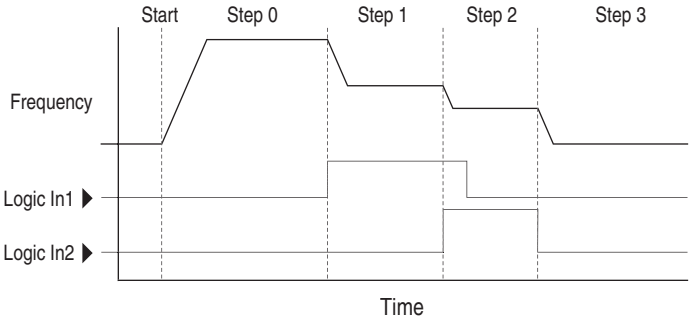
- Sequence begins with a valid start command.
- A normal sequence begins with Step 0 and transition to the next step when the corresponding StepLogic time has expired.
- Step 7 is followed by Step 0
- Sequence repeats until a stop is issued or a fault condition occurs.

## StepLogic Using Basic Logic Functions

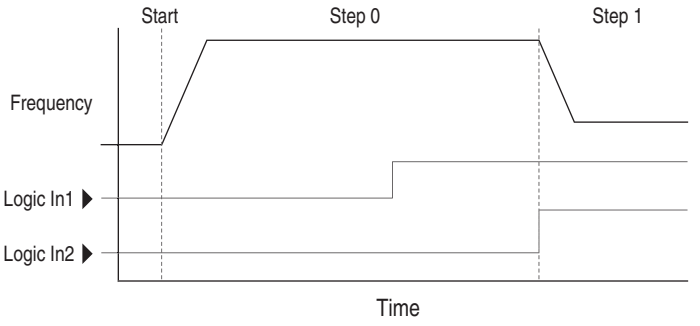
Digital input and digital output parameters can be configured to use logic to transition to the next step. Logic In1 and Logic In2 are defined by programming parameters A051-A054 [Digital Inx Sel] to option 23 “Logic In1” or option 24 “Logic In2”.

**Example**

- Run at Step 0.
- Transition to Step 1 when Logic In1 is true.
  Logic senses the edge of Logic In1 when it transitions from off to on. Logic In1 is not required to remain “on”.
- Transition to Step 2 when both Logic In1 and Logic In2 are true.
  The drive senses the level of both Logic In1 and Logic In2 and transitions to Step 2 when both are on.
- Transition to Step 3 when Logic In2 returns to a false or off state.
  Inputs are not required to remain in the “on” condition except under the logic conditions used for the transition from Step 2 to Step 3.




The step time value and the basic logic may be used together to satisfy machine conditions. For instance, the step may need to run for a minimum time period and then use the basic logic to trigger a transition to the next step.



## Timer Function

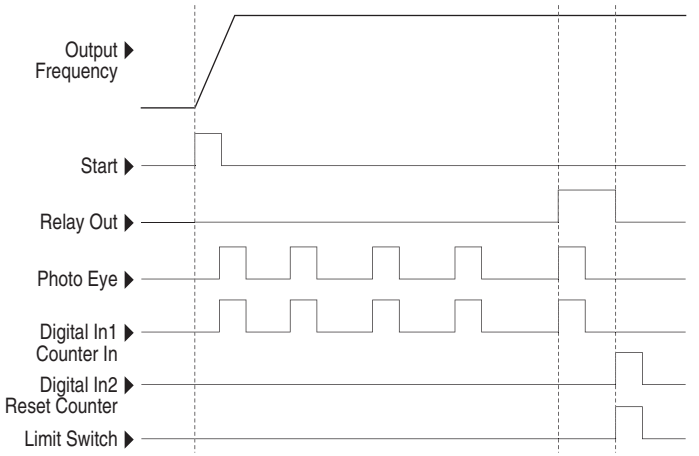
Digital inputs and outputs control the timer function and are configured with parameters A051-A054 [Digital Inx Sel] set to 18 “Timer Start” and 20 “Reset Timer”.

Digital outputs (relay and opto type) define a preset level and indicate when the level is reached. Level parameters A056 [Relay Out Level], A059 [Opto Out1 Level] and A062 [Opto Out2 Level] are used to set the desired time in seconds.

Parameters A055 [Relay Out Sel], A058 [Opto Out1 Sel] and A061 [Opto Out2 Sel] are set to option 16 “Timer Out” and causes the output to change state when the preset level is reached.

**Example**

- Drive starts up and accelerates to 30 Hz.
- After 30Hz has been maintained for 20 seconds, a 4-20mA analog input becomes the reference signal for speed control.
- The timer function is used to select a preset speed with a 20 second run time that overrides the speed reference while the digital input is active.
- Parameters are set to the following options:
  - P038 [Speed Reference] = 3 “4-20mA Input”
  - A051 [Digital In1 Sel] = 4 “Preset Freq”
  - A052 [Digital In2 Sel] = 18 “Timer Start”
  - A055 [Relay Out Sel] = 16 “Timer Out”
  - A056 [Relay Out Level] = 20.0 Secs
  - A071 [Preset Freq 1] = 30.0 Hz
- The control terminal block is wired such that a start command will also trigger the timer start.
- The relay output is wired to I/O Terminal 05 (Digital Input 1) so that it forces the input on when the timer starts.
- After the timer is complete, the output is turned off releasing the preset speed command. The drive defaults to following the analog input reference as programmed.




Note that a “Reset Timer” input is not required for this example since the “Timer Start” input both clears and starts the timer.

## Counter Function

Digital inputs and outputs control the counter function and are configured with parameters A051-A054 [Digital Inx Sel] set to 19 “Counter In” and 21 “Reset Counter”.

Digital outputs (relay and opto type) define a preset level and indicate when the level is reached. Level parameters A056 [Relay Out Level], A059 [Opto Out1 Level] and A062 [Opto Out2 Level] are used to set the desired count value.

Parameters A055 [Relay Out Sel], A058 [Opto Out1 Sel] and A061 [Opto Out2 Sel] are set to 17 “Counter Out” which causes the output to change state when the level is reached.

**Example**

- A photo eye is used to count packages on a conveyor line.
- An accumulator holds the packages until 5 are collected.
- A diverter arm redirects the group of 5 packages to a bundling area.
- The diverter arm returns to its original position and triggers a limit switch that resets the counter.
- Parameters are set to the following options:
  - A051 [Digital In1 Sel] set to 19 to select “Counter In”
  - A052 [Digital In2 Sel] set to 21 to select “Reset Counter”
  - A055 [Relay Out Sel] set to 17 to select “Counter Out”
  - A056 [Relay Out Level] set to 5.0 (counts)

## StepLogic Parameters

**Table E.A Code Descriptions for Parameters A140-A147**

| Digit 3 | Digit 2 | Digit 1 | Digit 0 |
|---|---|---|---|
| 0 | 0 | F | 1 |

**Table E.B Digit 3 – Defines the action during the step currently executing.**

| Setting | Accel/Decel Parameters Used | StepLogic Output State | Commanded Direction |
|---|---|---|---|
| 0 | 1 | Off | FWD |
| 1 | 1 | Off | REV |
| 2 | 1 | Off | No Output |
| 3 | 1 | On | FWD |
| 4 | 1 | On | REV |
| 5 | 1 | On | No Output |
| 6 | 2 | Off | FWD |
| 7 | 2 | Off | REV |
| 8 | 2 | Off | No Output |
| 9 | 2 | On | FWD |
| A | 2 | On | REV |
| b | 2 | On | No Output |

**Table E.C Digit 2 – Defines what step to jump to or how to end program when the logic conditions specified in Digit 1 are met.**

| Setting | Logic |
|---|---|
| 0 | Jump to Step 0 |
| 1 | Jump to Step 1 |
| 2 | Jump to Step 2 |
| 3 | Jump to Step 3 |
| 4 | Jump to Step 4 |
| 5 | Jump to Step 5 |
| 6 | Jump to Step 6 |
| 7 | Jump to Step 7 |
| 8 | End Program (Normal Stop) |
| 9 | End Program (Coast to Stop) |
| A | End Program and Fault (F2) |

**Table E.D Digit 1 – Defines what logic must be met to jump to a step other than the very next step.**

| Setting | Description | Logic |
|---|---|---|
| 0 | Skip Step (jump immediately) | SKIP |
| 1 | Step based on the time programmed in the respective [Stp Logic Time x] parameter. | TIMED |
| 2 | Step if “Logic In1” is active (logically true) | TRUE |
| 3 | Step if “Logic In2” is active (logically true) | TRUE |
| 4 | Step if “Logic In1” is not active (logically false) | FALSE |
| 5 | Step if “Logic In2” is not active (logically false) | FALSE |
| 6 | Step if either “Logic In1” or “Logic In2” is active (logically true) | OR |
| 7 | Step if both “Logic In1” and “Logic In2” is active (logically true) | AND |
| 8 | Step if neither “Logic In1” or “Logic In2” is active (logically true) | NOR |
| 9 | Step if “Logic In1” is active (logically true) and “Logic In2” is not active (logically false) | XOR |
| A | Step if “Logic In2” is active (logically true) and “Logic In1” is not active (logically false) | XOR |
| b | Step after [Stp Logic Time x] and “Logic In1” is active (logically true) | TIMED AND |
| C | Step after [Stp Logic Time x] and “Logic In2” is active (logically true) | TIMED AND |
| d | Step after [Stp Logic Time x] and “Logic In1” is not active (logically false) | TIMED OR |
| E | Step after [Stp Logic Time x] and “Logic In2” is not active (logically false) | TIMED OR |
| F | Do not step OR no “jump to”, so use Digit 0 logic | IGNORE |

**Table E.E Digit 0 – Defines what logic must be met to jump to the very next step.**

| Setting | Description | Logic |
|---|---|---|
| 0 | Skip Step (jump immediately) | SKIP |
| 1 | Step based on the time programmed in the respective [Stp Logic Time x] parameter. | TIMED |
| 2 | Step if “Logic In1” is active (logically true) | TRUE |
| 3 | Step if “Logic In2” is active (logically true) | TRUE |
| 4 | Step if “Logic In1” is not active (logically false) | FALSE |
| 5 | Step if “Logic In2” is not active (logically false) | FALSE |
| 6 | Step if either “Logic In1” or “Logic In2” is active (logically true) | OR |
| 7 | Step if both “Logic In1” and “Logic In2” is active (logically true) | AND |
| 8 | Step if neither “Logic In1” or “Logic In2” is active (logically true) | NOR |
| 9 | Step if “Logic In1” is active (logically true) and “Logic In2” is not active (logically false) | XOR |
| A | Step if “Logic In2” is active (logically true) and “Logic In1” is not active (logically false) | XOR |
| b | Step after [Stp Logic Time x] and “Logic In1” is active (logically true) | TIMED AND |
| C | Step after [Stp Logic Time x] and “Logic In2” is active (logically true) | TIMED AND |
| d | Step after [Stp Logic Time x] and “Logic In1” is not active (logically false) | TIMED OR |
| E | Step after [Stp Logic Time x] and “Logic In2” is not active (logically false) | TIMED OR |
| F | Use logic programmed in Digit 1 | IGNORE |

# PID Set Up

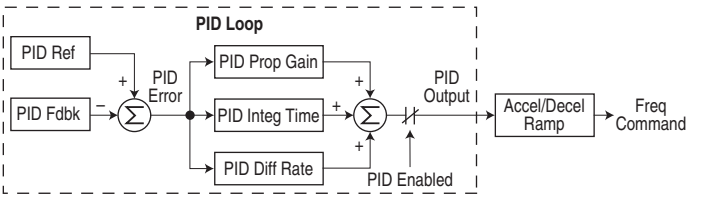
## PID Loop

The PowerFlex 40 has a built-in PID (proportional, integral, differential) control loop. The PID loop is used to maintain a process feedback (such as pressure, flow or tension) at a desired set point. The PID loop works by subtracting the PID feedback from a reference and generating an error value. The PID loop reacts to the error, based on the PID Gains, and outputs a frequency to try to reduce the error value to 0. To enable the PID loop, parameter A132 [PID Ref Sel] must be set to an option other than 0 “PID Disabled”.

Exclusive Control and Trim Control are two basic configurations where the PID loop may be used.

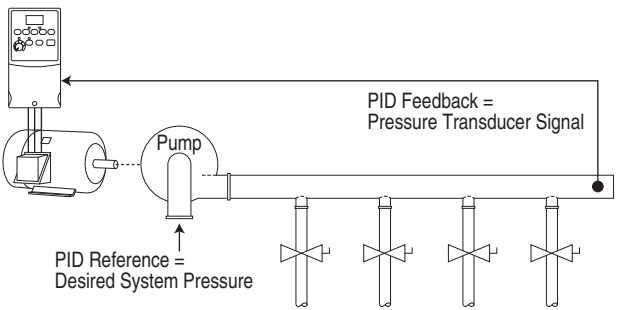
## Exclusive Control

In Exclusive Control, the Speed Reference becomes 0, and the PID Output becomes the entire Freq Command. Exclusive Control is used when A132 [PID Ref Sel] is set to option 1, 2, 3 or 4. This configuration does not require a master reference, only a desired set point, such as a flow rate for a pump.



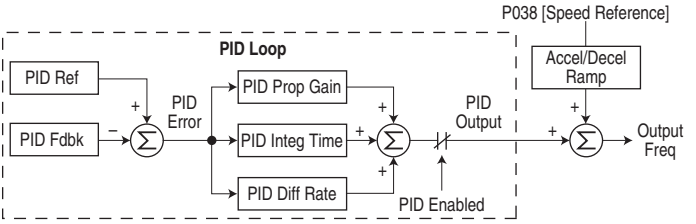

**Example**

- In a pumping application, the PID Reference equals the Desired System Pressure set point.
- The Pressure Transducer signal provides PID Feedback to the drive. Fluctuations in actual system pressure, due to changes in flow, result in a PID Error value.
- The drive output frequency increases or decreases to vary motor shaft speed to correct for the PID Error value.
- The Desired System Pressure set point is maintained as valves in the system are opened and closed causing changes in flow.
- When the PID Control Loop is disabled, the Commanded Speed is the Ramped Speed Reference.



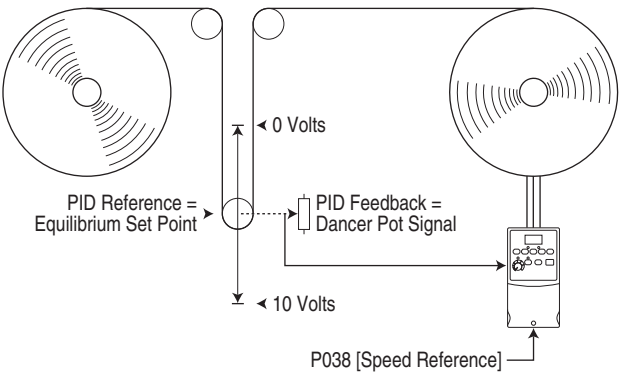
## Trim Control

In Trim Control, the PID Output is added to the Speed Reference. In Trim mode, the output of the PID loop bypasses the accel/decel ramp as shown. Trim Control is used when A132 [PID Ref Sel] is set to option 5, 6, 7 or 8.




**Example**

- In a winder application, the PID Reference equals the Equilibrium set point.
- The Dancer Pot signal provides PID Feedback to the drive. Fluctuations in tension result in a PID Error value.
- The Master Speed Reference sets the wind/unwind speed.
- As tension increases or decreases during winding, the Speed Reference is trimmed to compensate. Tension is maintained near the Equilibrium set point.



## PID Reference and Feedback

Parameter A132 [PID Ref Sel] is used to enable the PID mode (A132 ¦ 0 “PID Disabled”) and to select the source of the PID Reference. If A132 [PID Ref Sel] is not set to 0 “PID Disabled”, PID can still be disabled by select programmable digital input options (parameters A051-A054) such as “Jog”, “Local” or “PID Disable”.

**Table F.A A132 [PID Ref Sel] Options**

| Option | Description |
|---|---|
| 0 “PID Disabled” | Disables the PID loop (default setting) |
| 1 “PID Setpoint“ | Selects Exclusive Control. A137 [PID Setpoint] will be used to set the value of the PID Reference |
| 2 “0-10V Input” | Selects Exclusive Control. Selects the 0-10V Input. Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero. |
| 3 “4-20mA Input” | Selects Exclusive Control. Selects the 4-20mA Input. |
| 4 “Comm Port” | Selects Exclusive Control. The reference word from a communication network (see Appendix C for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Reference. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% reference. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% reference. |
| 5 “Setpnt, Trim” | Selects Trim Control. A137 [PID Setpoint] will be used to set the value of the PID Reference. |
| 6 “0-10V, Trim” | Selects Trim Control. Selects the 0-10V Input. Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero. |
| 7 “4-20mA, Trim” | Selects Trim Control. Selects the 4-20mA Input. |
| 8 “Comm, Trim” | Selects Trim Control. The reference word from a communication network (see Appendix C for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Reference. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% reference. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% reference. |

A133 [PID Feedback Sel] is used to select the source of the PID feedback.

**Table F.B A133 [PID Feedback Sel] Options**

| Option | Description |
|---|---|
| 0 “0-10V Input” | Selects the 0-10V Input (default setting). Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero. |
| 1 “4-20mA Input“ | Selects the 4-20mA Input. |
| 2 “Comm Port” | The reference word from a communication network (see Appendix C of the PowerFlex 40 User Manual for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Feedback. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% Feedback. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% Feedback. |

## Analog PID Reference Signals

Parameters A110 [Anlg In 0-10V Lo] and A111 [Anlg In 0-10V Hi] are used to scale or invert an analog PID Reference.

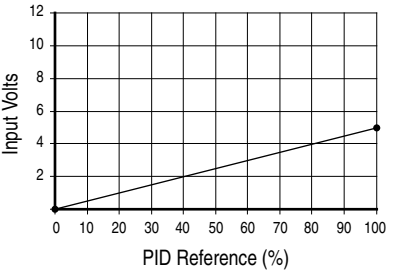
**Important:** Firmware version FRN 2.xx also allows PID Feedback scaling from an analog input.

**Examples**

### Scale Function

For a 0-5 volt signal, the following parameter settings are used so that a 0 volt signal = 0% PID Reference and a 5 volt signal = 100% PID Reference.

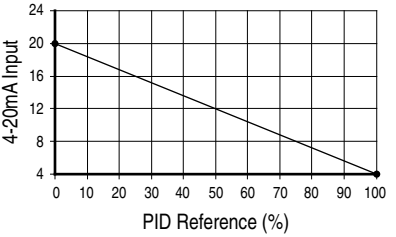
- A110 [Anlg In 0-10V Lo] = 0.0%
- A111 [Anlg In 0-10V Hi] = 50.0%
- A132 [PID Ref Sel] = 0 “0-10V Input”



### Invert Function

For a 4-20mA signal, the following parameter settings are used so that a 20mA signal = 0% PID Reference and a 4mA signal = 100% PID Reference.

- A112 [Anlg In 4-20mA Lo] = 100.0%
- A113 [Anlg In 4-20mA Hi] = 0.0%
- A132 [PID Ref Sel] = 3 “4-20mA Input”




Alternatively, you can set the value of A167 [PID Invert Error] to 1 to change the sign of the PID error. See A167 [PID Invert Error] in Chapter 3 for more details.

### PID Deadband

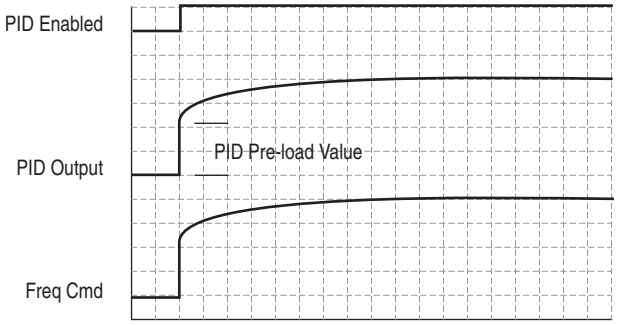
Parameter A138 [PID Deadband] is used to set a range, in percent, of the PID Reference that the drive will ignore.

**Example**

- [PID Deadband] is set to 5.0
- The PID Reference is 25.0%
- The PID Regulator will not act on a PID Error that falls between 20.0 and 30.0%

### PID Preload

The value set in A139 [PID Preload], in Hertz, will be pre-loaded into the integral component of the PID at any start or enable. This will cause the drive's frequency command to initially jump to that preload frequency, and the PID loop starts regulating from there.




### PID Limits

A130 [PID Trim Hi] and A131 [PID Trim Lo] are used to limit the PID output and are only used in trim mode. [PID Trim Hi] sets the maximum frequency for the PID output in trim mode. [PID Trim Lo] sets the reverse frequency limit for the PID output in trim mode. Note that when the PID reaches the Hi or Lo limit, the PID regulator stops integrating so that windup does not occur.

### PID Gains

The proportional, integral, and differential gains make up the PID regulator.

- A134 [PID Prop Gain]
  The proportional gain (unitless) affects how the regulator reacts to the magnitude of the error. The proportional component of the PID regulator outputs a speed command proportional to the PID error. For example, a proportional gain of 1 would output 100% of max frequency when the PID error is 100% of the analog input range. A larger value for [PID Prop Gain] makes the proportional component more responsive, and a smaller value makes it less responsive. Setting [PID Prop Gain] to 0.00 disables the proportional component of the PID loop.
- A135 [PID Integ Time]
  The integral gain (units of seconds) affects how the regulator reacts to error over time and is used to get rid of steady state error. For example, with an integral gain of 2 seconds, the output of the integral gain component would integrate up to 100% of max frequency when the PID error is 100% for 2 seconds. A larger value for [PID Integ Time] makes the integral component less responsive, and a smaller value makes it more responsive. Setting [PID Integ Time] to 0 disables the integral component of the PID loop.
- A136 [PID Diff Rate]
  The Differential gain (units of 1/seconds) affects the rate of change of the PID output. The differential gain is multiplied by the difference between the previous error and current error. Thus, with a large error the D has a large effect and with a small error the D has less of an effect. This parameter is scaled so that when it is set to 1.00, the process response is 0.1% of [Maximum Freq] when the process error is changing at 1% / second. A larger value for [PID Diff Rate] makes the differential term have more of an effect and a small value makes it have less of an effect. In many applications, the D gain is not needed. Setting [PID Diff Rate] to 0.00 (factory default) disables the differential component of the PID loop.

### Guidelines for Adjusting the PID Gains

1. Adjust the proportional gain. During this step it may be desirable to disable the integral gain and differential gain by setting them to 0. After a step change in the PID Feedback:
   - If the response is too slow increase A134 [PID Prop Gain].
   - If the response is too quick and/or unstable (see Figure F.1), decrease A134 [PID Prop Gain].
   - Typically, A134 [PID Prop Gain] is set to some value below the point where the PID begins to go unstable.
2. Adjust the integral gain (leave the proportional gain set as in Step 1). After a step change in the PID Feedback:
   - If the response is too slow (see Figure F.2), or the PID Feedback does not become equal to the PID Reference, decrease A135 [PID Integ Time].
   - If there is a lot of oscillation in the PID Feedback before settling out (see Figure F.3), increase A135 [PID Integ Time].
3. At this point, the differential gain may not be needed. However, if after determining the values for A134 [PID Prop Gain] and A135 [PID Integ Time]:
   - Response is still slow after a step change, increase A136 [PID Diff Rate].
   - Response is still unstable, decrease A136 [PID Diff Rate].

The following figures show some typical responses of the PID loop at different points during adjustment of the PID Gains.

**Figure F.1 Unstable**

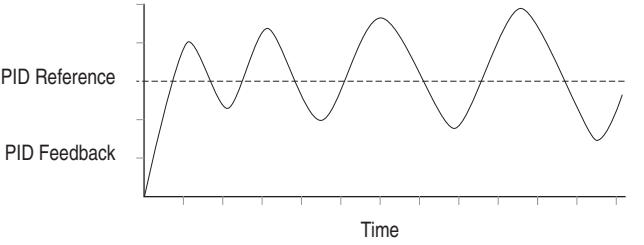



**Figure F.2 Slow Response – Over Damped**

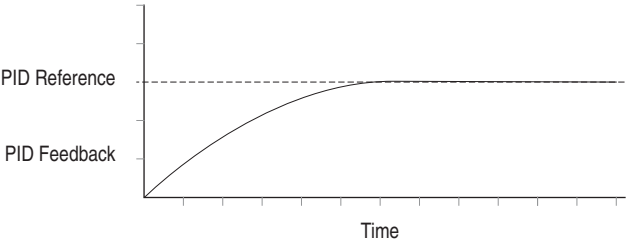



**Figure F.3 Oscillation – Under Damped**

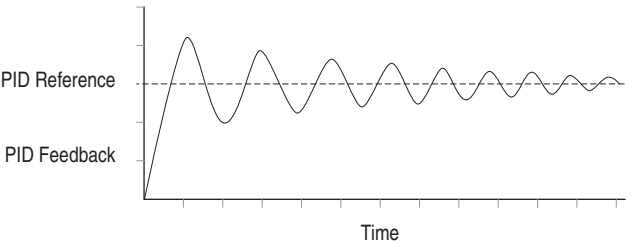
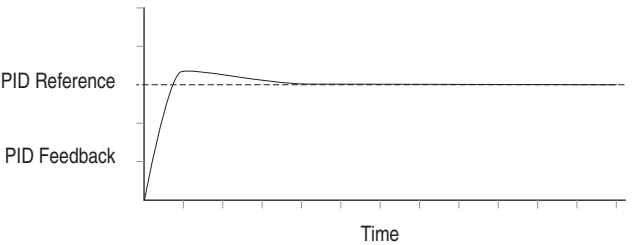



**Figure F.4 Good Response – Critically Damped**



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## Notes:

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# Installation & Maintenance Instructions

## 2-WAY INTERNAL PILOT-OPERATED SOLENOID VALVES
## HUNG DIAPHRAGM — 3/8, 1/2 AND 3/4 NPT
## NORMALLY CLOSED OPERATION

BULLETINS
8210
8211

Form No.V5825R1

## DESCRIPTION

Bulletin 8210's are 2-way, normally closed, internal pilot operated solenoid valves. Valve body and bonnet are of brass construction. Standard valves have a General Purpose, NEMA Type 1 Solenoid Enclosure.

Bulletin 8211's are the same as Bulletin 8210's except the solenoids are equipped with an enclosure which is designed to meet NEMA Type 4 Watertight, NEMA Type 7 (C or D) Hazardous Locations - Class I, Group C or D, and NEMA Type 9 (E, F or G) Hazardous Locations - Class II, Group E, F or G. The explosion-proof/watertight solenoid enclosure is shown on a separate sheet of Installation and Maintenance Instructions, Form No. V-5380.

Bulletin 8210 and 8211 valves with suffix 'HW' in the catalog number are specifically designed for hot water service.

## OPERATION

Normally Closed: Valve is closed when solenoid is de-energized and opens when solenoid is energized.

### MANUAL OPERATOR (Optional)

Valves with suffix 'MO' in catalog number are provided with a manual operator which allows manual operation when desired or during an interruption of electrical power. To operate valve manually, push in knurled cap and rotate clockwise 180°. Disengage manual operator by rotating knurled cap counterclockwise 180° before operating electrically.

### MANUAL OPERATOR LOCATION (Refer to Figure 3)

Manual operator (when shipped from factory) will be located over the valve outlet. Manual operator may be relocated at 90° increments by rotating valve bonnet. Remove bonnet screws (4) and rotate valve bonnet with solenoid to desired position. Replace bonnet screws (4) and torque in a crisscross manner to 110 ± 10 inch pounds.

If valve is installed in system and is operational, proceed in the following manner:

**WARNING: Depressurize valve and turn off electrical power supply.**

1. Remove retaining cap or clip and slip the entire solenoid enclosure off the solenoid base sub-assembly. CAUTION: When metal retaining clip disengages, it will spring upwards.
2. Remove bonnet screws (4) and rotate valve bonnet to desired position.
3. Replace bonnet screws (4) and torque in a crisscross manner to 110 ± 10 inch pounds.
4. Replace solenoid enclosure and retaining clip or cap.

## INSTALLATION

Check nameplate for correct catalog number, pressure, voltage and service.

### TEMPERATURE LIMITATIONS

For maximum valve ambient and fluid temperatures refer to chart. The temperature limitations listed are for UL applications. For non UL applications, higher ambient and fluid temperature limitations are available. Consult factory. Check catalog number on nameplate to determine maximum temperatures.

| Construction | Coil Class | Catalog Number Prefix | Maximum Ambient Temp. °F. | Maximum Fluid Temp. °F. |
|---|---|---|---|---|
| A-C Construction (Alternating Current) | A | None or DA | 77 | 180 |
| | F | DF or FT | 122 | 180 |
| | H | HT | 140 | 180 |
| D-C Construction (Direct Current) | A, F or H | None, FT or HT | 77 | 150 |
| **Catalog Numbers Suffixed 'HW'** A-C Construction (Alternating Current) | A | None or DA | 77 | 210 |
| | F | DF or FT | 77 | 210 |
| | H | HT | 122 | 210 |

### POSITIONING/MOUNTING

Valve may be mounted in any position. For mounting bracket (optional feature) dimensions, refer to Figure 1.

### PIPING

Connect piping to valve according to markings on valve body. Apply pipe compound sparingly to male pipe threads only; if applied to valve threads, it may enter the valve and cause operational difficulty. Pipe strain should be avoided by proper support and alignment of piping. When tightening the pipe do not use valve as a lever. Wrenches applied to valve body or piping are to be located as close as possible to connection point. **IMPORTANT: Valves with suffix 'HW' in the catalog number have a special diaphragm material which is specifically compounded for hot water service. This material can be attacked by oil and grease. Wipe the pipe threads clean of cutting oils and use teflon tape to seal pipe joints.**

**IMPORTANT: For the protection of the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required depending on the service conditions. See Bulletins 8600, 8601 and 8602 for strainers.**

### WIRING

Wiring must comply with Local and National Electrical Codes. Housings for all solenoids are provided with connections for 1/2 inch conduit. The general purpose solenoid enclosure may be rotated to facilitate wiring by removing the retaining cap or clip. CAUTION: When metal retaining clip disengages it will spring upwards. Rotate to desired position. Replace retaining cap or clip before operating.

**NOTE: Alternating Current (A-C) and Direct Current (D-C) Solenoids are built differently. To convert from one to the other, it is necessary to change the complete solenoid including the solenoid base sub-assembly and core assembly.**

## SOLENOID TEMPERATURE

Standard catalog valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched with the hand for only an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

## MAINTENANCE

**WARNING: Turn off electrical power and depressurize valve before making repairs. It is not necessary to remove valve from pipe line for repairs.**

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## CLEANING

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary, depending on media and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive leakage or noise will indicate that cleaning is required.

## PREVENTIVE MAINTENANCE

1. Keep the medium flowing through the valve as free from dirt and foreign material as possible.
2. While in service, operate valve at least once a month to insure proper opening and closing.
3. Periodic inspection (depending on media and service conditions) of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any parts that are worn or damaged.

## IMPROPER OPERATION

1. **Faulty Control Circuit:** Check electrical system by energizing solenoid. A metallic click signifies the solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or blown-out fuses, open circuited or grounded coil, broken lead wires or splice connections.
2. **Burned-Out Coil:** Check for open circuited coil. Replace coil if necessary.
3. **Low Voltage:** Check voltage across coil leads. Voltage must be at least 85% of nameplate rating.
4. **Incorrect Pressure:** Check valve pressure. Pressure to the valve must be within range specified on nameplate.
5. **Excessive Leakage:** Disassemble valve and clean all parts. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

## COIL REPLACEMENT (Refer to Figure 2)

**Turn off electrical power supply and disconnect coil leads. Proceed in the following manner:**

1. Remove retaining cap or clip, nameplate and cover. CAUTION: When metal retaining clip disengages, it will spring upwards.
2. Remove spring washer, insulating washer and coil. Insulating washers are omitted when a molded coil is used.
3. Reassemble in reverse order of disassembly paying careful attention to exploded view provided for identification and placement of parts.

**CAUTION: Solenoid must be fully reassembled as the housing and internal parts are part of and complete the magnetic circuit. Place insulating washer at each end of coil if required.**

## VALVE DISASSEMBLY (Refer to Figures 2 and 3)

**Depressurize valve and turn off electrical power supply. Proceed in the following manner:**

1. Remove retaining cap or clip and slip the entire solenoid enclosure off the solenoid base sub-assembly. CAUTION: When metal retaining clip disengages, it will spring upwards.
2. Unscrew solenoid base sub-assembly and remove bonnet gasket.
3. Remove valve bonnet screws (4) and valve bonnet.
4. For normal maintenance, it is not necessary to disassemble the manual operator (optional feature) unless external leakage is evident. To disassemble remove stem pin, manual operator stem, stem spring and stem gasket.
5. Remove core spring, core/diaphragm sub-assembly and body gasket. CAUTION: Do not damage or distort hanger spring between core/diaphragm sub-assembly.
6. All parts are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

## VALVE REASSEMBLY

1. Reassemble in reverse order of disassembly paying careful attention to exploded views provided for identification and placement of parts.
2. Replace body gasket and core/diaphragm sub-assembly. Locate the bleed hole in core/diaphragm sub-assembly approximately 45° from the valve outlet.
3. Replace core spring with wide end in core first; closed end protrudes from top of core.
4. If removed, replace manual operator stem, stem spring, stem gasket and stem pin.
5. Replace valve bonnet and bonnet screws (4). Torque bonnet screws (4) in a crisscross manner to 110 ± 10 inch pounds.
6. Replace bonnet gasket and solenoid base sub-assembly. Put solenoid base sub-assembly to 175 ± 25 inch pounds.
7. Replace solenoid enclosure and retaining cap or clip.
8. After maintenance, operate the valve a few times to be sure of proper opening and closing.

## SPARE PARTS KITS

Spare Parts Kits and Coils are available for ASCO valves.
Parts marked with an asterisk (*) are supplied in Spare Parts Kits.

**ORDERING INFORMATION FOR SPARE PARTS KITS**
When Ordering Spare Parts Kits or Coils Specify Valve Catalog Number, Serial Number and Voltage.

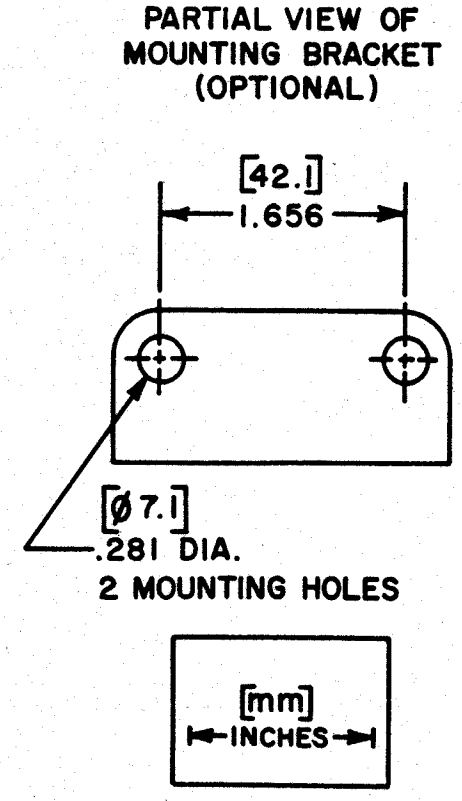


**Figure 1.** Dimensions For Mounting Bracket (Optional Feature)



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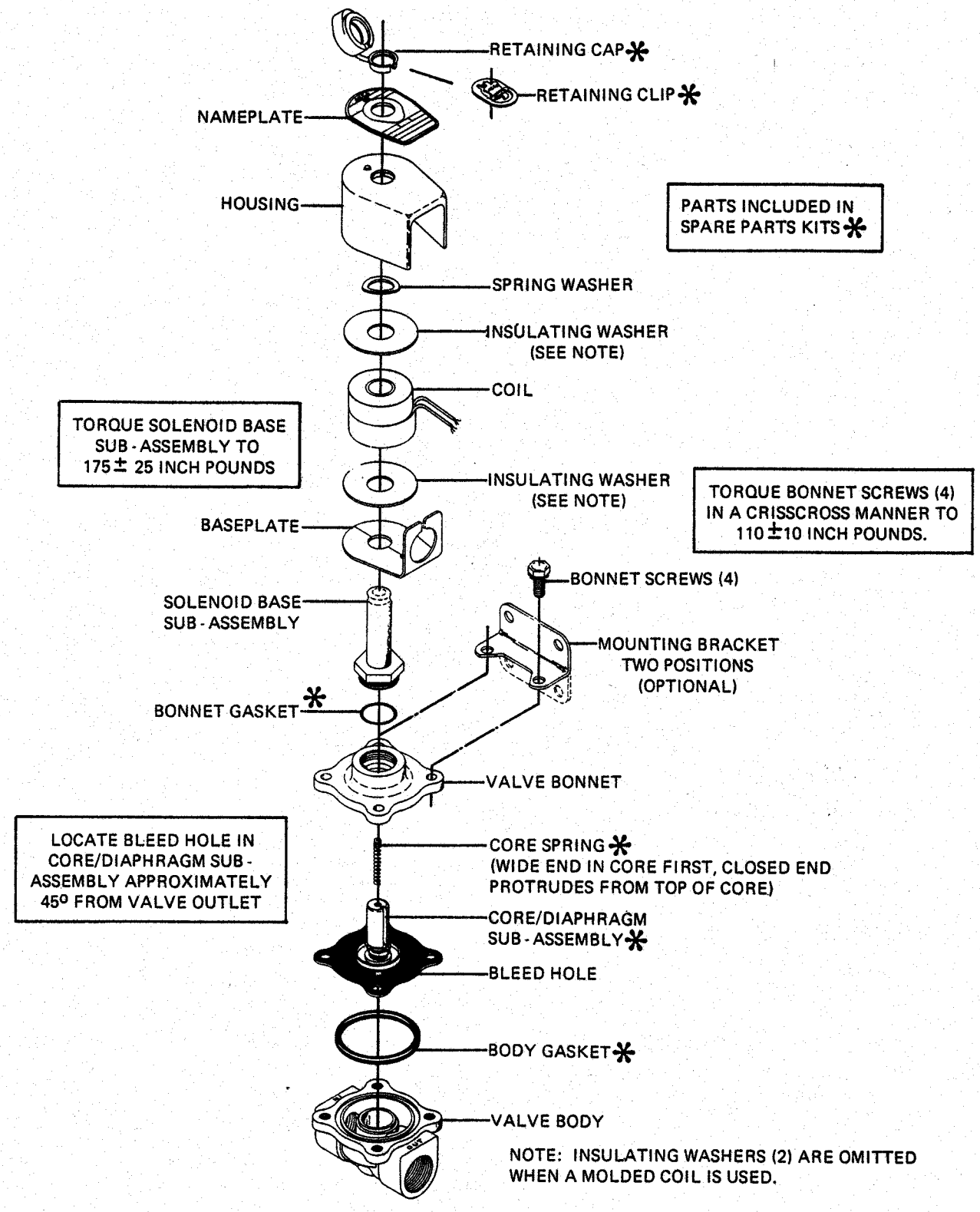


**Bulletin 8210 — 3/8, 1/2 & 3/4 N.P.T. — A-C Construction**
**General purpose solenoid enclosure shown.**

**Figure 2.** **For explosion-proof/watertight solenoid enclosure used on Bulletin 8211, see Form No. V-5380.**



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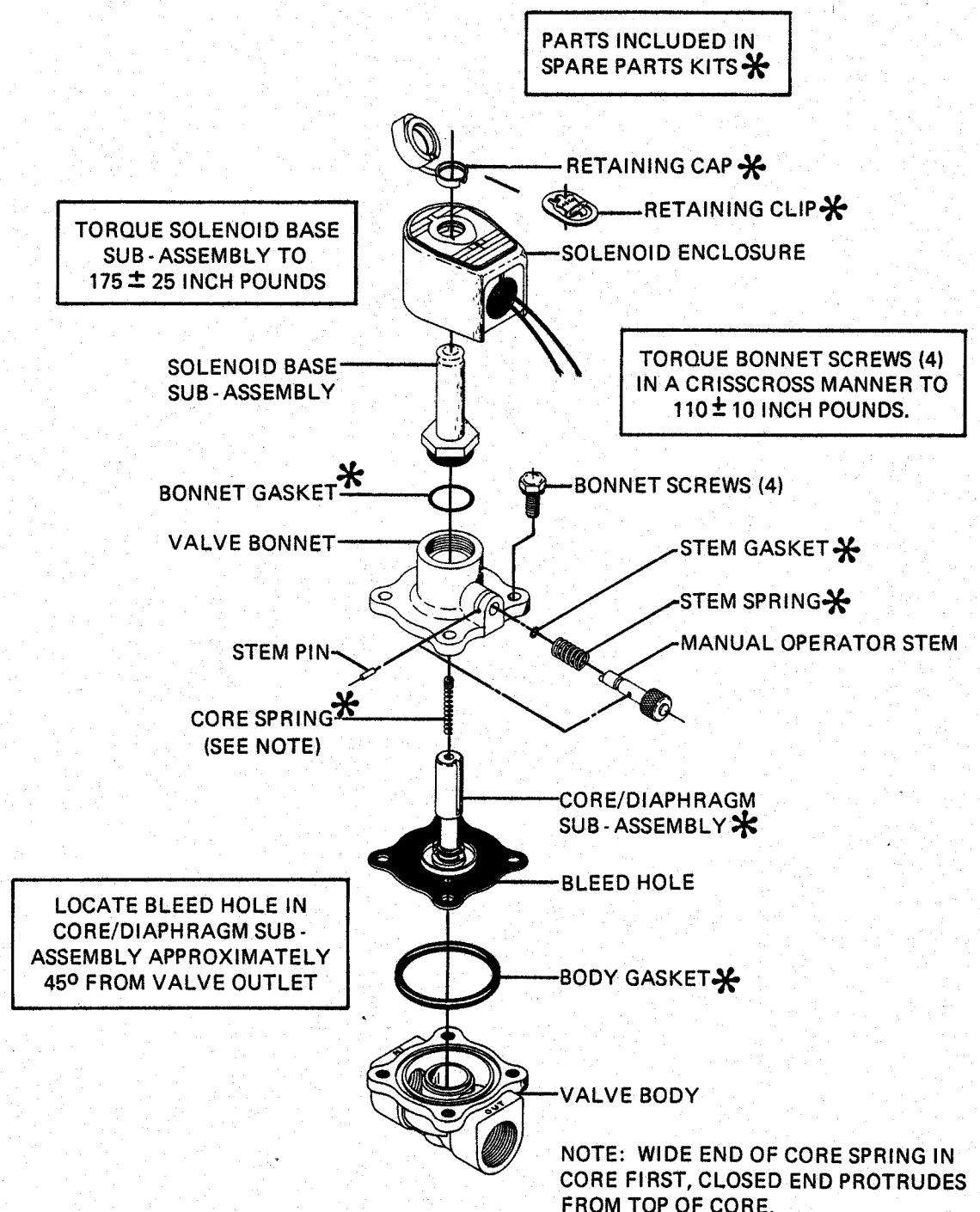


**Bulletin 8210 — Manual Operator**
**General purpose solenoid enclosure shown.**
**For explosion-proof/watertight solenoid enclosure used on Bulletin 8211, see Form No. V-5380.**

**Figure 3.**



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# Installation & Maintenance Instructions

ASCO Red-Hat II®

**OPEN–FRAME, GENERAL PURPOSE, WATERTIGHT/EXPLOSIONPROOF SOLENOIDS**

**SERIES**
**8003G**
**8202G**
**Form No.V6584R8**

## — SERVICE NOTICE —

ASCO® solenoid valves with design change letter "G" or "H" in the catalog number (ex. 8210G 1) have an epoxy encapsulated ASCO® Red Hat II® solenoid. This solenoid replaces some of the solenoids with metal enclosures and open–frame constructions. Follow these installation and maintenance instructions if your valve or operator uses this solenoid.

***See separate instructions for basic valve.***

## DESCRIPTION

Catalog numbers 8003G and 8202G are epoxy encapsulated pull–type solenoids. The green solenoid with lead wires and 1/2″ conduit connection is designed to meet Enclosure Type 1–General Purpose, Type 2–Dripproof, Types 3 and 3S–Raintight, and Types 4 and 4X–Watertight. The black solenoid on catalog numbers prefixed "EF" or "EV" is designed to meet Enclosure Types 3 and 3S–Raintight, Types 4 and 4X–Watertight, Types 6 and 6P–Submersible, Type 7 (A, B, C & D) Explosionproof Class I, Division 1 Groups A, B, C, & D and Type 9 (E, F, & G)–Dust–Ignitionproof Class II, Division 1 Groups E, F & G. The Class II, Groups F & G Dust Locations designation is not applicable for solenoids or solenoid valves used for steam service or when a class "H" solenoid is used. See *Temperature Limitations* section for solenoid identification and nameplate/retainer for service. When installed just as a solenoid and not attached to an ASCO valve, the core has a 0.250–28 UNF–2B tapped hole, 0.38 or 0.63 minimum full thread.

NOTE: Catalog number prefix "EV" denotes stainless steel construction.

Catalog numbers 8202G1, 8202G3, 8202G5 and 8202G7 are epoxy encapsulated push–type, reverse–acting solenoids having the same enclosure types as previously stated for Catalog numbers 8003G1 and 8003G2.

### Series 8003G and 8202G solenoids are available in:

- **Open–Frame Construction:** The green solenoid may be supplied with 1/4″ spade, screw or DIN terminals. (Refer to Figure 4)
- **Panel Mounted Construction:** These solenoids are specifically designed to be panel mounted by the customer through a panel having a .062 to .093 maximum wall thickness. Refer to Figure 1 and section on *Installation of Panel Mounted Solenoid.*

### Optional Features For Type 1 – General Purpose Construction Only

- **Junction Box:** This junction box construction meets Enclosure Types 2,3,3S,4, and 4X. Only solenoids with 1/4″ spade or screw terminals may have a junction box. The junction box provides a 1/2″ conduit connection, grounding and spade or screw terminal connections within the junction box (See Figure 5).
- **DIN Plug Connector Kit No.K236034:** Use this kit only for solenoids with DIN terminals. The DIN plug connector kit provides a two pole with grounding contact DIN Type 43650 construction (See Figure 6).

## OPERATION

Series 8003G – When the solenoid is energized, the core is drawn into the solenoid base sub–assembly. **IMPORTANT: When the solenoid is de–energized, the initial return force for the core, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force for AC construction is 11 ounces, and 5 ounces for DC construction.**

Series 8202G – When the solenoid is energized, the disc holder assembly seats against the orifice. When the solenoid is de–energized , the disc holder assembly returns. **IMPORTANT: Initial return force for the disc or disc holder assembly, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force is 1 pound, 5 ounces.**

## INSTALLATION

Check nameplate for correct catalog number, service, and wattage. Check front of solenoid for voltage and frequency.

**⚠ WARNING: Electrical hazard from the accessibility of live parts. To prevent the possibility of death, serious injury or property damage, install the open – frame solenoid in an enclosure.**

### FOR BLACK ENCLOSURE TYPES 7 AND 9 ONLY

**⚠ CAUTION: To prevent fire or explosion, do not install solenoid and/or valve where ignition temperature of hazardous atmosphere is less than 165° C. On valves used for steam service or when a class "H" solenoid is used, do not install in hazardous atmosphere where ignition temperature is less than 180°C. See nameplate/retainer for service.**

NOTE: These solenoids have an internal non–resetable thermal fuse to limit solenoid temperature in the event that extraordinary conditions occur which could cause excessive temperatures. These conditions include high input voltage, a jammed core, excessive ambient temperature or a shorted solenoid, etc. This unique feature is a standard feature only in solenoids with black explosionproof/dust–ignitionproof enclosures (Types 7 & 9).

**⚠ CAUTION: To protect the solenoid valve or operator, install a strainer or filter, suitable for the service involved in the inlet side as close to the valve or operator as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601, and 8602 for strainers.**

### Temperature Limitations

For maximum valve ambient temperatures, refer to chart. The temperature limitations listed, only indicate maximum application temperatures for field wiring rated at 90°C. Check catalog number prefix and watt rating on nameplate to determine maximum ambient temperature. See valve installation and maintenance instructions for maximum fluid temperature. NOTE: For steam service, refer to *Wiring* section, *Junction Box* for temperature rating of supply wires.

**Temperature Limitations For Series 8003G or 8202G Solenoids for use on Valves Rated at 10.1, 11.6, 17.1, or 22.6 Watts**

| Watt Rating | Catalog Number Coil Prefix | Class of Insulation | Maximum † Ambient Temp. |
|---|---|---|---|
| 10.1 & 17.1 | None, FB, KF, KP SC, SD, SF, & SP, | F | 125°F (51.7°C) |
| 10.1 & 17.1 | HB, HT, KB, KH, SS, ST, SU, | H | 140°F (60°C) |
| 11.6 & 22.6 | None, FB,KF, KP, SC, SD, SF, & SP. | F | 104°F (40°C) |
| 11.6 & 22.6 | HP, HT, KB, KH, SS, ST, SU, & SV | H | 104°F (40°C) |

† Minimum ambient temperature –40° F (–40° C).

### Positioning

This solenoid is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertically and upright to reduce the possibility of foreign matter accumulating in the solenoid base sub–assembly area.

### Wiring

Wiring must comply with local codes and the National Electrical Code. All solenoids supplied with lead wires are provided with a grounding wire which is green or green with yellow stripes and a 1/2″ conduit connection. To

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facilitate wiring, the solenoid may be rotated 360°. For the watertight and explosionproof solenoid, electrical fittings must be approved for use in the approved hazardous locations.

**⚠ CAUTION: Cryogenic Applications — Solenoid lead wire insulation should not be subjected to cryogenic temperatures. Adequate lead wire protection and routing must be provided.**

## Additional Wiring Instructions For Optional Features:

- **Open−Frame solenoid with 1/4″ spade terminals.**

For solenoids supplied with screw terminal connections use #12−18 AWG stranded copper wire rated at 90°C or greater. Torque terminal block screws to 10 ± 2 in−lbs [1,0 ± 1,2 Nm]. A tapped hole is provided in the solenoid for grounding, use a #10−32 machine screw. Torque grounding screw to 15 − 20 in−lbs [1,7 − 2,3 Nm]. On solenoids with screw terminals, the socket head screw holding the terminal block to the solenoid is the grounding screw. Torque the screw to 15 − 20 in−lbs [1,7 − 2,3 Nm] with a 5/32″ hex key wrench.

- **Junction Box**

The junction box is used with spade or screw terminal solenoids only and is provided with a grounding screw and a 1/2″ conduit connection. Connect #12−18 AWG standard copper wire only to the screw terminals. Within the junction box use field wire that is rated 90°C or greater for connections. For steam service use 105°C rated wire up to 50 psi or use 125°C rated wire above 50 psi. After electrical hookup, replace cover gasket, cover, and screws. Tighten screws evenly in a crisscross manner.

- **DIN Plug Connector Kit No.K236034**

1. The open−frame solenoid is provided with DIN terminals to accommodate the plug connector kit.
2. Remove center screw from plug connector. Using a small screwdriver, pry terminal block from connector cover.
3. Use #12−18 AWG stranded copper wire rated at 90°C or greater for connections. Strip wire leads back approximately 1/4″ for installation in socket terminals. The use of wire−end sleeves is also recommended for these socket terminals. Maximum length of wire−end sleeves to be approximately 1/4″. Tinning of the ends of the lead wires is not recommended.
4. Thread wire through gland nut, gland gasket, washer and connector cover.

NOTE: Connector housing may be rotated in 90° increments from position shown for alternate positioning of cable entry.

5. Check DIN connector terminal block for electrical markings. Then make electrical hookup to terminal block according to markings on it. Snap terminal block into connector cover and install center screw.
6. Position connector gasket on solenoid and install plug connector. Torque center screw to 5 ± 1 in−lbs [0,6 ± 1,1 Nm].

NOTE: Alternating current (AC) and direct current (DC) solenoids are built differently. To convert from one to the other, it may be necessary to change the complete solenoid including the core and solenoid base sub−assembly, not just the solenoid. Consult ASCO.

## Installation of Solenoid

Solenoids may be assembled as a complete unit. Tightening is accomplished by means of a hex flange at the base of the solenoid.

## Installation of Panel Mounted Solenoid (See Figure 1)

1. Disassemble solenoid following instruction under *Solenoid Replacement* then proceed.
2. Install solenoid base sub−assembly through customer panel.
3. Position spring washer on opposite side of panel over solenoid base sub−assembly.
4. Replace solenoid, nameplate/retainer and red cap.
5. Make electrical hookup, see *Wiring* section.

## Solenoid Temperature

Standard solenoids are designed for continuous duty service. When the solenoid is energized for a long period, the solenoid becomes hot and can be touched by hand only for an instant. This is a safe operating temperature.

# MAINTENANCE

**⚠ WARNING: To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize solenoid operator and/or valve, and vent fluid to a safe area before servicing.**

## Cleaning

All solenoid operators and valves should be cleaned periodically. The time between cleaning will vary depending on medium and service conditions. In general, if the voltage to the solenoid is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. Clean strainer or filter when cleaning the valve.

## Preventive Maintenance

- Keep the medium flowing through the solenoid operator or valve as free from dirt and foreign material as possible.
- While in service, the solenoid operator or valve should be operated at least once a month to insure proper opening and closing.
- Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any worn or damaged parts.

## Causes of Improper Operation

- **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic *click* signifies that the solenoid is operating. Absence of the *click* indicates loss of power supply. Check for loose or blown fuses, open−circuited or grounded solenoid, broken lead wires or splice connections.
- **Burned−Out Solenoid:** Check for open−circuited solenoid. Replace if necessary. Check supply voltage; it must be the same as specified on nameplate/retainer and marked on the solenoid. Check ambient temperature and check that the core is not jammed.
- **Low Voltage:** Check voltage across the solenoid leads. Voltage must be at least 85% of rated voltage.

## Solenoid Replacement

1. Disconnect conduit, coil leads, and grounding wire.

NOTE: Any optional parts attached to the old solenoid must be reinstalled on the new solenoid. For 3−way construction, piping or tubing must be removed from pipe adapter.

2. Disassemble solenoids with optional features as follows:

- **Spade or Screw Terminals**

Remove terminal connections, grounding screw, grounding wire, and terminal block (screw terminal type only).

NOTE: For screw terminals, the socket head screw holding the terminal block serves as a grounding screw.

- **Junction Box**

Remove conduit and socket head screw (use 5/32″ hex key wrench) from center of junction box. Disconnect junction box from solenoid.

- **DIN Plug Connector**

Remove center screw from DIN plug connector. Disconnect DIN plug connector from adapter. Remove socket head screw (use 5/32″ hex key wrench), DIN terminal adapter, and gasket from solenoid.

3. Snap off red cap from top of solenoid base sub−assembly. For 3−way construction with pipe adapter (Figure 3), remove pipe adapter, nameplate and solenoid. Omit steps 4 and 5.
4. Push down on solenoid. Then using a suitable screwdriver, insert blade between solenoid and nameplate/retainer. Pry up slightly and push to remove.

NOTE: Series 8202G solenoids have a spacer between the nameplate/retainer and solenoid.

5. Remove solenoid from solenoid base sub−assembly.
6. Reassemble in reverse order of disassembly. Use exploded views for identification and placement of parts.
7. Torque pipe adapter to 90 inch−pounds maximum [10,2 Nm maximum]. Then make up piping or tubing to pipe adapter on solenoid.

## Disassembly and Reassembly of Solenoids

1. Remove solenoid, see *Solenoid Replacement*.
2. Remove spring washer from solenoid base sub−assembly. For 3−way construction, remove plugnut gasket.
3. Unscrew solenoid base sub−assembly from valve body.
4. Remove internal solenoid parts for cleaning or replacement. Use exploded views for identification and placement of parts.
5. If the solenoid is part of a valve, refer to basic valve installation and maintenance instructions for further disassembly.
6. Torque solenoid base sub−assembly and adapter to 175±25 in−lbs [19,8±2,8 Nm].

### ORDERING INFORMATION FOR ASCO SOLENOIDS

When Ordering Solenoids for ASCO Solenoid Operators or Valves, order the number stamped on the solenoid. Also specify voltage and frequency.



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## Torque Chart

| Part Name | Torque Value Inch—Pounds | Torque Value Newton—Meters |
|---|---|---|
| solenoid base sub—assembly & adapter | 175 ± 25 | 19,8 ± 2,8 |
| pipe adapter | 90 maximum | 10,2 maximum |

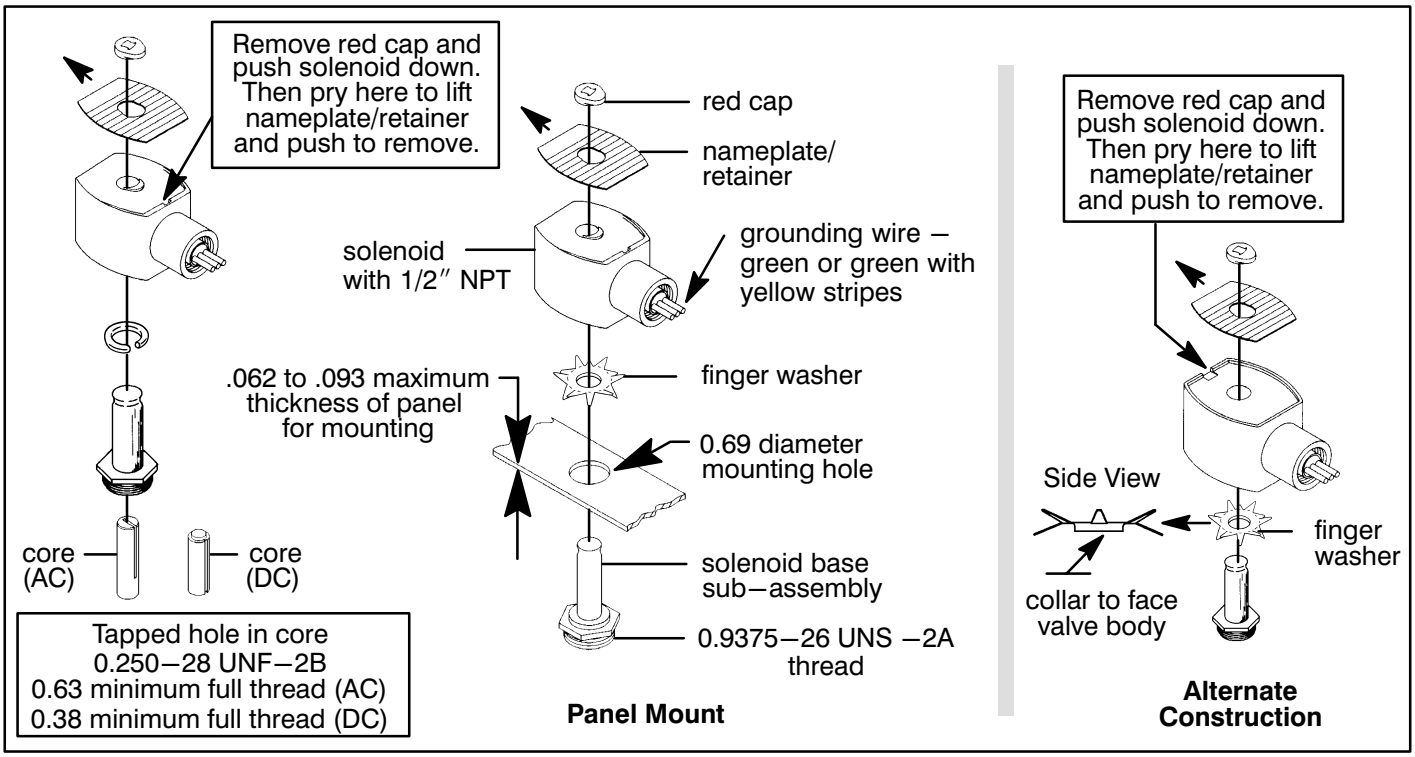


Figure 1. Series 8003G solenoids

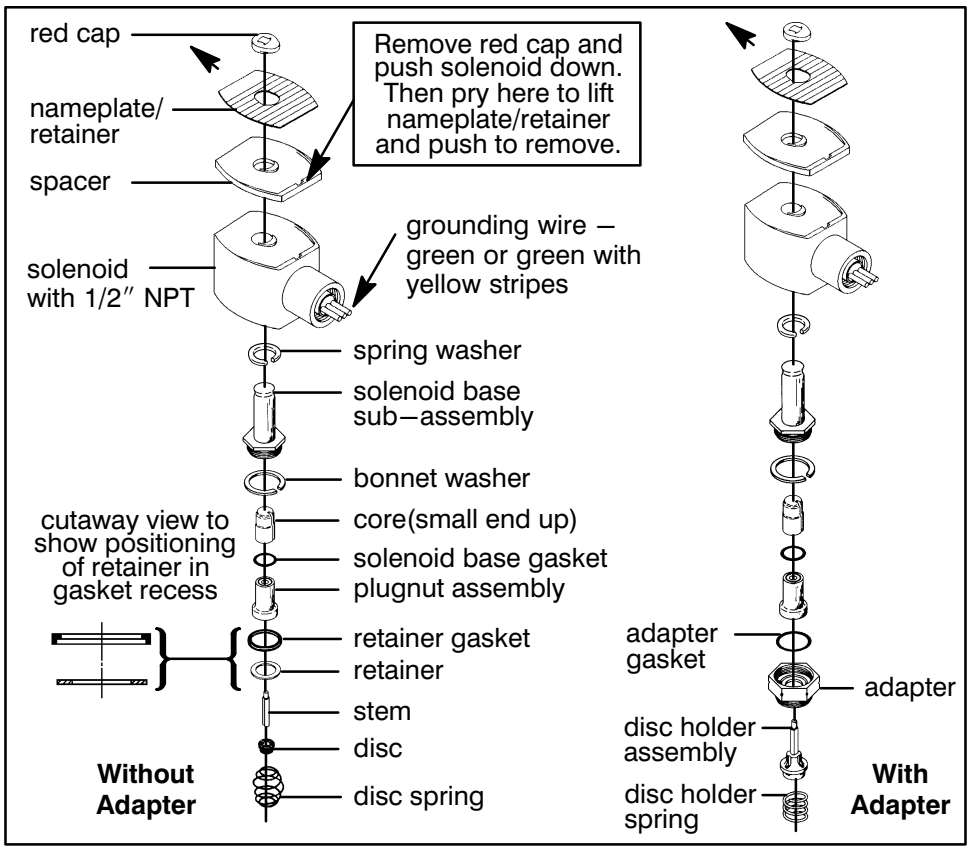


Figure 2. Series 8202G solenoids

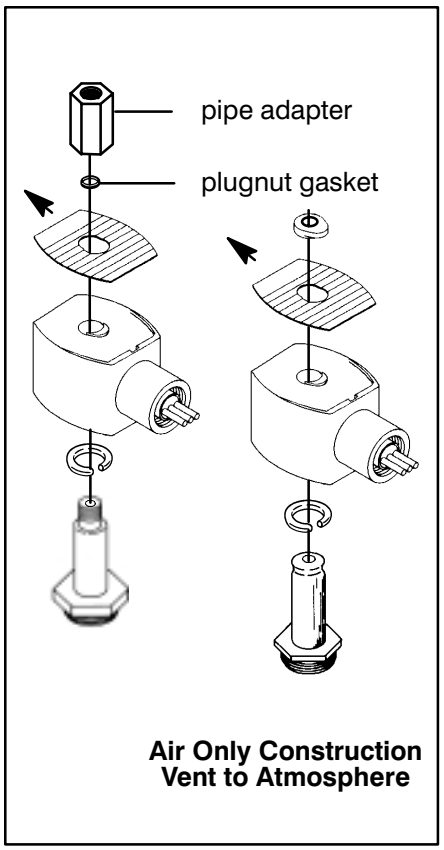


Figure 3. 3—Way Construction



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## Torque Chart

| Part Name | Torque Value in Inch—Pounds | Torque Value in Newton—Meters |
|---|---|---|
| terminal block screws | 10 ± 2 | 1,1 ± 0,2 |
| socket head screw | 15 – 20 | 1,7 – 2,3 |
| center screw | 5 ± 1 | 0,6 ± 0,1 |

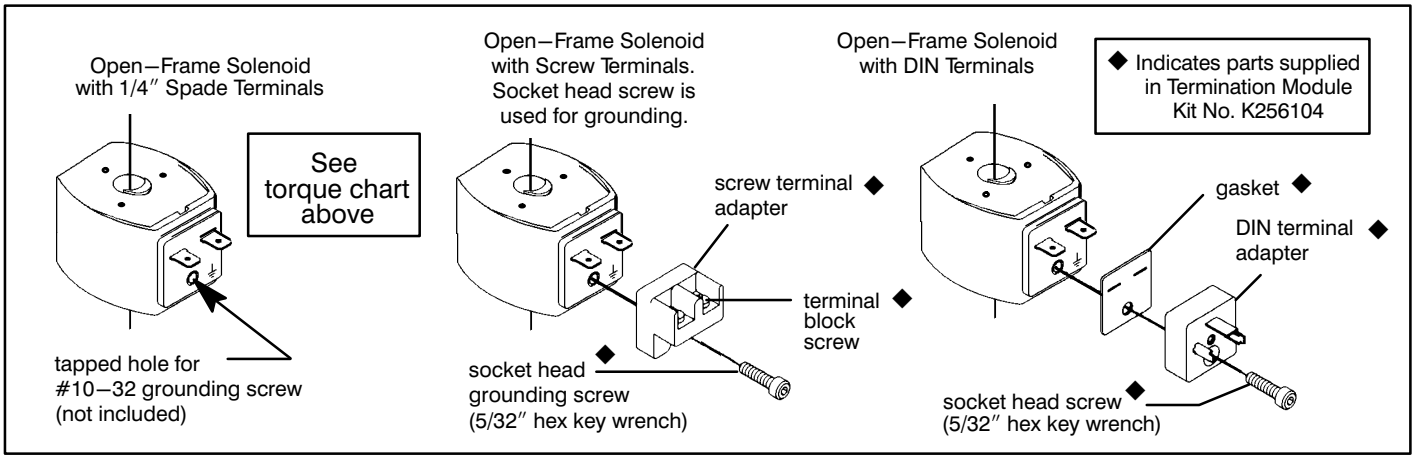


Figure 4. Open—frame solenoids

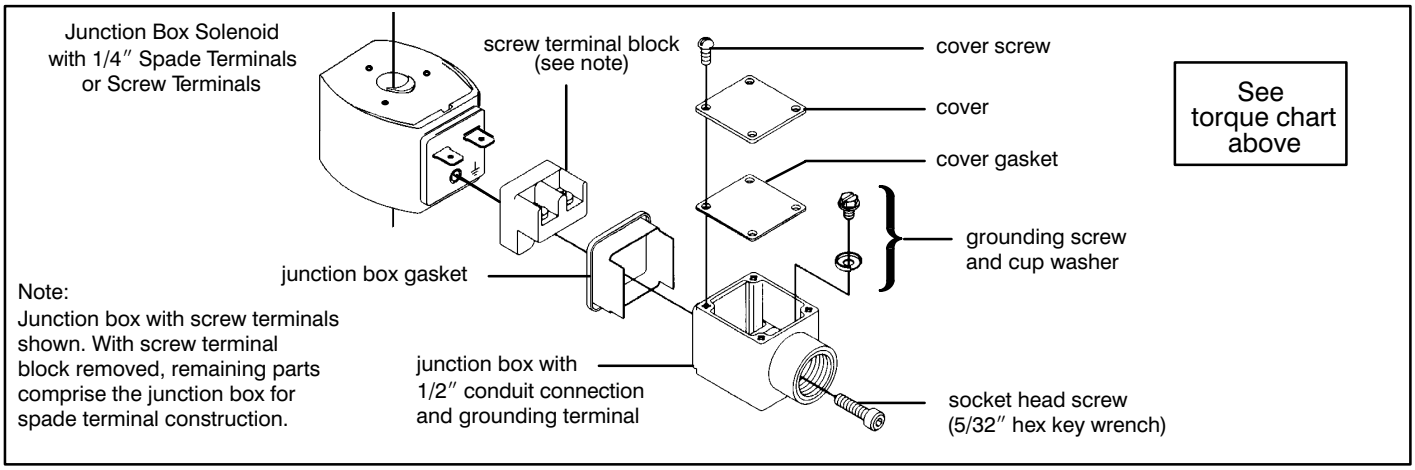


Figure 5. Junction box (optional feature)

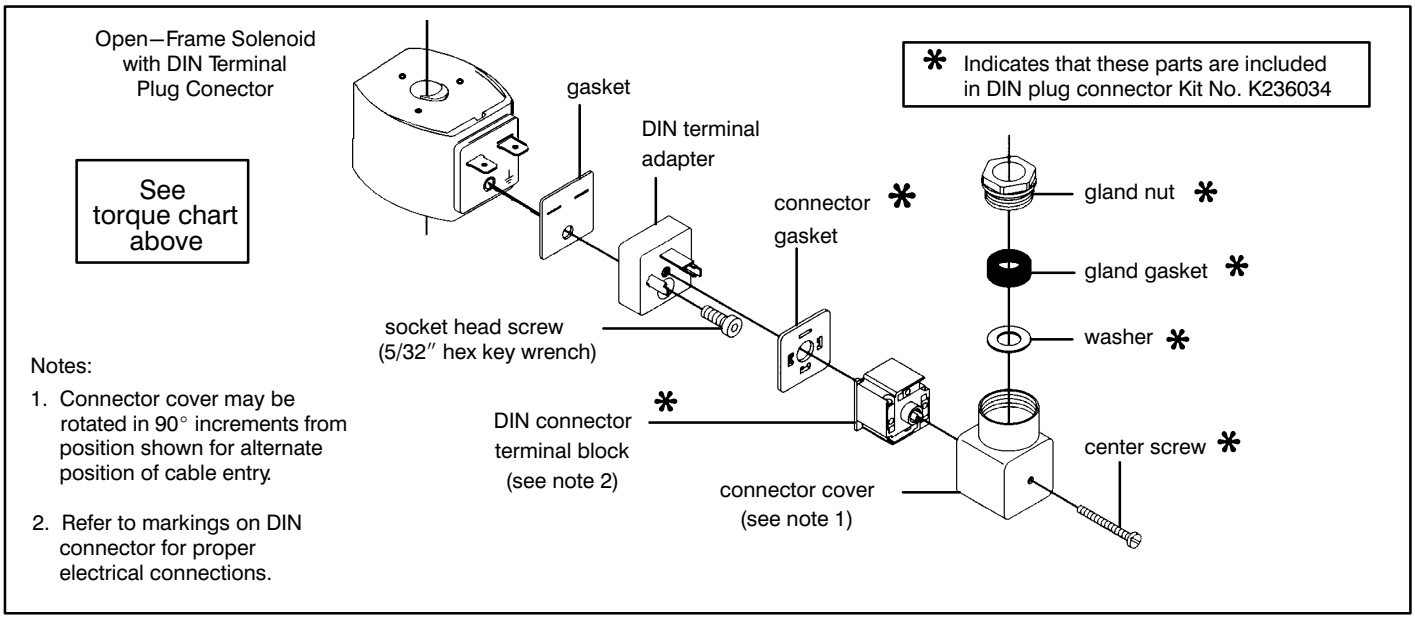


Figure 6. DIN plug connector kit No. K236034 (optional feature)



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ASHCROFT®

# PRESSURE GAUGE INSTALLATION, OPERATION AND MAINTENANCE

I&M008-10098-5/02 (250-1353-K) Rev. 01/12

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# 1.0 SELECTION & APPLICATION

Users should become familiar with ASME B40.100 (Gauges – Pressure Indicating Dial Type – Elastic Element) before specifying pressure measuring gauges. That document – containing valuable information regarding gauge construction, accuracy, safety, selection and testing – may be ordered from:

*ASME International*
Three Park Avenue
New York, N.Y. 10016-5990
800-843-2763 (US/Canada)
001-800-843-2763 (Mexico)
973-882-1170 outside North America
email: infocentral@asme.org
www.asme.org

***WARNING:*** To prevent misapplication, pressure gauges should be selected considering media and ambient operating conditions. Improper application can be detrimental to the gauge, causing failure and possible personal injury, property damage or death. The information contained in this manual is offered as a guide in making the proper selection of a pressure gauge. Additional information is available from Ashcroft Inc.

The following is a highlight of some of the more important considerations:

**1.1 Range** – The range of the instrument should be approximately twice the maximum operating pressure. Too low a range may result in (a) low fatigue life of the elastic element due to high operating stress and (b) susceptibility to overpressure set due to pressure transients that exceed the normal operating pressure. Too high a range may yield insufficient resolution for the application.

**1.2 Temperature** – Refer to Section 2 of this manual for important information concerning temperature related limitations of pressure gauges, both dry and liquid filled.

**1.3 Media** – The material of the process sensing element must be compatible with the process media. Use of a diaphragm seal with the gauge is recommended for process media that (a) is corrosive to the process sensing element; (b) contain heavy particulates (slurries) or (c) are very viscous including those that harden at room temperature.

**1.4 Oxidizing media** – Gauges for direct use on oxidizing media should be specially cleaned. Gauges for oxygen service should be ordered to variation X6B and will carry the ASME required dial marking "USE NO OIL" in red letters. Gauges for direct use on other oxidizing media may be ordered to variation X6W. They will be cleaned but carry no dial marking. *PLUS!*™ Performance gauges or Halocarbon filled gauge or diaphragm fill is required for use with oxidizing media; order variation XCF.

**1.5 Pulsation/Vibration** – Pressure pulsation can be dampened by several mechanisms; the patented *PLUS! Performance* gauge will handle the vast majority of applications. One exception to this is high frequency pulsation which is difficult to detect. The only indication may be an upscale zero shift due to movement wear. These applications should be addressed with a liquid filled gauge, or in extreme cases, a remotely mounted liquid filled gauge connected with a length of capillary line. The small diameter of the capillary provides excellent dampening, but can be plugged. The Ashcroft 1106 pulsation dampener and 1112 snubber are auxiliary devices which dampen pulsation with less tendency to plug.

**1.6 Gauge fills**. – Once it has been determined that a liquid filled gauge is in order, the next step is selecting the type of fill. **Glycerin** satisfies most applications. While being the least expensive fill, its usable temperature range is 20/180°F. **Silicone** filled gauges have a broader service range: –40/250°F. Oxidizing media require the use of **Halocarbon,** with a service range of –40/250°F. Pointer motion will be slowed at the low end of the low end of these temperature ranges.

**1.7 Mounting** – Users should predetermine how the gauge will be mounted in service: stem (pipe), wall (surface) or panel (flush). Ashcroft wall or panel mounting kits should be ordered with the gauge. See Section 3.

# 2.0 TEMPERATURE

**2.1 Ambient Temperature** – To ensure long life and accuracy, pressure gauges should preferably be used at an ambient temperature between –20 and +150°F (–30 to +65°C). At very low temperatures, standard gauges may exhibit slow pointer response. Above 150°F, the accuracy will be affected by approximately 1.5% per 100°F. Other than discoloration of the dial and hardening of the gasketing and degradation of accuracy, non-liquid filled Type 1279 (phenolic case) and 1379 (aluminum case) Duragauge® gauge, with standard glass windows, can withstand continuous operating temperatures up to 250°F. Unigauge models 2½″ and 3½″ 1009 and 1008S liquid filled gauges can withstand 200°F but glycerin fill and the acrylic window of Duragauge® gauges will tend to yellow. Silicone fill will have much less tendency to yellow. Low pressure, liquid filled Types 1008 and 1009 gauges may have some downscale errors caused by liquid fill expansion. This can be alleviated by venting the gauge at the top plug (pullout the blue plug insert). To do this the gauge must be installed in the vertical position.

Although the gauge may be destroyed and calibration lost, gauges can withstand short times at the following temperatures: gauges with all welded pressure boundary joints, 750°F (400°C); gauges with silver brazed joints, 450°F (232°C) and gauges with soft soldered joints, 250°F (121°C). For expected long term service below –20°F (–30°C) Duragauge® and 4½″ 1009 gauges should be hermetically sealed and specially lubricated; add "H" to the product code for hermetic sealing. Add variation XVY for special lubricant. Standard Duralife® gauges may be used to –50°F (–45°C) without modification.

**2.2 Accuracy** – Heat and cold affect accuracy of indication. A general rule of thumb for **dry gauges** is 0.5% of full scale change for every 40°F change from 75°F. Double that allowance for gauges with hermetically sealed or liquid filled cases, except for Duragauge® gauges where no extra allowance is required due to the elastomeric, compensating back. Above 250°F there may exist very significant errors in indication.

**2.3 Steam service** – In order to prevent live steam from entering the Bourdon tube, a siphon filled with water should be installed between the gauge and the process line. Siphons can be supplied with ratings up to 4,000 psi. If freezing of the condensate in the loop of the siphon is a possibility, a diaphragm seal should be used to isolate the gauge from the process steam. Siphons should also be used whenever condensing, hot vapors (not just steam) are present. Super heated steam should have enough piping or capillary line ahead of the siphon to maintain liquid water in the siphon loop.

**2.4 Hot or very cold media** – A five foot capillary line assembly will bring most hot or cold process media within the recommended gauge ambient temperature range. For media above

750°F (400°C) the customers should use their own small diameter piping to avoid possible corrosion of the stainless steel. The five foot capillary will protect the gauges used on the common cryogenic (less than –300°F (200°C) gases, liquid argon, nitrogen, and oxygen.) The capillary and gauge must be cleaned for oxygen service. The media must not be corrosive to stainless steel, and must not plug the small bore of the capillary.

**2.5 Diaphragm seals** – A diaphragm seal should be used to protect gauges from corrosive media, or media that will plug the instrument. Diaphragm seals are offered in a wide variety of designs and corrosion resistant materials to accommodate almost any application and most connections. Visit www.ashcroft.com for details.

**2.6 Autoclaving** – Sanitary gauges with clamp type connections are frequently steam sterilized in an autoclave. Gauges equipped with polysulfone windows will withstand more autoclave cycles than those equipped with polycarbonate windows. Gauges equipped with plain glass or laminated safety glass **should not be autoclaved.** Gauge cases should be vented to atmosphere (removing the rubber fill/safety plug if necessary) **before** autoclaving to prevent the plastic window from cracking or excessively distorting. If the gauge is liquid filled, the fill should be drained from the case and the front ring loosened before autoclaving.

# 3.0 INSTALLATION

**3.1 Location** – Whenever possible, gauges should be located to minimize the effects of vibration, extreme ambient temperatures and moisture. Dry locations away from very high thermal sources (ovens, boilers etc.) are preferred. If the mechanical vibration level is extreme, the gauge should be remotely located (usually on a wall) and connected to the pressure source via flexible tubing.

**3.2 Gauge reuse** – ASME B40.100 recommends that gauges not be moved indiscriminately from one application to another. The cumulative number of pressure cycles on an in-service or previously used gauge is generally unknown, so it is generally safer to install a new gauge whenever and wherever possible. This will also minimize the possibility of a reaction with previous media.

**3.3 Tightening of gauge** – Torque should never be applied to the gauge case. Instead, an open end or adjustable wrench should always be used on the wrench flats of the gauge socket to tighten the gauge into the fitting or pipe. NPT threads require the use of a suitable thread sealant, such as pipe dope or teflon tape, and must be tightened very securely to ensure a leak tight seal.

***CAUTION:*** Torque applied to a diaphragm seal or its attached gauge, that tends to loosen one relative to the other, can cause loss of fill and subsequent inaccurate readings. Always apply torque **only** to the wrench flats on the lower seal housing when installing filled, diaphragm seal assemblies or removing same from process lines.

**3.4 Process isolation** – A shut-off valve should be installed between the gauge and the process in order to be able to isolate the gauge for inspection or replacement without shutting down the process.

**3.5 Surface mounting** – Also known as wall mounting. Gauges should be kept free of piping strains. The gauge case mounting feet, if applicable, will ensure clearance between the pressure relieving back and the mounting surface.

**3.6 Flush mounting** – Also known as panel mounting. The applicable panel mounting cutout dimensions can be found at www.ashcroft.com

# 4.0 OPERATION

**4.1 Frequency of inspection** – This is quite subjective and depends upon the severity of the service and how critical the accuracy of the indicated pressure is. For example, a monthly inspection frequency may be in order for critical, severe service applications. Annual inspections, or even less frequent schedules, are often employed in non-critical applications.

**4.2 In-service inspection** – If the accuracy of the gauge cannot be checked in place, the user can at least look for (a) erratic or random pointer motion; (b) readings that are suspect – especially indications of pressure when the user believes the true pressure is 0 psig. Any gauge which is obviously not working or indicating erroneously, should be immediately valved-off or removed from service to avoid a possible pressure boundary failure.

**4.3 When to check accuracy** – Any suspicious behavior of the gauge pointer warrants that a full accuracy check be performed. Even if the gauge is not showing any symptoms of abnormal performance, the user may want to establish a frequency of bench type inspection.

**4.4 When to recalibrate** – This depends on the criticality of the application. If the accuracy of a 3-2-3% commercial type gauge is only 0.5% beyond specification, the user must decide whether it's worth the time and expense to bring the gauge back into specification. Conversely if the accuracy of a 0.25% test gauge is found to be 0.1% out of specification then the gauge should be recalibrated.

**4.5 Other considerations** – These include (a) bent or unattached pointers due to extreme pressure pulsation; (b) broken windows which should be replaced to keep dirt out of the internals; (c) leakage of gauge fill; (d) case damage – dents and/or cracks; (e) any signs of service media leakage through the gauge including its connection; (f) discoloration of gauge fill that impedes readability.

**4.6 Spare parts** – As a general rule it is recommended that the user maintain in inventory one complete Ashcroft® instrument for every ten (or fraction thereof) of that instrument type in service.

# 5.0 GAUGE REPLACEMENT

It is recommended that the user stock one complete Ashcroft® instrument for every ten (or fraction thereof) of that instrument type in service. With regard to gauges having a service history, consideration should be given to discarding rather than repairing them. Gauges in this category include the following:

**a.** Gauges that exhibit a span shift greater than 10%. It is possible the Bourdon tube has suffered thinning of its walls by corrosion.

**b.** Gauges that exhibit a zero shift greater than 25%. It is likely the Bourdon tube has seen significant overpressure leaving residual stresses that may be detrimental to the application.

**c.** Gauges which have accumulated over 1,000,000 pressure cycles with significant pointer excursion.

**d.** Gauges showing any signs of corrosion and/or leakage of the pressure system.

**e.** Gauges which have been exposed to high temperature or exhibit signs of having been exposed to high temperature – specifically 250°F or greater for soft soldered systems; 450°F or greater for brazed systems; and 750°F or greater for welded systems.

**f.** Gauges showing significant friction error and/or wear of the movement and linkage.

**g.** Gauges having damaged sockets, especially damaged threads.

**h.** Liquid filled gauges showing loss of case fill.

***NOTE:*** ASME B40.100 does not recommend moving gauges from one application to another. This policy is prudent in that it encourages the user to procure a new gauge, properly tailored by specification, to each application that arises.

# 6.0 ACCURACY: PROCEDURES/DEFINITIONS

**Accuracy inspection** – Readings at approximately five points equally spaced over the dial should be taken, both upscale and downscale, before and after lightly rapping the gauge to remove friction. **A pressure standard with accuracy at least four times greater than the accuracy of the gauge being tested is recommended.**

**Equipment** – A finely regulated pressure supply will be required. It is critical that the piping system associated with the test setup be leaktight. The gauge under test should be positioned as it will be in service to eliminate positional errors due to gravity.

**Method** – ASME B40.100 recommends that **known** pressure (based on the reading from the pressure standard used) be applied to the gauge under test. Readings including any error from the nominal input pressure, are then taken from the gauge under test. The practice of aligning the pointer of the gauge under test with a dial graduation and then reading the error from the master gauge ("reverse reading") can result in inconsistent and misleading data and should NOT be used.

**Calibration chart** – After recording all of the readings it is necessary to calculate the errors associated with each test point using the following formula: ERROR in percent = 100 times (TRUE VALUE minus READING) ÷ RANGE. Plotting the individual errors (Figure 1) makes it possible to visualize the total gauge characteristic. The plot should contain all four curves: upscale – before rap; upscale – after rap; downscale – before rap; downscale – after rap. "*Rap*" means lightly tapping the gauge **before** reading to remove friction as described in ASME B40.100.

Referring to Figure 1, several classes of error may be seen:

**Zero** – An error which is approximately equal over the entire scale. This error can be manifested when either the gauge is

FIG. 1

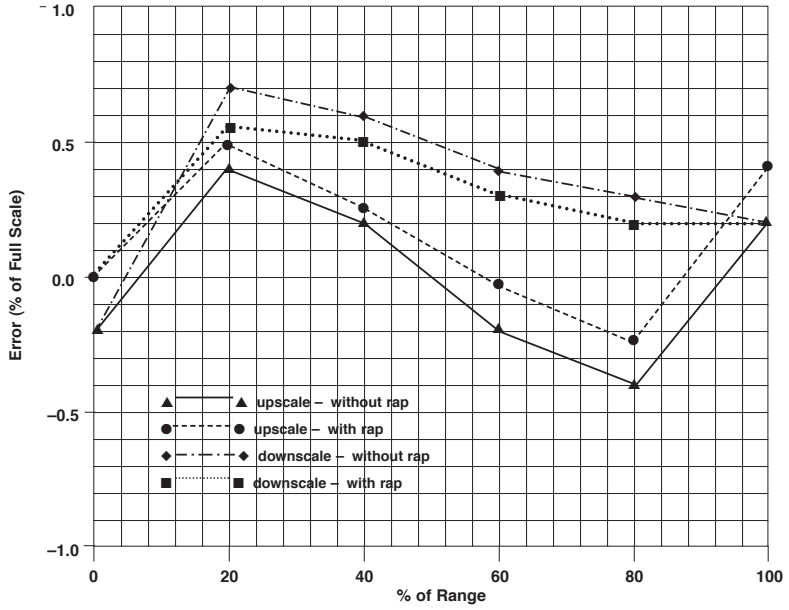
## TYPICAL CALIBRATION CHART

**INDICATED VALUE (PSI)**

| True Value – PSI | Increasing – Without RAP | Increasing – With RAP | Decreasing – Without RAP | Decreasing – With RAP |
|---|---|---|---|---|
| 0 | –.4 | 0 | –.4 | 0 |
| 40 | +.8 | +1.0 | +1.4 | +1.1 |
| 80 | +.4 | +.5 | +1.2 | +1.0 |
| 120 | –.4 | –1.0 | +.8 | +.6 |
| 160 | –.8 | –.5 | +.6 | +.4 |
| 200 | +.4 | +.8 | +.4 | +.4 |

**ERROR (% OF FULL SCALE)**

| True Value – % of Range | Increasing – Without RAP | Increasing – With RAP | Decreasing – Without RAP | Decreasing – With RAP |
|---|---|---|---|---|
| 0 | –.20 | 0 | –.20 | 0 |
| 20 | +.40 | +.50 | +.70 | +.55 |
| 40 | +.20 | +.25 | +.60 | +.50 |
| 60 | –.20 | –.05 | +.40 | +.30 |
| 80 | –.40 | –.25 | +.30 | +.20 |
| 100 | +.20 | +.40 | +.20 | +.20 |



dropped or overpressured and the Bourdon tube takes a permanent set. This error may often be corrected by simply repositioning the pointer. Except for test gauges, it is recommended that the pointer be set at midscale pressure to "split" the errors.

**Span** – A span error exists when the error at full scale pressure is different from the error at zero pressure. This error is often proportional to the applied pressure. Most Ashcroft gauges are equipped with an internal, adjusting mechanism with which the user can correct any span errors which have developed in service.

**Linearity** – A gauge that has been properly spanned can still be out of specification at intermediate points if the response of the gauge as seen in Figure 1 (Typical Calibration Chart) is not linear. The Ashcroft Duragauge® pressure gauge is equipped with a rotary movement feature which permits the user to minimize this class of error. Other Ashcroft gauge designs (e.g., 1009 Duralife®) require that the dial be moved left or right prior to tightening the dial screws.

**Hysteresis** – Some Bourdon tubes have a material property known as hysteresis. This material characteristic results in differences between the upscale and downscale curves. This class of error can **not** be eliminated by adjusting the gauge movement or dial position.

**Friction** – This error is defined as the difference in readings before and after lightly tapping the gauge case at a check point. Possible causes of friction are burrs or foreign material in the movement gearing, "bound" linkages between the movement and the bourdon tube, or an improperly tensioned hairspring. If correcting these potential causes of friction does not eliminate excessive friction error, the movement should be replaced.

**6.1 Calibration – Rotary Movement Gauges and Type 1259 Gauges –** Inspect gauge for accuracy. Many times gauges are simply "off zero" and a simple pointer adjustment using the micrometer pointer is adequate. If inspection shows the gauge warrants recalibration to correct span and/or linearity errors, proceed as follows:

**a.** Remove ring, window and, if solid front case, the rear closure assembly.

**b.** Pressurize the gauge **once** to full scale and back to zero.

**c.** Refer to Figure 2 (Ashcroft System Assembly w/Rotary Gear Movement) for a view of a typical Ashcroft rotary system assembly with component parts identified. Refer to Figure 2A for link configuration of Type 1259 gauge.

**FIG. 2 ASHCROFT SYSTEM ASSEMBLY W/ROTARY GEAR MOVEMENT**

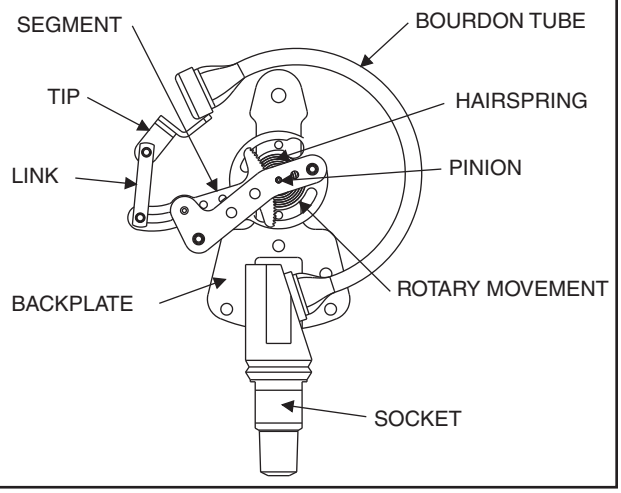
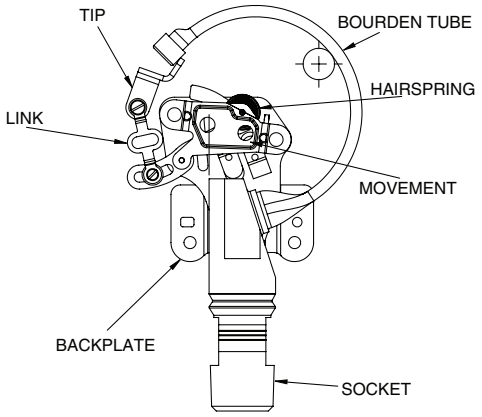



**FIG. 2A ASHCROFT TYPE 1259 SYSTEM ASSEMBLY**



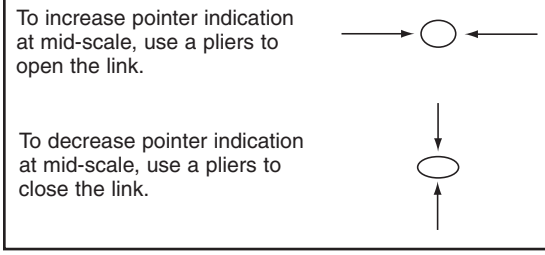

**d.** Adjust the micrometer pointer so that it rests at the true zero position. For open front gauges the pointer and dial must also be disassembled and the pointer should then be lightly pressed onto the pinion at the 9:00 o'clock position.

**e.** Apply full scale pressure and note the magnitude of the span error. With open front gauges, ideal span (270 degrees) will exist when at full scale pressure the pointer rests exactly at the 6:00 o'clock position.

**f.** If the span has shifted significantly (span error greater than 10%), the gauge should be replaced because there may be some partial corrosion inside the Bourdon tube which could lead to ultimate failure. If the span error exceeds 0.25%, loosen the lower link screw and move the lower end of the link toward the movement to increase span or away to decrease span. An adjustment of 0.004 inch will change the span by approximately 1%. This is a repetitive procedure which often requires more than one adjustment of the link position and the subsequent rechecking of the errors at zero and full scale pressure.

**g.** Apply midscale pressure and note error in reading. Even though the gauge is accurate at zero and full scale, it may be inaccurate at the midpoint. This is called linearity error. For corrections to linearity with the Type 1259 gauges refer to Figure 2B. For rotary movement gauges,

**FIG. 2B LINEARITY ADJUSTMENT & LINK CONFIGURATION FOR ASHCROFT TYPE 1259**




note the following: if the error is positive, the movement should be rotated counter clockwise. Rotating the movement one degree will change this error by approximately 0.25%. Rotating the movement often affects span and it should be subsequently rechecked and readjusted if necessary according to step 6.1e and 6.1f.

**h.** While recalibrating the gauge, the friction error – difference in readings taken with and without rap – should be noted. This error should not exceed the basic accuracy

of the gauge. If the friction error is excessive, the movement should be replaced. One possible cause of excessive friction is improper adjustment of the hairspring. The hairspring torque,or tension, must be adequate without being excessive. The hairspring should also be level, unwind evenly (no turns rubbing) and it should never tangle.

***NOTES:***

**1** For operation of test gauge external zero reset, refer to page 17.

**2** For test gauge calibration procedure, refer to Figure 2 on page 18.

# 7.0 DIAPHRAGM SEALS

**7.1 General** – A diaphragm seal (isolator) is a device which is attached to the inlet connection of a pressure instrument to isolate its measuring element from the process media. The space between the diaphragm and the instrument's pressure sensing element is solidly filled with a suitable liquid. Displacement of the liquid fill in the pressure element, through movement of the diaphragm, transmits process pressure changes directly to a gauge, switch or any other pressure instrument. When diaphragm seals are used with pressure gauges, an additional 0.5% tolerance must be added to the gauge accuracy because of the diaphragm spring rate.

Used in a variety of process applications where corrosives, slurries or viscous fluids may be encountered, the diaphragm seal affords protection to the instrument where:

- The process fluid being measured would normally clog the pressure element.
- Pressure element materials capable of withstanding corrosive effects of certain fluids are not available.
- The process fluid might freeze due to changes in ambient temperature and damage the element.

**7.2 Installation** – Refer to bulletin OH-1 for information regarding (a) seal configurations; (b) filling fluids; (c) temperature range of filling fluids; (d) diaphragm material pressure and temperature limits; (e) bottom housing material pressure and temperature limits; (f) pressure rating of seal assembly; (g) accuracy/temperature errors of seal assembly; (h) diaphragm seal displacement. The volumetric displacement of the diaphragm must at least equal the volumetric displacement of the measuring element in the pressure instrument to which the seal is to be attached.

It is imperative that the pressure instrument/diaphragm seal assembly be **properly** filled prior to being placed in service. Ashcroft diaphragm seal assemblies should only be filled by a seal assembler certified by Ashcroft Inc. Refer to section 3.3 for a cautionary note about not applying torque on either the instrument or seal relative to the other.

**7.3 Operation** – All Ashcroft® diaphragm seals, with the exception of Type 310 mini-seals, are continuous duty. Should the pressure instrument fail, or be removed accidentally or deliberately, the diaphragm will seat against a matching surface preventing damage to the diaphragm or leakage of the process fluid.

**7.4 Maintenance** – Clamp type diaphragm seals – Types 100, 200 and 300 – allow for replacement of the diaphragm or diaphragm capsule, if that ever becomes necessary. The Type 200 top housing must also be replaced with the diaphragm. With all three types the clamping arrangement allows field disassembly to permit cleaning of the seal interior.

**7.5 Failures** – Diaphragm failures are generally caused by either corrosion, high temperatures or fill leakage. Process media build-up on the process side of the diaphragm can also require seal cleaning or replacement. Consult Customer Service, Stratford CT for advice on seal failures and/or replacement.

***WARNING:*** All seal components should be selected considering process and ambient operating conditions to prevent misapplication. Improper application could result in failure, possible personal injury, property damage or death.

# 8.0 DAMPENING DEVICES

**8.1 General** – Some type of dampening device should be used whenever the pressure gauge may be exposed to repetitive pressure fluctuations that are fairly rapid, high in magnitude and especially when transitory pressure spikes exceeding the gauge range are present (as with starting and stopping action of valves and pumps). A restricted orifice of some kind is employed through which pressure fluctuations must pass before they reach the Bourdon tube. The dampener reduces the magnitude of the pressure pulse thus extending the life of the Bourdon tube and movement. This reduction of the pressure pulsation as "seen" by the pressure gauge is generally evidenced by a reduction in the pointer travel. If the orifice is very small the pointer may indicate the average service pressure, with little or no indication of the time varying component of the process pressure.

Commonly encountered media (e.g. – water and hydraulic oil) often carry impurities which can plug the orifice over time thus rendering the gauge inoperative until the dampener is cleaned or replaced.

Highly viscous media and media that tend to periodically harden (e.g., asphalt) require a diaphragm seal be fitted to the gauge. The seal contains an internal orifice which dampens the pressure fluctuation within the fill fluid.

**8.2 Throttle Screws & Plugs** – These accessories provide dampening for the least cost. They have the advantage of fitting completely within the gauge socket and come in three types: (a) a screwed-in type which permits easy removal for cleaning or replacement; (b) a pressed in, non-threaded design and (c) a pressed in, threaded design which provides a highly restrictive, helical flow path. Not all styles are available on all gauge types.

**8.3 Ashcroft Pulsation Dampener** – Type 1106 Ashcroft pulsation dampener is a moving pin type in which the restricted orifice is the clearance between the pin and any one of five preselected hole diameters. Unlike a simple throttle screw/plug, this device has a self-cleaning action in that the pin moves up and down under the influence of pressure fluctuations.

**8.4 Ashcroft Pressure Snubber** – The heart of the Type 1112 pressure snubber is a thick porous metal filter disc. The disc is available in four standard porosity grades.

**8.5 Ashcroft Needle Valves** – Type 7001 thru 7004 steel needle valves provide varying degrees of dampening. These devices, in the event of plugging, can easily be opened to allow the pressure fluid to clear away the obstruction.

**8.6 Chemiquip® Pressure Limiting Valves** – Model PLV-255, PLV-2550, PLV-5460, PLV-5500 and PLV-6430, available with and without built-in snubbers, automatically "shut off" at adjustable preset values of pressure to protect the gauge from damage to overpressure. They are especially useful on hydraulic systems wherein hydraulic transients (spikes) are common.

# 9.0 TEST EQUIPMENT & TOOL KITS

**See our website www.ashcroft.com for more details**

**9.1 Pressure Instrument Testing Equipment**

Type 1305D Deadweight Tester

Type 1327D Pressure Gauge Comparator

Type 1327CM “Precision” Gauge Comparator

**9.2 Tools & Tool Kits For Recalibration of 4½˝ and Larger Gauges**

Type 2505 universal carrying case for 1082 test gauge

Type 266A132-01 span wrench for 1082 test gauge

Type 1281 socket O-Ring kit for 1279/1379 lower connect

Type 1285 4½˝ ring wrench for 1279/1379 lower & back connect

Type 1286 6˝ ring wrench for 1379 lower & back connect

Type 3220 pointer puller (all gauges except 1009 Duralife®)

Type 3530 pinion back-up tool for 1009 Duralife®

Type 3220 Handjack set

Type 1105 Tool Kit

**9.3 Kits to Convert a Dry Gauge to a Liquid Filled or Weather Proof Case Gauge**

Type 1280 conversion kit for 4½˝ lower connect 1279/1379

Type 1283 conversion kit for 4½˝ back connect 1279/1379

Type 1284 conversion kit for 6˝ lower & back connect

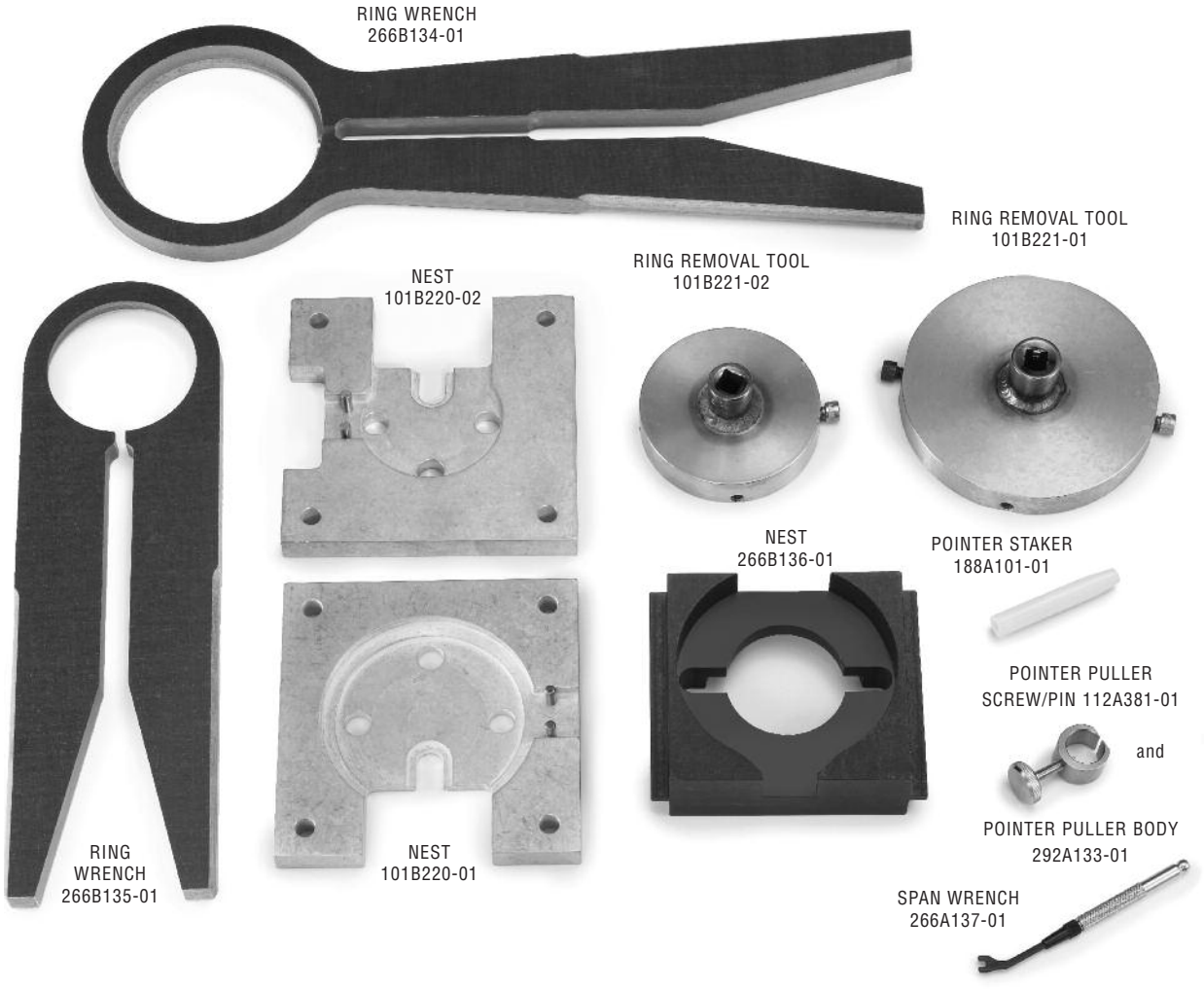
TYPE 1105
TOOL KIT

TYPE 3220
HAND JACK SET

### 9.4 2½ & 3½ 1009 Duralife® Gauge Tools

| Description | Part No. |
|---|---|
| Pointer Puller Screw/Pin[2][3][4] | 112A381-01 |
| Pointer Puller Body[2][3][4] | 292A133-01 |
| Pointer Staker[2][4] | 188A101-01 |
| Span Wrench[2][5] (to adjust span) | 266A137-01 |
| Ring Wrench 3½″[1][5] (for ring removal) (35 1009) | 266B134-01 |
| Ring Wrench 2½″[1][5] (for ring removal) (25 1009) | 266B135-01 |
| Nest 2½″ & 3½″[1][5] (to hold gauge for ring removal) (25/35 1009) | 266B136-01 |
| Ring Removal Tool[6] (25 1009) | 101B221-02 |
| Ring Removal Tool[6] (35 1009) | 101B221-01 |
| Nest 2½″[6] (to hold gauge for ring removal) (25 1009) | 101B220-02 |
| Nest 3½″[6] (to hold gauge for ring removal) (35 1009) | 101B220-01 |
| Type 1230 throttle plug insertion (¼ NPT) for 1009 Duralife®) | 1230 |
| Type 1231 throttle plug insertion (½ NPT) for 1009 Duralife® (body only) | 1231 |
| Tool to open orifice on push-in throttle plug | 101A206-01 |

**(1)** Formerly 1206T Tool Kit.
**(2)** Formerly some parts in 1205T Tool Kit.
**(3)** Both parts must be purchased together.
**(4)** Previous and current design.
**(5)** Previous design only.
**(6)** Current design only.



# ASHCROFT® Type 1188 Bellows Gauge Calibration Procedure

**CALIBRATION & TROUBLE CORRECTION DIAGRAM**

**RANGE SPAN ADJUSTMENT**

- **RANGE TOO SHORT** — Adjust slide "S" inward
- **RANGE TOO LONG** — Adjust slide "S" outward

**POINTER JUMPING**

- **STICKY PARTS** — Clean all bearings and gear teeth
- **LOOSE HAIRSPRING** — Remove backlash by disengaging pinion & rotate to tighten
- **COUNTER BALANCE RUBBING** — Bend if necessary to clear socket in travel

**NOTE:** After adjusting range span, set both movement stops. Set the underload stop so that the pointer will stop at zero. Set the overload stop so that the pointer will pass the maximum range approximately 5˝.

After adjusting span re-zero pointer by removing from pinion and re-assembling at the proper dial mark.

**SLUGGISH MOVEMENT**

**TIGHT HAIRSPRING** — Loosen by disengaging pinion & rotate

**NON LINEAR**

- **NON LINEAR FIRST 3RD.** → **ADJ. ANGLE OF PULL BY INCREASING ANGLE "A"**
- **NON LINEAR LAST 3RD.** → **ADJ. ANGLE OF PULL BY DECREASING ANGLE "A"**

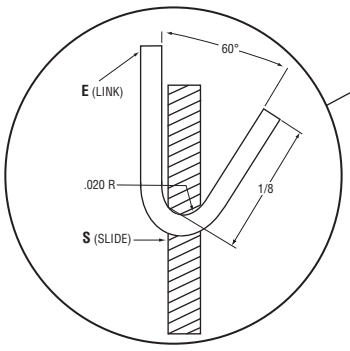
**NOTE:** To increase or decrease angle "A," bend tip inward or outward as required. Doing this may run the movement segment off the pinion. This can be corrected by cutting off one end off the link "E" decreasing its length, or makin a new length from .032 dia. phos. bronze wire.

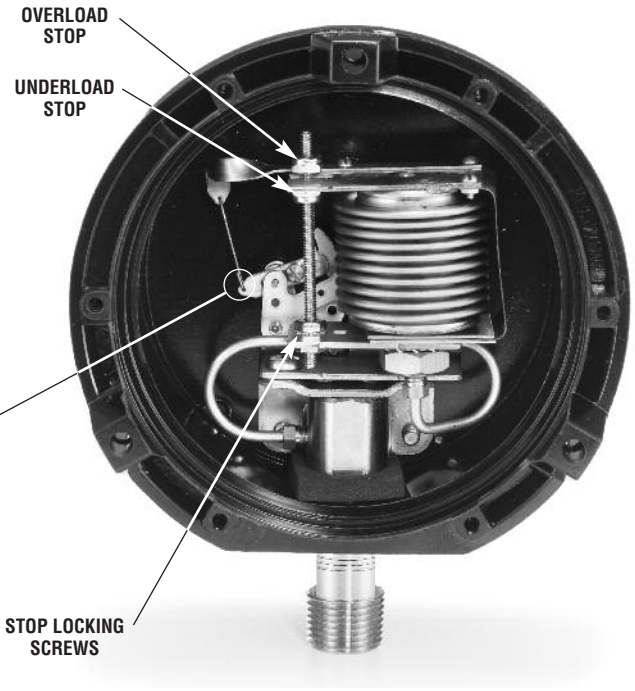
**Caution:** When reproducing link end, follow figure 44 very closely. this will prevent too much play, or, binding in operation.

**REF: Replacing System Bellows**

After assembling bellows to the gauge socket securely, subject system to 30 psi for five minutes, allowing bellows to travel approximately 1/8˝ against the overload stop. After this, heat treat system for 15 hours at 250°F, this procedure is necssary to prevent gauge drift.

**SLIDE AND LINK (angle "A")**
**Enlarged view of slide and link**

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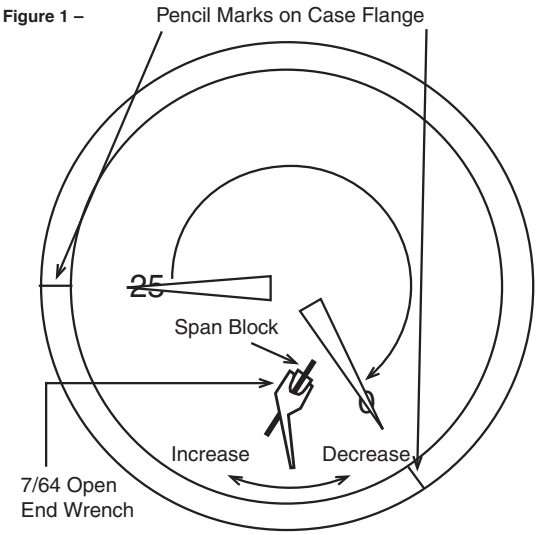
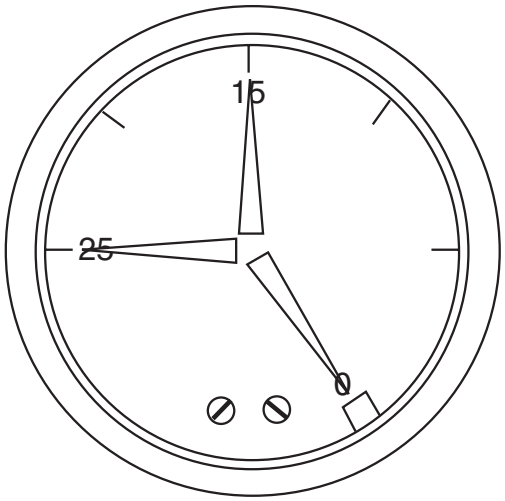
1. Remove ring, window and gasket pointer.
2. Using a pencil, refer to dial and mark the 0 and 25˝ Hg positions on the case flange.
3. Remove dial.
4. Apply 25˝ Hg vac.
5. Lightly press pointer onto pinion carefully aligning it with the 25˝ Hg vac. mark on the flange.
6. Release vacuum fully.
7. Note agreement of pointer to zero mark on flange.
8. If span is high or low, turn span block as shown in Figure 1.

**Figure 1 –**




9. Repeat steps 4 through 8 until span is correct.
10. Remove pointer.
11. With 25˝ Hg vac applied, reassemble dial, dial screws (finger tight) and point.
12. Apply 15˝ Hg vac. and note accuracy of indication. If required, slide dial left or right to reduce error to 1% maximum.
13. Firmly tighten dial screws.
14. Firmly tap pointer onto pinion.
15. recheck accuracy at 15 and 25˝ Hg vac. (Figure 2).
16. Reassemble window, gasket and ring.

**Figure 2 –**




**Notes:** See page 10 for any tools required to calibrate.

**For models produced prior to September 2008 for 2½˝ version and December 2008 for 3½˝ version.**
Back of gauge will have a date code sticker.

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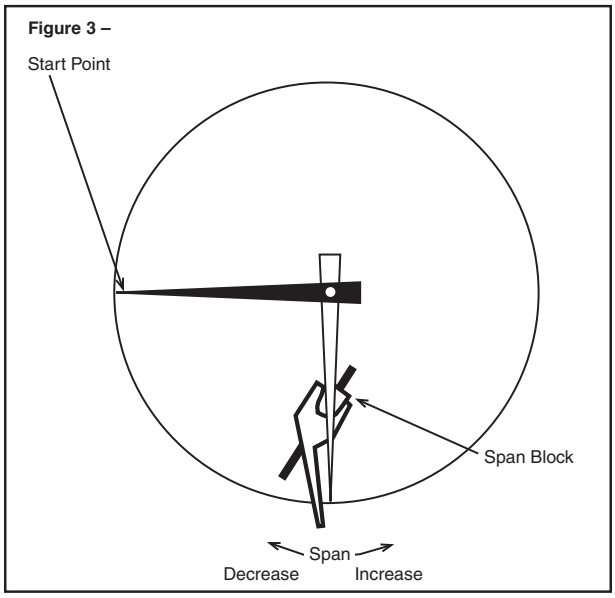
**Step 1.** With the dial off, install pointer at 9 o'clock "lightly," Figure 3.

**Figure 3 –**

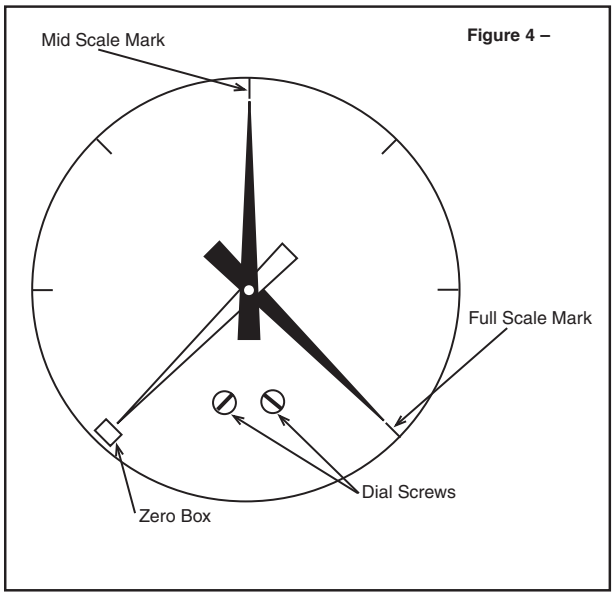



**Step 2.** Go to full scale pressure…rotate span block with tool until pointer rests at 6 o'clock.

**Step 3.** Go to zero pressure (9 o'clock)…if pointer has not moved away from start point, go to Step 4. If pointer has moved, repeat Step 1 until span is correct.

**Step 4.** Install dial with screws snug.

**Figure 4 –**




**Step 5.** Install pointer centered in zero box, Figure 4.

**Step 6.** Go to full scale pressure…check that pointer is within 1% of full scale mark. If not, remove pointer and dial and return to step 1, Figure 4.

**Step 7.** Go to mid-scale pressure…rotate dial until mid-scale mark is aligned with pointer, Figure 4.

**Step 8.** Tighten dials screws and stake on pointer.

**Step 9.** Check zero and full scale. Reassemble window, gasket and ring.

**Notes:** See page 10 for any tools required to calibrate.

**For models produced prior to September 2008 for 2½˝ version and December 2008 for 3½˝ version.**
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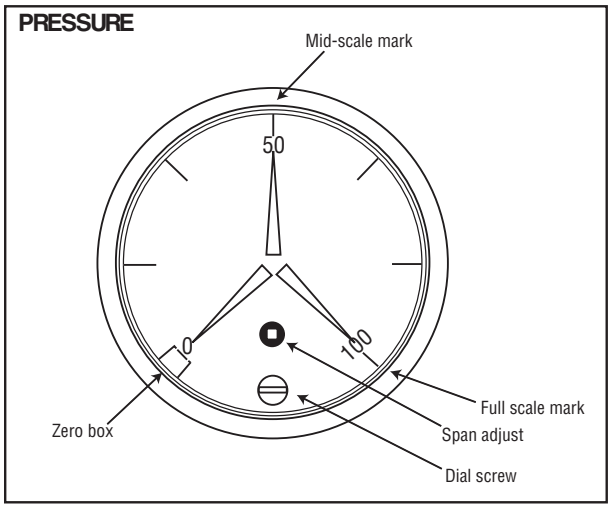
## ASHCROFT® Current Type 1009 Duralife® Calibration Procedure – Pressure and Vacuum Range

**Calibration – 1009 Duralife® Gauge –**
Inspect gauge for accuracy. At times gauges are simply "off zero" and opening the ventable plug at the top of the gauge will relieve internal gauge pressure and correct the offset. If this is not adequate and inspection shows that the gauge warrants recalibration to correct zero, span and/or linearity errors, proceed as follows:

Remove ring, window, and gasket using Ashcroft Ring Removal Tools P/N 101B220-02 and 101B221-02 for 2½" gauges and 101B220-01 and 101B221-01 for 3½" gauges.




**Positive Pressure Ranges** –

**1.** Adjust pointer with a slotted screwdriver until it is in the center of the zero box. This is often all that is required it correct calibration issues.

**2.** Apply full scale pressure. If error exceeds 1% rotate the black span adjustment device with a #0 square drive bit. Clockwise increases span, counterclockwise decrease span.

**3.** Fully exhaust pressure and check that pointer still is still in the zero box. If not, repeat step 1 and 2

**4.** Once 0 and full scale are within tolerance, pressurize gauge to mid-scale.

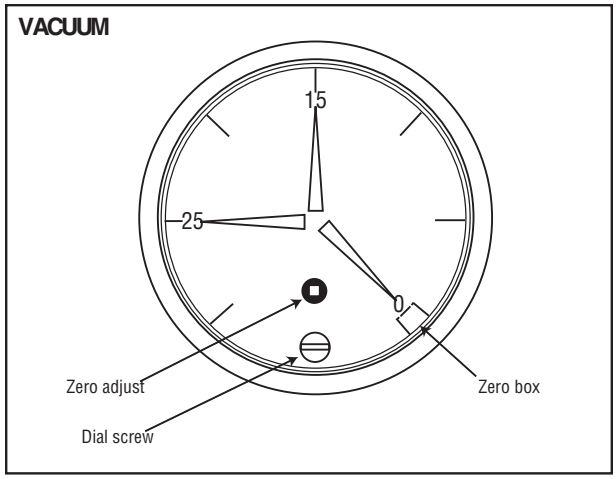
**5**. If gauge is within 1%, calibration is complete. If not loosen the dial screw and rotate dial left or right to adjust midpoint. Retighten dial screw.

**6.** If an adjustment was made in step 5, recheck the gauge at zero and full scale, adjust accordingly until zero, mid and full scale points are in tolerance.

**Vacuum Range –**

**1**. Adjust pointer with a slotted screwdriver until it is in the center of the zero box. This is often all that is required it correct calibration issues.

**2**. Apply 25 inches Hg vacuum. If the error exceeds 1% adjust pointer with a slotted screwdriver until gauge is within tolerance.




**3**. Vent to 0 pressure and check pointer position in the zero box. If error exceeds 1% rotate the black span adjustment device with a #0 square drive bit. Clockwise rotation moves pointer clockwise, counterclockwise rotation moves the pointer counterclockwise.

**4**. Repeat step 1 and 2 until 0 and 25 inches of Hg are within gauge tolerance.

**5**. Apply 15 inches Hg vacuum. If gauge is within 1%, calibration is complete. If not loosen the dial screw and rotate dial left or right to adjust midpoint. Retighten dial screw.

**6**. If an adjustment was made in step 4, recheck the gauge at zero and 25 inches of Hg vacuum, adjust accordingly until zero, 15 and 25 inches Hg are in tolerance.

**7**. Continue below.

Re-assemble window and ring to gauge:

**a**. If plastic window is used, push window back into front of gauge, ensure the o-ring does not roll out of window groove (lubricate if necessary). Align the tabs of the window with the tabs of the case front. Once window is in place, install ring and tighten with tools referenced above and shown on page 10.

**b** If safety glass is used, reinstall window, gasket, and ring. Ensure that the gasket is seated properly under all four tabs of the ring and does not wrinkle when ring is tightened.

Note: Tighten ring: Apply 120-200inlb of torque. Rotate ring clockwise to tighten. Warning: over tightening of safety glass may induce cracking.

**Notes:** See page 10 for any tools required to calibrate.

**For models produced after September 2008 for 2½" version and December 2008 for 3½" version.**
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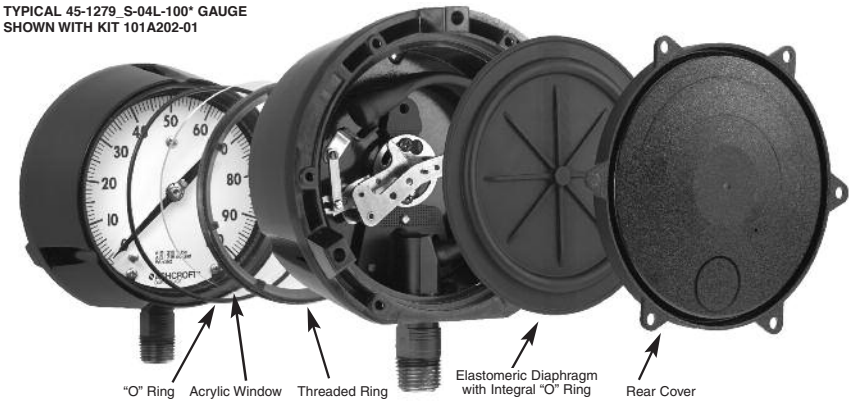
# Type 1279 & 1379 Solid Front Duragauge® Pressure Gauge Liquid Fill Conversion Instructions

ASHCROFT®

TYPICAL 45-1279_S-04L-100* GAUGE
SHOWN WITH KIT 101A202-01




| | 1279 | | 1379 | | |
|---|---|---|---|---|---|
| | 4½˝ LOWER | 4½˝ BACK | 4½˝ LOWER | 4½˝ BACK | 6˝ LOWER & BACK |
| KIT PART NO. | 101A202-01 | 101A203-01 | 1280 | 1283 | 1284 |
| | QUANTITY INCLUDED | | | | |
| ACRYLIC WINDOW | 1 | 1 | 1 | 1 | 1 |
| FRONT O-RING | 1 | 1 | 1 | 1 | 1 |
| DIAPHRAGM(1) | 1 | 1 | 1 | 1 | 2(1-LC:1-BC) |
| REAR COVER | 1 | 1 | 1 | 1 | 2(1-LC:1-BC) |
| COVER SCREWS | 4 | 4 | - | - | - |
| THROTTLE SCREWS | 2 | 2 | 2 | 2 | 2 |
| GARTER SPRING | – | 1 | 1 | 1 | 1 |
| FILL IDENTIFICATION | 1 | 1 | 1 | 1 | 1 |
| THREADED RING | – | – | 1 | 1 | 1 |

1. When Halocarbon fill is a requirement, rear case diaphragm bladder material is Viton instead of the standard Buna diaphragm bladder. Consult factory for part number.

| | Ambient Temp. Limits | | 60 psi and Under Down Scale Zero Shift Required |
|---|---|---|---|
| | °F | °C | |
| Weatherproof | –50/150 | –45/65 | N/A |
| Hermetically Sealed | –10/125 | –25/50 | N/A |
| Glycerin Filled | 0/150 | 30/65 | .15 psi |
| Silicone Filled | –50/150 | –45/65 | .12 psi |

1. Unscrew front threaded ring (turn CCW). Remove and discard glass window. For range spans 60 psi and under, shift pointer down scale by the amount shown in the table. With either the glass or plastic window, replace the O-ring with one furnished in the kit.
2. Remove protective paper from acrylic plastic window taking care not to scratch window. Assemble window in gauge.
3. Moisten face of threaded ring with silicone oil or silicone grease where ring bears up against window. Replace front threaded ring and tighten firmly hand tight. See instructions on reverse side for applying proper torque to ring to establish desired squeeze on O-ring seal. **(Fig. 4).**
   It is important to hold gauge **rigidly,** otherwise ring lugs may be damaged during removal or assembly process.
4. From rear of gauge, remove and discard these parts: rear cover and cover gaskets from case.
   **Note:** Disregard Step Nos. 5a and 5b if converting to hermetically sealed version. When converting a 45-1379 with the top fill hole configuration, p/n 256A176-01 fill plug is required and must be ordered separately.
5. **Filling Procedures:**
   a. **Manual Filling Procedure:** Place gauge face down on bench and **tip gauge** by blocking up front with a ⅜ inch block at the 12 o'clock dial position. Tipping of the gauge is necessary so fluid will flow into front cavity of the case. Pour in fill liquid to within about 1⁄16 inch of rear seal lip. When bubbles stop rising, front cavity is filled. Remove ⅜ inch block and pour in liquid until level is about 1⁄16 inch below rear sealing lip.
   **Note:** An alternative method of filling is to fill the front dial cavity, adding the front window, etc., as in Step No. 3. Then fill the rear of the gauge. This method eliminates the need to tip the gauge.
   b. **Vacuum Pump Fill Procedure:** (This procedure is recommended when filling a large number of gauges.) Place gauge face down and insert a ⅛ inch diameter tube, connected to a vacuum pump, through the 12 o'clock position hole in the rear, solid front portion of the case **(see Fig. 5).** Evacuate the air from the front dial cavity while pouring in the fill fluid through the case back. The vacuum will displace the air with fluid. When the dial cavity is solidly filled, remove the tubing and continue to pour the fill fluid to within 1⁄16 inch BELOW the O-ring channel lip. Pre-measuring fill amount is not necessary with above methods. For reference, amount of fill is approximately 400 ml. or 14 fluid oz. (4½˝ GA.) and 455 ml. or 16 fluid oz. (6˝ GA.).
   c. **Note:** The liquid fill level should be ⅜˝ (±⅛) as measured from the inside of the ring at the 12:00 o'clock position.
6. On lower connection gauges, assemble rear seal diaphragm to case.
   For back connection gauges see instructions on reverse side. **(Fig. 2/4).**
7. **For 1279:**
   Assemble rear cover and six self tapping screws in a criss-cross pattern and torque to 12 in lbs. (±2 in lbs.)
   **For 1379:**
   - Thread rear ring and torque to 200 in lbs
   - Install stainless steel back cover using two screws. Torque screws to 14 in lbs. (±2 in lbs.)
8. Assemble throttle screw to threaded hole in socket.
   **Note:** If system is monel (socket wrench flat stamped "PHS" or "PH") use monel throttle screw.
9. Check appropriate box on fill identification label, and peel off label back, and attach fill label to gauge case.
10. If gauge is to be repackaged:
    a. Include enclosed instruction sheet inside carton.
    b. Change type number on carton label to:
       (1) Hermetically Sealed – 1279(*)SH.
       (2) Liquid Filled – 1279(*)SL.
       *Bourdon Tube System Code

Glycerin or silicone should not be used in applications involving Oxygen, Chlorine, Nitric Acid, Hydrogen Peroxide or other strong oxidizing agents, because of danger of spontaneous chemical reaction, ignition or explosion. Halocarbon should be specified. Products with this fill can be ordered from factory.
The use of fluids other than those listed in the table above (for example, Hydrocarbon-based oils) may result in leakage caused by a reaction between the fluid and the elastomeric seals. Consult the factory before filling with any other fluid.

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# Type 1279 & 1379 Solid Front Duragauge® Pressure Gauge Liquid Fill Conversion Instructions

ASHCROFT®

## INSTRUCTIONS FOR USING CONE TOOL AND RING WRENCH

**Garter Spring & Diaphragm Assembly (Back Connection Gauge Only)**

**A.** Place cone tool over socket shank as shown.

**B.** Moisten lip of socket and outer O-ring surface with silicone oil or grease.

**C.** Place diaphragm with rib side facing upward over cone into case grove.
Diaphragm O-ring must be completely in socket-shank grove.

**D.** Place garter spring over cone as shown and slide onto diaphragm in socket grove

**E.** Assemble rear cover with screws per step 7.

**Front Ring Assembly (All Gauges)**

**A.** Assemble ring to case by hand to start.

**B.** Place ring on wrench as shown

**C.** Use ½˝ drive extension and torque ring to 200 in. lb

**Alternate Method**

**A.** Tighten ring snugly by hand

**B.** Mark case and ring.

**C.** Turn ring another 100 to 120 degrees (slightly less than ½ turn) using the ring wrench and ½˝ drive socket wrench or place the blunt end of a wooden or plastic dowel against a ring lug and tap with a hammer.

## INSTRUCTIONS FOR LIQUID FILLING ASHCROFT® TYPE 1279 AND 1379 SOLID FRONT DURAGAUGE® PRESSURE GAUGES USING A VACUUM PUMP

**A.** Insert a length of ⅛ ˝ diameter tubing through the 12 o'clock position hole in the rear, solid front portion of the case, as shown.

**B.** Evacuate the air from the front dial cavity while pouring in the fill fluid through the case back. The vacuum will displace the air with fluid.*

**C.** When the dial cavity is solidly filled, remove the tubing and continue to pour the fill fluid to within 1/16 ˝ below the o-ring channel lip, as shown.

**D.** When converting a 45-1379 with the top fill hole configuration, p/n 256A176-01 fill plug is required and must be ordered separately.

*To prevent breakage, reduce vacuum to 15 in. Hg for plain glass and safety glass.

**BACK CONNECTION ASSEMBLED GAUGE**

**Fig. 2**

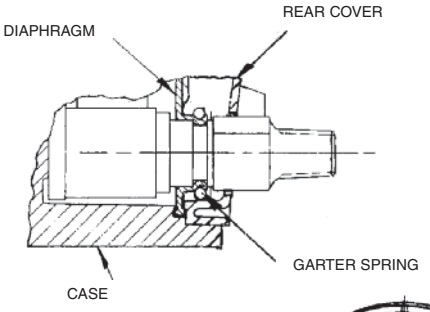



**Fig. 3**

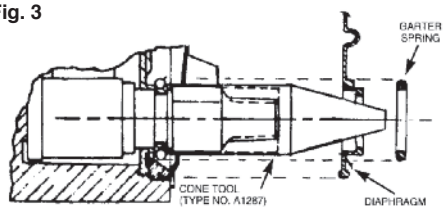



**Fig. 4**

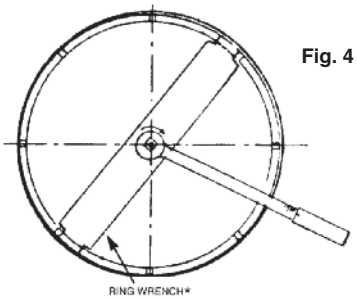
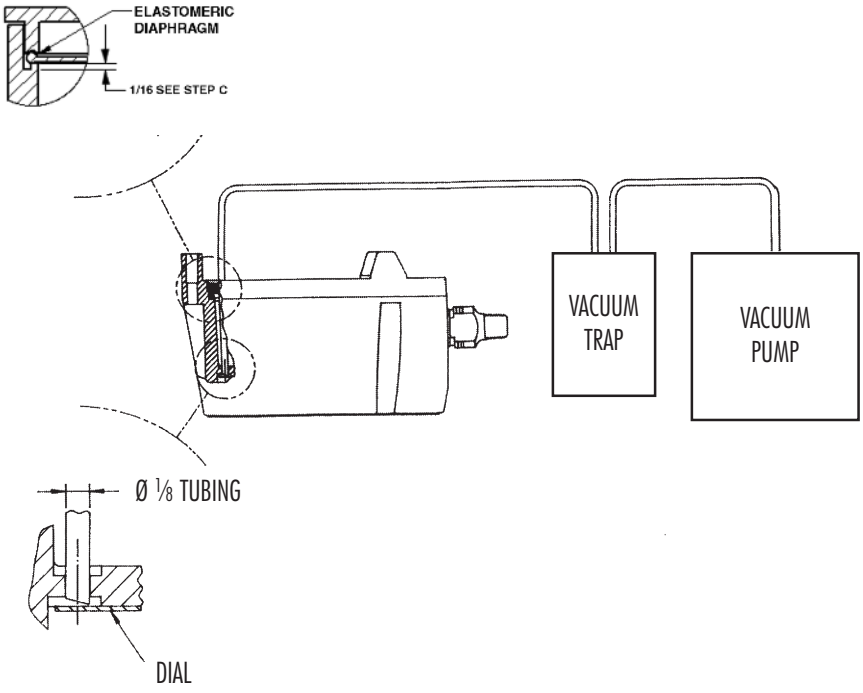



**Fig. 5**

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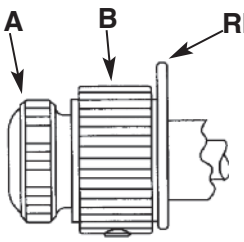
## INSTRUCTIONS FOR USE OF EXTERNAL EASY ZERO™ ADJUST FEATURE*

**Fig. 1**




1. LOOSEN RING-LOCKING SCREW **A**.
2. OBTAIN REQUIRED ADJUSTMENT BY ROTATING KNOB **B** CLOCKWISE OR COUNTER-CLOCKWISE.
3. TIGHTEN SCREW **A** DOWN ON KNOB **B**.

*Applicable only for test gauge with hinged ring design.

## ADDITIONAL CALIBRATION INSTRUCTIONS

1) "Standards shall have nominal errors no greater than ¼ of these permitted for the gauge being tested." *(Ref: ASME B40=100-1998)*
2) The instrument used as the calibration standard should have a maximum range no greater than 2x that of the gauge being tested. (i.e. Do not use a 400psi standard to test a 15psi gauge.)
3) "Known pressure shall be applied at each test point on increasing pressure (or vacuum) from one end to the other end of the scale. At each test point the gauge shall be . . .
lightly tapped, and then read . . ."
(*Ref: ASME B40.1 ¶ 6.2.4.1*)
4) To read gauge indication, move eye over red pointer tip at OD of printed dial until red reflection in mirror band is no longer visible, and then read the pointer position in reference to the dial.

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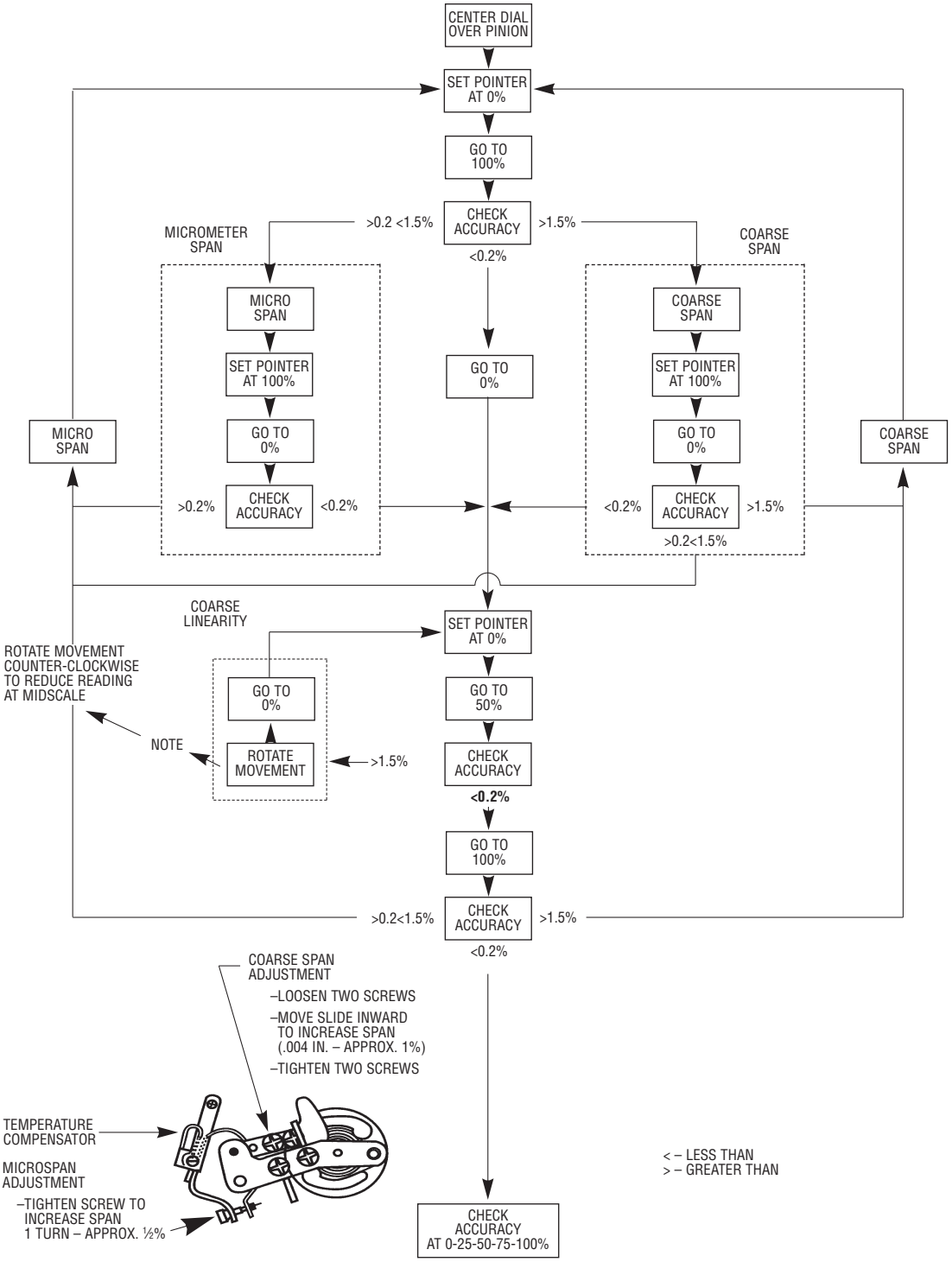
**Fi g. 2**

THIS TEST GAUGE IS PROVIDED WITH A MICROSPAN™ ADJUSTMENT TO SIMPLIFY CALIBRATION. THE FLOW CHART BELOW OUTLINES THE RECOMMENDED CALIBRATION PROCEDURE

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***Visit our web site www.ashcroft.com***

# Type 310, 315 All-Welded "Mini" Diaphragm Seal

## PRODUCT FEATURES

- Compact size to fit space-restricted areas
- Designed to protect transducers, mini-switches and 3½˝ or smaller pressure gauges from corrosion, plugging or freeze-up
- All-welded metal construction prevents leakage of process media
- Rated for 2500 psi at 100°F
- Fill/bleed connection is standard
- Available with male process connection (Type 315)

The compact size of the Ashcroft® 310 mini-seal allows it to fit into space-restricted areas and is designed to protect transducers, mini-switches, and 3½" or smaller dial size pressure gauges from corrosion, plugging or freeze- up. All welded metal construction prevents leakage of process media. It is rated for 2500 psi at 100°F and has a 316L stainless steel top housing standard. Lower housing materials include 316L stainless steel or Hastelloy C. Diaphragm materials include 316L stainless, Hastelloy C or Tantalum. ¼ NPT or ½ NPT process connection sizes are available. Instrument connection is ¼ NPT only.

## PRODUCT SPECIFICATIONS

| | |
|---|---|
| **Model Number:** | Type 310, 315 |
| **Process Connection Size:** | ¼˝, ½˝ (¾˝, 1˝- 315 only) (see table A) |
| **Instrument Connection Size:** | ⅛, ¼ NPT |
| **Diaphragm Material:** | 316L SS, Hastelloy C276, Tantalum, Monel |
| **Bottom Housing Materials:** | 316L SS, Hastelloy C276, Monel, Hastelloy B |
| **Filling Fluid:** | Glycerin, Silicone, Halocarbon, Syltherm |

All specifications are subject to change without notice.
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# Type 310, 315 All-Welded "Mini" Diaphragm Seall

## Table A – Process Connection

| Process Connection | Size | Code |
|---|---|---|
| Threaded – male NPT* | ⅛ | 01 |
| Threaded – male NPT* | ¼ | 02 |
| Threaded – male NPT* | ½ | 04 |
| Threaded – male NPT* | ¾ | 06 |
| Threaded – male NPT* | 1 | 08 |
| Threaded – female NPT† | ¼ | 25 |
| Threaded – female NPT† | ½ | 50 |

*Available in Type 310 only.
†Available in Types 310 & 315.

Pressure Ratings – All 2500 psi except flanged seals are per ASME B 16.5, temperature limit determined by diaphragm, bottom housing and/or filling fluid.

## Table B – Type

| Description | Code |
|---|---|
| All-welded mini-seal | 310 |
| All-welded midi-seal w/flushing connection | 315 |

## Table C – Diaphragm Materials

| Materials | Code |
|---|---|
| 316L stainless steel | S |
| Hastelloy C-276 | H |
| Tantalum | U |
| Monel | P |

## Table D – Housing Materials

| Bottom(1) | Code | Top(2) |
|---|---|---|
| 316L SS | S | 316L SS |
| Hastelloy C-276 | H | 316L SS |
| Monel | M | Monel |
| Hastelloy B | G | 316L SS |

**(1)** Other bottom housing materials on application.
**(2)** Top housing material is 316L SS (standard). Monel mini-seal standard with monel top housing.

## Table E – Instrument Connection

| Instrument Connection | Size | Code |
|---|---|---|
| Threaded – female NPT | ¼ | 02T |
| Threaded – female NPT | ⅛ | 01T |

**NOTES:**
**(1)** For use with most 3½″ and smaller gauges. Movementless gauge 4½″ (exception).
**(2)** Other bottom housing materials on application.
**(3)** Top housing material is 316L SS (standard). Monel mini-seal standard with monel top housing.
**(4)** Not available with monel bottom housing.

## Table F – Filling Fluid

| Fill | Service | Connection to Instrument | Temperature Range °F | Code |
|---|---|---|---|---|
| Glycerin | Pressure | Direct Only | 0/400 | CG |
| Silicone | Pressure/Vacuum | Direct or Flexible Line | –40/600 | CK |
| Halocarbon | Pressure/Vacuum in presence of strong oxidizing agent | Direct or Flexible Line | –70/300 | CF |
| Syltherm | Pressure | Direct or Flexible Line | –40/750 | HA |

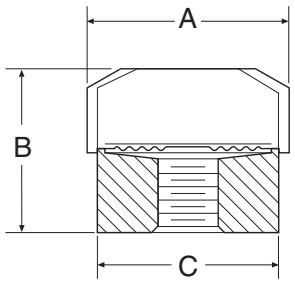
Monel is a registered trademark of Huntington Alloys, Inc.
Hastelloy is a registered trademark of Cabot Corp.
Halocarbon is a registered trademark of Halocarbon Products
GYLON 3510 is a registered trademark of Garlock Inc.

## HOW TO ORDER:

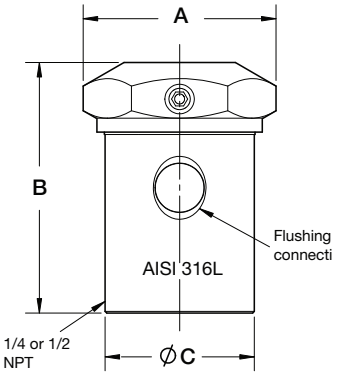
1. **From Table A...** select PROCESS CONNECTION (e.g., 1/4″ process code 25)
2. **From Table B...** select TYPE (310)
3. **From Table B...** select DIAPHRAGM MATERIAL. (e.g., 316L stainless steel–code S)
4. **From Table C...** select BOTTOM HOUSING MATERIAL. (e.g., 316 stainless steel–code S)
5. **From Table D...** select INSTRUMENT CONNECTION size. (e.g., 1/4 NPT–code 02T)
6. **From Table E...** select FILLING FLUID, if diaphragm seal will be attached to instrument. (e.g., Glycerin–code CG)

**Coded order:** **25-310SS-02T-CG**

**Dimension**




**Types 310 mini-seal – Threaded ¼, ½, ¾, NPT**




**Types 315 mini-seal – Threaded ¼, ½, ¾, NPT**

| | A in | A mm | B in | B mm | C in | C mm |
|---|---|---|---|---|---|---|
| **Type 310** | 1.75 | (38) | .81 | (30) | 1.34 | (34) |
| **Type 315** | 1.73 | (44) | 2.25 | (57.2) | 1.34 | (34) |




All specifications are subject to change without notice.
All sales subject to standard terms and conditions.
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CERTIFIED FINAL DOCUMENT

# FLEX-PRO®

*Peristaltic Metering Pump*

# SERIES A2V

Operating Manual

Exclusive:
TFD system
Tube Failure Detection
Patented

ProSeries 2 TWO-YEAR WARRANTY

ProSeries® by Blue-White Ind.

Protected by Patents: 8,418,364; 8,215,931; 7,001,153; 7,284,964; 4,496,295 and other patents pending

5300 Business Drive, Huntington Beach, CA 92649 USA
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**E mail:** sales@blue-white.com | techsupport@blue-white.com **URL:** www.Blue-White.com

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PLEASE READ ENTIRE INSTRUCTION MANUAL PRIOR TO INSTALLATION AND USE.

## 1.0 Introduction

Congratulations on purchasing Flex-Pro variable speed Peristaltic Metering Pump. A peristaltic pump is a type of positive displacement pump used for pumping a variety of fluids.

Your Flex-Pro pump is pre-configured for tubing that shipped with your metering pump. Tubing assembly has an Identification number printed on tube for easy re-order; such as ND, NH, etc.

**Please Note:** Your new pump has been pressure tested at factory with clean water before shipping. You may notice trace amounts of clean water in pre-installed tube assembly. This is part of our stringent quality assurance program at Blue-White Industries.

## 1.1 Available Models

### Norprene® A2 Tube Pumps

**Meets FDA criteria for food | Excellent chemical resistance | CIP | SIP**

| Feed Rate GPH | LPH | ML/Min | Max Speed RPM | Max Pressure PSI (bar) | Max Temperature F (C) | A2 Model Numbers 115V AC | 230V AC | 220V AC |
|---|---|---|---|---|---|---|---|---|
| .02 - 1.7 | .07 - 6.5 | 1 - 108 | 130 | 125 (8.6) | 185 (85) | A2V24-*ND | A2V25-*ND | A2V26-*ND |
| .06 - 5.5 | .21 - 20.6 | 3 - 344 | 130 | 125 (8.6) | 185 (85) | A2V24-*NF | A2V25-*NF | A2V26-*NF |
| .14 - 13.8 | .52 - 52.2 | 9 - 870 | 130 | 125 (8.6) | 185 (85) | A2V24-*NH | A2V25-*NH | A2V26-*NH |

### Norprene® Chemical A2 Tube Pumps

**Meets FDA criteria for food | Superb chemical resistance**

| Feed Rate GPH | LPH | ML/Min | Max Speed RPM | Max Pressure PSI (bar) | Max Temperature F (C) | A2 Model Numbers 115V AC | 230V AC | 220V AC |
|---|---|---|---|---|---|---|---|---|
| .15 - 14.9 | .56 - 56.2 | 9 - 937 | 130 | 50 (3.4) | 130 (54) | A2V24-*TH | A2V25-*TH | A2V26-*TH |

### Tygothane® A2 Tube Pumps

**Meets FDA criteria for food | Resistant to oils, greases and fuels**

| Feed Rate GPH | LPH | ML/Min | Max Speed RPM | Max Pressure PSI (bar) | Max Temperature F (C) | A2 Model Numbers 115V AC | 230V AC | 220V AC |
|---|---|---|---|---|---|---|---|---|
| .04 - 4.0 | .15 - 15.2 | 3 - 253 | 130 | 65 (4.5) | 130 (54) | A2V24-*GE | A2V25-*GE | A2V26-*GE |
| .09 - 9.3 | .35 - 35.2 | 6 - 587 | 130 | 65 (4.5) | 130 (54) | A2V24-*GG | A2V25-*GG | A2V26-*GG |

* Inlet/outlet connection type
S = 3/8" OD x 1/4" ID tubing compressions type connections
M = ½" male NPT
C-= 3/4" tri-clamp connections

- Flex-Pro Pumps motor speed is linear over entire 1% to 100% adjustment range.
- Output versus pressure is nearly linear in all models. Larger tubes exhibit greater losses.
- For optimum tube life, specify pump to operate at lowest possible RPM and pressure.
- Feed rates taken in laboratory environment with clean water after 20 minute tube break-in period with a 3 foot (1 meter) suction lift.

### Optional Extended Brackets

Stainless Steel extended brackets allow pump to be securely mounted to most any surface; floor, shelf, or skid. Brackets lift pump up 4-1/2 inches (11.43 cm), for easy pump access in hard to reach areas.

- Raise metering pump 4-1/2 inches (11.43 cm) off ground or a surface.
- Made out of tough Stainless Steel.
- Provides a stable mounting surface.

| Model # | Description |
|---|---|
| 72000-380 | Extended Mounting Bracket, 1 Pair, SS, 4 SS Screws |

## 2.0 Specifications

**Maximum working pressure (excluding pump tubes):**
125 psig (8.6 bar)
Note: see individual pump tube assembly maximum pressure ratings.

**Maximum Fluid temperature (excluding pump tubes):**
3/8" OD x 1/4" ID tubing connections: 130° F (54° C)
M/NPT connections: 185° F (85° C)
Note: see individual pump tube assembly maximum temperature ratings.

**Maximum fluid viscosity:**
12,000 Centipoise

**Maximum suction lift:**
30 ft. Water, 0 psig (4.5 m, 0 bar)

**Ambient Operating Temperature**
14°F to 115°F (-10°C to 46°C)

**Ambient Storage Temperature**
-40°F to 158°F (-40°C to 70°C)

**Operating Voltage:**
115VAC/60Hz, 1ph (1.5 Amp Maximum)
230VAC/60Hz, 1ph (0.7 Amp Maximum)
220VAC/50Hz, 1ph (1.0 Amp Maximum)
240VAC/50Hz, 1ph (1.0 Amp Maximum)

**Power Cord Options:**
115V60Hz = NEMA 5/15 (USA)
230V60Hz = NEMA 6/15 (USA)
220V50Hz = CEE 7/VII (EU)
240V50Hz = AS 3112 (Australia/New Zealand)

**Motor:**
Brushed DC, 1/8 H.P.

**Duty cycle:**
Continuous

**Motor speed adjustment range 100:1:**
1.0% - 100% motor speed (1.3 to 130 RPM)

**Motor speed adjustment resolution:**
0.1% increments

**Display**
Backlit LCD, UV resistant.

**Keypad**
Eight button positive action tactile switch keypad.

**Enclosure:**
NEMA 4X (IP66), Polyester powder coated aluminum.
Maximum Overall Dimensions:
7-1/2" W x 10-1/4" H x 14" D (19 W x 26 H x 35.6 D cm)

**Approximate shipping wt:**
25 lb. (12.0 Kg)

## 2.1 Materials of construction

### Wetted components:

**Pump Tube Assembly (Model Specific - 2 provided):**
**Tubing:** . . . . . Norprene® or Norprene Chemical® or Tygothane®
**Adapter fittings:** .PVDF

**Injection / Back-flow Check valve:**
**Body & insert:** .....PVDF
**Check Ball:** .....Ceramic
**Spring:** .....Hastelloy C-276
**Ball Seat O-ring:**.....Viton® (optional EPDM)
**Static Seal O-ring:**.....Viton® (optional EPDM)
**Duckbill anti-scale valve:** Santoprene®

**Ancillary Items provided**

**With "S" tubing type connections only:**
**Suction Tubing:** . . . . . 3/8" OD x 1/4" ID x 10' Clear PVC
**Discharge Tubing:** . . . . 3/8" OD x 1/4" ID x 10' Polyethylene (LLDPE)
**Suction Strainer:** . . . . . Polypropylene

**Suction Strainer:**
**Body:**. . . . . PVDF
**Check Ball:** . . . . . Ceramic
**Ball Seat O-ring:** . . . . . Viton® (optional EPDM)

**With "B" tubing and "M" M/NPT connections only:**
**Suction Strainer:**
**Body:** . . . . . PVDF
**Check Ball:** . . . . . Ceramic
**Ball Seat O-ring:** . . . . . Viton® (optional EPDM)

**With "C" Tri-clamp connections only:**
none

### Non-Wetted components:

**Enclosure:**
413 Aluminum (Polyester powder coated)

**Pump Head:**
Valox® (PBT) thermoplastic

**Pump Head Cover:**
Clear Acrylic - Annealed for added strength and chemical resistance.
Permanently lubricated sealed motor shaft support ball bearing.
Acrylic shaft support bearing retainer.

**Cover Screws:**
Stainless Steel

**Roller Assembly:**
**Rotor:**.....Valox® (PBT)
**Rollers:** .....Nylon
**Roller Bearings:** .....SS Ball Bearings

**Motor Shaft:**
Chrome plated steel

**TFD System Sensor pins:**
Hastelloy C-276

**Power Cord:**
3 conductor, SJTW-A Water-resistant

**Tube Installation Tool:**
GF Nylon

**Mounting Brackets and Hardware:**
316 Stainless Steel

## 3.0 Features

Peristaltic pump design does not have valves that can clog requiring maintenance.

Self priming - even against maximum line pressure. By-pass valves are not required. Cannot vapor lock or lose prime.

Variable speed DC motor.

Rated for continuous duty (24X7).

Specially engineered tubing for long life at high pressures. Meets FDA 21 CFR requirements for food contact applications.

Patented Tube Failure Detection (TFD) system. Senses tube failure by detecting chemical in pump head.

Backlit LCD displays motor speed, input signal values, service and alarm status.

CNC precision machined squeeze rollers and CNC machined alignment rollers for optimum squeeze, unparalleled accuracy, and tube life.

Heavy duty rotor - single piece plastic rotor means no flexing and increased accuracy with no metal springs or hinges to corrode.

Inject at maximum pressure in either direction (clockwise and counter clockwise).

Compatible with Blue-White's output Flow Verification Sensor (FVS) system.

## 3.1 Agency Listings

This pump is ETL listed to conforms to the following:
UL Standard 778 as a motor operated water pump
CSA Standard C22.2 as process control equipment

This pump complies to the Machinery Directive 98/37/EC, BS EN 60204-1, Low Voltage Directive 73/23/EC BS EN 61010-1, EMC Directive 89/336/EC, BS EN 50081-1/BS EN 50082-1.

| Symbol | Explanation |
|---|---|
| | WARNING, risk of electric shock |
| | CAUTION, refer to users' guide |
| | GROUND, PROTECTIVE CONDUCTOR TERMINAL |

**Enclosure Rating:**

**NEMA 4X:** Constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, and hose-directed water; and that will be undamaged by external formation of ice on enclosure.

**IP66:** No ingress of dust; complete protection against contact. Water projected in powerful jets against enclosure from any direction shall have no harmful effects.

## 4.0 Installation

| | |
|---|---|
| **CAUTION** ⚠ | Risk of chemical overdose. Be certain pump does not overdose chemical during backwash and periods of no flow in circulation system. |
| **CAUTION** ⚠ | Always wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on solution being pumped. Refer to MSDS precautions from your solution supplier. |
| **CAUTION** ⚠ | All diagrams are strictly for guideline purposes only. Always consult an expert before installing metering pump on specialized systems. Metering pump should be serviced by qualified persons only. |

## 4.1 Mounting Location

Choose an area located near chemical supply tank, chemical injection point, and electrical supply. Install pump where it can be easily serviced.

316SS Mounting brackets are included. Mount pump to a secure surface using enclosed mounting hardware.

Mount pump close to injection point. Keep inlet (suction) and outlet (discharge) tubing as short as possible. Longer discharge tubing increases back pressure at pump head.

**Important!** Install a back flow prevention check valve at discharge side of pump to prevent system fluid from flowing back through pump during tube replacement or if tube should rupture. **Important!**

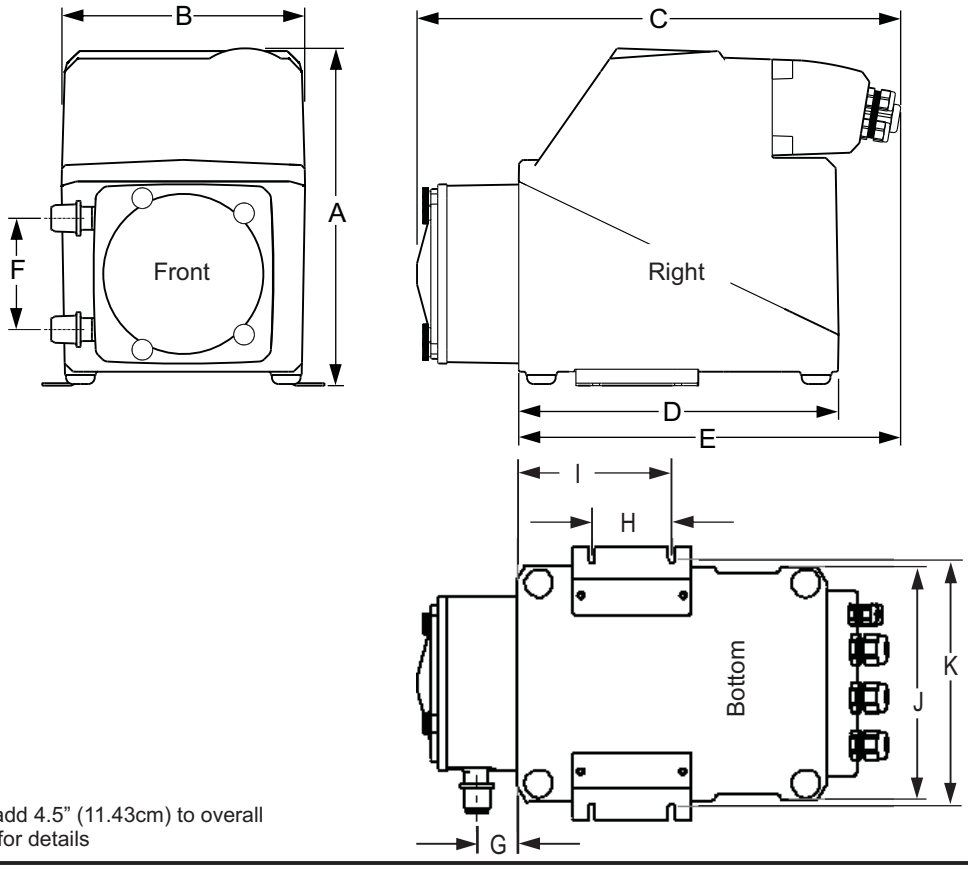
A pressure relief valve is recommended at discharge of pump to prevent premature wear and damage to pump tube in event discharge line becomes blocked.

Flex-Pro does not require back pressure. Keep discharge pressure as low as possible to maximize tube life.

## 4.2 Dimensions

**A2 Dimensions**

| Dim | Inches | cm |
|---|---|---|
| A | 10-1/4” | 26 |
| B | 7-1/2” | 19 |
| C | 14” | 35.6 |
| D | 9-1/2” | 24.1 |
| E | 11” | 27.9 |
| F | 3-3/8” | 8.6 |
| G | 1-1/4” | 3.2 |
| H | 2-1/2” | 6.4 |
| I | 4-7/8” | 12.3 |
| J | 7-1/4” | 18.5 |
| K | 7-3/4” | 19.7 |




*Note:* Optional Extended Bracket add 4.5” (11.43cm) to overall height (dimension A). See page 3 for details

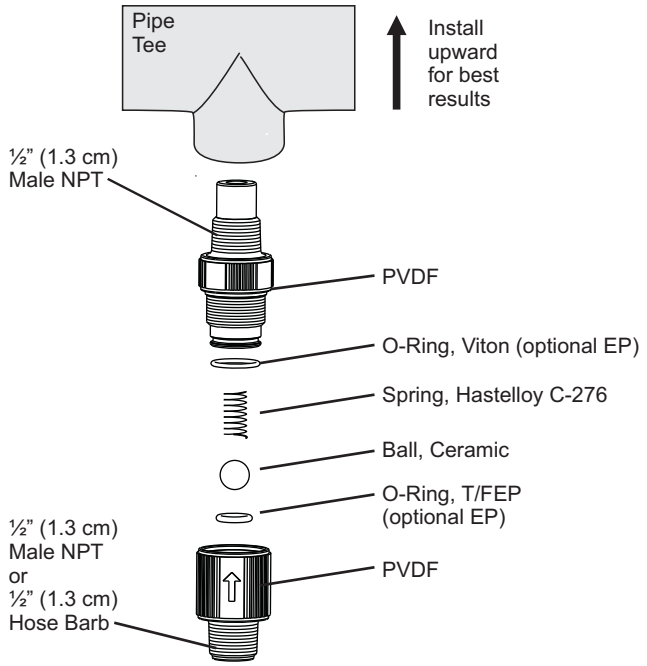
## 4.3 Installing Injection Fitting and Strainer

**CAUTION** Proper eye and skin protection must be worn when installing and servicing pump.

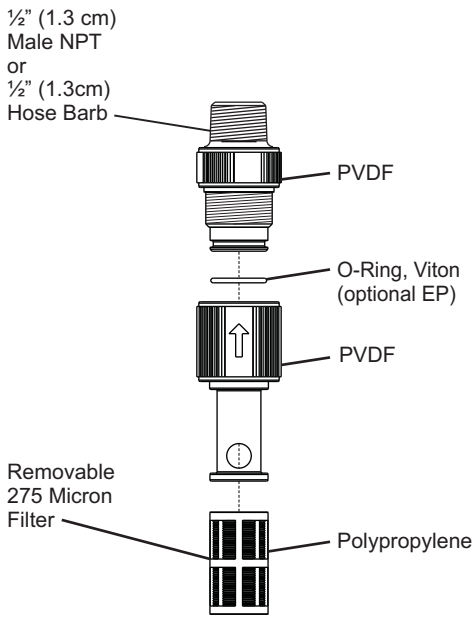
**CAUTION** This Pump Has Been Evaluated for Use with Water Only.

### Injection Fitting and Strainer for ½" (1.3cm) I.D. Connection End Models

#### Discharge Injection Fitting / Check Valve)

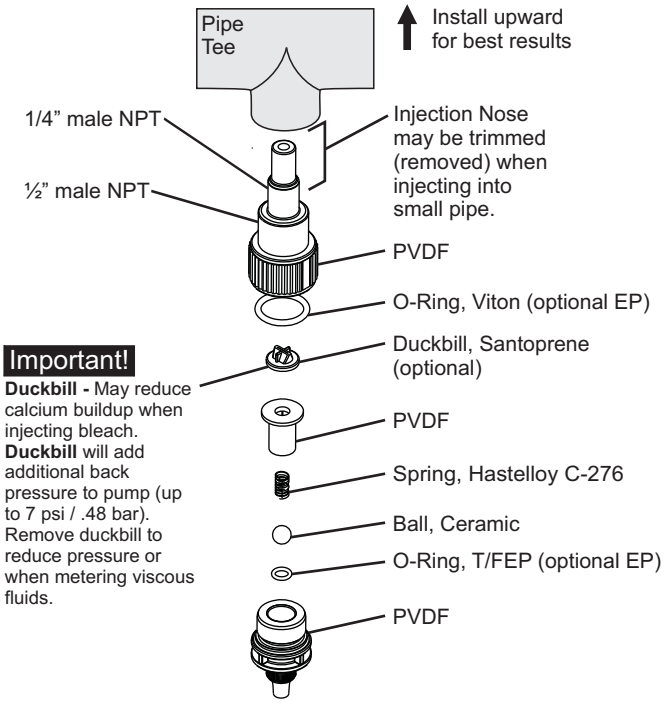



#### Suction Strainer




### Injection Fitting and Strainer for 1/4" (.64cm) I.D. Connection End Models

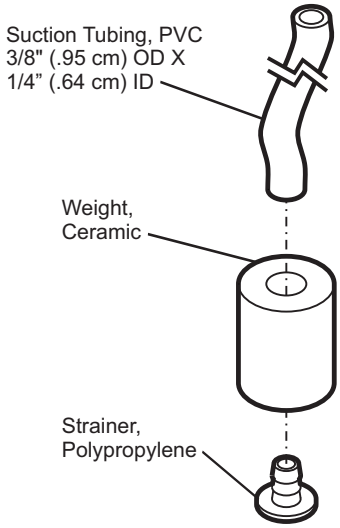
#### Discharge Injection Fitting / Check Valve




**Important!**

**Duckbill -** May reduce calcium buildup when injecting bleach. **Duckbill** will add additional back pressure to pump (up to 7 psi / .48 bar). Remove duckbill to reduce pressure or when metering viscous fluids.

#### Suction Tubing and Strainer



## 5.0 Power Connections

**WARNING** Risk of electric shock – cord connected models are supplied with a grounding conductor and grounding-type attachment plug. To reduce risk of electric shock, be certain that it is connected only to a properly grounded, grounding-type receptacle.

**WARNING** Electrical connections and grounding (earthing) must conform to local wiring codes. Be certain that a grounding conductor is connected to terminal T11-1 located in wiring compartment.

**WARNING** Risk of electric shock - Disconnect electricity before removing wiring compartment cover.

Be certain to connect pump to proper supply voltage. Using incorrect voltage will damage pump and may result in injury. Voltage requirement is printed on pump serial label.

Input power: 115VAC 50/60 Hz 1.5 amp or 230/240VAC 50/60 Hz 0.7 amp.

Power switch located in Junction Box.

Use voltage your power cord is rated for.

Cord connected models are supplied with a ground wire conductor and a grounding type attachment plug (power cord). To reduce risk of electric shock, be certain that power cord is connected only to a properly grounded, grounding type receptacle.

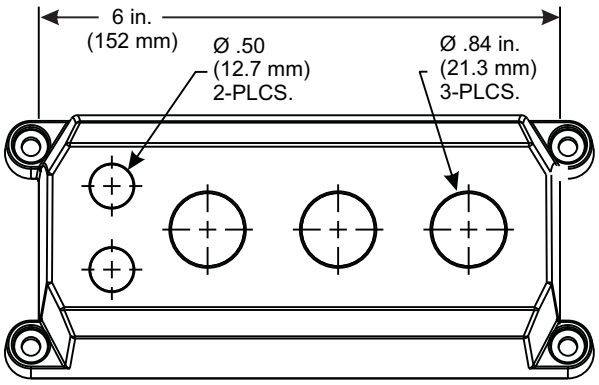
Permanently connected models must be properly grounded. Be certain that a grounding conductor is connected to terminal T11-1 located in wiring compartment.

Never strap control (input / output) cables and power cables together.

**Power Interruption:** This pump has an auto-restart feature which will restore pump to operating state it was in when power was lost.

***Note:*** *When in doubt regarding your electrical installation, contact a licensed electrician.*

### WIRING COMPARTMENT COVER




### POWER CORD OPTIONS

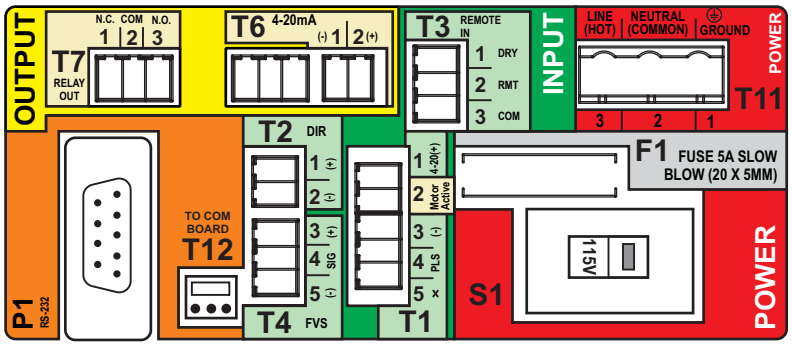
Three power cord plug types available.
Power cord length is 6 feet (3.83 meters)

| 115V 60Hz | 230V 60Hz | 240V 50Hz |
|---|---|---|
| NEMA 5/15 (USA) | NEMA 6/15 (USA) | CEE 7/VII (EU) |
| max: 125V AC | max: 250V AC | max: 250V AC |

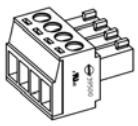
**Included cable and conduit connectors:**

| QTY. | DESCRIPTION |
|---|---|
| Qty: 2 | .50 Inch (12.7 Mm) Liq-tight Hole Plugs (mat'l = Neoprene), Pre-installed |
| Qty: 3 | .875 Inch (22.2 Mm) Liq-tight Hole Plugs (mat'l = Neoprene), 2 Pre-installed |
| Qty: 2 | .50 Inch (12.7 Mm) Liq-tight Connectors For Pass Thru Cords (mat'l = Nylon) Acceptable Cable Diameter .12 To .26 Inch (3.0 To 6.5 Mm), Not Installed |
| Qty: 3 | .875 Inch (22.2 Mm) Liq-tight Connectors For Pass Thru Cords (mat'l = Nylon) Acceptable Cable Diameter .20 To .40 Inch (5.1 To =10.0 Mm), 1 Pre-installed W/ Power Cord Models |
| Qty: 2 | Metallic Liq-tight Connectors For .50 Inch Flexible Conduit (mat'l = Die Cast Zinc), Not Installed |

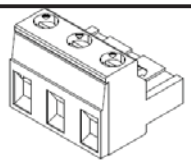
## 5.1 Wiring Terminals and I/O Schematics




**WARNING** Risk of electric shock - All wiring must be insulated and rated 300V minimum.



Terminals T1 Thru T8
Plug type
16 - 24 AWG



Power Input Terminal T11
Plug type
14 - 30 AWG

| FUNCTION | TERM | PIN # | RATING | ELECTRICAL SP. | BLOCK DIAGRAM |
|---|---|---|---|---|---|
| **INPUT:** 4-20 mA | T1 | 1 | (+) POSITIVE | 120 OHM IMPEDANCE, NON POWERED LOOP | **Single or dual pump (series) input. Loop voltage must not exceed 24 Volts.** ACTIVE 4-20mA TRANSMITTER SOURCE + - GND (-) 4-20(+) T1 |
| | T1 | 3 | (-) NEGATIVE | | |
| **INPUT:** FREQUENCY, AC SINE WAVE, TTL, CMOS | T1 | 3 | (-) NEGATIVE | 0-1000 HZ MAX. | FREQUENCY TRANSMITTER SOURCE - + GND (-) PULSE T1 |
| | T1 | 4 | (+) POSITIVE | | |
| **INPUT:** FVS SYSTEM (FLOW VERIFICATION SENSOR) FV SENSOR ONLY | T4 | 3 | (+) POSITIVE | | BLUE-WHITE FVS SENSOR RED (+) BARE BLACK (-) PWR (+) SIGNAL GND (-) T4 FVS |
| | T4 | 4 | SIGNAL | | |
| | T4 | 5 | (-) NEGATIVE | | |
| **INPUT:** FVS SYSTEM (FLOW VERIFICATION SENSOR) FS or FP MICRO-FLO FLOW METER ONLY | | | | | BLUE-WHITE MICRO-FLO FLOWMETER PULSE OUTPUT SIGNAL NEGATIVE (-) PWR (+) SIGNAL GND (-) T4 FVS |
| | T4 | 4 | SIGNAL | | |
| | T4 | 5 | (-) NEGATIVE | | |
| **INPUT:** REMOTE START / STOP (DRY CONTACT C.) | T3 | 1 | (+) POSITIVE | NO VOLTAGE | OPEN CIRCUIT IMPEDANCE MUST BE GREATER THAN 50K OHM (-) (+) T3 REMOTE IN 1 DRY 2 RMT 3 COM |
| | T3 | 2 | (-) NEGATIVE | | |
| **INPUT:** REMOTE START / STOP (WET CONTACT C.) | T3 | 2 | (+) POSITIVE | 6 TO 30 VOLT DC 1 AMP MAX. | EXTERNAL DEVICE 6 TO 30V DC (+) (-) T3 REMOTE IN 1 DRY 2 RMT 3 COM |
| | T3 | 3 | (-) NEGATIVE | | |
| **OUTPUT:** 4-20 mA | T6 | 2 | (+) POSITIVE | 120 OHM RESISTANCE ACTIVE LOOP | 4-20mA RECEIVER 600 OHM LOAD MAX. (-) (+) T6 4-20 (-) 1 2 (+) |
| | T6 | 1 | (-) NEGATIVE | | |
| **OUTPUT:** RELAY, 3 AMP | T7 | 1 | NORM. CLOSED | Form C 3 AMP MAX AT 250 VAC, 3 AMP MAX AT 30 VOLT DC | SWITCH LOAD 3 AMP MAX @ 250V AC 3 AMP MAX @ 30V DC NC C NO T7 RELAY OUT N.C. COM N.O. 1 2 3 |
| | T7 | 2 | COMMON | | |
| | T7 | 3 | NORM. OPEN | | |
| **OUTPUT:** OPEN COLLECTOR MOTOR ACTIVE | T1 | 2 | SIGNAL | 5 TO 24 VDC | **CLOSED WHILE MOTOR IS ENERGIZED** 4.7K OHM SIGNAL OUT NEGATIVE (-) MOTOR ACTIVE GND (-) T1 |
| | T1 | 3 | COMMON | | |
| **INPUT:** POWER | T11 | 1 | GROUND | 115V OR 230V AC MANUAL SWITCH 50 / 60 HZ 100W | AC VOLTAGE LINE (HOT) NEUTRAL (COMMON) GROUND POWER T11 SWITCH FROM 115V TO 230V S1 115V POWER POWER VOLTAGE SWITCH |
| | T11 | 2 | NEUTRAL | | |
| | T11 | 3 | LINE (HOT) | | |
| **FUSE** | F1 | N/A | 5 AMP | 5A SLOW BLOW (20 X 5MM) | |

## 6.0 How to Operate Flex-Pro - Control Pad

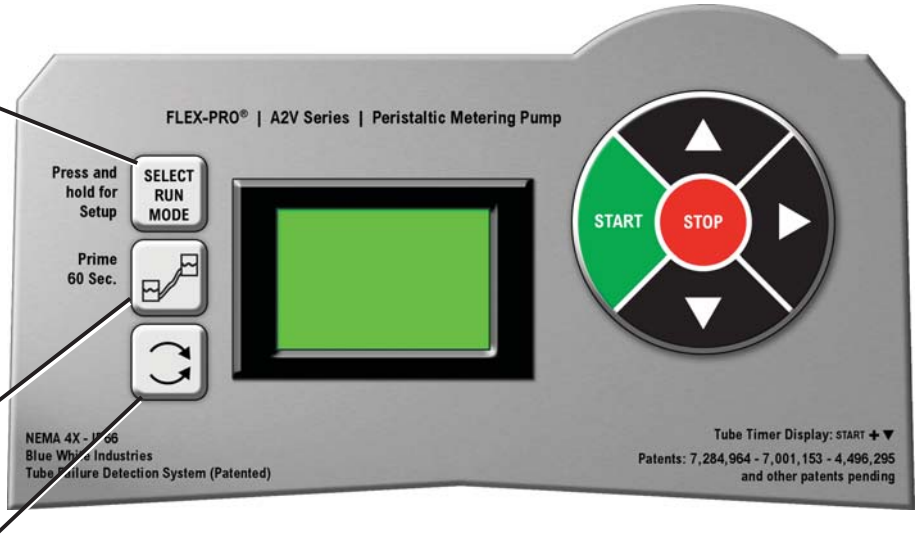
**Press and release**
To select Run Mode
- Mode 1: Manual
- Mode 2: 4-20mA input
- Mode 3: Frequency input
- Mode 4: Pulse / Batch

**Press and Hold**
To configure selected Mode
- Mode 0: Setup
- Mode 1: Manual
- Mode 2: 4-20mA input
- Mode 3: Frequency input
- Mode 4: Pulse / Batch

**Press and release**
To prime pump (60 seconds)

**Press and hold**
To change rotor direction clockwise or counterclockwise

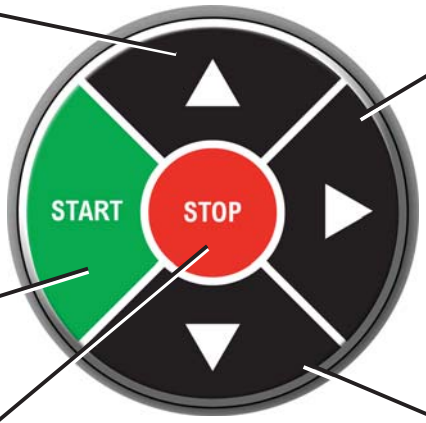
*Important:* Hold button down to trigger rotor reversal




**Press and release**
To scroll through menu options in Setup mode.
To increase value while in programming mode.
Press UP arrow to increase pump speed (output) in Manual mode (Mode 1).

**Press and release**
To Start pump.
To begin listening (reacting) to external signals.

**Press and release**
To Stop pump.




**Press and release**
To scroll through menu options in Setup mode.
To scroll through pump speed (output) and current incoming signals in run modes:
Mode 2, Mode 3, & Mode 4

**Press and release**
To scroll through menu options in Setup mode.
To decrease value while in programming mode.
Press DOWN arrow to decrease pump speed (output) in Manual mode (Mode 1).

**Tube Life Timer**

To view amount of run time hours on currently installed tube.

START + DOWN arrow displays current pump tube timer.

Hold down START button, then press and release DOWN arrow.

## 6.1 Mode Descriptions

### Mode 0 - Setup

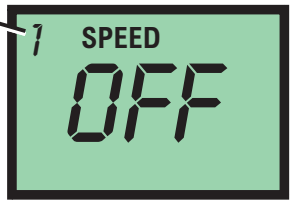
Mode 0

Press and Hold to configure:

- Remote Start / Stop
- TFD (Tube Failure Detection) sensitivity
- FVS (Flow Verification Sensor) time delay - requires sensor
- 4-20 mA output, available on certain models

### Mode 1 - Manual

Mode 1

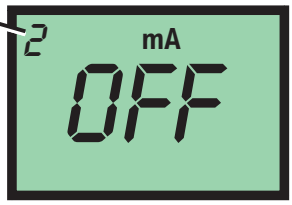



Run pump locally by selecting pump speed (1 - 100%).

- Control speed by using up or down arrows after start button is pressed.
- Control speed by entering Mode 1 setup and selecting desired pump speed (1 - 100%)

### Mode 2 - 4-20 mA Input Signal

Mode 2

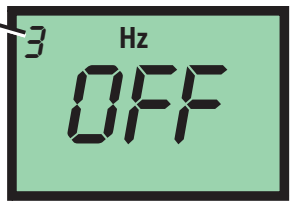



Run pump remotely via external 4-20 mA signal.

- Press and Hold “Select Run Mode” button with Mode 2 selected to configure settings.
- Select Mode 2 and press START button to allow pump to be controlled by external 4-20mA signal.

### Mode 3 - Frequency (Hz) Input Signal

Mode 3

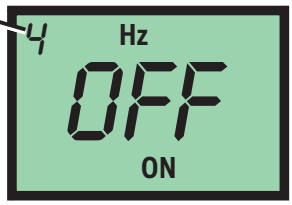



Run pump remotely via external high frequency (Hz) signal.

- Press and Hold “Select Run Mode” button with Mode 3 selected to configure settings.
- Select Mode 3 and press START button to allow pump to be controlled by external frequency (Hz) signal.

### Mode 4 - Pulse Batch Input Signal (low speed pulse)

Mode 4




Run pump remotely via external low speed pulse signal.

- Press and Hold “Select Run Mode” button with Mode 4 selected to configure settings.
- Select Mode 4 and press START button to allow pump to be controlled by external low speed pulse signal.

## 7.0 Mode 0 - Set Remote Start / Stop

Used to remotely start and stop pump using a dry contact closure signal.
When activated; CLOSE = START and OPEN = STOP.

Set to NO = Remote Start / Stop is disabled
Set to Yes = Remote Start / Stop is enabled

Can be used with external foot pedal, PLC, contact closure or other similar external devices.

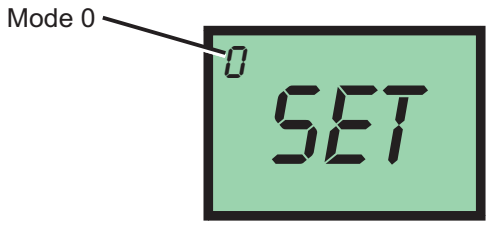
Default setting = No (disabled)

### Step 1

Press and release STOP button

Note: Mode cannot be changed while pump is in running.

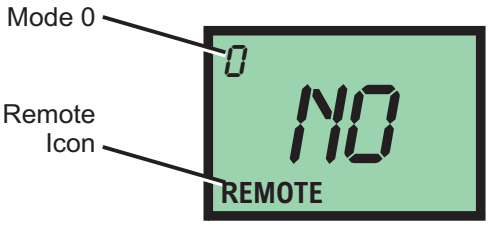
Press and release SELECT RUN MODE button multiple times until Mode 0 is selected.




### Step 2

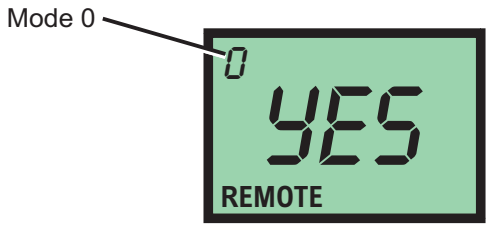
With Mode 0 selected, press and hold SELECT RUN MODE button until 'Remote' icon begins flashing.
Default setting 'NO' will also be visible when entering remote start / stop setup.

Note: If 'YES' had been selected previously, then 'YES' will be displayed on screen.



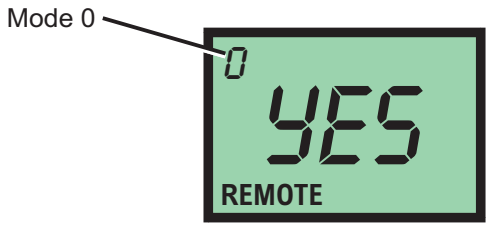

### Step 3

Press and release DOWN arrow to change setting to 'YES.'
To change setting back to 'NO' press and release UP arrow.




### Step 4

After you've made your selection, press and release RIGHT arrow button. This saves your setting.
You can now modify other settings in Mode 0 or you can exit Setup by pressing and holding SELECT RUN MODE button for a few seconds until you return to Run screen.




Running pump with Remote Start / Stop enabled, 'REMOTE' icon will always be visible on lower left side of screen.
Pump will display 'STBY' (standby) if pump is in stop mode via contact closure signal. **Please use caution in this mode, pump can start at anytime. If you must perform maintenance to pump, press and release STOP button.**

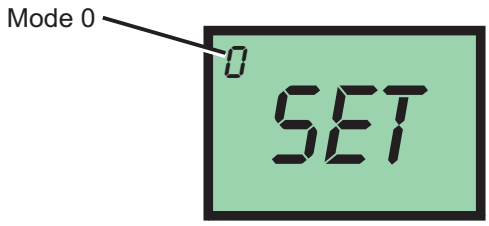
## 7.1 Mode 0 - Set TFD Sensitivity

Flex-Pro pump is equipped with a Tube Failure Detection (TFD) system which is designed to stop pump in event pump tube should rupture and chemical enters pump head. This patented system is capable of detection presence of a large number of chemicals including Sodium Hypochlorite (chlorine), Hydrochloric (muriatic) Acid, Sodium Hydroxide, and many others.

Minimum and Maximum setting = 75 % to 100%
Default Setting = 75% (75% is recommended; triggers with most water treatment chemicals without false alarms)
Important: 100% sensitivity setting may trigger false alarm by washdown or rain. 100% setting is only recommended when absolutely necessary.

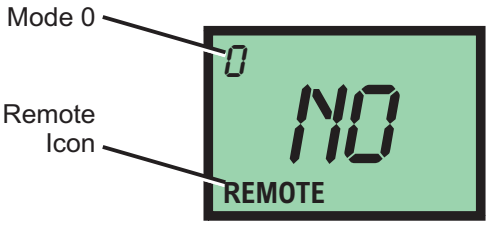
**Step 1**

Press and release STOP button
Note: Mode cannot be changed while pump is in running.
Press and release SELECT RUN MODE button multiple times until Mode 0 is selected.



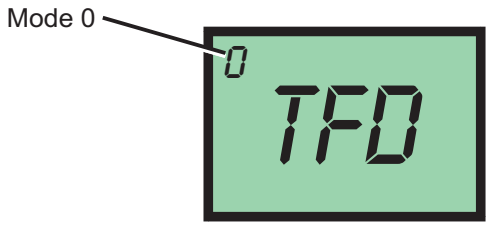

**Step 2**

With Mode 0 selected, press and hold SELECT RUN MODE button until 'Remote' icon begins flashing.
This indicates that you've entered Setup menu.



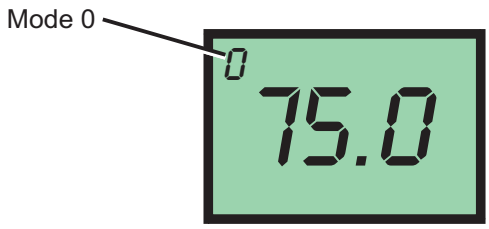

**Step 3**

Press and release RIGHT arrow button to scroll through menu until you see TFD icon.
If you pass TFD screen, continue to press and release RIGHT arrow button until TFD icon appears.



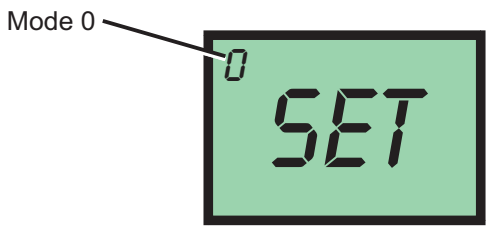

**Step 4**

TFD icon will appear for 1 second, followed by numbers.
Numbers indicate sensitivity value of TFD.
Press and release UP arrow button to increase sensitivity value.
Press and release DOWN arrow button to decrease sensitivity value.




**Step 5**

After you've made your selection, press and release RIGHT arrow button. This saves your setting.
You can now modify other settings in Mode 0 or you can exit Setup by; press and hold SELECT RUN MODE button for a few seconds until you return to Run screen.




**Confirm chemical detection** - To determine if your chemical will be detected by system, remove pump tube and rotor. Place a small amount of chemical in bottom of pump head - just enough to cover sensors. Turn on pump. If TFD system detects chemical, pump will stop after two seconds and TFD alarm screen will display. Press STOP button to clear alarm.

## 7.2 Mode 0 - Set FVS (flow verification system)

Flow verification sensor sold separately.

Flow verification system is designed to stop pump in an event sensor does not detect flow during pump operation. Indicating an empty chemical tank, clogged injection fitting, loose tubing connection, etc.

To allow pump to clear any gasses that may have accumulated over time, an alarm delay time value from 1 to 255 seconds must be programmed.

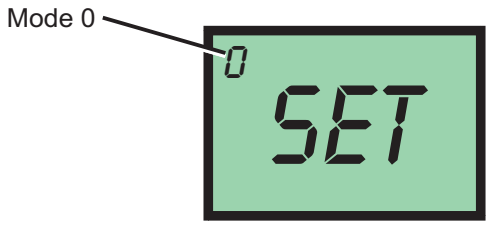
Note: An alarm delay of 000 seconds disables FVS system.

**Step 1**

Press and release STOP button

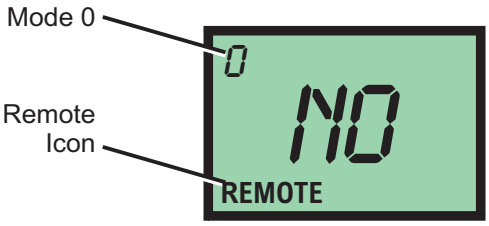
Note: Mode cannot be changed while pump is in running.

Press and release SELECT RUN MODE button multiple times until Mode 0 is selected.



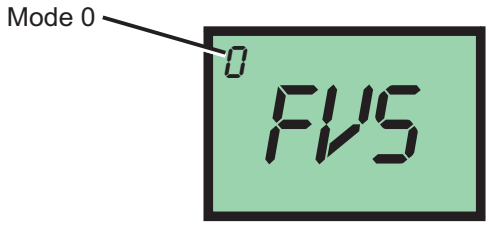

**Step 2**

With Mode 0 selected, press and hold SELECT RUN MODE button until 'Remote' icon begins flashing.
This indicates that you've entered Setup menu.



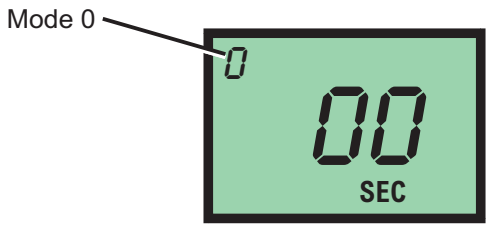

**Step 3**

Press and release RIGHT arrow to scroll through menu until you see FVS icon.
If you pass FVS screen, continue to press and release RIGHT arrow button until FVS icon appears.



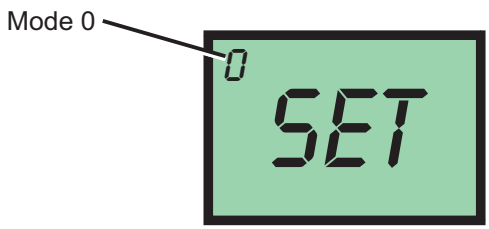

**Step 4**

FVS icon will appear for 1 second, followed by numbers.
These numbers indicate delay time setting for FVS.
Select a delay time in seconds. Delay time is amount of time pump will wait to receive a pulse from sensor until an alarm it triggered.
A delay time of 00 deactivates FVS feature.




**Step 5**

After you've made your selection, press and release RIGHT arrow button. This saves your setting.
You can now modify other settings in Mode 0 or you can exit Setup by; press and hold SELECT RUN MODE button for a few seconds until you return to Run screen.




**Time-out** - Flex-Pro pumps have a time-out setting of 20 seconds while in configuration menus. If built-in timer exceeds 20 seconds without a button being pressed, then pump will exit configuration menu. Changes will only be saved after RIGHT arrow button is pressed and released.

## 7.2 Mode 0 - Set FVS (flow verification system) - Continued

Flow Verification Sensor is designed to give you two installation options.

Sensor can be installed:

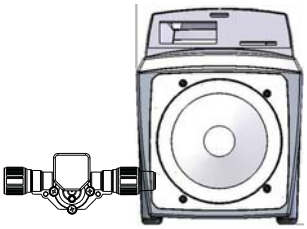
- Directly on pumphead of A2 pump, suction side.
- Anywhere on suction side of A2 pump.

Wiring for sensor can be connected directly to an A2 pump. Pump will stop pumping if sensor detects no flow. A relay will then close allowing for remote alarm indication or initiation of a back-up injector pump. **Install FVS Flow Sensor -** Flow Verification Sensor should be installed on inlet (suction) side of pump tube. Sensor includes a PVC tubing insert, located inside sensors female thread connection, that is designed to seal sensor onto pump tube inlet adapter. Thread sensor onto pump tube until tubing insert is snug against pump tube inlet fitting - do not over-tighten.

| Sensor Model Number | Published Flow Range | Actual Working Range with Flex-Pro Pump |
|---|---|---|
| | ML/Min | ML/Min |
| FV-100 | 30-300 | 30-200 |
| FV-200 | 100-1000 | 50-900 |
| FV-300 | 200-2000 | 100-1800 |
| FV-400 | 300-3000 | 300-3000 |
| FV-500 | 500-5000 | 500-5000 |
| FV-600 | 700-7000 | 700-7000 |

**Confirm FVS flow range -** Flow Verification Sensor (FVS) will only function within its operating range. See chart for available ranges.

Example: Sensor model FV-100 has an operation range of 30-300 ml/min when used as a flowmeter. However, due to pressure drop across sensor, pump's suction capability is limited to 14.7 psi. When used as a Flow Verification Sensor with a peristaltic pump, effective operating range is reduced to 30-200 ml/min.



NOTE: If pump output is less than 30 ml/min, sensor will not detect chemical and a signal will not be sent to pump, resulting in an alarm condition.

NOTE: For low viscosity (water-like) fluids only. Consult factory if attempting to use with viscous fluids.

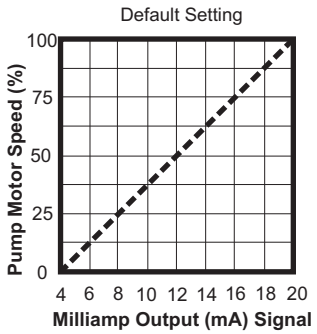
## 7.3 Mode 0 - Set 4-20mA Output

Available on certain models.

Sends a configurable 4-20 mA signal, based on pump rotor speed, to an external device. This feature can be used to control other pumps (in sync / proportionally), data logging systems, and other external devices for plant automation.

Default setting: Minimum Speed = 4 mA signal output
Maximum Speed = 20 mA signal output

Set to NO = disabled
Set to Yes = enabled

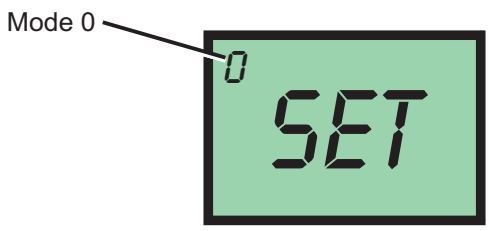



### Step 1

Press and release STOP button

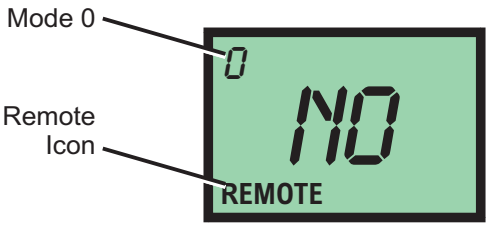
Note: Mode cannot be changed while pump is in running.

Press and release SELECT RUN MODE button multiple times until Mode 0 is selected.



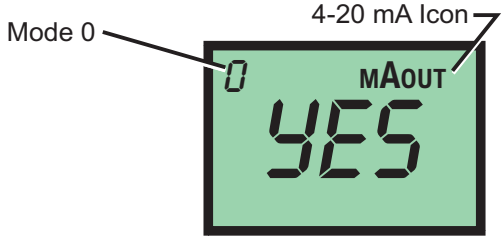

### Step 2

With Mode 0 selected, press and hold SELECT RUN MODE button until 'Remote' icon begins flashing.
This indicates that you've entered Setup menu.



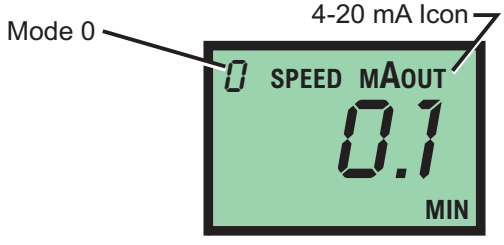

### Step 3

Press and release RIGHT arrow to scroll through menu until you see 4-20 mA icon.
To select Yes, press and release DOWN arrow.
To select No, press and release UP arrow.
To begin configuring values, select Yes.
Then press and release RIGHT arrow.




### Step 4

**Minimum pump speed** will be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.

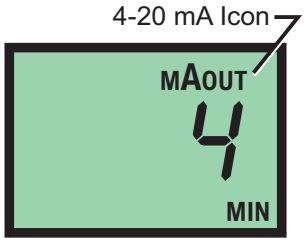



**Time-out** - Flex-Pro pumps have a time-out setting of 20 seconds while in configuration menus. If built-in timer exceeds 20 seconds without a button being pressed, then pump will exit configuration menu. Changes will only be saved after RIGHT arrow button is pressed and released.

## 7.3 Mode 0 - Set 4-20mA Output - Continued

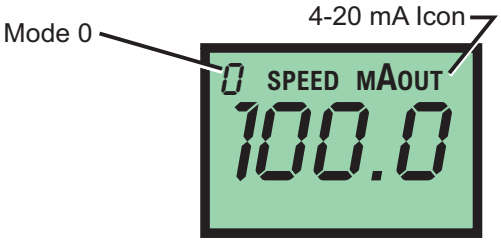
### Step 5

**Output signal at minimum speed** will now be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.



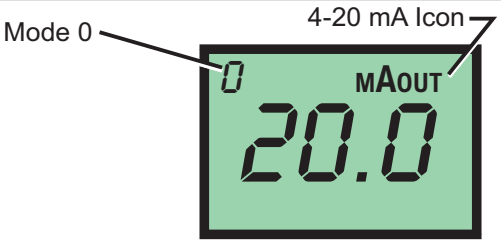

### Step 6

**Maximum pump speed** will be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.



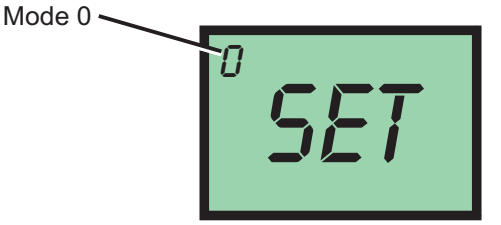

### Step 7

**Output signal at maximum speed** will now be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.

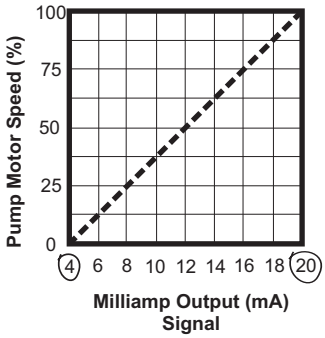



### Step 8

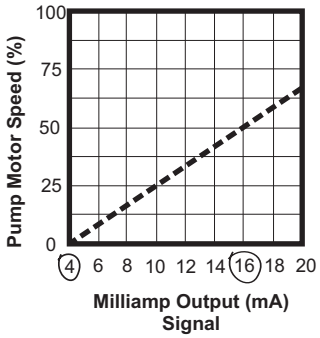
You can now modify other settings in Mode 0 or you can exit Setup by; press and hold SELECT RUN MODE button for a few seconds until you return to Run screen.




**Example 1**
0% Pump Output = 4 mA
100 % Pump Output = 20 mA




**Example 2**
0% Pump Output = 4 mA
50% Pump Output = 16 mA



## 8.0 Mode 1 - Manual Operation

Used to manually control speed of pump.

Use UP and DOWN arrows to adjust speed while pump is running.

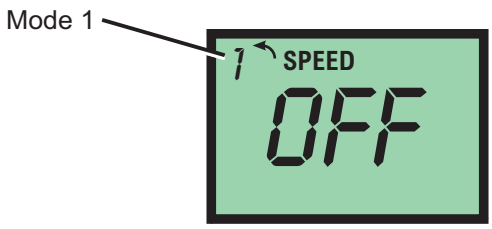
To select exact run speed, follow steps below.

### Step 1

Press and release STOP button

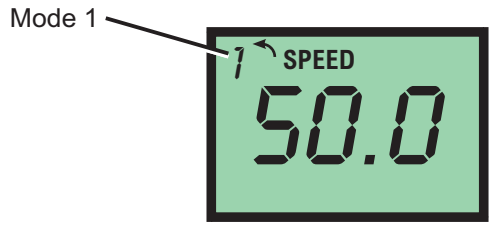
Note: Mode cannot be changed while pump is in running.

Press and release SELECT RUN MODE button multiple times until Mode 1 is selected.



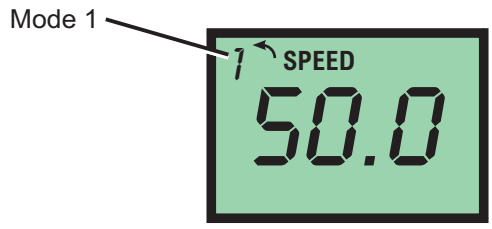

### Step 2

With Mode 1 selected, press and hold SELECT RUN MODE button until 'Speed' icon begins flashing.
This indicates that you've entered Setup menu.




### Step 3

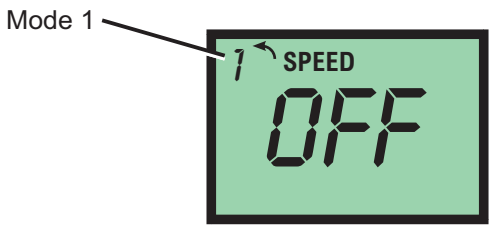
**Current pump speed** will be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and hold SELECT RUN MODE button until 'Speed' icon stop flashing.




### Step 4

Pump will now operate at your pre-configured speed.
Press and release START button to start pump.

Press and release STOP button at anytime to stop pump.

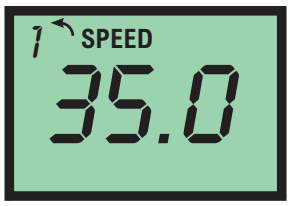



With pump operating in manual mode (Mode 1), pump speed can be changed at anytime by using UP or DOWN arrows during operation.

## 8.1 Mode 1 - Manual Operation Screen Shots

### Runtime Screen Shot 1

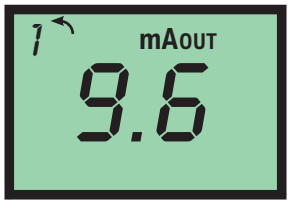
Display motor speed percentage.
Pump Running in Manual Operation




### Runtime Screen Shot 2

Display 4-20mA output (select models only)
Press and release RIGHT arrow to view mA output value in real-time.

***Please note:*** 4-20mA output is only available on select models. If included in your model; 4-20mA output must be enabled in Mode 0 (see page 16).



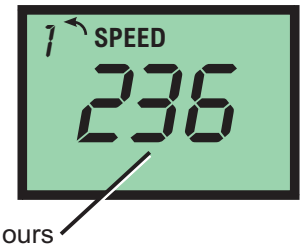

### Runtime Screen Shot 3

Display motor speed percentage.
Press and release RIGHT arrow to view percentage of motor speed.

### Runtime Screen Shot 4

Display tube life timer.
Press and hold START button.
Press and release DOWN arrow.

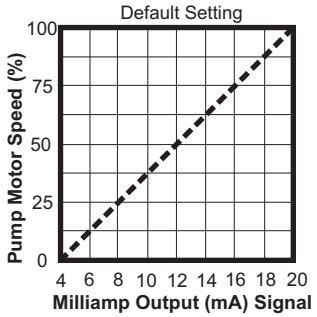
Displays amount of total runtime hours on currently installed tube.
Time will be displayed in hours.
Timer will be display for approximately 5 seconds before returning to previous runtime screen.



## 9.0 Mode 2 - 4-20mA Input Operation

Used to remotely control pump with an incoming 4-20 mA signal.

Default setting: 4 mA signal = 0.1% motor speed
20 mA signal = 100.0% motor speed

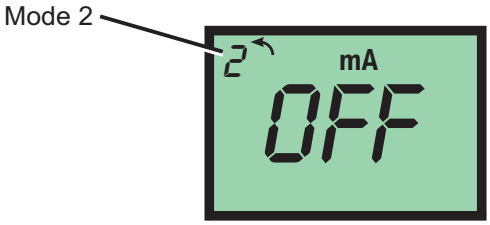



### Step 1

Press and release STOP button

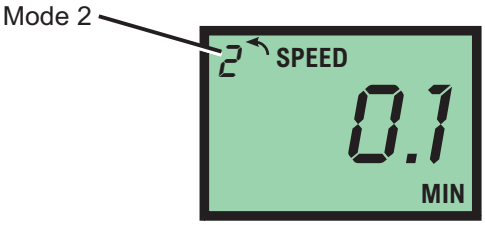
Note: Mode cannot be changed while pump is in running.

Press and release SELECT RUN MODE button multiple times until Mode 2 is selected.



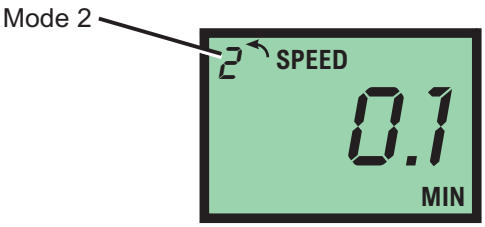

### Step 2

With Mode 2 selected, press and hold SELECT RUN MODE button until 'Speed' icon begins flashing.
This indicates that you've entered Setup menu.



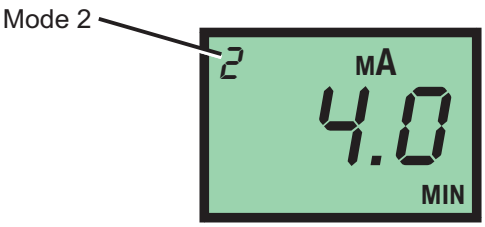

### Step 3

**Minimum pump speed** will be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.



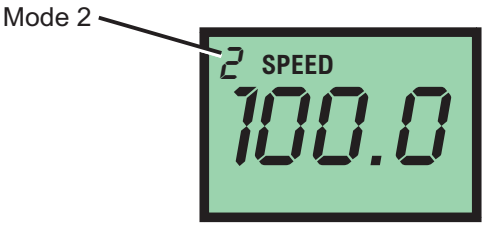

### Step 4

**mA value linked to minimum pump speed** will be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.




### Step 5

**Maximum pump speed** will be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.

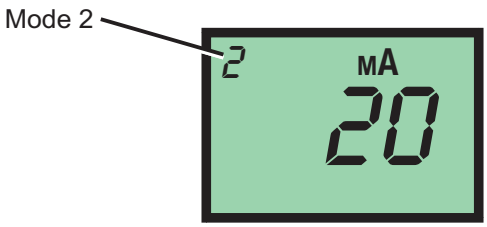



**Time-out** - Flex-Pro pumps have a time-out setting of 20 seconds while in configuration menus. If built-in timer exceeds 20 seconds without a button being pressed, then pump will exit configuration menu. Changes will only be saved after RIGHT arrow button is pressed and released.

## 9.0 Mode 2 - 4-20mA Input Operation - Continued

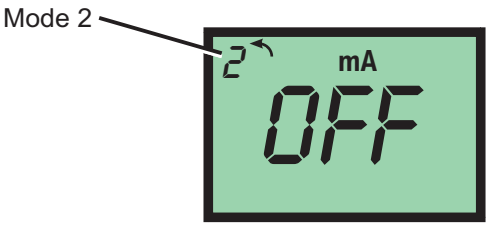
### Step 6

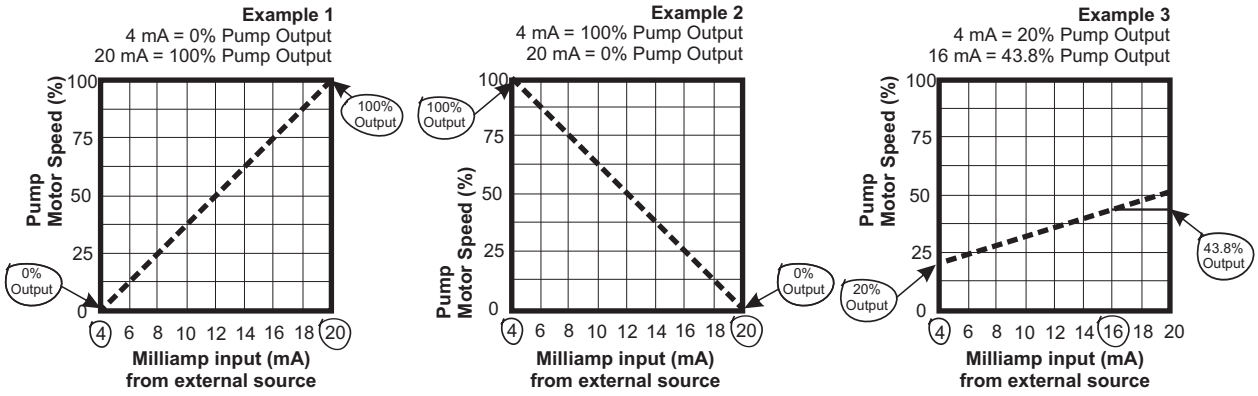
**mA value linked to minimum pump speed** will now be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.




### Step 7

To exit Setup, press and hold SELECT RUN MODE button for a few seconds until you return to Run screen.

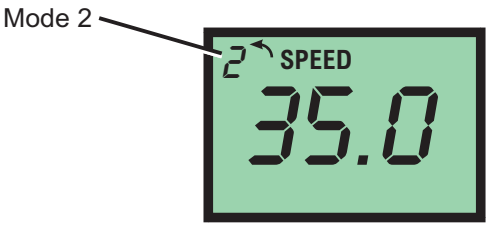



## 9.1 Mode 2 - 4-20mA Input Screen Shots

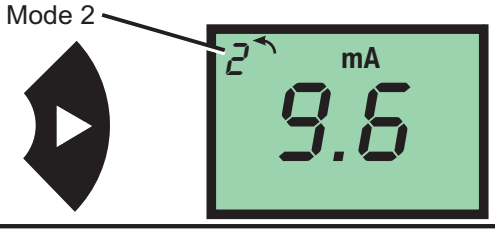
### Runtime Screen Shot 1

Display **motor speed percentage.**
Pump Running in 4-20mA Input Operation



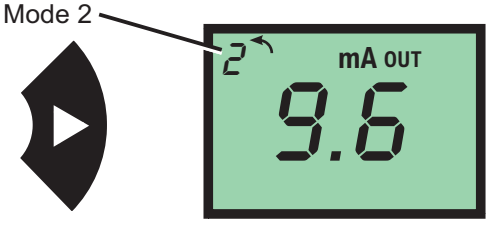

### Runtime Screen Shot 2

Display current 4-20mA input signal
Press and release RIGHT arrow to view **mA input** value in real-time.




### Runtime Screen Shot 3

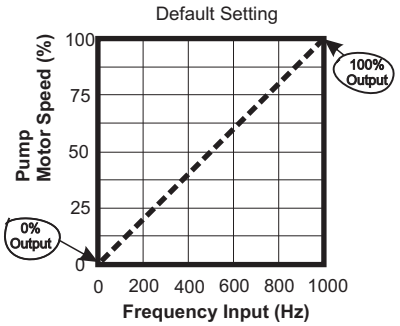
Press and release RIGHT arrow again to view **mA output** value in real-time (available on select models only).
Press and release RIGHT arrow again to view **motor speed percentage**, as in Screen Shot 1.



## 10.0 Mode 3 - Frequency Input (Hz) Operation

Used to remotely control pump with an incoming high speed frequency signal. Typically used with flow meters or other external devices.

Default setting: 0 Frequency (Hz) = 0% motor speed
1000 Frequency (Hz) = 100% motor speed

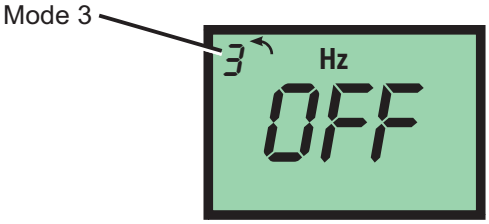



### Step 1

Press and release STOP button

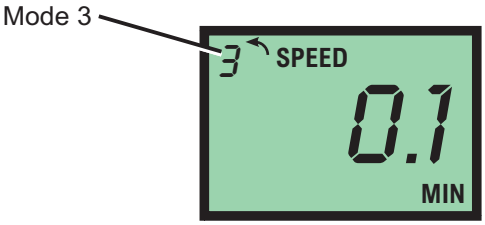
Note: Mode cannot be changed while pump is in running.

Press and release SELECT RUN MODE button multiple times until Mode 3 is selected.



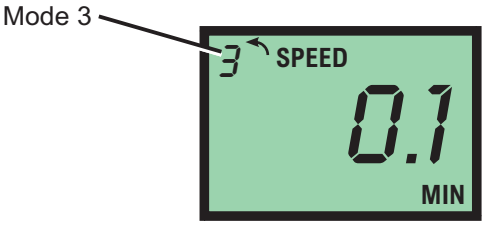

### Step 2

With Mode 3 selected, press and hold SELECT RUN MODE button until 'Speed' icon begins flashing.
This indicates that you've entered Setup menu.



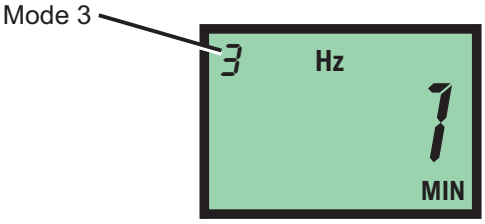

### Step 3

**Pump speed at minimum Frequency** will be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.




### Step 4

**Minimum Frequency (Hz) value** will be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.

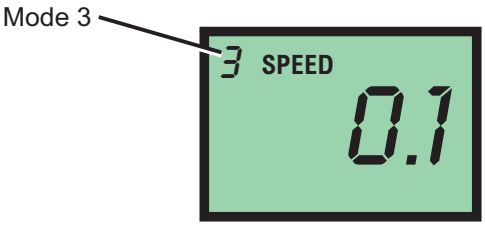



**Time-out** - Flex-Pro pumps have a time-out setting of 20 seconds while in configuration menus. If built-in timer exceeds 20 seconds without a button being pressed, then pump will exit configuration menu. Changes will only be saved after RIGHT arrow button is pressed and released.

## 10.0 Mode 3 - Frequency Input (Hz) Operation - Continued

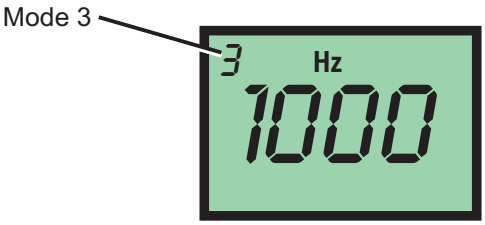
### Step 5

**Pump speed at maximum Frequency** will be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.



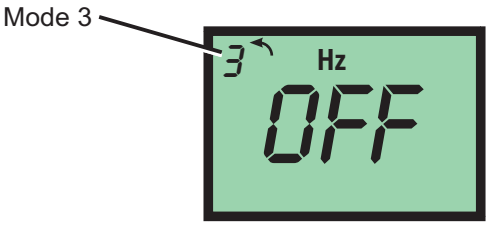

### Step 6

**Maximum Frequency value** will now be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.

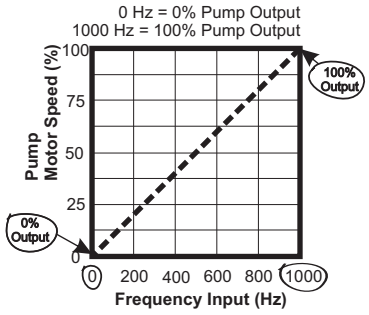


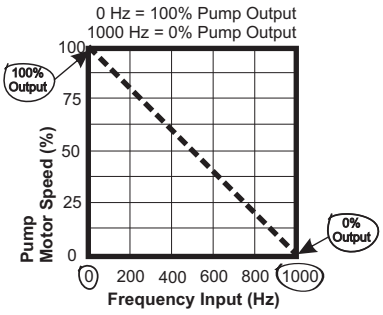

### Step 7

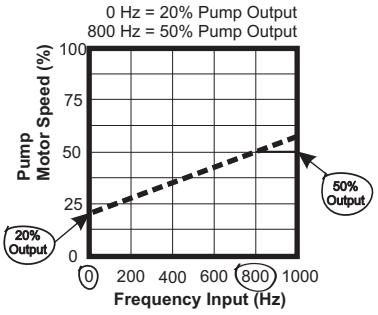
To exit Setup, press and hold SELECT RUN MODE button for a few seconds until you return to Run screen.



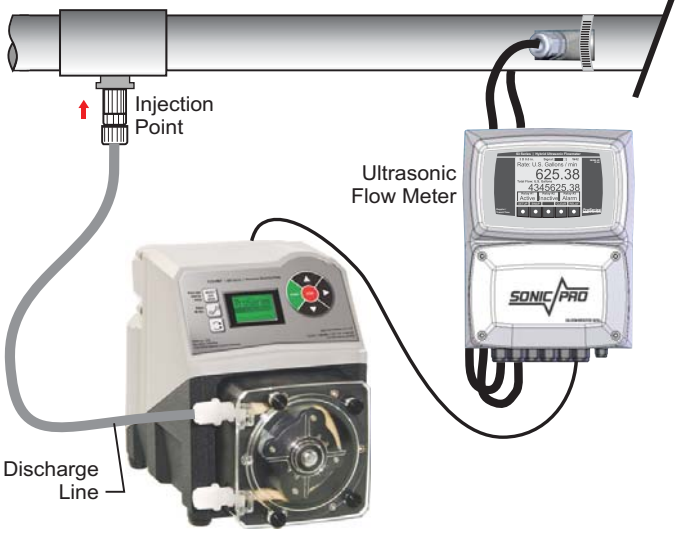

Examples:



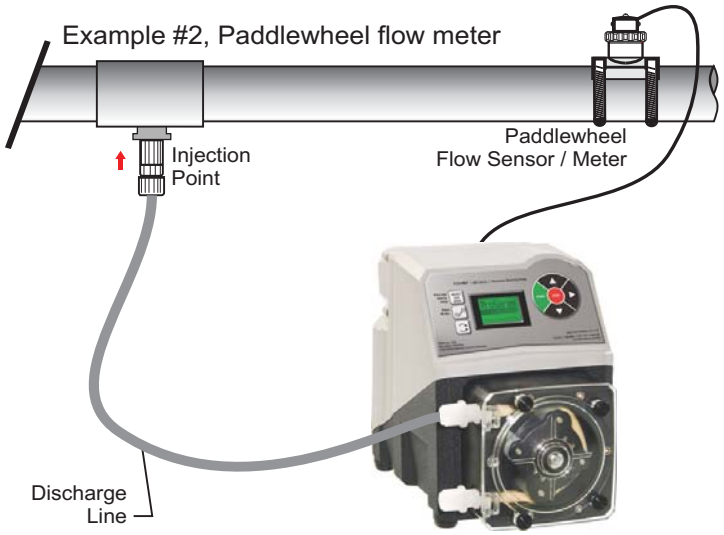




Example #1, Ultrasonic flow meter




or

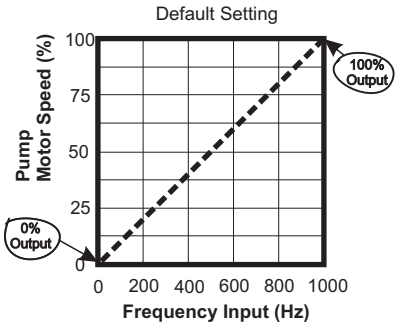
Example #2, Paddlewheel flow meter



## 11.0 Mode 4 - Pulse Batch (low speed pulse) Operation

Used to remotely control pump with an incoming pulse signal. Can be used with an external foot pedal, a water meter, a PLC, contact closure, or other low speed pulse devices.

Default setting: 1 Pulse = 100% motor speed for 2.5 seconds

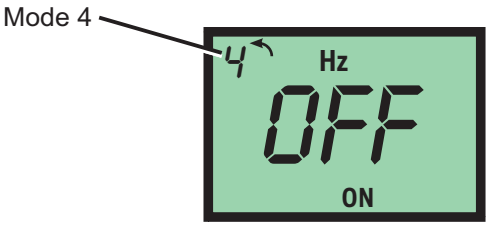



### Step 1

Press and release STOP button

Note: Mode cannot be changed while pump is in running.

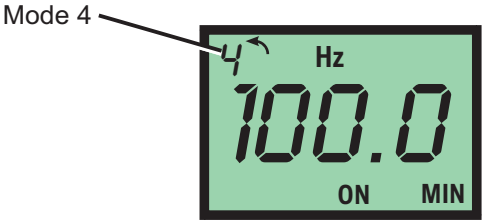
Press and release SELECT RUN MODE button multiple times until Mode 2 is selected.




### Step 2

With Mode 2 selected, press and hold SELECT RUN MODE button until 'On' icon begins flashing.

This indicates that you've entered Setup menu.



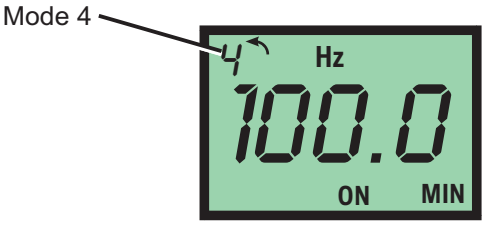

### Step 3

**Pump on-time** will be displayed in either MIN (minutes) or SEC (seconds).

To increase value, press and release UP arrow.

To decrease value, press and release DOWN arrow.

To save value, press and release RIGHT arrow.

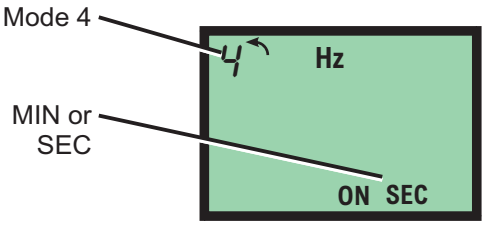



### Step 4

**MIN (minutes) or SEC (seconds)** will be displayed in lower right hand corner. This value will be linked to Pump on-time number in previous screen.

To change this setting, press and release either UP arrow or DOWN arrow.

To save value, press and release RIGHT arrow.

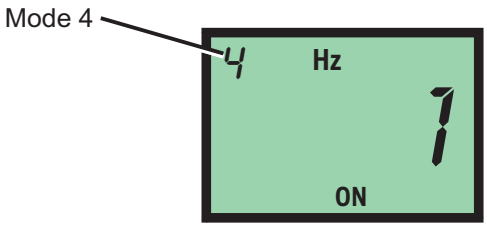



**Time-out** - Flex-Pro pumps have a time-out setting of 20 seconds while in configuration menus. If built-in timer exceeds 20 seconds without a button being pressed, then pump will exit configuration menu. Changes will only be saved after RIGHT arrow button is pressed and released.

## 11.0 Mode 4 - Pulse Batch (low speed pulse) Operation - Continued

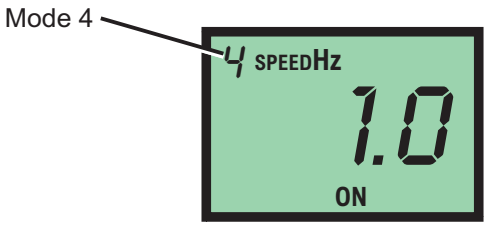
### Step 5

**Number of pulses to trigger pump start** will be displayed.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.



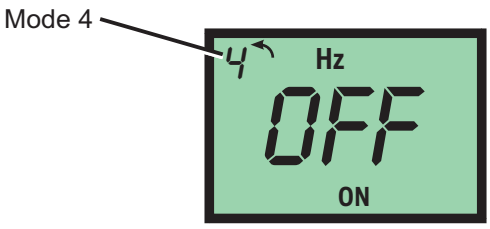

### Step 6

**Pump speed during on-time** will now be displayed.
Pump will run at this speed after selected number of pulses is reached from previous menu.
To increase value, press and release UP arrow.
To decrease value, press and release DOWN arrow.
To save value, press and release RIGHT arrow.




### Step 7

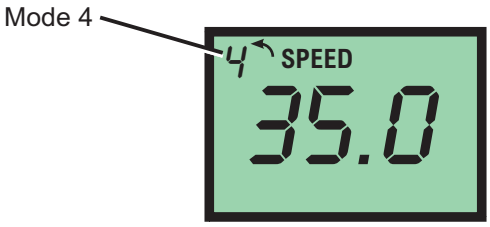
To exit Setup, press and hold SELECT RUN MODE button for a few seconds until you return to Run screen.




## 11.1 Mode 4 - Pulse Batch Operation Screen Shots

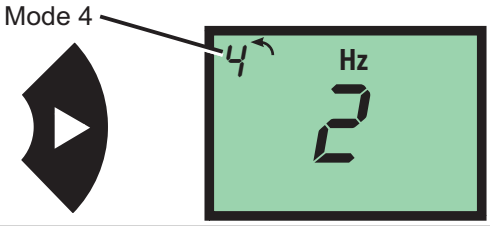
### Runtime Screen Shot 1

Display **motor speed percentage.**
Pump Running in Pulse Batch Operation



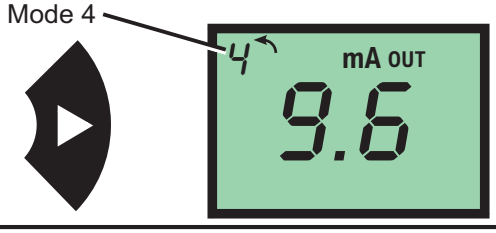

### Runtime Screen Shot 2

Display current number of pulses received
Press and release RIGHT arrow to view number of **pulses received** in real-time.




### Runtime Screen Shot 3

Press and release RIGHT arrow again to view **mA output** value in real-time (available on select models only).
Press and release RIGHT arrow again to view **motor speed percentage**, as in Screen Shot 1.



## 12.0 Pump Tube Timer

Flex-Pro has a built in Pump Tube Timer. Timer starts when rotor is rotating and stops when rotor is idle.

To view current Pump Tube Timer value, press and hold START button, then press and release DOWN arrow.

Tube Timer screen will appear. Screen will display current Pump Tube Time in run-time hours. Tube Timer screen will display for 4 seconds and then switch back to previous operating display screen.

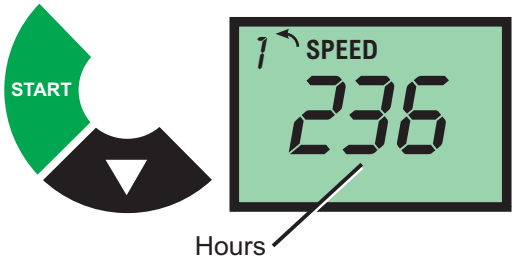
While displayed, press START button twice to reset Pump Tube Timer to zero.

When replacing pump tube, pump will ask you if you'd like to reset Pump Tube Timer. If you choose YES, screen will display current Pump Tube Time for 5 seconds before timer is reset to zero.

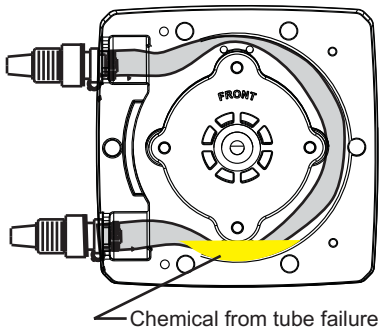
### Tube Life Timer

Display tube life timer.
Press and hold START button.
Press and release DOWN arrow.

Displays amount of total runtime hours on currently installed tube.
Time will be displayed in hours.
Timer will be display for approximately 4 seconds before returning to previous runtime screen.




## 13.0 TFD (Tube Failure Detection)




Flex-Pro is equipped with a *Tube Failure Detection* System which is designed to stop pump and provide an output alarm in event pump tube should rupture and chemical enters pump head. Pump will detect a chemical with a conductivity reading greater than 500 microsiemens. Chemicals with a conductivity of less than 500 microsiemens will not be detected.

This patented system is capable of detecting presence of a large number of chemicals including Sodium Hypochlorite (Chlorine), Hydrochloric (muriatic) Acid, Sodium Hydroxide, and many others. System will not be triggered by water (rain, condensation, etc.) or silicone oil (roller and tubing lubricant).

If system has detected chemical, pump tube must be replaced and pump head and roller assembly must be thoroughly cleaned. Failure to clean roller assembly will void warranty.

If TFD alarm occurs, pump will stop, close an alarm output, and screen will flash TFD with an alarm icon.

**Confirm Chemical Detection**

To determine if your chemical will be detected by system, remove pump head cover and pump tube and roller assembly.

Place a small amount of chemical in bottom of pump head - just enough to cover sensors. Replace pump head cover only.

Turn on pump (press START). If TFD system detects chemical, pump will stop after a two second confirmation period and TFD Alarm screen will display. If TFD system does not detect chemical, pump will continue to run after confirmation period.

Carefully clean chemical out of pump head being sure to remove all traces of chemical from sensor probes. Replace roller assembly and tubing. Replace pump head cover. Press START button to clear alarm condition and restart pump.

## 14.0 Alarm Relay

Pump has a built in 3 amp alarm output relay. Relay is pre-configured to energize on tube failure detection (TFD) and on Flow Verification Sensor (FVS).

A Flow Verification Sensor must be installed and configured for relay to trigger on no-flow conditions.

## 15.0 Reverse Rotor Rotation

| | |
|---|---|
| **CAUTION** ⚠ | Prior to service, pump clean water through pump and suction / discharge line to remove chemical. |

| | |
|---|---|
| **CAUTION** ⚠ | Always wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on solution being pumped. Refer to MSDS precautions from your solution supplier. |

Reverse rotation of pump; press and hold REVERSE ROTATION button until rotor begins rotating in opposite direction. This process can be used for many reasons throughout various industries.

Two reasons for reversing current rotor rotation; to purge chemical from tubing and to extend tube life.

Plan ahead before reversing rotor rotation. If check valves are installed, make necessary arrangements to allow back flow.

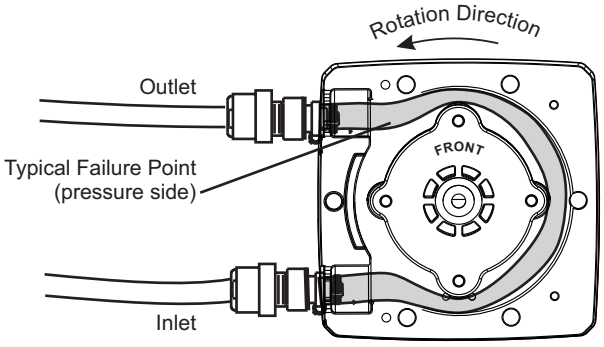
| | |
|---|---|
| **CAUTION** ⚠ | Failure to install check valves in their proper flow direction can cause excess pressure (PSIg) build up in system and can result in tube rupture.<br>Always use extreme caution and ensure proper connections when using this feature. |

If your desire is to simply extend tube life:

Typically tubing fails on outlet side (pressure side) of tube assembly in pump head.

Reversing rotation, moves outlet side (pressure side) to opposite side of tube assembly, greatly increasing tube life.

Stop pump before tube failure occurs.

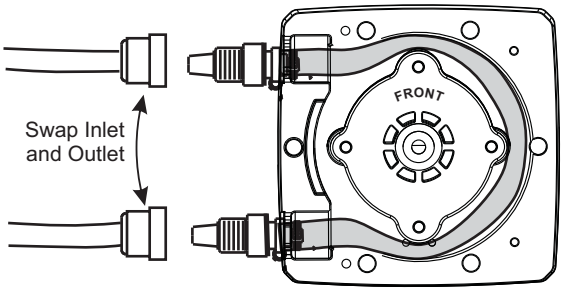



⚠

Disconnect power from pump. Carefully purge any pressure in discharge line of pump. Disconnect suction end tubing and discharge end tubing from pump head tubing.

IMPORTANT! Swap sides of suction (inlet) and discharge (outlet) tubing. No need to remove Pump Head Cover.

Double check all connections before starting pump.



## 16.0 Tube Replacement

| | |
|---|---|
| **CAUTION** ⚠ | Prior to service, pump clean water through pump and suction / discharge line to remove chemical. |
| **CAUTION** ⚠ | Always wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on solution being pumped. Refer to MSDS precautions from your solution supplier. |
| **CAUTION** ⚠ | Use provided Tube Installation Tool to leverage tubing into pump head, NOT YOUR FINGERS. |
| **CAUTION** ⚠ | Use extreme caution when replacing pump tube. Be careful of your fingers and DO NOT place fingers near rollers. |

## 16.1 Tube Removal

### Step 1

**Wear protective clothing, face shield, safety glasses and gloves during tube replacement.**

**CAUTION** ⚠

Relieve (remove) system pressure on discharge and suction side of pump. Failure to do so will cause solution to squirt when disconnecting tube connections. **SAFETY FIRST, REMOVE PRESSURE...**

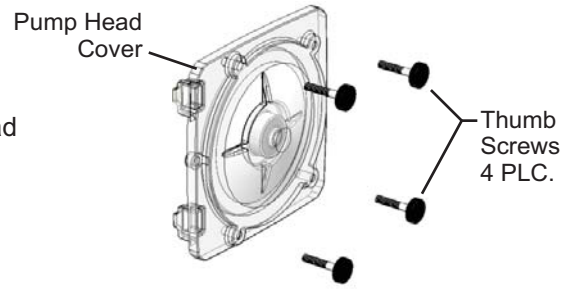
Disconnect system plumbing from pump tube adapters.

### Step 2

Press and release STOP button.

Remove four black thumb screws from front of pump head cover. Turn screws counterclockwise to remove.

Remove pump head cover by pulling straight out.



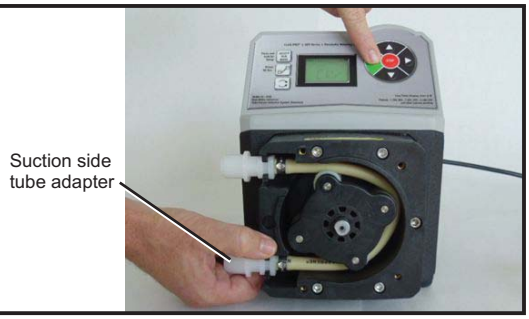

### Step 3

With pump stopped, securely grab hold of suction side of tube adapter.

**CAUTION!** Keep fingers away from rollers and rotor.

Press and release START button to allow rotation of rotor.

Gently pull suction side tube adapter out, away from pump.



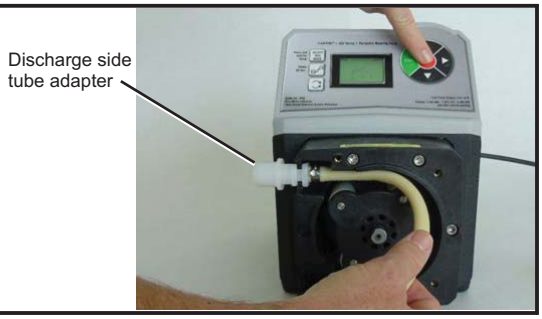

### Step 4

Continue to pull suction side adapter out of pump head while rotor is in rotation.

Press and release STOP button.

Carefully pull discharge side of tube adapter out of pump head.

Dispose of used tubing properly.



## 16.2 Tube Installation

**Before you begin.** Thoroughly clean Pump Head and Rotor. Rotor can be removed by pulling straight out. After cleaning process, push Rotor back on shaft. See drawing below for proper assembly. IMPORTANT! Rotor direction; word “FRONT” on Rotor must face forward (front of pump).

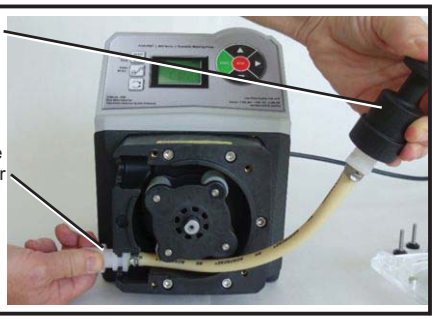
### Step 1

Press and release stop button to ensure pump is stopped.

With pump stopped, press suction side of tube adapter securely into pump head.

Clip Tube Installation Tool to discharge side of tube adapter.

Always keep fingers away from rollers and rotor.




### Step 2

Your hand should only come in contact with installation tool.

Press and release START button.

Use installation tool to leverage tubing into pump head while rotor is rotating.

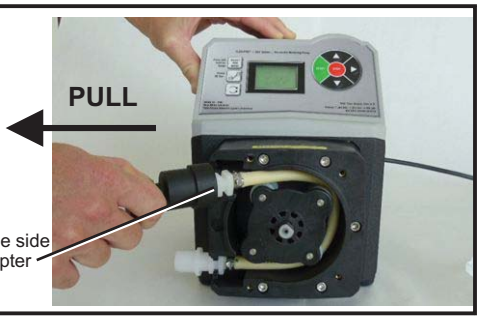
### Step 3

Continue to hold onto installation tool.

Allow rotor to rotate a few times, this will stretch tubing out.

After a few rotations, pull installation tool and tubing in direction of rotation.

Press discharge side of tube adapter securely into pump head.

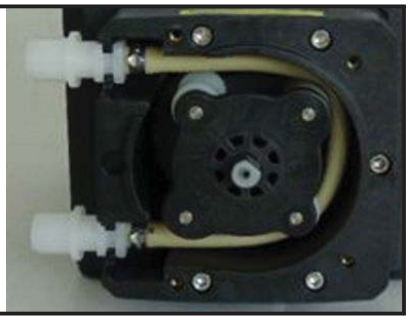



### Step 4

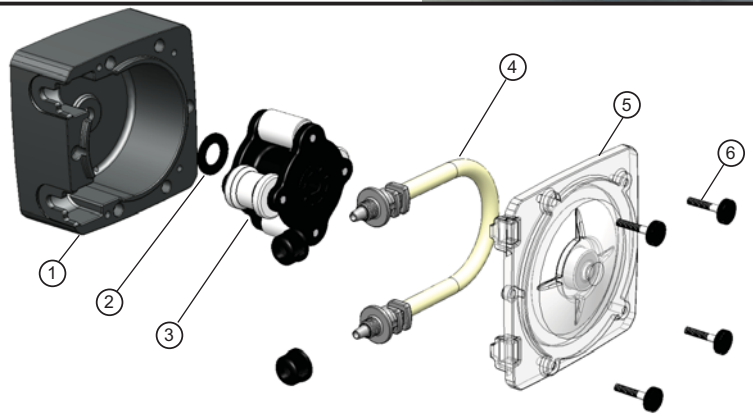
Press and release STOP button on pump.

Suction and discharge tube adapter ends should be securely held in place on pump head as illustrated in photo.

Secure pump head cover to pump head using four black thumb screws.



**Tube Installation Tool**
**90002-278**



## 17.0 Pump Maintenance

| CAUTION | Always wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on solution being pumped. Refer to MSDS precautions from your solution supplier. |
|---|---|

**Routine Inspection and Maintenance**

Pump requires very little maintenance. However, pump and all accessories should be checked weekly. This is especially important when pumping chemicals. Inspect all components for signs of leaking, swelling, cracking, discoloration or corrosion. Replace worn or damaged components immediately.

Cracking, crazing, discoloration during first week of operation are signs of severe chemical attack. If this occurs, immediately remove chemical from pump. Determine which parts are being attacked and replace them with parts that have been manufactured using more suitable materials. Manufacturer does not assume responsibility for damage to pump that has been caused by chemical attack.

**How to Clean and Lubricate Pump**

Pump will require occasional cleaning. Amount will depend on severity of service.

- When changing pump tube assembly, pump head chamber, roller assembly and pump head cover should be wiped free of any dirt and debris.

- When changing pump tube assembly, wipe motor shaft with clean towel. Apply a small amount of grease to shaft. This will help prevent possibility of rotor sticking to motor shaft.

- Pump head cover bearing may require grease periodically. Apply a small amount of grease (Aeroshell aviation grease #5 or equivalent) when necessary.

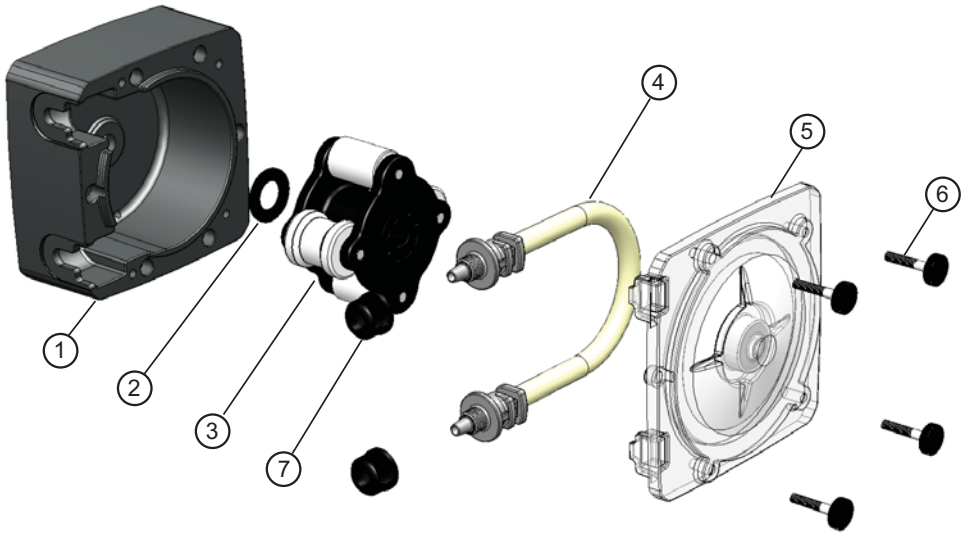
- Although not necessary, 100% silicon lubrication may be used on roller assembly and tube assembly.

- Periodically clean injection/check valve assembly, especially when injecting fluids that calcify such as sodium hypochlorite. These lime deposits and other build ups can clog fitting, increase back pressure and interfere with check valve operation.

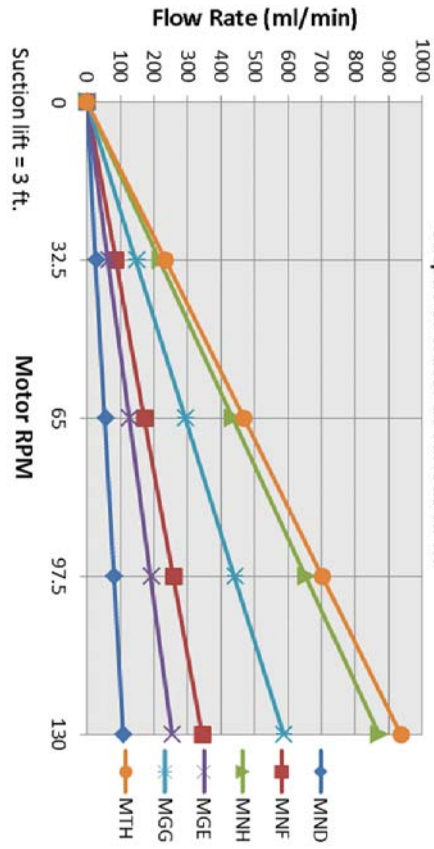
- Periodically clean suction strainer.

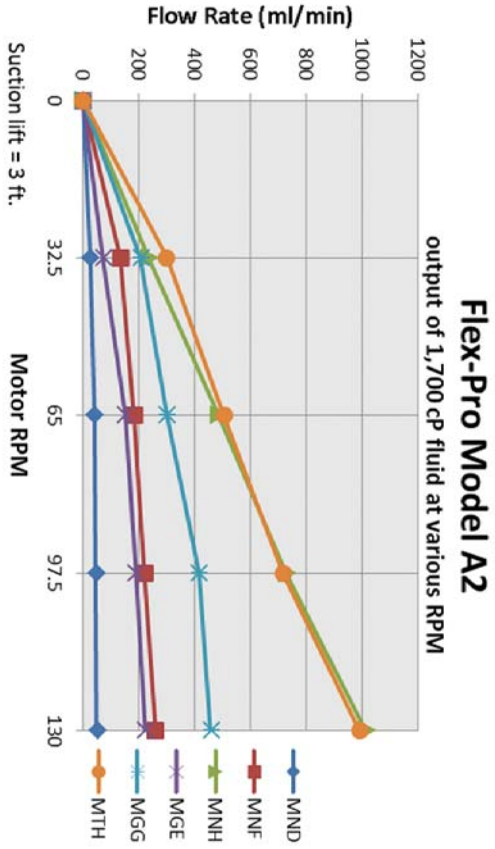
## 18.0 Pump Head Replacement Parts List

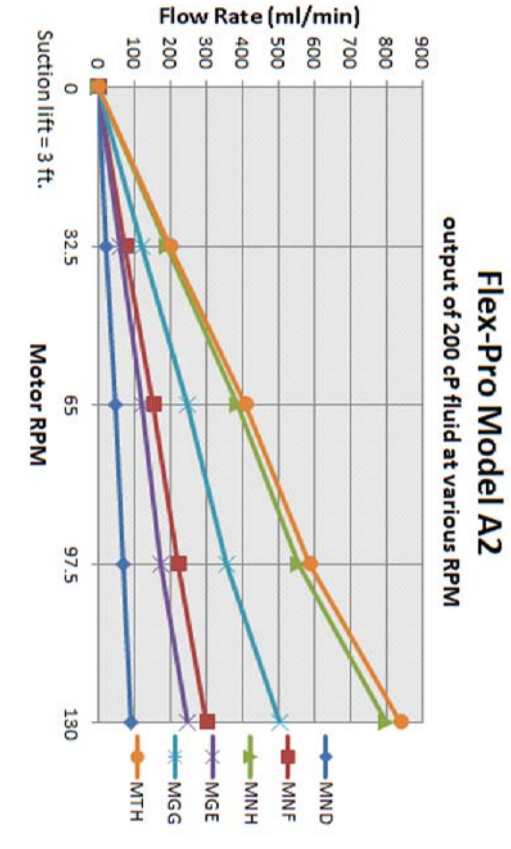
| | Item | Description | Part Number | QTY |
|---|---|---|---|---|
| | 1 | Pump Head | A2-SXX-H | 1 |
| | 2 | Spacer, Back | 76001-503 | 2 |
| Norprene® — Interchangeable Rotor. Tubing in this group are interchangeable with single rotor (roller assembly). | 3 | Roller Assembly Complete (Rotor), For ND and NF Tubes | A2-SND-R | 1 |
| | 4 | Tube Assembly, 3/8” tube connect, Norprene ND (.075 ID) | A2-SND-T | 1 |
| | 4 | Tube Assembly, 1/2” Male NPT connect, Norprene ND (.075 ID) | A2-MND-T | 1 |
| | 4 | Tube Assembly, 3/8” tube connect, Norprene NF (.155 ID) | A2-SNF-T | 1 |
| | 4 | Tube Assembly, 1/2” NPT Male, Norprene NF (.155 ID) | A2-MNF-T | 1 |
| Norprene® — Interchangeable Rotor. Tubing in this group are interchangeable with single rotor (roller assembly). | 3 | Roller Assembly Complete (Rotor), For NH Tubes | A2-SNH-R | 1 |
| | 4 | Tube Assembly, 3/8” tube connect, Norprene NH (.250 ID) | A2-SNH-T | 1 |
| | 4 | Tube Assembly, 1/2” Male NPT connect, Norprene NH (.250 ID) | A2-MNH-T | 1 |
| Norprene® Chemical — Interchangeable Rotor. Tubing in this group are interchangeable with single rotor (roller assembly). | 3 | Roller Assembly Complete (Rotor), For TH Tubes | A2-STH-R | 1 |
| | 4 | Tube Assembly, 3/8” tube connect, Norprene Chemical TH (.250 ID) | A2-STH-T | 1 |
| | 4 | Tube Assembly, 1/2” Male NPT, Norprene Chemical TH (.250 ID) | A2-MTH-T | 1 |
| Tygothane® — Interchangeable Rotor. Tubing in this group are interchangeable with single rotor (roller assembly). | 3 | Roller Assembly Complete (Rotor), For GE, and GG Tubes | A2-SGE-R | 1 |
| | 4 | Tube Assembly, 3/8” tube connect, Tygothane GE (.125 ID) | A2-SGE-T | 1 |
| | 4 | Tube Assembly, 1/2” Male NPT connect, Tygothane GE (.125 ID) | A2-MGE-T | 1 |
| | 4 | Tube Assembly, 3/8” tube connect, Tygothane GG (.187 ID) | A2-SGG-T | 1 |
| | 4 | Tube Assembly, 1/2” Male NPT connect, Tygothane GG (.187 ID) | A2-MGG-T | 1 |
| | 5 | Pump Head Cover, Annealed Acrylic | A2-SXX-C | 1 |
| | 6 | Thumb Screw | 90011-183 | 4 |
| | 7 | Tube Nut, Compression, For 3/8” Tubing | C-330-6 | 2 |
| | Not Shown | Stainless Steel mounting bracket kit (pair) | 72000-379 | 1 |
| | Not Shown | Stainless Steel extended mounting bracket kit (pair) | 72000-380 | 1 |
| | Not Shown | Rubber feet | 90003-561 | 4 |

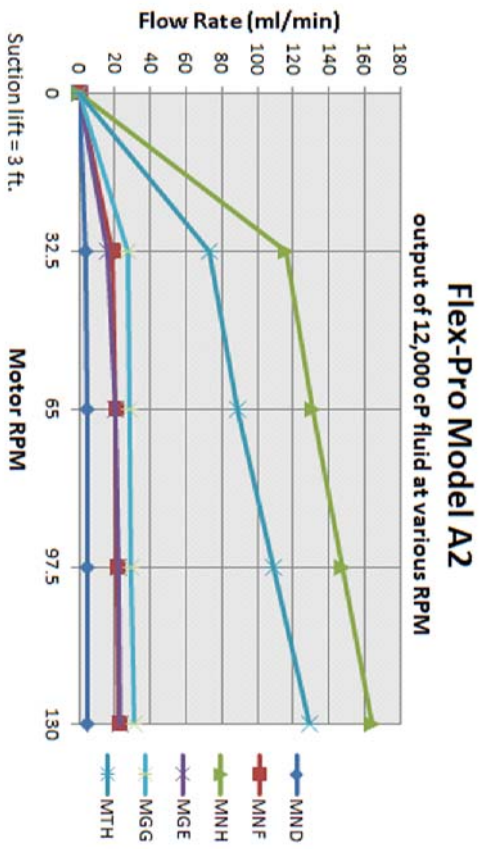


## 19.0 Output Versus Fluid Viscosity



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## LIMITED WARRANTY

Your new Flex-Pro pump is a quality product and is warranted for 24 months from date of purchase (proof of purchase is required). The pump will be repaired or replaced at our discretion. Pump Head and roller assembly is warrantied against damage from chemical attack when proper TFD (Tube Failure Detection) system instructions and maintenance procedures are followed.

## WHAT IS NOT COVERED

- **Pump Tube Assemblies and rubber components – They are perishable and require periodic replacement.**
- **Pump removal, or re-installation, and any related labor charge.**
- **Freight to the factory, or ProSeries service center.**
- **Pumps that have been tampered with, or in pieces.**
- **Damage to the pump that results from misuse, carelessness such as chemical spills on the enclosure, abuse, lack of maintenance, or alteration which is out of our control.**
- **Pumps damaged by faulty wiring, power surges or acts of nature.**

Blue-White Industries does not assume responsibility for any loss, damage, or expense directly or indirectly related to or arising out of the use of its products. Failure must have occurred due to defect in material or workmanship and not as a result of operation of the product other than in normal operation as defined in the pump manual.
Warranty status is determined by the pump's serial label and the sales invoice or receipt. The serial label must be on the pump and legible. The warranty status of the pump will be verified by Blue-White Industries or a factory authorized service center.

## OTHER IMPORTANT WARRANTY INFORMATION

Please be advised; injection and metering devices are not intended as a means of treating water to render it suitable for human consumption. When used as hypochlorinators, they are meant to destroy bacteria and algae contamination, before its removal by filtration. Acid and soda injectors are used for PH control (balance). Blue-White Industries injectors are factory tested with water only for pressure and performance. Installers and operators of these devices must be well informed and aware of the precautions to be taken when injecting various chemicals -especially those considered hazardous or dangerous, eye protection must be worn when working around this product or any other metering type of pump.
Should it become necessary to return the pump for repair or service, you must attach information regarding the chemical used as some residue may be present within the unit which could be a hazard to service personnel.
Blue-White Industries will not be liable for any damage that may result by the use of chemicals with their injectors and its components.
Thank you.

## PROCEDURE FOR IN WARRANTY REPAIR

Contact the factory to obtain a RMA (Return Material Authorization) number. Carefully pack the pump to be repaired. It is recommended to include foot strainer and injection/check valve fitting since these devices may be clogged and part of the problem. Please enclose a brief description of the problem as well as the original invoice or sales receipt, or copy showing the date of purchase. Prepay all shipping costs. COD shipments will not be accepted. Warranty service must be performed by the factory or an authorized ProSeries service center. Damage caused by improper packaging is the responsibility of the sender. When In-Warranty repair or replacement is completed, the factory pays for return shipping to the dealer or customer.

Users of electrical and electronic equipment (EEE) with the WEEE marking per Annex IV of the WEEE Directive must not dispose of end of life EEE as unsorted municipal waste, but use the collection framework available to them for the return, recycle, recovery of WEEE and minimize any potential effects of EEE on the environment and human health due to the presence of hazardous substances. The WEEE marking applies only to countries within the European Union (EU) and Norway. Appliances are labeled in accordance with European Directive 2002/96/EC.
Contact your local waste recovery agency for a *Designated Collection Facility* in your area.

ProSeries® by Blue-White Ind.

5300 Business Drive, Huntington Beach, CA 92649 USA
**Phone:** 714-893-8529 **FAX:** 714-894-9492
**E mail:** sales@blue-white.com **or** techsupport@blue-white.com **URL:** www.blue-white.com

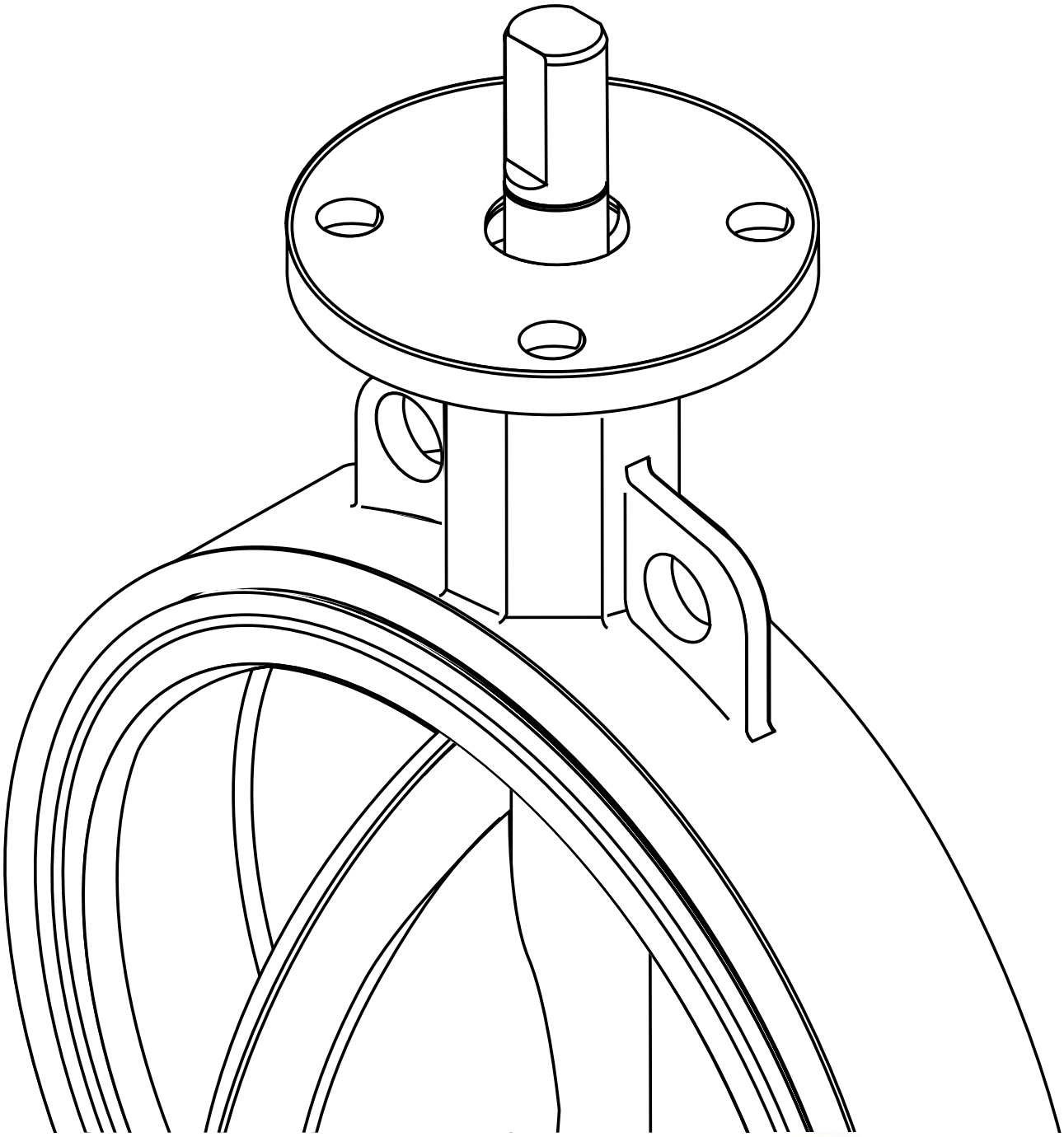
P.N. 80000-475 Rev. 07222013

Bray CONTROLS

OPERATION AND MAINTENANCE MANUAL

# RESILIENT SEATED BUTTERFLY VALVES

20/21, 22/23, 30/31, 3A/3AH, 31H, 31U, 32/33, 35/36, 36H



The High Performance Company

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FOR INFORMATION ON THESE PRODUCTS AND OTHER BRAY PRODUCTS
PLEASE VISIT US AT OUR WEB PAGE - www.bray.com

# Safety Instructions - Definition of Terms

**READ AND FOLLOW THESE INSTRUCTIONS**
**SAVE THESE INSTRUCTIONS**

| | |
|---|---|
| **WARNING** | indicates a potentially hazardous situation which, if not avoided, **could** result in death or serious injury. |
| **CAUTION** | indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. |
| **NOTICE** | used without the safety alert symbol indicates a potential situation which, if not avoided, may result in an undesirable result or state, including property damage. |

# Introduction

## Historical Experience

Based on over twenty years experience in the butterfly industry, Bray can state without question the majority of all field problems for resilient seated butterfly valves are directly related to poor installation procedures. For this reason, it is very important all distributor salespeople educate their customers regarding proper installation of resilient seated butterfly valves.

## Butterfly Valve Seat / Disc Function

Before reviewing the proper installation, maintenance, and repair procedures for resilient seated butterfly valves, let's discuss the seat-disc function of a butterfly valve. The seat in a resilient seated butterfly valve has molded o-rings on its flange face. **As a result, no gaskets are required as these o-rings serve the function of a gasket.** The flange face and molded o-rings of the seat extend beyond the body face-to-face to ensure sealing at the flange faces. The seat material, which extends past the face is compressed in installation and flows toward the center of the valve seat I.D.

In essence, the elastomer seat acts as a liquid, and the displaced elastomer moves toward the point of least resistance. The seat I.D. of all resilient seated butterfly valves is smaller than the disc O.D. This difference, the disc-seat interference, plus the increased interference due to the elastomer movement toward the seat center after installation, has been engineered so as to be the basis for pressure rating capability and the related seating/unseating torques. **Any change in this interference due to improper installation directly affects the pressure rating and seating/unseating torques.**

Finally, unlike many valve types, the resilient seated butterfly valve's disc actually extends beyond the face of the valve body at given angles of opening (say, 30° or more) when installed between flanges.

**CAUTION**

It is very important before installation to ensure the critical chord dimension of the disc at the full open position is less than the adjacent pipe flange I.D.

### Shipment & Storage

A. The seat, disc, stem and bushing of the resilient seated butterfly valve should be coated with silicone lubricant unless specified otherwise as recommended by Bray Technical Bulletin 1028.

B. The disc should be positioned at 10° open. **Note**: See page 2 for special considerations for valves with spring return actuators.

C. Valves should be stored indoors with a preferred temperature range from 40° F (4°C) to 85° F (29°C).

D. When valves are stored for a long time, open and close the valves once every 3 months.

E. Ship and store valves so that no heavy loads are applied to the bodies.

# Installation Considerations – Piping and Valve Orientation and Placement

## Piping and Flanged Compatibilities

### Piping

These valves have been engineered so that the critical disc chord dimension at the full open position will clear the adjacent inside diameter of most types of piping, including Schedule 40, lined pipe, heavy wall, etc.

### Metal Flanges

Resilient seated butterfly valves have been designed to be suitable for all types of flanges (ASME, DIN, JIS and other international flange standards), whether flat-faced, raised face, slip-on, weld-neck, etc. Proper alignment of any butterfly valve between flanges is critical to good performance of the valve. The flange bolts must also be evenly tightened around the circumference of the valve, providing consistent flange compression of the molded o-ring in the seat face.

Since Bray does not recommend the use of gaskets between flanges on resilient seated butterfly valves, a uniform flange face is critical to proper valve sealing. Most weld-neck and slip-on flanges conforming to ASME specifications have an appropriate flange face. Types A and B butt-weld stub-end flanges also provide a suitable mating surface for the molded o-ring.

It should be noted that Type C butt-weld stub-end flanges have an "as formed" flange face. The varying surface of this flange face can create sealing problems between any resilient-seated butterfly valve and the flange face. For this reason, Type C flanges are not recommended for use with resilient-seating butterfly valves.

### Non-Metallic Flanges

When non-metallic flanges, such as plastic or PVC, are used with resilient seated butterfly valves, care must be taken not to over-tighten the flange bolts. The inherent flexibility of these non-metallic flange materials allow them to be over-tightened relatively easily. Flexing caused by this over-tightening can actually reduce the compression of the valve between the flanges, causing leaks between the valve and the flange face. Proper alignment and firm, even, but not excessive tightening of flange bolts are especially important with non-metallic flanges. In some cases, non-metallic flanges of low quality will not mate tightly with butterfly valves regardless of the care taken during installation.

### Valves with Spring Return Actuators

#### 1. Fail Closed Assemblies

If the valve is supplied with an actuator, the butterfly valve is shipped in the full closed position (as no air pressure is present to compress the springs and open the disc).

**CAUTION**

Installing the valve with the disc in the full closed position may create a compression set on the seat causing higher than expected torques or premature seat failure. It is recommended to:

- Remove the actuator. Be sure to scribe the valve and actuator to ensure the re-installed actuator is in the exact same quadrant as originally configured
- Install the valve per the attached installation tag instructions
- Re-install the actuator ensuring it is in the proper quadrant

#### 2. Fail Open Assemblies

If the valve is supplied with an actuator, the butterfly valve disc is shipped in the full open position (as no air pressure is present to compress the springs and close the valve disc.) The sealing surface, or disc edge, is therefore exposed. Damage to that surface will cause premature seat failure.

**CAUTION**

Use caution installing the valve being careful not to damage the disc edge. It is recommended to:

- Remove the actuator. Be sure to scribe the valve and actuator to ensure the re-installed actuator is in the exact same quadrant as originally configured
- Install the valve per the attached installation tag instructions
- Re-install the actuator ensuring it is in the proper quadrant

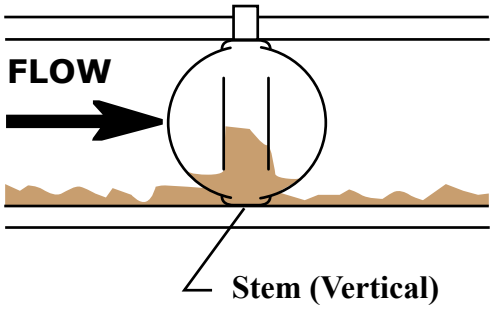
### 3. Valve Location

a. Resilient seated butterfly valves should be installed if possible a minimum of 6 pipe diameters from other line elements, i.e., elbows, pumps, valves, etc. of course, 6 pipe diameters are not always practical, but it is important to achieve as much distance as possible.

b. Where the resilient seated butterfly valve is connected to a check valve or pump, use an expansion joint between them to ensure the disc does not interfere with the adjacent equipment.

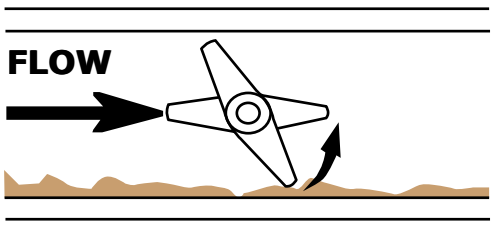
### 4. Valve Orientation

a. In general, Bray recommends the resilient seated valve be installed with the stem in the vertical position and the actuator mounted vertically directly above the valve; however, there are those applications as discussed below where the stem should be horizontal. **NOTE:** Bray does not recommend valves be installed in an upside-down position.




**INCORRECT INSTALLATION**

**Sludge builds up on disc**




**Stem (Horizontal)**

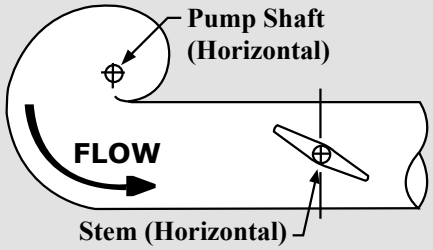
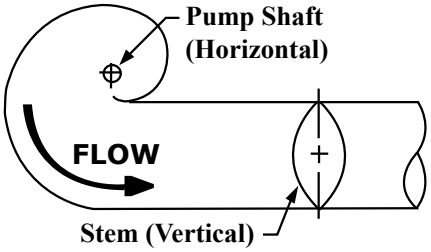
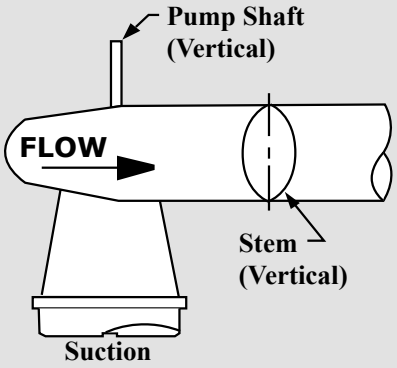
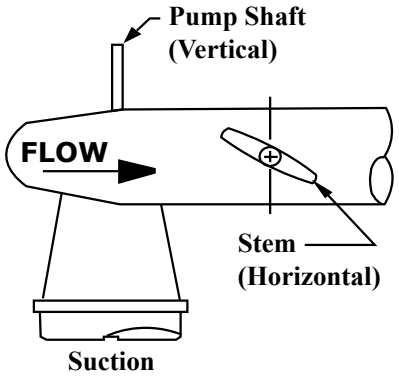
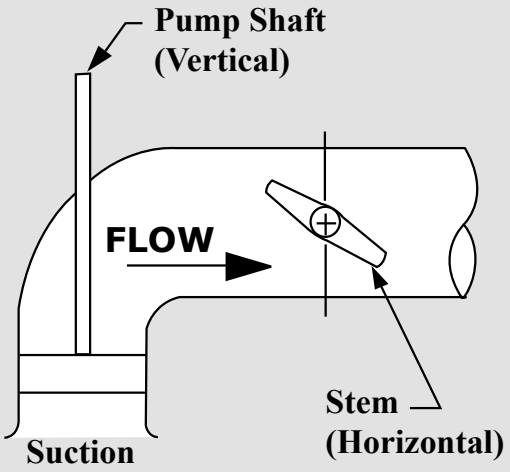
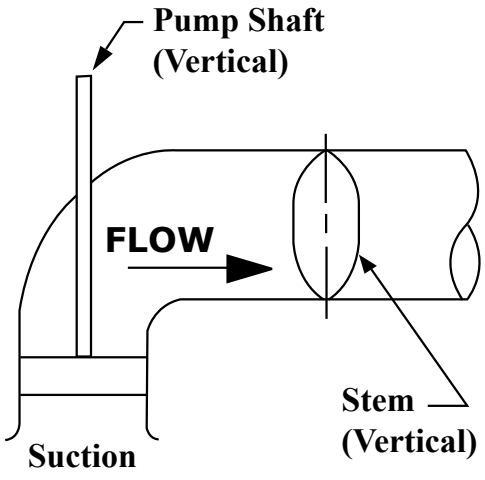
**CORRECT INSTALLATION**

**Sludge passes under disc**

**b. For slurries, sludge, mine tailing, pulp stock, dry cement, and any media with sediment or particles, Bray recommends the resilient seated valve be installed with the stem in the horizontal position with the lower disc edge opening in the downstream direction.**

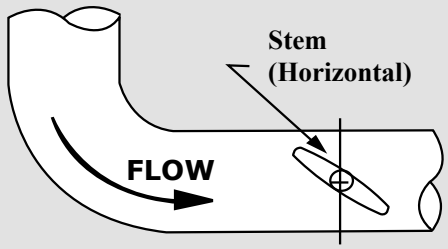
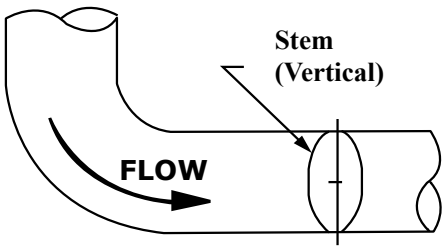
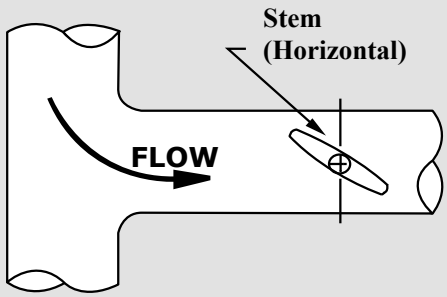
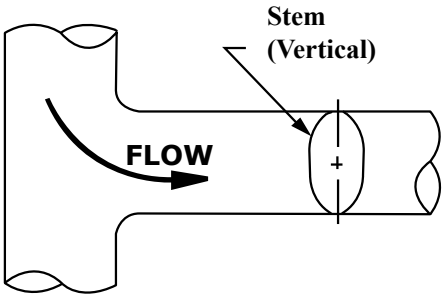
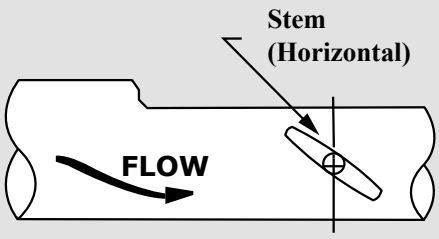
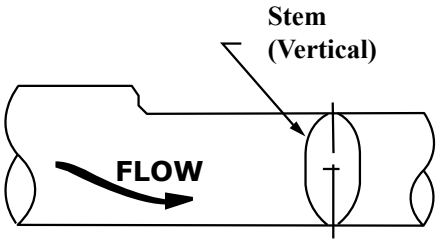
**Valve Orientation (Continued)**

c. Resilient seated butterfly valve located at the discharge of a pump should be oriented as follows:

| | INCORRECT INSTALLATION | CORRECT INSTALLATION |
|---|---|---|
| i.) For centrifugal Pump – Pump shaft horizontal and stem vertical |  |  |
| ii.) Centrifugal Pump – Pump shaft vertical & stem horizontal |  |  |
| iii.) Axial Pump – Pump shaft vertical & stem vertical |  |  |

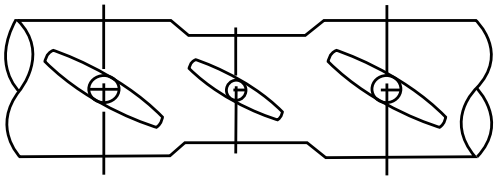
**Valve Orientation (Continued)**

d. Butterfly valves located downstream of a bend or pipe reducer should be oriented as follows:

| | INCORRECT INSTALLATION | CORRECT INSTALLATION |
|---|---|---|
| i.) Bend |  |  |
| ii.) Tee |  |  |
| iii.) Pipe Reducer |  |  |

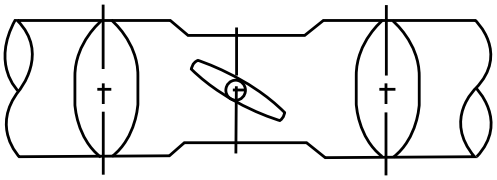
**Valve Orientation (Continued)**

e. Butterfly valves in combination for control/isolation applications should be installed as follows:




**INCORRECT INSTALLATION**

Combination with all valve stems in the same direction accelerates possible noise, vibration, & erosion problems.




**CORRECT INSTALLATION**

Combination with the stem of the control valve at right angle to those of other valves tends to cancel the drift of the fluid, and reduces noises, vibration, and erosion.

## Installation Procedure

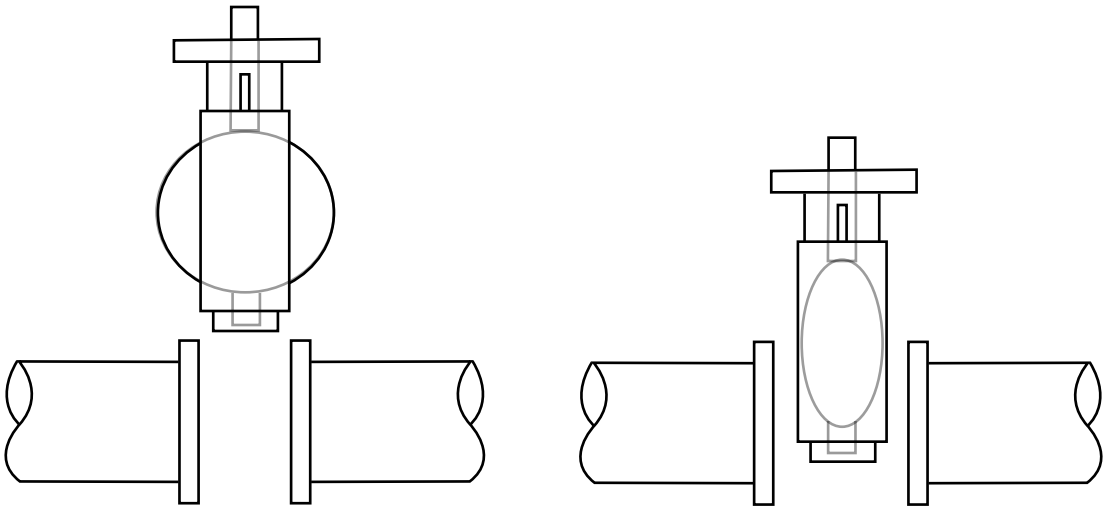
## A. General Installation

1. Make sure the pipeline and pipe flange faces are clean. Any foreign material such as pipe scale, metal chips, welding slag, welding rods, etc., can obstruct disc movement or damage the disc or seat.
2. The Bray elastomer seat has molded o-rings on the face of the seat. **As a result, no gaskets are required as these o-rings serve the function of a gasket.**
3. Align the piping and then spread the pipe flanges a distance apart so as to permit the valve body to be easily dropped between the flanges without contacting the pipe flanges ***(see figure 1 page 6).***
4. Check to see that the valve disc has been positioned to a partially open position, with the disc edge about 1/2 inch to 3/8 inch inside the face of the seat, (approximately 10° open) ***(see figure 1 page 6)*** **Note: See page 2 for special consideration for valves with spring return actuators.**
5. Insert the valve between the flanges as shown in figure 1 of page 6, taking care not to damage the seat faces. Always pick the valve up by the locating holes or by using a nylon sling on the neck of the body.

**WARNING**

Never pick up the valve by the actuator or operator mounted on top of the valve.

**Figure 1 – Insert Resilient Seated Butterfly Valve Between Flanges**



**INCORRECT INSTALLATION**

**CAUTION**

Pipe not spread, disc opened beyond valve body face; Results; Disc edge damaged when it hits pipe flange.

**CORRECT INSTALLATION**

Pipe spread and aligned, disc rotated; Results; no undesirable beginning seating/ unseating torque, disc edge protected.

6. Place the valve between the flanges, center it, and then span the valve body with all flange bolts, but do not tighten the bolts. Carefully open the disc to the full open position, making sure the disc does not hit the adjacent pipe I.D. Now systematically remove jack bolts or other flange spreaders, and hand-tighten the flange bolts as shown in **Figure 2** below. Very slowly close the valve disc to ensure disc edge clearance from the adjacent pipe flange I.D. Now open the disc to full open and tighten all flange bolts per specification as shown in **Figure 2**. Finally, repeat a full close to full open rotation of the disc to ensure proper clearances ***(See figures 3 & 4 page 7)***.

**Figure 2 – Flange Bolt Tightening Pattern**

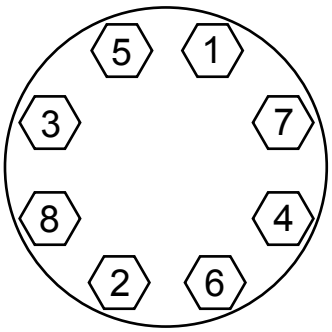
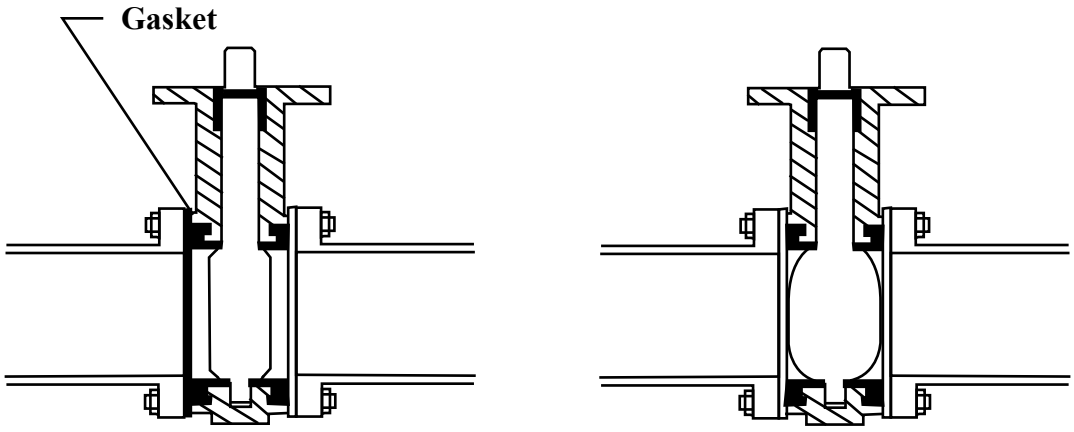


**Figure 3 – Initial Centering & Flanging of Valve**



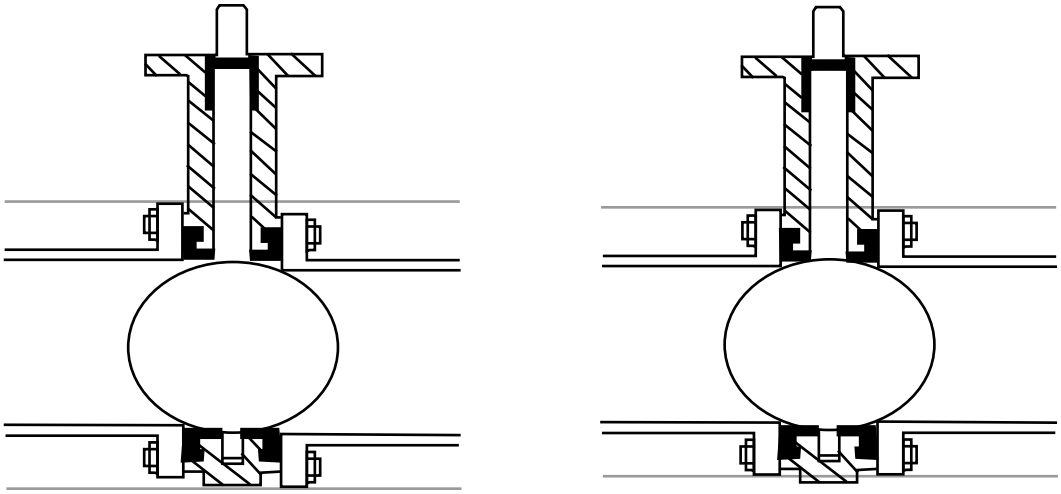

## INCORRECT INSTALLATION

Disc in closed position; gaskets used; Results – Seat distorted and over-compressed causing high initial unseating torque problems.

## CORRECT INSTALLATION

Bolts snugged, not torqued tight, disc edge within body face-to-face but not fully closed, no flange gaskets; Results: No disc edge damage, proper sealing allowed.

**Figure 4 – Final Aligning & Tightening of Flange Bolts**



## INCORRECT INSTALLATION

Piping misaligned; Results Disc O.D. strikes pipe I.D. causing disc edge damage, increased torque & leakage. Seat face o-rings will not seal properly with incorrectly aligned piping.

## CORRECT INSTALLATION

Piping aligned properly when bolts tightened, disc in full open position; Results – disc clears adjacent pipe I.D., seat face seals properly, no excessive initial torque.

When resilient seated butterfly valves are to be installed between ASME welding type flanges, care should be taken to abide by the following procedure to ensure no damage will occur to the seat:

1. Place the valve between the flanges with the flange bores and valve body aligned properly. The disc should be in the 10° open position.
2. Span the body with the bolts.
3. Take this assembly of flange-body-flange and align it properly to the pipe.
4. Tack weld the flanges to the pipe.
5. When tack welding is complete, remove the bolts and the valve from the pipe flanges and complete the welding of the flanges. Be sure to let the pipe and flanges cool before installing the valve.

**CAUTION**

Never complete the welding process (after tacking) with the valve between pipe flanges. This causes severe seat damage due to heat transfer.

**Installation of Bray PTFE Seated Butterfly Valves in Plastic Flanges.**

Bray recommends the following guidelines when PTFE Seated Valves are installed between plastic flanges:

1. The valve body should be coated with epoxy, not nylon. The extra thickness of the nylon coating slightly reduces the seat compression, and every advantage to maximize seat compression should be taken with plastic flanges.
2. The plastic flange can be either one piece construction, or two piece construction comprised of a stub end and a backup ring.
3. The plastic flange style can be butt-weld, socket or slip-on, but butt-weld and socket are preferred.
4. The plastic flange face must be flat. Concave and convex flange faces are not acceptable. This includes flange faces that were originally flat but later distorted into a concave shape by over tightening the flange bolts.
5. The plastic flange face surface may have grooves or serrations, provided the grooves do not exceed .100" (2.54 mm) in width or .020" (.508 mm) in depth. If the grooves are less than .100" (2.54 mm) in width, the groove depth must not exceed the width. However, fine conentric or "phonograph record" grooves are acceptable regardless of the groove depth.
6. Flange gaskets must not be used with PTFE seats, since they create an uncontrolled over compression that can buckle the PTFE and damage the seat. If a damaged face, a flange gasket can appear to cure the leak to atmosphere, while simultaneously damaging the PTFE seat and creating a second leak across the disc or up the stem hole. Leaks across the plastic flange must be cured without the use of gaskets, by proper selection and installation of the flange.
7. The bolts holding plastic flanges should be installed in strict conformance to the recommended practices of the plastic flange manufacturer. This usually involves aligning the flanges accurately, using lubricated bolts, and tightening the bolts in the proper sequence and to the specified torque. Uniform stress across the flange prevents leakage.

## Maintenance and Repair

The many Bray features minimize wear and maintenance requirements. No routine lubrication is required. **All components – stem, disc, seat, bushing, stem seal, etc., are field replaceable, no adjustment is required**. If components require replacement, the valve may be removed from the line by placing the disc in the near closed position, then supporting the valve and removing the flange bolts.

**WARNING** No valve maintenance, including removal of manual or power actuators, should be performed until the piping system is completely depressurized.

# Appendix A

# Disassembly/Assembly Instructions

# Series 20/21 Resilient Seated Butterfly Valves

## Disassembly

1. Remove handle, gear operator or power actuator from actuator mounting flange.
2. Remove the body bolts and pull the lower body half away from the seat.
3. Pull the seat and disc stem from the upper body half.
4. Remove bushing and seal from the upper body.
5. Push the seat into an oval shape and remove the disc stem by withdrawing the short stem end first.

## Assembly

1. Push the long stem end of the disc into the seat.
2. Then push the seat over the disc's short stem.
3. Place the disc stem and seat into the upper body half.
4. Align the lower body with the upper body and position lower body in the seat.

| | |
|---|---|
| **NOTICE** | The body halves have a matching casting node on one side only to ensure correct assembly of body halves. |

5. Replace the body bolts and tighten.
6. Install the stem seal, then the stem bushing.

   **Note: It is recommended that the stem bushing be coated with a light amount of silicone grease before installation in the valve body. This coating of silicone grease will assist in keeping the stem bushing in the valve body until an actuator is mounted on the valve.**

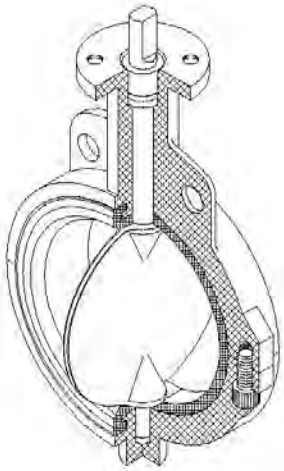
7. Replace handle, manual gear operator or power actuator on the actuator mounting flange.

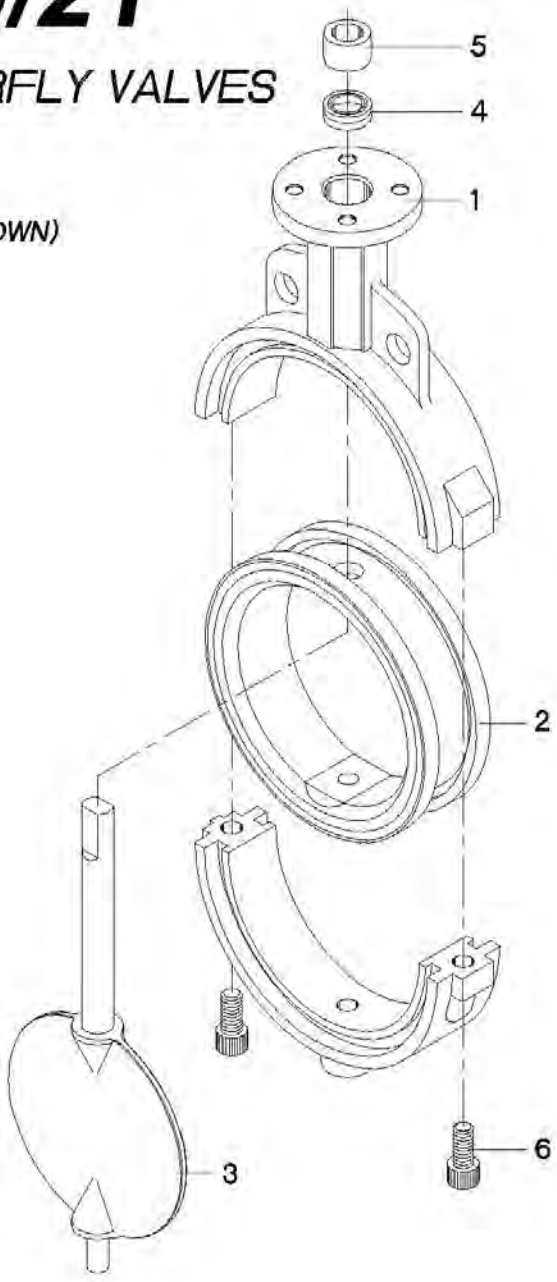
## Appendix A

# SERIES 20/21

## RESILIENT SEATED BUTTERFLY VALVES

1 BODY (S20 WAFER STYLE SHOWN)
2 SEAT
3 DISC STEM
4 STEM SEAL
5 STEM BUSHING
6 BODY BOLT





# Appendix B

## Disassembly/Assembly Instructions

## Series 22/23 Resilient Seated Butterfly Valves

### Disassembly –

1. Remove the handle, gear operator, or power actuator from actuator mounting flange.
2. Remove the "Spirolox"® retaining ring and the two C-ring stem retainers from the stem hole.
3. Then remove the stem, bushing and seal.
4. Remove the disc from the seat, protecting the disc edge at all times.
5. Remove the seat energizer from the stems and seat.
6. Remove the lower and upper stems from the disc or remove the lower stem if the upper stem is connected to the disc
7. Compress the seat just enough to allow the disc to be removed along with the seal capsules.
8. Remove the retainer bushing and upper stem seal.

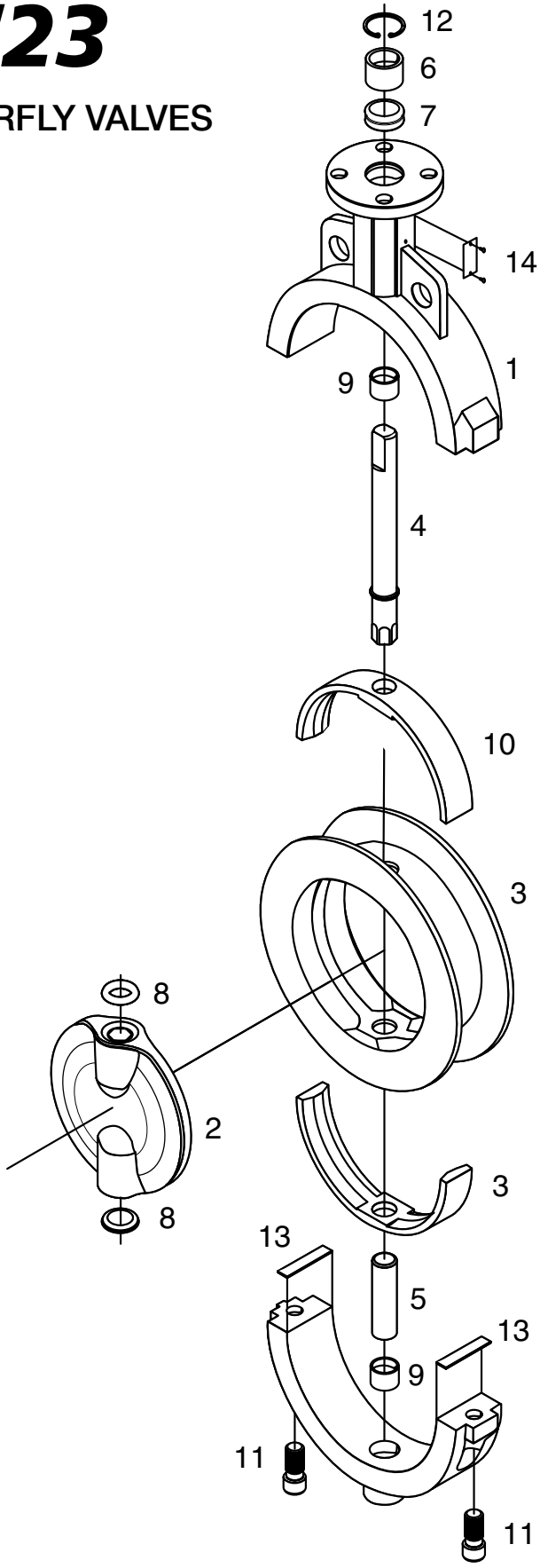
### Assembly –

1. Install the stem bearings in upper and lower body halves.
2. Place the body seal strip on the lower body half, overlapping the body width by approximately 0.19" on both sides.
3. Press the seat to make the I.D. elliptical, then insert the shaft seals and place the disc into the seat. Rotate the disc hubs into alignment with the seat.
4. Insert the upper and lower stems.
5. Slip one seat energizer strip onto the lower portion of the upper shaft.
6. Insert the upper shaft with the pre-installed seat energizer strip into the disc/seat sub assembly.
7. Drive the upper shaft into the disc and slip one seat energizer strip onto the lower shaft.
8. Rotate the disc into the open position and insert the disc/seat/stems/energizer sub assembly into the upper body half.
9. Place the lower body half over the seat, and ensure that both body halves are properly aligned (identified by cast-on markings.
10. Attach and tighten the body fasteners.

# SERIES 22/23

## RESILIENT SEATED BUTTERFLY VALVES

1. BODY
2. DISC
3. SEAT
4. UPPER STEM
5. LOWER STEM
6. BUSHING
7. UPPER STEM SEAL
8. SEAL CAPSULE
9. BEARING
10. SEAT ENERGIZER
11. CAP SCREW
12. RETAINER
13. BODY SEAL
14. ID TAG



# Appendix C

## Disassembly/Assembly Instructions

## Series 30/31 Resilient Seated Butterfly Valves

### Disassembly –

1. Remove the handle, gear operator, or power actuator from actuator mounting flange.
2. Remove the "Spirolox"® retaining ring and the two C-ring stem retainers from the stem hole.
3. Then remove the stem, bushing and seal.
4. Remove the disc from the seat, protecting the disc edge at all times.
5. Push the seat into an oval shape, and then remove the seat from the body.

### Assembly –

1. Push the valve seat into an oval and push it into the body with seat stem holes aligned to body stem holes.

| | |
|---|---|
| **NOTICE** | When installing the seat the larger hole should be on top and the smaller hole should be on bottom. |

2. Insert stem seal and bushing.
3. Push stem into the stem hole of the body until the bottom of the stem is flush with the inner top edge of the seat.
4. Install a light coating of silicone or grease on the I.D. of seat. Insert the disc into the seat by lining up the disc holes with the stem holes of the seat.

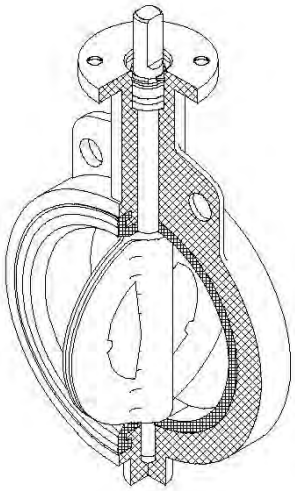
   **Note: The broached double "D" flats in the disc must be toward the bottom of the valve body.**

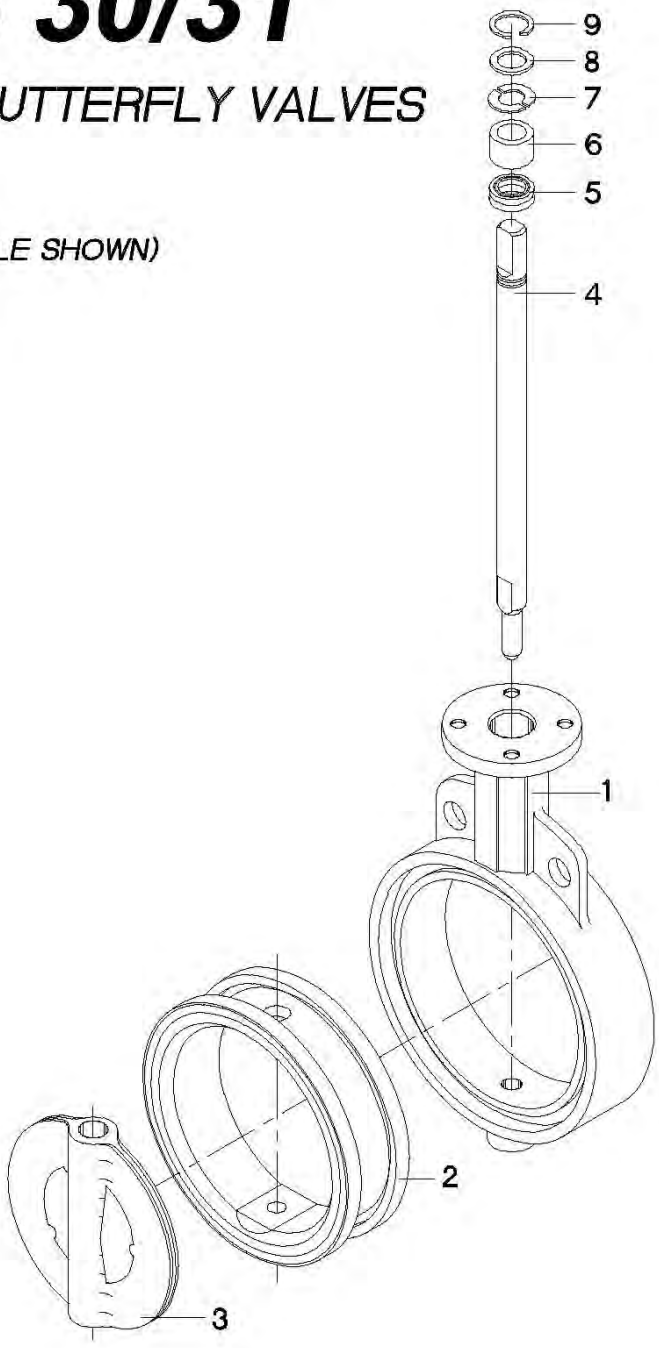
5. With a downward pressure and rotating the stem back and forth, push the stem until the stem touches the bottom of the body stem hole.
6. Make certain that when pushing the stem through the disc bottom, the broached flats of stem and disc are aligned.
7. Replace the stem bushing and two stem retainers, then replace the "Spirolox"® retaining ring back into position.
8. Replace handle, manual gear operator or power actuator on the actuator mounting flange.

# SERIES 30/31

## RESILIENT SEATED BUTTERFLY VALVES

*1 BODY (S30 WAFER STYLE SHOWN)*
*2 SEAT*
*3 DISC*
*4 STEM*
*5 STEM SEAL*
*6 STEM BUSHING*
*7 STEM RETAINER*
*8 THRUST WASHER*
*9 RETAINING RING*





# Appendix D

# Disassembly/Assembly Instructions

# Series 3A/3AH Resilient Seated Butterfly Valves

## Disassembly –

1. Remove the handle, gear operator, or power actuator from actuator mounting flange.
2. Remove the "Spirolox"® retaining ring and the two C-ring stem retainers from the stem hole.
3. Then remove the stem, bushing and seal.
4. Remove the disc from the seat, protecting the disc edge at all times.

   **Note: The seat is bonded to the body and is not easily field replaceable. Please contact your local Bray representative for seat replacement.**

## Assembly –

1. Insert stem seal and bushing.
2. Push stem into the stem hole of the body until the bottom of the stem is flush with the inner top edge of the seat.
3. Install a light coating of silicone or grease on the I.D. of seat. Insert the disc into the seat by lining up the disc holes with the stem holes of the seat.

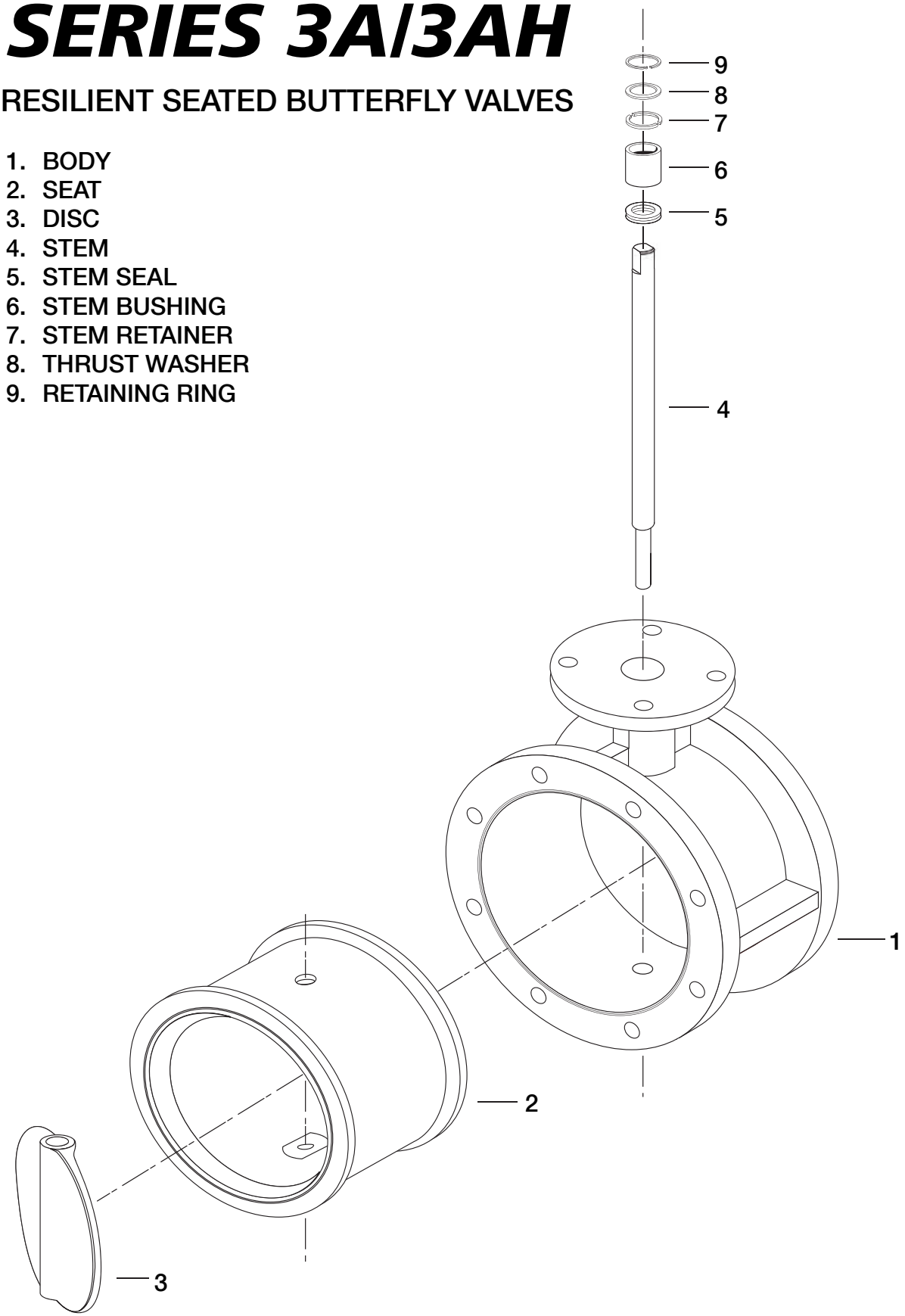
   **Note: The broached double "D" flats in the disc must be toward the bottom of the valve body.**

4. With a downward pressure and rotating the stem back and forth, push the stem until the stem touches the bottom of the body stem hole.
5. Make certain that when pushing the stem through the disc bottom, the broached flats of stem and disc are aligned.
6. Replace the stem bushing and two stem retainers, then replace the "Spirolox"® retaining ring back into position.
7. Replace handle, manual gear operator or power actuator on the actuator mounting flange.

# SERIES 3A/3AH

## RESILIENT SEATED BUTTERFLY VALVES

1. BODY
2. SEAT
3. DISC
4. STEM
5. STEM SEAL
6. STEM BUSHING
7. STEM RETAINER
8. THRUST WASHER
9. RETAINING RING



# Appendix E

# Disassembly/Assembly Instructions

# Series 31H Resilient Seated Butterfly Valves

## Disassembly –

1. Remove the handle, gear operator, or power actuator from actuator mounting flange.
2. Remove the "Spirolox"® retaining ring and the two C-ring stem retainers from the stem hole.
3. Then remove the stem, bushing and seal.
4. Remove the disc from the seat, protecting the disc edge at all times.

**Note: Valve is provided with the seat bonded to the body and therefore is not easily field replaceable. Please contact your local Bray representative for seat replacement.**

## Assembly –

1. Insert stem seal and bushing.
2. Push stem into the stem hole of the body until the bottom of the stem is flush with the inner top edge of the seat.
3. Install a light coating of silicone or grease on the I.D. of seat. Insert the disc into the seat by lining up the disc holes with the stem holes of the seat.

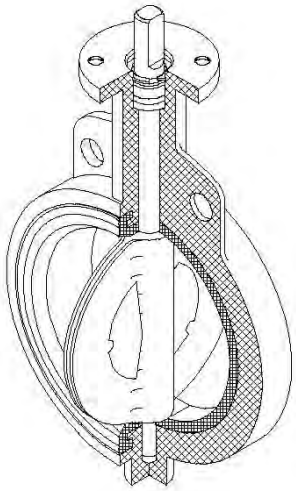
**Note: The broached double "D" flats in the disc must be toward the bottom of the valve body.**

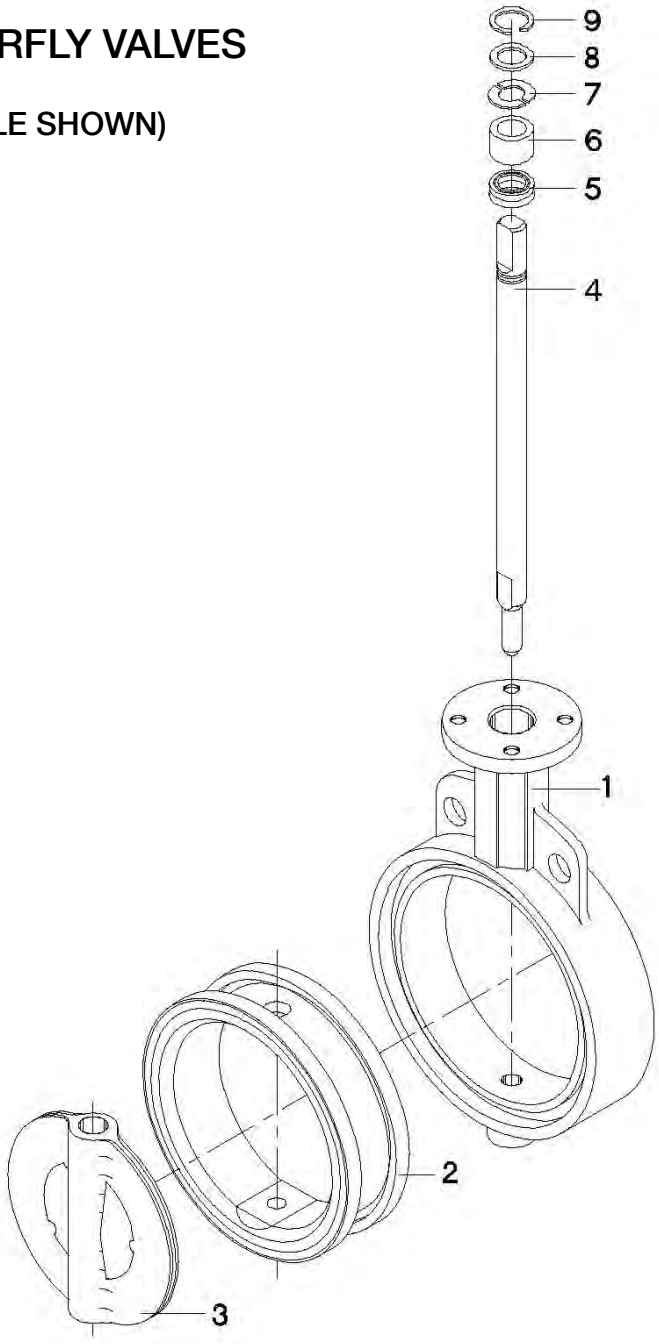
4. With a downward pressure and rotating the stem back and forth, push the stem until the stem touches the bottom of the body stem hole.
5. Make certain that when pushing the stem through the disc bottom, the broached flats of stem and disc are aligned.
6. Replace the stem bushing and two stem retainers, then replace the "Spirolox"® retaining ring back into position.
7. Replace handle, manual gear operator or power actuator on the actuator mounting flange.

# *SERIES 31H*

## RESILIENT SEATED BUTTERFLY VALVES

1. BODY (S30 WAFER STYLE SHOWN)
2. SEAT
3. DISC
4. STEM
5. STEM SEAL
6. STEM BUSHING
7. STEM RETAINER
8. THRUST WASHER
9. RETAINING RING





# Appendix F

## Disassembly/Assembly Instructions
## Series 31U Resilient Seated Butterfly Valves

### Disassembly –

1. Remove the handle, gear operator, or power actuator from actuator mounting flange.
2. Remove the "Spirolox"® retaining ring and the two C-ring stem retainers from the stem hole.
3. Then remove the top stem bushing and seal, upper stem and retaining rod.
4. Remove the disc from the seat, protecting the disc edge at all times.
5. The upper and lower stem bearings will remain in the valve behind the seat.

   **Note: The seat is bonded to the body and is not easily field replaceable. Please contact your local Bray representative for seat replacement.**

### Assembly –

1. Install a light coating of silicone or grease on the I.D. of seat.
2. Insert the lower stem inside the disc before inserting the disc into the seat.
3. Insert the disc into the seat by lining up the disc holes with the stem holes of the seat.
4. Line up the disc using a T-Bar (Allan key style)
5. With a downward pressure and rotating the T-Bar back and forth, push the lower stem until the lower stem touches the bottom of the body stem hole recess.

   **Note: The broached double "D" flats in the disc must be toward the bottom of the valve body.**

6. Make certain that when pushing the stem through the disc bottom, the broached flats of stem and disc are aligned.
7. Insert the spacer bar and upper stem into the disc and valve.
8. Replace the top stem bushing and seal and two stem retainers.
9. Then replace the two "C" ring stem retainers and the "Spirolox"® retaining ring back into position in the top stem hole.

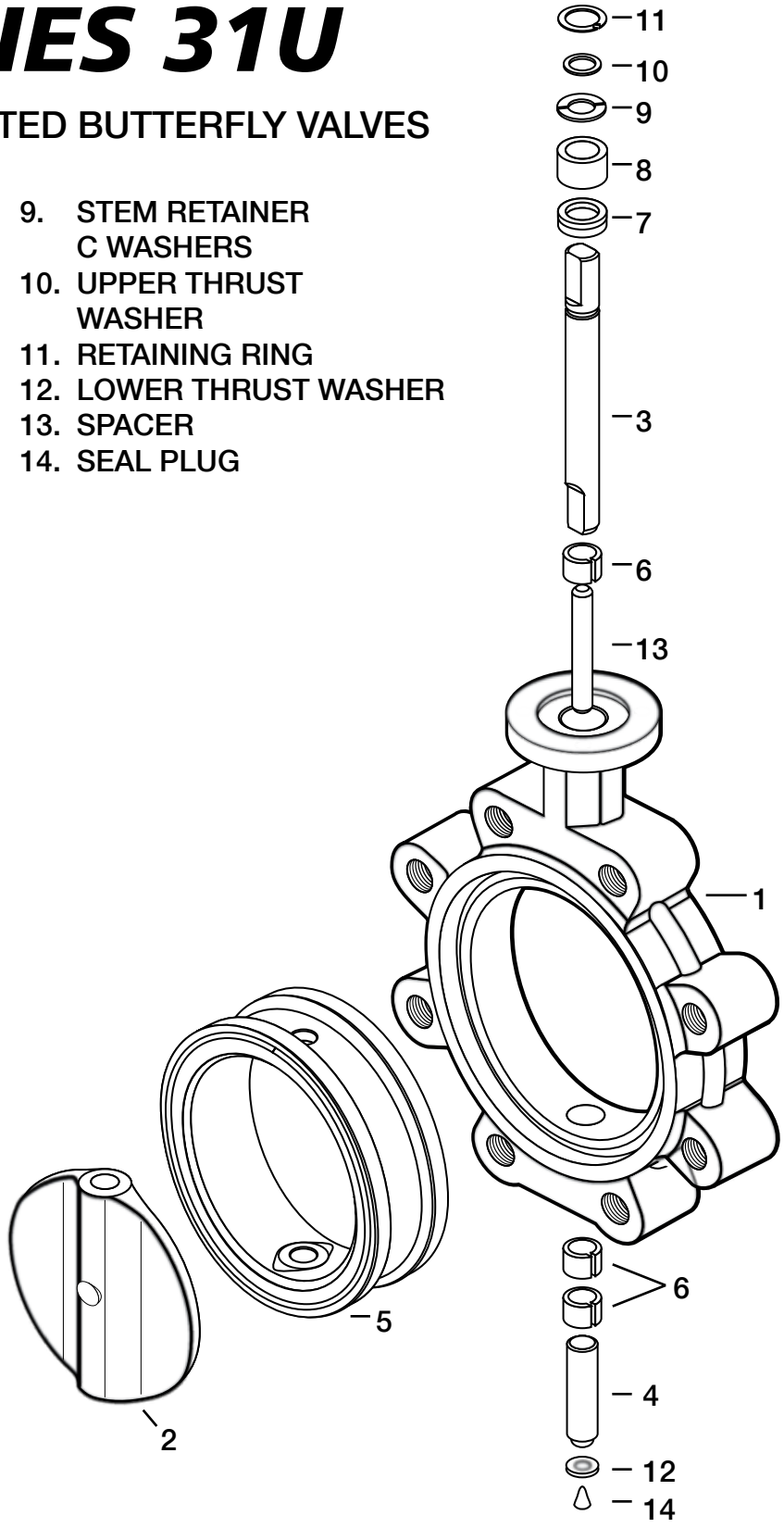
   **Note: It is recommended that a torque and seat test be done to confirm all is in order with the maintenance of the valve.**

10. Replace the handle, manual gear operator or power actuator on the actuator mounting flange.

# SERIES 31U

## RESILIENT SEATED BUTTERFLY VALVES

1. BODY
2. DISC
3. UPPER STEM
4. LOWER STEM
5. SEAT
6. BEARING
7. STEM SEAL
8. STEM BUSHING
9. STEM RETAINER C WASHERS
10. UPPER THRUST WASHER
11. RETAINING RING
12. LOWER THRUST WASHER
13. SPACER
14. SEAL PLUG



# Appendix G

## Disassembly/Assembly Instructions
## Series 32/33 Resilient Seated Butterfly Valves

### Disassembly –

1. Remove the gear operator or power actuator from the actuator mounting flange.
2. Secure the valve in a horizontal position with the taper-pin nuts facing upward.

**CAUTION**

Prior to removal of the valve stem the valve disc must be secured and supported to insure it does not drop out of the valve body once the stem is removed. Lay the valve down with two wood blocks located under the disc at the 6 o'clock and 12 o'clock positions making sure the blocks are in close contact with the disc but not supporting the valve.

3. Remove the packing gland by removing the retaining screws and sliding the gland off the top of the stem.
4. Remove bottom plate and thrust bearing to expose bottom of stem.
5. Remove nuts and washers from ends of taper pins and drive taper pins out of the disc. Avoid damaging the disc coating or surface when removing taper-pins.
6. Once taper-pins are removed, drive the stem, bushing, and packing out of the valve body through the top.
7. Remove the disc from the seat, protecting disc edge at all times.
8. Push the seat into an oval shape, and then remove the seat from the body.

# Appendix G (Cont'd)

## Disassembly/Assembly Instructions
## Series 32/33 Resilient Seated Butterfly Valves

### Assembly –

1. Replace bottom thrust bearing and plate.
2. Push the seat into an oval and push it into the body with seat stem holes aligned to body stem holes.
3. De-bur taper-pin grooves in the stem.
4. Push stem into stem hole of body until the bottom of the stem is flush with the inner top edge of the seat.

   **Note: The end of the stem containing the keyway must be toward the top of the valve body.**

5. Install a light coating of silicone or grease on the I.D. of the seat.
6. Insert the disc into the seat by lining up the disc hole with the upper stem hole of the seat.
7. With a downward pressure and rotating the stem back and forth, push the stem until the stem touches the bottom of the body stem hole.

   **Note: Make certain that when pushing the stem to the bottom of the body, the taper-pin grooves in the stem line up with the holes in the disc face.**

8. Tap the taper-pins into their holes from the large side of the hole, making sure the pins fit tightly in the hole and allow no movement of the stem in the disc.

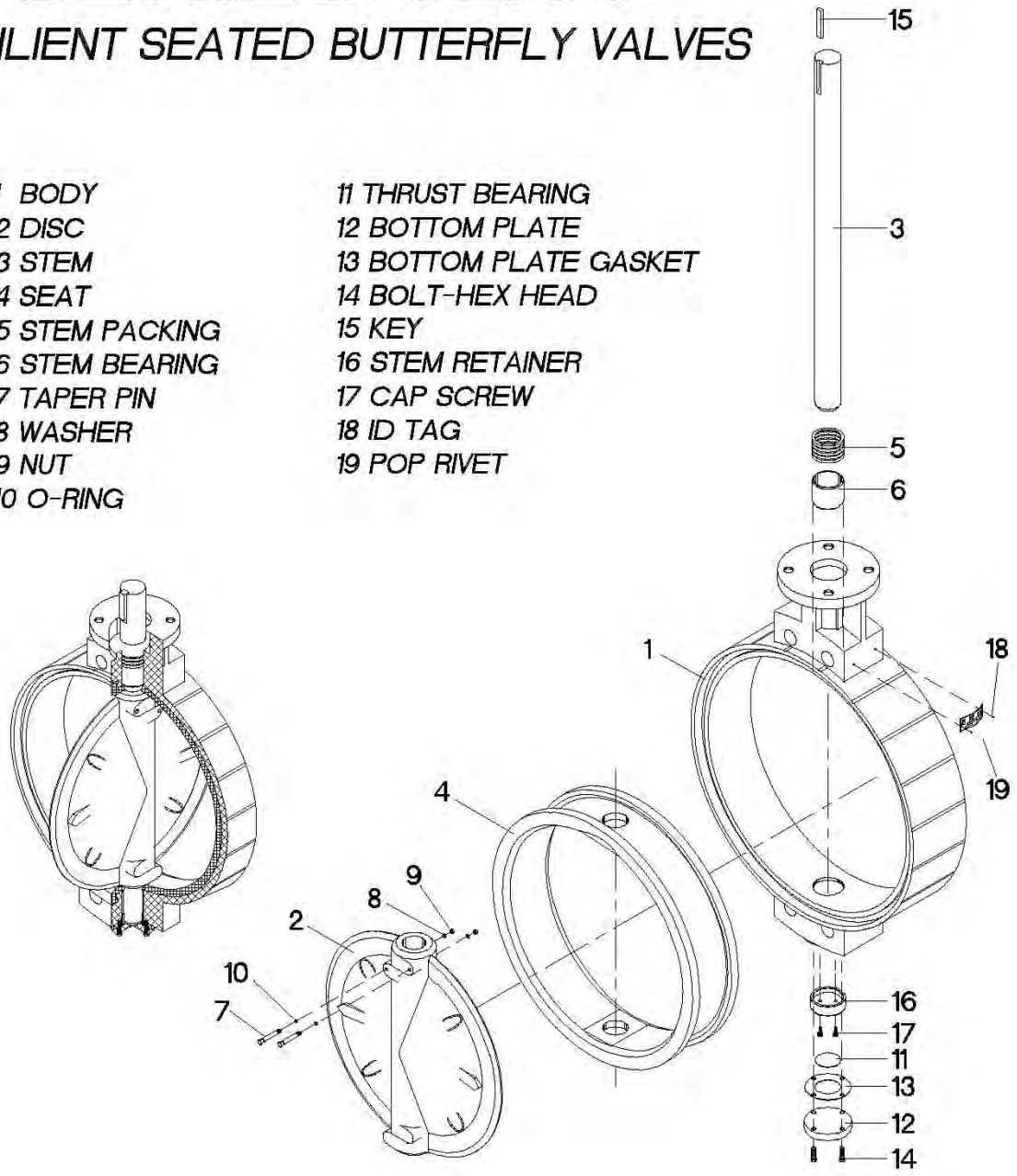
   **Note: Ensure that the taper-pin o-rings are in place before completing valve assembly.**

9. Replace the washers and nuts on the ends of the taper-pins.
10. Replace bushing, packing, and packing gland, and then tighten the retaining screws snugly.
11. Replace manual gear operator or power actuator on the actuator mounting flange.

# SERIES 32/33

## RESILIENT SEATED BUTTERFLY VALVES

1 BODY
2 DISC
3 STEM
4 SEAT
5 STEM PACKING
6 STEM BEARING
7 TAPER PIN
8 WASHER
9 NUT
10 O-RING
11 THRUST BEARING
12 BOTTOM PLATE
13 BOTTOM PLATE GASKET
14 BOLT-HEX HEAD
15 KEY
16 STEM RETAINER
17 CAP SCREW
18 ID TAG
19 POP RIVET



# Appendix H

## Disassembly/Assembly Instructions
## Series 35/36 Resilient Seated Butterfly Valves
## (Taper Pin Disc/Stem Connection)

### Disassembly –

1. Remove the gear operator or power actuator from the actuator mounting flange.
2. Secure the valve in a horizontal position with the taper-pin nuts facing upward.

| | |
|---|---|
| **CAUTION** | Prior to removal of the valve stem the valve disc must be secured and supported to insure it does not drop out of the valve body once the stem is removed. Lay the valve down with two wood blocks located under the disc at the 6 o'clock and 12 o'clock positions making sure the blocks are in close contact with the disc but not supporting the valve. |

3. Remove the packing gland by removing the retaining screws and sliding the gland off the top of the stem.
4. Remove bottom plate and thrust bearing to expose bottom of stem.
5. Remove nuts and washers from ends of taper pins and drive taper pins out of the disc. Avoid damaging the disc coating or surface when removing taper-pins.
6. Once taper-pins are removed, drive the stem, bushing, and packing out of the valve body through the top.
7. Remove the disc from the seat, protecting disc edge at all times.
8. Push the seat into an oval shape, and then remove the seat from the body.

**Note: Valves 54" and larger are provided with the seat bonded to the body and therefore is not easily field replaceable. Please contact your local Bray representative for seat replacement.**

# Appendix H (Cont'd)

## Disassembly/Assembly Instructions
## Series 35/36 Resilient Seated Butterfly Valves
## (Taper Pin Disc/Stem Connection)

### Assembly –

1. Replace bottom thrust bearing and plate.
2. Push the seat into an oval and push it into the body with seat stem holes aligned to body stem holes.

   **Note: Valves 54" and larger are provided with the seat bonded to the body and therefore is not easily field replaceable. Please contact your local Bray representative for seat replacement.**

3. De-bur taper-pin grooves in the stem.
4. Push stem into stem hole of body until the bottom of the stem is flush with the inner top edge of the seat.

   **Note: The end of the stem containing the keyway must be toward the top of the valve body.**

5. Install a light coating of silicone or grease on the I.D. of the seat.
6. Insert the disc into the seat by lining up the disc hole with the upper stem hole of the seat.
7. With a downward pressure and rotating the stem back and forth, push the stem until the stem touches the bottom of the body stem hole.

   **Note: Make certain that when pushing the stem to the bottom of the body, the taper-pin grooves in the stem line up with the holes in the disc face.**

8. Tap the taper-pins into their holes from the large side of the hole, making sure the pins fit tightly in the hole and allow no movement of the stem in the disc.

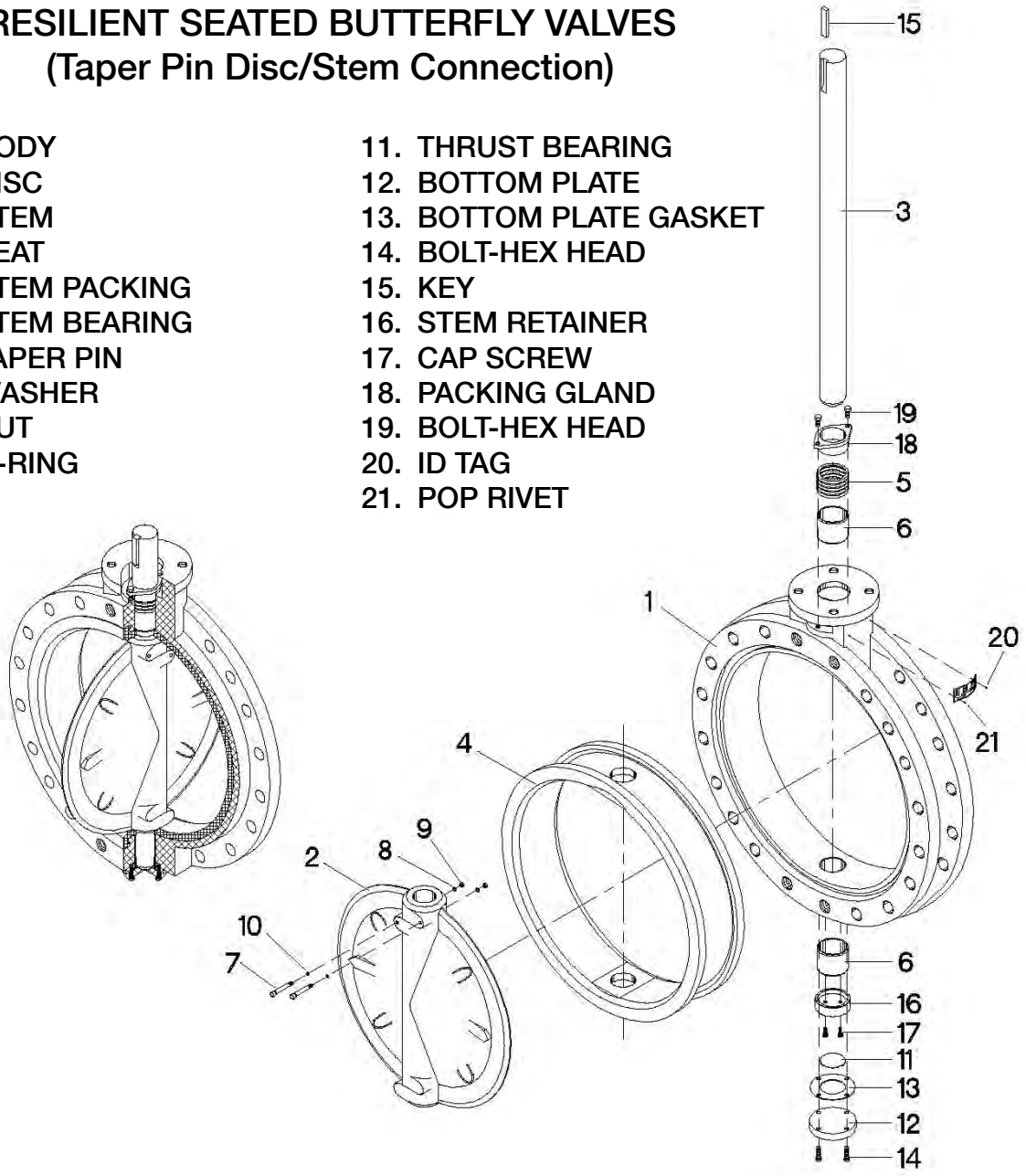
   **Note: Ensure that the taper-pin o-rings are in place before completing valve assembly.**

9. Replace the washers and nuts on the ends of the taper-pins.
10. Replace bushing, packing, and packing gland, and then tighten the retaining screws snugly.
11. Replace manual gear operator or power actuator on the actuator mounting flange.

# SERIES 35/36

## RESILIENT SEATED BUTTERFLY VALVES
## (Taper Pin Disc/Stem Connection)

1. BODY
2. DISC
3. STEM
4. SEAT
5. STEM PACKING
6. STEM BEARING
7. TAPER PIN
8. WASHER
9. NUT
10. O-RING
11. THRUST BEARING
12. BOTTOM PLATE
13. BOTTOM PLATE GASKET
14. BOLT-HEX HEAD
15. KEY
16. STEM RETAINER
17. CAP SCREW
18. PACKING GLAND
19. BOLT-HEX HEAD
20. ID TAG
21. POP RIVET



# Appendix I
# Disassembly/Assembly Instructions
# Series 35/36 Resilient Seated Butterfly Valves
# (Internal Spline or Keyed Disc/Stem Connection)

## Disassembly –

1. Remove the gear operator or power actuator from the actuator mounting flange.
2. Secure the valve in a horizontal position.

| | |
|---|---|
| ⚠ **CAUTION** | Prior to removal of the valve stems the valve disc must be secured and supported to insure it does not drop out of the valve body once the stems are removed. Lay the valve down with two wood blocks located under the disc at the 6 o'clock and 12 o'clock positions making sure the blocks are in close contact with the disc but not supporting the valve. |

**3.** Removal of the lower valve stem:

   a. Remove the bottom plate screws, bottom plate, bottom plate gasket and thrust bearing.

   b. Remove the locking nut from the tie bolt.

   c. Remove the stem retainer.

   d. Secure a hoist to the lower stem (end is imperial threaded).

   e. Then use the hoist to remove the lower stem from the valve body.

   f. Remove the stem bearing.

4. Removal of the upper valve stem:

   a. Remove the packing gland by removing the retaining screws and sliding the gland off the top of the stem.

   b. Secure a hoist to the upper stem (end is imperial threaded).

   c. Then use the hoist to remove the upper stem including the tie bolt from the valve body.

5. Removal of the valve disc:

   a. Remove the wood blocks noted above from below the disc.

   b. Using a rubber hammer, pound one area of the disc (ex. 12 o'clock position) repeatedly until the disc clears the face of the valve body.

# Appendix I (Cont'd)
# Disassembly/Assembly Instructions
# Series 35/36 Resilient Seated Butterfly Valves
# (Internal Spline or Keyed Disc/Stem Connection)

## Disassembly –

6. Removal of packing and bearings:
    a. Remove the stem packing.
    b. Use a slotted screwdriver to carefully remove the upper and lower stem bearings.
7. Removal of the valve seat:

**Note: Valves 54" and larger are provided with the seat bonded to the body and therefore is not easily field replaceable. Please contact your local Bray representative for seat replacement.**

**WARNING**

a. Set the valve body in an upright position and secure it in a floor vice capable of handling the weight of the valve body and seat.

**Note: Be sure to not clamp the seat in the vice.**

b. Insert a slotted screwdriver into the space between the body and the seat on the face of the valve at the 12 o'clock position.

c. Carefully leverage the seat away from the body.

d. Push the seat into an oval shape and remove the seat from the body.

## Assembly –

1. Installation of the valve seat:

**Note: Valves 54" and larger are provided with the seat bonded to the body and therefore is not easily field replaceable. Please contact your local Bray representative for seat replacement.**

**WARNING**

a. Set the valve body in an upright position and secure it in a floor vice capable of handling the weight of the valve body and seat.

**Note: Be sure to not clamp the seat in the vice.**

b. Check to assure the interior surface of the valve body is clean.

c. Install a light coating of silicone lubricant on the interior surface of the valve body.

d. Push the seat into an oval and push it into the body with seat stem holes aligned to the body stem holes.

# Appendix I (Cont'd)
# Disassembly/Assembly Instructions
# Series 35/36 Resilient Seated Butterfly Valves
# (Internal Spline or Keyed Disc/Stem Connection)

## Assembly –

2. Installation of the valve disc:

   **Note: Before installing the disc, check to assure the upper and lower stems are matched to the upper and lower stem holes in the disc.**

   a. With the valve still in the vice in a vertical position, hoist the upper stem with the splined end or the double keyed end pointing upward.

   b. Push the upper stem into the stem hole of the upper body until the bottom of the stem exceeds the upper stem hole of the seat by 20-50 mm.

   c. Apply a light coating of silicone or grease on the I.D. of the seat.

   d. Insert the disc into the seat with the splined end or the double keyed end up.

   e. Push the disc into the seat while inserting the upper stem into the upper stem hole in the disc.

   f. Adjust the disc to assure the lower stem hole of the disc is properly aligned with the lower body stem hole.

3. Installation of the lower stem:

   a. Close the valve so that the disc is inside the edge of the seat.

   b. Carefully place the valve in a horizontal position assuring that there is no damage to the body and disc coatings and disc edge.

   c. Insert the stem bearing into the bottom stem hole of the body.

   d. Insert the lower stem into the body and disc.

      **Note: The cone-shaped end of the lower stem should be toward the center of the disc.**

# Appendix I (Cont'd)
# Disassembly/Assembly Instructions
# Series 35/36 Resilient Seated Butterfly Valves
# (Internal Spline or Keyed Disc/Stem Connection)

**Assembly –**

4. Installation of the upper stem:

| | |
|---|---|
| **CAUTION** | a. Hoist the valve to an angle and secure it (be careful not to go to high so the lower stem does not drop out). |

   b. Remove the upper stem from the valve.

   c. Screw the tie bolt with lock nut to the splined or the double keyed end of the upper stem, tighten the lock nut and insert the upper stem into the valve with the tie bolt end first.

   **Note: The tie bolt will go through the disc and reach to the bottom of the valve**

   **Note: During this step, the keyway of the upper stem should be vertical to the front face of the valve.**

5. Installation of packing and bearings (upper valve stem):

   a. Insert the stem bearing into the top hole of the body followed by the stem packing and packing gland follower.

   b. Use two hexagon bolts to fasten the packing gland.

6. Installation of packing and bearings (lower valve stem):

   a. Insert the stem retainer into the bottom hole of the body using a nut to fasten it.

   b. Install the locking nut on the tie bolt.

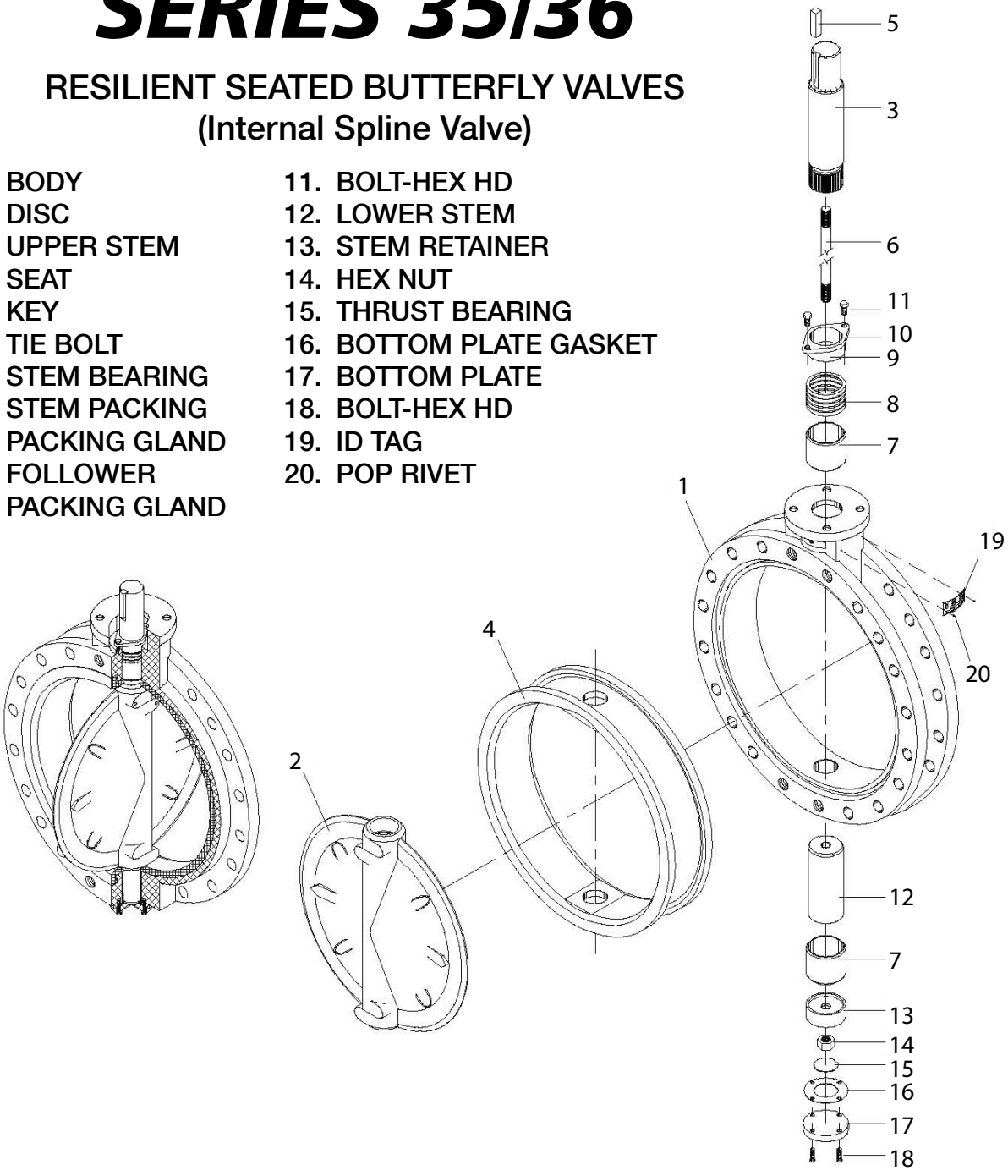
   c. Install the thrust bearing, bottom plate gasket and bottom plate follower.

   d. Use four hexagon bolts to fasten the bottom plate tightly.

# *SERIES 35/36*

## RESILIENT SEATED BUTTERFLY VALVES
## (Internal Spline Valve)

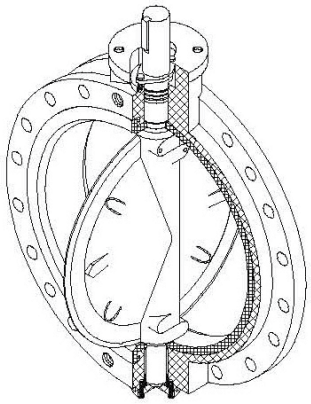
1. BODY
2. DISC
3. UPPER STEM
4. SEAT
5. KEY
6. TIE BOLT
7. STEM BEARING
8. STEM PACKING
9. PACKING GLAND FOLLOWER
10. PACKING GLAND
11. BOLT-HEX HD
12. LOWER STEM
13. STEM RETAINER
14. HEX NUT
15. THRUST BEARING
16. BOTTOM PLATE GASKET
17. BOTTOM PLATE
18. BOLT-HEX HD
19. ID TAG
20. POP RIVET

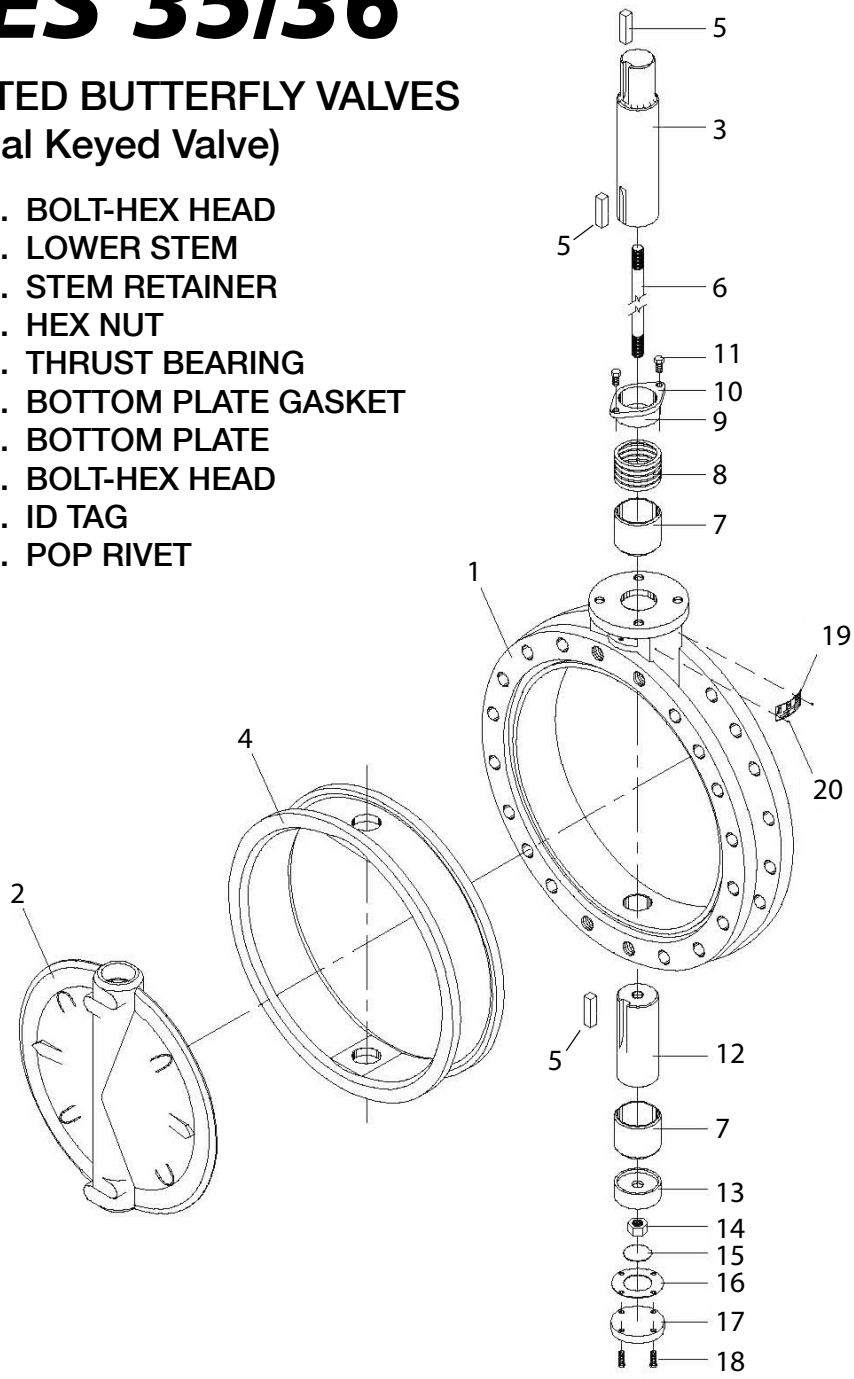


# *SERIES 35/36*

## RESILIENT SEATED BUTTERFLY VALVES
## (Internal Keyed Valve)

1. BODY
2. DISC
3. UPPER STEM
4. SEAT
5. KEY
6. TIE BOLT
7. STEM BEARING
8. STEM PACKING
9. PACKING GLAND FOLLOWER
10. PACKING GLAND
11. BOLT-HEX HEAD
12. LOWER STEM
13. STEM RETAINER
14. HEX NUT
15. THRUST BEARING
16. BOTTOM PLATE GASKET
17. BOTTOM PLATE
18. BOLT-HEX HEAD
19. ID TAG
20. POP RIVET





# Appendix J

## Disassembly/Assembly Instructions
## Series 36H Resilient Seated Butterfly Valves

### Disassembly –

1. Remove the gear operator or power actuator from the actuator mounting flange.
2. Secure the valve in a horizontal position with the taper-pin nuts facing upward.

| | |
|---|---|
| ⚠ **CAUTION** | Prior to removal of the valve stem the valve disc must be secured and supported to insure it does not drop out of the valve body once the stem is removed. Lay the valve down with two wood blocks located under the disc at the 6 o'clock and 12 o'clock positions making sure the blocks are in close contact with the disc but not supporting the valve. |

3. Remove the packing gland by removing the retaining screws and sliding the gland off the top of the stem.
4. Remove bottom plate and thrust bearing to expose bottom of stem.
5. Remove nuts and washers from ends of taper pins and drive taper pins out of the disc. Avoid damaging the disc coating or surface when removing taper-pins.
6. Once taper-pins are removed, drive the stem, bushing, and packing out of the valve body through the top.
7. Remove the disc from the seat, protecting disc edge at all times.

**Note: Valve is provided with the seat bonded to the body and therefore is not easily field replaceable. Please contact your local Bray representative for seat replacement.**

# Appendix J (Cont'd)

## Disassembly/Assembly Instructions
## Series 36H Resilient Seated Butterfly Valves

### Assembly –

1. Replace bottom thrust bearing and plate.
2. De-bur taper-pin grooves in the stem.
3. Push stem into stem hole of body until the bottom of the stem is flush with the inner top edge of the seat.

   **Note: The end of the stem containing the keyway must be toward the top of the valve body.**

4. Install a light coating of silicone or grease on the I.D. of the seat.
5. Insert the disc into the seat by lining up the disc hole with the upper stem hole of the seat.
6. With a downward pressure and rotating the stem back and forth, push the stem until the stem touches the bottom of the body stem hole.

   **Note: Make certain that when pushing the stem to the bottom of the body, the taper-pin grooves in the stem line up with the holes in the disc face.**

7. Tap the taper-pins into their holes from the large side of the hole, making sure the pins fit tightly in the hole and allow no movement of the stem in the disc.

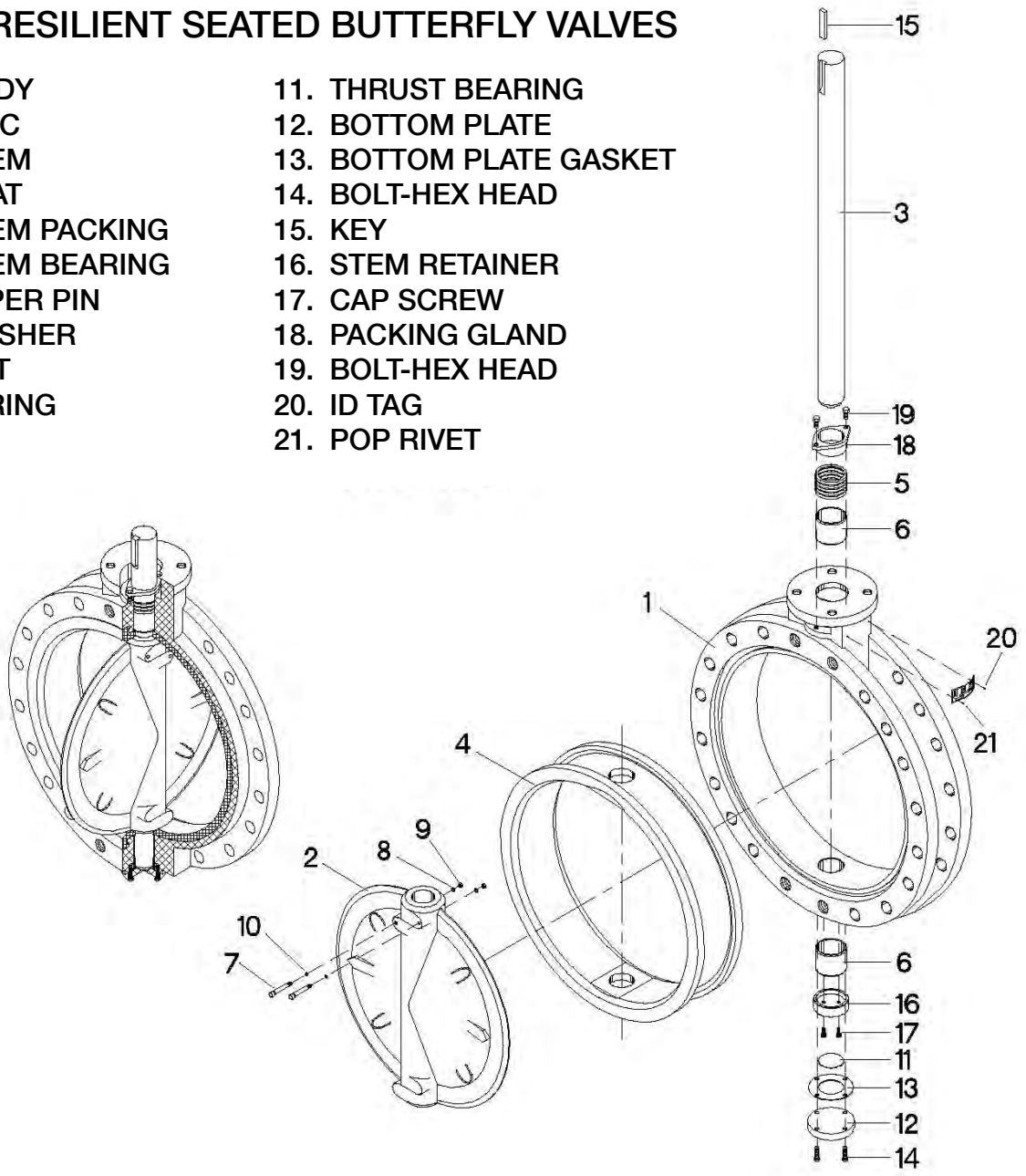
   **Note: Ensure that the taper-pin o-rings are in place before completing valve assembly.**

8. Replace the washers and nuts on the ends of the taper-pins.
9. Replace bushing, packing, and packing gland, and then tighten the retaining screws snugly.
10. Replace manual gear operator or power actuator on the actuator mounting flange.

# *SERIES 36H*

## RESILIENT SEATED BUTTERFLY VALVES

1. BODY
2. DISC
3. STEM
4. SEAT
5. STEM PACKING
6. STEM BEARING
7. TAPER PIN
8. WASHER
9. NUT
10. O-RING
11. THRUST BEARING
12. BOTTOM PLATE
13. BOTTOM PLATE GASKET
14. BOLT-HEX HEAD
15. KEY
16. STEM RETAINER
17. CAP SCREW
18. PACKING GLAND
19. BOLT-HEX HEAD
20. ID TAG
21. POP RIVET



Bray CONTROLS

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OM-RSBFV-001 08-2012

# LS2000 LEVEL SWITCH
# OWNERS MANUAL

## INSTALLATION and CALIBRATION

BABBITT
INTERNATIONAL, INC.

**P.O. Box 70094**
**Houston, Texas 77270**
**(713) 467-4438**

## General Description

The LS2000 is a point switch that detects the presence or absence of material in a bin silo, tank or other container. The basic unit is made up of a solid stainless steel probe attached to an explosion proof housing. Inside the explosion proof housing are all calibration adjustments and sensing electronics. The unit is calibrated in the absence of material and an internal relay changes state when material is detected.

## THEORY OF OPERATION

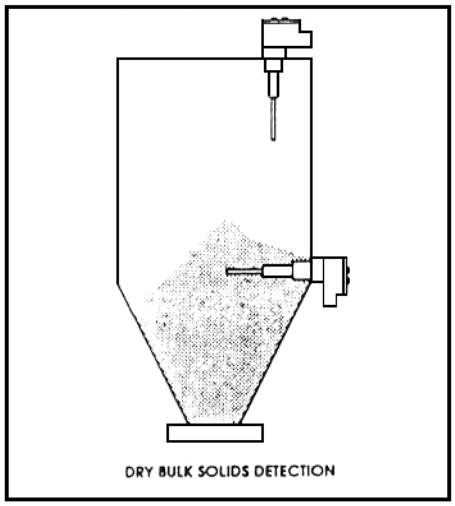
The LS2000 employs a radio frequency (RF) balanced impedence bridge circuit to detect if the probe is in contact with the material that is to be sensed. When material is not in contact with the probe, the bridge is balanced by turning the adjustment pot to find the threshold where the red L.E.D. goes out. When material is in contact with the probe, the bridge comes unbalanced and the comparing circuit realizes the change. This causes the relay to change state.

## INSTALLATION

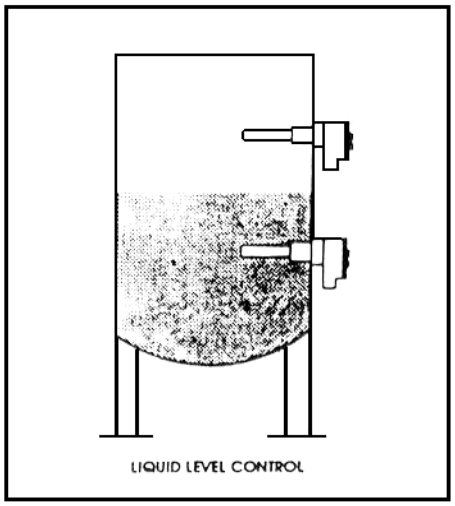
***CAUTION:** ALL INSTALLATION AND WIRING MUST CONFORM TO NEC AND ALL OTHER LOCAL ELECTRICAL CODES. TAKE SPECIAL CARE IN OBSERVING HAZARDOUS AREA SAFETY PROCEDURES. WE ASSUME NO LIABILITY FOR IMPROPERLY INSTALLED OR WIRED UNITS.

### Inspection and Operation

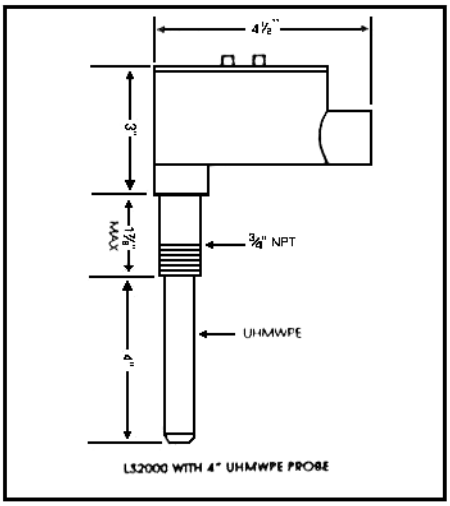
After unpacking the LS2000 visually inspect the unit for any damages. Please advise the factory or your local distributor of any damage.
Before installing the unit, a simple operational check can be performed.
On the bench, hook up the appropriate power to L1 and L2. The operating voltage of the LS2000 is marked on the power supply board. Hold the unit so that the probe is not touching any surface and touch the probe. When you touch the probe, the red led should come on. This simulates product touching the probe.



DRY BULK SOLIDS DETECTION



LIQUID LEVEL CONTROL




LS2000 WITH 4" UHMWPE PROBE

## SPECIFICATIONS

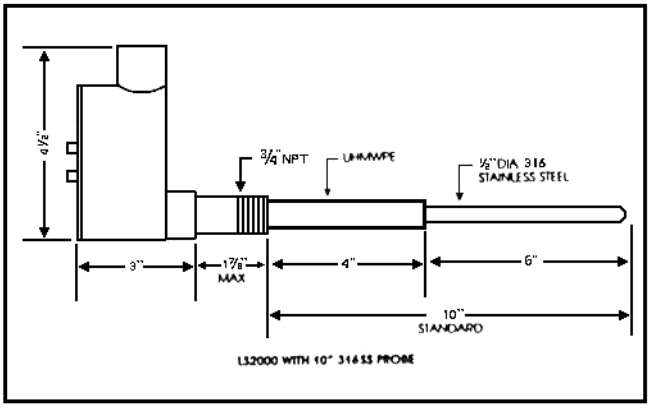
### ELECTRICAL

| | |
|---|---|
| Power: | 120 VAC (±15%) 60 Hz, 2 watts, standard (24 VDC optional) |
| Output: | 1 Form C contact SPDT relay, 10 amp resistive at 125 VAC, 8A250VAC, 5A30VDC |
| Fail Safe: | Selectable high or low level |
| RF Frequency: | Approximately 1.3 MHz |

### ENVIRONMENTAL

| | |
|---|---|
| Hazardous Area: | Class I, Group C, D, Class II, Group E, F G, Class III |
| Temperature: | Probe: -30°F to 180°F<br>Electronics: -30°F to 170°F |
| Pressure: | Probe 250 psi @ 75°F Note: at 180°F pressure should not exceed atmosphere. |
| Construction: | Probe: All wetted parts 316 SS, UHMWPE and Viton.<br>Electronics: Housed in cast aluminum explosion proof enclosure. |

**Specifications subject to change without notice.**




LS2000 WITH 10" 316 SS PROBE

## Physical Installation

1) The LS2000 is installed into the vessel wall using a connection. This can be either a threaded coupling or a tapped entry such as a flange.
2) The insulator should always extend at least 2" through the vessel wall.
3) Always check for physical room around the location you have chosen to allow for installation. Allow 3.75" turning radius to screw the probe in and clearance above for the length of the probe.
4) **CAUTION:** Always take the necessary safety precautions when cutting or welding in the coupling for the LS2000.
    a) Tag and lock out the electrical power to the equipment that services the vessels.
    b) Check liquid or dry powders that create a gas in the vessel for oxygen as well as the explosion factor. (All dust will explode.)
    c) Vessels that are cross vented have to be isolated.
5) Screw the LS2000 into the connection provided. In dry material application, no sealant on threads is required. On liquid, teflon or a good pipe thread sealant may be used.
6) The LS2000 has a ¾" conduit entry. When wiring these units, conform to the National Electrical Code and any other city or company codes.
7) Always install the electrical connection into the ¾" conduit entry on the LS2000 so water will not follow the connection routing into the threads of the conduit hub. To guarantee that condensation and water will stay outside the unit, install an EYSM unilet before each LS2000 and fill with explosion proof sealing cement.

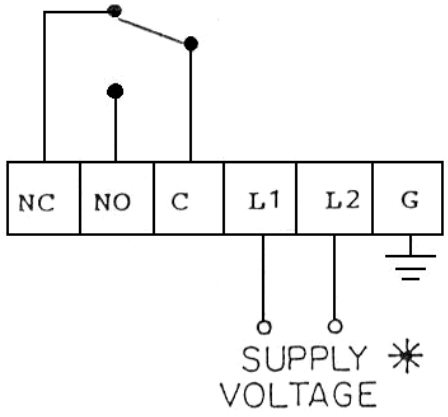
## Removing the Electronics

1) Disconnect supply power at main power source
2) Disconnect wires from terminal strip
3) Unplug blue antenna lead
4) Remove green grounding screw

To reinstall, reverse the above procedure.

LS 2000 TERMINAL LAYOUT

10 AMP RELAY CONTACTS

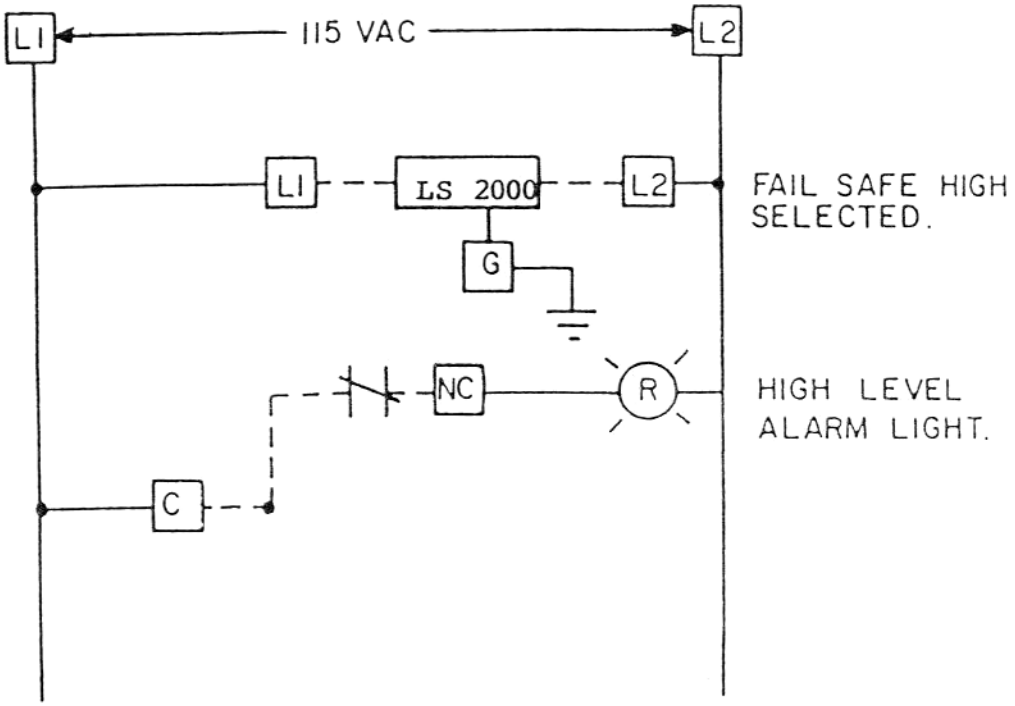



✳NOTE: EACH LS 2000 POWER SUPPLY IS INTENDED FOR ONLY ONE SUPPLY VOLTAGE. THIS VOLTAGE IS PRINTED ON THE POWER SUPPLY BOARD.

FOR 115 VAC UNITS HOOK UP THE HOT LEAD TO LI AND THE NEUTRAL TO L2, WITH APPROPRIATE GROUND.

24 VDC UNITS HOOK THE POSITIVE VOLTAGE TO LI AND THE COMMON OR GROUND TO L2.

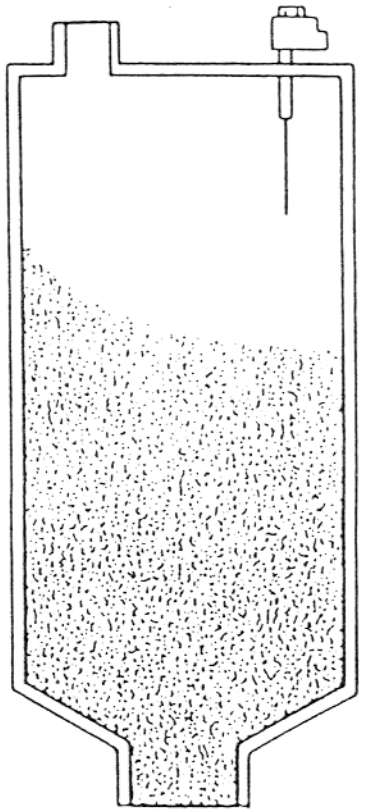
## TYPICAL WIRING



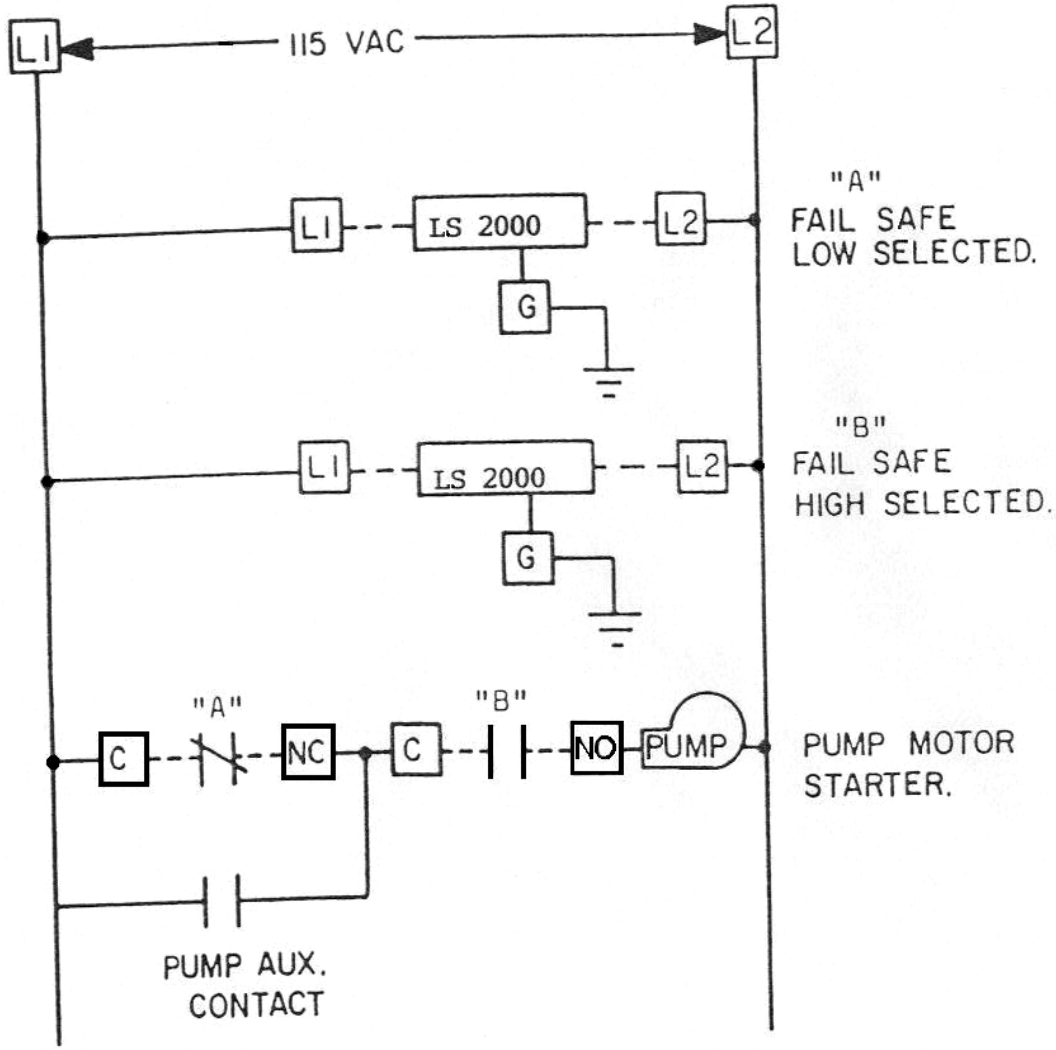

NOTE:
PLEASE REVIEW FAIL SAFE
INSTUCTIONS

## APPLICATION

HIGH LEVEL ALARM



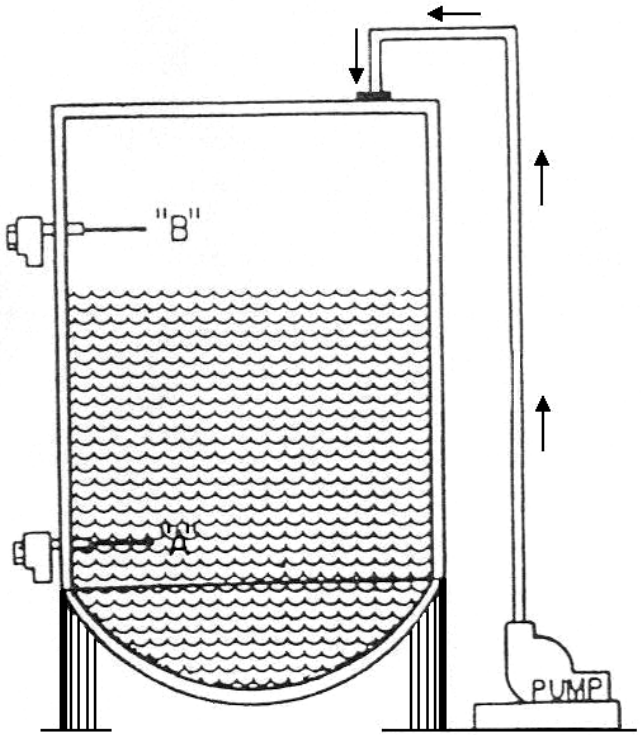
## TYPICAL WIRING




## APPLICATION

AUTOMATIC FILLING OF TANK.

(WHEN LEVEL FALLS TO POINT "A", A PUMP COMES ON TO FILL TO POINT "B", THEN TURNS OFF.)



CALIBRATION INSTRUCTIONS

## PLEASE READ THE ENTIRE CALIBRATION PROCEDURE BEFORE CALIBRATING

### A. Fail Safe Selection

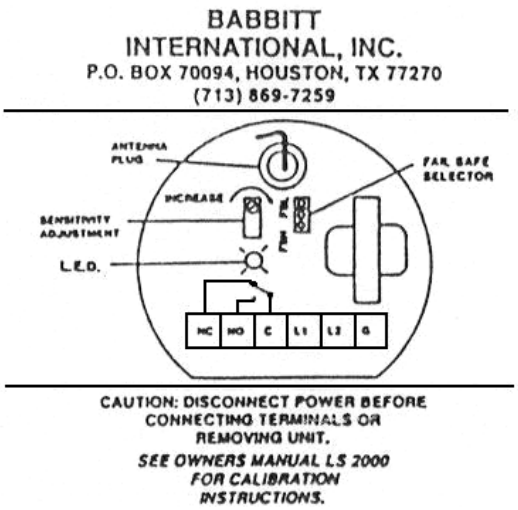
The fail safe feature provides a "false alarm" in case of power outage or major component failures. When properly selected, the fail safe feature can protect equipment or alert you of a unit failure.
Fail Safe High (FSH) means that the relay is energized when NO PRODUCT is touching the probe. When product comes into contact with the probe, the relay is de-energized.
Fail Safe Low (FSL) means that the relay is energized when PRODUCT IS touching the probe.
Fail Safe High or Fail Safe Low is selected by plugging the jumper next to the transformer in the appropriate position.

**NOTE:** Due to the wide variety of applications and possible control or alarm functions, the proper fail safe selection will depend on your circumstances. Please call your distributor or the factory if you need assistance.

### B. Sensitivity Calibration

The LS2000 should be calibrated when no material is touching the probe and when the unit is installed where it will be used.

1) Observe the red LED. If it is on, go to step 3.
2) If the red LED is off, turn the sensitivity adjustment potentiometer clockwise (CW) until it comes on.
3) Turn the sensitivity adjustment pot counter-clockwise (CCW) until the red LED just goes out. This sets the unit to its maximum sensitivity. If in your application this is too sensitive, you can turn the sensitivity adjustment pot further CCW; usually ¼ to ½ turn is sufficient to reduce the units sensitivity. Always bring the product into contact with the probe after calibration to assure proper performance.



## WARRANTY

All components of the LS2000 are warranted to be free from defects in material and workmanship for a period of two years from the date of purchase . This warranty applies to general purchaser and to components installed, serviced and operated according to instructions.

Babbitt International, Inc. will repair or replace, at its option, FOB at its plant or any other location designated, any part which proves to be defective in manufacture or workmanship.

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*Your Pipeline To Quality* Valves, Strainers, Flowmeters and Controls

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Thornhill, Ontario
L3T 6L2
Canada
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Fax: 905-889-8553

# MAINTENANCE & INSTALLATION INSTRUCTIONS
# For Chemline Type 21 True Union Ball Valve Size 1/2"- 4"

## *Installation:*

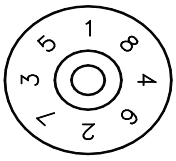
1. Make sure all surfaces are clear and free of debris prior to installing valve in pipeline. Pipeline should be empty at connection site.

2. Valve should be set to the closed position.

3. When installing valves with socket connections, ensure that only PVC solvent cement is used. Excessive use of cement can cause sticking in the valve interior, therefore use caution when applying cement, especially on vertical piping.

4. For threaded connections we recommend the use of sealing tape and, with the use of a strap wrench, to tighten no more than 2 full turns past finger-tight. Use of a pipe wrench can deform the pipe or union nut and cause damage to the valve and/or connection(s).

5. Flanged connections should be torqued evenly and in a symmetrical pattern with a torque wrench and as per the figure and chart below:




**RECOMMENDED FLANGE BOLT TORQUES**

| VALVE SIZE | FLANGE | BOLT TORQUE | IN FT-LB | AXIAL MISALIGNMENT | PARALLELISM (INCH) |
|---|---|---|---|---|---|
| | PSI - 50 | PSI - 100 | PSI – 150 | | |
| 1½ | 11 | 13 | 14 | 0.04 | 0.03 |
| 2 | 13 | 14 | 16 | 0.04 | 0.03 |
| 2½ | 13 | 14 | 16 | 0.04 | 0.03 |
| 3 | 18 | 20 | 22 | 0.04 | 0.03 |
| 4 | 20 | 20 | 22 | 0.04 | 0.04 |
| 5 | 22 | 15 | 29 | 0.04 | 0.04 |
| 6 | 25 | 15 | 32 | 0.04 | 0.04 |
| 8 | 25 | 32 | 40 | 0.06 | 0.04 |
| 10 | 25 | 32 | 40 | 0.06 | 0.04 |
| 12 | 29 | 36 | 43 | 0.06 | 0.04 |
| 14 | 32 | 36 | 43 | 0.06 | 0.04 |
| 16 | 36 | [58-85 PSI] | 58 | 0.06 | 0.04 |
| 18 | 36 | [58-85 PSI] | - | | |
| 20 | 72 | - | - | | |
| 24 | 72 | - | - | | |

# Maintenance Instructions Type 21 Ball Valve cont.

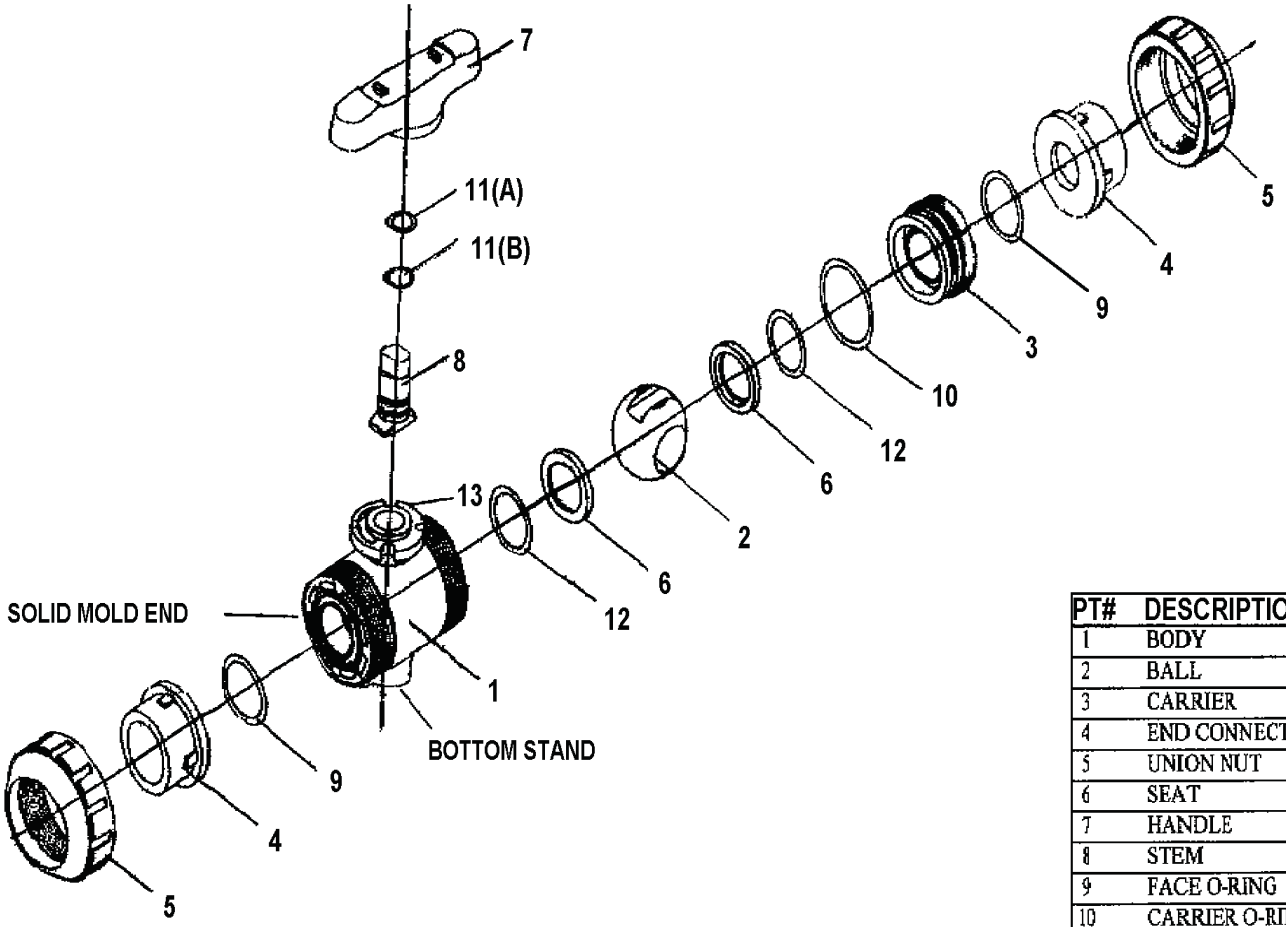
***Maintenance:***

Refer to **ASSEMBLY DRAWING T21V Rev. 0.** And proceed as follows:

1. Turn valve to the closed position.
2. Unscrew union nut (5) from both ends of valve.
3. Remove end connectors (4).
4. On solid mold end, remove face o-ring (9). This completely disassembles this end of valve.
5. Pull upward on handle (7) to remove.
6. On opposite end of valve, remove face o-ring (9) and use handle (7) as a spanner wrench to remove carrier (3).
7. Remove carrier o-ring (10).
8. Remove seat (6) and seat cushion (12) to expose ball (2).
9. Remove ball (2) by pushing from solid molded end of body.
10. Remove stem (6) by pushing it down into body (1).
11. Remove stem o-rings 11(A) and 11(B) from groves in stem.
12. Remove other seat (6) and seat cushion (12).
13. Inspect all parts for wear and replace as necessary.
14. Before re-assembling valve, lubricate all o-rings with Dow Corning III silicone compound or equivalent.
15. To re-assemble valve follow steps 1 through 10 in reverse order.

**NOTE:** If mounting actuator on mounting flange (13), make sure handle (7) is removed and stem (6) and actuator are aligned.

After replacing carrier (3), the face of the carrier should remain slightly projected from the end of the body. Make sure the ball rotates smoothly with only a touch of resistance.




| PT# | DESCRIPTION | QTY | MATERIALS |
|---|---|---|---|
| 1 | BODY | 1 | PVC/PP/PVDF/CPVC |
| 2 | BALL | 1 | PVC/PP/PVDF/CPVC |
| 3 | CARRIER | 1 | CPE/EPDM/VITON/HYP. |
| 4 | END CONNECTOR | 2 | PVC/PP/PVDF/CPVC |
| 5 | UNION NUT | 2 | PVC/PP/PVDF/CPVC |
| 6 | SEAT | 1 | CPE/EPDM/CITON/HYP. |
| 7 | HANDLE | 1 | PVC/PP/PVDF/CPVC |
| 8 | STEM | 1 | PVC/PP/PVDF/CPVC |
| 9 | FACE O-RING | 2 | CPE/EPDM/VITON/HYP. |
| 10 | CARRIER O-RING | 1 | CPE/EPDM/VITON/HYP. |
| 11(A) | STEM O-RING (Upper) | 1 | CPE/EPDM/VITON/HYP. |
| 11(B) | STEM O-RING (Lower) | 1 | CPE/EPDM/VITON/HYP. |
| 12 | SEAT CUSHION | 2 | CPE/EPDM/VITON/HYP |
| 13 | MOUNTING FLANGE | 1 | PVC/PP/PVDF/CPVC |

| | | | | | |
|---|---|---|---|---|---|
| TITLE<br>CHEMLINE TYPE 21 TRUE UNION BALL VALVE | SCALE | | DATE | CHEMLINE PLASTICS | |
| | DR. BY | | | | |
| REFERENCE<br>SIZES 1/2" - 4" | CHKD BY | | | DWG. NO.<br>T21V | REV.<br>0 |
| | APP. BY | | | | |

# Hardware User Manual

*EA9-USER-M*

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# HARDWARE USER MANUAL

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# Chapter 1
# Getting Started

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# Introduction

1

## The Purpose of this Manual

Thank you for purchasing our ***C-more***® Touch Panel family of products. This manual describes AutomationDirect.com's ***C-more*** Touch Panels, their specifications, included components, available accessories and provides you with important information for installation, connectivity and setup. The manual shows you how install, wire and use the products. It also helps you understand how to interface the panels to other devices in a control system.

This user manual contains important information for personnel who will install the touch panels and accessories, and for the personnel who will be programming the panel. If you understand control systems that make use of operating interfaces such as the ***C-more*** touch panels, our user manuals will provide all the information you need to get, and keep your system up and running.

## Supplemental Manuals

If you are familiar with industrial control type devices, you may be able to get up and running with just the aide of the Quick Start Guide that is included with each touch panel. You can also refer to the On-line help that is available in the ***C-more*** programming software for more information about programming the panel.

## Technical Support

We strive to make our manuals the best in the industry. We rely on your feedback to let us know if we are reaching our goal. If you cannot find the solution to your particular application, or, if for any reason you need technical assistance, please call us at:

**770–844–4200**

Our technical support group will work with you to answer your questions. They are available Monday through Friday from 9:00 A.M. to 6:00 P.M. Eastern Time. We also encourage you to visit our web site where you can find technical and non-technical information about our products and our company.

**http://c-more.automationdirect.com**

# Conventions Used

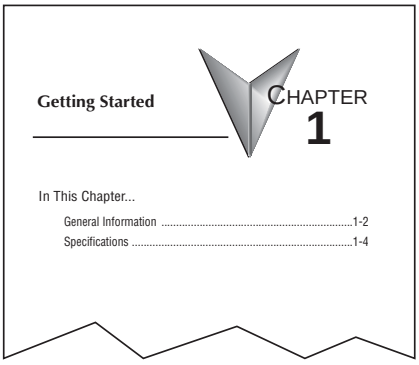


*When you see the "notepad" icon in the left-hand margin, the paragraph to its immediate right will be a special note. The word NOTE: in boldface will mark the beginning of the text.*

**When you see the "exclamation mark" icon in the left-hand margin, the paragraph to its immediate right will be a warning. This information could prevent injury, loss of property, or even death (in extreme cases). The word Warning: in boldface will mark the beginning of the text.**

## Key Topics for Each Chapter

The beginning of each chapter will list the key topics that can be found in that chapter.


Getting Started

CHAPTER 1

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# Product Overview



Some of the features designed into the product to provide excellent hardware and software are listed below.

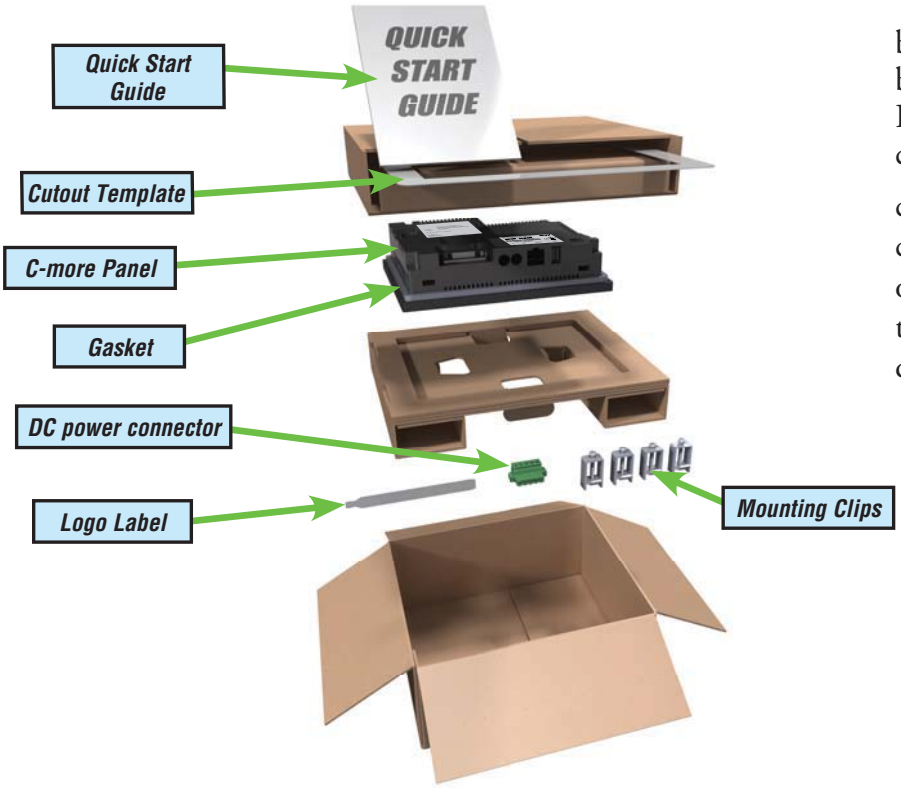
- Analog touch screen (no touch cell boundaries). The touchscreen is designed to respond to a single touch. If it is touched at multiple points at the same time, an unexpected object may be activated.
- Plenty of memory and methods to get data in/out of the panel
- Overlapping active devices on the touch screen
- 65,536 colors for enhanced graphics
- Screen resolutions up to 1024 X 768 pixels
- HDMI output on 12-inch and 15-inch models.
- Audio input port
- Built-in FTP client/server, E-mail client, and Web server
- Audio output port - stereo, requires amplifier and speaker(s)
- User configurable LED on the front of the panel
- Built-in project simulation; test on PC while developing
- Ethernet 10/100Base-T communications (Ethernet available on full feature units only.)
- 15 pin serial port with RS-232, RS422/485
- 3-wire terminal block RS-485 port and RJ12 RS-232 port (full feature units only)
- Programming via USB or Ethernet (Ethernet available on full feature units only.)
- Optional AC/DC power adapter (EA-AC)
- Animation of bitmaps and objects
- Thousands of built-in symbols and Windows fonts
- PID face plate, trending, alarming and a recipe database
- Event Manager to trigger actions based on assigned state changes, schedules, PLC tag names, etc. setup in a database environment. The event can also trigger a sound byte, initiate a screen capture, send a data file (FTP), send an E-mail, etc.
- Trend Data logging
- Internet Remote Access
- Customizable label on the front of the panel

# Quick Start Steps

## Step 1 – Unpack and Inspect

a.) Unpack the ***C-more*** Touch Panel from its shipping carton. Included in the carton are the following:

- ***C-more*** Touch Panel
- cutout template
- mounting clips
- DC power connector
- gasket
- logo label
- Quick Start Guide




b.) Unpack any accessories that have been ordered, such as: AC/DC Power Adapter, programming cable, communications cable, etc.

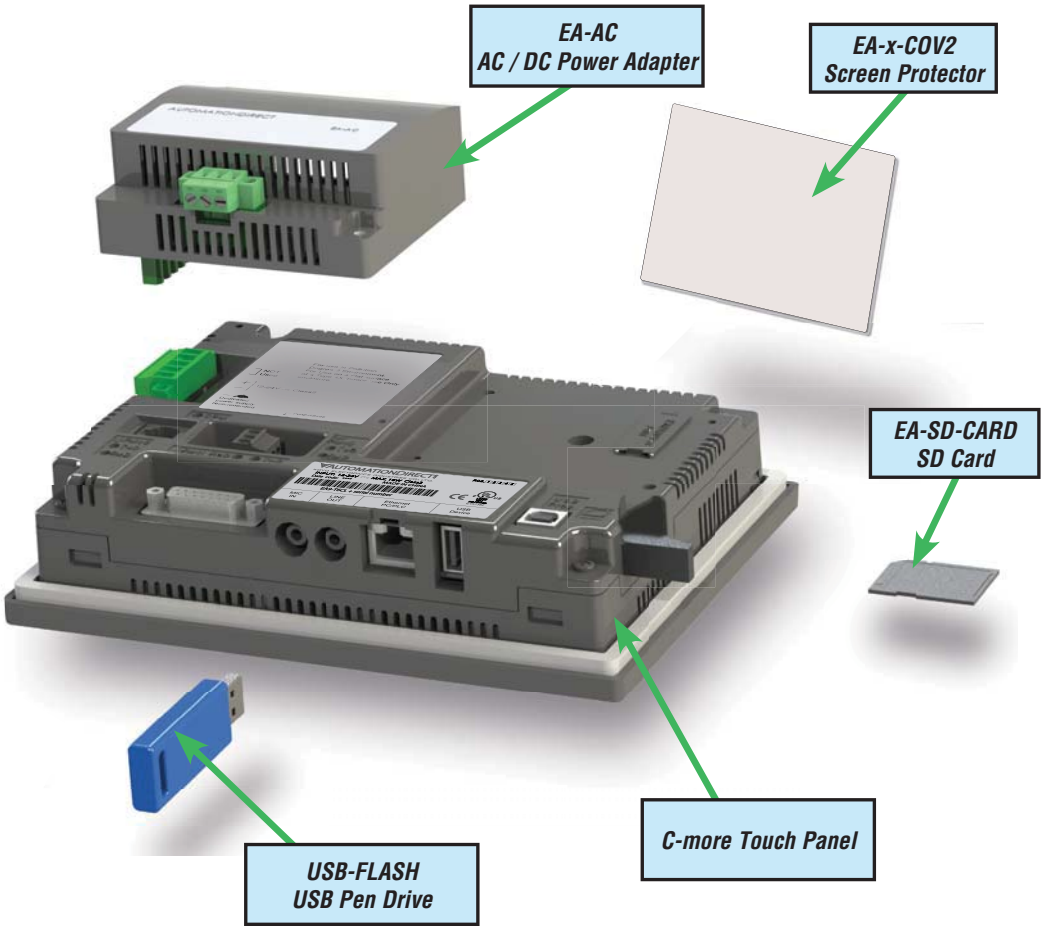
c.) Inspect all equipment for completeness. If anything is missing or damaged, immediately call the AutomationDirect® returns department @ 1-800-633-0405.

**Shipping Carton Contents**

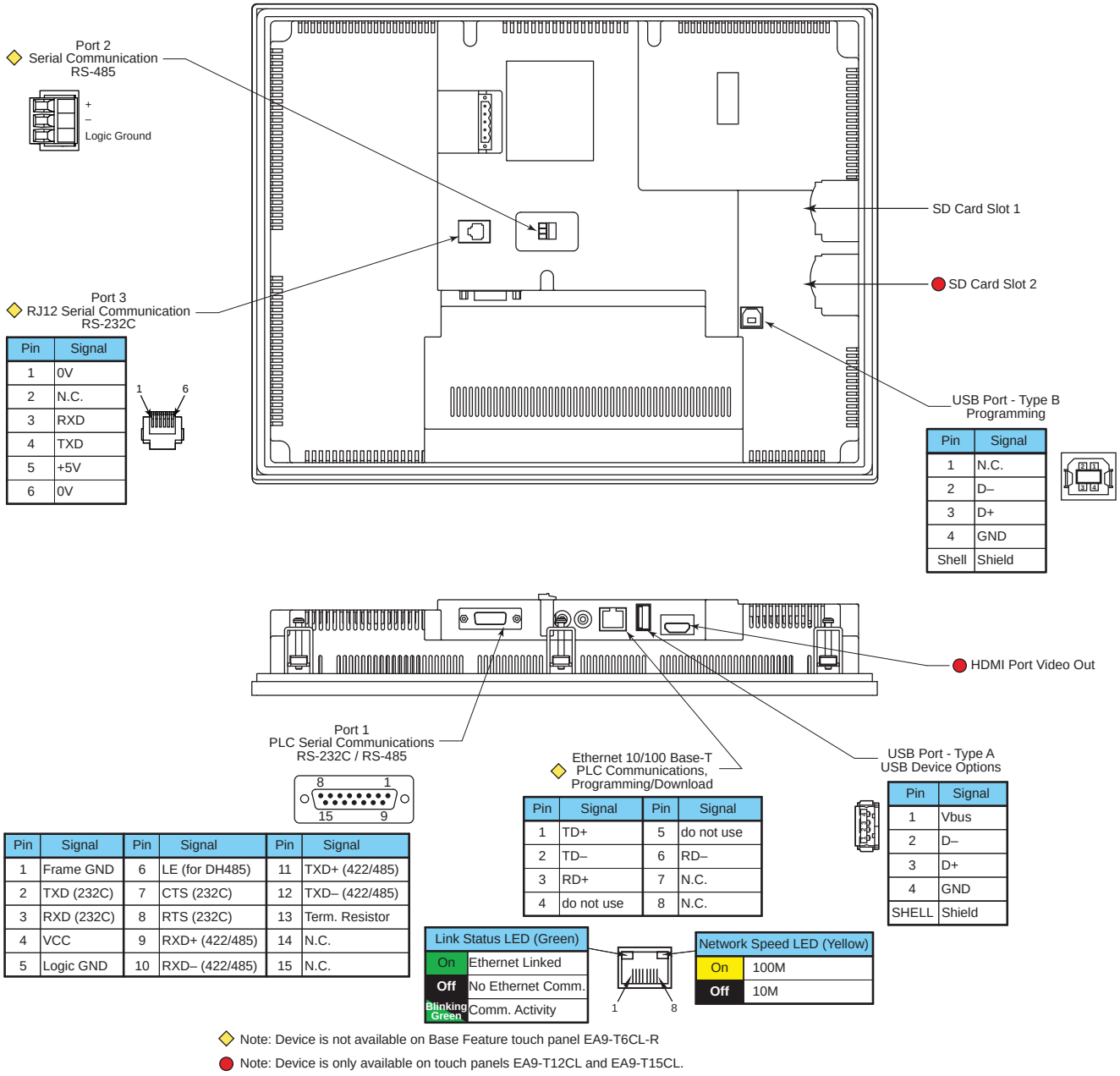
**Optional Accessories**

1

## Step 2 – Install Optional Hardware Accessories



## Step 3 – Become Familiar with Available Communication Ports




| Pin | Signal |
|---|---|
| 1 | 0V |
| 2 | N.C. |
| 3 | RXD |
| 4 | TXD |
| 5 | +5V |
| 6 | 0V |

| Pin | Signal |
|---|---|
| 1 | N.C. |
| 2 | D– |
| 3 | D+ |
| 4 | GND |
| Shell | Shield |

| Pin | Signal | Pin | Signal | Pin | Signal |
|---|---|---|---|---|---|
| 1 | Frame GND | 6 | LE (for DH485) | 11 | TXD+ (422/485) |
| 2 | TXD (232C) | 7 | CTS (232C) | 12 | TXD– (422/485) |
| 3 | RXD (232C) | 8 | RTS (232C) | 13 | Term. Resistor |
| 4 | VCC | 9 | RXD+ (422/485) | 14 | N.C. |
| 5 | Logic GND | 10 | RXD– (422/485) | 15 | N.C. |

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | TD+ | 5 | do not use |
| 2 | TD– | 6 | RD– |
| 3 | RD+ | 7 | N.C. |
| 4 | do not use | 8 | N.C. |

| Pin | Signal |
|---|---|
| 1 | Vbus |
| 2 | D– |
| 3 | D+ |
| 4 | GND |
| SHELL | Shield |

| Link Status LED (Green) | |
|---|---|
| On | Ethernet Linked |
| Off | No Ethernet Comm. |
| Blinking Green | Comm. Activity |

| Network Speed LED (Yellow) | |
|---|---|
| On | 100M |
| Off | 10M |

◇ Note: Device is not available on Base Feature touch panel EA9-T6CL-R

● Note: Device is only available on touch panels EA9-T12CL and EA9-T15CL.

*NOTE: See Chapter 2: Specifications and Chapter 6: PLC Communications for additional details on the available communication ports, protocols and cables.*

## Step 4 – Install the Programming Software and Develop a Project

Following are the minimum system requirements for running ***C-more*** Programming Software, p/n EA9-PGMSW, on a PC:

- Keyboard and Mouse or compatible pointing device
- Super VGA color video adapter and monitor with at least 800 x 600 pixels resolution (1024 x 768 pixels recommended) 64K color minimum
- 300 MB free hard-disk space
- CD-ROM or DVD drive for installing software from the CD
- USB port or Ethernet 10/100 Mbps port for project transfer from software to touch panel (Ethernet port not available on -R models)
- Operating System - Windows® XP Professional Edition (32 bit), Windows 7 (32 or 64 bit) or Windows 8 (32 or 64 bit)

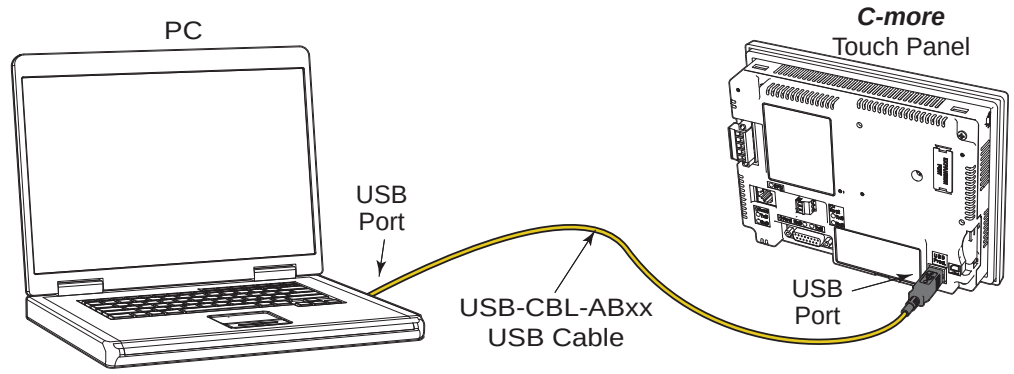
Insert the supplied CD into the PC's CD drive and follow the instructions. If you need assistance during the software installation, call the AutomationDirect Technical Support team @ 770-844-4200.

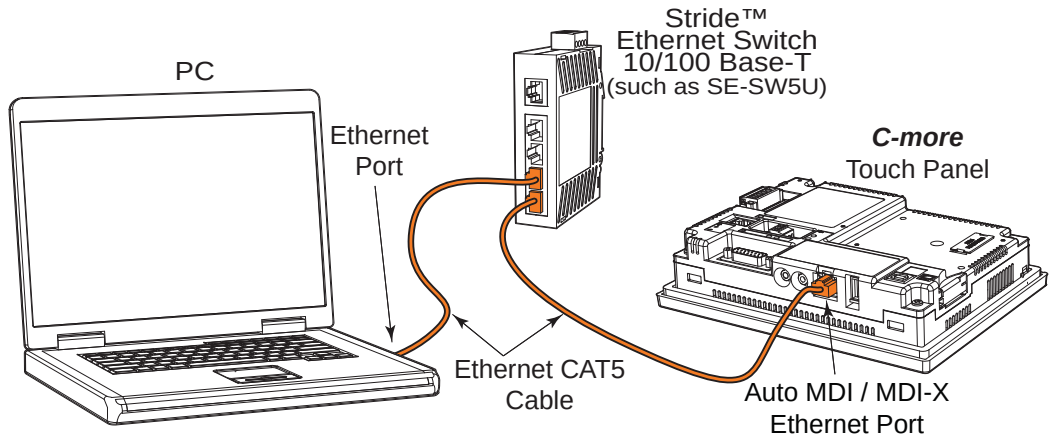
*NOTES: Regarding Ethernet access to a C-more panel.*
*If you intend to take advantage of the methods of remote access to the panel, including the web server, PC remote access, FTP, iPhone or iPad app, you need to consider the security exposure in order to minimize the risks to your process and your C-more panel.*

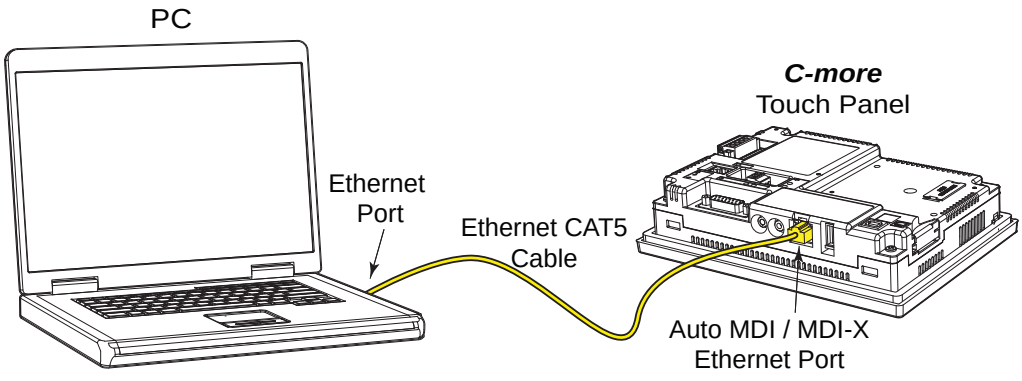
*Security measures may include password protection, changing the ports exposed on your network, including a VPN in your network, and other methods. Security should always be carefully evaluated for each installation.*

## Step 5 – Connect Touch Panel to Computer

- **Connect** a USB Programming Cable, such as p/n USB-CBL-AB15, from a USB type A port on the PC to the USB type B programming port on the ***C-more*** touch panel
- **or** connect the ***C-more*** touch panel and PC together either directly or via an Ethernet switch, and CAT5 Ethernet cables (full feature panels only)



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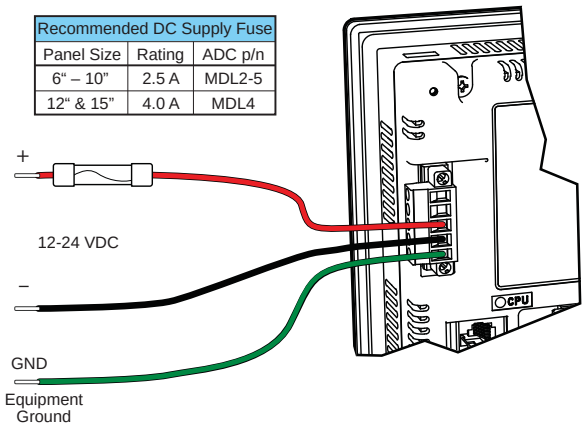
## Step 6 – Provide Power to the Touch Panel

- **Connect** a **dedicated** 12-24 VDC Class 2 power supply to the DC connector on the rear of the ***C-more*** touch panel, include wiring the ground terminal to a proper equipment ground
- **or** install a ***C-more*** AC/DC Power Adapter, EA-AC, to the rear of the touch panel and connect an AC voltage source of 100-240 VAC, 50/60Hertz, to its AC connector (see note below)
- **then** turn on the power **source** and check the LED status indicators on the front and rear of the ***C-more*** touch panel for proper indication (see next page)

*NOTE: The AC/DC Power Adapter, EA-AC, is for C-more touch panels only. The adapter is powered from a 100-240 VAC, 50/60 Hertz power source. The adapter provides 24 VDC @ 1.5 A. Power Fault features help protect data on an SD memory card during power failures.*

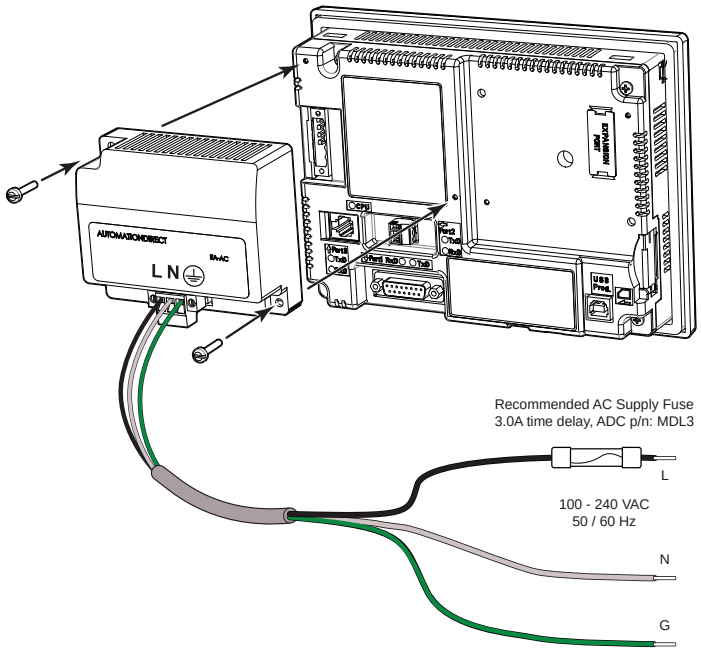
### DC Wiring

| Recommended DC Supply Fuse | | |
|---|---|---|
| Panel Size | Rating | ADC p/n |
| 6" – 10" | 2.5 A | MDL2-5 |
| 12" & 15" | 4.0 A | MDL4 |




| DC-CON Tightening Torque | |
|---|---|
| **Power connector screw torque** | 70.4 oz-in (0.5 Nm) |
| **Power connector mounting torque** | 56 oz-in (0.4 Nm) |

### AC Wiring

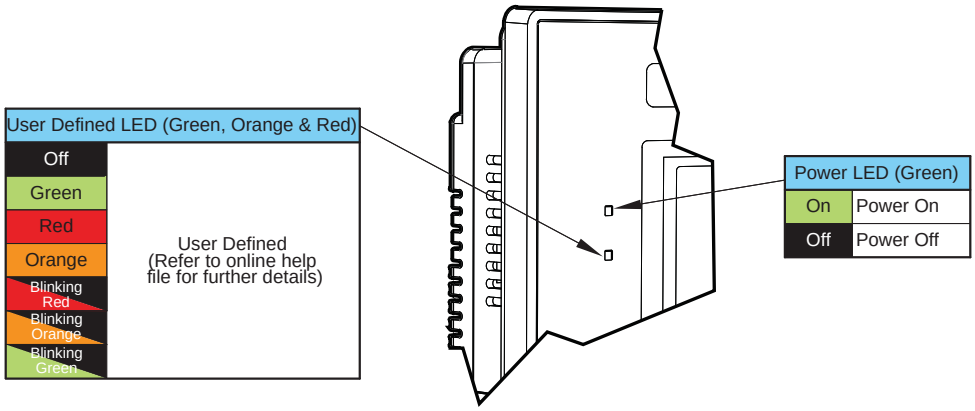



| Tightening Torque | |
|---|---|
| **Power supply cable torque** | 71 - 85 oz-in (0.5 - 0.6 Nm) |
| **Power connector mounting torque** | 71 - 85 oz-in (0.5 - 0.6 Nm) |
| **Mounting flange screw torque** | 57 - 71 oz-in (0.4 - 0.5 Nm) |

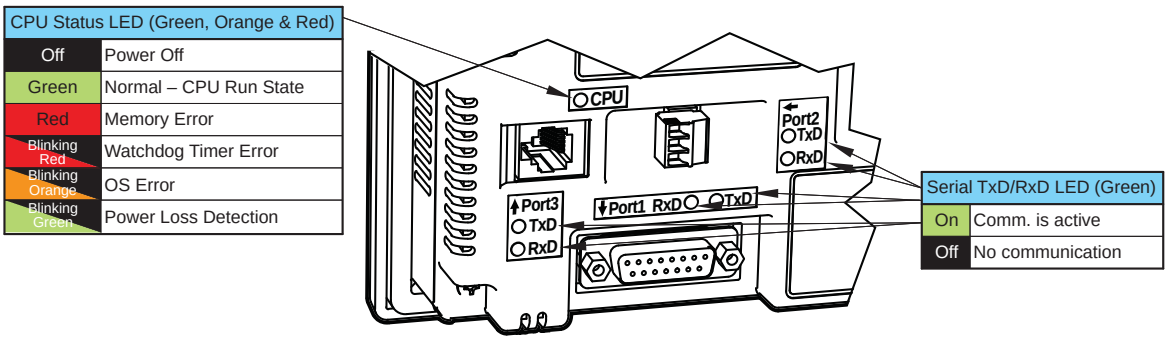
*NOTE: Use 60 / 75 °C copper conductors only*

## Step 6 – Provide Power to the Touch Panel (cont'd)

### *C-more* LED Status Indicators




Front View




Rear View

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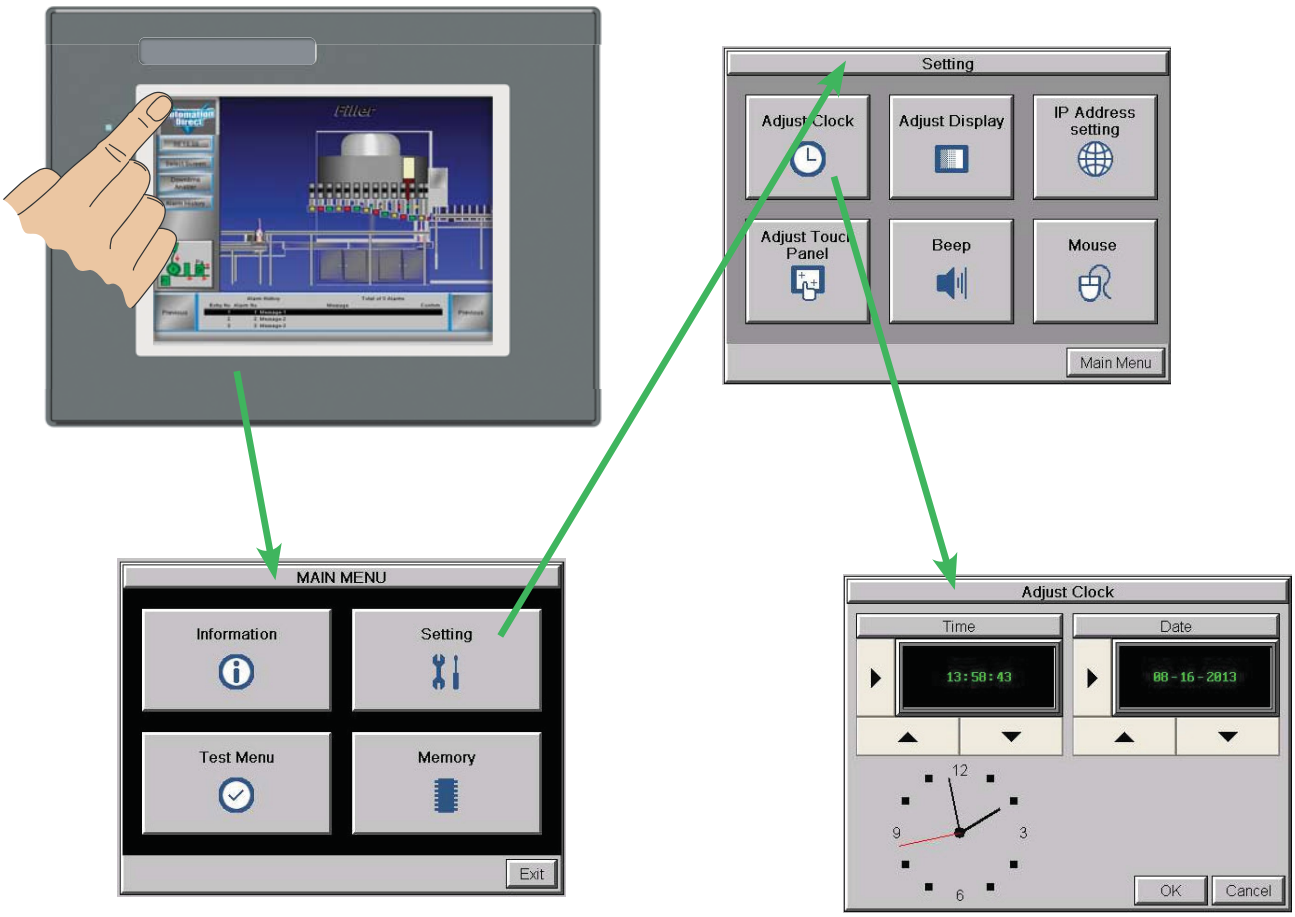
## Step 7 – Access the Touch Panel Setup Screens

- Access the Main Menu of the touch panel System Setup Screens by pressing the extreme upper left corner of the panel display area for three (3) seconds as shown below.
- Adjust the time and date for the panel by pressing the Setting button on the Main Menu, then press the Adjust Clock button on the Setting screen.
- Use the right pointing arrows for the time or date display to select the unit to change. Use the up and down arrows to increment or decrement the value for the selected unit.
- Press OK when done to accept the changes to the time and date in the touch panel or press Cancel to exit the Adjust Clock setup screen without making any changes.
- Press the Main Menu button on the Setting screen and then the Exit button on the Main Menu screen to return to the application screen.



## Step 8 – Choose Touch Panel to Device Protocol & Cables

| Compatibility Table | | | |
|---|---|---|---|
| **Model** | | | **Protocols** |
| **AutomationDirect** | Productivity3000 | | P3000 Serial |
| | | | P3000 Ethernet |
| | Do-more | all | Do-more Serial |
| | | | Do-more Ethernet |
| | CLICK | | Modbus (CLICK) |
| | DL05/DL06 | all | K-Sequence |
| | | | ***Direct***NET |
| | | | Modbus (Koyo addressing) |
| | | H0-ECOM/H0-ECOM100 | ***Direct***LOGIC Ethernet |
| | DL105 | all | K-Sequence |
| | DL205 | D2-230 | K-Sequence |
| | | D2-240 | K-Sequence |
| | | | ***Direct***NET |
| | | D2-250/D2-250-1/D2-260 | K-Sequence |
| | | | ***Direct***NET |
| | | | Modbus (Koyo addressing) |
| | | D2-240/D2-250-1/D2-260 Using DCM | ***Direct***NET |
| | | | Modbus (Koyo addressing) |
| | | H2-ECOM/H2-ECOM100 | ***Direct***LOGIC Ethernet |
| | DL305 | D3-330/330P (Requires the use of a Data Communications Unit) | ***Direct***NET |
| | | D3-340 | ***Direct***NET |
| | | D3-350 | K-Sequence |
| | | | ***Direct***NET |
| | | | Modbus (Koyo addressing) |
| | | D3-350 DCM | ***Direct***NET |
| | | | Modbus (Koyo addressing) |
| | DL405 | D4-430 | K-Sequence |
| | | | ***Direct***NET |
| | | D4-440 | K-Sequence |
| | | | ***Direct***NET |
| | | D4-450 | K-Sequence |
| | | | ***Direct***NET |
| | | | Modbus (Koyo addressing) |
| | | All with DCM | ***Direct***NET |
| | | | Modbus (Koyo addressing) |
| | | H4-ECOM/H4-ECOM100 | ***Direct***LOGIC Ethernet |
| | H2-WinPLC (Think & Do) Live V5.2 or later and Studio any version | | Think & Do Modbus RTU (serial port) |
| | H2-WinPLC (Think & Do) Live V5.5.1 or later and Studio V7.2.1 or later | | Think & Do Modbus TCP/IP (Ethernet port) |
| | GS Drives | | GS Drives Serial |
| | | | GS Drives TCP/IP (GS-EDRV) |
| | SOLO Temperature Controllers | | SOLO Temperature Controller |

## Step 8 – Choose Touch Panel to Device Protocol & Cables (cont'd)

| Compatibility Table (cont'd) | | |
|---|---|---|
| **Model** | | **Protocols** |
| **Allen-Bradley** | MicroLogix 1000, 1100, 1200, 1400, 1500, SLC 5-01/02/03, PLC5 | DH485/AIC/AIC+ |
| | MicroLogix 1000, 1100, 1200, 1400 and 1500 | DF1 Half Duplex; DF1 Full Duplex |
| | SLC 5-03/04/05 | |
| | ControlLogix™, CompactLogix™, FlexLogix™ | |
| | PLC-5 | DF1 Full Duplex |
| | ControlLogix, CompactLogix, FlexLogix - Tag Based | DF1 Half Duplex; DF1 Full Duplex |
| | ControlLogix, CompactLogix, FlexLogix - Generic I/O Messaging | EtherNet/IP Server |
| | ControlLogix, CompactLogix, FlexLogix - Tag Based | EtherNet/IP Client |
| | MicroLogix 1100, 1400 and SLC 5/05, via native Ethernet port | |
| | MicroLogix 1000, 1100, 1200, 1400, 1500, SLC 5-03/04/05, all via ENI adapter | |
| **GE** | 90/30, 90/70. Micro 90, VersaMax Micro | SNPX |
| **Mitsubishi** | FX Series | FX Direct |
| | Q02, Q02H, Q06H, Q12H, Q25H | Q CPU |
| | Q, QnA Serial | QnA Serial |
| | Q, QnA Ethernet | QnA Ethernet |
| **Modicon** | 984 CPU, Quantum 113 CPU, AEG Modicon Micro Series 110 CPU: 311-xx, 411-xx, 512-xx, 612-xx | Modbus RTU |
| | Other devices using Modicon Modbus addressing | Modbus RTU |
| | | TUModbus TCP/IP |
| **Omron** | C200 Adapter, C500 | Host Link |
| | CJ1/CS1 Serial | FINS |
| | CJ1/CS1 Ethernet | |
| **Siemens** | S7-200 CPU, RS-485 Serial | PPI |
| | S7-200 CPU, S7-300 CPU, S7-1200 CPU; Ethernet | Ethernet ISO over TCP |

## Step 8 – Choose Touch Panel to Device Protocol & Cables (cont'd)

### Available cables to connect from PLC to *C-more* serial Port 1

| Purchased Cable Description | Cable Part Number |
|---|---|
| AutomationDirect Productivity Series, Do-more, CLICK, ***Direct***LOGIC PLC RJ-12 port, DL05, DL06, DL105, DL205, D3-350, D4-450 & H2-WINPLC (RS-232C) | **EA-2CBL** |
| ***Direct***LOGIC (VGA Style) 15-pin port DL06, D2-250 (250-1), D2-260 (RS-232C) | **EA-2CBL-1** |
| ***Direct***LOGIC PLC RJ-11 port, D3-340 (RS-232C) | **EA-3CBL** |
| ***Direct***LOGIC DL405 PLC 15-pin D-sub port, DL405 (RS-232C) | **EA-4CBL-1** |
| ***Direct***LOGIC PLC 25-pin D-sub port, DL405, D3-350, DL305 DCU and all DCM's (RS-232C) | **EA-4CBL-2** |
| Allen-Bradley MicroLogix 1000, 1100, 1200, 1400, 1500 (RS-232C) | **EA-MLOGIX-CBL** |
| Allen-Bradley SLC 5-03/04/05, ControlLogix, CompactLogix, FlexLogix DF1 port (RS-232C) | **EA-SLC-232-CBL** |
| Allen-Bradley PLC-5 DF1 port (RS-232C) | **EA-PLC5-232-CBL** |
| Allen-Bradley MicroLogix, SLC 5-01/02/03, PLC5 DH485 port (RS-232C) | **EA-DH485-CBL** |
| GE 90/30, 90/70, Micro 90, VersaMax Micro 15-pin D-sub port (RS-422A) | **EA-90-30-CBL** |
| MITSUBISHI FX Series 25-pin port (RS-422A) | **EA-MITSU-CBL** |
| MITSUBISHI FX Series 8-pin mini-DIN (RS-422A) | **EA-MITSU-CBL-1** |
| OMRON Host Link (C200 Adapter, C500) (RS-232C) | **EA-OMRON-CBL** |

*NOTE: The above list of pre-made communications cables may be purchased. See Chapter 6: PLC Communications for wiring diagrams of additonal user constructed cables. Chapter 6 also includes wiring diagrams for the pre-made cables.*

**Pre-made cable examples**

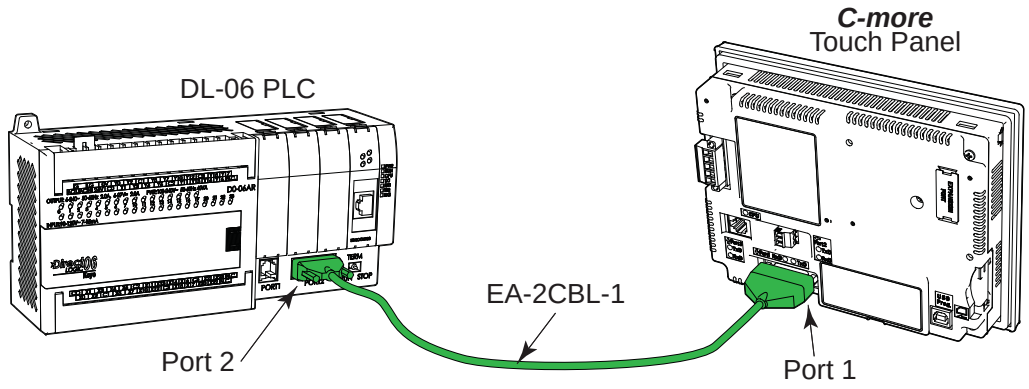
**EA-2CBL**

**EA-2CBL-1**

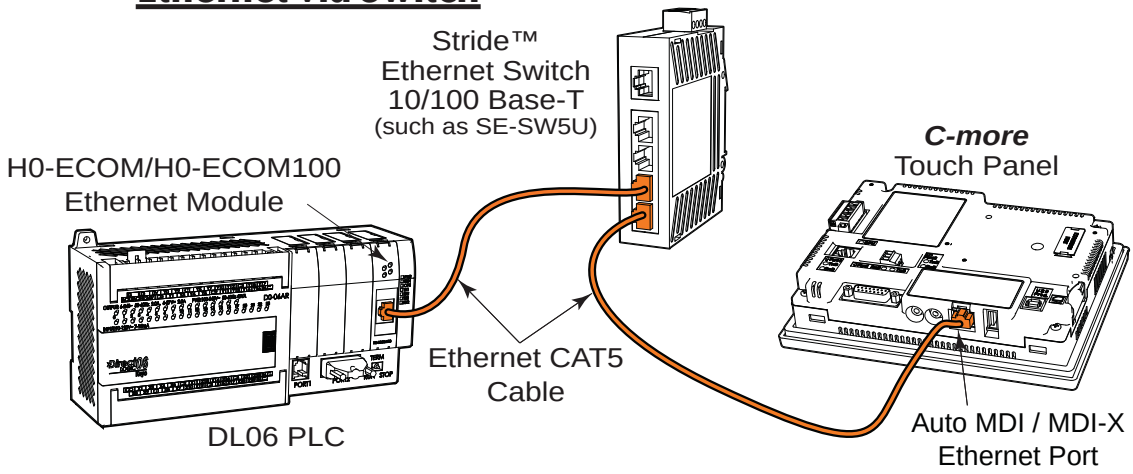
## Step 9 – Connect Touch Panel to PLC

- Connect the serial communications cable between the ***C-more*** touch panel and the PLC
- or connect the ***C-more*** touch panel and PLC together either directly or via an Ethernet switch, and CAT5 Ethernet cables (full feature panels only)

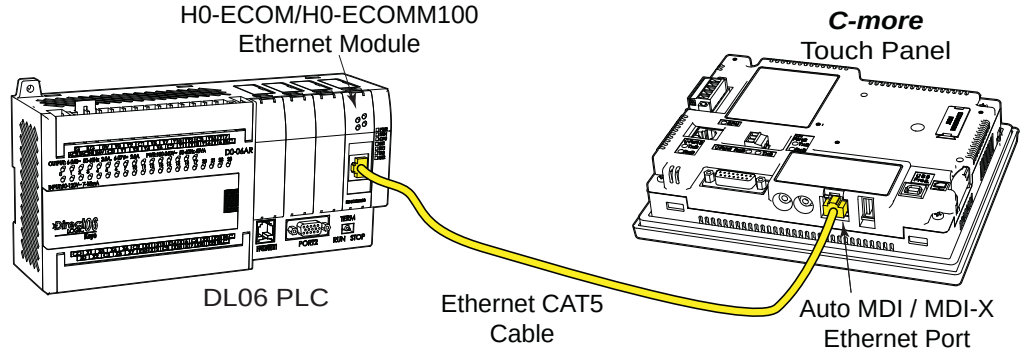
### Serial




### Ethernet via Switch




### Ethernet



# Chapter 2
# Specifications

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# Available Models



The ***C-more***® Operator Interface is the next generation of touch panel brought to you by AutomationDirect. It has been designed to display and interchange graphical data from a PLC by merely viewing or touching the screen.

The ***C-more*** Touch Panel is available in a variety of models to suit your application. Refer to the following tables for a list of part numbers, descriptions and options available.

| Part Number | Description | Project Memory | SD Card Option | USB Device | Ethernet | HDMI |
|---|---|---|---|---|---|---|
| **EA9-T6CL-R** | ***C-more*** EA9 series touch screen interface panel, 6-inch color TFT (5.7 inch viewable screen), base model, 64k colors, 320 x 240 pixel QVGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (1) serial port, USB 2.0 Type A and B ports, supports SD memory card, no Ethernet support. Compatible with EA9-PGMSW programming software version 5.0 or later. | 26 MB | 1 slot | Yes | No | No |
| **EA9-T6CL** | ***C-more*** EA9 series touch screen interface panel, 6-inch color TFT (5.7 inch viewable screen), 64k colors, 320 x 240 pixel QVGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (3) serial ports, USB 2.0 Type A and B ports and Ethernet port; supports SD memory card. Compatible with EA9-PGMSW programming software version 5.0 or later. | 26 MB | 1 slot | Yes | Yes | No |
| **EA9-T8CL** | ***C-more*** EA9 series touch screen interface panel, 8-inch color TFT (8.4 inch viewable screen), 64k colors, 800 x 600 pixel SVGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (3) serial ports, USB 2.0 Type A and B ports and Ethernet port; supports SD memory card. Compatible with EA9-PGMSW programming software version 5.0 or later. | 26 MB | 1 slot | Yes | Yes | No |
| **EA9-T10CL** | ***C-more*** EA9 series touch screen interface panel, 10-inch color TFT (10.4 inch viewable screen), 64k colors, 800 x 600 pixel SVGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (3) serial ports, USB 2.0 Type A and B ports and Ethernet port; supports SD memory card. Compatible with EA9-PGMSW programming software version 5.0 or later. | 26 MB | 1 slot | Yes | Yes | No |
| **EA9-T12CL** | ***C-more*** EA9 series touch screen interface panel, 12-inch color TFT (12.1 inch viewable screen), 64k colors, 800 x 600 pixel SVGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (3) serial ports, USB 2.0 Type A and B ports and Ethernet port; supports (2) SD memory cards. Includes HDMI video out. Compatible with EA9-PGMSW programming software version 5.0 or later. | 82 MB | 2 slot | Yes | Yes | Yes |
| **EA9-T15CL** | ***C-more*** EA9 series touch screen interface panel, 15-inch color TFT (15 inch viewable screen), 64k colors, 1024 x 768 pixel XGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (3) serial ports, USB #2.0 Type A and B ports and Ethernet port; supports (2) SD memory cards. Includes HDMI video out. Compatible with EA9-PGMSW programming software version 5.0 or later. | 82 MB | 2 slot | Yes | Yes | Yes |

# Model Specifications

The following specification tables are separated into these groups:

- Specifications common to all models
- 6” Reduced and Full Feature Models, EA9-T6CL-R, and EA9-T6CL
- 8” & 10” Full Feature Models, EA9-T8CL and EA9-T10CL
- 12” & 15” Full Feature Models, EA9-T12CL & EA9-T15CL

Specification tables begin on the next page.

## Specifications common to all models

| Model / Specification | All Models |
|---|---|
| Operating Temperature | 0 to 50 °C (32 to 122 °F); Maximum surrounding air temperature rating: 50 °C (122 °F)<br>IEC 60068-2-14 (Test Nb, Thermal Shock) |
| Storage Temperature | –20 to +60 °C (–4 to +140 °F)<br>IEC 60068-2-1 (Test Ab, Cold)<br>IEC 60068-2-2 (Test Bb, Dry Heat)<br>IEC 60068-2-14 (Test Na, Thermal Shock) |
| Humidity | 5–95% RH (non-condensing) |
| Environment | For use in Pollution Degree 2 environment, no corrosive gases permitted |
| Noise Immunity | NEMA ICS3-304 ( EN61131-2 )<br>RFI, (145MHz, 440Mhz 10W @ 10cm)<br>Impulse 1000V @ 1mS pulse<br>EN61000-4-2 (ESD),<br>EN61000-4-3 (RFI)<br>EN61000-4-4 (FTB)<br>EN61000-4-5 (Serge)<br>EN61000-4-6 (Conducted)<br>EN61000-4-8 (Power frequency magnetic field immunity) |
| Withstand Voltage | 1000 VAC, 1 min. (FG to Power supply ) |
| Insulation Resistance | > 10M ohm @ 500V DC (FG to Power supply ) |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Emission | EN55011 Class A (Radiated RF emission) |
| Enclosure | NEMA 250 type 4/4X indoor use only<br>UL50 type 4X indoor use only<br>IP-65 indoor use only<br>(When mounted correctly) |
| Agency Approvals | UL508 (E157382), CE (EN61131-2), CUL Canadian C22.2, RoHS (2011/65/EU) |
| Backlight Average Lifetime* | 50,000 hours @ 25 °C |
| Touch Panel Type** | Four-wire analog resistive |
| Supply Power | 12-24 VDC Class 2, or use the AC/DC Power Adapter, EA-AC, to power the touch panel from a 100-240 VAC, 50/60 Hz power source.<br>Reverse Polarity Protected |

** NOTE: The backlight average lifetime is defined as the average usage time it takes before the brightness becomes 50% of the initial brightness. The lifetime of the backlight depends on the ambient temperature. The lifetime will decrease under low or high temperature usage.*

*** NOTE: The Touchscreen is designed to respond to a single touch. If it is touched at multiple points at the same time, an unexpected object may be activated.*

## 6-inch Models

| Specification \ Model | 6" TFT color w/ base features | 6" TFT color w/ full features |
|---|---|---|
| Part Number | EA9-T6CL-R | EA9-T6CL |
| Display Actual Size and Type | 5.7" TFT color | |
| Display Viewing Area | 4.54" x 3.40" [115.2 mm x 86.4 mm] | |
| Weight | 1.56 lb (710g) | 1.59 lb (720g) |
| Screen Pixels | 3200 x 240 (QVGA) | |
| Display Brightness | 280 nits (typ) | |
| LCD Panel Dot Pitch | 0.18 mm x 0.18 mm | |
| Color Scale | 65,536 | |
| Project Memory | 26 MB | |
| Number of Screens | Up to 999 screens – limited by project memory | |
| Realtime Clock | Realtime Clock Built into panel, backed up for 30 days at 25°C | |
| Calendar - Month / Day / Year | Yes - monthly deviation 60 sec (Reference) | |
| Serial Port 1 | 15-pin D-sub female - RS2342C, RS-422/485 | |
| Serial Port 2 | N/A | 3-wire terminal block - RS-485 |
| Serial Port 3 | N/A | RJ-12 modular jack - RS-232C |
| USB Port - Type B | USB 2.0 High speed (480 Mbps) Type B - Download/Program | |
| USB Port - Type A | USB 2.0 High speed (480 Mbps) Type A -for USB device options | |
| Ethernet Port | N/A | Ethernet Port Ethernet 10/100 Base-T, auto MDI/MDI-X |
| Audio Line Out | N/A | 3.5 mm mini jack – requires amplifier and speaker(s) |
| Mic In | N/A | 3.5 mm mini jack |
| SD Card Slot | 1 slot. Supports max 2 GB (SD,) max 32 GB (SDHC) | |
| HDMI Video Out | N/A | |
| Power Consumption | 16.0W<br>1.30A @ 12 VDC<br>0.66A @ 24 VDC | |
| Internal Fuse (non-replaceable) | 4A | |

## 8-inch and 10-inch Models

| Specification \ Model | 8" TFT color w/ full features | 10" TFT color w/ full features |
|---|---|---|
| Part Number | EA9-T8CL | EA9-T10CL |
| Display Actual Size and Type | 8.4" TFT color | 10.4" TFT color |
| Display Viewing Area | 6.71" x 5.03" [170.4 mm x127.8mm] | 8.31" x 6.24" [211.2 mm x 158.4 mm] |
| Weight | 2.93 lb (1330g) | 4.19 lb (1900g) |
| Screen Pixels | 800 x 600 (SVGA) | |
| Display Brightness | 310 nits (typ) | 280 nits (typ) |
| LCD Panel Dot Pitch | 0.213 mm x 0.213 mm | 0.264 mm x 0.264 mm |
| Color Scale | 65,536 colors | |
| Project Memory | 26 MB | |
| Number of Screens | Up to 999 screens – limited by project memory | |
| Realtime Clock | Realtime Clock Built into panel, backed up for 30 days at 25°C | |
| Calendar - Month / Day / Year | Yes - monthly deviation 60 sec (Reference) | |
| Serial Port 1 | 15-pin D-sub female - RS2342C, RS-422/485 | |
| Serial Port 2 | 3-wire terminal block - RS-485 | |
| Serial Port 3 | RJ-12 modular jack - RS-232C | |
| USB Port - Type B | USB 2.0 High speed (480 Mbps) Type B - Download/Program | |
| USB Port - Type A | USB 2.0 High speed (480 Mbps) Type A -for USB device options | |
| Ethernet Port | Ethernet Port Ethernet 10/100 Base-T, auto MDI/MDI-X | |
| Audio Line Out | 3.5 mm mini jack – requires amplifier and speaker(s) | |
| Mic In | 3.5 mm mini jack | |
| SD Card Slot | 1 slot. Supports max 2 GB (SD,) max 32 GB (SDHC) | |
| HDMI Video Out | N/A | |
| Power Consumption | 18.0W<br>1.50A @ 12 VDC<br>0.75A @ 24 VDC | |
| Internal Fuse (non-replaceable) | 6.3A | |

## 12-inch and 15-inch Models

| Specification \ Model | 12" TFT color w/ full features | 15" TFT color w/ full features |
|---|---|---|
| Part Number | EA9-T12CL | EA9-T15CL |
| Display Actual Size and Type | 12.1" TFT color | 15.0" TFT color |
| Display Viewing Area | 9.69" x 7.26" [246.0 mm x 184.5 mm] | 11.97" x 8.98" [304.1 mm x 228.0 mm] |
| Weight | 4.85 lb (2200g) | 6.50 lb (2950g) |
| Screen Pixels | 800 x 600 (SVGA) | 1024 x 768 (XGA) |
| Display Brightness | 280 nits (typ) | |
| LCD Panel Dot Pitch | 0.3075 mm x 0.3075 mm | 0.297 mm x 0.297 mm |
| Color Scale | 65,536 colors | |
| Project Memory | 82 MB | |
| Number of Screens | Up to 999 screens – limited by project memory | |
| Realtime Clock | Realtime Clock Built into panel, backed up for 30 days at 25°C | |
| Calendar - Month / Day / Year | Yes - monthly deviation 60 sec (Reference) | |
| Serial PLC Interface Port 1 | 15-pin D-sub female - RS2342C, RS-422/485 | |
| Serial PLC Interface Port 2 | 3-wire terminal block - RS-485 | |
| Serial PLC Interface Port 3 | RJ-12 modular jack - RS-232C | |
| USB Port - Type B | USB 2.0 High speed (480 Mbps) Type B - Download/Program | |
| USB Port - Type A | USB 2.0 High speed (480 Mbps) Type A -for USB device options | |
| Ethernet Port | Ethernet Port Ethernet 10/100 Base-T, auto MDI/MDI-X | |
| Audio Line Out | 3.5 mm mini jack – requires amplifier and speaker(s) | |
| Mic In | 3.5 mm mini jack | |
| SD Card Slot | 2 slots. Supports max 2 GB (SD), max 32 GB (SDHC) | |
| HDMI Video Out | HDMI Type A Port | |
| Power Consumption | 21.0W<br>1.75A @ 12 VDC<br>0.88A @ 24 VDC | 29.0W<br>2.40A @ 12 VDC<br>1.20A @ 24 VDC |
| Internal Fuse (non-replaceable) | 6.3A | |

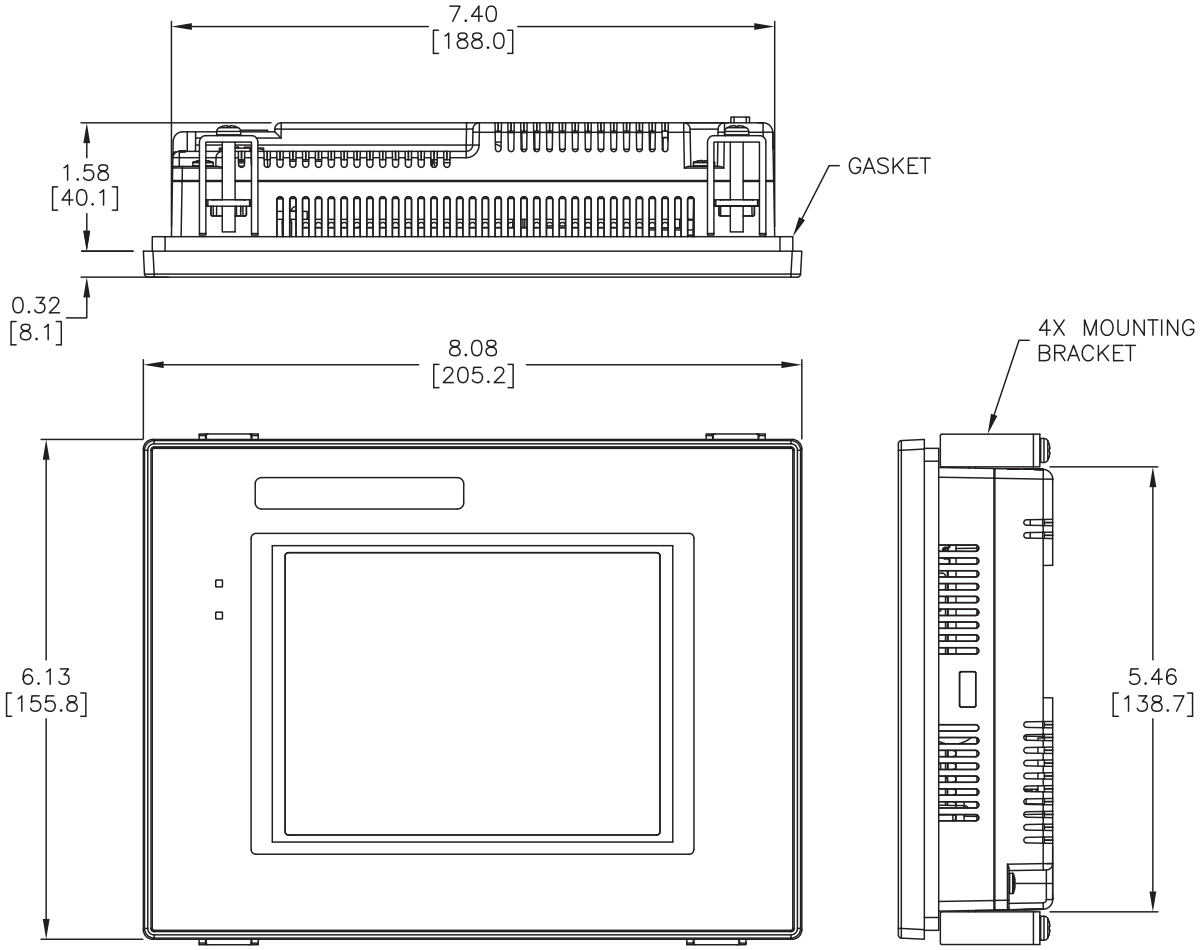
# EA9-T6CL-R, EA9-T6CL

## Dimensions, Inches [mm]

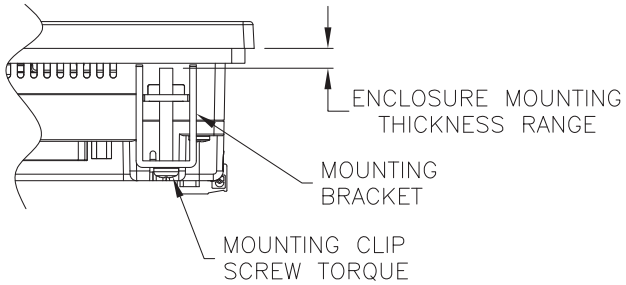
2

All the necessary mounting hardware is provided with the touch panel. Use the four mounting clips and screws to secure the touch panel to the cabinet or enclosure surface.

A template for marking the cutout dimensions on the mounting surface is provided in the box.



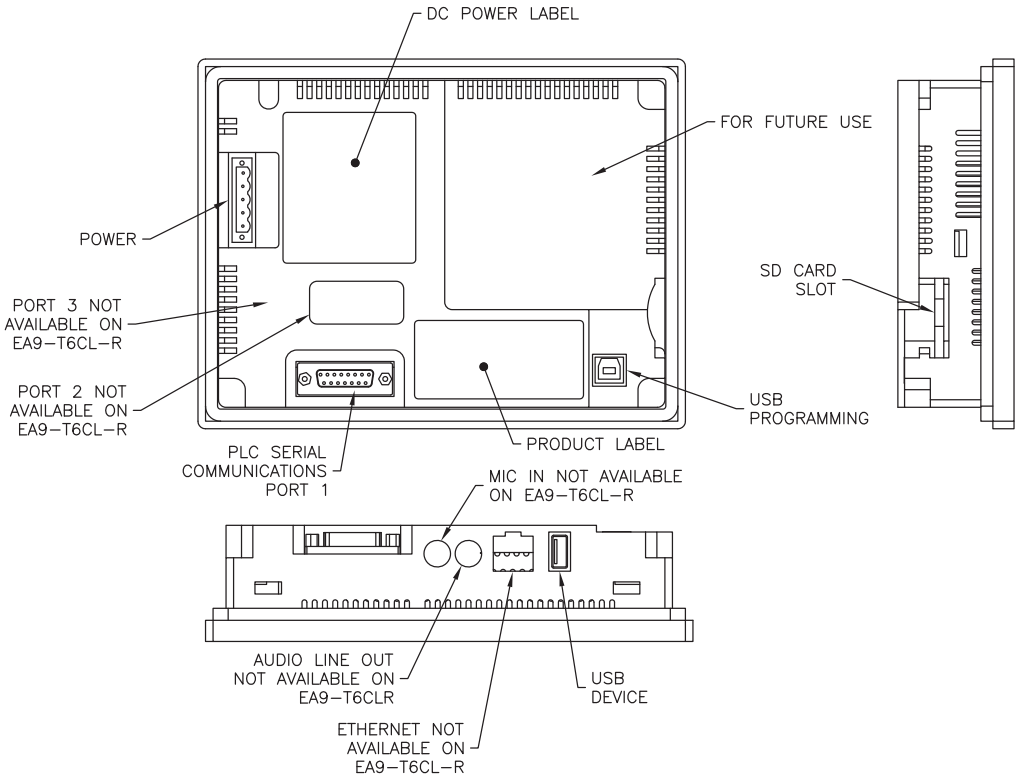

## Enclosure Mounting Thickness Ranges and Mounting Clip Screw Torque



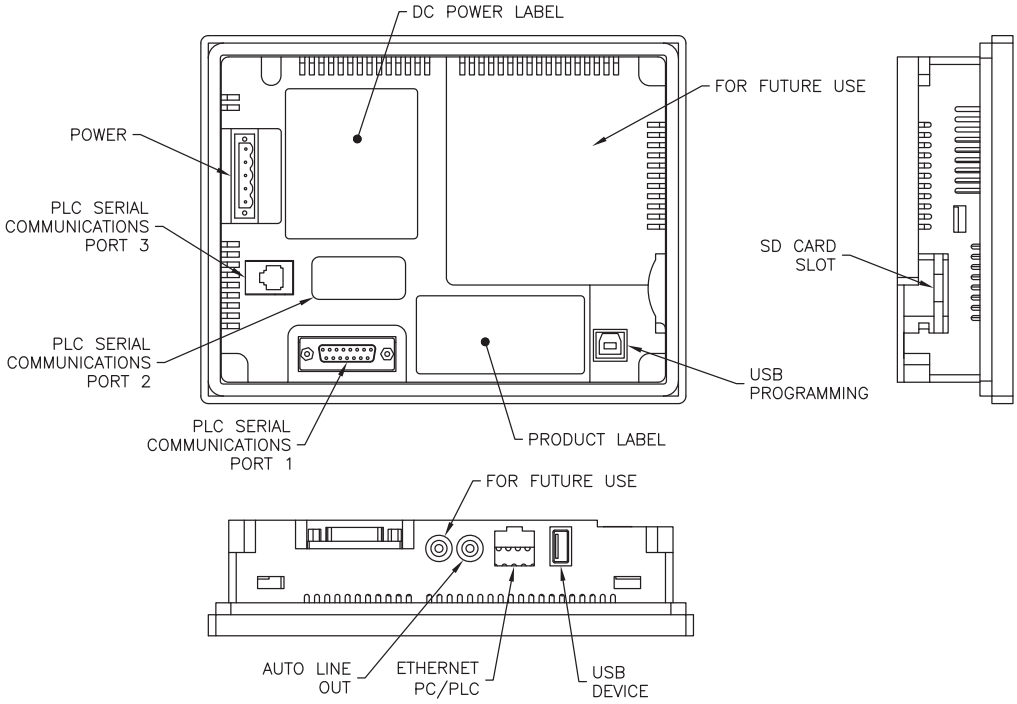

| Touch Panel Size | Enclosure Thickness Range | Mounting Clip Screw Torque |
|---|---|---|
| 6", 8", 10" and 12" | 0.039 - 0.20 inch [1 – 5 mm] | 63 - 77 oz-in [0.45 - 0.55 Nm] |

## Ports and Memory Expansion

### EA9-T6CL-R




### EA9-T6CL



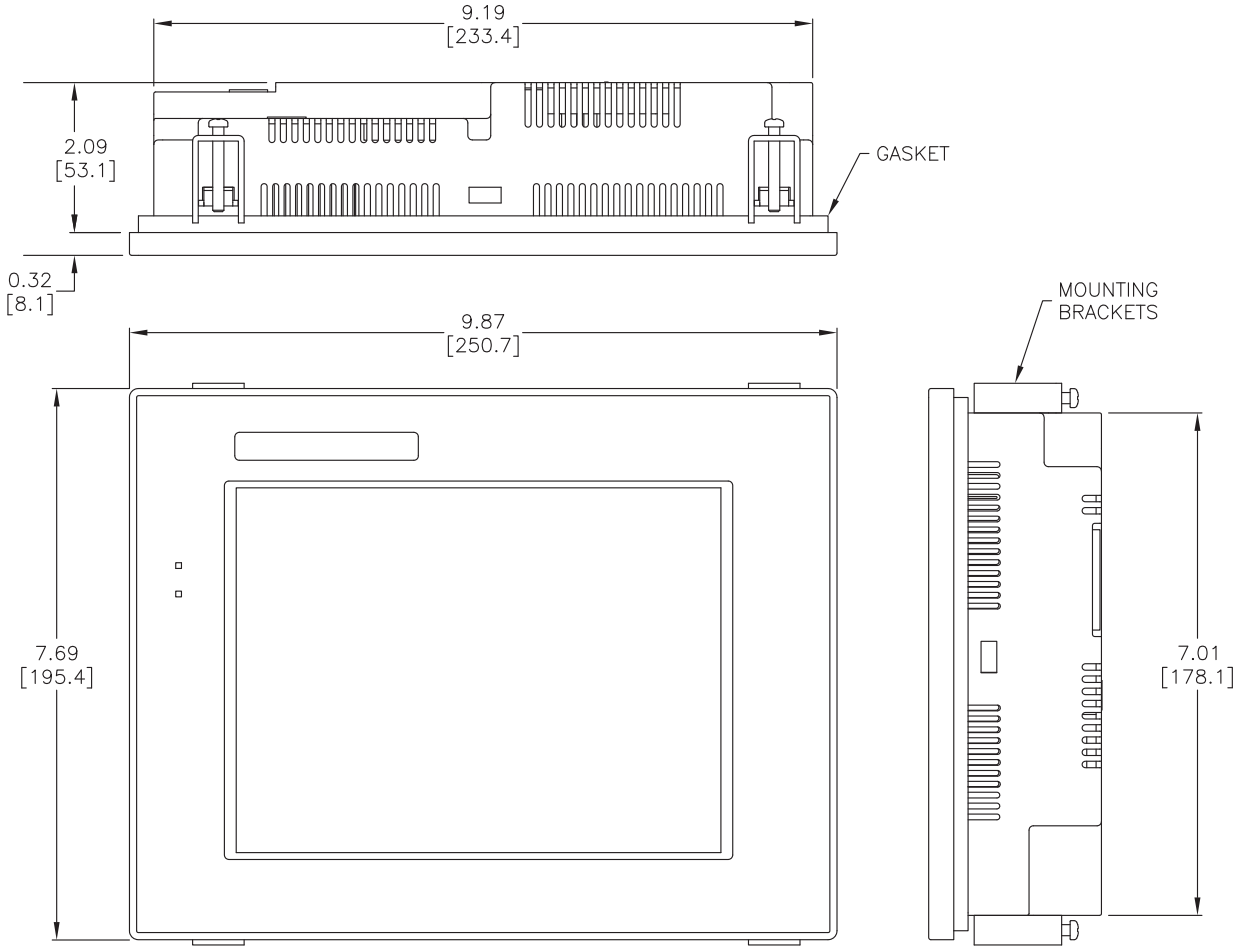
# EA9-T8CL

## Dimensions, Inches [mm]

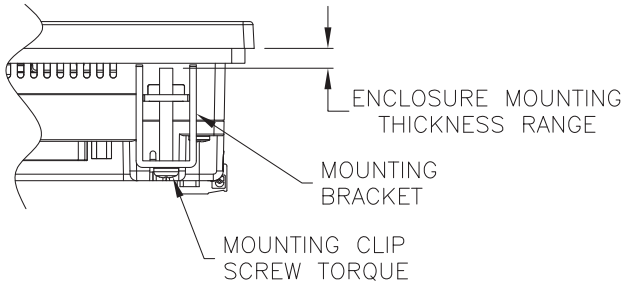
2

All the necessary mounting hardware is provided with the touch panel. Use the four mounting clips and screws to secure the touch panel to the cabinet or enclosure surface.

A template for marking the cutout dimensions on the mounting surface is provided in the box.



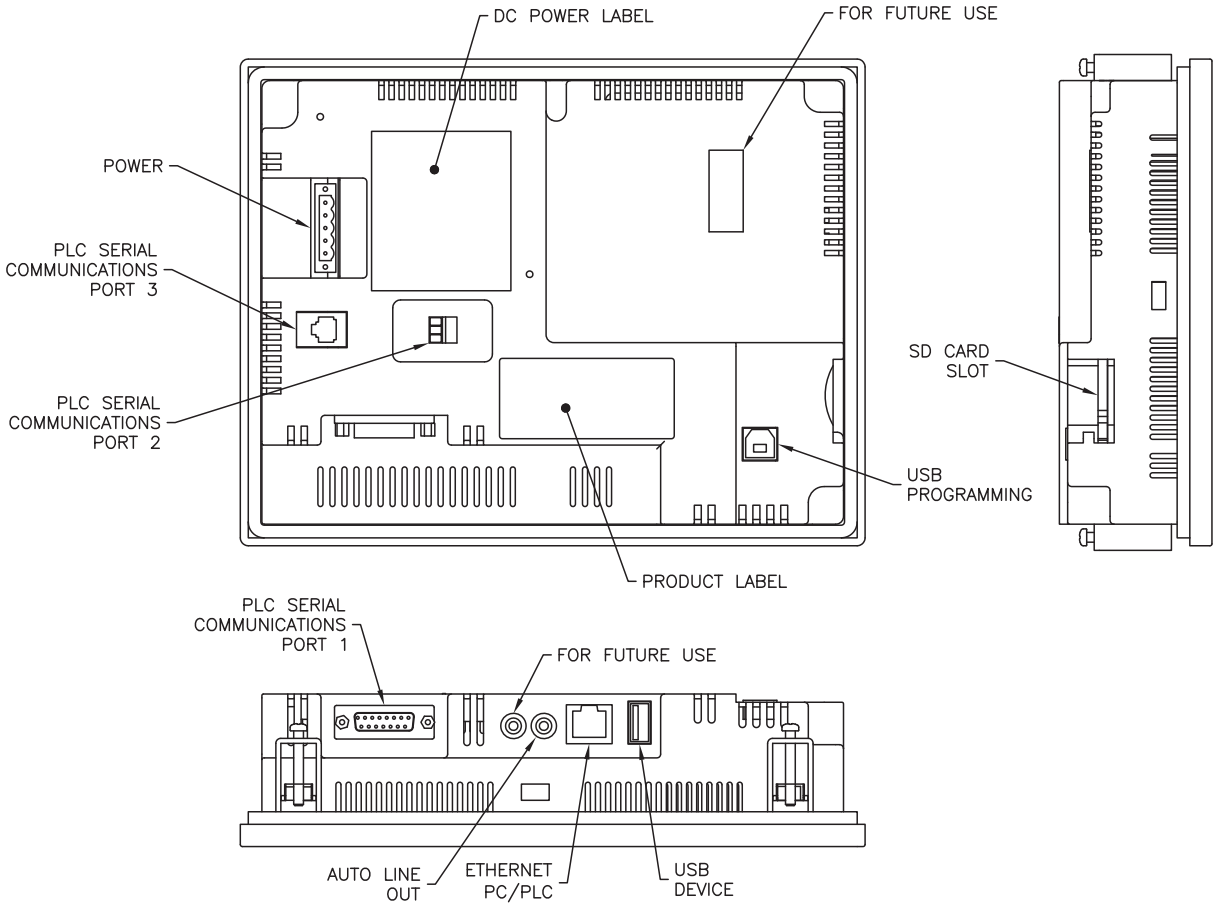

## Enclosure Mounting Thickness Ranges and Mounting Clip Screw Torque




| Touch Panel Size | Enclosure Thickness Range | Mounting Clip Screw Torque |
|---|---|---|
| 6", 8", 10" and 12" | 0.039 - 0.20 inch [1 – 5 mm] | 63 - 77 oz-in [0.45 - 0.55 Nm] |

## Ports and Memory Expansion

### EA9-T8CL



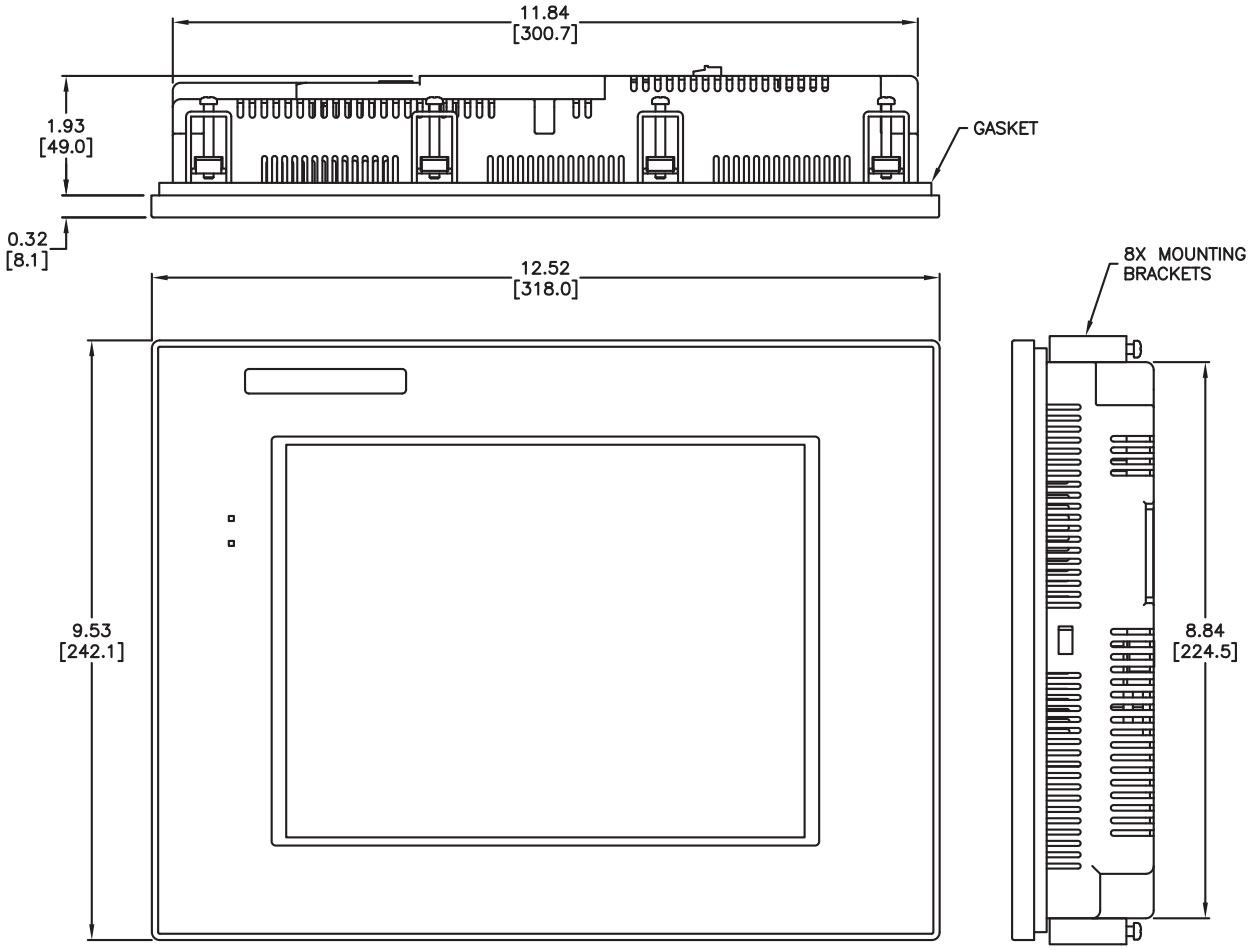
# EA9-T10CL

## Dimensions, Inches [mm]

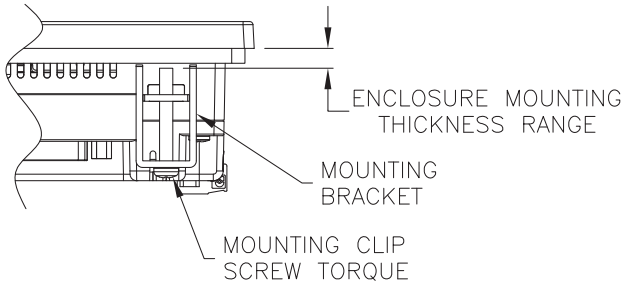
2

All the necessary mounting hardware is provided with the touch panel. Use the eight mounting clips and screws to secure the touch panel to the cabinet or enclosure surface.

A template for marking the cutout dimensions on the mounting surface is provided in the box.



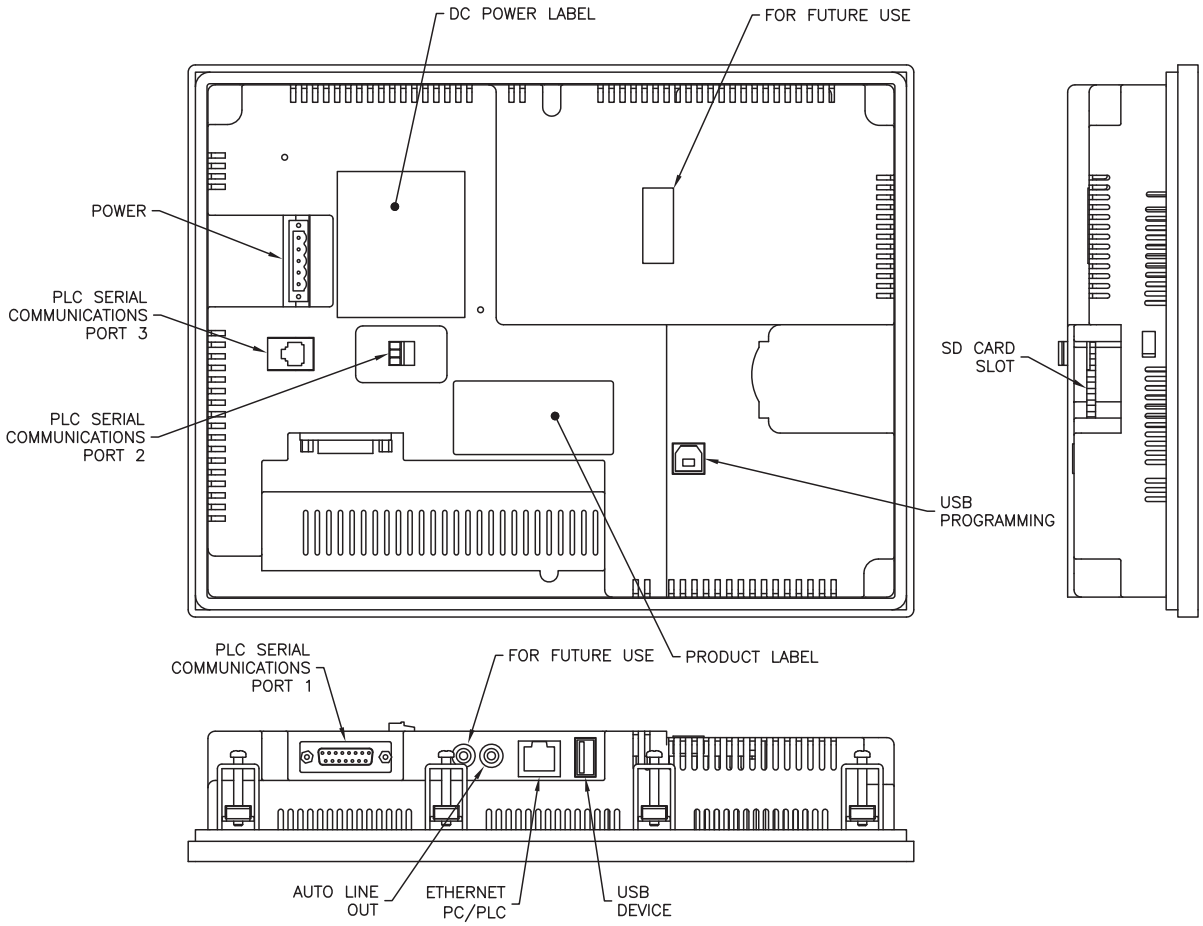

## Enclosure Mounting Thickness Ranges and Mounting Clip Screw Torque




| Touch Panel Size | Enclosure Thickness Range | Mounting Clip Screw Torque |
|---|---|---|
| 6", 8", 10" and 12" | 0.039 - 0.20 inch [1 – 5 mm] | 63 - 77 oz-in [0.45 - 0.55 Nm] |

## Ports and Memory Expansion

### EA9-T10CL



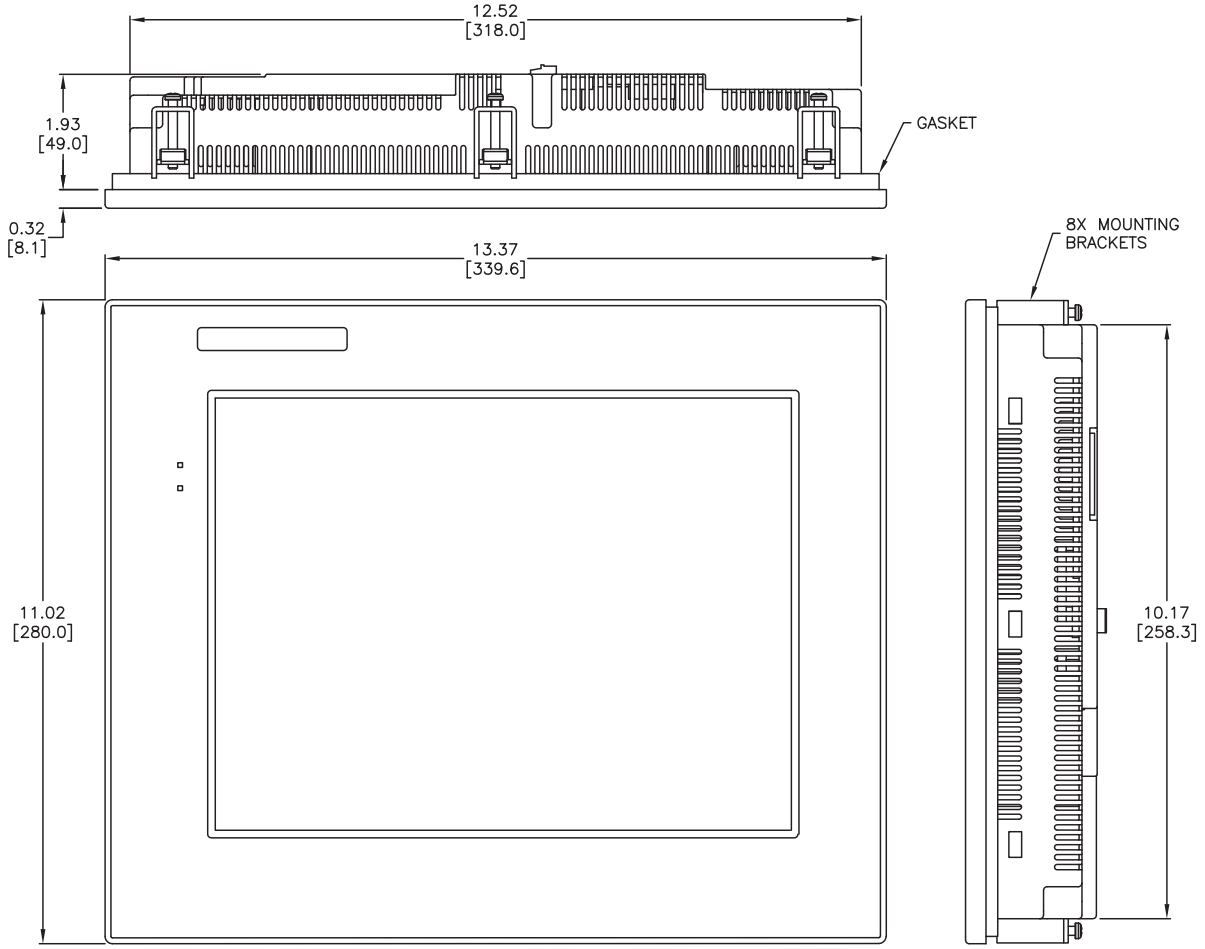
# EA9-T12CL

## Dimensions, Inches [mm]

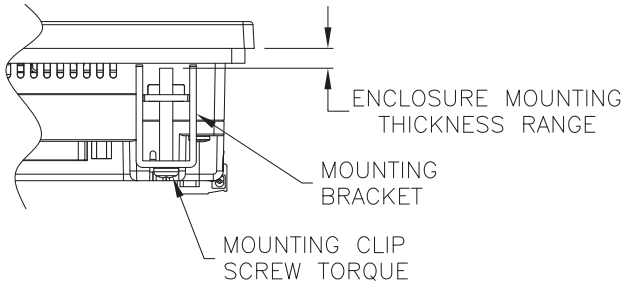
2

All the necessary mounting hardware is provided with the touch panel. Use the eight mounting clips and screws to secure the touch panel to the cabinet or enclosure surface.

A template for marking the cutout dimensions on the mounting surface is provided in the box.



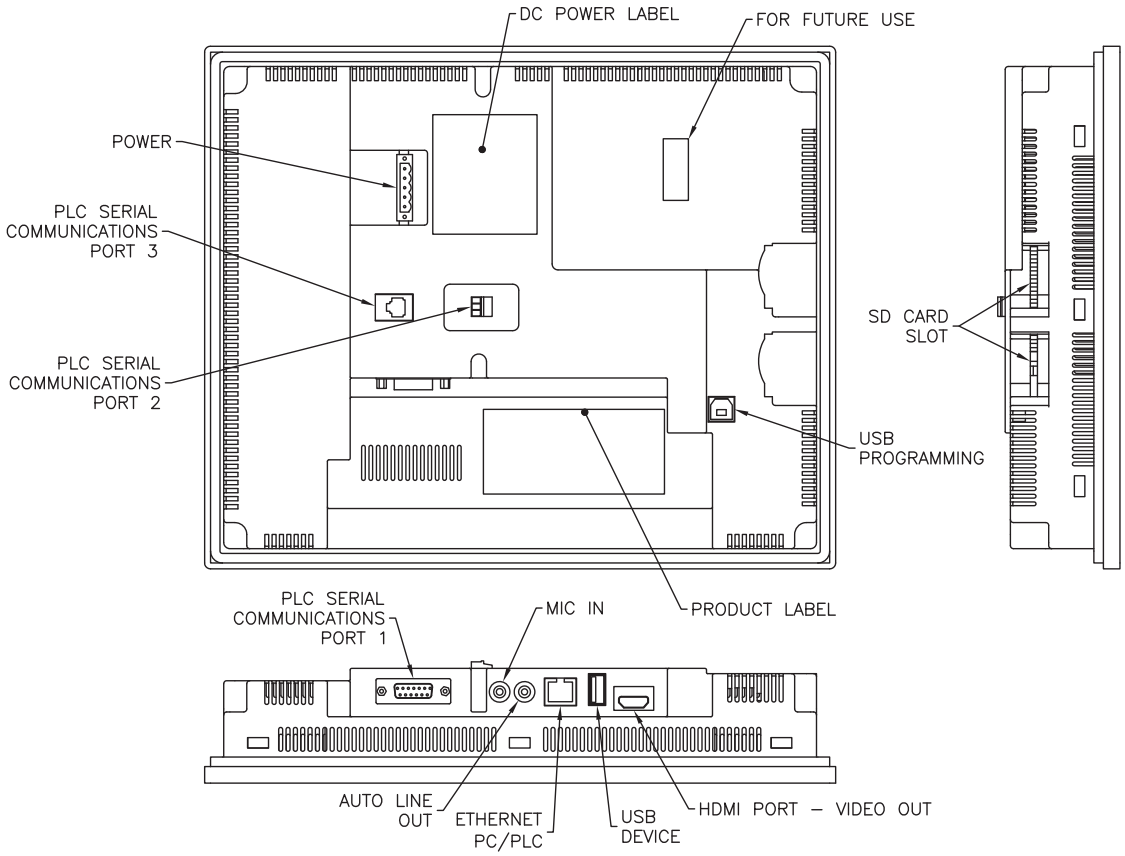

## Enclosure Mounting Thickness Ranges and Mounting Clip Screw Torque




| Touch Panel Size | Enclosure Thickness Range | Mounting Clip Screw Torque |
|---|---|---|
| 6", 8", 10" and 12" | 0.039 - 0.20 inch [1 – 5 mm] | 63 - 77 oz-in [0.45 - 0.55 Nm] |

## Ports and Memory Expansion

### EA9-T12CL



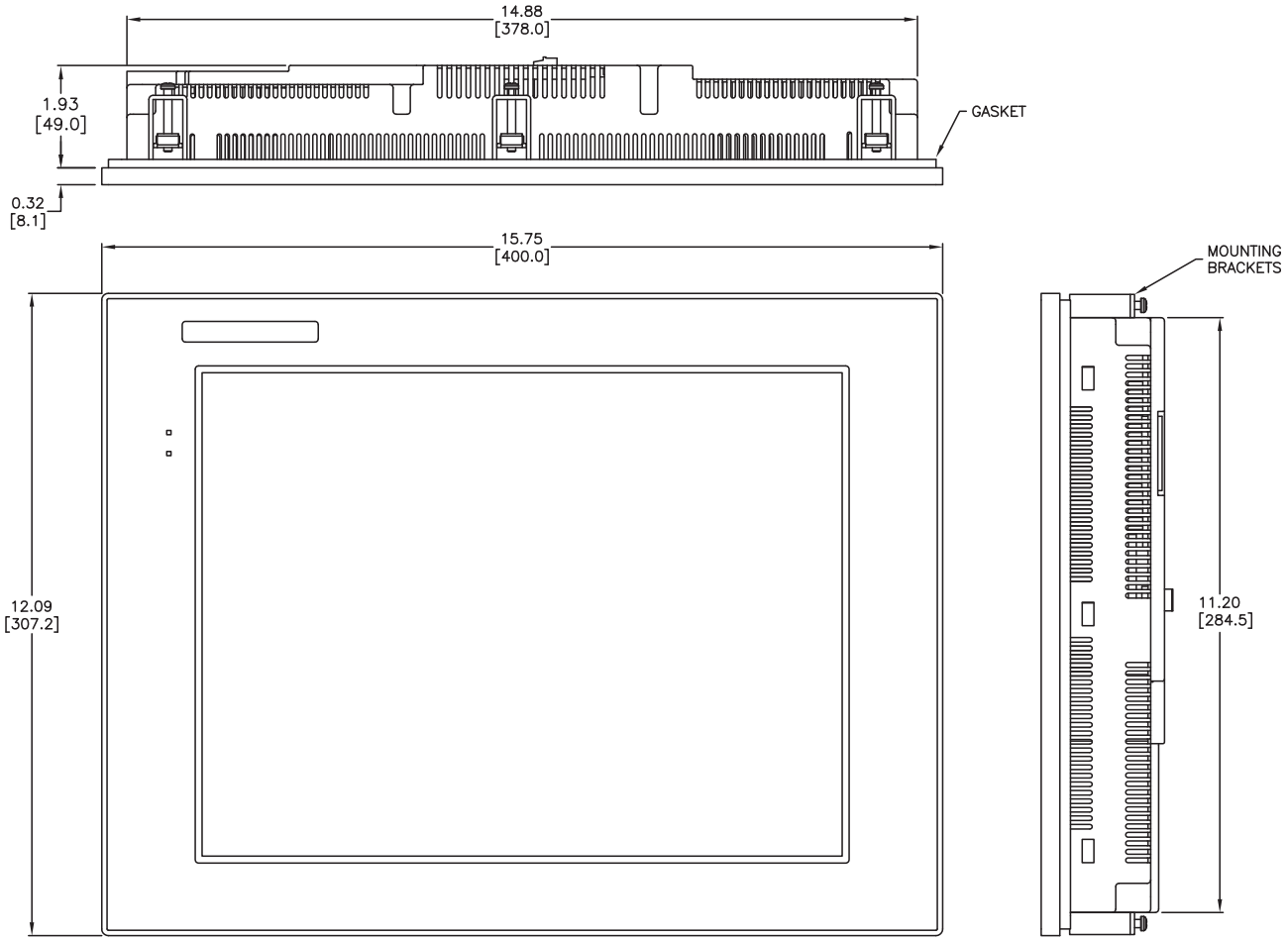
# EA9-T15CL

## Dimensions, Inches [mm]

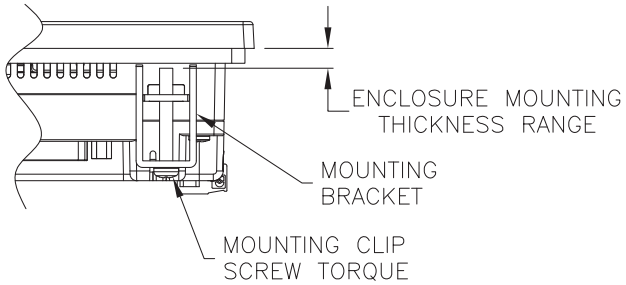
2

All the necessary mounting hardware is provided with the touch panel. Use the eight mounting clips and screws to secure the touch panel to the cabinet or enclosure surface.

A template is provided for marking the cutout dimensions on the mounting surface.



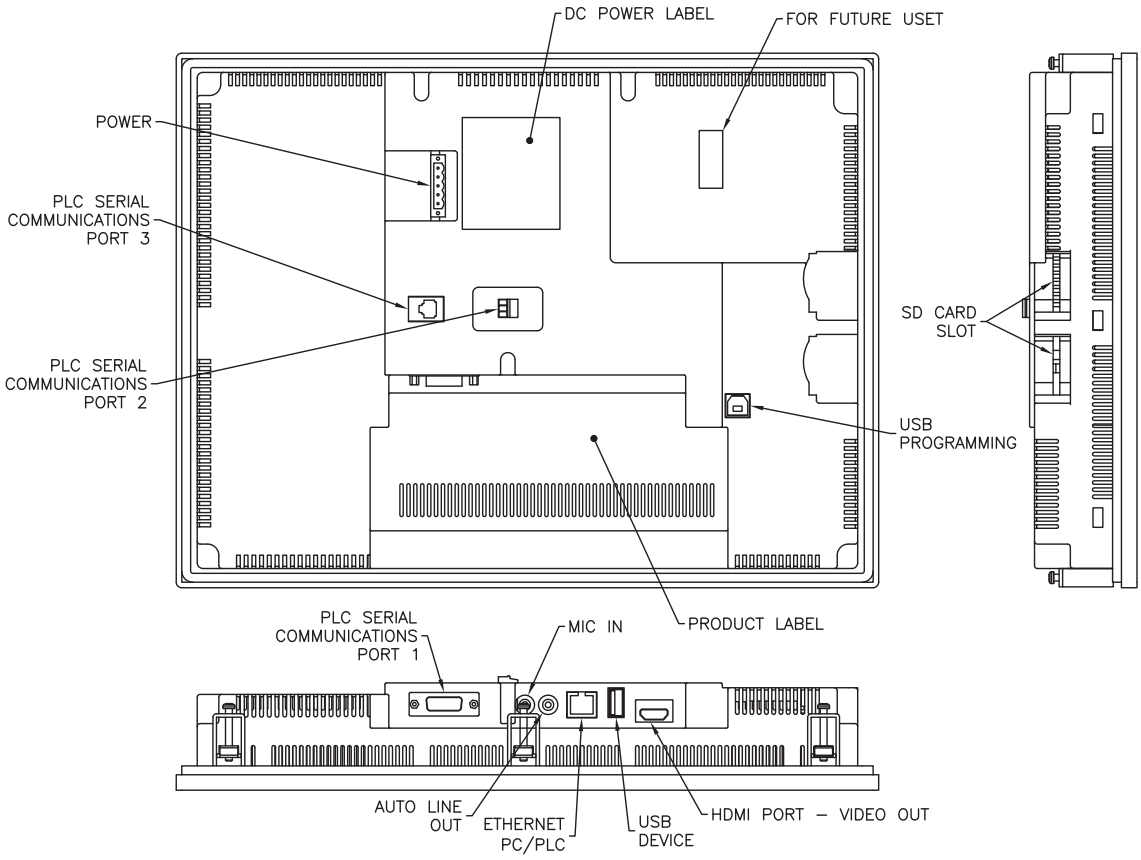

## Enclosure Mounting Thickness Ranges and Mounting Clip Screw Torque




| Touch Panel Size | Enclosure Thickness Range | Mounting Clip Screw Torque |
|---|---|---|
| 15” | 0.039 - 0.20 inch [1 – 5 mm] | 92 - 106 oz-in [0.65 - 0.75 Nm] |

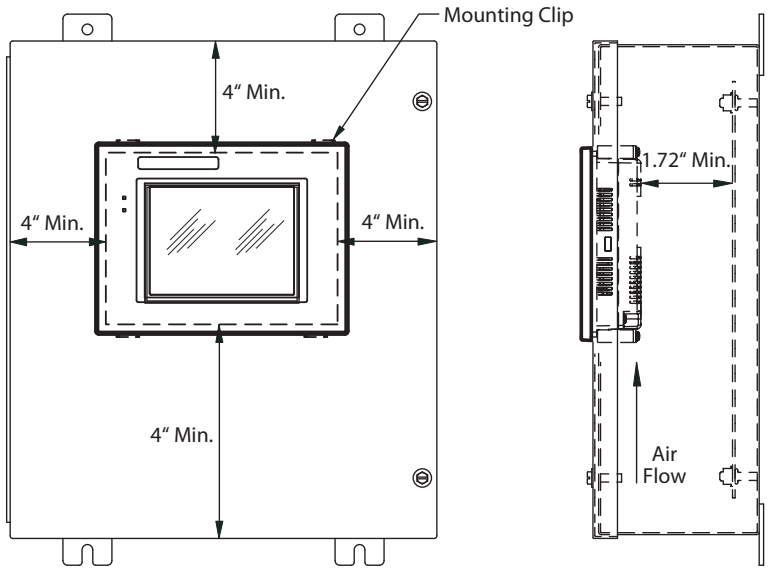
## Ports and Memory Expansion

### EA9-T15CL



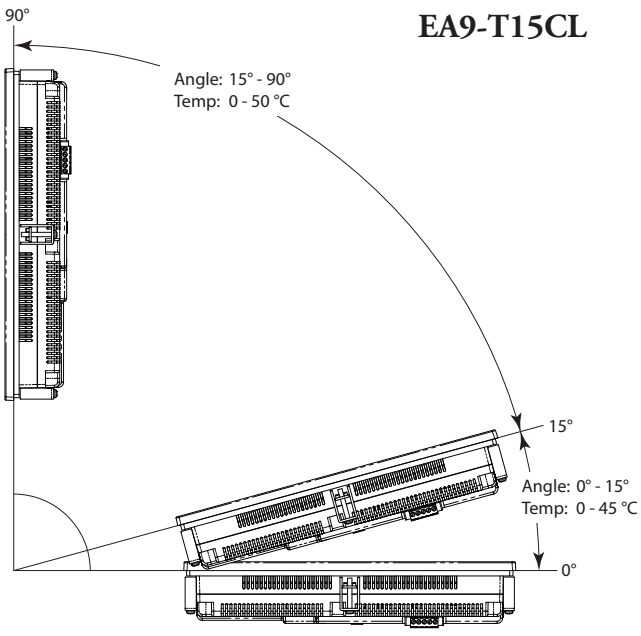
# Mounting Clearances

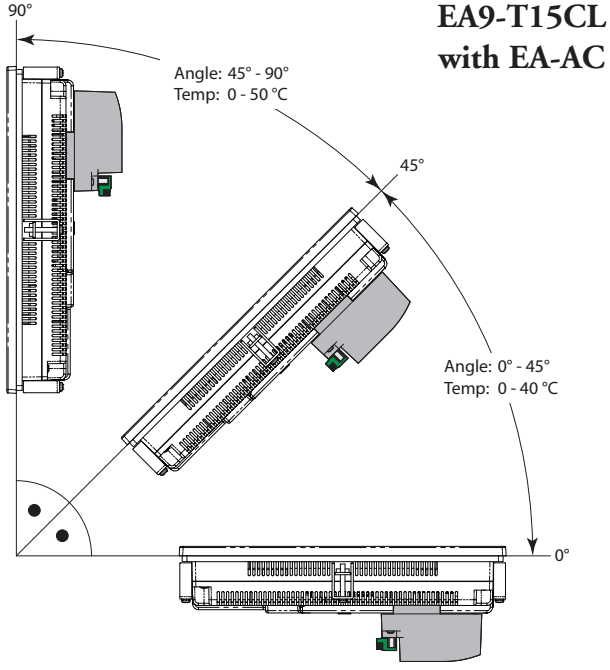
The following drawing shows the mounting clearances for the ***C-more*** touch panel. There should be a minimum of 4 inches of space between all sides of the panel and the nearest object or obstruction and at least 1.72 inches between the rear of the panel and the nearest object or obstruction.



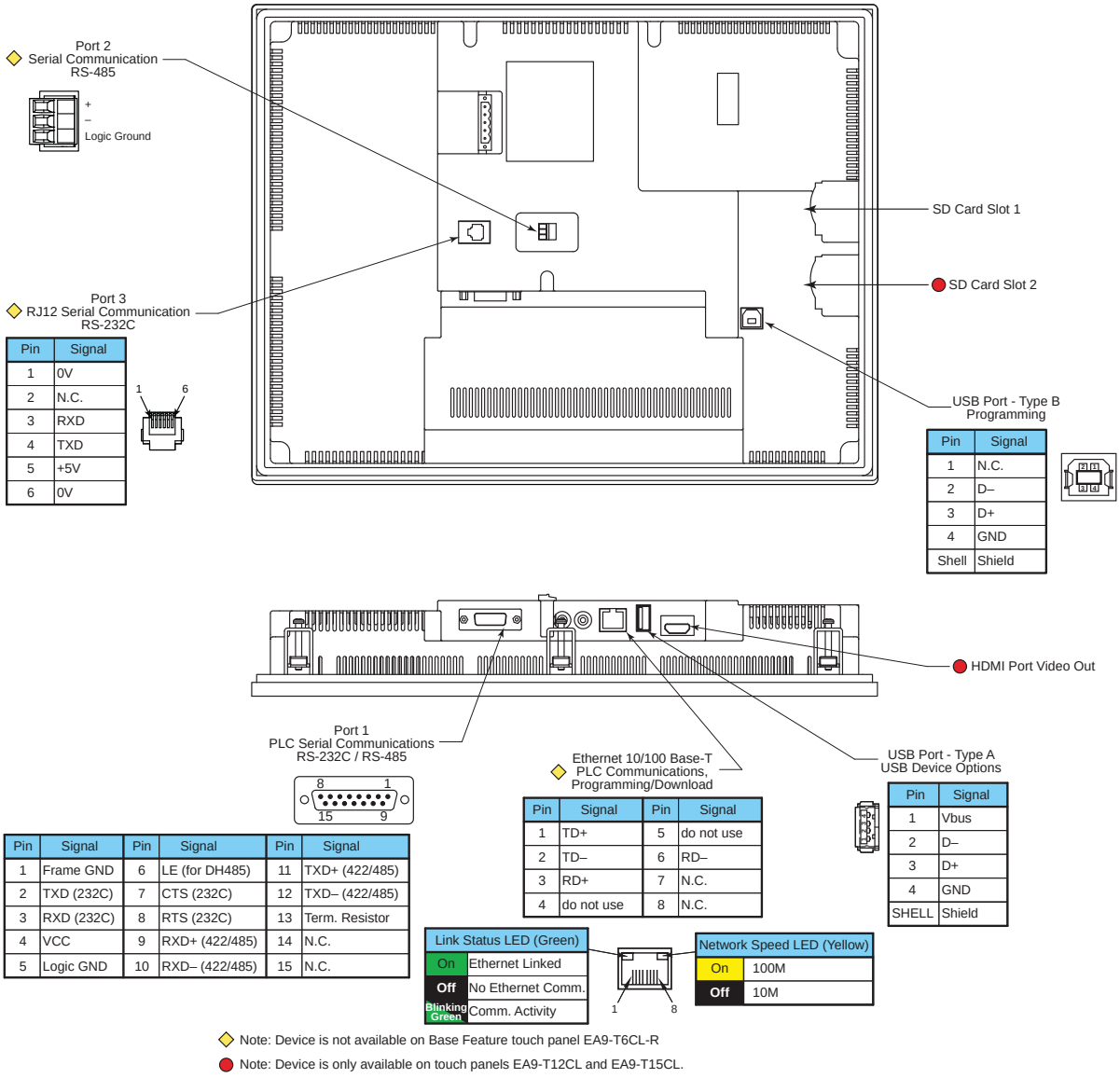

## EA9-T15CL Derating

If EA9-T15CL is mounted off the vertical plane facing upward, the temperature shall be derated as shown below. There is no derating if EA9-T15CL is mounted off the vertical plane facing downward. Other panels may be mounted at any angle without derating consideration.



# Communications Ports




| Pin | Signal |
|---|---|
| 1 | 0V |
| 2 | N.C. |
| 3 | RXD |
| 4 | TXD |
| 5 | +5V |
| 6 | 0V |

| Pin | Signal |
|---|---|
| 1 | N.C. |
| 2 | D– |
| 3 | D+ |
| 4 | GND |
| Shell | Shield |

| Pin | Signal | Pin | Signal | Pin | Signal |
|---|---|---|---|---|---|
| 1 | Frame GND | 6 | LE (for DH485) | 11 | TXD+ (422/485) |
| 2 | TXD (232C) | 7 | CTS (232C) | 12 | TXD– (422/485) |
| 3 | RXD (232C) | 8 | RTS (232C) | 13 | Term. Resistor |
| 4 | VCC | 9 | RXD+ (422/485) | 14 | N.C. |
| 5 | Logic GND | 10 | RXD– (422/485) | 15 | N.C. |

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | TD+ | 5 | do not use |
| 2 | TD– | 6 | RD– |
| 3 | RD+ | 7 | N.C. |
| 4 | do not use | 8 | N.C. |

| Pin | Signal |
|---|---|
| 1 | Vbus |
| 2 | D– |
| 3 | D+ |
| 4 | GND |
| SHELL | Shield |

## Ethernet Port

The Ethernet port can be used several ways: for programming the panel (downloading a project), for PLC communication, and for the advanced features, such as sending e-mail, web server, FTP access, and allowing users to access and control the panel remotely.

The Ethernet connector is an RJ-45 Module jack.

*NOTE: EA9-T6CL-R does not include an Ethernet port and does not have these capabilities.*

**Refer to http://c-more.automationdirect.com for the latest driver information.**

# Communications Ports (cont'd)



## USB Type B Port

Program ***C-more*** via the USB programming port. It's fast and easy, with no baud rate settings, parity, or stop bits to worry about. We stock standard USB cables for your convenience, such as part no. USB-CBL-AB15. The USB type B port can be used to upload or download projects to and from a PC (personnel computer).

## USB Type A Port

The USB type A port is a standard feature for all models and can be used to connect various USB 2.0 HID (Human Input Device) devices to the panel, such as:

- USB pen drives, (ADC p/n USB-FLASH)
- USB keyboards
- USB barcode scanners
- USB card scanners

***C-more*** can log data to the USB pen drive as well as restore projects to the panel from the pen drive. You can also back up project files and panel firmware.

## Sound Interface (Audio Line Out)

When attached to an amplifier and speaker(s), ***C-more*** can play warning sounds, or pre-recorded messages such as: "conveyor is jammed". Various "Objects" in the ***C-more*** programming software support sounds. ***C-more*** supports WAV type files. Sound files are stored in the sound library.

**Audio WAV File Specifications**

The ***C-more*** Audio Line Out port supports the following WAV file specifications:

**Audio Format (codec):** PCM

**Audio Sample Rate:** 44.1 kHz

**Channels:** 2 (stereo)

**Audio Sample Size:** 16-bit

## Serial Communication Ports

### Port 1

Connect to your serial controller network via Port 1. Port 1 is a 15-pin port that supports RS-232 and RS-422/485.

### Port 2

Connect your RS-485 network via Port 2. Port 2 is provided with a 3-wire removable terminal block.

### Port 3

Connect to your RS-232C device via Port 3. Port 3 is an RJ12 connection

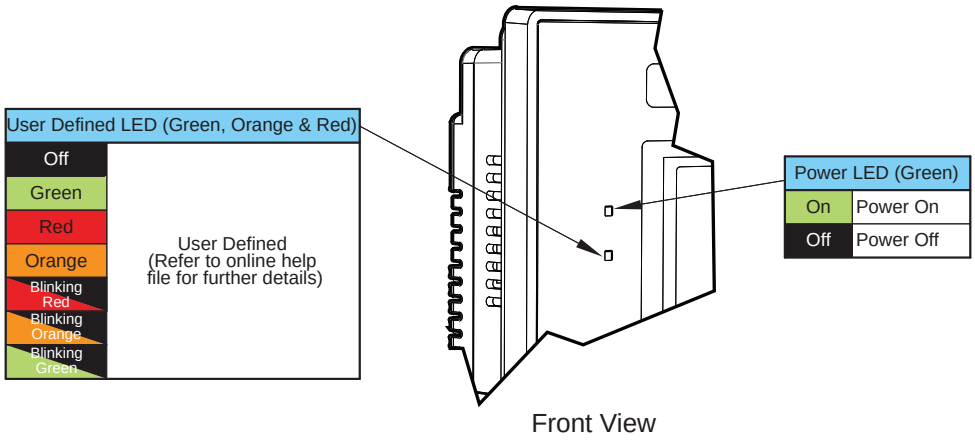
*NOTE: EA9-T6CL-R does not include Serial Ports 2 and 3.*

## HDMI Port

EA9-T12CL and EA9-T15CL include an HDMI Type A port to provide video output to a projector or remote monitor.

## User Defined LED

The user defined LED on the panel front bezel can be controlled from the project to illuminate red, green or orange. It can also be configured to blink these colors. Refer to the online help file provided with the programming software for details.



# Handling External Memory Devices

Consider the following to minimize the risk of data error when utilizing data logging.



- Do not turn off power to the ***C-more*** touch panel at any time the external memory device is being accessed.
- Do not remove any external memory device when the device is being accessed by the touch panel.

*NOTE: A system tag, such as SYS %device% WriteStatus can be used to detect when the external memory device is being accessed. See the C-more programming software on-line help for additional information on System Tag Names.*

- If an SD memory card is plugged into the SD card slot while the panel is running, the project will continue to run from the project that is currently in the internal SDRAM. If power is cycled and there is a good project stored on the SD memory card, then that project will overwrite the internal SDRAM and run.
- Be sure to backup the memory device at regular intervals.
- An SD memory card plugged into the SD card slot that includes a project that is being run cannot be used for backup.
- If you suspect the memory device is bad, you may want to use a PC to re-format the device, or use a known good memory device.

*NOTE: The C-more touch panel requires that all external memory devices be formatted with a FAT or FAT32 file system.*

*NOTE: SD cards must be formatted using the SD formatter provided by the SD Association at sdcard.org. SD cards up to 2GB capacity must be formatted FAT. SDHC cards up to 32 GB must be formatted FAT32. USB memory must be formatted FAT or FAT32.*

- The number of times the memory device can be written to is limited, approximately 300,000 times. Consequently, frequent writing at short intervals may shorten the service life of the memory device. Try to use as long as possible sampling times for logging data to reduce the amount of times the memory device is accessed.

Different types of numeric and text data from the ***C-more*** touch panel can be stored on an SD card or a USB memory device. Numeric data from Line Trend Graph and PID Faceplate Trend Graph objects may be stored. Text data from Lookup Text and Multi-state Text objects can also be stored. Up to 16 objects may be configured in the ***C-more*** programming software to log data. Along with the 16 object limit, available storage on the external memory device is subject to the memory capacity of the SD card or USB memory device. One log file is created in a 24 hour period for each object. Additionally log file data is written to the external memory device:

- when 2kB of data is cached,
- when 20 records have been stored,
- periodically, once every 1 minute,
- when one of the internal "copy logTo" or "Eject" tags is activated via an object or event,
- when there is an email or FTP action
- when the System Screen is called
- when the panel date is changed

## File Name Limitations

There is a limit of 999 file names with the same first four characters. Internal file names are restricted by the DOS 8-character-dot-3-character limit. Therefore trend log files are identified internally by the first four characters of the object name plus tilde plus a three digit number. Examples are:

TREND GRAPH EAST CHILLER TEMP_130925.txt *saved internally as* TREN~001.txt
TREND GRAPH WEST CHILLER TEMP_130925.txt *saved internally as* TREN~002.txt

As new log files are created in each 24 hour period, these files count against the maximum of 999 files. If multiple graph objects appear on one screen, the files will be identified internally by the first Two Characters of the screen name plus the first Two Characters of the object name plus tilde plus three digit number. To maximize storage capabilities on external memory devices use screen names that have unique characters in the first four digits and object names that are unique in the first two characters.

*NOTE: When the 999 filename limit is reached, the oldest files will automatically be deleted and logging will continue.*

## Monitoring Available Memory

External memory device memory can be monitored and events can be configured to alert the user when available memory is approaching the maximum capacity of the external memory device. The following internal tags allow external memory device data to be available:

- SYS SD1 TOTALMEMORY
- SYS SD1 FREEMEMORY
- SYS SD1 USEDMEMORY
- SYS SD2 TOTALMEMORY
- SYS SD2 FREEMEMORY
- SYS SD2 USEDMEMORY
- SYS USB TOTALMEMORY
- SYS USB FREEMEMORY
- SYS USB USEDMEMORY

Refer to the ***C-more*** programming software online help files for additional information on system tags and managing data logging devices.

### Minimizing Data Errors

To minimize data errors when logging data to external memory, consider the following:

- Do not turn off power to the ***C-more*** touch panel while the external memory device is being accessed. The optional EA-AC power adaptor is designed to protect external memory devices from damage during power failure.
- Do not remove any external memory device with the device is being accessed by the ***C-more*** panel. The following internal tags should be used to monitor, access and safely remove external memory devices:
  - SYS SD1 WriteStatus
  - SYS SD2 WriteStatus
  - SYS USB WriteStatus
  - SYS Copy LogToSD1
  - SYS Copy LogToSD2
  - SYS Copy LogToUSB
  - SYS SD1 Eject
  - SYS SD2 Eject
  - SYS USB Eject
  - SYS SD1 ReadyToUse
  - SYS SD2 ReadyToUse
  - SYS USB ReadyToUse

Refer to the ***C-more*** programming software online help files for additional information on system tags and managing data logging devices.

## Chemical Compatibility

The ***C-more*** touch panels comprise three different materials that may be exposed to outside elements: a gasket, a screen sheet and a bezel.

- Gasket material is silicone.
- Screen sheets are PET.
- Panel bezels are ABS plastic.

# Chapter 3
# Accessories

## In This Chapter...


**Accessories Overview** ..... **3-2**

**AC/DC Power Adapter** ..... **3-3**

AC/DC Power Adapter Dimensions ..... 3-5

AC/DC Power Adapter Installation ..... 3-6

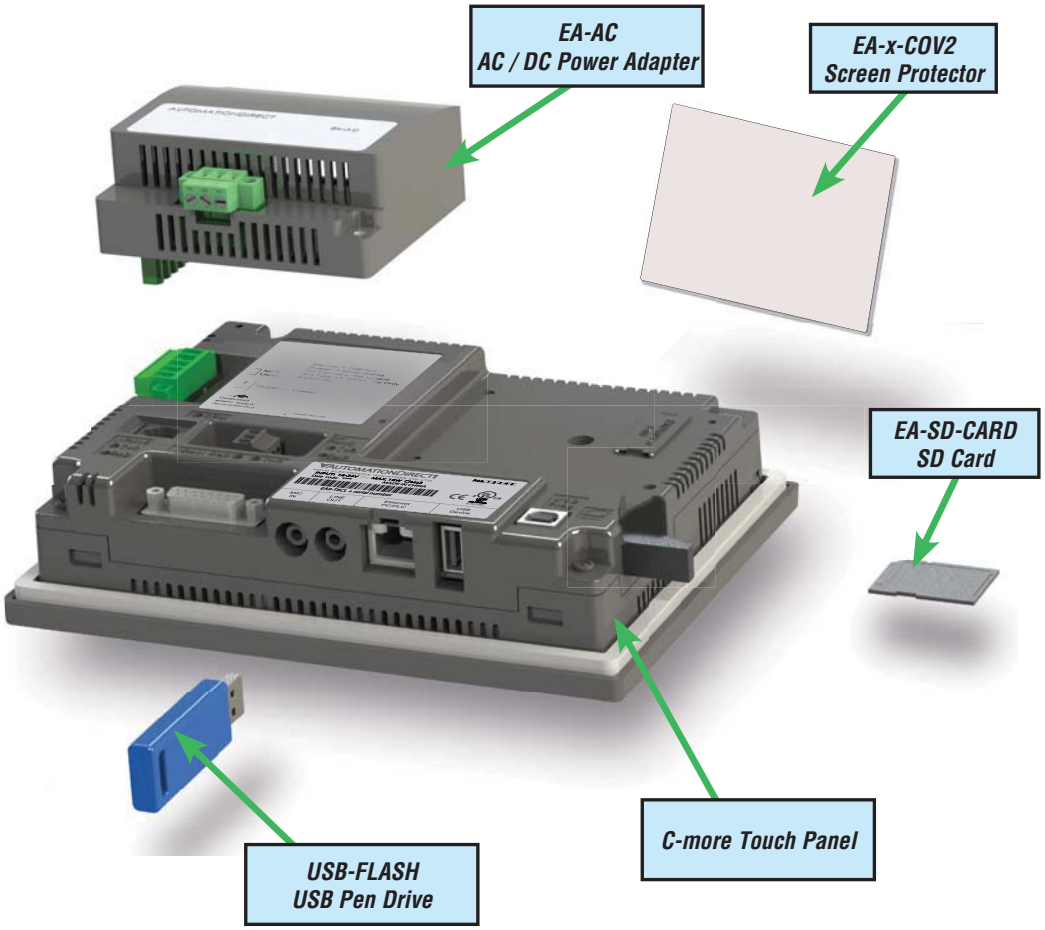
**Non-glare Screen Covers** ..... **3-7**

Clear Screen Overlay Installation ..... 3-8

**SD Card** ..... **3-9**

**USB FLASH Drive** ..... **3-9**

# Accessories Overview




| Part Number | Description |
|---|---|
| EA-AC | AC/DC Adapter for ***C-more*** EA7 and EA9 series touch panels; powered from a 100-240 VAC, 50/60 Hertz power source. Provides 24VDC at 1.5A. Power Fault features help protect data being logged to Compact Flash or SD card during power failures. ***C-more*** EA7 series panels must have firmware version 1.21 Build 6.18E or higher for proper operation. |
| EA-6-COV2 | Non-glare protective overlay, 6-inch, protects ***C-more*** touch screen and helps reduce glare from external light sources. Compatible with ***C-more*** EA7 and EA9 series and ***C-more*** Micro-Graphic 6-inch panels. Package of 3. |
| EA-8-COV2 | Non-glare protective overlay, 8-inch, protects ***C-more*** touch screen and helps reduce glare from external light sources. Compatible with ***C-more*** EA7 and EA9 series 8-inch panels. Package of 3. |
| EA-10-COV2 | Non-glare protective overlay, 10-inch, protects ***C-more*** touch screen and helps reduce glare from external light sources. Compatible with ***C-more*** EA7 and EA9 series 10-inch panels. Package of 3. |
| EA-12-COV2 | Non-glare protective overlay, 12-inch, protects ***C-more*** touch screen and helps reduce glare from external light sources. Compatible with ***C-more*** EA7 and EA9 series 12-inch panels. Package of 3. |
| EA-15-COV2 | Non-glare protective overlay, 15-inch, protects ***C-more*** touch screen and helps reduce glare from external light sources. Compatible with ***C-more*** EA7 and EA9 series 15-inch panels. Package of 3. |
| EA-SD-CARD | SD memory card for non-volatile storage, 2GB industrial grade. 85 degrees C maximum operating temperature makes it suitable for data logging in industrial applications. Recommended for the ***C-more*** EA9 series touch panels. |
| USB-FLASH | USB Flash drive, SanDisk, 4GB (SanDisk P/N SDCZ50-004G-A46). Recommended for use with the C-more touch panels and Productivity3000 controllers. |

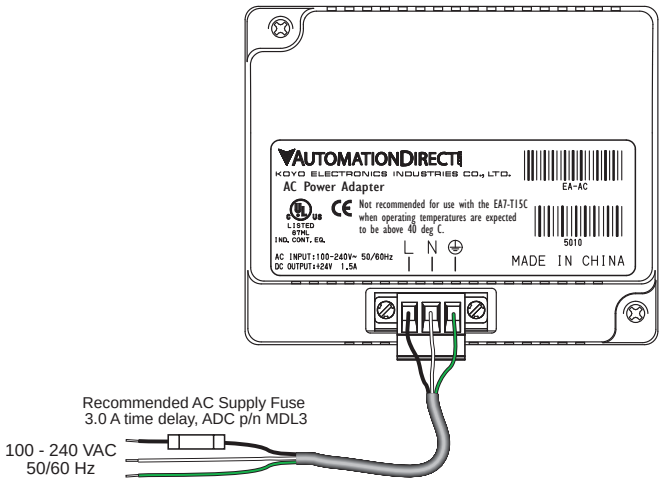
# AC/DC Power Adapter

The optional ***C-more*** AC/DC Power Adapter can be used to power the ***C-more*** touch panels from a 100-240 VAC, 50/60 Hertz, voltage source. The adapter provides 24 VDC @ 1.5 A to the touch panel's DC power connector and can be conveniently secured to the touch panel with two captive screws. The adapter provides a power loss signal to the touch panel that causes the touch panel to stop writing data to SD memory devices providing a controlled shutdown for increased data logging reliability.



## Part No. EA-AC

## AC/DC Adapter Wiring




| Tightening Torque | |
|---|---|
| **Power supply cable torque** | 71 - 85 oz-in (0.5 - 0.6 Nm) |
| **Power connector mounting torque** | 71 - 85 oz-in (0.5 - 0.6 Nm) |
| **Mounting flange screw torque** | 57 - 71 oz-in (0.4 - 0.5 Nm) |

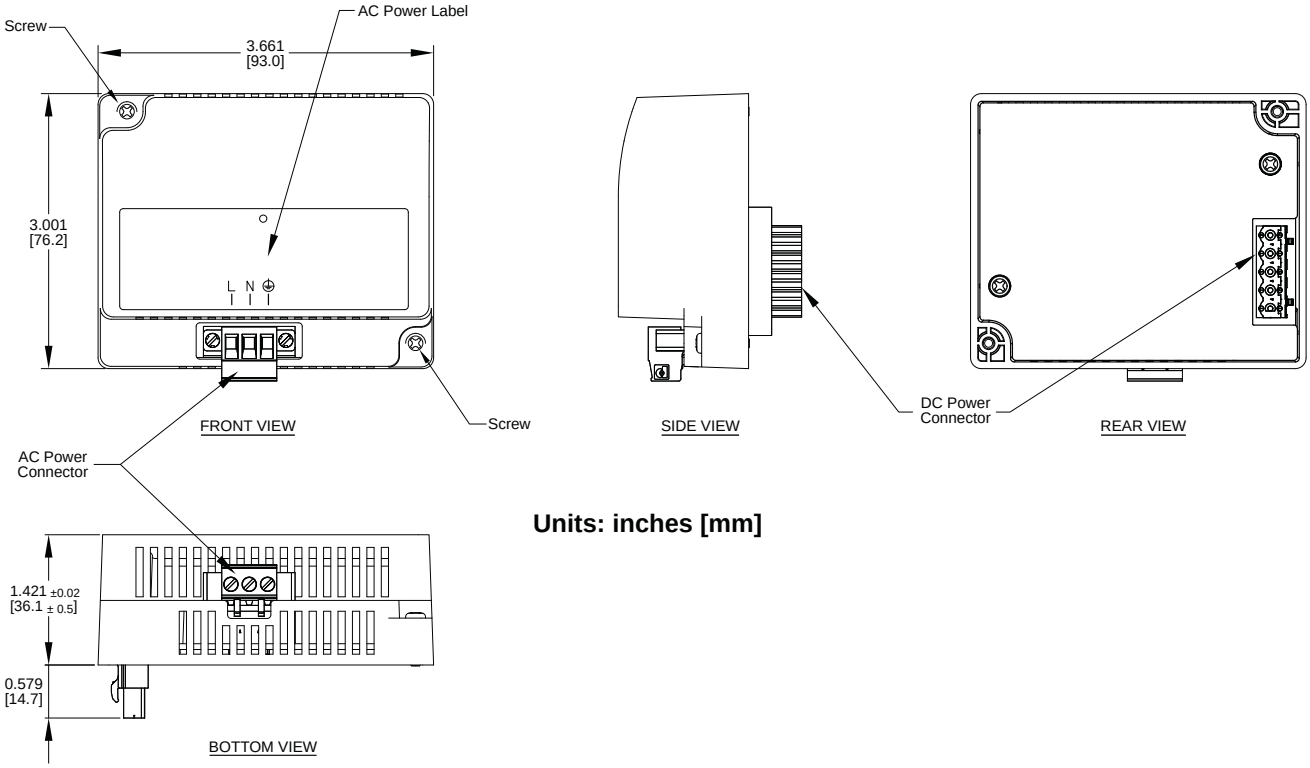
*NOTE: Use 60 / 75 °C copper conductors only*

| AC/DC Power Adapter Specifications | |
|---|---|
| **Part Number** | **EA-AC** |
| **Input Voltage & frequency** | 100-240 VAC; 50/60 Hertz |
| **Operating Temperature Range** | 0 °C to 50 °C [32 to 122 °F] Maximum surrounding temperature rating, 50 °C |
| **Storage Temperature Range** | -20 to 60 °C [-4 to 140 °F] |
| **Operating & Storage Humidity** | 10-85% RH (non-condensing) |
| **Noise Immunity** | 1000 VAC p-p (Pulse width 1 µs, rise time: 1 ns)<br>With proper ground connection on AC terminal block. |
| **Hi-pot** | 1000 VAC, 1 minute<br>With proper ground connection on AC terminal block. |
| **Insulation Resistance** | 500 VDC, 10 M ohm or above<br>With proper ground connection on AC terminal block. |
| **Vibration** | Compliant with IEC61131-2 |
| **Shock** | Pulse shape: Sine half wave, Peak acceleration: 147 m/s2 (15 G),<br>X, Y, Z: 3 directions, 2 times each |
| **Thermal Protection** | 140 °C [284 °F], with autorecovery |
| **Short Circuit Protection** | 85 VAC: 2.6 A, 100 VAC: 2.8 A, 264 VAC: 3.9 A |
| **Static Electricity Discharge Resistance** | Compliant with IEC61000-4-2, Contact: 4 kV, Air: 8 kV |
| **Agency Approvals** | UL508, UL Recognized, cUL, CE, EMC EN61132-2 |
| **Environment** | For use in pollution degree 2 environment |
| **Grounding** | Ground resistance: less than 100 ohm |
| **Weight** | 6.13 oz. [175 g] |
| **Removable AC Power Connector** | EA-AC-CON or DECA Switchlab MC101-508-03G<br>Secure with (2) captive M2.5 screws, torque to 70 oz-in [0.5 Nm] |
| **Output Current** | Maximum 1.5 A |
| **Inrush Current** | For 100 VAC: 15 A, 3 ms or less<br>For 240 VAC: 20 A, 3 ms or less |
| **Recommended AC Supply Fuse** | 3.0 A time delay, ADC p/n MDL3 |
| **Power Supply Cable Torque** | 71 - 85 oz-in (0.5 - 0.6 Nm) |
| **Mounting to Touch Panel** | Secure with (2) spring loaded captive M3-20 screws, torque to 50 oz-in [0.35 Nm] |

*NOTE: Logic within the EA-AC will turn off the backlight instantly when a power failure is detected to allow the CPU to run longer. The backlight turns on automatically when the power returns to the C-more operating voltage.*

## AC/DC Power Adapter Dimensions

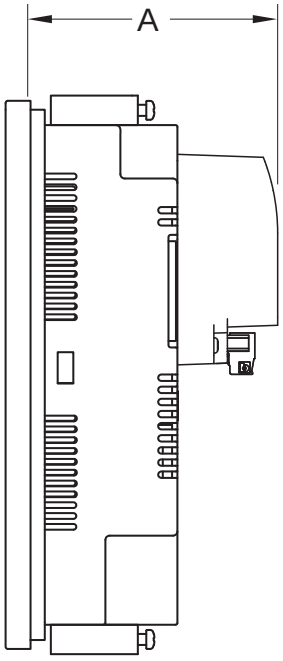
### Dimensions




**Units: inches [mm]**

### Panel Depth with AC/DC Power Adapter Installed

**Units: inches[mm]**




| Part Number | A |
|---|---|
| EA9-T6CL-R | 2.991 [76.0] |
| EA9-T6CL | 2.991 [76.0] |
| EA9-T8CL | 3.511 [89.2] |
| EA9-T10CL | 3.511 [89.2] |
| EA9-T12CL | 3.351 [85.8] |
| EA9-T15CL | 3.351 [85.1] |

## AC/DC Power Adapter Installation

**WARNING: This procedure should only be performed by qualified personnel who are experienced in working with electronic equipment. Take the necessary steps to prevent damage that may be caused by static electricity discharge. Disconnect input power to the touch panel before proceeding.**

Preparation: Place the touch panel face down on a lint-free soft surface to prevent scratching the display screen if not already installed in a control cabinet. Remove the DC power connector if it is installed.

Insert the AC/DC power adapter into the touch panel's 5-position DC power connector.

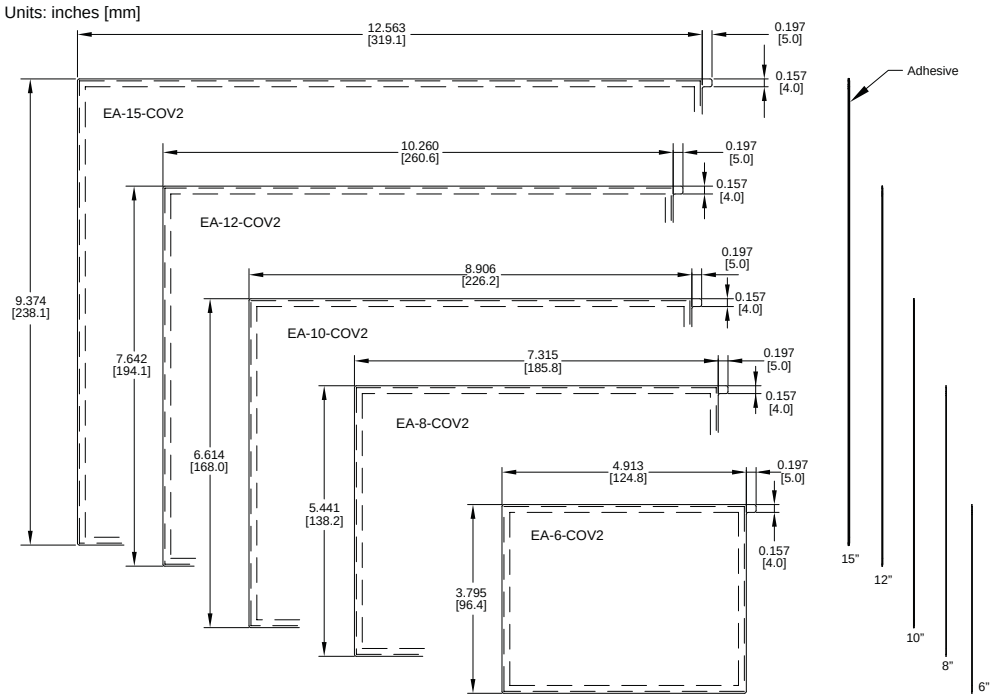
Secure the AC/DC Power Adapter to the touch panel by tightening the two (2) spring loaded captive M3-20 screws to a torque of 50 oz-in [0.35 Nm].

Plug the wired 3-pin AC Power Connector into its mating connector on the adapter and secure in place by tightening the two (2) captive M2.5 screws to a torque of 70 oz-in [0.5 Nm].

# Non-glare Screen Covers

Non Glare 6 Inch Screen Cover, protective overlay used to protect the touch screen while helping to reduce the glare from external light sources. (pk of 3)

## Part No. EA-6-COV2, EA-8-COV2, EA-10-COV2, EA-12-COV2 & EA-15-COV2



# Non-glare Screen Covers (cont'd)

## Clear Screen Overlay Installation

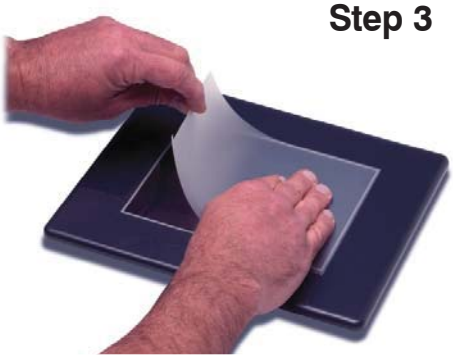
### Step 1

Check to be sure that the proper size non-glare screen cover is being used on the subject touch panel. Notice that the outer perimeter of the screen cover has an adhesive band. The adhesive band will be located on the outside edge of the touch panel's white frame bordering the touch area when installed.

### Step 2

Start in one corner and peel the screen cover from the backing.

### Step 3



Align the screen cover over the touch panel's white frame, then start on one side and gently lay the cover over the entire touch area.

### Step 4

Smooth out the screen cover and press all around the outside perimeter to secure the cover in place. The screen cover can be removed by lifting up on the small tab and gently pulling the cover away form the touch panel's surface.

### Step 5

Remove the protective sheet.

*NOTE: The protective cover ships with a thin protective sheet on the face of the cover that needs to be carefully removed. If your panel is not clear, the protective sheet may not have been removed.*

## SD Card

SD memory card for non-volatile storage, 2GB industrial grade. 85° C maximum operating temperature makes it suitable for data logging in industrial applications. Recommended for the ***C-more*** EA9 series touch panels. The SD card is the fastest option for writing data. If logged data is saved to external memory, AutomationDirect recommends using an EA-SD-CARD.

## USB FLASH Drive

USB-FLASH sold by AutomationDirect has been tested with ***C-more*** panels and is Hi-Speed USB 2.0 certified.

### Part No. USB-FLASH

# Installation and Wiring

## In This Chapter...

**Safety Guidelines** ..... **4-2**
**Introduction** ..... **4-3**
**EA9-T6CL-R and EA9-T6CL Cutout Dimensions** ..... **4-4**
**EA9-T8CL Cutout Dimensions** ..... **4-5**
**EA9-T10CL Cutout Dimensions** ..... **4-6**
**EA9-T12CL Cutout Dimensions** ..... **4-7**
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# Safety Guidelines

*NOTE: Products with CE marks perform their required functions safely and adhere to relevant standards as specified by CE directives provided they are used according to their intended purpose and that the instructions in this manual are adhered to. The protection provided by the equipment may be impaired if this equipment is used in a manner not specified in this manual. A listing of our international affiliates is available on our Web site: http://www.automationdirect.com*

**WARNING: Providing a safe operating environment for personnel and equipment is your responsibility and should be your primary goal during system planning and installation. Automation systems can fail and may result in situations that can cause serious injury to personnel or damage to equipment. Do not rely on the automation system alone to provide a safe operating environment. You should use external electromechanical devices, such as relays or limit switches, that are independent of the PLC application to provide protection for any part of the system that may cause personal injury or damage. Every automation application is different, so there may be special requirements for your particular application. Make sure you follow all national, state, and local government requirements for the proper installation and use of your equipment.**

## Plan for Safety

The best way to provide a safe operating environment is to make personnel and equipment safety part of the planning process. You should examine every aspect of the system to determine which areas are critical to operator or machine safety. If you are not familiar with control system installation practices, or your company does not have established installation guidelines, you should obtain additional information from the following sources.

- NEMA — The National Electrical Manufacturers Association, located in Washington, D.C. publishes many different documents that discuss standards for industrial control systems. You can order these publications directly from NEMA. Some of these include:

  ICS 1, General Standards for Industrial Control and Systems

  ICS 3, Industrial Systems

  ICS 6, Enclosures for Industrial Control Systems

- NEC — The National Electrical Code provides regulations concerning the installation and use of various types of electrical equipment. Copies of the NEC Handbook can often be obtained from your local electrical equipment distributor or your local library.
- Local and State Agencies — many local governments and state governments have additional requirements above and beyond those described in the NEC Handbook. Check with your local Electrical Inspector or Fire Marshall office for information.

# Introduction

The installation and wiring of the ***C-more***® touch panels requires selecting an appropriate location for the touch panel, laying out the cutout dimensions on the surface of the control cabinet that the panel will be mounted through, securing the touch panel with the provided mounting clips, tightening the screws to the appropriate torque rating to assure the gasket is sealing correctly, and finally connecting the appropriate power source to the touch panel.

*NOTE: Each C-more touch panel is provided with a cutout template to make marking the proper cutout size on the surface of the control cabinet that the panel will be mounted through a simple task.*



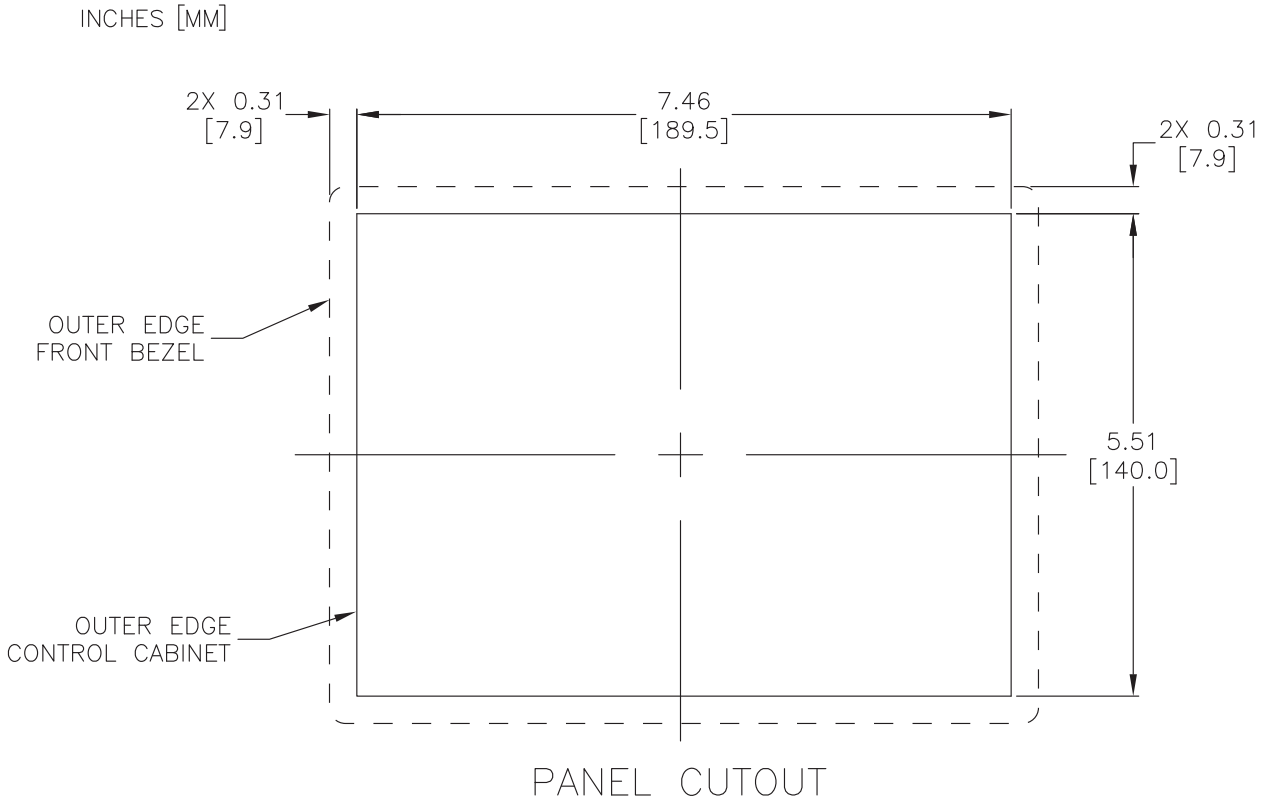
This chapter covers the proper mounting of the touch panel and connecting power. Once power is applied to the touch panel, the user will want to read Chapter 5 on the System Setup Screens in order to set the internal time and date for the panel, become familiar with the touch panel test features, and check memory options.

## Mounting Clips - EA9-BRK

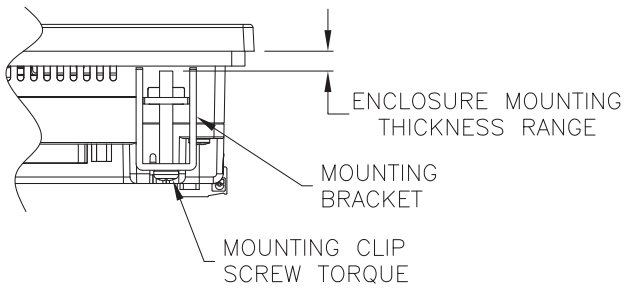
# EA9-T6CL-R and EA9-T6CL Cutout Dimensions

The ***C-more*** 6" touch panels are mounted into a cutout through the control cabinet and secured with four (4) mounting clips. The mounting clips are provided with the touch panel. The mounting clips will insert into a series of slots around the rear perimeter of the touch panel. Each clip has a tab that will mate to a slot. The screw of each mounting clip needs to be tightened to the torque rating shown in the table below so that the gasket is compressed to form the proper seal between the panel and cabinet surface.






## Enclosure Mounting Thickness Ranges and Mounting Clip Screw Torque

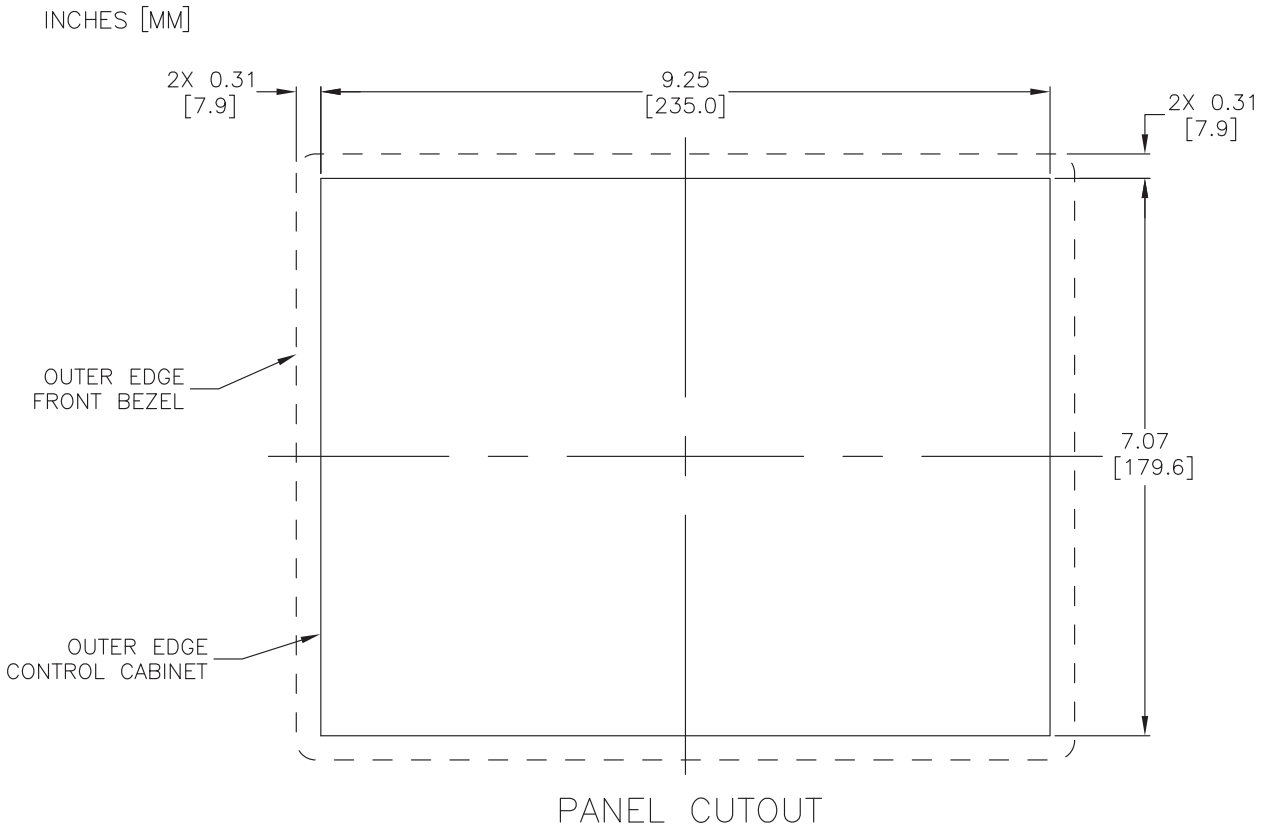



| Touch Panel Size | Enclosure Thickness Range | Mounting Clip Screw Torque |
|---|---|---|
| **6", 8", 10" and 12"** | 0.039 - 0.20 inch [1 – 5 mm] | 63 - 77 oz-in [0.45 - 0.55 Nm] |

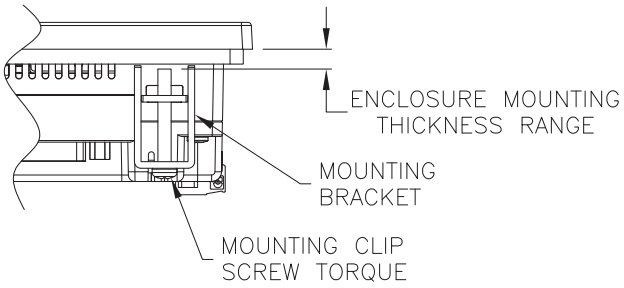
# EA9-T8CL Cutout Dimensions

The ***C-more*** 8" touch panels are mounted into a cutout through the control cabinet and secured with four (4) mounting clips. The mounting clips are provided with the touch panel. The mounting clips will insert into a series of slots around the rear perimeter of the touch panel. Each clip has a tab that will mate to a slot. The screw of each mounting clip needs to be tightened to the torque rating shown in the table below so that the gasket is compressed to form the proper seal between the panel and cabinet surface.






## Enclosure Mounting Thickness Ranges and Mounting Clip Screw Torque



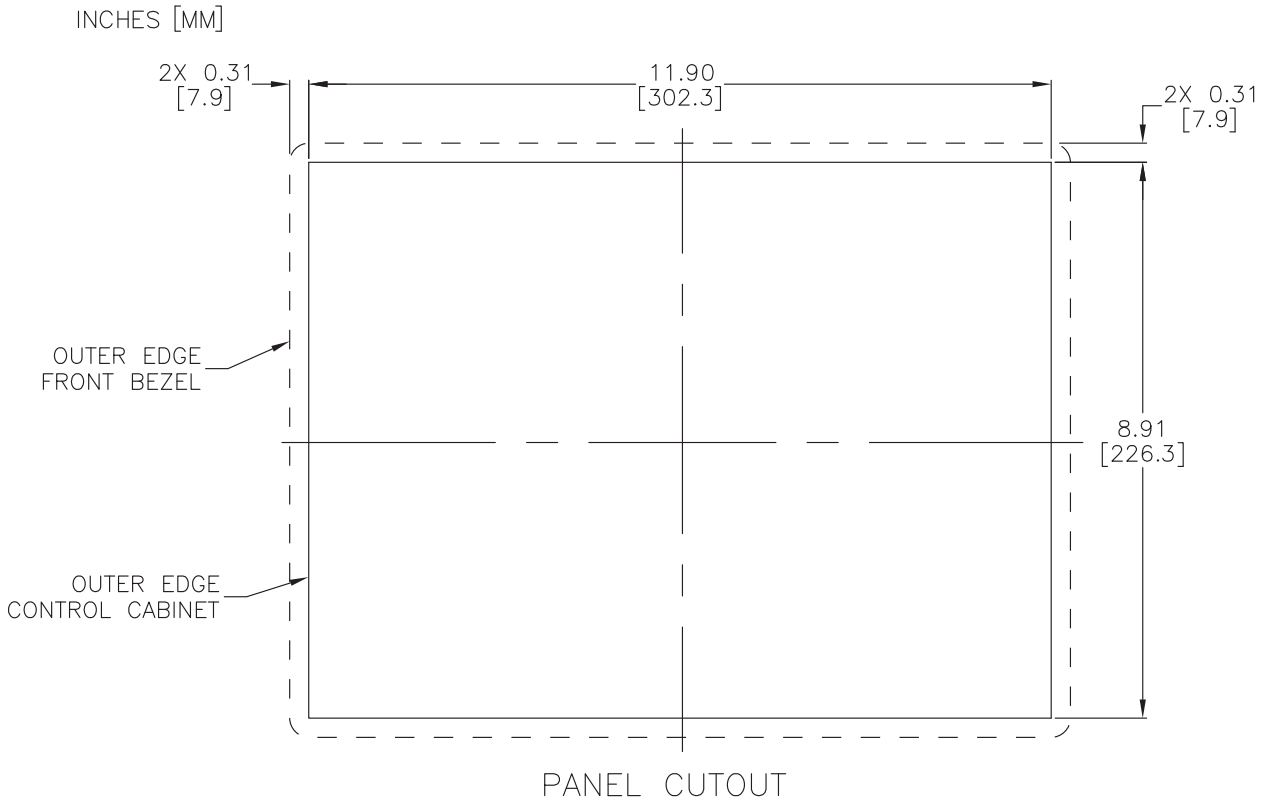

| Touch Panel Size | Enclosure Thickness Range | Mounting Clip Screw Torque |
|---|---|---|
| 6", 8", 10" and 12" | 0.039 - 0.20 inch [1 – 5 mm] | 63 - 77 oz-in [0.45 - 0.55 Nm] |

EA9-T8CL Cutout Dimensions

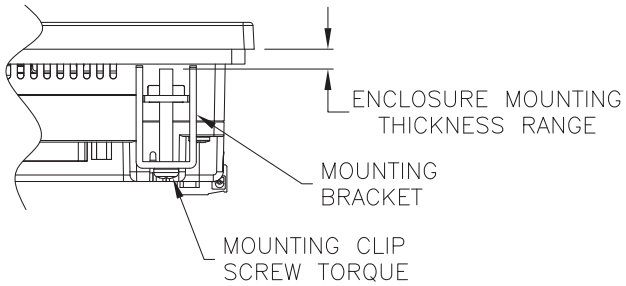
# EA9-T10CL Cutout Dimensions

The ***C-more*** 10" touch panels are mounted into a cutout through the control cabinet and secured with eight (8) mounting clips. The mounting clips are provided with the touch panel. The mounting clips will insert into a series of slots around the rear perimeter of the touch panel. Each clip has a tab that will mate to a slot. The screw of each mounting clip needs to be tightened to the torque rating shown in the table below so that the gasket is compressed to form the proper seal between the panel and cabinet surface.






## Enclosure Mounting Thickness Ranges and Mounting Clip Screw Torque

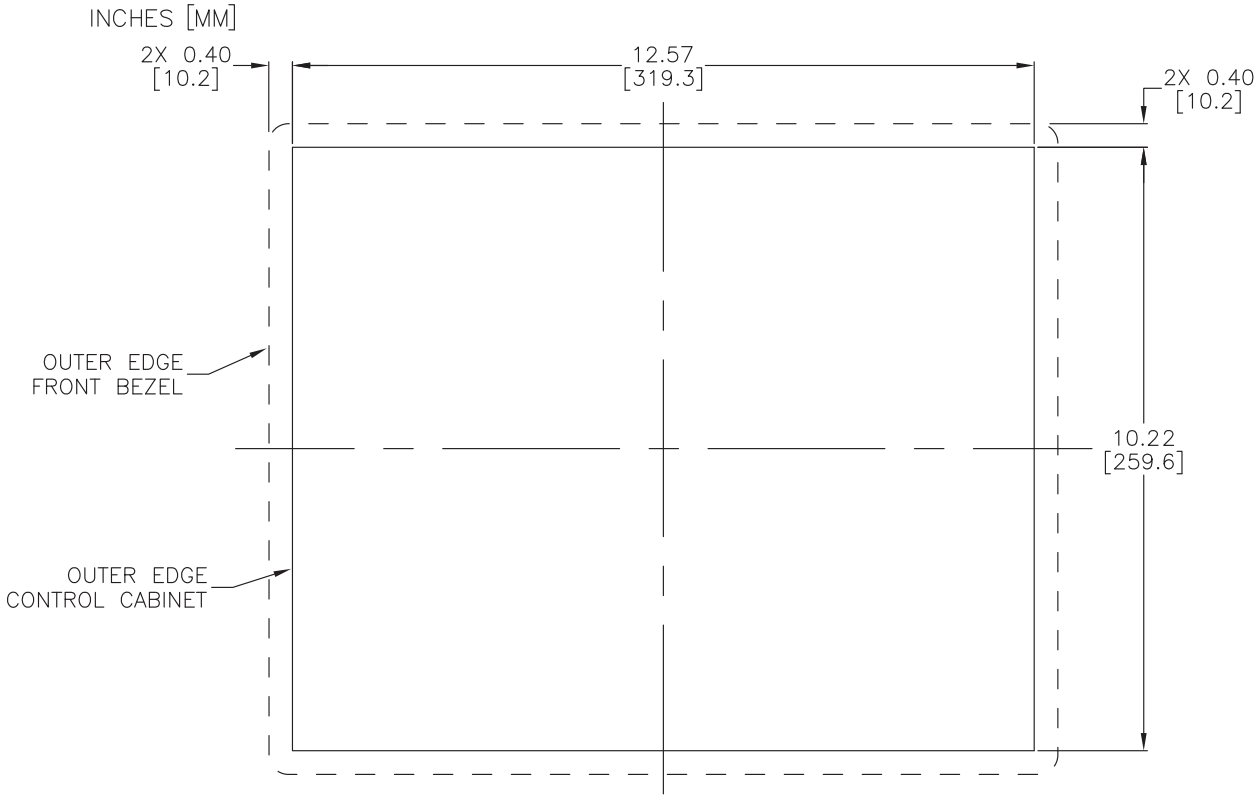



| Touch Panel Size | Enclosure Thickness Range | Mounting Clip Screw Torque |
|---|---|---|
| 6", 8", 10" and 12" | 0.039 - 0.20 inch [1 – 5 mm] | 63 - 77 oz-in [0.45 - 0.55 Nm] |

# EA9-T12CL Cutout Dimensions

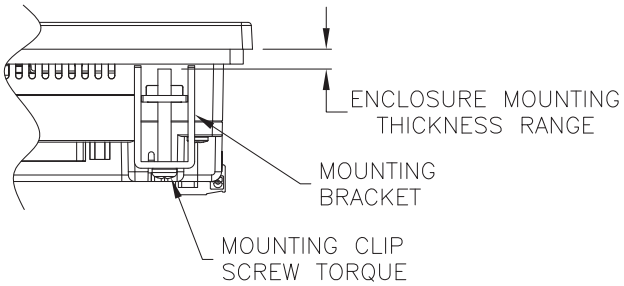
The ***C-more*** 12" touch panels are mounted into a cutout through the control cabinet and secured with eight (8) mounting clips. The mounting clips are provided with the touch panel. The mounting clips will insert into a series of slots around the rear perimeter of the touch panel. Each clip has a tab that will mate to a slot. The screw of each mounting clip needs to be tightened to the torque rating shown in the table below so that the gasket is compressed to form the proper seal between the panel and cabinet surface.






PANEL CUTOUT

## Enclosure Mounting Thickness Ranges and Mounting Clip Screw Torque

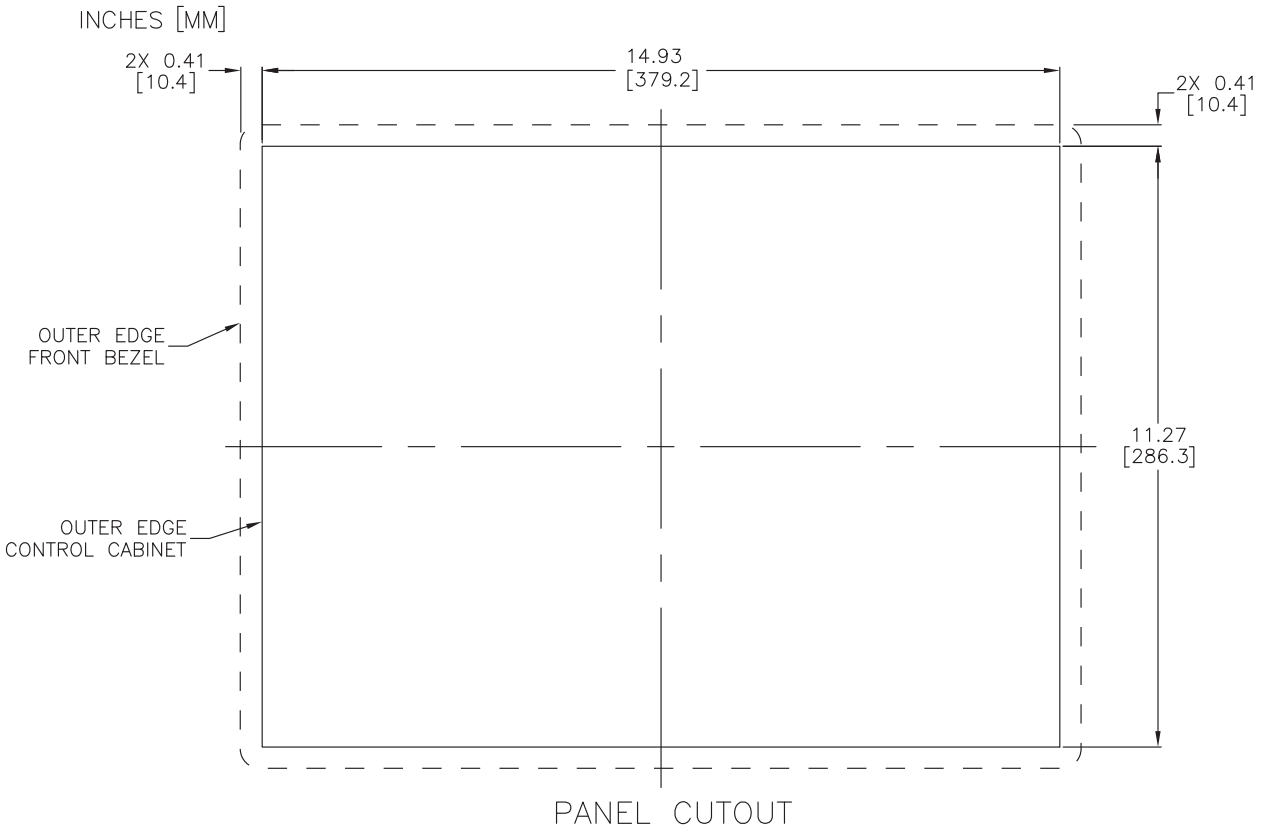



| Touch Panel Size | Enclosure Thickness Range | Mounting Clip Screw Torque |
|---|---|---|
| **6", 8", 10" and 12"** | 0.039 - 0.20 inch [1 – 5 mm] | 63 - 77 oz-in [0.45 - 0.55 Nm] |

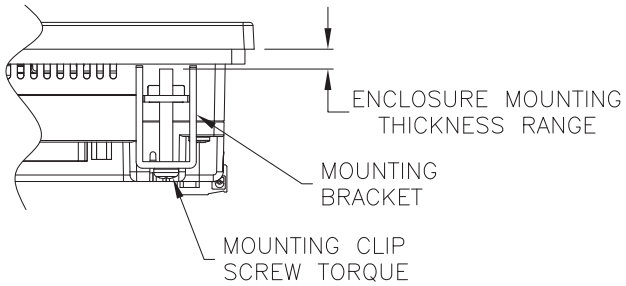
# EA9-T15CL Cutout Dimensions

The ***C-more*** 15" touch panels are mounted into a cutout through the control cabinet and secured with eight (8) mounting clips. The mounting clips are provided with the touch panel. The mounting clips will insert into a series of slots around the rear perimeter of the touch panel. Each clip has a tab that will mate to a slot. The screw of each mounting clip needs to be tightened to the torque rating shown in the table below so that the gasket is compressed to form the proper seal between the panel and cabinet surface.





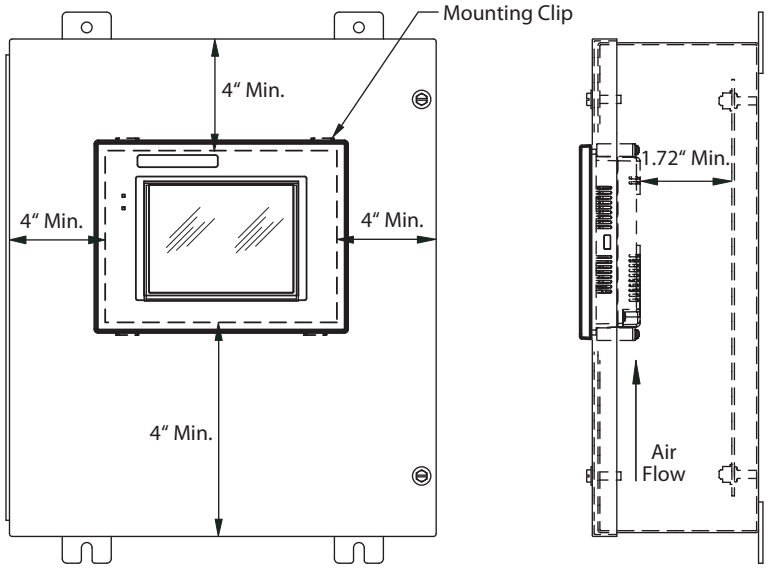

## Enclosure Mounting Thickness Ranges and Mounting Clip Screw Torque




| Touch Panel Size | Enclosure Thickness Range | Mounting Clip Screw Torque |
|---|---|---|
| 15" | 0.039 - 0.20 inch [1 – 5 mm] | 92 - 106 oz-in [0.65 - 0.75 Nm] |

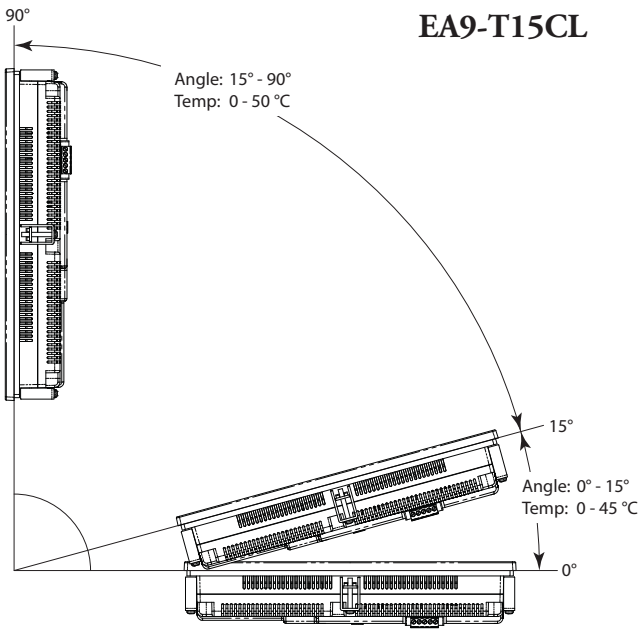
# Mounting Clearances

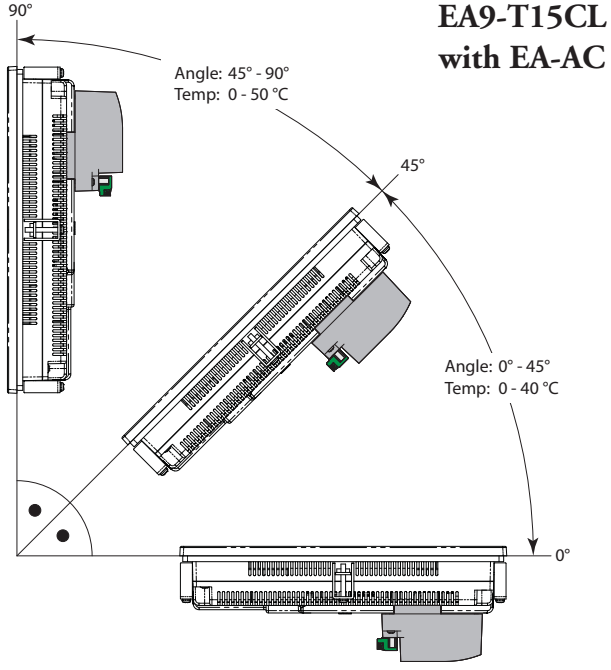
The following drawing shows the mounting clearances for the ***C-more*** touch panel. There should be a minimum of 4 inches of space between all sides of the panel and the nearest object or obstruction and at least 1.72 inches between the rear of the panel and the nearest object or obstruction.




## EA9-T15CL Derating

If EA9-T15CL is mounted off the vertical plane facing upward, the temperature shall be derated as shown below. There is no derating if EA9-T15CL is mounted off the vertical plane facing downward. Other panels may be mounted at any angle without derating consideration.



# Wiring Guidelines

**WARNING: To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and it is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation are in compliance with the latest revision of these codes.**

**Equipment damage or serious injury to personnel can result from the failure to follow all applicable codes and standards. We do not guarantee the products described in this publication are suitable for your particular application, nor do we assume any responsibility for your product design, installation, or operation.**

**If you have any questions concerning the installation or operation of this equipment, or if you need additional information, please call technical support at 1-800-633-0405 or 770-844-4200.**

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## Agency Approvals

Some applications require agency approvals for particular components. The ***C-more*** touch panel agency approvals are listed below:

- UL (Underwriters' Laboratories, Inc.)
- CUL (Canadian Underwriters' Laboratories, Inc.)
- CE (European Economic Union)

## Marine Use

American Bureau of Shipping (ABS) certification requires flame-retarding insulation as per 4-8-3/5.3.6(a). ABS will accept Navy low smoke cables, cable qualified to NEC "Plenum rated" (fire resistant level 4), or other similar flammability resistant rated cables. Use cable specifications for your system that meet a recognized flame retardant standard (i.e. UL, IEEE, etc.), including evidence of cable test certification (i.e. tests certificate, UL file number, etc.).

# Wiring Guidelines (cont'd)

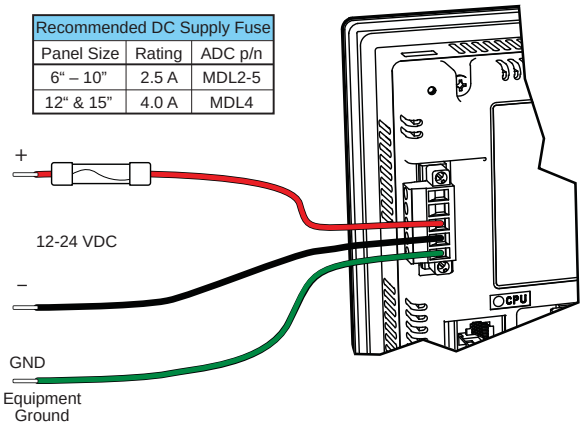
## Providing Power to the Touch Panel

- Connect a dedicated 12-24 VDC Class 2 power supply to the DC connector on the rear of the ***C-more*** touch panel. Connect the ground terminal to a proper equipment ground.
- or install a ***C-more*** AC/DC Power Adapter (EA-AC) to the rear of the touch panel and connect an AC voltage source of 100-240 VAC, 50/60Hertz, to its AC connector.
- then turn on the power source and check the LED status indicators on the front and rear of the ***C-more*** touch panel for proper operation. See the LED Status Indicator diagram on the next page for reference.



## DC Wiring Diagram

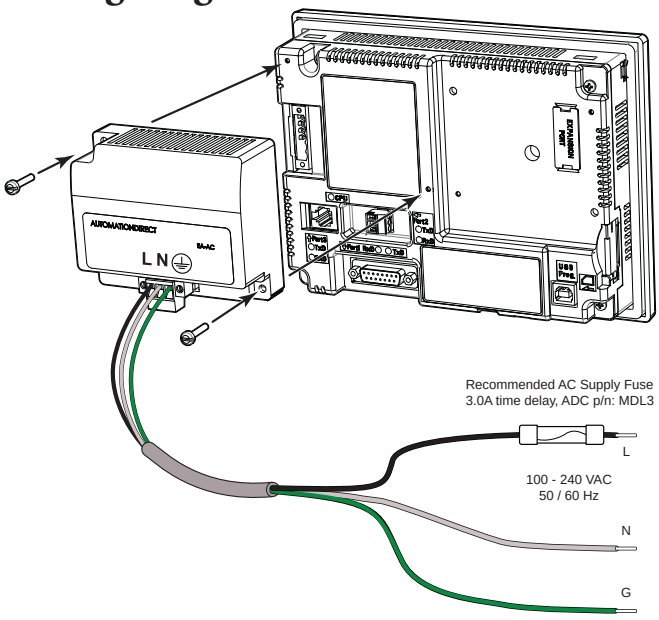
| Recommended DC Supply Fuse | | |
|---|---|---|
| Panel Size | Rating | ADC p/n |
| 6" – 10" | 2.5 A | MDL2-5 |
| 12" & 15" | 4.0 A | MDL4 |




| DC-CON Tightening Torque | |
|---|---|
| Power connector screw torque | 70.4 oz-in (0.5 Nm) |
| Power connector mounting torque | 56 oz-in (0.4 Nm) |

Recommended DC Power Supply:
***AutomationDirect*** Part No. PSC24-060

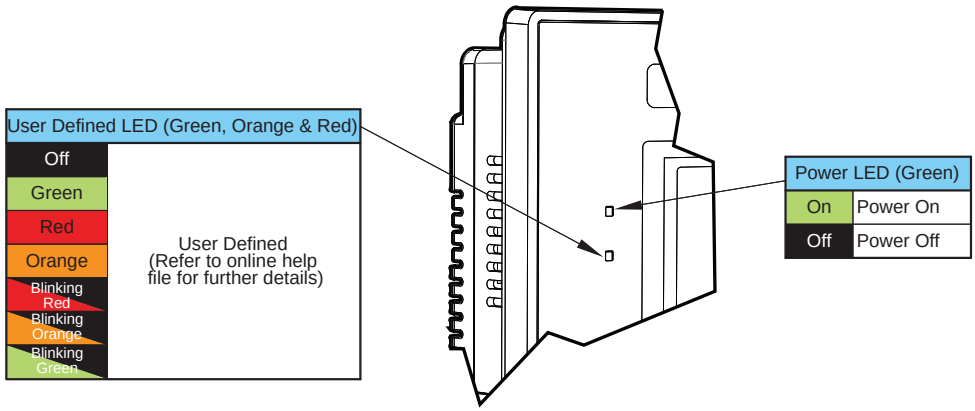
## AC Wiring Diagram



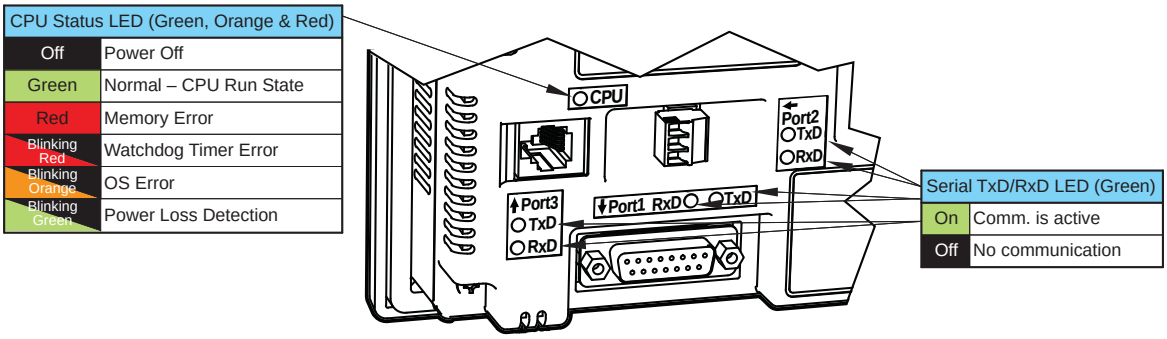

| EA-AC Tightening Torque | |
|---|---|
| Power supply cable torque | 71 - 85 oz-in (0.5 - 0.6 Nm) |
| Power connector mounting torque | 71 - 85 oz-in (0.5 - 0.6 Nm) |
| Mounting flange screw torque | 57 - 71 oz-in (0.4 - 0.5 Nm) |

*NOTE: Power Fault features of the EA-AC help protect data on an SD card during a power failure.*

## *C-more* LED Status Indicators




Front View




Rear View

# System Setup Screens

## In This Chapter...

Introduction ..... 5-2
Accessing the System Setup Screens (no project loaded) ..... 5-3
Accessing the System Setup Screens (with project loaded) ..... 5-4
System Setup Screens – Enable Password in Software ..... 5-6
System Setup Screens Flowchart ..... 5-12
Main Menu ..... 5-13
Information Menu ..... 5-14
Setting Menu ..... 5-18
Test Menu ..... 5-25
Memory Menu ..... 5-34

# Introduction

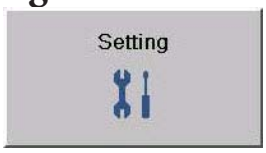
The ***C-more*** touch panels include a series of built-in System Setup Screens that allow the user to view detailed information about the panel; adjust certain features; configure communications; test various functions of the touch panel; backup & restore firmware, recipe, log and project memory; clear memory and reset all values and conditions back to the original factory defaults.

The four Main Menu selections are:

## Information

Here you will find detailed information in regards to the touch panel model, the panel's name, version information for the hardware, boot loader and firmware, clock source, battery status and beeper status. Also available are details on the panel's internal memory and the status of any external memory devices. Communication port details are available in this area, as well as an error log to help in trouble-shooting the system.

## Setting

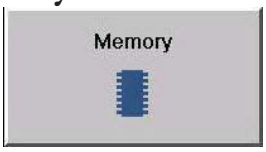



This is the area for 1.) making adjustments to the internal clock, 2.) adjusting the brightness of the display, 3.) setting the IP address 4.) adjusting (calibrating) the touch panel, 4.) enabling or disabling the internal beep, and 5.) enabling or disabling a mouse pointer.

## Test Menu

From this sub menu, the user can 1.) test the touch panel, 2.) test the display, 3.) test the user LED 4.) test the communication ports, and 5.) test both the internal beeper or the audio line output, if a speaker with an amplifier is connected. A WAV sound file is system provided for the audio line output test.

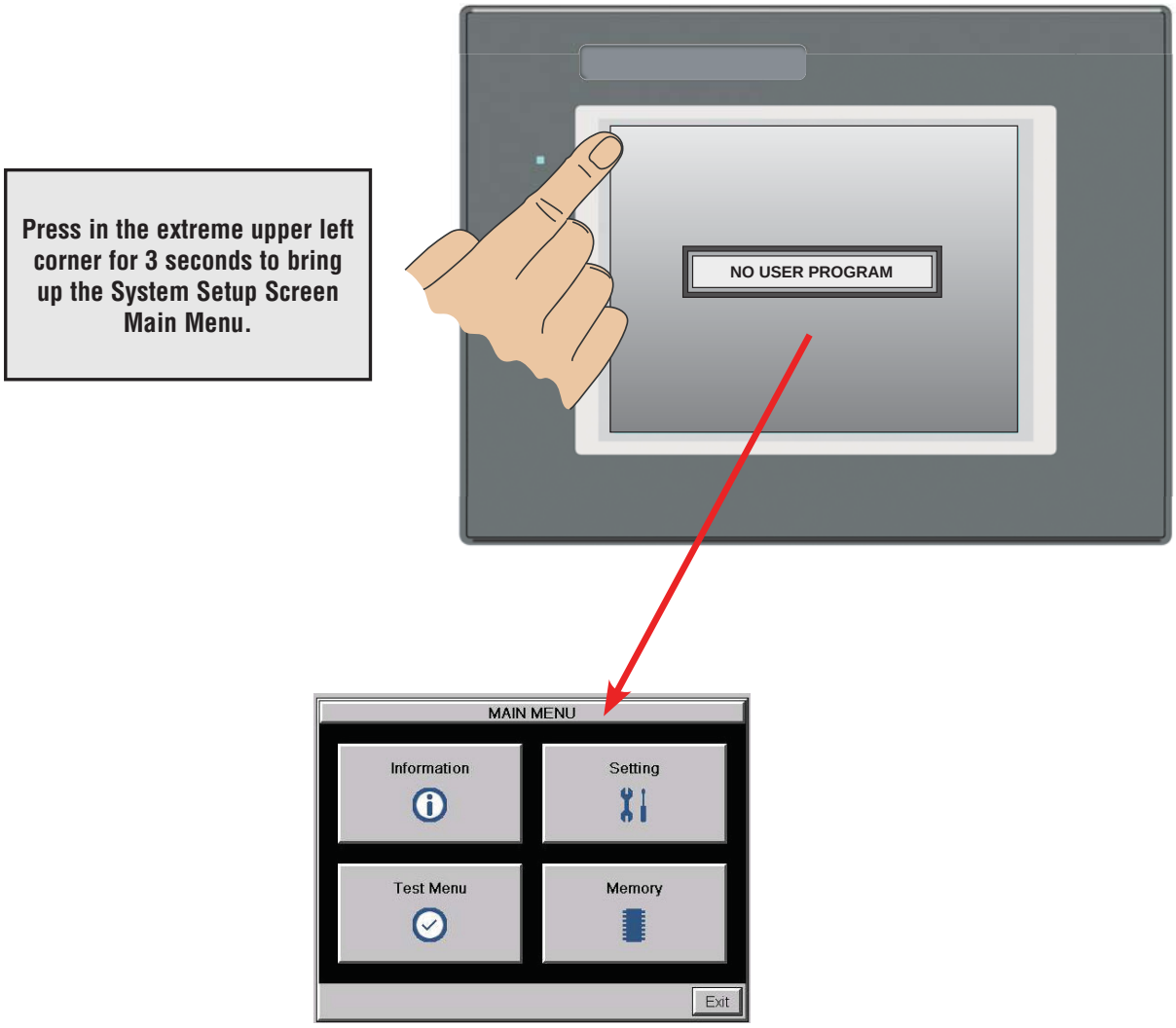
## Memory




Select the Memory menu item to either backup or restore your project, log data, recipe data and/or system memory. Selections can be made to backup to optional SD card memory or USB pen drive memory. The menu selections also give the user the ability to clear the memory, and there is also a selection to reset all of the touch panel settings back to the original factory defaults.

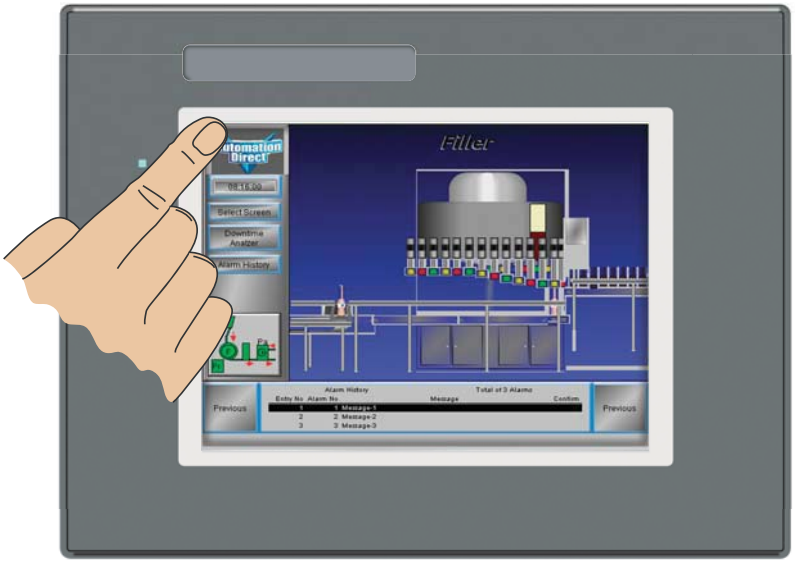
# Accessing the System Setup Screens (no project loaded)

To access the Main Menu of the touch panel System Setup Screens prior to downloading a project, press the extreme upper left corner of the panel display area for 3 seconds as shown below. The Main Menu will then be displayed.



# Accessing the System Setup Screens (with project loaded)

To access the Main Menu of the touch panel System Setup Screens with a project loaded into memory, press the upper left corner of the panel display area for 3 seconds as shown below.



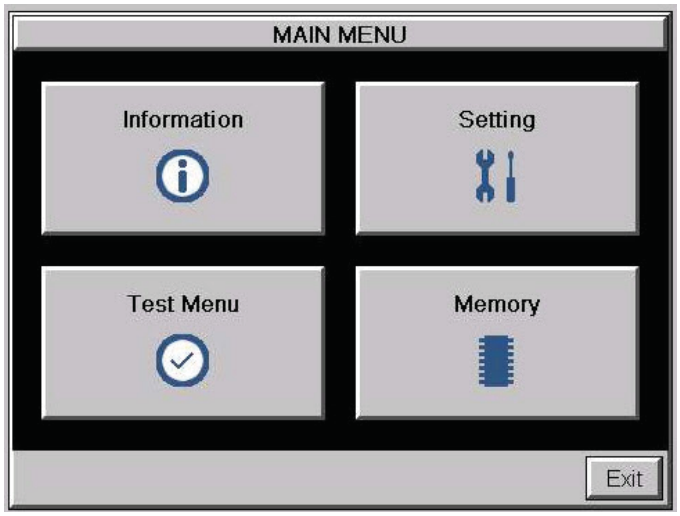
If no system screen password is enabled, the following WARNING dialog box will appear on the touch screen.:

- Pressing OK will display the system setup screen. See the WARNING below!
- Pressing Cancel will take you back to the project screen.
- Communications with the PLC is active while the Warning is displayed.
- The dialog box will close if no action is taken for 60 seconds.
- The dialog box will not display if the touch panel does not have a project loaded.
- The dialog box will display after a valid password is entered if the System Screen password is enabled.

**WARNING: Pressing OK at this point will STOP the PLC driver and therefore all communications between the touch panel and PLC will cease. It is strongly recommended that the password system tag "SYS SYSTEMSCREENPW" be enabled to add a safeguard step in accessing the system setup screens. See the next section for an overview for setting the System Tags in the Event Manager Database.**

## System Setup Screens

The OK button in the Warning dialog box will bring up the Main Menu as shown below. You can then proceed to the other system setup screens.

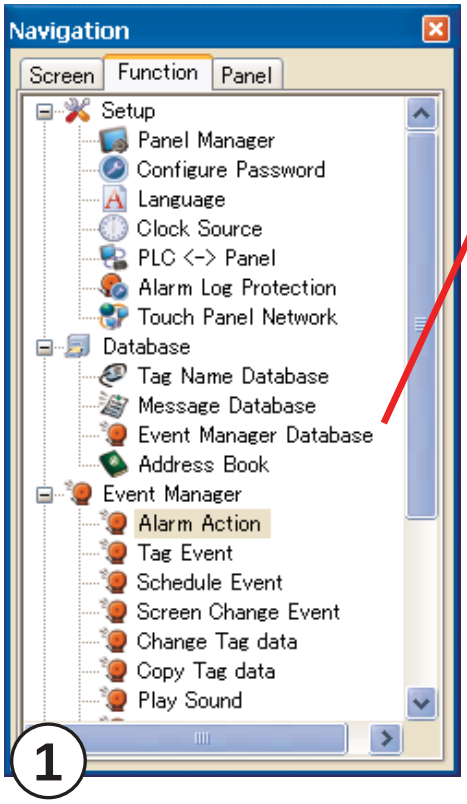


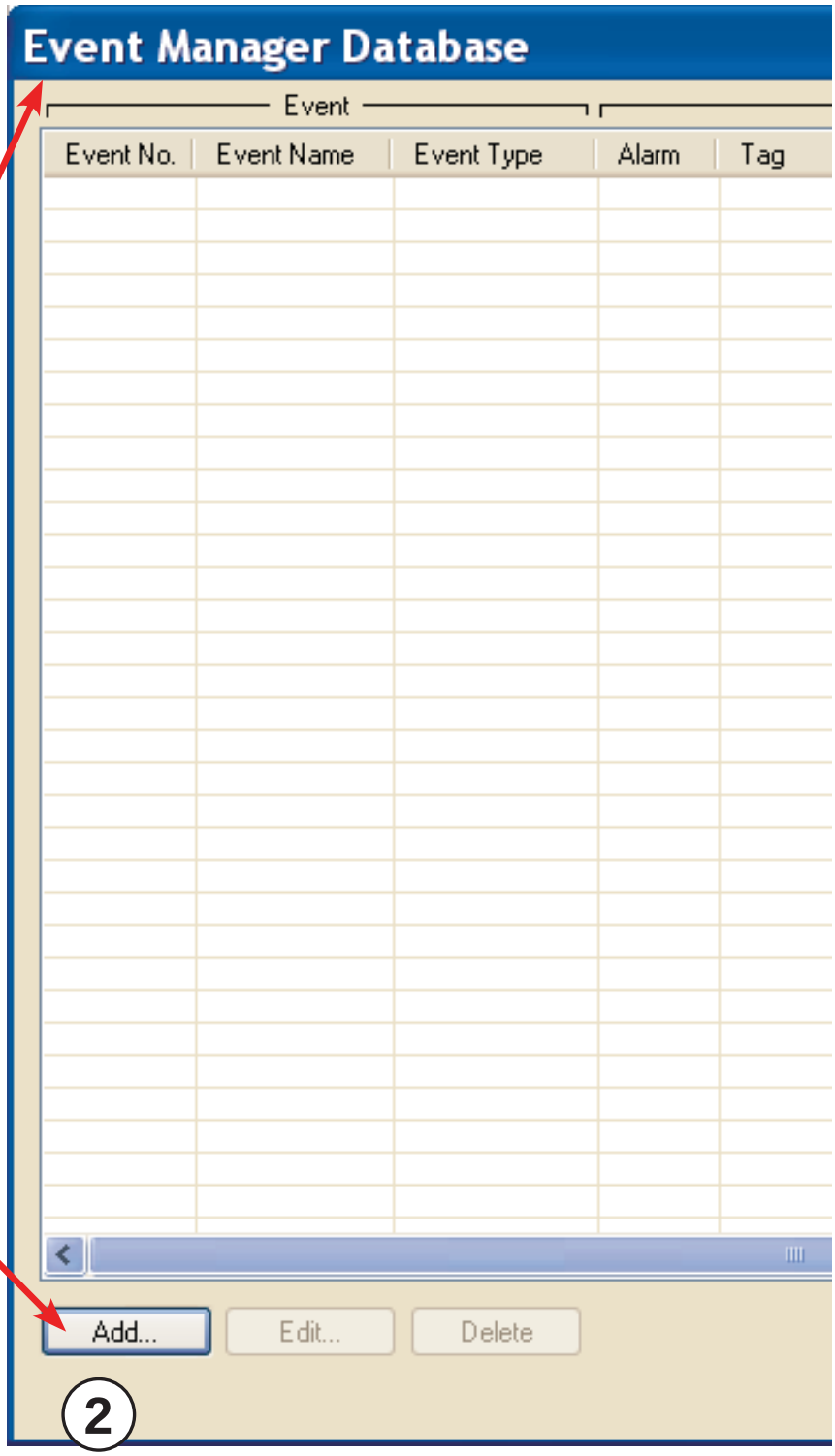

## Password Protecting System Screen Access

*NOTE: If the password system tag SYS SYSTEMSCREENPW is enabled, the Enter Security Code keypad shown below will open. The procedure to enable the SYS SYSTEMSCREENPW is detailed below.*
*Entering the correct password will display the Panel Run Mode warning dialog described previously. PLC communications continue while the keypad is displayed. The keypad will timeout after 60 seconds.*

# System Setup Screens – Enable Password in Software

Under the ***C-more*** Programming Software's Navigation window, select the Function tab, then double click on "Alarm Action" to display the Event Manager Database shown below:

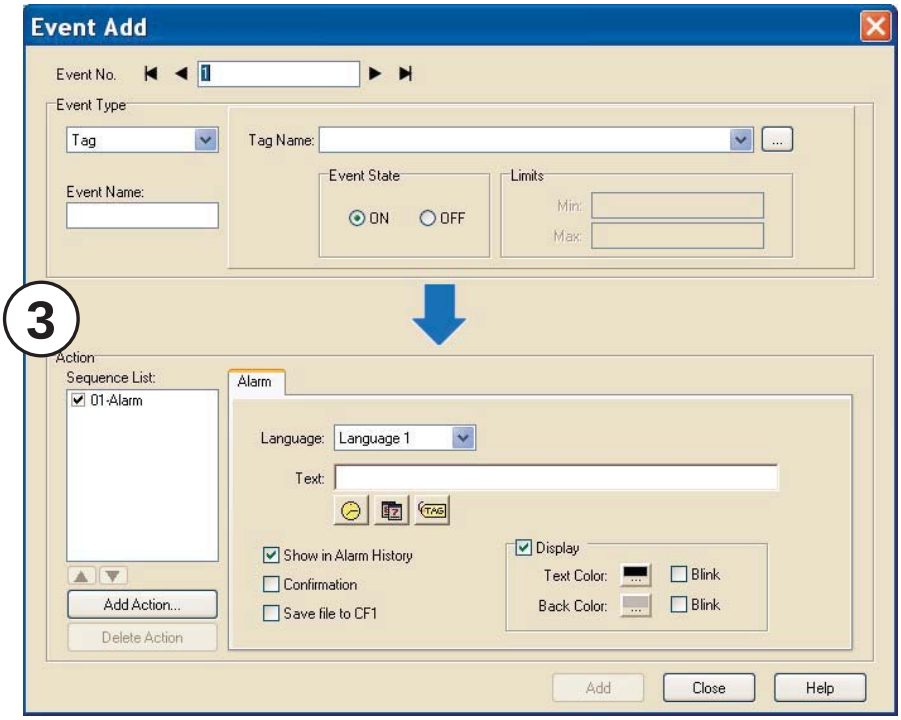


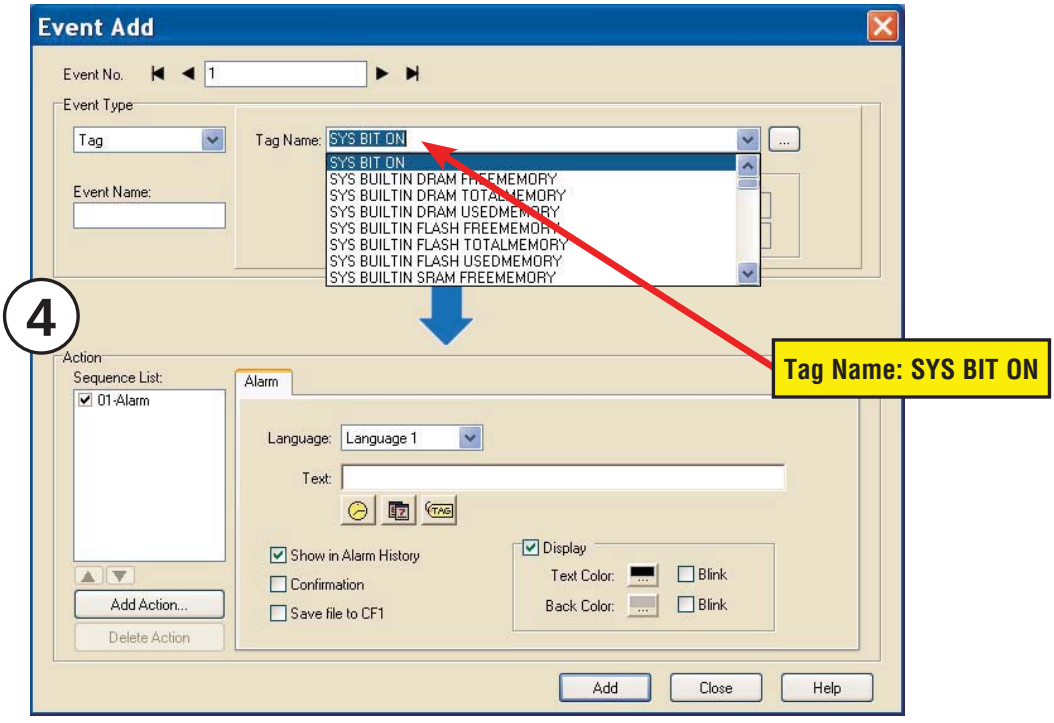

Click on the **Add** button to add an event to the database that will be used to enable the System Screen Password.

# System Setup Screens – Enable Password (cont'd)

The **Event Add** dialog box will be displayed as shown.



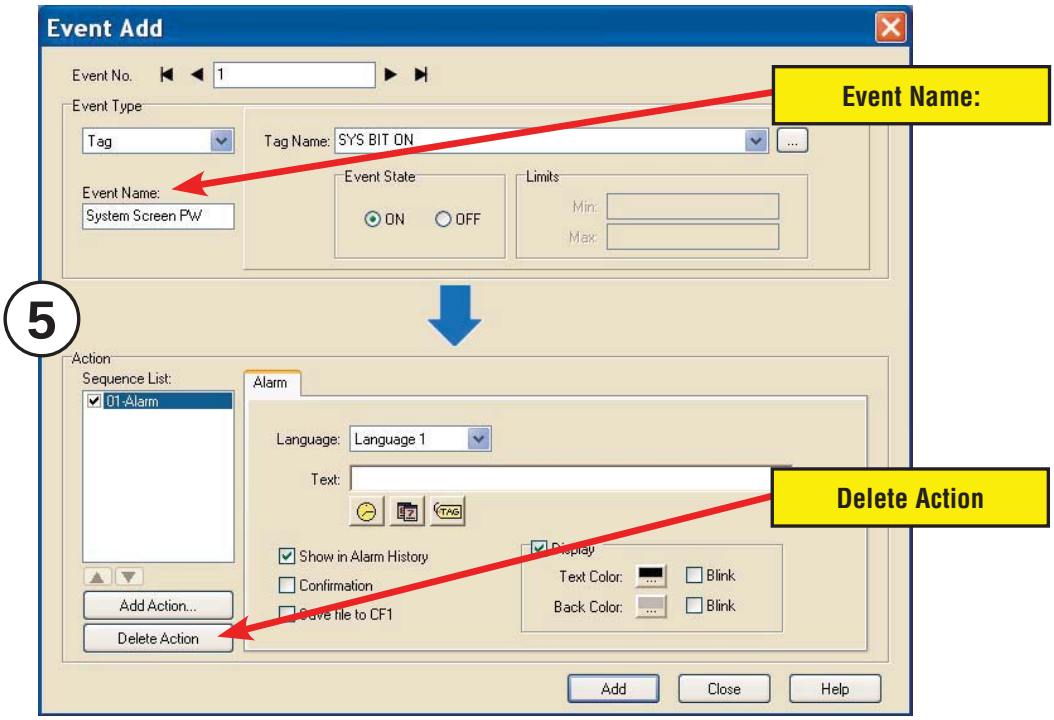

Click on the **Tag Name:** pull down menu and select the internal **System Bit On (SYS BIT ON)** tag as shown. This will force the tag event type to be continuously active.

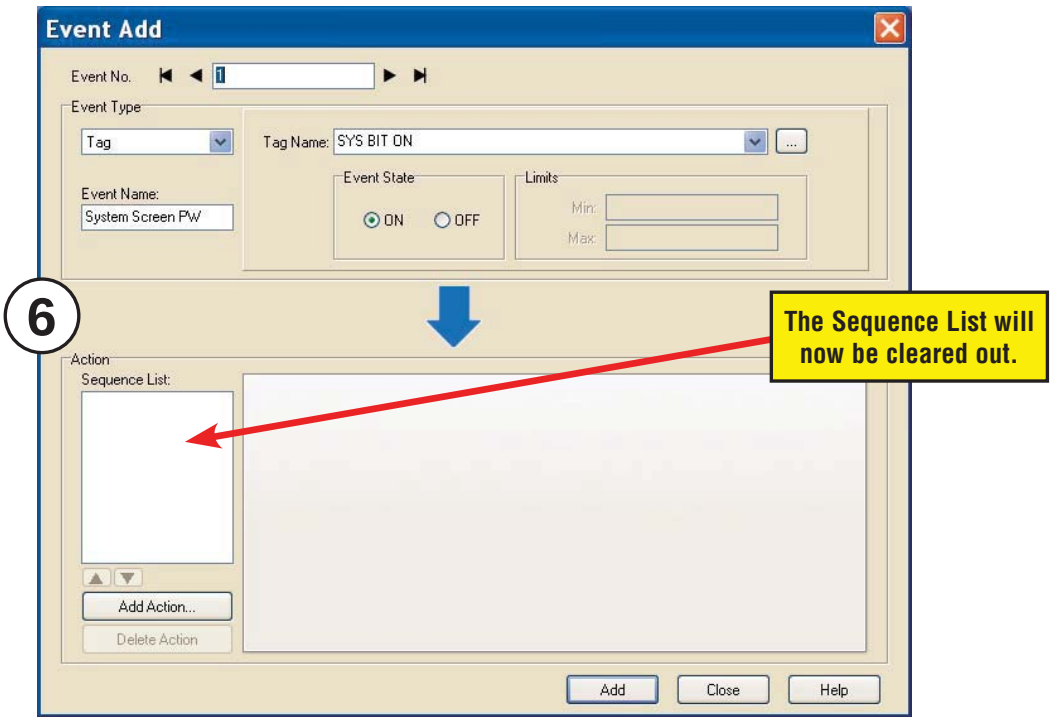


# System Setup Screens – Enable Password (cont'd)

Use the **Eve**nt Name: text box to document the event as "System Screen PW" for record keeping  This is optional.

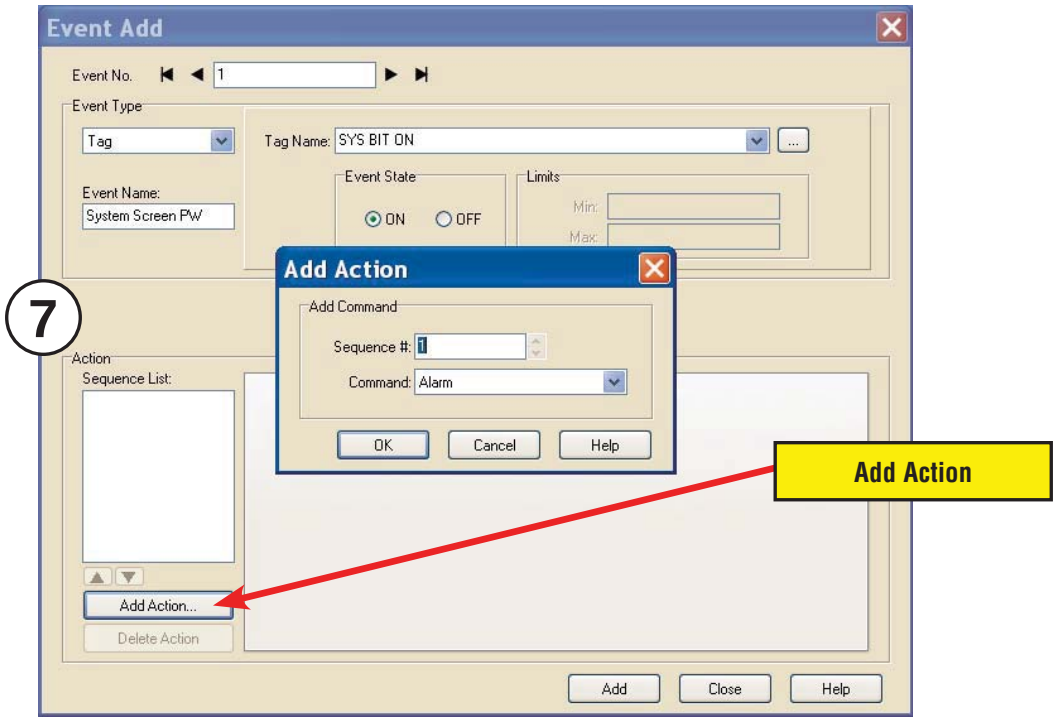
In the Action box, click once on the displayed 01-Alarm under the Sequence List: so that 01-Alarm is highlighted. Then click the **Delete Action** button to remove the **01-Alarm**.



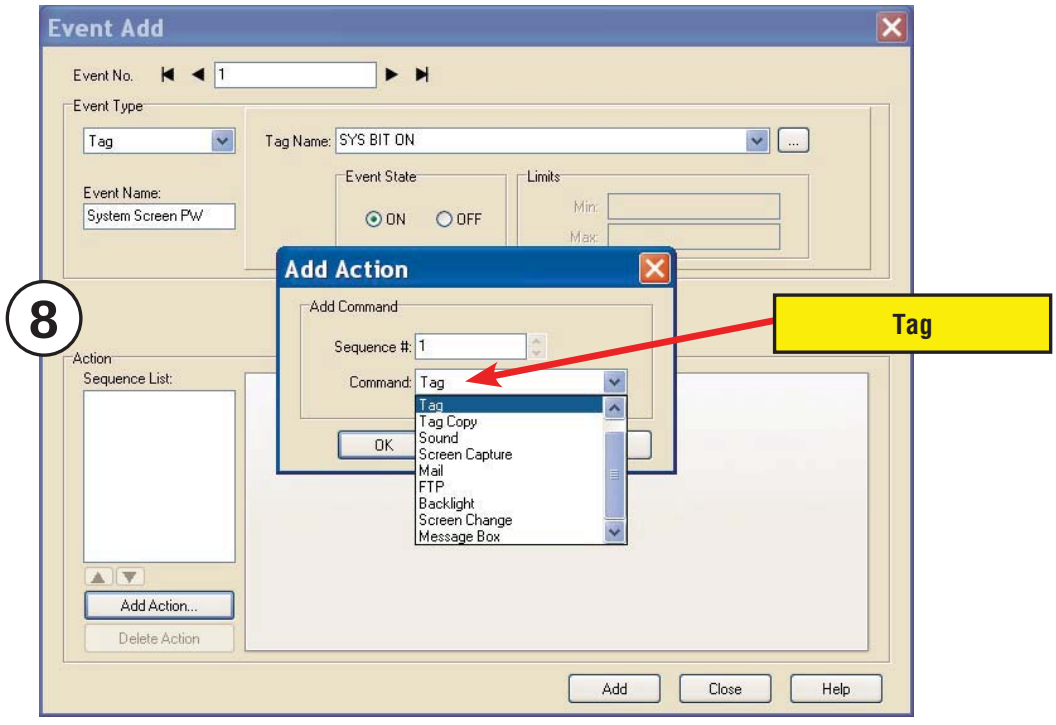



# System Setup Screens – Enable Password (cont'd)

In the **Action** box, click on the **Add Action...** button. This will bring up the **Add Action** dialog box as shown below:

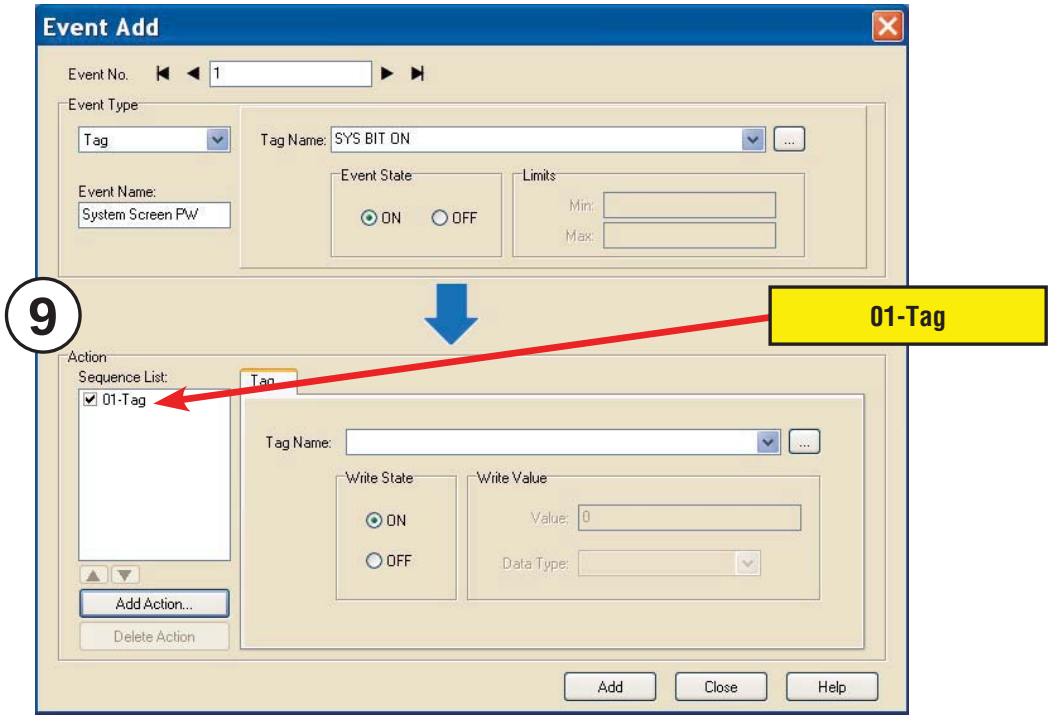



Click on the **Command:** pull down list in the **Add Command** box, select **Tag** from the list, then click **OK**.

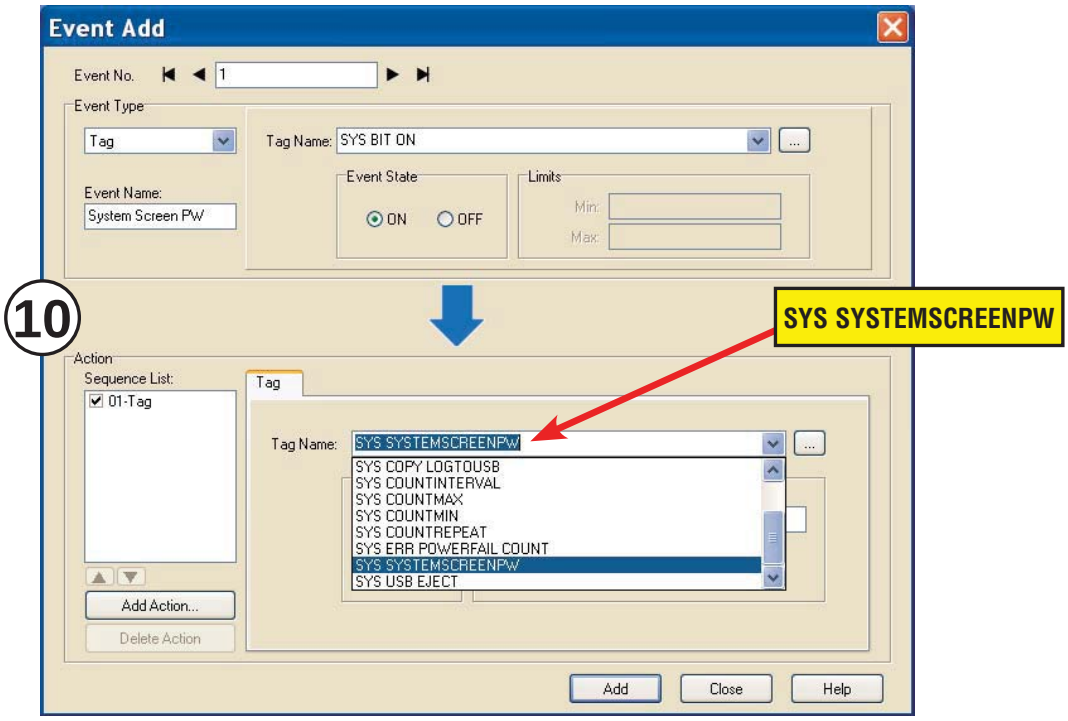


# System Setup Screens – Enable Password (cont'd)

A **01-Tag** action item will then be added to the **Sequence List**.

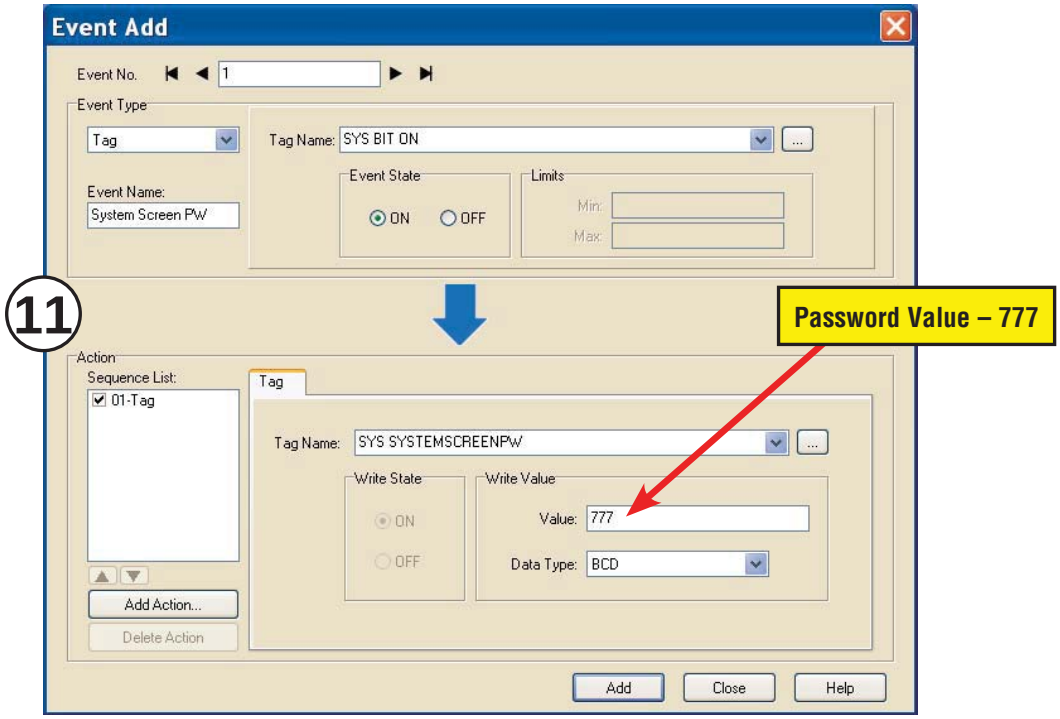



Click on the **Tag Name:** pull down list down arrow in the **Action** box's **Tag** tab, select **SYS SYSTEMSCREENPW** from the list, and click **OK**.

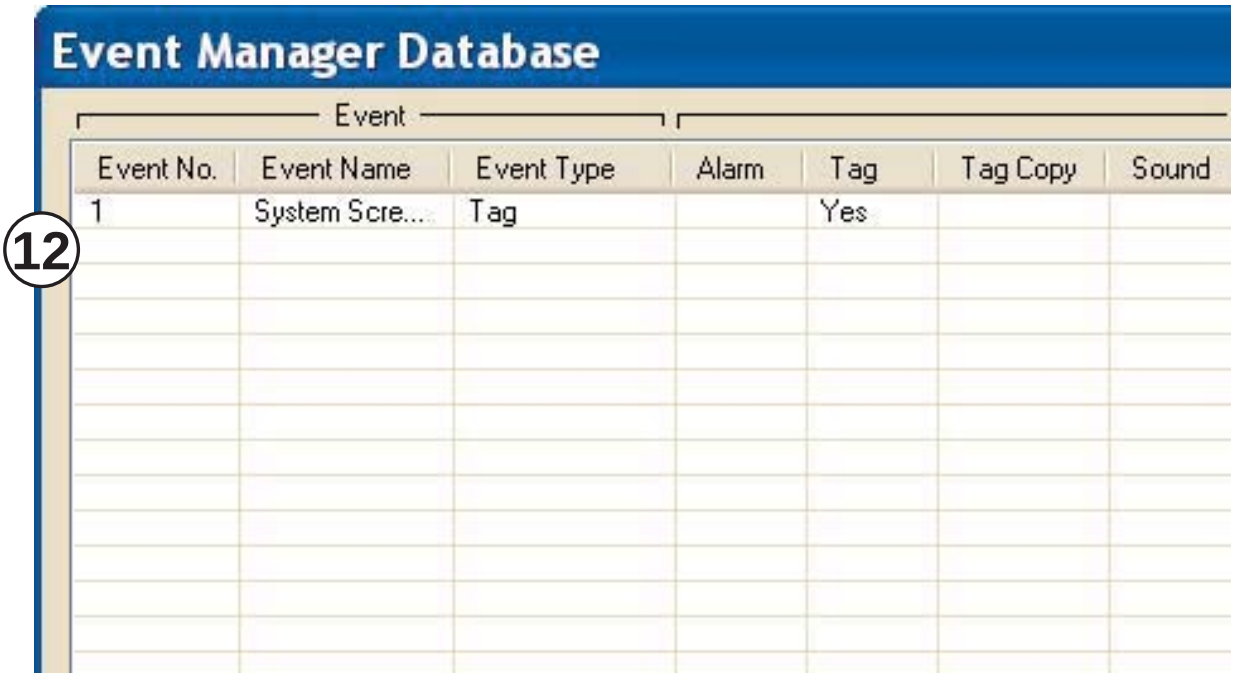


# System Setup Screens – Enable Password (cont'd)

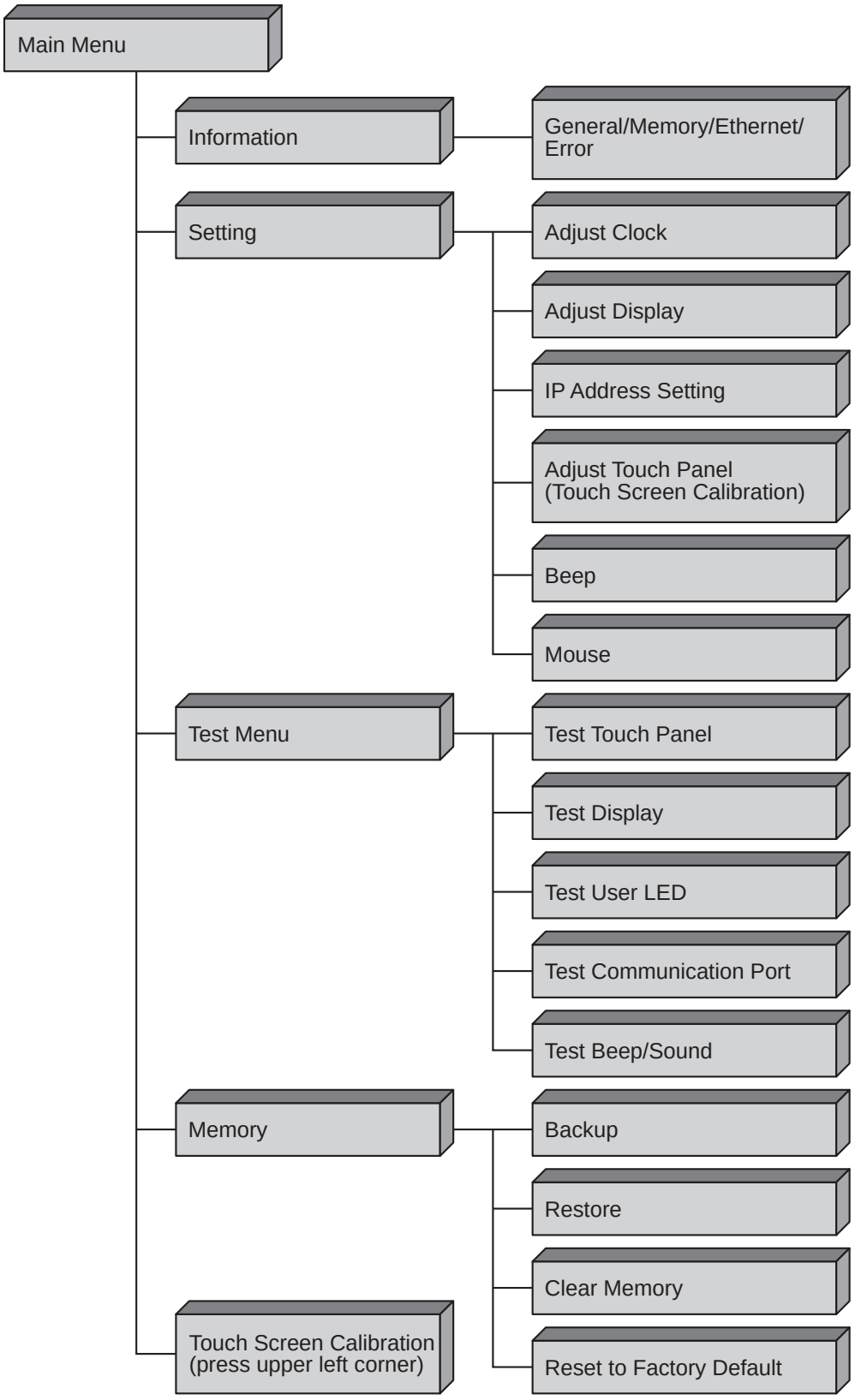
Enter a numeric value into the **Value:** box, such as "777". This value becomes the Password code to access the System Setup Screen's **Main Menu**.



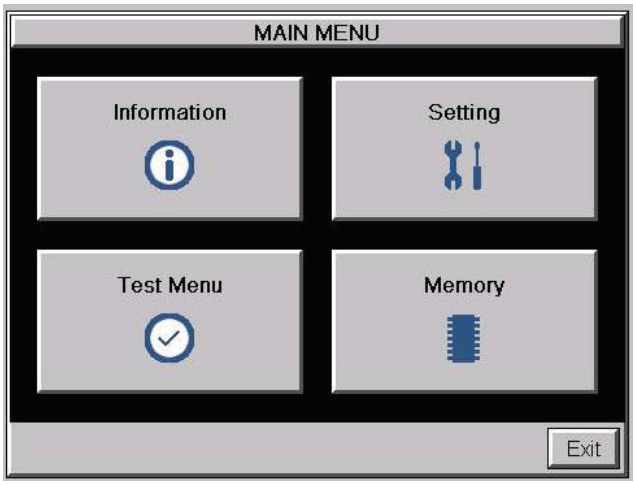

Click the **Apply** button in the Event Add dialog box and then the Close button to return to the Event Manager Database. You now will see that the first event in the database is for the System Screen Password and it is enabled.



# System Setup Screens Flowchart



# Main Menu




The **Main Menu** system setup screen is the top layer in the menu structure.

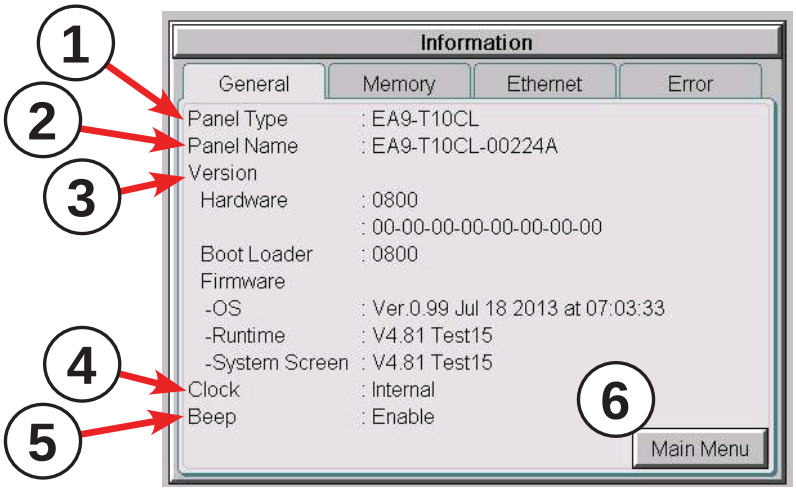


## Touch Screen Calibration

While the **Main Menu** system setup screen is being displayed, the extreme upper left corner of the touch panel can be pressed for 3 seconds to access the **Touch Screen Calibration** display. This feature is used if the touch panel data becomes corrupted and touching the **Main Menu** buttons does not work. It allows a shortcut to the touch panel calibration screen

# Information Menu

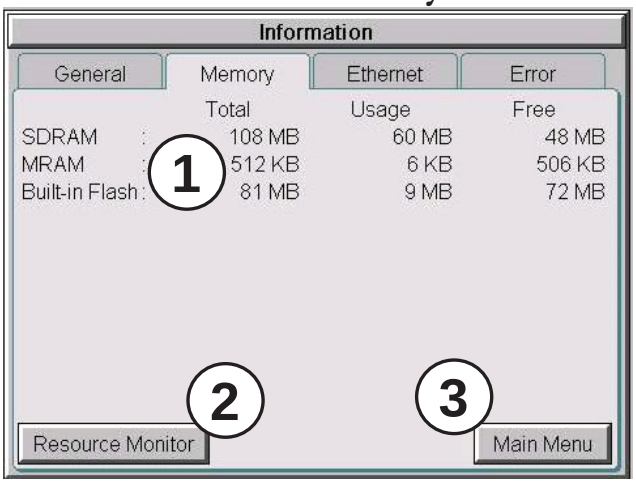
## Information - General tab



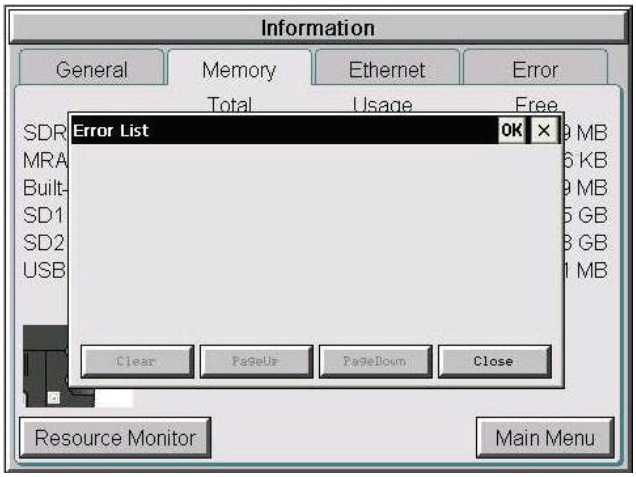

The **General** tab under the Information menu provides detailed information of the ***C-more*** touch panel.

| Item No. | Function | Description | Comments |
|---|---|---|---|
| 1 | **Panel Type** | EA9-T6CL-R,<br>EA9-T6CL,<br>EA9-T8CL,<br>EA9-T10CL,<br>EA9-T12CL,<br>EA9-T15CL | Model Number |
| 2 | **Panel Name** | The panel name is configured in the programming software and saved with a project. | The default panel name is the model number plus the lower three bytes of the panel MAC address, ie EA9-T8CL-0022C4. |
| 3 | **Version** | The version identifications provide information on the components and firmware in the panel | Files reside in the ***C-more*** touch panel's memory. |
| 4 | **Clock** | Internal/External clock selection. | Configured in the ***C-more*** Programming Software. |
| 6 | **Beep** | Status of the internal beeper. | Configurable in the **Setting Menu – Beeper** shown on page 5-23 or in the ***C-more*** Programming Software. |
| 7 | **Main Menu** | Press to return to the **Main Menu** screen. | **Main Menu** shown on previous page. |

## Information - Memory tab

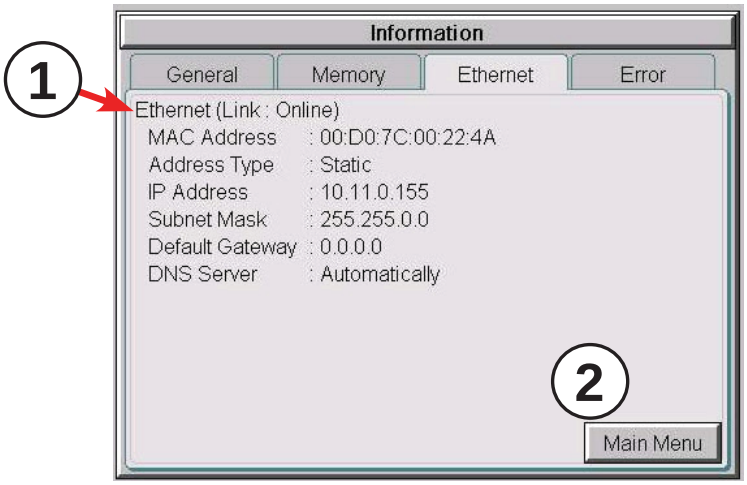



1. **Memory components** - Status of each memory component - SDRAM, MRAM and Built-in Flash are internal memory components. When external memory devices are installed in the panel they will be included in this list : SD1, SD2 (12 and 15 inch panels only) and USB.



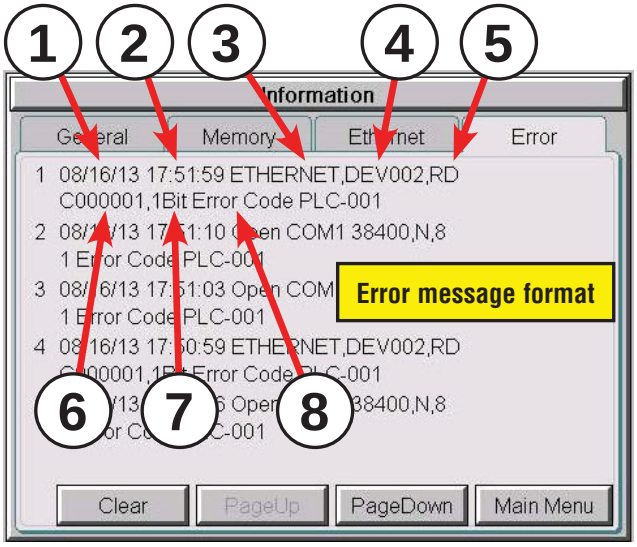

2. **Resource Monitor** - this troubleshooting tool displays CPU and panel internal memory usage. When enabled, the Resource Monitor will display on the panel screen WHILE THE PROJECT IS RUNNING that is, after you click Main Menu then click Exit) - the Resource Monitor also allows access to the Error Tab WITHOUT STOPPING COMMUNICATIONS WITH THE PLC
3. **Main Menu** - Press to return to the Main Menu screen - Main Menu shown previously

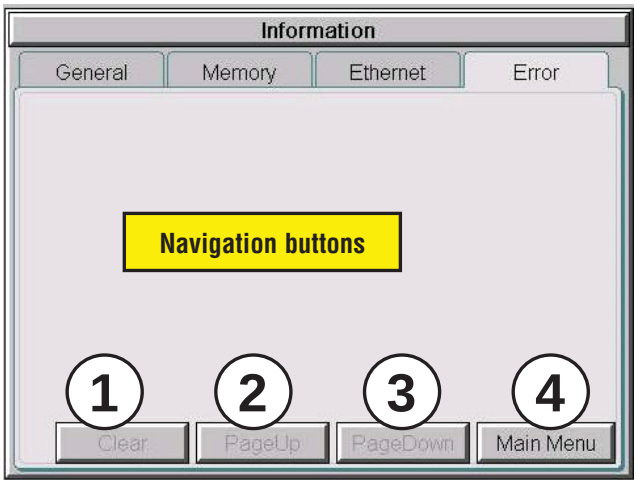
## Information - Ethernet tab




| Item No. | Function | Description | Comment |
|---|---|---|---|
| 1 | **Ethernet (Link: Online)** | Ethernet Settings:<br>MAC Address: 00 D0 7C XX XX XX<br>Address Type: DHCP/Static<br>IP Address:<br>Subnet Mask:<br>Default Gateway:<br>DNS: 1.) Automatically<br>2.) Use Designated Address<br>Note: N/A - not available on reduced featured models (–R) | Configurable in the **Setting Menu – IP Address Setting** shown on in this section or in the ***C-more*** Programming Software. |
| 2 | **Main Menu** | Press to return to the **Main Menu** screen. | |

## Information - Error tab



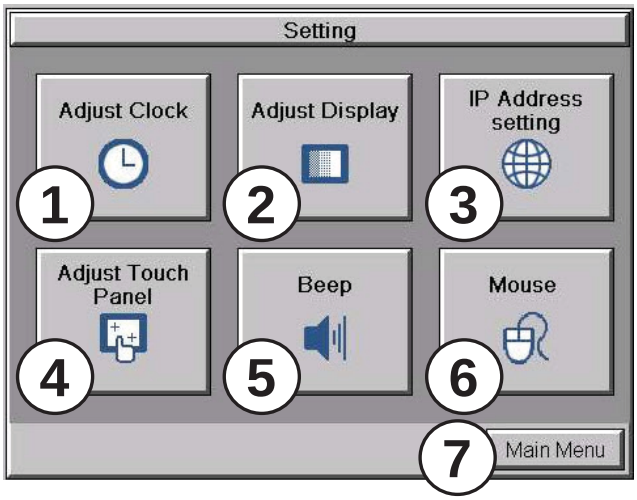

### Error Message Format:

| Item No. | Function | Description | Comment |
|---|---|---|---|
| **Order of error message functions:**<br>**Error Number, Date, Time, Error Port, Device Name, Error Type, PLC Device, Access Bytes, Error Message** | | | |
| **1** | **Date** | Format: MM/DD/YY | Date error occurred. |
| **2** | **Time** | Format: HH/MM/SS | Time error occurred. |
| **3** | **Error Port** | PLC Serial Communications Port:<br>Ethernet: | |
| **4** | **Device Name** | The name of the device reporting the error. | Device names are configured in the programming software, Panel Manager |
| **5** | **Error Type** | RD: Read<br>WT: Write | |
| **6** | **PLC Address** | The assigned address of the PLC that caused the error. | |
| **7** | **Access Bytes** | The number of access bytes. | |
| **8** | **Error Message** | The error message is the same as the message displayed in the upper left of the ***C-more*** touch panel's display. | A list of Error Massages is shown in Appendix A |

### Error Message navigation buttons:

| Item No. | Function | Description | Comment |
|---|---|---|---|
| **1** | **Clear** | Press to clear all error messages. This button is grayed out when there are no error messages to display. | Errors are also cleared with firmware is updated on the panel. Errors are not cleared on power cycle or project transfer. |
| **2** | **Page Down** | Press to go to to the next page. This button is grayed out when there is no error messages on the next page. | |
| **3** | **Page Up** | Press to go to the previous page. This button is grayed out when there is no error messages on the previous page. | |
| **4** | **Main Menu** | Press to return to the **Main Menu** screen. | |

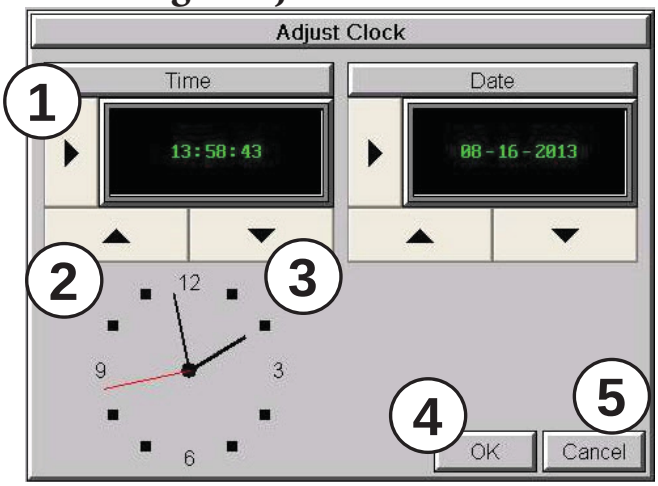
# Setting Menu




The **Setting Menu** is used to adjust the time & date, adjust the contrast or brightness of the display, enter the IP address settings, adjust (calibrate) the touch screen, enable or disable the internal beep and turn on and off the mouse cursor .

| Item No. | Function | Description | Comments |
|---|---|---|---|
| 1 | **Adjust Clock** | Press to go to the **Adjust Clock** screen. | |
| 2 | **Adjust Display** | Press to go to the **Adjust Display** screen. | |
| 3 | **IP Address** | Press to go to the **IP Address** screen | The IP Address can also be set from the programming software or by the project. |
| 4 | **Adjust Touch Panel** | Press to go to the **Adjust Touch Panel** screen. | |
| 5 | **Beep** | Press to go to the **Beep** screen. | |
| 6 | **Mouse** | Press to go to the **Mouse** screen. | |
| 7 | **Main Menu** | Press to return to the **Main Menu** screen. | |

## Setting – Adjust Clock

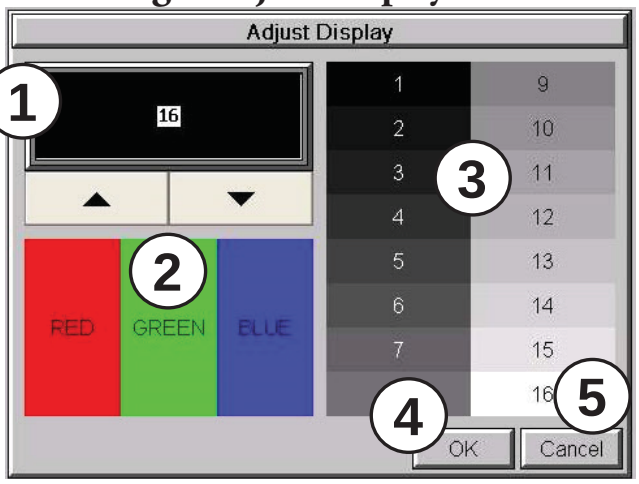



| Item No. | Function | | Description | Comments |
|---|---|---|---|---|
| 1 | **Select** | | **Time:** Each press of the **Select** button will cycle thru the following settings.<br>1.) No Selection to Hours<br>2.) Hours to Minutes<br>3.) Minutes to Seconds<br>4.) Seconds back to Hours<br>**Date:** Each press of the **Select** button will cycle thru the following settings.<br>1.) Month to Day<br>2.) Day to Year<br>3.) Year back to Month | |
| 2 | **Up** | | Press to increment the value by "1" with each press. | |
| 3 | **Down** | | Press to decrement the value by "1" with each press. | |
| 4 | **OK** | | Press to accept the changes. | |
| 5 | **Cancel** | | Press to return to the **Setting Menu** screen without accepting the changes. | |

*NOTE: The function buttons used to adjust the clock settings on the panel's setup screen are* ***disabled*** *if an* ***External*** *clock source is selected in the* ***C-more*** *programming software. The choice of an internal or external clock source is available by selecting* ***Clock Source*** *in the* ***C-more*** *programming software under the* ***Main Menu*** *drop down function* ***Setup****.*

*NOTE: The panel's clock can also be adjusted from the* ***C-more*** *programming software. The* ***Adjust Clock*** *function can be accessed in the software by selecting* ***Adjust Clock*** *under the* ***Main Menu*** *drop down function* ***Panel*** *or selecting* ***Adjust Clock*** *under the* ***Panel*** *tab in the software's* ***Navigation*** *window.*

## Setting – Adjust Display

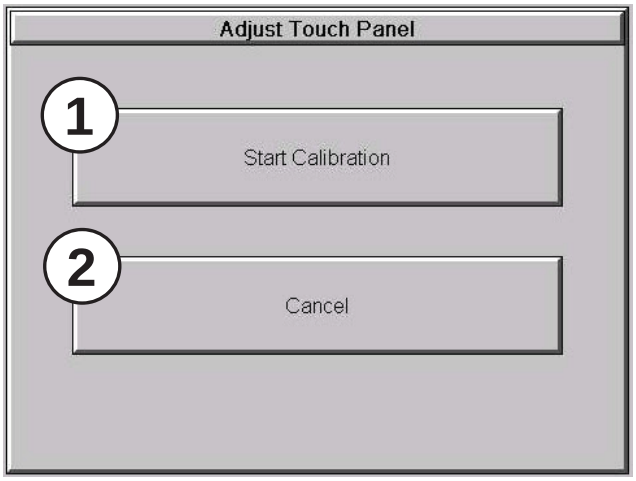


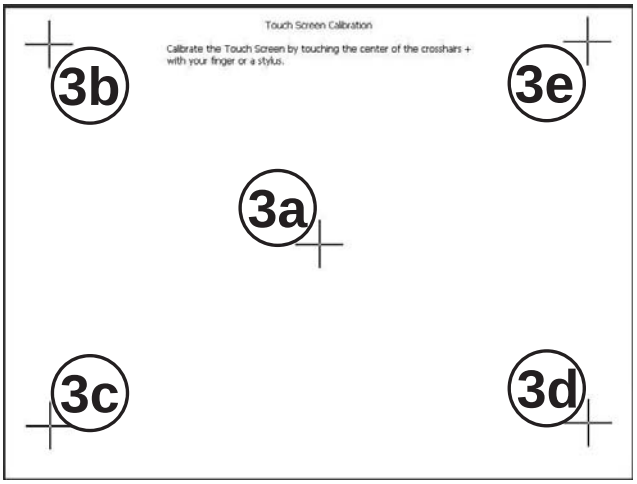

| Item No. | Function | Description | Comments |
|---|---|---|---|
| 1 | **Setting** | Use the Up and Down arrows to change the brightness. | |
| 2 | **Color Sample** | Displays a sample of how colors will appear with the new setting. | |
| 3 | **Contrast Sample** | Displays a sample of contrast with the new setting | |
| 4 | **OK** | Press to accept the changes. | |
| 5 | **Cancel** | Press to return to the **Setting Menu** screen without accepting the changes. | |

## Setting – Adjust Touch Panel

This procedure is used to calibrate the touch screen to ensure accuracy of the touch areas. There are five points on the touch screen that the calibration is based around. The adjustment relies on very narrow areas for the calibration points.

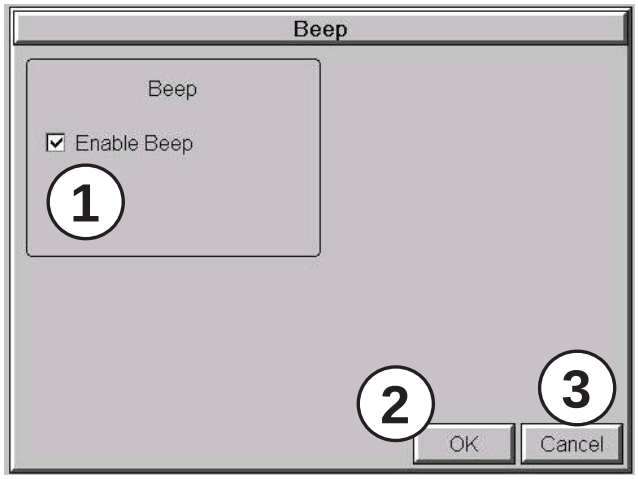
*NOTE: The panel will display the* ***Adjust Touch Panel*** *window on power up until the calibration procedure is completed.*




| Item No. | Function | Description | Comment |
|---|---|---|---|
| 1 | **Start Calibration** | Press to begin the touch screen calibration | |
| 2 | **Cancel** | Press to return to the **Setting Menu** screen. | |
| 3 | **Points 3a thru 3e** | The touch screen calibration crosshairs will appear individually in the order of point 3a thru 3e respectively as each proceeding crosshair is pressed. | If the touched co-ordinate point is too far off from normal, then the procedure will return to Point 3a. |

## Setting – Beep

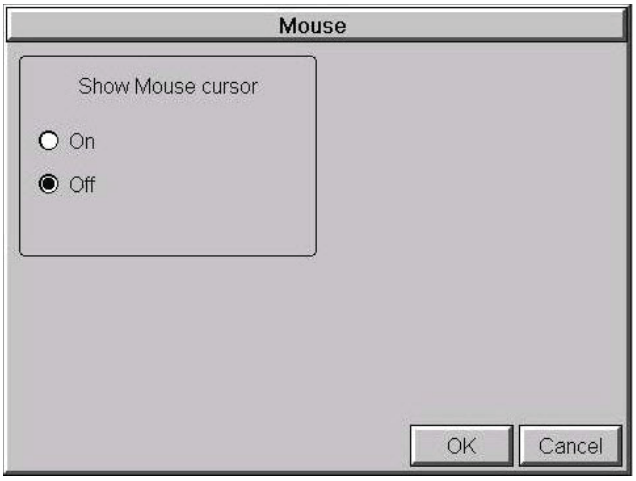



This system setup screen function is used to enable or disable the touch panel's internal beep function.

| Item No. | Function | Description | Comments |
|---|---|---|---|
| 1 | **Enable Beep** | Check to enable the internal beep. | |
| 2 | **OK** | Press to accept the changes. | |
| 3 | **Cancel** | Press to return to the **Setting Menu** screen without accepting the changes. | |

*NOTE: The project settings in the C-more programming software Panel Manager will override the touch panel's internal setting upon initial download.*

## Setting – Mouse

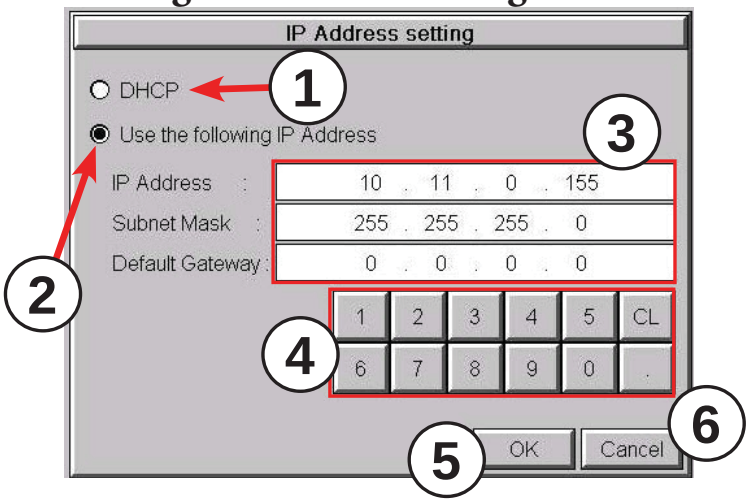



This system setup screen function is used to enable/ disable the arrow mouse cursor on the panel screen. It may be valuable to display the mouse cursor, for example, when an external USB keyboard is connected to the panel..



*NOTE: The project settings in the C-more programming software Panel Manager will override the touch panel's internal setting upon initial download.*

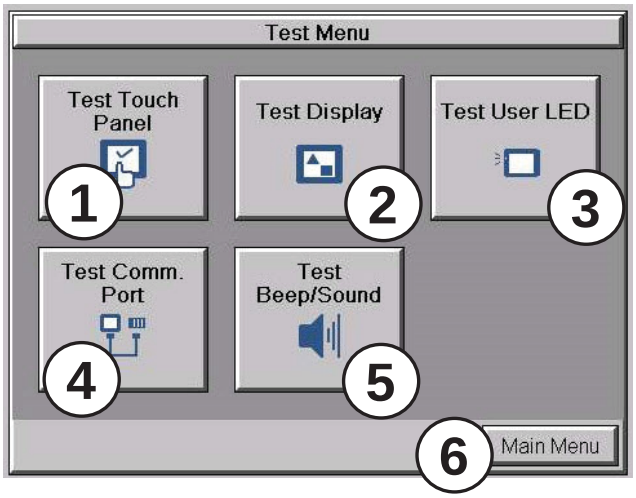
## Setting – IP Address Setting




| Item No. | Function | Description | Comment |
|---|---|---|---|
| 1 | **DHCP** | "DHCP" is enabled as the default when this system setup screen is first selected.<br>All of the other selections on this screen are dimmed when "DHCP" is selected and are not available. | |
| 2 | **IP Address** | The "Use the following IP Address" setting is selected when its radio button is pressed.<br>Use the numerical keypad to assign the IP address. | Note: If an Ethernet cable is not connected to the touch panel from an active Ethernet device, then the IP Address will show as 0.0.0.0. |
| 3 | **IP Address**<br>**Subnet Mask**<br>**Default Gateway** | Select the field that needs to be assigned by touching the entry value and use the keypad to enter the desired address. | Each field can be independently assigned. |
| 4 | **Keypad** | The keypad is used to enter the Address:<br>Use the numeric keys to enter the address, e.g: 192.168.10.1<br>"**CL**" = Clear value entered | |
| 5 | **OK** | Press to accept the changes and return to the **Setting Menu** screen. | |
| 6 | **Cancel** | Press to return to the **Setting Menu** screen without accepting the changes. | |

*NOTE: The project settings in the C-more programming software Panel Manager will override the touch panel's internal setting upon initial download.*

# Test Menu

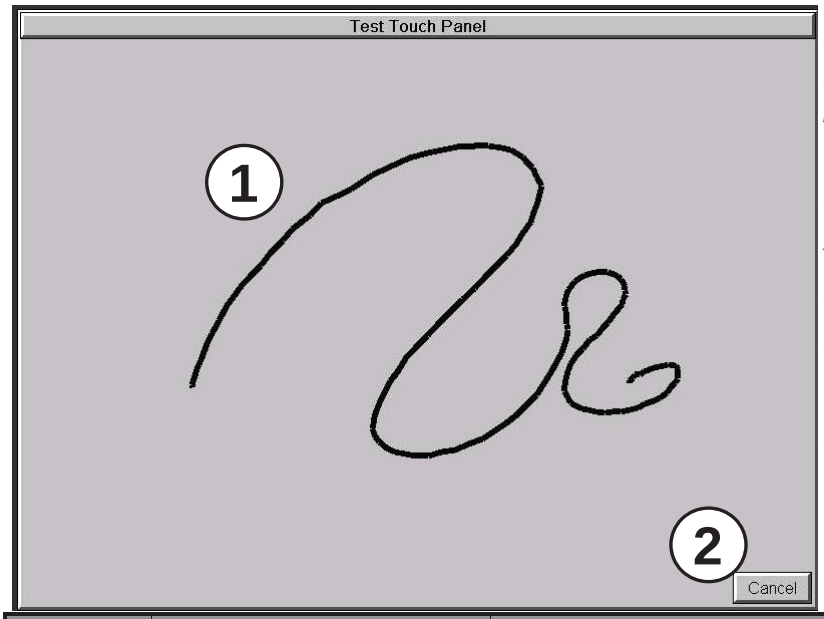



The **Test Menu** gives the user the ability to test the operation of the touch screen, test the LCD display, test the various communication ports, and also test the internal beeper and the audio line out through an user supplied amplified (stereo) speaker(s).



| Item No. | Function | Description | Comments |
|---|---|---|---|
| 1 | **Test Touch Panel** | Press to go to the **Test Touch Panel** screen. | |
| 2 | **Test Display** | Press to go to the **Test Display** screen. | |
| 3 | **Test User LED** | Tests the user configurable LED on the front of the panel.<br>Refer to the online help file for details on the configuration of this LED. | |
| 4 | **Test Communication Port** | Press to go to the **Test Communication Port** screen. | |
| 5 | **Test Beep/Sound** | Press to go to the **Test Beep/Sound** screen. | |
| 6 | **Main Menu** | Press to return to the **Main Menu** screen. | |

## Test Menu – Test Touch Panel




Using this test, normal or unusual operation of the analog touch panel can be determined.

**Testing:**

If an area of the touch screen is suspected to be inoperable, touch that area of the screen while in the **Test Touch Panel** screen mode. The screen pixels should turn black in that area. If the screen pixels do not turn black when touched, then the touch screen is defective or needs to be calibrated. See **Setting - Adjust Touch Screen**

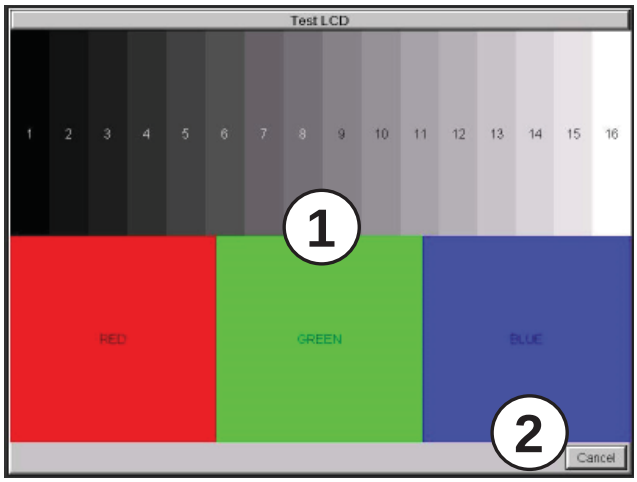
| Item No. | Function | Description | Comments |
|---|---|---|---|
| 1 | **Touch area** | Touch to turn on pixels on the screen. | Both the title bar (Test Touch Panel) and **Cancel** button can be drawn across to test the touch operation. |
| 2 | **Cancel** | Press to return to the **Test Menu** screen. | |

*NOTE: The Touchscreen is designed to respond to a single touch. If it is touched at multiple points at the same time, an unexpected object may be activated.*

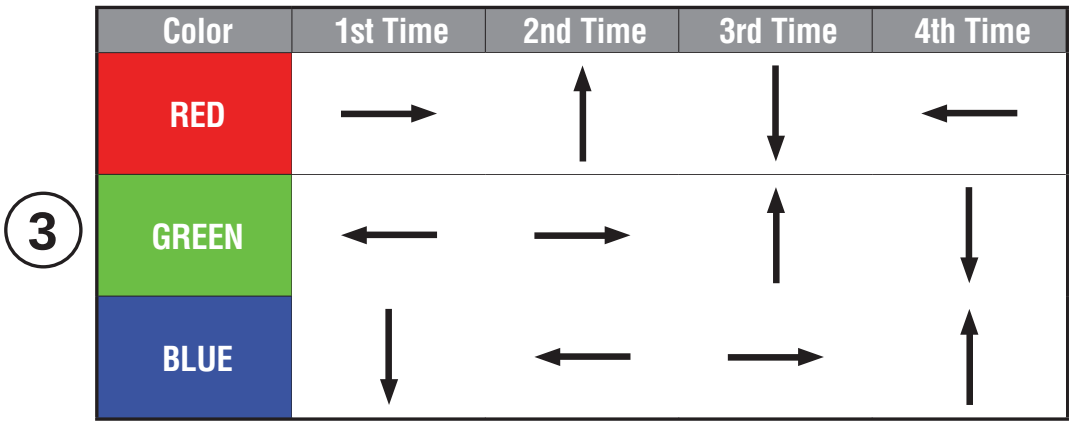
## Test Menu – Test Display

There are two different test patterns that may be run on the display to allow the user to check for display screen defects. If the screen is not touched within 3 seconds of **Test Pattern 1** being displayed, then **Test Pattern 2** will be displayed until the screen is touched, otherwise **Test Pattern 1** will remain until cancelled.

**Test Pattern 1** displays a test pattern of 16 grayscale graduations and RGB colors.



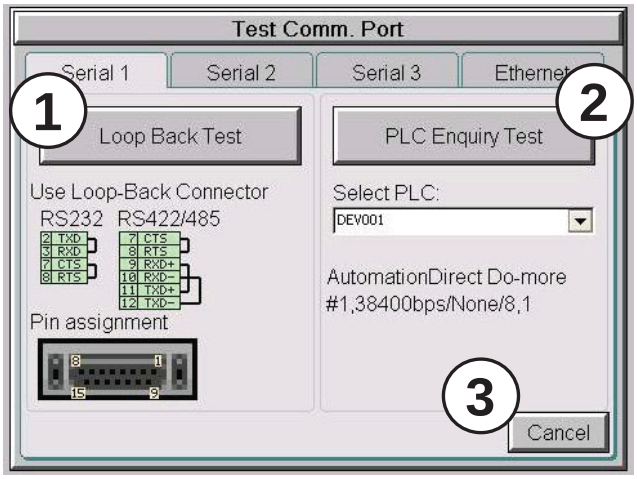

**Test Pattern 2** will follow the pattern as shown in the following chart with the color wiping across the screen in the direction indicated by the arrows, then repeats:




| Item No. | Function | Description | Comments |
|---|---|---|---|
| 1 | **Touch the Test Display screen.** | Press the screen anywhere except the **Cancel** button and the shown **Test Pattern 1** remains. | If the **Test Display** screen is not touched, then in three seconds the display will move to **Test Pattern 2**. |
| 2 | **Cancel (Test Pattern 1)** | Press to return to the **Test Menu** screen. | |
| 3 | **Touch Anywhere (Test Pattern 2)** | Touch the sceen anywhere during **Test Pattern 2** and return to the **Test Menu** screen. | |

**Test Results:** If any pixels on the screen do not appear the same color as the surrounding pixels, the screen may be defective. A single pixel gone bad is relatively common. Surrounding pixels going bad over time is another indication the screen may be defective.

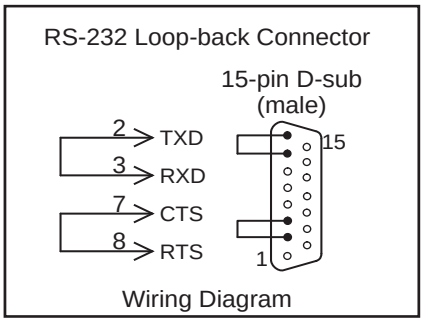
## Test Menu – Test Communication Ports: Serial Ports

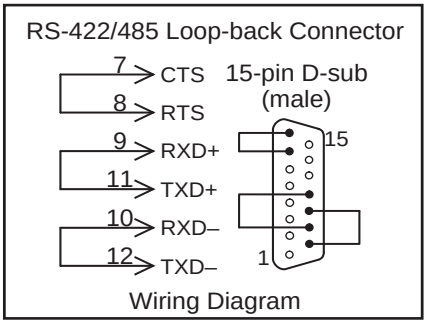



The following test can be used to check the operation of the serial communication ports, with the use of a loop back connector and can also check the serial communications to any connected and configured PLC.

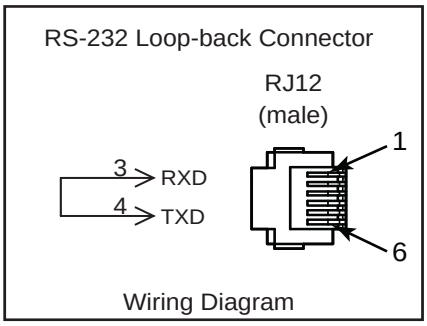
| Item No. | Function | Description | Comments |
|---|---|---|---|
| 1 | **Loop Back Test** | The loop back test checks the hardware components of the selected port for proper operation. | The loop back test may be performed on Serial Port 1 or Serial Port 3. Each tab shows diagrams to assist the user in building the loop back connector.. |
| 2 | **PLC Enquiry Test** | This function allows the ability to select any PLC that that may be connected to the touch panel via a serial connection and checks to see if the communications are working correctly. | The PLC must be configured for the selected port in the C-more programming software Panel Manager and transferred tot he panel before attempting the PLC Enquiry test. |
| 3 | **Cancel** | Press to return to the **Test Menu** screen. | |

**Serial Port 1**




**Serial Port 3**



## Test Menu – PLC Serial Comm Port – Loop Back Test

### Test Results

1.) Bytes Sent:
The number of bytes sent after a test is started.

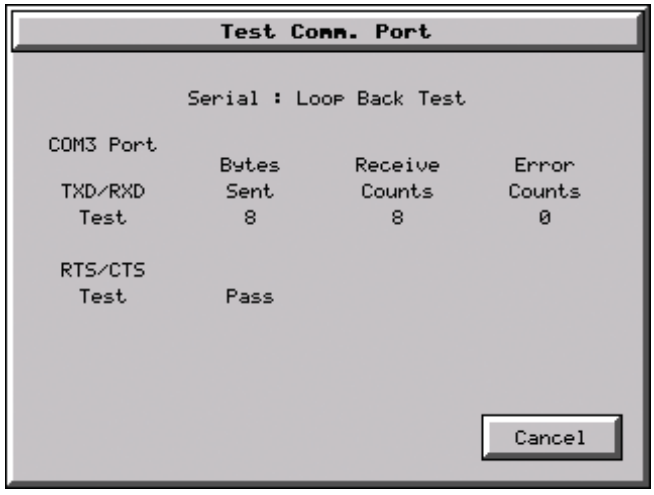
2.) Receive Counts:
The number of bytes which are received after the test is started.

3.) Error Counts:
The number of bytes which have not been received after the test is started.

4.) RTS/CTS Test: Pass/Fail
RTS is turned on and if CTS receives the signal then the test shows “Pass”, otherwise the test shows “Fail”.



*NOTE: The test will continue to run until the Cancel button is pressed. If there are any error counts, check the loop back connector. If it is OK, call Tech Support..*

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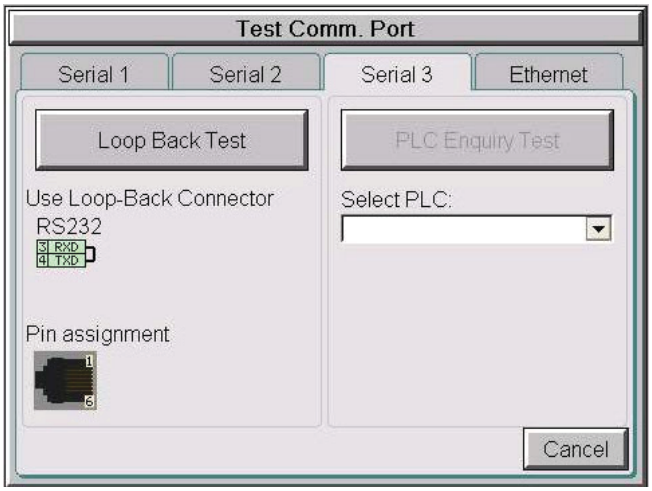
## Test Menu – PLC Enquiry Test: Serial Connection



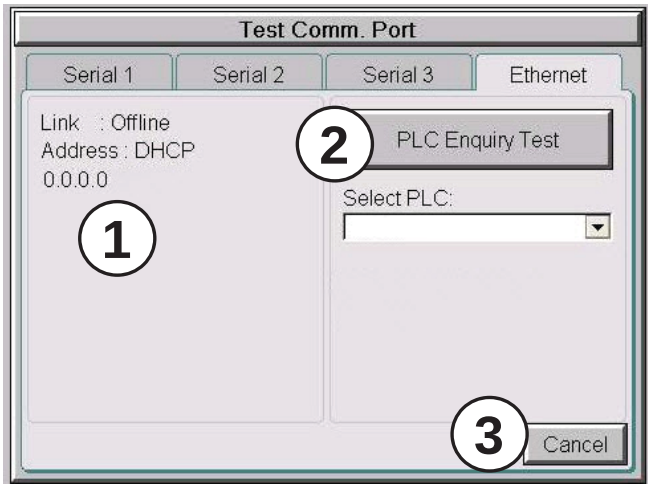

This function allows the ability to select any PLC that may be connected to the touch panel through the selected serial comm. port connection and checks to see if the communications are working correctly.

*NOTE: The communications protocol for the PLC being selected must be configured the same as the C-more touch panel. The touch panel's PLC serial communications are configured using the C-more Programming Software's Panel Manager.*

### PLC Enquiry Test

Four test packets are sent to the selected PLC. The test result with return either Pass or Fail.

## Test Menu – Test Communication Ports: Ethernet




The following test feature can be used to check the operation of the Ethernet communication port by indicating if an Ethernet link has been established or not, and can also check the status of the Ethernet communications to any connected PLC.

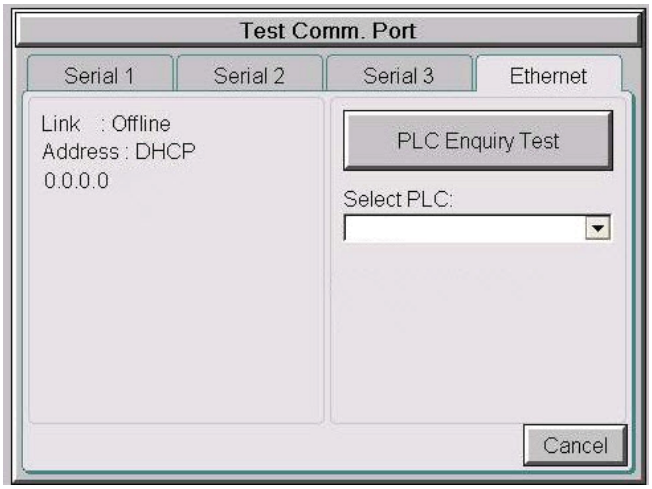
Base featured models (-R) do not include an Ethernet port, therefore this check is not displayed.

*NOTE: The communications protocol for the PLC being selected must be configured the same as the C-more touch panel. The touch panel's PLC serial communications are configured using the C-more Programming Software's Panel Manager.*

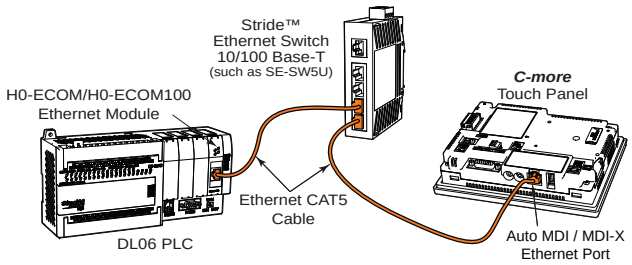
5

| Item No. | Function | Description | Comments |
|---|---|---|---|
| 1 | **Ethernet Connected** | This area displays information to whether an Ethernet link has been established for the touch panel's Ethernet comm port or not. Displays panel's IP address and shows whether it is static or assigned by a DHCP server. | |
| 2 | **PLC Enquiry Test** | This function allows the ability to select any PLC configured in the project that may be connected to the touch panel via an Ethernet connection and checks to see if the communications are working correctly. | The PLC must be configured for the selected port in the C-more programming software Panel Manager and transferred to the panel before attempting the PLC Enquiry test. |
| 3 | **Cancel** | Press to return to the **Test Menu** screen. | |

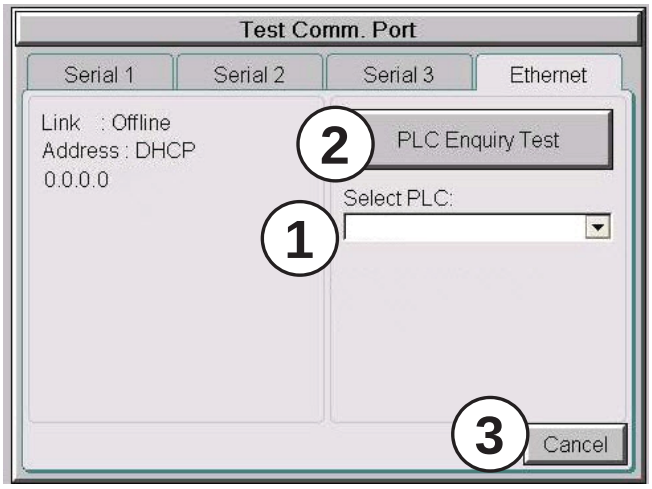
**Example of displayed message when the touch panel's Ethernet port is not connected. Note that the address resets to 0.0.0.0 even if it has previously been entered.**




**Typical Ethernet connection with Ethernet switch.**



## Test Menu – PLC Enquiry Test: Ethernet Connection




This function allows the ability to select any PLC configured in the project that may be connected to the touch panel through an Ethernet port connection and checks to see if the communications are working correctly.

*NOTE: The communications protocol for the PLC being selected must be configured the same as the C-more touch panel. The touch panel's PLC serial communications are configured using the C-more Programming Software's Panel Manager.*

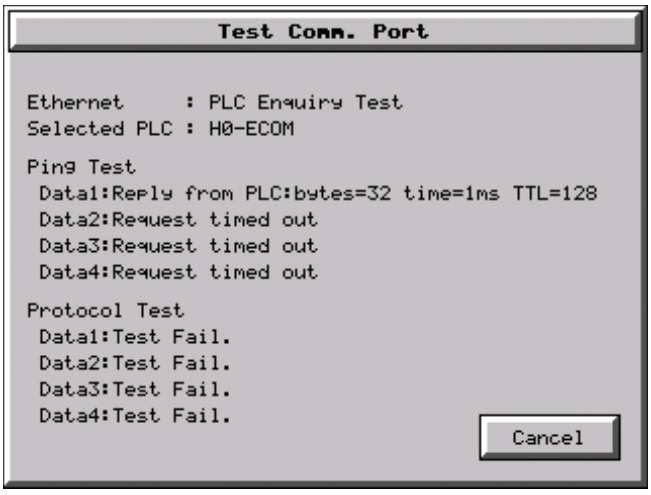
### PLC Enquiry Test

Following are the steps that the Ethernet PLC Enquiry Test performs:

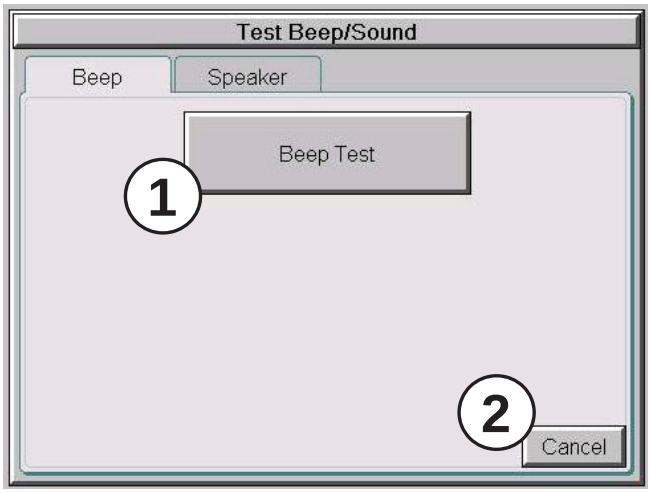
1.) Ping the network 4 times for the PLC selected.

2.) Four of the test read packets are sent to the selected PLC.

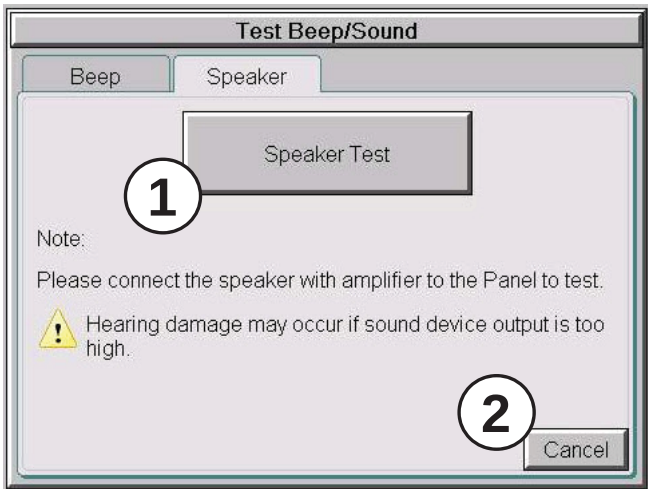
The test result will either be Pass or Fail. However, if the result of pinging the network shows an error, the test is stopped.



## Test Menu – Test Beep/Sound




The internal Beeper can be tested from this system setup screen whether the Beeper is enabled or disabled. After the **Beep Test** button is pressed and released, the Beeper will sound for 500 msec.

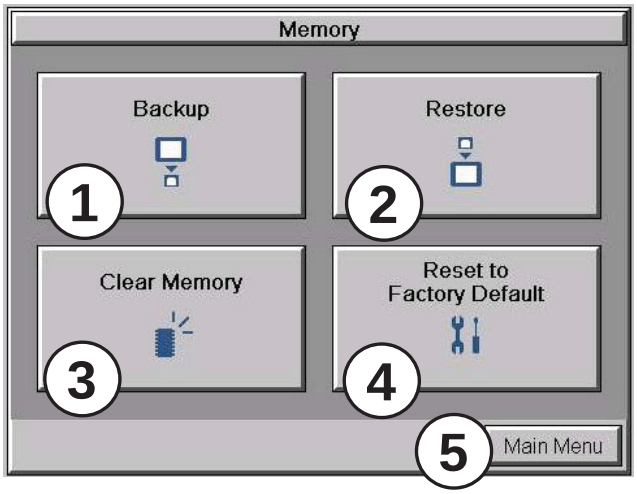



The **Speaker Test** function requires that a speaker(s) with an amplifier (can be stereo) be connected to the Audio Line Out stereo jack on the rear of the touch panel.

After the **Speaker Test** button is pressed then released, a system provided Test.WAV file will play once.

**WARNING: Hearing damage may occur if the volume on the user supplied external amplified speaker is set too high.**

# Memory Menu




The user's project, Firmware and OS, log and recipes files can be backed up to or restored from an SD memory card (SD Card Slot 1 or SD Card Slot 2), or a USB memory device. From this menu the user can also clear the project log files. The user also has the ability to clear the memory within the ***C-more*** touch panel.



| Item No. | Function | Description | Comments |
|---|---|---|---|
| 1 | **Backup** | Backup project, Firmware and OS, log & recipe files to the following memory devices:<br>USB port - Type A: USB pen drive<br>SD Card Slot1 (All panels): SD card<br>SD Card Slot2 (12-inch & 15-inch): SD Card | Any USB 2.0 pen drive.<br>SD formats SD and SDHC are supported. Capacity up to 32 GB.<br>The backup data files are created and copied to a folder on the memory device named "EA_Memory Copy."<br>The project file is named StartupStorage.eas9<br>"Log" and "Recipe" folders with the appropriate data files are also created on the memory device. |
| 2 | **Restore** | Restore project, Firmware and OS, log & recipe files to the internal memory from one of the following memory devices:<br>USB port - Type A: USB pen drive<br>SD Card Slot1 (All panels): SD card<br>SD Card Slot2 (12-inch & 15-inch): SD Card | A folder on the memory device named "EA_Memory Copy" must exist containing a file named "StartupStorage.eas9". The project data file is stored in this file, and if the system data file was backed up, it also will be stored in this file. Any backed up log or recipe data files will be located under the appropriate "Log" or "Recipe" folders. |
| 3 | **Clear Memory** | Clear selected data files from the memory of the following internal memory or external memory devices:<br>Built-in FLASH Memory<br>USB port - Type A: USB pen drive<br>SD Card Slot1 (All panels): SD card<br>SD Card Slot2 (12-inch & 15-inch): SD Card | Can only clear project, log and recipe data files of the Built-in FLASH memory.<br>Can clear entire contents or individual data files of external memory devices. |
| 4 | **Reset to Factory Default** | The touch panel's internal memory is set to the original factory defaults. | Clears all project memory. |
| 5 | **Main Menu** | Press to return to the **Main Menu** screen. | |

*NOTE: The Project is RESTORED to the panel from an external memory device. A project can be TRANSFERRED to and SD card or USB memory from the programming software to be RESTORED to a panel that is not connected to the programming software. This file has the .eas9 extension NOT the .eap9 extension of a projects SAVED from the software.*

## Project Executed from SD Card Slot 1

If an SD memory card is located in the SD Card Slot 1 at the time a project is transferred to the panel, the project will be stored on the SD card, not in the internal FLASH memory.

If Slot 1 contains an SD memory card with a project and the touch panel's power is cycled, then the project file stored on the SD card is loaded into the touch panel's internal memory and executed. Any project in the internal FLASH memory is cleared.

**WARNING: During power up with an SD memory card plugged into an SD card slot, do not remove the memory card from the slot. Damage to the SD memory card and possibly the touch panel may result.**

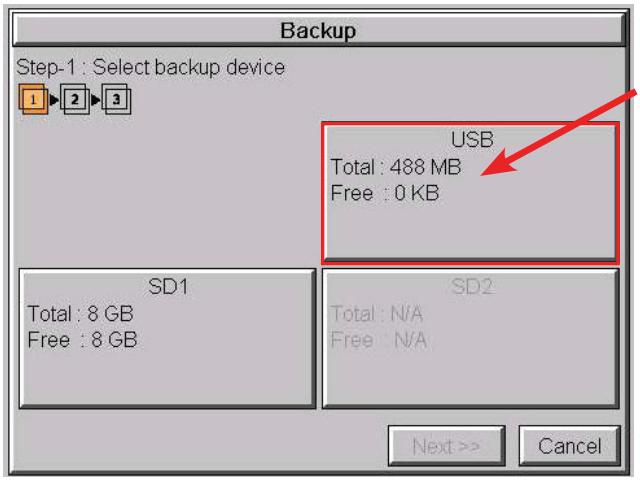
**WARNING: After a firmware update, the project files which are located in either the touch panel's internal FLASH memory or an SD memory card plugged into an SD card slot are cleared. The programming software will need to be used to Transfer the project file back into the panel. If you wish to retain the project on the SD memory card, power down the panel and remove the SD card before performing a firmware upgrade.**



### Increasing Project Memory Size using an SD memory card:

If a project is transferred to the panel with an SD memory card in SD slot 1, the Font and Recipe data files are not included in the 26 MB (82MB for 12" and 15" models) project size. Therefore using an SD memory card can allow a project to be loaded that is larger than 26MB IF the excessive size is caused by Fonts and/or Recipe Sheets.

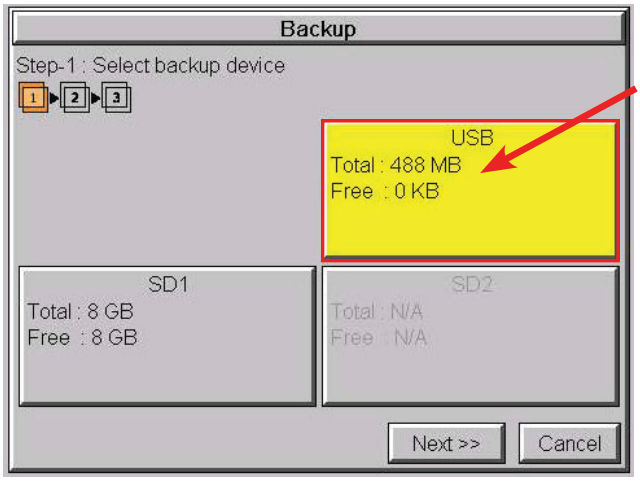
## Memory – Backup




The Memory - Backup selection allows you to backup the panel's **Project**, **Log** files, **Recipe** files or even the **Firmware** files to either an SD memory card or **USB** pen drive. The available memory devices will be displayed with their total and free memory.

If the device is not available, it will be grayed out. The **Next** button is grayed out until a device is selected.

The **Cancel** button can be pressed at any time to return to the **Memory Menu** screen.




This is an example of selecting a USB memory device to write the backed up files to.

The selected device is highlighted. Pressing again deselects it.

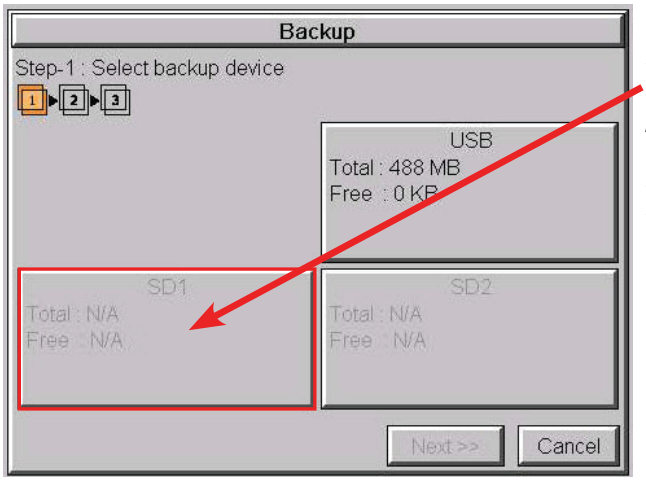
Even if there is only one available memory device, it still needs to be highlighted in order to go to the next step.

Press the Next button to continue to Step 2.

Please read the explanation for the availability of SD1 under different conditions that follow:

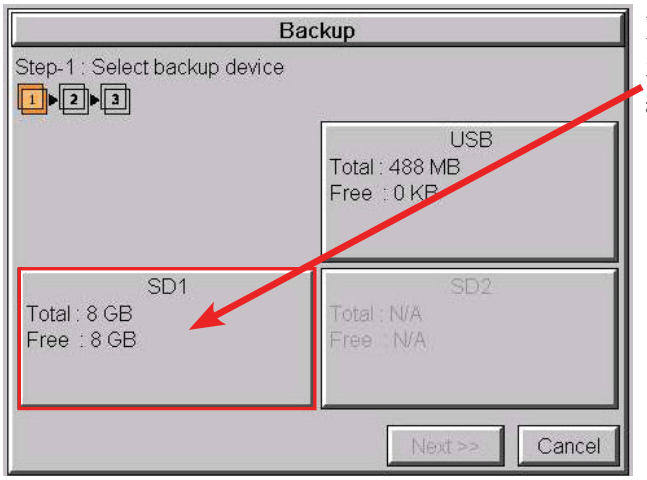
## Memory – Backup (cont'd)

### SD Card Slot1 Availability Explanation:




SD1 may be unavailable (grayed out) if there is no card in SD Slot 1 or the card in SD slot 1 has the project currently running on the panel stored on it.

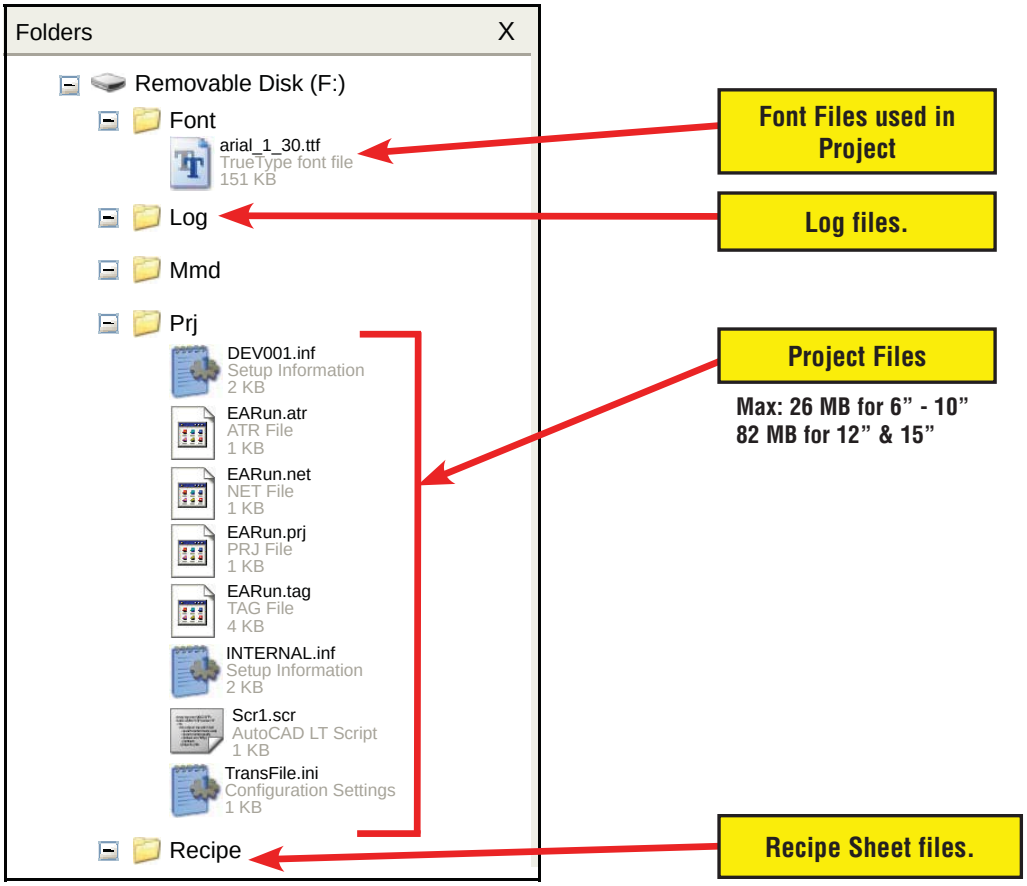
The project will exist on SD1 if the SD card was installed in SD1 when the project was TRANSFERRED to the panel by the ***C-more*** programming software.




If the panel is powered up or rebooted with an SD card inserted into SD1 Slot, then the SD1 button's Total and Free memory will be displayed.

## Memory – Backup (cont'd)

Below is an example of the folder and file structure that is stored on the SD card in the SD Slot 1 for a project that was directly transferred from the ***C-more*** Programming Software's Project Transfer to External Memory Device function when viewed in Windows® Explorer on a PC.

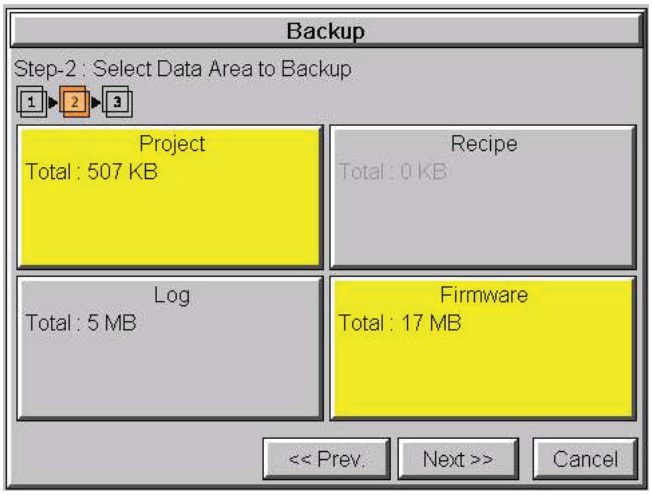


## Memory – Backup (cont'd)

*NOTE: The following definitions are for the various file types that can be backed up:*
***Project data** – consists of the actual developed project data that is created in the C-more programming software and includes all functionality, objects, screens, tag names, labels, comments, graphics, etc. Included in backup file name StartupStorage.eas9.*
***Recipe data** – consists of all the data values and labels that have been created for the various recipe sheets. Includes all recipe sheets loaded to the panel. Only recipe sheets used in the project are loaded to the panel.*
***Firmware** – consists of the operating system, firmware and run time files. Included in backup file name StartupStorage.eas9.*
***Log data** – consists of the Alarm Log, Message Log and Trend Data Logging files.*

Select the data file(s) to be backed up by pressing the appropriate data file button. The selection will be highlighted.






Pressing the highlighted data file button again will turn it off.

The Next >> button will stay grayed out until at least one data file is selected.

Any file type not available will be grayed out.

The Next >> button is now enabled.

Pressing Cancel will return to the previous menu.

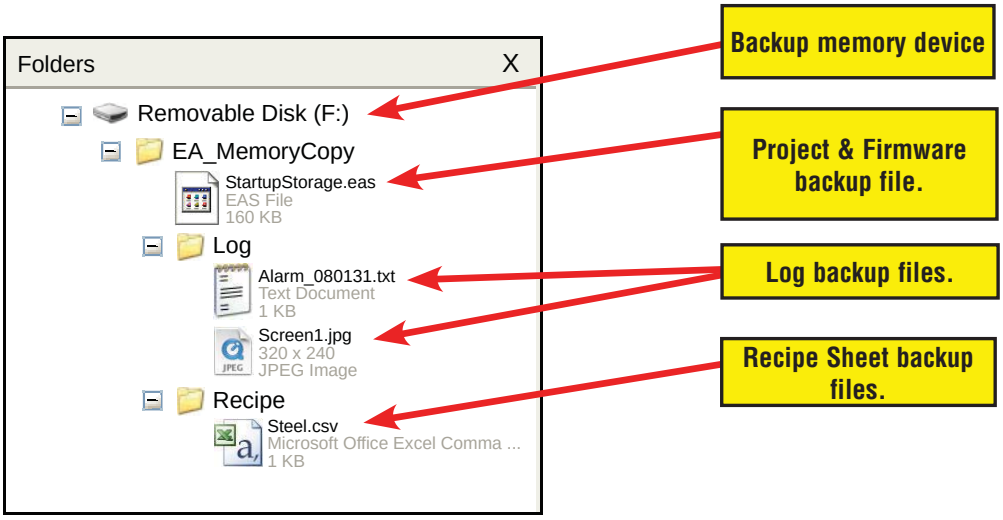
Press the Next button to continue.

*NOTE: In the case of the **Project** and **Firmware** files, these can be **Restored** later to another panel.*
***Recipe** files can be edited externally from the panel and then **Restored** to the panel.*
*The **Log** files are for viewing purposes only.*
*See **Memory - Restore** later in this chapter for instructions on Restoring the Project, Firmware and or Recipe files to a Panel.*

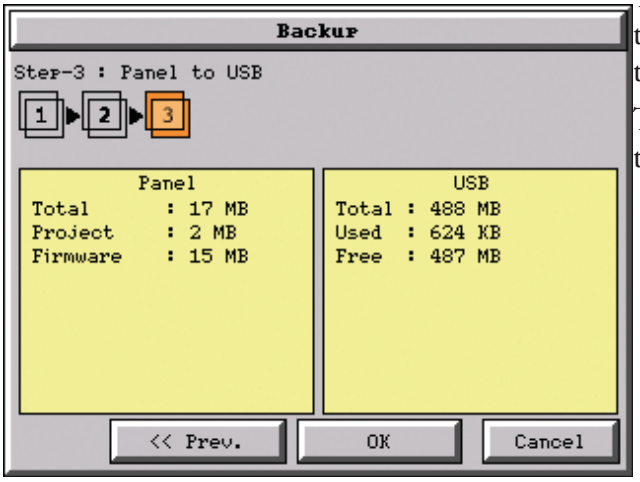
## Memory – Backup (cont'd)

### Backup Data Files Naming and Organization

The following graphic shows how the various data files are organized on the memory device when doing a **Backup** and also the file naming convention that is used when viewed in Windows® Explorer on a PC.

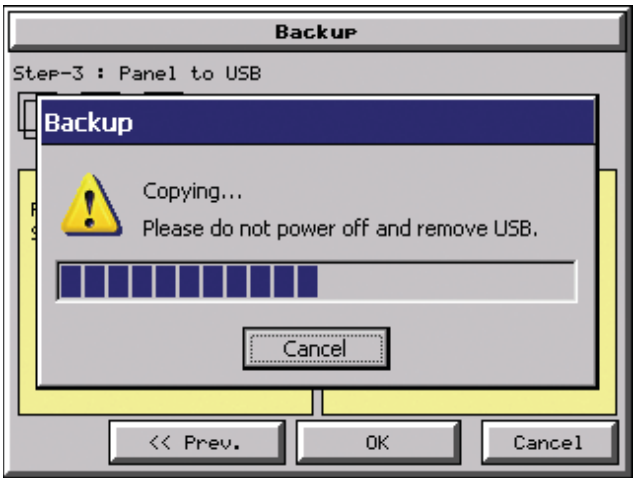


## Memory – Backup (cont'd)




The next system setup screen allows the verification of the data file selections. When the OK button is pressed, the backup begins.

The user can return to the previous screen by pressing the << Prev button.



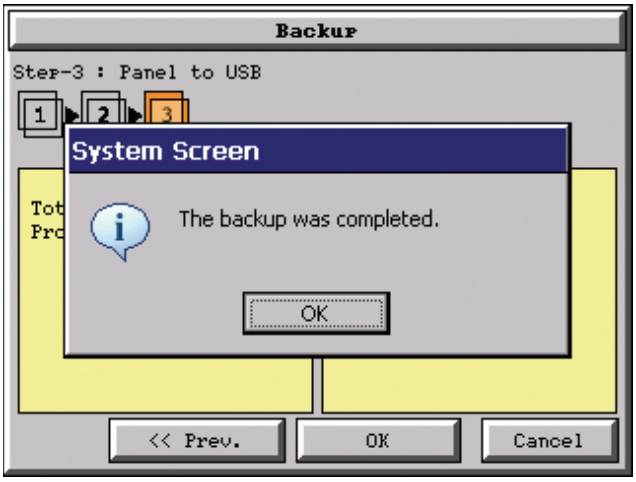

This message is displayed during the **Backup** copying process. Press the **Cancel** button to abort the backup.

The following text is shown in the copying progress message box:

Copy to USB Memory:
"Please do not Power Off and Remove USB"

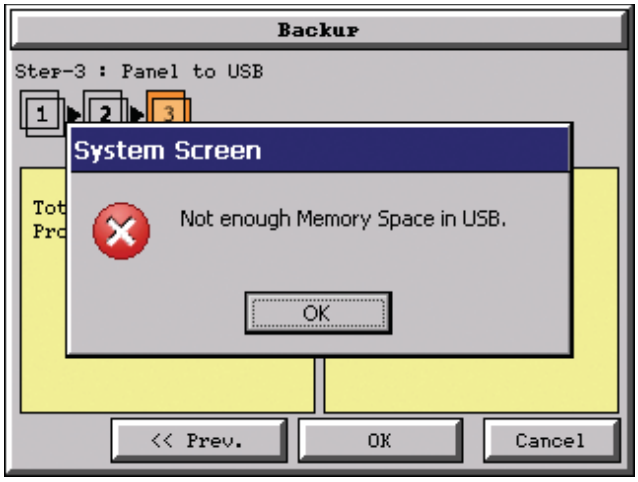
Copy to SD1 or SD2:
"Please do not Power Off and Remove SD"

**WARNING: During the copying process. Do not power off the touch panel or remove the memory device.**




This message is displayed to indicate the **Backup** is complete. Press the **OK** button to return to the previous menu selection.

## Memory – Backup (cont'd)




### Warning Messages

If the destination does not have enough space to store the selected memory size, then the message shown here will be displayed. Press the **OK** button to clear the warning message.

The warning message will read "Not enough Memory Space in %Device%".

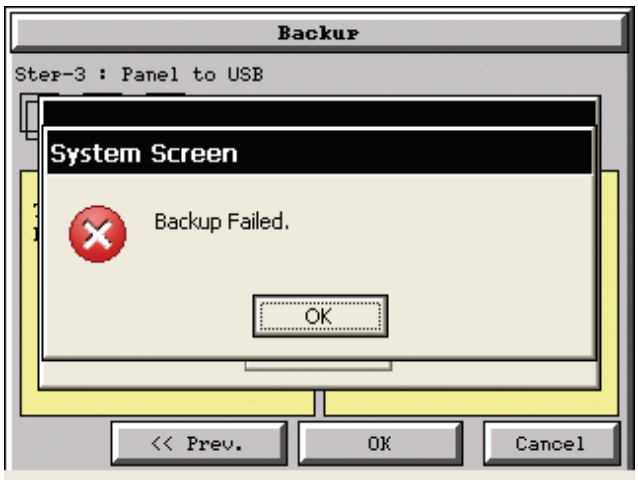
%Device% will show either "SD1", "SD2", or "USB".

This warning message will be displayed if the backup Memory device fails or is removed during the backup. Press the OK button to clear the warning message.

The warning message will read "Backup Failed. "%Device% cannot be found".

%Device% will show either "SD1", "SD2", or "USB".

Refer to **Chapter 8: Troubleshooting** for additional help.

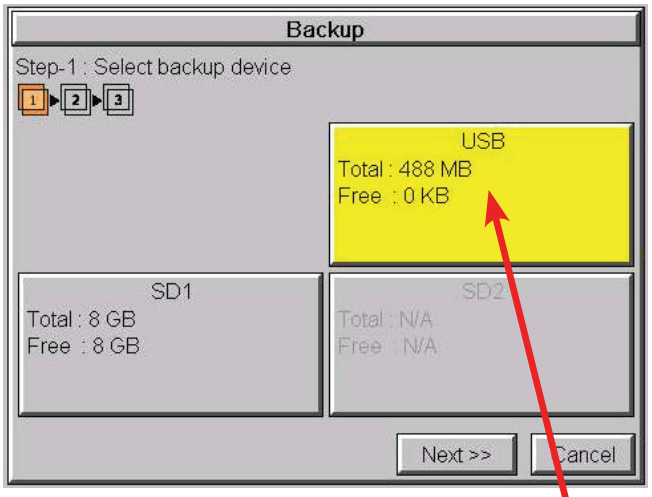



For any other reason the backup fails, then this warning message will be displayed. Press the **OK** button to clear the warning message.

The warning message will read "Backup Failed".

Refer to **Chapter 8: Troubleshooting** for additional help.

## Memory – Restore




The **Memory - Restore** function is used to:

1.) **Restore** a project previously backed up on an SD card or USB pen drive memory device to the same panel. See **Memory - Backup** previously in this chapter.

2.) Copy a project from one panel to another panel using a memory device to physically transport the data files.

3.) **Restore** a project into the panel that was transfered to an "External Memory Device" using the ***C-more*** Programming Software.

4.) **Restore Recipe Sheet(s)** previously backed up to a memory device or copied to the memory device using a PC.

The available memory devices will be displayed showing the total and free available memory for that device. If the device is not available, it will be grayed out. The **Next** button is grayed out until a device is selected.

The **Cancel** button can be pressed at any time to return to the **Memory Menu** screen.

This is an example of a USB memory device selected to be the source for restoring the data file(s).

The selected device is highlighted. Pressing again deselects it.

Even if there is only one available memory device, it needs to be highlighted in order to go to the next step.

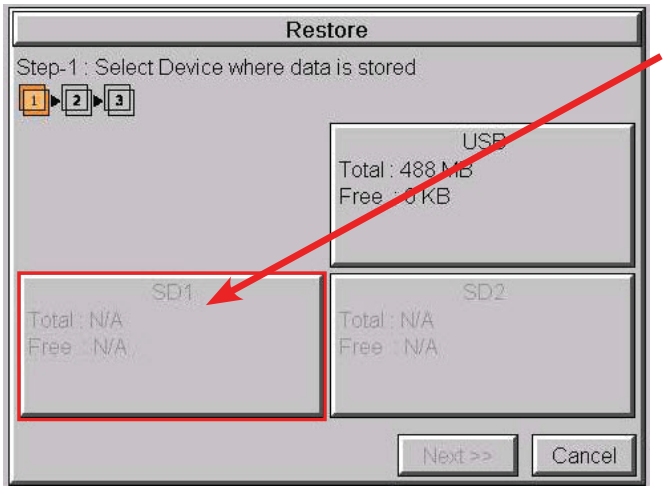
Press the **Next** button to continue to continue to Step 2.

*NOTE: If you have a memory device inserted into the proper port on the touch panel, but it doesn't show up as highlighted in Step 1 of the* **Backup** *setup screen, then try a different device to determine if the memory device is defective or if there is a possible problem with the memory device connection. It may not be compatible with the panel. Some USB pen drives are not USB 2.0 compatible and will not work with* **C-more** *touch panels. Some USB pen drives may take several minutes before they are recognized by the panel.*
*SD cards must be formatted using the SD formatter provided by* **SDcard.org**

## Memory – Restore (cont'd)

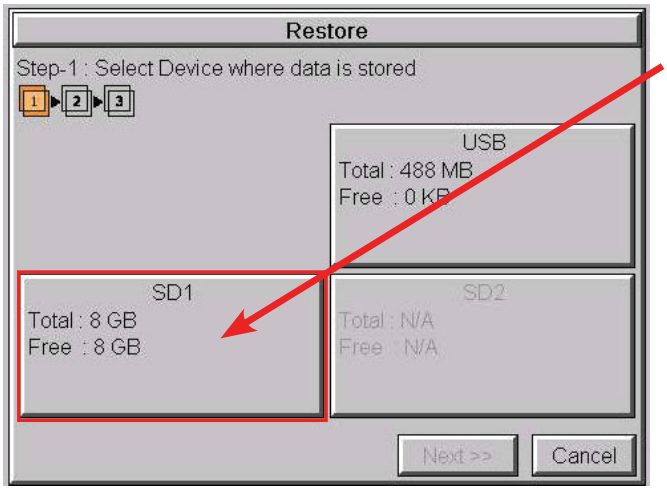
Please read the explanation for the availability of SD1 under different conditions as shown on this page and the next.

### SD1 Availability Explanation:




SD1 may be unavailable (grayed out) if there is no card in SD Slot 1 or the card in SD slot 1 has the project currently running on the panel stored on it.

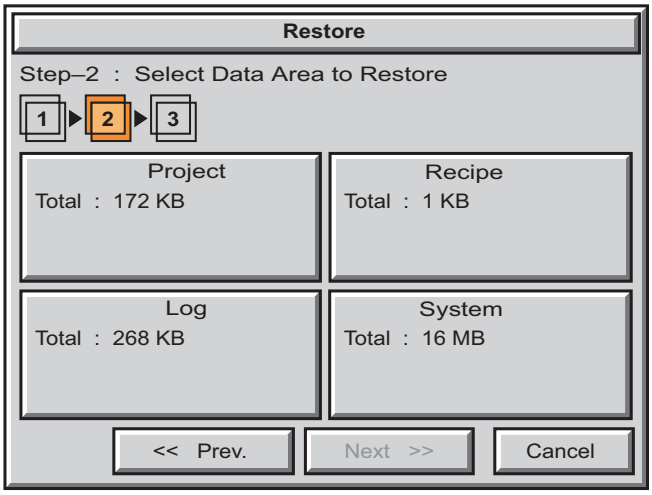
The project will exist on SD1 if the SD card was installed in SD1 when the project was TRANSFERRED to the panel by the ***C-more*** programming software.




If the panel is powered up or rebooted with an SD card inserted into SD1 Slot, then the SD1 button's Total and Free memory will be displayed.

*NOTE: The following definitions are for the various file types that can be restored:*
*Project data – consists of the actual developed project data that is created in the C-more programming software and includes all functionality, objects, screens, tag names, labels, comments, graphics, etc. Included in backup file name StartupStorage.eas9.*
*Recipe data – consists of all the data values and labels that have been created for the various recipe sheets. Includes all recipe sheets loaded to the panel. Only recipe sheets used in the project are loaded to the panel.*
*Firmware – consists of the operating system, firmware and run time files. Included in backup file name StartupStorage.eas9.*
*Log data – consists of the Alarm Log, Message Log and Trend Data Logging files.*

## Memory – Restore (cont'd)

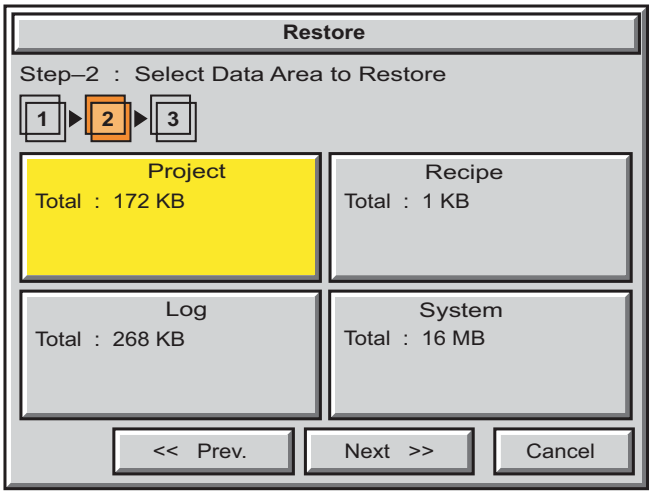



Select the data file(s) to be restored by pressing the appropriate data file button. The selection will be highlighted. The data file can be either the **Project, Firmware** and/or **Recipe files**. The selected data is restored to the internal built-in memory if there is no SD card inserted into the SD1 slot.

Pressing the highlighted data file again will turn it off.

The **Next >>** button will stay grayed out until at least one data file is selected.

Any file type not available will be grayed out.




This is an example of a file selected to restore.

The selected file is highlighted.

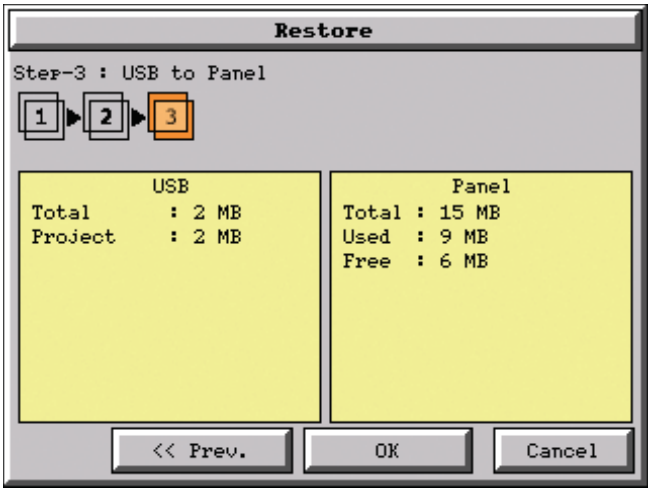
The **Next >>** button is now enabled.

Pressing **Cancel** will return to the previous menu.

Press the **Next** button to continue.

*NOTE: The following definitions are for the various file types that can be restored:*
*Project data – consists of the actual developed project data that is created in the C-more programming software and includes all functionality, objects, screens, tag names, labels, comments, graphics, etc. Included in backup file name StartupStorage.eas9.*
*Recipe data – consists of all the data values and labels that have been created for the various recipe sheets. Includes all recipe sheets loaded to the panel. Only recipe sheets used in the project are loaded to the panel.*
*Firmware – consists of the operating system, firmware and run time files. Included in backup file name StartupStorage.eas9.*
*Log data – consists of the Alarm Log, Message Log and Trend Data Logging files.*

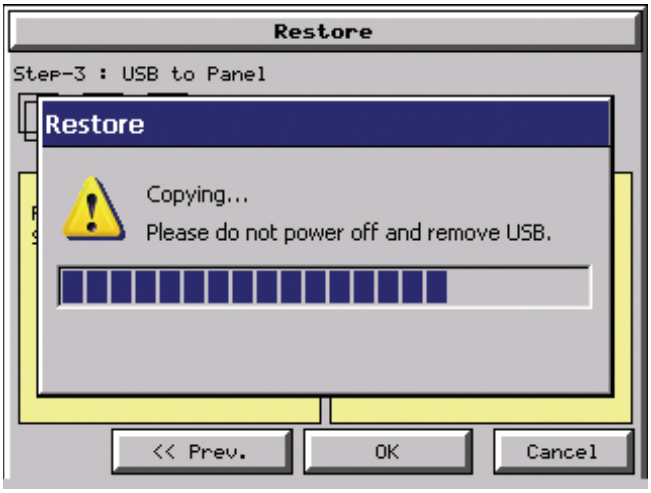
## Memory – Restore (cont'd)




The data selected to restore is checked. If the data is good, then the **OK** button can be pressed to start the restore.

If there is a problem with the data, the **OK** button will remain grayed out and the user can return to the previous screen by pressing the **<< Prev** button.

The problem could be caused by a corrupted data file. See **Chapter 8: Troubleshooting** for additional help.



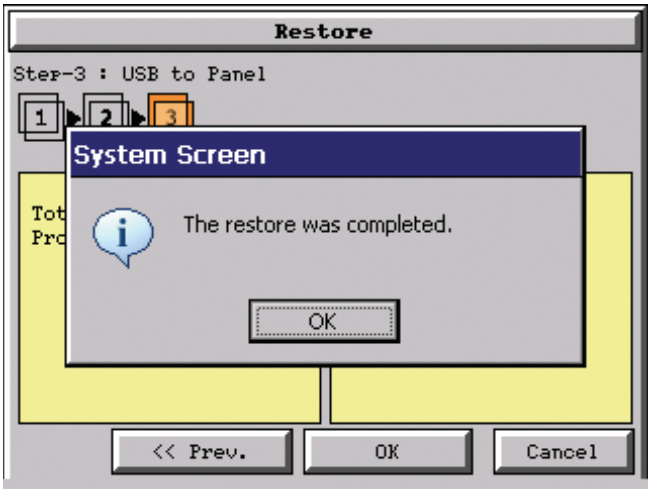

This message is displayed during the **Restore** process. Press the **Cancel** button to abort the backup.

The following text is shown in the copying progress message box:

Copy to USB Memory:
"Please do not Power Off and Remove USB"

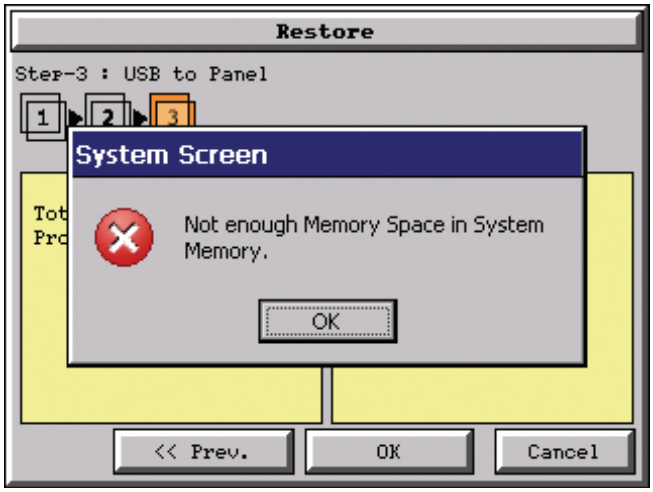
Copy to SD1 or SD2:
"Please do not Power Off and Remove SD card"

**WARNING: During the copying process. Do not power off the touch panel or remove the memory device.**




This message is displayed to indicate the **Restore** is complete. Press the **OK** button to return to the previous menu selection.

## Memory – Restore (cont'd)




### Warning Messages:

If the system memory does not have enough space to restore the selected memory size, then the message shown here will be displayed. Press the **OK** button to clear the warning message.

The warning message will read "Not enough Memory Space in System Memory".

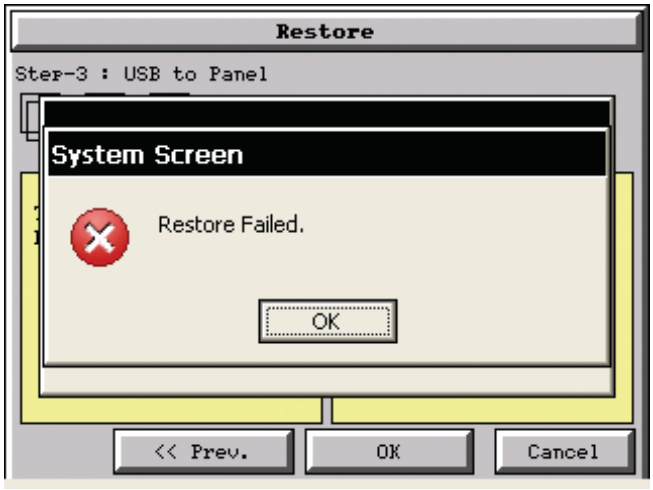
The Project size must be less than 10 MByte for 6"-10" panels and less than 40 MByte for 12" & 15" panels.

This warning message will be displayed if the restore Memory device fails or is removed during the backup. Press the **OK** button to clear the warning message.

The warning message will read "Restore Failed. "%Device% cannot be found".

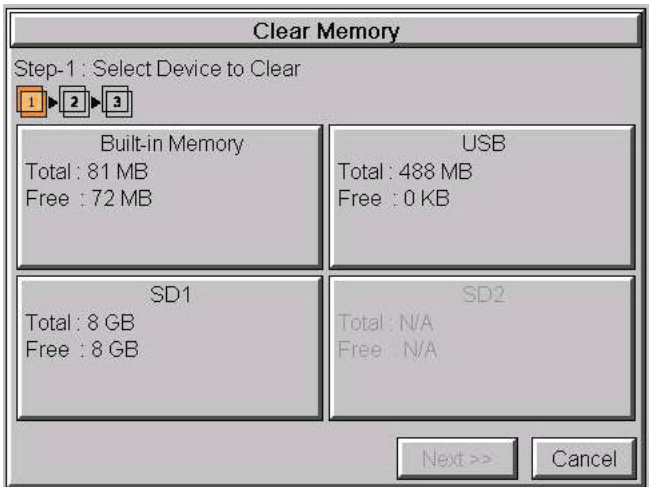
%Device% will show show "SD1", "SD2", or "USB".

Try using a different device with known good data in the same connector or using the device that is causing the error in a different connector.




For any other reason the restore fails, then this warning message will be displayed. Press the **OK** button to clear the warning message.

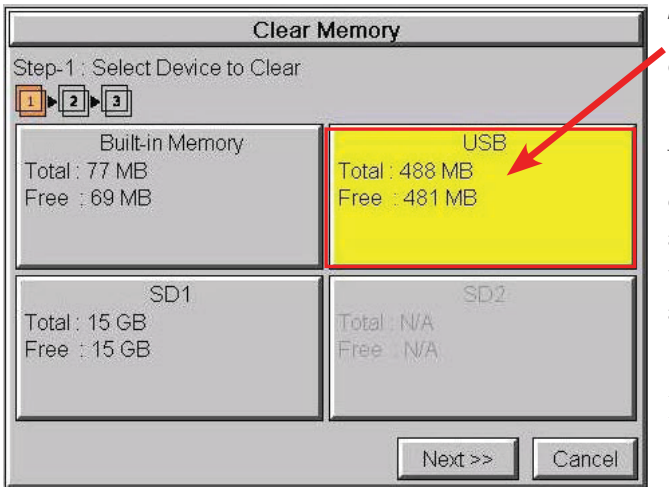
## Memory – Clear Memory




This function is used to clear individually selected data files, or all data files, within the panel's **Built-in Memory**, or any installed memory device such as a USB pen drive or an SD card.

Select the memory device to clear. If the device is not available, it will be grayed out.

The Next button is grayed out until a device is selected.

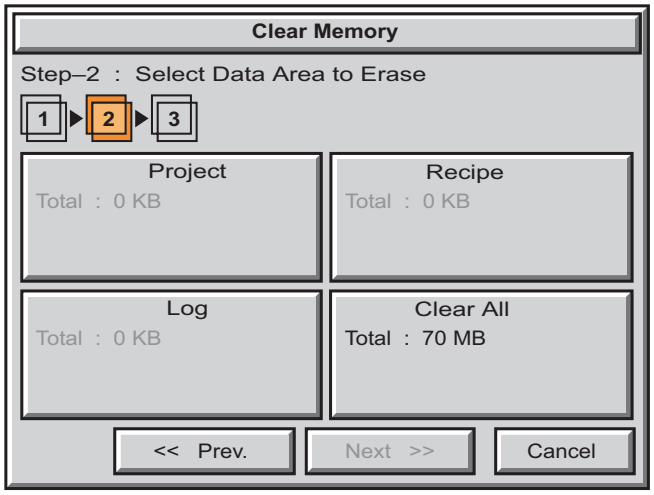



The selected device is highlighted. Pressing again deselects it.

When there are more than two available backup devices, the one selected will be highlighted. If another is selected, then the highlight will change to the last one pressed. Only one device can be selected at a time.

Press the **Next** button to continue.

## Memory – Clear Memory (cont'd)




Select the data file(s) to be cleared.

This is an example of an SD card or USB memory that was selected in **Clear Memory - Step-1**.

The selected file will be highlighted. Pressing again deselects it.

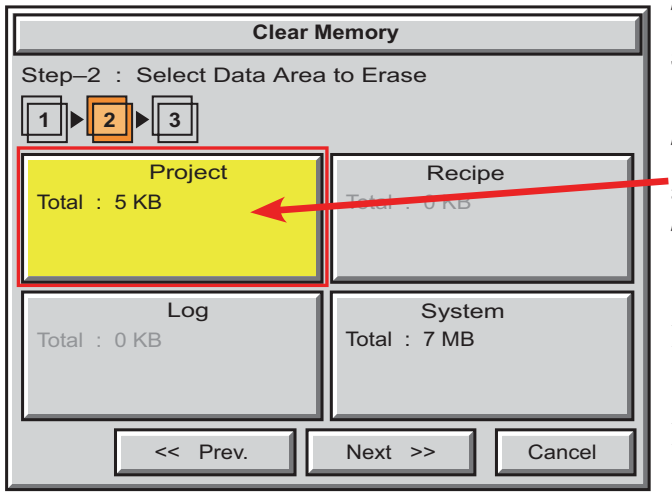
The **Next >>** button will stay grayed out until file(s) are selected.

Selecting **Clear All** will erase all files located on the memory device.

This is an example of **USB Memory** that was selected in **Clear Memory - Step-1**.

Notice the ability to select either the **Project** file, **Log** files, **Recipe** files, or the **System** files.

*NOTE: Firmware files cannot be cleared from internal memory.*




This is an example of the **Project** data file being selected for clearing.

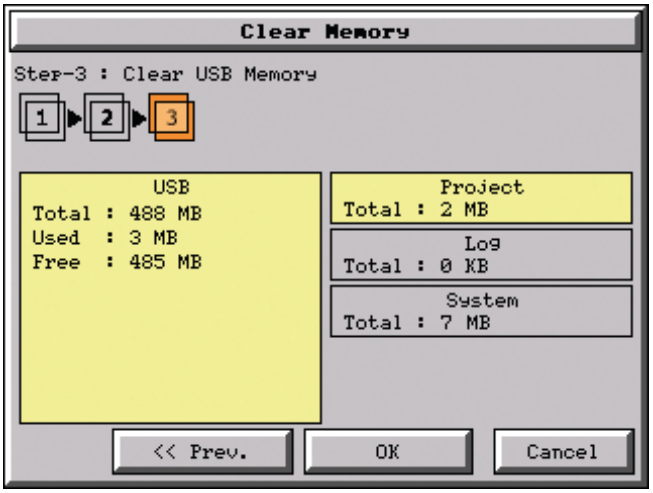
The selected memory area is highlighted. Pressing again deselects it.

The **Next >>** button is now enabled.

Pressing **Cancel** will deselect the file(s).

Press the **Next** button to continue.

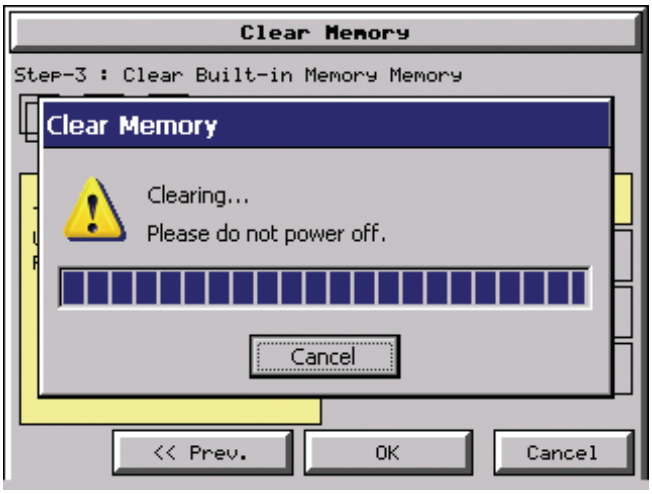
## Memory – Clear Memory (cont'd)




The data file(s)selected to clear are checked. If the data file is good, then the **OK** button can be pressed to start the clear procedure.

If there is a problem with the data file, the **OK** button will remain grayed out and the user can return to the previous screen by pressing the **<< Prev** button.

Press the OK button to continue.




This message is displayed during the clearing process. Press the **Cancel** button to abort the clearing.

The following text is shown in the clearing progress message box:

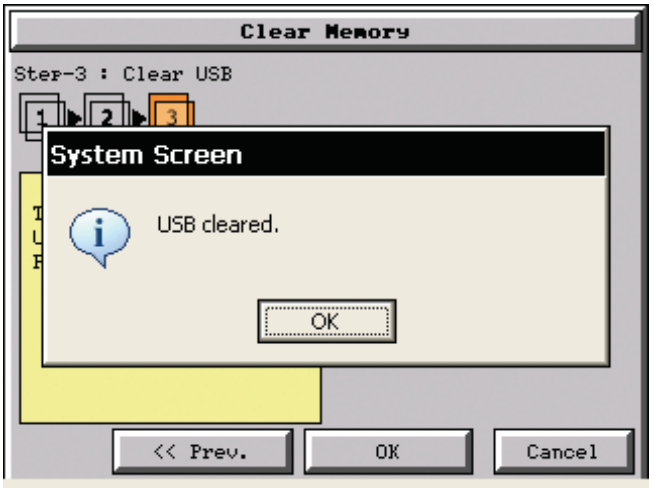
Clearing Built-in Memory:
"Please do not Power Off"

Clearing USB Memory:
"Please do not Power Off or Remove USB"

Clearing SD1 or SD2

"Please do not Power Off or Remove SD"

**WARNING: During the clearing process, do not power off the touch panel or remove the memory device.**



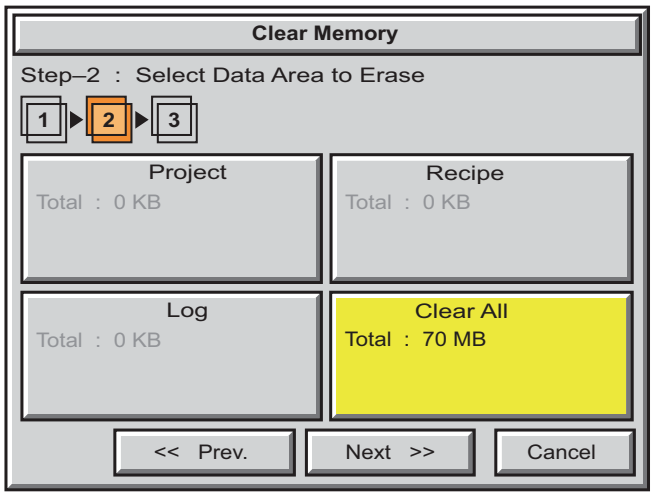

The following message is displayed when the clearing process is complete:

"%Device% cleared"

%Device% will show either "SD1", "SD2", or "USB".

Press the **OK** button to return to the **Memory Menu** screen.

## Memory – Clear Memory (cont'd)




The following is an example of **Clear All** selected for clearing.

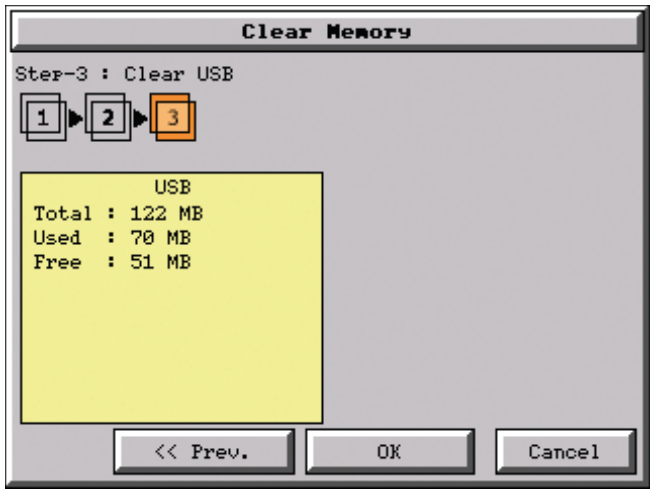
The selected device is highlighted.

The **Next >>** button is now enabled.

Pressing **Cancel** will deselect the **Clear All**.

5

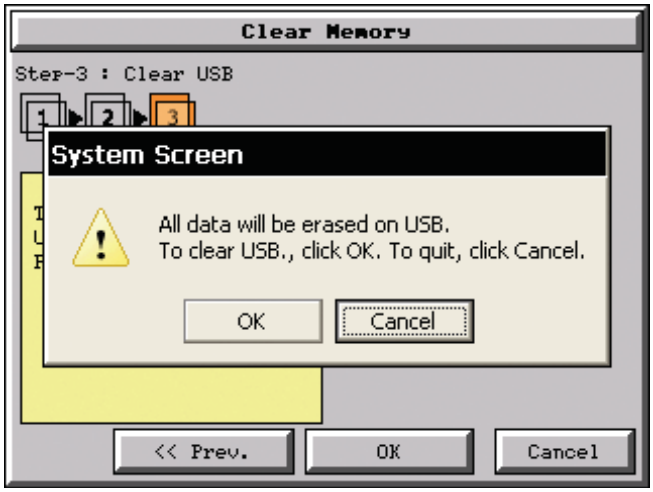
*NOTE: If Clear All is selected, all files will be erased from the memory device, even those not related to the C-more touch panel.*




The data file(s)selected to clear are verified. If the data file is good, then the OK button can be pressed to start the clear procedure.

If there is a problem with the data file, the **OK** button will remain grayed out and the user can return to the previous screen by pressing the << Prev button.

Press the **OK** button to continue.

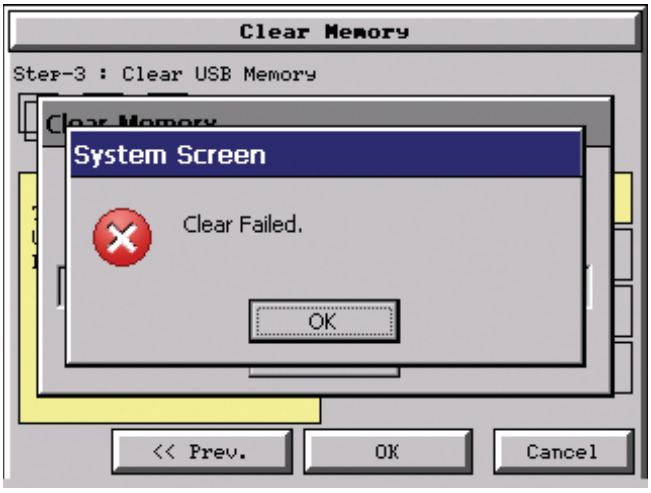



The warning message shown here will be displayed to give the user the opportunity to decide if they want to proceed or not.

Press the **OK** button to continue.

The **Clear All** process will start with a warning message as seen in the first example and continue until a message saying the device is cleared or a warning message as shown on the next page will appear.

## Memory – Clear Memory (cont'd)



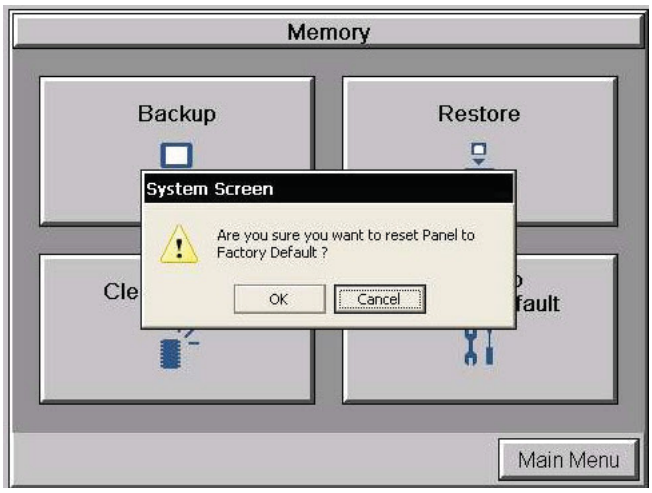

The warning message shown here will be displayed if the clearing process fails.

"Clear Failed".

Press the **OK** button to return to the **Clear Memory** screen and try again.

If the selected memory still fails to clear, then refer to **Chapter 8: Troubleshooting** for additional help.

## Memory – Reset to Factory Default




After pressing the **Reset to Factory Default** button from the **Memory Menu**, the message box shown will be displayed.

Resetting to the Factory Defaults produces the following actions:

1.) The touch screen calibration is reset to the Factory Defaults.

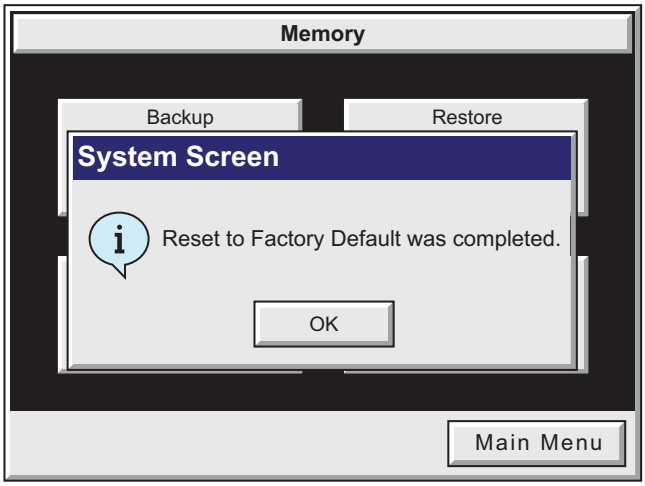
2.) The project file is cleared.

3.) The log, recipe & WAV files are cleared.

4.) The IP address is set to DHCP.

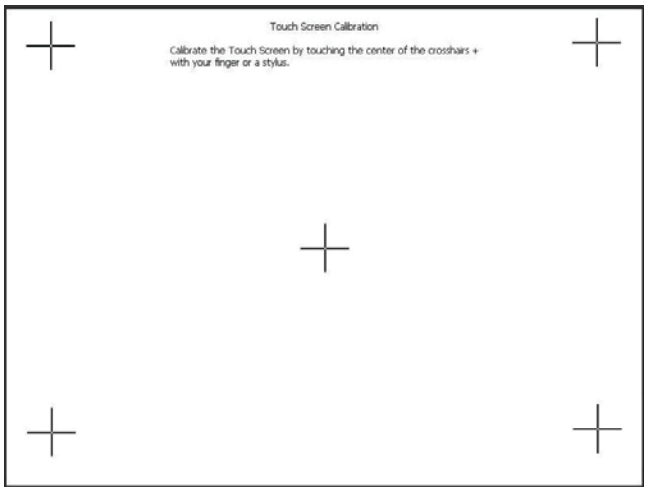
5

**WARNING: As a precaution, it is recommended to create a backup file to an SD card or USB storage device using the Memory Backup function before resetting to factory defaults.**




The message shown here is displayed once the **Factory Default** values have been stored into the system memory.

Press **OK** to continue.




After pressing **OK**, the touch panel will reboot and startup on the **Touch Screen Calibration** procedure as shown here.

The following note is also shown on the calibration screens to remind the user that the **Project File** has been cleared, there's no communications with the PLC, and the calibration procedure most be performed in order to ready the panel to download a project:

**Note: The panel will not communicate or run its project in this mode.**

Also, the ***C-more* Programming Software** will not connect to the panel in this situation.

# PLC Communications

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# Introduction

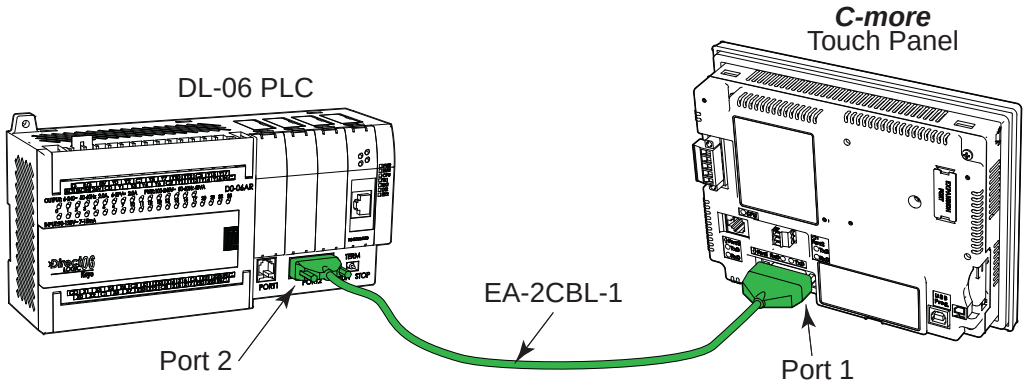
The ***C-more*** family of touch panels is capable of communicating with a wide variety of Programmable Logic Controllers. ***C-more*** is capable of communicating over RS232, RS422 and RS485 serial networks as well as Ethernet networks. It communicates with all AutomationDirect PLC's utilizing various protocols. ***C-more*** also communicates with other brands of PLCs by their different protocols. The table on the next page lists all of the various PLCs and protocols that can be configured. The page after the protocol table lists the various serial communication cables that are available to purchase. The rest of this chapter is devoted to showing the pin to pin connections of all the available cables plus wiring diagrams that the user can refer to in order to construct their own cables, along with wiring diagrams of cables that are not available for purchase. To simplify RS422/RS485 wiring schemes, we have included wiring diagrams showing connections for available terminal connectors such as our ZIPLink Communication Adapter Module, p/n ZL-CMA15, used for example with our DL-06 and D2-260 PLCs.



If you have difficulty determining whether the particular PLC and/or protocol you are using will work with the ***C-more*** series of touch panels, please contact our technical support group at 770-844-4200

# *Direct*LOGIC PLCs Password Protection

*NOTE: Many DirectLogic PLCs support multi-level password protection of the ladder program. This allows password protection while not locking the communication port to an operator interface. The multilevel password can be invoked by creating a password with an upper case "A" followed by seven numeric characters (e.g. A1234567). Please refer to the specific PLC user manual for further details.*



## PLC Protocol & Cables

| Compatibility Table | | | |
|---|---|---|---|
| **Model** | | | **Protocols** |
| **AutomationDirect** | Productivity3000 | | P3000 Serial |
| | | | P3000 Ethernet |
| | Do-more | all | Do-more Serial |
| | | | Do-more Ethernet |
| | CLICK | | Modbus (CLICK) |
| | DL05/DL06 | all | K-Sequence |
| | | | ***Direct*** NET |
| | | | Modbus (Koyo addressing) |
| | | H0-ECOM/H0-ECOM100 | ***Direct*** LOGIC Ethernet |
| | DL105 | all | K-Sequence |
| | DL205 | D2-230 | K-Sequence |
| | | D2-240 | K-Sequence |
| | | | ***Direct*** NET |
| | | D2-250/D2-250-1/D2-260 | K-Sequence |
| | | | ***Direct*** NET |
| | | | Modbus (Koyo addressing) |
| | | D2-240/D2-250-1/D2-260 Using DCM | ***Direct*** NET |
| | | | Modbus (Koyo addressing) |
| | | H2-ECOM/H2-ECOM100 | ***Direct*** LOGIC Ethernet |
| | DL305 | D3-330/330P (Requires the use of a Data Communications Unit) | ***Direct*** NET |
| | | D3-340 | ***Direct*** NET |
| | | D3-350 | K-Sequence |
| | | | ***Direct*** NET |
| | | | Modbus (Koyo addressing) |
| | | D3-350 DCM | ***Direct*** NET |
| | | | Modbus (Koyo addressing) |
| | DL405 | D4-430 | K-Sequence |
| | | | ***Direct*** NET |
| | | D4-440 | K-Sequence |
| | | | ***Direct*** NET |
| | | D4-450 | K-Sequence |
| | | | ***Direct*** NET |
| | | | Modbus (Koyo addressing) |
| | | All with DCM | ***Direct*** NET |
| | | | Modbus (Koyo addressing) |
| | | H4-ECOM/H4-ECOM100 | ***Direct*** LOGIC Ethernet |
| | H2-WinPLC (Think & Do) Live V5.2 or later and Studio any version | | Think & Do Modbus RTU (serial port) |
| | H2-WinPLC (Think & Do) Live V5.5.1 or later and Studio V7.2.1 or later | | Think & Do Modbus TCP/IP (Ethernet port) |
| | GS Drives | | GS Drives Serial |
| | | | GS Drives TCP/IP (GS-EDRV) |
| | SOLO Temperature Controllers | | SOLO Temperature Controller |

## PLC Protocol & Cables (cont'd)

| Compatibility Table (cont'd) | | |
|---|---|---|
| **Model** | | **Protocols** |
| **Allen-Bradley** | MicroLogix 1000, 1100, 1200, 1400, 1500, SLC 5-01/02/03, PLC5 | DH485/AIC/AIC+ |
| | MicroLogix 1000, 1100, 1200, 1400 and 1500 | DF1 Half Duplex; DF1 Full Duplex |
| | SLC 5-03/04/05 | |
| | ControlLogix™, CompactLogix™, FlexLogix™ | |
| | PLC-5 | DF1 Full Duplex |
| | ControlLogix, CompactLogix, FlexLogix - Tag Based | DF1 Half Duplex; DF1 Full Duplex |
| | ControlLogix, CompactLogix, FlexLogix - Generic I/O Messaging | EtherNet/IP Server |
| | ControlLogix, CompactLogix, FlexLogix - Tag Based | EtherNet/IP Client |
| | MicroLogix 1100, 1400 and SLC 5/05, via native Ethernet port | |
| | MicroLogix 1000, 1100, 1200, 1400, 1500, SLC 5-03/04/05, all via ENI adapter | |
| **GE** | 90/30, 90/70. Micro 90, VersaMax Micro | SNPX |
| **Mitsubishi** | FX Series | FX Direct |
| | Q02, Q02H, Q06H, Q12H, Q25H | Q CPU |
| | Q, QnA Serial | QnA Serial |
| | Q, Qna Ethernet | QnA Ethernet |
| **Modicon** | 984 CPU, Quantum 113 CPU, AEG Modicon Micro Series 110 CPU: 311-xx, 411-xx, 512-xx, 612-xx | Modbus RTU |
| | Other devices using Modicon Modbus addressing | Modbus RTU |
| | | Modbus TCP/IP |
| **Omron** | C200 Adapter, C500 | Host Link |
| | CJ1/CS1 Serial | FINS |
| | CJ1/CS1 Ethernet | |
| **Siemens** | S7-200 CPU, RS-485 Serial | PPI |
| | S7-200 CPU, S7-300 CPU; Ethernet | Ethernet ISO over TCP |

# PLC Communication Cables & Wiring Diagrams

| Purchased Cable Description | Cable Part Number |
|---|---|
| AutomationDirect Productivity Series, Do-more, CLICK, ***Direct*** LOGIC PLC RJ-12 port, DL05, DL06, DL105, DL205, D3-350, D4-450 & H2-WINPLC (RS-232C) | **EA-2CBL** |
| ***Direct*** LOGIC (VGA Style) 15-pin port DL06, D2-250 (250-1), D2-260 (RS-232C) | **EA-2CBL-1** |
| ***Direct*** LOGIC PLC RJ-11 port, D3-340 (RS-232C) | **EA-3CBL** |
| ***Direct*** LOGIC DL405 PLC 15-pin D-sub port, DL405 (RS-232C) | **EA-4CBL-1** |
| ***Direct*** LOGIC PLC 25-pin D-sub port, DL405, D3-350, DL305 DCU and all DCM's (RS-232C) | **EA-4CBL-2** |
| Allen-Bradley MicroLogix 1000, 1100, 1200, 1400, 1500 (RS-232C) | **EA-MLOGIX-CBL** |
| Allen-Bradley SLC 5-03/04/05, ControlLogix, CompactLogix, FlexLogix, MicroLogix DF1 port (RS-232C) | **EA-SLC-232-CBL** |
| Allen-Bradley PLC-5 DF1 port (RS-232C) | **EA-PLC5-232-CBL** |
| Allen-Bradley MicroLogix, SLC 5-01/02/03, PLC5 DH485 port (RS-232C) | **EA-DH485-CBL** |
| GE 90/30, 90/70, Micro 90, VersaMax Micro 15-pin D-sub port (RS-422A) | **EA-90-30-CBL** |
| MITSUBISHI FX Series 25-pin port (RS-422A) | **EA-MITSU-CBL** |
| MITSUBISHI FX Series 8-pin mini-DIN (RS-422A) | **EA-MITSU-CBL-1** |
| OMRON Host Link C200 Adapter, C500 (RS-232C) | **EA-OMRON-CBL** |

**Part No. EA-2CBL**

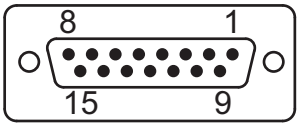
**Part No. EA-2CBL-1**

**Part No. EA-3CBL**



*NOTE: The above list of pre-made communications cables may be purchased. See further in this chapter for wiring diagrams of additonal* **user constructed cables**. *This chapter also includes wiring diagrams for the pre-made cables.*

**C-more PLC Serial Communications Port**




**D-Sub 15-pin female on rear of touch panel**

# PLC Communication Cables & Wiring Diagrams (cont'd)

Part No. EA-4CBL-1

Part No. EA-4CBL-2

Part No. EA-MLOGIX-CBL

Part No. EA-SLC-232-CBL

Part No. EA-PLC5-232-CBL

Part No. EA-DH485-CBL

Part No. EA-90-30-CBL

Part No. EA-MITSU-CBL

Part No. EA-MITSU-CBL-1

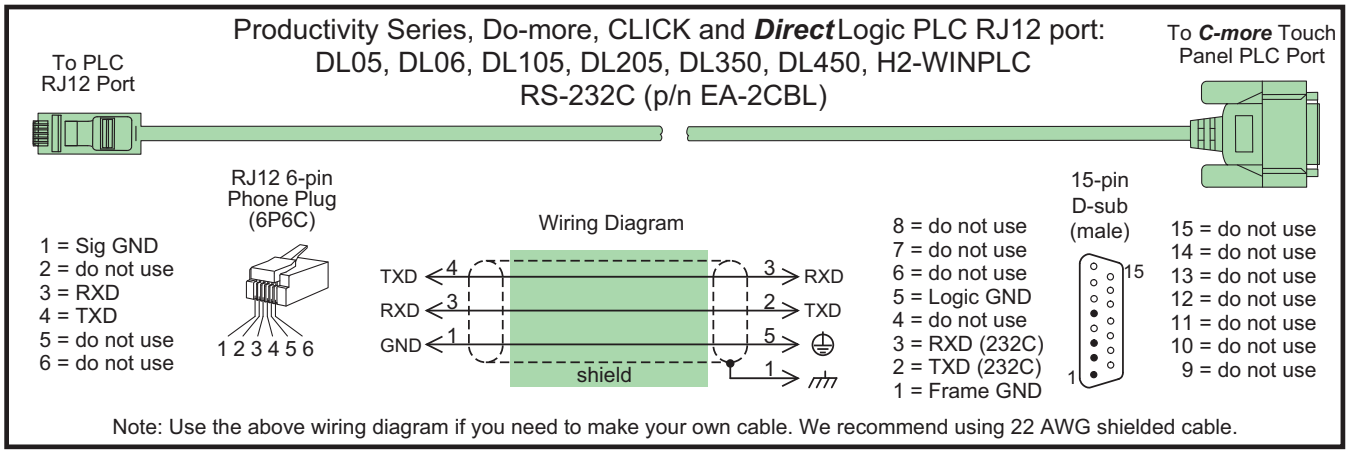
Part No. EA-OMRON-CBL

# PLC Communication Cables & Wiring Diagrams (cont'd)

The following series of wiring diagrams show the connectors and wiring details for the communication cables that are used between the ***C-more*** touch panels and various PLC controllers. Part numbers are included with the **pre-made cables** that can be purchased from ***AutomationDirect***. The information presented will allow the user to construct their own cables if so desired.

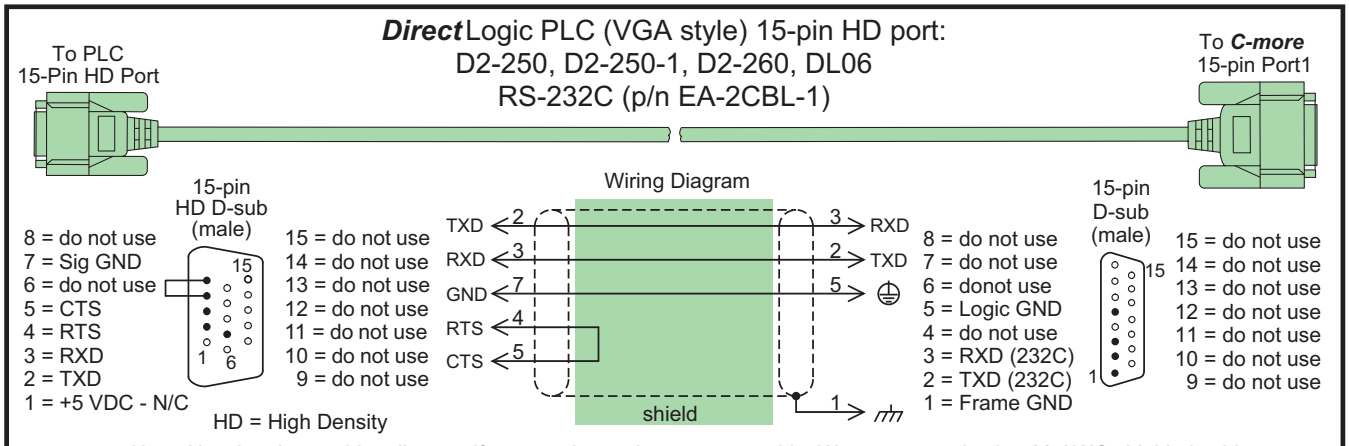
## AutomationDirect PLCs RS-232C Serial

### EA-2CBL




Note: Use the above wiring diagram if you need to make your own cable. We recommend using 22 AWG shielded cable.

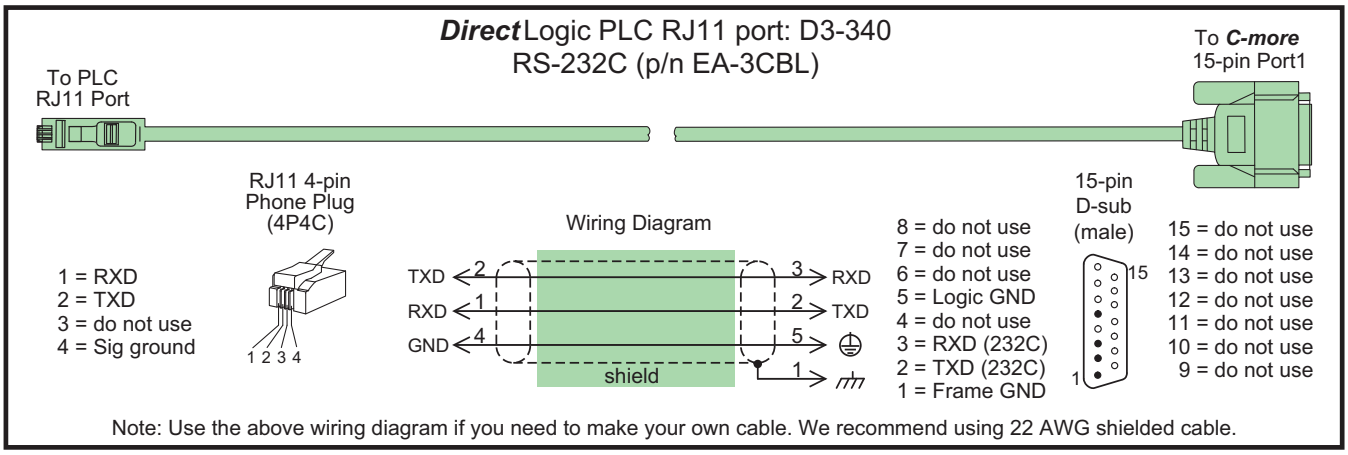
### EA-2CBL-1




Note: Use the above wiring diagram if you need to make your own cable. We recommend using 22 AWG shielded cable.

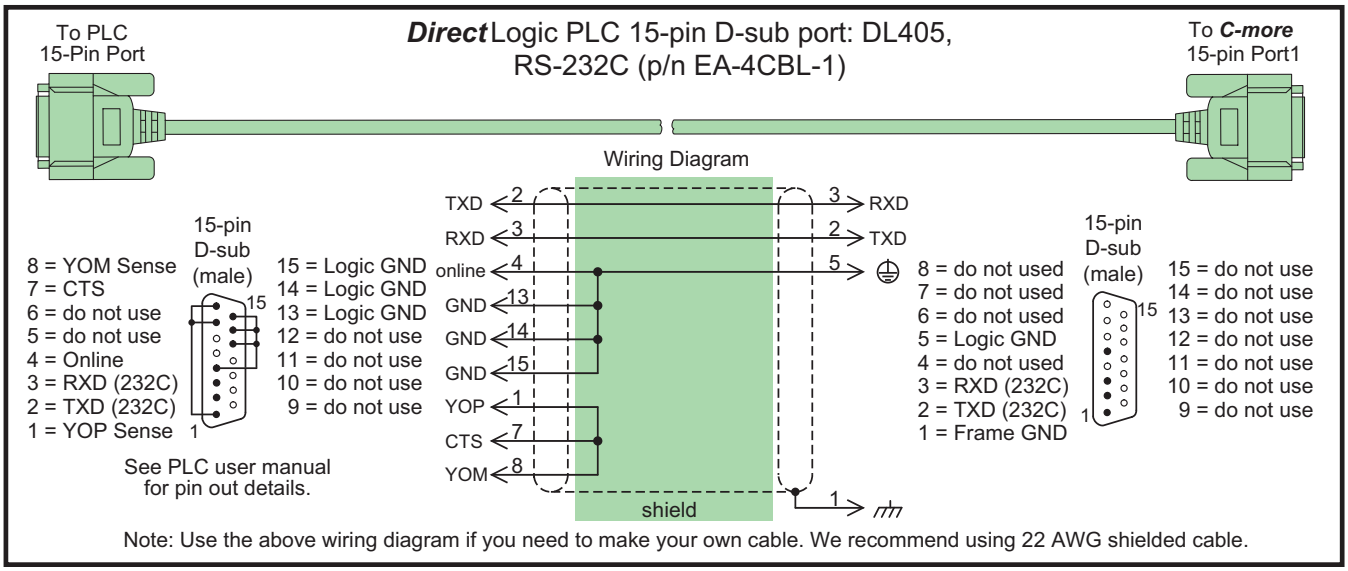
## AutomationDirect PLCs RS-232C Serial (cont'd)

### EA-3CBL




Note: Use the above wiring diagram if you need to make your own cable. We recommend using 22 AWG shielded cable.

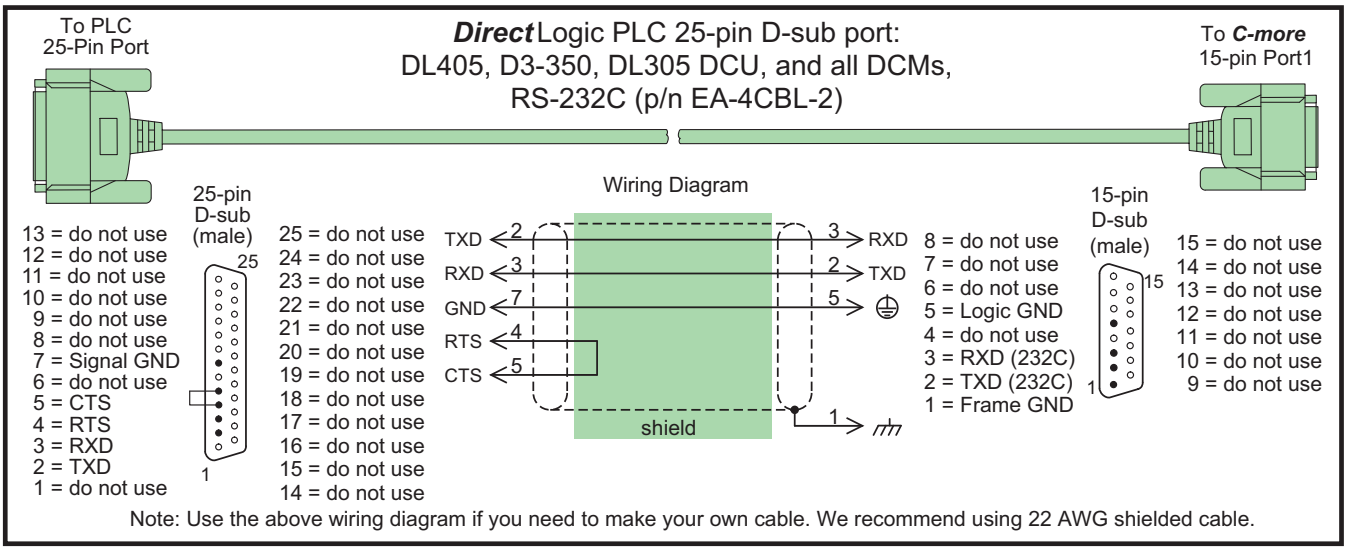
### EA-4CBL-1




Note: Use the above wiring diagram if you need to make your own cable. We recommend using 22 AWG shielded cable.

## AutomationDirect PLCs RS-232C Serial (cont'd)

### EA-4CBL-2

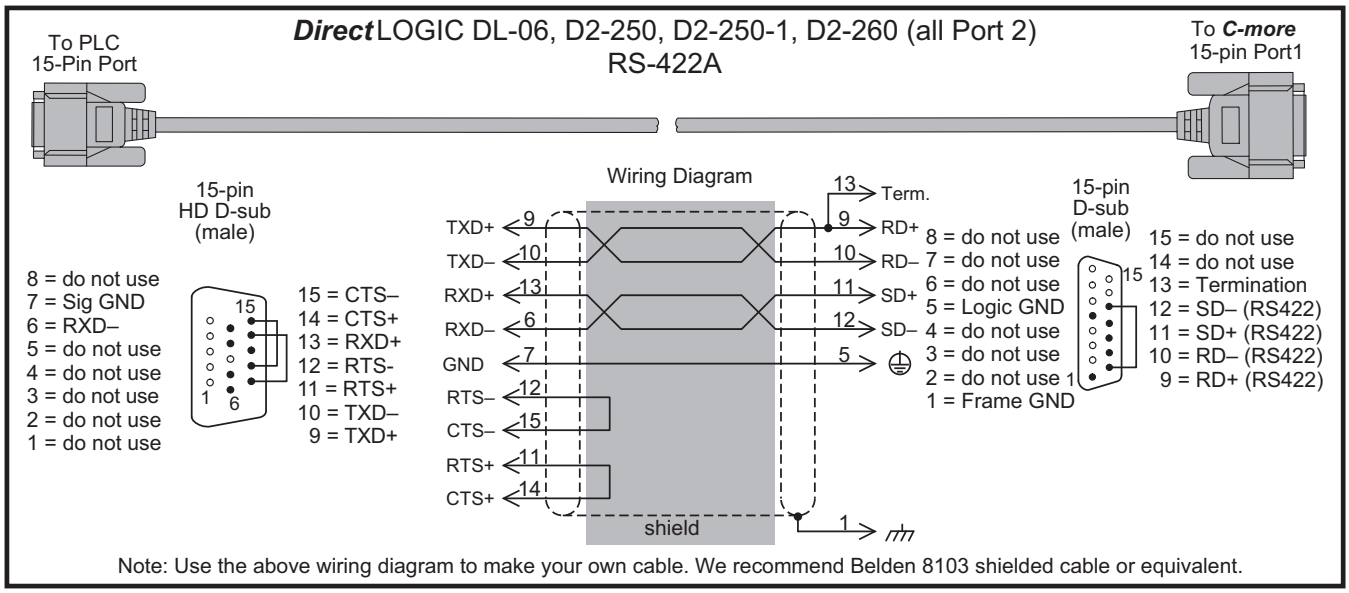



Note: Use the above wiring diagram if you need to make your own cable. We recommend using 22 AWG shielded cable.

## AutomationDirect PLCs RS-422A/RS-485A

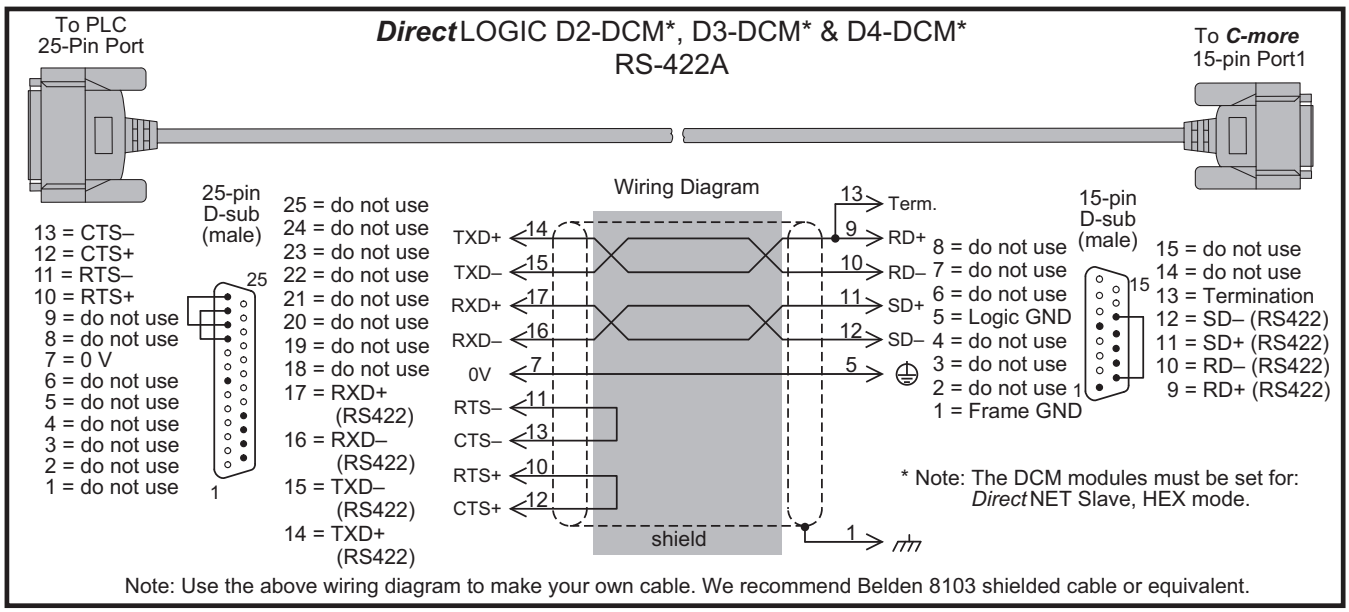
When using the RS-422A/RS-485A capabilities of the ***C-more*** 15-pin PLC communications Port1, the termination resistor is placed between the **RXD–** and **RXD+** terminals on the PLC side of the connection between the touch panel and PLC. The Termination Resistor value is based on the characteristic impedance of the cable being used. To enable the built-in 120 Ohm Termination Resistor, jumper pin **13** to pin **9 (RXD+)** on the ***C-more*** 15-pin PLC communications Port1.

**User Constructed**




Note: Use the above wiring diagram to make your own cable. We recommend Belden 8103 shielded cable or equivalent.

**User Constructed**

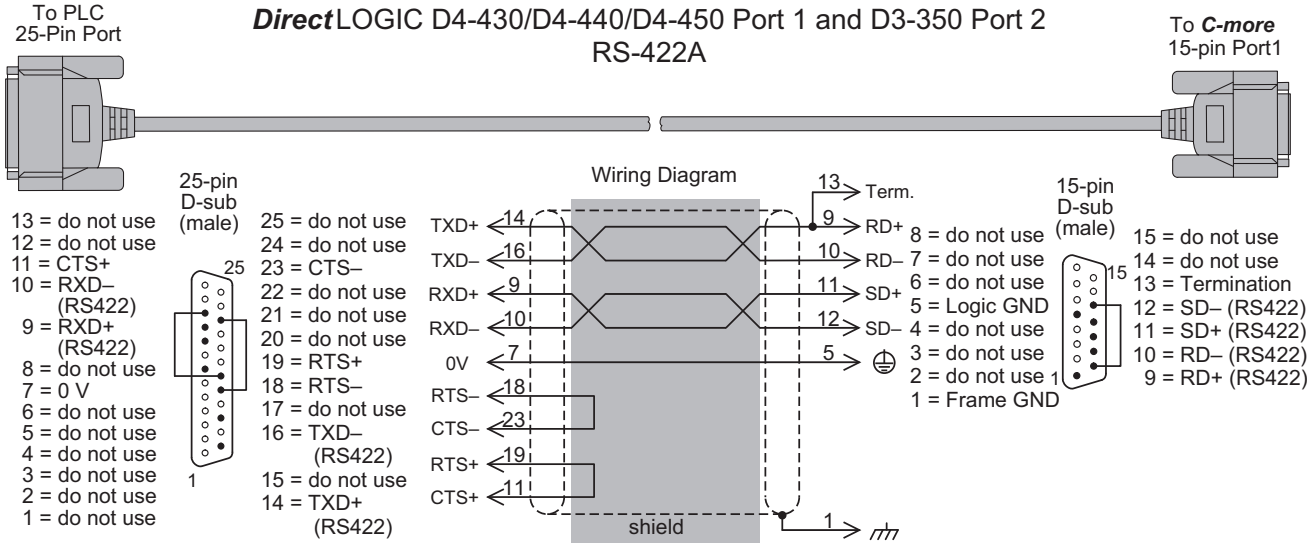



Note: Use the above wiring diagram to make your own cable. We recommend Belden 8103 shielded cable or equivalent.

*NOTE: The RS-422 wiring diagrams shown above are not for multi-drop networks involving connecting more than one PLC to a panel. Refer to the multi-drop wiring diagram examples later in this chapter if more than one PLC will be connected to a panel.*

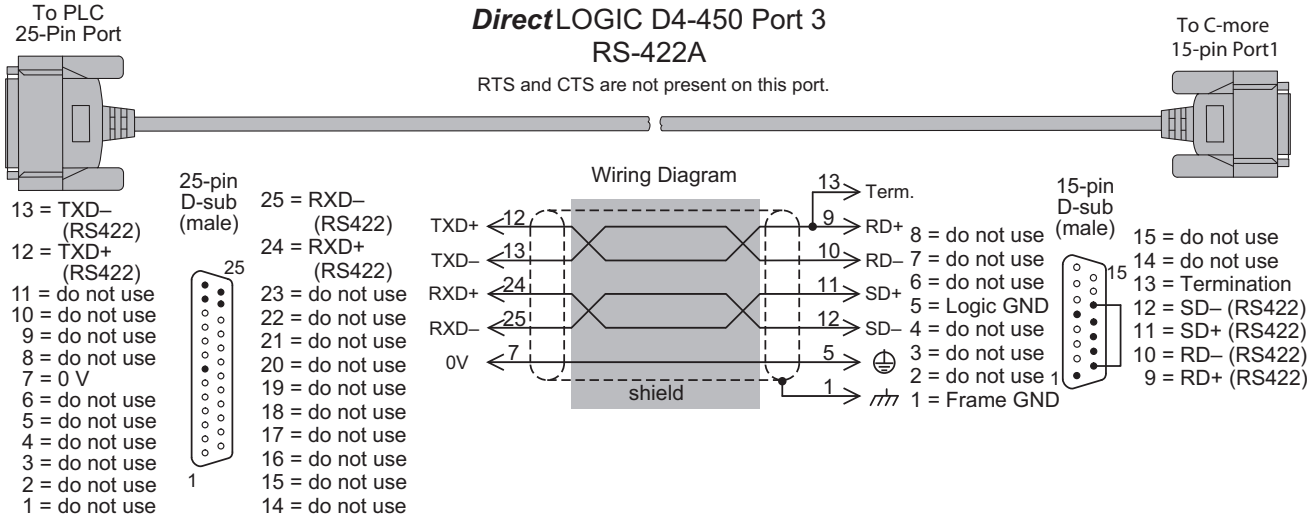
## AutomationDirect PLCs RS-422A/RS-485A (cont'd)

**User Constructed**




Note: Use the above wiring diagram to make your own cable. We recommend Belden 8103 shielded cable or equivalent.

**User Constructed**

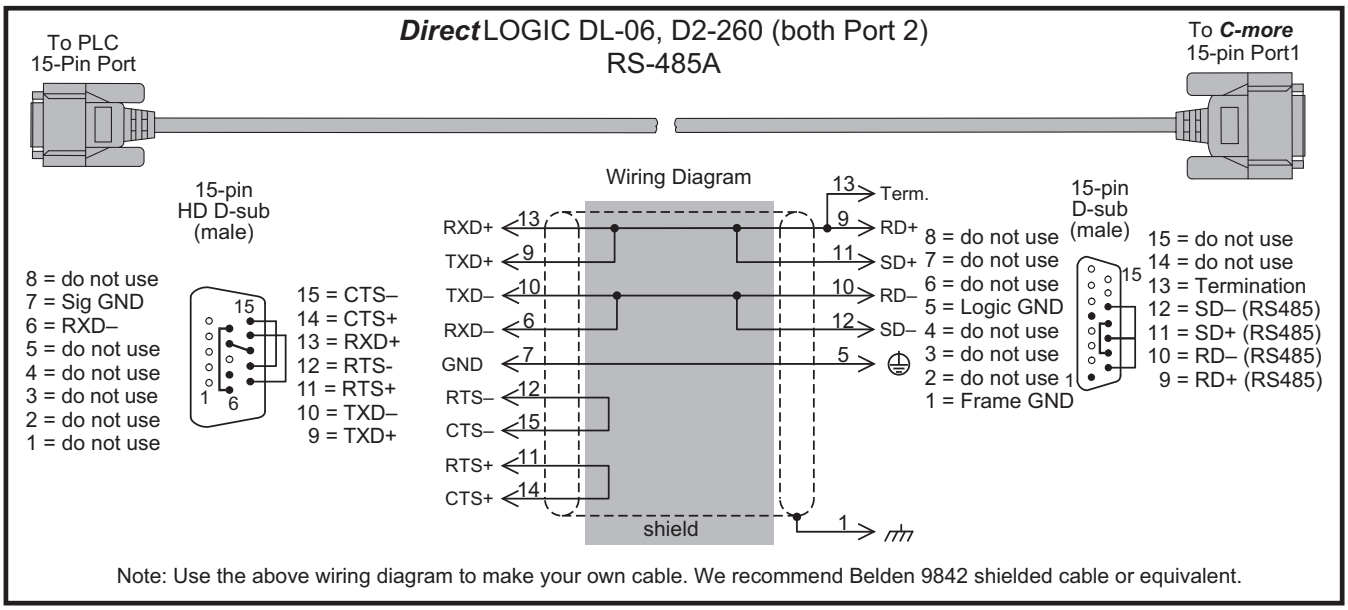



Note: Use the above wiring diagram to make your own cable. We recommend Belden 8103 shielded cable or equivalent.

*NOTE: The RS-422 wiring diagrams shown above are not for multi-drop networks involving connecting more than one PLC to a panel. Refer to the multi-drop wiring diagram examples later in this chapter if more than one PLC will be connected to a panel.*

## AutomationDirect PLCs RS-422A/RS-485A (cont'd)

**User Constructed**



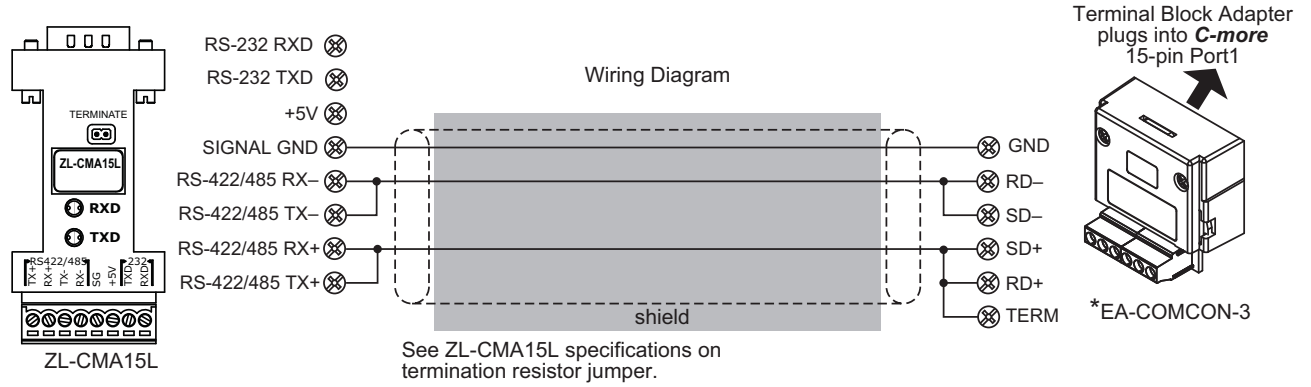

Note: Use the above wiring diagram to make your own cable. We recommend Belden 9842 shielded cable or equivalent.

*NOTE: The RS-485 wiring diagram shown above is not for multi-drop networks involving connecting more than one PLC to a panel. Refer to the multi-drop wiring diagram examples later in this chapter if more than one PLC will be connected to a panel.*

## AutomationDirect PLCs RS-422A/RS-485A (cont'd)

### User Constructed

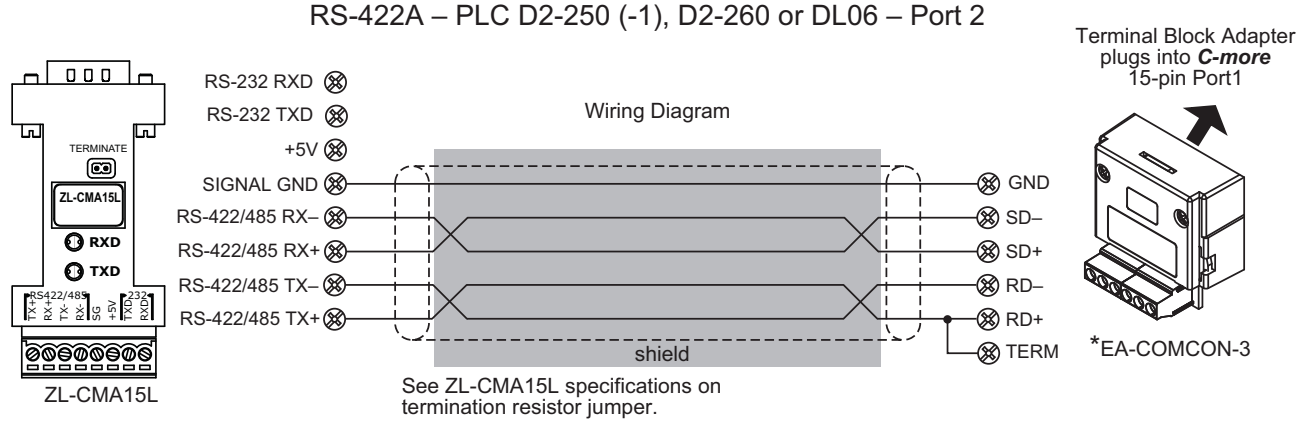
***Direct*LOGIC ZIPLink ZL-CMA15L Adapter Module to EA-COMCON-3 Terminal Block Adapter**
**RS-485A – PLC D2-260 or DL06 only – Port 2**




Note: Use the above wiring diagram to make your own cable. We recommend Belden 8103 shielded cable or equivalent.

### User Constructed

***Direct*LOGIC ZIPLink ZL-CMA15L Adapter Module to EA-COMCON-3 Terminal Block Adapter**
**RS-422A – PLC D2-250 (-1), D2-260 or DL06 – Port 2**




Note: Use the above wiring diagram to make your own cable. We recommend Belden 9842 shielded cable or equivalent.

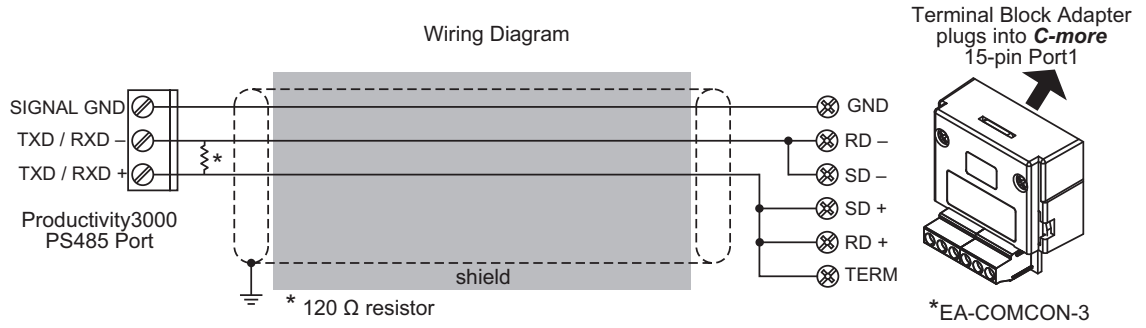
*NOTE: The RS-422 and RS-485 wiring diagrams shown above are not for multi-drop networks involving connecting more than one PLC to a panel. Refer to the multi-drop wiring diagram examples later in this chapter if more than one PLC will be connected to a panel.*

** NOTE: EA-COMCON-3 will install only on EA9-T6CL and EA9-T6CL-R panels*

## AutomationDirect PLCs RS-422A/RS-485A (cont'd)

### *User Constructed*

Productivity3000 PAC RS485 Port to EA-COMCON-3 Terminal Block Adapter

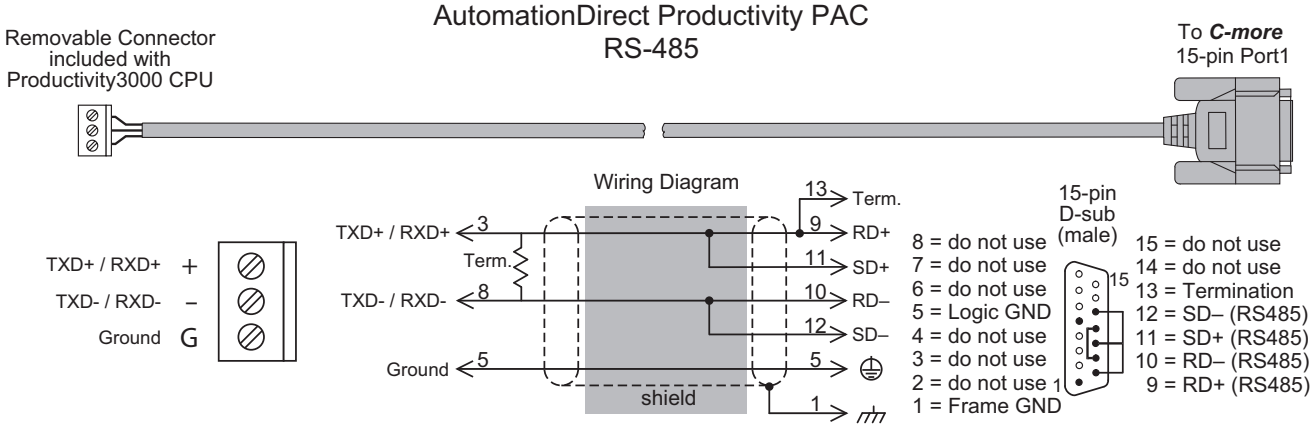



Note: Use the above wiring diagram to make your own cable. We recommend Belden 9842 shielded cable or equivalent.

6

### *User Constructed*

AutomationDirect Productivity PAC RS-485



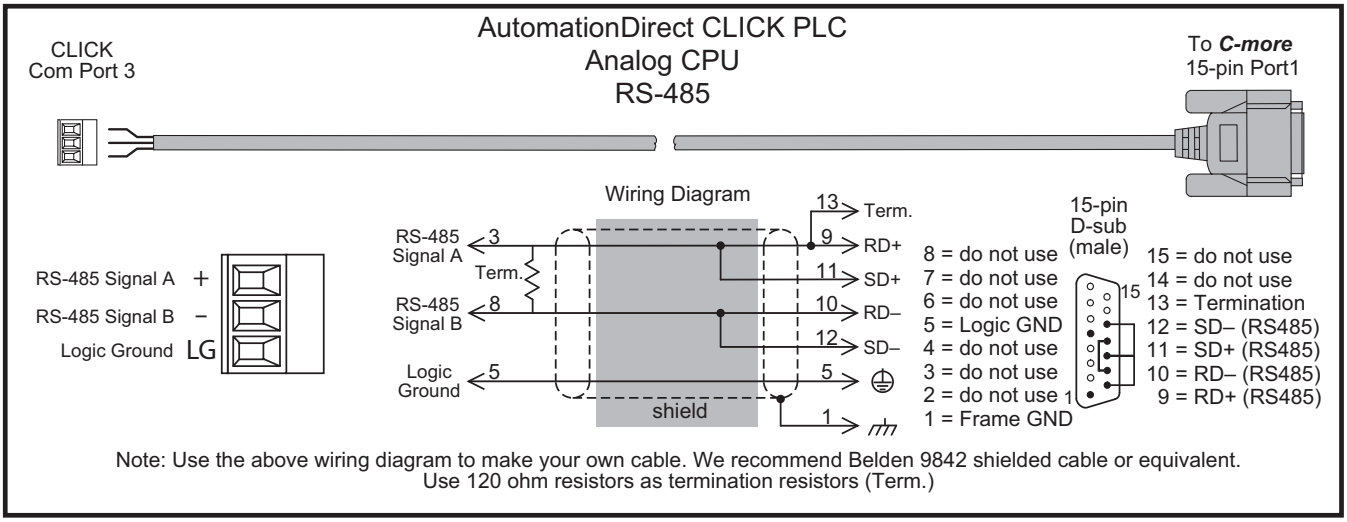

Note: Use the above wiring diagram to make your own cable. We recommend Belden 9842 shielded cable or equivalent.
Use 120 ohm resistors as termination resistors (Term.)

*NOTE: The RS-422 and RS-485 wiring diagrams shown above are not for multi-drop networks involving connecting more than one PLC to a panel. Refer to the multi-drop wiring diagram examples later in this chapter if more than one PLC will be connected to a panel.*

** NOTE: EA-COMCON-3 will install only on EA9-T6CL and EA9-T6CL-R panels*

## AutomationDirect PLCs RS-422A/RS-485A (cont'd)

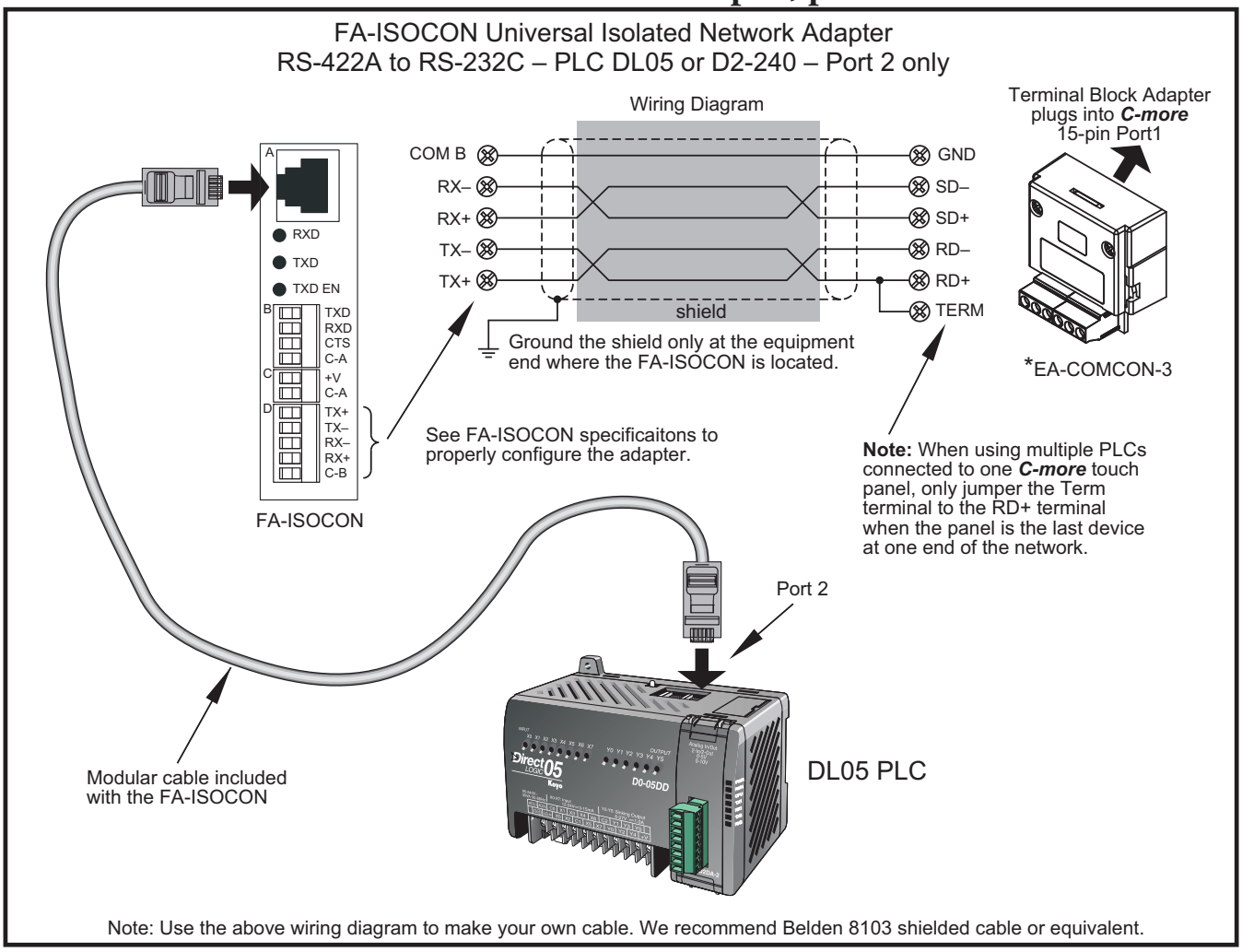
***User Constructed***




Note: Use the above wiring diagram to make your own cable. We recommend Belden 9842 shielded cable or equivalent.
Use 120 ohm resistors as termination resistors (Term.)

*NOTE: The RS-485 wiring diagram shown above is not for multi-drop networks involving connecting more than one PLC to a panel. Refer to the multi-drop wiring diagram examples later in this chapter if more than one PLC will be connected to a panel.*

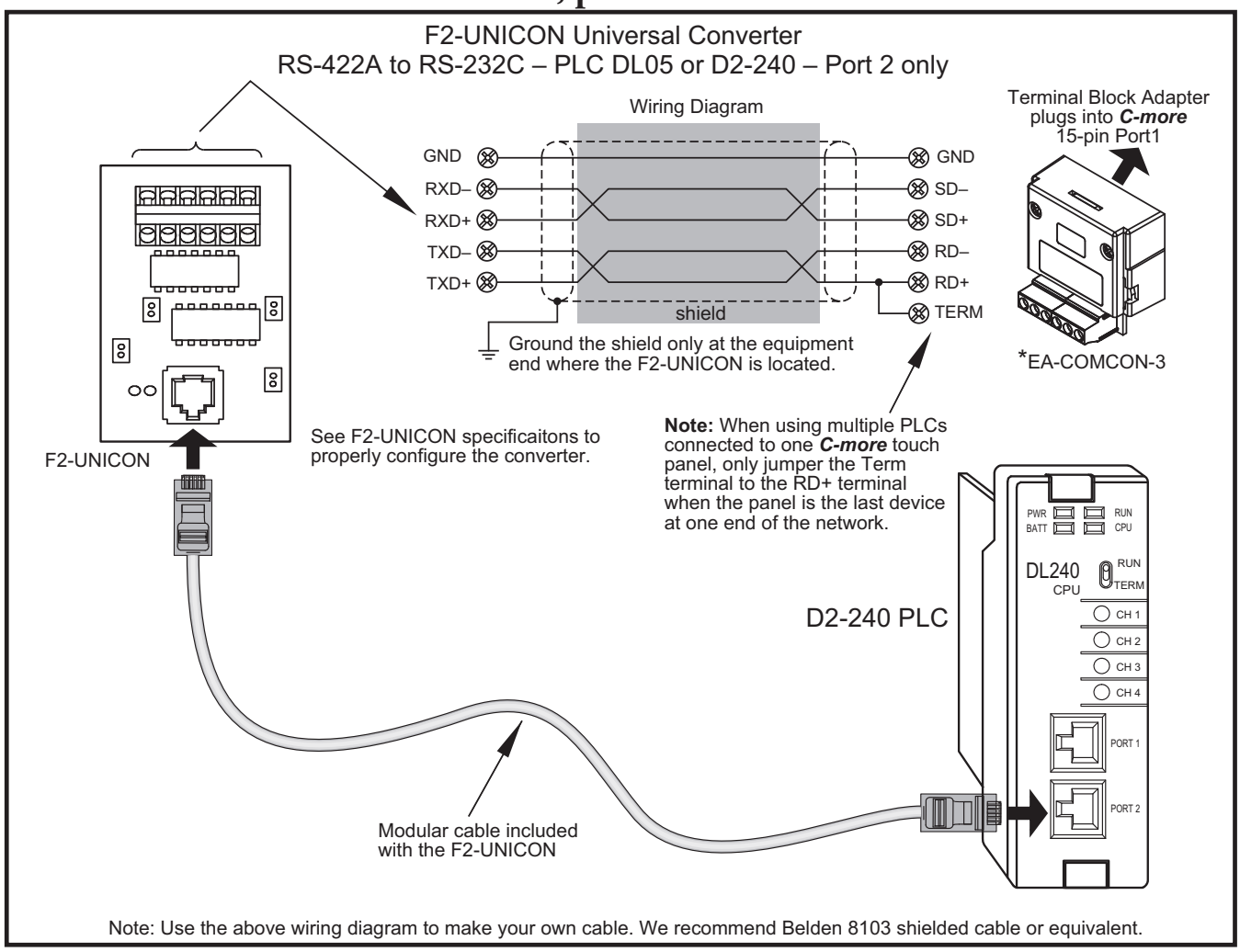
## *Direct*LOGIC Universal Isolated Network Adapter, p/n FA-ISOCON:




Note: Use the above wiring diagram to make your own cable. We recommend Belden 8103 shielded cable or equivalent.

** NOTE: EA-COMCON-3 will install only on EA9-T6CL and EA9-T6CL-R panels*

## *Direct*LOGIC Universal Converter, p/n F2-UNICON:

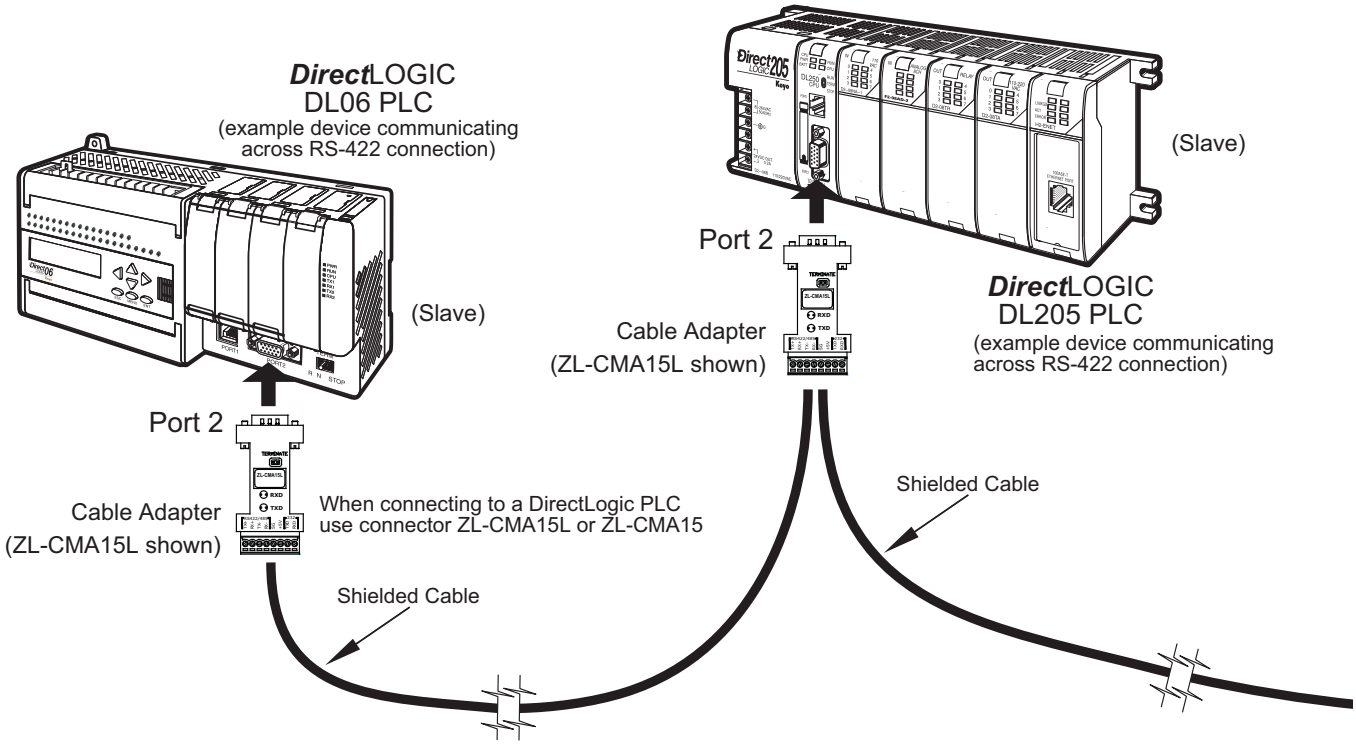



Note: Use the above wiring diagram to make your own cable. We recommend Belden 8103 shielded cable or equivalent.

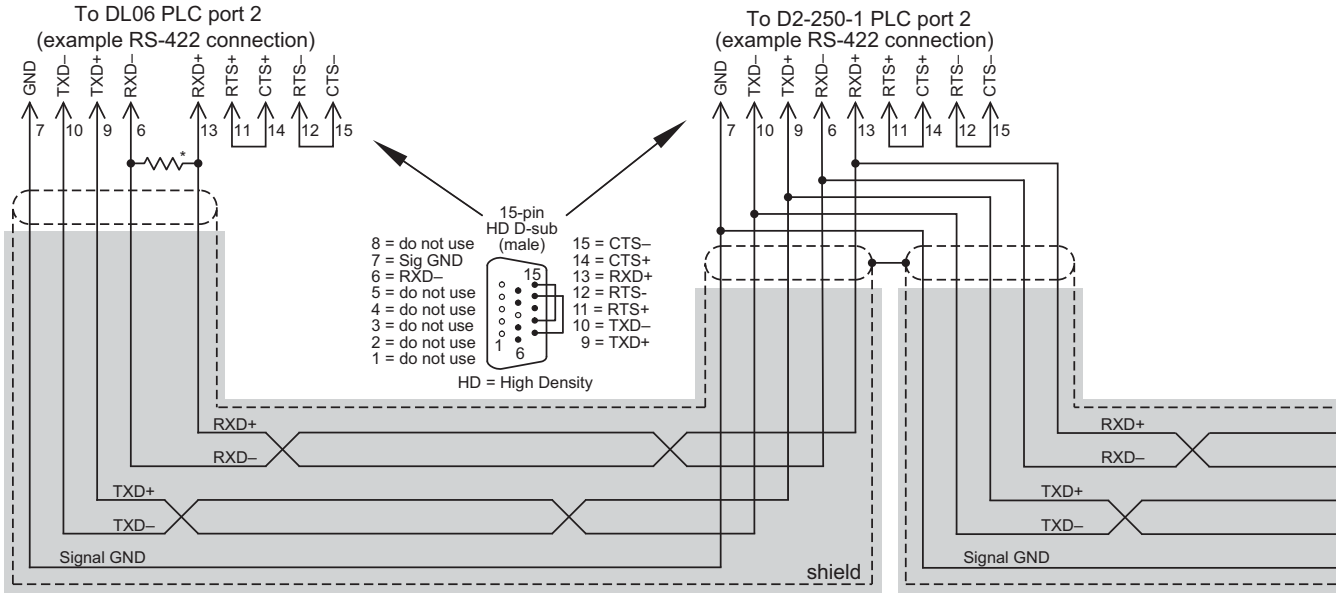
** NOTE: EA-COMCON-3 will install only on EA9-T6CL and EA9-T6CL-R panels*

# RS-422A/RS-485A Multi-Drop Wiring Diagram Examples

DL06 and DL205 used for illustration purposes




Notes: 1. We recommend Belden 8103 shielded cable or equivalent.
2. Wiring Diagram for this example, ZL-CMA15(L)



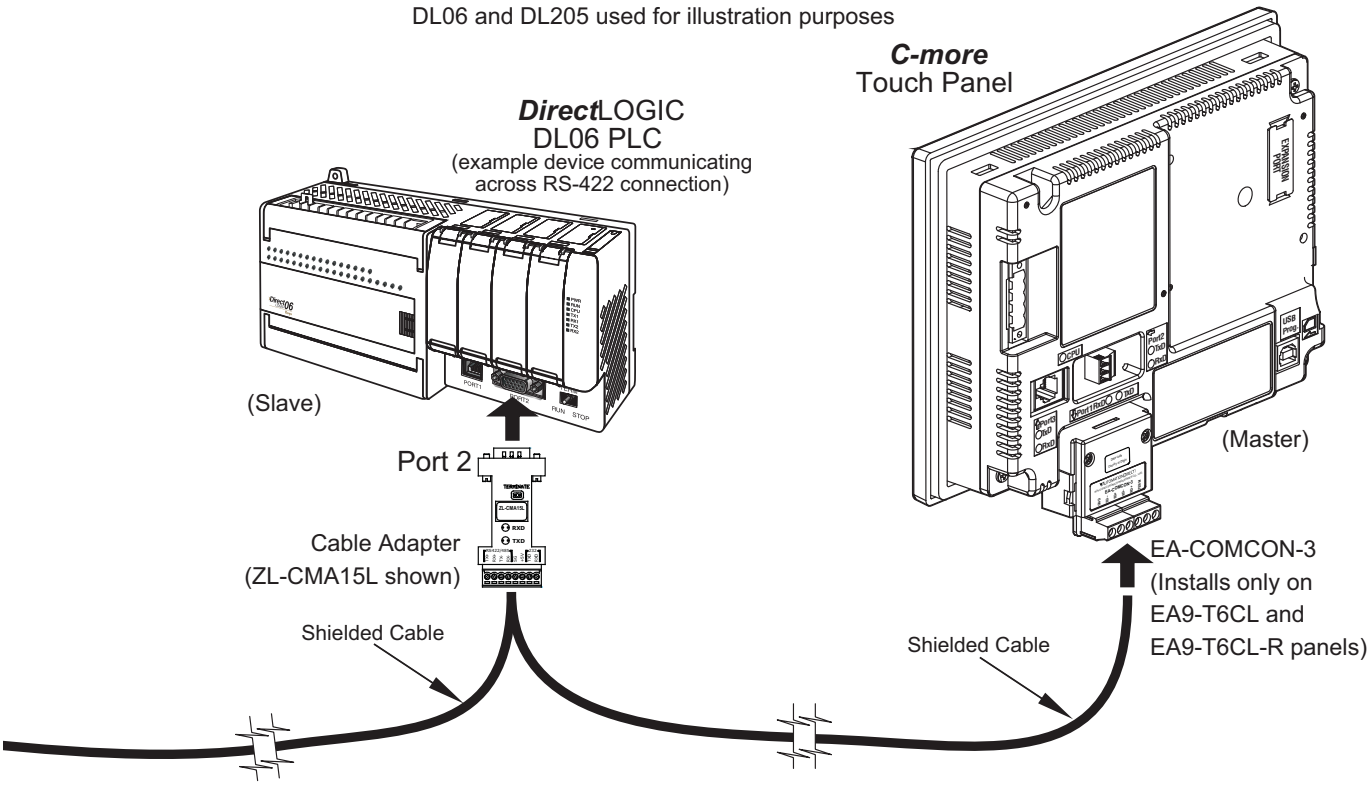

* Termination resistors required at both ends of the network receive data signals to match the impedance of the cable (between 100 and 500 ohms).

## Typical RS-422 Multi-Drop Wiring Diagram

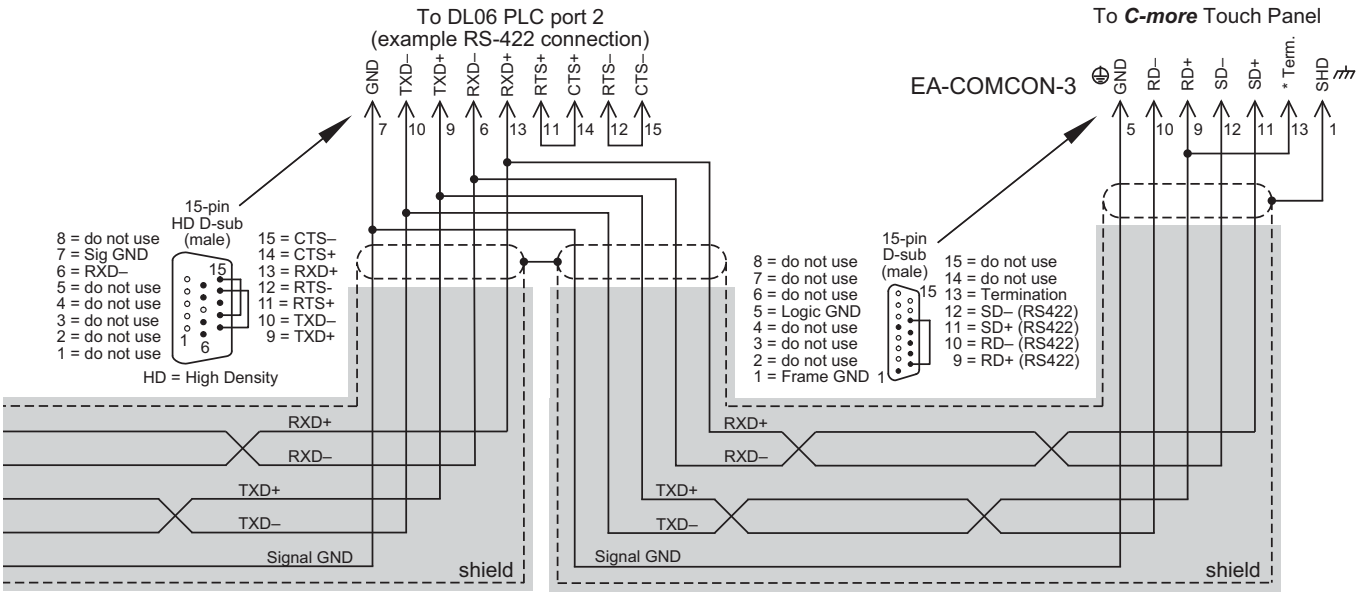
using DirectLogic pin numbers to illustrate

# RS-422A/RS-485A Multi-Drop Wiring Diagram Examples (cont'd)

DL06 and DL205 used for illustration purposes




Notes: 1. We recommend Belden 8103 shielded cable or equivalent.
2. Wiring Diagram for this example, ZL-CMA15(L)



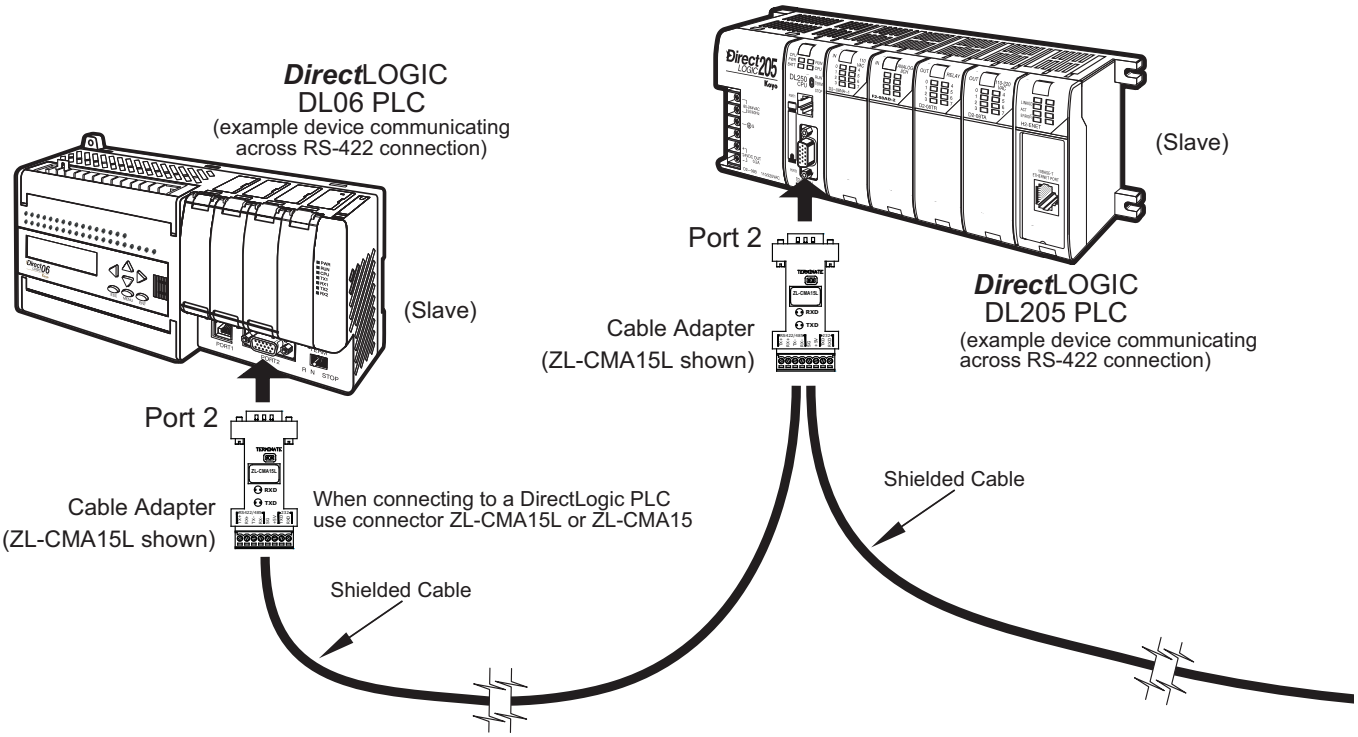

## Typical RS-422 Multi-Drop Wiring Diagram (cont-d)

using DirectLogic pin numbers to illustrate

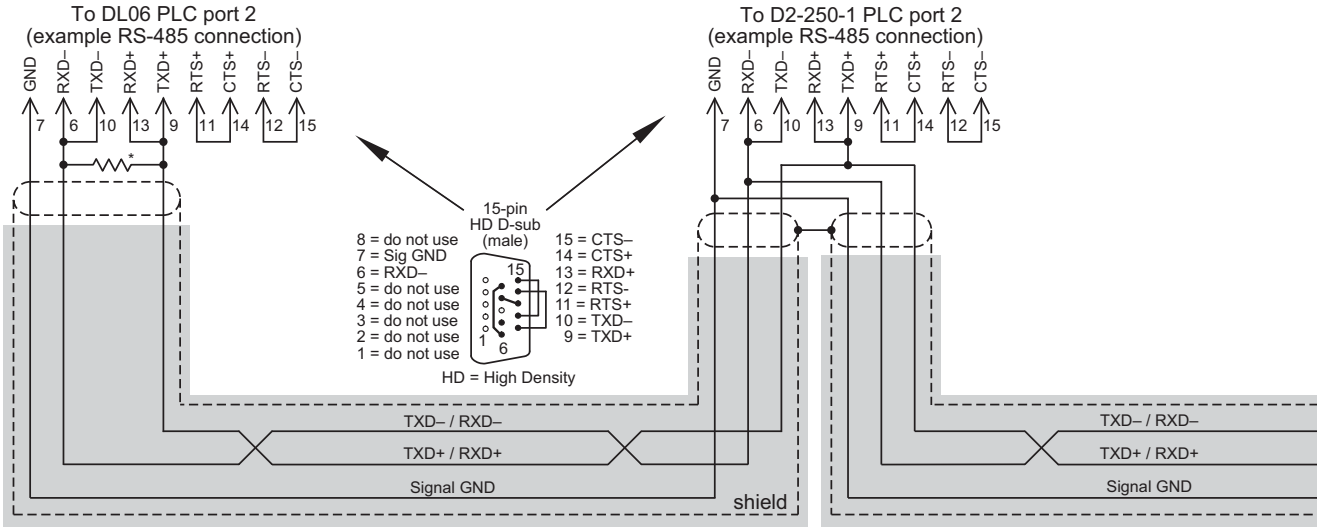
* Termination resistors required at both ends of the network receive data signals to match the impedance of the cable (between 100 and 500 ohms). Jumper pin 13 to 9 on the ***C-more*** Touch Panel 15-pin connector to place the 120Ω internal resistor into the network. If the cable impedance is different, then use an external resistor matched to the cable impedance.

# RS-422A/RS-485A Multi-Drop Wiring Diagram Examples (cont'd)

DL06 and DL205 used for illustration purposes




Notes: 1. We recommend Belden 9842 shielded cable or equivalent.
2. Wiring Diagram for this example, ZL-CMA15(L)



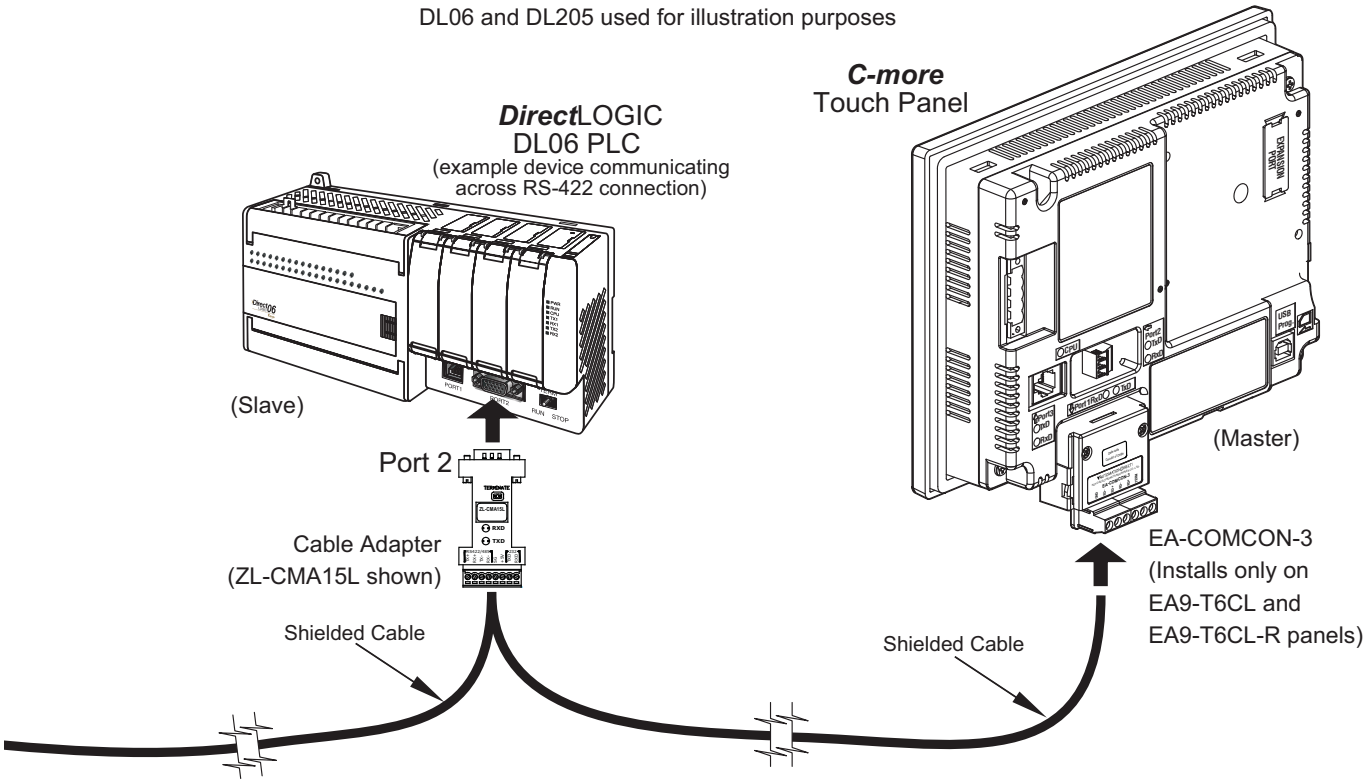

* Termination resistors required at both ends of the network to match the impedance of the cable (between 100 and 500 ohms).

## Typical RS-485 Multi-Drop Wiring Diagram

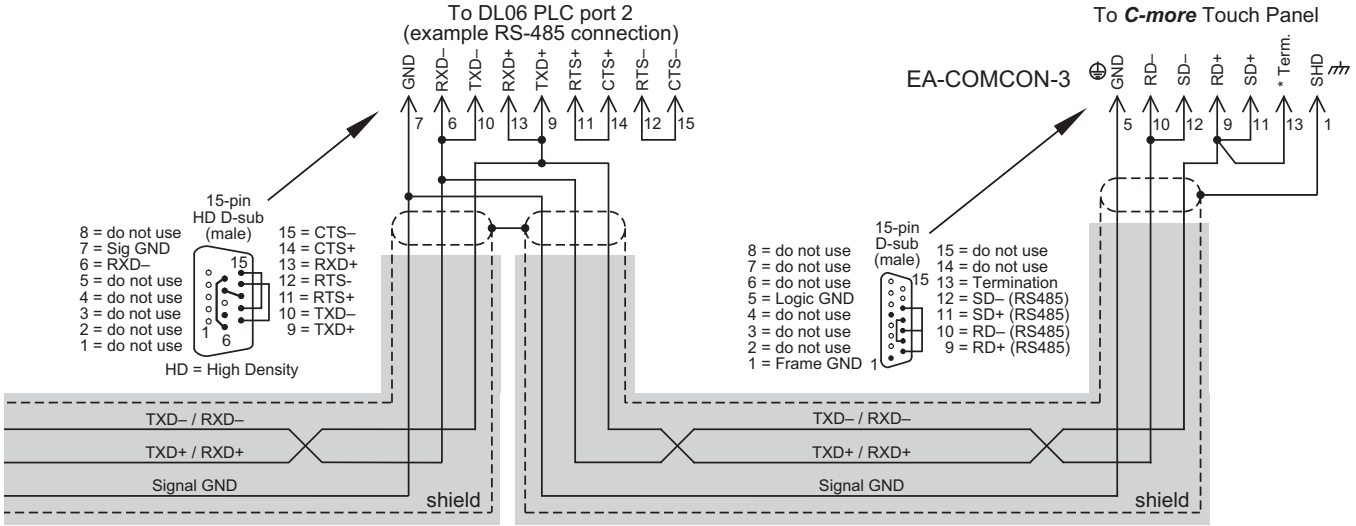
using DirectLogic pin numbers to illustrate

# RS-422A/RS-485A Multi-Drop Wiring Diagram Examples (cont'd)

DL06 and DL205 used for illustration purposes




Notes: 1. We recommend Belden 9842 shielded cable or equivalent.
2. Wiring Diagram for this example, ZL-CMA15(L)



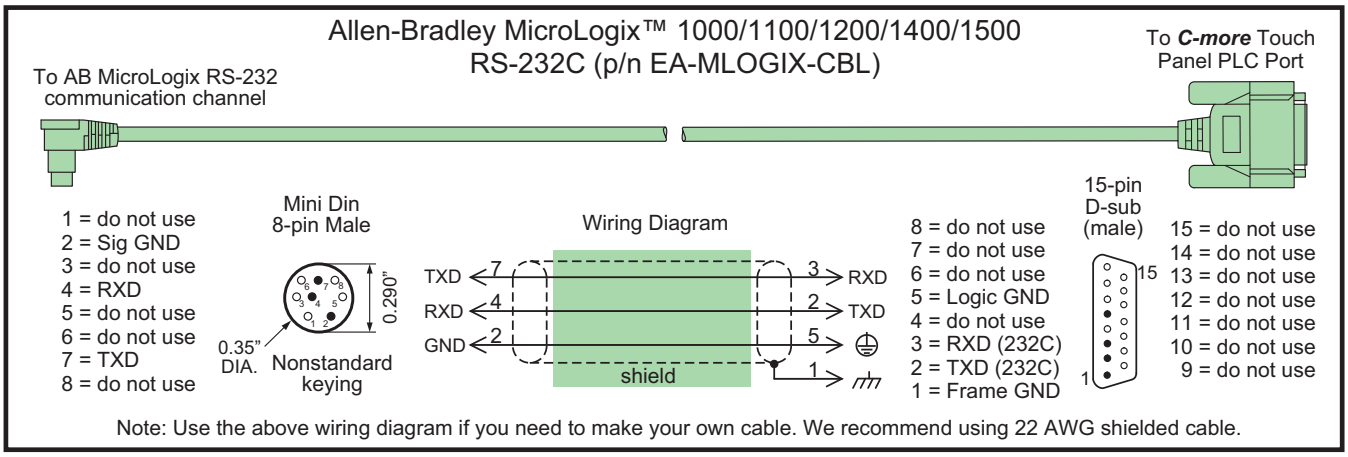

## Typical RS-485 Multi-Drop Wiring Diagram (cont-d)

using DirectLogic pin numbers to illustrate

* Termination resistors required at both ends of the network receive data signals to match the impedance of the cable (between 100 and 500 ohms). Jumper pin 13 to 9 on the ***C-more*** touch panel 15-pin connector to place the 120Ω internal resistor into the network. If the cable impedance is different, then use an external resistor matched to the cable impedance.

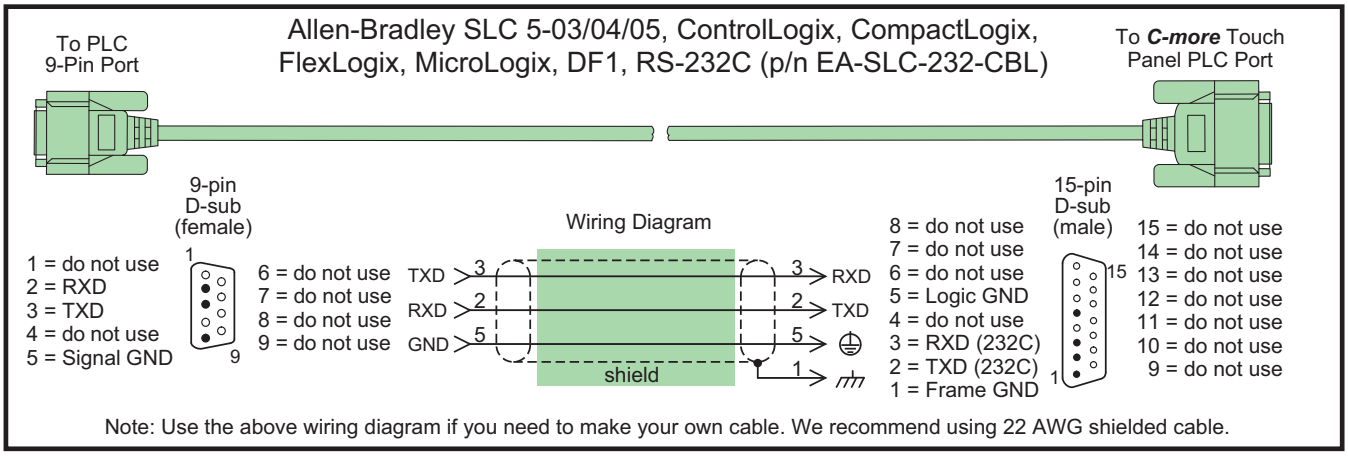
## Allen-Bradley

### EA-MLOGIX-CBL



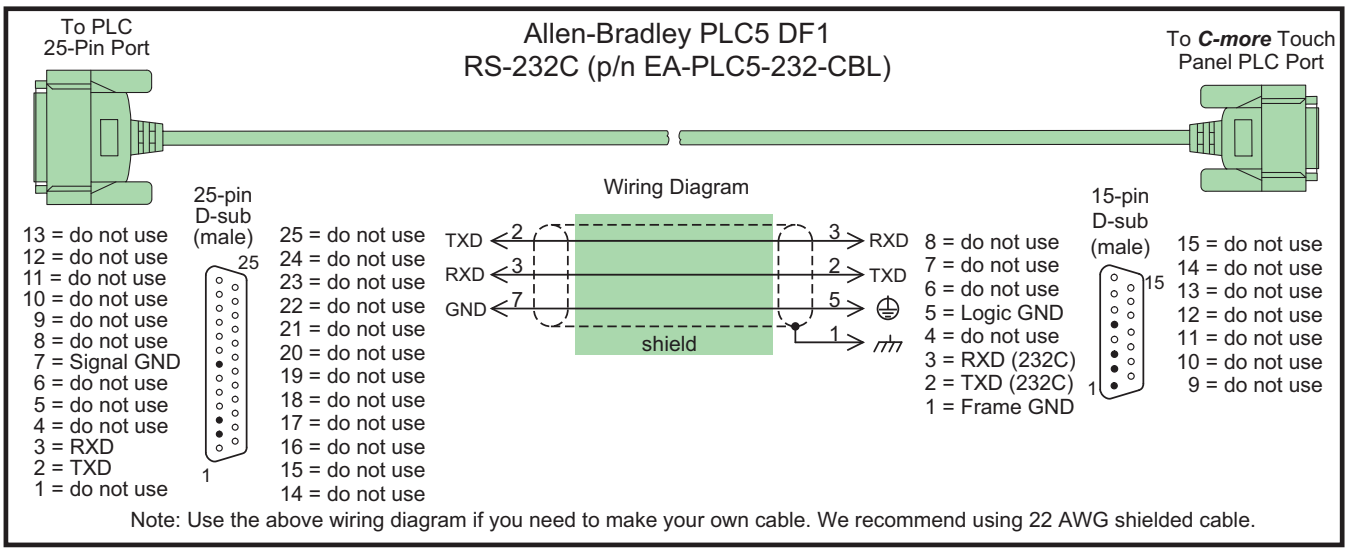

Note: Use the above wiring diagram if you need to make your own cable. We recommend using 22 AWG shielded cable.

### EA-SLC-232-CBL




Note: Use the above wiring diagram if you need to make your own cable. We recommend using 22 AWG shielded cable.

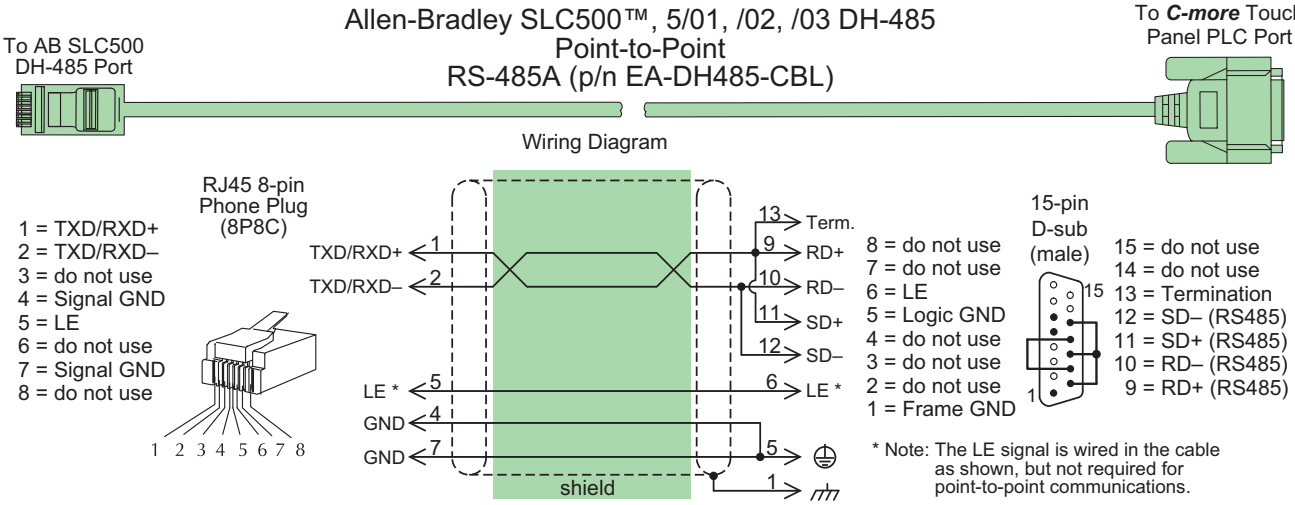
### EA-PLC5-232-CBL



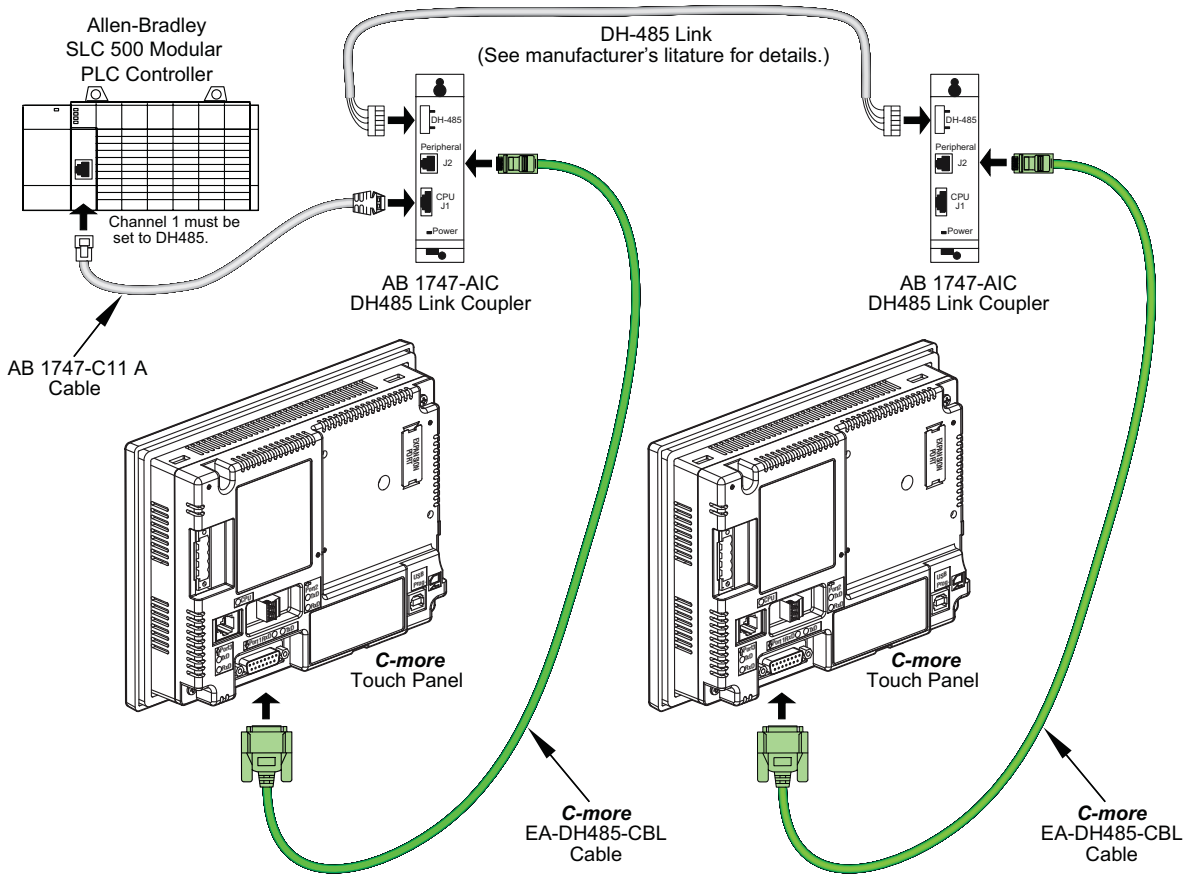

Note: Use the above wiring diagram if you need to make your own cable. We recommend using 22 AWG shielded cable.

## Allen-Bradley (cont'd)

### EA-DH485-CBL



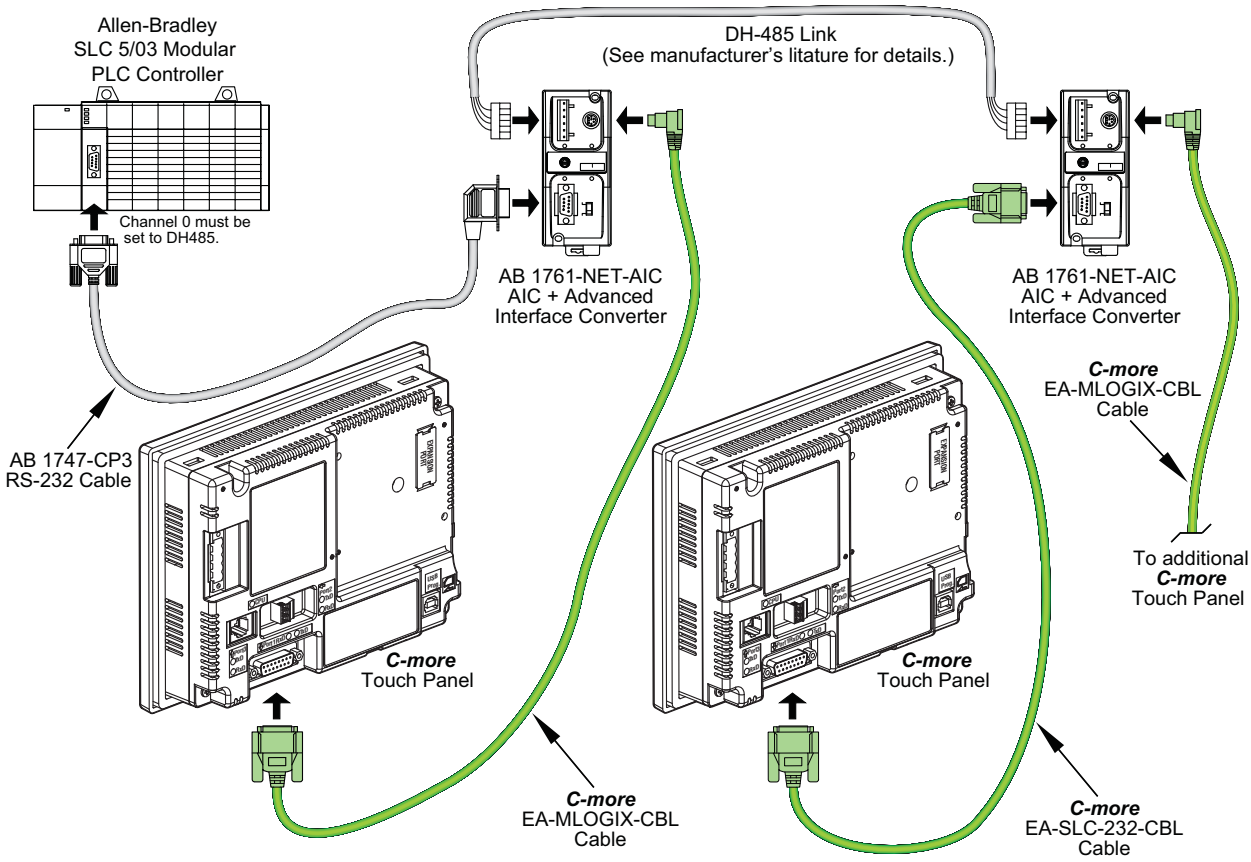

Note: Use the above wiring diagram if you need to make your own cable. We recommend Belden 9842 shielded cable or equivalent.




Note: The above diagram shows connecting multiple ***C-more*** touch panels to an Allen-Bradley DH485/AIC network using the AB DH485 Link Coupler, p/n 1747-AIC. Select the "Allen-Bradly DH485/AIC SLC500 MircroLogix" driver in the ***C-more*** Programming Software when starting the project. Also, set the AB channel configuration for DH485.

## Allen-Bradley (cont'd)

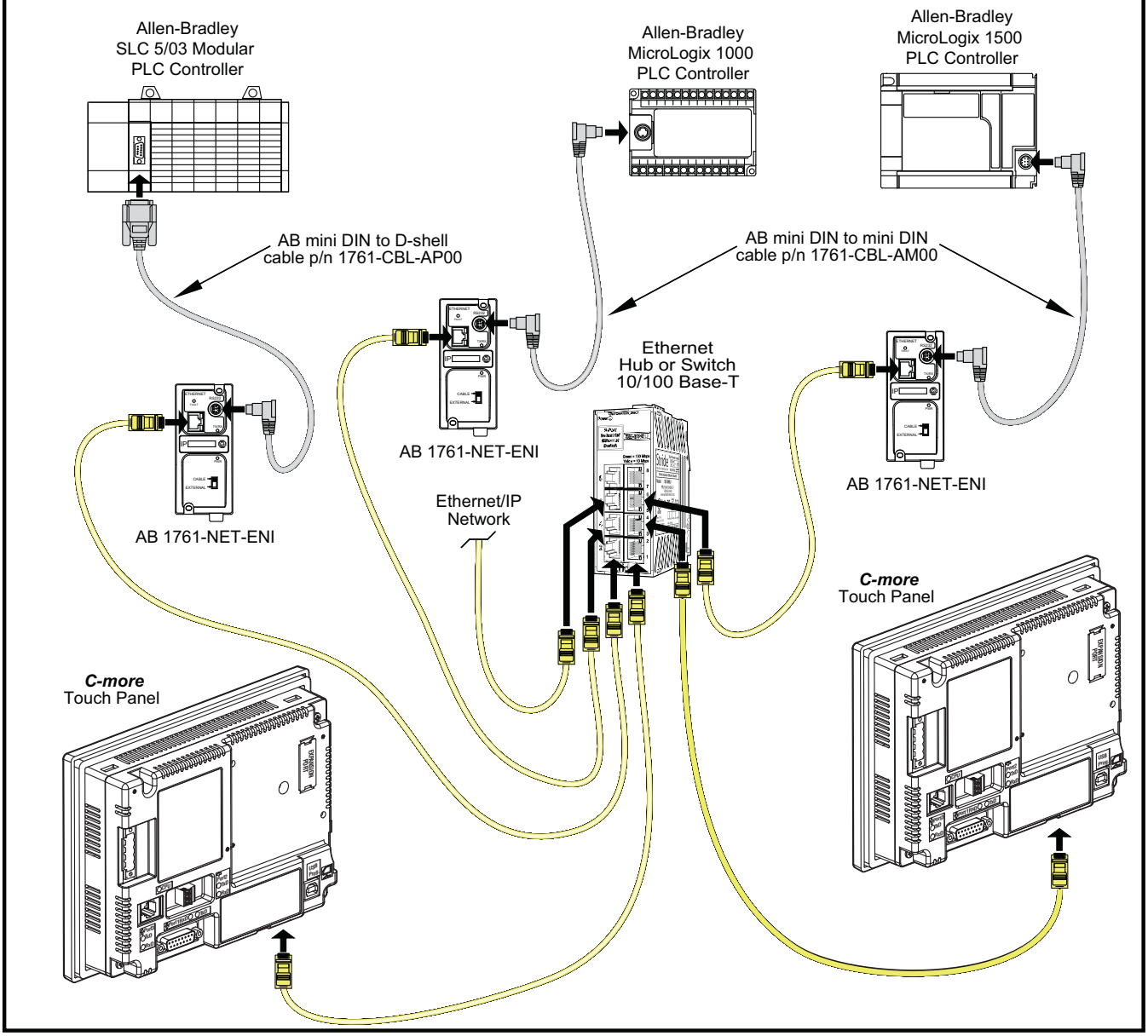
Allen-Bradley SLC500™ 5/03 DH-485/AIC to Multiple ***C-more*** Touch Panels
(using ***C-more*** cables p/n EA-MLOGIX-CBL, EA-SLC-232-CBL)




Note: The above diagram shows connecting multiple ***C-more*** touch panels to an Allen-Bradley DH485/AIC network using the AB AIC+ Advanced Interface Converter, p/n 1761-NET-AIC. Select the "Allen-Bradly DH485/AIC SLC500 MircroLogix" driver in the ***C-more*** Programming Software when starting the project. Also, set the AB channel configuration for DH485.

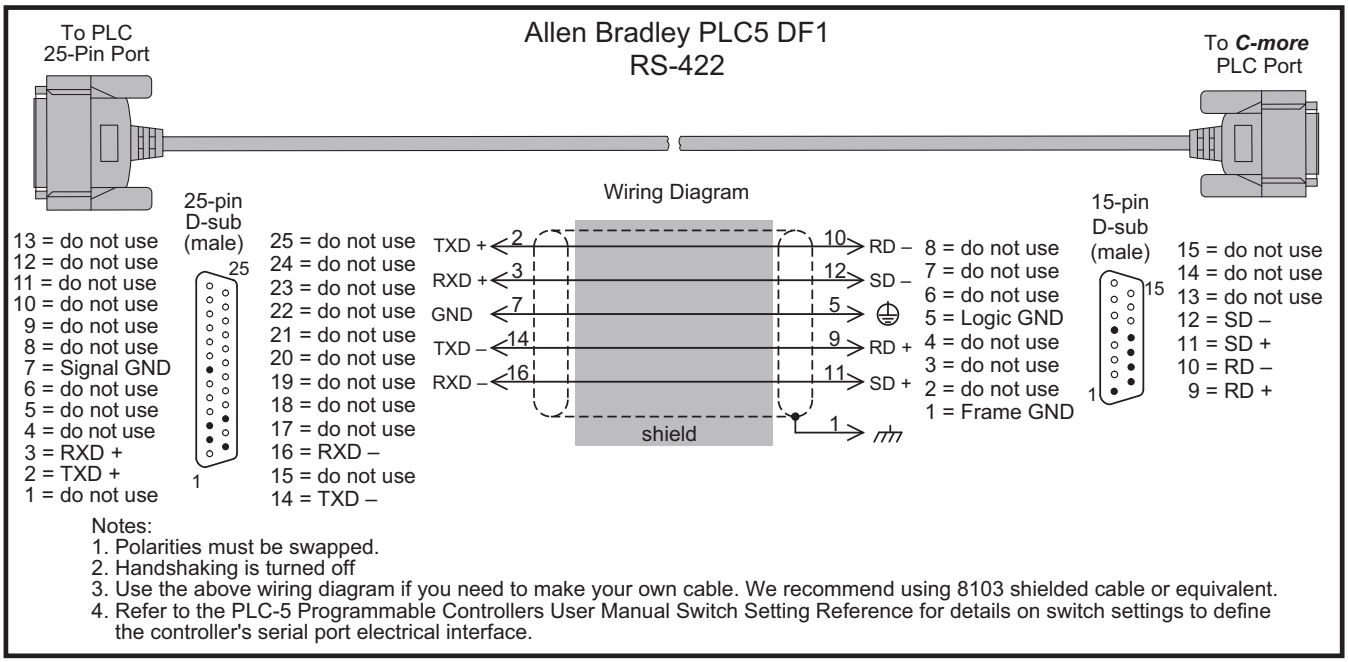
## Allen-Bradley (cont'd)

Multiple Allen-Bradley PLCs connected to multiple ***C-more*** Touch Panels
(using AB Ethernet Network Interface p/n 761-NET-ENI with EtherNet/IP protocol)



## Allen-Bradley (cont'd)

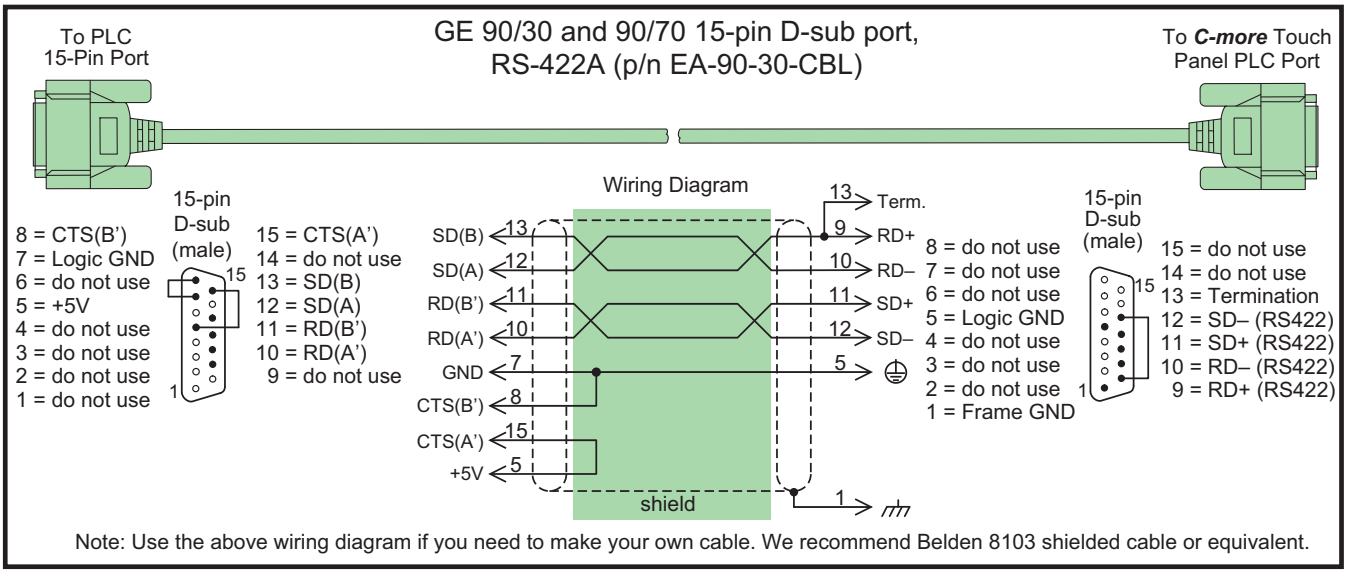
***User Constructed***




Notes:
1. Polarities must be swapped.
2. Handshaking is turned off
3. Use the above wiring diagram if you need to make your own cable. We recommend using 8103 shielded cable or equivalent.
4. Refer to the PLC-5 Programmable Controllers User Manual Switch Setting Reference for details on switch settings to define the controller's serial port electrical interface.

## GE

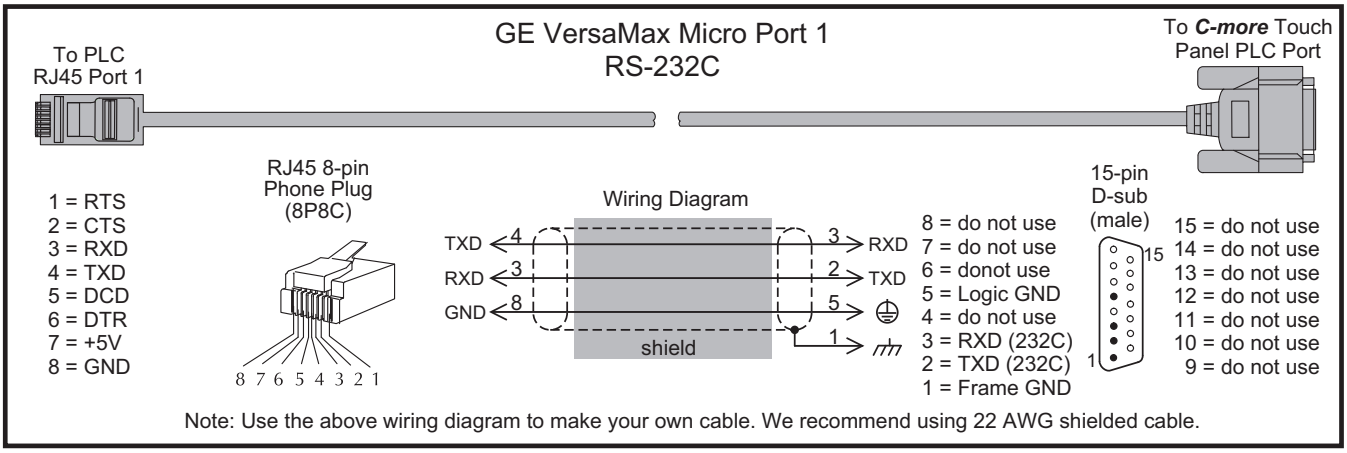
### EA-90-30-CBL




Note: Use the above wiring diagram if you need to make your own cable. We recommend Belden 8103 shielded cable or equivalent.

## GE VersaMax Micro

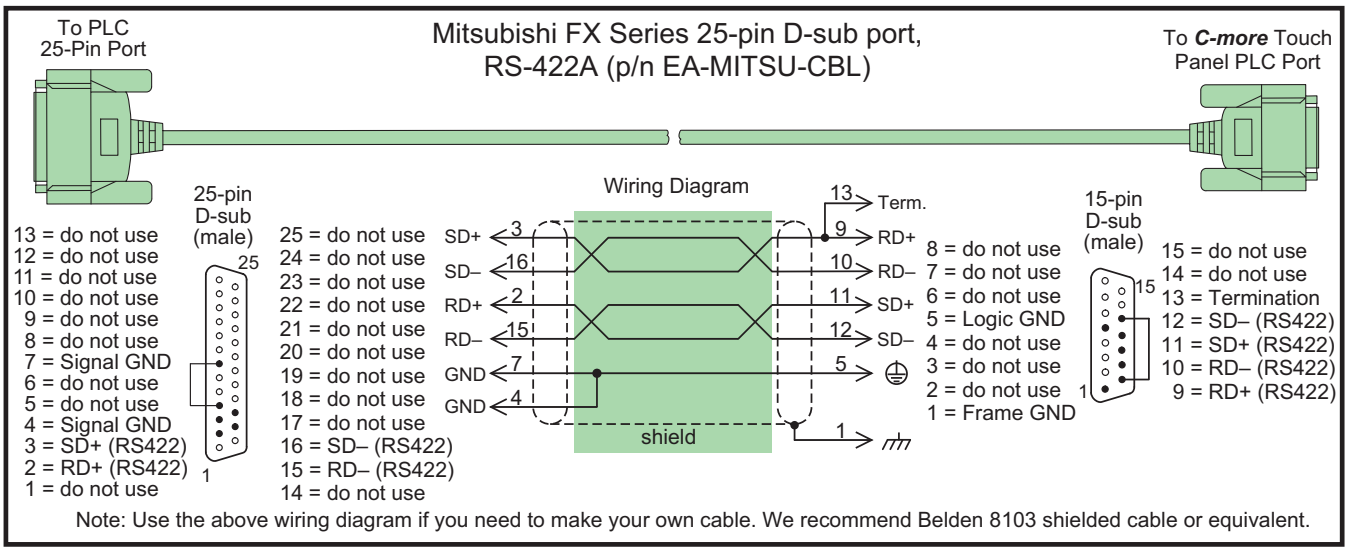
### User Constructed




Note: Use the above wiring diagram to make your own cable. We recommend using 22 AWG shielded cable.

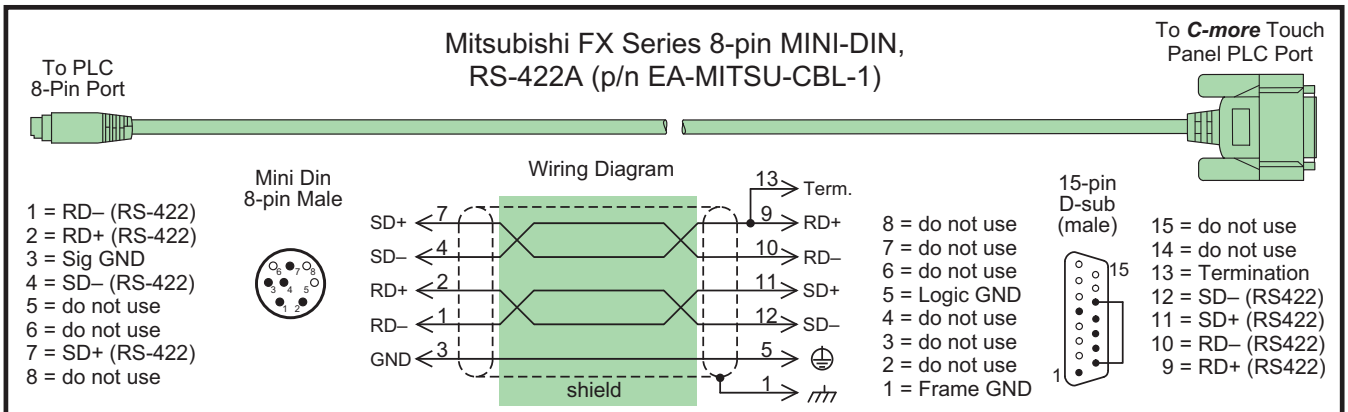
## Mitsubishi

### EA-MITSU-CBL



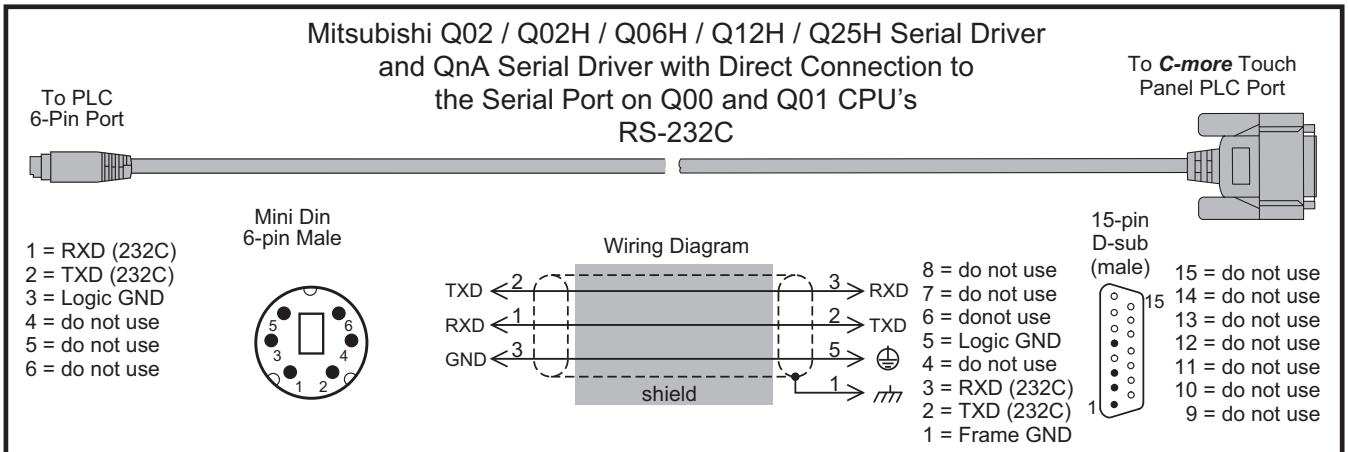

Note: Use the above wiring diagram if you need to make your own cable. We recommend Belden 8103 shielded cable or equivalent.

### EA-MITSU-CBL-1




Note: Use the above wiring diagram if you need to make your own cable. We recommend Belden 8103 shielded cable or equivalent.

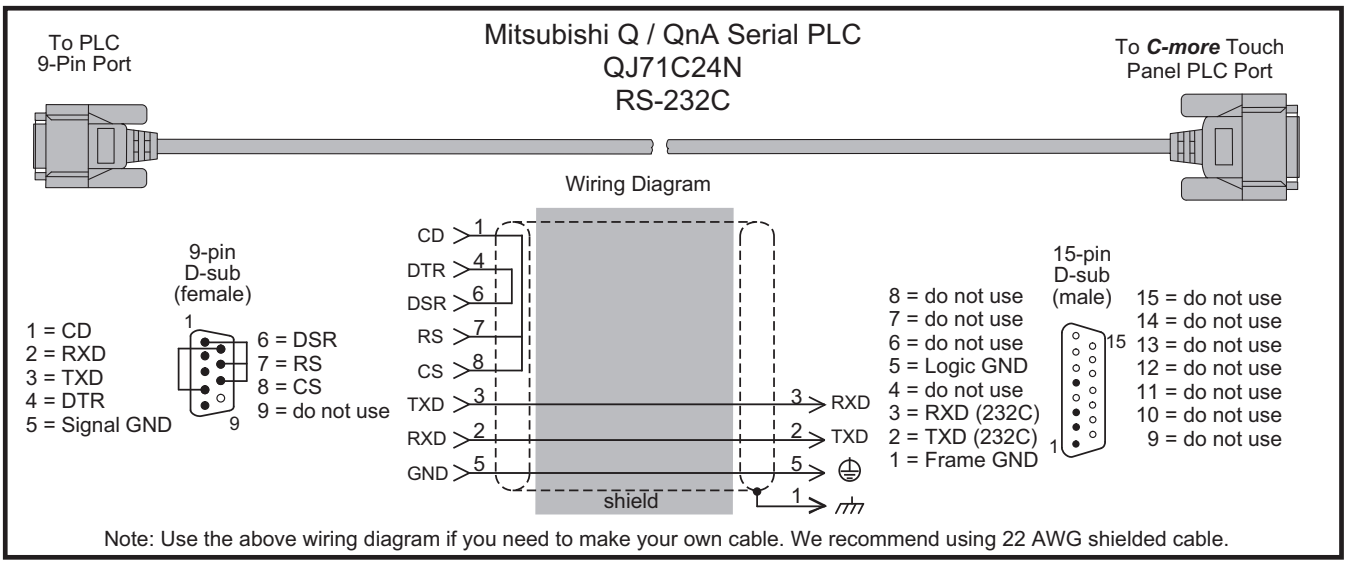
### User Constructed




Note: Use the above wiring diagram to make your own cable. We recommend using 22 AWG shielded cable.

## Mitsubishi (cont'd)

### *User Constructed*

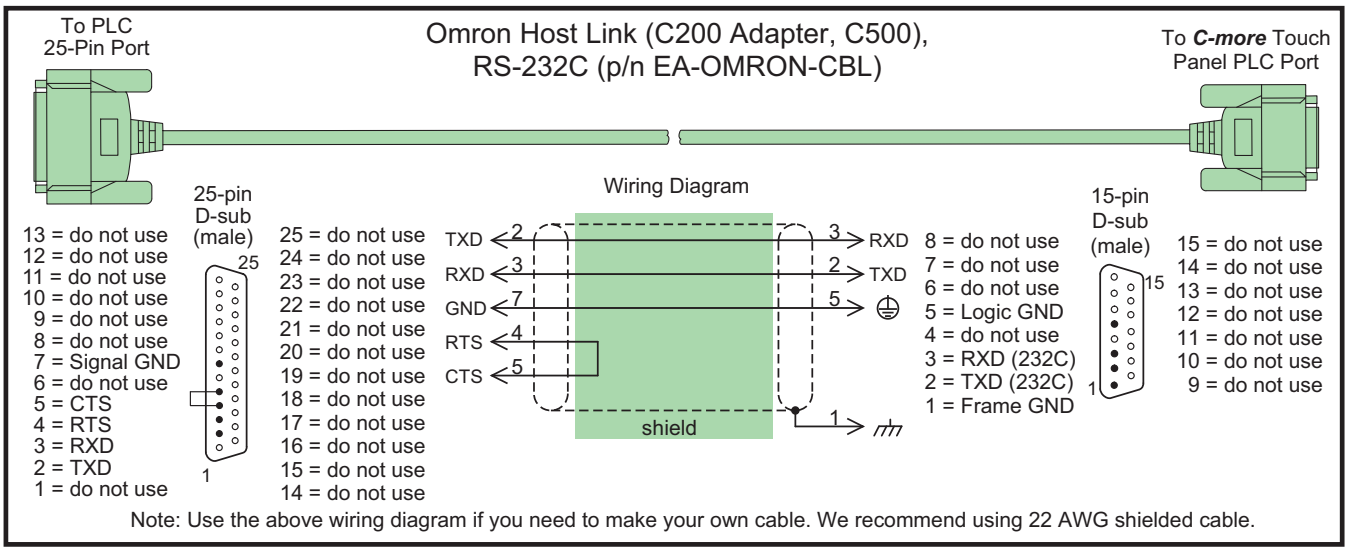



Note: Use the above wiring diagram if you need to make your own cable. We recommend using 22 AWG shielded cable.

6

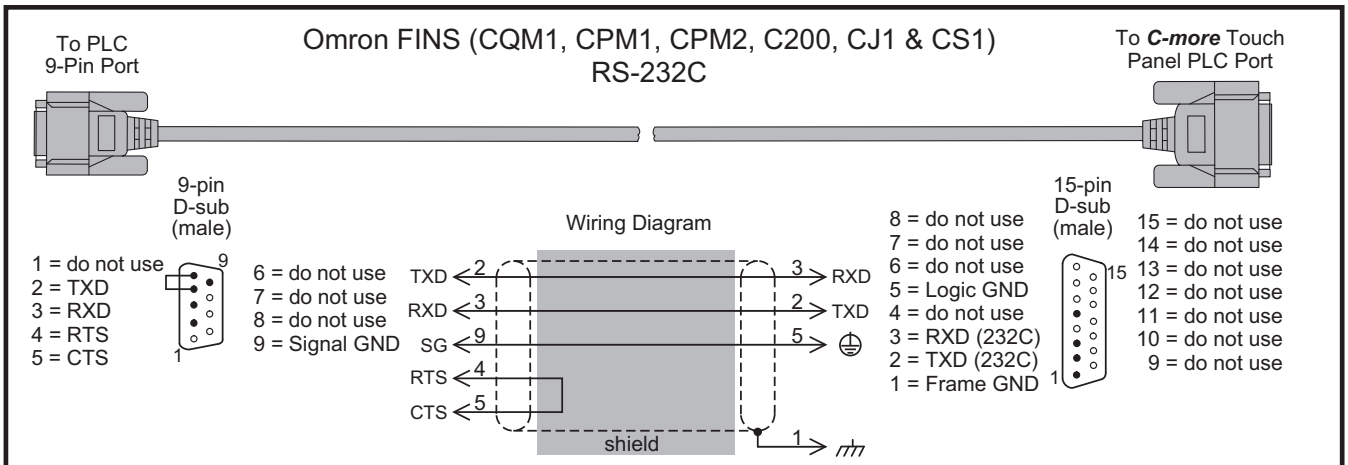
## Omron

### EA-OMRON-CBL



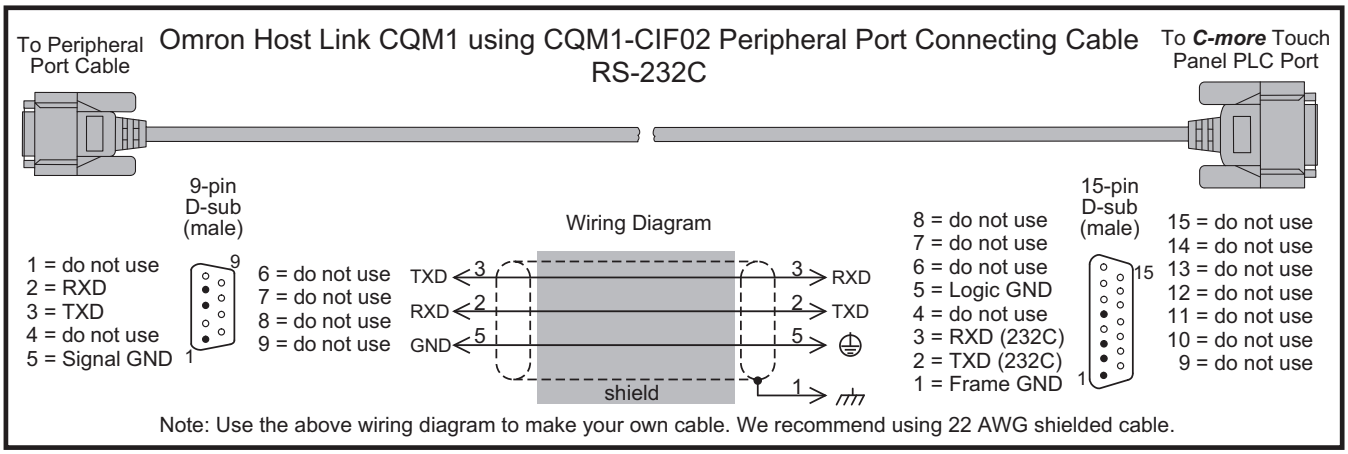

Note: Use the above wiring diagram if you need to make your own cable. We recommend using 22 AWG shielded cable.

### User Constructed




Note: Use the above wiring diagram to make your own cable. We recommend using 22 AWG shielded cable.

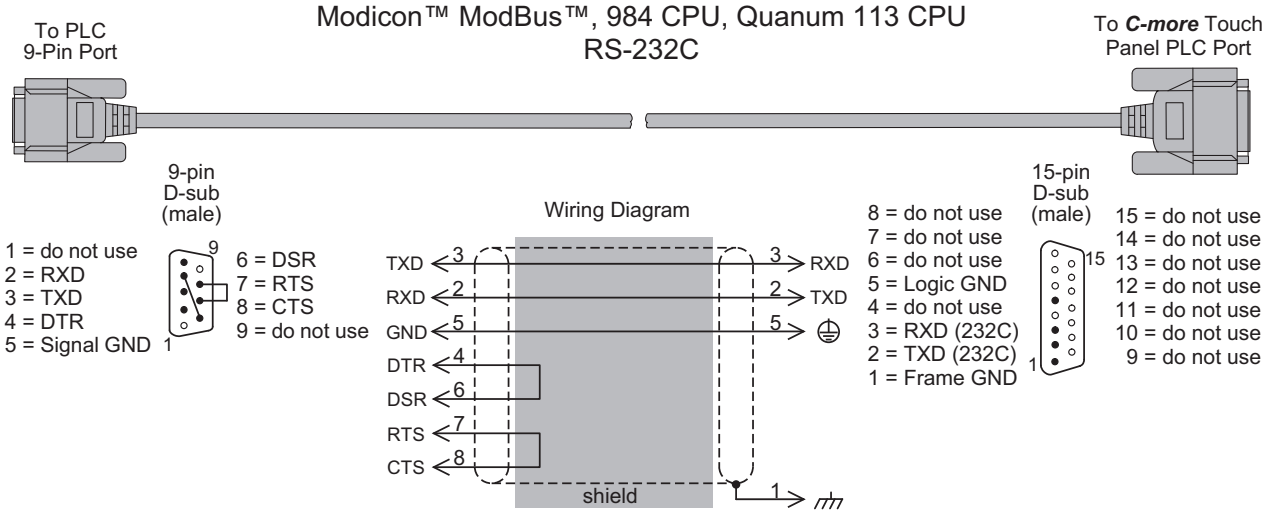
### User Constructed




Note: Use the above wiring diagram to make your own cable. We recommend using 22 AWG shielded cable.

## Modicon Modbus RS-232

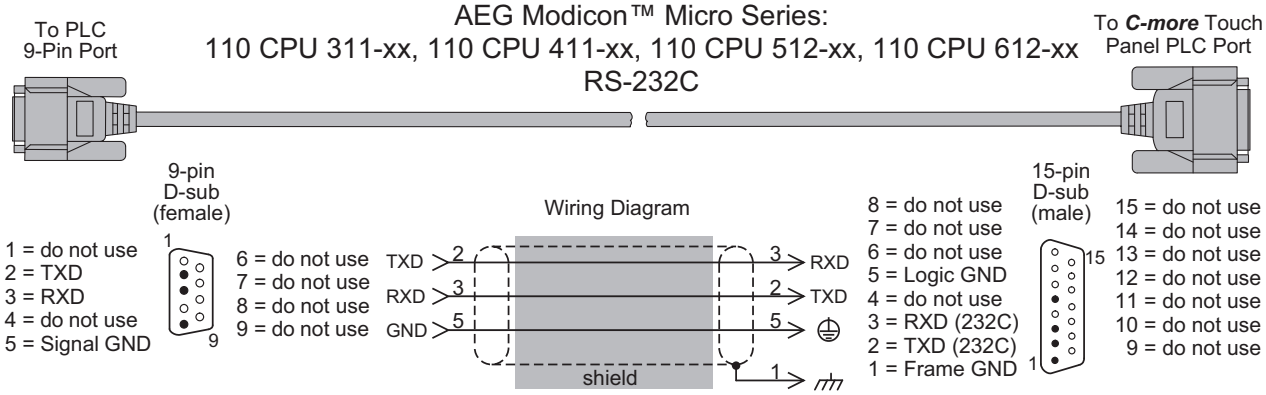
**User Constructed**




Note: Use the above wiring diagram to make your own cable. We recommend using 22 AWG shielded cable.

## Modicon Micro Series

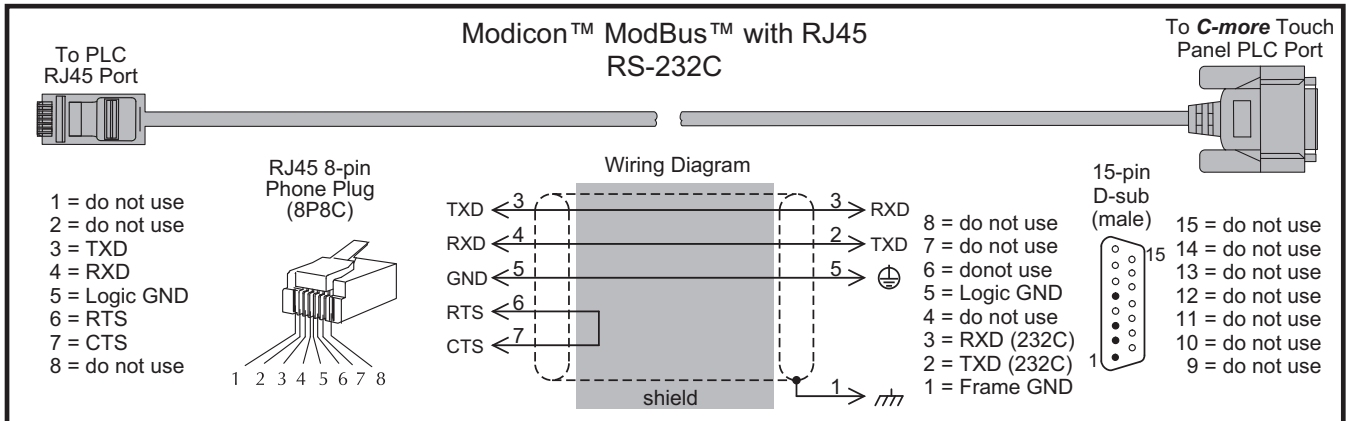
**User Constructed**




Note: Use the above wiring diagram to make your own cable. We recommend using 22 AWG shielded cable.

## Modicon Modbus with RJ45

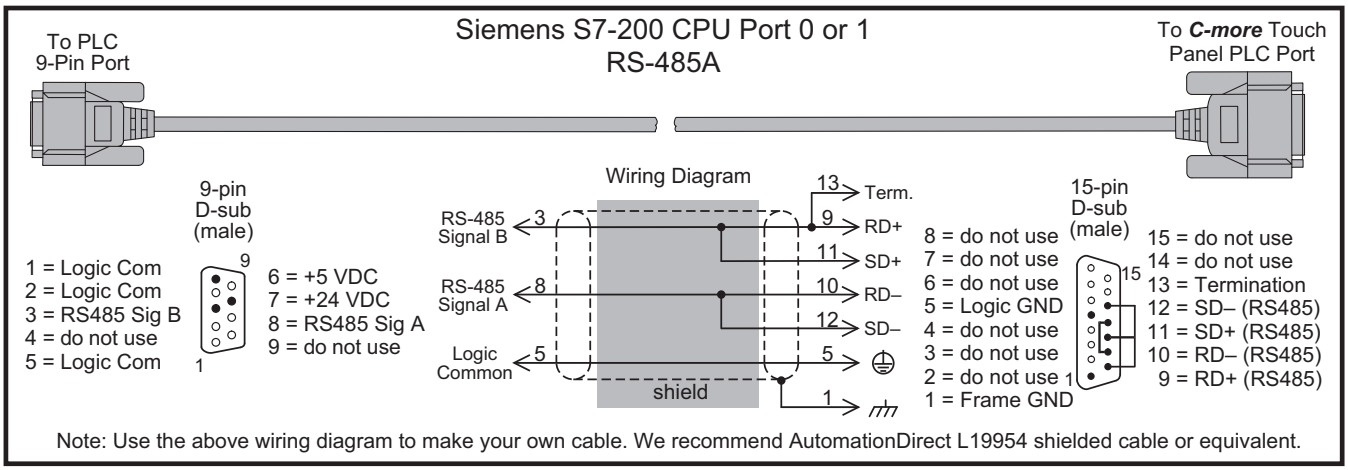
**User Constructed**




Note: Use the above wiring diagram to make your own cable. We recommend using 22 AWG shielded cable.

## Siemens

***User Constructed***




Note: Use the above wiring diagram to make your own cable. We recommend AutomationDirect L19954 shielded cable or equivalent.

# Maintenance

## In This Chapter...

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Check Operating Environment ..... 7-2
Check Operating Voltage ..... 7-2
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Check Physical Conditions ..... 7-3
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# Maintenance

Although the C-more touch panels require very little maintenance, setting up a routine maintenance schedule will ensure the longevity of the product in your application.

The following are some suggestions of items to include in a preventive maintenance list or schedule. Most of these items should be scheduled quarterly or semi-annually.

## Project Backup

- During routine preventive maintenance is a good time to make sure that there is an up-to-date backup of the application project. Although the C-more touch panel has the ability to upload the complete project from a panel through the programming software, insurance is warranted just in case the worse case scenario happens and the entire touch panel is destroyed.

## Check Operating Environment

- Make sure the touch panel is operating in the proper temperature range: 0 to 50 °C (32 to 122 °F).
- Make sure the touch panel is operating within the specified humidity range: (5 – 95% RH, non-condensing).
- Make sure the operating environment is free of corrosive gasses.

## Check Operating Voltage

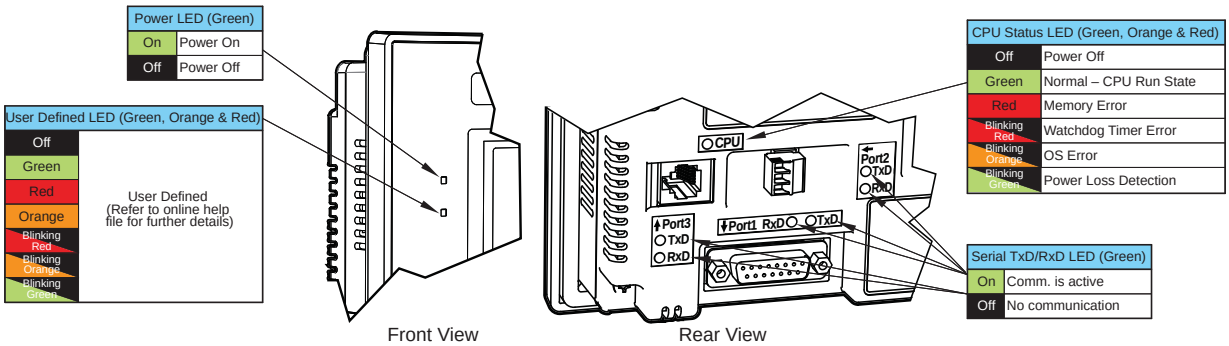
- Check the input voltage that is powering the touch panel to make sure it is within the appropriate range.

**DC:** 12 - 24 VDC

**AC:** If the panel is being powered from an AC/DC Power Adapter, EA-AC, then the acceptable input voltage range to the adapter is 100-240 VAC, 50/60 Hertz.

## Check Status Indicators

- During routine maintenance is a good time to take a quick look at the status indicators on the front and rear of the touch panel. The Power LED (PWR) indicator should be on and there should be activity on the TxD and RxD LED indicators when connected serially to a PLC or control device. Check the status of the CPU LED and compare it to the chart shown in the illustration below. Any indication of the CPU LED other than a solid green shows there is a possible problem, and the condition needs to be corrected.



## Check Physical Conditions

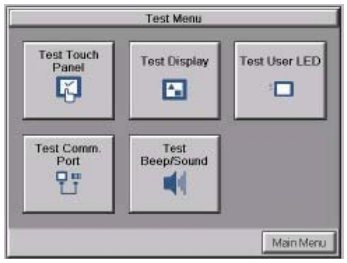
- Make sure that harmful chemicals are not being used around the panel. Look for any deterioration of the touch panel's bezel and front display area.
- Check the mounting gasket to make sure it is sealing properly and Replace the mounting gasket if there are any signs of deterioration, or if there is any evidence that moisture/liquids have penetrated to the inside of the enclosure where the panel is mounted. Information on a replacement gaskets can be found in **Chapter 9: Replacement Parts.**

p/n EA-xx-GSK

- Check to make sure that none of the cooling vents around the inside section of the touch panel are clogged with dust or debris. Also make sure that there is clearance around the touch panel as shown in **Chapter 4: Installation and Wiring.**

## Run Tests under System Setup Screens

- Use the touch panel's System Setup Screens to test the touch screen, display, communication ports, beeper and audio output (only with external amplifier and speaker(s) connected). See **Chapter 5: System Setup Screens** for additional details for the **Test Menu.**



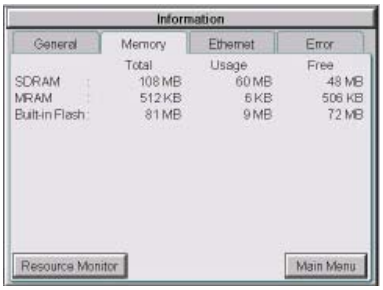

**Test Touch Panel** - allows the user to check the analog touch function of the screen by drawing free hand lines and shapes across the entire touch area. The display will retain the lines where the screen has been touched until the **Cancel** button is pressed.

**Test Display** - used to test the display and color rendition. A test pattern will first show both the primary colors and a gray scale. If the touch screen is not pressed within a few seconds, the display will go into alternating color sweeps across the screen until the panel is pressed again. If the screen is pressed when the test pattern first appears, it will stay in this mode until the **Cancel** button is pressed.

**Test Comm. Port** - used to test the functionality of the 15-pin PLC communication serial port, the 3-wire terminal block RS-485 port, the RJ12 RS-232 port and the Ethernet port. A loop-back connector can be fabricated and used on the serial ports to test the RS-232 or RS-422/485 communications for the TxD and RxD signals and also the RTS and CTS signals if applicable. The **Test Comm. Port** setup screens and **Chapter 5** show pin-outs for the RS-232 and RS-422/485 loop-back connectors. The Ethernet connection can also be tested for communications if it is at least connected to an Ethernet switch. If the touch panel is connected to a PLC, then an inquiry test can also be done to test the communications between the panel and the PLC. Press the Cancel button when finished to return to the **Test Menu** screen.

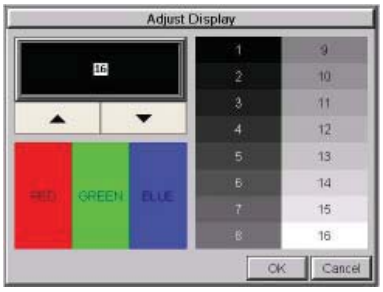
**Test Beep/Sound** - used to test the touch panel's internal beeper and also test the audio line output port with an external amplifier and speaker(s) connected. Testing the audio output is done by playing an included internal WAV file. Press the **Cancel** button when finished to return to the **Test Menu** screen.

## Check Memory Usage



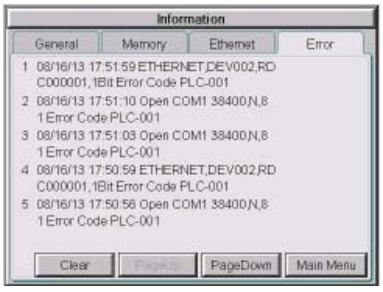

- A good time to check and record the touch panel's memory usage for future reference is during a routine maintenance schedule. The various memory devices being used by the panel are listed under the tab. This includes internal memory as well as any external memory device such as a USB pen drive or SD card memory. If no external memory device is inserted, it will not show up on the list.
- The memory usage can be viewed by use of the panel's **System Setup Screen's Main Menu**, and then selecting the **Information** button then the **Memory** tab. See **Chapter 5: System Setup Screens** for additional details on using the **Memory** tab.

## Check/Adjust Display Brightness



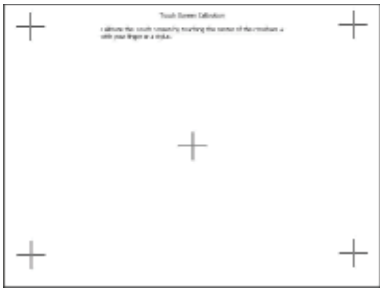

- Is is good practice to occasionally check the display brightness or contrast and adjust as required. This is done by using the **Setting Menu** in the **System Setup Screens**. See **Chapter 5: System Setup Screens** for additional details.

## Check Error Log




- Another good practice is to review the touch panel's **Error Log**. The log can be viewed by use of the panel's **System Setup Screen's Main Menu**, and then selecting the **Information** button. Look under the **Error** tab. See **Chapter 5: System Setup Screens** for additional details on using the **Error** tab, **Appendix A: PLC Protocol Error Codes** for a list of the error codes as they relate to the specific PLC that is being used with a description of the error, and **Appendix B: Touch Panel Runtime Errors** for a list of errors that may occur when the panel is in operation.

## Adjust Touch Panel



- It is recommended that a regularly scheduled maintenance program include **adjusting** the touch panel. The adjustment calibrates the touch area of the panel. The procedure should also be done anytime that it seems the touch area being pressed for an object is out of position by a small amount. The procedure is done by using the **Setting Menu** in the **System Setup Screens** and then selecting the **Adjust Touch Panel** button. See **Chapter 5: System Setup Screens** for additional details.

## Cleaning the Display Screen

EA-6-COV2

- The display screen should be cleaned periodically by wiping it with a lint free damp cloth using a mild soap solution. Dry the surface when finished with a lint free cloth. Do not clean with ammonia based products which are solvents and will damage the face of the panel.
- The longevity of the display can be increased by the use of a non-glare screen protector, p/n **EA-XX-COV2**, where XX = touch panel screen size, 6, 8, 10, 12, or 15. See **Chapter 3: Accessories** for additional information on the screen protectors.
- To prevent damage to the display screen, avoid touching the screen with sharp objects, striking the screen with a hard object, the use of abrasives near the screen, or using excessive force when pressing the touch screen.

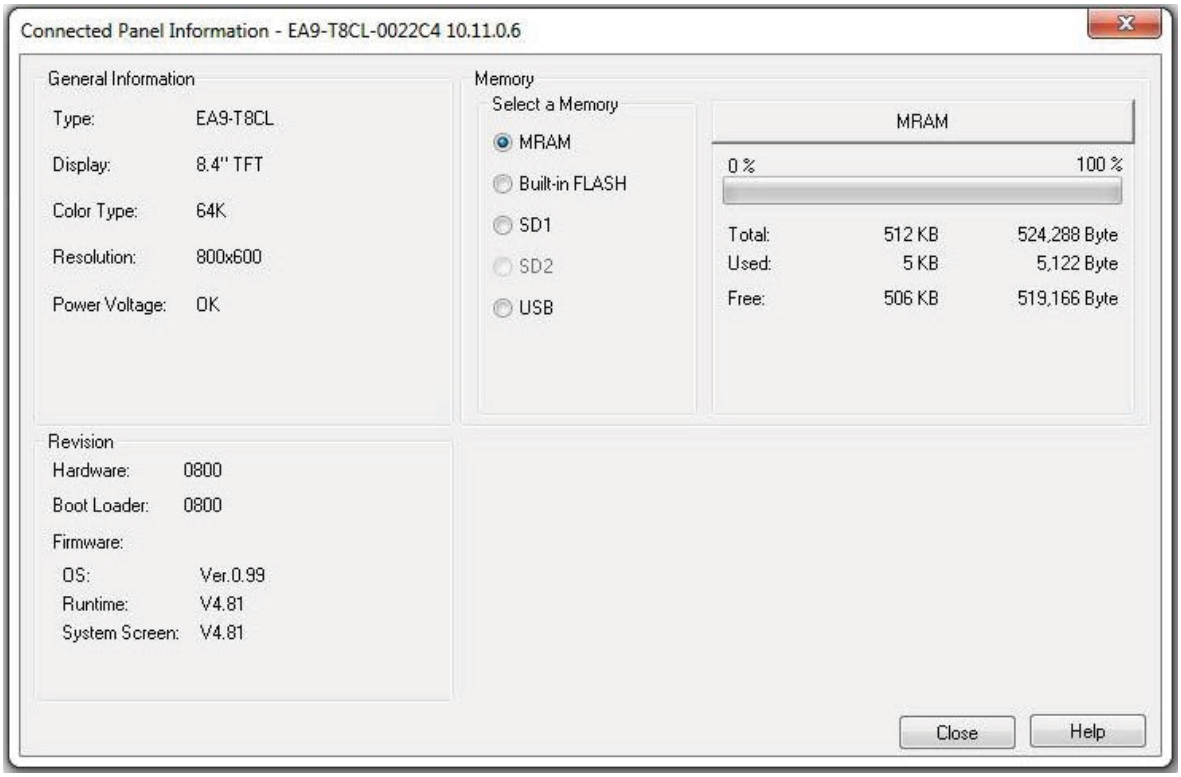
## Check Project Functionality

- During routine maintenance is a good time to check the functionality of your application, making sure that various areas on different screens do what they were designed to do. An outline or specification for the application is a useful tool for testing the various aspects of your application. As a starting point, you may want to run through all the screens to make sure they are accessible.
- If there are any trouble-shooting procedures built into the touch panel application, now is a good time to also check these aids.

## Checks from *C-more* Programming Software

- If you have a PC available with the ***C-more*** programming software, EA9-PGMSW, installed, and the PC is connected to the touch panel, there are checks you can make to the status of the touch panel by using the **Panel Information...** feature located under the **Main Menu** heading **Panel**. This includes the following:
  - Connected panel details
  - Memory availability and usage
  - Revisions






- Other functions that can be accessed from the programming software directly to the touch panel include: **DisplayScreen, Reboot, AdjustClock, MemoryClear,** and **Update Firmware**. Additional information for these functions can be found in the ***C-more*** programming software online help file.

## Notes:

# CHAPTER 8

# TROUBLESHOOTING

## In This Chapter...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The following topics are some of the more likely problems that may be encountered during the installation and operation of your C-more touch panel. We have made some suggestions on what to check in order to correct the problem. Please start with the troubleshooting flow chart that covers the more common problems encountered by other users.

## Common Problems

The troubleshooting flow chart shown on the following page is based on the more common problems fielded by our technical support team. If you are having problems, please start with the flow chart, follow the suggestions listed, and if you still need help, call our tech support team @ 770-844-4200. In addition to having ready the information suggested in the flow chart, please have the following available:

1) ***C-more*** touch panel part number including serial number with date code. Why is this information important? The various sizes of the touch panel use different processors and memory sizes, and therefore can have different types of problems within the particular panel size.

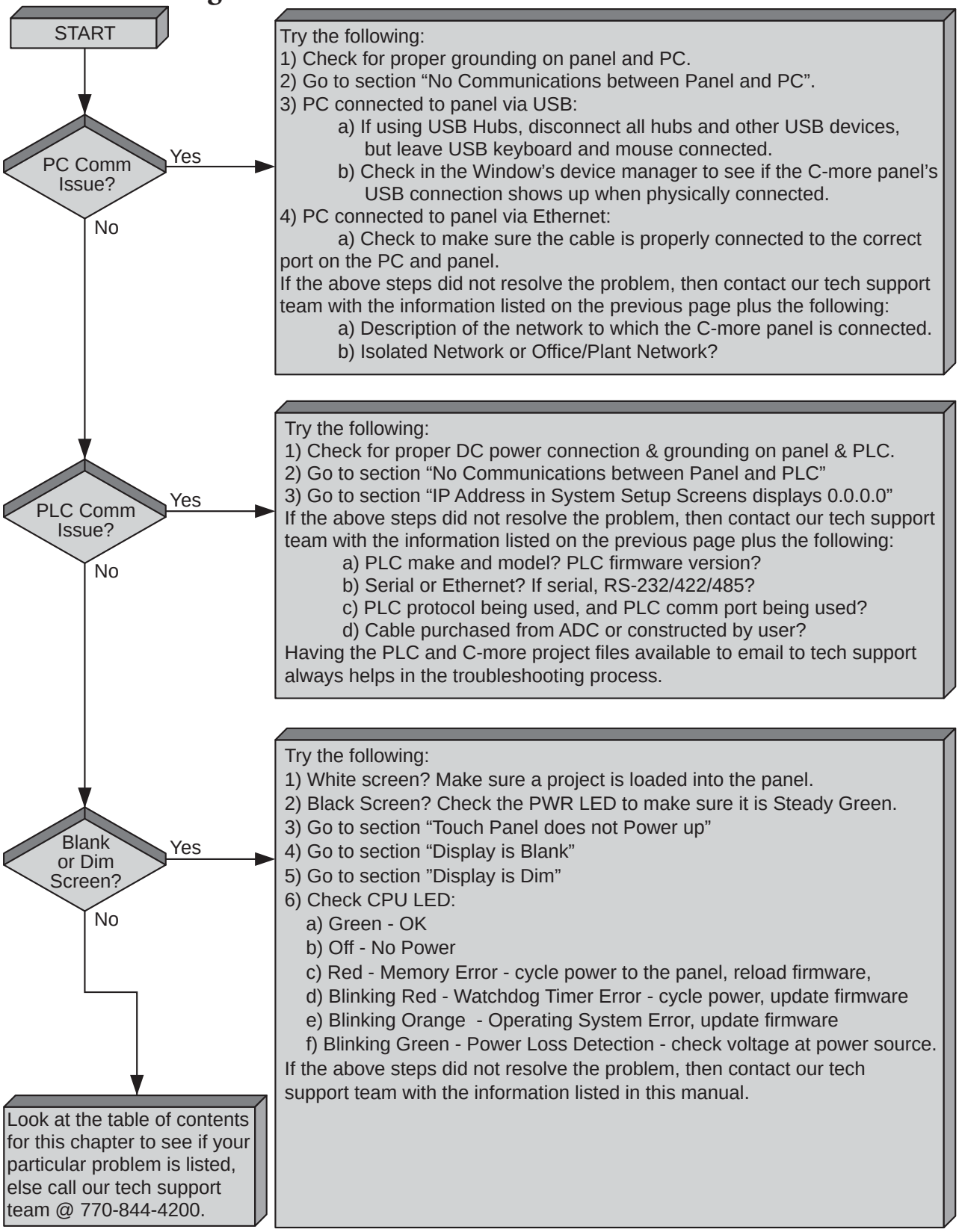
2) Programming software version that you are currently using. For example: Version 5.20. Having the software version number will allow our tech support team member to assess whether there are similar problems that have been reported when using the same version of the software. The programming software version can be found by clicking on **"About C-more Programming Software..."** selection under the **Help** pull down menu in the software. Also, it is always a good practice to visit the **Software/Firmware Downloads** area under the Tech Support section of the ***AutomationDirect*** website and check to see if you are using the latest version of the programming software. If you aren't using the latest software version, we suggest that you upgrade to see if this resolves your problem.

*NOTE: The "About C-more Programming Software..." dialog box will show a Firmware version. This is the current firmware version that is included with the programming software and does not reflect what firmware is actually loaded on your C-more touch panel. See the following for details on how to check the firmware version.*

3) Firmware version of the ***C-more*** touch panel. For example: V5.20. The firmware version can be checked by using the **System Setup Screens**, going to the **Information** menu under the **Main Menu**, and looking under the **General** tab for **Firmware: -Runtime**. The firmware version can also be checked by using the programming software, while connected to the panel, and clicking on the **Panel Information** selection under the Panel pull down menu. As with the programming software version, it is important for our tech support associates to know which firmware version you are using so they can check on any known problems. As with the programming software, we strongly suggest that the firmware be updated to the latest version. Check for the latest version and download from the **Software/Firmware Downloads** area of the ***AutomationDirect*** website.

It is also helpful to have a copy of your project file for our tech support associates to use in troubleshooting a problem, so please be prepared to forward a copy of your project if it is requested.

## Troubleshooting Flow Chart



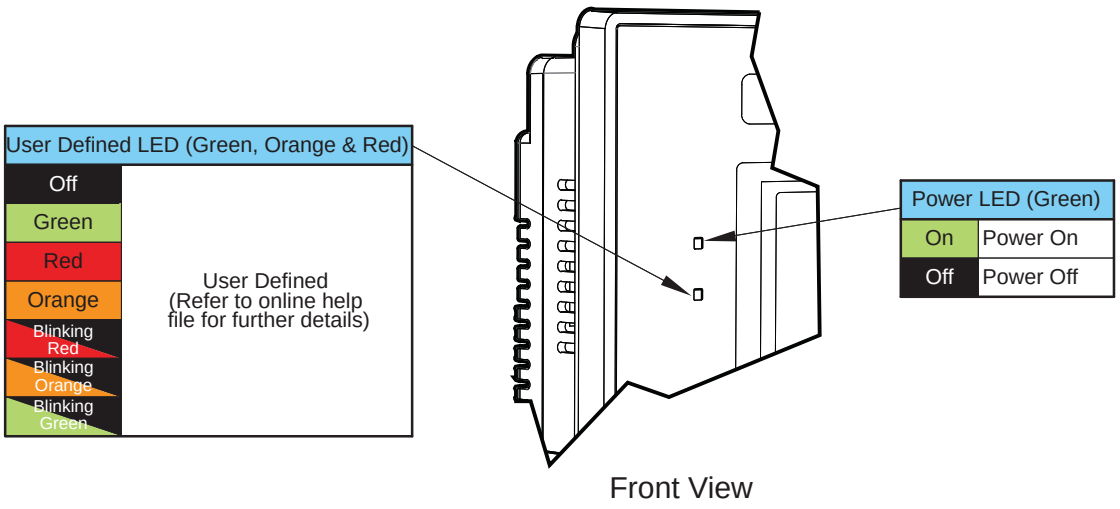
## Touch Panel does not Power up

1.) Check the status indicators on the front of the panel to see if the **Power LED (Green)** indicator is on. Refer to the diagram below. If the **Power LED (Green)** indicator is on and the panel was observed showing "Initializing..." during power up, but the display is now blank, go to the next troubleshooting tip, **Display is Blank.**

2.) If the **Power LED (Green)** indicator is off and the panel is being powered with a 12 or 24 VDC power source, use a voltmeter to check the incoming DC voltage level. If the incoming DC voltage is zero, check any fusing that may be in the circuit. If the fuse is open, determine cause and replace. If the DC voltage level is out of range, the DC power source needs to be corrected or replaced.

3.) If the **Power LED (Green)** indicator is off and the panel is being powered with an AC/DC Power Adapter, EA-AC, use a voltmeter to check the incoming AC power. The AC voltage to the AC/DC Power Adapter should be in the range of 100 to 240 VAC, 50/60 Hertz. If the incoming AC voltage is zero, check any fusing that may be in the circuit. If the fuse is open, determine cause and replace. If proper AC voltage is present on the AC/DC Power Adapter, but the **Power LED (Green)** indicator is off, replace the AC/DC Power Adapter, EA-AC.





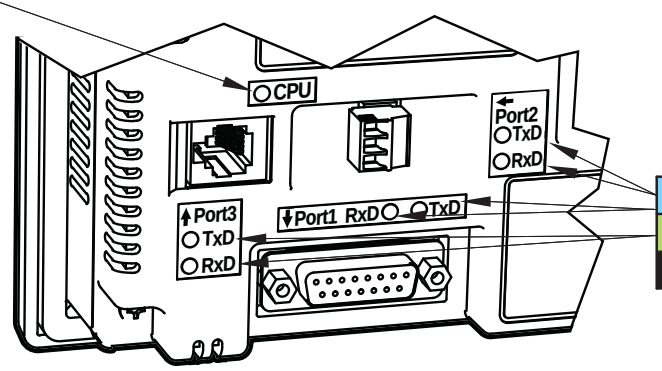
## Display is Blank

1.) Touch the screen to make sure the panel is not in the **Screen Saver** mode.

- The **Screen Saver** will be turned off and the panel screen will display:
  - If a **PLC Address** is configured to control the **Screen Saver** and changes from **On** to **Off.**
  - When the panel touchscreen is touched.
  - When the screen is clicked by **Remote Access.**
  - When the **Alarm Event** of the **Event Manager** occurs. (Only when the **Display** setting of the **Alarm Event** is checked).
  - When there is a screen change by the **PLC**.
  - When an **Error** such as a **Communication Error** occurs.

2.) If the panel is not in **Screen Saver** mode, check the status indicators on the rear of the panel.

| CPU Status LED (Green, Orange & Red) | |
|---|---|
| Off | Power Off |
| Green | Normal – CPU Run State |
| Red | Memory Error |
| Blinking Red | Watchdog Timer Error |
| Blinking Orange | OS Error |
| Blinking Green | Power Loss Detection |



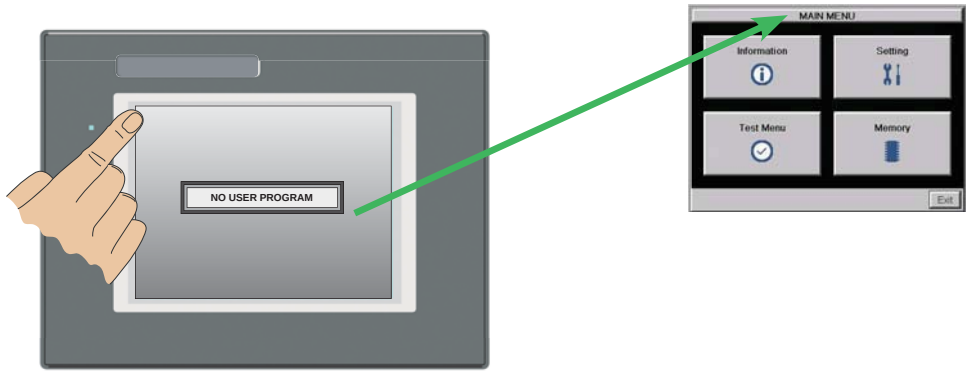

Rear View

| Serial TxD/RxD LED (Green) | |
|---|---|
| On | Comm. is active |
| Off | No communication |

- Make sure the **CPU** status **LED (Green, Orange, Red)** is a **steady Green**.
- If the **CPU** status **LED** is **blinking Green**, then the supply voltage is below 12 VDC, or below 100 VAC when using the optional ***C-more*** AC/DC Power Adapter, EA-AC. The backlight will turn off immediately to extend the power retention period. The panel will continue to run and the LCD display may be slightly visible. This may be seen as the display being dim, so it is advisable to check the incoming voltage.
- A **blinking Orange CPU** status LED indicates that the operating system could not be found. Reload the firmware to the touch panel. If this does not resolve the problem, the panel must be replaced.

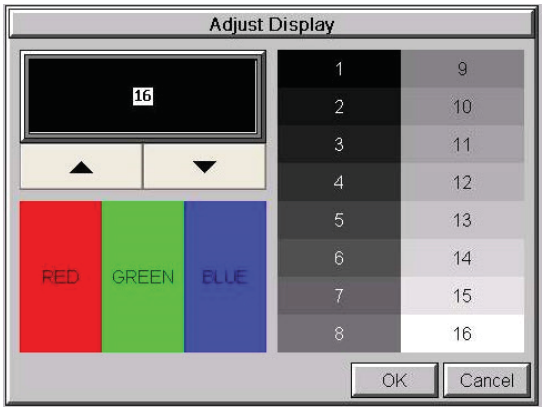
**Display is Blank continued on next page.**

3.) There is always the remote possibility that a project has been transferred to the touch panel that includes a screen that uses a black background and has no objects placed on the screen. To check for this possibility, access the **Main Menu** of the touch panel **System Setup Screens** by pressing the extreme upper left corner of the panel display area for three (3) seconds as shown below. If the **System Setup Screen's Main Menu** is displayed, then most likely an empty black background screen is being displayed.




## Display is Dim

1.) Check the brightness setting found under the System Setup Screens. See **Chapter 5: System Setup Screens** for additional information.




2.) Backlights will lose some luminance over time causing the display to slightly dim. The backlight average lifetime is rated at 50,000 hours and is defined as the average usage time it takes before the brightness becomes 50% of the initial brightness. The lifetime of the backlight depends on the ambient temperature; the lifetime decreases in low or high temperatures. To improve the backlight life, use the **Start Screen Saver** function that is available in the ***C-more*** Programming Software in the Panel Manager dialog box.

**Display is Dim continued on next page.**

- The **Screen Saver** will be turned off and the panel screen will display:
  - If a **PLC Address** is configured to control the **Screen Saver** and changes from **On** to **Off**.
  - When the panel touchscreen is touched.
  - When the screen is clicked by **Remote.**
  - When the **Alarm Event** of the **Event Manager** occurs. (Only when the **Display** setting of the **Alarm Event** is checked).
  - When there is a screen change by the **PLC**.
  - When an **Error** such as a **Communication Error** occurs.

3.) Another condition that may make the display appear dim is to view the touch panel in direct sunlight or in a location where direct light is reflected onto the display. The ***C-more*** touch panel displays have **Display Brightness** ratings of 280 to 310 cd/m2 (NITS), depending on the particular model. The higher the cd/m2 (NITS) rating, the more visible the display will be under bright lighting conditions.

*NOTE: The C-more panel is not rated for direct sunlight.*

## No User Program

If the touch screen is displaying the message "No User Program" after it has powered up, then either:

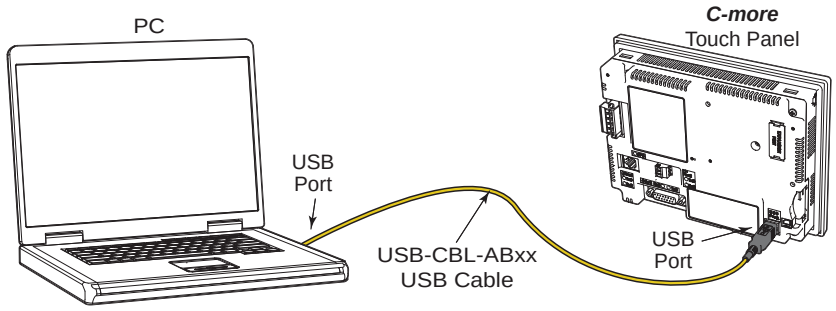
- the built-in Flash memory does not contain a recognized project, or
- an SD memory card is plugged into the SD1 slot and there is no project on the SD memory card. Turn the power off, remove the SD memory card and turn the power back on.

Keep in mind that on power up, the touch panel will either copy the project from its internal Flash memory to its internal SDRAM memory and run the project, or if an SD memory card is plugged into the SD1 slot, then any project contained on the SD memory card will be loaded to the panel's internal SDRAM memory and be run. In other words, the memory of an SD card in the SD1 slot will override the panel's internal Flash memory on power up or reboot, even if the SD memory card does not contain a project.

## No Communications between Panel and PC (Personal Computer) via USB

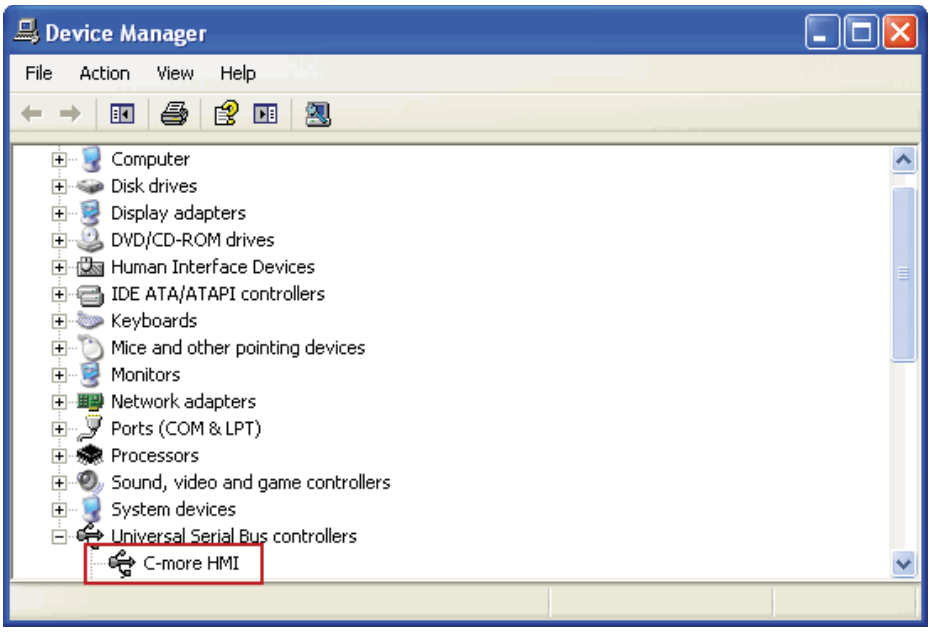
The ***C-more*** touch panel is programmed using the ***C-more*** Programming Software, EA9-PGMSW. The developed project is transferred from the PC to the touch panel by either a USB or an Ethernet connection between the two. (Ethernet available on full feature units only.)

If using USB, then a USB type AB programming cable, such as p/n USB-CBL-AB15, should be used to make a connection between the panel's USB Port, Type B and a USB port on the PC. The ***C-more*** Programming Software will install a USB driver on the PC during the software installation.



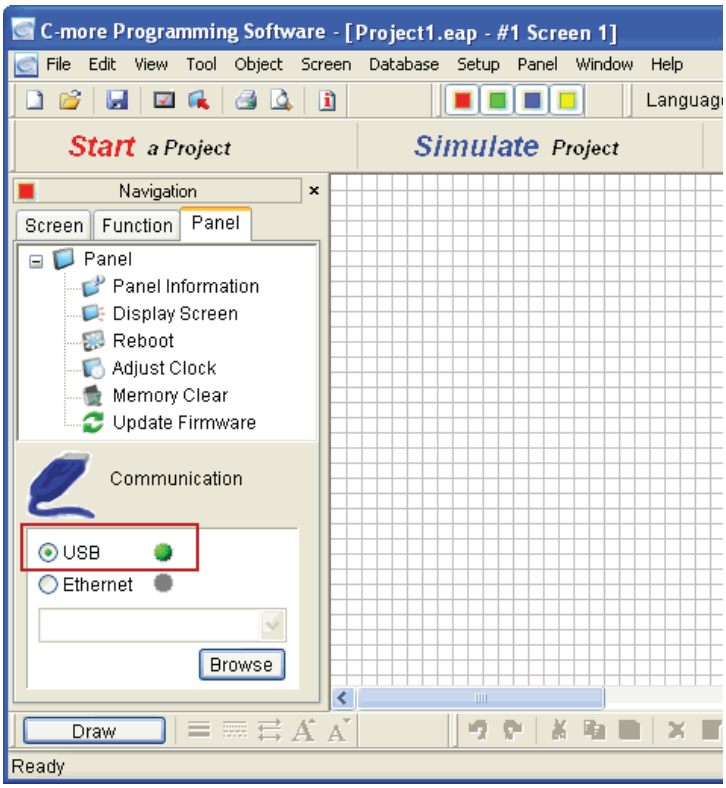



If the USB connection to the panel is recognized by the PC, you will hear the Windows device-recognized-sound when the powered panel is connected to the PC. The driver will appear in the Windows Device Manager as **C-more HMI**.



## No Communications between Panel and PC (Personal Computer) via USB (cont'd)

The ***C-more*** software will then identify the USB connection with a green indicator.

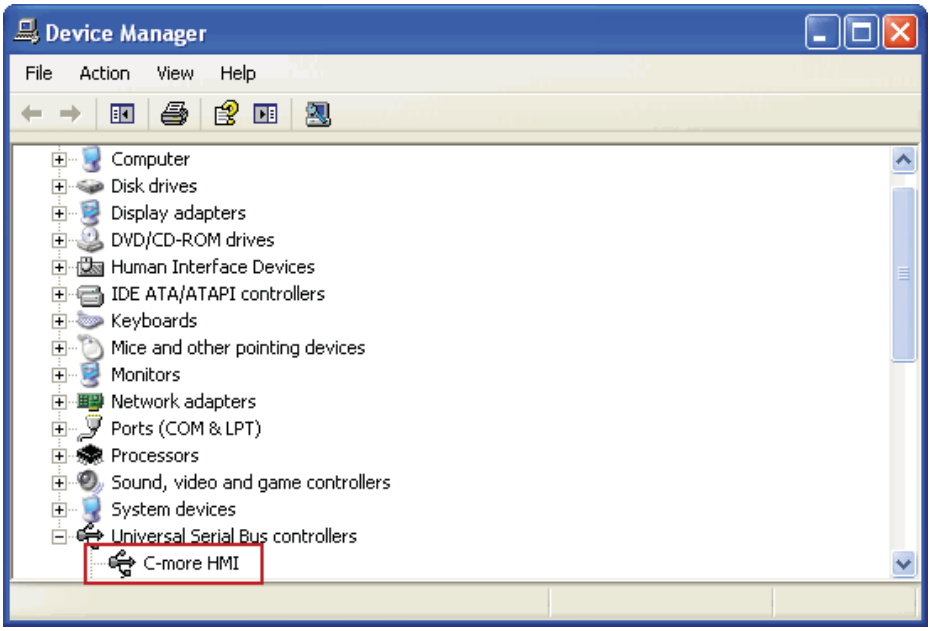



This Communication indicator appears on the Panel tab in the Navigation window and in the Project Transfer or Read from Panel windows.

## USB Driver Troubleshooting

Check the USB driver using Windows Device Manager:

With the ***C-more*** panel connected to the PC, on the PC, open **Control Panel--> System -->Hardware tab --> Device manager**. Next expand "Universal Serial Bus controllers". The ***C-more*** driver is named **C-more HMI** as shown below:




If the ***C-more*** programming software Communication Config dialog USB indicator is red, and the driver does not appear in Device Manager,

1) Unplug both end of the cable and replug them in.
2) If that does not establish communication, plug into a different USB port on the PC.
3) If there are any USB hubs or other devices being used, temporarily eliminate them to see if this solves the problem.
4) Reinstall the ***C-more*** HMI USB driver.

## USB Driver Troubleshooting (cont'd)

The ***C-more*** USB driver installation utility is bundled with the ***C-more*** software installation files. If you have a ***C-more*** software CD, the file is in the root, called **C-moreUSBDriver.exe**.

If you downloaded the software, when you extracted the files, the **C-moreUSBDriver.exe** was extracted to the location you chose. First, close the C-more software and disconnect the USB cable from the PC. Then, browse to **C-moreUSBDriver.exe** and run it.

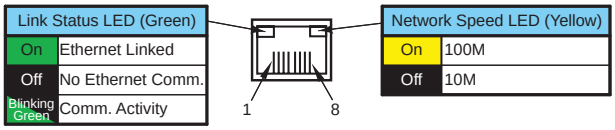
Plug the USB cable into the PC and the *C-more* panel.

The Found New Hardware Wizard will prompt you to search for the driver. Select "No not this time" , click Next. Select "Install the Software automatically (Recommended)" click **Next**. Click **Continue Anyway** in the Windows Logo warning popup. Click **Finish**.

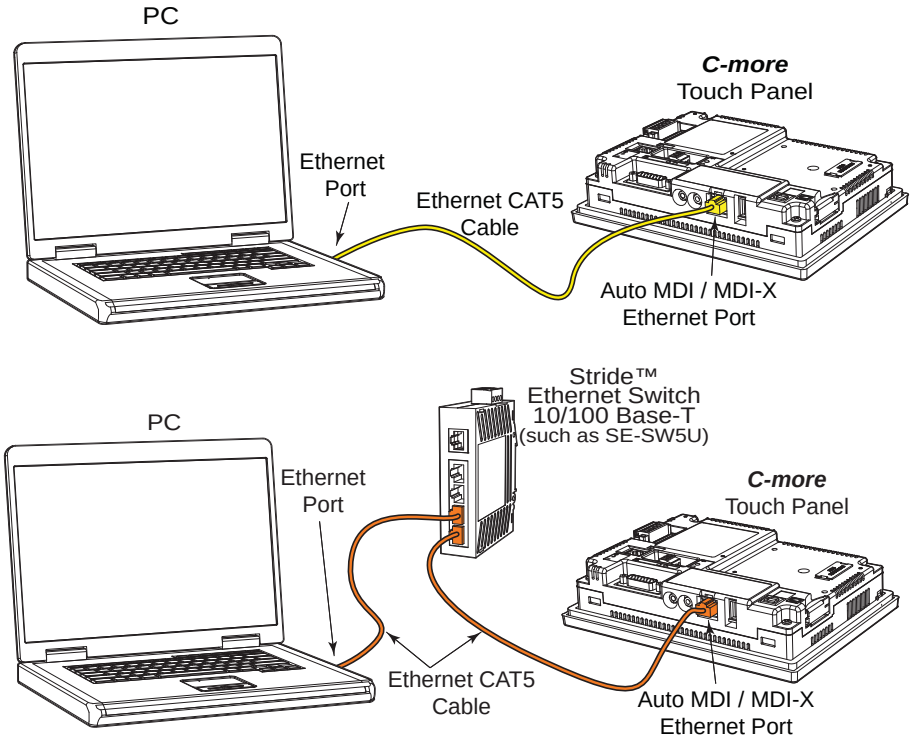
Open the project in the ***C-more*** software. The Communication Config (and Transfer Project) USB indicator should be green.

## No Communications between Panel and PC (Personal Computer) via Ethernet

When using an **Ethernet** connection to communicate between the touch panel and the PC and the communications does not seem to be working, the first area to check is the Ethernet status indicators located next to the **10/100 Base-T Ethernet Port** on the rear of the panel. The **Link Status LED** must be displaying a steady or blinking green.




If using **Ethernet**, there are two basic ways to make the connection. You can use an **Ethernet** cable to make a direct connection between the touch panel and PC or use an **Ethernet** cable from the touch panel to a switch and then to the PC.



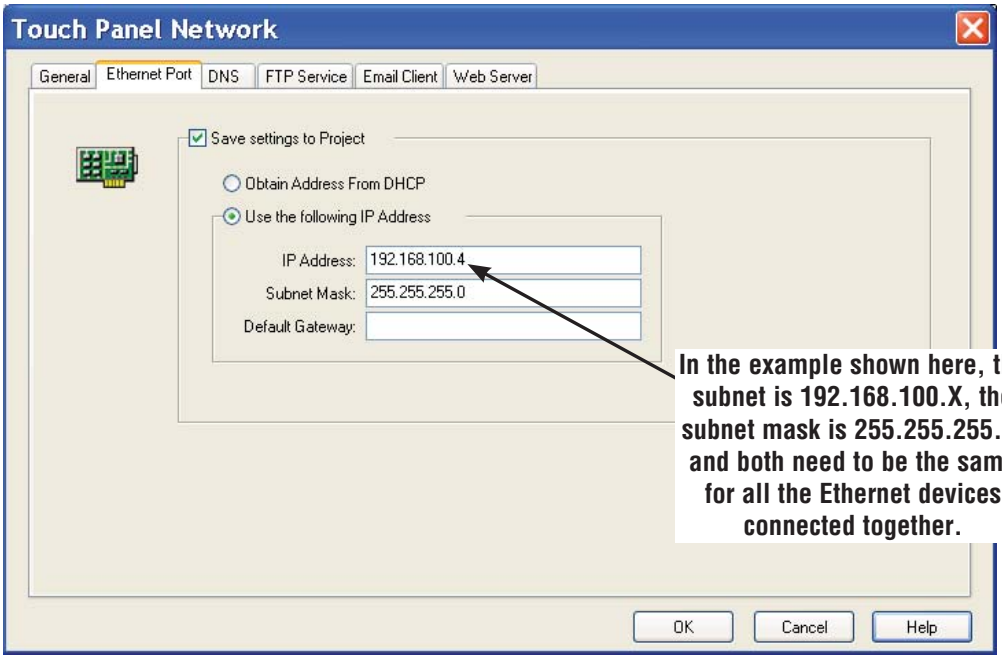

Use the ***C-more*** programming software to check the status of the **Ethernet** communications. From the **Navigation** window, select the **Panel** tab. At the bottom of the **Panel** tab is the **Communication Config** dialog box. Select the **Browse** button. If the connection is working the panel will be listed in the online link list. Select the panel and then select OK. If the **Ethernet** communications to the panel is working, then there should be a "green" indicator next to the **Ethernet** selection. There should also be an **IP Address** shown in the browse box below the **Ethernet** selection. If the **Ethernet** radio button is "red", then you will need to check your **Ethernet** cables and connections or **Browse** for the panel.

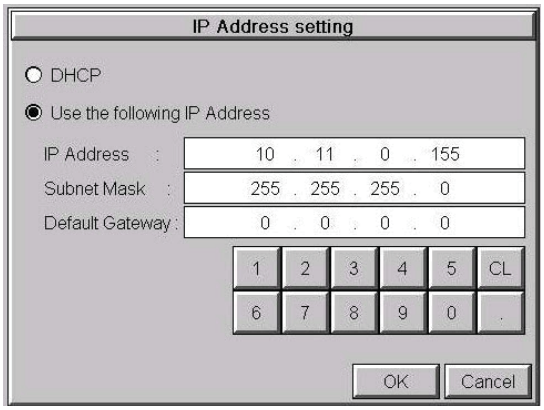
## No Communications between Panel and PC (Personal Computer) (cont'd)

There can also be a conflict with another Ethernet connection that may be using the same **IP Address**. You may want to check the setup both in the touch panel and also in your PC. As a starting point, it is best to start with an assigned IP Address and Subnet mask, mainly to eliminate IP addressing conflicts. Use the ***C-more*** programming software and open the **Touch Panel Network** dialog box under the **Main Menu's Setup** drop down menu. Click on the **Ethernet Port** tab to display the dialog box used to set up the touch panel's **Ethernet** port.

Another cause of an Ethernet communications problem that may be encountered, is the touch panel doesn't show up in the node list, which can be caused by the PC having a firewall.

The figure below shows the **Touch Panel Network** dialog box with the **Ethernet** port tab opened. The **Save settings to Project** check box is checked and we are using the **Use the following IP Address** selection by checking its radio button. **The subnet (192.168.100.X) and the subnet mask (255.255.255.0) must be the same for both the panel and the PC.** See the ***C-more*** programming software on-line help for additional details regarding the **Touch Panel Network**.



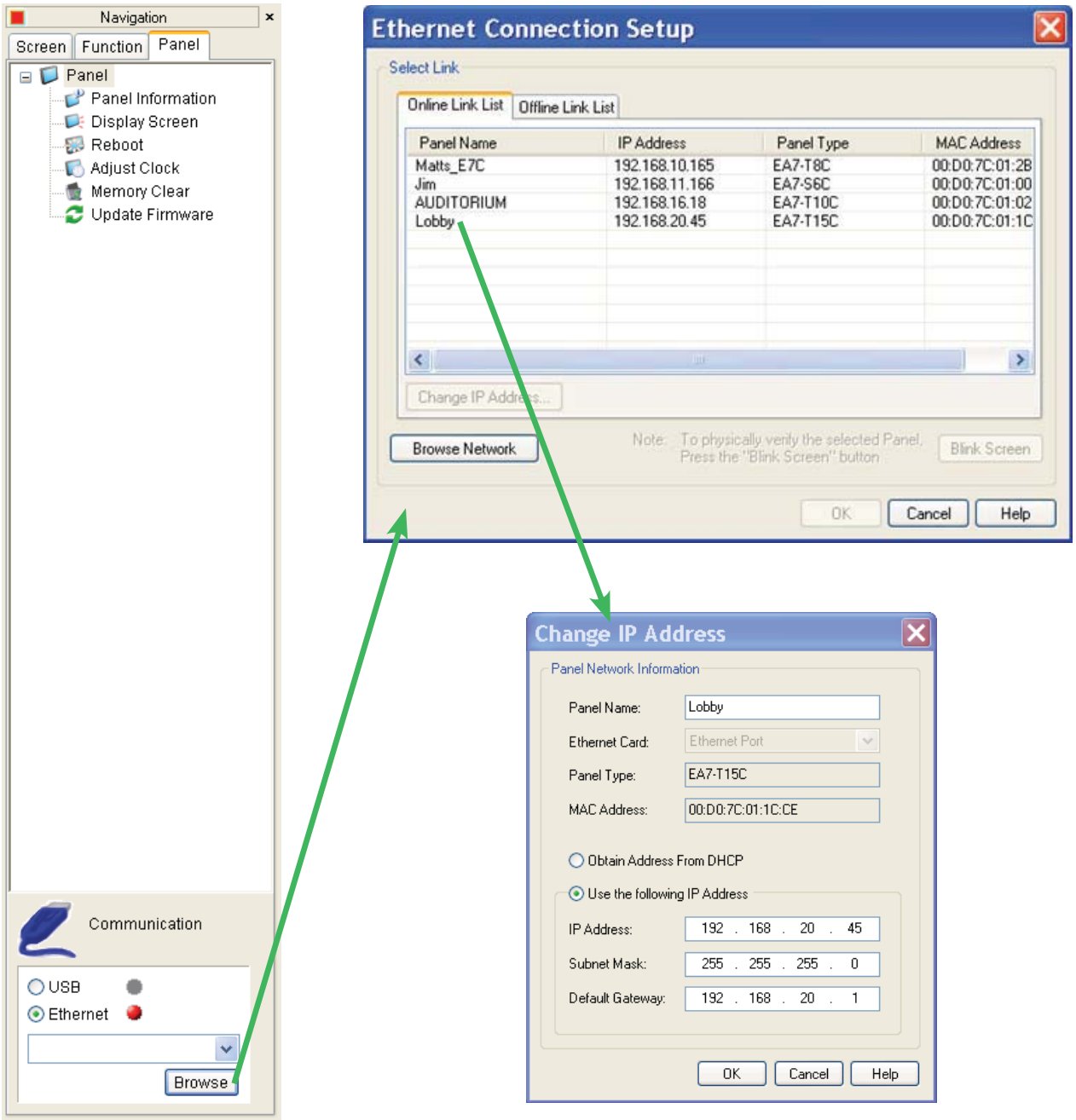




The **IP Address** assigned to the touch panel can also be checked or edited by using the system setup screens built into the touch panel. See **Chapter 5: System Setup Screens** for additional information.

The figure to the left shows a different example of the panel's **System Setup Screens' Ethernet Port** dialog box for configuring the **Ethernet** port. Again, make sure the subnet (10.11.0.x) and subnet mask (255.255.255.0) is the same for both the panel and the PC.

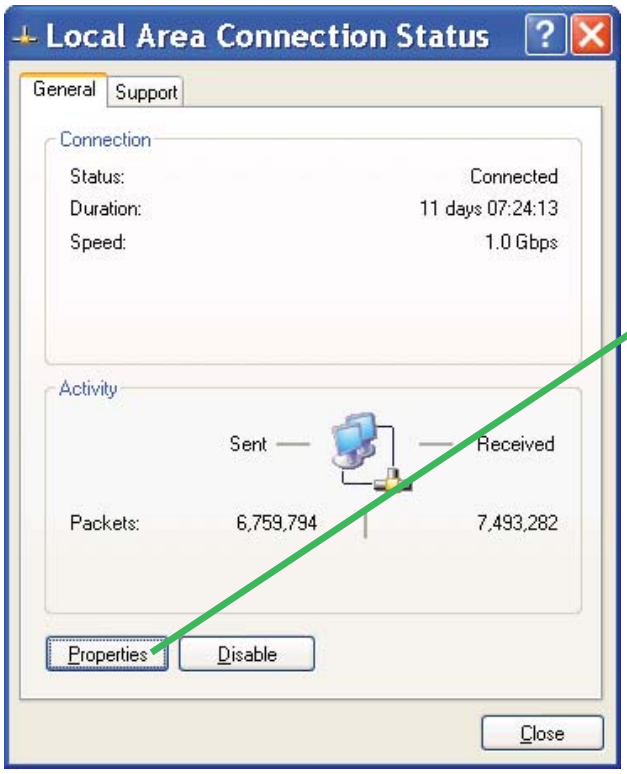
## No Communications between Panel and PC (Personal Computer) (cont'd)

Another option for accessing the **IP Address** assigned to the touch panel is to use the ***C-more*** Programming Software. Open the **Navigation** window's **Panel** tab and click on the **Browse** button under the **Communication** window at the bottom. This will open the **Ethernet Connection Setup** window. The **Online Link List** tab will show all of the connected panels. If none are shown, try clicking the **Browse Network** button to search for attached devices. Double click on the **Panel Name** you want to access and this will bring up the Change IP Address window. In this window changes can be made to the panel's name, IP address, subnet mask, and default gateway.

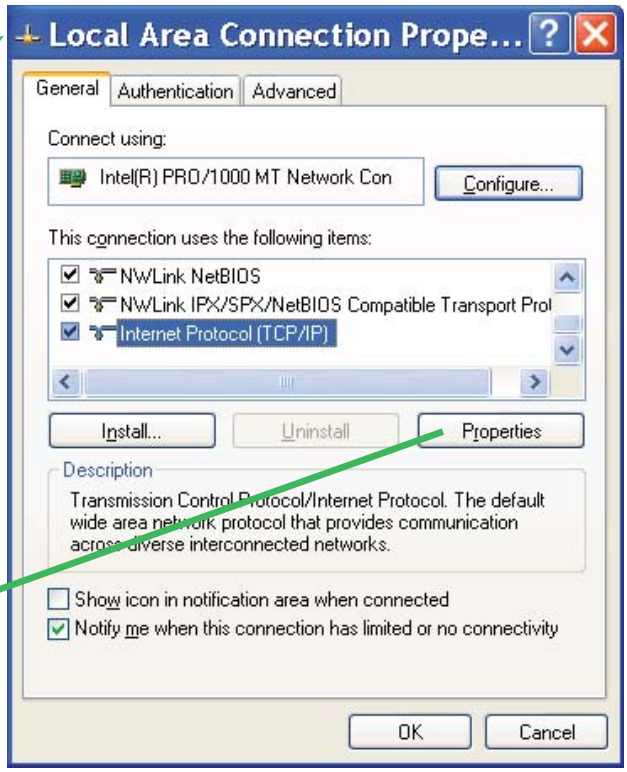


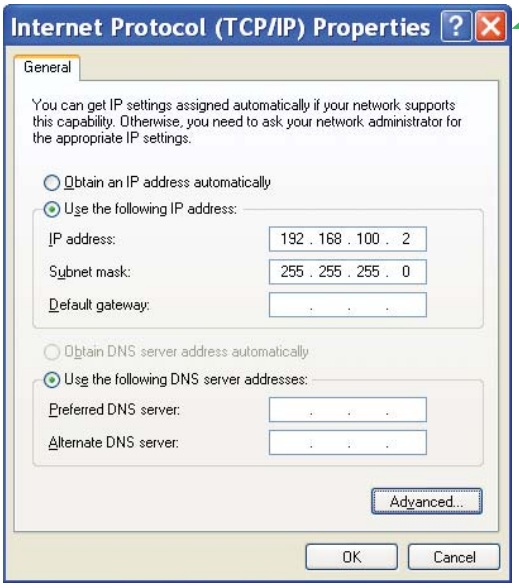
## No Communications between Panel and PC (Personal Computer) (cont'd)

Check the **IP Address** setting of the PC by opening the Windows operating system's **Control Panel** and then selecting the **Network Connections** utility. Click on **Properties**, scroll down to **Internet Protocol (TCP/IP)** and click **Properties**. The I**nternet Protocol (TCP/IP) Properties** dialog box will open. Again, make sure the **Subnet Mask** is set the same for both the panel and the PC and also make sure that the **IP Addresses** do not conflict.



*NOTE: If a DHCP Server is being used to obtain the IP Address for the PC, there are ways to identify the IP Address. For example, if using Windows XP, open a Command Prompt (Run > CMD) and type IPCONFIG /ALL. A list of all Ethernet assignments for the PC will be shown.*

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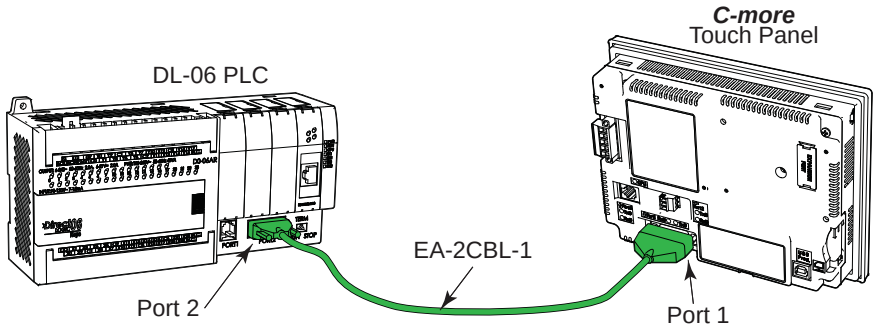
## No Communications between Panel and PLC

The communications between the ***C-more*** touch panel and designated PLC or controlling device can be accomplished by either a serial connection or by an **Ethernet** connection to the panel's **10/100 Base-T Ethernet Port**. (Ethernet available on full feature units only.) All panels include a 15-pin RS-232/422/485 port. Full featured panels include a 3-wire RS-485 connection and an RJ12 RS-232 connection.

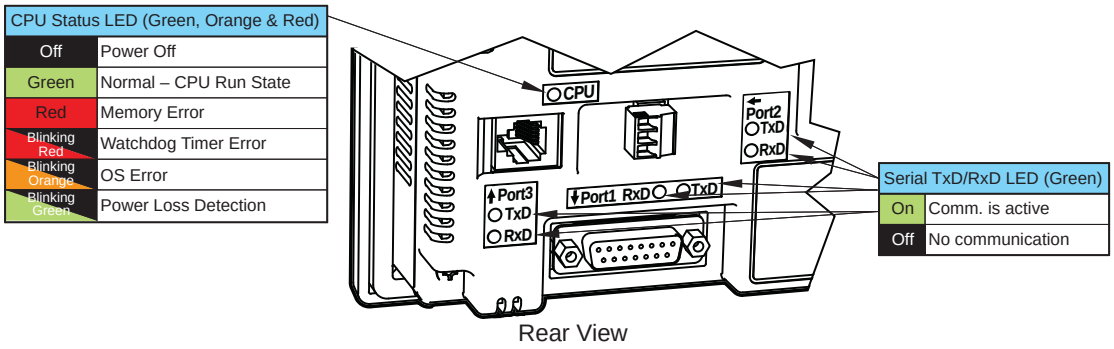
1.) If the touch panel and PLC are connected serially and the communications have seemed to stop working, then first check the **TxD** and **RxD** status indicators on the rear of the panel at the connected port for activity.






If there is no activity on one or both the **TxD** and **RxD** status indicators, then it should be suspected that either:

- serial comm port settings are incorrect
- the cable is bad and needs to be replaced
- the serial port on the panel is defective
- the PLC serial port is bad
- No TxD also can indicated no tags being polled on device



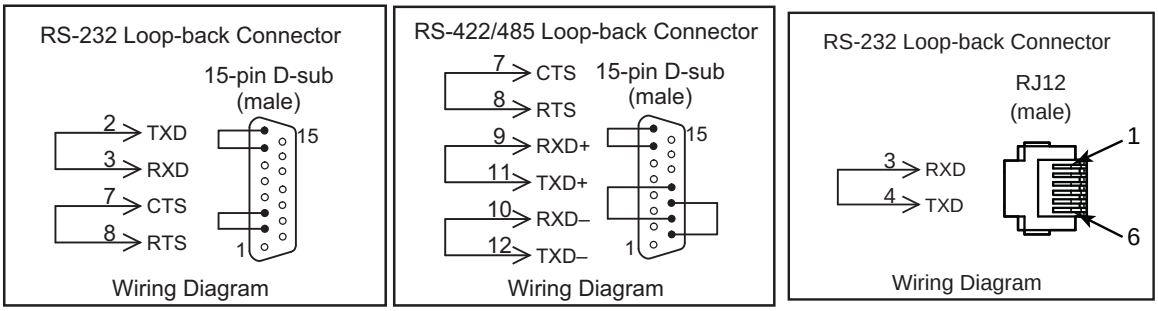

The status indicators will show activity whether the serial communications is wired for RS-232 or RS-422/485.

Electrical noise, pulse generating wiring and/or improper grounding can also cause problems with communications. Refer to the **Electrical Noise Problems** section later in this chapter for additional help.

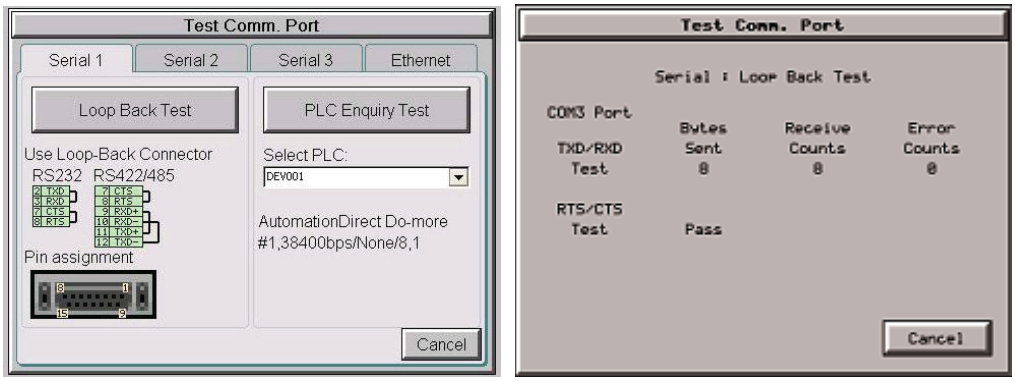
## No Communications between Panel and PLC (cont'd)

The serial ports on the ***C-more*** touch panel can be tested using the panel's system setup screens. Access the ***Main Menu*** of the panel's system setup screens, press the **Test Menu** button, then press the **Test Comm. Port** button and select the appropriate port tab. You will need to fabricate a **Loop Back Connector** for the type of serial connection that is being used in your application, either RS-232 or RS-422/485, per the wiring diagrams shown below. Plug the loop back connector into the panel's 15-pin PLC serial communications port and then press the **Loop Back Test** button to run the test. See **Chapter 5: System Setup Screens** for additional information.

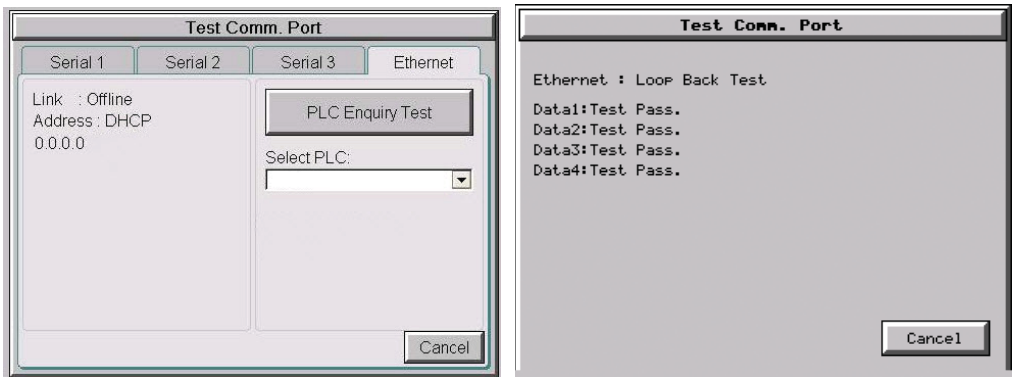
Loop back connector wiring diagrams:




System setup screens **Test Comm. Port** dialog boxes:

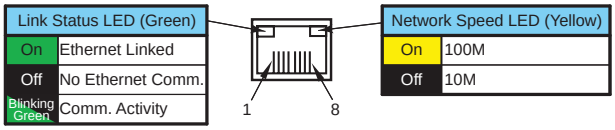



The **PLC Enquiry Test** can also be performed to determine if the **Ethernet** communication is working correctly between the panel and designated PLC.

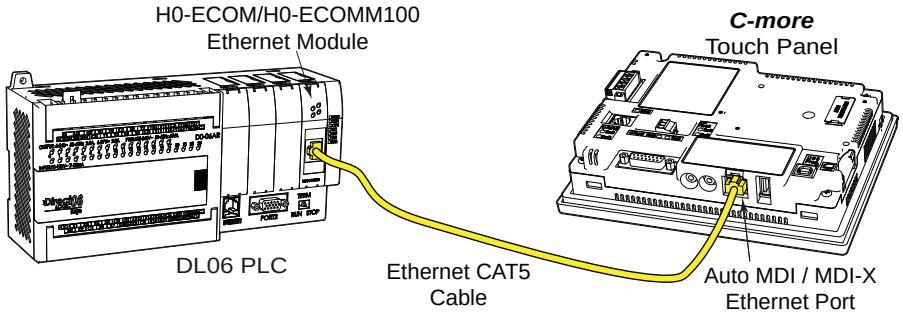


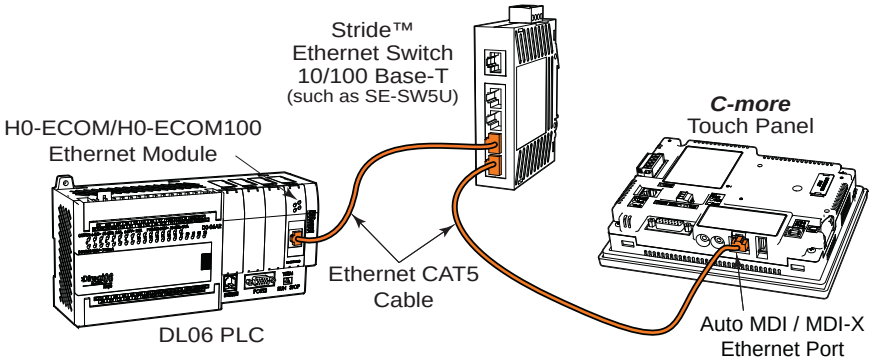
## No Communications between Panel and PLC (cont'd)

2.) If using an **Ethernet** connection between the touch panel and the PLC, and there is a problem with the communications, the first area to check is the **Ethernet** status indicators located next to the **10/100 Base-T Ethernet Port** (shown below) on the rear of the panel.




There are two basic ways to make the connection. You can connect directly from the touch panel to the PLC or connect from the touch panel to a switch that is also connected to the PLC.

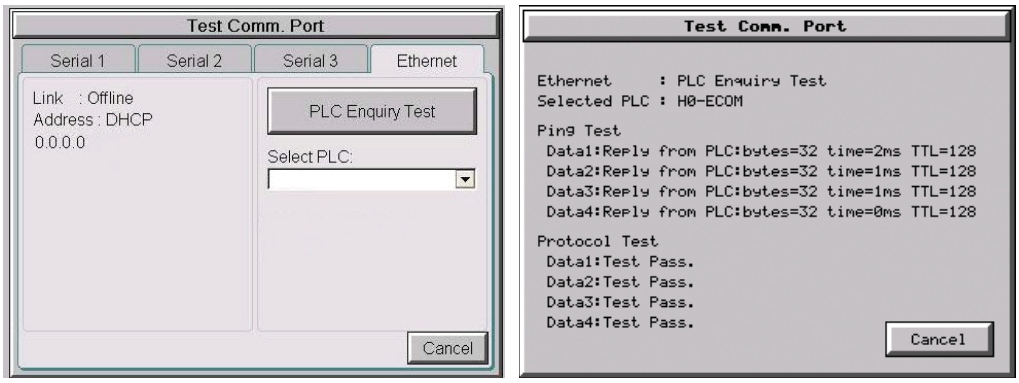



Check the status indicators that may be included with the **Ethernet** communications module or device that is part of the PLC. Refer to the PLC's Ethernet user manual for further troubleshooting information.

## No Communications between Panel and PLC (cont'd)

The Ethernet port on the ***C-more*** touch panel can be tested by using the panel's system setup screens. Access the **Main Menu** of the panel's system setup screens, press the **Test Menu** button and then press the **Test Comm. Port** button. Select the **Ethernet** tab in the **Test Comm. Port** dialog box, make sure the Ethernet port is connected to an Ethernet switch or other Ethernet communications device select a PLC from the drop down selection box, and then press the **PLC Enquiry** button to run the test. See **Chapter 5: System Setup Screens** for additional information.




If a PC running the ***C-more*** programming software is connected to the **Ethernet** network that is also connected to both the touch panel and PLC, then certain functions in the software, such as the **Main Menu's Setup** drop down selection for **Panel Manager** or **Touch Panel Network** and the **Main Menu's Panel** drop down selection for **Panel Information**, can be used to help troubleshoot problems with the touch panel's communications and operation. See the ***C-more*** programming software's on-line help for additional information.

## IP Address in System Setup Screens displays 0.0.0.0

*NOTE: If entering an IP Address for the C-more touch panel using the System Setup Screens, and the IP Address keeps displaying 0.0.0.0, even after entering an IP address, the panel is not functionally connected to an active network. Either the cable, hub, or switch is bad. The entered IP Address is stored in the panel's memory, but won't show up until a good connection is established. Keep in mind that if in the C-more programming software's Touch Panel Network dialog box, under the Ethernet Port tab, you have checked the Save settings to Project check box and have entered an IP Address of 0.0.0.0, then anytime the project is transferred to the panel, the panel's IP Address will be overwritten with the entered address.*

## Difficulty Connecting to the Panel over the Internet (Web server and Remote Access features)

1) Refer to the software help file topics **Touch Panel Network** and **Remote Access Setup** for information on configuring the Remote Access accounts, the Web Server Function and the panel IP Attributes.
2) In the Ethernet Port tab if DHCP is selected for assigning the IP address, verify the currect address of the panel. The IP address assigned by DHCP may change over time.
3) Note that the Web Server Function must be enabled on the Web Server tab before the Remote Access Server Function can be accessed on the panel.
4) Verify that the correct TCP ports have been opened and forwarded on the router controlling access to the network where the C-more panel resides.
5) If two C-more panels are on a network behind a firewall and they have the same **Remote Access port number**, the router will use the first entry in the Port Forwarding setup that it encounters. The same ***C-more*** panel will always come up even if the two panels have two different Web Server Port numbers.
6) When entering the URL in Internet Explorer to connect the ***C-more*** web server using a port number other than the default (80), be sure to use the full URL text including the prefix "http://". The URL should be http://xxx.xxx.xxx.xxx:aaaaa where xxx.xxx.xxx.xxx is the IP address of the panel and aaaaa is the port number configured in the Web Server tab of the Touch Panel Network setting.

## PLC Protocol Error Codes

The ***C-more*** touch panel includes built-in PLC communication protocol diagnostics that monitor the exchange of data between the panel and the PLC. The diagnostics look for the proper exchange of data, correct handshaking signals, addressing errors, incorrect data bytes, wrong packet format, etc. The diagnostics also monitor and report any of the errors that the designated PLC would normally generate if there is a problem with the PLC's communications. Each brand of PLC has its own unique set of diagnostic errors that are typically communicated over the PLC's communications port. The PLC generated errors are interpreted by the ***C-more*** software. See the PLC manufacturer's user manuals for additional details on the designated PLC's errors.

If a ***C-more*** communications error does occur, the error message will be displayed in the upper left of the ***C-more*** screen and the **Error Code** is recorded in the panel's error log. If a PLC error occurs, the PLC error code number will appear across the top of the screen, the PLC error message may not be included in some cases. The error log can be viewed using the system setup screens. See **Chapter 5: System Setup Screens** under the **Information** window to bring up the Error tab which includes a description of the logged data.

A detailed list and description of the various PLC protocol errors can be found in **Appendix A: PLC Protocol Error Codes**.



**PLC Protocol Error Codes** example:

| Error Codes for *Direct*LOGIC – K-Sequence | | |
|---|---|---|
| **Error Code** | **Error Message** | **Description** |
| PLC-001 | PLC Communication Timeout (for single PLC)<br>%Device% PLC Communication Timeout (for multiple PLCs, such as RS-422/485) | A timeout occurred after sending a request to the PLC %Device%.<br>%Device% indicates the device name, such as DEV001. Example error message for multiple PLCs: DEV001 PLC Communication Timeout |
| PLC-002 | NAK received from PLC | A negative acknowledgement (NAK) control code has been generated during a read/write request. |
| PLC-004 | STX is not found | A Start of Text (STX) control code was not found in the data packet received from the PLC. |

## Touch Panel Runtime Errors

The ***C-more*** touch panel includes built-in diagnostics that check for proper operation of the panel when it is running a project that has been transferred to its memory. Faults detected while the panel is running will produce a "Runtime" error. These errors are displayed in the upper left of the panel's display and are also recorded in the panel's error log. The error log can be viewed using the system setup screens. See **Chapter 5: System Setup Screens** under the **Information** window to bring up the **Error** tab which includes a description of the logged data.

A detailed list and description of the various touch panel runtime errors can be found in **Appendix B: Touch Panel Runtime Errors**.

**Touch Panel Runtime Errors** example:

| No. | Error Log Code | Error Message Located at upper left of screen | Error Message Tag | Tag Error Code Value | System Screen Info > Error | Cause |
|---|---|---|---|---|---|---|
| **Log Error** | | | | | | |
| 1 | RTE-001 | Log Failed.<br>Not enough Memory Space in %Device% | SYS ERR ERRORCODE | 2001 | MM/DD/YY HH/MM/SS Error Code RTE-001 | The size of the destination memory is not large enough to store the data. |
| 2 | RTE-002 | Log Failed.<br>%Device% cannot be found | SYS ERR ERRORCODE | 2002 | MM/DD/YY HH/MM/SS Error Code RTE-002 | No device available or the device is defective. |

## Panel Constantly Displays "Initializing" when Powering up

If the touch panel constantly displays a message reading "Initializing" while powering up, then check the following possible causes.

1.) ***C-more*** supports USB 1.1 and 2.0 memory devices. Ensure that the USB device is 1.1 or 2.0 or backward compatible to support version 2.0

2.) The project that is loaded into the panel's internal SDRAM memory is corrupted. Either use the ***C-more*** programming software to clear the panel's memory and re-transfer the project to the touch panel, or press the upper left corner of the touch panel screen while powering up to bypass the project and go directly to the **System Setup Screen** menu. Select the **Memory** menu, and use either the **Clear Memory** or **Set to Factory Default** utility to clear the panel's memory and re-transfer the project to the touch panel. (see Chapter 5 - System Setup Screens)

3.) An SD memory card has been plugged into an SD card slot and the SD card either has no project stored on it or the project is corrupted. Remove the SD memory card from the SD card slot and either load the project to the panel's internal Flash memory, or re-format the SD card using the SD formatter available from SDcard.org, or try a different SD memory card.

*NOTE: In the Error Log you may find the error RTE-500 - Check Sum Error, which is defined as "Memory in the panel has been corrupted by power loss, etc." If this is the case, try cycling power to the panel, re-transfer the project to the panel, and re-transfer the firmware, etc. in sequential steps to try to correct the problem.*

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## Data not Logging Problems

If the data log is missing entries, or a Runtime Error for the Log Errors as shown in **Appendix B: Touch Panel Runtime Errors** is seen, then check the following possible causes.

1.) Check that the memory devices, that were selected for **Data Storage** under the *C-more* programming software's **Main Menu - Setup** drop down - **Panel Manager** dialog box, are plugged into their proper location. Alarms, messages and screen captures can be independently selected to be saved to either a USB pen drive plugged into the USB Port - Type A, or an SD card plugged into SD Card Slot1 or SD Card Slot2 (12-inch and 15-inch panels only).

2.) Ensure that the SD card has been formatted with the SD formatter provided by SDcard.org.

3.) The memory device could be bad. If possible, check it by plugging it into a PC that has the ability to access the memory device. Also, not all USB devices are compatible with the ***C-more*** touch panels. Try using the ***AutomationDirect*** USB Pen Drive, p/n USB-FLASH. Check **System Screen, Memory** for the presence of the USB device inserted.

## Electrical Noise Problems

Noise is one of the most difficult problems to diagnose. Electrical noise can enter a system in many different ways which fall into one of two categories, conducted or radiated. It may be difficult to determine how the noise is entering the system but the corrective actions for either of the types of noise problems are similar.

- Conducted noise is when the electrical interference is introduced into the system by way of an attached wire, panel connection, etc. It may enter through a power supply connection, the communication ground connection, or the chassis ground connection.
- Radiated noise is when the electrical interference is introduced into the system without a direct electrical connection, much in the same manner as radio waves.

While electrical noise cannot be eliminated, it can be reduced to a level that will not affect the system.

- **Most noise problems result from improper grounding of the system. A good earth ground can be the single most effective way to correct noise problems.** If a ground is not available, install a ground rod as close to the system as possible. Ensure all ground wires are single point grounds and are not daisy chained from one device to another. Ground metal enclosures around the system. A loose wire can act as a large antenna, introducing noise into the system. Therefore, tighten all connections in your system. Loose ground wires are more susceptible to noise than the other wires in your system. Review **Chapter 4: Installation & Wiring** if you have questions regarding how to ground the touch panel.
- Electrical noise can enter the system through the power source for the touch panel. Installing a properly wired isolation transformer (neutral grounded) for all AC sources can help the problem, but only if wired correctly. DC sources should be well-grounded good quality supplies.
- Never run communication cables or low-voltage power wiring close to high voltage wiring or pulse generating wiring that controls such devices as solenoids, servos, VFDs, etc.

# Chapter 9

# Replacement Parts

## In This Chapter...


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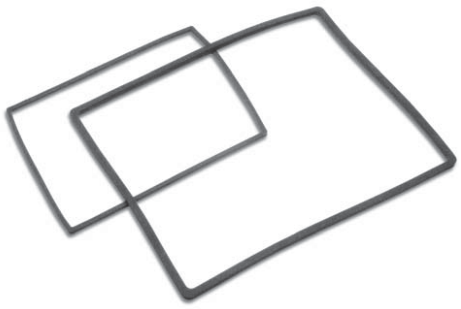
Logo Label Replacement Insert - EA9-LBL ..... 9-4
3-wire Communications Terminal Block – EA9-3TB ..... 9-4
DC Panel Power Connector Replacement – EA-DC-CON ..... 9-5
AC Power Adapter Connector Replacement– EA-AC-CON ..... 9-5
Panel Gasket Replacements – EA9-xx-GSK ..... 9-6
Gasket Replacement Installation Instructions: ..... 9-6

# Replacement Parts Overview

| Part Number | | Description |
|---|---|---|
| EA9-BRK | | Panel mounting brackets, replacement, for ***C-more*** EA9 series touch panels. Package of 8 brackets and screws. |
| EA9-LBL | | Blank label insert for front bezel, replacement, for ***C-more*** EA9 series touch panels. Package of 10. |
| EA9-3TB | | 3-pole terminal block, replacement, for 3-wire RS485 communications port on ***C-more*** EA9 series panels. Package of 2. |
| EA-DC-CON | | 5-terminal DC power connector, replacement, for ***C-more*** EA7 and EA9 series touch panels |
| EA-AC-CON | | 3-terminal AC power connector, replacement, for ***C-more*** EA7 and EA9 series touch panels |
| EA9-15-GSK |  | Panel mounting gasket, replacement, for ***C-more*** EA9-T15CL 15-inch touch panel, NEMA 4/4X |
| EA9-12-GSK | | Panel mounting gasket, replacement, for ***C-more*** EA9-T12CL 12-inch touch panel, NEMA 4/4X |
| EA9-10-GSK | | Panel mounting gasket, replacement, for ***C-more*** EA9-T10CL 10-inch touch panel, NEMA 4/4X |
| EA9-8-GSK | | Panel mounting gasket, replacement, for ***C-more*** EA9-T8CL 8-inch touch panel, NEMA 4/4X |
| EA9-6-GSK | | Panel mounting gasket, replacement, for ***C-more*** EA9-T6CL(-R) 6-inch touch panels, NEMA 4/4X |

# Panel Mounting Clip Replacements – EA9-BRK

Spare panel mounting clips for EA9 series ***C-more*** touch panels. Package of 8 clips with 8 screws.

Position the touch panel through the cutout in the control cabinet door and hold in place. Position the mounting clips as appropriate for your model. Refer to Chapter 2.

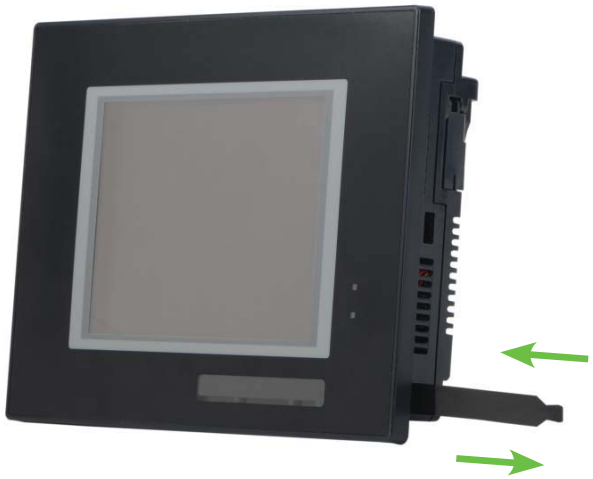
Tighten the mounting screws in an alternating fashion while observing the front of the touch panel. The goal is to make sure the front bezel is pulled up against the enclosure sheet metal uniformly, and the touch panel gasket is fully compressed all the way around its perimeter. Tighten the screws to a torque rating shown in the table below. Avoid over-tightening the screws to the point that they start to deform or bend the mounting clip.

The above photo shows an example ___-inch panel with mounting clips attached.

| Touch Panel Size | Enclosure Thickness Range | Mounting Clip Screw Torque |
|---|---|---|
| **6", 8", 10" and 12"** | 0.039 - 0.20 inch [1 – 5 mm] | 63 - 77 oz-in [0.45 - 0.55 Nm] |
| **15"** | 0.039 - 0.20 inch [1 – 5 mm]] | 92 - 106 oz-in [0.65 - 0.75 Nm] |

# Logo Label Replacement Insert - EA9-LBL

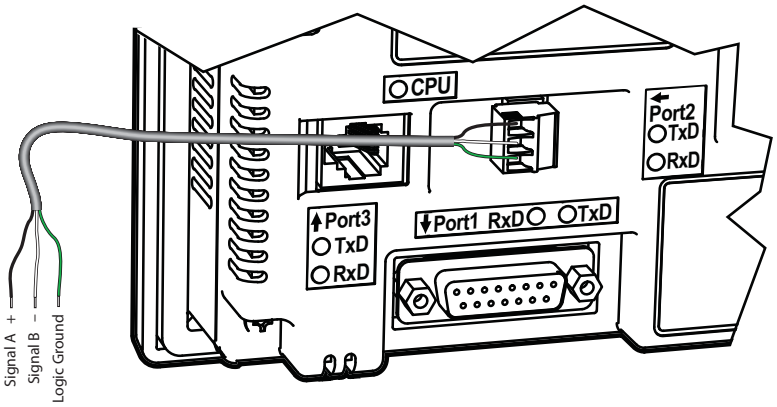
***C-more*** EA9 series panels include one customizable logo label. Additional logo labels can be purchased in packs of 10.



9

# 3-wire Communications Terminal Block – EA9-3TB

***C-more*** EA9 series 3-wire communications terminal block replacement. One (1) terminal block is supplied with each touch panel.




| Tightening Torque | |
|---|---|
| **Cable torque** | minimum 1.95 lb-in (0.22 Nm) |

*NOTE: Use 60 / 75 °C copper conductors only, 24 - 12 AWG*

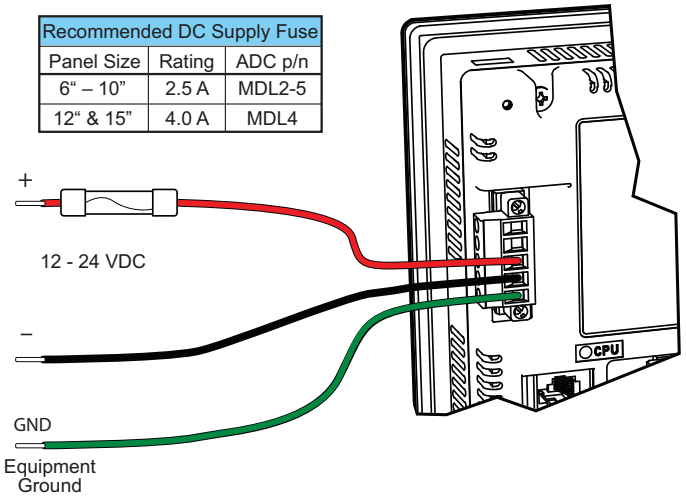
# DC Panel Power Connector Replacement – EA-DC-CON

*C-more* touch panel 5-position DC power connector terminal block replacement. One (1) DC Power Connector is supplied with each touch panel.

| DC-CON Tightening Torque | |
|---|---|
| Power connector screw torque | 70.4 oz-in (0.5 Nm) |
| Power connector mounting torque | 56 oz-in (0.4 Nm) |

*NOTE: Use 60 / 75 °C copper conductors only, 24 - 12 AWG*

| Recommended DC Supply Fuse | | |
|---|---|---|
| Panel Size | Rating | ADC p/n |
| 6“ – 10” | 2.5 A | MDL2-5 |
| 12“ & 15” | 4.0 A | MDL4 |

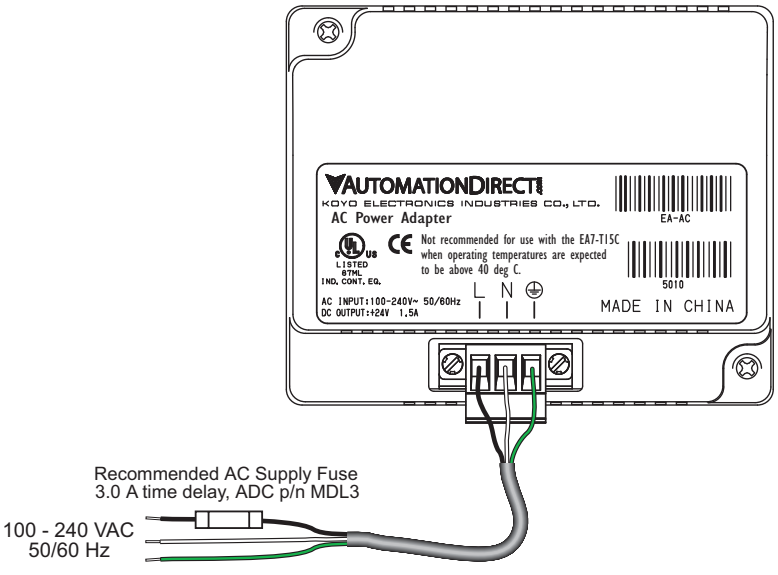



# AC Power Adapter Connector Replacement– EA-AC-CON

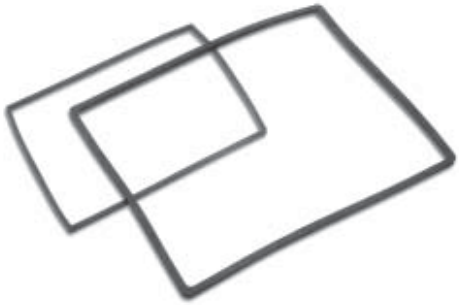
***C-more*** AC power adapter 3-position AC power connector terminal block replacement. One (1) AC Power Connector is supplied with each AC/DC Power Adapter, EA-AC.

| EA-AC Tightening Torque | |
|---|---|
| Power supply cable torque | 71 - 85 oz-in (0.5 - 0.6 Nm) |
| Power connector mounting torque | 71 - 85 oz-in (0.5 - 0.6 Nm) |
| Mounting flange screw torque | 57 - 71 oz-in (0.4 - 0.5 Nm) |

*NOTE: Use 60 / 75 °C copper conductors only, 24 - 12 AWG*



# Panel Gasket Replacements – EA9-xx-GSK



Replacement NEMA 4/4X touch panel gaskets for ***C-more*** 6", 8", 10", 12" and 15" touch panels.

(The part number is completed by substituting the panel size, 6, 8, 10, 12 or 15, for the xx shown above.)

# Gasket Replacement Installation Instructions:

**Preparation:** Disconnect input power and all other connections, then remove the touch panel from the control cabinet. In a clean environment, place the panel face down on a lint-free soft surface to prevent scratching the front of the panel.

Start at one corner and pull the old gasket out of the channel that holds the gasket in place. Pull the gasket up as you work around the entire perimeter of the touch panel. Discard the old gasket.

Lay the new gasket over the channel so that the long and short sides of the gasket match up to the long and short sides of the touch panel. Start at one corner and match the gasket's corner to the channel's corner. Press the gasket into the channel and work all away around the perimeter of the touch panel. Re-install the touch panel.

# Panel and PLC Error Code Tables

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# Panel and PLC Error Code Tables

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# Introduction

The ***C-more*** family of touch panels is capable of communicating with a wide variety of Programmable Logic Controllers. ***C-more*** is capable of communicating over RS232, RS422 and RS485 serial networks as well as Ethernet networks. It communicates with all AutomationDirect PLCs utilizing various protocols. C-more also communicates with other brands of PLCs by their different protocols. For a complete list of PLCs and protocols, see **Step 9 – Connect Touch Panel to PLC** in **Chapter 1: Getting Started**.

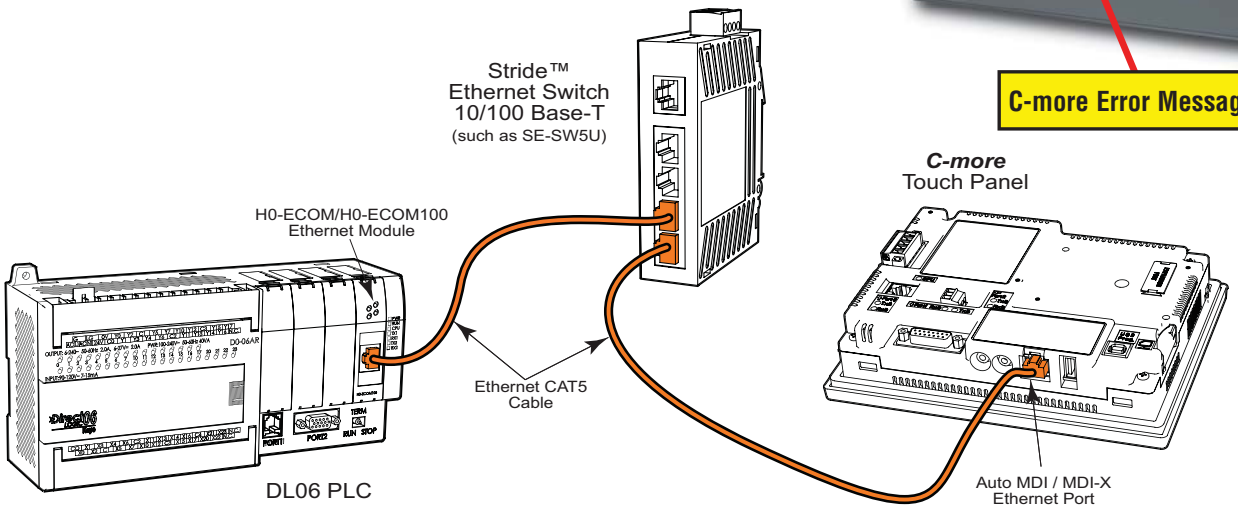
As with any network communications, errors will occur. To make it more simple for the user to identify the cause of the possible error, we have provided a error code table for all of the possible errors that ***C-more*** can detect.

If a ***C-more*** communications error does occur, the error message will appear across the top of the screen. The ***C-more*** touch panel also monitors any errors that are generated by the various PLCs that are connected to it. If any of the PLC generated errors are detected, they are displayed across the top of the panel's display embedded as a hexadecimal value in error code P499's message. An explanation of how the specific PLC error is identified in the panel error code P499 is shown proceeding the specific manufacturer's PLC error tables. How the hexadecimal error code value is interrupted is slightly different between manufacturers, so it is important to check the explanation at the beginning of each manufacturer's tables.

*NOTE: These PLC error codes are provided by the manufacturer of the related PLC and are subject to change by the PLC manufacturer. Please refer to the manufacturers documentation for a more complete and up-to-date list of error codes.*

All errors are also logged into the panel's **Error** log under the **Information** tab in the panel's **System Setup Screens** and are identified by the error code number. See **Chapter 5: System Setup Screens** for additional details.

If you have difficulty determining the cause of the error, please refer to **Chapter 8: Troubleshooting** for some troubleshooting tips or contact our technical support



# *C-more* Touch Panel Error Code Table

The following table includes all of the error codes and error messages that the panel will display if the listed cause is detected. All of these errors involve problems that could result with the panel communicating with the connected PLC. Be aware that not all of the panel errors are used with each type of PLC that can be connected to the panel.

| C-more Touch Panel Error Code Table | | |
|---|---|---|
| **Error Code** | **Error Message** | **Cause** |
| PLC-001 | PLC Communication Timeout (for single PLC)<br>%Device% PLC Communication Timeout (for multiple PLCs, such as RS-422/485) | A timeout occurred after sending a request to the PLC %Device%. %Device% indicates the device name, such as DEV001.<br>Example error message for multiple PLCs: DEV001 PLC Communication Timeout. |
| PLC-002 | NAK received from PLC | A negative acknowledgement (NAK) control code has been generated during a read/write request. |
| PLC-003 | EOT received from PLC | An End of Transmission (EOT) control code is sent by the PLC in response to a Read/Write/SetBit request.. |
| PLC-004 | STX is not found | A Start of Text (STX) control code was not found in the data packet received from the PLC. |
| PLC-005 | ETX or ETB is not found | Neither an End of Text (ETX) nor an End of Transmission Block (ETB) control code was found in the data packet received from the PLC. |
| PLC-006 | LRC does not match | There was an incorrect Longitudinal Redundancy Check (LRC) control code in the communications packet received from the PLC. This is an indication that the data in the packet is corrupted. |
| PLC-007 | CRC does not match | There was an incorrect Cyclic Redundancy Check (CRC) control code in the communications packet received from the PLC. This is an indication that the data in the packet is corrupted. |
| PLC-008 | Address does not match | The address value returned in the data packet from the PLC is incorrect. |
| PLC-009 | Different function code received from PLC | The function code returned in the data packet from the PLC is incorrect. |
| PLC-010 | Data size does not match | There are an incorrect number of bytes found in the data packet returned from the PLC. |
| PLC-011 | Invalid value in function code | There is an invalid value in the function code. |
| PLC-012 | Invalid command sent to PLC | There was an invalid command sent to the PLC that wasn't recognized by the PLC. |
| PLC-013 | ENQ received from PLC | If the data packet does not include a negative acknowledgement (NAK - 0x15 value) in the defined packet field, then an enquiry (ENQ) control code error will be displayed. |
| PLC-014 | Transaction ID does not match | This error will be displayed if after checking the Transaction ID Bytes in the data packet, there is no match to what was requested. |
| PLC-015 | %Device% No device found | A PLC device designated as %Device% could not be found. |
| PLC-016 | Data byte communication error | 0 byte of data is recieved |
| PLC-017 | Out of address range | The touch panel requested a file number larger than 255. |
| PLC-018 | Panel communication timeout | The server panel did not respond when using the Panel Pass Through. |
| PLC-019 | Found in parity error by hardware | An error detected in the PLC memory. |
| PLC-020 | Can't open serial port | Cannot open the Serial Port. If this error shows on the panel, it indicates a hardware problem. |
| PLC-021 | PLC number does not match | The PLC number does not match the PLC number configured. |
| PLC-022 | Can't reset DCB | Unable to reset the data communication bit. |
| PLC-023 | Cable not connected properly | Communication cable incorrectly installed. |

***C-more*** Touch Panel Error Code Table continued on the next page.

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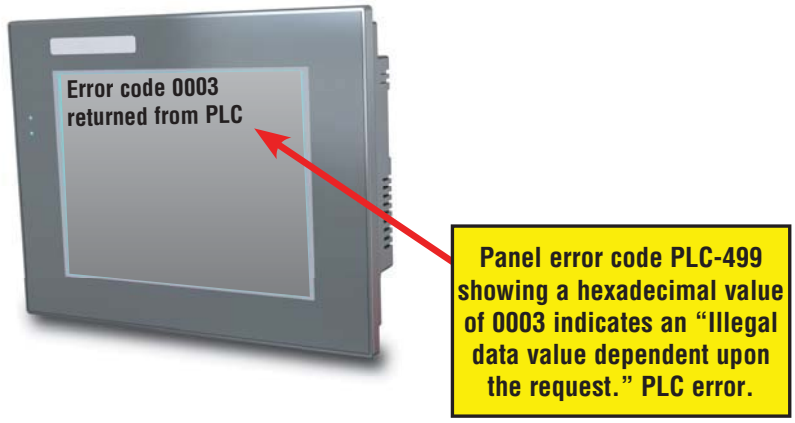
# *C-more* Touch Panel Error Code Table (cont'd)

| *C-more* Touch Panel Error Code Table (cont'd) | | |
|---|---|---|
| **Error Code** | **Error Message** | **Cause** |
| PLC-024 | Cannot detect other devices on network | The panel is not communicating with other devices on the network. |
| PLC-025 | Panel not in polling list | |
| PLC-026 | PLC connection timeout | A timeout occured after sending a request to the PLC. |
| PLC-027 | Memory type incorrect | |
| PLC-028 | PLC failed to respond | The PLC failed to respond after sending a request to the PLC. |
| PLC-029 | MemVer ERR HMI x PLCy | When connected to a Do-more PLC the PLC memory version must match the C-more project PLC memory version. Make sure that the PLC project does not write into the memory version address. |
| **PLC-495** | **Omron Ethernet Error** | **An error code specific to Omron Ethernet with a Value of XXXX has been returned from the PLC. See the explanation for error code PLC-495 proceeding the Omron CS/CJ FINS Ethernet error code tables.** |
| **PLC-496** | **Error code 0xaaaaaaaa returned from PLC** | **Allen-Bradley EtherNET/IP specific. Encapsulation Error. See the explanation for error code PLC-496 proceeding the Allen-Bradley EtherNet/IP error code tables.** |
| **PLC-497** | **Error code 0xaaaaaaaa returned from PLC** | **Allen-Bradley EtherNET/IP specific. CIP Error. See the explanation for error code PLC-497 proceeding the Allen-Bradley EtherNet/IP error code tables.** |
| **PLC-498** | **Error code 0xaaaaaaaa returned from PLC** | **Allen-Bradley EtherNET/IP specific. Service Packet Error. See the explanation for error code PLC-498 proceeding the Allen-Bradley EtherNet/IP error code tables.** |
| **PLC-499** | **Error code XXXX returned from PLC** | **An error code with a value of XXXX has been returned from the PLC. See the explanation for error code PLC-499 below for *Direct*LOGIC and proceeding each set of PLC error code tables that use this error code.** |
| PLC-500 | Cannot write to Serial Port | Data cannot write to the Serial port.<br>Data was sent to the PLC via the Serial Port.<br>If this error shows on the Panel, it indicates a Hardware Problem. |
| PLC-700 | Not enough buffer memory | There was an error while allocating memory for the read buffer.<br>When this error is displayed, a memory leak may have occurred. |
| PLC-701 | Access to inaccessible PLC memory | Request to inaccessible memory from the HMI layer to the PLC protocol layer. This error is an indication that there is a problem in the HMI layer. |
| PLC-702 | Cannot access by different function code | A Read/Write/SetBit request has been sent to an invalid memory area. This error is an indication that there is a problem in the HMI layer. |
| PLC-703 | Write request to PLC Read Only Memory | A PLC Write request was made to the PLC's Read-Only memory area.This error is an indication that there is a problem in the HMI layer or the PLC protocol layer. |
| PLC-704 | Bad device-access | No device (PLC) exists in the server panel or the device name does not match between the server and client when using the Panel Pass Through. |
| PLC-705 | Protocol does not match | The protocol for the device does Not match between the server and client when using the panel pass through. |

# *Direct*LOGIC – Panel Error Code PLC-499 Explanation

The PLC-499 error code is used to show any errors that are generated by the connected PLC. The PLC-499 error message includes a four digit hexadecimal value embedded in the message. This value can be looked up in the specific PLC's error tables to determine the cause of the error. The possible PLC generated error codes for the ***Direct***LOGIC communication protocol are represented by a hexadecimal value as shown in the following message example.

### *Direct* LOGIC Error Code PLC-499 Message Example:




# *Direct*LOGIC K-Sequence Protocol – PLC Error Code Table

The following table lists the errors that can be generated by the ***Direct***LOGIC PLC when using the K-Sequence protocol.

| PLC Error Codes for *Direct*LOGIC – K-Sequence | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 01F8 | Error setting value. |
| 020D | Error in key mode - Set switch on PLC CPU to "Term" |
| 021C | Password protected. |

*NOTE: The following errors can be generated from the designated PLC, are monitored by the C-more touch panel, and displayed on the touch panel's screen as a hexadecimal value in panel error code PLC-499 message, if active. Please refer to the PLC manufacturer's documentation for additional information.*

# *Direct*LOGIC *Direct*NET Protocol – PLC Error Codes

Only errors as listed in the Touch Panel Error Code Table shown on page A-3 can occur when using the ***Direct***LOGIC ***Direct***NET protocol, there are no PLC generated errors.

***Direct***LOGIC error code tables continued on the next page.

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# Modbus Protocols Error Code P499 Explanation

The following table lists the errors that can be generated by the Modbus protocols:

**AutomationDirect CLICK**

**AutomationDirect DirectLOGIC - Modbus (Koyo)**

**Modicon Modbus RTU**

**Entivity Modbus RTU**

*NOTE: The following errors can be generated from the designated PLC, are monitored by the C-more touch panel, and displayed on the touch panel's screen as a hexadecimal value in panel error code PLC-499 message, if active. Please refer to the PLC manufacturer's documentation for additional information.*

| PLC Error Codes Modbus Protocols | | |
|---|---|---|
| **Panel Error Code P499 Hex Value** | **Name** | **Meaning** |
| 0x0001 | ILLEGAL FUNCTION | The function code received in the query is not an allowable action for the server (or slave). This may be because the function code is only applicable to newer devices and was not implemented in the unit selected. It could also indicate that the server (or slave) is in the wrong state to process a request of this type, for example because it is unconfigured and is being asked to return registered values. |
| 0x0002 | ILLEGAL DATA ADDRESS | The data address received in the query is not an allowable address for the server (or slave). More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, the PDU addresses the first register as 0, and the last one as 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 4, then the request will successfully operate (address-wise at least) on registers 96, 97, 98, 99. If a request is submitted with a starting register of 96 and a quantity of registers of 5, then the request will fail with Exception code 0x02 "Illegal Data Address" since it attempts to operate on registers 96, 97, 98, 99 and 100, and there is no register with address 100. |
| 0x0003 | ILLEGAL DATA VALUE | A value contained in the query data field is not an allowable value for server (or slave). This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the Modbus protocol is unaware of the significance of any particular value of any particular register. |
| 0x0004 | SLAVE DEVICE FAILURE | An unrecoverable error occurred while the server (or slave) was attempting to perform the requested action. |

# *Direct*LOGIC ECOM Protocol – PLC Error Codes

Only errors as listed in the Touch Panel Error Code Table shown previously in this Appendix can occur when using the ***Direct***LOGIC ECOM protocol, there are no PLC generated errors.

# Productivity3000 Error Code P499

*NOTE: The following errors can be generated from the designated PLC, are monitored by the C-more touch panel, and displayed on the touch panel's screen as a hexadecimal value in panel error code PLC-499 message, if active. Please refer to the PLC manufacturer's documentation for additional information.*

| PLC Error Codes for Productivity3000 | |
|---|---|
| **Panel Error Code P499 Hex Value** | **Meaning** |
| 0x0001 | The function code received in the query is not an allowable action for the server (or slave). This may be because the function code is only applicable to newer devices and was not implemented in the unit selected. It could also indicate that the server (or slave) is in the wrong state to process a request of this type, for example because it is unconfigured and is being asked to return registered values. |
| 0x0002 | Address out of range. Check to make sure that the C-more tag and System ID match the Productivity3000 Programming Software Tag Name and System ID. The project file in the Productivity3000 system and the imported CSV into C-more must be in sync with each other. |
| 0x0003 | A value contained in the query data field is not an allowable value for the server (or slave). This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the Modbus protocol is unaware of the significance of any particular value of any particular register. |
| 0x0004 | An unrecoverable error occurred while the server (or slave) was attempting to perform the requested action. |

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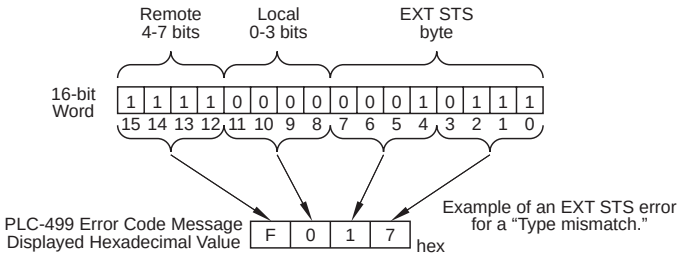
# Allen-Bradley – Panel Error Code PLC-499 Explanation

The PLC-499 error code is used to show any errors that are generated by the connected PLC. The PLC-499 error message includes a four digit hexadecimal value embedded in the message. This value can be looked up in the specific PLC's error tables to determine the cause of the error. The possible PLC generated error codes for the Allen-Bradley DF1 and DH485 communication protocols are represented by a hexadecimal value as shown in the following diagram. Please note that the error code is broken down into three sections. It is possible for more than one type of PLC error to be displayed in this value.

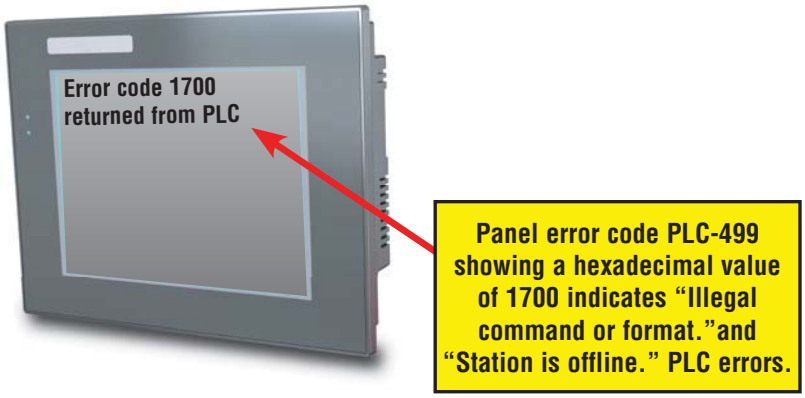
## Allen-Bradley Error Code PLC-499 Message Example:

AB DF1 and DH485 Protocol Error Code PLC-499 Breakdown




AB DF1 and DH485 Protocol – Multiple Error Code Examples

| | Example 1 | Example 2 | Example 3 |
|---|---|---|---|
| Remote 4-7 bits | F x x x | 1 x x x | F x x x |
| + | + | + | + |
| Local 0-3 bits | x 0 x x | x 1 x x | x 1 x x |
| + | + | + | + |
| EXT STS byte | x x 0 9 | x x 0 0 | x x 0 9 |
| = | = | = | = |
| Error PLC-499 Value Displayed | F 0 0 9 | 1 1 0 0 | F 1 0 9 |



# Allen-Bradley DF1 & DH485 Protocols – PLC Error Code Tables



The following PLC error code tables cover possible errors that are detected by the panel from Allen-Bradley PLCs using the DF1 and DH485 protocols. DF1 includes full and half duplex communications for the MicroLogix 1000, 1100. 1200, 1400, 1500, SLC 5/03, /04, /05, ControlLogix, CompactLogix and FlexLogix, and full duplex communications for the PLC5. DH485 includes all MicroLogix and SLC500 PLC's and any communication connection using an Allen-Bradley AIC device using the DH485 protocol.

*NOTE: The following errors can be generated from the designated PLC, are monitored by the C-more touch panel, and displayed on the touch panel's screen as a hexadecimal value in panel error code PLC-499 message, if active. Please refer to the PLC manufacturer's documentation for additional information.*

| PLC Errors for Allen-Bradley DF1 and DH485 Protocols, Local STS Errors (0-3 bits) | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x0 | Success; no error. |
| 0x1 | DST node is out of buffer space. |
| 0x2 | Cannot guarantee delivery; link layer.<br>(The remote node specified does not ACK command.) |
| 0x3 | Duplicate token holder detected. |
| 0x4 | Local port is disconnected. |
| 0x5 | Application layer timed out waiting for response. |
| 0x6 | Duplicate node detected. |
| 0x7 | Station is offline. |
| 0x8 | Hardware fault. |

| PLC Errors for Allen-Bradley DF1 and DH485 Protocols, Remote STS Errors (4-7 bits) | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x0 | Success; no error. |
| 0x10 | Illegal command or format. |
| 0x20 | Host has a problem and will not communicate. |
| 0x30 | Remote node host is missing, disconnected, or shut down. |
| 0x40 | Host could not complete function due to hardware fault. |
| 0x50 | Addressing problem or memory protect rungs. |
| 0x60 | Function not allowed due to command protection selection. |
| 0x70 | Processor is in Program Mode. |
| 0x80 | Compatibility mode file missing or communication zone problem. |
| 0x90 | Remote node cannot buffer command. |
| 0xA0 | Wait ACK (1775 KA buffer full). |
| 0xB0 | Remote node problem due to download. |
| 0xC0 | Wait ACK (1775 KA buffer full). |
| 0xD0 | not used |
| 0xE0 | not used |
| 0xF0 | Error code in the EXT STS byte. See the error code table on the next page. |

(PLC generated error codes for the Allen-Bradley DF1 protocol continued on the next page.)

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# Allen-Bradley DF1 & DH485 Protocols – PLC Error Code Tables (cont'd)

| PLC Errors for Allen-Bradley DF1 and DH485 Protocols, EXT STS Command Code for F0 Command | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x0 | not used |
| 0x1 | A field has an illegal value. |
| 0x2 | Fewer levels specified in address than minimum for any address. |
| 0x3 | More levels specified in address than system supports. |
| 0x4 | Symbol not found. |
| 0x5 | Symbol is of improper format. |
| 0x6 | Address does not point to something usable. |
| 0x7 | File is wrong size. |
| 0x8 | Cannot complete request; situation has changed since start of the command. |
| 0x9 | Data or file size is too large. |
| 0xA | Transaction size plus word address is too large. |
| 0xB | Access denied; improper privilege. |
| 0xC | Condition cannot be generated; resource is not available. |
| 0xD | Condition already exists; resource is readily available. |
| 0xE | Command cannot be executed. |
| 0xF | Histogram overflow. |
| 0x10 | No access. |
| 0x11 | Illegal data type. |
| 0x12 | Invalid parameter or invalid data. |
| 0x13 | Address reference exists to deleted area. |
| 0x14 | Command execution failure for unknown reason; possible PLC 3 histogram overflow. |
| 0x15 | Data conversion error. |
| 0x16 | Scanner not able to communicate with 1771 rack adapter. |
| 0x17 | Type mismatch. |
| 0x18 | 1771 module response was not valid. |
| 0x19 | Duplicated label. |
| 0x22 | Remote rack fault. |
| 0x23 | Timeout. |
| 0x24 | Unknown error. |
| 0x1A | File is open; another node owns it. |
| 0x1B | Another node is the program owner. |
| 0x1C | Disk File is write protectid or otherwise unavailable |
| 0x1D | Disk File is being used by another application. Update not performed (offline only). |
| 0x1E | Data table element protection violation. |
| 0x1F | Temporary internal problem. |

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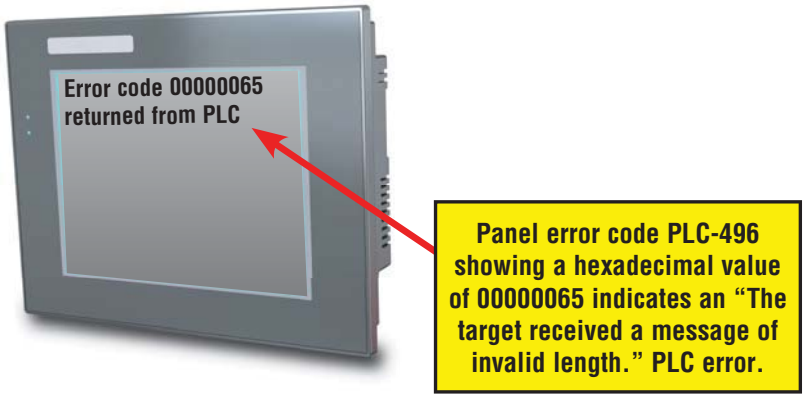
# Allen-Bradley EtherNet/IP Protocol – Panel Error Code PLC-496, 497 and 498 Explanation

The PLC-496, PLC-497, and PLC-498 error codes are used to show any errors that are generated by the connected PLC. These error messages include an eight digit hexadecimal value displayed embedded in the message. This value can be looked up in the specific PLC's error tables to determine the cause of the error. The possible PLC generated error codes for the Allen-Bradley EtherNet/IP communication protocol is represented by a hexadecimal value as shown in the following message example.

## Allen-Bradley Error Code PLC-496, 497, 498 Message Example:



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# Allen-Bradley – EtherNet/IP Protocol – PLC Error Code Tables ControlLogix, CompactLogix, & FlexLogix

The following PLC error code tables cover possible errors that are detected by the panel from Allen-Bradley PLCs using the EtherNet/IP protocol. This includes all ControlLogix, CompactLogix and FlexLogix PLCs.

*NOTE: The following errors can be generated from the designated PLC, are monitored by the C-more touch panel, and displayed on the touch panel's screen as a hexadecimal value in panel error code PLC-496 message, if active. Please refer to the PLC manufacturer's documentation for additional information.*

| PLC Errors for Allen-Bradley EtherNet/IP Protocol –Encapsulation Errors (Error code 0xaaaaaaaa returned from the PLC.) | |
|---|---|
| **Panel Error Code PLC-496 Hex Value** | **Description** |
| 0x00000001 | The sender issued an invalid or unsupported encapsulation command. |
| 0x00000002 | Insufficient memory resources in the receiver to handle the command. You can get this error if the 1761-NET-ENI cannot connect to the PLC serially. |
| 0x00000003 | Poorly formed or incorrect data in the data portion of the encapsulation message. |
| 0x00000004 - 0x00000063 | Reserved for legacy (Rockwell Automation). |
| 0x00000064 | An orginator used an invalid session handle when sending an encapsulation message to the target. |
| 0x00000065 | The target received a message of invalid length. |
| 0x00000066 - 0x00000068 | Reserved for legacy (Rockwell Automation). |
| 0x00000069 | Unsupported encapsulation protocol revision. |
| 0x0000006a - 0x0000ffff | Reserved for future expansion. |

| PLC Errors for Allen-Bradley EtherNet/IP Protocol – CIP Errors (Error code 0xaaaaaaaa returned from the PLC.) | |
|---|---|
| **Panel Error Code PLC-497 Hex Value** | **Description** |
| 0x010100 | Connection Manager: Connection in Use or Duplicate Forward Open. |
| 0x010103 | Connection Manager: Transport Class and Trigger combination not supported. |
| 0x010106 | Connection Manager: Ownership Conflict. |
| 0x010107 | Connection Manager: Connection not found at target application. |
| 0x010108 | Connection Manager: Invalid connection type (problem with type or priority). |
| 0x010109 | Connection Manager: Invalid connection size. |
| 0x010110 | Connection Manager: Device not configured. |
| 0x010111 | Connection Manager: RPI not supported. Could also be problem with inactivity timeout. |
| 0x010113 | Connection Manager: Connection Manager cannot support any more connections. |
| 0x010114 | Connection Manager: Either the vendor ID or the Product Code in the key segment did not match the device. |
| 0x010115 | Connection Manager: Product Type in the key segment did not match the device. |
| 0x010116 | Connection Manager: Major or minor revision information in the key segment did not match the device. |

(PLC generated error codes for the Allen-Bradley EtherNet/IP protocol for ControlLogix, CompactLogix, and FlexLogix continued on the next page.)

# Allen-Bradley – EtherNet/IP Protocol – PLC Error Code Tables ControlLogix, CompactLogix, & FlexLogix (cont'd)



| PLC Errors for Allen-Bradley EtherNet/IP Protocol – CIP Errors (Error code 0xaaaaaaaa returned from the PLC.) | |
|---|---|
| **Panel Error Code PLC-497 Hex Value** | **Description** |
| 0x010117 | Connection Manager: Invalid connection point. |
| 0x010118 | Connection Manager: Invalid configuration format. |
| 0x010119 | Connection Manager: Connection request fails since there is no controlling connection currently open. |
| 0x01011a | Connection Manager: Target application cannot support any more connections. |
| 0x01011b | Connection Manager: RPI is smaller than the Production Inhibit Time. |
| 0x010203 | Connection Manager: Connection cannot be closed since the connection has timed out. |
| 0x010204 | Connection Manager: Unconnected Send timed out waiting for a response. |
| 0x010205 | Connection Manager: Parameter error in Unconnected send service. |
| 0x010206 | Connection Manager: Message too large for Unconnected message service. |
| 0x010207 | Connection Manager: Unconnected acknowledge without reply. |
| 0x010301 | Connection Manager: No buffer memory available. |
| 0x010302 | Connection Manager: Network Bandwidth not available for data. |
| 0x010303 | Connection Manager: No Tag filters available. |
| 0x010304 | Connection Manager: Not configured to send real-time data. |
| 0x010311 | Connection Manager: Port specified in Port segment not available. |
| 0x010312 | Connection Manager: Link address specified in port segment not available. |
| 0x010315 | Connection Manager: invalid segment type or segment value in path. |
| 0x010316 | Connection Manager: Path and Connection not equal in close. |
| 0x010317 | Connection Manager: Ether Segment not present or Encoded Value in Network Segment is invalid. |
| 0x010318 | Connection Manager: Link address to self invalid. |
| 0x010319 | Connection Manager: Resources on Secondary unavailable. |
| 0x01031a | Connection Manager: Connection already established. |
| 0x01031b | Connection Manager: Direct connection already established. |
| 0x01031c | Connection Manager: Miscellaneous. |
| 0x01031d | Connection Manager: Redundant connection mismatch. |
| 0x01031e | Connection Manager: No more consumer resources available in the producing module. |
| 0x01031f | Connection Manager: No connection resources exist for target path. |
| 0x010320 - 0x0107ff | Connection Manager: Vendor specific. |
| 0x020000 | Resource unavailable: Connection Manager resources are unavailable to handle service request. |
| 0x030000 | Invalid parameter value. |
| 0x040000 | Path segment error: The path segment identifier or the segment syntax was not understood by the processing node. |
| 0x050000 | Path destination unknown: The path is referencing an object class, instance or structure element that is not known or is not contained in the processing node. |
| 0x060000 | Partial transfer: Only part of the expected data was transferred. |
| 0x070000 | Connection lost: The messaging connection was lost. |

(PLC generated error codes for the Allen-Bradley EtherNet/IP protocol for ControlLogix, CompactLogix, and FlexLogix continued on the next page.)

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# Allen-Bradley – EtherNet/IP Protocol – PLC Error Code Tables ControlLogix, CompactLogix, & FlexLogix (cont'd)

| PLC Errors for Allen-Bradley EtherNet/IP Protocol – CIP Errors (Error code 0xaaaaaaaa returned from the PLC.) | |
|---|---|
| Panel Error Code PLC-497 Hex Value | Description |
| 0x080000 | Service not supported: The requested service was not implemented or was not defined for this Object Class/Instance. |
| 0x090000 | Invalid attribute value: Invalid attribute data detected. |
| 0x0a0000 | Attribute list error: An attribute in the Get_Attribute_List or Set_Attribute_List response has a non-zero status. |
| 0x0b0000 | Already in requested mode/state: The object is already in the mode/state being requested by the service. |
| 0x0c0000 | Object state conflict: The object cannot perform the requested service in its current mode/state. |
| 0x0d0000 | Object already exists: The requested instance of object to be created already exists. |
| 0x0e0000 | Attribute not settable: A request to modify non-modifiable attribute was received. |
| 0x0f0000 | Privilege violation: A permission/privilege check failed. |
| 0x100000 | Device state conflict: The device's current mode/state prohibits the execution of the requested service. |
| 0x110000 | Reply data too large: The data to be transmitted in the response buffer is larger than the allocated response buffer. |
| 0x120000 | Fragmentation of a primitive value: The service specified an operation that is going to fragment a primitive data value. For example, trying to send a 2 byte value to a REAL data type (4 byte). |
| 0x130000 | Not enough data: The service did not supply enough data to perform the specified operation. |
| 0x140000 | Attribute not supported: The attribute specified in the request is not supported. |
| 0x150000 | Too much data: The service supplied more data than was expected. |
| 0x160000 | Object does not exist: The object specified does not exist in the device. |
| 0x170000 | Service fragmentation sequence not in progress: The fragmentation sequence for this service is not currently active for this data. |
| 0x180000 | No stored attribute data: The attribute data of this object was no saved prior to the requested service. |
| 0x190000 | Store operation failure: The attribute data of this object was not saved due to a failure during the attempt. |
| 0x1a0000 | Routing failure, request packet too large: The service request packet was too large for transmission on a network in the path to the destination. |
| 0x1b0000 | Routing failure, response packet too large: The service reponse packet was too large for transmission on a network in the path from the destination. |
| 0x1c0000 | Missing attribute list entry data: The service did not supply an attribute in a list of attributes that was needed by the service to perform the requested behavior. |
| 0x1d0000 | Invalid attribute value list: The service is returning the list of attributes supplied with status information for those attributes that were invalid. |
| 0x1e0000 | Embedded service error: See Service Packet error list (PLC-498 Error codes) below: |
| 0x1f0000 | Vendor specific error: A vendor specific error has been encountered. This occurs when none of the specified errors relate to the error in the device. |
| 0x200000 | Invalid parameter: A parameter associated with the request was invalid. This code is used when a parameter does meet the requirements defined in an Application Object specification. |
| 0x210000 | Write-once value or medium already written: An attempt was made to write to a write-once-medium that has already been written or to modify a value that cannot be change once established. |
| 0x220000 | Invalid Reply Received: An invalid reply is received (example: service code sent doesn't match service code received.). |

(PLC generated error codes for the Allen-Bradley EtherNet/IP protocol for ControlLogix, CompactLogix and FlexLogix continued on the next page.)

# Allen-Bradley – EtherNet/IP Protocol – PLC Error Code Tables ControlLogix, CompactLogix, & FlexLogix (cont'd)



| PLC Errors for Allen-Bradley EtherNet/IP Protocol – CIP Errors (Error code 0xaaaaaaaa returned from the PLC.) | |
|---|---|
| **Panel Error Code PLC-497 Hex Value** | **Description** |
| 0x230000 | Reserved by CIP for future extensions. |
| 0x240000 | Reserved by CIP for future extensions. |
| 0x250000 | Key failure in path: The key segment was included as the first segment in the path does not match the destination module. The object specific status shall indicate which part of the key check failed. |
| 0x260000 | Path Size Invalid: The size of the path which was sent with the Service Request is either not large enough to allow the Request to be routed to an object or too much routing data was included. |
| 0x270000 | Unexpected attribute in list: An attempt was made to set an attribute that is not able to be set at this time. |
| 0x280000 | Invalid Member ID: The Member ID specified in the request does not exist in the specified Class/Instance/ Attribute. |
| 0x290000 | Member not settable: A request to modify a non-modifiable member was received. |
| 0x2a0000 | Group 2 only server general failure: This error code may only be reported by DeviceNet group 2 only servers with 4K or less code space and only in place of Service not supported, Attribute not supported and Attribute not settable. |
| 0x2b0000 - 0xcf0000 | Reserved by CIP for future extensions. |
| 0xd00000 - 0xff0000 | Reserved for Object Class and service errors: This range of error codes is to be used to indicate Object Class specific errors. Use of this range should only be used when errors in this table don't accurately reflect the error encountered. |

| PLC Errors for Allen-Bradley EtherNet/IP Protocol – Service Packet Errors (Error code 0xaaaaaaaa returned from the PLC.) | |
|---|---|
| **Panel Error Code PLC-498 Hex Value** | **Description** |
| 0x040000 | This general status codes that the tag name could not be deciphered. This could mean that the tag name was entered incorrectly or does not exist in the PLC. |
| 0x050000 | The particular item referenced (usually instance) could not be found. |
| 0x060000 | The amount of data requested would not fit into the response buffer. Partial data transfer has occurred. |
| 0x0a0000 | An error has occurred trying to process one of the attributes. |
| 0x130000 | Not enough command data/parameters were supplied in the command to execute the service requested. |
| 0x1c0000 | An insufficient number of attributes were provided compared to the attribute count. |
| 0x260000 | The tag name length specified did not match what was in the message. |
| 0xff0521 | You have tried to access beyond the end of the data object. |
| 0xff0721 | The abbreviated type does not match the data type of the data object. |
| 0xff0421 | The beginning offset was beyond the end of the template. |

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# Allen-Bradley – EtherNet/IP Protocol – PLC Error Code Tables

The following PLC error code tables cover possible errors that are detected by the panel from Allen-Bradley PLCs using the EtherNet/IP protocol. This includes MicroLogix 1100, 1400 & SLC 5/05, both using their native Ethernet port, and MicroLogix 1000, 1100, 1200, 1400, 1500, SLC 5/03, 5/04 and 5/05 using an Allen-Bradly ENI Adapter.

*NOTE: The following errors can be generated from the designated PLC, are monitored by the C-more touch panel, and displayed on the touch panel's screen as a hexadecimal value in panel error code PLC-496 message, if active. Please refer to the PLC manufacturer's documentation for additional information.*

| PLC Errors for Allen-Bradley EtherNet/IP Protocol –Encapsulation Errors (Error code 0xaaaaaaaa returned from the PLC.) | |
|---|---|
| Panel Error Code PLC-496 Hex Value | Description |
| 0x00000001 | The sender issued an invalid or unsupported encapsulation command. |
| 0x00000002 | Insufficient memory resources in the receiver to handle the command. You can get this error if the 1761-NET-ENI cannot connect to the PLC serially. |
| 0x00000003 | Poorly formed or incorrect data in the data portion of the encapsulation message. |
| 0x00000004 - 0x00000063 | Reserved for legacy (Rockwell Automation). |
| 0x00000064 | An orginator used an invalid session handle when sending an encapsulation message to the target. |
| 0x00000065 | The target received a message of invalid length. |
| 0x00000066 - 0x00000068 | Reserved for legacy (Rockwell Automation). |
| 0x00000069 | Unsupported encapsulation protocol revision. |
| 0x0000006a - 0x0000ffff | Reserved for future expansion. |

| PLC Errors for Allen-Bradley EtherNet/IP Protocol – CIP Errors (Error code 0xaabbbb returned from the PLC.) | |
|---|---|
| **Panel Error Code PLC-497 Hex Value** | **Description** |
| 0x010100 | Connection Manager: Connection in Use or Duplicate Forward Open. |
| 0x010103 | Connection Manager: Transport Class and Trigger combination not supported. |
| 0x010106 | Connection Manager: Ownership Conflict. |
| 0x010107 | Connection Manager: Connection not found at target application. |
| 0x010108 | Connection Manager: Invalid connection type (problem with type or priority). |
| 0x010109 | Connection Manager: Invalid connection size. |
| 0x010110 | Connection Manager: Device not configured. |
| 0x010111 | Connection Manager: RPI not supported. Could also be problem with inactivity timeout. |

(PLC generated error codes for the Allen-Bradley EtherNet/IP protocol continued on the next page.)

# Allen-Bradley – EtherNet/IP Protocol – PLC Error Code Tables (cont'd)



| PLC Errors for Allen-Bradley EtherNet/IP Protocol – CIP Errors (Error code 0xaabbbb returned from the PLC.) | |
|---|---|
| **Panel Error Code PLC-497 Hex Value** | **Description** |
| 0x010113 | Connection Manager: Connection Manager cannot support any more connections. |
| 0x010114 | Connection Manager: Either the vendor ID or the Product Code in the key segment did not match the device. |
| 0x010115 | Connection Manager: Product Type in the key segment did not match the device. |
| 0x010116 | Connection Manager: Major or minor revision information in the key segment did not match the device. |
| 0x010117 | Connection Manager: Invalid connection point. |
| 0x010118 | Connection Manager: Invalid configuration format. |
| 0x010119 | Connection Manager: Connection request fails since there is no controlling connection currently open. |
| 0x01011a | Connection Manager: Target application cannot support any more connections. |
| 0x01011b | Connection Manager: RPI is smaller than the Production Inhibit Time. |
| 0x010203 | Connection Manager: Connection cannot be closed since the connection has timed out. |
| 0x010204 | Connection Manager: Unconnected Send timed out waiting for a response. |
| 0x010205 | Connection Manager: Parameter error in Unconnected send service. |
| 0x010206 | Connection Manager: Message too large for Unconnected message service. |
| 0x010207 | Connection Manager: Unconnected acknowledge without reply. |
| 0x010301 | Connection Manager: No buffer memory available. |
| 0x010302 | Connection Manager: Network Bandwidth not available for data. |
| 0x010303 | Connection Manager: No Tag filters available. |
| 0x010304 | Connection Manager: Not configured to send real-time data. |
| 0x010311 | Connection Manager: Port specified in Port segment not available. |
| 0x010312 | Connection Manager: Link address specified in port segment not available. |
| 0x010315 | Connection Manager: invalid segment type or segment value in path. |
| 0x010316 | Connection Manager: Path and Connection not equal in close. |
| 0x010317 | Connection Manager: Ether Segment not present or Encoded Value in Network Segment is invalid. |
| 0x010318 | Connection Manager: Link address to self invalid. |
| 0x010319 | Connection Manager: Resources on Secondary unavailable. |
| 0x01031a | Connection Manager: Connection already established. |
| 0x01031b | Connection Manager: Direct connection already established. |
| 0x01031c | Connection Manager: Miscellaneous. |
| 0x01031d | Connection Manager: Redundant connection mismatch. |
| 0x01031e | Connection Manager: No more consumer resources available in the producing module. |
| 0x01031f | Connection Manager: No connection resources exist for target path. |
| 0x010320 - 0x0107ff | Connection Manager: Vendor specific. |

(PLC generated error codes for the Allen-Bradley EtherNet/IP protocol continued on the next page.)

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# Allen-Bradley – EtherNet/IP Protocol – PLC Error Code Tables (cont'd)

| PLC Errors for Allen-Bradley EtherNet/IP Protocol – CIP Errors (Error code 0xaabbbb returned from the PLC.) | |
|---|---|
| **Panel Error Code PLC-497 Hex Value** | **Description** |
| 0x020000 | Resource unavailable: Connection Manager resources are unavailable to handle service request. |
| 0x030000 | Invalid parameter value. |
| 0x040000 | Path segment error: The path segment identifier or the segment syntax was not understood by the processing node. |
| 0x050000 | Path destination unknown: The path is referencing an object class, instance or structure element that is not known or is not contained in the processing node. |
| 0x060000 | Partial transfer: Only part of the expected data was transferred. |
| 0x070000 | Connection lost: The messaging connection was lost. |
| 0x080000 | Service not supported: The requested service was not implemented or was not defined for this Object Class/Instance. |
| 0x090000 | Invalid attribute value: Invalid attribute data detected. |
| 0x0a0000 | Attribute list error: An attribute in the Get_Attribute_List or Set_Attribute_List response has a non-zero status. |
| 0x0b0000 | Already in requested mode/state: The object is already in the mode/state being requested by the service. |
| 0x0c0000 | Object state conflict: The object cannot perform the requested service in its current mode/state. |
| 0x0d0000 | Object already exists: The requested instance of object to be created already exists. |
| 0x0e0000 | Attribute not settable: A request to modify non-modifiable attribute was received. |
| 0x0f0000 | Privilege violation: A permission/privilege check failed. |
| 0x100000 | Device state conflict: The device's current mode/state prohibits the execution of the requested service. |
| 0x110000 | Reply data too large: The data to be transmitted in the response buffer is larger than the allocated response buffer. |
| 0x120000 | Fragmentation of a primitive value: The service specified an operation that is going to fragment a primitive data value. For example, trying to send a 2 byte value to a REAL data type (4 byte). |
| 0x130000 | Not enough data: The service did not supply enough data to perform the specified operation. |
| 0x140000 | Attribute not supported: The attribute specified in the request is not supported. |
| 0x150000 | Too much data: The service supplied more data than was expected. |
| 0x160000 | Object does not exist: The object specified does not exist in the device. |
| 0x170000 | Service fragmentation sequence not in progress: The fragmentation sequence for this service is not currently active for this data. |
| 0x180000 | No stored attribute data: The attribute data of this object was no saved prior to the requested service. |
| 0x190000 | Store operation failure: The attribute data of this object was not saved due to a failure during the attempt. |
| 0x1a0000 | Routing failure, request packet too large: The service request packet was too large for transmission on a network in the path to the destination. |
| 0x1b0000 | Routing failure, response packet too large: The service reponse packet was too large for transmission on a network in the path from the destination. |
| 0x1c0000 | Missing attribute list entry data: The service did not supply an attribute in a list of attributes that was needed by the service to perform the requested behavior. |

(PLC generated error codes for the Allen-Bradley EtherNet/IP protocol continued on the next page.)

# Allen-Bradley – EtherNet/IP Protocol – PLC Error Code Tables (cont'd)



| PLC Errors for Allen-Bradley EtherNet/IP Protocol – CIP Errors (Error code 0xaabbbb returned from the PLC.) | |
|---|---|
| **Panel Error Code PLC-497 Hex Value** | **Description** |
| 0x1d0000 | Invalid attribute value list: The service is returning the list of attributes supplied with status information for those attributes that were invalid. |
| 0x1e0000 | Embedded service error: See Service Packet error list (PLC-498 Error codes) below: |
| 0x1f0000 | Vendor specific error: A vendor specific error has been encountered. This occurs when none of the specified errors relate to the error in the device. |
| 0x200000 | Invalid parameter: A parameter associated with the request was invalid. This code is used when a parameter does meet the requirements defined in an Application Object specification. |
| 0x210000 | Write-once value or medium already written: An attempt was made to write to a write-once-medium that has already been written or to modify a value that cannot be change once established. |
| 0x220000 | Invalid Reply Received: An invalid reply is received (example: service code sent doesn't match service code received.). |
| 0x230000 | Reserved by CIP for future extensions. |
| 0x240000 | Reserved by CIP for future extensions. |
| 0x250000 | Key failure in path: The key segment was included as the first segment in the path does not match the destination module. The object specific status shall indicate which part of the key check failed. |
| 0x260000 | Path Size Invalid: The size of the path which was sent with the Service Request is either not large enough to allow the Request to be routed to an object or too much routing data was included. |
| 0x270000 | Unexpected attribute in list: An attempt was made to set an attribute that is not able to be set at this time. |
| 0x280000 | Invalid Member ID: The Member ID specified in the request does not exist in the specified Class/Instance/ Attribute. |
| 0x290000 | Member not settable: A request to modify a non-modifiable member was received. |
| 0x2a0000 | Group 2 only server general failure: This error code may only be reported by DeviceNet group 2 only servers with 4K or less code space and only in place of Service not supported, Attribute not supported and Attribute not settable. |
| 0x2b0000 - 0xcf0000 | Reserved by CIP for future extensions. |
| 0xd00000 - 0xff0000 | Reserved for Object Class and service errors: This range of error codes is to be used to indicate Object Class specific errors. Use of this range should only be used when errors in this table don't accurately reflect the error encountered. |

(PLC generated error codes for the Allen-Bradley EtherNet/IP protocol continued on the next page.)

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# Allen-Bradley – EtherNet/IP Protocol – PLC Error Code Tables (cont'd)

| PLC Errors for Allen-Bradley EtherNet/IP Protocol – Service Packet Errors (Error code 0xaabbbb returned from the PLC.) | |
|---|---|
| **Panel Error Code PLC-498 Hex Value** | **Description** |
| 0x010000 | DST Node is out of buffer space. |
| 0x020000 | Cannot guarantee delivery; link layer (The remote node specified does not ACK command). |
| 0x030000 | Duplicate token holder detected. |
| 0x040000 | Local port is disconnected. |
| 0x050000 | Application layer timed out waiting for response. |
| 0x060000 | Duplicate node detected. |
| 0x070000 | Station is offline. |
| 0x080000 | Hardware fault. |
| 0x100000 | Illegal command or format. Typical error received from PLC when addressed requested to the PLC does not exist. Usually occurs if memory map has not been expanded in PLC to the range requested from panel. |
| 0x200000 | Host has a problem and will not communicate. |
| 0x300000 | Remote node host is missing, disconnected, or shut down. |
| 0x400000 | Host could not complete function due to hardware fault. |
| 0x500000 | Addressing problem or memory protected rungs. |
| 0x600000 | Function not allowed due to command protection selection. |
| 0x700000 | Processor is in Program Mode. |
| 0x800000 | Compatibility mode file missing or communication zone problem. |
| 0x900000 | Remote node cannot buffer command. |
| 0xA00000 | Wait ACK (1775 KA buffer full). |
| 0xB00000 | Not used. |
| 0xC00000 | Not used. |
| 0xD00000 | Error code in the EXT STS byte. See the error code table below. |
| 0xE00000 | Fewer levels specified in address than minimum for any address. |
| 0xF00300 | More levels specified in address than system supports. |
| 0xF00400 | Symbol not found. |
| 0xF00500 | Symbol is of improper format. |
| 0xF00600 | Address does not point to something usable. |
| 0xF00700 | File is wrong size. |
| 0xF00800 | Cannot complete request, situation has changed since start of the command. |
| 0xF00900 | Data or file size is too large. |
| 0xF00900 | Transaction size plus word address is too large. |
| 0xF00B00 | Access denied; improper privilege. This will occur if data file is set to constant or protected. |
| 0xF00C00 | Condition cannot be generated; resource is not available. |
| 0xF00D00 | Condition already exists; resource is readily available. |

(PLC generated error codes for the Allen-Bradley EtherNet/IP protocol continued on the next page.)

# Allen-Bradley – EtherNet/IP Protocol – PLC Error Code Tables (cont'd)



| PLC Errors for Allen-Bradley EtherNet/IP Protocol – Service Packet Errors (Error code 0xaabbbb returned from the PLC.) | |
|---|---|
| **Panel Error Code PLC-498 Hex Value** | **Description** |
| 0xF00E00 | Command cannot be executed. |
| 0xF00F00 | Histogram overflow. |
| 0xF01000 | No access. |
| 0xF01100 | Illegal data type. |
| 0xF01200 | Invalid parameter or invalid data. |
| 0xF01300 | Address reference exists to deleted area. |
| 0xF01400 | Command execution failure for unknown reason; possible histogram overflow. |
| 0xF01500 | Data conversion error. |
| 0xF01600 | Scanner not able to communicate with 1771 rack adapter. |
| 0xF01700 | Type mismatch. |
| 0xF01800 | 1771 module response was not valid. |
| 0xF01900 | Duplicated label. |
| 0xF02200 | Remote rack fault. |
| 0xF02300 | Timeout. |
| 0xF02400 | Unknown error. |
| 0xF01A00 | File is open; another node owns it. |
| 0xF01B00 | Another node is the program owner. |
| 0xF01C00 | Reserved. |
| 0xF01D00 | Reserved. |
| 0xF01E00 | Data table element protection violation. |
| 0xF01F00 | Temporary internal problem. |

# Generic EtherNet IP Protocol – PLC Error Codes

Only errors as listed in the Touch Panel Error Code Table shown previously in this Appendix can occur when using the Generic Ethernet IP protocol, there are no PLC generated errors.

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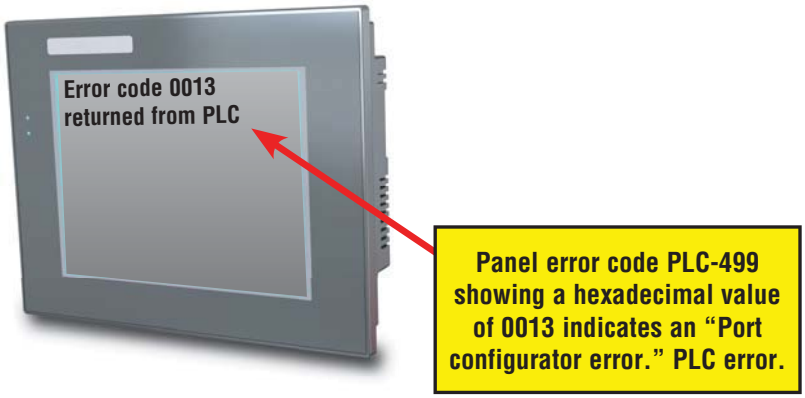
# GE 90-30 – Panel Error Code PLC-499 Explanation

The PLC-499 error code is used to show any errors that are generated by the connected PLC. The PLC-499 error message includes a four digit hexadecimal value embedded in the message. This value can be looked up in the specific PLC's error tables to determine the cause of the error.The possible PLC generated error codes for the GE 90-30 communication protocol are represented by a hexadecimal value as shown in the following message example.

## GE 90-30 Error Code PLC-499 Message Example:



# GE 90-30 SNPX Protocol – PLC Error Code Tables



The following table lists the errors that can be generated by the GE 90-30 PLC when using the SNPX protocol.

*NOTE: The following errors can be generated from the designated PLC, are monitored by the C-more touch panel, and displayed on the touch panel's screen as a hexadecimal value in panel error code PLC-499 message, if active. Please refer to the PLC manufacturer's documentation for additional information.*

| PLC Errors for GE 90-30 SNPX Protocol (Major) | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| No error | Successful completion. (This is the expected completion value in the COMMREQ Status Word.) |
| 0x0002 | Insufficient Privilege. For Series 90-70 PLC, the minor error code contains the privilege level required for the service request. |
| 0x0004 | Protocol Sequence Error. The CPU has received a message that is out of order. |
| 0x0005 | Service Request Error, the minor error code contains the specific error code. |
| 0x0006 | Illegal Mailbox Type. Service request mailbox type is either undefined or unexpected. |
| 0x0007 | The PLC CPU's Service Request Queue is full. The master should retry later. It is recommended that the master wait a minimum of 10 msec before sending another service request. |
| 0x000A | SNP DOS Driver Error. The minor error code contains the specific error code. |
| 0x000B | Illegal Service Request. The requested service is either not defined or not supported. (This value is returned in lieu of the actual 01h value passed in the SNP error message, to avoid confusion with the normal successful COMMREQ completion.) |
| 0x000C | Local SNP/SNP-X Error. An error occurred within the SNP task in the CMM module in this PLC. This error may occur in either an SNP master or an SNP slave. The minor error code contains the specific error code. |
| 0x000D | Remote SNP Error. An error occurred within the SNP slave task in the CMM module in the remote PLC. The minor error code contains the specific error code. |
| 0x000E | Autodial Error. An error occurred while attempting to send a command string to an attached external modem. The minor error code contains the specific error code. |
| 0x000F | SNP-X slave error. An error occurred within the SNPX task in the remote slave device. The minor error code contains the specific error code. |
| 0x0013 | Port configurator error. |
| 0x0050 | Problem with sending mail to the slave Service Request task. (Series 90-70 PLC CPUs only) |
| 0x0051 | Problem with getting mail from the slave Service Request task. (Series 90-70 PLC CPUs only) |
| 0x0055 | Slave SNP task timed out before receiving an SRP response. (Series 90-70 PLC CPUs only) |
| 0x0056 | Slave SNP task could not find the requested datagram connection. (Series 90-70 PLC CPUs only) |
| 0x0057 | Slave SNP task encountered an error in trying to write the datagram. (Series 90-70 PLC CPUs only) |
| 0x0058 | Slave SNP task encountered an error in trying to update the datagram. (Series 90-70 PLC CPUs only) |

(PLC generated error codes for the GE 90-30 SNPX protocol continued on the next page.)

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# GE 90-30 SNPX Protocol – PLC Error Code Tables (cont'd)

| PLC Errors for GE 90-30 SNPX Protocol (Minor-Major) (cont'd) | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| PLC Error 0x010C | WAIT-type COMMREQ is not permitted; must use NOW AIT-type. |
| PLC Error 0x010E | Not used |
| PLC Error 0x010F | The service request code in an X-Request message is unsupported or invalid at this time. This error may occur if an SNP-X communication session has not been success fully established at the slave device. |
| PLC Error 0x020C | COMMREQ command is not supported. |
| PLC Error 0x020E | The modem command string length exceeds 250 characters. |
| PLC Error 0x020F | Insufficient privilege level in the slave PLC CPU for the requested SNP-X service.<br>Password protection at PLC CPU may be preventing the requested service. |
| PLC Error 0x0213 | Unsupported COMMREQ. These errors are only generated when there is no protocol currently being run on a port, and the port receives a COMMREQ.<br>(The port may be disabled or an error has occurred in processing a new configuration). |
| PLC Error 0x030C | SNP communication is not active. Must initiate a new SNP communication by sending an Attach or Long Attach COMMREQ. |
| PLC Error 0x030E | COMMREQ Data Block Length is too small.<br>Output command string data is missing or incomplete. |
| PLC Error 0x030F | Invalid slave memory type in X-Request message. |
| PLC Error 0x0313 | Invalid COMMREQ length. |
| PLC Error 0x040C | SNP slave did not respond to Attach message from master. |
| PLC Error 0x040E | Serial output timeout. The CMM module was unable to transmit the modem autodial output from the serial port. (May be due to missing CTS signal when the CMM is configured to use hardware flow control.) |
| PLC Error 0x040F | Invalid slave memory address or range in X-Request message. |
| PLC Error 0x0413 | Invalid COMMREQ status word location. |
| PLC Error 0x050C | Unable to write SNP Status Word to local PLC memory;<br>may be due to invalid Status Word memory type or address. |
| PLC Error 0x050E | Response was not received from modem. Check modem and cable. |
| PLC Error 0x050F | Invalid data length in X-Request message.<br>Data length must be non-zero, and may not exceed decimal 1000 bytes. |
| PLC Error 0x0513 | Invalid COMMREQ data. |
| PLC Error 0x060C | Master device memory type is not valid in this PLC. |
| PLC Error 0x060E | Modem responded with BUSY.<br>Modem is unable to complete the requested connection. The remote modem is already in use; retry the connection request at a later time. |
| PLC Error 0x060F | X-Buffer data length does not match the service request in X-Request message.<br>The X-Buffer message length is obtained from the Next Message Length field in the X-Request message; the length of the data within the buffer message is always the message length. |
| PLC Error 0x070C | Master device memory address or length is zero. |
| PLC Error 0x070E | Modem responded with NO CARRIER.<br>Modem is unable to complete the requested connection.<br>Check the local and remote modems and the telephone line. |
| PLC Error 0x070F | Queue Full indication from Service Request Processor in slave PLC CPU.<br>The slave is temporarily unable to complete the service request.<br>The master should try again later. It is recommended that the master wait at least 10 msec before repeating the X-Request. |

(PLC generated error codes for the GE 90-30 SNPX protocol continued on the next page.)

# GE 90-30 SNPX Protocol – PLC Error Code Tables (cont'd)



| PLC Errors for GE 90-30 SNPX Protocol (Minor-Major) (cont'd) | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x080C | Unable to read or write master device memory locations specified in COMMREQ. Usually caused by invalid memory address for this PLC. SNP message exchange may have taken place. |
| 0x080E | Modem responded with NO DIALTONE. Modem is unable to complete the requested connection. Check the modem connections and the telephone line. |
| 0x080F | Service Request Processor response exceeds 1000 bytes;<br>the SNP-X slave device cannot return the data in an X-Response message.<br>(This error applies to CMM module only.) |
| 0x090C | Master device memory data length exceeds maximum data size of CMM module (2048 bytes). Must use a smaller data length. Use multiple COMMREQs if total data length exceeds this maximum value. |
| 0x090E | Modem responded with ERROR. Modem is unable to complete the requested command. Check the modem command string and modem. |
| 0x0A0C | Slave device memory type is missing or not valid. |
| 0x0A0E | Modem responded with RING, indicating that the modem is being called by another modem. Modem is unable to complete the requested command. Retry the modem command at a later time. |
| 0x0B0C | Slave device memory address is missing or zero. |
| 0x0B0E | An unknown response was received from the modem. Modem is unable to complete the requested command. Check the modem command string and modem. The modem response is expected to be either CONNECT or OK. |
| 0x0C0C | COMMREQ Data Block Length is too small.<br>(When expected COMMREQ length is 6 words or less. An improper length may cause other minor error codes 6-11.) |
| 0x0D0C | Invalid Diagnostic Status Word (DSW) starting word or length. |
| 0x0E0C | Invalid maximum SNP message data size.<br>Must be an even value from 42 to 2048. |
| 0x0F0C | Invalid Privilege Level. Must be 0 through 4 or -1. |
| 0x100C | Invalid Fault Table selector.<br>Must be 1 for I/O Fault Table, or 2 for PLC Fault Table. |
| 0x100F | Unexpected Service Request Processor error.<br>(This error applies to CMM module only; the unexpected SRP error code is saved in the Diagnostic Status Words in the CMM module.) |
| 0x110C | Invalid Fault Table starting index.<br>Must be 1-32 for I/O Fault Table, or 1-16 for PLC. |
| 0x120C | Invalid fault count. Must be 1-32 for I/O Fault Table, or 1-16 for PLC Fault Table. |
| 0x130C | Invalid Set PLC Date/Time mode. Must be 1-4. |
| 0x140C | Invalid Set PLC Date/Time date, time, or day-of-week value. |
| 0x150C | Unable to retrieve master device PLC time/date from PLC CPU. |
| 0x150F | Requested service is not permitted in a Broadcast request. The master must direct the X-Request message to a specific SNP-X slave device. |
| 0x160C | Invalid slave PLC type.<br>Must be 0 for Series 90-70, or 1 for Series 90-30 or Series 90-20. |
| 0x170C | Invalid datagram type.<br>Must be 01h for normal datagram, or 81h (129) for permanent datagram. |
| 0x180C | Missing or too many datagram point formats. Must be 1-32. |
| 0x190C | Invalid datagram point format data. |

(PLC generated error codes for the GE 90-30 SNPX protocol continued on the next page.)

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# GE 90-30 SNPX Protocol – PLC Error Code Tables (cont'd)

| PLC Errors for GE 90-30 SNPX Protocol (Minor-Major) (cont'd) | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x1A0C | Datagram area size is too small to include data for all specified point formats. |
| 0x1B0C | Invalid number of Control Program Names. Must be 1-8. |
| 0x1C0C | SNP-X Request exceeds maximum data size (1000 bytes).<br>Must use a smaller data length. Use multiple COMMREQs if necessary. |
| 0x1D0C | Invalid SNP-X communication session type.<br>Must be 0 for a single slave device, or 1 for multiple slave devices. |
| 0x1E0C | Illegal destination SNP ID specified for SNP-X slave. Must be 0-7 ASCII characters, plus a terminating null character (00h). The Null SNP ID (eight bytes of 00h) may be used to specify any single device. The Broadcast SNP ID (eight bytes of FFh) may be use to specify all slave devices on the serial link. |
| 0x1F0C | Destination SNP ID does not match SNP-X session type.<br>The Broadcast SNP ID is not permitted in a single-slave SNP-X session.<br>The Null SNP ID is not permitted in a multiple-slave SNP-X session. |
| 0x200C | Inactivity timeout (T3'). The SNP slave has not received any new SNP messages within the configured T3' time interval. |
| 0x200F | Invalid Message Type field in a received X-Request message.<br>The message type of an X-Request message must be 58h = 'X'. |
| 0x210C | A Parity error has occurred on an Attach, Attach Response, or Update Real–time Datagram message.<br>Communications have not been established. |
| 0x210F | Invalid Next Message Type or Next Message Length field in a received X Request message. If this request does not use a buffer (0-2 bytes of data), the Next Message Type must be zero. If this request will be followed with a buffer message (more than 2 byte.)), the Next Message Type must be 54h = 'T', and the Next Message Length must specify the length of the X-Buffer message. Valid X-Buffer message lengths are 9-1008 bytes (data length plus 8 bytes). |
| 0x220C | A BCC (Block Check Code) error has occurred on an Attach, Attach Response, or Update Realtime Datagram message. Communications have not been established. |
| 0x220F | Invalid Message Type field in a received X-Buffer message.<br>The message type of an X-Buffer message must be 54h = 'T'. |
| 0x230C | A Framing or Overrun serial error has occurred on an Attach, Attach Response, or Update Realtime Datagram message. Communications have not been established. |
| 0x230F | Invalid Next Message Type field in a received X-Buffer message. Since an X-Buffer message is never followed by another message, the Next Message Type must always be zero. |
| 0x240C | An invalid SNP message type was received when an Attach, Attach Response, or Update Realtime Datagram message was required. Communications have not been established. |
| 0x250C | An invalid next message length value was specified in an Attach, Attach Response, or Update Realtime Datagram message. Communications have not been established. |
| 0x260C | An unexpected SNP message type was received when an Attach, Attach Response, or Update Realtime Datagram was required. Communications have not been established. |
| 0x270C | Another Break was received while SNP slave was waiting for an Attach or Update Realtime Datagram message. |
| 0x280C | An SNP message has been sent and retried the maximum number of times.<br>A maximum of two retries are permitted.<br>A retry is caused by a NAK from from the remote SNP device. |
| 0x290C | A received SNP message has been NAKed the maximum number of two times.<br>The NAKed message may be retransmitted a maximum of two times. |

(PLC generated error codes for the GE 90-30 SNPX protocol continued on the next page.)

# GE 90-30 SNPX Protocol – PLC Error Code Tables (cont'd)



| PLC Errors for GE 90-30 SNPX Protocol (Minor-Major) (cont'd) | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x2A0C | An unknown message was received when an acknowledge (ACK or NAK) was required. |
| 0x2B0C | Sequence Error. An unexpected SNP message type was received. |
| 0x2C0C | Received SNP message contains bad next message length value. |
| 0x2D0C | Acknowledge timeout. An acknowledge (ACK or NAK) was not received within the configured T2 time interval. A slave device may generate this error if the master device has aborted after maximum response NAKs and does not NAK the next response retry. |
| 0x2E0C | Response timeout. The SNP Master did not receive an SNP Response message within the configured T5' time interval. |
| 0x2F0C | Buffer message timeout. An expected Text Buffer or Connection Data message was not received within the configured T5'' time interval. |
| 0x300C | Serial output timeout. The CMM module was unable to transmit a Break, an SNP message, or SNP acknowledge (ACK or NAK) from the serial port. (May be due to missing CTS signal when the CMM module is configured to use hardware flow control.) |
| 0x310C | SNP slave did not receive a response from the Service Request Processor in the PLC CPU. |
| 0x320C | COMMREQ timeout.<br>The COMMREQ did not complete within the configured time interval. |
| 0x330C | An SNP Request or Response was aborted prior to completion due to reception of a Break. |
| 0x340C | PLC backplane communications error |
| 0x350C | Invalid Piggyback Status data memory type or address.<br>Communications have not been established. |
| 0x360C | Invalid SNP Slave SNP ID. Must be a 0-7 ASCII characters, plus a terminating null character (00h). The Null SNP ID (eight bytes of 00h) may be used to specify any single slave device. |
| 0x370C | The SNP master has received a response message containing an unexpected data length. Usually indicates a problem with the remote SNP slave device. May occur when Series 90-70 commands (Task Memory or Program Block Memory Read/Write) are issued to a Series 90-30 slave device. |
| 0x380C | Response code in received SNP-X response message does not match expected value. (Response code must equal the request code +80h.) |
| 0x390C | SNP-X Response message exceeds maximum data size (decimal 1000 bytes).<br>Data in the Response is ignored. |
| 0x400C | A parity error has occurred on an X-Attach Response message when establishing a new SNP-X communication session. Communications have not been established. |
| 0x400D | The requested service is not supported by the SNP slave. |
| 0x400F | Serial output timeout. The slave was unable to transmit an SNP-X message from the serial port. (May be due to missing CTS signal when the CMM module is configured to use hardware flow control.) |

(PLC generated error codes for the GE 90-30 SNPX protocol continued on the next page.)

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# GE 90-30 SNPX Protocol – PLC Error Code Tables (cont'd)

| PLC Errors for GE 90-30 SNPX Protocol (Minor-Major) (cont'd) | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x410C | A framing or overrun error has occurred on an X-Attach Response message when establishing a new SNP-X communication session. Communications have not been established. |
| 0x410D | SNP slave on CMM module requires PLC CPU privilege level 2 to operate. The SNP slave has rejected a request to change to a higher or lower privilege level. |
| 0x410F | An SNP-X request was aborted prior to completion due to reception of a Break. |
| 0x420C | A BCC (Block Check Code) error has occurred on an X-Attach Response message when establishing a new SNP-X communication session. Communications have not been established. |
| 0x420D | SNP Request or Response message exceeds maximum data length of the CMM module. (Total data length for Mailbox and all following Buffer messages is 2048 bytes.) The master must use a smaller data length. Use multiple requests if total data length exceeds the maximum value. |
| 0x420F | An X-Buffer message was received containing greater than 1000 bytes of data. The data is ignored. |
| 0x430C | An invalid message type was received when an X-Attach Response was required when establishing a new SNP-X communication session. Communications have not been established. |
| 0x430D | Improper Write Datagram message format. Series 90-70 slave devices use a different format for this message than Series 90-30 or Series 90-20 slave devices. The master must use the proper message format for this SNP slave device. (The SNP master in the CMMmodule sends this message as part of the Establish Datagram COMMREQ command. The datagram has been partially established, but is not usable; the datagram should be cancelled by using the Datagram ID returned by the COMMREQ.) |
| 0x430F | The SNP-X slave did not receive a response from the Service Request Processor in the PLC CPU. |
| 0x440C | An invalid next message type value was detected in an X-Attach Response message when establishing a new SNP-X communication session. Communications have not been established. |
| 0x440D | A datagram error occurred in a Series 90-70 slave device (dual-port error). |
| 0x440F | PLC backplane communications error. |
| 0x450C | An invalid response code was detected in an X-Attach Response message when establishing a new SNP-X communication session. Communications have not been established. |
| 0x460C | An expected X-Attach Response message was not received within the response timeout interval when establishing a new SNP-X communication session. The master has retried the X-Attach message twice without receiving a response. Communications have not been established. |
| 0x500C | A parity error has occurred on an X-Attach Response message when re-establishing an existing SNP-X communication session. Communications have not been established. |
| 0x500F | A parity error has occurred in a received X-Attach message. |
| 0x510C | A framing or overrun error has occurred on an X-Attach Response message when re-establishing an existing SNP-X communication session. Communications have not been established. |
| 0x510F | A framing or overrun error has occurred in a received X-Attach message. |
| 0x520C | A BCC (Block Check Code) error has occurred on an X-Attach Response message when re-establishing an existing SNP-X communication session. Communications have not been established. |
| 0x520F | A BCC (Block Check Code) error has occurred in a received X-Attach message. |

(PLC generated error codes for the GE 90-30 SNPX protocol continued on the next page.)

# GE 90-30 SNPX Protocol – PLC Error Code Tables (cont'd)



| PLC Errors for GE 90-30 SNPX Protocol (Minor-Major) (cont'd) | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| **0x530C** | An invalid message type was received when an X-Attach Response was required when re-establishing an existing SNP-X communication session. Communications have not been established. |
| **0x530F** | An invalid Message Type was received when an X-Attach message was required. (For an X-Attach message, the message type must be 58h = 'T'.) |
| **0x540C** | An invalid Next Message Type value was detected in an X-Attach Response message when re-establishing an existing SNP-X communication session. Communications have not been established. |
| **0x540F** | An invalid Next Message Type value was detected in a received X-Attach message. (For an X-Attach message, the Next Message Length must be zero.) |
| **0x550C** | An invalid response code was detected in an X-Attach Response message when re-establishing an existing SNP-X communication session. Communications have not been established. |
| **0x550F** | An invalid request code was detected in a received X-Attach message. |
| **0x560C** | An expected X-Attach Response message was not received within the response timeout interval when re-establishing an existing SNP-X communication session. The master has retried the X-Attach message twice without receiving a response. Communications have not been established. |
| **0x600C** | A parity error has occurred on an X-Response message. |
| **0x600F** | A parity error has occurred in a received X-Request message. |
| **0x610C** | A framing or overrun error has occurred on an X-Response message. |
| **0x610F** | A framing or overrun error has occurred in a received X-Request message. |
| **0x620C** | A BCC (Block Check Code) error has occurred on an X-Response message. |
| **0x620F** | A BCC (Block Check Code) error has occurred in a received X-Request message. |
| **0x630C** | An invalid message type was received when an X-Response message was required. |
| **0x640C** | An invalid next message type value was detected in an X-Response message. |
| **0x650C** | An invalid response code was detected in an X-Response message. |
| **0x660C** | An expected X-Response message was not received within the response time. |
| **0x700C** | A parity error has occurred on an Intermediate Response message. |
| **0x700F** | A parity error has occurred in a received X-Buffer message. |
| **0x710C** | A framing or overrun error has occurred on an Intermediate Response message. |
| **0x710F** | A framing or overrun error has occurred in a received X-Buffer message. |
| **0x720C** | A BCC (Block Check Code) error has occurred on an Intermediate Response message. |
| **0x720F** | A BCC(Block Check Code) error has occurred in a received X-Buffer message. |
| **0x730C** | An invalid message type was received when an Intermediate Response message was required. |
| **0x730F** | An expected X-Buffer message was not received. |
| **0x740C** | An invalid next message type value was detected in an Intermediate Response message. |
| **0x750C** | An invalid response code was detected in an Intermediate Response message. |
| **0x760C** | An expected Intermediate Response message was not received within the response timeout interval. |

(PLC generated error codes for the GE 90-30 SNPX protocol continued on the next page.)

# GE 90-30 SNPX Protocol – PLC Error Code Tables (cont'd)



| PLC Errors for GE 90-30 SNPX Protocol (Minor-Major) (cont'd) | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x8D0A | Bad DOS Version. Must have DOS 2.0, or later, to support the SNP DOS Driver. |
| 0x8E0A | PC Serial port configured for SNP Master driver is not open; no communication can take place. |
| 0x8F0A | Out–of–Sequence SNP message. SNP message type received was not the type expected. |
| 0x900A | Bad SNP BCC encountered. Transmission was aborted after maximum retries due to a bad Block Check Code. |
| 0x910A | Bad SNP communication. Transmission was aborted after maximum retries due to serial errors (that is, parity, overrun, or framing errors). |
| 0x920A | No SNP communication. Either communication has been lost or a communication session has not been established. |
| 0xC105 | Invalid block state transition. |
| 0xC205 | The OEM key is NULL (inactive). |
| 0xC305 | Text length does not match traffic type. |
| 0xC405 | Verify with FA Card or EEPROM failed. |
| 0xC505 | No task–level Rack/Slot configuration to read or delete. |
| 0xC605 | Control Program (CP) tasks exist but requestor not logged into main CP. |
| 0xC705 | Passwords are set to inactive and cannot be enabled or disabled. |
| 0xC805 | Password(s) already enabled and can not be forced inactive. |
| 0xC905 | Login using non–zero buffer size required for block commands. |
| 0xCA05 | Device is write–protected. |
| 0xCB05 | A comm or write verify error occurred during save or restore. |
| 0xCC05 | Data stored on device has been corrupted and is no longer reliable. |
| 0xCD05 | Attempt was made to read a device but no data has been stored on it. |
| 0xCE05 | Specified device has insufficient memory to handle request. |
| 0xCF05 | Specified device is not available in the system (not present). |
| 0xD005 | One or more PLC modules configured have unsupported revision. |
| 0xD105 | Packet size or total program size does not match input. |
| 0xD205 | Invalid write mode parameter. |
| 0xD305 | User Program Module (UPM) read or write exceeded block end. |
| 0xD405 | Mismatch of configuration checksum. |
| 0xD505 | Invalid block name specified in datagram. |
| 0xD605 | Total datagram connection memory exceeded. |
| 0xD705 | Invalid datagram type specified. |
| 0xD805 | Point length not allowed. |
| 0xD905 | Transfer type invalid for this Memory Type selector. |
| 0xDA05 | Null pointer to data in Memory Type selector. |
| 0xDB05 | Invalid Memory Type selector in datagram. |
| 0xDC05 | Unable to find connection address. |
| 0xDD05 | Unable to locate given datagram connection ID. |
| 0xDE05 | Size of datagram connection invalid. |
| 0xDF05 | Invalid datagram connection address. |

(PLC generated error codes for the GE 90-30 SNPX protocol continued on the next page.)

# GE 90-30 SNPX Protocol – PLC Error Code Tables (cont'd)



| PLC Errors for GE 90-30 SNPX Protocol (Minor-Major) (cont'd) | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0xE005 | Service in process cannot login. |
| 0xE105 | No I/O configuration to read or delete. |
| 0xE205 | IOS could not delete configuration, or bad type. |
| 0xE305 | CPU revision number does not match. |
| 0xE405 | Memory Type for this selector does not exist. |
| 0xE505 | DOS file area not formatted. |
| 0xE605 | CPU model number does not match. |
| 0xE705 | Configuration is not valid. |
| 0xE805 | No user memory is available to allocate. |
| 0xE905 | Memory Type selector not valid in context. |
| 0xEA05 | Not logged in to process service request. |
| 0xEB05 | Task unable to be deleted. |
| 0xEC05 | Task unable to be created. |
| 0xED05 | VME bus error encountered. |
| 0xEE05 | Could not return block sizes. |
| 0xEF05 | Programmer is already attached. |
| 0xF005 | Request only valid in stop mode. |
| 0xF105 | Request only valid from programmer. |
| 0xF205 | Invalid program cannot log in. |
| 0xF305 | I/O configuration mismatch. |
| 0xF405 | Invalid input parameter in request. |
| 0xF505 | Invalid password. |
| 0xF605 | Invalid sweep state to set. |
| 0xF705 | Required to log in to a task for service. |
| 0xF805 | Invalid Task Name referenced. |
| 0xF905 | Task address out of range. |
| 0xFA05 | Cannot replace I/O module. |
| 0xFB05 | Cannot clear I/O configuration. |
| 0xFC05 | I/O configuration is invalid. |
| 0xFD05 | Unable to perform auto configuration. |
| 0xFE05 | No privilege for attempted operation. |
| 0xFF05 | Service Request Error has been aborted. |

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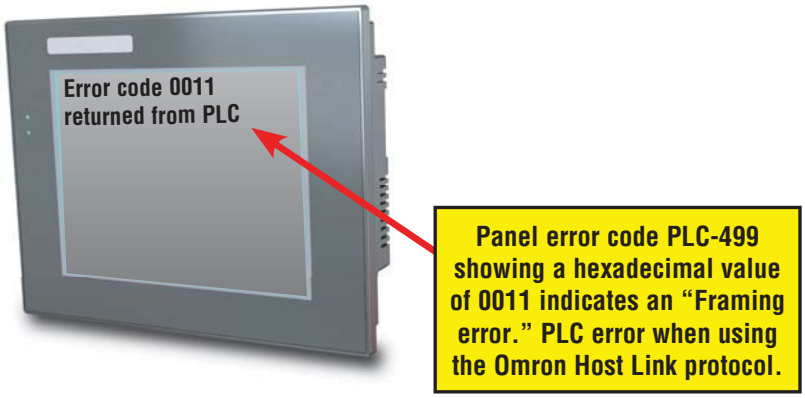
# Mitsubishi FX Protocol – PLC Error Codes

Only errors as listed in the Touch Panel Error Code Table shown previously in this Appendix can occur when using the Mitsubishi FX protocol, there are no PLC generated errors.

# Omron – Panel Error Code PLC-499 Explanation

The PLC-499 error code is used to show any errors that are generated by the connected PLC. The PLC-499 error message includes a four digit hexadecimal value embedded in the message. This value can be looked up in the specific PLC's error tables to determine the cause of the error. The possible PLC generated error codes for the Omron Host Link and FINS communication protocol are represented by a hexadecimal value as shown in the following message example.

## Omron Error Code PLC-499 Message Example:



# Omron Host Link Protocol – PLC Error Code Table



The following table lists the errors that can be generated by the Omron PLC when using the Host Link protocol.

*NOTE: The following errors can be generated from the designated PLC, are monitored by the C-more touch panel, and displayed on the touch panel's screen as a hexadecimal value in panel error code PLC-499 message, if active. Please refer to the PLC manufacturer's documentation for additional information.*

| PLC Error Codes for Omron Host Link | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x0000 | Normal Completion. |
| 0x0001 | Not executable in RUN mode. |
| 0x0002 | Not executable in MONITOR mode. |
| 0x0003 | Not executable with PROM mounted. |
| 0x0004 | Address over (data overflow). |
| 0x000B | Not executable in PROGRAM mode. |
| 0x000C | Not executable in DEBUG mode. |
| 0x000D | Not executable in LOCAL mode. |
| 0x0010 | Parity error. |
| 0x0011 | Framing error. |
| 0x0012 | Overrun. |
| 0x0013 | FCS error. |
| 0x0014 | Format error (parameter length error). |
| 0x0015 | Entry number data error (parameter error, data code error, data length error). |
| 0x0016 | Instruction not found. |
| 0x0018 | Frame length error. |
| 0x0019 | Not executable (due to Un-executable error clear, non-registration of I/O table, etc.). |
| 0x0020 | I/O table generation impossible (unrecognized remote I/O unit, channel over, duplication of optical transmitting I/O unit). |
| 0x00A0 | Abort due to parity error in transmit data under process. |
| 0x00A1 | Abort due to framing error in transmit data under process. |
| 0x00A2 | Abort due to overrun in transmit data under process. |
| 0x00A3 | Abort due to FCS error in transmit data under process. |
| 0x00A4 | Abort due to format error in transmit data under process. |
| 0x00A5 | Abort due to frame length error in transmit data under process. |
| 0x00A8 | Abort due to entry number data error in transmit data under process. |
| 0x00B0 | Un-executable due to program area capacity other than 16k bytes. |

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# Omron FINS Protocol – PLC Error Code Table

The following table lists the errors that can be generated by the Omron PLC when using the FINS protocol.

*NOTE: The following errors can be generated from the designated PLC, are monitored by the C-more touch panel, and displayed on the touch panel's screen as a hexadecimal value in panel error code PLC-499 message, if active. Please refer to the PLC manufacturer's documentation for additional information.*

| PLC Error Codes for Omron FINS | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x0000 | Normal Completion. |
| 0x0001 | Service Canceled. |
| 0x0101 | Local Error: Local node not in network. |
| 0x0102 | Local Error: Token Timeout. |
| 0x0103 | Local Error: Retries Failed. |
| 0x0104 | Local Error: Too many send frames. |
| 0x0105 | Local Error: Node address range error. |
| 0x0106 | Local Error: Node Address Duplication. |
| 0x0201 | Destination Node Error: Destination Node not in network. |
| 0x0202 | Destination Node Error: Unit Missing. |
| 0x0203 | Destination Node Error: Third Node missing. |
| 0x0204 | Destination Node Error: Destination Node busy. |
| 0x0205 | Destination Node Error: Response Timeout. |
| 0x0301 | Controller Error: Communications Controller Error. |
| 0x0302 | Controller Error: CPU Unit Error. |
| 0x0303 | Controller Error: Controller Error. |
| 0x0304 | Controller Error: Unit number Error. |
| 0x0401 | Service Unsupported: Undefined Command. |
| 0x0402 | Service Unsupported: Not supported by Model/Version. |
| 0x0501 | Routing Table Error: Destination address setting error. |
| 0x0502 | Routing Table Error: No routing tables. |
| 0x0503 | Routing Table Error: Routing table error. |
| 0x0504 | Routing Table Error: Too many delays. |
| 0x1001 | Command Format Error: Command too long. |
| 0x1002 | Command Format Error: Command too short. |
| 0x1003 | Command Format Error: Elements/Data don't match. |
| 0x1004 | Command Format Error: Command format error. |
| 0x1005 | Command Format Error: Header Error. |
| 0x1101 | Parameter Error: Area classification missing. |
| 0x1102 | Parameter Error: Access Size Error. |
| 0x1103 | Parameter Error: Address range error. |

(PLC generated error codes for the Omron FINS protocol continued on the next page.)

# Omron FINS Protocol – PLC Error Code Table (cont'd)



| PLC Error Codes for Omron FINS | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x1104 | Parameter Error: Address range exceeded. |
| 0x1106 | Parameter Error: Program Missing. |
| 0x1109 | Parameter Error: Relational Error. |
| 0x110A | Parameter Error: Duplicate Data Access. |
| 0x110B | Parameter Error: Response too long. |
| 0x110C | Parameter Error: Parameter Error. |
| 0x2002 | Read Not Possible: Protected. |
| 0x2003 | Read Not Possible: Table missing. |
| 0x2004 | Read Not Possible: Data missing. |
| 0x2005 | Read Not Possible: Program missing. |
| 0x2006 | Read Not Possible: File missing. |
| 0x2007 | Read Not Possible: Data mismatch. |
| 0x2101 | Write Not Possible: Read Only. |
| 0x2102 | Write Not Possible: Protected - cannot write data link table. |
| 0x2103 | Write Not Possible: Cannot register. |
| 0x2105 | Write Not Possible: Program missing. |
| 0x2106 | Write Not Possible: File missing. |
| 0x2107 | Write Not Possible: File name already exists. |
| 0x2108 | Write Not Possible: Cannot change. |
| 0x2201 | Not executable in current mode: Not possible during execution. |
| 0x2202 | Not executable in current mode: Not possible while running. |
| 0x2203 | Not executable in current mode: Wrong PLC mode (Program). |
| 0x2204 | Not executable in current mode:  Wrong PLC mode (Debug). |
| 0x2205 | Not executable in current mode: Wrong PLC mode (Monitor). |
| 0x2206 | Not executable in current mode: Wrong PLC mode (Run). |
| 0x2207 | Not executable in current mode: Specified node not polling node. |
| 0x2208 | Not executable in current mode: Step cannot be executed. |
| 0x2301 | No such device: File device missing. |
| 0x2302 | No such device: Missing memory. |
| 0x2303 | No such device: Clock missing. |
| 0x2401 | Cannot Start/Stop: Table missing. |
| 0x2502 | Unit Error: Memory Error. |
| 0x2503 | Unit Error: I/O setting Error. |
| 0x2504 | Unit Error: Too many I/O points. |
| 0x2505 | Unit Error: CPU bus error. |
| 0x2506 | Unit Error: I/O Duplication. |

(PLC generated error codes for the Omron FINS protocol continued on the next page.)

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# Omron FINS Protocol – PLC Error Code Table (cont'd)

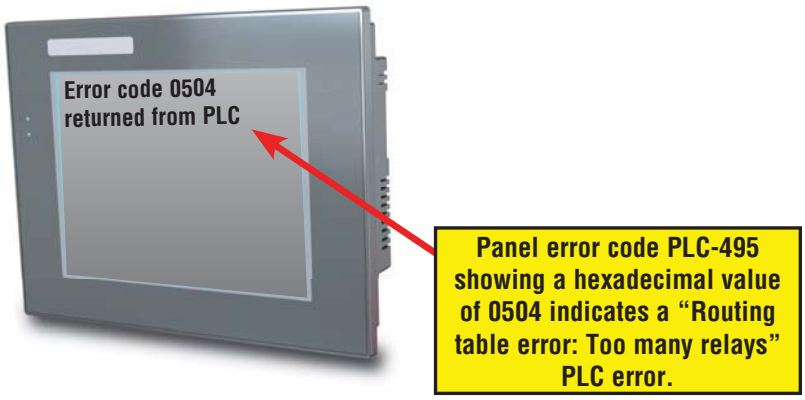
| PLC Error Codes for Omron FINS | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x2507 | Unit Error: I/O bus error. |
| 0x2509 | Unit Error: SYSMAC BUS/2 error. |
| 0x250A | Unit Error: CPU Bus Unit Error. |
| 0x250D | Unit Error: SYSMAC BUS No. duplication. |
| 0x250F | Unit Error: Memory Error. |
| 0x2510 | Unit Error: SYSMAC BUS terminator missing. |
| 0x2601 | Command Error: No protection. |
| 0x2602 | Command Error: Incorrect password. |
| 0x2604 | Command Error: Protected. |
| 0x2605 | Command Error: Service already executing. |
| 0x2606 | Command Error: Service stopped. |
| 0x2607 | Command Error: No execution right. |
| 0x2608 | Command Error: Settings not complete. |
| 0x2609 | Command Error: Necessary items not set. |
| 0x260A | Command Error: Number already defined. |
| 0x260B | Command Error: Error will not clear. |
| 0x3001 | Access Right Error: No access right. |
| 0x4001 | Abort: Service aborted. |

# Omron – Panel Error Code P495 Explanation



The PLC-495 error code is used to show any errors that are generated by the connected PLC. The PLC-495 error message includes a four digit hexadecimal value embedded in the message. This value can be looked up in the specific PLC's error tables to determine the cause of the error. The possible PLC generated error codes for the Omron CS/CJ FINS Ethernet communication protocol are represented by a hexadecimal value as shown in the following message example.

## Omron Error Code PLC-495 Message Example:



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# Omron CS/CJ FINS Ethernet Protocol – PLC Error Code Table

The following table lists the errors that can be generated by the Omron PLC when using the CS/CJ FINS Ethernet protocol.

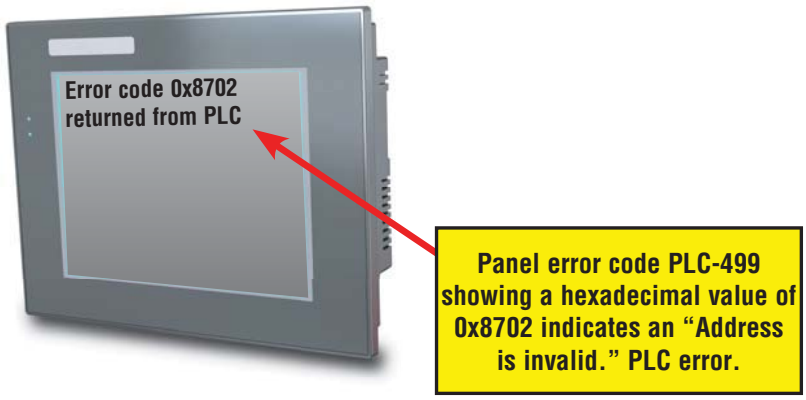
*NOTE: The following errors can be generated from the designated PLC, are monitored by the C-more touch panel, and displayed on the touch panel's screen as a hexadecimal value in panel error code PLC-495 message, if active. Please refer to the PLC manufacturer's documentation for additional information.*

| PLC Error Codes for Omron CS/CJ FINS Ethernet | |
|---|---|
| **Panel Error Code PLC-495 Hex Value** | **Description** |
| 0103 | Local Error: Send Error from lack of buffer space. Try reducing Ethernet load to the module. |
| 0201 | Destination Node Error: IP address of remote node not set correctly. |
| 0202 | Destination Node Error: No node with the specified unit address found. |
| 0205 | Destination Node Error: Packet corrupted or Response timeout. Try increasing timeout. |
| 0301 | Controller Error: Communications controller error. |
| 0302 | Controller Error: CPU Unit error. Check error LEDs on PLC. Refer to documentation for that CPU. |
| 0304 | Controller Error: Unit number error. Make sure Unit number is not used twice. |
| 0401 | Service unsupported: Undefined command. |
| 0501 | Routing table error: Destination address setting error. Routing table incorrect. |
| 0502 | Routing table error: No routing tables. |
| 0503 | Routing table error: Routing table error. |
| 0504 | Routing table error: Too many relays. |
| 1001 | Command format error: Command too long. Bad packet: check for electrical noise and grounding. |
| 1002 | Command format error: Command too short. Bad packet: check for electrical noise and grounding. |
| 1003 | Command format error: Elements/data don't match. Bad packet: check for electrical noise and grounding. |
| 1005 | Command format error: Header error. This is the error received when station # set in the command does not match the station # of the Ethernet module. |
| 1100 | Parameter error: UDP socket number bad. |
| 1101 | Parameter error: Address requested does not exist in PLC. |
| 1103 | Parameter error: Address area requested in not accessible. |
| 220F | Status error: Duplicate Socket error. |
| 2210 | Status error: Specified socket not open. |
| 2305 | Environment Error: IP address conversion failed. Only encountered when using routing tables. |
| 2307 | Environment Error: IP address conversion set for automatic. |
| 2503 | Unit error: I/O setting error. |
| 2505 | Unit error: CPU bus error. |
| 250A | Unit error: CPU Bus Unit error. |

# Siemens – Panel Error Code P499 Explanation

The PLC-499 error code is used to show any errors that are generated by the connected PLC. The PLC-499 error message includes a four digit hexadecimal value displayed at the end of the message. This value can be looked up in the specific PLC's error tables to determine the cause of the error. The possible PLC generated error codes for the Siemens PPI communication protocols breakdown into a four digit hexadecimal value as shown in the following message example.

## Siemens Error Code PLC-499 Message Example:



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# Siemens PPI Protocol – PLC Error Code Table

| PLC PDU Header Errors for S7-200 PPI | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x0001 | Hardware Fault. |
| 0x0003 | Object access not allowed: Occurs when access to Timer and Counter data type is set to Signed Integer and not BCD. |
| 0x0004 | Context not supported. |
| 0x0005 | Address out of range: Occurs when requesting an address within a Data Block that does not exist or is out of range. |
| 0x0006 | Address out of range. |
| 0x0007 | Write Data size mismatch. |
| 0x000A | Object does not exist: Occurs when trying to request a Data Block that does not exist. |
| 0x8000 | Function being used. |
| 0x8001 | Action is not allowed in current mode. |
| 0x8101 | Hardware fault. |
| 0x8103 | Access not allowed. |
| 0x8104 | Function not supported. |
| 0x8105 | Address invalid. |
| 0x8106 | Data Type not supported. |
| 0x8107 | Data Type is not consistent with size. |
| 0x810A | Object does not exist. |
| 0x8500 | PDU Size is incorrect. |
| 0x8702 | Address is invalid. |
| 0xD201 | Block name syntax error. |
| 0xD202 | Error with function parameter. |
| 0xD203 | Error with block type. |
| 0xD204 | No linked block. |
| 0xD205 | Object already exists. |
| 0xD206 | Object already exists. |
| 0xD207 | Block already used in EPROM. |
| 0xD209 | Block does not exist. |
| 0xD20E | No Block does not exist. |
| 0xD210 | Block number incorrect. |

# Siemens ISO over TCP Protocol – PLC Error Code Table



| PLC PDU Header Errors for S7-300 CPU, S7-200 Ethernet | |
|---|---|
| **Panel Error Code PLC-499 Hex Value** | **Description** |
| 0x0001 | Hardware Fault. |
| 0x0003 | Object access not allowed: Occurs when access to Timer and Counter data type is set to Signed Integer and not BCD. |
| 0x0004 | Context not supported. |
| 0x0005 | Address out of range: Occurs when requesting an address within a Data Block that does not exist or is out of range. |
| 0x0006 | Address out of range. |
| 0x0007 | Write Data size mismatch. |
| 0x000A | Object does not exist: Occurs when trying to request a Data Block that does not exist. |
| 0x8000 | Function being used. |
| 0x8001 | Action is not allowed in current mode. |
| 0x8101 | Hardware fault. |
| 0x8103 | Access not allowed. |
| 0x8104 | Function not supported. |
| 0x8105 | Address invalid. |
| 0x8106 | Data Type not supported. |
| 0x8107 | Data Type is not consistent with size. |
| 0x810A | Object does not exist. |
| 0x8500 | PDU Size is incorrect. |
| 0x8702 | Address is invalid. |
| 0xD201 | Block name syntax error. |
| 0xD202 | Error with function parameter. |
| 0xD203 | Error with block type. |
| 0xD204 | No linked block. |
| 0xD205 | Object already exists. |
| 0xD206 | Object already exists. |
| 0xD207 | Block already used in EPROM. |
| 0xD209 | Block does not exist. |
| 0xD20E | No Block does not exist. |
| 0xD210 | Block number incorrect. |

# Touch Panel Runtime Errors

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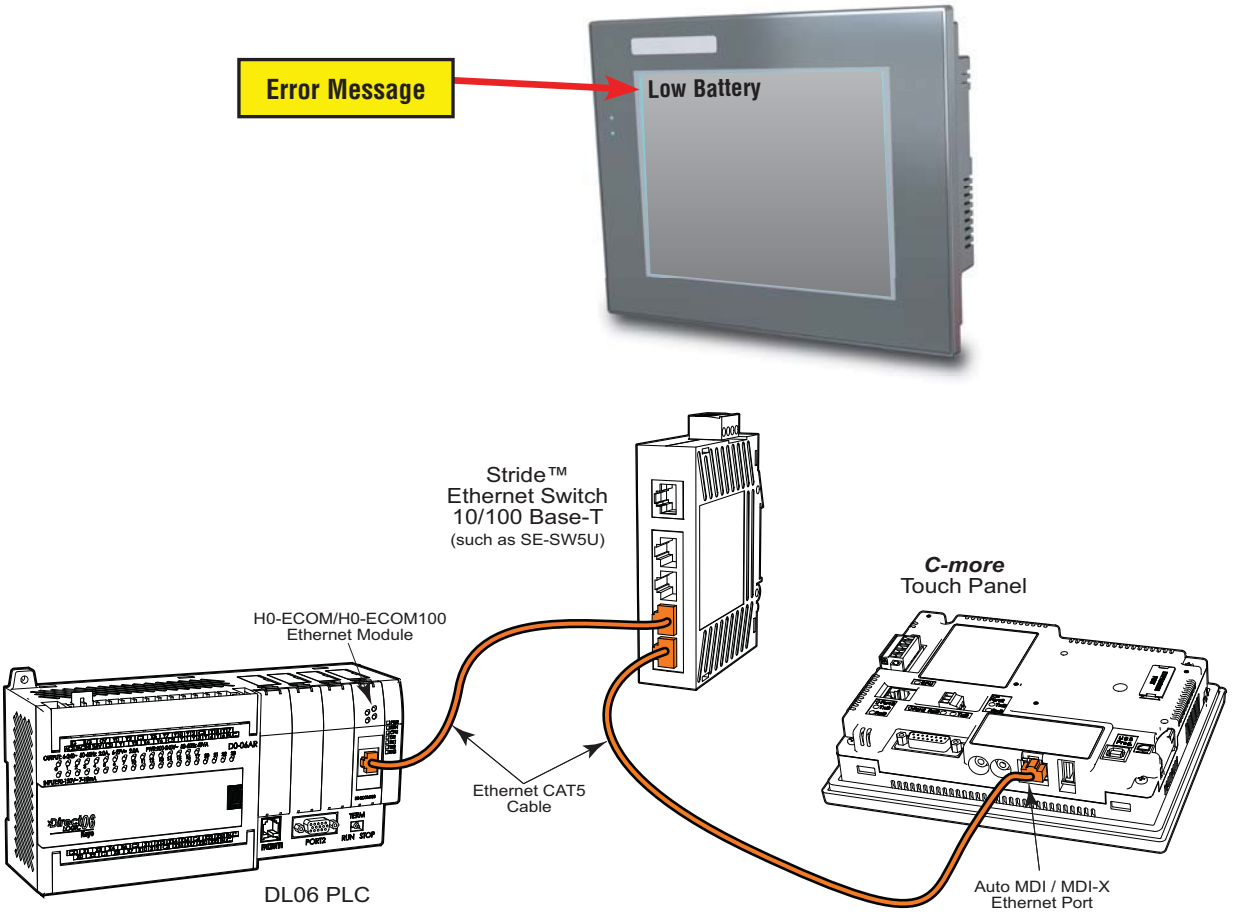
# Introduction



The ***C-more*** touch panels have diagnostics built-in to the operating system that monitor various runtime functions that will display an error message on the panel's display indicating that a particular error has occurred and what the error represents. The Error Message(s) is displayed in the upper left area of the display screen. The Runtime Errors are also logged into the panel's Error log under the Information tab in the panel's System Setup Screens. The Error Log Code, such as RTE-031, is how the error is identified in the error log. See Chapter 5: System Setup Screens for additional details. The tables that follow show the possible Runtime Errors and include the error message, log error code, tag error code value, cause, etc.

The user can include in their touch panel project the use of this diagnostic information by using the system tag name SYS ERR ERRORCODE to control displayed screens, operator messages, etc., and also communicate error information to the PLC or controlling device. If a runtime error occurs, the SYS ERR ERRORCODE system tag will contain the numeric value shown under the Tag Code Error Value. For example, if a Low Battery runtime error is indicated, then the screen display will show Low Battery and the SYS ERR ERRORCODE system tag will contain the value 2031. The value of the last runtime error detected will remain in the SYS ERR ERRORCODE.

If you have difficulty determining the cause of the error, refer to **Chapter 8: Troubleshooting** for additional help or contact our technical support group at 770-844-4200



# Runtime Errors

If there is more than one **Runtime Error**, then the **Error Message** displayed at the top of the panel's screen will display for 3 seconds, then be off for 2 seconds. The next **Error Message** will display for the same time increments, continue through any other active runtime error messages, and then start over. When only one **Runtime Error** is active, then that message will continuously be displayed until it is no longer active.



| No. | Error Log Code | Error Message Located at upper left of screen | Error Message Tag | Tag Error Code Value | System Screen Info > Error | Cause |
|---|---|---|---|---|---|---|
| **Log Error** | | | | | | |
| 1 | RTE-001 | Log Failed.<br>Not enough Memory Space in %Device% | SYS ERR ERRORCODE | 2001 | MM/DD/YY HH/MM/SS Error Code RTE-001 | The size of the destination memory is not large enough to store the data.<br>See Log File Naming below. |
| 2 | RTE-002 | Log Failed.<br>%Device% cannot be found | SYS ERR ERRORCODE | 2002 | MM/DD/YY HH/MM/SS Error Code RTE-002 | No device available or the device is defective.<br>See Log File Naming below. |
| 3 | RTE-003 | Log Failed.<br>Can not write file - %file% | SYS ERR ERRORCODE | 2003 | MM/DD/YY HH/MM/SS Error Code RTE-003 | Logging the data has failed due to a problem such as the memory write protect is enabled.<br>See Log File Naming below. |
| 4 | RTE-004 | Log cache memory is full | SYS ERR ERRORCODE | 2004 | MM/DD/YY HH/MM/SS Error Code RTE-004 | The data log buffer in the SRAM memory is full.<br>See Log File Naming below. |
| **Screen Capture** | | | | | | |
| 1 | RTE-011 | Capture Failed.<br>Not enough Memory Space in %Device% | SYS ERR ERRORCODE | 2011 | MM/DD/YY HH/MM/SS Error Code RTE-011 | The size of the destination memory is not large enough to store the data. |
| 2 | RTE-012 | Capture Failed.<br>%Device% cannot be found | SYS ERR ERRORCODE | 2012 | MM/DD/YY HH/MM/SS Error Code RTE-012 | No device available or the device is defective. |
| 3 | RTE-013 | Capture Failed.<br>Can not write file - %file% | SYS ERR ERRORCODE | 2013 | MM/DD/YY HH/MM/SS Error Code RTE-013 | Logging the data has failed due to a problem such as the memory write protect is enabled. |

**Table continued**

## Log File Naming

The Log file name is formed automatically in the panel. The visible file name has the format:

Screen Name + "_" + Object name + "_" + Date Stamp YYMMDD + ".txt"

Internal to the panel, the file references are stored as the first four characters of the file name + "~" + a serial number between 000 and 999 + ".txt" So, any "group" of filenames is limited to 999 members.

For Example: The following filenames form the same group. All filenames start with "**SCRE**":

**Scre**en1_Trend1_yymmdd.txt
**Scre**en2_Trend2_yymmdd.txt
**Scre**en3_Trend3_yymmdd.txt

If an attempt is made to store more than 999 files in a "group" the panel will return RTE-001, RTE-002, RTE-003 or RTE-004.

| Visible File Name | Internal File Name |
|---|---|
| Screen1_Trend1_120101.txt | **SCRE**~001.TXT |
| Screen2_Trend2_120101.txt | **SCRE**~002.TXT |
| Screen3_Trend3_120101.txt | **SCRE**~003.TXT |
| Screen1_Trend1_120102.txt | **SCRE**~004.TXT |
| Screen2_Trend2_120102.txt | **SCRE**~005.TXT |
| Screen3_Trend3_120102.txt | **SCRE**~006.TXT |
| ... | |
| Screen1_Trend1_121129.txt | **SCRE**~997.TXT |
| Screen2_Trend2_121129.txt | **SCRE**~998.TXT |
| Screen3_Trend3_121129.txt | **SCRE**~999.TXT |
| Screen1_Trend3_121130.txt | Runtime Error RTE-001 |

**Workaround**: To minimize membership in any one group, change the Screen name and the Object name so the first four characters of the visible file name are unique

For example,

Screen Names: S1, S2

Object Names: AAA, BAA

| Visible File Name | Internal File Name |
|---|---|
| **S1_A**AA_120101.txt | **S1_A**~001.TXT |
| **S1_B**AA_120101.txt | **S1_B**~001.TXT |
| **S2_A**AA_120101.txt | **S2_A**~001.TXT |
| **S2_B**AA_120101.txt | **S2_B**~001.TXT |
| **S1_A**AA_120102.txt | **S1_A**~002.TXT |
| **S1_B**AA_120102.txt | **S1_B**~002.TXT |
| **S2_A**AA_120102.txt | **S2_A**~002.TXT |
| **S2_B**AA_120102.txt | **S2_B**~002.TXT |
| … | |
| **S1_A**AA_121231.txt | **S1_A**~365.TXT |
| **S1_B**AA_121231.txt | **S1_B**~365.TXT |
| **S2_A**AA_121231.txt | **S2_A**~365.TXT |
| **S2_B**AA_121231.txt | **S2_B**~365.TXT |

Note that there is no conflict between file names and since no log group will exceed 365 (days) the 999 member limit is never exceeded.

# Runtime Errors (cont'd)

| No. | Error Log Code | Error Message Located at upper left of screen | Error Message Tag | Tag Error Code Value | System Screen Info > Error | Cause |
|---|---|---|---|---|---|---|
| **Handshake** | | | | | | |
| 1 | RTE-021 | Handshake Timeout Error | SYS ERR ERRORCODE | 2021 | MM/DD/YY HH/MM/SS Error Code RTE-021 | A communications timeout occurred when either a Recipe or Numeric Entry Object, in which Notification and Handshake signals are used, failed to complete the responses. |
| **e-mail** | | | | | | |
| 1 | RTE-041 | E-mail Connection Error %Address% | SYS ERR ERRORCODE | 2041 | MM/DD/YY HH/MM/SS Error Code RTE-041 | An incorrect SMTP address has been entered into the Touch Panel Network dialog screen. |
| 2 | RTE-042 | Send E-mail Error %Address% | SYS ERR ERRORCODE | 2042 | MM/DD/YY HH/MM/SS Error Code RTE-042 | An incorrect email address has been entered into the Address Book. |
| 3 | RTE-043 | Email Failed: The file cannot be attached | SYS ERR ERRORCODE | 2043 | MM/DD/YY HH/MM/SS Error Code RTE-043 | |
| **Send FTP** | | | | | | |
| 1 | RTE-051 | FTP Connection Error %Address%&%ID% | SYS ERR ERRORCODE | 2051 | MM/DD/YY HH/MM/SS Error Code RTE-051 | An incorrect FTP Service has been assigned into the Touch Panel Network dialog screen. |
| 2 | RTE-052 | Send FTP Error %Address%&%ID% | SYS ERR ERRORCODE | 2052 | MM/DD/YY HH/MM/SS Error Code RTE-052 | Permission to write to the FTP folder has not been authorized. The FTP site may require a user ID and password. |
| 3 | RTE-053 | FTP Failed: The file cannot be copied | SYS ERR ERRORCODE | 2053 | MM/DD/YY HH/MM/SS Error Code RTE-053 | |
| **Recieve FTP** | | | | | | |
| 1 | RTE-061 | Receive FTP Error | SYS ERR ERRORCODE | 2061 | MM/DD/YY HH/MM/SS Error Code RTE-061 | |
| **Receive HTTP** | | | | | | |
| 1 | RTE-071 | Receive HTTP Error | SYS ERR ERRORCODE | 2071 | MM/DD/YY HH/MM/SS Error Code RTE-071 | |

# Runtime Errors (cont'd)

| No. | Error Log Code | Error Message Located at upper left of screen | Error Message Tag | Tag Error Code Value | System Screen Info > Error | Cause |
|---|---|---|---|---|---|---|
| **Sound** | | | | | | |
| 1 | RTE-081 | Sound Failed. Not enough Memory | SYS ERR ERRORCODE | 2081 | MM/DD/YY HH/MM/SS Error Code RTE-081 | The sound file failed to play due to insufficient memory. |
| **Confiict** | | | | | | |
| 1 | RTE-091 | IP Address Conflict - Correct IP Address and Power Cycle | SYS ERR ERRORCODE | 2091 | MM/DD/YY HH/MM/SS Error Code RTE-091 | Conflict of IP Address |
| **Multiple Recipe** | | | | | | |
| 1 | RTE-101 | Record doesn't exist | SYS ERR ERRORCODE | 2101 | MM/DD/YY HH/MM/SS Error Code RTE-101 | The recipe file or data doesn't exist. |
| 2 | RTE-102 | File cannot open | SYS ERR ERRORCODE | 2102 | MM/DD/YY HH/MM/SS Error Code RTE-102 | The recipe file cannot be opened. |
| 3 | RTE-103 | E-mail Connection Error %Address% | SYS ERR ERRORCODE | 2103 | MM/DD/YY HH/MM/SS Error Code RTE-103 | Abnormality is found in the numberic character data of the recipe file. |
| 4 | RTE-104 | Send E-mail Error %Address% | SYS ERR ERRORCODE | 2104 | MM/DD/YY HH/MM/SS Error Code RTE-104 | Abnormality is found in the Tag data of the recipe file. |
| 5 | RTE-105 | Recipe - Index (%Row%) error | SYS ERR ERRORCODE | 2105 | MM/DD/YY HH/MM/SS Error Code RTE-105 | Recipe was operated by the record number outside the range. |
| 6 | RTE-106 | Not enough buffer memory | SYS ERR ERRORCODE | 2106 | MM/DD/YY HH/MM/SS Error Code RTE-106 | Memory allocation error |
| 7 | RTE-107 | File cannot write | SYS ERR ERRORCODE | 2107 | MM/DD/YY HH/MM/SS Error Code RTE-107 | There was an error trying to write the recipe file. |
| 8 | RTE-108 | Wrong file format | SYS ERR ERRORCODE | 2108 | MM/DD/YY HH/MM/SS Error Code RTE-108 | The recipe file format is incorrect. |
| 9 | RTE-109 | Not enough Memory Space in %Device% | SYS ERR ERRORCODE | 2109 | MM/DD/YY HH/MM/SS Error Code RTE-109 | Insufficient storage space on media. |

# Runtime Errors (cont'd)

| No. | Error Log Code | Error Message Located at upper left of screen | Error Message Tag | Tag Error Code Value | System Screen Info > Error | Cause |
|---|---|---|---|---|---|---|
| **Action** | | | | | | |
| 1 | RTE-121 | Action Overflows | SYS ERR ERRORCODE | 2121 | MM/DD/YY HH/MM/SS Error Code RTE-121 | The number of actions executed in the event exceeded the maximum number. |
| **SRAM Error** | | | | | | |
| 1 | RTE-500 | SRAM Check Sum Error | SYS ERR ERRORCODE | 2500 | MM/DD/YY HH/MM/SS Error Code RTE-500 | Memory in Panel has been Corrupted by Power Loss, etc. Try cycling power to the panel and re-transfer the project to the panel, in sequential steps to attempt to resolve the error. |

Automation
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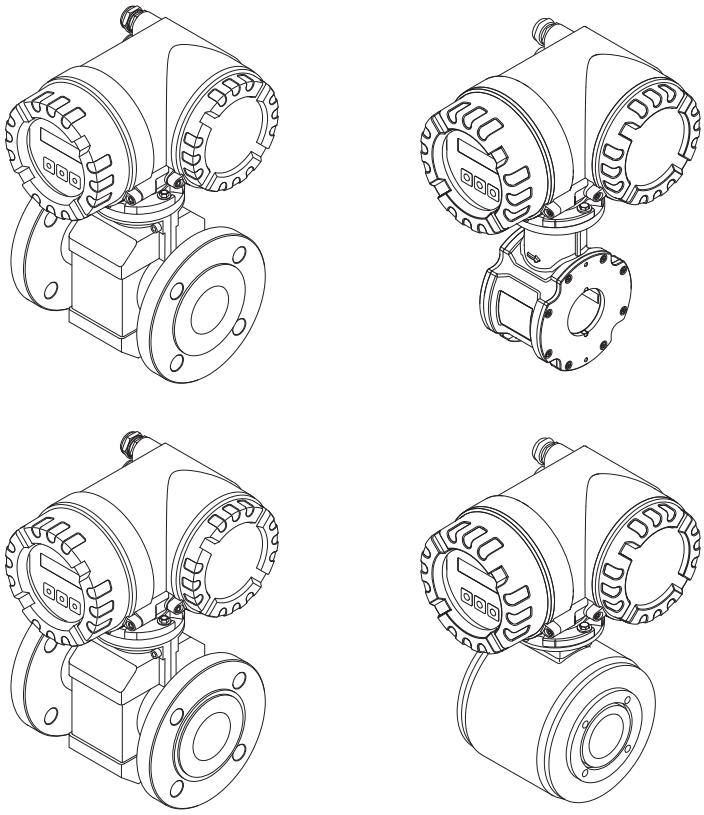
Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Operating Instructions

# Proline Promag 50 HART

## Electromagnetic flow measuring system

HART® FIELD COMMUNICATION PROTOCOL



BA00046D/06/EN/14.11
71136623

Valid as of version
V 2.03.XX (device software)

Endress+Hauser
People for Process Automation

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# 1 Safety instructions

## 1.1 Designated use

The measuring device described in this Operating Manual is to be used only for measuring the flow rate of conductive fluids in closed pipes.

A minimum conductivity of 20 µS/cm is required for measuring demineralized water. Most liquids can be measured as of a minimum conductivity of 5 µS/cm.

Examples:
- Acids, alkalis,
- Drinking water, wastewater, sewage sludge,
- Milk, beer, wine, mineral water, etc.

Resulting from incorrect use or from use other than that designated the operational safety of the measuring devices can be suspended. The manufacturer accepts no liability for damages being produced from this.

## 1.2 Installation, commissioning and operation

Please note the following:
- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist must have read and understood this Operating Manual and must follow the instructions it contains.
- The device must be operated by persons authorized and trained by the facility's owner-operator. Strict compliance with the instructions in the Operating Manual is mandatory.
- With regard to special fluids, including fluids used for cleaning, Endress+Hauser will be happy to assist in clarifying the corrosion-resistant properties of wetted materials.
  However, minor changes in temperature, concentration or in the degree of contamination in the process may result in variations in corrosion resistance. For this reason, Endress+Hauser does not accept any responsibility with regard to the corrosion resistance of wetted materials in a specific application.
  The user is responsible for the choice of suitable wetted materials in the process.
- If welding work is performed on the piping system, do not ground the welding appliance through the Promag flowmeter.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded apart from when special protective measures are taken (e.g. galvanically isolated SELV or PELV power supply)
- Invariably, local regulations governing the opening and repair of electrical devices apply.

## 1.3 Operational safety

Please note the following:
- Measuring systems for use in hazardous environments are accompanied by separate Ex documentation, which is an integral part of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this Ex documentation indicates the approval and the certification body (e.g. Ex Europe, FM USA, CSA Canada).
- The measuring device complies with the general safety requirements in accordance with EN 61010-1, the EMC requirements of IEC/EN 61326 and NAMUR Recommendations NE 21 and NE 43.
- Depending on the application, the seals of the process connections of the Promag H sensor require periodic replacement.

- When hot fluid passes through the measuring tube, the surface temperature of the housing increases. In the case of the sensor, in particular, users should expect temperatures that can be close to the fluid temperature. If the temperature of the fluid is high, implement sufficient measures to prevent burning or scalding.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser distributor will supply you with current information and updates to these Operating Instructions.

## 1.4 Return

- Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
- Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.

## 1.5 Notes on safety conventions and icons

The devices are designed to meet state-of-the-art safety requirements, have been tested, and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010-1 "Safety requirements for electrical equipment for measurement, control and laboratory use".
The devices can, however, be a source of danger if used incorrectly or for anything other than the designated use. Consequently, always pay particular attention to the safety instructions indicated in this Operating Manual by the following icons:

Warning!
"Warning" indicates an action or procedure which, if not performed correctly, can result in injury or a safety hazard. Comply strictly with the instructions and proceed with care.

Caution!
"Caution" indicates an action or procedure which, if not performed correctly, can result in incorrect operation or destruction of the device. Comply strictly with the instructions.

Note!
"Note" indicates an action or procedure which, if not performed correctly, can have an indirect effect on operation or trigger an unexpected response on the part of the device.

# 2 Identification

## 2.1 Device designation

The flow measuring system consists of the following components:

- Promag 50 transmitter
- Promag D, Promag L, Promag W, Promag P or Promag H sensor

In the *compact version*, the transmitter and sensor form a single mechanical unit; in the *remote version* they are installed separately.

### 2.1.1 Nameplate of the transmitter

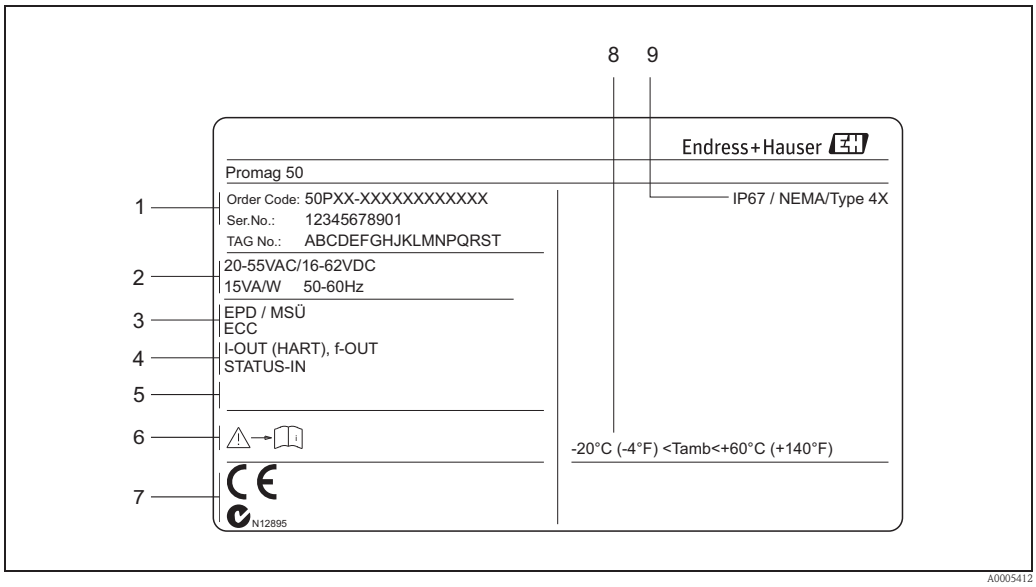



*Fig. 1: Nameplate specifications for the "Promag 50" transmitter (example)*

*1 Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.*
*2 Power supply, frequency, power consumption*
*3 Additional information:*
*EPD/MSÜ: with Empty Pipe Detection*
*ECC: with electrode cleaning*
*4 Outputs available:*
*I-OUT (HART): with current output (HART)*
*f-OUT (HART): with frequency output*
*STATUS-IN: with status input (power supply)*
*5 Reserved for information on special products*
*6 Observe device documentation*
*7 Reserved for additional information on device version (approvals, certificates)*
*8 Permitted ambient temperature range*
*9 Degree of protection*

## 2.1.2 Nameplate of the sensor

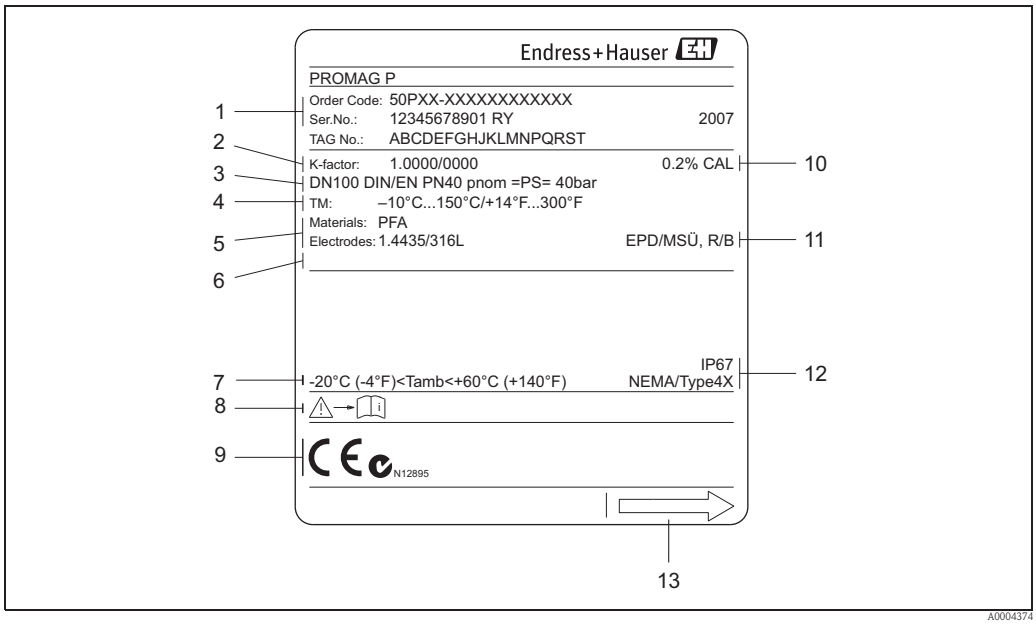



*Fig. 2: Nameplate specifications for the "Promag" sensor (example)*

*1 Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.*
*2 Calibration factor with zero point*
*3 Nominal diameter / Pressure rating*
*4 Fluid temperature range*
*5 Materials: lining/measuring electrodes*
*6 Reserved for information on special products*
*7 Permitted ambient temperature range*
*8 Observe device documentation*
*9 Reserved for additional information on device version (approvals, certificates)*
*10 Calibration tolerance*
*11 Additional information (examples):*
*– EPD/MSÜ: with Empty Pipe Detection electrode*
*– R/B: with reference electrode*
*12 Degree of protection*
*13 Flow direction*

### 2.1.3 Nameplate, connections

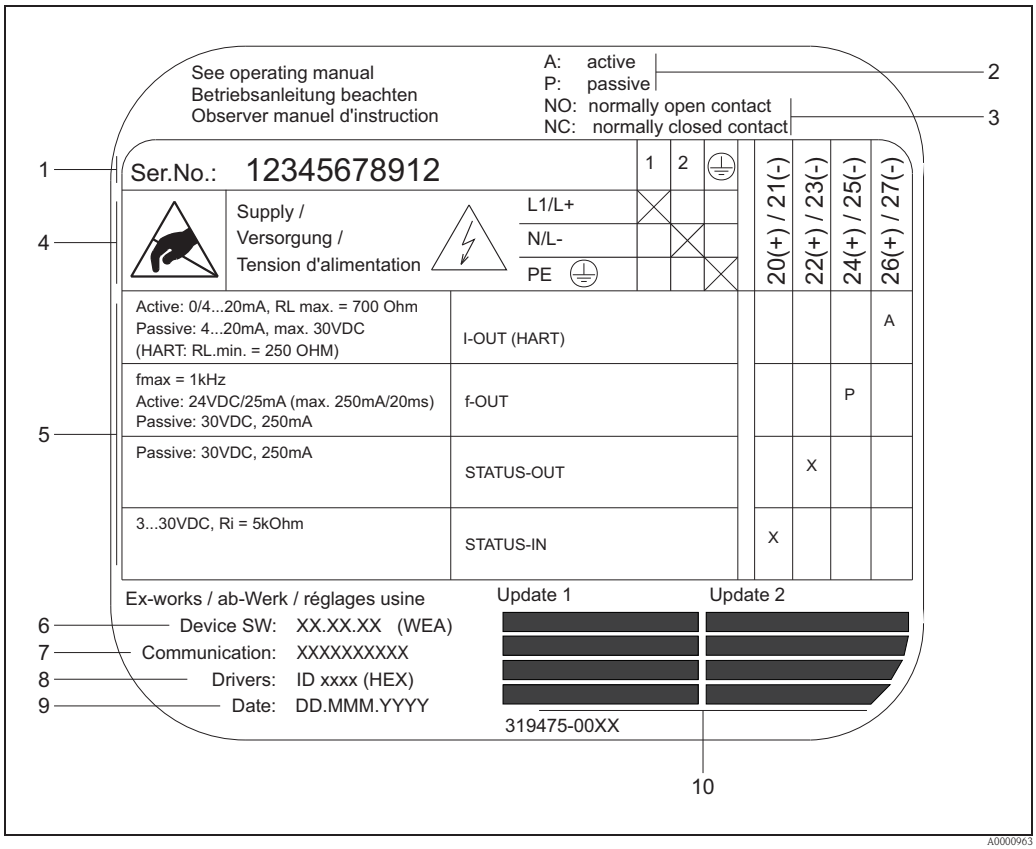



*Fig. 3: Nameplate specifications for transmitter (example)*

*1 Serial number*
*2 Possible configuration of current output*
*3 Possible configuration of relay contacts*
*4 Terminal assignment, cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC*
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L– for DC*
*5 Signals present at inputs and outputs, possible configuration and terminal assignment (20 to 27), see also "Electrical values of inputs/outputs"*
*6 Version of device software currently installed*
*7 Installed communication type, e.g.: HART, PROFIBUS PA, etc.*
*8 Information on current communication software (Device Revision and Device Description), e.g.: Dev. 01 / DD 01 for HART*
*9 Date of installation*
*10 Current updates to data specified in points 6 to 9*

## 2.2 Certificates and approvals

The devices are designed to meet state-of-the-art safety requirements in accordance with sound engineering practice. They have been tested and left the factory in a condition in which they are safe to operate.

The devices comply with the applicable standards and regulations in accordance with EN 61010-1 "Safety requirements for electrical equipment for measurement, control and laboratory use" and with the EMC requirements of IEC/EN 61326/A1.

The measuring system described in this Operating Manual is therefore in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

The measuring system meets the EMC requirements of the Australian Communications and Media Authority (ACMA)

## 2.3 Registered trademarks

KALREZ® and VITON®
Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

TRI-CLAMP®
Registered trademark of Ladish & Co., Inc., Kenosha, USA

HART®
Registered trademark of the HART Communication Foundation, Austin, USA

HistoROM™, S-DAT®, Field Xpert™, FieldCare®, Fieldcheck®, Applicator®
Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

# 3 Installation

## 3.1 Incoming acceptance, transport and storage

### 3.1.1 Incoming acceptance

On receipt of the goods, check the following:
- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

### 3.1.2 Transport

The following instructions apply to unpacking and to transporting the device to its final location:
- Transport the devices in the containers in which they are delivered.
- Do not remove the protective plates or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.

**Special notes on flanged devices**

Caution!
- The wooden covers mounted on the flanges from the factory protect the linings on the flanges during storage and transportation. In case of Promag L they are additionally used to hold the lap joint flanges in place. Do not remove these covers until **immediately before** the device in the pipe.
- Do not lift flanged devices by the transmitter housing, or the connection housing in the case of the remote version.

*Transporting flanged devices DN ≤ 300 (≤ 12")*

Use webbing slings slung round the two process connections. Do not use chains, as they could damage the housing.

Warning!
Risk of injury if the measuring device slips. The center of gravity of the assembled measuring device might be higher than the points around which the slings are slung.
At all times, therefore, make sure that the device does not unexpectedly turn around its axis or slip.

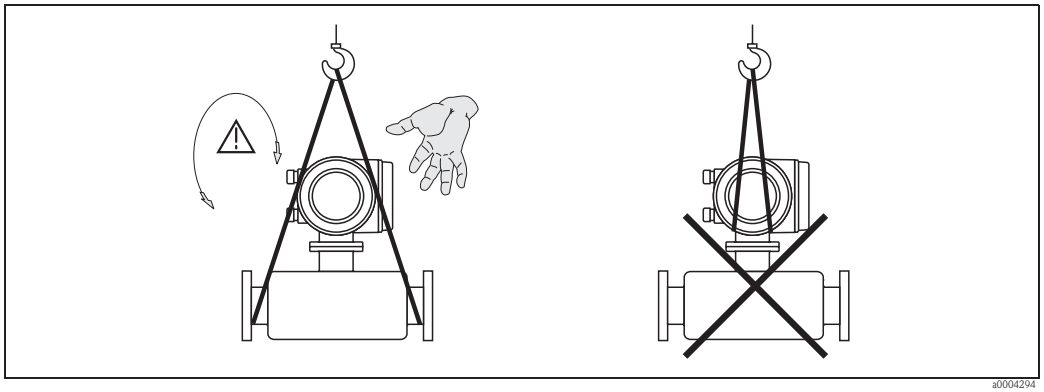



*Fig. 4: Transporting sensors with DN ≤ 300 (≤ 12")*

*Transporting flangeddevices DN > 300 (> 12")*

Use only the metal eyes on the flanges for transporting the device, lifting it and positioning the sensor in the piping.

Caution!
Do not attempt to lift the sensor with the tines of a fork-lift truck beneath the metal casing. This would buckle the casing and damage the internal magnetic coils.

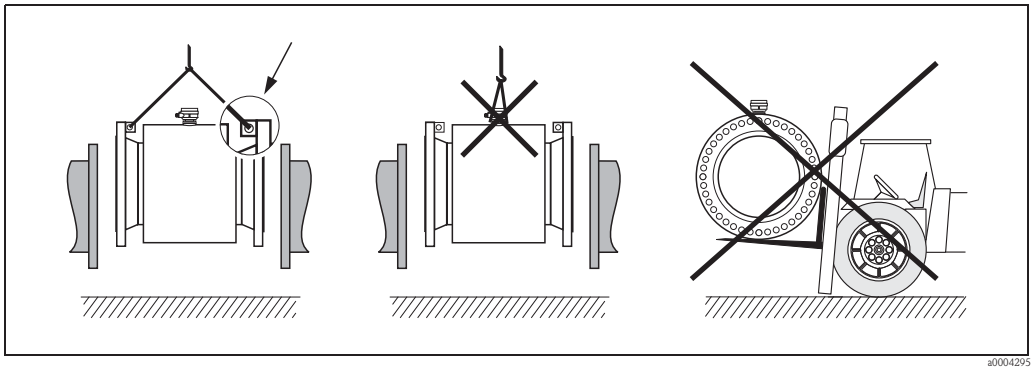



*Fig. 5: Transporting sensors with DN > 300 (> 12")*

### 3.1.3 Storage

Please note the following:
- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors → 99.
- Do not remove the protective plates or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.

# 3.2 Installation conditions

## 3.2.1 Dimensions

The dimensions and installation lengths of the sensor and transmitter can be found in the "Technical Information" for the device in question. This document can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in the "Documentation" section on → 116.

## 3.2.2 Mounting location

Entrained air or gas bubble formation in the measuring tube can result in an increase in measuring errors.
**Avoid** the following locations:
- Highest point of a pipeline. Risk of air accumulating!
- Directly upstream from a free pipe outlet in a vertical pipeline.

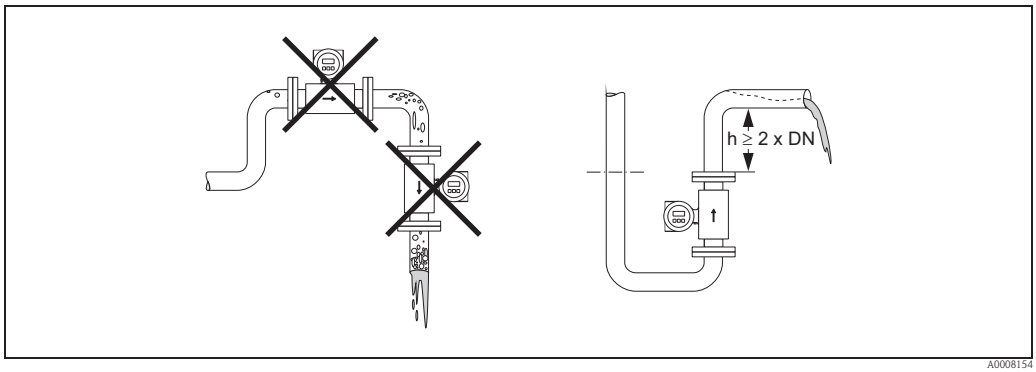



*Fig. 6: Mounting location*

### Installation of pumps

Do **not** install the sensor on the intake side of a pump. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the lining's resistance to partial vacuum can be found on → 103.

It might be necessary to install pulse dampers in systems incorporating reciprocating, diaphragm or peristaltic pumps. Information on the measuring system's resistance to vibration and shock can be found on → 99.

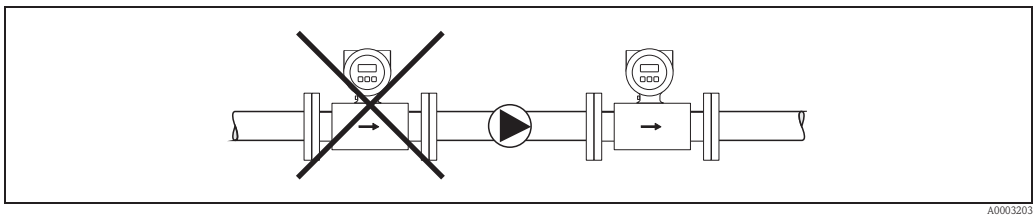



*Fig. 7: Installation of pumps*

### Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration.
The Empty Pipe Detection function (EPD → 📄 73) offers additional protection by detecting empty or partially filled pipes.

Caution!
Risk of solids accumulating. Do not install the sensor at the lowest point in the drain. It is advisable to install a cleaning valve.

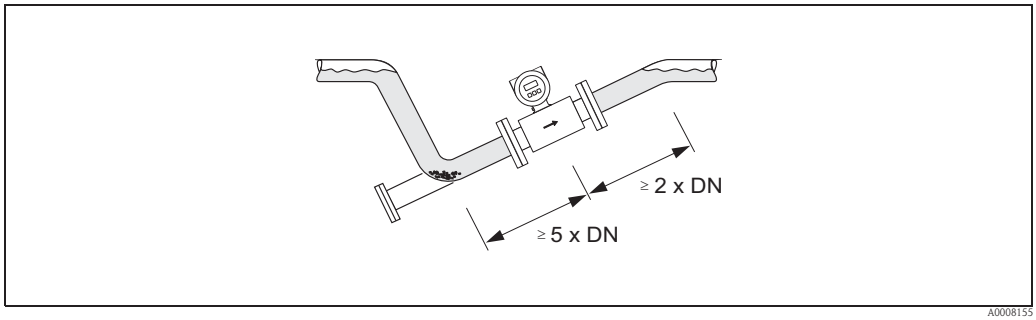



*Fig. 8: Installation in a partially filled pipe*

### Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes whose length h ≥ 5 m (16.4 ft). This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube.
This measure also prevents the system losing prime, which could cause air pockets. Information on the lining's resistance to partial vacuum can be found on → 📄 103.

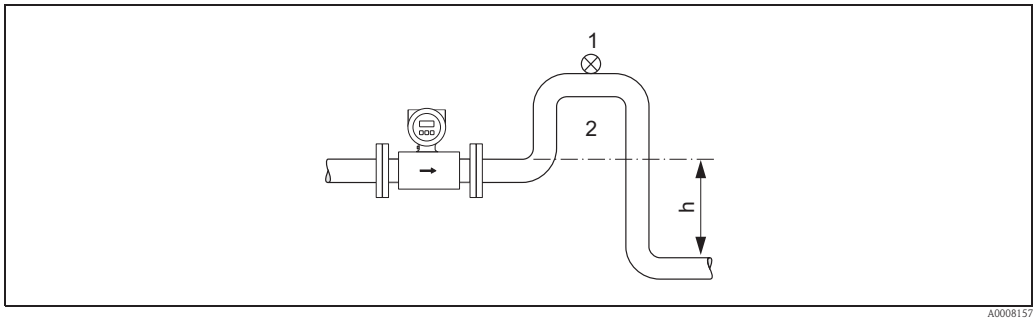



*Fig. 9: Measures for installation in a down pipe*

*1 Vent valve*
*2 Pipe siphon*
*h Length of down pipe*

### 3.2.3 Orientation

An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube. However, Promag offers the additional Empty Pipe Detection (EPD) function to ensure the detection of partially filled measuring tubes, e.g. in the case of degassing fluids or varying process pressure:

- Electrode Cleaning Circuit (ECC) for applications with accretive fluids, e.g. electrically conductive deposits (→ "Description of Device Functions" manual).
- Empty Pipe Detection (EPD) ensures the detection of partially filled measuring tubes, e.g. in the case of degassing fluids (→ 73)
- Exchangeable Measuring Electrodes for abrasive fluids (→ 92)

#### Vertical orientation

This is the ideal orientation for self-emptying piping systems and for use in conjunction with Empty Pipe Detection.

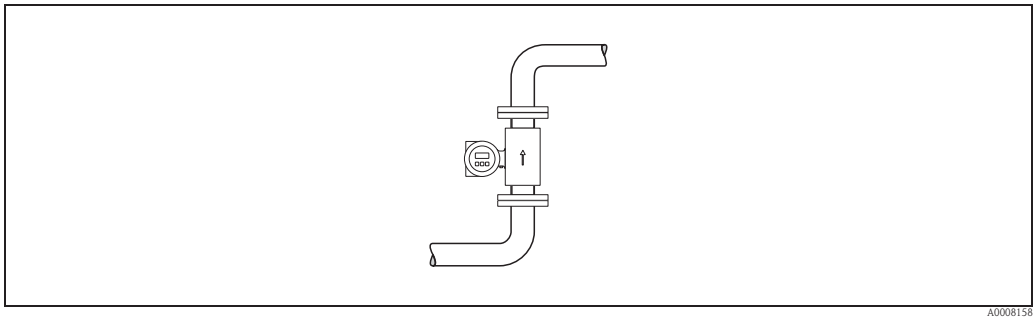



*Fig. 10: Vertical orientation*

#### Horizontal orientation

The measuring electrode plane should be horizontal. This prevents brief insulation of the two measuring electrodes by entrained air bubbles.

Caution!
Empty Pipe Detection functions correctly only when the measuring device is installed horizontally and the transmitter housing is facing upward (→ 10). Otherwise there is no guarantee that Empty Pipe Detection will respond if the measuring tube is only partially filled or empty.

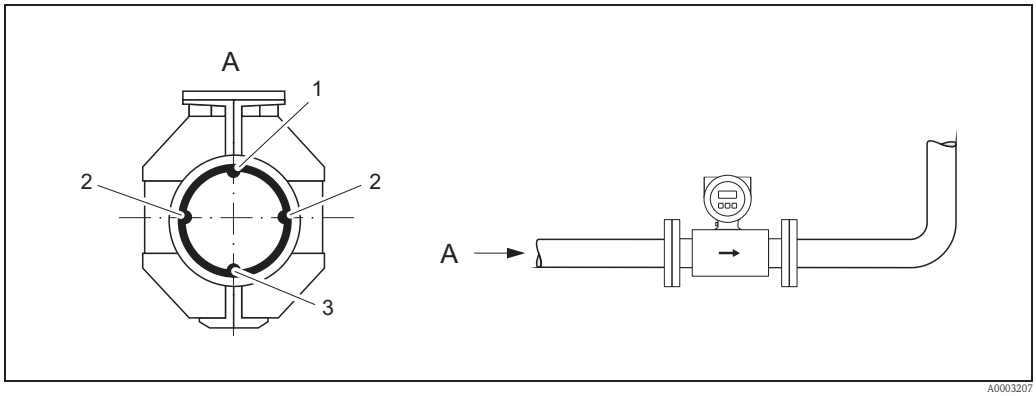



*Fig. 11: Horizontal orientation*

*1 EPD electrode for the detection of empty pipes (not with Promag D and Promag H (DN 2 to 15; 1/12" to ½"))*
*2 Measuring electrodes for signal detection*
*3 Reference electrode for the potential equalization (not with Promag D and H)*

**Inlet and outlet run**

If possible, install the sensor upstream from fittings such as valves, T-pieces, elbows, etc. The following inlet and outlet runs must be observed in order to meet accuracy specifications:
- Inlet run: ≥ 5 × DN
- Outlet run: ≥ 2 × DN

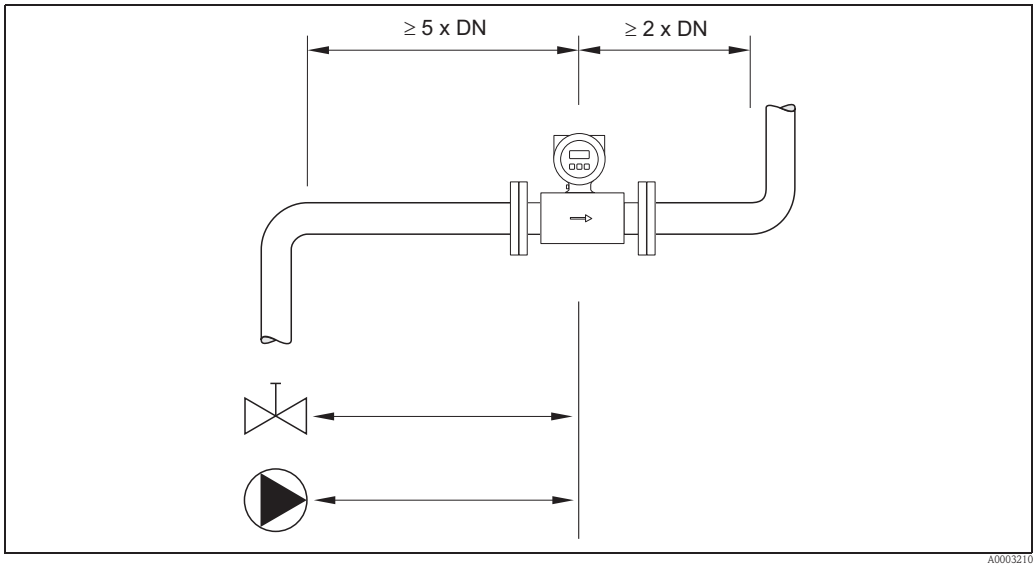



*Fig. 12: Inlet and outlet runs*

## 3.2.4 Vibrations

Secure the piping and the sensor if vibration is severe.

Caution!
If vibrations are too severe, we recommend the sensor and transmitter be mounted separately. Information on resistance to vibration and shock can be found on → 99.

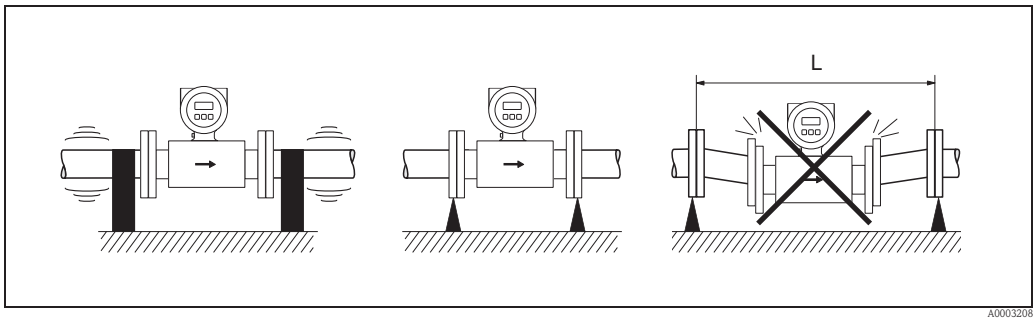



*Fig. 13: Measures to prevent vibration of the device (L > 10 m (32.8 ft))*

### 3.2.5 Foundations, supports

If the nominal diameter is DN ≥ 350, mount the sensor on a foundation of adequate load-bearing strength.

Caution!
Risk of damage.
Do not support the weight of the sensor on the metal casing: the casing would buckle and damage the internal magnetic coils.

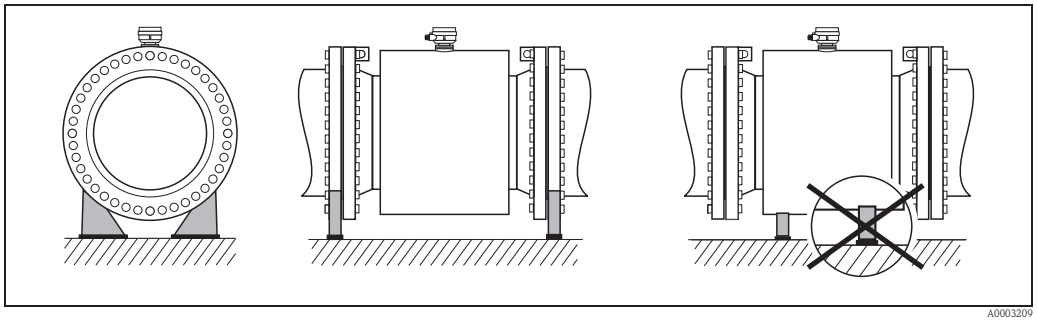



*Fig. 14: Correct support for large nominal diameters (DN ≥ 350)*

### 3.2.6 Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes.
The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids. The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders.

Note!
The nomogram only applies to liquids of viscosity similar to water.

1. Calculate the ratio of the diameters d/D.
2. From the nomogram read off the pressure loss as a function of flow velocity (*downstream* from the reduction) and the d/D ratio.

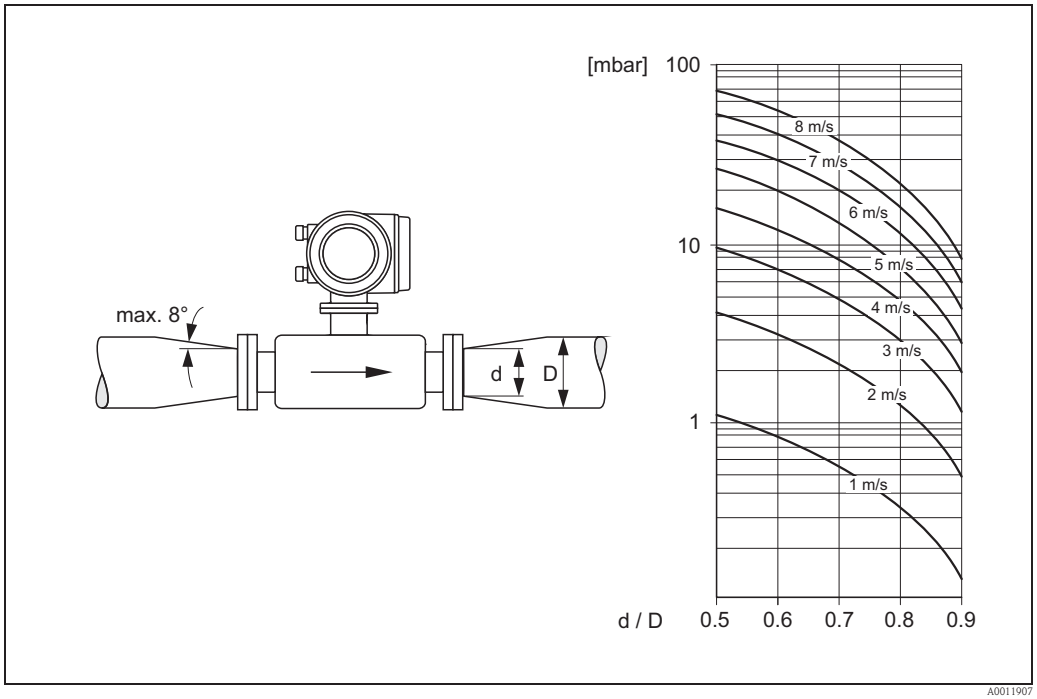



*Fig. 15: Pressure loss due to adapters*

### 3.2.7 Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum velocity of flow is between 2 and 3 m/s (6.5 to 9.8 ft/s)

The velocity of flow (v), moreover, has to be matched to the physical properties of the fluid:
- v < 2 m/s (v < 6.5 ft/s): for abrasive fluids
- v > 2 m/s (v > 6.5 ft/s): for fluids producing buildup

Note!
Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor (→ 17).

**Recommended flow (SI units)**

| Nominal diameter [mm] | Promag D | Promag L | Promag W | Promag P | Promag H |
|---|---|---|---|---|---|
| | Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [dm³/min] | | | | |
| 2 | – | – | – | – | 0.06 to 1.8 |
| 4 | – | – | – | – | 0.25 to 7 |
| 8 | – | – | – | – | 1 to 30 |
| 15 | – | – | – | 4 to 100 | 4 to 100 |
| 25 | 9 to 300 | – | 9 to 300 | 9 to 300 | 9 to 300 |
| 32 | – | – | 15 to 500 | 15 to 500 | – |
| 40 | 25 to 700 | – | 25 to 700 | 25 to 700 | 25 to 700 |
| 50 | 35 to 1100 | 35 to 1100 | 35 to 1100 | 35 to 1100 | 35 to 1100 |
| 65 | 60 to 2000 | 60 to 2000 | 60 to 2000 | 60 to 2000 | 60 to 2000 |
| 80 | 90 to 3000 | 90 to 3000 | 90 to 3000 | 90 to 3000 | 90 to 3000 |
| 100 | 145 to 4700 | 145 to 4700 | 145 to 4700 | 145 to 4700 | 145 to 4700 |
| 125 | – | 220 to 7500 | 220 to 7500 | 220 to 7500 | – |
| [mm] | Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [m³/h] | | | | |
| 150 | – | 20 to 600 | 20 to 600 | 20 to 600 | – |
| 200 | – | 35 to 1100 | 35 to 1100 | 35 to 1100 | – |
| 250 | – | 55 to 1700 | 55 to 1700 | 55 to 1700 | – |
| 300 | – | 80 to 2400 | 80 to 2400 | 80 to 2400 | – |
| 350 | – | 110 to 3300 | 110 to 3300 | 110 to 3300 | – |
| 375 | – | 140 to 4200 | 140 to 4200 | – | – |
| 400 | – | 140 to 4200 | 140 to 4200 | 140 to 4200 | – |
| 450 | – | 180 to 5400 | 180 to 5400 | 180 to 5400 | – |
| 500 | – | 220 to 6600 | 220 to 6600 | 220 to 6600 | – |
| 600 | – | 310 to 9600 | 310 to 9600 | 310 to 9600 | – |
| 700 | – | 420 to 13500 | 420 to 13500 | – | – |
| 750 | – | 480 to 15200 | 480 to 15200 | – | – |
| 800 | – | 550 to 18000 | 550 to 18000 | – | – |
| 900 | – | 690 to 22500 | 690 to 22500 | – | – |
| 1000 | – | 850 to 28000 | 850 to 28000 | – | – |
| 1050 | – | 950 to 40000 | 950 to 40000 | – | – |
| 1200 | – | 1250 to 40000 | 1250 to 40000 | – | – |
| 1400 | – | – | 1700 to 55000 | – | – |
| 1600 | – | – | 2200 to 70000 | – | – |
| 1800 | – | – | 2800 to 90000 | – | – |
| 2000 | – | – | 3400 to 110000 | – | – |

### Recommended flow (US units)

| Nominal diameter | Promag D | Promag L | Promag W | Promag P | Promag H |
|---|---|---|---|---|---|
| [inch] | Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [gal/min] | | | | |
| 1 1/12" | – | – | – | – | 0.015 to 0.5 |
| 5/32" | – | – | – | – | 0.07 to 2 |
| 5/16" | – | – | – | – | 0.25 to 8 |
| 1/2" | – | – | – | 1.0 to 27 | 1.0 to 27 |
| 1" | 2.5 to 80 | – | 2.5 to 80 | 2.5 to 80 | 2.5 to 80 |
| 1 1/4" | – | – | 4 to 130 | 4 to 130 | – |
| 1 1/2" | 7 to 190 | 7 to 190 | 7 to 190 | 7 to 190 | 7 to 190 |
| 2" | 10 to 300 | 10 to 300 | 10 to 300 | 10 to 300 | 10 to 300 |
| 2 1/2" | 16 to 500 | 16 to 500 | 16 to 500 | 16 to 500 | 16 to 500 |
| 3" | 24 to 800 | 24 to 800 | 24 to 800 | 24 to 800 | 24 to 800 |
| 4" | 40 to 1250 | 40 to 1250 | 40 to 1250 | 40 to 1250 | 40 to 1250 |
| 5" | – | 60 to 1950 | 60 to 1950 | 60 to 1950 | – |
| 6" | – | 90 to 2650 | 90 to 2650 | 90 to 2650 | – |
| 8" | – | 155 to 4850 | 155 to 4850 | 155 to 4850 | – |
| 10" | – | 250 to 7500 | 250 to 7500 | 250 to 7500 | – |
| 12" | – | 350 to 10600 | 350 to 10600 | 350 to 10600 | – |
| 14" | – | 500 to 15000 | 500 to 15000 | 500 to 15000 | – |
| 15" | – | 600 to 19000 | 600 to 19000 | – | – |
| 16" | – | 600 to 19000 | 600 to 19000 | 600 to 19000 | – |
| 18" | – | 800 to 24000 | 800 to 24000 | 800 to 24000 | – |
| 20" | – | 1000 to 30000 | 1000 to 30000 | 1000 to 30000 | – |
| 24" | – | 1400 to 44000 | 1400 to 44000 | 1400 to 44000 | – |
| 28" | – | 1900 to 60000 | 1900 to 60000 | – | – |
| 30" | – | 2150 to 67000 | 2150 to 67000 | – | – |
| 32" | – | 2450 to 80000 | 2450 to 80000 | – | – |
| 36" | – | 3100 to 100000 | 3100 to 100000 | – | – |
| 40" | – | 3800 to 125000 | 3800 to 125000 | – | – |
| 42" | – | 4200 to 135000 | 4200 to 135000 | – | – |
| 48" | – | 5500 to 175000 | 5500 to 175000 | – | – |
| [inch] | Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [Mgal/d] | | | | |
| 54" | – | – | 9 to 300 | – | – |
| 60" | – | – | 12 to 380 | – | – |
| 66" | – | – | 14 to 500 | – | – |
| 72" | – | – | 16 to 570 | – | – |
| 78" | – | – | 18 to 650 | – | – |

### 3.2.8 Length of connecting cable

In order to ensure measuring accuracy, comply with the following instructions when installing the remote version:

- Fix cable run or lay in armored conduit. Cable movements can falsify the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalization between sensor and transmitter, if necessary.
- The permitted connecting cable length $L_{max}$ is determined by the fluid conductivity (→ 16). A minimum conductivity of 20 µS/cm is required for measuring demineralized water. Most liquids can be measured as of a minimum conductivity of 5 µS/cm.
- The maximum connecting cable length is 10 m (32.8 ft) when empty pipe detection (EPD → 73) is switched on.

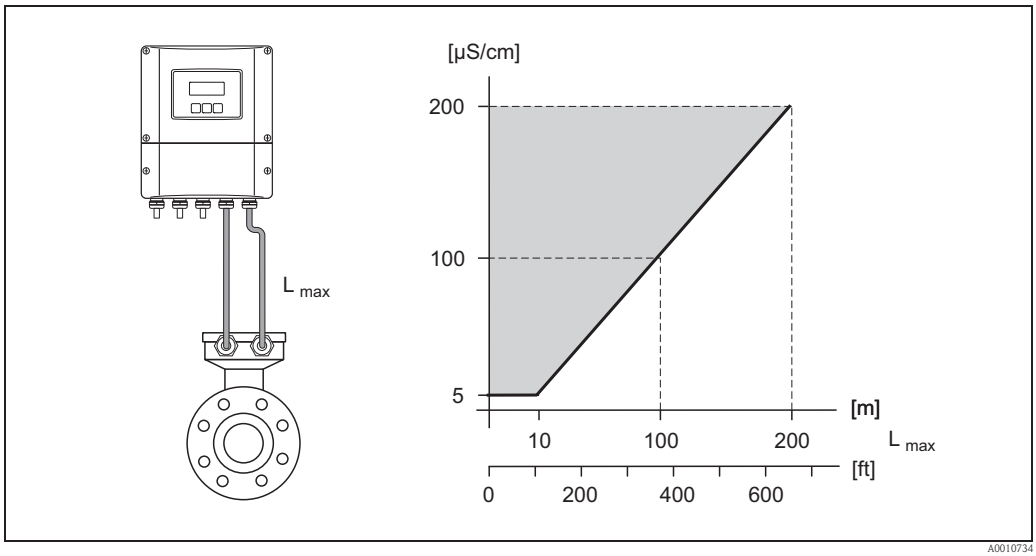



*Fig. 16: Permissible cable length for the remote version*

*Area shaded gray = permitted range*
*Lmax = connecting cable length in [m]*
*Fluid conductivity in [µS/cm]*

## 3.3 Installation instructions

### 3.3.1 Installing the Promag D sensor

The sensor is installed between the pipe flanges with a mounting kit. The device is centered using recesses on the sensor (→ 📄 22).

Note!
A mounting kit consisting of mounting bolts, seals, nuts and washers can be ordered separately (→ 📄 76). Centering sleeves are provided with the device if they are required for the installation.

Caution!
When installing the transmitter in the pipe, observe the necessary torques (→ 📄 23).

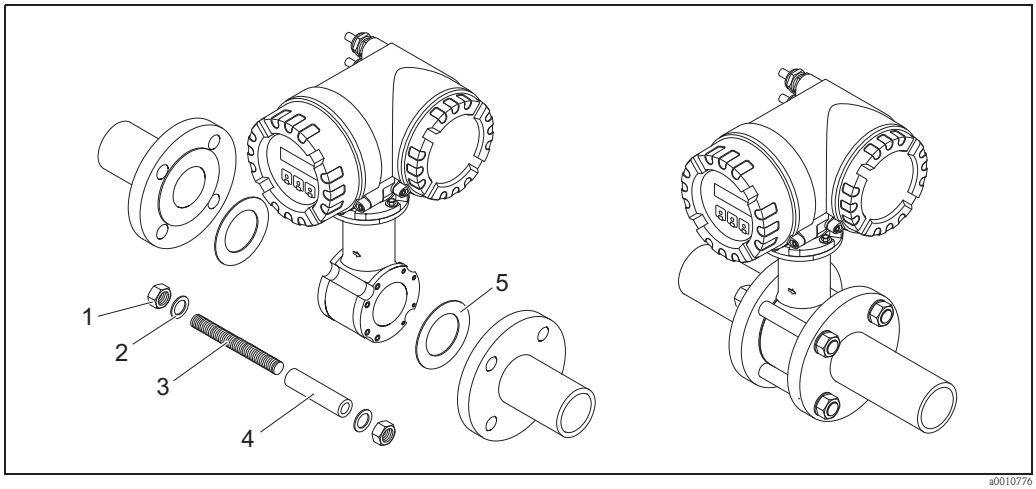



*Fig. 17: Mounting the sensor*

*1 Nut*
*2 Washer*
*3 Mounting bolt*
*4 Centering sleeve*
*5 Seal*

**Seals**

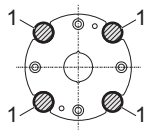
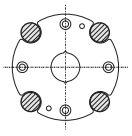
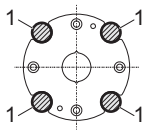
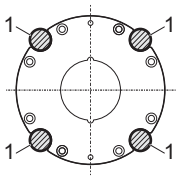
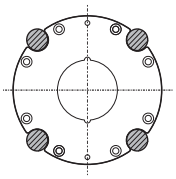
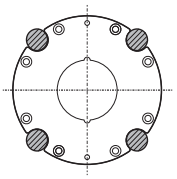
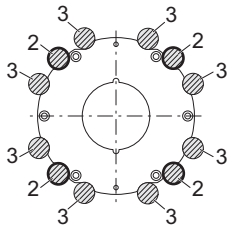
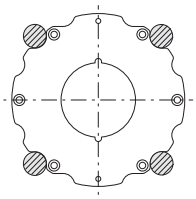
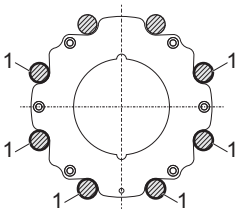
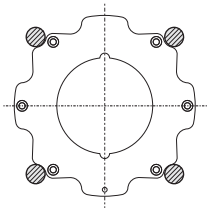
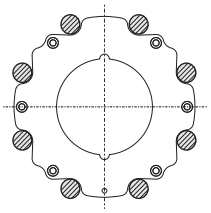
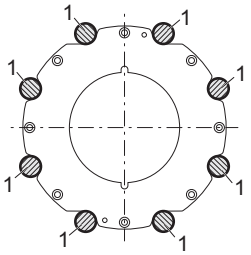
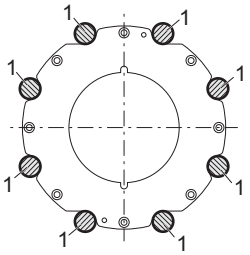
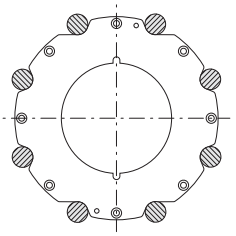
When installing the sensor, make sure that the seals used do not project into the pipe cross-section.

Caution!
Risk of short circuit! Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Note!
Use seals with a hardness rating of 70° Shore.

### Arrangement of the mounting bolts and centering sleeves

The device is centered using recesses on the sensor. The arrangement of the mounting bolts and the use of the centering sleeves supplied depend on the nominal diameter, the flange standard und the pitch circle diameter.

| | Process connection | | |
|---|---|---|---|
| | EN (DIN) | ANSI | JIS |
| DN 25 to 40<br>(DN 1" to 1 ½") |  A0010896 |  A0010824 |  A0010896 |
| DN 50<br>(DN 2") |  A0010897 |  A0010825 |  A0010825 |
| DN 65 |  A0012170 | |  A0012171 |
| DN 80<br>(DN 3") |  A0010898 |  A0010827 |  A0010826 |
| DN 100<br>(DN 4") |  A0012168 |  A0012168 |  A0012169 |

1 = Mounting bolts with centering sleeves
2 = EN (DIN) flanges: 4-hole → with centering sleeves
3 = EN (DIN) flanges: 8-hole → without centering sleeves

### Screw tightening torques (Promag D)

Please note the following:
- The tightening torques listed below are for lubricated threads only.
- Always tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

The tightening torques apply to situations where an EPDM soft material flat seal (e.g. 70 Shore) is used.

*Tightening torques, mounting bolts and centering sleeves for EN (DIN) PN 16*

| Nominal diameter [mm] | Mounting bolts [mm] | Centering sleeve length [mm] | Tightening torque [Nm] with a process flange with a | |
|---|---|---|---|---|
| | | | smooth seal face | raised face |
| 25 | 4 × M12 × 145 | 54 | 19 | 19 |
| 40 | 4 × M16 × 170 | 68 | 33 | 33 |
| 50 | 4 × M16 × 185 | 82 | 41 | 41 |
| 65[1)] | 4 × M16 × 200 | 92 | 44 | 44 |
| 65[2)] | 8 × M16 × 200 | – [3)] | 29 | 29 |
| 80 | 8 × M16 × 225 | 116 | 36 | 36 |
| 100 | 8 × M16 × 260 | 147 | 40 | 40 |

[1)] EN (DIN) flanges: 4-hole → with centering sleeves
[2)] EN (DIN) flanges: 8-hole → without centering sleeves
[3)] A centering sleeve is not required. The device is centered directly via the sensor housing.

*Tightening torques, mounting bolts and centering sleeves for JIS 10 K*

| Nominal diameter [mm] | Mounting bolts [mm] | Centering sleeve length [mm] | Tightening torque [Nm] with a process flange with a | |
|---|---|---|---|---|
| | | | smooth seal face | raised face |
| 25 | 4 × M16 × 170 | 54 | 24 | 24 |
| 40 | 4 × M16 × 170 | 68 | 32 | 25 |
| 50 | 4 × M16 × 185 | – * | 38 | 30 |
| 65 | 4 × M16 × 200 | – * | 42 | 42 |
| 80 | 8 × M16 × 225 | – * | 36 | 28 |
| 100 | 8 × M16 × 260 | – * | 39 | 37 |

* A centering sleeve is not required. The device is centered directly via the sensor housing.

*Tightening torques, mounting bolts and centering sleeves for ANSI Class 150*

| Nominal diameter [inch] | Mounting bolts [inch] | Centering sleeve length [inch] | Tightening torque [lbf · ft] with a process flange with a | |
|---|---|---|---|---|
| | | | smooth seal face | raised face |
| 1" | 4 × UNC 1/2" × 5.70" | – * | 14 | 7 |
| 1 ½" | 4 × UNC 1/2" × 6.50" | – * | 21 | 14 |
| 2" | 4 × UNC 5/8" × 7.50" | – * | 30 | 27 |
| 3" | 4 × UNC 5/8" × 9.25" | – * | 31 | 31 |
| 4" | 8 × UNC 5/8" × 10,4" | 5,79 | 28 | 28 |

* A centering sleeve is not required. The device is centered directly via the sensor housing.

### 3.3.2 Installing the Promag L sensor

Caution!
- The protective covers mounted on the two sensor flanges (DN 50…300) are used to hold the lap joint flanges in place and to protect the PTFE liner during transportation. Consequently, do not remove these covers until immediately before the sensor is installed in the pipe.
- The covers must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 📄 25
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment
- To comply with the device specification, a concentrical installation in the measuring section is required

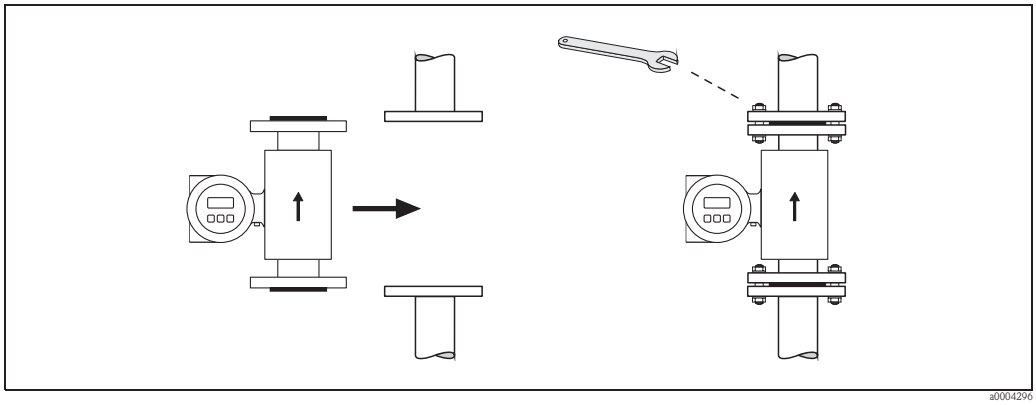



*Fig. 18: Installing the Promag L sensor*

#### Seals

Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are **always** necessary.
- Polyurethane lining → **no** seals are required.
- PTFE lining → **no** seals are required.
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit!
Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

#### Ground cable

- If necessary, special ground cables for potential equalization can be ordered as an accessory (→ 📄 76).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 📄 55.

### Screw tightening torques (Promag L)

Please note the following:
- The tightening torques listed below are for lubricated threads only.
- Always tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

*Promag L tightening torques for EN (DIN)*

| Nominal diameter | EN (DIN) | | Max. tightening torque | | |
|---|---|---|---|---|---|
| | | | Hard rubber | Polyurethane | PTFE |
| [mm] | Pressure rating [bar] | Threaded fasteners | [Nm] | [Nm] | [Nm] |
| 50 | PN 10/16 | 4 × M 16 | – | 15 | 40 |
| 65* | PN 10/16 | 8 × M 16 | – | 10 | 22 |
| 80 | PN 10/16 | 8 × M 16 | – | 15 | 30 |
| 100 | PN 10/16 | 8 × M 16 | – | 20 | 42 |
| 125 | PN 10/16 | 8 × M 16 | – | 30 | 55 |
| 150 | PN 10/16 | 8 × M 20 | – | 50 | 90 |
| 200 | PN 10 | 8 × M 20 | – | 65 | 130 |
| 250 | PN 10 | 12 × M 20 | – | 50 | 90 |
| 300 | PN 10 | 12 × M 20 | – | 55 | 100 |
| 350 | PN 6 | 12 × M 20 | 111 | 120 | – |
| 350 | PN 10 | 16 × M 20 | 112 | 118 | – |
| 400 | PN 6 | 16 × M 20 | 90 | 98 | – |
| 400 | PN 10 | 16 × M 24 | 151 | 167 | – |
| 450 | PN 6 | 16 × M 20 | 112 | 126 | – |
| 450 | PN 10 | 20 × M 24 | 153 | 133 | – |
| 500 | PN 6 | 20 × M 20 | 119 | 123 | – |
| 500 | PN 10 | 20 × M 24 | 155 | 171 | – |
| 600 | PN 6 | 20 × M 24 | 139 | 147 | – |
| 600 | PN 10 | 20 × M 27 | 206 | 219 | – |
| 700 | PN 6 | 24 × M 24 | 148 | 139 | – |
| 700 | PN 10 | 24 × M 27 | 246 | 246 | – |
| 800 | PN 6 | 24 × M 27 | 206 | 182 | – |
| 800 | PN 10 | 24 × M 30 | 331 | 316 | – |
| 900 | PN 6 | 24 × M 27 | 230 | 637 | – |
| 900 | PN 10 | 28 × M 30 | 316 | 307 | – |
| 1000 | PN 6 | 28 × M 27 | 218 | 208 | – |
| 1000 | PN 10 | 28 × M 33 | 402 | 405 | – |
| 1200 | PN 6 | 32 × M 30 | 319 | 299 | – |
| 1200 | PN 10 | 32 × M 36 | 564 | 568 | – |

* Designed acc. to EN 1092-1 (not to DIN 2501)

*Promag L tightening torques for ANSI*

| Nominal diameter | | ANSI | Threaded fasteners | Max. tightening torque | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Pressure rating | | Hard rubber | | Polyurethane | | PTFE | |
| [mm] | [inch] | [lbs] | | [Nm] | [lbf · ft] | [Nm] | [lbf · ft] | [Nm] | [lbf · ft] |
| 50 | 2" | Class 150 | 4 × 5/8" | – | – | 15 | 11 | 40 | 29 |
| 80 | 3" | Class 150 | 4 × 5/8" | – | – | 25 | 18 | 65 | 48 |
| 100 | 4" | Class 150 | 8 × 5/8" | – | – | 20 | 15 | 44 | 32 |
| 150 | 6" | Class 150 | 8 × ¾" | – | – | 45 | 33 | 90 | 66 |
| 200 | 8" | Class 150 | 8 × ¾" | – | – | 65 | 48 | 125 | 92 |
| 250 | 10" | Class 150 | 12 × 7/8" | – | – | 55 | 41 | 100 | 74 |
| 300 | 12" | Class 150 | 12 × 7/8" | – | – | 68 | 56 | 115 | 85 |
| 350 | 14" | Class 150 | 12 × 1" | 135 | 100 | 158 | 117 | – | – |

| Nominal diameter | | ANSI | Threaded fasteners | Max. tightening torque | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Pressure rating | | Hard rubber | | Polyurethane | | PTFE | |
| [mm] | [inch] | [lbs] | | [Nm] | [lbf · ft] | [Nm] | [lbf · ft] | [Nm] | [lbf · ft] |
| 400 | 16" | Class 150 | 16 × 1" | 128 | 94 | 150 | 111 | – | – |
| 450 | 18" | Class 150 | 16 × 1 1/8" | 204 | 150 | 234 | 173 | – | – |
| 500 | 20" | Class 150 | 20 × 1 1/8" | 183 | 135 | 217 | 160 | – | – |
| 600 | 24" | Class 150 | 20 × 1 ¼" | 268 | 198 | 307 | 226 | – | – |

*Promag L tightening torques for AWWA*

| Nominal diameter | | AWWA | Threaded fasteners | Max. tightening torque | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Pressure rating | | Hartgummi | | Polyurethane | | PTFE | |
| [mm] | [inch] | | | [Nm] | [lbf · ft] | [Nm] | [lbf · ft] | [Nm] | [lbf · ft] |
| 700 | 28" | Class D | 28 × 1 ¼" | 247 | 182 | 292 | 215 | – | – |
| 750 | 30" | Class D | 28 × 1 ¼" | 287 | 212 | 302 | 223 | – | – |
| 800 | 32" | Class D | 28 × 1 ½" | 394 | 291 | 422 | 311 | – | – |
| 900 | 36" | Class D | 32 × 1 ½" | 419 | 309 | 430 | 317 | – | – |
| 1000 | 40" | Class D | 36 × 1 ½" | 420 | 310 | 477 | 352 | – | – |
| 1050 | 42" | Class D | 36 × 1 ½" | 528 | 389 | 518 | 382 | – | – |
| 1200 | 48" | Class D | 44 × 1 ½" | 552 | 407 | 531 | 392 | – | – |

*Promag L tightening torques for AS 2129*

| Nominal diameter | AS 2129 | Threaded fasteners | Max. tightening torque | | |
|---|---|---|---|---|---|
| | Pressure rating | | Hard rubber | Polyurethane | PTFE |
| [mm] | | | [Nm] | [Nm] | [Nm] |
| 350 | Table E | 12 × M 24 | 203 | – | – |
| 400 | Table E | 12 × M 24 | 226 | – | – |
| 450 | Table E | 16 × M 24 | 226 | – | – |
| 500 | Table E | 16 × M 24 | 271 | – | – |
| 600 | Table E | 16 × M 30 | 439 | – | – |
| 700 | Table E | 20 × M 30 | 355 | – | – |
| 750 | Table E | 20 × M 30 | 559 | – | – |
| 800 | Table E | 20 × M 30 | 631 | – | – |
| 900 | Table E | 24 × M 30 | 627 | – | – |
| 1000 | Table E | 24 × M 30 | 634 | – | – |
| 1200 | Table E | 32 × M 30 | 727 | – | – |

*Promag L tightening torques for AS 4087*

| Nominal diameter | AS 4087 | Threaded fasteners | Max. tightening torque | | |
|---|---|---|---|---|---|
| | Pressure rating | | Hard rubber | Polyurethane | PTFE |
| [mm] | | | [Nm] | [Nm] | [Nm] |
| 350 | PN 16 | 12 × M 24 | 203 | – | – |
| 375 | PN 16 | 12 × M 24 | 137 | – | – |
| 400 | PN 16 | 12 × M 24 | 226 | – | – |
| 450 | PN 16 | 12 × M 24 | 301 | – | – |
| 500 | PN 16 | 16 × M 24 | 271 | – | – |
| 600 | PN 16 | 16 × M 27 | 393 | – | – |
| 700 | PN 16 | 20 × M 27 | 330 | – | – |
| 750 | PN 16 | 20 × M 30 | 529 | – | – |
| 800 | PN 16 | 20 × M 33 | 631 | – | – |
| 900 | PN 16 | 24 × M 33 | 627 | – | – |
| 1000 | PN 16 | 24 × M 33 | 595 | – | – |
| 1200 | PN 16 | 32 × M 33 | 703 | – | – |

### 3.3.3 Installing the Promag W sensor

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 27
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment

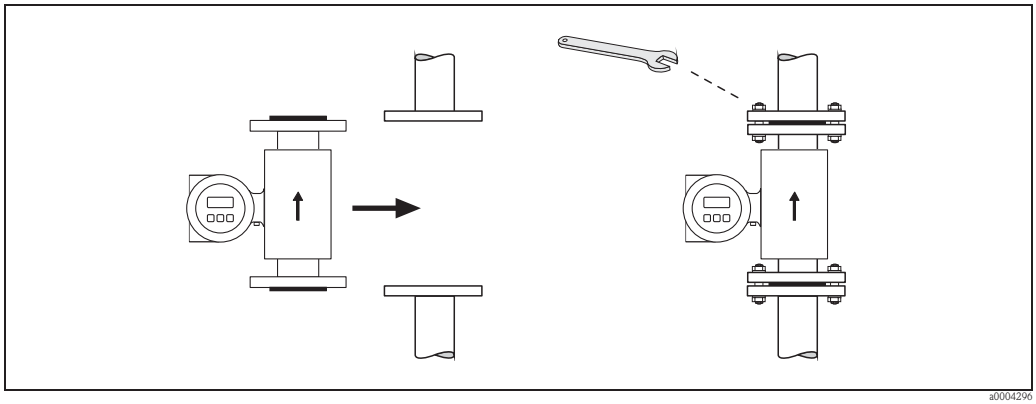



*Fig. 19: Installing the Promag W sensor*

#### Seals

Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are **always** necessary.
- Polyurethane lining → **no** seals are required.
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit!
Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

#### Ground cable

- If necessary, special ground cables for potential equalization can be ordered as an accessory (→ 76).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 55

#### Screw tightening torques (Promag W)

Please note the following:
- The tightening torques listed below are for lubricated threads only.
- Always tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Tightening torques for:
- EN (DIN)→ 28
- JIS→ 30
- ANSI→ 29
- AWWA → 30
- AS 2129 → 31
- AS 4087 → 31

*Promag W tightening torques for EN (DIN)*

| Nominal diameter [mm] | EN (DIN) Pressure rating [bar] | Threaded fasteners | Max. tightening torque [Nm] | |
|---|---|---|---|---|
| | | | Hard rubber | Polyurethane |
| 25 | PN 40 | 4 × M 12 | - | 15 |
| 32 | PN 40 | 4 × M 16 | - | 24 |
| 40 | PN 40 | 4 × M 16 | - | 31 |
| 50 | PN 40 | 4 × M 16 | 48 | 40 |
| 65* | PN 16 | 8 × M 16 | 32 | 27 |
| 65 | PN 40 | 8 × M 16 | 32 | 27 |
| 80 | PN 16 | 8 × M 16 | 40 | 34 |
| 80 | PN 40 | 8 × M 16 | 40 | 34 |
| 100 | PN 16 | 8 × M 16 | 43 | 36 |
| 100 | PN 40 | 8 × M 20 | 59 | 50 |
| 125 | PN 16 | 8 × M 16 | 56 | 48 |
| 125 | PN 40 | 8 × M 24 | 83 | 71 |
| 150 | PN 16 | 8 × M 20 | 74 | 63 |
| 150 | PN 40 | 8 × M 24 | 104 | 88 |
| 200 | PN 10 | 8 × M 20 | 106 | 91 |
| 200 | PN 16 | 12 × M 20 | 70 | 61 |
| 200 | PN 25 | 12 × M 24 | 104 | 92 |
| 250 | PN 10 | 12 × M 20 | 82 | 71 |
| 250 | PN 16 | 12 × M 24 | 98 | 85 |
| 250 | PN 25 | 12 × M 27 | 150 | 134 |
| 300 | PN 10 | 12 × M 20 | 94 | 81 |
| 300 | PN 16 | 12 × M 24 | 134 | 118 |
| 300 | PN 25 | 16 × M 27 | 153 | 138 |
| 350 | PN 6 | 12 × M 20 | 111 | 120 |
| 350 | PN 10 | 16 × M 20 | 112 | 118 |
| 350 | PN 16 | 16 × M 24 | 152 | 165 |
| 350 | PN 25 | 16 × M 30 | 227 | 252 |
| 400 | PN 6 | 16 × M 20 | 90 | 98 |
| 400 | PN 10 | 16 × M 24 | 151 | 167 |
| 400 | PN 16 | 16 × M 27 | 193 | 215 |
| 400 | PN 25 | 16 × M 33 | 289 | 326 |
| 450 | PN 6 | 16 × M 20 | 112 | 126 |
| 450 | PN 10 | 20 × M 24 | 153 | 133 |
| 450 | PN 16 | 20 × M 27 | 198 | 196 |
| 450 | PN 25 | 20 × M 33 | 256 | 253 |
| 500 | PN 6 | 20 × M 20 | 119 | 123 |
| 500 | PN 10 | 20 × M 24 | 155 | 171 |
| 500 | PN 16 | 20 × M 30 | 275 | 300 |
| 500 | PN 25 | 20 × M 33 | 317 | 360 |
| 600 | PN 6 | 20 × M 24 | 139 | 147 |
| 600 | PN 10 | 20 × M 27 | 206 | 219 |
| 600 * | PN 16 | 20 × M 33 | 415 | 443 |
| 600 | PN 25 | 20 × M 36 | 431 | 516 |
| 700 | PN 6 | 24 × M 24 | 148 | 139 |
| 700 | PN 10 | 24 × M 27 | 246 | 246 |
| 700 | PN 16 | 24 × M 33 | 278 | 318 |

| Nominal diameter [mm] | EN (DIN) Pressure rating [bar] | Threaded fasteners | Max. tightening torque [Nm] Hard rubber | Polyurethane |
|---|---|---|---|---|
| 700 | PN 25 | 24 × M 39 | 449 | 507 |
| 800 | PN 6 | 24 × M 27 | 206 | 182 |
| 800 | PN 10 | 24 × M 30 | 331 | 316 |
| 800 | PN 16 | 24 × M 36 | 369 | 385 |
| 800 | PN 25 | 24 × M 45 | 664 | 721 |
| 900 | PN 6 | 24 × M 27 | 230 | 637 |
| 900 | PN 10 | 28 × M 30 | 316 | 307 |
| 900 | PN 16 | 28 × M 36 | 353 | 398 |
| 900 | PN 25 | 28 × M 45 | 690 | 716 |
| 1000 | PN 6 | 28 × M 27 | 218 | 208 |
| 1000 | PN 10 | 28 × M 33 | 402 | 405 |
| 1000 | PN 16 | 28 × M 39 | 502 | 518 |
| 1000 | PN 25 | 28 × M 52 | 970 | 971 |
| 1200 | PN 6 | 32 × M 30 | 319 | 299 |
| 1200 | PN 10 | 32 × M 36 | 564 | 568 |
| 1200 | PN 16 | 32 × M 45 | 701 | 753 |
| 1400 | PN 6 | 36 × M 33 | 430 | 398 |
| 1400 | PN 10 | 36 × M 39 | 654 | 618 |
| 1400 | PN 16 | 36 × M 45 | 729 | 762 |
| 1600 | PN 6 | 40 × M 33 | 440 | 417 |
| 1600 | PN 10 | 40 × M 45 | 946 | 893 |
| 1600 | PN 16 | 40 × M 52 | 1007 | 1100 |
| 1800 | PN 6 | 44 × M 36 | 547 | 521 |
| 1800 | PN 10 | 44 × M 45 | 961 | 895 |
| 1800 | PN 16 | 44 × M 52 | 1108 | 1003 |
| 2000 | PN 6 | 48 × M 39 | 629 | 605 |
| 2000 | PN 10 | 48 × M 45 | 1047 | 1092 |
| 2000 | PN 16 | 48 × M 56 | 1324 | 1261 |
| * Designed acc. to EN 1092-1 (not to DIN 2501) | | | | |

*Promag W tightening torques for ANSI*

| Nominal diameter [mm] | Nominal diameter [inch] | ANSI Pressure rating [lbs] | Threaded fasteners | Max. tightening torque Hard rubber [Nm] | Hard rubber [lbf · ft] | Polyurethane [Nm] | Polyurethane [lbf · ft] |
|---|---|---|---|---|---|---|---|
| 25 | 1" | Class 150 | 4 × ½" | - | - | 7 | 5 |
| 25 | 1" | Class 300 | 4 × 5/8" | - | - | 8 | 6 |
| 40 | 1 ½" | Class 150 | 4 × ½" | - | - | 10 | 7 |
| 40 | 1 ½" | Class 300 | 4 × ¾" | - | - | 15 | 11 |
| 50 | 2" | Class 150 | 4 × 5/8" | 35 | 26 | 22 | 16 |
| 50 | 2" | Class 300 | 8 × 5/8" | 18 | 13 | 11 | 8 |
| 80 | 3" | Class 150 | 4 × 5/8" | 60 | 44 | 43 | 32 |
| 80 | 3" | Class 300 | 8 × ¾" | 38 | 28 | 26 | 19 |
| 100 | 4" | Class 150 | 8 × 5/8" | 42 | 31 | 31 | 23 |
| 100 | 4" | Class 300 | 8 × ¾" | 58 | 43 | 40 | 30 |
| 150 | 6" | Class 150 | 8 × ¾" | 79 | 58 | 59 | 44 |
| 150 | 6" | Class 300 | 12 × ¾" | 70 | 52 | 51 | 38 |
| 200 | 8" | Class 150 | 8 × ¾" | 107 | 79 | 80 | 59 |
| 250 | 10" | Class 150 | 12 × 7/8" | 101 | 74 | 75 | 55 |
| 300 | 12" | Class 150 | 12 × 7/8" | 133 | 98 | 103 | 76 |
| 350 | 14" | Class 150 | 12 × 1" | 135 | 100 | 158 | 117 |
| 400 | 16" | Class 150 | 16 × 1" | 128 | 94 | 150 | 111 |
| 450 | 18" | Class 150 | 16 × 1 1/8" | 204 | 150 | 234 | 173 |
| 500 | 20" | Class 150 | 20 × 1 1/8" | 183 | 135 | 217 | 160 |
| 600 | 24" | Class 150 | 20 × 1 ¼" | 268 | 198 | 307 | 226 |

*Promag W tightening torques for JIS*

| Nominal diameter [mm] | JIS Pressure rating | Threaded fasteners | Max. tightening torque [Nm] | |
|---|---|---|---|---|
| | | | Hard rubber | Polyurethane |
| 25 | 10K | 4 × M 16 | – | 19 |
| 25 | 20K | 4 × M 16 | – | 19 |
| 32 | 10K | 4 × M 16 | – | 22 |
| 32 | 20K | 4 × M 16 | – | 22 |
| 40 | 10K | 4 × M 16 | – | 24 |
| 40 | 20K | 4 × M 16 | – | 24 |
| 50 | 10K | 4 × M 16 | 40 | 33 |
| 50 | 20K | 8 × M 16 | 20 | 17 |
| 65 | 10K | 4 × M 16 | 55 | 45 |
| 65 | 20K | 8 × M 16 | 28 | 23 |
| 80 | 10K | 8 × M 16 | 29 | 23 |
| 80 | 20K | 8 × M 20 | 42 | 35 |
| 100 | 10K | 8 × M 16 | 35 | 29 |
| 100 | 20K | 8 × M 20 | 56 | 48 |
| 125 | 10K | 8 × M 20 | 60 | 51 |
| 125 | 20K | 8 × M 22 | 91 | 79 |
| 150 | 10K | 8 × M 20 | 75 | 63 |
| 150 | 20K | 12 × M 22 | 81 | 72 |
| 200 | 10K | 12 × M 20 | 61 | 52 |
| 200 | 20K | 12 × M 22 | 91 | 80 |
| 250 | 10K | 12 × M 22 | 100 | 87 |
| 250 | 20K | 12 × M 24 | 159 | 144 |
| 300 | 10K | 16 × M 22 | 74 | 63 |
| 300 | 20K | 16 × M 24 | 138 | 124 |

*Promag W tightening torques for AWWA*

| Nominal diameter | | AWWA Pressure rating | Threaded fasteners | Max. tightening torque | | | |
|---|---|---|---|---|---|---|---|
| | | | | Hard rubber | | Polyurethane | |
| [mm] | [inch] | | | [Nm] | [lbf · ft] | [Nm] | [lbf · ft] |
| 700 | 28" | Class D | 28 × 1 ¼" | 247 | 182 | 292 | 215 |
| 750 | 30" | Class D | 28 × 1 ¼" | 287 | 212 | 302 | 223 |
| 800 | 32" | Class D | 28 × 1 ½" | 394 | 291 | 422 | 311 |
| 900 | 36" | Class D | 32 × 1 ½" | 419 | 309 | 430 | 317 |
| 1000 | 40" | Class D | 36 × 1 ½" | 420 | 310 | 477 | 352 |
| 1050 | 42" | Class D | 36 × 1 ½" | 528 | 389 | 518 | 382 |
| 1200 | 48" | Class D | 44 × 1 ½" | 552 | 407 | 531 | 392 |
| 1350 | 54" | Class D | 44 × 1 ¾" | 730 | 538 | 633 | 467 |
| 1500 | 60" | Class D | 52 × 1 ¾" | 758 | 559 | 832 | 614 |
| 1650 | 66" | Class D | 52 × 1 ¾" | 946 | 698 | 955 | 704 |
| 1800 | 72" | Class D | 60 × 1 ¾" | 975 | 719 | 1087 | 802 |
| 2000 | 78" | Class D | 64 × 2" | 853 | 629 | 786 | 580 |

*Promag W tightening torques for AS 2129*

| Nominal diameter [mm] | AS 2129 Pressure rating | Threaded fasteners | Max. tightening torque [Nm] Hard rubber |
|---|---|---|---|
| 50 | Table E | 4 × M 16 | 32 |
| 80 | Table E | 4 × M 16 | 49 |
| 100 | Table E | 8 × M 16 | 38 |
| 150 | Table E | 8 × M 20 | 64 |
| 200 | Table E | 8 × M 20 | 96 |
| 250 | Table E | 12 × M 20 | 98 |
| 300 | Table E | 12 × M 24 | 123 |
| 350 | Table E | 12 × M 24 | 203 |
| 400 | Table E | 12 × M 24 | 226 |
| 450 | Table E | 16 × M 24 | 226 |
| 500 | Table E | 16 × M 24 | 271 |
| 600 | Table E | 16 × M 30 | 439 |
| 700 | Table E | 20 × M 30 | 355 |
| 750 | Table E | 20 × M 30 | 559 |
| 800 | Table E | 20 × M 30 | 631 |
| 900 | Table E | 24 × M 30 | 627 |
| 1000 | Table E | 24 × M 30 | 634 |
| 1200 | Table E | 32 × M 30 | 727 |

*Promag W tightening torques for AS 4087*

| Nominal diameter [mm] | AS 4087 Pressure rating | Threaded fasteners | Max. tightening torque [Nm] Hard rubber |
|---|---|---|---|
| 50 | Table E | 4 × M 16 | 32 |
| 80 | PN 16 | 4 × M 16 | 49 |
| 100 | PN 16 | 4 × M 16 | 76 |
| 150 | PN 16 | 8 × M 20 | 52 |
| 200 | PN 16 | 8 × M 20 | 77 |
| 250 | PN 16 | 8 × M 20 | 147 |
| 300 | PN 16 | 12 × M 24 | 103 |
| 350 | PN 16 | 12 × M 24 | 203 |
| 375 | PN 16 | 12 × M 24 | 137 |
| 400 | PN 16 | 12 × M 24 | 226 |
| 450 | PN 16 | 12 × M 24 | 301 |
| 500 | PN 16 | 16 × M 24 | 271 |
| 600 | PN 16 | 16 × M 27 | 393 |
| 700 | PN 16 | 20 × M 27 | 330 |
| 750 | PN 16 | 20 × M 30 | 529 |
| 800 | PN 16 | 20 × M 33 | 631 |
| 900 | PN 16 | 24 × M 33 | 627 |
| 1000 | PN 16 | 24 × M 33 | 595 |
| 1200 | PN 16 | 32 × M 33 | 703 |

### 3.3.4 Installing the Promag P sensor

Caution!
- The protective covers mounted on the two sensor flanges guard the PTFE, which is turned over the flanges. Consequently, do not remove these covers until **immediately before** the sensor is installed in the pipe.
- The covers must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 33
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment

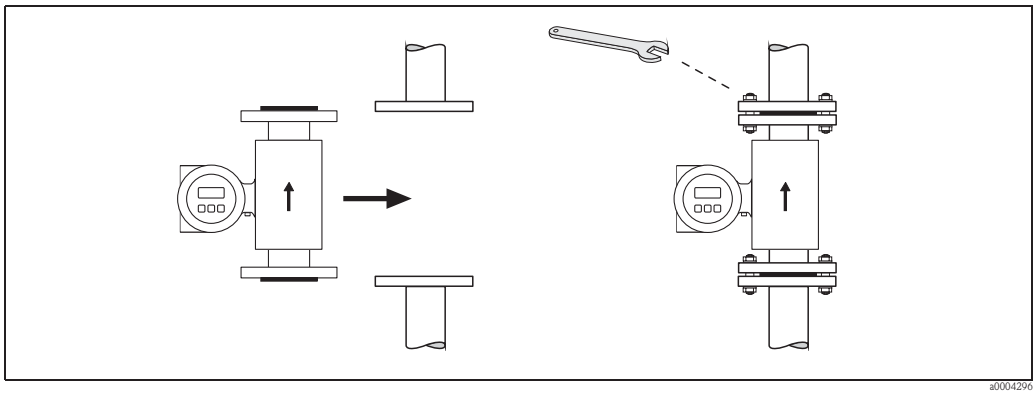



*Fig. 20: Installing the Promag P sensor*

#### Seals

Comply with the following instructions when installing seals:
- PFA or PTFE lining → **No** seals are required!
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit! Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

#### Ground cable

- If necessary, special ground cables for potential equalization can be ordered as an accessory (→ 76).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 53

### Installing the high-temperature version (with PFA lining)

The high-temperature version has a housing support for the thermal separation of sensor and transmitter. The high-temperature version is always used for applications in which high ambient temperatures are encountered **in conjunction with** high fluid temperatures. The high-temperature version is obligatory if the fluid temperature exceeds +150 °C.

Note!
You will find information on permissible temperature ranges on → 100

*Insulation*

Pipes generally have to be insulated if they carry very hot fluids, in order to avoid energy losses and to prevent accidental contact with pipes at temperatures that could cause injury. Guidelines regulating the insulation of pipes have to be taken into account.

Caution!
Risk of measuring electronics overheating. The housing support dissipates heat and its entire surface area must remain uncovered. Make sure that the sensor insulation does not extend past the top of the two sensor shells.

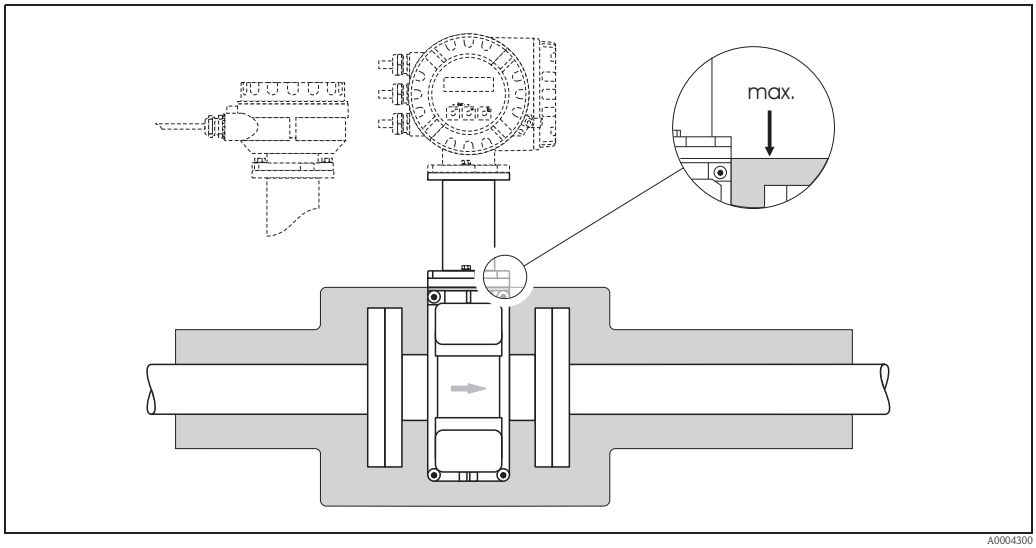



*Fig. 21: Promag P (high-temperature version): Insulating the pipe*

### Tightening torques for threaded fasteners (Promag P)

Please note the following:
- The tightening torques listed below are for lubricated threads only.
- Always tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Tightening torques for:
- EN (DIN) → 34
- ANSI → 35
- JIS → 35
- AS 2129 → 36
- AS 4087 → 36

*Promag P tightening torques for EN (DIN)*

| Nominal diameter [mm] | EN (DIN) Pressure rating [bar] | Threaded fasteners | Max. tightening torque [Nm] | |
|---|---|---|---|---|
| | | | PTFE | PFA |
| 15 | PN 40 | 4 × M 12 | 11 | – |
| 25 | PN 40 | 4 × M 12 | 26 | 20 |
| 32 | PN 40 | 4 × M 16 | 41 | 35 |
| 40 | PN 40 | 4 × M 16 | 52 | 47 |
| 50 | PN 40 | 4 × M 16 | 65 | 59 |
| 65 * | PN 16 | 8 × M 16 | 43 | 40 |
| 65 | PN 40 | 8 × M 16 | 43 | 40 |
| 80 | PN 16 | 8 × M 16 | 53 | 48 |
| 80 | PN 40 | 8 × M 16 | 53 | 48 |
| 100 | PN 16 | 8 × M 16 | 57 | 51 |
| 100 | PN 40 | 8 × M 20 | 78 | 70 |
| 125 | PN 16 | 8 × M 16 | 75 | 67 |
| 125 | PN 40 | 8 × M 24 | 111 | 99 |
| 150 | PN 16 | 8 × M 20 | 99 | 85 |
| 150 | PN 40 | 8 × M 24 | 136 | 120 |
| 200 | PN 10 | 8 × M 20 | 141 | 101 |
| 200 | PN 16 | 12 × M 20 | 94 | 67 |
| 200 | PN 25 | 12 × M 24 | 138 | 105 |
| 250 | PN 10 | 12 × M 20 | 110 | – |
| 250 | PN 16 | 12 × M 24 | 131 | – |
| 250 | PN 25 | 12 × M 27 | 200 | – |
| 300 | PN 10 | 12 × M 20 | 125 | – |
| 300 | PN 16 | 12 × M 24 | 179 | – |
| 300 | PN 25 | 16 × M 27 | 204 | – |
| 350 | PN 10 | 16 × M 20 | 188 | – |
| 350 | PN 16 | 16 × M 24 | 254 | – |
| 350 | PN 25 | 16 × M 30 | 380 | – |
| 400 | PN 10 | 16 × M 24 | 260 | – |
| 400 | PN 16 | 16 × M 27 | 330 | – |
| 400 | PN 25 | 16 × M 33 | 488 | – |
| 450 | PN 10 | 20 × M 24 | 235 | – |
| 450 | PN 16 | 20 × M 27 | 300 | – |
| 450 | PN 25 | 20 × M 33 | 385 | – |
| 500 | PN 10 | 20 × M 24 | 265 | – |
| 500 | PN 16 | 20 × M 30 | 448 | – |
| 500 | PN 25 | 20 × M 33 | 533 | – |
| 600 | PN 10 | 20 × M 27 | 345 | – |
| 600 * | PN 16 | 20 × M 33 | 658 | – |
| 600 | PN 25 | 20 × M 36 | 731 | – |
| * Designed acc. to EN 1092-1 (not to DIN 2501) | | | | |

*Promag P tightening torques for ANSI*

| Nominal diameter | | ANSI | | Max. tightening torque | | | |
|---|---|---|---|---|---|---|---|
| | | | | PTFE | | PFA | |
| [mm] | [inch] | Pressure rating [lbs] | Threaded fasteners | [Nm] | [lbf · ft] | [Nm] | [lbf · ft] |
| 15 | ½" | Class 150 | 4 × ½" | 6 | 4 | – | – |
| 15 | ½" | Class 300 | 4 × ½" | 6 | 4 | – | – |
| 25 | 1" | Class 150 | 4 × ½" | 11 | 8 | 10 | 7 |
| 25 | 1" | Class 300 | 4 × 5/8" | 14 | 10 | 12 | 9 |
| 40 | 1 ½" | Class 150 | 4 × ½" | 24 | 18 | 21 | 15 |
| 40 | 1 ½" | Class 300 | 4 × ¾" | 34 | 25 | 31 | 23 |
| 50 | 2" | Class 150 | 4 × 5/8" | 47 | 35 | 44 | 32 |
| 50 | 2" | Class 300 | 8 × 5/8" | 23 | 17 | 22 | 16 |
| 80 | 3" | Class 150 | 4 × 5/8" | 79 | 58 | 67 | 49 |
| 80 | 3" | Class 300 | 8 × ¾" | 47 | 35 | 42 | 31 |
| 100 | 4" | Class 150 | 8 × 5/8" | 56 | 41 | 50 | 37 |
| 100 | 4" | Class 300 | 8 × ¾" | 67 | 49 | 59 | 44 |
| 150 | 6" | Class 150 | 8 × ¾" | 106 | 78 | 86 | 63 |
| 150 | 6" | Class 300 | 12 × ¾" | 73 | 54 | 67 | 49 |
| 200 | 8" | Class 150 | 8 × ¾" | 143 | 105 | 109 | 80 |
| 250 | 10" | Class 150 | 12 × 7/8" | 135 | 100 | – | – |
| 300 | 12" | Class 150 | 12 × 7/8" | 178 | 131 | – | – |
| 350 | 14" | Class 150 | 12 × 1" | 260 | 192 | – | – |
| 400 | 16" | Class 150 | 16 × 1" | 246 | 181 | – | – |
| 450 | 18" | Class 150 | 16 × 1 1/8" | 371 | 274 | – | – |
| 500 | 20" | Class 150 | 20 × 1 1/8" | 341 | 252 | – | – |
| 600 | 24" | Class 150 | 20 × 1 ¼" | 477 | 352 | – | – |

*Promag P tightening torques for JIS*

| Nominal diameter | JIS | | Max. tightening torque [Nm] | |
|---|---|---|---|---|
| [mm] | Pressure rating | Threaded fasteners | PTFE | PFA |
| 25 | 10K | 4 × M 16 | 32 | 27 |
| 25 | 20K | 4 × M 16 | 32 | 27 |
| 32 | 10K | 4 × M 16 | 38 | – |
| 32 | 20K | 4 × M 16 | 38 | – |
| 40 | 10K | 4 × M 16 | 41 | 37 |
| 40 | 20K | 4 × M 16 | 41 | 37 |
| 50 | 10K | 4 × M 16 | 54 | 46 |
| 50 | 20K | 8 × M 16 | 27 | 23 |
| 65 | 10K | 4 × M 16 | 74 | 63 |
| 65 | 20K | 8 × M 16 | 37 | 31 |
| 80 | 10K | 8 × M 16 | 38 | 32 |
| 80 | 20K | 8 × M 20 | 57 | 46 |
| 100 | 10K | 8 × M 16 | 47 | 38 |
| 100 | 20K | 8 × M 20 | 75 | 58 |
| 125 | 10K | 8 × M 20 | 80 | 66 |
| 125 | 20K | 8 × M 22 | 121 | 103 |
| 150 | 10K | 8 × M 20 | 99 | 81 |
| 150 | 20K | 12 × M 22 | 108 | 72 |
| 200 | 10K | 12 × M 20 | 82 | 54 |
| 200 | 20K | 12 × M 22 | 121 | 88 |
| 250 | 10K | 12 × M 22 | 133 | – |
| 250 | 20K | 12 × M 24 | 212 | – |
| 300 | 10K | 16 × M 22 | 99 | – |
| 300 | 20K | 16 × M 24 | 183 | – |

*Promag P tightening torques for AS 2129*

| Nominal diameter [mm] | AS 2129 Pressure rating | Threaded fasteners | Max. tightening torque [Nm] PTFE |
|---|---|---|---|
| 25 | Table E | 4 × M 12 | 21 |
| 50 | Table E | 4 × M 16 | 42 |

*Promag P tightening torques for AS 4087*

| Nominal diameter [mm] | AS 4087 Pressure rating | Threaded fasteners | Max. tightening torque [Nm] PTFE |
|---|---|---|---|
| 50 | PN 16 | 4 × M 16 | 42 |

### 3.3.5 Installing the Promag H sensor

The sensor is supplied to order, with or without pre-installed process connections. Pre-installed process connections are secured to the sensor with 4 or 6 hex-head threaded fasteners.

Caution!
The sensor might require support or additional attachments, depending on the application and the length of the piping run. When plastic process connections are used, the sensor must be additionally supported mechanically. A wall-mounting kit can be ordered separately from Endress+Hauser as an accessory (→ 76).

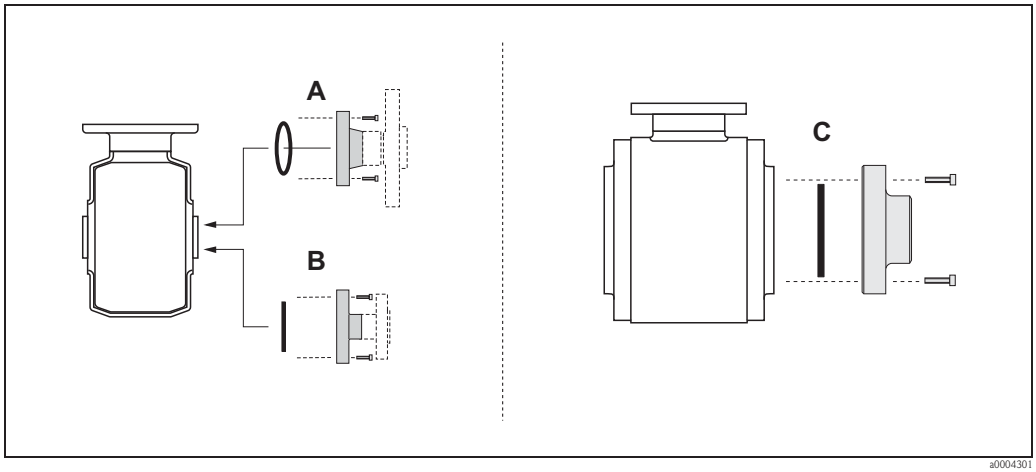



*Abb. 22: Promag H process connections (DN 2…25 / DN 40…100, 1/12"…1" / DN 1½"…4")*

*A = DN 2…25, 1/12"…1"/ process connections with O-ring*
- *welding flanges (DIN EN ISO 1127, ODT / SMS),*
- *flange (EN (DIN), ANSI, JIS ), flange PVDF (EN (DIN), ANSI, JIS )*
- *external and internal thread, hose connection, PVC adhesive fitting*

*B = DN 2…25, 1/12"…1"/ process connections with aseptic gasket vseal*
- *weld nipples (DIN 11850, ODT/SMS)*
- *Clamp (ISO 2852, DIN 32676, L14 AM7)*
- *coupling (DIN 11851, DIN 11864-1, SMS 1145)*
- *flange DIN 11864-2*

*C = DN 40…100, 1½…4"/ process connections with aseptic gasket seal*
- *weld nipples (DIN 11850, ODT/SMS)*
- *Clamp (ISO 2852, DIN 32676, L14 AM7)*
- *coupling (DIN 11851, DIN 11864-1, ISO 2853, SMS 1145)*
- *flange DIN 11864-2*

#### Seals

When installing the process connections, make sure that the seals are clean and correctly centered.

Caution!
- With metal process connections, you must fully tighten the screws. The process connection forms a metallic connection with the sensor, which ensures a defined compression of the seal.
- With plastic process connections, note the max. torques for lubricated threads (7 Nm / 5.2 lbf ft). With plastic flanges, always use seals between connection and counter flange.
- The seals must be replaced periodically, depending on the application, particularly in the case of gasket seals (aseptic version)!
  The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature. Replacement seals can be ordered as accessories → 76.

**Usage and assembly of ground rings (DN 2 to 25, 1/12" to 1")**

In case the process connections are made of plastic (e.g. flanges or adhesive fittings), the potential between the sensor and the fluid must be equalized using additional ground rings.
If the ground rings are not installed this can affect the accuracy of the measurements or cause the destruction of the sensor through the electrochemical erosion of the electrodes.

Caution!
- Depending on the option ordered, plastic disks may be installed at the process connections instead of ground rings. These plastic disks serve only as spacers and have no potential equalization function. In addition, they provide a sealing function at the interface between the sensor and process connection. For this reason, with process connections without ground rings, these plastic disks/seals must not be removed, or must always be installed.
- Ground rings can be ordered separately from Endress+Hauser as accessories (→ 76). When placing the order, make certain that the ground ring is compatible with the material used for the electrodes. Otherwise, there is a risk that the electrodes may be destroyed by electrochemical corrosion! Information about the materials can be found on → 111.
- Ground rings, including the seals, are mounted within the process connections.
  Therefore, the fitting length is not affected.

1. Loosen the four or six hexagonal headed bolts (1) and remove the process connection from the sensor (4).
2. Remove the plastic disk (3), including the two O-ring seals (2).
3. Place one seal (2) in the groove of the process connection.
4. Place the metal ground ring (3) on the process connection.
5. Now place the second seal (2) in the groove of the ground ring.
6. Finally, mount the process connection on the sensor again.
   With plastic process connections, note the max. torques for lubricated threads (7 Nm / 5.2 lbf ft).

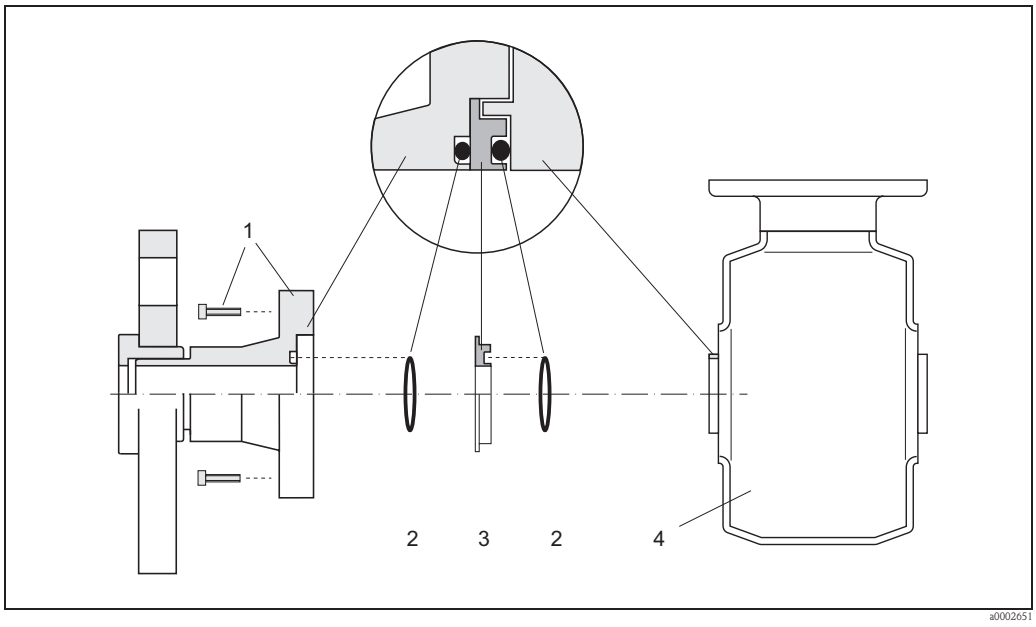



*Fig. 23: Installing ground rings with Promag H (DN 2 to 25, 1/12" to 1")*

*1 = Hexagonal-headed bolt (process connection)*
*2 = O-ring seals*
*3 = Ground ring or plastic disk (spacer)*
*4 = Sensor*

### Welding the transmitter into the piping (weld nipples)

Caution!
Risk of destroying the measuring electronics. Make sure that the welding machine is *not* grounded via the sensor or the transmitter.

1. Tack-weld the sensor into the pipe. A suitable welding jig can be ordered separately as an accessory (→ 76).
2. Loosen the screws on the process connection flange and remove the sensor, complete with the seal, from the pipe.
3. Weld the process connection to the pipe.
4. Reinstall the sensor in the pipe. Make sure that everything is clean and that the seal is correctly seated.

Note!
- If thin-walled foodstuffs pipes are not welded correctly, the heat could damage the installed seal. It is therefore advisable to remove the sensor and the seal prior to welding.
- The pipe has to be spread approximately 8 mm to permit disassembly.

### Cleaning with pigs

If pigs are used for cleaning, it is essential to take the inside diameters of the measuring tube and process connection into account. All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation "Technical Documentation" → 116.

## 3.3.6 Turning the transmitter housing

### Turning the aluminum field housing

Warning!
The turning mechanism in devices with Ex d/de or FM/CSA Cl. I Div. 1 classification is not the same as that described here. The procedure for turning these housings is described in the Ex-specific documentation.

1. Loosen the two securing screws.
2. Turn the bayonet catch as far as it will go.
3. Carefully lift the transmitter housing:
   – Promag D: approx. 10 mm (0.39 inch) above the securing screws
   – Promag L, W, P, H: to the stop
4. Turn the transmitter housing to the desired position:
   – Promag D: max. 180° clockwise or max. 180° counterclockwise
   – Promag L, W, P, H: max. 280° clockwise or max. 20° counterclockwise
5. Lower the housing into position and re-engage the bayonet catch.
6. Retighten the two securing screws.

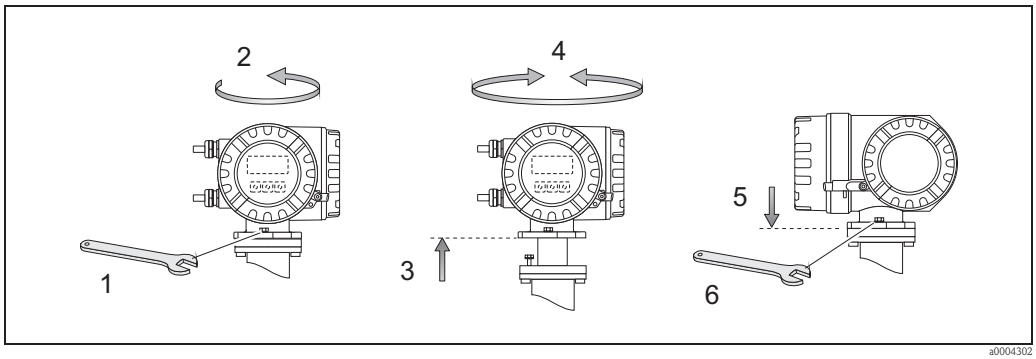



*Fig. 24: Turning the transmitter housing (aluminum field housing)*

### Turning the stainless-steel field housing

1. Loosen the two securing screws.
2. Carefully lift the transmitter housing as far as it will go.
3. Turn the transmitter housing to the desired position (max. 2 × 90° in either direction).
4. Lower the housing into position.
5. Retighten the two securing screws.

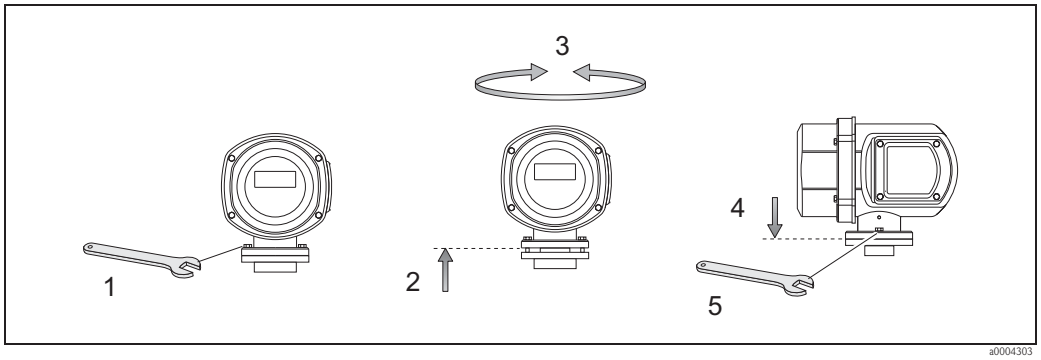



*Fig. 25: Turning the transmitter housing (stainless-steel field housing)*

### 3.3.7 Turning the onsite display

1. Unscrew the cover of the electronics compartment from the transmitter housing.
2. Press the side latches on the display module and remove it from the electronics compartment cover plate.
3. Turn the display to the desired position (max. 4 × 45° in both directions) and reset it onto the cover plate of the electronics compartment.
4. Screw the cover of the electronics compartment firmly back onto the transmitter housing.

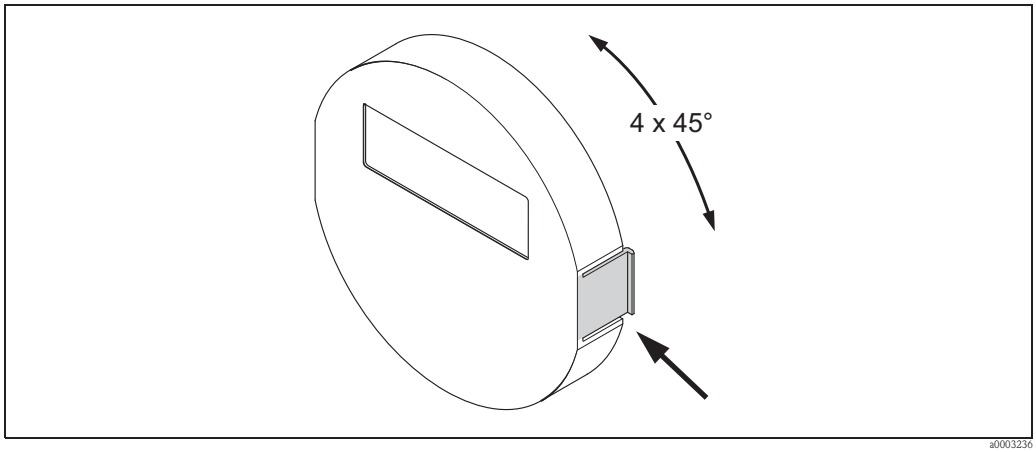



*Fig. 26: Turning the local display (field housing)*

### 3.3.8 Installing the wall-mount housing

There are various ways of installing the wall-mount transmitter housing:

- Direct wall mounting
- Installation in control panel (with separate mounting kit, accessories) → 42
- Pipe mounting (with separate mounting kit, accessories) → 42

Caution!

- Make sure that the ambient temperature does not exceed the permissible range at the mounting location, –20 to +60 °C (–4 to + °140 F), optional –40 to +60 °C (–40 to +140 °F). Install the device at a shady location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

**Direct wall mounting**

1. Drill the holes as illustrated in the graphic.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
   – Securing screws (M6): max. Ø 6.5 mm (0.26")
   – Screw head: max. Ø 10.5 mm (0.41")
4. Secure the transmitter housing to the wall as indicated.
5. Screw the cover of the connection compartment (a) firmly onto the housing.

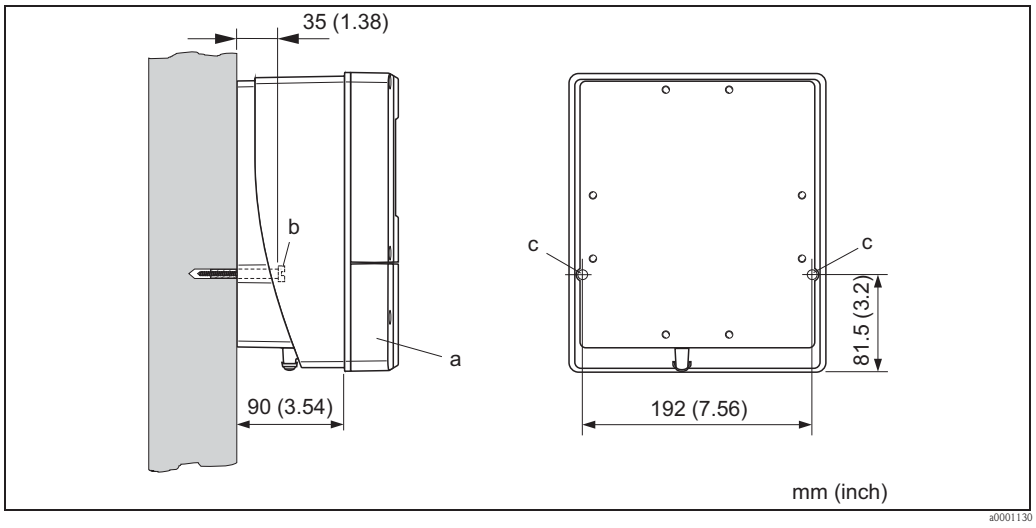



*Fig. 27: Mounted directly on the wall*

### Panel-mounted installation

1. Prepare the opening in the panel as illustrated in the graphic.
2. Slide the housing into the opening in the panel from the front.
3. Screw the fasteners onto the wall-mount housing.
4. Place the threaded rods in the fasteners and screw them down until the housing is seated tightly against the panel. Afterwards, tighten the locking nuts. Additional support is not necessary.

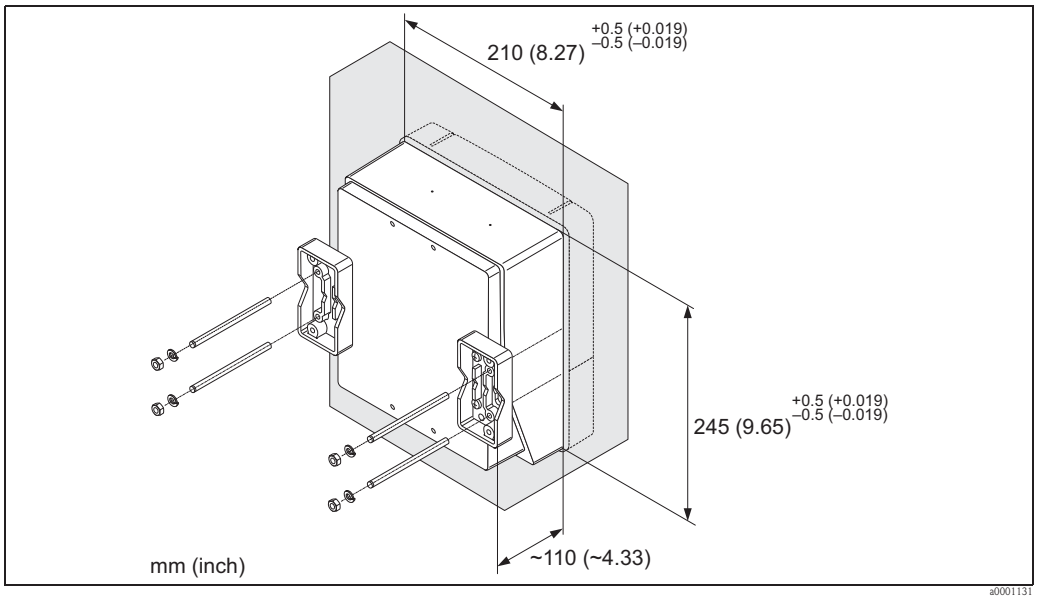



*Fig. 28: Panel installation (wall-mount housing)*

### Pipe mounting

The assembly should be performed by following the instructions in the graphic.

Caution!
If the device is mounted to a warm pipe, make certain that the housing temperature does not exceed +60 °C (+140 °F), which is the maximum permissible temperature.

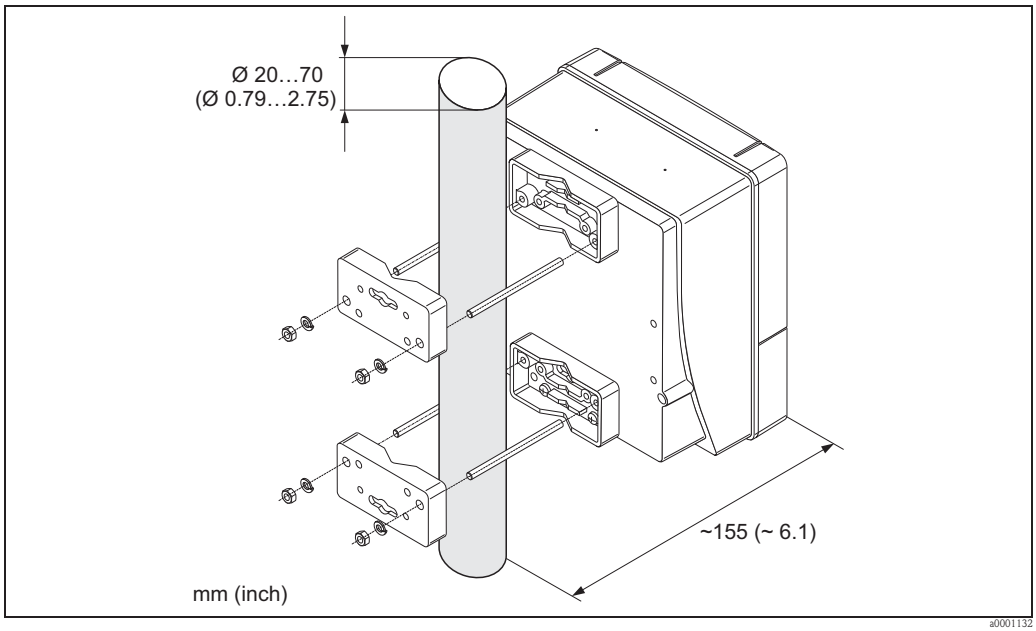



*Fig. 29: Pipe mounting (wall-mount housing)*

## 3.4 Post-installation check

Perform the following checks after installing the measuring device in the pipe:

| Device condition and specifications | Notes |
|---|---|
| Is the device damaged (visual inspection)? | – |
| Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, minimum fluid conductivity, measuring range, etc.? | → 📄 100 |
| **Installation** | **Notes** |
| Does the arrow on the sensor nameplate match the actual direction of flow through the pipe? | – |
| Is the position of the measuring electrode plane correct? | → 📄 15 |
| Is the position of the empty pipe detection electrode correct? | → 📄 15 |
| Were all screws tightened to the specified torques when the sensor was installed? | Promag D → 📄 23<br>Promag L → 📄 25<br>Promag W → 📄 27<br>Promag P → 📄 33 |
| Were the correct seals used (type, material, installation)? | Promag D → 📄 21<br>Promag L→ 📄 24<br>Promag W → 📄 27<br>Promag P → 📄 32<br>Promag H → 📄 36 |
| Are the measuring point number and labeling correct (visual inspection)? | – |
| **Process environment / process conditions** | **Notes** |
| Were the inlet and outlet runs respected? | Inlet run ≥ 5 × DN<br>Outlet run ≥ 2 × DN |
| Is the measuring device protected against moisture and direct sunlight? | – |
| Is the sensor adequately protected against vibration (attachment, support)? | Acceleration up to 2 g by analogy with IEC 600 68-2-8 |

# 4 Wiring

Warning!
When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to these Operating Instructions.
Please do not hesitate to contact your Endress+Hauser representative if you have any questions.

Note!
The device does not have an internal circuit breaker. For this reason, assign the device a switch or power-breaker switch capable of disconnecting the power supply line from the mains.

## 4.1 Connecting the remote version

### 4.1.1 Connecting Promag D, L, W, P, H

Warning!
- Risk of electric shock! Switch off the power supply before opening the device. Do **not** install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock! Connect the protective conductor to the ground terminal on the housing before the power supply is applied.

Caution!
- Only sensors and transmitters with the same serial number can be connected to one another. Communication problems can occur if the devices are not connected in this way.
- Risk of damaging the coil driver. Always switch off the power supply before connecting or disconnecting the coil cable.

Procedure

1. Transmitter: Remove the cover from the connection compartment (a).
2. Sensor: Remove the cover from the connection housing (b).
3. Feed the signal cable (c) and the coil cable (d) through the appropriate cable entries.

   Caution!
   Route the connecting cables securely (see "Connecting cable length" → 20).
4. Terminate the signal and coil current cable as indicated in the table:
   Promag D, L, W, P → Refer to the table → 47
   Promag H → Refer to the "Cable termination" table → 48
5. Establish the wiring between the sensor and the transmitter.
   The electrical wiring diagram that applies to your device can be found:
   - In the corresponding graphic:
     → 30 (Promag D) → 31 (Promag L, W, P); → 32 (Promag H)
   - In the cover of the sensor and transmitter

   Note!
   The cable shields of the Promag H sensor are grounded by means of the strain relief terminals (see also the "Cable termination" table → 48)

   Caution!
   Insulate the shields of cables that are not connected to eliminate the risk of short-circuits with neighboring cable shields inside the connection housing.
6. Transmitter: Screw the cover on the connection compartment (a).
7. Sensor: Secure the cover on the connection housing (b).

## Promag D

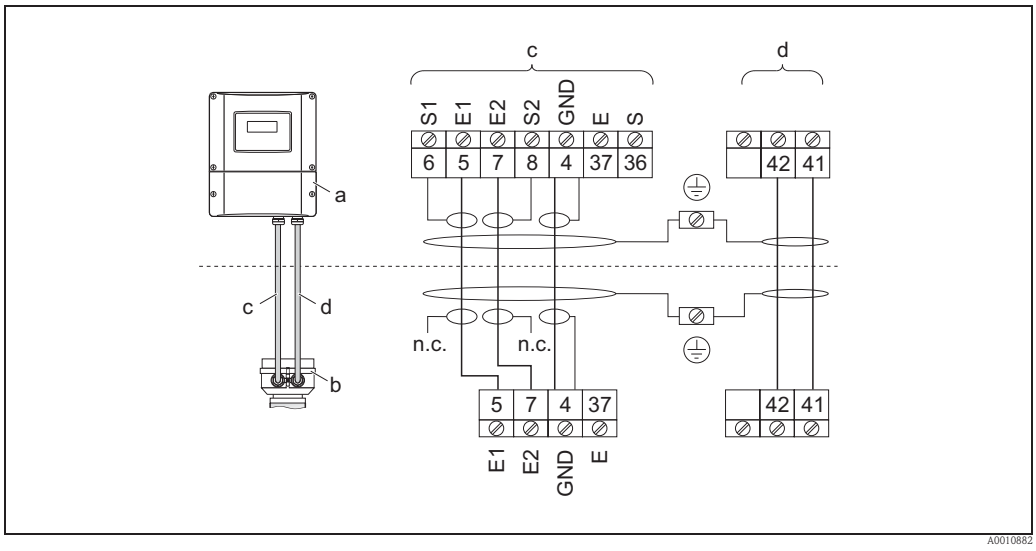



*Fig. 30: Connecting the remote version of Promag D*

*a Wall-mount housing connection compartment*
*b Cover of the sensor connection housing*
*c Signal cable*
*d Coil current cable*
*n.c. Not connected, insulated cable shields*

*Wire colors/Terminal No.:*
*5/6 = braun, 7/8 = white, 4 = green, 37/36 = yellow*

## Promag L, W, P

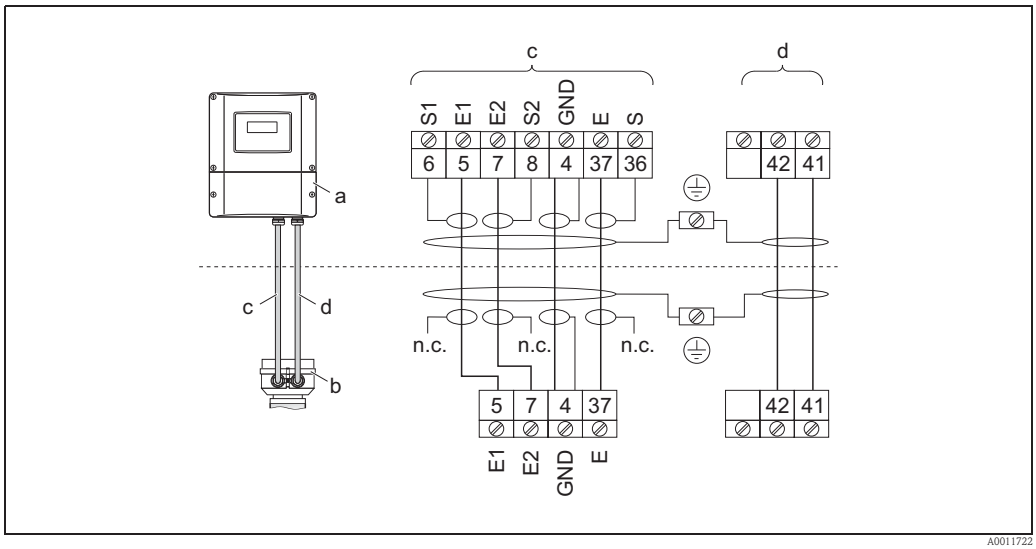



*Fig. 31: Connecting the remote version of Promag L, W, P*

*a Wall-mount housing connection compartment*
*b Cover of the sensor connection housing*
*c Signal cable*
*d Coil current cable*
*n.c. Not connected, insulated cable shields*

*Wire colors/Terminal No.:*
*5/6 = braun, 7/8 = white, 4 = green, 37/36 = yellow*

## Promag H

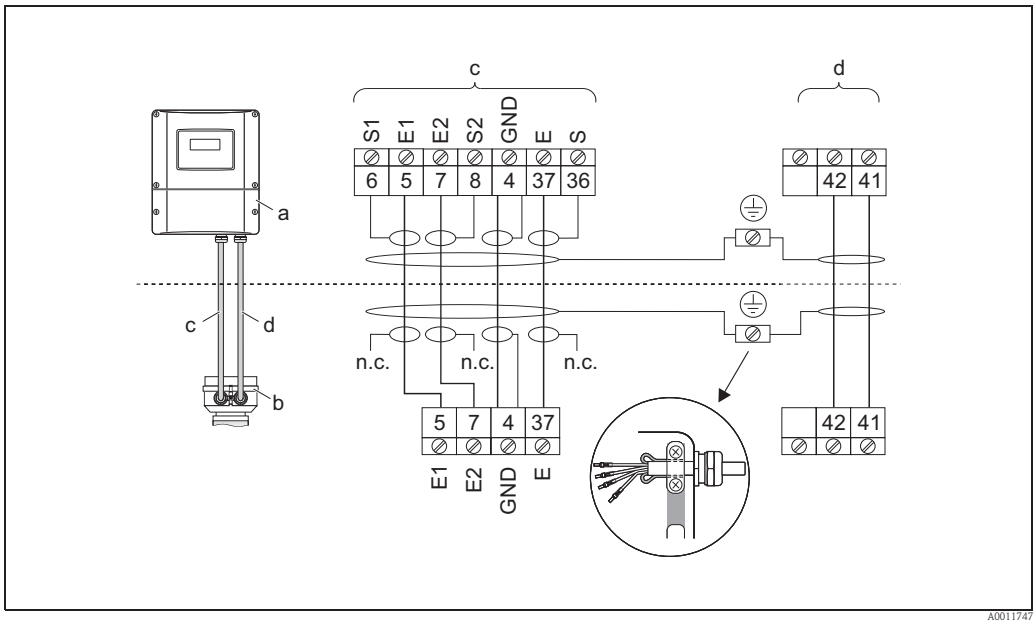



*Fig. 32: Connecting the remote version of Promag H*

*a Wall-mount housing connection compartment*
*b Cover of the sensor connection housing*
*c Signal cable*
*d Coil current cable*
*n.c. Not connected, insulated cable shields*

*Wire colors/Terminal No.:*
*5/6 = braun, 7/8 = white, 4 = green, 37/36 = yellow*

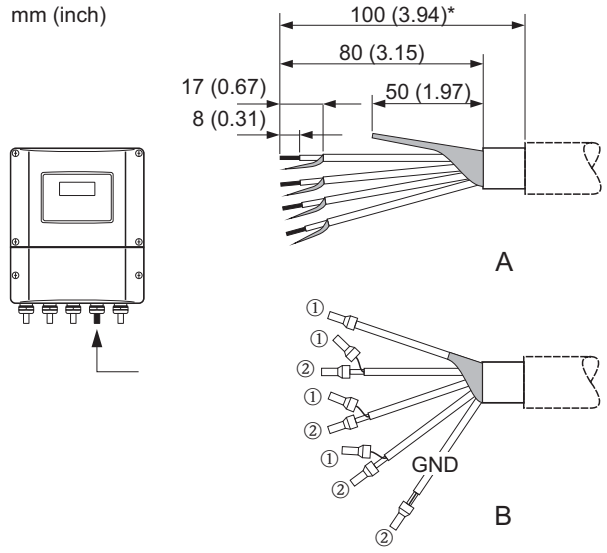
**Cable termination for the remote version**
**Promag D / Promag L / Promag W / Promag P**

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Ferrules must be provided on the fine-wire cores (Detail B: ① = red ferrules, ∅ 1.0 mm; ② = white ferrules, ∅ 0.5 mm).
* Stripping only for reinforced cables

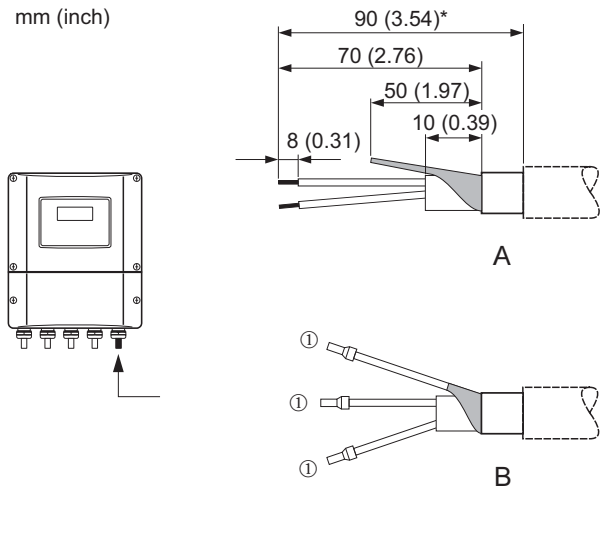
Caution!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the ferrules do not touch the wire shield on the sensor side. Minimum distance = 1 mm (exception "GND" = green cable)
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.

**TRANSMITTER**

Signal cable

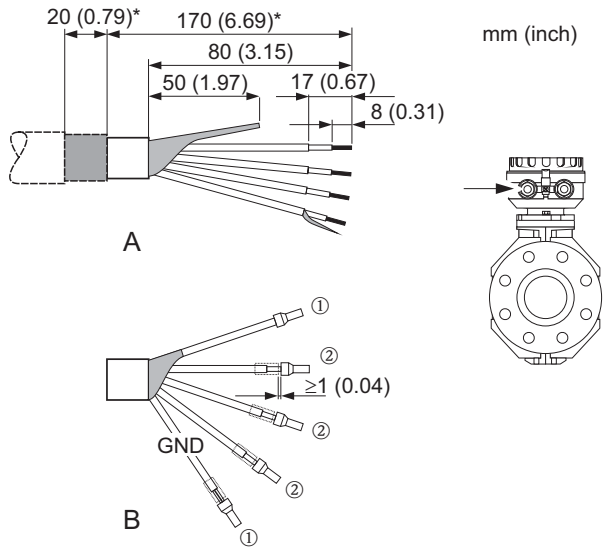



Coil current cable

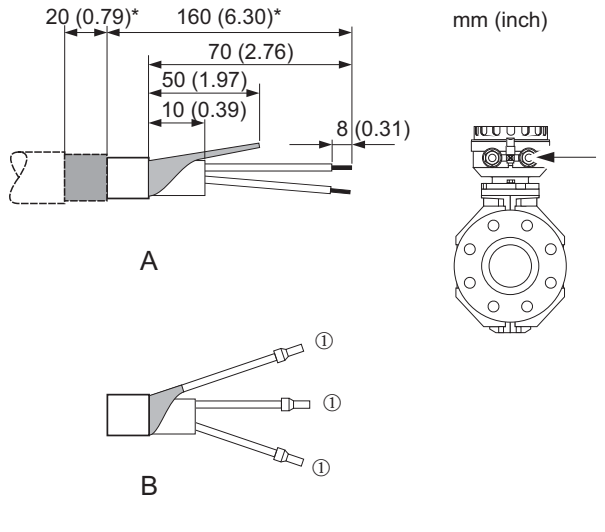



**SENSOR**

Signal cable




Coil current cable



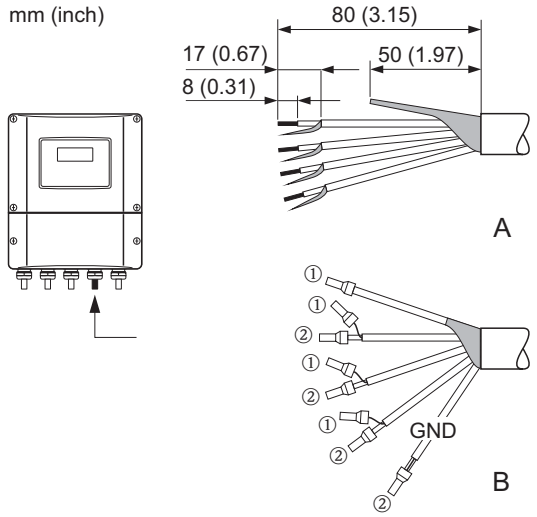
**Cable termination for the remote version**
**Promag H**

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Ferrules must be provided on the fine-wire cores (Detail B: ① = red ferrules, ∅ 1.0 mm; ② = white ferrules, ∅ 0.5 mm).

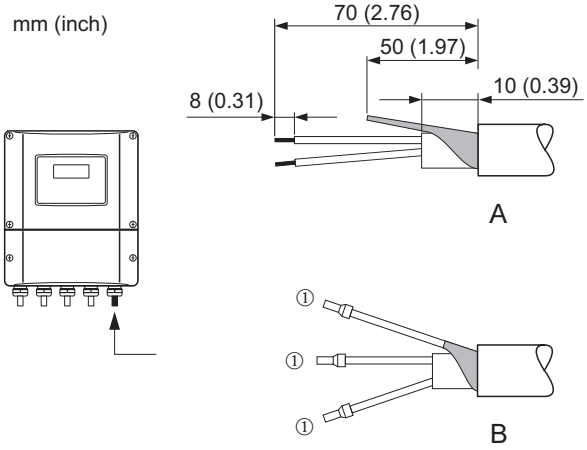
Caution!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the ferrules do not touch the wire shield on the sensor side. Minimum distance = 1 mm (exception "GND" = green cable).
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.
- On the sensor side, reverse both cable shields approx. 15 mm over the outer jacket. The strain relief ensures an electrical connection with the connection housing.

**TRANSMITTER**

Signal cable

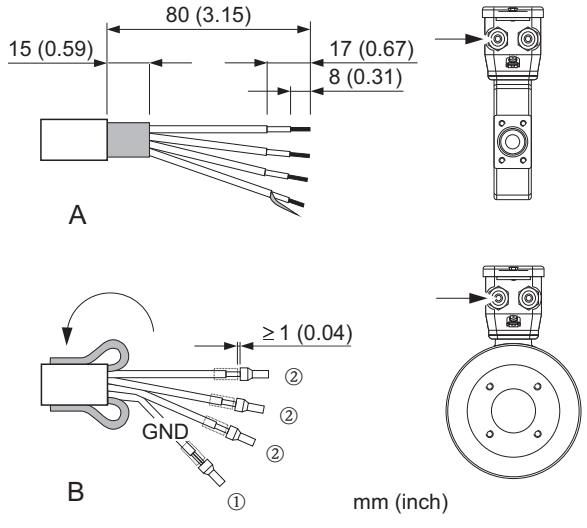



Coil current cable

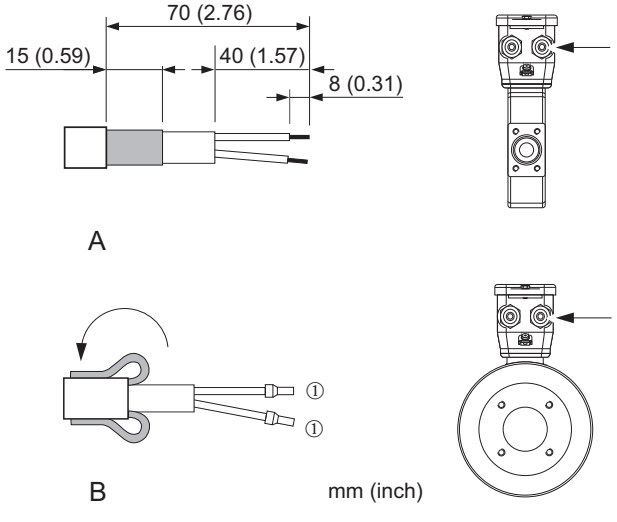



**SENSOR**

Signal cable




Coil current cable



### 4.1.2 Cable specifications

*Signal cable*

- 3 × 0.38 mm² PVC cable with common, braided copper shield (∅ ~7 mm) and individually shielded cores
- With Empty Pipe Detection (EPD): 4 × 0.38 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm) and individually shielded cores
- Conductor resistance: ≤ 50 Ω/km
- Capacitance: core/shield: ≤ 420 pF/m
- Permanent operating temperature: –20 to +80 °C
- Cable cross-section: max. 2.5 mm²

*Coil cable*

- 2 × 0.75 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm)
- Conductor resistance: ≤ 37 Ω/km
- Capacitance: core/core, shield grounded: ≤ 120 pF/m
- Operating temperature: –20 to +80 °C
- Cable cross-section: max. 2.5 mm²
- Test voltage for cable insulation: ≥1433 V AC r.m.s. 50/60 Hz or ≥2026 V DC

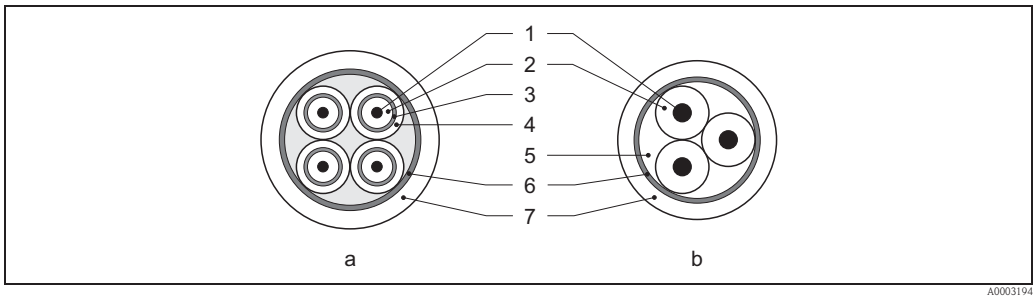



*Fig. 33: Cable cross-section*

*a Signal cable*
*b Coil current cable*

*1 Core*
*2 Core insulation*
*3 Core shield*
*4 Core jacket*
*5 Core reinforcement*
*6 Cable shield*
*7 Outer jacket*

*Reinforced connecting cables*

As an option, Endress+Hauser can also deliver reinforced connecting cables with an additional, reinforcing metal braid. Reinforced connecting cables should be used when laying the cable directly in the ground, if there is a risk of damage from rodents or if using the measuring device below IP 68 degree of protection.

*Operation in zones of severe electrical interference:*

The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of IEC/EN 61326.

Caution!
Grounding is by means of the ground terminals provided for the purpose inside the connection housing. Ensure that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible.

## 4.2 Connecting the measuring unit

### 4.2.1 Connecting the transmitter

Warning!

- Risk of electric shock! Switch off the power supply before opening the device. Do not install or wire the device while it is energized. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock! Connect the protective conductor to the ground terminal on the housing before the power supply is applied (not necessary if the power supply is galvanically isolated).
- Compare the specifications on the nameplate with the local voltage supply and frequency. Also comply with national regulations governing the installation of electrical equipment.

1. Remove the cover of the connection compartment (f) from the transmitter housing.
2. Feed the power supply cable (a) and the signal cable (b) through the appropriate cable entries.
3. Perform the wiring:
   – Wiring diagram (aluminum housing) → 34
   – Wiring diagram (stainless steel housing) → 35
   – Wiring diagram (wall-mount housing) → 36
   – Terminal assignment → 52
4. Screw the cover of the connection compartment (f) firmly onto the transmitter housing.

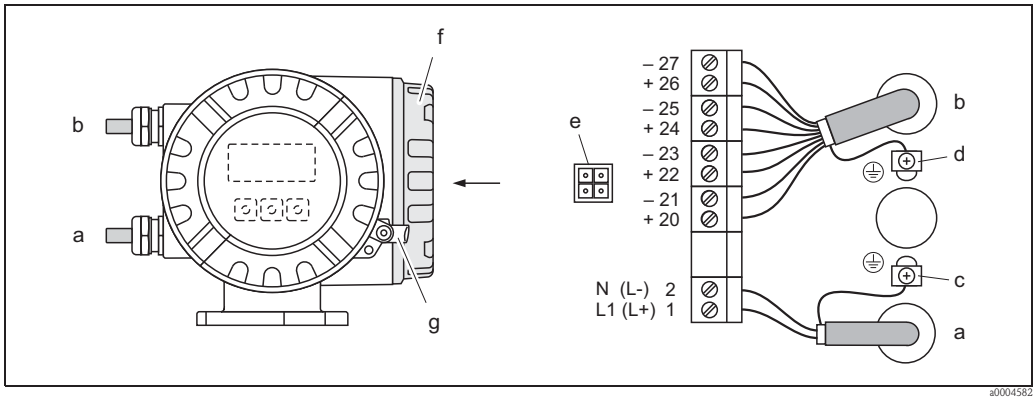



*Fig. 34: Connecting the transmitter (aluminum field housing). Cable cross-section: max. 2.5 mm²*

*a Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC*
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L- for DC*
*b Signal cable: Terminals **Nos. 20–27** → 52*
*c Ground terminal for protective ground*
*d Ground terminal for signal cable shield*
*e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)*
*f Cover of the connection compartment*
*g Securing clamp*

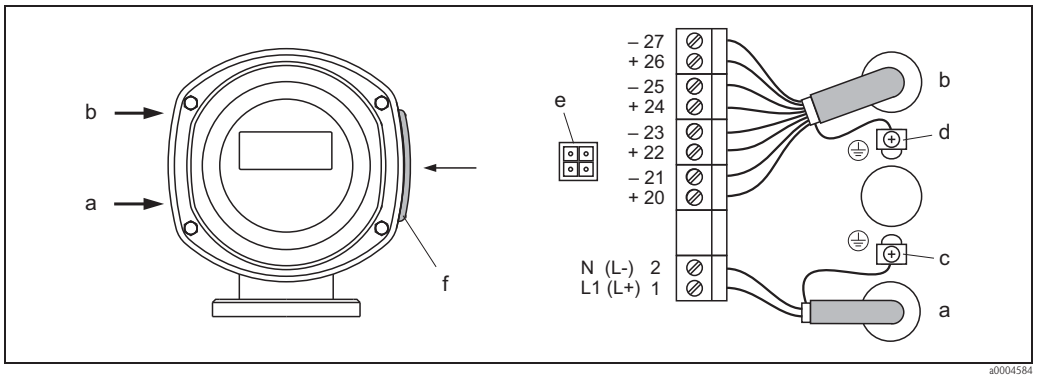



*Fig. 35: Connecting the transmitter (stainless steel field housing); cable cross-section: max. 2.5 mm²*

*a Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC*
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L- for DC*
*b Signal cable: Terminals **Nos. 20–27** → 52*
*c Ground terminal for protective ground*
*d Ground terminal for signal cable shield*
*e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)*
*f Cover of the connection compartment*

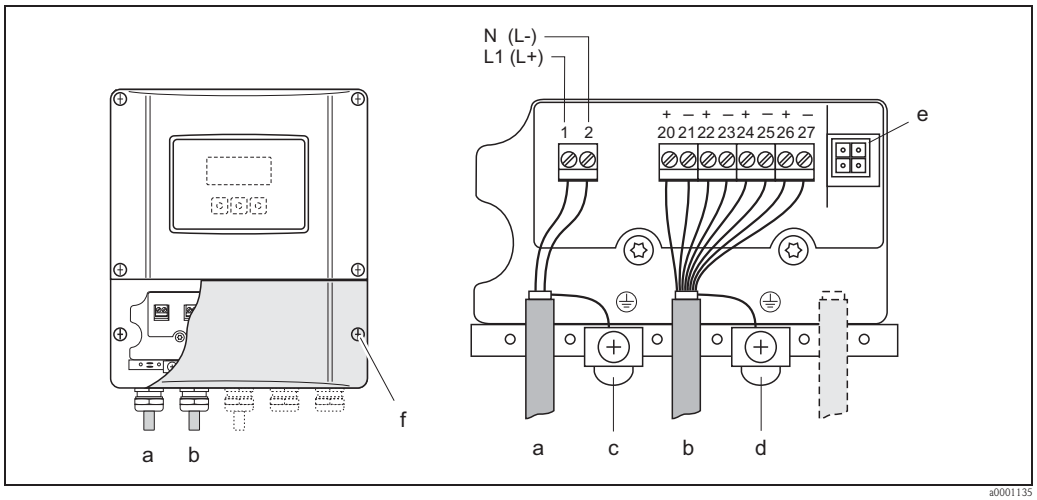



*Fig. 36: Connecting the transmitter (wall-mount housing); cable cross-section: max. 2.5 mm²*

*a Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC*
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L- for DC*
*b Signal cable: Terminals **Nos. 20–27** → 52*
*c Ground terminal for protective ground*
*d Ground terminal for signal cable shield*
*e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)*
*f Cover of the connection compartment*

### 4.2.2 Terminal assignment

| Order version | Terminal No. (inputs / outputs) | | | |
|---|---|---|---|---|
| | 20 (+) / 21 (–) | 22 (+) / 23 (–) | 24 (+) / 25 (–) | 26 (+) / 27 (–) |
| 50***-***********W | - | - | - | Current output HART |
| 50***-***********A | - | - | Frequency output | Current output HART |
| 50***-***********D | Status input | Status output | Frequency output | Current output HART |
| 50***-***********S | - | - | Frequency output Ex i | Current output, Ex i, active, HART |
| 50***-***********T | - | - | Frequency output Ex i | Current output, Ex i, passive, HART |

Note!
Functional values of the inputs and outputs → 96

### 4.2.3 HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 26(+) and 27 (–)
- Connection by means of the 4 to 20 mA circuit.

Note!
- The measuring loop's minimum load must be at least 250 Ω.
- After commissioning, make the following settings:
  - CURRENT SPAN function → "4–20 mA HART"
  - Switch HART write protection on or off → 63

#### Connection of the HART handheld communicator

See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".

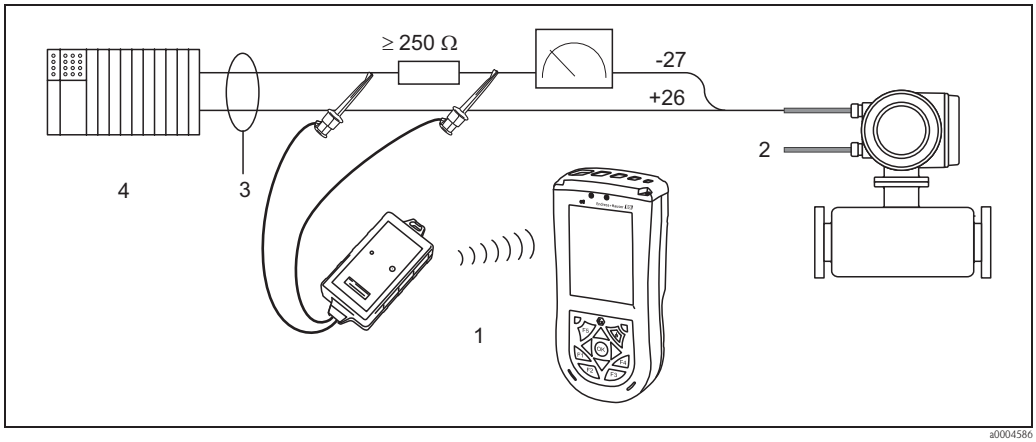



*Fig. 37: Electrical connection of HART handheld Field Xpert SFX100*

*1 HART handheld Field Xpert SFX100*
*2 Auxiliary energy*
*3 Shielding*
*4 Other devices or PLC with passive input*

**Connection of a PC with an operating software**

In order to connect a PC with operating software (e.g. "FieldCare"), a HART modem (e.g. "Commubox FXA195") is needed.

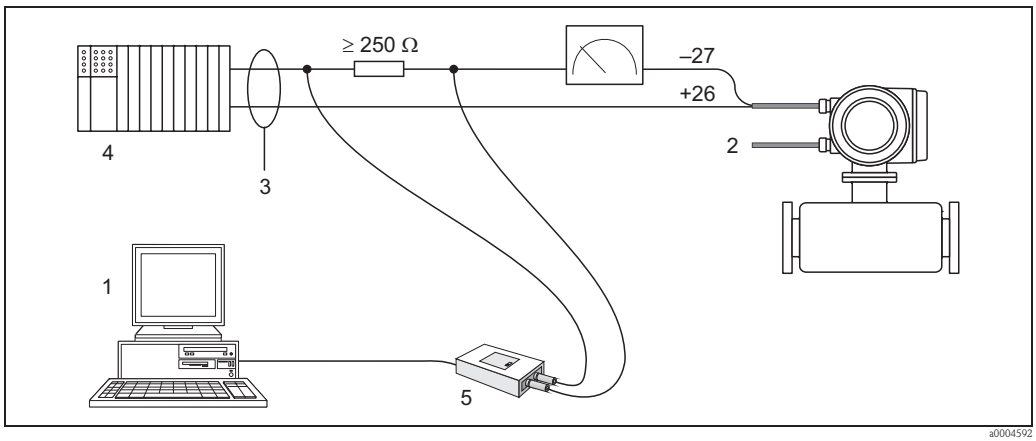



*Fig. 38: Electrical connection of a PC with operating software*

*1 PC with operating software*
*2 Auxiliary energy*
*3 Shielding*
*4 Other devices or PLC with passive input*
*5 HART modem, e.g. Commubox FXA195*

## 4.3 Potential equalization

Warning!
The measuring system must be included in the potential equalization.

Perfect measurement is only ensured when the fluid and the sensor have the same electrical potential. This is ensured by the reference electrode integrated in the sensor as standard.

The following should also be taken into consideration for potential equalization:
- Internal grounding concepts in the company
- Operating conditions, such as the material/grounding of the pipes (see Table)

### 4.3.1 Potential equalization for Promag D

- No reference electrode is integrated!
  For the two ground disks of the sensor an electrical connection to the fluid is always ensured.
- Exampels for connections → 54

### 4.3.2 Potential equalization for Promag W, P, L

- Reference electrode integrated in the sensor as standard
- Exampels for connections → 55

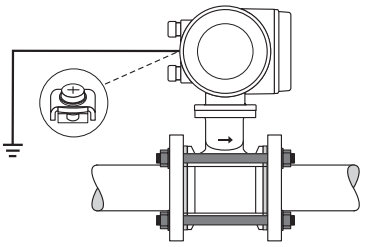
### 4.3.3 Potential equalization for Promag H

No reference electrode is integrated!
For the metal process connections of the sensor an electrical connection to the fluid is always ensured.

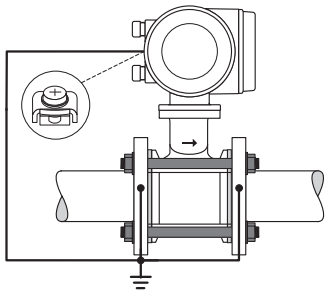
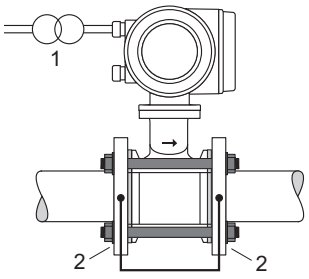
Caution!
If using process connections made of a synthetic material, ground rings have to be used to ensure that potential is equalized (→ 37). The necessary ground rings can be ordered separately from Endress+Hauser as accessories (→ 76).

## 4.3.4 Exampels for potential equalization connections for Promag D

### Standard case

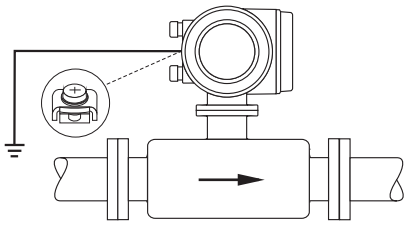
| Operating conditions | Potential equalization |
|---|---|
| When using the measuring device in a:<br>■ Metal, grounded pipe<br>■ Plastic pipe<br>■ Pipe with insulating lining<br><br>Potential equalization takes place via the ground terminal of the transmitter (standard situation).<br><br>✎ Note!<br>When installing in metal pipes, we recommend you connect the ground terminal of the transmitter housing with the piping. |  <br>a00012172<br>*Fig. 39: Via the ground terminal of the transmitter* |

### Special cases

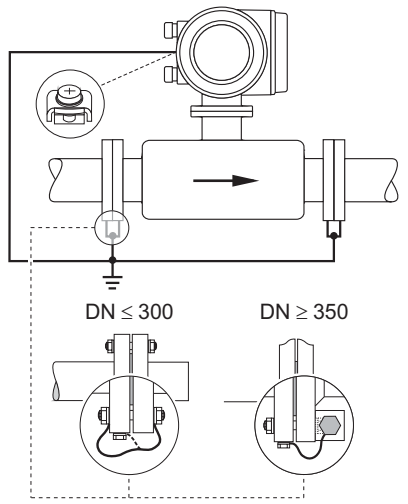
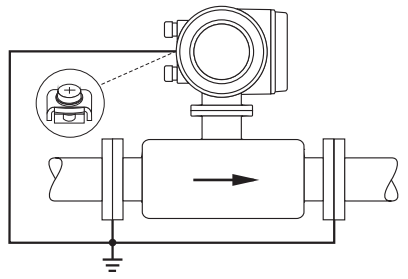
| Operating conditions | Potential equalization |
|---|---|
| When using the measuring device in a:<br>■ Metal pipe that is not grounded<br><br>This connection method also applies in situations where:<br>■ Customary potential equalization cannot be ensured<br>■ Excessively high equalizing currents can be expected<br><br>Potential equalization takes place via the ground terminal of the transmitter and the two pipe flanges.<br>Here, the ground cable (copper wire, 6 mm² (0.0093 in²)) is mounted directly on the conductive flange coating with flange screws. |  <br>a00012173<br>*Fig. 40: Via the ground terminal of the transmitter and the flanges of the pipe .* |
| When using the measuring device in a:<br>■ Pipe with a cathodic protection unit<br><br>The device is installed potential-free in the pipe.<br>Only the two flanges of the pipe are connected with a ground cable (copper wire, 6 mm² (0.0093 in²)). Here, the ground cable is mounted directly on the conductive flange coating with flange screws.<br><br>Note the following when installing:<br>■ The applicable regulations regarding potential-free installation must be observed.<br>■ There should be **no** electrically conductive connection between the pipe and the device.<br>■ The mounting material must withstand the applicable torques. |  <br>a00012174<br>*Fig. 41: Potential equalization and cathodic protection*<br><br>*1 Power supply isolation transformer*<br>*2 Electrically isolated* |

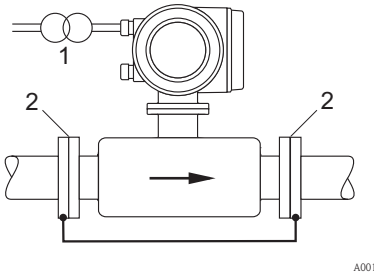
## 4.3.5 Exampels for potential equalization connections for Promag L, W, P

### Standard case

| Operating conditions | Potential equalization |
|---|---|
| When using the measuring device in a:<br>■ Metal, grounded pipe<br><br>Potential equalization takes place via the ground terminal of the transmitter (standard situation).<br><br>✎ Note!<br>When installing in metal pipes, we recommend you connect the ground terminal of the transmitter housing with the piping. |  <br>A0011892<br>*Fig. 42: Via the ground terminal of the transmitter* |

### Special cases

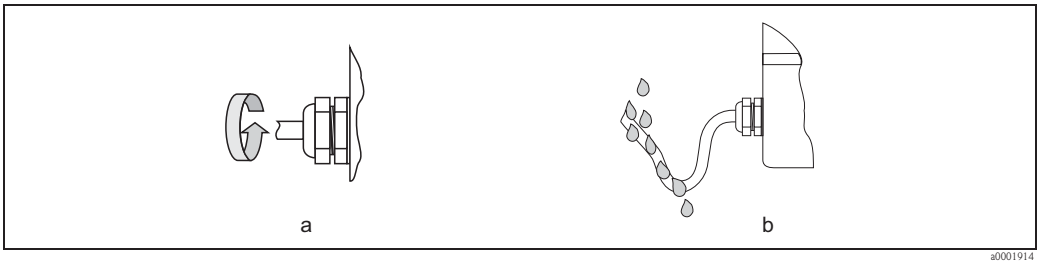
| Operating conditions | Potential equalization |
|---|---|
| When using the measuring device in a:<br>■ Metal pipe that is not grounded<br><br>This connection method also applies in situations where:<br>■ Customary potential equalization cannot be ensured<br>■ Excessively high equalizing currents can be expected<br><br>Both sensor flanges are connected to the pipe flange by means of a ground cable (copper wire, 6 mm² (0.0093 in²)) and grounded. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose.<br><br>Ground cable installation depends on the nominal diameter:<br>■ DN ≤ 300: The ground cable is mounted directly on the conductive flange coating with the flange screws.<br>■ DN ≥ 350: The ground cable is mounted directly on the metal transport bracket.<br><br>✎ Note!<br>The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser. |  <br>A0011893<br>*Fig. 43: Via the ground terminal of the transmitter and the flanges of the pipe* |
| When using the measuring device in a:<br>■ Plastic pipe<br>■ Pipe with insulating lining<br><br>This connection method also applies in situations where:<br>■ Customary potential equalization cannot be ensured<br>■ Excessively high equalizing currents can be expected<br><br>Potential equalization takes place using additional ground disks, which are connected to the ground terminal via a ground cable (copper wire, min. 6 mm² (0.0093 in²)). When installing the ground disks, please comply with the enclosed Installation Instructions. |  <br>A0011895<br>*Fig. 44: Via the ground terminal of the transmitter* |

| Operating conditions | Potential equalization |
|---|---|
| When using the measuring device in a:<br>■ Pipe with a cathodic protection unit<br><br>The device is installed potential-free in the pipe.<br>Only the two flanges of the pipe are connected with a ground cable (copper wire, 6 mm² (0.0093 in²)). Here, the ground cable is mounted directly on the conductive flange coating with flange screws.<br><br>Note the following when installing:<br>■ The applicable regulations regarding potential-free installation must be observed.<br>■ There should be **no** electrically conductive connection between the pipe and the device.<br>■ The mounting material must withstand the applicable torques. |  <br>A0011896<br>*Fig. 45: Potential equalization and cathodic protection*<br>*1 Power supply isolation transformer*<br>*2 Electrically isolated* |

## 4.4 Degree of protection

The devices meet all the requirements of IP 67 degree of protection.

Compliance with the following points is mandatory following installation in the field or servicing in order to ensure that IP 67 protection is maintained:
- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- All threaded fasteners and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outside diameter → 📄 49.
- Firmly tighten the cable entries.
- The cables must loop down before they enter the cable entries ("water trap"). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point up.
- Remove all unused cable entries and insert plugs instead.
- Do not remove the grommet from the cable entry.



a0001914

*Fig. 46: Installation instructions, cable entries*

Caution!
Do not loosen the threaded fasteners of the sensor housing, as otherwise the degree of protection guaranteed by Endress+Hauser no longer applies.

Note!
The Promag L, Promag W and Promag P sensors can be supplied with IP 68 rating (permanent immersion in water to a depth of 3 meters (10 ft)). In this case the transmitter must be installed remote from the sensor.
The Promag L sensors with IP 68 rating are only available with stainless steel flanges.

## 4.5 Post-connection check

Perform the following checks after completing electrical installation of the measuring device:

| Device condition and specifications | Notes |
|---|---|
| Are cables or the device damaged (visual inspection)? | - |
| **Electrical connection** | **Notes** |
| Does the supply voltage match the specifications on the nameplate? | ■ 85 to 250 V AC (50 to 60 Hz)<br>■ 20 to 28 V AC (50 to 60 Hz)<br>11 to 40 V DC |
| Do the cables used comply with the necessary specifications? | → 📄 49 |
| Do the cables have adequate strain relief? | - |
| Is the cable type route completely isolated?<br>Without loops and crossovers? | - |
| Are the power-supply and signal cables correctly connected? | See the wiring diagram inside the cover of the terminal compartment |
| Only remote version:<br>Is the flow sensor connected to the matching transmitter electronics? | Check serial number on nameplates of sensor and connected transmitter. |
| Only remote version:<br>Is the connecting cable between sensor and transmitter connected correctly? | → 📄 44 |
| Are all screw terminals firmly tightened? | - |
| Have the measures for grounding/potential equalization been correctly implemented? | → 📄 53 |
| Are all cable entries installed, firmly tightened and correctly sealed?<br>Cables looped as "water traps"? | → 📄 56 |
| Are all housing covers installed and firmly tightened? | - |

# 5 Operation

## 5.1 Display and operating elements

The local display enables you to read all important parameters directly at the measuring point and configure the device.
The display area consists of two lines; this is where measured values are displayed, and/or status variables (direction of flow, partially filled pipe, bar graph, etc.). You can change the assignment of display lines to variables at will in order to customize the display to suit your needs and preferences (→ "Description of Device Functions" manual).

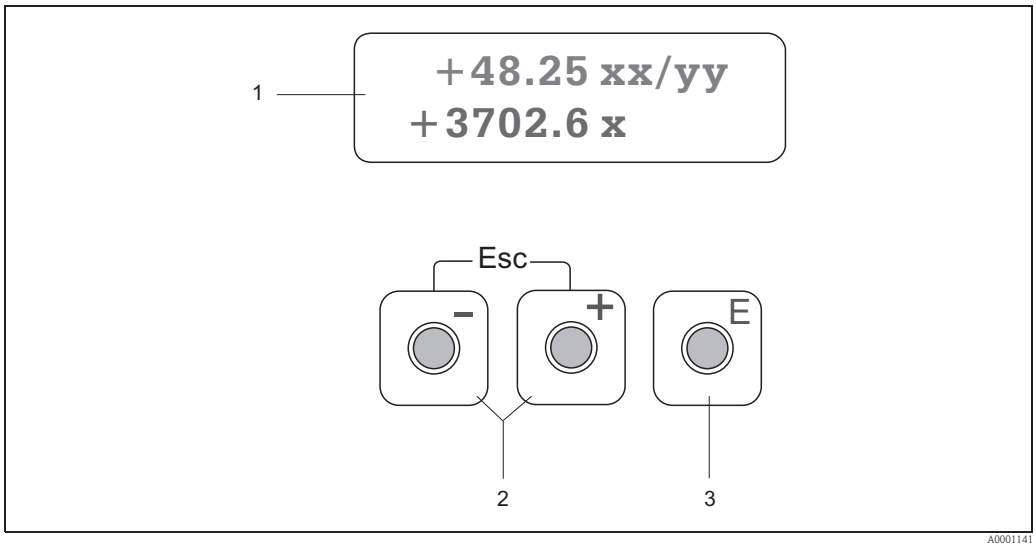



*Fig. 47: Display and operating elements*

*1 Liquid crystal display*
*The two-line liquid-crystal display shows measured values, dialog texts, error messages and information messages.*
*The display as it appears when normal measuring is in progress is known as the HOME position (operating mode).*
*– Upper display line: Shows primary measured values, e.g. volume flow in [ml/min] or in [%].*
*– Lower display line: Shows supplementary measured variables and status variables, e.g. totalizer reading in [m3], bar graph, measuring point designation*

*2 Plus/minus keys*
*– Enter numerical values, select parameters*
*– Select different function groups within the function matrix*

*Press the +/- keys simultaneously to trigger the following functions:*
*– Exit the function matrix step by step → HOME position*
*– Press and hold down +/- keys for longer than 3 seconds → Return directly to HOME position*
*– Cancel data entry*

*3 Enter key*
*– HOME position → Entry into the function matrix*
*– Save the numerical values you input or settings you change*

## 5.2 Brief operating instructions on the function matrix

Note!
- See the general notes on → 60.
- Detailed description of all the functions → "Description of Device Functions" manual

The function matrix comprises two levels, namely the function groups and the functions of the function groups.
The groups are the highest-level grouping of the control options for the device. A number of functions is assigned to each group. You select a group in order to access the individual functions for operating and configuring the device.

1. HOME position → E → Enter the function matrix
2. Select a function group (e.g. OPERATION)
3. Select a function (e.g. LANGUAGE)
   Change parameter/enter numerical values:
   ± → select or enter enable code, parameters, numerical values
   E → save your entries
4. Exit the function matrix:
   – Press and hold down Esc key (Esc) for longer than 3 seconds → HOME position
   – Repeatedly press Esc key (Esc) → return step by step to HOME position

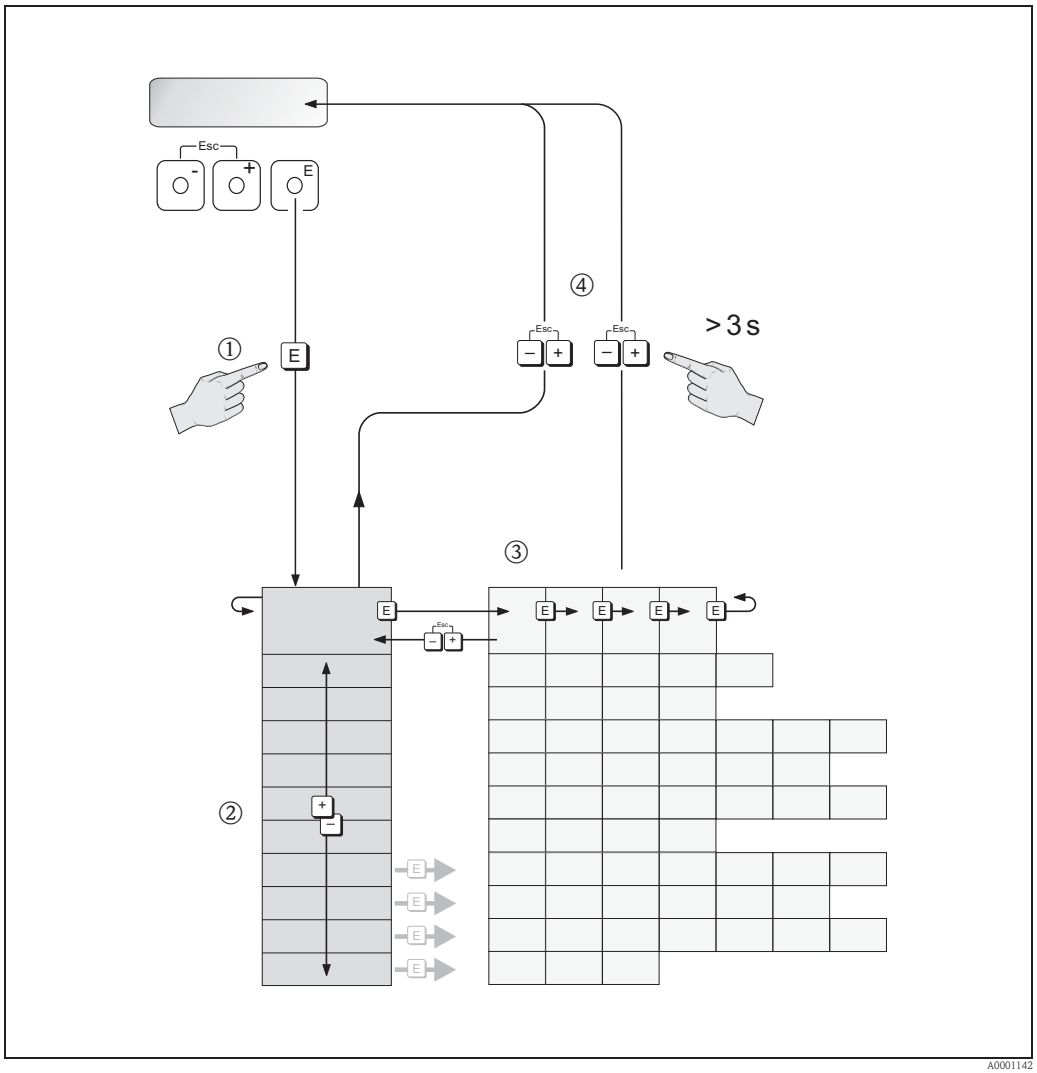



*Fig. 48: Selecting functions and configuring parameters (function matrix)*

### 5.2.1 General notes

The Quick Setup menu (→ 70) is adequate for commissioning in most instances. Complex measuring operations on the other hand necessitate additional functions that you can configure as necessary and customize to suit your process parameters. The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged in a number of function groups.

Comply with the following instructions when configuring functions:
- You select functions as described on → 59.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries.
  Press ± to select "SURE [ YES ]" and press E again to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.

Note!
- The transmitter continues to measure while data entry is in progress, i.e. the current measured values are output via the signal outputs in the normal way.
- If the power supply fails, all preset and configured values remain safely stored in the EEPROM.

Caution!
All functions are described in detail, including the function matrix itself, in the "Description of Device Functions" manual, which is a separate part of these Operating Instructions.

### 5.2.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 50) has to be entered before settings can be changed.
If you use a code number of your choice, you exclude the possibility of unauthorized persons accessing data (→ see the "Description of Device Functions" manual).

Comply with the following instructions when entering codes:
- If programming is disabled and the ± operating elements are pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is specified as the customer's code, programming is always enabled.
- The Endress+Hauser service organization can be of assistance if you mislay your personal code.

Caution!
Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy.
There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to the Endress+Hauser service organization.
Please contact Endress+Hauser if you have any questions.

### 5.2.3 Disabling the programming mode

Programming is disabled if you do not press the operating elements within 60 seconds following automatic return to the HOME position.
You can also disable programming in the "ACCESS CODE" function by entering any number (other than the customer's code).

# 5.3 Displaying error messages

## 5.3.1 Type of error

Errors which occur during commissioning or measuring operation are displayed immediately. If two or more system or process errors occur, the error with the highest priority is the one shown on the display.

The measuring system distinguishes between two types of error:
- *System errors* → 📄 80*:*
  This group comprises all device errors, e.g. communication errors, hardware faults, etc.
- *Process errors* → 📄 82:
  This group comprises all application errors, e.g. empty pipe, etc.

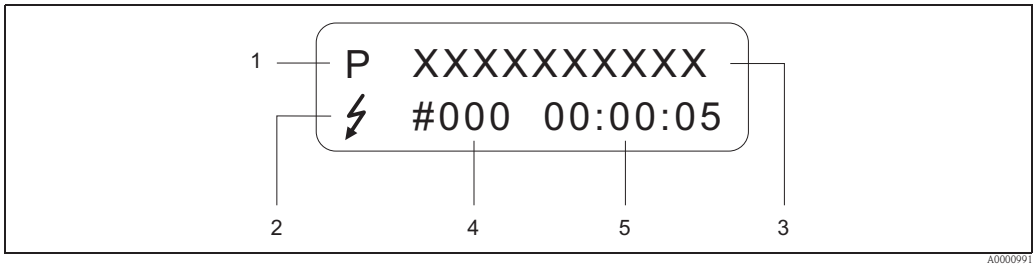



*Fig. 49: Error messages on the display (example)*

*1 Error type:*
*– P = process error*
*– S = system error*
*2 Error message type:*
*– ϟ = fault message*
*– ! = notice message*
*3 Error designation: e.g. EMPTY PIPE = measuring tube is only partly filled or completely empty*
*4 Error number: e.g. #401*
*5 Duration of most recent error occurrence (in hours, minutes and seconds)*

## 5.3.2 Error message types

Users have the option of weighting certain errors differently, in other words having them classed as "Fault messages" or "Notice messages". You can define messages in this way with the aid of the function matrix (→ "Description of Device Functions" manual).
Serious system errors, e.g. module defects, are always identified and classed as "fault messages" by the measuring device.

**Notice message (!)**

- Displayed as → Exclamation mark (!), error type (S: system error, P: process error)
- The error in question has no effect on the outputs of the measuring device.

**Fault message (ϟ)**

- Displayed as → Lightning flash ( ϟ), error type (S: system error, P: process error).
- The error in question has a direct effect on the outputs.
  The response of the individual outputs (failsafe mode) can be defined in the function matrix using the "FAILSAFE MODE" function (→ "Description of Device Functions" manual).

Note!
For security reasons, error messages should be output via the status output.

## 5.4 Communication

In addition to local operation, the measuring device can be configured and measured values can be obtained by means of the HART protocol. Digital communication takes place using the 4–20 mA current output HART → 52.

The HART protocol allows the transfer of measuring and device data between the HART master and the field devices for configuration and diagnostics purposes.
The HART master, e.g. a handheld terminal or PC-based operating programs (such as FieldCare), require device description (DD) files which are used to access all the information in a HART device. Information is exclusively transferred using so-called "commands". There are three different command classes:

- *Universal commands:*
  All HART device support and use universal commands.
  The following functionalities are linked to them:
  – Identify HART devices
  – Reading digital measured values (volume flow, totalizer, etc.)
- *Common practice commands:*
  Common practice commands offer functions which are supported and can be executed by most but not all field devices.
- *Device-specific commands:*
  These commands allow access to device-specific functions which are not HART standard. Such commands access individual field device information, amongst other things, such as empty/full pipe calibration values, low flow cutoff settings, etc.

Note!
The device has access to all three command classes. A list of all the "Universal commands" and "Common practice commands" is provided on → 64.

### 5.4.1 Operating options

For the complete operation of the measuring device, including device-specific commands, there are DD files available to the user to provide the following operating aids and programs:

**Field Xpert HART Communicator**

Selecting device functions with a HART Communicator is a process involving a number of menu levels and a special HART function matrix.
The HART manual in the carrying case of the HART Communicator contains more detailed information on the device.

**Operating program "FieldCare"**

FieldCare is Endress+Hauser's FDT-based plant Asset Management Tool and allows the configuration and diagnosis of intelligent field devices. By using status information, you also have a simple but effective tool for monitoring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA193.

**Operating program "SIMATIC PDM" (Siemens)**

SIMATIC PDM is a standardized, manufacturer-independent tool for the operation, configuration, maintenance and diagnosis of intelligent field devices.

**Operating program "AMS" (Emerson Process Management)**

AMS (Asset Management Solutions): program for operating and configuring devices.

### 5.4.2 Current device description files

The following table illustrates the suitable device description file for the operating tool in question and then indicates where these can be obtained.

HART protocol:

| | | |
|---|---|---|
| **Valid for device software:** | 2.03.XX | → Function DEVICE SOFTWARE |
| **Device data HART** | | |
| Manufacturer ID: | $11_{hex}$ (ENDRESS+HAUSER) | → Function MANUFACTURER ID |
| Device ID: | $41_{hex}$ | → Function DEVICE ID |
| **HART version data:** | Device Revision 6/ DD Revision 1 | |
| **Software release:** | 07.2009 | |

| **Operating program:** | **Sources for obtaining device descriptions:** |
|---|---|
| Handheld Field Xpert SFX100 | Use update function of handheld terminal |
| FieldCare / DTM | ■ www.endress.com → Download<br>■ CD-ROM (Endress+Hauser order number 56004088)<br>■ DVD (Endress+Hauser order number 70100690) |
| AMS | www.endress.com → Download |
| SIMATIC PDM | www.endress.com → Download |

| **Tester/simulator:** | **Sources for obtaining device descriptions:** |
|---|---|
| Fieldcheck | Update by means of FieldCare with the flow device FXA193/291 DTM in the Fieldflash module |

Note!
The "Fieldcheck" tester/simulator is used for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed out and used for official certification. Contact your Endress+Hauser representative for more information.

### 5.4.3 Device variables

The following device variables are available using the HART protocol:

| Code (decimal) | Device variable |
|---|---|
| 0 | OFF (not assigned) |
| 1 | Volume flow |
| 250 | Totalizer 1 |
| 251 | Totalizer 2 |

At the factory, the process variables are assigned to the following device variables:
- Primary process variable (PV) → Volume flow
- Second process variable (SV) → Totalizer 1
- Third process variable (TV) → not assigned
- Fourth process variable (FV) → not assigned

Note!
You can set or change the assignment of device variables to process variables using Command 51.

### 5.4.4 Switching HART write protection on/off

The HART write protection can be switched on and off using the HART WRITE PROTECT device function (→ "Description of Device Functions" manual).

### 5.4.5 Universal and common practice HART commands

The following table contains all the universal commands supported by the device.

| Command No.<br>HART command / Access type | | Command data<br>(numeric data in decimal form) | Response data<br>(numeric data in decimal form) |
|---|---|---|---|
| **Universal commands** | | | |
| 0 | Read unique device identifier<br>Access type = read | none | Device identification delivers information on the device and the manufacturer. It cannot be changed.<br>The response consists of a 12 byte device ID:<br>– Byte 0: fixed value 254<br>– Byte 1: Manufacturer ID, 17 = E+H<br>– Byte 2: Device type ID, 65 = Promag 50<br>– Byte 3: Number of preambles<br>– Byte 4: Universal commands rev. no.<br>– Byte 5: Device-specific commands rev. no.<br>– Byte 6: Software revision<br>– Byte 7: Hardware revision<br>– Byte 8: Additional device information<br>– Bytes 9–11: Device identification |
| 1 | Read primary process variable<br>Access type = read | none | – Byte 0: HART unit code of the primary process variable<br>– Bytes 1–4: Primary process variable<br>Factory setting:<br>Primary process variable = Volume flow<br>Note!<br>■ Manufacturer-specific units are represented using the HART unit code "240".<br>■ You can change the assignment of device variables to process variables using Command 51. |
| 2 | Read the primary process variable as current in mA and percentage of the set measuring range<br>Access type = read | none | – Bytes 0–3: actual current of the primary process variable in mA<br>– Bytes 4–7: % value of the set measuring range<br>Factory setting:<br>Primary process variable = Volume flow<br>Note!<br>You can change the assignment of device variables to process variables using Command 51. |
| 3 | Read the primary process variable as current in mA and four dynamic process variables<br>Access type = read | none | 24 bytes are sent as a response:<br>– Bytes 0–3: primary process variable current in mA<br>– Byte 4: HART unit code of the primary process variable<br>– Bytes 5–8: Primary process variable<br>– Byte 9: HART unit code of the second process variable<br>– Bytes 10–13: Second process variable<br>– Byte 14: HART unit code of the third process variable<br>– Bytes 15–18: Third process variable<br>– Byte 19: HART unit code of the fourth process variable<br>– Bytes 20–23: Fourth process variable<br>*Factory setting:*<br>■ Primary process variable = Volume flow<br>■ Second process variable = Totalizer 1<br>■ Third process variable = OFF (not assigned)<br>■ Fourth process variable = OFF (not assigned)<br>Note!<br>■ Manufacturer-specific units are represented using the HART unit code "240".<br>■ You can change the assignment of device variables to process variables using Command 51. |

| Command No.<br>HART command / Access type | | Command data<br>(numeric data in decimal form) | Response data<br>(numeric data in decimal form) |
|---|---|---|---|
| 6 | Set HART shortform address<br>Access type = write | Byte 0: desired address (0 to 15)<br>Factory setting: 0<br>✎ Note!<br>With an address >0 (multidrop mode), the current output of the primary process variable is set to 4 mA. | Byte 0: active address |
| 11 | Read unique device identification using the TAG (measuring point designation)<br>Access type = read | Bytes 0-5: TAG | Device identification delivers information on the device and the manufacturer. It cannot be changed.<br>The response consists of a 12 byte device ID if the given TAG agrees with the one saved in the device:<br>– Byte 0: fixed value 254<br>– Byte 1: Manufacturer ID, 17 = E+H<br>– Byte 2: Device type ID, 65 = Promag 50<br>– Byte 3: Number of preambles<br>– Byte 4: Universal commands rev. no.<br>– Byte 5: Device-specific commands rev. no.<br>– Byte 6: Software revision<br>– Byte 7: Hardware revision<br>– Byte 8: Additional device information<br>– Bytes 9-11: Device identification |
| 12 | Read user message<br>Access type = read | none | Bytes 0-24: User message<br>✎ Note!<br>You can write the user message using Command 17. |
| 13 | Read TAG, descriptor and date<br>Access type = read | none | – Bytes 0-5: TAG<br>– Bytes 6-17: descriptor<br>– Bytes 18-20: Date<br>✎ Note!<br>You can write the TAG, descriptor and date using Command 18. |
| 14 | Read sensor information on primary process variable | none | – Bytes 0-2: Sensor serial number<br>– Byte 3: HART unit code of sensor limits and measuring range of the primary process variable<br>– Bytes 4-7: Upper sensor limit<br>– Bytes 8-11: Lower sensor limit<br>– Bytes 12-15: Minimum span<br>✎ Note!<br>■ The data relate to the primary process variable (= volume flow).<br>■ Manufacturer-specific units are represented using the HART unit code "240". |
| 15 | Read output information of primary process variable<br>Access type = read | none | – Byte 0: Alarm selection ID<br>– Byte 1: Transfer function ID<br>– Byte 2: HART unit code for the set measuring range of the primary process variable<br>– Bytes 3-6: upper range, value for 20 mA<br>– Bytes 7-10: lower range, value for 4 mA<br>– Bytes 11-14: Damping constant in [s]<br>– Byte 15: Write protection ID<br>– Byte 16: OEM dealer ID, 17 = E+H<br>Factory setting: Primary process variable = Volume flow<br>✎ Note!<br>■ Manufacturer-specific units are represented using the HART unit code "240".<br>■ You can change the assignment of device variables to process variables using Command 51. |

| Command No. HART command / Access type | | Command data (numeric data in decimal form) | Response data (numeric data in decimal form) |
|---|---|---|---|
| 16 | Read the device production number<br>Access type = read | none | Bytes 0-2: Production number |
| 17 | Write user message<br>Access = write | You can save any 32-character long text in the device under this parameter:<br>Bytes 0-23: Desired user message | Displays the current user message in the device:<br>Bytes 0-23: Current user message in the device |
| 18 | Write TAG, descriptor and date<br>Access = write | With this parameter, you can store an 8 character TAG, a 16 character descriptor and a date:<br>– Bytes 0-5: TAG<br>– Bytes 6-17: descriptor<br>– Bytes 18-20: Date | Displays the current information in the device:<br>– Bytes 0-5: TAG<br>– Bytes 6-17: descriptor<br>– Bytes 18-20: Date |
| 19 | Write the device production number<br>Access = write | Bytes 0-2: Production number | Bytes 0-2: Production number |

**The following table contains all the common practice commands supported by the device.**

| Command No. HART command / Access type | | Command data (numeric data in decimal form) | Response data (numeric data in decimal form) |
|---|---|---|---|
| **Common practice commands** | | | |
| 34 | Write damping value for primary process variable<br>Access = write | Bytes 0-3: Damping value of the primary process variable "volume flow" in seconds<br>*Factory setting:*<br>Primary process variable = Current output damping | Displays the current damping value in the device:<br>Bytes 0-3: Damping value in seconds |
| 35 | Write measuring range of primary process variable<br>Access = write | Write the desired measuring range:<br>– Byte 0: HART unit code of the primary process variable<br>– Bytes 1-4: upper range, value for 20 mA<br>– Bytes 5-8: lower range, value for 4 mA<br>*Factory setting:*<br>Primary process variable = Volume flow<br>Note!<br>■ The start of the measuring range (4 mA) must correspond to the zero flow.<br>■ If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. | The currently set measuring range is displayed as a response:<br>– Byte 0: HART unit code for the set measuring range of the primary process variable<br>– Bytes 1-4: upper range, value for 20 mA<br>– Bytes 5-8: lower range, value for 4 mA<br>Note!<br>■ Manufacturer-specific units are represented using the HART unit code "240".<br>■ You can change the assignment of device variables to process variables using Command 51. |
| 38 | Device status reset (configuration changed)<br>Access = write | none | none<br>Note!<br>It is also possible to execute this HART command when write protection is activated (= ON)! |
| 40 | Simulate input current of primary process variable<br>Access = write | Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode:<br>Bytes 0-3: Output current in mA<br>*Factory setting:*<br>Primary process variable = Volume flow<br>Note!<br>You can set the assignment of device variables to process variables using Command 51. | The momentary output current of the primary process variable is displayed as a response:<br>Bytes 0-3: Output current in mA |
| 42 | Perform master reset<br>Access = write | none | none |

| Command No. HART command / Access type | | Command data (numeric data in decimal form) | Response data (numeric data in decimal form) |
|---|---|---|---|
| 44 | Write unit of primary process variable<br>Access = write | Set unit of primary process variable. Only units which are suitable for the process variable are transferred to the device:<br>Byte 0: HART unit code<br>*Factory setting:*<br>Primary process variable = Volume flow<br>Note!<br>■ If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit.<br>■ If you change the unit of the primary process variable, this has a direct impact on the system units. | The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code<br>Note!<br>Manufacturer-specific units are represented using the HART unit code "240". |
| 48 | Read additional device status<br>Access = read | none | The device status is displayed in extended form as the response: Coding: see table → 68 |
| 50 | Read assignment of the device variables to the four process variables<br>Access = read | none | Display of the current variable assignment of the process variables:<br>– Byte 0: Device variable code to the primary process variable<br>– Byte 1: Device variable code to the second process variable<br>– Byte 2: Device variable code to the third process variable<br>– Byte 3: Device variable code to the fourth process variable<br>*Factory setting:*<br>■ Primary process variable: Code 1 for volume flow<br>■ Second process variable: Code 250 for totalizer<br>■ Third process variable: Code 0 for OFF (not assigned)<br>■ Fourth process variable: Code 0 for OFF (not assigned) |
| 51 | Write assignment of the device variables to the four process variables<br>Access = write | Setting of the device variables to the four process variables:<br>– Byte 0: Device variable code to the primary process variable<br>– Byte 1: Device variable code to the second process variable<br>– Byte 2: Device variable code to the third process variable<br>– Byte 3: Device variable code to the fourth process variable<br>*Factory setting:*<br>■ Primary process variable: Volume flow<br>■ Second process variable: Totalizer 1<br>■ Third process variable: OFF (not assigned)<br>■ Fourth process variable: OFF (not assigned) | The variable assignment of the process variables is displayed as a response:<br>– Byte 0: Device variable code to the primary process variable<br>– Byte 1: Device variable code to the second process variable<br>– Byte 2: Device variable code to the third process variable<br>– Byte 3: Device variable code to the fourth process variable |
| 53 | Write device variable unit<br>Access = write | This command sets the unit of the given device variables. Only those units which suit the device variable are transferred:<br>– Byte 0: Device variable code<br>– Byte 1: HART unit code<br>Code of the supported device variables: See information → 63<br>Note!<br>■ If the written unit is not the correct one for the device variable, the device will continue with the last valid unit.<br>■ If you change the unit of the device variable, this has a direct impact on the system units. | The current unit of the device variables is displayed in the device as a response:<br>– Byte 0: Device variable code<br>– Byte 1: HART unit code<br>Note!<br>Manufacturer-specific units are represented using the HART unit code "240". |
| 59 | Write number of preambles in response message<br>Access = write | This parameter sets the number of preambles which are inserted in the response messages:<br>Byte 0: Number of preambles (4 to 20) | The current number of preambles is displayed in the response telegram: Byte 0: Number of preambles |

### 5.4.6 Device status and error messages

You can read the extended device status, in this case, current error messages, via Command "48". The command delivers information which is partly coded in bits (see table below).

Note!
- You can find a detailed explanation of the device status and error messages and their elimination on → 68
- Bits and bytes not listed are not assigned.

| Byte | Bit | Error No. | Short error description |
|---|---|---|---|
| 0 | 0 | 001 | Serious device error |
| | 1 | 011 | Measuring amplifier has faulty EEPROM |
| | 2 | 012 | Error when accessing data of the measuring amplifier EEPROM |
| 1 | 1 | 031 | S-DAT: defective or missing |
| | 2 | 032 | S-DAT: Error accessing saved values |
| | 5 | 051 | I/O and the amplifier are not compatible. |
| 3 | 3 | 111 | Totalizer checksum error |
| | 4 | 121 | I/O board and amplifier not compatible. |
| 4 | 3 | 251 | Internal communication fault on the amplifier board. |
| | 4 | 261 | No data reception between amplifier and I/O board |
| 5 | 0 | 321 | Coil current of the sensor is outside the tolerance. |
| | 7 | 339 | Flow buffer:<br>The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds. |
| 6 | 0 | 340 | |
| | 1 | 341 | |
| | 2 | 342 | |
| | 3 | 343 | Frequency buffer:<br>The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds. |
| | 4 | 344 | |
| | 5 | 345 | |
| | 6 | 346 | |
| | 7 | 347 | Pulse buffer:<br>The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds. |
| 7 | 0 | 348 | |
| | 1 | 349 | |
| | 2 | 350 | |
| | 3 | 351 | Current output:<br>Flow is out of range. |
| | 4 | 352 | |
| | 5 | 353 | |
| | 6 | 354 | |
| | 7 | 355 | Frequency output:<br>Flow is out of range. |
| 8 | 0 | 356 | |
| | 1 | 357 | |
| | 2 | 358 | |

| Byte | Bit | Error No. | Short error description |
|---|---|---|---|
| 8 | 3 | 359 | Pulse output:<br>Flow is out of range. |
| | 4 | 360 | |
| | 5 | 361 | |
| | 6 | 362 | |
| 10 | 7 | 401 | Measuring tube partially filled or empty |
| 11 | 2 | 461 | EPD calibration not possible because the fluid's conductivity is either too low or too high. |
| | 4 | 463 | The EPD calibration values for empty pipe and full pipe are identical, and therefore incorrect. |
| 12 | 1 | 474 | Maximum flow value entered is overshot |
| | 7 | 501 | Amplifier software version is loaded. Currently no other commands are possible. |
| 13 | 0 | 502 | Upload/download of device files. Currently no other commands are possible. |
| 14 | 3 | 601 | Positive zero return active |
| | 7 | 611 | Simulation current output active |
| 15 | 0 | 612 | |
| | 1 | 613 | |
| | 2 | 614 | |
| | 3 | 621 | Simulation frequency output active |
| | 4 | 622 | |
| | 5 | 623 | |
| | 6 | 624 | |
| | 7 | 631 | Simulation pulse output active |
| 16 | 0 | 632 | |
| | 1 | 633 | |
| | 2 | 634 | |
| | 3 | 641 | Simulation status output active |
| | 4 | 642 | |
| | 5 | 643 | |
| | 6 | 644 | |
| 17 | 7 | 671 | Simulation of the status input active |
| 18 | 0 | 672 | |
| | 1 | 673 | |
| | 2 | 674 | |
| | 3 | 691 | Simulation of response to error (outputs) active |
| | 4 | 692 | Simulation of volume flow active |

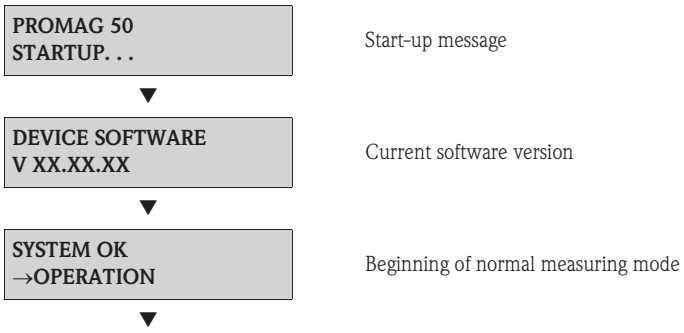
# 6 Commissioning

## 6.1 Function check

Make sure that all final checks have been completed before you start up your measuring point:
- Checklist for "Post-installation check" → 📄 43
- Checklist for "Post-connection check" → 📄 57

## 6.2 Switching on the measuring device

Once the connection checks have been successfully completed, it is time to switch on the power supply. The device is now operational. The measuring device performs a number of post switch-on self-tests. As this procedure progresses the following sequence of messages appears on the local display:




Normal measuring mode commences as soon as start-up completes.
Various measured-value and/or status variables (HOME position) appear on the display.

Note!
If start-up fails, an error message indicating the cause is displayed.

## 6.3 Quick Setup

In the case of measuring devices without a local display, the individual parameters and functions must be configured via the operating program, e.g. FieldCare.
If the measuring device is equipped with a local display, all the important device parameters for standard operation, as well as additional functions, can be configured quickly and easily by means of the following Quick Setup menu.

### 6.3.1 "Commissioning" Quick Setup menu

This Quick Setup menu guides you systematically through the setup procedure for all the major device functions that have to be configured for standard measuring operation.

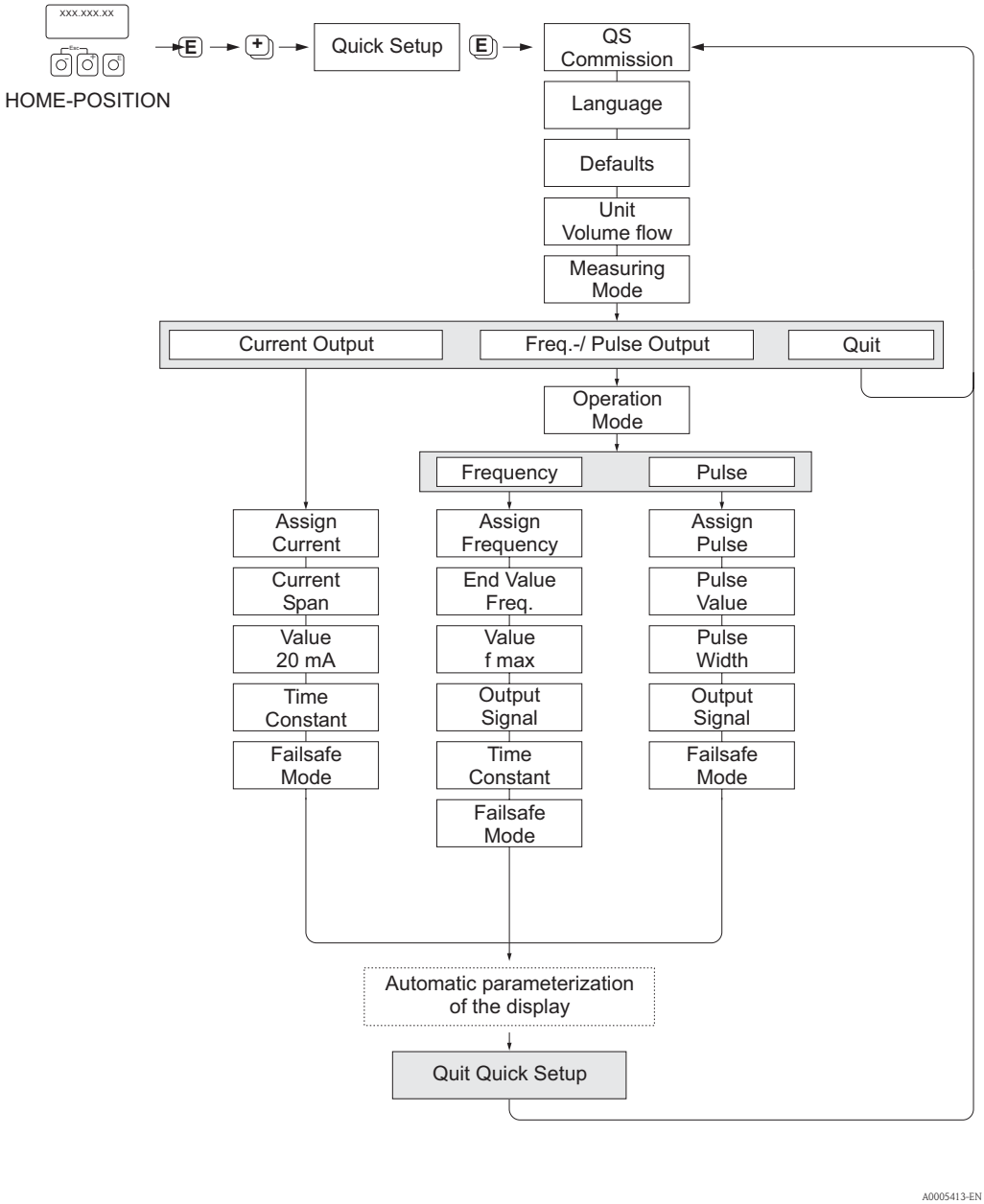



*Fig. 50: "QUICK SETUP COMMISSIONING" menu for the rapid configuration of important device functions*

# 6.4 Configuration

## 6.4.1 Current output: active/passive

The current output is configured as "active" or "passive" by means of various jumpers on the I/O board.

Warning!
Risk of electric shock! Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1. Switch off power supply.
2. Remove the I/O board → 87
3. Position the jumper → 51

   Caution!
   Risk of destroying the measuring device. Set the jumpers exactly as shown in the graphic. Pay strict attention to the position of the jumpers as indicated in the graphic.
4. Installation of the I/O board is the reverse of the removal procedure.

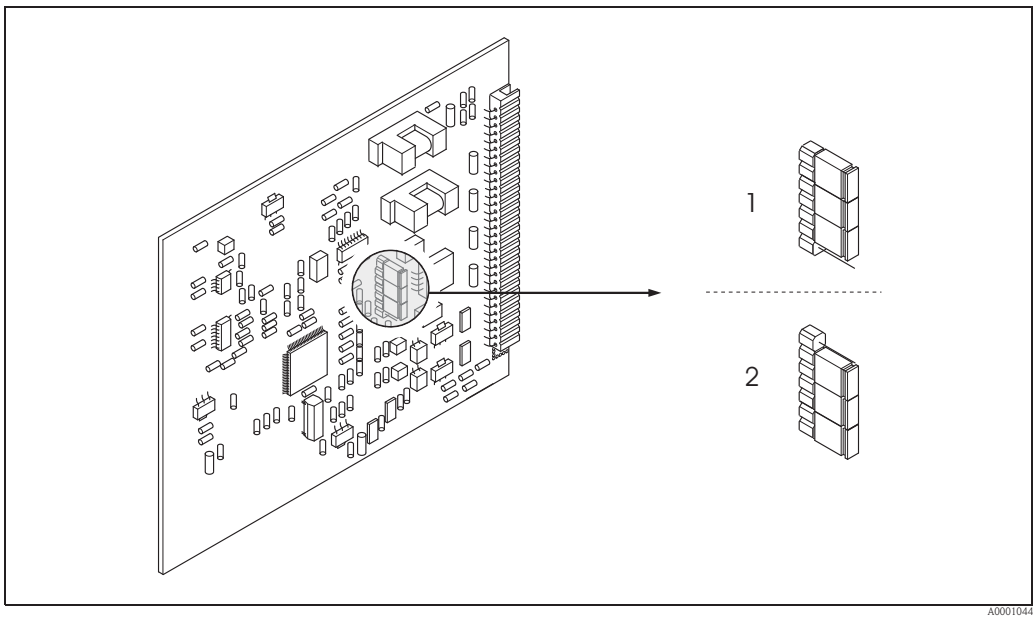



*Fig. 51: Configuring current outputs using jumpers (I/O board)*

*1 Active current output (factory setting)*
*2 Passive current output*

# 6.5 Adjustment

## 6.5.1 Empty-pipe/full-pipe adjustment

Flow cannot be measured correctly unless the measuring tube is completely full.
This status can be permanently monitored using the Empty Pipe Detection:

- EPD = Empty Pipe Detection (with the help of an EPD electrode)
- OED = Open Electrode Detection (Empty Pipe Detection with the help of the measuring electrodes, if the sensor is not equipped with an EPD electrode or the orientation is not suitable for using EPD).

Caution!
Detailed information on the empty-pipe/full-pipe adjustment procedure can be found in the "Description of Device Functions" manual:
- EPD/OED ADJUSTMENT (carrying out the adjustment).
- EPD (switching on and off EPD/OED).
- EPD RESPONSE TIME (input of the response time for EPD/OED).

Note!
- The EPD function is not available unless the sensor is fitted with an EPD electrode.
- The devices are already calibrated at the factory with water (approx. 500 µS/cm). If the fluid conductivity differs from this reference, empty-pipe/full-pipe adjustment has to be performed again on site.
- The default setting for EPD when the devices are delivered is OFF; the function has to be activated if required.
- The EPD process error can be output by means of the configurable relay output.

**Performing empty-pipe and full-pipe adjustment (EPD)**

1. Select the appropriate function in the function matrix:
   HOME → E → ± → PROCESS PARAMETER → E → ± → EPD ADJUSTMENT
2. Empty the piping:
   – The wall of the measuring tube should still be wet with fluid during EPD empty pipe adjustment
   – The wall of the measuring tube/the measuring electrodes should **no longer** be wet with fluid during OED empty pipe adjustment
3. Start empty-pipe adjustment: Select "EMPTY PIPE ADJUST" or "OED EMPTY ADJUST" and press E to confirm.
4. After empty-pipe adjustment, fill the piping with fluid.
5. Start full-pipe adjustment: Select "FULL PIPE ADJUST" or "OED FULL ADJUST" and press E to confirm.
6. Having completed the adjustment, select the setting "OFF" and exit the function by pressing E.
7. Switch on empty pipe detection in the EPD function:
   – EPD empty pipe adjustment: Select ON STANDARD or ON SPECIAL and press E to confirm
   – OED empty pipe adjustment: Select OED and confirm with E.

   Caution!
   The adjustment coefficients must be valid before you can activate the EPD function. If adjustment is incorrect the following messages might appear on the display:
   – FULL = EMPTY
     The adjustment values for empty pipe and full pipe are identical. In cases of this nature you must repeat empty-pipe or full-pipe adjustment!
   – ADJUSTMENT NOT OK
     Adjustment is not possible because the fluid's conductivity is out of range.

## 6.6 Data storage device (HistoROM)

At Endress+Hauser, the term HistoROM refers to various types of data storage modules on which process and measuring device data are stored. It is possible to plug these modules into other devices to copy device configurations from one device to another, for example.

### 6.6.1 HistoROM/S-DAT (sensor-DAT)

The S-DAT is an exchangeable data storage device in which all sensor relevant parameters are stored, i.e., diameter, serial number, calibration factor, zero point.

# 7 Maintenance

No special maintenance work is required.

## 7.1 Exterior cleaning

When cleaning the exterior of measuring devices, always use cleaning agents that do not attack the surface of the housing and the seals.

## 7.2 Seals

The seals of the Promag H sensor must be replaced periodically, particularly in the case of gasket seals (aseptic version).
The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature.

Replacement seals (accessories) → 76.

# 8 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Your Endress+Hauser service organization can provide detailed information on the specific order codes on request.

## 8.1 Device-specific accessories

| Accessory | Description | Order code |
|---|---|---|
| Proline Promag 50 transmitter | Transmitter for replacement or storage. Use the order code to define the following specifications:<br>■ Approvals<br>■ Degree of protection/version<br>■ Cable for remote version<br>■ Cable entry<br>■ Display/power supply/operation<br>■ Software<br>■ Outputs/inputs | 50XXX – XXXXX****** |

## 8.2 Measuring principle-specific accessories

| Accessory | Description | Order code |
|---|---|---|
| Mounting set for Promag 50 transmitter | Mounting set for the transmitter (remote version). Suitable for:<br>■ Wall mounting<br>■ Pipe mounting<br>■ Panel-mounted installation<br>Mounting set for aluminum field housing. Suitable for:<br>■ Pipe mounting | DK5WM – * |
| Wall-mounting kit for Promag H | Wall-mounting kit for the Promag H sensor. | DK5HM – ** |
| Cable for remote version | Coil and signal cables, various lengths. | DK5CA – ** |
| Mounting kit for Promag D, wafer version | Mounting kit consisting of:<br>■ Mounting bolts<br>■ Nuts incl. washers<br>■ Flange seals<br>■ Centering sleeves (if required for the flange) | DKD** – ** |
| Set of seals for Promag D | Set of seals consisting of two flange seals. | DK5DD – *** |
| Mounting kit for Promag H | Mounting kit consisting of:<br>■ 2 process connections<br>■ Threaded fasteners<br>■ Seals | DKH** – **** |
| Set of seals for Promag H | For regular replacement of the seals of the Promag H sensor. | DK5HS – *** |
| Welding jig for Promag H | Weld nipple as process connection:<br>welding jig for installation in pipe. | DK5HW – *** |
| Adapter connection for Promag A, H | Adapter connections for installing a Promag 10 H instead of a Promag 30/33 A or Promag 30/33 H DN 25. | DK5HA – ***** |
| Ground rings for Promag H | Ground rings for potential equalization. | DK5HR – *** |
| Ground cable for Promag L, W, P | Ground cable for potential equalization. | DK5GC – *** |
| Ground disk for Promag L, W, P | Ground disk for potential equalization. | DK5GD – * * *** |

| Accessory | Description | Order code |
|---|---|---|
| Process display RIA45 | Multifunctional 1-channel display unit:<br>■ Universal input<br>■ Transmitter power supply<br>■ Limit relay<br>■ Analog output | RIA45 – ****** |
| Process display RIA251 | Digital display device for looping into the 4 to 20 mA current loop. | RIA251 – ** |
| Field display unit RIA16 | Digital field display device for looping into the 4 to 20 mA current loop. | RIA16 – *** |
| Application Manager RMM621 | Electronic recording, display, balancing, control, saving and event and alarm monitoring of analog and digital input signals. Values and conditions determined are output by means of analog and digital output signals. Remote transmission of alarms, input values and calculated values using a PSTN or GSM modem. | RMM621 – ********** |

## 8.3 Communication-specific accessories

| Accessory | Description | Order code |
|---|---|---|
| HART Communicator Field Xpert SFX 100 | Handheld terminal for remote configuration and for obtaining measured values via the HART current output (4 to 20 mA) and FOUNDATION Fieldbus.<br>Contact your Endress+Hauser representative for more information. | SFX100 – ******* |
| Fieldgate FXA320 | Gateway for remote interrogation of HART sensors and actuators via Web browser:<br>■ 2-channel analog input (4 to 20 mA)<br>■ 4 binary inputs with event counter function and frequency measurement<br>■ Communication via modem, Ethernet or GSM<br>■ Visualization via Internet/Intranet in Web browser and/or WAP cellular phone<br>■ Limit value monitoring with alarm by e-mail or SMS<br>■ Synchronized time stamping of all measured values. | FXA320 – ***** |
| Fieldgate FXA520 | Gateway for remote interrogation of HART sensors and actuators via Web browser:<br>■ Web server for remote monitoring of up to 30 measuring points<br>■ Intrinsically safe version [EEx ia]IIC for applications in hazardous areas<br>■ Communication via modem, Ethernet or GSM<br>■ Visualization via Internet/Intranet in Web browser and/or WAP cellular phone<br>■ Limit value monitoring with alarm by e-mail or SMS<br>■ Synchronized time stamping of all measured values<br>■ Remote diagnosis and remote configuration of connected HART devices | FXA520 – **** |
| FXA195 | The Commubox FXA195 connects intrinsically safe Smart transmitters with HART protocol to the USB port of a personal computer. This makes the remote operation of the transmitters possible with the aid of configuration programs (e.g. FieldCare). Power is supplied to the Commubox by means of the USB port | FXA195 – * |

## 8.4 Service-specific accessories

| Accessory | Description | Order code |
|---|---|---|
| Applicator | Software for selecting and planning flowmeters. The Applicator software can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC.<br>Contact your Endress+Hauser representative for more information. | DXA80 – * |
| Fieldcheck | Tester/simulator for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed out and used for official certification.<br>Contact your Endress+Hauser representative for more information. | 50098801 |
| FieldCare | FieldCare is Endress+Hauser's FDT-based asset management tool. It can configure all intelligent field units in your system and helps you manage them. By using status information, it is also a simple but effective way of checking their status and condition. | See the product page on the Endress+Hauser Web site: www.endress.com |
| Memograph M graphic display recorder | The Memograph M graphic display recorder provides information on all the relevant process variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a DSD card or USB stick.<br>Memograph M boasts a modular design, intuitive operation and a comprehensive security concept. The ReadWin® 2000 PC software is part of the standard package and is used for configuring, visualizing and archiving the data captured.<br>The mathematics channels which are optionally available enable continuous monitoring of specific power consumption, boiler efficiency and other parameters which are important for efficient energy management. | RSG40 – ********** |
| FXA193 | Service interface from the device to the PC for operation via FieldCare. | FXA193 – * |

# 9 Troubleshooting

## 9.1 Troubleshooting instructions

Always start troubleshooting with the checklist below if faults occur after start-up or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

| **Check the display** | |
|---|---|
| No display visible and no output signals present. | 1. Check the supply voltage → terminals 1, 2<br>2. Check the power line fuse → 📄 91<br>85 to 260 V AC: 0.8 A slow-blow / 250 V<br>20 to 55 V AC / 16 to 62 V DC: 2 A slow-blow / 250 V<br>3. Measuring electronics defective → order spare parts → 📄 86 |
| No display visible, but output signals are present. | 1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → 📄 87<br>2. Display module defective → order spare parts → 📄 86<br>3. Measuring electronics defective → order spare parts → 📄 86 |
| Display texts are in a foreign language. | Switch off power supply. Press and hold down both the ± buttons and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast. |
| Measured value indicated, but no signal at the current or pulse output. | Electronics board defective → order spare parts → 📄 86 |
| ↓ | |
| **Error messages on display** | |
| Errors which occur during commissioning or measuring operation are displayed immediately.<br>Error messages consist of a variety of icons: the meanings of these icons are as follows (example):<br>– Error type: **S** = system error, **P** = process error<br>– Error message type: ϟ = fault message, **!** = notice message<br>– **EMPTY PIPE** = Type of error, e.g. measuring tube is only partly filled or completely empty<br>– **03:00:05** = duration of error occurrence (in hours, minutes and seconds)<br>– **#**401 = error number<br>☝ Caution!<br>■ See the information on → 📄 61!<br>■ The measuring system interprets simulations and positive zero return as system errors, but displays them as notice message only. | |
| Error number:<br>No. 001 – 399<br>No. 501 – 699 | System error (device error) has occurred → 📄 80 |
| Error number:<br>No. 401 - 499 | Process error (application error) has occurred → 📄 82 |
| ↓ | |
| **Other error (without error message)** | |
| Some other error has occurred. | Diagnosis and rectification → 📄 83 |

## 9.2 System error messages

Serious system errors are **always** recognized by the device as "Fault message", and are shown as a lightning flash ( ϟ) on the display. Fault messages immediately affect the outputs.

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. The necessary procedures on → 🖹 6 must be carried out before you return a flowmeter to Endress+Hauser. Always enclose a duly completed "Declaration of Contamination" form. You will find a master copy of this form at the back of this manual.

Note!
Also observe the information on → 🖹 61.

| No. | Error message / Type | Cause | Remedy (spare part → 🖹 86) |
|---|---|---|---|
| S = System error<br>ϟ = Fault message (with an effect on the outputs)<br>! = Notice message (without an effect on the outputs) | | | |
| **No. # 0xx → Hardware error** | | | |
| **001** | S: CRITICAL FAILURE<br>ϟ: # 001 | Serious device error | Replace the amplifier board. |
| **011** | S: AMP HW EEPROM<br>ϟ: # 011 | Amplifier:<br>Defective EEPROM | Replace the amplifier board. |
| **012** | S: AMP SW EEPROM<br>ϟ: # 012 | Amplifier:<br>Error accessing EEPROM data | The EEPROM data blocks in which an error has occurred are displayed in the TROUBLESHOOTING function.<br>Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the errored parameter values.<br>Note!<br>The measuring device has to be restarted if an error has occurred in a totalizer block (see error No. 111 / CHECKSUM TOTAL). |
| **031** | S: SENSOR HW DAT<br>ϟ: # 031 | 1. S-DAT is not plugged into the amplifier board correctly (or is missing).<br>2. S-DAT is defective. | 1. Check whether the S-DAT is correctly plugged into the amplifier board.<br>2. Replace the S-DAT if it is defective.<br>Check that the new replacement DAT is compatible with the measuring electronics.<br>Check the:<br>- Spare part set number<br>- Hardware revision code<br>3. Replace measuring electronics boards if necessary.<br>4. Plug the S-DAT into the amplifier board. |
| **032** | S: SENSOR SW DAT<br>ϟ: # 032 | | |
| **No. # 1xx → Software error** | | | |
| **101** | S: GAIN ERROR AMP<br>ϟ: # 101 | Gain deviation compared to reference gain > 25%. | Replace the amplifier board. |
| **111** | S: CHECKSUM TOTAL<br>ϟ: # 111 | Totalizer checksum error. | 1. Restart the measuring device.<br>2. Replace the amplifier board if necessary. |
| **121** | S: A / C COMPATIB.<br>!: # 121 | Due to different software versions, I/O board and amplifier board are only partially compatible (possibly restricted functionality).<br>Note!<br>– This message is only listed in the error history.<br>– Nothing is shown on the display. | Module with lower software version has either to be updated by FieldCare with the required software version or the module has to be replaced. |

| No. | Error message / Type | Cause | Remedy (spare part → 📄 86) |
|---|---|---|---|
| **No. # 2xx → Error in DAT / no communication** | | | |
| **251** | S: COMMUNICATION I/O<br>ϟ: # 251 | Internal communication fault on the amplifier board. | Replace the amplifier board. |
| **261** | S: COMMUNICATION I/O<br>ϟ: # 261 | No data reception between amplifier and I/O board or faulty internal data transfer. | Check the BUS contacts. |
| **No. # 3xx → System limits exceeded** | | | |
| **321** | S: TOL. COIL CURR.<br>ϟ: # 321 | Sensor:<br>Coil current is out of tolerance. | ⚠ Warning!<br>Switch off power supply before manipulating the coil current cable, coil current cable connector or measuring electronics boards!<br>Remote version:<br>1. Check wiring of terminals 41/42 → 📄 44<br>2. Check coil current cable connector.<br>Compact and remote version:<br>Replace measuring electronics boards if necessary |
| **339 to 342** | S: STACK CUR OUT n<br>!: # 339 to 342 | The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds. | 1. Change the upper or lower limit setting, as applicable.<br>2. Increase or reduce flow, as applicable.<br>Recommendations in the event of fault category = FAULT MESSAGE (ϟ)<br>■ Configure the fault response of the output to "ACTUAL VALUE" so that the temporary buffer can be cleared.<br>■ Clear the temporary buffer by the measures described under Item 1. |
| **343 to 346** | S: STACK FREQ. OUT n<br>!: # 343 to 346 | | |
| **347 to 350** | S: STACK PULSE OUT n<br>!: # 343 to 346 | The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds. | 1. Increase the setting for pulse weighting<br>2. Increase the max. pulse frequency if the totalizer can handle a higher number of pulses.<br>3. Increase or reduce flow, as applicable.<br>Recommendations in the event of fault category = FAULT MESSAGE (ϟ)<br>■ Configure the fault response of the output to "ACTUAL VALUE" so that the temporary buffer can be cleared.<br>■ Clear the temporary buffer by the measures described under Item 1. |
| **351 to 354** | S: CURRENT RANGE n<br>!: # 351 to 354 | Current output:<br>flow is out of range. | 1. Change the upper or lower limit setting, as applicable.<br>2. Increase or reduce flow, as applicable. |
| **355 to 358** | S: FREQ. RANGE n<br>!: # 355 to 358 | Frequency output:<br>flow is out of range. | 1. Change the upper or lower limit setting, as applicable.<br>2. Increase or reduce flow, as applicable. |
| **359 to 362** | S: PULSE RANGE<br>!: # 359 to 362 | Pulse output:<br>the pulse output frequency is out of range. | 1. Increase the setting for pulse weighting<br>2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.).<br>*Determine the pulse width:*<br>– Variant 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration.<br>– Variant 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration.<br>Example:<br>The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is:<br>$\frac{1}{2 \cdot 10\ \text{Hz}} = 50\ \text{ms}$<br>a0004437<br>3. Reduce flow. |

| No. | Error message / Type | Cause | Remedy (spare part → 86) |
|---|---|---|---|
| **No. # 5xx → Application error** | | | |
| **501** | S: SW.-UPDATE ACT.<br>!: # 501 | New amplifier or communication (I/O module) software version is loaded.<br>Currently no other functions are possible. | Wait until the procedure is finished.<br>The device will restart automatically. |
| **502** | S: UP-/DOWNLOAD ACT<br>!: # 502 | Uploading or downloading the device data via operating program.<br>Currently no other functions are possible. | Wait until the procedure is finished. |
| **No. # 6xx → Simulation mode active** | | | |
| **601** | S: POS. ZERO-RETURN<br>!: # 601 | Positive zero return active<br>☝ Caution!<br>This message has the highest display priority! | Switch off positive zero return |
| **611 to 614** | S: SIM. CURR. OUT. n<br>!: # 611 to 614 | Simulation current output active | |
| **621 to 624** | S: SIM. FREQ. OUT. n<br>!: # 621 to 624 | Simulation frequency output active | Switch off simulation |
| **631 to 634** | S: SIM. PULSE n<br>!: # 631 to 634 | Simulation pulse output active | Switch off simulation |
| **641 to 644** | S: SIM. STAT. OUT n<br>!: # 641 to 644 | Simulation status output active | Switch off simulation |
| **671 to 674** | S: SIM. STATUS IN n<br>!: # 671 to 674 | Simulation status input active | Switch off simulation |
| **691** | S: SIM. FAILSAFE<br>!: # 691 | Simulation of response to error (outputs) active | Switch off simulation |
| **692** | S: SIM. MEASURAND<br>!: # 692 | Simulation of a measured variable active (e.g. mass flow). | Switch off simulation |
| **698** | S: DEV. TEST ACT.<br>!: # 698 | The measuring device is being checked on site via the test and simulation device. | – |

## 9.3 Process error messages

✎ Note!
Also observe the information on → 61.

| No. | Error message / Type | Cause | Remedy (spare part → 86) |
|---|---|---|---|
| P = Process error<br>ϟ = Fault message (with an effect on the outputs)<br>! = Notice message (without an effect on the outputs) | | | |
| **401** | EMPTY PIPE<br>ϟ: # 401 | Measuring tube partially filled or empty | 1. Check the process conditions of the plant<br>2. Fill the measuring tube |
| **461** | ADJ. NOT OK<br>!: # 461 | EPD calibration not possible because the fluid's conductivity is either too low or too high. | The EPD function cannot be used with fluids of this nature. |
| **463** | FULL = EMPTY<br>ϟ: # 463 | The EPD calibration values for empty pipe and full pipe are identical, therefore incorrect. | Repeat calibration, making sure procedure is correct → 73. |

## 9.4 Process errors without messages

| Symptoms | Rectification |
|---|---|
| Remark: You may have to change or correct certain settings in functions in the function matrix in order to rectify the fault. | |
| Flow values are negative, even though the fluid is flowing forwards through the pipe. | 1. Remote version:<br>– Switch off the power supply and check the wiring → 📄 44<br>– If necessary, reverse the connections at terminals 41 and 42<br>2. Change the setting in the "INSTALLATION DIRECTION SENSOR" function accordingly |
| Measured-value reading fluctuates even though flow is steady. | 1. Check grounding and potential equalization → 📄 53<br>2. Check the fluid for presence of gas bubbles.<br>3. In the "SYSTEM DAMPING" function → increase the value |
| Measured-value reading shown on display, even though the fluid is at a standstill and the measuring tube is full. | 1. Check grounding and potential equalization → 📄 53<br>2. Check the fluid for presence of gas bubbles.<br>3. Activate the "LOW FLOW CUTOFF" function, i.e. enter or increase the value for the switching point. |
| Measured-value reading on display, even though measuring tube is empty. | 1. Perform empty-pipe/full-pipe adjustment and then switch on Empty Pipe detection → 📄 73<br>2. Remote version: Check the terminals of the EPD cable → 📄 44<br>3. Fill the measuring tube. |
| The current output signal is always 4 mA, irrespective of the flow signal at any given time. | 1. Select the "BUS ADDRESS" function and change the setting to "0".<br>2. Value for creepage too high. Reduce the value in the "LOW FLOW CUTOFF" function. |
| The fault cannot be rectified or some other fault not described above has arisen.<br><br>In these instances, please contact your Endress+Hauser service organization. | The following options are available for tackling problems of this nature:<br>**Request the services of an Endress+Hauser service technician**<br>If you contact our service organization to have a service technician sent out, please be ready to quote the following information:<br>– Brief description of the fault<br>– Nameplate specifications (→ 📄 7): order code, serial number<br>**Returning devices to Endress+Hauser**<br>The necessary procedures (→ 📄 6) must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser.<br>Always enclose a duly completed "Declaration of Conformity" form with the flowmeter. You will find a master copy of this form at the back of this manual.<br>**Replace transmitter electronics**<br>Components in the measuring electronics defective → order spare parts → 📄 86 |

## 9.5 Response of outputs to errors

Note!
The failsafe mode of totalizers, current, pulse and frequency outputs can be customized by means of various functions in the function matrix. You will find detailed information on these procedures in the "Description of Device Functions" manual.

You can use positive zero return to set the signals of the current, pulse and status outputs to their fallback value, for example when measuring has to be interrupted while a pipe is being cleaned. This function takes priority over all other device functions: simulations, for example, are suppressed.

| **Failsafe mode of outputs and totalizers** | | |
|---|---|---|
| | Process/system error is current | Positive zero return is activated |
| Caution!<br>System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. See the information on → 64 | | |
| Current output | MINIMUM VALUE<br>0–20 mA → 0 mA<br>4–20 mA → 2 mA<br>4–20 mA HART → 2 mA<br>4–20 mA NAMUR →3.5 mA<br>4–20 mA HART NAMUR →3.5 mA<br>4–20 mA US → 3.75 mA<br>4–20 mA HART US → 3,75 mA<br>0–20 mA (25 mA) → 0 mA<br>4–20 mA (25 mA) → 2 mA<br>4–20 mA (25 mA) HART → 2 mA<br><br>MAXIMUM VALUE<br>0–20 mA → 22 mA<br>4–20 mA → 22 mA<br>4–20 mA HART → 22 mA<br>4–20 mA NAMUR → 22.6 mA<br>4–20 mA HART NAMUR → 22.6 mA<br>4–20 mA US → 22.6 mA<br>4–20 mA HART US → 22.6 mA<br>0–20 mA (25 mA) → 25 mA<br>4–20 mA (25 mA) → 25 mA<br>4–20 mA (25 mA) HART → 25 mA<br><br>HOLD VALUE<br>Last valid value (preceding occurrence of the fault) is output.<br><br>ACTUAL VALUE<br>Measured value display on the basis of the current flow measurement. The fault is ignored. | Output signal corresponds to "zero flow" |
| Pulse output | MIN/MAX VALUE → FALLBACK VALUE<br>Signal output → no pulses<br><br>HOLD VALUE<br>Last valid value (preceding occurrence of the fault) is output.<br><br>ACTUAL VALUE<br>Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement. | Output signal corresponds to "zero flow" |

| **Failsafe mode of outputs and totalizers** | | |
|---|---|---|
| | Process/system error is current | Positive zero return is activated |
| Frequency output | *FALLBACK VALUE*<br>Signal output → 0 Hz<br><br>*FAILSAFE LEVEL*<br>Output of the frequency specified in the FALLSAFE VALUE function.<br><br>*HOLD VALUE*<br>Measured value display on the basis of the last saved value preceding occurrence of the fault.<br><br>*ACTUAL VALUE*<br>Measured value display on the basis of the current flow measurement. The fault is ignored. | Output signal corresponds to "zero flow" |
| Totalizer | *STOP*<br>The totalizers are paused until the error is rectified.<br><br>*ACTUAL VALUE*<br>The fault is ignored. The totalizer continues to count in accordance with the current flow value.<br><br>*HOLD VALUE*<br>The totalizer continues to count the flow in accordance with the last valid flow value (before the error occurred). | Totalizer stops |
| Status output | In the event of a fault or power supply failure:<br>Status output → non-conductive | No effect on status output |

## 9.6 Spare parts

Detailed troubleshooting instructions are provided in the previous sections → 📄 79
The measuring device, moreover, provides additional support in the form of continuous self-diagnosis and error messages.
Fault rectification can entail replacing defective components with tested spare parts. The illustration below shows the available scope of spare parts.

Note!
You can order spare parts directly from your Endress+Hauser service organization by providing the serial number printed on the transmitter's nameplate → 📄 7

Spare parts are shipped as sets comprising the following parts:
- Spare part
- Additional parts, small items (threaded fasteners, etc.)
- Mounting instructions
- Packaging

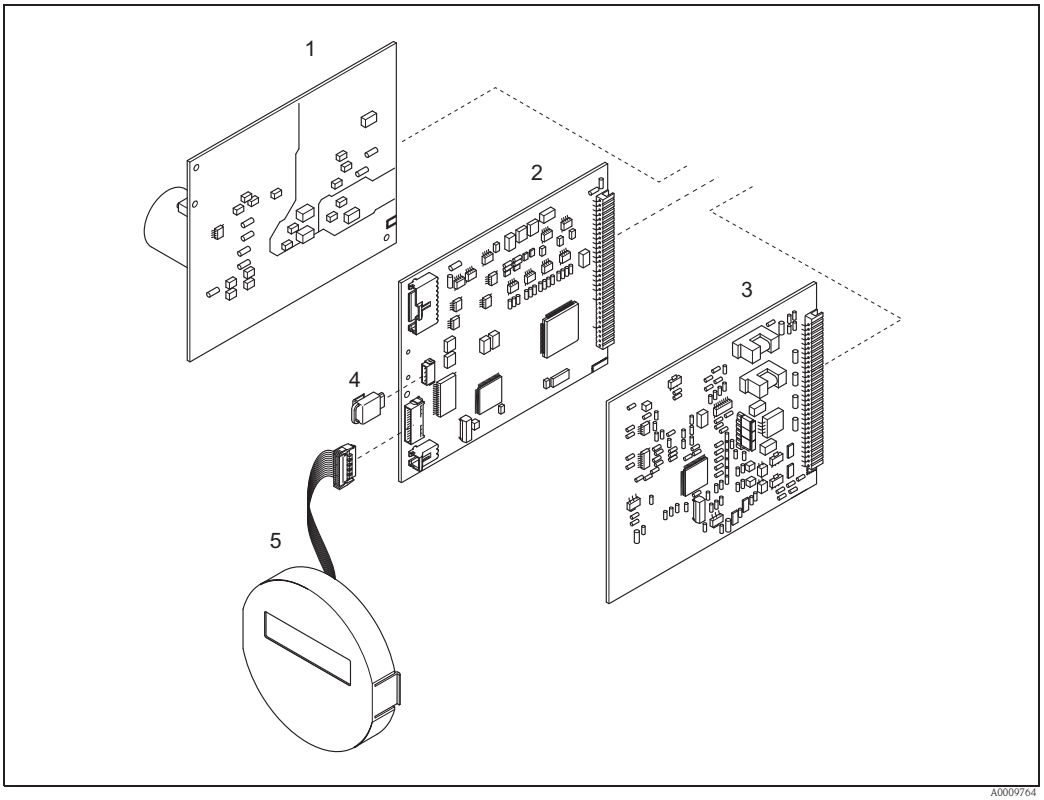



*Fig. 52: Spare parts for Promag 50 transmitter (field and wall-mounted housings)*

*1 Power unit board (85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC)*
*2 Amplifier board*
*3 I/O board (COM module)*
*4 HistoROM / S-DAT (sensor data memory)*
*5 Display module*

### 9.6.1 Removing and installing printed circuit boards

**Field housing: removing and installing printed circuit boards → 53**

Warning!
- Risk of electric shock!
  Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface purpose-built for electrostatically sensitive devices!
- If you cannot guarantee that the dielectric strength of the device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.
- When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to these Operating Instructions.

Caution!
Use only original Endress+Hauser parts.

1. Switch off power supply.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. Remove the local display (1) as follows:
   – Press in the latches (1.1) at the side and remove the display module.
   – Disconnect the ribbon cable (1.2) of the display module from the amplifier board.
4. Remove the screws and remove the cover (2) from the electronics compartment.
5. Remove the boards (4, 6): Insert a suitable tool into the hole (3) provided for the purpose and pull the board clear of its holder.
6. Remove amplifier board (5):
   – Disconnect the plug of the electrode signal cable (5.1) including S-DAT (5.3) from the board.
   – Loosen the plug locking of the coil current cable (5.2) and gently disconnect the plug from the board, i.e. without moving it to and fro.
   – Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
7. Installation is the reverse of the removal procedure.

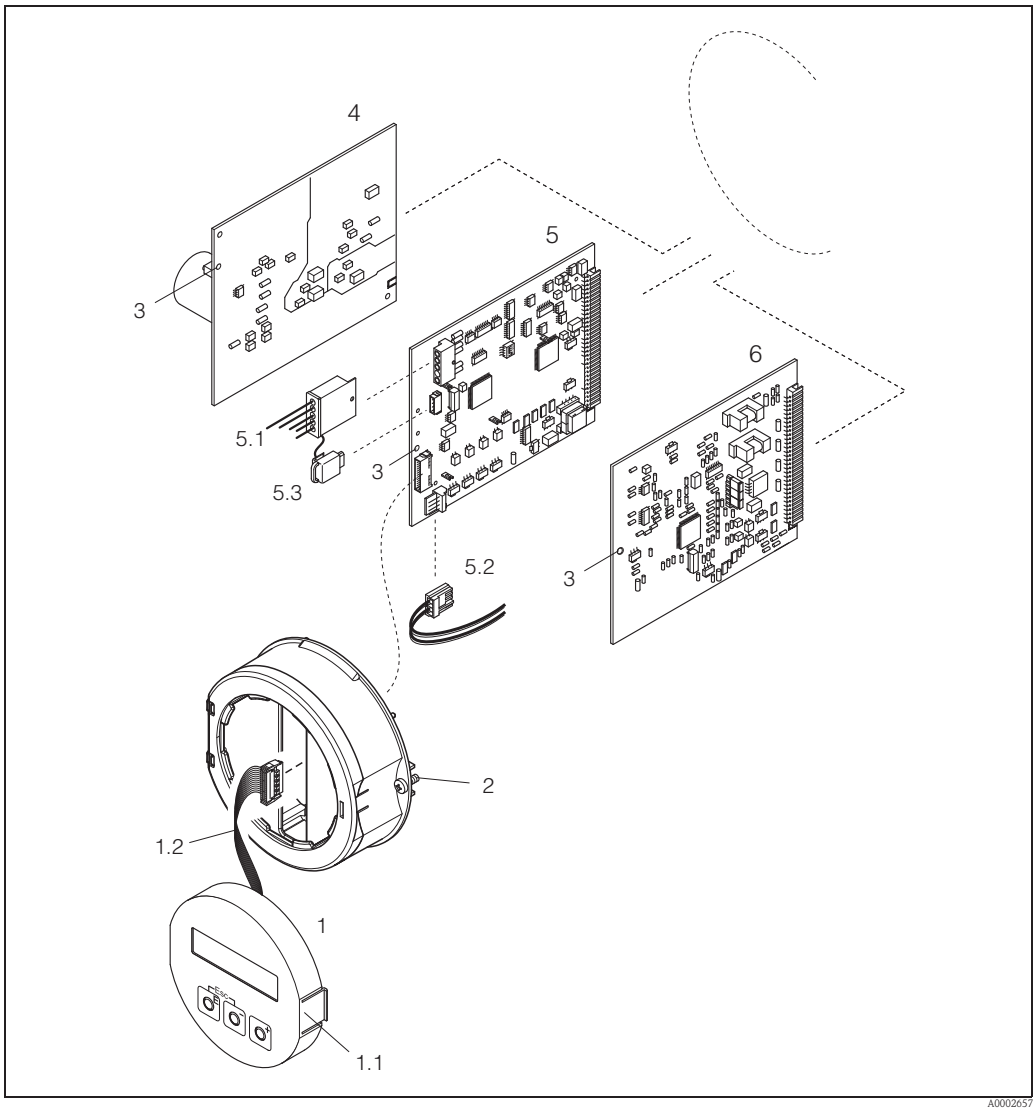



*Fig. 53: Field housing: removing and installing printed circuit boards*

*1 Local display*
*1.1 Latch*
*1.2 Ribbon cable (display module)*
*2 Screws of electronics compartment cover*
*3 Aperture for installing/removing boards*
*4 Power supply board*
*5 Amplifier board*
*5.1 Electrode signal cable (sensor)*
*5.2 Coil current cable (sensor)*
*5.3 Histo-ROM / S-DAT (sensor data memory)*
*6 I/O board*

**Wall-mount housing: removing and installing printed circuit boards → 54**

Warning!
- Risk of electric shock!
  Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface purpose-built for electrostatically sensitive devices!
- If you cannot guarantee that the dielectric strength of the device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.
- When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to these Operating Instructions.

Caution!
Use only original Endress+Hauser parts.

1. Switch off power supply.
2. Remove the screws and open the hinged cover (1) of the housing. Remove screws of the electronics module (2).
3. Then push up electronics module and pull it as far as possible out of the wall-mounted housing.
4. Disconnect the following cable plugs from amplifier board (7):
   – Electrode signal cable plug (7.1) including S-DAT (7.3).
   – Plug of coil current cable (7.2). To do so, loosen the plug locking of the coil current cable and gently disconnect the plug from the board, i.e. without moving it to and fro.
   – Ribbon cable plug (3) of the display module.
5. Remove the screws and remove the cover (4) from the electronics compartment.
6. Remove the boards (6, 7, 8): Insert a suitable tool into the hole (5) provided for the purpose and pull the board clear of its holder.
7. Installation is the reverse of the removal procedure.

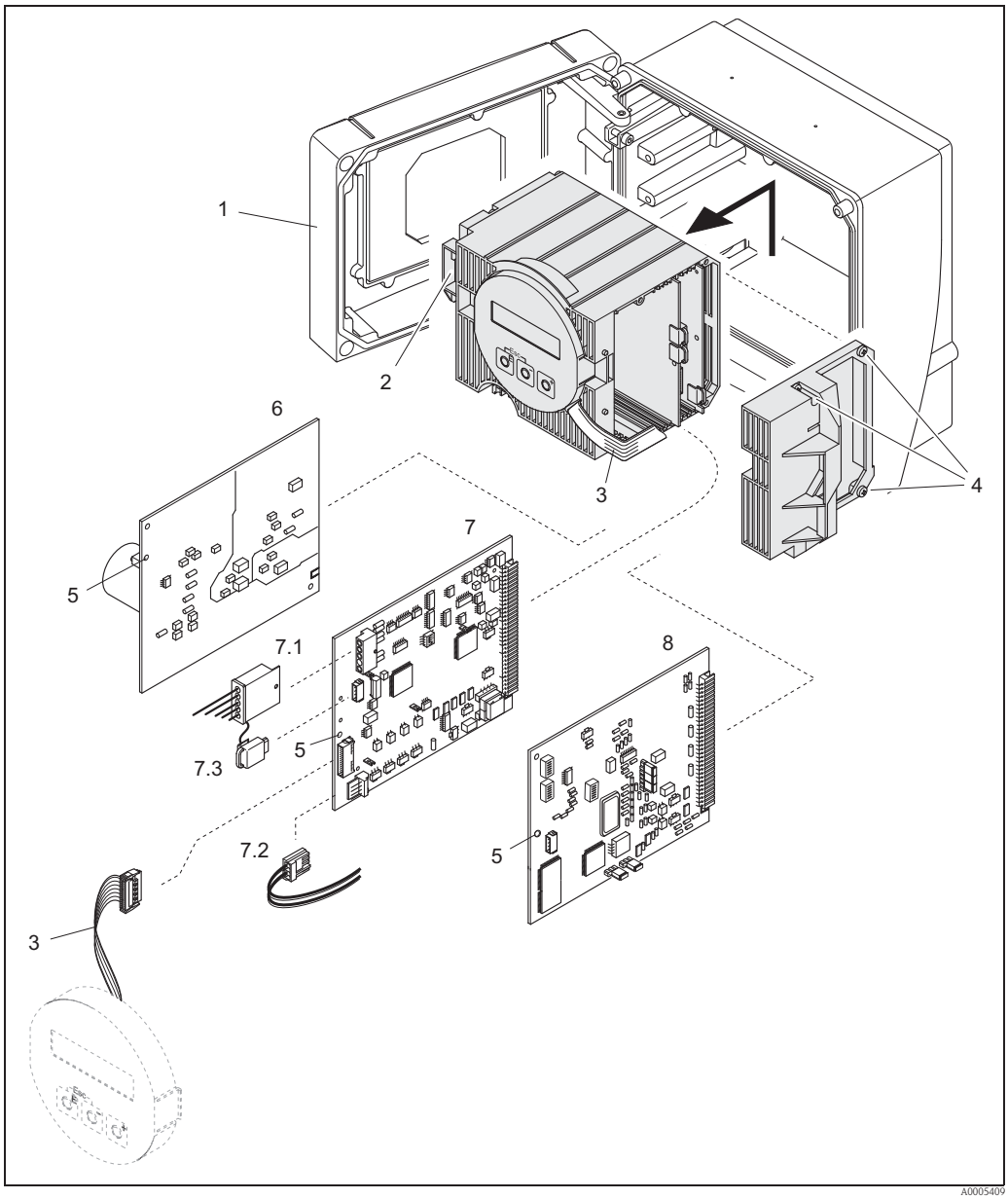



*Fig. 54: Wall-mount housing: removing and installing printed circuit boards*

*1 Housing cover*
*2 Electronics module*
*3 Ribbon cable (display module)*
*4 Cover of electronics compartment (3 screws)*
*5 Aperture for installing/removing boards*
*6 Power supply board*
*7 Amplifier board*
*7.1 Electrode signal cable (sensor)*
*7.2 Coil current cable (sensor)*
*7.3 Histo-ROM / S-DAT (sensor data memory)*
*8 I/O board*

### 9.6.2 Replacing the device fuse

Warning!
Risk of electric shock! Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

The main fuse is on the power supply board (→ 55).
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power supply board: field housing → 87, wall-mount housing → 89
3. Remove cap (1) and replace the device fuse (2).
   Use only fuses of the following type:
   – Power supply 20 to 55 V AC / 16 to 62 V DC → 2.0 A slow-blow / 250 V; 5.2 × 20 mm
   – Power supply 85 to 260 V AC → 0.8 A slow-blow / 250 V; 5.2 × 20 mm
   – Ex-rated devices → see the Ex documentation.
4. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser parts.

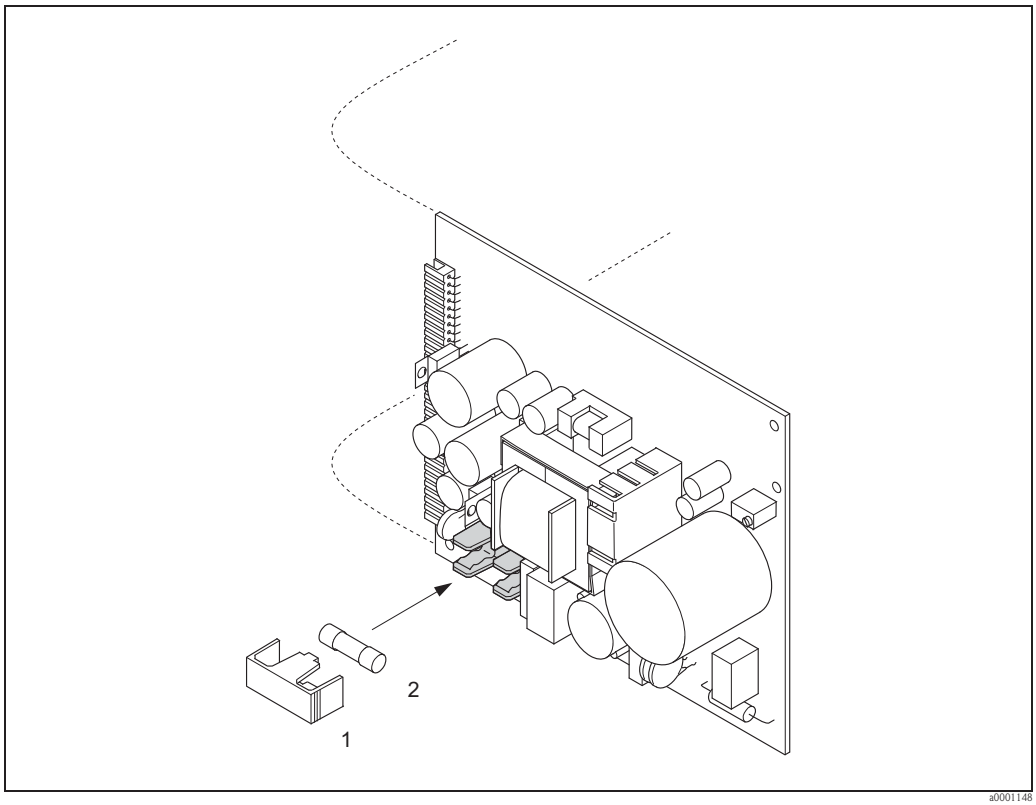



*Fig. 55: Replacing the device fuse on the power supply board*

*1 Protective cap*
*2 Device fuse*

### 9.6.3 Replacing the exchangeable electrode

The Promag W sensor (DN 350 to 2000; 14" to 78") is available with exchangeable measuring electrodes as an option. This design permits the measuring electrodes to be replaced or cleaned under process conditions.

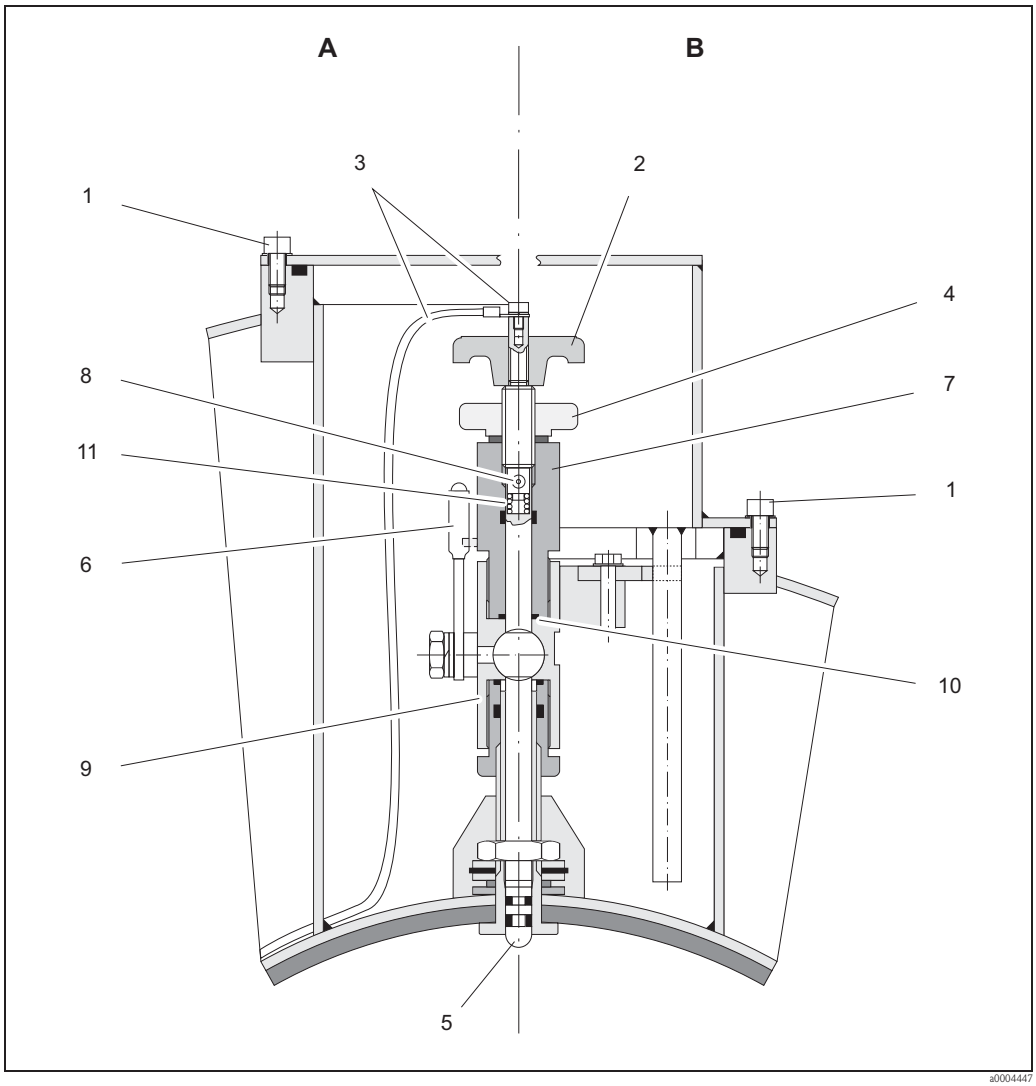



*Fig. 56: Apparatus for replacing exchangeable measuring electrodes*

*View A = DN 1200 to 2000 (48" to 78")*

*View B = DN 350 to 1050 (14" to 42")*

*1 Allen screw*
*2 Handle*
*3 Electrode cable*
*4 Knurled nut (locknut)*
*5 Measuring electrode*
*6 Stop cock (ball valve)*
*7 Retaining cylinder*
*8 Locking pin (for handle)*
*9 Ball-valve housing*
*10 Seal (retaining cylinder)*
*11 Coil spring*

| Removing the electrode | Installing the electrode |
|---|---|
| 1 Loosen Allen screw (1) and remove the cover. | 1 Insert new electrode (5) into retaining cylinder (7) from below. Make sure that the seals at the tip of the electrode are clean. |
| 2 Remove electrode cable (3) secured to handle (2). | 2 Mount handle (2) on the electrode and insert locking pin (8) to secure it in position.<br>Caution!<br>Make sure that coil spring (11) is inserted. This is essential to ensure correct electrical contact and correct measuring signals. |
| 3 Loosen knurled nut (4) by hand.<br>This knurled nut acts as a locknut. | 3 Pull the electrode back until the tip of the electrode no longer protrudes from retaining cylinder (7). |
| 4 Remove electrode (5) by turning handle (2). The electrode can now be pulled out of retaining cylinder (7) as far as a defined stop.<br>Warning!<br>Risk of injury.<br>Under process conditions (pressure in the piping system) the electrode can recoil suddenly against its stop. Apply counter-pressure while releasing the electrode. | 4 Screw the retaining cylinder (7) onto ball-valve housing (9) and tighten it by hand.<br>Seal (10) on the cylinder must be correctly seated and clean.<br>Note!<br>Make sure that the rubber hoses on retaining cylinder (7) and stop cock (6) are of the same color (red or blue). |
| 5 Close stop cock (6) after pulling out the electrode as far as it will go.<br>Warning!<br>Do not subsequently open the stop cock, in order to prevent fluid escaping. | 5 Open stop cock (6) and turn handle (2) to screw the electrode all the way into the retaining cylinder. |
| 6 Remove the electrode complete with retaining cylinder (7). | 6 Screw knurled nut (4) onto the retaining cylinder. This firmly locates the electrode in position. |
| 7 Remove handle (2) from electrode (5) by pressing out locking pin (8). Take care not to lose coil spring (11). | 7 Use the Allen screw to secure electrode cable (3) to handle (2).<br>Caution!<br>Make sure that the machine screw securing the electrode cable is firmly tightened. This is essential to ensure correct electrical contact and correct measuring signals. |
| 8 Remove the old electrode and insert the new electrode.<br>Replacement electrodes can be ordered separately from Endress+Hauser. | 8 Reinstall the cover and tighten Allen screw (a). |

## 9.7 Return

Caution!
Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.

The following steps must be taken before returning a flow measuring device to Endress+Hauser, e.g. for repair or calibration:
- Always enclose a duly completed "Declaration of contamination" form. Only then can Endress+Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EC REACH Regulation No. 1907/2006.
- Remove all residues. Pay special attention to the grooves for seals and crevices which could contain residues. This is particularly important if the substance is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

Note!
You will find a preprinted "Declaration of contamination" form at the back of these Operating Instructions.

## 9.8 Disposal

Observe the regulations applicable in your country!

## 9.9 Software history

| Date | Software version | Changes to software | Operating Instructions |
|---|---|---|---|
| 11.2009 | Amplifier:<br>V 2.03.XX | Introduction of Calf history | 71106181 / 12.09<br>71105332 / 11.09 |
| 06.2009 | Amplifier:<br>V 2.02.XX | Introduction of Promag L | 71095684 / 06.09 |
| 03.2009 | Amplifier:<br>V 2.02.XX | Introduction of Promag D<br>Introduction of new nominal diameter | 71088677 / 03.09 |
| 11.2004 | Amplifier:<br>1.06.01<br>Communication module:<br>1.04.00 | Software update relevant only for production | 50097089 / 10.03 |
| 10.2003 | Amplifier:<br>1.06.00<br>Communication module:<br>1.03.00 | Software expansion:<br>■ Language groups<br>■ Flow direction pulse output selectable<br>New functionalities:<br>■ Second Totalizer<br>■ Adjustable backlight (display)<br>■ Operation hours counter<br>■ Simulation function for pulse output<br>■ Counter for access code<br>■ Reset function (fault history)<br>■ Up-/download with FieldTool | 50097089 / 10.03 |

| Date | Software version | Changes to software | Operating Instructions |
|---|---|---|---|
| 08.2003 | Communication module: 1.02.01 | Software expansion:<br>■ New / revised functionalities<br>New functionalities:<br>■ Current span NAMUR NE 43<br>■ Failsafe mode function<br>■ Troubleshooting function<br>■ System and process error messages<br>■ Response of status output | 50097089 / 08.03 |
| 08.2002 | Amplifier: 1.04.00 | Software expansion:<br>■ New / revised functionalities<br>New functionalities:<br>■ Current span NAMUR NE 43<br>■ EPD (new mode)<br>■ Failsafe mode function<br>■ Acknowledge fault function<br>■ Troubleshooting function<br>■ System and process error messages<br>■ Response of status output | 50097089 / 08.02 |
| 03.2002 | Amplifier: 1.03.00 | Software expansion:<br>■ Suitability for custody transfer measurement Promag 50/51 | none |
| 06.2001 | Amplifier: 1.02.00<br>Communication module: 1.02.00 | Software expansion:<br>■ New functionalities:<br>New functionalities:<br>■ General device functions<br>■ "OED" software function<br>■ "Pulse width" software function | 50097089 / 06.01 |
| 09.2000 | Amplifier: 1.01.01<br>Communication module: 1.01.00 | Software expansion:<br>■ Functional adaptations | none |
| 08.2000 | Amplifier: 1.01.00 | Software expansion:<br>■ Functional adaptations | none |
| 04.2000 | Amplifier: 1.00.00<br>Communication module: 1.00.00 | Original software<br>Compatible with:<br>■ FieldTool<br>■ Commuwin II (version 2.05.03 and higher)<br>■ HART Communicator DXR 275 (from OS 4.6) with Rev. 1, DD1 | 50097089 / 04.00 |

Note!
Uploads or downloads between the individual software versions are only possible with a special service software.

# 10 Technical data

## 10.1 Technical data at a glance

### 10.1.1 Application

→ 📄 5

### 10.1.2 Function and system design

| | |
|---|---|
| Measuring principle | Electromagnetic flow measurement on the basis of Faraday's Law. |
| Measuring system | → 📄 7 |

### 10.1.3 Input

| | |
|---|---|
| Measured variable | Flow velocity (proportional to induced voltage) |
| Measuring range | Typically v = 0.01 to 10 m/s (0.033 to 33 ft/s) with the specified accuracy |
| Operable flow range | Over 1000 : 1 |
| Input signal | *Status input (auxiliary input)*<br>■ Galvanically isolated<br>■ U = 3 to 30 V DC<br>■ Ri = 5 kΩ<br>■ Can be configured for: totalizer reset, positive zero return, error message reset. |

### 10.1.4 Output

| | |
|---|---|
| Output signal | *Current output*<br>■ Galvanically isolated<br>■ Active/passive can be selected:<br>– Active: 0/4 to 20 mA, $R_L$ < 700 Ω (HART: $R_L \geq 250$ Ω)<br>– Passive: 4 to 20 mA, supply voltage $V_S$ 18 to 30 V DC, $R_i \geq 150$ Ω)<br>■ Time constant can be selected (0.01 to 100s)<br>■ Full scale value adjustable<br>■ Temperature coefficient: typ. 0.005% o.f.s./°C, resolution: 0.5 µA<br>o.f.s. = of full scale value<br><br>*Pulse/frequency output*<br>■ Galvanically isolated<br>■ Passive: 30 V DC / 250 mA<br>■ Open collector<br>■ Can be configured as:<br>– Pulse output<br>Pulse value and pulse polarity can be selected, max. pulse width adjustable (0.5 to 2000 ms)<br>– Frequency output<br>Full scale frequency 2 to 1000 Hz ($f_{max}$ = 1.25 Hz), on/off ratio 1:1, pulse width max. 10 s |

| | |
|---|---|
| Signal on alarm | *Current output*<br>Failsafe mode can be selected (e.g. in accordance with NAMUR Recommendation NE 43)<br><br>*Pulse/frequency output*<br>Failsafe mode can be selected<br><br>*Status output*<br>"Not conductive" in the event of fault or power supply failure |
| Load | See "Output signal" |
| Switching output | *Status output*<br>■ Galvanically isolated<br>■ Max. 30 V DC/250 mA<br>■ Open collector<br>■ Can be configured for: error messages, empty pipe detection (EPD), flow direction, limit values |
| Low flow cut off | Low flow cut off, switch-on point can be selected as required |
| Galvanic isolation | All circuits for inputs, outputs, and power supply are galvanically isolated from each other. |

### 10.1.5 Power supply

| | |
|---|---|
| Electrical connections | → 📄 44 |
| Supply voltage<br>(power supply) | ■ 85 to 260 V AC, 45 to 65 Hz<br>■ 20 to 55 V AC, 45 to 65 Hz<br>■ 16 to 62 V DC |
| Cable entry | *Power supply and signal cables (inputs/outputs):*<br>■ Cable entry M20 × 1.5 (8 to 12 mm/0.31 to 0.47 inch)<br>■ Sensor cable entry for armored cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63 inch)<br>■ Threads for cable entries ½" NPT, G ½"<br><br>*Connecting cable for remote version:*<br>■ Cable entry M20 × 1.5 (8 to 12 mm/0.31 to 0.47 inch)<br>■ Sensor cable entry for armored cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63 inch)<br>■ Threads for cable entries ½" NPT, G ½" |
| Cable specifications | → 📄 49 |
| Power consumption | *Power consumption*<br>■ AC: <15 VA (incl. sensor)<br>■ DC: <15 W (incl. sensor)<br><br>*Switch-on current*<br>■ max. 3 A (<5 ms) for 24 V DC<br>■ max. 8.5 A (<5 ms) for 260 V AC |

Power supply failure

- Lasting min. 1 cycle frequency:
- EEPROM saves measuring system data
- S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point etc.)

Potential equalization

→ 📄 53

### 10.1.6 Performance characteristics

Reference operating conditions

*To DIN EN 29104 and VDI/VDE 2641:*

- Fluid temperature: +28 °C ± 2 K
- Ambient temperature: +22 °C ± 2 K
- Warm-up period: 30 minutes

*Installation:*

- Inlet run >10 × DN
- Outlet run > 5 × DN
- Sensor and transmitter grounded.
- The sensor is centered in the pipe.

Maximum measured error

- Current output: plus typically ± 5 µA
- Pulse output: ± 0.5% o.r. ± 1 mm/s
  Option: ± 0.2% o.r. ± 2 mm/s (o.r. = of reading)

Fluctuations in the supply voltage do not have any effect within the specified range.

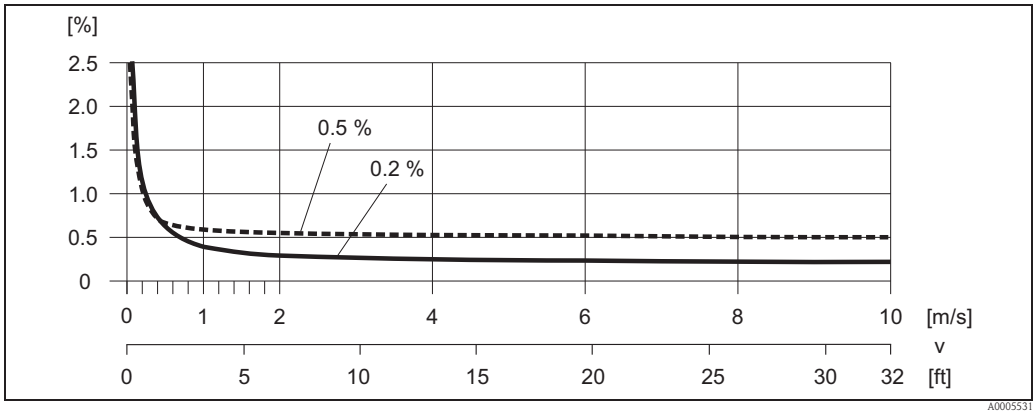



*Fig. 57: Max. measured error in % of reading*

Repeatability

Max. ± 0.1% o.r. ± 0.5 mm/s (o.r. = of reading)

### 10.1.7 Operating conditions: Installation

Installation instructions

Any orientation (vertical, horizontal), restrictions and installation instructions → 📄 13

Inlet and outlet run

If possible, install the sensor upstream from fittings such as valves, T-pieces, elbows, etc. The following inlet and outlet runs must be observed in order to meet accuracy specifications (→ 📄 16, → 🖼 12):

- Inlet run: ≥ 5 × DN
- Outlet run: ≥ 2 × DN

Adapters → 17

Length of connecting cable → 20

### 10.1.8 Operating conditions: Environment

**Ambient temperature range**

- Transmitter:
  - Standard: –20 to +60 °C (–4 to +140 °F)
  - Optional: –40 to +60 °C (–40 to +140 °F)

  Note!
  At ambient temperatures below –20 (–4 °F) the readability of the display may be impaired.
- Sensor (the ambient temperatur range is dependent on the sensor type):
  - Flange material carbon steel: –10 to +60 °C (+14 to +140 °F)
  - Flange material stainless steel: –40 to +60 °C (–40 to +140 °F)

Caution!
- The permitted temperature range of the measuring tube lining may not be undershot or overshot (→ "Operating conditions: Process" → "Medium temperature range").
- Install the device in a shady location. Avoid direct sunlight, particularly in warm climatic regions.
- The transmitter must be mounted separate from the sensor if both the ambient and fluid temperatures are high.

**Storage temperature**

The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.

Caution!
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- A storage location must be selected where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.

**Degree of protection**

- Standard: IP 67 (NEMA 4X) for transmitter and sensor
- Optional: IP 68 (NEMA 6P) for remote version of Promag L, W and P sensor.
  Promag L only with stainless steel flanges.

**Shock and vibration resistance**

Acceleration up to 2 g following IEC 60068-2-6
(high-temperature version: no data available)

**CIP cleaning**

Caution!
The maximum fluid temperature permitted for the device may not be exceeded.

*CIP cleaning is possible:*
Promag P, Promag H

*CIP cleaning is not possible:*
Promag D, Promag L, Promag W

**SIP cleaning**

Caution!
The maximum fluid temperature permitted for the device may not be exceeded.

*SIP cleaning is possible:*
Promag H

*SIP cleaning is not possible:*
Promag D, Promag L, Promag W, Promag P

Electromagnetic compatibility (EMC)
- As per IEC/EN 61326 and NAMUR Recommendation NE 21
- Emission: to limit value for industry EN 55011

## 10.1.9 Operating conditions: Process

Medium temperature range

The permissible temperature depends on the lining of the measuring tube

*Promag D*

0 to +60 °C (+32 to +140 °F) for polyamide

*Promag L*

- 0 to +80 °C (+32 to +176 °F) for hard rubber (DN 350 to 1200)
- –20 to +50 °C (–4 to +122 °F) for polyurethane (DN 50 to 1200)
- –20 to +90 °C (–4 to +194 °F) for PTFE (DN 50 to 300)

*Promag W*

- 0 to +80 °C (+32 to +176 °F) for hard rubber (DN 50 to 2000)
- –20 to +50 °C (–4 to +122 °F) for polyurethane (DN 25 to 1200)

*Promag P*

Standard
- –40 to +130 °C (–40 to +266 °F) for PTFE (DN 15 to 600 / 1/2" to 24"), Restrictions → see the following diagrams
- –20 to +130 °C (–4 to +266 °F) for PFA/HE (DN 25 to 200 / 1" to 8"), Restrictions → see the following diagrams
- –20 to +150 °C (–4 to +302 °F) for PFA (DN 25 to 200 / 1" to 8"), Restrictions → see the following diagrams

Optional
High-temperature version (HT): –20 to +180 °C (–4 to +356 °F) for PFA (DN 25 to 200 / 1" to 8")

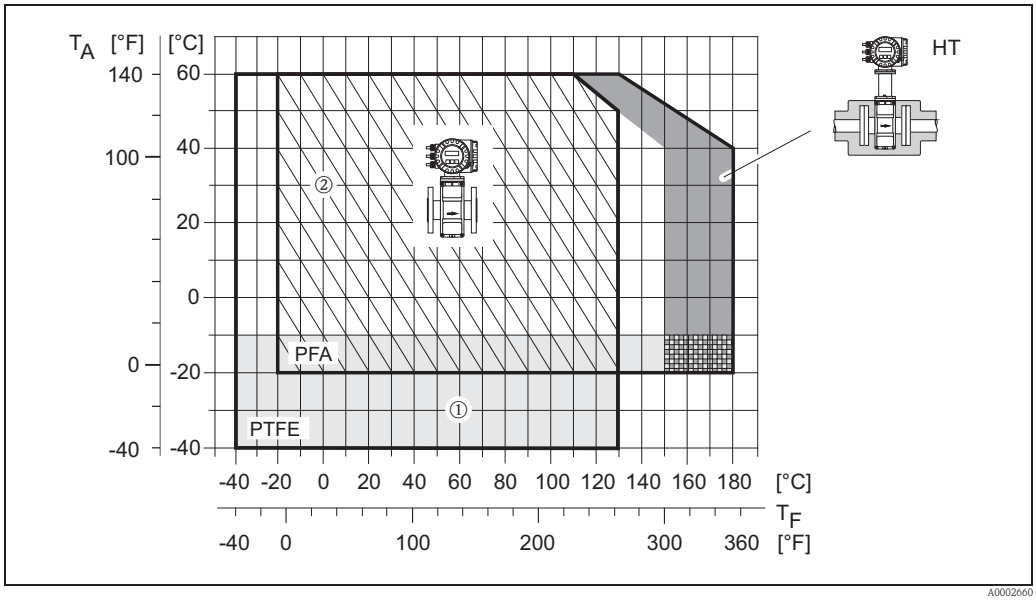



*Abb. 58: Compact version Promag P (with PFA- or PTFE-lining)*

*$T_A$ = ambient temperature; $T_F$ = fluid temperature; HT = high-temperature version with insulation*
*① = light gray area → temperature range from –10 to –40 °C (–14 to –40 °F) is valid for stainless steel version only*
*② = diagonal hatched area → foam lining (HE) and degree of protection IP 68 = fluid temperature max. 130°C / 266 °F*

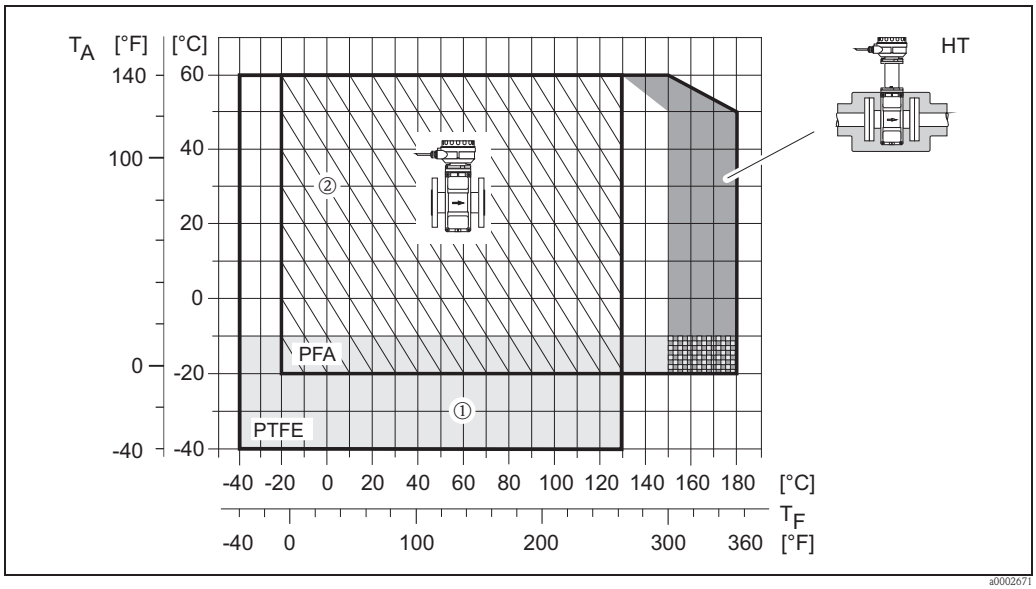



*Abb. 59: Remote version Promag P (with PFA- or PTFE-lining)*

*$T_A$ = ambient temperature; $T_F$ = fluid temperature; HT = high-temperature version with insulation*
*① = light gray area → temperature range from –10 to –40 °C (–14 to –40 °F) is valid for stainless steel version only*
*② = diagonal hatched area → foam lining (HE) and degree of protection IP68 = fluid temperature max. 130°C / 266 °F*

*Promag H*

Sensor:
- DN 2 to 25: –20 to +150 °C (–4 to +302 °F)
- DN 40 to 100: –20 to +150 °C (–4 to +302 °F)

Seals:
- EPDM: –20 to +150 °C (–4 to +302 °F)
- Silicone: –20 to +150 °C (–4 to +302 °F)
- Viton: –20 to +150 °C (–4 to +302 °F)
- Kalrez: –20 to +150 °C (–4 to +302 °F)

Conductivity

The minimum conductivity is ≥ 5 µS/cm (≥ 20 µS/cm for demineralized water)

Note!
Note that in the case of the remote version, the requisite minimum conductivity is also influenced by the length of the connecting cable → 20

Medium pressure range (nominal pressure)

*Promag D*

- EN 1092-1 (DIN 2501)
  – PN 16
- ANSI B 16.5
  – Class 150
- JIS B2220
  – 10 K

*Promag L*

- EN 1092-1 (DIN 2501)
  – PN 6 (DN 350…1200)
  – PN 10 (DN 50…1200)
  – PN 16 (DN 50…150)
- EN 1092-1, lap joint flange, stampel plate
  – PN 10 (DN 50 to 300)

- ANSI B 16.5
  – Class 150 (2" to 24")
- AWWA
  – Class D (28" to 48")
- AS2129
  – Table E (DN 350 to 1200)
- AS4087
  – PN 16 (DN 350 to1200)

*Promag W*

- EN 1092-1 (DIN 2501)
  – PN 6 (DN 350 to 2000)
  – PN 10 (DN 200 to 2000)
  – PN 16 (DN 65 to 2000)
  – PN 25 (DN 200 to 1000)
  – PN 40 (DN 25 to 150)
- ANSI B 16.5
  – Class 150 (1" to 24")
  – Class 300 (1" to 6")
- AWWA
  – Class D (28" to 78")
- JIS B2220
  – 10 K (DN 50 to 300)
  – 20 K (DN 25 to 300)

- AS 2129
  – Table E (DN 80, 100, 150 to 1200)
- AS 4087
  – PN 16 (DN 80, 100, 150 to 1200)

*Promag P*

- EN 1092-1 (DIN 2501)
  – PN 10 (DN 200 to 600)
  – PN 16 (DN 65 to 600)
  – PN 25 (DN 200 to 600)
  – PN 40 (DN 15 to 150)
- ANSI B 16.5
  – Class 150 (½" to 24")
  – Class 300 (½" to 6")
- JIS B2220
  – 10 K (DN 50 to 300)
  – 20 K (DN 15 to 300)
- AS 2129
  – Table E (DN 25, 50)
- AS 4087
  – PN 16 (DN 50)

*Promag H*

The permissible nominal pressure depends on the process connection and the seal:
- 40 bar → flange, weld nipple (with O-ring seal)
- 16 bar → all other process connections

Pressure tightness

*Promag D*

Measuring tube: 0 mbar abs (0 psi abs) with a fluid temperature of ≤ 60 °C (≤ 140 °F)

*Promag L (Measuring tube lining: Polyurethane, Hard rubber)*

| Promag L Nominal diameter | | Measuring tube lining | Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures | | |
|---|---|---|---|---|---|
| | | | 25 °C | 50 °C | 80° C |
| [mm] | [inch] | | 77 °F | 122 °F | 176° F |
| 50 to 1200 | 2 to 48" | Polyurethane | 0 | 0 | – |
| 350 to 1200 | 14 to 48" | Hard rubber | 0 | 0 | 0 |

*Promag L*
*Measuring tube lining: PTFE*

| Promag L Nominal diameter | | Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures | | | |
|---|---|---|---|---|---|
| | | 25 °C | | 90 °C | |
| | | 77 °F | | 194 °F | |
| [mm] | [inch] | [mbar] | [psi] | [mbar] | [psi] |
| 50 | 2" | 0 | 0 | 0 | 0 |
| 65 | – | 0 | 0 | 40 | 0.58 |
| 80 | 3" | 0 | 0 | 40 | 0.58 |
| 100 | 4" | 0 | 0 | 135 | 1.96 |
| 125 | – | 135 | 1.96 | 240 | 3.48 |
| 150 | 6" | 135 | 1.96 | 240 | 3.48 |
| 200 | 8" | 200 | 2.90 | 290 | 4.21 |
| 250 | 10" | 330 | 4.79 | 400 | 5.80 |
| 300 | 12" | 400 | 5.80 | 500 | 7.25 |

*Promag W*

| Promag W Nominal diameter | | Measuring tube lining | Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 25 °C | 50 °C | 80° C | 100 °C | 130 °C | 150 °C | 180 °C |
| [mm] | [inch] | | 77 °F | 122 °F | 176° F | 212 °F | 266 °F | 302 °F | 356 °F |
| 25 to 1200 | 1 to 48" | Polyurethane | 0 | 0 | – | – | – | – | – |
| 50 to 2000 | 2 to 78" | Hard rubber | 0 | 0 | 0 | – | – | – | – |

*Promag P*
*Measuring tube lining: PFA*

| Promag P Nominal diameter | | Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures | | | | | |
|---|---|---|---|---|---|---|---|
| | | 25 °C | 80° C | 100 °C | 130 °C | 150 °C | 180 °C |
| [mm] | [inch] | 77 °F | 176° F | 212 °F | 266 °F | 302 °F | 356 °F |
| 25 | 1" | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | – | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 1 ½" | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 2" | 0 | 0 | 0 | 0 | 0 | 0 |
| 65 | – | 0 | * | 0 | 0 | 0 | 0 |
| 80 | 3" | 0 | * | 0 | 0 | 0 | 0 |

| Promag P Nominal diameter | | Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures | | | | | |
|---|---|---|---|---|---|---|---|
| | | 25 °C | 80° C | 100 °C | 130 °C | 150 °C | 180 °C |
| [mm] | [inch] | 77 °F | 176° F | 212 °F | 266 °F | 302 °F | 356 °F |
| 100 | 4" | 0 | * | 0 | 0 | 0 | 0 |
| 125 | - | 0 | * | 0 | 0 | 0 | 0 |
| 150 | 6" | 0 | * | 0 | 0 | 0 | 0 |
| 200 | 8" | 0 | * | 0 | 0 | 0 | 0 |
| * No value can be quoted. | | | | | | | |

*Promag P*
*Measuring tube lining: PTFE*

| Promag P Nominal diameter | | Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 25 °C | | 80° C | 100 °C | | 130 °C | | 150 °C | 180 °C |
| | | 77 °F | | 176° F | 212 °F | | 266 °F | | 302 °F | 356 °F |
| [mm] | [inch] | [mbar] | [psi] | | [mbar] | [psi] | [mbar] | [psi] | | |
| 15 | ½" | 0 | 0 | 0 | 0 | 0 | 100 | 1.45 | – | – |
| 25 | 1" | 0 | 0 | 0 | 0 | 0 | 100 | 1.45 | – | – |
| 32 | - | 0 | 0 | 0 | 0 | 0 | 100 | 1.45 | – | – |
| 40 | 1 ½" | 0 | 0 | 0 | 0 | 0 | 100 | 1.45 | – | – |
| 50 | 2" | 0 | 0 | 0 | 0 | 0 | 100 | 1.45 | – | – |
| 65 | - | 0 | 0 | * | 40 | 0.58 | 130 | 1.89 | – | – |
| 80 | 3" | 0 | 0 | * | 40 | 0.58 | 130 | 1.89 | – | – |
| 100 | 4" | 0 | 0 | * | 135 | 1.96 | 170 | 2.47 | – | – |
| 125 | - | 135 | 1.96 | * | 240 | 3.48 | 385 | 5.58 | – | – |
| 150 | 6" | 135 | 1.96 | * | 240 | 3.48 | 385 | 5.58 | – | – |
| 200 | 8" | 200 | 2.90 | * | 290 | 4.21 | 410 | 5.95 | – | – |
| 250 | 10" | 330 | 4.79 | * | 400 | 5.80 | 530 | 7.69 | – | – |
| 300 | 12" | 400 | 5.80 | * | 500 | 7.25 | 630 | 9.14 | – | – |
| 350 | 14" | 470 | 6.82 | * | 600 | 8.70 | 730 | 10.59 | – | – |
| 400 | 16" | 540 | 7.83 | * | 670 | 9.72 | 800 | 11.60 | – | – |
| 450 | 18" | Partial vacuum is impermissible! | | | | | | | | |
| 500 | 20" | | | | | | | | | |
| 600 | 24" | | | | | | | | | |
| * No value can be quoted. | | | | | | | | | | |

*Promag H (Measuring tube lining: PFA)*

| Promag H Nominal diameter | | Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures | | | | | |
|---|---|---|---|---|---|---|---|
| | | 25 °C | 80° C | 100 °C | 130 °C | 150 °C | 180 °C |
| [mm] | [inch] | 77 °F | 176° F | 212 °F | 266 °F | 302 °F | 356 °F |
| 2 to 100 | 1/12 to 4" | 0 | 0 | 0 | 0 | 0 | 0 |

Limiting flow → 18

Pressure loss

- No pressure loss if the sensor is installed in a pipe of the same nominal diameter (Promag H: only DN 8 and larger).
- Pressure losses for configurations incorporating adapters according to DIN EN 545 (see "Adapters" → 17)

## 10.1.10 Mechanical construction

Design, dimensions

The dimensions and installation lengths of the sensor and transmitter can be found in the "Technical Information" for the device in question. This document can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in the "Documentation" section on → 🖹 116.

Weight (SI units)

*Promag D*

| Weight data of Promag D in kg | | | | |
|---|---|---|---|---|
| Nominal diameter | | Compact version | Remote version (without cable) | |
| [mm] | [inch] | | Sensor | Transmitter |
| 25 | 1" | 4.5 | 2.5 | 6.0 |
| 40 | 1 ½" | 5.1 | 3.1 | 6.0 |
| 50 | 2" | 5.9 | 3.9 | 6.0 |
| 65 | 2 ½" | 6.7 | 4.7 | 6.0 |
| 80 | 3" | 7.7 | 5.7 | 6.0 |
| 100 | 4" | 10.4 | 8.4 | 6.0 |
| Transmitter Promag (compact version): 3.4 kg (Weight data valid without packaging material) | | | | |

*Promag L compact version (lap joint flanges / welded flanges DN >350)*

| Weight data of Promag L in kg | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Nominal diameter | | Compact version (including transmitter) | | | | | | |
| [mm] | [inch] | EN (DIN) | | EN (DIN) | | ANSI / AWWA | | AS | |
| 50 | 2" | PN 16 | 10.6 | PN 6 | – | ANSI / Class 150 | 10.6 | PN 16. Tabelle E | – |
| 65 | 2 ½" | | 12.0 | | – | | – | | – |
| 80 | 3" | | 14.0 | | – | | 14.0 | | – |
| 100 | 4" | | 16.0 | | – | | 16.0 | | – |
| 125 | 5" | | 21.5 | | – | | – | | – |
| 150 | 6" | | 25.5 | | – | | 25.5 | | – |
| 200 | 8" | PN 10 | 45 | | – | | 45 | | – |
| 250 | 10" | | 65 | | – | | 65 | | – |
| 300 | 12" | | 70 | | – | | 70 | | – |
| 350 | 14" | | 90 | | 79 | | 139 | | 101 |
| 375 | 15" | | – | | – | | – | | 107 |
| 400 | 16" | | 106 | | 91 | | 170 | | 122 |
| 450 | 18" | | 114 | | 101 | | 193 | | 135/145* |
| 500 | 20" | | 134 | | 116 | | 230 | | 184 |
| 600 | 24" | | 157 | | 157 | | 304 | | 262 |
| 700 | 28" | | 248 | | 200 | AWWA / Class D | 277 | | 354 |
| 750 | 30" | | – | | – | | 329 | | 441 |
| 800 | 32" | | 322 | | 248 | | 396 | | 501 |
| 900 | 36" | | 402 | | 316 | | 482 | | 698 |
| 1000 | 40" | | 475 | | 366 | | 601 | | 769 |
| | 42" | | – | | – | | 684 | | – |
| 1200 | 48" | | 724 | | 537 | | 914 | | 1227 |
| Transmitter Promag (compact version): 3,4 kg (Weight data valid without packaging material) * DN 450 AS Tab E | | | | | | | | | |

*Promag L remote version (lap joint flanges / welded flanges DN >350)*

| Weight data of Promag L in kg | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Nominal diameter | | Remote version (sensor plus sensor housing without cable) | | | | | | | |
| [mm] | [inch] | EN (DIN) | | EN (DIN) | | ANSI / AWWA | | AS | |
| 50 | 2" | PN 16 | 8.6 | PN 6 | – | ANSI / Class 150 | 8.6 | PN 16, Tabelle E | – |
| 65 | 2 ½" | | 10.0 | | – | | – | | – |
| 80 | 3" | | 12.0 | | – | | 12.0 | | – |
| 100 | 4" | | 14.0 | | – | | 14.0 | | – |
| 125 | 5" | | 19.5 | | – | | – | | – |
| 150 | 6" | | 23.5 | | – | | 23.5 | | – |
| 200 | 8" | PN 10 | 43 | | – | | 43 | | – |
| 250 | 10" | | 63 | | – | | 63 | | – |
| 300 | 12" | | 68 | | – | | 108 | | – |
| 350 | 14" | | 87 | | 76 | | 136 | | 98 |
| 375 | 15" | | – | | – | | – | | 104 |
| 400 | 16" | | 103 | | 88 | | 167 | | 119 |
| 450 | 18" | | 111 | | 98 | | 190 | | 132/142* |
| 500 | 20" | | 131 | | 113 | | 227 | | 181 |
| 600 | 24" | | 154 | | 154 | | 301 | | 259 |
| 700 | 28" | | – | | 198 | AWWA / Class D | 275 | | 352 |
| 750 | 30" | | – | | – | | 327 | | 439 |
| 800 | 32" | | 320 | | 246 | | 394 | | 499 |
| 900 | 36" | | 400 | | 314 | | 480 | | 696 |
| 1000 | 40" | | 473 | | 364 | | 599 | | 767 |
| | 42" | | – | | – | | 682 | | – |
| 1200 | 48" | | 722 | | 535 | | 912 | | 1225 |

Transmitter Promag (remote version): 6 kg
(Weight data valid without packaging material)
*DN 450 AS Tab E

*Promag L (lap joint flanges, stamped plate)*

| Weight data of Promag L in kg | | | | | | |
|---|---|---|---|---|---|---|
| Nominal diameter | | Compact version | | Remote version (without cable) | | |
| [mm] | [inch] | EN (DIN) | | Sensor EN (DIN) | | Transmitter |
| 50 | 2" | PN 10 | 7.2 | PN 10 | 5.2 | 6.0 |
| 65 | 2 ½" | | 8.0 | | 6.0 | 6.0 |
| 80 | 3" | | 9.0 | | 7.0 | 6.0 |
| 100 | 4" | | 11.5 | | 9.5 | 6.0 |
| 125 | 5" | | 15.0 | | 13.0 | 6.0 |
| 150 | 6" | | 19.0 | | 17.0 | 6.0 |
| 200 | 8" | | 37.5 | | 35.5 | 6.0 |
| 250 | 10" | | 56.0 | | 54.0 | 6.0 |
| 300 | 12" | | 57.0 | | 55.0 | 6.0 |

Transmitter Promag (compact version): 3.4 kg
(Weight data valid for standard pressure ratings and without packaging material)

*Promag W*

**Weight data of Promag W in kg**

| Nominal diameter | | Compact version | | | | | | Remote version (without cable) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Sensor | | | | | | Trans-mitter |
| [mm] | [inch] | EN (DIN) / AS* | | JIS | | ANSI / AWWA | | EN (DIN) / AS* | | JIS | | ANSI / AWWA | | |
| 25 | 1" | PN 40 | 7.3 | 10K | 7.3 | Class 150 | 7.3 | PN 40 | 5.3 | 10K | 5.3 | Class 150 | 5.3 | 6.0 |
| 32 | 1 ¼" | | 8.0 | | 7.3 | | – | | 6.0 | | 5.3 | | – | 6.0 |
| 40 | 1 ½" | | 9.4 | | 8.3 | | 9.4 | | 7.4 | | 6.3 | | 7.4 | 6.0 |
| 50 | 2" | | 10.6 | | 9.3 | | 10.6 | | 8.6 | | 7.3 | | 8.6 | 6.0 |
| 65 | 2 ½" | PN 16 | 12.0 | | 11.1 | | – | PN 16 | 10.0 | | 9.1 | | – | 6.0 |
| 80 | 3" | | 14.0 | | 12.5 | | 14.0 | | 12.0 | | 10.5 | | 12.0 | 6.0 |
| 100 | 4" | | 16.0 | | 14.7 | | 16.0 | | 14.0 | | 12.7 | | 14.0 | 6.0 |
| 125 | 5" | | 21.5 | | 21.0 | | – | | 19.5 | | 19.0 | | – | 6.0 |
| 150 | 6" | | 25.5 | | 24.5 | | 25.5 | | 23.5 | | 22.5 | | 23.5 | 6.0 |
| 200 | 8" | PN 10 | 45 | | 41.9 | | 45 | PN 10 | 43 | | 39.9 | | 43 | 6.0 |
| 250 | 10" | | 65 | | 69.4 | | 65 | | 63 | | 67.4 | | 73 | 6.0 |
| 300 | 12" | | 70 | | 72.3 | | 110 | | 68 | | 70.3 | | 108 | 6.0 |
| 350 | 14" | | 115 | | | | 175 | | 113 | | | | 173 | 6.0 |
| 400 | 16" | | 135 | | | | 205 | | 133 | | | | 203 | 6.0 |
| 450 | 18" | | 175 | | | | 255 | | 173 | | | | 253 | 6.0 |
| 500 | 20" | | 175 | | | | 285 | | 173 | | | | 283 | 6.0 |
| 600 | 24" | | 235 | | | | 405 | | 233 | | | | 403 | 6.0 |
| 700 | 28" | | 355 | | | Class D | 400 | | 353 | | | Class D | 398 | 6.0 |
| – | 30" | | – | | | | 460 | | – | | | | 458 | 6.0 |
| 800 | 32" | | 435 | | | | 550 | | 433 | | | | 548 | 6.0 |
| 900 | 36" | | 575 | | | | 800 | | 573 | | | | 798 | 6.0 |
| 1000 | 40" | | 700 | | | | 900 | | 698 | | | | 898 | 6.0 |
| – | 42" | PN 6 | – | | | | 1100 | PN 6 | – | | | | 1098 | 6.0 |
| 1200 | 48" | | 850 | | | | 1400 | | 848 | | | | 1398 | 6.0 |
| – | 54" | | – | | | | 2200 | | – | | | | 2198 | 6.0 |
| 1400 | – | | 1300 | | | | – | | 1298 | | | | – | 6.0 |
| – | 60" | | – | | | | 2700 | | – | | | | 2698 | 6.0 |
| 1600 | – | | 1700 | | | | – | | 1698 | | | | – | 6.0 |
| – | 66" | | – | | | | 3700 | | – | | | | 3698 | 6.0 |
| 1800 | 72" | | 2200 | | | | 4100 | | 2198 | | | | 4098 | 6.0 |
| – | 78" | | – | | | | 4600 | | – | | | | 4598 | 6.0 |
| 2000 | – | | 2800 | | | | – | | 2798 | | | | – | 6.0 |

Transmitter Promag (compact version): 3.4 kg
(Weight data valid for standard pressure ratings and without packaging material)
*Flanges according to AS are only available for DN 80, 100, 150 to 400, 500 and 600

*Promag P*

| Weight data of Promag P in kg | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal diameter | | Compact version | | | | | | Remote version (without cable) | | | | | | |
| | | | | | | | | Sensor | | | | | | Trans-mitter |
| [mm] | [inch] | EN (DIN) / AS* | | JIS | | ANSI / AWWA | | EN (DIN) / AS* | | JIS | | ANSI / AWWA | | |
| 15 | ½" | PN 40 | 6.5 | 10K | 6.5 | Class 150 | 6.5 | PN 40 | 4.5 | 10K | 4.5 | Class 150 | 4.5 | 6.0 |
| 25 | 1" | | 7.3 | | 7.3 | | 7.3 | | 5.3 | | 5.3 | | 5.3 | 6.0 |
| 32 | 1 ¼" | | 8.0 | | 7.3 | | – | | 6.0 | | 5.3 | | – | 6.0 |
| 40 | 1 ½" | | 9.4 | | 8.3 | | 9.4 | | 7.4 | | 6.3 | | 7.4 | 6.0 |
| 50 | 2" | | 10.6 | | 9.3 | | 10.6 | | 8.6 | | 7.3 | | 8.6 | 6.0 |
| 65 | 2 ½" | PN 16 | 12.0 | | 11.1 | | – | PN 16 | 10.0 | | 9.1 | | – | 6.0 |
| 80 | 3" | | 14.0 | | 12.5 | | 14.0 | | 12.0 | | 10.5 | | 12.0 | 6.0 |
| 100 | 4" | | 14.4 | | 14.7 | | 16.0 | | 14.0 | | 12.7 | | 14.0 | 6.0 |
| 125 | 5" | | 16.0 | | 21.0 | | – | | 19.5 | | 19.0 | | – | 6.0 |
| 150 | 6" | | 21.5 | | 24.5 | | 25.5 | | 23.5 | | 22.5 | | 23.5 | 6.0 |
| 200 | 8" | PN 10 | 45 | | 41.9 | | 45 | PN 10 | 43 | | 39.9 | | 43 | 6.0 |
| 250 | 10" | | 65 | | 69.4 | | 75 | | 63 | | 67.4 | | 73 | 6.0 |
| 300 | 12" | | 70 | | 72.3 | | 110 | | 68 | | 70.3 | | 108 | 6.0 |
| 350 | 14" | | 115 | | | | 175 | | 113 | | | | 173 | 6.0 |
| 400 | 16" | | 135 | | | | 205 | | 133 | | | | 203 | 6.0 |
| 450 | 18" | | 175 | | | | 255 | | 173 | | | | 253 | 6.0 |
| 500 | 20" | | 175 | | | | 285 | | 173 | | | | 283 | 6.0 |
| 600 | 24" | | 235 | | | | 405 | | 233 | | | | 403 | 6.0 |

Transmitter Promag (compact version): 3.4 kg
High-temperature version: + 1.5 kg
(Weight data valid for standard pressure ratings and without packaging material)
* Flanges according to AS are only available for DN 25 and 50.

*Promag H*

| Weight data of Promag H in kg | | | | |
|---|---|---|---|---|
| Nominal diameter | | Compact version | Remote version (without cable) | |
| [mm] | [inch] | DIN | Sensor | Transmitter |
| 2 | 1/12" | 5.2 | 2 | 6.0 |
| 4 | 5/32" | 5.2 | 2 | 6.0 |
| 8 | 5/16" | 5.3 | 2 | 6.0 |
| 15 | ½" | 5.4 | 1.9 | 6.0 |
| 25 | 1" | 5.5 | 2.8 | 6.0 |
| 40 | 1 ½" | 6.5 | 4.5 | 6.0 |
| 50 | 2" | 9.0 | 7.0 | 6.0 |
| 65 | 2 ½" | 9.5 | 7.5 | 6.0 |
| 80 | 3" | 19.0 | 17.0 | 6.0 |
| 100 | 4" | 18.5 | 16.5 | 6.0 |

Transmitter Promag (compact version): 3.4 kg
(Weight data valid for standard pressure ratings and without packaging material)

Weight (US units)

*Promag D*

| Weight data of Promag D in lbs | | | | |
|---|---|---|---|---|
| Nominal diameter | | Compact version | Remote version (without cable) | |
| [mm] | [inch] | | Sensor | Transmitter |
| 25 | 1" | 10 | 6 | 13 |
| 40 | 1 ½" | 11 | 7 | 13 |
| 50 | 2" | 13 | 9 | 13 |
| 80 | 3" | 17 | 13 | 13 |
| 100 | 4" | 23 | 19 | 13 |
| Transmitter Promag (compact version): 7.5 lbs (Weight data valid without packaging material) | | | | |

*Promag L (ANSI / AWWA: lap joint flanges / welded flanges DN >700)*

| Weight data of Promag L in lbs | | | | | |
|---|---|---|---|---|---|
| Nominal diameter | | Compact version | | Remote version (without cable) | |
| [mm] | [inch] | ANSI / AWWA | | ANSI / AWWA | |
| 50 | 2" | ANSI / Class 150 | 23 | ANSI / Class 150 | 19 |
| 65 | 2 ½" | | – | | – |
| 80 | 3" | | 31 | | 26 |
| 100 | 4" | | 35 | | 31 |
| 125 | 5" | | – | | – |
| 150 | 6" | | 56 | | 52 |
| 200 | 8" | | 99 | | 95 |
| 250 | 10" | | 143 | | 139 |
| 300 | 12" | | 243 | | 238 |
| 350 | 14" | | – | | – |
| 400 | 16" | | – | | – |
| 450 | 18" | | – | | – |
| 500 | 20" | | – | | – |
| 600 | 24" | | – | | – |
| 700 | 28" | AWWA / Class D | 611 | AWWA / Class D | 606 |
| 750 | 30" | | 725 | | 721 |
| 800 | 32" | | 873 | | 869 |
| 900 | 36" | | 1063 | | 1058 |
| 1000 | 40" | | 1324 | | 1320 |
| | 42" | | 1508 | | 1504 |
| 1200 | 48" | | 2015 | | 2011 |
| Transmitter Promag (compact version): 7,5 lbs<br>Transmitter Promag (remote version): 13 lbs<br>(Weight data valid without packaging material) | | | | | |

*Promag P (ANSI/AWWA)*

| Weight data of Promag P in lbs | | | | | | |
|---|---|---|---|---|---|---|
| Nominal diameter | | Compact version | | Remote version (without cable) | | |
| [mm] | [inch] | | | | Sensor | Transmitter |
| 15 | ½" | Class 150 | 14 | Class 150 | 10 | 13 |
| 25 | 1" | | 16 | | 12 | 13 |
| 40 | 1 ½" | | 21 | | 16 | 13 |
| 50 | 2" | | 23 | | 19 | 13 |
| 80 | 3" | | 31 | | 26 | 13 |
| 100 | 4" | | 35 | | 31 | 13 |
| 150 | 6" | | 56 | | 52 | 13 |
| 200 | 8" | | 99 | | 95 | 13 |
| 250 | 10" | | 165 | | 161 | 13 |
| 300 | 12" | | 243 | | 238 | 13 |
| 350 | 14" | | 386 | | 381 | 13 |
| 400 | 16" | | 452 | | 448 | 13 |
| 450 | 18" | | 562 | | 558 | 13 |
| 500 | 20" | | 628 | | 624 | 13 |
| 600 | 24" | | 893 | | 889 | 13 |
| Transmitter Promag (compact version): 7.5 lbs<br>High-temperature version: 3.3 lbs<br>(Weight data valid for standard pressure ratings and without packaging material) | | | | | | |

*Promag W (ANSI/AWWA)*

| Weight data of Promag W in lbs | | | | | | |
|---|---|---|---|---|---|---|
| Nominal diameter | | Compact version | | Remote version (without cable) | | |
| [mm] | [inch] | | | | Sensor | Transmitter |
| 25 | 1" | Class 150 | 16 | Class 150 | 12 | 13 |
| 40 | 1 ½" | | 21 | | 16 | 13 |
| 50 | 2" | | 23 | | 19 | 13 |
| 80 | 3" | | 31 | | 26 | 13 |
| 100 | 4" | | 35 | | 31 | 13 |
| 150 | 6" | | 56 | | 52 | 13 |
| 200 | 8" | | 99 | | 95 | 13 |
| 250 | 10" | | 143 | | 161 | 13 |
| 300 | 12" | | 243 | | 238 | 13 |
| 350 | 14" | | 386 | | 381 | 13 |
| 400 | 16" | | 452 | | 448 | 13 |
| 450 | 18" | | 562 | | 558 | 13 |
| 500 | 20" | | 628 | | 624 | 13 |
| 600 | 24" | | 893 | | 889 | 13 |

| Weight data of Promag W in lbs | | | | | | |
|---|---|---|---|---|---|---|
| Nominal diameter | | Compact version | | Remote version (without cable) | | |
| [mm] | [inch] | | | Sensor | | Transmitter |
| 700 | 28" | Class D | 882 | Class D | 878 | 13 |
| – | 30" | | 1014 | | 1010 | 13 |
| 800 | 32" | | 1213 | | 1208 | 13 |
| 900 | 36" | | 1764 | | 1760 | 13 |
| 1000 | 40" | | 1985 | | 1980 | 13 |
| – | 42" | | 2426 | | 2421 | 13 |
| 1200 | 48" | | 3087 | | 3083 | 13 |
| – | 54" | | 4851 | | 4847 | 13 |
| – | 60" | | 5954 | | 5949 | 13 |
| – | 66" | | 8159 | | 8154 | 13 |
| 1800 | 72" | | 9041 | | 9036 | 13 |
| – | 78" | | 10143 | | 10139 | 13 |
| Transmitter Promag (compact version): 7.5 lbs<br>(Weight data valid for standard pressure ratings and without packaging material) | | | | | | |

*Promag H*

| Weight data of Promag H in lbs | | | | |
|---|---|---|---|---|
| Nominal diameter | | Compact version | Remote version (without cable) | |
| [mm] | [inch] | | Sensor | Transmitter |
| 2 | 1/12" | 11 | 4 | 13 |
| 4 | 5/32" | 11 | 4 | 13 |
| 8 | 5/16" | 12 | 4 | 13 |
| 15 | ½" | 12 | 4 | 13 |
| 25 | 1" | 12 | 6 | 13 |
| 40 | 1 ½" | 14 | 10 | 13 |
| 50 | 2" | 20 | 15 | 13 |
| 65 | 2 ½" | 21 | 17 | 13 |
| 80 | 3" | 42 | 37 | 13 |
| 100 | 4" | 41 | 36 | 13 |
| Transmitter Promag (compact version): 7.5 lbs<br>(Weight data valid for standard pressure ratings and without packaging material) | | | | |

## Material

*Promag D*

- Transmitter housing: powder-coated die-cast aluminum
- Sensor housing: powder-coated die-cast aluminum
- Measuring tube: polyamide, O-rings EPDM
  (Drinking water approvals: WRAS BS 6920, ACS, NSF 61, KTW/W270)
- Electrodes: 1.4435/316L
- Ground disks: 1.4301/304

*Promag L*

- Transmitter housing:
  – Compact housing: powder-coated die-cast aluminum
  – Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing
  – DN 50 to 300: powder-coated die-cast aluminum
  – DN 350 to 1200: with protective lacquering

- Measuring tube:
  – DN ≤300; stainless steel 1.4301 or 1.4306/304L
  – DN ≥350; stainless steel 202 or 304
- Electrodes: 1.4435, Alloy C-22
- Flange
  – EN 1092-1 (DIN 2501): DN ≤ 300: 1.4306; 1.4307; 1.4301; 1.0038 (S235JRG2)
  – EN 1092-1 (DIN 2501): DN ≥ 350: A105; 1.0038 (S235JRG2)
  – AWWA: A181/A105; 1.0425/316L (P265GH); 1.0044 (S275JR)
  – AS 2129: A105; 1.0345 (P235GH); 1.0425/316L (P265GH); 1.0038 (S235JRG2); FE 410 WB
  – AS 4087: A105; 1.0425/316L (P265GH); 1.0044 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435/316L or Alloy C-22

*Promag W*

- Transmitter housing:
  – Compact housing: powder-coated die-cast aluminum
  – Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing
  – DN 25 to 300: powder-coated die-cast aluminum
  – DN 350 to 2000: with protective lacquering
- Measuring tube
  – DN ≤ 300: stainless steel 1.4301 or 1.4306/304L
    (for flanges made of carbon steel with Al/Zn protective coating)
  – DN ≥ 350: stainless steel 1.4301 or 1.4306/304
    (for flanges made of carbon steel with protective lacquering)
- Electrodes: 1.4435 or Alloy C-22, Tantalum
- Flange
  – EN 1092-1 (DIN2501): 1.4571/316L; RSt37-2 (S235JRG2); C22; FE 410 WB
    (DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective lacquering)
  – ANSI: A105; F316L
    (DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective lacquering)
  – AWWA: 1.0425
  – JIS: RSt37-2 (S235JRG2); HII; 1.0425/316L
    (DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective lacquering)
  – AS 2129
    – (DN 150, 200, 250, 300, 600) A105 or RSt37-2 (S235JRG2)
    – (DN 80, 100, 350, 400, 500) A105 or St44-2 (S275JR)
  – AS 4087: A105 or St44-2 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435/316L, Alloy C-22, Titanium, Tantalum

*Promag P*

- Transmitter housing:
  – Compact housing: powder-coated die-cast aluminum
  – Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing
  – DN 15 to 300: powder-coated die-cast aluminum
  – DN 350 to 2000: with protective lacquering
- Measuring tube
  – DN ≤ 300: stainless steel 1.4301 or 1.4306/304L; for flanges made of carbon steel with Al/Zn protective coating
  – DN ≥ 350.: stainless steel 1.4301 or 1.4306/304L; for flanges made of carbon steel with Al/Zn protective coating

- Electrodes: 1.4435, Platinum, Alloy C-22, Tantalum, Titanium
- Flange
  - EN 1092-1 (DIN2501): 1.4571/316L; RSt37-2 (S235JRG2); C22; FE 410W B (DN ≤ 300: with Al/Zn protective coating; DN ≥ 350 with protective lacquering)
  - ANSI: A105; F316L (DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective lacquering)
  - AWWA: 1.0425
  - JIS: RSt37-2 (S235JRG2); HII; 1.0425/316L (DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective lacquering)
  - AS 2129
    - (DN 25) A105 or RSt37-2 (S235JRG2)
    - (DN 40) A105 or St44-2 (S275JR)
  - AS 4087: A105 or St44-2 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435/316L or Alloy C-22

*Promag H*

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum or stainless steel field housing (1.4301/316L)
  - Wall-mounted housing: powder-coated die-cast aluminum
  - Window material: glas or polycarbonate
- Sensor housing: stainless steel 1.4301
- Wall mounting kit: stainless steel 1.4301
- Measuring tube: stainless steel 1.4301
- Liner: PFA (USP class VI; FDA 21 CFR 177.1550: 3A)
- Electrodes:
  - Standard: 1.4435
  - Option: Alloy C-22, Tantalum, Platinum
- Flange:
  - All connections stainless-steel 1.4404/316L
  - EN (DIN), ANSI, JIS made of PVDF
  - Adhesive fitting made of PVC
- Seals
  - DN 2 to 25: O-ring (EPDM, Viton, Kalrez), gasket seal (EPDM*, Viton, Silicone*)
  - DN 40 to 100: gasket seal (EPDM*, Silicone*)

  * = USP class VI; FDA 21 CFR 177.2600: 3A
- Ground rings: 1.4435/316L (optional: Tantalum, Alloy C-22)

**Material load diagram**

The material load diagrams (pressure-temperature graphs) for the process connections are to be found in the "Technical Information" documents of the device in question:
List of supplementary documentation → 116.

**Fitted electrodes**

*Promag D*

- 2 measuring electrodes for signal detection

*Promag L, W and P*

- 2 measuring electrodes for signal detection
- 1 EPD electrode for empty pipe detection
- 1 reference electrode for potential equalization

*Promag H*

- 2 measuring electrodes for signal detection
- 1 EPD electrode for empty pipe detection (apart from DN 2 to 15)

Process connections

*Promag D*

Wafer version → without process connections

*Promag L*

Flange connections:
- EN 1092-1 (DIN 2501)
  - DN ≤ 300 = Form A
  - DN ≥ 350 = Form B
- ANSI
- AWWA
- AS

*Promag W and P*

Flange connections:
- EN 1092-1 (DIN 2501)
  - DN ≤ 300 = form A
  - DN ≥ 350 = flat face
  - DN 65 PN 16 and DN 600 PN 16 only as per EN 1092-1
- ANSI
- AWWA (only Promag W)
- JIS
- AS

*Promag H*

With O-ring:
- Weld nipple DIN (EN), ISO 1127, ODT/SMS
- Flange EN (DIN), ANSI, JIS
- Flange made of PVDF EN (DIN), ANSI, JIS
- External thread
- Internal thread
- Hose connection
- PVC adhesive fitting

With gasket seal:
- Weld nipple DIN 11850, ODT/SMS
- Clamp ISO 2852, DIN 32676, L14 AM7
- Threaded joint DIN 11851, DIN 11864-1, ISO 2853, SMS 1145
- Flange DIN 11864-2

Surface roughness

All data relate to parts in contact with fluid.

- Liner → PFA: ≤ 0.4 µm (15 µin)
- Electrodes: 0.3 to 0.5 µm (12 to 20 µin)
- Process connection made of stainless-steel (Promag H): ≤ 0.8 µm (31 µin)

## 10.1.11 Human interface

Display elements

- Liquid crystal display: illuminated, two-line, 16 characters per line
- Custom configurations for presenting different measured-value and status variables
- 2 totalizers

Note!
At ambient temperatures below –20 (–4 °F) the readability of the display may be impaired.

| | |
|---|---|
| Operating elements | ■ Local operation with three keys (−, +, E)<br>■ "Quick Setup" menus for straightforward commissioning |
| Language groups | Language groups available for operation in different countries:<br>■ Western Europe and America (WEA):<br>English, German, Spanish, Italian, French, Dutch and Portuguese<br>■ Eastern Europe/Scandinavia (EES):<br>English, Russian, Polish, Norwegian, Finnish, Swedish and Czech<br>■ Southeast Asia (SEA):<br>English, Japanese, Indonesian<br> Note!<br>You can change the language group via the operating program "FieldCare". |
| Remote operation | Operation via HART protocol and Fieldtool |

### 10.1.12 Certificates and approvals

| | |
|---|---|
| CE mark | The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark. |
| C-tick mark | The measuring system meets the EMC requirements of the Australian Communications and Media Authority (ACMA) |
| Ex approval | Information about currently available Ex versions (ATEX, FM, CSA, IECEx, NEPSI etc.) can be supplied by your Endress+Hauser Sales Center on request. All explosion protection data are given in a separate documentation which is available upon request. |
| Sanitary compatibility | *Promag D, L, W and P*<br>No applicable approvals or certification<br><br>*Promag H*<br>■ 3A authorization and EHEDG-tested<br>■ Seals: in conformity with FDA (except Kalrez seals) |
| Drinking water approval | *Promag D, L and W*<br>■ WRAS BS 6920<br>■ ACS<br>■ NSF 61<br>■ KTW/W270<br><br>*Promag P and H*<br>No drinking water approval |
| Pressure Equipment Directive | *Promag D and L*<br>No pressure measuring device approval<br><br>*Promag W, P and H*<br>The measuring devices can be ordered with or without PED (Pressure Equipment Directive). If a device with PED is required, this must be ordered explicitly. For devices with nominal diameters less than or equal to DN 25 (1"), this is neither possible nor necessary. |

- "With the identification PED/G1/III on the sensor nameplate, Endress+Hauser confirms conformity with the "Basic safety requirements" of Appendix I of the Pressure Equipment Directive 97/23/EC.
- "Devices with this identification (with PED) are suitable for the following types of fluid:
  – Fluids of Group 1 and 2 with a steam pressure of greater or less than 0.5 bar (7.3 psi)
  – Unstable gases
- "Devices without this identification (without PED) are designed and manufactured according to good engineering practice. They correspond to the requirements of Art. 3, Section 3 of the Pressure Equipment Directive 97/23/EC. Their application is illustrated in Diagrams 6 to 9 in Appendix II of the Pressure Equipment Directive 97/23/EC.

Other standards and guidelines

- EN 60529
  Degrees of protection by housing (IP code).
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC/EN 61326
  Electromagnetic compatibility (EMC requirements)
- ANSI/ISA-S82.01
  Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment – General Requirements. Pollution degree 2, Installation Category II.
- CAN/CSA-C22.2 (No. 1010.1-92)
  Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2, Installation Category I.
- NAMUR NE 21
  Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.
- NAMUR NE 43
  Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.

### 10.1.13 Ordering information

Your Endress+Hauser service organization can provide detailed ordering information and information on the order codes on request.

### 10.1.14 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor → 📄 76.
Your Endress+Hauser service organization can provide detailed information on the specific order codes on request.

### 10.1.15 Documentation

- Flow measuring technology (FA005D/06)
- Technical Information Promag 50D (TI082D/06)
- Technical Information Promag 50L (TI00097D/06)
- Technical Information Promag 50W, 53W (TI046D/06)
- Technical Information Promag 50P, 53P (TI047D/06)
- Technical Information Promag 50H, 53H (TI048D/06)
- Description of Device Functions Promag 50 HART (BA049D/06)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, etc.

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Endress+Hauser

People for Process Automation

# Declaration of Hazardous Material and De-Contamination

## *Erklärung zur Kontamination und Reinigung*

**RA No.** ☐☐☐☐☐☐☐☐

Please reference the Return Authorization Number (RA#), obtained from Endress+Hauser, on all paperwork and mark the RA# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility.

*Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.*

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.

*Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.*

**Type of instrument / sensor**
*Geräte-/Sensortyp* _____

**Serial number**
*Seriennummer* _____

☐ **Used as SIL device in a Safety Instrumented System /** *Einsatz als SIL Gerät in Schutzeinrichtungen*

**Process data/** *Prozessdaten*

Temperature / *Temperatur*_____ [°F] _____ [°C]
Pressure / *Druck* _____ [psi] _____ [ Pa ]
Conductivity / *Leitfähigkeit* _____ [µS/cm]
Viscosity / *Viskosität* _____ [cp] _____ [$mm^2/s$]

**Medium and warnings**
*Warnhinweise zum Medium*

| | Medium /concentration *Medium /Konzentration* | Identification CAS No. | flammable *entzündlich* | toxic *giftig* | corrosive *ätzend* | harmful/ irritant *gesundheits-schädlich/ reizend* | other * *sonstiges** | harmless *unbedenklich* |
|---|---|---|---|---|---|---|---|---|
| Process medium / *Medium im Prozess* | | | | | | | | |
| Medium for process cleaning / *Medium zur Prozessreinigung* | | | | | | | | |
| Returned part cleaned with / *Medium zur Endreinigung* | | | | | | | | |

* explosive; oxidising; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.
*Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.*

**Description of failure /** *Fehlerbeschreibung* _____

_____

_____

**Company data /** *Angaben zum Absender*

Company / *Firma* _____

_____

Address / *Adresse*

_____

_____

Phone number of contact person / *Telefon-Nr. Ansprechpartner:*

_____

Fax / E-Mail _____

Your order No. / *Ihre Auftragsnr.* _____

"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge.We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."

*"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefahrbringender Menge sind."*

_____ (place, date / *Ort, Datum*)

_____ Name, dept./*Abt.* (please print / *bitte Druckschrift*)

_____ Signature / *Unterschrift*

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Endress+Hauser

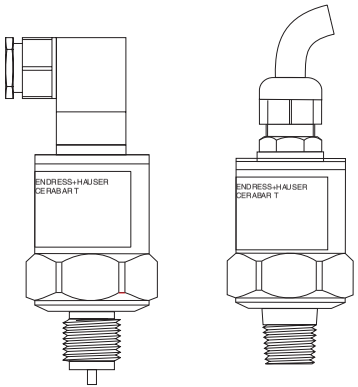
People for Process Automation

BA00046D/06/EN/14.11
71136623
FM+SGML6.0 ProMoDo

Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Operating Instructions

# Cerabar T PMC131




**de** - Drucktransducer
**en** - Pressure Transducer
**fr** - Transducteur de pression
**it** - Trasduttore di pressione
**es** - Transmisorde presión
**nl** - Druk-transducer

KA00085P/00/A6/13.12
71158704

Endress+Hauser
People for Process Automation

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## de - Sicherheitshinweise

Der Cerabar T dient der Absolut- und Relativdruckmessung in Gasen, Dämpfen, Flüssigkeiten und Stäuben. Bei unsachgemäßem Einsatz können Gefahren von ihm ausgehen. Das Gerät darf nur von qualifiziertem und autorisiertem Fachpersonal unter strenger Beachtung dieser Betriebsanleitung und der Technischen Information TI00415P, der einschlägigen Normen, gesetzlichen Vorschriften und Zertifikate eingebaut, angeschlossen, in Betrieb genommen und gewartet werden.

## en - Notes on Safety

The Cerabar T is designed for measuring absolute and gauge pressure of gases, vapours, liquids and dusts. If used incorrectly it is possible that application related dangers may arise.The Cerabar T may be installed, commissioned, operated and maintained by qualified and authorised personnel only, under strict observance of these operating instructions and Technical Information TI00415P, any relevant standards, legal requirements, and, where appropriate, the certificate.

## fr - Conseils de sécurité

Le Cerabar T est destiné à la mesure de pression absolue et relative dans les gaz, vapeurs, liquides et poussières. Il peut être source de danger en cas d'utilisation non conforme aux prescriptions. L'appareil ne doit être installé, raccordé, mis en service et maintenu que par un personnel qualifié et autorisé, qui tiendra compte des indications contenues dans la présente mise en service et de l' Information Technique TI00415P, des normes en vigueur et des certificats disponibles (selon l'application).

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## es - Notas sobre seguridad

Cerabar T está diseñado para medir presión absoluta y relativa en gases, vapores, liquidos y sólidos pulvurulentos. Su empleo inapropiado puede resultar peligroso. El equipo deberá ser montado, conectado, instalado y mantenido única y exclusivamente por personal cualificado y autorizado, bajo rigurosa observación de las presentes instrucciones de servicio y de la Información Técnica TI00415P, de las normativas y legislaciones vigentes, así como de los certificados (dependiendo de la aplicación).

## it - Note sulla sicurezza

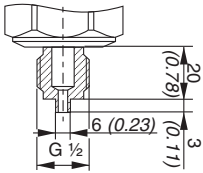
Il Cerabar T è stato progettato per la misura della pressione assoluta e relativa di gas, vapori, liquidi e polveri. Un'installazione non corretta può determinare pericolo per le persone e le cose. Lo strumento deve essere montato collegato e messo in servizio solamente da personale qualificato ed autorizzato, nel totale rispetto delle indicazioni operative qui riportate, delle prescrizioni presenti nelle informazioni tecniche TI00415P ed in accordo a tutte le norme e legislazioni vigenti e le certificazioni utilizzate.

## nl - Veiligheidsinstructies

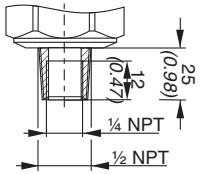
De Cerabar T is ontworpen voor het meten absoluut en overdruk van gassen, dampen, vloeistoffen en vaste stoffen. Bij niet correct gebruik kunnen gevaarlijke situaties onstaan. Het instrument mag uitsluitend door gekwalificeerd en geautoriseerd vakpersoneel geinstalleerd, aangesloten en inbedrijf genomen worden met inachtneming van dit inbedrij-fstellingsvoorschrift, het bijbehorende Technisch Informatie blad TI00415P en de betreffende normen, de wettelijke voorschriften en eventuele certificaten in acht.

de - Geräte-Identifikation
en - Device Identification
fr - Dénomination de l'appareil
es - Identificación del equipo
it - Identificazione dello strumento
nl - Instrument-identificatie
Endress+Hauser
Cerabar T
PMC131- ## # # # ###
p
SER No.
Tag.No.
IP ##
Nema##
(1) (rd) +
(2) (bk) –
A1 = M16x1.5, ISO 4400, IP 65/NEMA 4X
A2 = ½ NPT, ISO 4400, IP 65/NEMA 4X
A3 = 5 m (15 ft), IP 68/NEMA 6P
A4 = 25 m (75 ft), IP 68/NEMA 6P
A5 = M12, IP65/NEMA 4
B1 = M16x1.5, ISO 4400, IP 65/NEMA 4X
ATEX II 3G EEx nA II T4
B3 = 5 m, IP 68/NEMA 6P
ATEX II 3G EEx nA II T4
B5 = M12, IP 65, ATEX II 3G EEx nA II T4
C1 = M16x1.5, ISO 4400, IP 65/NEMA 4X,
CSA GP
C2 = ½ NPT, ISO 4400, IP 65/NEMA 4X,
CSA GP
C3 = 5 m (15 ft), IP 68/NEMA 6P, CSA GP
C5 = M12, IP 65/NEMA 4, CSA GP
M12
M16x1.5
½ NPT
5 m (15 ft)
25 m (75 ft)

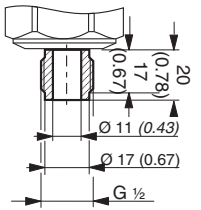
1 = G ½A, ISO 228
1.4301 (AISI 304)




2 = ½ MNPT, ¼ FNPT,
1.4301 (AISI 304)




5 = G ½A, ø11 mm, ISO228
1.4301 (AISI 304)




F = FKM Viton
S = FKM Viton, $O_2$

1 = ohne/without/sans/sin/senza/zonder
2 = Protokoll/Protocol/Protocole
S = German Lloyd

p

D10 = 0..100 mbar, 0...10 kPa
• • •
R4T = 0...500 psi a

**de - Montage**

- Die Funktion des Drucktransducers ist unabhängig von der Einbaulage.
- Zum Schutz des Gewindes und der Druckmembran darf die Schutzkappe am Gewindestutzen erst kurz vor dem Einbau entfernt werden.
- Der Drucktransducer ist nach den gleichen Richtlinien wie ein Manometer zu montieren. Wir empfehlen die Verwendung von Absperrhähnen und Wassersackrohren.
- Beim Einbau ist darauf zu achten, dass kein Tropfwasser in das Gehäuse eindringen kann.
- Einsatzgrenzen für Sauerstoff beachten (bei FKM Viton/$O_2$ gemäß BAM-Liste).
- Bei Anwendungen in explosionsfähiger Atmosphäre der Zone 2 (Zündschutzart Ex nA), Gehäuse vor Schlageinwirkung schützen.

**en - Mounting**

- The function of the transducer is independent of mounting orientation.
- To protect the thread and pressure diaphragm from damage, the protective cover on the threaded nozzle should be removed just before installation only.
- The pressure transducer is to be mounted like a manometer. The guidelines are identical. Isolating valves and water pocket pipes should be used.
- When installing, ensure that no water enters the housing.
- Note the application limits for oxygen (for FKM Viton/$O_2$ as per BAM list).
- In the event of applications in a Zone 2 explosive atmosphere (Ex nA explosion protection) protect the housing from impact.

**fr - Montage**

- Le fonctionnement du transducteur de pression est indépendant de son implantation.
- Afin de protéger le filetage et la membrane, ne retirer le capot de protection, placé sur le raccord fileté, qu'au moment du montage.
- Le transducteur de pression doit être monté conformément aux directives concernant les manomètres. Nous recommandons l'utilisation de robinets d'isolement et de siphons.
- Lors du montage, veiller à ce qu'il n'y ait pas d'infiltration d'eau dans le boîtier.
- Tenir compte des limites d'utilisation sur l'oxygène (pour FKP Viton/$O_2$ selon liste BAM).
- Les applications en atmosphère explosible de zone 2 (mode de protection antidéflagrant Ex nA), protéger le boîtier contre les chocs.

**es - Montaje**

- El funcionamiento del transmisor de presión es independiente de la orientación de montaje.
- No retirar la protección del casquillo roscado hasta el momento previo a su instalación para evitar dañar la rosca o el diafragma de presión.
- El transmisor de presión se deberá montar como un manómetro. El procedimiento es el mismo. Utilizar válvulas de corte y sifón.
- Durante la instalación asegurar que no entre agua en la caja.
- Observar los límites de utilización en oxígeno (para FKP Viton/$O_2$ según lista BAM).
- En las aplicaciones en atmósferas con riesgo de explosión de la zona 2 (tipo de protección contra ignición Ex nA) se debe proteger la carcasa contra el efecto de los impactos.

**it - Montaggio**

- Il funzionamento del trasduttore non dipende dalla posizione di montaggio.
- Per proteggere la filettatura e la membrana di pressione da eventuali danneggiamenti, eliminare il coperchio di protezione dell'ugello filettato solo immediatamente prima dell'installazione.
- Il trasduttore di pressione deve essere montato come un manometro. Utilizzare solo valvole di arresto e tubi separatori d'acqua.
- Durante l'installazione, assicurarsi che non entri acqua nella custodia.
- Osservare i limiti operativi per ossigeno (per FKM Viton/$O_2$ in accordo con lista BAM).
- Per l'utilizzo in ambienti a rischio di esplosione della zona 2 (Protezione antideflagrante Ex nA), proteggere le custodie contro gli urti.

**nl - Montage**

- Het functioneren van de Druk-transducer is onhafhankelijk van de montagepositie.
- Ter bescherming van de buitendraad en het membraan moet de beschermhuls pas vlak voor de montage verwijderd worden.
- De Druk-transducer moet identiek als een manometer gemonteerd worden. De richtlijnen t.a.v. gebruik van afsluitkranen, afstandsstukken en watersloten moeten worden aangehouden.
- Bij installatie ervoor zorgen dat er geen water in de behuizing kan komen, ook niet via de connector/wartel.
- Toepassingen in zuurstof bekijken (met FKM Viton/$O_2$ conform BAM lijst).
- Bescherm de behuizing tegen schokken bij toepassingen in explosiegevaarlijke atmosferen zone 2 (ontstekingsklasse Ex nA).

de - Elektrischer Anschluss
Stecker-Version

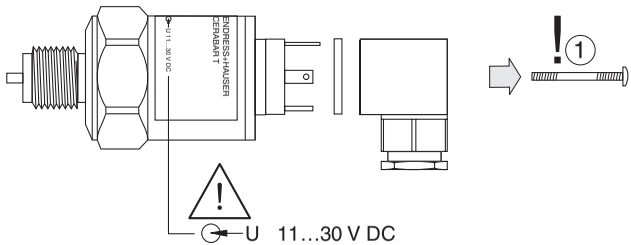
en - Electrical Connection
Plug version

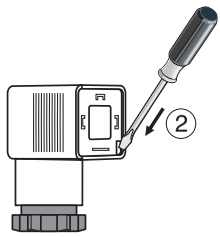
fr - Raccordement électrique
Version connecteur

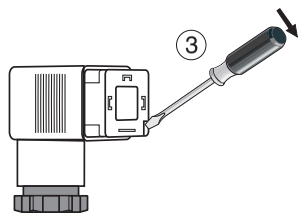
es - Conexión eléctrica
Con conector

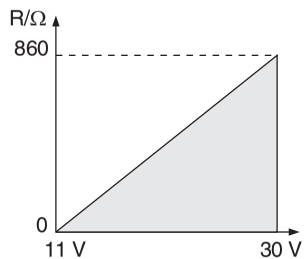
it - Collegamento elettrico
Spina

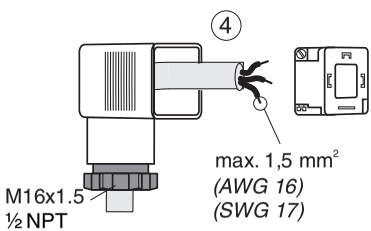
nl - Elektrische aansluiting
Steker-versie

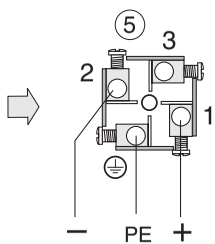


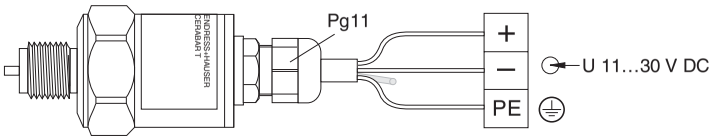



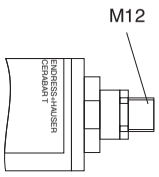






**de - Referenzluft- Zuführung**
Nicht verschließen! Vor Wasser schützen!

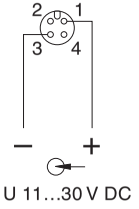
**en - Reference air tube**
Do not close! Protect from water!




**fr - Mise à l'atmosphère**
Ne pas boucher! Prótéger de l'eau!

**es - Tubo de compensación de presión atmosférica**
No tapar! Proteger del agua!

**it - Ingresso aria di riferimento**
Non chiudere! Proteggere dall'acqua!




**nl - Drukvereffening**
Niet laten vervuilen en beschermen tegen vocht!

**de** + = rot; – = schwarz, PE = grün/gelb
**en** + = red; – = black, PE = green/yellow
**fr** + = rouge; – = noir, PE = vert/jaune
**es** + = rojo, – = negro, PE = verde/amarillo
**it** + = rosso, – = nero, PE = verde/giallo
**nl** + = rood; – = zwart, PE = groen/geel

**de - Elektrischer Anschluß**
**Kabel-/Stecker-Version**

**en - Electrical Connection**
**Cable/plug version**

**fr - Raccordement électrique**
**Version câble/connecteur**

**es - Conexión eléctrica**
**Cable/conector**

**it - Collegamento elettrico**
**Cavo/spina**

**nl - Elektrische aansluiting**
**Kabel-/steker-versie**

**de - Einsatzbedingungen**

- Umgebungstemperatur: –20…85 °C
- Lagerungstemperatur: –50…100 °C
- Meßstofftemperaturgrenze: max. 100 °C
- Meßstoffdruckgrenze: $p_{max}$
- Geräte mit CSA GP-Zulassung dürfen nur mit einer SELV oder Class 2 Spannungsversorgung betrieben werden.

**en - Operating Conditions**

- Ambient temperature range: –20…85°C
- Storage temperature range: –50…100°C
- Limiting temperature range: max. 100°C
- Limiting pressure range: $p_{max}$
- Devices with CSA GP approval may only be operated with a SELV or Class 2 power supply.

**fr - Conditions d'utilisation**

- Température ambiante: –20…85 °C
- Température de stockage: –50…100 °C
- Limite de température du produit: max. 100 °C
- Limite de pression du produit: $p_{max}$
- Les appareils avec agrément CSA GP ne doivent être utilisés qu'avec une tension d'alimentation SELV ou Class 2.

**es - Condiciones de operación**

- Rango de temperatura ambiental: –20…85 °C
- Rango de temperatura de almacenamiento: –50…100 °C
- Temperatura máxima de trabajo: máx. 100 °C
- Presión máx. de trabajo: $p_{max}$
- Los equipos con la certificación CSA GP sólo pueden trabajar con alimentación de clase 2 o SELV.

**it - Condizioni operative**

- Temperatura ambiente: –20…85 °C
- Temperatura per la conservazione in magazzino: –50…100 °C
- Temperatura limite del prodotto: max. 100 °C
- Pressione limite del prodotto: $p_{max}$
- Strumenti con approvazione CSA GP possono essere alimentati solo con unità tipo SELV o Classe 2

**nl - Omgevingscondities**

- Omgevingstemperatuur: –20…+85 °C
- Opslagtemperatuur: –50…100 °C
- Producttemp. : max. 100 °C
- max. procesdruk: $p_{max}$
- Instrumenten met een CSA GP certificaat mogen uitsluitend via een SELV of een klasse 2 voeding gevoed worden.

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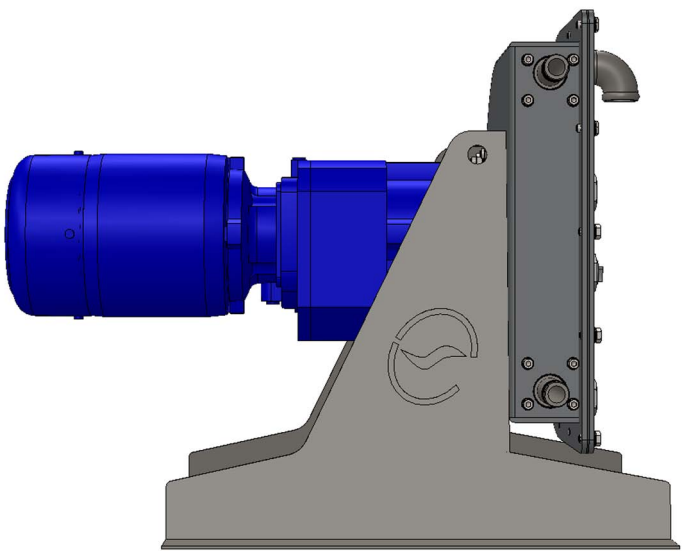
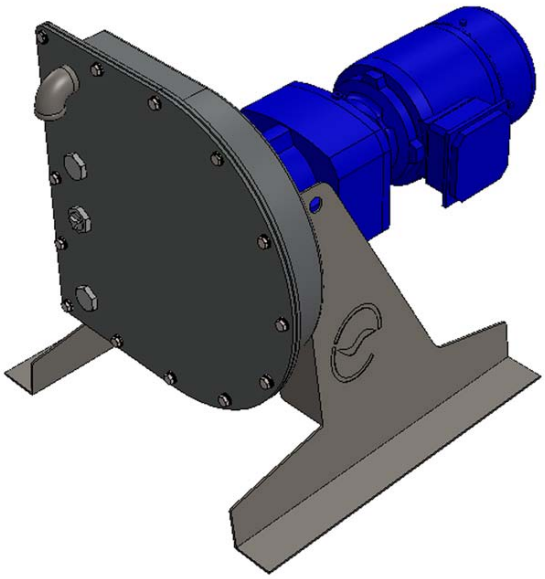
# ENVIROFLEX® L SERIES

## L20 to L80 Peristaltic Pumps

## Installation, Operation & Maintenance Manual





| **BEFORE INSTALLING YOUR PUMP HAVE YOU……..** | Tick |
|---|---|
| Read this Manual in its entirety? | |
| Ordered recommended spares? (spares not always in stock) | |
| Checked we have shown the correct pump duty on the data sheet? | |
| Checked pump supplied as per the technical data sheet? | |
| Installed overpressure protection for the pump? | |
| Protected the pump motor against over current? | |
| Installed suitable pulsation dampeners where required? | |
| Completed all Pre start-up checks highlighted in this manual? | |

Manual Revision 1 December 2012 CE

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Manual Revision 1 December 2012

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# 1 Introduction

Thank you for choosing a quality pump from Environmental Pumping Solutions Ltd.

Critical information before start up:

**For safety reasons and in order for you to get the full usage of your new pump, it is necessary to read this manual thoroughly before putting it into service.**

Ensure all commissioning checks on page 14 have been carried out

Within 7 days of delivery and before mounting and installing the pump please make sure that the unit corresponds exactly to that ordered and has not been damaged during transport.

This manual is divided into 4 parts:

1. **Introduction** to give the user an overview of the pump and this manual.
2. **Installation Guide** for installing or uninstalling and commissioning the pump.
3. **Maintenance Guide** for maintenance, repair or troubleshooting.
4. **User Guide** for daily use of the pump.

The L series pump range provides a high quality product that is designed to provide reliability, low energy consumption and low maintenance costs.

Environmental Pumping Solutions Ltd supplies the complete range of peristaltic hose pumps including 10mm (3/8”), 15mm (1/2”), 20mm (3/4”), 25mm (1”), 32mm (1 1/4”), 40mm (1 1/2”), 50mm (2”), 65mm (2 1/2”), 80mm (3”), 100mm (4”) and 150mm (6”).

## 1.1 *General*

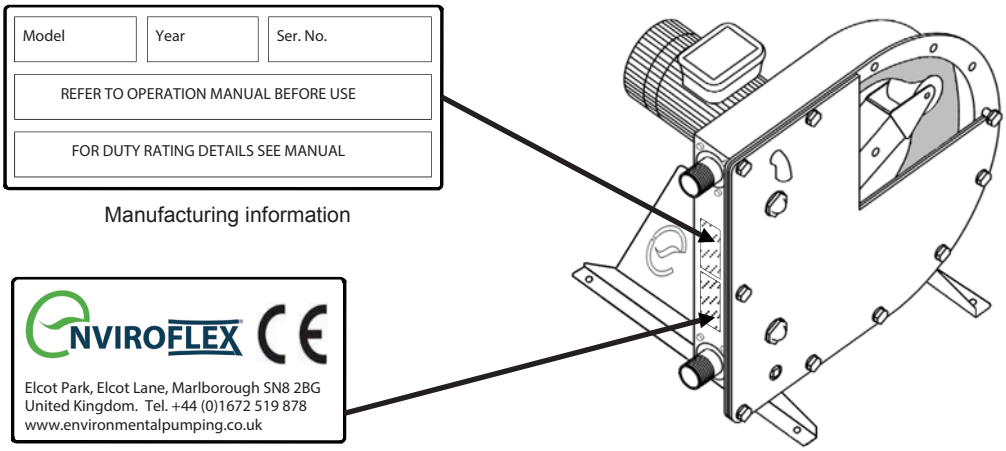
These instructions are intended as a reference book by means of which qualified users are able to install, commission and maintain Environmental Pumping Solutions L series peristaltic pumps. These instructions do not absolve the user of responsibility for carrying out work in accordance with good engineering practices and adherence to local Health & Safety regulations.

Documentation on the drive system used with the pump is not included within this manual. Reference must be made to separate documentation for the drive system, and its recommendations and instructions strictly observed.

For further information specifically about the L series range of peristaltic pumps which is not found within these instructions, please contact Environmental Pumping Solutions Limited, or your authorised local dealer.
Please ensure you have the following data at hand:

- serial number of the pump
- material of the pump hose
- serial number of the drive gearbox and motor

Identification plates are mounted on the pump head, drive gearbox and electric motor.




Labels fixed to the pump body contain model type, year of manufacture, product serial number and manufacturer's details.

## 1.2 *Safety*

In these instructions the following symbols are used:

**WARNING**
Procedures, which, if not carried out with the necessary care, may result in serious damage to the pump equipment or in serious bodily harm.

**CAUTION**
Procedures not carried out with the necessary care, may result in serious damage to the pump equipment, the surrounding area or the environment.

Remarks, suggestions and advice.

During installation & maintenance all personnel should ensure they wear suitable personal protection equipment (PPE) such as safety glasses, gloves, safety boots and safety helmets as appropriate.

## 1.3 *Intended Use*

Environmental Pumping Solutions L series peristaltic pumps are designed exclusively for pumping suitable products as defined in the technical data sheet supplied with your final quotation. Every other or further use is not in conformance with the "intended use" as laid down in EN 292-1.(1) The manufacturer cannot be held responsible for damage or harm resulting from use other than the "intended use".

If you wish to change the application of your pump, please contact Environmental Pumping Solutions Limited, or your authorised local dealer to establish if the change is appropriate for the supplied pump.

(1) The "Intended use" as laid down in EN 292-1 is "… the use for which the technical product is intended in accordance with the specifications of the manufacturer, inclusive of his indications in the sales brochure". In case of doubt it is the use which appears to be its intended use judging from the construction, execution and function of the product. Observing the instructions in the user's documentation also belongs to intended use.

## 1.4 *Warranty Conditions*

Unless stated otherwise in the Technical Selection Sheet provided at the time of pump selection, the manufacturer offers a two–year warranty on proper workmanship of all parts of the pump. Exclusion is made for normal wear and tear of consumables, such as pump hoses, lubricant, hose clamps, compression rollers, bearings and bushes, wear ring and seals, or parts which have been misused or damaged through negligence.

The warranty only applies if the pump has been used for the application specified in the technical selection sheet and according to the guidance in this manual. Operation at pressures outside of the range specified in the Technical Selection Sheet shall invalidate this warranty.

This manufacturer's warranty is null and void for any user who uses parts not of Environmental Pumping Solutions Limited original supply in their L series peristaltic pump (including use of an alternative hose lubricant).

The warranty is strictly a return to base warranty, which means that the pump is required to be returned to our UK factory by arrangement for any investigation, replacement or repair work. The cost of transport back to our factory is not covered by this warranty; however with any valid warranty claim all time, replacement parts and carriage back to the original delivery address are included.

Any parts to be returned to the manufacturer must be accompanied by a fully filled in and signed declaration form declaring the conditions of use and materials pumped. Parts which have been contaminated or which have been corroded by chemicals or other substances which can pose a health risk must be cleaned before they are returned to the manufacturer.

Furthermore, it should be indicated in the declaration form what specific cleaning procedures have been followed, and that the equipment has been decontaminated.

The declaration form is required for all items, even if the parts have not been used.

A Declaration Form can be found at the end of this manual.

Warranties purporting to be on behalf of Environmental Pumping Solutions Limited made by any person, including representatives of Environmental Pumping Solutions Limited, its subsidiaries, or its distributors, which do not accord with the terms of this warranty shall not be binding upon Environmental Pumping Solutions Limited unless expressly approved in writing by a Director of Environmental Pumping Solutions Limited.

## 1.5 *Description*

### 1.5.1 Operation of the pump

The heart of the L series peristaltic pump is a specially constructed pump hose which lies within the pump housing. (Upon pump installation both ends of this hose are connected to the suction and discharge lines). A rotor with two opposing compression rollers lies in the centre of the pumphead.

During pump operation the rotor rotates, with the compression rollers compressing the pump hose. This action "pushes" the pumped fluid through the hose, and as soon as the compression

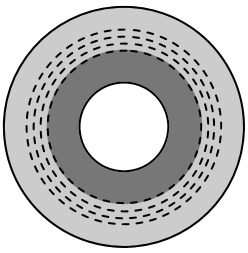
roller has passed, the hose recovers to its original shape due to the mechanical properties of the material.

Simultaneously fresh pumped fluid is drawn into the hose behind the compression roller by the (continuous) turning motion of the rotor.

The second compression roller will subsequently compress the pump hose. Due to the continuous rotating movement of the rotor not only is new product sucked in, but the already present product is pushed out by the moving compression roller. When the first compression roller leaves the pump hose, the second compression roller has already closed the pump hose and the product is prevented from flowing back. This is known as the “positive displacement principle” pumping principle.

### 1.5.2 Pump hose

The pump hose is made of specially compounded rubbers, reinforced with nylon cords. The outer cover of the pump hose is always made of natural rubber, whilst the inner layer is supplied in a variety of materials to suit the product to be pumped.



Dependent on the specific requirements of your application a corresponding pump hose must be selected. For each pump model various hose types are available.

*i* Consult Environmental Pumping Solutions Limited or your authorised local dealer for more detailed information about the range of hoses available, and their chemical and temperature resistance.

Environmental Pumping Solutions pump hoses have been carefully machined, to ensure minimum tolerances in wall thickness. It is very important to guarantee the correct compression of the pump hose, because over compression can cause too high a load on the pump and pump hose leading to reduced pump hose life and gearbox failure.

Under compression will result in loss of capacity and backflow resulting in reduced pump hose life.

*i* Please refer to the maintenance section of this manual regarding adjustment of hose compression settings.

### 1.5.3 Hose Lubrication

The pumphead is part filled with our specially compounded Envirolube lubricant. The lubricant lubricates the compression rollers and movement between the hose and the pump housing and the cover.

To those familiar with other types of peristaltic pumps utilising compressions shoes, our lubricant may appear thin, but this is essential in order to reach the roller bearings with maximum efficiency of lubrication.

Our lubricant is the result of decades of development and is perfectly mixed for use specifically in the L series pumps, ensuring the hose is fully lubricated at all times with no reaction on the hose material that would cause swelling and early hose failure.

Environmental Pumping Solutions Envirolube lubricant will not freeze during cold weather.

### 1.5.4 Drive systems

The L series pumps described in this manual use a variety of drive types. Motors and gearboxes are selected according to the particular application for which the pump is applied.

### 1.5.5 Available options

The following options are available for the L series range of pumps:

- Hose Failure Detectors (senses elevated lubricant levels within the pump as a result of hose failure)
- Flanged pipework connections
- Complete stainless steel pumps

# 2 Installation

## 2.1 *Unpacking*

Upon unpacking of the pump check and inspect all items against the purchase order and packing list and for any damage caused during shipment. All claims for shortages and/or damage must be notified immediately to Environmental Pumping Solutions Limited.

Suitable lifting equipment must be used when handling components and assembling pumps.

ENVIRONMENT

When disposing of unwanted packaging materials, please consider the possibilities for reuse or environmentally friendly processing of packaging materials.
Always observe local regulations with respect to disposal of non reusable items.

## 2.2 *Storage*

After receipt and inspection, if pumps are not to be put into service immediately provision should be made for the pump to be rotated for a couple of turns on a weekly basis, ensuring the rollers are not allowed to come to rest in the same position consecutively. Alternatively one roller can be removed from the pump, leaving the remaining roller not in contact with the hose between the inlet and outlet ports.

Failure to adhere to the above procedure may result in a ‘permanent set’ of the hose which can result in reduced performance and premature hose failure.

Pumps that are to be stored for extended periods of time should have the hoses removed and stored in accordance with Environmental Pumping Solutions recommendations. The pumps should be repackaged and placed in a suitable clean dry storage area free from excess moisture and vibrations. Protective blanking caps fitted before despatch from the factory should not be removed. Any unpainted surfaces not factory treated with a rust inhibiting coating should have a protective coating applied.

Where applicable, if pumps were supplied with electric motors fitted with anticondensation heaters, these should be connected to a temporary supply and switched on throughout the storage period.

## 2.3 *Locating the Pump*

Before mounting the pump, make sure that all your site safety procedures have been reviewed and that any appropriate risk assessments have been completed.

Upon installation ensure that all markings on the pump will be clearly visible when installation is complete.

Ensure the pump is to be sited in an area where the ambient temperature during operation is not below –15° and above +45°C.

Check that the foundation where the pump is to be mounted can carry the load of the pump. Also have the appropriate SWL marked lifting gear / crane ready for the given situation.

Ensure the foundation/floor surface is flat and horizontal. Minor irregularities in surface level can be accommodated by the use of shims placed under the support frame.

Ensure there is sufficient room around the pump to carry out the necessary maintenance activities. Particularly ensure the front cover door can be opened and a hose taken out and replaced (If it cannot, it maybe possible to modify the door to remove the hinge if fitted, please enquire).

Ensure the installation environment is sufficiently ventilated allowing heat developed by the pump and drive to be discharged, particularly that the motor cowl has sufficient air to circulate to support cooling.

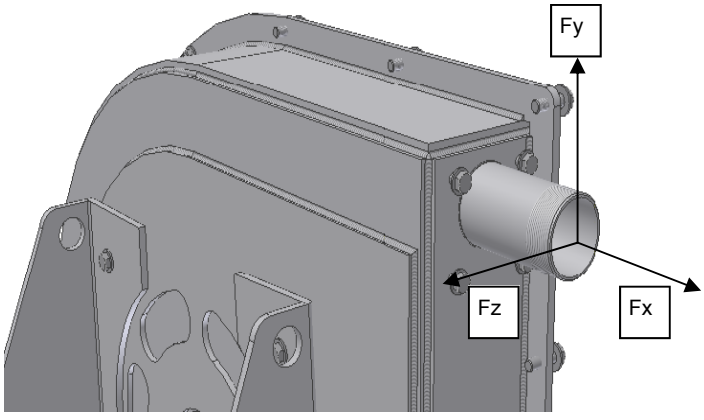
No special tools are required to install the L series pumps, other than ordinary hand tools and a hammer/drilling machine for the installation of the foundation bolts.

## 2.4 *Connecting the Pipework*

It is recommended that the connection to a pipe system is made as a flexible joint. There are several flexible systems on the market which include both metallic and rubber systems.

By making a flexible joint, the risk of introducing vibrations into the complete pipe system is reduced. Vibrations may cause wear and in some cases fatigue fractures in the pipe system.

The pipework system must be independently supported and must not use the pump in anyway to support its weight (The pipe system must never hang by the connections of the pump).




| Permissible Load (N) | | | |
|---|---|---|---|
| | **L20 & 25** | **L32** | **L40** |
| **Fx** | 600 | 600 | 800 |
| **Fy** | 150 | 150 | 200 |
| **Fz** | 150 | 150 | 200 |
| | **L50** | **L65** | **L80** |
| **Fx** | 1000 | 1200 | 1500 |
| **Fy** | 200 | 300 | 300 |
| **Fz** | 200 | 300 | 300 |

Suction line bore must be larger than the bore size of the pump hose. Discharge line bore must be the same or larger than the bore size of the pump hose.

Keep the suction and delivery lines as short and direct as possible.

Suction and discharge lines should preferably exit straight from the pump so that the pump is not pumping directly into a restriction for example a 90 degree bend, as this may cause the hose to come off. Where bends are used, ensure the radiuses are as large as possible. It is recommended to use Y-connections instead of T-connections.

Prevent any possibilities of exceeding the maximum working pressure of the pump. It is essential that you discuss this with your system designers in order to ensure safe system and pump operation. If necessary fit an overpressure protection device.

To avoid misunderstanding, protecting the motor against over current will not protect the pump from overpressure. Pump overpressure needs to be protected against independently using a pipeline mounted overpressure protection device.

All L series pumps have a pressure overflow connection found on the front of the pump above the lubricant fill plug. When the pump hose fails, liquid will come out of this overflow connector. If this is a potential safety or hygienic issue, the connector will need to be piped back to a safe location in a way that will not impede normal atmospheric pressure reaching the pump body during normal operation.

Consider the maximum permissible working pressure of the pump and pipework used. Exceeding maximum working pressures may lead to serious damage.

## 2.5 *Pulsations*

Some systems require pulsation dampers to avoid excessive and damaging pressure spikes and vibrations. Situations that may lead to excessive pulsations and vibration are:

- incorrectly secured pipelines
- high pump speeds with long suction and delivery lines or the product SG is high
- pipeline bore is too small

Where unacceptable pulsations are encountered, it may be possible to install pulsation dampeners to alleviate the problems.

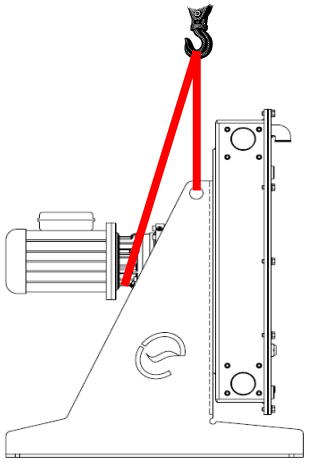
Dampeners need to be sized very carefully in order to protect the pump and system from excessive pressure peaks.

- Never use an existing dampener employed on another application or pump make and assume it will automatically work on an application with an L series pump. Different pump displacements and system characteristics often mean a dampener will not work effectively.
- Many dampeners are not suitable for variable speed applications. Where pump speeds and pressures vary, dampeners need to be carefully selected and sized to accommodate all the duty conditions.

Consult Environmental Pumping Solutions Limited or your authorised local dealer for more detailed information about the need and use of pulsation dampeners.

## 2.6 *Lifting the Pump*

The complete pump should be lifted using the lifting eyes on the pump frame. Due to the selection of drives available the centre of lift will vary dependant upon the size and weight of the drive fitted. If desirable to lift the pump squarely an additional lifting strap may be positioned around the juncture of the gearbox and motor. The length of this will need to be adjusted to establish a level lift if so desired. Suitably rated lifting straps or slings only must be used. Gearbox and motor lifting eyes must not be used for lifting the complete pump unit.



When lifting the pump ensure that all standard lifting practices are adhered to and carried out by qualified personnel only.

## 2.7 *Mounting the Pump*

The pump is fastened to the foundation via the holes in the frame or pump-chassis using suitable anchor bolts.

If the pump is to be mounted on rubber pads, it is very important that the connecting pipeline is fitted with a flexible joint.

## 2.8 *Electrical Connection*

Electrical connection of the pump must only be done by suitably qualified personnel.

The motor is to be thermally protected against overload by a protective circuit switch and is to have the correctly sized fuse according to the local existing rules and regulations.

**Important:**
In order to insure that the pump remains free of static electricity, the pump needs to be grounded. This is done via the grounding of the motor. The motor must be grounded with a wire of sufficient size!

For electrical connection details, please see the motor datasheet.

The pump should have its own dedicated electrical isolation switch meeting the requirements of BS EN 60947 - 3 (Switches, disconnectors, switch disconnectors and fuse combination units) so that it is not possible to start the pump during maintenance. There should also be an emergency stop button meeting the requirements of BS EN 60947 - 5 - 1 (Electro - mechanical control circuit devices) and BS EN 60947 - 5 - 5 (Electrical emergency stop devices with mechanical latching function.)

It is recommended to have local electrical control to the pump for use during commissioning and maintenance operations.

These electrical items should be installed according to the manufacturer's instructions by an electrician qualified to install electrical equipment on machinery.

If the pump is incorporated into a more complex installation then the installer should ensure the completed installation complies with the Machinery Directive 2006/42/EC.

## 2.9 *Use of Frequency Inverters*

The pump will not come with a motor that is suitable for use with a frequency inverter unless this has been stated on the pump technical data sheet.

Use of an inverter when no allowance has been made for one, can be dangerous and may lead to motor failure.

Where the use of an inverter has been specified on the pump technical data sheet it is essential that the control panel does not allow an operator to run the pump outside of the turndown design parameters there specified.

Frequency inverters used with peristaltic hose pumps must be of the constant torque type, and ideally sized at least one size larger than the pump fitted motor kilowatts.

## 2.10 *ATEX Approved Units*

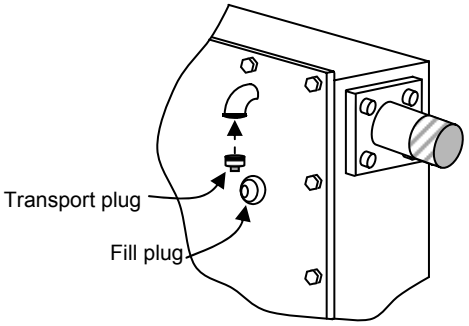
Standard L series pumps must not be used in potentially explosive hazardous atmospheres (European Directive 94/9/EC -ATEX Directive). If you require a pump to operate in a hazardous area classification, please contact Environmental Pumping Solutions Limited or your authorised local dealer for more detailed information.

## 2.11 *Commissioning*

### 2.11.1 Prestart-up Checks

Before commissioning, carry out the following checks:

- Check the pipework connections, ensuring there is no undue strain on the pipework.
- Ensure that there are no obstructions such as closed valves in the pipework. It is advisable to flush the system through with water to clear any debris.
- Ensure the Transport Plug is removed from the pressure overflow connection on the front of the pump.




- Check the pump casing is filled to the correct level with Envirolube specially compounded Roller Hose Lubricant. If necessary add lubricant. **- Before adding lubricant, check you have the correct hose lubricant; fill only with our Roller grade lubricant.**
- Check there is oil in the gearbox, and filled to the correct level.

It is advisable prior to powering up the pump to check rotation by hand to ensure there are no obstructions. This can be achieved as follows:

Isolate and lock off the electrical supply. Remove the motor fan cowl and turn the electric motor fan by hand to ensure free running. The motor should be rotated for enough turns to ensure the pump rotor has turned through 360 degrees. (If the gearbox ratio is 50:1, the motor fan must be rotated 50 revolutions). If any difficulties are found these should be investigated and rectified.

### 2.11.2 Start-up Checks

Prepare the electric motor for operation in accordance with the manufacturer's instructions, and ensure pump control panels are energised ready for operation.

When satisfied that all preliminary checks and procedures have been carried out, start up the pump.

Whilst running carry out the following checks:

- Check the rotation of the rotor.
- Check for any leaks in the system
- Check for excessive vibrations
- Check the pumping capacity of the pump.

Generally monitor the behaviour of the pumpset during the run period, ensuring that temperatures stabilise within the run period.

Check the integrity of the foundation holding bolts.

Following all start-up checks, if any items deviate from expected, refer to the "Troubleshooting" section of this manual or contact Environmental Pumping Solutions Limited, or your authorised local dealer.

# 3 Maintenance

Only use original Environmental Pumping Solutions parts when maintaining the pump. Environmental Pumping Solutions Limited cannot otherwise guarantee correct functioning of the pump. Any consequential damage that occurs from the use of non-original components cannot be warranted.

## 3.1 *Routine Maintenance*

The L series pumps are designed to minimise service and maintenance.

A small number of simple preventive measures are however needed in order to ensure continuous and trouble free pump life.

Important: it is very important, that the pump is maintained according to the table below.

Never clean or repair the pump without it being fully isolated.

When cleaning, maintaining or repairing the pump, the power supply to the motor has to be disconnected by means of a key locked switch.

| Action | To be carried out | Comments |
|---|---|---|
| Check hose lubricant level | Before start-up and thereafter on a daily operational basis | Lubricant should be visible in the lower sight glass on the pump front cover |
| Check the pumphead for any lubricant leakage around the cover and the connections | Before start-up and thereafter on a daily operational basis | |
| Check pump for high temperature or unusual noise | On a daily operational basis | |
| Check compression rollers for wear | When replacing the pump hose | Replace if there is more than 1mm wear across the roller |
| Changing the hose lubricant | When replacing the pump hose | Only use Envirolube hose lubricants |
| Check gearbox oil level | Before start-up and thereafter on a daily operational basis | |
| Replacing the gearbox oil | Refer to the gearbox manufacturers instructions | |

In certain installations it may be desirable to try and change the pump hose before failure on a routine scheduled basis. If this is the case, we suggest changing the hose after 75% of the time the first hose lasted.

Due to the variety of motor and gearboxes supplied according to both application and client requirements, maintenance detail is not shown in this manual. Please refer to the manufacturer's manual for maintenance detail on your specific drive.

## 3.2 *Cleaning the pump Hose*

The inside of the pump hose is easily cleaned by flushing with water or any other compatible cleaning fluid. Ensure that the pump hose can not only resist the chemical compatibility of any cleaning fluids, but also the temperature of cleaning liquid used.

Cleaning systems must not generate pressures in excess of the pump operating design pressure.

## 3.3 *Hose Removal*

When pumping potentially hot, hazardous or dangerous media, it is critical to ensure that personnel are adequately protected during hose removal and that the hose is washed through with a media harmless to man and the environment before the hose is dismantled.

There can be a significant pressure difference between the upper and the lower pump connections. This can mean that while having vacuum in one connecting pipe there can be a large overpressure in the other connecting pipe. It is therefore essential that the pipework is depressurised safely prior to opening the pump cover and dismantling the hose.

Before dismantling any items, shut off the suction and discharge valves.

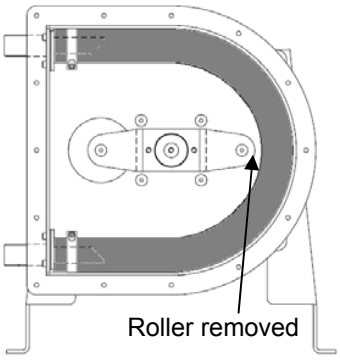
Drain the hose lubricant by positioning a container at the base of the pump, remove the top fill plug, remove the drain plug at the bottom of the pump and drain the lubricant into the container.

Always dispose of used lubricant in safe and proper manner. Refer to local Environmental restrictions as appropriate.

Unbolt the pump front cover and swing open on its hinges.

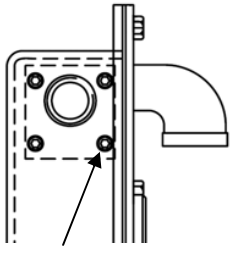
There are two options of hose removal with the L series pumps. Either the complete hose and inserts can be removed as one element assembly, or the hose can be removed with the inserts left in the pump.

With both methods of hose removal we suggest that one of the compression rollers is removed. To remove a roller ensure the roller is not in contact with the hose, remove the roller spindle screw and screws holding the roller side plate and lift the roller out. Rotate the rotor so that the remaining roller lies between the inlet and outlet ports. The hose can then be removed and a new one inserted easily without having to rotate the rotor. To refit the compression roller, rotate the rotor 180º so that the roller to be replaced lies between the inlet and outlet ports.




<u>Removing the hose as an Element Assembly</u>
First disconnect suction and discharge piping

Remove the insert retaining bolts from both hose inserts, lift the hose element assembly out of the pump, withdrawing the inserts through the pump body.



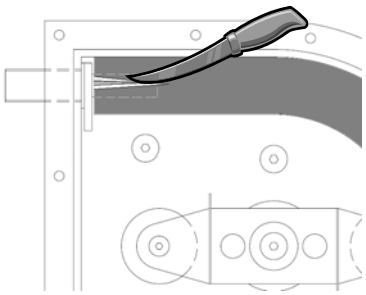
Removing the hose only

Note: There is no need to disconnect the suction and discharge piping when removing the hose only via this method.

*i* Where difficulty pulling the hose off the connectors is encountered, try cutting the hose along the side of the connector as shown.

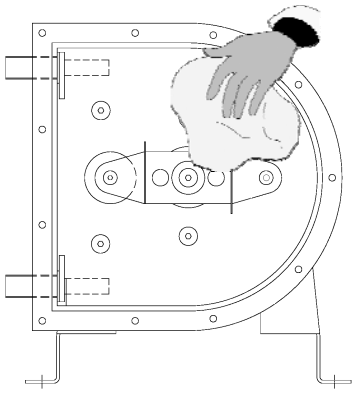
Carefully loosen top and bottom hose clamps.

From the bottom hose connector pull the hose off and out as far as possible. Continue pulling out the old hose until you have arrived at the top hose connection and finally pull the hose off this connection.



Check mechanical parts, such as Rollers, bushings and shafts for damage or wear.

Clean all components thoroughly, flushing with clean water if necessary. Pay particular attention to any residue of pumped material. Deposits of any abrasive media left within the pump body will be detrimental to future component life.



Check before replacing the hose that it is the correct diameter, and material and measure the exact thickness of the hose and note this down. This is needed if adjustment of the rollers is needed.

Before fitting the new hose, we recommend you check the compression roller occlusion setting to ensure optimum pumping efficiency throughout the pump life.

*i* When ordering spare parts, please make reference to the serial number on the nameplate.

## 3.4 *Replacing the Roller Bushes*

With the hose removed, remove the compression rollers if not already done so, by removing the roller spindle screw and lifting the roller out of the roller carrier.

Using a suitable mandrel, press the old bushes out of the roller.

Lightly lubricate the outer surfaces of the new bushes and press into place, ensuring the face of each bush is flush with the face of the roller each side.

Refitting the roller is a reversal of the removal process.

## 3.5 *Adjusting the Compression Rollers*

The distance 'A' between the inner face of the pump body housing, and the compression roller should be set according to the following formula:

**A = (2 x t) - t1**
(at pressures 0 to 5 bar)

When the application pressure is to exceed 5 bar, subtract
**0,1 x t1 x Pd**

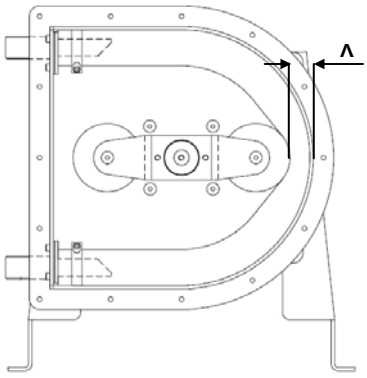



Figure 1 Distance from roller to pump housing

| Variable | Value |
|---|---|
| **A** | Distance from roller to pump housing, see Figure 1 |
| **t** | Thickness of the hose wall, see Figure 2 |
| **t1** | Material dependent scale, see below |
| **Pd** | Nominal working pressure on the pump. |

Example:

Hose thickness t = 14 mm
Hose material NBR t1 = 1.0 mm
Working pressure Pd= 7 bar
A = 2 x 14 – 1.0 = 27.0 mm
Subtraction from higher working pressure:
0.1 x 1.0 x 7 = 0.7 mm

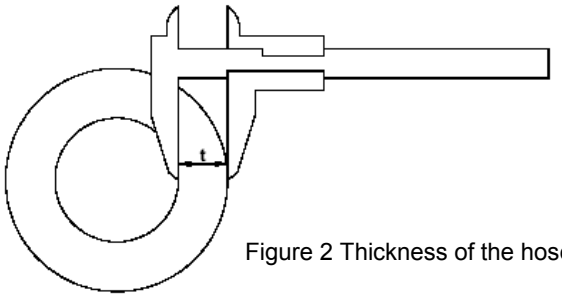



Figure 2 Thickness of the hose

A = 27.0 mm – 0.7 = 26.3 mm

| **Hose material** | **Scale: t1** | **Hose material** | **Scale: t1** |
|---|---|---|---|
| Natural rubber | 1,5 mm | Butyl | 1,0 mm |
| NBR (Nitrile) | 1,0 mm | Hypalon (CSM) | 1,0 mm |
| EPDM | 1,0 mm | Neoprene | 1,0 mm |

To adjust the compression roller gap shims should be inserted under the roller carrier. Additional shims of 0.5mm and 1.0mm thickness are available from Environmental Pumping Solutions Limited or your authorised local dealer.

The above procedure is intended as a guide only. After carrying out operational tests as detailed later in these instructions it may be found necessary to further adjust the rollers to decrease the distance 'A'.

Should it be found necessary to further adjust the rollers to decrease the distance 'A', this should be done in increments of 0,5 mm. If the rollers are adjusted too much, over occlusion of the hose will occur. Hose over occlusion is detrimental to hose life.

## 3.6 *Fitting the Pump Hose*

Take care when fitting the pump hose, there is a possibility of trapping hands if care is not taken.

Ensure the pump body housing is clean and free from foreign particles.

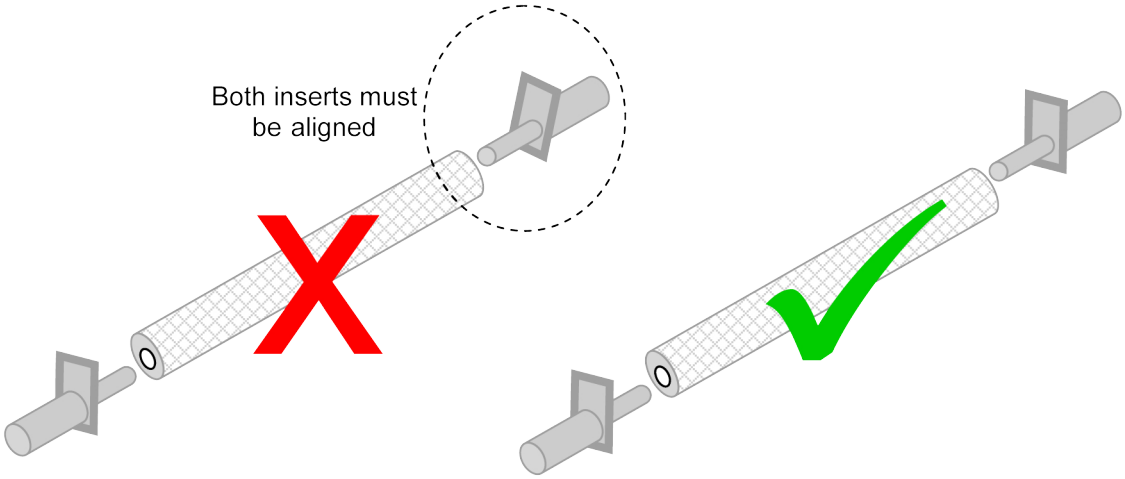
If not already removed, remove one of the compression rollers. To remove a roller ensure the roller is not in contact with the hose, remove the roller spindle screw and screws holding the roller side plate and lift the roller out. Rotate the rotor 180º so that the remaining roller lies between the inlet and outlet ports. The hose can then be inserted easily without having to rotate the rotor. To refit the compression roller, rotate the rotor 180º so that the roller to be replaced lies between the inlet and outlet ports.

Refitting the hose as an Element Assembly

Prior to installing a new element hose assembly, ensure that both hose inserts are aligned correctly. The hose inserts can only be fitted to the pump in one orientation, checking the correct orientation and alignment now will avoid delays later.

Correct alignment can be achieved by assembly on a flat surface ensuring both insert flanges sit flat on the surface whilst assembly takes place.

It is important to ensure correct alignment of the hose inserts. Misalignment will result in a twisted hose once the hose is fitted, leading to premature hose failure.




Push the hose onto the hose insets along with the hose clamps – do not tighten clamps.

Aid assembly by lubricating inserts and hose bore with hose lubricant.

Never lubricate the hose, or any components in contact with the pump hose with mineral oils or lubricants, these are not compatible with the materials of hose construction.

Ensure the hose is pushed up to the insert flange on both connections, and that the inserts are in correct alignment.

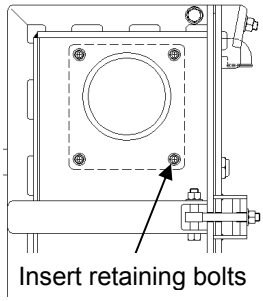
Tighten both hose clamps and re check the insert alignment.

If the assembled hose element is not to be installed into the pump straight away, ensure the assembly is wrapped and stored in accordance with Environmental Pumping Solutions recommendations.

Prior to fitting to the pump, ensure the hose assembly is clean and free from grit and particles on the outer cover. Place the hose connector gasket over the outer connections.

Insert the hose element assembly in to the pump, passing the outer connections through the respective port in the pump body, with the gaskets on the inside of the pump body.

Insert and tighten the insert retaining bolts.




The hose must now be properly positioned in the pump housing as detailed below.

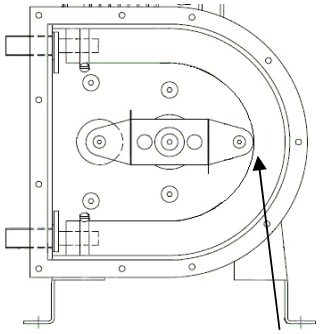
Failure to correctly position the hose may lead to premature hose failure.

Refitting the hose only (inserts not removed)

Push the hose clamps and hose onto the top connector – do not tighten clamps.

To aid assembly, lubricate the hose connector and hose bore with a little hose lubricant.

Never lubricate the hose, or any components in contact with the pump hose with mineral oils or lubricants, these are not compatible with the materials of hose construction.

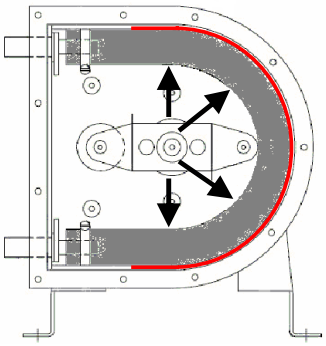



Push the hose over the bottom connector put the hose clamps over the hose - do not tighten clamps.

With the roller removed the hose can be pushed into the housing.

Positioning and Seating the hose

Ensure the hose clamps are loose. (If the hose was fitted as a complete element with inserts, it will be necessary to loosen the clamps.)



Push the hose firmly into the “U” arc of the pump body, ensuring contact is made with the hose and pump body along the complete length of the compression path and then tighten both hose clamps.

If difficulty is found seating the hose against the pump body try refitting the roller as below, the action of the rollers compressing the hose as the pump is rotated will help position the hose.

Refit the compression roller, by first rotating the rotor 180º so that the roller to be replaced lies between the inlet and outlet ports.

Always recheck the roller gap after you have refitted the roller.

## 3.7 *Fitting the Front Cover*

Fit the front cover gasket seal and bolt the front cover to the pump body housing.

Passing a couple of fixing bolts through the front cover and “hanging” the gasket on these will aid with assembly and alignment of the gasket.

Be careful to avoid cross threading. When the cover bolt holes are not fully aligned with the threaded holes in the pump body housing the risk of cross threading the bolts can occur.

Ensure the lubricant drain plug is installed with PTFE tape of similar demountable pipe thread sealant.

Fill the pump housing with the correct quantity of lubricant through the fill plug hole. Once filled you should be able to see the lubricant in the middle of the sight glass at the front of the pump.

Replace the fill plug and check the pump housing for leakage.

If previously disconnected, reconnect all pipework and open all suction and discharge valves.

The pump is now ready for normal operation. Upon restarting check for abnormal vibrations and other irregularities such as abnormal noise.

## 3.8 *Rotor Removal*

Follow the procedures as detailed earlier for the removal of the pump hose.

Remove the rotor clamp screw & retaining washer and slide the rotor off the shaft.

It is likely that the rotor may be a tight fit on the shaft. Do not hammer the rotor assembly. In such instances use a proprietary puller to extract the complete rotor assembly. Tapped holes are provided in the front of the rotor to insert threaded rod to aid withdrawal from the shaft.

## 3.9 *Gearbox Drive Removal*

Once the rotor has been removed, the gearbox can be removed if required.

The fixing screws on the L20 through L50 are countersunk headed screws through the rear of the pump housing, with nuts and washers on the gearbox flange. The L65 & L80 pumps utilise fixings through the gearbox flange into threaded holes in the pump body.

Before removing the gearbox fixing bolts ensure the gearbox is adequately supported via the correct lifting method, and that the pump is properly fastened to the floor as removing the gearbox will cause a sudden change in the centre of gravity.

Remove the gearbox fixings and carefully pull the gearbox off the mating spigot, taking care not to damage the drive protection seal in the rear of the pump housing.

***Drive Protection Seal Removal***

A seal is fitted between the pump and the gearbox. This seal acts as protection for the gearbox drive in the event of a hose failure, reducing the chance of contaminated hose lubricant from reaching the front seal of the gearbox.

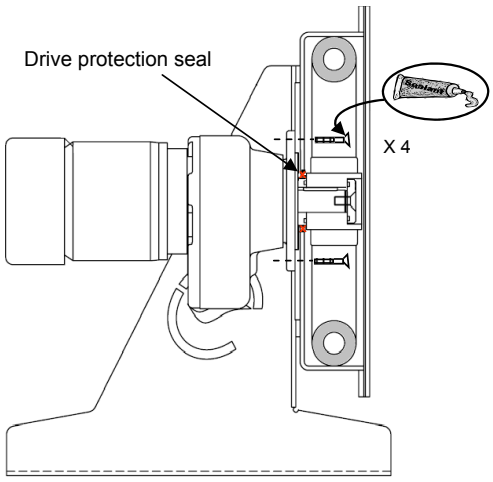
*i* Once the rotor has been removed, the Drive Protection Seal will be seen. Whilst it is possible to remove the seal without gearbox removal, it may be found easier to remove the gearbox in to provide better access to the seal.

A little effort may be needed to remove the gearbox, as the joint may be sealed with a proprietary silicone gasket sealer. Once the gearbox is removed the seal can be removed from the rear of the pump body.

***Drive Protection Seal Replacement***

Ensure the rear of the pump body is clean where the seal is to be fitted. Lightly lubricate the seal bore with a silicone based lubricant, and using a fly press or similar carefully press the new seal into place, taking care not to damage the seal lip.

3.10 ***Gearbox Drive Replacement L20 - L50***




With the new Drive Protection Seal fitted, the gearbox can be fitted to the pump housing.

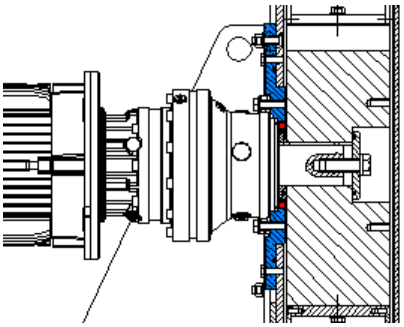
Prior to assembly clean and degrease all mating surfaces, ensuring all faces are free from traces of paint and sealants.

Carefully lift the gearbox drive into place taking care not to damage the drive protection seal, and locate the flange spigot on the rear of the pump housing.

Line up the four fixing holes and insert the M8 countersunk socket head screws through the rear of the pump housing.

*i* Note: the 4 off countersunk screws must have “Instant Gasket” sealant applied under the head before insertion through the pump housing.

***Gearbox Drive Replacement L65 & L80***



With the new Drive Protection Seal fitted, the gearbox can be fitted to the pump body housing.

On the L65 pump the gearbox is mounted directly to the pump housing. The L80 utilises a gearbox adapter ring (coloured blue in the drawing) which is mounted directly to the pump housing with the gearbox mounted to this.

Prior to assembly clean and degrease all mating surfaces, ensuring all faces are free from traces of paint and sealants

On the L80 the gearbox adapter should be mounted to the pump body, ensuring the O-ring seal is fitted into the groove to seal between adapter and pump body housing.

Carefully lift the gearbox drive into place taking care not to damage the drive protection seal whilst ensuring the flange spigot on the gearbox is fully located.

Line up the fixing holes and insert the socket head screws fastening with spring washers.

### 3.11 *Rotor Replacement*

Clean the bore of the rotor assembly and rotor spacer, applying a small amount of anti-seize compound such as Copaslip® to the bores and keyways.

Slide first the rotor spacer onto the shaft locating it in the bore of the drive protection seal, followed by the rotor assembly. The rotor spacer acts as a wearing surface for the drive protection seal as well as ensuring the rotor is correctly positioned in the pump housing. In the stainless steel pump option there will be an O ring seated in the end of the spacer. Ensure this O ring faces outwards, sealing against the rear of the rotor.

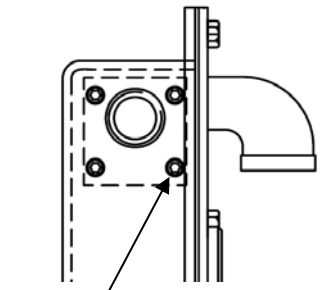
Do not hammer the rotor assembly if the shaft is a tight fit in the rotor, pull the rotor onto the shaft with a long bolt.

Fit the rotor clamp washer and countersunk retaining screw. In the stainless steel pump option there will be an O ring seated in the rear face of the clamp washer. Ensure this O ring faces inwards, sealing against the front of the rotor.

### 3.12 *Hose Connector Assembly*

The hose connector inserts may be fitted independently, rather than as a hose element assembly. After first ensuring all mating faces are clean, fit the gaskets over the threaded connection of each hose connector.

Insert hose connector in to the pump, passing the threaded connection through the respective port in the pump body, with the gaskets on the inside of the pump body.




Insert and tighten the insert retaining bolts.

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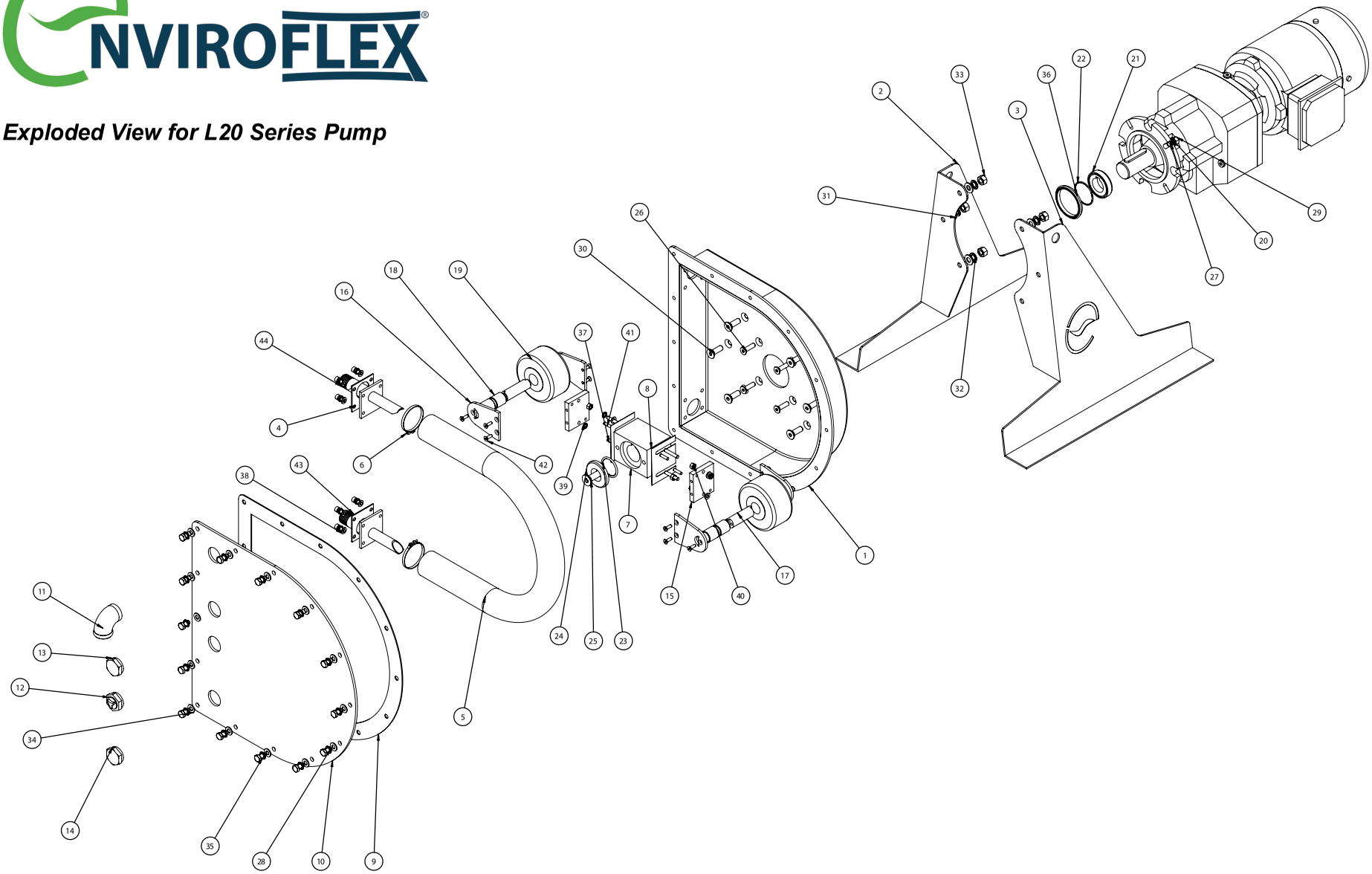
***Exploded View for L20 Series Pump***



## L20 Series Pump Parts List

| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-20-PH-1 | Housing Body | 10257.62 | 1 |
| 2 | L-20-F-L-1 | Pump Frame Left | 3329.15 | 1 |
| 3 | L-20-F-R-1 | Pump Frame Left | 3329.16 | 1 |
| 4 | L-20-HC-CS-1 | Hose Flange Seal | 6.40 | 2 |
| 5** | L-20-NRH | Pump Hose - NATURAL RUBBER | 1324.25 | 1 |
| | L-20-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 1324.25 | 1 |
| | L-20-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 1324.25 | 1 |
| | L-20-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 1324.25 | 1 |
| | L-20-EPDM | Pump Hose - EPDM | 1324.25 | 1 |
| | L-20-HYP | Pump Hose - HYPALON | 1324.25 | 1 |
| 6** | LC-4016 | Hose Clip | 8.88 | 2 |
| 7 | L-20-R-1 | Rotor | 802.91 | 1 |
| 8 | L20/L25-SH-3 / L20/L25-SH-4 | Shim 0.6mm / Shim 1.0mm | 19.15 | 4/8 |
| 9 | L-20-FC-DS-1 | Front Cover Door Seal | 126.70 | 1 |
| 10 | L-20-FC-1 | Front Cover | 6753.39 | 1 |
| 11 | LT-5100S | Breather Elbow | 101.92 | 1 |
| 12 | LT-5012 | Sight Glass | 32.68 | 1 |
| 13 | LP-1001 | Fill Plug | 28.81 | 1 |
| 14 | LP-1002 | Drain Plug | 28.81 | 1 |
| 15 | L-20-ROL-M-1 | Roller Mount | 266.78 | 2 |
| 16 | L-20-ROL-SP-1 | Roller Side Plate | 169.30 | 4 |
| 17 | L-20-ROL-SH-2 | Roller Shaft | 144.44 | 2 |
| 18 | L-20-ROL-B-1 | Roller Bush | 27.59 | 4 |
| 19 | L-20-ROL-1 | Roller | 362.62 | 2 |
| 20 | L-20-Gearbox | Gearbox | | 1 |
| 21 | L-20-R-RS-3 | Rotor Spacer | 168.62 | 1 |
| 22 | LS-6806 | Rotor Spacer O Ring | 0.55 | 1 |
| 23 | LS-6100 | Rotor Clamp Washer O Ring | 1.39 | 1 |
| 24 | L-20-R-RC-3 | Roller Clamp Washer | 105.89 | 1 |
| 25 | LB-1266 | Rotor Clamp Screw | | 1 |
| 26 | LB-1215 | Gearbox to Housing Fixing | | 4 |
| 27 | LW-3001 | Flat Washer | | 4 |
| 28 | LW-3101 | Spring Washer | | 18 |
| 29 | LN-2000 | Nut | | 4 |
| 30 | LB-1227 | Frame Mounting Screw | | 6 |
| 31 | LW-3002 | Flat Washer | | 6 |
| 32 | LW-3102 | Spring Washer | | 6 |
| 33 | LN-2002 | Nut | | 6 |
| 34 | LW-3001 | Flat Washer | | 14 |
| 35 | LB-1012 | Front Cover Fixing | | 14 |
| 36 | LS-6001 | Drive Protection Seal | | 1 |
| 37 | LB-1278 | Roller Mount Fixing | | 4 |
| 38 | LW-3000 | Flat Washer | | 12 |
| 39 | LW-3100 | Spring Washer | | 12 |
| 40 | LN-4010 | Nut | | 4 |
| 41 | LD-7008 | Roller Mount Dowel | | 4 |
| 42 | LB-1257 | Roller Shaft Fixing | | 12 |
| 43 | LB-1103 | Hose Connector Fixing | | 8 |
| 44 | L-20-HC-1 | Hose Connector | 349.12 | 2 |

* 1 g = 0.0353 ounce / 0.0022 pound

** Recommended spares with 2.5 litres of Envirolube Lubricant.

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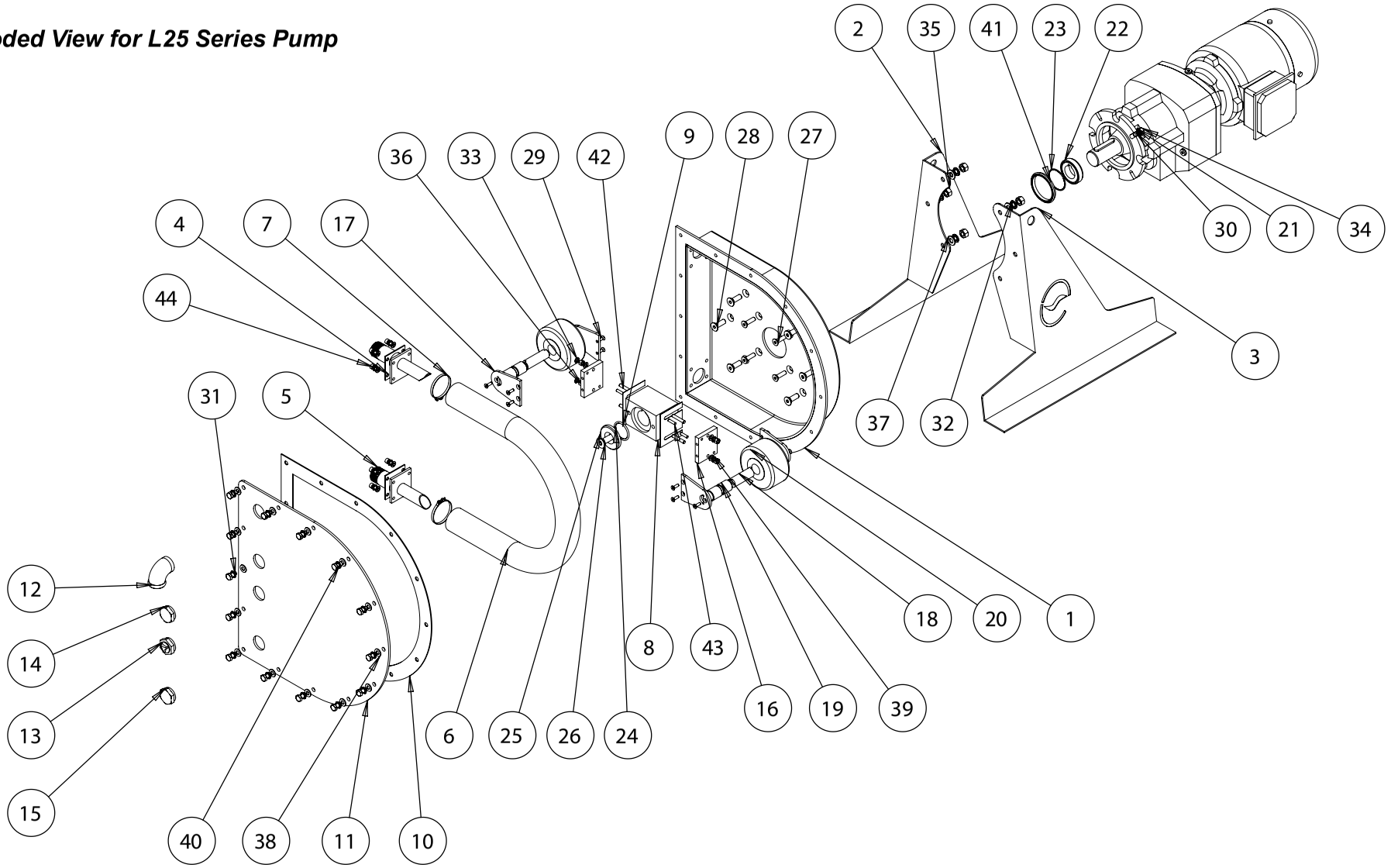
***Exploded View for L25 Series Pump***



## L25 Series Pump Parts List

| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-25-PH-1 | Housing Body | 10261.38 | 1 |
| 2 | L-25-F-L-1 | Pump Frame Left | 3329.15 | 1 |
| 3 | L-25-F-R-1 | Pump Frame Left | 3329.16 | 1 |
| 4 | L-25-HC-CS-1 | Hose Flange Seal | 6.40 | 2 |
| 5 | L-25-HC-1 | Hose Connector | 440.46 | 2 |
| 6** | L-25-NRH | Pump Hose - NATURAL RUBBER | 1324.25 | 1 |
| | L-25-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 1324.25 | 1 |
| | L-25-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 1324.25 | 1 |
| | L-25-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 1324.25 | 1 |
| | L-25-EPDM | Pump Hose - EPDM | 1324.25 | 1 |
| | L-25-HYP | Pump Hose - HYPALON | 1324.25 | 1 |
| 7** | LC-4016 | Hose Clip | 8.88 | 2 |
| 8 | L-25-R-1 | Rotor | 802.91 | 1 |
| 9 | L20/L25-SH-3 / L20/L25-SH-4 | Shim 0.6mm / Shim 1.0mm | 19.15 | 4/8 |
| 10 | L-25-FC-DS-1 | Front Cover Door Seal | 126.95 | 1 |
| 11 | L-25-FC-1 | Front Cover | 6753.39 | 1 |
| 12 | LT-5100S | Breather Elbow | 101.92 | 1 |
| 13 | LT-5012 | Sight Glass | 32.68 | 1 |
| 14 | LP-1001 | Fill Plug | 28.81 | 1 |
| 15 | LP-1002 | Drain Plug | 28.81 | 1 |
| 16 | L-25-ROL-M-1 | Roller Mount | 266.78 | 2 |
| 17 | L-25-ROL-SP-1 | Roller Side Plate | 169.30 | 4 |
| 18 | L-25-ROL-SH-2 | Roller Shaft | 144.44 | 2 |
| 19 | L-25-ROL-B-1 | Roller Bush | 27.59 | 4 |
| 20 | L-25-ROL-1 | Roller | 362.62 | 2 |
| 21 | L-25-Gearbox | Gearbox | | 1 |
| 22 | L-25-R-RS-3 | Rotor Spacer | 168.62 | 1 |
| 23 | LS-6806 | Rotor Spacer O Ring | 0.55 | 1 |
| 24 | LS-6100 | Rotor Clamp Washer O Ring | 1.39 | 1 |
| 25 | L-25-R-RC-3 | Roller Clamp Washer | 105.89 | 1 |
| 26 | LB-1266 | Rotor Clamp Screw | | 1 |
| 27 | LB-1215 | Gearbox to Housing Fixing | | 4 |
| 28 | LB1227 | Frame Mounting Fixing | | 6 |
| 29 | LB-1257 | Roller Side Plate Fixing | | 12 |
| 30 | LW-3001 | Flat Washer | | 4 |
| 31 | LW-3101 | Spring Washer | | 18 |
| 32 | LW-3102 | Spring Washer | | 6 |
| 33 | LW-3100 | Spring Washer | | 12 |
| 34 | LN-2000 | Nut | | 4 |
| 35 | LN-2002 | Nut | | 6 |
| 36 | LN-4010 | Nut | | 4 |
| 37 | LW-3002 | Flat Washer | | 6 |
| 38 | LW-3001 | Flat Washer | | 14 |
| 39 | LW-3000 | Flat Washer | | 12 |
| 40 | LB-1012 | Front Cover Fixing | | 14 |
| 41 | LS-6001 | Drive Protection Seal | | 1 |
| 42 | LB-1278 | Roller Mount Fixing | | 4 |
| 43 | LD-7008 | Roller Mout Dowel | | 4 |
| 44 | LB-1103 | Hose Connector Fixing | | 8 |

* 1 g = 0.0353 ounce / 0.0022 pound
** Recommended spares with 2.5 litres of Envirolube Lubricant.

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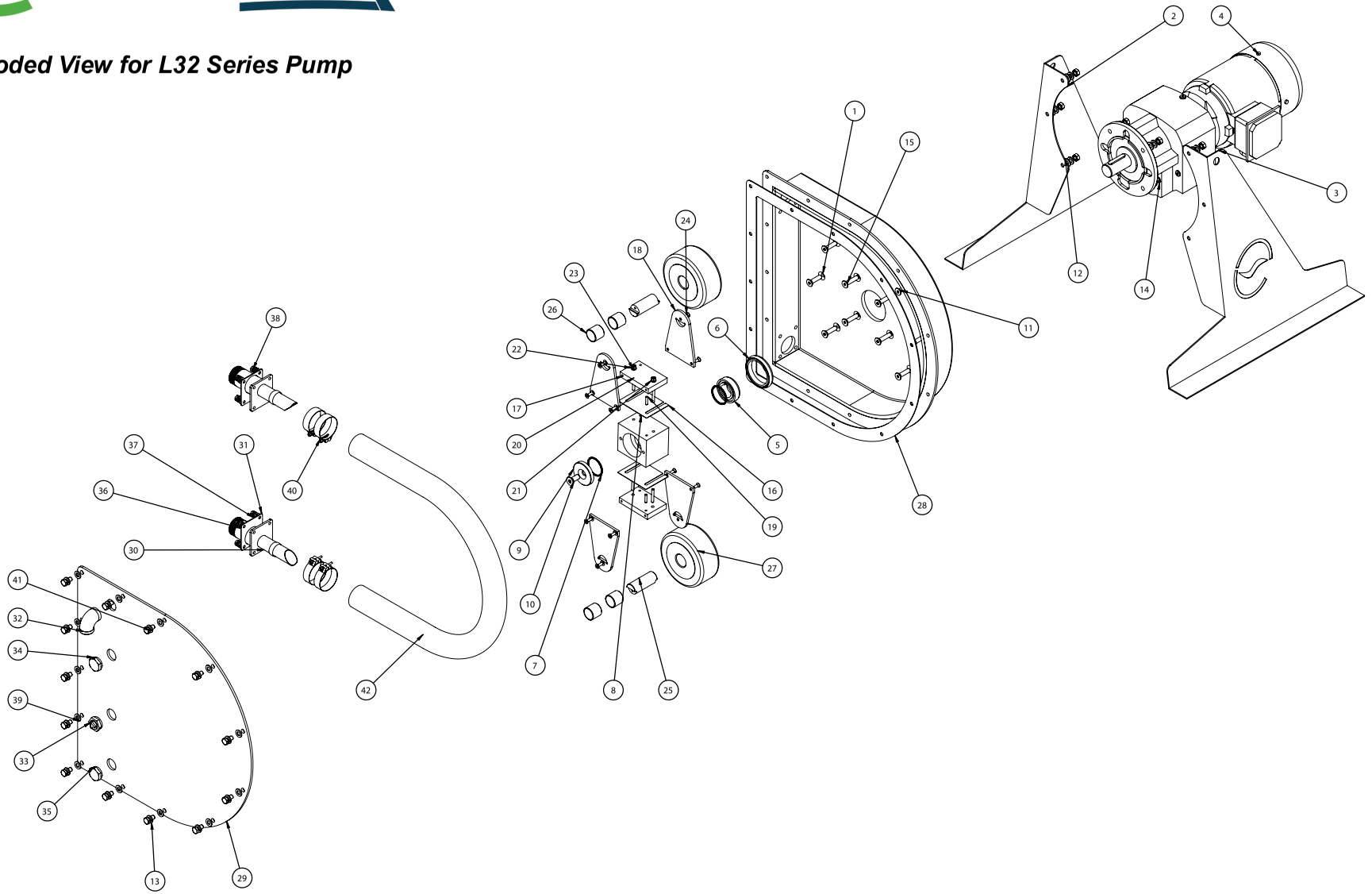
***Exploded View for L32 Series Pump***



## L32 Series Pump Parts List

| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-32-PH-1 | Housing Body | 43351.56 | 1 |
| 2 | L-32-F-R-1 | Pump Frame Right | 5120.60 | 1 |
| 3 | L-32-F-L-1 | Pump Frame Left | 5120.61 | 1 |
| 4 | L-32-Motor and Gearbox | Motor and Gearbox | 11678.00356 | 1 |
| 5 | L-32-R-RS-1 | Rotor Spacer | 335.17 | 1 |
| 6 | LS-6300 | Drive Protection Seal | 28.50 | 1 |
| 7 | LS-6301 | Rotor Clamp O Ring | 1.37 | 2 |
| 8 | L-32-R-1 | Rotor | 1389.90 | 1 |
| 9 | L-32-R-RC-1 | Rotor Clamp Washer | 203.52 | 1 |
| 10 | LB-1229 | Rotor Clamp Bolt | | 1 |
| 11 | LB-1235 | Frame Mounting Screw | | 6 |
| 12 | LW-3002 | Flat Washer | | 10 |
| 13 | LW-3102 | Spring Washer | | 23 |
| 14 | LN-2002 | Nut | | 10 |
| 15 | LB-1238 | Gearbox Mounting Screw | | 4 |
| 16 | L-32-SH-3 / L-32-SH-4 | Shim 0.6mm / Shim 1.0mm | 33.82 | A/R |
| 17 | L-32-ROL-M-1 | Roller Mount | | 2 |
| 18 | L-32-ROL-SP-1 | Roller Side Plate | 492.51 | 4 |
| 19 | LD-7000 | Roller Mount Dowel | | 4 |
| 20 | LB-1280 | Roller Mount Fixing | | 4 |
| 21 | LB-3000 | Flat Washer | | 4 |
| 22 | LB-3100 | Spring Washer | | 4 |
| 23 | LN-4010 | Nut | | 4 |
| 24 | ISO 10642 - M6 x 20 --- 20N | | | 12 |
| 25 | L-32-ROL-SH-1 | Roller Shaft | 396.39 | 2 |
| 26 | L-32-ROL-B-1 | Roller Bush | 48.04 | 4 |
| 27 | L-32-ROL-1 | Roller | 1011.40 | 2 |
| 28 | L-32-FC-DS-1 | Front Cover Door Seal | 185.28 | 1 |
| 29 | L-32-FC-1 | Front Cover | 15612.36 | 1 |
| 30 | L-32-HC-1 | Hose Connector | 1047.97 | 2 |
| 31 | L-32-HC-CS-1 | Hose Flange Seal | 9.79 | 2 |
| 32 | LT-5100S | Breather Elbow | 101.921 | 1 |
| 33 | LT-5012 | Sight Glass | 32.68 | 1 |
| 34 | LP-1001 | Fill Plug | 28.81 | 1 |
| 35 | LP-1002 | Drain Plug | 28.81 | 1 |
| 36 | LW-3001 | Flat Washer | | 8 |
| 37 | LW-3101 | Spring Washer | | 8 |
| 38 | LB-1231 | Hose Connector Screw | | 8 |
| 39 | LW-3002 | Flat Washer | | 13 |
| 40** | LC-4017 | Hose Clamp L32 | 51.31 | 4 |
| 41 | LB-1037 | Front Cover Screw | | 13 |
| 42** | L-32-NRH | Pump Hose - NATURAL RUBBER | 3096.60 | 1 |
| | L-32-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 3096.60 | 1 |
| | L-32-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 3096.60 | 1 |
| | L-32-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 3096.60 | 1 |
| | L-32-EPDM | Pump Hose - EPDM | 3096.60 | 1 |
| | L-32-HYP | Pump Hose - HYPALON | 3096.60 | 1 |

* 1 g = 0.0353 ounce / 0.0022 pound
** Recommended spares with 5.0 litres of Envirolube Lubricant.

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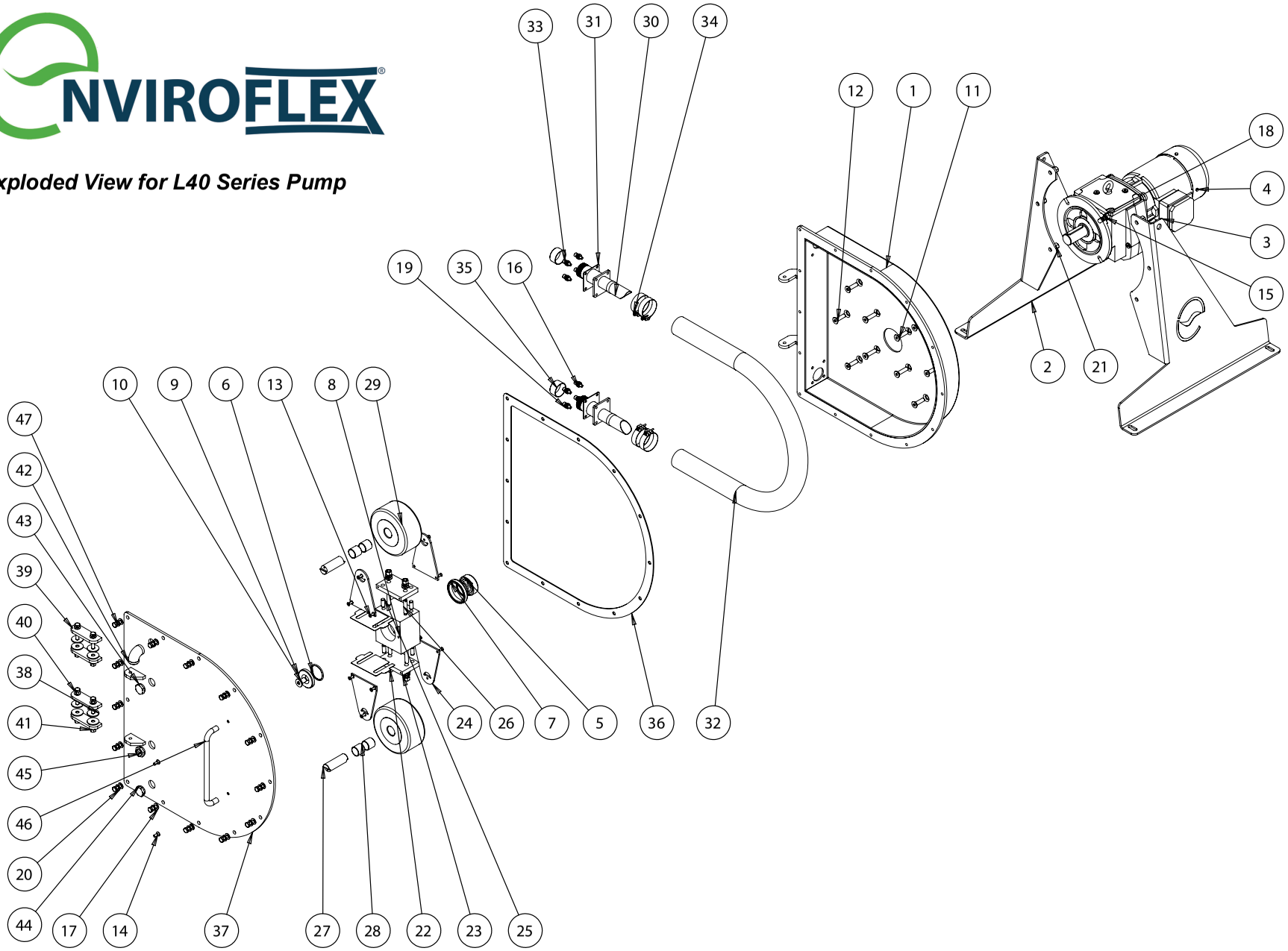
***Exploded View for L40 Series Pump***



## L40 Series Pump Parts List

| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-40-PH-1 | Housing Body | 40104.81 | 1 |
| 2 | L-40-F-L-1 | Pump Frame Left | 13140.98 | 1 |
| 3 | L-40-F-R-1 | Pump Frame Right | 13140.99 | 1 |
| 4 | L40 Gearbox | | | 1 |
| 5 | L-40-R-RS-1 | Rotor Spacer | 431.91 | 1 |
| 6 | LS-6814 | Rotor Spacer O Ring | 2.61 | 2 |
| 7 | LS-6400 | Drive Protection Seal | | 1 |
| 8 | L-40-R-2 | Rotor | 3312.65 | 1 |
| 9 | L-40-R-RC-1 | Rotor Clamp Washer | 223.08 | 1 |
| 10 | LB-3239 | Rotor Clamp Screw | | 1 |
| 11 | LB-3230 | Gearbox Mounting Screw | | 4 |
| 12 | LB-3228 | Frame Mounting Screw | | 6 |
| 13 | LB-3232 | Roller Shaft Screw | | 12 |
| 14 | LB-3213 | Front Cover Handle Fixing | | 2 |
| 15 | LW-5003 | Flat Washer M12 | | 14 |
| 16 | LW-5001 | Flat Washer M8 | | 8 |
| 17 | LW-5002 | Flat Washer M10 | | 22 |
| 18 | LW-5103 | Spring Washer M12 | | 14 |
| 19 | LW-5108 | Spring Washer M8 | | 8 |
| 20 | LW-5102 | Spring Washer M10 | | 14 |
| 21 | LN-4003 | Nut M12 | | 14 |
| 22 | L-40-SH-3 / L-40-SH-4 | Shim 0.6mm / Shim 1.0mm | 46.49 | 4/8 |
| 23 | L-40-ROL-M-2 | Roller Mount | | 2 |
| 24 | L-40-ROL-SP-1 | Roller Side Plate | 529.524 | |
| 25 | LD-7007 | Roller Mount Dowel | | 4 |
| 26 | LB-3274 | Hinge Screw | | 4 |
| 27 | L-40-ROL-SH-1 | Roller Shaft | | 2 |
| 28 | L-40-ROL-B-1 | Roller Bush | 48.04 | 4 |
| 29 | L-40-ROL-1 | Roller | 1810.39 | 2 |
| 30 | L-40-HC-1 | Hose Connector | 880.00 | 2 |
| 31 | L-40-HC-CS-1 | Hose Connector Seal | 9.87 | 2 |
| 32** | L-40-NRH | Pump Hose - NATURAL RUBBER | 3925.32 | 1 |
| | L-40-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 3925.32 | 1 |
| | L-40-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 3925.32 | 1 |
| | L-40-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 3925.32 | 1 |
| | L-40-EPDM | Pump Hose - EPDM | 3925.32 | 1 |
| | L-40-HYP | Pump Hose - HYPALON | 3925.32 | 1 |
| 33 | LB-3294 | Hose Connector Screw | | 8 |
| 34** | LC-4018 | Hose Clip | 54.28 | 4 |
| 35 | L-40-CON-CAP | Hose Connector Cap | 10.95 | 2 |
| 36 | L-40-FC-DS-1 | Front Door Seal | 325.07 | 1 |
| 37 | L-40-FC-1 | Front Cover | 28906.19 | 1 |
| 38 | L-40-62 | Friction Hinge Washer | 3.95 | 8 |
| 39 | L-40-59 | Hinge Link Plate | | 4 |
| 40 | LB-3274 | Hinge Screw | | 4 |
| 41 | LN-4012 | Nyloc Nut M10 | | 4 |
| 42 | LT-5100S | Breather Elbow | 101.92 | 1 |
| 43 | LP-1001 | Fill Plug | 28.81 | 1 |
| 44 | LP-1002 | Drain Plug | 28.81 | 1 |
| 45 | LT-5012 | Sight Glass | 32.68 | 1 |
| 46 | LH-4000 | Handle | 227.52 | 1 |
| 47 | LB-3026 | Front Cover Screw | | 14 |

* 1 g = 0.0353 ounce / 0.0022 pound
** Recommended spares with 7.5 litres of Envirolube Lubricant.

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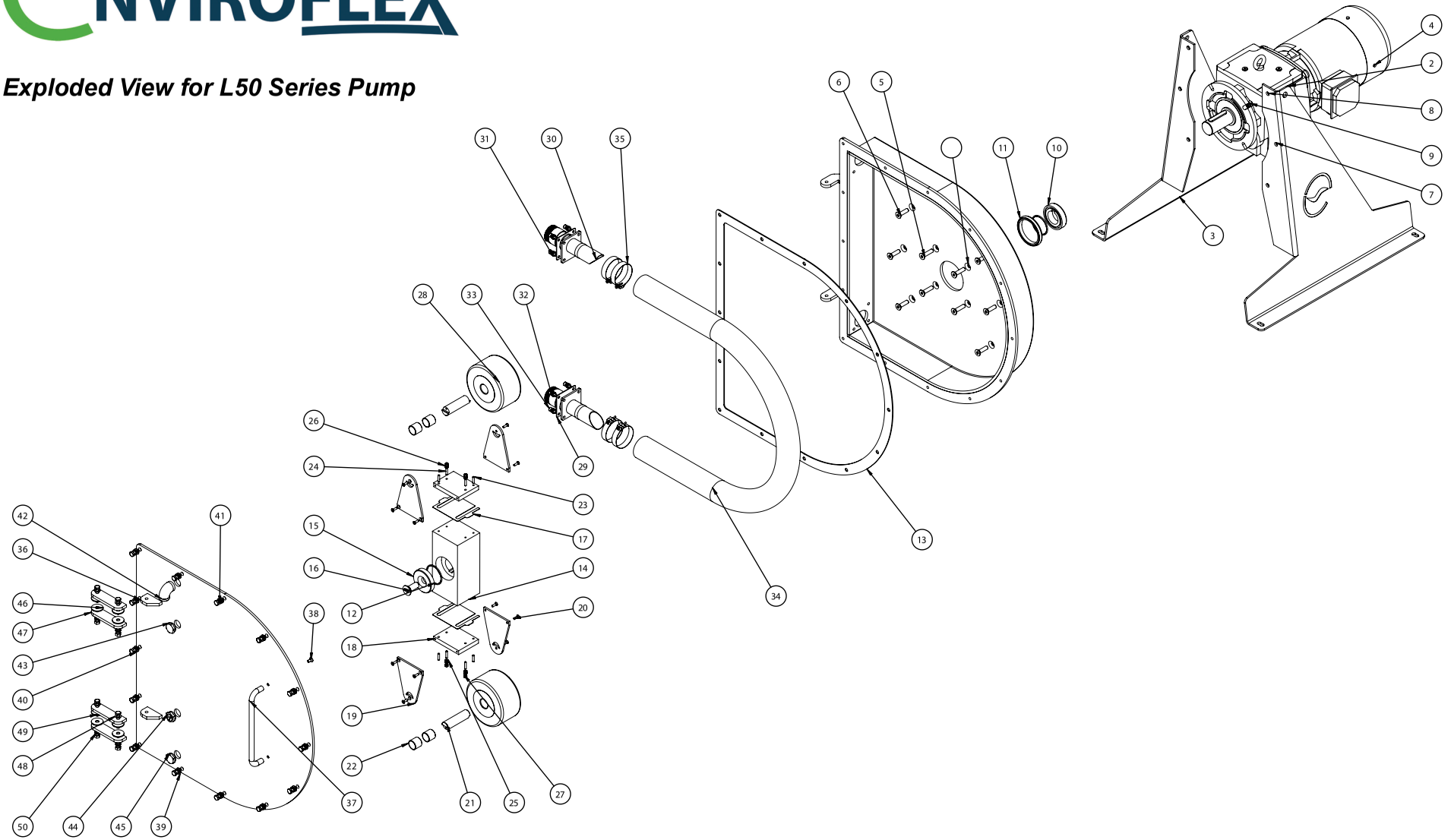
## *Exploded View for L50 Series Pump*



## L50 Series Pump Parts List

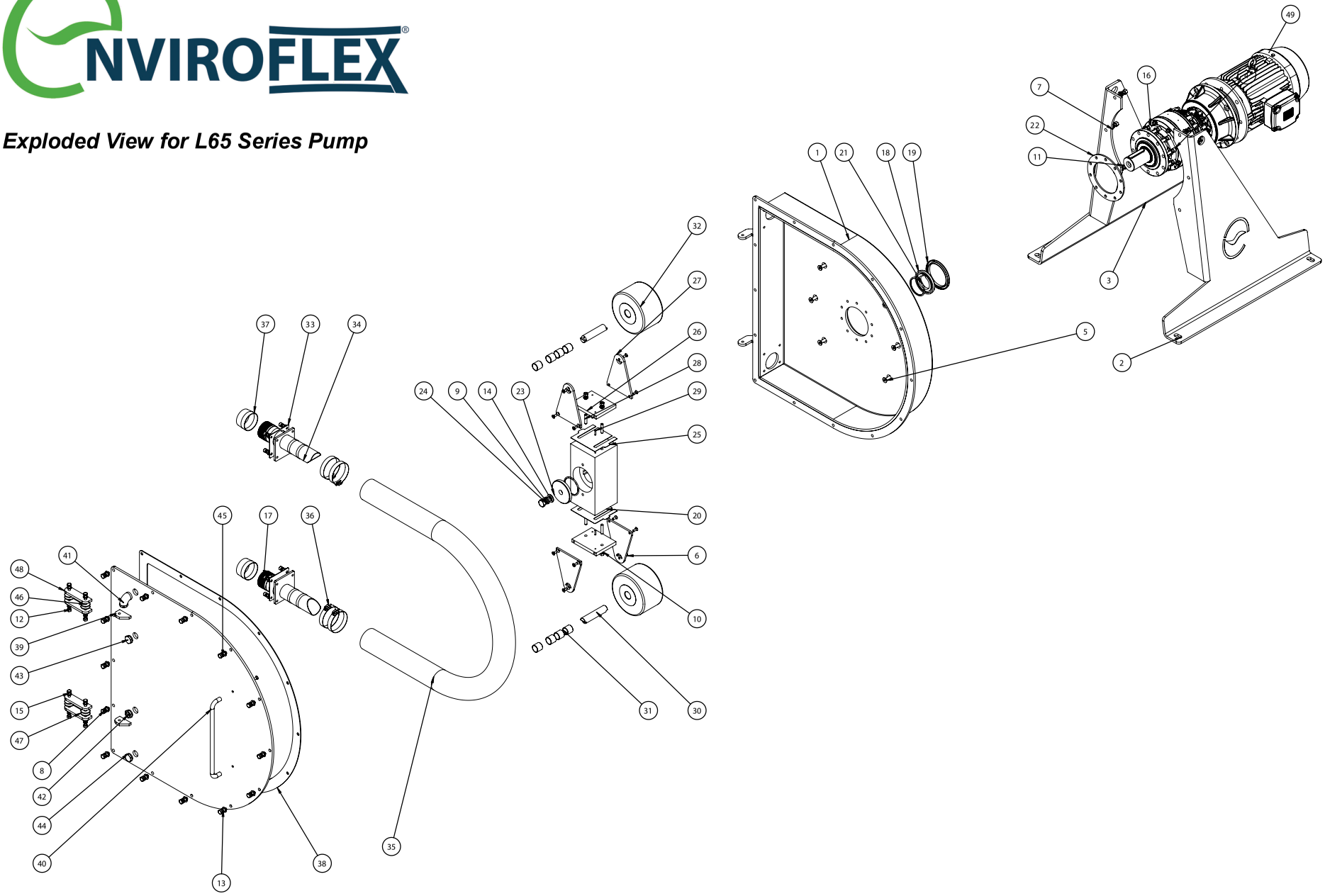
| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-50-PH-1 | Housing Body | 88040.96 | 1 |
| 2 | L-50-F-L-1 | Pump Frame Left | 16263.51 | 1 |
| 3 | L-50-F-R-1 | Pump Frame Right | 16263.51 | 1 |
| 4 | D-L-50-Gear Box and Motor | Gearbox and Motor | | 1 |
| 5 | LB-1230 | Gearbox Mounting Screw | | 4 |
| 6 | LB-1228 | Frame Mounting Screw | | 6 |
| 7 | LW-3003 | Flat Washer | | 10 |
| 8 | LW-3103 | Spring Washer | | 10 |
| 9 | LN-2003 | Nut | | 10 |
| 10 | L-50-R-RS-1 | Rotor Spacer | 736.67 | 1 |
| 11 | LS-6500 | Drive Protection Seal | | 1 |
| 12 | LS-6501 | Rotor Clamp O Ring | 2.52 | 2 |
| 13 | L-50-FC-DS-1 | Front Door Seal | 406.99 | 1 |
| 14 | L-50-R-1 | Rotor | 7789.00 | 1 |
| 15 | L-50-R-RC-1 | Rotor Clamp Washer | 655.71 | 1 |
| 16 | LB-1240 | Rotor Clamp Screw | | 1 |
| 17 | L-50-SH-1 / L-50-SH-2 | Shim 0.6mm / Shim 1.0mm | 53.09 | 4/8 |
| 18 | L-50-ROL-M-1 | Roller Mount | | 2 |
| 19 | L-50-ROL-SP-1 | Roller Side Plate | 636.01 | 4 |
| 20 | LB-1232 | Roller Side Plate Screw | | 12 |
| 21 | L-50-ROL-SH-1 | Roller Shaft | | 2 |
| 22 | L-50-ROL-B-1 | Roller Bush | 48.04 | 4 |
| 23 | LD-7000 | Roller Mount Dowel | | 4 |
| 24 | LB-1281 | Roller Mount Fixing | | 4 |
| 25 | LB-3000 | Flat Washer | | 4 |
| 26 | LB-3100 | Spring Washer | | 4 |
| 27 | LN-4010 | Nut | | 4 |
| 28 | L-50-ROL-1 | Roller | 2111.27 | 2 |
| 29 | L-50-HC-CS-1 | Hose Connector Seal | 12.73 | 2 |
| 30 | L-50-HC-1 | Hose Connector | 1079.04 | 2 |
| 31 | LW-3001 | Flat Washer | | 8 |
| 32 | LW-3101 | Spring Washer | | 8 |
| 33 | LB-1231 | Hose Connector Screw | | 8 |
| 34** | L-50-NRH | Pump Hose - NATURAL RUBBER | 6722.09 | 1 |
| | L-50-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 6722.09 | 1 |
| | L-50-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 6722.09 | 1 |
| | L-50-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 6722.09 | 1 |
| | L-50-EPDM | Pump Hose - EPDM | 6722.09 | 1 |
| | L-50-HYP | Pump Hose - HYPALON | 6722.09 | 1 |
| 35** | LC-4019 | Hose Clip | 61.21 | 4 |
| 36 | L-50-FC-1 | Front Cover | 39753.58 | 1 |
| 37 | LH-4000 | Handle | 227.52 | 1 |
| 38 | LB-1269 | Front Cover Handle Fixing | | 2 |
| 39 | LW-3002 | Flat Washer | | 14 |
| 40 | LW-3102 | Spring Washer | | 18 |
| 41 | LB-1026 | Front Cover Screw | | 14 |
| 42 | LT-5100S | Breather Elbow | 101.92 | 1 |
| 43 | LP-1001 | Fill Plug | 28.81 | 1 |
| 44 | LT-5012 | Sight Glass | 32.68 | 1 |
| 45 | LP-1002 | Drain Plug | 28.81 | 1 |
| 46 | L-50-67 | Friction Hinge Washer | 3.95 | 8 |
| 47 | L-50-66 | Hinge Link Plate | | 4 |
| 48 | LW-3002 | Flat Washer | | 8 |
| 49 | LB-1274 | Hinge Screw | | 4 |
| 50 | LN-2002 | Nut | | 4 |

* 1 g = 0.0353 ounce / 0.0022 pound

** Recommended spares with 10 litres of Envirolube Lubricant.

ENVIROFLEX®

***Exploded View for L65 Series Pump***



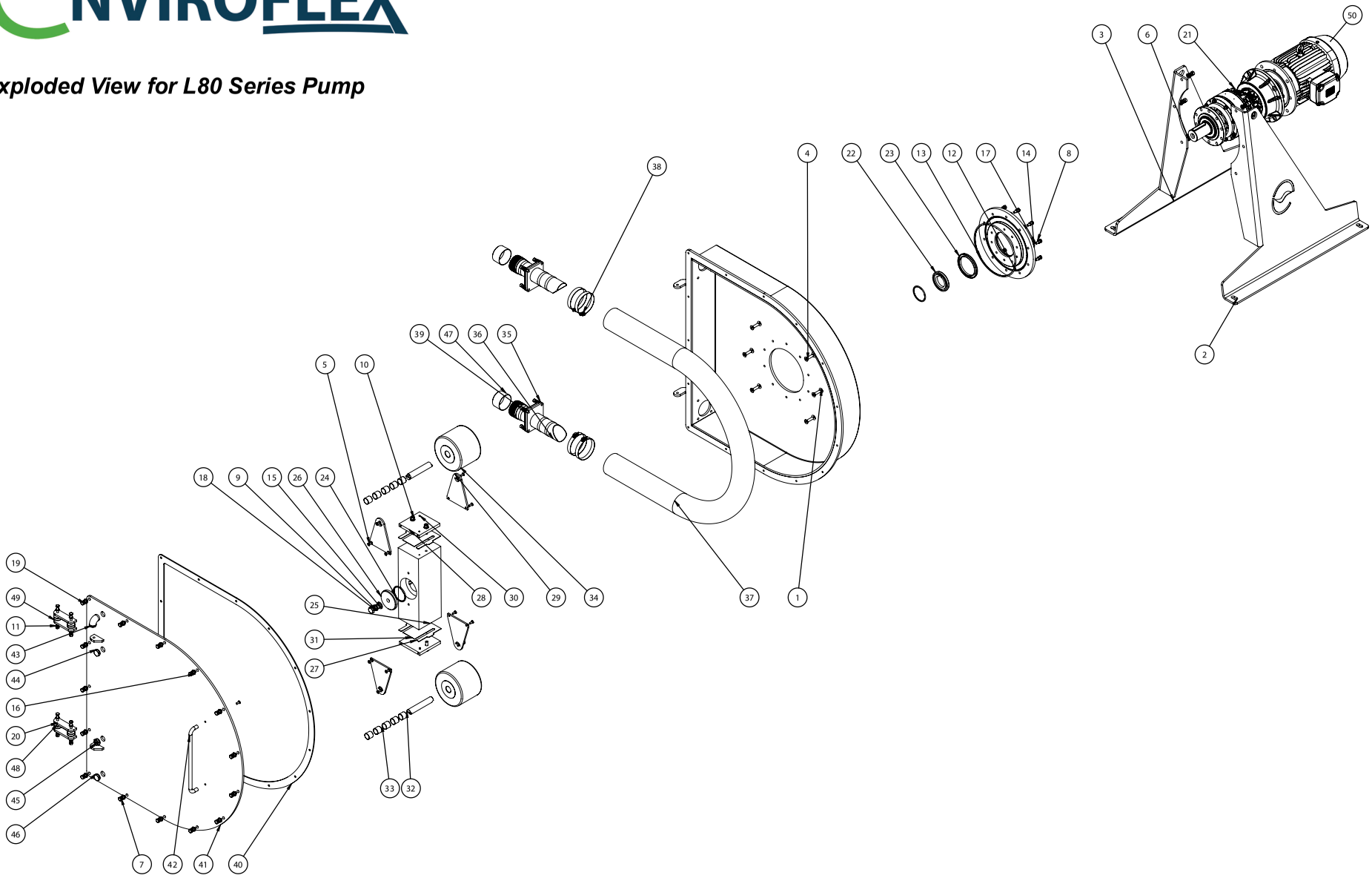
## L65 Series Pump Parts List

| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-65-PH-1 | Housing Body | 123018.97 | 1 |
| 2 | L-65-F-L-1 | Pump Frame Left | 35654.28 | 1 |
| 3 | L-65-F-R-1 | Pump Frame Right | 35654.23 | 1 |
| 4 | L-65-Gearbox | Gearbox | 48719.85 | 1 |
| 5 | LB-3230 | Frame Mounting Screw | | 6 |
| 6 | LB-3213 | Roller Side Plate and Roller Shaft Screw | | 14 |
| 7 | LW-5003 | Flat Washer | | 6 |
| 8 | LWS-5103 | Spring Washer | | 20 |
| 9 | LW-5104 | Spring Washer | | 1 |
| 10 | LW-5102 | Spring Washer | | 16 |
| 11 | LN-4003 | Nut | | 6 |
| 12 | LN-5102 | Nut | | 8 |
| 13 | LW-5003 | Flat Washer | | 24 |
| 14 | LW-5004 | Flat Washer | | 1 |
| 15 | LW-5002 | Flat Washer | | 20 |
| 16 | LB-3270 | Gearbox Mounting Screw | | 10 |
| 17 | LB-3275 | Hose Connector Screw | | 8 |
| 18 | L-65-R-RS-1 | Rotor Spacer | 538.21 | 1 |
| 19 | LS-6800 | Drive Protection Seal | 29.95 | 1 |
| 20 | L-65-R-1 | Rotor | 15093.56 | 1 |
| 21 | LS-6801 | Rotor Spacer O Ring | 6.12 | 2 |
| 22 | L-65-81 | Gearbox Spacer | 931.56 | 1 |
| 23 | L-65-R-RC-1 | Rotor Clamp Washer | 894.79 | 1 |
| 24 | LB-3271 | Rotor Clamp Bolt | | 1 |
| 25 | L-65-SH-1 / L-65-SH-2 | Shim 0.6mm / Shim 1.0mm | 88.54 | A/R |
| 26 | L-65-ROL-M-1 | Roller Mount | 2223.85 | 2 |
| 27 | L-65-ROL-SP-1 | Roller Side Plate | 1220.17 | 4 |
| 28 | LB-3279 | Roller Mount Fixing | | 4 |
| 29 | LD-7000 | Roller Mount Dowel | | 4 |
| 30 | L-65-ROL-SH-1 | Roller Shaft | 710.05 | 2 |
| 31 | L-65-ROL-B-1 | Roller Bush | 48.85 | 8 |
| 32 | L-65-ROL-1 | Roller | 3664.83 | 2 |
| 33 | L-65-HC-CS-1 | Hose Connector Seal | 24.44 | 2 |
| 34 | L-65-HC-1 | Hose Connector | 2369.20 | 2 |
| 35** | L-65-NRH | Pump Hose - NATURAL RUBBER | 11681.65 | 1 |
| | L-65-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 11681.65 | 1 |
| | L-65-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 11681.65 | 1 |
| | L-65-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 11681.65 | 1 |
| | L-65-EPDM | Pump Hose - EPDM | 11681.65 | 1 |
| | L-65-HYP | Pump Hose - HYPALON | 11681.65 | 1 |
| 36** | LC-4020 | Hose Clip | 70.69 | 4 |
| 37 | L-65-CON-CAP | Hose Connector Cap | 32.86 | 2 |
| 38 | L-65-FC-DS-1 | Front Door Seal | 609.75 | 1 |
| 39 | L-65-FC-1 | Front Cover | 68786.85 | 1 |
| 40 | LH-4001 | Handle | 288.81 | 1 |
| 41 | LT-5100S | Breather Elbow | 101.92 | 1 |
| 42 | LT-5012 | Sight Glass | 32.68 | 1 |
| 43 | LP-1001 | Fill Plug | 28.81 | 1 |
| 44 | LP-1002 | Drain Plug | 28.81 | 1 |
| 45 | LB-3242 | Front Cover Screw | | 14 |
| 46 | LB-3274 | Hinge Screw | | 4 |
| 47 | L-65-56 | Friction Hinge Washer | 3.95 | 8 |
| 48 | L-65-53 | Hinge Link Plate | 411.16 | 4 |
| 49 | Motor | Motor | | 1 |

* 1 g = 0.0353 ounce / 0.0022 pound
** Recommended spares with 20 litres of Envirolube Lubricant.

ENVIROFLEX®

***Exploded View for L80 Series Pump***



## L80 Series Pump Parts List

| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-80-PH-1 | Housing Body | 187658.33 | 1 |
| 2 | L-80-F-L-1 | Pump Frame Left | 41936.39 | 1 |
| 3 | L-80-F-R-1 | Pump Frame Right | 41936.37 | 1 |
| 4 | LB-3230 | Frame Mounting Screw | | 6 |
| 5 | LB-3213 | Roller Shaft and Roller Side Plate Screw | | 14 |
| 6 | LW-5003 | Flat Washer | | 6 |
| 7 | LW-5103 | Spring Washer | | 25 |
| 8 | LW-5102 | Spring Washer | | 22 |
| 9 | LW-5104 | Spring Washer | | 1 |
| 10 | LN-4003 | Nut | | 10 |
| 11 | LN-4002 | Nut | | 4 |
| 12 | L-80-GB-MF-1 | Gearbox Mounting Flange | 15616.15 | 1 |
| 13 | LS-6814 | Rotor Spacer O Ring | 34.11 | 1 |
| 14 | LW-5002 | Flat Washer | | 26 |
| 15 | LW-5004 | Flat Washer | | 1 |
| 16 | LB-5003 | Flat Washer | | 19 |
| 17 | LB-3236 | Gearbox Mounting Screw | | 10 |
| 18 | LB-3243 | Rotor Clamp Bolt | | 1 |
| 19 | LB-3242 | Front Cover Screw | | 15 |
| 20 | LB-3274 | Hinge Screw | | 4 |
| 21 | L-80-Gearbox | Gearbox | 48719.85 | 1 |
| 22 | L-80-R-RS-1 | Rotor Spacer | 579.00 | 1 |
| 23 | LS-6800 | Drive Protection Seal | 23.31 | 1 |
| 24 | LS-6801 | Rotor Clamp O Ring | 6.12 | 2 |
| 25 | L-80-R-1 | Rotor | 27573.15 | 1 |
| 26 | L-80-R-RC-1 | Rotor Clamp Washer | 877.10 | 1 |
| 27 | L-80-SH-1 / L-80-SH-2 | Shim 0.6mm / Shim 1.0mm | 106.08 | A/R |
| 28 | L-80-ROL-M-1 | Roller Mount | 2768.59 | 2 |
| 29 | L-80-ROL-SP-1 | Roller Side Plate | 1183.66 | 4 |
| 30 | LD-7002 | Roller Mount Dowel | | 4 |
| 31 | LB-3282 | Roller Mount Fixing | | 4 |
| 32 | L-80-ROL-SH-1 | Roller Shaft | 865.89 | 2 |
| 33 | L-80-ROL-B-1 | Roller Bush | 48.04 | 10 |
| 34 | L-80-ROL-1 | Roller | 4519.05 | 2 |
| 35 | L-80-HC-CS-1 | Hose Connector Seal | 24.97 | 2 |
| 36 | L-80-HC-1 | Hose Connector | 2611.40 | 2 |
| 37** | L-80-NRH | Pump Hose - NATURAL RUBBER | 11681.65 | 1 |
| | L-80-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 11681.65 | 1 |
| | L-80-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 11681.65 | 1 |
| | L-80-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 11681.65 | 1 |
| | L-80-EPDM | Pump Hose - EPDM | 11681.65 | 1 |
| | L-80-HYP | Pump Hose - HYPALON | 11681.65 | 1 |
| 38** | LC-4021 | Hose Clip | 80.59 | 4 |
| 39 | LB-3244 | Hose Connector Screw | | 8 |
| 40 | L-80-FC-DS-1 | Front Door Seal | 913.61 | 1 |
| 41 | L-80-FC-1 | Front Cover | 91983.49 | 1 |
| 42 | LH-4001 | Handle | 288.81 | 1 |
| 43 | LT-5100S | Breather Elbow | 101.92 | 1 |
| 44 | LP-1001 | Fill Plug | 28.81 | 1 |
| 45 | LT-5102 | Sight Glass | 32.68 | 1 |
| 46 | LP-1002 | Drain Plug | 28.81 | 1 |
| 47 | L-80-CON-CAP | Hose Connector Cap | 36.55 | 2 |
| 48 | L-80-56 | Friction Hinge Washer | 3.95 | 8 |
| 49 | L-80-53 | Hinge Link Plate | 411.16 | 4 |
| 50 | Motor | Motor | | 1 |

* 1 g = 0.0353 ounce / 0.00220 pound

** Recommended spares with 25 litres of Envirolube Lubricant.

# 4 User Guide

## 4.1 *Troubleshooting*

If the pump does not appear to be functioning correctly, consult the following guide to see if you can identify and remedy the problem yourself. If the problem still persists, please contact Environmental Pumping Solutions Limited or your authorised local dealer for more detailed information.

| Problem | Probable Cause(s) | Suggested Remedy |
|---|---|---|
| The pump does not start when turned on. | Defective motor | Check motor is running<br>Check fuses.<br>Check motor protection switch<br>Make sure that all phases have required voltage |
| | Frequency inverter (when used) incorrectly set-up | Connect motor DOL<br>Check inverter settings |
| | Shaft key broken or missing | Make sure that a key is fitted and that all surfaces of friction are clean and undamaged. The hub screws are correctly tightened |
| | Pump rotating in reverse | Check direction of the motor is correct |
| | The pump is taking in air | Identify the source of air intake and exchange seals or gaskets |
| | Rollers are not adjusted correctly | Adjust the roller occlusion |
| Pump runs but there is no flow of media | Hose blocked | Reverse the pumps rotation and remove any obstacles. If this is not possible with your system, the pump needs to be disassembled and obstacles removed. |
| | Pipeline on suction side of the pump is clogged | Clean pipeline, valves, filters etc. |
| | Pump has pumped against excessive pressure and hose has detached from hose connector | Remove reason for overpressure, fit overpressure protection, check pump for damage and reattach hose and refill lube |
| Flow is less than calculated | Pump is running too slow | It maybe possible to fit a speed inverter or make a gear ratio change (not always possible). Call Environmental Pumping Solutions Ltd. to discuss |
| | The pump is taking in air | Locate the source of air intake and exchange seals or gaskets |
| Flow is less than calculated | Restriction in the suction pip | Identify and remove the restriction |
| | Viscosity is too high for the size of pump | Turn down the pump speed and/or utilise a larger pump |

| Problem | Probable Cause(s) | Suggested Remedy |
|---|---|---|
| Flow is less than calculated | Rollers are not adjusted correctly | Adjust the roller occlusion |
| | Backpressure is too high | Change the pipeline on the pressure side of the pump |
| | Suction pipe is too long for the diameter creating too high suction pulsation losses | Consult Environmental Pumping Solutions Ltd. |
| Noise | Pump cavitating | Lower the speed or utilise a bigger pump or change the pipelines |
| | Air or gas in the pipelines | Seal off possible air intakes |
| | Pressure too high | Clear pipelines and check pipe sizes<br>Lower the pumping speed |
| | Rollers are not adjusted correctly | Adjust the roller occlusion |
| | Gearwheels or bearings worn out | Workshop overhaul of pump needed |
| | Hose damaged | Exchange the hose |
| | Suction and discharge lines not correctly fastened | Fasten correctly |
| Vibration of the pump and pipework | High pump speed with long suction and discharge lines or high product specific gravity or a combination of these factors | Reduce pump speed.<br>Reduce the line lengths on both suction and discharge where possible. Consult Environmental Pumping Solutions Ltd. |
| | Too small diameter of suction and/or discharge pipework | Increase the pipework size |
| | Pressure too high | Check discharge pressure is as per pump data sheet.<br>Check pump speed is as per pump data sheet.<br>Check pipelines are clear<br>Check pump hose is not damaged<br>(New installation) Check pipes sized correctly |
| Pump draws too much current | Sedimentation of solid substance when not using the pump | Empty the pump after use, flush the pump with clean water after use |
| | Fluid or particle buildup in or by the motor | Clean the motor |
| | High pump speed | Reduce pump speed or install larger pump |
| Short Hose Life | Hose Deteriorating chemically | Reassess the choice of material for the hose |
| | High pulsations | Consult Environmental Pumping Solutions Ltd. for detailed advice |
| | Incorrect hose lubricant used | Use only Envirolube lubricant |
| Pump parts wearing quickly | Hose wearing mechanically on the outside | Check compression roller occlusion |

| Problem | Probable Cause(s) | Suggested Remedy |
|---|---|---|
| Pump parts wearing quickly | Hose wearing mechanically on the inside | Check compression roller occlusion |
| | Roller bearings (bushings) wear down quickly | Check compression roller occllusion |
| | Abrasive product mixed in the hose lubricant | Wash out pump body and change lubricant. Ensure pump body is fully cleaned when replacing a failed hose |
| High pump temperature | Incorrect hose lubricant used | Use only Envirolube lubricant |
| | Product temperature too high | Consult Environmental Pumping Solutions Ltd. |
| | Pump running to fast | Reduce pump speed |
| | Possible restriction in the suction pipe | Dismantle the suction piping, identify the restriction and remove |
| Lubricant leakage | Leaking seal or gasket | Identify the leaking seal or gasket. Tighten retaining bolts. Replace seal or gasket if needed |

For trouble free pump operation, please refer also to the Routine Maintenance instructions as detailed earlier in this manual.

## 4.2 *Specifications*

### 4.2.1 Pump operating conditions

| Description | L20 | L25 | L32 | L40 | L50 | L65 | L80 |
|---|---|---|---|---|---|---|---|
| Max continuous flow ($m^3/hr$) | 1.2* | 2.21* | 4.00* | 6.5* | 10.4* | 19.2* | 25.9* |
| Capacity per revolution (l/rev) | 0.23 | 0.41 | 0.95 | 1.82 | 3.46 | 7.10 | 12.33 |

| | |
|---|---|
| Maximum working pressure | 10 Barg* |
| Ambient working temperature | -15°C to +45°C |
| Product working temperature | -10°C to +80°C |
| Sound level at 1m | < 70 dB(A) whilst pumping water at maximum continuous flow |

* Your pump may not have been configured to run at these stated maximums. Please check your Technical Data Sheet.

### 4.2.2 Materials of Construction

| Description | Standard | Optional | |
|---|---|---|---|
| Pump Body | Carbon Steel | 304 st. stl. | 316 st. stl. |
| Front Cover | Carbon Steel | 304 st. stl. | 316 st. stl. |
| Rotor | Carbon Steel | 304 st. stl. | 316 st. stl. |
| Compression Rollers | POM | | |
| Hose connectors | 304 st. stl. | 316 st. stl. | |
| Support Frame | 304 st. stl. | | 316 st. stl. |
| Gasket Frame | Nitrile | | |
| Fasteners | MS BZP | 304 st. stl. | 316 st. stl. |

### 4.2.3 Hose Lubricant Quantities

| Pump Model | L20 | L25 | L32 | L40 | L50 | L65 | L80 |
|---|---|---|---|---|---|---|---|
| Volume of hose lubricant (litres) | 2.5 | 2.5 | 5.0 | 7.5 | 10 | 20 | 25 |

*i* Contact Environmental Pumping Solutions Limited or your authorised local dealer should you require a Material Safety Data Sheet (MSDS) for Envirolube hose lubricant.

### 4.2.4 Weights and Dimensions

The details below are approximate only. Please refer to your Technical Data Sheet or Environmental Pumping Solutions for specific details of the supplied equipment.

| Pump Model | L20 | L25 | L32 | L40 | L50 | L65 | L80 |
|---|---|---|---|---|---|---|---|
| Net weight (kgs) | 65 | 65 | 155 | 250 | 300 | 375 | 540 |
| Overall size (mm) | 536H<br>513W<br>503L | 536H<br>513W<br>503L | 723H<br>691W<br>670L | 857H<br>790W<br>750L | 986H<br>852W<br>790L | 1134H<br>1067W<br>889L | 1319H<br>1242W<br>994L |

## 4.3 ***Recommendations for Hose Storage***

We recommend that pump hoses are stored in accordance with BS3574. Peristaltic hoses can be considered as Group A products as detailed in this specification, i.e. products with moderate susceptibility to deterioration.

The relevant points from this specification are:

| | |
|---|---|
| Temperature: | To be below 25ºc and articles stored away from direct sources of heat such as boilers, radiators and direct sunlight.<br><br>For articles stored below 15ºc their temperature should be raised to approx. 30ºc throughout their mass prior to use. |
| Humidity: | Humidity shall be such that condensation shall not occur. The criterion for this is that either the storage temperature should be above the dew point or humidity levels should be low enough to ensure the dew point is below the storage temperature. |
| Light: | Protect from strong light sources, in particular direct sunlight or intense artificial light having a high ultraviolet content. |
| Ozone: | Storage areas shall not contain equipment which generates ozone - e.g. mercury vapour lamps, high voltage electrical equipment, combustion gases, organic vapours. |
| Deformation: | Store free from superimposed tensions or compression.<br>For a hose this means that the supports must be wide enough and spaced in a way as to spread the load over a wide area. We would recommend a minimum width of 100mm for any support spaced no more than 500mm apart. It is preferable that hoses are supported over their entire length.<br>**Do not store hoses coiled.** |
| Contact with Liquids: | Do not allow contact with liquids (e.g. petrol, greases, acids, disinfectants, cleaning fluids). |
| Contact between Hoses: | Avoid direct contact between hoses of different types, particularly between hoses of different colours. |
| Rotation of Stock: | Hoses must be issued in strict rotation by manufacturing date or production code. |

Hoses will be delivered wrapped individually in opaque polythene, we would recommend that the packing is kept on the hoses prior to use to reduce the effects of light and to minimise contact with other materials. Individual hoses are marked with a production code identifying the manufacturing period.

# EC Declaration of Conformity

In accordance with EN ISO 17050-1:2004

*We* Environmental Pumping Solutions Limited

*of* Elcot Park, Elcot Lane, Marlborough, Wiltshire, SN8 2BG, United Kingdom

*in accordance with the following Directive(s):*

| | |
|---|---|
| 2004/108/EC | The Electromagnetic Compatibility Directive |
| 2006/42/EC | The Machinery Directive |

*hereby declare that:*

| | |
|---|---|
| Equipment | Peristaltic Pump |
| Models | L20, L25, L32, L40, L50, L65, L80 |

*is in conformity with the applicable requirements of the following documents*

| Ref. No. | Title | Edition/date |
|---|---|---|
| BS EN ISO 12100-1 | Safety of machinery. Basic concepts, general principles for design. Basic terminology, methodology | 2003 |
| BS EN ISO 12100-2 | Safety of machinery. Basic concepts, general principles for design. Technical principles | 2003 |
| BS EN 809 | Pumps and pump units for liquids. Common safety requirements | 1998 |
| BS EN 60204-1 | Safety of machinery. Electrical equipment of machines. General requirements | 2006 +A1:2009 |
| BS EN 61000-6-1 | Electromagnetic compatibility (EMC). Generic standards. Immunity for residential, commercial and light-industrial environments | 2007 |
| BS EN 61000-6-3 | Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments | 2007 |

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications and is in accordance with the requirements of the Directive(s)

Signed by: .....

Name: Tony Fenn

Position: Sales Director

Done at Marlborough, Wiltshire, UK

On November 2012

The technical documentation for the machinery is available from the manufacturer at the above address.

4.5

## Product Use Declaration Form

In compliance with the Health & Safety Regulations and the Control of Substances Hazardous to Health Regulations you, the user are required to declare the substances which have been in contact with the product(s) you are returning to Environmental Pumping Solutions Limited or any of its subsidiaries or distributors. Failure to do so will cause delays in servicing the item or in issuing a response. Therefore, please complete this form to ensure that we have the information before receipt of the items(s) being returned. **A FURTHER COPY MUST BE ATTACHED TO THE OUTSIDE OF THE PACKAGING CONTAINING THE ITEM(S)** before returning. You, the user, are responsible for cleaning and decontaminating the item(s) before returning them.

**Please complete a separate Declaration Form for each item returned.**

Company: ……...

Address: ……

…… Postcode: ……..

Telephone: …… Fax Number: ……

e-mail: ……...

Product: ……..

Serial Number: ……..

Has the Product been used?

| YES | | NO | |
|---|---|---|---|

If yes, please complete all the following sections

If no, please complete declaration only

Details of Substances Pumped

Chemical names:

1. ……..
2. ……..
3. ……..
4. ……..

Precautions to be taken when handling the above:

1. ……
2. ……
3. ……
4. ……

Action to be taken in the event of human contact:

1. ……
2. ……
3. ……
4. ……

Cleaning fluids to be used if residue product is found during servicing:

1. ……..
2. ……..
3. ……..
4. ……..

I herby confirm that the only substance(s) that the item specified has handled or come into contact with are those named, that the information given is correct, and the carrier has been informed if the consignment is of a hazardous nature.

Signed:

Name:

Position:

Date:

Any other additional information you may regard as useful:

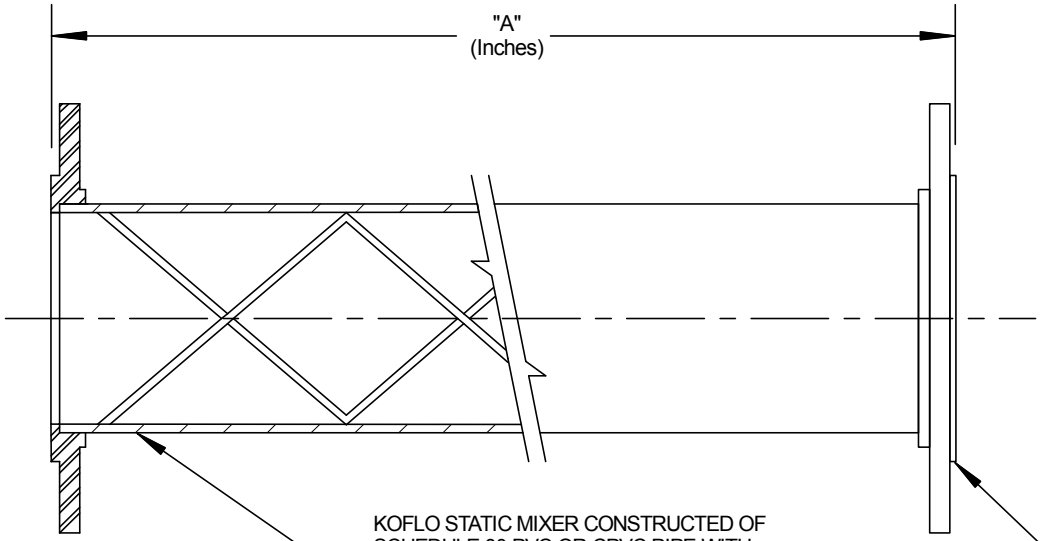
……

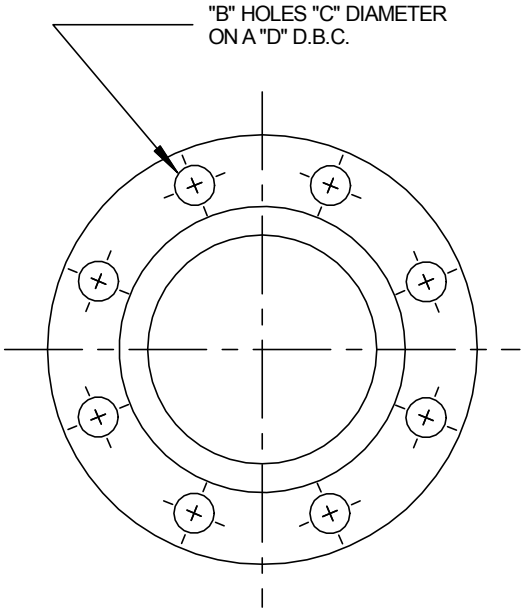
……

……

……

Environmental Pumping Solutions Limited Tel: +44 (0) 1672 519 878 Fax: +44 (0) 1672 515 650




| SIZE | "A" *NUMBER OF ELEMENTS | | | | | "B" | "C" | "D" |
|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 6 | | | |
| 1/2" | 5 | 5 | 5 | 5 | 5 | 4 | 5/8" | 2-3/8" |
| 3/4" | 7 | 7 | 7 | 7 | 7 | 4 | 5/8" | 2-3/4" |
| 1" | 7 | 7 | 7 | 8 | 8 | 4 | 5/8" | 3-1/8" |
| 1-1/2" | 8 | 8 | 10 | 12 | 13 | 4 | 5/8" | 3-7/8" |
| 2" | 8 | 9 | 12 | 14 | 16 | 4 | 3/4" | 4-3/4" |
| 2-1/2" | 9 | 11 | 14 | 17 | 19 | 4 | 3/4" | 5-1/2" |
| 3" | 12 | 14 | 18 | 22 | 24 | 4 | 3/4" | 6" |
| 4" | 13 | 18 | 23 | 28 | 32 | 8 | 3/4" | 7-1/2" |
| 6" | 19 | 25 | 33 | 41 | 48 | 8 | 7/8" | 9-1/2" |
| 8" | 23 | 34 | 44 | 54 | 64 | 8 | 7/8" | 11-3/4" |
| 10" | 28 | 40 | 54 | 66 | 80 | 12 | 1" | 14-1/4" |
| 12" | 34 | 50 | 66 | 78 | 96 | 12 | 1" | 17" |

Koflo Corporation
309 CARY POINT DR.
CARY, IL 60013

| | | | |
|---|---|---|---|
| SCALE: NONE | APPROVED BY JLT | DRAWN BY NJF | |
| DATE: 9/11/85 | | REVISED 12/13/93 | |
| CUSTOMER: | | REVISED 5/22/08 | |
| | | REVISED 7/15/10 | |
| MODEL NO: TYPICAL FLANGED SCHEDULE 80 PVC OR CPVC MIXER | | DRAWING NUMBER: KD-1027 | |

LEVITON
Building A Connected World

PK-93370-10-00-2A

# Installing and Testing a GFCI Receptacle

**Please read this leaflet completely before getting started.**

## ⚠ CAUTION

- To prevent severe shock or electrocution always turn the power OFF at the service panel before working with wiring.
- Use this GFCI with copper or copper-clad wire. Do not use it with aluminum wire.
- Do not install this GFCI receptacle on a circuit that powers life support equipment because if the GFCI trips it will shut down the equipment.
- For installation in wet locations, protect the GFCI receptacle with a weatherproof cover that will keep both the receptacle and any plugs dry.
- Must be installed in accordance with national and local electrical codes.

## 1. What is a GFCI?

A GFCI receptacle is different from conventional receptacles. In the event of a ground fault, a GFCI will trip and quickly stop the flow of electricity to prevent serious injury.

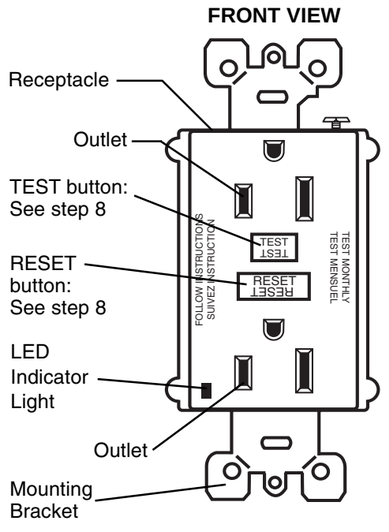
**Definition of a ground fault:**
Instead of following its normal safe path, electricity passes through a person's body to reach the ground. For example, a defective appliance can cause a ground fault.

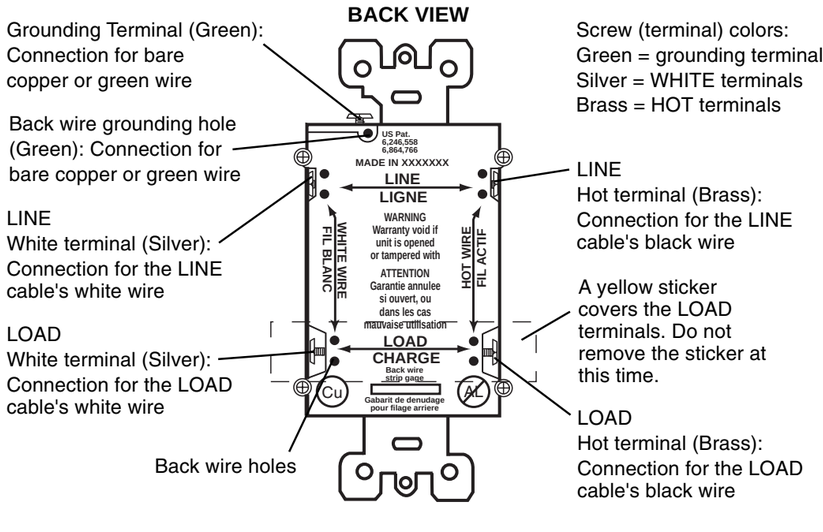
A GFCI receptacle does **NOT** protect against circuit overloads, short circuits, or shocks. For example, you can still be shocked if you touch bare wires while standing on a non-conducting surface, such as a wood floor.

GFCI's contain a lockout feature that will prevent RESET if:

- There is no power being supplied to the GFCI.
- The GFCI is miswired due to reversal of the LINE and LOAD leads.
- The GFCI cannot pass its internal test, indicating that it may not be able to provide protection in the event of a ground fault.

## 2. The GFCI's features




## 3. Should you install it?

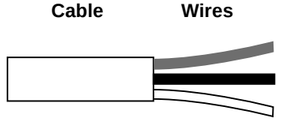
Installing a GFCI receptacle can be more complicated than installing a conventional receptacle.

Make sure that you:

- Understand basic wiring principles and techniques
- Can interpret wiring diagrams
- Have circuit wiring experience
- Are prepared to take a few minutes to test your work, making sure that you have wired the GFCI receptacle correctly

## 4. LINE vs. LOAD

A cable consists of 2 or 3 wires.

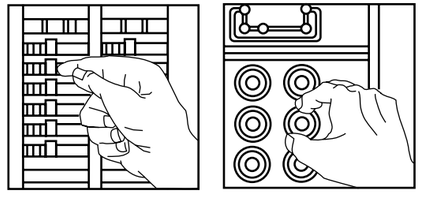



**LINE cable:**
Delivers power from the service panel (breaker panel or fuse box) to the GFCI. If there is only one cable entering the electrical box, it is the LINE cable. This cable should be connected to the GFCI's LINE terminals only.

**LOAD cable:**
Delivers power from the GFCI to another receptacle in the circuit. This cable should be connected to the GFCI's LOAD terminals only. The LOAD terminals are under the yellow sticker. Do **NOT** remove the sticker at this time.

## 5. Turn the power OFF

Plug an electrical device, such as a lamp or radio, into the receptacle on which you are working. Turn the lamp or radio ON. Then, go to the service panel. Find the breaker or fuse that protects that receptacle. Place the breaker in the OFF position or completely remove the fuse. The lamp or radio must turn OFF.



Next, plug in and turn ON the lamp or radio at the receptacle's other outlet to make sure the power is OFF at both outlets. If the power is not OFF, stop work and call an electrician to complete the installation.

## 6. Identify cables/wires

**Important:**
DO NOT install the GFCI receptacle in an electrical box containing (a) more than four (4) wires (not including the grounding wires) or (b) cables with more than two (2) wires (not including the grounding wire). Contact a qualified electrician if either (a) or (b) are true.

If you are replacing an old receptacle, pull it out of the electrical box without disconnecting the wires.

- If you see one cable (2-3 wires), it is the LINE cable. The receptacle is probably in position C (see diagram to the right). Remove the receptacle and go to step 7A.
- If you see two cables (4-6 wires), the receptacle is probably in position A or B (see diagram to the right). Follow steps a-e of the procedure to the right.

**Procedure: box with two (2) cables (4-6 wires):**

(a) Detach one cable's white wire and hot wires from the receptacle and cap each one separately with a wire connector. Make sure that they are from the same cable.

(b) Re-install the receptacle in the electrical box, attach faceplate, then turn the power ON at the service panel.

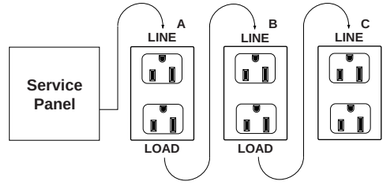
(c) Determine if power is flowing to the receptacle. If so, the capped wires are the LOAD wires. If not, the capped wires are the LINE wires.

(d) Turn the power OFF at the service panel, label the LINE and LOAD wires, then remove the receptacle.

(e) Go to step 7B.

**Placement in circuit:**
The GFCI's place in the circuit determines if it protects other receptacles in the circuit.

**Sample circuit:**



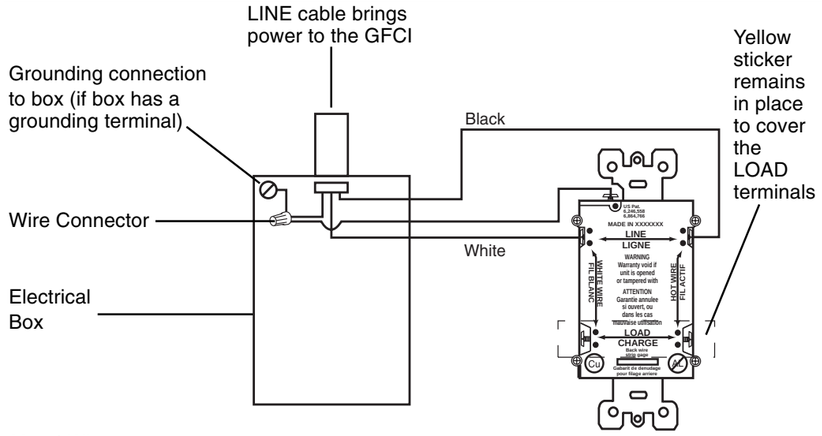

Placing the GFCI in position A will also provide protection to "load side" receptacles B and C. On the other hand, placing the GFCI in position C will not provide protection to receptacles A or B. Remember that receptacles A, B, and C can be in different rooms.

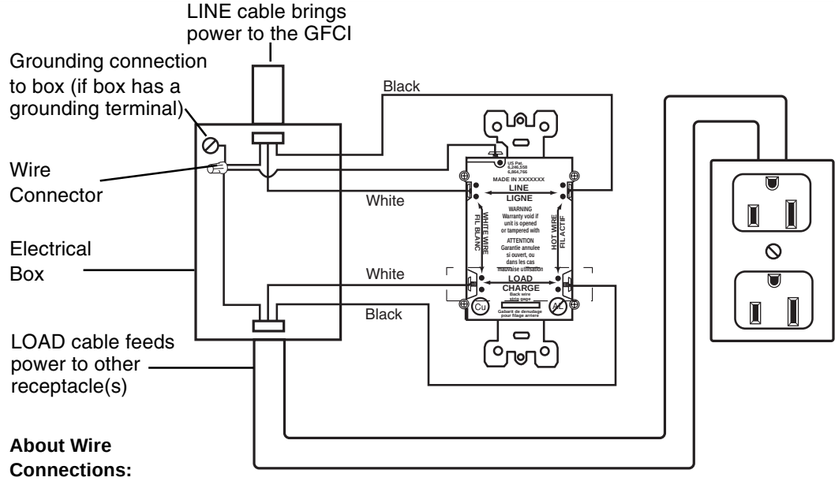
## 7. Connect the wires (choose A or B)... only after reading other side completely

### A: One Cable (2 or 3 wires) entering the box

OR

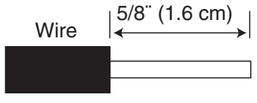
### B: Two cables (4 or 6 wires) entering the box



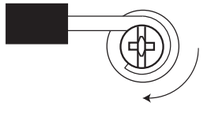




**About Wire Connections:**

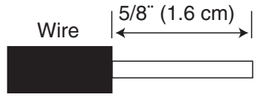
**Side Wire:**



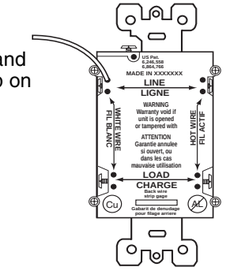

**For Side wire -**
Loop clockwise 2/3 of the way around screw



**Back Wire:**

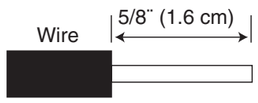



**For Back wire -**
Insert bare wire fully and tighten terminal clamp on conductor ONLY

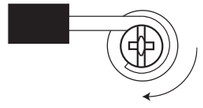


**About Wire Connections:**

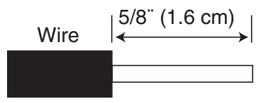
**Side Wire:**



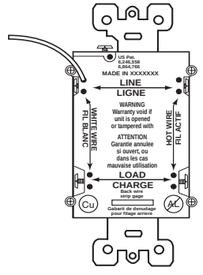

**For Side wire -**
Loop clockwise 2/3 of the way around screw



**Back Wire:**




**For Back wire -**
Insert bare wire fully and tighten terminal clamp on conductor ONLY



**Connect the LINE cable wires to the LINE terminals:**

- The white wire connects to the WHITE terminal (Silver)
- The black wire connects to the HOT terminal (Brass)

**Connect the grounding wire (only if there is a grounding wire):**

- For a box with no grounding terminal (diagram not shown): Connect the LINE cable's bare copper (or GREEN) wire directly to the grounding terminal on the GFCI receptacle.
- For a box with a grounding terminal (diagram shown above): Connect a 6-inch bare copper (or GREEN) 12 or 14 AWG wire to the grounding terminal on the GFCI. Also connect a similar wire to the grounding terminal on the box. Connect the ends of these wires to the LINE cable's bare copper (or GREEN) wire using a wire connector. If these wires are already in place, check the connections.

**Complete the installation:**

- Fold the wires into the box, keeping the grounding wire away from the WHITE and HOT terminals. Screw the receptacle to the box and attach the faceplate.
- Go to step 8.

**Connect the LINE cable wires to the LINE terminals:**

- The white wire connects to the WHITE terminal (Silver)
- The black wire connects to the HOT terminal (Brass)

**Connect the LOAD cable wires to the LOAD terminals:**

- Remove the YELLOW sticker to reveal the LOAD terminals
- The white wire connects to the WHITE terminal (Silver)
- The black wire connects to the HOT terminal (Brass)

**Connect the grounding wires (only if there is a grounding wire):**

- Connect a 6-inch bare copper (or GREEN) 12 or 14 AWG wire to the grounding terminal on the GFCI. If the box has a grounding terminal, also connect a similar wire to the grounding terminal on the box. Connect the ends of these wires to the LINE or LOAD cable's bare copper (or GREEN) wire using a wire connector. If these wires are already in place, check the connections.

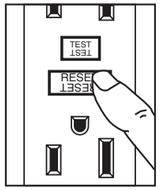
**Complete the installation:**

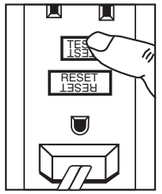
- Fold the wires into the box, keeping the grounding wire away from the WHITE and HOT terminals. Screw the receptacle to the box and attach the faceplate.
- Go to step 8.

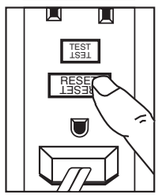
## 8. Test your work

### Why perform this test?

- If you miswired the GFCI it may not prevent personal injury or death due to a ground fault (electrical shock).
- If you mistakenly connect the LINE wires to the LOAD terminals, the GFCI will not reset and will not provide power to either the GFCI receptacle face or any receptacles fed from the GFCI.




### Procedure:

(a) This GFCI is shipped from the factory in the tripped condition and cannot be reset until it is wired correctly and power is supplied to the device. Plug a lamp or radio into the GFCI (and leave it plugged in). Turn the power ON at the service panel. Ensure that the GFCI is still in the tripped condition by pressing the TEST button. If the indicator light on the GFCI receptacle face is ON and the lamp or radio is OFF go to the Troubleshooting section because LINE and LOAD wiring connections have been reversed. You will not be able to RESET the GFCI in this condition.

(b) Press the RESET button ***fully***. If the lamp or radio turns ON and the Indicator Light turns ON, the GFCI has been installed correctly. If the GFCI cannot be reset, go to the Troubleshooting section.

(c) If you installed your GFCI using step 7B press the TEST button, then plug a lamp or radio into surrounding receptacles to see which one(s), in addition to the GFCI, lost power when you pressed the TEST button. DO NOT plug life saving devices into any of the receptacles that lost power. Place a "GFCI PROTECTED OUTLET" sticker on every receptacle that lost power, then press the RESET button to reset the GFCI.

(d) Press the TEST button (then RESET button) every month to assure proper operation. If the Indicator light does not go out and come back on or if the GFCI cannot be reset, then it must be replaced.

### TROUBLESHOOTING

Turn the power OFF and check the wire connections against the appropriate wiring diagram in step 7A or 7B. Make sure that there are no loose wires or loose connections. Start the test from the beginning of step 8 if you rewired any connections to the GFCI.

### General Information

GFCI ratings:
15A-125V AC - Cat No. 7599 Duplex Receptacle
20A-125V AC - Cat. No. 7590 Faceless
20A-125V AC - Cat. No. 7899 Duplex Receptacle

All devices rated 20A feed-through

This product is covered by U.S. Patents Nos. 6,040,967; 6,246,558; 6,282,070; 6,381,112; 6,437,953; 6,864,766, as well as other U.S. and foreign patents pending.

**LIMITED 2 YEAR WARRANTY AND EXCLUSIONS**

Leviton warrants to the original consumer purchaser and not for the benefit of anyone else that this product at the time of its sale by Leviton is free of defects in materials and workmanship under normal and proper use for two years from the purchase date. Leviton's only obligation is to correct such defects by repair or replacement, at its option, if within such two year period the product is returned prepaid, with proof of purchase date, and a description of the problem to **Leviton Manufacturing Co., Inc., Att: Quality Assurance Department, 59-25 Little Neck Parkway, Little Neck, New York 11362-2591.** This warranty excludes and there is disclaimed liability for labor for removal of this product or reinstallation. This warranty is void if this product is installed improperly or in an improper environment, overloaded, misused, opened, abused, or altered in any manner, or is not used under normal operating conditions or not in accordance with any labels or instructions. **There are no other or implied warranties of any kind, including merchantability and fitness for a particular purpose**, but if any implied warranty is required by the applicable jurisdiction, the duration of any such implied warranty, including merchantability and fitness for a particular purpose, is limited to two years. **Leviton is not liable for incidental, indirect, special, or consequential damages, including without limitation, damage to, or loss of use of, any equipment, lost sales or profits or delay or failure to perform this warranty obligation.** The remedies provided herein are the exclusive remedies under this warranty, whether based on contract, tort or otherwise.


**For Technical Assistance Call:**
**1-800-824-3005 (U.S.A. Only)**
**1 800 405-5320 (Canada Only)**
**www.leviton.com**



PK-93370-10-00-2A

# Relay Module - PLC-RSC-24DC/21 - 2966171

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PLC relay, consisting of base terminal block PLC-BSC.../21 with screw connection and pluggable miniature relay with power contact, for assembly on DIN rail NS 35/7.5, 1 PDT, input voltage 24 V DC

## Why buy this product

- Narrow design
- Efficient connection to system cabling using V8 adapter
- Safe isolation according to DIN EN 50178 between coil and contact
- RT III sealed relay
- Functional plug-in bridges
- Integrated input circuit and interference suppression circuit

## Key commercial data

| | |
|---|---|
| Packing unit | 1 pc |
| GTIN | 4 017918 130732 |
| Weight per Piece (excluding packing) | 35.13 GRM |
| Custom tariff number | 85364190 |
| Country of origin | Germany |

## Technical data

### Note:

| | |
|---|---|
| Utilization restriction | EMC: class A product, see manufacturer's declaration in the download area |

### Dimensions

| | |
|---|---|
| Width | 6.2 mm |
| Height | 80 mm |
| Depth | 94 mm |

### Ambient conditions

| | |
|---|---|
| Ambient temperature (operation) | -40 °C ... 60 °C |

# Relay Module - PLC-RSC-24DC/21 - 2966171

## Technical data

### Ambient conditions

| | |
|---|---|
| Ambient temperature (storage/transport) | -40 °C ... 85 °C |

### Coil side

| | |
|---|---|
| Nominal input voltage $U_N$ | 24 V DC |
| Nominal input current at $U_{IN}$ | 9 mA |
| Typical response time | 5 ms |
| Typical release time | 8 ms |
| Operating voltage display | Yes |
| Protective circuit | Protection against polarity reversal Polarity protection diode |
| | Free-wheeling diode Damping diode |

### Contact side

| | |
|---|---|
| Contact type | 1 PDT |
| Contact material | AgSnO |
| Maximum switching voltage | 250 V AC/DC (The separating plate PLC-ATP should be installed for voltages larger than 250 V (L1, L2, L3) between identical terminal blocks in adjacent modules. Potential bridging is then carried out with FBST 8-PLC... or ...FBST 500...) |
| Minimum switching voltage | 5 V (at 100 mA) |
| Maximum inrush current | (on request) |
| Min. switching current | 10 mA (at 12 V) |
| Limiting continuous current | 6 A |
| Interrupting rating (ohmic load) max. | 140 W (at 24 V DC) |
| | 20 W (at 48 V DC) |
| | 18 W (at 60 V DC) |
| | 23 W (at 110 V DC) |
| | 40 W (at 220 V DC) |
| | 1500 VA (for 250 V AC) |

### General

| | |
|---|---|
| Test voltage relay winding/relay contact | 4 kV AC (50 Hz, 1 min.) |
| Operating mode | 100% operating factor |
| Mechanical service life | $2 \times 10^7$ cycles |
| Inflammability class according to UL 94 | V0 |
| Name | Standards/regulations |
| Standards/regulations | IEC 60664 |
| | EN 50178 |
| | IEC 62103 |
| Pollution degree | 3 |
| Surge voltage category | III |
| Mounting position | any |
| Assembly instructions | In rows with zero spacing |

### Connection data

# Relay Module - PLC-RSC-24DC/21 - 2966171

## Technical data

### Connection data

| | |
|---|---|
| Connection method | Screw connection |
| Conductor cross section solid min. | 0.14 mm² |
| Conductor cross section solid max. | 2.5 mm² |
| Conductor cross section stranded min. | 0.14 mm² |
| Conductor cross section stranded max. | 2.5 mm² |
| Conductor cross section AWG/kcmil min. | 26 |
| Conductor cross section AWG/kcmil max | 14 |
| Stripping length | 8 mm |
| Screw thread | M3 |

## Classifications

### eCl@ss

| | |
|---|---|
| eCl@ss 4.0 | 27371102 |
| eCl@ss 4.1 | 27371102 |
| eCl@ss 5.0 | 27371001 |
| eCl@ss 5.1 | 27371001 |
| eCl@ss 6.0 | 27371001 |
| eCl@ss 7.0 | 27371001 |
| eCl@ss 8.0 | 27371001 |

### ETIM

| | |
|---|---|
| ETIM 2.0 | EC000196 |
| ETIM 3.0 | EC000196 |
| ETIM 4.0 | EC000196 |
| ETIM 5.0 | EC000196 |

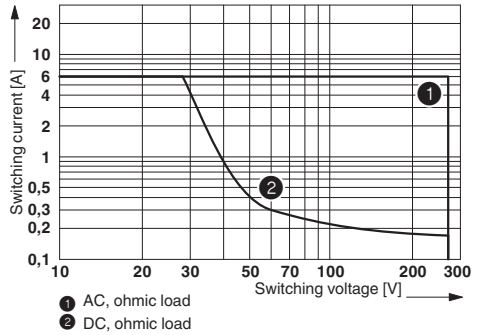
### UNSPSC

| | |
|---|---|
| UNSPSC 6.01 | 30211916 |
| UNSPSC 7.0901 | 39121515 |
| UNSPSC 11 | 39121515 |
| UNSPSC 12.01 | 39121515 |
| UNSPSC 13.2 | 39121515 |

## Drawings

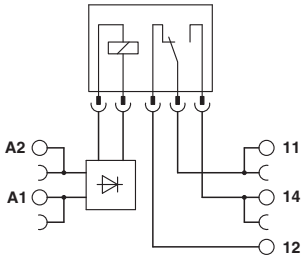
# Relay Module - PLC-RSC-24DC/21 - 2966171

Diagram

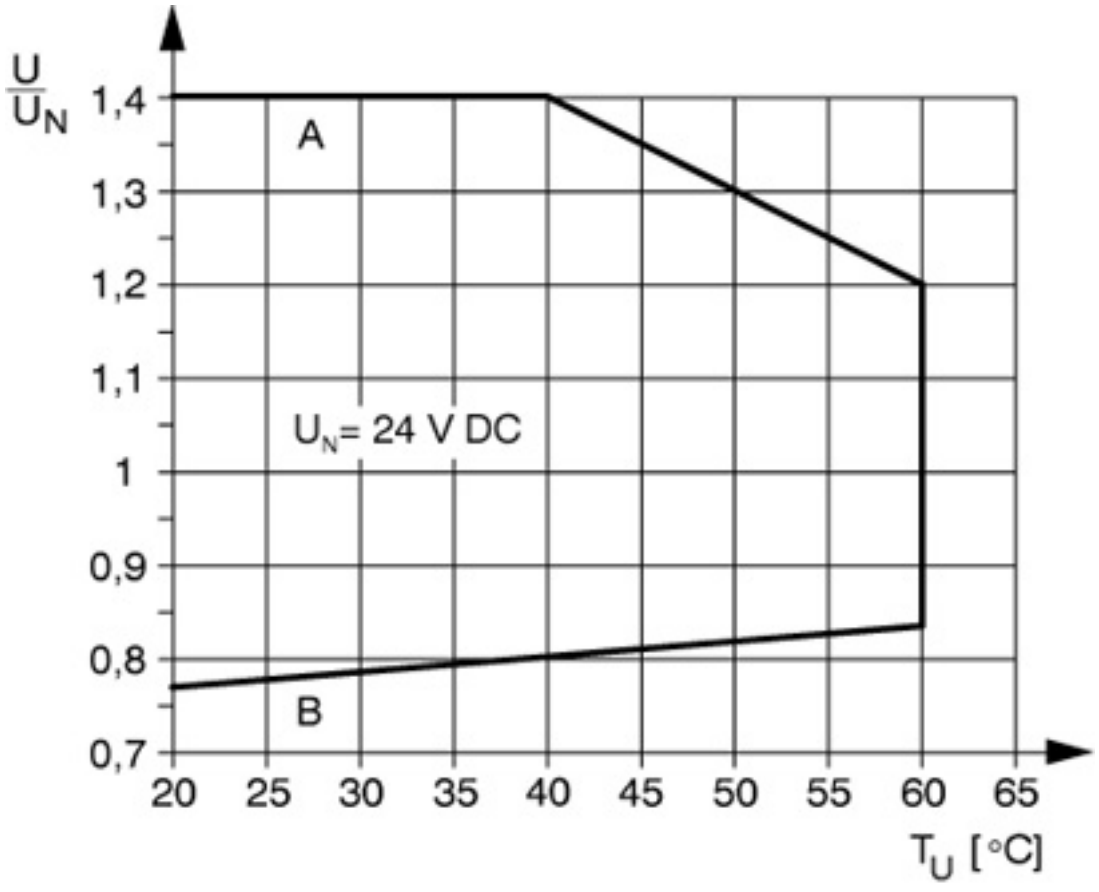



Interrupting rating

Circuit diagram




Diagram




Curve A
Maximum permissible continuous voltage $U_{max}$ with limiting continuous current on the contact side (see relevant technical data)
Curve B
Minimum permissible operate voltage $U_{op}$ after pre-excitation (see relevant technical data)

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# Rhino PSM Power Supplies

## Operating Instructions

# RHINO Power Supplies PSM Series

## Description

The PSM power supplies are built-in units. The mounting position for PSM power supplies must fulfill the requirements for fireproof case according to IEC/EN 60950 or other appropriate national standard. The relevant CSA regulations or equivalent national regulations must be observed during installation. The PSM power supplies are designed for mounting on a DIN rail (DIN EN 50022-35x15/7.5) and for operation from 115 or 230 VAC, 50/60Hz (universal input voltage range for PSM12-078S and PSM24-090S, and auto range for PSM12-156S, PSM24-180S, PSM24-360S and PSM24-600S ) single-phase systems. The output voltage of the PSM power supplies is floating and protected against short circuit.

***Before installation, read these instructions carefully and completely. These installation instructions cannot cover every possible installation, operation or maintenance situation. Further information is available on our website at www.automationdirect.com. Information is subject to change without prior notice.***

**The power supplies are constructed in accordance with the safety requirements of IEC 60950, EN60950, EN60204, EN50178, EN61558-2-8, IEC/EN60079-15 (Class I, Zone 2, AEX nC II C T4 U). They fulfill the requirements for CE-compatibility, carry the CE-mark, and are CSA approved. The PSM built-in power supplies were designed especially for use in process automation and other industrial applications. Components with dangerously high voltage and high stored energy are located in the device; however, these are inaccessible. Failure to properly maintain the power supply can result in death, severe personal injury or substantial property damage. The power supplies should be installed and operated by qualified personnel only. The corresponding national regulations (e.g. CSA, ANSI, VDE, DIN) must be observed. The successful and safe operation of this power supply is dependent on proper storage, handling, installation and operation. The potentiometer to adjust the output voltage must be actuated using only an insulated screwdriver, because accidental contact may be made with parts inside the power supply carrying dangerous voltages.**

## Before operating:

- Read operating instructions carefully and completely.
- Ensure that the main power connection has been done by a qualified person, and protection against electrical shock is assured.
- Ensure that the power supply can be disconnected in accordance with applicable regulations, as in IEC/EN/UL 60950 or other applicable national regulations.
- Check that the protective ground is connected.
- Check that the input wiring is sufficiently protected and is the correct size.
- Check that the output wiring is rated for the maximum output current, and connected with the correct polarity.
- Verify that sufficient cooling is assured.
- Caution: The temperature of the housing can become very high, depending on the ambient temperature and load,.
- ***Never work on the power supply if power is applied!*** Before installation, ensure that the main switch is off and locked out. Touching any live components or improper usage of this power supply can result in death or severe injury.
- Do not open the power supply until at least five minutes after the main power is completely disconnected.
- Power supply is an electrostatic sensitive device. Only qualified and trained personnel should open the power supply.

# Installation

- This power supply is designed for professional indoor systems. During operation, the power supply must not be accessible. It is to be installed and put into service by qualified personnel only.
- Do not operate without Ground connection! To comply with EMC and safety standards (CE mark, approvals), the power supply must be operated only if Ground terminal is connected to the non-fused earth conductor.
- The internal fuse is not accessible, as it is not to be replaced by the user. If this internal fuse has blown, the power supply most probably has an internal defect and, for safety reasons, must be discarded, or returned if under warranty.
- Recycling: The unit contains some elements that are suitable for recycling, ***and*** some components that need special disposal. Make sure that the power supply is recycled properly at the end of its service life.

**Warning: To minimize the risk of potential safety problems, follow all applicable local and national codes regulating the installation and operation of this equipment. These codes vary from area to area and it is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation are in compliance with the latest revision of these codes. Failure to follow all applicable codes, or exceeding the limiting value can impair the function and electrical safety and destroy the power supply. Serious injury to personnel can result from the failure to follow all applicable codes and standards. We do not guarantee the products described in this publication to be suitable for your particular application, nor do we assume any responsibility for your product design, installation or operations.**

- If you have any questions concerning the installation or operation of this equipment, or if you need additional information, please call us at 770-844-4200. This publication is based on information that was available at the time it was printed. At Automationdirect.com® we constantly strive to improve our products and services; therefore, we reserve the right to make changes to the products and/or publications at any time without notice and without any obligation. This publication may also discuss features that may not be available in certain revisions of the product.

# Assembly

Use a sufficiently strong DIN rail, such as DN-R35S1. Leave a minimum free space of 80 mm [3.15 in.] above and below, and 50 mm [1.97 in.] on each side of the power supply to allow air convection. Do not cover any ventilation holes. The air temperature measured 10 mm [0.39 in.] below the device must not exceed the ranges specified (see Operating Temperatures table on page 7 of these instructions). Observe power derating above ambient temperatures of 40°C and at low line. Attach the unit to the DIN rail, following the in-box directions. Connect the wires as indicated on the power supply. For wall-mounting or chassis-mounting, remove the DIN clips by removing the screw and place the mounting brackets in the same place as the DIN-clips.

| Mounting | | |
|---|---|---|
| **Part Number** | **Panel** | **Wall or Chassis** |
| PSM1-078S | DN-R35S1 | PANEL1 mounting bracket countersink screws included (tightening torque 0.8-0.9Nm) |
| PSM24-090S (N) | | |
| PSM12-156S | | |
| PSM24-180S | | |
| PSM24-360S | DN-R35S1 | PANEL2 mounting bracket countersink screws included (tightening torque 0.8-0.9Nm) |
| PSM24-600S | | |

## Connecting Cable

Allow only qualified personnel to install these power supplies. The PSM12-078S, PSM24-090S, PSM12-156S, PSM24-180S and PSM24-360S are equipped with a COMBICON plug connector. PSM24-600S has a COMBICON connector. This reliable and easy-to-assemble connection method provides a fast connection of the devices and a visible isolation of the electrical connection.

## Input (Connector J1)

The 100-240 VAC connection is made by using the L, N and Ground connections and must be done in compliance with local regulations. Use the correct size input wiring. Supply a protective device (fuse, circuit breaker, etc.) and an easily accessible isolating device for disconnecting the power supply from mains. The Ground conductor must be connected. If flexible wires are used, terminate them using ferrules.

| Input Specifications | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Part Number** | **Input Voltage Range** | **Input Frequency Range** | **Input Current (Typical) at full load** | | **Inrush Current Max (<2ms) @ +25°C** | | **Holdup Time** | **Efficiency (Typical) @ 115 VAC** |
| | | | **115 VAC** | **230 VAC** | **115 VAC** | **230 VAC** | | |
| PSM12-078S | 100 - 240 VAC 85 - 264 VAC (63 Hz) | 47 - 63 Hz | 2.0 A | 1.0 A | <12 A | <20 A | 20 ms min. (full load 115/230 VAC) | 82% |
| PSM24-090S | | | 2.1 A | 1.0 A | | | | 85% |
| PSM24-090S(N) | | | 2.1 A | 1.0 A | | | | 85% |
| PSM12-156S | 100 - 120 VAC/ 220 - 230 VAC 85 - 132 VAC 187 - 264 VAC (47 - 63 Hz) Auto-select | | 2.5 A | 1.4 A | <13 A | <25 A | | 85% |
| PSM24-180S | | | 2.8 A | 1.5 A | | | | 88% |
| PSM24-360S | | | 5.0 A | 2.5 A | <16 A | <25 A | | 87% |
| PSM24-600S | | | 10.0 A | 5.0 A | <25 A | <30 A | | 89% |

## Output (Connector J2)

The 12 VDC or 24 VDC connection is made using the "+" and "-" connections. All output terminals should be connected to the load. *Make sure that all output lines are sized according to the maximum output current, or are separately protected!* The wires on the secondary side should be large enough to keep the voltage drops on these lines as low as possible. Strip the connecting ends for a reliable and shockproof connection. If flexible wires are used, terminate them using ferrules. At delivery, the output voltage is 12 VDC (PSM12-xxx) or 24 VDC (PSM24-xxx). The output voltage can be set (using an insulated screwdriver) from 12 to 14 VDC (PSM12-xxx) or 24 to 28 VDC (PSM24-xxx) on the potentiometer. The device is electronically protected against overload and short circuit.

| Output Specifications | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Part Number** | **Output Voltage** | **Output Voltage Adj. Range** | **Output Current (Max.)** | **Output Power (Max.)** | **Output Overvoltage Protection** | **Power - Good Signal** | | | **MTBF (IEC 61709 @ 25°C)** |
| | | | | | | **Trigger Threshold** | **Active Output Signal** | **Relay Output** | |
| PSM12-078S | 12 VDC | 12 - 14 VDC | 6.5 A | 78 watts | 20 VDC | 9 - 11 V | 11 V ± 1 V/20 mA max | DC OK = contact closed (rated: 30 VDC 1.0 A) | 350,000 hours |
| PSM24-090S | 24 VDC | 24 - 28 VDC | 3.75 A | 90 watts | 35 VDC | 18 - 22 V | 22 V ± 2 V/10 mA max | | |
| PSM24-090S-N | | | 3.75 A | 90 watts | 35 VDC | | | | |
| PSM12-156S | 12 VDC | 12 - 14 VDC | 13.0 A | 156 watts | 20 VDC | 9 - 11 V | 11 V ± 1 V/40 mA max | | |
| PSM24-180S | 24 VDC | 24 - 28 VDC | 7.5 A | 180 watts | 35 VDC | 18 - 22 V | 22 V ± 2 V/20 mA max | | |
| PSM24-360S | | | 15.0 A | 360 watts | 35 VDC | | | | |
| PSM24-600S | | | 25.0 A | 600 watts | 35 VDC | | | | |

## Signaling (connector J5, pin 1, pin 2, pin 3, pin 4, pin 5 & pin 6)

The two DC-OK outputs allow monitoring of the power supply functions. A floating signal contact (connector J2, pin 6 & pin 7) and an active DC-OK signal (Connector J2, pin 5) are available. The DC-OK LED also allows a visual evaluation of the function of the power supply directly on site.

### Floating contacts

The floating signal contact opens and signals a drop in the output voltage. Signals and ohmic loads up to 30 VDC and currents of up to 1 amp can be connected. For inductive loads such as relay or solenoid, a suitable protection circuit (e.g., damping diode) is necessary.

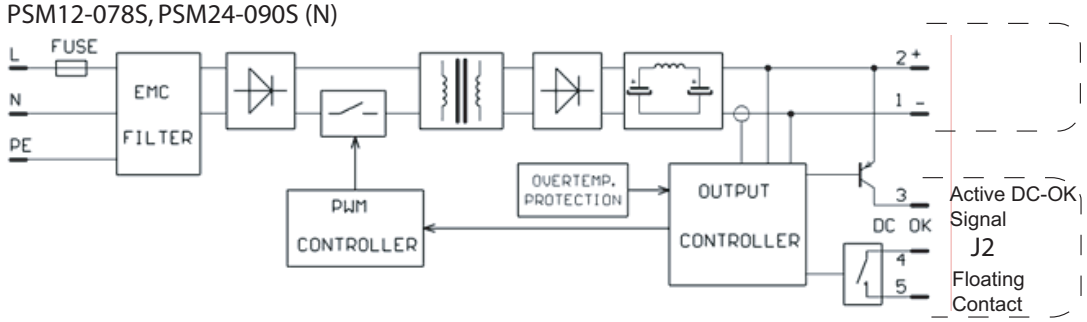
| Floating Signal Contacts | | |
|---|---|---|
| **Part Number** | **Relay Contact Address** | **Trigger Threshold** |
| PSM1-078S | J2 pin 4 & 5 | 9 to 11 VDC |
| PSM24-090S (N) | | 18 to 22 VDC |
| PSM12-156S | J2 pin 6 & 7 | 9 to 11 VDC |
| PSM24-180S | | 18 to 22 VDC |
| PSM24-360S | | |
| PSM24-600S | J5 pin 1 & 2 | |

### Active DC-OK signal output

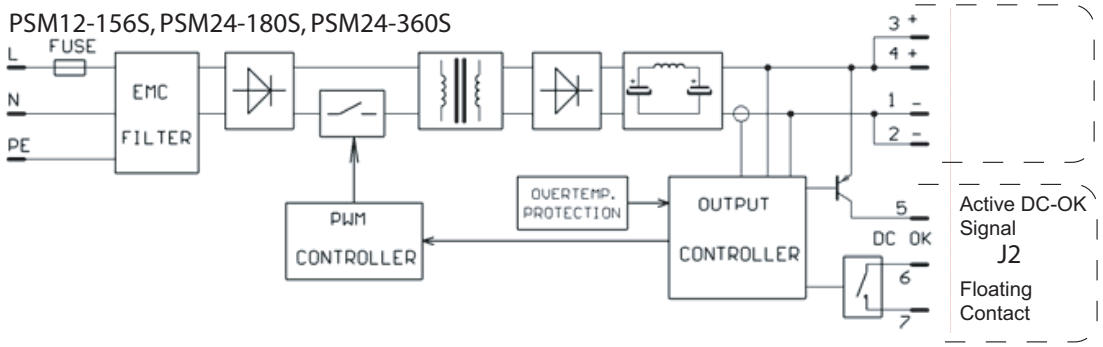
This signal output is referenced to –Vout (GND) and signals when the output voltage drops below 9 VDC for PSM12-xxx models and below 18 VDC for PSM24-xxx models by switching from high to low. The DC-OK signal is de-coupled from the power output, so it is not possible for parallel-switched devices to provide external supply. The DC-OK signal can be directly connected to a logic input for evaluation.

| Active Signal Outputs | | | | |
|---|---|---|---|---|
| **Part Number** | **Active Signal Outputs** | **Contact Address** | **Signals at voltage level** | **mA** |
| PSM12-078S | 11 VDC ± 1 VDC | J2 pin 3 | 9 to 11 VDC | 60 |
| PSM24-090S (N) | 22 VDC ± 2 VDC | | 18 to 22 VDC | 30 |
| PSM12-156S | 11 VDC ± 1 VDC | J2 pin 5 | 9 to 11 VDC | 60 |
| PSM24-180S | 22 VDC ± 2 VDC | | 18 to 22 VDC | 30 |
| PSM24-360S | | | | |
| PSM24-600S | | J5 pin 3 | | |

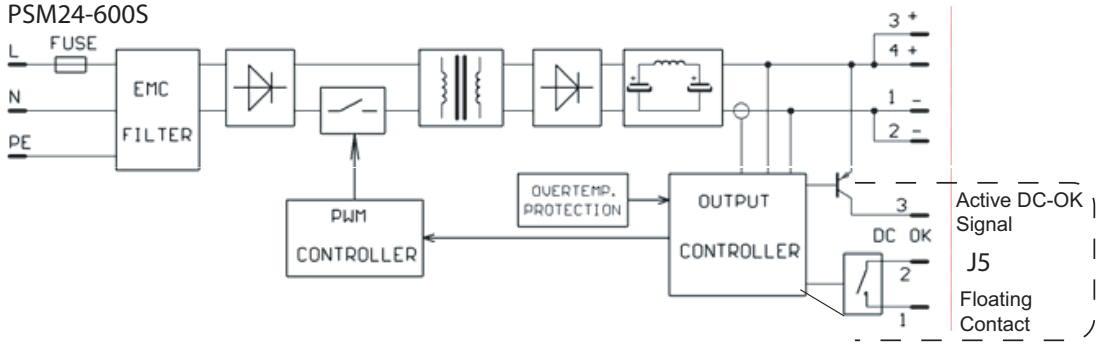
PSM12-078S, PSM24-090S (N)



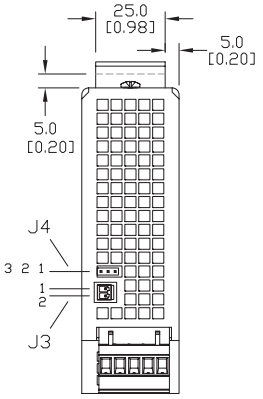

PSM12-156S, PSM24-180S, PSM24-360S



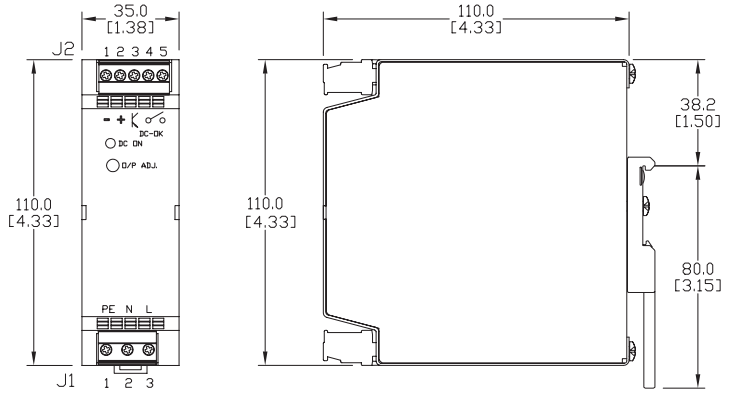

PSM24-600S



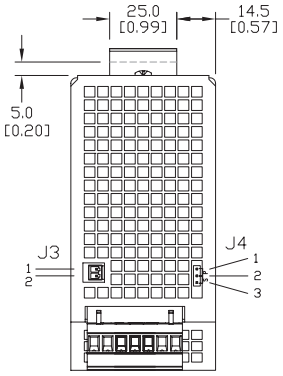
## PSM12-078S/PSM24-090S
## PSM24-REM360S
## PSM24-BCM360S



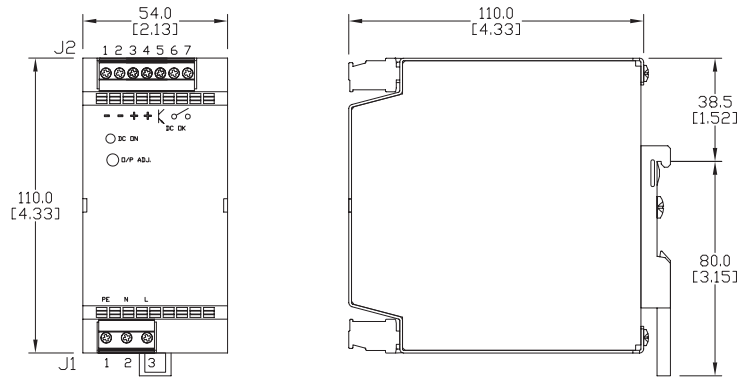

| | J1 | J2 | J3 | J4 |
|---|---|---|---|---|
| Pin 1 | Earth | GND (-) | S+ | Normal mode |
| Pin 2 | Neutral | Vout (+) | S- | Common |
| Pin 3 | Line | DC-OK Signal | — | Parallel mode |
| Pin 4 | — | DC-OK Relay contact 1 | — | — |
| Pin 5 | — | DC-OK Relay contact 2 | — | — |



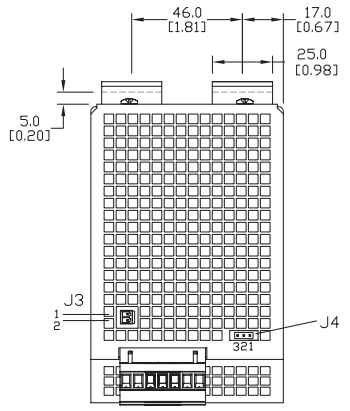

## PSM12-156S/PSM24-180S
## PSM24-BFM600S



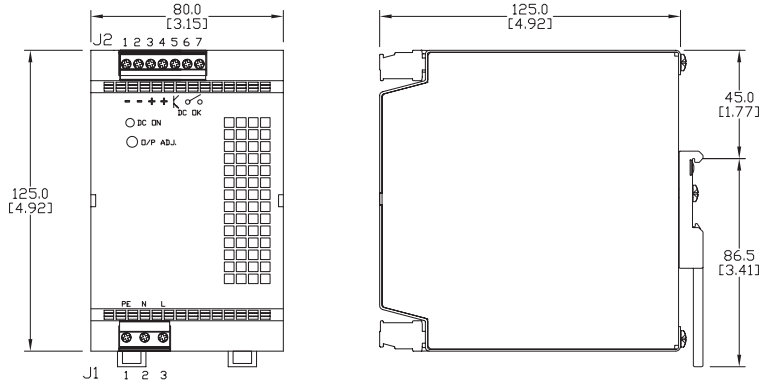

| | J1 | J2 | J3 | J4 |
|---|---|---|---|---|
| Pin 1 | Earth | GND (-) | S+ | Normal mode |
| Pin 2 | Neutral | GND (-) | S- | Common |
| Pin 3 | Line | Vout (+) | — | Parallel mode |
| Pin 4 | — | Vout (+) | — | — |
| Pin 5 | — | DC-OK Signal | — | — |
| Pin 6 | — | DC-OK Relay contact 1 | — | — |
| Pin 7 | — | DC-OK Relay contact 2 | — | — |



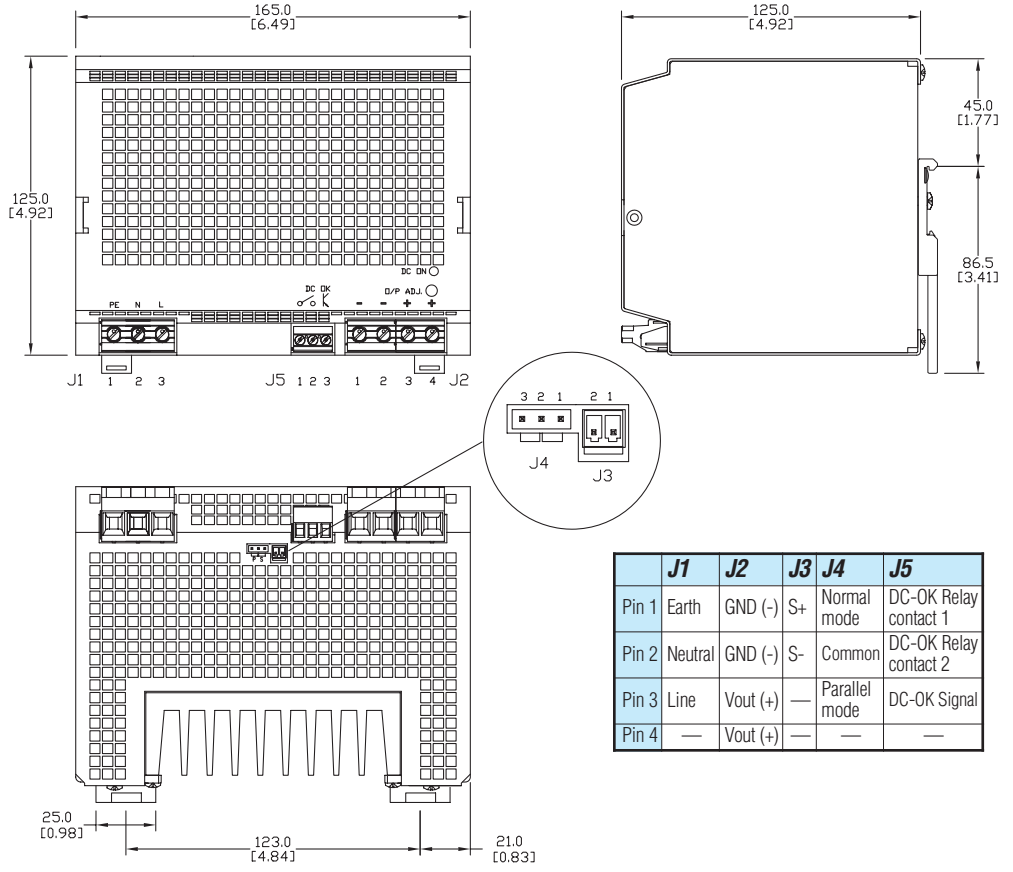
## PSM24-360S




| | J1 | J2 | J3 | J4 |
|---|---|---|---|---|
| Pin 1 | Earth | GND (-) | S+ | Normal mode |
| Pin 2 | Neutral | GND (-) | S- | Common |
| Pin 3 | Line | Vout (+) | — | Parallel mode |
| Pin 4 | — | Vout (+) | — | — |
| Pin 5 | — | DC-OK Signal | — | — |
| Pin 6 | — | DC-OK Relay contact 1 | — | — |
| Pin 7 | — | DC-OK Relay contact 2 | — | — |




## PSM24-600S




| | J1 | J2 | J3 | J4 | J5 |
|---|---|---|---|---|---|
| Pin 1 | Earth | GND (-) | S+ | Normal mode | DC-OK Relay contact 1 |
| Pin 2 | Neutral | GND (-) | S- | Common | DC-OK Relay contact 2 |
| Pin 3 | Line | Vout (+) | — | Parallel mode | DC-OK Signal |
| Pin 4 | — | Vout (+) | — | — | — |

## Signal loop

The two above-mentioned signals can be easily combined. Example: monitoring of two devices. Use the active signal output of device one and loop in the floating signal output of device two. A common alarm is available in the event of malfunctioning. Up to five units can be looped in. This signal combination saves wiring costs and logic inputs.

## DC-OK LED

The two-color DC-OK LED indicates the status of the output and allows visual evaluation of the function.

| Output Status LED Function | |
|---|---|
| ***DC-OK LED Green*** | Normal operation |
| ***DC-OK LED Red*** | Output failure (if input main power is still present) |

## Connections and Terminal Assignments

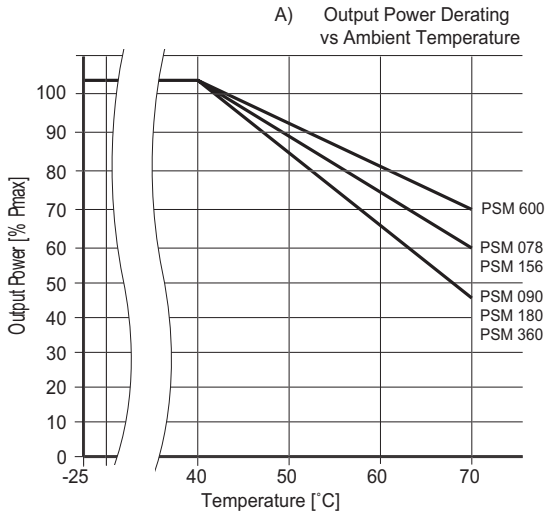
| Device | Terminals | Function | Solid or Stranded Wires | | Torque | Stripping Length mm |
|---|---|---|---|---|---|---|
| | | | mm² | AWG | Nm | |
| ***PSM24-090S<br>PSM24-090S-N<br>PSM24-180S*** | L1 & N | Input voltage (85 to 264 VAC) | 0.5 ... 2.5 | 24 ... 12 | 0.5 - 0.6 | 7.0 |
| | ⏚ | Protective earth Ground conductor | 0.5 ... 2.5 | 24 ... 12 | 0.5 - 0.6 | 7.0 |
| | + & - | Output voltage (2C) | 0.5 ... 2.5 | 24 ... 12 | 0.5 - 0.6 | 7.0 |
| | Signal | DC - OK, active output and relay outputs | 0.2 ... 2.5 | 32 ... 12 | 0.5 - 0.6 | 7.0 |
| ***PSM12-078S<br>PSM12-156S<br>PSM24-360S*** | L1 & N | Input voltage (85 to 264 VAC or 115/240 VAC)) | 0.5 ... 2.5 | 24 ... 12 | 0.5 - 0.6 | 7.0 |
| | ⏚ | Protective earth Ground conductor | 0.5 ... 2.5 | 24 ... 12 | 0.5 - 0.6 | 7.0 |
| | + & - | Output voltage (12 VDC and 2C) | 1.0 ... 2.5 | 18 ... 12 | 0.5 - 0.6 | 7.0 |
| | Signal | DC - OK, active output and relay outputs | 0.2 ... 2.5 | 32 ... 12 | 0.5 - 0.6 | 7.0 |
| ***PSM24-600S*** | L1 & N | Input voltage (115 to 230 VAC) | 1.0 ... 4.0 | 18 ... 10 | 0.5 - 0.6 | 7.0 |
| | ⏚ | Protective earth Ground conductor | 1.0 ... 4.0 | 18 ... 10 | 0.5 - 0.6 | 7.0 |
| | + & - | Output voltage (2C) | 2.0 ... 4.0 | 18 ... 10 | 0.5 - 0.6 | 8.0 |
| | Signal | DC - OK, active output and relay outputs | 0.2 ... 2.5 | 32 ... 12 | 0.5 - 0.6 | 7.0 |

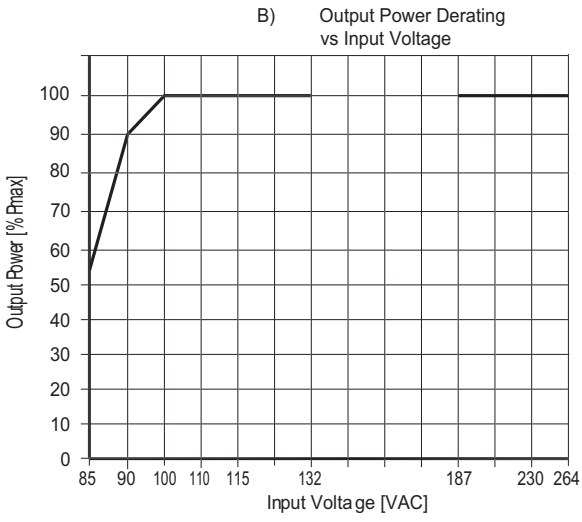
# Function

## Output characteristic curve

When the ambient temperature is no higher than +40°C, the device can continuously supply I-out max. In the event of a higher load, the operating point follows the U/I characteristic curve by use of overcurrent protection. The output current is limited at I-out max. by use of a constant current characteristic, with automatic restart if the short circuit or overload condition has been removed. The U/I characteristic curve ensures that heavily capacitive loads can be fed without problems.

## Output Power Derating



## Thermal behavior

The device should not be operated at higher loads than indicated on the derating graphs, and automatically switches off at thermal overload. After sufficient cooling, the device will switch on again.

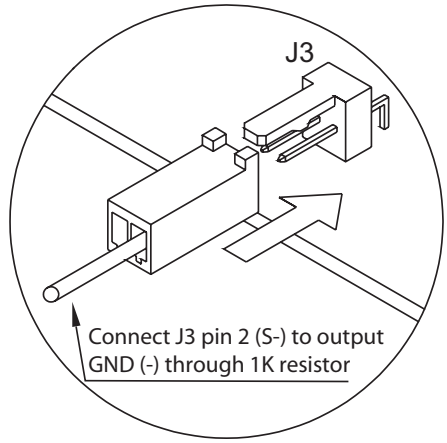
## Parallel operation

Parallel connection to increase efficiency is used for the expansion of existing systems. It is advisable to use parallel connection if the power supply does not cover the current requirement of the most powerful consumer. Otherwise the consumers should be spread among individual devices independent of one another. No more than five devices of the same type can be connected in parallel to enable increased output power. For n parallel connected devices, the output current can be increased to nx Imax. To provide a proper and reliable startup, the jumper at connector J4 has to be set. At delivery, the jumper is set for normal operation with the jumper at connector J4 between pin 1 and 2. Set the jumper at connector J4 between pin 2 and 3 for parallel operation. Setting all paralleled power supplies to the same output voltage assures an equal distribution of power. To ensure symmetrical distribution of power if output voltage is adjusted, all cables from the power supplies must be the same length and diameter. Install a protective circuit (e.g., de-coupling diode or DC fuse) at the output of each device when more than two power supplies are paralleled. This will prevent high reverse-feed currents if there is a secondary device fault.

## Remote ON/OFF Function

The standard device provides a remote ON/OFF function by use of pin 2 at connector J3. With no connection between J3 pin 2 and J2 pin 1, the device is providing the adjusted output voltage. Make a connection between connector J3 pin 2 (S-) and connector J2 pin 1 GND (-) by use of a 1K resistor to switch the power supply off. When the "OFF" function is engaged, a maximum of 3VDC will be across Vout(+) and Vout(-).

**Remote ON/OFF function**




# Operating Temperature Ranges and Load Derating

| Model | Operating Temperature Range |
|---|---|
| PSM12-078S | -10 to 40°C (from 40 to 70°C Load derating by 0.5w/°c) |
| PSM24-090S (N) | -10 to 40°C (from 40 to 70°C Load derating by 1.5w/°c) |
| PSM12-156S | -10 to 40°C (from 40 to 70°C Load derating by 3.0w/°c) |
| PSM24-180S | -10 to 40°C (from 40 to 70°C Load derating by 3.0w/°c) |
| PSM24-360S | -10 to 40°C (from 40 to 70°C Load derating by 6.0w/°c) |
| PSM24-600S | -10 to 40°C (from 40 to 70°C Load derating by 6.0w/°c) |

# General Specifications

| General Specifications | |
|---|---|
| ***Specification*** | ***Description*** |
| ***Temperature*** | **Operating (ambient):** -25°C to + 70°C max (-13°F to 158°F). Above +40°C(104°F) load derating<br>**Storage (non-operating):** -25°C to + 85°C max (-13°F to 185°F).<br>**Temperature drift:** 0.02%/C.<br>**Cooling:** convection, no internal fan |
| ***Humidity*** | 95% (non-condensing) relative humidity maximum |
| ***Isolation*** | According to IEC/EN 60950, EN50178, EN61558-2-8, EN60204, CSA |
| ***Output Regulation*** | **Input variation (Line regulation)** $V_{in\ mind}$ - $V_{in\ max}$: 0.5% maximum.<br>**Load variation (Load regulation)** (10 to 100% of $I_{out\ max}$): 0.5% maximum;<br>2.0% in parallel operation |
| ***Output Voltage Ripple*** | 100 mV peak-to-peak typical (20 MHz bandwidth), (200 mV peak-to-peak maximum at Imax) |
| ***Output Protection*** | Current limit: 110% constant current, automatic recovery, thermal protection, output rating, Voltage limit: 140% Vout nom |
| ***Reverse Voltage Protection*** | 35 VDC (40 VDC < 1 sec.) |
| ***Over-temperature Protection*** | Switch off at over-temperature, automatic restart |
| ***Hold-up Time*** | At full load and $V_{in}$ = 115 VAC: 10 ms. min. At full load and $V_{in}$ = 230 VAC: 20 ms. min. |
| ***Status Indicator*** | Dual color LED: **Green:** normal operation;<br>**Red:** Output failure (if AC input main power is present) |
| ***Remote ON/OFF*** | By external contact. **DC On:** -S contact open.<br>**DC Off:** -S connected via 1 KΩ to -Vout [3VDC max across Vout(+) and Vout(-)] |
| ***Maximum Capacitive Load*** | Unlimited |
| ***Vibration*** | IEC 60068-2-6: 3 axis, sine sweep, 10-55 Hz, 1g, 1 oct/min. |
| ***Shock*** | IEC 60068-2-27: 3 axis, 15g half sine, 11ms |
| ***Enclosure Rating*** | IP20 (IEC 529) |
| ***Enclosure Material*** | Aluminum (chassis) / zinc plated steel (cover) |
| ***Mounting*** | Snap-on with self-locking spring for 35mm DIN rails per EN 50022-35x15/75, or wall mount with bracket |
| ***Connection*** | Pluggable screw terminals (plugs included) 2 terminals per output (not available on 600 watt model). |
| ***Agency Approvals*** | CSA |
| ***Note: Unless otherwise stated, all specifications are valid at nominal input voltage, full load and +25°C after warmup time.*** | |

| Safety Standards | | |
|---|---|---|
| ***Specification*** | ***Standard*** | ***Document Number*** |
| ***Harmonic Limits*** | Harmonic Current Limits | EN 61000-3-2, Class A for limited output power |
| ***Safety Standards*** | Information technology equipment | IEC/EN60950 |
| | Industrial control equipment | CSA |
| | Electrical equipment of machines | EN 6020 |
| | Electronic equipment for power installation | EN 50178 |
| | Safety, transformers | EN 61558-2-8 |
| | Limited power source (model PSM24-090S-N) | EN 60950 sect. 2.5 and NEC Class 2 |
| ***Safety Approvals*** | CC-Report per IEC 60950 | EN 50178, EN 60079-15 EN 61558-2-8, CSA |
| ***Safety Class*** | Degree of electrical protection Class1 | IEC 536 |
| ***Electromagnetic Compatibility (EMC), Emissions*** | EMC, Emissions | EN 61204-3, EN61000-6-3 |
| | Conducted RI suppression on input | EN 55011 class B, EN 55022 class B |
| | Radiated RI suppression | EN 55011 class B, EN 55022 class B |
| ***Electromagnetic Compatibility (EMC), Immunity*** | EMC, Immunity | EN 61000-6-2, EN 61204-3 |
| | Electrostatic Discharge (ESP) | IEC / EN 61000-4-24 kY (contact discharge) / 8 kY (air discharge) |
| | Radiated RH field immunity (80-1000 MHz) | IEC / EN 61000-4-3 10 V / m |
| | Electrical fast transient / burst immunity | IEC / EN 61000-4-4 2 kY |
| | Surge immunity | IEC / EN 61000-4-5 1 kY / 2 kY |
| | Immunity to conducted RH disturbances (0.15 to 80 MHz) | IEC / EN 61000-4-6 10 V |
| | Power frequency field immunity | IEC / EN 61000-4-8 30 A / m |
| | Voltage dips | IEC / EN 61000-4-11(70% UN Crt. B/four40%/100% UN Crt. C) |
| ***Pollution Degree*** | 2 | |

# Rittal – The System.

**Faster – better – worldwide.**

## WM Wallmount enclosures

Rittal WM enclosures set the standard for maximum use of space and ease of installation. WM compact enclosures can be used for virtually any application. NEMA protection ratings are ensured through a secure locking system, foamed-in-place gasket and knife-edge perimeter. Features include a body constructed of cold rolled steel, steel doors and zinc-plated mounting panels. WM enclosures are readily available in all of the most popular sizes, protection categories and configurations – including universal disconnect cutout. For complete details on the entire line, go to **www.rittal.us**.

- One-piece welded cold-rolled steel body
- Available in carbon and stainless steel
- Zinc-plated mounting panel standard
- Available with universal disconnect cutout
- Foamed-in-place gasket
- Quick-release hidden 130° door hinges
- Electrophoresis dip-coat primer with powder-coat surface
- Flange-trough collar opening channels liquids and dust away from enclosure gasket and enclosure interior
- Left-hand hinged door (the single door configuration is reversible)
- Wall-mounting holes
- Single door enclosures less than 20” in height have one ¼ turn latch with screwdriver insert
- Single door enclosures 20 - 40” in height have two ¼-turn latches with screwdriver inserts
- Single door enclosures greater than or equal to 42” in height have a 3-point latching L-handle
- Double door and disconnect enclosures have a 2- or 3-point latching L-handle

The Rittal enclosures and accessories you need most often are in stock and ready for quick access. The RittalXpress stocking program includes more than 2,220 part numbers, continuously in stock and ready for shipping when you need them. Visit **www.rittal.us/rittalxpress** to find out more.

RITTAL XPRESS™ STOCK > MOD > SHIP

**Note:** measurements are approximate.

**Carbon Steel, Single Door – UL/cUL Type 12, 3R, 4**

| Part No. | H x W x D |
|---|---|
| WM121206NC | 12x12x6 |
| WM161206NC | 16x12x6 |
| WM161606NC | 16x16x6 |
| WM162006NC | 16x20x6 |
| WM201606NC | 20x16x6 |
| WM202006NC | 20x20x6 |
| WM241606NC | 24x16x6 |
| WM242006NC | 24x20x6 |
| WM242406NC | 24x24x6 |
| WM302406NC | 30x24x6 |
| WM161208NC | 16x12x8 |
| WM161608NC | 16x16x8 |
| WM162008NC | 16x20x8 |
| WM201608NC | 20x16x8 |
| WM202008NC | 20x20x8 |
| WM202408NC | 20x24x8 |
| WM241608NC | 24x16x8 |
| WM242008NC | 24x20x8 |
| WM242408NC | 24x24x8 |
| WM243008NC | 24x30x8 |
| WM302008NC | 30x20x8 |
| WM302408NC | 30x24x8 |
| WM303008NC | 30x30x8 |
| WM362408NC | 36x24x8 |
| WM423608NC | 42x36x8 |
| WM483608NC | 48x36x8 |
| WM202010NC | 20x20x10 |
| WM242010NC | 24x20x10 |

**Carbon Steel, Single Door – UL/cUL Type 12, 3R, 4**

| Part No. | H x W x D |
|---|---|
| WM363008NC | 36x30x8 |
| WM363608NC | 36x36x8 |
| WM423008NC | 42x30x8 |
| WM242410NC | 24x24x10 |
| WM302410NC | 30x24x10 |
| WM303010NC | 30x30x10 |
| WM362410NC | 36x24x10 |
| WM363010NC | 36x30x10 |
| WM423610NC | 42x36x10 |
| WM483610NC | 48x36x10 |
| WM603610NC | 60x36x10 |
| WM202012NC | 20x20x12 |
| WM242012NC | 24x20x12 |
| WM242412NC | 24x24x12 |
| WM302412NC | 30x24x12 |
| WM303012NC | 30x30x12 |
| WM362412NC | 36x24x12 |
| WM363012NC | 36x30x12 |
| WM363612NC | 36x36x12 |
| WM423612NC | 42x36x12 |
| WM483612NC | 48x36x12 |
| WM603612NC | 60x36x12 |
| WM363016NC | 36x30x16 |
| WM483616NC | 48x36x16 |
| WM603616NC | 60x36x16 |
| WM302420NC | 30x24x20 |
| WM483620NC | 48x36x20 |

**Carbon Steel, Double Door – UL/cUL Type 12**

| Part No. | H x W x D |
|---|---|
| WM244208NC | 24x42x8 |
| WM304210NC | 30x42x10 |
| WM304810NC | 30x48x10 |
| WM364212NC | 36x42x12 |

**Carbon Steel, Double Door – UL/cUL Type 12**

| Part No. | H x W x D |
|---|---|
| WM364812NC | 36x48x12 |
| WM366012NC | 36x60x12 |
| WM426012NC | 42x60x12 |
| WM484812NC | 48x48x12 |

**Carbon Steel Disconnect – UL/cUL Type 12, 3R, 4**

| Part No. | H x W x D |
|---|---|
| WM202208XC | 20x22x8 |
| WM242208XC | 24x22x8 |
| WM242608XC | 24x26x8 |
| WM302608XC | 30x26x8 |
| WM363208XC | 36x32x8 |
| WM363210XC | 36x32x10 |
| WM603810XC | 60x38x10 |
| WM302612XC | 30x26x12 |

**Carbon Steel Disconnect – UL/cUL Type 12, 3R, 4**

| Part No. | H x W x D |
|---|---|
| WM363212XC | 36x32x12 |
| WM423212XC | 42x32x12 |
| WM423812XC | 42x38x12 |
| WM483812XC | 48x38x12 |
| WM603812XC | 60x38x12 |
| WM483816XC | 48x38x16 |
| WM603816XC | 60x38x16 |

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SENTRY™

PULSATION & SURGE CONTROL

# Installation and Operation Manual

## Inlet Stabilizer Dampener Models

**SENTRY dampeners are pressure vessels** containing a flexible bladder or bellows inside that separates an inert pressurized gas (air or Nitrogen) from a system fluid in the lower chamber. Depending on how dampeners are configured, they are used as **Pulsation Dampeners, Inlet Stabilizers or Surge Suppressors** to control pressure fluctuations and spikes in liquid piping systems.

Dampeners work on the principle that volume is inversely proportional to pressure (P1V1=P2V2). Compressed air or Nitrogen (never Oxygen) is introduced into the non-wetted side of the dampener. The gas charge is contained by the bladder or bellows preventing contact between the system fluid and the gas.

When the dampener is sized correctly, properly installed and charged according to the instructions provided it will greatly reduce the damaging effects of pressure variations in piping systems and significantly improve the efficiency of transferring liquids.

**All dampeners manufactured by BLACOH use pressure bodies made in the USA to insure quality. Prior to shipment, each and every dampener is factory tested at design pressure or higher to assure proper function and leak-free operation.**

Go to www.blacoh.com for literature in multiple languages.

BLACOH™

FLUID CONTROL

SENTRY™

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# MODEL Specifications & Installation Information

| | | |
|---|---|---|
| Model No. | Serial No. | Installation Date |
| / | | |
| Body Material: Wetted / Non-wetted | Bladder / Bellows Material | Pump Area and Number |

| | | | |
|---|---|---|---|
| Purchased From | Contact | Phone | Email |

**The word "dampener", as used in this Manual, has the same meaning as Pulsation Dampener, Inlet Stabilizer or Surge Suppressor.**


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# SAFETY Warnings

Dampeners should only be installed, operated and repaired by experienced and trained professional mechanics. Read and observe all instructions and safety warnings in this Manual before installing, operating or repairing dampeners.

## Safety Symbols

The following symbols indicate cautions, warnings and notes that must be observed for safe and satisfactory installation, operation and maintenance of dampener.

| | | |
|---|---|---|
| | **WARNINGS** | Danger of serious injury or death could occur if these warnings are ignored. |
| | **CAUTIONS** | Equipment damage, injury or death could occur if these cautions are not observed. |
| | **NOTES** | Special instructions for safe and satisfactory installation, operation and maintenance. |

## General Safety

**CAUTION!**

- Observe all safety symbols in installation and operation instructions.
- The internal dampener pressure will equal the maximum fluid pressure of the system in which it is installed.
- **DO NOT** exceed maximum allowable working pressure (MAWP) specified on dampener serial tag or marked on dampener. If serial tag is missing, **DO NOT** use dampener without consulting distributor or factory for maximum pressure rating.
- Always make sure safety shutoff valves, regulators, pressure relief valves, gauges, etc. are working properly before starting system or assembly.
- Verify dampener model received against purchase order and shipper.
- Before starting a system or assembly make certain the discharge point of the piping system is clear and safe, and all persons have been warned to stand clear.
- **DO NOT** put your face or body near dampener when the system or assembly is operating or dampener is pressurized.
- **DO NOT** operate a dampener that is leaking, damaged, corroded or otherwise unable to contain internal fluid, air or gas pressure.
- **DO NOT** pump incompatible fluids through dampener. Consult distributor or factory if you are not sure of the compatibility of system fluids with dampener materials.
- Dampeners are designed to operate with compressed air or clean dry Nitrogen **only**. Other compressed gases have not been tested and may be unsafe to use. **DO NOT USE OXYGEN.**
- Always shut off air supply, remove internal dampener pressure and shut dampener isolation valve before performing dampener maintenance or repair.
- Remove all pressure from dampener AND pumping system before disassembly, removal or maintenance.
- **Static spark can cause an explosion resulting in severe injury or death. Ground dampeners and pumping system when pumping flammable fluids or operating in flammable environments.**
- **NOTE: EC standard EN-13463-1 and EN-13463-5 (ATEX) require grounding (earthing) on dampeners when the potential for static sparking is present. A grounding point is located and marked on ATEX specific dampener models.**

## Equipment Misuse Hazard

**CAUTION!**

### General Safety

**DO NOT** misuse dampener, including but not limited to over-pressurization, modification of parts, using incompatible chemicals, or operating with worn or damaged parts. **DO NOT** use any gases other than compressed air or clean dry Nitrogen to charge dampener. **DO NOT USE OXYGEN.** Any misuse could result in serious bodily injury, death, fire, explosion or property damage.

### Over-Pressurization

Never exceed the maximum pressure rating for the dampener model being used. Maximum allowable working pressure (MAWP) is specified on dampener serial tag or marked on dampener. Maximum allowable working pressure (MAWP) is rated at 70°F (21°C).

### Temperature Limits

**DO NOT** exceed the operating temperature limits for the body and/or elastomer materials being used. Excessive temperature will result in dampener failure. For temperature limits, refer to the “Temperature Limits” section of this Manual. Temperature limits are stated at zero psi/bar.

### Installation and Start-Up Hazards

Install dampener before charging or pressurizing. **DO NOT** start system or assembly without first charging or pressurizing dampener. Failure to charge may result in damage to the elastomeric bladder or PTFE bellows.

### Temperature & Pressure Hazard

Temperature and pressure reduce the strength and chemical resistance of plastic, metal, elastomers and PTFE.

### Charging / Pressurization

Charge or pressurize dampener with compressed air or clean dry Nitrogen only. **DO NOT USE OXYGEN.**

### Dampener Bladder/Bellows Failure

Dampeners utilize an elastomeric membrane (bladder) or PTFE bellows to separate system fluid from the air supply or gas charge. When failure occurs, system fluid may be expelled from the air valve. Always perform preventive maintenance and replace bladder/bellows before excessive wear occurs. O-rings for PTFE bellows cannot be re-used.

### Maintenance Hazards

Never over-tighten fasteners. This may cause leakage of system fluid and damage to dampener body. Bolts on metal models should not be reused as re-torquing reduces bolt strength. **After maintenance or re-assembly of metal models, use new fasteners and torque fasteners according to specification on dampener tag.**

# GENERAL Information

For safe and satisfactory operation of dampener read all safety warnings, caution statements and this complete Manual before installation, startup, operation or maintenance.

## Must Read Before Installation

**DO NOT** use Oxygen to charge dampener. Use compressed air or clean dry Nitrogen only.

**DO NOT** exceed maximum allowable working pressure (MAWP) specified on dampener serial tag or marked on dampener.

Turn pump off and remove all pressure from system prior to dampener installation.

Always wear safety glasses and other appropriate safety equipment when installing, charging or repairing dampener.

**Danger of static spark!** Grounding precautions must be considered when dampener is used in flammable or explosive environments.

ATEX models must be grounded (earthed) before operation.

**DO NOT** operate a dampener that is leaking, damaged, corroded or otherwise unable to contain internal fluid, air or gas pressure.

Temperature, pressure and chemicals affect the strength of plastic, elastomer and metal components.

Many plastics lose strength rapidly as temperature increases. Consult factory if in doubt.

## Installation Notes

△ Dampening of flow pulsations can only be effective if a minimum of 5 to 10 psi (0.4 to 0.7 bar) back pressure downstream of dampener is available. A BLACOH back pressure valve may be required downstream of dampener, except when dampener is used as an inlet stabilizer for the inlet side of the pump.

△ It is recommended that a BLACOH pressure relief valve be installed in all pump systems to ensure compliance with pressure limits on system equipment.

△ To avoid possible damage to bladder/bellows from a system pressure test:

**Adjustable and Chargeable models** — charge dampener to 80% of the system test pressure prior to test.

**Automatic model** — prior to test, dampener must be equipped with a constant source of compressed air with pressure equal to or greater than system test pressure.

**Inlet Stabilizer model** — maximum pressure test 30 psi (2.0 bar), charge to 20 psi (1.3 bar) for system pressure test.

△ Install dampener in-line as close to the pump discharge/inlet or quick closing valve as possible. Dampener installation should be no more than ten pipe diameters from pump discharge/inlet or quick closing valve.

△ It is recommended that an isolation valve be installed between the dampener and system piping.

## ATEX Standard

△ Certain models made for the European market comply with the ATEX standard for use in potentially explosive atmospheres. These models have the AT designation at the end of the part number and comply with EC standard EN-13463-5 with protection degree of II 2GD TXC. AT models have a grounding lug and must be grounded (earthed) before operation.

## Maintenance

**Remove all pressure from dampener AND pumping system before disassembly, removal or maintenance.**

Dampeners require very little maintenance. There is only ONE wear part – the elastomeric bladder or the PTFE bellows. There is no need for lubrication.

Elastomeric bladder replacement should be part of a preventive maintenance program. Dampeners used in conjunction with diaphragm pumps should have the bladders replaced at least every second time the diaphragms in the pump are replaced. As with any pumping system, wear is dependent on many factors including material, temperature, chemicals, fluid abrasiveness and system design. This suggested maintenance program may need to be adjusted according to specific applications.

Periodic inspection of the dampener and fasteners should be conducted to visually check for signs of over-pressurization, fatigue, stress or corrosion. Body housings and fasteners must be replaced at first indication of deterioration.

**CAUTION! Replace nut and bolt fasteners on metal models at each re-assembly with fasteners of equal grade/strength value. DO NOT re-use old nuts and bolts.**

After the initial torque of fasteners, bolts will usually lose up to 20% of their strength when re-torqued. Failure to replace both nuts and bolts upon each vessel reassembly will void the product warranty given by the manufacturer and the manufacturer will have no liability whatsoever for any vessel failure or malfunction.

Where dampeners are used in corrosive environments, nut and bolt fasteners should be regularly inspected and replaced with nut and bolt fasteners of equal grade/strength value if corrosion is observed. Failure to conduct such regular inspections and replacement will void the product warranty given by the manufacturer and the manufacturer will have no liability whatsoever for any vessel failure or malfunction.

**IMPORTANT!** After maintenance or re-assembly of metal models, use new fasteners and torque fasteners according to specification on dampener tag.

**DO NOT** use dampener if the fasteners (nuts and bolts) are corroded. Check for fastener corrosion frequently, especially in atmospheres containing salt or corrosive chemicals, or if dampener leakage has occurred.

## Temperature Limits

**Operating temperatures are based on the maximum temperature of the wetted dampener components only. Non-wetted dampener components may have a lower temperature limit. Temperature and certain chemicals may reduce the maximum allowable working pressure (MAWP) of the dampener.**

**CAUTION! Plastic (non-metallic) body materials lose strength as temperature increases, which reduces the maximum pressure sustainable by the material. All plastic materials must have an appropriate de-rating factor applied when working at elevated temperatures above 73.4°F (23°C) to determine maximum allowable working pressure (MAWP).**

| Elastomer Materials | Temperature Limits | Applications |
|---|---|---|
| Aflas | 0°F to +400°F (-18°C to +204°C) | High temperature, petroleum based chemicals, strong acids and bases. |
| Buna-N | +10°F to +180°F (-12°C to +82°C) | Good flex life; use with petroleum, solvents and oil-based fluids. |
| FDA Buna-N | +10°F to +180°F (-12°C to +82°C) | FDA-approved food grade; similar characteristics of regular Buna-N. |
| EPDM | -60°F to +280°F (-51°C to +138°C) | Use in extreme cold; good chemical resistance with ketones, caustics. |
| FDA EPDM | -50°F to +225°F (-45°C to +107°C) | FDA-approved food grade; similar characteristics of regular EPDM. |
| Hypalon | -20°F to +275°F (-29°C to +135°C) | Excellent abrasion resistance; good in aggressive acid applications. |
| Neoprene | 0°F to +200°F (-18°C to +93°C) | Good abrasion resistance and flex; use with moderate chemicals. |
| PTFE Diaphragm | +40°F to +220°F (+4°C to +104°C) | Use with highly aggressive fluids. |
| PTFE Bellows | -20°F to +220°F (-29°C to +104°C) | Exclusive bellows design with excellent flex life; use with highly aggressive fluids. |
| Santoprene | -20°F to +225°F (-29°C to +107°C) | Excellent choice as a low cost alternative for PTFE in many applications. |
| FDA Silicone | -20°F to +300°F (-29°C to +149°C) | FDA-approved food grade material; for use in food and pharmaceutical processing. |
| USP Class VI Silicone | -20°F to +300°F (-29°C to +149°C) | Pharmaceutical grade material; for use in food and pharmaceutical processing. |
| Viton® | -10°F to +350°F (-23°C to +177°C) | Use in hot and aggressive fluids; good with aromatics, solvents, acids and oils. |

| Non-Metallic Body Materials | Temperature Limits | Applications |
|---|---|---|
| Acetal* | +32°F to +175°F (0°C to +79°C) | Good flex life; low moisture sensitivity; high resistance to solvents and chemicals. |
| CPVC | +32°F to +180°F (0°C to +82°C) | Chlorinated PVC (CPVC): Good general chemical resistance; loses strength as temperature rises. |
| Noryl | +32°F to +220°F (0°C to +104°C) | Good resistance to acids and bases; good temperature stability. |
| Polypropylene* | +32°F to +175°F (0°C to +79°C) | Good general purpose plastic; broad chemical compatibility at medium temperatures. |
| PTFE | +40°F to +220°F (+4°C to +104°C) | Use with highly aggressive fluids, high temperatures. |
| PVC | +32°F to +140°F (0°C to +60°C) | Good general chemical resistance; loses strength as temperature rises. |
| PVDF | +10°F to +200°F (-12°C to +93°C) | Excellent resistance to most acids and bases; high temperatures. |

** Conductive Acetal and Conductive Polypropylene available.*

[T22E11_010]

# Installation & Operation Instructions: INLET SABILIZER Models

**Inlet Stabilizer dampener models are for use on the inlet side of pumps only.**

**ATEX models must be grounded (earthed) before operation.**

Turn pump off and remove all pressure from system prior to dampener installation.

Remove all pressure from dampener AND pumping system before disassembly, removal or maintenance.

Use compressed air to charge dampener. **DO NOT USE OXYGEN.**

**DO NOT exceed 30 psi (2 bar) maximum allowable working pressure (MAWP) to prevent damage to the compound pressure gauge. Check maximum pressure rating specified on dampener serial tag.**

Before performing a system pressure test, dampener must be charged with 80% of system test pressure, not to exceed 30 psi (2 bar), to avoid possible damage to bladder/bellows.

Always wear safety glasses and other appropriate safety equipment when installing, charging or repairing dampener.

Read and observe all safety warnings and instructions in this Manual before installation, operation or repair.

**IMPORTANT! After maintenance or re-assembly of metal models, use new fasteners and torque fasteners according to specification on dampener tag.**

To properly adjust an Inlet Stabilizer dampener model, a compound pressure gauge must be installed in the pump inlet piping.

## Pre-Charge Notes

**Read Before Installation**

Pre-charge pressure should be checked at least monthly as gas molecules will diffuse through elastomeric bladders, the speed of which depends on the elastomer material, temperature and pressure. Checks must occur when no system pressure is present or inaccurate readings will be recorded. If temperature is above 72°F (22°C) and/or pressure is over 300 psi (20.7 bar), checks should be performed more frequently. **To prevent pre-charge loss through the fill valve, always replace the fill valve cap after charging.** A proper gas charge is the key to dampener effectiveness and bladder/bellows life.

## Installation for Pump Inlet

**Read Before Installation**

**Step 1 — Installation Position**

Install the dampener in-line as close to the pump inlet as possible and after any upstream equipment such as risers, valves, elbows, meters or filters. Dampener installation should be no more than ten pipe diameters from pump inlet. If using a flexible connector on the inlet side of the pump between the system piping and pump, the dampener should be installed on a tee at the pump inlet manifold. The flexible connector should be attached to the dampener's tee and system piping (see FIGURE 1). A compound pressure gauge should be installed upstream of the dampener to aid in proper dampener adjustment.

**Step 2 — Charging and Start-Up (see Pre-Charge Notes)**

Inlet Stabilizer dampener models do not require an air line connection.

**A. Suction Lift/Negative Inlet Pressure Application:** Follow the steps below to make required adjustments. Pump must be running before adjusting dampener.

1. Close the ball valve (Part ② on FIGURE 2).
2. Turn the pump on and observe the changes in pressure on the compound pressure gauge at the pump inlet (FIGURE 1).
3. Attach a compressed air line with an air chuck (not included) to the venturi valve (Part ① on FIGURE 2).
4. Open the ball valve. As compressed air flows through the venturi valve, observe the compound pressure gauge (Part ③ on FIGURE 2) on the dampener. As soon as the gauge reads 5" to 6" Hg vacuum (-0.17 to 0.20 bar), close the ball valve. If the ball valve is left open too long while adding compressed air pressure to the venturi valve, the

bladder/bellows will be drawn all the way up to the top of the dampener. This will eliminate the vacuum pull of the bladder/bellows making the dampener less effective. If this occurs, turn the pump off, add 10 psi (0.7 bar) pressure to the dampener to push the bladder/bellows back down, and repeat steps 1 through 4.

5. The vacuum observed on the dampener's compound pressure gauge (Part ③ on FIGURE 2) should read approximately the same as that on the inlet pipe's compound gauge, and needle fluctuations should now be minimal. The vacuum may need to be adjusted up or down to obtain minimum movement on the inlet pipe's compound gauge.

**B. Positive Inlet Pressure:** Pre-charge the dampener with 50%, not to exceed 30 psi (2 bar), of the static system pressure realized at the pump inlet. Start the pump to generate working pressure. Minor pressure adjustments may be required. Allow the system to respond to each adjustment (this may take a minute or two) before making further adjustments. Follow the steps below to make required adjustments.

1. Close the ball valve (Part ② on FIGURE 2).
2. Attach a compressed air line with an air chuck (not included) to the venturi valve (Part ① on FIGURE 2).
3. Open the ball valve.
4. With a finger partially covering the exhaust air from the bottom of the venturi valve, watch the compound pressure gauge on the dampener (Part ③ on FIGURE 2) until it reaches 50%, not to exceed 30 psi (2 bar), of static inlet pressure. Close the ball valve.

To prevent damage to the compound pressure gauge, **DO NOT** exceed 30 psi (2 bar) maximum allowable working pressure (MAWP).

**FIGURE 1**

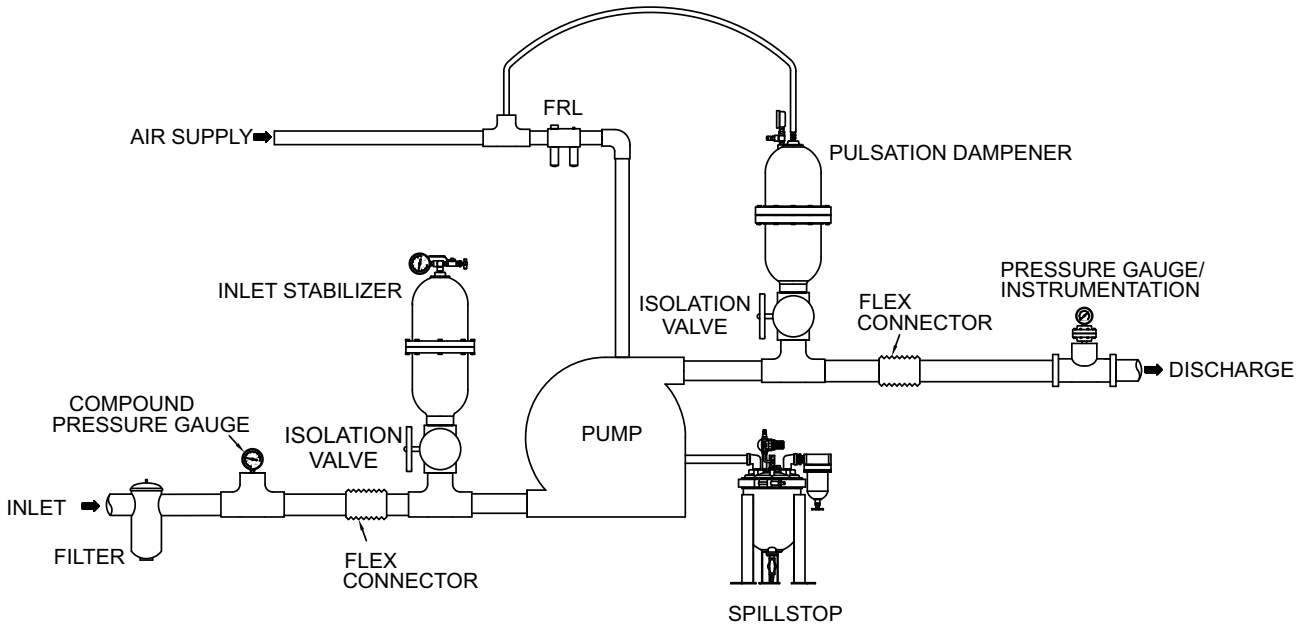
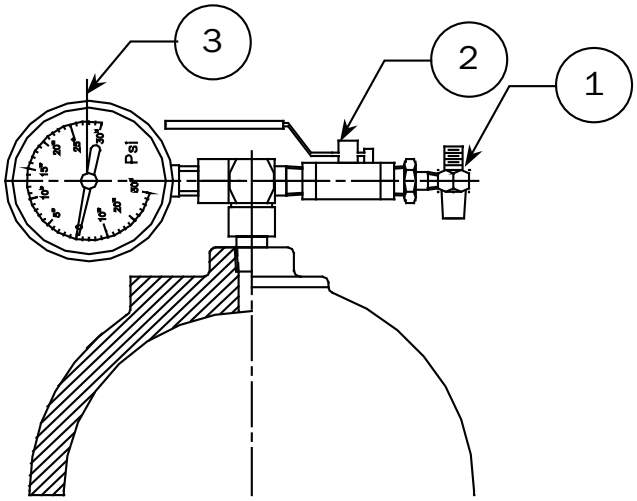


**FIGURE 2**



## NOTES

# Manufacturer’s Limited Warranty & Return Policy

**Standard Product Limited Warranty**

Subject to the limitations set forth below, BLACOH Fluid Controls, Inc. ("BLACOH") warrants its products to be free from defects in material and workmanship under normal use, service, and maintenance in accord with BLACOH’s published specifications for a period of two years from date of shipment by BLACOH (the "Warranty"). The EXCLUSIVE REMEDY for any product defect covered under this Warranty shall be one of the following, as determined by BLACOH in BLACOH’s sole discretion: (a) refund of the purchase price; or (b) replacement or repair of the defective part or parts at BLACOH’s facility. This Warranty will be null and void if the product is used in an inappropriate application or if the product has been altered, misapplied, improperly installed, or not properly inspected and maintained. To the maximum extent allowed by applicable law, BLACOH will not be responsible for nor have any liability for any “Damage,” which means any of the following, whether the claim sounds in breach of contract, breach of warranty, tort, strict liability, implied contractual indemnity, or otherwise: (i) any damage, loss, or injury of any kind, or destruction, or death, whether or not caused by any defect in a BLACOH product and whether or not the BLACOH product is installed, used, operated, and/or maintained in accord with BLACOH instructions, to other products, machinery, buildings, property, or persons, and (ii) any costs, expenses, losses, or incidental, consequential, or special damages of any kind or nature, including but not limited to loss of profits, arising from or related to any BLACOH product, whether or not caused by any defect in a BLACOH product and whether or not the BLACOH product is installed, used, operated, and/or maintained in accord with BLACOH instructions. Damage resulting from chemical incompatibility or from over-pressurization of a product, whether from gas or fluid, is not covered under this Warranty, nor will BLACOH be responsible in any way for any such Damage. Because BLACOH does not determine and cannot anticipate or control the many different conditions under which its products may be used, BLACOH does not warranty the applicability, suitability, or fitness of any of its products for any particular use or purpose. Statements concerning the possible use of BLACOH products are not intended and shall not be interpreted as warranties of fitness for any specific use of such products. Each user of BLACOH products must conduct its own engineering analysis and tests to determine the suitability of each BLACOH product for the user's intended uses or purposes, including but not limited to chemical compatibility and pressurization, and any written or oral assistance from BLACOH in this regard does not relieve the user from exclusive responsibility for such engineering analysis and testing. BLACOH products are sold with only this limited Warranty, and each buyer assumes all responsibility for Damage (as defined above), including but not limited to, Damage arising from defects in BLACOH products and/or from the handling and use of BLACOH products whether used in accordance with BLACOH's directions or otherwise. Any products sold by BLACOH which are manufactured by and sold under the name of another company are NOT WARRANTED by BLACOH under the foregoing Warranty or otherwise. The buyer must rely exclusively on the product warranty, if any, given by such other company. Products manufactured by BLACOH as an original equipment manufacturer (OEM) to be sold by a customer under the customer’s brand and name are warranted by BLACOH only under the above Warranty, and BLACOH shall have no liability whatsoever with respect to any representation or warranty given by such customer (or such customer’s representatives, distributors, agents, employees, or independent contractors) to any of its buyers which is different in any respect whatsoever from the foregoing Warranty. EXCEPT FOR THE WARRANTY GIVEN ABOVE, WHICH IS SUBJECT TO THE ADDITIONAL LIMITATIONS STATED ABOVE, AND EXCEPT FOR THE ADDITIONAL LIMITED WARRANTY ON BLACOH’S PTFE BELLOWS STATED BELOW, BLACOH GIVES NO WARRANTY OF ANY NATURE WHATSOEVER, EXPRESS OR IMPLIED, WITH RESPECT TO ANY OF ITS PRODUCTS, INCLUDING WITHOUT LIMITATION NO WARRANTY OF MERCHANTABILITY AND NO WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. NO COURSE OF DEALING, USAGE OF TRADE, OR OTHER ORAL OR WRITTEN STATEMENTS SHALL MODIFY THE FOREGOING WARRANTY PROVISIONS AND LIMITATIONS IN ANY RESPECT WHATSOEVER. This Warranty shall be governed by and construed in accordance with the laws of the State of California.

**PTFE Bellows Limited Warranty**

In addition to BLACOH's Standard Product Limited Warranty and subject to the limitations set forth below, BLACOH warrants that its PTFE Bellows equipment (“PTFE Bellows”) on BLACOH's PTFE Bellows-fitted pulsation dampener will perform in accordance with BLACOH's written product description for three years from date of shipment ("PTFE Bellows Warranty"). This PTFE Bellows Warranty applies only to PTFE Bellows that are sized, charged, installed, used, operated, and maintained strictly in accordance with all installation, use, operation, and maintenance instructions provided by BLACOH, and failure to properly size, charge, install, use, operate, and maintain the PTFE Bellows (or failure to do any of them) shall make the PTFE Bellows Warranty null and void. This PTFE Bellows Warranty does not include applications where failure of performance is due to an unbalanced pressure load or a transient pressure spike (sometimes called a water hammer). The EXCLUSIVE REMEDY for breach of this PTFE Bellows Warranty is replacement of the PTFE Bellows at BLACOH’s facility, and not any other equipment or parts whatsoever, and BLACOH will not be responsible for any Damage or any other loss of any kind, including but not limited to incidental, consequential, or special damages (including but not limited to loss of profits), in any way arising from failure of the PTFE Bellows to perform in accordance with BLACOH’s written product description. This PTFE Bellows Warranty shall be governed and construed in accordance with the laws of the State of California.

SENTRY™

**Warranty Claims**

1. Prior to returning any product to BLACOH based on a claim of breach of Warranty or PTFE Bellows Warranty, a BLACOH Return Request form must be completed. The form will be reviewed by BLACOH to determine if a Return Merchandise Authorization (RMA) number will be issued. The issuance of an RMA number does not constitute BLACOH's acknowledgment or agreement that the warranty claim is justified or correct.
2. If an RMA number is issued by BLACOH, customer should then deliver the product in question to the address specified on the RMA, freight prepaid.
3. All products so returned to BLACOH based on a claim of breach of Warranty or of PTFE Bellows Warranty must be cleaned, sanitized and neutralized prior to shipment to BLACOH. BLACOH will not accept any part that contains corrosive chemicals, organic cultures, blood, any harmful residue or air borne materials that might contaminate a breathable atmosphere or put at risk any person or property. Any shipment that does not comply will be returned at the expense of the customer, or the customer will be required to arrange for pickup.
4. HAZMAT SHIPMENTS WILL BE REMOVED AND PROCESSED AT CUSTOMER'S EXPENSE.
5. Receipt by BLACOH of a return does not constitute BLACOH's agreement that BLACOH is in breach of its Warranty or PTFE Bellows Warranty.
6. If BLACOH determines that a defect in workmanship or material of a part has occurred, customer is not entitled to a complete unit replacement. In the event of such a defect, BLACOH will repair or replace the defective part or parts or refund the purchase price, as BLACOH determines in BLACOH's sole discretion.

**New Product Returns**

1. If a customer wishes to return a new, unused product, the customer must first request a Return Merchandise Authorization (RMA) number from BLACOH. BLACOH will determine if the unit can be returned for possible credit.
2. Product to be returned must be new, unused, and of current design and purchased within thirty (30) days of the return request. In addition the product must not have been damaged after original shipment by BLACOH.
3. Product returns must be delivered, freight prepaid.
4. BLACOH has the right to inspect all returned products prior to acceptance or rejection.
5. ALL RETURNS are subject to a minimum $50.00 or 30% restocking fee, whichever is greater. (Higher restocking fees may be charged on special items and some models may not be eligible for return). Returns accepted by BLACOH will be credited to the customer's account less the re-stocking fee. Refunds will not be issued.
6. Any outsourced product supplied by BLACOH will be subject to the warranty, return policy and re-stock fee charged by the manufacturer of the outsourced product.

[L11E11_060]

BLACOH™
FLUID CONTROL

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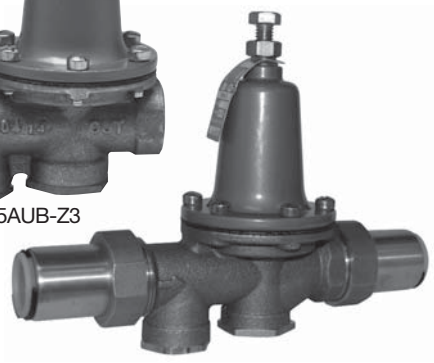
# Series 25AUB-Z3 and LF25AUB-Z3

## ½"– 2" (15-50mm)

25AUB-Z3



25AUB-DU-QC-Z3

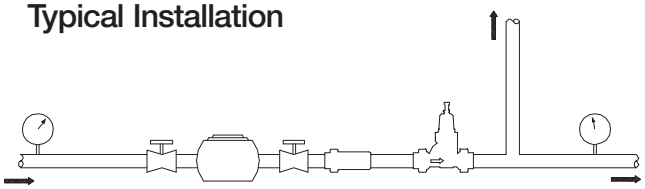
## Installation Instructions

1. The valve should be installed by a licensed contractor in accordance with local codes and ordinances.
2. This valve should be installed where it is accessible with sufficient clearance for cleaning, service, or adjustment.
3. Before installing the valve, be sure that the pipe ends are reamed and threads are cut to size. For valves with Quick-Connect tailpieces refer to "Quick-Connect Installation" instructions below.
4. Flush the lines to remove all loose scale, dirt and other foreign matter that can damage or clog the valve.
5. Install the regulator with the arrow on the body pointing in the direction of the flow.
6. Regulator may be installed vertically or horizontally (upright or inverted).
7. Start Up — Open cold water supply then hot water supply. Inspect for leaks.

**Note:** The valve should be inspected annually to assure maximum life and performance.

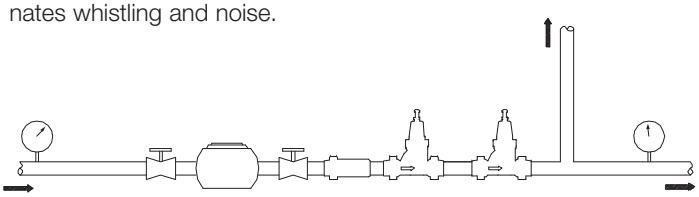
**Note:** 25AUB-Z3 or LF25AUB-Z3 valves are suitable for accessible outdoor or pit installations.

### Typical Installation



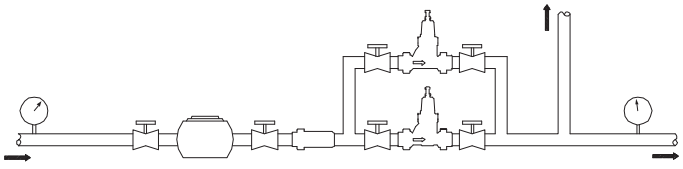
### Series Installation

Series installations are recommended where very high supply pressure must be reduced to a very low downstream pressure. Reducing the pressure in stages eliminates whistling and noise.



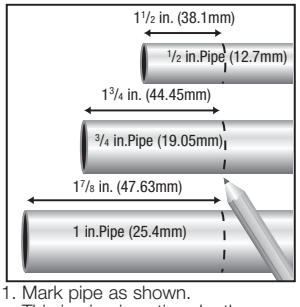
### Parallel Installation

Parallel installations are recommended where high flow or low flow demand is intermittent/occasional. They are also used for installations where service cannot be interrupted.

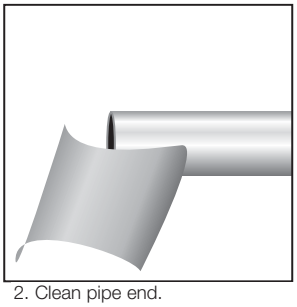


### Quick-Connect Installation

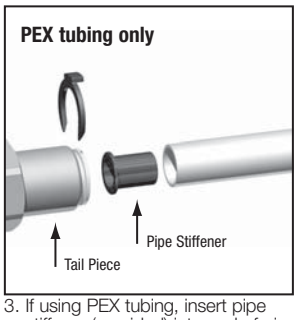
**To Connect**



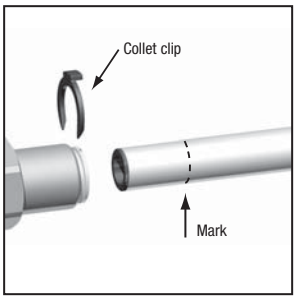

1. Mark pipe as shown. This is pipe insertion depth.



2. Clean pipe end.

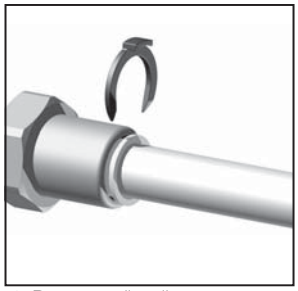



3. If using PEX tubing, insert pipe stiffener (provided) into end of pipe.

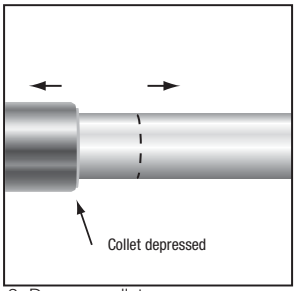



4. Push tubing into tailpiece up to mark.
5. Insert collet clip.

**To Disconnect**



1. Remove collet clip.




2. Depress collet.
3. Pull tubing from tailpiece.

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## Maintenance Instructions

- To clean strainer; shut off inlet water pressure, remove strainer plug (2), remove and clean strainer.
- To replace seat disc; shut off supply, loosen nut (51) and back off adjusting screw (53) remove spring cage (3), spring (52) and washer (62). Remove bottom plug (12) and gasket (101). Insert and hold screw driver in slot on top of stem while loosening seat disc holder (47) from bottom of stem (27).
- To replace diaphragm; loosen lock nut (48) and remove lock washer (46), diaphragm plate (60) and diaphragm (20).
- When reassembling apply a drop of low strength thread lock to disc holder.
- Open inlet water supply slowly.

## Adjustment

Regulator is factory preset to 50psi (344 kPa). To adjust pressure setting, loosen the lock nut and turn the adjusting bolt clockwise to increase pressure, counterclockwise to decrease pressure.

**CAUTION:** Any time a reducing valve is adjusted, the use of a pressure gauge is recommended to verify correct pressure setting. Do not bottom out adjusting screw on spring cage.

## Bypass Feature*

This regulator has a built-in thermal expansion bypass feature. This feature prevents downstream pressure from rising to more than 10psi above the supply pressure.

* The bypass feature will not prevent the pressure relief valve from opening on the hot water supply system with pressure above 150psi (10.3 bar).

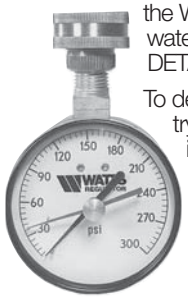
## Troubleshooting

### High System Pressure

If the downstream system pressure is higher than the set pressure under no flow conditions, the cause could be thermal expansion, pressure creep or dirt/debris on the seat.

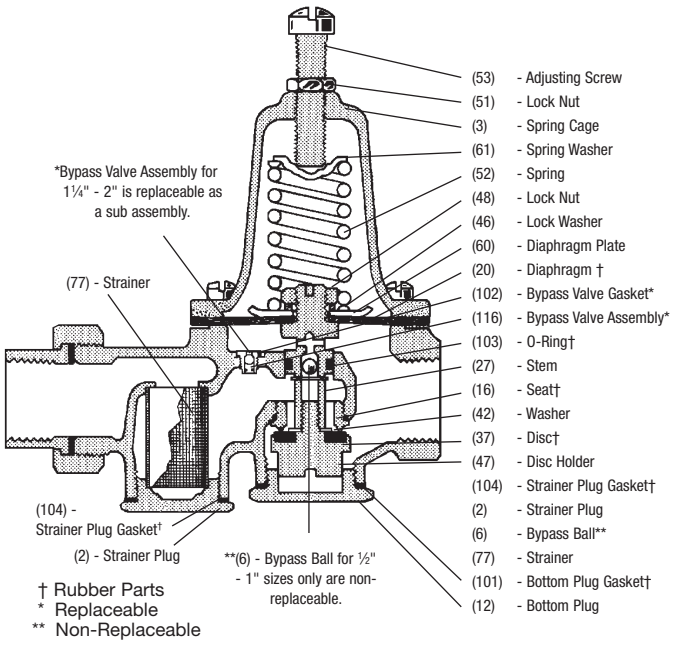
Thermal expansion occurs whenever water is heated in a closed system. The system is closed when supply pressure exceeds 150psi, or a check valve or backflow preventer is installed in the supply piping.

You must make provisions for pressure relief protection of your plumbing system and components. The use of a relief valve such as the Watts 530C, BRV, Governor 80, or 3L or potable water expansion tank such as the Watts DET, PLT or DETA may be required.



Watts 276H300

To determine if this is the result of thermal expansion, try briefly opening the cold water tap. If the increased pressure is caused by thermal expansion, the pressure will immediately be relieved and the system will return to the set pressure. Watts offers a pressure test gauge, model 276H300 to assist you in determining if you have high water pressure. The 276H300 when attached to a hose bibb registers the highest pressure reading over the period of time it is left on the system.




† Rubber Parts
* Replaceable
** Non-Replaceable

## Repair Kits

**† Kit for Series 25AUB-Z3 includes all items shown above.**

| ORDERING CODE | KIT NO. | SIZE (DN) | |
|---|---|---|---|
| | | *in* | *mm* |
| 0864941 | ½" 25AUB-RK | ½ | 15 |
| 0864943 | ¾" 25AUB-RK | ¾ | 20 |
| 0864942 | 1" 25AUB-RK | 1 | 25 |
| 0864944 | 1¼" 25AUB-RK | 1¼ | 32 |
| 0864945 | 1½" 25AUB-RK | 1½ | 40 |
| 0864946 | 2" 25AUB-RK | 2 | 50 |

**When Ordering, Specify:**

1. Ordering Code
2. Size of Valve
3. Type Number
4. Model shown on Nameplate

**NOTICE!**

For valves with CPVC or PEX end connections, do not exceed the tubing manufacturers pressure and temperature ratings. Refer to the tubing manufacturers product specifications for that information.

**CALIFORNIA PROPOSITION 65 WARNING**

**WARNING:** This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

(California law requires this warning to be given to customers in the State of California.)

**For more information: www.watts.com/prop65**

**Limited Warranty:** Watts Regulator Co. (the "Company") warrants each product to be free from defects in material and workmanship under normal usage for a period of one year from the date of original shipment. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge.
**THE WARRANTY SET FORTH HEREIN IS GIVEN EXPRESSLY AND IS THE ONLY WARRANTY GIVEN BY THE COMPANY WITH RESPECT TO THE PRODUCT. THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED. THE COMPANY HEREBY SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**
The remedy described in the first paragraph of this warranty shall constitute the sole and exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if this product does not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemical, or any other circumstances over which the Company has no control. This warranty shall be invalidated by any abuse, misuse, misapplication, improper installation or improper maintenance or alteration of the product.
Some States do not allow limitations on how long an implied warranty lasts, and some States do not allow the exclusion or limitation of incidental or consequential damages. Therefore the above limitations may not apply to you. This Limited Warranty gives you specific legal rights, and you may have other rights that vary from State to State. You should consult applicable state laws to determine your rights. **SO FAR AS IS CONSISTENT WITH APPLICABLE STATE LAW, ANY IMPLIED WARRANTIES THAT MAY NOT BE DISCLAIMED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO ONE YEAR FROM THE DATE OF ORIGINAL SHIPMENT.**

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**Water Safety & Flow Control Products**

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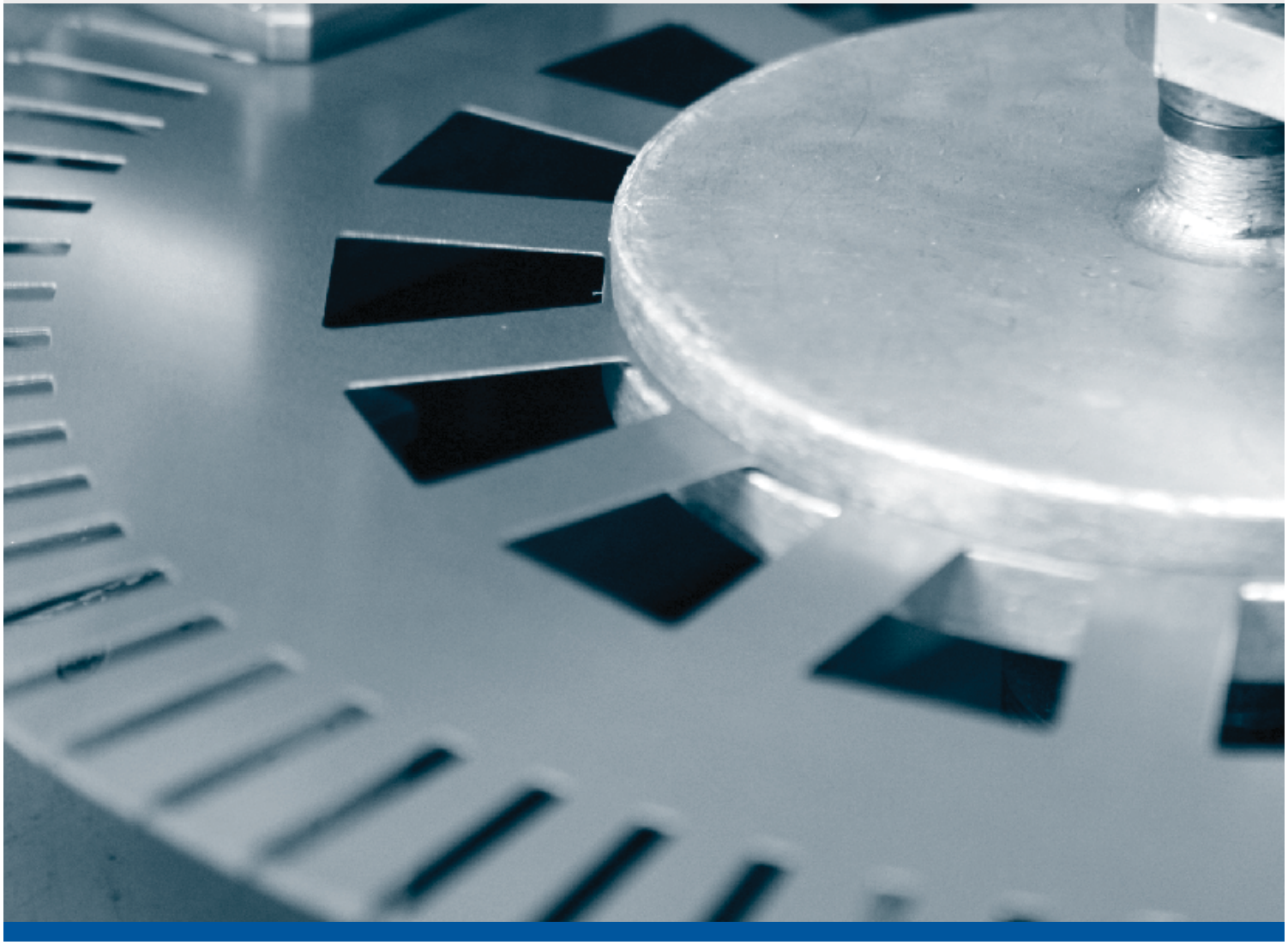

# INSTALLATION, OPERATION AND MAINTENANCE MANUAL OF ELECTRIC MOTORS

This manual provides information about WEG induction motors fitted with squirrel cage, permanent magnet or hybrid rotors, low, medium and high voltage, in frame sizes IEC 56 to 630 and NEMA 42 to 9606/10.
The motor lines indicated below have additional information that can be checked in their respective manuals:

- Smoke Extraction Motors;
- Electromagnetic Brake Motors;
- Hazardous Area Motors.

These motors meet the following standards, if applicable:

- NBR 17094-1: Máquinas Elétricas Girantes - Motores de Indução - Parte 1: trifásicos.
- NBR 17094-2: Máquinas Elétricas Girantes - Motores de Indução - Parte 2: monofásicos.
- IEC 60034-1: Rotating Electrical Machines - Part 1: Rating and Performance.
- NEMA MG 1: Motors and Generators.
- CSA C 22.2 N°100: Motors and Generators.
- UL 1004-1: Rotating Electrical Machines - General Requirements.

If you have any questions regarding this manual please contact your local WEG branch, contact details can be found at www.weg.net.

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## 1. TERMINOLOGY

***Balancing:*** the procedure by which the mass distribution of a rotor is checked and, if necessary, adjusted to ensure that the residual unbalance or the vibration of the journals and/or forces on the bearings at a frequency corresponding to service speed are within specified limits in International Standards.
[ISO 1925:2001, definition 4.1]

***Balance quality grade:*** indicates the peak velocity amplitude of vibration, given in mm/s, of a rotor running free-in-space and it is the product of a specific unbalance and the angular velocity of the rotor at maximum operating speed.

***Grounded Part:*** metallic part connected to the grounding system.

***Live Part:*** conductor or conductive part intended to be energized in normal operation, including a neutral conductor.

***Authorized personnel:*** employee who has formal approval of the company.

***Qualified personnel:*** employee who meets the following conditions simultaneously:
- Receives training under the guidance and responsibility of a qualified and authorized professional;
- Works under the responsibility of a qualified and approved professional.

***Note****: The qualification is only valid for the company that trained the employee in the conditions set out by the authorized and qualified professional responsible for training.*

# 2. INITIAL RECOMMENDATIONS

Electric motors have energized circuits, exposed rotating parts and hot surfaces that may cause serious injury to people during normal operation. Therefore, it is recommended that transportation, storage, installation, operation and maintenance services are always performed by qualified personnel.
Also the applicable procedures and relevant standards of the country where the machine will be installed must be considered.
Noncompliance with the recommended procedures in this manual and other references on the WEG website may cause severe personal injuries and/or substantial property damage and may void the product warranty.

For practical reasons, it is not possible to include in this Manual detailed information that covers all construction variables nor covering all possible assembly, operation or maintenance alternatives.
This Manual contains only the required information that allows qualified and trained personnel to carry out their services. The product images are shown for illustrative purpose only.

For *Smoke Extraction Motors*, please refer to the additional instruction manual 50026367 available on the website www.weg.net.

For brake motors, please refer to the information contained in WEG 50006742 / 50021973 brake motor manual available on the website www.weg.net.

For information about permissible radial and axial shaft loads, please check the product technical catalogue.

The user is responsible for the correct definition of the installation environment and application characteristics.

During the warranty period, all repair, overhaul and reclamation services must be carried out by WEG authorized Service Centers to maintain validity of the warranty.



## 2.1. WARNING SYMBOL

Warning about safety and warranty.

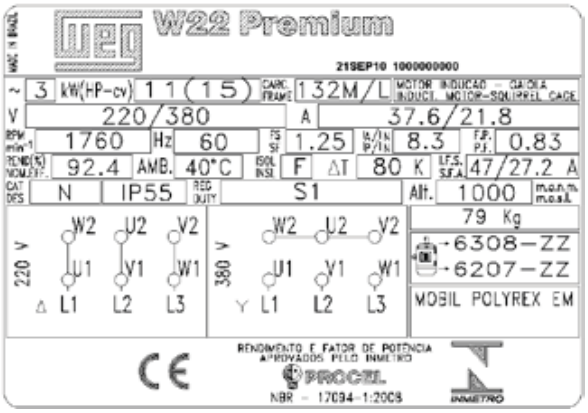
## 2.2. RECEIVING INSPECTION

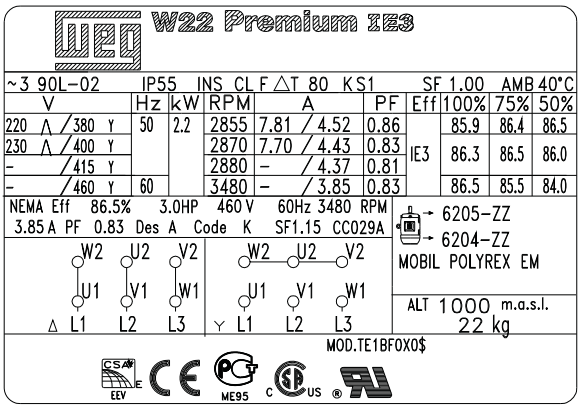
All motors are tested during the manufacturing process.
The motor must be checked when received for any damage that may have occurred during the transportation. All damages must be reported in writing to the transportation company, to the insurance company and to WEG. Failure to comply with such procedures will void the product warranty.
You must inspect the product:
- Check if nameplate data complies with the purchase order;
- Remove the shaft locking device (if any) and rotate the shaft by hand to ensure that it rotates freely;
- Check that the motor has not been exposed to excessive dust and moisture during the transportation.

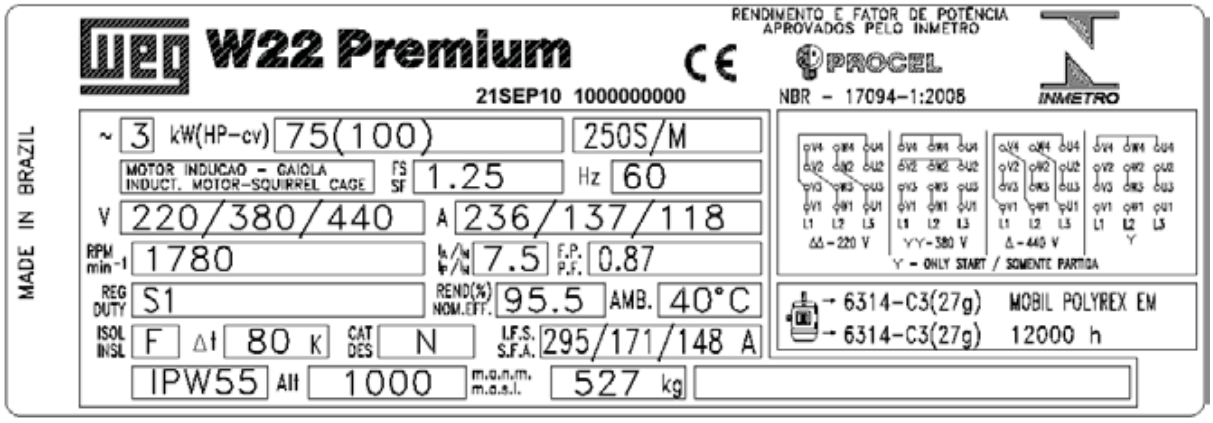
Do not remove the protective grease from the shaft, or the plugs from the cable entries. These protections must remain in place until the installation has been completed.

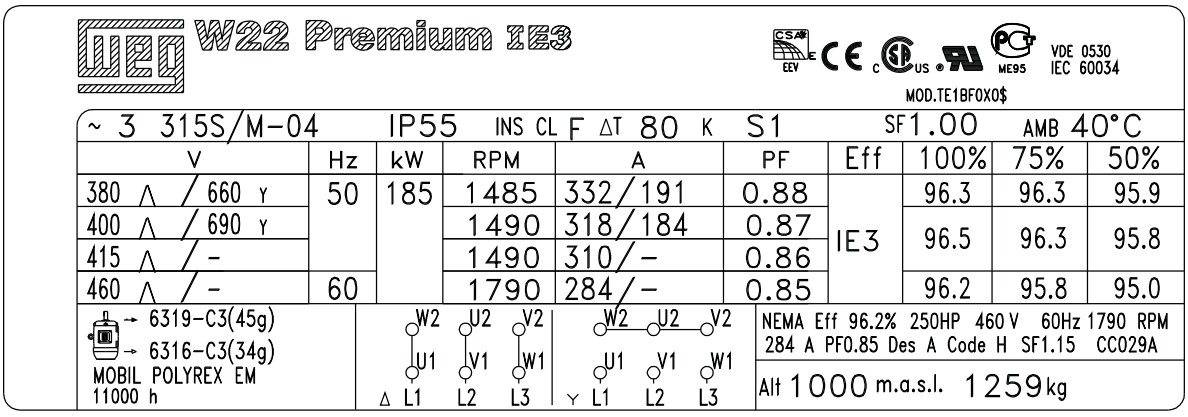
## 2.3. NAMEPLATES

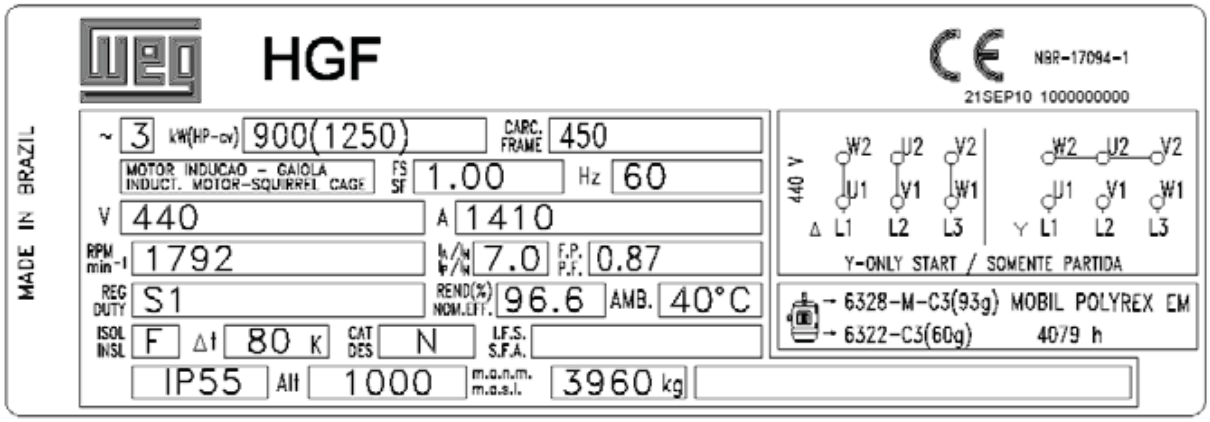
The nameplate contains information that describes the construction characteristics and the performance of the motor. Figure 2.1 and Figure 2.2 show nameplate layout examples.





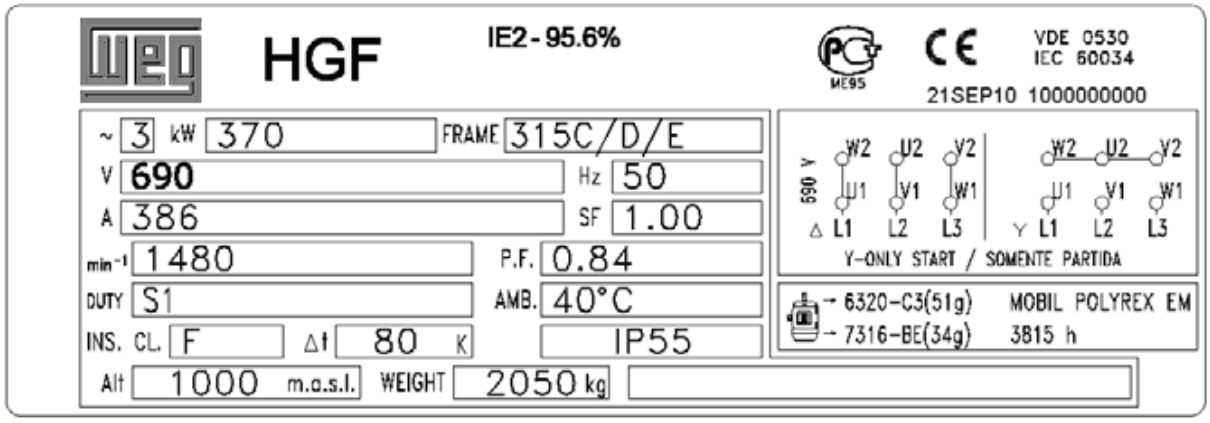
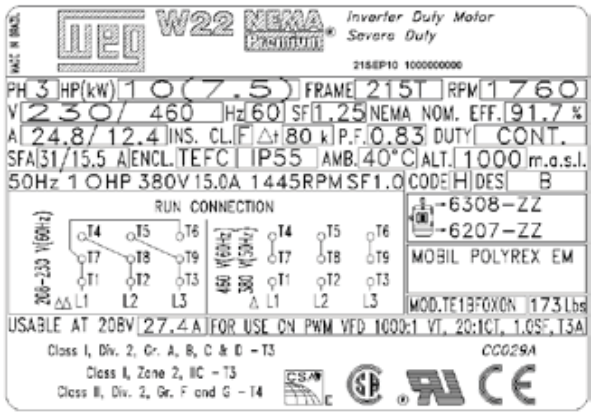




***Figure 2.1*** *- IEC motor nameplate*



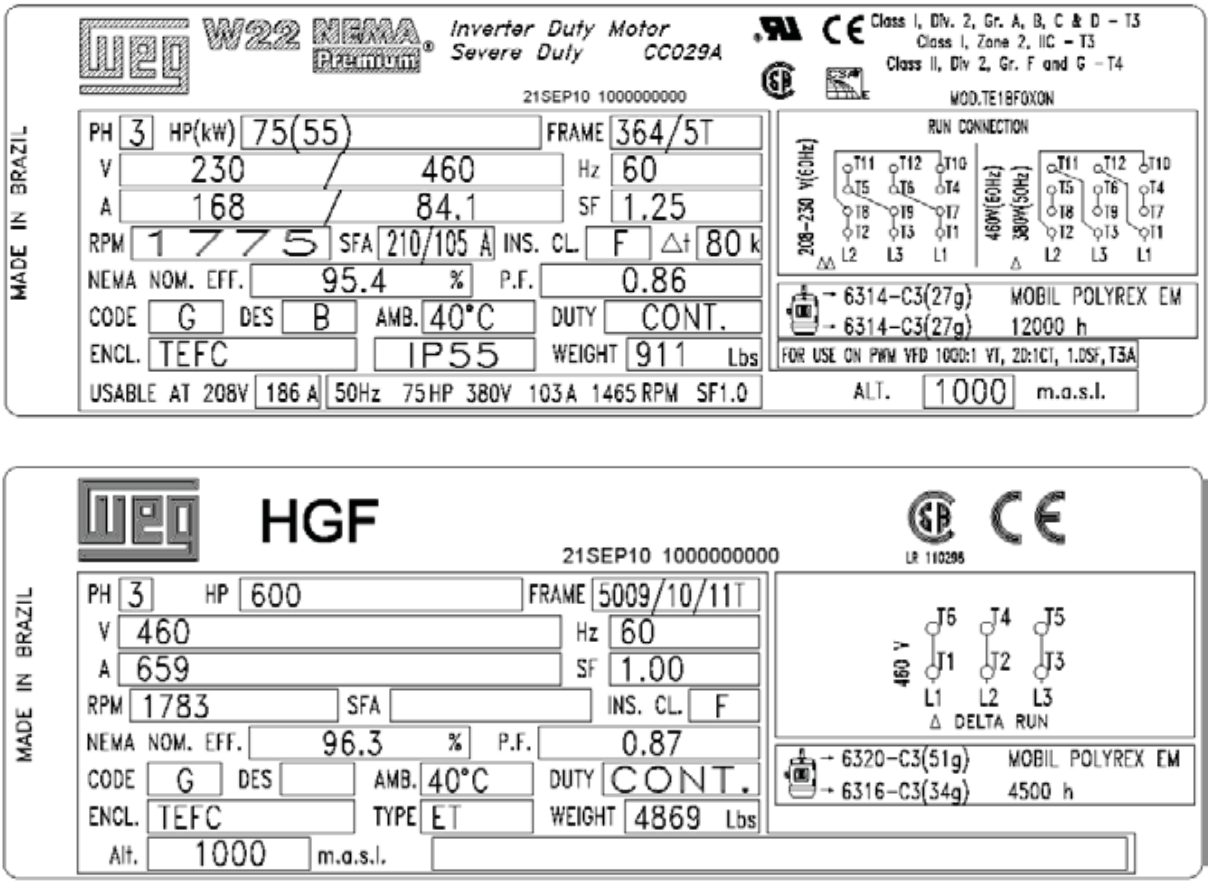






***Figure 2.2*** *- NEMA motor nameplate*

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## 3. SAFETY INSTRUCTIONS

The motor must be disconnected from the power supply and be completely stopped before conducting any installation or maintenance procedures. Additional measures should be taken to avoid accidental motor starting.

Professionals working with electrical installations, either in the assembly, operation or maintenance, should use proper tools and be instructed on the application of standards and safety requirements, including the use of Personal Protective Equipment (PPE) that must be carefully observed in order to reduce risk of personal injury during these services.

Electric motors have energized circuits, exposed rotating parts and hot surfaces that may cause serious injury to people during normal operation. It is recommended that transportation, storage, installation, operation and maintenance services are always performed by qualified personnel.

Always follow the safety, installation, maintenance and inspection instructions in accordance with the applicable standards in each country.

# 4. HANDLING AND TRANSPORT

Individually packaged motors should never be lifted by the shaft or by the packaging. They must be lifted only by means of the eyebolts, when supplied. Use always suitable lifting devices to lift the motor. Eyebolts on the frame are designed for lifting the machine weight only as indicated on the motor nameplate. Motors supplied on pallets must be lifted by the pallet base with lifting devices fully supporting the motor weight.

The package should never be dropped. Handle it carefully to avoid bearing damage.

Eyebolts provided on the frame are designed for lifting the machine only. Do not use these eyebolts for lifting the motor with coupled equipment such as bases, pulleys, pumps, reducers, etc..

Never use damaged, bent or cracked eyebolts. Always check the eyebolt condition before lifting the motor.

Eyebolts mounted on components, such as on end shields, forced ventilation kits, etc. must be used for lifting these components only. Do not use them for lifting the complete machine set.

Handle the motor carefully without sudden impacts to avoid bearing damage and prevent excessive mechanical stresses on the eyebolts resulting in its rupture.

To move or transport motors with cylindrical roller bearings or angular contact ball bearings, use always the shaft locking device provided with the motor.
All HGF motors, regardless of bearing type, must be transported with shaft locking device fitted.

## 4.1. LIFTING

Before lifting the motor ensure that all eyebolts are tightened properly and the eyebolt shoulders are in contact with the base to be lifted, as shown in Figure 4.1. Figure 4.2 shows an incorrect tightening of the eyebolt.
Ensure that lifting machine has the required lifting capacity for the weight indicated on the motor nameplate.

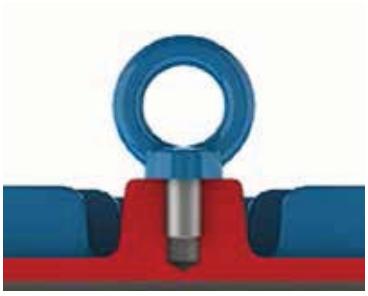

***Figure 4.1*** *- Correct tightening of the eyebolt*

***Figure 4.2*** *- Incorrect tightening of the eyebolt*

The center-of-gravity may change depending on motor design and accessories. During the lifting procedures the maximum allowed angle of inclination should never be exceeded as specified below.

### 4.1.1. Horizontal motors with one eyebolt

For horizontal motors fitted with only one eyebolt, the maximum allowed angle-of-inclination during the lifting process should not exceed 30° in relation to the vertical axis, as shown in Figure 4.3.

***Figure 4.3*** *- Maximum allowed angle-of-inclination for motor with one eyebolt*

### 4.1.2. Horizontal motor with two eyebolts

When motors are fitted with two or more eyebolts, all supplied eyebolts must be used simultaneously for the lifting procedure.

There are two possible eyebolt arrangements (vertical and inclined), as shown below:

- For motors with vertical lifting eyebolts, as shown in Figure 4.4, the maximum allowed lifting angle should not exceed 45° in relation to the vertical axis. We recommend to use a spreader bar for maintaining the lifting elements (chain or rope) in vertical position and thus preventing damage to the motor surface;

***Figure 4.4*** *- Maximum resulting angle for motors with two or more lifting eyebolts*



- For HGF motors, as shown in Figure 4.5, the maximum resulting angle should not exceed 30° in relation to the vertical axis;

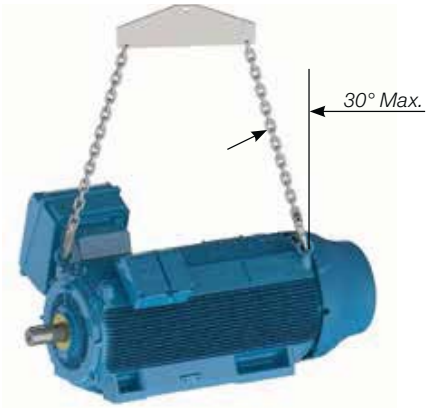


***Figure 4.5*** *- Maximum resulting angle for horizontal HGF motors*

- For motors fitted with inclined eyebolts, as shown in Figure 4.6, the use of a spreader bar is required for maintaining the lifting elements (chain or rope) in vertical position and thus preventing damage to the motor surface.

***Figure 4.6*** *- Use of a spreader bar for lifting*

### 4.1.3. Vertical motors

For vertical mounted motors, as shown in Figure 4.7, the use of a spreader bar is required for maintaining the lifting element (chain or rope) in vertical position and thus preventing damage to the motor surface.

***Figure 4.7*** *- Lifting of vertical mounted motors*

Always use the eyebolts mounted on the top side of the motor, diametrically opposite, considering the mounting position. See Figure 4.8.

***Figure 4.8*** *- Lifting of HGF motors*

#### 4.1.3.1. Procedures to place W22 motors in the vertical position

For safety reasons during the transport, vertical mounted Motors are usually packed and supplied in horizontal position.
To place W22 motors fitted with eyebolts (see Figure 4.6), to the vertical position, proceed as follows:

1. Ensure that the eyebolts are tightened properly, as shown in Figure 4.1;
2. Remove the motor from the packaging, using the top mounted eyebolts, as shown in Figure 4.9;

***Figure 4.9*** *- Removing the motor from the packaging*

3. Install a second pair of eyebolts, as shown in Figure 4.10;

***Figure 4.10*** *- Installation of the second pair of eyebolts*

4. Reduce the load on the first pair of eyebolts to start the motor rotation, as shown in Figure 4.11. This procedure must be carried out slowly and carefully.

***Figure 4.11*** *- End result: motor placed in vertical position*



These procedures will help you to move motors designed for vertical mounting. These procedures are also used to place the motor from the horizontal position into the vertical position and vertical to horizontal.

### 4.1.3.2. Procedures to place HGF motors in the vertical position

HGF motors are fitted with eight lifting points: four at drive end and four at non-drive end. The HGF motors are usually transported in horizontal position, however for the installation they must be placed in the vertical position.
To place an HGF motor in the vertical position, proceed as follows:

1. Lift the motor by using the four lateral eyebolts and two hoists, see Figure 4.12;

***Figure 4.12*** *- Lifting HGF motor with two hoists*

2. Lower the hoist fixed to motor drive end while lifting the hoist fixed to motor non-drive end until the motor reaches its equilibrium, see Figure 4.13;

***Figure 4.13*** *- Placing HGF motor in vertical position*

3. Remove the hoist hooks from the drive end eyebolts and rotate the motor 180° to fix the removed hooks into the two eyebolts at the motor non-drive end, see Figure 4.14;

***Figure 4.14*** *- Lifting HGF motors by the eyebolts at the non-drive end*

4. Fix the removed hoist hooks in the other two eyebolts at the non-drive end and lift the motor until the vertical position is reached, see Figure 4.15.

***Figure 4.15*** *- HGF motor in the vertical position*

These procedures will help you to move motors designed for vertical mounting. These procedures are also used to place the motor from the horizontal position into the vertical position and vertical to horizontal.

## 4.2 Procedures to place W22 vertical mount motors in horizontal position

To place W22 vertical mount motor in horizontal position, proceed as follows:

1. Ensure that all eyebolts are tightened properly, as shown in Figure 4.1;

2. Install the first pair of eyebolts and lift the motor as shown in Figure 4.16;

***Figure 4.16 -*** *Install the first pair of eyebolts*

3. Install the second pair of eyebolts, as shown in Figure 4.17;

***Figure 4.17 -*** *Install the second pair of eyebolts*

4. Reduce the load on the first pair of eyebolts for rotating the motor, as shown in Figure 4.18. This procedure must be carried out slowly and carefully;

***Figure 4.18 -*** *Motor is being rotated to horizontal position*

5. Remove the first pair of eyebolts, as shown in Figure 4.19.

***Figure 4.19 -*** *Final result: motor placed in horizontal position*

# 5. STORAGE

If the motor is not installed immediately, it must be stored in a dry and clean environment, with relative humidity not exceeding 60%, with an ambient temperature between 5 °C and 40 °C, without sudden temperature changes, free of dust, vibrations, gases or corrosive agents. The motor must be stored in horizontal position, unless specifically designed for vertical operation, without placing objects on it. Do not remove the protection grease from shaft end to prevent rust.

If the motor are fitted with space heaters, they must always be turned on during the storage period or when the installed motor is out of operation. Space heaters will prevent water condensation inside the motor and keep the winding insulation resistance within acceptable levels. Store the motor in such position that the condensed water can be easily drained. If fitted, remove pulleys or couplings from the shaft end (more information are given on item 6).

The space heaters should never be energized when the motor is in operation.

## 5.1. EXPOSED MACHINED SURFACES

All exposed machined surfaces (like shaft end and flange) are factory-protected with temporary rust inhibitor. A protective film must be reapplied periodically (at least every six months), or when it has been removed and/or damaged.

## 5.2. STORAGE

The stacking height of the motor packaging during the storage period should not exceed 5 m, always considering the criteria indicated in Table 5.1:

***Table 5.1*** *- Max. recommended stacking height*

| Packaging type | Frame sizes | Maximum stacking quantity |
|---|---|---|
| **Cardboard box** | IEC 63 to 132<br>NEMA 143 to 215 | Indicated on the top side of the cardboard box |
| **Wood crate** | IEC 63 to 315<br>NEMA 48 to 504/5 | 06 |
| | IEC 355<br>NEMA 586/7 and 588/9 | 03 |
| | HGF IEC 315 to 630<br>HGF NEMA 5000 to 9600 | Indicated on the packaging |

***Notes****:*
*1) Never stack larger packaging onto smaller packaging;*
*2) Align the packaging correctly (see Figure 5.1 and Figure 5.2);*

***Figure 5.1*** *- Correct stacking*

***Figure 5.2*** *- Incorrect stacking*

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*3) The feet of the crates above should always be supported by suitable wood battens (Figure 5.3) and never stand on the steel tape or without support (Figure 5.4);*

*Figure 5.3 - Correct stacking*

*Figure 5.4 - Incorrect stacking*

*4) When stacking smaller crates onto longer crates, always ensure that suitable wooden supports are provided to withstand the weight (see Figure 5.5). This condition usually occurs with motor packaging above IEC 225S/M (NEMA 364/5T) frame sizes.*

***Figure 5.5** - Use of additional battens for stacking*



## 5.3 BEARINGS

### 5.3.1 Grease lubricated bearings

We recommend rotating the motor shaft at least once a month (by hand, at least five revolutions, stopping the shaft at a different position from the original one). If the motor is fitted with shaft locking device, remove it before rotating the shaft and install it again before performing any handling procedure. Vertical motors may be stored in the vertical or in horizontal position. If motors with open bearings are stored longer than six months, the bearings must be relubricated according to item 8.2 before commissioning of the motor.
If the motor is stored for longer than 2 years, the bearings must be replaced or removed, washed, inspected and relubricated according to item 8.2.

### 5.3.2 Oil lubricated bearings

The motor must be stored in its original operating position and with oil in the bearings. Correct oil level must be ensured. It should be in the center of the sight glass.
During the storage period, remove the shaft locking device and rotate the shaft by hand every month, at least five revolutions, thus achieving an even oil distribution inside the bearing and maintaining the bearing in good operating conditions. Reinstall the shaft locking device every time the motor has to be moved.
If the motor is stored for a period of over six months, the bearings must be relubricated according to Item 8.2 before starting the operation. If the motor is stored for a period of over two years, the bearings must be replaced or removed, washed according to manufacturer instructions, checked and relubricated according to Item 8.2. The oil of vertical mounted motors that are transported in horizontal position is removed to prevent oils leaks during the transport. These motors must be stored in vertical position after receiving and the bearing must be lubricated.

### 5.3.3 Oil Mist lubricated bearings

The motor must be stored in horizontal position. Lubricate the bearings with ISO VG 68 mineral oil in the amount indicated in the Table 5.2 (this is also valid for bearings with equivalent dimensions). After filling with oil, rotate the shaft by hand, at least five revolutions)
During the storage period, remove the shaft locking device (if any) and rotate the shaft by hand every week, at least five revolutions, stopping it at a different position from the original one. Reinstall the shaft locking device every time the motor has to be moved. If the motor is stored for a period of over two years, the bearings must be replaced or removed, washed according to manufacturer instructions, checked and relubricated according to item 8.2.

***Table 5.2 -*** *Amount of oil per bearing*

| Bearing size | Amount of oil (ml) | Bearing size | Amount of oil (ml) |
|---|---|---|---|
| 6201 | 15 | 6309 | 65 |
| 6202 | 15 | 6311 | 90 |
| 6203 | 15 | 6312 | 105 |
| 6204 | 25 | 6314 | 150 |
| 6205 | 25 | 6315 | 200 |
| 6206 | 35 | 6316 | 250 |
| 6207 | 35 | 6317 | 300 |
| 6208 | 40 | 6319 | 350 |
| 6209 | 40 | 6320 | 400 |
| 6211 | 45 | 6322 | 550 |
| 6212 | 50 | 6324 | 600 |
| 6307 | 45 | 6326 | 650 |
| 6308 | 55 | 6328 | 700 |

The oil must always be removed when the motor has to be handled. If the oil mist system is not operating after installation, fill the bearings with oil to prevent bearing rusting. During the storage period, rotate the shaft by hand, at least five revolutions, stopping it at a different position from the original one. Before starting the motor, all bearing protection oil must be drained from the bearing and the oil mist system must be switched ON.

### 5.3.4 Sleeve bearing

The motor must be stored in its original operating position and with oil in the bearings. Correct oil level must be ensured. It should be in the middle of the sight glass. During the storage period, remove the shaft locking device and rotate the shaft by hand every month, at least five revolutions, and at 30 rpm, thus achieving an even oil distribution inside the bearing and maintaining the bearing in good operating conditions. Reinstall the shaft locking device every time the motor has to be moved.
If the motor is stored for a period of over six months, the bearings must be relubricated according to the Item 8.2 before starting the operation.

If the motor is stored for a period longer than the oil change interval, or if it is not possible to rotate the motor shaft by hand, the oil must be drained and a corrosion protection and dehumidifiers must be applied.

## 5.4. INSULATION RESISTANCE

We recommend measuring the winding insulation resistance at regular intervals to follow-up and evaluate its electrical operating conditions. If any reduction in the insulation resistance values are recorded, the storage conditions should be evaluated and corrected, where necessary.

### 5.4.1. Insulation resistance measurement

We recommend measuring the winding insulation resistance at regular intervals to follow-up and evaluate its electrical operating conditions. If any reduction in the insulation resistance values are recorded, the storage conditions should be evaluated and corrected, where necessary.

The insulation resistance must be measured in a safe environment.

The insulation resistance must be measured with a megohmmeter. The machine must be in cold state and disconnected from the power supply.

To prevent the risk of an electrical shock, ground the terminals before and after each measurement. Ground the capacitor (if any) to ensure that it is fully discharged before the measurement is taken.

It is recommended to insulate and test each phase separately. This procedure allows the comparison of the insulation resistance between each phase. During the test of one phase, the other phases must be grounded. The test of all phases simultaneously evaluates the insulation resistance to ground only but does not evaluate the insulation resistance between the phases.
The power supply cables, switches, capacitors and other external devices connected to the motor may considerably influence the insulation resistance measurement. Thus all external devices must be disconnected and grounded during the insulation resistance measurement.
Measure the insulation resistance one minute after the voltage has been applied to the winding. The applied voltage should be as shown in Table 5.3.

***Table 5.3*** *- Voltage for the insulation resistance*

| Winding rated voltage (V) | Testing voltage for measuring the insulation resistance (V) |
|---|---|
| < 1000 | 500 |
| 1000 - 2500 | 500 - 1000 |
| 2501 - 5000 | 1000 - 2500 |
| 5001 - 12000 | 2500 - 5000 |
| > 12000 | 5000 - 10000 |

The reading of the insulation resistance must be corrected to 40 °C as shown in the Table 5.4.

***Table 5.4*** *- Correction factor for the insulation resistance corrected to 40 °C*

| Measuring temperature of the insulation resistance (°C) | Correction factor of the insulation resistance corrected to 40 °C | Measuring temperature of the insulation resistance (°C) | Correction factor of the insulation resistance corrected to 40 °C |
|---|---|---|---|
| 10 | 0.125 | 30 | 0.500 |
| 11 | 0.134 | 31 | 0.536 |
| 12 | 0.144 | 32 | 0.574 |
| 13 | 0.154 | 33 | 0.616 |
| 14 | 0.165 | 34 | 0.660 |
| 15 | 0.177 | 35 | 0.707 |
| 16 | 0.189 | 36 | 0.758 |
| 17 | 0.203 | 37 | 0.812 |
| 18 | 0.218 | 38 | 0.871 |
| 19 | 0.233 | 39 | 0.933 |
| 20 | 0.250 | 40 | 1.000 |
| 21 | 0.268 | 41 | 1.072 |
| 22 | 0.287 | 42 | 1.149 |
| 23 | 0.308 | 43 | 1.231 |
| 24 | 0.330 | 44 | 1.320 |
| 25 | 0.354 | 45 | 1.414 |
| 26 | 0.379 | 46 | 1.516 |
| 27 | 0.406 | 47 | 1.625 |
| 28 | 0.435 | 48 | 1.741 |
| 29 | 0.467 | 49 | 1.866 |
| 30 | 0.500 | 50 | 2.000 |

The motor insulation condition must be evaluated by comparing the measured value with the values indicated in Table 5.5 (corrected to 40 °C):

***Table 5.5*** *- Evaluation of the insulation system*

| Limit value for rated voltage up to 1.1 kV (MΩ) | Limit value for rated voltage above 1.1 kV (MΩ) | Situation |
|---|---|---|
| Up to 5 | Up to 100 | Dangerous. The motor can not be operated in this condition |
| 5 to 100 | 100 to 500 | Regular |
| 100 to 500 | Higher than 500 | Good |
| Higher than 500 | Higher than 1000 | Excellent |

The values indicated in the table should be considered only as reference values. It is advisable to log all measured values to provide a quick and easy overview on the machine insulation resistance.
If the insulation resistance is low, moisture may be present in the stator windings. In this case the motor should be removed and transported to a WEG authorized Service Center for proper evaluation and repair (This service is not covered by the warranty). To improve the insulation resistance through the drying process, see section 8.4.

# 6. INSTALLATION

The insulation resistance must be measured in a safe environment.

Check some aspects before proceeding with the installation:

1. Insulation resistance: must be within the acceptable limits. See item 5.4.
2. Bearings:
   a. Rolling bearings: oxidized bearings must be replaced. If no oxidation is detected, lubricate the bearings as described in Item 8.2. If the motor is stored for a period of over two years, the bearings must be replaced before starting the motor;
   b. Sleeve bearing: if sleeve bearing motors are stored longer than the recommended oil change interval, the oil must be changed before machine starting. Don't forget to remove the dehumidifiers when you drain the oil from the motor and to fill it again with new oil before starting the machine. For more details, see item 8.2.
3. Operating conditions of the start capacitors: If single-phase motors are stored for a period of over two years, it is recommended to change the start capacitors before motor starting since they lose their operating characteristics.
4. Terminal box:
   a. the inside of the terminal box must be clean and dry;
   b. the contacts must be correctly connected and corrosion free. See 6.9 and 6.10;
   c. the cable entries must be correctly sealed and the terminal box cover properly mounted in order to ensure the degree of protection indicated on the motor nameplate.
5. Cooling: the cooling fins, air inlet and outlet openings must be clean and unobstructed. The distance between the air inlet openings and the wall should not be shorter than ¼ (one quarter) of the diameter of the air inlet. Ensure sufficient space to perform the cleaning services. See item 7.
6. Coupling: remove the shaft locking device (where fitted) and the corrosion protection grease from the shaft end and flange just before installing the motor. See item 6.4.
7. Drain hole: the motor must always be positioned so the drain hole is at the lowest position (If there is any indication arrow on the drain, the drain must be so installed that the arrow points downwards).
   Motors supplied with rubber drain plugs leave the factory in the closed position and must be opened periodically to allow the exit of condensed water. For environments with high water condensation levels and motor with degree of protection IP55, the drain plugs can be mounted in open position (see Figure 6.1).
   For motors with degree of protection IP56, IP65 or IP66, the drain plugs must remain at closed position (see Figure 6.1), being opened only during the motor maintenance procedures.
   The drain system of motors with Oil Mist lubrication system must be connected to a specific collection system (see Figure 6.12).

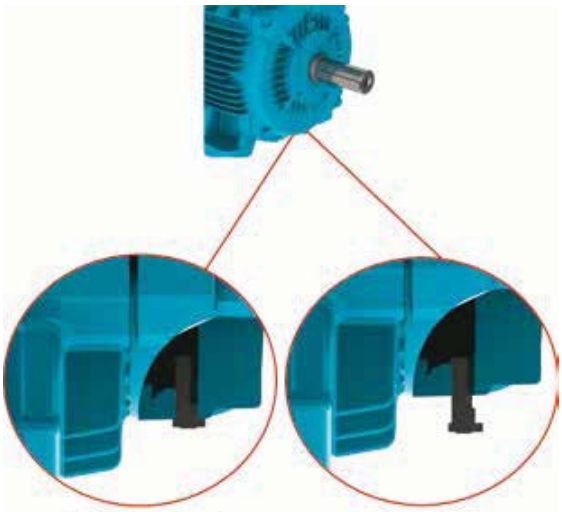



***Figure 6.1*** *- Detail of the rubber drain plug mounted in closed and open position*

8.Additional recommendations:
a. Check the direction of motor rotation, starting the motor at no-load before coupling it to the load;
b. Vertical mounted motors with shaft end down must be fitted with drip cover to protect them from liquids or solids that may drop onto the motors;
c. Vertical mounted motors with shaft end up must be fitted with water slinger ring to prevent water penetration inside the motor.

Remove or fix the shaft key before starting the motor.

## 6.1. FOUNDATIONS

The foundation is the structure, structural element, natural or prepared base, designed to withstand the stresses produced by the installed equipment, ensuring safe and stable performance during operation. The foundation design should consider the adjacent structures to avoid the influences of other installed equipment and no vibration is transferred through the structure

The foundation must be flat and its selection and design must consider the following characteristics:

a) The features of the machine to be installed on the foundation, the driven loads, application, maximum allowed deformations and vibration levels (for instance, motors with reduced vibration levels, foot flatness, flange concentricity, axial and radial loads, etc. lower than the values specified for standard motors).

b) Adjacent buildings, conservation status, maximum applied load estimation, type of foundation and fixation and vibrations transmitted by theses constructions.

If the motor is supplied with leveling/alignment bolts, this must be considered in the base design.

Please consider for the foundation dimensioning all stresses that are generated during the operation of the driven load.
The user is responsible for the foundation designing and construction.

The foundation stresses can be calculated by using the following equations (see Figure 6.2):

$$F_1 = 0,5 * g * m - (4 * T_b / A)$$
$$F_2 = 0,5 * g * m + (4 * T_b / A)$$

Where:

$F_1$ and $F_2$ = lateral stresses (N);
g = gravitational acceleration (9,8 m/s$^2$);
m = motor weight (kg);
$T_b$ = breakdown torque (Nm);
A = distance between centerlines of mounting holes in feet or base of the machine (end view) (m).

The motors may be mounted on:
- Concrete bases: are most used for large-size motors (see Figure 6.2);
- Metallic bases: are generally used for small-size motors (see Figure 6.3).

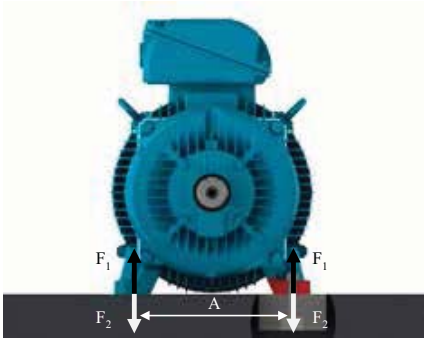



***Figure 6.2*** *- Motor installed on concrete base*

***Figure 6.3*** *- Motor installed on metallic base*

The metallic and concrete bases may be fitted with sliding system. These types of foundations are generally used where the power transmission is achieved by belts and pulleys. This power transmission system is easier to assemble/disassemble and allows the belt tension adjustment. Other important aspect of this foundation type is the location of the base locking screws that must be diagonally opposite. The rail nearest the drive pulley is placed in such a way that the positioning bolt is between the motor and the driven machine. The other rail must be placed with the bolt on the opposite side (diagonally opposite), as shown in Figure 6.4 .

To facilitate assembly, the bases may have the following features:
- Shoulders and/or recesses;
- Anchor bolts with loose plates;
- Bolts cast in the concrete;
- Leveling screws;
- Positioning screws;
- Steel & cast iron blocks, plates with flat surfaces.

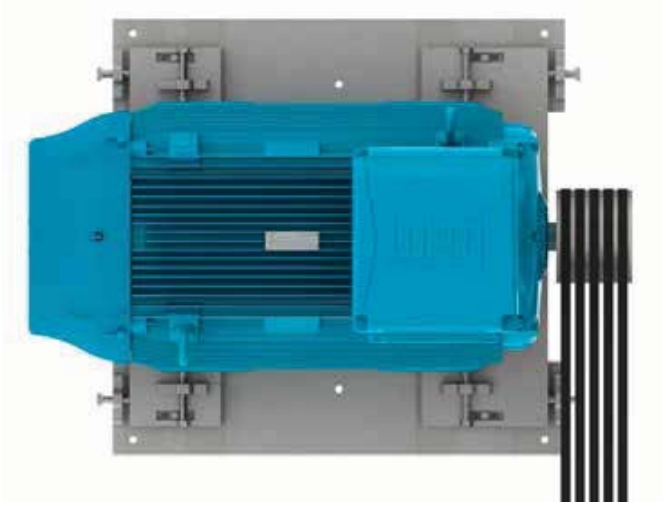


***Figure 6.4*** *- Motor installed on sliding base*

After completing the installation, it is recommended that all exposed machined surfaces are coated with suitable rust inhibitor.

## 6.2. MOTOR MOUNTING

Footless motors supplied with transportation devices, according to Figure 6.5, must have their devices removed before starting the motor installation.

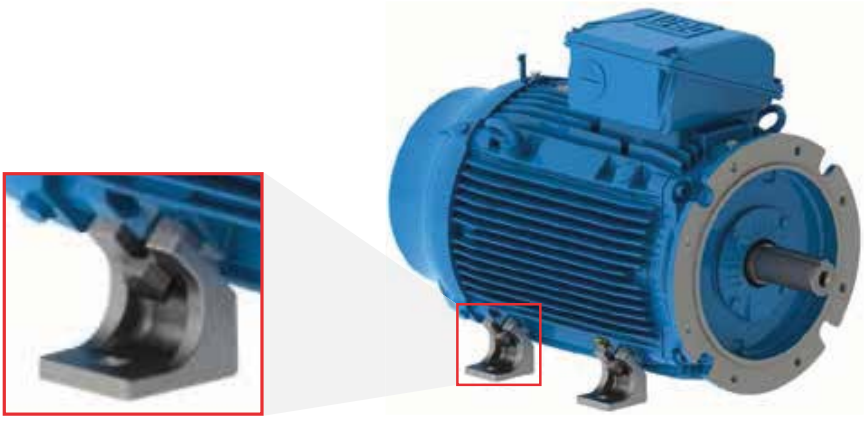


***Figure 6.5*** *- Detail of the transportation devices for footless motors*

### 6.2.1. Foot mounted motors

The drawings of the mounting hole dimensions for NEMA or IEC motors can be checked in the respective technical catalogue.
The motor must be correctly aligned and leveled with the driven machine. Incorrect alignment and leveling may result in bearing damage, generate excessive vibration and even shaft distortion/breakage.
For more details, see section 6.3 and 6.6. The thread engagement length of the mounting bolt should be at least 1.5 times the bolt diameter. This thread engagement length should be evaluated in more severe applications and increased accordingly.
Figure 6.6 shows the mounting system of a foot mounted motor indicating the minimum required thread engagement length.

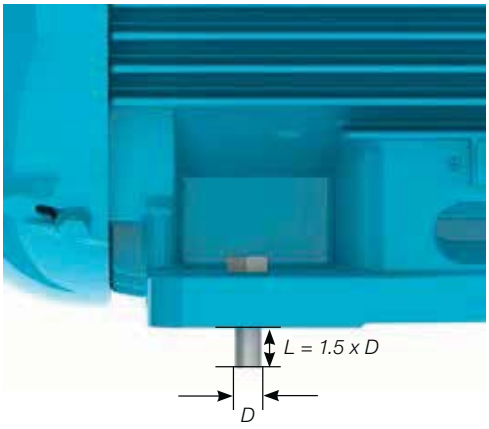



***Figure 6.6*** *- Mounting system of a foot mounted motor*

### 6.2.2. Flange mounted motors

The drawings of the flange mounting dimensions, IEC and NEMA flanges, can be checked in the technical catalogue.
The coupling of the driven equipment to the motor flange must be properly dimensioned to ensure the required concentricity of the assembly.
Depending on the flange type, the mounting can be performed from the motor to the driven equipment flange (flange FF (IEC) or D (NEMA)) or from the driven equipment flange to the motor (flange C (DIN or NEMA)).
For the mounting process from the driven equipment flange to the motor, you must consider the bolt length, flange thickness and the thread depth of the motor flange.

If the motor flange has tapped through-holes, the length of the mounting bolts must not exceed the tapped through-hole length of the motor flange, thus preventing damage to the winding head.

For flange mounting the thread engagement length of the mounting bolt should be at least 1.5 times the bolt diameter. In severe applications, longer thread engagement length may be required.
In severe applications or if large motors are flange mounted, a foot or pad mounting may be required in addition to the flange mounting (Figure 6.7). The motor must never be supported on its cooling fins.

***Figure 6.7*** *- Mounting method of flange mounted motors with frame base support*

***Note**:*
*When liquid (for example oil) is likely to come into contact with the shaft seal, please contact your local WEG representative.*

### 6.2.3. Pad mounted motors

Typically, this method of mounting is used in axial fans. The motor is fixed by tapped holes in the frame. The dimensions of these tapped holes can be checked in the respective product catalogue. The selection of the motor mounting rods/bolts must consider the dimensions of the fan case, the installation base and the thread depth in the motor frame.
The mounting rods and the fan case wall must be sufficiently stiff to prevent the transmission of excessive vibration to the machine set (motor & fan). Figure 6.8 shows the pad mounting system.

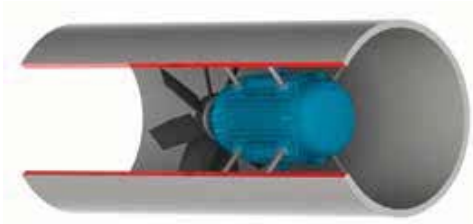


***Figure 6.8*** *- Mounting of the motor inside the cooling duct*

## 6.3. BALANCING

Unbalanced machines generate vibration which can result in damage to the motor. WEG motors are dynamically balanced with “half key” and without load (uncoupled). Special balancing quality level must be stated in the Purchase Order.

The transmission elements, such as pulleys, couplings, etc., must balanced with “half key” before they are mounted on the motor shaft.

The balance quality grade meets the applicable standards for each product line.

The maximum balancing deviation must be recorded in the installation report.

## 6.4. COUPLINGS

Couplings are used to transmit the torque from the motor shaft to the shaft of the driven machine. The following aspects must be considered when couplings are installed:

- Use proper tools for coupling assembly & disassembly to avoid damages to the motor and bearings;
- Whenever possible, use flexible couplings, since they can absorb eventual residual misalignments during the machine operation;
- The maximum loads and speed limits informed in the coupling and motor manufacturer catalogues cannot be exceeded;
- Level and align the motor as specified in sections 6.5 and 6.6, respectively.

Remove or fix the shaft key firmly when the motor is operated without coupling in order to prevent accidents.

### 6.4.1. Direct coupling

Direct coupling is characterized when the Motor shaft is directly coupled to the shaft of the driven machine without transmission elements. Whenever possible, use direct coupling due to lower cost, less space required for installation and more safety against accidents.

Do not use roller bearings for direct coupling, unless sufficient radial load is expected.

### 6.4.2. Gearbox coupling

Gearbox coupling is typically used where speed reduction is required.
Make sure that shafts are perfectly aligned and strictly parallel (in case of straight spur gears) and in the right meshing angle (in case of bevel and helical gears).

### 6.4.3. Pulley and belt coupling

Pulleys and belts are used when speed increase or reduction between motor shaft and driven load is required.

Excessive belt tension will damage the bearings and cause unexpected accidents such as breakage of the motor shaft.

### 6.4.4. Coupling of sleeve bearing motors

Motors designed with sleeve bearings must be operated with direct coupling to the driven machine or a gearbox. Pulley and belts can not be applied for sleeve bearing motors.

Motors designed with sleeve bearings have 3 (three) marks on the shaft end. The center mark is the indication of the magnetic center and the 2 (two) outside marks indicate the allowed limits of the rotor axial movement, as shown in Figure 6.9.
The motor must be so coupled that during operation the arrow on the frame is placed over the central mark indicating the rotor magnetic center. During start-up, or even during operation, the rotor may freely move between the two outside marks when the driven machine exerts an axial load on the motor shaft. However, under no circumstance, the motor can operate continuously with axial forces on the bearing.

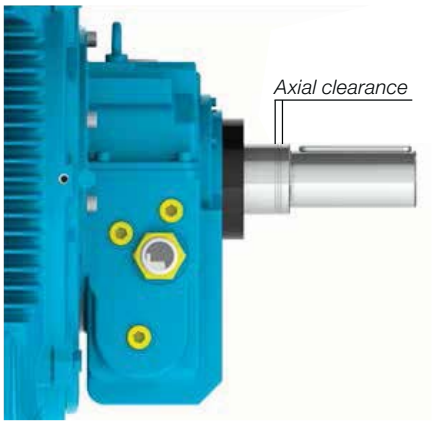



***Figure 6.9*** *- Axial clearance of motor designed with sleeve bearing*

For coupling evaluation consider the maximum axial bearing clearance as shown in Table 6.1.
The axial clearance of the driven machine and coupling influence the maximum bearing clearance.

***Table 6.1*** *- Clearance used for sleeve bearings*

| Bearing size | Total axial clearance (mm) |
|---|---|
| 9* | 3 + 3 = 6 |
| 11* | 4 + 4 = 8 |
| 14* | 5 + 5 =10 |
| 18 | 7,5 + 7,5 = 15 |

** For Motors in accordance with API 541, the total axial clearance is 12.7 mm*

The sleeve bearings used by WEG were not designed to support axial load continuously.
Under no circumstance must the motor be operated continuously at its axial clearance limits.

## 6.5. LEVELING

The motor must be leveled to correct any deviations in flatness arising from the manufacturing process and the material structure rearrangement. The leveling can be carried out by a leveling screw fixed on the motor foot or on the flange or by means of thin compensation shims. After the leveling process, the leveling height between the motor mounting base and the motor cannot exceed 0.1 mm.
If a metallic base is used to level the height of the motor shaft end and the shaft end of the driven machine, level only the metallic base relating to the concrete base.

Record the maximum leveling deviations in the installation report.

## 6.6. ALIGNMENT

The correct alignment between the motor and the driven machine is one of the most important variables that extends the useful service life of the motor. Incorrect coupling alignment generates high loads and vibrations reducing the useful life of the bearings and even resulting in shaft breakages. Figure 6.10 illustrates the misalignment between the motor and the driven machine.

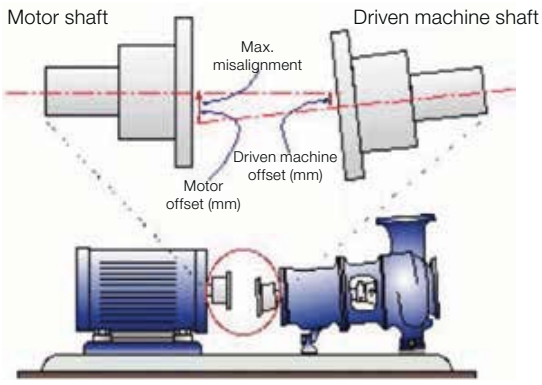



***Figure 6.10*** *- Typical misalignment condition*

Alignment procedures must be carried out using suitable tools and devices, such as dial gauge, laser alignment instruments, etc.. The motor shaft must be aligned axially and radially with the driven machine shaft.

The maximum allowed eccentricity for a complete shaft turn should not exceed 0.03 mm, when alignment is made with dial gauges, as shown in Figure 6.11. Ensure a gap between couplings to compensate the thermal expansion between the s*Dial gauge* specified by the coupling manufacturer.

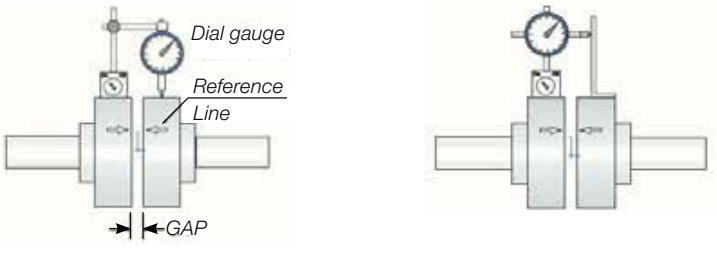



***Figure 6.11*** *- Alignment with dial gauge*

If alignment is made by a laser instrument, please consider the instructions and recommendations provided by the laser instrument manufacturer.
The alignment should be checked at ambient temperature with machine at operating temperature.

The coupling alignment must be checked periodically.

Pulley and belt couplings must be so aligned that the driver pulley center lies in the same plane of the driven pulley center and the motor shaft and the shaft of the driven machine are perfectly parallel.
After completing the alignment procedures, ensure that mounting devices do not change the motor and machine alignment and leveling resulting into machine damage during operation.

It is recommended to record the maximum alignment deviation in the Installation Report.

## 6.7. CONNECTION OF OIL LUBRICATED OR OIL MIST LUBRICATED MOTORS

When oil lubricated or oil mist lubricated motors are installed, connect the existing lubricant tubes (oil inlet and oil outlet tubes and motor drain tube), as shown in Figure 6.12. The lubrication system must ensure continuous oil flow through the bearings as specified by the manufacturer of the installed lubrication system.

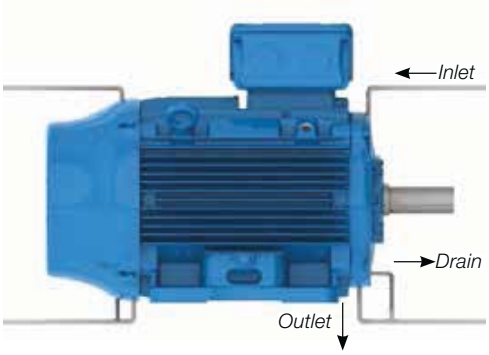



***Figure 6.12*** *- Oil supply and drain system of oil lubricated or oil mist lubricated motors*

## 6.8. CONNECTION OF THE COOLING WATER SYSTEM

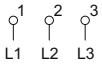
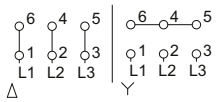
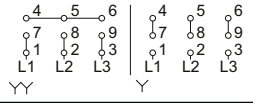
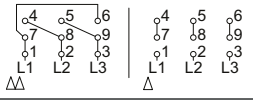
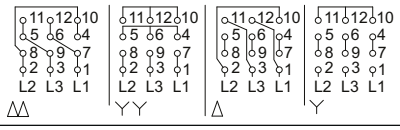
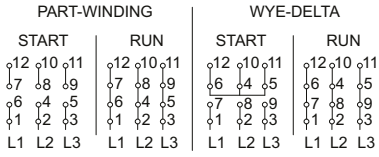
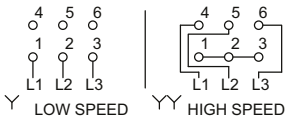
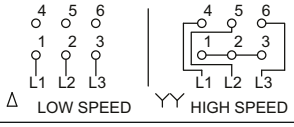
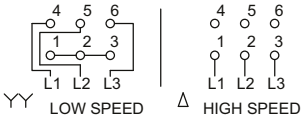
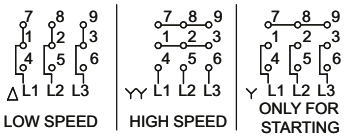
When water cooled motors are installed, connect the water inlet and outlet tubes to ensure proper motor cooling. According to item 7.2, ensure correct cooling water flow rate and water temperature in the motor cooling system.

## 6.9. ELECTRICAL CONNECTION

Consider the rated motor current, service factor, starting current, environmental and installation conditions, maximum voltage drop, etc. to select appropriate power supply cables and switching and protection devices. All motors must be installed with overload protection systems. Three-phase motors should be fitted with phase fault protection systems.

Before connecting the motor, check if the power supply voltage and the frequency comply with the motor nameplate data. All wiring must be made according to the connection diagram on the motor nameplate. Please consider the connection diagrams in the Table 6.2 as reference value.
To prevent accidents, check if motor has been solidly grounded in accordance with the applicable standards.

*Table 6.2 - Typical connection diagram for three-phase motors.*

| Configuration | Quantity of leads | Type of connection | Connection diagram |
|---|---|---|---|
| Single speed | 3 | - |  |
| | 6 | Δ - Y |  |
| | 9 | YY - Y |  |
| | | ΔΔ - Δ |  |
| | 12 | ΔΔ - YY - Δ - Y |  |
| | | Δ - PWS<br>Part-winding start |  |
| Double speed<br>Dahlander | 6 | YY - Y<br>Variable Torque |  |
| | | Δ - YY<br>Constant Torque |  |
| | | YY - Δ<br>Constant Output |  |
| | 9 | Δ - Y - YY |  |
| Double speed<br>Double winding | 6 | - | |

| Equivalent table for lead identification | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lead identification on the wiring diagram** | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| Single speed | NEMA MG 1 Part 2 | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 | T11 | T12 |
| | IEC 60034-8 | U1 | V1 | W1 | U2 | V2 | W2 | U3 | V3 | W3 | U4 | V4 | W4 |
| | JIS (JEC 2137) - up to 6 terminals | U | V | W | X | Y | Z | | | | | | |
| | JIS (JEC 2137) - above 6 terminals | U1 | V1 | W1 | U2 | V2 | W2 | U5 | V5 | W5 | U6 | V6 | W6 |
| Double speed (Dahlander / Double winding) | NEMA MG 1 Part 2[1)] | 1U | 1V | 1W | 2U | 2V | 2W | 3U | 3V | 3W | 4U | 4V | 4W |
| | IEC 60034-8 | 1U | 1V | 1W | 2U | 2V | 2W | 3U | 3V | 3W | 4U | 4V | 4W |
| | JIS (JEC 2137) | 1U | 1V | 1W | 2U | 2V | 2W | 3U | 3V | 3W | 4U | 4V | 4W |

*1) NEMA MG 1 Part 2 defines T1 to T12 for two or more winding, however WEG adopts 1U to 4W.*

If motors are supplied without terminal blocks, insulate the cable terminals with suitable insulation material that meets the power supply voltage and the insulation class indicated on the motor nameplate.

Ensure correct tightening torque for the power cable and grounding connections as specified in Table 8.7

The clearance distance (see Figure 6.13) between non-insulated live parts with each other and between grounded parts must be as indicated in Table 6.3.

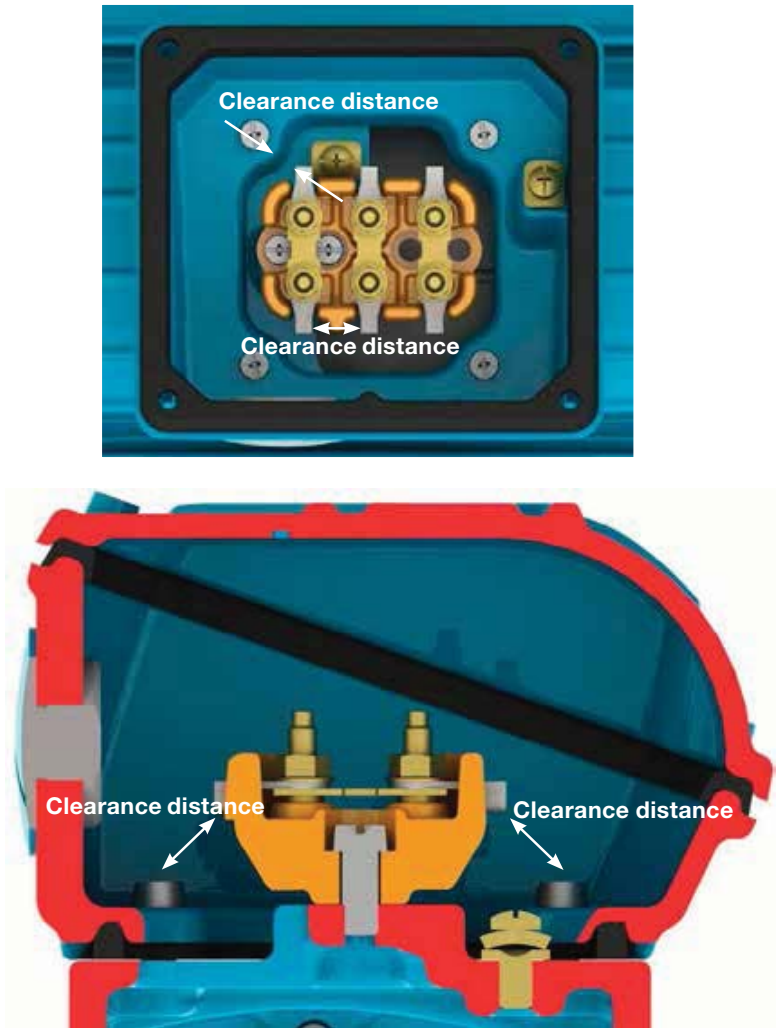



***Figure 6.13*** *- Clearance distance representation*

***Table 6.3*** *- Minimum clearance distance (mm) x supply voltage*

| Voltage | Minimum clearance distance (mm) |
|---|---|
| U ≤ 440 V | 4 |
| 440 < U ≤ 690 V | 5.5 |
| 690 < U ≤ 1000 V | 8 |
| 1000 < U ≤ 6900 V | 45 |
| 6900 < U ≤ 11000 V | 70 |
| 11000 < U ≤ 16500 V | 105 |

Even when the motor is off, dangerous voltages may be present inside the terminal box used for the space heater supply or winding energization when the winding is used as heating element.
Motor capacitors will hold a charge even after the power has been cut off. Do not touch the capacitors and/or motor terminals, before discharging the capacitors completely.

After the motor connection has been completed, ensure that no tool or foreign body has been left inside the terminal box.

Unused cable inlet holes in the terminal box must be properly closed to ensure the degree of protection indicated on the motor nameplate.
The cable inlets used for power supply and control must be fitted with components (for example, cable-glands and conduits) that meet the applicable standards and regulations in each country.

If the motor is fitted with accessories, such as brakes and forced cooling systems, these devices must be connected to the power supply according to the information provided on their nameplates and with special care as indicated above.

All protection devices, including overcurrent protection, must be set according to the rated machine conditions. These protection devices must protect the machine against short circuit, phase fault or locked rotor condition. The motor protection devices must be set according to the applicable standards.

Check the direction of rotation of the motor shaft. If there is no limitation for the use of unidirectional fans, the shaft rotation direction can be changed by reversing any two of the phase connections. For single-phase motor, check the connection diagram indicated on the motor nameplate.

## 6.10. CONNECTION OF THE THERMAL PROTECTION DEVICES

If the motor is supplied with temperature monitoring devices, such as, thermostat, thermistors, automatic thermal protectors, Pt-100 (RTD), etc., they must be connected to the corresponding control devices as specified on the accessory nameplates. The non-compliance with this procedure may void the product warranty and cause serious material damages.

Do not apply test voltage above 2.5 V on thermistors and current above 1 mA on RTDs (Pt-100) according to IEC 60751 standard.

Figure 6.14 and Figure 6.15 show the connection diagram of the bimetal thermal protector (thermostats) and thermistors, respectively.

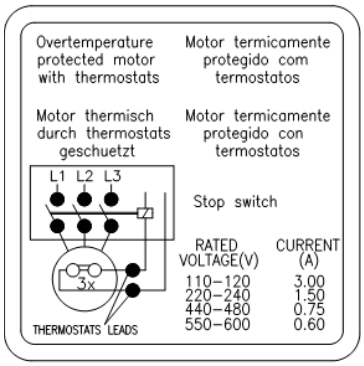



***Figure 6.14*** *- Connection of the bimetal thermal protectors (thermostats)*

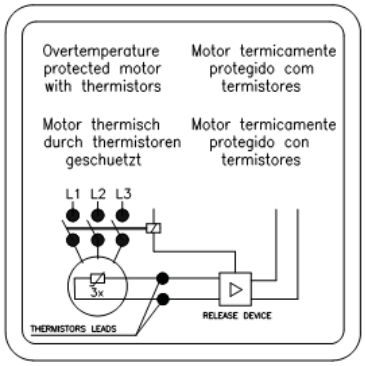



***Figure 6.15*** *- Thermistor connection*

The alarm temperature limits and thermal protection shutdowns can be defined according to the application; however these temperature limits can not exceed the values in Table 6.4.

***Table 6.4*** *- Maximum activation temperature of the thermal protections*

| Component | Insulation class | Maximum temperature of the protection setting (°C) | |
|---|---|---|---|
| | | Alarm | Tripping |
| Winding | B | - | 130 |
| | F | 130 | 155 |
| | H | 155 | 180 |
| Bearing | All | 110 | 120 |

***Notes****:*
*1) The number and type of the installed protection devices are stated on the accessory nameplate of the motor.*
*2) If the motor is supplied with calibrated resistance, (for example, Pt-100), the motor protection system must be set according to the operating temperatures indicated in Table 6.4.*

## 6.11. RESISTANCE TEMPERATURE DETECTORS (PT-100)

The thermocouples Pt-100 are made of materials, whose resistance depends on the temperature variation, intrinsic property of some materials (usually platinum, nickel or copper), calibrated resistance. Its operation is based on the principle that the electric resistance of a metallic conductor varies linearly with the temperature, thus allowing a continuous monitoring of the motor warm-up through the controller display ensuring a high level of precision and answer stability. These devices are widely used for measuring temperatures in various industry sectors.
In general these devices are used in installations where precise temperature control is required, for example, in installation for irregular or intermittent duty.
The same detector may be used for alarm and tripping purposes.

Table 6.5 and Figure 6.16 show the equivalence between the Pt-100 resistance and the temperature.

*Table 6.5 - Equivalence between the Pt-100 resistance and the temperature*

| °C | Ω | °C | Ω | °C | Ω | °C | Ω | °C | Ω |
|---|---|---|---|---|---|---|---|---|---|
| -29 | 88.617 | 17 | 106.627 | 63 | 124.390 | 109 | 141.908 | 155 | 159.180 |
| -28 | 89.011 | 18 | 107.016 | 64 | 124.774 | 110 | 142.286 | 156 | 159.553 |
| -27 | 89.405 | 19 | 107.404 | 65 | 125.157 | 111 | 142.664 | 157 | 159.926 |
| -26 | 89.799 | 20 | 107.793 | 66 | 125.540 | 112 | 143.042 | 158 | 160.298 |
| -25 | 90.193 | 21 | 108.181 | 67 | 125.923 | 113 | 143.420 | 159 | 160.671 |
| -24 | 90.587 | 22 | 108.570 | 68 | 126.306 | 114 | 143.797 | 160 | 161.043 |
| -23 | 90.980 | 23 | 108.958 | 69 | 126.689 | 115 | 144.175 | 161 | 161.415 |
| -22 | 91.374 | 24 | 109.346 | 70 | 127.072 | 116 | 144.552 | 162 | 161.787 |
| -21 | 91.767 | 25 | 109.734 | 71 | 127.454 | 117 | 144.930 | 163 | 162.159 |
| -20 | 92.160 | 26 | 110.122 | 72 | 127.837 | 118 | 145.307 | 164 | 162.531 |
| -19 | 92.553 | 27 | 110.509 | 73 | 128.219 | 119 | 145.684 | 165 | 162.903 |
| -18 | 92.946 | 28 | 110.897 | 74 | 128.602 | 120 | 146.061 | 166 | 163.274 |
| -17 | 93.339 | 29 | 111.284 | 75 | 128.984 | 121 | 146.438 | 167 | 163.646 |
| -16 | 93.732 | 30 | 111.672 | 76 | 129.366 | 122 | 146.814 | 168 | 164.017 |
| -15 | 94.125 | 31 | 112.059 | 77 | 129.748 | 123 | 147.191 | 169 | 164.388 |
| -14 | 94.517 | 32 | 112.446 | 78 | 130.130 | 124 | 147.567 | 170 | 164.760 |
| -13 | 94.910 | 33 | 112.833 | 79 | 130.511 | 125 | 147.944 | 171 | 165.131 |
| -12 | 95.302 | 34 | 113.220 | 80 | 130.893 | 126 | 148.320 | 172 | 165.501 |
| -11 | 95.694 | 35 | 113.607 | 81 | 131.274 | 127 | 148.696 | 173 | 165.872 |
| -10 | 96.086 | 36 | 113.994 | 82 | 131.656 | 128 | 149.072 | 174 | 166.243 |
| -9 | 96.478 | 37 | 114.380 | 83 | 132.037 | 129 | 149.448 | 175 | 166.613 |
| -8 | 96.870 | 38 | 114.767 | 84 | 132.418 | 130 | 149.824 | 176 | 166.984 |
| -7 | 97.262 | 39 | 115.153 | 85 | 132.799 | 131 | 150.199 | 177 | 167.354 |
| -6 | 97.653 | 40 | 115.539 | 86 | 133.180 | 132 | 150.575 | 178 | 167.724 |
| -5 | 98.045 | 41 | 115.925 | 87 | 133.561 | 133 | 150.950 | 179 | 168.095 |
| -4 | 98.436 | 42 | 116.311 | 88 | 133.941 | 134 | 151.326 | 180 | 168.465 |
| -3 | 98.827 | 43 | 116.697 | 89 | 134.322 | 135 | 151.701 | 181 | 168.834 |
| -2 | 99.218 | 44 | 117.083 | 90 | 134.702 | 136 | 152.076 | 182 | 169.204 |
| -1 | 99.609 | 45 | 117.469 | 91 | 135.083 | 137 | 152.451 | 183 | 169.574 |
| 0 | 100.000 | 46 | 117.854 | 92 | 135.463 | 138 | 152.826 | 184 | 169.943 |
| 1 | 100.391 | 47 | 118.240 | 93 | 135.843 | 139 | 153.200 | 185 | 170.313 |
| 2 | 100.781 | 48 | 118.625 | 94 | 136.223 | 140 | 153.575 | 186 | 170.682 |
| 3 | 101.172 | 49 | 119.010 | 95 | 136.603 | 141 | 153.950 | 187 | 171.051 |
| 4 | 101.562 | 50 | 119.395 | 96 | 136.982 | 142 | 154.324 | 188 | 171.420 |
| 5 | 101.953 | 51 | 119.780 | 97 | 137.362 | 143 | 154.698 | 189 | 171.789 |
| 6 | 102.343 | 52 | 120.165 | 98 | 137.741 | 144 | 155.072 | 190 | 172.158 |
| 7 | 102.733 | 53 | 120.550 | 99 | 138.121 | 145 | 155.446 | 191 | 172.527 |
| 8 | 103.123 | 54 | 120.934 | 100 | 138.500 | 146 | 155.820 | 192 | 172.895 |
| 9 | 103.513 | 55 | 121.319 | 101 | 138.879 | 147 | 156.194 | 193 | 173.264 |
| 10 | 103.902 | 56 | 121.703 | 102 | 139.258 | 148 | 156.568 | 194 | 173.632 |
| 11 | 104.292 | 57 | 122.087 | 103 | 139.637 | 149 | 156.941 | 195 | 174.000 |
| 12 | 104.681 | 58 | 122.471 | 104 | 140.016 | 150 | 157.315 | 196 | 174.368 |
| 13 | 105.071 | 59 | 122.855 | 105 | 140.395 | 151 | 157.688 | 197 | 174.736 |
| 14 | 105.460 | 60 | 123.239 | 106 | 140.773 | 152 | 158.061 | 198 | 175.104 |
| 15 | 105.849 | 61 | 123.623 | 107 | 141.152 | 153 | 158.435 | 199 | 175.472 |
| 16 | 106.238 | 62 | 124.007 | 108 | 141.530 | 154 | 158.808 | 200 | 175.840 |

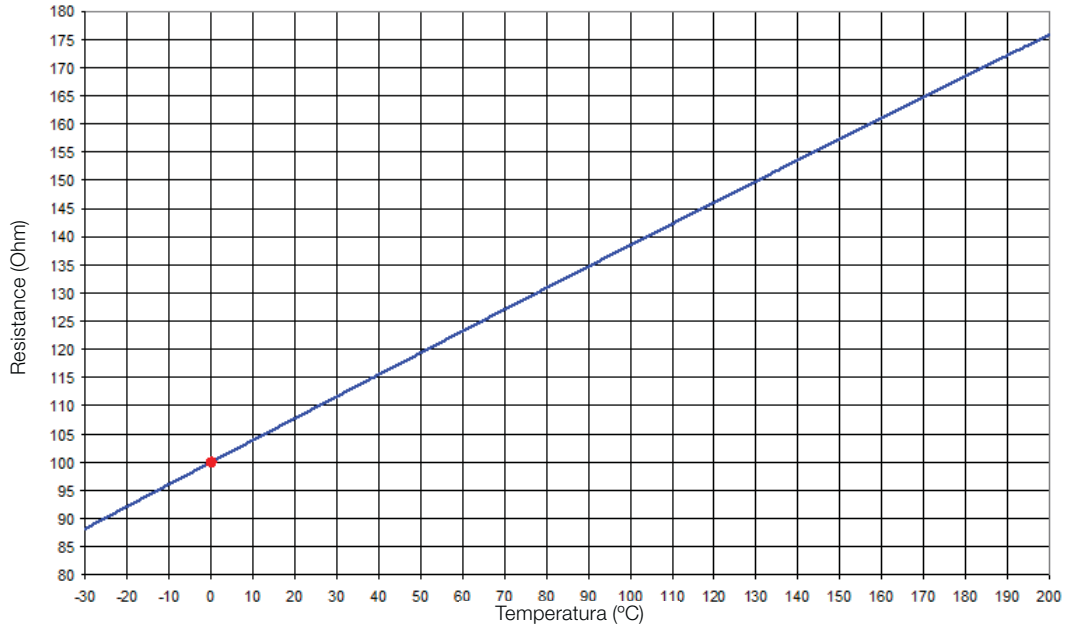



***Figure 6.16*** *- Ohmic resistance of the Pt-100 x temperature*

## 6.12. CONNECTION OF THE SPACE HEATERS

Before switching ON the space heaters, check if the space heaters connection have been made according to the connection diagram shown on the space heater nameplate. For motors supplied with dual voltage space heaters (110-127/220-240 V), see Figure 6.17.

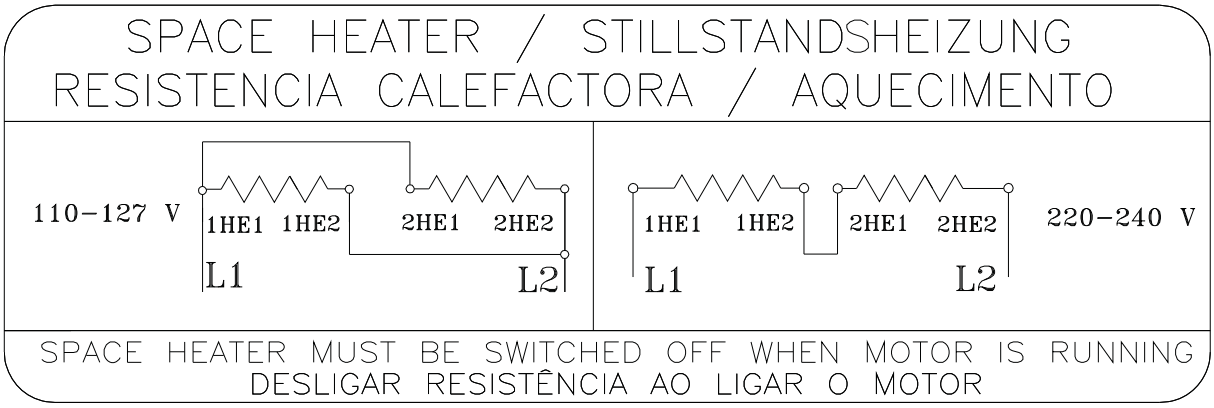



***Figure 6.17*** *- Dual voltage space heater connection*

The space heaters should never be energized when the motor is in operation.

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## 6.13. STARTING METHODS

Whenever possible, the motor starting must be Direct On Line (DOL) at rated voltage. This is the most simple and feasible starting method. However, it must only be applied when the starting current does not affect the power supply. Please consider the local electric utility regulations when installing a motor.
High inrush current may result in:
a) high voltage drop in the power supply line creating unacceptable line disturbance on the distribution system;
b) requiring oversized protection system (cables and contactor) increasing the installation costs.

If DOL starting is not allowed due to the reasons mentioned above, an indirect starting method compatible with the load and motor voltage to reduce the starting current may be used.
If reduced voltage starters are used for starting, the motor starting torque will also be reduced.

Table 6.6 shows the possible indirect starting methods that can be used depending on the number of the motor leads.

***Table 6.6*** *- Starting method x number of motor leads*

| Number of leads | Possible starting methods |
|---|---|
| 3 leads | Autotransformer<br>Soft-starter |
| 6 leads | Star-Delta<br>Autotransformer<br>Soft-starter |
| 9 leads | Series/Parallel<br>Part winding<br>Autotransformer<br>Soft-starter |
| 12 leads | Star-Delta<br>Series/Parallel<br>Part winding<br>Autotransformer<br>Soft-starter |

Table 6.7 shows examples of possible indirect starting methods to be used according to the voltage indicated on the motor nameplate and the power supply voltage.

***Table 6.7*** *- Starting methods x voltage*

| Nameplate voltage | Operating voltage | Star-delta | Autotransformer starting | Starting by series/ parallel switch | Part-winding starting | Starting by Soft-starter |
|---|---|---|---|---|---|---|
| 220/380 V | 220 V<br>380 V | YES<br>NO | YES<br>YES | NO<br>NO | NO<br>NO | YES<br>YES |
| 220/440 V | 220 V<br>440 V | NO<br>NO | YES<br>YES | YES<br>NO | YES<br>NO | YES<br>YES |
| 230/460 V | 230 V<br>460 V | NO<br>NO | YES<br>YES | YES<br>NO | YES<br>NO | YES<br>YES |
| 380/660 V | 380 V | YES | YES | NO | NO | YES |
| 220/380/440 V | 220 V<br>380 V<br>440 V | YES<br>NO<br>YES | YES<br>YES<br>YES | YES<br>YES<br>NO | YES<br>YES<br>NO | YES<br>YES<br>YES |

The WQuattro line motors must be started direct on-line (DOL) or driven by a frequency inverter in scalar mode.

## 6.14. MOTORS DRIVEN BY FREQUENCY INVERTER

The operation with frequency inverter must be stated in the Purchase Order since this drive type may require some changes of the motor design.

Wmagnet Motors must only be driven by WEG frequency inverter.

The frequency inverter used to drive motors up to 690 V must be fitted with Pulse With Modulation (PWM) with vector control.

When a motor is driven by a frequency inverter at lower frequencies than the rated frequency, you must reduce the motor torque to prevent motor overheating. The torque reduction (derating torque) can be found in the item 6.4 of the "Technical Guidelines for Induction Motors driven by PWM Frequency inverters" available on the site www.weg.net.

If the motor is operated above the rated frequency, please note:
- That the motor must be operated at constant output;
- That the motor can supply max. 95% of its rated output;
- Do not exceed the maximum speed and please consider:
  - max. operating frequency stated on the additional nameplate;
  - mechanical speed limitation of the motor.

Information on the selection of the power cables between the frequency inverter and the motor can be found in the item 6.4 of the "Technical Guidelines for Induction Motors driven by PWM Frequency inverters" available at www.weg.net.

### 6.14.1. Use of dV/dt filter

#### 6.14.1.1. Motor with enameled round wire

Motors designed for rated voltages up to 690 V, when driven by frequency inverter, do not require the use of dV/dT filters, provided that following criteria are considered.

| Criteria for the selection of motors with round enameled wire when driven by frequency inverter [1] | | | | |
|---|---|---|---|---|
| **Motor rated votage [2]** | **Peak voltage at the motor terminals (max)** | **dV/dt inverter output (max)** | **Inverter Rise Time [3] (min.)** | **MTBP [3] Time between pulses (min)** |
| Vnom ≤ 460 V | ≤ 1600 V | ≤ 5200 V/µs | ≥ 0,1 µs | ≥ 6 µs |
| 460 < Vnom ≤ 575 V | ≤ 1800 V | ≤ 6500 V/µs | | |
| 575 < Vnom ≤ 690 V [4] | ≤ 1600 V | ≤ 5200 V/µs | | |
| 575 < Vnom ≤ 690 V [5] | ≤ 2200 V | ≤ 7800 V/µs | | |

***Notes**:*
*1. For the application of motors with round enameled wires designed for 690 < Vnom ≤ 1100 V, please contact WEG.*
*2. For the application of dual voltage motors, example 380/660 V, consider the lower voltage (380 V).*
*3. Information supplied by the inverter manufacturer.*
*4. When not stated in the Purchase Order that the motor will be driven by frequency inverter.*
*5. When stated in the Purchase Order that the motor will be driven by frequency inverter.*

#### 6.14.1.2. Motor with prewound coils

Motors with prewound coils (medium and high voltage motors regardless of frame sizes, and low voltage motors from IEC 500 / NEMA 800 frame on), designed for the use with frequency inverters, do not require the use of filters, provided they comply with the criteria in Table 6.8.

***Table 6.8** - Criteria to be considered when using motor with prewound coils to be drive by frequency inverters*

| **Motor rated voltage** | **Type of modulation** | **Turn to turn insulation (phase-phase)** | | **Phase-ground insulation** | |
|---|---|---|---|---|---|
| | | **Peak voltage at the motor terminals** | **dV/dt at the motor terminals** | **Peak voltage at the motor terminals** | **dV/dt at the motor terminals** |
| 690 < Vnom ≤ 4160 V | Sinusoidal | ≤ 5900 V | ≤ 500 V/µs | ≤ 3400 V | ≤ 500 V/µs |
| | PWM | ≤ 9300 V | ≤ 2700 V/µs | ≤ 5400 V | ≤ 2700 V/µs |
| 4160 < Vnom ≤ 6600 V | Sinusoidal | ≤ 9300 V | ≤ 500 V/µs | ≤ 5400 V | ≤ 500 V/µs |
| | PWM | ≤ 14000 V | ≤ 1500 V/µs | ≤ 8000 V | ≤ 1500 V/µs |

### 6.14.2. Bearing insulation

Only the motors in IEC frame size 400 (NEMA 680) and larger are supplied, as standard, with insulated bearing. If motor must be driven by frequency inverter, insulate the bearing according to Table 6.9.

***Table 6.9*** *- Recommendation on the bearing insulation for inverter driven motors*

| Frame size | Recommendation |
|---|---|
| IEC 315 and 355<br>NEMA 445/7, 447/9, L447/9, 504/5, 5006/7/8, 5009/10/11, 586/7, 5807/8/9, 5810/11/12 and 588/9 | ■ Insulated bearing/end shield<br>■ Grounding between shaft and frame by grounding brush |
| IEC 400 and larger<br>NEMA 680 and larger | ■ Insulated NDE bearing<br>■ Grounding between shaft and frame by grounding brush |

When motors are supplied with shaft grounding system, monitor the grounding brush constantly during its operation and, when it reaches the end of its useful life, it must be replaced by another brush with the same specification.

### 6.14.3. Switching frequency

The minimum inverter switching frequency must not be lower than 2.5 kHz and should not exceed 5 kHz.

The non-compliance with the criteria and recommendations indicated in this manual may void the product warranty.

### 6.14.4. Mechanical speed limitation

Table 6.10 shows the maximum speeds allowed for motors driven by frequency inverter.

***Table 6.10*** *- Maximum motor speed (in rpm)*

| Frame size | | DE-bearing | Maximum speed for standard motors |
|---|---|---|---|
| IEC | NEMA | | |
| 63-90 | 143/5 | 6201<br>6202<br>6203<br>6204<br>6205 | 10400 |
| 100 | - | 6206 | 8800 |
| 112 | 182/4 | 6207 | 7600 |
| | | 6307 | 6800 |
| 132 | 213/5 | 6308 | 6000 |
| 160 | 254/6 | 6309 | 5300 |
| 180 | 284/6 | 6311 | 4400 |
| 200 | 324/6 | 6312 | 4200 |
| 225-630 | 364/5-9610 | 6314 | 3600 |
| | | 6315 | 3600 |
| | | 6316 | 3200 |
| | | 6319 | 3000 |
| | | 6220 | 3600 |
| | | 6320 | 2200 |
| | | 6322 | 1900 |
| | | 6324 | 1800 |
| | | 6328 | 1800 |
| | | 6330 | 1800 |

***Note:***
*To select the maximum allowed motor speed, consider the motor torque derating curve.*

For more information on the application of frequency inverters, contact WEG or check the “Technical Guidelines for Induction Motors driven by PWM Frequency inverters” available at www.weg.net.

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# 7. COMMISSIONING

## 7.1. INITIAL START-UP

After finishing the installation procedures and before starting the motor for the first time or after a long period without operation, the following items must be checked:

- If the nameplate data (voltage, current, connection diagram, degree of protection, cooling system, service factor, etc.) meet the application requirements;
- If the machine set (motor + driven machine) has been mounted and aligned correctly;
- If the motor driving system ensures that the motor speed does not exceed the max. allowed speed indicated in Table 6.10;
- Measure the winding insulation resistance, making sure it complies with the specified values in item 5.4;
- Check the motor rotation direction;
- Inspect the motor terminal box for damage and ensure that it is clean and dry and all contacts are rust-free, the seals are in perfect operating conditions and all unused threaded holes are properly closed thus ensuring the degree of protection indicated on the motor nameplate;
- Check if the motor wiring connections, including grounding and auxiliary equipment connection, have been carried out properly and are in accordance with the recommendations in item 6.9;
- Check the operating conditions of the installed auxiliary devices (brake, encoder, thermal protection device, forced cooling system, etc.);
- Check bearing operating conditions. If signs of oxidation are detected, replace the bearings. If no sign of oxidation is detected, relubricate the bearings as described in item 8.2. If the motors are stored for more than two years, the bearings must be replaced before starting the motor;
- When motors are fitted with sleeve bearings, ensure:
  - Correct oil level for the sleeve bearing. The oil level should be in the center of the sight glass (see Figure 6.8);
  - That the motor is not started or operated with axial or radial loads;
  - That if the motor is stored for a period equal or longer than the oil change interval, the oil must be changed before starting the motor.
- Inspect the capacitor operating condition, if any. If motors are installed for more than two years, but were never commissioned, it is recommended to change the start capacitors since they lose their operating characteristics;
- Ensure that the air inlet and outlet opening are not blocked. The minimum clearance to the nearest wall (L) should be at least ¼ of the fan cover diameter (D), see Figure 7.1. The intake air temperature must be at ambient temperature.

***Figure 7.1***- *Minimum clearance to the wall*

Please consider the minimum distances shown in the Table 7.1 as reference value;

***Table 7.1*** *- Minimum distance between the fan cover and wall*

| Frame size | | Distance between the fan cover and the wall (L) | |
|---|---|---|---|
| **IEC** | **NEMA** | **mm** | **inches** |
| 63 | - | 25 | 0.96 |
| 71 | - | 26 | 1.02 |
| 80 | - | 30 | 1.18 |
| 90 | 143/5 | 33 | 1.30 |
| 100 | - | 36 | 1.43 |
| 112 | 182/4 | 41 | 1.61 |
| 132 | 213/5 | 50 | 1.98 |
| 160 | 254/6 | 65 | 2.56 |
| 180 | 284/6 | 68 | 2.66 |
| 200 | 324/6 | 78 | 3.08 |
| 225<br>250 | 364/5<br>404/5 | 85 | 3.35 |
| 280 | 444/5<br>445/7<br>447/9 | 108 | 4.23 |
| 315 | L447/9<br>504/5<br>5006/7/8<br>5009/10/11 | 122 | 4.80 |
| 355 | 586/7<br>588/9<br>5807/8/9<br>5810/11/12 | 136 | 5.35 |
| 400 | 6806/7/8<br>6809/10/11 | 147 | 5.79 |
| 450 | 7006/10 | 159 | 6.26 |
| 500 | 8006/10 | 171 | 6.73 |
| 560 | 8806/10 | 185 | 7.28 |
| 630 | 9606/10 | 200 | 7.87 |

- Ensure correct water flow rate and water temperature when water cooled motors are used. See item 7.2;
- Ensure that all rotating parts, such as pulleys, couplings, external fans, shaft, etc. are protected against accidental contact.

Other tests and inspections not included in the manual may be required, depending on the specific installation, application and/or motor characteristics.

After all previous inspections have been carried out, proceed as follows to start the motor:

- Start the motor on no-load (if possible) and check the motor direction of rotation. Check for the presence of any abnormal noise, vibration or other abnormal operating conditions;
- Ensure the motor starts smoothly. If any abnormal operating condition is noticed, switch off the motor, check the assembly system and connections before the motor is started again;
- If excessive vibrations are noticed, check if the motor mounting bolts are well tightened or if the vibrations are not generated and transmitted from adjacent installed equipment. Check the motor vibration periodically and ensure that the vibration limits are as specified in item 7.2.1;
- Start the motor at rated load during a short time and compare the operating current with the rated current indicated on the nameplate;
- Continue to measure the following motor variables until thermal equilibrium is reached: current, voltage, bearing and motor frame temperature, vibration and noise levels;
- Record the measured current and voltage values on the Installation Report for future comparisons.

As induction motors have high inrush currents during start-up, the acceleration of high inertia load requires an extended starting time to reach full speed resulting in fast motor temperature rise. Successive starts within short intervals will result in winding temperature increases and can lead to physical insulation damage reducing the useful life of the insulation system. If the duty cycle S1 / CONT. is specified on the motor nameplate, this means that the motor has been designed for:

- Two successive starts: first start from cold condition, i. e., the motor windings are at room temperature and the second start immediately after the motor stops;
- One start from hot condition, i. e., the motor windings are at rated temperature.

The Troubleshooting Chart in section 10 provides a basic list of unusual cases that may occur during motor operation with the respective corrective actions.

## 7.2. OPERATING CONDITIONS

Unless otherwise stated in the Purchase Order, electric motors are designed and built to be operated at altitudes up to 1000 meters above sea level and in a temperature range from -20 °C to +40 °C. Any deviation from the normal condition of motor operation must be stated on the motor nameplate. Some components must be changed if the ambient temperature is different from the specified one. Please contact WEG to check the required special features.

For operating temperatures and altitudes differing from those above, the factors indicated in Table 7.2 must be applied to the nominal motor power rating in order to determine the derated available output (Pmax = Pnom x correction factor).

***Table 7.2 -*** *Correction factors for altitude and ambient temperature*

| T (°C) | Altitude (m) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1000 | 1500 | 2000 | 2500 | 3000 | 3500 | 4000 | 4500 | 5000 |
| 10 | | | | | | | 0.97 | 0.92 | 0.88 |
| 15 | | | | | | 0.98 | 0.94 | 0.90 | 0.86 |
| 20 | | | | | 1.00 | 0.95 | 0.91 | 0.87 | 0.83 |
| 25 | | | | 1.00 | 0.95 | 0.93 | 0.89 | 0.85 | 0.81 |
| 30 | | | 1.00 | 0.96 | 0.92 | 0.90 | 0.86 | 0.82 | 0.78 |
| 35 | | 1.00 | 0.95 | 0.93 | 0.90 | 0.88 | 0.84 | 0.80 | 0.75 |
| 40 | 1.00 | 0.97 | 0.94 | 0.90 | 0.86 | 0.82 | 0.80 | 0.76 | 0.71 |
| 45 | 0.95 | 0.92 | 0.90 | 0.88 | 0.85 | 0.81 | 0.78 | 0.74 | 0.69 |
| 50 | 0.92 | 0.90 | 0.87 | 0.85 | 0.82 | 0.80 | 0.77 | 0.72 | 0.67 |
| 55 | 0.88 | 0.85 | 0.83 | 0.81 | 0.78 | 0.76 | 0.73 | 0.70 | 0.65 |
| 60 | 0.83 | 0.82 | 0.80 | 0.77 | 0.75 | 0.73 | 0.70 | 0.67 | 0.62 |
| 65 | 0.79 | 0.76 | 0.74 | 0.72 | 0.70 | 0.68 | 0.66 | 0.62 | 0.58 |
| 70 | 0.74 | 0.71 | 0.69 | 0.67 | 0.66 | 0.64 | 0.62 | 0.58 | 0.53 |
| 75 | 0.70 | 0.68 | 0.66 | 0.64 | 0.62 | 0.60 | 0.58 | 0.53 | 0.49 |
| 80 | 0.65 | 0.64 | 0.62 | 0.60 | 0.58 | 0.56 | 0.55 | 0.48 | 0.44 |

Motors installed inside enclosures (cubicles) must be ensured an air renewal rate in the order of one cubic meter per second for each 100 kW installed power or fraction of installed power. Totally Enclosed Air Over motors - TEAO (fan and exhaust / smoke extraction) are supplied without cooling fan and the manufacturer of the driven machine is responsible for sufficient motor cooling. If no minimum required air speed between motor fins is indicated on the motor nameplate, ensure the air speed indicated in the table 7.3 is provided. The values shown in Table 7.3 are valid for 60 Hz motors. To obtain the minimum air speed for 50 Hz motors, multiply the values in the table by 0.83.

***Table 7.3*** *- Minimum required air speed between motor fins (metres/second)*

| Frame | | Poles | | | |
|---|---|---|---|---|---|
| IEC | NEMA | 2 | 4 | 6 | 8 |
| 63 to 90 | 143/5 | 14 | 7 | 5 | 4 |
| 100 to 132 | 182/4 to 213/5 | 18 | 10 | 8 | 6 |
| 160 to 200 | 254/6 to 324/6 | 20 | 20 | 12 | 7 |
| 225 to 280 | 364/5 to 444/5 | 22 | 22 | 18 | 12 |
| 315 to 355 | 445/7 to 588/9 | 25 | 25 | 20 | 15 |

The voltage and frequency variations may affect the performance characteristics and the electromagnetic compatibility of the motor. The power supply variations should not exceed the values specified in the applicable standards. Examples:

- ABNT NBR 17094 - Parts 1 and 2. The motor has been designed to supply the rated torque for a combined variation in voltage and frequency:
  - Zone A: ±5% of the rated voltage and ±2% of the rated frequency;
  - Zone B: ±10% of the rated voltage and +3% -5% of the rated frequency.

When operated continuously in Zone A or B, the motor may show performance variations and the operating temperature may increase considerably. These performance variations will be higher in Zone B. Thus it is not recommended to operate the motor in Zone B during extended periods.

- IEC 60034-1. The motor has been designed to supply the rated torque for combined variation in voltage and frequency:
  - Zone A: ±5% of the rated voltage and ±2% of the rated frequency;
  - Zone B: ±10% of the rated voltage and +3% -5% of the rated frequency.

When operated continuously in Zone A or B, the motor may show performance variations and the operating temperature may increase considerably. These performance variations will be higher in Zone B. Thus it is not recommended to operate the motor in Zone B during extended periods. For multivoltage motors (example 380-415/660 V), a ±5% voltage variation from the rated voltage is allowed.

- NEMA MG 1 Part 12. The motor has been designed to be operated in one of the following variations:
  - ±10% of the rated voltage, with rated frequency;
  - ±5% of the rated frequency, with rated voltage;
  - A combined variation in voltage and frequency of ±10%, provided the frequency variation does not exceed ±5%.

If the motor is cooled by ambient air, clean the air inlet and outlet openings and cooling fins at regular intervals to ensure a free airflow over the frame surface. The hot air should never be returned to the motor. The cooling air must be at room temperature limited to the temperature range indicated on the motor nameplate (if no room temperature is specified, please consider a temperature range between -20 °C and +40 °C).

Table 7.4 shows the minimum required water flow for water cooled motors considering the different frame sizes and the maximum allowed temperature rise of the cooling water after circulating through the motor. The inlet water temperature should not exceed 40 °C.

***Table 7.4*** *- Minimum required water flow and the maximum allowed temperature rise of the cooling water after circulating through the motor*

| Frame size | | Flow rate (litres/minute) | Maximum allowed water temperature rise (°C) |
|---|---|---|---|
| IEC | NEMA | | |
| 180 | 284/6 | 12 | 5 |
| 200 | 324/6 | 12 | 5 |
| 225 | 364/5 | 12 | 5 |
| 250 | 404/5 | 12 | 5 |
| 280 | 444/5<br>445/7<br>447/9 | 15 | 6 |
| 315 | 504/5 | 16 | 6 |
| 355 | 586/7<br>588/9 | 25 | 6 |

Motors fitted with oil mist lubrication systems can be operated continuously for a maximum of one hour after the failure of the oil pumping system.

Considering the sun's heat increases the operating temperature, externally mounted motors should always be protected from direct sunlight exposure.

Each and every deviation from the normal operating condition (tripping of the thermal protection, noise and vibration level increase, temperature and current rise) should be investigated and corrected by WEG Authorized Service Centers.

Motors fitted with cylindrical roller bearings require a minimum radial load to ensure a normal operation. For information regarding the radial preload, please contact WEG.

### 7.2.1.Limits of vibration

The vibration severity is the maximum vibration value measured at all positions and in all directions as recommended in the standard IEC 60034-14. Table 7.5 specifies the limits of the maximum vibrations magnitudes according to standard IEC 60034-14 for shaft heights IEC 56 to 400, for vibrations grades A and B. The vibration severity limits in Table 7.5 are given as RMS values (Root Mean Square values or effective values) of the vibration speed in mm/s measured in free suspension condition.

***Table 7.5*** *- Recommended limits for the vibration severity according to standard IEC 60034-14*

| Shaft height [mm] | 56 ≤ H ≤ 132 | 132 ≤ H ≤ 280 | H > 280 |
|---|---|---|---|
| Vibration grade | Vibration severity on elastic base [mm/s RMS] | | |
| A | 1.6 | 2.2 | 2.8 |
| B | 0.7 | 1.1 | 1.8 |

***Notes:***

*1 - The values in Table 7.5 are valid for measurements carried out with decoupled machines (without load) operated at rated voltage and frequency.*

*2 - The values in Table 7.5 are valid regardless of the direction of rotation of the machine.*

*3 - The values in Table 7.5 are not applicable to single-phase motors, three-phase motors powered by a single-phase system or to machines mounted in situ or coupled with inertia flywheels or to loads.*

According to NEMA MG 1, the allowed vibration limit for standard motors is 0.15 in/s (peak vibration in in/s).

***Note:***

*For the load operation condition, the use of the standard ISO 10816-3 is recommended for evaluating the motor vibration limits. In the load condition the motor vibration will be influenced by several factors, such as, type of the coupled load, condition of the motor fixation, alignment condition under load, structure or base vibration due to other equipments, etc..*

# 8. MAINTENANCE

The purpose of the maintenance is to extend the useful life of the equipment. The non-compliance with one of these previous items can cause unexpected machine failures.

If motors with cylindrical roller or angular contact bearings are to be transported during the maintenance procedures, the shaft locking device must always be fitted. All HGF motors, regardless of the bearing type, must always be transported with the shaft locking device fitted.

All repairs, disassembly and assembly related services must be carried out only by qualified and well-trained personnel by using proper tools and techniques. Make sure that the machine has stopped and it is disconnected from the power supply, including the accessory devices (space heater, brake, etc.), before any servicing is undertaken.
The company does not assume any responsibility or liability for repair services or maintenance operations executed by non-authorized Service Centers or by non qualified service personnel. The company shall have no obligation or liability whatsoever to the buyer for any indirect, special, consequential or incidental loss or damage caused or arising from the company's proven negligence

## 8.1. GENERAL INSPECTION

The inspection intervals depend on the motor type, application and installation conditions. Proceed as follows during inspection:

- Visually inspect the motor and coupling. Check if abnormal noises, vibrations, excessive heating, wear signs, misalignment or damaged parts are noticed. Replace the damaged parts as required;
- Measure the insulation resistance according to the item 5.4;
- Clean the motor enclosure. Remove oil spills and dust accumulation from the motor frame surface to ensure a better heat transfer to the surrounding ambient;
- Check cooling fan condition and clean the air inlet & outlet openings to ensure a free air flow over the motor;
- Investigate the actual condition of the seals and replace them, if required;
- Drain the condensed water from inside the motor. After draining, reinstall the drain plugs to ensure the degree of protection as indicated on the motor nameplate. The motor must always be positioned so the drain hole is at the lowest position (see item 6);
- Check the connections of the power supply cables, ensuring the correct clearance distance between live and grounded parts, as specified in Table 6.3;
- Check if the tightening torque of the bolted connections and mounting bolts meets the tightening torque specified in Table 8.7;
- Check the status of the cable passages, the cable gland seals and the seals inside the terminal box and replace them, if required;
- Check the bearing operating conditions. Check for the presence of any abnormal noise, vibration or other abnormal operating conditions, like motor temperature rise. Check the oil level, the lube oil condition and compare the workings hours with the informed life time;
- Record and file all changes performed on the motor.

Do not reuse damaged or worn parts. Damaged or worn parts must be replaced by parts supplied by the manufacturer and must be installed as if they were the original parts.

## 8.2. LUBRICATION

Proper lubrication plays a vital role in the motor performance. Only use the grease or oil types, amounts and lubrication intervals recommended for the bearings. This information is available on the motor nameplate and the lubrication procedures must be carried out according to the type of lubricant (oil or grease).
When the motor is fitted with thermal protection devices for bearing temperature control, consider the operating temperature limits shown in Table 6.4.
The maximum operating temperature of motors used in special applications may differ from those shown in Table 6.4. The grease and oil disposal should be made in compliance with applicable laws in each country.

Please contact WEG when motors are to be installed in special environments or used for special applications.

### 8.2.1. Grease lubricated rolling bearings

Excess grease causes bearing overheating, resulting in bearing failure.

The lubrication intervals specified in Table 8.1, Table 8.2, Table 8.3 and Table 8.4 consider an absolute temperature on the bearing of 70 °C (up to frame size IEC 200 / NEMA 324/6) and 85 °C (for frame size IEC 225 / NEMA 364/5 and above), the motor running at rated speed, a motor mounted in horizontal position and greased with Mobil Polyrex EM grease. Any variation of the parameters listed above must be evaluated.

***Table 8.1*** *- Lubrication intervals for ball bearings*

| Frame | | Poles | Bearing designation | Amount of grease (g) | Lubrication intervals (hours) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ODP (Open Drip Proof) | | W21 TEFC (Totally Enclosed Fan Cooled) | | W22 TEFC (Totally Enclosed Fan Cooled) | |
| IEC | NEMA | | | | 50 Hz | 60 Hz | 50 Hz | 60 Hz | 50 Hz | 60 Hz |
| 90 | 143/5 | 2 | 6205 | 4 | - | - | 20000 | 20000 | 25000 | 25000 |
| | | 4 | | | | | | | | |
| | | 6 | | | | | | | | |
| | | 8 | | | | | | | | |
| 100 | - | 2 | 6206 | 5 | - | - | 20000 | 20000 | 25000 | 25000 |
| | | 4 | | | | | | | | |
| | | 6 | | | | | | | | |
| | | 8 | | | | | | | | |
| 112 | 182/4 | 2 | 6207/ 6307 | 9 | - | - | 20000 | 20000 | 25000 | 25000 |
| | | 4 | | | | | | | | |
| | | 6 | | | | | | | | |
| | | 8 | | | | | | | | |
| 132 | 213/5 | 2 | 6308 | 11 | - | - | 20000 | 18400 | 25000 | 23200 |
| | | 4 | | | | | 20000 | 20000 | 25000 | 25000 |
| | | 6 | | | | | | | | |
| | | 8 | | | | | | | | |
| 160 | 254/6 | 2 | 6309 | 13 | 20000 | 20000 | 18100 | 15700 | 22000 | 20000 |
| | | 4 | | | | | 20000 | 20000 | 25000 | 25000 |
| | | 6 | | | | | | | | |
| | | 8 | | | | | | | | |
| 180 | 284/6 | 2 | 6311 | 18 | 20000 | 20000 | 13700 | 11500 | 17000 | 14000 |
| | | 4 | | | | | 20000 | 20000 | 25000 | 25000 |
| | | 6 | | | | | | | | |
| | | 8 | | | | | | | | |
| 200 | 324/6 | 2 | 6312 | 21 | 20000 | 20000 | 11900 | 9800 | 15000 | 12000 |
| | | 4 | | | | | 20000 | 20000 | 25000 | 25000 |
| | | 6 | | | | | | | | |
| | | 8 | | | | | | | | |
| 225 250 280 315 355 | 364/5 404/5 444/5 445/7 447/9 L447/9 504/5 5008 5010/11 586/7 588/9 | 2 | 6314 | 27 | 18000 | 14400 | 4500 | 3600 | 5000 | 4000 |
| | | 4 | | | 20000 | 20000 | 11600 | 9700 | 14000 | 12000 |
| | | 6 | | | | | 16400 | 14200 | 20000 | 17000 |
| | | 8 | | | | | 19700 | 17300 | 24000 | 20000 |
| | | 2 | 6316 | 34 | 14000 | *Upon request | 3500 | *Upon request | 4000 | *Upon request |
| | | 4 | | | 20000 | 20000 | 10400 | 8500 | 13000 | 10000 |
| | | 6 | | | | | 14900 | 12800 | 18000 | 16000 |
| | | 8 | | | | | 18700 | 15900 | 20000 | 20000 |
| | | 2 | 6319 | 45 | 9600 | *Upon request | 2400 | *Upon request | 3000 | *Upon request |
| | | 4 | | | 20000 | 20000 | 9000 | 7000 | 11000 | 8000 |
| | | 6 | | | | | 13000 | 11000 | 16000 | 13000 |
| | | 8 | | | | | 17400 | 14000 | 20000 | 17000 |
| | | 4 | 6322 | 60 | 20000 | 20000 | 7200 | 5100 | 9000 | 6000 |
| | | 6 | | | | | 10800 | 9200 | 13000 | 11000 |
| | | 8 | | | | | 15100 | 11800 | 19000 | 14000 |

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*Table 8.2* - *Lubrication intervals for cylindrical roller bearings*

| Frame | | Poles | Bearing designation | Amount of grease (g) | LUBRICATION INTERVALS (hours) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ODP (Open Drip Proof) | | W21 TEFC (Totally Enclosed Fan Cooled) | | W22 TEFC (Totally Enclosed Fan Cooled) | |
| IEC | NEMA | | | | 50 Hz | 60 Hz | 50 Hz | 60 Hz | 50 Hz | 60 Hz |
| 160 | 254/6 | 2 | NU309 | 13 | 20000 | 19600 | 13300 | 9800 | 16000 | 12000 |
| | | 4 | | | | 20000 | 20000 | 20000 | 25000 | 25000 |
| | | 6 | | | | | | | | |
| | | 8 | | | | | | | | |
| 180 | 284/6 | 2 | NU311 | 18 | 18400 | 12800 | 9200 | 6400 | 11000 | 8000 |
| | | 4 | | | 20000 | 20000 | 20000 | 19100 | 25000 | 25000 |
| | | 6 | | | | | | 20000 | | |
| | | 8 | | | | | | | | |
| 200 | 324/6 | 2 | NU312 | 21 | 15200 | 10200 | 7600 | 5100 | 9000 | 6000 |
| | | 4 | | | 20000 | 20000 | 20000 | 17200 | 25000 | 21000 |
| | | 6 | | | | | | 20000 | | 25000 |
| | | 8 | | | | | | | | |
| 225<br>250<br>280<br>315<br>355 | 364/5<br>404/5<br>444/5<br>445/7<br>447/9<br>L447/9<br>504/5<br>5008<br>5010/11<br>586/7<br>588/9 | 4 | NU314 | 27 | 17800 | 14200 | 8900 | 7100 | 11000 | 9000 |
| | | 6 | | | 20000 | 20000 | 13100 | 11000 | 16000 | 13000 |
| | | 8 | | | | | 16900 | 15100 | 20000 | 19000 |
| | | 4 | NU316 | 34 | 15200 | 12000 | 7600 | 6000 | 9000 | 7000 |
| | | 6 | | | 20000 | 19000 | 11600 | 9500 | 14000 | 12000 |
| | | 8 | | | | 20000 | 15500 | 13800 | 19000 | 17000 |
| | | 4 | NU319 | 45 | 12000 | 9400 | 6000 | 4700 | 7000 | 5000 |
| | | 6 | | | 19600 | 15200 | 9800 | 7600 | 12000 | 9000 |
| | | 8 | | | 20000 | 20000 | 13700 | 12200 | 17000 | 15000 |
| | | 4 | NU322 | 60 | 8800 | 6600 | 4400 | 3300 | 5000 | 4000 |
| | | 6 | | | 15600 | 11800 | 7800 | 5900 | 9000 | 7000 |
| | | 8 | | | 20000 | 20000 | 11500 | 10700 | 14000 | 13000 |

*Table 8.3* - *Lubrication intervals for ball bearings - HGF line*

| Frame | | Poles | Bearing designation | Amount of grease (g) | Lubrication intervals (hours) | |
|---|---|---|---|---|---|---|
| IEC | NEMA | | | | 50 Hz | 60 Hz |
| 315L/A/B and 315C/D/E | 5006/7/8T and 5009/10/11T | 2 | 6314 | 27 | 3100 | 2100 |
| | | 4 - 8 | 6320 | 50 | 4500 | 4500 |
| | | | 6316 | 34 | 4500 | 4500 |
| 355L/A/B and 355C/D/E | 5807/8/9T and 5810/11/12T | 2 | 6314 | 27 | 3100 | 2100 |
| | | 4 - 8 | 6322 | 60 | 4500 | 4500 |
| | | | 6319 | 45 | 4500 | 4500 |
| 400L/A/B and 400 C/D/E | 6806/7/8T and 6809/10/11T | 2 | 6315 | 30 | 2700 | 1800 |
| | | 4 - 8 | 6324 | 72 | 4500 | 4500 |
| | | | 6319 | 45 | 4500 | 4500 |
| 450 | 7006/10 | 2 | 6220 | 31 | 2500 | 1400 |
| | | 4 | 6328 | 93 | 4500 | 3300 |
| | | | 6322 | 60 | 4500 | 4500 |
| | | 6 - 8 | 6328 | 93 | 4500 | 4500 |
| | | | 6322 | 60 | 4500 | 4500 |
| 500 | 8006/10 | 4 | 6330 | 104 | 4200 | 2800 |
| | | | 6324 | 72 | 4500 | 4500 |
| | | 6 - 8 | 6330 | 104 | 4500 | 4500 |
| | | | 6324 | 72 | 4500 | 4500 |
| 500 | 8006/10 | 4 | 6330 | 104 | 4200 | 2800 |
| | | | 6324 | 72 | 4500 | 4500 |
| | | 6 - 8 | 6330 | 104 | 4500 | 4500 |
| | | | 6324 | 72 | 4500 | 4500 |
| 560 | 8806/10 | 4 - 8 | *Upon request | | | |
| 630 | 9606/10 | 4 - 8 | | | | |

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*Table 8.4 - Lubrication intervals for cylindrical roller bearings - HGF line*

| Frame | | Poles | Bearing designation | Amount of grease (g) | Lubrication intervals (hours) | |
|---|---|---|---|---|---|---|
| IEC | NEMA | | | | 50 Hz | 60 Hz |
| 315L/A/B and 315C/D/E | 5006/7/8 and 5009/10/11 | 4 | NU320 | 50 | 4300 | 2900 |
| | | 6 - 8 | | | 4500 | 4500 |
| 355L/A/B and 355C/D/E | 5807/8/9 and 5810/11/12 | 4 | NU322 | 60 | 3500 | 2200 |
| | | 6 - 8 | | | 4500 | 4500 |
| 400L/A/B and 400C/D/E | 6806/7/8 and 6809/10/11 | 4 | NU324 | 72 | 2900 | 1800 |
| | | 6 - 8 | | | 4500 | 4500 |
| 450 | 7006/10 | 4 | NU328 | 93 | 2000 | 1400 |
| | | 6 | | | 4500 | 3200 |
| | | 8 | | | 4500 | 4500 |
| 500 | 8006/10 | 4 | NU330 | 104 | 1700 | 1000 |
| | | 6 | | | 4100 | 2900 |
| | | 8 | | | 4500 | 4500 |
| 560 | 8806/10 | 4 | NU228 + 6228 | 75 | 2600 | 1600 |
| | | 6 - 8 | | 106 | 4500 | 4500 |
| 630 | 9606/10 | 4 | NU232 + 6232 | 92 | 1800 | 1000 |
| | | 6 | | 120 | 4300 | 3100 |
| | | 8 | | 140 | 4500 | 4500 |

For each increment of 15 ºC above the bearing temperature, the relubrication intervals given in the Table must be halved. The relubrication interval of motors designed by the manufacturer for mounting in horizontal position, but installed in vertical position (with WEG authorization), must be halved.
For special applications, such as: high and low temperatures, aggressive environments, driven by frequency inverter (VFD - frequency inverter), etc., please contact WEG about the required amount of grease and the relubrication intervals.

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#### 8.2.1.1. Motor without grease fitting

Motors without grease fittings must be lubricated in accordance with the existing Maintenance Plan. Motor disassembly must be carried out as specified in Item 8.3. If motors are fitted with shielded bearings (for example, ZZ, DDU, 2RS, VV), these bearings must be replaced at the end of the grease service life.

#### 8.2.1.2. Motor with grease fitting

To lubricate the bearings with the motor stopped, proceed as follows:
- Before lubricating, clean the grease nipple and immediate vicinity thoroughly;
- Lift grease inlet protection;
- Remove the grease outlet plug;
- Pump in approximately half of the total grease indicated on the motor nameplate and run the motor for about 1 (one) minute at rated speed;
- Switch-off the motor and pump in the remaining grease;
- Lower again the grease inlet protection and reinstall the grease outlet protection.

To grease the motor while running, proceed as follows:
- Before lubricating, clean the grease nipple and immediate vicinity thoroughly;
- Pump the total grease indicated on the motor nameplate;
- Lower again the grease inlet protection.

For lubrication, use only manual grease gun.

If Motors are provided with a spring device for grease removal, the grease excess must be removed by pulling the rod and cleaning the spring until the spring does not remove more grease.

#### 8.2.1.3. Compatibility of the Mobil Polyrex EM grease with other greases

The Mobil Polyrex EM grease has a polyurea thickener and a mineral oil thus being compatible with greases that contain:
- Lithium based thickener, lithium-based complex thickener, polyurea thickener and refined mineral oil;
- The used grease must have in its formulation corrosion and oxidation inhibitors.

In general terms, greases with the same type of soap are compatible to each other. However, depending on the proportion of the mixture there may be incompatibility. In such a case, it is not recommended to mix different types of greases without contacting the supplier or WEG beforehand.

### 8.2.2. Oil lubricated bearings

To change the oil of oil lubricated motor proceed as follows:
- Switch-off the motor;
- Remove threaded oil drain plug;
- Open the valve and drain the oil;
- Close the drain vale again;
- Reinstall the threaded oil drain plug;
- Fill-up with the type and amount of oil as specified on the nameplate;
- Check oil level. The oil level is OK when the lubricant can be viewed approximately in the center of the sight glass;
- Reinstall oil inlet plug;
- Check for oil leaks and ensure that all not used threaded plugs are closed with plugs.

The bearing lubricating oil must be replaced as specified on the nameplate or whenever changes in the oil properties are noticed. The oil viscosity and pH must be checked periodically. The oil level must be checked every day and must be kept in the center of the sight glass.
Please contact WEG, when oils with different viscosities should be used.

***Note**:*
*The HGF vertical mounted motors with high axial thrust are supplied with grease lubricated DE-bearings and with oil lubricated NDE-bearings. The DE-bearings must be lubricated according to recommendations in item 8.2.1. Table 8.5 specifies the oil type and the amount of oil required for this motor lubrication.*

***Table 8.5** - Oil properties for HGF vertical mounted motors with high axial thrust*

| | Frame | | Poles | Bearing designation | Oil (liters) | Interval (h) | Lubricant | Lubricant specification |
|---|---|---|---|---|---|---|---|---|
| | IEC | NEMA | | | | | | |
| Mounting - high axial thrust | 315L/A/B e 315C/D/E | 5006/7/8T e 5009/10/11T | 4 - 8 | 29320 | 20 | 8000 | Renolin DTA 40 / SHC 629 | ISO VG150 mineral oil with antifoam and antioxidant additives |
| | 355L/A/B e 355C/D/E | 5807/8/9T e 5810/11/12T | 4 - 8 | 29320 | 26 | | | |
| | 400L/A/B e 400C/D/E | 6806/7/8T e 6809/10/11T | 4 - 8 | 29320 | 37 | | | |
| | 450 | 7006/10 | 4 - 8 | 29320 | 45 | | | |

### 8.2.3. Oil mist lubricated bearings

Check the service conditions of the seals and if replacement is required use only original components. Clean the seal components before assembly (bearing caps, end shields, etc.).
Apply joint sealant between the bearing caps and end shields. The joint sealant must be compatible with the used lubricating oil. Connect the oil lubricant tubes (oil inlet and oil outlet tubes and motor drain tube), as shown in Figure 6.12.

### 8.2.4. Sleeve bearings

The lubricating oil of sleeve bearings must be changed at the intervals specified in Table 8.6. To replace the oil, proceed as follows:
- NDE-bearing: remove the protection plate from the fan cover;
- Drain the oil through the drain hole located at the bottom of the bearing (see Figure 8.1);
- Close the oil drain hole;
- Remove the oil inlet plug;
- Fill the sleeve bearing with the specified oil and with the amount of oil specified in;
- Check the oil level and ensure it is kept close to the center of the sight glass;
- Install the oil inlet plug;
- Check for oil leaks.

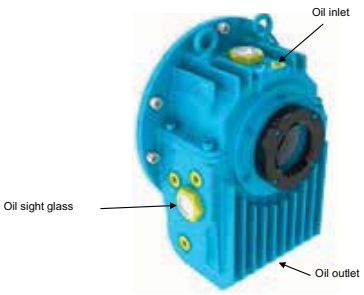


***Figure 8.1** - Sleeve bearing*

*Table 8.6 - Oil properties for sleeve bearings*

| Frame | | Poles | Bearing designation | Oil (liters) | Interval (h) | Lubricant | Lubricant specification |
|---|---|---|---|---|---|---|---|
| IEC | NEMA | | | | | | |
| 315L/A/B and 315C/D/E | 5006/7/8T and 5009/10/11T | 2 | 9-80 | 2.8 | 8000 | Renolin DTA 10 | ISO VG32 mineral oil with antifoam and antioxidant additives |
| 355L/A/B and 355C/D/E | 5807/8/9T and 5810/11/12T | | | | | | |
| 400L/A/B and 400C/D/E | 6806/7/8 and 6809/10/11T | | | | | | |
| 450 | 7006/10 | | | | | | |
| 315L/A/B and 315C/D/E | 5006/7/8T and 5009/10/11T | 4 - 8 | 9-90 | 2.8 | 8000 | Renolin DTA 15 | ISO VG46 mineral oil with antifoam and antioxidant additives |
| 355L/A/B and 355C/D/E | 5807/8/9T and 5810/11/12T | | 9-100 | | | | |
| 400L/A/B and 400C/D/E | 6806/7/8 and 6809/10/11T | | 11-110 | 4.7 | | | |
| 450 | 7006/10 | | 11-125 | | | | |
| 500 | 8006/10 | | | | | | |

The lubricating oil must be replaced as specified on the nameplate or whenever changes on the oil properties are noticed. The oil viscosity and pH must be checked periodically. The oil level must be checked every day and kept in the center of the sight glass.
Please contact WEG, when oils with different viscosities are to be used.

## 8.3. MOTOR ASSEMBLY AND DISASSEMBLY

All repair services on motors should be always performed by qualified personnel and in accordance with the applicable laws and regulations in each country. Always use proper tools and devices for motor disassembly and assembly.

Disassembly and assembly services can be carried out only after the motor has been disconnected from the power supply and is completely stopped.

Dangerous voltages may be present at the motor terminals inside the terminal box since capacitors can retain electrical charge for long periods of time even when they are not connected directly to a power source or when space heaters are connected to the motor or when the motor windings are used as space heaters. Dangerous voltages may be present at the motor terminals when they are driven by frequency inverter even when they are completely stopped.

Record the installation conditions such as terminal connection diagram, alignment / leveling conditions before starting the disassembly procedures. These records should be considered for later assembly.

Disassemble the motor carefully without causing scratches on machined surfaces or damaging the threads.

Assemble the motor on a flat surface ensuring a good support base. Footless motors must be fixed/locked on the base to prevent accidents.

Handle the motor carefully to not damage the insulated components such as windings, insulated rolling bearings, power cables etc..

Seal elements, such as joint seals and bearing seals should always be replaced when wear or damage is noticed.

Motors with degree of protection higher than IP55 are supplied with joint and screw seal Loctite 5923 (Henkel) Clean the components and apply a new coat of Loctite 5923 on the surfaces before assembly.

### 8.3.1. Terminal box

Proceed as follows to remove the terminal box cover and to disconnect/connect the power supply cables and the cables of the accessory devices:

- Ensure that during the screw removal the terminal box cover does not damage the components installed inside the terminal box;
- If the terminal box cover is fitted with lifting eyebolt, lift the terminal box cover always by its lift eyebolt;
- If motors are supplied with terminal blocks, ensure the correct tightening torque on the motor terminals as specified in Table 8.7;
- Ensure that the cables do not contact sharp edges;
- Ensure that the original IP degree of protection is not changed and is maintained as indicate on the motor nameplate. The power supply cables and the control cables must always be fitted with components (cable glands, conduits) that meet the applicable standards and regulations of each country;
- Ensure that the pressure relief device is in perfect operating condition, if provided. The seals in the terminal box must be in perfect condition for reuse and must be reinstalled correctly to ensure the specified degree of protection;
- Ensure the correct tightening torque for the securing bolts of the terminal box cover as specified in Table 8.7.

***Table 8.7*** *- Tightening torque for the securing bolts [Nm]*

| Screw type and seal | M4 | M5 | M6 | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|---|
| Hex bolt/hex socket bolt (without seal) | - | 4 to 7 | 7 to 12 | 16 to 30 | 30 to 50 | 55 to 85 | 120 to 180 | 230 to 360 |
| Combined slotted screw (without seal) | - | 3 to 5 | 5 to 10 | 10 to 18 | - | - | - | - |
| Hex bolt/hex socket bolt (with seal with metallic stop/cord) | - | - | - | 13 to 20 | 25 to 37 | 40 to 55 | 50 to 65 | - |
| Combined slotted screw (with flat seal 'and/or mettallic stop/cord) | - | 3 to 5 | 4 to 8 | 8 to 15 | - | - | - | - |
| Hex bolt/hex socket bolt (with flat seal) | - | - | - | 8 to 15 | 18 to 30 | 25 to 40 | 35 to 50 | - |
| Terminal blocks | 1 to 1,5 | 1,5 to 4 | 3 to 6,5 | 6 to 9 | 10 to 18 | 15,5 to 30 | 30 to 50 | - |
| Grounding terminals | - | 3 to 5 | 5 to 10 | 10 to 18 | 30 to 50 | 55 to 85 | 120 to 180 | - |



## 8.4. DRYING THE STATOR WINDING INSULATION

Dismantle the motor completely. Remove the end shields, the rotor with the shaft, the fan cover, the fan and the terminal box before the wound stator with the frame is transferred to the oven for the drying process. Place the wound stator in the oven heated to max. 120 °C for two hours. For larger motors a longer drying time may be required. After the drying process has been concluded, allow the stator to cool to room temperature. Measure the insulation resistance again as described in item 5.4. Repeat the stator drying process if the required insulation resistance does not meet the values specified in Table 5.3. If the insulation resistance does not improve despite several drying processes, evaluate the causes of the insulation resistance drop carefully and an eventual replacement of the motor winding may be required. If in doubt contact WEG.

To prevent electrical shock, discharge the motor terminals immediately before, and after each measurement. If the motor is equipped with capacitors, these must be discharged before beginning any repair.

## 8.5. SPARE PARTS

When ordering spare parts, always provide complete motor designation, indicating the motor type, the code number and the serial number, which are stated on the motor nameplate.

Spare parts must always be purchased from WEG authorized Service Centers. The use of non-original spare parts can cause motor failure, performance drop and void the product warranty.

The spare parts must be stored in a clean, dry and properly ventilated room, with relative air humidity not exceeding 60%, with ambient temperature between 5 °C and 40 °C, free of dust, vibrations, gases, corrosive smokes and at constant temperature. The spare parts must be stored in their normal mounting position without placing other components onto them.

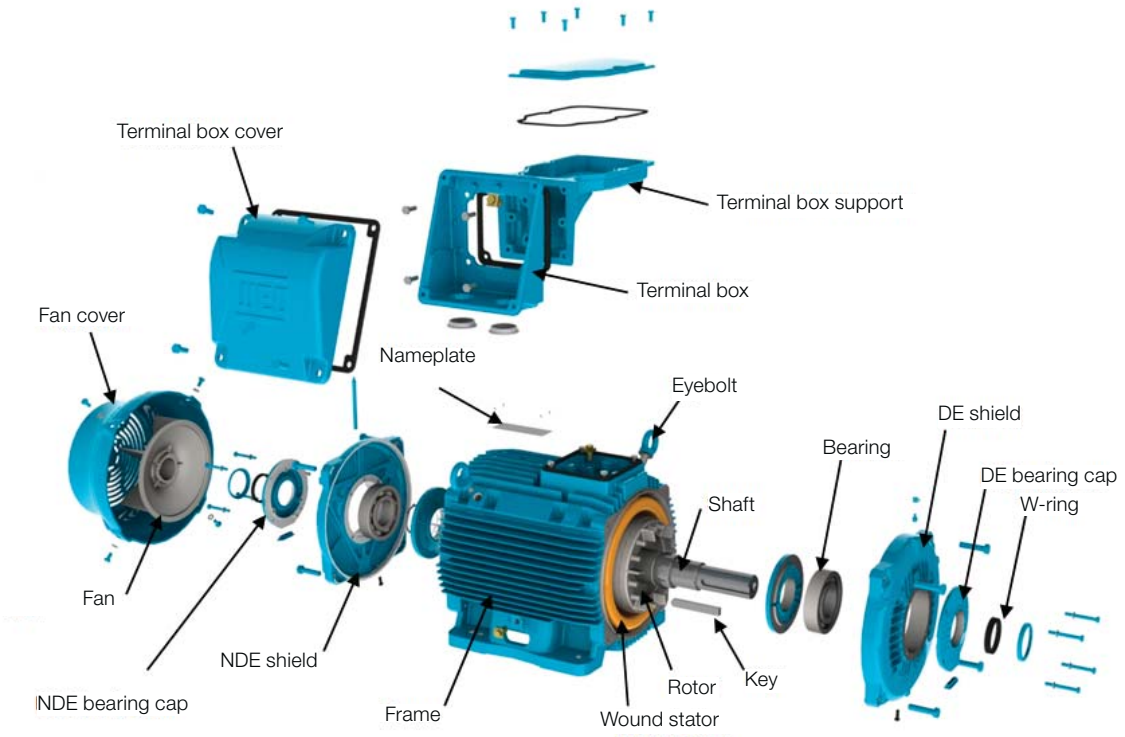


***Figure 8.2*** *- Exploded view of the components of a W22 motor*

# 9. ENVIRONMENTAL INFORMATION

## 9.1. PACKAGING

WEG electric motors are supplied in cardboard, plastic or wooden packaging. These materials can be recycled and must be disposed according to the applicable laws and regulations in each country. All wood used in the packaging of WEG motors come from the company reforestation program and is not submitted to any chemical conservation treatment.

## 9.2. PRODUCT

Electric motors consist mainly of ferrous metals (steel plates and cast iron), non ferrous metals (copper and aluminum) and plastic materials.

In general, electric motors have relatively long service live. However when they must be discarded, WEG recommends to dismantle the motor, sort the different materials and send them for recycling.

No-recyclable materials should be disposed of at industrial landfills according to the applicable environmental laws and regulations in each country, or co-processed in cement kilns or incinerated.

The recycling service providers, the disposal in industrial landfills, the waste co-processing or the incineration process must be properly authorized by the state environment agency to carry out these activities.

## 10. TROUBLESHOOTING CHART X SOLUTIONS

This troubleshooting chart provides a basic list of problems that may occur during motor operation, possible causes and recommended corrective actions. In case of doubts, please contact WEG Service Center.

| Problem | Possible cause | Corrective action |
|---|---|---|
| Motor does not start, neither coupled nor decoupled | Power cables are interrupted | Check the control panel and the motor power supply cables |
| | Blown fuses | Replace blown fuses |
| | Wrong motor connection | Correct the motor connection according to connection diagram |
| | Locked rotor | Check motor shaft to ensure that it rotates freely |
| The motor starts at no-load, but fails when load is applied. It starts very slowly and does not reach the rated speed | Load toque is too high during start-up | Do not start the motor on load |
| | Too high voltage drop in the power cables | Check the installation dimensioning (transformer, cable cross section, relays, circuit breakers, etc.) |
| Abnormal/excessive noise | Defective transmission component or defective driven machine | Check the transmission force, the coupling and the alignment |
| | Misaligned / unleveled base | Align / level the motor with the driven machine |
| | Unbalanced components or unbalanced driven machine | Balance the machine set again |
| | Different balancing methods used for motor and coupling balancing (halve key, full key) | Balance the motor again |
| | Wrong motor direction of rotation | Reverse the direction of rotation |
| | Loose bolts | Retighten the bolts |
| | Foundation resonance | Check the foundation design |
| | Damaged bearings | Replace the bearings |
| Motor overheating | Insufficient cooling | Clean air inlet and outlet and cooling fins |
| | | Check the minimum required distance between the fan cover and nearest walls. See item 7 |
| | | Check air temperature at inlet |
| | Overload | Measure motor current, evaluate motor application and if required, reduce the load |
| | Number of starts per hour is too high or the load inertia moment is too high | Reduce the number of starts per hour |
| | Power supply voltage too high | Check the motor power supply voltage. Power supply voltage must not exceed the tolerance specified in item 7.2 |
| | Power supply voltage too low | Check the motor power supply voltage and the voltage drop. Power supply voltage must not exceed the tolerance specified in item 7.2 |
| | Interrupted power supply | Check the connection of the power cables |
| | Voltage unbalance at the motor terminals | Check for blown fuses, wrong commands, voltage unbalance in the power line, phase fault or interrupted power cables |
| | Direction of rotation is not compatible with the unidirectional fan | Check if the direction of rotation matches the rotation arrow indicated on end shield |
| Bearing overheating | Excessive grease/oil | Clean the bearing and lubricate it according to the provided recommendations |
| | Grease/oil aging | |
| | The used grease/oil does not matches the specified one | |
| | Lack of grease/oil | Lubricate the bearing according to the provided recommendations |
| | Excessive axial or radial forces due to the belt tension | Reduce the belt tension |
| | | Reduce the load applied to the motor |

## 11. WARRANTY TERM

WEG Equipamentos Elétricos S/A, Motors Unit ("WEG"), offers warranty against defects in workmanship and materials for its products for a period of 18 months from the invoice date issued by the factory or distributor/ dealer, limited to 24 months from the date of manufacture.
Motors of the HGF Line are covered for a period of 12 months from the invoice date issued by the factory or distributor / dealer, limited to 18 months from the date of manufacture.
The paragraphs above contain the legal warranty periods.
If a warranty period is defined in a different way in the commercial/technical proposal of a particular sale, that will supersede the time limits set out above.
The warranty periods above are independent of the product installation date and the startup.
If any defect or abnormal occurrence is detected during machine operation, the customer must immediately notify WEG in writing about the occurred defect, and make the product available for WEG or its Authorized Service Center for the period required to identify the cause of the defect, check the warranty coverage, and perform the proper repairs.
In order for the warranty to be valid, the customer must be sure to follow the requirements of WEG's technical documents, especially those set out in the product Installation, Operation and Maintenance Manual, as well as the applicable standards and regulations in force in each country.
Defects arising from the inappropriate or negligent use, operation, and/or installation of the equipment, non-execution of regular preventive maintenance, as well as defects resulting from external factors or equipment and components not supplied by WEG, will not be covered by the warranty.
The warranty will not apply if the customer at its own discretion makes repairs and/or modifications to the equipment without prior written consent from WEG.
The warranty will not cover equipment, components, parts and materials whose lifetime is usually shorter than the warranty period. It will not cover defects and/or problems resulting from force majeure or other causes not imputable to WEG, such as, but not limited to: incorrect or incomplete specifications or data supplied by the customer; transportation, storage, handling, installation, operation and maintenance not complying with the provided instructions; accidents; defects in the construction works; use in applications and/or environments for which the machine was not designed; equipment and/or components not included in the scope of WEG supply. The warranty does not include disassembly services at the buyer's premises, product transportation costs and travel, lodging and meal expenses for the technical staff of the Service Centers, when requested by the customer.
The services under warranty will be provided exclusively at WEG authorized Service Centers or at one of its manufacturing plants. Under no circumstances will the warranty services extend the equipment warranty period.
WEG's Civil Liability is limited to the supplied product; WEG will not be liable for indirect or consequential damages, such as losses of profit and revenue losses and alike which may arise from the contract signed between the parties.

# 12. EC DECLARATION OF CONFORMITY

**WEG Equipamentos Elétricos S/A**
Av. Prefeito Waldemar Grubba, 3000
89256-900 - Jaraguá do Sul – SC – Brazil,

and its authorised representative established in the European Community,
**WEGeuro – Industria Electrica SA**
Contact person: Luís Filipe Oliveira Silva Castro Araújo
Rua Eng Frederico Ulrich, Apartado 6074
4476-908 – Maia – Porto – Portugal

hereby declare that the products:

WEG induction motors and components for using in these motors:

Three-phase
**IEC frames 63 to 630**
**Nema frames 42, 48, 56 and 143 to 9610**
……
Single-phase
**IEC frames 63 to 132**
**Nema frames 42, 48, 56 and 143 to 215**
……

when installed, maintained and used in applications for which they were designed, and in compliance with the relevant installation standards and manufacturer's instructions, comply with the requirements of the following European Directives and standards where applicable:

Directives:
**Low Voltage Directive 2006/95/EC***
**Regulation (EC) No 640/2009***
**Directive 2009/125/EC***
**Machinery Directive 2006/42/EC****
**EMC Directive 2004/108/EC** (inductions motors are considered inherently benign in terms of electromagnetic compatibility)

Standards:
**EN 60034-1:2010/ EN 60034-2-1:2007/EN 60034-5:2001/A1:2007/ EN 60034-6:1993/ EN 60034-7:1993/A1:2001/ EN 60034-8:2007/ EN 60034-9:2005/A1:2007/ EN 60034-11:2004/ EN 60034-12:2002/A1:2007/ EN 60034-14:2004/A1:2007/ EN 60034-30:2009, EN 60204-1:2006/AC:2010 and EN 60204-11:2000/AC:2010**

CE marking in: **1996**
* Electric motors designed for use with a voltage rating higher than 1,000 V are not considered under the scope.
** Low voltage electric motors are not considered under the scope and electric motors designed for use with a voltage rating higher than 1,000 V are considered partly completed machinery and are supplied with a

**Declaration of Incorporation:**

*The products above cannot be put into service until the machinery into which they have been incorporated has been declared in conformity with the Machinery Directive.*

*A Technical Documentation for the products above is compiled in accordance with part B of annex VII of Machinery Directive 2006/42/EC.*

*We undertake to transmit, in response to a reasoned request by the national authorities, relevant information on the partly completed machinery identified above through WEG authorised representative established in the European Community. The method of transmission shall be electronic or physical method and shall be without prejudice to the intellectual property rights of the manufacturer.*

Milton Oscar Castella
*Engineering Director*

Jaraguá do Sul, April 8th, 2013

Honeywell

# 5500 & 7700 Series Half Masks

## *Operating and Maintenance Instruction Manual*


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## INTRODUCTION

The 5500 and 7700 Series are comprised of half masks that are one component of a complete respirator. Components of these respirators are sold separately. Only those components manufactured by Honeywell and listed on the approval label may be used. These User Instructions refer only to the use and maintenance of these half masks, and to the assembly and use of these half masks as part of an air-purifying respirator. These respirators should **only** be used and maintained by individuals who have completely read and understand the instructions contained within this Instruction Manual and any other Operating and Maintenance Instruction Manuals included with the other components of a complete respirator. For more information and a complete listing of approved components refer to the Honeywell web site www.honeywellsafety.com.

## NIOSH CERTIFICATIONS

When components listed on the NIOSH Approval Label are used, these respirators are approved as part of air-purifying, powered air-purifying or supplied air respirators. Refer to the User Instructions of those components (e.g. Compact Air PAPR) and the NIOSH approval labels supplied with these products for a listing of all components that must be used to assemble a complete NIOSH approved respirator. When used as air-purifying respirators the 5500 and 7700 Series are for protection from hazardous gases, vapors and/or particulates where the concentration does not exceed 10 times the Permissible Exposure Limit (PEL); is below the contaminant's Immediately Dangerous to Life or Health (IDLH) threshold; and there is sufficient oxygen according to the OSHA or CSA requirements.

## AUSTRALIAN CERTIFICATIONS

When components listed on the AS/NZS Approval Label are used, these respirators are approved under Australian and New Zealand Standard 1716.2003 Lic. 0563 for respiratory protection against hazardous gases, vapors and/or particulates; depending on the air-purifying cartridges and/or filters used and the contaminant concentration and/or toxicity; and if there is sufficient oxygen present in the contaminated atmosphere to support life.

## TERMINOLOGY

Warnings, cautions and notes used in this manual have the following significance:

**NOTE**

Procedures and techniques that are considered important enough to emphasize.

**CAUTION**

Procedures and techniques which, if not carefully followed, will result in damage to the equipment.

**⚠ WARNING**

Procedures and techniques which, if not carefully followed, will expose the user to the risk of serious injury, illness or death.

**⚠ WARNINGS**

**Improper Use of Your Respirator Can Be Harmful or Deadly!**
**For Your Safety, Read and Follow These Directives.**
**If You Do Not Understand Them—Ask Your Supervisor!**

1. Failure to follow these instructions and warnings may result in exposure to the hazardous materials, exposing the user to the risk of serious injury, illness or death. These instructions DO NOT APPLY if your half mask is being used as part of a powered air-purifying or supplied air respirator. Refer to the User Instructions for those components.

2. Never use this respirator:
   - To perform or observe sand-blasting/abrasive-blasting;
   - To fight fires;
   - In oxygen deficient atmospheres (any atmosphere having less than 19.5% oxygen by volume at sea level);

- In atmospheres where the concentrations of toxic contaminants are unknown, or are Immediately Dangerous to Life or Health (IDLH). An IDLH atmosphere is any atmosphere which has a concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life, which would cause irreversible debilitating effects on health, or which would interfere with the ability to escape from a dangerous atmosphere.
- In atmospheres where the concentration of the contaminant exceeds:
  - *i. If part of an OSHA or CSA Respiratory Protection Program:*
    1. 10 times the contaminant's permissible exposure limit (PEL). PEL is defined as the maximum permissible 8-hour time weighted average (TWA) concentration established by applicable OSHA or other government regulations, or by NIOSH, ACGIH or CSA.
    2. Any lower Maximum Use Concentration for that contaminant established by OSHA or other government regulations, NIOSH, ACGIH or CSA publications, or shown in the contaminant's Material Safety Data Sheet.
  - *ii. If part of a Worksafe Australia Respiratory Protection Program:*
    1. In atmospheres where the concentration of the contaminant exceeds 10 times the contaminant's permissible exposure limit set by Worksafe Australia or other government regulations.
- With any filters or cartridges other than those certified for use with this facepiece by the appropriate certifying organization.
- To protect against contaminants not listed on the label for that filter or cartridge.
  - *i. If part of an OSHA or CSA Respiratory Protection Program* the label is the NIOSH Approval label included with NIOSH approved cartridges and included with these User Instructions.
  - *ii. If part of a Worksafe Australia Respiratory Protection Program* the ratings on filters and cartridges are marked on cartridges certified to Australian and New Zealand Standards as P, A, B, E and/or K.
- To protect against oil-based aerosols unless an 'R' or 'P' filter (defined by NIOSH) is used when the respirator is used as part of an OSHA or CSA Respiratory Protection Program.
- Without either an End-of-Service-Life Indicator (ESLI) on the cartridge for the gas and/or vapor present, or an established cartridge change schedule for all gases and vapors for which there is no ESLI.
- In poorly ventilated areas, or confined spaces such as tanks, small rooms, tunnels or vessels, unless the confined space is well ventilated and the concentration of toxic contaminants is known to be, and will continue to be, below the Maximum Use Concentration recommended for the respirator.

3. Immediately leave work area and remove respirator if:
   - Breathing becomes difficult;
   - You become dizzy or disoriented;
   - You smell, taste or otherwise sense contaminants; or
   - Your respirator is damaged.

4. This respirator will not protect exposed areas of face or body from gases, vapors or airborne particles that can irritate, burn or be absorbed through your skin. You must wear hand and/or body protection.

5. Do not alter or modify this device in any way. Any alterations or modifications, including painting, affixing labels or using unapproved replacement parts can reduce protection and expose the user to the risk of illness, injury or death.

## HEALTH LIMITATIONS

You should be certified medically fit prior to using this respirator. In addition there are both physiological and psychological limitations which should be considered before using respirators. They include, but are not limited to:

a) Emphysema
b) Chronic obstructive pulmonary disease
c) Bronchial asthma
d) X-ray evidence of pneumoconiosis
e) Evidence of reduced pulmonary function
f) Coronary artery disease
g) Severe or progressive hypertension
h) Epilepsy (grand mal or petit mal)
i) Pernicious anemia
j) Diabetes (insipidus or mellitus)
k) Breathing difficulties when wearing a supplied air respirator
l) Claustrophobia or anxiety when wearing a supplied air respirator
m) Abnormal EKG results from resting or stress tests
n) Punctured or ruptured ear drum
o) Medications

## TRAINING PROGRAM

These brief written instructions cannot substitute for a formal Respirator Training Program. Such training must be taken prior to first use of this product and should include an opportunity for you to handle the respirator, learn how to inspect it, have it properly fitted, wear it in normal air for a long familiarity period, and finally, to wear it in a test atmosphere.

The Training Program should be based on the most recent OSHA Regulation 29 CFR Section 1910.134, CSA Standard Z94.4, or Australian and New Zealand Standard 1715. You should also be familiar with any other pertinent regulations promulgated by various Regulatory Authorities including ANSI Z88.2 in the USA.

## FIT TESTING

Any respirator with a tight fitting facepiece may not be assigned until the user is given a qualitative or quantitative respirator fit test and the results of the test indicate that the facepiece of the respirator fits that person properly. The 5500 and 7700 Series are available in three sizes. The letters "S" "M" or "L" on the facepiece indicate sizes Small, Medium or Large. See instructions below for putting on the respirator. Refer to the most recent OSHA 29 CFR 1910.134 Appendix A (USA), CSA Z94 (Canada), or AS/NZS 1715 for specific Fit Test procedures (Australia and New Zealand).

## KEY TO NIOSH APPROVAL LABEL CAUTIONS AND LIMITATIONS FOR AIR-PURIFYING RESPIRATORS

| | |
|---|---|
| A | Not for use in atmospheres containing less than 19.5 percent oxygen. |
| B | Not for use in atmospheres immediately dangerous to life or health. |
| C | Do not exceed maximum use concentrations established by regulatory standards. |
| H | Follow established cartridge and canister change schedules or observe ESLI to ensure that cartridges and canisters are replaced before breakthrough occurs. |
| J | Failure to properly use and maintain this product could result in injury or death. |
| L | Follow the manufacturer's User's Instruction for changing cartridges, canisters and/or filters. |
| M | All approved respirators shall be selected, fitted, used and maintained in accordance with OSHA and other applicable regulations. |
| N | Never substitute, modify, add or omit parts. Use only exact replacement parts in the configuration as specified by the manufacturer. |
| O | Refer to the User's Instructions and/or maintenance manuals for information on use and maintenance of these respirators. |
| P | NIOSH does not evaluate respirators for use as surgical masks. |

S1 Honeywell N-Series gas and vapor cartridges manufactured after August 2012 require the use of a spider (P/N N750038) when a pad style filter is used with the cartridge.

S2 If the air-purifying cartridges have an ESLI, you must be able to see the indicator without moving the facepiece in any way that could break the facepiece-to-face seal.

## INSPECTION

Each and every time you put on your respirator and prior to storage, you must inspect all components for wear or damage. If any component is missing or damaged, do not use this respirator.

1) Check the facepiece for any tears, holes or other damage.
2) Check the inhalation and exhalation valves to assure they are not missing or damaged.
3) Pull gently on the head straps to assure the elastic is not worn. Check the hook and eye for any damage.
4) Check the cartridge connectors to assure they are seated properly and are not cracked.

If any components are missing or damaged do not use this respirator.

## ASSEMBLING THE RESPIRATOR

To use this half mask as an air-purifying respirator you need to attach a filter, cartridge or cartridge/filter combination. Follow the directions below for the filter or cartridge type you are using.

1) If you are using a pad style filter only, you will need P/N N750037 (includes two N750027 covers and two N750015 filter holders) in addition to the two filters.
   a) Place each filter into the filter cover, paying attention to the instructions on the filter "this side towards face" or "this side away from face" (Figure 1).
   b) Snap the filter cover and filter onto the filter holder (Figure 2). Proceed to Step 5.
2) If you are using a pad style filter with a gas or vapor cartridge manufactured after August 2012 you will need P/N N750036 (includes two N750027 filter covers and two N750038 spiders) in addition to the two filters. If your cartridge was manufactured prior to August 2012 you will need two filter covers (P/N N750027), and proceed to Step 2b.

### ⚠ S1 – SPECIAL OR CRITICAL USER'S INSTRUCTIONS

Honeywell N-Series gas and vapor cartridges manufactured after August 2012 require the use of a spider (P/N N750038) when a pad style filter is used with the cartridge.

NOTE

Cartridges manufactured prior to August 2012 have a grid pattern; those manufactured after August 2012 have a circular pattern and require the use of a spider, (P/N N750038) (Figure 3).

a) Place the spider (P/N N750038) on the cartridge so the eight indented notches nestle on the inner raised circle and the part number "N750038" is not backwards (Figure 4).
b) Place each filter into the filter cover (P/N N750027), paying attention to the instructions on the filter "this side towards face" or "this side away from face" (Figure 1).
c) Snap the filter assembly onto the cartridge (Figure 5). Proceed to Step 5.

3) If you are using low profile filters with a gas or vapor cartridge you will need two N750035 adapters in addition to the filters.
   a) Snap the N750035 onto the cartridge.
   b) Being careful not to cross thread, attach the filter to the adapter. Proceed to Step 5.
4) If you are using the Backpack Adapter (P/N BP1002) with any combination of filters or cartridges, attach them to the male threaded end of the adapter. Check that the cartridges or filters are effectively sealed against the gasket on the back plate connector.

## ⚠ S2 – SPECIAL OR CRITICAL USER'S INSTRUCTIONS

If the air-purifying cartridges have an ESLI, you must be able to see the indicator without moving the facepiece in any way that could break the facepiece-to-face seal. Do not use cartridges with an ESLI if you are using the Backpack Adapter.

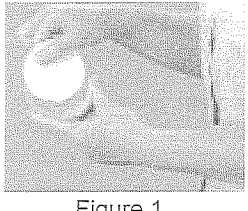


Figure 1

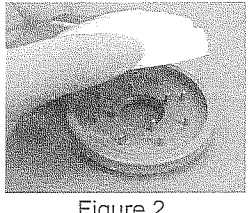


Figure 2

*Cartridges after June 2012*

*Cartridges before June 2012*

Figure 3

5) Attach your filter, filter assembly, cartridge, filter/cartridge or Backpack assembly onto the facepiece.
   a) Make sure the filters or cartridges do not cross thread.
   b) Turn filters / cartridges until they are seated snugly against the gasket and you notice resistance to further turning. Ensure the cartridges are flush with the facepiece seal and that the cartridge connectors and gaskets are also flush with the inside of the mask.
   c) Do not overtighten, as this may crack the cartridge connectors (Figure 6).
6) Tug slightly on your filter / cartridge assembly to assure that it is firmly affixed.

## ⚠ WARNINGS

The NIOSH and AS/NZS approvals and all Honeywell warranties for this respirator are nullified if cartridges and/or filters from other manufacturers are used.

Filters, cartridges, and filter cartridge combinations must be the same on both sides of the respirator.

Only use filters, cartridges or filter cartridge combinations for protection from contaminants listed on that filter or cartridge NIOSH or AS/NZS Approval Label.

Do not use the Backpack Adapter with cartridges that have an ESLI as you will not be able to see the indicators while wearing the respirator, and will not know when to change the cartridges.

Failure to comply with these warnings will result in the risk of serious injury, illness or death.

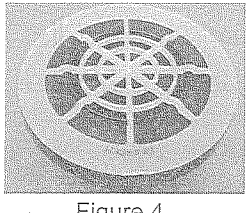


Figure 4

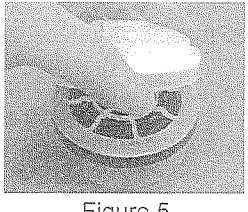


Figure 5

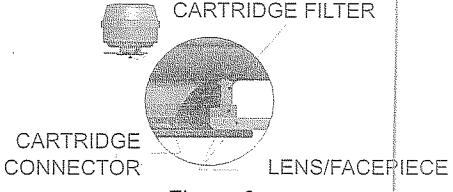



Figure 6

## PUTTING ON THE RESPIRATOR

Follow INSPECTION directions 1 through 3, then tug once more on the cartridges or filters to assure they are securely attached.

1) Remove any eyewear, hard hat or other headgear prior to putting on your respirator.
2) Adjust the head straps of the respirator to their full outward position.
3) With one hand holding the respirator, place your chin inside the chin cup, and the top of the respirator over your nose (Figure 7). If using the Backpack Adapter, the breathing tubes will go over your head and rest on your shoulders.
4) With your other hand, position the plastic head straps so they are centered on your head (Figure 8).
5) Remove any slack in the upper straps by pulling the two end tabs straight back. Do not pull out and away from your face. DO NOT TIGHTEN AT THIS POINT.
6) Fasten the bottom elastic straps behind your neck, and under any hair that is below the hairline (Figure 9).
7) Remove any slack in the lower straps by pulling the two back end tabs forward (Figure 10). DO NOT TIGHTEN AT THIS POINT.
8) Tighten the two upper and then two lower head straps in small, equal increments to ensure the respirator is tightened evenly and it is snug, comfortable and centered on your face. You can use either the back or front tabs of the lower straps.
9) Pull the respirator away from your face and maneuver it to assure it's centered, comfortable and snug. Put on any eyewear and headgear removed earlier.

Figure 7

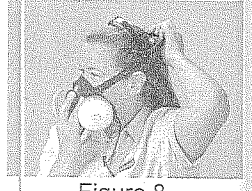


Figure 8

Figure 9

**⚠ WARNING**

Do not use your respirator if you cannot achieve a good facepiece-to-face seal due to:

1. Facial hair, including stubble,
2. Face coverings, jewelry or any other item that interferes with the sealing area, or
3. Missing teeth or dentures, facial deformities or deep scars that prevent a good seal.

NOTE

Honeywell respirators have a wide sealing area to assure a maximum seal to the face. Be careful not to overtighten the respirator. Overtightening could distort the facepiece and may cause leakage between the facepiece-to-face seal.

## USER SEAL CHECKS

Each time you put on a respirator before entering a hazardous atmosphere, and periodically while wearing the respirator in the contaminated area, you must check the effectiveness of the facepiece-to-face seal by conducting a User Seal Check.

1) Positive Pressure User Seal Check
   a) Place the palm of your hand over the exhalation valve and exhale normally (Figure 11).
   b) If the facepiece bulges slightly and no air leaks between the face and the facepiece, an effective seal has been obtained.
2) Negative Pressure User Seal Check
   a) Place the palms of both hands over the cartridges or filter covers and inhale normally. Hold your breath for 5 seconds (Figure 12).
   b) If the facepiece collapses and no air leaks between the face and the facepiece, an effective seal has been obtained.
3) If you detect any leaks, reseat the facepiece and/or readjust the tension of the head straps. Note that sometimes the straps may need to be loosened.
4) Repeat the User Seal Check(s) until an effective seal has been obtained. If you cannot achieve a seal, do not use this respirator. See your Supervisor for either a replacement respirator or to be refitted to an appropriate size.

⚠ WARNING

If you cannot promptly achieve an effective seal while wearing the respirator in a contaminated area, you should immediately leave the contaminated area to prevent the risk of serious injury, illness or death.

Figure 10

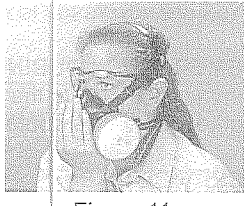


Figure 11

Figure 12

**NOTE**

OSHA 29 CFR 1910.134 Appendix B requires either a Positive or a Negative User Seal Check following the Manufacturer's instructions. CSA recommends following the Manufacturer's instructions, and provides guidelines for a Positive and Negative User Seal Check in Z94.4 Annex A.

Honeywell provides instructions for both seal checks since many Industrial Hygienists prefer the use of both methods, but only one of either two methods needs to be conducted. If you are conducting both a Positive and a Negative User Seal Check, conduct the Positive Seal Check first.

You are now ready to enter the contaminated area for which this respirator was designed.

## EMERGENCY DURING USE

Immediately leave the contaminated area if breathing becomes difficult; you become dizzy or disoriented; you smell, taste or otherwise sense contaminants; or your respirator becomes damaged.

## SERVICE LIFE

When this respirator is used for protection from gases or vapors with defined occupational exposure limits, you must follow a change-out schedule to assure the cartridges are changed before the end of their useful life. If the cartridges have an End-of-Service-Life Indicator (ESLI), the cartridges must be changed per the instructions that come with the ESLI cartridge. Filters must be replaced when breathing becomes difficult.

## REMOVING THE RESPIRATOR

**⚠ WARNING**

Before removing your respirator you must go to an area with uncontaminated air.

Unhook the clip on the bottom strap and remove the respirator.

## CLEANING YOUR FACEPIECE

During breaks and between a more thorough cleaning, a refresher wipe pad may be used to clean the portion of the mask that comes in contact with your face. Follow the steps below for a thorough cleaning.

1) Remove the cartridges or filters. Remove the Backpack Adapter if used.
2) Remove the headband assembly, all valves, exhalation seat and guard, and inhalation connectors from the facepiece.
3) Prepare a solution of cleaner sanitizer according to instructions.
4) Wash the facepiece and components thoroughly in the cleaner sanitizer solution. Use a soft brush on the facepiece and headgear assembly to loosen any caked on dirt.
5) Rinse the facepiece and components in clean, warm water and then let dry completely.
6) Reassemble your facepiece after following all steps outlined in INSPECTION.

**⚠ WARNING**

Never allow cartridges or filters to come in contact with water or cleaning and sanitizing solutions. Moisture can damage the cartridges or filters, and failure to comply with these warnings will result in the risk of serious injury, illness or death.

## STORAGE

Store in a clean, dry area away from the chance of any contamination. Use the respirator storage bag provided with the facepiece or any other sealable container that will protect the facepiece. Optimum storage conditions are room temperature, between 50°F (10°C) and 100°F (38°C).

**⚠ WARNING**

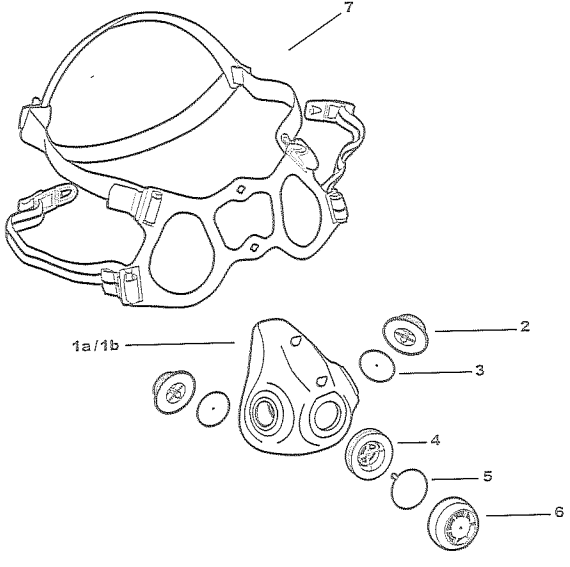
Never store the facepiece with cartridges or filters that have been exposed to contaminants. If cartridges and/or filters are to be reused, seal them in a separate bag or container. Do not expose to direct sunlight, chemical pollutants or dust.

Cartridges that have been exposed to contaminants with a low boiling point, and all NIOSH rated R filters that have been exposed to oil-based aerosols must be discarded at the end of a shift. When discarding contaminated cartridges, facepieces or components, follow local, state and/or national regulations pertaining to disposal of HazMat and/or other contaminated articles. Consult your supervisor and/or proper authorities.

**CAUTION**

Do not expose the respirator to excessive heat (above 140°F [60°C]), moisture or contaminative substances, or stack undue weight on top of the facepiece or components during storage because such conditions may distort the facepiece, resulting in the inability to achieve a proper fit the next time the facepiece is worn, or they may compromise the functionality of the component.

## REPLACEMENT PARTS




**Complete Assembly**

For NIOSH Approved Respirators:

| | |
|---|---|
| 550030S, M, L | Elastomeric Half Mask, sizes small, medium and large |
| 7700030S, M, L | Silicone Half Mask, sizes small, medium and large |

For AS/NZS Approved Respirators:

| | |
|---|---|
| 550030AS, M, L | Elastomeric Half Mask, sizes small, medium and large |
| 7700030AS, M, L | Silicone Half Mask, sizes small, medium and large |

**Replacement Parts for NIOSH & AS/NZS Approved Respirators**

| | | |
|---|---|---|
| 1a | 550011S, M, L | Basic Facepiece for 5500, sizes small, medium and large |
| 1b | 770011S, M, L | Basic Facepiece for 7700, sizes small, medium and large |
| 2 | 770016 | Cartridge Connector |
| 3 | 770017 | Inhalation Valve |
| 4 | 770019 | Exhalation Valve Seat |
| 5 | 770018 | Exhalation Valve |
| 6 | 770020 | Exhalation Valve Guard |
| 7 | 770092 | Cradle Suspension System |

## ADDITIONAL COMPONENTS

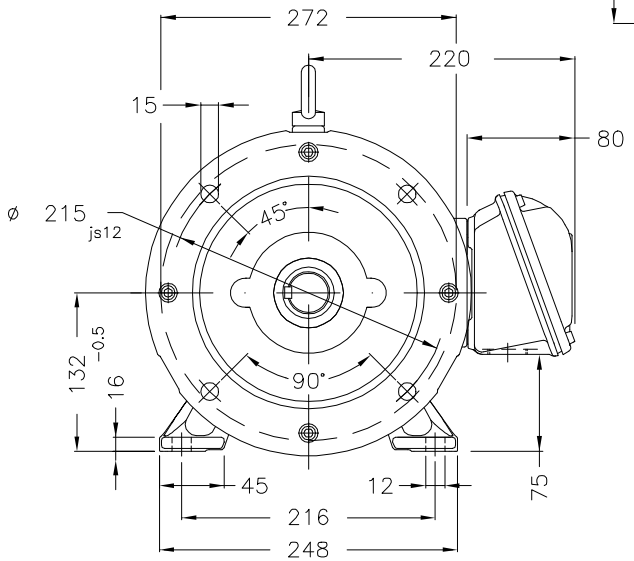
| Part No. | Description |
|---|---|
| **Cartridge and Filter Holders** | |
| N750035 | Adapter for low profile filters to attach filters to gas or vapor cartridges |
| N750036 | Assembly for filters. Includes (2) N750027 covers and (2) N750038 spiders to attach filter pads to gas and vapor cartridges |
| N750037 | Assembly for filters. Includes (2) N750027 covers and (2) N750015 filter holders to attach filters to facepiece |
| N750037A | Assembly for filters. Includes (2) N750027 covers and (2) N750015 filter holders to attach filters to facepiece |
| BP1002 | Backpack Adapter |

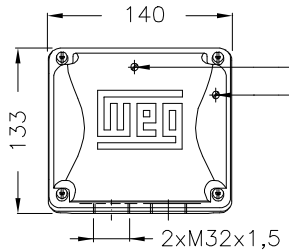
| EIXO/SHAFT | |
|---|---|
| PADRÃO/STANDARD | X |
| OPCIONAL/OPTIONAL | |
| ESPECIAL/SPECIAL | |

Dimensões em mm
Dimensions in mm

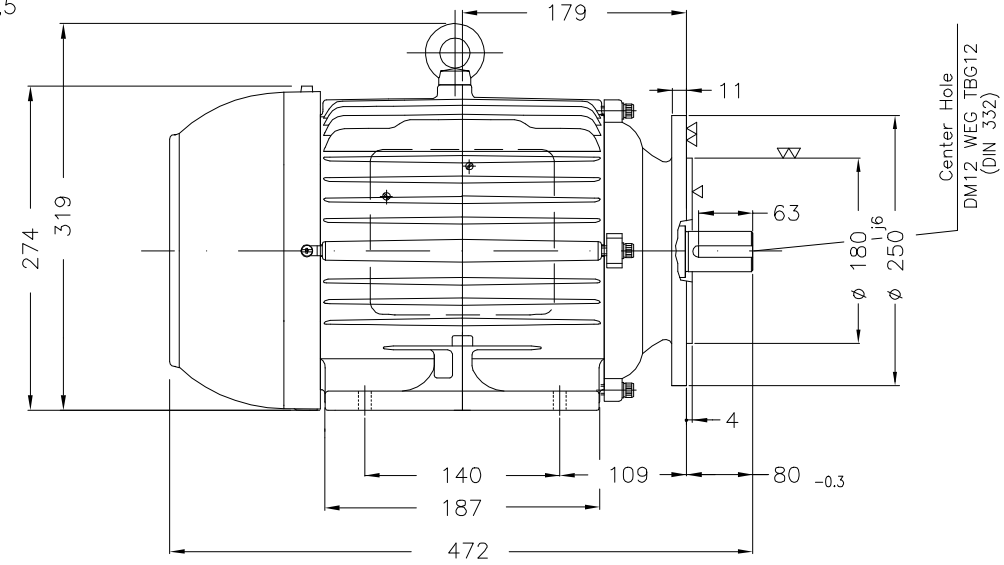
CERTIFIED
WEG MOTORES
Certified document.
Not subject to changes.

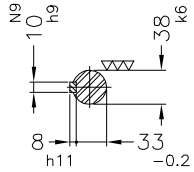
THIS IS AN UPDATED REVISION, THE PREVIOUS ONE MUST BE DISREGARDED.




Main terminal box




DE Shaft End

Tampa flangeada (FF) inferior / One size reduced flange
Plano de pintura 207A / Painting plan 207A
Forma construtiva B35E / Mounting B35L(E)

V.J. PAMENSKY CANADA INC.

| ECM | LOC | SUMMARY OF MODIFICATIONS | EXECUTED | CHECKED | RELEASED | DATE | VER |
|---|---|---|---|---|---|---|---|
| 500000857248 | | DOCUMENTO NOVO | SCARMAGNANI | | DFRANCISCO | 20.02.2014 | 00 |

| | | | |
|---|---|---|---|
| EXECUTED | SCARMAGNANI | THREE PHASE W22 TRU-METRIC PREMIUM EFF | 10002722104 |
| CHECKED | | FRAME 132S IP55 | 000 \| 00 |
| RELEASED | DFRANCISCO | | |
| REL DT | 20.02.2014 | WMO JARAGUA DO SUL ENGENHARIA DE PRODUTO | SHEET 1 / 1 |

7.5 HP 04 Poles 60Hz 413340526/0 A

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**Price® Pump Co.**

# INSTALLATION, OPERATING AND MAINTENANCE MANUAL

## TYPE RC CENTRIFUGAL PUMPS

## MODELS: RC 200/300

**PLEASE FILL IN FROM PUMP NAMEPLATE**

Pump Model_____

BOM. No._____

Serial No._____

RETAIN MANUAL FOR REFERENCE

Price® Pump Company
21775 8th. Street East
Sonoma, CA 95476
Tel: 707-938-8441
Fax 707-938-0764
Email: sales@pricepump.com

# Congratulations

You are now the owner of a Price® Pump Co. Centrifugal Pump. This pump was carefully inspected and subjected to final performance tests before being released for shipment. In order to achieve maximum performance and reliability, please follow the simple instructions in this manual.

## RECOMMENDED PRECAUTIONS

**1. For satisfactory operation and safety, maximum system pressure must not exceed 350 psi* (24.6kg/sq cm).**

**2. For satisfactory operation and safety, maximum fluid temperature must not exceed 300°F* (121°C).**

**3. No modifications, additions or deletions should be made to the pump without prior approval of the factory.**

**4. Drain pump completely and flush with water before servicing a pump handling volatile or harmful liquids.**

## READ CAREFULLY THE CAUTION BELOW

The performance of your Price® Pump Co. Centrifugal Pump is based on clean, room temperature, water with suction conditions as shown on the performance curves. If used to pump liquids other than water, pump performance may differ from rated performance based on the different specific gravity, temperature, viscosity, etc. of the liquid being pumped. A standard pump, however, may not be safe for pumping all types of liquids, such as toxic, volatile or chemical liquids, or liquids under extreme temperatures or pressures.

Please consult Price® Pump Co. technical specifications as well as local codes and general references to determine the appropriate pump for your particular application. Since it is impossible for us to anticipate every application of a Price® Centrifugal pump, if you plan to use the pump for a non-water application, contact Price® Pump Co. beforehand to determine whether such application may be appropriate and safe under the operating conditions. Failure to do so could result in property damage or personal harm.

* Depends on seal materials and seal type

Visit our website for product information and technical support

www.pricepump.com

# INSTALLATION / OPERATING INSTRUCTIONS
# CENTRIFUGAL PUMPS

**Warning**

Before installing, repairing or performing maintenance on this pump, read these instructions completely.

Disconnect power to pump before servicing to avoid dangerous or fatal electrical shock.

Match supply voltage and frequency to motor nameplate values. Incorrect voltage can cause fire or serious motor damage and void warranty.

Ground motor before connection to electrical power supply! Failure to ground motor can cause severe or fatal electrical shock!

**Do not ground to gas supply line!**

Before disassembling pump, be certain all liquid has been removed. If pump was used to pump hazardous or toxic fluid, it must be decontaminated prior to disassembly.

**Close Coupled Motor Pumps**

It is suggested that these pumps be firmly bolted to a level surface. Adequate air movement around motor will help prevent overheating.

Do not over tighten inlet and outlet piping or volute may be damaged.

**Power Frame Mounted Pumps**

Power Frame mounted pumps must be mounted on a rigid base that will not warp or flex. Each pump must be mounted such that the pump shaft centerline is in-line with the driver shaft centerline. Pads and/or shims will be required on the pump, the driver or both to insure proper alignment. The two shafts should not touch each other (end to end) and the distance between them depends on the coupling used to connect them.

Misalignment will cause vibration, bearing failure and void warranty. Pumps are rough aligned at the factory but must be realigned after shipment and installation.

Pulley driven pump must have pulleys inline and proper belt tightness practices followed.

**Direction of Rotation**

Note: Motor shaft rotation is viewed from the suction end of pump. A rotational arrow is shown on the front of the pump volute casing. Incorrect rotation can cause pump damage, failure or reduced performance, voiding warranty. It is best to check rotation by momentarily energizing or jogging the motor prior to filling pump with liquid.

**Warning!** Do not operate pump without liquid as damage may result to the pump internal wear surfaces.

**Plumbing**

All piping needs to be supported independently of the pump. Piping connections should not exert any stress on the pump volute or fittings.

**Suction Piping (Inlet)**

(Horizontal Pumps)

Suction line must provide adequate suction pressure and even (Laminar) liquid flow for proper pump operation. Air, entrapped in the suction line due to leaks or improper piping design, may cause the pump to lose prime. Non-priming pumps must have their suction 'flooded' at start up (see datasheets for minimum NPSHR). Also, the suction line must provide sufficient pressure (NPSH) and even flow to pump inlet to prevent pump cavitation. The suction pipe entering the pump should be straight and a minimum length of 5 times and preferably 10 times the pump inlet diameter. Elbows, fittings or valves installed close to the pump inlet can disrupt liquid flow and cause cavitation. Suction lines must be at least the same diameter as the pump inlet or larger if possible.

Price Pump Company recommends against using foot valves in the suction line to maintain liquid in the pump when it's not operating. If foot valves are used, due to suction lift conditions, they must be properly maintained to avoid leaks resulting from wear or fouling. Suction piping must be designed to prevent vapor from being trapped in high spots in the piping. This condition may cause the pump to vapor lock.

**Discharge Piping (Outlet)**

To control flow and discharge head, it is advisable to install a valve (globe, ball, or other adjustable and non-leak type) in the discharge line adjacent to the pump. The valve may be closed during system repairs to prevent backflow. By installing a check valve in the discharge line, backflow can also be prevented during maintenance or during periods of pump stoppage.

**Operation**

All centrifugal pumps must be filled with liquid prior to start up. It is suggested that during initial start up the discharge valve be closed and then opened as the motor reaches full rpm's. If pump does not build up pressure as motor speed increases, shut down and make sure that liquid flow into pump is not restricted (see "Troubleshooting").

**Note:** A centrifugal pumps flow rate and head (pressure) will vary with the amount of resistance (pipe friction and flow restrictions) in the discharge line. As the valve on the discharge line opens, the flow rate and motor amperes draw will increase and head (pressure) will decrease. As the valve on the discharge line is closed, the flow rate and amperes draw will decrease and the head (pressure) will increase.

If resistance in the discharge line is not sufficient, the pump will operate at a condition of maximum flow, sometimes called "end of curve" performance. Maximum horse-power is required to operate at this point and motor overload may result. If excessive amperes draw and motor overload is occurring, reduce the system flow rate by installing a valve or orifice in the discharge line to control (restrict) the pumps flow rate. Alternatively, reduce pump head by trimming impeller to a smaller diameter.

Consult Price Pump or a local Price Pump distributor for assistance.

www.appsupport@pricepump.com

**1. Pump fails to build head pressure:**

Check for:

a. Pump not primed.

b. Incorrect pump rotation.

c. Driver speed too low.

d. Suction line restricted.

e. Driver failure.

f. Plugged or damaged impeller.

g. Pump or impeller undersized.

h. Pump cavitation.

i. Improper impeller clearance.

**2. Pump fails to provide enough flow rate.**

Check for:

a. System resistance too high.

b. Pump undersized.

c. Pump not primed.

d. Driver speed too low.

e. Poor suction conditions.

f. Improper impeller clearance.

**3. Excessive noise or vibration during operation.**

Check for:

a. Motor bearing failing.

b. Pump cavitation.

c. Improper impeller clearance.

**4. Leaking mechanical seal.**

Check for:

a. Improper assembly.

b. Worn or cracked seal faces.

c. Abrasive material in fluid.

d. Liquid flashing at seal faces (Fluid temperature too high).

e. Seal pressure rating too low for the service.

f. Chemical attack of seal components.

g. Seal operated dry or with a liquid having poor lubricating properties.

**5. Pump gradually loses pressure and head.**

Check for:

a. Increasing temperature causing cavitation or liquid vaporization.

b. Driver failure.

c. Suction lift too high.

d. Air entering suction line.

**6. Motor overheating.**

Check for:

a. Excessive flow and amp draw (Throttle discharge).

b. Low voltage or frequency.

c. Flow rate too low with resulting heat rise.

d. Bearing failure.

e. System temperature too high.

Before attempting any repairs under warranty, contact Price Pump to obtain factory authorization. Repairs carried out without authorization may void warranty. Many causes of pump failure are due to improper system design. Refer to the trouble shooting list in this manual before carrying out pump inspection or repair.

**DISASSEMBLY**

1. Disconnect power source to motor.

2. Disconnect electrical connections tagging wires carefully to preserve correct rotation. Loosen motor base.

3. Remove pump and motor assembly to repair area.

4. Remove volute from pump.

5. Unscrew and remove impeller lockdown bolt and lock washers. Slide impeller off shaft. (If 'keyed' shaft design, do not throw away the shaft key).

6. Remove seal head from the shaft. **Type 6A:** Remove seal head from bracket. **Type 21:** Slide seal head from the shaft. **Type 9:** Loosen set screws and slide seal head off shaft.

7. Remove four motor bolts and remove bracket from motor.

8. Remove seal seat from bracket. Use wooden or plastic dowel to remove the seat from the bracket.

**REASSEMBLY**

If PEO (pump end only) go assembling PEO.

1. Thoroughly clean the seat cavity of the bracket.

2. Thoroughly clean pump shaft. Assure that the shaft is not grooved and that there is no evidence of pitting or scoring. If the shaft is grooved, scored or worn, replace it.

3. Install the pump shaft onto the motor shaft, aligning set screws of the pump shaft with the keyway of the motor shaft. Install slinger between the pump shaft setscrews.

4. **Type 6A**

a. Place bracket on firm surface with seat cavity (pump end) up. Using a tool (1-19/64" ID x 1-5/8" OD x 1/2" deep), press seal into seal cavity with carbon face of seal (volute end up) up. Press until flange is seated in seal cavity of bracket. Press only on outer flange of seal. Avoid touching carbon surface.

b. Place bracket on motor (aligning the base if applicable). Secure bracket with four motor bolts.

c. Pull pump shaft forward until shoulder of pump shaft contacts back of bracket and slightly snug one setscrew to hold shaft in place.

d. Apply small amount of oil (vegetable or other light oil) on the pump shaft and I.D. of seat elastomer. Gently place seat on end of shaft with ceramic face down toward seal. After sliding impeller onto shaft, seat will be properly located.

e. Slide impeller onto shaft ensuring seat is pushed flush with shoulder of shaft and impeller hub.

f. Install shaft key (if applicable), impeller flat washer, lock washers and lockdown bolt. Tighten securely to 10ft.lbs. Caution: Serviceable Loctite (or equivalent) must be used on lockdown bolt. Lock washer pairs must be assembled 'cam face' to 'cam face'. See diagram.

g. Loosen pump shaft set screw.

h. Install new volute gasket or o-ring and mount volute to bracket. Secure with bolts and tighten evenly.

i. **Setting impeller clearance:**

**Slide pump shaft forward until impeller touches volute. Slide shaft back .010-.015". Tighten pump shaft set screws. Turn shaft by hand to ensure impeller does not rub against volute. Proceed to step 9.**

5. **For Type 21, 8, 9 seals:**

a. Place the bracket on a firm surface with the seat cavity (pump end) up.

b. Place a small amount of light oil on the seat cup or o-ring seat. Place the seat in the seat cavity with the polished face up toward the pump end.

c. Evenly push seat into cavity with fingers then gently tap seat into place with a wooden dowel or plastic rod (1-1/8" outside diameter). To help ensure the seat is not damaged place the cardboard disk supplied with the seal over the seat face.

6. Place bracket on motor (aligning the base if applicable). Secure bracket with four motor bolts.

7. Pull pump shaft forward until shoulder of pump shaft contacts back of bracket and slightly snug one setscrew to hold shaft in place

8. Install seal head assembly

**For Type 21 Seals:**

a. Lubricate shaft and seal elastomer with oil (vegetable or other light oil).

b. Install rotary seal head onto pump shaft and slide toward seat until carbon face contacts ceramic seat.

c. Install seal spring and retainer.

d. Installing impeller. Install key in pump shaft. Slide impeller onto shaft ensuring that the spring retainer does not slip between the shoulder of the shaft and the hub of the impeller. Install impeller flat washer, lock washers and lockdown. Tighten securely to 10 ft. lbs. **Caution:** Serviceable Loctite (or equivalent) must be used on lockdown bolt. Lock washer pairs must be assembled 'cam face' to 'cam face'. See diagram

e. Loosen pump shaft set screw.

f. Install new volute gasket/o-ring and mount volute to bracket. Secure with bolts and tighten evenly.

g. Slide pump shaft forward until impeller touches volute. Slide shaft back with a screwdriver **.010"-.015".** Tighten pump shaft set screws. Turn shaft by hand to ensure impeller does not rub against volute. Proceed to step 9.

**For Type 8 & 9 Seals:**

a. Install impeller. Install key in pump shaft. Slide impeller onto shaft and install impeller washer and lockdown bolt. Tighten securely.

b. Loosen pump shaft set screw.

c. Install new volute gasket/o-ring and mount volute to bracket. Tighten at least two bolts at this time.

d. Slide pump shaft forward until impeller touches volute. Slide shaft back **.010"-.015".** Tighten pump shaft set screws. Turn shaft by hand to ensure impeller does not rub against volute.

Remove volute and impeller.

e. Install seal head onto pump shaft sliding gently past shoulder of shaft. Slide seal head toward seat until carbon face contacts ceramic seat. Tighten seal head setscrews to pump shaft. **Remove clips in seal head and discard.**

j. Reinstall impeller, flat washer, lock washers and lockdown bolt. Tighten securely (10 ft. lbs.)

**Caution:** Serviceable Loctite (or equivalent) must be used on lockdown bolt. Lock washer pairs must be assembled 'cam face' to 'cam face'. See diagram

k. Install new volute gasket or o-ring and mount volute to bracket. Secure with bolts and tighten evenly.

l. Rotate pump shaft by hand to ensure impeller does not rub against volute.

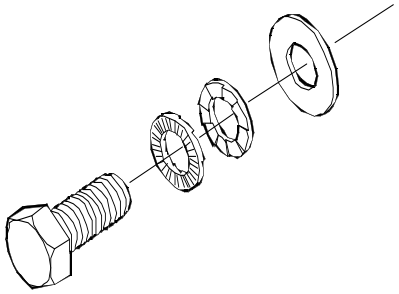
9. Return pump to installation, reconnect electric connections.

10. Start pump momentarily to observe shaft rotation. If rotation corresponds to the rotation arrow, pump may be put into service. If rotation is incorrect, switch any two leads on 3-phase motors. Check wiring diagram of motor for proper single phase rotation.

11. Remove top pipe plug (if applicable) from the front of volute and prime pump thoroughly, making sure all entrapped air is purged.

12. Start pump allowing adequate time to purge all air from system. Observe any gauges, flow meters, etc. to see of pump performs properly.

DIAGRAM OF
LOCKDOWN ASSEMBLY



**INSTALLING A PEO (PUMP END ONLY)**

a. Place the bracket on a firm surface, loosen stub shaft setscrews and carefully remove shipping plug.

b. Place motor in an upright position with motor shaft pointing upward. Make sure motor shaft and end bell flange are free of burrs and surfaces are clean.

c. Align PEO stub shaft setscrews with motor shaft keyway and carefully slid the PEO onto the motor shaft until it sits firmly onto the motor end bell flange.

d. Oriented the PEO's discharge port or base to preferred motor configuration while referencing the motors electrical box position.

e. Install flange bolts and tighten. (Install pump base if applicable)

f. Reposition pump back onto motor base.

g. Refer to pump Reassembly Instructions and proceed to **setting the impeller clearance**.

**Type 21 C Face Style Double Seal Installation**

**(For Type CD, RC, LT & MS Series Pumps)**

Double Seal pumps are generally used for one of these reasons:

1. To avoid seal damage when pumping abrasives.

2. To manage seal temperature when pumping hot liquids.

3. To prevent pump fluid from leaking to atmosphere when pumping toxic or other hazardous liquids.

A double seal must have pressure to the seal chamber at a minimum of 5 PSI preferable 10 PSI above pump pressure.

Flow rate through seal chamber will depend upon pump fluid temperature. Minimum flow should be 1 GPM for CD, RC, LT & MS Series Pumps. Flow rates may have to be increased with higher temperatures. Check the seal chamber discharge fluid temperature to be sure fluid is below boiling. We suggest a 140°F to 150°F temperature range. If seal cooling liquid flashes, seal may become damaged. Seal chamber fluid should enter at the bottom and discharge at the top to avoid entrapped air in the chamber. Be sure to prime the secondary pumping system properly as you would any other system.

**CAUTION: Always Pressurize the Seal Chamber before starting the main pump!**

In a pumping system that starts and stops automatically, insure that both pumps start at the same time.

**REASSEMBLY:**

1. Clean seat cavity of the bracket and seal plate thoroughly.

2. Thoroughly clean pump shaft. Assure that the shaft is not grooved and that there is no evidence of pitting or fretting. Polish the shaft with extra fine emery cloth and clean the keyway. If the shaft is grooved, fretted or worn, replace it.

3. Install the pump shaft onto the motor shaft, aligning set screws of the pump shaft with the keyway of the motor shaft. Ensure all debris and burrs are removed from the motor shaft and that the slinger is in place.

4. Place bracket on motor (aligning the base if applicable). Secure bracket with four motor bolts.

5. Pull out pump shaft as far as it will go toward volute end and slightly tighten one set screw to hold shaft in place

6. Place a small amount of vegetable oil (or equivalent) on the seat cup. Install seats into seat plate and bracket with polished faces up. Evenly push seat into seat cavity with fingers, then gently tap seat into place with a wooden dowel or plastic rod (1-1/8" outside diameter). To help ensure the seat is not damaged, place the cardboard disk supplied with the seal under the end of the dowel to prevent damaging the seat face.

7. Install seal head assembly:

**For Type 21:**

a. Lubricate shaft and elastomer with vegetable oil or equivalent.

b. Install first rotary seal head onto pump shaft and slide toward seat using a twisting motion until carbon face touches seal seat.

c. Install second rotary seal head onto shaft sleeve with carbon facing towards pump end.

8. Install seal plate onto pump end of bracket with new gasket and tighten cap screws evenly (note: use pipe sealant on bolts).

9. Install impeller:

a. Install key in pump shaft.

b. Slide impeller onto shaft.

c. Install impeller washer and lockdown. Tighten to 10 ft-lbs.

10. Loosen pump shaft set screw.

11. Install new volute gasket or o-ring and mount volute. Secure with bolts and tighten evenly.

12. Move shaft back with a screwdriver **.010"-.015"**. Tighten pump shaft set screws. Turn shaft by hand to ensure impeller does not rub against volute.

13. Return pump to installation, reconnect electric connections.

14. Start pump momentarily to observe shaft rotation. If rotation corresponds to the rotation arrow on the pump, it may be put into service. If rotation is incorrect, switch any two leads on 3-phase motors to change rotation. Check wiring diagram of motor for single phase rotation correction.

15. Remove top pipe plug (if applicable) from the front of volute and prime pump thoroughly, making sure all air is purged. Turn shaft one revolution and then refill. Replace the pipe plug.

16. Start pump allowing adequate time to purge all air from system. Observe any gauges, flow meters, etc., to see if pump performs properly.

**Double Seal Flush Piping Installation**

1. Piping of the double seal arrangement should be done in accordance with all governmental regulations and safety codes.

2. All double seals require a barrier flush between the seals for proper lubrication and cooling. The barrier liquid must be maintained at 10-15 PSIG above the discharge pressure of the pump and it must be chemically compatible with the pumped liquid, material construction of the pump, and seals (5/8" double seals have 18-8 parts).

3. The barrier flush shall have a minimum flow rate in accordance with the graph below. If water is used as a fluid, the inlet temperature should not exceed 140°F.

4. A positive pressure must be maintained to the barrier flush between the seal faces even when the pump is not running. To conserve the barrier liquid a solenoid valve (Item 1) may be installed and connected electrically in parallel with the motor so the barrier fluid flows only when the pump is running. Note: The maximum pressure of the barrier fluid at the inlet is 150 PSIG.

5. The inlet should be connected to the bottom and the outlet to the top of the seal cavity.

**Procedures for Checking Double Seals for Internal Leakage**

**Option 1 - for use with 2 flow meters.**

Install flow meters on the inlet and outlet lines. Normal operating conditions will be indicated by equal or near equal flow on both flow meters. If the inlet flow meter shows more flow than the outlet, this could indicate excessive leakage.

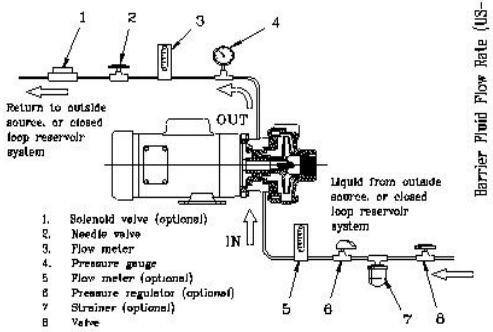
**Option 2 - for use with 1 flow meter.**

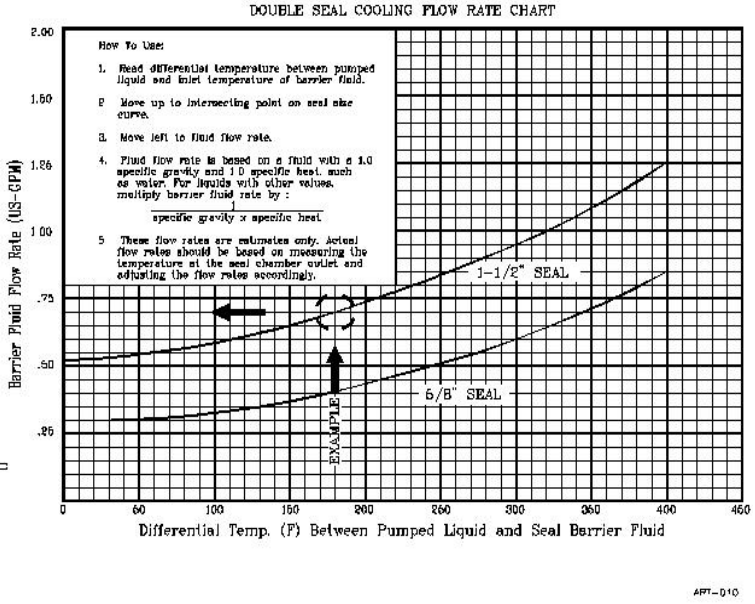
1. Shut off flow at outlet needle valve (Item 2).

2. Shut off inlet gate valve (Item 8) - for 15 seconds maximum.

3. If pressure in seal cavity drops rapidly rather than gradually while the gate valve is shut, the seal is leaking excessively.

4. To restart open gate valve first then reset valve on outlet.



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| Key # | Description | Quantity | RC200 Part # | RC300 Part # |
|---|---|---|---|---|
| A. | Volute SS | 1 | 3710-0 | 3712-0 |
| B. | Pipe Plugs 1/8" | 2 | 0557 | 0557 |
| C. | Impeller Specify diameter ** | | | |
| | SS (Hex bore) | 1 | 3711- (specify dia.) | 3713- (specify dia.) |
| D. | O-ring, Viton | 1 | 3070 | 3070 |
| E. | Bracket | 1 | 0972 | 0972 |
| F[1] | Mounting Base | 1 | 0197 | 0197 |
| F[2] | Volute Bolts | 8 | 0573 | 0573 |
| G[1] | Motor Bolts | | 0593 | 0593 |
| | Base | 2 | | |
| | No Base | 4 | | |
| G[2] | Motor Bolts | | 0673 | 0673 |
| | Base | 2 | | |
| | No Base | 0 | | |
| H. | Hex Shaft w/ setscrews 5/8" ID (56C motor) | 1 | 3714-1 | 3714-1 |
| H. | Hex Shaft w/ setscrews 7/8" ID (143TC, 145TC, 182C, 184C motor) | 1 | 3715-1 | 3715-1 |
| J. | Slinger (For 5/8" shaft pumps only) | 1 | 0522 | 0522 |
| | Seal with Seat | | | |
| K[1] | T.21 Fluorocarbon (std.) | 1 | 0553 | 0553 |
| K[2] | T.9 PTFE (optional) | 1 | 1150 | 1150 |
| K[3] | Double Seal/Seat (opt): | | | |
| | T.21 Fluorocarbon | 2 | 0985 | 0985 |
| | T.21 Neoprene | 2 | 0984 | 0984 |
| | T.21 EPR | 2 | 1023 | 1023 |
| | Double Seal Plate | 1 | 0973 | 0973 |
| | Plate Gasket, PTFE | 1 | 0974 | 0974 |
| | Seal Plate Cover Bolts | 3 | 0256 | 0256 |
| L. | T.21 Quench Opt (For 5/8" shaft pumps only) Fluorocarbon Lip Seal | 1 | 0891 | 0891 |
| M. | Impeller Lockdown Bolt | 1 | 0575 | 0575 |
| N. | Impeller Lockdown Washer | 1 | 2423 | 2423 |
| P. | Impeller Lock Washer | 2 | 2344 | 2344 |
| Q[1] | Motor, Electric | 1 | Specify P/N | Specify P/N |
| | (For 5HP 184C or other footed motors, only use bracket.) | | | |
| Q[2] | Power Frames | | | |
| | For use with 5/8" ID Shaft | 1 | 5478 | 5478 |
| | For use with 7/8" ID Shaft | 1 | 5501 | 5501 |
| Q[3] | Air Motor | 1 | Specify P/N | Specify P/N |
| | **RC - Repair Parts Kit** | | | |
| | For **56C 5/8" Hex** shaft | 1 | 2206 | -------- |
| | For **56C 7/8" Hex** shaft | 1 | -------- | 2206-1 |

(Includes: O-ring Viton, Hexed Shaft w/ SS Slinger, Impeller Lockdown Bolt, 2ea. Impeller Lockdown Washers)

** Double seal pumps use double seal impellers, for example; P/N 3711DS - (specify dia.)

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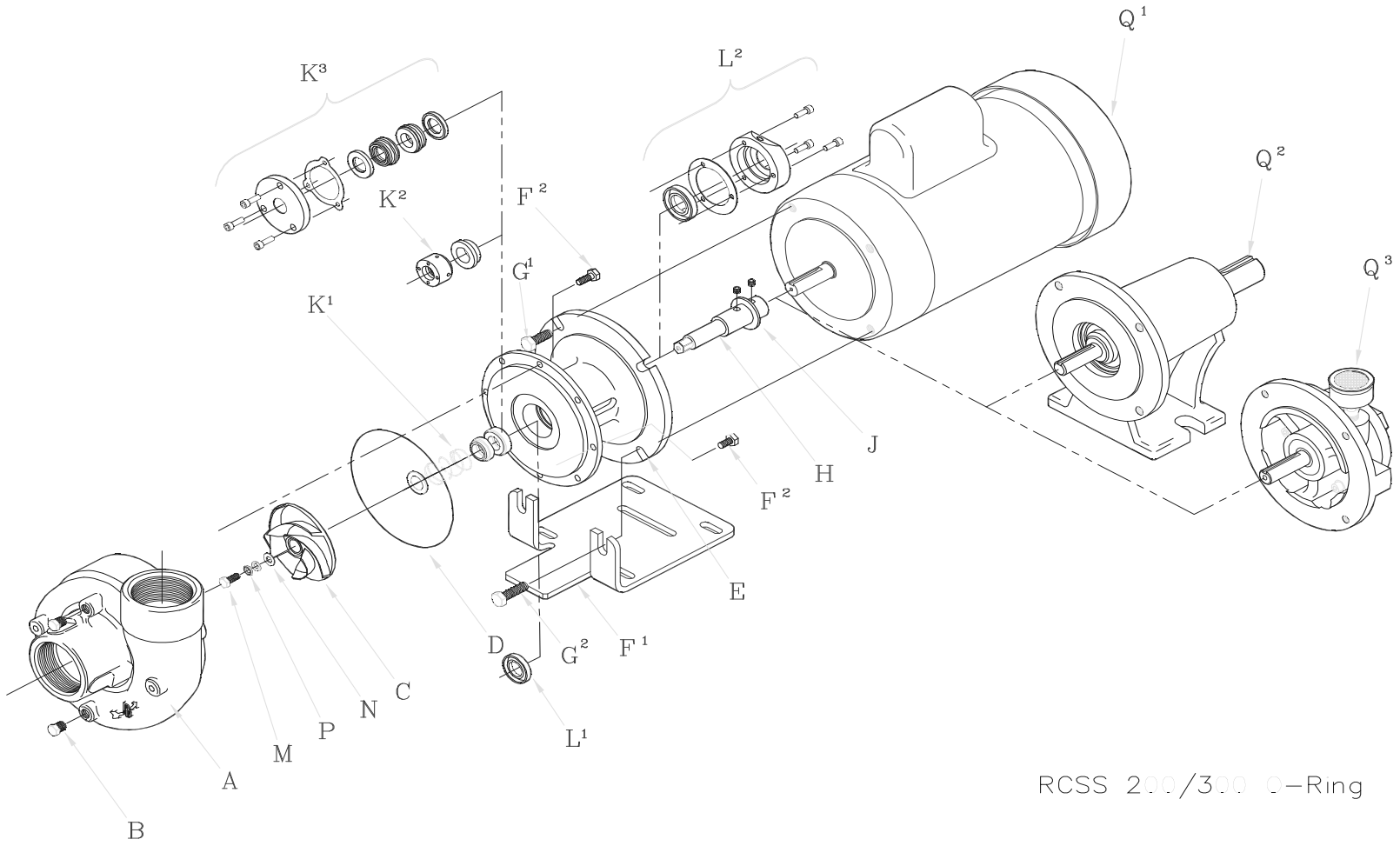


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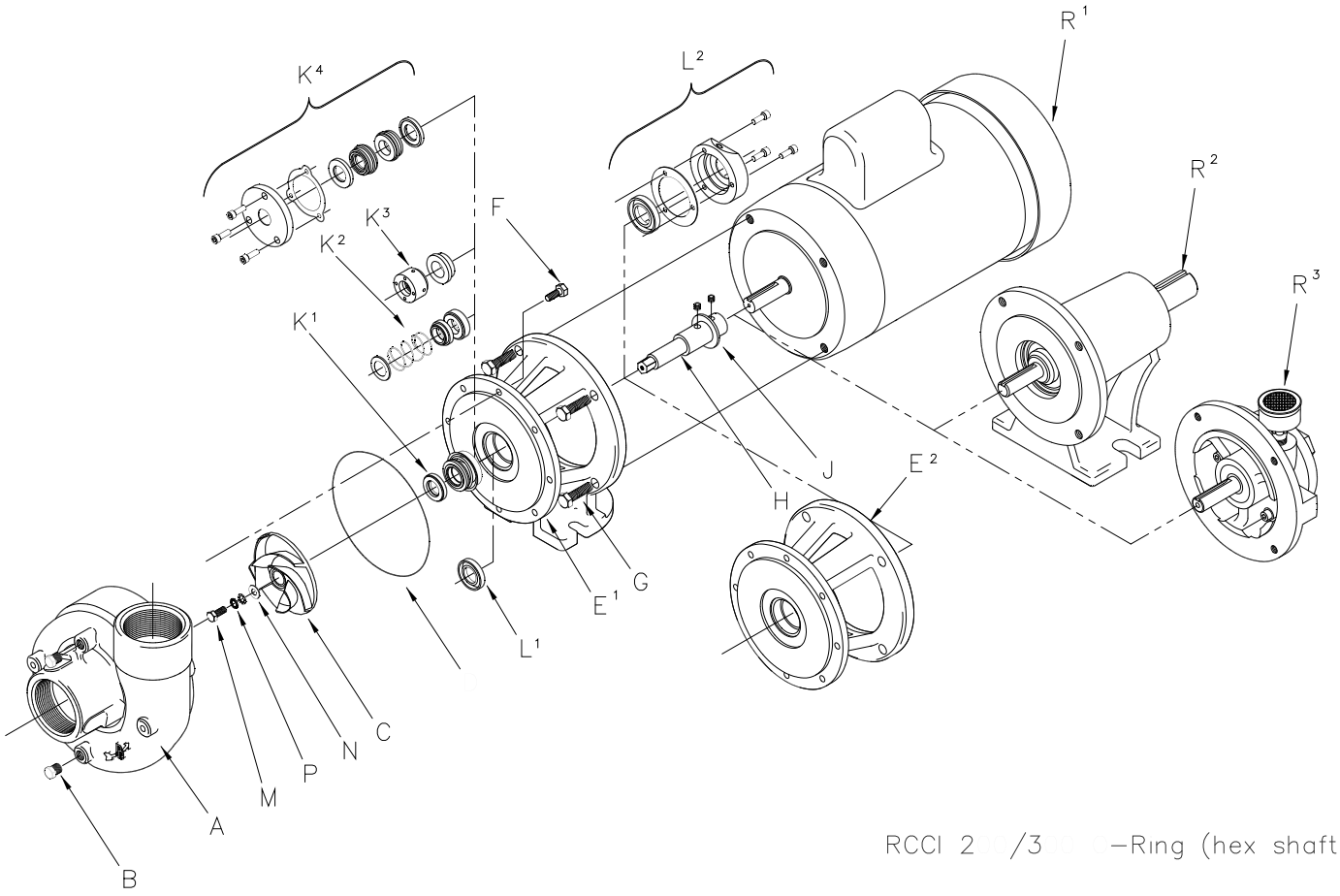
| Key # | Description | Quantity | RC200Part # | RC300 Part # |
|---|---|---|---|---|
| A. | Volute Cast Iron | 1 | 0183-0 | 0120-0 |
| A. | Volute Bronze | 1 | 3716-0 | 3717-0 |
| B. | Pipe Plugs 1/8" | 2 | 0557 | 0557 |
| C. | Impeller Specify diameter ** | | | |
| | Cast Iron (Hex Bore) | 1 | 4185 - (specify dia.) | 4186 - (specify dia.) |
| | Bronze (Hex Bore) | 1 | 4115 - (specify dia.) | 4116 - (specify dia.) |
| | Stainless Steel (Hex Bore) | 1 | 3711- (specify dia.) | 3713 - (specify dia.) |
| D. | O-ring (Buna std.) | 1 | 3074 | 3074 |
| E[1] | Bracket w/ Foot | 1 | 2426 | 2426 |
| E[2] | Bracket w/o Foot | 1 | 2428 | 2428 |
| F. | Volute Bolts | 8 | 0573 | 0573 |
| G. | Motor Bolts | 4 | 0588 | 0588 |
| H. | Shaft w/ setscrews 5/8" ID, Keyed (56C motor) | 1 | 3714-1 | 3714-1 |
| H. | Shaft w/ setscrews 7/8" ID, Keyed (143TC, 145TC, 182C, 184C motor) | 1 | 3715-1 | 3715-1 |
| J. | Slinger (For 5/8" shaft pumps only) | 1 | 0522 | 0522 |
| | Seal with Seat | | | |
| K[1] | T.6A Buna (std.) | 1 | 0538 | 0538 |
| K[2] | T.21 Fluorocarbon (optional) | 1 | 0553 | 0553 |
| K[3] | T.9 PTFE (optional) | 1 | 1150 | 1150 |
| K[4] | Double Seal/Seat (opt): | | | |
| | T.21 Fluorocarbon | 2 | 0985 | 0985 |
| | T.21 Neoprene | 2 | 0984 | 0984 |
| | T.21 EPR | 2 | 1023 | 1023 |
| | Double Seal Plate | 1 | 0973 | 0973 |
| | Plate Gasket, PTFE | 1 | 0974 | 0974 |
| | Seal Plate Cover Bolts | 3 | 0256 | 0256 |
| L[1] | T.6A Quench Lip Seal, Fluorocarbon | 1 | 0899 | 0899 |
| L[2] | T.21 Quench (5/8" shaft pumps only) | | | |
| | Quench Plate | 1 | 0308 | 0308 |
| | Plate Gasket, Syn. Fiber | 1 | 0504 | 0504 |
| | Seal Plate Cover Bolts | 3 | 0267 | 0267 |
| | Fluorocarbon Lip Seal | 1 | 0891 | 0891 |
| M. | Impeller Lockdown Bolt | 1 | 0569 | 0569 |
| N. | Impeller Lockdown Washer | 1 | 2423 | 2423 |
| P. | Impeller Lock Washer | 2 | 2344 | 2344 |
| R[1] | Motor – Specify P/N | 1 | | |
| | (For 5HP 184C or other footed motors, use P/N 2428 bracket.) | | | |
| R[2] | Power Frames | | | |
| | For use with 5/8" ID Shaft | 1 | 5478 | 5478 |
| | For use with 7/8" ID Shaft | 1 | 5501 | 5501 |
| R[3] | Air Motor - Specify P/N | 1 | 1150 | 1150 |
| **RC - Repair Parts Kit** | | | | |
| | For **56C 5/8" Hex** shaft | 1 | 2207 | -------- |
| | For **56C 7/8" Hex** shaft | 1 | -------- | 2207-1 |

(Includes: O-ring, Buna, Hex Shaft w/ SS Slinger, Impeller Lockdown Bolt, Washer and Key)

** Double seal pumps use double seal impellers, for example; P/N 4185DS - (specify dia.)

PRICE® PUMP CO.

RCCI_P.dwg rev. C




RCCI 2 /3 —Ring (hex shaft)

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# PRICE CENTRIFUGAL PUMP CAUTIONS & WARNINGS

- **CAUTION:** Price Pump centrifugal pumps must be operated above minimum flow rate to avoid damage.
- **CAUTION:** All Price Pump centrifugal pumps require the suction to be flooded.
- **CAUTION:** It is recommended that all piping connections to the pump be flexible.
- **WARNNING:** Verify chemical compatibility of the pump materials of construction with the fluid being pumped.
- **WARNNING:** Price centrifugal pumps are not designed for use in sanitary or food applications.
- **CAUTION:** Use only Price Pump original equipment factory replacement parts.
- **WARNNING:** Price pump fluid temperature limits must be observed. Maximum operating temperature is 300°F.
- **CAUTION:** The pump should be thoroughly flushed and drained before disassembly.
- **CAUTION:** For larger pump motor units, weight may exceed 65 1bs. (30 kg).

**CAUTION:** Maximum working pressure for seals:

- Type 6 Seal **75 PSI** (5.2 bar)
- Type 6A Seal **75 PSI** (5.2 bar)
- Type 8 Seal **325 PSI** (22.4 bar)
- Type 9 Seal **350 PSI** (24.1 bar)
- Type 21 Seal **150 PSI** (10.3 bar)
- Type 2106 Seal **150 PSI** (10.3 bar)

**CAUTION:** Maximum solid size by pump

- HP75 / MS50 **0.030"** (0.76mm)
- SP150 **0.060"** (1.50mm)
- LT25 **0.120"** (3.05mm)
- F50/75/95 **0.150"** (3.81mm)
- OH75 **0.150"** (3.81mm)
- CD100/150 **0.150"** (3.81mm)
- CL150 **0.150"** (3.81mm)
- RC200/300 **0.380"** (9.60mm)
- XJ-JB100 **0.120"** (3.05mm)
- XJ-JB150 **0.250"** (6.40mm)
- XJ-JB200 **0.440"** (11.2mm)
- XL-XT100 **0.120"** (3.05mm)
- XL-XT150 **0.250"** (6.40mm)
- XL-XT200 **0.440"** (11.2mm)

- HP75 / MS50 **0.5 GPM** (1.9 LPM)
- SP150 **10 GPM** (38 LPM)
- LT25 **0.5 GPM** (1.9 LPM)
- F50/75/95 **5.0 GPM** (19 LPM)
- OH75 **7.0 GPM** (26 LPM)
- CD100 **12 GPM** (45 LPM)
- CD150 **25 GPM** (94 LPM)
- CL150 **40 GPM** (150 LPM)
- RC200 **10 GPM** (38 LPM)
- RC300 **50 GPM** (189 LPM)
- XJ-JB150 **20 GPM** (75 LPM)
- XJ-JB150 **40 GPM** (150 LPM)
- XJ-JB200 **90 GPM** (340 LPM)
- XL-XT100 **10 GPM** (38 LPM)
- XL-XT150 **35 GPM** (132 LPM)
- XL-XT200 **50 GPM** (189 LPM)

# GENERAL TERMS OF SALE

**1. GENERAL**

**A.** Seller's price is based on these sales terms and conditions. The agreement and inclusion of other or amended terms in this contract will result in a change (including increase) in Seller's price (as may be contained in any price books or quotations) to reflect such other or amended terms. This contract shall represent the final, complete and exclusive statement of the agreement between the parties and may not be modified, supplemented, explained or waived by parole evidence, any Terms and Conditions contained in Buyer's purchase order or request for quotation, any course of dealings between the parties, Seller's performance or delivery, or in any other way. The Terms and Conditions of this contract may only be modified or waived in a written document signed by an Officer of Seller. These terms are intended to cover all activity of Seller and Buyer hereunder, including sales and use of products, parts and work and all related matters (references to products include parts and references to work include construction, installation and start-up). Any reference by Seller to Buyer's specifications and similar requirements are only to describe the products and work covered hereby and no warranties or other terms therein shall have any force of effect. Any information provided by Seller including, but not limited to, suggestions as to specific equipment does not imply any guarantee of specific suitability and/or material compatibility in a particular application, since many factors outside the control of Seller may affect the suitability of products in a particular application. Catalogs, circulars, similar pamphlets and information contained on websites of the Seller are issued for general information purposes only and shall not be deemed to modify the provisions hereof.

**B.** The agreement formed hereby and the language herein shall be construed and enforced under the Uniform Commercial Code as in effect in the State of California on the date hereof.

**2. TAXES**

Any sales, use or other similar type taxes imposed on this sale or on this transaction and/or any import or export duties or fees as may be assessed or imposed on or as a result of deliveries under this transaction are not included in the price. Such taxes shall be billed separately to the Buyer. Seller will accept a valid exemption certificate from the Buyer if applicable; however, if an exemption certificate previously accepted is not recognized by the governmental taxing authority involved and the Seller is required to pay the tax covered by such exemption certificate. Buyer agrees to promptly reimburse Seller for the taxes paid.

**3. PERFORMANCE, INSPECTION AND ACCEPTANCE**

**A**. Unless Seller specifically assumes installation, construction or start-up responsibility, all products shall be finally inspected and accepted within thirty (30) days after arrival at point of delivery. Where seller has responsibility for installation, construction or start-up all work shall be finally inspected and accepted with thirty (30) days after completion of the applicable work by Seller. All claims whatsoever by Buyer, (including claims for shortages) except only those provided for under the WARRANTY AND LIMITATION OF LIABILITY and PATENTS Clauses, hereof, must be asserted in writing by Buyer within said thirty (30) day period or they are waived. If this contract involves partial performance, all such claims must be asserted within said thirty- (30) day period for each partial performance. There shall be no revocation of acceptance. Rejection may be only for defects substantially impairing the value of products or work and Buyer's remedy for lesser defects shall be those provided for under the WARRANTY AND LIMITATION OF LIABILITY Clause.

**B.** Seller shall not be responsible for non-performance or for delays in performance occasioned by any causes beyond Seller's reasonable control, including, by way of example and not limitation, to labor difficulties, delays of vendors or carriers, fires, governmental actions, or shortages of material, components, labor, or manufacturing facilities. Any delays so occasioned shall affect a corresponding extension of Seller's performance dates, which are, in any event, understood to be approximate. IN NO EVENT SHALL BUYER BE ENTITLED TO INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR LATE PERFORMANCE OR FOR A FAILURE TO PERFORM. Seller reserves the right to make partial shipments and to ship products, parts or work which may be completed prior to the scheduled performance date.

**C.** In the event that Seller has agreed to mount motors, turbines, gears, or other products which are not manufactured by Seller and which are not an integral part of Seller's manufactured product, and a delay in the delivery of such products to Seller occurs that will cause a delay in Seller's performance date, Seller reserves the right to ship its product upon completion of manufacture and to refund an equitable portion of the amount originally included in the purchase price for mounting without incurring liability for non-performance.

**D.** Seller reserves to itself the right to change its specifications, drawings and standards if such changes will not impair the performance of its products, and parts, and further those products, and parts, will meet any of Buyer's specifications and other specific product requirements which are a part of this agreement. Seller is a global supplier of products and utilizes parts and products obtained worldwide, and Seller's products supplied under this contract shall be subject to Seller's sole determination as to all manufacturing, sourcing, assembly and supply unless otherwise specifically agreed in writing.

**E.** The manufacture and inspection of products and parts shall be to Seller's Engineering and Quality Assurance standards, plus such other inspections or tests of documentation as are specifically agreed to by Seller. Requirements for any additional inspection, tests, documentation, or Buyer witness of manufacture, test, and/or inspection shall be subject to additional charges.

**4. TITLE AND RISK OF LOSS**

Title and risk of loss shall pass to buyer upon delivery of products at the designated "Ex Works" as defined by Incoterms, unless other wise agreed by the parties.

**5. EROSION AND CORROSION**

It is specifically understood that products and parts sold hereunder are not warranted for operation with erosive or corrosive fluids or for operation with any fluid or under any operating condition in variance with the specifications of this contract. No product or part shall be deemed to be defective by reason of failure to resist erosive or corrosive action of any fluid and Buyer shall have no claim whatsoever against Seller therefore. No product shall be deemed defective by reason of any effect on Seller's products of the action or results (such as vibration) of any goods or system (such as piping) not supplied by Seller.

**6. BUYER'S RESPONSIBILITY**

The design specifications of the equipment require the operation of the equipment within certain parameters and may call for the use of speed controls, safety devices, set points or other control devices to insure that the operation remains within design parameters. Buyer agrees and understands that the equipment must be operated and maintained within design specifications and operated within the specifications of the contract, irrespective of whether controls or devices are otherwise required.

**7. WARRANTY AND LIMITATION OF LIABILITY.**

**A.** Seller warrants only that its product and parts, when shipped, will be free from defects in materials and workmanship. All claims for defective products or parts under this warranty must be made in writing immediately upon discovery and, in any event, within two (2) years of shipment by seller and all claims for defective work must be made in writing immediately upon discovery. Defective items must be held for Seller's inspection and returned to the sellers' point of original shipment upon request. ANY UNAUTHORIZED DISSASSEMBLY, ALTERATION OF OR TAMPERING WITH ANY PRODUCT OR COMPONENT MAY "VOID" THE WARRANTY, IN THAT SUCH ACTION WILL RESULT IN SELLER BEING RELEASED AND RELIEVED FROM ITS OBLIGATIONS UNDER THIS WARRANTY AND FOR ANY FURTHER COSTS OR ACTIONS UNDER CLAUSE 7.C, FOLLOWING, AND THE BUYER ASSUMING SOLE RESPONSIBILITY FOR THE COSTS AND RESULTS OF SUCH ACTION. THE FOREGOING IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES WHATSOEVER, EXPRESS, IMPLIED AND STATUTORY, INCLUDING WITHOUT LIMITATION, THE IMPLIED, WARRANTIES OF MERCHANTABILITY AND FITNESS.

**B.** ANY PRODUCT (S) SOLD HEREUNDER WHICH ARE NOT MANUFACTURED BY SELLER ARE NOT WARRANTED BY SELLER and shall be covered only by the express warranty, if any, of the manufacturer thereof. With respect to products and parts not manufactured by Seller, Seller's only obligation shall be to assign to Buyer, to the extent possible, whatever warranty Seller obtains from the manufacturer.

**C.** Upon Buyer's submission of a claim as provided above and its substantiation, Seller shall at its option either (i) repair or replace its product, part or work at the original place of shipment, or (ii) refund an equitable portion of the purchase price.

**D.** THE FOREGOING IS SELLER'S ONLY OBLIGATION AND BUYER'S EXCLUSIVE REMEDY FOR BREACH OF WARRANTY AND, EXCEPT FOR THE REMEDIES PERMITTED UNDER THE PERFORMANCE, INSPECTION AND ACCEPTANCE AND THE PATENTS CLAUSES HEREOF, THE FOREGOING IS BUYER EXCLUSIVE REMEDY AGAINST SELLER FOR ALL CLAIMS ARISING HEREUNDER OR RELATING HERETO WHETHER SUCH CLAIMS ARE BASED ON BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY), INDEMNITY OR OTHER THEORIES. BUYER'S FAILURE TO SUBMIT A CLAIM AS PROVIDED ABOVE SHALL SPECIFICALLY WAIVE ALL CLAIMS FOR DAMAGES OR OTHER RELIEF, INCLUDING BUT NOT LIMITED TO CLAIMS BASED ON LATENT DEFECTS. IN NO EVENT SHALL BUYER BE ENTITLED TO INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, NOR FOR DAMAGES FOR LOSS OF USE, LOST PROFITS OR REVENUE, INTEREST, LOST GOODWILL, WORK OR PRODUCTION STOPPAGE, IMPAIRMENT OF OTHER GOODS, INCREASED EXPENSES OF OPERATION, OR THE COST OF PURCHASING REPLACEMENT POWER OR OTHER SERVICES BECAUSE OF SERVICE INTERRUPTIONS. FURTHERMORE, IN NO EVENT SHALL SELLER'S TOTAL LIABILITY FOR DAMAGES OF BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS OR PARTS MANUFACTURED BY SELLER AND UPON WHICH SUCH LIABILITY IS BASED. ANY ACTION ARISING HEREUNDER RELATED HERETO, WHETHER BASED ON BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE) OR OTHER THEORIES, MUST BE COMMENCED WITHIN ONE (1) YEAR AFTER THE CAUSE OF ACTION ACCRUES OR IT SHALL BE BARRED.

**8. PURCHASER'S REPRESENTATIONS & WARRANTIES**

Purchaser represents and warranties that the products(s) covered by this contract shall not be used in or in connection with a nuclear facility or application. The parties agree that this representation and warranty is material and is being relied on by seller. This provision may be modified in a separate writing signed by an officer of Price Pump Co.

**9. PATENTS**

Seller agrees to assume the defense of any suit for infringement of any patents brought against Buyer to the extent of such suit charges infringement of an apparatus or product claim by Seller's product in and of itself, provided (i) said product is built entirely to Seller's design, (ii) Buyer notifies Seller in writing of the filing of such suit within ten (10) days after the service of process thereof, and (iii) Seller is given complete control of the defense of such suit, including the right to defend, settle and make changes in the product for the purpose of avoiding infringement of any process or method claims. Provided however, Seller will not defend any suit for infringement of a claimed patent where such alleged infringement is the result of following specific instruction furnished by Seller.

**10. EXTENT OF SUPPLY**

Only products as listed in Seller's proposal are included in this agreement. It must not be assumed that Seller has included anything beyond same.

**11. MANUFACTURING SOURCES**

To maintain delivery schedules, Seller reserves the right to have all or any part of the Buyer's order manufactured at any of Sellers', sellers' licensees or sub contractors' plants, globally.

**12. TERMS OF PAYMENT**

Net 30 days from date of invoice.

**13. ARBITRATION**

In the event a dispute arises between the parties relating to or arising out of this agreement, the parties agree to attempt to have their senior management amicably settle the matter. In the event that the matter cannot be settled, the parties shall submit all disputes relating to this Agreement (whether contract, tort, products liability or otherwise) to binding Arbitration before a panel of arbitrators under the Commercial Dispute Resolution Procedures of the American Arbitration Association. Each party shall appoint an arbitrator and the third shall be selected in accordance with the rules of the American Arbitration Association. Judgment upon the award may be entered in any court having jurisdiction. The parties shall cooperate in providing reasonable disclosure of relevant documents. Each party shall bear its own expenses, and the costs and fees of the arbitration shall be borne as allocated by the Arbitrator.

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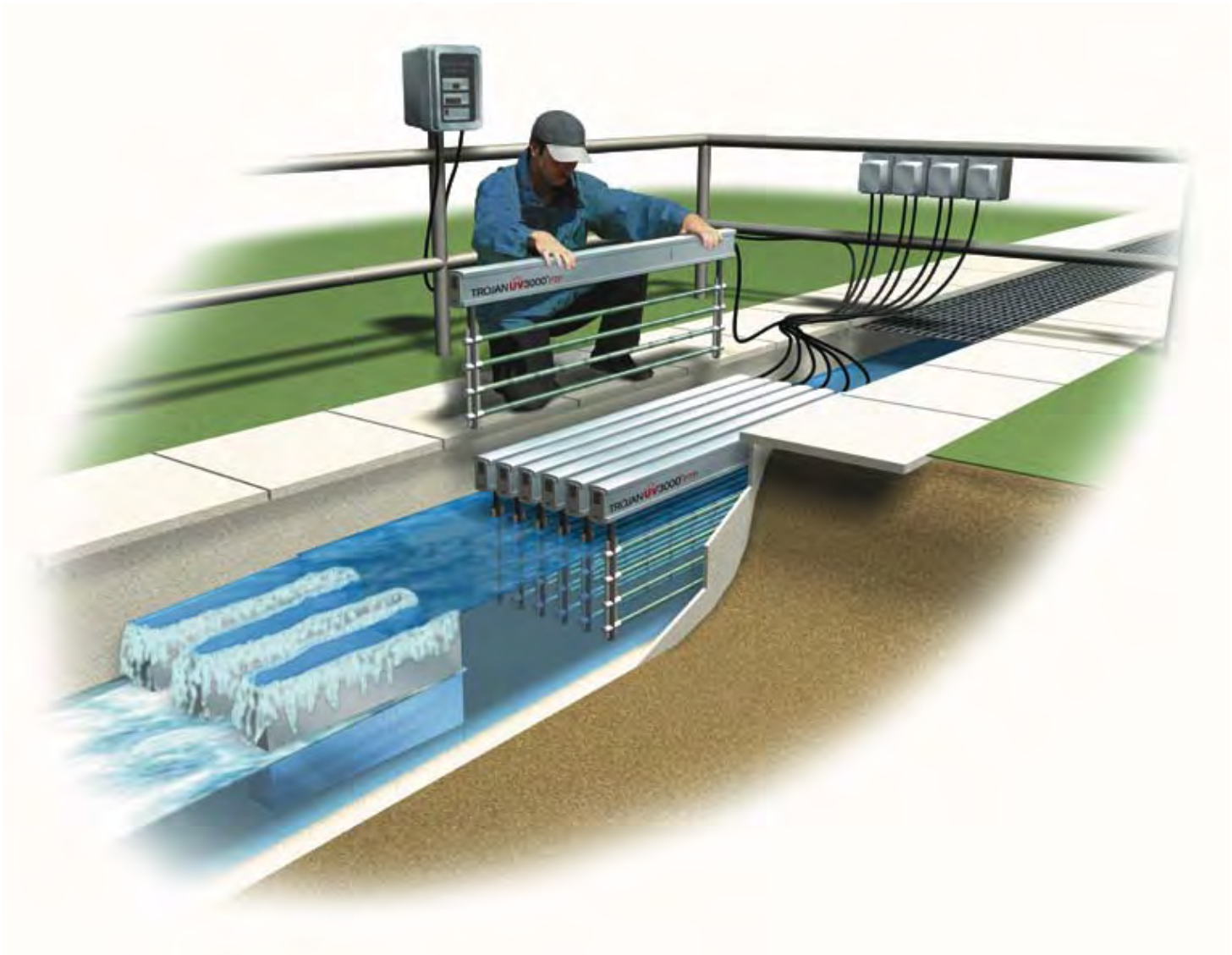
# TROJAN UV3000™ PTP

Operation and Maintenance User Manual
Original Instructions

Edition 4



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# Section 1 Specifications

Specifications are subject to change without notice.

| | |
|---|---|
| **UV module** | |
| Ballast enclosure material | Anodized aluminum |
| UV module frame | Stainless steel, 316 |
| Input | 120 VAC ± 10%, 1.6 A, 50 - 60 Hz; 175 W |
| Output | 2 x 78 W |
| **Electronic ballast** | |
| Input | 120 VAC ± 10%, 1.6 A, 50 - 60 Hz; 175 W |
| Output | 2 x 78 W |
| **Quartz sleeves** | |
| Material | Type 214 clear fused quartz circular tubing |
| UV transmittance | No less than 90.8% UV light |
| **UV sensor** | |
| Input power | UV sensor is designed to function with a supply voltage between 15 and 30 VDC |
| Cable | Twisted pair, shielded |
| Wavelength | UV sensor responds only to ultraviolet energy |
| Storage temperature | -40 ºC to +80 ºC (-40 ºF to 176 ºF) |
| Operating temperature | 0.5 ºC to 60 ºC (33 ºF to 140 ºF) |
| **Level control weir** | |
| Weir | A drain is installed at the bottom of the weir to completely empty the channel if required. Material Stainless Steel. |
| **UV module rack** | |
| UV module rack | Stainless steel |

The information in this manual has been carefully checked and is believed to be accurate. However, the manufacturer assumes no responsibility for any inaccuracies that may be contained in this manual. In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual, even if advised of the possibility of such damages. In the interest of continued product development, the manufacturer reserves the right to make improvements in this manual and the products it describes at any time, without notice or obligation.

## 2.1 Safety information

Read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger, warning and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

### 2.1.1 Use of hazard information

| **⚠ DANGER** | |
|---|---|
| | Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury. |

| **⚠ WARNING** |
|---|
| Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury. |

| **⚠ CAUTION** |
|---|
| Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. |

| ***NOTICE*** |
|---|
| Indicates a situation that is not related to personal injury. |

***Note:*** *Information that supplements points in the main text.*

### 2.1.2 Precautionary labels

Read all labels and tags attached to the equipment. Personal injury or damage to the equipment could occur if not observed.

| | |
|---|---|
| | Electrical equipment marked with this symbol may not be disposed of in European public disposal systems. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user.<br>***Note:*** *For return for recycling, contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.* |
| | This is the safety alert symbol. Obey all safety messages that follow this symbol to avoid potential injury. If on the instrument, refer to the instruction manual for operation or safety information. |
| | This symbol indicates that a risk of electrical shock and/or electrocution exists. |
| | This symbol indicates that a risk from a hazardous energy source exists, and that all appropriate lockout/tagout procedures must be obeyed. |

| | |
|---|---|
| | This symbol indicates that a full face shield is required for protection against intense UV exposure. |
| | This symbol indicates that the marked item can be hot and should not be touched without care. |
| | This symbol indicates that the marked item can be hot and should not be touched without care. |
| | This symbol indicates that the marked item should not be touched. |
| | This symbol indicates that the marked item is pressurized. Obey all procedures to safely release pressure. |
| | This symbol indicated the presence of devices sensitive to Electro-static Discharge (ESD) and indicated that care must be taken to prevent damage with the equipment. |
| | This symbol indicates that the operator must read all available documentation to perform required procedures. |

## 2.2 Patents and permissions

The UV System in this manual may be protected by one or more patents in the United States of America, Canada, and/or other countries. For a list of patents owned by Trojan Technologies, go to www.trojanuv.com.

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## 2.3 Safety equipment

### 2.3.1 Operator kit

An operator kit is provided with each TrojanUV3000™PTP.

- One clear UV face shield.
- Four pairs of disposable vinyl gloves.

A Trojan-approved cleaning agent is recommended with the TrojanUV3000™PTP System, but it is not included in the operator kit.

## 2.4 List of abbreviations

Table 1 shows a list of common acronyms, symbols and abbreviations.

**Table 1 Common acronyms, symbols and abbreviations**

| Acronym | Definition | Acronym | Definition |
|---|---|---|---|
| °C | Degrees Celsius | LED | Light Emitting Diode |
| °F | Degrees Fahrenheit | LOC | Local |
| ~ | Single Phase Alternating Current | LPM | Liters / minute |
| %T | percent Transmittance | L/s | Liters / second |
| #L | # Lamp (ie. 3L - 3 Lamp) | m | Meters |
| Δ | Delta | mA | Milli Amp |
| ε | Edison | MAX | Maximum |
| 100%T | 100 percent Transmittance | $m^3$/Day | Cubic Meters per Day |

**Table 1 Common acronyms, symbols and abbreviations**

| Acronym | Definition | Acronym | Definition |
|---|---|---|---|
| 3~ | Three Phase Alternating Current | MCB | Module Circuit Board |
| 3R | Type 3R | MGD | Million Gallons / Day |
| 4 | Type 4 | mg/L | Milligrams per liter |
| 4X | Type 4X | MIN | Minimum |
| A | Amps | $mJ/cm^2$ | Millijoules per squared centimeter |
| AC | Alternating Current | mL | Milliliters |
| ACK | Acknowledge | MLD | Million Liters per Day |
| ALC | Automatic Level Controller | mm | Millimeters |
| ANSI | American National Standards Institute | MSDS | Material Safety Data Sheets |
| A/R | As Required | $mW/cm^2$ | Milliwatts per squared centimeter |
| ASTM | American Society for Testing & Materials | $mWs/cm^2$ | Milliwatt seconds per squared centimeter |
| Bar | Barometric Pressure | NO. | Number |
| BSP | British Standard Pipe | nm | Nanometer |
| CE | Conformitée Européenne (European Conformity) | N.m | Newton meter |
| CCB | Communications Control Board | NPT | National Pipe Thread |
| cm | Centimeters | O&M | Operation and Maintenance |
| COMM | Communications | OEM | Original Equipment Manufacture |
| CPU | Central Processing Unit | OI | Operator Interface |
| CSA | Canadian Standards Association | ph | Phase |
| c/w | Complete With | PLC | Programmable Logic Controller |
| D | Disabled | PPM | Parts per Million |
| DC | Direct Current | PREV | Previous |
| DNA | Deoxyribonucleic Acid | PSi | Pounds per Square Inch |
| DP | Distribution Panel | PSS | Point Source Summation |
| DWG | Drawing | Qty. | Quantity |
| E | Enabled | REM | Remote |
| EC | *E. coli* | RET | Retract |
| EL | Elevation | REV. | Revision |
| ELPD | Earth Leakage Protection Device | RCB | Relay Control Board |
| EMI | Electro Magnetic Interference | RNA | Ribonucleic Acid |
| EOL | End of Life | SCADA | System Control and Data Acquisition |
| EPA | US Environmental Protection Agency | SCC | System Control Center |
| EPDM | Ethylene-propylene-diene rubber | sec | Second |
| EPROM | Erasable Programmable Read Only Memory | SPEC | Specification |
| Est. | Estimated | SPSS | Single Point Source Summation Method |
| EXT | Extend | SST | Stainless Steel |
| FC | Fecal Coliform | Temp | Temperature |
| Ft | Foot/Feet | TC | Total Coliform |
| FWP | Fixed Weir Plate | TSS | Total Suspended Solids |
| G# | Generation # (ie. G1 - Generation 1) | TVSS | Transient Voltage Surge Suppressor |
| GND | Ground | TYP. | Typical |
| GPD | Gallons / Day | UI | User Interface |
| gpm | US Gallons Per Minute | UPS | Uninterrupted Power Supply |
| GUI | Graphical User Interface | UV3PTP | Trojan UV3000™PTP |

**Table 1 Common acronyms, symbols and abbreviations**

| Acronym | Definition | Acronym | Definition |
|---|---|---|---|
| Hp | Horsepower | UL | Underwriters Laboratory |
| Hrs | Hours | UV | Ultraviolet |
| Hz | Hertz | UVT | On-line UV Transmittance monitor |
| in. | Inch(es) | V | Volts |
| in.lb | Inch pound | VA | Volt amps |
| I/O | Input/Output | VAC | Volts Alternating Current |
| JIS | Japanese Industrial Standards | VDC | Volts Direct Current |
| kPA | Killopascals | w | Wire |
| kVA | Kilovolt amps | WL | Water Level |
| kW | Kilowatts | $W/m^2$ | Watts per meter squared |
| kWh | Kilowatt hours | Y | Wye |

## 2.5 Power distribution receptacle (PDR)

The optional PDR consists of a duplex ground fault interrupter receptacle that can be mounted in a location which allows convenient hook-up of UV modules. The PDR is provided with a weatherproof cover. However, direct water sprays should be avoided. One PDR is required for every two UV modules.

Figure 1 PDR

## 2.6 UV module

**NOTICE**

Effluent level within the channel should never increase more than 1 inch above the top UV lamp.

The UV module is the basic unit of the flow-through UV bank (Figure 2). A UV bank is made up of UV modules placed in parallel, 76.2 mm (3 in.) between UV lamp centers. The UV module/bank configuration is determined at the factory based on relevant information collected from the site.

The number of UV lamps is determined by the flow to be treated and varies from 2 to 4 UV lamps in each UV module depending on the size of the treatment plant. The UV module/bank configuration is based on the plant process.

UV modules consist of a 316 stainless steel frame that holds the low-pressure, low-output UV lamps in position, and houses all connecting wires in a watertight enclosure.

Mounted on top of each UV module is an anodized aluminum ballast enclosure that is held to lift the UV module out of the channel. The ballast enclosure contains the electronic ballasts and the UV module circuit board. One ballast powers two UV lamps. UV modules are held in the support frame with the ballast enclosure above the water.

The power cable for each UV module is connected to a power distribution receptacle (PDR). The power cable is located at one end of the ballast enclosure. UV lamps are enclosed in quartz sleeves and attached to the UV module at each end with a sleeve cup and the formed leg of the UV module.

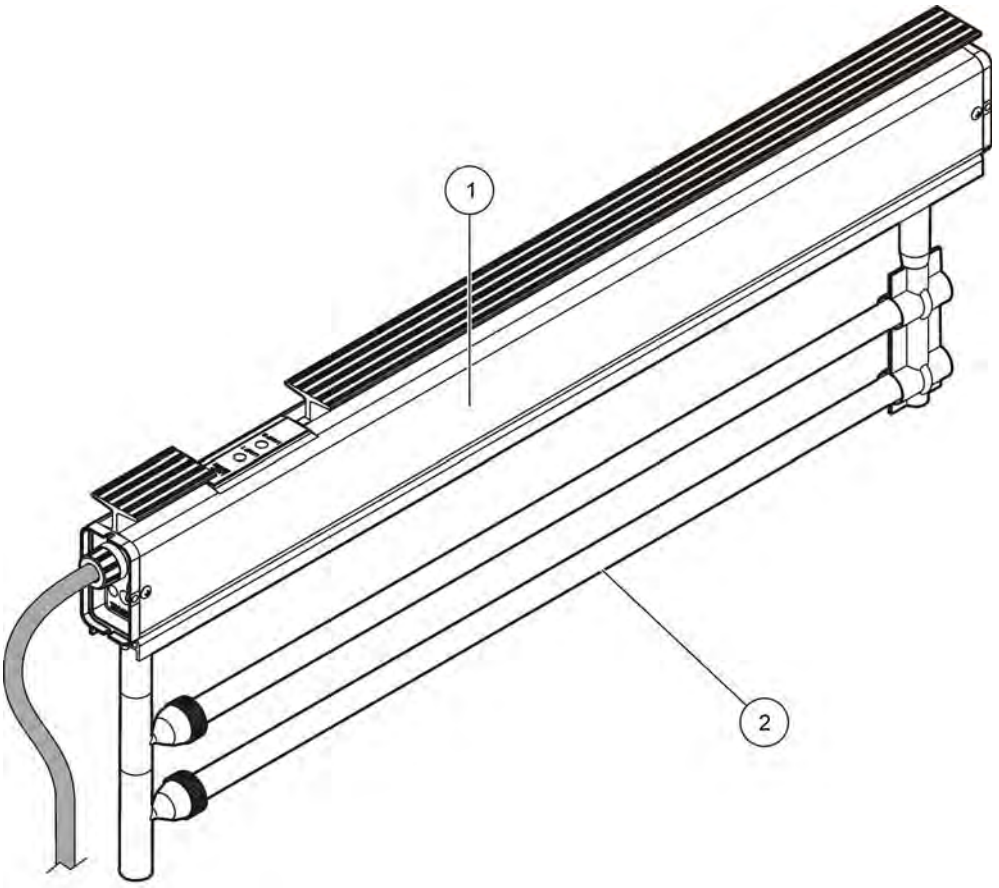


Figure 2 UV module

| | | | |
|---|---|---|---|
| **1** | Ballast enclosure | **2** | UV lamp |

## 2.7 UV lamps

The manufacturer supplies 864 mm (34 in.) and 1625 mm (64 in.) UV lamps. The germicidal lamp is a low-pressure, low-output UV lamp. The UV lamps produce zero levels of ozone, withstand shock and vibration and are constructed of materials resistant to UV. Refer to Figure 3.

UV lamp output after 12,000 hours of operation is approximately 80% of the output after the 100-hour burn-in period. Frequent power cycling shortens the life of the UV lamps. The UV lamp warranty is for four on/off cycles a day.

### 2.7.1 Quartz sleeves

UV lamps are enclosed in cylindrical quartz sleeves that protect the UV lamp. In conjunction with the spacer rings, they provide insulation assuring minimum UV lamp temperature variation, which could affect UV lamp performance.

The quartz sleeves are made out of Type 214 clear fused quartz circular tubing. They are rated for UV Transmittance of 90% and are not subject to solarization.

The spring at the closed end of the sleeve pushes the UV lamp against the lamp holder (at the opposite end of the UV lamp) to provide a good electrical contact.

### 2.7.2 Lamp seal holder assembly

The open end of the lamp sleeve is sealed with a stainless steel type 316 sleeve nut which threads onto a sleeve cup and compresses the sleeve O-ring. The knurled surface of the sleeve nut allows a positive hand grip for tightening. The sleeve nut does not require any tools for removal.The UV lamp is held in place by the molded lamp holder, which incorporates a triple seal. The lamp holder seals against the inside of the quartz sleeve to act as a second seal in series with the external O-ring seals. Another seal on the lamp holder isolates and seals the UV lamp from the UV module frame and all other UV lamps in the UV module.

In the event of a quartz sleeve fracture, the seals of the lamp holder prevent moisture from entering the UV module frame and the electrical connections to the other UV lamps in the UV module.

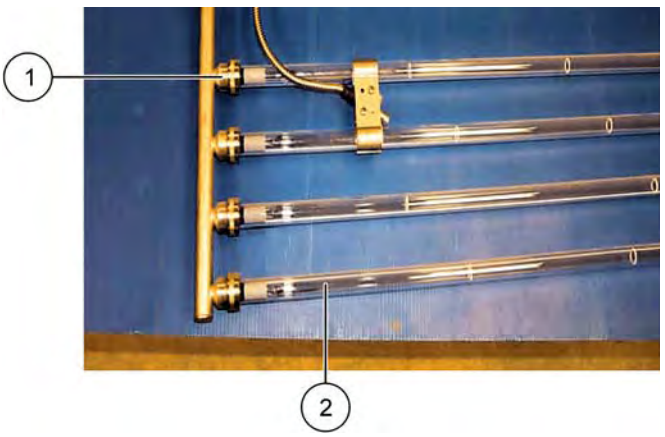


Figure 3 UV lamp assembly

| | | | |
|---|---|---|---|
| **1** | Sleeve cup | **2** | UV lamp and lamp sleeve |

## 2.8 System monitor

The operation of the TrojanUV3000™PTP is monitored at the system monitor (Figure 4).

The optional monitoring system provides add-on monitoring capabilities for all models of the TrojanUV3000™PTP series.

The monitoring system offers several features:

- A submersible UV sensor that continuously monitors the UV intensity produced in each bank of UV modules.

- A three-character display that indicates UV intensity in milliwatt per square centimeter ($mW/cm^2$). This display will flash when the intensity drops below the Low UV Intensity Alarm setpoint.
- A five-character display that indicates elapsed time in hours. The Elapsed Time display will flash when the display reading is between 12,000 and 12,500 hours and it will also flash for each period of 12,000 hours after the 12,000 hour mark; i.e. the display will flash from 12,000 - 12,500 hours, 24,000 - 24,500, 36,000 - 36,500..., until the display reaches 65,535 hours, at which point the hour counter automatically resets to 0 hours. The flashing period indicates the UV lamps will need to be changed soon.
- Seven segment LEDs are used by both displays and are visible through the panel door.
- A dry contact is provided for Low UV intensity alarm.
- An isolated 4-20 mA signal is available for remote indication of UV intensity.
- The monitoring system (12 x 10 x 6 inches) is enclosed in a Type 4X reinforced fiberglass wall mounted panel.

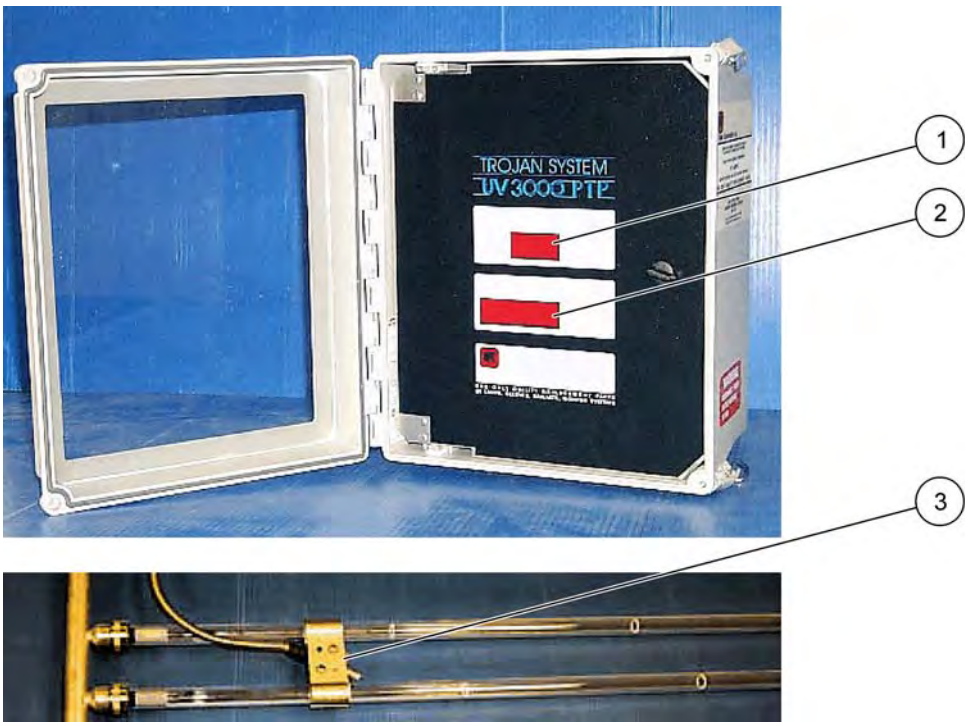


Figure 4 System monitor

| | | | | | |
|---|---|---|---|---|---|
| **1** | UV Intensity | **2** | Elapsed time in hours | **3** | UV sensor |

## 2.9 UV sensor

The UV sensor continuously measures the UV intensity produced in each bank of UV modules (Figure 4). The submersible UV sensor measures only the germicidal portion of the light emitted by the low-pressure UV lamps.

The UV sensor incorporates a photodiode that gathers UV light from the UV lamp underneath the UV sensor, which is converted into an analog signal and then displayed in $mW/cm^2$ at the operator interface in the system monitor.

The UV sensor is mounted on one UV module per bank of UV modules, and its installation is typically located on the second lamp sleeve from the top of a UV module. The UV sensor is mounted such that it faces away from the effluent flow.

## 2.10 Level control weir

A water level control weir controls the effluent level within the UV channel (Figure 5). Depending on the TrojanUV3000™PTP model provided and its configuration, the level control weir will be preinstalled in either the stainless steel channel or transition box or ready to install in a concrete channel if a stainless steel channel and transition boxes are not supplied

To achieve proper disinfection, the top of the weir is set at an elevation to control the depth of water above the top UV lamp. The weir height makes sure that the UV lamps will remain submerged in zero or low flow conditions.

The head associated with a fixed weir is dependent on the length of the weir. The shorter the weir length, the greater the head, or depth of water over the weir for any given flow.

As effluent depth increases over the weir downstream of the UV system, effluent depth upstream of the Bank(s) increases a corresponding amount. Therefore, when using a fixed weir, the hydraulic capacity of the plant upstream of the bank(s) must be considered under peak flow conditions.

The manufacturer uses a trapezoidal weir in both the TrojanUV3000™PTP stainless steel and concrete channels.

Weirs can have many different shapes. The most common shape for a trapezoidal weir is a “finger” weir where the weir is lengthened into the channel in order to have a longer edge. This longer edge distributes the water over a longer perimeter and reduces the head.

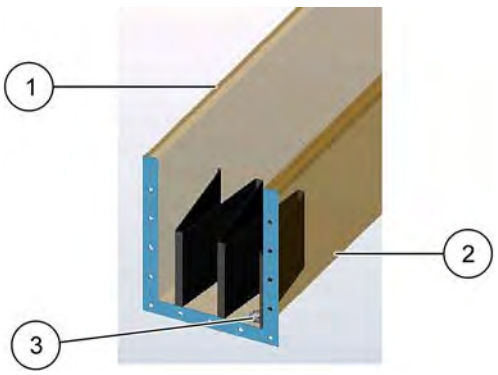


Figure 5 Sample weir configuration

| | | | | | |
|---|---|---|---|---|---|
| **1** | Channel, SST shown | **2** | Level control weir | **3** | Drain plug |

### 2.10.1 UV module rack

The UV module rack is a stainless steel support frame, which supports each bank of UV modules (Figure 6). For stainless steel channel installations, the rack comes welded in place to the inside of the channel (Section 2.11.1.1). For concrete channel installations, a stainless steel support rack will be provided for bolting into the channel by a qualified contractor (Section 2.11.2.1).

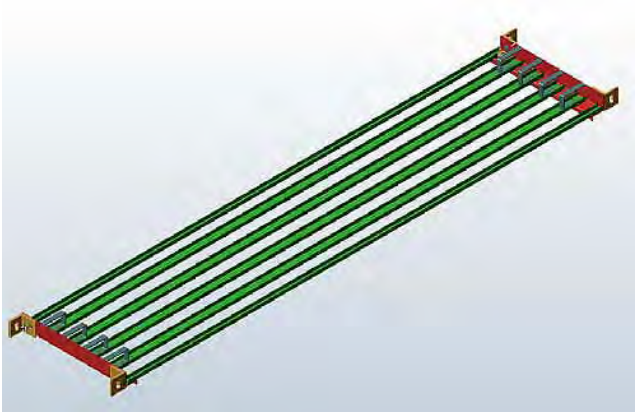

Figure 6  UV module rack

## 2.11 Channels

### 2.11.1 Stainless steel channel (type K option)

The stainless steel channel can be supplied with or without optional transition boxes and an optional turn box (Figure 7). Stainless steel channels with transition boxes and the turn box form a freestanding structure that connects to flanged pipes supplied by others.

The stainless steel channel is typically constructed of 14 gauge stainless steel and comes complete with drain, UV module rack and downstream serpentine weir.

Multiple channels may be connected in parallel, or series with a turn box, depending on the application requirements.

All interconnecting piping, associated material, such as gaskets, will be supplied by the customer.

UV modules are mounted in the stainless steel channel module rack. The UV module rack is shipped welded in the channel. Each channel must support one bank of UV modules.

An overflow weir maintains correct water depth over a complete range of flow rates to be treated. Depending on the model and site requirements the weir may be located in the channel or in the most downstream transition box (if applicable).

Due to variations in effluent quality and flow characteristics, debris may settle at the bottom of the channel. A built-in drain helps facilitate channel cleaning.

The channel (and transition boxes, if provided) should always be thoroughly cleaned after any plant upset.

#### 2.11.1.1 UV module rack for stainless steel channels (type K models)

The UV module rack for K (stainless steel channel) systems is a stainless steel frame that supports the UV modules in the stainless steel channel.

Where a stainless steel channel is supplied, the rack comes welded in the channel. The UV module rack requires no further installation.

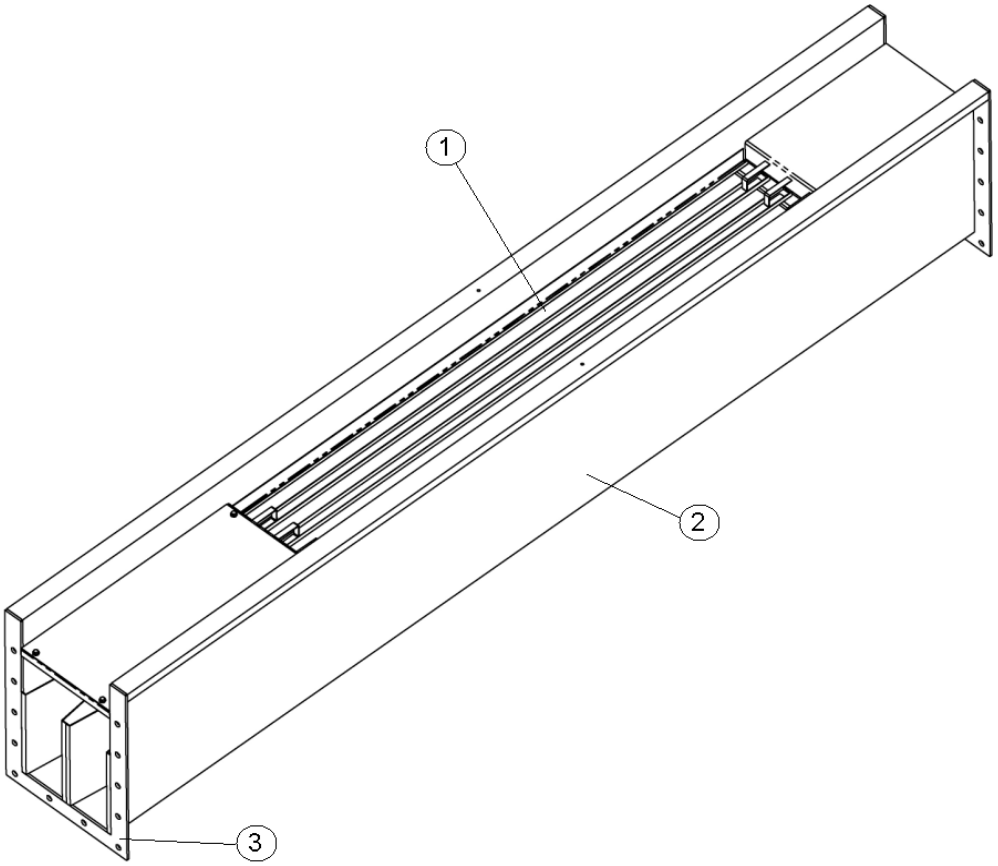


Figure 7 Type K stainless steel channel

| | | | |
|---|---|---|---|
| **1** | UV module rack | **3** | Channel flange |
| **2** | Stainless steel channel | | |

### 2.11.1.2 Transition boxes (type K models only)

For installations where a stainless steel channel is used, optional transition boxes can be provided for each end of the stainless steel channel (Figure 8).

Transition boxes are designed to provide transition between the UV channel and flanged inlet and outlet pipes. The inlet transition box helps to ensure a plug flow condition that is conducive to more efficient disinfections. The transition boxes should be subjected to the same periodic maintenance as the channel.

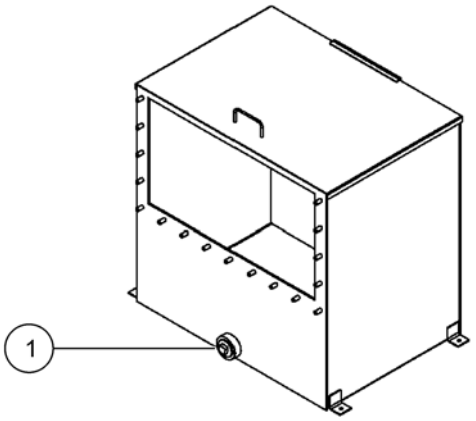


Figure 8 Transition box for type K channels

| | |
|---|---|
| **1** | Drain plug |

### 2.11.1.3 Turn box (type K models only)

A stainless steel turn box is provided to connect two channels in a U-shape configuration (Figure 9). This is an optional configuration for all stainless steel models (both standard and double flow). Not available on 3800K-3001M or D3800K or D3001M.

Effluent flow enters the upstream transition box, passes through the first channel, enters the turn box where the flow is reversed 180°, passes through the second channel, to exit through a downstream transition box. Refer to Figure 10.

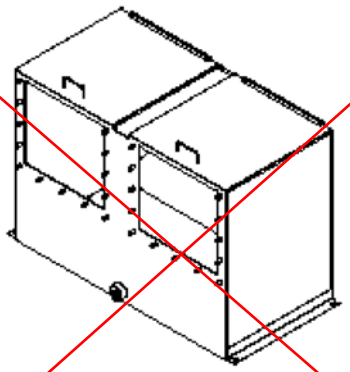

Figure 9 Turn box for type K channels

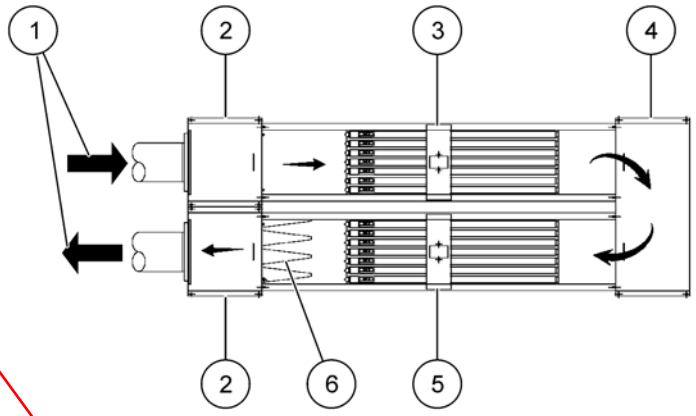


Figure 10 Turn box flow

| | | | |
|---|---|---|---|
| **1** | Flow | **4** | Turn box |
| **2** | Transition box (2x) | **5** | Downstream channel |
| **3** | Upstream channel | **6** | Weir, located in downstream channel |

## 2.11.2 Concrete channel (type K-1 option)

For installations where a concrete UV channel will be used, stainless steel channel(s) and transition boxes will not be provided. UV module rack(s) and level control weir(s) must be installed by the customer or a contractor. The poured concrete is also the responsibility of the customer.

Refer to Table 2 for reference on models that are available for concrete channel installation.

**Table 2 Models available for concrete channel installation**

| **TrojanUV3000™PTP model** | **Concrete channels, customer-supplied (stainless steel channel and transition boxes are not provided, K-1 models)** |
|---|---|
| 3025 - 3300 andD3025 - D3300 | N/A |
| 3400 to 3001 and D3400 to D3001 | X |

### 2.11.2.1 UV module rack for concrete channels (type K-1 models)

The UV module rack for K-1 (concrete channel) systems is a stainless steel frame that supports the UV modules in the concrete channel.

The UV module rack is fastened to four channel brackets attached to the concrete channel walls. The rack weldments are mounted to the side of the channel with angle brackets.

The support rack is adjusted to position the UV module's bottom UV lamp at a precise height in the bottom of the channel. No fastening of the individual UV modules is necessary.

**⚠ DANGER**

Only qualified personnel should conduct the tasks described in this section of the manual.

## 3.1 Unpacking the system

The TrojanUV3000™PTP is typically delivered to the site by truck. The components of the system are packed in wooden crates. A forklift and 4-point lifting sling may be used to unload these crates.

The wooden shipping crates are labeled with the component name and symbols showing a glass to indicate fragile and an umbrella to indicate that the crates. The contents should be kept dry.

The TrojanUV3000™PTP is usually shipped in one crate depending on the size of the system and optional equipment provided. For larger systems, transition boxes (if required) and cleaning racks (if required) will be crated separately.

Do not unpack the equipment until ready for installation.

The complete crates weigh from 170 kg (375 lbs) to 460 kg (1015 lbs) depending on the system size. The monitor system weighs 6.8 kg (15 lbs).

**⚠ CAUTION**

Do not stack or top load the shipping crates.

Read the instructions that list the proper removal procedure for each component and how they are shipped.

If transportation of the UV equipment between the storage location and the installation location is required use a flatbed truck. Secure the equipment to the truck. Use proper loading and unloading procedures to load and unload equipment from the flatbed.

***Note:*** *Improper handling of equipment during removal from flatbed may void of the warranty.*

**UV module rack and UV modules**

- Shipped together
- Shipped with stainless steel UV Channel (optional)
- Mass dependent upon system configuration. See the submittal manual for specific weights
- Lift the channel with UV module rack and UV module with a 4-point lifting sling. Use a stationary overhead crane for channel placement. Smaller systems can be lifted by hand.
- When no channel is provided, the UV module rack and UV modules can be lifted using a 4-point, lifting sling
- Cleaning rack shipped in a separate crate

**Monitor system (if applicable)**

- Do not dent or mark the monitor
- Weight 6.8 kg (15 lbs)
- Power Distribution Receptacle (PDR)
- Shipped in same crate as the UV module rack and UV modules

- Mass dependent upon system configuration. See the submittal manual for specific weights.

**Optional equipment**

- UV Photometer is an industrial control system housed in a panel. Care should be taken not to dent or mark the panel.

**Spare parts**

- Mass dependent upon system configuration. See the submittal manual for specific weights.
- Depending on size and number of spare parts, they could be shipped in a separate crate.

## 3.2 Equipment storage

The manufacturer recommends indoor storage of the TrojanUV3000™PTP equipment. The equipment should be stored in a dry warehouse. Heating is not necessary during storage. However, prior to system start up the equipment must be warmed to an ambient minimum temperature of 15 °C (60 °F).

Storage volume is estimated to be 300 cubic feet or 10 cubic meters. Storage will depend on size of the system.

If indoor storage is not possible, the UV modules, PDR, channel, transition boxes, and cleaning equipment may be stored outdoors under the specified conditions:

- Equipment is stored on high ground that is not susceptible to flooding.
- Equipment is elevated a minimum of 150 mm (6 inches) above the ground, or as appropriate to avoid wet conditions.
- Equipment is completely covered with waterproof tarps to prevent exposure to the elements (i.e. rain, snow, sand, etc.).

***Note:*** *Tarps should be tight fitting, fastened securely and inspected weekly to make sure that the equipment is properly covered and protected.*

All other equipment including the system monitor, and UV photometer (if applicable), and spare parts should be stored as specified:

- In a dry warehouse
- Heating is not necessary. Prior to start up, however, the equipment must be warmed up to an ambient temperature of 15 ºC (60 ºF) minimum.

## 3.3 General installation instructions

***Note:*** *The dimensions and location of the system components may vary.*

No special tools are required for installation, other than those used in the day-to-day operation of a mechanical and electrical contracting firm. An appropriately sized crane may be required for off loading and installation of the unit. Size is dependent upon each project configuration.

Installation of the TrojanUV3000™PTP varies depending on site conditions and the system model provided. Refer to the installation procedures for the equipment provided:

- Stainless steel channel installation without turn or transition boxes (Section 3.4.1)
- Stainless steel channel installation with transition boxes (Section 3.4.2)
- Stainless steel channel turn box installation option (Section 3.4.3)

- Concrete channel installation (Section 3.4.4)

The general steps in this section are to be obeyed by the contractor.

- For installation where stainless steel channels will not be used, a concrete UV channel is to be poured by a qualified contractor according to the dimensions specified on the drawings supplied by the manufacturer or by the contractor.
- Necessary equipment interconnections need to be allowed for prior to pouring the concrete pad (if applicable), as identified in the drawings supplied by the manufacturer or a qualified contractor. There are no special requirements beyond those for a typical electrical panel (electrical service, communication, etc.)

## 3.4 Channel installation

### 3.4.1 Stainless steel channel installation option without turn or transition boxes

This procedure is for installations where a stainless steel UV channel has been provided without transition or turn boxes.

***Note:*** *Before installing the channel, remove the UV modules from the channel. Store them in a safe place.*

1. Attach the downstream flange (on the weir side of the channel) to the plate prior to discharge (Figure 11). Connection of the channel flange and plate must be water-tight.
2. Use the supplied gasket and apply outdoor sealant between the gasket and the flange surfaces.
3. Support the channel in two places (UV3025K - UV3075K) or in three equally distant places (UV3100K - UV3001M).

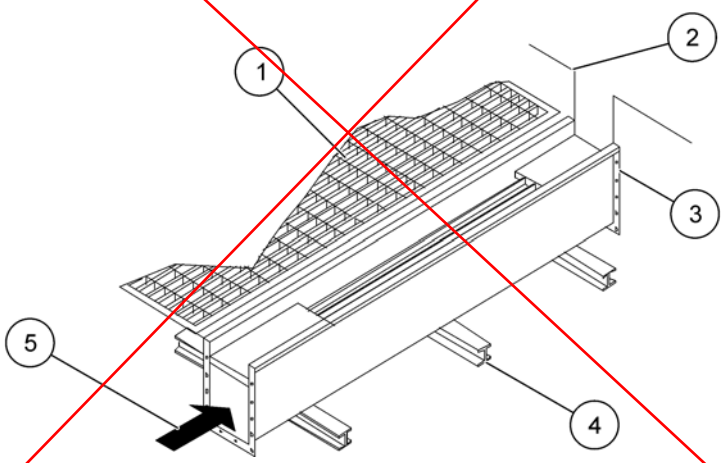


Figure 11 Channel bolted to plate prior to discharge

| | | | |
|---|---|---|---|
| **1** | Access grating (supplied by others) | **4** | Support beam |
| **2** | Plate before discharge | **5** | Flow |
| **3** | Water-tight seal | | |

### 3.4.2 Stainless steel channel installation option with transition boxes

This procedure is for installations where a stainless steel UV channel is provided with transition boxes.

Before installing the channel and optional transition boxes, ensure the following:

- Remove the UV modules from the channel. Store them in a safe place.
- Reverse the handle(s) for PTP transition box (Figure 12).

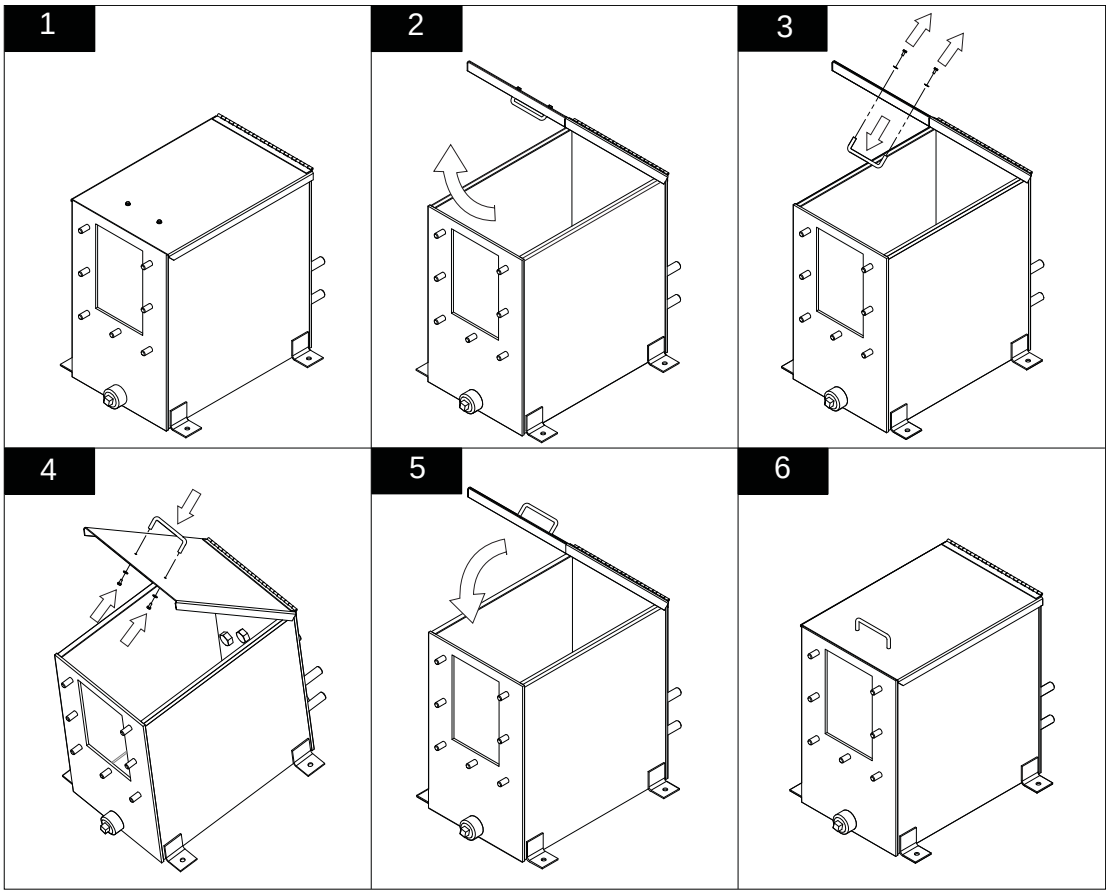


Figure 12 Reversing Handle for PTP Transition Box

Poured concrete channels are required when a stainless steel channel is not provided. The manufacturer does not recommend that concrete be poured around a TrojanUV3000™PTP stainless steel channel, transition or turn box.

For some installations a turn box may be used. Refer to Section 3.4.3.

1. Make sure that the channel flange and transition box flange connection surfaces are clean and dry.
2. Apply outdoor water proof sealant between the gasket and flange surfaces.
3. Assemble the channel and transition box (Figure 13 and Figure 15).

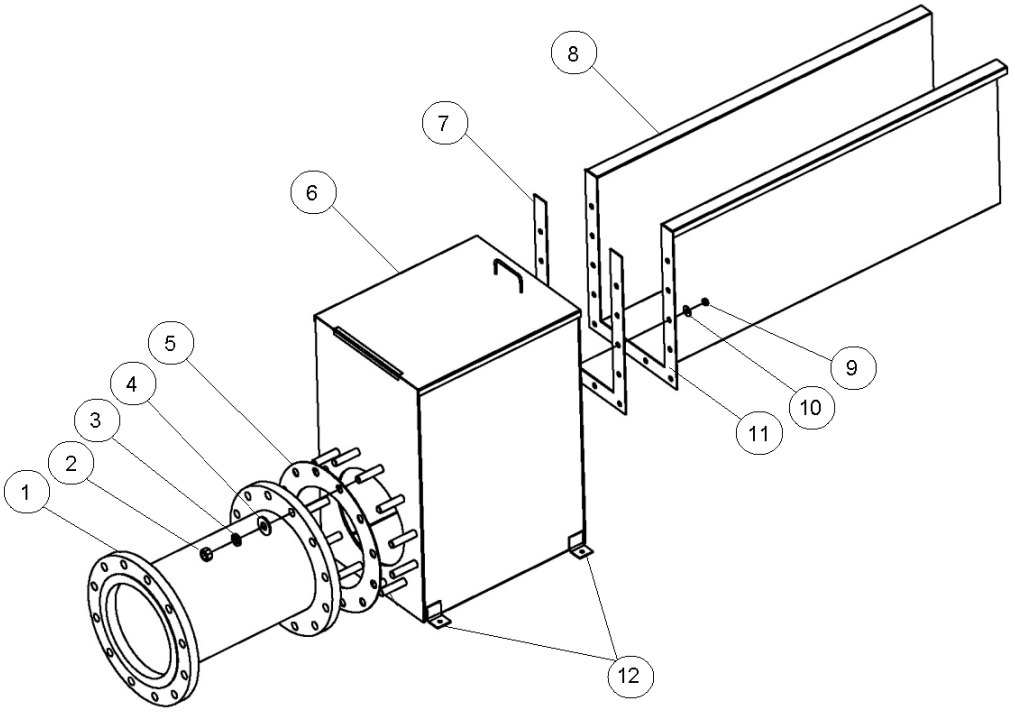


Figure 13 Assembly of transition box and channel

| | | | |
|---|---|---|---|
| **1** | Inlet / outlet pipe and connection flanges (customer-supplied) | **7** | Gasket, channel |
| **2** | Nut | **8** | Channel |
| **3** | Lock Washer | **9** | Nut |
| **4** | Flat washer | **10** | Flat washer |
| **5** | Gasket, pipe flange | **11** | Channel connection flange |
| **6** | Transition box | **12** | Transition mounting brackets (x4) |

4. If a turn box is supplied to connect multiple channels, refer to Section 3.4.3. For installations without a turn box, go to the next step.
5. Tighten channel flange, gasket and transition box together using hardware provided. A channel with transition boxes forms a self-supporting structure, which is bolted to the concrete slab through bottom angles of turn box and transition boxes.
   a. Hand tighten bolts, then pre-tighten bolts to 10-20 ft-lbs torque, but don't exceed 20% of the target torque.
   b. Check gap for uniformity.

**NOTICE**

Final bolt torque value is to be the preferred torque for the selected flange gaskets. The torque value is not to exceed the standard dry torque of the 316 stainless steel bolt.

**Table 3 Standard dry torque values**

| Bolt size (inches) | Standard dry torque (foot-pounds) |
|---|---|
| 1/2 - 13 | 45.2 |
| 5/8 - 11 | 96.7 |
| 3/4 -10 | 130 |
| 7/8 -9 | 202.5 |

6. Tighten inlet pipe flange, gasket and transition box together using hardware provided.
   a. Apply outdoor water proof sealant between the gasket and flange surfaces.
   b. Support the connection of the inlet pipe flange and transition box from the bottom to reduce stress on the transition box.
   c. Apply anti-seize to the bolts before installing washers and nuts.
   d. Install flat washers, lock washers and nuts onto the transition box bolts.
7. Use the cross pattern tightening sequence (Figure 14 and Table 4).

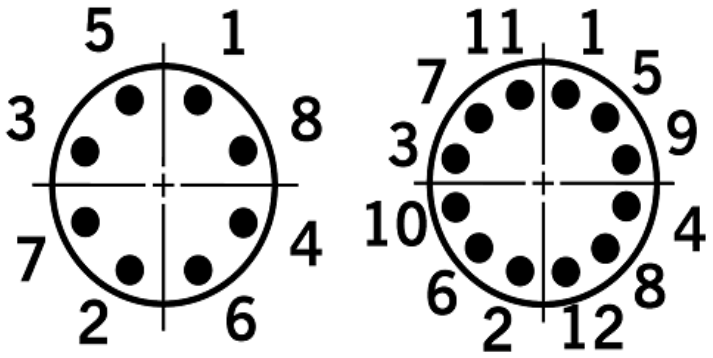


Figure 14 Cross pattern tightening sequence

**Table 4 Final torque percentage**

| Round | Percentage of final torque (%) |
|---|---|
| 1 | 25 |
| 2 | 50 |
| 3 | 100 |

8. Check gap around the circumference between each round, measured at every other bolt. If the gap is not reasonable uniform around the circumference, make the appropriate adjustment by selective bolt tightening before proceeding.

**NOTICE**

Short term bolt preload loss can occur between 4 to 24 hours after initial tightening due to relaxation. Consider retightening to help recover this loss.

9. Repeat steps 6 through 8 for outlet pipe flange.
10. Attach the channel to the slab with the transition boxes (Figure 15). For installations with turn boxes refer to Figure 18 and Figure 19.

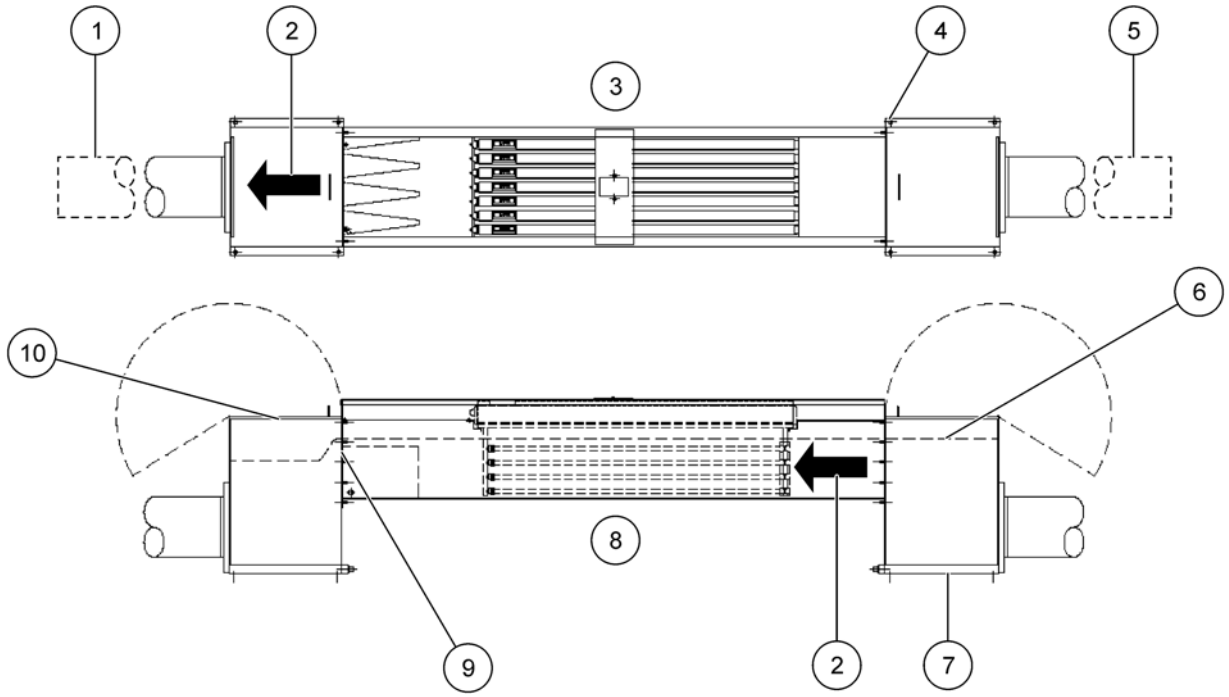


Figure 15 Stainless steel channel with transition boxes

| | | | |
|---|---|---|---|
| **1** | Outlet pipe (customer-supplied) | **6** | Water level |
| **2** | Flow direction | **7** | Translation box (typical installation at both ends) |
| **3** | Plan view | **8** | Side view |
| **4** | Anchor bolts, 10 mm (3/8 in.), (customer supplied) (4x) | **9** | Water-tight seal (typical installation at both ends) |
| **5** | Inlet pipe (customer-supplied) | **10** | Hinged lid with handle (typical installation at both ends) |

**11.** Make sure that the channel is level with a tolerance of 6.4 mm (¼ in.) at either end (Figure 16).

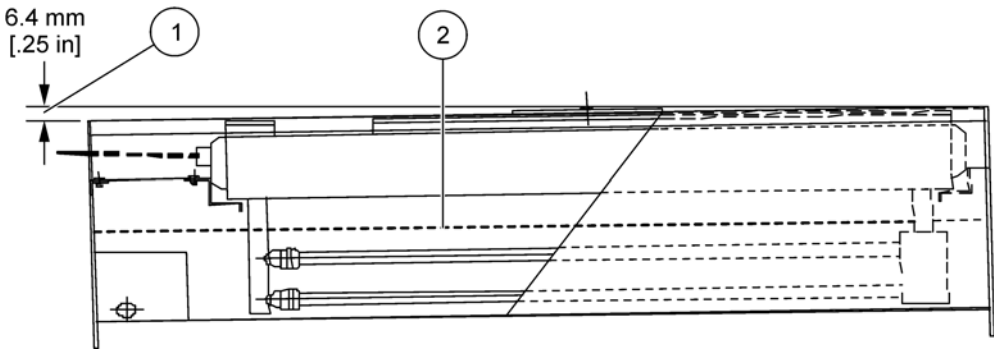


Figure 16 Level the channel

| | | | |
|---|---|---|---|
| **1** | Level tolerance | **2** | Water level |

12. Make sure that the weir is in a free discharge at peak flow. Minimal discharge (Figure 17) is 2.5 to 3 inches.
13. Make sure that the correct water level heights are available for peak flow conditions (Figure 17):
    - UV3025K-UV3300K: 6 to 7 inches, D3025K-D3300: 6.5 to 8 inches
    - UV3400K to UV3001M: 12 to 12.5 inches, D3300-D3001M: 14 inches
14. Insert UV modules back into the channel and plug them into suitable outdoor outlets.

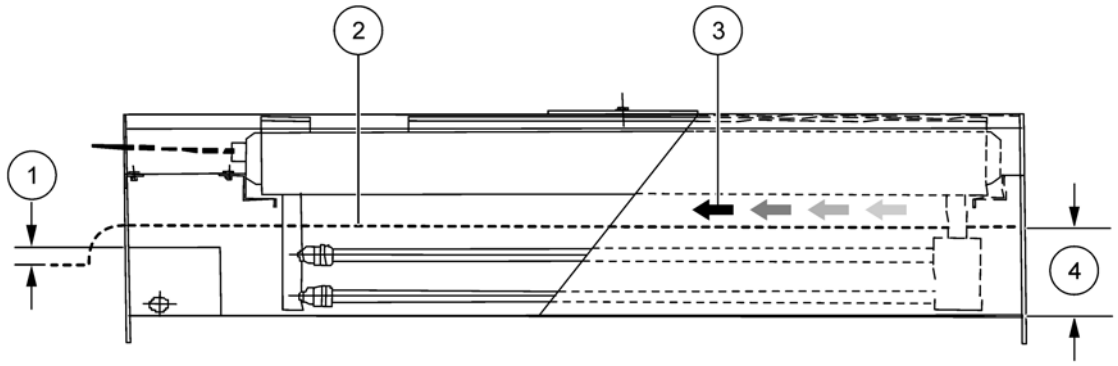


Figure 17 Free discharge and hydraulic profile verification[1]

| | | | |
|---|---|---|---|
| **1** | Minimal distance after weir at peak flow | **3** | Water flow |
| **2** | Water level | **4** | Water height for peak flow |

[1] To convert inches to millimeters (mm), multiply by 25.4.

### 3.4.3 Stainless steel channel turn box installation option

This procedure is for installations where stainless steel UV Channels have been provided with a turn box.

Before installing the channel and optional transition boxes, remove the UV modules from the channel. Store them in a safe place.

Connect the inlet and outlet transition boxes Refer to Section 3.4.2.

Turn boxes are connected to the UV channel and mounted the same as transition boxes.

Poured concrete channels are required when a stainless steel channel is not provided. The manufacturer does not recommend that concrete be poured around a TrojanUV3000™PTP stainless steel channel, transition or turn box.

1. If not complete, refer to Section 3.4.2 before proceeding.
2. Make sure that the turn box flange surfaces are clean and dry.
3. Apply outdoor sealant between the gasket and flange surfaces.
4. Assemble the channels and turn box (Figure 18).

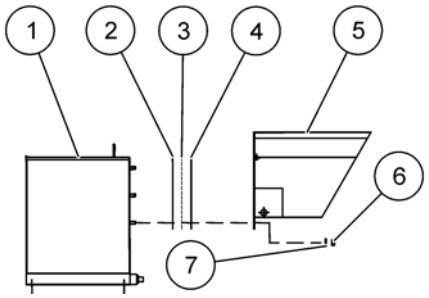


Figure 18 Turn box and channel assembly

| | | | |
|---|---|---|---|
| **1** | Turn box | **5** | Channel |
| **2** | Outdoor sealant | **6** | Nut |
| **3** | Gasket | **7** | Flat washer |
| **4** | Outdoor sealant | | |

**5.** Tighten the channel flanges, gaskets and turn box together using the hardware provided.

**NOTICE**

The recommended torque for bolting the channel to the transition and the pipe flange to the transition box is 55 inch- lbs.

**6.** Return to Section 3.4.2 to complete the installation instructions.

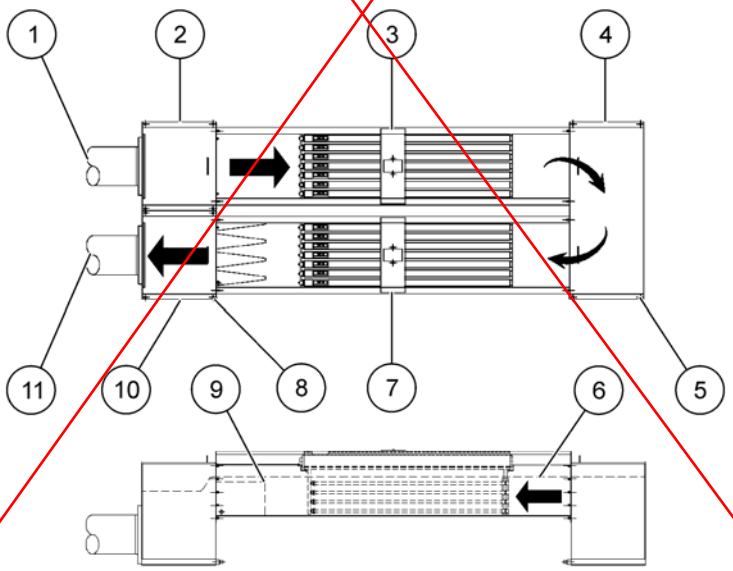


Figure 19 Stainless steel channel with transition boxes and turn box

| | | | |
|---|---|---|---|
| **1** | Inlet, (customer-supplied) | **7** | Downstream channel |
| **2** | Transition box, upstream | **8** | Anchor bolts, 10 mm (3/8 in.), (customer-supplied) (4x) |
| **3** | Upstream channel | **9** | Level control weir |
| **4** | Turn box | **10** | Transition box, downstream |
| **5** | Anchor bolts, 13 mm (0.5 in.), (customer-supplied) (4x) | **11** | Outlet, (customer-supplied) |
| **6** | Water level | | |

## 3.4.4 Concrete channel installation option

Poured concrete channels are required when a stainless steel channel is not provided. The manufacturer recommends that concrete not be poured around a TrojanUV3000™PTP stainless steel channel, transition or turn box.

For 3400K-1, 3600K-1, 3800K-1 and 3001M-1 TrojanUV3000™PTP models, stainless steel channels and transition boxes are not provided. UV module racks and level control weirs are installed in a poured concrete channel by qualified contractors.

Refer to Figure 20 for the installation procedure.

1. Secure the UV rack to the channel walls with 10-mm ($^3/_8$-inch) anchor bolts. The center line of the anchor bolt should be mounted 400 mm (15.75 in.) from the channel floor.
2. Verify the correct height of the rack and install the UV modules. The dimension from the bottom of the channel to the top of the top quartz sleeve should be 279-mm (11-in.). An additional reference dimension is measured from the channel floor to the center of the first lamp, 38 mm (1.5 in.).
3. Attach the level control weir to channel floor and walls with 10-mm ($^3/_8$-inch) anchor bolts. Put grout around all outside edges for a watertight seal.

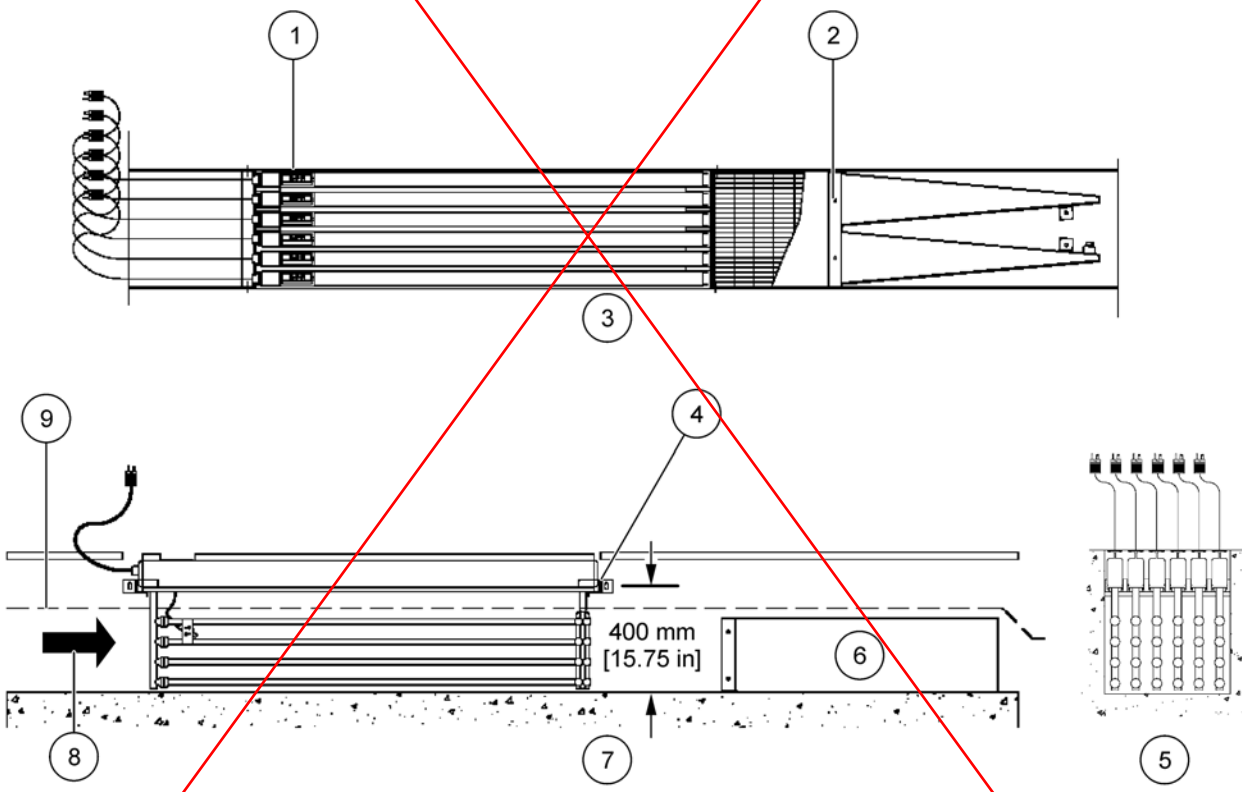


Figure 20 Concrete channel installation[1]

| | | | |
|---|---|---|---|
| **1** | Anchor bolts, $^3/_8$-in., (customer supplied) (4x) | **6** | Level control weir |
| **2** | Seal, anchor bolts, $^3/_8$-in., (customer supplied) | **7** | Side view of channel |
| **3** | Plan view of channel | **8** | Flow direction |
| **4** | UV rack, vertical adjustment ± 0.5 in. | **9** | Hydraulic profile |
| **5** | End view of channel | | |

[1] To convert inches to millimeters (mm), multiply by 25.4.

## 3.5 Power distribution receptacle (PDR)

The UV module power cords attach to the respective receptacles on the optional PDR. The power cords from the UV sensor plug into the optional system monitor.

## 3.6 Equipment interconnections

The TrojanUV3000™PTP interconnections are shown in the drawings supplied by the manufacturer or a qualified contractor.

- One main power feed terminated at the service entrance for each of the splitter panels
- One power supply is to be terminated at the system monitor
- One power supply is to be provided for each PDR
- Once checked, the TrojanUV3000™PTP is ready for official commissioning and operator training by the manufacturer representative

# Section 4 Replacement parts and accessories

## 4.1 Optional equipment and parts

| Part description | Part number |
|---|---|
| Operator's kit complete (face shield/ disposable gloves) | 906015-320 |
| Face shield | 906002 |
| UV module | 321592C |
| ***Note:*** *Models #3025K to # 3075K use 34-in. lamps and 900 mm domed sleeves* | |
| ***Note:*** *Models #3100K to # 3001M use 64-in. lamps and 1610 mm domed sleeves* | |
| UV lamp, 34 in. long, UV3614 (package of four) | 302417-004 |
| UV lamp, 64 in. long, UV6414 (package of four) | 302418-004 |
| Quartz lamp sleeve, 900mm domed (package of four) | 302108-004 |
| Quartz lamp sleeve, 1610mm domed (package of four) | 302208-004 |
| Ballast, 120V/60 Hz | 302403 |
| LED module circuit board (MCB), 2-lamp UV module | 308012 |
| LED Module circuit board (MCB), 4-lamp UV module | 308011 |
| Power cord | 308195 |
| Sleeve cup nut | 302312 |
| Lamp holders/Seal socket assembly | 316018 |
| O-ring sleeve support | 302314 |
| O-ring sleeve seal | 302300 |

## 4.2 Service end cap replacement parts

Refer to Figure 21 for components.

| Component | Part description | Part number |
|---|---|---|
| 1 | Strain relief | 914478-129 |
| 2 | Service end cap, power cord end | 316559-001 |
| 3 | Silicone seal, service end cap | 316558 |
| 4 | Screw, service end cap, Philips head, 2x | 013039 |
| 5 | O-ring, air pressure test access | 002226G |
| 6 | Screw, socket head plug for pressure test access | 303314 |
| 7 | Service end cap, blank end | 316559-002 |

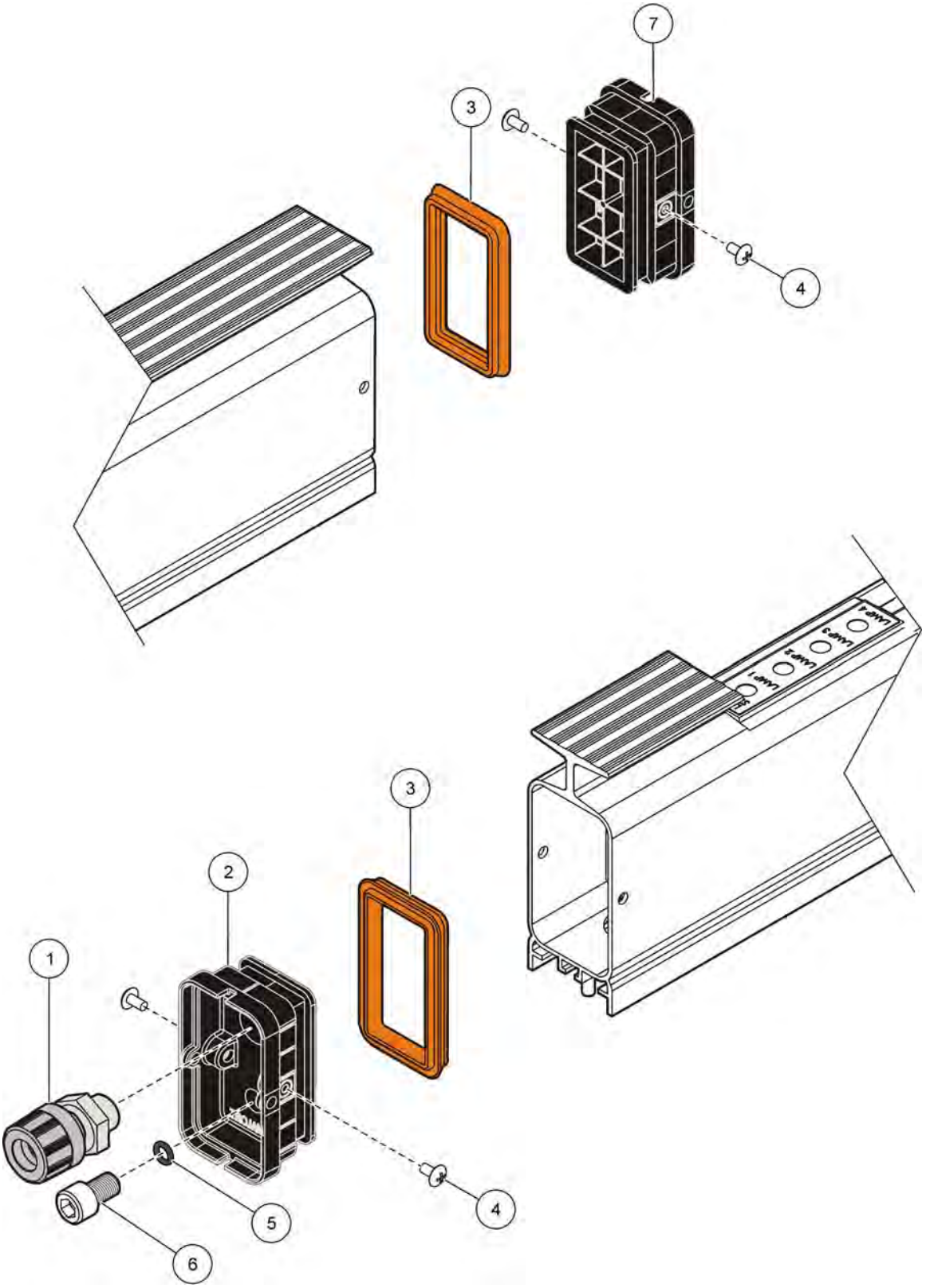


Figure 21 Service end cap components

## 4.3 Air pressure test tool

| Description | Part number |
|---|---|
| Air pressure test tool | 907631 |

## 4.4 Monitoring system

| Part Description | Part number |
|---|---|
| Monitor assembly (includes UV sensor) | 321159 |
| Monitor enclosure assembly | 308799 |
| UV sensor assembly, 20 ft | 015200 |
| UV sensor bracket kit | 015306 |
| Monitoring system circuit board | 308772 |

## 4.5 Power distribution receptacle (PDR)

| Part Description | Part number |
|---|---|
| Power distribution receptacle assembly | 308162 |
| Ground fault circuit interrupter | 261125 |
| Receptacle enclosure | 306337 |

***Note:*** *Using non-approved replacement parts in a UV system may affect the equipment reliability and void both the original warranty and performance guarantee. Contact a local representative referenced under the prefix of this manual for details on pricing and availability.*

# CHAPTER 2

# PROJECT & SYSTEM DESCRIPTION

# TrojanUV3000™PTP Project and System Description

TROJAN UV
WATER CONFIDENCE™

| Project Information | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Project Name:** | Pangnirtung WWTP Upgrade | | | **State/Province:** | NU | | |
| **Consulting Engineer & Address:** | exp Services Inc, 2650 Queensview Dr, Unit 100, Ottawa, ON, K2B 8H6 | | | | | | |
| **Contractor Name & Address:** | MECELEC, 1790 Rue Provincial Suite 104, Quebec, QC, G1N 4A2 | | | | | | |
| **Design Flow:** | 7.8 | L/s | **Total Suspended Solids (TSS):** | 20 | mg/L | 30 Day Average | |
| **% Transmittance:** | 65% | **Disinfection Standards:** | 200 /100 mL | FC | based on a | 30 Day Geo Mean | |

| Equipment: | | |
|---|---|---|
| **Model:** | **Bank Quantity:** | **Type:** |
| 3200K | 1 | Stainless Steel |

**System Includes:**

| Quantity: | Equipment: |
|---|---|
| 4 | UV Modules |
| 2 | UV Lamps per Module |
| 1 | Module Support Rack |
| 1 | Monitoring System |
| 2 | Power Distribution Receptacle(s) (GFI's) |
| 1 | Stainless Steel Channel |
| 2 | Transition Box |
| 0 | Turn Box |
| 1 | Operators Kit |
| 3 | O&M Manuals |

**Additional Equipment/Spare Parts**

| Quantity: | Equipment: | |
|---|---|---|
| 4 | Quartz Sleeves | Spare Parts |
| 4 | UV Lamps | |
| 4 | Lamp Holder Seals | |
| 1 | Weir | Additional Equipment |
| 1 | Maintenance/Cleaning Rack | |
| | Other: | |
| | Other: | |
| | Other: | |
| | Other: | |
| | Other: | |

**ATLANTIC PURIFICATION SYSTEMS LTD.**
10 Ferguson Road, Dartmouth, Nova Scotia, B3A 4M1
P.O. Box 877, Dartmouth, Nova Scotia, B2Y 3Z5
Phone: (902) 469-2806 Fax: (902) 463-3529

# SCOPE OF SUPPLY
# ULTRAVIOLET DISINFECTION EQUIPMENT
# TROJANUV3000™PTP - 3200K Stainless Steel Channel

| | |
|---|---|
| Project Name: | Pangnirtung WWTP Upgrade |
| Quote No: | QE 1068 12 |
| Date: | January 14, 2014 |
| Model Number: | **TrojanUV3000™PTP model 3200K** |
| Total Units Included: | 1 |
| Unit Configuration: | Single Unit [ x ] In Series [ ] In Parallel [ ] |

Design Criteria:

| | |
|---|---|
| Current Peak Design Flow: | 7.8 L/s |
| UV Transmission: | 65% minimum |
| Total Suspended Solids: | 20 mg/l, 30 day average |
| Max Mean Particle Size: | 30 microns |
| Disinfection Limit: | 200 Fecal Coliform per 100 ml, based on a 30 day geometric mean of consecutive daily grab samples |

We are pleased to submit the following scope of equipment supply based on the above criteria. The equipment described herein is named as the basis for the design.

**The purchaser is responsible for reading all information contained in this Supply Contract. Trojan / Atlantic Purification Systems will not be held accountable for the supply of equipment not specifically detailed in this document. Detailed installation instructions are provided with the shop drawings and are available upon request. Changes to the Scope of Supply that affect selling price will be handled through a change order.**

**Please refer all inquiries to Trojans' Manufacturer Representative:**

**APS Atlantic Purification Systems Ltd.**
*Patrick MacPherson CET - Environmental Sales*
☎ 902-469-2806 ext.132
902-463-3529
patrick@aps.ns.ca
www.aps.ns.ca

**ATLANTIC PURIFICATION SYSTEMS LTD.**
10 Ferguson Road, Dartmouth, Nova Scotia, B3A 4M1
P.O. Box 877, Dartmouth, Nova Scotia, B2Y 3Z5
Phone: (902) 469-2806 Fax: (902) 463-3529

**ULTRAVIOLET MODULES** – By Trojan

Each UV module will be supplied completely assembled containing lamps, quartz sleeves and electronic ballasts. Each module will be supplied with a 10 foot (3.0 m) weather-proof cable and standard 120 Volt plug for connection to a GFI receptacle.

| | |
|---|---|
| Quantity: | 4 UV modules will be supplied each containing 2 lamps |
| Material of Construction: | 316 stainless steel frame |
| Approximate Weight: | 30 lbs (14kg) per module |
| Enclosure Rating | Type 6P |

**STAINLESS STEEL CHANNEL** – By Trojan

One (1) Type 304 stainless steel, 14 gauge, channel assembly will be provided. Channel assembly will include UV module support rack and one (1) downstream serpentine weir with 1" NPT drain plug. Please refer to UV equipment layout drawings for exact channel dimensions and layout.

96" x 12" x 17.08" (243.8cm x 30.5cm x 43.4cm)

**MONITORING SYSTEM** – By Trojan

1 Type 4X fiberglass Monitoring Panel(s) will be supplied per Unit for monitoring system parameters, including lamp age and UV intensity. The monitoring system includes a submersible UV sensor, mounted on one module, to measure UV intensity in $mW/cm^2$. Approximate weight of the Monitoring Panel is 10 lbs (4.5kg).

***Installation Contractor's Responsibility:***

The Installation Contractor to be responsible for wall mounting the Monitoring Panel as shown on the layout drawings. The Installation Contractor to be responsible for the supply, installation and connection of the following at each Monitoring Panel:

One (1) 120 Volt, 1 phase, 2 wire (plus ground), 50 / 60 Hz, 5 Amps power supply
One (1) 4-20 mA for remote indication for UV intensity (required if UV intensity will be monitored remotely)
One (1) dry contact for low UV intensity alarm (required if remote low UV intensity alarm is required)

**POWER DISTRIBUTION RECEPTACLES (PDRs)** – By Trojan

Type 3R, impact resistant thermoplastic duplex GFI PDRs will be provided to power the UV Modules.

| | |
|---|---|
| Quantity Supplied: | 2 PDR(s) will be supplied (one PDR per 2 modules) |
| Total Current Draw: | 6.4 A |

***Installation Contractor's Responsibility:***

Contractor to supply and distribute 120 Volt, single phase, 50 / 60 Hz power to the PDRs. Electrical work to be all encompassing and in accordance with local electrical codes.

**ATLANTIC PURIFICATION SYSTEMS LTD.**
10 Ferguson Road, Dartmouth, Nova Scotia, B3A 4M1
P.O. Box 877, Dartmouth, Nova Scotia, B2Y 3Z5
Phone: (902) 469-2806 Fax: (902) 463-3529

**TRANSITION CONNECTIONS** – By Trojan

Type 304 Stainless Steel transition boxes with flange openings (flanges by other) will be supplied for connection to plant piping.

| | |
|---|---|
| Quantity Supplied: | 1 Inlet Transition Box |
| | 1 Outlet Transition Box |
| Flange Diameter: | 8" ANSI (203 DIN) |

**MAINTENANCE RACK –** By Trojan

1 Type 304 stainless steel maintenance rack(s) will be supplied to support modules during service or maintenance activities.

Approximate Weight: 50 lbs (23kg)

**UV 254nm SPECTROPHOTOTMETER**

One portable UV 254nm Spectrophototometer will be included as per item 3.5.1.4 in the tender specification.

**SPARE PARTS AND SAFETY EQUIPMENT** – By Trojan

The following spare parts and safety equipment will be supplied with the Trojan UV system:

4 UV lamps
4 Quartz sleeves
4 Lamp holder seals
1 Operators Kit (including face shield, gloves)

**NOTES AND CLARIFICATIONS TO SPECIFICATION**

| | |
|---|---|
| 3.1.3 | Fasteners and Anchor bolts are not included. |
| 3.4.5.3 | Transition boxes have 200mm ANSI Bolt Hole Openings, Flanges not included. |
| 3.4.6.12 | Modules have a rating of 6P. |

**ATLANTIC PURIFICATION SYSTEMS LTD.**
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Phone: (902) 469-2806 Fax: (902) 463-3529

## STARTUP AND COMMISSIONING – NOT INCLUDED IN PRICE

UV System Start-up and Operator training will be provided by factory trained service personnel for $1200/day plus all travel and living expenses. This per diem rate will be applied to actual service days, travel days, and all days on site.

## WARRANTIES

Notwithstanding the contractor's obligations to the owner, Trojan Technology's Warranties are as follows;
Trojan Technologies warrantees the UV equipment supplied for 12 months after start up or 18 months after shipment, whichever comes first. Extended warranty is available for additional cost.
UV lamps are warranted for 12,000 hours (non-prorated) or thirty-six (36) calendar months from shipment, whichever comes first.

## ADDITIONAL NOTES

Three (3) copies of submittal shop drawings will be provided 2-4 weeks after receipt of purchase order.
Equipment delivery 4-6 weeks after release for fabrication (approved Shop Drawings).
Three (3) copies of Standard O&M Manuals will be provided at time of equipment delivery.

## PAYMENT TERMS

100% Net 30 Days or prior to system start-up, whichever comes first.
F.O.B Factory; Freight paid to Quebec
All taxes extra
Start up will not be scheduled or performed until payment for the UV system is received in full.
Quote valid for 30 days

# CHAPTER 3

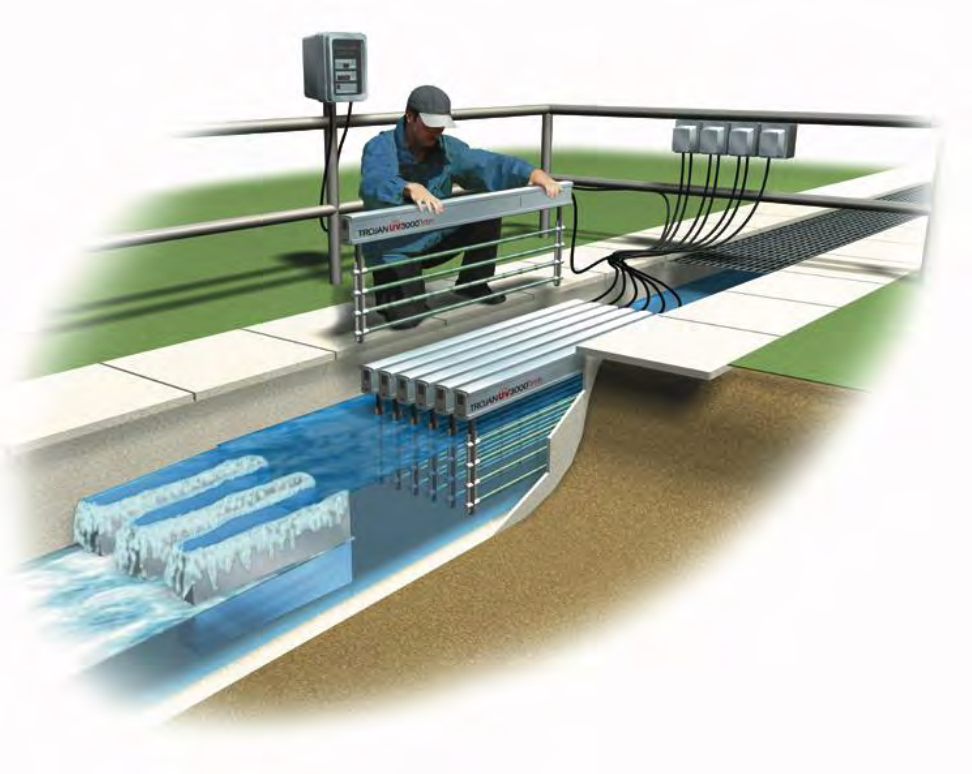
# PROJECT AND PRODUCT DRAWINGS

TROJAN UV

# TROJAN UV3000™ PTP

## SUBMITTAL

# PANGNIRTUNG WWTP



**Rev: 2**
**Last Updated:** 2011-10-12

Document # _____ Checked By: _____ Date: _____
Revision: _____ Approved By: _____ Date: _____

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# PREFACE

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1-800-291-0213 Northern Midwest USA
1-800-294-2150 South Eastern USA
1-800-291-0851North Eastern USA

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# ISO 9001 CERTIFICATE OF REGISTRATION

ISO 9001 certificate is included on the following page.

# Certificate of Registration

## QUALITY MANAGEMENT SYSTEM - ISO 9001:2008

*This is to certify that:*

**Trojan Technologies Inc.**
**3020 Gore Road**
**London**
**Ontario**
**N5V 4T7**
**Canada**

*Holds Certificate No:* **FM 63961**

*and operates a Quality Management System which complies with the requirements of ISO 9001:2008 for the following scope:*

Research, design, engineering, and manufacture of ultraviolet (UV) light technologies for wastewater, industrial, and drinking water disinfection applications, and for the destruction of pollutants in liquid streams.

*For and on behalf of BSI:*

*Gary Fenton, Global Assurance Director*

Originally Registered: **03/27/1998** Latest Issue: **06/25/2012** Expiry Date: **07/10/2015**



This certificate remains the property of BSI and shall be returned immediately upon request.
An electronic certificate can be authenticated online. Printed copies can be validated at www.bsigroup.com/ClientDirectory
To be read in conjunction with the scope above or the attached appendix.
Information and Contact: BSI, Kitemark Court, Davy Avenue, Knowlhill, Milton Keynes MK5 8PP. Tel: + 44 845 080 9000
BSI Assurance UK Limited, registered in England under number 7805321 at 389 Chiswick High Road, London W4 4AL, UK.
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# TROJAN TECHNOLOGIES COMPANY PROFILE

## IMPROVING YOUR QUALITY OF WATER WORLDWIDE

From the water we drink, to the wastewater or sewage we produce, and the processed water we use in our industries and in agriculture, water is a precious resource that touches every person on the planet in one way or another every single day.

As the world's population increases, so too does the demand for this commodity, and given the fact that only 1% of the world's water is fresh water, and that only a small percentage of that is drinkable, the challenges in maximizing this resource for current and future generations are abundantly obvious.

## TROJAN TECHNOLOGIES – MATCHING NEW MARKETS WITH NEW SOLUTIONS

Identifying key market opportunities and matching proven solutions to water-related environmental problems has been the hallmark of Trojan Technologies Inc. for more than a quarter of a century. Founded in 1976, the company has led the change to water disinfection systems that use environmentally responsible, cost-effective ultraviolet light in place of chemicals.

Today, Trojan is recognized around the world as being the leader in UV disinfection technology and is committed to aggressively leveraging its proprietary expertise in a growing number of key market sectors. These markets include municipal drinking water, municipal wastewater, environmental contaminant treatment, and residential applications as well as the ultrapurification of water used in food and beverage manufacturing, pharmaceutical processing, and semi-conductor applications around the world.

Trojan is a Canadian-based company, and is publicly traded on the Toronto Stock Exchange under the trading symbol TUV.

Trojan's success is evident in the fact that it has the largest installed base of municipal UV disinfection systems operating around the world.

Trojan employs over 300 employees at its offices in Canada, Europe, the United States and the Pacific Rim and services a growing customer base around the globe through an extensive network of dealers and representatives. This strong distribution network allows us to provide unparalleled levels of service and support to customers regardless of where they are located.

## MEETING CURRENT AND EMERGING NEEDS

All Trojan systems are designed to meet specific regulatory requirements around the world, including the United States, Canada, Great Britain, New Zealand, Australia and Germany. In addition to meeting and exceeding these requirements, UV disinfection creates minimal by-product formation, and is extremely safe for both UV system operators and the public.

Trojan's advanced manufacturing facilities ensure a high level of quality control at every stage of the process, from initial design to final installation. In 2003, Trojan received the ISO 9001-2000 designation - an internationally recognized model for quality assurance in design, development, production, installation and service.

## FIRST IN OUR FIELD

Recognized as being the most experienced and knowledgeable professionals in the industry, Trojan scientists and engineers have introduced many of today's global innovations in UV technology:

- The first application of UV technology to disinfect reclaimed wastewater to stringent limits

- The first incorporation of electronic ballasts into low-pressure UV lamp disinfection technologies

- The first commercially successful medium pressure UV lamp system (TrojanUV4000PlusTM) for high volume and lower quality wastewater treatment

The first integrated chemical and mechanical cleaning system for both low and medium pressure UV lamp systems

- The first electronic ballast with extended control capacity for medium pressure UV lamps in any application

- The first underwater UV lamp testing facility in the industry.

- The first Environmental Contaminant Treatment process utilizing UV lamp technology

Our track record for innovation has set us apart and with more than 45 Trojan patents granted or pending, we are well positioned to continue leading the way to safer, more efficient water disinfection techniques.

Market Focused

## MUNICIPAL WASTEWATER

Recognized as a safer, more cost-effective and environmentally-responsible alternative to chlorination, UV has become the preferred choice for wastewater disinfection.

Trojan UV systems offer municipal wastewater treatment plants a safe, practical, and economical alternative to chlorination.  Today, Trojan has more UV disinfection systems in operation around the world than anyone else - treating more than 11.4 billion gallons a day (1.8 million m3/hr) - demonstrating the high regard in which Trojan's proven products and service are held in the industry.

### TrojanUV4000Plus™

Our most advanced wastewater system, the TrojanUV4000Plus™ builds on the innovative design established by the original

TrojanUV4000Plus™ - the first commercially successful medium pressure, high-intensity UV lamp system specifically designed for handling high volume and lower quality wastewaters.

Engineered and built for maximum dependability, the TrojanUV4000Plus™ incorporates automatic chemical/mechanical cleaning (ActiCleanTM) technology. The System is designed for municipalities with populations of between 50,000 and 5 million.

**TrojanUV3000Plus™**

Designed using the latest UV technology, the TrojanUV3000Plus™ uses cost-saving amalgam lamps. These high output lamps are automatically dimmed when flow demand drops or when the water clarity increases. This feature significantly extends lamp life and reduces operating and maintenance costs. The TrojanUV3000Plus™, which also features Trojan's exclusive ActiClean™ chemical/mechanical cleaning system, is designed for municipalities with populations of between 25,000 and 300,000.

## MUNICIPAL DRINKING WATER

Trojan offers the most advanced UV systems in the world for safeguarding drinking water from harmful microorganisms, including Cryptosporidium and Giardia.

The leader in the municipal wastewater market, Trojan is also aggressively pursuing the rapidly expanding municipal drinking water market. UV offers a proven solution and safe alternative to chemical disinfection, which can produce harmful by-products. UV also has the benefit of not affecting the taste, color or odor of water.

Though relatively new to the drinking water sector, Trojan has quickly capitalized on this growth market. In fact, Trojan is installing the largest UV drinking water disinfection system in the world. When ready, this system will be capable of handling 180 million gallons per day – double the capacity of the largest existing UV system.

Not only are Trojan's Municipal Drinking Water contracts growing in scope and size, there is increasing diversity in how the innovative UV systems are being integrated with existing chemical and non-UV disinfection treatments.

A key reason is that government legislation is changing the way communities look at safeguarding their drinking water supplies. Municipalities are responding by supplementing their systems with other forms of disinfection in a strategy known as “multi-barrier protection.” Based on efficacy, and environmental-safety, Trojan UV technology is extremely well positioned to continue capturing significant marketshare.

Another key consideration is cost. Trojan UV costs are about 1/5 that of ozone disinfection and 1/10 the price of membrane filtration – the two key technologies competing with UV in the multi-barrier treatment market.

### The TrojanUVSwift™

The TrojanUVSwift™ Municipal Drinking Water system provides a flexible platform that allows for upgrades to meet new or more stringent requirements, such as changes in flow rate, regulatory requirements, disinfection redundancy demands, or changes in intake water quality. With one of the smallest reactor dimensions in the industry, the TrojanUVSwift™ offers important cost advantages over other larger UV systems for retrofit applications in existing drinking water treatment plants as well as new plant construction.

### TrojanUVSwift™SC

Specially designed for smaller communities (SC), the TrojanUVSwift™SC allows regions with flow volumes of less than 1 million gallons per day to safeguard their drinking water supply against Cryptosporidium and Giardia and other harmful microorganisms. Although the TrojanUVSwift™SC system itself is small, the market for it is significant – in North America, Europe and abroad.

The advanced, high efficiency reactor of the TrojanUVSwift™SC outperforms other UV reactors by up to 30% and is compact enough to retrofit into most existing drinking water supply lines. The TrojanUVSwift™SC has the added benefit of a lower capital cost than other disinfection technologies. It is also extremely affordable and easy to operate.

## INDUSTRIAL/COMMERCIAL APPLICATIONS

Trojan's industrial product, the TrojanUVLogic™, is considered to be the best in the industry. Manufactured to Class 100,000 Cleanroom specifications, the TrojanUVLogic™ meets the exacting needs of a diverse range of ultra-pure water users, including the food and beverage industries, pharmaceutical companies and micro-chip manufacturers.

### TrojanUVSwift™$_{SC}$

Trojan is gaining a strong foothold in the industrial/ commercial market through its acquisition strategy and depth of experience in robust product design and manufacturing. TrojanUVLogic™ systems are designed to deliver the highest quality water, free of microbiological and total organic carbon, for a wide range of growth sectors:

**Process water:** Food, beverage and cosmetic industries.

**Ultra-Pure Water:** Electronic, semi-conductor, optical and pharmaceutical industries.

**Aquaculture:** Fish hatcheries and shellfish cultures.

**Cooling Water:** Cooling towers, humidifiers and plastic injection molding.

**Fountain Water:** Fountains and swimming pools.

**Reuse:** Reuse of process water for fruit and vegetable processing, car and bottle washes

**Marine:** Disinfection of Drinking water and Wastewater on large boats and ships

## ENVIRONMENTAL CONTAMINANT TREATMENT (ECT)

Many chemicals, such as pharmaceuticals and industrial byproducts, are difficult to treat with conventional technologies. UV, however, is capable of effectively treating a multitude of these compounds safely and efficiently.

The need to safely and effectively treat the rapidly emerging problem of environmental contaminants in our soil and groundwater is a growing concern to people around the world. Every day new contaminants are being discovered in the water cycle and are potentially reaching the tap. Many of these contaminants have endocrine-disrupting potential, and in many cases the health effects of combining different chemicals are unknown. The market potential of utilizing UV light – often the only economical way to remove specific environmental contaminants - is staggering. Trojan is leading the way in harnessing ultraviolet light for safe, effective Environmental Contaminant Treatment. Using UV technology, we can remove toxic micropollutants - such as pesticides, industrial solvents and other manufacturing by-products like n-nitrosodimethylamine (NDMA), and 1,4- dioxane - from contaminated water supplies and restore these critical sources of drinking water.

Trojan's groundbreaking UV solutions for ECT are being utilized in a variety of growing markets, including:

- Water reuse
- Groundwater remediation
- Chemical remediation
- Wastewater treatment
- Drinking water treatment

Dangerous environmental contaminants have been detected in each of the above applications, and Trojans scientists have conducted extensive work in the application of UV to ensure the safety of water users. In addition to the TrojanUVSwift™, Trojan offers the revolutionary TrojanUVPhox™ for the treatment of environmental contaminants.

### TrojanUVPhox™

Trojan now offers the next generation UV reactor for Environmental Contaminant Treatment (ECT): the TrojanUVPhox™. The patent-pending TrojanUVPhox™ (UVPhotolysis and Oxidation) is a groundbreaking, pressurized ultraviolet (UV) light reactor that utilizes Trojan's low energy, high output UV lamps. Through the extensive use of computational fluid dynamics models and other computer simulation tools, the TrojanUVPhox™ has been optically and hydraulically optimized to provide extremely efficient and cost-effective UV treatment. Its unique design allows for the use of multiple TrojanUVPhox™ reactors in series, giving the low-energy TrojanUVPhox™ an extremely compact footprint. As an added benefit, the lowenergy TrojanUVPhox™ can provide disinfection capabilities as well, leading to further cost savings.

One of the premier water treatment facilities in the world, operated by the Orange County Water District, has selected the TrojanUVPhox™ as the UV solution for the treatment of NDMA in its Groundwater Replenishment System (GWRS), to be constructed in 2003-04. When completed, the facility will employ the largest quantity of UV treatment equipment ever assembled for one project, treating up to 70 MGD of contaminated water to drinking water standards.

## RESIDENTIAL APPLICATIONS

Effective against pathogenic viruses, bacteria, and protozoa, UV disinfection is now the preferred choice for water disinfection.

Compact in size, and easy to install, the TrojanUVMax™ series of high-performance and commercial disinfection systems is designed for homes, cottages, hospitals, restaurants, and nursing homes. Unlike virtually all other residential and commercial treatment technologies, Trojan UV systems provide effective elimination of harmful microorganisms such as Cryptosporidium, Giardi, and E-coli.

- The pursuit of new distribution channels is opening this product category to significant opportunities for growth.

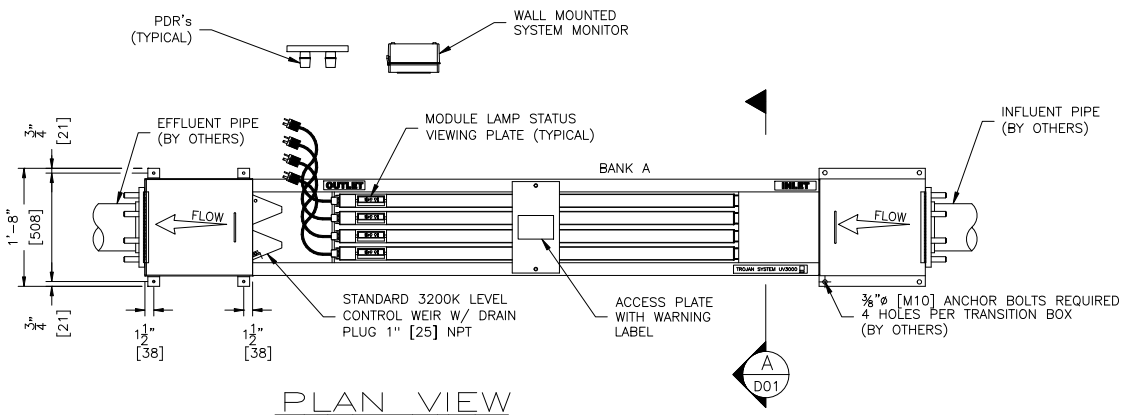
# CHAPTER 1

# PRODUCT INFORMATION SUBMITTAL

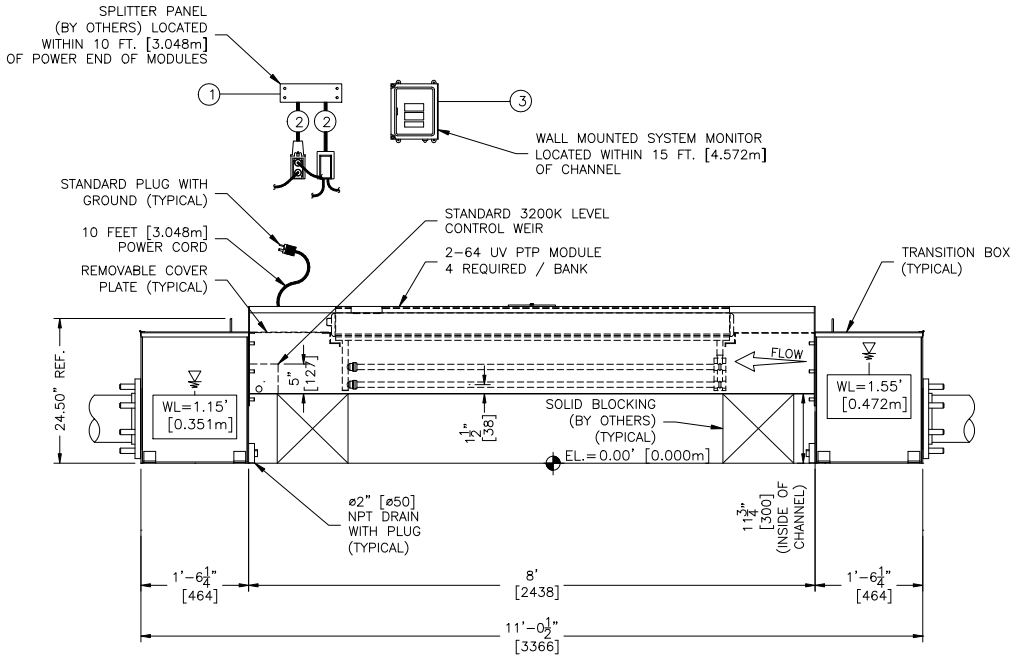
# TROJAN UV3000™ PTP
## EQUIPMENT INTERCONNECTIONS

| No. | DESCRIPTION | FROM | TO |
|---|---|---|---|
| 1 | SPLITTER PANEL POWER SUPPLY<br>120V, 1 PHASE, 2 WIRE, ACTUAL DRAW<br>6.4 AMPS / SPLITTER PANEL | DISTRIBUTION PANEL<br>(DP) (NOT SHOWN)<br>(BY OTHERS) | SPLITTER PANEL<br>(BY OTHERS) |
| 2 | POWER DISTRIBUTION RECEPTACLE (PDR)<br>POWER SUPPLY<br>120V, 1 PHASE, 2 WIRE,<br>ACTUAL DRAW 3.2 AMPS / PDR | SPLITTER PANEL<br>(BY OTHERS) | PDR |
| 3 | SYSTEM MONITOR POWER SUPPLY<br>120V, 1 PHASE, 2 WIRE, 5 AMPS | DP (NOT SHOWN)<br>(BY OTHERS) | SYSTEM MONITOR |

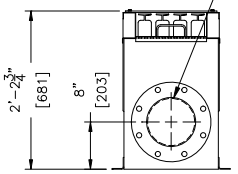
NOTES:
: DO NOT SLOPE CHANNEL FLOOR.
: CHANNEL WIDTH & DEPTH MUST BE KEPT WITHIN A TOLERANCE OF + OR – ¼" [6].
: ANCHOR BOLTS ARE NOT SUPPLIED BY TROJAN TECHNOLOGIES.
: BOLTS, WASHERS & NUTS FOR CONNECTION OF CHANNEL TO TRANSITION BOXES ARE PROVIDED BY TROJAN TECHNOLOGIES.
: SYSTEM CONDUIT, WIRING, DISTRIBUTION PANELS & INTERCONNECTIONS BY OTHERS.
: ELECTRICAL REQUIREMENTS SHOWN ARE TO SUPPLY TROJAN UV EQUIPMENT ONLY. ELECTRICAL INRUSH FACTOR TO BE ADDED AS PER LOCAL CODE.
: ANY EXTRA OUTLETS NOT BEING USED BY TROJAN EQUIPMENT HAVE NOT BEEN INCLUDED IN THE INTERCONNECT AMPERAGE.
: CONTRACTOR TO REVIEW ALL TROJAN TECHNOLOGIES INSTALLATION INSTRUCTIONS PRIOR TO EQUIPMENT INSTALLATION.
: ACCESS IS REQUIRED FOR MODULE REMOVAL – NOTE THE CHANNEL WIDTH AND ENSURE ADEQUATE ACCESS IS PROVIDED TO ALL MODULES.
: DO NOT ENCASE THE STEEL CHANNEL IN CONCRETE.
: [ ] INDICATES MILLIMETERS UNLESS OTHERWISE SPECIFIED.



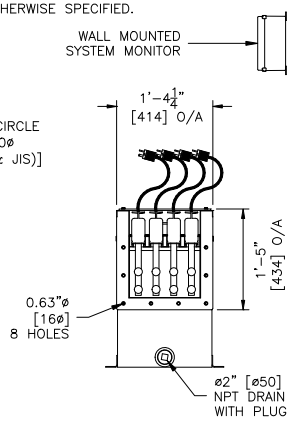

PLAN VIEW
SCALE:AS SHOWN




FRONT VIEW
SCALE:AS SHOWN




END VIEW (TYPICAL)
SCALE:AS SHOWN




A D01 SECTION
SCALE:AS SHOWN
NOTE: PDR NOT SHOWN FOR CLARITY

MULTIPLE CHANNELS IN PARALLEL (OPTION):
: ADDITIONAL UNITS CAN BE INSTALLED PARALLEL TO THE UNIT SHOWN.
: ACCESS BETWEEN EVERY 2 PARALLEL CHANNELS IS REQUIRED FOR MODULE REMOVAL – NOTE THE CHANNEL WIDTH AND ENSURE ADEQUATE ACCESS IS PROVIDED BETWEEN TRANSITION BOXES AND CHANNELS.
: ACCESS BETWEEN A MAXIMUM OF 2 CHANNELS IS NOT REQUIRED FOR MODULE REMOVAL. TRANSITION BOXES CAN BE INSTALLED ADJACENT TO EACH OTHER.

TROJAN UV

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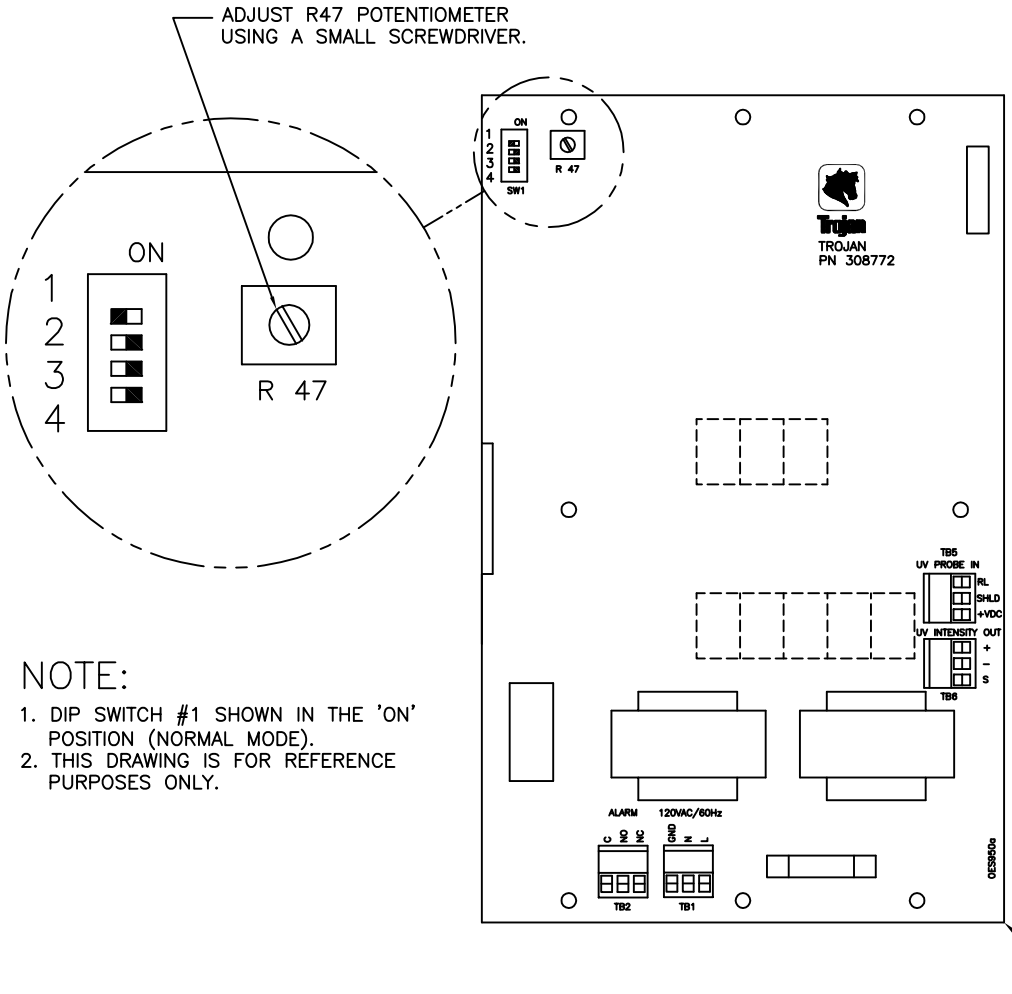
DESCRIPTION: LAYOUT, UV3000PTP–UV3200K 1 CHANNEL 1 BANK 2 LAMPS WEIR

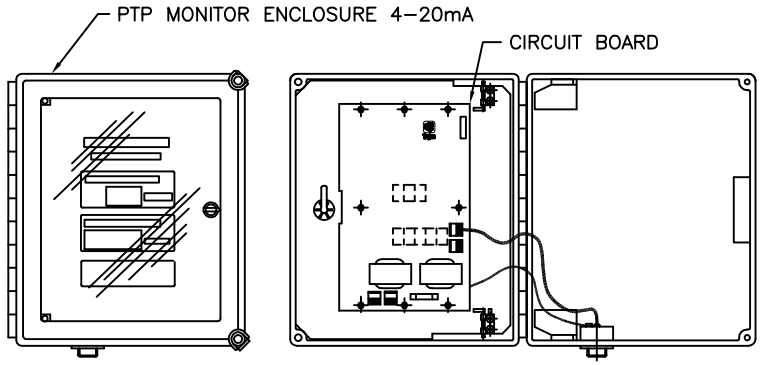
| | |
|---|---|
| DRAWN BY : LZ/JMM/SPM | DATE : 12JN21 |
| CHECKED BY : SAH | DATE : 12JN22 |
| APPROVED BY : CAP | DATE : 12JN22 |
| SCALE (8½x11 ) NOT TO SCALE | LOG NUMBER : N/A |

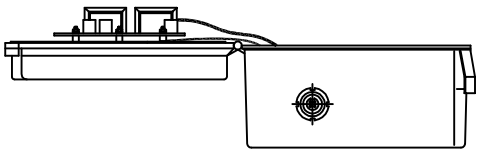
STANDARD DRAWING NO. 3M0512
REFERENCE NO. N/A
DWG NO. D01
REV. D




NOTE:

1. DIP SWITCH #1 SHOWN IN THE 'ON' POSITION (NORMAL MODE).
2. THIS DRAWING IS FOR REFERENCE PURPOSES ONLY.



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| | | | |
|---|---|---|---|
| DESCRIPTION: BOARD, CONFIG INSTN UV3000 PTP | | | STANDARD DRAWING NO. 3M0208 |
| DRAWN BY : JAW/CAR | DATE : 03FE26 | | REFERENCE NO. N/A |
| CHECKED BY : CMS | DATE : 13MR13 | | |
| APPROVED BY : SDK | DATE : 03MR14 | | DWG NO. D01 / REV. B |
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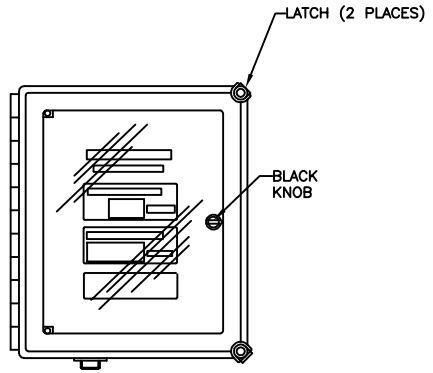
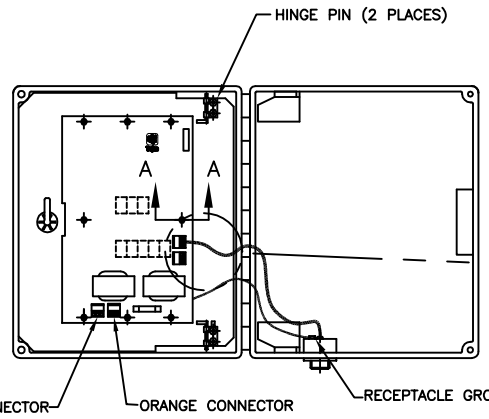
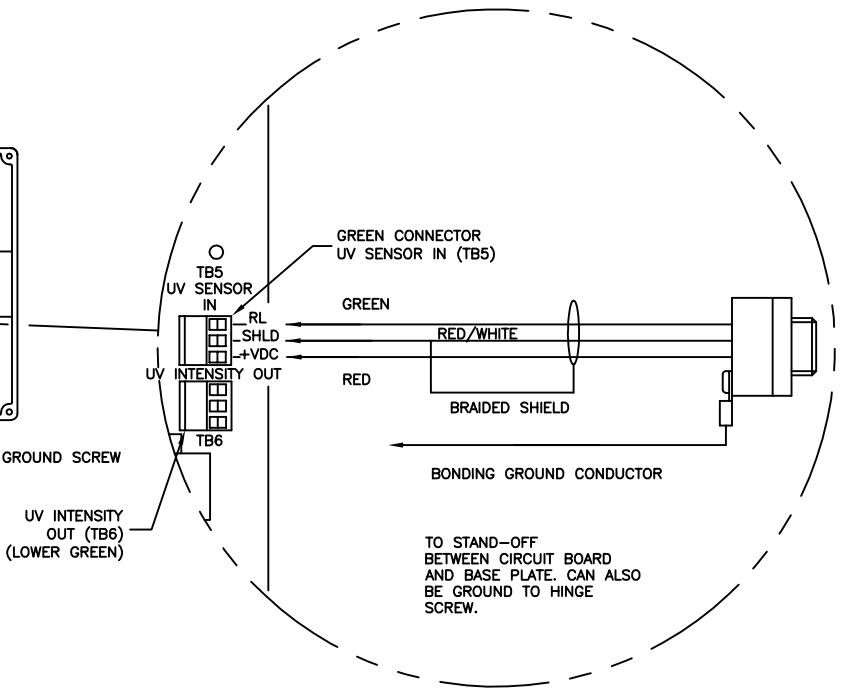
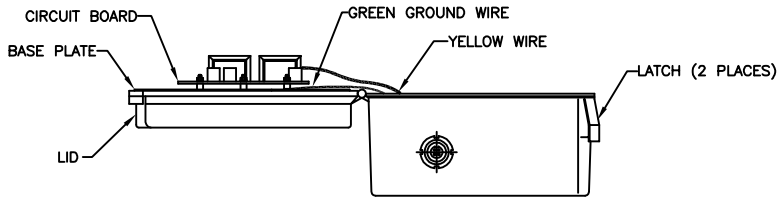
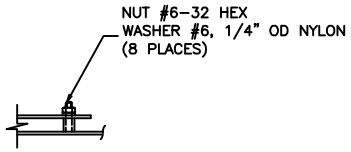



FRONT OF MONITOR




SECTION A-A

SCALE: AS SHOWN
TYPICAL 8-PLACES

NOTE:

1. THIS DRAWING IS FOR REFERENCE PURPOSES ONLY.
2. CIRCUIT BOARD IS SHOWN REMOVED FROM HINGE PIN SLOTS AND PLACED ON INSIDE OF LID.
3. REFER TO INSTRUCTION MANUAL FOR PROCEDURE.

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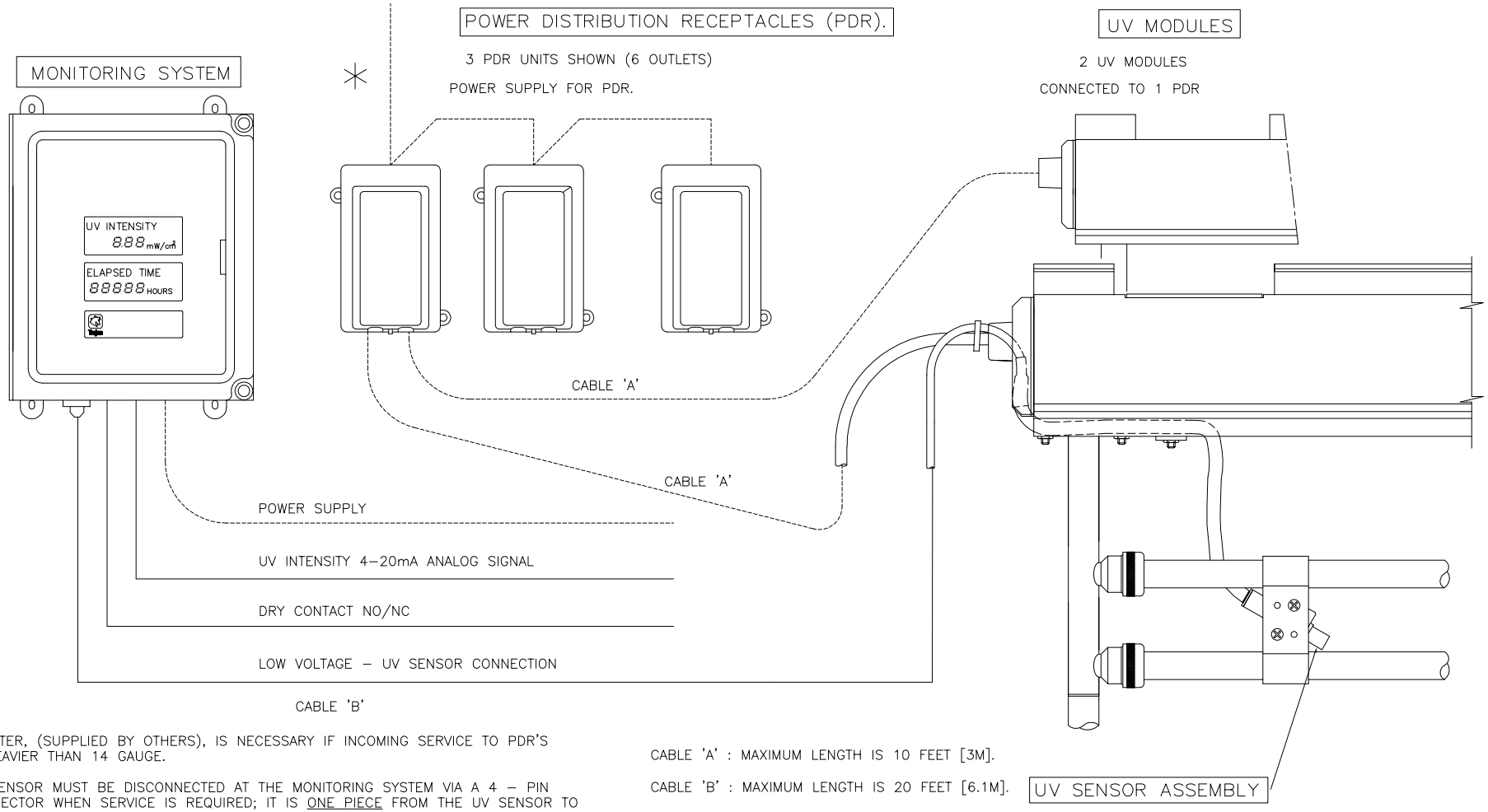
| | | | |
|---|---|---|---|
| DESCRIPTION: BOARD INSTALLATION, UV3000 PTP MON. ENCL. | | | STANDARD DRAWING NO. 3M0207 |
| DRAWN BY : LZ/SMC | DATE : 01MR09 | | PROJECT NO. N/A |
| CHECKED BY : CMS | DATE : 03MR19 | | |
| APPROVED BY : SDK | DATE : 03MR20 | | DWG NO. D01 / REV. C |
| SCALE (8½x11) : NOT TO SCALE | LOG NUMBER : N/A | | |




✳ SPLITTER, (SUPPLIED BY OTHERS), IS NECESSARY IF INCOMING SERVICE TO PDR'S IS HEAVIER THAN 14 GAUGE.

✳ ✳ UV SENSOR MUST BE DISCONNECTED AT THE MONITORING SYSTEM VIA A 4 – PIN CONNECTOR WHEN SERVICE IS REQUIRED; IT IS ONE PIECE FROM THE UV SENSOR TO THE MONITORING SYSTEM.

CABLE 'A' : MAXIMUM LENGTH IS 10 FEET [3M].

CABLE 'B' : MAXIMUM LENGTH IS 20 FEET [6.1M].

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DESCRIPTION: ELECTRICAL HOOKUP DIAGRAM

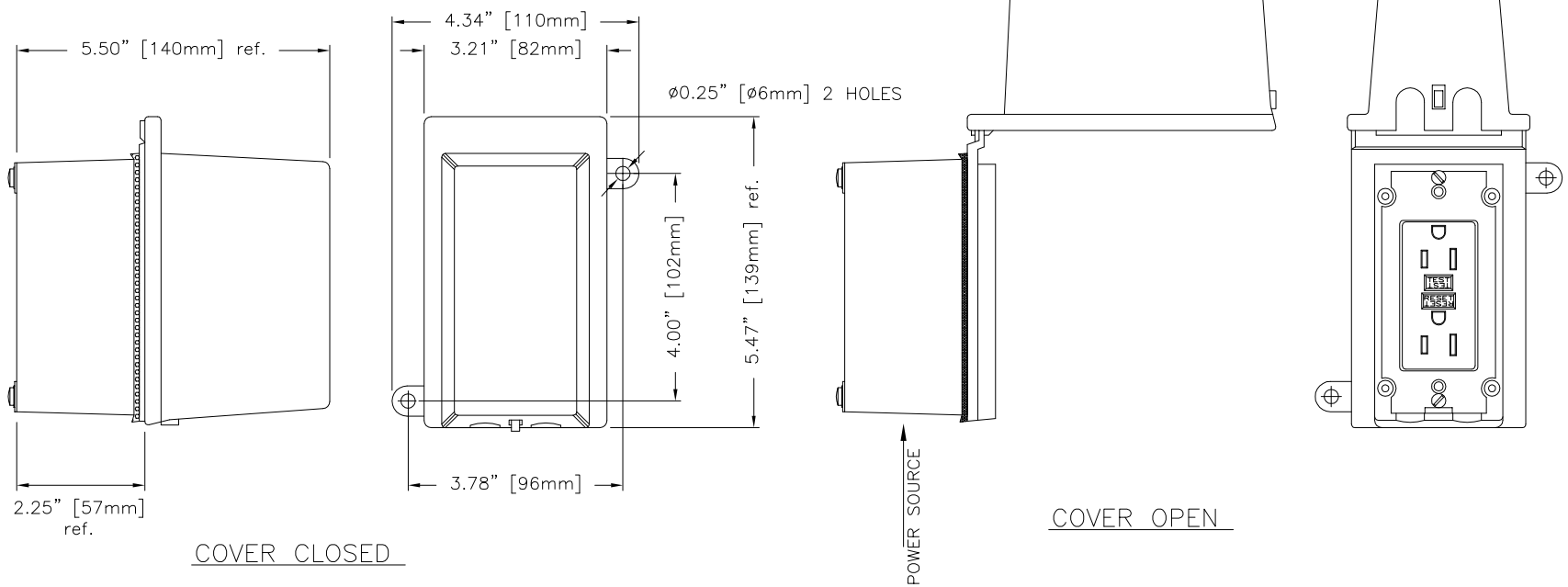
| | |
|---|---|
| DRAWN BY : ELF | DATE : 01JL11 |
| CHECKED BY : SDK | DATE : 01JL25 |
| APPROVED BY : RSH | DATE : 01JL25 |
| SCALE (8½x11) : NOT TO SCALE | LOG NUMBER : N/A |

STANDARD DRAWING NO. 3M0087

REFERENCE NO. N/A

DWG NO. D01

REV. F




COVER CLOSED

COVER OPEN

POWER DISTRIBUTION RECEPTACLE CONSIST OF:
1 – GROUND FAULT CIRCUIT INTERUPTER
1 – ONE GANG OUTLET BOX c/w MOUNTING LUGS
1 – DEEP COVER FOR GFCI, VERTICAL MOUNT

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| | | | |
|---|---|---|---|
| DESCRIPTION: POWER DISTRIBUTION RECEPTACLES | | STANDARD DRAWING NO. | 3M0232 |
| DRAWN BY : CAR | DATE : 03FE26 | REFERENCE NO. | N/A |
| CHECKED BY : CMS | DATE : 03MR27 | | |
| APPROVED BY : SDK | DATE : 03MR27 | DWG NO. | D01 |
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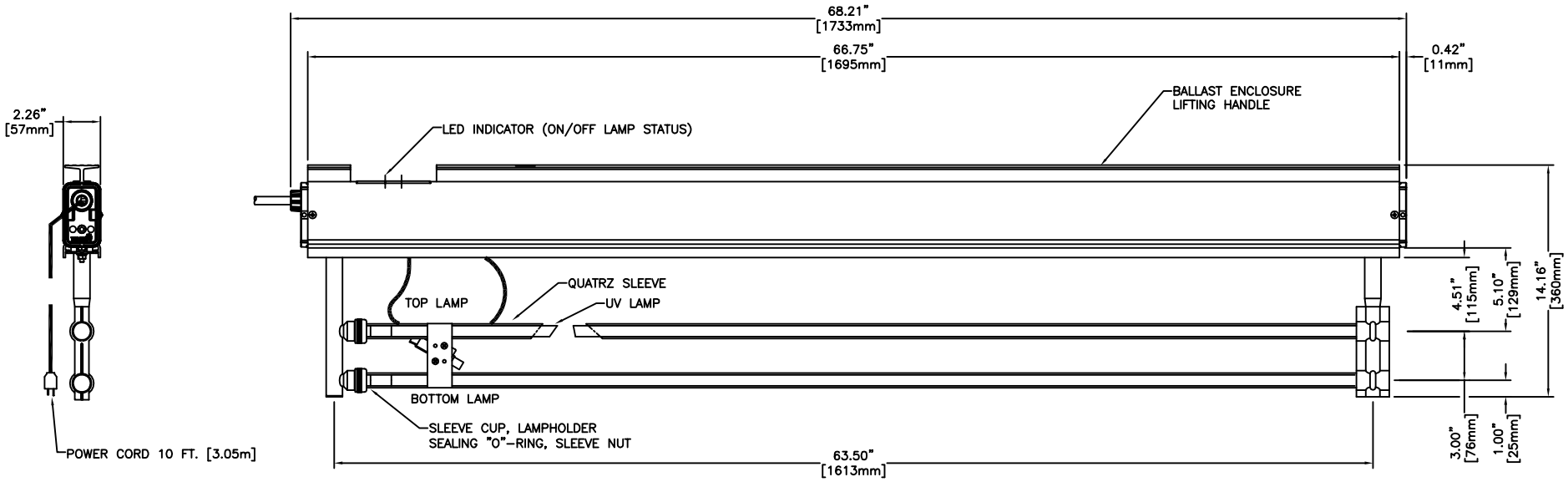
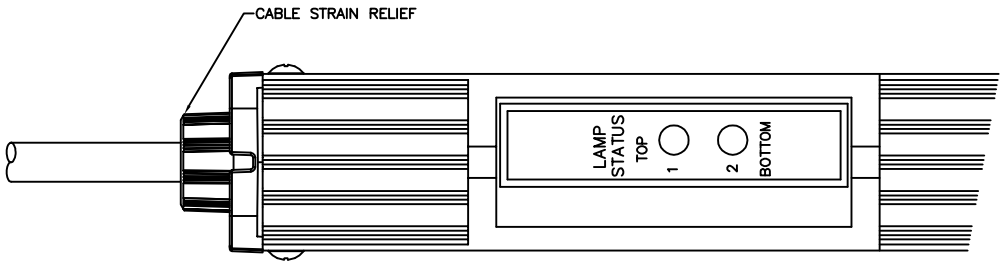



END VIEW

SIDE VIEW




TOP VIEW OF LED INDICATOR
SCALE 4X

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| | | | |
|---|---|---|---|
| DESCRIPTION: STD, UV MODULE 2-64 PTP | | | STANDARD DRAWING NO. 3M0185 |
| DRAWN BY : MAN | DATE : 10JL19 | | PROJECT NO. N/A |
| CHECKED BY : SAH | DATE : 10JL29 | | |
| APPROVED BY : CLC | DATE : 10JL30 | | DWG NO. D01 / REV. I |
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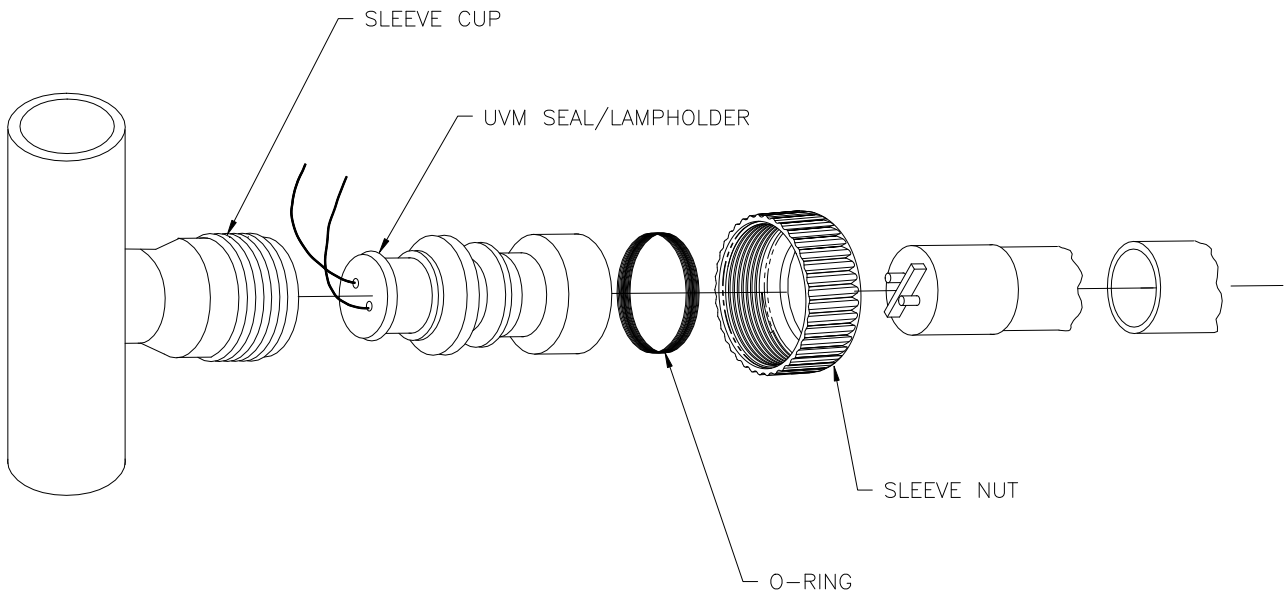


TROJANUV

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DESCRIPTION: STD, UV3000 MODULE ENDSEAL ASSEMBLY

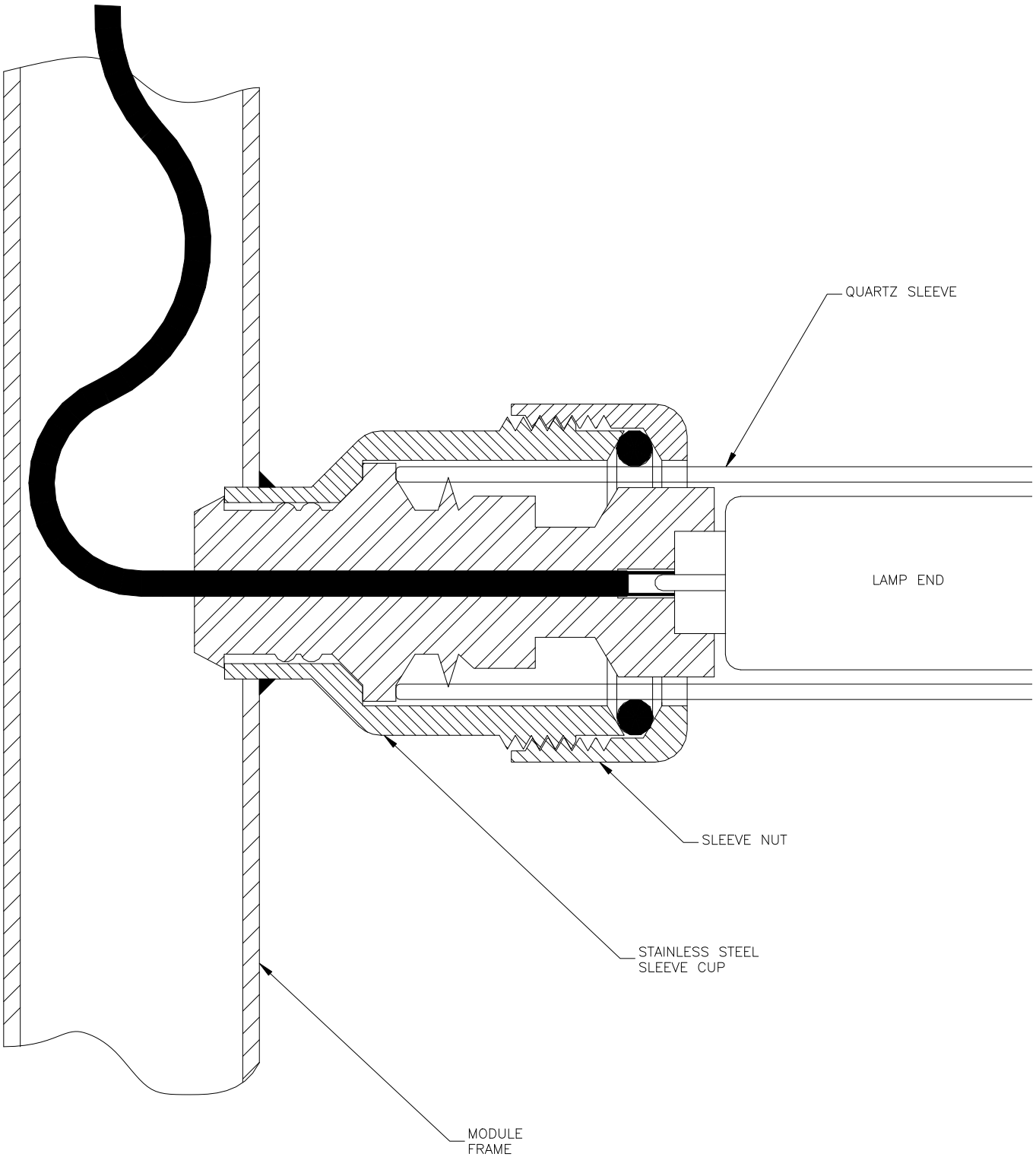
| | | |
|---|---|---|
| DRAWN BY : | RLM | DATE : 11OC27 |
| CHECKED BY : | CAR | DATE : 11OC27 |
| APPROVED BY : | SAH | DATE : 11OC27 |
| SCALE (11x17) : NOT TO SCALE | | LOG NUMBER : N/A |

STANDARD DRAWING NO. 3M0044

REFERENCE NO. N/A

DWG NO. D01

REV. D




TROJANUV

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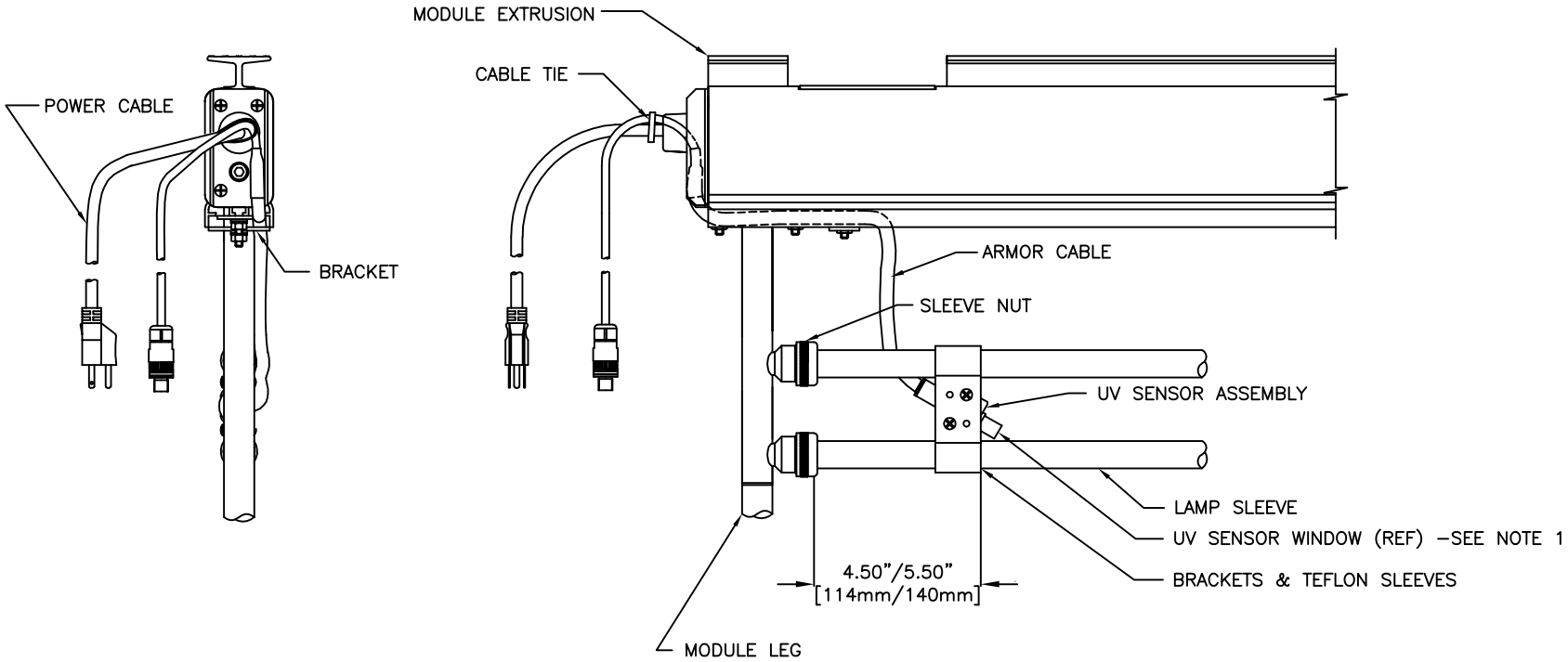
| | | | |
|---|---|---|---|
| DESCRIPTION: STD, UV3000 MODULE ENDSEAL | | | STANDARD DRAWING NO. 3M0043 |
| DRAWN BY : LKV/AJL | DATE : 05MR22 | | REFERENCE NO. N/A |
| CHECKED BY : CMS | DATE : 05MR24 | | |
| APPROVED BY : CAR | DATE : 05MR24 | DWG NO. D01 | REV. E |
| SCALE (8½ x11 ) NOT TO SCALE | LOG NUMBER : N/A | | |




NOTE:
1. BE SURE THAT TEFLON RING IN LAMP DOES NOT INTERFERE WITH ALIGNMENT OF UV SENSOR WINDOW.

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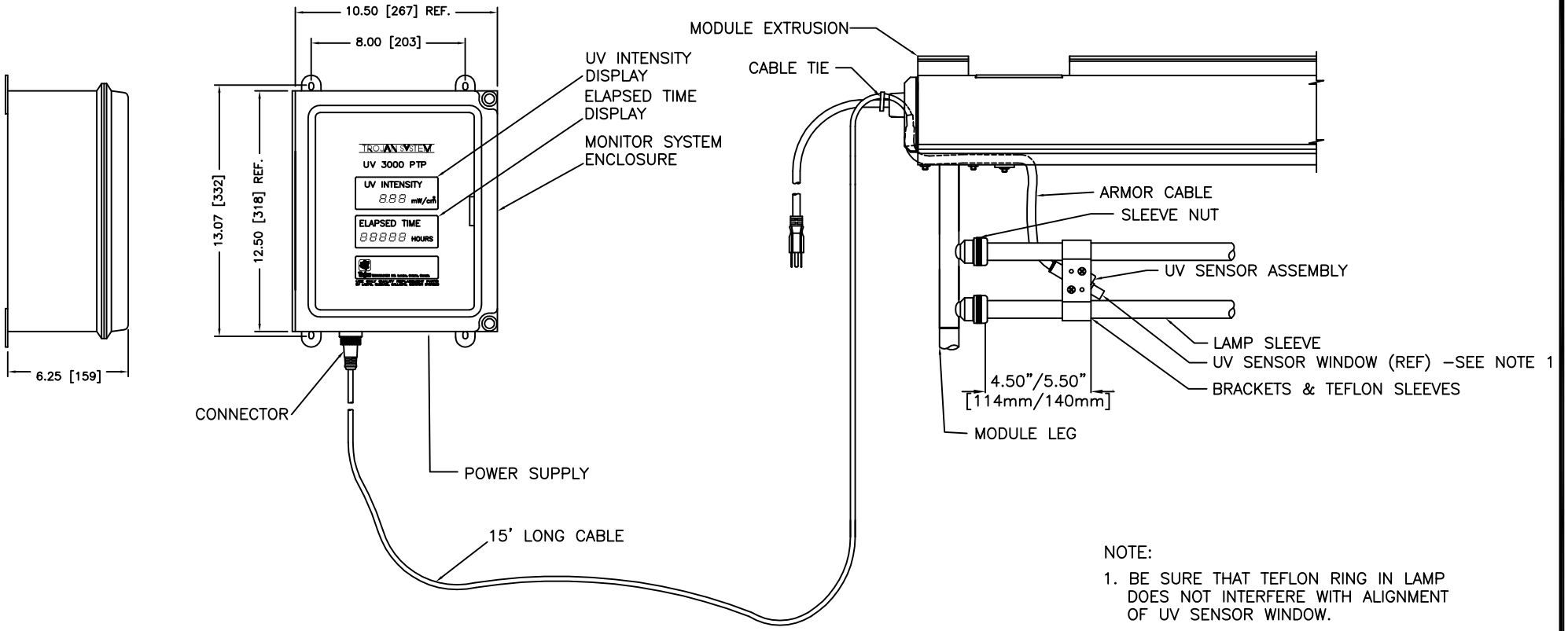
| | | | |
|---|---|---|---|
| DESCRIPTION: UV SENSOR INSTALLATION, UV3000 PTP | | | STANDARD DRAWING NO. 3M0206 |
| DRAWN BY : SAK/SMC | DATE : 03MR11 | | REFERENCE NO. N/A |
| CHECKED BY : CAR | DATE : 03MR20 | | |
| APPROVED BY : SDK | DATE : 03MR21 | DWG NO. D01 | REV. F |
| SCALE (8½x11) : NOT TO SCALE | LOG NUMBER : N / A | | |




NOTE:

1. BE SURE THAT TEFLON RING IN LAMP DOES NOT INTERFERE WITH ALIGNMENT OF UV SENSOR WINDOW.

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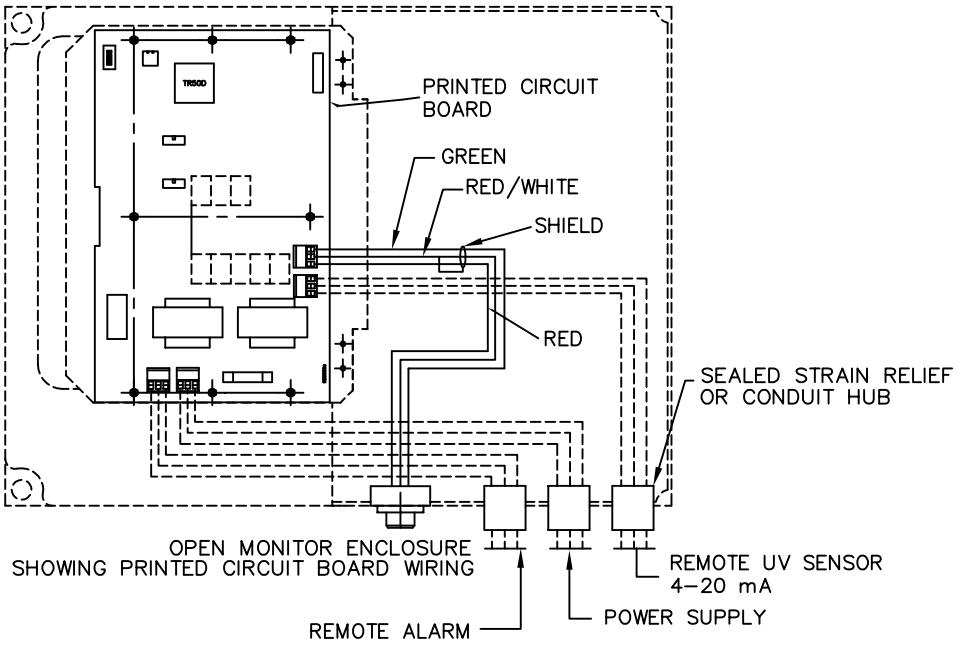
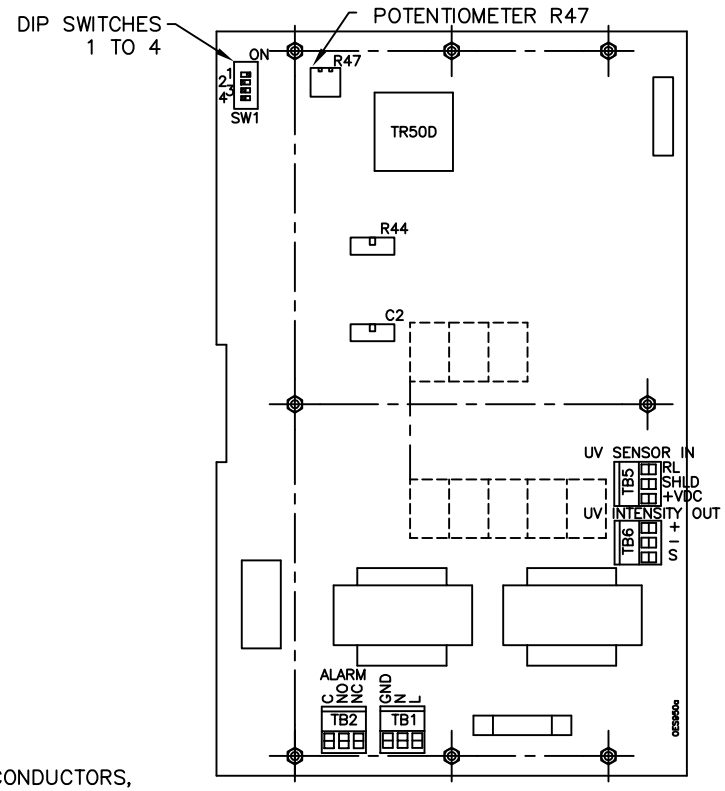
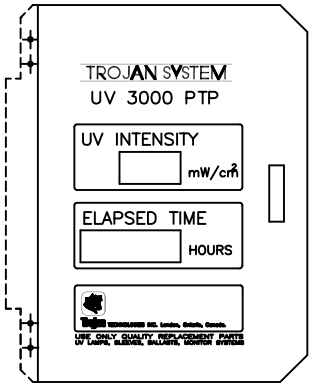
| | | | |
|---|---|---|---|
| DESCRIPTION: MONITORING SYSTEM UV3 PTP | | | STANDARD DRAWING NO. 3M0228 |
| DRAWN BY : ELF/SMC | DATE : 03MR11 | | REFERENCE NO. N/A |
| CHECKED BY : CMS | DATE : 03MR14 | | |
| APPROVED BY : SDK | DATE : 03MR14 | | DWG NO. D01 / REV. E |
| SCALE (8½x11) : NOT TO SCALE | LOG NUMBER : N/A | | |

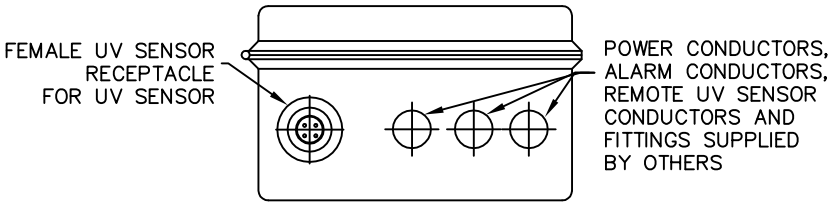



PRINTED CIRCUIT BOARD (SCALE X2)




FRONT FACE OF A SWING–OUT PANEL




BOTTOM VIEW OF MONITOR ENCLOSURE

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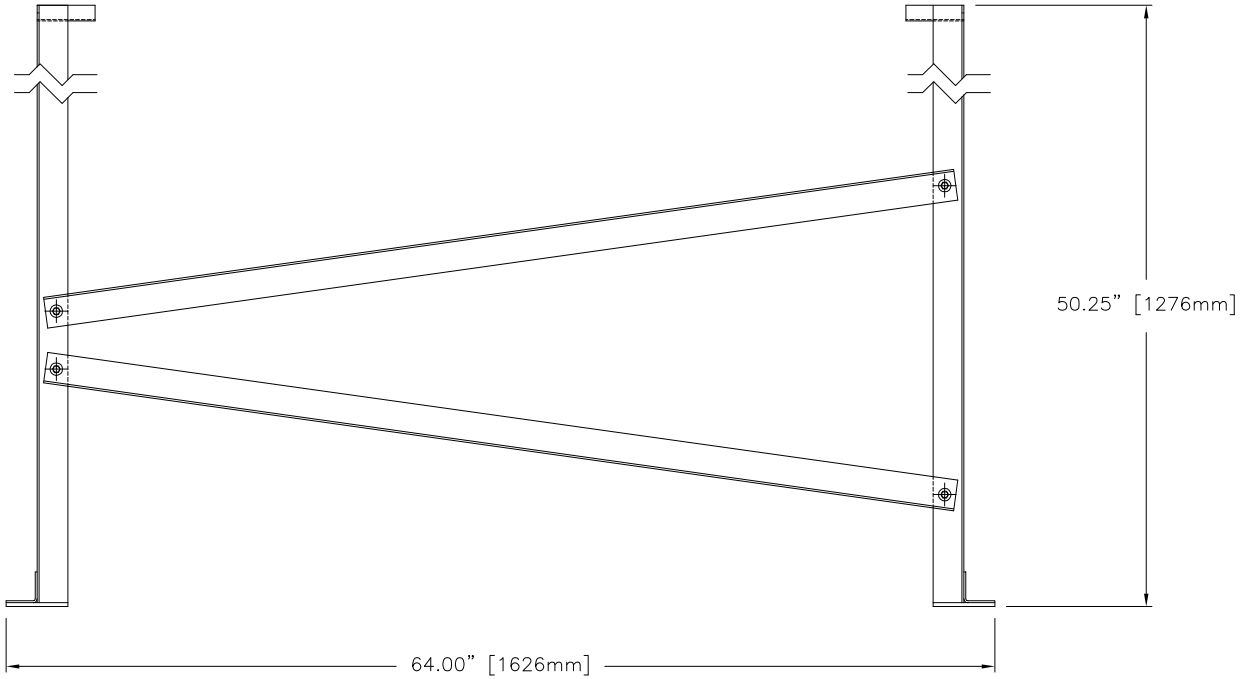
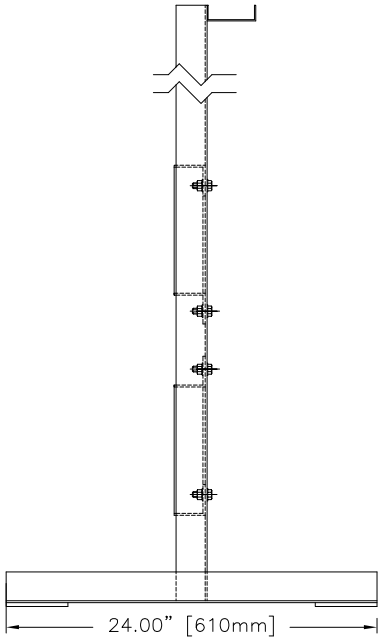
Trojan Technologies Inc.

| | | | |
|---|---|---|---|
| DESCRIPTION: MONITORING ENCLOSURE, UV3 PTP | | STANDARD DRAWING NO. | 3M0229 |
| DRAWN BY : ELF/SMC | DATE : 03MR11 | REFERENCE NO. | N/A |
| CHECKED BY : CMS | DATE : 03MR13 | | |
| APPROVED BY : SDK | DATE : 03MR14 | DWG NO. | D01 |
| SCALE (8½x11) : NOT TO SCALE | LOG NUMBER : N/A | REV. | F |




FRONT VIEW




END VIEW

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Trojan Technologies Inc.

DESCRIPTION: RACK, MAINTENANCE KIT PTP 64" MDL

| | |
|---|---|
| DRAWN BY : CAR | DATE : 03MR14 |
| CHECKED BY : CMS | DATE : 03MR14 |
| APPROVED BY : SDK | DATE : 03MR14 |
| SCALE (8½x11) : NTS | LOG NUMBER : N/A |

STANDARD DRAWING NO. 3M0266

REFERENCE NO. N/A

DWG NO. D01 REV. C

# CHAPTER 4

# WARRANTIES

TROJAN UV

**November 23, 2007**

# Equipment Limited Warranty

The following terms and conditions will govern the equipment warranty provided by Trojan Technologies to the Owner/Operator:

**Period of Coverage:** Trojan Technologies ("Trojan") warrants to the Owner/Operator noted above (the "Customer") that if within 12 calendar months from equipment Substantial Completion or 18 calendar months from the date of delivery (the "Warranty Period"), whichever comes first, equipment manufactured by Trojan (the "Equipment") will be free from defects in material and workmanship and will function in accordance with the specifications agreed to by Trojan for the Equipment.

> "Substantial Completion" is the date on which the Equipment commissioning and start-up is sufficiently completed such that the Equipment is capable of being put into operation such that the Owner can utilize the Equipment for its intended disinfection use.

Customer must notify Trojan in writing within 5 days of the date of any Equipment failure. This notification shall include a description of the problem, a copy of the operator's log, a copy of the Customer's maintenance record and any analytical results detailing the problem. If Customer has not maintained the operator's log and maintenance record in the manner directed in the Operation and Maintenance manual, or does not notify Trojan of the problem as specified above, this warranty may, in Trojan's discretion, be invalid.

If a defect occurs, Trojan will, at its option, repair or replace the defective component free of charge, provided that:

1. Customer fully cooperates with Trojan, in the manner requested by Trojan, in attempting to diagnose and resolve the problem by way of telephone support. If the problem can be diagnosed and verified by telephone support and a replacement part is required, Trojan will either ship at Trojan's expense, a repaired, reworked or new part to the Customer, who will install such part as directed by Trojan, or direct Customer to acquire, at Trojan's expense, such part from a third party and to install such part as directed by Trojan;
2. In the event that Trojan determines that the problem cannot be resolved by way of telephone support and/or shipment by Trojan, or acquisition by the Customer of a replacement part for installation by the Customer, Trojan will send one or more persons to make an onsite inspection of the problem. If an onsite visit is made, Trojan personnel will evaluate the problem and repair or replace any Equipment determined to be in breach of this warranty. If the problem is not attributable to a breach of this warranty, Trojan reserves the right to invoice the Customer for this service; and
3. The Equipment is covered and the failure occurs within the Warranty Period

Trojan will, at its option, use new and/or reconditioned parts in performing warranty repair. Trojan has the right to use parts or products of original or improved design in the repair or replacement.

The products or general components replaced or repaired free of charge under the Equipment Limited Warranty are warranted only for the *remaining* portion of the original Equipment Limited Warranty Period.

**Limitations:** This warranty shall not apply to any failure or defect which results from:

- the Equipment not being operated and maintained in strict accordance with instructions specified in the Operation and Maintenance manual or Product Bulletin or which results from mishandling, misuse, neglect, improper storage, improper operation of the Equipment with other equipment furnished by the Customer or by other third parties or from defects in designs or specifications furnished by or on behalf of the Customer by a person other than Trojan.
- Equipment that has been altered or repaired after start-up by anyone except: (a) authorized representatives of Trojan, or (b) Customer acting under specific written instructions from Trojan.
- Use of parts not supplied or approved by Trojan

This warranty does not cover:

- Equipment components manufactured by third parties but furnished to Customer by Trojan are warranted by the original manufacturer, only to the extent of the original manufacturer's warranty
- Normal wear and tear of the product
- Consumable components including but not limited to wiper seals, cleaning chemical, batteries
- Trojan supplied components that are the subject of a separate warranty
- Costs related to removal, installation, or troubleshooting of a component
- Physical damage
- Improper installation
- Acts of God, terrorism, biological infestations, or input voltage that create operating conditions beyond the minimum or maximum limits listed in the Operations Manual including high input voltage from generators and lightening strikes
- Damage caused by improper return packaging
- Taxes, duties or brokerage fees (if any)

This warranty is the exclusive remedy for all claims based on a failure of or defect in the Equipment, whether the claim is based on contract (including fundamental breach), tort (including negligence), strict liability or otherwise. This warranty is in lieu of all other warranties whether written, oral, implied or statutory. Without limitation, no warranty of merchantability or fitness for a particular purpose shall apply to the Equipment.

Trojan does not assume any liability for personal injury or property damage caused by use or misuse of the Equipment. Trojan shall not in any event be liable for special, incidental, indirect or consequential damages including, without limitation, lost profits, lost business opportunities, lost revenue or loss or depreciation of goodwill, even if it has been advised of the possibility thereof. Trojan's liability shall, in all instances, be limited to repair or replacement of Equipment in breach of this warranty and shall not exceed the cost of such repair or replacement. This liability with respect to repair or replacement will terminate upon the expiration date of this warranty.

In addition to the foregoing, in no event shall Trojan's liability relating to the Equipment, or the agreement between Trojan and the Customer relating to the Equipment, exceed that portion of the purchase price for the Equipment which is actually paid to Trojan.

**November 8, 2007**

# Ballast Limited Warranty
# Trojan UV3000™, Trojan UV3000™PTP & Trojan UV3000Plus™

**Warranty Coverage**: The following warranty applies to the Trojan Technologies Ballast (the "Ballast") for the Trojan UV3000™, Trojan UV3000™PTP and Trojan UV3000Plus™. The warranty is only valid with respect to a new Ballast that is purchased as: (i) a component of a new system, (ii) a spare part shipped with a new system, or (iii) a purchased replacement component, and that is properly stored, handled and installed as specified in the Operation and Maintenance manual supplied with the system in which the Ballast is installed or as outlined in Product Bulletins. Without limiting the generality of the foregoing, any excess vibration or improper operation of the Ballast shall void this warranty. In addition, Trojan Technologies shall not be liable for any Ballast failure which results from UV equipment not being operated and maintained in strict accordance with the instructions set out in the Operation and Maintenance manual or Product Bulletins.

Trojan Technologies reserves the right to require the Customer to return failed Ballasts to Trojan Technologies' facilities for inspection along with the operator's log and maintenance records. Failure to return the Ballast or provide logs or records when requested shall void the warranty. Trojan Technologies will cover the return shipping expense.

**Period Of Coverage:** Where a Ballast has been stored, handled and installed as specified in the Operation and Maintenance manual, and the relevant UV equipment has been operated and maintained in accordance with instructions specified in the Operation and Maintenance manual or Product Bulletin, and:

1. the Ballast fails within one (1) calendar year after the Warranty Start Date, Trojan Technologies shall provide the Customer with a replacement Ballast free of charge;

2. the Ballast fails after the first ($1^{st}$), and before the fifth ($5^{th}$), anniversary of the Warranty Start Date, Trojan Technologies shall provide the Customer with a replacement Ballast at a discounted price. The following formula is used to determine the discounted price for replacement Ballasts:

   Replacement Ballast Price = ((Number of Elapsed Months) / 60 x Ballast List Price)

   The "Warranty Start Date" is, in the case of a Ballast forming part of a new system installation or shipped as a spare part with a new system, the commissioning date of the new system and, in the case of a Ballast purchased as a replacement component, the shipment date of the Ballast. One "Elapsed Month" shall be deemed to have passed at the beginning of the day in each subsequent month that is the same calendar day as the day on which the Warranty Start Date falls, or the first day of the next following month if the Warranty Start Date falls on a day not present in any particular month. (For example, if the Warranty Start Date is January 10, one Elapsed Month will have occurred on each of February 10 and March 10, but if the Warranty Start Date is January 29, one Elapsed Month will have occurred on each of March 1 and March 29.)

In order to assess and process any Ballast warranty claim, Trojan Technologies requires the customer to notify Trojan within one (1) month of the failure and submit a completed Ballast Claim Form (See Attachment) otherwise the warranty shall be void.

**Limitations:** This limited warranty does not cover:

- Ballasts that have been used with parts not supplied or approved by Trojan Technologies
- Ballasts that have been physically damaged or fail due to corrosion, improper installation, exposure to moisture or abnormal stresses
- Costs related to removal, installation, or troubleshooting
- Damage caused by improper return packaging or damage caused by power quality disturbances falling outside the acceptable voltage tolerance of the ITIC (CBEMA) curve referenced from IEEE Standard 1100-2005.
- Taxes, duties or brokerage fees, if any

The above warranty is the exclusive remedy for all claims based on a failure of or defect in a Ballast, whether the claim is based on contract (including fundamental breach), tort (including negligence), strict liability or otherwise. This warranty is in lieu of all other warranties whether written, oral, implied or statutory. Without limitation, no warranty of merchantability or of fitness for a particular purpose shall apply to a Ballast.

Trojan Technologies does not assume any liability for personal injury or property damage caused by use or misuse of a Ballast. Trojan Technologies shall not in any case be liable for special, incidental, indirect or consequential damages, even if it has been advised of the possibility thereof. Trojan Technologies' liability shall not, in any case, exceed the cost of the Ballast.

# TrojanUV3000, TrojanUV3000PTP & TrojanUV3000Plus Ballast Warranty Claim Form

(Please complete every column for each claim and submit within 1 month of failure otherwise Warranty will be void)

| Site: | Project Serial Number: | Completed by: |
|---|---|---|

| | Ballast Position | | | | Ballast Operating Hours | | | | RMA #: | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Date of Ballast | | Bank | | Module | Ballast Position (example A1-A12, B1-B12) | Bank Runtime Hours at Installation of Ballast | Bank Runtime Hours at Time of Failure | Net Ballast Operating Hours | Ballast Serial Number (if applicable) 8 digit number found on the ballast case | Confirm that the ballast has been swapped with a known working ballast. | Confirm the ballast is clean (eg. No corrosion or moisture or marking or writing) | Confirm that there was an attempt to reset the module | Confirm that the ballast has been handled, installed and operated in accordance to the O&M manual | **Internal Use Only** Warranty ACCEPTED | **Internal Use Only** Warranty REJECTED |
| | Installation | Failure | # | Letter | | | | | | | | | | | |
| 1 | | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2 | | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3 | | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4 | | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 5 | | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 6 | | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 7 | | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 8 | | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 9 | | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10 | | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11 | | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 12 | | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

FOR TROJAN INTERNAL USE ONLY

**WARRANTY CLAIM COMMENTS:**

**SIGNATURE:** **DATE:**

**November 23, 2007**

# Low Pressure Lamp Limited Warranty
# TrojanUV3000™ & TrojanUV3000™PTP

**Warranty Coverage:** The following warranty applies to Trojan Technologies Low Pressure Lamps (the "Lamps") for the TrojanUV3000™ and the TrojanUV3000™PTP. The warranty is only valid with respect to a Lamp that is properly stored, handled and installed as specified in the Operation and Maintenance manual supplied with the system in which the Lamp is installed or as outlined in Product Bulletins. Without limiting the generality of the foregoing, any excess vibration or improper operation of a Lamp shall void this warranty. In addition, Trojan Technologies shall not be liable for any Lamp failure which results from UV equipment not being operated and maintained in strict accordance with the instructions set out in the Operation and Maintenance manual.

In order to process any Lamp warranty claim, Trojan Technologies requires the Customer to provide a copy of the operator's log, all maintenance records and a completed Warranty Claim Form (see attachment) within one (1) month of the lamp failure. Failure to meet these conditions will void the Lamp warranty.

Trojan Technologies also reserves the right to require the Customer to return a failed Lamp to Trojan Technologies' facilities for inspection. Failure to return the Lamp when requested shall void the warranty.

**Period of Coverage:** Where a Lamp has been stored, handled and installed as specified in the Operation and Maintenance manual or as outlined in Product Bulletins, and the relevant UV equipment has been operated and maintained in accordance with instructions specified in the Operation and Maintenance manual, and the Lamp fails within the first 12,000 hours of operation, Trojan Technologies shall provide the Customer with a replacement Lamp replacement free of charge.

Regardless of actual Lamp operating hours, the Lamp warranty is void if the date of Lamp failure occurs more than thirty-six (36) calendar months after the Lamp shipment date from Trojan Technologies.

**Limitations**: This limited warranty does not cover:

- Lamps that have greater than 4 On/Off cycles, on average per 24 hour period
- Lamps that have been used with parts not supplied or approved by Trojan Technologies
- Lamps that have been physically damaged or fail due to corrosion, exposure to contaminants (e.g. effluent), incorrect installation or operation,
- Costs related to removal, installation, or troubleshooting
- Damage caused by improper return packaging
- Taxes, duties or brokerage fees (if any)

The above warranty is the exclusive remedy for all claims based on a failure of or defect in a Lamp, whether the claim is based on contract (including fundamental breach), tort (including negligence), strict liability or otherwise. This warranty is in lieu of all other warranties whether written, oral, implied or statutory. Without limitation, no warranty of merchantability or of fitness for a particular purpose shall apply to a Lamp.

Trojan Technologies does not assume any liability for personal injury or property damage caused by use or misuse of a Lamp. Trojan Technologies shall not in any case be liable for special, incidental, indirect or consequential damages, even if it has been advised of the possibility thereof. Trojan Technologies' liability shall not, in any case, exceed the cost of replacement of a defective Lamp.

# *TrojanUV3000, TrojanUV3000PTP & TrojanUV3000Plus Lamp Warranty Claim Form*

(Please complete every column for each claim, write the number of hours on each lamp and submit within 1 month of failure otherwise Warranty will be void)

| | **Site:** | | | | | **Project Number:** | | | **Completed by:** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lamp Position | | | | Lamp Operating Hours | | | | RMA #: | | | | | | | |
| | Date of Lamp Failure | Bank # | Bank Letter | Module | Lamp Position (Top Lamp = #1) | Bank Lamp Hours at Installation | Bank Lamp Hours at Time of Failure | Net Lamp Operating Hours | Lamp Lot or Serial Number found on the lamp quartz (e.g. 6121-L28 or 03/07 036625, not 794447) | Confirm the lamp has not been directly exposed to contaminants, including effluent | Confirm that there are no signs of corrosion on the lamp pins | Confirm that there was an attempt to reset the module | Confirm that the lamp has not been damaged (fractured/broken) | Confirm the lamp has been handled, installed and operated in accordance to the O&M manual | **Internal Use Only** Warranty ACCEPTED | **Internal Use Only** Warranty REJECTED |
| 1 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 5 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 6 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 7 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 8 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 9 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 12 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 13 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 14 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 15 | | | | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

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**WARRANTY CLAIM COMMENTS:**

**SIGNATURE:** **DATE:**

# SECTION 5

# 3RD PARTY BIOASSY

# Ultraviolet Dose Bioassay of the Trojan UV3000™ Disinfection System

*Final Report*

*March 30, 2001*

00-8517

*Submitted by*

**Dillon Consulting Limited**

## 1. INTRODUCTION

Dillon Consulting Limited (Dillon) validated a bioassay on a UV3000™ ultraviolet disinfection system manufactured by Trojan Technologies Inc. of London, Ontario, Canada. Dillon, a leading Canadian environmental consulting engineers firm with over 450 employees and 50 years of experience, first began designing and evaluating ultraviolet light systems almost 15 years ago. The system discussed in this report consisted of low-pressure lamps placed horizontally and parallel to effluent flow. In order to evaluate the system at a wide range of dose levels, a single bank was used to deliver low doses while multiple banks in series were used to deliver high levels. All testing was conducted with secondary effluent at the Greenway Pollution Control Centre in the City of London, Ontario.

The bioassay technique uses an empirical method to determine the dose delivered by a reactor. A comparison of the bacteriological inactivation achieved with the proposed reactor to that achieved with a collimated beam allows the dose delivered by the reactor to be assessed. The collimated beam correlates inactivation to applied dose. This is accomplished by measuring the light intensity using a radiometer for a pre-determined period of time. Dose is the product of light intensity and exposure time, and can therefore be accurately determined. The kill achieved at known doses is then compared with that achieved by the reactor in question at various flows. Using this technique, the effective dose delivered by the reactor can be plotted as a function of flow.

The method for determining dose described above is a more rigorous approach than mathematical estimates for a number of reasons. Firstly, theoretical approaches use an assumed lamp output as a basis for determining reactor intensity. Unfortunately, lamp output measurements vary significantly from lab to lab depending on the material and methods used. Secondly, theoretical approaches do not take into account the hydraulic inefficiencies of the reactor. Since the bioassay is based on an empirical technique, the impact of both lamp output and hydraulic performance is taken into account.

## 2. METHODOLOGY

### 2.1 Test Organism

In order to keep the results as relevant as possible, fecal coliform was used for the bioassay. This is the same organism as that identified in most wastewater plant permits in North America. It is important to use an organism that has a similar dose response to that identified in the permit. The use of an organism with a different dose response, such as F-Specific RNA bacteriophage for example, can result in an overestimate of the dose delivered. Please refer to Appendix A for a more complete explanation.

### 2.2 Collimated Beam

A low-pressure mercury arc lamp (wavelength 254 nm) was enclosed in a horizontal box with a vertical collimating tube. The enclosure provided protection from UV exposure and air circulation to maintain constant lamp temperature and a stable UV intensity. The UV intensity depends upon the lamp output and decreases with the increasing length of the collimating tube. Intensity was measured using a calibrated IL1700 radiometer with a diffuser and UV254 filter. Copies of the calibration certificates for the radiometer are located in Appendix B.

Measured volumes of wastewater (50 mL and sample depth of 2.2 cm) were irradiated at selected exposure times to provide UV doses ranging from 12 $mWs/cm^2$ to 80 $mWs/cm^2$. The intensity was checked before each exposure to verify that no variation in intensity occurred during the testing period.

Samples were also taken before UV exposure to provide initial indicator organism or $N_o$ values. To increase the accuracy of results, all exposures were completed in duplicate. Directly after irradiation, all samples were analyzed in accordance with *The Standard Methods for the Examination of Water and Wastewater* (1998) 20th Ed., Method 9222D. After the incubation period the samples were placed in an insulated container and sent to GAP Enviromicrobial Services Inc. for enumeration. Chain of custodies and enumeration results are located in Appendix C.

## 2.3 Field Reactor Tests

The field reactor contained three banks of UV lamps (7.62 cm (3 inch) lamp spacing) with four modules per bank and four lamps per module, for a total of 48 UV lamps. As mentioned earlier, a single bank was used to deliver low doses while three banks were used to deliver higher doses. All fieldwork was conducted at the Greenway Pollution Control Centre in the City of London, Ontario, Canada. Refer to Appendix D for a detailed layout of the pilot unit.

Secondary effluent was introduced into the reactor by two submersible pumps equipped with variable frequency drives, through two 25.4 cm (10 inch) pipes, into the UV3000™ pilot unit. Flow was measured with two flow meters located approximately twenty pipe diameters away from any change in flow direction. Calibration certificates for the flowmeters are located in Appendix B.

Power was provided to each bank from a local Power Distribution Centre (PDC). The water level in the unit was controlled with a level controller and was kept approximately constant at 12 inches.

The UV3000™ system has a power draw of approximately 87.5 W per lamp, which includes the ballast. The lamps have a nominal length of 156 cm (61.5 inches) (including the electrical connections) and an effective arc length of 147 cm (58 inches). The lamps used in the bioassay test had reached the end of their life, simulating worse case conditions that might be experienced at a plant. The quartz sleeves used were 23 mm (0.9 inch) in diameter with domed ends.

The UV dose applied was varied by changing the flow rate as well as the number of operating banks. One dose response run was performed at five UV dose levels per UV Transmittance (UVT) tested. The lamps were driven by an electronic ballast (1 ballast controlling 2 lamps).

## 2.4 Bioassay Analysis

Testing was conducted at flow rates varying between 458 to 1472 USgpm (1734 to 5572 Lpm) which corresponds to hydraulic loading rates of between 10 to 84 USgpm/lamp (36 to 319 Lpm/lamp)

The bioassay took place on January 17, 2001. Testing began with the measurement of the background transmittance of the influent wastewater with the P254C unit. The P254C photometer measures the transmittance at a wavelength of 254 nm only. The accuracy of the P254C photometer

was verified using NIST certified potassium dichromate standards prior to testing. The NIST certified calibration certificates for the standards are located in Appendix B.

The UVT was adjusted, if required, through the addition of PHBA until the desired UVT was reached.

The flow rate was adjusted to a predetermined set point and the system was allowed to stabilize for at least 5 minutes. After reaching equilibrium, samples upstream and downstream of the unit were taken simultaneously and the %UVT was verified. The samples were taken in standard, sterilized, pre-labeled sample bottles. The comparative upstream and collimated beam samples were taken at an appropriate location and time to ensure that similar influent conditions to the UV field reactor samples were maintained throughout testing.

Samples were immediately placed into coolers with ice. The UV Transmittance and the flow rate displayed on the flow meter were checked directly after sampling to ensure consistency.

Field notes, which indicate the sample numbers, are included in Appendix E. Also included in the field notes are tables summarizing field observations and measurements, including wastewater flow rate, wastewater transmittance, number of banks on, predicted UV dose and water temperature.

Effluent samples were collected in quadruplicate for each sampling event. Influent samples were collected in duplicate at the beginning and end of the testing period.

The bioassay test run was performed as follows:

**UV Dose (1)**

1) Lamps were cleaned.
2) Submersible pumps were turned on.
3) Lamps were turned on.
4) Flow rate was set.
5) A sample was taken to measure the background UV Transmittance (%UVT).
6) PHBA addition started (if required) to lower %UVT
7) System was allowed to stabilize.

8) UVT was measured to confirm %UVT.
9) Samples were taken at the inlet and outlet of the pilot unit.
10) %UVT was measured and recorded.
11) Flow rate was checked and recorded.
12) Number of banks used was recorded.
13) Measurements were recorded in log sheets.

This sequence was repeated for a total of five UV Doses.

Each sample was analyzed in duplicate in accordance with *The Standard Methods for the Examination of Water and Wastewater* (1998) 20th Ed., Method 9222D. At the end of the incubation period, the plates were removed and placed into insulated coolers and transported to GAP Enviromicrobial Services Inc. Colonies were then enumerated and the data was returned to Dillon according to the chain of custody for data analysis.

## 3. RESULTS

### 3.1 Collimated Beam

Data for the collimated beam, performed at approximately 75% UVT, is summarized graphically in Appendix F. Exposure times were calculated to deliver UV doses of 12 mWs/cm$^2$, 24 mWs/cm$^2$, 40 mWs/cm$^2$, 60 mWs/cm$^2$ and 80 mWs/cm$^2$. Based on a 50 mL sample size, 2.2 cm water layer, a correction factor of 0.722 was used to calculate the average intensity throughout the sample. At an applied intensity of 0.216 mW/cm$^2$, the average intensity throughout the sample was calculated to be 0.156 mW/cm$^2$.

Data for the collimated beam, performed at approximately 65% UVT, is also summarized graphically in Appendix F. Exposure times were calculated to deliver UV doses of 12 mWs/cm$^2$, 24 mWs/cm$^2$, 40 mWs/cm$^2$, 60 mWs/cm$^2$ and 80 mWs/cm$^2$. Based on a 50 mL sample size, 2.2 cm water layer, a correction factor of 0.637 was used to calculate the average intensity throughout the sample. At an applied intensity of 0.216 mW/cm$^2$, the average intensity throughout the sample was calculated to be 0.138 mW/cm$^2$.

All collimated beam data including method details are summarized in Appendix F.

### 3.2 Field Dose Response Run

Data for the field dose response run is summarized in Figure 1 and presented as delivered UV dose versus hydraulic loading rate (Lpm/Lamp). Summarized field data can also be found in Appendix F.

The equation that best fits the measured data at 75 %UV transmittance can be expressed as:

$$\text{Dose} = 5497.1 \cdot (Q)^{-1.0083}$$

The correlation ($R^2$) for the curve is 0.9995.

The equation that best fits the measured data at 65 %UV transmittance can be expressed as:

$$\text{Dose} = 2823.5 \cdot (Q)^{-0.9976}$$

The correlation ($R^2$) for the curve is 0.9995.

In the equations above, dose has the units $mWs/cm^2$ and flow is in Lpm.

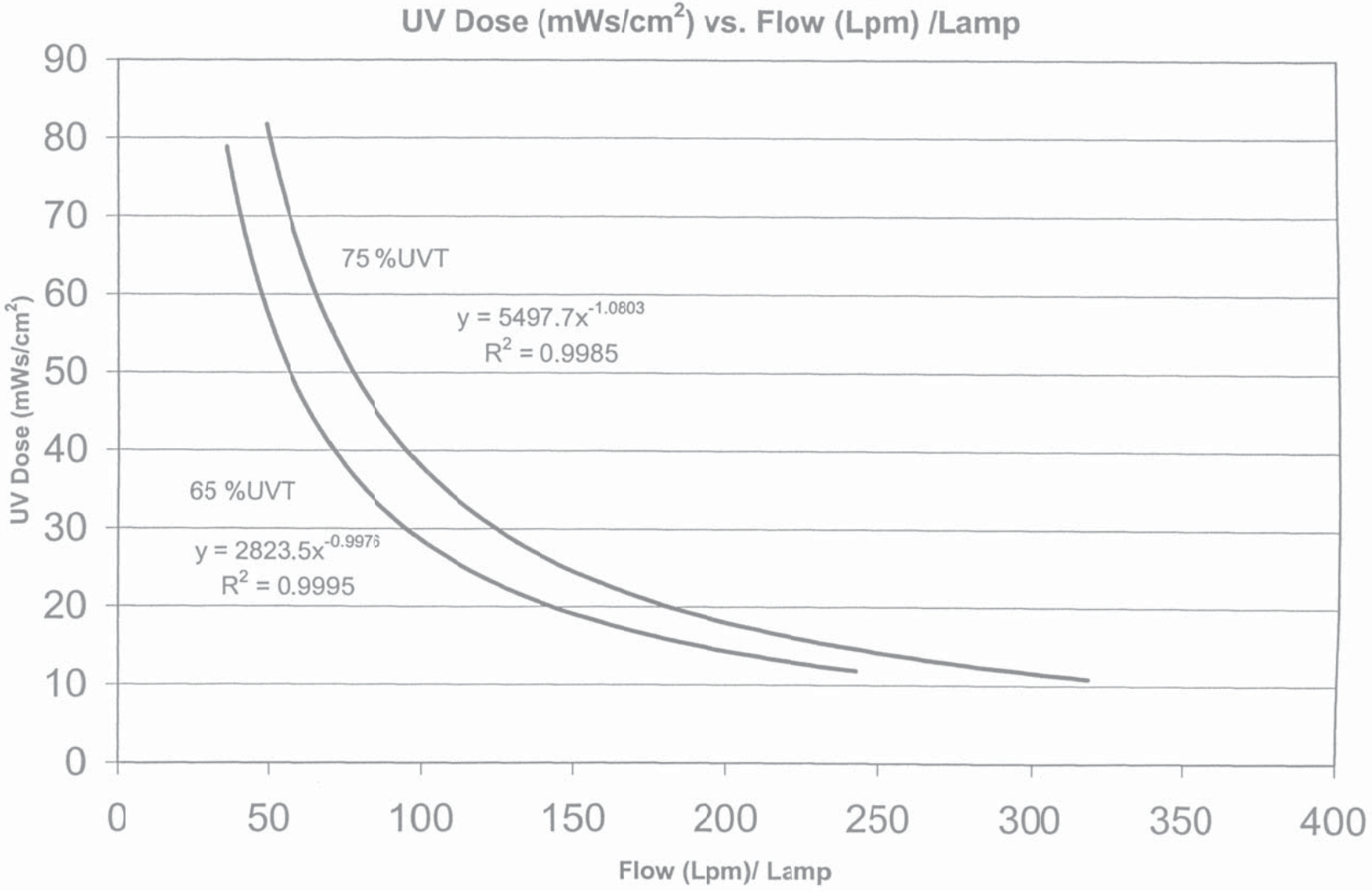
## 4. CONCLUSIONS

The bioassay data was plotted as Dose vs Flow per lamp for both the 75% UVT and the 65% UVT runs.

The curve resulting from data obtained in the 75% UVT run is best represented by the following power equation ($R^2 = 0.9985$):

$$\text{Dose} = 5497.7 \cdot (Q)^{-1.0803}$$

# Figure 1: UV3000 Bioassay Results




Dillon Consulting
UV3000™

00-8517

The curve resulting from data obtained in the 65% UVT run is best represented by the following power equation ($R^2 = 0.9995$):

$$\text{Dose} = 2823.5 \cdot (Q)^{-0.9976}$$

In the above equations, dose has units of $mWs/cm^2$ and flow has units of Lpm.

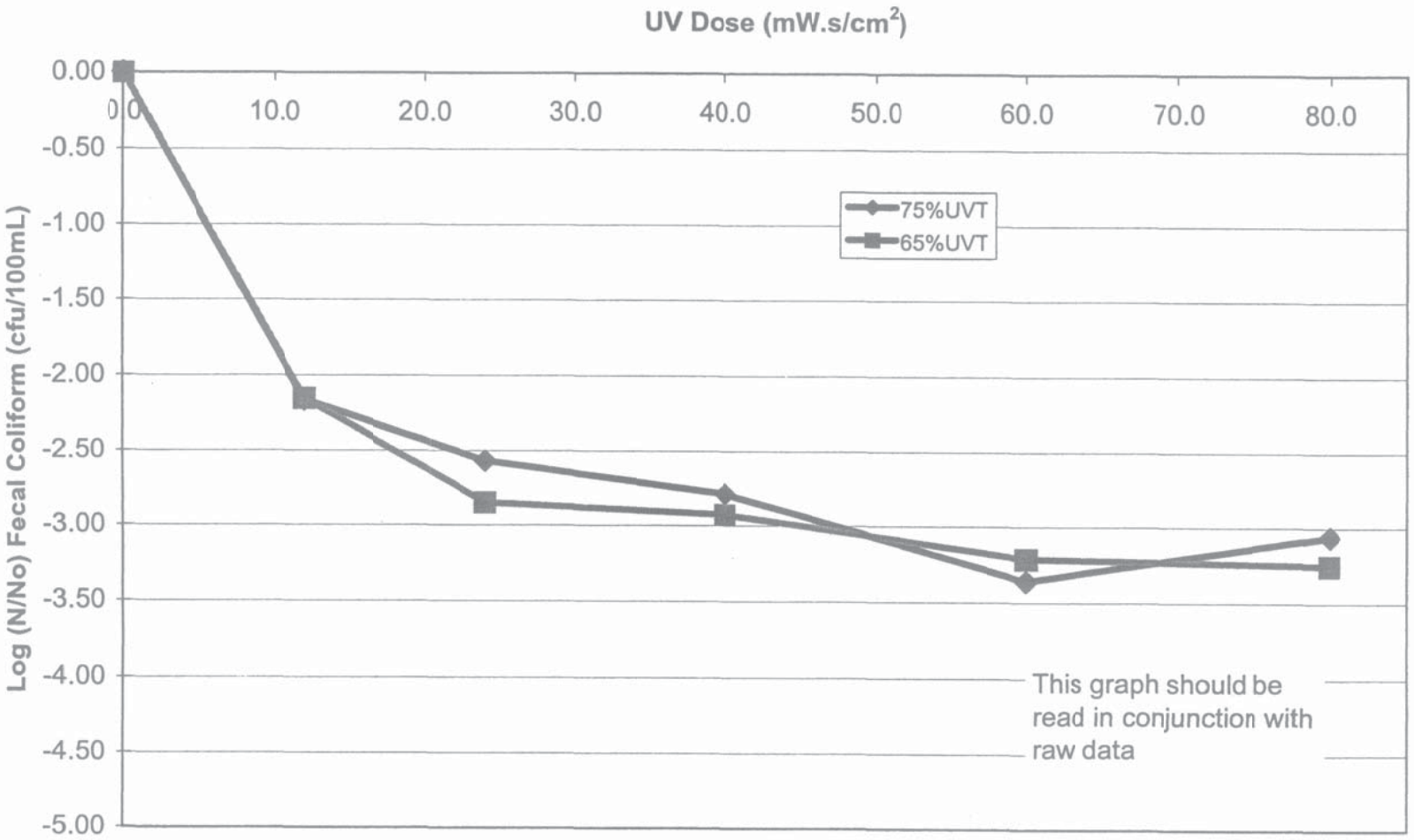
DILLON CONSULTING LIMITED
LONDON, ONTARIO

Louis Tasfi, Ph.D., P.Eng.
Project Manager

# APPENDIX F

# COLLIMATED BEAM METHOD, DATA AND FIELD DATA SUMMARIES

## Figure F-1: Collimated Beam Results
## Log (N/No) Fecal coliform (cfu)/100 mL vs UV Dose (mWs/cm$^2$)




Dillon Consulting
UV3000$^{TM}$

00-8517

**Table 1: Summary of Collimated Beam Results (3B-V1)**

| UV Dose ($mWs/cm^2$) | Exposure Times (sec) | Log Survival ($N/N_o$) |
|---|---|---|
| 12 | 77 | -2.2 |
| 24 | 154 | -2.6 |
| 40 | 256 | -2.8 |
| 60 | 385 | -3.4 |
| 80 | 513 | -3.1 |

**Table 2: Field Dose Response Data (3B-V1)**

| Flow Rate (Lpm) | Number of Banks | Hydraulic Loading/Lamp (Lpm/Lamp) | Geometric Mean Influent Fecal coliform (cfu)/100mL ($N_o$) | Geometric Mean Effluent Fecal coliform (cfu)/100mL (N) | Log Survival ($N/N_o$) | Delivered UV Dose ($mWs/cm^2$) |
|---|---|---|---|---|---|---|
| 5097 | 1 | 319 | 16000 | 260 | -2.1 | 10.5 |
| 5080 | 2 | 159 | 16000 | 84 | -2.8 | 24.0 |
| 4688 | 3 | 98 | 16000 | 48 | -3.0 | 40.0 |
| 3110 | 3 | 65 | 16000 | 22 | -3.4 | 60.0 |
| 2362 | 3 | 49 | 16000 | 17 | -3.7 | 80.0 |

**Table 3: Summary of Collimated Beam Results (3B-V2)**

| UV Dose ($mWs/cm^2$) | Exposure Times (sec) | Log Survival ($N/N_o$) |
|---|---|---|
| 12 | 87 | -2.2 |
| 24 | 174 | -2.8 |
| 40 | 291 | -2.9 |
| 60 | 436 | -3.2 |
| 80 | 581 | -3.3 |

**Table 4: Field Dose Response Data (3B-V2)**

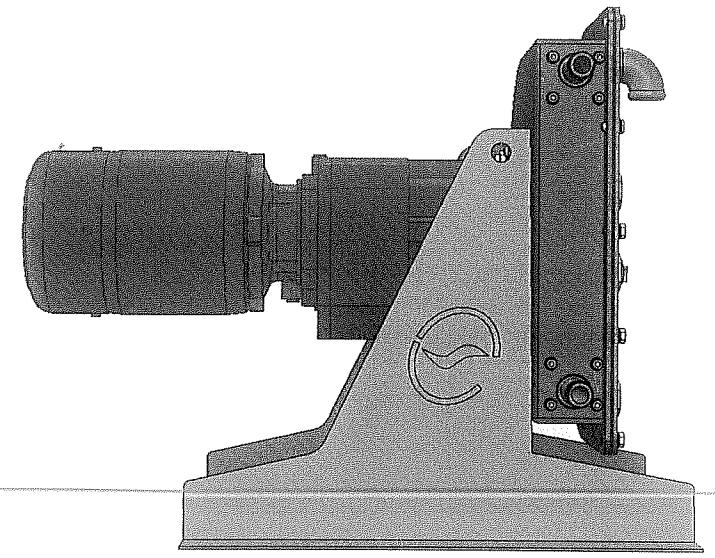
| Flow Rate (Lpm) | Number of Banks | Hydraulic Loading/Lamp (Lpm/Lamp) | Geometric Mean Influent Fecal coliform (cfu)/100mL ($N_o$) | Geometric Mean Effluent Fecal coliform (cfu)/100mL (N) | Log Survival ($N/N_o$) | Delivered UV Dose ($mWs/cm^2$) |
|---|---|---|---|---|---|---|
| 3877 | 1 | 242 | 12000 | 126 | -2.0 | 12.0 |
| 5572 | 3 | 116 | 12000 | 21 | -2.8 | 24.0 |
| 3422 | 3 | 71 | 12000 | 8 | -3.2 | 40.0 |
| 2267 | 3 | 47 | 12000 | 7 | -3.2 | 60.0 |
| 1734 | 3 | 36 | 12000 | 6 | -3.3 | 80.0 |

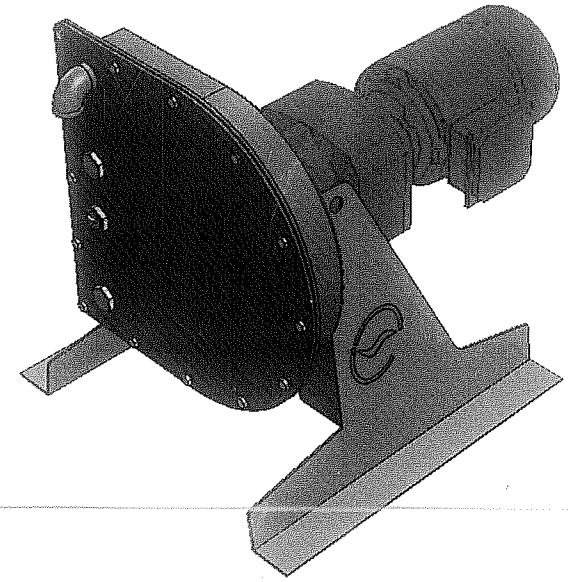
# ENVIROFLEX® L SERIES

## L20 to L80 Peristaltic Pumps

## Installation, Operation & Maintenance Manual

ENVIROFLEX®





**BEFORE INSTALLING YOUR PUMP HAVE YOU.....**

| | Tick |
|---|---|
| Read this Manual in its entirety? | |
| Ordered recommended spares? (spares not always in stock) | |
| Checked we have shown the correct pump duty on the data sheet? | |
| Checked pump supplied as per the technical data sheet? | |
| Installed overpressure protection for the pump? | |
| Protected the pump motor against over current? | |
| Installed suitable pulsation dampeners where required? | |
| Completed all Pre start-up checks highlighted in this manual? | |

Manual Revision 1 December 2012 CE

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Manual Revision 1 December 2012

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This manual is owned by Environmental Pumping Solutions Limited and may not be reproduced by any means in part without their written consent. Reproduction by the user for the purposes of Installation, Operation and Maintenance of their L Series peristaltic pump only excepted.
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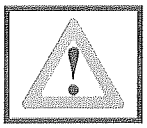
# 1 Introduction

Thank you for choosing a quality pump from Environmental Pumping Solutions Ltd.

Critical information before start up:



**For safety reasons and in order for you to get the full usage of your new pump, it is necessary to read this manual thoroughly before putting it into service.**

Ensure all commissioning checks on page 14 have been carried out

Within 7 days of delivery and before mounting and installing the pump please make sure that the unit corresponds exactly to that ordered and has not been damaged during transport.

This manual is divided into 4 parts:

1. **Introduction** to give the user an overview of the pump and this manual.
2. **Installation Guide** for installing or uninstalling and commissioning the pump.
3. **Maintenance Guide** for maintenance, repair or troubleshooting.
4. **User Guide** for daily use of the pump.

The L series pump range provides a high quality product that is designed to provide reliability, low energy consumption and low maintenance costs.

Environmental Pumping Solutions Ltd supplies the complete range of peristaltic hose pumps including 10mm (3/8"), 15mm (1/2"), 20mm (3/4"), 25mm (1"), 32mm (1 1/4"), 40mm (1 1/2"), 50mm (2"), 65mm (2 1/2"), 80mm (3"), 100mm (4") and 150mm (6").

## 1.1 *General*

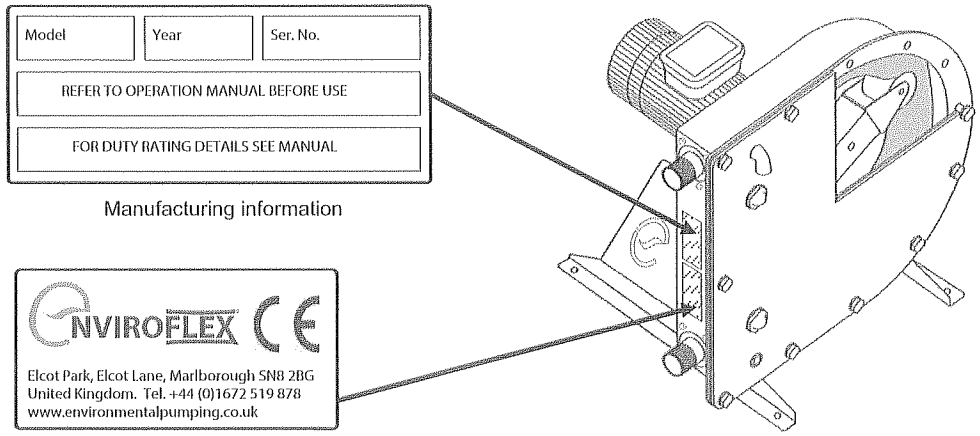
These instructions are intended as a reference book by means of which qualified users are able to install, commission and maintain Environmental Pumping Solutions L series peristaltic pumps. These instructions do not absolve the user of responsibility for carrying out work in accordance with good engineering practices and adherence to local Health & Safety regulations.

Documentation on the drive system used with the pump is not included within this manual. Reference must be made to separate documentation for the drive system, and its recommendations and instructions strictly observed.

For further information specifically about the L series range of peristaltic pumps which is not found within these instructions, please contact Environmental Pumping Solutions Limited, or your authorised local dealer.
Please ensure you have the following data at hand:

- serial number of the pump
- material of the pump hose
- serial number of the drive gearbox and motor

Identification plates are mounted on the pump head, drive gearbox and electric motor.




Labels fixed to the pump body contain model type, year of manufacture, product serial number and manufacturer's details.

## 1.2 *Safety*

In these instructions the following symbols are used:

**WARNING**
Procedures, which, if not carried out with the necessary care, may result in serious damage to the pump equipment or in serious bodily harm.

**CAUTION**
Procedures not carried out with the necessary care, may result in serious damage to the pump equipment, the surrounding area or the environment.

*i* Remarks, suggestions and advice.

During installation & maintenance all personnel should ensure they wear suitable personal protection equipment (PPE) such as safety glasses, gloves, safety boots and safety helmets as appropriate.

## 1.3 *Intended Use*

Environmental Pumping Solutions L series peristaltic pumps are designed exclusively for pumping suitable products as defined in the technical data sheet supplied with your final quotation. Every other or further use is not in conformance with the "intended use" as laid down in EN 292-1.(1) The manufacturer cannot be held responsible for damage or harm resulting from use other than the "intended use".

If you wish to change the application of your pump, please contact Environmental Pumping Solutions Limited, or your authorised local dealer to establish if the change is appropriate for the supplied pump.

(1) The "Intended use" as laid down in EN 292-1 is "... the use for which the technical product is intended in accordance with the specifications of the manufacturer, inclusive of his indications in the sales brochure". In case of doubt it is the use which appears to be its intended use judging from the construction, execution and function of the product. Observing the instructions in the user's documentation also belongs to intended use.

## 1.4 *Warranty Conditions*

Unless stated otherwise in the Technical Selection Sheet provided at the time of pump selection, the manufacturer offers a two–year warranty on proper workmanship of all parts of the pump. Exclusion is made for normal wear and tear of consumables, such as pump hoses, lubricant, hose clamps, compression rollers, bearings and bushes, wear ring and seals, or parts which have been misused or damaged through negligence.

The warranty only applies if the pump has been used for the application specified in the technical selection sheet and according to the guidance in this manual. Operation at pressures outside of the range specified in the Technical Selection Sheet shall invalidate this warranty.

This manufacturer's warranty is null and void for any user who uses parts not of Environmental Pumping Solutions Limited original supply in their L series peristaltic pump (including use of an alternative hose lubricant).

The warranty is strictly a return to base warranty, which means that the pump is required to be returned to our UK factory by arrangement for any investigation, replacement or repair work. The cost of transport back to our factory is not covered by this warranty; however with any valid warranty claim all time, replacement parts and carriage back to the original delivery address are included.

Any parts to be returned to the manufacturer must be accompanied by a fully filled in and signed declaration form declaring the conditions of use and materials pumped. Parts which have been contaminated or which have been corroded by chemicals or other substances which can pose a health risk must be cleaned before they are returned to the manufacturer.

Furthermore, it should be indicated in the declaration form what specific cleaning procedures have been followed, and that the equipment has been decontaminated.

The declaration form is required for all items, even if the parts have not been used.

A Declaration Form can be found at the end of this manual.

Warranties purporting to be on behalf of Environmental Pumping Solutions Limited made by any person, including representatives of Environmental Pumping Solutions Limited, its subsidiaries, or its distributors, which do not accord with the terms of this warranty shall not be binding upon Environmental Pumping Solutions Limited unless expressly approved in writing by a Director of Environmental Pumping Solutions Limited.

## 1.5 *Description*

### 1.5.1 Operation of the pump

The heart of the L series peristaltic pump is a specially constructed pump hose which lies within the pump housing. (Upon pump installation both ends of this hose are connected to the suction and discharge lines). A rotor with two opposing compression rollers lies in the centre of the pumphead.

During pump operation the rotor rotates, with the compression rollers compressing the pump hose. This action "pushes" the pumped fluid through the hose, and as soon as the compression

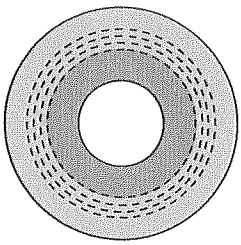
roller has passed, the hose recovers to its original shape due to the mechanical properties of the material.

Simultaneously fresh pumped fluid is drawn into the hose behind the compression roller by the (continuous) turning motion of the rotor.

The second compression roller will subsequently compress the pump hose. Due to the continuous rotating movement of the rotor not only is new product sucked in, but the already present product is pushed out by the moving compression roller. When the first compression roller leaves the pump hose, the second compression roller has already closed the pump hose and the product is prevented from flowing back. This is known as the "positive displacement principle" pumping principle.

### 1.5.2 Pump hose

The pump hose is made of specially compounded rubbers, reinforced with nylon cords. The outer cover of the pump hose is always made of natural rubber, whilst the inner layer is supplied in a variety of materials to suit the product to be pumped.



Dependent on the specific requirements of your application a corresponding pump hose must be selected. For each pump model various hose types are available.

*i* Consult Environmental Pumping Solutions Limited or your authorised local dealer for more detailed information about the range of hoses available, and their chemical and temperature resistance.

Environmental Pumping Solutions pump hoses have been carefully machined, to ensure minimum tolerances in wall thickness. It is very important to guarantee the correct compression of the pump hose, because over compression can cause too high a load on the pump and pump hose leading to reduced pump hose life and gearbox failure.

Under compression will result in loss of capacity and backflow resulting in reduced pump hose life.

*i* Please refer to the maintenance section of this manual regarding adjustment of hose compression settings.

### 1.5.3 Hose Lubrication

The pumphead is part filled with our specially compounded Envirolube lubricant. The lubricant lubricates the compression rollers and movement between the hose and the pump housing and the cover.

To those familiar with other types of peristaltic pumps utilising compressions shoes, our lubricant may appear thin, but this is essential in order to reach the roller bearings with maximum efficiency of lubrication.

Our lubricant is the result of decades of development and is perfectly mixed for use specifically in the L series pumps, ensuring the hose is fully lubricated at all times with no reaction on the hose material that would cause swelling and early hose failure.

Environmental Pumping Solutions Envirolube lubricant will not freeze during cold weather.

### 1.5.4 Drive systems

The L series pumps described in this manual use a variety of drive types. Motors and gearboxes are selected according to the particular application for which the pump is applied.

### 1.5.5 Available options

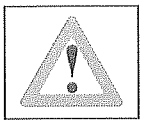
The following options are available for the L series range of pumps:

- Hose Failure Detectors (senses elevated lubricant levels within the pump as a result of hose failure)
- Flanged pipework connections
- Complete stainless steel pumps

# 2 Installation

## 2.1 *Unpacking*

Upon unpacking of the pump check and inspect all items against the purchase order and packing list and for any damage caused during shipment. All claims for shortages and/or damage must be notified immediately to Environmental Pumping Solutions Limited.



Suitable lifting equipment must be used when handling components and assembling pumps.

ENVIRONMENT

When disposing of unwanted packaging materials, please consider the possibilities for reuse or environmentally friendly processing of packaging materials.
Always observe local regulations with respect to disposal of non reusable items.

## 2.2 *Storage*

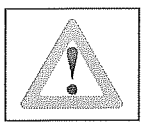
After receipt and inspection, if pumps are not to be put into service immediately provision should be made for the pump to be rotated for a couple of turns on a weekly basis, ensuring the rollers are not allowed to come to rest in the same position consecutively. Alternatively one roller can be removed from the pump, leaving the remaining roller not in contact with the hose between the inlet and outlet ports.

Failure to adhere to the above procedure may result in a 'permanent set' of the hose which can result in reduced performance and premature hose failure.

Pumps that are to be stored for extended periods of time should have the hoses removed and stored in accordance with Environmental Pumping Solutions recommendations. The pumps should be repackaged and placed in a suitable clean dry storage area free from excess moisture and vibrations. Protective blanking caps fitted before despatch from the factory should not be removed. Any unpainted surfaces not factory treated with a rust inhibiting coating should have a protective coating applied.

Where applicable, if pumps were supplied with electric motors fitted with anticondensation heaters, these should be connected to a temporary supply and switched on throughout the storage period.

## 2.3 *Locating the Pump*



Before mounting the pump, make sure that all your site safety procedures have been reviewed and that any appropriate risk assessments have been completed.

*i* Upon installation ensure that all markings on the pump will be clearly visible when installation is complete.

Ensure the pump is to be sited in an area where the ambient temperature during operation is not below –15° and above +45°C.

Check that the foundation where the pump is to be mounted can carry the load of the pump. Also have the appropriate SWL marked lifting gear / crane ready for the given situation.

Ensure the foundation/floor surface is flat and horizontal. Minor irregularities in surface level can be accommodated by the use of shims placed under the support frame.

Ensure there is sufficient room around the pump to carry out the necessary maintenance activities. Particularly ensure the front cover door can be opened and a hose taken out and replaced (If it cannot, it maybe possible to modify the door to remove the hinge if fitted, please enquire).

Ensure the installation environment is sufficiently ventilated allowing heat developed by the pump and drive to be discharged, particularly that the motor cowl has sufficient air to circulate to support cooling.

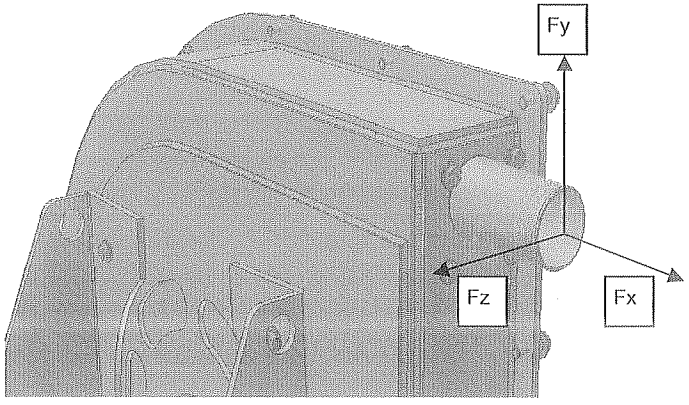
No special tools are required to install the L series pumps, other than ordinary hand tools and a hammer/drilling machine for the installation of the foundation bolts.

## 2.4 *Connecting the Pipework*

It is recommended that the connection to a pipe system is made as a flexible joint. There are several flexible systems on the market which include both metallic and rubber systems.

By making a flexible joint, the risk of introducing vibrations into the complete pipe system is reduced. Vibrations may cause wear and in some cases fatigue fractures in the pipe system.

The pipework system must be independently supported and must not use the pump in anyway to support its weight (The pipe system must never hang by the connections of the pump).




| Permissible Load (N) | | | |
|---|---|---|---|
| | L20 & 25 | L32 | L40 |
| Fx | 600 | 600 | 800 |
| Fy | 150 | 150 | 200 |
| Fz | 150 | 150 | 200 |
| | L50 | L65 | L80 |
| Fx | 1000 | 1200 | 1500 |
| Fy | 200 | 300 | 300 |
| Fz | 200 | 300 | 300 |

Suction line bore must be larger than the bore size of the pump hose. Discharge line bore must be the same or larger than the bore size of the pump hose.

Keep the suction and delivery lines as short and direct as possible.

Suction and discharge lines should preferably exit straight from the pump so that the pump is not pumping directly into a restriction for example a 90 degree bend, as this may cause the hose to come off. Where bends are used, ensure the radiuses are as large as possible. It is recommended to use Y-connections instead of T-connections.

Prevent any possibilities of exceeding the maximum working pressure of the pump. It is essential that you discuss this with your system designers in order to ensure safe system and pump operation. If necessary fit an overpressure protection device.

To avoid misunderstanding, protecting the motor against over current will not protect the pump from overpressure. Pump overpressure needs to be protected against independently using a pipeline mounted overpressure protection device.

All L series pumps have a pressure overflow connection found on the front of the pump above the lubricant fill plug. When the pump hose fails, liquid will come out of this overflow connector. If this is a potential safety or hygienic issue, the connector will need to be piped back to a safe location in a way that will not impede normal atmospheric pressure reaching the pump body during normal operation.

Consider the maximum permissible working pressure of the pump and pipework used. Exceeding maximum working pressures may lead to serious damage.

## 2.5 *Pulsations*

Some systems require pulsation dampers to avoid excessive and damaging pressure spikes and vibrations. Situations that may lead to excessive pulsations and vibration are:

- incorrectly secured pipelines
- high pump speeds with long suction and delivery lines or the product SG is high
- pipeline bore is too small

Where unacceptable pulsations are encountered, it may be possible to install pulsation dampeners to alleviate the problems.

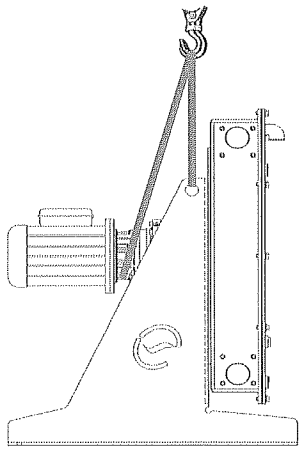
Dampeners need to be sized very carefully in order to protect the pump and system from excessive pressure peaks.

- Never use an existing dampener employed on another application or pump make and assume it will automatically work on an application with an L series pump. Different pump displacements and system characteristics often mean a dampener will not work effectively.
- Many dampeners are not suitable for variable speed applications. Where pump speeds and pressures vary, dampeners need to be carefully selected and sized to accommodate all the duty conditions.

Consult Environmental Pumping Solutions Limited or your authorised local dealer for more detailed information about the need and use of pulsation dampeners.

## 2.6 *Lifting the Pump*

The complete pump should be lifted using the lifting eyes on the pump frame. Due to the selection of drives available the centre of lift will vary dependant upon the size and weight of the drive fitted. If desirable to lift the pump squarely an additional lifting strap may be positioned around the juncture of the gearbox and motor. The length of this will need to be adjusted to establish a level lift if so desired. Suitably rated lifting straps or slings only must be used. Gearbox and motor lifting eyes must not be used for lifting the complete pump unit.



When lifting the pump ensure that all standard lifting practices are adhered to and carried out by qualified personnel only.

## 2.7 *Mounting the Pump*

The pump is fastened to the foundation via the holes in the frame or pump-chassis using suitable anchor bolts.

If the pump is to be mounted on rubber pads, it is very important that the connecting pipeline is fitted with a flexible joint.

## 2.8 *Electrical Connection*

Electrical connection of the pump must only be done by suitably qualified personnel.

The motor is to be thermally protected against overload by a protective circuit switch and is to have the correctly sized fuse according to the local existing rules and regulations.

**Important:**
In order to insure that the pump remains free of static electricity, the pump needs to be grounded. This is done via the grounding of the motor. The motor must be grounded with a wire of sufficient size!

For electrical connection details, please see the motor datasheet.

The pump should have its own dedicated electrical isolation switch meeting the requirements of BS EN 60947 - 3 (Switches, disconnectors, switch disconnectors and fuse combination units) so that it is not possible to start the pump during maintenance. There should also be an emergency stop button meeting the requirements of BS EN 60947 - 5 - 1 (Electro - mechanical control circuit devices) and BS EN 60947 - 5 - 5 (Electrical emergency stop devices with mechanical latching function.)

It is recommended to have local electrical control to the pump for use during commissioning and maintenance operations.

These electrical items should be installed according to the manufacturer's instructions by an electrician qualified to install electrical equipment on machinery.

If the pump is incorporated into a more complex installation then the installer should ensure the completed installation complies with the Machinery Directive 2006/42/EC.

## 2.9 *Use of Frequency Inverters*

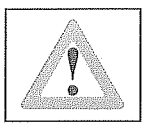
The pump will not come with a motor that is suitable for use with a frequency inverter unless this has been stated on the pump technical data sheet.

Use of an inverter when no allowance has been made for one, can be dangerous and may lead to motor failure.

Where the use of an inverter has been specified on the pump technical data sheet it is essential that the control panel does not allow an operator to run the pump outside of the turndown design parameters there specified.

Frequency inverters used with peristaltic hose pumps must be of the constant torque type, and ideally sized at least one size larger than the pump fitted motor kilowatts.

## 2.10 *ATEX Approved Units*



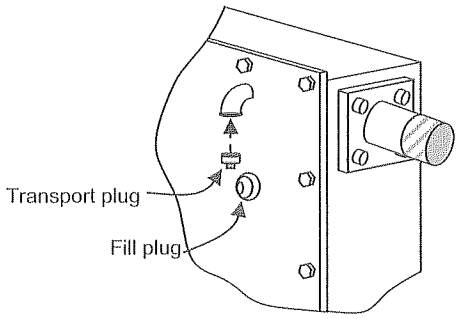
Standard L series pumps must not be used in potentially explosive hazardous atmospheres (European Directive 94/9/EC -ATEX Directive). If you require a pump to operate in a hazardous area classification, please contact Environmental Pumping Solutions Limited or your authorised local dealer for more detailed information.

## 2.11 *Commissioning*

### 2.11.1 Prestart-up Checks

Before commissioning, carry out the following checks:

- Check the pipework connections, ensuring there is no undue strain on the pipework.
- Ensure that there are no obstructions such as closed valves in the pipework. It is advisable to flush the system through with water to clear any debris.
- Ensure the Transport Plug is removed from the pressure overflow connection on the front of the pump.




- Check the pump casing is filled to the correct level with Envirolube specially compounded Roller Hose Lubricant. If necessary add lubricant. - **Before adding lubricant, check you have the correct hose lubricant; fill only with our Roller grade lubricant.**
- Check there is oil in the gearbox, and filled to the correct level.

It is advisable prior to powering up the pump to check rotation by hand to ensure there are no obstructions. This can be achieved as follows:

Isolate and lock off the electrical supply. Remove the motor fan cowl and turn the electric motor fan by hand to ensure free running. The motor should be rotated for enough turns to ensure the pump rotor has turned through 360 degrees. (If the gearbox ratio is 50:1, the motor fan must be rotated 50 revolutions). If any difficulties are found these should be investigated and rectified.

### 2.11.2 Start-up Checks

Prepare the electric motor for operation in accordance with the manufacturer's instructions, and ensure pump control panels are energised ready for operation.

When satisfied that all preliminary checks and procedures have been carried out, start up the pump.

Whilst running carry out the following checks:

- Check the rotation of the rotor.
- Check for any leaks in the system
- Check for excessive vibrations
- Check the pumping capacity of the pump.

Generally monitor the behaviour of the pumpset during the run period, ensuring that temperatures stabilise within the run period.

Check the integrity of the foundation holding bolts.

Following all start-up checks, if any items deviate from expected, refer to the "Troubleshooting" section of this manual or contact Environmental Pumping Solutions Limited, or your authorised local dealer.

# 3 Maintenance

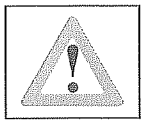
Only use original Environmental Pumping Solutions parts when maintaining the pump. Environmental Pumping Solutions Limited cannot otherwise guarantee correct functioning of the pump. Any consequential damage that occurs from the use of non-original components cannot be warranted.

## 3.1 *Routine Maintenance*

The L series pumps are designed to minimise service and maintenance.

A small number of simple preventive measures are however needed in order to ensure continuous and trouble free pump life.

Important: it is very important, that the pump is maintained according to the table below.



Never clean or repair the pump without it being fully isolated.

When cleaning, maintaining or repairing the pump, the power supply to the motor has to be disconnected by means of a key locked switch.

| Action | To be carried out | Comments |
|---|---|---|
| Check hose lubricant level | Before start-up and thereafter on a daily operational basis | Lubricant should be visible in the lower sight glass on the pump front cover |
| Check the pumphead for any lubricant leakage around the cover and the connections | Before start-up and thereafter on a daily operational basis | |
| Check pump for high temperature or unusual noise | On a daily operational basis | |
| Check compression rollers for wear | When replacing the pump hose | Replace if there is more than 1mm wear across the roller |
| Changing the hose lubricant | When replacing the pump hose | Only use Envirolube hose lubricants |
| Check gearbox oil level | Before start-up and thereafter on a daily operational basis | |
| Replacing the gearbox oil | Refer to the gearbox manufacturers instructions | |

In certain installations it may be desirable to try and change the pump hose before failure on a routine scheduled basis. If this is the case, we suggest changing the hose after 75% of the time the first hose lasted.

Due to the variety of motor and gearboxes supplied according to both application and client requirements, maintenance detail is not shown in this manual. Please refer to the manufacturer's manual for maintenance detail on your specific drive.

## 3.2 *Cleaning the pump Hose*

The inside of the pump hose is easily cleaned by flushing with water or any other compatible cleaning fluid. Ensure that the pump hose can not only resist the chemical compatibility of any cleaning fluids, but also the temperature of cleaning liquid used.

Cleaning systems must not generate pressures in excess of the pump operating design pressure.

## 3.3 *Hose Removal*

When pumping potentially hot, hazardous or dangerous media, it is critical to ensure that personnel are adequately protected during hose removal and that the hose is washed through with a media harmless to man and the environment before the hose is dismantled.

There can be a significant pressure difference between the upper and the lower pump connections. This can mean that while having vacuum in one connecting pipe there can be a large overpressure in the other connecting pipe. It is therefore essential that the pipework is depressurised safely prior to opening the pump cover and dismantling the hose.

Before dismantling any items, shut off the suction and discharge valves.

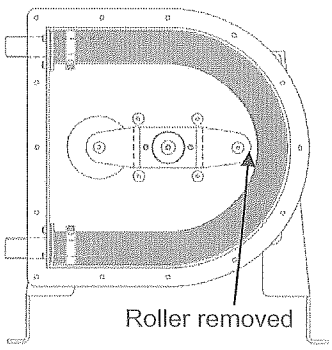
Drain the hose lubricant by positioning a container at the base of the pump, remove the top fill plug, remove the drain plug at the bottom of the pump and drain the lubricant into the container.

Always dispose of used lubricant in safe and proper manner. Refer to local Environmental restrictions as appropriate.

Unbolt the pump front cover and swing open on its hinges.

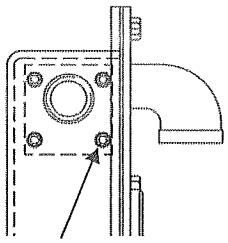
There are two options of hose removal with the L series pumps. Either the complete hose and inserts can be removed as one element assembly, or the hose can be removed with the inserts left in the pump.

With both methods of hose removal we suggest that one of the compression rollers is removed. To remove a roller ensure the roller is not in contact with the hose, remove the roller spindle screw and screws holding the roller side plate and lift the roller out. Rotate the rotor so that the remaining roller lies between the inlet and outlet ports. The hose can then be removed and a new one inserted easily without having to rotate the rotor. To refit the compression roller, rotate the rotor 180° so that the roller to be replaced lies between the inlet and outlet ports.




<u>Removing the hose as an Element Assembly</u>
First disconnect suction and discharge piping

Remove the insert retaining bolts from both hose inserts, lift the hose element assembly out of the pump, withdrawing the inserts through the pump body.



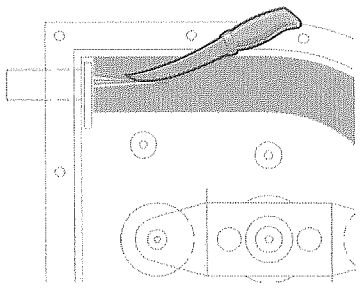
Removing the hose only

Note: There is no need to disconnect the suction and discharge piping when removing the hose only via this method.

*i* Where difficulty pulling the hose off the connectors is encountered, try cutting the hose along the side of the connector as shown.

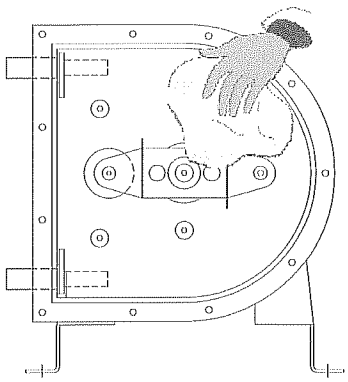
Carefully loosen top and bottom hose clamps.

From the bottom hose connector pull the hose off and out as far as possible. Continue pulling out the old hose until you have arrived at the top hose connection and finally pull the hose off this connection.



Check mechanical parts, such as Rollers, bushings and shafts for damage or wear.

Clean all components thoroughly, flushing with clean water if necessary. Pay particular attention to any residue of pumped material. Deposits of any abrasive media left within the pump body will be detrimental to future component life.



Check before replacing the hose that it is the correct diameter, and material and measure the exact thickness of the hose and note this down. This is needed if adjustment of the rollers is needed.

Before fitting the new hose, we recommend you check the compression roller occlusion setting to ensure optimum pumping efficiency throughout the pump life.

*i* When ordering spare parts, please make reference to the serial number on the nameplate.

## 3.4 *Replacing the Roller Bushes*

With the hose removed, remove the compression rollers if not already done so, by removing the roller spindle screw and lifting the roller out of the roller carrier.

Using a suitable mandrel, press the old bushes out of the roller.

Lightly lubricate the outer surfaces of the new bushes and press into place, ensuring the face of each bush is flush with the face of the roller each side.

Refitting the roller is a reversal of the removal process.

## 3.5 *Adjusting the Compression Rollers*

The distance 'A' between the inner face of the pump body housing, and the compression roller should be set according to the following formula:

**A = (2 x t) - t1**
(at pressures 0 to 5 bar)

When the application pressure is to exceed 5 bar, subtract
**0,1 x t1 x Pd**

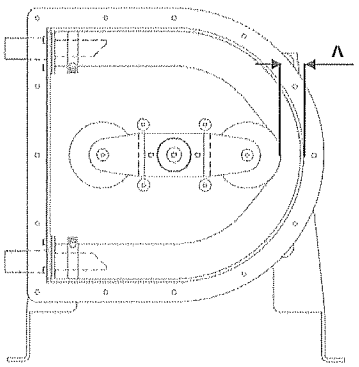



Figure 1 Distance from roller to pump housing

| Variable | Value |
|---|---|
| **A** | Distance from roller to pump housing, see Figure 1 |
| **t** | Thickness of the hose wall, see Figure 2 |
| **t1** | Material dependent scale, see below |
| **Pd** | Nominal working pressure on the pump. |

Example:

Hose thickness t = 14 mm
Hose material NBR t1 = 1.0 mm
Working pressure Pd= 7 bar
A = 2 x 14 – 1.0 = 27.0 mm
Subtraction from higher working pressure:
0.1 x 1.0 x 7 = 0.7 mm

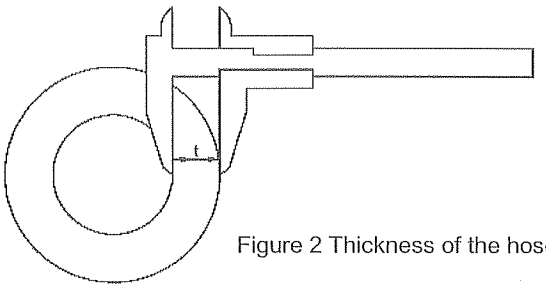



Figure 2 Thickness of the hose

A = 27.0 mm – 0.7 = 26.3 mm

| Hose material | Scale: t1 | Hose material | Scale: t1 |
|---|---|---|---|
| Natural rubber | 1,5 mm | Butyl | 1,0 mm |
| NBR (Nitrile) | 1,0 mm | Hypalon (CSM) | 1,0 mm |
| EPDM | 1,0 mm | Neoprene | 1,0 mm |

To adjust the compression roller gap shims should be inserted under the roller carrier. Additional shims of 0.5mm and 1.0mm thickness are available from Environmental Pumping Solutions Limited or your authorised local dealer.

*i* The above procedure is intended as a guide only. After carrying out operational tests as detailed later in these instructions it may be found necessary to further adjust the rollers to decrease the distance 'A'.

Should it be found necessary to further adjust the rollers to decrease the distance 'A', this should be done in increments of 0,5 mm. If the rollers are adjusted too much, over occlusion of the hose will occur. Hose over occlusion is detrimental to hose life.

## 3.6 *Fitting the Pump Hose*

Take care when fitting the pump hose, there is a possibility of trapping hands if care is not taken.

Ensure the pump body housing is clean and free from foreign particles.

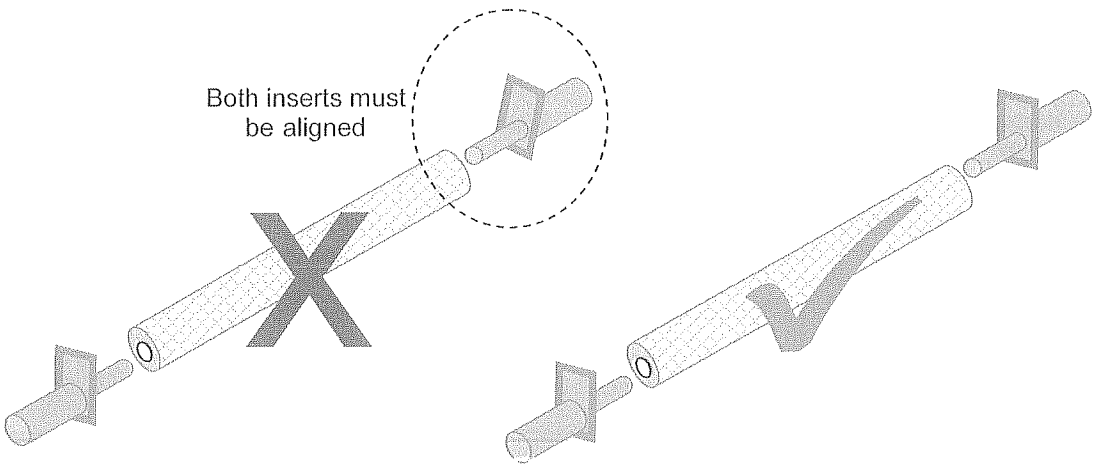
If not already removed, remove one of the compression rollers. To remove a roller ensure the roller is not in contact with the hose, remove the roller spindle screw and screws holding the roller side plate and lift the roller out. Rotate the rotor 180° so that the remaining roller lies between the inlet and outlet ports. The hose can then be inserted easily without having to rotate the rotor. To refit the compression roller, rotate the rotor 180° so that the roller to be replaced lies between the inlet and outlet ports.

Refitting the hose as an Element Assembly

Prior to installing a new element hose assembly, ensure that both hose inserts are aligned correctly. The hose inserts can only be fitted to the pump in one orientation, checking the correct orientation and alignment now will avoid delays later.

Correct alignment can be achieved by assembly on a flat surface ensuring both insert flanges sit flat on the surface whilst assembly takes place.

It is important to ensure correct alignment of the hose inserts. Misalignment will result in a twisted hose once the hose is fitted, leading to premature hose failure.




Push the hose onto the hose insets along with the hose clamps – do not tighten clamps.

Aid assembly by lubricating inserts and hose bore with hose lubricant.

Never lubricate the hose, or any components in contact with the pump hose with mineral oils or lubricants, these are not compatible with the materials of hose construction.

Ensure the hose is pushed up to the insert flange on both connections, and that the inserts are in correct alignment.

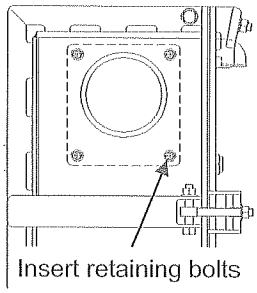
Tighten both hose clamps and re check the insert alignment.

If the assembled hose element is not to be installed into the pump straight away, ensure the assembly is wrapped and stored in accordance with Environmental Pumping Solutions recommendations.

Prior to fitting to the pump, ensure the hose assembly is clean and free from grit and particles on the outer cover. Place the hose connector gasket over the outer connections.

Insert the hose element assembly in to the pump, passing the outer connections through the respective port in the pump body, with the gaskets on the inside of the pump body.

Insert and tighten the insert retaining bolts.




The hose must now be properly positioned in the pump housing as detailed below.

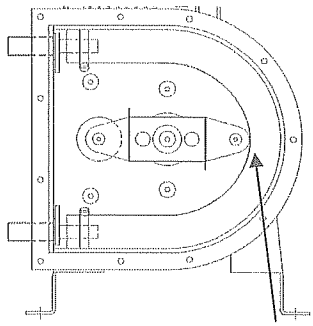
Failure to correctly position the hose may lead to premature hose failure.

Refitting the hose only (inserts not removed)

Push the hose clamps and hose onto the top connector – do not tighten clamps.

To aid assembly, lubricate the hose connector and hose bore with a little hose lubricant.

Never lubricate the hose, or any components in contact with the pump hose with mineral oils or lubricants, these are not compatible with the materials of hose construction.



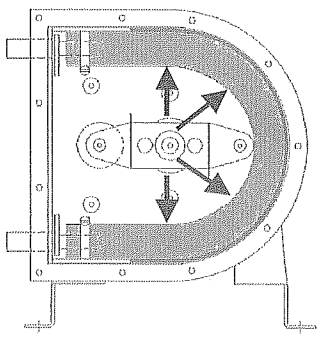

Push the hose over the bottom connector put the hose clamps over the hose - do not tighten clamps.

With the roller removed the hose can be pushed into the housing.

Positioning and Seating the hose

Ensure the hose clamps are loose. (If the hose was fitted as a complete element with inserts, it will be necessary to loosen the clamps.)

Push the hose firmly into the "U" arc of the pump body, ensuring contact is made with the hose and pump body along the complete length of the compression path and then tighten both hose clamps.



If difficulty is found seating the hose against the pump body try refitting the roller as below, the action of the rollers compressing the hose as the pump is rotated will help position the hose.

Refit the compression roller, by first rotating the rotor 180° so that the roller to be replaced lies between the inlet and outlet ports.

Always recheck the roller gap after you have refitted the roller.

## 3.7 *Fitting the Front Cover*

Fit the front cover gasket seal and bolt the front cover to the pump body housing.

Passing a couple of fixing bolts through the front cover and "hanging" the gasket on these will aid with assembly and alignment of the gasket.

Be careful to avoid cross threading. When the cover bolt holes are not fully aligned with the threaded holes in the pump body housing the risk of cross threading the bolts can occur.

Ensure the lubricant drain plug is installed with PTFE tape of similar demountable pipe thread sealant.

Fill the pump housing with the correct quantity of lubricant through the fill plug hole. Once filled you should be able to see the lubricant in the middle of the sight glass at the front of the pump.

Replace the fill plug and check the pump housing for leakage.

If previously disconnected, reconnect all pipework and open all suction and discharge valves.

The pump is now ready for normal operation. Upon restarting check for abnormal vibrations and other irregularities such as abnormal noise.

## 3.8 *Rotor Removal*

Follow the procedures as detailed earlier for the removal of the pump hose.

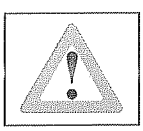
Remove the rotor clamp screw & retaining washer and slide the rotor off the shaft.

It is likely that the rotor may be a tight fit on the shaft. Do not hammer the rotor assembly. In such instances use a proprietary puller to extract the complete rotor assembly. Tapped holes are provided in the front of the rotor to insert threaded rod to aid withdrawal from the shaft.

## 3.9 *Gearbox Drive Removal*

Once the rotor has been removed, the gearbox can be removed if required.

The fixing screws on the L20 through L50 are countersunk headed screws through the rear of the pump housing, with nuts and washers on the gearbox flange. The L65 & L80 pumps utilise fixings through the gearbox flange into threaded holes in the pump body.



Before removing the gearbox fixing bolts ensure the gearbox is adequately supported via the correct lifting method, and that the pump is properly fastened to the floor as removing the gearbox will cause a sudden change in the centre of gravity.

Remove the gearbox fixings and carefully pull the gearbox off the mating spigot, taking care not to damage the drive protection seal in the rear of the pump housing.

*Drive Protection Seal Removal*

A seal is fitted between the pump and the gearbox. This seal acts as protection for the gearbox drive in the event of a hose failure, reducing the chance of contaminated hose lubricant from reaching the front seal of the gearbox.

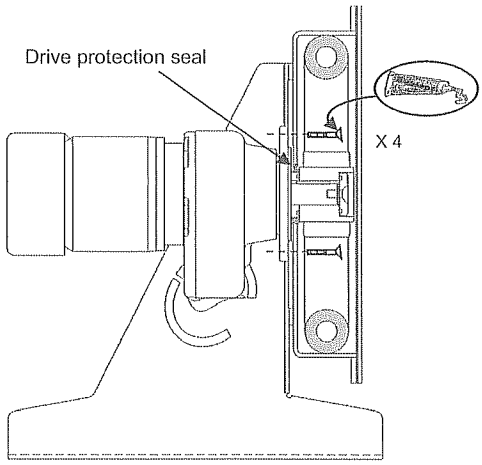
*i* Once the rotor has been removed, the Drive Protection Seal will be seen. Whilst it is possible to remove the seal without gearbox removal, it may be found easier to remove the gearbox in to provide better access to the seal.

A little effort may be needed to remove the gearbox, as the joint may be sealed with a proprietary silicone gasket sealer. Once the gearbox is removed the seal can be removed from the rear of the pump body.

*Drive Protection Seal Replacement*

Ensure the rear of the pump body is clean where the seal is to be fitted. Lightly lubricate the seal bore with a silicone based lubricant, and using a fly press or similar carefully press the new seal into place, taking care not to damage the seal lip.

3.10 *Gearbox Drive Replacement L20 - L50*




With the new Drive Protection Seal fitted, the gearbox can be fitted to the pump housing.

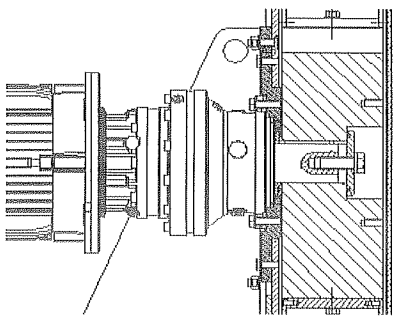
Prior to assembly clean and degrease all mating surfaces, ensuring all faces are free from traces of paint and sealants.

Carefully lift the gearbox drive into place taking care not to damage the drive protection seal, and locate the flange spigot on the rear of the pump housing.

Line up the four fixing holes and insert the M8 countersunk socket head screws through the rear of the pump housing.

*i* Note: the 4 off countersunk screws must have "Instant Gasket" sealant applied under the head before insertion through the pump housing.

*Gearbox Drive Replacement L65 & L80*



With the new Drive Protection Seal fitted, the gearbox can be fitted to the pump body housing.

On the L65 pump the gearbox is mounted directly to the pump housing. The L80 utilises a gearbox adapter ring (coloured blue in the drawing) which is mounted directly to the pump housing with the gearbox mounted to this.

Prior to assembly clean and degrease all mating surfaces, ensuring all faces are free from traces of paint and sealants

On the L80 the gearbox adapter should be mounted to the pump body, ensuring the O-ring seal is fitted into the groove to seal between adapter and pump body housing.

Carefully lift the gearbox drive into place taking care not to damage the drive protection seal whilst ensuring the flange spigot on the gearbox is fully located.

Line up the fixing holes and insert the socket head screws fastening with spring washers.

### 3.11 *Rotor Replacement*

Clean the bore of the rotor assembly and rotor spacer, applying a small amount of anti-seize compound such as Copaslip® to the bores and keyways.

Slide first the rotor spacer onto the shaft locating it in the bore of the drive protection seal, followed by the rotor assembly. The rotor spacer acts as a wearing surface for the drive protection seal as well as ensuring the rotor is correctly positioned in the pump housing. In the stainless steel pump option there will be an O ring seated in the end of the spacer. Ensure this O ring faces outwards, sealing against the rear of the rotor.

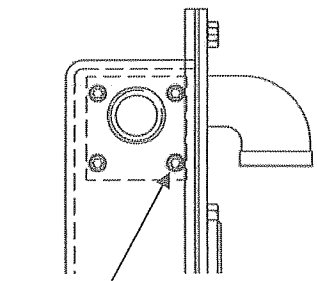
Do not hammer the rotor assembly if the shaft is a tight fit in the rotor, pull the rotor onto the shaft with a long bolt.

Fit the rotor clamp washer and countersunk retaining screw. In the stainless steel pump option there will be an O ring seated in the rear face of the clamp washer. Ensure this O ring faces inwards, sealing against the front of the rotor.

### 3.12 *Hose Connector Assembly*

The hose connector inserts may be fitted independently, rather than as a hose element assembly. After first ensuring all mating faces are clean, fit the gaskets over the threaded connection of each hose connector.

Insert hose connector in to the pump, passing the threaded connection through the respective port in the pump body, with the gaskets on the inside of the pump body.




Insert and tighten the insert retaining bolts.

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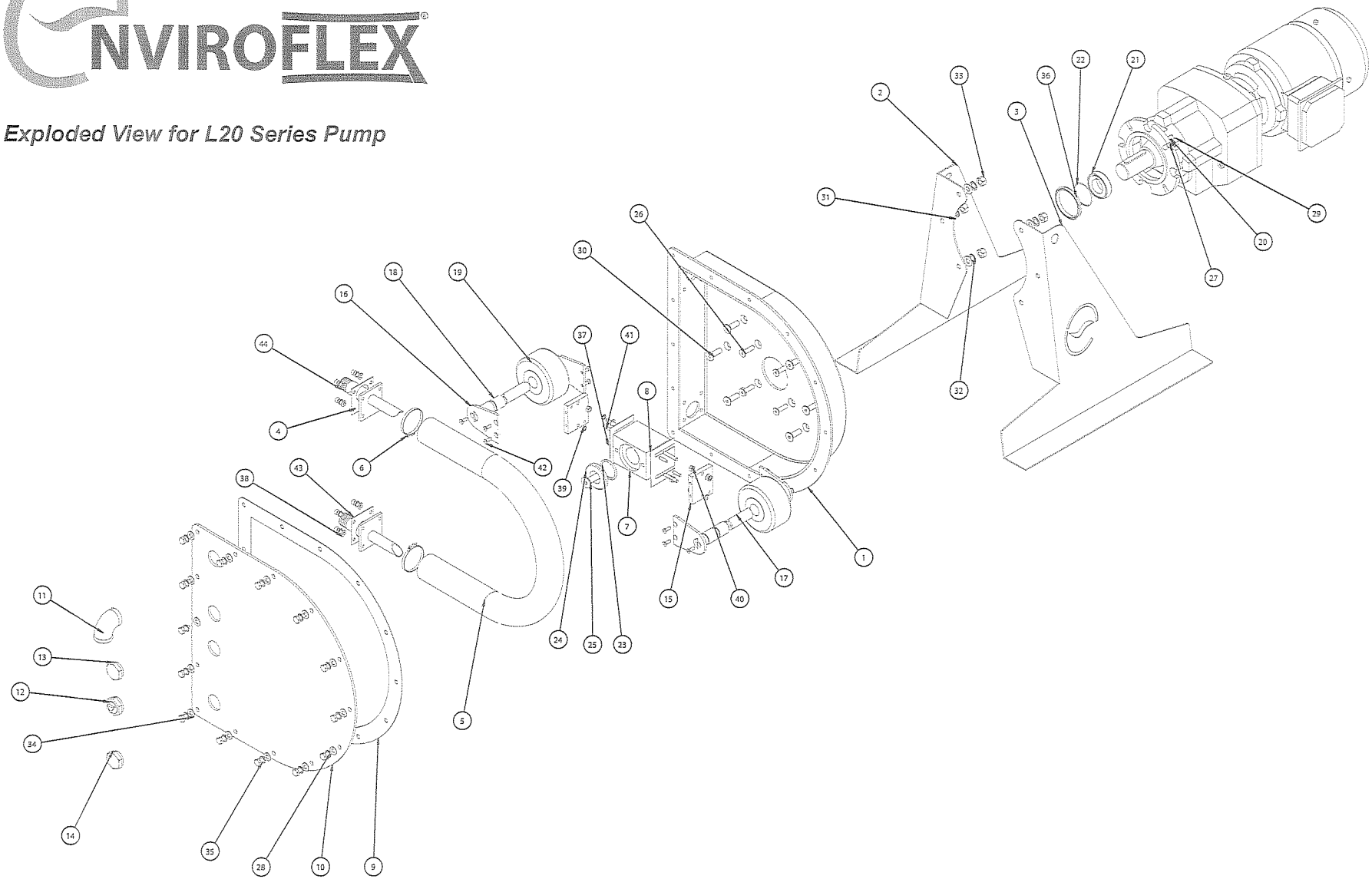
*Exploded View for L20 Series Pump*



## L20 Series Pump Parts List

| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-20-PH-1 | Housing Body | 10257.62 | 1 |
| 2 | L-20-F-L-1 | Pump Frame Left | 3329.15 | 1 |
| 3 | L-20-F-R-1 | Pump Frame Left | 3329.16 | 1 |
| 4 | L-20-HC-CS-1 | Hose Flange Seal | 6.40 | 2 |
| 5** | L-20-NRH | Pump Hose - NATURAL RUBBER | 1324.25 | 1 |
| | L-20-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 1324.25 | 1 |
| | L-20-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 1324.25 | 1 |
| | L-20-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 1324.25 | 1 |
| | L-20-EPDM | Pump Hose - EPDM | 1324.25 | 1 |
| | L-20-HYP | Pump Hose - HYPALON | 1324.25 | 1 |
| 6** | LC-4016 | Hose Clip | 8.88 | 2 |
| 7 | L-20-R-1 | Rotor | 802.91 | 1 |
| 8 | L20/L25-SH-3 / L20/L25-SH-4 | Shim 0.6mm / Shim 1.0mm | 19.15 | 4/8 |
| 9 | L-20-FC-DS-1 | Front Cover Door Seal | 126.70 | 1 |
| 10 | L-20-FC-1 | Front Cover | 6753.39 | 1 |
| 11 | LT-5100S | Breather Elbow | 101.92 | 1 |
| 12 | LT-5012 | Sight Glass | 32.68 | 1 |
| 13 | LP-1001 | Fill Plug | 28.81 | 1 |
| 14 | LP-1002 | Drain Plug | 28.81 | 1 |
| 15 | L-20-ROL-M-1 | Roller Mount | 266.78 | 2 |
| 16 | L-20-ROL-SP-1 | Roller Side Plate | 169.30 | 4 |
| 17 | L-20-ROL-SH-2 | Roller Shaft | 144.44 | 2 |
| 18 | L-20-ROL-B-1 | Roller Bush | 27.59 | 4 |
| 19 | L-20-ROL-1 | Roller | 362.62 | 2 |
| 20 | L-20-Gearbox | Gearbox | | 1 |
| 21 | L-20-R-RS-3 | Rotor Spacer | 168.62 | 1 |
| 22 | LS-6806 | Rotor Spacer O Ring | 0.55 | 1 |
| 23 | LS-6100 | Rotor Clamp Washer O Ring | 1.39 | 1 |
| 24 | L-20-R-RC-3 | Roller Clamp Washer | 105.89 | 1 |
| 25 | LB-1266 | Rotor Clamp Screw | | 1 |
| 26 | LB-1215 | Gearbox to Housing Fixing | | 4 |
| 27 | LW-3001 | Flat Washer | | 4 |
| 28 | LW-3101 | Spring Washer | | 18 |
| 29 | LN-2000 | Nut | | 4 |
| 30 | LB-1227 | Frame Mounting Screw | | 6 |
| 31 | LW-3002 | Flat Washer | | 6 |
| 32 | LW-3102 | Spring Washer | | 6 |
| 33 | LN-2002 | Nut | | 6 |
| 34 | LW-3001 | Flat Washer | | 14 |
| 35 | LB-1012 | Front Cover Fixing | | 14 |
| 36 | LS-6001 | Drive Protection Seal | | 1 |
| 37 | LB-1278 | Roller Mount Fixing | | 4 |
| 38 | LW-3000 | Flat Washer | | 12 |
| 39 | LW-3100 | Spring Washer | | 12 |
| 40 | LN-4010 | Nut | | 4 |
| 41 | LD-7008 | Roller Mount Dowel | | 4 |
| 42 | LB-1257 | Roller Shaft Fixing | | 12 |
| 43 | LB-1103 | Hose Connector Fixing | | 8 |
| 44 | L-20-HC-1 | Hose Connector | 349.12 | 2 |

* 1 g = 0.0353 ounce / 0.0022 pound

** Recommended spares with 2.5 litres of Envirolube Lubricant.

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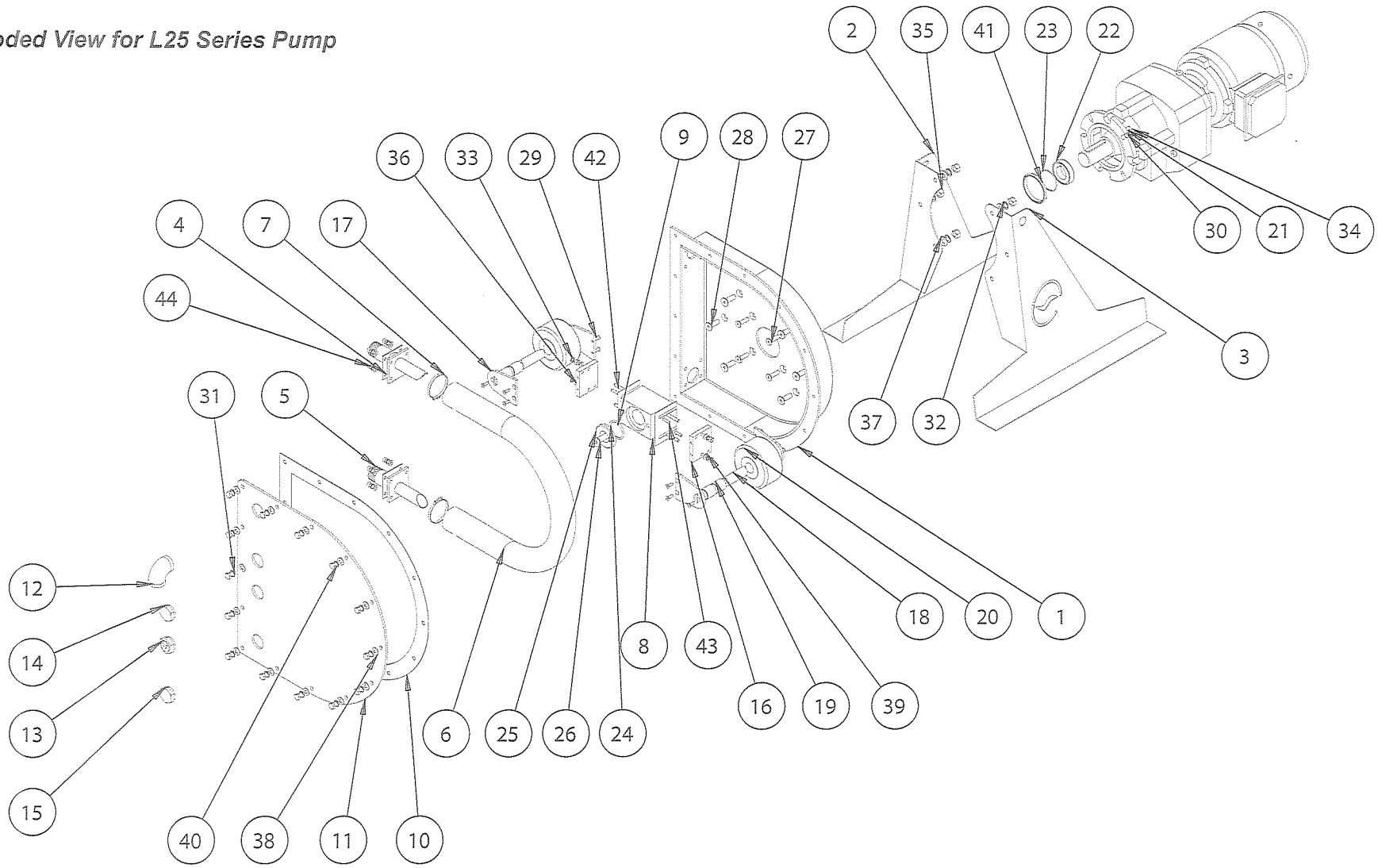
*Exploded View for L25 Series Pump*



## L25 Series Pump Parts List

| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-25-PH-1 | Housing Body | 10261.38 | 1 |
| 2 | L-25-F-L-1 | Pump Frame Left | 3329.15 | 1 |
| 3 | L-25-F-R-1 | Pump Frame Left | 3329.16 | 1 |
| 4 | L-25-HC-CS-1 | Hose Flange Seal | 6.40 | 2 |
| 5 | L-25-HC-1 | Hose Connector | 440.46 | 2 |
| 6** | L-25-NRH | Pump Hose - NATURAL RUBBER | 1324.25 | 1 |
| | L-25-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 1324.25 | 1 |
| | L-25-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 1324.25 | 1 |
| | L-25-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 1324.25 | 1 |
| | L-25-EPDM | Pump Hose - EPDM | 1324.25 | 1 |
| | L-25-HYP | Pump Hose - HYPALON | 1324.25 | 1 |
| 7** | LC-4016 | Hose Clip | 8.88 | 2 |
| 8 | L-25-R-1 | Rotor | 802.91 | 1 |
| 9 | L20/L25-SH-3 / L20/L25-SH-4 | Shim 0.6mm / Shim 1.0mm | 19.15 | 4/8 |
| 10 | L-25-FC-DS-1 | Front Cover Door Seal | 126.95 | 1 |
| 11 | L-25-FC-1 | Front Cover | 6753.39 | 1 |
| 12 | LT-5100S | Breather Elbow | 101.92 | 1 |
| 13 | LT-5012 | Sight Glass | 32.68 | 1 |
| 14 | LP-1001 | Fill Plug | 28.81 | 1 |
| 15 | LP-1002 | Drain Plug | 28.81 | 1 |
| 16 | L-25-ROL-M-1 | Roller Mount | 266.78 | 2 |
| 17 | L-25-ROL-SP-1 | Roller Side Plate | 169.30 | 4 |
| 18 | L-25-ROL-SH-2 | Roller Shaft | 144.44 | 2 |
| 19 | L-25-ROL-B-1 | Roller Bush | 27.59 | 4 |
| 20 | L-25-ROL-1 | Roller | 362.62 | 2 |
| 21 | L-25-Gearbox | Gearbox | | 1 |
| 22 | L-25-R-RS-3 | Rotor Spacer | 168.62 | 1 |
| 23 | LS-6806 | Rotor Spacer O Ring | 0.55 | 1 |
| 24 | LS-6100 | Rotor Clamp Washer O Ring | 1.39 | 1 |
| 25 | L-25-R-RC-3 | Roller Clamp Washer | 105.89 | 1 |
| 26 | LB-1266 | Rotor Clamp Screw | | 1 |
| 27 | LB-1215 | Gearbox to Housing Fixing | | 4 |
| 28 | LB1227 | Frame Mounting Fixing | | 6 |
| 29 | LB-1257 | Roller Side Plate Fixing | | 12 |
| 30 | LW-3001 | Flat Washer | | 4 |
| 31 | LW-3101 | Spring Washer | | 18 |
| 32 | LW-3102 | Spring Washer | | 6 |
| 33 | LW-3100 | Spring Washer | | 12 |
| 34 | LN-2000 | Nut | | 4 |
| 35 | LN-2002 | Nut | | 6 |
| 36 | LN-4010 | Nut | | 4 |
| 37 | LW-3002 | Flat Washer | | 6 |
| 38 | LW-3001 | Flat Washer | | 14 |
| 39 | LW-3000 | Flat Washer | | 12 |
| 40 | LB-1012 | Front Cover Fixing | | 14 |
| 41 | LS-6001 | Drive Protection Seal | | 1 |
| 42 | LB-1278 | Roller Mount Fixing | | 4 |
| 43 | LD-7008 | Roller Mout Dowel | | 4 |
| 44 | LB-1103 | Hose Connector Fixing | | 8 |

* 1 g = 0.0353 ounce / 0.0022 pound

** Recommended spares with 2.5 litres of Envirolube Lubricant.

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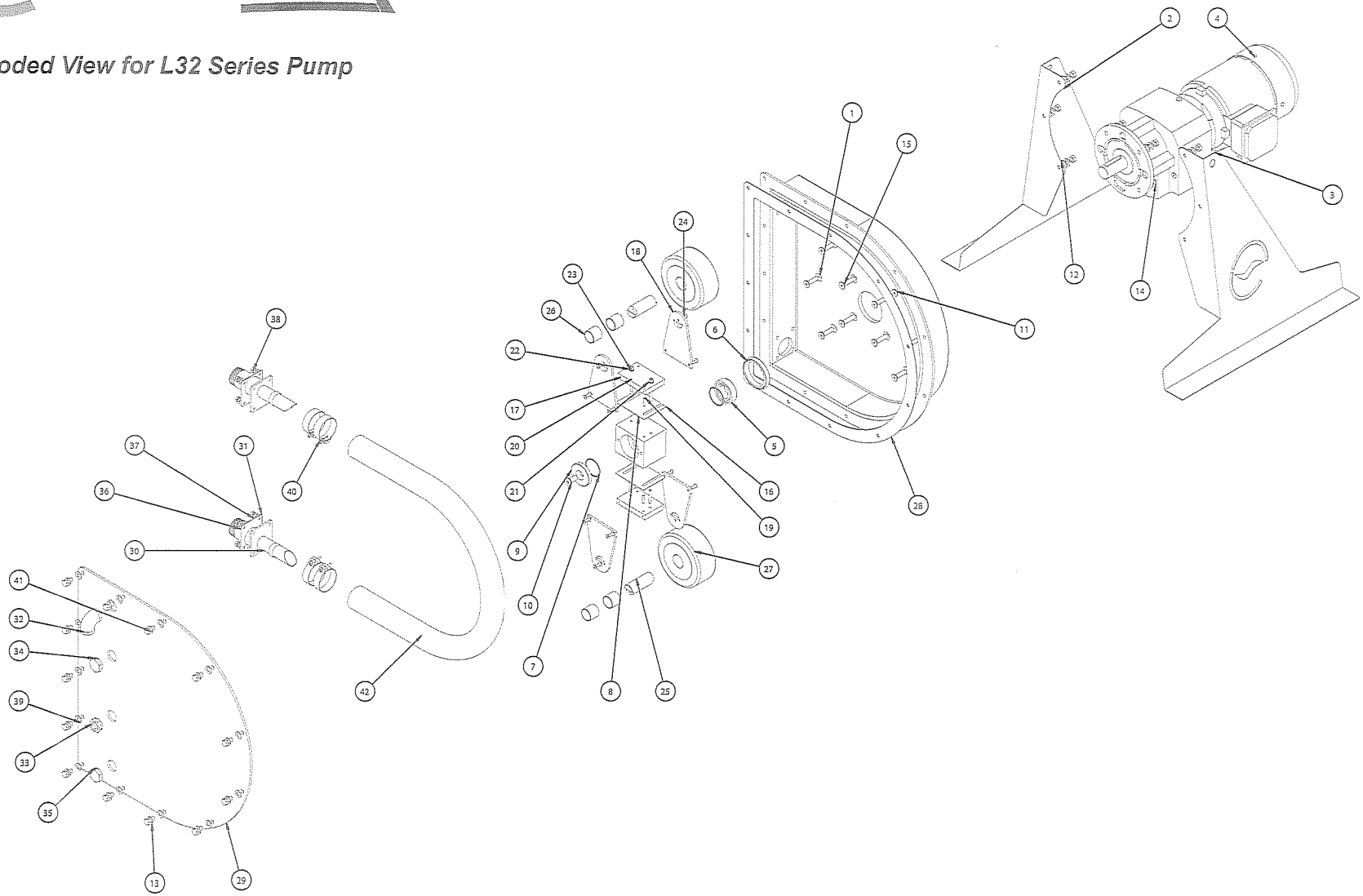
*Exploded View for L32 Series Pump*



## L32 Series Pump Parts List

| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-32-PH-1 | Housing Body | 43351.56 | 1 |
| 2 | L-32-F-R-1 | Pump Frame Right | 5120.60 | 1 |
| 3 | L-32-F-L-1 | Pump Frame Left | 5120.61 | 1 |
| 4 | L-32-Motor and Gearbox | Motor and Gearbox | 11678.00356 | 1 |
| 5 | L-32-R-RS-1 | Rotor Spacer | 335.17 | 1 |
| 6 | LS-6300 | Drive Protection Seal | 28.50 | 1 |
| 7 | LS-6301 | Rotor Clamp O Ring | 1.37 | 2 |
| 8 | L-32-R-1 | Rotor | 1389.90 | 1 |
| 9 | L-32-R-RC-1 | Rotor Clamp Washer | 203.52 | 1 |
| 10 | LB-1229 | Rotor Clamp Bolt | | 1 |
| 11 | LB-1235 | Frame Mounting Screw | | 6 |
| 12 | LW-3002 | Flat Washer | | 10 |
| 13 | LW-3102 | Spring Washer | | 23 |
| 14 | LN-2002 | Nut | | 10 |
| 15 | LB-1238 | Gearbox Mounting Screw | | 4 |
| 16 | L-32-SH-3 / L-32-SH-4 | Shim 0.6mm / Shim 1.0mm | 33.82 | A/R |
| 17 | L-32-ROL-M-1 | Roller Mount | | 2 |
| 18 | L-32-ROL-SP-1 | Roller Side Plate | 492.51 | 4 |
| 19 | LD-7000 | Roller Mount Dowel | | 4 |
| 20 | LB-1280 | Roller Mount Fixing | | 4 |
| 21 | LB-3000 | Flat Washer | | 4 |
| 22 | LB-3100 | Spring Washer | | 4 |
| 23 | LN-4010 | Nut | | 4 |
| 24 | ISO 10642 - M6 x 20 --- 20N | | | 12 |
| 25 | L-32-ROL-SH-1 | Roller Shaft | 396.39 | 2 |
| 26 | L-32-ROL-B-1 | Roller Bush | 48.04 | 4 |
| 27 | L-32-ROL-1 | Roller | 1011.40 | 2 |
| 28 | L-32-FC-DS-1 | Front Cover Door Seal | 185.28 | 1 |
| 29 | L-32-FC-1 | Front Cover | 15612.36 | 1 |
| 30 | L-32-HC-1 | Hose Connector | 1047.97 | 2 |
| 31 | L-32-HC-CS-1 | Hose Flange Seal | 9.79 | 2 |
| 32 | LT-5100S | Breather Elbow | 101.921 | 1 |
| 33 | LT-5012 | Sight Glass | 32.68 | 1 |
| 34 | LP-1001 | Fill Plug | 28.81 | 1 |
| 35 | LP-1002 | Drain Plug | 28.81 | 1 |
| 36 | LW-3001 | Flat Washer | | 8 |
| 37 | LW-3101 | Spring Washer | | 8 |
| 38 | LB-1231 | Hose Connector Screw | | 8 |
| 39 | LW-3002 | Flat Washer | | 13 |
| 40** | LC-4017 | Hose Clamp L32 | 51.31 | 4 |
| 41 | LB-1037 | Front Cover Screw | | 13 |
| 42** | L-32-NRH | Pump Hose - NATURAL RUBBER | 3096.60 | 1 |
| | L-32-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 3096.60 | 1 |
| | L-32-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 3096.60 | 1 |
| | L-32-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 3096.60 | 1 |
| | L-32-EPDM | Pump Hose - EPDM | 3096.60 | 1 |
| | L-32-HYP | Pump Hose - HYPALON | 3096.60 | 1 |

* 1 g = 0.0353 ounce / 0.0022 pound
** Recommended spares with 5.0 litres of Envirolube Lubricant.

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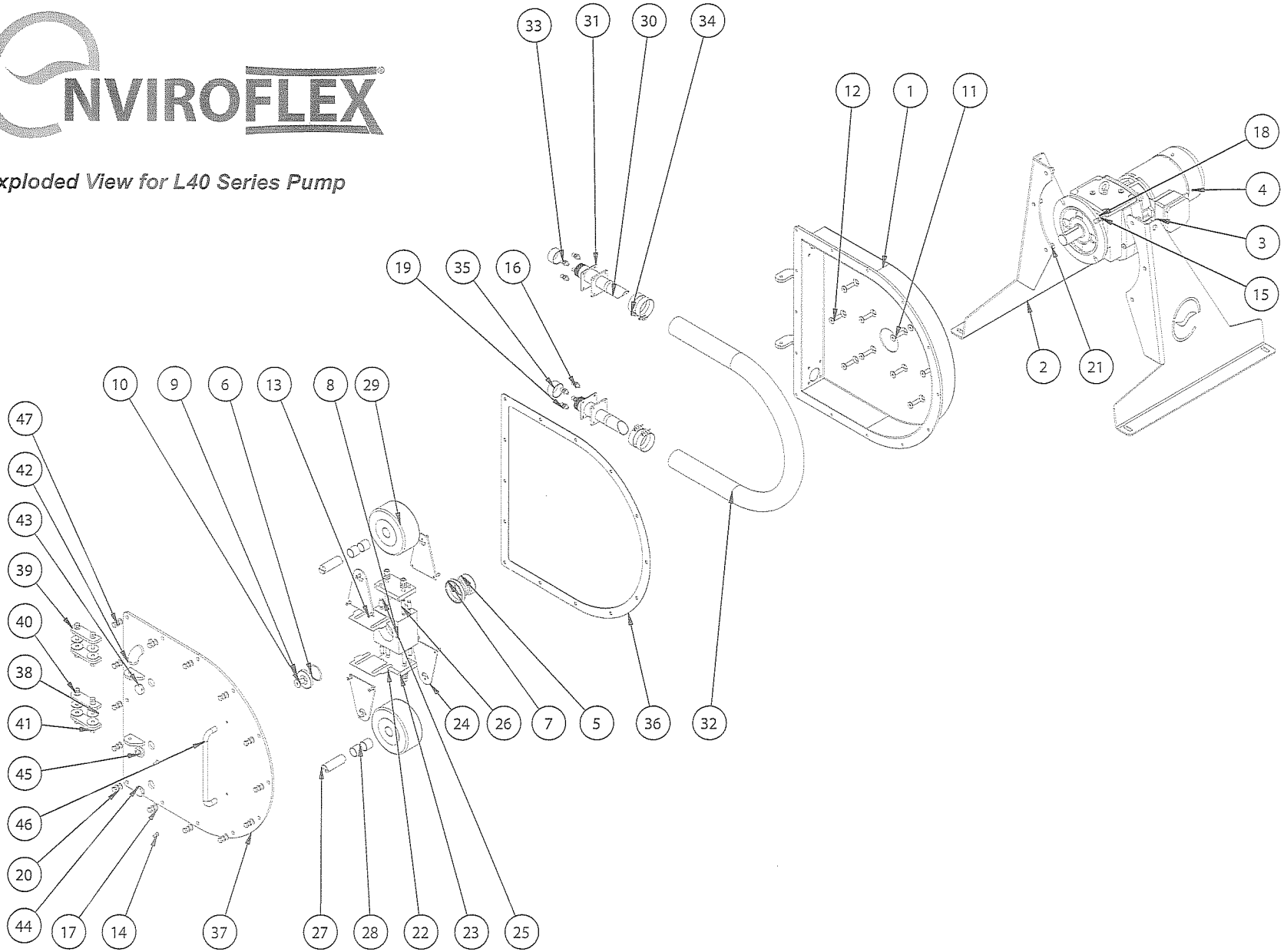
*Exploded View for L40 Series Pump*



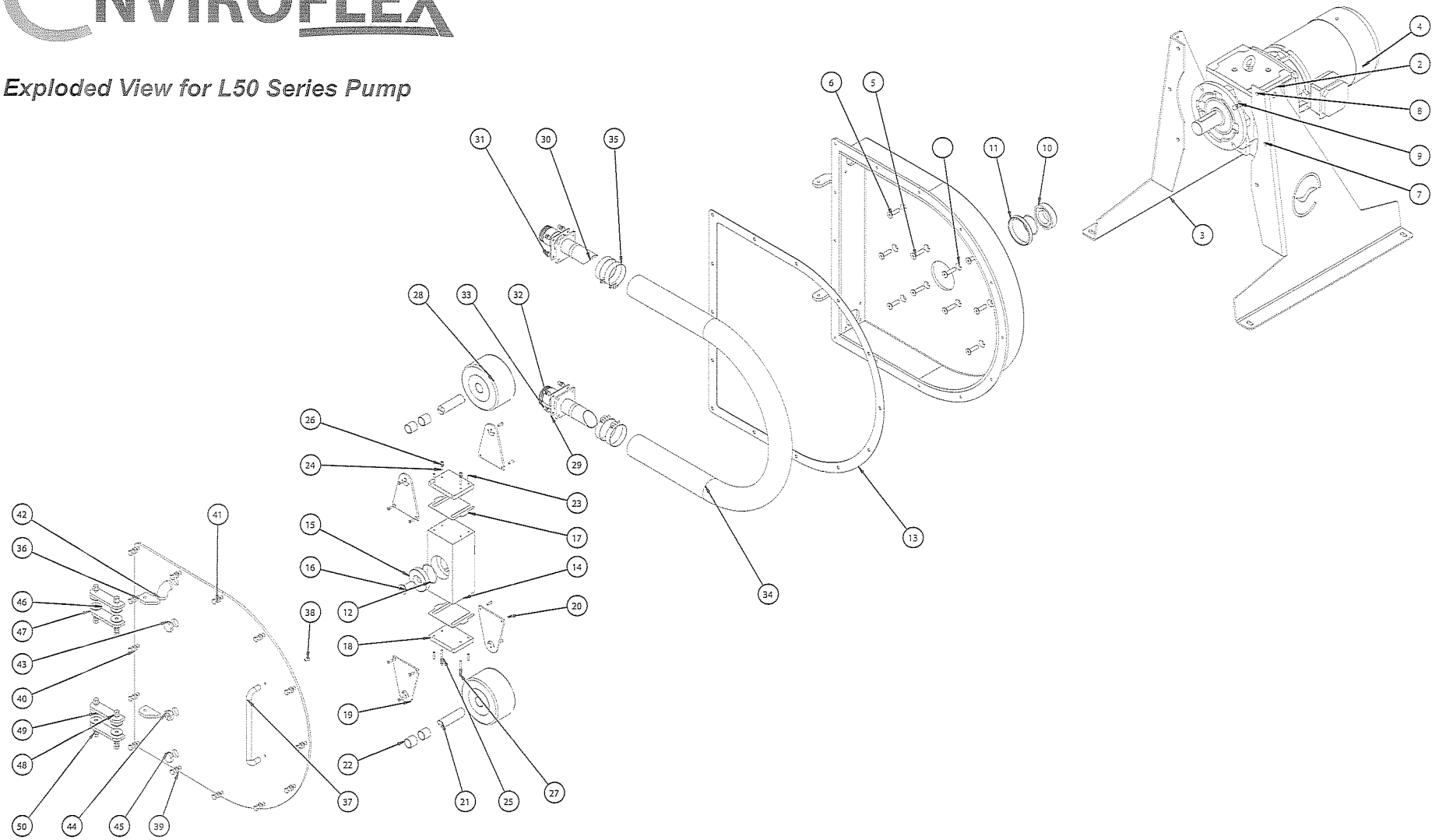
## L40 Series Pump Parts List

| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-40-PH-1 | Housing Body | 40104.81 | 1 |
| 2 | L-40-F-L-1 | Pump Frame Left | 13140.98 | 1 |
| 3 | L-40-F-R-1 | Pump Frame Right | 13140.99 | 1 |
| 4 | L40 Gearbox | | | 1 |
| 5 | L-40-R-RS-1 | Rotor Spacer | 431.91 | 1 |
| 6 | LS-6814 | Rotor Spacer O Ring | 2.61 | 2 |
| 7 | LS-6400 | Drive Protection Seal | | 1 |
| 8 | L-40-R-2 | Rotor | 3312.65 | 1 |
| 9 | L-40-R-RC-1 | Rotor Clamp Washer | 223.08 | 1 |
| 10 | LB-3239 | Rotor Clamp Screw | | 1 |
| 11 | LB-3230 | Gearbox Mounting Screw | | 4 |
| 12 | LB-3228 | Frame Mounting Screw | | 6 |
| 13 | LB-3232 | Roller Shaft Screw | | 12 |
| 14 | LB-3213 | Front Cover Handle Fixing | | 2 |
| 15 | LW-5003 | Flat Washer M12 | | 14 |
| 16 | LW-5001 | Flat Washer M8 | | 8 |
| 17 | LW-5002 | Flat Washer M10 | | 22 |
| 18 | LW-5103 | Spring Washer M12 | | 14 |
| 19 | LW-5108 | Spring Washer M8 | | 8 |
| 20 | LW-5102 | Spring Washer M10 | | 14 |
| 21 | LN-4003 | Nut M12 | | 14 |
| 22 | L-40-SH-3 / L-40-SH-4 | Shim 0.6mm / Shim 1.0mm | 46.49 | 4/8 |
| 23 | L-40-ROL-M-2 | Roller Mount | | 2 |
| 24 | L-40-ROL-SP-1 | Roller Side Plate | 529.524 | |
| 25 | LD-7007 | Roller Mount Dowel | | 4 |
| 26 | LB-3274 | Hinge Screw | | 4 |
| 27 | L-40-ROL-SH-1 | Roller Shaft | | 2 |
| 28 | L-40-ROL-B-1 | Roller Bush | 48.04 | 4 |
| 29 | L-40-ROL-1 | Roller | 1810.39 | 2 |
| 30 | L-40-HC-1 | Hose Connector | 880.00 | 2 |
| 31 | L-40-HC-CS-1 | Hose Connector Seal | 9.87 | 2 |
| 32** | L-40-NRH | Pump Hose - NATURAL RUBBER | 3925.32 | 1 |
| | L-40-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 3925.32 | 1 |
| | L-40-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 3925.32 | 1 |
| | L-40-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 3925.32 | 1 |
| | L-40-EPDM | Pump Hose - EPDM | 3925.32 | 1 |
| | L-40-HYP | Pump Hose - HYPALON | 3925.32 | 1 |
| 33 | LB-3294 | Hose Connector Screw | | 8 |
| 34** | LC-4018 | Hose Clip | 54.28 | 4 |
| 35 | L-40-CON-CAP | Hose Connector Cap | 10.95 | 2 |
| 36 | L-40-FC-DS-1 | Front Door Seal | 325.07 | 1 |
| 37 | L-40-FC-1 | Front Cover | 28906.19 | 1 |
| 38 | L-40-62 | Friction Hinge Washer | 3.95 | 8 |
| 39 | L-40-59 | Hinge Link Plate | | 4 |
| 40 | LB-3274 | Hinge Screw | | 4 |
| 41 | LN-4012 | Nyloc Nut M10 | | 4 |
| 42 | LT-5100S | Breather Elbow | 101.92 | 1 |
| 43 | LP-1001 | Fill Plug | 28.81 | 1 |
| 44 | LP-1002 | Drain Plug | 28.81 | 1 |
| 45 | LT-5012 | Sight Glass | 32.68 | 1 |
| 46 | LH-4000 | Handle | 227.52 | 1 |
| 47 | LB-3026 | Front Cover Screw | | 14 |

* 1 g = 0.0353 ounce / 0.0022 pound
** Recommended spares with 7.5 litres of Envirolube Lubricant.

ENVIROFLEX®

*Exploded View for L50 Series Pump*



## L50 Series Pump Parts List

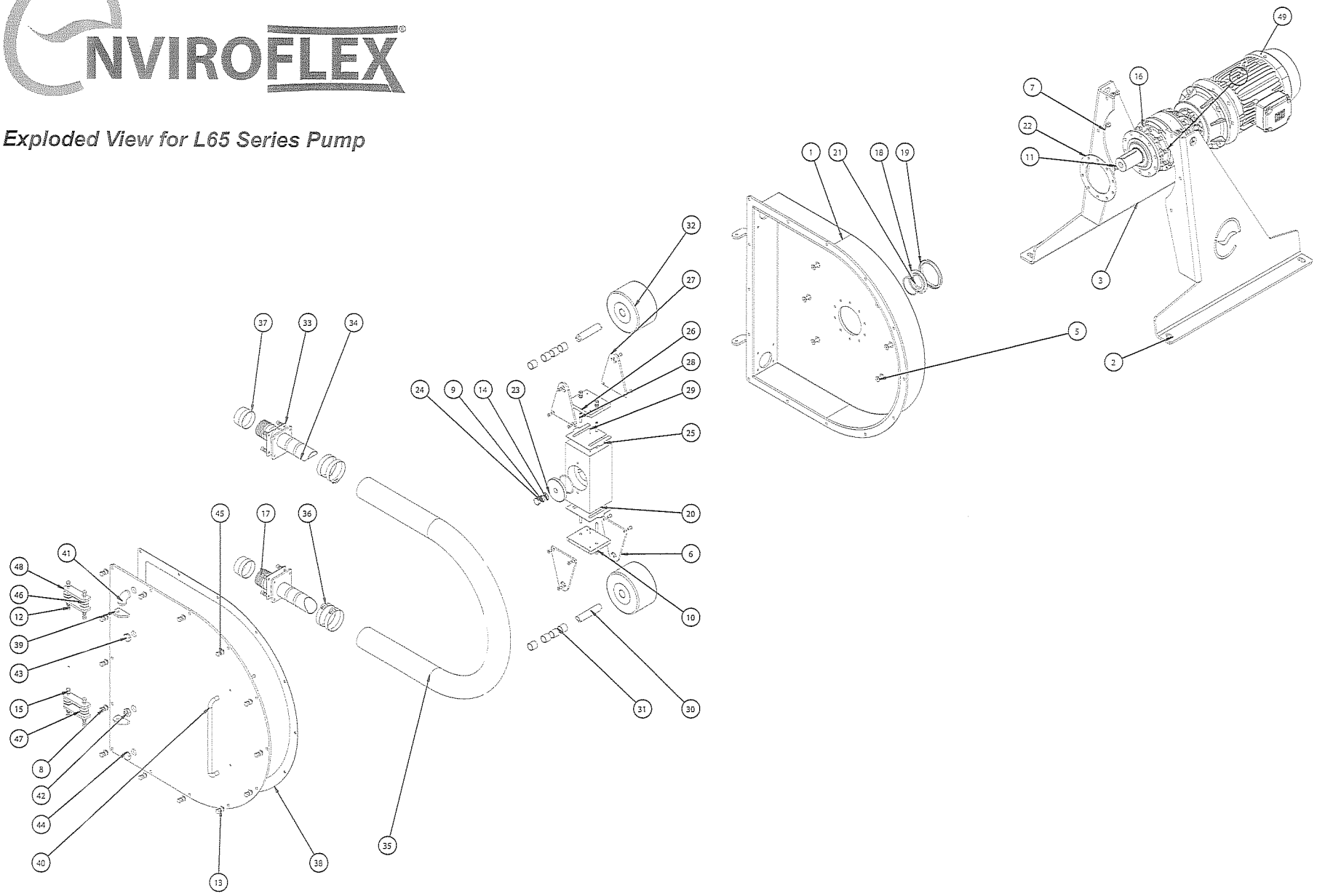
| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-50-PH-1 | Housing Body | 88040.96 | 1 |
| 2 | L-50-F-L-1 | Pump Frame Left | 16263.51 | 1 |
| 3 | L-50-F-R-1 | Pump Frame Right | 16263.51 | 1 |
| 4 | D-L-50-Gear Box and Motor | Gearbox and Motor | | 1 |
| 5 | LB-1230 | Gearbox Mounting Screw | | 4 |
| 6 | LB-1228 | Frame Mounting Screw | | 6 |
| 7 | LW-3003 | Flat Washer | | 10 |
| 8 | LW-3103 | Spring Washer | | 10 |
| 9 | LN-2003 | Nut | | 10 |
| 10 | L-50-R-RS-1 | Rotor Spacer | 736.67 | 1 |
| 11 | LS-6500 | Drive Protection Seal | | 1 |
| 12 | LS-6501 | Rotor Clamp O Ring | 2.52 | 2 |
| 13 | L-50-FC-DS-1 | Front Door Seal | 406.99 | 1 |
| 14 | L-50-R-1 | Rotor | 7789.00 | 1 |
| 15 | L-50-R-RC-1 | Rotor Clamp Washer | 655.71 | 1 |
| 16 | LB-1240 | Rotor Clamp Screw | | 1 |
| 17 | L-50-SH-1 / L-50-SH-2 | Shim 0.6mm / Shim 1.0mm | 53.09 | 4/8 |
| 18 | L-50-ROL-M-1 | Roller Mount | | 2 |
| 19 | L-50-ROL-SP-1 | Roller Side Plate | 636.01 | 4 |
| 20 | LB-1232 | Roller Side Plate Screw | | 12 |
| 21 | L-50-ROL-SH-1 | Roller Shaft | | 2 |
| 22 | L-50-ROL-B-1 | Roller Bush | 48.04 | 4 |
| 23 | LD-7000 | Roller Mount Dowel | | 4 |
| 24 | LB-1281 | Roller Mount Fixing | | 4 |
| 25 | LB-3000 | Flat Washer | | 4 |
| 26 | LB-3100 | Spring Washer | | 4 |
| 27 | LN-4010 | Nut | | 4 |
| 28 | L-50-ROL-1 | Roller | 2111.27 | 2 |
| 29 | L-50-HC-CS-1 | Hose Connector Seal | 12.73 | 2 |
| 30 | L-50-HC-1 | Hose Connector | 1079.04 | 2 |
| 31 | LW-3001 | Flat Washer | | 8 |
| 32 | LW-3101 | Spring Washer | | 8 |
| 33 | LB-1231 | Hose Connector Screw | | 8 |
| 34** | L-50-NRH | Pump Hose - NATURAL RUBBER | 6722.09 | 1 |
| | L-50-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 6722.09 | 1 |
| | L-50-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 6722.09 | 1 |
| | L-50-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 6722.09 | 1 |
| | L-50-EPDM | Pump Hose - EPDM | 6722.09 | 1 |
| | L-50-HYP | Pump Hose - HYPALON | 6722.09 | 1 |
| 35** | LC-4019 | Hose Clip | 61.21 | 4 |
| 36 | L-50-FC-1 | Front Cover | 39753.58 | 1 |
| 37 | LH-4000 | Handle | 227.52 | 1 |
| 38 | LB-1269 | Front Cover Handle Fixing | | 2 |
| 39 | LW-3002 | Flat Washer | | 14 |
| 40 | LW-3102 | Spring Washer | | 18 |
| 41 | LB-1026 | Front Cover Screw | | 14 |
| 42 | LT-5100S | Breather Elbow | 101.92 | 1 |
| 43 | LP-1001 | Fill Plug | 28.81 | 1 |
| 44 | LT-5012 | Sight Glass | 32.68 | 1 |
| 45 | LP-1002 | Drain Plug | 28.81 | 1 |
| 46 | L-50-67 | Friction Hinge Washer | 3.95 | 8 |
| 47 | L-50-66 | Hinge Link Plate | | 4 |
| 48 | LW-3002 | Flat Washer | | 8 |
| 49 | LB-1274 | Hinge Screw | | 4 |
| 50 | LN-2002 | Nut | | 4 |

* 1 g = 0.0353 ounce / 0.0022 pound

** Recommended spares with 10 litres of Envirolube Lubricant.

ENVIROFLEX®

*Exploded View for L65 Series Pump*



## L65 Series Pump Parts List

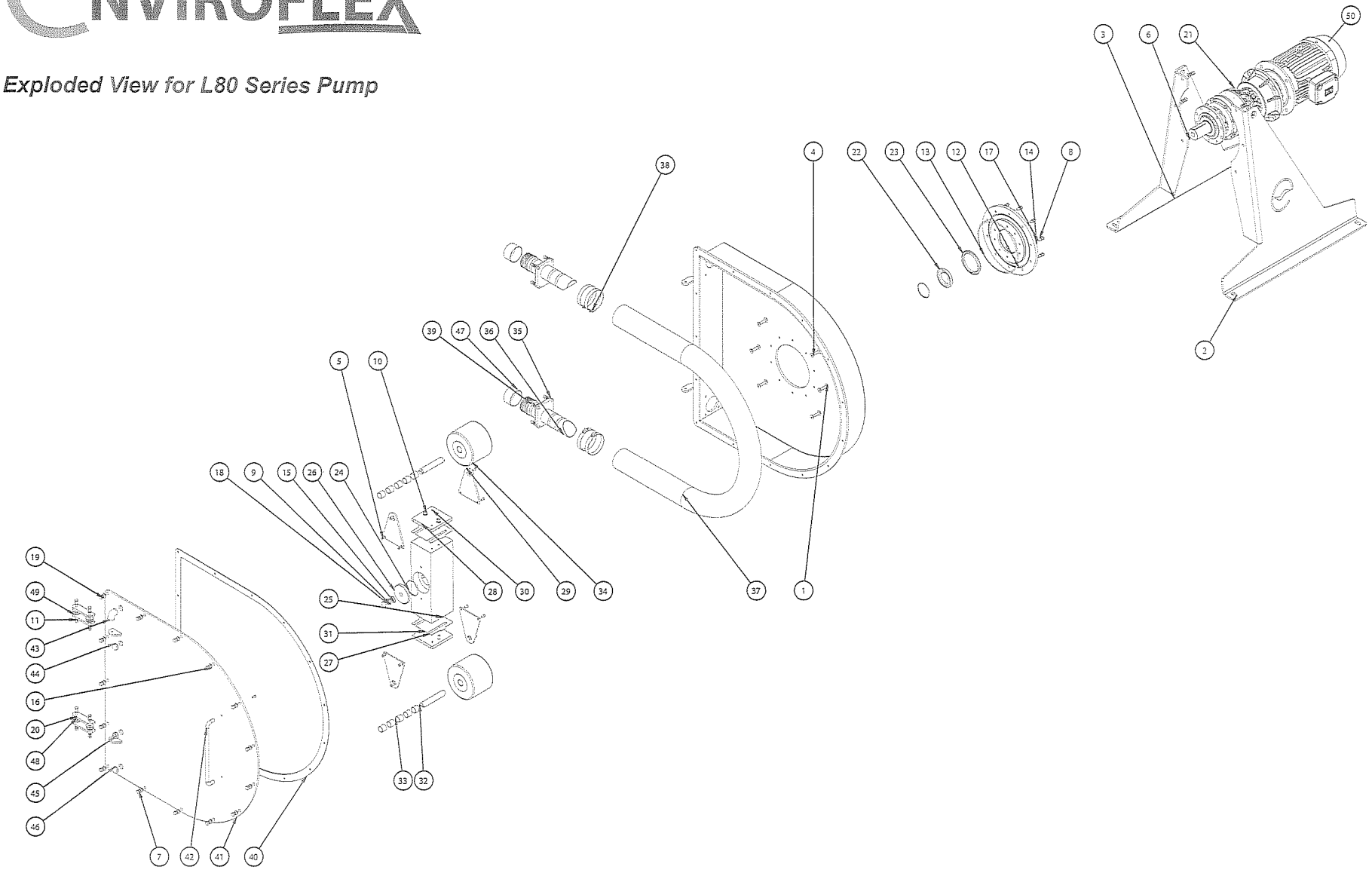
| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-65-PH-1 | Housing Body | 123018.97 | 1 |
| 2 | L-65-F-L-1 | Pump Frame Left | 35654.28 | 1 |
| 3 | L-65-F-R-1 | Pump Frame Right | 35654.23 | 1 |
| 4 | L-65-Gearbox | Gearbox | 48719.85 | 1 |
| 5 | LB-3230 | Frame Mounting Screw | | 6 |
| 6 | LB-3213 | Roller Side Plate and Roller Shaft Screw | | 14 |
| 7 | LW-5003 | Flat Washer | | 6 |
| 8 | LWS-5103 | Spring Washer | | 20 |
| 9 | LW-5104 | Spring Washer | | 1 |
| 10 | LW-5102 | Spring Washer | | 16 |
| 11 | LN-4003 | Nut | | 6 |
| 12 | LN-5102 | Nut | | 8 |
| 13 | LW-5003 | Flat Washer | | 24 |
| 14 | LW-5004 | Flat Washer | | 1 |
| 15 | LW-5002 | Flat Washer | | 20 |
| 16 | LB-3270 | Gearbox Mounting Screw | | 10 |
| 17 | LB-3275 | Hose Connector Screw | | 8 |
| 18 | L-65-R-RS-1 | Rotor Spacer | 538.21 | 1 |
| 19 | LS-6800 | Drive Protection Seal | 29.95 | 1 |
| 20 | L-65-R-1 | Rotor | 15093.56 | 1 |
| 21 | LS-6801 | Rotor Spacer O Ring | 6.12 | 2 |
| 22 | L-65-81 | Gearbox Spacer | 931.56 | 1 |
| 23 | L-65-R-RC-1 | Rotor Clamp Washer | 894.79 | 1 |
| 24 | LB-3271 | Rotor Clamp Bolt | | 1 |
| 25 | L-65-SH-1 / L-65-SH-2 | Shim 0.6mm / Shim 1.0mm | 88.54 | A/R |
| 26 | L-65-ROL-M-1 | Roller Mount | 2223.85 | 2 |
| 27 | L-65-ROL-SP-1 | Roller Side Plate | 1220.17 | 4 |
| 28 | LB-3279 | Roller Mount Fixing | | 4 |
| 29 | LD-7000 | Roller Mount Dowel | | 4 |
| 30 | L-65-ROL-SH-1 | Roller Shaft | 710.05 | 2 |
| 31 | L-65-ROL-B-1 | Roller Bush | 48.85 | 8 |
| 32 | L-65-ROL-1 | Roller | 3664.83 | 2 |
| 33 | L-65-HC-CS-1 | Hose Connector Seal | 24.44 | 2 |
| 34 | L-65-HC-1 | Hose Connector | 2369.20 | 2 |
| 35** | L-65-NRH | Pump Hose - NATURAL RUBBER | 11681.65 | 1 |
| | L-65-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 11681.65 | 1 |
| | L-65-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 11681.65 | 1 |
| | L-65-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 11681.65 | 1 |
| | L-65-EPDM | Pump Hose - EPDM | 11681.65 | 1 |
| | L-65-HYP | Pump Hose - HYPALON | 11681.65 | 1 |
| 36** | LC-4020 | Hose Clip | 70.69 | 4 |
| 37 | L-65-CON-CAP | Hose Connector Cap | 32.86 | 2 |
| 38 | L-65-FC-DS-1 | Front Door Seal | 609.75 | 1 |
| 39 | L-65-FC-1 | Front Cover | 68786.85 | 1 |
| 40 | LH-4001 | Handle | 288.81 | 1 |
| 41 | LT-5100S | Breather Elbow | 101.92 | 1 |
| 42 | LT-5012 | Sight Glass | 32.68 | 1 |
| 43 | LP-1001 | Fill Plug | 28.81 | 1 |
| 44 | LP-1002 | Drain Plug | 28.81 | 1 |
| 45 | LB-3242 | Front Cover Screw | | 14 |
| 46 | LB-3274 | Hinge Screw | | 4 |
| 47 | L-65-56 | Friction Hinge Washer | 3.95 | 8 |
| 48 | L-65-53 | Hinge Link Plate | 411.16 | 4 |
| 49 | Motor | Motor | | 1 |

* 1 g = 0.0353 ounce / 0.0022 pound

** Recommended spares with 20 litres of Envirolube Lubricant.

ENVIROFLEX®

*Exploded View for L80 Series Pump*



## L80 Series Pump Parts List

| Item No. | Part Number | Description | * Weight (gramme) Per Unit | Qty. |
|---|---|---|---|---|
| 1 | L-80-PH-1 | Housing Body | 187658.33 | 1 |
| 2 | L-80-F-L-1 | Pump Frame Left | 41936.39 | 1 |
| 3 | L-80-F-R-1 | Pump Frame Right | 41936.37 | 1 |
| 4 | LB-3230 | Frame Mounting Screw | | 6 |
| 5 | LB-3213 | Roller Shaft and Roller Side Plate Screw | | 14 |
| 6 | LW-5003 | Flat Washer | | 6 |
| 7 | LW-5103 | Spring Washer | | 25 |
| 8 | LW-5102 | Spring Washer | | 22 |
| 9 | LW-5104 | Spring Washer | | 1 |
| 10 | LN-4003 | Nut | | 10 |
| 11 | LN-4002 | Nut | | 4 |
| 12 | L-80-GB-MF-1 | Gearbox Mounting Flange | 15616.15 | 1 |
| 13 | LS-6814 | Rotor Spacer O Ring | 34.11 | 1 |
| 14 | LW-5002 | Flat Washer | | 26 |
| 15 | LW-5004 | Flat Washer | | 1 |
| 16 | LB-5003 | Flat Washer | | 19 |
| 17 | LB-3236 | Gearbox Mounting Screw | | 10 |
| 18 | LB-3243 | Rotor Clamp Bolt | | 1 |
| 19 | LB-3242 | Front Cover Screw | | 15 |
| 20 | LB-3274 | Hinge Screw | | 4 |
| 21 | L-80-Gearbox | Gearbox | 48719.85 | 1 |
| 22 | L-80-R-RS-1 | Rotor Spacer | 579.00 | 1 |
| 23 | LS-6800 | Drive Protection Seal | 23.31 | 1 |
| 24 | LS-6801 | Rotor Clamp O Ring | 6.12 | 2 |
| 25 | L-80-R-1 | Rotor | 27573.15 | 1 |
| 26 | L-80-R-RC-1 | Rotor Clamp Washer | 877.10 | 1 |
| 27 | L-80-SH-1 / L-80-SH-2 | Shim 0.6mm / Shim 1.0mm | 106.08 | A/R |
| 28 | L-80-ROL-M-1 | Roller Mount | 2768.59 | 2 |
| 29 | L-80-ROL-SP-1 | Roller Side Plate | 1183.66 | 4 |
| 30 | LD-7002 | Roller Mount Dowel | | 4 |
| 31 | LB-3282 | Roller Mount Fixing | | 4 |
| 32 | L-80-ROL-SH-1 | Roller Shaft | 865.89 | 2 |
| 33 | L-80-ROL-B-1 | Roller Bush | 48.04 | 10 |
| 34 | L-80-ROL-1 | Roller | 4519.05 | 2 |
| 35 | L-80-HC-CS-1 | Hose Connector Seal | 24.97 | 2 |
| 36 | L-80-HC-1 | Hose Connector | 2611.40 | 2 |
| 37** | L-80-NRH | Pump Hose - NATURAL RUBBER | 11681.65 | 1 |
| | L-80-NRH-FG | Pump Hose - NATURAL RUBBER (FOOD GRADE) | 11681.65 | 1 |
| | L-80-NIT-IND | Pump Hose - NITRILE (INDUSTRIAL) | 11681.65 | 1 |
| | L-80-NIT-FG | Pump Hose - NITRILE (FOOD GRADE) | 11681.65 | 1 |
| | L-80-EPDM | Pump Hose - EPDM | 11681.65 | 1 |
| | L-80-HYP | Pump Hose - HYPALON | 11681.65 | 1 |
| 38** | LC-4021 | Hose Clip | 80.59 | 4 |
| 39 | LB-3244 | Hose Connector Screw | | 8 |
| 40 | L-80-FC-DS-1 | Front Door Seal | 913.61 | 1 |
| 41 | L-80-FC-1 | Front Cover | 91983.49 | 1 |
| 42 | LH-4001 | Handle | 288.81 | 1 |
| 43 | LT-5100S | Breather Elbow | 101.92 | 1 |
| 44 | LP-1001 | Fill Plug | 28.81 | 1 |
| 45 | LT-5102 | Sight Glass | 32.68 | 1 |
| 46 | LP-1002 | Drain Plug | 28.81 | 1 |
| 47 | L-80-CON-CAP | Hose Connector Cap | 36.55 | 2 |
| 48 | L-80-56 | Friction Hinge Washer | 3.95 | 8 |
| 49 | L-80-53 | Hinge Link Plate | 411.16 | 4 |
| 50 | Motor | Motor | | 1 |

* 1 g = 0.0353 ounce / 0.00220 pound

** Recommended spares with 25 litres of Envirolube Lubricant.

# 4 User Guide

## 4.1 *Troubleshooting*

If the pump does not appear to be functioning correctly, consult the following guide to see if you can identify and remedy the problem yourself. If the problem still persists, please contact Environmental Pumping Solutions Limited or your authorised local dealer for more detailed information.

| Problem | Probable Cause(s) | Suggested Remedy |
|---|---|---|
| The pump does not start when turned on. | Defective motor | Check motor is running<br>Check fuses.<br>Check motor protection switch<br>Make sure that all phases have required voltage |
| | Frequency inverter (when used) incorrectly set-up | Connect motor DOL<br>Check inverter settings |
| | Shaft key broken or missing | Make sure that a key is fitted and that all surfaces of friction are clean and undamaged. The hub screws are correctly tightened |
| | Pump rotating in reverse | Check direction of the motor is correct |
| | The pump is taking in air | Identify the source of air intake and exchange seals or gaskets |
| | Rollers are not adjusted correctly | Adjust the roller occlusion |
| Pump runs but there is no flow of media | Hose blocked | Reverse the pumps rotation and remove any obstacles. If this is not possible with your system, the pump needs to be disassembled and obstacles removed. |
| | Pipeline on suction side of the pump is clogged | Clean pipeline, valves, filters etc. |
| | Pump has pumped against excessive pressure and hose has detached from hose connector | Remove reason for overpressure, fit overpressure protection, check pump for damage and reattach hose and refill lube |
| Flow is less than calculated | Pump is running too slow | It maybe possible to fit a speed inverter or make a gear ratio change (not always possible). Call Environmental Pumping Solutions Ltd. to discuss |
| | The pump is taking in air | Locate the source of air intake and exchange seals or gaskets |
| Flow is less than calculated | Restriction in the suction pip | Identify and remove the restriction |
| | Viscosity is too high for the size of pump | Turn down the pump speed and/or utilise a larger pump |

| Problem | Probable Cause(s) | Suggested Remedy |
|---|---|---|
| Flow is less than calculated | Rollers are not adjusted correctly | Adjust the roller occlusion |
| | Backpressure is too high | Change the pipeline on the pressure side of the pump |
| | Suction pipe is too long for the diameter creating too high suction pulsation losses | Consult Environmental Pumping Solutions Ltd. |
| Noise | Pump cavitating | Lower the speed or utilise a bigger pump or change the pipelines |
| | Air or gas in the pipelines | Seal off possible air intakes |
| | Pressure too high | Clear pipelines and check pipe sizes<br>Lower the pumping speed |
| | Rollers are not adjusted correctly | Adjust the roller occlusion |
| | Gearwheels or bearings worn out | Workshop overhaul of pump needed |
| | Hose damaged | Exchange the hose |
| | Suction and discharge lines not correctly fastened | Fasten correctly |
| Vibration of the pump and pipework | High pump speed with long suction and discharge lines or high product specific gravity or a combination of these factors | Reduce pump speed.<br>Reduce the line lengths on both suction and discharge where possible. Consult Environmental Pumping Solutions Ltd. |
| | Too small diameter of suction and/or discharge pipework | Increase the pipework size |
| | Pressure too high | Check discharge pressure is as per pump data sheet.<br>Check pump speed is as per pump data sheet.<br>Check pipelines are clear<br>Check pump hose is not damaged<br>(New installation) Check pipes sized correctly |
| Pump draws too much current | Sedimentation of solid substance when not using the pump | Empty the pump after use, flush the pump with clean water after use |
| | Fluid or particle buildup in or by the motor | Clean the motor |
| | High pump speed | Reduce pump speed or install larger pump |
| Short Hose Life | Hose Deteriorating chemically | Reassess the choice of material for the hose |
| | High pulsations | Consult Environmental Pumping Solutions Ltd. for detailed advice |
| | Incorrect hose lubricant used | Use only Envirolube lubricant |
| Pump parts wearing quickly | Hose wearing mechanically on the outside | Check compression roller occlusion |

| Problem | Probable Cause(s) | Suggested Remedy |
|---|---|---|
| Pump parts wearing quickly | Hose wearing mechanically on the inside | Check compression roller occlusion |
| | Roller bearings (bushings) wear down quickly | Check compression roller occllusion |
| | Abrasive product mixed in the hose lubricant | Wash out pump body and change lubricant. Ensure pump body is fully cleaned when replacing a failed hose |
| High pump temperature | Incorrect hose lubricant used | Use only Envirolube lubricant |
| | Product temperature too high | Consult Environmental Pumping Solutions Ltd. |
| | Pump running to fast | Reduce pump speed |
| | Possible restriction in the suction pipe | Dismantle the suction piping, identify the restriction and remove |
| Lubricant leakage | Leaking seal or gasket | Identify the leaking seal or gasket. Tighten retaining bolts. Replace seal or gasket if needed |

For trouble free pump operation, please refer also to the Routine Maintenance instructions as detailed earlier in this manual.

## 4.2 *Specifications*

### 4.2.1 Pump operating conditions

| Description | L20 | L25 | L32 | L40 | L50 | L65 | L80 |
|---|---|---|---|---|---|---|---|
| Max continuous flow ($m^3/hr$) | 1.2* | 2.21* | 4.00* | 6.5* | 10.4* | 19.2* | 25.9* |
| Capacity per revolution (l/rev) | 0.23 | 0.41 | 0.95 | 1.82 | 3.46 | 7.10 | 12.33 |

| | |
|---|---|
| Maximum working pressure | 10 Barg* |
| Ambient working temperature | -15°C to +45°C |
| Product working temperature | -10°C to +80°C |
| Sound level at 1m | < 70 dB(A) whilst pumping water at maximum continuous flow |

* Your pump may not have been configured to run at these stated maximums. Please check your Technical Data Sheet.

### 4.2.2 Materials of Construction

| Description | Standard | Optional | |
|---|---|---|---|
| Pump Body | Carbon Steel | 304 st. stl. | 316 st. stl. |
| Front Cover | Carbon Steel | 304 st. stl. | 316 st. stl. |
| Rotor | Carbon Steel | 304 st. stl. | 316 st. stl. |
| Compression Rollers | POM | | |
| Hose connectors | 304 st. stl. | 316 st. stl. | |
| Support Frame | 304 st. stl. | | 316 st. stl. |
| Gasket Frame | Nitrile | | |
| Fasteners | MS BZP | 304 st. stl. | 316 st. stl. |

### 4.2.3 Hose Lubricant Quantities

| Pump Model | L20 | L25 | L32 | L40 | L50 | L65 | L80 |
|---|---|---|---|---|---|---|---|
| Volume of hose lubricant (litres) | 2.5 | 2.5 | 5.0 | 7.5 | 10 | 20 | 25 |

*i* Contact Environmental Pumping Solutions Limited or your authorised local dealer should you require a Material Safety Data Sheet (MSDS) for Envirolube hose lubricant.

### 4.2.4 Weights and Dimensions

The details below are approximate only. Please refer to your Technical Data Sheet or Environmental Pumping Solutions for specific details of the supplied equipment.

| Pump Model | L20 | L25 | L32 | L40 | L50 | L65 | L80 |
|---|---|---|---|---|---|---|---|
| Net weight (kgs) | 65 | 65 | 155 | 250 | 300 | 375 | 540 |
| Overall size (mm) | 536H<br>513W<br>503L | 536H<br>513W<br>503L | 723H<br>691W<br>670L | 857H<br>790W<br>750L | 986H<br>852W<br>790L | 1134H<br>1067W<br>889L | 1319H<br>1242W<br>994L |

## 4.3 *Recommendations for Hose Storage*

We recommend that pump hoses are stored in accordance with BS3574. Peristaltic hoses can be considered as Group A products as detailed in this specification, i.e. products with moderate susceptibility to deterioration.

The relevant points from this specification are:

| | |
|---|---|
| Temperature: | To be below 25°c and articles stored away from direct sources of heat such as boilers, radiators and direct sunlight.<br><br>For articles stored below 15°c their temperature should be raised to approx. 30°c throughout their mass prior to use. |
| Humidity: | Humidity shall be such that condensation shall not occur. The criterion for this is that either the storage temperature should be above the dew point or humidity levels should be low enough to ensure the dew point is below the storage temperature. |
| Light: | Protect from strong light sources, in particular direct sunlight or intense artificial light having a high ultraviolet content. |
| Ozone: | Storage areas shall not contain equipment which generates ozone - e.g. mercury vapour lamps, high voltage electrical equipment, combustion gases, organic vapours. |
| Deformation: | Store free from superimposed tensions or compression.<br>For a hose this means that the supports must be wide enough and spaced in a way as to spread the load over a wide area. We would recommend a minimum width of 100mm for any support spaced no more than 500mm apart. It is preferable that hoses are supported over their entire length.<br>**Do not store hoses coiled.** |
| Contact with Liquids: | Do not allow contact with liquids (e.g. petrol, greases, acids, disinfectants, cleaning fluids). |
| Contact between Hoses: | Avoid direct contact between hoses of different types, particularly between hoses of different colours. |
| Rotation of Stock: | Hoses must be issued in strict rotation by manufacturing date or production code. |

Hoses will be delivered wrapped individually in opaque polythene, we would recommend that the packing is kept on the hoses prior to use to reduce the effects of light and to minimise contact with other materials. Individual hoses are marked with a production code identifying the manufacturing period.

# EC Declaration of Conformity

In accordance with EN ISO 17050-1:2004

*We* Environmental Pumping Solutions Limited

*of* Elcot Park, Elcot Lane, Marlborough, Wiltshire, SN8 2BG, United Kingdom

*in accordance with the following Directive(s):*

| | |
|---|---|
| 2004/108/EC | The Electromagnetic Compatibility Directive |
| 2006/42/EC | The Machinery Directive |

*hereby declare that:*

| | |
|---|---|
| Equipment | Peristaltic Pump |
| Models | L20, L25, L32, L40, L50, L65, L80 |

*is in conformity with the applicable requirements of the following documents*

| Ref. No. | Title | Edition/date |
|---|---|---|
| BS EN ISO 12100-1 | Safety of machinery. Basic concepts, general principles for design. Basic terminology, methodology | 2003 |
| BS EN ISO 12100-2 | Safety of machinery. Basic concepts, general principles for design. Technical principles | 2003 |
| BS EN 809 | Pumps and pump units for liquids. Common safety requirements | 1998 |
| BS EN 60204-1 | Safety of machinery. Electrical equipment of machines. General requirements | 2006 +A1:2009 |
| BS EN 61000-6-1 | Electromagnetic compatibility (EMC). Generic standards. Immunity for residential, commercial and light-industrial environments | 2007 |
| BS EN 61000-6-3 | Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments | 2007 |

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications and is in accordance with the requirements of the Directive(s)

Signed by: .....

Name: Tony Fenn

Position: Sales Director

Done at Marlborough, Wiltshire, UK

On November 2012

CE

The technical documentation for the machinery is available from the manufacturer at the above address.

4.5

## Product Use Declaration Form

In compliance with the Health & Safety Regulations and the Control of Substances Hazardous to Health Regulations you, the user are required to declare the substances which have been in contact with the product(s) you are returning to Environmental Pumping Solutions Limited or any of its subsidiaries or distributors. Failure to do so will cause delays in servicing the item or in issuing a response. Therefore, please complete this form to ensure that we have the information before receipt of the items(s) being returned. **A FURTHER COPY MUST BE ATTACHED TO THE OUTSIDE OF THE PACKAGING CONTAINING THE ITEM(S)** before returning. You, the user, are responsible for cleaning and decontaminating the item(s) before returning them.

**Please complete a separate Declaration Form for each item returned.**

Company: .....

Address: .....

..... Postcode: .....

Telephone: ..... Fax Number: .....

e-mail: .....

Product: .....

Serial Number: .....

Has the Product been used?

| YES | | NO | |
|---|---|---|---|

If yes, please complete all the following sections

If no, please complete declaration only

Details of Substances Pumped

Chemical names:

1. .....
2. .....
3. .....
4. .....

Precautions to be taken when handling the above:

1. .....
2. .....
3. .....
4. .....

Action to be taken in the event of human contact:

1. .....
2. .....
3. .....
4. .....

Cleaning fluids to be used if residue product is found during servicing:

1. .....
2. .....
3. .....
4. .....

I herby confirm that the only substance(s) that the item specified has handled or come into contact with are those named, that the information given is correct, and the carrier has been informed if the consignment is of a hazardous nature.

Signed:

Name:

Position:

Date:

Any other additional information you may regard as useful:

.....

.....

.....

.....

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Berkelmans Welding & MFG.INC.
RR#7 Aylmer Ont. N5H-2R6
Phone 519 765 4230.
Fax 519 765 4507

# 25 ton Dump trailer instruction.

1- When towing the trailer always allow extra room between the vehicle ahead and your tractor and trailer.

2- 20 percent of the load from the trailer when loaded level will be on the tractor hitch. Example, if you have 40000 lbs in the trailer there will be 8000 lb load on the tractor hitch. Check with your tractor dealer for load rating on the tractor hitch.

3- There is a prop rod to support the box when servicing the trailer with the box in the raised position. This support rod is not to be used when the trailer is loaded. Never work under lifted box when the trailer has any weight in it.

4- The wheels need to be torqued the first day of trailer use, the first week of trailer use and check every 200 hours after that. Torque to a minimum of 200 PSI and maximum of 300 PSI.

5- The trailer tire performs best when the tires are inflated to the recommended tire pressure. Check tire pressure on a regular basis and inflate to the recommended 120 PSI.

5- The hubs are oil bath hubs. Check oil levels while trailer is on level ground. Oil should be up to the bottom of the fill plug on the wheel hub.
Use 90 weight gear lube on wheel bearings.
Every 1000 hrs, pull wheel assembly apart and inspect bearings, Replace if worn or damaged.

6- Replace the trailer pintle ring if it is showing signs of wear.

7- All pivot points have a grease fitting these points will be marked with a grease fitting sticker.
These points should be greased every 300 hrs of trailer use.

8- Inspect the trailer on a regular basis for frame and unibody wear or cracks and repair or replace parts as needed.

9- It is very important to dump on even ground as the trailer will tip on its side if you are a slope and dumping the load at the same time. (The trailer is very top heavy when in the raise position)

10- When dumping the load do not have anyone stand within 50 feet beside or behind the trailer.

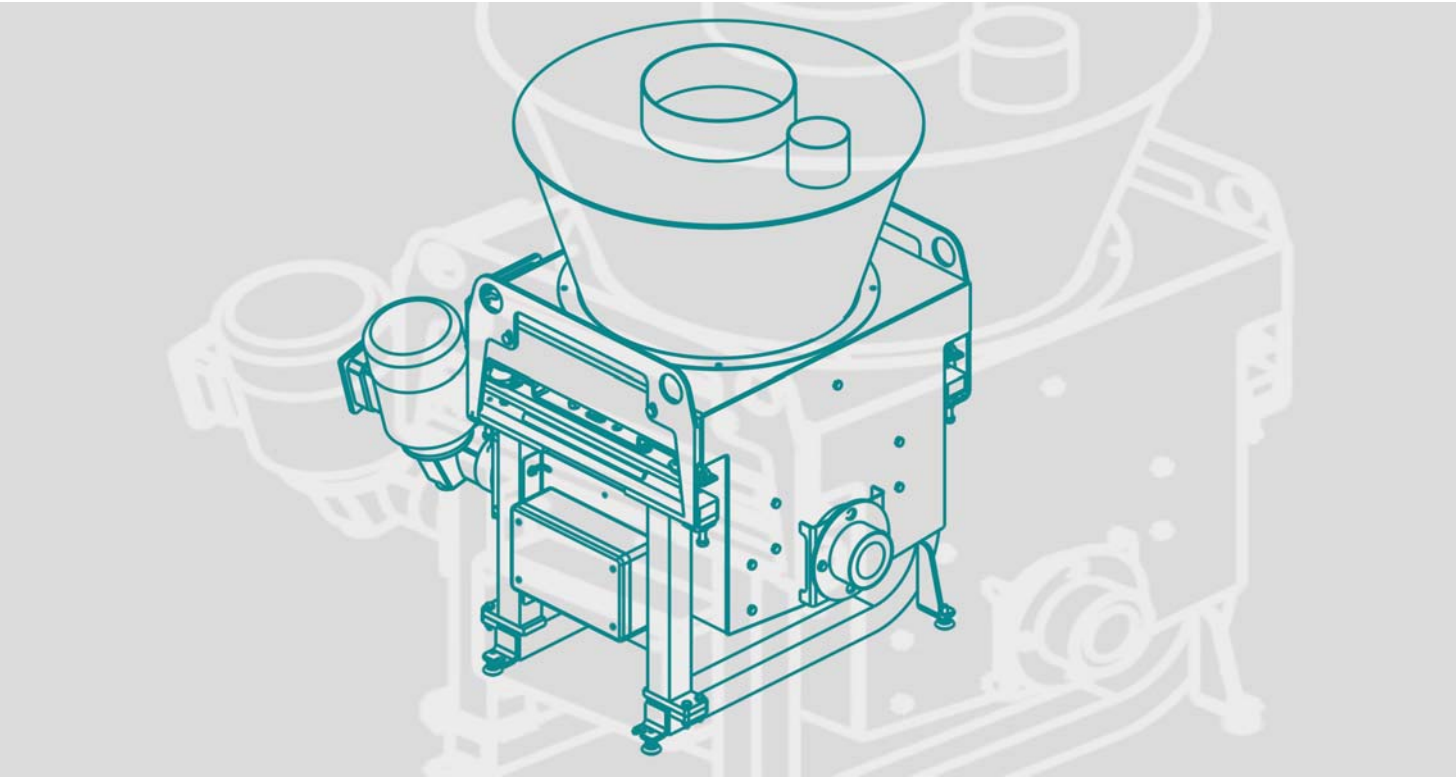
11- Do not jerk the load when the trailer is in the raised position as you could pull the cylinder apart.

Always operate this machine with caution and be aware as to what is around you when doing so.

schenck process

# MechaTron® Instruction Manual

## Midrange Coni-Flex™ Dual Drive Feeder



BV-H5003GB

we make processes work

PASS - Service you can rely on
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Note: The Original Instruction Manual is English

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# 1 Safety Information

## 1.1 Using the Feeder for the Intended Purpose

**Your MechaTron feeder is designed for accurately feeding bulk solids within the feedrate ranges (Theoretical Feedrates) found in TAB 4 of your MechaTron Binder.**

- When commissioning your MechaTron feeder for the material specified in your order, follow the information given in this instruction manual and refer to the technical data supplied in the system documentation.
- Your MechaTron feeder has been configured to process the material specified in your order. If processing alternate materials is desired, reconfiguration of your system may be necessary.
- If your MechaTron feeder is a component of a larger system or process, always determine safety considerations before commissioning from the perspective of upstream and downstream equipment.

Any change to the basic construction of the MechaTron feeder should not be performed without the approval of SCHENCK. This warning also applies to the installation and set up of safety devices and any welding work on component parts of the feeder.

Spare parts must meet the technical specifications indicated by SCHENCK. To ensure that this requirement is met, only genuine SCHENCK spare parts should be used.

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# 1.2 Residual Risks/Precautions

Residual risks may be present if the system is improperly installed or commissioned, or if it is operated by inexperienced personnel.

In this manual, you will be able to identify residual risks by the following symbols:

**Danger**
The presence of this symbol indicates that the operation, procedure or item being described has the potential to cause severe personal injury. Follow all safety instructions to prevent an injury from occurring.

**Warning**
The presence of this symbol indicates that the operation, procedure or item being described may cause damage to the machine or components. Follow all safety instructions to prevent any damage from occurring.

**Note**
The presence of this symbol indicates a precaution to be taken during an operation or procedure. It may also point out helpful hints to make an operation easier or safer to complete.

**Gravmetric System Information**
The presence of this symbol indicates that important gravimetric information is being presented. In comparison to volumetric feeding systems, gravimetric feeders use weight measurements and controller feedback to accurately meter bulk solids.

# 1.3 Component or Stand-Alone Use

## 1.3.1 Component Use

- If the MechaTron feeder is interlinked with other devices or processes in the plant, responsible personnel must make additional information available to the operators of the feeder that will augment this instruction manual and ease overall system operation and use.

## 1.3.2 Stand-Alone Use

- **Inlet**
  If your MechaTron feeder is to be used as a stand-alone device, ensure that the “filling grid” at the top of the hopper is in place and securely fastened. If this grid is not present, make alternate arrangements to make certain the safety of any activity at this area of the device is ensured.

- **Outlet**
  **DANGER: Do not place hands or fingers near the helix at the outlet of the feeder**. Severe personal injury could result if this warning is not heeded.

## 1.4 Feeding of Bulk Solids Dangerous to Health

**DANGER:** Incomplete service interventions, aging or wear can cause

- material
- material-escaping gases and
- oxygen-displacing media (e.g. inert gas)

to emerge in quantities dangerous to health.

The user should take immediate measures for protection of health and/or environment.

## 1.5 Damaged / Defective Seals and/or Components

**DANGER:** Worn or damaged seals and/or components can cause material to emerge.
If the materials used are dangerous to health, immediately replace the defective seals and/or components under consideration of the safety regulations applying to the material in question.

## 1.6 Work on Electrical Equipment

**DANGER:** There is danger to life.
Ensure that work on electrical equipment is always performed by skilled electricians.

Ensure that damaged or defective electrical components and assemblies are immediately replaced and/or repaired by skilled electricians.

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## 1.7 Workmen's Qualification

- Only trained and authorized personnel may perform the work described in the manual(s).
- Workmen must be familiar with the construction and safe operation of a crane or forklift if used in installing the device.
- Work on the weighing system associated with the feeder must be performed only by skilled personnel.
- Workmen are required to know and follow all local safety regulations and accident prevention rules.

## 1.8 Operator's Qualification

- Only skilled and authorized personnel may operate the MechaTron feeder in accordance with instructions provided in this manual.
- Operators must know and follow all in-plant, safety regulations and accident prevention rules.

## 1.9 Safety Information for the User

- Responsible personnel are required to be aware of all safety information provided in this manual in addition to related items of safe system operation. Responsible personnel must ensure that operators understand and follow all safety instructions.
- Before commissioning, responsible personnel are required to determine if the operation of the MechaTron feeder has the potential to cause residual risks in conjunction with other plant components. If necessary, additional safety information must be developed. In order to prevent residual risks from occurring, responsible personnel associated with in-house use of the MechaTron feeder must issue in-plant safety instructions and have their receipt confirmed by the operators. Responsible personnel are required to clearly define responsibilities regarding the operation of the MechaTron feeder in order to avoid uncertainties in the lines of responsibility where safety is concerned.

## 1.10 Safe Operating Environment for the MechaTron

A safe working environment for the MechaTron is important and can be achieved when the feeder is used for the intended purpose, as described in section 1.1, and all safety precautions are followed.

To ensure a safe working environment and proper system operation, these safety guidelines should be followed:

- Protect the MechaTron feeder from overfill.
- While the MechaTron feeder is in operation, access areas around the feeder may be entered only by workmen authorized to perform the work described in this manual.
- Walking or climbing on the MechaTron feeder at any time is not permitted.

**SAFETY INSTRUCTIONS**

Before servicing the MechaTron feeder, disconnect all electrical connections from the power supply.

- **Disconnect and lock out all power to the feeder**.
- Never unlock and restore power to the feeder before all equipment guards have been closed and any safety items are restored.

## 1.11 Design Notes

Device configurations depicted and described in this document are generic and may not apply to your situation. For your system, the mechanical and electrical drawings and associated design documentation supplied with your order should be referenced.

# 1.12 Maintenance and Repair

Maintenance and repair work on the MechaTron feeder not described in this manual should be performed only by SCHENCK service personnel or workmen authorized by SCHENCK.

**CAUTION WITH WELDING WORK!**

- To perform welding work, and in order to protect the electrical components of your MechaTron feeder, attach the negative pole of the welder directly to the point of welding.
- Welding on safety-related or component parts of the system should be performed only in consultation with the approval of SCHENCK.

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# 1.13 Maximum Surface Temperature

The MechaTron with Coni-Flex feed hopper is designed to feed materials in an ambient environment **not to exceed 50°C (122°F)**.

**NOTE**: Surface temperatures on the MechaTron feeder could **equal or exceed 80°C (176°F**) due to feed material temperatures or other causes. Exercise extreme caution under these conditions.

**DANGER**: Hot surfaces on or around the feeder could create a dangerous condition. Severe personal injury may result if the operator does not follow all safety precautions and use recommended safety devices. Before performing any work on the feeder, allow a sufficient period of time for it to cool down.

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# 1.17 Hazard Points at Material Discharge

## 1.17.1 Front Material Discharge

**Danger**

If discharge elements are designed with bigger diameters, fingers may be drawn in and get crushed.

Disconnect and lock out all power to the feeder before starting work at the discharge point.

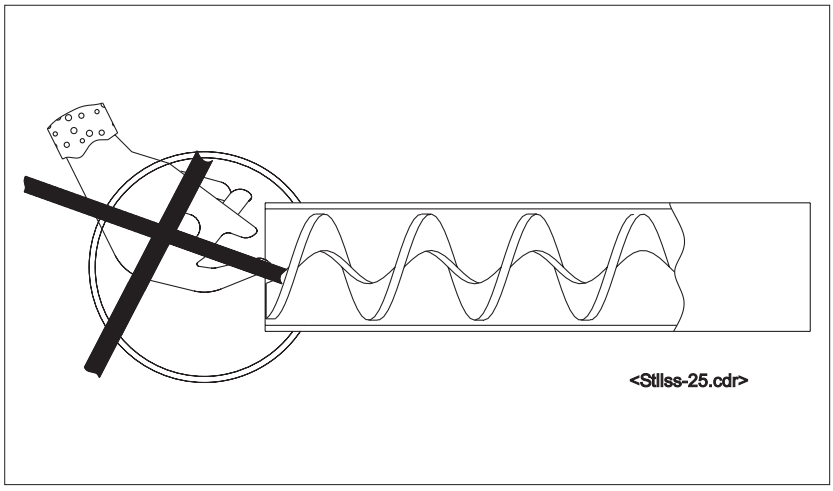


Figure 1: Hazard at the front material discharge

## 1.17.2 Lateral Material Discharge

**Danger** of pinch point hazards between the screw flights and the nozzle. Material characteristics do not always allow for the installation of a protective device.

Disconnect and lock out all power to the feeder before performing work at the discharge point.

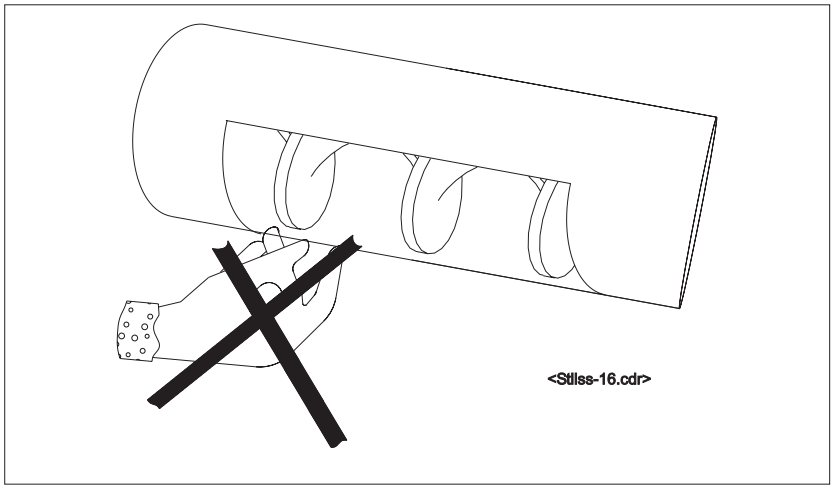


Figure 2: Hazards at the material discharge

# 2 Brief Description

This manual documents installation, operation and maintenance of the midrange, **dual-drive**, Coni-Flex MechaTron feeder system. A motor controller is used to adjust and control feedrate. External agitation of the Coni-Flex feed hopper is also regulated by the motor controller.

The steep-wall design of the feed hopper readily facilitates material mass flow and movement to the helix. Consistent, external agitation ensures flowable bulk materials without bridging. Complete filling of all helix flights producing reliable feedrates is a positive result of both design and agitation. The MechaTron feeder is fully accessible from the back (service side) of the feeder, aiding servicing and cleaning activities while allowing the process side (front) to remain in place. System electrical connection points are protected in an electrical junction box at the side of the feeder. An extremely stable, functional, feeder lifting device (**FLD**) is employed to lift and move the feeder and help service load cells.
To facilitate transport it may be necessary to supply the feeder by single components. The chapters below contain instructions for reassembly.

**Figures** 3 **and** 4 on pages 16 and 17 (respectively) depict the MechaTron feeder and components from two different views.

**Figure** 3 shows the MechaTron in an exploded-view format and indicates essential building blocks of the feeder system.

**Figure** 4 depicts a line drawing of the MechaTron with system components identified.

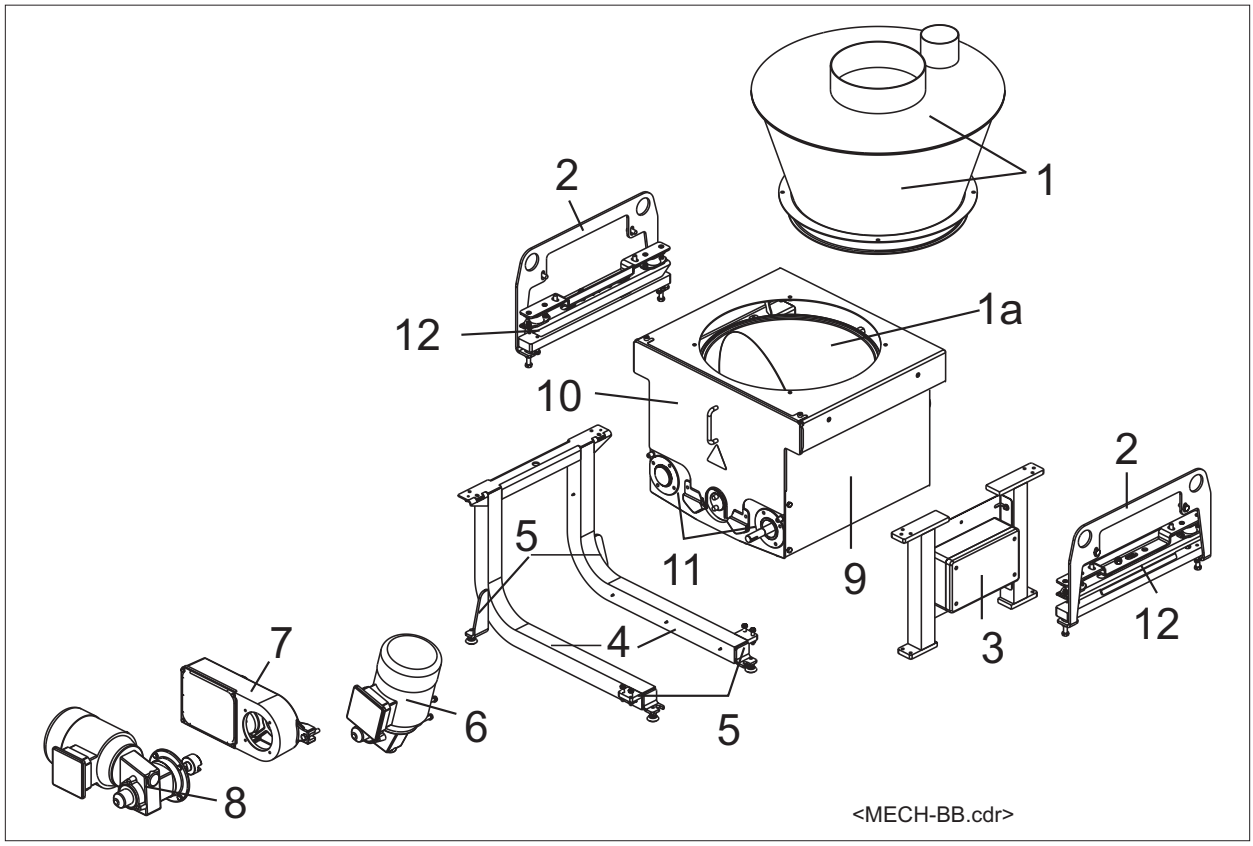


Figure 3: MechaTron Feeder Building Blocks

**Figures** 3 **and** 4 **call-outs**:

1 Extension hopper w/infeed and vent
  1a Feed hopper (Fig. 3 only)
2 Feeder lifting device (FLD)
3 Electrical junction box
4 Feeder structural support
5 Feeder leveling and anchoring base
6 Agitation gear motor
7 Swivel drive casting (Fig. 3 only)
8 Helix drive motor (Fig. 3 only)
9 Feeder frame
10 Back panel (Fig. 3 only)
11 Cast back plate (Fig. 3 only)
12 Weigh modules
13 Nozzle, support flange and bracket (Fig. 4 only).

**NOTE**: Service side is at the back (left) of the feeder, process side is at the front (right) of the feeder in Figure 4 with the FLD's at the sides of the feeder.

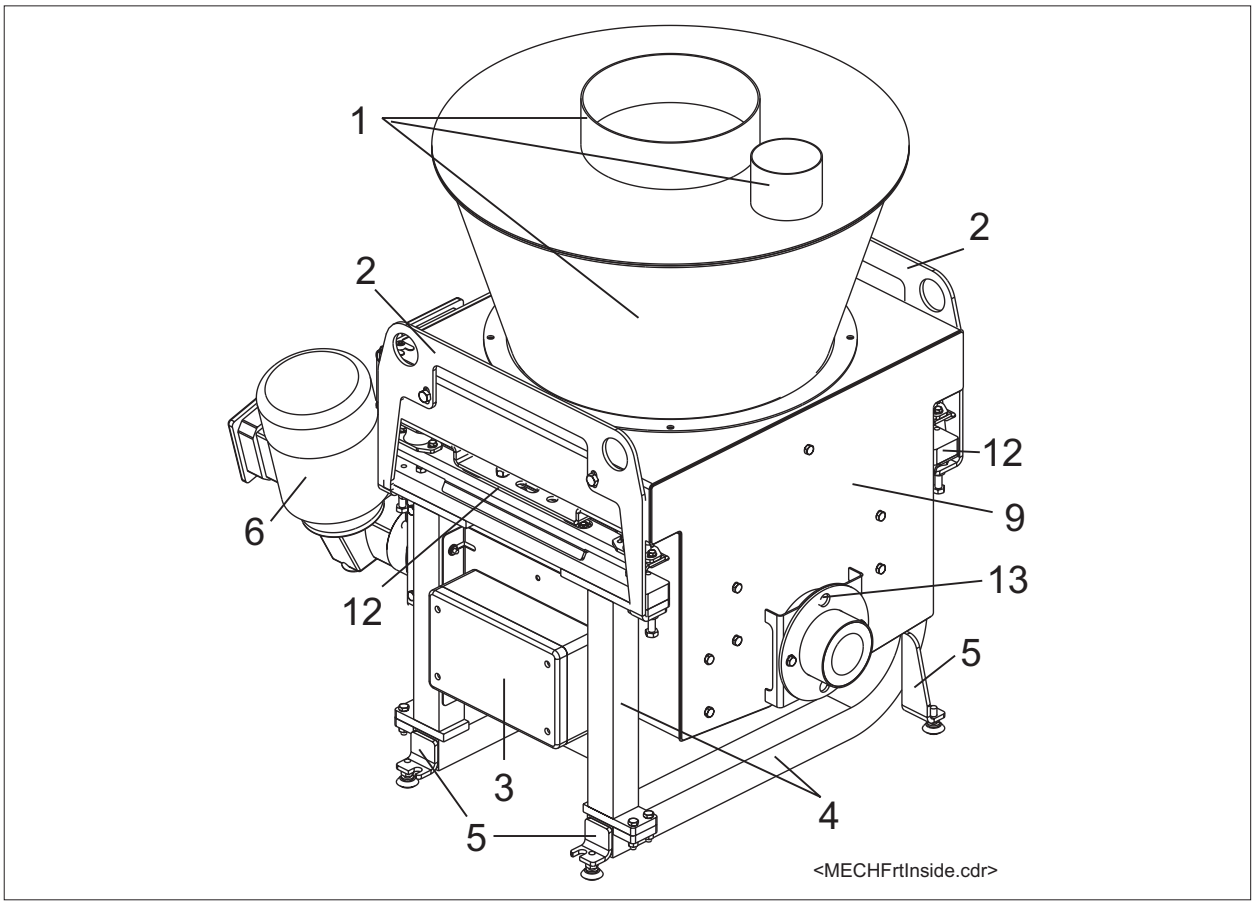


Figure 4: MechaTron Feeder Outline

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# 2.1 Feeder Characteristics

Bulk material handling devices share certain characteristics. In general, all feeders contain:

**Active Section** (also known as the *Weighed Section* in gravimetric systems-see item 2, figure 5, page 20) that includes:

- Material hopper (which may include agitation of some type)
- Discharge device (such as a feed screw or helix)
- Motor and drive
- Feeder frame

**Inactive Section** (also known as the *Non-Weighed Section* in gravimetric systems-see item 1, figure 5, page 20) that includes:

- Support structure
- Electrical enclosure

**Transfer Section** (also known as the *Bridge Section*-see item 3, figure 5, page 20) that includes:

- Weighing mechanism (i.e., load cell)
- Wiring from electrical control box to discharge device motor

**Note:** The transfer section forms a bridge between the active and inactive sections of the feeder.

At this point, a distinction should be made between *volumetric* and *gravimetric* feeding/metering for bulk material handling devices.

**Volumetric feeding** deals with volumes of bulk material and can be described according to the following equation:

**FILL VOLUME per HELIX REVOLUTION x HELIX RPM** = **FEED RATE** (generally in cubic liters/hr. or feet/hr.).

If we multiply this value (**FEED RATE**) times **MATERIAL DENSITY**, we derive **KILOGRAMS OR POUNDS /HR**. It should be noted that **no feedback** from the system is provided with volumetric systems.

Gravimetric feeding/metering deals with precise weights of bulk materials and controls feeding of bulk material via a gravimetric controller connected to a measuring device or scale that regulates feedrate. **Feedback** from the system is provided to control feedrate.

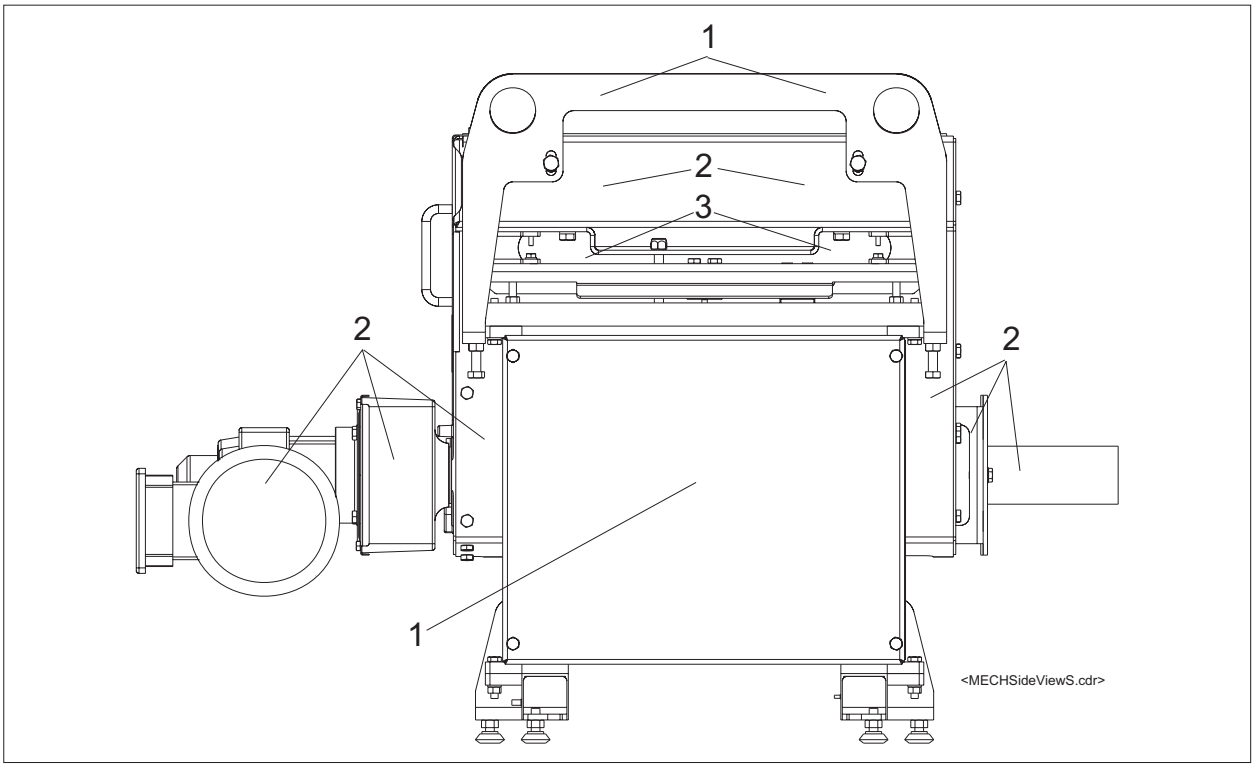


Figure 5: Active, Inactive and Transfer Sections of the MechaTron Feeder

Figure 5 call-outs:
1 Inactive section
2 Active section
3 Transfer section

# 3 Mechanical Installation

## 3.1 Overview

**Refer to Tab 5-Mechanical Drawings for mechanical installation drawings and associated information.**

Carefully select a stable, level site for your new feeder that is fully accessible to service and material handling activities. When these preparations are successfully performed, the functionality of the feeder system is improved and accuracy and reliability are enhanced.

**The objective of mechanical installation is to ensure:**

- A stable, level surface on which to mount the feeder and controls.
- A suitable platform for the feeder and controls for accuracy of metering and weighing.
- Appropriate connections for proper material flow to and from the feeder for disturbance-free operation.
- Proper grounding of all electrical devices for safety and trouble-free operation.
- Appropriate hopper venting so that “unequalized pressure” is not present on the feeding mechanism (helix) and no material leakage occurs.

## 3.2 Unpacking Instructions

Carefully remove the shipping container to expose the feeder assembly. If the feeder is attached to a shipping pallet, retain on the pallet and move to the installation site prior to removing the pallet.

During shipping crate disassembly, carefully inspect the feeder for any damage during transit. **If damage to the feeder is discovered, contact your carrier immediately and file a claim for damages.** The feeder is shipped in good condition when it leaves our factory.

# 3.3 Safe Handling and Transit

A functional Feeder Lifting Device (**FLD**) is an integral part of the MechaTron feeder system.

**NOTE: The FLD should be used for all system handling and transit activities.**

**In volumetric applications**, the FLD is the shipping bracket. **This FLD must remain with the feeder.** See Figure 6, page 22.

**In gravimetric applications**, the FLD may remain connected to the non-weighed section of the feeder during operation (see Maintenance section 7.9, 7.10, 7.11, page 79). See figure 7, page 23.

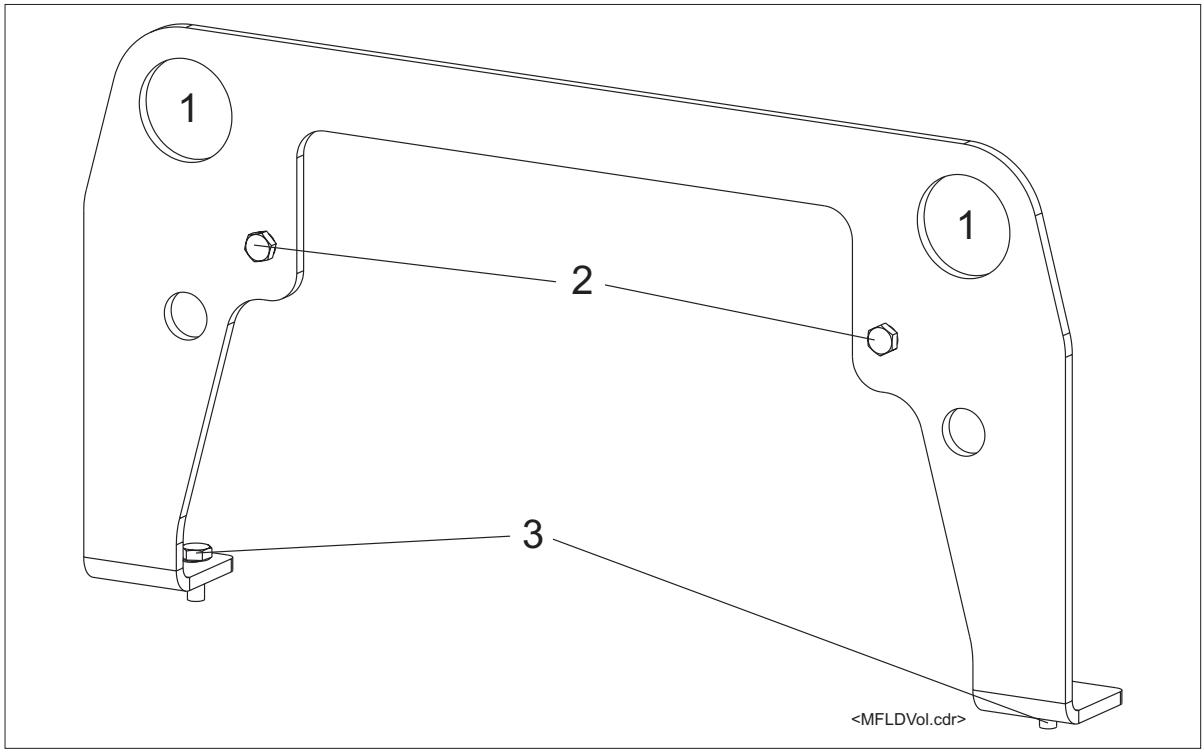


Figure 6 : MechaTron Feeder Lifting Device (FLD)-Volumetric

**Figure 6 call-outs**:
1 FLD lifting holes
2 Top retention bolts
3 Bottom retention bolts

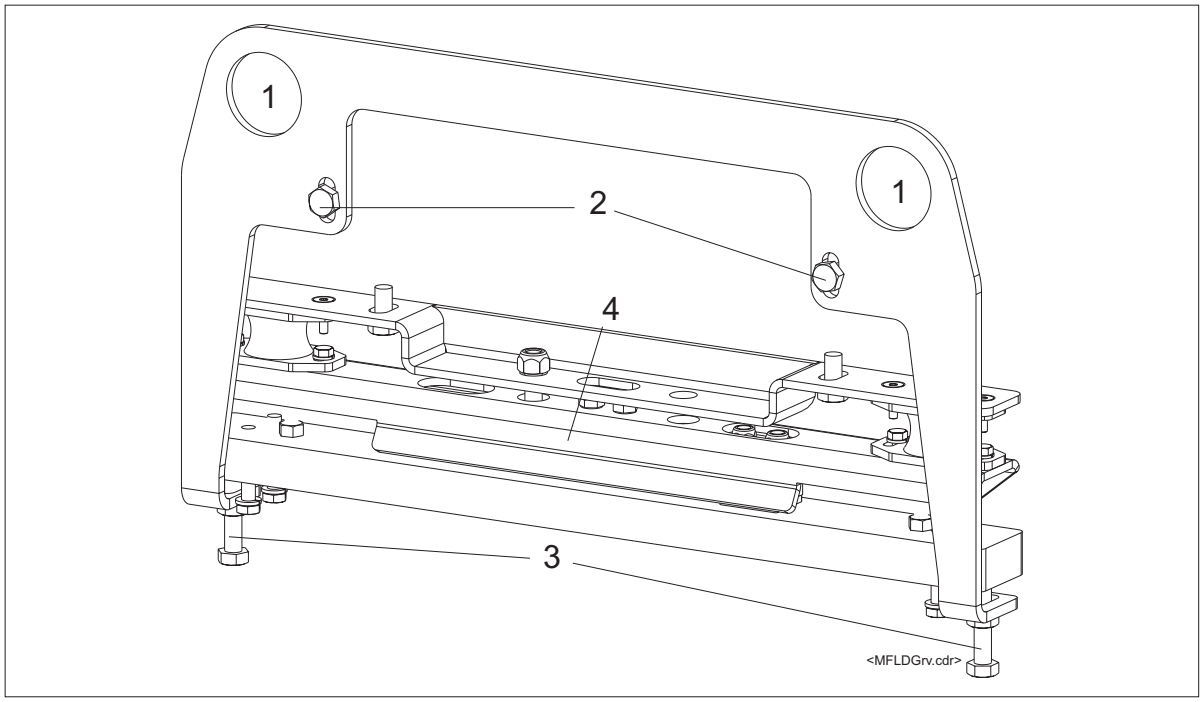


Figure 7: MechaTron Feeder Lifting Device (FLD)-Gravimetric

**Figure 7 call-outs**:
1 FLD lifting holes
2 Top retention bolts
3 Bottom retention/lifting bolts
4 Weighing module

## 3.3.1 Transport with Forklift or Crane

A heavy-duty, material handling device such as a forklift or crane should be employed in handling or moving the feeder system. Primary emphasis in the transportation of the feeder should be placed on maintaining the feeder level to the ground and moving slowly and safely to the installation site.

If the feeder is to be transported by forklift and the feeder assembly is palletized, the tines of the fork may be inserted into the pallet and the feeder can be carefully transported in that fashion.

CAUTION: The tines of the forklift should never be inserted into the frame- work of the feeder assembly. Severe equipment damage could result and warranty will be void. With gravimetric feeders, always check to see before transport that the transit restraint is activated. Otherwise the weighing modules can get damaged.

**Whether system transport is accomplished with forklift or crane, FLD use is required.**

**NOTE**: The extension hopper (if present) can be removed to facilitate safe and easy transport of the feeder.

**Procedure for lifting or moving the feeder with the FLD**:

1. Use all four lift holes on the FLD to lift or move the feeder. Stability will be enhanced by using all available lift holes. If chains, straps or hooks are employed, ensure that they are rated for the weight of the load being lifted.
2. Attach the lifting device(s) securely to the tines of the forklift or lifting platform of the crane. Primary emphasis should be on maintaining a level, stable orientation to the ground.
3. After securely attaching the lifting device(s) to the lift holes on the FLD, slowly raise the feeder assembly to a minimal height and inspect for stability and level. Next, move the assembly a short distance and ensure that the assembly has not shifted in transit.
4. Once satisfied that the load is stable and level, slowly move the feeder to the installation site and carefully lower to the set-up area.

**NOTE**: The volumetric FLD must remain attached to the feeder. The gravimetric FLD should remain attached to the feeder and repositioned as appropriate to aid in load cell maintenance. See Maintenance sections 7.10, 7.8, 7.9, 7.9, 7.10, 7.11 repositioning instructions.

## 3.4 Site Preparation

**Refer to Tab 5-Mechanical Drawings for feeder dimensions and related installation information.**

The mounting base for the feeder system should be solid, level and as disturbance-free (from external vibration, ambient conditions, winds or fans-and other machinery in close proximity) as reasonably possible. See section 3.7 for more information.

Any support platform that is provided for the feeder system (floor, balcony, mezzanine) should also be solid and level to provide a sturdy base for operations. It is strongly recommended that a carpenter's bubble level be employed prior to selecting a potential placement site to determine the real characteristic of the base level. If the base is not level, appropriate actions should be taken to compensate with the platform on which the feeder will be placed.

Since primary access to the feeder will be from the back (or service side), adequate space should be provided in that location. However, service access to the sides and front (process side) will also be necessary and should be provided. Figure 8, page 27, indicates feeder access locations. Recommended clearances for service, maintenance and supply activities are also listed in the call-out section.

## 3.5 Leveling and Anchoring the Feeder

**Floor Mount Applications**

Leveling and securely anchoring the feeder are important considerations for system accuracy, repeatability and proper functioning. In addition to choosing a site that is level and accessible, the platform on which the feeder assembly rests must also be level and "true" (as determined, for example, by a carpenter's bubble level).

To ensure that the feeder does not "travel" or move out of alignment during operation, the feeder leveling and anchoring base(s) should be employed for this purpose.

# 3.6 Service Access Areas

Service access areas to the feeder are important considerations for feeder placement and service/maintenance activities. As depicted in Figure 8, page 27, service access areas may be defined in three general locations around the feeder:

**Primary Service Area**

Located at the service side (back) of the feeder, the primary service area allows access to:

- Quill/Helix
- Drive mechanism(s)
- Sprocket(s)
- Motors (agitation and helix drives)
- Seal(s)
- Feed and extension hoppers.

**Secondary Service Area**

Located at the sides of the feeder, secondary service areas allow access to:

- Electrical junction box (power and control connections)
- Load cells (if present)
- FLD (Feeder Lifting Device).

**Tertiary Service Area**

Located at the process side (front) of the feeder, the tertiary service area allows access to:

- Nozzle, nozzle support bracket and flange.

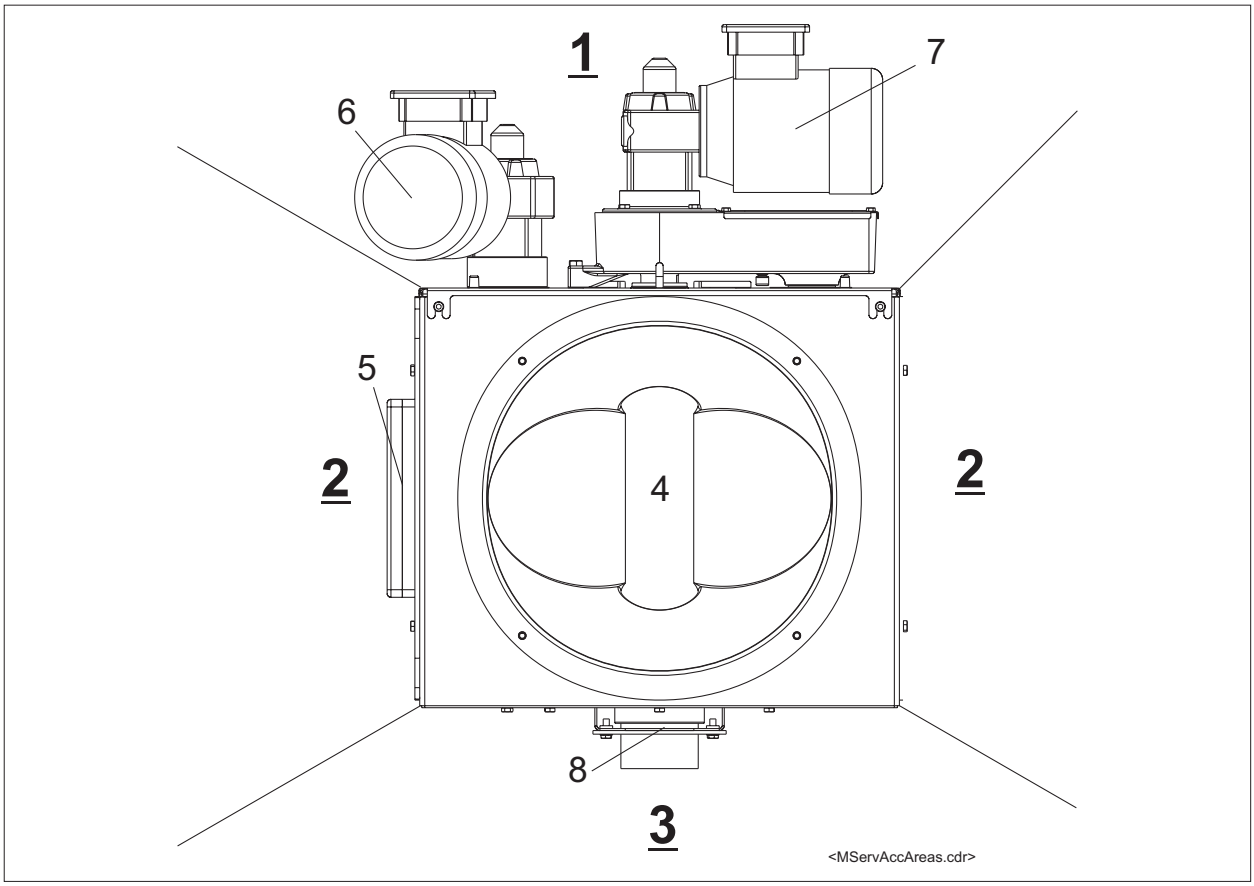


Figure 8: MechaTron Service Access Areas

**Figure** 8 **call-outs**:

**1** **Primary Service Area**
Recommended clearance: 610mm (2 feet), including helix length.

**2** **Secondary Service Area**
Recommended clearance: 610mm (2 feet).

**3** **Tertiary Service Area**
Recommended clearance: 610mm (2 feet).

4 Feed hopper

5 Electrical junction box

6 Agitation motor drive assembly

7 Helix motor swivel drive assembly

8 Nozzle and helix support flange.

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# 3.7 Permissible Acceleration and Displacement

**Pay attention to the following limits for gravimetric applications. At one vibration of feeder support area for frequency "f":**

The diagrams show the limit curves of the acceleration amplitude "**a**" and displacement amplitude "**x**", which separate the ranges of admissible and inadmissible amplitudes.

**a** = Acceleration amplitude in [$m/s^2$]
**x** = Displacement amplitude in [m]
**f** = Frequency in [Hz]
**g** = Acceleration due to gravity = $9.81 m/s^2$

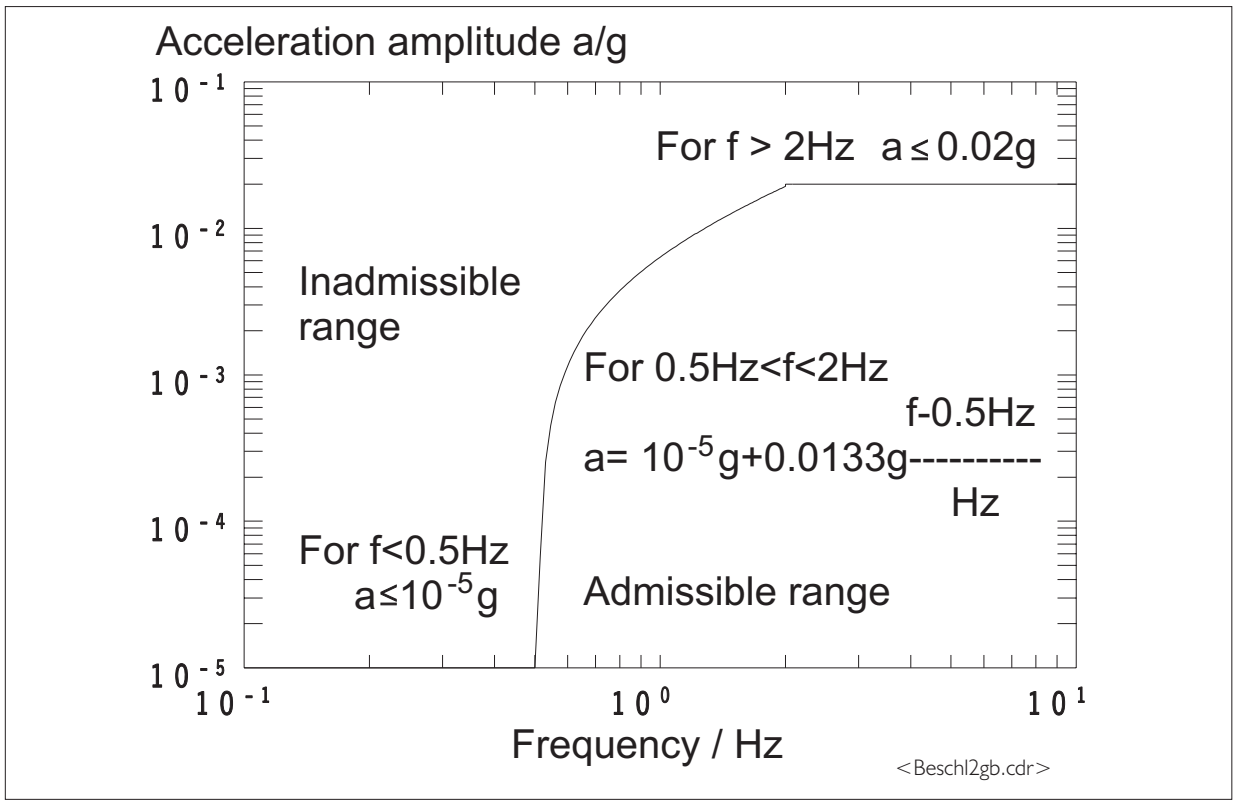


Figure 9: Acceleration amplitude

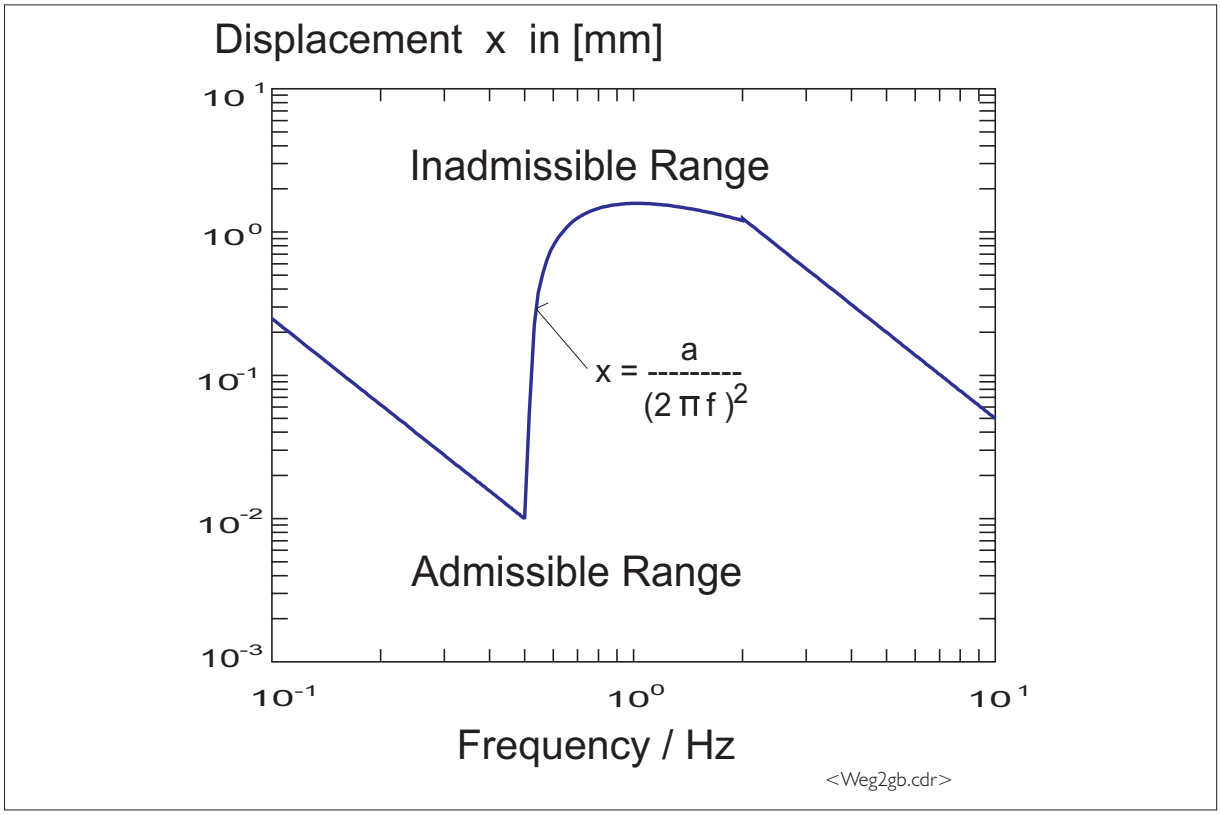


Figure 10 : Displacement

**The diagrams make clear that**:

- Vibration-isolated support of the feeder may become necessary.
- As a general rule, the support should be very rigid.

In general, the generation of vibrations should therefore be countered by using appropriate dampening and stiffening measures.

# 3.8 Attaching Extension Hoppers

When installed properly, the lower flange at the base of the extension hopper and the upper flange at the top of the feed hopper are secured to the feeder frame and locked in place via a band clamp and retention bolts at the top of the frame. See figure 11, page 32, for an illustration, for feed and extension hopper orientation.

**To attach extension and feed hoppers:**

1. Remove the back panel and feed hopper from the feeder frame. If any system components are stored in the feed hopper, remove them and place in a safe area for future use.
2. Remove the four bolts from the top of the feed hopper cavity, if present.
3. Place the extension hopper on top of the feeder frame and align bolt holes on both components. The lower flange of the extension hopper should be visible inside the feeder frame.
4. Insert bolts and lock washers through the bolt holes of the upper flange of the extension hopper and top of the feeder frame, then tighten.
5. Ensure that the band clamp is inside the feeder. Location of the clamp should be above the lower flange of the extension hopper, resting on the clamp positioning pin.
6. Replace the feed hopper in the feeder frame with the longer nozzle at the base of the feed hopper oriented toward and inserted into the opening at the front (process side) of the feeder.
7. Reach inside the feeder from the service side and align the lower flange of the extension hopper with the upper flange of the feed hopper.
8. Open the band clamp and place it completely around both flanges described in step 7. Prior to closing the clamp, ensure that both flanges are within the inner lip of the clamp.
9. Close and tighten the band clamp.

**NOTE**: Visually inspect the clamp union to ensure that both flanges are enclosed within the band clamp and are tightened securely prior to system operation.

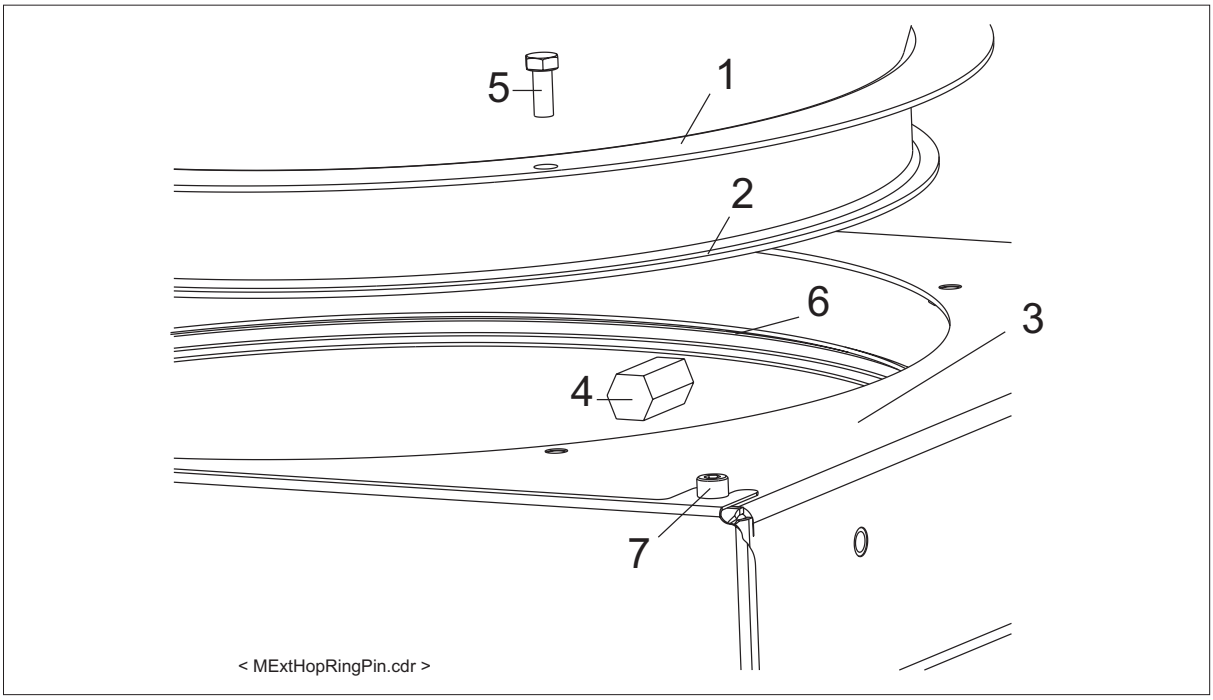


Figure 11: Extension Hopper with Flange Ring and Clamp Positioning Pin

**Figure** 11 **call-outs:**

1 Upper flange-Extension hopper
2 Lower flange-Extension hopper
3 Feeder frame
4 Clamp positioning pin
5 Retaining bolt
6 Band clamp position prior to tightening
7 Back panel retention bolt

# 3.9 Attaching Feed Hoppers

When installed properly, the lower flange at the base of the extension hopper and the upper flange at the top of the feed hopper are secured to the feeder frame and locked in place via a band clamp and retention bolts at the top of the frame.

**Note:** As a point of reference, the part number on the feed hopper should face the back (service side) of the feeder.

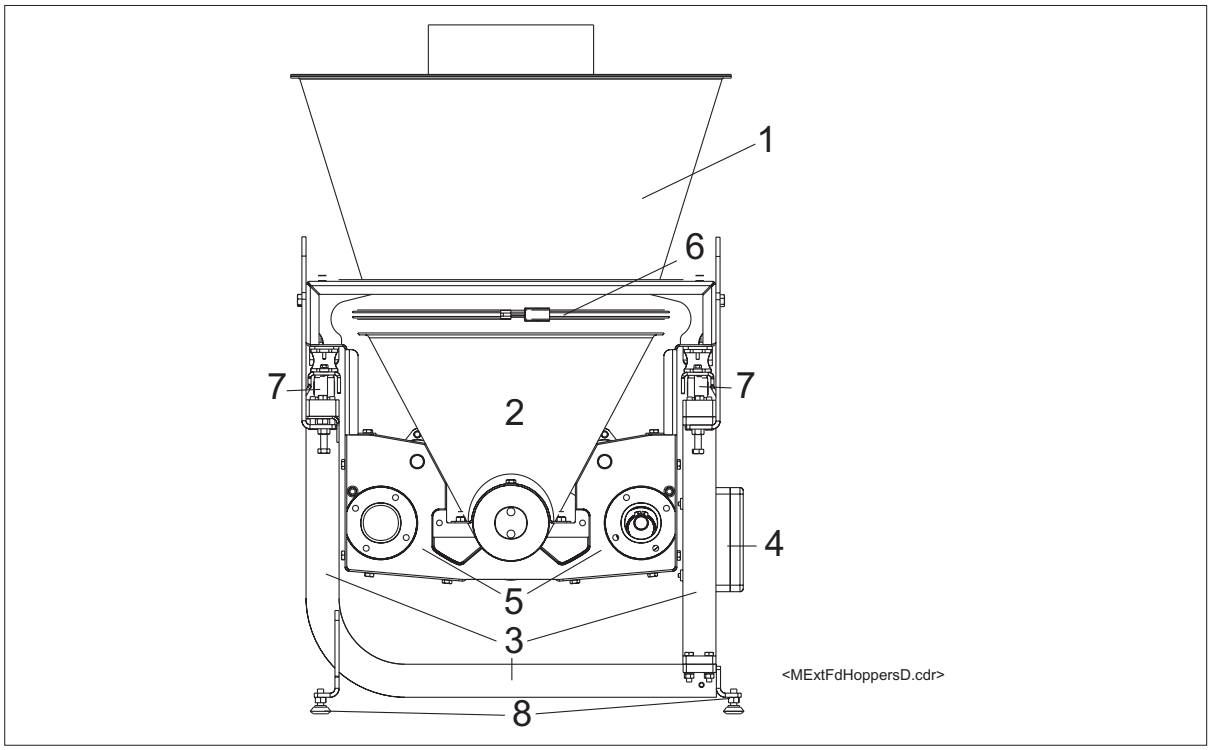


Figure 12: MechaTron Extension and Feed Hoppers

**Figure** 12 **call-outs**:

1 Extension hopper
2 Feed hopper
3 Feeder structural support
4 Electrical enclosure/electrical junction box
5 Feeder back plate
6 Hopper band clamp
7 Weighing module(s), if present
8 Feeder leveling and anchoring base(s).

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# 3.10 Installing the Nozzle and Nozzle Support Flange

The nozzle and nozzle support assembly are key elements for helix guidance and stability. The nozzle support assembly contains nozzle, support bracket, flange and spacer. See figures 13 and 14, page 35 .

**To install the nozzle and nozzle support assembly**:

1. Locate the nozzle (89mm tube-possibly with spacer) at the process side of the feeder and nozzle support flange with keyed, slotted areas.
2. Place the nozzle assembly (nozzle, flange and spacer) into the nozzle support bracket.
3. Rotate the assembly 90 to lock, then tighten the bolts on the flange for **front discharge applications**.
4. **For side discharge applications**, the nozzle assembly can be rotated 45 per material requirements (see figure 2, page14).

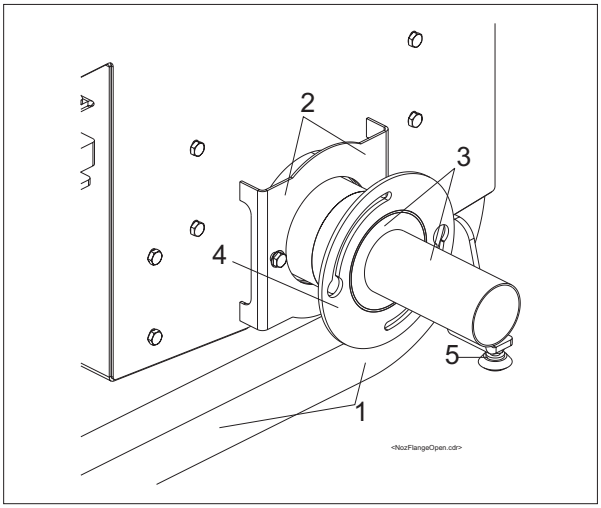


Figure 13: Nozzle and Nozzle Support Flange (open)

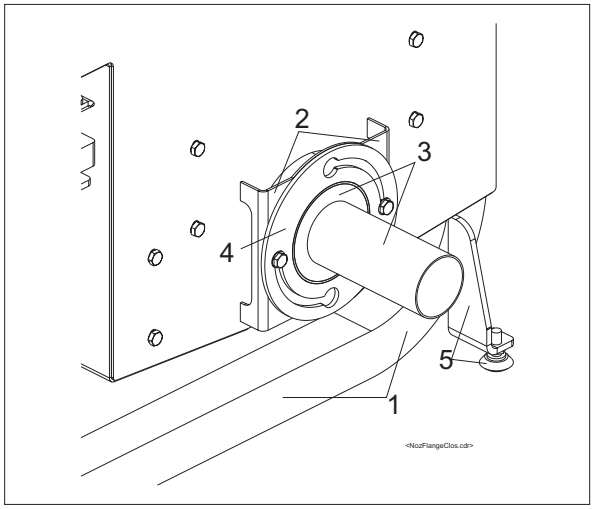


Figure 14: Nozzle and Nozzle Support Flange ( closed)

**Figures** 13 **and** 14 **call-outs:**

1 Feeder structural frame
2 Nozzle support bracket
3 Nozzle and spacer
4 Nozzle support flange
5 Feeder leveling and anchoring base.

# 3.11 Installing the Helix and Quill

The purpose of the helix/quill assembly is to provide a reliable, repeatable and accurate means of emptying the feed hopper in a controlled fashion. The back of the quill assembly is attached to a drive motor that regulates helix speed and feedrate. Proper installation of the helix and quill assembly are important factors in the correct functioning and accurate output of the feeder assembly.

**Danger**: Ensure that all power is disconnected and locked out from the feeder before attempting this procedure.

**To assemble helix, quill and T-drive**:

1. Locate the helix, quill and T-drive (see figure 15, page 37).
2. Orient the parts as shown in the figure, so that the helix is in front, quill in the center and T-drive is at the back.
3. Assemble the parts by inserting the T-drive into the rear of the quill and helix into the front.
4. Carefully screw the T-drive into the back of the helix until tight.

**To install and remove the helix/quill assembly**:

1. Locate the hose clamp and place it around the hopper spout.
2. The helix/quill assembly includes a metal quill clamp that is attached to the quill and secures it to the back plate. Insert the helix/quill assembly into the back of the hopper spout and push carefully forward so that the front of the helix lodges in the nozzle in the nozzle support at the front (process side) of the feeder. Ensure that the shoulder of the quill is flush with the end of the hopper spout (service end). The slots on the quill clamp should bottom out on the retaining bolts.
3. Tighten the hose clamp at the back of the quill assembly (service side-feed hopper spout to quill assembly) to ensure that the components don't move around in the hopper trough. Also, tighten the two bolts on the sides of the quill clamp.
4. To remove the quill assembly, loosen the two bolts on the sides of the quill clamp and pull carefully out and away from the hopper spout.

**NOTE**: The quill clamp should remain attached to the quill.

**Refer to figure** 15**, page** 37 **for component identification.**

**Refer to figure** 16**, page** 38 **for quill section identification.**

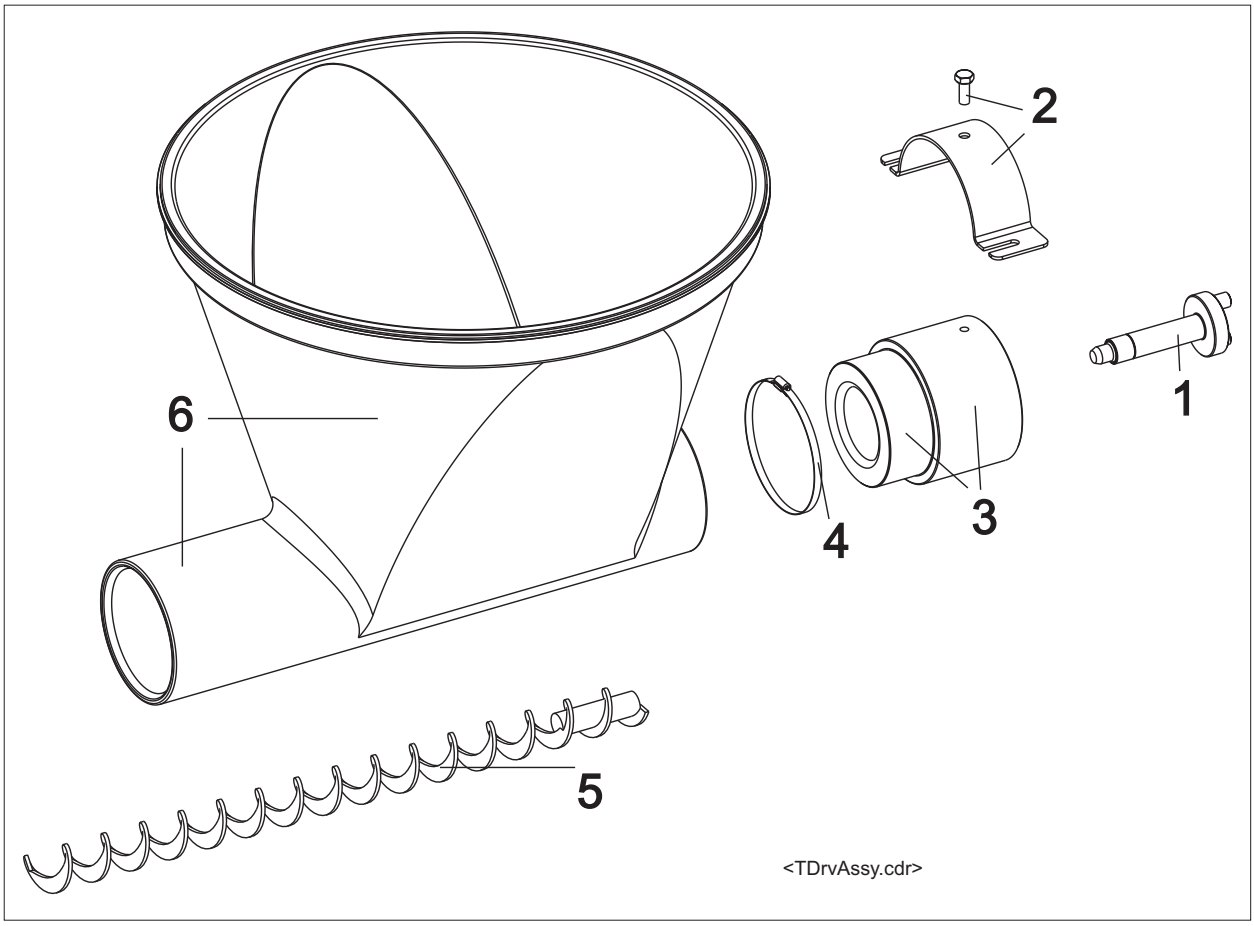


Figure 15: Helix, Quill and T-Drive Assembly

**Figure** 15 **call-outs**:

1 T-drive
2 Quill clamp and retaining screw
3 Quill
4 Hose clamp
5 Helix (insert into base of item #6 in figure)
6 Feed hopper

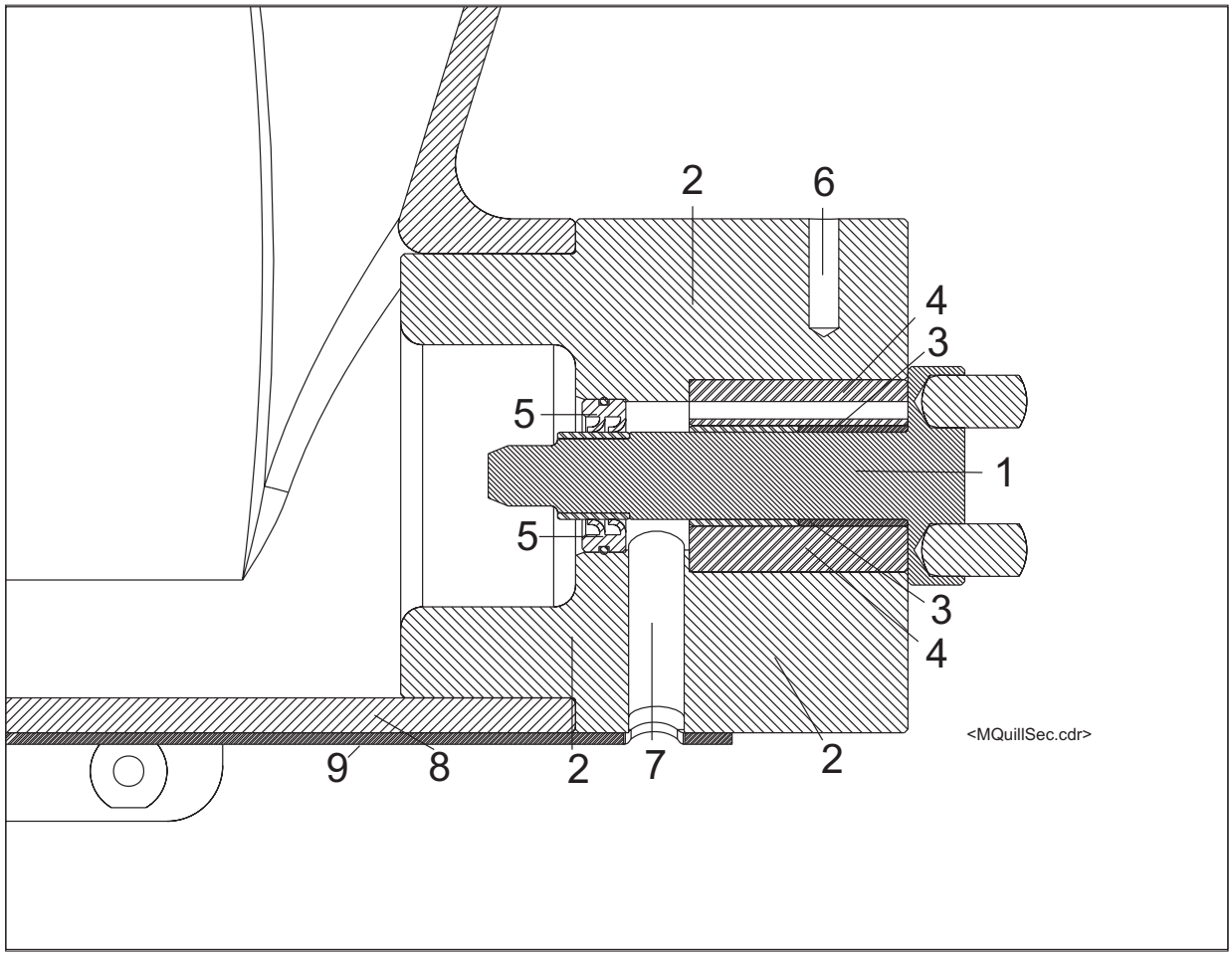


Figure 16: MechaTron Quill Section (side view)

**Figure** 16 **call-outs:**

1 T-drive shaft assembly
2 Quill
3 Bushings (2)
4 Quill insert
5 Seal
6 Quill clamp screw hole
7 Drop-out hole
8 Feed hopper
9 Saddle

# 3.12 Engaging Helix Drive Motor

**Before operating the feeder**:

1. Ensure that the T-drive shaft pins and motor drive shaft end align properly before engaging. The T-drive shaft can be manually rotated into the correct position. The motor drive shaft can be rotated using a wrench.
2. Grasp the helix drive motor by the casting and carefully swivel down into the operating position.
3. Tighten the swivel stop bolt (item 5 figure 17, page 40) to hold the assembly firmly in place during operation.
4. Locate the back panel and replace at the back (service side) of the feeder. Tighten the retention bolts at the top of the panel to secure. See figure 17, page 40.

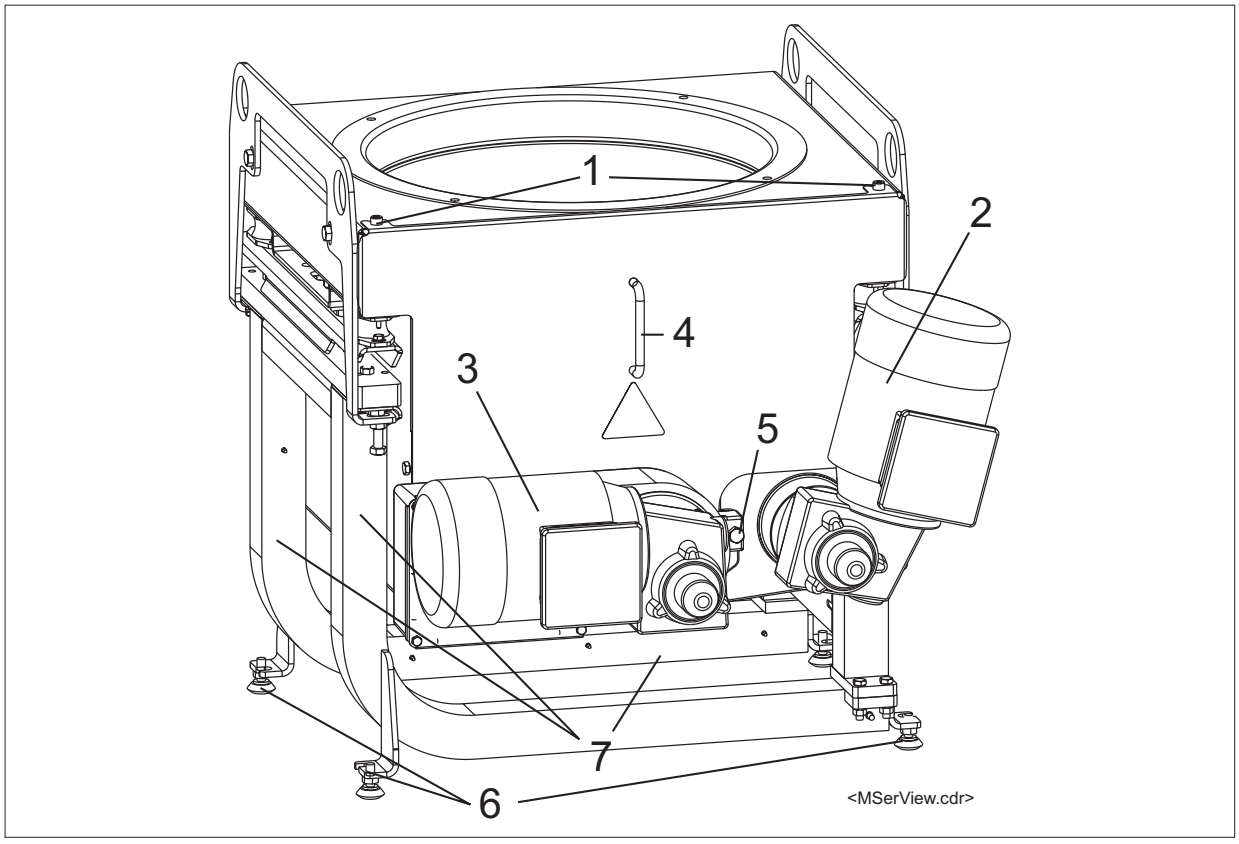


Figure 17 : Helix-Drive Motor - MechaTron Service View

**Figure** 17 **call-outs**:

1 Back panel and retention bolt locations
2 Gear drive motor
3 Helix Drive Motor
4 Back panel with transport handle
5 Swivel stop bolt
6 Feeder leveling and anchoring base(s)
7 Feeder structural support.

# 3.9 Material In-Feed and Discharge Considerations

Material in-feed and discharge connections to and from the feeder may dramatically impact feeder system output and accuracy. These connections must be carefully thought out and correctly installed to ensure optimal performance for your system. Since gravimetric systems are very sensitive to disturbances and vibration, and since these problems can impact feeding accuracy, special measures may be necessary to neutralize or eliminate them. **If your site experiences disturbance or vibration problems and feeding accuracy is not meeting expectations**, contact your SCHENCK representative for assistance.

## 3.9.1 Volumetric Applications

**Without Weighing Module**

In-feed and discharge considerations for volumetric applications center primarily around dust control and containment. The hopper cover, if present, contains two openings: the larger opening (inlet) is for material in-feed, the smaller opening (vent) allows air to escape during refill. See figure 18, page 41.

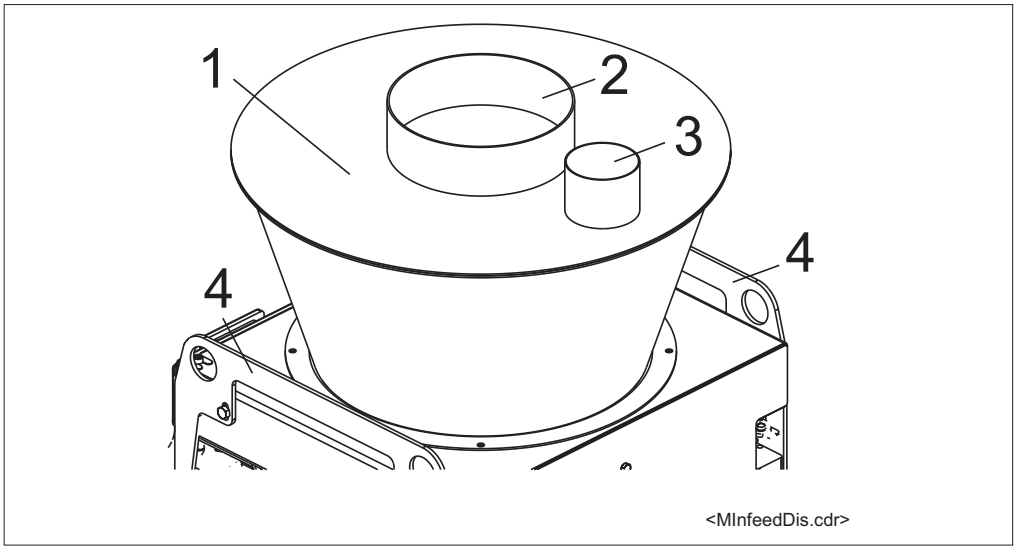


Figure 18: Material In-feed and Discharge

**Figure** 18 **call-outs**:

1 Hopper cover
2 Material in-feed spout
3 Discharge vent
4 Feeder lifting device (FLD).

For volumetric systems, an appropriate method of connecting inlet opening to material source is acceptable as long as it is attached in a manner that will not result in material flow issues. For dust control, the vent should be connected to either a dust containment system or an adequate filtering system.

If dust or material containment is a consideration when connecting the feeder nozzle (outlet) to a receiving vessel, care must be taken to ensure that pressure build-up (**unequalized pressure**) from material discharge is not an issue. **The impact of unequalized pressure could include false feedrates** which would negatively impact system accuracy. In these cases, proper venting of the receiving vessel is very important. Whether or not material or dust containment is an issue, the opening (diameter) of the **receiving vessel should be a minimum of 25% larger** than the feeder discharge nozzle to provide for an air escape path and to prevent material build up and blockage.

## 3.9.2 Gravimetric Applications

**With Weighing Module**

In gravimetric applications, material in-feed and discharge considerations are more complex and focus on neutralizing or dissipating disturbances and vibration.

**NOTE**: Any external disturbance that is registered by the weighing module may impact system performance and accuracy.

As with volumetric applications, the hopper cover has two openings-inlet for material infeed and vent for air expulsion during refill.

**Material in-feed and air vent connections must not influence the weighing module**. SCHENCK recommends the following criteria when connecting material in-feed and venting:

- Length of flexible connections should be kept to a minimum: 102mm to 152mm (4 to 6 inches) is recommended. It is very important that enough clearance exists between connected parts so that unwanted disturbances to the system do not occur.
- Tension, flexing or bending **should not be present** on the flexible connector.
- *Unequalized pressure* must not be present in the system. If it exists, measures (i.e., venting or pressure release) should be employed to contain or eliminate.
- Use of approved SCHENCK flexible connectors is recommended.

See figure 19, page 43, and figures 20 and 21, pages 45 and 46, for flexible connector installation information and outline.

**NOTE**: The same criteria should be used when connecting the feeder discharge nozzle to the receiving vessel.

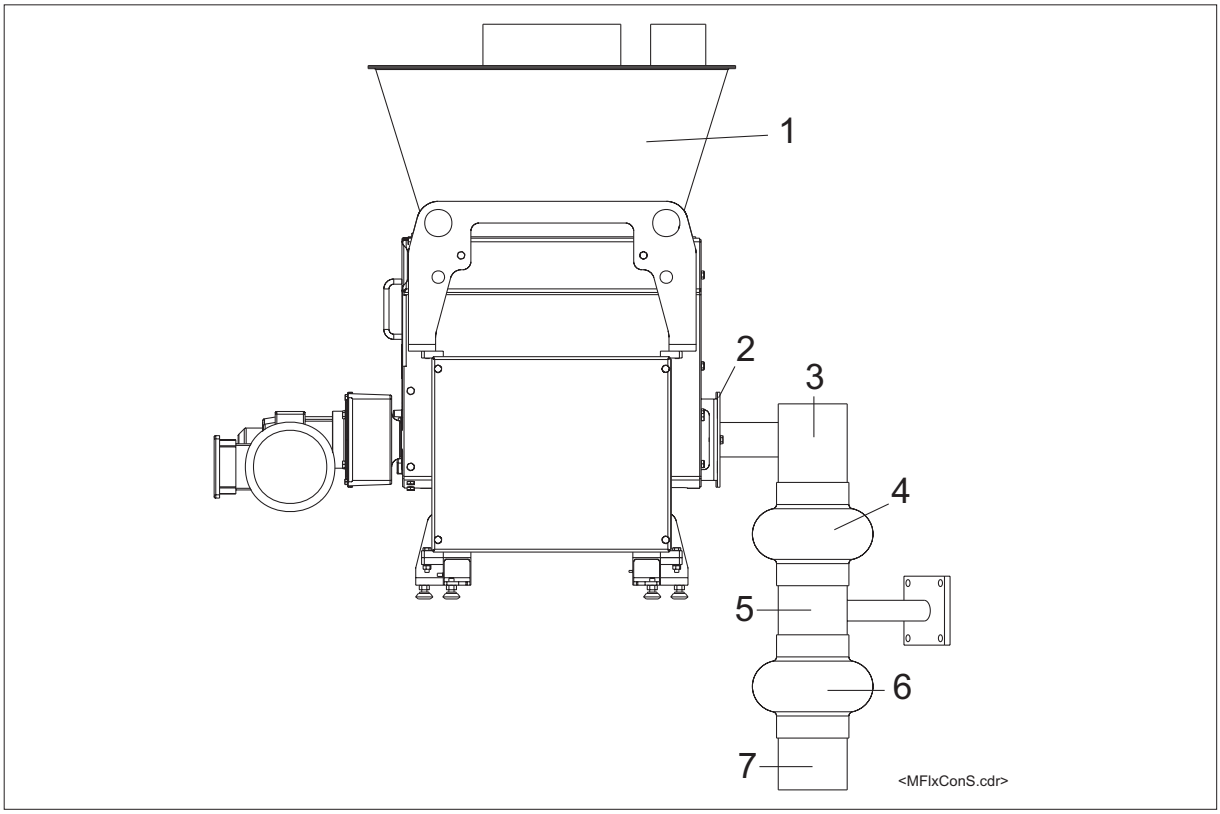


Figure 19: Flexible Connections-Discharge Outlet Installation

**Figure** 19 **call-outs**:

1 MechaTron feeder-extension hopper
2 Feeder outlet (nozzle and nozzle support assembly)
3 Downturn
4 Flexible connection (**upper**-isolates feeder from process)
5 Stationary support
6 Flexible connection (**lower**-isolates process from feeder)
7 Outlet to receiving vessel.

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# 3.11 Flexible Connectors

**If the feeder is interlinked with other devices or processes in the plant, the flexible connectors at material infeed and discharge points serve to protect the operator from contact with the rotating parts and bulk solids.**
**No feeder must be interlinked without the use of these flexible connectors.**

When using flexible connectors at the material infeed and discharge points, observe the following:

The **alignment offset (A) between the tubes** linked by using a flexible connector must not exceed **2mm (0.078 in.)**.

The distance (B) between the two tubes must comply with the indication of the drawing supplied with your order (cf. Tab 5 of the binder).

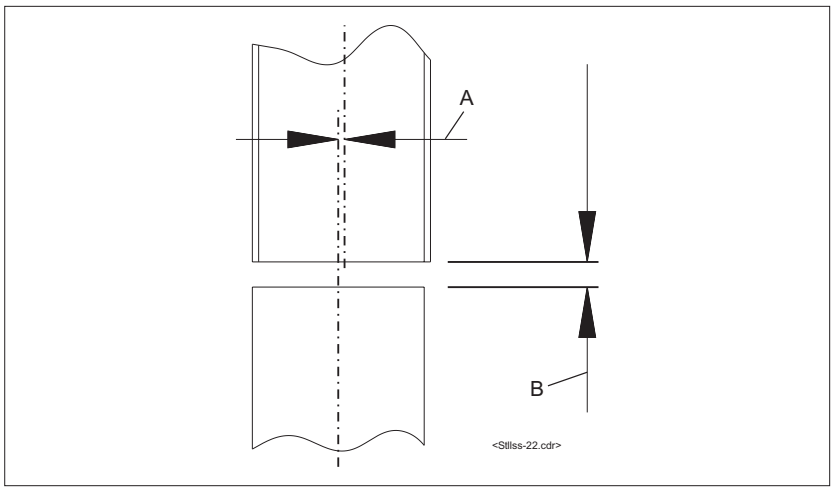


Figure 20: Flexible Connectors distance between tubes

Length of flexible connections should be kept to a minimum:
102 - 152mm (4 to 6 inches) is recommended. It is very important that enough clearance exists between connected parts so that unwanted disturbances to the system do not occur.

## 3.11.1 Mounting and Fixing Flexible Connectors

**Mount flexible connectors** so that the arrows (**1**) point downward.

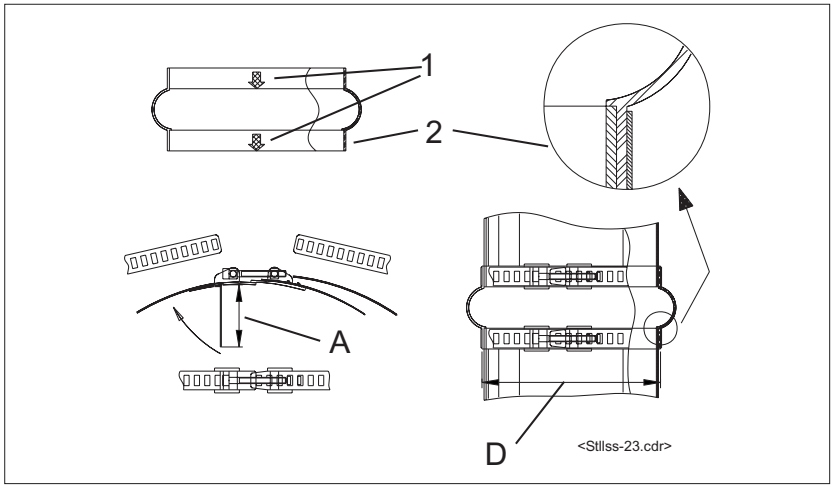


Figure 21: Flexible connectors mounting and attaching

- Draw the flexible connector lower sleeve (**2**) towards the end of the lower tube.
- Orient the flexible connector upper sleeve so that the flexible connector is free from tension, flexing and bending.

When using the **tension strips (hose clamps) for securely attaching flexible connectors**, observe the following criteria:

- Tension strip length “**L**” results from:
  L = (**D** x 3.14) + 10cm (3.9 in).
- Debur tension strip to protect persons from injury and flexible connectors from damage.
- Bend the tension strip at one end (**A ) by approx. 5cm (1.9 in), hook this end into the turnbuckle and bend strip completely, as above.**
- Place tension strip around the flexible connector sleeve and hook it onto the turnbuckle nose.
- Tighten tension strip with the use of the turnbuckle. Damage, flexing or bending should not be present on flexible connector.

# 4 Electrical Installation

**Refer to Tab 6-Electrical Drawings for electrical schematics, lay-out drawings and additional information.**

## 4.1 Connecting Electrical Equipment

Electrical wiring is performed in the electrical enclosure/electrical junction box.

For specific information concerning connection of power to your feeder system, refer to **Tab 6- Electrical Drawings** of the system binder.

## 4.2 Basic Electrical Information

Sound earth grounding techniques should be employed to ensure system safety and functionality:

- All power supplies terminated in the electrical enclosure/electrical junction box must originate from a common ground bus.
- The ground cables to the feeder and separate control enclosure(s) must originate from a common ground bus.
- Ground cables must be equal to (in gauge) or larger than the corresponding current-carrying conductors.
- Attach all control cable shields according to instructions in the appropriate system manual (refer to information in **Tab 3- Measuring and Automation System** of the system binder).

**Quality of power** entering the system is an important consideration and should be employed to ensure system safety and functionality:

- UPS (uninterruptible power source) is recommended for power systems that experience frequent interruptions and/or periodic voltage fluctuations.
- A lightning arrester is recommended for power systems that experience frequent voltage surges due to lightning or large inductive loads.
- A line reactor is recommended for power systems that experience frequent voltage spikes.

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# 5 Commissioning

## 5.1 Overview

**System set-up drawings and electrical schematics for your MechaTron feeder can be found at Tab 5-Mechanical Drawings and Tab 6-Electrical Drawings.**

Commissioning is the act of fine tuning and running a system properly once set-up and installation activities have been completed. Systems may be self-commissioned (i.e., the customer performs the activity) or commissioning may be performed by a competent third party such as SCHENCK. In any case, these instructions will help you achieve timely, accurate system commissioning and operation for greater control and system functionality.

Mechanical and electrical installation procedures can be found in **Chapters and** 4 respectively of this instruction manual.

Calibration information can be found in this chapter (**Items** 5.6**, page** 53 **and** 5.8**, page** 61) of the manual.

Operation and maintenance information can be found in **Chapters 6 and 7 respectively of this manual.**

And finally, troubleshooting information and related system data can be found in **Chapters 8 and 9** respectively of this manual.

## 5.2 Commissioning Procedures

- Applying power to the system.
- Ensuring that the motor controller is working properly.
- Ensuring that the entire infeed/discharge system (feed hopper, enclosure for discharge element and T-drive, helix, nozzle and downturn) is working properly.
- Securing appropriate infeed and discharge connections that are adequate for your requirements and do not introduce undesired disturbances into the system.
- Calibrating the system and ensuring output accuracy prior to operation.

## 5.2.1 Applying Power to the System

**Chapter** 4 of this manual details applying power to the MechaTron feeder system. Refer to this section prior to and during commissioning activities to ensure that all safety and customer requirements have been satisfied.

## 5.2.2 Motor Control Operation

A key to proper functioning of the MechaTron feeder system is accurate motor controller functioning.

Performance information, specifications and related data concerning your motor controller can be found at **Tab 2- Volumetric Controls** and **Tab 7- Accessories** of the system binder.

**Danger**: The motor control for feedrate should be set to "**0**" or **OFF** before power is applied. If this precaution is not followed, significant equipment damage and or bodily injury could occur. Refer to **Tab 2- Volumetric Controls**, for operating information concerning your feeder.

## 5.2.3 Infeed/Discharge System Operation

The infeed/discharge system is at the heart of the MechaTron feeder system. When this system works properly, system accuracy and operability are enhanced. Before proceeding, ensure that all infeed/discharge system components have been installed and are operating properly.

## 5.3 Filling the Hopper by Hand

The MechaTron hopper (feed or extension) may require hand filling during commissioning for calibration, first-run or a variety of other functional tasks.

**DANGER**: Be careful not to reach into the feed hopper when the feeder is running. Serious injury from the helix could result.

**To fill the hopper by hand**:

1. Ensure that the feed and/or extension hopper and enclosure for discharge element and T-drive have been installed properly.
2. Place an appropriately-sized container at the process end of the feeder beneath the nozzle outlet or downturn to catch the output.
3. Attain a safe position relative to the hopper to hand-feed (via bucket, scoop, etc.) enough material into the hopper to ensure complete covering of the helix flights and filling of the lower portion of the hopper.
4. Turn the drive motor on and observe evacuation of the hopper via the helix. Make adjustments to feedrate or modify other parameters as appropriate.
5. Observe the feed level in the hopper closely during system operation. If it appears that feed material will run out prior to the end of the test or operation at hand, refill the hopper from the outlet container or with fresh material.

## 5.4 Integration with Upstream/Downstream Devices

When installed in a total system environment, it is extremely important that careful consideration be given to the MechaTron feeder and its place in the overall system. Integration of the feeder with upstream and downstream processes and devices is key to proper functioning of the entire system.

**Key integration considerations include:**

- Appropriate connections to and from the feeder for upstream and downstream devices.
- Appropriate discharge vessel diameter at the outlet of the feeder.
- Adequate in-feed and venting for any dust collection or containment system that may be employed.
- Use of disturbance-controlled connections and SCHENCK supplied or approved flexible connectors.

**See Items 3.9, page 41 and 3.11, page 47 of this manual for more information.**

# 5.5 Operator Interface and Commissioning

Operator interface information, including motor control data and additional control parameters, can be found at:
**Tab 2- Volumetric Controls**,
**Tab 3- Measuring and Automation System** and
**Tab 7- Accessories**.

# 5.6 Calibration of Bulk Material Flow-Volumetric

**NOTE**: Refer to **Tab 2- Volumetric Controls** and / or **Tab 7- Accessories** for additional information on the motor controller that has been supplied with your system.

Your MechaTron feeder has been electronically calibrated at the factory to ensure linear helix speed (RPMs) throughout the range of motor speeds. However, it is difficult to accurately calculate material feedrate based on helix speed alone because:

- *The bulk density of the material being fed may vary.*
- *Consistency and accuracy of filled helix flights is estimated.*

For these reasons, your system should be calibrated on site for the material that will be used with the system.

**The purpose of system calibration** is to determine the parameters necessary to calculate the amount of material that will be fed at each motor speed setting.

**NOTE**: This calibration procedure will work for most materials. If gross material inconsistencies or other unusual conditions are present, alternate calibration or adjustments in agitation speed methods may be required. Contact your SCHENCK representative for more information.

## 5.6.1 Calibration Procedure

A **correct feedrate** is determined by:

- Helix speed
- Material bulk density
- Size and type of helix employed

**Equipment required** for this procedure:

- A large container to catch the test material
- An accurate scale to weigh the container and material
- An accurate timing device (i.e., stopwatch)

**Calibration Procedure**

1. Run the feeder for 5 to 10 minutes to ensure stable motor temperature.
2. Place the empty, large container on the scale and record the weight.
3. Fill the feed hopper with the material to be processed (see section 5.3, page 51).
4. Turn the feeder ON and run until the discharge nozzle is full of process material.
5. Set the feed rate potentiometer at 75% of maximum speed. See TAB 2 - Volumetric Controls for information on setting the potentiometer speed.
6. Collect and weigh 3 separate catch samples by running the feeder for one-minute intervals and weighing the samples after each interval. Record the data on the calibration calculation table on page 57 (see also Examples on page 59).

**Note:**
Shorter test intervals may be used if the catch container will not hold one-minute interval samples. If a shorter test interval is used, the measured weight must be equalized to the appropriate unit of time (weight/min or weight/hr). For example, a 30-second sample weight will be multiplied by 2 to compare to one-minute samples.

Longer test intervals to attain a measurable sample may be required if the feedrate is very low. If a longer test interval is used, the measured weight must be equalized to the appropriate unit of time (weight/min or weight/hr). For example, a 3-minute sample weight will be divided by 3 to compare to one-minute samples.

7. Next set the potentiometer at 50% of maximum speed.
8. Repeat step 6. Continue using 25% and 10% potentiometer settings and enter the values in the Calibration Calculation table, page 57.

**Note:**
Additional catch samples at other potentiometer settings may be required for some difficult to feed materials. Repeat step 6 as required with other potentiometer settings.

9. Calculate the Average Sample Weight by adding the three catch samples together and dividing by three.

**Note:**
Make sure that all samples are adjusted to use the same unit of time (weight / min or weight / hr).

10. Calculate the Average Net Weight by subtracting the sample container weight from the Average Sample Weight.

11. Plot the Average Net Weight for the various potentiometer settings on the calibration graph on page 58.

To determine the scale for the vertical axis (Net Weight), multiply the Net Weight value at the 50% potentiometer setting by 0.2 to get the Vertical Axis Scale Value.

Multiply the Vertical Axis Scale Value by 1 and enter this in position (a) on the graph. Multiply the Vertical Axis Scale Value by 2 and enter into position (b) and so on through position (j); see for example on page 59 and 60.

12. Connect the Average Net Weight points to determine the feedrate curve for the specific material in this feeder. This curve provides an estimated potentiometer setting for a selected feedrate.

**Note:**
The plotted curve of the Average Net Weight for the various motor speed settings (potentiometer setting) may not be a straight line.

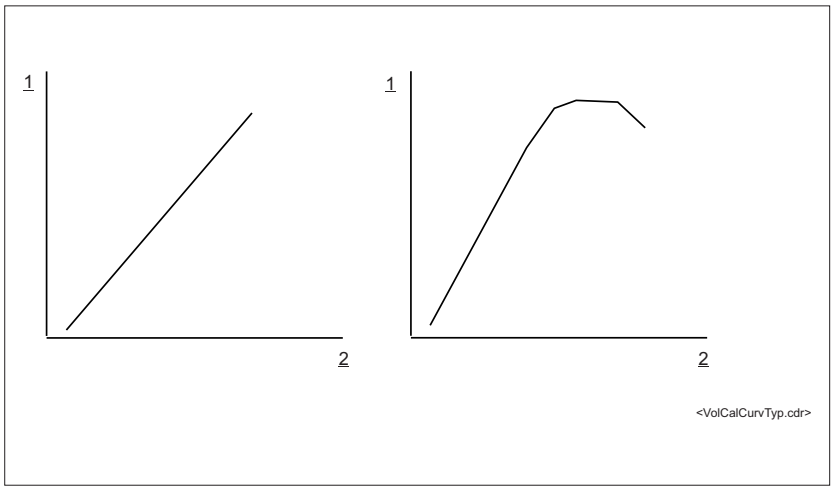


Figure 22: Typical Plotted Feedrate Curves

**Figure** 22 **Call-outs:**

**1** Weight per unit time
**2** Potentiometer setting (motor speed)

## 5.6.2 Feedrate Determination and Calculation

Once the volumetric calibration procedure has been completed, you will be able to find a motor speed setting (potentiometer setting) to obtain a desired feedrate.

**Note:**
If the plotted feedrate curve is not a straight line, a feedrate may have two motor speed settings. Always use the lowest motor speed setting.

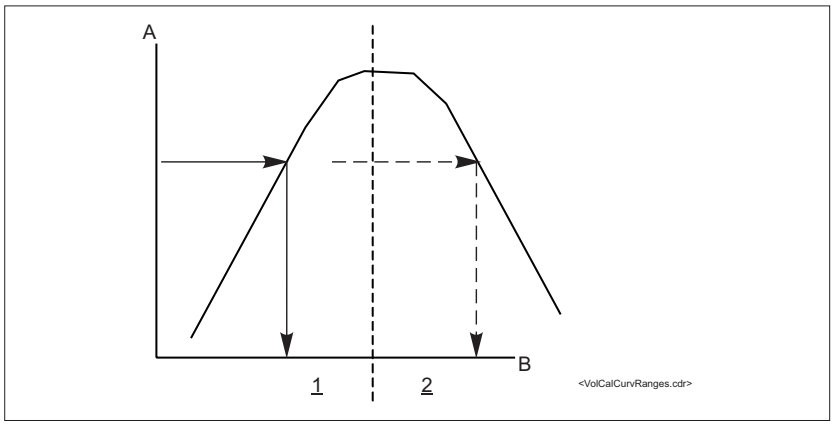


Figure 23 : **1** Acceptable and **2** unacceptable Operating Ranges

Figure 23 call-outs:
**1** Acceptable range
**2** Unacceptable ranges
A Net. weight value
B Potentiometer setting

1. Select a weight per unit time (weight/min or weight/hr) from the vertical axis that corresponds to the desired feedrate.
2. Move along a straight horizontal line to the right until the plotted feedrate curve is intersected.
3. Move down in a straight line to intersect the horizontal axis and read the corresponding motor speed setting for that feedrate.
4. Verify the motor setting by running at the motor speed setting from the selected Calibration Graph. Obtain several catch samples and determine the feedrate (see item 5.6.1, step 6). Minor adjustments to the motor speed setting may be required to achieve the desired feedrate.
5. Repeat step 4 as required.

**Note:**
The bulk solid properties could change over time. So it maybe necessary to check the calibration calculation periodically.

| Potentiometer Setting | Actual Sample Weights | Average Sample Weight | Sample Container Weight | Average Net Weight |
|---|---|---|---|---|
| **75 %** | | | | |
| **50 %** | | | | |
| **25 %** | | | | |
| **10 %** | | | | |

Table 1 : Volumetric Calibration Calculation Table

Vertical Axis Scale Value = Avg. Net Weight at 50% Potentiometer setting _____ x 0.2 =_____

Vertical Axis Scale Value at position:
(a) = 1x Vertical Axis Scale Value=_____
(b) = 2x Vertical Axis Scale Value=_____
(c) = 3x Vertical Axis Scale Value=_____
(d) = 4x Vertical Axis Scale Value=_____
(e) = 5x Vertical Axis Scale Value=_____
(f) = 6x Vertical Axis Scale Value=_____
(g) = 7x Vertical Axis Scale Value=_____
(h) = 8x Vertical Axis Scale Value=_____
(i) = 9x Vertical Axis Scale Value=_____

(J) 10x Vertical Axis Scale Value=_____

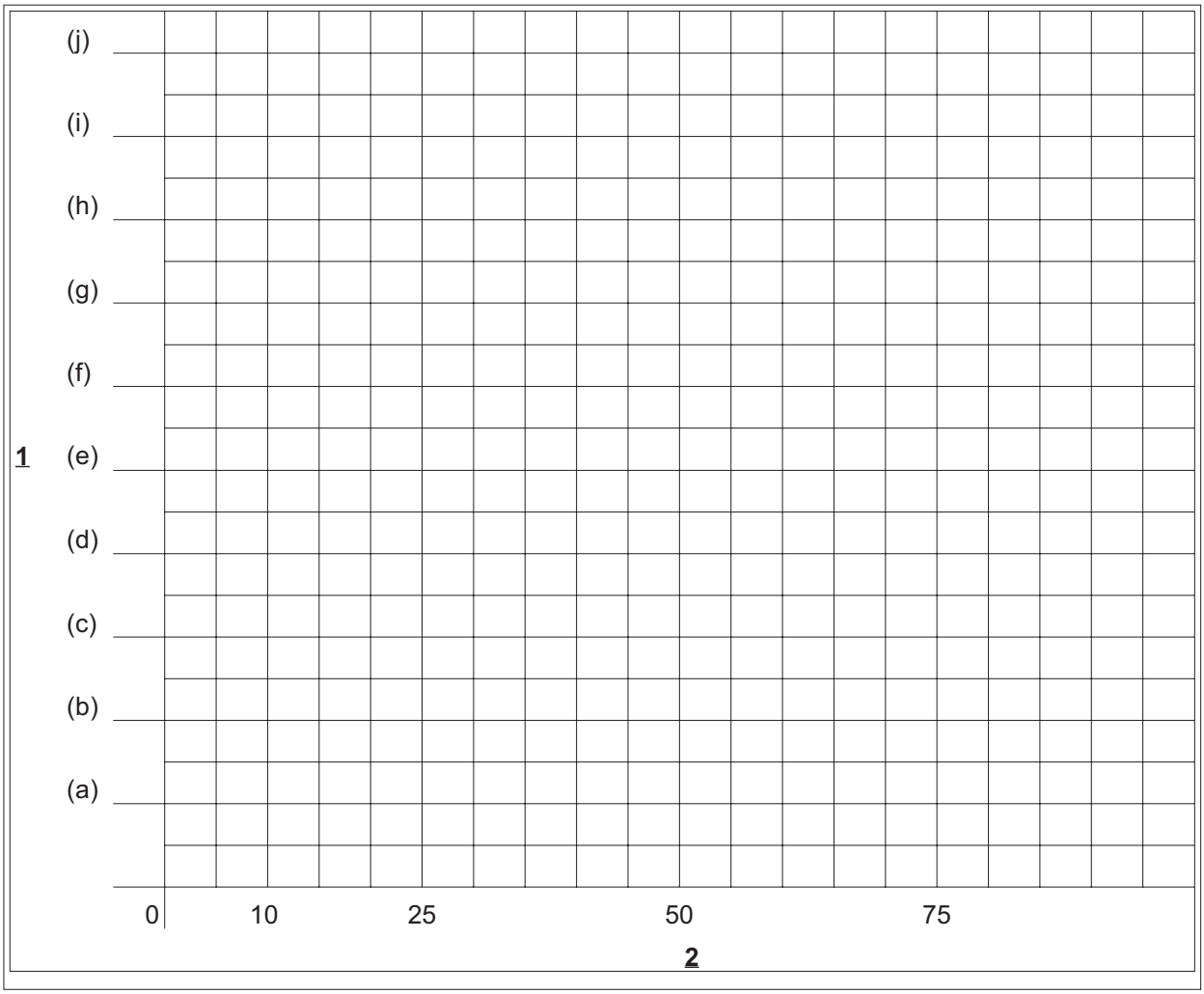


Table 2: Volumetric Calibration Graph

**Table 2 call-outs:**

**1** Average Net Weight in____per ____(weight /min. or weight / hr.)

**2** Potentiometer Setting (%)

# 5.7 Examples for Volumetric Calibration Calculation

| Potentiometer Setting | Actual Sample Weights | Average Sample Weight | Sample Container Weight | Average Net Weight |
|---|---|---|---|---|
| **75 %** | 204 | | | |
| | 208 | | | |
| | 213 | 208 | 3 | 205 |
| **50 %** | 180 | | | |
| | 175 | | | |
| | 179 | 178 | 3 | 175 |
| **25 %** | 85 | | | |
| | 87 | | | |
| | 83 | 85 | 3 | 82 |
| **10 %** | 35 | | | |
| | 33 | | | |
| | 33 | 34 | 3 | 31 |

Table 3 : Example vor Volumetric Calibration Calculation Table

Vertical Axis Scale Value = Avg. Net Weight at 50% Potentiometer setting 175 x 0.2 = 35

Vertical Axis Scale Value at position:

(a) = 1x Vertical Axis Scale Value= 35
(b) = 2x Vertical Axis Scale Value= 70
(c) = 3x Vertical Axis Scale Value= 105
(d) = 4x Vertical Axis Scale Value= 140
(e) = 5x Vertical Axis Scale Value= 175
(f) = 6x Vertical Axis Scale Value= 210
(g) = 7x Vertical Axis Scale Value= 245
(h) = 8x Vertical Axis Scale Value= 280
(i) = 9x Vertical Axis Scale Value= 315
(j) = 10x Vertical Axis Scale Value= 350

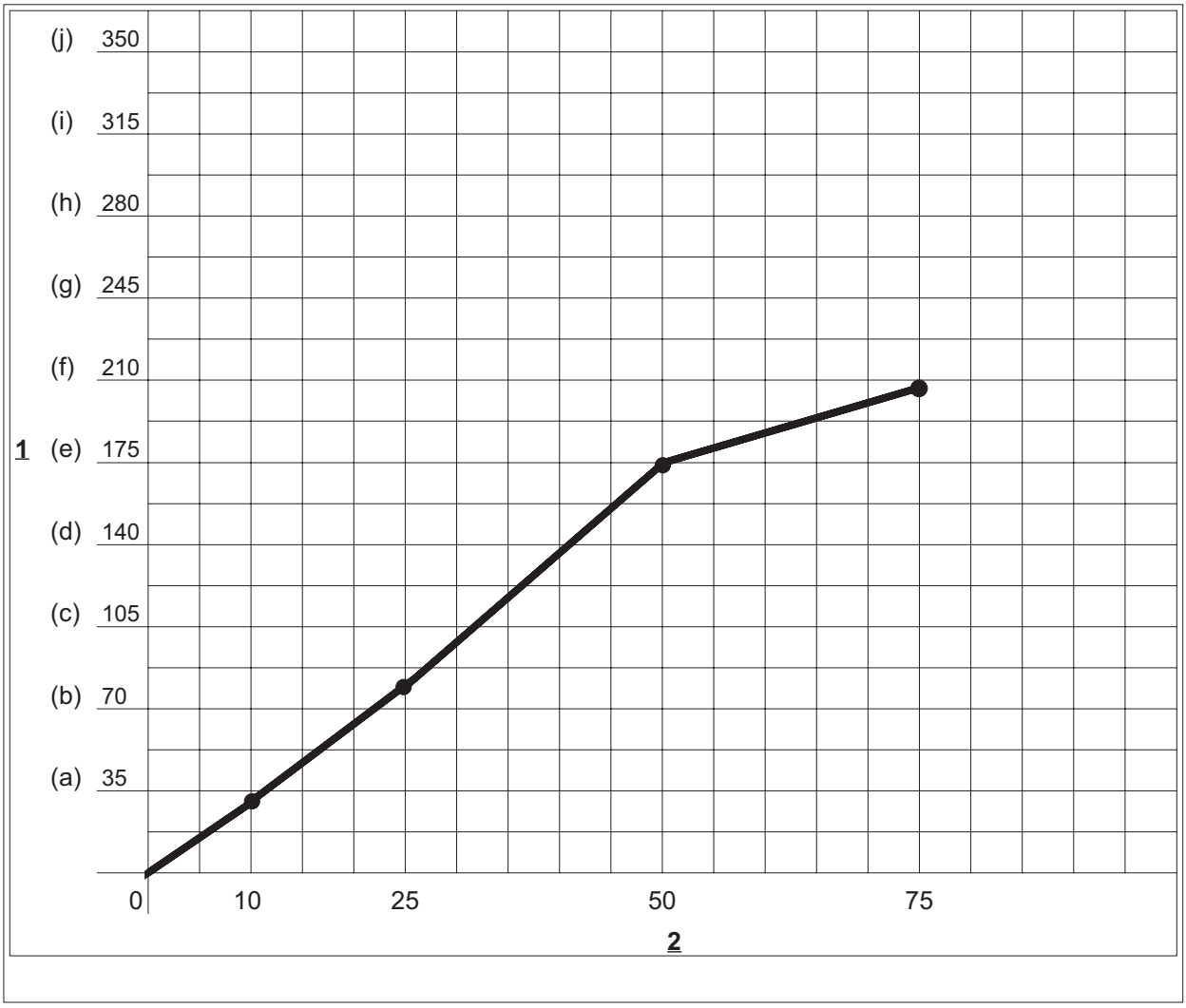


Table 4: Example for Volumetric Calibration Graph

**Table 4 call-outs:**

**1** Average Net Weight in_____per ____(weight/min. or weight/hr.)

**2** Potentiometer Setting (%)

# 5.8 Calibration of Bulk Material Flow-Gravimetric

Gravimetric calibration of your feeder system is dependent on the type of gravimetric system controller being employed. If the controller has been provided by SCHENCK, calibration information will be found at **Tab 3, Measuring and Automation System**. If the system controller has not been provided by SCHENCK, consult alternate supplier information manual(s).

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# 5.9 System Commissioning Checklist

The system commissioning checklist:

- Is a handy reference to ensure that all system components are installed properly and working according to requirements.
- Prompts you to check all connections to upstream/downstream devices to ensure that they are appropriate for requirements.

**System Commissioning Checklist**

*Before system operation*, verify that:

- ❑ An appropriate system site has been chosen and properly prepared.
- ❑ An adequate support structure has been provided for feeder system placement.
- ❑ The support structure for the feeder, controls and peripheral devices has a surface area equal to, or greater than, the total area required for equipment placement and servicing.
- ❑ System site location provides easy access for all service, maintenance and cleaning activities for the feeder and adequate operator activity room.
- ❑ System site location provides easy access to forklifts or other material handling devices that may operate in the area.
- ❑ All system components have been carefully unpacked, identified, verified to be in good physical condition, checked off the packing list or customer order sheet and placed in a secure location, convenient for installation activities.
- ❑ Responsible personnel, familiar with system design parameters,
  interconnection requirements and all safety considerations are closely involved with installation, commissioning and operation activities.
- ❑ Responsible personnel have familiarized themselves with all system manuals and technical documentation, all locally approved
  safety procedures and requirements and any site or customer-specific issues prior to system installation and operation.
- ❑ Responsible personnel supervise the physical installation of the system. Only qualified and properly-trained personnel perform electrical connection hook-ups and any other tasks that require advanced knowledge or skills to properly install the system.
- ❑ All component parts of the system are properly installed, appropriately connected and set up per overall system requirements and engineering drawings.
- ❑ All connections to and from the feeder are appropriate for the requirements of the system.

- The feeder is level and true to the ground and appropriately secured to its base for optimum functionality.
- Electrical grounding and quality of power considerations have been adequately addressed to ensure safe and accurate operation of the feeder system.
- All mechanical connections to upstream/downstream devices and processes are appropriate, secure and stable.
- All mechanical/electrical connections to system components are secure, stable and appropriate per the engineering drawings and customer requirements.
- Any outstanding issues that have arisen during installation, commissioning or operation have been identified and resolved.

# 6 Operation

**WARNING**: Only skilled and authorized personnel may operate the MechaTron feeder in accordance with instructions provided in this manual. Operators must know and follow all in-plant safety regulations and accident prevention rules.

**The MechaTron feeder can be controlled and operated either manually or automatically.**

**Before operating the system**, determine which mode of operation is desired and reference either:

- **Tab 2-Volumetric Control Information** of the system binder using the system motor controls.
- **Tab 3-Measuring and Automation System** of the system binder using the system controller.

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# 7 Maintenance

## 7.1 Inspection

**DANGER**:
If inspection, maintenance or repair work requires safety guards or devices to be removed or disconnected, **lock out power to the feeder** and protect the machine from inadvertent restart while work is being performed.

Your MechaTron feeder has been designed and constructed of the highest quality, long-life materials and components. Due to this extended-use design, long-term, maintenance-reduced operation will result.

**NOTE**: Remove back panel, belt cover and if necessary other parts to perform these maintenance activities.

**Visual Check**

- **During normal maintenance cycles, visually inspect these feeder components:**
  - Seals
  - Bearings
  - Helix

If inordinate wear on any of these components is observed or irregular performance during operation is noted, servicing and/or maintenance should be performed.

## 7.2 Preventive Maintenance

A preventive maintenance schedule is strongly recommended to maintain your MechaTron feeder at peak functionality.

- **During normal maintenance cycles, visually inspect, check and clean, as required:**
  - Seals
  - Bearings
  - Helix

- **At regular intervals**:
  - Check the helix for status and attitude.
  - Check the seals and bearings for wear and clean or replace as necessary.

- **On a time interval in accordance with supplier documentation**:
  - Perform all suggested maintenance checks and procedures.

**Refer to supplier documentation for instructions.**

**WARNING**: *Excessive Agitation Speed*
It is very important to keep hopper agitation speed as slow as possible while consistently feeding material. This agitation speed should be reviewed if feedrates change since reduction ratio changes may also be required. **Agitation speeds greater than 100 rpm** may result in **load cell noise, excessive frame vibration** and/or **premature component wear**.

## 7.3 Washdown

Washdown of your Mechatron feeder should be performed on a regular basis.

For washdown instructions, refer to the Mechatron Feeder Washdown Instructions Addendum found in your documentation binder.

# 7.4 Maintenance Procedures

**SAFETY NOTE**: Remove and lock out power to the feeder system before performing any maintenance procedures. If this lock out procedure is not performed, equipment damage and/or personal injury, including death, could result.

## 7.4.1 Remove Back Panel

**NOTE**: Removal of the feeder back panel is necessary to expose system components on the service side (back) of the unit.

**Back panel removal**:

1. Hand knobs are provided for easy removal on standard models.
2. Disconnect power to the feeder.
3. Loosen retention bolts (2) on the back panel (do not remove).
4. Grasp the back panel by the transport handle and lift away from the feeder frame. See figure 24, page 69.
5. Place the panel in a secure location for immediate replacement after maintenance work is completed.

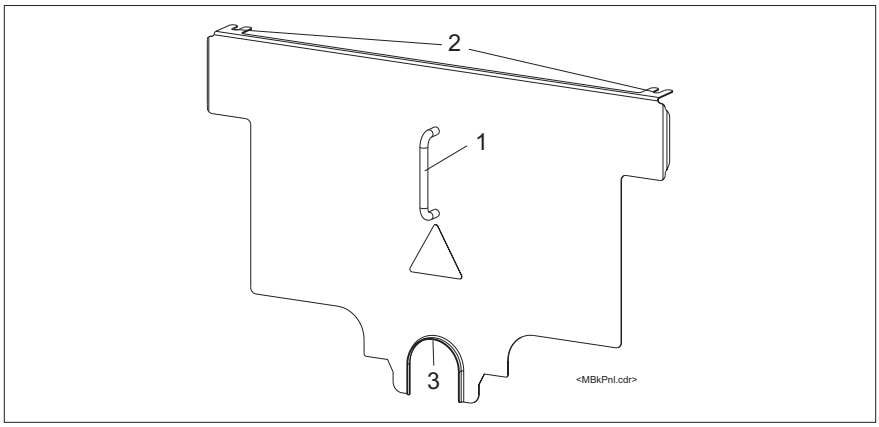



Figure 24: MechaTron Back Panel

**Figure** 24 **call-outs**:

1 Transport handle
2 Back panel retention bolt locations
3 Lower hopper mantle.

**NOTE**: To access system components inside the feeder frame, you must disengage the drive motor assembly and swivel it away.

## 7.4.2 Disengage Helix Drive Motor

**Cast swivel motor assembly disengage**:

1. **Disconnect and lock out power to the feeder**.
2. The gear motor and T-drive assembly couplings are properly aligned during operation. To disengage this union, turn gear with a suitable tool until the lock areas on the gear pin are in vertical position.

**NOTE:** Some gear ratios may require jogging of the motor to achieve proper in alignment.

3. Disengage the swivel stop bolt (see item 6, figure 25, page 70).
4. Grasp the swivel motor assembly casting and lift up and rotate to the stop position (see figure 26, page 70).
5. Allow the swivel motor assembly to rest in this position while performing service and/or maintenance activities.
6. Once these activities are completed, swivel the motor down to the operating position, tighten the swivel stop bolt and reengage gear motor and T-drive couplings after ensuring corrrect alignment.
7. Restore power to the system and resume operating activities.

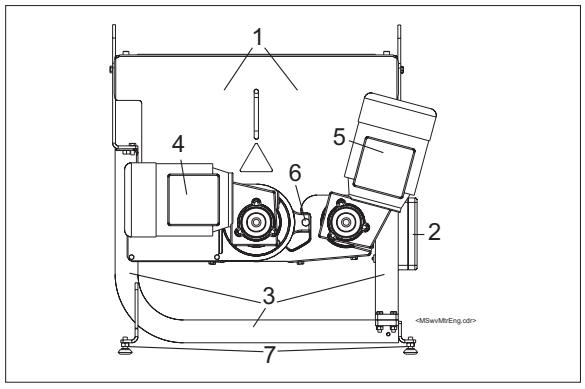



Figure 25: Helix Drive Motor Assembly- Engaged

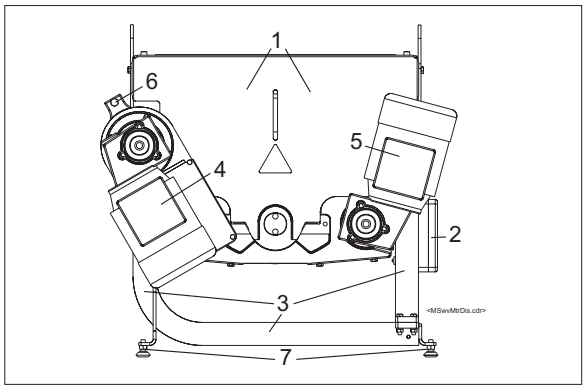



Figure 26: Helix Drive Motor Assembly- Disengaged

**Figures** 25 **and** 26 **Call-outs**:

1 Back panel
2 Electrical enclosure/electrical junction box
3 Feeder structural support
4 Feeder leveling and anchoring base(s)
5 Helix drive motor and swivel motor casting assembly
6 Swivel stop bolt.

## 7.5 Remove the Quill and Helix

**Quill/Helix removal**:

1. **Disconnect and lock out power to the feeder**.
   Ensure that the feed hopper is empty, disengage the swivel stop bolt, grasp the motor swivel casting and rotate to the stop position.
2. Loosen the quill clamp bolts at the sides of the bracket.
3. Carefully slide the quill assembly out and away from the hopper spout. The helix is attached to the quill via the T-drive shaft and will be removed as the quill assembly is removed.

## 7.6 Remove Feed / Extension Hoppers

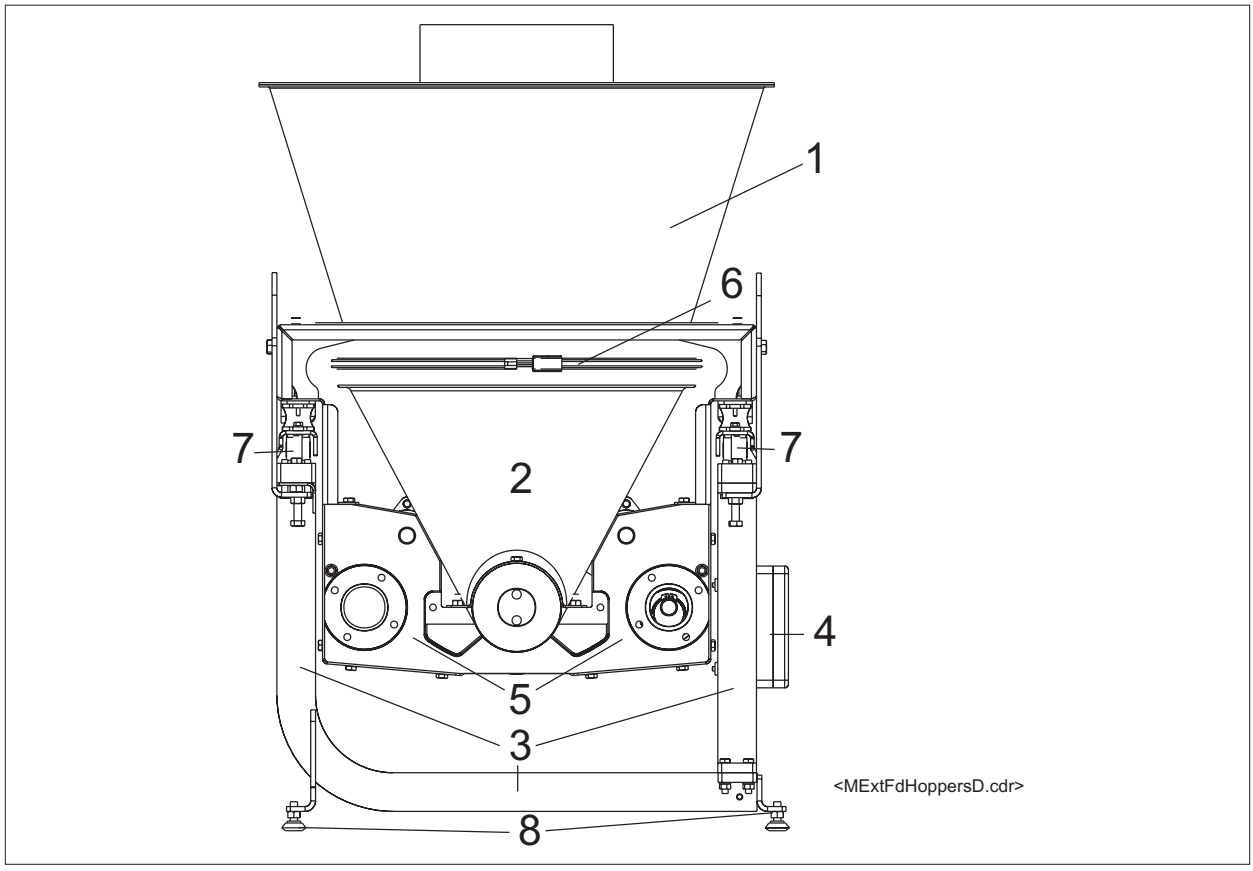
**Feed hopper removal**:

1. Prior to proceeding, ensure that:
   -**Power is disconnected and locked out**.
   -The feed hopper is empty.
   -The drive motor swivel casting is swiveled away.
   -The quill and helix are removed.
2. Reach inside the feeder frame and release the band clamp connecting feed and extension hoppers.
3. Open the band clamp and place around the lower flange of the extension hopper, then close the clamp and leave it there.
4. Carefully pull the feed hopper out and away from the feeder frame and store in a secure location.

**Extension hopper removal**:

1. **Disconnect and lock out power to feeder** and ensure that any connections at the top of the hopper are removed.
2. If the feed hopper is still in the feeder frame, follow the feed hopper removal procedure.
3. Remove all four bolts at the base of the extension hopper that screw into the top of the feeder frame.
4. Lift the extension hopper up (to clear the ring barrier) and off of the feeder frame and store in a secure location.

**See figure** 27**, page** 72 **for correct hopper orientation.**


1
6
7
7
2
4
5
3
8
<MExtFdHoppersD.cdr>

# 7.7 Remove/Replace Bearings-Adjust Agitation Paddle Depth

**NOTE**: Although the extension hopper may remain in place for this procedure, **the feed hopper must be removed**. This procedure involves the removal of both drive motors at the back of the feeder.

**To remove/replace bearings**:

1. **Disconnect and lock out power to the feeder**.

**Warning**: Support the helix drive motor assembly as the screws are removed. Failure to do so may cause the motor to fall and become damaged.

2. Remove helix drive motor / swivel drive motor assembly.
   Loosen the swivel stop bolt at the side of the swivel drive casting and remove the snap retaining ring (using a snap retaining ring tool) holding the swivel box to the back plate.
3. Carefully slide the swivel casting and motor assembly off the helix drive shaft and out and away from the back of the feeder. Place in a dry, safe area for easy reinstallation.
4. Remove agitation gear motor assembly.
   **Warning**: Protect the agitation gear motor from damage through falling down.
   Once the helix drive motor assembly is removed, reach inside the feeder to the inner face of the back plate. Locate the four screws located there and remove with a wrench.
5. Carefully slide the motor assembly out and away from the drive shaft and back plate. Place in a dry, safe area for easy reinstallation.
6. Remove the feed hopper from the feeder frame along with the quill, quill clamp and T-drive assembly.
   Remove the bolts fastening back plate to main feeder frame. Remove the back plate. This action will expose the paddle shafts and the back bearings (item 2, figure 28, page 74).
7. On the back plate, push the bearing(s) out and replace.
8. The front (process side) bearings (item 3, figure 28, page 74), are bolted in place and these bolts must be removed before the bearings can be replaced.

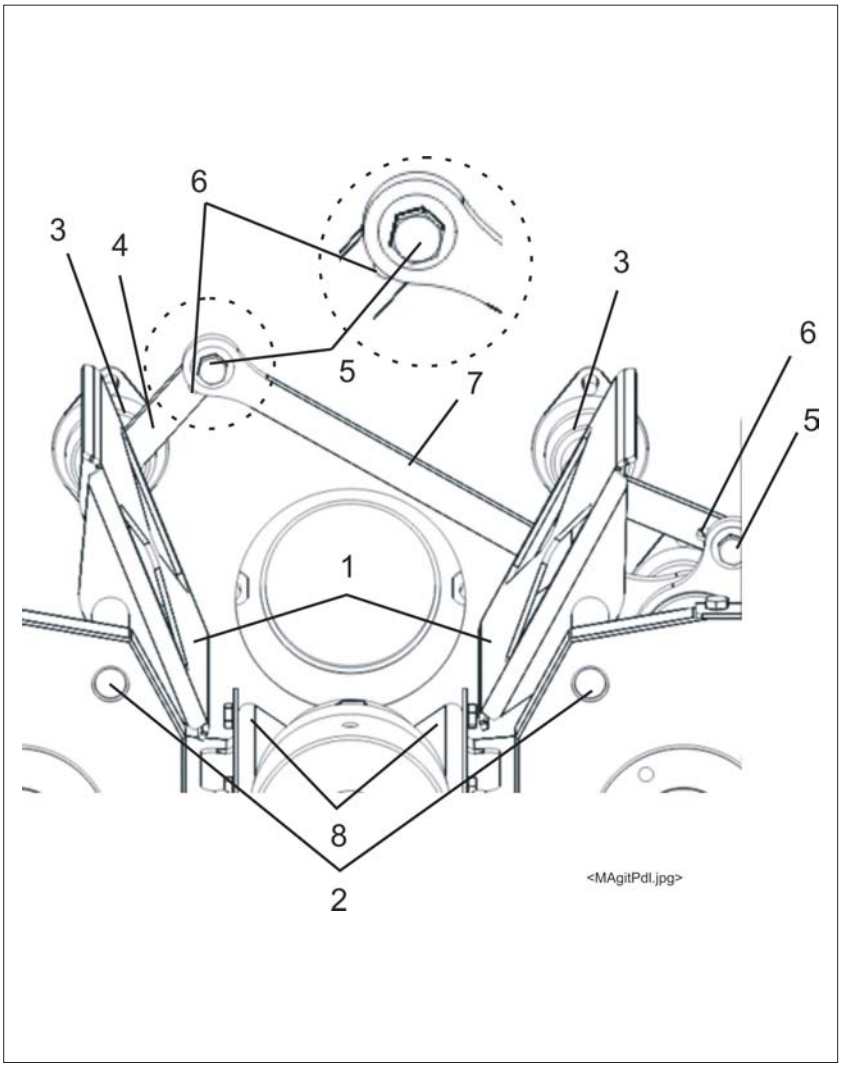



Figure 28: MechaTron Agitation Paddle Assembly

**Figure** 28 **call-outs**:

1 Agitation paddles
2 Back (service side) bearings
3 Front (process side) bearings
4 Agitation paddle lever
5 Connector bolt (in low agitation setting)
6 Alternate (high) agitation setting
7 Agitation linkage assembly
8 Saddle

# 7.8 Adjust Agitation Paddle Depth

**To adjust agitation paddle depth**:

1. With the feed hopper removed, reach into the feeder frame toward the process side (front) of the feeder.
2. Locate the agitation linkage assembly (item 7 in figure 28, page 74) near the front bearings.
3. Remove the bolt from the agitation paddle lever bar and replace in the alternate hole beneath it. See items 4 and 6 in figure 28.
4. Repeat step 3 for the alternate side of the agitation linkage and tighten both bolts.

**NOTE**: The feeder is shipped with the agitation assembly set at the upper bolt (for standard agitation). Most applications will use this standard agitation depth setting. Change to the lower bolt on the assembly if deeper penetration is desired.

**WARNING**: Agitation paddle depth settings on both paddles must be the same (i.e., both at standard setting or both at deeper penetration setting). See Troubleshooting section 8.4.

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# 7.10 Weighing Module / Load Cell Maintenance

Weighing module or load cell maintenance may be required periodically, especially if the load cell assembly has been subjected to out-of-tolerance loads or accidental bumping or other types of damage. In these cases, replacement of the load cell / weighing module is required. Since setting the load cells between plates, brackets and load cell stops requires exact settings, this work is best performed by qualified SCHENCK personnel.

## 7.10.1 Using Feeder Lifting Device to Service Load Cells

**To use the feeder lifting device (FLD) to service load cells:**

See Figures 29, 30, and 31, Page 78 for illustrations.

1. Disconnect the load cell wire(s) and thread through the feeder frame to free them (weighing module [Item 3, in figures]).
2. Loosen the nut (Item 1, in figures) at the base of the FLD (Item 6, in figures) and slide the FLD in until it contacts the side of the feeder frame.
3. Insert the screw (Item 2, in figures) through the slot at the upper portion of the FLD and thread into the feeder frame (**loosely**).
4. Lower the FLD by loosening the nut (Item 1, in figures) at the base of the FLD until the upper screw (Item 2, in figures) is at the top of the upper screw slot.
5. Tighten the upper screw (Item 2, in figures) so that the FLD is positioned tightly against the feeder frame.
6. Loosen the weighing module (Item 3, in figures) bolts (two on top, four on bottom).
7. Raise the feeder frame approximately 3mm (0.10 inch) by turning the nuts (Item 1, in figures) (two/FLD) clockwise.
   Remove the weighing module (item 3, in figures).
8. Place a new weighing module assembly into the framework and secure by replacing and tightening the bolts in step 6.
9. Place the FLD in the **operating position** (top portion of FLD away from the feeder frame [Item 5, in figures], screws [Item 2, in figures] removed from the feeder frame [Item 5, in figures] and nuts [Item 1, in figures] beneath FLD tightened).

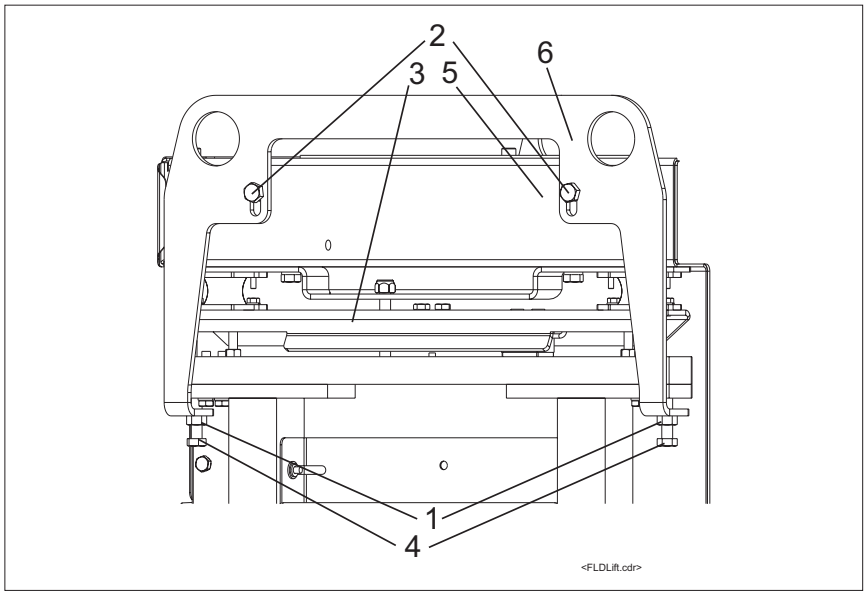


Figure 31 Feeder Lifting Device (FLD) Lifting Positon

Figures 31, 29, and 30 call-outs:

1 Nuts for lifting the FLD
2 Screws to connect the FLD with the feeder frame (main frame)
3 Weighing module.
4 Screws for the lifting nut (1)
5 Feeder frame (main frame)
6 Feeder lifting device (FLD)

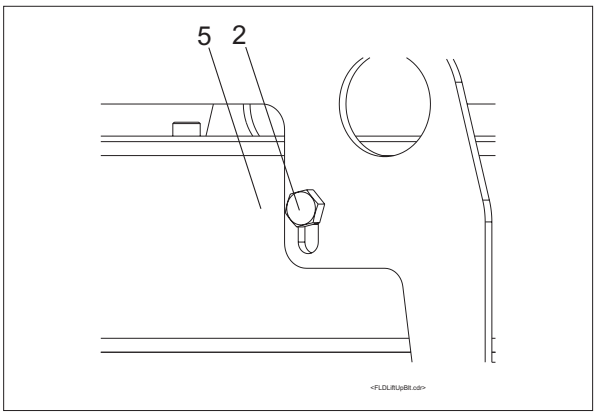


Figure 29: FLD in Lifting Position Upper Screw

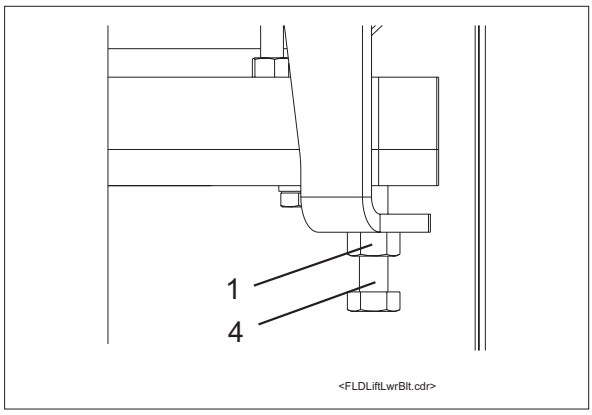


Figure 30: FLD in Lifting Position Lower Screw

# 7.11 Placing Feeder Lifting Device for Gravimetric Operation

**Procedure for placing the FLD in the operating position:**

See figures 29, 30 and 31, page 78 for illustrations.

1. Remove the screws (2) securing the FLD to the top of the feeder frame (5) (two per FLD) .
2. Loosen the nuts (1) at the base of the FLD and slide the FLD away from the feeder until the vertical (fixed) screws (4) bottom out in their slots.
3. Tighten the nuts (1) at the base of the FLD (6).

# 7.12 Placing the Feeder Lifting Device in the Shipping Position

See figures 29, 30 and 31, page 78 for illustrations.

1. Loosen the nuts (1) at the base of the FLD.
2. Slide the FLD (6) in towards the feeder frame (5) until the top portion contacts the feeder frame, then tighten the nuts at the base of the FLD.
3. Fasten the top portion of the FLD securely to the feeder frame with the screws (2) (two per FLD).

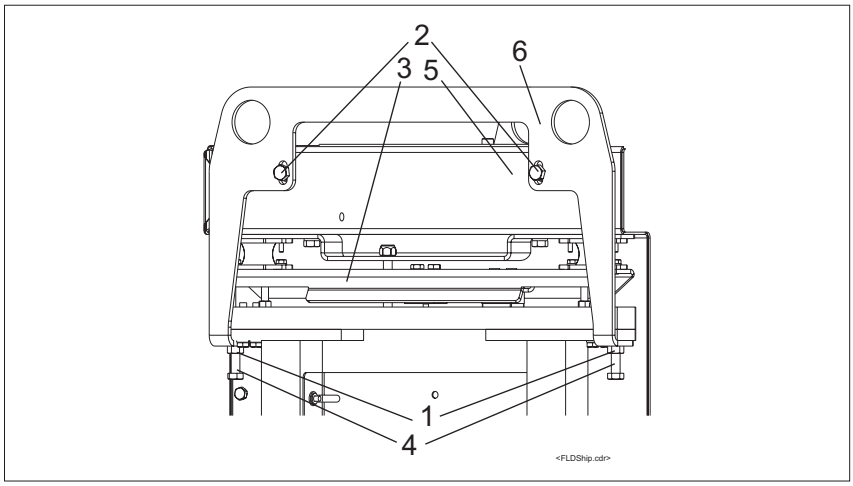


Figure 32: FLD (Feeder Lifting Device)- Shipping Position

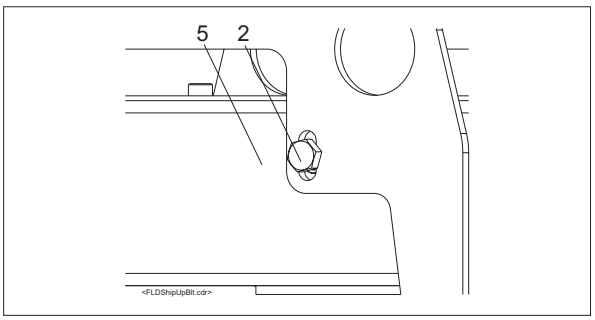


Figure 33: FLD in Shipping Position Upper Screw

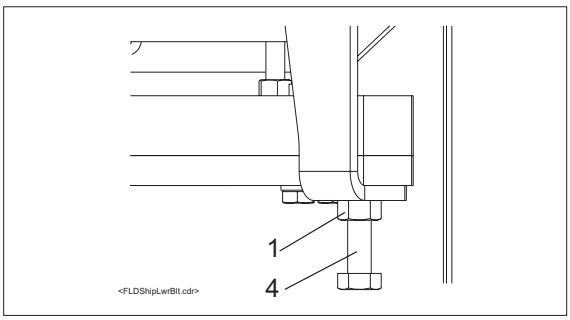


Figure 34: FLD in Shipping Position Lower Screw

# 7.12 Changing Paddling Frequency

Varying bulk solids properties may ask for a change of the paddling frequency.

To change frequency:

- Set frequency on existing control unit in accordance with material requirements.

  If the motor controller is not yet installed, check for installation prerequisites and mount unit.

  Inappropriate controllers can be destructive to unit or motor.

- Attaching geared motor or gearbox, with other ratio for paddle drive.
  In some cases, only the gearbox and not the complete geared motor reducer must be replaced. For relevant instructions, please see motor reducer description included in your MechaTron binder.

Dismounting of the geared motor reducer is detailed below.

## 7.12.1 Exchanging Agitation Gear Motor

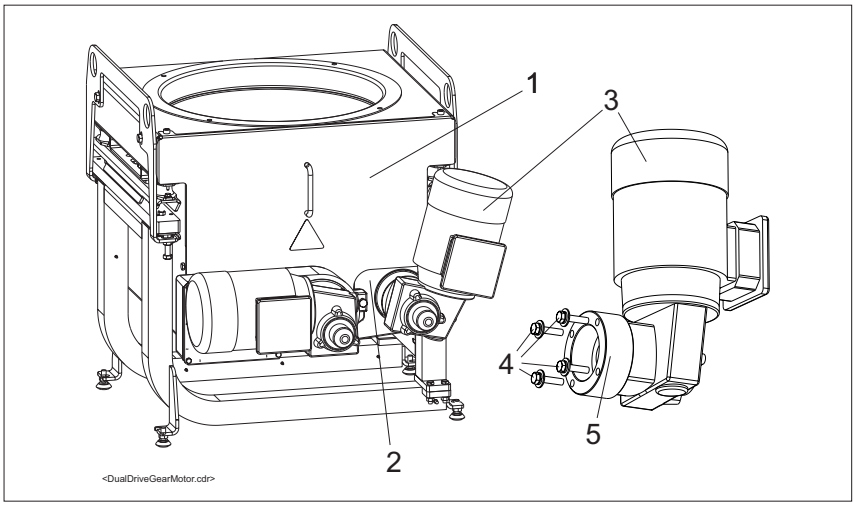


Figure 35: Agitation Gear Motor

To exchange geared motor:

**Disconnect feeder from power supply and protect from inadvertent restart.**

- Dismount back panel (1) on feeder service side.

**To prevent injury and damages from occurring, protect geared motor (3) from uncontrolled slewing about the paddle drive shaft when extracting geared motor from drive shaft.**

- Remove bolts (4) from the back plate (2) side inside of feeder.
- Extract geared motor from paddle mechanics drive shaft.
- To remove spacer (5) from geared motor (3), extract spacer from gearbox centering flange. Keep spacer (5) for reuse when mounting of new geared motor.

To install new geared motor, reverse this procedure. Watch out for damage and dirt and remove before mounting.

# 8 Troubleshooting

**NOTE**: Verify that all system components have been installed correctly and are working properly prior to proceeding with troubleshooting activities.

**DANGER**: **Remove and lock out power to the feeder** before performing any troubleshooting activities. Failure to do so could lead to injury or death and/or damage to the feeder.

## 8.1 Clearing a Foreign Object from the Feeder

**Problem**: Motor stalls out or material blockage occurs.
*Solution*:

- Identify probable location of foreign object.
- Remove helix and nozzle and search for foreign object in that area.
- If object is not found, remove feed and/or extension hoppers and search for object in that area.

# 8.2 Removing a Damaged Helix

Problem: Helix has been damaged and must be removed.
Solution:

- Look at discharge end (process side) of feeder. If helix is not visible, it probably is damaged and should be removed from the service side (back) of feeder, if possible.
- Disengage appropriate components from feeder and carefully remove helix and nozzle.
- Order and install a new helix.

**WARNING: DO NOT TRY TO REPAIR AND USE THE OLD HELIX!**

**NOTE**: In certain extreme cases, the helix may be so damaged that other parts may also have to be removed and replaced since they will have been damaged in removing the helix.

# 8.3 Material Feeding Issues

**Material Bridging**

**Problem**: Material is bridging in the hopper prior to processing.
*Solution*:

- Check material size and/or consistency.
  Is feeder set up for this type of material?
  If not, adjust the agitation paddle depth to generate deeper paddle penetration (which may be required for lower density material).

**Material Compaction**

**Problem**: Material is compacting in hopper and helix either freezes or stalls out. Flights may be full and/or drive motor stalls out.
*Solution*:

- Install a larger helix and reduce motor speed.
- Adjust the agitation paddle setting (less penetration-standard setting).
- Adjust helix speed or modify gearing to lower agitation paddle speed.

**Material Plugging**

**Problem**: Due to material size or consistency, pinching, binding and/or plugging occurs at various places in the feeder.
*Solution*:

- Is material binding at nozzle (material between helix and nozzle) causing stalling and spitting?
  -Try a smaller helix and run at greater speed.
- Is helix turning or is there difficulty in removing the helix?
  - Try a smaller helix in the feeder and run at greater speed.
- Is a signal present from the controller?
  -Check the system controller for malfunction.

**Material Stalling**

**Problem**: Feeder stalls out during operation.
*Solution*:

- This condition signals a helix problem. Install a smaller helix and run the feeder at a faster rate.

## 8.4 Material Agitation Issues

Problem: **Mechanical or Electrical?**
Material agitation issues will be either mechanical or electrical in nature.
*Solution:*
Is agitation running?

- Check agitation and the agitation motor.

If the agitation motor seems to be the cause, repair or replace.

## 8.5 Bulk Solids Leakage

**Problem:** Bulk solids leak from areas of feeder.
*Solution*:

- Material leakage appears to come from union between feed and extension hoppers.
  -Reinstall band clamp and ensure that union is tight.
- Material leakage appears to come from back (service side) of feeder in the area of the quill assembly.
  -Material seal in quill has broken down and needs replacement.
  -Hose clamp needs to be tightened.
- Material leakage appears to come from front (process side) of feeder in the area of helix and nozzle.
  -Install a hose clamp at nozzle/helix junction and tighten.

## 8.6 Oil Seepage

**Problem**: **Oil seepage.**
This condition may occur from two areas of the feeder.
*Solution*:

- **Gearbox**
  -If the gearbox leaks, this is an indication of a defective unit and the gearbox should be replaced.
- **Agitation Paddle Bushings**
  -These bushings may leak slightly when the feeder is first started and during a short break-in period. After a reasonable period of normal usage, though, they will self-seal and not pose any problem.

# 9 Data

## 9.1 Technical Data

For technical data concerning your MechaTron feeder, see the specification sheet(s) supplied with your order.

### Sound Pressure:

The continuous sound pressure levels are lower or equal then 70dB(A).

### Theoretical Feedrates

See TAB 4 in your MechaTron Binder.

## 9.1.1 System Weight and Capacity

| COMPONENT | WEIGHT kg (lbs) | CAPACITY $dm^3$ (cu ft) |
|---|---|---|
| **Feeder Stand** | 23 (52) | |
| **Feeder** (Tare *) | 98 (215) | 35 (1.2) |
| **Extension Hopper** (empty) | | |
| $75dm^3$ | 7,1 (15.8) | 75 (2.5) |
| $210dm^3$ | 12,7 (28) | 210 (7) |
| $380dm^3$ | 25 (55) | 380 (13.4) |
| **Hopper Cover** | | |
| $75dm^3$ | 50 (110.25) | |
| $210dm^3$ / $380dm^3$ | 50 (110.25) | |
| **TOTALS (System Weights)** | | |
| Total Volumetric Weight = Stand + Feeder + Extension Hopper (if used) + Cover (if used) | | |
| Total Gravimetric Weight = Stand + Feeder + Extension Hopper + Cover | | |
| Gravimetric Weighed Portion = Feeder + Extension Hopper (if used) + Cover (if used) | | |
| * Tare is the weighed section in gravimetric systems. | | |

Table 5: MechaTron Component Weights and Capacities

# 9.2 Miscellaneous System Data / Conversion Table

| METRIC | ENGLISH | ENGLISH | METRIC |
|---|---|---|---|
| **Weight** (basic unit is gram-g) | | | |
| 1 gram | .03527 ozs. | 1 oz. | 28.4 g |
| 1 kg | 2.205 lbs. | 1 lb. | .454 kg |
| 1 kg | 35.3 ozs. | 1 oz. | .028 kg |
| 1 Metric Ton | 2204.6 lbs. | | |
| **Length** (basic unit is meter-m) | | | |
| 1 m | 3.281 ft. | 1 ft. | .305 m |
| 1 m | 1.094 yds. | 1 yard | .914 m |
| 1 cm | .393 ins. | 1 inch | 2.54 cm |
| 1 mm | .039 ins. | 1 inch | 25.4 mm |
| **Capacity** (basic unit is liter-l) | | | |
| 1 l | 61.023 cu. ins. | 1.057 quarts | 1 liter |
| 1 l | .03531 cu. ft. | 1 cu. ft. | 28.32 l |
| **Force/Stress** (basic unit is pascal = 1 Newton (N)/square meter | | | |
| 1 N | .225 lbs. | 1 lb. | 4.448 N |
| 1 Nm | 8.85 lb. ins. | 1 lb in. | .113 Nm |
| 1 Nm | .738 lb. ft. | 1 lb. ft. | 1.355 Nm |

Table 6 : Metric-English Conversion Factors

**NOTE:** *Multiply cubic feet x 28.32 to calculate liters.*
*Multiply liters x 0.03531 to calculate cubic feet.*

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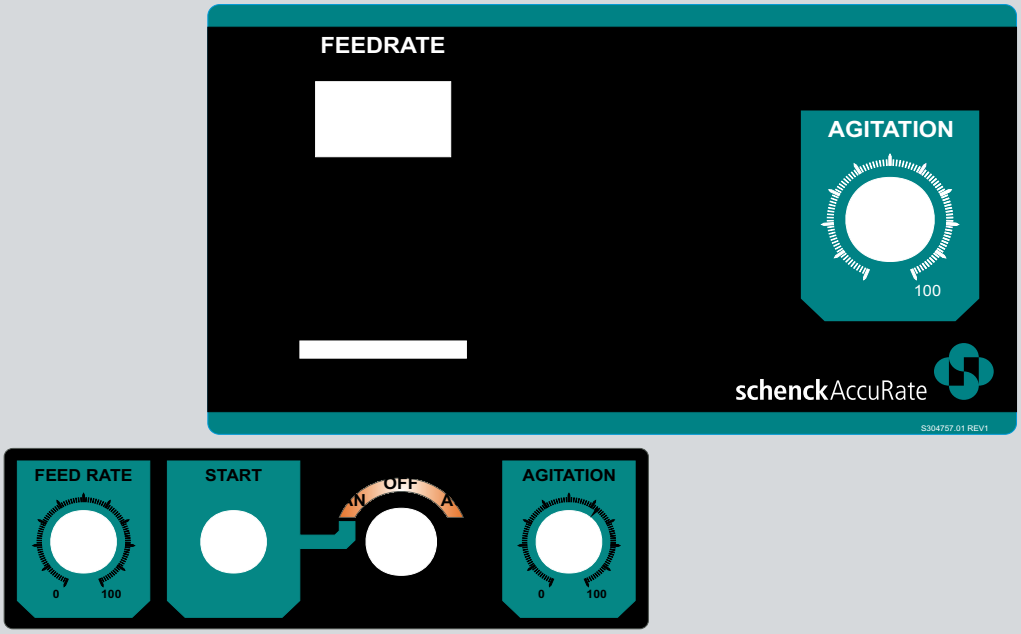
# Variable Speed AC Motor Control

## Instruction Manual




BV-H5002GB

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# 1 Volumetric Controls

**SAFETY NOTE**: **DANGER**

Before starting or operating these volumetric controls, ensure that all safety devices are in place and working properly. The motor control for feedrate should be set to OFF or “000” before power is applied. If this precaution is not followed, significant equipment damage and/or bodily injury, including death, could result.

# 2 Introduction

## Purpose

The purpose of this document is to provide the operator with all information necessary to control the bulk material feeder in **volumetric mode**.

## Overview

**Definitions**:

- “*Automatic*” (**AUTO**) in this document refers to device control from a remote source (such as a DISOCONT VSE unit, Accu-Rate model 8000 controller or customer PLC).
- “*Manual*” (**MAN**) in this document refers to device control from a local source (i.e., the controls described in this document).

In volumetric applications, helix speed or tray vibration (and agitation speed, if present) is directly controlled in order to regulate material flow. Volumetric controls (”operators” such as the AUTO/MAN switch, START/STOP button, and potentiometers) can be provided in a variety of configurations that are specific to the operation and application requirements.

This document has been developed to describe the function(s) of each volumetric control operator, whatever the final configuration may be for your system. Your volumetric control may have been implemented locally or remotely, but the basic concept of the control device and the functionality remain the same (i.e., the AUTO/MAN switch will always retain the same functionality).

A discussion of functionality begins by describing the operation of the feedrate (potentiometer) controls, and is then followed by an examination of the AUTO/MAN switch and START/STOP operation.

# 3 Feedrate Control

**Manual potentiometer operation is necessary when a touchpad potentiometer is not present**. Motor control is achieved via two control knobs (feedrate and agitation) on the operator panel.
See *Manual Potentiometer* and *Agitation Control* in this document.

**Touchpad Potentiometer**

The electronic potentiometer depicted in Figure 1 controls the feedrate. “000” displayed corresponds to zero feedrate. “999” displayed corresponds to maximum feedrate. Press the UP and DOWN arrow keys to increase or decrease the feedrate, respectively.

**NOTE**: This control is enabled only when the AUTO/MANUAL selector switch is in the MANUAL position. Also, *if the material is being fed and “000” is displayed, your TPP* (touchpad potentiometer) *may require adjustment*. Contact your SCHENCK AccuRate representative.

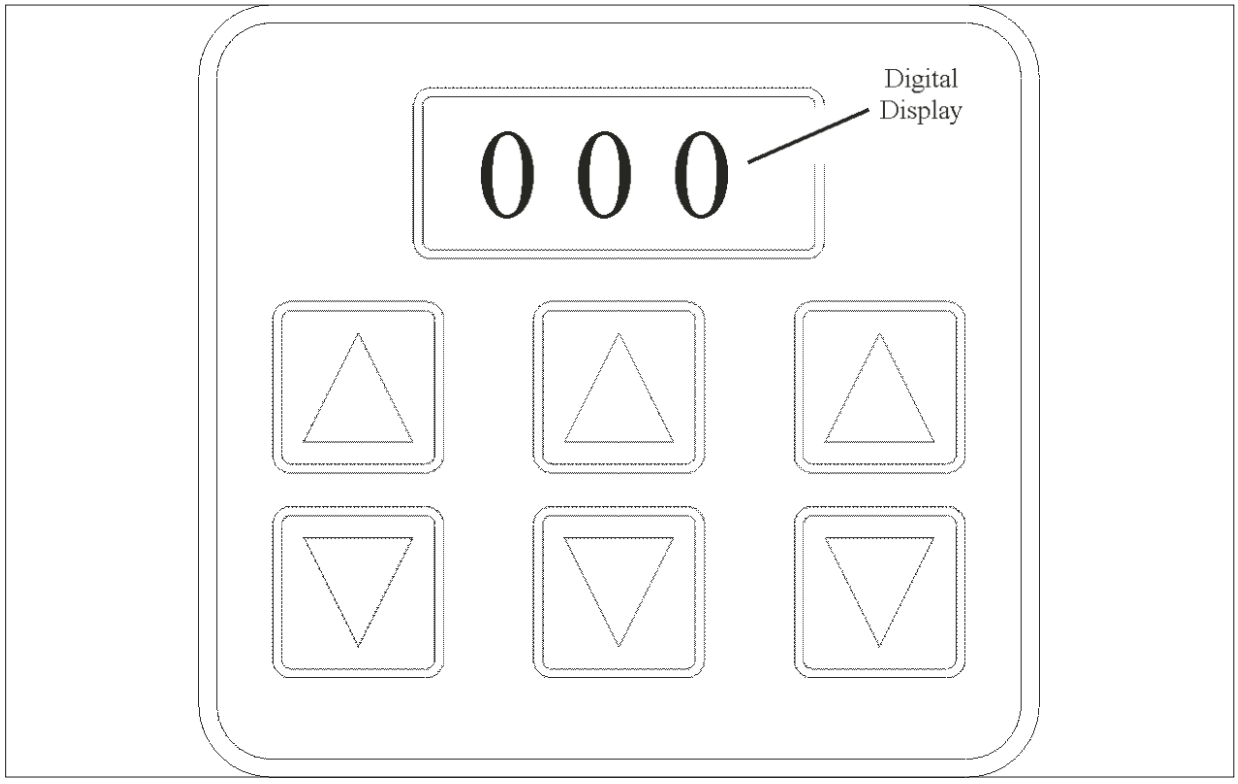



Figure 1: Touchpad Potentiometer

Manual Potentiometer

This control knob may be turned in a clockwise fashion starting at 0% (zero feedrate) and progressing to 100% (maximum feedrate).

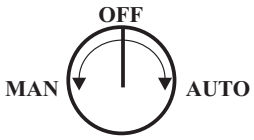
**NOTE**: This control is enabled only when the AUTO/MANUAL selector switch is in the MANUAL position.

# 4 Agitation Control (if present)

This control knob may be turned in a clockwise fashion similar to the feedrate control knob. Turn in a clockwise fashion starting at 0% (minimum agitation) and progressing to 100% (maximum agitation). **This control sets agitation speed in both manual and auto modes.**

**NOTE**: Agitation control will not be available unless the feeder has a dual motor configuration (two touch pads will not be required).

# 5 Auto/Manual Switch Operation




**MANUAL (MAN)**

The MANUAL switch *disables* all AUTO control functions and *enables* manual motor control operators- START and Feedrate control.

**OFF**

The OFF switch *disables* all drive operators- MANUAL and AUTO and will also immediately shut down any motors under it's control that are in operation.

**AUTO**

The AUTO switch *disables* START and FEEDRATE control operators and *enables* automatic external control of feeder motors (via DISOCONT, 8000 controller, customer PLC, etc.).

# 6 Start-Push Button Operation

When the selector switch on the touchpad potentiometer is in MANUAL mode, the drive will start when the appropriate switch/button is depressed (either I/O Switch, top or Start-Push Button, bottom-see left).

**NOTE**: *If the selector switch is in* OFF *or* AUTO *mode, the* START *button is non-functional.*

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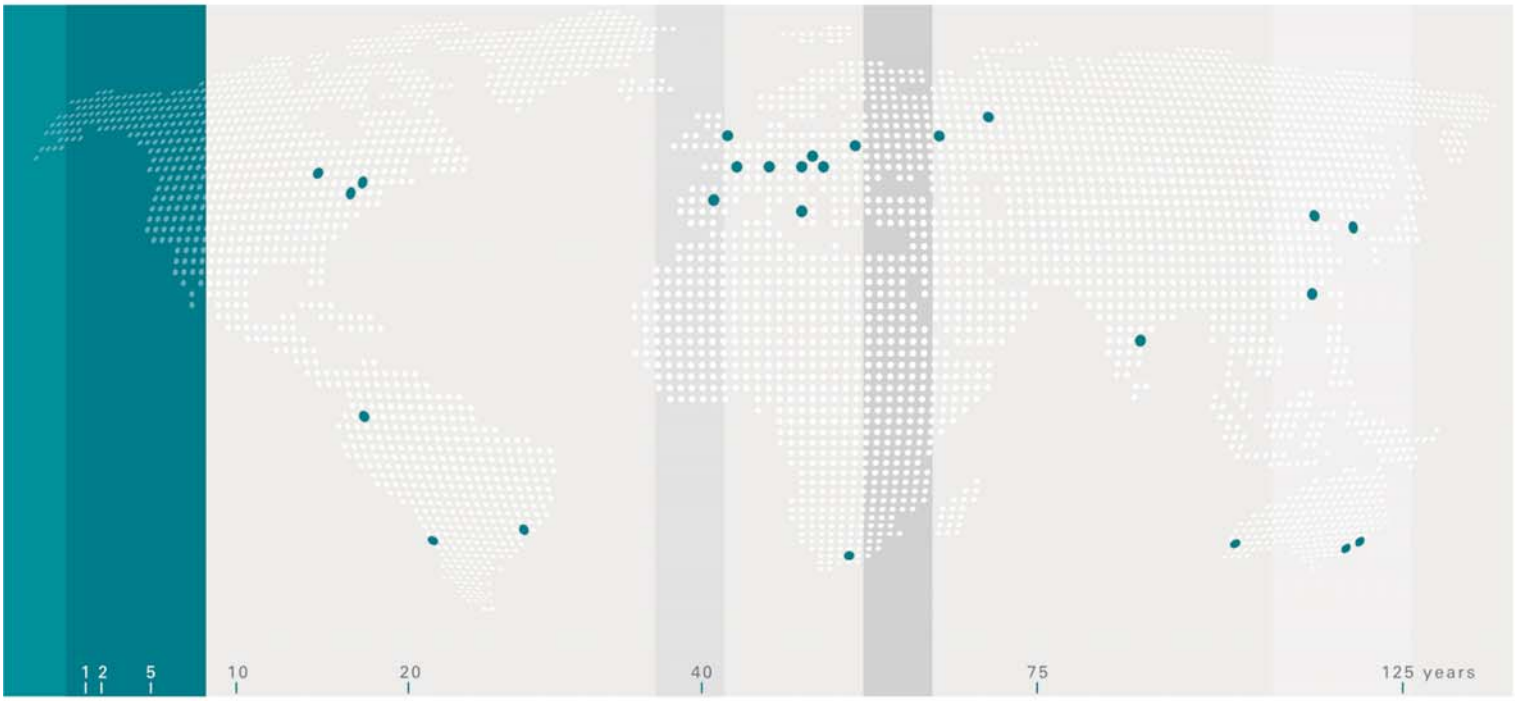
feeding

screening

automation

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SCHENCK

# SacMaster™ Bulk Bag Discharge System Control Logic

**BV-H5048 GB**

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# 1 Introduction

The purpose of this document is to provide the standard SacMaster™ control logic for translation into a third-party control device. Schenck AccuRate makes no warranties regarding the agitation performance of the SacMaster™ running on a third party controller.

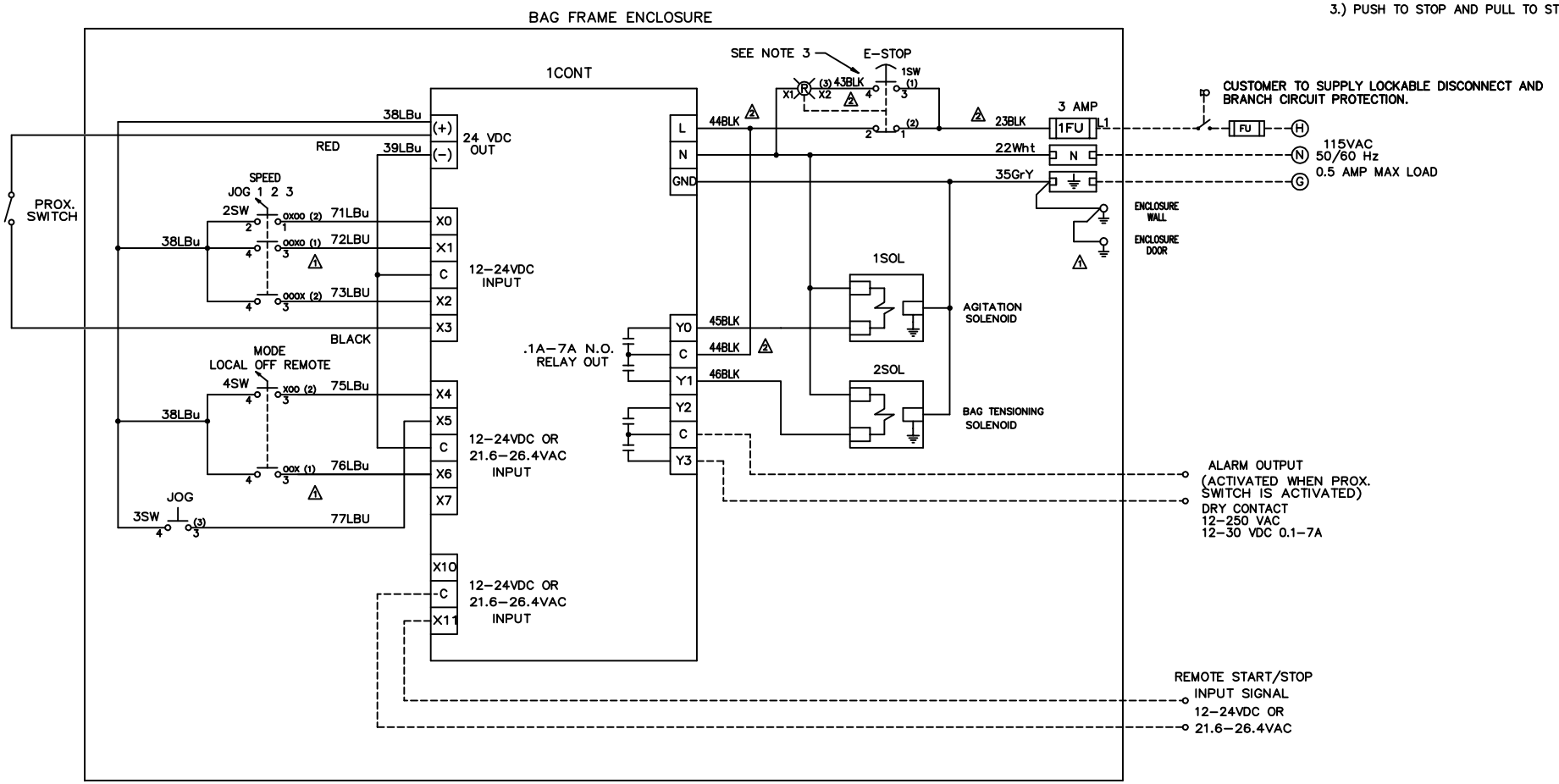
A general description of operation of the SacMaster ™ and it's control panel is available in the SacMaster™ Bulk Bag Discharge System User Manual-USM10016.

# 2 System Drawing & Control Logic

The attached control drawing illustrates the I/O points utilized by the SacMaster™ control system. Following the drawing is a listing of the associated ladder logic.

| REV | ECN# | CHANGED BY | CHECKED BY | APPROVED BY | DESCRIPTION |
|---|---|---|---|---|---|
| 0 | 011220-1 | MPH10/23/02 | – | – | NEW RELEASE |
| 1 | 030213-2 | MPH2/13/03 | – | – | EXCH (1) & (2) SW DECK & ADD GROUND WIRING |
| 2 | 030502-1 | MPH 5/2/03 | TV 5/8/03 | – | CHANGE RED WIRE TO BLACK FOR NEW UL508A |

NOTE:
1.) ------ INDICATES WIRING SUPPLIED BY CUSTOMER
2.) 1CONT: TERMINALS ACCEPT #16-24 AWG WIRE.
3.) PUSH TO STOP AND PULL TO START.




| DRAWN BY/DATE | CHECKED BY/DATE | ENG. APVL/DATE |
|---|---|---|
| MPH 10/23/02 | TV 10/28/02 | – |

SCHENCK AccuRate

CONTROL,BAG FRAME,115V, W/TENSION,UL,SCH

INCH[MM] | TOLERANCES PER ACCURATE W.I.3.2.1

| SIMILAR TO | | SCALE | |
|---|---|---|---|
| NONE | D | NONE | S300576.99 |

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Program Name: PLC105BF.01
File Name: PLC105BF

Rev 1 Initial Release
Rev 2 Corrected logic to allow tensioning device to lower when the man/off/auto selector is placed in the off position. -tv
Rev 3 Make Tensioning output both Y2 and Y1 to match UL Bagframe release on ECN #011220 and also work with old bagframe controls. Remove all code for separate agitation of paddles. Reset tensioning bit on first scan.
Rev 4 ECN# 030516-2. Latch RUN command to guarantee at least one full agitation cycle. Restructure program for ease of understanding. -tv

1

NOP

Load Speed1 timer values. Bag Full Operating Mode.

2

Speed 1 input X0
Bag Empty C10

LD K1200
OUT Down Timer Value V2000
LD K30
OUT Up timer Value V2001

Load Speed2 timer values. Bag Full Operating Mode.

3

Speed 2 input X1
Bag Empty C10

LD K600
OUT Down Timer Value V2000
LD K30
OUT Up timer Value V2001

Load Speed3 timer values. Bag Full Operating Mode.

4

Speed 3 input X2
Bag Empty C10

LD K50
OUT Down Timer Value V2000
LD K30
OUT Up timer Value V2001

Load Speed1 timer values. Bag Empty Operating Mode.

5

Load Speed2 timer values. Bag Empty Operating Mode.

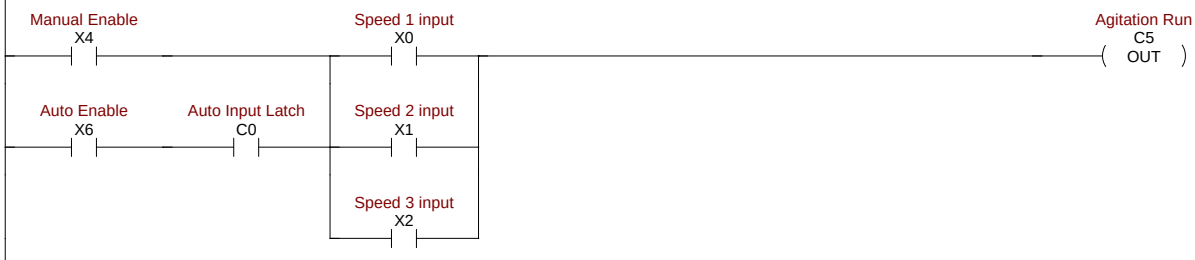
6

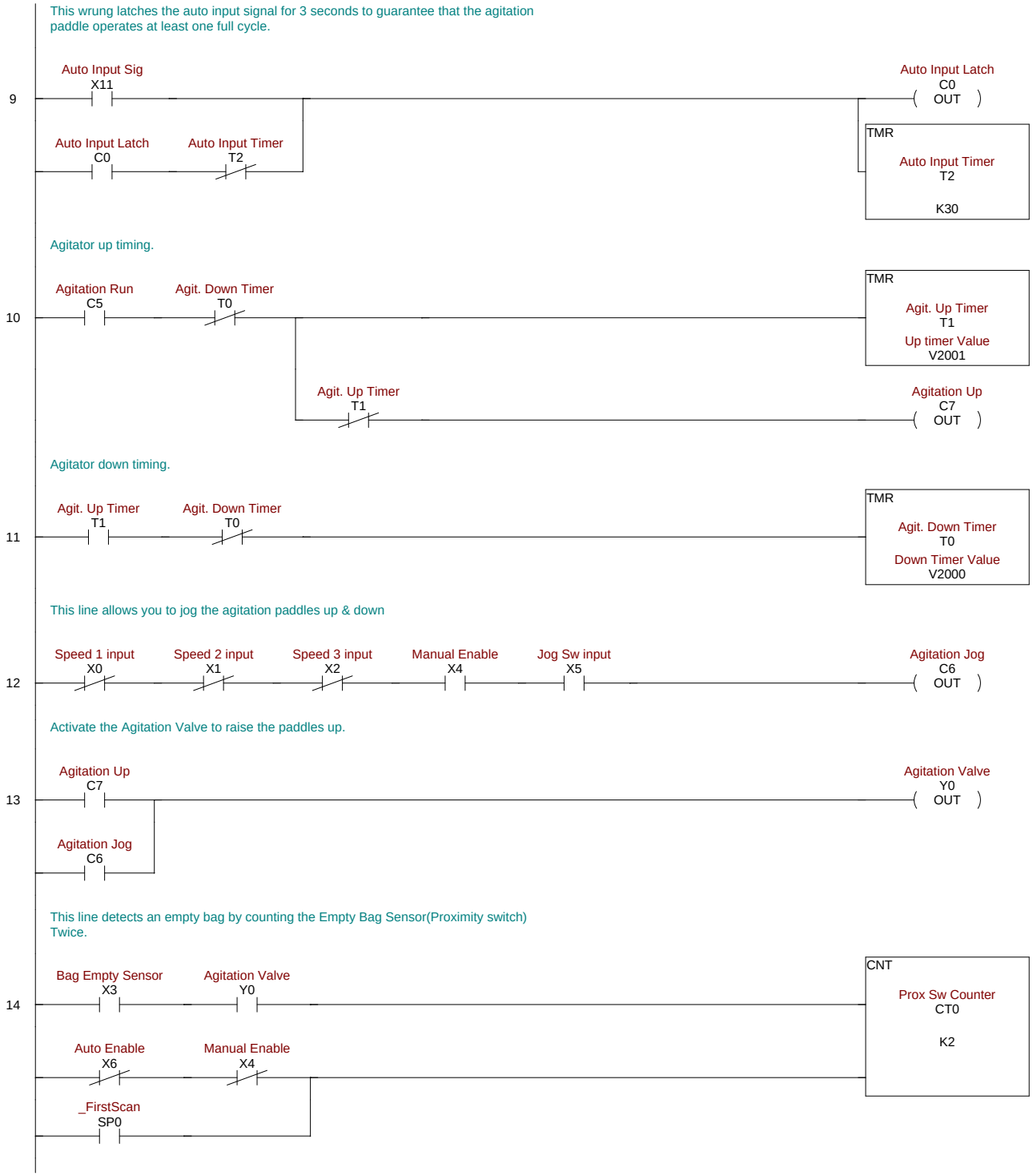
Load Speed3 timer values. Bag Empty Operating Mode.

7

Trigger the Agitation timers to run. Agitation Run will be maintained for then entire

8




This wrung latches the auto input signal for 3 seconds to guarantee that the agitation paddle operates at least one full cycle.
9
Auto Input Sig
X11
Auto Input Latch
C0
Auto Input Timer
T2
Auto Input Latch
C0
OUT
TMR
Auto Input Timer
T2
K30
Agitator up timing.
10
Agitation Run
C5
Agit. Down Timer
T0
TMR
Agit. Up Timer
T1
Up timer Value
V2001
Agit. Up Timer
T1
Agitation Up
C7
OUT
Agitator down timing.
11
Agit. Up Timer
T1
Agit. Down Timer
T0
TMR
Agit. Down Timer
T0
Down Timer Value
V2000
This line allows you to jog the agitation paddles up & down
12
Speed 1 input
X0
Speed 2 input
X1
Speed 3 input
X2
Manual Enable
X4
Jog Sw input
X5
Agitation Jog
C6
OUT
Activate the Agitation Valve to raise the paddles up.
13
Agitation Up
C7
Agitation Jog
C6
Agitation Valve
Y0
OUT
This line detects an empty bag by counting the Empty Bag Sensor(Proximity switch) Twice.
14
Bag Empty Sensor
X3
Agitation Valve
Y0
Auto Enable
X6
Manual Enable
X4
_FirstScan
SP0
CNT
Prox Sw Counter
CT0
K2

When the bag is empty, turn on the alarm output and bag tension outputs.
Prox Sw Counter
CT0
15
Bag Empty
C10
OUT
Alarm Output
Y3
OUT
Tension Valve
Y1
OUT
Tension Valv Old
Y2
OUT
16
END
17
NOP

SCHENCK AccuRate

# ADDENDUM

## Electrical Connections for the SacMaster

### SCOPE

This document is an addendum for the SacMaster User Manual. This addendum describes the procedure for connecting the power and control signal wiring.

### PROCEDURE

The bag frame requires two power connections, one for the bag frame control and one for the hoist. The typical power connections are shown in Figures 1 and 2. Please refer to the electrical drawings supplied with the bag frame for actual voltage requirements and control signal connections.

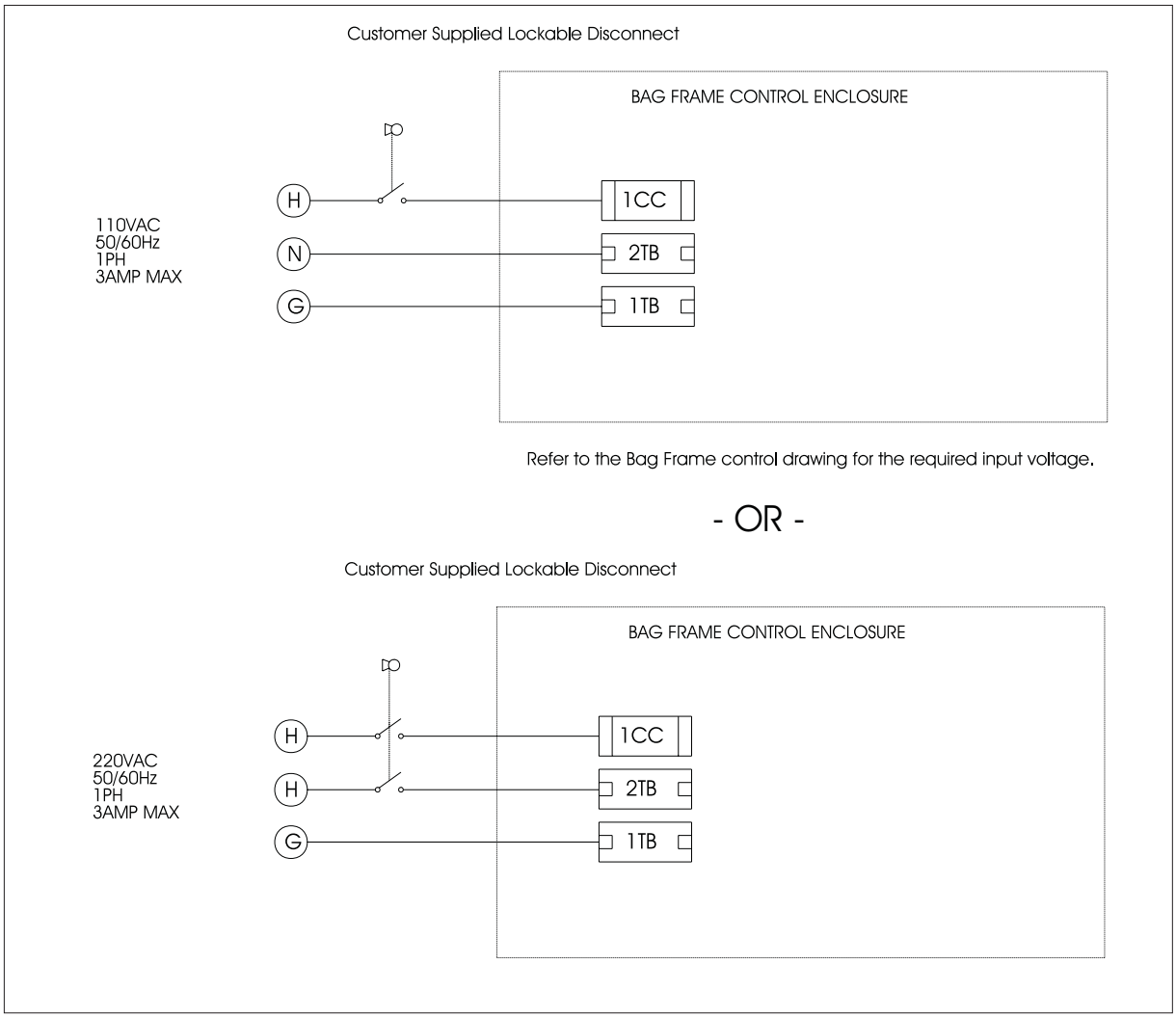



Figure 1: Bag Frame Control Power Connection

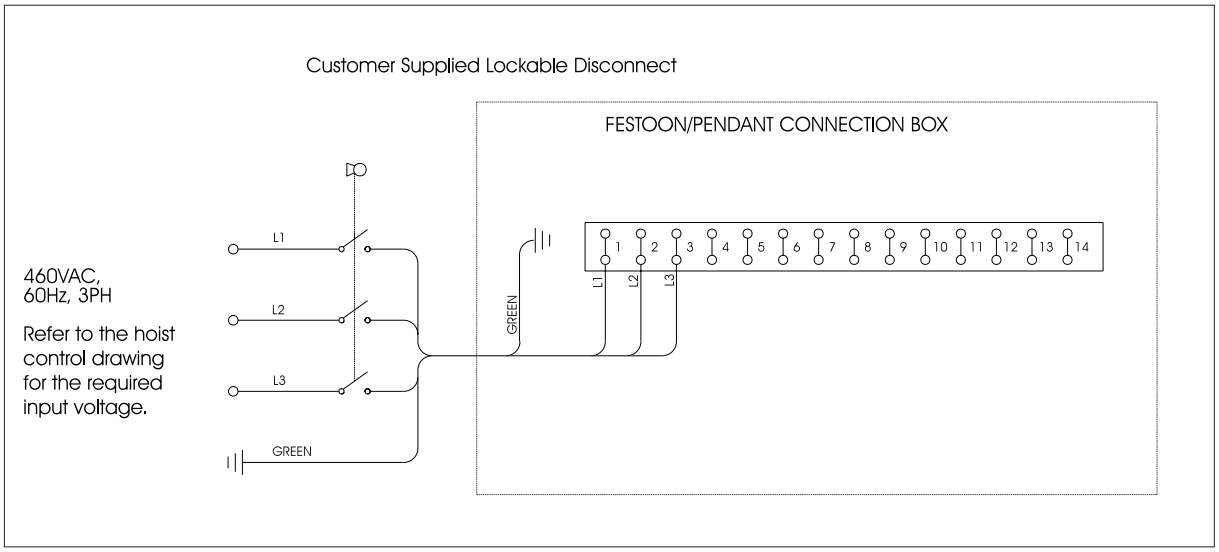
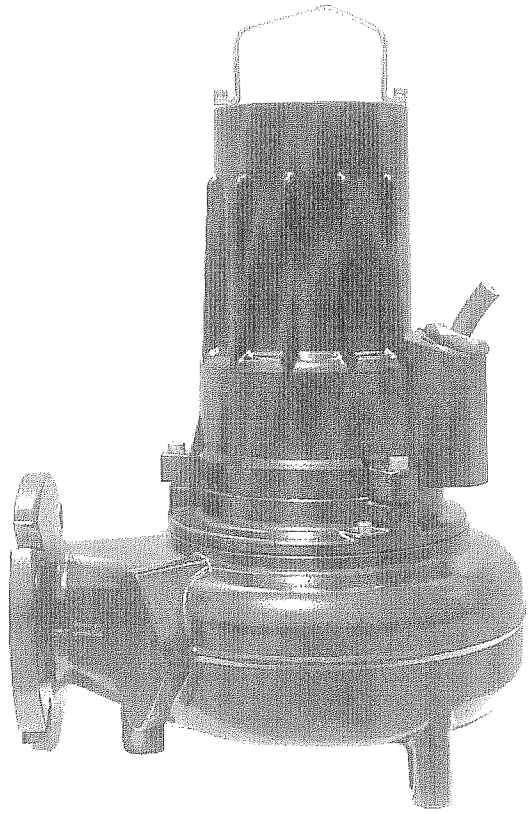


Figure 2: Hoist Power Connection

Individual Parts List



# DP 3068 MT

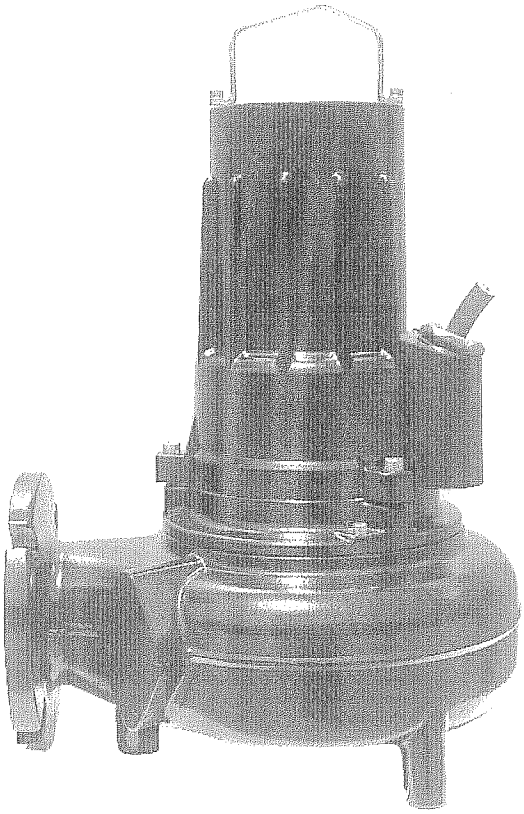
Serial No 3068.180 1421044

6022 - en/fr

FLYGT

a xylem brand

Liste des pièces individuelles



# DP 3068 MT

No De Serie 3068.180 1421045

6022 - enfr

FLYGT

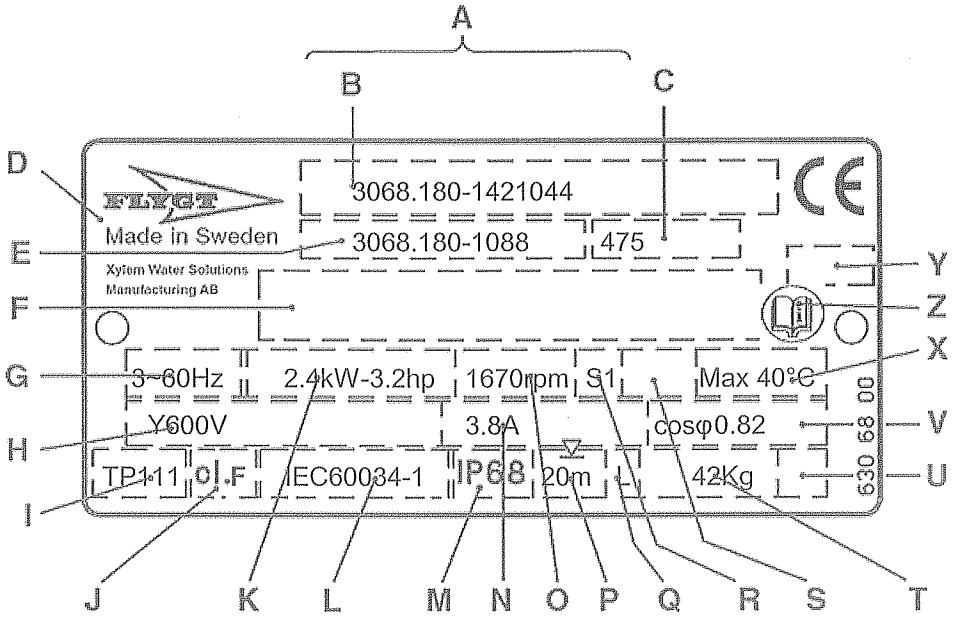
a xylem brand

# Dataplate

## Flygt DP 3068 MT

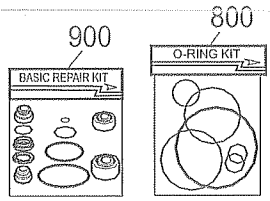
Date: 2014-03-28

## Serial No: 3068.180 1421044




**Dataplate interpretation:**

| | | | |
|---|---|---|---|
| A | Serial number | M | Degree of protection |
| B | Product code + Number | N | Rated current |
| C | Curv code / Propeller code | O | Rated speed |
| D | Country of origin | P | Max. submergence |
| E | Product number | Q | Direction of rotation R=right, L=left |
| F | Additional information | R | Duty class |
| G | Phase; Type of current; Frequency | S | Duty factor |
| H | Rated voltage | T | Product weight |
| I | Thermal protection | U | Locked rotor code letter |
| J | Thermal class | V | Power factor |
| K | Rated shaft power | X | Max. ambient temperature |
| L | International standard | Y | Notified body<br>Only for EN-approved Ex-products |
| | | Z | Read Installation Manual |




(1 kg = 2.2 pound, 1 Lit=0.26 US gallon, 1 l = 0,22 UK gallon)

**Recommended spare parts:**

See REC. column: A = Parts for inspection and maintenance
B = Parts for major overhaul

For service;
To ensure long operating life use Flygt Bearing Grease 90 20 61 (Cartridge).
Lubrication kit 84 15 40 contains two 90 20 61 and one 84 15 30 (Grease gun).

The O-ring kit contains a full set of O-rings. Position no 800.

The Basic Repair kits contain both inner and outer Mechanical seals, bearings and a O-ring kit. Position no 900.

A complete set of tools can be ordered for repair and maintenance work, i.e. standard hand tools and special tools for seal change and hydraulic-end use.
Order:
This partlist can be used as an order form by marking out the number of parts in the Qty/Order column.
Please send or fax the form to your Flygt representative.

# Parts List

## Flygt DP 3068 MT
## Serial No 3068.180 1421044

| Item no | Part no Type | Rec | Denomination | Qty/ord. |
|---|---|---|---|---|
| 1 | 555 61 01 | | Lifting handle V2A | 1 |
| 2 | 82 00 13 | B | Hex.socket hd screw M6X16-A2-70 | 5 |
| 3 | 630 68 00 | | Data plate USE 6306801 AS SPARE PART | 2 |
| 5 | 543 42 00 | | Instruction plate CANADA | 1 |
| 5 | 594 43 00 | | Instruction plate | 2 |
| 9 | 82 20 88 | | Drive screw 4X5-A2/A4 | 8 |
| 10 | 722 53 00 | | Stator housing | 1 |
| 11 | 83 04 45 | | Hex.socket hd screw M8X35-A4-80 | 3 |
| 15 | 427 13 00 | | Marking tape | 1 |
| 15 | 772 17 00 | | Connection plate | 1 |
| 16 | 82 78 26 | B | O-ring 156X3 NBR | 1 |
| 17 | 83 33 13 | B | Ball bearing 20X52X15 MM | 1 |
| 18 | 645 79 01 (Ex) | | Shaft unit 4-POL 3-PHASE 100 MM | 1 |
| 19 | 656 13 03 | | Stator 13-10-4b | 1 |
| 20 | 83 65 00 | B | Insulating hose DIAM=30, L=90 MM | 2 |
| 21 | 83 45 59 | | Cable tie 200X2.4 PA 6/6 -55+105 | 3 |
| 23 | 94 20 59 | B | Motor cable subcab | 16.2 m |
| 34 | 82 35 73 | | Plain washer 6-A4-170 | 2 |
| 37 | 504 78 07 | | Cable unit | 1 |
| 38 | 518 89 02 | | Leakage detect.unit (FLS) | 1 |
| 40 | 645 57 00 | | Bearing holder GG-20 | 1 |
| 41 | 83 30 15 | B | Ball bearing 3305A-2Z/C3VT113 | 1 |
| 44 | 720 45 07 | B | Mechanical seal AL2O3/CARBON | 1 |
| 45 | 82 00 15 | | Hex.socket hd screw M6X20-A2-70 | 3 |
| 46 | 539 94 06 | | Oil housing bottom FOR SLURRY SEAL | 1 |
| 48 | 82 79 12 | AB | O-ring 13.3X2.4 FPM | 1 |
| 49 | 303 44 03 | B | Hex.socket hd screw | 1 |
| 53 | 720 45 02 | B | Mechanical seal WCCR/WCCR | 1 |
| 57 | 82 78 41 | | O-ring 183.5X3 NBR | 1 |
| 63 | 397 88 00 | B | Sleeve | 1 |
| 64 | 645 78 05 | | Impeller | 1 |
| 67 | 516 20 01 | | Pump housing | 1 |
| 72 | 83 02 99 | | Hex.socket hd screw M8X20-A4-70 | 1 |
| 144 | 82 62 12 | | Retaining ring SGH 62 | 1 |
| 145 | 82 50 60 | | Sealing washer DUBO NR 301 | 3 |
| 169 | 667 40 00 | | Sticker | 2 |

Ordered by:

Company:.....Ref:.....Tel:.....Date:.....

# Parts List

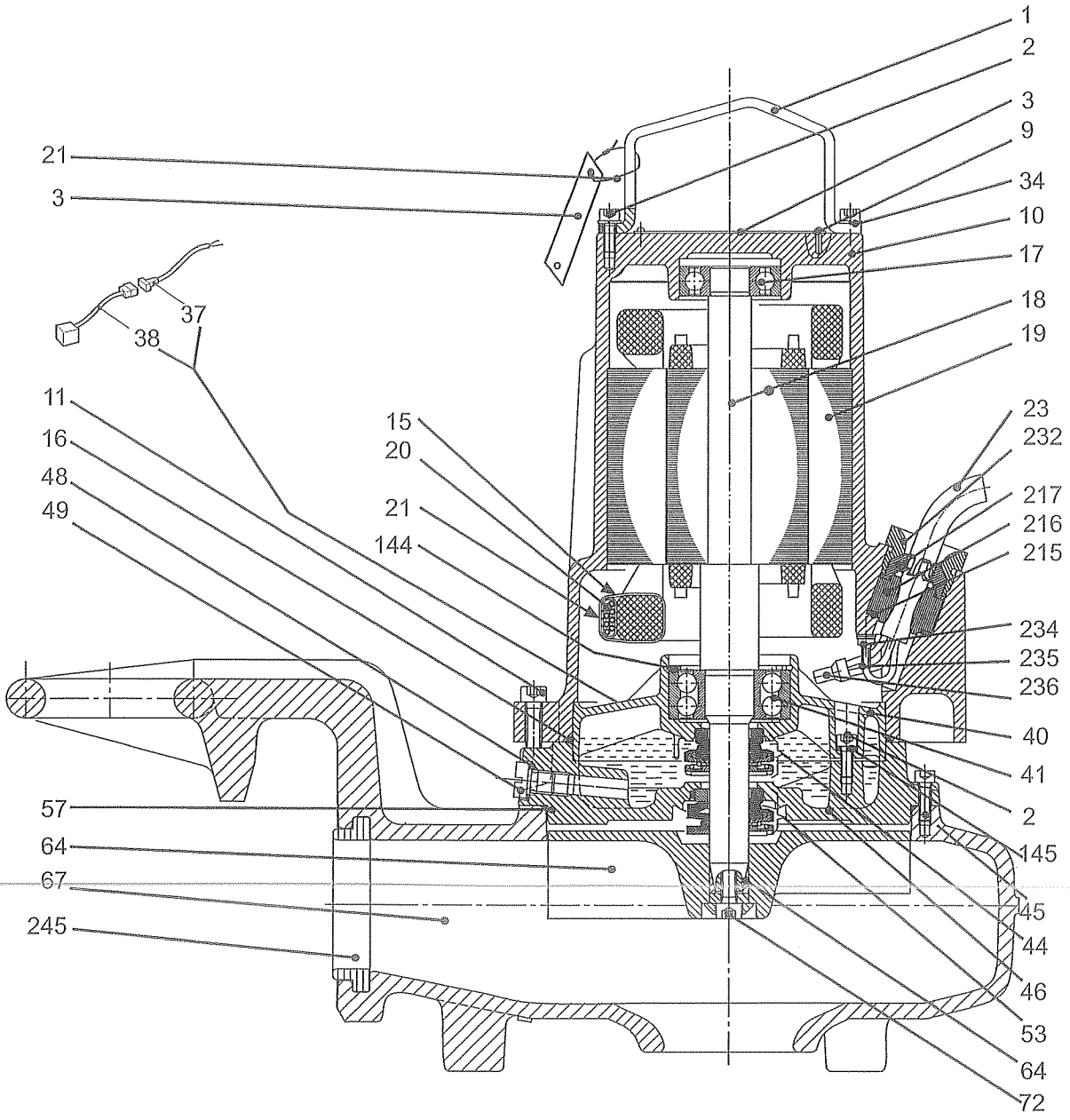
| Item no | Part no Type | Rec | Denomination | Qty/ord. |
|---|---|---|---|---|
| 215 | 82 40 61 | | Plain washer (10)-22 MM | 1 |
| 216 | 84 37 98 | | Seal sleeve (16)-18 MM | 1 |
| 217 | 678 58 18 | | Cable clip (16)-18 MM | 1 |
| 232 | 397 81 00 (Ex) | | Gland screw FOR CABLE ENTRY | 1 |
| 234 | 82 17 61 | | Cutting screw TAPTITE-M6X12 | 1 |
| 235 | 83 43 58 | | Cable lug INSUL.UL/CSA 1.04-2.6 MM2 | 1 |
| 236 | 83 42 65 | | Terminal block | 5 |
| 236 | 83 42 67 | | Terminal block | 1 |
| 245 | 493 72 00 | | Seal ring | 1 |
| 800 | 80 33 20 | | O-ring kits 3068.180/250 | 1 |
| 900 | 601 89 56 | | Basic repair kit | 1 |
| | 90 17 52 | | Oil ISO VG 32 | 0.5 l |
| ... | ..... | ..... | ..... | .... |
| ... | ..... | ..... | ..... | .... |
| ... | ..... | ..... | ..... | .... |
| ... | ..... | ..... | ..... | .... |

Ordered by:

Company:.....Ref:.....Tel:.....Date:.....

# Exploded View

DP 3068.180




30803C

Installation,
Operation, and
Maintenance Manual

# 3068

FLYGT
a xylem brand

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# Introduction and Safety

## Introduction

### Purpose of this manual

The purpose of this manual is to provide necessary information for:

- Installation
- Operation
- Maintenance

CAUTION:

Read this manual carefully before installing and using the product. Improper use of the product can cause personal injury and damage to property, and may void the warranty.

NOTICE:

Save this manual for future reference, and keep it readily available at the location of the unit.

## Safety

WARNING:

- The operator must be aware of safety precautions to prevent physical injury.
- Any pressure-containing device can explode, rupture, or discharge its contents if it is over-pressurized. Take all necessary measures to avoid over-pressurization.
- Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment. This includes any modification to the equipment or use of parts not provided by Xylem. If there is a question regarding the intended use of the equipment, please contact an Xylem representative before proceeding.
- This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal.
- Do not change the service application without the approval of an authorized Xylem representative.

CAUTION:

You must observe the instructions contained in this manual. Failure to do so could result in physical injury, damage, or delays.

### Safety terminology and symbols

#### About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- Personal accidents and health problems
- Damage to the product
- Product malfunction

### Hazard levels

| Hazard level | Indication |
|---|---|
| DANGER: | A hazardous situation which, if not avoided, will result in death or serious injury |
| WARNING: | A hazardous situation which, if not avoided, could result in death or serious injury |
| CAUTION: | A hazardous situation which, if not avoided, could result in minor or moderate injury |
| NOTICE: | • A potential situation which, if not avoided, could result in undesirable conditions<br>• A practice not related to personal injury |

### Hazard categories

Hazard categories can either fall under hazard levels or let specific symbols replace the ordinary hazard level symbols.

Electrical hazards are indicated by the following specific symbol:

Electrical Hazard:

These are examples of other categories that can occur. They fall under the ordinary hazard levels and may use complementing symbols:

- Crush hazard
- Cutting hazard
- Arc flash hazard

### The Ex symbol

The Ex symbol indicates safety regulations for Ex-approved products when used in atmospheres that are potentially explosive or flammable.

## Environmental safety

### The work area

Always keep the station clean to avoid and/or discover emissions.

### Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

- Appropriately dispose of all waste.
- Handle and dispose of the processed liquid in compliance with applicable environmental regulations.

- Clean up all spills in accordance with safety and environmental procedures.
- Report all environmental emissions to the appropriate authorities.

WARNING:

Do NOT send the product to the Xylem manufacturer if it has been contaminated by any nuclear radiation. Inform Xylem so that accurate actions can take place.

### Electrical installation

For electrical installation recycling requirements, consult your local electric utility.

### Recycling guidelines

Always recycle according to these guidelines:

1. Follow local laws and regulations regarding recycling if the unit or parts are accepted by an authorized recycling company.
2. If the first guideline is not applicable, then return the unit or parts to your Xylem representative.

## User safety

### General safety rules

These safety rules apply:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.

### Safety equipment

Use safety equipment according to the company regulations. Use this safety equipment within the work area:

- Hard hat
- Safety goggles, preferably with side shields
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection
- First-aid kit
- Safety devices

NOTICE:

Never operate a unit unless safety devices are installed. Also see specific information about safety devices in other chapters of this manual.

### Electrical connections

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local regulations. For more information about requirements, see sections dealing specifically with electrical connections.

### Hazardous liquids

The product is designed for use in liquids that can be hazardous to your health. Observe these rules when you work with the product:

- Make sure that all personnel who work with biologically hazardous liquids are vaccinated against diseases to which they may be exposed.
- Observe strict personal cleanliness.

### Wash the skin and eyes

Follow these procedures for chemicals or hazardous fluids that have come into contact with your eyes or your skin:

| Condition | Action |
|---|---|
| Chemicals or hazardous fluids in eyes | 1. Hold your eyelids apart forcibly with your fingers.<br>2. Rinse the eyes with eyewash or running water for at least 15 minutes.<br>3. Seek medical attention. |
| Chemicals or hazardous fluids on skin | 1. Remove contaminated clothing.<br>2. Wash the skin with soap and water for at least 1 minute.<br>3. Seek medical attention, if necessary. |

## Ex-approved products

Follow these special handling instructions if you have an Ex-approved unit.

### Personnel requirements

These are the personnel requirements for Ex-approved products in potentially explosive atmospheres:

- All work on the product must be carried out by certified electricians and Xylem-authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas, the vapor, or both present in hazardous areas.
- Any maintenance for Ex-approved products must conform to international and national standards (for example, IEC/EN 60079-17).

Xylem disclaims all responsibility for work done by untrained and unauthorized personnel.

### Product and product handling requirements

These are the product and product handling requirements for Ex-approved products in potentially explosive atmospheres:

- Only use the product in accordance with the approved motor data.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.
- Make sure that thermal contacts are connected to a protection circuit according to the approval classification of the product, and that they are in use.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Do not modify the equipment without approval from an authorized Xylem representative.
- Only use parts that are provided by an authorized Xylem representative.

### Guidelines for compliance

Compliance is fulfilled only when you operate the unit within its intended use. Do not change the conditions of the service without the approval of an Xylem representative. When you install or maintain explosion proof products, always comply with the directive and applicable standards (for example, IEC/EN 60079–14).

### Minimum permitted liquid level

See the dimensional drawings of the product for the minimum permitted liquid level according to the approval for explosion proof products. If the information is missing on the dimensional drawing, the product must be fully submerged. Level-sensing equipment must be installed if the product can be operated at less than the minimum submersion depth.

### Monitoring equipment

For additional safety, use condition-monitoring devices. Condition-monitoring devices include but are not limited to the following:

- Level indicators
- Temperature detectors

## Product warranty

### Coverage

Xylem undertakes to remedy defects in products from Xylem under these conditions:

- The faults are due to defects in design, materials, or workmanship.
- The faults are reported to an Xylem representative within the warranty period.
- The product is used only under the conditions described in this manual.
- The monitoring equipment incorporated in the product is correctly connected and in use.
- All service and repair work is done by Xylem-authorized personnel.
- Genuine Xylem parts are used.
- Only Ex-approved spare parts and accessories authorized by Xylem are used in Ex-approved products.

### Limitations

The warranty does not cover defects caused by these situations:

- Deficient maintenance
- Improper installation
- Modifications or changes to the product and installation made without consulting Xylem
- Incorrectly executed repair work
- Normal wear and tear

Xylem assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses

### Warranty claim

Xylem products are high-quality products with expected reliable operation and long life. However, should the need arise for a warranty claim, then contact your Xylem representative.

### Spare parts

Xylem guarantees that spare parts will be available for 15 years after the manufacture of this product has been discontinued.

# Transportation and Storage

## Inspect the delivery

### Inspect the package

1. Inspect the package for damaged or missing items upon delivery.
2. Note any damaged or missing items on the receipt and freight bill.
3. File a claim with the shipping company if anything is out of order.
   If the product has been picked up at a distributor, make a claim directly to the distributor.

### Inspect the unit

1. Remove packing materials from the product.
   Dispose of all packing materials in accordance with local regulations.
2. Inspect the product to determine if any parts have been damaged or are missing.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.
   For your personal safety, be careful when you handle nails and straps.
4. Contact your sales representative if anything is out of order.

## Transportation guidelines

#### Precautions

WARNING:
- Stay clear of suspended loads.
- Observe accident prevention regulations in force.

#### Position and fastening

The unit can be transported either horizontally or vertically. Make sure that the unit is securely fastened during transportation, and cannot roll or fall over.

### Lifting

WARNING:
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
- Lift and handle the product carefully, using suitable lifting equipment.
- The product must be securely harnessed for lifting and handling. Use eyebolts or lifting lugs if available.
- Always lift the unit by its lifting handle. Never lift the unit by the motor cable or by the hose.
- Do not attach sling ropes to shaft ends.

### Lifting equipment

Lifting equipment is always required when handling the unit. It must fulfill the following requirements:

- The minimum height (contact Xylem for information) between the lifting hook and the floor must be sufficient to lift the unit.
- The lifting equipment must be able to hoist the unit straight up and down, preferably without the need for resetting the lifting hook.
- The lifting equipment must be securely anchored and in good condition.
- The lifting equipment must support weight of the entire assembly and must only be used by authorized personnel.
- Two sets of lifting equipment must be used to lift the unit for repair work.
- The lifting equipment must be dimensioned to lift the unit with any remaining pumped media in it.
- The lifting equipment must not be oversized.

NOTICE:

Oversized lifting equipment could cause damage if the unit should stick when being lifted.

## Temperature ranges for transportation, handling and storage

### Handling at freezing temperature

At temperatures below freezing, the product and all installation equipment, including the lifting gear, must be handled with extreme care.

Make sure that the product is warmed up to a temperature above the freezing point before starting up. Avoid rotating the impeller/propeller by hand at temperatures below the freezing point. The recommended method to warm the unit up is to submerge it in the liquid which will be pumped or mixed.

NOTICE:

Never use a naked flame to thaw the unit.

### Unit in as-delivered condition

If the unit is still in the condition in which it left the factory - all packing materials are undisturbed - then the acceptable temperature range during transportation, handling and storage is: –50°C (–58°F) to +60°C (+140°F).

If the unit has been exposed to freezing temperatures, then allow it to reach the ambient temperature of the sump before operating.

### Lifting the unit out of liquid

The unit is normally protected from freezing while operating or immersed in liquid, but the impeller/propeller and the shaft seal may freeze if the unit is lifted out of the liquid into a surrounding temperature below freezing.

Units equipped with an internal cooling system are filled with a mixture of water and 30% glycol. This mixture remains a flowing liquid at temperatures down to –13°C (9°F). Below –13°C (9°F), the viscosity increases such that the glycol mixture will lose its flow properties. However, the glycol-water mixture will not solidify completely and thus cannot harm the product.

Follow these guidelines to avoid freezing damage:

1. Empty all pumped liquid, if applicable.
2. Check all liquids used for lubrication or cooling, both oil and water-glycol mixtures, for the presence of water. Change if needed.

# Storage guidelines

### Storage location

The product must be stored in a covered and dry location free from heat, dirt, and vibrations.

NOTICE:

- Protect the product against humidity, heat sources, and mechanical damage.
- Do not place heavy weights on the packed product.

### Long-term storage

If the unit is stored more than 6 months, the following apply:

- Before operating the unit after storage, it must be inspected with special attention to the seals and the cable entry.
- The impeller/propeller must be rotated every other month to prevent the seals from sticking together.

# Product Description

## Pump design

The pump is submersible, and driven by an electric motor.

### Intended use

The product is intended for moving wastewater, sludge, raw and clean water. Always follow the limits that are given in *Application limits* (page 49). If there is a question regarding the intended use of the equipment, please contact an Xylem representative before proceeding.

WARNING:

In explosive or flammable environments, only use Ex- or MSHA-approved pumps.

NOTICE:

Do NOT use the pump in highly corrosive liquids.

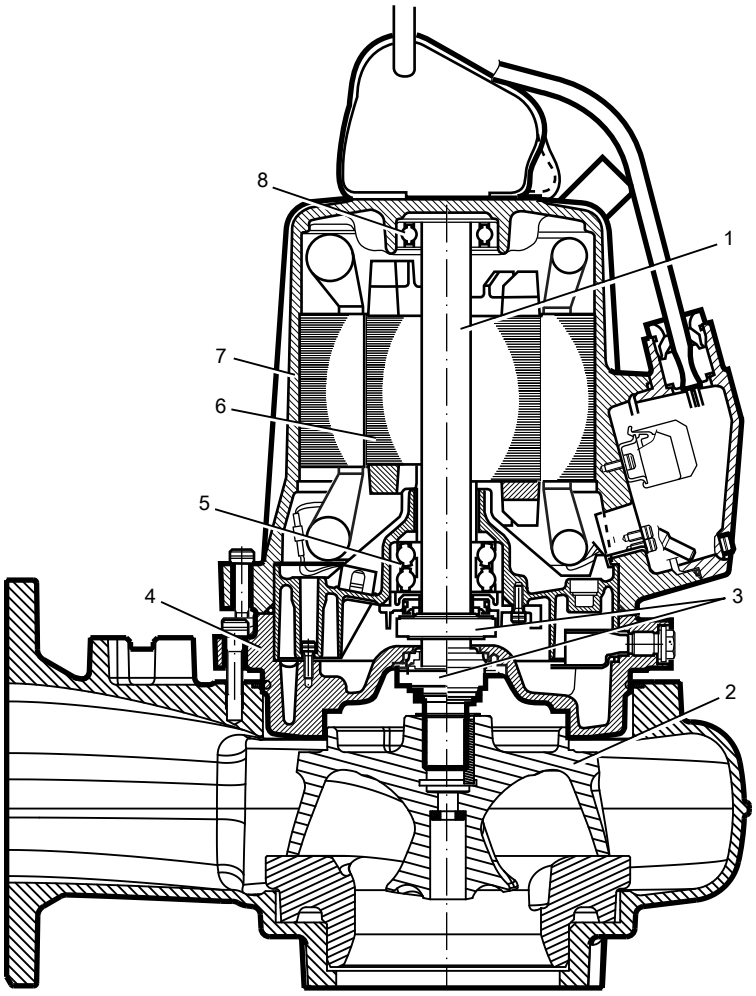
### Spare parts

- Modifications to the unit or installation should only be carried out after consulting with Xylem.
- Original spare parts and accessories that are authorized by Xylem are essential for compliance. The use of other parts can invalidate any claims for warranty or compensation. For more information contact your Xylem representative.

### Pressure class

| | |
|---|---|
| LT | Low head |
| MT | Medium head |
| HT | High head |

## Parts




| Position | Part | Description |
|---|---|---|
| 1 | Shaft | The shaft is made of stainless steel, with an integrated rotor. |
| 2 | Impeller | There are multiple types of impellers. For information about the pumps impellers, see Parts List. |
| 3 | Mechanical seals | One inner and one outer seal in a combination of materials:<br>• Aluminium oxide $Al_2O_3$<br>• Carbon CSb<br>• Silicon carbide RSiC<br>• Corrosion-resistant cemented carbide WCCR<br>For information about the pumps mechanical seals, see Parts List. |
| 4 | Oil housing | The oil housing includes a coolant that lubricates and cools the seals; the housing acts as a buffer between the pumped fluid and the drive unit. |
| 5 | Main bearing | 3068.090, 3068.180, 3068.250, 3068.590, 3068.890: The bearing consisting of a two-row angular contact ball bearing.<br>3068.170, 3068.890: The bearing consisting of a single-row ball bearing. |
| 6 | Motor | For information about the motor, see *Motor data* (page 49). |

| Position | Part | Description |
|---|---|---|
| 7 | Stator housing | The pump is cooled by the ambient liquid/air. |
| 8 | Support bearing | The bearing consisting of a single-row ball bearing. |

# Monitoring equipment

The following applies to the monitoring equipment of the pump:

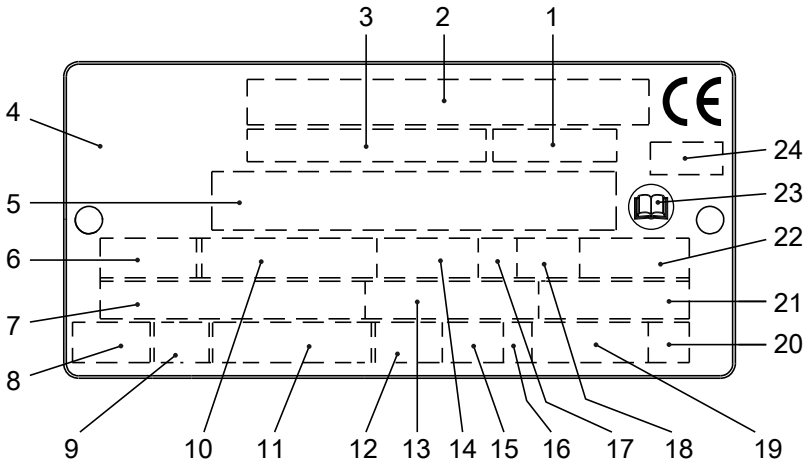
- The stator incorporates three thermal contacts connected in series that activate the alarm and stops the pump at overtemperature
- The thermal contacts open at 125°C (257°F).
- Only 3068.090, 3068.180: The pump is equipped with thermal contacts that open at 125°C (257°F) or 140°C (285°F).
- Ex-approved pumps must have thermal contacts connected to the control panel.
- The sensors must be connected to either the MiniCAS II monitoring equipment or an equivalent equipment.
- The monitoring equipment must be of a design that makes automatic restart impossible.
- Information in the junction box shows if the pump is equipped with optional sensors.

### Optional sensors

**FLS** FLS is a miniature float switch for detection of liquid in the stator housing. Due to its design it is best suited for pumps in a vertical position. The FLS sensor is installed in the bottom of the stator housing.

# The data plate

The data plate is a metal label located on the main body of the products. The data plate lists key product specifications. Specially approved products also have an approval plate.




1. Curve code/Propeller code
2. Serial number, see *Product denomination* (page 15)
3. Product number
4. Country of origin
5. Additional information
6. Phase; type of current; frequency
7. Rated voltage
8. Thermal protection
9. Thermal class
10. Rated shaft power
11. International standard
12. Degree of protection

13. Rated current
14. Rated speed
15. Maximum submergence
16. Direction of rotation: L=left, R=right
17. Duty class
18. Duty factor
19. Product weight
20. Locked rotor code letter
21. Power factor
22. Maximum ambient temperature
23. Read installation manual
24. Notified body. Only for EN-approved Ex-products

Figure 1: The data plate

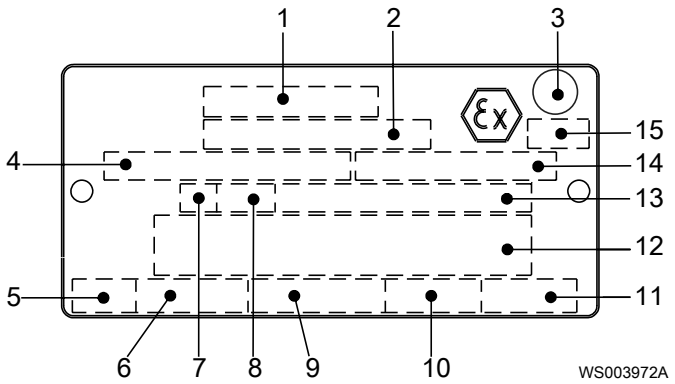
# Approvals

## Product approvals for hazardous locations

| Pump | Approval |
|---|---|
| • 3068.090<br>• 3068.590<br>• 3068.890 | European Norm (EN)<br>• ATEX Directive<br>• EN 60079-0, EN 60079-1, EN 1127-1<br>• ⟨Ex⟩<br>I M2 Ex d I (3068.090)<br>• ⟨Ex⟩<br>II 2 G Ex d IIB T4 |
| | EN approval for cable entry:<br>• Certificate number: INERIS 02ATEX9008 U<br>• ⟨Ex⟩<br>II 2 G Ex d IIC or I M2 Ex d I |
| | Factory Mutural (FM)<br>• Class I. Div 1. Group C and D<br>• Dust ignition proof for use in Class II. Div 1. Group E, F and G<br>• Suitable for use in Class III. Div 1. Hazardous Locations |

## EN approval plate

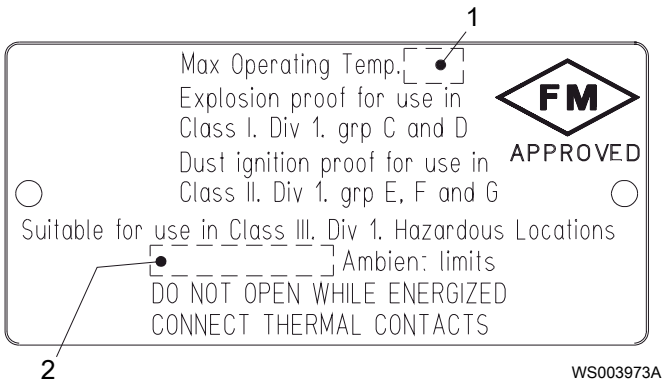
This illustration describes the EN approval plate and the information contained in its fields.




1. Approval
2. Approval authority + approval number
3. Approval for Class I
4. Approved drive unit
5. Stall time
6. Starting current/Rated current
7. Duty class
8. Duty factor
9. Input power
10. Rated speed
11. Controller
12. Additional information
13. Maximum ambient temperature
14. Serial number
15. ATEX marking

### FM approval plate

This illustration describes the FM approval plate and the information contained in its fields.



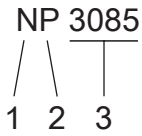

1. Temperature class
2. Maximum ambient temperature

## Product denomination

### Sales denomination

The sales denomination consists of the four-digit sales code and two letters that indicate the hydraulic end and type of installation.

This is an example of a sales denomination, and an explanation of its parts.

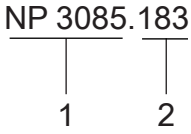



1. Hydraulic part
2. Installation type
3. Sales code

### Product code

The product code consists of nine characters divided into two parts.

This is an example of a product code, and an explanation of its parts.

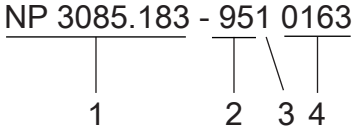



1. Sales denomination
2. Version

### Serial number

The serial number is used for identification of an individual product, and is divided into four parts.

This is an example of a serial number, and an explanation of its parts.




1. Product code
2. Production year
3. Production cycle
4. Running number

# Installation

## Install the pump

WARNING:

- Before installing the pump, check that the cable and cable entry have not been damaged during transportation.
- Note that special rules apply to installation in explosive atmospheres.
- Make sure that the unit cannot roll or fall over and injure people or damage property.
- Do not install CSA-approved products in locations that are classified as hazardous in the national electric code, ANSI/NFPA 70-2005.
- Do not install the starter equipment in an explosive zone unless it is explosion-proof rated.

NOTICE:

- Do not run the pump dry.
- Never force piping to make a connection with a pump.
- Always remove all debris and waste material from the sump, inlet piping, and discharge connection, before you install the pump.

These requirements apply:

- Use the pump dimensional drawing in order to ensure proper installation.
- Provide a suitable barrier around the work area, for example, a guard rail.
- Check the explosion risk before you weld or use electric hand tools.

### Authority regulation

Vent the tank of a sewage machine station in accordance with local plumbing codes.

### Fasteners

WARNING:

- Only use fasteners of the proper size and material.
- Replace all corroded fasteners.
- Make sure that all fasteners are properly tightened and that there are no missing fasteners.

## Install with P-installation

In the P-installation, the pump is installed on a stationary discharge connection, and operates either completely or partially submerged in the pumped liquid. These requirements and instructions only apply when the installation is made according to the dimensional drawing.

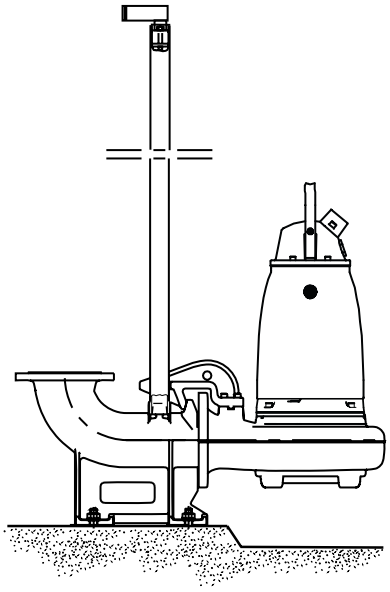


Figure 2: P-installation

These items are required:

- Guide bars
- Guide bar bracket for attaching the guide equipment to the access frame or to the upper part of the sump
- Cable holder for holding the cable
- Access frame (with covers) to which the upper guide bar bracket and cable holder can be attached
- Discharge connection for connecting the pump to the discharge line

  The discharge connection has a flange which fits the pump casing flange and a bracket for attaching the guide equipment.
- Fasteners for the discharge connection
- Anchor bolts

1. Install the access frame:
   a) Place the access frame in position and align it horizontally.
   b) Grout the frame in place.
2. Grout the anchor bolts in place.

   Be careful when you align and position the discharge connection in relation to the access frame.
3. Place the discharge connection in position, and tighten the nuts.
4. Install the guide bars:
   a) Secure the guide bars in the bracket.
   b) Check that the guide bars are placed vertically. Use a level or a plumb line.
5. Connect the discharge pipe to the discharge connection.
6. Lower the pump along the guide bars.

   When it reaches the bottom position, the pump automatically connects to the discharge connection.

7. Secure the motor cable:
   a) Fasten the permanent lifting device to the pump and to the access frame. For example, you can use a stainless-steel lifting chain with shackles.
   b) Fasten the cable to the cable holder.

      Make sure that the cable cannot be sucked into the pump inlet or that it is neither sharply bent, or pinched. Support straps are required for deep installations.
   c) Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

      Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* (page 30).

Clean all debris from the sump before starting the pump.

## Install with S-installation

In the S-installation, the pump is transportable and intended to operate either completely or partially submerged in the pumped liquid. The pump is equipped with a connection for hose or pipe and stands on a base stand.

These requirements and instructions only apply when the installation is made according to the dimensional drawing. For information about the different installation types, see Parts List.

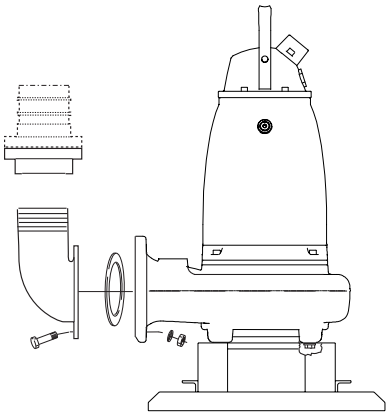


Figure 3: S-installation

1. Run the cable so that it has no sharp bends. Make sure that it is not pinched, and cannot be sucked into the pump inlet.
2. Connect the discharge line.
3. Lower the pump into the sump.
4. Place the pump on the base and make sure it cannot fall over or sink.

   Alternatively, the pump can be suspended with a lifting chain just above the sump bottom. Make sure that the pump cannot rotate at startup or during operation.
5. Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

   Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* (page 30).

## Install with F-installation

In the F-installation, the pump is free standing and installed primarily in a small sump on a firm surface. The pump is intended to operate completely or partially submerged in the pumped liquid. The pump is equipped with a connection for hose or pipe and with supporting legs and/or a strainer. These requirements and instructions are for F-installations that comply to the dimensional drawing.

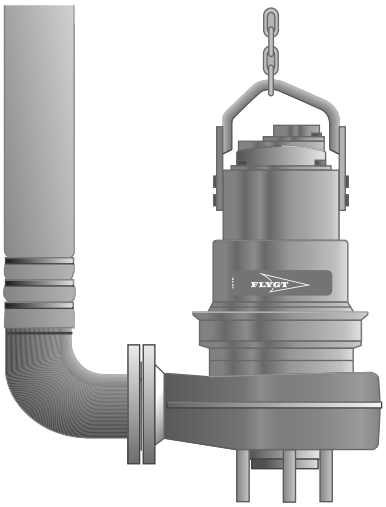


Figure 4: F-installation

These items are required:

- Nipple pipe/Flange/Coupling
- Pipe or hose

1. Run the cable so that is has no sharp bends, is not pinched, and cannot be sucked into the pump inlet.
2. Fit the nipple pipe/flange/coupling.
3. Lower the pump into the sump.
4. Place the pump on the sump bottom and make sure it cannot fall over.
5. Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

   Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* (page 30).

## Install with X-installation

In the X-installation, the pump has no pre-determined mechanical connection. The flange is drilled.

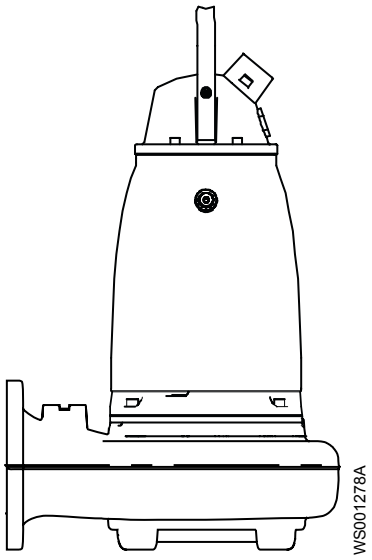



Figure 5: X-installation

NOTICE:

A pump prepared for X-installation is only approved to be used in P- or S-installation. Never use it in T- or Z-installation

For installation instructions, see appropriate mechanical accessories.

# Make the electrical connections

## General precautions

Electrical Hazard:

- A certified electrician must supervise all electrical work. Comply with all local codes and regulations.
- Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.
- Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the end of the motor cable above the liquid level.
- Make sure that all unused conductors are insulated.
- There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out or if there is fault or damage on the product.

WARNING:

Do not install the starter equipment in an explosive zone unless it is explosion-proof rated.

CAUTION:

If the pump is equipped with automatic level control and/or internal contactor, there is a risk of sudden restart.

## Requirements

These general requirements apply for electrical installation:

- The supply authority must be notified before installing the pump if it will be connected to the public mains. When the pump is connected to the public power supply, it may cause flickering of incandescent lamps when started.
- The mains voltage and frequency must agree with the specifications on the data plate. If the pump can be connected to different voltages, then the connected voltage is specified by a yellow sticker close to the cable entry.
- The fuses and circuit breakers must have the proper rating, and the pump overload protection (motor protection breaker) must be connected and set to the rated current according to the data plate and if applicable the cable chart. The starting current in direct-on-line start can be up to six times higher than the rated current.
- The fuse rating and the cables must be in accordance with the local rules and regulations.
- If intermittent operation is prescribed, then the pump must be provided with monitoring equipment supporting such operation.
- If stated on the data plate, then the motor is convertible between different voltages.
- The thermal contacts/thermistors must be in use.
- For FM-approved pumps, FLS must be connected and in use in order to meet approval requirements.

### Cables

These are the requirements to follow when you install cables:

- The cables must be in good condition, not have any sharp bends, and not be pinched.
- The sheathing must not be damaged and must not have indentations or be embossed (with markings, etc.) at the cable entry.
- The cable entry seal sleeve and washers must conform to the outside diameter of the cable.
- The minimum bending radius must not be below the accepted value.
- If using a cable which has been used before, a short piece must be peeled off when refitting it so that the cable entry seal sleeve does not close around the cable at the same point again. If the outer sheath of the cable is damaged, then replace the cable. Contact an Xylem service shop.
- The voltage drop in long cables must be taken into account. The drive unit's rated voltage is the voltage measured at the cable connection point in the pump.

NOTICE:

Do not use Variable Frequency Drive (VFD) with this pump.

### Earthing (Grounding)

Electrical Hazard:

- You must earth (ground) all electrical equipment. This applies to the pump equipment, the driver, and any monitoring equipment. Test the earth (ground) lead to verify that it is connected correctly.
- If the motor cable is jerked loose by mistake, the earth (ground) conductor should be the last conductor to come loose from its terminal. Make sure that the earth (ground) conductor is longer than the phase conductors. This applies to both ends of the motor cable.
- Risk of electrical shock or burn. You must connect an additional earth- (ground-) fault protection device to the earthed (grounded) connectors if persons are likely to come into physical contact with the pump or pumped liquids.

## Connect the motor cable to the pump

CAUTION:

Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the end of the motor cable above the liquid level.

1. Remove the entry gland screw from the stator housing.
2. Remove the stator housing.

   This provides access to the terminal board/closed end splices.
3. Remove the terminal board.
4. Check the data plate to see which connections are required for the power supply.
5. Arrange the connections on the terminal board/closed end splices in accordance with the required power supply.
6. Connect the mains leads (L1, L2, L3, and earth (ground)) according to applicable cable chart.

   The earth (ground) lead must be 50 mm ( 2.0 in.) longer than the phase leads in the junction box of the unit.
7. Make sure that the pump is correctly connected to earth (ground).

8. Make sure that any thermal contacts incorporated in the pump are properly connected to the terminal block/closed end splices.
9. Install the stator housing.
10. Install the entry gland screw.

## Connect the motor cable to the starter and monitoring equipment

WARNING:
Do not install the starter equipment in an explosive zone unless it is explosion-proof rated.

NOTICE:
- Thermal contacts are incorporated in the pump.
- Thermal contacts must never be exposed to voltages higher than 250 V, breaking current maximum 4 A. It is recommended that they are connected to 24 V over separate fuses to protect other automatic equipment.

The single phase pumps must be equipped with a starter which has start and run capacitors.

A specially Flygt designed starter is required for the operation of single phase pumps. The connection of the motor cable to the starter is shown in the wiring diagram.

1. If thermal contacts are included in the pump installation, connect the T1 and T2 control conductors to the monitoring equipment.

   Do not connect the T1 and T2 leads to thermal contacts if the temperature of the pumped liquid is above 40°C (104°F).

   NOTICE:
   Ex-approved products must always have the thermal contacts connected irrespective of the ambient temperature.
2. Connect the mains leads (L1, L2, L3, and earth [ground]) to the starter equipment.

   For information about the phase sequence and the color codes of the leads, see *Cable charts*.
3. Check the functionality of the monitoring equipment:

   a) Check that the signals and the tripping function work properly.
   b) Check that the relays, lamps, fuses, and connections are intact.

   Replace any defective equipment.

## Cable charts

### Description

This topic contains general connection information. It also provides cable charts that show connection alternatives for use with different cables and power supply.

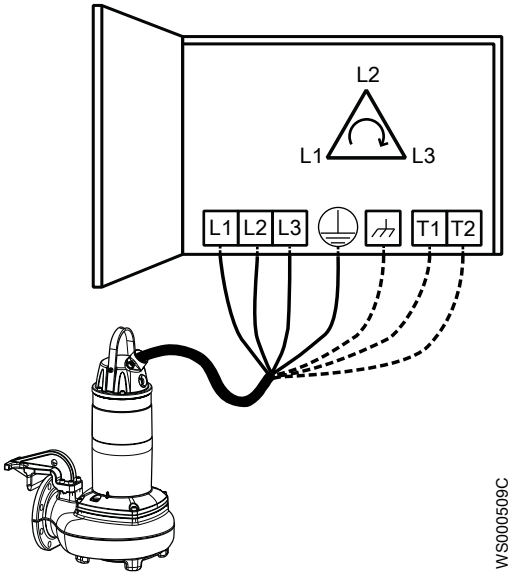
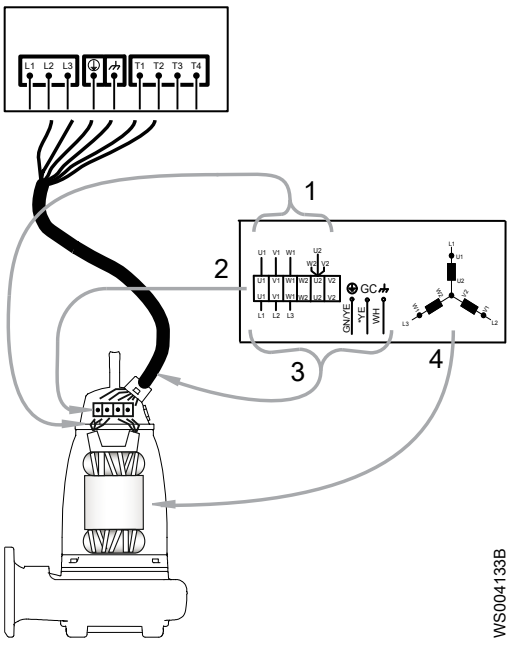


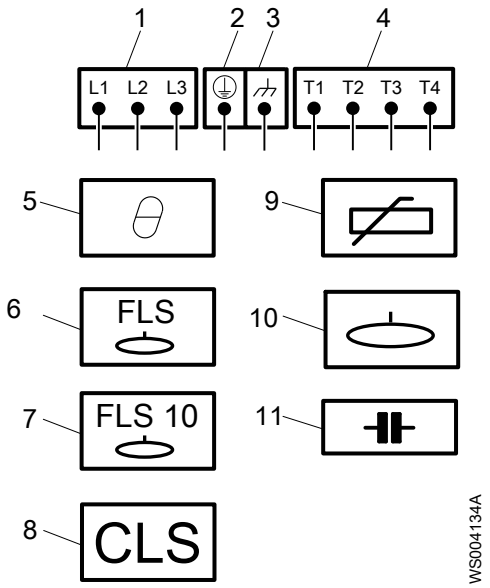

Figure 6: Phase sequence

## Connection locations

The figures in this section illustrate how to interpret the connection strip symbols.




1. Stator leads
2. Terminal board
3. Motor cable leads
4. Connection




1. Starter equipment and mains leads (L1, L2, L3)
2. Earth (ground)
3. Functional ground
4. Control leads (T1, T2, T3, T4)
5. Thermal contact
6. FLS
7. FLS 10
8. CLS
9. Thermistor
10. Level sensor
11. Capacitor

## Color code standard

| Code | Description |
|---|---|
| BN | Brown |
| BK | Black |
| WH | White |
| OG | Orange |
| GN | Green |
| GNYE | Green-Yellow |
| RD | Red |
| GY | Grey |
| BU | Blue |
| YE | Yellow |

## Colors and markings of leads

**Motor connection**

Colours and marking of main leads

COLOUR STANDARD

BN=Brown
BK=Black
WH=White
OG=Orange
GN=Green
GN/YE=Green-Yellow
RD=Red
GY=Grey
BU=Blue
YE=Yellow

STATOR LEADS

U1,U5 RD
U2,U6 GN
V1,V5 BN
V2,V6 BU
W1,W5 YE
W2,W6 BK
T1,T2 WH/YE

*SUBCAB AWG
* * Ground Conductor is stranded around cores
GC=Ground Check

772 17 00/1

| Mains 1~ | Mains 3~ | SUBCAB 7GX Screenflex 7GX | SUBCAB 4GX Screenflex 4GX | SUBCAB AWG | SUBCAB Screened |
|---|---|---|---|---|---|
| 1 | L1 | BK 1 | BN | RD | BN |
| 2 | L2 | BK 2 | BK | BK | BK |
| 3 | L3 | BK 3 | GY | WH | GY |
| | L1 | BK 4 | - | - | - |
| | L2 | BK 5 | - | - | - |
| | L3 | BK 6 | - | - | - |
| ⏚ | | GN/YE | GN/YE | GN/YE | **Screen/PE from cores |
| ⏚ | | Screen (WH) | Screen (WH) | - | Screen (WH) |
| GC | | - | - | YE | - |

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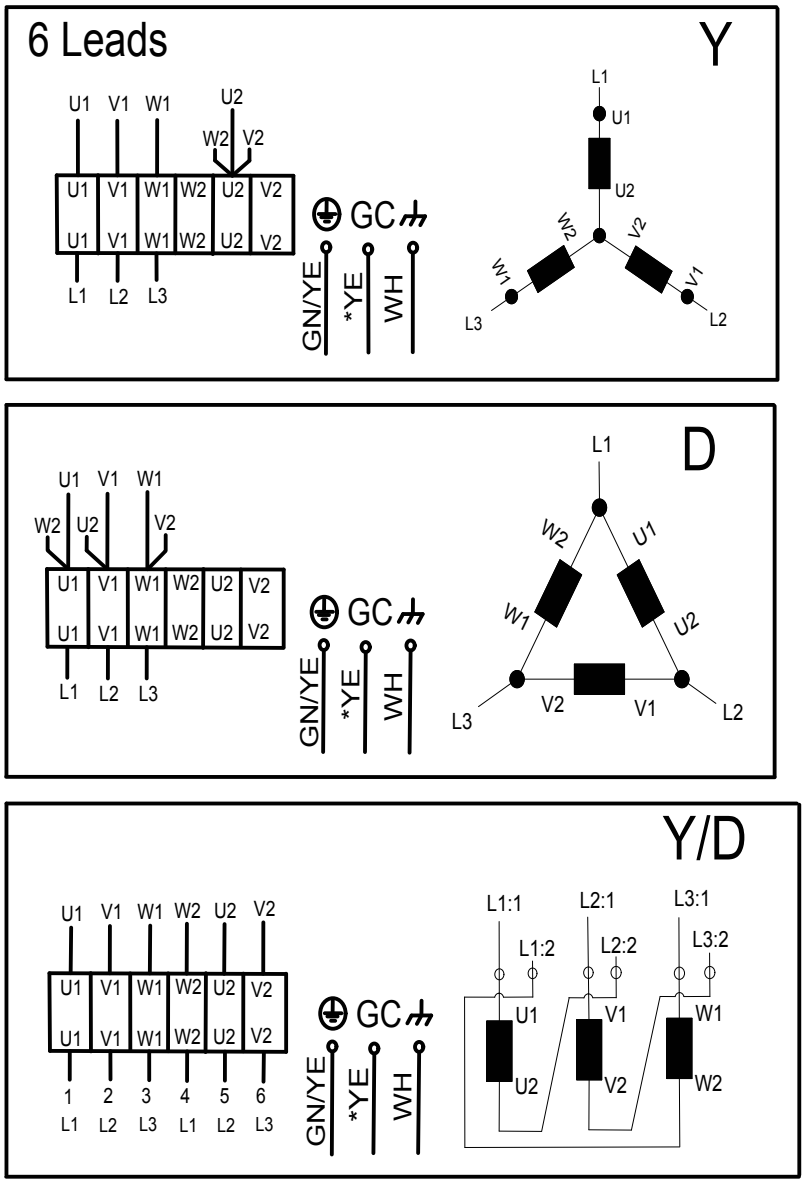
For markings on sensor leads, see *Sensors connection* (page 29).

## Connections included

- *3-phase connection* (page 25)
- *1-phase connection* (page 27)

- *Sensors connection* (page 29)
- *Screened cable connection* (page 28)

### 3-phase connection

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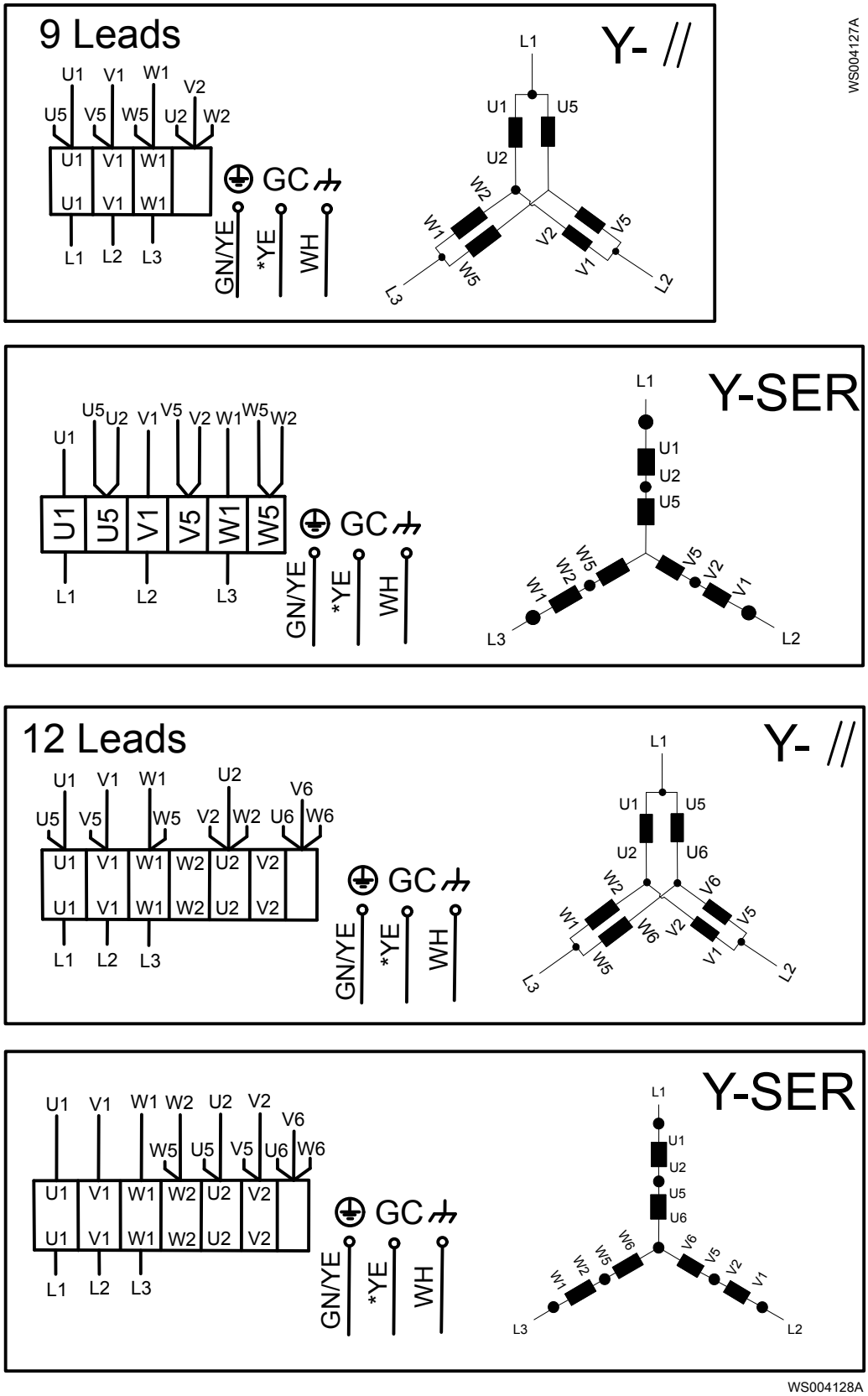
9 Leads
Y- //
U1 V1 W1 V2
U5 V5 W5 U2 W2
U1 V1 W1
U1 V1 W1
L1 L2 L3
GC
GN/YE
*YE
WH
L1
U1 U5
U2
W2 W1 W5
V2 V5 V1
L3 L2
WS004127A
Y-SER
U5 U2 V1 V5 V2 W1 W5 W2
U1
U1 U5 V1 V5 W1 W5
L1 L2 L3
GC
GN/YE
*YE
WH
L1
U1
U2
U5
W5 W2 W1
V5 V2 V1
L3 L2
12 Leads
Y- //
U1 V1 W1 U2 V6
U5 V5 W5 V2 W2 U6 W6
U1 V1 W1 W2 U2 V2
U1 V1 W1 W2 U2 V2
L1 L2 L3
GC
GN/YE
*YE
WH
L1
U1 U5
U2 U6
W2 V6
W1 W6 V2 V5
W5 V1
L3 L2
Y-SER
U1 V1 W1 W2 U2 V2 V6
W5 U5 V5 U6 W6
U1 V1 W1 W2 U2 V2
U1 V1 W1 W2 U2 V2
L1 L2 L3
GC
GN/YE
*YE
WH
L1
U1
U2
U5
U6
W6 W5 V6
W2 V5
W1 V2
V1
L3 L2
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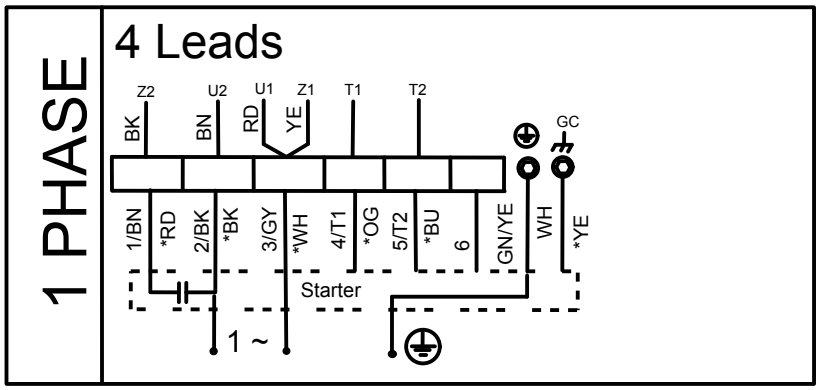
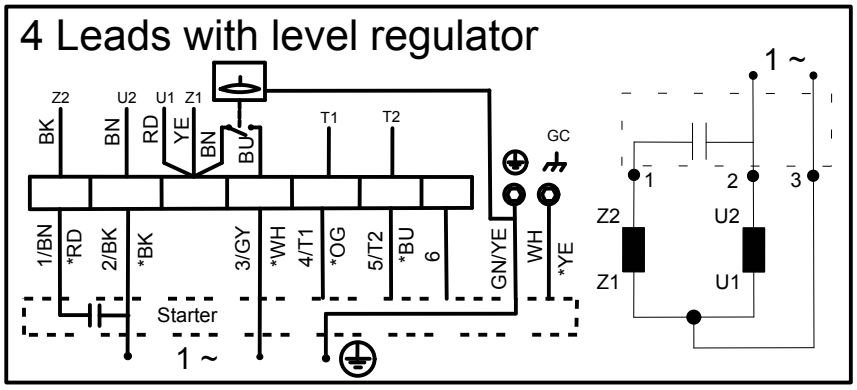
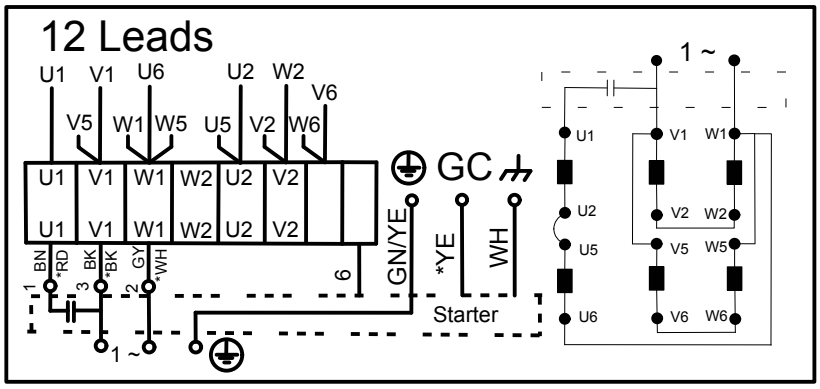
1-phase connection

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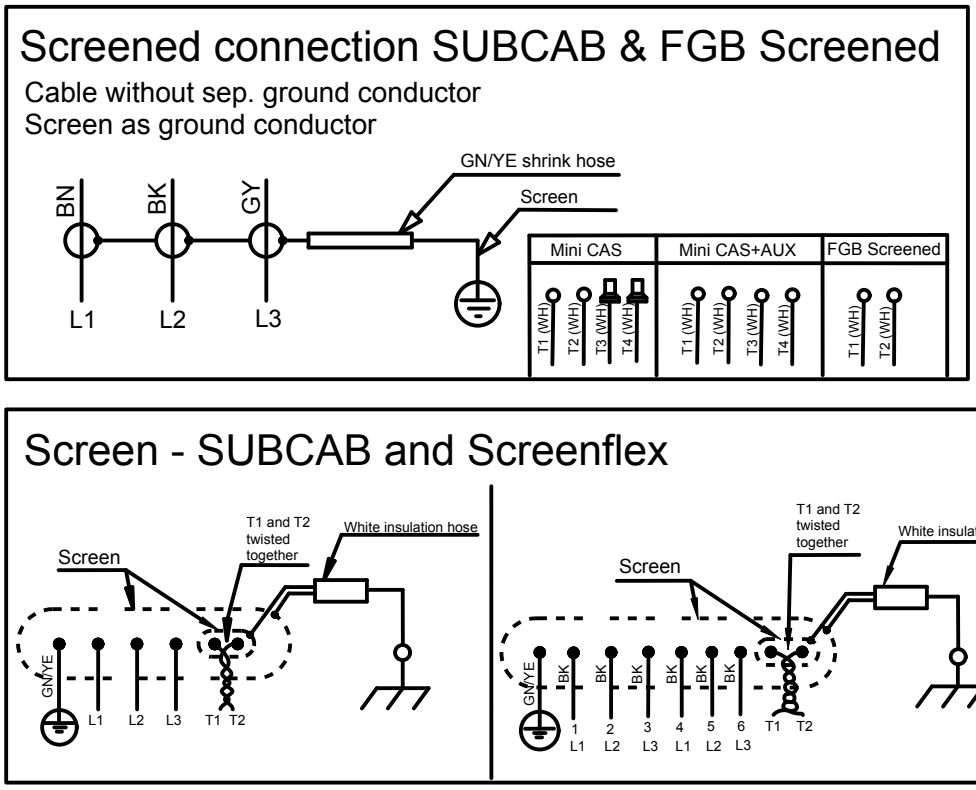
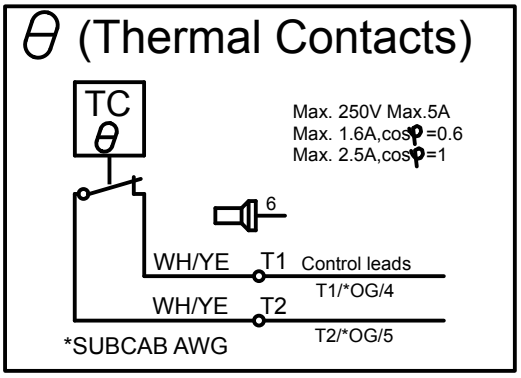
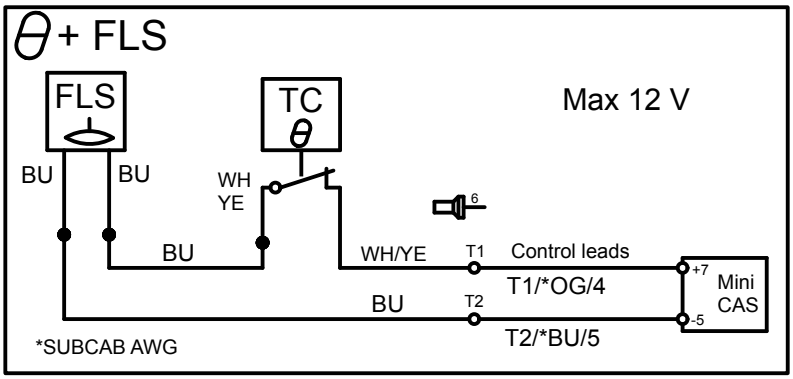
## Screened cable connection

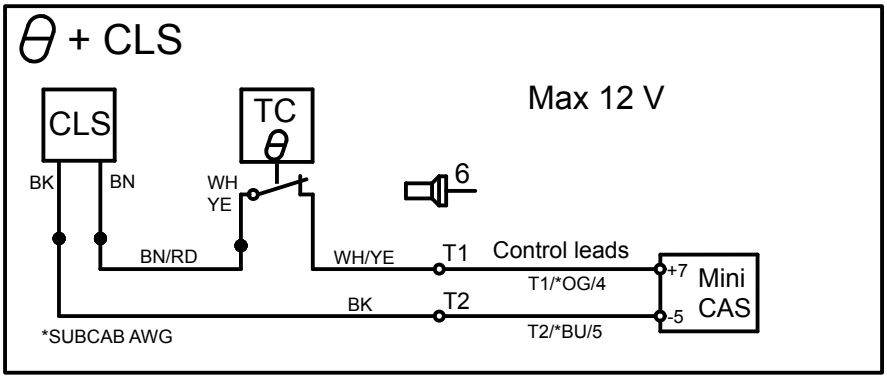


## Sensors connection

| SENSORS | Control | SUBCAB 7GX & 4GX Screenflex | SUBCAB AWG | SUBCAB screened |
|---|---|---|---|---|
| | T1 | WH T1 | OG | WH T1 |
| | T2 | WH T2 | BU | WH T2 |
| | T3 | - | - | WH T3 |
| | T4 | - | - | WH T4 |

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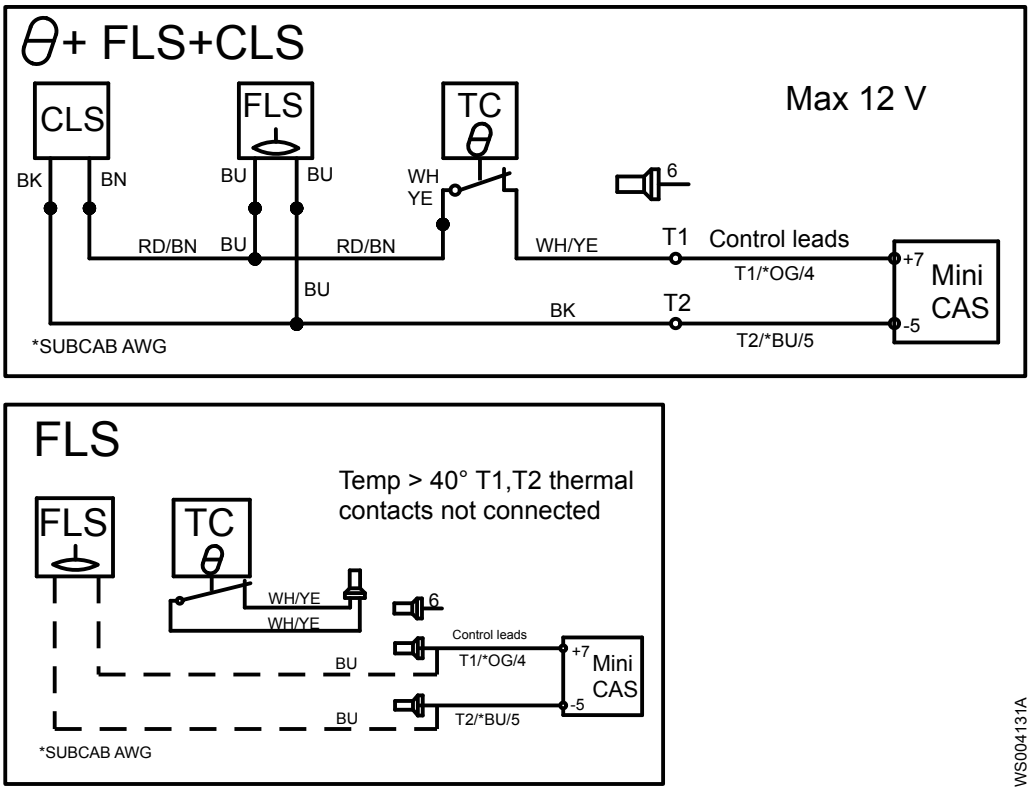



Sensor connection characteristics

The values have a 10 % tolerance.

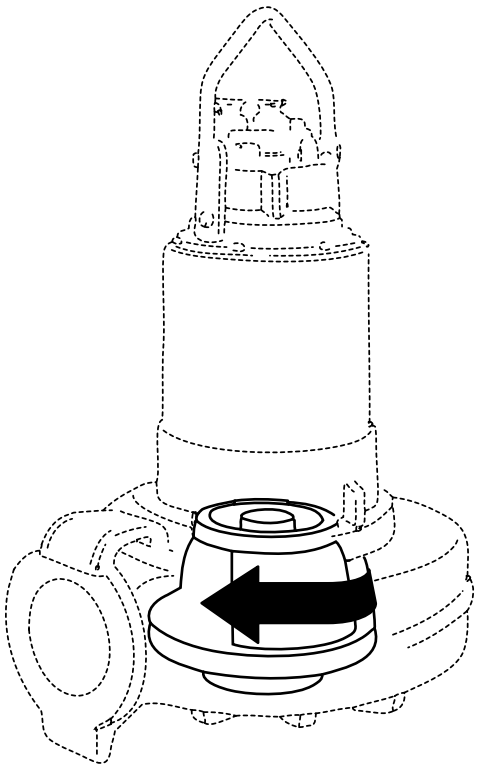
| Sensors | Value (mA) | Definition |
|---|---|---|
| FLS and thermal contact | 0 | Overtemperature |
| | 7.8 | OK |
| | 36 | Leakage |
| CLS and thermal contact | 0 | Overtemperature |
| | 5.5 | OK |
| | 29 | Leakage (5 seconds delay) |
| CLS, FLS and thermal contact | 0 | Overtempterature |
| | 13.3 | OK |
| | 36–42 | Leakage (0/5 seconds delay) |

# Check the impeller rotation

WARNING:

The starting jerk can be powerful.

1. Start the motor.
2. Stop the motor after a few seconds.
3. Check that the impeller rotates according to this illustration.



The correct direction of impeller rotation is clockwise when you look at the pump from above.

4. If the impeller rotates in the wrong direction, do one of these steps:
   - If the motor has a 1-phase connection, contact the local Xylem shop.
   - If the motor has a 3-phase connection, transpose two phase leads and do this procedure again.

# Operation

### Precautions

WARNING:

- Never operate the pump without safety devices installed.
- Never operate the pump with the discharge valve closed.
- Make sure you have a clear path of retreat.
- Never work alone.

CAUTION:

If the pump is equipped with automatic level control and/or internal contactor, there is a risk of sudden restart.

### Distance to wet areas

Electrical Hazard:

Risk of electrical shock. Make sure no one gets closer than 20 m (65 ft.) to the unit when being in contact with the pumped or mixed liquid.

Electrical Hazard:

Risk of electrical shock. This unit has not been investigated for use in swimming pools. If used in connection with swimming pools special safety regulations apply.

### Noise level

NOTICE:

The noise level of the product is lower than 70 dB. However, the noise level of 70 dB may be exceeded in some installations and at certain operating points on the performance curve. Make sure that you understand the noise level requirements in the environment where the pump is installed. Failure to do so may result in hearing loss or violation of local laws.

## Start the pump

WARNING:

- If you need to work on the pump, make sure that it is isolated from the power supply and cannot be energized.
- Make sure that the unit cannot roll or fall over and injure people or damage property.
- In some installations, the pump and the surrounding liquid may be hot. Bear in mind the risk of burn injuries.
- Make sure nobody is close to the unit when it is started. The unit will jerk in the opposite direction of the impeller rotation.

NOTICE:

Make sure that the rotation of the impeller is correct. For more information, see Check the impeller rotation.

1. Check the oil level in the oil housing.
2. Remove the fuses or open the circuit breaker, and check that the impeller can be rotated freely.
3. Conduct insulation test phase to ground. To pass, the value must exceed 5 megohms.
4. Check that the monitoring equipment works.
5. Start the pump.

# Maintenance

## Precautions

WARNING:

- Always follow safety guidelines when working on the product. See *Introduction and Safety* (page 3).
- Disconnect and lock out electrical power before installing or servicing the pump.
- Make sure that the unit cannot roll or fall over and injure people or damage property.
- Rinse the unit thoroughly with clean water before working on the unit.
- Rinse the components in water after dismantling.

Make sure that you follow these requirements:

- Check the explosion risk before you weld or use electrical hand tools.
- Allow all system and pump components to cool before you handle them.
- Make sure that the product and its components have been thoroughly cleaned.
- Do not open any vent or drain valves or remove any plugs while the system is pressurized. Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.

## Maintenance guidelines

During maintenance and before reassembly, always remember to perform these tasks:

- Clean all parts thoroughly, particularly O-ring grooves.
- Change all O-rings, gaskets, and seal washers.
- Lubricate all springs, screws, and O-rings with grease.

During reassembly, always make sure that existing index markings are in line.

The reassembled drive unit must always be insulation-tested and the reassembled pump must always be test-run before normal operation.

# Torque values

All screws and nuts must be lubricated to achieve correct tightening torque. Screws that are screwed into stainless steel must have the threads coated with suitable lubricants to prevent seizing.

If there is a question regarding the tightening torques, please contact a sales representative.

## Screws and nuts

**Table 1: Stainless steel, A2 and A4, torque Nm (ft-lbs)**

| Property class | M4 | M5 | M6 | M8 | M10 | M12 | M16 | M20 | M24 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 1.0 (0.74) | 2.0 (1.5) | 3.0 (2.2) | 8.0 (5.9) | 15 (11) | 27 (20) | 65 (48) | 127 (93.7) | 220 (162) | 434 (320) |
| 70, 80 | 2.7 (2) | 5.4 (4) | 9.0 (6.6) | 22 (16) | 44 (32) | 76 (56) | 187 (138) | 364 (268) | 629 (464) | 1240 (915) |

| Property class | M4 | M5 | M6 | M8 | M10 | M12 | M16 | M20 | M24 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 4.1 (3) | 8.1 (6) | 14 (10) | 34 (25) | 66 (49) | 115 (84.8) | 248 (183) | 481 (355) | – | – |

**Table 2: Steel, torque Nm (ft-lbs)**

| Property class | M4 | M5 | M6 | M8 | M10 | M12 | M16 | M20 | M24 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| 8.8 | 2.9 (2.1) | 5.7 (4.2) | 9.8 (7.2) | 24 (18) | 47 (35) | 81(60) | 194 (143) | 385 (285) | 665 (490) | 1310 (966.2) |
| 10.9 | 4.0 (2.9) | 8.1 (6) | 14 (10) | 33 (24) | 65 (48) | 114 (84) | 277 (204) | 541 (399) | 935 (689) | 1840 (1357) |
| 12.9 | 4.9 (3.6) | 9.7 (7.2) | 17 (13) | 40 (30) | 79 (58) | 136 (100) | 333 (245) | 649 (480) | 1120 (825.1) | 2210 (1630) |

### Hexagon screws with countersunk heads

For hexagon socket head screws with countersunk head, maximum torque for all property classes must be 80% of the values for property class 8.8 above.

## Change the oil

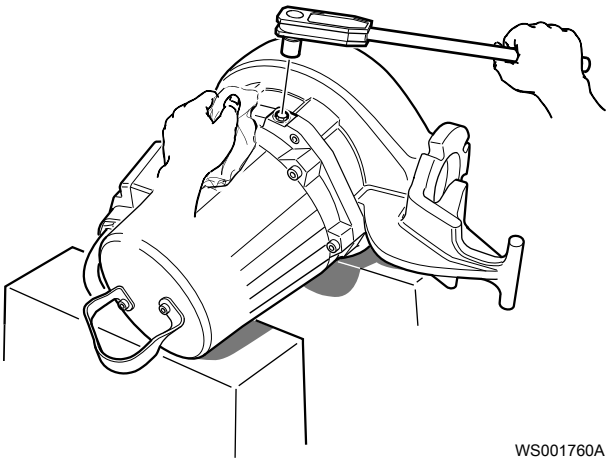
This image shows the plugs that are used to change the oil.

### Empty the oil

WARNING:

The oil housing may be pressurized. Hold a rag over the oil plug to prevent oil from spraying out.

1. Place the pump in a horizontal position and unscrew the oil plug.

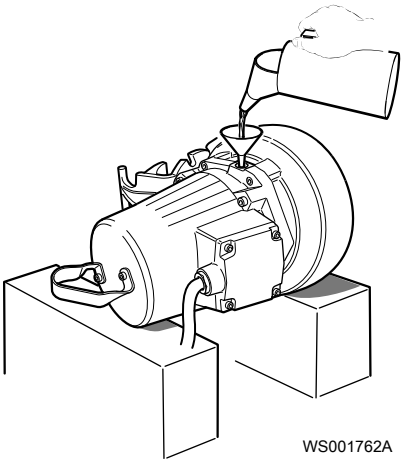



2. Place a container under the pump and turn the pump.

### Fill with oil

The oil should be a medical white oil of paraffin type that fulfills FDA 172.878 (a) and viscosity close to VG32.

1. Replace the O-ring of the oil plug.
2. Fill with oil.
   Quantity: approximately 0.6 L (0.63 qt.)




3. Refit the oil plug and tighten.
   Tightening torque: 10-40 Nm (7.5-29.5 ft-lbs)

## Service the pump

| Type of service | Purpose | Inspection interval |
|---|---|---|
| Initial inspection | To make a check up of the pump condition by an authorized Xylem service representative and, based on the result and findings from these measures, to determine the intervals for periodical inspection and major overhaul for the specific installation. | Within the first year of operation. |
| Periodical inspection | To prevent operational interruptions and machine breakdown. Measures | Up to every year |

| Type of service | Purpose | Inspection interval |
|---|---|---|
| | to secure performance and pump efficiency are defined and decided for each individual application. It can include such things as impeller trimming, wear part control and replacement, control of zinc-anodes and control of the stator. | Applies to normal applications and operating conditions at media (liquid) temperatures <40°C.<br>Up to every 5 year<br>Applies to application with M-impeller with usage < 10 min/day and approximately 10 starts/day. |
| Major overhaul | To secure a long operating lifetime for the product. It includes replacement of key components and the measures taken during an inspection. | Up to every 3 year<br>Applies to normal applications and operating conditions at media (liquid) temperatures <40°C.<br>Up to 20,000 hours<br>Applies to application with M-impeller with usage < 10 min/day and approximately 10 starts/day. |

NOTICE:

Shorter intervals may be required when the operating conditions are extreme, for example with very abrasive or corrosive applications or when the liquid temperatures exceed 40°C (104°F).

## Inspection

| Service item | Action |
|---|---|
| Cable | 1. If the outer jacket is damaged, replace the cable.<br>2. Check that the cables do not have any sharp bends and are not pinched. |
| Connection to power | Check that the connections are properly tightened. |
| Electrical cabinets | Check that they are clean and dry. |
| Impeller | 1. Check the impeller clearance.<br>2. Adjust the impeller, if necessary. |
| Stator housing | 1. Drain all liquid, if any.<br>2. Check the resistance of the leakage sensor.<br>Normal value approx.1500 ohms, alarm approx. 430 ohms. |
| Insulation | Use a megger maximum 1000 V.<br>1. Check that the resistance between the earth (ground) and phase lead is more than 5 megohms.<br>2. Conduct a phase-to-phase resistance check. |
| Junction box | Check that it is clean and dry. |
| Lifting device | Check that local safety regulations are followed. |
| Lifting handle | 1. Check the screws.<br>2. Check the condition of the lifting handle.<br>3. Replace if necessary. |

| Service item | Action |
|---|---|
| O-rings | 1. Replace the oil plug O-rings.<br>2. Replace the O-rings at the entrance or junction cover.<br>3. Grease the new O-rings. |
| Overload protection and other protections | Check the correct settings. |
| Personnel safety devices | Check the guard rails, covers, and other protections. |
| Rotation direction | Check the impeller rotation. |
| Oil housing | Fill with new oil, if necessary. |
| Terminal block/closed end splice | Check that the connections are properly tightened. |
| Thermal contacts | Normally closed circuit; interval 0–1 ohm. |
| Voltage and amperage | Check the running values. |

## Major overhaul

For a major overhaul, take this action in addition to the tasks listed under Inspection.

| Service item | Action |
|---|---|
| Support and main bearing | Replace the bearings with new bearings. |
| Mechanical seal | Replace with new seal units. |

## Service in case of alarm

For information about indication values for sensors, see *Sensor-connection*.

| Alarm source | Action |
|---|---|
| FLS | 1. Check for liquid in the stator housing.<br>2. Drain all liquid, if any.<br>3. Check the mechanical seal unit, the O-rings, and the cable entry, if liquid was found. |
| Thermal contact | Check the start and stop levels. |
| The overload protection | Check that the impeller can rotate freely. |

# Replace the impeller

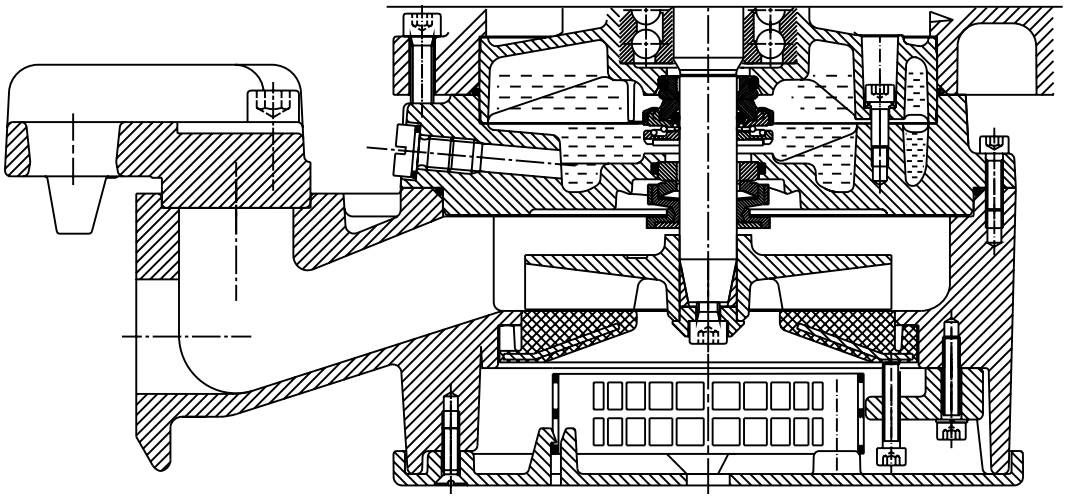


Figure 7: B-impeller

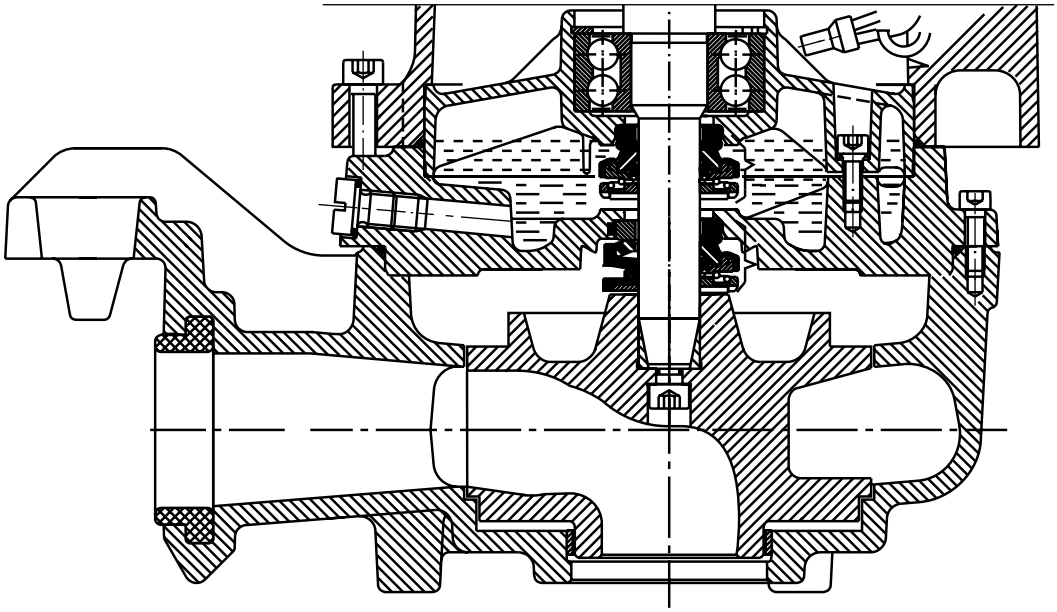


Figure 8: C-impeller

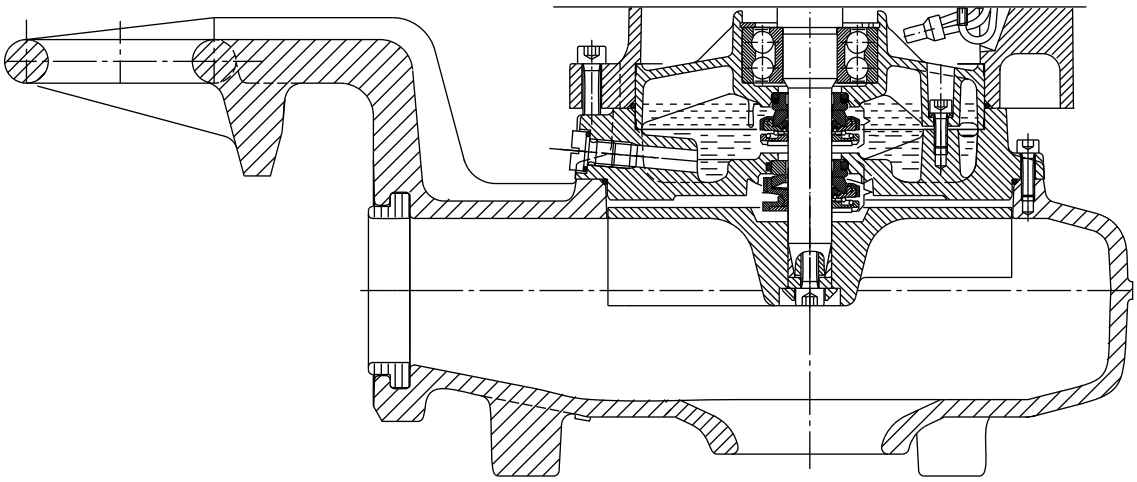


Figure 9: D-impeller

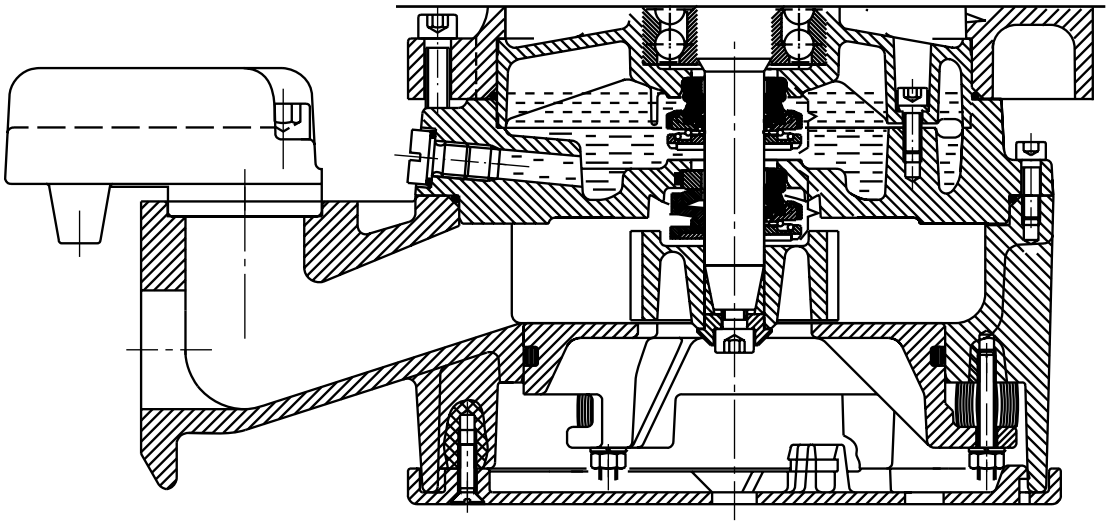


Figure 10: F-impeller

Required tools:

- 6 mm hexagon bit adapter with an extension of at least 125 mm (4.92 in.)
- Impeller puller
  If applicable, contact your local Xylem representative for correct type and size.
- Rod (wood or copper) for locking the impeller in place, if applicable.
- Two crowbars, if applicable

WARNING:
- If you fail with the impeller installation, you must redo the installation procedure from the beginning.
- A worn impeller and/or pump housing can have very sharp edges. Wear protective gloves.
- When laying the pump on its side, do not allow the weight of the pump to rest on any portion of the impeller. The impeller must not be allowed to make contact with the concrete floor or other hard and rough surfaces.

## Remove the impeller

CAUTION:
A worn impeller and/or pump housing can have very sharp edges. Wear protective gloves.

1. Lay the pump on its side.
2. For the S-installation, remove the strainer bottom.
3. Remove these items, based on your pump version:
   - For the C and D impellers in pressure classes MT and HT, remove the pump housing.
   - For the B, F, and D impellers in pressure class LT, remove the suction cover.
4. Remove the impeller screw.
   If applicable, use the rod.
5. Remove the impeller.
   Use the impeller puller or the crowbars.
6. Remove the conical sleeve.

## Install the impeller

1. Make sure that the end of the shaft is clean and free from burrs.
   Polish off any flaws with a fine emery cloth.
2. Mount the impeller:
   a) Fit the conical sleeve onto the shaft.
   b) Press the impeller onto the shaft with the lubricated impeller screw.
   c) Tighten the impeller screw.
      For tightening torque, see *Torque values* (page 34).
      If applicable, use the rod.
      Check that the impeller can rotate freely.
3. For B-, F-impeller, D-impeller pressure class LT:
   a) Fit the suction cover.
   b) Fit and tighten the lubricated screws.
      For tightening torque, see *Torque values* (page 34).
4. For C-, D-impeller pressure class MT and HT:
   a) Fit the pump housing.
   b) Fit and tighten the lubricated screws.
      For tightening torque, see *Torque values* (page 34).
5. For S-installation, mount the strainer bottom.
   a) Fit the strainer bottom to the pump housing.
   b) Fit and tighten the lubricated screws.
      For tightening torque, see *Torque values* (page 34).

## Replace the M-impeller

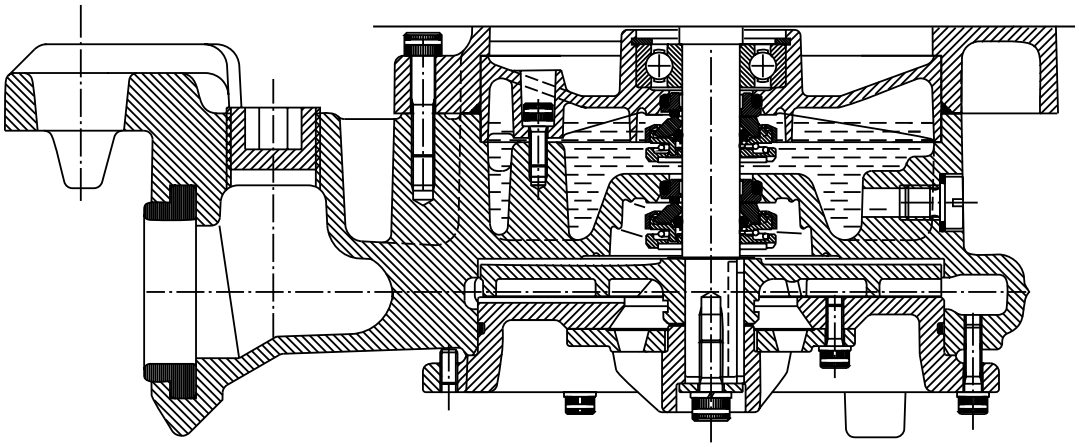


Figure 11: M-impeller

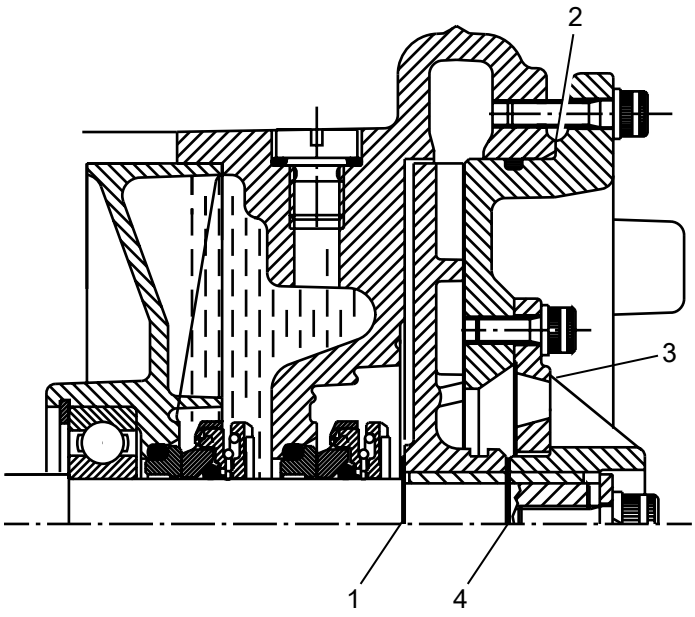
### Remove the M-impeller

CAUTION:
A worn impeller and/or pump housing can have very sharp edges. Wear protective gloves.

1. Lay the pump on its side.
2. Remove the impeller screw.
   If applicable, use the rod.
3. Remove the washers.
4. Remove the suction cover unit and cutter wheel:
   a) Remove the suction cover screws and washers.
   b) Remove the suction cover.
   c) Remove the cutter ring.
   d) Remove the cutter wheel.
5. Remove the impeller.
   Use the impeller puller or the crowbars.
6. Remove the washers.

### Install and adjust the M-impeller

This figure shows correct position of washers or positions of where to measure distances by fitting washers.




WARNING:

Rotating cutting wheel. Disconnect power before lifting the pump.

1. Prepare the shaft:
   a) Make sure that the end of the shaft is clean and free from burrs.
      Polish off any flaws with a fine emery cloth.
   b) Make sure that the parallel key is seated in the keyway on the shaft.
   c) Fit four adjusting washers onto the shaft.
      Use washers with a thickness of 0.1 mm (0.004 in.) or 0.3 mm (0.12 in.).
      Position 1
2. Prepare the suction cover unit:
   a) Make sure that the cutter ring is mounted on the suction cover.
   b) Remove the O-ring from the outside of the suction cover.
3. Adjust the impeller:
   a) Mount the impeller, the suction cover, cutter ring, and the cutter wheel.
   b) Hand-tighten the impeller screw and the suction cover screws.
   c) Measure the distance between the suction cover and the pump housing by fitting as many adjusting washers in the gap as possible.
      Use washers with a thickness of 0.1 mm (0.004 in.) or 0.3 mm (0.12 in.).
      Note the numbers of washers equals X.
      Position 2
   d) Remove the impeller screw, the suction cover, the cutter ring, and the impeller.

e) Add/remove the adjustment washers to achieve correct distance.
f) Keep Y number of washers on the shaft.
   Use the formula Y = X-1.
g) Mount the impeller.

4. Adjust the cutting device:
   a) Fit four adjusting washers onto the shaft.
      Use washers with a thickness of 0.1 mm (0.004 in.) or 0.3 mm (0.12 in.).
      Position 4
   b) Fit the suction cover unit and the cutter wheel.
   c) Fit and hand-tighten the impeller screw and the suction cover screws.
   d) Measure the distance between the cutter wheel and the cutter ring.
      The distance should be between 0.05 - 0.15 mm (0.002 - 0.006 in.).
      Position 3
   e) Remove the impeller screw, the cutter wheel, and the suction cover unit from the shaft.
   f) Remove or add adjusting washers at position 4 in order to get the requested distance.
      Use washers with a thickness of 0.1 mm (0.004 in.) or 0.3 mm (0.12 in.).
5. Mount the suction cover unit:
   a) Fit a new greased O-ring on the outside of the suction cover.
   b) Fit the suction cover unit onto the shaft.
   c) Fit and tighten the lubricated screws.
      For tightening torque, see *Torque values* (page 34).
6. Mount the cutter wheel:
   a) Fit the cutter wheel.
   b) Fit the washer on the lubricated impeller screw.
   c) Tighten the impeller screw.
      For tightening torque, see *Torque values* (page 34).
      Check that the impeller and cutter wheel can rotate freely.

# Troubleshooting

### Introduction

Follow these guidelines when troubleshooting the pump:

- Disconnect and lock out the power supply except when conducting checks that require voltage.
- Make sure that no one is near the pump when the power supply is reconnected.
- When troubleshooting electrical equipment, use the following:
  - Universal instrument multimeter
  - Test lamp (continuity tester)
  - Wiring diagram

## The pump does not start

WARNING:

Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

| Cause | Remedy |
|---|---|
| An alarm signal has been triggered on the control panel. | Check that:<br>• The impeller rotates freely.<br>• The sensor indicators do not indicate an alarm.<br>• The overload protection is not tripped.<br>If the problem still persists:<br>Contact the local Xylem service shop. |
| The pump does not start automatically, but can be started manually. | Check that:<br>• The start level regulator is functioning. Clean or replace if necessary.<br>• All connections are intact.<br>• The relay and contactor coils are intact.<br>• The control switch (Man/Auto) makes contact in both positions.<br>Check the control circuit and functions. |
| The installation is not receiving voltage. | Check that:<br>• The main power switch is on.<br>• There is control voltage to the start equipment.<br>• The fuses are intact.<br>• There is voltage in all phases of the supply line.<br>• All fuses have power and that they are securely fastened to the fuse holders.<br>• The overload protection is not tripped.<br>• The motor cable is not damaged. |
| The impeller is stuck. | Clean: |

| Cause | Remedy |
|---|---|
| | • The impeller<br>• The sump in order to prevent the impeller from clogging again. |

If the problem persists, refer to the Flygt Service Guide on the web or contact the local Xylem service shop. Always state the serial number of your pump when you contact Xylem, see *Product Description* (page 11).

## The pump does not stop when a level sensor is used

WARNING:

Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

| Cause | Remedy |
|---|---|
| The pump is unable to empty the sump to the stop level. | Check that:<br>• There are no leaks from the piping and/or discharge connection.<br>• The impeller is not clogged.<br>• The non-return valve(s) are functioning properly.<br>• The pump has adequate capacity. For information: Contact the local Xylem service shop. |
| There is a malfunction in the level-sensing equipment. | • Clean the level regulators.<br>• Check the functioning of the level regulators.<br>• Check the contactor and the control circuit.<br>• Replace all defective items. |
| The stop level is set too low. | Raise the stop level. |

If the problem persists, refer to the Flygt Service Guide on the web or contact the local Xylem service shop. Always state the serial number of your pump when you contact Xylem, see *Product Description* (page 11).

## The pump starts-stops-starts in rapid sequence

| Cause | Remedy |
|---|---|
| The pump starts due to back-flow which fills the sump to the start level again. | Check that:<br>• The distance between the start and stop levels is sufficient.<br>• The non-return valve(s) work(s) properly.<br>• The length of the discharge pipe between the pump and the first non-return valve is sufficiently short. |
| The self-holding function of the contactor malfunctions. | Check:<br>• The contactor connections.<br>• The voltage in the control circuit in relation to the rated voltages on the coil.<br>• The functioning of the stop-level regulator.<br>• Whether the voltage drop in the line at the starting surge causes the contactor's self-holding malfunction. |

If the problem persists, refer to the Flygt Service Guide on the web or contact the local Xylem service shop. Always state the serial number of your pump when you contact Xylem, see *Product Description* (page 11).

## The pump runs but the motor protection trips

WARNING:
Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

NOTICE:
Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

| Cause | Remedy |
|---|---|
| The motor protection is set too low. | Set the motor protection according to the data plate and if applicable the cable chart. |
| The impeller is difficult to rotate by hand. | • Clean the impeller.<br>• Clean out the sump.<br>• Check that the impeller is properly trimmed. |
| The drive unit is not receiving full voltage on all three phases. | • Check the fuses. Replace fuses that have tripped.<br>• If the fuses are intact, notify a certified electrician. |
| The phase currents vary, or they are too high. | Contact the local Xylem service shop. |
| The insulation between the phases and ground in the stator is defective. | 1. Use an insulation tester. With a 1000 V DC megger, check that the insulation between the phases and between any phase and ground is > 5 megohms.<br>2. If the insulation is less:<br>Contact the local Xylem service shop. |
| The density of the pumped fluid is too high. | Make sure that the maximum density is 1100 kg/m$^3$ (9.2 lb/US gal)<br>• Change the impeller, or<br>• Change to a more suitable pump.<br>• Contact the local Xylem service shop. |
| There is a malfunction in the overload protection. | Replace the overload protection. |

If the problem persists, refer to the Flygt Service Guide on the web or contact the local Xylem service shop. Always state the serial number of your pump when you contact Xylem, see *Product Description* (page 11).

## The pump delivers too little or no water

WARNING:
Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

| Cause | Remedy |
|---|---|
| The impeller rotates in the wrong direction. | • If it is a 3-phase pump, transpose two phase leads.<br>• If it is a 1-phase pump:<br>Contact the local Xylem service shop. |
| One or more of the valves are set in the wrong positions. | • Reset the valves that are set in the wrong position.<br>• Replace the valves, if necessary.<br>• Check that all valves are correctly installed according to media flow.<br>• Check that all valves open correctly. |
| The impeller is difficult to rotate by hand. | • Clean the impeller.<br>• Clean out the sump.<br>• Check that the impeller is properly trimmed. |
| The pipes are obstructed. | Clean out the pipes to ensure a free flow. |
| The pipes and joints leak. | Find the leaks and seal them. |
| There are signs of wear on the impeller, pump, and casing. | Replace the worn parts. |
| The liquid level is too low. | • Check that the level sensor is set correctly.<br>• Depending on the installation type, add a means for priming the pump, such as a foot valve. |

If the problem persists, refer to the Flygt Service Guide on the web or contact the local Xylem service shop. Always state the serial number of your pump when you contact Xylem, see *Product Description* (page 11).

# Technical Reference

## Motor data

| Feature | Description |
|---|---|
| Motor type | Squirrel-cage induction motor |
| Frequency | 50 or 60 Hz |
| Supply | 1-phase or 3-phase |
| Starting method | • Direct on-line<br>• Star-delta |
| Maximum starts per hour | 15 evenly spaced starts per hour |
| Code compliance | IEC 60034-1 |
| Rated output variation | ±5% |
| Voltage variation without overheating | ±10%, provided that it does not run continuously at full load |
| Voltage imbalance tolerance | 2% |
| Stator insulation class | F (155°C [310°F]) |

## Application limits

| Data | Description |
|---|---|
| Liquid temperature | 40°C (104°F) maximum<br>The pump can be operated at full load only if at least half the stator housing is submerged.<br>Ex-approved pumps: 40°C (104°F) maximum |
| Liquid density | 1100 kg/m³ (9.2 lb per US gal) maximum |
| pH of the pumped media (liquid) | 5.5–14 |
| Depth of immersion | 20 m (65 ft) maximum |
| Other | For the specific weight, current, voltage, power ratings, and speed of the pump, see the data plate of the pump. |

# Xylem |ˈzīləm|

1) The tissue in plants that brings water upward from the roots
2) A leading global water technology company

We're 12,500 people unified in a common purpose: creating innovative solutions to meet our world's water needs. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. We move, treat, analyze, and return water to the environment, and we help people use water efficiently, in their homes, buildings, factories and farms. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise, backed by a legacy of innovation.

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Visit our Web site for the latest version of this document and more information

The original instruction is in English. All non-English instructions are translations of the original instruction.

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# 247 Series
# Compressor Pump

| Model: | Flywheel: |
|---|---|
| 247-4502 | |
| 247-510 | X |

## Specifications:

Minimum rpm: 300
Maximum rpm: 900

Max Duty Cycle for 8 hour/day operation: 75-80%
Max Duty Cycle for 16 hour/day operation: 60%
Max Duty Cycle for 24 hour/day operation: 30-35%

Maximum Continuous Duty Working Pressure: 175 psi

Approx. Oil Capacity of Crankcase: 2.8 litres

| HP | 150 psi | | Cylinders | | | Flywheel | |
|---|---|---|---|---|---|---|---|
| | rpm | CFM | Qty | Bore | Stroke | Dia. | Groove |
| 5 | 550 | 19.1 | 2 | 4.5" and 2.5" | 4" | 20" | 2B |
| 7.5 | 800 | 25.8 | | | | | |
| 13 Gas | 800 | 25.8 | | | | | |

**NOTE**

**For installation and maintenance information, refer to DV Systems Bulletin 'HDI01'.**

**CAUTION**

**Check for proper oil level prior to using the Pump.**

**Service & Maintenance:** Use only Genuine DV Systems Oil and Kits as indicated on Page 3 of this manual.

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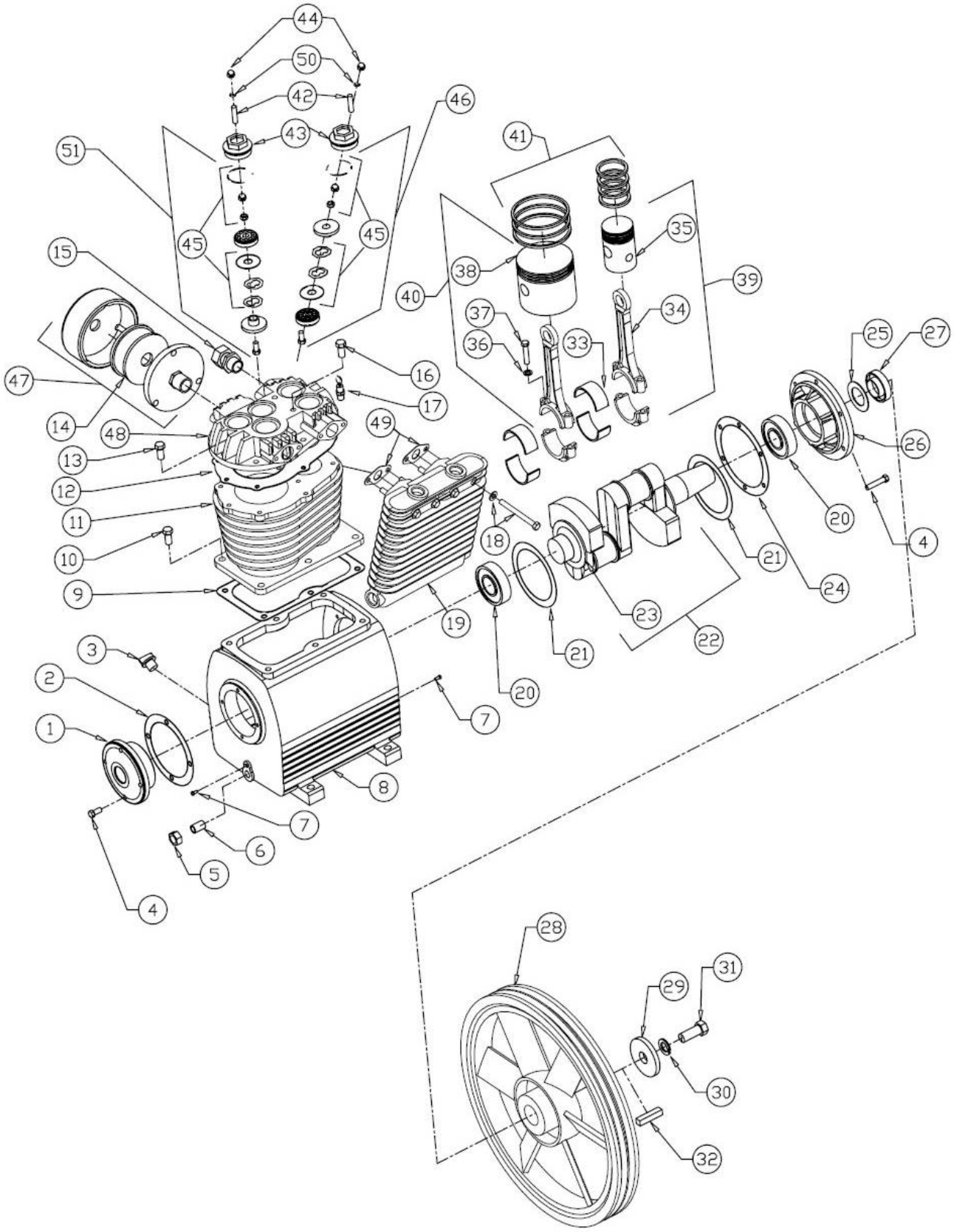
Fax: (705) 728-4974
Email: sales@dvsystems.ca
Web: www.dvsystems.ca

Available from Allparts Equipment and Accessories - 1-877-475-5660 - www.allpartsinc.com




Available from Allparts Equipment and Accessories - 1-877-475-5660 - www.allpartsinc.com

| Ref. #: | Qty: | Part #: | Description: | Ref. #: | Qty: | Part #: | Description: |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 37331-105 | End Plate | 26 | 1 | 37333-305 | 1/2"-13 x 1" Hex Head Cap Screw |
| 2 | 1 | 432-12 | End Plate Gasket | 27 | 1 | 342-111 | Oil Seal |
| 3 | 1 | NCB-303-1 | Oil Filler Plug | 28 | 1 | 432-2-1 | Flywheel, 20" OD, 2B |
| 4 | 10 | SS-14 | 5/15-18 x 1" Hex Head Cap Screw | 29 | 1 | 432-326 | Retaining Washer |
| 5 | 1 | SS-9924 | 3/8" NPT Pipe Cap | 30 | 1 | SS-1508 | 5/8" Medium Lock Washer |
| 6 | 1 | SS-2108 | 3/8" x 2" Nipple | 31 | 1 | SS-6883 | 5/8-18 x 1-1/2" Hex Hd Cap Screw |
| 7 | 2 | 225-6 | Screw | 32 | 1 | SS-10482 | 3/8" x 2" Square Key |
| 8 | 1 | 37137-104 | Crankcase | 33 | 2 | 445-474 | Bearing Insert |
| 9 | 1 | 445-327 | Crankcase to Cylinder Gasket | 34 | 2 | 445-4110-3 | Rod + Cap Assy |
| 10 | 6 | SS-48 | 1/2-13 x 1" Hex Head Cap Screw | 35 | 1 | 445-4112-1 | High Pressure Piston + Pin Assy |
| 11 | 1 | 447-325 | Cylinder | 36 | 4 | SS-9946 | Lock Washer |
| 12 | 1 | 447-26 | Head Gasket | 37 | 4 | SS-9947 | Connecting Rod Bolt |
| 13 | 7 | SS-26 | 3/8-16 x 1-1/2" Hex Hd Cap Screw | 38 | 1 | 445-412-1 | Low Pressure Piston + Pin Assy |
| 14 | 1 | 357-9701 | Air Filter Element | 39 | 1 | 445-9403 | High Pressure Rod + Piston Assy |
| 15 | 1 | ACC-9010 | 3/4" Compression Fitting | 40 | 1 | 445-9402 | Low Pressure Rod + Piston Assy |
| 16 | 2 | SS-31 | 3/8-16 x 2-1/2" Hex Hd Cap Screw | 41 | 1 | KK-9805 | Ring Kit - Standard Size |
| 17 | 1 | TIA-5075 | 75 psi Safety Valve | 42 | 5 | SS-6045 | 3/8-16 x 1-1/2" Set Screw |
| 18 | 4 | SS-01973 | 3/8-16 x 3-3/4" Hex Bolt | 43 | 5 | 445-89 | Valve Plug |
| 18 | 4 | SS-1525 | 3/8" Flatwasher (See Note Below) | 44 | 5 | SS-7424 | 3/8-16 Cap Nut |
| 19 | 1 | 447-330 | Intercooler | 45 | 1 | VRK-247 | Valve Repair kit |
| 20 | 2 | 235-23 | Ball Bearing | 46 | 2 | 445-4205 | Exhaust Valve Assembly |
| 21 | 2 | 445-5-1 | Oil Throw Ring | 47 | 1 | 357-9401 | Air Filter - Silencer Assembly |
| 22 | 1 | 45817-514 | Crankshaft Assembly | 48 | 1 | 447-24 | Cylinder Head |
| 23 | 2 | 235-43 | Oil Cup | 49 | 2 | 445-196 | Intercooler Gasket |
| 24 | 1 | 432-13 | End Plate Gasket | 50 | | | |
| 25 | 1 | | Felt Washer (No Longer Available) | 51 | 3 | 445-4217 | Intake Valve Assembly |

Note: SS-1525 Flatwasher (#18) are only used when replacing an existing Copper Finned Tube Intercooler. They are not required when replacing a Cast Intercooler.

## Service Kits and Maintenance Items:

PR-20-4: 20 Weight Oil, 4 litre (1 US gallon), suitable for ambient temperatures below 30°C (90°F)
PR-30-4: 30 Weight Oil, 4 litre (1 US gallon), suitable for ambient temperatures above 30°C (90°F)
OJ2000-K1: Synthetic Oil, 4 litre (1 US gallon)

MK-247: Includes (4) litres of 'PR-20' Oil and (1) '357-9701' Air Filter
MKS-247: Includes (4) litres of 'OJ2000' Oil and (2) '357-9701' Air Filters

VRK-247: Valve Repair Kit includes (5) Valve Discs, (10) Springs, (5) Jam Nuts, (5) Cap Nuts, (5) Brass Cap Nuts, (5) Socket head Cap Screws, and (3) Copper Gaskets. One Kit required.

OK-247: Overhaul Kit includes (1) 'VRK-247' Valve Repair Kit, (1) 'GK-9404' Gasket Kit, (1) 'KK-9805' Ring Kit, (1) '342-111' Oil Seal, and (2) '445-474' Bearing Insert Kits

GK-9404: Gasket Kit includes all Gaskets

KK-9865: Intercooler Kit to include (1) '447-330' Intercooler, (2) '445-196' Gaskets, (4) 'SS-01973' Bolts, and (4) 'SS-1525' Washers

## Compressor Pump Torque Values:

| Ref. #: | Description: | In Lbs | Ft Lbs | Nm | Ref. #: | Description: | In Lbs | Ft Lbs | Nm |
|---|---|---|---|---|---|---|---|---|---|
| 4 | Hex Screw @ Small End Plate | 144 | 12 | 16.2 | 31 | Flywheel Bolt | 1860 | 155 | 210 |
| 4 | Hex Screw @ Large End Plate | 144 | 12 | 16.2 | 37 | Connecting Rod Bolt | 408 | 34 | 46 |
| 7 | Oil Ring Retainer | 144 | 12 | 16.2 | 42 | Valve Set Screw | 180 | 15 | 20.3 |
| 10 | Cylinder to Crankcase | 564 | 47 | 63.7 | 43 | Valve Plug | 1500 | 125 | 169 |
| 13 & 16 | Head Bolts | 360 | 30 | 40.6 | 44 | Cap Nuts | 180 | 15 | 20.3 |
| 18 | Intercooler Bolt | 360 | 30 | 40.6 | 45 | Valve Assemblies | 180 | 15 | 20.3 |

Note: Re-torque End Plate Screws (#4), Cylinder Bolts (#10), Head Bolts (#13 & 16), and Intercooler Bolts (#18) after first 10 hours of operation.

Available from Allparts Equipment and Accessories - 1-877-475-5660 - www.allpartsinc.com

## Pump Overhaul Specifications:

### Honing Specifications:

| Cylinder: | Standard Hone Dia: | Skirt / Cyl Dia Clearance |
|---|---|---|
| LP Cylinder | 4.5000" / 4.5005" | .0065" / .0085" |
| HP Cylinder | 2.5000" / 2.5005" | .0025" / .0045" |

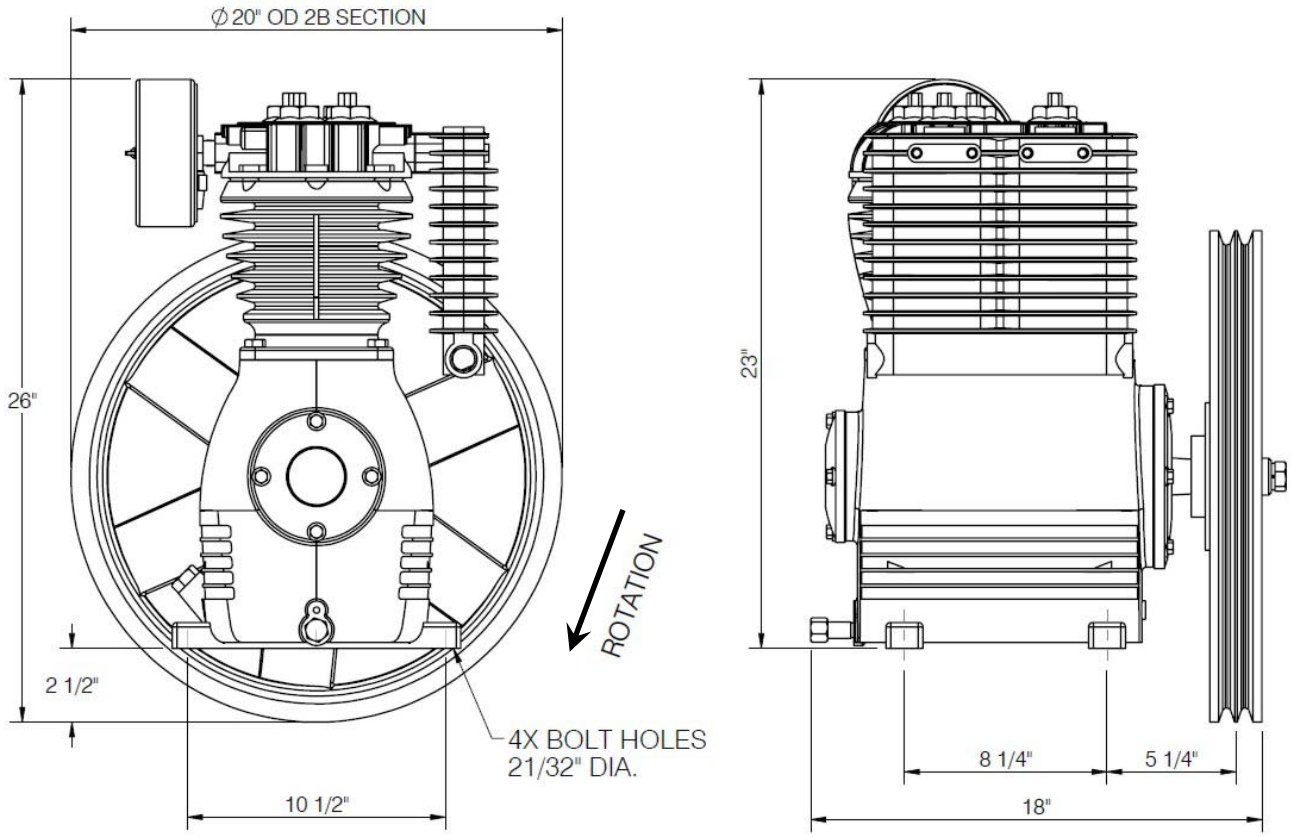
1. Cylinder must be within diametral tolerance at all points. Out-of-round or taper must not exceed 0.005".
2. Hone, 20 minimum to 35 maximum micro-inches of surface roughness.
3. De-burr the sharp corners at the top and bottom of the Cylinder opening with a 1/64" to 1/32" x 30° chamfer.

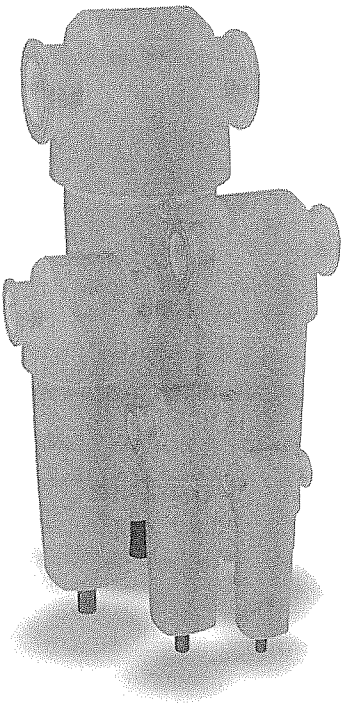
### Connecting Rod Insert Bearing Specifications:

| Insert | Crank Throw Dia: | Part #: |
|---|---|---|
| Standard | 2.2490" / 2.2485" | 445-474 |
| 0.02" Oversize | 2.2290" / 2.2285" | 445-474-020 |

**Caution:** Pre-lubricate all Crank Throws and Insert Bearing surfaces to prevent Pump tie-up during the first few minutes of operation. Pour oil on the outside of the Connecting Rod and Crank Shoulders. Use the Crankcase oil, do not use grease.

## Pump Dimensions:





# Filters for Compressed Air

## 005 - 045 (AO, AA, ACS, AR, AAR)

User Guide

(EN) Original Language

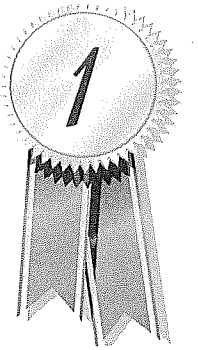
(NL) (DE) (FR) (FI) (SV) (NO) (DA) (EL) (ES) (PT) (IT) (PL)
(SK) (CS) (ET) (HU) (LV) (LT) (RU) (SL) (TR) (MT) (RO) (BG)

aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

Parker domnick hunter

ENGINEERING YOUR SUCCESS.

## (EN) ONE YEAR AIR QUALITY GUARANTEE




Your air quality has been guaranteed for 1 year and will be renewed at every annual filter element change.
Annual filter element changes ensure:

- Optimal performance is maintained
- Air quality continues to meet international standards
- Protection of downstream equipment, personnel and processes
- Low operational costs
- increased productivity and profitability
- peace of mind

## (NL) LUCHTKWALITEITSGARANTIE VAN ÉÉN JAAR

De luchtkwaliteit wordt 1 jaar lang gegarandeerd. De garantie wordt elk jaar verlengd wanneer het filterelement wordt vervangen.
Een jaarlijkse vervanging van het filterelement heeft de volgende voordelen:

- Een onverminderde optimale prestatie
- Luchtkwaliteit die blijft voldoen aan de internationale normen
- Bescherming van apparatuur, personeel en processen achter de compressor
- Lage bedrijfskosten
- Hogere productiviteit en rentabiliteit
- Gemoedsrust

## (DE) EIN JAHR GARANTIE AUF DIE LUFTQUALITÄT

Wir gewähren Ihnen eine 1-jährige Garantie auf die Luftqualität, die bei jedem jährlichen Austausch des Filterelements erneuert wird.
Ein jährlicher Austausch des Filterelements stellt Folgendes sicher:

- Optimale Leistung wird gewährleistet
- Die Luftqualität erfüllt weiterhin internationale Standards
- Schutz der nachgeschalteten Geräte, der Arbeitskräfte und Produktionsabläufe
- Geringe Betriebskosten
- Höhere Produktivität und Wirtschaftlichkeit
- Sorgenfreiheit

## (FR) QUALITÉ DE L'AIR GARANTIE PENDANT 1 AN

La qualité de l'air est garantie pendant 1 an, garantie renouvelable à chaque remplacement annuel la de cartouche filtrante.
Le remplacement annuel des cartouches filtrantes garantit :

- La préservation de performances optimales
- Une qualité de l'air conforme aux normes internationales
- Une protection de l'équipement, des processus et du personnel en aval
- Des coûts d'utilisation réduits
- Un niveau de productivité et de rentabilité accru
- Votre tranquillité d'esprit

## (ES) GARANTÍA DE CALIDAD DEL AIRE PARA UN AÑO

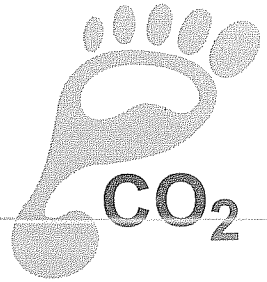
La calidad del aire tiene una garantía de 1 año y se renovará con cada cambio anual del filtro
El cambio anual del filtro le asegura:

- Se mantiene un rendimiento óptimo.
- La calidad del aire sigue cumpliendo las normas internacionales
- Protección del equipo, personal y procesos aguas abajo.
- Bajos costes de funcionamiento.
- mayor productividad y rentabilidad.
- tranquilidad.

## (IT) GARANZIA DI UN ANNO SULLA QUALITÀ DELL'ARIA

La qualità dell'aria è garantita per un anno e la garanzia sarà rinnovata dopo ogni sostituzione annuale dell'elemento filtrante.
La sostituzione annuale dell'elemento filtrante assicura:

- Prestazioni ottimali nel tempo
- Aria di qualità sempre conforme alle norme internazionali
- Protezione del personale, delle apparecchiature e dei processi a valle
- Bassi costi di esercizio
- Maggiore produttività e redditività
- Tranquillità



## (EN) Model Coding example:

| Model | | | | | |
|---|---|---|---|---|---|
| [Grade] | Filter Size | Pipe Size | Connection Type | Drain Option | Incident monitor Option |
| AO<br>AA<br>AR<br>AAR<br>ACS | 3 digit code as shown below | Letter denotes pipe size | G = BSPP<br>N = NPT<br>(B = BSPT) | F = Float<br>M = Manual | X = None<br>I = Incident Monitor<br>Not available on models 005 & 010 |
| AA | 010 | A | G | F | X |

## (NL) Voorbeeld van model codering:

| Model | | | | | |
|---|---|---|---|---|---|
| [Klasse] | Filtergrootte | Buisgrootte | Verbindingstype | afvoer (optioneel) | Incidentmonitor (optioneel) |
| AO<br>AA<br>AR<br>AAR<br>ACS | 3-cijferige code zoals hieronder afgebeeld | Letter geeft flens-connectie aan | G = BSPP<br>N = NPT<br>(B = BSPT) | F = Float<br>M = Manual | X = None<br>I = Incident Monitor<br>Not available on models 005 & 010 |
| AA | 010 | A | G | F | X |

## (DE) Beispiel für Modellschlüssel:

| Modell | | | | | |
|---|---|---|---|---|---|
| [Klasse] | Filtergröße | Leitungsgröße | Anschlusstyp | Ablassoption | Störfallüberwa-chungsoption |
| AO<br>AA<br>AR<br>AAR<br>ACS | Dreistelliger Code wie unten dargestellt | Buchstabe gibt Flanschanschluss an | G = BSPP<br>N = NPT<br>(B = BSPT) | F = Float<br>M = Manual | X = None<br>I = Incident Monitor<br>Not available on models 005 & 010 |
| AA | 010 | A | G | F | X |

## (FR) Exemple de code de modèle :

| Modèle | | | | | |
|---|---|---|---|---|---|
| [Grade] | Taille du filtre | Taille du tuyau | Type de raccord | Option de purge | Option de contrôle des incidents |
| AO<br>AA<br>AR<br>AAR<br>ACS | Code à 3 chiffres comme indiqué ci-dessous | La lettre renvoie au raccord de bride | G = BSPP<br>N = NPT<br>(B = BSPT) | F = Float<br>M = Manual | X = None<br>I = Incident Monitor<br>Not available on models 005 & 010 |
| AA | 010 | A | G | F | X |

## (ES) Ejemplo de códigos de modelos:

| Modelo | | | | | |
|---|---|---|---|---|---|
| [Grado] | Tamaño de filtro | Diámetro de tubería | Tipo de conexión | Opción de drenaje | Monitor de inciden-cias opcional |
| AO<br>AA<br>AR<br>AAR<br>ACS | Código de 3 dígitos, tal y como se muestra a continuación | La letra indica conexión embridada | G = BSPP<br>N = NPT<br>(B = BSPT) | F = Float<br>M = Manual | X = None<br>I = Incident Monitor<br>Not available on models 005 & 010 |
| AA | 010 | A | G | F | X |

## (IT) Esempio di codifica dei modelli

Modello

| [Grado] | Dimensioni del filtro | Dimensioni del tubo | Tipo di collegamento | Opzione scarico | Opzione monitor criticità |
|---|---|---|---|---|---|
| AO<br>AA<br>AR<br>AAR<br>ACS | Codice a 3 cifre come riportato in basso | La lettera indica il collegamento a flangia | G = BSPP<br>N = NPT<br>(B = BSPT) | F = Float<br>M = Manual | X = None<br>I = Incident Monitor<br>Not available on models 005 & 010 |
| AA | 010 | A | G | F | X |

## (EN) Product Selection

Stated flows are for operation at 7 bar g (100 psi g) with reference to 20°C, 1 bar a, 0% relative water vapour pressure.
For flows at other pressures apply the correction factors shown.

## (NL) Productselectie

De weergegeven stroomsnelheden zijn voor een werking bij 7 bar (g) (100 psi g) met betrekking tot 20°C, 1 bar (a), 0% relatieve waterdampdruk.
Voor stroomsnelheden bij andere drukverhoudingen dient u de vermelde correctiefactoren toe te passen.

## (DE) Produktauswahl

Die angegebenen Durchflussraten beziehen sich auf den Betrieb bei 7 bar ü (100 psi g), 20 °C, 1 bar ü und einem relativen Wasserdampfdruck von 0 %.
Wenden Sie zur Bestimmung der Durchflussraten bei anderen Drücken die angegebenen Korrekturfaktoren an.

## (FR) Choix du produit

Les débits indiqués correspondent à un fonctionnement à une pression de 7 bar eff (100 psi eff) et aux conditions de référence suivantes :
20 °C, 1 bar (a) et 0 % de pression de vapeur d'eau relative.
Pour les débits de pression différente, appliquez les facteurs de correction indiqués.

## (ES) Selección de productos

Los caudales se indican para el funcionamiento a 7 bar g (100 psi g), referidos a 20 °C (1 bar) y presión relativa del vapor de agua del 0%.
Para caudales a otras presiones, aplique los factores de corrección que se muestran.

## (IT) Scelta del prodotto

Le portate indicate si riferiscono al funzionamento con una pressione di 7 bar g (100 psi g) a 20°C, 1 bar a, pressione relativa del vapore acqueo 0%.
Per altri valori di pressione applicare i fattori di correzione indicati.

| Model | | Port Size | L/s | m3/min | m3/hr | cfm | Replacement Element kit | | No. |
|---|---|---|---|---|---|---|---|---|---|
| [grade] | 005A [ ] [ ] [X] | ¼ | 6 | 0.4 | 22 | 13 | 010 | [grade] | 1 |
| [grade] | 005B [ ] [ ] [X] | ¾ | 6 | 0.4 | 22 | 13 | 010 | [grade] | 1 |
| [grade] | 005C [ ] [ ] [X] | ½ | 6 | 0.4 | 22 | 13 | 010 | [grade] | 1 |
| [grade] | 010A [ ] [ ] [X] | ¼ | 10 | 0.6 | 36 | 21 | 010 | [grade] | 1 |
| [grade] | 010B [ ] [ ] [X] | ⅜ | 10 | 0.6 | 36 | 21 | 010 | [grade] | 1 |
| [grade] | 010C [ ] [ ] [X] | ½ | 10 | 0.6 | 36 | 21 | 010 | [grade] | 1 |
| [grade] | 015B [ ] [ ] [ ] | ⅜ | 20 | 1.2 | 72 | 42 | 015 | [grade] | 1 |
| [grade] | 015C [ ] [ ] [ ] | ½ | 20 | 1.2 | 72 | 42 | 015 | [grade] | 1 |
| [grade] | 020C [ ] [ ] [ ] | ½ | 30 | 1.8 | 108 | 64 | 020 | [grade] | 1 |
| [grade] | 020D [ ] [ ] [ ] | ¾ | 30 | 1.8 | 108 | 64 | 020 | [grade] | 1 |
| [grade] | 020E [ ] [ ] [ ] | 1 | 30 | 1.8 | 108 | 64 | 020 | [grade] | 1 |
| [grade] | 025D [ ] [ ] [ ] | ¾ | 60 | 3.6 | 216 | 127 | 025 | [grade] | 1 |
| [grade] | 025E [ ] [ ] [ ] | 1 | 60 | 3.6 | 216 | 127 | 025 | [grade] | 1 |
| [grade] | 030E [ ] [ ] [ ] | 1 | 110 | 6.6 | 396 | 233 | 030 | [grade] | 1 |
| [grade] | 030F [ ] [ ] [ ] | 1 ¼ | 110 | 6.6 | 396 | 233 | 030 | [grade] | 1 |
| [grade] | 030G [ ] [ ] [ ] | 1 ½ | 110 | 6.6 | 396 | 233 | 030 | [grade] | 1 |
| [grade] | 035F [ ] [ ] [ ] | 1 ¼ | 160 | 9.6 | 576 | 339 | 035 | [grade] | 1 |
| [grade] | 035G [ ] [ ] [ ] | 1 ½ | 160 | 9.6 | 576 | 339 | 035 | [grade] | 1 |
| [grade] | 040G [ ] [ ] [ ] | 1 ½ | 220 | 13.2 | 792 | 466 | 040 | [grade] | 1 |
| [grade] | 040H [ ] [ ] [ ] | 2 | 220 | 13.2 | 792 | 466 | 040 | [grade] | 1 |
| [grade] | 045H [ ] [ ] [ ] | 2 | 330 | 19.8 | 118 | 699 | 045 | [grade] | 1 |

[grade] = grade
[klasse] = klasse
[Klasse] = Klasse
[grade] = grade
[grado] = grado
[grado] = grado

## Technical Data

### Technische gegevens, Technische Daten, Données techniques, Datos técnicos, Dati tecnici

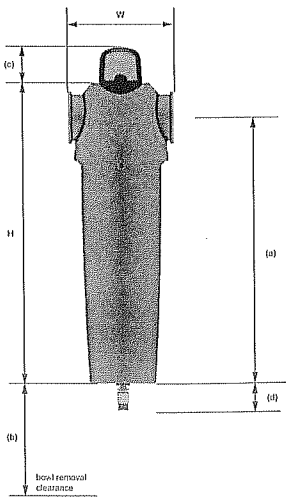
| Model | Filter Models | | | | Min Operating Pressure | | Max Operating Pressure | | Min Recommended Operating Temp | | Max Recommended Operating Temp | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | bar g | psi g | bar g | psi g | °C | °F | °C | °F |
| AO | 005 [ ] [ ] F [ ] | - | 045 | [ ] [ ] F [ ] | 1 | 15 | 16 | 232 | 1.5 | 35 | 80 | 176 |
| AO | 005 [ ] [ ] M [ ] | - | 045 | [ ] [ ] M [ ] | 1 | 15 | 20 | 290 | 1.5 | 35 | 100 | 212 |
| AA | 005 [ ] [ ] F [ ] | - | 045 | [ ] [ ] F [ ] | 1 | 15 | 16 | 232 | 1.5 | 35 | 80 | 176 |
| AA | 005 [ ] [ ] M [ ] | - | 045 | [ ] [ ] M [ ] | 1 | 15 | 20 | 290 | 1.5 | 35 | 100 | 212 |
| AR | 005 [ ] [ ] M [ ] | - | 045 | [ ] [ ] M [ ] | 1 | 15 | 20 | 290 | 1.5 | 35 | 100 | 212 |
| AAR | 005 [ ] [ ] M [ ] | - | 045 | [ ] [ ] M [ ] | 1 | 15 | 20 | 290 | 1.5 | 35 | 100 | 212 |
| ACS | 005 [ ] [ ] M [ ] | - | 045 | [ ] [ ] M [ ] | 1 | 15 | 20 | 290 | 1.5 | 35 | 50 | 122 |

*Note:*

*AO / AA grade filters for use up to 16 bar g (232 psi g) are supplied with a float drain [F] as standard.*
*For pressures between 16 and 20 bar g (232 and 290 psi g) a manual drain [M] must be used.*
*ACS / AR / AAR grade filters are supplied with a manual drain [M] as standard.*

## Weights and Dimensions

**Gewichten en afmetingen, Gewichte und Abmessungen, Poids et dimensions, Pesos y dimensiones, Pesi e dimensioni**



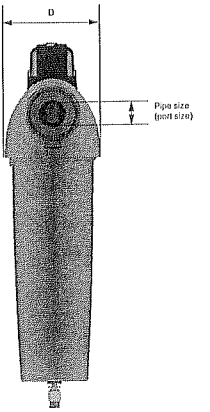




*Image shows AA030EBFI*

| Model | Pipe Size | Height (H) | | Width (W) | | Depth (D) | | (a) | | (b) | | (c) | | (d) | | Weight | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | mm | ins | mm | ins | mm | ins | mm | ins | mm | ins | mm | ins | mm | ins | kg | lbs |
| 005A | ¼" | 154.5 | 6.1 | 76 | 3.0 | 64 | 2.5 | 126.5 | 5 | 40 | 1.58 | - | - | 32.3 | 1.3 | 0.5 | 1.1 |
| 005B | ⅜" | 154.5 | 6.1 | 76 | 3.0 | 64 | 2.5 | 126.5 | 5 | 40 | 1.58 | - | - | 32.3 | 1.3 | 0.5 | 1.1 |
| 005C | ½" | 154.5 | 6.1 | 76 | 3.0 | 64 | 2.5 | 126.5 | 5 | 40 | 1.58 | - | - | 32.3 | 1.3 | 0.5 | 1.1 |
| 010A | ¼" | 181.5 | 7.2 | 76 | 3.0 | 64 | 2.5 | 153 | 6 | 40 | 1.58 | - | - | 32.3 | 1.3 | 0.6 | 1.3 |
| 010B | ⅜" | 181.5 | 7.2 | 76 | 3.0 | 64 | 2.5 | 153 | 6 | 40 | 1.58 | - | - | 32.3 | 1.3 | 0.6 | 1.3 |
| 010C | ½" | 181.5 | 7.2 | 76 | 3.0 | 64 | 2.5 | 153 | 6 | 40 | 1.58 | - | - | 32.3 | 1.3 | 0.6 | 1.3 |
| 015B | ⅜" | 235 | 9.3 | 97 | 3.8 | 84 | 3.3 | 201 | 7.9 | 50 | 1.97 | 48.7 | 1.9 | 32.3 | 1.3 | 1.1 | 2.4 |
| 015C | ½" | 235 | 9.3 | 97 | 3.8 | 84 | 3.3 | 201 | 7.9 | 50 | 1.97 | 48.7 | 1.9 | 32.3 | 1.3 | 1.1 | 2.4 |
| 020C | ½" | 235 | 9.3 | 97 | 3.8 | 84 | 3.3 | 201 | 7.9 | 50 | 1.97 | 48.7 | 1.9 | 32.3 | 1.3 | 1.1 | 2.4 |
| 020D | ¾" | 235 | 9.3 | 97 | 3.8 | 84 | 3.3 | 201 | 7.9 | 50 | 1.97 | 48.7 | 1.9 | 32.3 | 1.3 | 1.1 | 2.4 |
| 020E | 1" | 235 | 9.3 | 97 | 3.8 | 84 | 3.3 | 201 | 7.9 | 50 | 1.97 | 48.7 | 1.9 | 32.3 | 1.3 | 1.1 | 2.4 |
| 025D | ¾" | 275 | 10.8 | 129 | 5.1 | 115 | 4.5 | 232.5 | 9.2 | 70 | 2.76 | 48.7 | 1.9 | 32.3 | 1.3 | 2.2 | 2.5 |
| 025E | 1" | 275 | 10.8 | 129 | 5.1 | 115 | 4.5 | 232.5 | 9.2 | 70 | 2.76 | 48.7 | 1.9 | 32.3 | 1.3 | 2.2 | 2.5 |
| 030E | 1" | 364.5 | 14.3 | 129 | 5.1 | 115 | 4.5 | 322 | 12.7 | 70 | 2.76 | 48.7 | 1.9 | 32.3 | 1.3 | 2.7 | 2.9 |
| 030F | 1 ¼" | 364.5 | 14.3 | 129 | 5.1 | 115 | 4.5 | 322 | 12.7 | 70 | 2.76 | 48.7 | 1.9 | 32.3 | 1.3 | 2.7 | 2.9 |
| 030G | 1 ½" | 364.5 | 14.3 | 129 | 5.1 | 115 | 4.5 | 322 | 12.7 | 70 | 2.76 | 48.7 | 1.9 | 32.3 | 1.3 | 2.7 | 2.9 |
| 035F | 1 ¼" | 432.5 | 17 | 170 | 6.7 | 156 | 6.1 | 382.5 | 15.1 | 100 | 3.94 | 48.7 | 1.9 | 32.3 | 1.3 | 5.1 | 11.2 |
| 035G | 1 ½" | 432.5 | 17 | 170 | 6.7 | 156 | 6.1 | 382.5 | 15.1 | 100 | 3.94 | 48.7 | 1.9 | 32.3 | 1.3 | 5.1 | 11.2 |
| 040G | 1 ½" | 524.5 | 20.6 | 170 | 6.7 | 156 | 6.1 | 474.5 | 18.7 | 100 | 3.94 | 48.7 | 1.9 | 32.3 | 1.3 | 5.7 | 12.5 |
| 040H | 2" | 524.5 | 20.6 | 170 | 6.7 | 156 | 6.1 | 474.5 | 18.7 | 100 | 3.94 | 48.7 | 1.9 | 32.3 | 1.3 | 5.7 | 12.5 |
| 045H | 2" | 524.5 | 20.6 | 170 | 6.7 | 156 | 6.1 | 474.5 | 18.7 | 100 | 3.94 | 48.7 | 1.9 | 32.3 | 1.3 | 5.7 | 12.5 |
| 050I | 2 ½" | 641.5 | 25.3 | 205 | 8.1 | 181 | 7.1 | 581.5 | 22.9 | 120 | 4.72 | 48.7 | 1.9 | 30.8 | 1.2 | 11.1 | 24.4 |
| 050J | 3" | 641.5 | 25.3 | 205 | 8.1 | 181 | 7.1 | 581.5 | 22.9 | 120 | 4.72 | 48.7 | 1.9 | 30.8 | 1.2 | 11.1 | 24.4 |
| 055I | 2 ½" | 832 | 32.8 | 205 | 8.1 | 181 | 7.1 | 772 | 30.4 | 120 | 4.72 | 48.7 | 1.9 | 30.8 | 1.2 | 13.9 | 30.6 |
| 055J | 3" | 832 | 32.8 | 205 | 8.1 | 181 | 7.1 | 772 | 30.4 | 120 | 4.72 | 48.7 | 1.9 | 30.8 | 1.2 | 13.9 | 30.6 |

## (En) Installation recommendations

It is recommended that the compressed air is treated prior to entry into the distribution system and also at critical usage points / applications.

Installation of compressed air dryers to a previously wet system could result in additional dirt loading for point of use filters for a period whilst the distribution system dries out. Filter elements may need to be changed more frequently during this period.

For installations where oil-free compressors are used, water aerosol and particulate are still present, general purpose and high efficiency grades should still be used.

A general purpose filter must always be installed to protect the high efficiency filter from bulk liquid aerosols and solid particulate.

Install purification equipment at the lowest temperature above freezing point, preferably downstream of after coolers and air receivers.

Point of use purification equipment should be installed as close to the application as possible.

Purification equipment should not be installed downstream of quick opening valves and should be protected from possible reverse flow or other shock conditions.

Purge all piping leading to the purification equipment before installation and all piping after the purification equipment is installed and before connection to the final application.

If by-pass lines are fitted around purification equipment, ensure adequate filtration is fitted to the by-pass line to prevent contamination of the system downstream.

Fit drain lines from the coalescing filters directly to a condensate separator. If it is not possible to connect the drain lines directly to a separator, the lines should be vented in to a condensate manifold (vented at one end) and then in to a single inlet of a condensate separator.

Provide a facility to drain away collected liquids from the purification equipment. Collected liquids should be treated and disposed of in a responsible manner.

## (NL) Aanbevelingen voor de installatie

Aanbevolen wordt de perslucht te zuiveren voordat de lucht in het distributiesysteem wordt toegelaten, en ook bij kritieke gebruikspunten of -toepassingen.

De aansluiting van persluchtdrogers op een systeem dat nat was, kan extra vuilophoping veroorzaken bij de gebruikspuntfilters terwijl het distributiesysteem uitdroogt. Het is mogelijk dat gedurende deze periode de filterelementen vaker vervangen moeten worden.

Voor installaties met olievrije compressoren, waarin water-aërosols en deeltjes nog steeds aanwezig zijn, moeten filters voor algemeen gebruik en filters met een hoge efficiencygraad worden gebruikt.

Een filter voor algemeen gebruik moet altijd geïnstalleerd worden om het filter met hoge efficiencygraad tegen bulkvloeistof-aërosols en vaste deeltjes te beschermen.

Installeer zuiveringsapparatuur op de laagste temperatuur boven het vriespunt, bij voorkeur op een punt in het systeem na de nakoelers en luchtontvangers.

De zuiveringsapparatuur bij gebruikspunten moet zo dicht mogelijk bij de applicatie geïnstalleerd worden.

Zuiveringsapparatuur dient niet op een punt in het systeem na snel-openende kleppen te worden geïnstalleerd en moet worden beschermd tegen mogelijke tegenstroom of andere schoksituaties.

Reinig alle leidingen naar de zuiveringsapparatuur voorafgaand aan de installatie en ook nadat de zuiveringsapparatuur is geïnstalleerd, voorafgaand aan de aansluiting op de definitieve applicatie.

Als er omloopleidingen rond de zuiveringsapparatuur zijn gemonteerd, zorg er dan voor dat er voldoende filtering bij deze leidingen bestaat om te voorkomen dat het systeem verderop vervuild raakt.

Bevestig de afvoerleidingen van de coalescentiefilters direct aan een condensaatafscheider. Als het niet mogelijk is om de afvoerleidingen direct op een afscheider aan te sluiten, moeten de leidingen worden ontlucht in een condensaatverdeelstuk (dat aan één zijde wordt ontlucht) en daarna in een enkele inlaat van een condensaatafscheider.

Zorg ervoor dat het mogelijk is om de verzamelde vloeistof uit het zuiveringssysteem af te voeren. Deze vloeistof moet eerst worden gezuiverd en dan op verantwoorde wijze van de hand worden gedaan..

## (DE) Installationsempfehlungen

Es wird empfohlen, die Druckluft vor dem Eintritt in das Verteilungssystem bzw. in kritische Einsatzstellen/Anwendungspunkte aufzubereiten.

Der Anschluss von Druckluftrocknern an Systeme, die zuvor nass waren, könnte während der Trocknung des Verteilungssystems bei eingebauten Filtern zu einer zusätzlichen Verschmutzung führen. Die Filterelemente sind in dieser Phase ggf. häufiger auszutauschen.

Bei Einrichtungen, in denen ölfreie Kompressoren eingesetzt werden und noch Wassertropfen und Schmutzpartikel vorhanden sind, müssen universelle und Hochleistungsfilter verwendet werden.

Zum Schutz des Hochleistungsfilters vor großen Mengen an Flüssigkeitstropfen und festen Schmutzpartikeln muss immer ein universeller Filter vorgeschaltet werden.

Installieren Sie den Filter bei der niedrigsten Temperatur über dem Gefrierpunkt vorzugsweise hinter den Nachkühlern und Luftbehältern.

Der Einsatzort des Filters muss sich in unmittelbarer Nähe zur Anwendung befinden.

Der Filter darf sich schnell öffnenden Ventilen nicht nachgeschaltet werden. Außerdem muss ein Schutz gegen Rückfluss und andere Schockzustände gewährleistet sein.

Spülen Sie alle zum Filter führenden Rohrleitungen vor der Installation sowie nach der Installation des Filters und auch vor dem Anschluss an die endgültige Anwendung.

Sofern Bypass-Leitungen den Filter umgehen, muss zum Schutz des nachgeschalteten Systems gegen Verschmutzung für eine ausreichende Filterung dieser Leitungen gesorgt werden.

Führen Sie Ablassleitungen von den Koaleszenzfiltern direkt zu einem Kondensatabscheider. Wenn es nicht möglich ist, die Ablassleitungen direkt an einen Abscheider anzuschließen, müssen die Leitungen an ein Kondensatsammelrohr (mit Entlüftung an einem Ende) und dann an einen einzelnen Einlass eines Kondensatabscheiders angeschlossen werden.

Sorgen Sie für eine Einrichtung, die angesammelte Flüssigkeit von dem Filter entfernt. Die angesammelte Flüssigkeit muss sicher aufbereitet und entsorgt werden.

## (FR) Consignes d'installation

Il est recommandé de traiter l'air comprimé avant l'entrée dans le système de distribution, ainsi qu'au niveau des applications/points d'utilisation stratégiques.

L'installation d'un sécheur à air comprimé sur un ancien système humide peut entraîner une teneur en poussière supplémentaire pour les points d'utilisation des filtres pendant la période durant laquelle le système de distribution sèche. Il sera peut-être nécessaire de changer les cartouches filtrantes plus souvent au cours de cette période.

Pour les installations équipées de compresseurs sans huile et où des particules et un aérosol d'eau sont toujours présents, il faut continuer d'utiliser des filtres polyvalents et des filtres haute efficacité.

Un filtre polyvalent doit toujours être installé pour protéger le filtre haute efficacité des aérosols de liquide en masse et des particules solides.

Installez l'équipement de purification à la température la plus basse avant le point de gel, de préférence en aval des réfrigérants et des collecteurs d'air.

L'équipement de purification au point d'utilisation doit être installé aussi près que possible de l'application.

L'équipement de purification ne doit pas être installé en aval de soupapes à ouverture rapide et doit être protégé d'un éventuel flux en sens inverse ou des chocs.

Purgez tous les conduits menant à l'équipement de purification avant l'installation, et recommencez une fois l'équipement installé et avant la connexion à l'application finale.

Si des conduites de dérivation sont en place autour de l'équipement de purification, assurez-vous qu'un élément filtrant approprié est monté sur la conduite de dérivation pour éviter la contamination du système en aval.

Installez directement les conduites d'évacuation des filtres coalescents sur un séparateur de condensation. S'il n'est pas possible de raccorder directement les conduites à un séparateur, elles doivent disposer d'une évacuation vers un collecteur de condensation (avec une extrémité d'évacuation), puis vers un séparateur de condensation à entrée unique.

Installez un dispositif permettant d'évacuer les liquides collectés dans l'équipement de purification. Ces liquides doivent être traités et éliminés comme il convient.

## (ES) Recomendaciones de instalación

Se recomienda tratar el aire comprimido antes de que entre en el sistema de distribución y también en aplicaciones o puntos de utilización críticos.

La instalación de secadores de aire comprimido en un sistema húmedo existente puede producir una carga de suciedad adicional en los puntos de uso de los filtros durante un tiempo, hasta que el sistema de distribución se seque. Filter elements may need to be changed more frequently during this period.

En instalaciones que utilicen compresores sin aceite, sigue habiendo aerosoles de agua y partículas, por lo que deben utilizarse filtros de grados de alta eficiencia y carácter general.

Siempre debe instalarse un filtro de carácter general para proteger el filtro de alta eficiencia frente a altas cantidades de aerosoles líquidos y partículas sólidas.

Instale equipos de purificación en el punto de mínima temperatura sobre el punto de congelación, preferentemente aguas abajo de postenfriadores y depósitos de aire.

Los equipos de purificación en punto de utilización se deben instalar lo más cerca posible de la aplicación.

Los equipos de purificación no deben instalarse aguas abajo de válvulas de apertura rápida y deben protegerse del posible flujo inverso o de otras condiciones de cambio brusco.

Antes de instalar los equipos de purificación, purgue todas las tuberías aguas arriba de los mismos; y todas las tuberías entre la citada instalación y la conexión a la aplicación final.

Si se instalan líneas para derivar los equipos de purificación, asegúrese de montar unos filtros adecuados en la línea de derivación para evitar la contaminación del sistema aguas abajo.

Instale conductos de drenaje desde los filtros coalscentes hasta el separador de condensado. Si no es posible conectar los conductos de drenaje directamente a un separador, los conductos deberían derivarse a un colector de condensado (a un extremo) y luego a una entrada individual de un separador de condensado

Disponga los medios para drenar los líquidos recogidos en los equipos de purificación. Los líquidos recogidos se deben tratar y desechar de forma responsable.

## (IT) Istruzioni di installazione

L'aria compressa deve essere trattata prima di entrare nel sistema di distribuzione e anche in corrispondenza dei punti di utilizzo / applicazione critici.

L'installazione di essiccatori per aria compressa su un impianto "umido" può provocare un ulteriore accumulo di impurità sui filtri del punto di utilizzo mentre il sistema di distribuzione si asciuga. In questo intervallo di tempo potrebbe essere necessario sostituire gli elementi filtranti con maggiore frequenza.

Gli impianti che utilizzano compressori senza olio richiedono comunque l'uso di filtri universali e ad alto grado di efficienza per la presenza di acqua sotto forma di aerosol e particelle.

Occorre sempre installare un filtro universale per proteggere il filtro ad alta efficienza dai liquidi misti in forma di aerosol e da particelle solide.

Installare depuratori a una temperatura immediatamente superiore al punto di congelamento, preferibilmente a valle di postrefrigeratori e serbatoi d'aria.

I depuratori destinati ai punti di utilizzo si devono installare il più vicino possibile alle applicazioni.

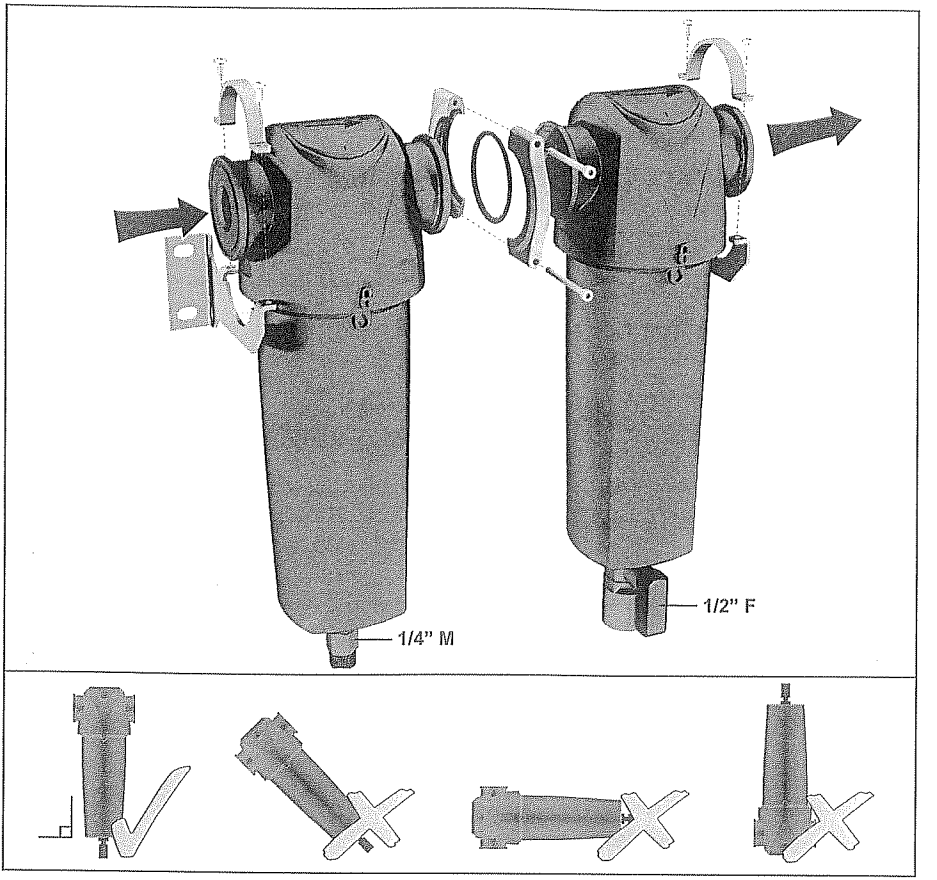
I depuratori non si devono installare a valle delle valvole ad apertura rapida e si devono proteggere dal riflusso o da altre condizioni d'urto.

Spurgare tutti i tubi che portano al depuratore prima dell'installazione, dopo aver installato il depuratore e prima di collegarli all'applicazione finale.

Se il depuratore è provvisto di linee di derivazione controllare che siano adeguatamente filtrate per evitare di contaminare il sistema a valle.

Montare le linee di scarico dai filtri a coalescenza direttamente su un separatore di condensa. Qualora non sia possibile collegare le linee di scarico direttamente a un separatore, le linee devono essere scaricate in un collettore di condensa (con sfiato su un'estremità) e quindi in un'unica entrata di un separatore di condensa.

Prevedere un sistema di deflusso dei liquidi raccolti dal depuratore. Trattare e smaltire i liquidi raccolti in modo responsabile.


1/4" M
1/2" F

## (EN) Startup and Operation

**Warning**

**Before pressurising the filter ensure that the head and bowl are correctly fitted and that the locking detail is properly aligned as shown in the maintenance section (maintenance procedure 6) of this manual.**

1. Open inlet valve slowly to gradually pressurise the unit.

2. Open outlet valve slowly to re-pressurise the downstream piping.

Do not open inlet or outlet valves rapidly or subject unit to excessive pressure differential or damage may occur.

## (NL) Starten en bediening

**Warning**

**Voordat het filter onder druk wordt gezet, moet u ervoor zorgen dat de kop en de kom juist zijn gemonteerd en dat de vergrendeling goed is uitgelijnd, zoals aangegeven in de onderhoudsinformatie (onderhoudsprocedure 6) van deze handleiding.**

1. Doe de inlaatklep langzaam open om de druk in het toestel geleidelijk op te voeren.

2. Doe de uitlaatklep langzaam open om de druk in de leidingen verderop in het systeem opnieuw op te voeren.

Doe de inlaat- en uitlaatkleppen niet snel open en stel het toestel niet aan een te groot drukdifferentieel bloot om schade te voorkomen.

## (DE) Starten und Betrieb

**Warning**

**Bevor Sie den Filter mit Druck beaufschlagen, stellen Sie sicher, dass der Filterkopf und die Filterschale ordnungsgemäß montiert sind und dass die Sperrklinke wie im Abschnitt „Wartung" dieser Anleitung (Wartungsverfahren 6) dieser Anleitung beschrieben ordnungsgemäß ausgerichtet ist.**

1. Einlassventil langsam öffnen, damit die Einheit allmählich mit Druck beaufschlagt wird.

2. Auslassventil langsam öffnen, damit nachgeschaltete Rohrleitungen erneut mit Druck beaufschlagt werden.

Einlass- und Auslassventil nicht schnell öffnen. Einheit nicht extremen Druckunterschieden aussetzen. Gefahr von Schäden.

## (FR) Démarrage et exploitation

**Warning**

**Avant de mettre le filtre sous pression, vérifiez que la tête et la cuve sont montées correctement et que l'indicateur de verrouillage est bien aligné, comme indiqué dans la section de maintenance (procédure de maintenance 6) du présent manuel.**

1. Ouvrez lentement la soupape d'admission pour mettre progressivement l'unité sous pression.

2. Ouvrez lentement la soupape de refoulement pour faire remonter la pression des conduits en aval.

Ne pas ouvrir la soupape d'admission ou la soupape de refoulement trop rapidement, ne pas soumettre l'unité à une pression différentielle trop importante. Vous risqueriez d'endommager l'équipement.

## (ES) Puesta en marcha y funcionamiento

**Warning**

**Antes de presurizar el filtro, asegúrese de que la cabeza y el cilindro están correctamente ajustados y que el detalles de bloqueo está alineado de la forma apropiada, como se muestra en la sección de mantenimiento (procedimiento de mantenimiento 6) de este manual.**

1. Abra lentamente la válvula de admisión para presurizar gradualmente la unidad.

2. Abra lentamente la válvula de descarga para volver a presurizar las tuberías aguas abajo.

Para evitar daños, no abra bruscamente las válvulas de admisión o de descarga ni someta la unidad a una diferencia de presiones excesiva.

## (IT) Avvio e funzionamento

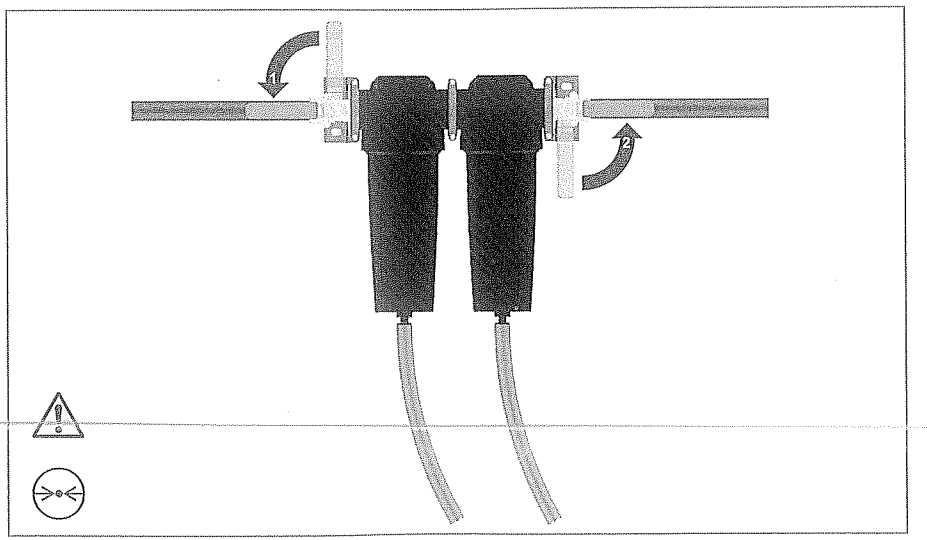
**Warning**

**Prima di pressurizzare il filtro assicurarsi che la testa e il bicchiere siano montati correttamente e che l'elemento di bloccaggio sia allineato in maniera adeguata, come indicato nella sezione relativa alla manutenzione (procedura di manutenzione 6) del presente manuale.**

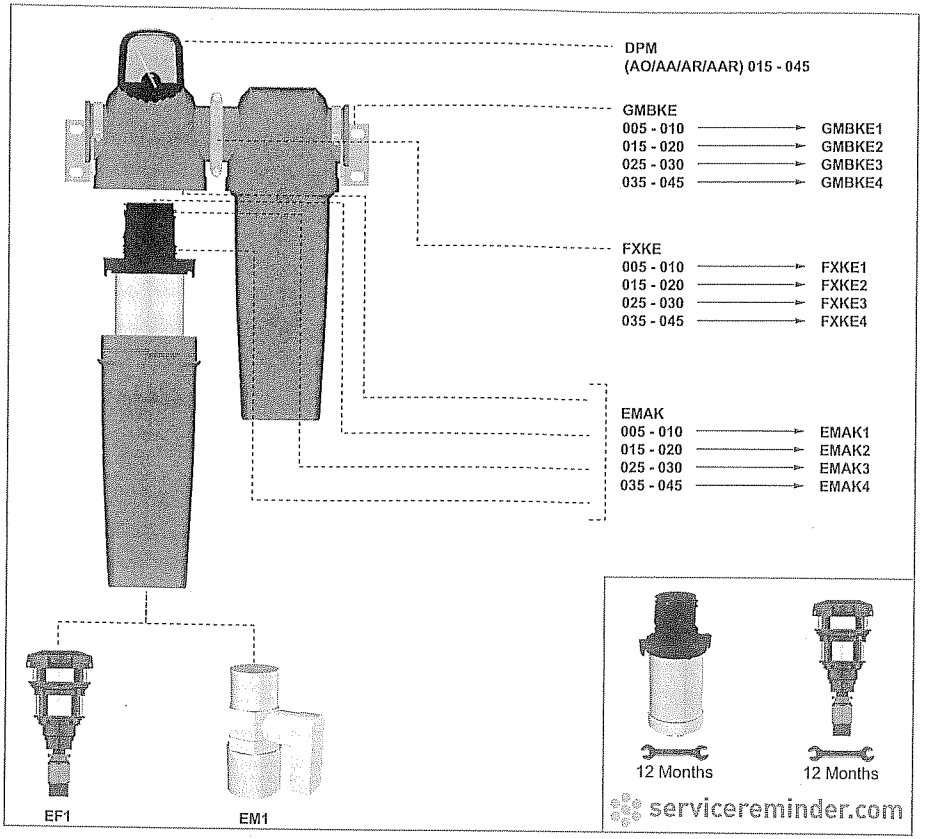
1. Aprire lentamente la valvola di mandata per aumentare gradualmente la pressione nell'unità.

2. Aprire lentamente la valvola di scarico per pressurizzare nuovamente i tubi a valle.

Non aprire rapidamente le valvole di mandata o scarico né sottoporre l'unità a una differenza di pressione eccessiva; rischio di danni.



Accessories / Spare Parts (Service Kits)
Toebehoren / reserveonderdelen (onderhoudskits), Zubehör / Ersatzteile (Wartungssätze), Accessoires / Pièces de rechange (kits d'entretien),
Accesorios / Piezas de repuesto (kits de mantenimiento), Accessori / Parti di ricambio (kit di manutenzione)




(EN) For replacement element codes please refer to the rating label located on the filter bowl.

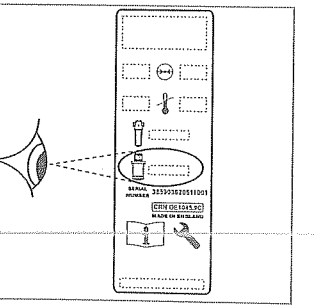
(NL) Voor de codes van de vervangende elementen raadpleegt u het etiket op de filterkom.

(DE) Die Produkt-Codes für Austauschelemente finden Sie auf dem Filterkennaufkleber an der Filterschale.

(FR) Pour obtenir les références des pièces de rechange, consultez l'étiquette qui se trouve sur la cuve du filtre.

(ES) Para sustituir los códigos de elemento, consultar la etiqueta de grado localizada en el cilindro de filtro.

(IT) Per i codici degli elementi di ricambio fare riferimento all'etichetta dei dati posizionata sul bicchiere del filtro.



(EN) **Maintenance Intervals**

To ensure optimal filter performance the AO, AA, AR, AAR grade elements require changing every 12 months along with the automatic drain (EF1).

The performance of the ACS element is based upon a maximum oil vapour inlet concentration of 0.018mg/m$^3$. Replace the carbon filter element upon detection of vapour, odour or taste.

Unlike oil aerosol removal filters which are changed annually to guarantee compressed air quality, the lifetime of an oil vapour removal filter can be attributed to various factors and require more frequent changes (unless OVR is used which is sized for 6000hrs life):

**Factors affecting the lifetime of adsorption filters**

**Oil vapour concentration**

The higher the inlet concentration of oil vapour, the faster the activated carbon capacity will expire.

**Bulk oil**

Adsorption filters are designed to remove oil vapour and odours, not liquid oil or aerosols. Poorly maintained or non-existent pre-filtration will cause the OVR filter capacity to quickly expire.

**Temperature**

Oil vapour content increases exponentially to inlet temperature, reducing element life. Additionally, as temperature increases, the adsorption capacity decreases, again reducing element life.

**Relative Humidity or Dewpoint**

Wet air reduces the adsorptive capacity of the carbon.

**Compressor oil changes**

When compressor oil is changed, the new lubricant burns off "light ends" which increases the oil vapour content for hours or even weeks afterwards. This increase in oil vapour content is adsorbed by the OVR filter, significantly reducing its adsorptive life.

(NL) **Onderhoudsintervallen**

Voor een optimale filterprestatie moeten de elementen van graad AO, AA, AR, AAR om de 12 maanden worden vervangen, samen met de automatische afvoer (EF1).

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(DE) **Wartungsintervalle**

Um eine optimale Filterleistung zu gewährleisten, müssen die Elemente der Klassen AO, AA, AR, AAR alle 12 Monate zusammen mit dem automatischen Ablass (EF1) ausgetauscht werden.

Im Gegensatz zu Filtern für die Abscheidung von Ölaerosolen, die zur Gewährleistung der Druckluftqualität jährlich ausgetauscht werden, kann die Lebensdauer eines Ölnebel-Abscheidefilters von zahlreichen verschiedenen Faktoren abhängen, die einen häufigeren Austausch erfordern. Negative Faktoren für die Lebensdauer von Adsorptionsfiltern sind:

**Ölnebel-Konzentration:** Je höher die Ölnebel-Einlasskonzentration ist, desto schneller ist die Kapazität der Aktivkohle erschöpft.

**Öl:** Adsorptionsfilter sind entwickelt worden, um Ölnebel und Gerüche abzuscheiden, sie dienen nicht der Entfernung von flüssigem Öl oder Aerosolen. Schlecht gewartete oder nicht vorhandene Vorfiltration führt dazu, dass die OVR-Filterkapazität für die Ölnebelabscheidung schnell erschöpft ist.

**Temperatur:** Der Ölnebelgehalt steigt exponentiell zur Einlasstemperatur an und verringert so die Lebensdauer des Filterelements. Zudem verringert sich mit steigender Temperatur auch die Adsorptionskapazität, was ebenfalls die Lebensdauer des Filterelements verkürzt.

**Relative Feuchtigkeit oder Taupunkt:** Feuchte Luft verringert die Adsorptionsfähigkeit der Aktivkohle.

**Austausch des Kompressoröls:** Bei einem Austausch des Kompressoröls werden durch den neuen Schmierstoff „lose Enden" abgebrannt, was zu einem Anstieg des Ölnebelgehalts für Stunden oder sogar Wochen führt. Dieser erhöhte Ölnebelgehalt wird vom OVR-Filter für die Ölabscheidung adsorbiert, wodurch sich die Lebensdauer des Filters erheblich reduziert.

Die Filterelementleistung nach ACS/AC basiert auf einer maximalen Ölnebel-Einlasskonzentration von 0,018 mg/m$^3$, mit einer Drucklufttemperatur von 21 °C und einem Drucktaupunkt von -40 °C.

**Diese Elemente sollten ausgetauscht werden, wenn Ölnebel, Gerüche oder Geschmack festgestellt werden.**

(FR) **Intervalles de maintenance**

Pour assurer des performances de filtrage optimales, les cartouches de grade AO, AA, AR, AAR doivent être changées tous les 12 mois, en même temps que le purgeur automatique (EF1).

Contrairement aux filtres de suppression des aérosols d'huile remplacés chaque année pour garantir la qualité de l'air comprimé, la durée de vie d'un filtre d'élimination des vapeurs d'huile dépend de différents facteurs et nécessite des remplacements plus fréquents. Facteurs influant sur la durée de vie des filtres d'adsorption :

**concentration de vapeur d'huile** - Plus la concentration d'entrée des vapeurs d'huile est élevée, plus vite la capacité d'absorption du charbon actif est épuisée.

**présence massive d'huile** - les filtres à adsorption sont conçus pour éliminer les vapeurs et les odeurs d'huile, et non pas l'huile ou les aérosols. Si la pré-filtration est mal entretenue, voire inexistante, le filtre OVR devient rapidement inefficace.

**Température** - la teneur en vapeurs d'huile augmente de façon exponentielle selon la température d'admission, réduisant ainsi la durée de vie de l'élément. En outre, plus la température augmente, plus la capacité d'adsorption diminue, ce qui réduit encore la durée de vie de l'élément.

**Humidité relative ou point de rosée** - l'air humide réduit la capacité d'adsorption du carbone.

**Vidanges d'huile de compresseur** - lorsque l'huile de compresseur est changée, le nouveau lubrifiant brûle « des extrémités légères » ce qui augmente la teneur en vapeur d'huile pendant des heures, voire des semaines après. Cette augmentation de la teneur en vapeur d'huile est absorbée par le filtre OVR, réduisant de manière significative la durée de vie d'adsorption.

Les performances des filtres ACS/AC sont basées sur une concentration maximale des vapeurs d'huile d'entrée de 0,018 mg/m$^3$, avec de l'air comprimé à 21°C et un point de rosée sous pression de -40°c PDP.

**Ces éléments doivent être remplacés en cas de détection de vapeur, d'odeur ou de goût.**

(ES) **Intervalos de mantenimiento**

Para asegurar un óptimo rendimiento del filtro, es necesario cambiar los elementos de grado AO, AA, AR, AAR cada 12 meses junto con el drenaje automático (EF1).

A diferencia de los filtros de eliminación de aerosoles de aceite que se cambian anualmente con el fin de garantizar la calidad del aire comprimido, la vida útil de un filtro de eliminación de vapores de aceite puede atribuirse a diversos factores y requiere cambios más frecuentes. Los factores que afectan a la vida útil de los filtros de adsorción son:

**Concentración de vapores de aceite** - Cuanto mayor sea la concentración de vapores de aceite en la entrada, más rápidamente se agotará la capacidad del carbón activado.

**Aceite** - Los filtros de adsorción se han diseñado para eliminar los vapores y los olores de aceite, pero no los aerosoles ni el aceite líquidos. Si no existe prefiltrado o su mantenimiento es inadecuado, se agotará rápidamente la capacidad del filtro OVR.

**Temperatura** - El contenido de vapores de aceite aumenta de forma exponencial a la temperatura de admisión, lo que reduce la vida útil del elemento. Asimismo, a medida que aumenta la temperatura disminuye la capacidad de adsorción, lo que una vez más reduce la vida útil del elemento.

**Humedad relativa o punto de condensación** - El aire húmedo reduce la capacidad de adsorción del carbón.

**Cambios del aceite del compresor** - Cuando se cambia el aceite del compresor, se evaporan las fracciones más ligeras del aceite nuevo, lo cual aumenta el contenido de vapores de aceite durante las horas o incluso las semanas posteriores. El filtro OVR adsorbe este aumento del contenido de vapores de aceite, lo que reduce considerablemente la vida útil de adsorción.

El rendimiento de los elementos ACS/AC se calcula tomando como base una concentración de entrada de vapores de aceite máxima de 0,018 mg/m$^3$, con aire comprimido a 21 °C y un punto de condensación de presión a -40 °C PDP.

**Estos elementos deberán sustituirse si se detecta vapor, olor y gusto.**

(IT) **Intervalli di manutenzione**

Per garantire prestazioni ottimali del filtro è necessario sostituire gli elementi filtranti di grado AO, AA, AR, AAR ogni 12 mesi, insieme allo scarico automatico (EF1).

A differenza dei filtri per l'eliminazione di aerosol, che vengono cambiati una volta all'anno per garantire la qualità dell'aria compressa, i filtri per la rimozione dei vapori d'olio hanno una durata variabile e devono essere sostituiti più frequentemente. Fattori che influenzano la durata dei filtri ad adsorbimento:

**Concentrazione di vapori d'olio** - La capacità del carbone attivo si esaurisce tanto più rapidamente quanto maggiore è la concentrazione di vapori d'olio in ingresso.

**Oli misti** - I filtri ad adsorbimento sono studiati per eliminare vapori d'olio e odori, ma non oli liquidi o aerosol. La scarsa manutenzione o la mancanza di prefiltrazione causano il rapido esaurimento della capacità dei filtri OVR.

**Temperatura** - Il contenuto di vapori d'olio aumenta proporzionalmente con la temperatura di mandata, riducendo la durata del filtro. Inoltre, all'aumentare della temperatura, diminuisce la capacità di adsorbimento e ancora una volta si riduce la durata del filtro.

**Umidità relativa o punto di rugiada** - L'aria umida riduce la capacità di adsorbimento del carbone.

**Cambio olio del compressore** - Quando si cambia l'olio del compressore, il nuovo lubrificante brucia completamente gli idrocarburi leggeri provocando l'aumento del contenuto di vapori d'olio per alcune ore o addirittura per settimane. Il maggiore contenuto di vapori d'olio viene assorbito dal filtro OVR e provoca una riduzione significativa della durata di adsorbimento.

Le prestazioni degli elementi ACS / AC si basano su una concentrazione massima dei vapori d'olio in ingresso pari a 0,018 mg/m$^3$ con aria compressa a 21°C e un punto di rugiada in pressione di -40°C PDP.

**Questi elementi devono essere sostituiti non appena vengono percepiti vapori, odori o sapori.**

(EN) **Maintenance Procedure 1**

Slowly close the inlet (1) and outlet (2) valves and depressurise the filter (3) using the drain.

(NL) **Onderhoudsprocedure 1**

Sluit de inlaat- (1) en uitlaatkleppen (2) langzaam en haal de druk van het filter (3) af met de afvoer.

(DE) **Wartungsverfahren 1**

Einlass- (1) und Auslassventile (2) langsam schließen und den Druck vom Filter (3) mit dem Ablass ablassen.

(FR) **Procédure de maintenance 1**

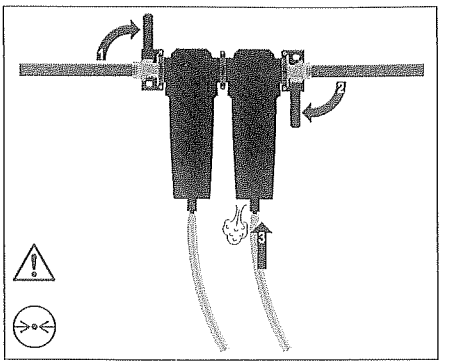
Fermez lentement la soupape d'admission (1) et la soupape de refoulement (2), puis dépressurisez le filtre (3) à l'aide du purgeur.

(ES) **Procedimiento de mantenimiento 1**

Cierre lentamente las válvulas de admisión (1) y de descarga (2) y despresurice el filtro (3) utilizando el drenaje.

(IT) **Procedura di manutenzione 1**

Chiudere lentamente le valvole di mandata (1) e di scarico (2) e depressurizzare il filtro (3) tramite lo scarico.




(EN) **Maintenance Procedure 2**

Unscrew the filter bowl (1 & 2) and remove the used element (3)

(NL) **Onderhoudsprocedure 2**

Schroef de filterkom (1 & 2) los en verwijder het gebruikte element (3)

(DE) **Wartungsverfahren 2**

Filterschale lösen (1 & 2) und das verbrauchte Element entfernen (3)

(FR) **Procédure de maintenance 2**

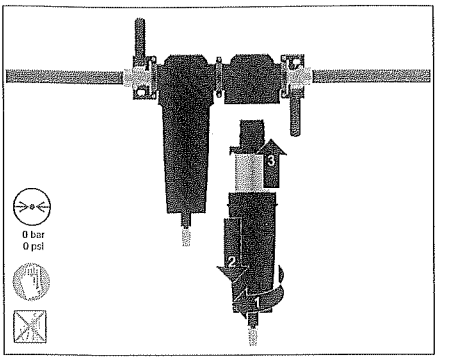
Dévissez la cuve du filtre (1 et 2) et retirez la cartouche usagée (3)

(ES) **Procedimiento de mantenimiento 2**

Desenrosque el cilindro del filtro (1 y 2) y retire el elemento utilizado (3)

(IT) **Procedura di manutenzione 2**

Svitare il bicchiere del filtro (1 e 2) e rimuovere l'elemento filtrante usato (3)




(EN) **Maintenance Procedure 3**

Unscrew the automatic drain (1) and discard (2). Fit the new drain (3) and tighten (4).

(NL) **Onderhoudsprocedure 3**

Schroef de automatische afvoer (1) los en verwijder hem (2). Plaats de nieuwe afvoer (3) en draai hem vast (4).

(DE) **Wartungsverfahren 3**

Den automatischen Ablass abschrauben (1) und entsorgen (2). Den neuen Ablass anbringen (3) und festziehen (4).

(FR) **Procédure de maintenance 3**

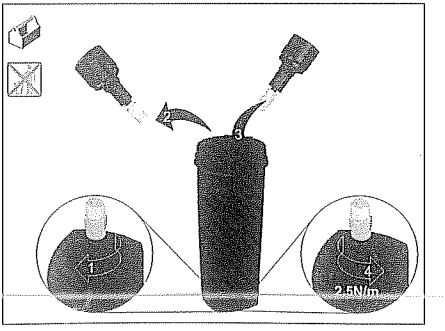
Dévissez le purgeur automatique (1) puis mettez-le au rebut (2). Montez le nouveau purgeur (3) puis serrez (4).

(ES) **Procedimiento de mantenimiento 3**

Desenrosque el drenaje automático (1) y deséchelo (2). Instale el nuevo drenaje (3) y apriételo (4).

(IT) **Procedura di manutenzione 3**

Svitare lo scarico automatico (1) ed eliminarlo (2). Montare lo scarico nuovo (3) e serrare (4).



(EN) **Maintenance Procedure 4**

Insert the new element into the filter bowl ensuring that the lugs are seated correctly in the grooves.

(NL) **Onderhoudsprocedure 4**

Steek het nieuwe element in de filterkom, waarbij de lipjes goed in de groeven steken.

(DE) **Wartungsverfahren 4**

Das neue Filterelement in die Filterschale einsetzen und sicherstellen, dass die Führungen richtig in den Nuten sitzen.

(FR) **Procédure de maintenance 4**

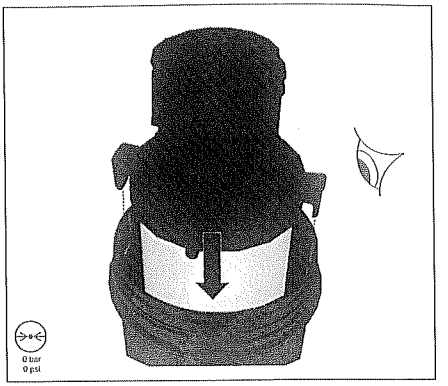
Insérez la nouvelle cartouche dans la cuve en vérifiant que les languettes sont bien enfoncées dans les encoches.

(ES) **Procedimiento de mantenimiento 4**

Inserte el nuevo elemento en el cilindro del filtro, asegurándose de que los anillos están correctamente asentados en las ranuras.

(IT) **Procedura di manutenzione 4**

Inserire il nuovo elemento filtrante nel bicchiere del filtro assicurandosi che le alette siano inserite correttamente nelle scanalature.




(EN) **Maintenance Procedure 5**

Replace the O-ring located in the filter head with the new O-ring provided.

Caution

**Ensure to lubricate the O-ring and threads with a suitable acid free petroleum jelly.**

(NL) **Onderhoudsprocedure 5**

Vervang de O-ring in de filterkop door de nieuwe meegeleverde O-ring.

Caution

**Zorg ervoor dat de O-ring en de draden worden gesmeerd met een geschikt soort zuurloze vaseline.**

(DE) **Wartungsverfahren 5**

Den O-Ring im Filterkopf durch den mitgelieferten neuen O-Ring ersetzen..

Caution

**Sicherstellen, den O-Ring und das Gewinde mit geeigneter säurefreier Vaseline zu schmieren.**

(FR) **Procédure de maintenance 5**

Remplacez le joint torique qui se trouve dans la tête du filtre par le nouveau joint fourni

Caution

**Lubrifiez le joint torique et le filetage à l'aide d'une gelée de pétrole sans acide.**

(ES) **Procedimiento de mantenimiento 5**

Sustituya la junta tórica localizada en la cabeza del filtro por la nueva junta tórica proporcionada.

Caution

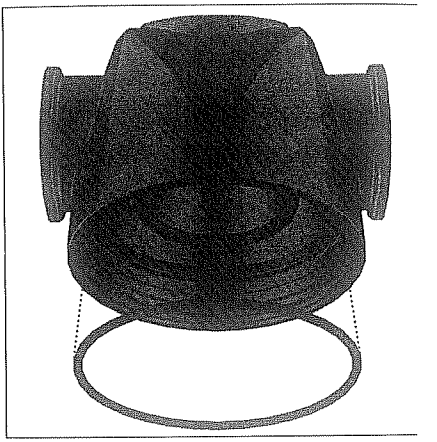
**Asegúrese de lubricar la junta tórica y las roscas con un gel ácido sin petróleo apropiado.**

(IT) **Procedura di manutenzione 5**

Sostituire l'O-ring situato nella testa del filtro con il nuovo O-ring fornito in dotazione.

Caution

**Assicurarsi che l'O-ring e le filettature siano lubrificati con vaselina senza acido idonea.**



(EN) **Maintenance Procedure 6 (a)**

Refit the filter bowl and head ensuring that the threads are fully engaged and the locking details are aligned.

**Note: To ensure that the bowl is fully engaged into the head, the 005-030 bowl requires 360°of rotation until the thread stop and 720° for the 035-045 bowl**

(NL) **Onderhoudsprocedure 6 (a)**

Zet de filterkom en de kop terug op hun plaats en zorg ervoor dat de draden volledig gegrepen zijn en de vergrendeling uitgelijnd is.

**Opmerking: Zorg ervoor dat de kom volledig in de kop steekt. De 005-030 kom moet 360° gedraaid worden, tot aan de draadstop en 720° voor de 035-045 kom**

(DE) **Wartungsverfahren 6 (a)**

Die Filterschale und den Filterkopf wieder anbringen und dabei sicherstellen, dass die Gewinde vollständig fassen und die Sperrklinken richtig ausgerichtet sind.

**Hinweis: Um sicherzustellen, dass die Filterschale vollständig im Filterkopf sitzt, müssen die Schalen 005 bis 030 um 360° und die Schalen 035 bis 045 um 720° gedreht werden, bis das Gewinde stoppt.**

(FR) **Procédure de maintenance 6 (a)**

Remontez la cuve et la tête du filtre en vérifiant que le filetage est vissé à fond et que les indicateurs de verrouillage sont alignés.

**Remarque: pour vérifier que la cuve est bien enfoncée dans la tête, le modèle de cuve 005-030 doit opérer une rotation de 360°jusqu'à la fin du filetage et le modèle de cuve 035-045 doit opérer une rotation de 720°.**

(ES) **Procedimiento de mantenimiento 6 (a)**

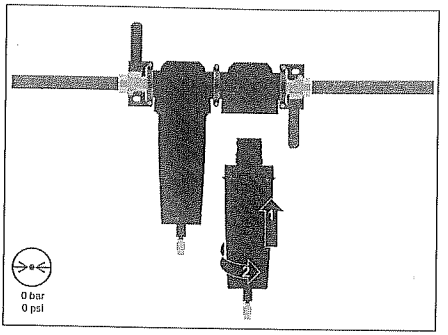
Reinstale el cilindro y la cabeza del filtro, asegurándose de que las roscas están completamente acopladas y que los detalles de bloqueo están alineados.

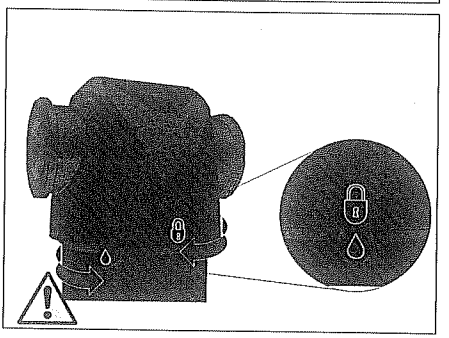
**Nota: Para asegurarse de que el filtro está completamente acoplado a la cabeza, el cilindro de 005-030 necesita 360°de rotación, hasta que la rosca se detenga y 720° para el el cilindro de 035-045 .**

(IT) **Procedura di manutenzione 6 (a)**

Rimontare il bicchiere e la testa del filtro assicurandosi che le filettature siano completamente inserite e gli elementi di bloccaggio siano allineati.

**Nota: per assicurarsi che il bicchiere sia completamente inserito nella testa, è necessaria una rotazione di 360° fino al termine della filettatura per il bicchiere 005-030 e una rotazione di 720° per il bicchiere 035-045.**



(EN) **Maintenance Procedure 7**

Attach the element change date label to the filter bowl and write on the date the element is to be replaced, i.e 12 months after element change.

Caution

**Do not use solvents or alcohol to clean the labels as this could cause damage.**

(NL) **Onderhoudsprocedure 7**

Plak het etiket met de vervangingsdatum aan de kom en schrijf de datum erop waarop het element weer vervangen moet worden, ofwel 12 maanden later..

Caution

**Gebruik geen oplosmiddelen of alcohol om de etiketten te reinigen, omdat dit schade kan veroorzaken.**

(DE) **Wartungsverfahren 7**

Den Austauschdatum-Aufkleber des Filterelements an der Filterschale anbringen und darauf das Datum notieren, zu dem das Filterelement ausgetauscht werden muss (d.h. 12 Monate nach dem Austausch des Elements).

Caution

**Zur Reinigung der Aufkleber keine Lösungsmittel oder Alkohol verwenden. Gefahr von Schäden.**

(FR) **Procédure de maintenance 7**

Attachez l'étiquette de date de remplacement de la cartouche à la cuve de filtre et notez la date du prochain remplacement, dans 12 mois..

Caution

**Ne pas utiliser de solvants ou d'alcool pour nettoyer les étiquettes car cela peut endommager l'équipement.**

(ES) **Procedimiento de mantenimiento 7**

Ponga la etiqueta de cambio de fecha en el cilindro del filtro y escriba en ella la fecha en la que hay que sustituir el elemento; i.e. 12 meses después del cambio de elemento.

Caution

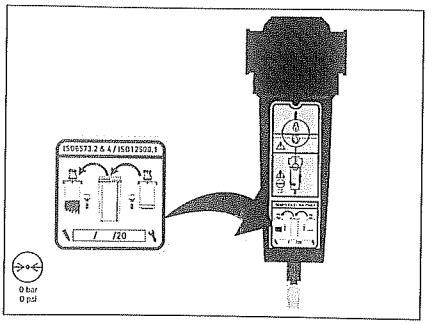
**No utilice disolventes o alcohol para limpiar las etiquetas, puesto que podría dañarlas.**

(IT) **Procedura di manutenzione 7**

Attaccare l'etichetta della data di sostituzione dell'elemento filtrante al bicchiere del filtro riportando la data in cui l'elemento deve essere sostituito, ovvero 12 mesi dopo la sostituzione dell'elemento.

Caution

**Non usare solventi o alcol per pulire le etichette poiché potrebbero provocare danni.**

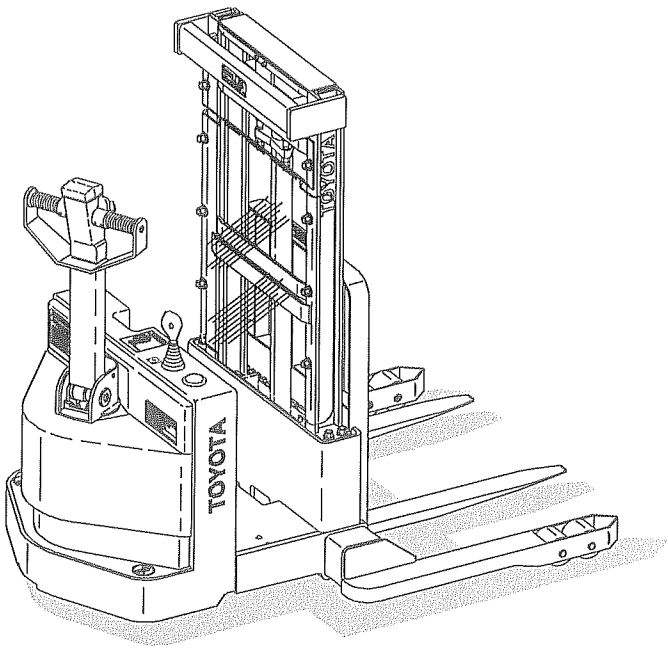


TOYOTA
INDUSTRIAL EQUIPMENT

# Operator's Manual

## 6BWS11/6BWS15/6BWS20

Electric Straddle Stacker Truck
Effective Serial Number 6BWS11-10001 - UP




The operator must read and understand this manual before operating this truck.

| | |
|---|---|
| ⚠ **WARNING** | Read and observe all warnings on this unit before operating it. |
| ⚠ **WARNING** | **DO NOT** operate this equipment unless all factory installed guards and shields are properly secured in place. |

Part no: 00700-6BWSO-P Date: March 14, 2005

# Operator's warning

## IMPORTANT NOTICE

This is the **"SAFETY ALERT SYMBOL"**. This symbol is used to call your attention to items or operations that could be dangerous to you or other persons using this equipment. Please read these messages carefully. It is essential that you read the instructions and safety regulations before you attempt to assemble or use this truck.

**Before operating truck:**

1. The operator must be instructed on safe and correct use of this truck.

2. The operator must read and understand the **Operator's Manual** for this truck.

## WARNING

BEFORE OPERATING TRUCK
STUDY OPERATOR'S MANUAL SAFETY MESSAGES.
READ ALL SAFETY DECALS ON TRUCK.
CLEAR THE AREA OF OTHER PERSONS.

LEARN AND PRACTICE USE OF
CONTROLS BEFORE OPERATING.

IT IS YOUR RESPONSIBILITY TO UNDERSTAND AND FOLLOW MANUFACTURER'S INSTRUCTIONS ON TRUCK OPERATION AND TO OBSERVE PERTINENT LAWS AND REGULATIONS. OPERATOR MANUALS, PARTS MANUALS, AND SERVICE MANUALS MAY BE OBTAINED FROM YOUR EQUIPMENT DEALER.

**WARNING** INJURY OR DEATH TO YOU OR OTHER PERSONNEL COULD OCCUR IF YOU DO NOT FOLLOW THESE INSTRUCTIONS AND MESSAGES.

# Foreword

## It is important that you read and understand this Operator's Manual for your own safety and the safety of those who work with you!

Before you start to use this truck it is of extreme importance that you have **read** the contents of the entire Operator's Manual to be able to use the truck in a **safe** and **efficient** manner.

This Operator's Manual contains information on how you should use the truck and how to keep the truck in a safe condition by following daily service routines.

Only personnel that have been trained as a truck operator, for this type of truck, are permitted to use this truck.

It is your employer's responsibility to ensure that you have been trained to use your truck safely. Contact your supervisor if you feel uncertain about how to use this truck.

Always follow the warnings given in this Operator's Manual and on the truck to avoid accidents.

## Standard Compliance

This truck complies with the following standards and regulation in effect on the date the truck was manufactured:

- American Society of Mechanical Engineers (ASME) B56.1
- Underwriters Laboratory (UL) # 583
- Occupational Safety and Health Administration (OSHA) 29 C.F.R. Section 1910.178

## Dimensions and capacities

The dimensions and capacities shown in this manual have been converted from their original measurements and rounded for convenience. Metric dimensions and capacities are shown in brackets.

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## Warning symbols

*Always follow the warnings given in this Operator's Manual and on the truck to avoid accidents from occurring.*

### Warning levels

Warning text is given in four levels and provide information on the risks, describe the consequences, and instruct how to avoid accidents.

**DANGER**

*Warns that an accident will occur if you do not follow the instructions.*
*The consequences are serious personal injury or possibly death, and/or extremely severe material damage.*

**WARNING**

*Warns that an accident can occur if the instructions are not followed.*
*The consequences are serious personal injury or possibly death, and/or severe material damage.*

**CAUTION**

*Warns that an accident can occur if the instructions are not followed.*
*The consequences are personal injury and/or material damage.*

**NOTE!**

*Marks risk of an accident or breakdown if instructions are not followed.*

## Prohibitory symbols

NO SMOKING

*If smoking occurs in situations where a restriction against smoking is stated, a serious accident can occur.*

OPEN FLAMES PROHIBITED

*If open flames are used in situations where open flames are prohibited, a serious accident can occur.*

GENERAL PROHIBITION

*If the prohibition is ignored, a serious accident can occur.*

## Ordinance symbols

SAFETY SHOES

*When the directive for safety shoes is given, safety shoes shall always be worn to reduce personal injury.*

PROTECTIVE GLASSES

*When the directive for protective glasses is given, protective glasses shall always be worn to reduce personal injury.*

## General safety regulations

### Control

- Always carry out the daily service before the truck is used. The working order of all safety equipment, guards, and safety switches should be checked before the truck is used. Such safety equipment must not be disengaged or removed.

- Check to make sure that all warning decals, nameplate and data plates, and any other decals are clean and undamaged.

- The battery must be secured in its intended compartment. The battery shall have a weight that corresponds with the value stated on the truck's data plate/nameplate.

- Read the nameplates. **Do not** operate the truck if there are any differences between the data stated on the nameplate and the truck.

- The truck must not be used if it is damaged or has conditions that affect safety or its safe use. The truck may not be used if it has been repaired, modified, or adjusted unless it has been checked and approved by **Toyota®** authorized personnel.

## General safety regulations

### Operating the truck

- The truck is designed and produced to be your tool when transporting goods to locations.
- If the truck is to be used in cold storage environments the truck must be especially built for this type of use.
- **Never** allow anyone to stand or walk under any elevated portion of this truck.
- It is **not permitted** to use the truck for other purposes than it has been designed and produced for such as the following applications:
  - In areas where the atmosphere contains gases that can cause fires or explosions.
  - As a towing truck for trailers.
  - To tow other trucks.
  - To transport/lift passengers.

## General safety regulations

### Operator's responsibility

- The truck shall only be driven by personnel that have been specially trained and that have permission to drive the truck.
- Each country (state) has its own safety regulations. It is the operator's obligation to know and follow these regulations. This also applies to local regulations and for different types of handling. If the recommendations in this manual deviate from your country's (state), the local safety regulations should be followed.
- The truck shall only be driven with care, good judgement and in a responsible manner.
- The truck should be insured in accordance with local directives and laws where the truck is used.
- Any accidents or near accidents (incidents) must be reported to your supervisor.
- Local regulations regarding personal safety equipment shall be followed.
- The truck should not be driven with oily hands or oily shoes due to the risk of slipping.
- **DO NOT** place any part of body between moving and stationary objects.

## General safety regulations

### Working area

- If there are marked truck routes these shall be used.
- Truck should only be driven on a dry, clean surface. **Do not** operate on wet, oily surfaces.
- The truck should only be driven on hard and level surfaces.
- Ensure that the floor where the truck is to be used has sufficient load bearing capacity for **total weight** of the truck including the maximum load.
- Take special care if there are protruding parts from racks, shelves, or walls that can cause injury or damage the truck.
- It is forbidden for persons to be present in the area around the truck when there is a risk of personal injury, that is areas that can be reached by falling goods, lowering or falling lifting devices, or in the truck's maneuvering area.
- Grades, ramps, or inclines: This truck is designed for use on level floor operation. If it is necessary to operate on a grade, ramp, or incline on all grades, the truck shall be operated with load-engaging means downgrade. If load restricts visibility or requires the load backrest to retain the load, travel with the load upgrade, with the operator positioned off to one side.

## General safety regulations

### Driving and conduct while driving

- Always drive the truck from the normal operator position.
- Always drive the truck in a responsible manner and with full control. Sudden starts and braking, as well as cornering at high speed, should be avoided.
- Drive at a reduced speed on inclines. Drive the truck straight up and down on inclines. It is **not** permitted to turn the truck on an incline.
- Reduce truck speed if floor surface is slippery to prevent the truck from sliding or overturning.
- Always drive with the forks fully lowered except when a load is collected or left.
- Adapt your speed to driving conditions, both to pedestrians and other trucks, in working area. Reduce speed when line of vision is limited and when pedestrians or other vehicles can be encountered. Always yield the right of way to pedestrians.
- Pay particular attention to other personnel, as well as fixed and moving objects, within the working area and thereby avoid accidents.
- Always be prepared to stop if other personnel are in the working area.
- Keep a safe distance from all vehicles ahead.
- Always keep a safe distance from the edges of loading bays and loading ramps. Be attentive to marked risk areas.
- Sound the horn when overtaking other vehicles and when the attention of other personnel is required.

# Safety regulations

- Always yield the right of way to a loaded truck at junctions and in confined aisles.
- **Never** allow passengers to ride on truck.
- **Never** drive with any part of your body outside of the operator position.
- Keep hands and feet clear of controls other than those in use.
- Lift and lower with caution. Make sure there are no obstructions under, or in the path, of he lifting mechanism.
- Make sure the lifting mechanism is operating smoothly.
- Whenever truck is driven **ON** and **OFF** semi-trailers not coupled to a tractor, supports may be needed to prevent upending or corner dipping.
- Before truck is driven over a loading ramp ensure that the ramp is correctly secured and has the necessary load bearing capacity. Drive slowly and carefully across ramp.
- When truck is driven on to another vehicle make sure the other vehicle is stable and that the brakes have been applied correctly and wheels chocked.
- Before you drive the truck into an elevator ensure that the elevator is approved for the total weight of the truck, the load, operator, and any other passengers in the elevator. Enter elevator with load first. No other personnel should be in the elevator when the load or truck enters or leaves.
- **DO NOT** run over loose objects, uneven surfaces, or other obstructions on roadway surfaces.
- **DO NOT** smoke or use open flame while working around the truck.

- Look in the direction of travel and keep a clear view of the path of travel.
- Slow down and sound your horn at cross aisles and wherever vision is obstructed.

## General safety regulations

### Handling loads

- Drive with care when collecting or leaving a load.
- Only drive with the forks lifted when collecting or leaving a load. Keep a safe distance from persons in the immediate area.
- Only handle loads that are within the truck's permitted lifting capacity, See "Data plate" on page 29. The length and width of the forks shall be adapted to the load's shape and dimensions.
- Only handle loads that are stable and arranged in a safe manner.
- Particular care should be exercised when handling long and high loads.
- Make sure that the truck is equipped with a suitable load support when handling high loads.
- Watch so that overhead obstructions such as lights, pipes, sprinkler systems, etc. are **NOT** contacted.
- The load shall **Only** be lifted vertically and **NEVER** dragged or pushed horizontally.
- The load shall be transported with bottom of load and forks as low as possible.
- Adjust distance between forks to the width of the load.

## General safety regulations

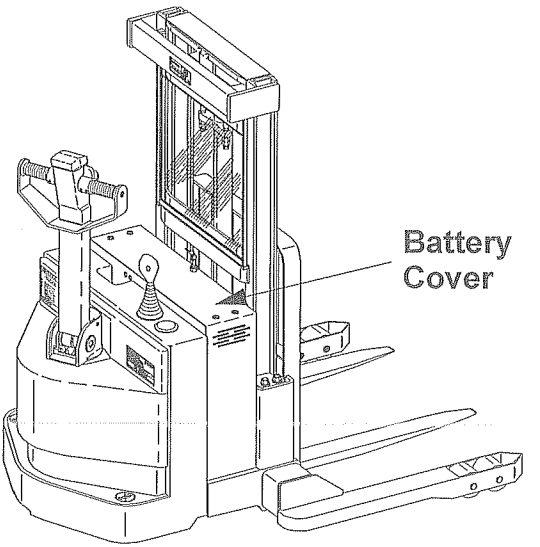
### Parking the truck

- **Always** park with the load carriers or forks fully lowered and the brakes applied and secured.
- **Always** park in designated areas if available.
- **Never** leave the truck parked with the power still on or key still in the key switch.
- **Never** park the truck on an incline.
- **Never** park the truck so that it obstructs emergency exits.
- **Never** park the truck so that it obstructs traffic or work.
- If truck is left unattended, fully lower the forks, shut power off, remove key, and disconnect battery.

## General safety regulations

### Handling the battery

- Always handle the battery and its connections with care. Read and follow the instructions for changing or recharging the battery carefully. See chapter See "Appendix B, Battery" on page 75.
- Always wear protective glasses when working with the battery.
- Make sure the battery in the truck is of a weight that corresponds with the information on the truck's data plate.
- Make sure the battery is secured in its compartment.
- Make sure battery cover for battery type "EE" truck **6BWS11** is replaced after removal for any reason. The battery cover must be locked in place with key secured in a safe place.



## General safety regulations

### Maintenance and repair

Maintenance instructions should be followed to prevent faults and accidents. See "Maintenance" on page 57. Only qualified and trained personnel are permitted to maintain, adjust, or repair the truck.

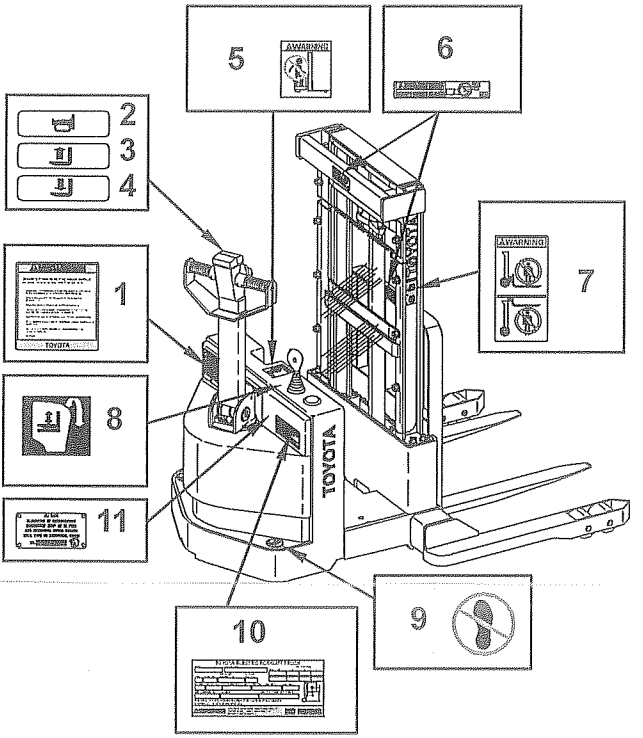
All replacement parts shall be **Toyota** approved spare parts.

Modifications and additions which affect capacity and safe operation shall not be performed by the customer or user without manufacturer's prior written approval. Capacity, operation, and maintenance instruction plate, tags, or decals shall be changed accordingly.

## Warning and information decals

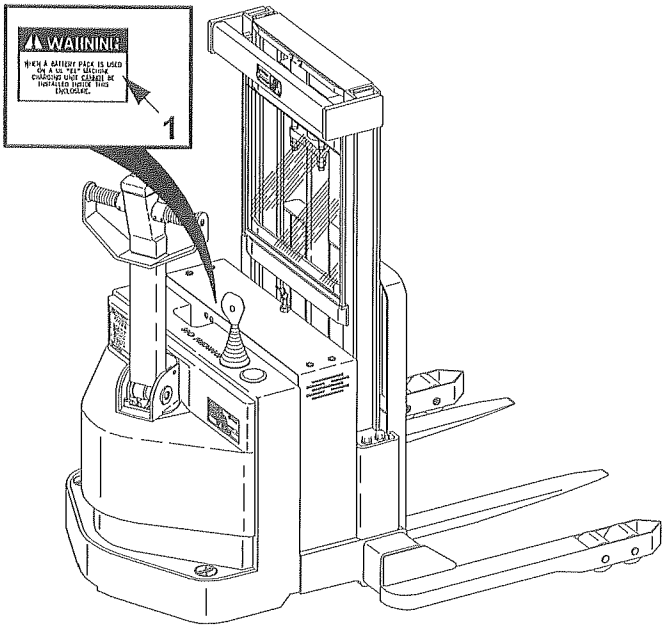
The figure shows the position and significance of the decals location on the truck.

1. List of warnings
2. Signal/Horn
3. Hydraulic controls: Raising
4. Hydraulic controls: Lowering
5. No Riding decal
6. Pinch points: **Do not** reach through uprights.
7. **Do not** walk under an elevated load.
8. Decal: Mast function (Raise/Lower)
9. Warning decal: No Step, or No Standing, or No Riding
10. Truck data plate
11. U.L. listed



## 6BWS11 "EE" battery decals

The figure below shows the location of the battery charger warning decal (1) for battery type "EE" 6BWS11 trucks.




## Warning decals

Clean or replace all safety and instruction decals that cannot be read.

When you clean decals use only a cloth, soap, and water. DO NOT use solvent, gasoline, etc.

You must replace a decal if the decal is damaged, missing, or cannot be read.

If a decal is on a part that is replaced, make sure you install a new decal on the new part. New warning decals can be obtained from your Toyota Dealer.

## Presentation of truck

The **Toyota** truck is intended for handling pallets indoors or alternatively other types of loads using other load carriers. This truck is operated by a walking operator. This **Toyota** truck has available different fork lengths and mast heights. Refer to the truck's data plate for this information.

| Maximum lifting capacity | |
|---|---|
| **6BWS11** | 2200 lb [998 kg] |
| **6BWS15** | 3000 lb [1361 kg] |
| **6BWS20** | 4000 lb [1814 kg] |
| Refer to the data plate on truck for information on lifting capacities. | |

Truck is equipped with a 24 volt electrical system. Travel speeds are regulated by a transistor controller to provide gentle control of acceleration and speed while operating.

Forks are raised by a hydraulic pump unit. Control of the lift is done electrically with a push button on steering control handle. Control of the speed and positioning of the forks when stacking are done with a mechanical valve lever of the truck.

Fork functions lever (option) is also hydraulically powered using the same hydraulic pump unit. Control of the fork function is done with a mechanical valve lever by selecting fork function (pressing a button on the function lever) and moving lever forward or rearward.

The trucks can be fitted with different accessories including sideshifter, warning light, hourmeter/battery indicator, and BDI with lift interrupt. The trucks can be specially equipped to work in cold conditions and explosive environments.

## Application area for Toyota's trucks

**Toyota** trucks are solely designed and manufactured to handle goods. The truck should be fitted with the appropriate accessories relevant to the application.

## Prohibited applications for Toyota's trucks

The trucks are designed for handling goods indoors. It is not permitted to use the trucks for other purposes including the following:

- **Do not** use in areas that contain gases which can cause fires or explosions
- **Do not** use as a towing truck for trailers
- **Do not** use to tow other trucks
- **Do not** use to transport/lift passengers
- **Do not** use to drive on gravel or grass

## Truck data

The table provides information regarding some technical data which is of value with daily use of the truck.

| Truck data | | 6BWS11/15/20 |
|---|---|---|
| Maximum load capacity | | 2200/3000/4000 lb<br>(997/1360/1814 kg) |
| Lift height | | 100 -189 inch<br>(2540 - 4800 mm) |
| Operating speed | Empty | **6BWS11/15** 0 - 3.3 mph (0 - 5.3 kph)<br>**6BWS20** 0 - 3.2 mph (0 - 5.1 kph) |
| | Loaded | **6BWS11/15** 0 - 2.8 mph (0 - 4.5 kph)<br>**6BWS20** 0 - 2.6 mph (0 - 4.1 kph) |
| Service weight | Without battery | 3500 lb<br>[1587 kg] |
| | With battery | 4480 lb<br>[2032 kg] |

The truck's lifting capacity and weight can be found on the truck's data plate.

## Truck battery dimensions

### Truck battery dimensions

**Important**

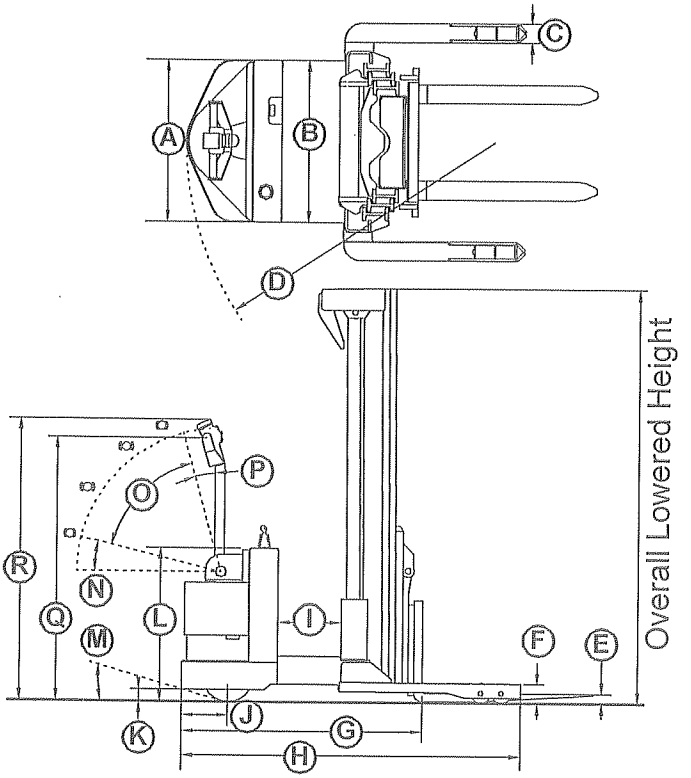
Use only batteries that meet the following specifications:

| Compartment Size: | Minimum | Maximum |
|---|---|---|
| **6BWS11** | | |
| Deep | 8.5 inch [215 mm] | 9 inch [228 mm] |
| Wide | 31.3 inch [795 mm] | 31.8 inch [807 mm] |
| Battery Weight | (Consult Data plate on truck) | |
| **6BWS15/BWS20** | | |
| Deep | 12.5 inch [317 mm] | 13 inch [330 mm] |
| Wide | 31.3 inch [795 mm] | 31.8 inch [807 mm] |
| Battery Weight | (Consult Data plate on truck) | |

For smaller industrial battery sizes, provide blocking to restrain the battery from moving not more than 0.5 inch [12.7 mm] in any horizontal direction.

## 6BWS11 truck dimensions

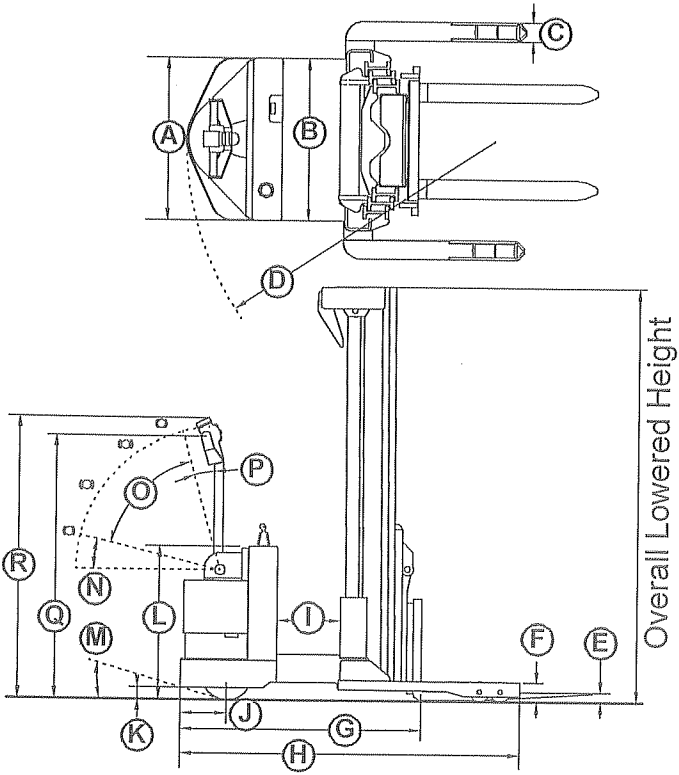
The following diagrams show external dimensions for 6BWS11 trucks.




| | | | |
|---|---|---|---|
| A | 34.1 inch (886 mm) | J | 9.7 inch (246 mm) |
| B | 32.3 inch (820 mm) | K | 2.1 inch (53 mm) |
| C | 4 inch (101 mm) | L | 32.5 inch (8.25 mm) |
| D | 60.8 inch (1544 mm) | M | 16.2° |
| E | 2 inch (50 mm) | N | 10.5° |
| F | 4 inch (101 mm) | O | 67° |
| G | 38.4 inch (975 mm) 2-Stage<br>43.6 inch (1107 mm) 3-Stage | P | 12.5° |
| | | Q | 55.6 inch (1412 mm) |
| H | 67 inch (1701 mm) | R | 59.5 inch (1511 mm) |
| I | 9 inch (228 mm) | | |

## 6BWS15 truck dimensions

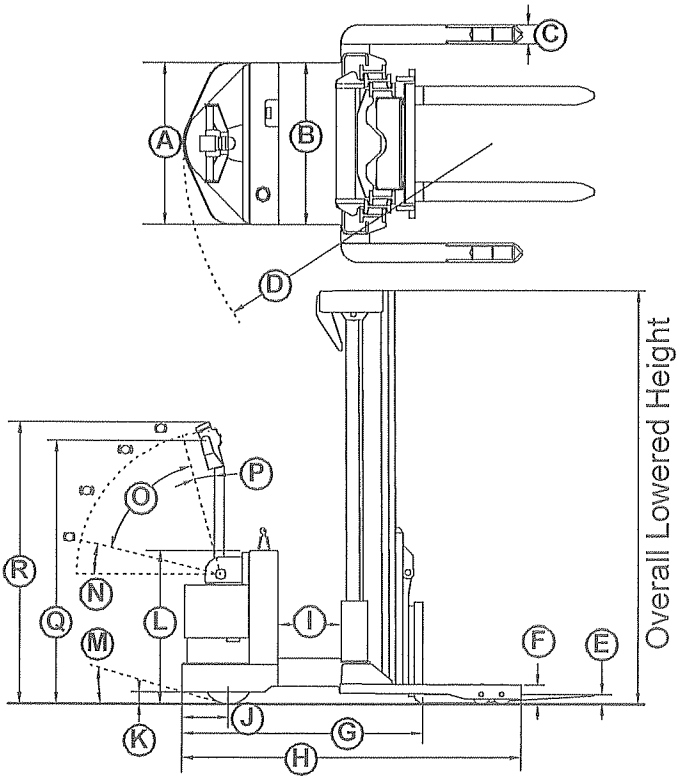
The following diagrams show external dimensions for 6BWS15 trucks.




| | | | |
|---|---|---|---|
| A | 34.1 inch (886 mm) | J | 9.7 inch (246 mm) |
| B | 32.3 inch (820 mm) | K | 2.1 inch (53 mm) |
| C | 4 inch (101 mm) | L | 32.5 inch (8.25 mm) |
| D | 65.1 inch (1653 mm) | M | 16.2° |
| E | 2 inch (50 mm) | N | 10.5° |
| F | 4 inch (101 mm) | O | 67° |
| G | 42.7 inch (1084 mm) 2-Stage<br>47.9 inch (1216 mm) 3-Stage | P | 12.5° |
| | | Q | 55.6 inch (1412 mm) |
| H | 71.3 inch (1811 mm) | R | 59.5 inch (1511 mm) |
| I | 13.3 inch (337 mm) | | |

## 6BWS20 truck dimensions

The following diagrams show external dimensions for 6BWS20 trucks.

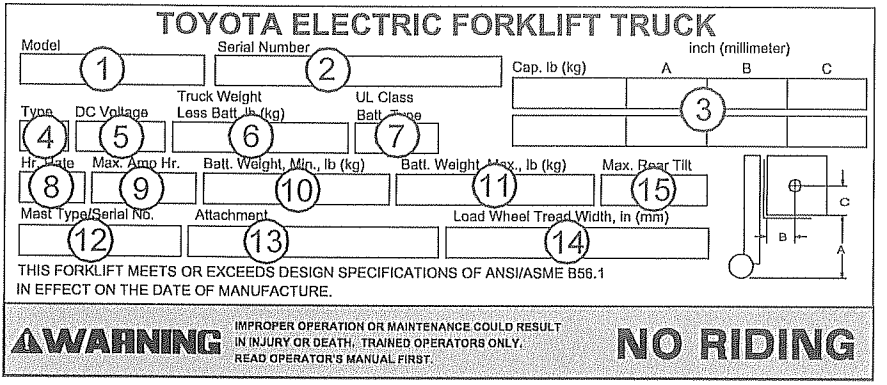



| | | | |
|---|---|---|---|
| A | 34.1 inch (886 mm) | J | 9.7 inch (246 mm) |
| B | 32.3 inch (820 mm) | K | 2.1 inch (53 mm) |
| C | 4 inch (101 mm) | L | 32.5 inch (8.25 mm) |
| D | 65.1 inch (1653 mm) | M | 16.2° |
| E | 2 inch (50 mm) | N | 10.5° |
| F | 4 inch (101 mm) | O | 67° |
| G | 44.7 inch (1135 mm) 2-Stage<br>47.9 inch (1216 mm) 3-Stage | P | 12.5° |
| | | Q | 55.6 inch (1412 mm) |
| H | 71.3 inch (1811 mm) | R | 59.5 inch (1511 mm) |
| I | 13.3 inch (337 mm) | | |

## Data plate

Know the rated capacity on the data plate and understand areas 1 through 15 as shown in the illustration.

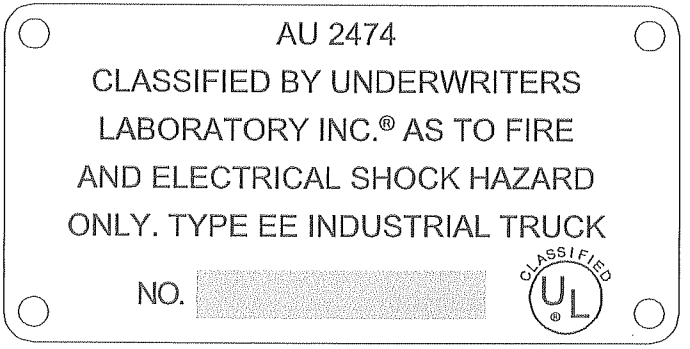
1. Truck model number
2. Truck serial number
3. Truck capacity
4. Battery type
5. Truck voltage
6. Truck weight less battery
7. Truck type
8. Battery hour rating
9. Battery maximum AMP hours
10. Minimum battery weight
11. Maximum battery weight
12. Mast serial number
13. Attachment
14. Load wheel tread width **(NOT USED on this model)**
    The distance between outrigger centers at ground level.
15. Maximum degree rear tilt




This data plate is located in the electrical compartment access shield. Knowing the model and serial numbers for this unit is very helpful when ordering repair parts. For further information and specifications on this unit, or any other, contact your **Toyota Dealer**.

## U.L. construction type

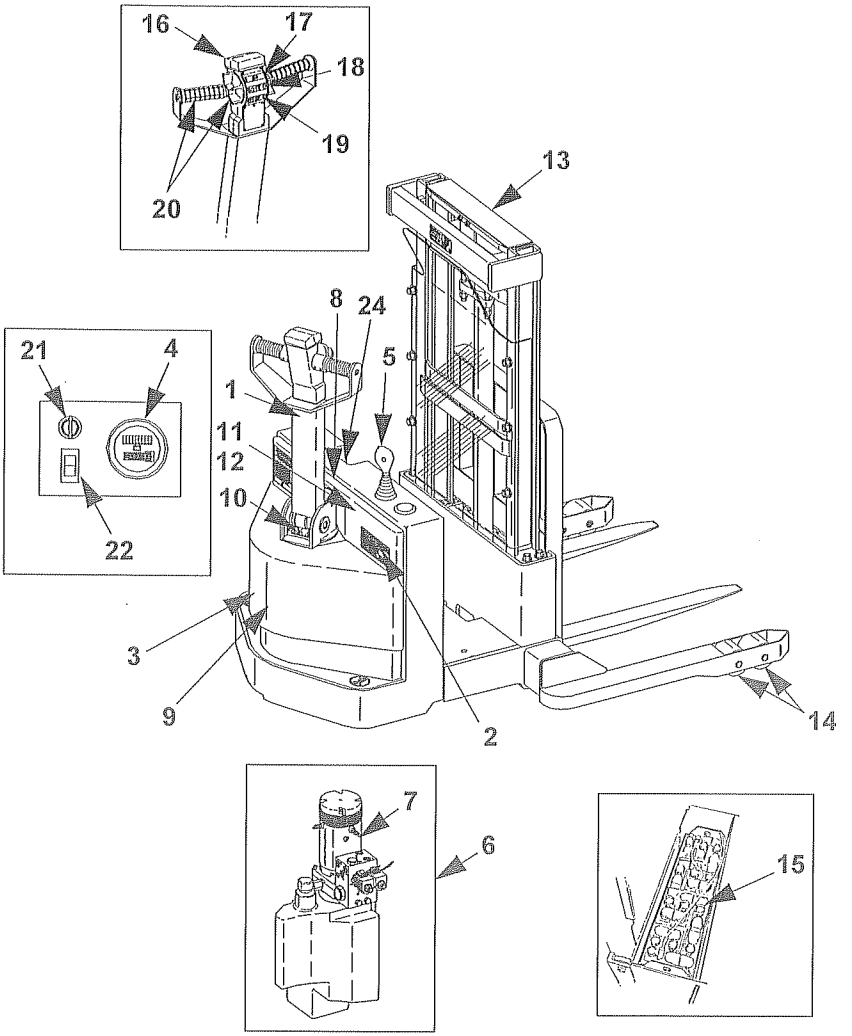
Know the U.L. construction type of this truck and make certain that trucks of this type may be operated in restricted areas before you enter. Never take an unauthorized truck in restricted or hazardous areas.



## Presentation of main components

1. **Steering control handle**
   The truck is to be controlled by the operator with 180 degree steering angle.
   The brake is applied in the upper and lower position of the steering arm.
2. **Data plate**
   Contains type designation, serial number, service weight, battery weight, rated lifting capacity, battery voltage, and manufacturer. See "Data plate" on page 29.
3. **Door**
   Swing open which provides good accessibility when servicing.
   The door can be completely removed from the truck by lifting the door from the hinges.
4. **Gauge**
   Hourmeter/battery indicator, hourmeter/battery indicator with lift interrupt, or hourmeter only.
5. **Hydraulic control levers (manual valve)**
   For controlling raising/lowering and auxiliary functions.
6. **Hydraulic unit**
   Pump motor, pump, electric valves, and oil tank integrated in a compact unit.
7. **Hydraulic electric solenoid valve**
   For controlling lifting and lowering function with electric solenoid valve.
8. **Hydraulic manual valves**
   For controlling hydraulic functions with a manual lever on top of truck.
9. **Drive unit with brake**
   Fixed drive unit with a spring applied brake, drive motor, gear box, and drive wheel combined into a compact unit. The steering bearings are at the top of the drive unit.
10. **Steering pivot point**
    Lubricate pivot point to prevent stiff steering.
11. **Electric panel**
    24 volt electrical system. Vehicle speed is regulated by means of a transistor controller.

12. **Circuit breaker**
    Control
    12A, part number 00590-41046-71.
    Pump
    300A, part number 00590-41025-71.
    Drive
    105A, part number 00590-41034-71
13. **Mast**
    Covered by a finger protection which covers the operator's normal range of reach from the operating position.
14. **Load wheel**
    Lubricate load wheels to prevent wheels from locking up.
15. **Battery**
    24 volt with different capacities and weights.
16. **Reverser switch**
    The function is to prevent the operator from being pinched between the handle and an obstruction when traveling in the forward direction.
17. **Horn switch**
    The horn sounds to warn others of your position.
18. **Fork raise switch**
    The forks will raise when switch is pressed or until lift stops are reached.
19. **Fork lower switch**
    The forks will lower when switch is pressed or until lower stops are reached.
20. **Travel speed / direction selection**
    To select direction rotate in the direction you wish to move. The further in that direction you rotate the faster you move.
21. **Key switch (toggle switch)**
    Shuts off electrical power to control system.
22. **Master control on/off switch**
    The stop switch will stop all control functions.
23. **Emergency battery disconnect**
    Pulling the battery connector will shut off all electrical power to the truck.




Presentation of main components drawing

## Controls and instruments

Guards and shields have been provided on the truck for your protection.

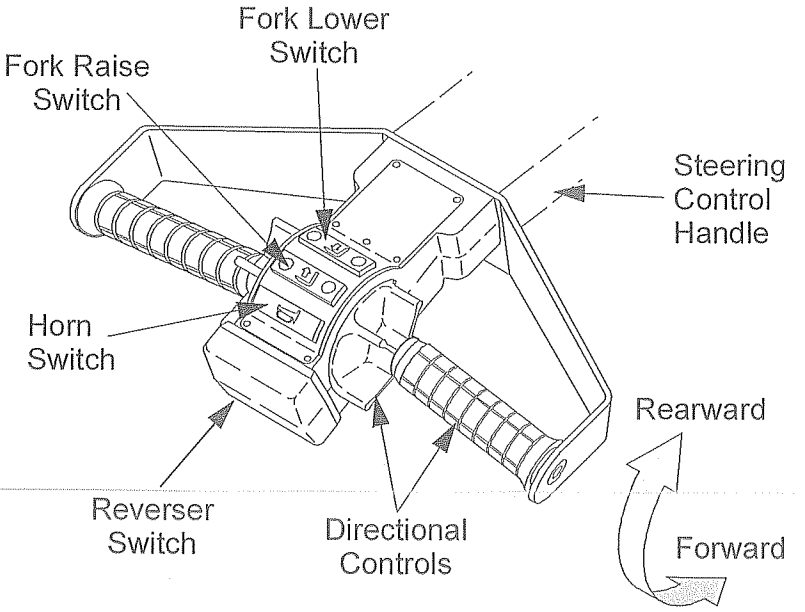
> **⚠ WARNING** **DO NOT** operate this truck unless all factory installed guards and shields are properly secured in place.

Decals are also provided to warn of potential danger as well as to display special operating procedures.

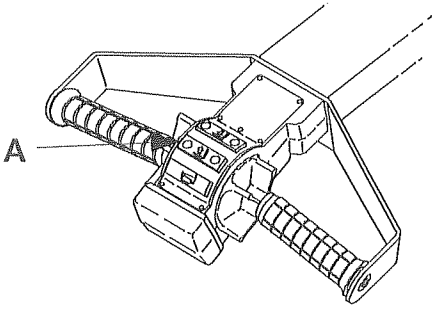
> **⚠ WARNING** Read and observe all warnings on this unit before operating it.

## Control handle

The control handle is used to provide hand brake, direction, speed, and horn on this truck.



## Raising the forks

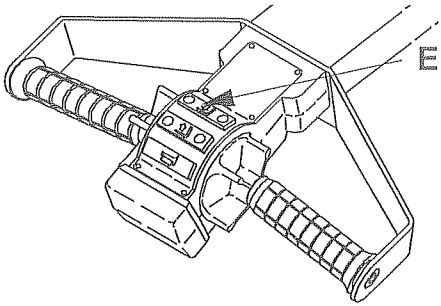



The control button activates a micro switch to start the pump motor with lifting.

The diagram illustrates the controls as seen from the operator's position. Lift the forks by pressing 'A'.

| NOTE! | The forks cannot be raised with the key switch in position O. |
|---|---|

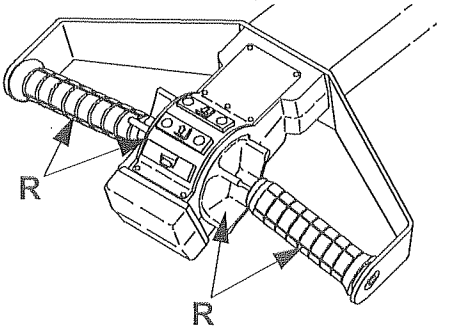
## Lowering the forks




Lower the forks by pressing 'E'. The lowering speed of the forks is controlled by a flow control valve.

| NOTE! | The forks cannot be lowered with the key switch in position O. |
|---|---|

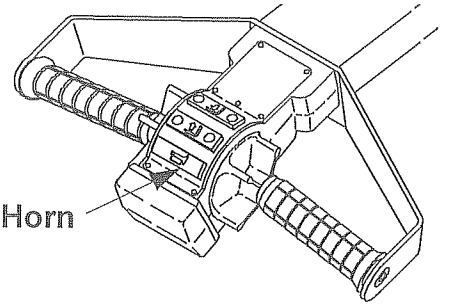
## Travel direction selector and speed control




Select the travel direction by rotating the thumb wheel, R, in the required direction. The speed is variably controlled based on the position of the thumb wheel.

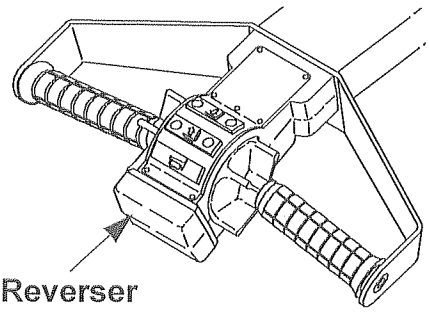
This truck is equipped with a thumb control and optional picking knob for speed and direction control. Rotating control in the forks trailing or fork first direction will select that direction of travel. The truck speed will progressively increase as the control is rotated. Reversing the control can be used to quickly decrease speed or brake the truck.

## Horn



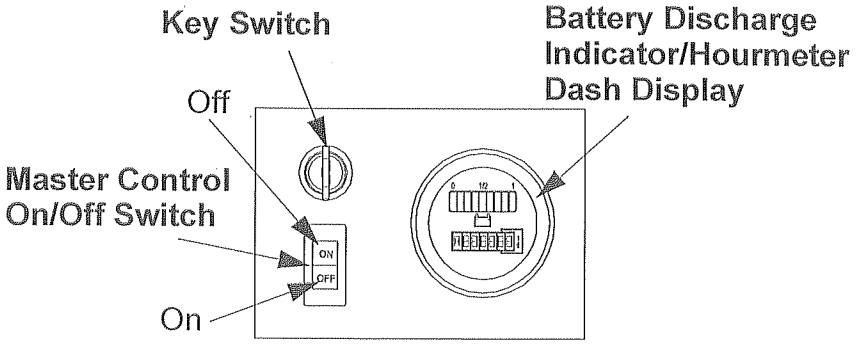

The horn sounds as long as the button is pressed.

## Reverser switch




The end of the control handle is equipped with a red automatic reversing button which causes the truck to travel in the fork direction when activated. The operator must move the travel direction selector to its neutral position to start the truck again.

## Dash Controls




Dash Panel Layout

### Key switch (Toggle switch)

A **key switch** is provided to assist in preventing unauthorized use of this unit. The key switch is located on the control panel cover.

The key switch has two (2) positions: **OFF and ON.**

1. **Off Position:** Turning the key to **"OFF"** will stop all electrical power from going to the control circuit from the battery.

2. **On Position:** Turn the key to **"ON"** to check function of the hourmeter and battery discharge indicator. The key switch must be in this position to provide power to the control circuit when unit is operated.

### Master control on/off switch

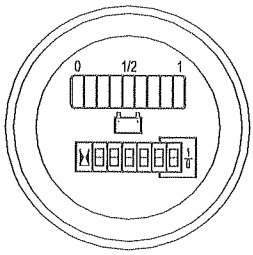
The master control on/off switch will cut off electrical power to the control functions on the truck when pushed. To reset switch turn key switch to OFF position, repair, push switch on. The master control on/off switch is physically located on the dash below the key switch.

### BDI/hourmeter with lift interrupt

1 Fully-charged battery

1/2 Half-charged battery

0 Discharged battery

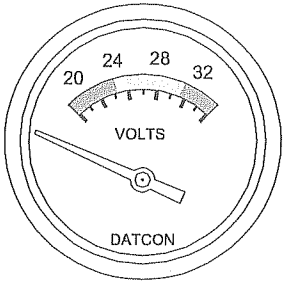



The battery indicator shows the actual charge level of the truck's battery.

The battery indicator has an integrated lift interrupt that disables the truck's lift function when a preset discharge level is reached. This prevents damage to the battery and increases the running economy of the truck. When the battery has reached a charge level equivalent to 70 percent discharge a warning signal is given by a flashing light. A further 10 percent of the battery's capacity can be used before the battery indicator interrupts the lifting function.

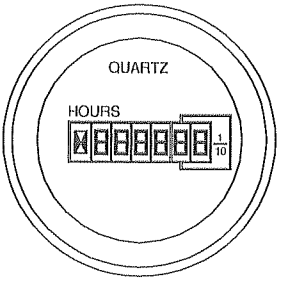
The hourmeter displays the time the drive motor is operating.

### Battery discharge indicator (BDI)



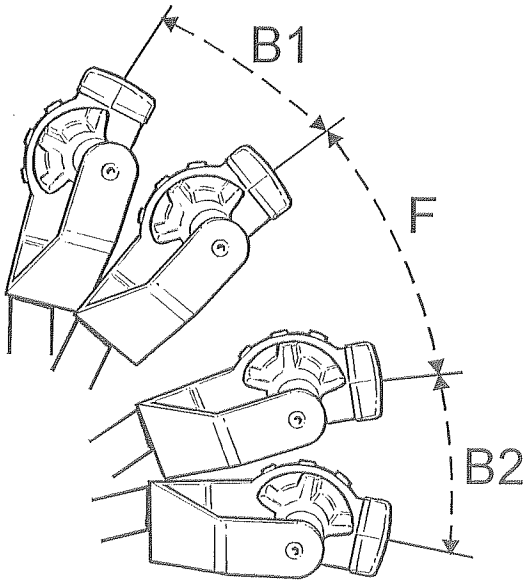

The battery discharge indicator (BDI) is used to indicate the degree the battery has been drained of charge. The BDI is to be read when unit is at rest with the key switch "ON" and with NO motors running.

## Hourmeter




The hourmeter displays the time the drive motor and/or the pump motor are operating.

## Steering control handle/brake control




Operate the truck with the steering control handle in the center range **(F)**.

The brake is activated mechanically by the steering control handle/brake control. The brake is applied in two positions, **(B1 and B2)**.

**Parking brake (B1):**

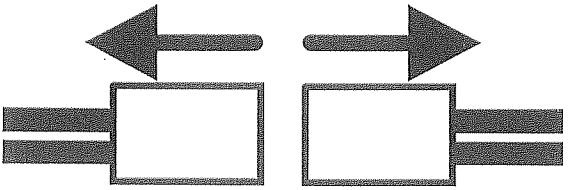
The steering arm automatically returns to position **(B1)** when released.

**Travel brake (B2):**

Apply the brake by pushing the steering control handle downwards.

The brake function should always be checked before using this unit.

## Battery connector



Pull out the battery connector (see diagram) in order to cut all electrical power supply:

- When charging the battery.
- In the event of an accident.

To charge battery, disconnect battery connector from truck and connect battery to the charger connector. After charging, reconnect battery to truck.

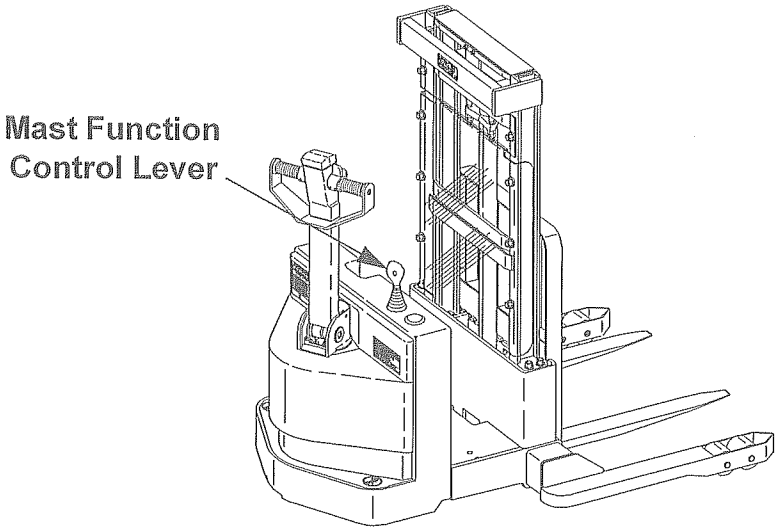
In an emergency, first push the master control on/off switch to OFF position this will disable all controls under normal circumstances. Then disconnect the battery connector. This will cut all electrical power to the truck.

## Mast Function Control Lever

The mast function control lever is controlled by pushing or pulling the control lever. The mast function control lever is used to raise/lower the fork height on mast. The lever is located on top and to the right side of electrical dash panel.

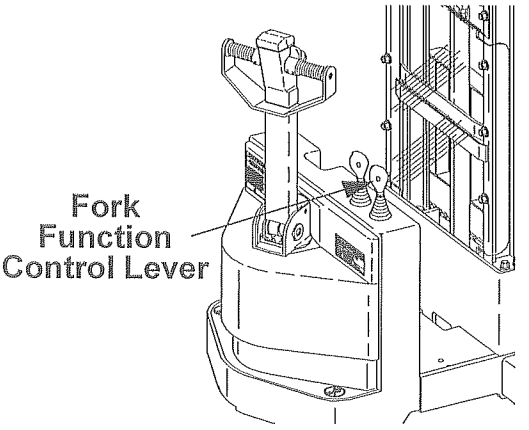
### Control for Raise/Lower using control lever

The **Raise/Lower** is controlled by pushing lever forward to lower the fork height on mast and pulling back to raise. The speed of raising/lowering can be controlled by the degree of movement of lever.



## Fork Function Control Lever (optional)

The fork control lever is controlled by pushing or pulling the control lever. The fork control lever is used for sideshifter control, and an auxiliary functions. The lever is located on top and to the right side of electrical dash panel.




### Control for Sideshifting Forks (optional)

The **Sideshifter** is controlled by pulling lever to move forks **Right** and pushing lever to move forks **Left**. The speed of sideshifter can be controlled by the degree of movement of lever.

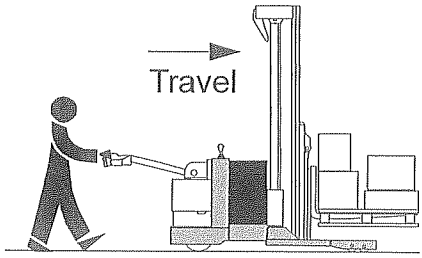
### Control for Auxiliary Fork Function (optional)

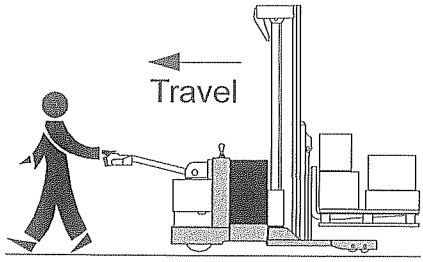
This function is controlled by depressing and holding the function button on the side of the fork function control lever and moving lever. Pulling lever will move auxiliary function one way and pushing lever will move auxiliary function the other way. The speed of auxiliary function can be controlled by the degree of movement of lever.

## Driving

There are certain hazards that cannot be avoided solely by mechanical means in the everyday use of material handling trucks. Only the intelligence, good sense, and care of the operator, along with proper maintenance, will assure that the trucks are operated properly. It is important to have trained, reliable personnel operating your units. If at any time the operator finds that the unit is not performing properly, he should discontinue operation of the truck and report the condition to his supervisor for correction.

The proper operator position for this truck is shown and described below.



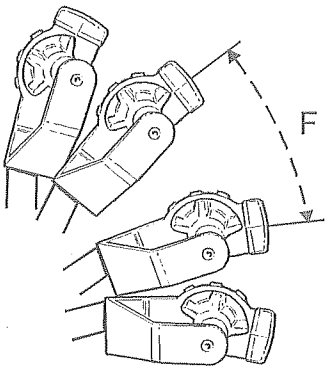

Proper operation of this unit is with forks trailing when possible. Steering the truck is easier with the forks trailing. Always look in the direction of travel.

When forks are first to enter a confined area or elevator or on an incline keep both hands on control handle. Keep both hands within the handle guard and always look in the direction of travel.

## Starting the Truck

- Ensure battery connector is connected to truck.
- Master control on/off switch is in the on position. Turn key switch to position I. The instrument lighting comes on.
- Make sure battery indicator indicates a sufficient charge level (1/2 - 1) to operate truck.

| | |
|---|---|
| **NOTE!** | Prolonged operation with a low battery charge level can result in damage to the battery and/or truck. Do not drive without first recharging the battery. |



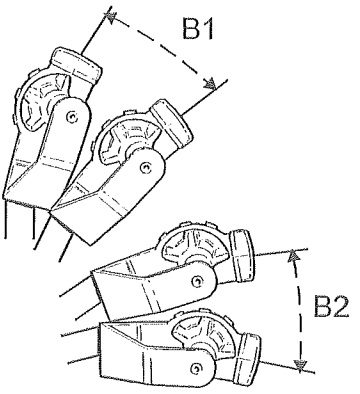

- Move the control handle to the drive position (F). The parking brake is released when the control handle is moved to the drive position (F).
- Move the travel direction selector/speed control in the desired direction.

| | |
|---|---|
| ⚠ **WARNING** | To reduce function failure and not to jeopardize safety, always check the following safety functions before starting the day's work. |

- Check that the:
  - horn functions correctly.
  - steering functions correctly.
  - brakes function correctly.
  - hydraulic controls function in both direction.
  - deceleration functions correctly.
  - hydraulic functions are operational.
- Start gently by accelerating slowly until you reach the desired speed.

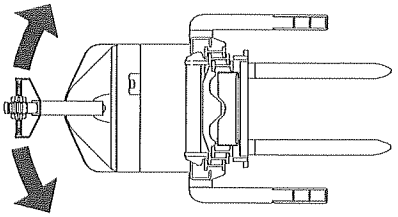
> ⚠ **WARNING** Driving dangerously can cause accidents. Always drive with care, good judgement and responsibility as set out in the general safety guidelines.

## Braking the Truck




- By moving the steering control handle to position **B2** you will apply the travel brake. When you release the steering control handle it automatically returns to the parking brake position, **B1**. Using the steering control handle to brake is the recommended method of stopping the truck in the event of an emergency.
- You can also plug brake by switching the travel direction switch to the opposite travel direction. Control the braking force by the position of the speed control. The steering control handle may be moved to its lower position to brake while driving, **B2**.
- The steering handle automatically returns to position, B1 when released.

## Steering the truck



- Steer by means of the control handle.
- If the truck gets caught against an obstacle do not use more force to steer than used when steering the truck under normal conditions. When this occurs try to free the truck by carefully driving forwards and backwards and at the same time carefully moving the control handle.

> ⚠ **WARNING** To reduce risk of slipping and loosing control of the truck, always dry oily hands and shoes before operating the truck.

## Parking the truck

- Stop truck and disengage travel direction selector.
- Release steering control handle. The handle will automatically return to the parking brake position and brakes are applied.
- Turn key switch to the O position.
- Always remove key from key switch when truck is left unattended.

# Transporting loads

## General Information

The weight of the load should be within the truck's permitted lifting capacity. See the truck's data plate.

| | |
|---|---|
| ⚠ WARNING | The lifting capacity is reduced if additional equipment is attached to the truck. Always check the truck's overall lifting capacity. |

- Only handle loads that are stable and arranged safely. Take particular care when handling high and long loads.
- Make sure that the truck is equipped with a suitable load support when handling high loads.
- Always drive with the forks fully lowered except when collecting or leaving a load.
- Adjust distance between forks to the width of the load.

| | |
|---|---|
| ⚠ WARNING | Tall loads can fall when cornering at high speed or cause tipover. Drive slowly and carefully when cornering and travel with loads in lowered position. |

| | |
|---|---|
| ⚠ WARNING | The load can collide with personnel, fixed or moving objects. A truck with a protruding load requires more room when cornering. |

| | |
|---|---|
| NOTE! | The outriggers can collide with fixed objects. A truck with wide outriggers requires a greater operating area. |

- If necessary, when the operator's vision is impaired, ask someone to direct operations so that transportation can take place without the risk of causing personal injury or material damage.

- Before the truck is driven into an elevator ensure that the elevator is approved for the overall load (the truck's weight and load). Enter with load first. **DO NOT** permit other personnel to be in the elevator while entering or leaving.

| | |
|---|---|
| ⚠ **WARNING** | A loaded truck can overturn when attempting to turn on an incline. |

| | |
|---|---|
| ⚠ **WARNING** | Braking distance is increased when traveling downhill. Drive at a reduced speed, use the truck's motor brake. |

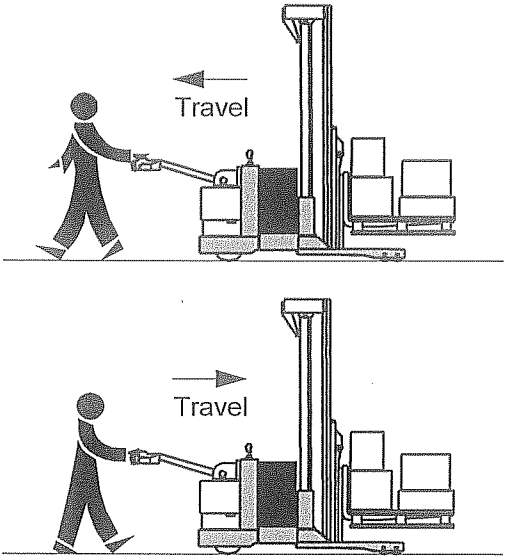
| | |
|---|---|
| ⚠ **WARNING** | An overloaded elevator can fall out of control down the elevator shaft.<br>Always check the capacity of the elevator before driving in with the truck. |

- Before you drive the truck over a loading ramp ensure that the ramp is correctly secured and that it has the necessary load bearing capacity. The truck should be driven slowly and carefully across the ramp and at a safe distance from the edges.

| | |
|---|---|
| ⚠ **WARNING** | Always check the ramp's load bearing capacity and that it is secured correctly. Drive at a safe distance from the edges. |

## Collecting a load

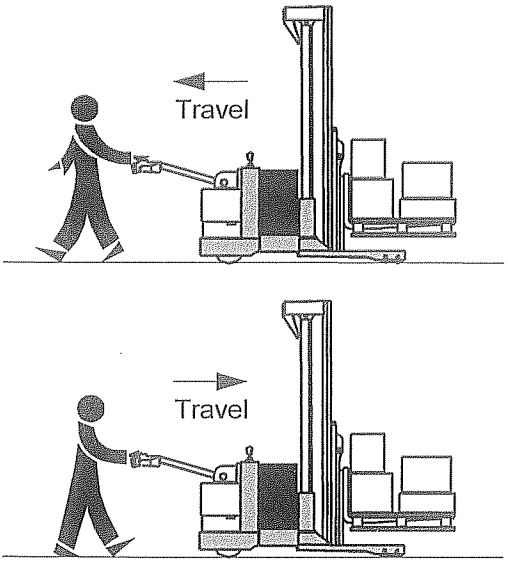
- Slow down and position the truck carefully in front of the load.
- Lower the forks to the required position.
- Drive the truck rearward so that the forks are positioned in the center and as far as possible under the load.
- Lift the forks so that the load is lifted free.
- Reverse the truck so that the load clears the rack.
- Lower the load to floor level and drive carefully away from the rack by starting slowly and then increasing the speed.




⚠ **CAUTION** Lifting a loaded pallet when truck is still moving can result in load falling off the pallet. Never lift a load if truck is moving.

## Leaving a load

- Slow down and position truck carefully in front of the load.
- Lift the load to the required lifting position.
- Drive truck forward so that load goes on rack load carrier.
- Lower the forks so that they clear the load.
- Reverse the truck.
- Lower the forks to floor level and drive carefully away from the rack by starting slowly and then increasing the speed.



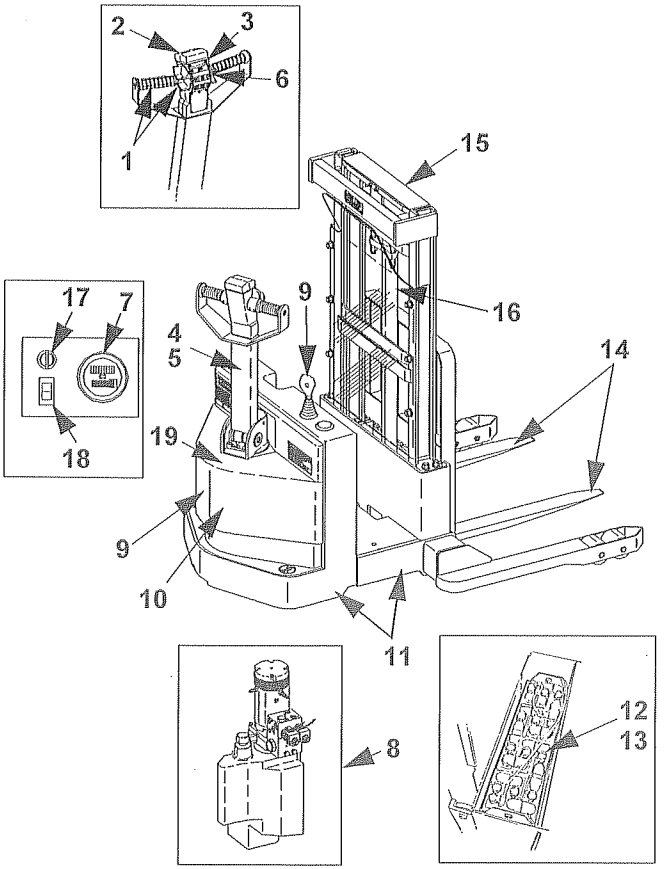

⚠ **CAUTION** Lowering a loaded pallet when truck is still moving can result in load falling off the pallet. Never lift a load if truck is moving.

## Daily service/safety checks

- The operator is responsible for the daily service and care of the truck.
- Carry out the daily service at the start of the day or shift, before the truck is used. The daily service is a simple safety and function control as shown in the chart.
- You need no tools to carry out the service checks.
- If you fail to carry out the daily service the safety and reliability of the truck can be affected.

> ⚠ **WARNING** Never neglect the daily service and safety checks, accidents can occur. Always report any faults or damage to your supervisor without delay. Never use a truck that does not function properly.

## Daily service/safety checks drawing




**WARNING** **DO NOT** continue to operate the truck when it is not functioning properly.

| Item # | Check points | Action |
|---|---|---|
| 1 | Direction / accelerator | Check its function |
| 2 | Reverser switch | Check its function |
| 3 | Horn | Check its function |
| 4 | Handle steering | Check its function |
| 5 | Parking brake | Check its function |

| Item # | Check points | Action |
|---|---|---|
| 6 | Hydraulic function | Check its function |
| 7 | Running time | Inform your supervisor if your truck is ready for a scheduled maintenance check. See **"Maintenance"** page 62. |
| 8 | Hydraulic system | Check for oil leakage, hoses, and floor |
| 9 | Drive unit | Inspect abnormal noises and leakage |
| 10 | Wheels | Check for damage, remove oil, metal chips, and debris |
| 11 | Chassis | Check for damage, remove dirt and debris |
| 12 | Battery | Check acid level, charge, and condition (see battery maintenance) |
| 13 | Battery cables and connections | Check for breakage, cutting, or damage |
| 14 | Fork carriage | Check the locking and for damage and wear |
| 15 | Lifting device | Check for damage and alignment of forks |
| 16 | Hydraulic cylinder | Check for damage and leakage |
| 17 | Key switch (toggle) | Check its function |
| 18 | Master control on/off switch | Check its function |
| 19 | Covers / guards | Check for damage, ensure placement |

If any of the functions fail to operate properly, inform your supervisor or maintenance personnel to have the truck repaired.

## Special equipment

Your truck may have been fitted with optional or special equipment that requires a routine check. To ensure safe operation consult with your supervisor and your **Toyota® Dealer** about routine checks.

# Maintenance

## General information

- Under normal conditions ensure that truck is given a regular maintenance service. See "Maintenance chart" on page 62. The truck's safety, efficiency, and service life is dependent on the service and maintenance it is given.
- Only use **Toyota** approved spare parts when service or repair work is carried out.
- **Toyota** recommends that you contact your **Toyota® Dealer** to set up a service and maintenance agreement to ensure your truck is operating efficiently and safety.

## Safety regulations with maintenance work

- Only personnel that have been trained in the service and repair of this type of truck are authorized to carry out service and repair work.
- Do not carry out any maintenance work on the truck unless you have the correct training and knowledge to do so.
- Keep the area where you carry out service clean. Oil or water makes the floor slippery.
- Never wear loose objects or jewelry when working on the truck.

> ⚠ **WARNING** When working with the truck's electrical system, short circuiting/burns can occur if a metal object comes into contact with live electrical connections. Remove watches, ring or other types of metal jewelry.

- Always switch **OFF** the truck's power supply before opening the covers on the drive unit or electrical systems.
- Always disconnect the battery by pulling out the battery

connector when carrying out maintenance work on the truck unless otherwise stated in this publication or the **Service Manual**.

- Relieve the system pressure slowly before starting work on the truck's hydraulic systems.
- Use paper or a rigid sheet of cardboard when checking for oil leakage. **Never** use your hand.
- Bear in mind that the oil in the transmission or the hydraulic system can be **hot**.

> ⚠ **WARNING** Risk of burns.
> Hot transmission and hydraulic oil.
> Let the truck cool before changing the oil.

- Only fill the hydraulic system with new, clean oil which meets cleanliness specification See "Lubrication chart" on page 66. Contact your **Toyota® Dealer** for assistance or more information.

> ⚠ **WARNING** The hydraulic components can be damaged if different hydraulic fluids are used. Always use the same type of hydraulic fluid when filling or changing fluid in the hydraulic system.

- Store and dispose of changed oil in accordance with local regulations.
- **Do not** dump cleaning solution, which are used for cleaning/washing, into drains that are not intended for this purpose. Follow the local regulations that apply for disposal.
- When working underneath the truck support the truck on trestle-blocks.

> ⚠ **WARNING** Risk of crushing.
> A badly supported truck can fall.
> Never work under a truck that is not supported on blocks and secured by a lifting device.

**Maintenance work that can be carried out by the operator**

The **Daily service/Safety checks** as set out in the check list.

Maintenance points with intervals **1 day**, **1 week**, and **1 month** as set out in the **Maintenance chart** may be carried out by the operator with the knowledge provided by the **Operator's Manual**, See "Maintenance chart" on page 62.

Other maintenance points as set out in the **Maintenance chart** may only be carried out by personnel who have completed maintenance training for this type of truck.

**Maintenance work that can be carried out by trained maintenance personnel.**

All maintenance points as set out in the **Maintenance chart**.

If uncertain regarding working procedures, consult the **Service Manual** for the truck.

**Other service and repair work**

- In addition to the maintenance points in the Maintenance chart, all service and repair work should be carried out by personnel with special training for this type of truck.

## Cleaning and washing

### General

- Cleaning and washing the truck is important to ensure the truck will operate safely and reliably.
- Carry out general cleaning and washing weekly.

| | |
|---|---|
| **NOTE!** | Disconnect the battery before washing by pulling out the battery connector. Do not spray water directly into the electrical compartments of the truck. |

### External cleaning

- Remove debris, etc. from the wheels daily.
- Use a degreasing agent diluted to a suitable concentration.
- Rinse off loose grime using warm water.

| | |
|---|---|
| **NOTE!** | Mechanical components can be damaged. After washing, the truck should be lubricated as set out in the chapter Maintenance/Lubrication chart page 62. |

### Cleaning motor compartment

- Cover the electric motors, electrical compartments, connectors, and valves before washing.
- Clean carefully using the minimum of water and detergent. **Never pressure wash** or **steam clean** in the electrical compartments.

| | |
|---|---|
| **NOTE!** | Risk of short-circuiting.<br>The electrical system can be damaged.<br>Electrical components must not be cleaned with a high pressure washing unit. |

- Clean the motor compartment using a well-know degreasing agent, diluted to a suitable concentration.
- Rinse off loose grime using tepid water.

**Electrical components**

- Blow electric motors dry using compressed air.

> ⚠ **WARNING** Compressed air used for cleaning **MUST** be reduced to less than 30 psi [206 kPa], and then only with effective chip-guarding and personal protective equipment.

- Clean the electrical panels, electronic boards, contacts, connector, solenoid valves, etc. using a damp cloth and a cleaning agent.
- **Do not spray or pressure wash** in the compartment.

> **NOTE!** Do not break the warranty seal on the electronic board.

## Maintenance chart

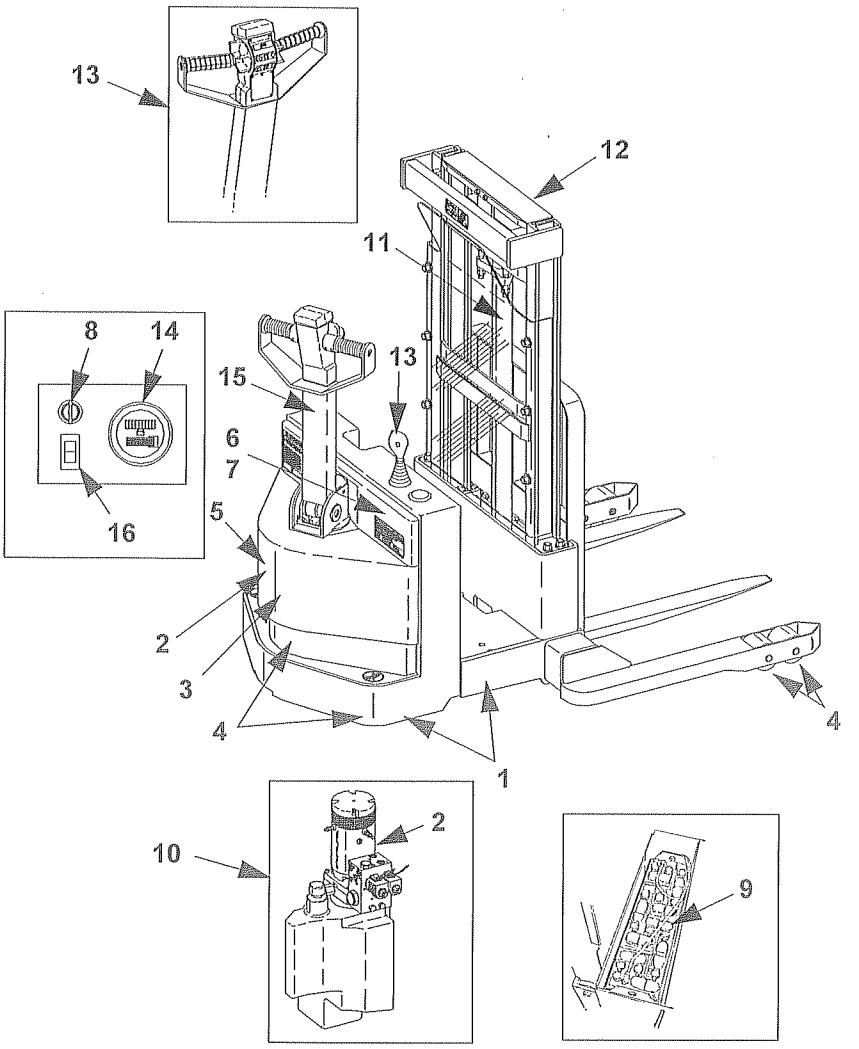
Planned Maintenance Interval:

A=8 Hours or 1 Day
B=30 Hours or 1 Week
C=120 Hours or 1 Month
D=360 Hours or 3 Months
E=720 Hours or 6 Months
F=1440 Hours or 12 Months
G=4320 Hours or 36 Months

| No. | Action | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| 1.0 | Chassis | | | | | | | |
| 1.1 | Check that the truck's data plate and decals are legible | X | | | | | | |
| 1.2 | Check the cover screws | | | | | X | | |
| 1.3 | Check door lock | | | | | X | | |
| 1.4 | Check for damage and crack formation | | | | | X | | |
| 1.5 | Check fork frame mounting | | | | | X | | |
| 2.0 | Motors | | | | | | | |
| 2.1 | Check for loose connections | | | | | X | | |
| 2.2 | Clean motor | | | | | X | | |
| 2.3 | Check mounting bolts | | | | X | | | |
| 2.4 | Check for abnormal bearing noise | | | | | X | | |
| 2.5 | Check brush wear | | | | | X | | |
| 3.0 | Drive unit | | | | | | | |
| 3.1 | Check for leakage | | | | | X | | |
| 3.2 | Check oil level | | | | | X | | |
| 3.3 | Check for noises | | | | | X | | |
| 3.4 | Check the mounting on support | | | | X | | | |
| 4.0 | Wheels | | | | | | | |
| 4.1 | Remove string and debris | X | | | | | | |
| 4.2 | Check all wheels for wear | X | | | | | | |
| 4.3 | Check that all wheels rotate and axles are fitted correctly | | | | | X | | |
| 4.4 | Check all wheels for loose screws | | | | | X | | |
| 4.5 | Grease load wheel bearings | | | | X | | | |
| 4.6 | Grease caster and caster wheels | | | | X | | | |
| 4.7 | Dismantle and lubricate all wheel bearings. | | | | | | | X |
| 5.0 | Brake | | | | | | | |
| 5.1 | Clean dust and debris | | | X | | | | |
| 5.2 | Check shoes and discs for wear | | | | | X | | |
| 5.3 | Check correct clearance brake | | | | | X | | |

| No. | Action | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| 5.4 | Check brake operation | X | | | | | | |
| 6.0 | Electrical panel | | | | | | | |
| 6.1 | Clean and check the mounting | | | | | X | | |
| 6.2 | Tighten cable connections | | | | X | | | |
| 6.3 | Check contactor tips | | | | | X | | |
| 6.4 | Check the contactor tips for free movements | | | | | X | | |
| 6.5 | Check all cable insulation for damage | | | | | X | | |
| 7.0 | Electronic card | | | | | | | |
| 7.1 | Check for connections in harness connectors | | | | | X | | |
| 8.0 | Electronic control system | | | | | | | |
| 8.1 | Check key switch (toggle) | X | | | | | | |
| 8.2 | Check brake switch | | | | | X | | |
| 8.3 | Check control wiring harness for proper routing | | | | | X | | |
| 9.0 | Battery | | | | | | | |
| 9.1 | Check electrolyte level, 1/2 -5/8 inch (10-15 mm above cell plate) | | X | | | | | |
| 9.2 | Check the connections on battery, truck, and charger | | X | | | | | |
| 9.3 | Check all cells and pole guards | | | X | | | | |
| 9.4 | Check the fluid density and temperature | | | X | | | | |
| 9.5 | Check power cables are not cut or frayed | X | | | | | | |
| 10.0 | Hydraulic system | | | | | | | |
| 10.1 | Check hoses and connections for leakage | | | | | X | | |
| 10.2 | Check hoses for wear and damage | | | | | X | | |
| 10.3 | Check oil tank for cracks, leaks, and mounting | | | | | X | | |
| 10.4 | Check oil level | | | | | X | | |
| 10.5 | Change oil | | | | | | X | |
| 11.0 | Cylinders | | | | | | | |
| 11.1 | Check for leakage | | | | | X | | |
| 11.2 | Check the mountings | | | | | X | | |
| 12.0 | Mast carriage | | | | | | | |
| 12.1 | Check for damage and cracks | | | | | X | | |
| 12.2 | Check mast mounting bolts torque | | | | | X | | |
| 12.3 | Check for play on rollers | | | | | X | | |
| 12.4 | Check the electrical limit switch function | X | | | | | | |

| No. | Action | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| 12.5 | Check for wear and stretch on the chains and sheaves | | | | | X | | |
| 12.6 | Check hoses and couplings for leakage, cuts, and other damage | | | | | X | | |
| 12.7 | Check for wear to the forks and other lifting devices | | | | | X | | |
| 12.8 | Lube all grease fittings | | | | X | | | |
| 13.0 | Controls | | | | | | | |
| 13.1 | Check handle mounting | X | | | | | | |
| 13.2 | Check the handle brake switch | X | | | | | | |
| 13.3 | Check travel direction/speed control | X | | | | | | |
| 13.4 | Check horn button function | X | | | | | | |
| 13.5 | Check hydraulic button functions | X | | | | | | |
| 13.6 | Check the reverser switch | X | | | | | | |
| 13.7 | Check hydraulic manual control lever functions | X | | | | | | |
| 14.0 | Gauge | | | | | | | |
| 14.1 | Check dash display | X | | | | | | |
| 15.0 | Brake levers | | | | | | | |
| 15.1 | Check parking brake lever | X | | | | | | |
| 15.2 | Check that the control handle returns to the upright position with parking brake applied | X | | | | | | |
| 16.0 | Master control on/off switch | | | | | | | |
| 16.1 | Check the function of switch | X | | | | | | |

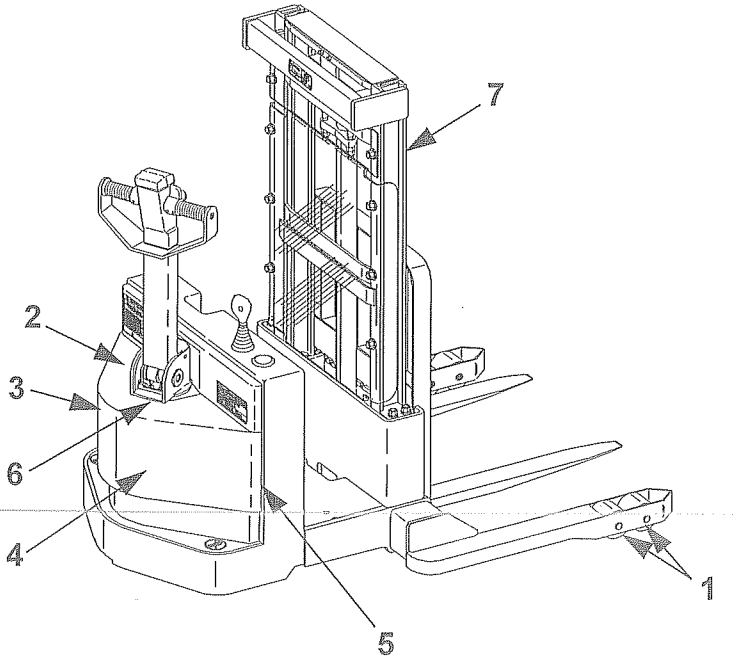



Maintenance chart drawing

## Lubrication chart

| Pos No. | Service point | Interval/Running hours | | | Lubricant See "Approved Oils and Grease" on page 67. |
|---|---|---|---|---|---|
| | | 720h | 1440h | 4320h | |
| 1 | Wheel bearings | | | L | A |
| 2 | Hydraulic system | C | O | | B |
| 3 | Parking brake | C | | | |
| 4 | Drive gear | C | | O | C |
| 5 | Hinges | | L | | D |
| 6 | Steering bearings | | L | | A |
| 7 | Mast | L | | | E |

L=Lubrication C=Check O=Oil change



# Approved Oils and Grease

| Specification | | | | |
|---|---|---|---|---|
| Location | Lubricant | Standard and Corrosion | Cold Storage | Application area |
| | | Continuous Operation Above 23°F [-5°C] | Continuous Operation To 5°F [-15°C] Intermittent Operation To -13°F [-25°C] | |
| A | Grease | Mystik JT-6 | | Bearings and bushings |
| B | Hydraulic oil | Sunoco TH | ATF | Hydraulic system |
| C | Transmission oil | SAE 80W | | Gears |
| D | Motor oil | #10 W 40 | | Chains, springs, hinges |
| E | Grease | 00590-41420-71* Molykote 00590-41422-71* | | Mast columns, Reach, Sideshift |

* Refer to section 10000 of Parts Book for special lubricants.

| Environmental Definitions | |
|---|---|
| **Standard** | The standard truck conditioning is designed for operation in temperatures down to 23° F (-5° C). |
| **Corrosion** | The corrosion conditioning specification is designed for operation in environments with standing water, high humidity, limited brine or salt solution exposure, food processing, or frequent wash downs. |
| **Cold Storage Continuous Operation** | The truck should be completely dry before beginning operation in the cold storage area and should be parked inside the cold storage for operator breaks. Charging and maintenance work must be carried out in normal ambient temperatures above freezing. The truck must be completely dry before resuming operation in cold storage area. |
| **Cold Storage Intermittent Operation** | The truck will experience some surface condensation as part of the normal work cycle. In "wet" conditions, the truck should **neither** remain idle in the cold storage area for longer than 10 minutes nor operate inside cold storage for extended periods. **Condensation must not be allowed to freeze on the truck at any time.** When not in use due to operator breaks, charging, or maintenance work, the truck should be parked outside of the cold storage area. |
| **Freezer Condition** | The freezer conditioning specification is designed for continuous operation in freezers operating down to -31° F (-35° C). The truck must be parked inside the freezer for operator breaks during the shift. The truck should stay in the freezer during battery change or battery charging. If the truck is removed from the freezer for maintenance work or battery charging, it must be completely dry before re-entering the freezer. |
| **For more in-depth description see the Master Service Manual for this model** | |

# Transporting and storing the truck

## The truck's dimensions and weight as standard

**NOTE!** The truck's weights and measurements are only estimates and can very on trucks with different accessories. Consult your truck's data plate for specific information.

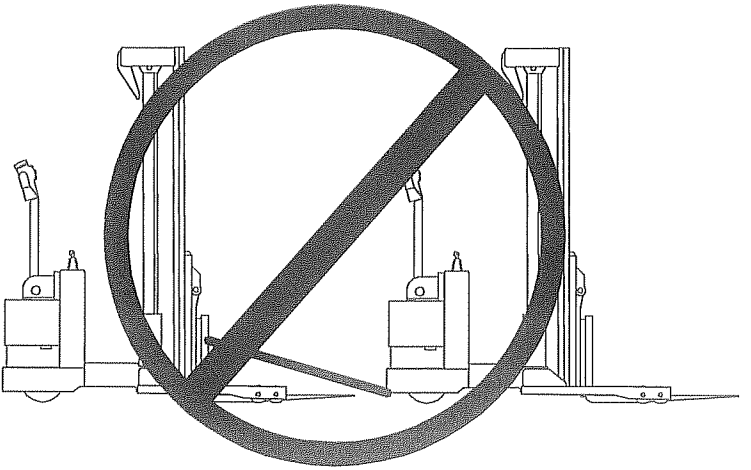
**Truck's dimensions and weight**

| Truck data | 6BWS11 | 6BWS15 | 6BWS20 |
|---|---|---|---|
| Height (with out mast) | 60 inch (1524 mm) | | |
| Width (Plus outrigger widths) | 34.1 inch (866 mm) | | |
| Length (with out forks) | 67.0 inch (1702 mm) | 71.3 inch (1811 mm) | |
| Minimum battery weight | 290 lb [131.5 kg] | 980 lb [444.5 kg] | 980 lb [444.5 kg] |
| Truck weight (less battery) | Approximately 2500 lb | | |

## Towing and transporting a disabled truck

> **WARNING** **DO NOT** tow a disabled truck.

It is not recommended to tow a disabled lift truck.



## Storing the truck

Take the following action if the truck is not used for **one week** or more:

### Battery

- Recharge the battery fully and carry out usual battery maintenance.
- Maintenance charge the battery every **3rd month** and check the fluid level.

### Hydraulic system

- Change the oil in the hydraulic system when stored for periods longer then **1 year**. See the oil specification in the section **Maintenance and lubrication chart**.

### Drive unit

- Block up the truck's drive section to take the load off the drive wheel and load wheels when storing for periods longer than **one week**.

## Starting after a period of disuse

- Before the truck is put into operation after a period of disuse it should undergo a function and safety check as stated in the section **Daily service/safety checks**.

When stored for a period **greater** then **3 months** carry out preventive maintenance as stated in the "Maintenance chart" on page 62

## APPENDIX A, Selected OSHA regulations

The use of forklift trucks in the workplace is governed by various regulations. In the United States, the Department of Labor Occupational Safety and Health Administration (OSHA) has issued regulations which cover the majority of workplaces. In addition, several states have implemented regulations which apply instead of the Department of Labor regulations. Check with your local OSHA office or provincial Labor Bureau to confirm which regulations govern your workplace. Because of their wide applicability, this section of your manual lists several parts of the Department of Labor OSHA regulations which may be of particular importance to your workplace. The full text of the Department of Labor regulations may be found in the Code of Department of Labor Regulations at 29 CFR Section 1910.178. The selections cited below and on the next page are followed by a reference to the appropriate subparagraph of the regulations.

- Modifications and additions which affect capacity and safe operation shall not be performed by the customer or user without manufacturers prior written approval. Capacity, operation and maintenance instruction plates, tags or decals shall be changed accordingly. (a) (3)
- The user shall see that all nameplates and markings are in place and are maintained in a legible condition. (a) (6)
- The employer shall ensure that each powered industrial truck operator is competent to operate a powered industrial truck safely, as demonstrated by the successful completion of the training and evaluation specified in this paragraph. (l) (1) (i)
- Prior to permitting an employee to operate a powered industrial truck (except for training purposes), the employer shall ensure that each operator has successfully completed the training required by this paragraph. (l) (1) (ii)

- Trainees may operate a powered industrial truck only under the direct supervision of persons who have the knowledge, training, and experience to train operators and evaluate their competence and where such operation does not endanger the trainee or other employees. (l) (2) (i) (A) (B)
- Training shall consist of a combination of formal instruction (e.g. lecture, discussion, interactive computer learning, videotape, written material), practical training (demonstrations performed by the trainer and practical exercises performed by the trainee), and evaluation of the operator's performance in the workplace. (l) (2) (B) (ii) (**Editorial Note:** For required Training program content, refer to (l) (3) (i) (A-M) and (l) (3) (ii) (A-l).)
- Refresher training, including an evaluation of the effectiveness of that training, shall be conducted as required by paragraph (l) (4) (ii) to ensure that the operator has the knowledge and skills needed to operate the powered industrial truck safely. (l) (4) (i)
- An evaluation of each powered industrial truck operator's performance shall be conducted at least once every three years. (l) (4) (iii)
- The employer shall certify that each operator has been trained and evaluated as required by this paragraph (l). The certification shall include the name of the operator, the date of the training, the date of the evaluation, and the identity of the person(s) performing the training or evaluation. (l) (6)
- The employer shall prohibit arms or legs from being placed between the uprights of the mast or outside the running lines of the truck. (m) (4)
- Brakes shall be set and wheel blocks shall be in place to prevent movement of trucks, trailers or railroad cars while loading or unloading. Fixed jacks may be necessary to

support a semitrailer when the trailer is not coupled to a tractor. The flooring of trucks, trailers, and railroad cars shall be checked for breaks and weakness before they are driven into. (m) (7)

- Only approved industrial trucks shall be used in hazardous locations. (m) (11)
- All traffic regulations shall be observed, including authorized plant speed limits. A safe distance shall be maintained approximately three truck lengths from the truck ahead, and the truck shall be kept under control at all times. (n) (1)
- The driver shall be required to slow down and sound the horn at cross aisles and other locations where vision is obstructed. If the load being carried obstructs forward view, the driver shall be required to travel with the load trailing. (n) (4)
- Under all travel conditions the truck shall be operated at a speed that will permit it to be brought to a stop in a safe manner. (n) (8)
- Stunt driving and horseplay shall not be permitted. (n) (9)
- If at any time a powered industrial truck is found to be in need of repair, defective, or in any way unsafe, the truck shall be taken out of service until it has been restored to safe operating condition. (p) (1)
- Any power-operated industrial truck not in safe operating condition shall be removed from service. All repairs shall be made by authorized personnel. (q) (1)
- All parts of any such industrial truck requiring replacement shall be replaced only by parts equivalent as to safety with those used in the original design. (q) (5)
- Industrial trucks shall be examined before being placed in service, and shall not be placed in service if the

examination shows any condition adversely affecting the safety of the truck. Such examination shall be made at least daily. Where powered industrial trucks are used on a round-the-clock basis, they shall be examined after each shift. Defects when found shall be immediately reported and corrected. (q) (7)

# Appendix B, Battery

## General

Battery must be secured in its intended compartment make sure battery cannot move more then 0.5 inch (12.7 mm) in any horizontal direction. Shim or block to restrain the battery. The battery shall have a weight that corresponds with the value stated on the truck's data plate.

## Type of battery

- Check that the battery used in this truck is the correct voltage and type as shown on the truck's data plate. Use a traction battery having a weight within the minimum/ maximum values stated on the data plate.

## Changing the battery

- Only replace the battery with a battery of the same weight as the original. The battery weight affects the truck's stability and its braking capacity. Information on the lowest permitted battery weight can be found on the truck's data plate

| | |
|---|---|
| ⚠ **WARNING** | Risk of moving the center of gravity.<br>A battery weight that is too low gives impaired stability and braking capacity.<br>The battery weight must be in accordance with the information on the truck's data plate. |

## When changing the battery proceed as follows:

- Park truck at battery removal station.
- Turn OFF key and remove.

- Push the master control on/off switch to the **OFF** position to stop hourmeter from running.
- Disconnect the battery connector from the battery.
- Remove battery stops.
- Slide out the discharged/old battery, then slide in the new battery.
- Connect battery and truck connectors.
- Connect the battery connector and truck connector.

| | |
|---|---|
| **NOTE!** | The cables can be damaged and cause a short-circuit. Ensure the battery cables are not crushed. |

- Push the master control on/off switch to the **ON** position.
- Install battery stops.

| | |
|---|---|
| ⚠ **WARNING** | If the truck should tip over the battery can fall out if the battery stops have not been installed. Make sure the battery stops have been installed. |

| | |
|---|---|
| ⚠ **WARNING** | When changing the battery, it can be dropped. Always lift battery using an approved lifting device, and use a battery yoke intended for the battery. |

## Charging the battery

### General prohibition

When recharging the battery it is absolutely forbidden to smoke or use an open flame.

Use an automatic charger intended for recharging traction batteries.

The charger must have an automatic maintenance charging feature for a certain period after the main charging period has been completed. This eliminates the risk of over charging the battery and the need to monitor the charging procedure is reduced to a minimum.

The charger shall have a minimum charging current of:

| Battery (Ah) | Charger (A) |
|---|---|
| 300-480 | 50-70 |
| 480-730 | 80-110 |
| 730-900 | 130-150 |

**⚠ WARNING** The battery fluid contains sulfuric acid. Fluid spilled on skin should be rinsed OFF immediately. Wash thoroughly with soap and water.
If the fluid has come into contact with the eyes, wash the eyes immediately using an eye shower. Contact a doctor.

**ALWAYS WEAR PROTECTIVE GLASSES AND PROTECTIVE GLOVES WHEN CHECKING THE BATTERY.**

## Pre-charging

- Park the truck in the assigned charging area.
- Ensure nothing prevents ventilation above the battery.
- Turn key switch to the **OFF** position.
- Remove the battery connector from the truck's connector.
- Make sure the battery charger is switched **OFF**.
- Connect the **battery connector to charger** connector.
- **Never** connect charger connector to truck connector.
- Switch **ON** the battery charger.

> ⚠ **WARNING** During the charging process, oxygen and hydrogen gases are always formed in the battery.
> Short circuits, open flames, and sparks in the vicinity of the battery can cause an **EXPLOSION**.
> Always switch **OFF** the charger current **BEFORE** removing the battery connector.
> Provide good ventilation, especially if the battery is recharged in a confined area.

## During charging

- After approximately ten minutes make sure that the ammeter indicates a normal reading and that the control lamp is **ON**.

### After charging

- Make sure that the ammeter indicates an insignificant or no reading and that maintenance charge lamp is **ON**, if equipped.
- Switch **OFF** the charger.
- Disconnect the battery connector from charger connector.

| | |
|---|---|
| **NOTE!** | The terminals can otherwise be damaged inside and result in a subsequent short circuit. Do not pull the cables to disconnect from the charger. |

## Battery maintenance

Carry out battery maintenance after recharging.

| | |
|---|---|
| ⚠ **WARNING** | The battery fluid contains sulfuric acid. Fluid spilled on skin should be rinsed OFF immediately. Wash thoroughly with soap and water. If the fluid has come into contact with the eyes, wash the eyes immediately using an eye shower. Contact a doctor. |

**ALWAYS WEAR PROTECTIVE GLASSES AND PROTECTIVE GLOVES WHEN CHECKING THE BATTERY.**

### Each week:

- Remove all cell caps.

| | |
|---|---|
| **NOTE!** | This does not apply to batteries with level caps or central filling. |

- Check the fluid level in the cells and note any cells that consume more than a normal amount of fluid.
- Fill using distilled water. The fluid level should be 0.25 inch (10-15 mm) above the cell plates.
- Refit all of the cell caps.
- Rinse off and dry the battery.

**Each month:**

- Measure the temperature in one of the center cells immediately after charging. The temperature should not exceed 122°F (50°C).
- Measure the density of the battery fluid using an acid tester. Hold the acid tester absolutely vertical and extract sufficient fluid so that the hydrometer float moves freely.
- Adjust specific gravity with temperatures based on the chart below.

| Temperature | Gravity |
|---|---|
| 77°F (25.2°C) | 1.280 |

**⚠ WARNING** Battery manufactures maintenance and charging procedures must be followed. Battery acid is very corrosive and must be immediately cleaned up after spillage.

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TOYOTA
MATERIAL HANDLING U.S.A.

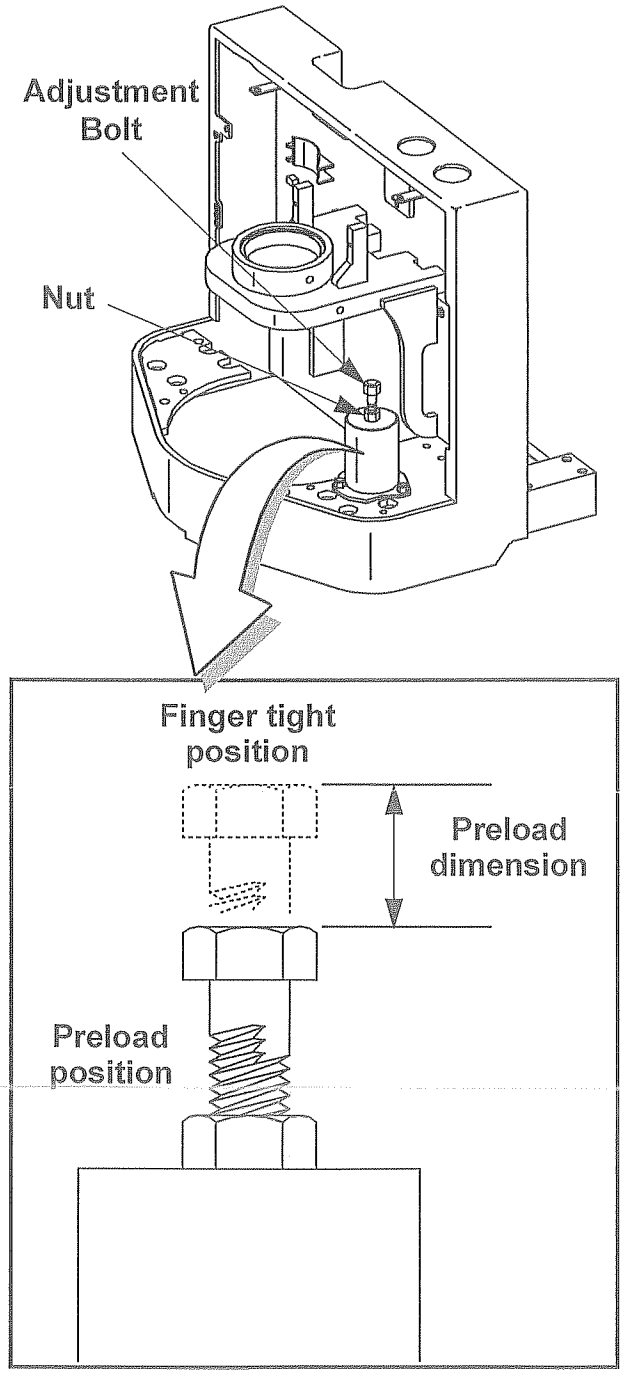
September 03, 2002
Instructions Sheet # 00590-42195-71

# IMPORTANT:

This truck has been delivered with no caster spring preload. This preload will reduce the required steering effort.

**Adjust the preload as follows:**

1. Install correct battery (refer to the Data Plate on truck).
2. With the battery unplugged, locate the spring adjustment bolt inside the truck, to the right of the transmission.
3. Loosen locking nut and tighten adjustment bolt until you feel the bolt contact spring retainer.
4. Tighten the adjustment bolt further according to the table below, compressing the spring.
5. Holding adjustment bolt, tighten locking nut to secure both.




| Spring Compression Settings | | |
|---|---|---|
| **Model** | **Mast** | **Preload dimension** |
| 6BWS10 | All | 1.15 inch (29 mm) |
| MWH15C | All | 1.4 inch (35 mm) |
| 6BWS20 | All | 1.4 inch (35 mm) |
| 6BWS11 | 2 Stage | 1.15 inch (29 mm) |
| 6BWS11 | 2 Stage 95/150<br>2 Stage 95/152 | 1.4 inch (35 mm) |
| 6BWS11 | 3 Stage | 1.4 inch (35 mm) |
| 6BWS15 | 2 Stage | 1.15 inch (29 mm) |
| 6BWS15 | 2 Stage 95/150<br>2 Stage 95/152 | 1.4 inch (35 mm) |
| 6BWS15 | 3 Stage | 1.4 inch (35 mm) |
| 6BWS20 | 2 Stage 71/100 | 1.15 inch (29 mm) |
| 6BWS20 | 2 Stage | 1.4 inch (35 mm) |
| 6BWS20 | 3 Stage | 1.4 inch (35 mm) |
| 6BWR15 | All | 1.4 inch (35 mm) |

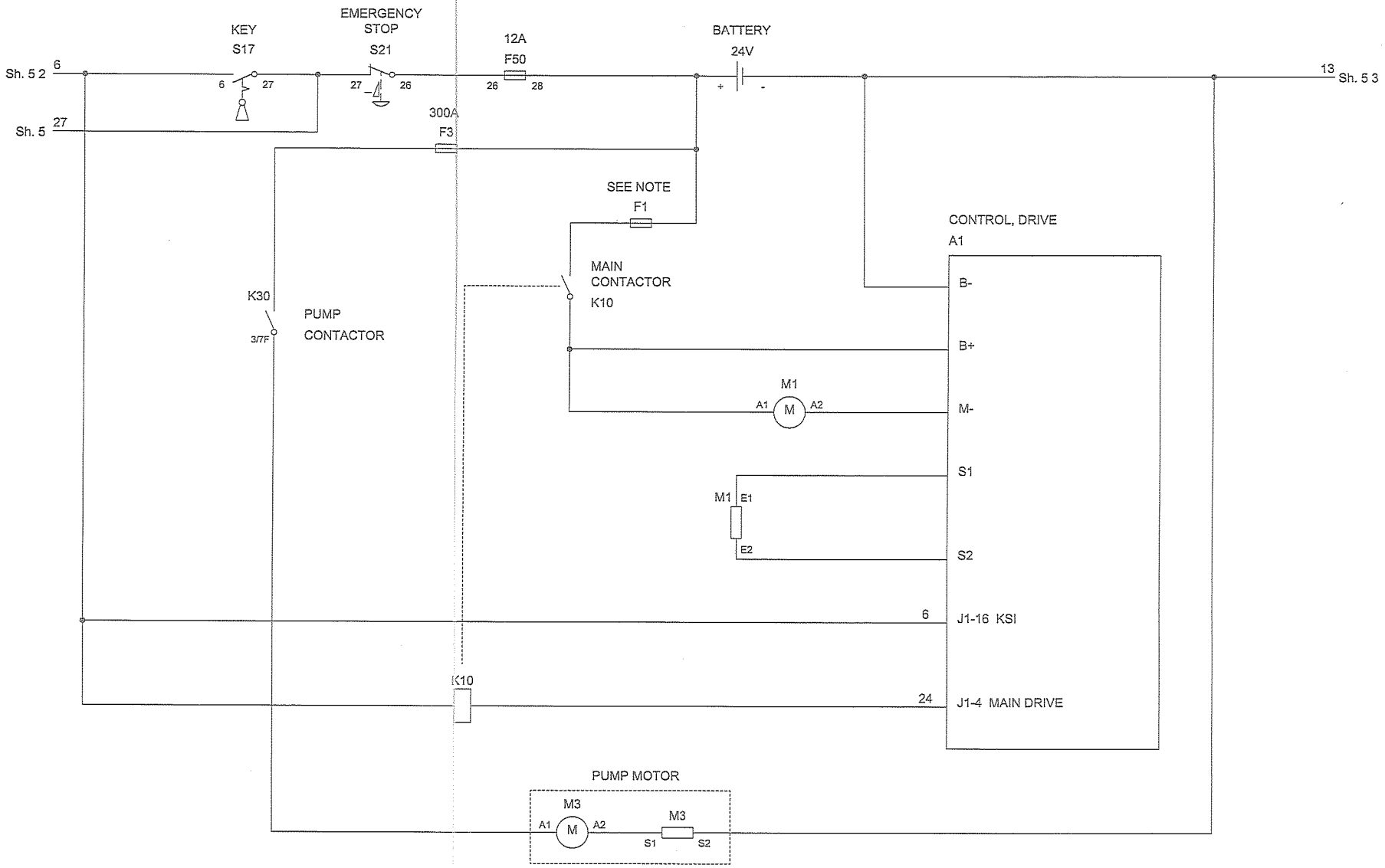
Please refer to the service manual for additional information.

## Legend

**Sh.** = Sheet or page of Diagram
**First number** = Previous page wire was found.
**Second number** = Next page wire is found.

**Effective Serial Number**
6BWC10/15/20 20044 - UP
6BWS11/15/20 10093 - UP
6BWR15 30148 - UP

TOYOTA
INDUSTRIAL EQUIPMENT



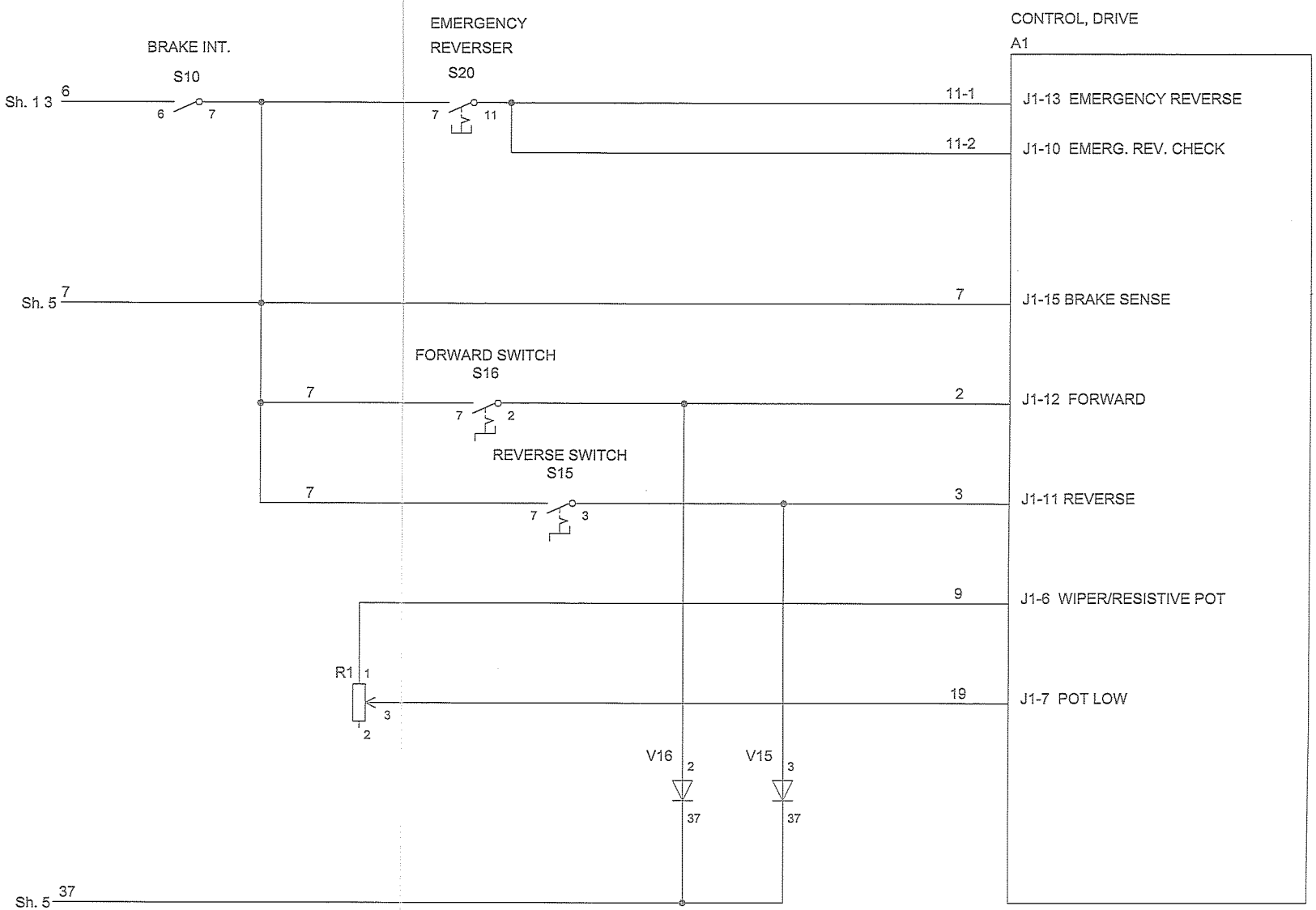

6BWC/6BWS/6BWR Circuit Diagram 1(5)

## Legend

**Sh.** = Sheet or page of Diagram
**First number** = Previous page wire was found.
**Second number** = Next page wire is found.

**Effective Serial Number**
6BWC10/15/20 *20044 - UP*
6BWS11/15/20 *10093 - UP*
6BWR15 *30148 - UP*

TOYOTA
INDUSTRIAL EQUIPMENT




6BWC/6BWS/6BWR Circuit Diagram 2(5)

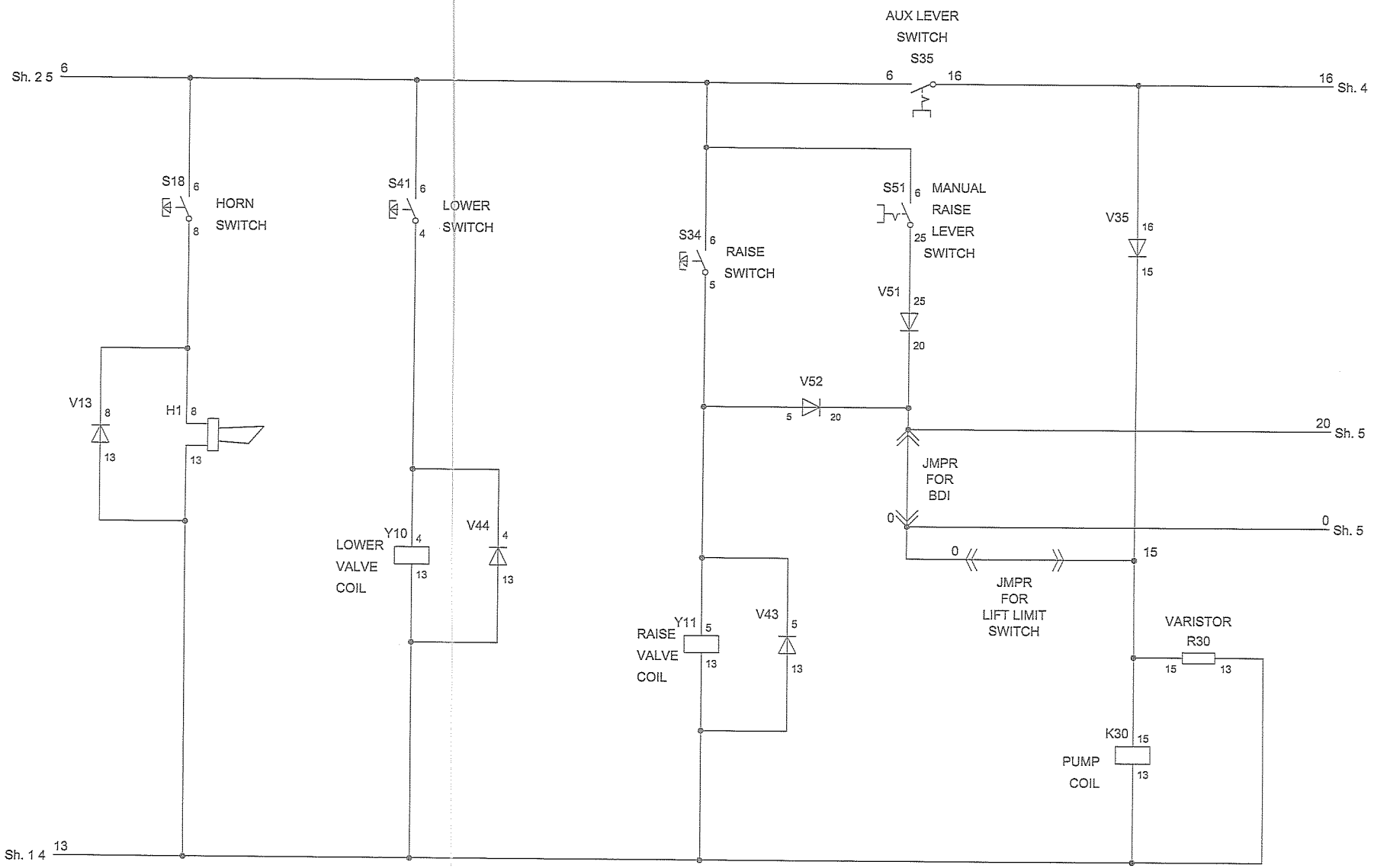
## Legend

**Sh.** = Sheet or page of Diagram
**First number** = Previous page wire was found.
**Second number** = Next page wire is found.

**Effective Serial Number**
6BWC10/15/20 20044 - UP
6BWS11/15/20 10093 - UP
6BWR15 30148 - UP

TOYOTA
INDUSTRIAL EQUIPMENT

# 6BWC/6BWS/6BWR Circuit Diagram 3(5)



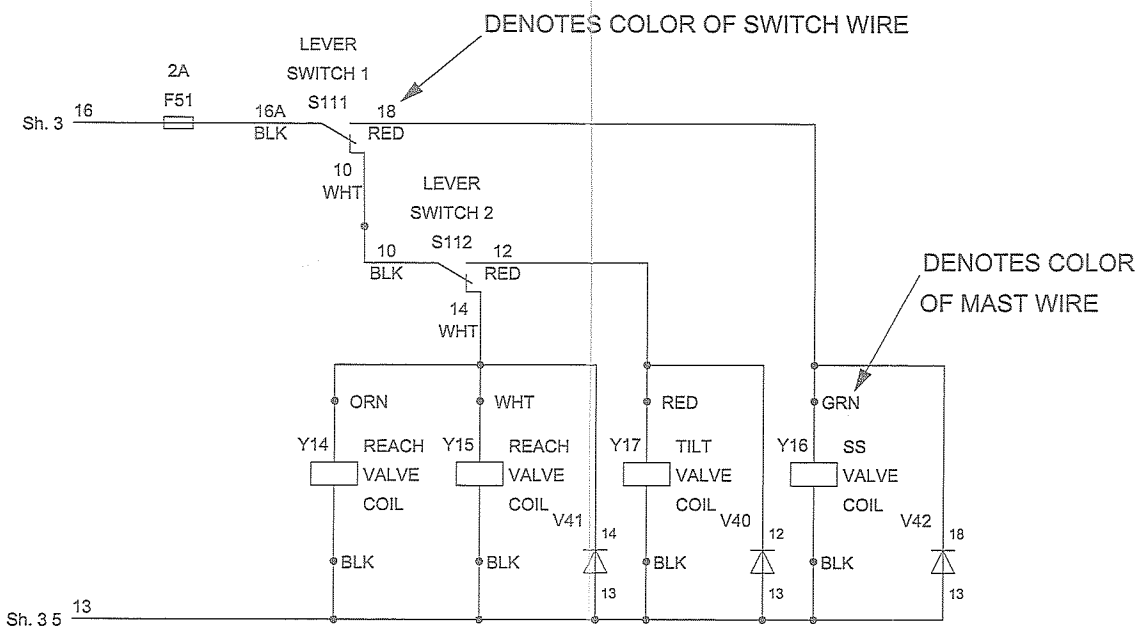
## Legend

**Sh.** = Sheet or page of Diagram
**First number** = Previous page wire was found.
**Second number** = Next page wire is found.

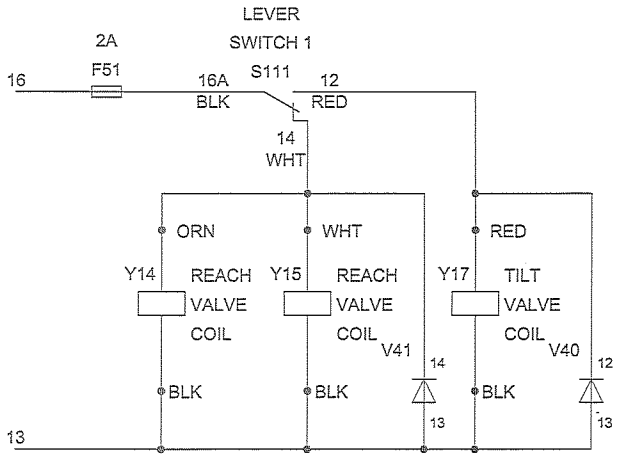
**Effective Serial Number**
6BWC10/15/20 *20044 - UP*
6BWS11/15/20 *10093 - UP*
6BWR15 *30148 - UP*

TOYOTA
INDUSTRIAL EQUIPMENT

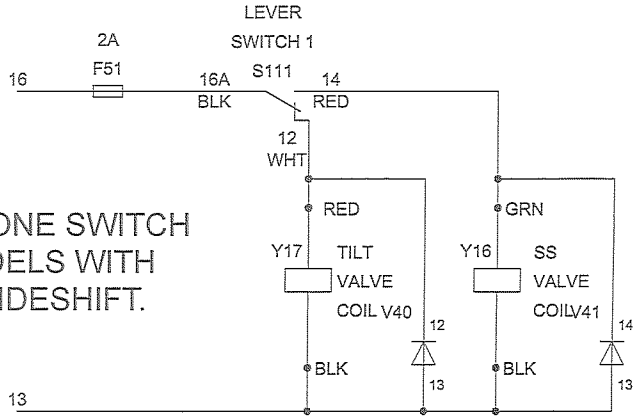
# 6BWC/6BWS/6BWR Circuit Diagram 4(5)




WIRING FOR TWO SWITCH LEVER MODELS WITH REACH, TILT, AND SIDESHIFT.




WIRING FOR ONE SWITCH LEVER MODELS WITH REACH AND SIDESHIFT.



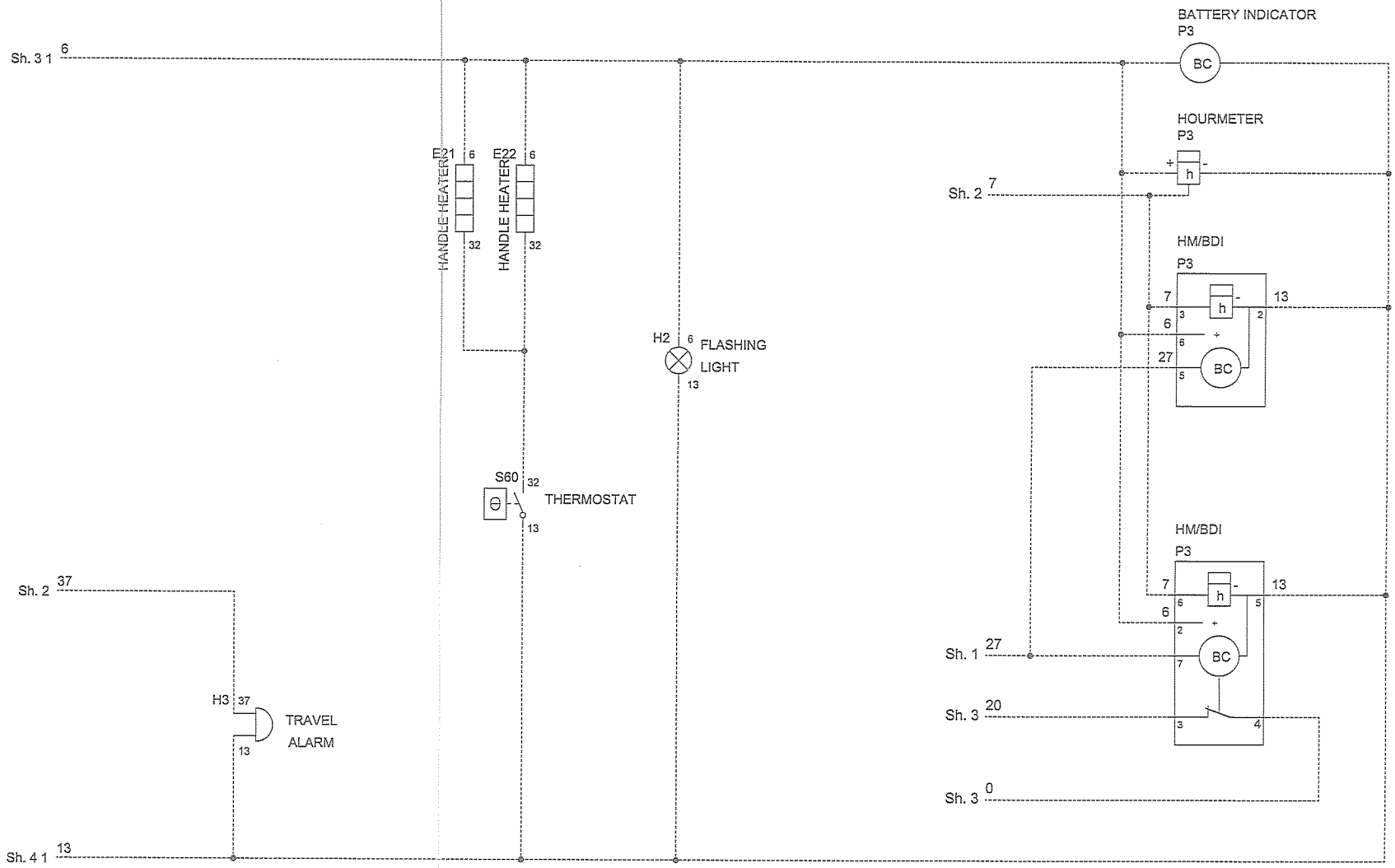

WIRING FOR ONE SWITCH LEVER MODELS WITH TILT AND SIDESHIFT.

## Legend

**Sh.** = Sheet or page of Diagram
**First number** = Previous page wire was found.
**Second number** = Next page wire is found.

**Effective Serial Number**
6BWC10/15/20 20044 - UP
6BWS11/15/20 10093 - UP
6BWR15 30148 - UP

TOYOTA
INDUSTRIAL EQUIPMENT




***Note:*** **This page shows optional Cold Storage / Freezer components.**

6BWC/6BWS/6BWR Circuit Diagram 5(5)

TOYOTA INDUSTRIAL EQUIPMENT

# List of Symbols

| Symbol | Designation | Function | Remark |
|---|---|---|---|
| A1 | Transistor controller | Drive motor | |
| A2 | Transistor controller | Pump motor | |
| | | | |
| BT | Battery | | 24V |
| | | | |
| E21 | Heater | Handle | |
| E22 | Heater | Handle | |
| F1 | Fuse | Drive motor | 105A - 6BWC10, 6BWR15, 6BWS11/15/20<br>150A - 6BWC15/20 |
| F3 | Fuse | Pump motor | 300A |
| F50 | Fuse | Control circuit | 12A |
| F51 | Fuse | Lever | 2A |
| | | | |
| H1 | Horn | Alarm | |
| H2 | Flashing light | Light | |
| H3 | Travel | Alarm | |
| | | | |
| K10 | Contactor | Main | |
| K30 | Contactor | Pump motor | |
| | | | |
| M1 | Motor | Drive | |
| M3 | Motor | Pump | |
| | | | |
| P3 | Indicator option | Hourmeter | |
| P3 | Indicator option | Battery Indicator | |
| P3 | Indicator option | Hourmeter/BDI | |
| | | | |
| R1 | Potentiometer | Travel | |
| | | | |
| S10 | Switch | Brake | |
| S15 | Switch | Drive direction | Fork direction |

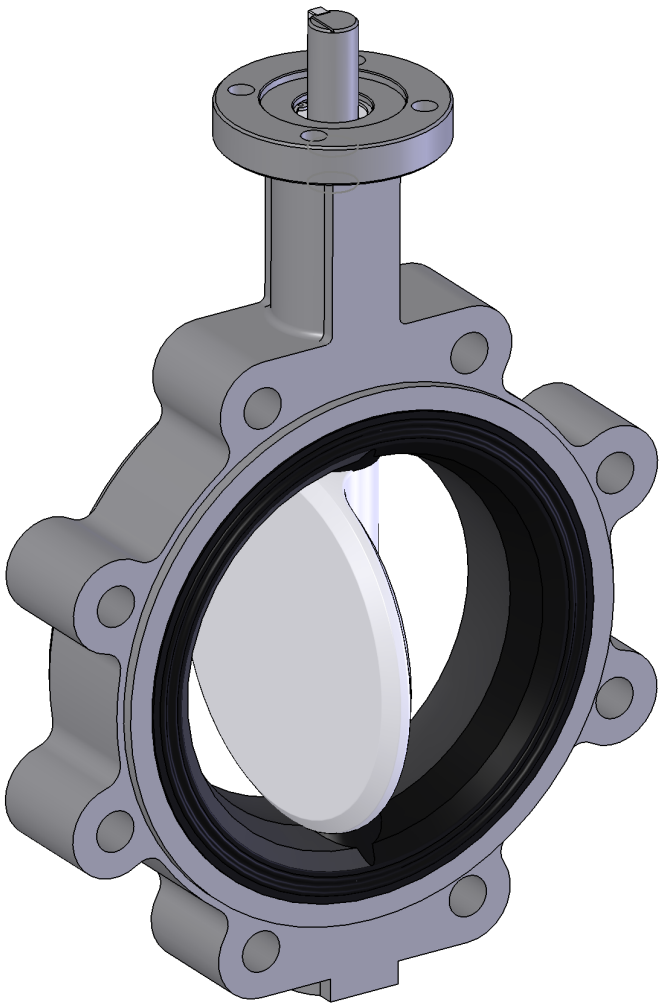
**Effective Serial Number**
6BWC10/15/20 *20044 - UP*
6BWS11/15/20 *10093 - UP*
6BWR15 *30148 - UP*

Effective Serial Number
6BWC10/15/20 20044 - UP
6BWS11/15/20 10093 - UP
6BWR15 30148 - UP

| Symbol | Designation | Function | Remark |
|---|---|---|---|
| S16 | Switch | Drive direction | Steer wheel direction |
| S17 | Switch | Key | |
| S18 | Switch | Horn | |
| S20 | Switch | Emergency reverser | |
| S21 | Switch | Emergency stop | |
| S34 | Switch | Fork lift | |
| S35 | Switch | Auxiliary lever | |
| S41 | Switch | Fork lower | |
| S51 | Switch | Fork lift | Manual lift lever |
| S60 | Switch | Thermostat Heater | |
| S111 | Switch | Lever | |
| S112 | Switch | Lever | |
| | | | |
| V13 | Diode | Horn | |
| V15 | Diode | Travel alarm | |
| V16 | Diode | Travel alarm | |
| V30 | Diode | Pump | |
| V35 | Diode | Auxiliary | |
| V40 | Diode | Tilt | |
| V41 | Diode | Sideshift | |
| V42 | Diode | Sideshift | |
| V43 | Diode | Lift | |
| V44 | Diode | Lower | |
| V51 | Diode | Raise | |
| V52 | Diode | Raise | |
| | | | |
| Y10 | Valve | Lower valve coil | |
| Y11 | Valve | Raise valve coil | |
| Y14 | Valve | Reach valve coil | |
| Y15 | Valve | Reach valve coil | |
| Y16 | Valve | Sideshift valve coil | |
| Y17 | Valve | Tilt valve coil | |

DeZURIK

# DeZURIK 2-20" BOS BUTTERFLY VALVES



Instruction **D10459**
October 2013

DeZURIK | APCO | HILTON | WILLAMETTE

# Instructions

These instructions provide information about BOS Butterfly Valves. They are for use by personnel who are responsible for installation, operation and maintenance of BOS Butterfly Valves.

# Safety Messages

All safety messages in the instructions are flagged with an exclamation symbol and the word Caution, Warning or Danger. These messages indicate procedures that must be followed exactly to avoid equipment damage, personal injury or death.

Safety label(s) on the product indicate hazards that can cause equipment damage, personal injury or death. If a safety label becomes difficult to see or read, or if a label has been removed, please contact DeZURIK for replacement label(s).

**WARNING!**

**Personnel involved in the installation or maintenance of valves should be constantly alert to potential emission of pipeline material and take appropriate safety precautions. Always wear suitable protection when dealing with hazardous pipeline materials. Handle valves, which have been removed from service with suitable protection for any potential pipeline material in the valve.**

## Inspection

Your BOS Butterfly Valve has been packaged to provide protection during shipment, however, it can be damaged in transport. Carefully inspect the unit for damage upon arrival and file a claim with the carrier if damage is apparent.

# Parts

Recommended spare parts are listed on the assembly drawing. These parts should be stocked to minimize downtime.

Order parts from your DeZURIK sales representative, or directly from DeZURIK. When ordering parts, please include the 7-digit part number and 4-digit revision number (example: **9999999R000**) located on the data plate attached to the valve assembly. Also include the part name, the assembly drawing number, the balloon number and the quantity stated on the assembly drawing.

# DeZURIK Service

DeZURIK service personnel are available to install, maintain and repair all DeZURIK products. DeZURIK also offers customized training programs and consultation services.

For more information, contact your local DeZURIK sales representative or visit our website at www.dezurik.com.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# Table of Contents

Description - - -

# Description

The BOS Butterfly Valve is a resilient-seated valve for general industrial applications. Lugged or wafer end connections are offered, with a choice of disc, seat, and shaft materials. Pressure and temperature ratings are shown on the valve data plate.

# Handling

Lifting the valve improperly may damage it. Do not fasten lifting devices to the actuator, disc or through the seat opening in the body. Lift the valve with slings, chains or cables fastened around the valve body, or fastened to bolts or rods through bolt holes in the flanges

# Installation

Refer to the valve installation drawing for dimensional information.

- Installing the valve in the wrong location may cause excessive dynamic torque and damage the valve. Install the valve at least 8 pipe diameters downstream from the nearest pump or elbow.
- Pipeline flow may be in either direction through the valve. For optimum performance, install the valve with the higher pressure on the seat side of the valve (flat side of disc). If possible, install the valve with the shaft horizontal to provide a self-cleaning action on the seat.
- Use pipeline flanges that conform to ASME/ANSI B16.1 Class 125 or ASME/ANSI B16.5 Class 150.
- Mount wafer body valves to the pipeline flanges with either bolts or studs that extend through both flanges:
- Mount lugged body valves to the pipeline flanges with bolts only. Studs are not recommended.

**CAUTION!**

**Lifting a larger size valve incorrectly can damage it. Do not fasten lifting devices to the actuator or disc, or through the seat opening in the body. Lift the valve with slings fastened around the valve body, or attach them to bolts or rods run through holes for the pipeline flanges.**

1. If the valve has been ordered without an actuator, mount the actuator on the valve.
   - For a DeZURIK actuator, refer to the Actuator Instructions.
   - For an actuator other than DeZURIK, the dimensional requirements for the actuator interface are shown on the Installation Drawing for the valve.
2. Before installation, remove all foreign material such as weld spatter, oil, grease, and dirt from the valve, flanges, and pipeline.
3. Open the valve, and clean the seat and the sealing edge of the disc.
4. Place the valve in the pipeline with the valve closed. Handle the valve carefully so that the integral flange sealing surfaces are not scratched or damaged. Do not use gaskets between valve and mating flanges.
5. Ensure that the valve, the pipeline and the mating connections are aligned and centered before tightening the pipeline bolts.
6. Open the valve slowly to ensure that there is adequate clearance between the open disc and the pipeline.
7. Tighten the bolts evenly, in a crisscross pattern.

# Operation

Clockwise rotation of the valve shaft closes the disc into the seat. The valve is fully closed when the flat side of the disc is parallel with the flange sealing surface on the body. The valve is fully open when the disc is 90° counterclockwise from the closed position. A machined flat on the top of the valve shaft corresponds to the flat side of the disc. The machined flat may be used to determine the approximate position of the disc when the disc is not visible.

The valve actuator is connected to the valve shaft, and positions the disc at the open, closed, or intermediate positions. The adjustable open and closed position stops in the valve actuator are set to match the open and closed positions of the valve. Refer to the Actuator Instructions for actuator stop adjustment information.

# Lubrication

The valve is lubricated at the factory, and does not require routine lubrication. Refer to the actuator instructions for actuator lubrication requirements.

If the valve is disassembled, apply a paint-like coating of the below lubricant to the following surfaces (see Figure 1 for each area listed below):

A. The two shaft holes and lip seals in the seat.

B. The area of the seat adjacent to the two shaft holes.

C. The upper shaft seal (A6).

D. The inside diameters of the four shaft bearings (A4, A5 & A12).

E. The chamfer on the bottom end of the shaft (A3).

F. The spline of the shaft (A3).

G. The spline of the disc (A2).

H. The area of shaft just above the spline.

- For oxygen service valves, use Hooker Fluorolube GR-362 (no substitutes are allowed).
- For other valves with EPDM, NBR or FKM seat material, use Dow Corning 111 (no substitutes are allowed).

## Lubrication *(Continued)*

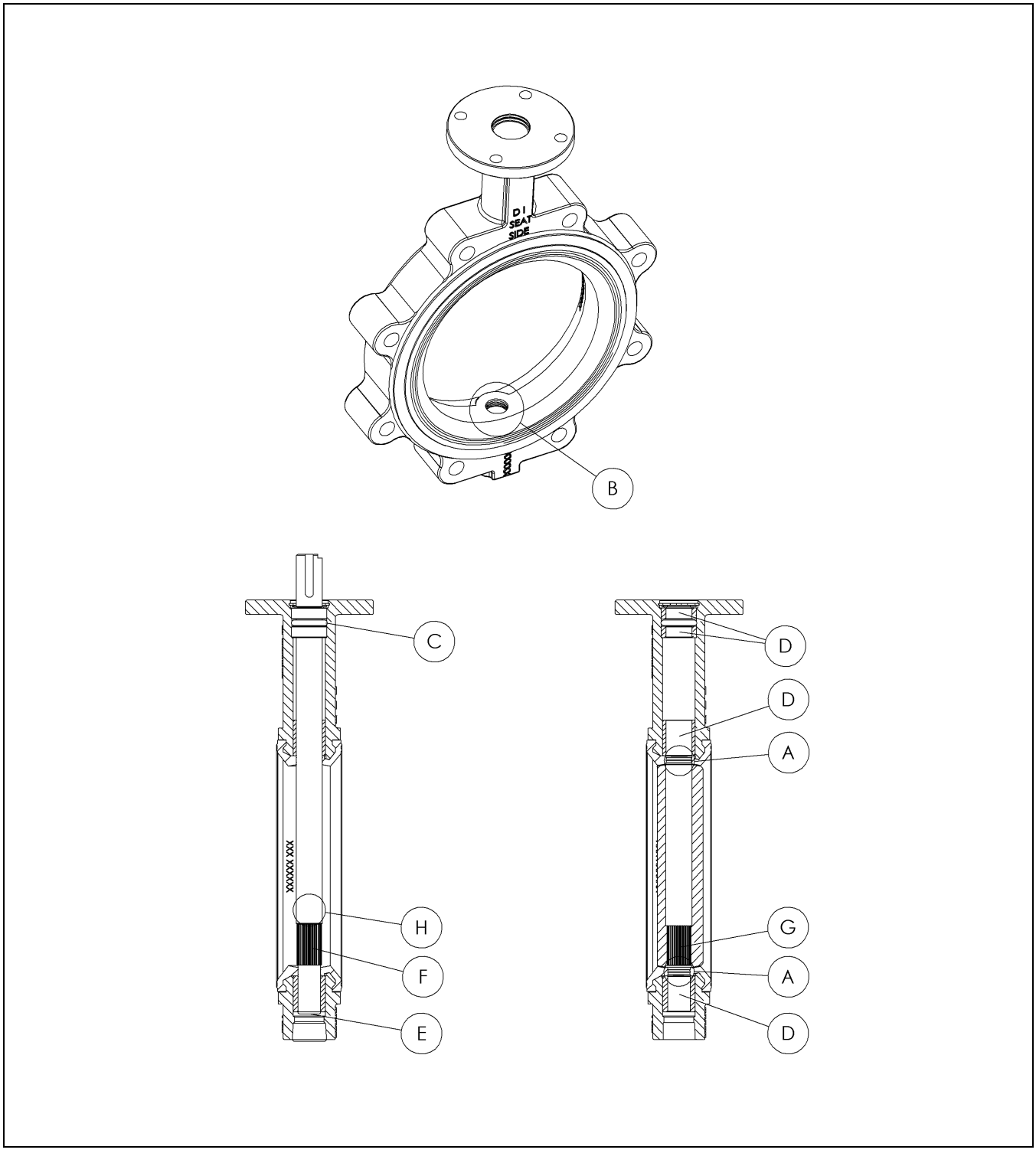


**Figure 1—Areas to Lubricate**

# Parts Identification

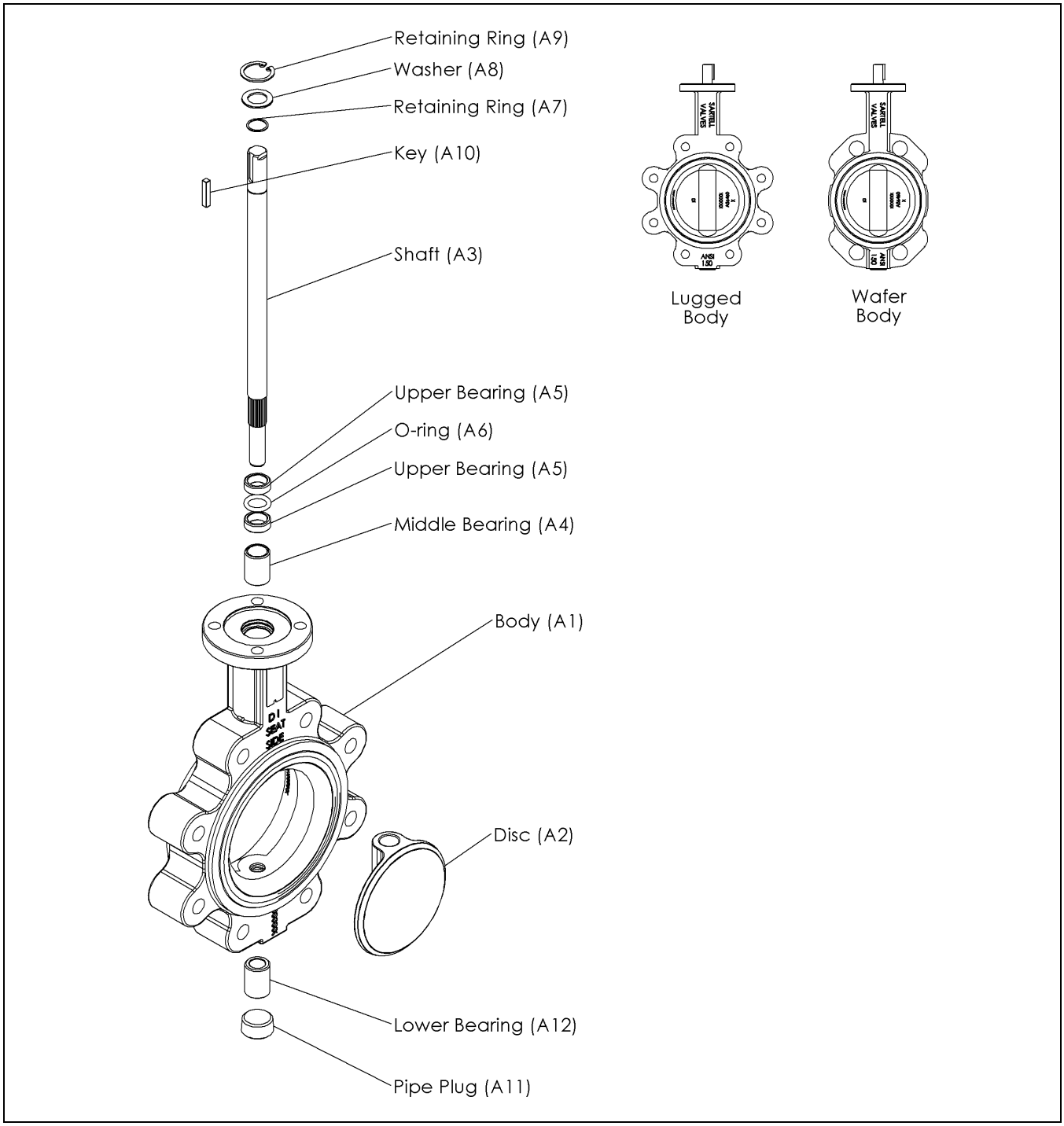


**Figure 2—Parts Identification**

# Removing Valve from Pipeline

Follow the steps below to remove the valve from the pipeline.

**WARNING!**

**Loosening the flange bolts on a pressurized valve can allow the valve to suddenly shift position and release uncontrolled pipeline fluid. To avoid personal injury or pipeline damage, relieve the pressure in the pipeline before loosening the pipeline flange bolts.**

1. Relieve pressure in the pipeline, and drain the pipeline.
2. Close the valve.

**WARNING!**

**Moving parts from accidental operation of a powered actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.**

3. If the actuator is powered, disconnect and lock out the pneumatic, hydraulic, or electrical power to prevent accidental operation.
4. Support the valve, remove the flange bolting, and remove the valve from the pipeline. Refer to the lifting requirements in the *"Installation"* section.

# Disassembling the Valve

Refer to Figure 2 for parts identification.

1. Remove the valve from the pipeline as described in the *"Removing Valve From Pipeline"* section.
2. Remove the actuator as described in the Actuator Instructions.
3. Remove the pipe plug (A11) from threaded lower end of body (A1).
4. Remove the retaining ring (A9) from the groove in the upper end of body (A1).
5. Remove the washer (A8).
6. To remove the shaft (A3) from the disc (A2), tap the lower end of the shaft (A3) towards the upper end of the body (A1) and remove the shaft from the body.
7. Remove the disc (A2) from the body (A1).
8. Remove the two upper bearings (A5) and o-ring (A6) from the upper body shaft bore.

# Reassembling the Valve

Clean and inspect all parts, and replace worn parts. Refer to Figure 2 for parts identification. Lubricate the valve as noted in the "*Lubrication*" section.

1. Place the two upper bearings (A5) and o-ring (A6) seal in the upper body shaft bore.
2. Assemble the disc (A2) in the body (A1) with the spline towards the bottom of the body aligning the disc shaft bore with the body shaft bores.
3. Assemble the shaft (A3) into the body (A1) and disc (A2) shaft bores until the spline in the shaft just contacts the disc spline (slight resistance will be felt between shaft and disc).

   ***Note:*** If the retaining ring (A7) in the shaft (A3) is damaged, replace the retaining ring. Verify that the new retaining ring is completely seated in the shaft groove before installing the shaft.
4. Position the flat on shaft (A3) so that it is parallel to and on the same side of the flat on the disc (A2). See Figure 3 for disc/shaft alignment. Then slide and fully engage the shaft spline with the disc spline (shaft will bottom out in disc bore when fully engaged).

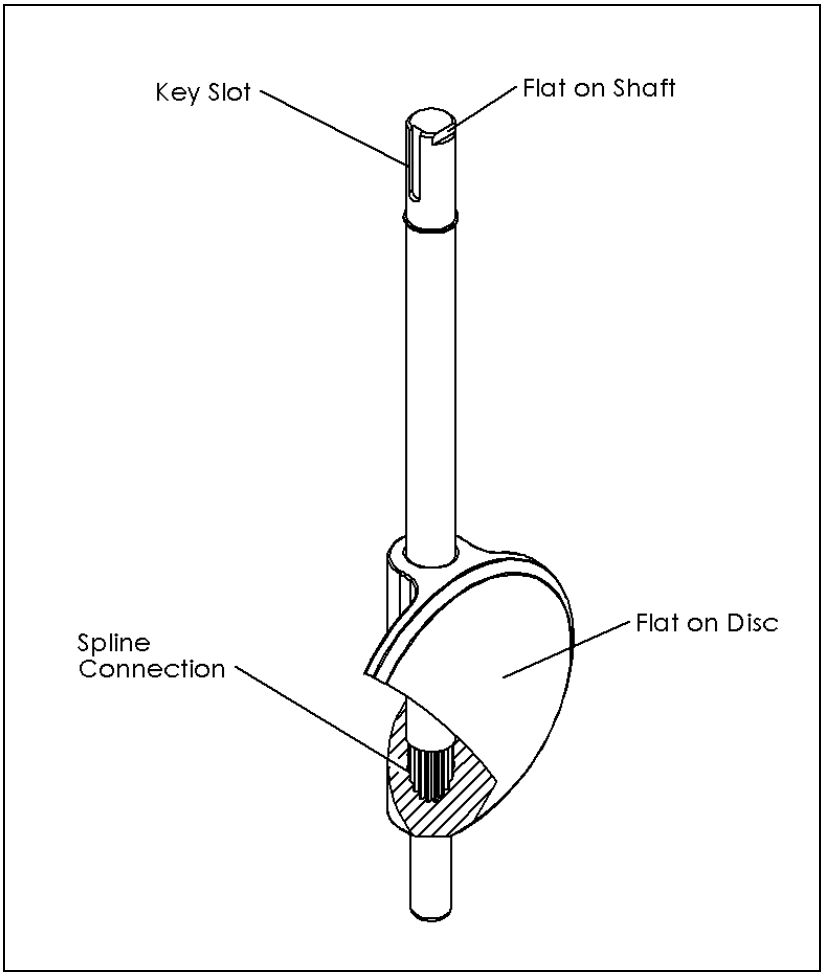


**Figure 3—Disc/Shaft Alignment**

## Reassembling the Valve *(Continued)*

5. Assemble the thrust washer (A8) into the upper body shaft bore and against the snap ring (A7) in the shaft (A3).
6. Assemble the retaining ring (A9) into the retaining ring groove located in the upper body bore.

   ***Note:*** Verify that the retaining ring is completely seated in the retaining ring body groove.
7. Assemble the pipe plug (A11) into the threaded lower body.
8. Mount the actuator on the valve as described in the "*Actuator*" instructions.
9. Install the valve as described in the "*Installation*" section. If the actuator is a powered actuator, re-connect the power and other connections.

# Troubleshooting

| Condition | Possible Cause | Corrective Action |
|---|---|---|
| Valve does not fully close. | Object is wedged between disc and seat | Open valve, and allow flow to remove object |
| | Closed position stop is not adjusted correctly. | Adjust closed stop. |
| | Disc-to-shaft connection has failed. | Replace shaft and/or disc. |
| Valve leaks when closed. | Closed position stop is not adjusted correctly. | Adjust closed stop. |
| | Seat is worn or damaged. | Replace valve or valve body. |
| | Sealing edge of disc is worn or damaged. | Replace valve or valve body. |
| Valve does not fully open. | Open position stop is not adjusted correctly. | Adjust open stop. |
| | Disc-to-shaft connection has failed. | Replace shaft and/or disc. |
| Opening or closing torque is excessive. | Bearings, shaft, disc or seat are dirty or worn | Clean or replace dirty or worn components. |
| | Shaft is bent. | Replace shaft. |
| Valve leaks between body and pipeline flanges. | Valve flange seal is damaged. | Replace valve or valve body. |
| | Flange bolts are tightened incorrectly. | Tighten the flange bolts evenly, in a crisscross pattern. |
| | Flange gaskets were used between valve and pipeline flanges. | Remove flange gaskets. |
| Media leaks between actuator and top of valve | O-ring (A6) leaking at top of shaft. | Inspect and replace O-ring (A6). |

# Guarantee

Products, auxiliaries and parts thereof of DeZURIK, Inc. manufacture are warranted to the original purchaser for a period of twenty-four (24) months from date of shipment from factory, against defective workmanship and material, but only if properly installed, operated and serviced in accordance with DeZURIK, Inc. recommendations. Repair or replacement, at our option, for items of DeZURIK, Inc. manufacture will be made free of charge, (FOB) our facility with removal, transportation and installation at your cost, if proved to be defective within such time, and this is your sole remedy with respect to such products. Equipment or parts manufactured by others but furnished by DeZURIK, Inc. will be repaired or replaced, but only to the extent provided in and honored by the original manufacturers warranty to DeZURIK, Inc., in each case subject to the limitations contained therein. No claim for transportation, labor or special or consequential damages or any other loss, cost or damage shall be allowed. You shall be solely responsible for determining suitability for use and in no event shall DeZURIK, Inc. be liable in this respect. DeZURIK, Inc. does not guarantee resistance to corrosion, erosion, abrasion or other sources of failure, nor does DeZURIK, Inc. guarantee a minimum length of service. Your failure to give written notice to us of any alleged defect under this warranty within twenty (20) days of its discovery, or attempts by someone other than DeZURIK, Inc. or its authorized representatives to remedy the alleged defects therein, or failure to return product or parts for repair or replacement as herein provided, or failure to install and operate said products and parts according to instructions furnished by DeZURIK, Inc., or misuse, modification, abuse or alteration of such product, accident, fire, flood or other Act of God, or failure to pay entire contract price when due shall be a waiver by you of all rights under this warranty.

The foregoing guarantee shall be null and void if, after shipment from our factory, the item is modified in any way or a component of another manufacturer, such as but not limited to, an actuator is attached to the item by anyone other than DeZURIK, Inc. Factory Service personnel. All orders accepted shall be deemed accepted subject to this limited warranty, which shall be exclusive of any other or previous Warranty, and this shall be the only effective guarantee or warranty binding on DeZURIK, Inc., despite anything to the contrary contained in the purchase order or represented by any agent or employee of DeZURIK, Inc., in writing or otherwise, notwithstanding, including but not limited to implied warranties.

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# Limitation of liability

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## Sales and Service

For information about our worldwide locations, approvals, certifications and local representative:

Web site: www.dezurik.com E-Mail: info@dezurik.com

DeZURIK

APCO | HILTON

250 Riverside Ave. N., Sartell, MN 56377 ● Phone: 320-259-2000 ● Fax: 320-259-2227

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*Design features, materials of construction and dimensional data, as described in this manual, are provided for your information only and should not be relied upon unless confirmed in writing by DeZURIK, Inc. Certified drawings are available upon request.*

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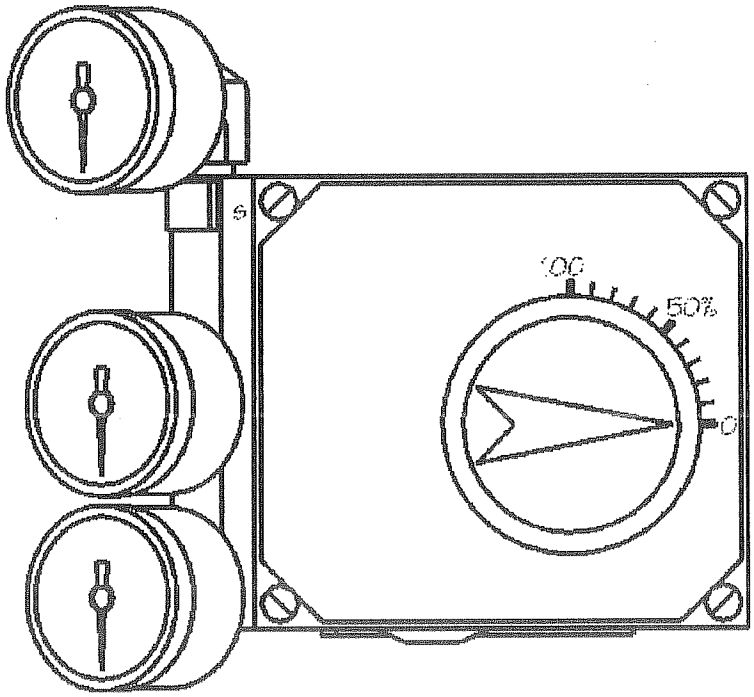
# DeZURIK

# PMV P36C AND P41C POSITIONERS

## USED WITH DeZURIK PNEUMATIC ACTUATORS




Instruction **D10327**
August 2012

DeZURIK | APCO | HILTON | WILLAMETTE

# DeZURIK

## PMV P36C and P41C Positioners used with DeZURIK Pneumatic Actuators

## Instructions

These instructions provide information about Models P36C and P41C PMV Positioners. They are for use by personnel who are responsible for installation, operation and maintenance of Models P36C and P41C PMV Positioners.

## Safety Messages

All safety messages in the instructions are flagged with an exclamation symbol and the word Caution, Warning or Danger. These messages indicate procedures that must be followed exactly to avoid equipment damage, personal injury or death. Safety label(s) on the product indicate hazards that can cause equipment damage, personal injury or death. If a safety label becomes difficult to see or read, or if a label has been removed, please contact DeZURIK for replacement label(s).

**WARNING!**

**Personnel involved in the installation or maintenance of valves should be constantly alert to potential emission of pipeline material and take appropriate safety precautions. Always wear suitable protection when dealing with hazardous pipeline materials. Handle valves that have been removed from service with the assumption of pipeline material within the valve.**

## Inspection

Your positioner has been packaged to provide protection during shipment; however, it can be damaged in transport. Carefully inspect the unit for damage upon arrival and file a claim with the carrier if damage is apparent.

## Parts

Order parts from your local DeZURIK sales representative, or directly from DeZURIK. When ordering parts, please include the 7-digit part number and 4-digit revision number (example: **9999999R000**) located on the data plate attached to the valve assembly. Also include the part name, the assembly drawing number, the balloon number and the quantity stated on the assembly drawing.

## DeZURIK Service

DeZURIK service personnel are available to install, maintain and repair all DeZURIK products. DeZURIK also offers customized training programs and consultation services.

For more information, contact your local DeZURIK sales representative or visit our website at www.dezurik.com.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# Technical Specifications

| | Model P36C | Both Models | Model P41C |
|---|---|---|---|
| Input signal | 20–100 kPa 3–15 psi | | 4–20mA |
| Linearity | =<0,5% [a] | | =<0,75% [a] |
| Hysterisis | =<0,75% [a] | | =<1% |
| Repeatability | =<0,5% [a] | | =<0,5% [a] |
| Gain factor at 80% load. (Supply: 87 psi) | | 1000 (kPa/kPa)<br>1000 (psi/psi) | |
| Gain factor at 50% load. (Supply: 87 psi) | | 1250 (kPa/kPa)<br>1250 (psi/psi) | |
| Air consumption at supply pressure: | ±20% | | ±20% |
| 0,2 MPa/29 psi | 5,4 nl/min 0.19 SCFM | | 6,1 nl/min 0.22 SCFM |
| 0,4 MPa/58 psi | 12,3 nl/min 0.43 SCFM | | 13,6 nl/min 0.48 SCFM |
| 0,6 MPa/87 psi | 20 nl/min 0.71S CFM | | 22 nl/min 0.78 SCFM |
| 0,8 MPa/116 psi | 27,8 nl/min 0.98 SCFM | | 30,5 nl/min 1.08 SCFM |
| 1 MPa/145 psi | 35,7 nl/min 1.26 SCFM | | 39 nl/min 1.38 SCFM |
| Air delivery at Supply pressure: | | ±20% | |
| 0,2 MPa/29 psi | | 135 nl/min 4.7 SCFM | |
| 0,4 MPa/58 psi | | 250 nl/min 8.7 SCFM | |
| 0,6 MPa/87 psi | | 360 nl/min 12.6 SCFM | |
| 0,8 MPa/116 psi | | 480 nl/min 16.8 SCFM | |
| 1 MPa/145 psi | | 590 nl/min 20.6 SCFM | |
| Supply Pressure | Max 1 MPa 145 psi | | 0,15–1 MPa 8–145 psi |
| Temperature Range | | -15°C to +85°C<br>(5°F to 185°F) | |
| Connector threads | | 1/4" NTP or G | |
| Gauge threads | | 1/8" NTP or G | |
| Weight std. | 1,1 kg 2.4 lbs | | 1,6kg 3.5 lbs |
| Weight with gauges | 1,3 kg 2.9 lbs | | 1,8 kg 4 lbs |
| Ingress Protection | | | IP 65/NEMA 4 |

a. Percent of full scale.

## Description

The positioner is a precision instrument which, when used in conjunction with a DeZURIK actuator, can provide the exacting control necessary to satisfy the most demanding process requirements.

The model P36C will accept a 3-15psi, 3-9psi, or 9-15 psi input signal.

The model P41C will accept either a 0-20mA or a 4-20mA input signal.

The modular design allows for easy parts replacement, and quick access to Zero and Span adjustments. The housing uses an O-ring seal that can be adjusted to a sealed or drained position.

## Operation

P36C and P41C positioners operate on a force balance principal. Force is applied from a signal pressure that is transmitted through a diaphragm (1) to the balance arm (2). The feedback spring (3) provides the opposing force. This force is proportional to the level of the lower arm (4). The lower arm level is determined by the position of the cam (5), which is secured to the spindle (6). The spindle is connected to the actuator shaft thus providing the feedback from the actuator and valve. See Figure 1.

When the opposing forces are equal, the balance arm (2) and the spool in the pilot valve (7) are in neutral position and the complete system is in a balanced condition.

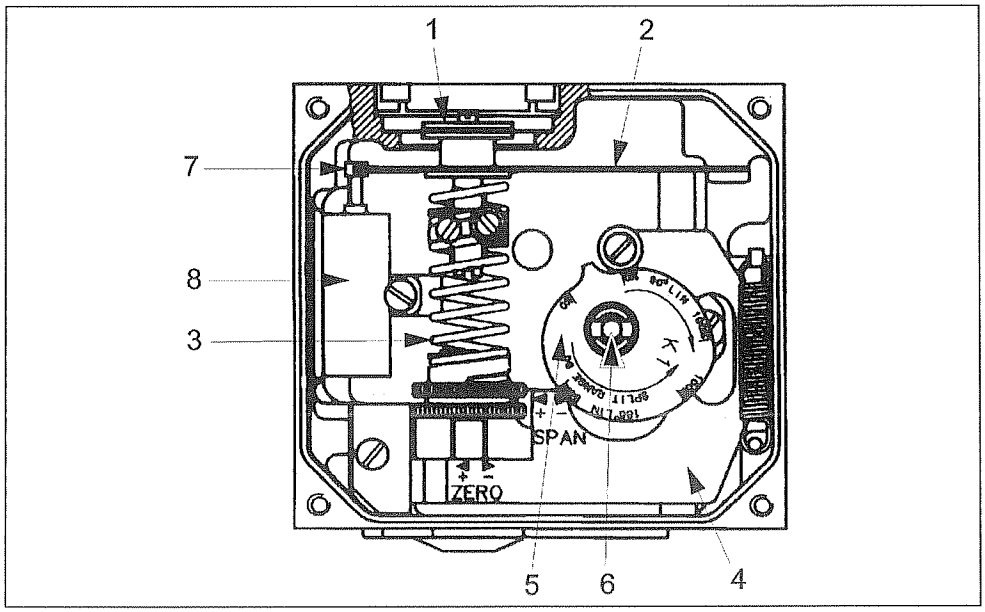



**Figure 1 – Internal Parts**

Air is supplied through port S to the pilot valve, which controls air flow through ports C1 and C2. Starting from a balanced condition, an increased control pressure will deflect the diaphragm (1) down, compressing the feedback spring (3). The balance arm (2) moves the spool (7) in the pilot valve (8) thus supplying air to the actuator. At the same time air is exhausted from the actuator and vented to atmosphere through the pilot valve and the OUT port.

Air pressure to the actuator is increased, causing the actuator to move the valve and the positioner spindle (6). The spindle and cam (5) rotate, forcing the lower arm upward, compressing the feedback spring (3). This motion continues until the two forces are equal and the system returns to a balanced condition.

## Cam Selection

Each cam is designed to provide split range instrument signals. Standard cam characterization is linear; however, other characterizations are available.

## Installation

**WARNING!**

**Positioners installed in hazardous areas can be ignition sources. Ensure positioners used in hazardous areas have proper fire/explosion ratings.**

### *Air Requirements*

Maximum positioner supply pressure is 145 psi (1 MPa).

Supply air must be clean, dry and free from oil, water, moisture, dirt and debris. The air should be freeze-dried or similar to a dew point of at least 18 degrees F (10°C) below lowest ambient temperature.

A 30 micron (or finer) filter/regulator should be installed as close to the positioner as possible to ensure proper supply air quality.

### *Air Connections*

Air connections are for 1/4" NPT male connectors and are marked on the positioner. Gauge ports are for 1/8" NPT.

DeZURIK recommends Loctite® 577 tape or similar for sealing.

| | |
|---|---|
| Port I | Input instrument pneumatic signal 3-15 psi (20-100kPa) |
| Port S | Supply air, maximum 145 psi (1 MPa), minimum 21 psi (0.15 MPa) for P41C |
| Port C1, C2 | Actuator connections. C2 opening port |
| OUTLET | Exhaust air port. **Do not plug.** |
| Port $I_P$ | Gauge port for pneumatic input signal (P36C). |
| Port $I_E$ | Input electric signal (4–20 mA) (P41C) |
| Port P | Gauge port for I/P unit output pressure (P41C) |

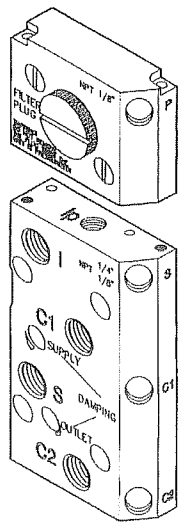



**Figure 2 - Connecting Block**

## Installation *(Continued)*

The outlet port is used for venting the positioner. All air from the positioner, actuator and I/P unit is vented to atmosphere through this port. **Do not plug this port.** A high flow silencer or an exhaust pipe can be connected to the outlet port to prevent foreign objects from entering and blocking the exhaust. When using gas for supply, please contact. Port I should be plugged on the P41C. For single acting operation, plug port C1 for increasing signal to OPEN, or C2 for increasing signal to CLOSE.

***Note:*** See Figure 4 for proper cam position.

With the I/P unit mounted, the positioner is supplied with air from port S and does not need an external air supply. See pages 8–11 for more information on the I/P unit.

### *I/P Unit Electrical Connections*

Electrical connection on I/P unit accepts 1/2" NPT or PG 13,5 cable gland.

See Figure 10E for wiring connections. Maximum recommended wire size is 16 AWG.

### *Front Cover and Indicator Cover*

The front cover is secured to the pneumatic positioner with four captive screws and sealed with an O-ring (1). This sealing system allows for complete sealing or draining of the positioner by changing the position of the O-ring. The O-ring system is common to the Pneumatic positioner, I/P unit and Feedback unit in the Valve Control System.

The O-ring can be looped over notches (2) in the front cover to allow for drainage. There are eight locations on the front cover where the O-ring can be looped. See Figure 3.

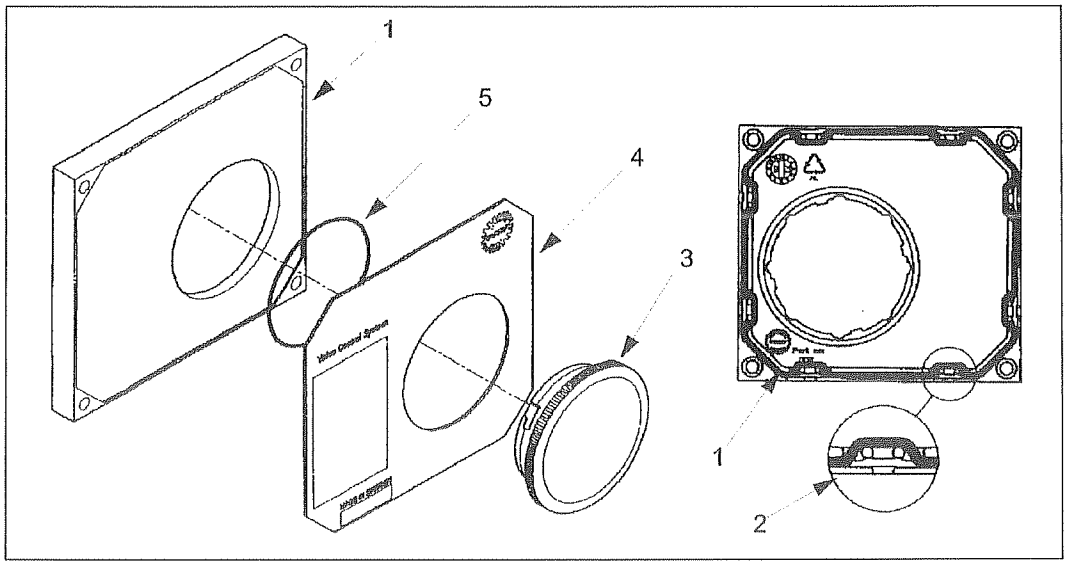



**Figure 3 – Front Cover and Indicator Cover**

The indicator cover (3) is O-ring sealed and secured by a bayonet coupling. The indicator cover is also used to secure the identification cover (4).

To remove the indicator cover turn it slightly counterclockwise until it loosens. Once loosened, the identification cover and O-ring (5) can be removed. When installing the indicator cover and identification cover ensure the O-ring is properly sealed.

## Reversing the Positioner Action

To change the positioner action from increasing signal to OPEN to increasing signal to CLOSE, or vice versa, follow the steps below.

**WARNING!**

**Moving parts from accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to the actuator before servicing.**

1. Shut off the supply air pressure and the input signal pressure.
2. On double-acting cylinders, disconnect and reverse the two connections to positioner ports C1 and C2. For spring-return cylinders, proceed to step 3.
3. Remove the positioner cover and dial indicator.
4. Loosen the cam locking nut screw and remove the cam locking nut.
5. Turn the cam over and position the cam so the cam roller is about 1/32" from the stop on the cam. See Figure 4.

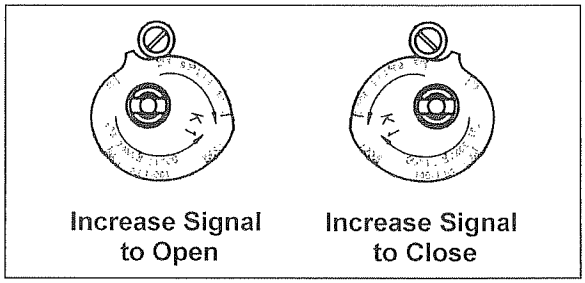



**Figure 4 – Cam Positions**

6. Tighten the locking screw — allow room for movement of the cam as the cam locking nut is tightened.
7. Turn on the supply and input pressures and operate the valve.
8. Adjust the zero and span adjustments, if necessary.

# Cam Adjustment

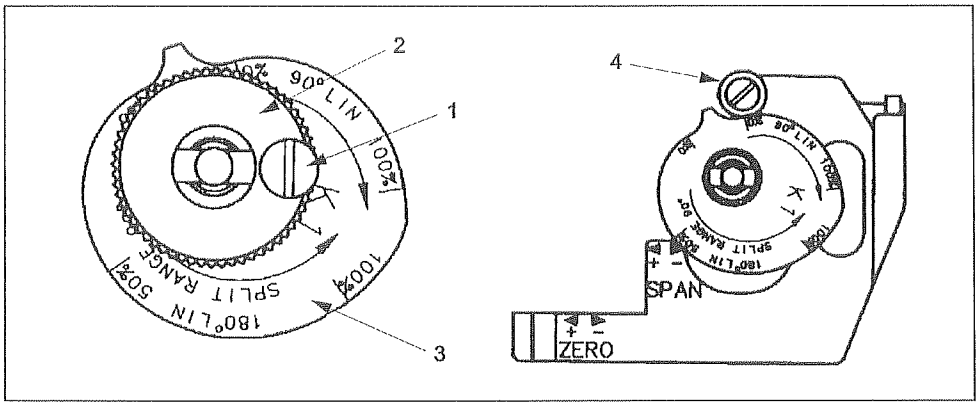



**Figure 5 – Cam Adjustment**

1. With the cover and indicator removed, loosen the screw (1) and turn the cam locking nut (2) counterclockwise until the cam loosens. See Figure 5.
2. Adjust the cam (3) as desired, making sure the ball bearing (4) is always riding on an active lobe on the cam.
3. Finger tighten the locking nut and tighten the screw (1).

   ***Note:*** Ensure screw (1) is loose from the cam before tightening locking nut (2).
4. Install and adjust the indicator, and install cover.

# Zero and Span Adjustment

## *Span Adjustment*

Span is adjusted with the yellow (upper) thumb wheel (1) located on the feedback spring. See Figure 6. To adjust the span, loosen the locking screw (2) and turn the yellow thumb wheel. Do not allow the top of the spring to contact the spring guide (3). When span is set, tighten the locking screw. Always check Zero after adjusting Span.

## *Zero Adjustment*

Zero is adjusted by turning the silver (lower) thumb wheel (4) located on the lower arm (5). It can also be adjusted externally with a screwdriver (7), through the zero adjust opening. Remember to re-install the zero adjust cover (6) to keep the unit clean.

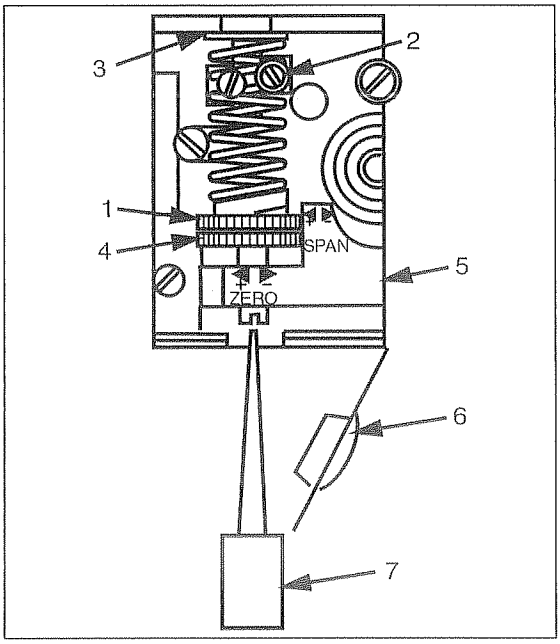



**Figure 6 – Zero and Span Adjustment**

## Resetting the Range Spring

If the correct span cannot be obtained after 2 or 3 zero/span adjustments, reset the range spring as follows:

1. Disconnect air supply and remove the range spring from the positioner.
2. Loosen screws (1 and 2).
3. Adjust the collar so it is 3/16" or 9/32"* below the flange face.

   *Depending on spring style—see Figure 7

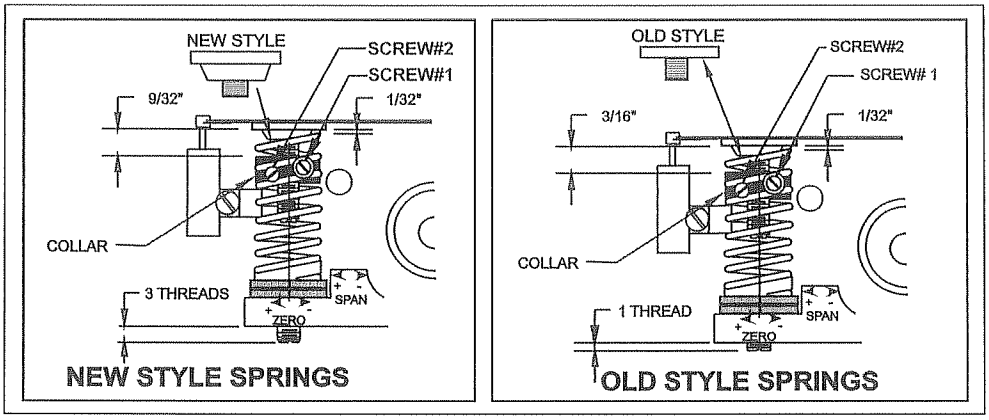



**Figure 7 – Spring Styles**

4. Adjust the spring end to 1/32" clearance.
5. Tighten screws (1 and 2).
6. Adjust the lower zero screw so that 1 or 3 threads are showing (depending on spring style).
7. Reinstall the range spring assembly.

## Indicator Adjustment

To adjust the indicator, remove front cover and pull the indicator upward until it comes off the Allen screw. Before installing the indicator make sure the Allen screw is tightened. Press the indicator on the screw and adjust it by rotating clockwise into position.

### *Adjusting Travel Speed Dampers*

The dampers (5) located on the connecting block provide a simple means of adjusting the actuator travel speed. See Figure 8.

For double acting actuators, set the damper marked Supply to fully open and adjust only the damper marked Outlet.

For single acting actuators, adjust both the Supply and Outlet dampers for operation.

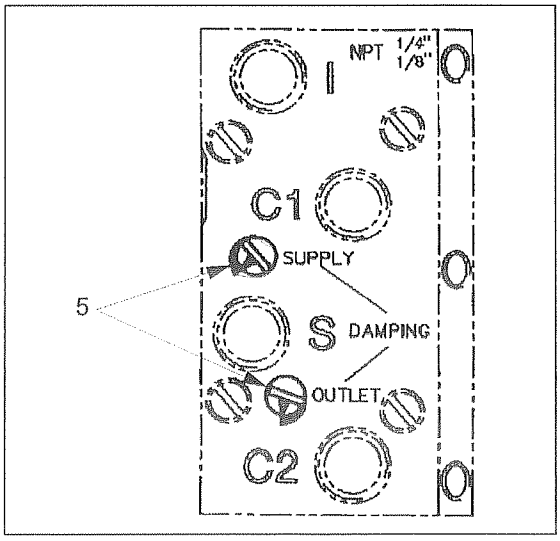



**Figure 8 – Speed Dampers**

# I/P Electric Control Unit, P41C

## *The I/P Unit*

The I/P unit is mounted directly on top of the positioner. Span and Zero for the I/P converter are factory set. No external air supply is needed, as the I/P unit is supplied with air from the positioner. The I/P unit accepts a 4–20 mA input signal. (Other ranges are available on request.)

**WARNING!**

**Positioners installed in hazardous areas can be ignition sources. Ensure positioners used in hazardous areas have proper fire/explosion ratings.**

## *Filter*

**WARNING!**

**The filter plug can blow out and cause injury or damage if it is removed while under pressure. Do not remove the filter plug when the positioner is pressurized.**

The I/P unit is equipped with a built in filter. The threaded filter plug can easily be removed for replacement. During replacement, always check the filter compartment, and clean if necessary. Make sure the filter plug O-ring is in good condition.

# Installing I/P Unit On Positioner

**WARNING!**

**Positioners installed in hazardous areas can be ignition sources. Ensure positioners used in hazardous areas have proper fire/explosion ratings.**

1. Turn off the supply air and remove the connecting block (1), gauge or plug from port IP, and the existing gasket (4) between the positioner (2) and connecting block. See Figure 9.
2. Carefully install the new gasket supplied with the I/P unit.

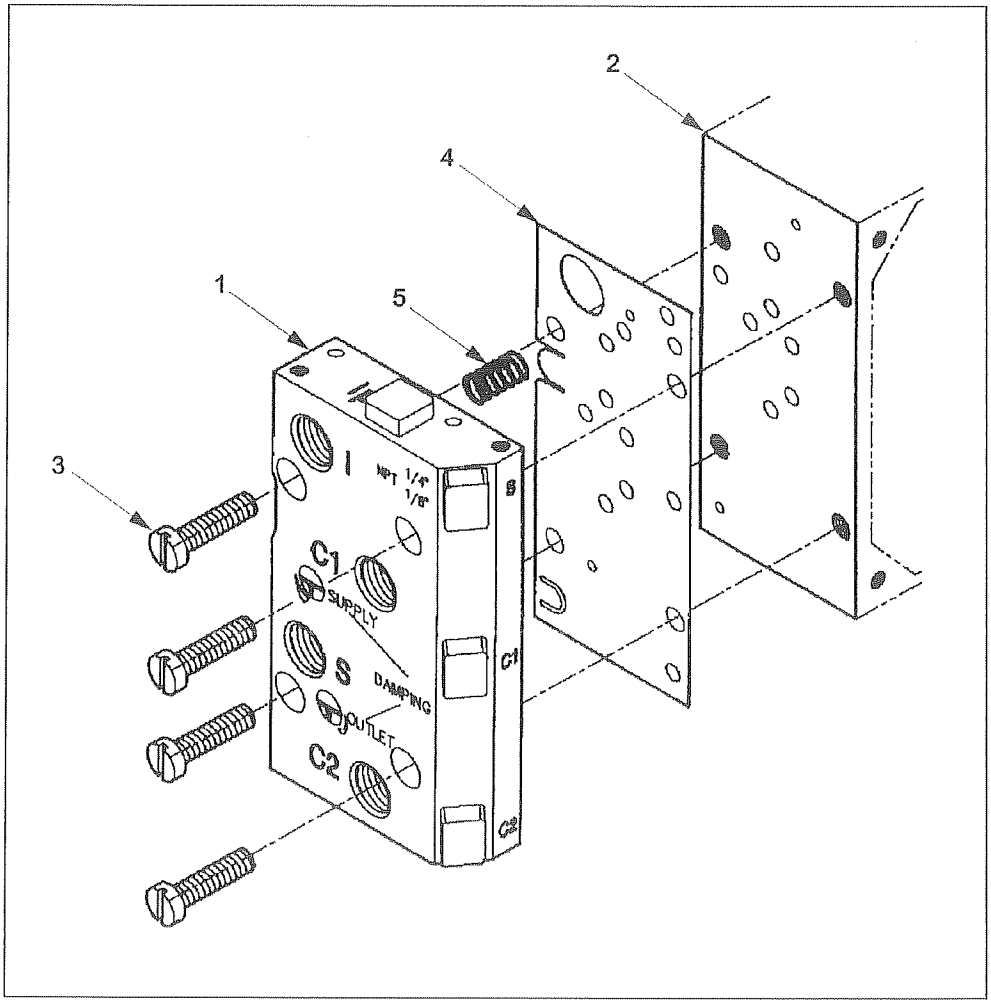



**Figure 9 – Installing I/P Electric Control Unit P41C**

3. Ensure the relief valve spring (5) is installed properly.
4. Install the connecting block on the Positioner, and plug port I.
5. Remove cover on I/P unit.

## Installing I/P Unit On Positioner *(Continued)*

6. Install the I/P unit on the top of the positioner, making sure the four O-rings are in the correct places. See Figure 10b.
7. Tighten the I/P unit with the three screws. See Figure 10a.

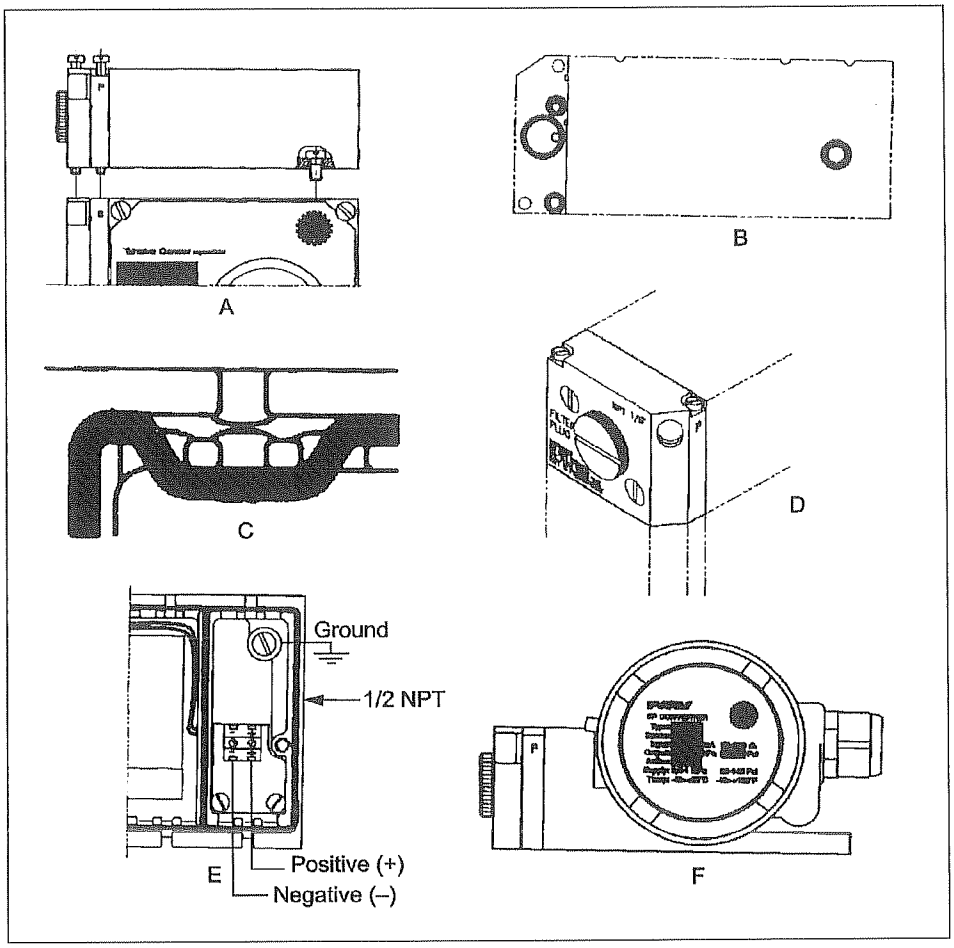



**Figure 10 – I/P Unit On Positioner**

8. Connect input signal cable to port IE and tighten the cable gland (see Figure 10e).
9. Adjust the O-ring on the I/P unit housing to desired position; sealed or drained (see Figure 10c).
10. Install a plug or a gauge in port P, and make sure the filter plug is tightened (see Figure 10d).

# Maintenance for Positioners

## *Pilot Valve*

To remove the pilot valve for cleaning:

1. Remove the screw (1) and carefully lift out the complete assembly (2).
2. Gently remove the spool (3) from the block.
3. Clean the parts, using methylate cleaner or similar.
4. Blow the parts dry with compressed air.

   ***Note:*** If the parts show signs of wear, replace the assembly. Do not mix parts from other assemblies.
5. Check the O-rings, then secure and install the pilot valve assembly to the positioner and secure it with the screw (1).

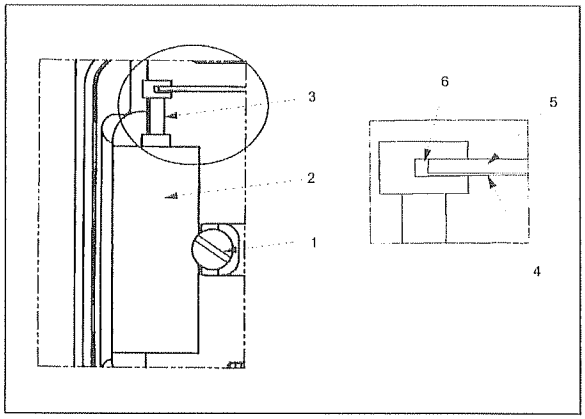



**Figure 11 – Location of Pilot Valve Spool**

6. Ensure the leaf spring (4) on the balance arm (5) is properly fitted in the groove on the spool (6).
7. Check again to ensure smooth operation of the assembly.

## *Diaphragm*

On P41C positioners the I/P unit must be removed to reach the diaphragm. See Figure 12.

1. Loosen screws (1), remove the diaphragm cover (2).
2. Loosen screw (3), then remove diaphragm (4) and washers (5).
3. When installing the diaphragm, place one washer on each side of the diaphragm. Ensure the raised circle on the washers is facing the diaphragm.
4. Install the screw (3) and tighten.
5. Check the O-ring on the diaphragm cover (2), then install and secure the cover with screws (1).

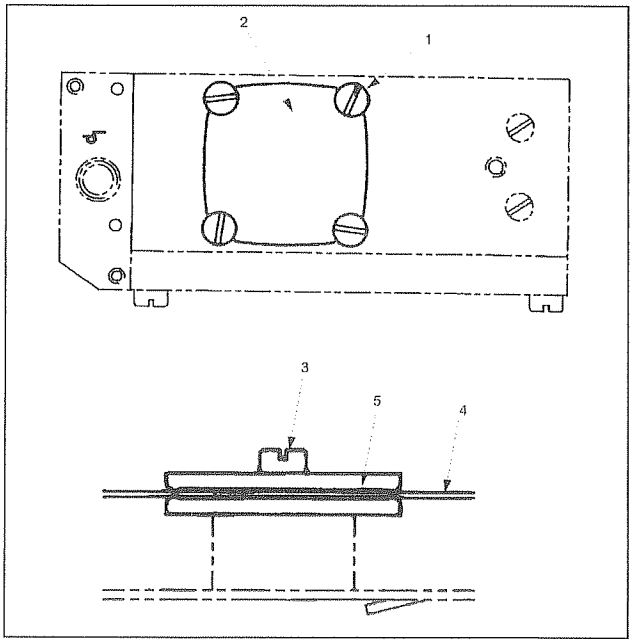



**Figure 12 – Diaphragm Removal and Installation**

## Maintenance for Positioners *(Continued)*

### *Feedback Spring*

Once the front cover and indicator are removed, the feedback spring can be easily reached. See Figure 13.

1. Hold the spring (1) from the top, pull down and out.
2. When installing, hold the assembly at the top, guide the lower part to position on the zero screw, then press down until it fits easily under the balance arm (2).
3. Ensure the assembly is aligned properly against the balance arm.

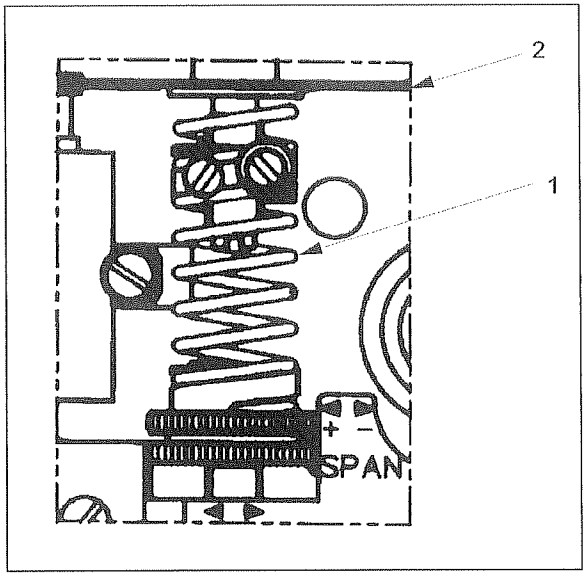



**Figure 13 – Feedback Spring Access**

### *Balance Arm*

The balance arm can only be removed after I/P unit, diaphragm and feedback spring have been removed. See Figure 14.

Refer to "Diaphragm" and "Feedback" sections above.

1. Loosen the screws (3) and remove the balance arm.
2. When installing the balance arm make sure the leafspring (4) on the underside of the balance arm (5) is properly engaged in the groove (6) of the spool in the pilot valve.
3. Tighten the two screws (3) holding the balance arm to the positioner.

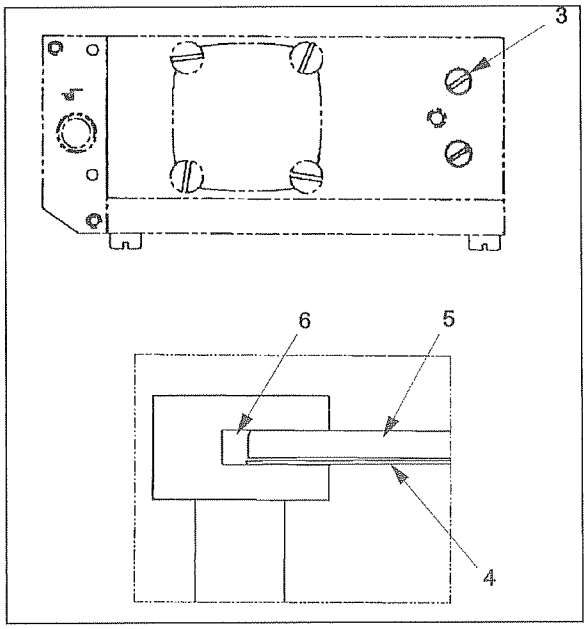



**Figure 14 – Balance Arm Access**

## Maintenance for Positioners *(Continued)*

### *Lower Arm*

After the front cover has been removed, the lower arm can be easily reached. See Figure 15.

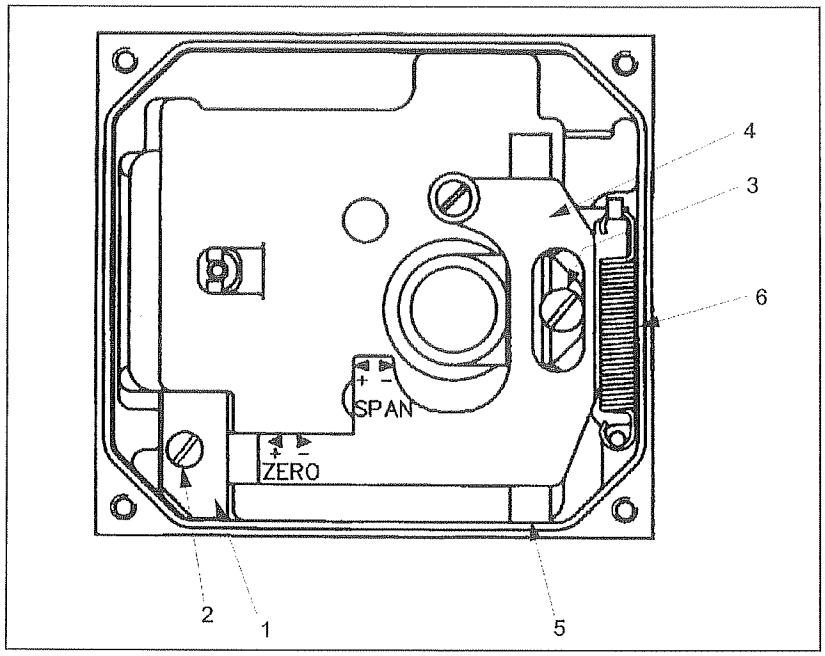



**Figure 15 – Lower Arm**

1. Remove the indicator, feedback spring and the cam.
2. Loosen screw (2) and remove twist stop (1).
3. Remove screw (3), lower arm (4), rod (5) and spring (6).
4. Check rod and lower arm for wear, and replace if necessary.
5. Clean the rod and install it in the lower arm.

   ***Note:*** The lower arm should move easily and smoothly.
6. Install the lower arm and rod assembly into the positioner housing, making sure the spring (6) is attached properly to the lower arm and positioner housing.
7. Secure the lower arm and rod assembly with the screw (3).
8. Check again that the lower arm moves smoothly.
9. Apply a small amount of grease on the small tongue on the lower arm, then install and secure the twist stop.
10. Install the cam, feedback spring, indicator and front cover.

### *O-Rings*

With time and use, O-rings can become brittle. This can cause poor operation or failure. Always check O-rings when performing work on the positioner, and replace any brittle O-rings.

***Note:*** A thin layer of silicon grease applied on the O-rings prolongs their life.

## Troubleshooting

| Condition | Possible Cause | Corrective Action |
|---|---|---|
| Signal change has no effect on actuator position. | Indicator is loose. | Check indicator and screw. Re-position indicator and tighten. |
| | Air supply is not adequate. | Check air supply to positioner, and tubing to actuator. |
| | Input signal is fluctuating. | Check input signal. Repair or replace wiring. |
| | Diaphragm is damaged. | Check diaphragm for damage or leakage. Repair or replace diaphragm. |
| | Pilot valve is dirty or worn. | Check pilot valve function. Clean or replace pilot valve. |
| | Cam is incorrectly positioned. | Check cam for correct setting. |
| Signal change results in actuator running to end position | Positioner is loose. | Check coupling between positioner and actuator. |
| | Cam is loose. | Check cam position and locking screw. |
| | Input signal is fluctuating. | Check input signal. Repair or replace wiring. |
| Inaccurate Positioning | Pilot valve is dirty or worn. | Check pilot valve function. Clean or replace pilot valve. |
| | Diaphragm is damaged. | Check diaphragm; repair or replace diaphragm. |
| | Input signal is fluctuating. | Check input signal. Repair or replace wiring. |
| | Actuator is not sized correctly. | Check sizing. Replace with correct actuator. |
| | Valve torque is increased from wear or damage. | Rebuild or replace valve. |

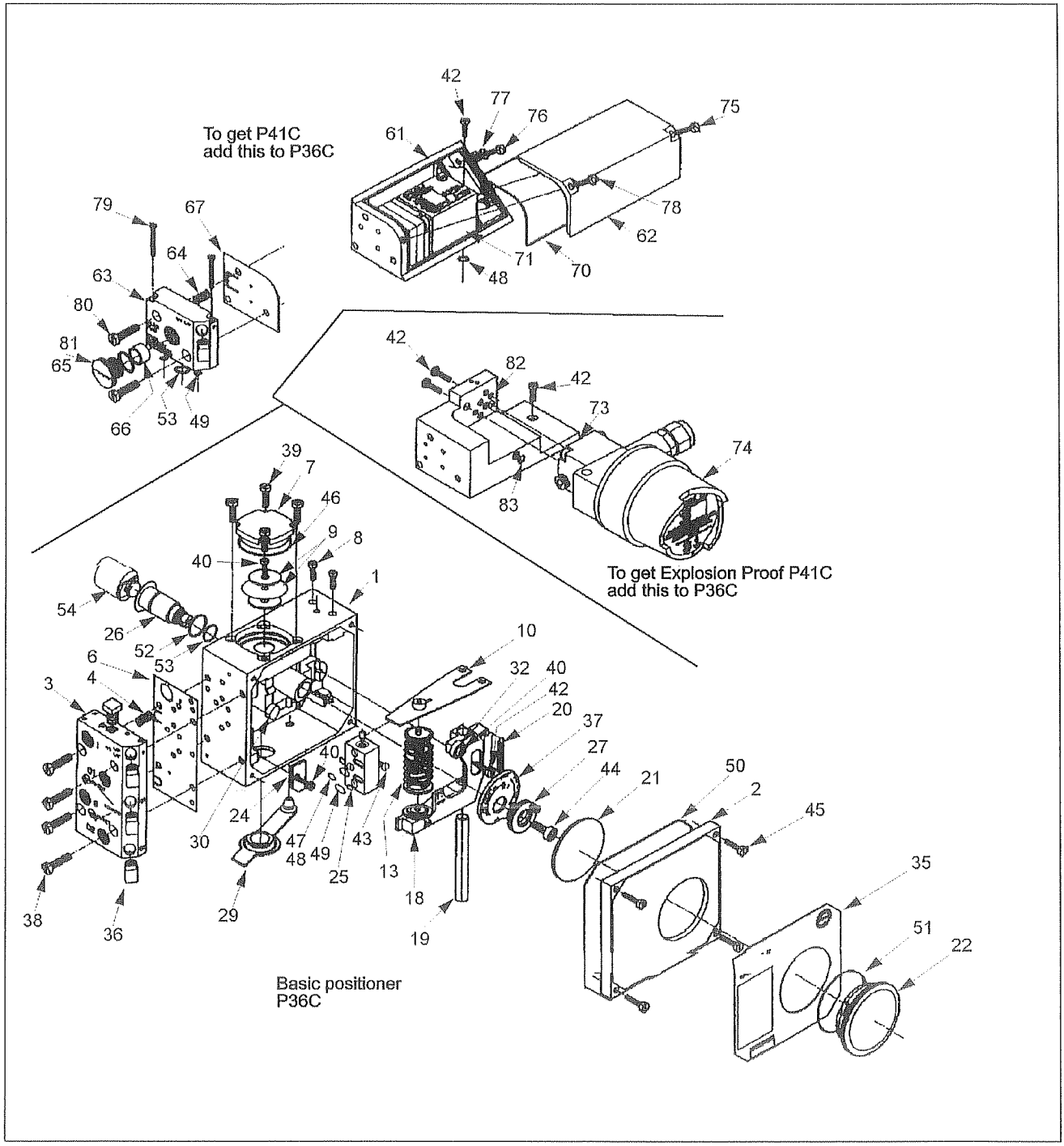



Figure 16 – Positioner Configurations

# Parts

Table A: Parts - Positioner

| Part No. | Qty | Description |
|---|---|---|
| 1 | 1 | Housing |
| 2 | 1 | Front cover with O-ring |
| 3 | 1 | Connecting block [a] |
| 4 | 1 | Relief valve spring |
| 6 | 1 | Gasket P5 [a] |
| 7 | 1 | Diaphragm cover with O-ring |
| 8 | 1 | Diaphragm |
| 9 | 2 | Diaphragm washer |
| 10 | 1 | Balance arm |
| 13 | 1 | Feedback spring [b] |
| 18 | 1 | Lower arm assembly |
| 19 | 1 | Rod |
| 20 | 1 | Spring |
| 21 | 1 | Indicator: arrow, flag, or pointer |
| 22 | 1 | Indicator Cover [c] |
| 24 | 1 | Twist stop |
| 25 | 1 | Pilot valve with O-rings |
| 26 | 1 | Shaft with O-rings and screw |
| 27 | 1 | Cam locking nut |
| 29 | 1 | Zero cover |
| 30 | 1 | Cover |
| 32 | 11 | Ball bearing |
| 35 | 1 | Identification cover |

a. Specify 1/4" NTP or G.

b. Specify 3–15 psi or 6–30 psi Spring Assembly.

c. Specify Flag, Transparent or Opaque.

Table A: Parts – Positioner, continued

| Part No. | Qty | Description |
|---|---|---|
| 36 | 4 | Plug [a] |
| 37 | 1 | Cam |
| 38–45 | 1 | Screw set |
| 46–53 | 1 | O-ring set |
| 54 | 1 | Spindle adaptor |

a. Specify 1/8" NTP or G.

Table B: Parts – I/P Unit

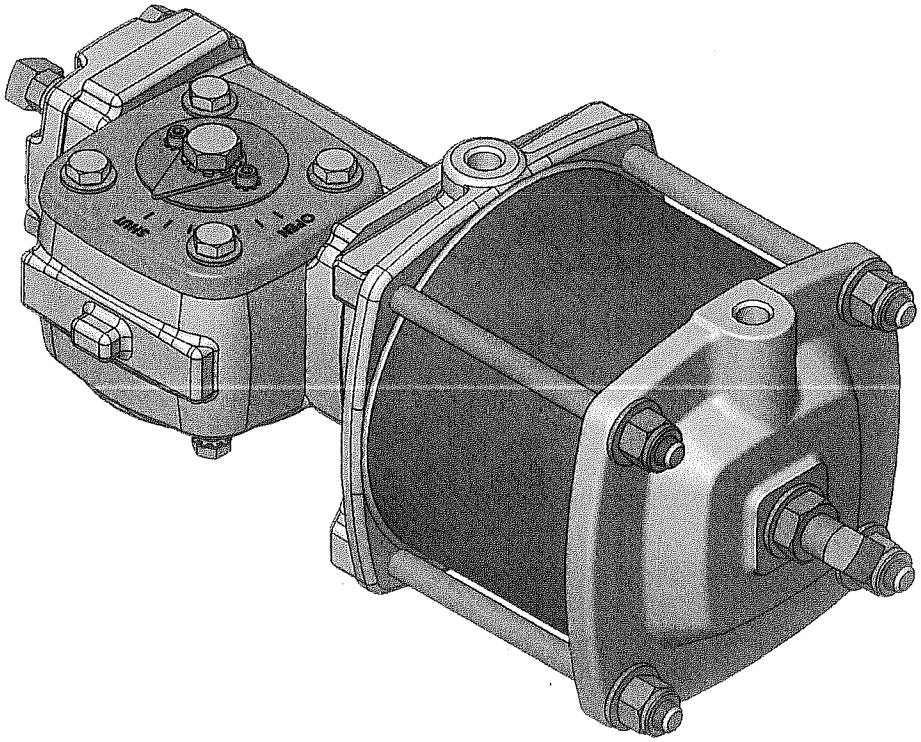
| Part No. | Qty | Description |
|---|---|---|
| 61 | 1 | I/P box |
| 62 | 1 | I/P cover with screws |
| 63 | 1 | I/P nose assembly [a] |
| 64 | 1 | Relief valve spring |
| 65 | 1 | Filter and plug |
| 66 | 1 | Filter (5 nos) |
| 67 | 1 | I/P Gasket |
| 70 | 1 | O-ring |
| 71 | 1 | I/P converter |
| 73 | 1 | Round I/P mounting bracket with hardware |
| 74 | 1 | I/P enclosure with converter [b] |

a. Specify 1/4" NTP or G.

b. Specify Std., Cenelec (flameproof), or Explosion Proof FM.

DeZURIK

# DeZURIK R1 AND R2 POWERRAC™ ACTUATORS USED WITH BOS BUTTERFLY VALVES



Instruction **D10494**
June 2013

DeZURIK | APCO | HILTON | WILLAMETTE

# DeZURIK

## R1 and R2 POWERRAC™ Actuators used with BOS Butterfly Valves

## Instructions

These instructions provide installation, operation, and maintenance information for DeZURIK R1 AND R2 POWERRAC™ Actuators. They include procedures which, when carefully followed, help to ensure satisfactory performance of these actuators. All warnings and cautions included in these instructions must be followed to avoid personal injury and equipment damage.

These instructions are intended for use by personnel who are responsible for installation, operation or maintenance of R1 and R2 POWERRAC™ actuators.

## Safety Messages

All safety messages in the instructions are flagged with an exclamation symbol and the word Caution, Warning or Danger. These messages indicate procedures that must be followed exactly to avoid equipment damage, personal injury or death. Safety label(s) on the product indicate hazards that can cause equipment damage, personal injury or death.

Safety label(s) on the product indicate hazards that can cause equipment damage, personal injury or death. If a safety label becomes difficult to see or read, or if a label has been removed, please contact DeZURIK for replacement label(s).

**WARNING!**

**Personnel involved in the installation or maintenance of valves should be constantly alert to potential emission of pipeline material and take appropriate safety precautions. Always wear suitable protection when dealing with hazardous pipeline materials. Handle valves, which have been removed from service with suitable protection for any potential pipeline material in the valve.**

## Inspection

Your POWERRAC™ Actuator has been packaged to provide protection during shipment; however, it can be damaged in transport. Carefully inspect the unit for damage upon arrival and file a claim with the carrier if damage is apparent.

## Parts

Recommended spare parts are listed on the assembly drawing. These parts should be stocked to minimize downtime.

Order parts from your DeZURIK sales representative, or directly from DeZURIK. When ordering parts, please include the 7-digit part number and 4-digit revision number (example: **9999999R000**) located on the data plate attached to the valve assembly. Also include the part name, the assembly drawing number, the balloon number and the quantity stated on the assembly drawing.

## DeZURIK Service

DeZURIK service personnel are available to install, maintain and repair all DeZURIK products. DeZURIK also offers customized training programs and consultation services.

For more information, contact your local DeZURIK sales representative or visit our website at www.dezurik.com.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# Description

The DeZURIK R1 and R2 PowerRac™ actuators are quarter-turn, enclosed rack and gear cylinder actuators. The R1 and R2 PowerRac™ actuator are used for on-off or modulating control on valves that have a keyed or double-D shaft connection.

The R number designates the radius of the actuator gear. A choice of cylinder diameters is offered—4 and 6" (100 mm and 150 mm) on the R1 actuator, and 6 and 8" (150 mm and 200 mm) on the R2 actuator.

The R1 and R2 PowerRac™ actuator are available as double-acting actuators or as a spring-return actuators, either spring-to-open or spring-to-close. The spring action may be reversed by ordering the alternate spring-return cylinder assembly, and exchanging the positions of the two cylinders. The cylinder mounting interface is the same for all PowerRac™ actuators.

A lockable model of The DeZURIK PowerRac™ actuator is also available. Operation of the lockable model is described on page 25.

These instructions include information for all three actuator configurations, and for changing from one to another. See Figure 1 to identify the applicable configuration; refer to Figures 2 through 4 to identify the components within each configuration.

# Installation

Pneumatic connections are required as shown in Figure 1, and as described below. All cylinder port connections are ¼" NPT.

## *Double-Acting Actuator*

The double-acting actuator requires two pneumatic connections—one to each port on opposite ends of the cylinder. Air to the connection closest to the actuator drives the actuator clockwise, towards the "shut" position on the dial; air to the connection farthest from the actuator drives the actuator counterclockwise, towards the "open" position on the dial.

## *Spring-Return Actuator*

The spring-return actuator requires one pneumatic connection—to the fitting on the tubing that connects the two cylinders. With a spring-to-open spring cartridge, air to the connection drives the actuator clockwise, towards the "shut" position on the dial; with a spring-to-close spring cartridge, air to the connection drives the actuator counterclockwise, towards the "open" position on the dial.

As the spring-return actuator is cycled, air is alternately exhausted and drawn in through two breathers—one on each cylinder as shown in Figure 1. The breathers must be protected from water because water inside of the actuator will cause sticking and premature wear of the internal components. If the actuator is located outdoors or in an area that will be hosed down, the breathers must be oriented vertically. The "umbrella" top of the breathers will then prevent water from being drawn in through the breathers. In locations that are submerged or subject to flooding, the breathers must be removed and remotely piped to a protected location.

## Installation *(continued)*

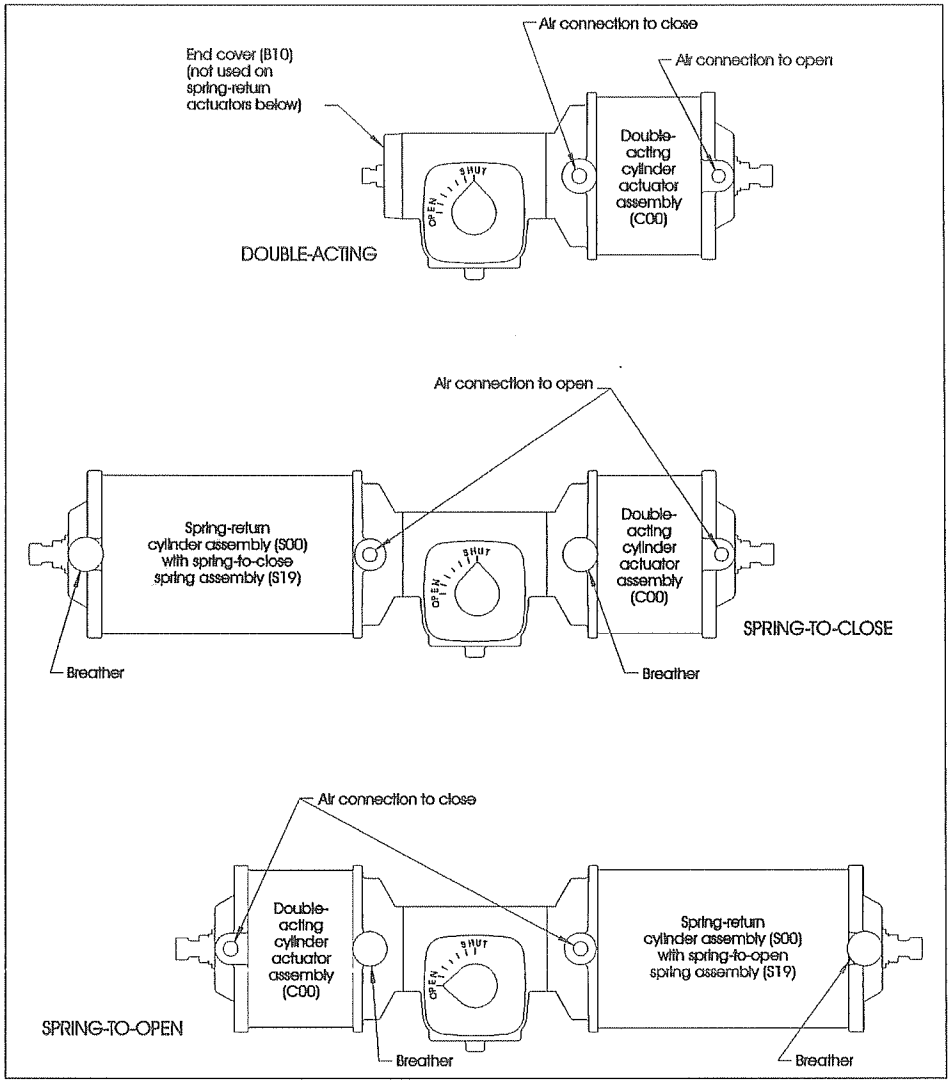



**Figure 1—R1 and R2 PowerRac™ Configurations**

# Operation

The R1 and R2 PowerRac™ actuator is powered pneumatically, and rotates 90° between the open and closed positions, in the direction as described above.

The double-acting cylinder is sized for 50 psi or 80 psi (345 kPa or 550 kPa), and the spring-return cylinder is sized for a 50 psi (345 kPa) spring only.

All cylinders are limited to 100 psi (690 kPa) maximum.

## Lubrication

The actuator has been lubricated at the factory and requires no routine lubrication. If the actuator is disassembled (see Figures 2 thru 4 for actuator parts identification);

apply a paint-like coating using one of these lubricants:

- Dow Corning Molykote No. 44 (**recommended**)
- Shell Retinax AM (alternate)
- Shell Lithall MDS (alternate)

to the following surfaces:

- Inside diameter of cylinder tube (C6 or S6)
- Chamfer for cylinder tube on cylinder cap (C11 or S11) and cylinder head of housing (C1 or S1)
- O-rings (C5 or S5, C8 or S8, and C14 or S14) and grooves
- Seals (C3 or S3 and C9 or S9) and grooves
- Thread seal (C16 or S16)
- Inside diameter of bearing (C2 or S2) located in cylinder head housing.
- Outside diameter of piston rod (C4 or S4).

apply a paint-like coating using one of these lubricants:

- Keystone Zeniplex-1 (**recommended**)
- Amoco Amolith Grease #1-EP (alternate)
- Amsoil GHD (alternate)
- Mobil Mobilux EP 1 (alternate)
- Petro-Canada Vultrex MPG EP 1 (alternate)
- Shell Alvania EP 1 (alternate)
- Texaco Multifak EP 1 (alternate)

to the following surfaces:

- Flat side of rack bearing (B3), before assembly
- Back side of rack (B5) that contacts rack bearing, before assembly
- Both bearing hubs of gear (B8), before assembly
- Top cover O-ring (B10) and groove in top cover (B11), before assembly
- Teeth in rack (B5) and gear (B8) after assembly (so witness marks are visible during assembly).

# Position Stops

The adjustable open and closed position stops prevent the actuator from rotating beyond the open and closed positions of the valve.

## *Double Acting Actuator*

The closed position stop is located in the cylinder cap, and the open position stop is located in the actuator end cover.

## *Spring-Return Actuators*

With a spring-to-open spring cartridge, the closed position stop is located in the spring cylinder (the longer cylinder), and the open position stop is located in the other (shorter) cylinder.

With a spring-to-close spring cartridge, the open position stop is located in the spring cylinder (the longer cylinder), and the closed position stop is located in the other (shorter) cylinder.

## *Adjustments*

If the actuator is factory-mounted on the valve, the stops are preset, and do not require further adjustment. If the actuator is not factory-mounted on the valve, or if the actuator is removed and/or disassembled, the stops will require adjustment as described below. Refer to the Valve Instructions for closed-position information, and adjust the stops after the actuator is mounted on the valve.

The adjustable stops are square head screws, secured with jam nuts, and located in the extreme ends of the actuator as shown in Figures 1 through 4.

To adjust either stop:

1. Loosen the jam nut, and turn the screw counterclockwise to increase the stroke, or clockwise to decrease the stroke.
2. After the stop is adjusted to the desired position, hold the screw from turning, and tighten the jam nut to the torque value shown in Table A.

| Jam Nut | Carbon Steel | | Stainless Steel | |
|---|---|---|---|---|
| | Foot Pounds | Newton Meters | Foot Pounds | Newton Meters |
| 1/2" Nut on 4" Cylinder Cap | 63 ± 8 | 85 ± 11 | 38 ± 5 | 52 ± 7 |
| 5/8" Nut on 6" Cylinder Cap | 130 ± 20 | 176 ± 27 | 77 ± 10 | 104 ± 14 |
| 3/4" Nut on 8" Cylinder Cap | 230 ± 30 | 312 ± 41 | 140 ± 18 | 190 ± 24 |
| 5/8" Nut on End Cover | 130 ± 20 | 176 ± 27 | 77 ± 10 | 104 ± 14 |

## Removing Actuator

Refer to Figure 2 for component identification.

**WARNING!**

**Flow in the pipeline with the actuator removed can allow the valve to slam closed and cause personal injury and/or damage to the flow system. Shut down the flow in the pipeline before removing the actuator from the valve.**

1. Shut down the flow in the pipeline.

**WARNING!**

**Moving parts from unexpected operation of a powered actuator can cause personal injury or equipment damage. Disconnect and lock out power to the actuator before servicing.**

2. Disconnect and lockout the pneumatic power to the actuator to prevent accidental operation of the actuator.
3. Remove the four mounting screws (B26) and lockwashers (B27) that fasten the actuator to the valve.
4. Remove the actuator from the valve by lifting the actuator from the valve shaft.

## Actuator Disassembly

Refer to Figures 2, 3 and 4 for component identification.

1. Remove the two pointer screws (B47) and lockwashers (B48) and remove the gear cover (B9) from the actuator.
2. Remove the four top cover screws (B15) and lockwashers (B14) and remove the top cover (B11).
3. Remove the top cover gasket (B13) and the O-ring (B10).
4. Remove the gear (B8).
5. Remove the four cylinder assembly nuts (B20) and lockwashers (B19), and remove the cylinder assembly (C00) and gasket (B16).
6. Remove the rack screw (B7), the lockwasher (B6), and separate the rack (B5) from the piston rod (C4).
7. Remove the rack bearing (B3) from the pin (B4).
8. If the actuator is double-acting, remove the four end cover nuts (B20) the lockwashers (B19), the end cover (B17) and gasket (B16).
9. If the actuator is spring-return, remove the four cylinder assembly nuts (B20) lockwashers (B19), the spring-return cylinder assembly (S00) and the gasket (B16).

## Actuator Disassembly *(continued)*

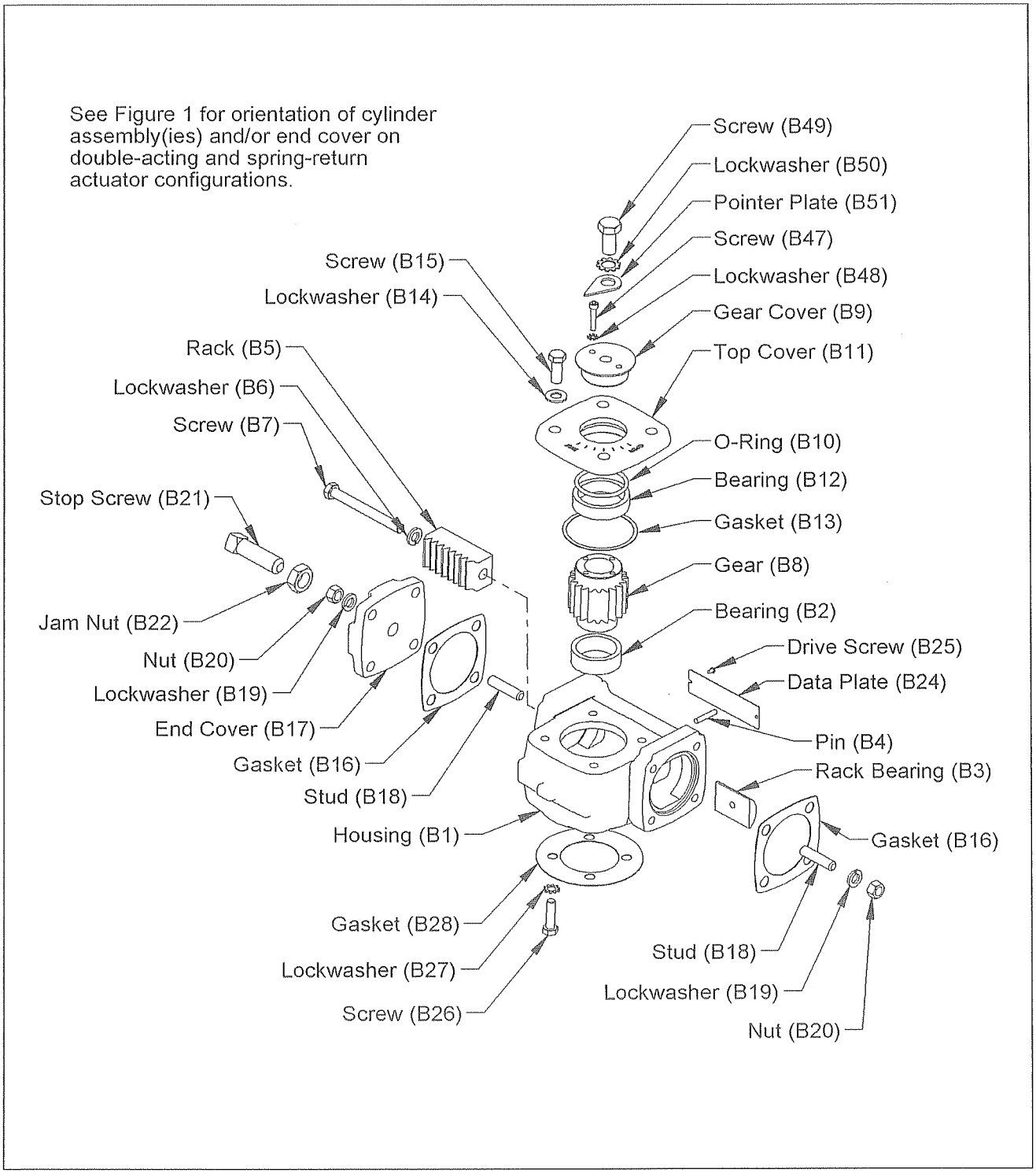



**Figure 2—Actuator Assembly, Less Cylinders**

## Double-Acting Cylinder Disassembly

Refer to Figure 3 for component identification.

1. Remove the tie rod nuts (C15) and washers (C13) from the tie rods (C12).
2. Remove the cylinder cap (C11).
3. Push the piston rod (C4) through the cylinder head (C1), and remove the piston (C7) and piston rod (C4).
4. Remove the piston nut (C10), the piston (C7), and the O-ring (C14) from the piston rod (C4).
5. Remove the cylinder tube (C6) from the cylinder head (C1).
6. Remove the piston seal (C9) and the O-ring (C8) from the piston (C7).
7. Remove the piston rod seal (C3) from the cylinder head (C1).
8. Remove the two cylinder tube O-rings (C5) from the cylinder head (C1) and from the cylinder cap (C11).

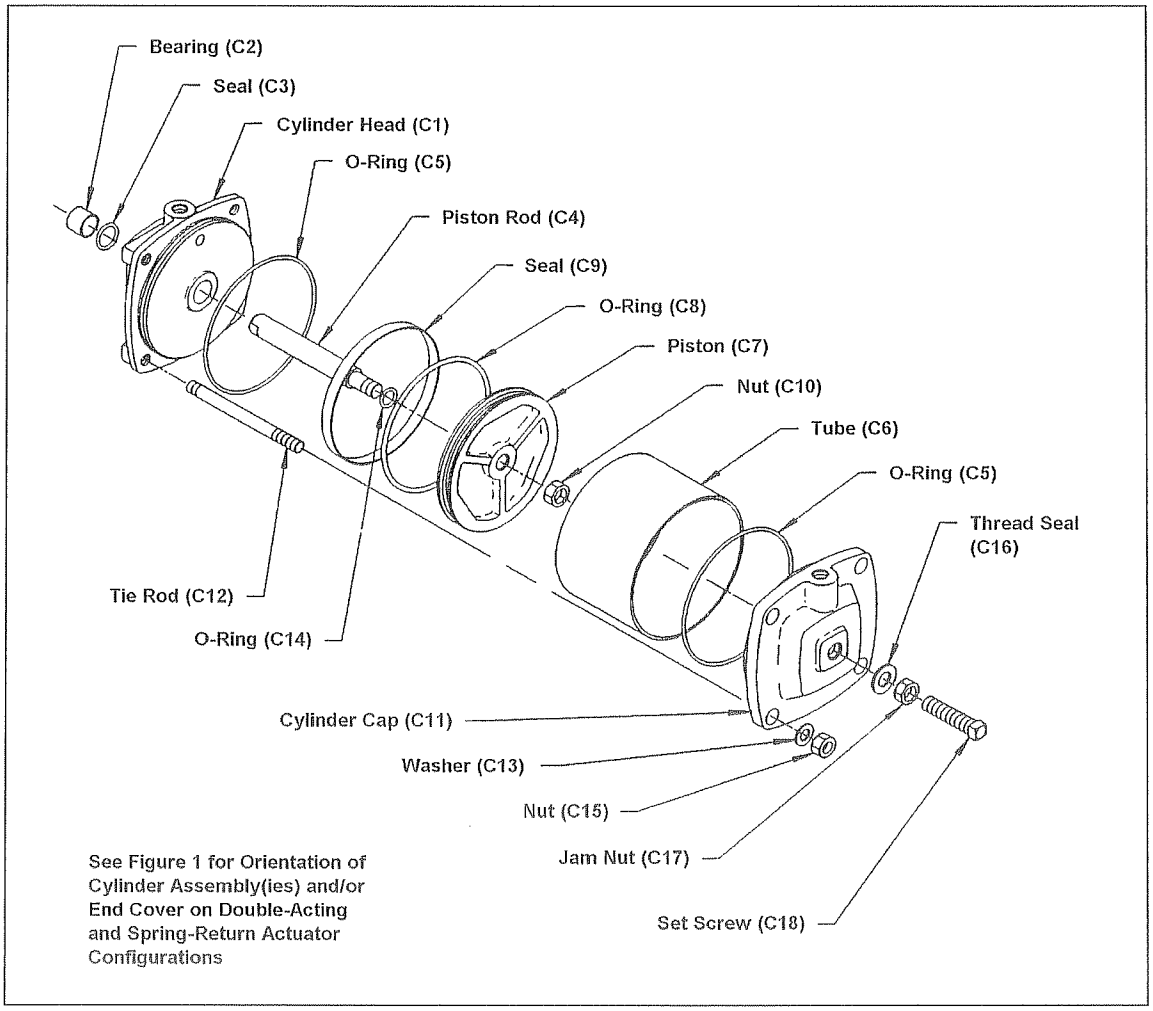



Figure 3—Double-Acting Cylinder Assembly

## Spring-Return Cylinder Disassembly

Refer to Figure 4 for component identification.

**DANGER!**

**The spring assembly (S19) contains a compressed spring that can cause death or personal injury if the cylinder tie rod nuts are removed while the spring force is on the tie rod nuts. DO NOT REMOVE THE CYLINDER TIE ROD NUTS UNLESS THE SPRING FORCE DECREASES TO ZERO!**

1. Loosen the tie rod nuts (S15) on the tie rods (S12).

   ***Note:*** Force from the spring assembly will be felt during the first few turns of the nuts. As the cylinder tie rod nuts are loosened, the force from the spring assembly must decrease to zero before the nuts can be removed from the tie rods. The nuts and washers (S13) may be removed safely after the force from the spring assembly decreases to zero. If the spring force does not decrease to zero, re-tighten the nuts and contact the factory.

2. Remove the cylinder cap (S11).
3. Push the piston rod (S4) through the cylinder head (S1) so that the spring assembly (S19) is accessible.

**DANGER!**

**The spring assembly (S19) contains a compressed spring that can cause death or personal injury if the assembly is taken apart. DO NOT DISASSEMBLE THE SPRING ASSEMBLY!**

4. Remove the spring assembly (S19) carefully from the cylinder tube (S6).

   ***Note:*** Do not damage the cylinder wall with the spring assembly during this step. Do not disassemble the spring assembly!

5. Remove the cylinder tube (S6), the piston (S7) and the piston rod (S4) from the cylinder head (S1).
6. Remove the piston (S7) and the piston rod (S4) from the cylinder tube (S6).
7. Remove the piston nut (S10), the piston (S7) and the O-ring (S14) from the piston rod (S4).
8. Remove the piston seal (S9) and the O-ring (S8) from the piston (S7).
9. Remove the piston rod seal (S3) from the cylinder head (S1).
10. Remove the two cylinder tube O-rings (S5) from the cylinder head (S1) and from the cylinder cap (S11).

## Spring-Return Cylinder Reassembly

Clean and inspect all parts before reassembly. Refer to Figure 4 for component identification. See Figure 1 for orientation of cylinder assembly and end cover on spring-to-open and spring-to-close actuator configurations. See "*Lubrication*" section for lubricating requirements.

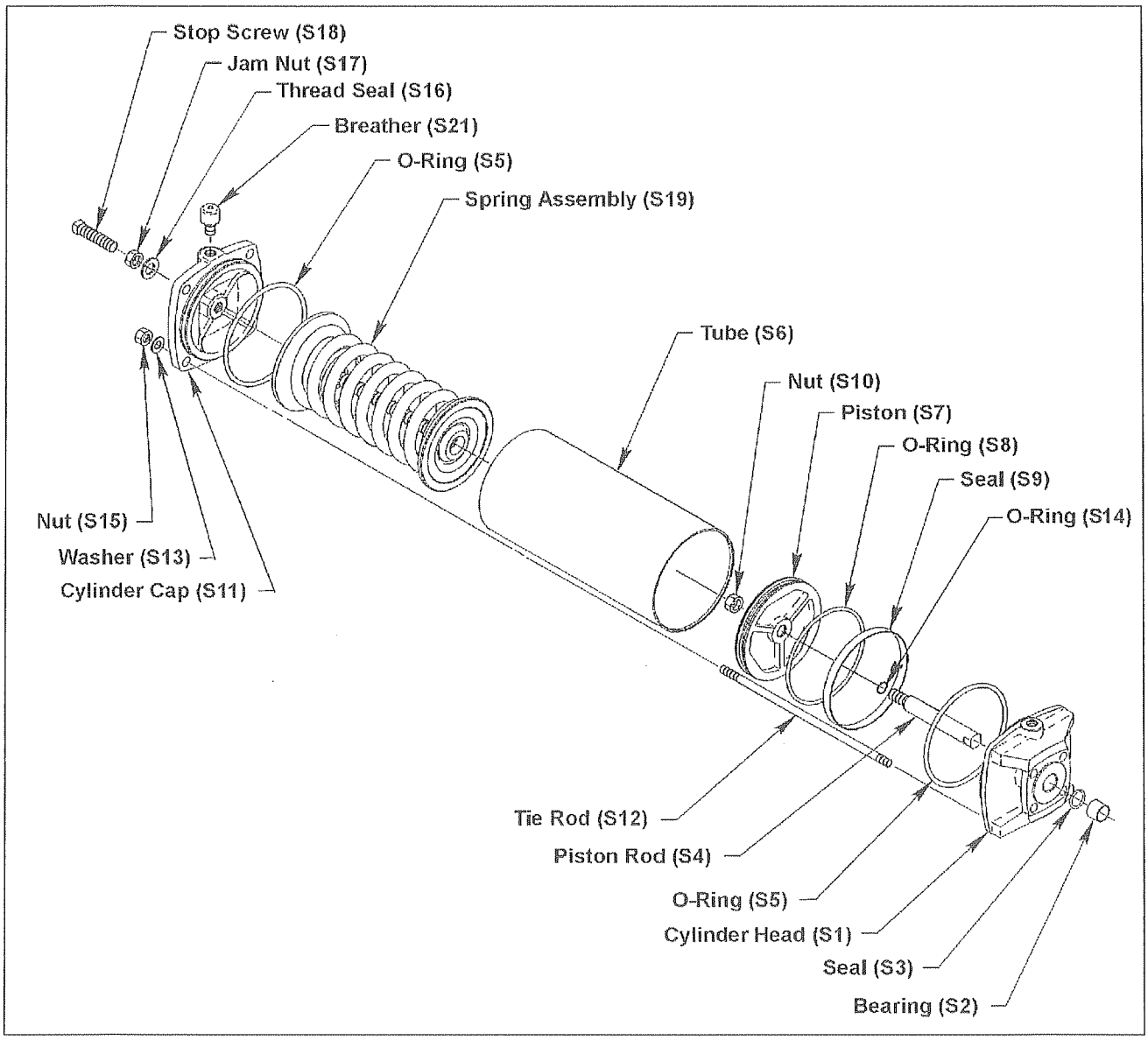



Figure 4—Cylinder Assembly

1. Replace worn parts, especially sealing components such as O-rings, other seals, and the cylinder tube.
2. Lubricate O-rings, other seals, and the cylinder tube walls.
3. With the O-ring and groove toward the piston rod, place the O-ring (S14), the piston (S7), and the nut (S10) on the piston rod (S4).

## Spring-Return Cylinder Reassembly *(continued)*

4. Tighten the nut to 45 ± 5 foot pounds (61 ± 7 Nm).
5. Place the O-ring (S8) in the smaller groove of the piston (S7). Place the piston seal (S9) in the larger groove of the piston as far around the circumference as possible without stretching the seal. Angle the remaining portion of the seal, and carefully slip it over the edge of the piston and into the groove.
6. Place the piston rod seal (S3) in the cylinder head (S1).
7. Push the piston rod (S4) through the cylinder head (S1) so that the piston (S7) is against the cylinder head.
8. Place the two cylinder tube O-rings (S5) in the groove in the cylinder head (S1) and in the groove in the cylinder cap (S11).
9. Using care to avoid damage to the piston seal (S9), replace the cylinder tube following the appropriate steps for the size:
    a. If the cylinder tube (S6) diameter is 6 or 8" (150 mm), place the cylinder tube over the piston (S7) at about a 45° angle. Carefully square the cylinder tube into alignment with the piston, and push the cylinder tube into position on the cylinder head (S1).
    b. If the cylinder tube diameter is 4" (100 mm), push the cylinder tube on straight, without the angle.
10. Note the end of the spring assembly (S19) that has a 1 1/8" (29 mm) diameter machined hole. With the hole toward the piston (S7), carefully insert the spring assembly into the cylinder tube (S6) so that the hole fits over the piston nut (S10). Do not damage the cylinder wall with the spring assembly during this step.
11. Align the holes in the cylinder cap (S11) with the tie rods (S12) and insert the cylinder cap into the cylinder tube (S6). Place the tie rod nuts (S15) and washers (S13) on the tie rods. If the cylinder tube diameter is 4" (100 mm), tighten the nuts (5/16") to 12 ± 2 foot pounds (16 ± 3 Nm); if the cylinder tube diameter is 6" (150 mm), tighten the nuts (1/2") to 16 ± 2 foot pounds (22 ± 3 Nm).

## Double-Acting Cylinder Reassembly

Clean and inspect all parts before reassembly. Refer to Figure 3 for component identification. See "*Lubrication*" section for lubricating requirements.

1. Replace worn parts, especially sealing components such as O-rings, other seals, and the cylinder tube.
2. Lubricate O-rings, other seals, and the cylinder tube walls.
3. With the O-ring and groove toward the piston rod, place the O-ring (S14), the piston (S7), and the nut (S10) on the piston rod (S4).
4. Tighten the nut to 45 ± 5 foot pounds (61 ± 7 Nm).
5. Place the O-ring (S8) in the smaller groove of the piston (S7). Place the piston seal (S9) in the larger groove of the piston as far around the circumference as possible without stretching the seal. Angle the remaining portion of the seal, and carefully slip it over the edge of the piston and into the groove.

## Double-Acting Cylinder Reassembly *(continued)*

6. Place the piston rod seal (S3) in the cylinder head (S1).
7. Push the piston rod (S4) through the cylinder head (S1) so that the piston (S7) is against the cylinder head.
8. Place the two cylinder tube O-rings (S5) in the groove in the cylinder head (S1) and in the groove in the cylinder cap (S11).
9. Using care to avoid damage to the piston seal (S9), replace the cylinder tube following the appropriate steps for the size:
    a. If the cylinder tube (S6) diameter is 6 or 8" (150 mm), place the cylinder tube over the piston (S7) at about a 45° angle. Carefully square the cylinder tube into alignment with the piston, and push the cylinder tube into position on the cylinder head (S1).
    b. If the cylinder tube diameter is 4" (100 mm), push the cylinder tube on straight, without the angle.
10. Align the holes in the cylinder cap (S11) with the tie rods (S12) and insert the cylinder cap into the cylinder tube (S6). Place the tie rod nuts (S15) and washers (S13) on the tie rods. If the cylinder tube diameter is 4" (100 mm), tighten the nuts (5/16") to 12 ± 2 foot pounds (16 ± 3 Nm); if the cylinder tube diameter is 6" (150 mm), tighten the nuts (1/2") to 16 ± 2 foot pounds (22 ± 3 Nm).

## Double-Acting Actuator Reassembly

Clean and inspect all parts before reassembly. Refer to Figure 3 for component identification. See *"Lubrication"* section for lubricating requirements.

1. Replace worn parts, especially sealing components such as O-rings and gaskets.
2. Lubricate the following surfaces:
    - The flat side of the rack bearing (B3)
    - Both bearing hubs of the gear (B8)
    - The top cover O-ring (B10) and the groove in the top cover (B11)
    - The teeth in the rack (B5) and in the gear (B8)
3. Place the rack bearing (B3) on the pin (B4).

    ***Note:*** A dab of grease on the curved side of the bearing will help hold it in place.
4. Note the witness mark(s) on the teeth near one end of the rack (B5). Assemble the end of the rack opposite the witness marks to the end of the double-acting piston rod (C4) with the rack screw (B7) and lockwasher (B6). Do not tighten the screw until step number 10.
5. With the pneumatic connections facing upwards (towards the top of the actuator), mount the cylinder assembly (C00) and the gasket (B16) to the housing (B1). Use the four studs (B18) on the left-hand side of the housing, as viewed when facing the data plate (B24) on the housing. Place the lockwashers (B19) and nuts (B20) on the studs. Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.

## Double-Acting Actuator Reassembly *(continued)*

6. With the four tapped holes facing upwards, place the gear (B8) into the housing bearing (B2), and engage the gear teeth with the rack (B5) following the procedure applicable to your configuration:

   - **R1 Actuator on a Keyed valve shaft**

     One tooth on the rack is marked with a raised dot that must mesh between two teeth with similar dots on the R1 gear, as shown in Figure 5.

   - **R2 Actuator on a Keyed valve shaft**

     One tooth on the gear is marked with a raised dot that must mesh between two teeth with similar dots on the R2 rack, as shown in Figure 5.

   - **R1 Actuator on a Double-D valve shaft**

     One tooth on the rack is marked with a raised dot that must mesh between one of two pair of teeth with similar dots on the R1 gear. The correct pair of teeth to use is shown in Figure 5, as determined by the desired actuator mounting position on the valve. The optional mounting positions are shown on the Valve Installation Drawing.

   - **R2 Actuator on a Double-D valve shaft**

     Two non-adjacent teeth on the gear are marked with a raised dot. One of the marked gear teeth must mesh between the two adjacent teeth with similar dots on the R2 rack. The correct gear tooth to use is shown in Figure 5, as determined by the desired actuator mounting position on the valve. The optional mounting positions are shown on the Valve Installation Drawing.

## Double-Acting Actuator Reassembly *(continued)*

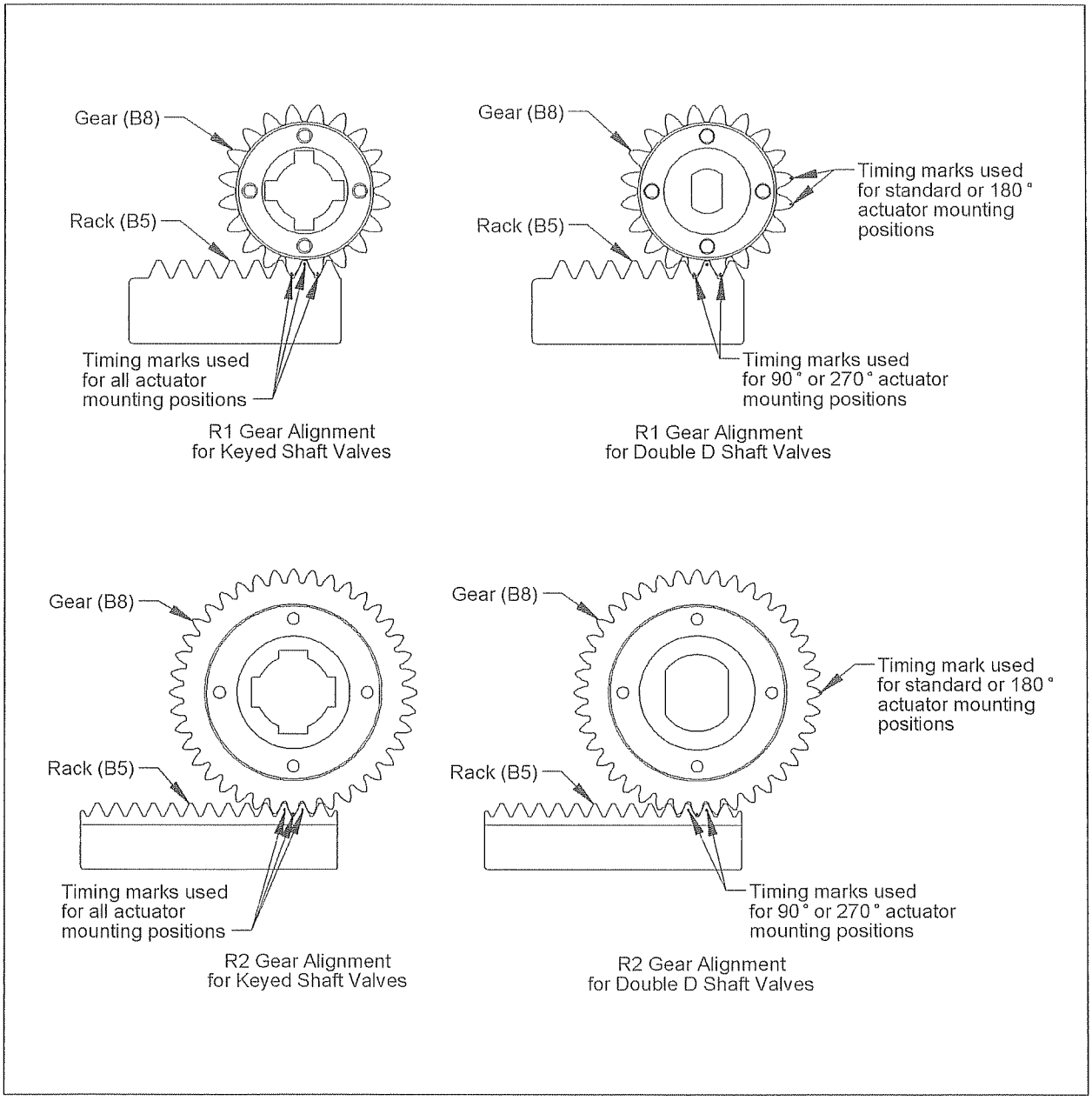



**Figure 5 — Gear Alignment**

7. Place the O-ring (B10) in the groove of the top cover (B11).
8. Mount the top cover (B11) and gasket (B13) to the housing (B1) with the four screws (B15) and washers (B14). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
9. Place the actuator in the open position (with the piston rod C4 extended into the actuator) before the next step.

## Double-Acting Actuator Reassembly *(continued)*

10. Tighten the rack screw (B7):
    - On the R1 model, tighten the screw (3/8") to 35 ± 5 foot pounds (47 ± 7 Nm)
    - On the R2 model, tighten screw (1/2") to 89 ± 12 foot pounds (121 ± 16 Nm).
11. Turn the jam nut (B22) onto the stop screw (B21), and turn the stop screw into the center hole in the end cover (B17) until the end of the stop screw protrudes about 1/4" (6 mm) through the end cover. Turn the jam nut finger tight.
12. Mount the end cover (B17) and the gasket (B16) to the housing studs (B18) with the four nuts (B20) and lockwashers (B19). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
13. With the actuator in the open or closed position, align the gear cover (B9) with the corresponding position on the top cover (B11). Mount the gear cover (B9) to the gear with the two screws (B47) and washers (B48). On the R1 model, tighten the screws (#10-24) to 18 ± 2 inch pounds (2.0 ± 0.2 Nm); on the R2 model, tighten the screws (5/16") to 8 ± 1 foot pounds (11 ± 1 Nm).
14. Align the pointer plate (B51) with the corresponding position on the top cover (B11) and tighten the pointer plate to the gear cover (B9) with screw (B49) and lockwasher (B50).

## Spring-Return Actuator Reassembly

Clean and inspect all parts before reassembly. Refer to Figure 4 for component identification. See "*Lubrication*" section for lubricating requirements.

1. Replace worn parts, especially sealing components such as O-rings and gaskets.
2. Lubricate the following surfaces:
   - The flat side of the rack bearing (B3)
   - Both bearing hubs of the gear (B8)
   - The top cover O-ring (B10) and the groove in the top cover (B11)
   - The teeth in the rack (B5) and in the gear (B8)
3. Place the rack bearing (B3) on the pin (B4).

   ***Note:*** A dab of grease on the curved side of the bearing will help hold it in place.
4. Note the witness mark(s) on the teeth near one end of the rack (B5). Assemble the end of the rack opposite the witness marks to the end of the double-acting piston rod (C4) with the rack screw (B7) and lockwasher (B6). Do not tighten the screw until step number 10.
5. With the pneumatic connections facing upwards (towards the top of the actuator), mount the cylinder assembly (C00) and the gasket (B16) to the housing (B1). Using the four studs (B18) on the side of the housing, place the nuts (B20) and lockwashers (B19) on the studs. Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.

   ***Note:*** The cylinder assembly (C00) is mounted on the left-hand side of the housing for spring-to-close (as viewed when facing the data plate (B24) on the housing) and on the right-hand side for spring-to-open.
6. With the four tapped holes facing upwards, place gear (B8) into the housing bearing (B2), and engage the gear teeth with the rack (B5) according to configuration:
   - **R1 Actuator on a Keyed valve shaft**

     One tooth on the rack is marked with a raised dot that must mesh between two teeth with similar dots on the R1 gear, as shown in Figure 6.
   - **R2 Actuator on a Keyed valve shaft**

     One tooth on the gear is marked with a raised dot that must mesh between two teeth with similar dots on the R2 rack, as shown in Figure 6.
   - **R1 Actuator on a Double-D valve shaft**

     One tooth on the rack is marked with a raised dot that must mesh between one of two pair of teeth with similar dots on the R1 gear. The correct pair of teeth to use is shown in Figure 6, as determined by the desired actuator mounting position on the valve. The optional mounting positions are shown on the Valve Installation Drawing.
   - **R2 Actuator on a Double-D valve shaft**

     Two non-adjacent teeth on the gear are marked with a raised dot. One of the marked gear teeth must mesh between the two adjacent teeth with similar dots on the R2 rack. The correct gear tooth to use is shown in Figure 6, as determined by the desired actuator mounting position on the valve. The optional mounting positions are shown on the Valve Installation Drawing.

## Spring-Return Actuator Reassembly *(continued)*

7. Place the O-ring (B10) in the groove of the top cover (B11).

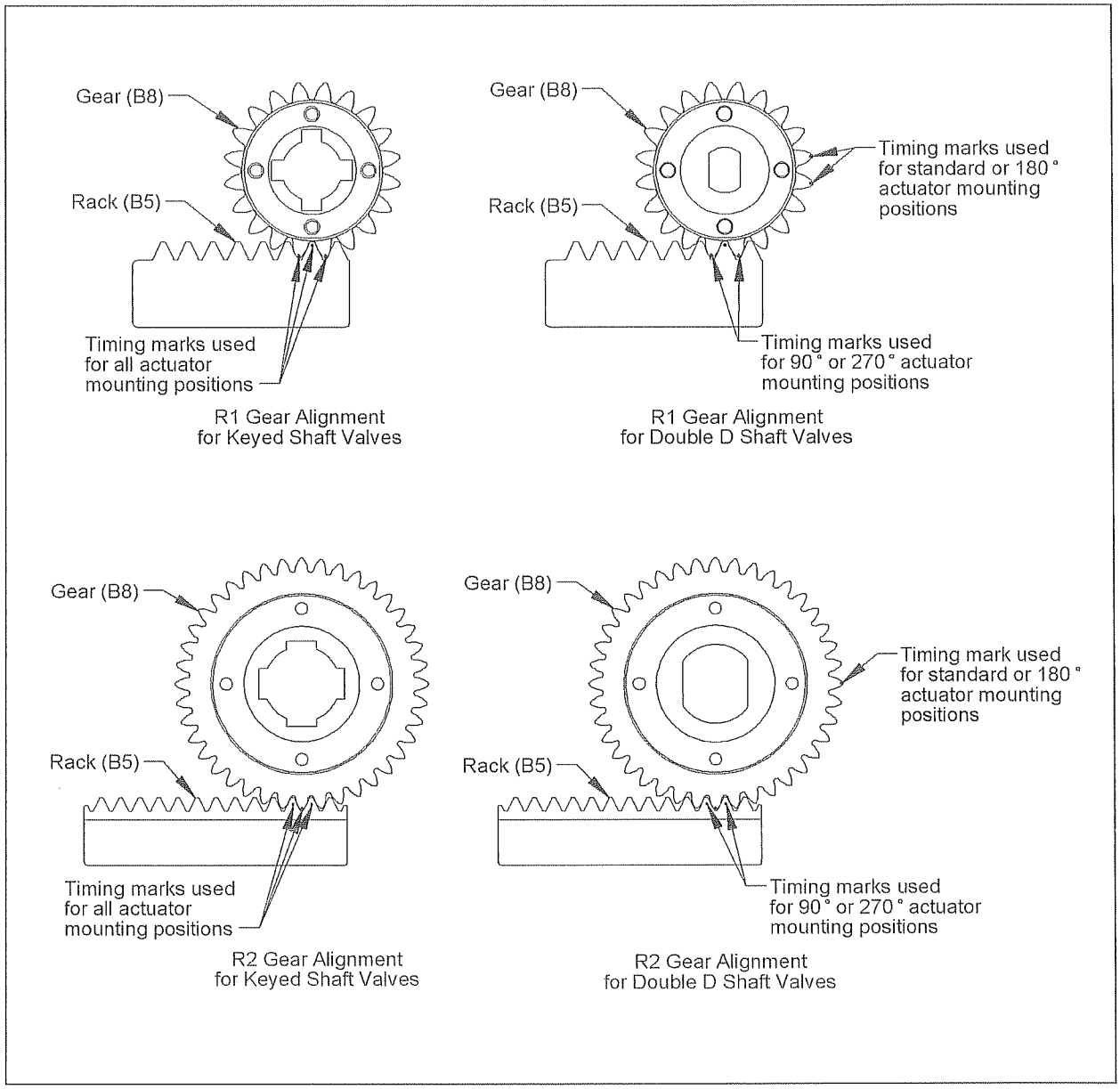



**Figure 6 — Gear Alignment**

8. Mount the top cover (B11) and gasket (B13) to the housing (B1) with the four screws (B15) and washers (B14). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
9. Place the actuator open position for a spring-to-close actuator or the closed position for a spring-to-open actuator.

## Spring-Return Actuator Reassembly *(continued)*

10. Tighten the rack screw (B7).
    - On the R1 model, tighten the screw (3/8") to 35 ± 5 foot pounds (47 ± 7 Nm)
    - On the R2 model, tighten screw (1/2") to 89 ± 12 foot pounds (121 ± 16 Nm).
11. Turn the jam nut (B22) onto the stop screw (B21), and turn the stop screw into the center hole in the end cover (B17) until the end of the stop screw protrudes about 1/4" (6 mm) through the end cover. Turn the jam nut finger tight.
12. Mount the spring-return cylinder (S00) and the gasket (B16) to the housing studs (B18) with the four nuts (B20) and lockwashers (B19). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
13. With the actuator in the open or closed position, mount the gear cover (B9) to the gear with the two screws (B47) and washers (B48). On the R1 model, tighten the screws (#10-24) to 18 ± 2 inch pounds (2.0 ± 0.2 Nm); on the R2 model, tighten the screws (5/16") to 8 ± 1 foot pounds (11 ± 1 Nm).
14. Align the pointer plate (B51) with the corresponding position on the top cover (B11) and tighten the pointer plate to the gear cover (B9) with screw (B49) and lockwasher (B50).

# Mounting Actuator

Refer to Figure 2 for component identification.

1. Determine which of the four actuator-to-valve mounting positions is desired, as shown on the Valve Installation Drawing.
2. Match the open or closed position of the valve with the open or closed position of the actuator.
3. Note the position of the word "open" on the top cover (B11).
4. Position the cover on the housing (B1) so that dial hash mark for "open" will be parallel with the pipeline when the valve is installed.

   ***Note:*** One or more of the steps below may be required, depending upon the mounting position selected, the type of valve shaft, and the positions of the valve, actuator, and actuator cover.

   a. Rotate the valve shaft.

   b. Stroke the actuator.

   c. Select a different actuator-to-valve mounting position.

   d. Remove and re-index the actuator cover: Remove the four cover screws (B15), rotate the cover, and replace the four cover screws (B15) and washers (B14). Tighten the screws to 15 ± 2 foot pounds (20 ± 3 Nm).

   e. If the valve has a double-D shaft connection, the actuator may be mounted in the standard or 180° position with a given gear-timing configuration, or may be mounted in the 90° or 270° position with an alternative gear-timing configuration. To change to the other configuration, remove the cover screws (B15), the cover (B11), and the gear (B8). Then re-time the gear and replace the cover as described in steps 6 and 7 in the *"Double-Acting Actuator Reassembly"* section.

## Mounting Actuator *(continued)*

5. Place the gasket (B28) between the actuator and the valve, engage the actuator with the valve shaft in the desired mounting position, and slide the actuator onto the valve shaft.

   ***Note:*** Certain high-temperature valves include and require a high-temperature gasket. If the valve includes a gasket, use the gasket included with the valve rather than the gasket included with the actuator.

6. Assemble the four actuator mounting screws (B26) with lockwashers (B27) up through the mounting holes in the top of the valve (or the actuator adaptor on the valve), through the gasket (B28), and into the threaded holes in the bottom of the actuator. Tighten the four actuator mounting screws (B26):

   - **For the R1 actuator**, tighten the screws to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel
   - **For the R2 actuator**, tighten the screws to 83 ± 10 foot pounds (113 ± 14 Nm) if carbon steel, or to 38 ± 5 foot pounds (52 ± 7 Nm) if stainless steel.

7. Adjust the open and closed position stops as explained in the "*Open and Closed Position Stops*" section.

8. Operate the actuator and valve three full cycles to demonstrate that the unit operates smoothly in both directions. Do not exceed 100 psi (690 kPa) in cylinder(s).

## Changing from Double-Acting to Spring-Return Spring-to-Close

1. Relieve the cylinder pressure, if any, to the actuator.
2. If an actuator accessory will be mounted on the actuator, refer to the Accessory Kit Instructions for cylinder orientation requirements. Certain actuator accessories require the cylinder ports to be rotated 180° to provide piping clearance.
3. Remove the end cover (B17) and gasket (B16) by removing the four nuts (B20) and lockwashers (B19). The end cover, including the stop screw (B21) and jam nut (B22), are not required on a spring-return actuator.
4. Loosen the jam nut (C17) and back out the stop screw (C18) on the double-acting cylinder assembly (C00).
5. Mount the spring-return cylinder assembly (S00) and gasket (B16) to the studs from which the end cover was removed. Use the same four nuts (B20) and lockwashers (B19). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
6. If actuator sizing requires a larger (or smaller) double-acting cylinder, replace the double-acting cylinder by following the steps below; however the locations of the two cylinders with respect to the actuator must remain unchanged.
7. Adjust the open and closed position stops as explained in the "*Open and Closed Position Stops*" section.

## Changing from Double-Acting to Spring-Return Spring-to-Open

1. If the actuator is on a valve, remove the actuator from the valve as described in the *"Removing Actuator"* section.
2. If an actuator accessory will be mounted on the actuator, refer to the Accessory Kit Instructions for cylinder orientation requirements. Certain actuator accessories require the cylinder ports to be rotated 180° to provide piping clearance.
3. Remove the two pointer screws (B47), and remove the gear cover (B9) from the actuator.
4. Remove the four top cover screws (B15), and remove the top cover (B11) and gear (B8).
5. Remove the four cylinder assembly nuts (B20) and lockwashers (B19), and remove the cylinder assembly (C00).
6. Remove the end cover (B17) and gasket (B16) by removing the four nuts (B20) and lockwashers (B22). The end cover, including the stop screw (B21) and jam nut (B22), may be discarded.
7. Loosen the rack screw (B7), but do not remove the rack screw and rack (B5) from the piston rod (C4). Rotate the rack 180° on the rack screw.
8. Ensure that the rack bearing (B3) has stayed in position on the pin (B4). A dab of grease on the curved side of the rack bearing will help to hold it in place if necessary.

## Changing from Double-Acting to Spring-Return Spring-to-Open *(continued)*

9. Mount the double-acting cylinder assembly and gasket (B16) to the studs from which the end cover was removed. Place the nuts (B20) and lockwashers (B19) on the studs. Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel. Replace the gear (B8), and engage the teeth with the rack (B5) as follows:

    - **R1 actuator on a Keyed valve shaft**

      One tooth on the rack is marked with a raised dot that must mesh between two teeth with similar dots on the R1 gear, as shown in Figure 6.

    - **R2 Actuator on a Keyed valve shaft**

      One tooth on the gear is marked with a raised dot that must mesh between two teeth with similar dots on the R2 rack, as shown in Figure 6.

    - **R1 Actuator on a Double-D valve shaft**

      One tooth on the rack is marked with a raised dot that must mesh between one of two pair of teeth with similar dots on the R1 gear. The correct pair of teeth to use is shown in Figure 6, as determined by the desired actuator mounting position on the valve. The optional mounting positions are shown on the Valve Installation Drawing.

    - **R2 Actuator on a Double-D valve shaft**

      Two non-adjacent teeth on the gear are marked with a raised dot. One of the marked gear teeth must mesh between the two adjacent teeth with similar dots on the R2 rack. The correct gear tooth to use is shown in Figure 6, as determined by the desired actuator mounting position on the valve. The optional mounting positions are shown on the Valve Installation Drawing.

10. Mount the top cover (B11) and gasket (B13) to the housing (B1) with the four screws (B15) and washers (B14). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
11. Place the actuator in the open position (with the rack B5 extended into the actuator) before the next step.
12. Tighten the rack screw (B7). On the R1 actuator, tighten the screw (3/8") to 35 ± 5 foot pounds (47 ± 7 Nm); on the R2 actuator, tighten the screw (1/2") to 89 ± 12 foot pounds (121 ± 16 Nm).
13. Loosen the jam nut (C17) and back out the stop screw (C18) on the double-acting cylinder assembly (C00).
14. Mount the spring-return cylinder assembly (S00) and gasket (B16) to the same studs from which the double-acting cylinder assembly was removed. Place the nuts (B20) and lockwashers (B19) on the studs. Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
15. Mount the gear cover (B9) with the two screws (B47) and washers (B48). On the R1 actuator, tighten the screws (#10-24) to 18 ± 2 inch pounds (2.0 ± 0.2 Nm); on the R2 actuator, tighten the screws (5/16") to 8 ± 1 foot pounds (11 ± 1 Nm).
16. Mount the pointer plate (B51) to the gear cover (B9) with screw (B49) and lockwasher (B50).
17. Replace the actuator on the valve as described in the *"Mounting Actuator"* section.

## Changing from Spring-Return Spring-to-Close to Double-Acting

1. Relieve the cylinder pressure, if any, to the actuator.
2. Remove the four cylinder assembly nuts (B20) and lockwashers (B19), and remove the spring-return cylinder assembly (S00) and gasket (B16).
3. Mount the new end cover (B17) and gasket (B16) to the studs from which the cylinder assembly was removed. Use the same four nuts (B20) and lockwashers (B19). Tighten the nuts to 26 ± 3 foot pounds (35 ± 4 Nm) if carbon steel, or to 15 ± 2 foot pounds (20 ± 3 Nm) if stainless steel.
4. If actuator sizing requires a different sized cylinder, replace the double-acting cylinder by following the steps in the next section.

## Changing from Spring-Return Spring-to-Open to Double-Acting

1. If the actuator is on a valve, remove the actuator from the valve as described in the *"Removing Actuator"* section.
2. Disassemble the actuator as described in the *"Actuator Disassembly"* section.
3. Assemble the actuator as described in the *"Double-Acting Actuator Reassembly"* section.
4. Replace the actuator on the valve as described in the *"Mounting Actuator"* section.

## Reversing Spring Action

**The spring action is not reversible with existing parts.**

The spring action of a spring-return actuator may be reversed from spring-to-open to spring-to-close—or vice versa—as described below; however, a new cylinder assembly with the opposite action is required. Cylinder assemblies with opposite action are not interchangeable; thus a spring-to-close cylinder may not be used for spring-to-open, and a spring-to-open cylinder may not be used for spring-to-close.

1. If the actuator is on a valve, remove the actuator from the valve as described in the *"Removing Actuator"* section.
2. Disassemble the actuator as described in the *"Actuator Disassembly"* section.
3. Assemble the actuator as described in the *"Spring-Return Cylinder Reassembly"* section, except: (a) Reverse the locations of the two cylinder assemblies, and (b) Use the appropriate (spring-to-open or spring-to-close) spring assembly.
4. Replace the actuator on the valve as described in the *"Mounting Actuator"* section.

## Changing Mounting Position

The actuator may be mounted in any of four positions on the valve.

The mounting position may be changed as follows:

1. Remove the actuator from the valve as described in the *"Removing Actuator"* section.
2. Replace actuator on the valve as described in the *"Mounting Actuator"* section.

# Lockable Model

The double-acting and spring-return DeZURIK PowerRac™ R1 and R2 Actuators are each available as a lockable model that allows the actuator to be locked in either the open or closed position. The lockable model is identified by PRL in the catalog characteristic.

As shown in Figure 7, the lockable model has a notched gear (B8) and an enlarged housing (B1) that includes two lock screws (B64) and two jam nuts (B65). A lockout cover assembly (B60) is also included.

**CAUTION!**

**The two lock screws (B64) must be in either the unlocked or the locked position as described in the following sections. The gear (B8) will be damaged if either of the stop screws is placed in an intermediate position between the unlocked and locked positions.**

## *Unlocked Condition*

Under normal unlocked running conditions, both of the lock screws are backed out of the housing to allow the gear to rotate freely in either direction. To be fully disengaged, the distance from the housing to the end of each lock screw must be at least 1.81" (46 mm) on the R1 actuator, and at least 3" (76 mm) on the R2 Actuator. To hold the lock screws in position, the jam nuts are tightened to 38 ± 5 foot pounds (52 ± 7 Nm) on the R1 Actuator, and to 77 ± 10 foot pounds (104 ± 14 Nm) on the R2 actuator.

## *Locked Closed Position*

Follow the steps below to change the unit from the unlocked condition to the locked closed position. Refer to Figure 7 for component identification. Before proceeding, the open and closed position stops must be correctly adjusted as described in the Open and Closed Stops section.

1. Operate the actuator to the fully closed (clockwise) position.

**WARNING!**

**Adjust only the left-side lock screw to lock the actuator in the closed position. Adjusting the wrong screw does not lock the actuator, and can result in personal injury or equipment damage.**

2. Loosen the jam nut (B65) on the **left** side lock screw (B64), as viewed when facing the top of the heads of the lock screws. Hold the lock screw from turning, and turn the jam nut several turns counterclockwise, to the head of the lock screw.
3. Turn the **left** side lock screw clockwise several turns until resistance is felt from the lock screw contacting the notch in the gear (B8). Tighten the lock screw to 5 to 10 foot pounds (7 to 14 Nm) to assure that the lock screw is contacting the gear.
4. Turn the **left** side jam nut clockwise against the actuator housing. While holding the lock screw from turning, tighten the jam nut to 38 ± 5 foot pounds (52 ± 7) on the R1 Actuator, and to 77 ± 10 foot pounds (104 ± 14 Nm) on the R2 Actuator.
5. Place and lock the lockout cover assembly (B60) on head of the **left** side lock screw.

## Lockable Model *(continued)*

### *Locked Open Position*

Follow the steps below to change the unit from the unlocked condition to the locked open position. Refer to Figure 7 for component identification. Before proceeding, the open and closed position stops must be correctly adjusted as described in the Open and Closed Stops section.

1. Operate the actuator to the fully open (counterclockwise) position.

**WARNING!**

**Adjust only the right-side lock screw to lock the actuator in the open position. Adjusting the wrong screw does not lock the actuator, and can result in personal injury or equipment damage.**

2. Loosen the jam nut (B65) on the **right** side lock screw (B64), as viewed when facing the Loosen top of the heads of the lock screws. Hold the lock screw from turning, and turn the jam nut several turns counterclockwise, to the head of the lock screw.
3. Turn the **right** side lock screw clockwise several turns until resistance is felt from the lock screw contacting the notch in the gear (B8). Tighten the lock screw to 5 to 10 foot pounds to assure that the lock screw is contacting the gear.
4. Turn the **right** side jam nut clockwise against actuator housing. While holding the lock screw from turning, tighten the jam nut to 38 ± 5 foot pounds (52 ± 7 Nm) on the R1 Actuator, and to 77 ± 10 foot pounds (104 ± 14 Nm) on the R2 Actuator.
5. Place & lock the lockout cover assembly (B60) on head of the **right** side lockscrew.

## Lockable Model *(continued)*

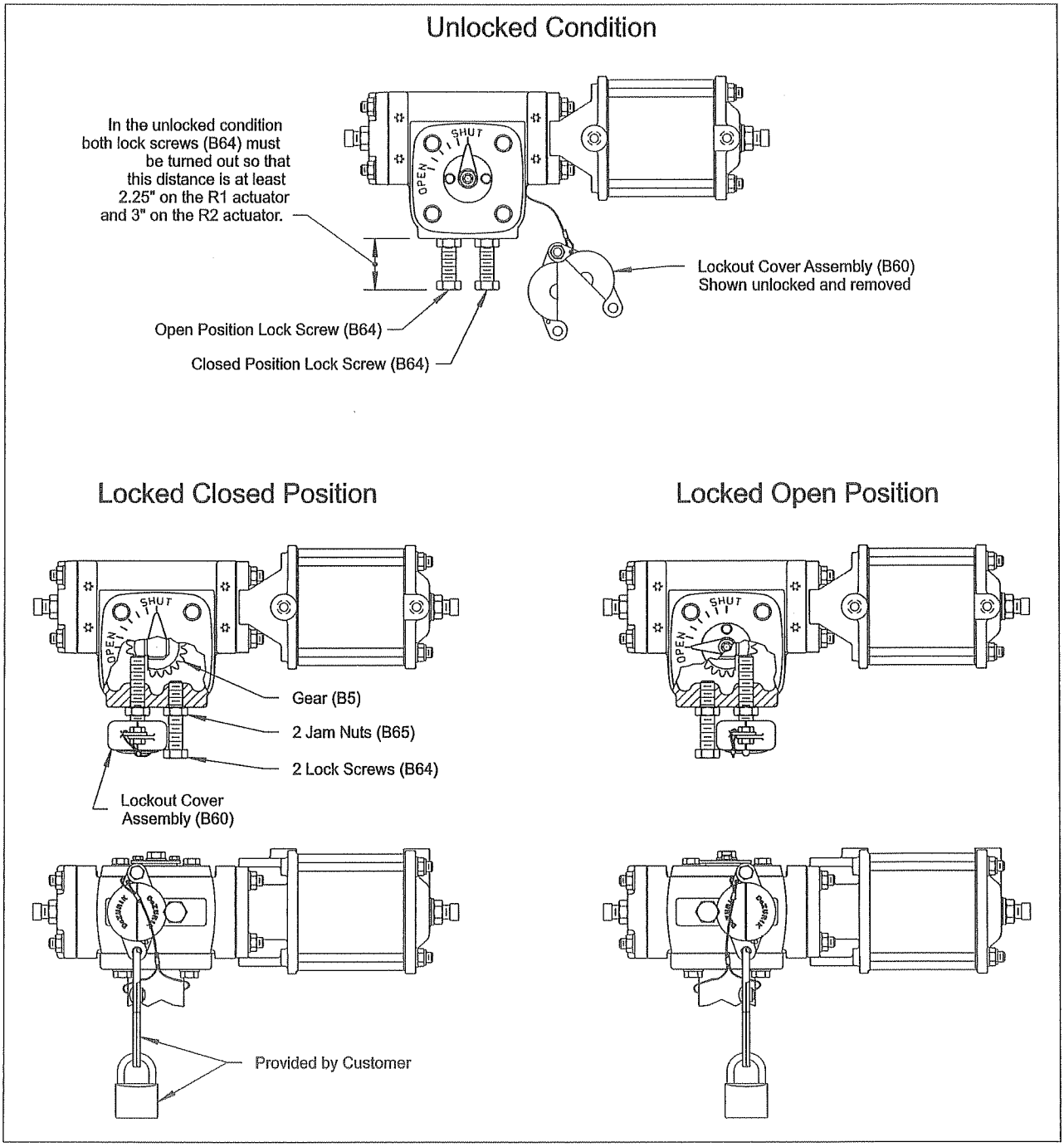
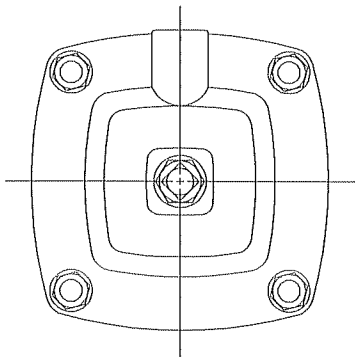


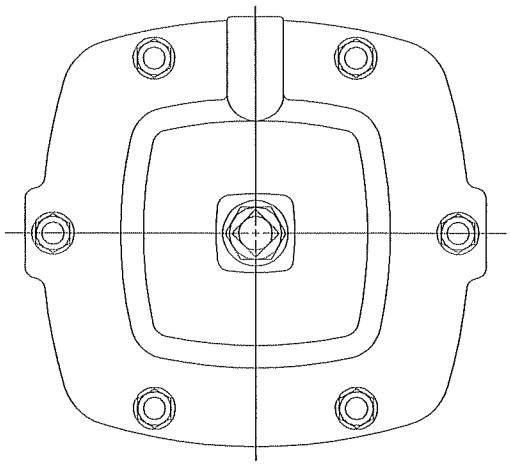

Figure 7 – Lockable Model Component Identification

## Troubleshooting

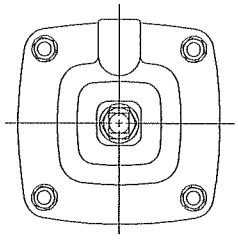
| Condition | Possible Cause | Corrective Action |
|---|---|---|
| Actuator closes to wrong position. | Closed position stop is set incorrectly. | Adjust closed position stop. See *Position Stops* section. |
| Actuator opens to wrong position. | Open position stop is set incorrectly. | Adjust open position stop. See *Position Stops* section. |
| Actuator will not fully operate valve. | Cylinder pressure is low. | Increase cylinder pressure. Do not exceed 100 PSI. |
| | Actuator is not sized correctly. | Use larger actuator. |
| | Piston seal in cylinder is leaking. | Replace piston seal(s). |
| | Cylinder has wrong spring assembly. | Use spring assembly with opposite action. |
| | Obstruction in valve is preventing closure. | Remove obstruction. |
| | Lockable model is locked. | Place in unlocked condition. See *Lockable Model* section. |
| Double-acting actuator rotates wrong direction. | Air connections to cylinder are incorrect. | Reverse air connections to cylinder. |
| Valve fails in wrong direction with spring-return actuator. | Actuator is assembled incorrectly. | Exchange locations of spring-return and double-acting cylinders. |



SC6 & SC6_ CYLINDER
VIEW B – B



SC8 CYLINDER

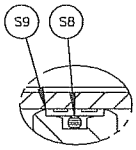


SC4 & SC4A CYLINDER

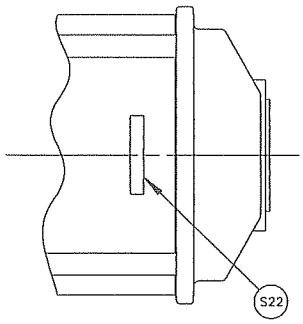
| NO | PART NAME | QTY |
|---|---|---|
| S1 | CYLINDER HEAD | 1 |
| S2 | BEARING | 1 |
| S3 | SEAL (PISTON ROD) | 1 |
| S4 | PISTON ROD | 1 |
| S5 | O-RING (CYLINDER TUBE) | 2 |
| S6 | TUBE | 1 |
| S7 | PISTON | 1 |
| S8 | O-RING (PISTON) | 1 |
| S9 | SEAL (PISTON) | 1 |
| S10 | NUT | 1 |
| S11 | CYLINDER CAP | 1 |
| S12 | TIE ROD (SC4, SC4A, SC6 & SC6_ CYL) | 4 |
| S12 | TIE ROD (SC8 CYL) | 6 |
| S13 | WASHER (SC4, SC4A, SC6 & SC6_ CYL) | 4 |
| S13 | WASHER (SC8 CYL) | 6 |
| S14 | O-RING (PISTON ROD) | 1 |
| S15 | LOCK NUT (SC4, SC4A, SC6 & SC6_ CYL) | 4 |
| S15 | LOCK NUT (SC8 CYL) | 6 |
| S16 | THREAD SEAL (CYLINDER CAP) | – |
| S17 | JAM NUT | 1 |
| S18 | STOP SCREW | 1 |
| S19 | SPRING ASSEMBLY | 1 |
| S21 | BREATHER | 1 |
| S22 | IDENTIFICATION TAG (EXCEPT SC4A & SC6_) | 1 |
| S23 | WARNING TAG | 1 |

NOTE:

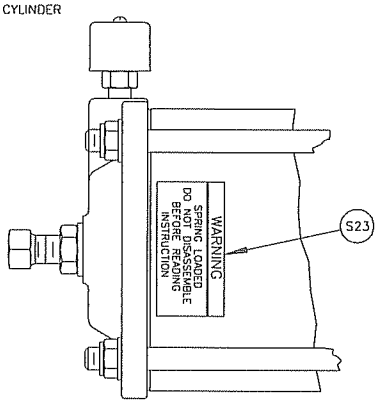
1. WHEN ORDERING PARTS, INCLUDE VALVE SIZE AND PART NUMBER FROM DATA PLATE. ALSO INCLUDE THIS DRAWING NUMBER WITH PART NAME, NUMBER AND QUANTITY.
2. RECOMMENDED SPARE PARTS ARE ITEMS NO S3, S5, S8, S9, S14 AND S16.



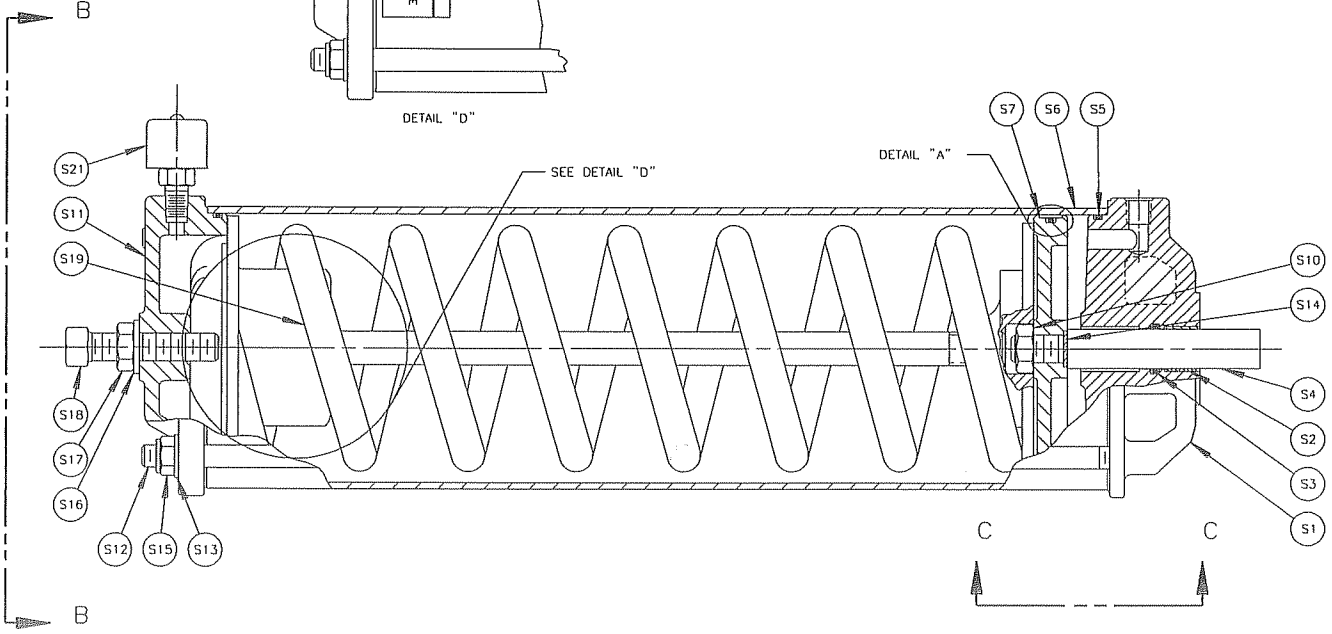

DETAIL "A"
ENLARGED




VIEW C – C




DETAIL "D"




| REV | DATE | ECN |
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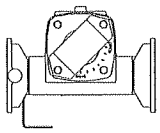
| F | 09/22/98 | 54539 |
| E | 05/18/93 | 52386 |
| D | 06/11/92 | 51948 |
| C | 03/27/92 | 51883 |
| B | 10/22/91 | 50312 |
| A | | |

DeZURIK
Sartell, MN USA 56377
www.dezurik.com

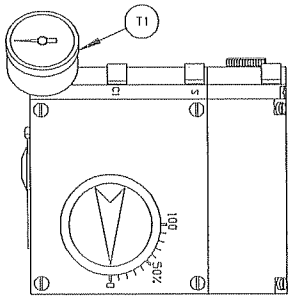
SC4, SC4A, SC6, SC6_ & SC8 SPRING RETURN CYLINDER ASSEMBLY FOR USE WITH POWER RAC SPRING RETURN CYLINDER ACTUATORS

| DOCT. CODE | DRAWN | APPROVED | |
|---|---|---|---|
| C1 | SN | DT | A39532 |
| | CHECKED TNB | DATE 09-04-91 | |

| ACTUATOR NUMBER | DIMENSIONS INCHES / MILLIMETERS | | | |
|---|---|---|---|---|
| | A | B | C | D |
| PR_-R1_-SC4-R-60 | 4.19 / 106 | 5.62 / 143 | 6.75 / 171 | 8.25 / 210 |
| PR_-R1_-SC6-R-60 | 5.25 / 133 | 5.62 / 143 | 6.75 / 171 | 9.62 / 244 |
| PR_-R2_-SC6-R-60 | 5.25 / 133 | 5.94 / 151 | 7.06 / 179 | 9.62 / 244 |
| PR_-R2_-SC8-R-60 | 6.69 / 170 | 5.94 / 151 | 7.06 / 179 | 9.62 / 244 |

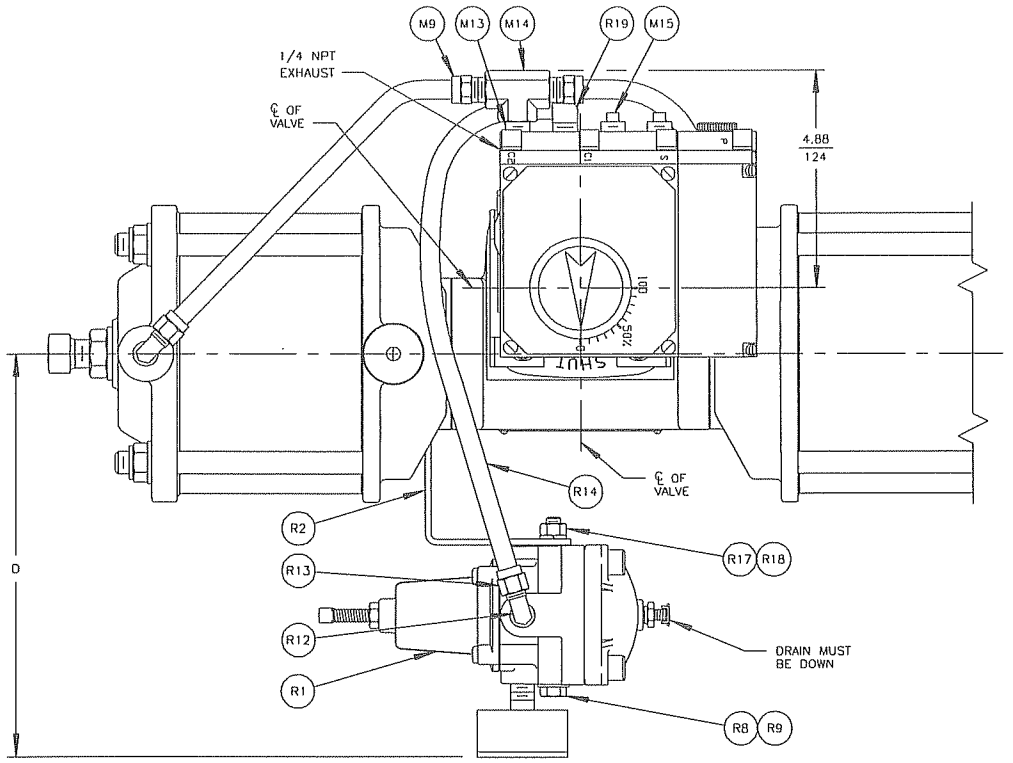


ACCESSORY MOUNTING FOR USE WITH R2_ ACTUATOR



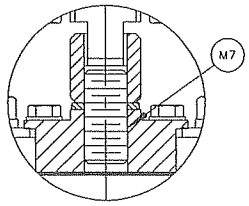

GAGES (OPTIONAL) FURNISHED WHEN G IS ORDERED

| NO | PART NAME | QTY |
|---|---|---|
| M1 | POSITIONER | 1 |
| M2 | BRACKET (R1 ACT'R) | 2 |
| M2 | BRACKET (R2 ACT'R) | 1 |
| M5 | SCREW | 4 |
| M6 | LOCKWASHER | 4 |
| M7 | STUD (WHEN REQUIRED) | 1 |
| M8 | ELBOW | 2 |
| M9 | CONNECTOR | 2 |
| M10 | CONNECTOR, SWIVEL (FOR HOSE CONSTRUCTION ONLY) | 2 |
| M11 | HOSE OR TUBING | – |
| M12 | COUPLING | 1 |
| M13 | NIPPLE | 1 |
| M14 | TEE | 1 |
| M15 | PIPE PLUG | 1 |
| R1 | AIRSET | 1 |
| R2 | BRACKET | 1 |
| R8 | SCREW | 2 |
| R9 | WASHER | 2 |
| R12 | ELBOW | 1 |
| R13 | CONNECTOR, SWIVEL (FOR HOSE CONSTRUCTION ONLY) | 2 |
| R14 | HOSE OR TUBING | – |
| R17 | LOCKWASHER | 2 |
| R18 | NUT | 2 |
| R19 | ELBOW | 1 |
| T1 | GAGE | 1 |

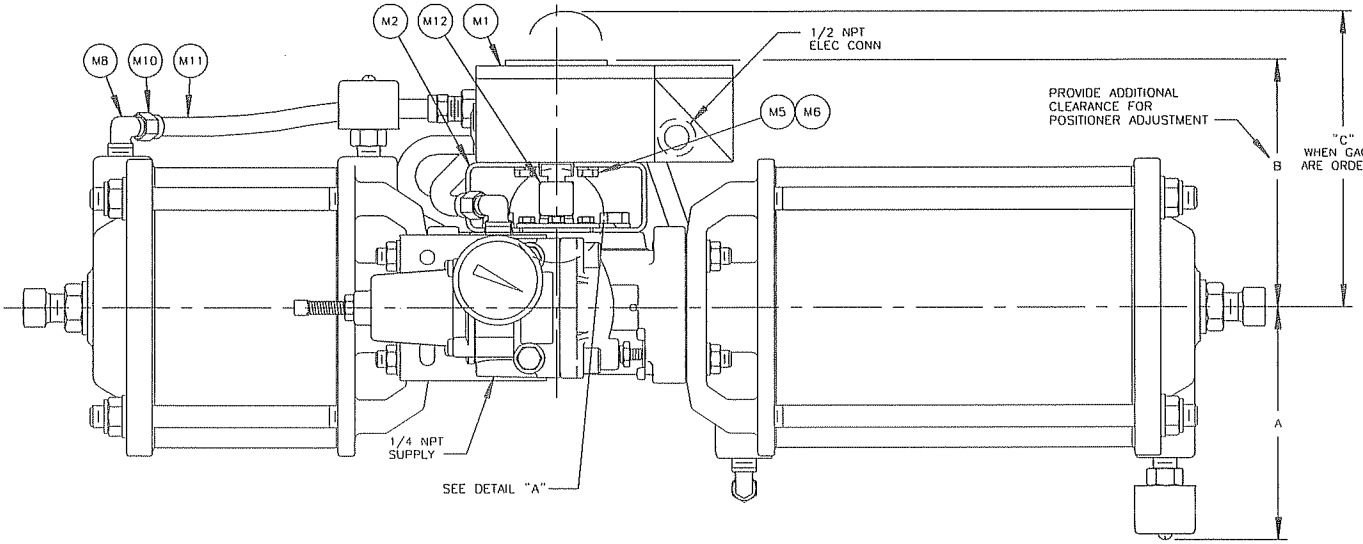



NOTE:

1. WHEN ORDERING PARTS, INCLUDE VALVE SIZE AND PART NUMBER FROM DATA PLATE, ALSO INCLUDE THIS DRAWING NUMBER WITH PART NAME, NUMBER AND QUANTITY.
2. INCREASING SIGNAL TO POSITIONER OPENS VALVE.




DETAIL "A" (ENLARGED)




| G | F | E | D | C | B | A | 02234 | 01/31/12 |
|---|---|---|---|---|---|---|---|---|

DeZURIK
Sartell, MN USA 56377
www.dezurik.com

P41C PMV ELECTRO-PNEUMATIC POSITIONER AND AFR2 FILTER REGULATOR (AIRSET) FOR USE WITH POWERRAC SPRING RETURN CYLINDER ACTUATORS, REVERSE ACTING (SPRING-TO-CLOSE)

| DOCT. CODE | DRAWN | APPROVED |
|---|---|---|
| C1 | MOC | DT |
| | CHECKED | DATE |
| | DT | 05/16/02 |

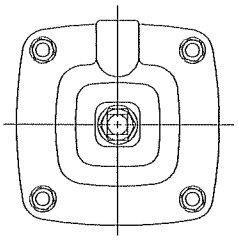
A54303

| NO | PART NAME | QTY |
|---|---|---|
| C1 | CYLINDER HEAD | 1 |
| C2 | BEARING | 1 |
| C3 | SEAL (PISTON ROD) | 1 |
| C4 | PISTON ROD | 1 |
| C5 | O-RING (CYLINDER TUBE) | 2 |
| C6 | TUBE | 1 |
| C7 | PISTON | 1 |
| C8 | O-RING (PISTON) | 1 |
| C9 | SEAL (PISTON) | 1 |
| C10 | NUT | 1 |
| C11 | CYLINDER CAP | 1 |
| C12 | TIE ROD (PC4 & PC6 CYL) | 4 |
| C12 | TIE ROD (PC8 CYL) | 6 |
| C13 | WASHER (PC4 & PC6 CYL) | 4 |
| C13 | WASHER (PC8 CYL) | 6 |
| C14 | O-RING (PISTON ROD) | 1 |
| C15 | LOCK NUT (PC4 & PC6 CYL) | 4 |
| C15 | LOCK NUT (PC8 CYL) | 6 |
| C16 | THREAD SEAL (CYLINDER CAP) | – |
| C17 | JAM NUT | 1 |
| C18 | SET SCREW | 1 |

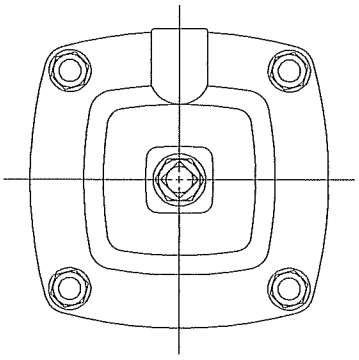
NOTE:

1. WHEN ORDERING PARTS, INCLUDE VALVE SIZE AND PART NUMBER FROM DATA PLATE. ALSO INCLUDE THIS DRAWING NUMBER WITH PART NAME, NUMBER AND QUANTITY.

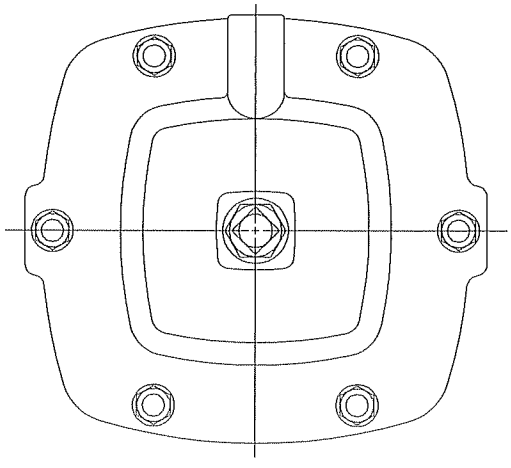
2. RECOMMENDED SPARE PARTS ARE ITEMS NO C3, C5, C8, C9, C14 AND C16.



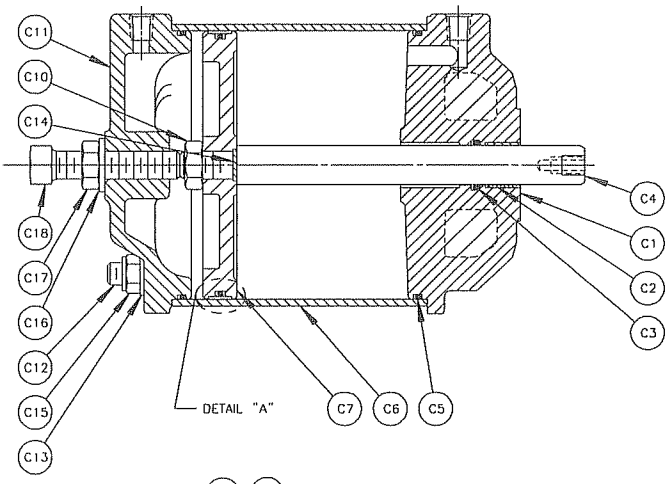
PC4 CYLINDER

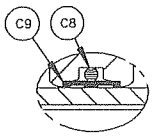


PC6 CYLINDER



PC8 CYLINDER




DETAIL "A"

| G | F | E | D | C | B | A | 53112 | 07/30/92 |
|---|---|---|---|---|---|---|---|---|

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www.dezurik.com

PC4, PC6 & PC8 CYLINDER ASSEMBLY FOR USE WITH POWER RAC DOUBLE ACTING CYLINDER ACTUATORS

| DOCT. CODE | DRAWN | APPROVED |
|---|---|---|
| C1 | SN | DT |
| | CHECKED | DATE |
| | TNB | 09-04-91 |

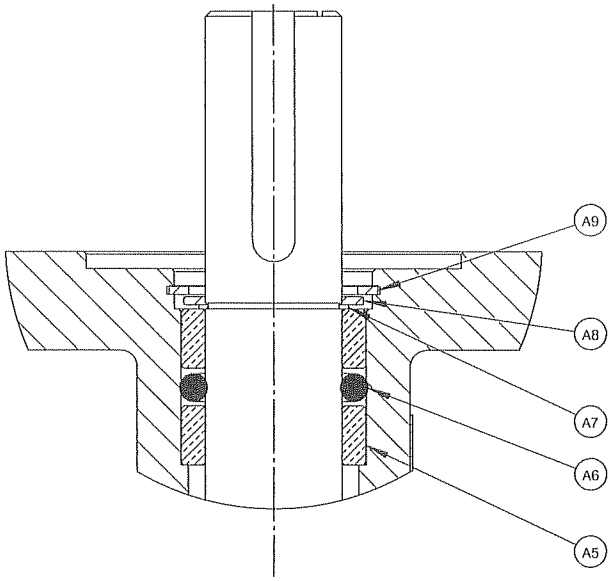
A-37259

| NO | DESCRIPTION | QTY |
|---|---|---|
| A1 | BODY | 1 |
| A2 | DISC | 1 |
| A3 | SHAFT | 1 |
| A4 | BEARING, MIDDLE | 1 |
| A5 | BEARING, UPPER | 2 |
| A6 | O-RING | 1 |
| A7 | RETAINING RING | 1 |
| A8 | WASHER | 1 |
| A9 | RETAINING RING | 1 |
| A10 | KEY | 1 |
| A11 | PIPE PLUG | 1 |
| A12 | BEARING, LOWER | 1 |
| A13 | NAMEPLATE | 1 |
| A14 | DRIVE SCREW | 2 |
| A15 | MARKING PLATE (WHEN REQUIRED) | 1 |
| A16 | DRIVE SCREW (WHEN REQUIRED) | 2 |

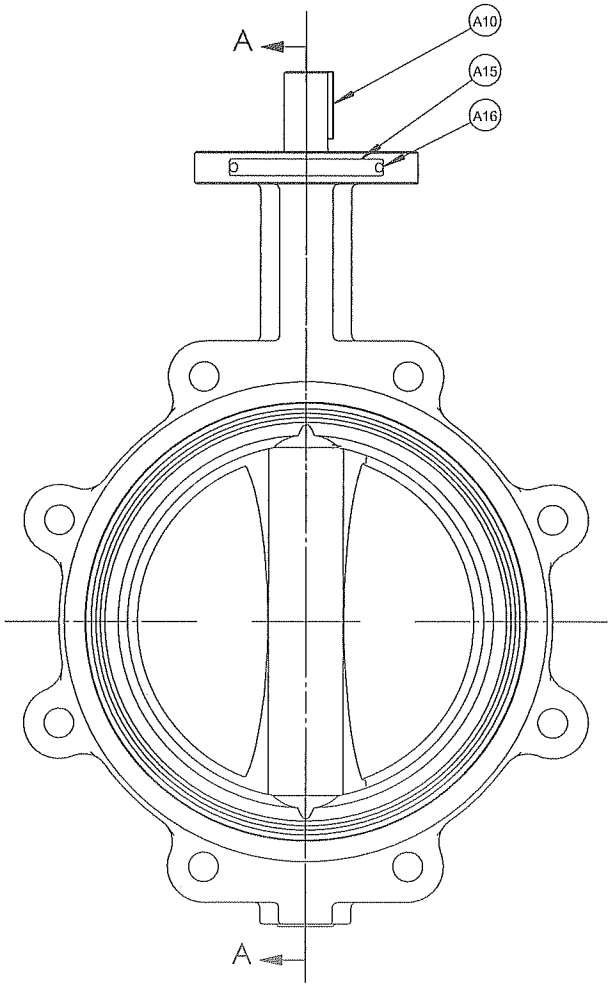
NOTE:

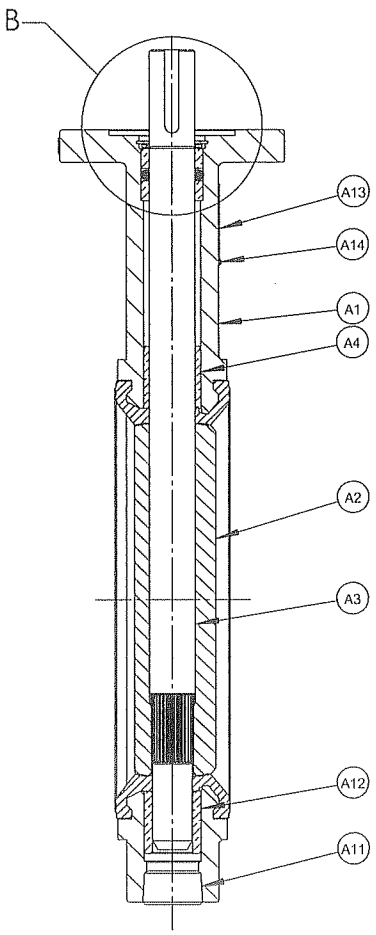
1. WHEN ORDERING PARTS, INCLUDE VALVE SIZE AND PART NUMBER FROM DATA PLATE. ALSO INCLUDE THIS DRAWING NUMBER WITH PART NAME, NUMBER AND QUANTITY.

2. RECOMMENDED SPARE PARTS ARE ITEMS NO A5 AND A6.




DETAIL B




SECTION A-A

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| G | F | E | D | C | B | A | | 9/2/14 | 2/16/09 |
| | | | | | 56312 | 61716 | | | |

DeZURIK
Sartell, MN USA 56377
www.dezurik.com

BOS-US BUTTERFLY VALVES SIZE 2" - 20"
LUGGED VALVE ASSEMBLY

| DOCT CODE | DRAWN | APPROVED | A56940 |
|---|---|---|---|
| C1 | TC | CEG | |
| | CHECKED | DATE | |
| | CEG | 4/10/07 | |

| VALVE SIZE | | DIMENSIONS IN [MM] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| IN | MM | A | B | C | D | E | F | | G |
| 2 | 50 | 1.69 [43] | 6.42 [163] | 3.31 [84] | 5.79 [147] | .51 [13] | 4 | 5/8-11 UNC | 4.75 [121] |
| 2-1/2 | 65 | 1.81 [46] | 7.00 [178] | 3.31 [84] | 6.10 [155] | .51 [13] | 4 | 5/8-11 UNC | 5.50 [140] |
| 3 | 80 | 1.81 [46] | 7.50 [191] | 3.54 [90] | 6.50 [165] | .51 [13] | 4 | 5/8-11 UNC | 6.00 [152] |
| 4 | 100 | 2.06 [52] | 9.00 [229] | 4.47 [114] | 7.52 [191] | .63 [16] | 8 | 5/8-11 UNC | 7.50 [191] |
| 5 | 125 | 2.19 [56] | 10.00 [254] | 4.82 [122] | 8.11 [206] | .63 [16] | 8 | 3/4-10 UNC | 8.50 [216] |
| 6 | 150 | 2.19 [56] | 11.00 [279] | 5.51 [140] | 8.62 [219] | .63 [16] | 8 | 3/4-10 UNC | 9.50 [241] |

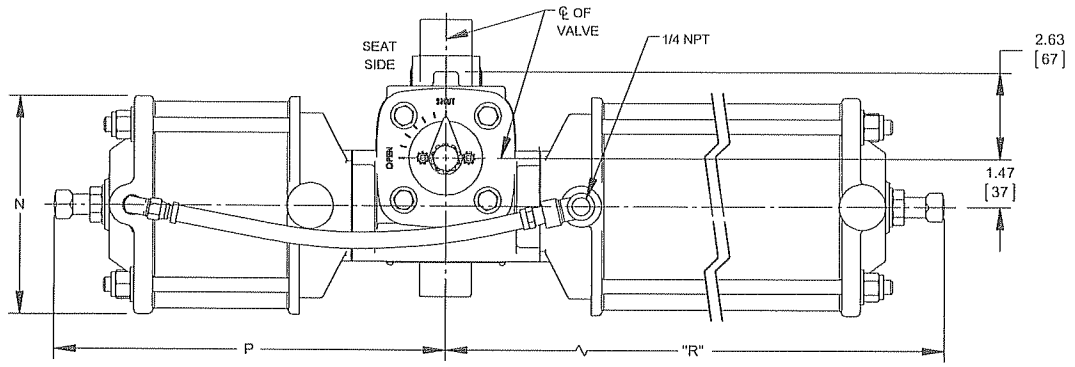
| ACTUATOR NUMBER | DIMENSIONS IN [MM] | | | |
|---|---|---|---|---|
| | M | N | P | R |
| PR_-R1A-SC4-R-60 | 3.88 [99] | 4.50 [114] | 12.12 [308] | 21.00 [533] |
| PR_-R1A-SC6-R-60 | 4.94 [125] | 6.62 [168] | 12.62 [321] | 21.88 [556] |

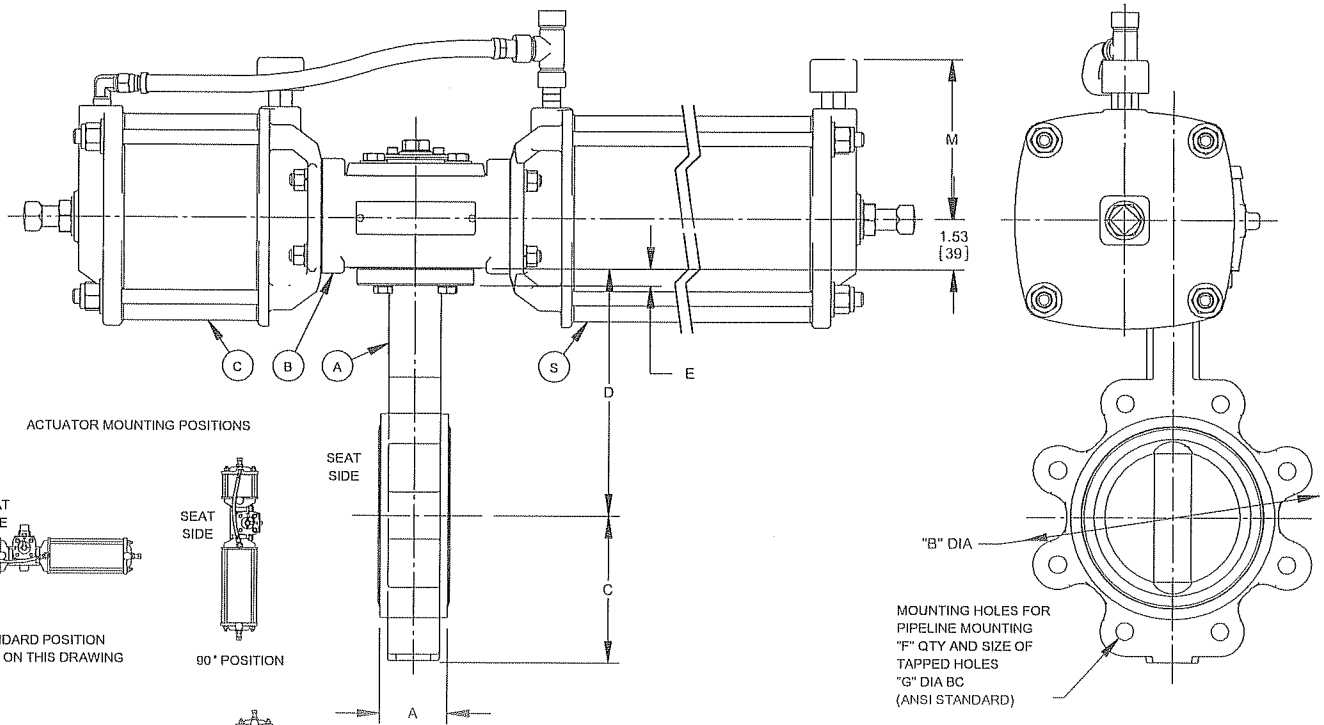
| | |
|---|---|
| A | VALVE |
| B | ACTUATOR |
| C | CYLINDER |
| S | SPRING CYLINDER |

NOTE:

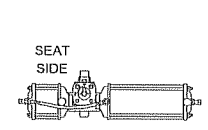
1. DRAWING SHOWS MOUNTING HOLES FOR ANSI CLASS 125/150 FLANGES.
2. FOR FLANGES OTHER THAN ANSI STANDARD SEE D10478 FOR DIMENSIONS.
3. RECOMMENDED FLOW DIRECTION IS WITH THE HIGHER PRESSURE AGAINST THE SEAT SIDE OF VALVE (FLAT SIDE OF DISC).

NOTICE
THIS DRAWING DOES NOT SHOW ACTUATOR ACCESSORIES. IF ACCESSORIES ARE REQUIRED, REFER TO THE APPROPRIATE ACCESSORY INSTALLATION DRAWING FOR DIMENSIONS AND OTHER RELATED INFORMATION.



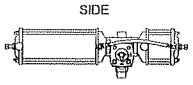

ACTUATOR MOUNTING POSITIONS



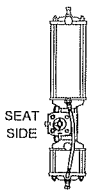

STANDARD POSITION SHOWN ON THIS DRAWING




90° POSITION




180° POSITION




270° POSITION

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DOCT CODE C1

BOS US BUTTERFLY VALVES SIZE 2 - 6 LUGGED
POWERRAC PR-R1A-SC_-R-60 SPRING RETURN CYLINDER ACTUATOR, REVERSE ACTING (SPRING-TO-CLOSE)

| DRAWN | APPROVED |
|---|---|
| SN | SN |
| CHECKED | DATE |
| SN | 8/21/12 |

A59358

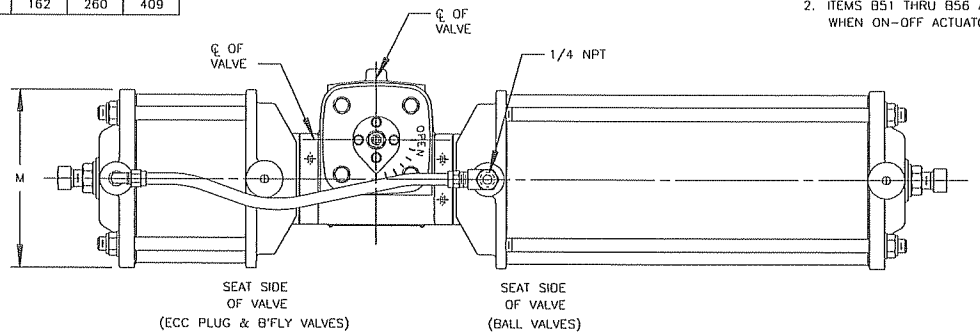
| ACTUATOR NUMBER | DIMENSIONS INCHES / MILLIMETERS | | | | |
|---|---|---|---|---|---|
| | J | K | L | M | N |
| PR-R1_-SC4-D-60<br>MSGR1_C4D60 | 1.50<br>38 | 19.12<br>486 | 3.88<br>99 | 4.50<br>114 | 12.12<br>308 |
| PR-R1_-SC6-D-60<br>MSGR1_C6D60 | 1.50<br>38 | 19.16<br>487 | 4.94<br>125 | 6.62<br>168 | 12.62<br>321 |
| PR-R1_-SC4-R-60<br>MSGR1_C4R60 | 1.50<br>38 | 21.00<br>533 | 3.88<br>99 | 4.50<br>114 | 12.12<br>308 |
| PR-R1_-SC6-R-60<br>MSGR1_C6R60 | 1.50<br>38 | 21.88<br>556 | 4.94<br>125 | 6.62<br>168 | 12.62<br>321 |
| PR-R2_-SC6-D-60<br>MSGR2_C6D60 | 1.84<br>47 | 25.00<br>635 | 4.94<br>125 | 6.62<br>168 | 16.00<br>406 |
| PR-R2_-SC8-D-60<br>MSGR2_C8D60 | 1.84<br>47 | 27.50<br>699 | 6.38<br>162 | 10.25<br>260 | 16.12<br>409 |
| PR-R2_-SC6-R-60<br>MSGR2_C6R60 | 1.84<br>47 | 31.16<br>791 | 4.94<br>125 | 6.62<br>168 | 16.00<br>406 |
| PR-R2_-SC8-R-60<br>MSGR2_C8R60 | 1.84<br>47 | 32.75<br>832 | 6.38<br>162 | 10.25<br>260 | 16.12<br>409 |

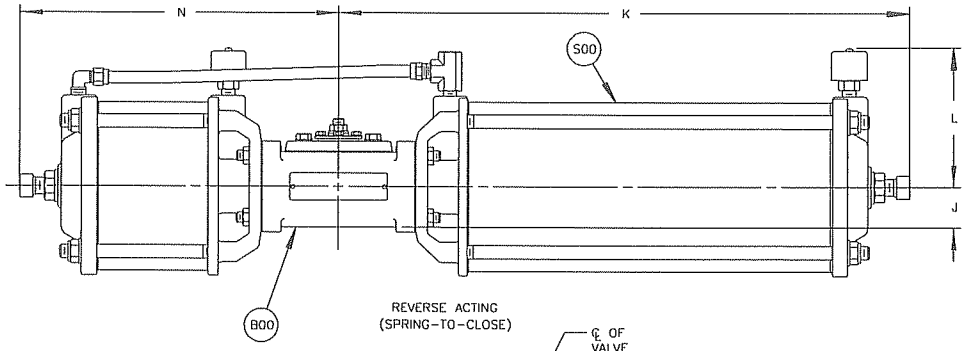
| NO | PART NAME | QTY |
|---|---|---|
| B00 | CYLINDER ACTUATOR ASSEMBLY | 1 |
| S00 | SPRING CYLINDER ASSEMBLY | 1 |
| B51 | NIPPLE | 1 |
| B52 | TEE | 1 |
| B53 | CONNECTOR | 1 |
| B54 | HOSE OR TUBING | 1 |
| B55 | ELBOW | 1 |
| B56 | CONNECTOR, SWIVEL (FOR HOSE CONSTRUCTION ONLY) | 1 |
| B57 | BREATHER | 1 |

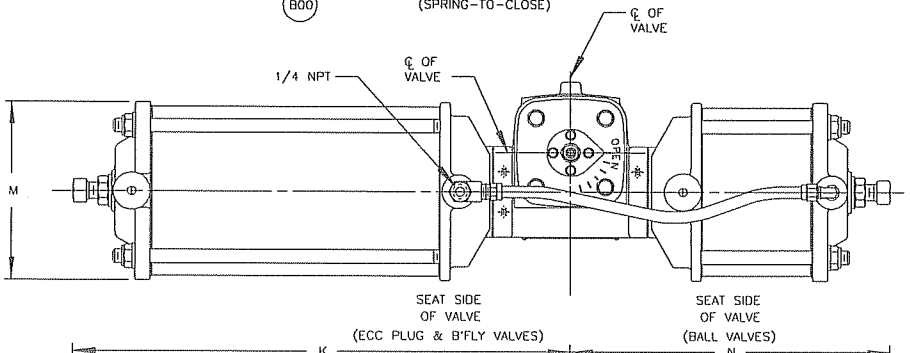
NOTE:

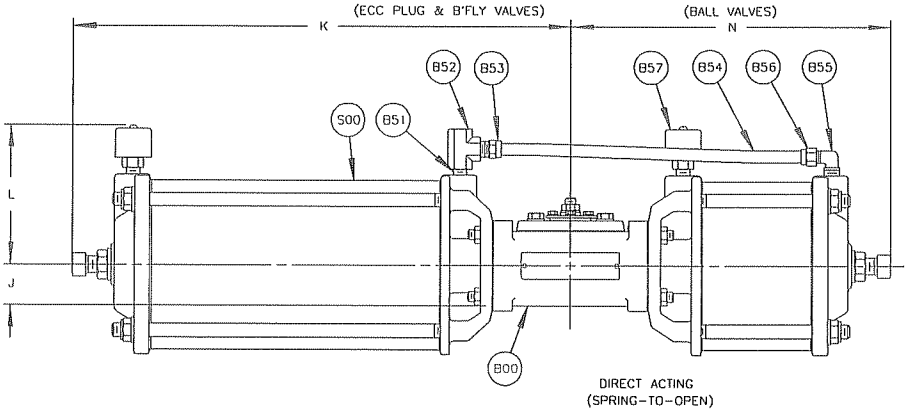
1. WHEN ORDERING PARTS, INCLUDE VALVE SIZE AND PART NUMBER FROM DATA PLATE. ALSO INCLUDE THIS DRAWING NUMBER WITH PART NAME, NUMBER AND QUANTITY.

2. ITEMS B51 THRU B56 ARE FURNISHED ONLY WHEN ON-OFF ACTUATOR IS ORDERED.




| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| K | J | H | G | F | E | D | C | B | A | |
| 61808 | 60005 | 54049 | 53816 | 50312 | 50312 | 51951 | 50312 | 50312 | 50312 | |
| 08/26/09 | 07/21/99 | 05/29/97 | 01/02/95 | 11/03/94 | 06/03/92 | 05/22/92 | 01/10/92 | 11/01/91 | 10/22/91 | |

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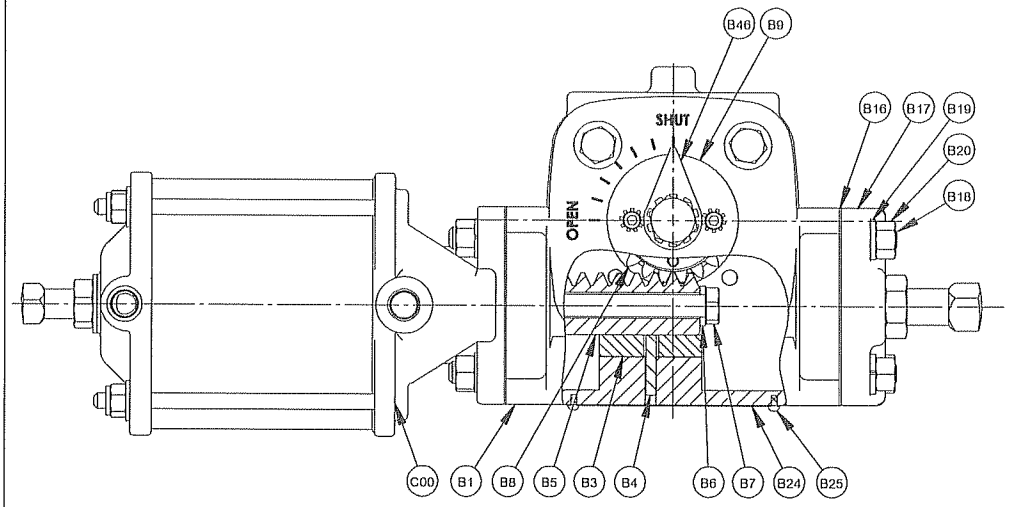
POWERRAC SPRING RETURN CYLINDER ACTUATOR ASSEMBLY
(PR-R__-SC_-_-60 OR MSGR__C_R60)

| DOCT. CODE | DRAWN | APPROVED | |
|---|---|---|---|
| C1 | SN | DT | A39784 |
| | CHECKED TNB | DATE 09-04-91 | |

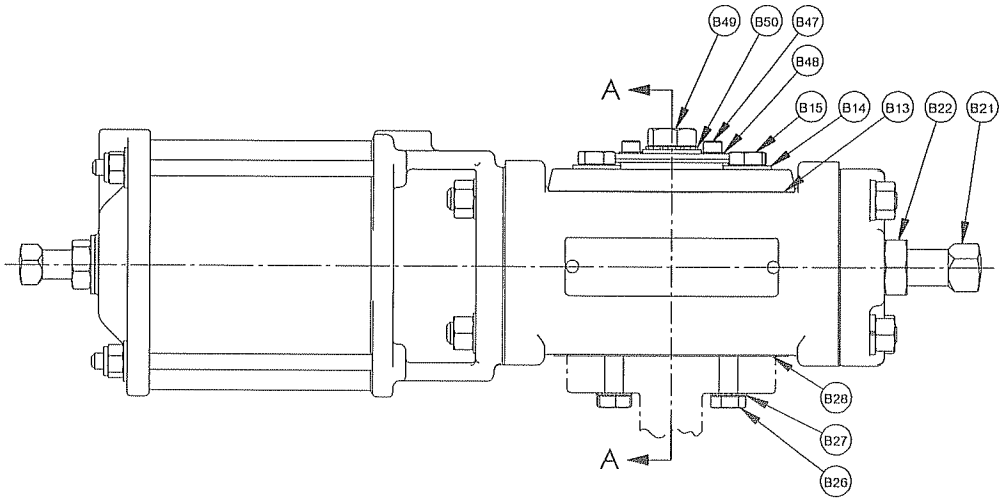
| NO | DESCRIPTION | QTY |
|---|---|---|
| B1 | HOUSING | 1 |
| B2 | BEARING (HOUSING) | 1 |
| B3 | RACK BEARING | 1 |
| B4 | PIN | 1 |
| B5 | RACK | 1 |
| B6 | LOCKWASHER | 1 |
| B7 | SCREW | 1 |
| B8 | GEAR | 1 |
| B9 | GEAR COVER | 1 |
| B10 | O-RING (TOP COVER) | 1 |
| B11 | TOP COVER | 1 |
| B12 | BEARING (COVER) | 1 |
| B13 | GASKET (TOP COVER) | 1 |
| B14 | LOCKWASHER | 4 |
| B15 | SCREW | 4 |
| B16 | GASKET (END COVER) | 2 |
| B17 | END COVER | 1 |
| B18 | STUD | 8 |
| B19 | LOCKWASHER | 8 |
| B20 | NUT | 8 |
| B21 | STOP SCREW | 1 |
| B22 | JAM NUT | 1 |
| B24 | DATA PLATE (WHEN REQUIRED) | 1 |
| B25 | DRIVE SCREWS (WHEN REQUIRED) | 2 |
| B26 | SCREW (EXCEPT TMO) | 4 |
| B27 | LOCKWASHER | 4 |
| B28 | GASKET | 1 |
| B46 | POINTER PLATE | 1 |
| B47 | SCREW | 2 |
| B48 | LOCKWASHER | 2 |
| B49 | SCREW | 1 |
| B50 | LOCKWASHER | 1 |
| C00 | CYLINDER ASSEMBLY | 1 |

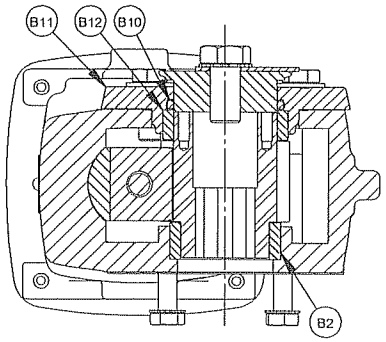



NOTE:

1. WHEN ORDERING PARTS, INCLUDE VALVE SIZE AND PART NUMBER FROM DATA PLATE. ALSO INCLUDE THIS DRAWING NUMBER WITH PART NAME, NUMBER AND QUANTITY.

2. RECOMMENDED SPARE PARTS ARE ITEMS NO B10, B13, B16 AND B28.




SECTION A-A

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| G | F | E | D | C | B | A | 62500 |

5/28/2013

DeZURIK
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www.dezurik.com

PR-R__-PC POWERRAC DOUBLE ACTING
CYLINDER ACTUATOR ASSEMBLY
FOR USE WITH ALL VALVES (EXCEPT SQUARE SHAFT)

| DOCT. CODE | DRAWN | APPROVED | |
|---|---|---|---|
| C1 | SN | SN | A59340 |
| | CHECKED | DATE | |
| | SN | 10/15/12 | |

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DeZURIK
APCO | HILTON

# AFR2 AIR FILTER REGULATOR

## General

The AFR2 Instrument Air Filter Regulator is designed to provide clean, accurate air pressure to DeZURIK actuators and positioners. This filter regulator has been proven to provide accurate operating characteristics under variable conditions. Durable materials and a standard epoxy paint finish provide long lasting corrosion resistance in harsh industrial environments. The AFR2 is a quality unit that is ideal as an economical alternative for control of process applications.

- **Stable Output and Repeatability**
  Provides constant control under variable flow rates and supply pressures.
- **Corrosion-Resistant Construction**
  Aluminum die-castings are finished with irridite and baked epoxy paint.
- **Depth Filter**
  Unit comes equipped with high capacity 5 micron filter housed in dripwell for complete air filtration.
- **Self-Relieving**
- **Low Droop at High Flow Levels**
  Aspirator design helps maintain set pressure at higher flow levels.
- **Tight Shutoff**
  A soft, rubberized valve provides a positive shutoff and compensates for dirt and other foreign matter.

## Materials of Construction

| | |
|---|---|
| Body | Diecast Aluminum Alloy, Irridite and Baked Epoxy Finish |
| Filter | 5 Micron Phenolic Impregnated Cellulose as standard, 3 micron on application |
| Diaphragm | Nitrile Elastomer and Nylon Fabric |
| Valve Seat Plug | Nitrile Elastomer |
| Additional Materials | Brass, Zinc Plated Steel, Acetal |

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## Principle of Operation

Turning the adjusting screw changes the force exerted by the range spring on the diaphragm assembly. In equilibrium of set pressure, the force exerted by the range spring is balanced by the force from the output pressure acting underneath the diaphragm assembly.

An unbalanced state between the output pressure and the set pressure causes a corresponding reaction in the diaphragm and supply valve assemblies. If the output pressure rises above the set pressure, an upward force is exerted on the diaphragm assembly causing the relief seat to lift and open. Excess pressure is vented to atmosphere until equilibrium is reached. If the output pressure drops below the set pressure, the unbalanced force of the range spring causes a downward force on the diaphragm assembly. The supply valve opens until the pressure builds up once more to the equilibrium condition.

Under forward flow conditions, the range spring force is balanced by the diaphragm pressure force, with the supply valve open just enough to maintain the required equilibrium pressure. When high flow occurs, a specially designed aspirator helps maintain downstream pressure and compensates for droop.

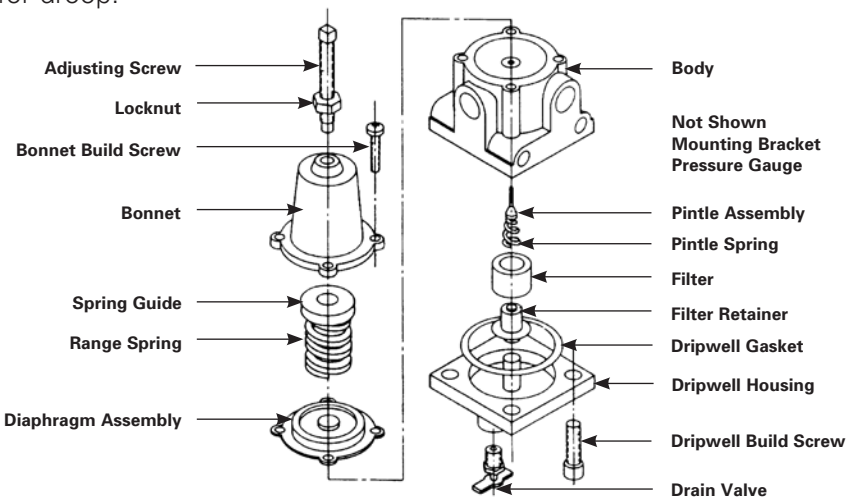
## Specifications

| | |
|---|---|
| Port Size | (In, Out and Gauge) 1/4" N.P.T. |
| Output Ranges | 0-120 psig (0-800 kPa) |
| Maximum Supply Pressure | 250 psig (1700 kPa) |
| Mounting | Pipe or Through Body |
| Flow Capacity | 33 SCFM (56.1 $m^3$/hr) at 90 psig (620 kPa) supply with 20 psig (140 kPa) output |
| Exhaust Capacity | 0.1 SCFM (0.17 $m^3$/hr) with downstream pressure 5 psig (35 kPa) above set point |
| Sensitivity | 1" (2.5 cm) of water |
| Air Consumption | less than 5 SCFH (0.17$m^3$/hr) |
| Effect of Supply Pressure Variation | less than .2 psig (1.4 kPa) for 25 psi (170 kPa) change |
| Weight | 1.6 lb. (725 g) |

## Ordering

To order AFR2 add the code AFR2 after the valve/actuator order code.

**Ordering Example:**
PEC, 6, F1, CI, NBR, CR*GS-6-PC6, 4V2110-AFR2




### Sales and Service

For information about our worldwide locations, approvals, certifications and local representative:
Web Site: www.dezurik.com E-Mail: info@dezurik.com

DeZURIK
APCO | HILTON

250 Riverside Ave. N. Sartell, Minnesota 56377 • Phone: 320-259-2000 • Fax: 320-259-2227

*DeZURIK, Inc. reserves the right to incorporate our latest design and material changes without notice or obligation. Design features, materials of construction and dimensional data, as described in this bulletin, are provided for your information only and should not be relied upon unless confirmed in writing by DeZURIK, Inc. Certified drawings are available upon request.*

Printed in the U.S.A.

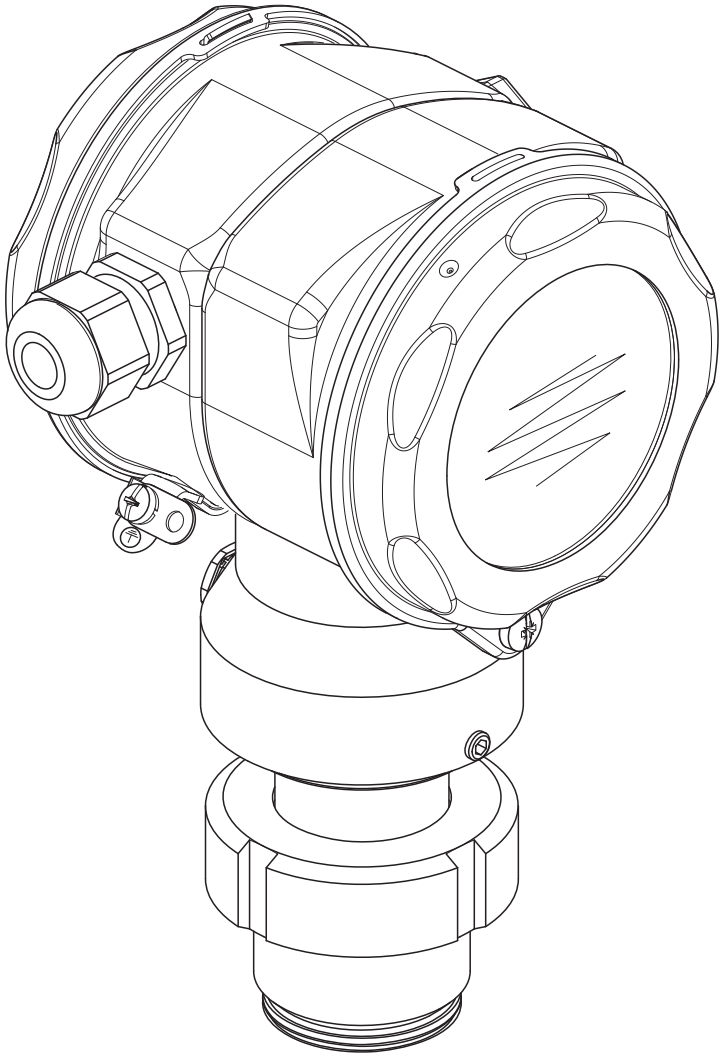
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating Instructions

# Deltapilot S FMB70

## Hydrostatic level measurement

HART COMMUNICATION PROTOCOL



BA00332P/00/EN/14.12
71161907

valid from Software version:
02.10.zz

Endress+Hauser
People for Process Automation

# Overview documentation

| Device | Documentation | Content | Remarks |
|---|---|---|---|
| Deltapilot S<br>4...20 mA HART | Technical Information TI00416P | Technical data | – The documentation can be found on the supplied documentation CD.<br>– The documentation is also available via the Internet. → See: www.endress.com |
| | Operating Instructions BA00332P | – Identification<br>– Installation<br>– Wiring<br>– Operation<br>– Commissioning, Description of Quick Setup menus<br>– Maintenance<br>– Trouble-shooting and spare parts<br>– Appendix: Illustration of menu | |
| | Operating Instructions BA00274P | – Examples of configuration for pressure and level measurement<br>– Description of parameters<br>– Trouble-shooting<br>– Appendix: Illustration of menu | |
| | Brief Operating Instructions KA01020P | – Installation<br>– Wiring<br>– Operation on-site<br>– Commissioning<br>– Description of Quick Setup menus | – The documentation is supplied with the device.<br>– The documentation can be found on the supplied documentation CD.<br>– The documentation is also available via the Internet. → See: www.endress.com |
| | Leporello KA00218P | – Wiring<br>– Description of operating elements<br>– Operation HistoROM®/M-DAT | – The documentation is supplied with the device. See cover of the terminal compartment.<br>– The documentation can also be found on the supplied documentation CD. |
| | Functional Safety Manual SD00213P | – Safety function with Deltapilot S<br>– Behaviour in operation and failure<br>– Commissioning and iterative tests<br>– Settings<br>– Technical safety characteristic quantities<br>– Management Summary | – The documentation applies to the devices showing version "E" in feature 100 "Additional options 1" or in feature 110 "Additional options 2".<br>→ See also Technical Information TI00416P, chapter "Ordering information". |

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# 1 Safety instructions

## 1.1 Designated use

The Deltapilot S is a hydrostatic pressure transmitter for measuring level and pressure.

The manufacturer accepts no liability for damages resulting from incorrect use or use other than that designated.

## 1.2 Installation, commissioning and operation

The device has been designed to operate safely in accordance with current technical, safety and EU standards. If installed incorrectly or used for applications for which it is not intended, however, it is possible that application-related dangers may arise, e.g. product overflow due to incorrect installation or calibration. For this reason, the instrument must be installed, connected, operated and maintained according to the instructions in this manual: personnel must be authorised and suitably qualified. The manual must have been read and understood, and the instructions followed. Modifications and repairs to the device are permissible only when they are expressly approved in the manual. Pay particular attention to the technical data on the nameplate.

## 1.3 Operational safety and process safety

Alternative monitoring measures must be taken to ensure operational safety and process safety during configuration, testing and maintenance work on the device.

### 1.3.1 Hazardous areas (optional)

Devices for use in hazardous areas are fitted with an additional nameplate (→ 6). If the device is to be installed in an explosion hazardous area, then the specifications in the certificate as well as all national and local regulations must be observed. The device is accompanied by separate "Ex documentation", which is an integral part of this Operating Instructions. The installation regulations, connection values and Safety Instructions listed in this Ex document must be observed. The documentation number of the related Safety Instructions is also indicated on the additional nameplate.

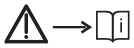
- Ensure that all personnel are suitably qualified.

### 1.3.2 Functional Safety SIL 3 (optional)

If using devices for applications with safety integrity, the Functional Safety Manual (SD00213P) must be observed thoroughly.

## 1.4 Notes on safety conventions and icons

In order to highlight safety-relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding icon in the margin.

| Safety conventions | |
|---|---|
| | **Warning!**<br>A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument. |
| | **Caution!**<br>Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument. |
| | **Note!**<br>A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned. |
| | **Device certified for use in explosion hazardous area**<br>If the device has this symbol embossed on its nameplate, it can be installed in an explosion hazardous area or a non-explosion hazardous area, according to the approval. |
| | **Explosion hazardous area**<br>Symbol used in drawings to indicate explosion hazardous areas.<br>– Devices used in hazardous areas must possess an appropriate type of protection. |
| | **Safe area (non-explosion hazardous area)**<br>Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas.<br>– Devices used in hazardous areas must possess an appropriate type of protection. Lines used in hazardous areas must meet the necessary safety-related characteristic quantities. |
| | **Direct voltage**<br>A terminal to which or from which a direct current or voltage may be applied or supplied. |
|  | **Alternating voltage**<br>A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied. |
| | **Grounded terminal**<br>A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system. |
| | **Protective grounding (earth) terminal**<br>A terminal which must be connected to earth ground prior to making any other connection to the equipment. |
| | **Equipotential connection (earth bonding)**<br>A connection made to the plant grounding system which may be of type e.g. neutral star or equipotential line according to national or company practice. |
| | **Temperature resistance of the connection cables**<br>States, that the connection cables must be resistant to a temperature of at least 85 °C (185 °F). |
|  | **Safety instruction**<br>For safety instructions refer to the manual for the appropriate instrument version. |

# 2 Identification

## 2.1 Device designation

### 2.1.1 Nameplate

Note!
- The MWP (maximum working pressure) is specified on the nameplate. This value refers to a reference temperature of 20°C (68°F) or 100°F (38 °C) for ANSI flanges.
- The pressure values permitted at higher temperatures can be found in the following standards:
  – EN 1092-1: 2001 Tab. 18 [1)]
  – ASME B 16.5a – 1998 Tab. 2-2.2 F316
  – ASME B 16.5a – 1998 Tab. 2.3.8 N10276
  – JIS B 2220
- The test pressure corresponds to the over pressure limit (OPL) of the device = MWP x 1.5.
- The Pressure Equipment Directive (EC Directive 97/23/EC) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the measuring device.

1) With regard to their stability-temperature property, the materials 1.4435 and 1.4404 are grouped together under 13EO in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.

**Aluminium housing (T14/T15)**

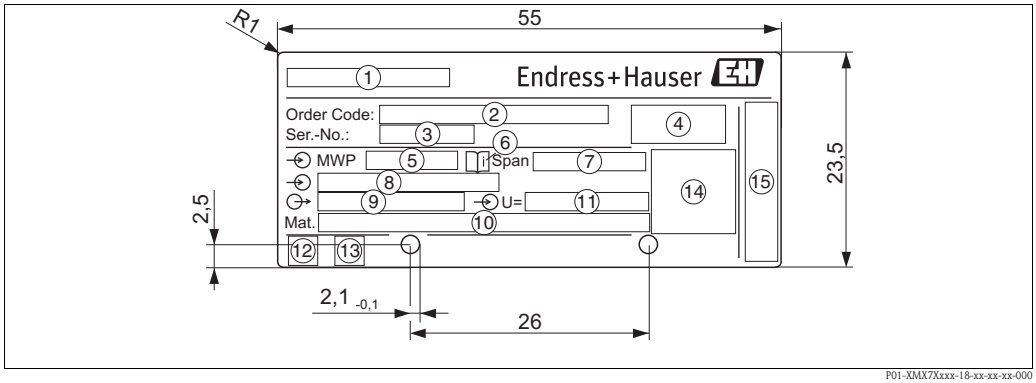



*Fig. 1: Nameplate*

*1 Device name*
*2 Order code*
*See the specifications on the order confirmation for the meanings of the individual letters and digits.*
*3 Serial number*
*4 Degree of protection*
*5 MWP (Maximum working pressure)*
*6 Symbol: Note: pay particular attention to the data in the "Technical Information"!*
*7 Minimum/maximum span*
*8 Nominal measuring range*
*9 Electronic version (output signal)*
*10 Wetted materials*
*11 Supply voltage*
*12 GL-symbol for GL marine certificate (optional)*
*13 SIL-symbol for devices with SIL3/IEC 61508 Declaration of conformity (optional)*
*14 Approval ID and ID numbers*
*15 Address of manufacturer*

Devices for use in hazardous areas are fitted with an additional nameplate.

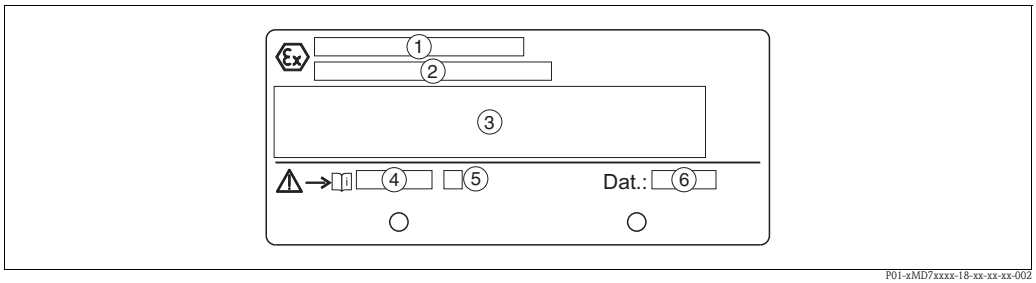



*Fig. 2: Additional nameplate for devices for hazardous areas*

*1 EC type examination certificate number*
*2 Type of protection e.g. II 1/2 G Ex ia IIC T4/T6*
*3 Electrical data*
*4 Safety Instructions number e.g. XA00235P*
*5 Safety Instructions index e.g. A*
*6 Device manufacture data*

Devices suitable for oxygen applications are fitted with an additional nameplate.

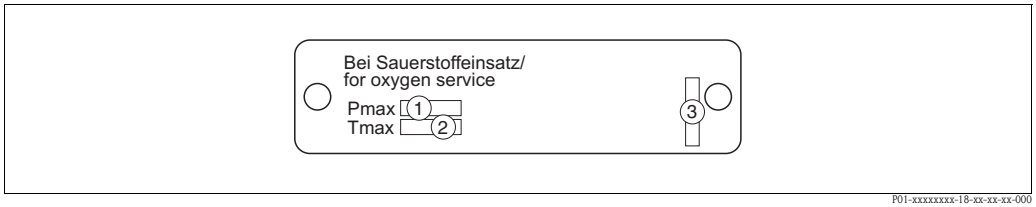



*Fig. 3: Additional nameplate for devices suitable for oxygen applications*

*1 Maximum pressure for oxygen applications*
*2 Maximum temperature for oxygen applications*
*3 Layout identification of the nameplate*

**Hygenic stainless steel housing (T17)**

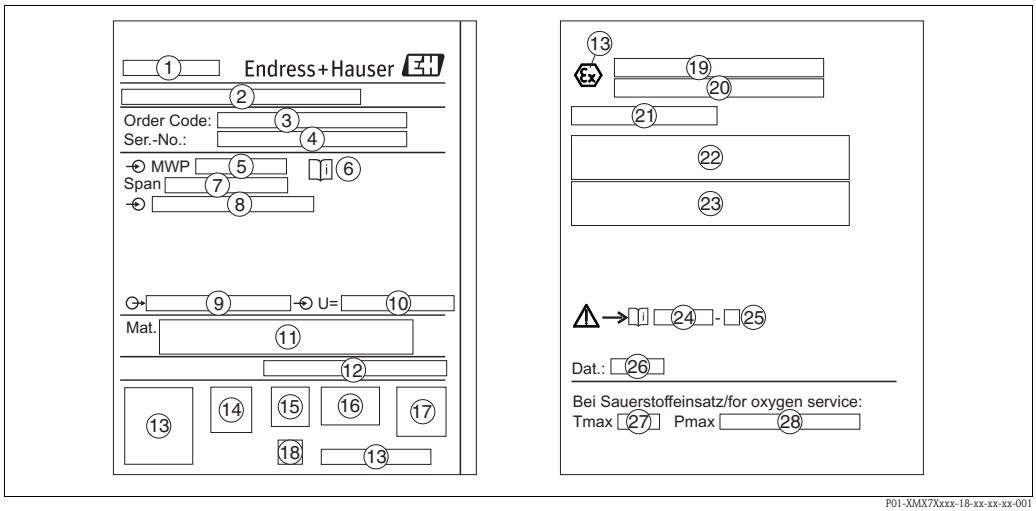



*Fig. 4: Nameplate*

*1 Device name*
*2 Address of manufacturer*
*3 Order code*
*See the specifications on the order confirmation for the meanings of the individual letters and digits.*
*4 Serial number*
*5 MWP (Maximum working pressure)*
*6 Symbol: Note: pay particular attention to the data in the "Technical Information"!*
*7 Minimum/Maximum span*
*8 Nominal measuring range*
*9 Electronic version (output signal)*
*10 Supply voltage*
*11 Wetted materials*
*12 Degree of protection*

*Optional:*
*13 Approval ID and ID numbers*
*14 3A-symbol*
*15 CSA-symbol*
*16 FM-symbol*
*17 SIL-symbol for devices with SIL3/IEC 61508 Declaration of conformity*
*18 GL-symbol for GL marine certificate*
*19 EC type examination certificate*
*20 Type of protection*
*21 Approval number for WHG overspill protection*
*22 Temperature operating range for devices for use in hazardous areas*
*23 Electrical data for devices for use in hazardous areas*
*24 Safety Instructions number*
*25 Safety Instructions index*
*26 Device manufacture data*
*27 Maximum temperature for devices suitable for oxygen applications*
*28 Maximum pressure for devices suitable for oxygen applications*

## 2.1.2 Identifying the sensor type

See parameter "Sensor Meas.Type" in Operating Instruction BA00274P. The Operating Instruction BA00274P can be found on the supplied documentation CD.

## 2.2 Scope of delivery

The scope of delivery comprises:
- Deltapilot S hydrostatic pressure transmitter
- For devices with the "HistoROM/M-DAT" option:
  CD-ROMs with Endress+Hauser operating program and documentation
- Optional accessories

Documentation supplied:
- The Operating Instructions BA00332P and BA00274P, the Technical Information TI00416P and the Safety Instructions, Functional Safety Manual and brochures can be found on the supplied documentation CD.
  See also → 2, "Overview documentation" chapter.
- Brief Operating Instructions KA01020P
- Leporello KA00218P
- Final inspection report
- Also Safety Instructions with devices for use in hazardous areas
- Optional: factory calibration form, test certificates

## 2.3 CE mark, declaration of conformity

The device is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. The device complies with the applicable standards and regulations as listed in the EC declaration of conformity and thus complies with the statutory requirements of the EC Directives. Endress+Hauser confirms the successful testing of the device by affixing to it the CE mark.

## 2.4 Registered trademarks

KALREZ, VITON, TEFLON
Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

TRI-CLAMP
Registered trademark of Ladish & Co., Inc., Kenosha, USA

HART
Registered trademark of the HART Communication Foundation, Austin, USA.

GORE-TEX®
Registered trademark of W.L. Gore & Associates, Inc., USA

# 3 Installation

## 3.1 Incoming acceptance and storage

### 3.1.1 Incoming acceptance

- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

### 3.1.2 Transport

Caution!
Follow the safety instructions and transport conditions for devices of more than 18 kg (39.69 lbs). Transport the measuring device to the measuring point in its original packaging or at the process connection.

### 3.1.3 Storage

The device must be stored in a dry, clean area and protected against damage from impact (EN 837-2).

Storage temperature range:
- –40 to +90°C (–40 to +194°F)
- On-site display: –40 to +85°C (–40 to +185°F)
- Separate housing: –40 to +60°C (–40 to +140°F)

## 3.2 Installation conditions

### 3.2.1 Dimensions

→ For dimensions, please refer to the Technical Information for Deltapilot S TI00416P, "Mechanical construction" section. See also → 🖹 2, "Overview documentation" chapter.

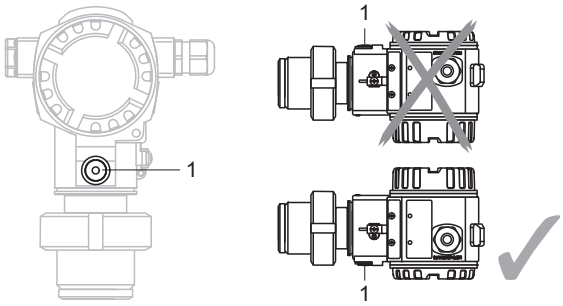
## 3.3 Installation instructions

Note!
- Due to the orientation of the Deltapilot S, there may be a shift in the measured value, i.e. when the container is empty, the measured value does not display zero. You may correct this zero point shift either directly on the device using the "E"-key or by remote operation. → 🖹 24, "Function of the operating elements – on-site display not connected" or → 🖹 40, "Position adjustment"..
- To ensure optimal readability of the on-site display, it is possible to rotate the housing up to 380°. → 🖹 15, Section 3.3.5 "Rotating the housing".
- The on-site display can be rotated in 90° stages.
- Endress+Hauser offers a mounting bracket for installing on pipes or walls. → 🖹 13, Section 3.3.3 "Wall and pipe-mounting (optional)".

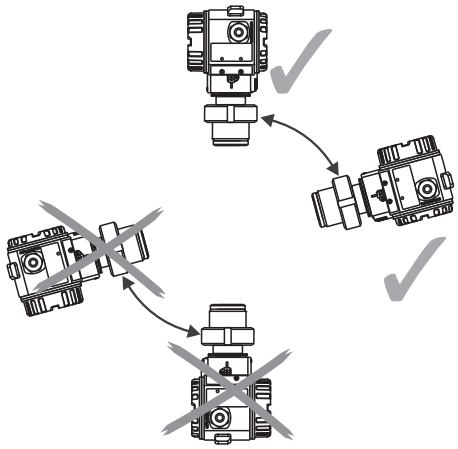
### 3.3.1 Installation instructions

Note!

- If a heated Deltapilot S is cooled during the cleaning (e.g. by cold water), a vacuum develops for a short time, whereby water can penetrate the sensor through the pressure compensation (1). If this is the case, mount the sensor with the pressure compensation (1) pointing downwards.




- Keep the pressure compensation and GORE-TEX® filter (1) free from contaminations.
- Do not clean or touch process isolating diaphragm with hard or pointed objects.
- The device must be installed as follows in order to comply with the cleanability requirements of the ASME-BPE (Part SD Cleanability):



**Level measurement**

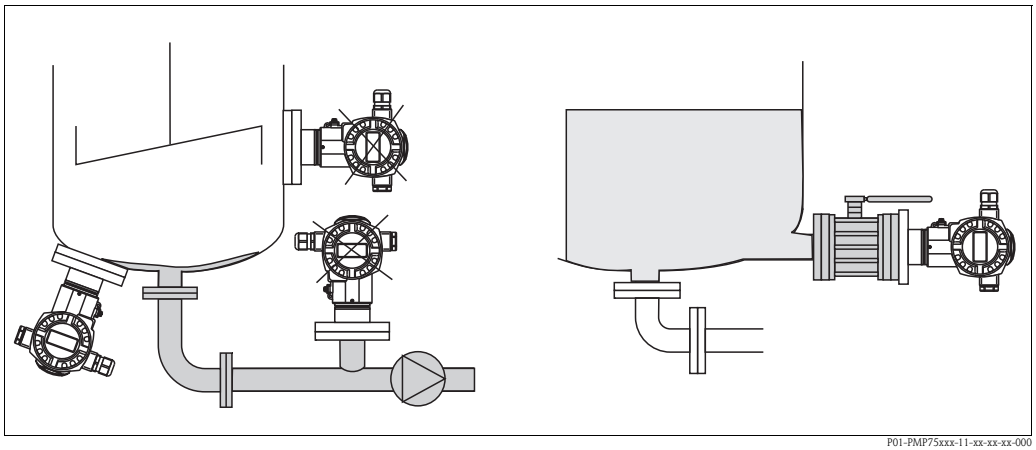



*Fig. 5: Measuring arrangement for level*

- Always install the device below the lowest measuring point.
- Do not install the device at the following positions:
  – in the filling curtain
  – in the tank outflow

– in the suction area of a pump
– or at a point in the tank that can be affected by pressure pulses from the agitator
- The calibration and functional test can be carried out more easily if you mount the device downstream of a shutoff device.
- Deltapilot S must be included in the insulation for media that can harden when cold.

**Pressure measurement in gases**

- Mount Deltapilot S with shutoff device above the tapping point so that any condensate can flow into the process.

**Pressure measurement in steams**

- Mount Deltapilot S with siphon above the tapping point.
- Fill the siphon with liquid before commissioning.
  The siphon reduces the temperature to almost the ambient temperature.

**Pressure measurement in liquids**

- Mount Deltapilot S with the shutoff device below or at the same level as the tapping point.

## 3.3.2 Seal for flange mounting

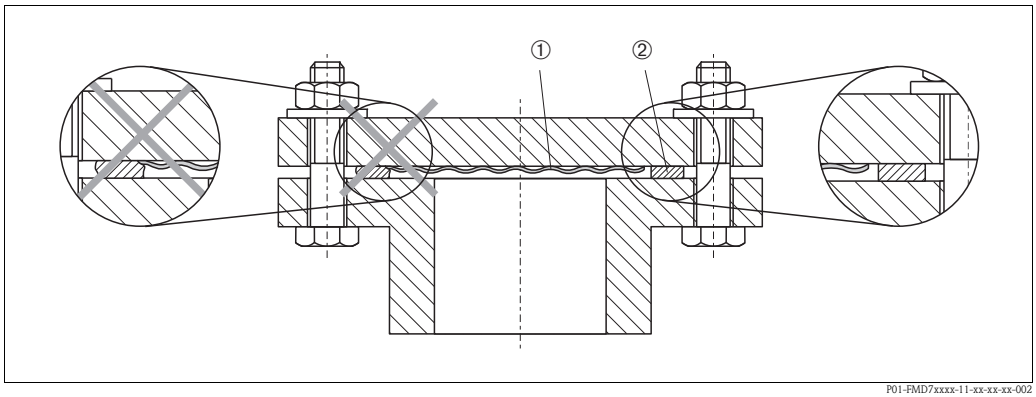


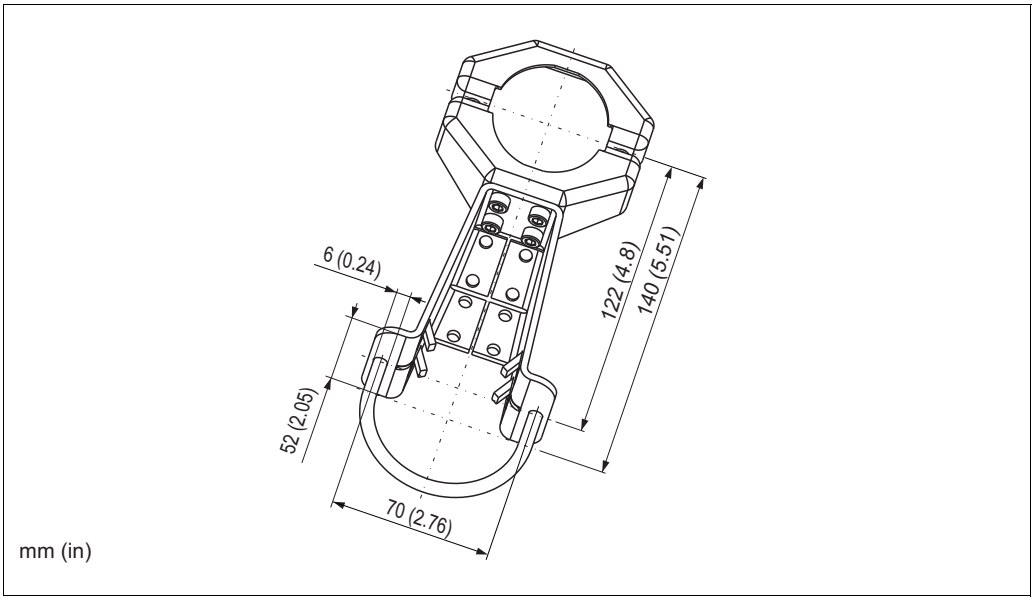

*Fig. 6: Mounting the versions with flange*

*1 Process isolating diaphragm*
*2 Seal*

⚠ Warning!
The seal is not allowed to press on the process isolating diaphragm as this could affect the measurement result.

### 3.3.3 Wall and pipe-mounting (optional)

Endress+Hauser offers a mounting bracket for installing on pipes or walls.




P01-xMx5xxxx-06-xx-xx-xx-001

Please note the following when mounting:

- In the case of pipe mounting, the nuts on the bracket must be tightened uniformly with a torque of at least 5 Nm (3.69 lbs ft).

### 3.3.4 Assembling and mounting the "separate housing" version

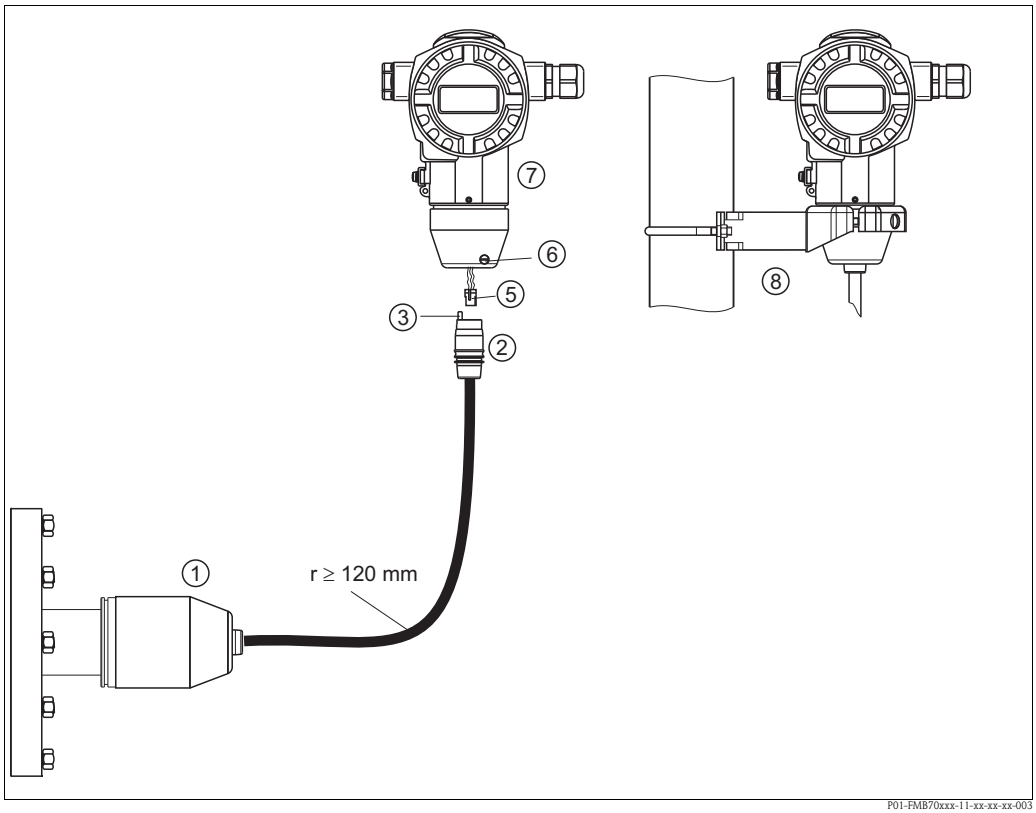



*Fig. 7: "Separate housing" version*

*1 In the "separate housing" version, the sensor is supplied with process connection and cable fitted.*
*2 Cable with connection jack*
*3 Pressure compensation*
*5 Plug*
*6 Locking screw*
*7 Housing fitted with housing adapter, included*
*8 Mounting bracket suitable for wall and pipe mounting, included*

**Assembly and mounting**

1. Connect plug (item 5) into the corresponding connection jack of the cable (item 2).
2. Plug the cable into the housing adapter (item 7).
3. Tighten the locking screw (item 5).
4. Mount the housing on a wall or pipe using the mounting bracket (item 8). When mounting on a pipe, tighten the nuts on the bracket uniformly with a torque of at least 5 Nm (3.69 lbs ft). Mount the cable with a bending radius (r) ≥ 120 mm (4.72 in).

### 3.3.5 Rotating the housing

The housing can be rotated up to 380° by loosening the Allen screw.

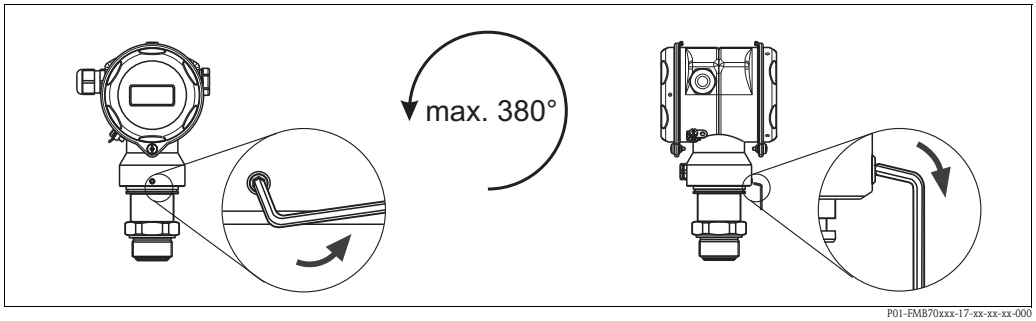



*Fig. 8: Aligning the housing*

*– For aluminium housing (T14/T15): Loosen setscrew with a 2 mm (0.08 in) Allen key.*
*For hygenic stainless steel housing (T17): Lossen setscrew with a 3 mm (0.12 in) Allen key.*
*– Rotate housing (max. up to 380°).*
*– Retighten setscrew with 1 Nm (0,74 lbf ft).*

### 3.3.6 Supplementary installation instructions

**Seal**

- Deltapilot M with a G 1 1/2 thread:
  When screwing the device into the tank, the flat seal has to be positioned on the sealing surface of the process connection. To avoid additional strain on the process isolating diaphragm, the thread should never be sealed with hemp or similar materials.
- Deltapilot M with NPT threads:
  – Wrap Teflon tape around the thread to seal it.
  – Tighten the device at the hexagonal bolt only. Do not turn at the housing.
  – Do not overtighten the thread when screwing. Max. torque: 20 to 30 Nm (14.75 to 22.13 lbf ft)

**Sealing the probe housing**

- Moisture must not penetrate the housing when mounting the device, establishing the electrical connection and during operation.
- Always firmly tighten the housing cover and the cable entries.

### 3.3.7 Mounting of the profile seal for universal process mounting adapter

For details on mounting, see KA00096F/00/A3.

### 3.3.8 Close cover on a hygenic stainless steel housing (T17)

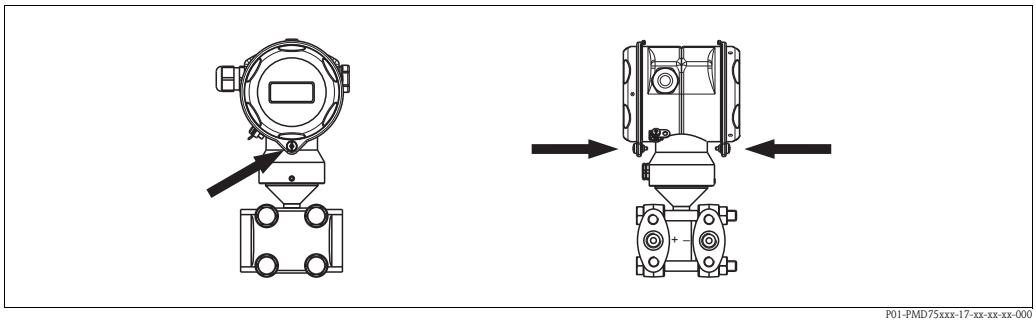



*Fig. 9: Close cover*

The covers for the terminal and electronics compartment are hooked into the casing and closed with a screw. These screws should be finger-tightened (2 Nm (1,48 lbf ft)) to the stop to ensure that the covers sit tightly.

## 3.4 Post-installation check

After installing the device, carry out the following checks:
- Are all screws firmly tightened?
- Are the housing covers screwed down tight?

# 4 Wiring

## 4.1 Connecting the device

Caution!
BIf the operating voltage is > 35 VDC, do not open the cover when energized in wet locations. Hazardous live voltage at the terminals.

Note!
- When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.
- Devices with integrated overvoltage protection must be earthed.
- Protective circuits against reverse polarity, HF influences and overvoltage peaks are installed.
- The supply voltage must match the supply voltage on the nameplate. (→ 🖹 6, Section 2.1.1 "Nameplate")
- Switch off the supply voltage before connecting the device.
- Remove housing cover of the terminal compartment.
- Guide cable through the gland. Preferably use twisted, screened two-wire cable.
- Connect device in accordance with the following diagram.
- Screw down housing cover.
- Switch on supply voltage.

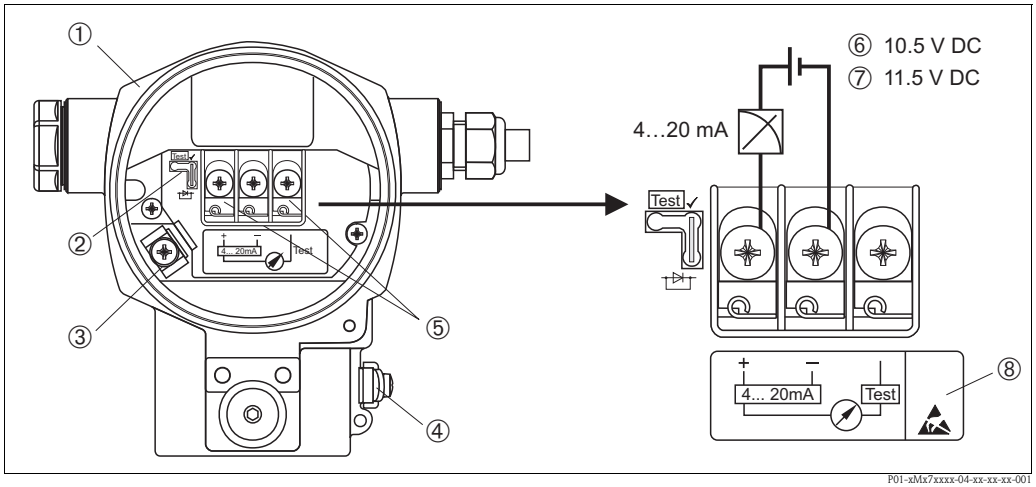
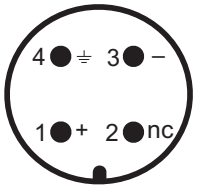



*Fig. 10: Electrical connection 4 to 20 mA HART*
*→ Observe also Section 4.2.1 "Supply voltage", → 🖹 19.*

*1 Housing*
*2 Jumper for 4 to 20 mA test signal.*
*→ 🖹 19, Section 4.2.1 "Taking 4 to 20 mA test signal" part.*
*3 Internal earth terminal*
*4 External earth terminal*
*5 4 to 20 mA test signal between plus and test terminal*
*6 Minimum supply voltage = 10.5 V DC, jumper is inserted in accordance with the illustration.*
*7 Minimum supply voltage = 11.5 V DC, jumper is inserted in "Test" position.*
*8 Devices with integrated overvoltage protection are labelled OVP (overvoltage protection) here.*

### 4.1.1 Connecting devices with an M12 connector

**PIN assignment for M12 connector**




| PIN | Meaning |
|---|---|
| 1 | Signal + |
| 2 | Not assigned |
| 3 | Signal – |
| 4 | Earth |

### 4.1.2 Connecting devices with Harting plug Han7D

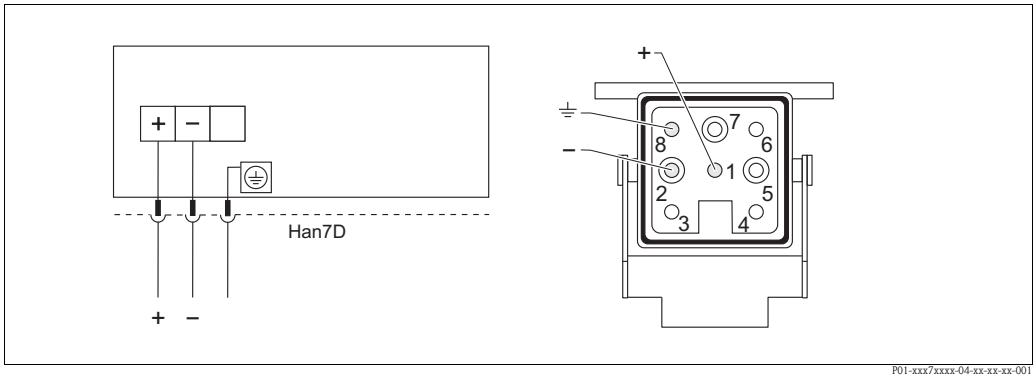



*Fig. 11: Left: electrical connection for devices with Harting plug Han7D*
*Right: view of the plug connector at the device*

## 4.2 Connecting the measuring unit

### 4.2.1 Supply voltage

Note!
- All explosion protection data are given in separate documentation which is available upon request. The Ex documentation is supplied as standard with all devices approved for use in explosion hazardous areas.
- When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.

| Electronic version | Jumper for 4 to 20 mA test signal in "Test" position (Delivery status) | Jumper for 4 to 20 mA test signal in "Non-Test" position |
|---|---|---|
| 4 to 20 mA HART, for non-hazardous areas | 11.5 to 45 V DC | 10.5 to 45 V DC |

**Taking 4 to 20 mA test signal**

A 4 to 20 mA signal may be measured via the positive and test terminal without interrupting the measurement. The minimum supply voltage of the device can be reduced by simply changing the position of the jumper. As a result, operation is also possible with lower voltage sources. To keep the measured error below 0.1%, the current measuring device should display an internal resistance of < 0.7 Ω. Observe the position of the jumper in accordance with the following table.

| Jumper position for test signal | Description |
|---|---|
| | – Taking 4 to 20 mA test signal via plus and test terminal: possible. (Thus, the output current can be measured without interruption via the diode.)<br>– Delivery status<br>– minimum supply voltage: 11.5 V DC |
| | – Taking 4 to 20 mA test signal via plus and test terminal: not possible.<br>– minimum supply voltage: 10.5 V DC |

### 4.2.2 Cable specification

- Endress+Hauser recommends using twisted, screened two-wire cables.
- Terminals for wire cross-sections 0.5 to 2.5 $mm^2$ (20 to 14 AWG)
- Cable external diameter: 5 to 9 mm (0.2 to 0.35 in)

### 4.2.3 Load

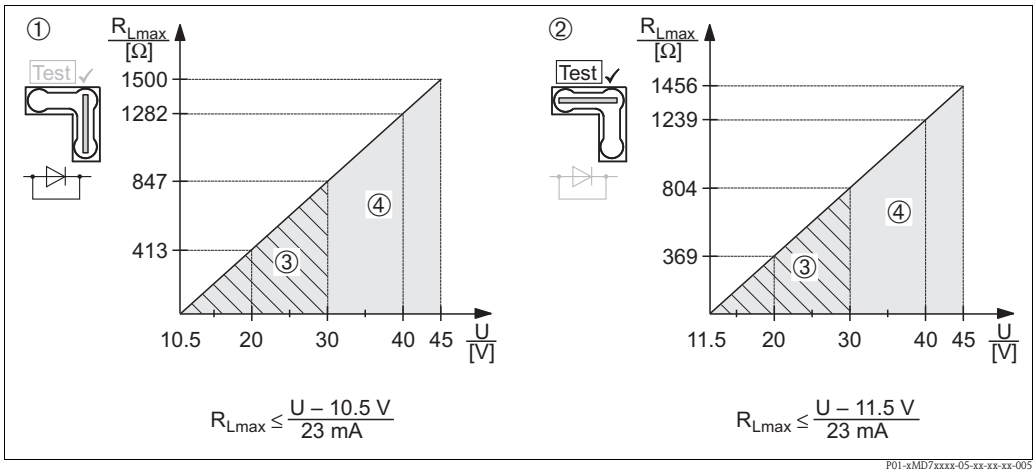



*Fig. 12: Load diagram, observe the position of the jumper and the explosion protection. (→ 19, Section 4.2.1 "Taking 4 to 20 mA test signal" part.)*

*1 Jumper for the 4 to 20 mA test signal inserted in "Non-Test" position*
*2 Jumper for the 4 to 20 mA test signal inserted in "Test" position*
*3 Supply voltage 10.5 (11.5) to 30 V DC for Ex ia, 1/2 D, 1 GD, 1/2 GD, FM IS and CSA IS, IEC Ex ia, NEPSI Ex ia*
*4 Supply voltage10.5 (11.5) to 45 V DC for devices for non-hazardous areas, 1/3 D, Ex nA, FM DIP, FM NI*
*$R_{Lmax}$ Maximum load resistance*
*U Supply voltage*

Note!
When operating via a handheld terminal or via PC with an operating program, a minimum communication resistance of 250 Ω must exist within the loop.

### 4.2.4 Screening/potential matching

- You achieve optimum screening against disturbances if the screening is connected on both sides (in the cabinet and on the device). If you have to reckon with potential equalisation currents in the plant, only earth screening on one side, preferably at the transmitter (possibility of hydrogen diffusion).
- When using in hazardous areas, you must observe the applicable regulations.
  Separate Ex documentation with additional technical data and instructions is included with all Ex systems as standard.

### 4.2.5 Connecting Field Xpert SFX100

Compact, flexible and robust industry handheld terminal for remote parametrization and measured value inspection via the HART current output (4-20mA).
For details refer to Operating Instructions BA00060S/04/EN.

### 4.2.6 Connecting Commubox FXA195

The Commubox FXA195 connects intrinsically safe transmitters with the HART protocol to a computer's USB port. This allows remote operation of the transmitter using Endress+Hauser's FieldCare operating program. Power is supplied to the Commubox through the USB port. The Commubox is also suitable for connection to intrinsically safe circuits. → See Technical Information TI00404F for further information.

### 4.2.7 Connecting Commubox FXA291/ToF Adapter FXA291 for operation via FieldCare

**Connecting Commubox FXA291**

The Commubox FXA291 connects Endress+Hauser field instruments with CDI interface (= Endress+Hauser Common Data Interface) to the USB interface of a personal computer or a notebook. For details refer to TI00405C/07/en.

Note!
For the following Endress+Hauser instruments you need the "ToF Adapter FXA291" as an additional accessory:

- Cerabar S PMC71, PMP7x
- Deltabar S PMD7x, FMD7x
- Deltapilot S FMB70

**Connecting ToF Adapter FXA291**

The ToF Adapter FXA291 connects the Commubox FXA291 via the USB interface of a personal computer or a notebook to the following Endress+Hauser instruments:

- Cerabar S PMC71, PMP7x
- Deltabar S PMD7x, FMD7x
- Deltapilot S FMB70

For details refer to KA00271F/00/a2.

## 4.3 Potential matching

Ex applications: Connect all devices to the local potential matching.
Observe the applicable regulations.

## 4.4 Overvoltage protection (optional)

Devices showing version "M" in feature 100 "Additional options 1" or feature 110 "Additional options 2" in the order code are equipped with overvoltage protection (see also Technical Information TI00416P "Ordering information".

- Overvoltage protection:
  - Nominal functioning DC voltage: 600 V
  - Nominal discharge current: 10 kA
- Surge current check $\hat{i}$ = 20 kA as per DIN EN 60079-14: 8/20 µs satisfied
- Arrester AC current check I = 10 A satisfied

Warning!
Devices with integrated overvoltage protection must be earthed.

## 4.5 Post-connection check

Perform the following checks after completing electrical installation of the device:

- Does the supply voltage match the specifications on the nameplate?
- Is the device connected as per Section 4.1?
- Are all screws firmly tightened?
- Are the housing covers screwed down tight?

As soon as voltage is applied to the device, the green LED on the electronic insert lights up for a few seconds or the connected on-site display lights up.

# 5 Operation

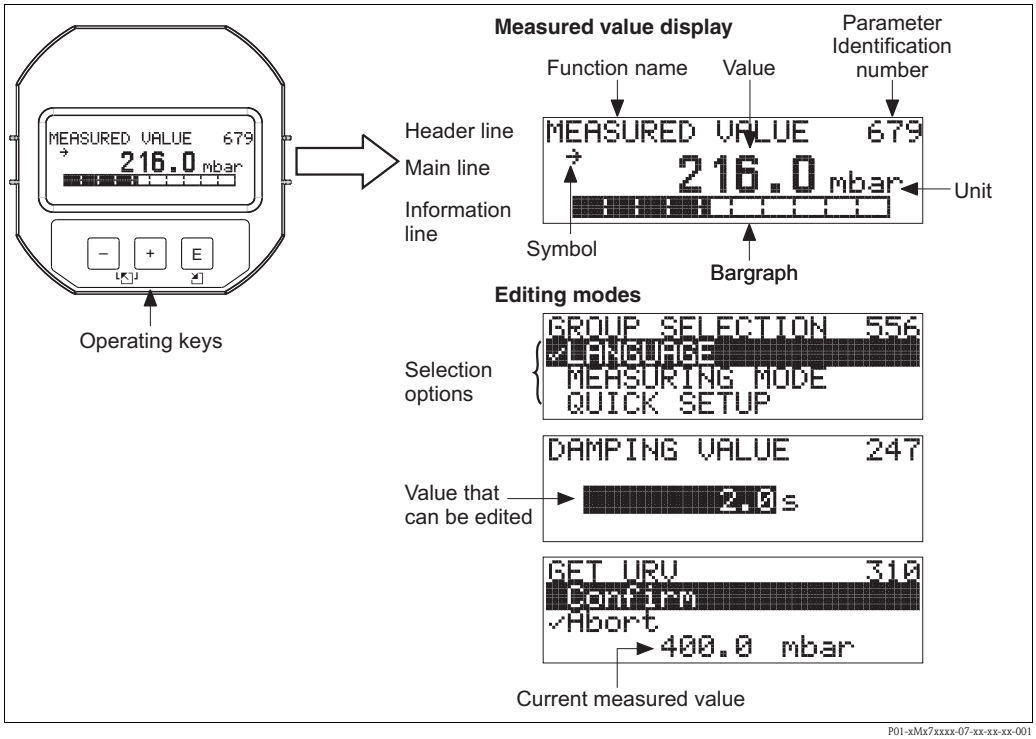
Feature 20 "Output; operation" in the order code provides you with information on the operating options available to you.

| Versions in the order code | | Operation |
|---|---|---|
| A | 4 to 20 mA HART; external operation, LCD | Via on-site display and 3 key on the exterior of the device |
| B | 4 to 20 mA HART; internal operation, LCD | Via on-site display and 3 key on the inside of the device |
| C | 4 to 20 mA; internal operation | Without on-site display, 3 key on the inside of the device |

## 5.1 On-site display (optional)

A 4-line liquid crystal display (LCD) is used for display and operation. The on-site display shows measured values, dialog texts, fault messages and notice messages.
The display of the device can be turned in 90° steps.
Depending on the installation position of the device, this makes it easy to operate the device and read the measured values.

Functions:
- 8-digit measured value display including sign and decimal point, bargraph for current display
- simple and complete menu guidance thanks to separation of the parameters into several levels and groups
- Menu guidance in 8 languages (de, en, fr, es it, nl, jp, ch)
- each parameter is given a 3-digit ID number for easy navigation
- option for configuring the display according to individual requirements and desires, such as language, alternating display, contrast setting, display of other measured values such as sensor temperature
- comprehensive diagnostic functions (fault and warning message, peak-hold indicators, etc.)
- rapid and safe commissioning with the Quick Setup menus



The following table illustrates the symbols that can appear on the on-site display. Four symbols can occur at one time.

| Symbol | Meaning |
|---|---|
| | **Alarm symbol**<br>– Symbol flashing: warning, device continues measuring.<br>– Symbol permanently lit: error, device does not continue measuring.<br>*Note:* The alarm symbol may overlie the tendency symbol. |
| | **Lock symbol**<br>The operation of the device is locked. Unlock device, → see Section 5.9. |
| | **Communication symbol**<br>Data transfer via communication<br>*Note:* The alarm symbol may overlie the communication symbol. |
| | **Tendency symbol (increasing)**<br>The measured value is increasing. |
| | **Tendency symbol (decreasing)**<br>The measured value is decreasing. |
| | **Tendency symbol (constant)**<br>The measured value has remained constant over the past few minutes. |

## 5.2 Operating elements

### 5.2.1 Position of operating elements

With regard to aluminium housings (T14/T15), the operating keys are located either outside the device under the protection cap or inside on the electronic insert. In hygenic stainless steel housings (T17), the operating keys are always located inside on the electronic insert.

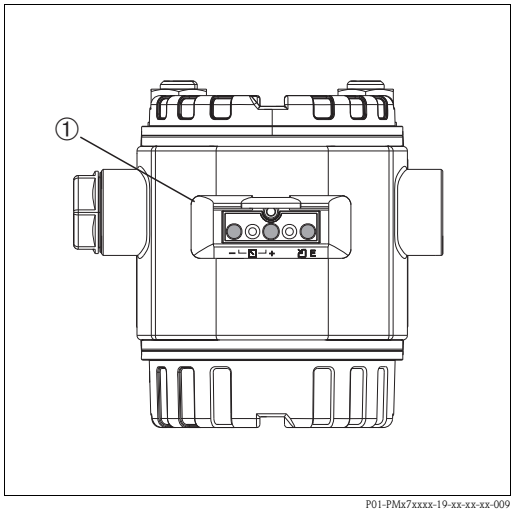



*Fig. 13: Operating keys, external*

*1 Operating keys on the exterior of the device under the protective flap*

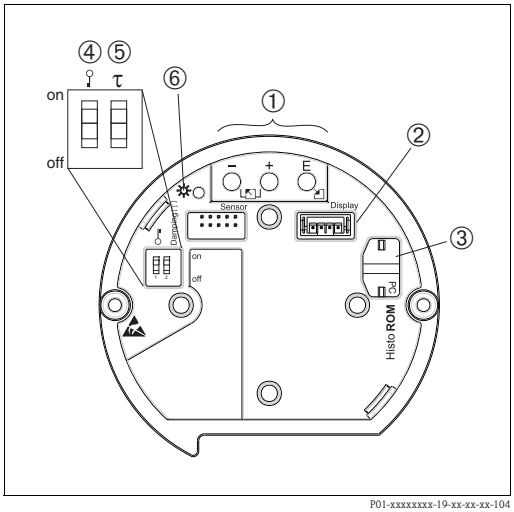
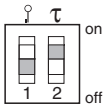



*Fig. 14: Operating keys, internal*

*1 Operating keys*
*2 Slot for optional display*
*3 Slot for optional HistoROM®/M-DAT*
*4 DIP-switch for locking/unlocking measured-value-relevant parameters*
*5 DIP-switch for damping on/off*
*6 Green LED to indicate value being accepted*

### 5.2.2 Function of the operating elements – on-site display not connected

Press and hold the key or the key combination for at least 3 seconds to execute the corresponding function. Press the key combination for at least 6 seconds for a reset.

| Operating key(s) | Meaning |
|---|---|
| – | Adopt lower range value. A reference pressure is present at the device. → 25, Section 5.3.1 "Level measuring mode" or → 27, Section 5.3.2 "Level measuring mode". |
| + | Adopt upper range value. A reference pressure is present at the device. → 25, Section 5.3.1 "Level measuring mode" or → 27, Section 5.3.2 "Level measuring mode". |
| E | Position adjustment |
| + and – and E | Reset all parameters. The reset via operating keys corresponds to the software reset code 7864. |
| + and E | Copy the configuration data from the optional HistoROM®/M-DAT module to the device. |
| – and E | Copy the configuration data from the device to the optional HistoROM®/M-DAT module. |
|   P01-xxxxxxxx-19-xx-xx-xx-057 | – DIP-switch 1: for locking/unlocking measured-value-relevant parameters Factory setting: off (unlocked)<br>– DIP-switch 2: damping on/off, Factory setting: on (damping on) |

### 5.2.3 Function of the operating elements – on-site display connected

| Operating key(s) | Meaning |
|---|---|
| + | – Navigate upwards in the picklist<br>– Edit the numerical values and characters within a function |
| – | – Navigate downwards in the picklist<br>– Edit the numerical values and characters within a function |
| E | – Confirm entry<br>– Jump to the next item |
| + and E | Contrast setting of on-site display: darker |
| – and E | Contrast setting of on-site display: brighter |
| + and – | ESC functions:<br>– Exit edit mode without saving the changed value.<br>– You are in a menu within a function group. The first time you press the keys simultaneously, you go back a parameter within the function group. Each time you press the keys simultaneously after that, you go up a level in the menu.<br>– You are in a menu at a selection level. Each time you press the keys simultaneously, you go up a level in the menu.<br>*Note:* The terms function group, level and selection level are explained in → 28, Section 5.4.1. |

## 5.3 On-site operation – on-site display not connected

Note!
To operate the device with a HistoROM®/M-DAT module → 30, Section 5.5 "HistoROM®/M-DAT (optional)".

### 5.3.1 Level measuring mode

If no on-site display is connected, the following functions are possible by means of the three keys on the electronic insert or on the exterior of the device:
- Position adjustment (zero point correction)
- Set the lower and upper pressure value and assign to the lower and upper level value
- Device reset, → 24, Section 5.2.2 "Function of the operating elements – on-site display not connected", Table.

Note!
- The "-" and "+"- keys only have a function in the following cases:
  – LEVEL SELECTION "Level Easy Pressure", CALIBRATION MODE "Wet"
  – LEVEL SELECTION "Level Standard", LEVEL MODE "Linear", CALIBRATION MODE "Wet"
  The keys have no function in other settings.
- The device is configured for the Level measuring mode as standard. You can switch measuring modes by means of the MEASURING MODE parameter. → 38, Section 6.2 "Selecting language and measuring mode".
  The following parameters are set to the following values in the factory:
  – LEVEL SELECTION: Level Easy Pressure
  – CALIBRATION MODE: Wet
  – OUTPUT UNIT or LIN. MEASURAND: %
  – EMPTY CALIB.: 0.0
  – FULL CALIB.: 100.0.
  – SET LRV: 0.0 (corresponds to 4 mA value)
  – SET URV: 100.0 (corresponds to 20 mA value)
  These parameters can only be modified by means of the on-site display or remote operation such as the FieldCare.
- The operation must be unlocked. → 35, Section 5.8 "Locking/unlocking operation".
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.
- → 41, Section 6.4 "Section 6.4". For parameter description see Operating Instructions BA00274P.
- LEVEL SELECTION, CALIBRATION MODE, LEVEL MODE, EMPTY CALIB., FULL CALIB, SET LRV and SET URV are parameter names used for on-site display or remote operation such as FieldCare, for instance.

| **Carry out position adjustment.**[1)] | | **Setting lower pressure value.** | | **Setting upper pressure value.** | |
|---|---|---|---|---|---|
| Pressure is present at device. | | Desired pressure for lower pressure value (EMPTY PRESSURE[2)]) is present at device. | | Desired pressure for upper pressure value (FULL PRESSURE[1]) is present at device. | |
| ↓ | | ↓ | | ↓ | |
| Press "E"-key for 3 s. | | Press "–"-key for 3 s. | | Press "+"-key for 3 s. | |
| ↓ | | ↓ | | ↓ | |
| Does the LED on the electronic insert light up briefly? | | Does the LED on the electronic insert light up briefly? | | Does the LED on the electronic insert light up briefly? | |
| Yes | No | Yes | No | Yes | No |
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| Applied pressure for position adjustment has been accepted. | Applied pressure for position adjustment has not been accepted. Observe the input limits. | The pressure present was saved as the lower pressure value (EMPTY PRESSURE[1]) and assigned to the lower level value (EMPTY CALIB.[1]). | The pressure present was not saved as the lower pressure value. Observe the input limits. | The pressure present was saved as the upper pressure value (FULL PRESSURE[1]) and assigned to the upper level value (FULL CALIB.[1]). | The pressure present was not saved as the upper pressure value. Observe the input limits. |

1) Observe "Warning" on → 38, Section 6 "Commissioning".

2) Parameter name used for the on-site display or remote operation such as the FieldCare.

### 5.3.2 Pressure measuring mode

If no on-site display is connected, the following functions are possible by means of the three keys on the electronic insert or on the exterior of the device:
- Position adjustment (zero point correction)
- Setting lower range value and upper range value
- Device reset, → 24, Section 5.2.2 "Function of the operating elements – on-site display not connected", Table.

Note!
- The operation must be unlocked. → 35, Section 5.8 "Locking/unlocking operation".
- The device is configured for the Level measuring mode as standard. You can switch measuring modes by means of the MEASURING MODE parameter. → 38, Section 6.2 "Selecting language and measuring mode".
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.

| **Carry out position adjustment.**[1] | |
|---|---|
| Pressure is present at device. | |
| ↓ | |
| Press "E"-key for 3 s. | |
| ↓ | |
| Does the LED on the electronic insert light up briefly? | |
| Yes | No |
| ↓ | ↓ |
| Applied pressure for position adjustment has been accepted. | Applied pressure for position adjustment has not been accepted. Observe the input limits. |

| **Setting lower range value.** | |
|---|---|
| Desired pressure for lower range value is present at device. | |
| ↓ | |
| Press "–"-key for 3 s. | |
| ↓ | |
| Does the LED on the electronic insert light up briefly? | |
| Yes | No |
| ↓ | ↓ |
| Applied pressure for lower range value has been accepted. | Applied pressure for lower range value has not been accepted. Observe the input limits. |

| **Setting upper range value.** | |
|---|---|
| Desired pressure for upper range value is present at device. | |
| ↓ | |
| Press "+"-key for 3 s. | |
| ↓ | |
| Does the LED on the electronic insert light up briefly? | |
| Yes | No |
| ↓ | ↓ |
| Applied pressure for upper range value has been accepted. | Applied pressure for upper range value has not been accepted. Observe the input limits. |

1) Observe "Warning" on → 38, Section 6 "Commissioning".

## 5.4 On-site operation – on-site display connected

If the on-site display is connected, the three operating keys are used to navigate through the operating menu, → 24, Section 5.2.3 "Function of the operating elements – on-site display connected".

### 5.4.1 General structure of the operating menu

The menu is split into four levels. The three upper levels are used to navigate while you use the bottom level to enter numerical values, select options and save settings. The entire menu is illustrated in → Section 10.1 "Operating menu for on-site display, ToF Tool, FieldCare and HART handheld terminal".
The structure of the OPERATING MENU depends on the measuring mode selected, e.g. if the "Pressure" measuring mode is selected, only the functions necessary for this mode are displayed.

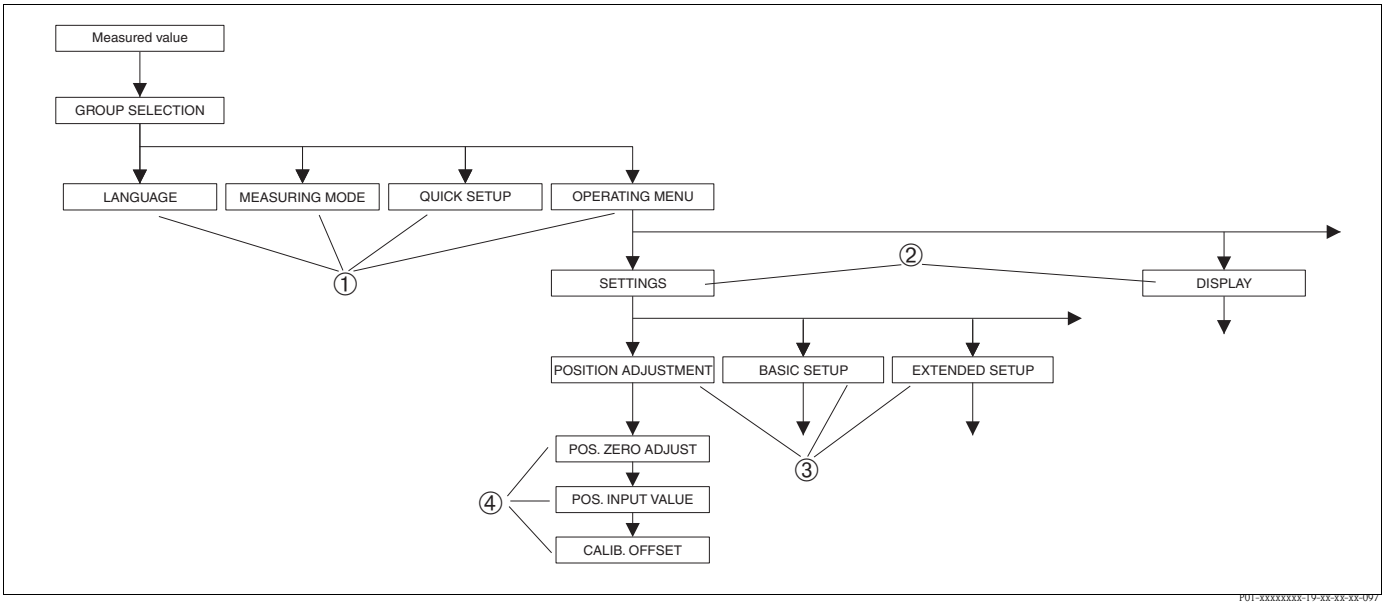


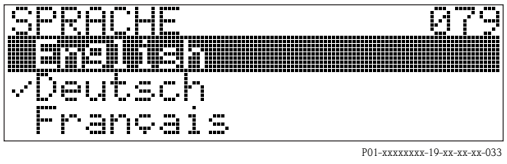
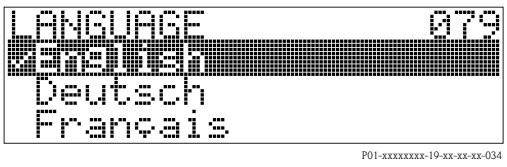

*Fig. 15: Structure of the operating menu*

*1 1. Selection level*
*2 2. Selection level*
*3 Function groups*
*4 Parameter*

Note!
The LANGUAGE and MEASURING MODE parameters are only displayed via the on-site display on the 1st selection level. In the digital communication, the LANGUAGE parameter is displayed in the DISPLAY group and the MEASURING MODE parameter is displayed in the QUICK SETUP menus or in the BASIC SETUP function group. → Section 10.1 "Operating menu for on-site display, ToF Tool, FieldCare and HART handheld terminal".

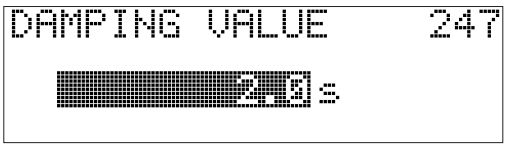
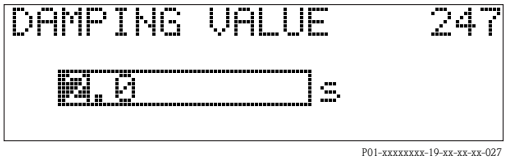
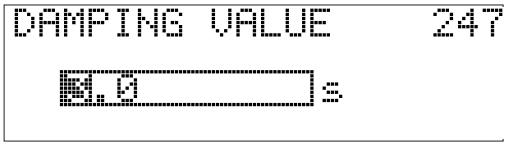
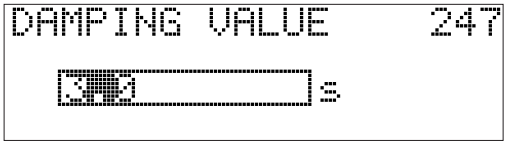
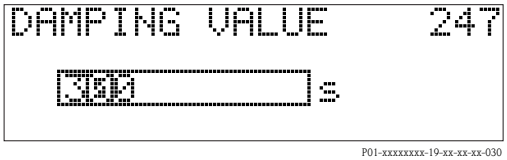
### 5.4.2 Selecting an option

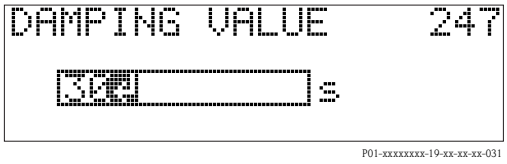
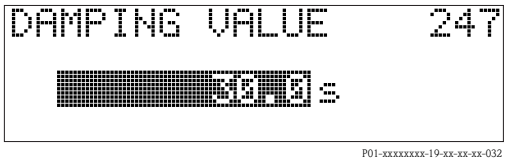
Example: select "English" as the language of the menu.

| On-site display | Operation |
|---|---|
| | German is selected as the language. A ✓in front of the menu text indicates the active option. |
|  | Select English with "+" or "–". |
|  | 1. Confirm your choice with "E". A ✓ in front of the menu text indicates the active option. (English is now selected as the menu language.)<br>2. Jump to the next item with "E". |

### 5.4.3 Editing a value

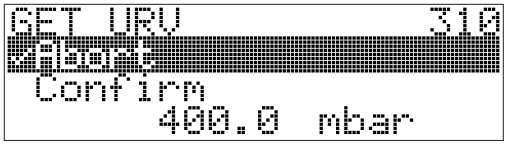
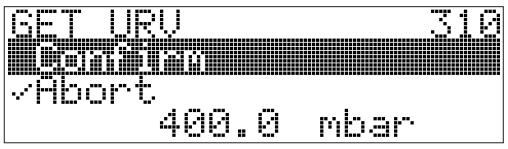
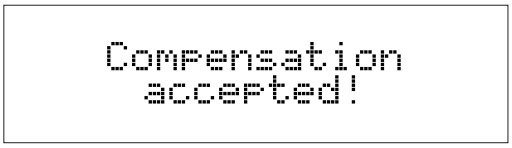
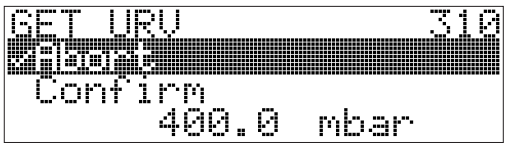
Example: adjusting DAMPING VALUE function from 2.0 s to 30.0 s. → 📄 24, Section 5.2.3 "Function of the operating elements – on-site display connected".

| On-site display | Operation |
|---|---|
|  | The on-site display shows the parameter to be changed. The value highlighted in black can be changed. The "s" unit is fixed and cannot be changed. |
|  | 1. Press "+" or "–" to get to the editing mode.<br>2. The first digit is highlighted in black. |
|  | 1. Use "+" to change "2" to "3".<br>2. Confirm "3" with "E". The cursor jumps to the next position (highlighted in black). |
|  | The decimal point is highlighted in black, i.e. you can now edit it. |
|  | 1. Keep pressing "+" or "–" until "0" is displayed.<br>2. Confirm "0" with "E".<br>The cursor jumps to the next position. ↵ is displayed and is highlighted in black. → See next graphic. |

| On-site display | Operation |
|---|---|
|  P01-xxxxxxxx-19-xx-xx-xx-031 | Use "E" to save the new value and exit the editing mode. →See next graphic. |
|  P01-xxxxxxxx-19-xx-xx-xx-032 | The new value for the damping is now 30.0 s.<br>– Jump to the next parameter with "E".<br>– You can get back to the editing mode with "+" or "–". |

### 5.4.4 Taking pressure applied at device as value

Example: configuring upper range value – assign 20 mA to the pressure value 400 mbar.

| On-site display | Operation |
|---|---|
|  P01-xxxxxxxx-19-xx-xx-xx-035 | The bottom line on the on-site display displays the pressure present, here 400 mbar. |
|  P01-xxxxxxxx-19-xx-xx-xx-036 | Use "+" or "–" to switch to the "Confirm" option. The active selection is highlighted in black. |
|  P01-xxxxxxxx-19-xx-xx-xx-037 | Use "E" to assign the value (400 mbar) to the GET URV parameter. The device confirms the calibration and jumps back to the parameter, here GET URV (see next graphic). |
|  P01-xxxxxxxx-19-xx-xx-xx-035 | Switch to the next parameter with "E". |

## 5.5 HistoROM®/M-DAT (optional)

HistoROM®/M-DAT is a memory module, which is attached to the electronic insert and fulfils the following functions:
- Back-up copy of configuration data
- Copying configuration data of a transmitter into another transmitter
- Cyclic recording of pressure and sensor-temperature measured values
- Recording diverse events, such as alarms, configuration changes, counters for measuring range undershooting and exceeding for pressure and temperature, exceeding and undershooting the user limits for pressure and temperature, etc.

⚠ Warning!
Detach HistoROM®/M-DAT from the electronic insert or attach it to the insert in a deenergised state only.

Note!
- The HistoROM®/M-DAT module may be retrofitted at any time (Order No.: 52027785).
- The HistoROM data and the data in the device are analysed once a HistoROM®/M-DAT is attached to the electronic insert and power is reestablished to the device. During the analysis, the messages "W702, HistoROM data not consistent" and "W706, Configuration in HistoROM and device not identical" can occur. For measures, → 48, Section 8.1 "Messages".

### 5.5.1 Copying configuration data

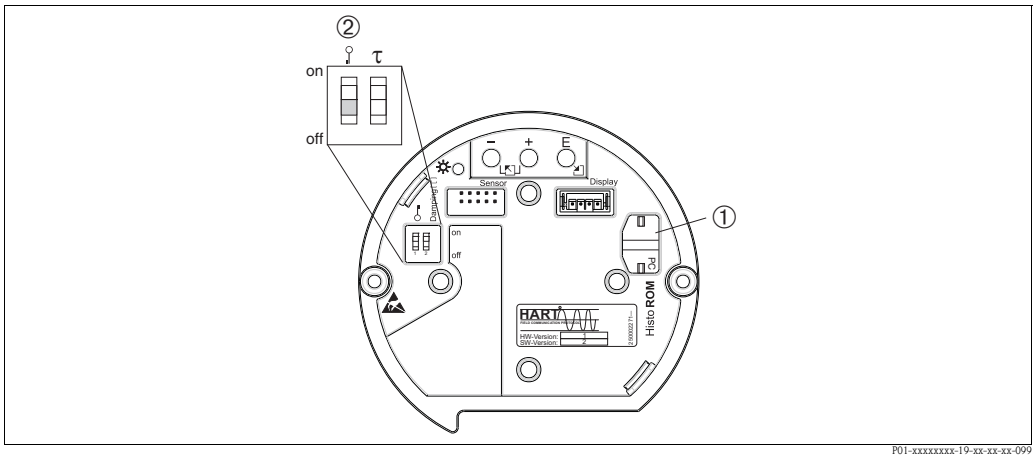



*Abb. 16: Electronic insert with optional HistoROM®/M-DAT memory module*

*1 Optional HistoROM®/M-DAT*
*2 To copy configuration data from the HistoROM®/M-DAT module to a device or from a device to a HistoROM®/M-DAT, the operation must be unlocked (DIP-switch 1, Position "off", parameter INSERT PIN NO. = 100). Observe → 35, Section 5.8 "Locking/unlocking operation".*

**On-site operation – on-site display not connected**

**Copying configuration data from a device to a HistoROM®/M-DAT module:**

Note!
The operation must be unlocked.

1. Disconnect device from supply voltage.
2. Attach the HistoROM®/M-DAT module to the electronic insert.
3. Reestablish supply voltage to the device.
4. Press "E" and "–"-keys (for at least 3 seconds) until the LED on the electronic insert lights up.
5. Wait approx. 20 seconds. Configuration data are loaded from the device to the HistoROM®/M-DAT. The device is not restarted.
6. Disconnect device from the supply voltage again.
7. Detach memory module.
8. Reestablish supply voltage to the device.

**Copying configuration data from a HistoROM®/M-DAT to a device:**

Note!
The operation must be unlocked.

1. Disconnect device from supply voltage.
2. Attach the HistoROM®/M-DAT module to the electronic insert. Configuration data from another device are stored in the HistoROM®/M-DAT.
3. Reestablish supply voltage to the device.
4. Press "E" und "+"-keys (for at least 3 seconds) until the LED on the electronic insert lights up.
5. Wait approx. 20 seconds. All parameters except DEVICE SERIAL No, DEVICE DESIGN., CUST. TAG NUMBER, LONG TAG NUMBER, DESCRIPTION, BUS ADDRESS and the parameters in the POSITION ADJUSTMENT and PROCESS CONNECTION group are loaded into the device by HistoROM®/M-DAT. The device is restarted.
6. Before removing the HistoROM®/M-DAT again from the electronic insert, disconnect the device from supply voltage.

**On-site operation via on-site display (optional) or remote operation**

**Copying configuration data from a device to a HistoROM®/M-DAT:**

Note!
The operation must be unlocked.

1. Disconnect device from supply voltage.
2. Attach the HistoROM®/M-DAT module to the electronic insert.
3. Reestablish supply voltage to the device.
4. The DOWNLOAD SELECT. parameter setting has no influence on an upload from the device into HistoROM.
   (Menu path: (GROUP SELECTION →) OPERATING MENU → OPERATION)
5. Using the HistoROM CONTROL parameter select the option "Device → HistoROM" as the data transfer direction.
   (Menu path: GROUPSELECTION → OPERATING MENU → OPERATION)
6. Wait approx. 20 seconds. Configuration data are loaded from the device to the HistoROM®/M-DAT. The device is not restarted.
7. Disconnect device from the supply voltage again.
8. Detach memory module.
9. Reestablish supply voltage to the device.

**Copying configuration data from a HistoROM®/M-DAT to a device**:

Note!
The operation must be unlocked.

1. Disconnect device from supply voltage.
2. Attach the HistoROM®/M-DAT module to the electronic insert. Configuration data from another device are stored in the HistoROM®/M-DAT.
3. Reestablish supply voltage to the device.
4. Use the DOWNLOAD SELECT parameter to select which parameters are to be overwritten (Menu path: (GROUPS SELECTION →) OPERATING MENU → OPERATION).
   The following parameters are overwritten according to the selection:
   – **Configuration copy (factory setting):**
     all parameters except DEVICE SERIAL No, DEVICE DESIGN., CUST. TAG NUMBER, LONG TAG NUMBER, DESCRIPTION, BUS ADDRESS and the parameters in the POSITION ADJUSTMENT, PROCESS CONNECTION, CURR. TRIM (SERVICE/ SYSTEM 2), SENSOR TRIM and SENSOR DATA group.
   – **Device replacement:**
     all parameters except DEVICE SERIAL No, DEVICE DESIGN. and the parameters in the POSITION ADJUSTMENT, PROCESS CONNECTION, CURR. TRIM (SERVICE/ SYSTEM2), SENSOR TRIM and SENSOR DATA group.
   – **Electronics replacement**:
     all parameters except the parameters in the CURR. TRIM (SENSOR/SYSTEM2), POSITION ADJUSTMENT and SENSOR DATA group.
   Factory setting: Configuration copy
5. Using the HistoROM CONTROL parameter select the option "HistoROM → Device" as the data transfer direction.
   (Menu path: GROUP SELECTION → OPERATING MENU → OPERATION)
6. Wait approx. 20 seconds. Configuration data are loaded from the device to the HistoROM®/ M-DAT. The device is restarted.
7. Before removing the HistoROM®/M-DAT again from the electronic insert, disconnect the device from supply voltage.

## 5.6 Operation via SFX100

Compact, flexible and robust industry handheld terminal for remote parametrization and measured value inspection via the HART current output (4-20mA).
For details refer to Operating Instructions BA00060S/04/EN.

## 5.7 FieldCare

FieldCare is an Endress+Hauser asset management tool based on FDT technology. With FieldCare, you can configure all Endress+Hauser devices as well as devices from other manufacturers that support the FDT standard. Hardware and software requirements you can find on the internet: www.endress.com → select your country → Search: FieldCare → FieldCare → Technical Data.

FieldCare supports the following functions:
- Configuration of transmitters in online operation
- Loading and saving device data (upload/download)
- HistoROM®/M-DAT analysis
- Documentation of the measuring point

Connection options:
- HART via Commubox FXA195 and USB interface of a computer
- HART via Fieldgate FXA520

Note!
- → 20, Section 4.2.6, "Connecting Commubox FXA195".
- → 21, Section 4.2.7, "Connecting Commubox FXA291/ToF Adapter FXA291 for operation via FieldCare".
- Further information on the FieldCare can be found on the Internet (http://www.endress.com, Download → Search for: FieldCare).

## 5.8 Locking/unlocking operation

Once you have entered all the parameters, you can lock your entries against unauthorised and undesired access.

You have the following possibilities for locking/unlocking the operation:
- Via a DIP-switch on the electronic insert, locally on the display.
- Via the on-site display (optional)
- Via digital communication.

The -symbol on the on-site display indicates that operation is locked. Parameters which refer to how the display appears, e.g. LANGUAGE and DISPLAY CONTRAST can still be altered.

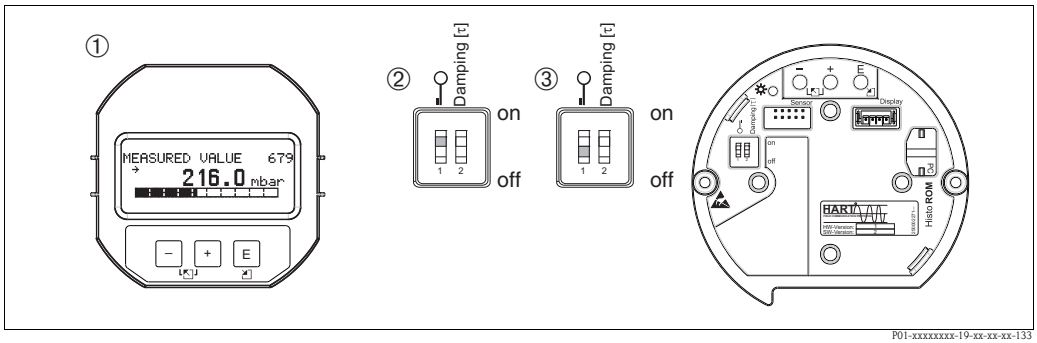
Note!
- If operation is locked by means of the DIP-switch, you can only unlock operation again by means of the DIP-switch. If operation is locked by means of the on-site display or remote operation e.g. FieldCare, you can only unlock operation again by means of the on-site display or remote operation.

The table provides an overview of the locking functions:

| Locking via | View/read parameter | Modify/write via[1] | | Unlocking via | | |
|---|---|---|---|---|---|---|
| | | On-site display | Remote operation | DIP-switch | On-site display | Remote operation |
| DIP-switch | Yes | No | No | Yes | No | No |
| On-site display | Yes | No | No | No | Yes | Yes |
| Remote operation | Yes | No | No | No | Yes | Yes |

1) Parameters which refer to how the display appears, e.g. LANGUAGE and DISPLAY CONTRAST can still be altered.

### 5.8.1 Locking/unlocking operation locally via DIP-switch




P01-xxxxxxxx-19-xx-xx-xx-133

*Fig. 17: DIP-switch position "Hardware locking" on the electronic insert*

*1 If necessary, remove on-site display (optional)*
*2 DIP-switch is at "on": operation is locked.*
*3 DIP-switch is at "off": operation is unlocked (operation possible)*

### 5.8.2 Locking/unlocking operation via on-site display or remote operation

| | Description |
|---|---|
| Locking operation | 1. Select INSERT PIN NO. parameter,<br>Menu path: OPERATING MENU → OPERATION → INSERT PIN NO.<br>2. To lock operation, enter a number for this parameter between 0 to 9999 that is ≠100. |
| Unlocking operation | 1. Select INSERT PIN NO. parameter.<br>2. To unlock operation, enter "100" for the parameter. |

## 5.9 Factory setting (reset)

By entering a certain code, you can completely, or partially, reset the entries for the parameters to the factory settings. (→ For factory settings refer to the Operating Instructions BA00274P "Cerabar S/Deltabar S/Deltapilot S, Description of device functions". See also → 📄 2, "Overview documentation".) Enter the code by means of the ENTER RESET CODE parameter (Menu path: (GROUP SELECTION →) OPERATING MENU → OPERATING).
There are various reset codes for the device. The following table illustrates which parameters are reset by the particular reset codes. Operation must be unlocked to reset parameters (→ 📄 36, Section 5.9).

Note!
Any customer-specific configuration carried out by the factory is not affected by a reset (customer-specific configuration remains). If, after a reset, you wish the parameters to be reset to the factory settings, please contact Endress+Hauser Service.

| Reset code | Description and effect |
|---|---|
| 1846 | **Display reset**<br>– This reset resets all parameters which have to do with how the display appears (DISPLAY group).<br>– Any simulation which may be running is ended.<br>– The device is restarted. |
| 62 | **PowerUp reset (warm start)**<br>– This reset resets all the parameters in the RAM. Data are read back anew from the EEPROM (processor is initialised again).<br>– Any simulation which may be running is ended.<br>– The device is restarted. |
| 2710 | **Measuring mode level reset**<br>– Depending on the settings for the LEVEL MODE, LIN MEASURAND, LINdMEASURAND or COMB. MEASURAND parameters, the parameters needed for this measuring task will be reset.<br>– Any simulation which may be running is ended.<br>– The device is restarted.<br>Example LEVEL MODE = linear and LIN. MEASURAND = Height<br>■ HEIGHT UNIT = m<br>■ CALIBRATION MODE = wet<br>■ EMPTY CALIB. = 0<br>■ FULL CALIB. = Sensor end value converted to $mH_2O$, e.g. 4 $mH_2O$ for a 400 mbar (6 psi) sensor |
| 333 | **User reset**<br>– Affects the following parameters:<br>– Function group POSITION ADJUSTMENT<br>– Function group BASIC SETUP, except for the customer-specific units<br>– Function group EXTENDED SETUP<br>– Group OUTPUT<br>– Function group HART DATA: BUS ADDRESS and PREAMBLE NUMBER<br>– Any simulation which may be running is ended.<br>– The device is restarted. |

| Reset code | Description and effect |
|---|---|
| 7864 | **Total reset**<br>– Affects the following parameters:<br>– Function group POSITION ADJUSTMENT<br>– Function group BASIC SETUP<br>– Function group EXTENDED SETUP<br>– Function group LINEARISATION (an existing linearisation table is erased)<br>– Group OUTPUT<br>– Function group PEAK HOLD INDICATOR<br>– Function group HART DATA<br>– All configurable messages ("Error" type) are set to factory setting.<br>See also → 48, Section 8.1 "Messages" and → 56, Section 8.2 "Response of outputs to errors".<br>– Function group USER LIMITS<br>– Function group SYSTEM 2<br>– Any simulation which may be running is ended.<br>– The device is restarted. |
| 8888 | **HistoROM reset**<br>The measured value memory and event memory are cleared. During the reset, the HistoROM must be attached to the electronic insert. |

# 6 Commissioning

Warning!
- If a pressure smaller than the minimum permitted pressure is present at the device, the messages "E120 Sensor low pressure" and "E727 Sensor pressure error - overrange" are output in succession.
- If a pressure greater than the maximum permitted pressure is present at the device, the messages "E115 Sensor overpressure" and "E727 Sensor pressure error - overrange" are output in succession.
- Messages E727, E115 and E120 are "Error"-type messages and can be configured as a "Warning" or an "Alarm". These messages are configured as "Warning" messages at the factory. This setting prevents the current output from assuming the set alarm current value for applications (e.g. cascade measurement) where the user is consciously aware of the fact that the sensor range can be exceeded
- We recommend setting messages E727, E115 and E120 to "Alarm" in the following instances:
  - The sensor range does not have to be exceeded for the measuring application.
  - Position adjustment has to be carried out that has to correct a large measured error as a result of the orientation of the device.

Note!
By default, the device is set up for the Level measuring mode, "Level Easy Pressure" level selection and "%" as the unit.

## 6.1 Function check

Carry out a post-installation and a post-connection check as per the checklist before commissioning the device.

- "Post-installation check" checklist → see Section 3.4
- "Post-connection check" checklist → see Section 4.5

## 6.2 Selecting language and measuring mode

### 6.2.1 On-site operation

The LANGUAGE and MEASURING MODE parameters are located on the top menu level. → See also → 28, Section 5.4.1 "General structure of the operating menu".

The following languages are available:
- Deutsch
- English
- Français
- Italiano
- Español
- Nederlands
- Chinese (CHS)
- Japanese (JPN)

The following measuring modes are available:
- Pressure
- Level

### 6.2.2 Digital communication

The MEASURING MODE parameter is displayed in the digital communication in the QUICK SETUP menus and in the BASIC SETUP function group (OPERATING MENU → SETTINGS → BASIC SETUP).

The following measuring modes are available:
- Pressure
- Level

The LANGUAGE parameter is arranged in the DISPLAY group (OPERATING MENU → DISPLAY).
- Use the LANGUAGE parameter to select the menu language for the on-site display.
- Select the menu language for ToF Tool via the "Options" menu → "Options" → "Display" → "Language".
- Select the menu language for FieldCare by means of the "Language Button" in the configuration window. Select the menu language for the FieldCare frame via the "Extra" menu → "Options" → "Display" → "Language".

The following languages are available:
- Deutsch
- English
- Français
- Italiano
- Español
- Nederlands
- Chinese (CHS)
- Japanese (JPN)

## 6.3 Position adjustment

Due to the orientation of the device, there may be a shift in the measured value, i.e. when the container is empty or partly filled, the measured value parameter does not display zero. There are three options to choose from when performing position adjustment.
(Menu path: (GROUP SELECTION →) OPERATING MENU → SETTINGS → POSITION ADJUSTMENT)

| Parameter name | Description |
|---|---|
| POS. ZERO ADJUST (685)<br>Entry | Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known.<br>**Example:**<br>– MEASURED VALUE = 2.2 mbar (0.032 psi)<br>– Correct the MEASURED VALUE via the POS. ZERO ADJUST parameter with the "Confirm" option. This means that you are assigning the value 0.0 to the pressure present.<br>– MEASURED VALUE (after pos. zero adjust) = 0.0 mbar<br>– The current value is also corrected.<br>The CALIB. OFFSET parameter displays the resulting pressure difference (offset) by which the MEASURED VALUE was corrected.<br>**Factory setting:**<br>0.0 |
| POS. INPUT VALUE (563)<br>Entry | Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known. To correct the pressure difference, you need a reference measurement value (e. g. from a reference device).<br>**Example:**<br>– MEASURED VALUE = 0.5 mbar (0.0073 psi)<br>– For the POS. INPUT VALUE parameter, specify the desired set point for the MEASURED VALUE, e.g. 2.0 mbar (0.029 psi).<br>(MEASURED $VALUE_{new}$ = POS. INPUT VALUE)<br>– MEASURED VALUE (after entry for POS. INPUT VALUE) = 2.0 mbar (0.029 psi)<br>– The CALIB. OFFSET parameter displays the resulting pressure difference (offset) by which the MEASURED VALUE was corrected.<br>CALIB. OFFSET = MEASURED $VALUE_{old}$ – POS. INPUT VALUE,<br>here: CALIB. OFFSET = 0.5 mbar (0.0073 psi) – 2.0 mbar (0.029 psi) = – 1.5 mbar (0.022 psi))<br>– The current value is also corrected.<br>**Factory setting:**<br>0.0 |
| CALIB. OFFSET (319)<br>Entry | Position adjustment – the pressure difference between zero (set point) and the measured pressure is known.<br>**Example:**<br>– MEASURED VALUE = 2.2 mbar (0.032 psi)<br>– Via the CALIB. OFFSET parameter, enter the value by which the MEASURED VALUE should be corrected. To correct the MEASURED VALUE to 0.0 mbar, you must enter the value 2.2 here.<br>(MEASURED $VALUE_{new}$ = MEASURED $VALUE_{old}$ – CALIB. OFFSET)<br>– MEASURED VALUE (after entry for calib. offset) = 0.0 mbar<br>– The current value is also corrected.<br>**Factory setting:**<br>0.0 |

## 6.4 Level measurement

### 6.4.1 Information on level measurement

Note!

- The Pressure and Level operating modes each have a quick setup menu which guides you through the most important basic functions. See → 📄 43 for the "Level" quick setup menu.
- Furthermore, the three level modes "Level Easy Pressure", "Level Easy Height" and "Level Standard" are available to you for level measurement. You can select from the "Linear", "Pressure linearized" and "Height linearized" level types for the "Level Standard" level mode. The table in the "Overview of level measurement" section below provides an overview of the various measuring tasks.
  - In the "Level Easy Pressure" and "Level Easy Height" level modes, the values entered are not tested as extensively as in the "Level Standard" level mode. The values entered for EMPTY CALIB./FULL CALIB., EMPTY PRESSURE/FULL PRESSURE, EMPTY HEIGHT/FULL HEIGHT and SET LRV/SET URV must have a minimum interval of 1% for the "Level Easy Pressure" and "Level Easy Height" level modes. The value will be rejected with a warning message if the values are too close together. Further limit values are not checked; i.e. the values entered must be appropriate for the sensor and the measuring task so that the measuring device can measure correctly.
  - The "Level Easy Pressure" and "Level Easy Height" level modes encompass fewer parameters than the "Level Standard" mode and are used for quick and easy configuration of a level application.
  - Customer-specific units of fill level, volume and mass or a linearization table may only be entered in the "Level Standard" level mode.
  - Where the device is intended for use as a subsystem in a safety function (SIL), a "Device configuration with enhanced parameter security" (SAFETY CONFIRM.) is only possible for the "Level" operating mode in the "Level Easy Pressure" level mode. All parameters previously entered are checked after a password is entered. Once the "Level Easy Height" or "Level Standard" has been selected, the configuration will first have to be reset to the ex-works setting using the RESET parameter (menu path: (GROUP SELECTION →) OPERATING MENU → OPERATION) using the reset code "7864". → For further information see the Deltapilot S (SD00213P) Functional Safety Manual.
- See the Operating Instructions BA00274P "Cerabar S/Deltabar S/Deltapilot S, Description of device functions". → 📄 2, "Overview documentation" section.

### 6.4.2 Overview of level measurement

| Measuring task | LEVEL SELECTION/ LEVEL MODE | Measured variable options | Description | Comment | Measured value display |
|---|---|---|---|---|---|
| The measured variable is in direct proportion to the measured pressure. Calibration is performed by entering two pressure-level value pairs. | LEVEL SELECTION: Level Easy Pressure | Via OUTPUT UNIT parameter: %, level, volume or mass units. | – Calibration with reference pressure – wet calibration, see Operating Instructions BA00274P.<br>– Calibration without reference pressure – dry calibration, see Operating Instructions BA00274P. | – Incorrect entries are possible<br>– SIL mode possible<br>– Customised units are not possible | The measured value display and the LEVEL BEFORE LIN parameter show the measured value. |
| The measured variable is in direct proportion to the measured pressure. Calibration is performed by entering the density and two height-level value pairs. | LEVEL SELECTION: Level Easy Height | Via OUTPUT UNIT parameter: %, level, volume or mass units. | – Calibration with reference pressure – wet calibration, see Operating Instructions BA00274P.<br>– Calibration without reference pressure – dry calibration, see Operating Instructions BA00274P. | – Incorrect entries are possible<br>– SIL mode not possible<br>– Customised units are not possible | The measured value display and the LEVEL BEFORE LIN parameter show the measured value. |
| The measured variable is in direct proportion to the measured pressure. | LEVEL SELECTION: Level standard/ LEVEL MODE: Linear | Via LIN. MEASURAND parameter:<br>– % (level)<br>– Level<br>– Volume<br>– Mass | – Calibration with reference pressure – wet calibration, see Operating Instructions BA00274P.<br>– Calibration without reference pressure – dry calibration, see Operating Instructions BA00274P. | – Incorrect entries are rejected by the device<br>– SIL mode not possible<br>– Customised level, volume and mass units are possible | The measured value display and the LEVEL BEFORE LIN parameter show the measured value. |
| The measured variable is not in direct proportion to the measured pressure as, for example, with containers with a conical outlet. A linearisation table must be entered for the calibration. | LEVEL SELECTION: Level standard/ LEVEL MODE: Pressure linearized | Via LINd MEASURAND parameter:<br>– Pressure + %<br>– Pressure + volume<br>– Pressure + mass | – Calibration with reference pressure: semiautomatic entry of linearisation table, see Operating Instructions BA00274P.<br>– Calibration without reference pressure: manual entry of linearisation table, see Operating Instructions BA00274P. | – Incorrect entries are rejected by the device<br>– SIL mode not possible<br>– Customised level, volume and mass units are possible | The measured value display and the TANK CONTENT parameter show the measured value. |
| – Two measured variables are required or<br>– The container shape is given by value pairs, such as height and volume.<br>The 1st measured variable %-height or height must be in direct proportion to the measured pressure. The 2nd measured variable volume, mass or % must not be in direct proportion to the measured pressure. A linearisation table must be entered for the 2nd measured variable. The 2nd measured variable is assigned to the 1st measured variable by means of this table. | LEVEL SELECTION: Level standard/ LEVEL MODE: Height linearized | Via COMB. MEASURAND parameter:<br>– Height + volume<br>– Height + mass<br>– Height + %<br>– %-Height + volume<br>– %-Height + mass<br>– %-Height + % | – Calibration with reference pressure: wet calibration and semiautomatic entry of linearisation table, see Operating Instructions BA00274P.<br>– Calibration without reference pressure: dry calibration and manual entry of linearisation table, see Operating Instructions BA00274P. | – Incorrect entries are rejected by the device<br>– SIL mode not possible<br>– Customised level, volume and mass units are possible | The measured value display and the TANK CONTENT parameter show the 2nd measured value (volume, mass or %).<br>The LEVEL BEFORE LIN parameter displays the 1st measured value (%-height or height). |

### 6.4.3 Quick Setup menu for Level measuring mode

Note!

- Some parameters are only displayed if other parameters are appropriately configured. For example, the EMPTY CALIB. parameter is only displayed in the following cases:
  – LEVEL SELECTION "Level Easy Pressure" and CALIBRATION MODE "Wet"
  – LEVEL SELECTION "Level Standard", LEVEL MODE "Linear" and CALIBRATION MODE "WET"
  You can find the LEVEL MODE parameter in the BASIC SETTINGS function group (menu path: (GROUP SELECTION →) OPERATING MENU → SETTINGS → BASIC SETTINGS).
- The following parameters are set to the following values in the factory:
  – LEVEL SELETION: Level Easy Pressure
  – CALIBRATION MODE: Wet
  – OUTPUT UNIT or LIN. MEASURAND: %
  – EMPTY CALIB.: 0.0
  – FULL CALIB.: 100.0
  – SET LRV (BASIC SETTINGS group): 0.0 (corresponds to 4 mA value)
  – SET URV (BASIC SETTINGS group): 100.0 (corresponds to 20 mA value).
- The quick setup is suitable for simple and quick commissioning. If you wish to make more complex settings, e.g. change the unit from "%" to "m", you will have to calibrate using the BASIC SETTINGS group. → See Operating Instructions BA00274P or → 🖹 2, "Overview documentation" section.

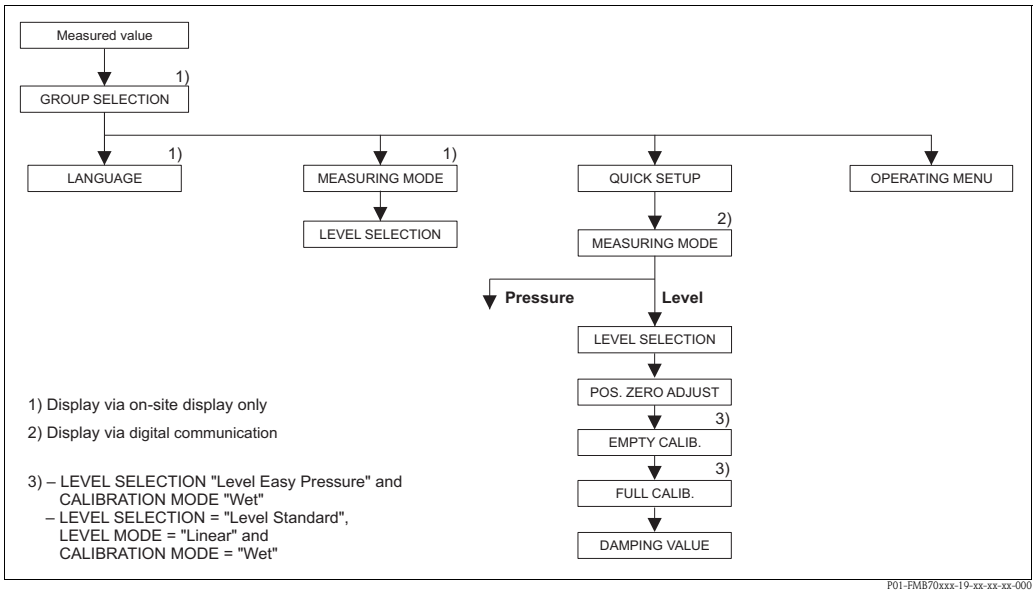



*Fig. 18: Quick Setup menu for the Level measuring mode*

| On-site operation |
|---|
| **Measured value display**<br>On-site display: Switch from the measured value display to GROUP SELECTION with E. |
| **GROUP SELECTION**<br>Select MEASURING MODE. |
| **MEASURING MODE**<br>Select "Level" option. |
| **LEVEL SELECTION**<br>Select level mode. For an overview see → 🖹 42. |
| **GROUP SELECTION**<br>Select QUICK SETUP menu. |

| Digital communication |
|---|
| **Measured value display**<br>Select QUICK SETUP menu. |
| **MEASURING MODE**<br>Select "Level" option. |
| **LEVEL SELECTION**<br>Select level mode. For an overview see → 🖹 42. |

| On-site operation | Digital communication |
|---|---|
| **POS. ZERO ADJUST**<br>Due to orientation of the device, there may be a shift in the measured value. You correct the MEASURED VALUE via the POS. ZERO ADJUST parameter with the "Confirm" option, i. e. you assign the value 0.0 to the pressure present. | **POS. ZERO ADJUST**<br>Due to orientation of the device, there may be a shift in the measured value. You correct the MEASURED VALUE via the POS. ZERO ADJUST parameter with the "Confirm" option, i. e. you assign the value 0.0 to the pressure present. |
| **EMPTY CALIB.** 1)<br>Enter level for the lower calibration point.<br>For this parameter, enter a level value which is assigned to the pressure present at the device. | **EMPTY CALIB.** 1<br>Enter level for the lower calibration point.<br>For this parameter, enter a level value which is assigned to the pressure present at the device. |
| **FULL CALIB.** 1<br>Enter level for the upper calibration point.<br>For this parameter, enter a level value which is assigned to the pressure present at the device. | **FULL CALIB.** 1<br>Enter level for the upper calibration point.<br>For this parameter, enter a level value which is assigned to the pressure present at the device. |
| **DAMPING TIME**<br>Enter damping time (time constant $\tau$). The damping affects the speed at which all subsequent elements, such as the on-site display, measured value and current output react to a change in the pressure. | **DAMPING TIME**<br>Enter damping time (time constant $\tau$). The damping affects the speed at which all subsequent elements, such as the on-site display, measured value and current output react to a change in the pressure. |

1) – LEVEL SELECTION "Level Easy Pressure" and CALIBRATION MODE "Wet"
– LEVEL SELECTION "Level Standard", LEVEL MODE "Linear" and CALIBRATION MODE "Wet"

Note!
For on-site operation, see also → 24, Section 5.2.3 "Function of the operating elements – on-site display connected" and → 28, Section 5.4 ff "Operating elements".

# 6.5 Pressure measurement

## 6.5.1 Information on pressure measurement

Note!

- There is a Quick Setup menu for each of the measuring modes Pressure and Level which guides you through the most important basic functions. With the setting in the MEASURING MODE parameter, you specify which Quick Setup menu should be displayed. → 38, Section 6.2 "Selecting language and measuring mode".
- For a detailed description of the parameters see the Operating Instructions BA00274P "Cerabar S/Deltabar S/Deltapilot S, Description of device functions"
  – Table 6, POSITION ADJUSTMENT
  – Table 7, BASIC SETUP
  – Table 15, EXTENDED SETUP
  → 2, "Overview documentation".
- For pressure measurement, select the "Pressure" option by means of the MEASURING MODE parameter. The operating menu is structured appropriately. → See also Section 10.1.

## 6.5.2 Quick Setup menu for Pressure measuring mode

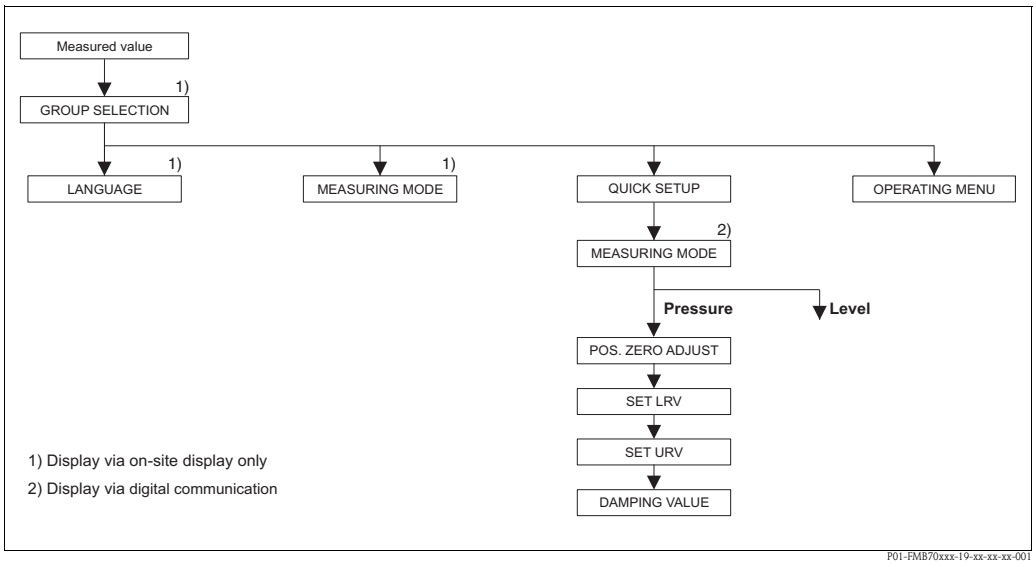



*Fig. 19: Quick Setup menu for Pressure measuring mode*

| On-site operation | Digital communication |
|---|---|
| **Measured value display**<br>On-site display: Switch from the measured value display to GROUP SELECTION with E. | **Measured value display**<br>Select QUICK SETUP menu. |
| **GROUP SELECTION**<br>Select MEASURING MODE. | **MEASURING MODE**<br>Select "Pressure" option. |
| **MEASURING MODE**<br>Select "Pressure" option. | |
| **GROUP SELECTION**<br>Select QUICK SETUP menu. | |
| **POS. ZERO ADJUST**<br>Due to orientation of the device, there may be a shift in the measured value. You correct the MEASURED VALUE via the POS. ZERO ADJUST parameter with the "Confirm" option, i. e. you assign the value 0.0 to the pressure present. | **POS. ZERO ADJUST**<br>Due to orientation of the device, there may be a shift in the measured value. You correct the MEASURED VALUE via the POS. ZERO ADJUST parameter with the "Confirm" option, i. e. you assign the value 0.0 to the pressure present. |

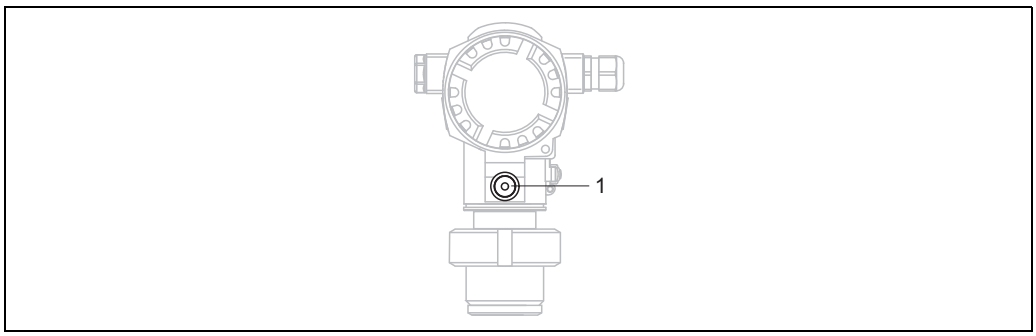
| On-site operation |
| --- |
| **SET LRV**<br>Set the measuring range (enter 4 mA value).<br>Specify a pressure value for the lower current value (4 mA value). A reference pressure does not have to be present at the device. |
| **SET URV**<br>Set the measuring range (enter 20 mA value).<br>Specify a pressure value for the upper current value (20 mA value). A reference pressure does not have to be present at the device. |
| **DAMPING TIME**<br>Enter damping time (time constant $\tau$). The damping affects the speed at which all subsequent elements, such as the on-site display, measured value and current output react to a change in the pressure. |

| Digital communication |
| --- |
| **SET LRV**<br>Set the measuring range (enter 4 mA value).<br>Specify a pressure value for the lower current value (4 mA value). A reference pressure does not have to be present at the device. |
| **SET URV**<br>Set the measuring range (enter 20 mA value).<br>Specify a pressure value for the upper current value (20 mA value). A reference pressure does not have to be present at the device. |
| **DAMPING TIME**<br>Enter damping time (time constant $\tau$). The damping affects the speed at which all subsequent elements, such as the on-site display, measured value and current output react to a change in the pressure. |

Note!
For on-site operation, → 24, Section 5.2.3 "Function of the operating elements – on-site display connected" and → 28, Section 5.4 ff "Operating elements".

# 7 Maintenance

Keep the pressure compensation and GORE-TEX® filter (1) free from contaminations.




P01-FMB70xxx-17-xx-xx-xx-003

## 7.1 Exterior cleaning

Please note the following points when cleaning the device:
- The cleaning agents used should not attack the surface and the seals.
- Mechanical damage to the process isolating diaphragm, e.g. due to pointed objects, must be avoided.
- Observe degree of protection. See therefore nameplate if necessary (→ 🖹 6).

# 8 Trouble-shooting

## 8.1 Messages

The following table lists all the possible messages that can occur.
The device differentiates between the error types "Alarm", "Warning" and "Error". You may specify whether the instrument should react as if for an "Alarm" or "Warning" for "Error" messages.
→ See "Error type/NA 64" column and Section 8.2 "Response of outputs to errors".

In addition, the "Error type/NA 64" column classifies the messages in accordance with NAMUR Recommendation NA 64:
- Break down: indicated with "B"
- Maintenance need: indicated with "C" (check request)
- Function check: indicated with "I" (in service)

Error message display on the on-site display:
- The measured value display shows the message with the highest priority. → See "Priority" column.
- The ALARM STATUS parameter shows all the messages present in descending order of priority. You can scroll through all the messages present with the −-key or +-key.

Message display via the digital communication:
- The ALARM STATUS parameter shows the message with the highest priority. → See "Priority" column.

Note!
- If the device detects a defect in the on-site display during initialization, special error messages are generated. → For the error messages, → 📄 55, Section 8.1.1 "On-site display error messages".
- For support and further information, please contact Endress+Hauser Service.
- → See also Section 8.4 ff.

| Code | Error type/ NA 64 | Message/description | Cause | Measure | Priority |
|---|---|---|---|---|---|
| 101 (A101) | Alarm<br>B | B>Sensor electronic EEPROM error | – Electromagnetic effects are greater than specifications in the technical data. (→ See Section 9.) This message normally only appears briefly.<br>– Sensor defect. | – Wait a few minutes.<br>– Restart the device. Perform reset (Code 62).<br>– Block off electromagnetic effects or eliminate source of disturbance.<br>– Replace sensor. | 17 |
| 102 (W102) | Warning<br>C | C>Checksum error in EEPROM: peakhold segment | – Main electronics defect. Correct measurement can continue as long as you do not need the peak hold indicator function. | – Replace main electronics. | 53 |
| 106 (W106) | Warning<br>C | C>Downloading - please wait | – Downloading. | – Wait for download to complete. | 52 |
| 110 (A110) | Alarm<br>B | B>Checksum error in EEPROM: configuration segment | – The supply voltage is disconnected when writing.<br>– Electromagnetic effects are greater than specifications in the technical data. (→ See Section 9.)<br>– Main electronics defect. | – Reestablish supply voltage. Perform reset (Code 7864) if necessary. Carry out calibration again.<br>– Block off electromagnetic effects or eliminate sources of disturbance.<br>– Replace main electronics. | 6 |
| 113 (A113) | Alarm<br>B | B>ROM failure in transmitter electronic | – Main electronics defect. | – Replace main electronics. | 1 |

| Code | Error type/ NA 64 | Message/description | Cause | Measure | Priority |
|---|---|---|---|---|---|
| 115 (E115) | Error<br>B<br>factory setting:<br>Warning | B>Sensor overpressure | – Overpressure present.<br>– Sensor defect. | – Reduce pressure until message disappears.<br>– Replace sensor. | 29 |
| 116 (W116) | Warning<br>C | C>Download error, repeat download | – The file is defect.<br>– During the download, the data are not correctly transmitted to the processor, e.g. because of open cable connections, spikes (ripple) on the supply voltage or electromagnetic effects. | – Use another file.<br>– Check cable connection PC – transmitter.<br>– Block off electromagnetic effects or eliminate sources of disturbance.<br>– Perform reset (Code 7864) and carry out calibration again.<br>– Repeat download. | 36 |
| 120 (E120) | Error<br>B<br>factory setting:<br>Warning | B>Sensor low pressure | – Pressure too low.<br>– Sensor defect. | – Increase pressure until message disappears.<br>– Replace sensor. | 30 |
| 121 (A121) | Alarm<br>B | B>Checksum error in factory segment of EEPROM | – Main electronics defect. | – Replace main electronics. | 5 |
| 122 (A122) | Alarm<br>B | B>Sensor not connected | – Cable connection sensor –main electronics disconnected.<br>– Electromagnetic effects are greater than specifications in the technical data.<br>(→ See Section 9.)<br>– Main electronics defect.<br>– Sensor defect. | – Check cable connection and repair if necessary.<br>– Block off electromagnetic effects or eliminate source of disturbance.<br>– Replace main electronics.<br>– Replace sensor. | 13 |
| 130 (A130) | Alarm<br>B | B>EEPROM is defect. | – Main electronics defect. | – Replace main electronics. | 10 |
| 131 (A131) | Alarm<br>B | B>Checksum error in EEPROM: min/max segment | – Main electronics defect. | – Replace main electronics. | 9 |
| 132 (A132) | Alarm<br>B | B>Checksum error in totalizer EEPROM | – Main electronics defect. | – Replace main electronics. | 7 |
| 133 (A133) | Alarm<br>B | B>Checksum error in History EEPROM | – An error occurred when writing.<br>– Main electronics defect. | – Perform reset (Code 7864) and carry out calibration again.<br>– Replace electronics. | 8 |
| 602 (W602) | Warning<br>C | C>Linearisation curve not monoton | – The linearisation table is not monotonic increasing or decreasing. | – Add to linearisation table or perform linearisation again. | 57 |
| 604 (W604) | Warning<br>C | C>Linearisation table not valid. Less than 2 points or points too close | – The linearisation table consists of less than 2 points.<br>– At least 2 points in the linearisation table are too close together. A minimum gap of 0.5 % of the distance between two points must be maintained.<br>Spans for the "Pressure linearized" option: HYDR. PRESS MAX. – HYDR. PRESS MIN.; TANK CONTENT MAX. – TANK CONTENT MIN.<br>Spans for the "Height linearized" option: LEVEL MAX – LEVEL MIN; TANK CONTENT MAX. – TANK CONTENT MIN. | – Add to linearisation table. If necessary, perform linearisation again.<br>– Correct linearisation table and accept again. | 58 |
| 613 (W613) | Warning<br>I | I>Simulation is active | – Simulation is switched on, i.e. the device is not measuring at present. | – Switch off simulation. | 60 |

| Code | Error type/ NA 64 | Message/description | Cause | Measure | Priority |
|---|---|---|---|---|---|
| 620 (E620) | Error<br>C<br>Factory setting:<br>Warning | C>Current output out of range | The current is outside the permitted range 3.8 to 20.5 mA.<br>– The pressure applied is outside the set measuring range (but within the sensor range).<br>– Loose connection at sensor cable | – Check pressure applied, reconfigure measuring range if necessary (→ See also Operating Instructions BA00274P, chapter 4 to 6 or these Operating Instructions → 2.)<br>– Perform reset (Code 7864) and carry out calibration again.<br>– Wait a short period of time and tighten the connection, or avoid loose connection. | 49 |
| 700 (W700) | Warning<br>C | C>Last configuration not stored | – An error occurred when writing or reading configuration data or the power supply was disconnected.<br>– Main electronics defect. | – Perform reset (Code 7864) and carry out calibration again.<br>– Replace main electronics. | 54 |
| 701 (W701) | Warning<br>C | C>Measuring chain config. exceeds sensor range | – The calibration carried out would result in the sensor nominal operating range being undershot or overshot. | – Carry out calibration again. | 50 |
| 702 (W702) | Warning<br>C | C>HistoROM data not consistent. | – Data were not written correctly to the HistoROM, e.g. if the HistoROM was detached during the writing process.<br>– HistoROM does not have any data. | – Repeat upload.<br>– Perform reset (Code 7864) and carry out calibration again.<br>– Copy suitable data to the HistoROM. (→ See also → 31, Section 5.5.1 "Copying configuration data".) | 55 |
| 703 (A703) | Alarm<br>B | B>Measurement error | – Fault in the main electronics.<br>– Main electronics defect. | – Briefly disconnect device from the power supply.<br>– Replace main electronics. | 22 |
| 704 (A704) | Alarm<br>B | B>Measurement error | – Fault in the main electronics.<br>– Main electronics defect. | – Briefly disconnect device from the power supply.<br>– Replace main electronics. | 12 |
| 705 (A705) | Alarm<br>B | B>Measurement error | – Fault in the main electronics.<br>– Main electronics defect. | – Briefly disconnect device from the power supply.<br>– Replace main electronics. | 21 |
| 706 (W706) | Warning<br>C | C>Configuration in HistoROM and device not identical | – Configuration (parameters) in the HistoROM and in the device is not identical. | – Copy data from the device to the HistoROM. (See also → 31, Section 5.5.1 "Copying configuration data".)<br>– Copy data from the HistoROM to the device. (See also → 31, Section 5.5.1 "Copying configuration data".) The message remains if the HistoROM and the device have different software versions. The message goes out if you copy the data from the device to the HistoROM.<br>– Device reset codes such as 7864 do not have any effect on the HistoROM. That means that if you do a reset, the configurations in the HistoROM and in the device may not be the same. | 59 |
| 707 (A707) | Alarm<br>B | B>X-VAL. of lin. table out of edit limits. | – At least one X-VALUE in the linearisation table is either below the value for HYDR. PRESS MIN. or MIN. LEVEL or above the value for HYDR. PRESS. MAX. or LEVEL MAX. | – Carry out calibration again. (→ See also Operating Instructions BA00274P or these Operating Instructions → 2.) | 38 |

| Code | Error type/ NA 64 | Message/description | Cause | Measure | Priority |
|---|---|---|---|---|---|
| 710 (W710) | Warning C | B>Set span too small. Not allowed. | – Values for calibration (e.g. lower range value and upper range value) are too close together.<br>– The sensor was replaced and the customer-specific configuration does not suit the sensor.<br>– Unsuitable download carried out. | – Adjust calibration to suit sensor. (→ See also Operating Instructions BA00274P, parameter description MINIMUM SPAN or these Operating Instructions → 2.)<br>– Adjust calibration to suit sensor.<br>– Replace sensor with a suitable sensor.<br>– Check configuration and perform download again. | 51 |
| 711 (A711) | Alarm B | B>LRV or URV out of edit limits | – Lower range value and/or upper range value undershoot or overshoot the sensor range limits.<br>– The sensor was replaced and the customer-specific configuration does not suit the sensor.<br>– Unsuitable download carried out. | – Reconfigure lower range value and/ or upper range value to suit the sensor. Pay attention to position factor.<br>– Reconfigure lower range value and/ or upper range value to suit the sensor. Pay attention to position factor.<br>– Replace sensor with a suitable sensor.<br>– Check configuration and perform download again. | 37 |
| 713 (A713) | Alarm B | B>100% POINT level out of edit limits | – The sensor was replaced. | – Carry out calibration again. | 39 |
| 715 (E715) | Error C Factory setting: Warning | C>Sensor over temperature | – The temperature measured in the sensor is greater than the upper nominal temperature of the sensor. (→ See also Operating Instructions BA00274P, parameter description Tmax SENSOR or these Operating Instructions → 2.)<br>– Unsuitable download carried out. | – Reduce process temperature/ ambient temperature.<br>– Check configuration and perform download again. | 32 |
| 716 (E716) | Error B Factory setting: Alarm | B>Process isolating diaphragm broken | – Sensor defect. | – Replace sensor.<br>– Reduce pressure. | 24 |
| 717 (E717) | Error C Factory setting: Warning | C>Transmitter over temperature | – The temperature measured in the electronics is greater than the upper nominal temperature of the electronics (+88 °C (+190 °F)).<br>– Unsuitable download carried out. | – Reduce ambient temperature.<br>– Check configuration and perform download again. | 34 |
| 718 (E718) | Error C Factory setting: Warning | C>Transmitter under temperature | – The temperature measured in the electronics is smaller than the lower nominal temperature of the electronics (–43 °C (-45 °F)).<br>– Unsuitable download carried out. | – Increase ambient temperature. Insulate device if necessary.<br>– Check configuration and perform download again. | 35 |
| 719 (A719) | Alarm B | B>Y-VAL of lin. table out of edit limits | – At least on Y-VALUE in the linearisation table is below the MIN. TANK CONTANT or above the MAX. TANK CONTENT. | – Carry out calibration again. (→ See also Operating Instructions BA00274P or these Operating Instructions → 2.) | 40 |

| Code | Error type/ NA 64 | Message/description | Cause | Measure | Priority |
|---|---|---|---|---|---|
| 720 (E720) | Error<br>C<br>Factory setting:<br>Warning | C>Sensor under temperature | – The temperature measured in the sensor is smaller than the lower nominal temperature of the sensor. (→ See also Operating Instructions BA00274P, parameter description Tmin SENSOR or Operating Instructions → 🖹 2.)<br>– Unsuitable download carried out.<br>– Loose connection at sensor cable | – Increase process temperature/ ambient temperature.<br>– Check configuration and perform download again.<br>– Wait a short period of time and tighten the connection, or avoid loose connection. | 33 |
| 721 (A721) | Alarm<br>B | B>ZERO POSITION level out of edit limits | – LEVEL MIN or LEVEL MAX has been changed. | – Perform reset (Code 2710) and carry out calibration again. | 41 |
| 722 (A722) | Alarm<br>B | B>EMPTY CALIB. or FULL CALIB. out of edit limits | – LEVEL MIN or LEVEL MAX has been changed. | – Perform reset (Code 2710) and carry out calibration again. | 42 |
| 723 (A723) | Alarm<br>B | B>MAX. FLOW out of edit limits | – FLOW-MEAS. TYPE has been changed. | – Carry out calibration again. | 43 |
| 725 (A725) | Alarm<br>B | B>Sensor connection error, cycle disturbance | – Electromagnetic effects are greater than specifications in the technical data. (→ See Section 9.)<br>– Setscrew loose.<br>– Sensor or main electronics defect. | – Block off electromagnetic effects or eliminate source of disturbance.<br>– Retighten setscrew with 1 Nm (0,74 lbf ft) (see Chap. 3.3.5).<br>– Replace sensor or main electronics. | 25 |
| 726 (E726) | Error<br>C<br>Factory setting:<br>Warning | C>Sensor temperature error - overrange | – Electromagnetic effects are greater than specifications in the technical data. (→See Section 9.)<br>– Process temperature is outside permitted range.<br>– Sensor defect. | – Block off electromagnetic effects or eliminate source of disturbance.<br>– Check temperature present, reduce or increase if necessary.<br>– If the process temperature is within the permitted range, replace sensor. | 31 |
| 727 (E727) | Error<br>C<br>Factory setting:<br>Warning | C>Sensor pressure error - overrange | – Electromagnetic effects are greater than specifications in the technical data. (→ See Section 9.)<br>– Pressure is outside permitted range.<br>– Sensor defect. | – Block off electromagnetic effects or eliminate source of disturbance.<br>– Check pressure present, reduce or increase if necessary.<br>– If the pressure is within the permitted range, replace sensor. | 28 |
| 728 (A728) | Alarm<br>B | B>RAM error | – Fault in the main electronics.<br>– Main electronics defect. | – Briefly disconnect device from the power supply.<br>– Replace main electronics. | 2 |
| 729 (A729) | Alarm<br>B | B>RAM error | – Fault in the main electronics.<br>– Main electronics defect. | – Briefly disconnect device from the power supply.<br>– Replace main electronics. | 3 |

| Code | Error type/ NA 64 | Message/description | Cause | Measure | Priority |
|---|---|---|---|---|---|
| 730 (E730) | Error<br>C<br>Factory setting:<br>Warning | C>LRV user limits exceeded | – Pressure measured value has undershot the value specified for the Pmin ALARM WINDOW parameter.<br>– Loose connection at sensor cable | – Check system/pressure measured value.<br>– Change value for Pmin ALARM WINDOW if necessary. (→ See also Operating Instructions BA00274P, parameter description Pmin ALARM WINDOW or these Operating Instructions → 2.)<br>– Wait a short period of time and tighten the connection, or avoid loose connection. | 46 |
| 731 (E731) | Error<br>C<br>Factory setting:<br>Warning | C>URV user limits exceeded | – Pressure measured value has overshot the value specified for the Pmax ALARM WINDOW parameter.<br>– Loose connection at sensor cable | – Check system/pressure measured value.<br>– Change value for Pmax ALARM WINDOW if necessary. (→ See also Operating Instructions BA00274P, parameter description Pmax ALARM WINDOW or these Operating Instructions → 2.)<br>– Wait a short period of time and tighten the connection, or avoid loose connection. | 45 |
| 732 (E732) | Error<br>C<br>Factory setting:<br>Warning | C>LRV Temp. User limits exceeded | – Temperature measured value has undershot the value specified for the Tmin ALARM WINDOW parameter. | – Check system/temperature measured value.<br>– Change value for Tmin ALARM WINDOW if necessary. (→ See also Operating Instructions BA00274P, parameter description Tmin ALARM WINDOW or these Operating Instructions → 2.) | 48 |
| 733 (E733) | Error<br>C<br>Factory setting:<br>Warning | C>URV Temp. User limits exceeded | – Temperature measured value has overshot the value specified for the Tmax ALARM WINDOW parameter. | – Check system/temperature measured value.<br>– Change value for Tmax ALARM WINDOW if necessary. (→ See also Operating Instructions BA00274P, parameter description Tmax ALARM WINDOW or these Operating Instructions → 2.) | 47 |
| 736 (A736) | Alarm<br>B | B>RAM error | – Fault in the main electronics.<br>– Main electronics defect. | – Briefly disconnect device from the power supply.<br>– Replace main electronics. | 4 |
| 737 (A737) | Alarm<br>B | B>Measurement error | – Fault in the main electronics.<br>– Main electronics defect. | – Briefly disconnect device from the power supply.<br>– Replace main electronics. | 20 |
| 738 (A738) | Alarm<br>B | B>Measurement error | – Fault in the main electronics.<br>– Main electronics defect. | – Briefly disconnect device from the power supply.<br>– Replace main electronics. | 19 |
| 739 (A739) | Alarm<br>B | B>Measurement error | – Fault in the main electronics.<br>– Main electronics defect. | – Briefly disconnect device from the power supply.<br>– Replace main electronics. | 23 |

| Code | Error type/ NA 64 | Message/description | Cause | Measure | Priority |
|---|---|---|---|---|---|
| 740 (E740) | Error<br>C<br>Factory setting:<br>Warning | C>Calculation overflow, bad configuration | – Level measuring mode: the measured pressure has undershot the value for HYDR. PRESS. MIN. or overshot the value for HYDR. PRESS MAX.<br>– Level measuring mode: The measured level did not reach the LEVEL MIN value or exceeded the LEVEL MAX value.<br>– Flow measuring mode: the measured pressure has undershot the value for MAX. PRESS FLOW. | – Check configuration and carry out calibration again if necessary.<br>– Select a device with a suitable measuring range.<br>– Check configuration and carry out calibration again if necessary. (→ See also Operating Instructions BA00274P, parameter description LEVEL MIN. these Operating Instructions → 2.)<br>– Check configuration and carry out calibration again if necessary.<br>– Select a device with a suitable measuring range. | 27 |
| 741 (A741) | Alarm<br>B | B>TANK HEIGHT out of edit limits | – LEVEL MIN or LEVEL MAX has been changed. | – Perform reset (Code 2710) and carry out calibration again. | 44 |
| 742 (A742) | Alarm<br>B | B>Sensor connection error (upload) | – Electromagnetic effects are greater than specifications in the technical data. (→ See Section 9.) This message normally only appears briefly.<br>– Cable connection sensor –main electronics disconnected.<br>– Sensor defect. | – Wait a few minutes.<br>– Perform reset (Code 7864) and carry out calibration again.<br>– Check cable connection and repair if necessary.<br>– Replace sensor. | 18 |
| 743 (E743) | Alarm<br>B | B>Electronic PCB error during initialisation | – This message normally only appears briefly.<br>– Main electronics defect. | – Wait a few minutes.<br>– Restart the device. Perform reset (Code 62).<br>– Replace main electronics. | 14 |
| 744 (A744) | Alarm<br>B | B>Main electronic PCB error | – Electromagnetic effects are greater than specifications in the technical data. (→ See Section 9.)<br>– Main electronics defect. | – Restart the device. Perform reset (Code 62).<br>– Block off electromagnetic effects or eliminate source of disturbance.<br>– Replace main electronics. | 11 |
| 745 (W745) | Warning<br>C | C>Sensor data unknown | – Sensor does not suit the device (electronic sensor nameplate). Device continues measuring. | – Replace sensor with a suitable sensor. | 56 |
| 746 (W746) | Warning<br>C | C>Sensor connection error - initialising | – Electromagnetic effects are greater than specifications in the technical data. (→ See Section 9.) This message normally only appears briefly.<br>– Overpressure or low pressure present. | – Wait a few minutes.<br>– Restart the device. Perform reset (Code 7864).<br>– Block off electromagnetic effects or eliminate source of disturbance.<br>– Reduce or increase pressure. | 26 |
| 747 (A747) | Alarm<br>B | B>Sensor software not compatible to electronics | – Sensor does not suit the device (electronic sensor nameplate). | – Replace sensor with a suitable sensor. | 16 |
| 748 (A748) | Alarm<br>B | B>Memory failure in signal processor | – Electromagnetic effects are greater than specifications in the technical data. (→See Section 9.)<br>– Main electronics defect. | – Block off electromagnetic effects or eliminate source of disturbance.<br>– Replace main electronics. | 15 |

### 8.1.1 On-site display error messages

If the device detects a defect in the on-site display during initialization, the following error messages can be displayed:

| Message | Measure |
|---|---|
| Initialization, VU Electr. Defect A110 | Exchange on-site display. |
| Initialization, VU Electr. Defect A114 | |
| Initialization, VU Electr. Defect A281 | |
| Initialization, VU Checksum Err. A110 | |
| Initialization, VU Checksum Err. A112 | |
| Initialization, VU Checksum Err. A171 | |

## 8.2 Response of outputs to errors

The device differentiates between the error types Alarm, Warning and Error.
→ See the following table and → 📄 48, Section 8.1 "Messages".

| Output | A (Alarm) | W (Warning) | E (Error: Alarm/Warning) |
|---|---|---|---|
| Current output | Assumes the value specified via the OUTPUT FAIL MODE[1)], ALT. CURR. OUTPUT[1] and SET MAX. ALARM[1] parameter. → See also the following section "Configuring current output for an alarm". | Device continues measuring. | For this error, you can enter whether the device should react as in the event of an alarm or as in the event of a warning. See corresponding "Alarm" or "Warning" column. (→ See also Operating Instructions BA00274P, parameter description SELECT ALARM TYPE or these Operating Instructions → 📄 2.) |
| Bargraph (on-site display) | The bargraph adopts the value defined by the OUTPUT FAIL MODE [1] parameter. | The bargraph adopts the value which corresponds to the current value. | → See this table, "Alarm" or "Warning" column, depending on selection. |
| On-site display | – The measured value and message are displayed alternately<br>– Measured value display: ↯ -symbol is permanently displayed.<br><br>Message display<br>– 3-digit number such as A122 and description | – The measured value and message are displayed alternately<br>– Measured value display: ↯ -symbol flashes.<br><br>Message display:<br>– 3-digit number such as W613 and description | – The measured value and message are displayed alternately<br>– Measured value display: see corresponding "Alarm" or "Warning" column<br><br>Message display:<br>– 3-digit number such as E731 and description |
| Remote operation (digital communication) | In the case of an alarm, the ALARM STATUS[2)] parameter displays a 3-digit number such as 122 for "Sensor not connected". | In the case of a warning, the ALARM STATUS[2] parameter displays a 3-digit number such as 613 for "Simulation is active". | In the case of an error, the ALARM STATUS[2] parameter displays a 3-digit number such as 731 for "URV user limits exceeded". |

1) Menu path: (GROUP SELECTION →) OPERATING MENU → OUTPUT

2) Menu path: (GROUP SELECTION →) OPERATING MENU → MESSAGES

### 8.2.1 Configuring current output for an alarm

You can configure the current output for the event of an alarm by means of the OUTPUT FAIL MODE, ALT. CURR. OUTPUT and SET MAX. ALARM parameters. These parameters are displayed in the OUTPUT group (menu path: (GROUP SELECTION →) OPERATING MENU → OUTPUT).

In the event of an alarm, the current and the bargraph assume the value entered with the OUTPUT FAIL MODE parameter.

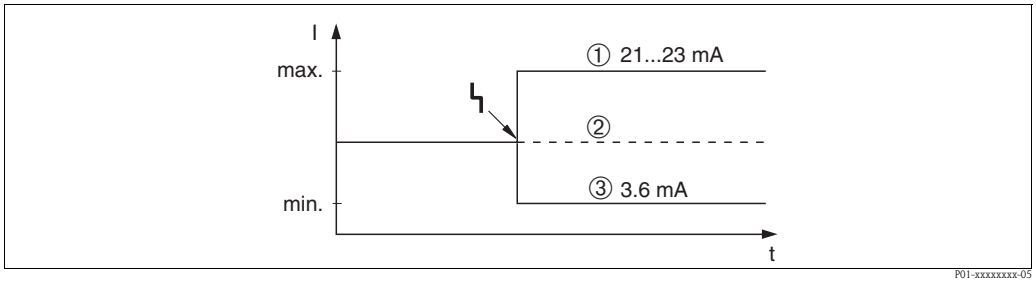



*Fig. 20: Current output in the event of an alarm*

*Options:*
*1 Max. alarm (110%): can be set between 21 to 23 mA via the SET MAX. ALARM parameter*
*2 Hold meas. value: last measured value is kept*
*3 Min. alarm (–10%): 3.6 mA*

Factory setting:
- OUTPUT FAIL MODE: Max. Alarm (110%)
- SET MAX. ALARM: 22 mA

Use the ALT. CURR. OUTPUT parameter to set the current output value for the error messages E 120 "Sensor low pressure" and E 115 "Sensor overpressure". You have the following options:
– Normal: the current output assumes the value set via the OUTPUT FAIL MODE and SET MAX. ALARM parameters.
– NAMUR
  – Lower sensor limit undershot (E 120 "Sensor low pressure"): 3.6 mA
  – Upper sensor limit overshot (E 115 "Sensor overpressure") overshot: current output assumes the value set via the SET MAX ALARM parameter.

Factory setting:
- ALT. CURR. OUTPUT: normal

## 8.3 Confirming messages

Depending on the settings for the ALARM DISPL. TIME and ACK. ALARM MODE parameters, the following measures should be taken to clear a message:

| Settings [1] | Measures |
|---|---|
| – ALARM DISPL. TIME = 0 s<br>– ACK. ALARM MODE = off | – Rectify cause of the message (see also Section 8.1). |
| – ALARM DISPL. TIME > 0 s<br>– ACK. ALARM MODE = off | – Rectify cause of the message (see also Section 8.1).<br>– Wait for the alarm display time to elapse. |
| – ALARM DISPL. TIME = 0 s<br>– ACK. ALARM MODE = on | – Rectify cause of the message (see also Section 8.1).<br>– Confirm message using ACK. ALARM parameter. |
| – ALARM DISPL. TIME > 0 s<br>– ACK. ALARM MODE = on | – Rectify cause of the message (see also Section 8.1).<br>– Confirm message using ACK. ALARM parameter.<br>– Wait for the alarm display time to elapse. If a message appears and the alarm display time elapses before the message has been acknowledged, the message will be cleared once it has been acknowledged. |

1) Menu path for ALARM DISPL. TIME and ACK. ALARM MODE: (GROUP SELECTION →) OPERATING MENU → DIAGNOSTICS → MESSAGES

If the on-site display displays a message, you can suppress it with the E-key.
If there are several messages, the on-site display shows the message which has the highest priority (see also Section 8.1). Once you have suppressed this message using the E-key, the message with the next highest priority is displayed. You can use the E-key to suppress each message, one after the other.
The ALARM STATUS parameter continues to display all the messages present.

## 8.4 Repair

The Endress+Hauser repairs concept provides for measuring devices to have a modular design and also the customer may carry out repairs (see Chap. 8.6 "Spare Parts" on → 59).

Note!
- For certified devices, please consult Chapter "Repair of Ex-certified devices".
- For more information on service and spare parts contact the Endress+Hauser Service. → See www.endress.com/worldwide.

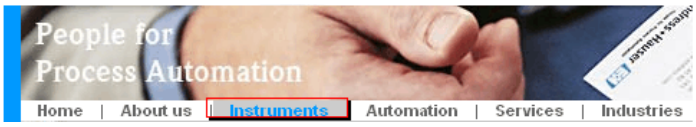
## 8.5 Repair of Ex-certified devices

Warning!
When repairing Ex-certified devices, please note the following:
- Only specialist personnel or Endress+Hauser may undertake repairs of certified devices.
- Relevant standards, national hazardous area regulations and Safety Instructions and Certificates must be observed.
- Only genuine Endress+Hauser spare parts may be used.
- When ordering spare parts, please check the device designation on the nameplate. Identical parts may only be used as replacements.
- Electronic inserts or sensors already in use in a standard instrument may not be used as spare parts for a certified device.
- Carry out repairs according to the instructions. After repairs, the device must fulfil the requirements of the specified individual tests.
- A certified device may only be converted into another certified variant by Endress+Hauser.
- All repairs and modifications must be documented.

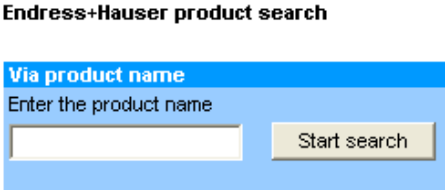
## 8.6 Spare Parts

An overview of the spare parts for your device is available in the internet at www.endress.com. To obtain information on the spare parts, proceed as follows:

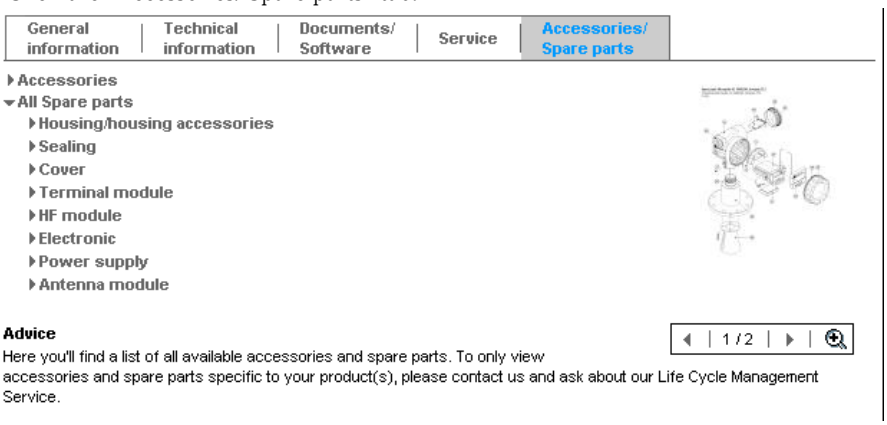
1. Go to "www.endress.com" and select your country.
2. Click "Instruments".




3. Enter the product name into the "product name" field.




4. Select the device.
5. Click the "Accessories/Spare parts" tab.




6. Select the required spare parts (You may also use the overview drawing on the right side of the screen.)

When ordering spare parts, always quote the serial number indicated on the nameplate. As far as necessary, the spare parts also include replacement instructions.

## 8.7 Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as a ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with process fluids.
To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at www.services.endress.com/return-material.

## 8.8 Disposal

When disposing, separate and recycle the device components based on the materials.

## 8.9 Software history

| Date | Software version | Software changes | Documentation | | |
|---|---|---|---|---|---|
| | | | **CD-ROM** | **Operating Instructions** | **Description of Instrument Functions** |
| 06.2006 | 02.10.zz | Original software.<br>Compatible with:<br>– ToF Tool Field Tool Package, version 4.0 or higher<br>– FieldCare version 2.02.00<br>– HART Communicator DXR375 with Device Rev.: 21, DD Rev.: 1 | — | — | BA274P/00/EN/07.06<br>71027249 |
| | | | — | BA332P/00/EN/08.06<br>71027253 | BA274P/00/EN/08.06<br>71027249 |
| | | | CD508P/00/A2/07.07<br>71033932 | BA332P/00/EN/07.07<br>71043309 | BA274P/00/EN/07.07<br>71061022 |
| | | | CD508P/00/A2/12.07<br>71033932 | BA332P/00/EN/12.07<br>71043309 | BA274P/00/EN/07.07<br>71061022 |
| | | | CD508P/00/A2/05.08<br>71071728 | BA332P/00/EN/05.08<br>71071716 | BA274P/00/EN/05.08<br>71071855 |
| | | | CD508P/00/A2/08.08<br>71077498 | BA332P/00/EN/08.08<br>71077293 | BA274P/00/EN/05.08<br>71071855 |
| | | | CD508P/00/A2/06.09<br>71095413 | BA332P/00/EN/06.09<br>71095397 | BA274P/00/EN/06.09<br>71095452 |
| | | | CD508P/00/A2/05.10<br>71111770 | BA332P/00/EN/05.10<br>71114100 | BA274P/00/EN/05.10<br>71118244 |
| | | | CD00508P/00/A2/13.11<br>71139760 | BA00332P/00/EN/13.11<br>71139745 | BA00274P/00/EN/13.11<br>71139795 |
| | | | CD00508P/00/A2/14.12<br>71158713 | BA00332P/00/EN/14.12<br>71161907 | BA00274P/00/EN/13.11<br>71139795 |

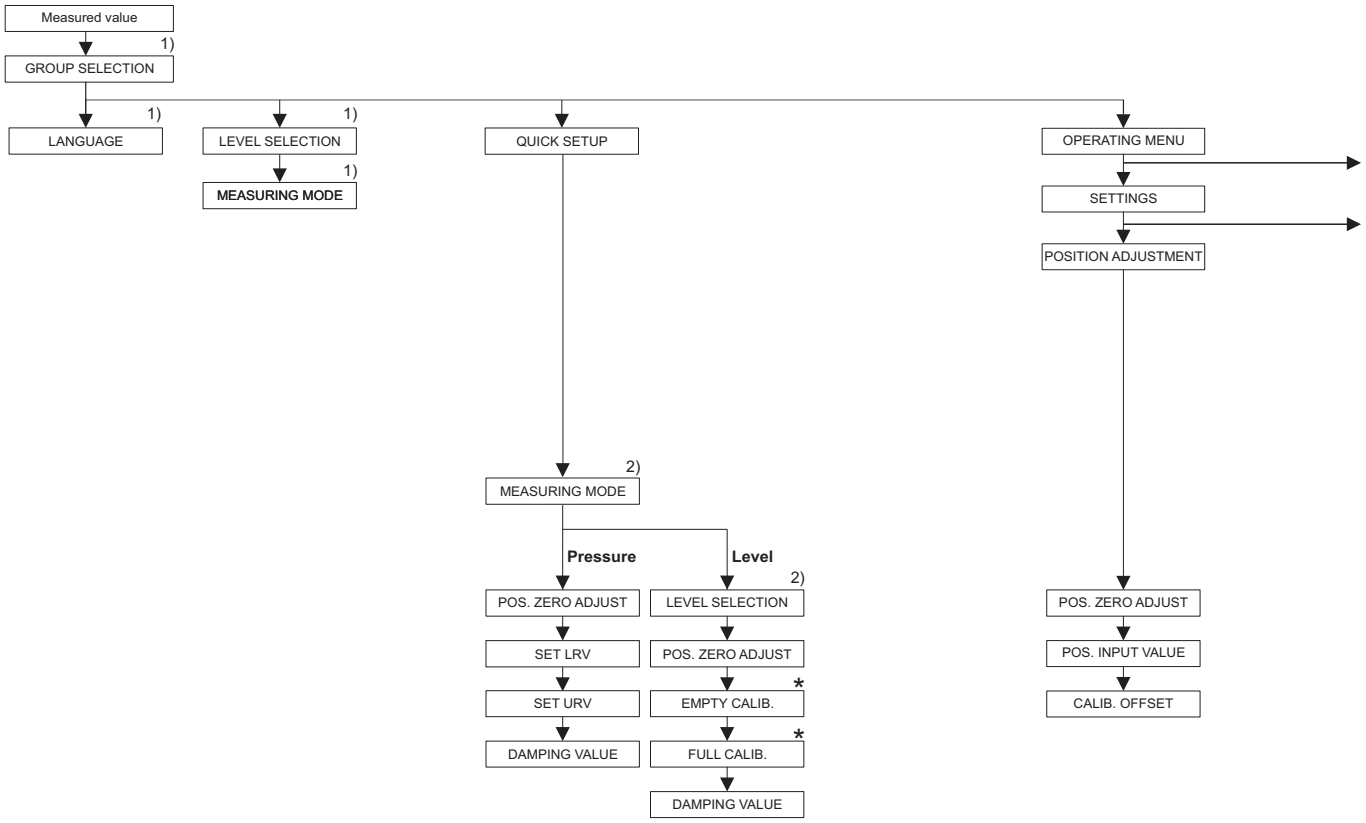
# 9 Technical data

For technical data, please refer to the Technical Information TI00416P for Deltapilot S.
→ 🖹 2, "Overview documentation".

# 10 Appendix

## 10.1 Operating menu for on-site display, ToF Tool, FieldCare and HART handheld terminal

Note!
- The entire menu is depicted on the following pages.
- The menu has a different structure depending on the measuring mode selected. This means that some function groups are only displayed for one measuring mode, e.g. "LINEARISATION" function group for the Level measuring mode.
- In addition, there are also parameters that are only displayed if other parameters are appropriately configured. For example the Customer Unit P parameter is only displayed if the "User unit" option was selected for the PRESS. ENG. UNIT parameter. These parameters are indicated with a "*".
- For a description of the parameters, please refer to Operating Instructions BA00274P "Description of device functions". The exact dependency of individual parameters on one another is explained here. See also → 🖹 2, "Overview documentation".

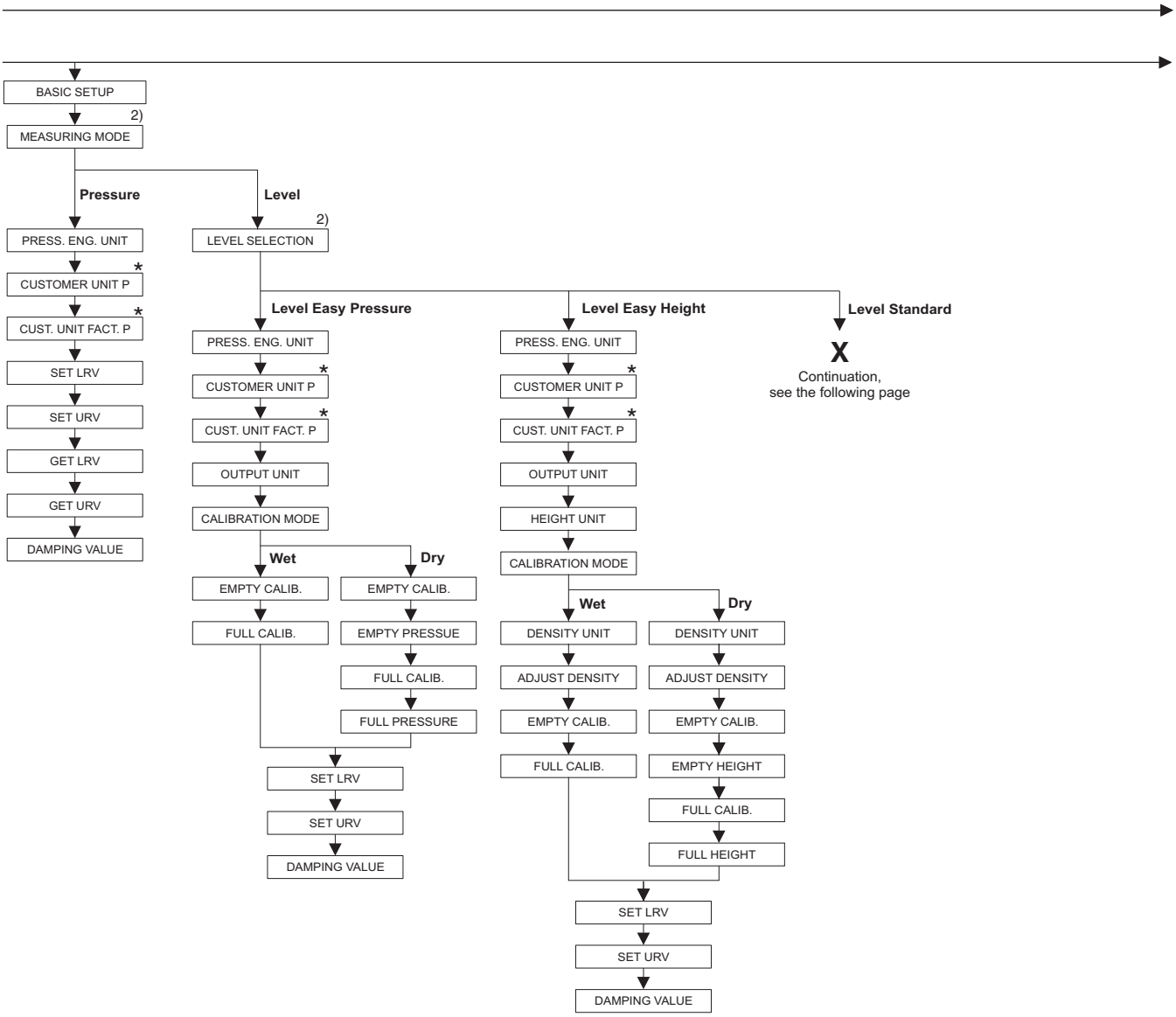



1) Display via on-site display only

2) Display via digital communication

* There are parameters that are only displayed if other parameters are appropriately configured.
For example the CUSTOMER UNIT P parameter is only displayed if the "User unit" option was selected for the PRESS. ENG. UNIT parameter.
These parameters are indicated with a "*".

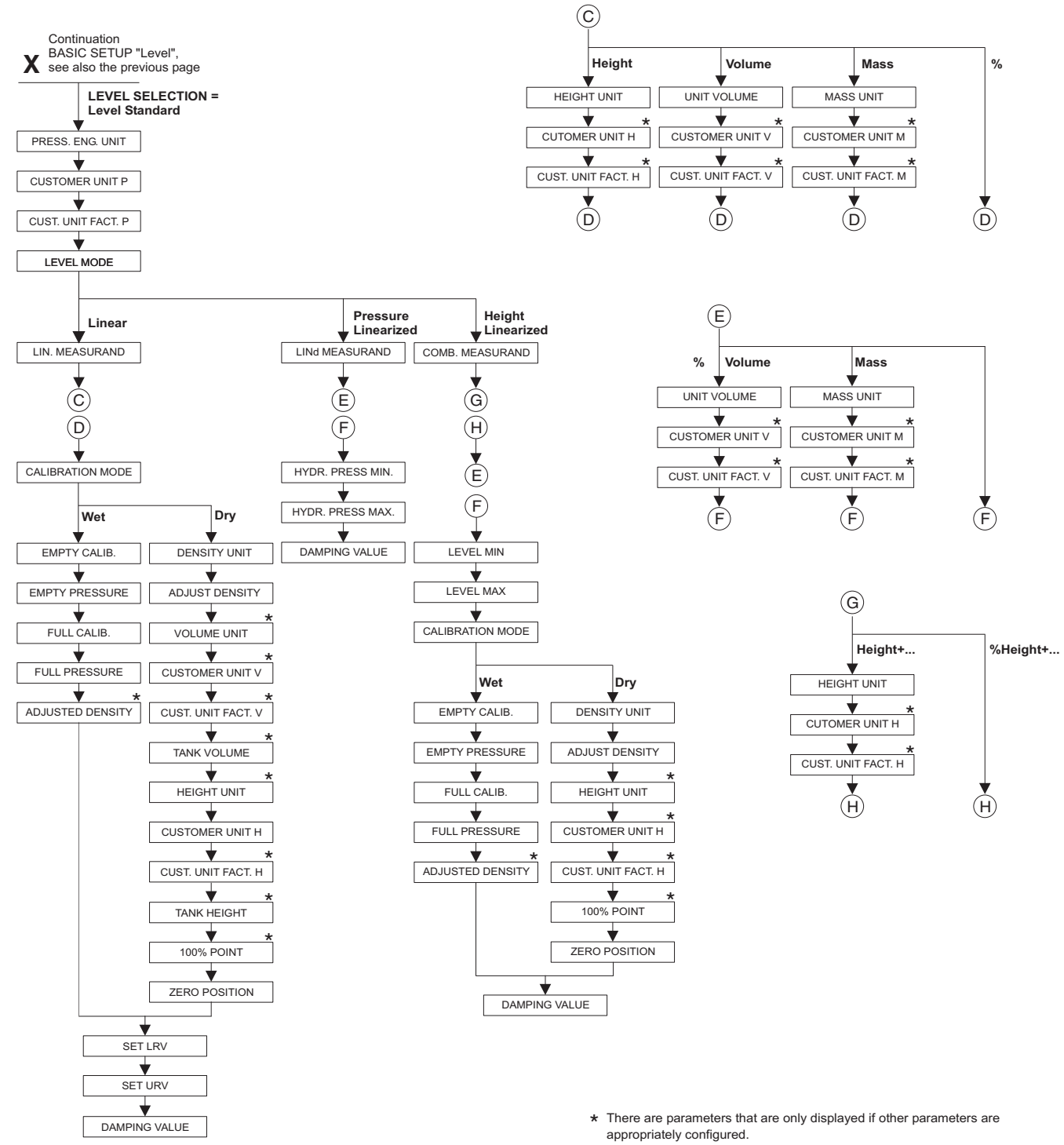
P01-FMB70xxx-19-xx-xx-xx-002




2) Display via digital communication

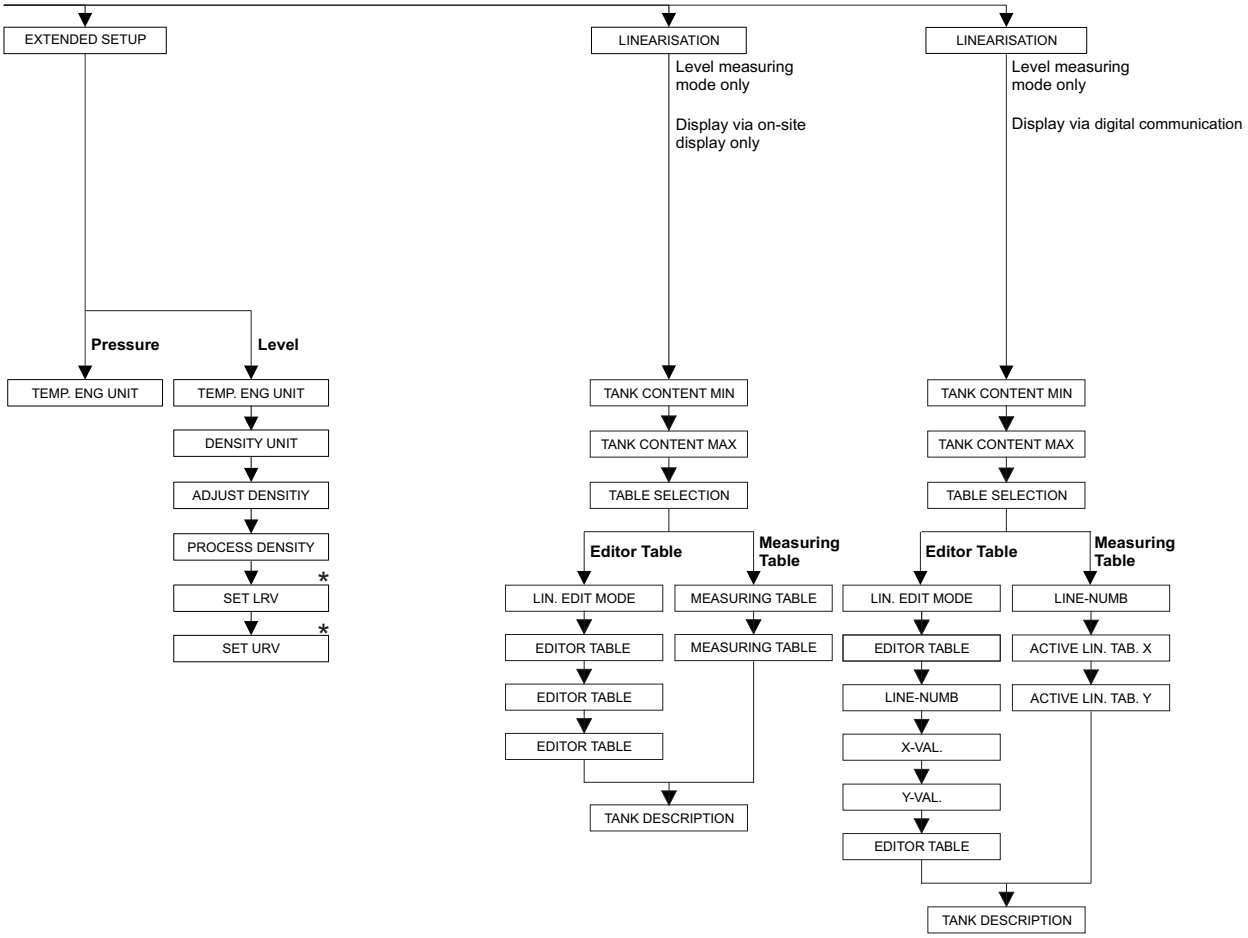
* There are parameters that are only displayed if other parameters are appropriately configured.
For example the CUSTOMER UNIT P parameter is only displayed if the "User unit" option was selected for the PRESS. ENG. UNIT parameter.
These parameters are indicated with a "*".

P01-FMB70xxx-19-xx-xx-xx-003



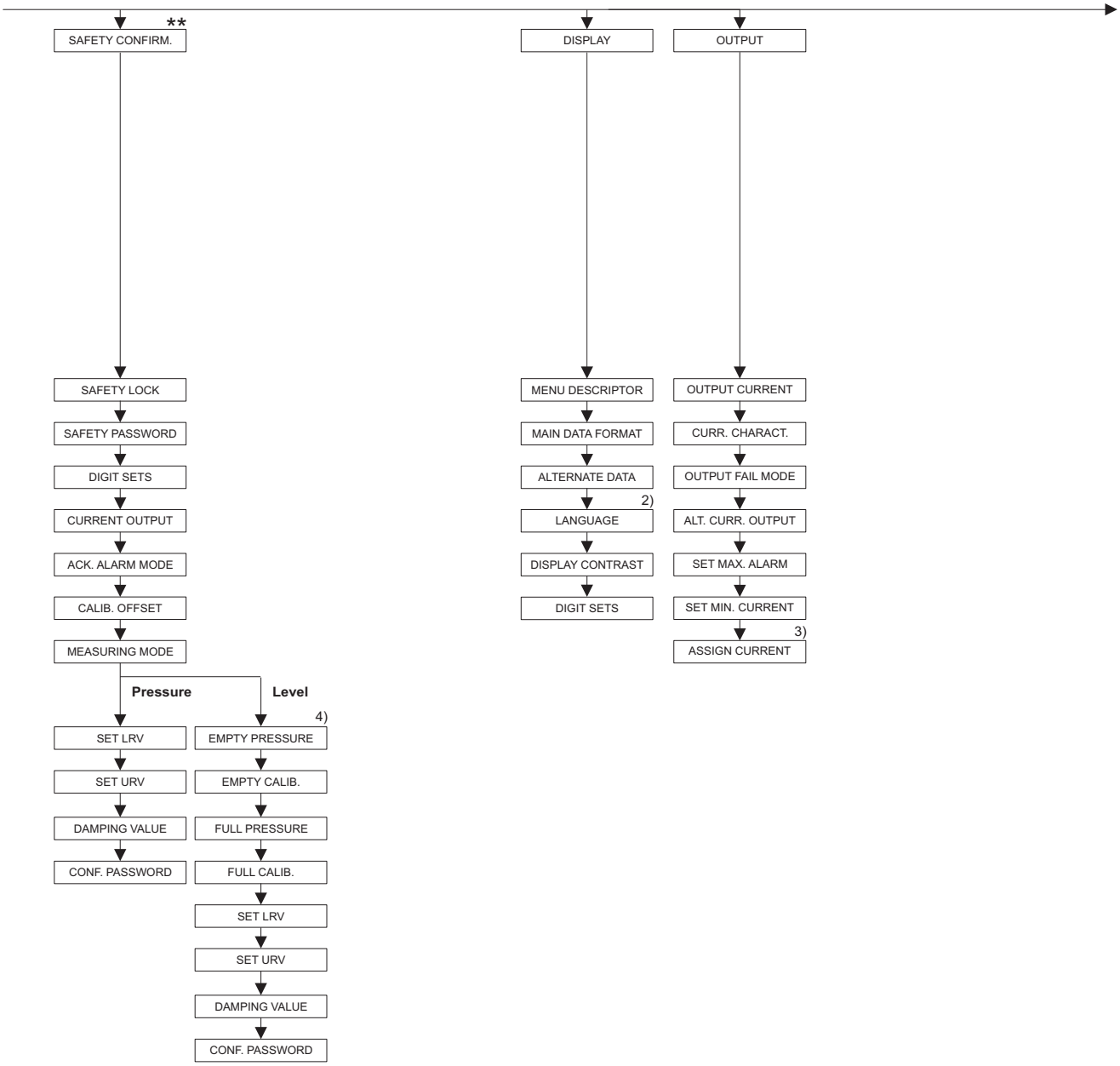

* There are parameters that are only displayed if other parameters are appropriately configured.
For example the CUST. UNIT FACT. H parameter is only displayed if the "User unit" option was selected for the HEIGHT UNIT parameter.
These parameters are indicated with a "*".

P01-FMB70xxx-19-xx-xx-xx-004




* There are parameters that are only displayed if other parameters are appropriately configured.
These parameters are indicated with a "*".

P01-FMB70xxx-19-xx-xx-xx-006




2) Display via digital communication

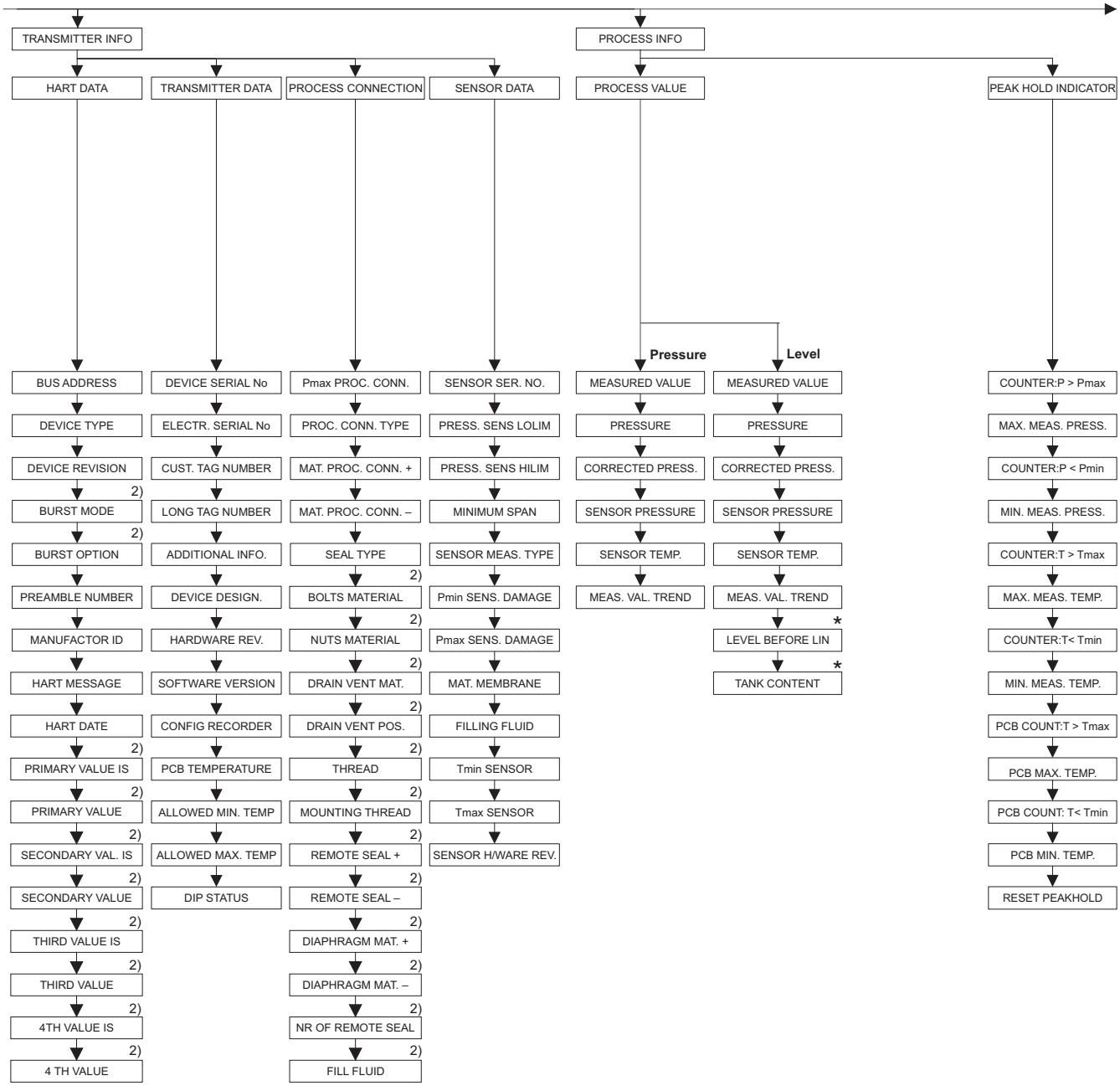
3) Level measuring mode only

4) only LEVEL SELECTION = Level Easy Pressure

* There are parameters that are only displayed if other parameters are appropriately configured.
These parameters are indicated with a "*".

** See Safety Manual SD213P.

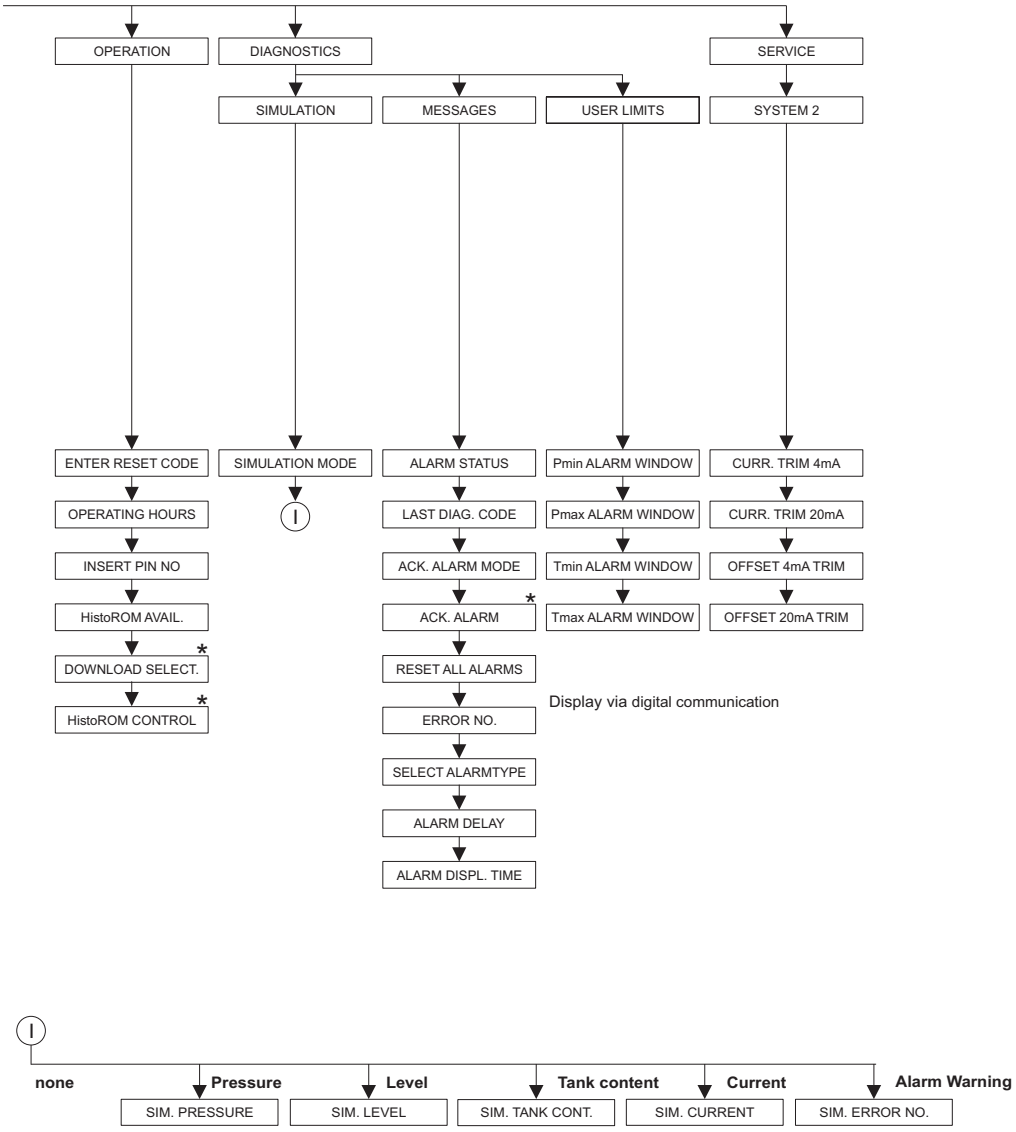
P01-PMx7xxxx-19-xx-xx-xx-007




2) Display via digital communication

* There are parameters that are only displayed if other parameters are appropriately configured.
These parameters are indicated with a "*".

P01-FMB70xxx-19-xx-xx-xx-007




* There are parameters that are only displayed if other parameters are appropriately configured.
These parameters are indicated with a "*".

P01-FMB70xxx-19-xx-xx-xx-008

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# Operating instructions

## Control module delta®

## Supplementary operating instructions for delta® Solenoid metering pump

Three sets of operating instructions are required for the safe, correct and proper operation of the metering pumps: The product specific operating instructions, the "General operating instructions for ProMinent® solenoid metering pumps" and the operating instructions "Solenoid metering pump delta® with controlled solenoid drive optoDrive®". These operating instructions are only valid when read together.

**Please carefully read these operating instructions before use! · Do not discard!**
**The operator shall be liable for any damage caused by installation or operating errors!**
**Technical changes reserved.**

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# 1 Introduction

These operating instructions provide information on the technical data and functions of the control module delta®.

## 1.1 Explanation of the Safety Information

**Introduction**

These operating instructions provide information on the technical data and functions of the product. These operating instructions provide detailed safety information and are provided as clear step-by-step instructions.

The safety information and notes are categorised according to the following scheme. A number of different symbols are used to denote different situations. The symbols shown here serve only as examples.

**DANGER!**

**Nature and source of the danger**

Consequence: Fatal or very serious injuries.

Measure to be taken to avoid this danger.

Danger!

– Denotes an immediate threatening danger. If this is disregarded, it will result in fatal or very serious injuries.

**WARNING!**

**Nature and source of the danger**

Possible consequence: Fatal or very serious injuries.

Measure to be taken to avoid this danger.

Warning!

– Denotes a possibly hazardous situation. If this is disregarded, it could result in fatal or very serious injuries.

**CAUTION!**

**Nature and source of the danger**

Possible consequence: Slight or minor injuries. Material damage.

Measure to be taken to avoid this danger.

Caution!

– Denotes a possibly hazardous situation. If this is disregarded, it could result in slight or minor injuries. May also be used as a warning about material damage.

NOTICE!

**Nature and source of the danger**

Damage to the product or its surroundings.

Measure to be taken to avoid this danger.

Note!

– Denotes a possibly damaging situation. If this is disregarded, the product or an object in its vicinity could be damaged.

*Type of information*

*Hints on use and additional information.*

*Source of the information. Additional measures.*

*Information!*

– *Denotes hints on use and other useful information. It does not indicate a hazardous or damaging situation.*

## 1.2 Users' qualifications

WARNING!

**Danger of injury with inadequately qualified personnel!**

**The operator of the plant / device is responsible for ensuring that the qualifications are fulfilled.**

If inadequately qualified personnel work on the unit or loiter in the hazard zone of the unit, this could result in dangers that could cause serious injuries and material damage.

– All work on the unit should therefore only be conducted by qualified personnel.
– Unqualified personnel should be kept away from the hazard zone

| Training | Definition |
|---|---|
| Instructed personnel | An instructed person is deemed to be a person who has been instructed and, if required, trained in the tasks assigned to him/her and possible dangers that could result from improper behaviour, as well as having been instructed in the required protective equipment and protective measures. |
| Trained user | A trained user is a person who fulfils the requirements made of an instructed person and who has also received additional training specific to the system from ProMinent or another authorised distribution partner. |
| Trained qualified personnel | A qualified employee is deemed to be a person who is able to assess the tasks assigned to him and recognize possible hazards based on his/her training, knowledge and experience, as well as knowledge of pertinent regulations. The assessment of a person's technical training can also be based on several years of work in the relevant field. |

| Training | Definition |
|---|---|
| Electrician | Electricians are deemed to be people, who are able to complete work on electrical systems and recognize and avoid possible hazards independently based on his/her technical training and experience, as well as knowledge of pertinent standards and regulations.<br>Electricians should be specifically trained for the working environment in which the are employed and know the relevant standards and regulations.<br>Electricians must comply with the provisions of the applicable statutory directives on accident prevention. |
| Customer Service department | Customer Service department refers to service technicians, who have received proven training and have been authorised by ProMinent to work on the system. |

***Note for the system operator***

*The pertinent accident prevention regulations, as well as all other generally acknowledged safety regulations, must be adhered to!*

# 2 Safety and responsibility

## 2.1 General Safety Information

**WARNING!**

**Live parts!**

Possible consequence: Fatal or very serious injuries

- Measure: Disconnect the mains power supply prior to opening the housing
- De-energise damaged, defective or manipulated units by disconnecting the mains plug

**WARNING!**

**Unauthorised access!**

Possible consequence: Fatal or very serious injuries

- Measure: Ensure that there can be no unauthorised access to the unit

**WARNING!**

**Operating errors!**

Possible consequence: Fatal or very serious injuries

- The unit should only be operated by adequately qualified and technically expert personnel
- Please also observe the operating instructions for controllers and fittings and any other component groups, such as sensors, measuring water pumps ...
- The operator is responsible for ensuring that personnel are qualified

**CAUTION!**

**Electronic malfunctions**

Possible consequence: Material damage to destruction of the unit

- The mains connection cable and data cable should not be laid together with cables that are prone to interference
- Measure: Take appropriate interference suppression measures

**NOTICE!**

**Correct and proper use**

Damage to the product or its surroundings

- The unit is not intended to measure or regulate gaseous or solid media
- The unit may only be used in accordance with the technical details and specifications provided in these operating instructions and in the operating instructions for the individual components

NOTICE!

**Correct sensor operation / Run-in time**

Damage to the product or its surroundings

- Correct measuring and dosing is only possible if the sensor is working perfectly
- It is imperative that the run-in times of the sensors are adhered to
- The run-in times should be allowed for when planning initial operation
- It may take a whole working day to run-in the sensor
- Please read the operating instructions for the sensor

NOTICE!

**Correct sensor operation**

Damage to the product or its surroundings

- Correct measuring and dosing is only possible if the sensor is working perfectly
- Check and calibrate the sensor regularly

NOTICE!

**Compensation of control deviations**

Damage to the product or its surroundings

- This controller cannot be used in control circuits which require rapid compensation (< 30 s)

## 2.2 Specific safety instructions for the control module delta®

WARNING!

**Emergency stop switch**

Possible consequence: Fatal or very serious injuries

An emergency stop switch on the complete system. This should enable the complete system to be switched off in event of an emergency in such a way that the complete system is stopped in a safe condition.

WARNING!

- Hazardous substances
- Danger resulting from contact, breathing in or other contaminations with / from substances or media
- Observe the safety data sheet of the substances / media used
- The system operator must ensure that these safety data sheets are available and that they are kept up to date

**WARNING!**

- Unexpected starting after a failure, malfunction of the controller / power supply or as an action wanted due to a control process
- Danger due to unexpected actions of the system
- In event of a failure / malfunction of the controller or power supply, the measuring / control station must be disconnected from the power supply. For further information, read the operating instructions of the devices and sensors used

**NOTICE!**

- Secure the measuring / control station against unauthorised access
- Please also observe the operating instructions for controllers and fittings and any other component groups, such as sensors, sample water pumps ...
- Observe the resistance of the wetted materials for all modules (see also, e.g. also the ProMinent resistance list in the product equipment catalogue or at www.prominent.com)
- Protect the measuring / control station against direct sunlight and other UV sources
- Observe the basic rules for ergonomic principles

## 2.3 Correct and proper use

**NOTICE!**

**Compensation for control deviations**

Damage to the product or its surroundings

- The controller can be used in processes, which require compensation of > 30 seconds

**NOTICE!**

**Correct and proper use**

The unit is intended to measure and regulate liquid media. The marking of the measured variables is located on the controller and is absolutely binding.

The unit may only be used in accordance with the technical details and specifications provided in this operating manual and in the operating manuals for the individual components (such as, for example, sensors, fittings, calibration devices, metering pumps etc.).

Any other uses or modifications are prohibited.

# 3 Functional description

**Brief functional description**

The control module delta® enhances the delta® range of pumps to become measurement variable-dependent metering pumps. The control module delta® has an active 4-20 mA input for use in combination with pHV1, RHV1 measuring transducers or chlorine sensors CLE-mA. The control module delta® uses PID control behaviour to adapt the delta® solenoid metering pump precisely to the requirements of the process. If a two-sided control is required, a second pump can be controlled via the optional pacing relay.

**Table of measured variables: Assignment of the measured variable to the measuring input of the control module delta®**

| Measured variable | mA input | Part no.: |
|---|---|---|
| Chlorine | X | |
| pH | X* | 809126 |
| Redox | X* | 809127 |
| | * with measuring transducer | |

## 3.1 Application examples for the control module delta®

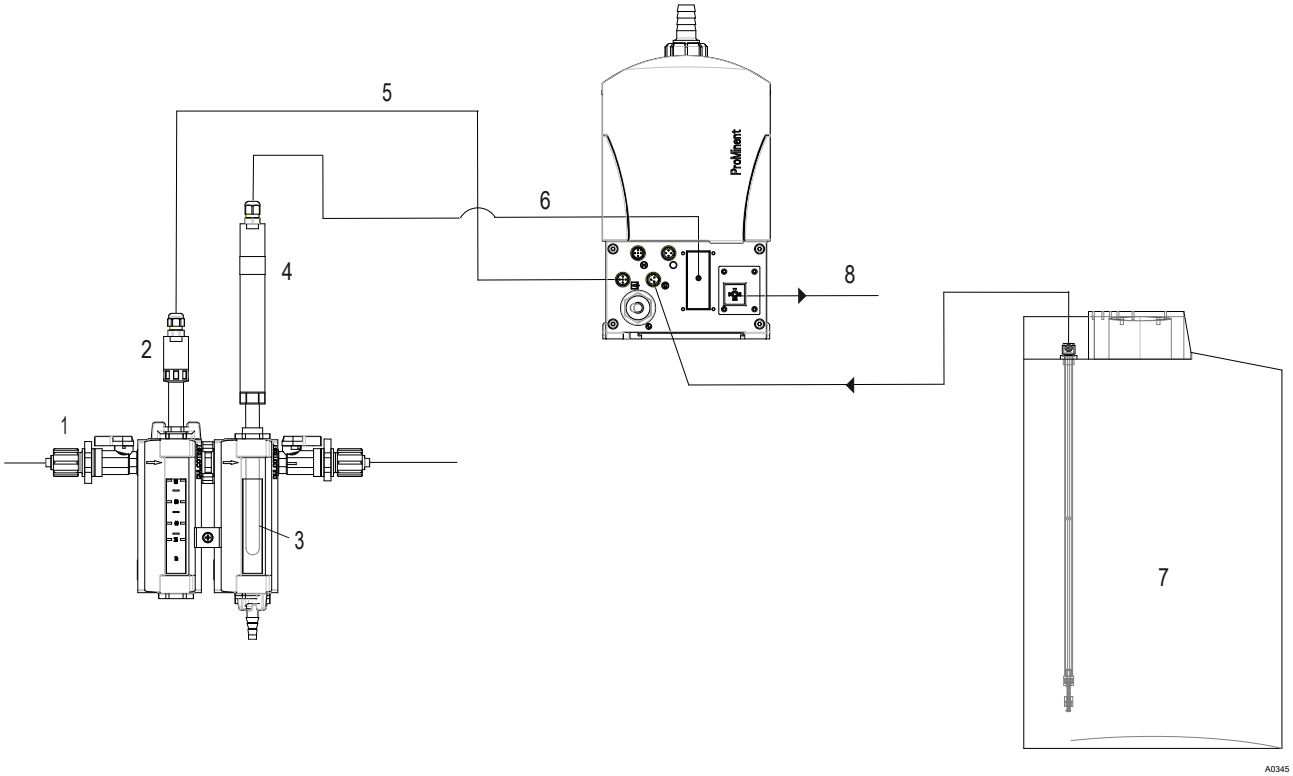



*Fig. 1: Application examples for pH or Redox for one-way control*

1. Measurement water inflow (30 - 60 l/h)
2. Flow gauge (Part of the DGMA)
3. pH sensor (PHEP 112SE) or Redox sensor (e.g. RHEP-Pt-SE)
4. pH measuring transducer (pHV1 / 809126) or Redox measuring transducer (RHV1 / 809127)
5. Universal control wire (e.g. 1001300)
6. External wire (2-pin / e.g. 707702)
7. Metering tank with two-stage lance
8. Relay cable (part of the delta® solenoid metering pump)

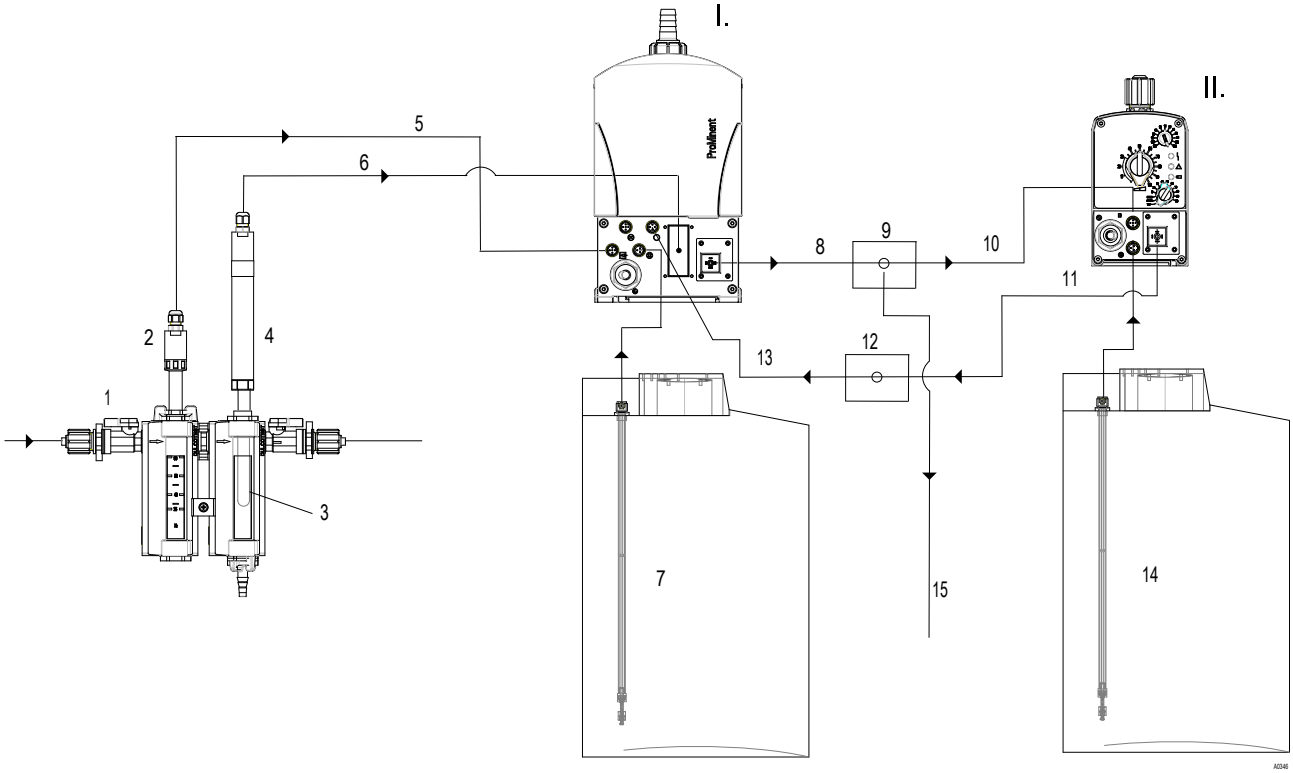



*Fig. 2: Application examples for pH or Redox for two-way control*

I. First pump delta® with control module delta®
II. Second pump, e.g. Beta®
1. Measurement water inflow (30 - 60 l/h)
2. Flow gauge (Part of the DGMA)
3. pH sensor (e.g. PHEP 112SE) or Redox sensor (e.g. RHEP-Pt-SE)
4. pH measuring transducer (pHV1 / 809126) or Redox measuring transducer (RHV1 / 809127)
5. Universal control wire (e.g. 1001300)
6. External wire (2-pin / e.g. 707702)
7. Metering tank with two-stage lance
8. Relay cable (part of the delta® solenoid metering pump)
9. Connecting box 1
10. External wire (2-pin / e.g. 707702)
11. Relay cable (3-pin, part of the external pump)
12. Connecting box 2
13. Diaphragm rupture cable
14. Suction lance
15. Collective alarm

## 3.2 Electrical interfaces

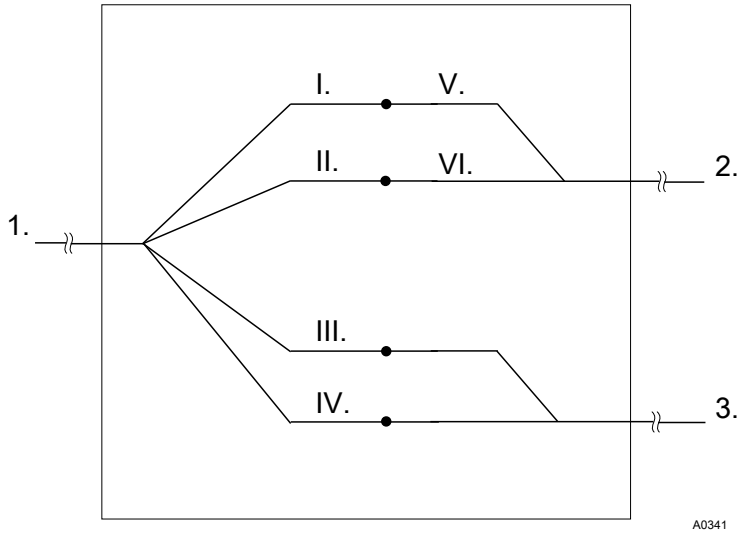



*Fig. 3: Connection box 1 (IP 65)*

1. Relay cable 4-pin
2. External cable for the second pump
3. Fault indicating relay = External overall alarm (max. load 24 V / 100 mA)

I. White (pacing pulse relay)
II Brown (pacing pulse relay)
III. Yellow (fault indicating relay)
IV. Green (fault indicating relay)
V. White
VI. Brown

Connection of the external pump via a 4-pin relay cable.

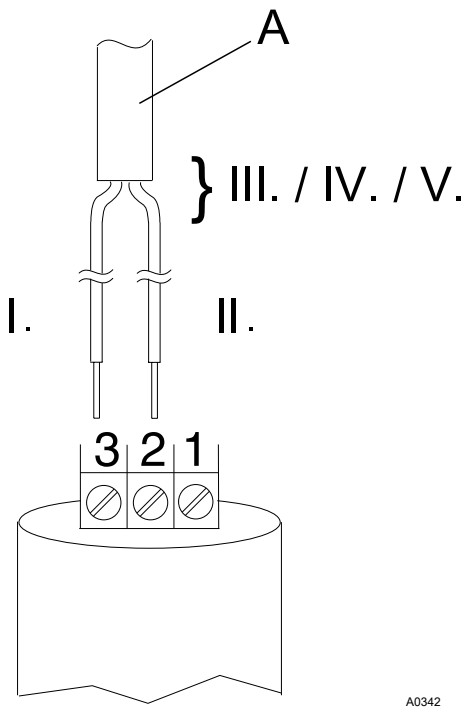



*Fig. 4: Connection of the flow gauge*

A. 5-pin universal cable
I. Black
II. Brown
III. Blue (not used)
IV. Grey (not used)
V. White (not used)

Functional description: As soon as the flow falls below the set threshold, the contact is opened and the delta® solenoid metering pump switches to *„PAUSE“*.

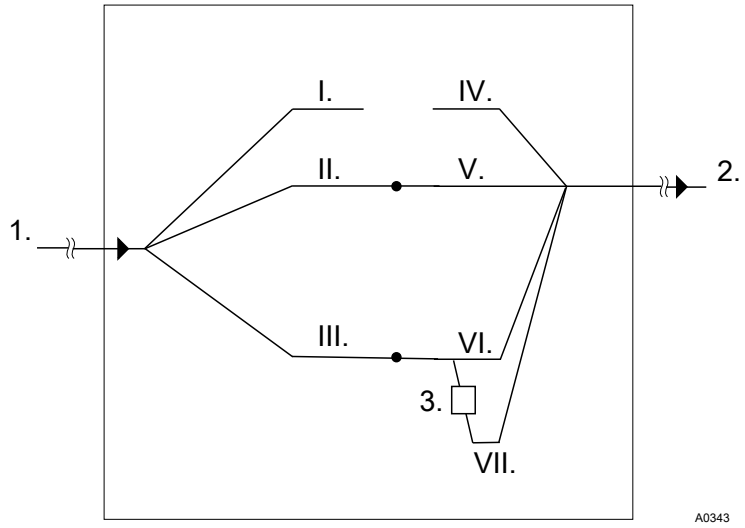



*Fig. 5: Connection box 2 (IP 65)*

1. Relay cable 3-pin Beta
2. Delta diaphragm rupture cable
3. Resistance 300 Ω

I. White (open)
II. Green (NC)
III. Brown (C)
IV. White (open)
V. Blue (signal)
VI. Black (ground)
VII. Brown (5 V)

Connecting the alarm relay of the external pump to the input of the diaphragm rupture alarm of the delta® solenoid metering pump. As soon as the external pump reports an error, this error is passed on to the delta® via the input of the diaphragm rupture alarm. The delta® solenoid metering pump stops and outputs a collective alarm.

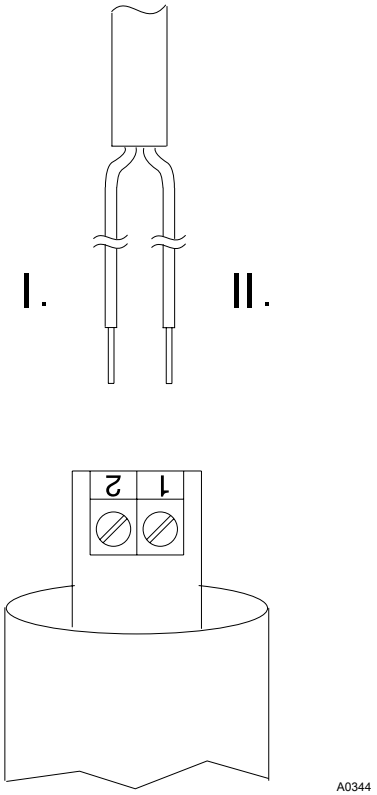



*Fig. 6: Connecting the sensor or measuring transducer*

I. White
II. Brown

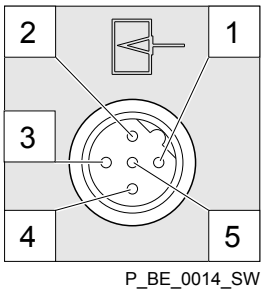



*Fig. 7: Assignment on the control module*

1 Free
2 Supply voltage approx. 25.5 Volt
3 Ground
4 Voltage input
5 Free

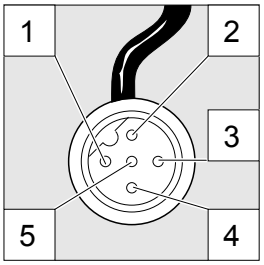



*Fig. 8: Assignment on the cable / 2-wire external cable*

1 Voltage input
2 Brown / supply voltage approx. 25.5 Volt
3 Free
4 White / voltage input
5 Free

# 4 Assembly

**NOTICE!**

**Installation position and conditions**

- Ensure that there is unimpeded access for operation
- Secure, low-vibration fixing
- Avoid direct sunlight
- Permissible ambient temperature at fixing position: -10 ... + 45 °C at max. 95% relative air humidity (non-condensing)

**NOTICE!**

**Operating instruction for all components used**

Possibility of material damage due to incorrect assembly.

When assembling the system, observe the operating instructions for all components used.

*Reading and operating position*

- *Install the device at a favourable position for reading and operating (preferably at eye level)*

The control module delta® is fully integrated in the delta® solenoid metering pump and must not be installed separately.

## 4.1 Installation (hydraulic)

**CAUTION!**

- Observe the maximum permissible operating parameter for the entire installation of the measuring / control station (e.g. pressure, temperature, flow)
- In the process, observe the lowest maximum permissible operating parameter of the parts of the measuring / control and the sensors installed (see their operating instructions)
- Please also observe the operating instructions for controllers and fittings and any other component groups, such as sensors, sample water pumps ...
- Observe the flow direction of the measured water.
- One pressure reducer must be installed.
- Danger resulting from media under pressure.
- Before working with hydraulic parts of the measuring / control station, this must be depressurised in a controlled manner via the sampling cock.
- Wear protective goggles

**Fittings**

The bypass fitting (flow gauge) used depends particularly on the measured water, in some cases also from the measured variable or or the combination of the measured variables. The type DGMA with flow controller is always used for all clear water types and the type DLG III for contaminated water is also used for upstream flow controlling.

**Hydraulic connection, pipework**

With the DGMa, the hydraulic connection of the measured water is carried out using an 8 x 5 mm hose connection. A shut-off ball valve is installed before and after the bypass fitting. The optionally available measuring water filter is installed before the bypass fitting. Each of the bypass fittings have a mounted sampling cock.

## 4.2 Hydraulic test run after installation

A hydraulic test run of the measuring / control station is necessary after successful installation.

- The sampling cock must be closed! Otherwise measured water will escape
- Check all screw connections before the initial commissioning
- Open the shut-off ball valve on the inlet and outlet ends.
- The system must now be hydraulically tight. No fluid must leak out.

If fluid should leak out, the reason for this must be determined and eliminated.

### 4.2.1 Set the flow meter switching point

1. For testing, reduce the flow - the delta® Solenoid metering pump must indicate *„Pause“*
2. Check the screw connection for leaks.

The flow gauge DGMa:

Goal: Reduction in flow should switch - *„Pause“* on the delta® solenoid metering pump when the inlet is closed

1. Set the flow using the ball valve.
2. Set value: 40 l/h
3. Test value: 30 to 60 l/h (read-off from the top edge of the float)
4. Loosen the flow gauge.
5. Push the flow gauge upwards in the rail until the delta® Solenoid metering pump switches to *„Pause“*.
6. Push the flow gauge down far enough until *„Pause“* on the delta® solenoid metering pump has just cancelled.
7. Fasten the flow gauge.
8. For testing, reduce the flow

   ⇨ - the delta® Solenoid metering pump must switch to *„Pause“*.

## 4.3 Commissioning sensors

**WARNING!**

- Hazardous substances
- Danger resulting from contact, breathing in or other contaminations with / from substances or media
- Observe the safety data sheet of the substances / media used
- The system operator must ensure that these safety data sheets are available and that they are kept up to date

**CAUTION!**

- The sampling cock must be closed! Otherwise measured water will escape
- The measured water must be free of air bubbles to guarantee a reliable measurement and control! If air has to be carried along in the measuring water due to the process, the air must be discharged using a suitable technical method.
- Please also observe the operating instructions for controllers and fittings and any other component groups, such as sensors, sample water pumps ...

**Preparation**

1. Retighten all screw connections and check for leaks.
2. Check the position of all shut-off valves. The position of the shut-off valves must guarantee that the measuring / control station is tight and the flow of the measured water is given.
3. Commission the measuring / control station

### 4.3.1 Run-in time

A run-in time must be observed for the chlorine sensor. Depending on the sensor, this may vary between 1 hour and 24 hours. For this purpose, the respective sensor must be located in the measured water to be measured and connected electrically. This measured water must already contain the measured variables in a quality and quantity sufficient for the process.

The running-in of the sensors is described in the operating instructions of the sensor.

# 5 Commissioning

**WARNING!**
**Run-in time of sensors**
This can result is hazardous incorrect metering

Take into consideration run-in times when commissioning

- Correct measuring and metering is only possible if the sensor is working perfectly
- It is imperative that the run-in times of the sensors are adhered to
- The run-in times should be allowed for when planning initial operation
- It may take a whole working day to run-in the sensor
- Please read the operating manual for the sensor

## 5.1 Initial Commissioning

The control module delta® has the same language settings as the control module delta® connected to the delta® solenoid metering pump.

### 5.1.1 Selecting the operating language

Setting the operating language is carried out via the setting menu of the connected delta® solenoid metering pump.

### 5.1.2 Selection of the Measured Variable and Measuring Range

**WARNING!**
**Incorrect metering due to incorrect metering range**
Possible consequence: Fatal or serious injuries

- **The measuring range of the sensor is essential for the measuring range!**
- If the assignment of the measuring range is modified, the settings must be checked in all menus
- If the assignment of the measuring range is changed, the sensor must be recalibrated

# 6 Operating Schematics / Display Symbols

***Operating the delta® solenoid metering pump with controlled solenoid drive optoDrive®***

*For the fundamental operation of the delta® solenoid metering pump, the operating instructions of the delta® solenoid metering pump with controlled solenoid drive optoDrive® is available. The operating instructions of the control module delta® describes the enhanced operating possibilities of the control module delta® in conjunction with the delta® solenoid metering pump.*

***Access to the settings of the control module delta®***

*For accessing the settings of the control module delta® , you have to stop the delta® solenoid metering pump using the STOP-key. The display indicates the following symbols and Stop. You will only then be able to access the settings of the control module delta®.*

## 6.1 Overview of device / operating elements

***Contents of the LCD display***
*The content of the LCD display can vary depending on the Identcode of the delta® solenoid metering pump.*

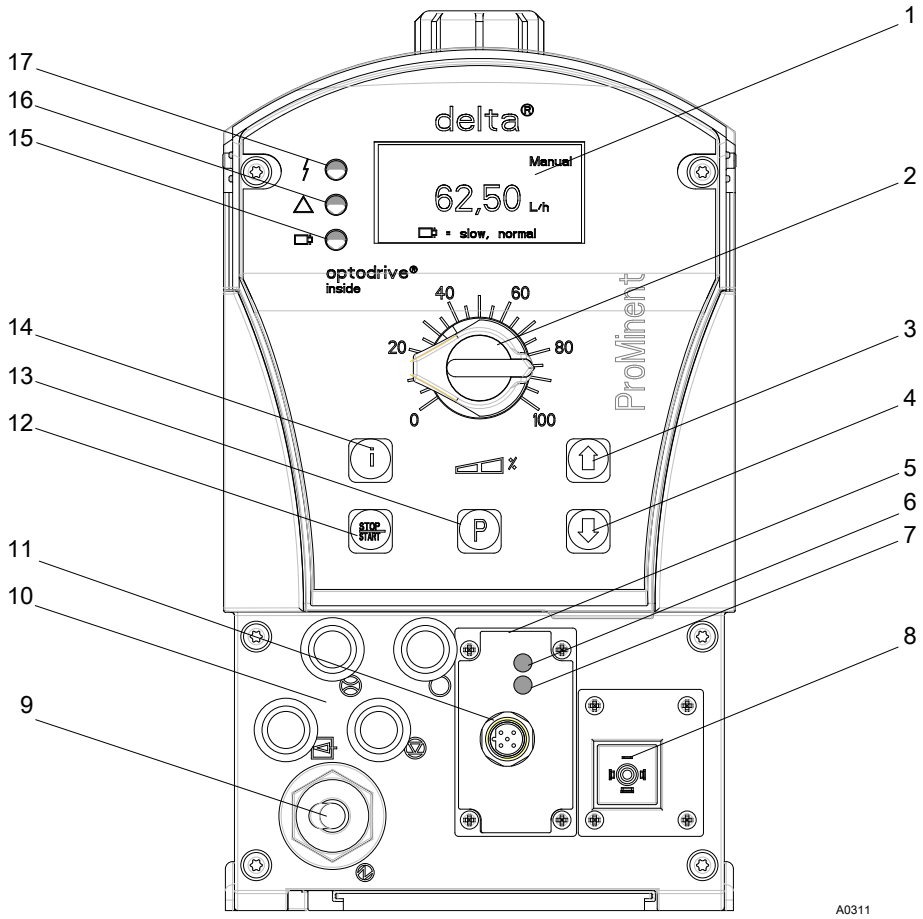
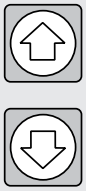



*Fig. 9: Operating elements of the delta® solenoid metering pump*

1 LCD display
2 Stroke length adjustment knob
3 UP key
4 DOWN key
5 Control module delta®
6 Device LED-LED
7 Connecting LED
8 Relay insert (optional)
9 Mains power
10 Terminal for the additional functions
11 Sensor connection
12 STOP / START key
13 P key
14 i key
15 Operating indicator (green)
16 Warning indicator (yellow)
17 Fault indicator (red)

### 6.1.1 Key functions

| Key | Operation | In continuous displays (Operation) | In setting mode (Settings) |
|---|---|---|---|
| STOP / START key | briefly pressed (0.2 - 1 s) | stop pump<br>start pump | stop pump<br>start pump |
| P key | briefly pressed (0.2 - 1 s) | start batch (only in operating mode "Batch") | Confirm entry - Jump to next menu option or in the continuous display |
| | 2 s pressed | go to setting mode | ---- |
| | 3 s pressed | ---- | Return *[ESCAPE]* to the continuous display |
| i key | briefly pressed (0.2 - 1 s) | toggle between the continuous displays | ---- |
| | long pressed (> 1 s) | go to the second level of the continuous display | ---- |
| Arrow keys UP or DOWN  | individually pressed (until double arrows appear) | change directly adjustable variables | select another setting.<br>change individual figure or number.<br>at the upper end of a selection, effect similar to the ESC key |
| | simultaneously pressed | suction (in continuous display "stroke frequency") | ---- |

## 6.2 Continuous display extended control module delta®

In the main display, in addition to the display of the delta® solenoid metering pump, the display for the control module delta® can also be added.

The control module delta® display has all the values for the setpoint and actual values of the control module delta® .

- I. Setpoint (of the control module delta® ) in a very large figure (12 x 24 points), in the selected unit (ppm, pH or mV)
- II. Actual value *[i]* (input value of the control module delta® ) in a very large figure (12 x 24 points), in the selected unit (ppm, pH or mV)
- III. Existing continuous display on the delta® solenoid metering pump

Format for the main display (S = Setpoint):

- Chlorine: (S) XXX.YY ppm
- pH: (S) XX.YY pH
- Redox:(S) XXX mV

Display: Only measured value = actual value

Display: Measured value with an *„S“* in front of it = Setpoint

## 6.3 Secondary display extended control module delta®

In the secondary display, the specified nominal value as well as the current actual value of the control module delta® can be displayed.

- I. Setpoint (of the control module delta® ) in a very large figure (8 x 8 points), in the selected unit (ppm, pH or mV)
- II. Actual value *[i]* (input value of the control module delta® ) in a very large figure (8 x 8 points), in the selected unit (ppm, pH or mV)
- III. Current value (input value of the control module delta® ) in xx,xx mA
- IV. Existing continuous display on the delta® solenoid metering pump

Format for the secondary display (S = Setpoint):

- Chlorine: (S) XXX.YY ppm
- pH: (S) XX.YY pH
- Redox: (S) XXX mV

Display: Only measured value = actual value

Display: Measured value with an *„S“* in front of it = Setpoint

## 6.4 Activating / deactivating the control module delta®

This menu is available for putting the delta® solenoid metering pump in the operating mode for the control module delta® .

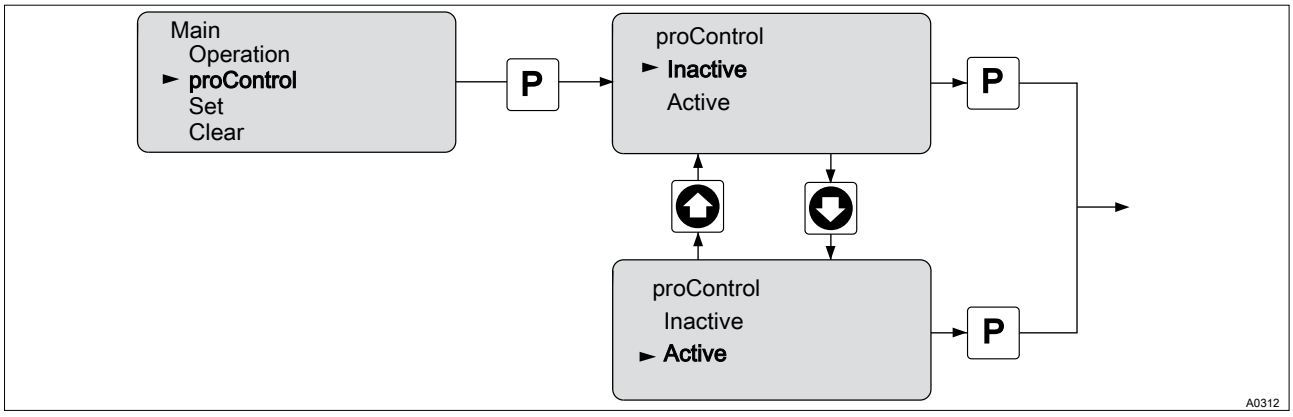



*Fig. 10: Activating / deactivating the control module delta®*

If the control module delta® is set to *„active“* , then operation or controlling of the delta® solenoid metering pump takes place in the control module delta® . Independent as to which operating mode the delta® solenoid metering pump was previously located. If the control module delta® is set to *„inactive“* , then the delta® solenoid metering pump returns back to its original operating mode.

In the inactive state, no error messages or warning messages are transferred to the delta® solenoid metering pump.

If the control module delta® is set to *„active“* then the symbol appears in the operating indicator of the delta® solenoid metering pump to indicate that the control module delta® is working actively. At the same time, the light diode *„Connecting LED“* switches to green with regular operation.

## 6.5 Selection of the Measured Variable and Measuring Range

The control module delta® has a 4 - 20 mA input. A sensor can be connected to this input. The control parameter, the menu navigation and the continuous display are sensor specific.

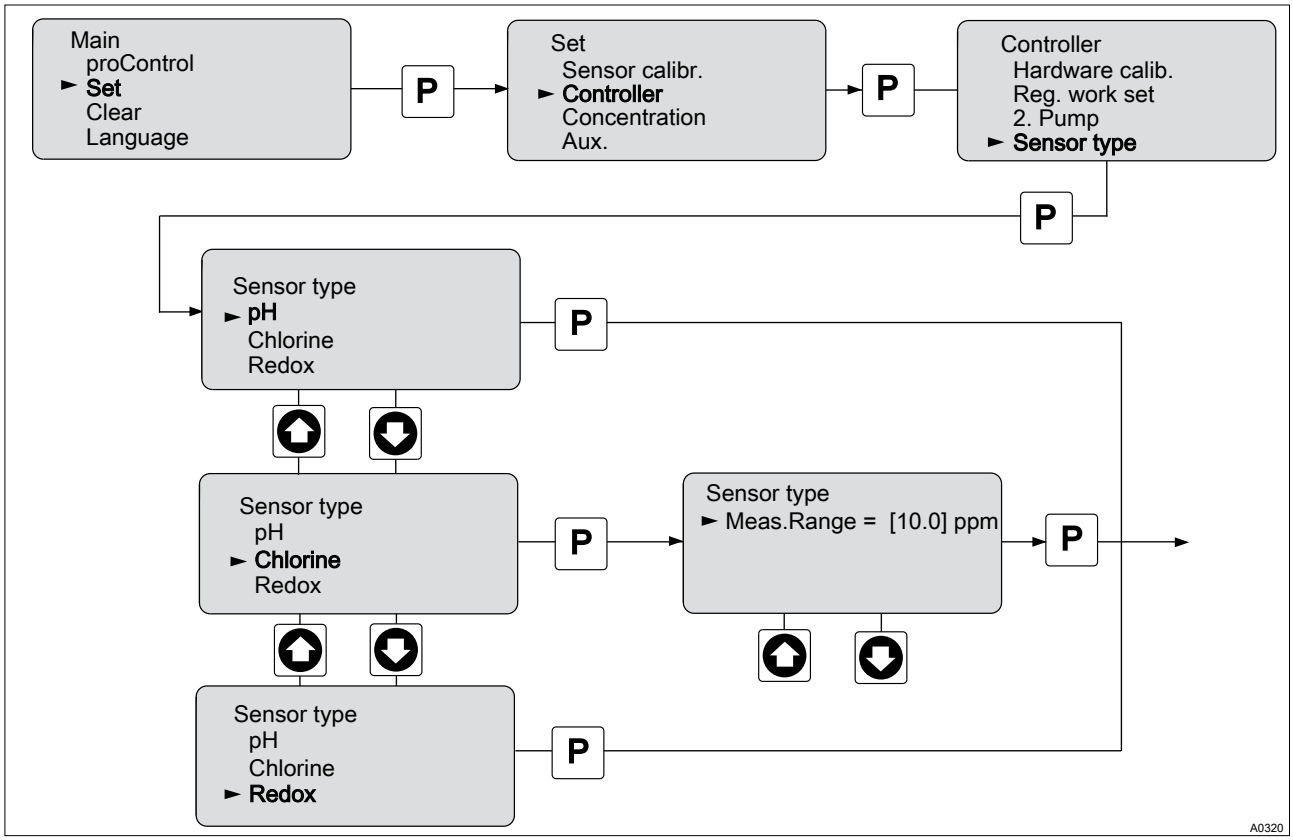



*Fig. 11: Selection of the Measured Variable and Measuring Range*

Using the menu item *„Sensor Type“* , you are able to select the respective sensor. The different versions or measurement ranges of the sensors can also be selected in this menu item.

| Sensors | Types |
|---|---|
| Redox | Only one sensor version is operated with the measuring transducer "RhV1".<br>■ 1,000 mV ➡ 20 mA<br>■ 0 mV ➡ 4 mA |
| Chlorine | ■ Measuring range from 0 ... 20 ppm |
| pH | Only one sensor version is operated with the measuring transducer "pHV1".<br>■ -500 mV ~ pH 0 ➡ 20 mA<br>■ 500 mV ~ pH 14 ➡ 4 mA |

## 6.6 Setting the limit values

***Hysteresis***

*An hysteresis is installed here so that when in the range of the limit value of the control module delta®, switching is not constantly carried out between the control and base load metering.*

*The hysteresis is approx. 2% of the measuring range:*

– *(„Limit value up“ minus „Limit value down“) * 2 %*

You have the possibility of setting the permissible value for the controlling for each sensor type. When a measurement value lies outside this limit value, the control will be discontinued. Basic load control is only active in this case.

If the measurement value lies outside the limit value than a warning is reported and the symbol is displayed in the status display of the delta® solenoid metering pump.

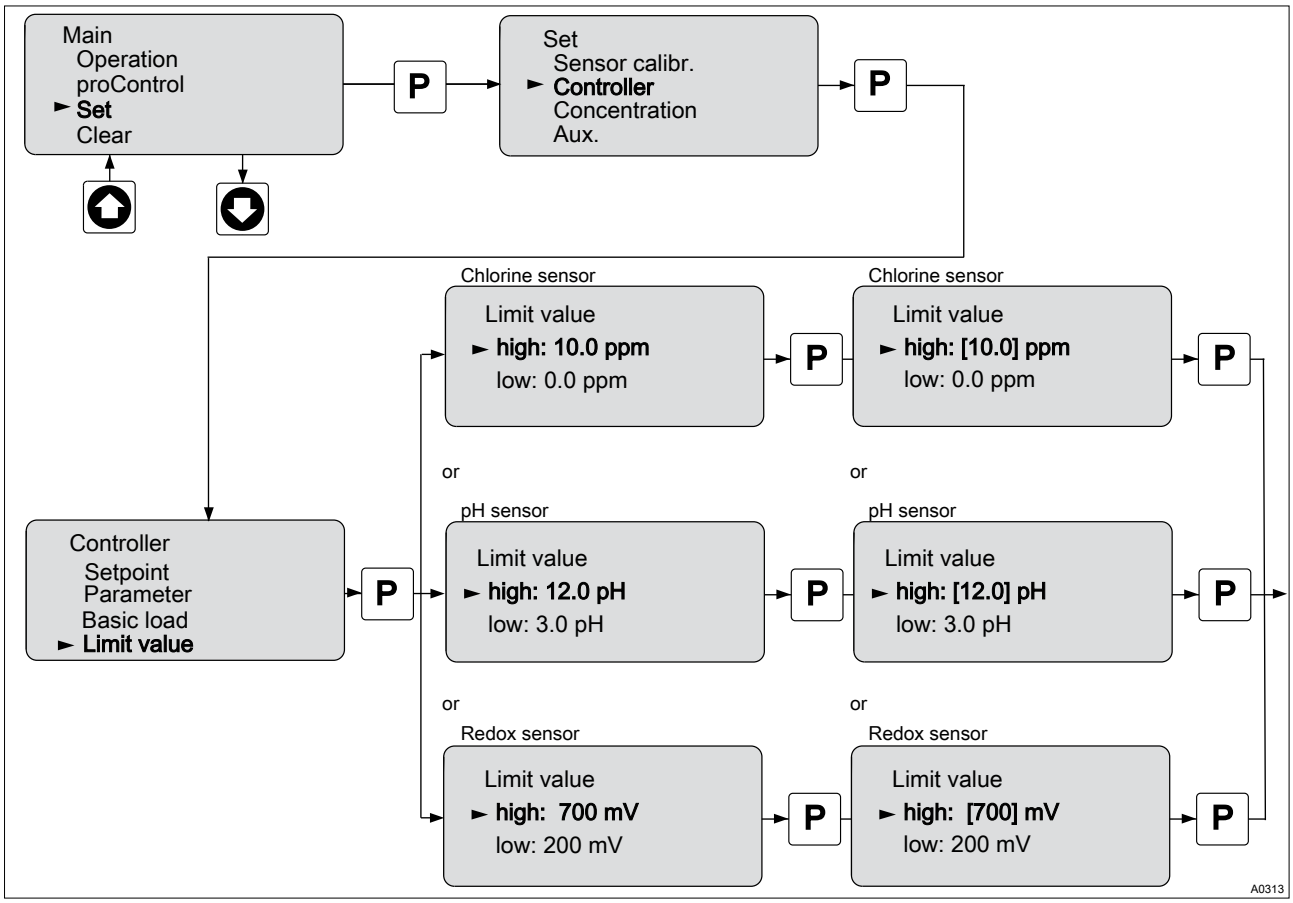



*Fig. 12: Setting the limit values*

| Sensor | Factory setting | | Settings |
|---|---|---|---|
| | top | bottom | |
| Chlorine | 0 ppm | 20 ppm | 0 ppm up to the maximum value of the sensor. In increments of 0.1 ppm |
| pH | 0 pH | 14 pH | 0 pH to 14 pH. In increments of 0.1 pH |
| Redox | 0 mV | 1,000 mV | 0 mV to 1,000 mV. In increments of 1 mV |

## 6.7 Setting the basic load

*Basic load*

*It may be necessary to meter the feed chemical with a basic load.*

You can switch the basic load control on or off using this menu. You switch the basic load on by entering a percentage proportion of the maximum set value.

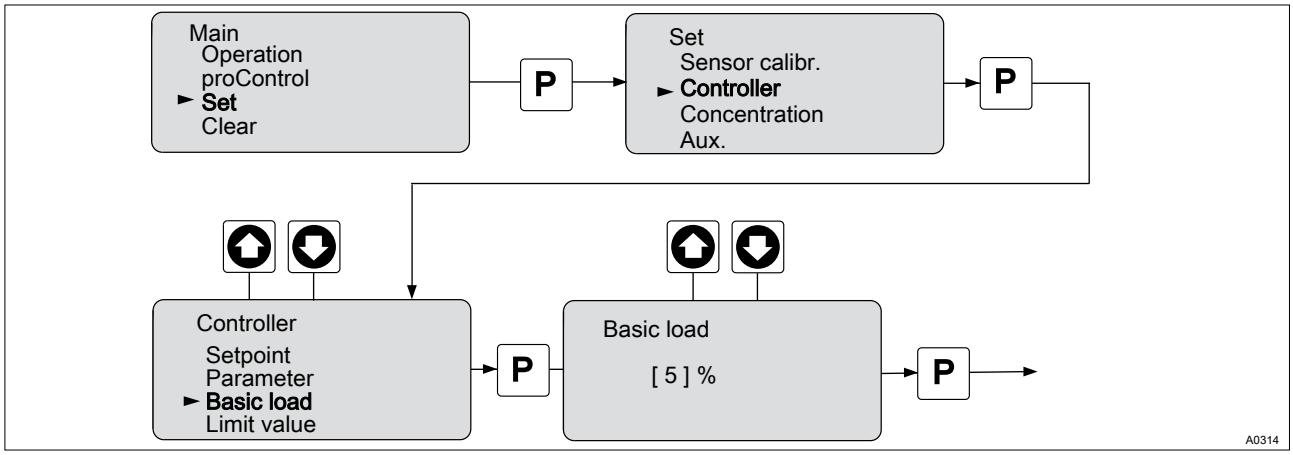



*Fig. 13: Setting the basic load*

| Basic load | Settings |
|---|---|
| Setting values | 0 % to 100 % in increments of 1 %. Start value of 0 %. 0 % = Basic load off. |

## 6.8 Setting the set value

You can set the set value via this menu. An *„S“* is put in front in the display value for the set value is displayed in the continuous display.

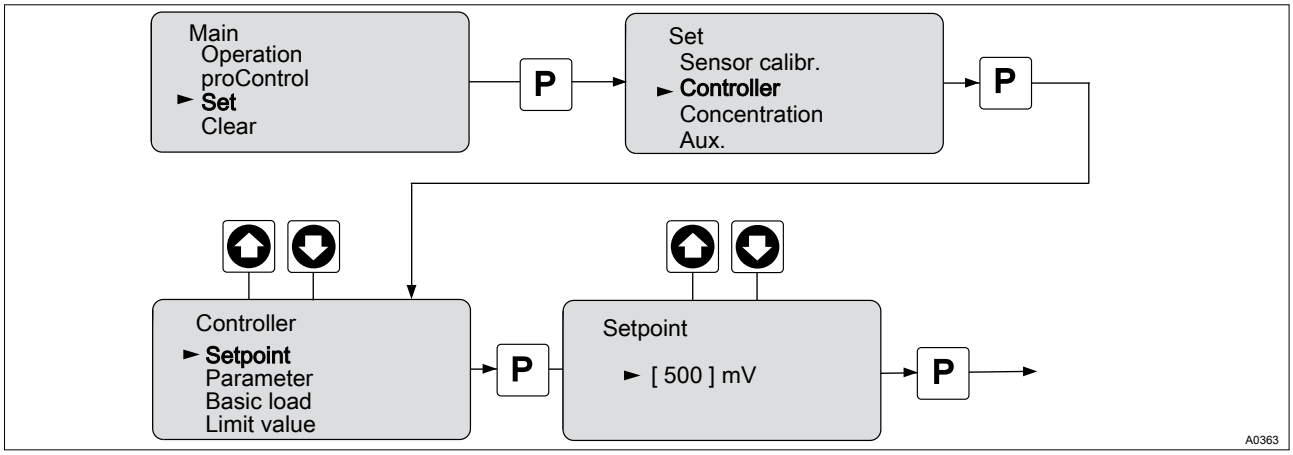



*Fig. 14: Setting the set value*

| Setting | | Possible values | | | |
|---|---|---|---|---|---|
| **Display** | **Starting value** | **Increment** | **Lower value** | **Upper value** | **Remarks** |
| mV | 500 mV | 1 mV | 0 mV | 999 mV | Redox |
| pH | 7.00 pH | 0.01 pH | 0.00 pH | 14.00 pH | |
| Chlorine | 5.00 ppm | 0.01 ppm | 0 ppm | 20 ppm | |
| The upper and lower value can only be adjusted in the scope of the adjusted limit values, see ↳ *Chapter 6.6 „Setting the limit values“ on page 27*. The values in the table shows the maximum possible range. | | | | | |

## 6.9 Setting the checkout time

***Monitoring of the controlled system***

*The checkout time monitors the controlled system. Possible defective sensors may be detected via the mechanism of the checkout time.*

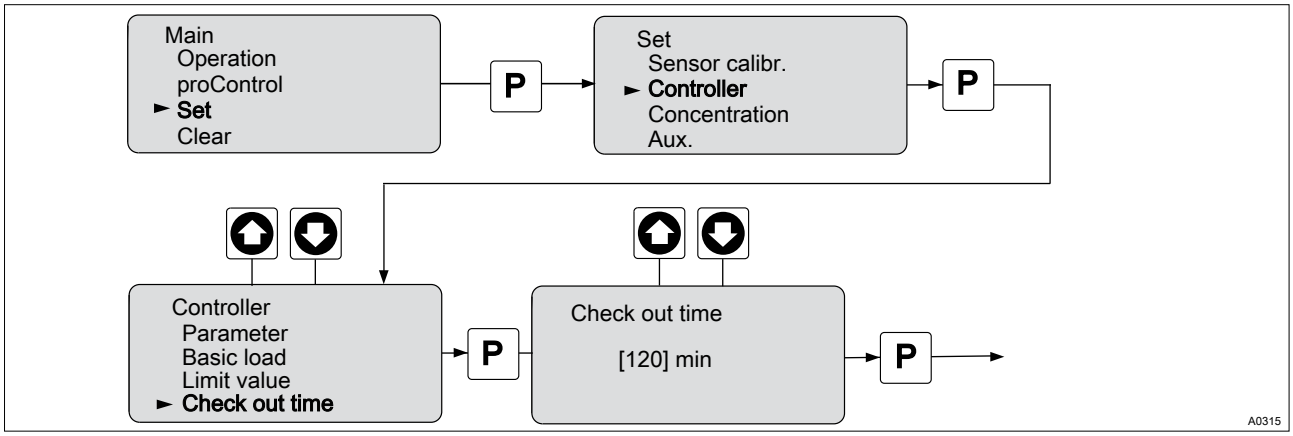



*Fig. 15: Setting the checkout time*

*Determine the dead time and adjusting the checkout time*

Each controlled system has a dead time. The dead time is the time that the controlled system requires to determine a change caused by the addition of the metered chemicals by measurement.

You have to select the checkout time greater than the dead time. You can determine the dead time by allowing the the metering pump to operate in manual mode and, e.g. metering acid.

**NOTICE!**

**Dead time determination**

You should only determine the dead time when the actual process cannot be influenced in a negative way by the manual metering.

You have to determine the time that the controlled system (therefore, the entirety of the controller, sensor, measured water, flow gauge, etc.) requires to detect the first change to the measured value, from beginning the metering. This time is the *„Dead Time“*. A safety margin must be added to this determined dead time, e.g. 25%. This safety margin must be determined individually for your process. If the set value is not reached after the checkout time has elapsed, see *Chapter 6.8 „Setting the set value“ on page 29*, the metering pump switches to base load metering.

If the control module delta® should not have reached a certain threshold after the checkout time, the control module delta® switches to base load operation. A warning is released to the superior system, the delta® solenoid metering pump in this case and the symbol is displayed in the status display of the delta® solenoid metering pump.

| Settings | Comment |
|---|---|
| Settings | 1 min to 999 min in increments of 1 minute |
| Starting value | off (= 0 min) |

**Reset after activating the checkout time**

If the control module delta® is in operating mode *„Checkout time, “*then the base load metering is active. If, however, one wants to return to the normal control mode then the checkout time must be restarted. Press the -key to restart the checkout time.

## 6.10 Setting the control module delta®

The controlled system can be adjusted via this menu. The feed chemical that will be metered must be selected, e.g. "raise" or "lower".

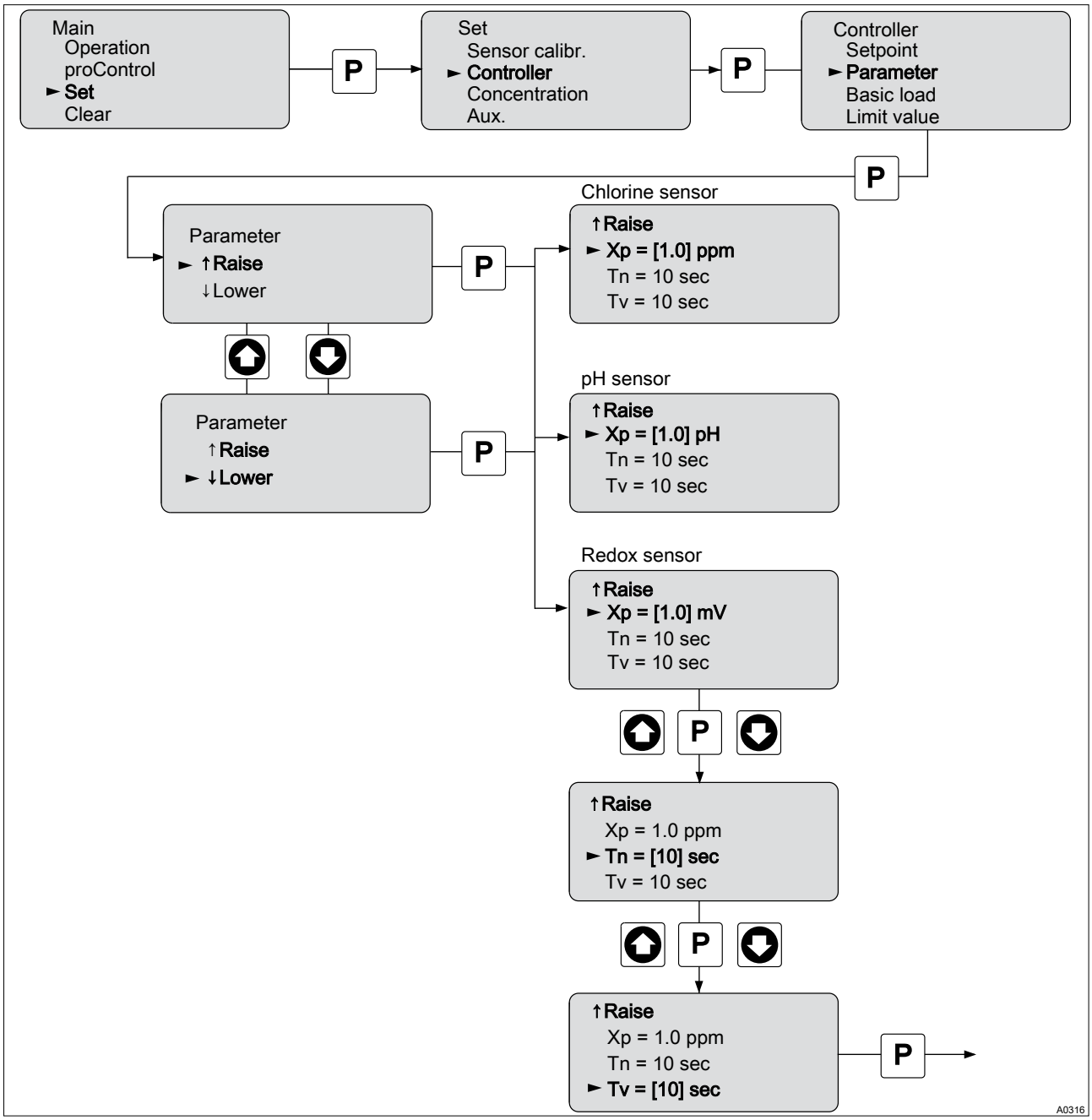



*Fig. 16: Setting the control module delta®*

Then the parameter for the controlled system can be adjusted. These are:

- $X_p$ ➡ KP (reciprocal proportional coefficient)
- $T_N$ ➡ I-controller reset time in seconds
- $T_V$ ➡ Derivative time of D-control in seconds

| $T_N$ | $T_V$ | Controllers |
|---|---|---|
| 0 | 0 | P controller |
| >0 | 0 | PI controller |
| 0 | >0 | PD controller |
| >0 | >0 | PID controller |

| Sensor | Parameter | Comment |
|---|---|---|
| Chlorine | Set point | 0.01 ppm to the upper limit of the measuring range. In increments of 0.01 ppm. Start value: 50 % of the measuring range |
| | $X_p$ | 0 to measuring range in increments of 0.01 ppm. Start value: 10 % of the measuring range |
| | $T_N$ | 0 s to 9999 s in increments of 1s. Start value 0 s. |
| | $T_V$ | 0 s to 9999 s in increments of 1s. Start value 0 s. |
| pH | Set point | pH 0,01 pH to 14 pH in increments of 0.01 pH. Start value 50 % of measuring range |
| | $X_p$ | 0 pH to measuring range in increments of 0.01 pH. Start value: 10 % of the measuring range |
| | $T_N$ | 0 s to 9999 s in increments of 1s. Start value 0 s. |
| | $T_V$ | 0 s to 9999 s in increments of 1s. Start value 0 s. |
| Redox | Set point | 0 mV to 1,000 mV in increments of 1 mV. Start value: 50 % of the measuring range |
| | $X_p$ | 0 mV to 1,000 mV in increments of 1 mV. Start value: 10 % of the measuring range |
| | $T_N$ | 0 s to 9999 s in increments of 1s. Start value 0 s. |
| | $T_V$ | 0 s to 9999 s in increments of 1s. Start value 0 s. |

## 6.11 Factory settings of the control module delta®

The factory settings that are loaded always refer to the current sensor used (pH, Redox or chlorine).

If the request is acknowledged with *„yes“*, then the default values for the characteristic curve data, measurement range, set value and control parameters can be loaded.

***Default values for the characteristic curve data***

*As the parameters for the characteristic curve are default values, the sensors must be calibrated.*

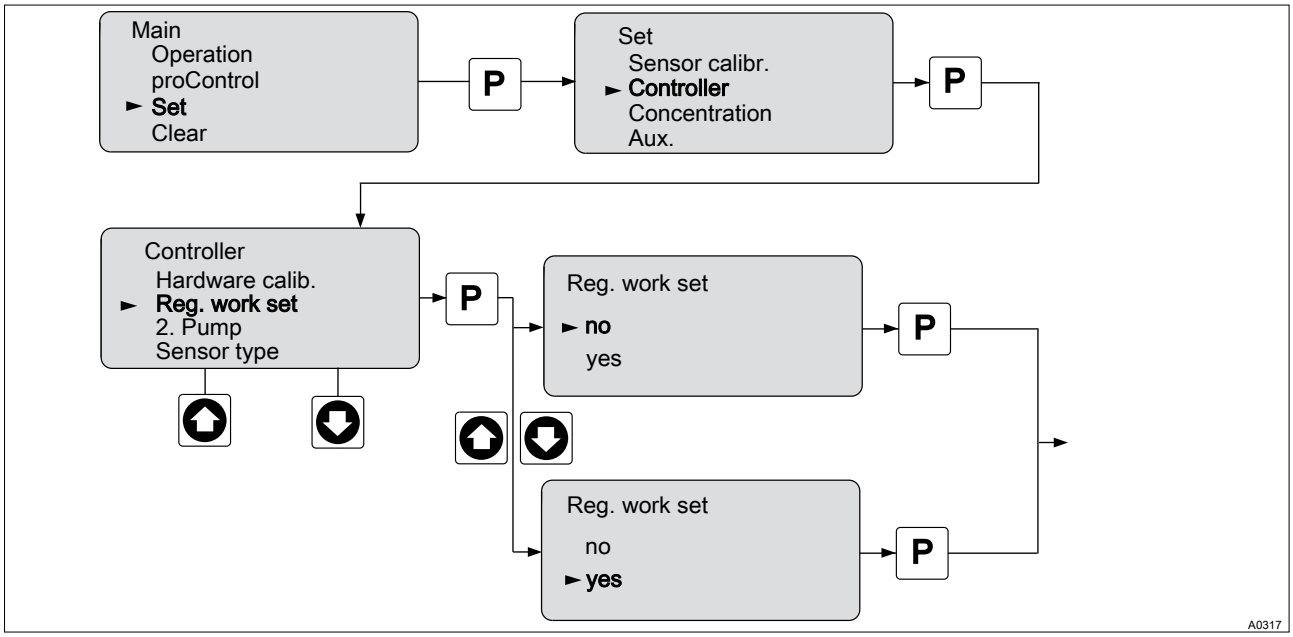



*Fig. 17: Factory settings of the control module delta®*

| Parameter | Value | | | Comment |
|---|---|---|---|---|
| | Chlorine | pH | Redox | |
| Measuring range bottom | 0 ppm | 0 pH | 0 mV | |
| Measuring range top | 10 ppm | 14 pH | 100 mV | |
| Set point | 50 % of the measuring range | | | |
| Set point | 50 % of the measuring range | | | |
| Parameter $X_p$ | 10 % of the measuring range | | | |
| Parameter $T_N$ | 0 sec. | | | |
| Parameter $T_V$ | 0 sec. | | | |
| Characteristic curve | Default | | | Default parameter for the characteristic curve |

## 6.12 Setting the "Two-pump mode"

The control module delta® can also be operated in two-pump mode. Different parameters have to be entered for both pumps for this purpose.

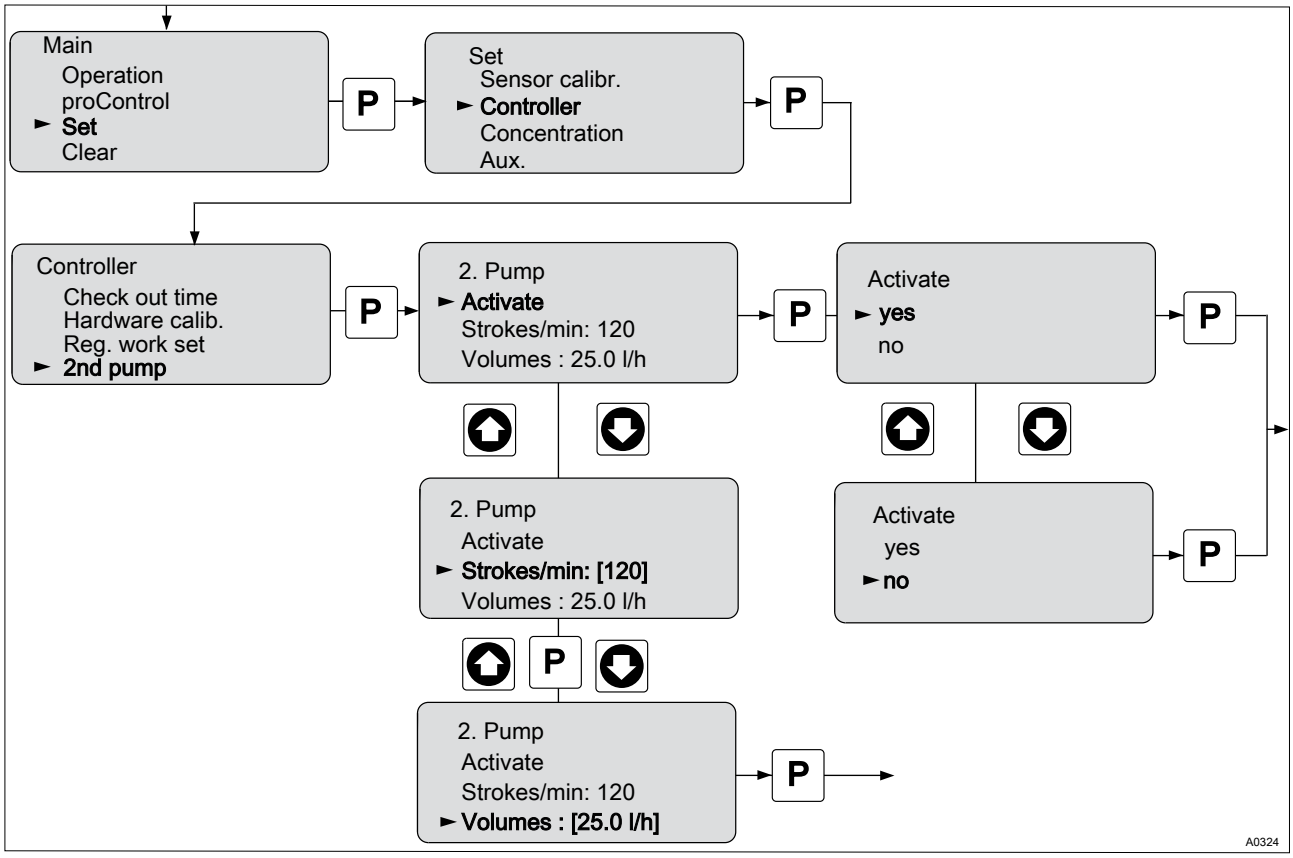



*Fig. 18: Setting the "Two-pump mode"*

The control module delta® now controls the second pump indirectly via the relay output of the delta® solenoid metering pump.

| Settings | Comment |
|---|---|
| Activating | The controller is only active when the control relay in the delta® solenoid metering pump has been activated. |
| Strokes / min. | Stroke rate of the pump in strokes / minute. maximum 180 / min. |
| Volume | Volumes in litre / hour |

### 6.12.1 Setting the controller pulse of the second pump

**NOTICE!**

**Calibrating the delta® solenoid metering pump**

To enable the second pump to be controlled by the delta® solenoid metering pump, the delta® solenoid metering pump must have been calibrated. Notes for this purpose: Operating instructions "Solenoid metering pump delta® with controlled solenoid drive optoDrive®", chapter *„Settings for the function “Calibration” (CALIBRATION menu)“*

Depending on the pump type that should be connected to the control relay of the delta® solenoid metering pump, it is necessary to set the controller pulse accordingly. The controller pulse can be a growing or a falling pulse of the controller relay. Take note that this menu can only be called up when a control relay has been installed in the delta® solenoid metering pump.

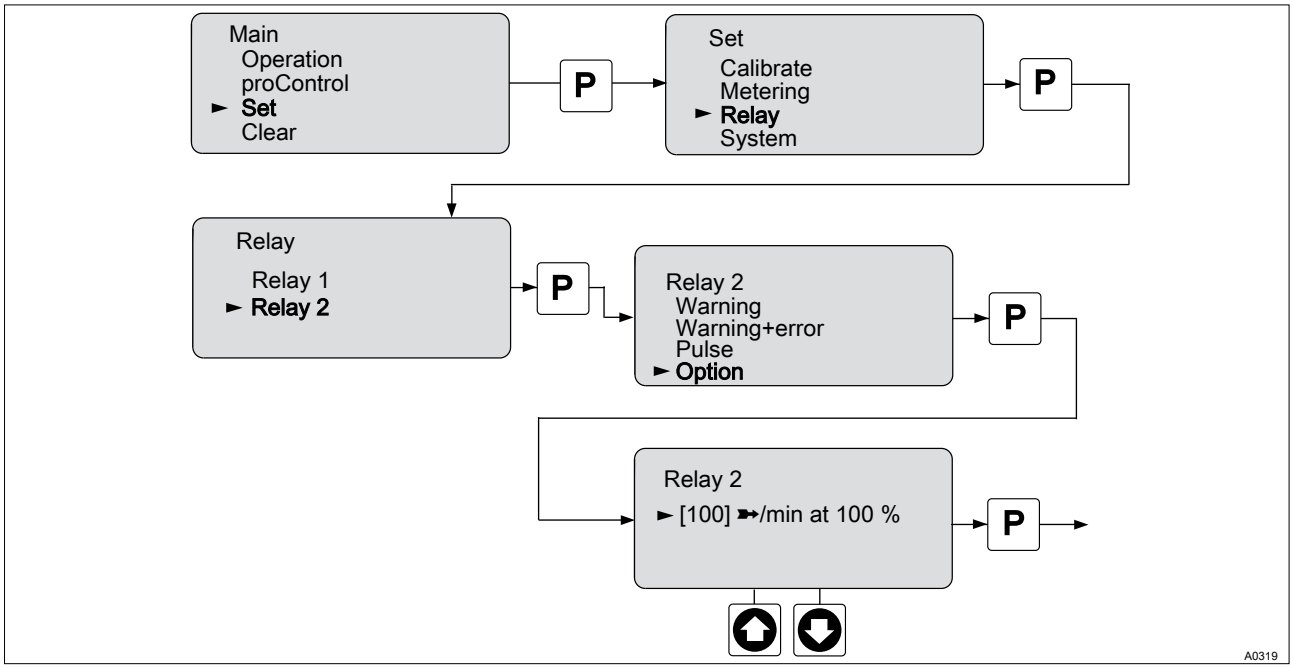



*Fig. 19: Menu for adjusting the controller pulse of the second pump*

# 7 Measured variables for the control module delta®

**WARNING!**

**Danger of incorrect metering**

This can result in hazardous incorrect metering

During initial commissioning, the measured variable and the measuring range of the sensor must be set prior to calibration.

When working on or with sensors, also observe the respective technical documentation of the sensors.

***Measurement range of the sensors***

*You must adapt the measuring range of the controller to the measuring range of the chlorine sensor used.*

| Measured variable | Preset measuring range (default) |
|---|---|
| Chlorine | 10 ppm |
| **The measuring range can be selected infinitely from 0.5 ... 20 ppm.** | |

| pH Measured variable | Typical measuring range |
|---|---|
| Measuring range | 0 ... 20 mA |
| Display range | At least pH -1.45 … 15,45 |
| Reference temperature | + 25 °C |
| Resolution | 0.01 pH |

| Redox measured variable | Typical measuring range |
|---|---|
| Measuring range | - 1,000 mV ... + 1,000 mV |
| Resolution | 1 mV |

## 7.1 Calibrating the sensor for chlorine

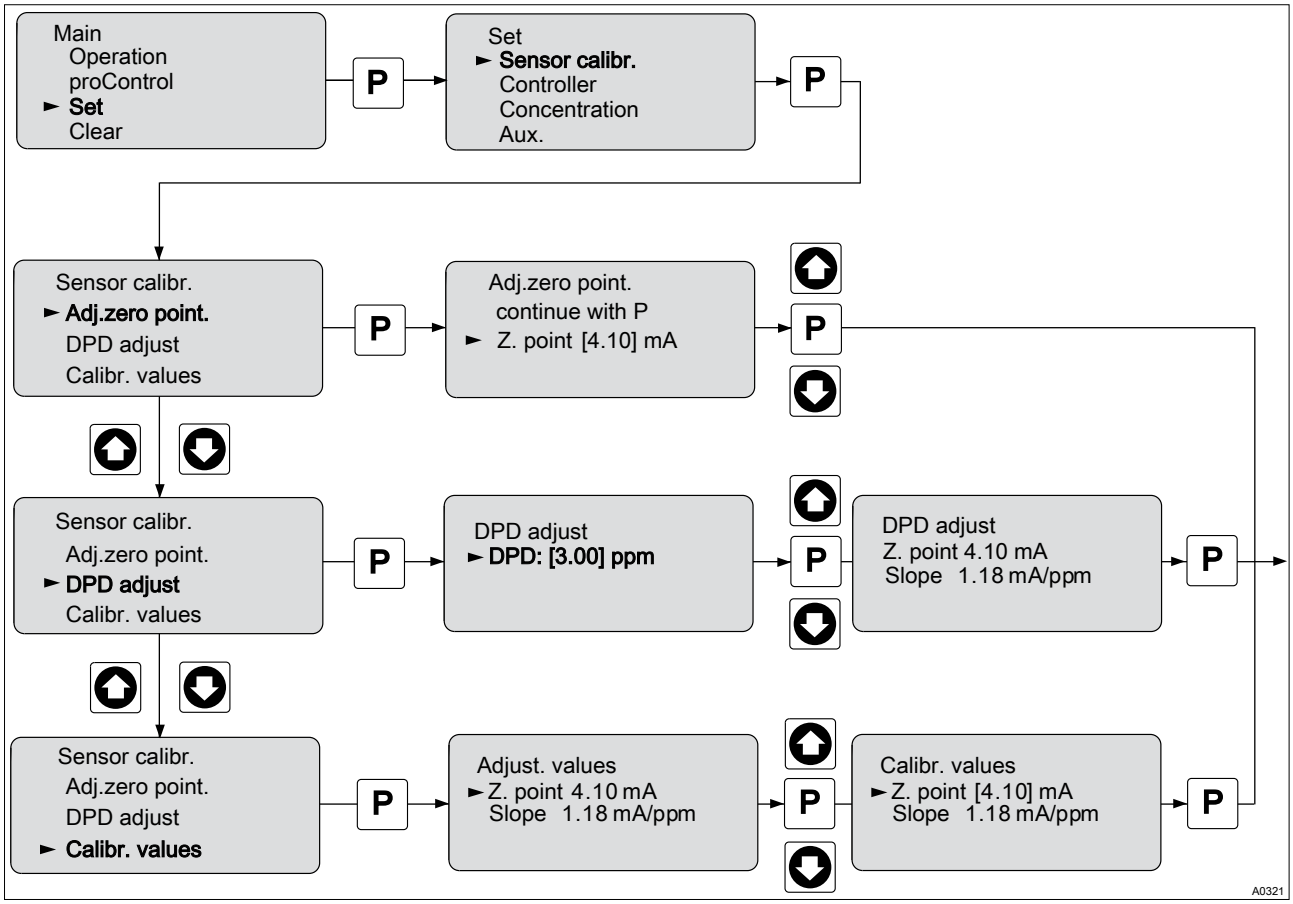



*Fig. 20: Calibrating the sensor for chlorine*

### 7.1.1 Preparing the calibration of the sensor for chlorine

**CAUTION!**

**Correct sensor operation / Run-in time**

Damage to the product or its surroundings

- Correct measuring and metering is only possible if the sensor is working perfectly
- Please read the operating manual for the sensor
- Please also read the operating manuals for the fittings and other components used
- It is imperative that the run-in times of the sensors are adhered to
- The run-in times should be allowed for when planning initial operation
- It may take a whole working day to run-in the sensor

***Necessity of calibrating the zero point***

*Calibration of the zero point is not generally necessary. Calibration of the zero point is only necessary if the sensor is operated at the lower limit of the measuring range or if the 0.5 ppm sensor version is used.*

During the calibration, the control module delta® sets the actuating outputs to *„0“*. The mA standard signal outputs are frozen. The reading frozen at the start of calibration is suggested as a DPD value. The DPD value can be set using the arrow keys.

### 7.1.2 Calibration of Zero Point and Gradient

**NOTICE!**

**Prerequisites for correct calibration of the sensor gradient**

- The DPD method required by the metering medium employed will be used
- The run-in time for the sensor has been adhered to
- There is permitted and constant flow at the flow gauge
- There is temperature equalisation between the sensor and the sample water
- There is a constant pH value in the permitted range

**Calibrating the chlorine sensor: slope**

The sensor is fitted, flushed with sample water and connected electrically to the control module delta® and run-in.

There has to be adequate metering medium in the sample water for calibration (> 2% of the measuring range of the sensor).

Remove sample water directly at the measuring point and using an appropriate reference method (e.g. DPD, titration etc.), determine the content of metering medium in the sample water in *„ppm“*. Enter this value in the control module delta® as follows:

1. Select the calibration menu *[Sensor Calibration]*. The press the button P
2. Take a sample of water and perform a reference measurement immediately.
3. Select the unit *„DPD adjust“* to be calibrated using the buttons ▽ or △
4. The press the button P
   ⇨ The current reading will now be frozen.
5. When necessary, adapt the ppm value determined using keys ▽ and △
   ⇨ The ppm value of the sensor shown in this display now corresponds to the reading in *„ppm“*.
6. The press the button P
   ⇨ The display now shows the value determined for the zero point and gradient. Refer to the Error Message table should an error be displayed

***Necessity of calibrating the zero point***

*Calibration of the zero point is not generally necessary. Calibration of the zero point is only necessary if the sensor is operated at the lower limit of the measuring range or if the 0.5 ppm sensor version is used.*

### Calibrating the chlorine sensor: Zero point

A container with water, which is free of additives that could falsify the measured result, is needed for calibration. Immerse the sensor removed that is still connected to the control module delta® electrically into this water. Stir the sensor around the water for approx. 5 minutes until the reading on the on the control module delta® is displayed steady and close to *„0“*.

1. Select the calibration menu *[Sensor Calibration]*. The press the button P
2. Select the unit *„Adj. zero point“* to be calibrated using the buttons ⇩ or ⇧
3. Continue with P
   ⇨ A prompt is shown in the display
4. Adapt the *„ Zero point“* value displayed during the calibration using the buttons ⇩ or ⇧ and when necessary, accept the value using the button P
   ⇨ Refer to the Error Message table should an error be displayed

**NOTICE!**
Then definitively calibrate the gradient with a suitable reference method (e.g. DPD. titration etc.).

## 7.2 Calibrating the sensor for pH

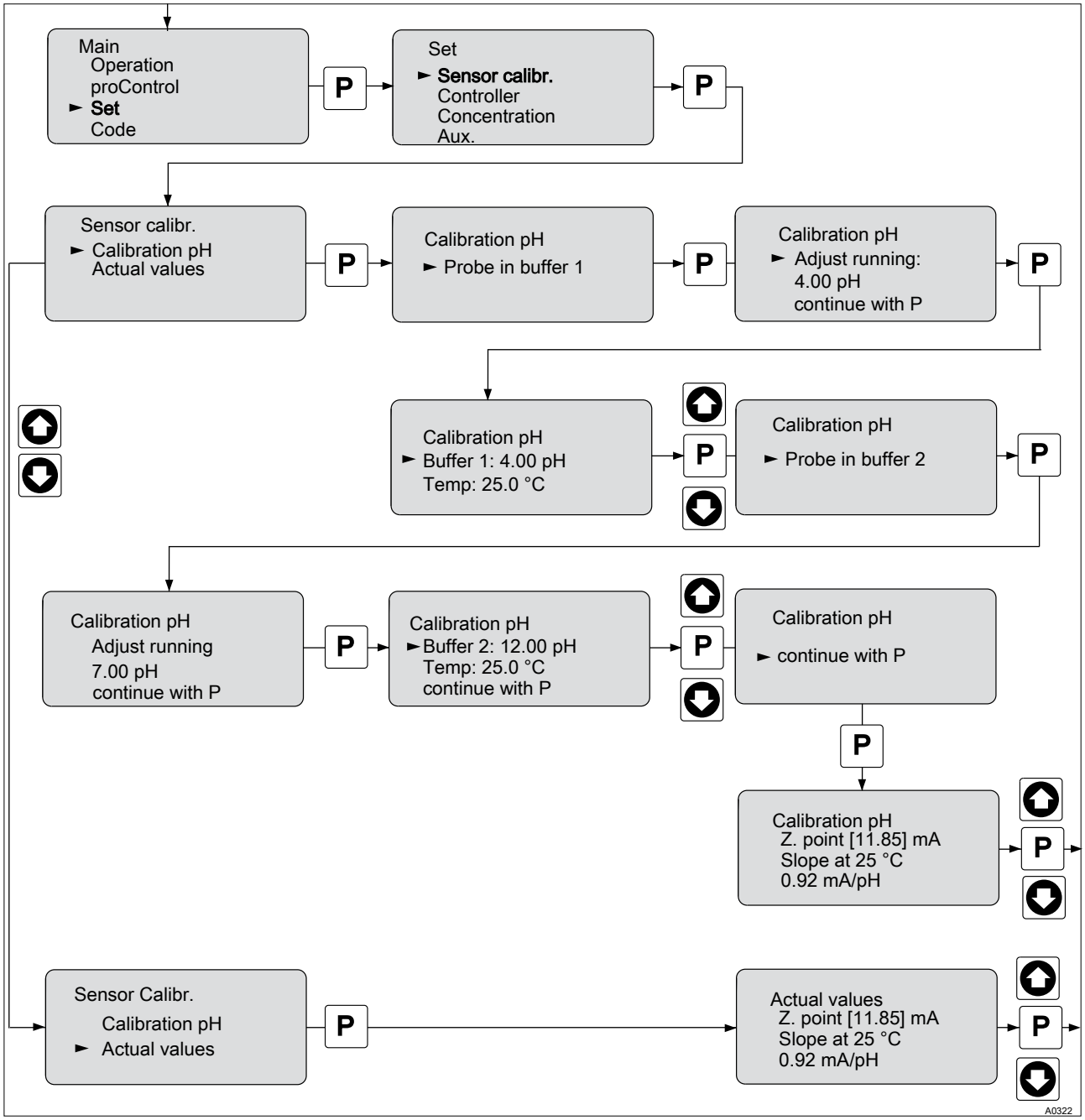



*Fig. 21: Calibrating the sensor for pH*

## 7.3 Calibrating the sensor for Redox

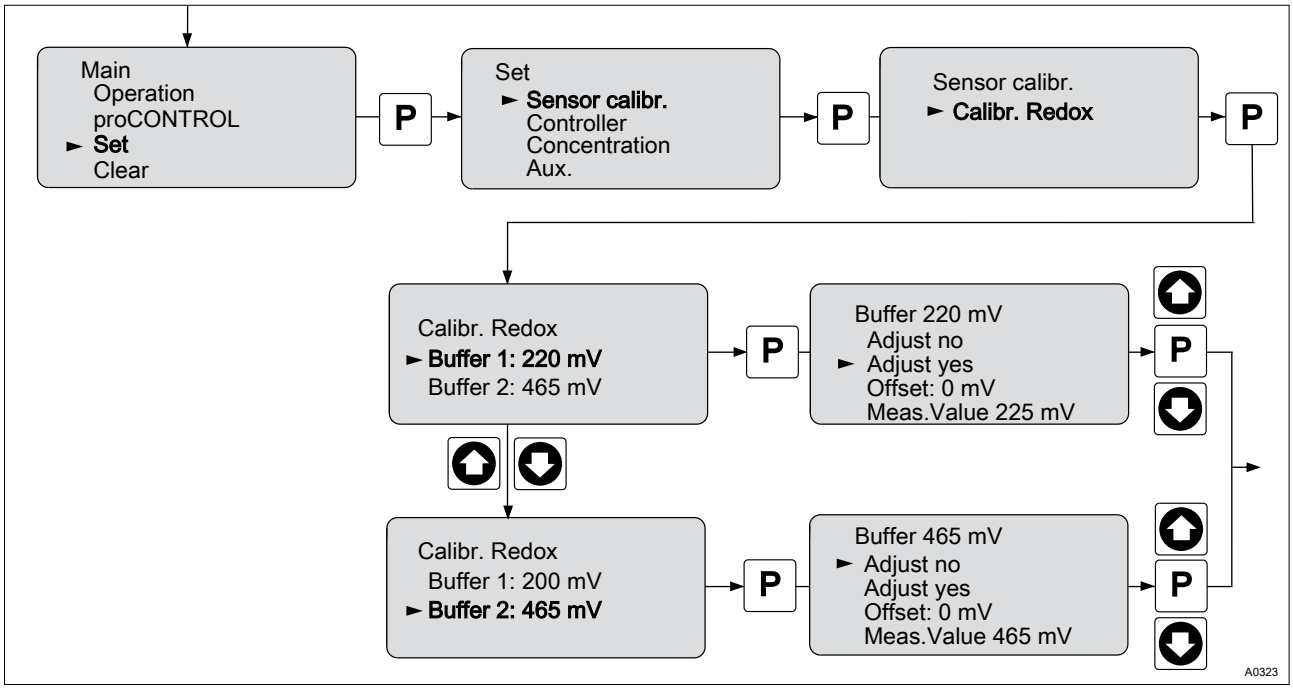



*Fig. 22: Calibrating the sensor for Redox*

# 8 Troubleshooting

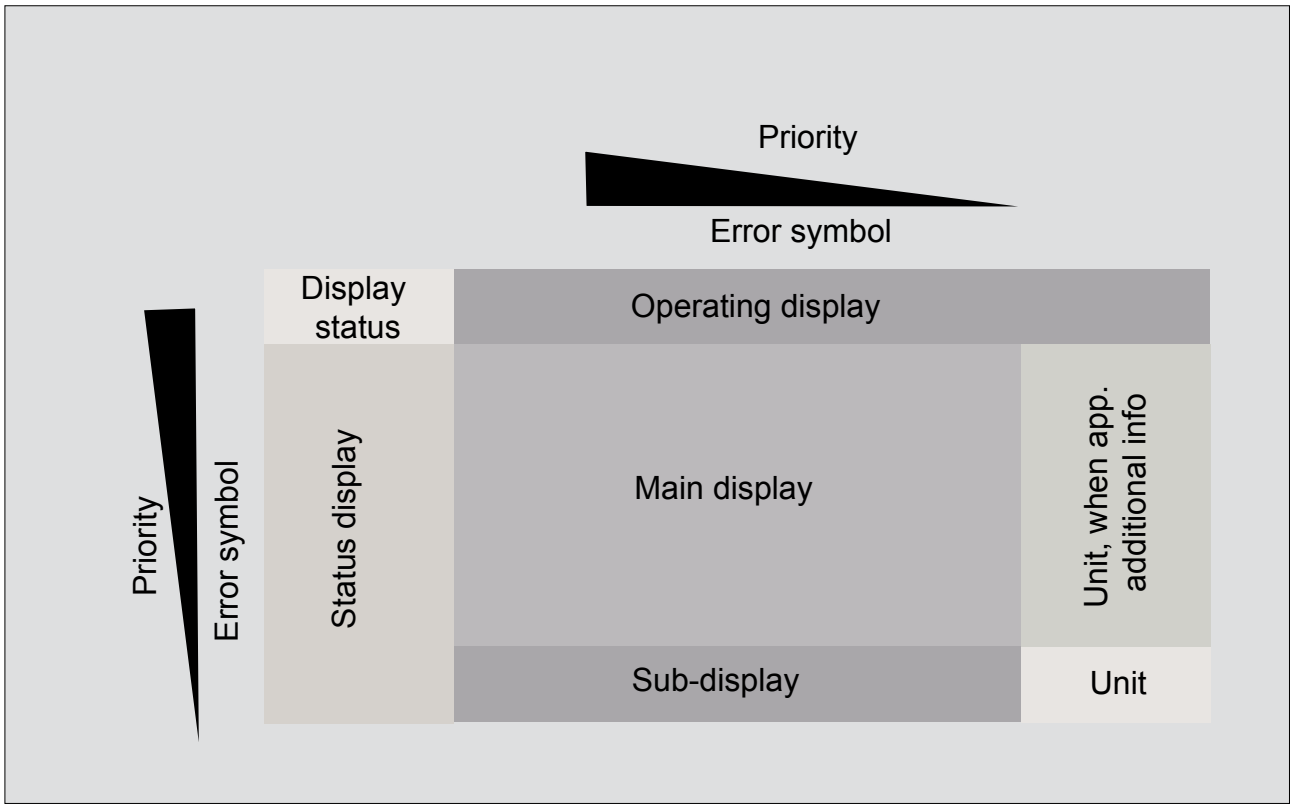



*Fig. 23: Overview of the operating indicator of the delta® solenoid metering pump*

| | | |
|---|---|---|
| | Control module operating indicator | Standard display with regular operation. If the control module delta® is not activated then the symbol will not be displayed. |

## 8.1 "Fault" status display

In the inactive state of the control module delta®, no error messages or warning messages are transferred to the delta delta® solenoid metering pump.

The symbol will be displayed in the status display. Then the respective error symbol flashes in the main display. If several errors occur simultaneously, these will be displayed one after another.

| Photo | Error | Description |
|---|---|---|
| | Control module | In the control module delta®, an error has been detected<br>■ EEProm error<br>■ Data error<br>■ When in the field *„Status display“* the symbol is displayed additionally then an error has been detected when calibrating the Redox sensor (deviating from the buffer value >+/- 40 mV) |
| i < 4 mA | Control module | A value less than 4. mA has been measured at the voltage input |
| i > 20 mA | Control module | A value greater than 20. mA has been measured at the voltage input |
| 20 mA! | Control module | The 20 mA interface has been put in an error state.<br>■ Short circuit<br>■ Overcurrent (> approx. 50 mA)<br>■ Counter voltage (< 0 V) |
| | Control module missing | Option module is missing or communication with the option module cannot be established<br>If the option module "Control module" has been switched into the active state, then the delta® solenoid metering pump expects the login of the control module delta®. If no login takes place then this symbol will be displayed |

## 8.2 Error control module delta®

| Error | Description |
|---|---|
| Hardware error | A hardware error has been detected<br>■ Access error to EEProm<br>■ Overcurrent / undercurrent sensor<br>■ Communication error |
| Software / data | Configuration values cannot be used, e.g. the control parameters ($X_P$, $T_V$, $T_N$) are all set to zero. |

## 8.3 Status display Warning

The display flashes. An explanation of the warning is displayed on the bottom line. In this state, the control module delta® is still functional.

| Photo | Warning | Description |
|---|---|---|
| | Control module | A warning from the control module delta® has been detected<br>■ Error with the feedforward control (control module delta® still operates)<br>■ Overflow of the control module output value (control module delta® still operates)<br>■ The control module is located in basic load control |
| | checkout time, | A warning from the control module delta® has been detected<br>■ Checkout time has elapsed (control module delta® still with basic load) |
| | Limit | The limit value has been exceeded / undershot<br>■ The control module delta® is located in basic load control |
| | Calibration | A calibration error has been detected<br>When an error has been detected then the calibration data will not be accepted. Operation is continued with the old data. This affects the calibration for the current interface and the sensors. If a warning is displayed during a sensor calibration, this could indicate a sensor error. |

## 8.4 Warnings control module delta®

| Warning | Description |
|---|---|
| Communication | A continuous communication error has been determined |
| Software / data | ■ Configuration values are inconsistent<br>■ Communication error (unknown reply, wrong checksum) |
| Controllers | ■ Limit value undershot / exceeded<br>■ Checkout time elapsed |

## 8.5 LED status control of the control module delta®

The LED status control signalises the current operating status of the control module delta® . There are different LED status displays: The device LED and the connection LED. The LED status displays do not have a flash mode.

### Device LED

| LED | Status |
|---|---|
| Green | Operating indicator |
| Red | Fault display<br>■ Internal hardware error<br>■ Sensor error |
| Orange | Warning display<br>■ Configuration error |

### Connecting LED

| LED | Status |
|---|---|
| - | Passive controller operation, otherwise okay |
| Green | Active controller operation |
| Red | No connection establishment to the pump |

# 9 Technical data, maintenance, disposal

## Electrical data

### Voltage input

| | Value |
|---|---|
| Measuring range | 0/4 mA - 25 mA (at 50 Ohm measurement resistor) |
| Accuracy | After calibrating ± 0.5% of the measuring range transmitting value at calibration temperature |
| Resolution | 10-12 Bit |
| Input voltage protected against incorrect polarity and return of electric energy to ± 30 V. | |

### Switchable voltage output

| | Value |
|---|---|
| Output voltage | 22.5V-26V load dependent, < 50 Ohm; maximum 50mA |
| Output voltage protected against incorrect polarity and return of electric energy to ± 30 V. | |

Galvanic Isolation to the delta® front panel. Load current limiting to approx. 55mA (51 mA - 58 mA).

Deactivation with short circuit (approx. 70 mA) due to foldback and by software. Reactivation using software.

## Maintenance

The control module delta ® is maintenance free.

## Disposal of Used Parts

**NOTICE!**

**Regulations governing disposal of used parts**

– Note the current national regulations and legal standards which apply in your country

ProMinent Dosiertechnik, Heidelberg / Germany is prepared to take back the decontaminated and cleaned used parts.

The current valid Declaration of Decontamination can be obtained as download at *www.prominent.com*.

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