WIRING DIAGRAMS

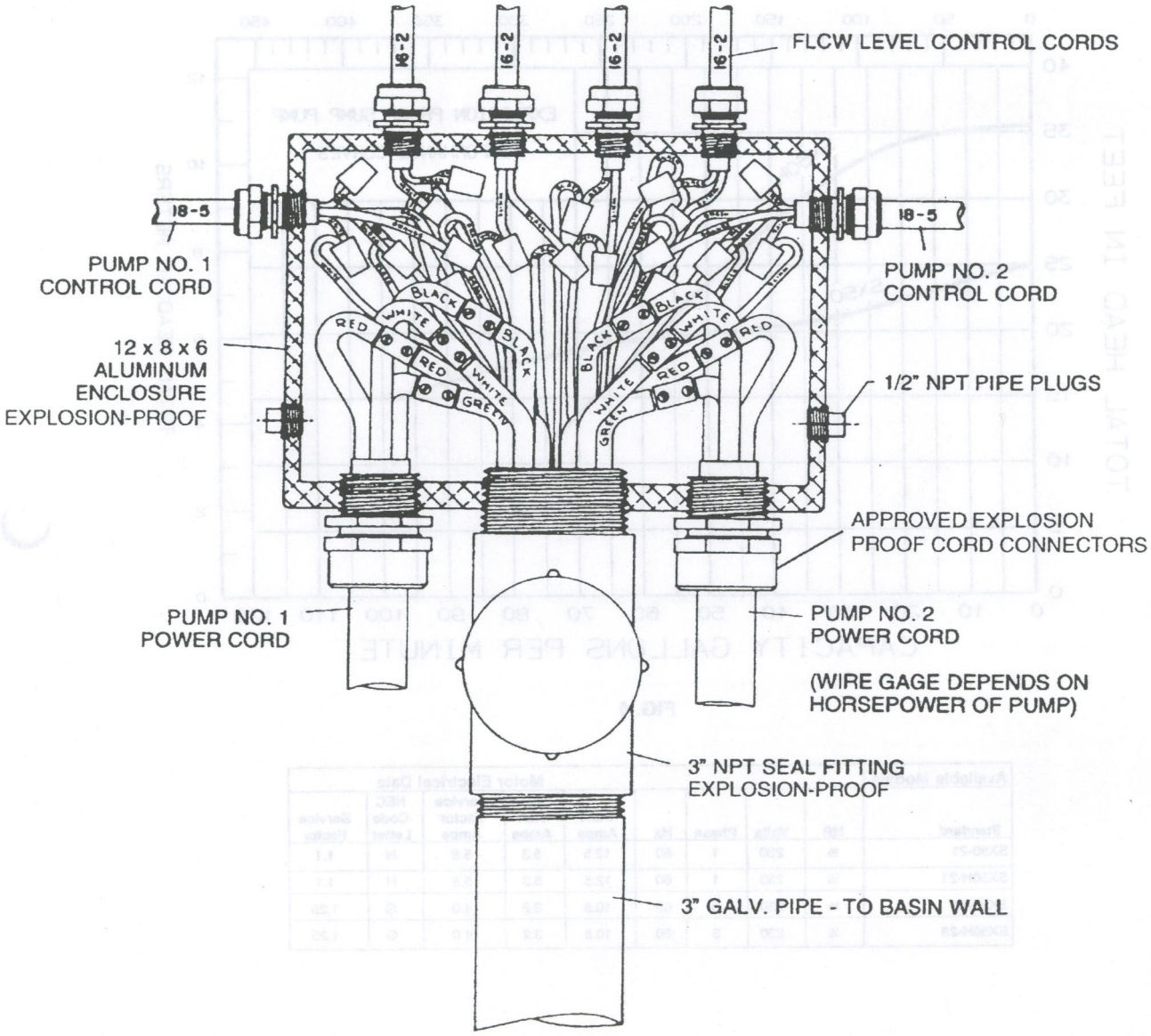
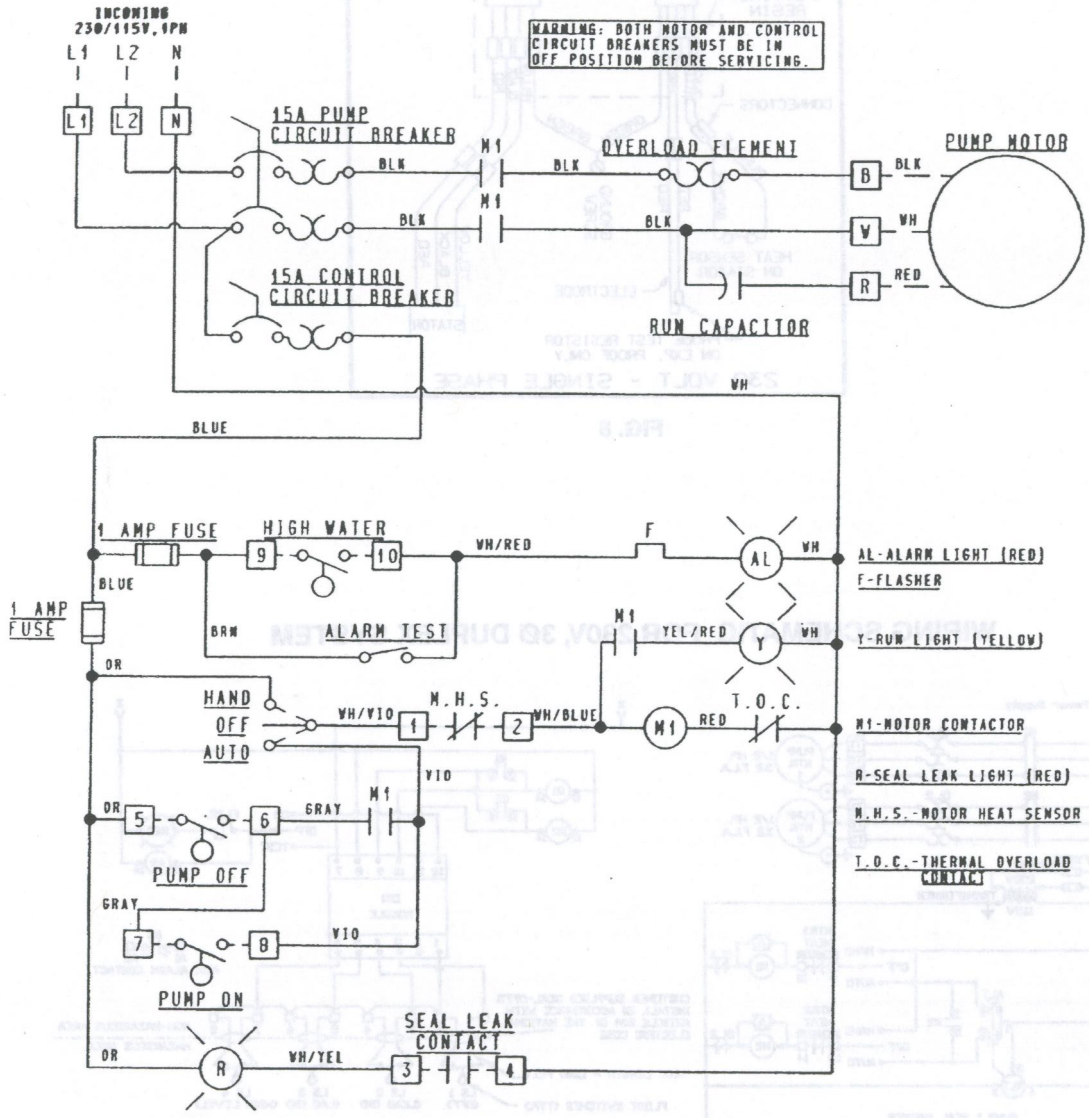


FIG. 6

23.4.11

WIRING SCHEMATIC FOR 230V, 1Ø SIMPLEX SYSTEM



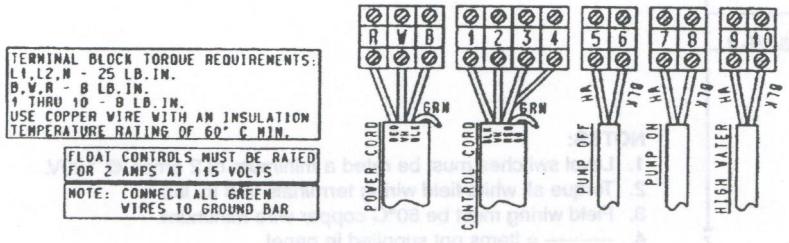


FIG. 7

23833A465

WIRING DIAGRAM 230V, 1Ø

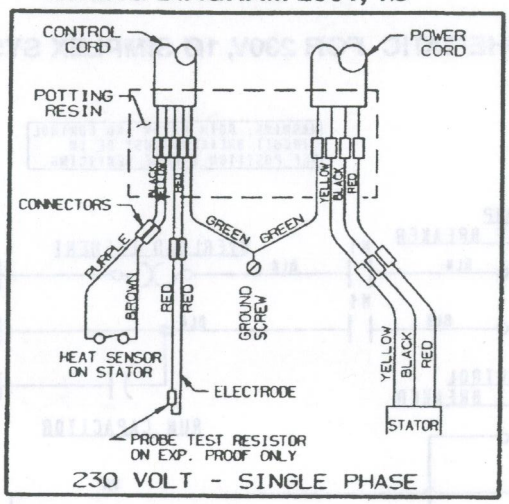
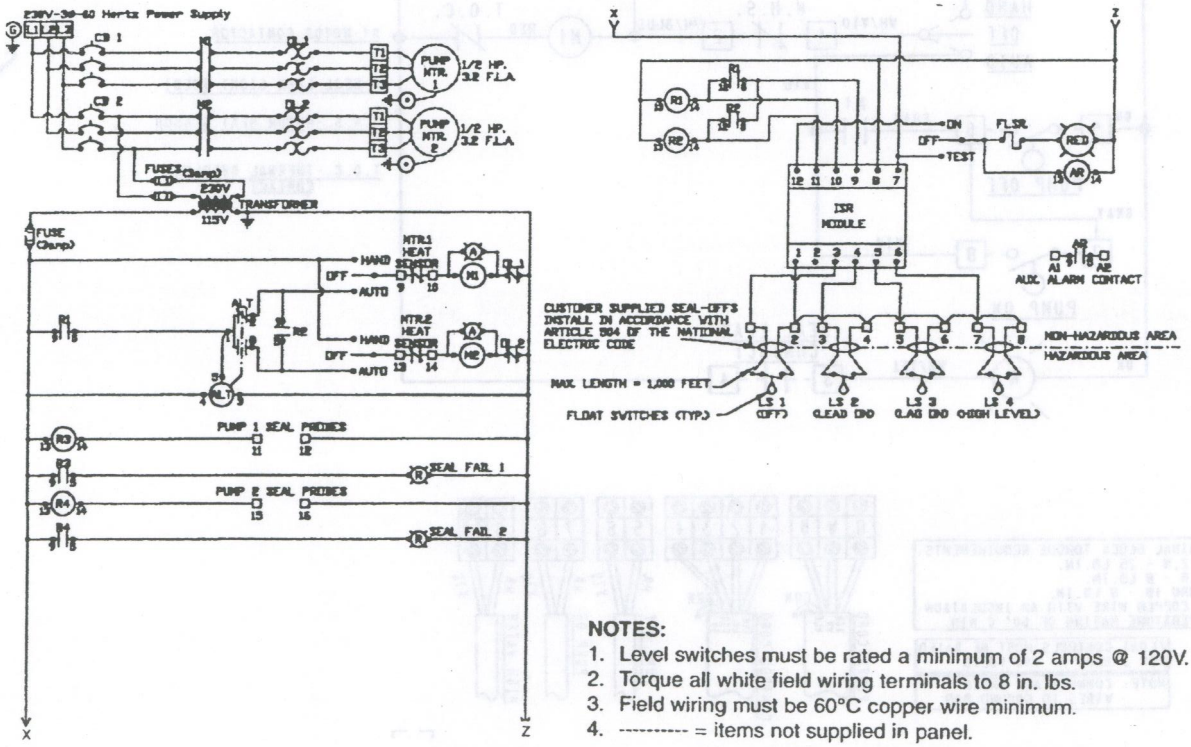


FIG. 8

WIRING SCHEMATIC FOR 230V, 3Ø DUPLEX SYSTEM

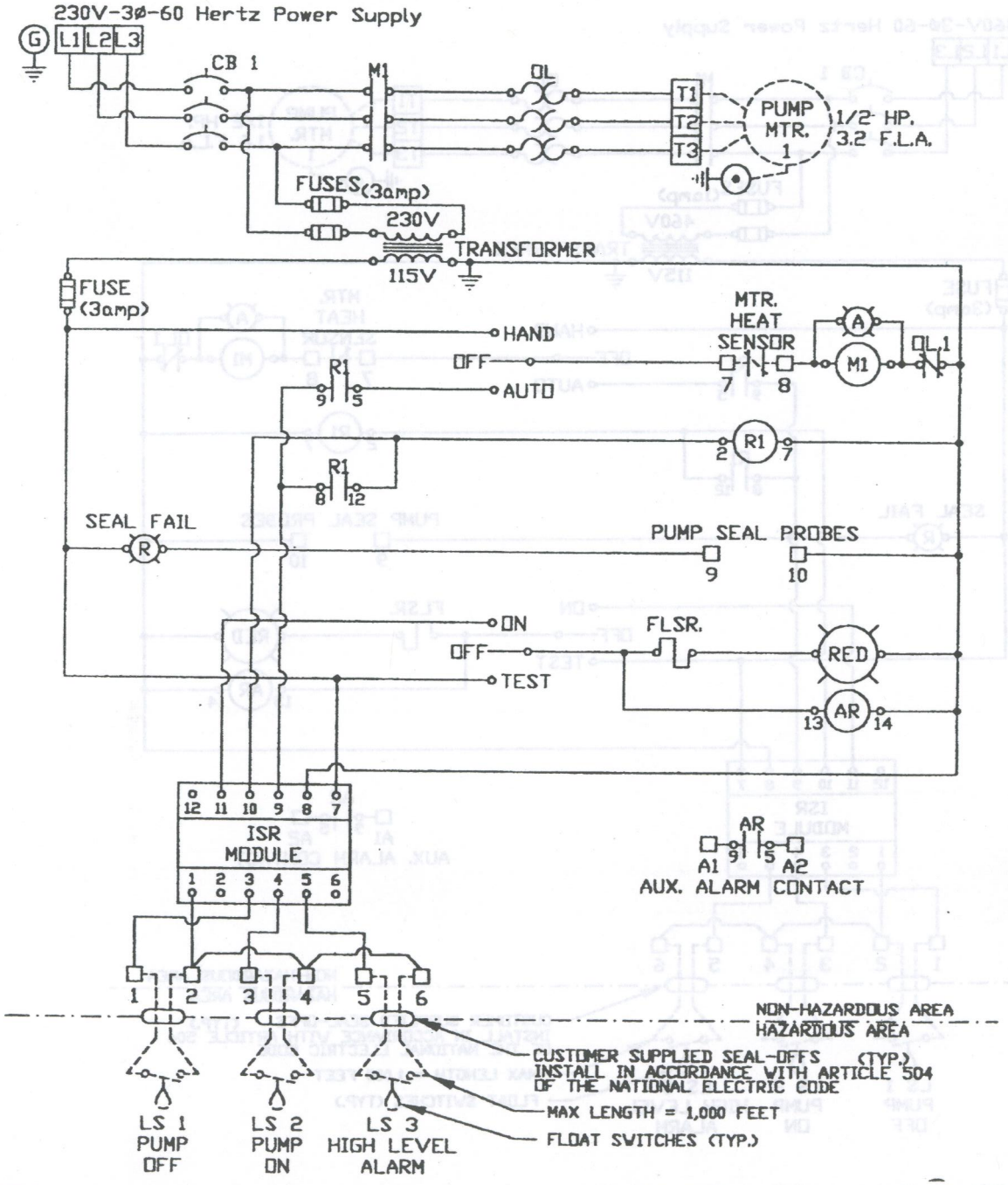


NOTES:

1. Level switches must be rated a minimum of 2 amps @ 120V.
2. Torque all white field wiring terminals to 8 in. lbs.
3. Field wiring must be 60°C copper wire minimum.
4. ---------- = items not supplied in panel.

23.4.13

WIRING SCHEMATIC FOR 230V, 3Ø SIMPLEX SYSTEM



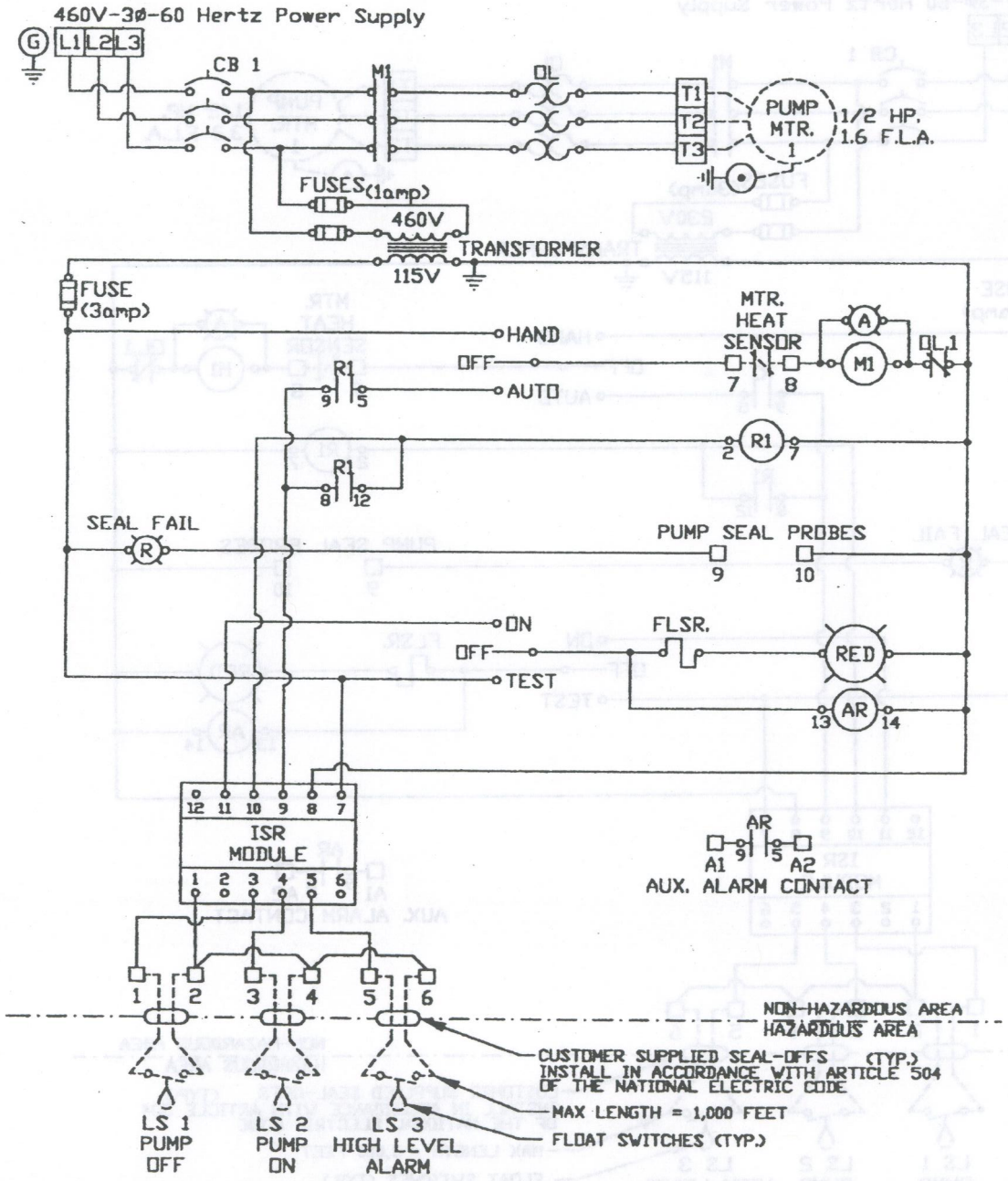
NOTES:

1. Level switches must be rated a minimum of 2 amps @ 120V.
2. Torque all white field wiring terminals to 8 in. lbs.
3. Field wiring must be 60°C copper wire minimum.
4. ---------- = items not supplied in panel.

23833A465

23.4.14

WIRING SCHEMATIC FOR 460V, 3Ø SIMPLEX SYSTEM

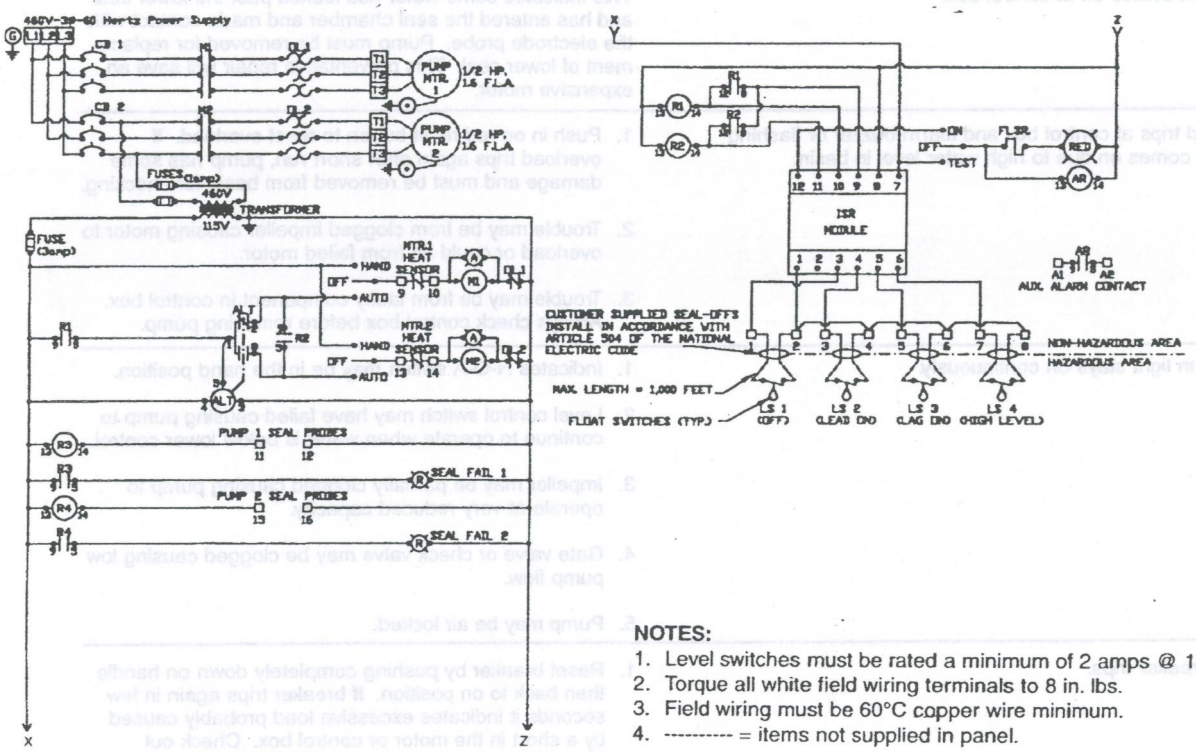


NOTES:

1. Level switches must be rated a minimum of 2 amps @ 120V.
2. Torque all white field wiring terminals to 8 in. lbs.
3. Field wiring must be 60°C copper wire minimum.
4. ---------- = items not supplied in panel.

23.4.15

WIRING SCHEMATIC FOR 460V, 3Ø DUPLEX SYSTEM



NOTES:

1. Level switches must be rated a minimum of 2 amps @ 120V.
2. Torque all white field wiring terminals to 8 in. lbs.
3. Field wiring must be 60°C copper wire minimum.
4. ---------- = items not supplied in panel.

CHECK LIST IF PUMP DOES NOT OPERATE PROPERLY

Checking for Moisture in Motor: Use an ohmmeter or a megger and set on highest scale. Readings on the large power cord between any of the conductors red, black or white to the green conductor or to the motor housing should be greater than 1,000,000 ohms (megaohm). A motor will probably run with a lower reading, but if the pump is out of service and the value of the reading is below 1,000,000 ohms (1 megaohm), the motor housing and stator should be removed and baked in a drying oven at 220°F. This service work should only be done at an authorized service station. ***Note, readings should be taken with line leads disconnected from the control panel.***

Resistance of Windings: Every motor winding has a fixed resistance. The windings must check close to the values given in the tables to operate properly.

See the motor electrical data chart. Use an ohmmeter and set to the one ohm scale. Read the resistance with the motor leads disconnected from the pump control panel.

23.4.16

CONDITION	PROBABLE CAUSE
Red Light comes on at control box.	This indicates some water has leaked past the lower seal and has entered the seal chamber and made contact with the electrode probe. Pump must be removed for replacement of lower seal. This preventative repair will save an expensive motor.
Overload trips at control box and alarm buzzer or flashing red light comes on due to high water level in basin.	1. Push in on red reset button to reset overload. If overload trips again after short run, pump has some damage and must be removed from basin for checking. 2. Trouble may be from clogged impeller causing motor to overload or could be from failed motor. 3. Trouble may be from faulty component in control box. Always check control box before removing pump.
Yellow run light stays on continuously.	1. Indicates H-O-A switch may be in the hand position. 2. Level control switch may have failed causing pump to continue to operate when water is below lower control. 3. Impeller may be partially clogged causing pump to operate at very reduced capacity. 4. Gate valve or check valve may be clogged causing low pump flow. 5. Pump may be air locked.
Circuit breaker trips.	1. Reset breaker by pushing completely down on handle then back to on position. If breaker trips again in few seconds it indicates excessive load probably caused by a short in the motor or control box. Check out instructions given with control box before pulling pump. 2. If this condition happens after an electrical storm, motor or control box may be damaged by lightning. 3. Resistance reading of the motor with lead wires disconnected from the control box can determine if trouble is in motor or control box.
Pump is noisy and pump rate is low.	1. Impeller may be partially clogged with some foreign objects causing noise and overload on the motor.
Grease and solids have accumulated around pump and will not pump out of basin.	1. Lower control switch may be set too high. 2. Run pump on hand operation for several minutes with small amount of water running into basin to clean out solids and grease. This allows pump to break suction and surge which will break up the solids. If level switch is set properly this condition generally will not occur. 3. Trash and grease may have accumulated around floats causing pump to operate erratically.

IMPORTANT - Pump should be thoroughly cleaned of trash and deposits before starting disassembly operations.

CAUTION - DISCONNECT ALL POWER AND CONTROL WIRES TO MOTOR AT CONTROL PANEL BEFORE STARTING DISASSEMBLY OPERATIONS. NEVER RELY ON OPENING CIRCUIT BREAKER ONLY.

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Myers®
Pentair Pump Group

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419/289-1144, FAX: 419/289-6658, www.femyers.com

Myers (Canada), 269 Trillium Drive, Kitchener, Ontario N2G 4W5
519/748-5470, FAX: 519/748-2553

23.4.17

MYERS
LIMITED WARRANTY
SUMP & RESIDENTIAL SEWAGE

During the time periods and subject to the conditions hereinafter set forth, **F. E. Myers** will repair or replace to the original user or consumer any portion of your new **MYERS product which proves defective due to defective materials or workmanship of MYERS**. Contact your nearest Authorized **MYERS** Dealer for warranty service. At all times **MYERS** shall have and possess the sole right and option to determine whether to repair or replace defective equipment, parts, or components. Damage due to lightning or conditions beyond the control of **MYERS** is NOT COVERED BY THIS WARRANTY.

WARRANTY PERIOD

Pumps: 12 months from date of purchase or 18 months from date of manufacture.

Labor, etc. Costs: MYERS shall IN NO EVENT be responsible or liable for the cost of field labor or other charges incurred by any customer in removing and/or reaffixing any **MYERS** product, part or component thereof.

THIS WARRANTY WILL NOT APPLY: (a) to defects or malfunctions resulting from failure to properly install, operate or maintain the unit in accordance with printed instructions provided; (b) to failures resulting from abuse, accident or negligence; (c) to normal maintenance services and the parts used in connection with such service; (d) to units which are not installed in accordance with applicable local codes, ordinances and good trade practices; or (e) unit is used for purposes other than for what it was designed and manufactured, and (f) if three phase submersible motors are installed on a single phase power supply using a phase converter or if three phase power is supplied by only two transformers, making an open Delta system.

RETURN OR REPLACED COMPONENTS: any item to be replaced under this Warranty must be returned to **MYERS** in Ashland, Ohio, or such other place as **MYERS** may designate, freight prepaid.

PRODUCT IMPROVEMENTS: MYERS reserves the right to change or improve its products or any portions thereof without being obligated to provide such a change or improvement for units sold and/or shipped prior to such a change or improvement.

WARRANTY EXCLUSIONS: MYERS SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AFTER THE TERMINATION OF THE WARRANTY PERIOD SET FORTH HEREIN.

Some states do not permit some or all of the above warranty limitations and, therefore, such limitations may not apply to you. No warranties or representations at any time made by any representatives of Myers shall vary or expand the provision hereof.

LIABILITY LIMITATION: IN NO EVENT SHALL **MYERS** BE LIABLE OR RESPONSIBLE FOR CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES RESULTING FROM OR RELATED IN ANY MANNER TO ANY **MYERS** PRODUCT OR PARTS THEREOF. PERSONAL INJURY AND/OR PROPERTY DAMAGE MAY RESULT FROM IMPROPER INSTALLATION. MYERS DISCLAIMS ALL LIABILITY, INCLUDING LIABILITY UNDER THIS WARRANTY, FOR IMPROPER INSTALLATION -- MYERS RECOMMENDS FOLLOWING THE INSTRUCTIONS IN THE INSTALLATION MANUAL. WHEN IN DOUBT, CONSULT A PROFESSIONAL.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This Warranty gives you specific legal rights and you may also have other rights which vary from state to state.

In the absence of suitable proof of this purchase date, the effective date of this warranty will be based upon the date of manufacture.

DETERMINATION OF UNIT DATE OF MANUFACTURE: Submersible Sump pump (8-95) month and year stamped on pump nameplate; column sump pump month and year on red warranty tag.

Myers
Pentair Pump Group
F. E. Myers, 1101 Myers Parkway, Ashland, Ohio 44805
419-289-1144 • Fax 419-289-6658 • www.femyers.com

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23.4.18

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

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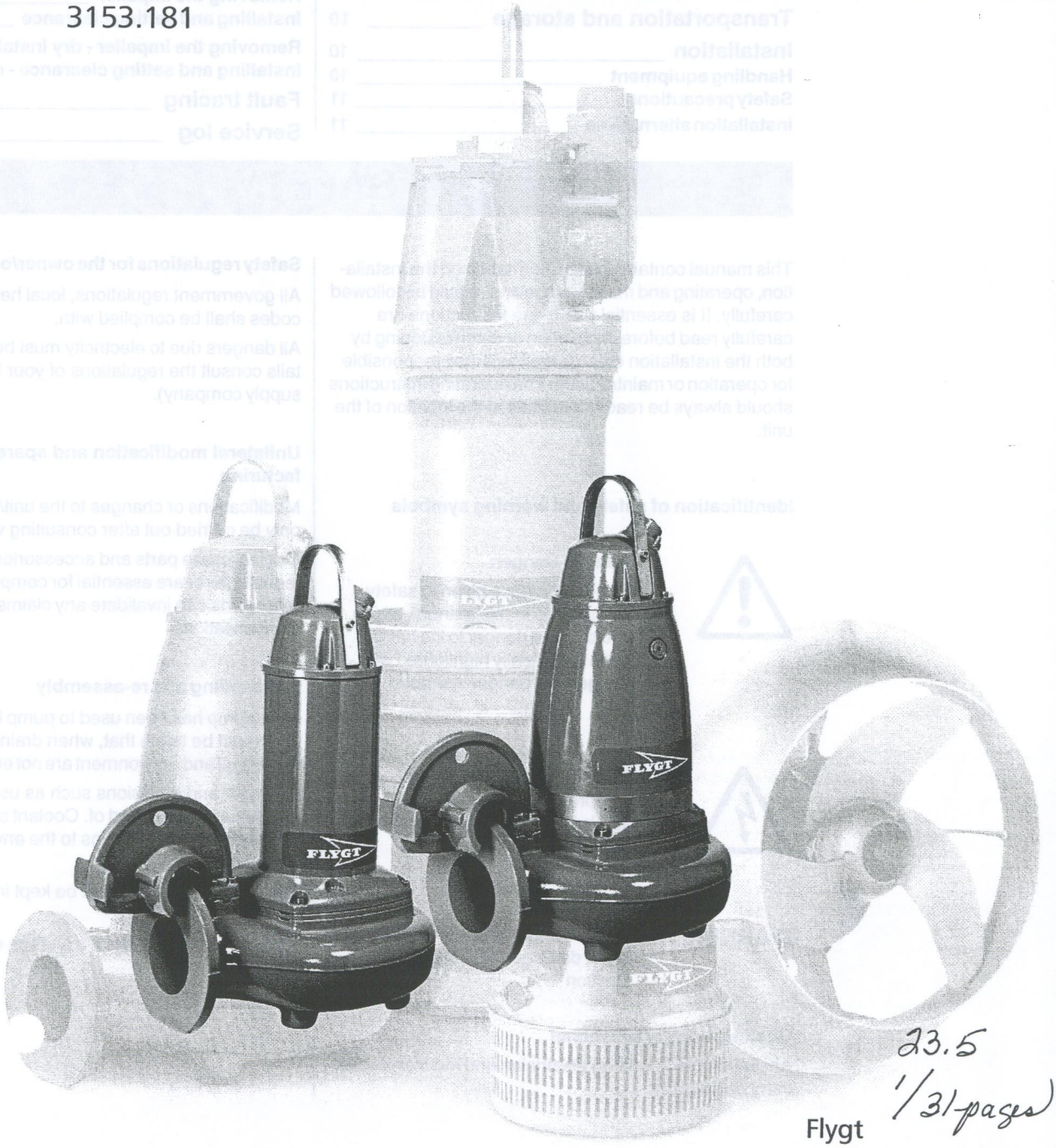
GRUNDFOS

23.4.19

Installation, Care and Maintenance

3153.181



23.5
1/31-pages)

Flygt

ITT Industries

895381/02

SAFETY

This manual contains basic information on the installation, operating and maintenance and should be followed carefully. It is essential that these instructions are carefully read before installation or commissioning by both the installation crew as well as those responsible for operation or maintenance. The operating instructions should always be readily available at the location of the unit.

Identification of safety and warning symbols

General Danger:

Non-observance given to safety instructions in this manual, which could cause danger to life have been specifically highlighted with this general danger symbol.

High Voltage:

The presence of a dangerous voltage is identified with this safety symbol.

WARNING! Non-observance to this warning could damage the unit or affect its function

Qualifications of personnel

An authorized (certified) electrician and mechanic shall carry out all work.

Safety regulations for the owner/operator

All government regulations, local health and safety codes shall be complied with.

All dangers due to electricity must be avoided (for details consult the regulations of your local electricity supply company).

Unilateral modification and spare parts manufacturing

Modifications or changes to the unit/installation should only be carried out after consulting with Flygt.

Original spare parts and accessories authorized by the manufacturer are essential for compliance. The use of other parts can invalidate any claims for warranty or compensation.

Dismantling and re-assembly

If the pump has been used to pump hazardous media, care must be taken that, when draining the leakage, personnel and environment are not endangered.

All waste and emissions such as used coolant must be appropriately disposed of. Coolant spills must be cleaned up and emissions to the environment must be reported.

The pumping station must be kept in good order at all times.

All government regulations shall be observed.

GUARANTEE

ITT Flygt undertakes to remedy faults in products sold by Flygt provided:

— that the fault is due to defects in design, materials or workmanship;

— that the faults are reported to Flygt or Flygt's representative during the guarantee period;

— that the product is used only under condition described in the Installation, Care and Maintenance manual and in applications for which it is intended;

— that the monitoring equipment incorporated in the product is correctly **connected** and **in use**;

— that all service and repair work is done by a work shop authorized by Flygt;

— that genuine Flygt parts are used.

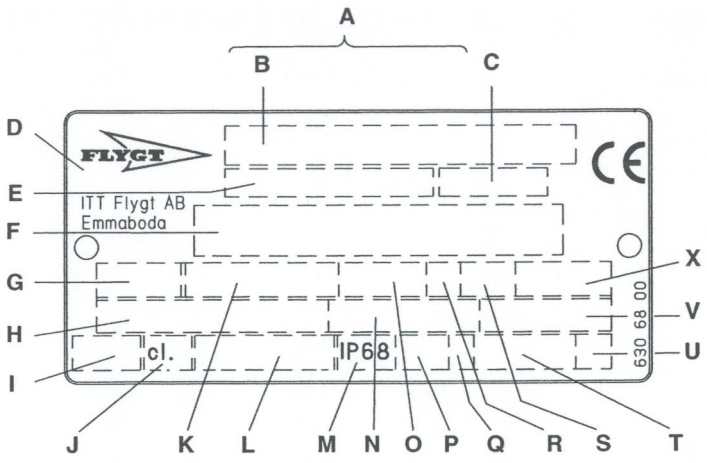
Hence, the guarantee does not cover faults caused by deficient maintenance, improper installation, incorrectly executed repair work or nomal wear and tear.

Flygt assumes no liability for either bodily injuries, material damages or economic losses beyond what is stated above.

Flygt guarantees that spare parts will be kept for 15 years after that the manufacture of this product has been discontinued.

23.5

General data plate



A	Serial number
B	Product code + Number
C	Curve code / Propeller code
D	Country of origin
E	Product number
F	Additional information
G	Phase; Type of current; Frequency
H	Rated voltage
I	Thermal protection
J	Thermal class
K	Rated shaft power
L	International standard
M	Degree of protection
N	Rated current
O	Rated speed
P	Max. submergence
Q	Direction of rotation: L=left, R=right
R	Duty class
S	Duty factor
T	Product weight
U	Locked rotor code letter
V	Power factor
X	Max. ambient temperature

Approval plates

These approval plates apply to an explosion-proof submersible ITT Flygt pump. The plates are used together with the general data plate on the pump.

Introduction

Thank you for buying a submersible ITT Flygt pump. In this Installation, Care and Maintenance manual you will find general information on how to install and service the 3153 pump to give it a long and reliable life.

Application

This Installation, Care and Maintenance manual applies to a submersible ITT Flygt pump.

If you have bought an Ex-approved pump (please see approval plate on your pump or Parts List) special handling instructions apply as described in this document.

The pump is intended to be used for;

— pumping of waste water

— pumping of raw or clean water

— pumping of sludge

Installation alternatives

P = semi permanent wet well arrangement with pump installed by means of twin guide bars with automatic connection to discharge.

S = transportable version with hose connection or flange for connection to discharge pipeline.

T = permanent dry well or in-line arrangement with flange connection to suction and discharge pipework; vertical mounting.

Z = permanent dry well or in-line arrangement with flange connection to suction and discharge pipework; horizontal mounting.

In **T-**, **Z-** and **S**-installations the pump must be equipped with cooling jacket.

For further information on applications, contact your nearest Flygt representative.

Pump versions

LT = low head execution
MT = medium head execution
HT = high head execution
SH = super high head execution

Liquid temperature: max. 40°C (104°F)
Also available in an execution for liquid temperature up to 70°C (158°F) only with cooling jacket.

Higher temperatures than 40° C (104° F) are not permitted for the Ex-approved pumps.

Liquid density: max. 1100 kg/m³ (9.2 lb per US gal.)

The pH of the pumped liquid: 5.5 —14.

Lowest liquid level: See illustration on page 8.

Depth of immersion: max. 20 m (65 ft).

Weights

Weight including connections, but without motor cable in kg (lb).

Pump type	With cooling jacket	Without cooling jacket	Discharge connection
NP 3153 LT	320 (705)	307 (677)	78 (172)
NP 3153 MT	206 (454)	193 (425)	54 (119)
NP 3153 HT	192 (423)	179 (395)	42 (93)
NP 3153 SH	215 (474)	202 (445)	35 (77)
NS 3153 LT	379 (836)	—	
NS 3153 MT	240 (529)	—	
NS 3153 HT	214 (472)	—	
NS 3153 SH	237 (522)	—	
NT 3153 LT	437 (963)	—	
NT 3153 MT	284 (626)	—	
NT 3153 HT	235 (518)	—	
NT 3153 SH	258 (569)	—	
NZ 3153 LT	310 (683)	—	
NZ 3153 MT	196 (432)	—	
NZ 3153 HT	182 (401)	—	
NZ 3153 SH	205 (452)	—	

23.5

50 Hz, 7.5 kW, 1460 r/min, 3- phase, 4-pole

Voltage V	Rated current A	Starting current A
230 D	29	168
380 D	17	96
400 D	16	91
400 Y	17	98
415 D	15	86
440 D	16	88
500 D	13	70
660 Y	9.9	56
690 Y	9.3	52

50 Hz, 9.0 kW, 1460 r/min, 3-phase, 4-pole

Voltage V	Rated current A	Starting current A
230 D	32	181
380 D	20	114
400 D	19	107
400 Y	19	105
415 D	18	105
440 D	19	107
500 D	15	86
660 Y	11	66
690 Y	11	62

50 Hz, 13.5 kW, 1455 r/min, 3-phase, 4-pole

Voltage V	Rated current A	Starting current A
230 D	47	250
380 D	28	150
400 D	28	150
400 Y	27	145
415 D	26	133
440 D	26	143
500 D	21	112
660 Y	16	87
690 Y	16	86

50 Hz, 9.0 kW, 955 r/min, 3-phase, 6-pole

Voltage V	Rated current A	Starting current A
230 D	36	151
380 D	22	95
400 D	21	90
400 Y	21	88
415 D	20	81
440 D	20	87
500 D	17	73
660 Y	13	55
690 Y	12	52

50 Hz, 15.0 kW, 2925 r/min, 3-phase, 2-pole

Voltage V	Rated current A	Starting current A
230 D	47	370
380 D	29	239
400 D	27	213
400 Y	27	216
415 D	27	222
440 D	28	238
500 D	22	187
660 Y	17	138
690 Y	16	123

60 Hz, 12 hp, (8.9 kW) 1755 r/min, 3-phase, 4-pole

Voltage V	Rated current A	Starting current A
200 D	36	216
208 D	36	227
230 Y//	32	204
380 D	19	115
380 Y	20	124
440 D	17	101
460 D	16	95
460 Y ser	16	102
575 D	13	73
600 D	12	78

60 Hz, 15 hp, (11.2 kW) 1755 r/min, 3-phase, 4-pole

Voltage V	Rated current A	Starting current A
200 D	44	246
208 D	43	259
230 Y//	39	228
380 D	23	133
380 Y	23	139
440 D	20	121
460 D	19	112
460 Y ser	19	114
575 D	15	90
600 D	15	95

60 Hz, 20 hp, (14.9 kW) 1755 r/min, 3-phase, 4-pole

Voltage V	Rated current A	Starting current A
200 D	59	330
208 D	58	345
230 Y//	52	296
380 D	31	186
380 Y	31	180
440 D	26	158
460 D	26	157
460 Y ser	26	148
575 D	21	116
600 D	21	123

60 Hz, 15 hp, (11.2 kW) 1150 r/min, 3-phase, 6-pole

Voltage V	Rated current A	Starting current A
200 D	49	214
208 D	49	225
230 Y//	46	212
380 D	26	114
380 Y	26	109
440 D	23	100
460 D	21	95
460 Y ser	22	101
575 D	17	76
600 D	17	81

60 Hz, 23 hp, (17.2 kW) 3525 r/min, 3-phase, 2-pole

Voltage V	Rated current A	Starting current A
200 D	59	460
208 D	58	480
230 Y//	52	415
440 D	28	243
460 D	26	215
460 Y ser	26	207
575 D	21	189
600 D	21	198

Motor
Squirrel-cage 3-phase induction motor for 50 Hz or 60 Hz.
The motor is started by means of direct on-line or star delta start.
The motor can be run continuously or intermittently with a maximum of 30 evenly spaced starts per hour.
Flygt motors are tested in accordance with IEC 34-1.

The stator is insulated in accordance with class H (180°C, 360 F). The motor is designed to supply its rated output at ± 10% variation of the rated voltage. Without overheating the motor, ± 10% variation of the rated voltage can be accepted provided that the motor does not run continuously at full load.

Monitoring equipment
The stator incorporates three thermal contacts connected in series that activate an alarm at overtemperature.
The thermal contacts: open at 140°C (285°F). The sensors shall be connected to Flygt's monitoring unit MiniCAS II or equivalent unit.
The monitoring equipment shall be of a design that makes automatic restart impossible.
The 3153 is supplied with inspection sensor FLS10 for sensing the presence of any liquid in the inspection chamber.

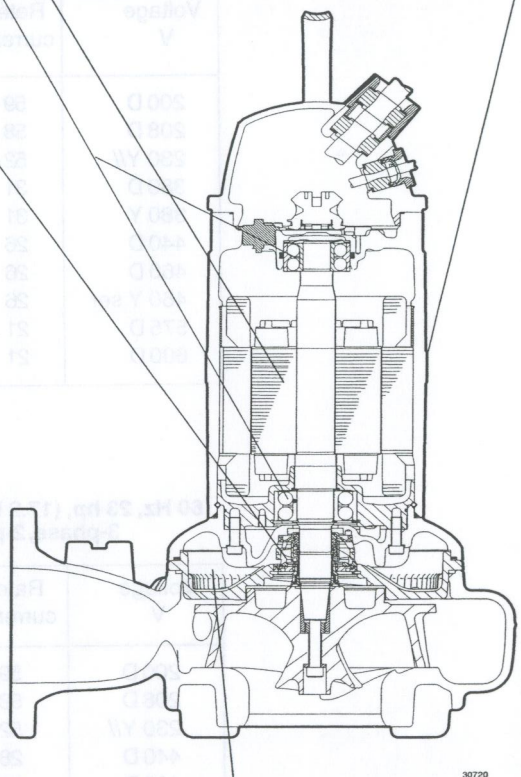
Cooling
The pump is cooled by the ambient liquid.
For lowest liquid level, see illlustration below.

Bearings
The support bearing of the shaft is a double row ball bearing. The main bearing of the shaft is a double row angular contact ball bearing.

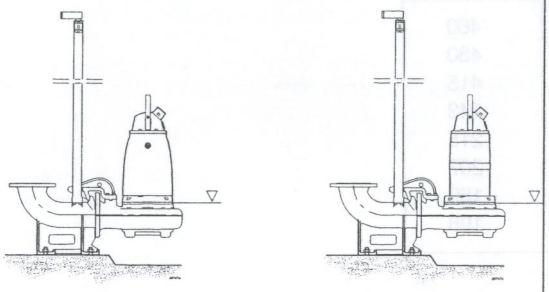
Mechanical seal unit
The pump has one shaft mechanical seal unit consisting of two independently operating seals:

Alt I	Inner seal:	Corrosion resistant cemented carbide WCCR/WCCR
	Outer seal:	Corrosion resistant cemented carbide WCCR/WCCR
Alt II	Inner seal:	Corrosion resistant cemented carbide/Aluminum Oxide WCCR/Al_2O_3
	Outer seal:	Silicon Carbide RSiC/RSiC

Without cooling jacket

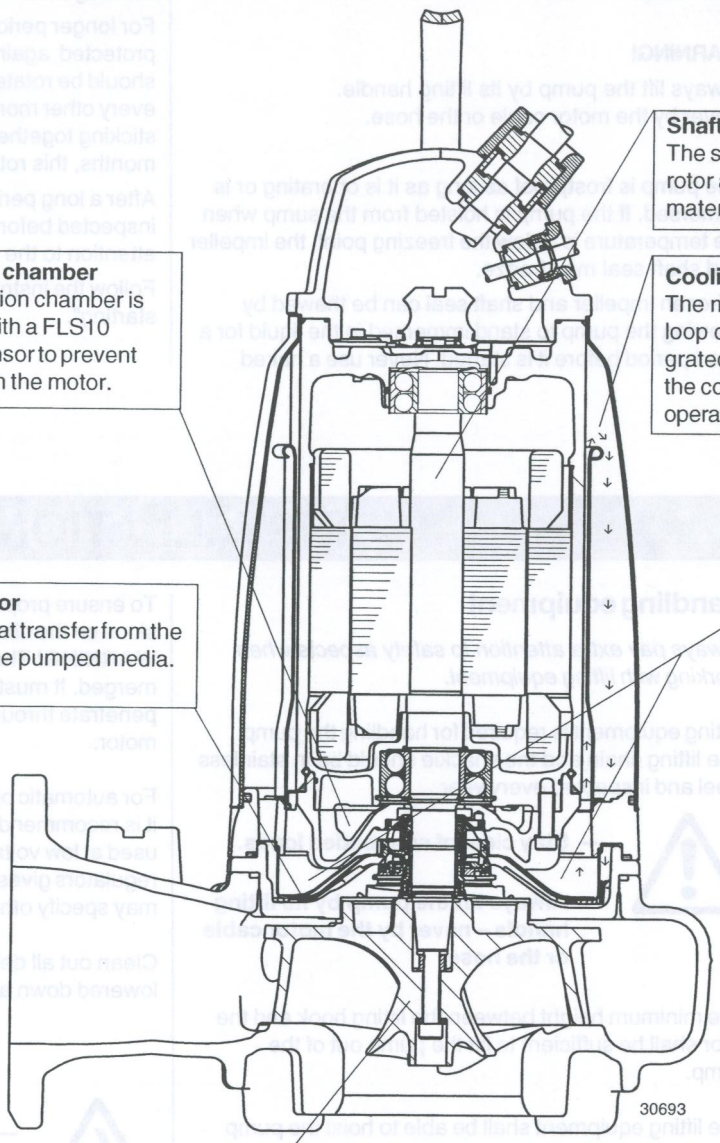


Lowest liquid level



Seal housing
A coolant fluid lubricates and cools the mechanical seal unit and acts as a buffer between the pumped media and the electric motor.

With cooling jacket



Shaft
The shaft is delivered with the rotor as an integral part. Shaft material; stainless steel.

Cooling
The motor is cooled by a closed loop cooling system. An integrated coolant pump circulates the coolant whenever the pump is operated.

Inspection chamber
The inspection chamber is equipped with a FLS10 leakage sensor to prevent damages on the motor.

Flow diffusor
Provides heat transfer from the coolant to the pumped media.

Seal housing
The coolant lubricates and cools the mechanical seal unit and acts as a buffer between the pumped media and the electric motor.

Impeller
The pump is equipped with a N-impeller, a semiopen two-vane impeller.

23.5

The pump may be transported and stored in a vertical or horizontal position. Make sure that the pump cannot roll or fall over.

WARNING!

Always lift the pump by its lifting handle.
Never by the motor cable or the hose.

The pump is frostproof as long as it is operating or is immersed. If the pump is hoisted from the sump when the temperature is below the freezing point, the impeller and shaft seal may freeze.

A frozen impeller and shaft seal can be thawed by allowing the pump to stand immersed in the liquid for a short period before it is started. Never use a naked flame to thaw the pump. The pump should run for a few seconds after being taken up in order to expel all remaining water from the hydraulic end.

For longer periods of storage, the pump must be protected against moisture and heat. The impeller should be rotated by hand occasionally (for example every other month) to prevent the seal rings from sticking together. If the pump is stored for more than 6 months, this rotation is mandatory.

After a long period of storage, the pump should be inspected before it is put into operation. Pay special attention to the shaft seal and the cable entry.

Follow the instructions under the heading "Before starting".

INSTALLATION

Handling equipment

Always pay extra attention to safety aspects when working with lifting equipment.

Lifting equipment is required for handling the pump. The lifting chain and the shackle should be in stainless steel and inspected every year.

— **Stay clear of suspended loads.**

— **Always lift the pump by its lifting handle – never by the motor cable or the hose.**

The minimum height between the lifting hook and the floor shall be sufficient to lift the pump out of the sump.

The lifting equipment shall be able to hoist the pump straight up and down in the sump, preferably without the need for resetting the lifting hook.

Oversized lifting equipment could cause damage if the pump should stick when being lifted.

Make sure that the lifting equipment is securely anchored and in good condition.

Check that the lifting handle and chain are in good condition.

To ensure proper installation, please see the dimensions on the dimensional drawing.
WARNING! The end of the cable must not be submerged. It must be above flood level, as water could penetrate through the cable into the junction box or the motor.

For automatic operation of the pump (level control), it is recommended that the level regulators should be used at low voltage. The data sheet delivered with the regulators gives the permissible voltage. Local rules may specify otherwise.

Clean out all debris from the sump before the pump is lowered down and the station is started.

— **Minimum stop level should be according to the dimensional drawing.**

— **The pump must never run dry.**

Safety precautions

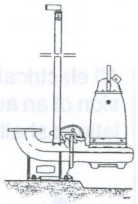
In order to minimize the risk of accidents in connection with service and installation work, the following rules should be followed:

1. Never work alone. Use a lifting harness, safety line and a respirator as required. Do not ignore the risk of drowning.
2. Make sure there are no dangerous gases within the work area.
3. Check the explosion risk before welding or using electric hand tools.
4. Before the pump is installed check that the cable and cable entry have not been damaged during the transportation.
5. Observe strict cleanliness. Do not ignore health hazards.
6. Bear in mind the risk of electrical accidents.
7. Make sure that the lifting equipment is in good condition and comply to local ordinances.
8. Provide a suitable barrier around the work area, e.g. a guard rail.
9. Make sure you have a clear path of retreat.
10. Use safety helmet, safety goggles and protective shoes.
11. All personnel who work with sewage systems must be vaccinated against diseases to which they may be exposed.
12. A first-aid kit must be close at hand.
13. Note that special rules apply to installation in explosive atmosphere.

Follow all health and safety rules and local codes and ordinances.

Installation alternatives

P- installation



In the P- installation, the pump is installed on a stationary discharge connection and operates completely or partially submerged in the pumped liquid.

In addition to the pump the following items are required:

Guide bars consisting of two hot dip galvanized or stainless steel pipes.

Guide bar bracket for attaching the guide bars to the access frame or the upper part of the sump.

Level regulators or other control equipment for start, stop and alarm.

Cable holder for holding the cable and regulating the height of the level regulators.

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.

Bushings for vibration damping between the guide bars and the discharge connection.

Instructions

- Provide a barrier around the pump pit, for example a guardrail.
- Arrange for a cable between the sump and the electric control box. Make sure that the cables are not sharply bent or pinched.
- Place the access frame in position.
- Align the frame so that it is horizontal and then grout it in place.
- Grout the anchor bolts in place. Be careful when aligning and positioning the discharge connection in relation to the access frame.
- Place the discharge connection in position and tighten the nuts.
- Secure the guide bars in the bracket.
- Check that the guide bars are placed vertically by using a level or a plumb line.
- Connect the discharge pipe to the discharge connection.
- Bolt the cable holder to the access frame. Thread the level regulator cables through the holes in the cable holder and adjust the height of the level regulators.
- Protect bolts and nuts with corrosion preventive compound.
- Lower the pump along the guide bars.
- Fasten the lifting chain (stainless steel) on the access frame and the cables on the cable holder. Make sure that the cables cannot be sucked into the inlet of the pump. Support straps are required for deep installations.
- Run the cables up to the electric control box.
- Clean out debris from the sump before starting up the station.
- The pump can be hoisted up along the guide bars for inspection without any connections having to be undone.

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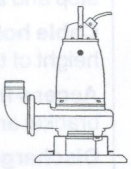
S- installation

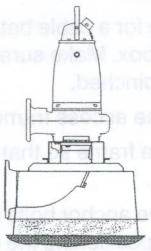


In the S- installation, the pump is transportable and intended to operate completely or partially submerged in the pumped liquid. The pump is equipped with a connection for hose or pipe, see "Parts list".

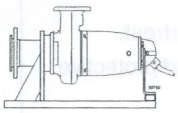
The pump stands on a base stand.

WARNING! Watch for the starting jerk which can be powerful.

T/Z- installation



T



Z

In the T- installation, the pump is installed in a stationary position in a dry well next to the wet sump.

In the Z- installation the pump is installed in a horizontal position on a support stand and a bell-mouth is connected to the inlet pipe.

The pump has a watertight motor and will therefore not be damaged in the event of flooding.

The pump is equipped with a cooling jacket.

In addition to the pump the following items are required:

Support stand for anchoring the pump to a base.

Shut-off valves to permit the pump to be removed for service.

Level regulators or other control equipment for start, stop and alarm.

WARNING! The risk of freezing is particularly great at certain T or Z installations.

Instruction

Bolt the base stand to the concrete base by means of the anchor bolts. Bolt the pump to the base stand and the suction connection.

Connect the motor cable, suction line and discharge line.

Make sure that the weight of the pump does not bear on the system piping.

ELECTRICAL CONNECTIONS

— **Before starting work on the pump, make sure that the pump and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.**

— **If the pump is equipped with automatic level control, there is a risk of sudden restart.**

— **If persons are likely to come into physical contact with the pump or pumped media (liquid), e.g on con-struction sites and farms, the earthed (grounded) socket must have an additional earth-(ground-) fault protection device (GFI) connected.**

All electrical work shall be carried out under the supervision of an authorized electrician. Local codes and regulations shall be complied with.

— **All electrical equipment must be earthed (grounded). This applies to both pump equipment and any monitoring equipment. Failure to heed this warning may cause a lethal accident. Make sure that the earth (ground) lead is correctly connected by testing it.**

Check the data plate to deterimine which voltage supply is valid for your pump.

Check that the main voltage and frequency agree with the specifications on the pump data plate.

If the pump can be connected to different voltages, the connected voltage is specified by a yellow sticker.

Connect the motor cable to the starter equipment as illustrated in the wiring diagrams.

When the pump is connected to the public mains it may cause flicker of incandescent lamps when starting. In this case the supply authority should be notified before installing the pump.

Leads that are not in use must be isolated.

The cable should be replaced if the outer sheath is damaged. Contact a Flygt service shop.
Make sure that the cable does not have any sharp bends and is not pinched.

Under no circumstances may the starter equipment be installed in the sump.

WARNING! For safety reasons, the earth (ground) lead should be approx. 100 mm (4.0") longer than the phase lead. If the motor cable is jerked loose by mistake, the earth (ground) lead should be the last lead to come loose from its terminal. This applies to both ends of the cable.

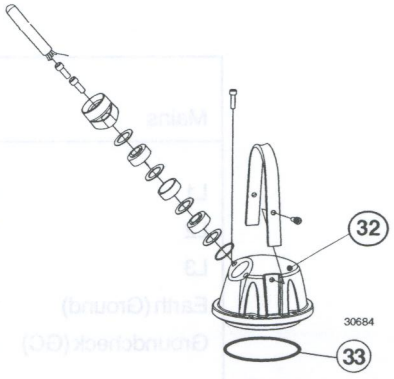
The motor is convertible between different voltages as stated on the data plate. This conversion is done on the terminal board or the contactor.

— **Bear in mind the risk of electrical shock and the risk of explosion if the electrical connections are not correctly carried out.**

When using a variable-frequency-drive (VFD) the shielded cable (type NSSHÖU.../3E+St) should be used in order to fulfil European CE requirements. Contact your Flygt representative and ask your VFD-supplier for electrical limitations. Also please see VFD-recommendation Flygt article no. 893472.

Connection of stator and motor leads

- Check on the data plate which connection, Y, D or YD, is valid for the voltage supply. Then, depending on voltage, arrange the connection on the terminal board in accordance with Y, D or YD. See figure.
- Connect the motor cable to the connection block, U1, V1, W1 and earth (ground). Connect the leads from the motor control circuit.
- If star-delta start is used, motor cables are connected as shown in the figure. Links (jumper strips) are not used with star-delta start.
- Make sure that the pump is correctly earthed (grounded).
- Install the O-ring (33) and connection cover (32).
- Tighten the screws and the gland nut so that the cable entry unit bottoms out.
- Connect the motor cable to the starter equipment.
- Check the direction of rotation, see "Before starting".
- If the direction of rotation is wrong, transpose two of the phase leads.
- Remember that the starting surge with the direct-on line start can be up to six times higher than the rated current. Make sure that the fuses and circuit breakers are of the proper amperage.
- The incorporated thermal contacts must be connected and in use. The pump must be connected to an overload protection which must be set to rated power.



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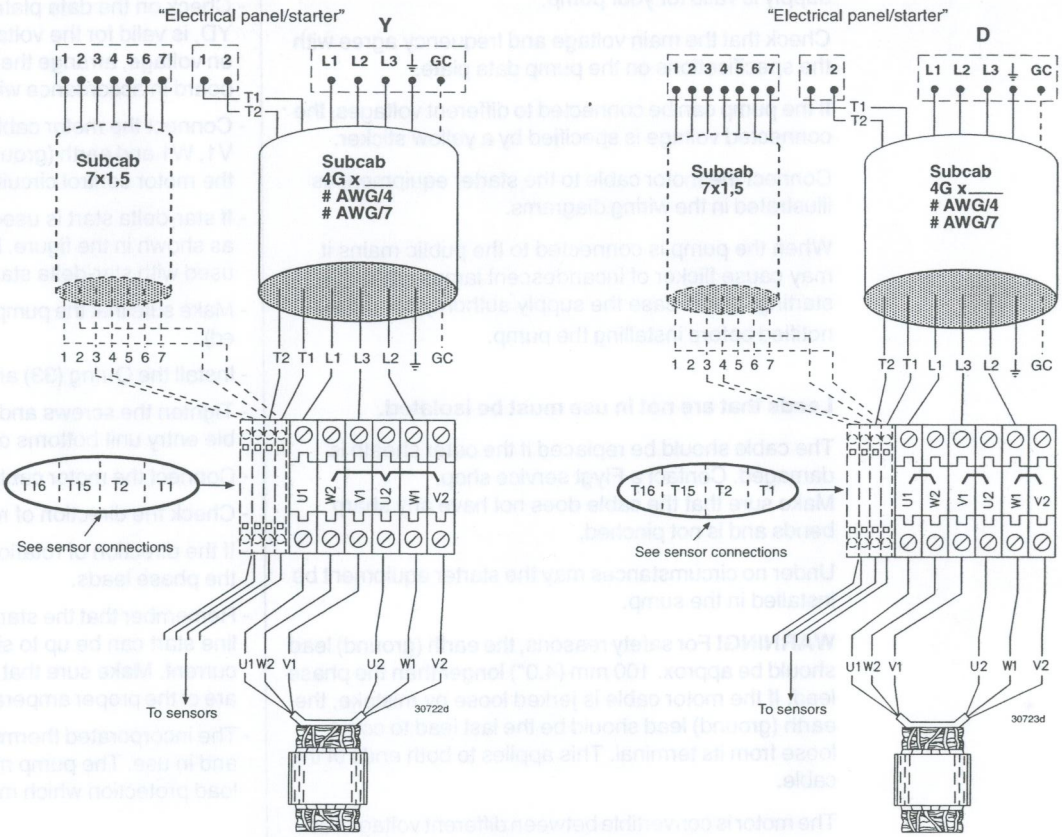
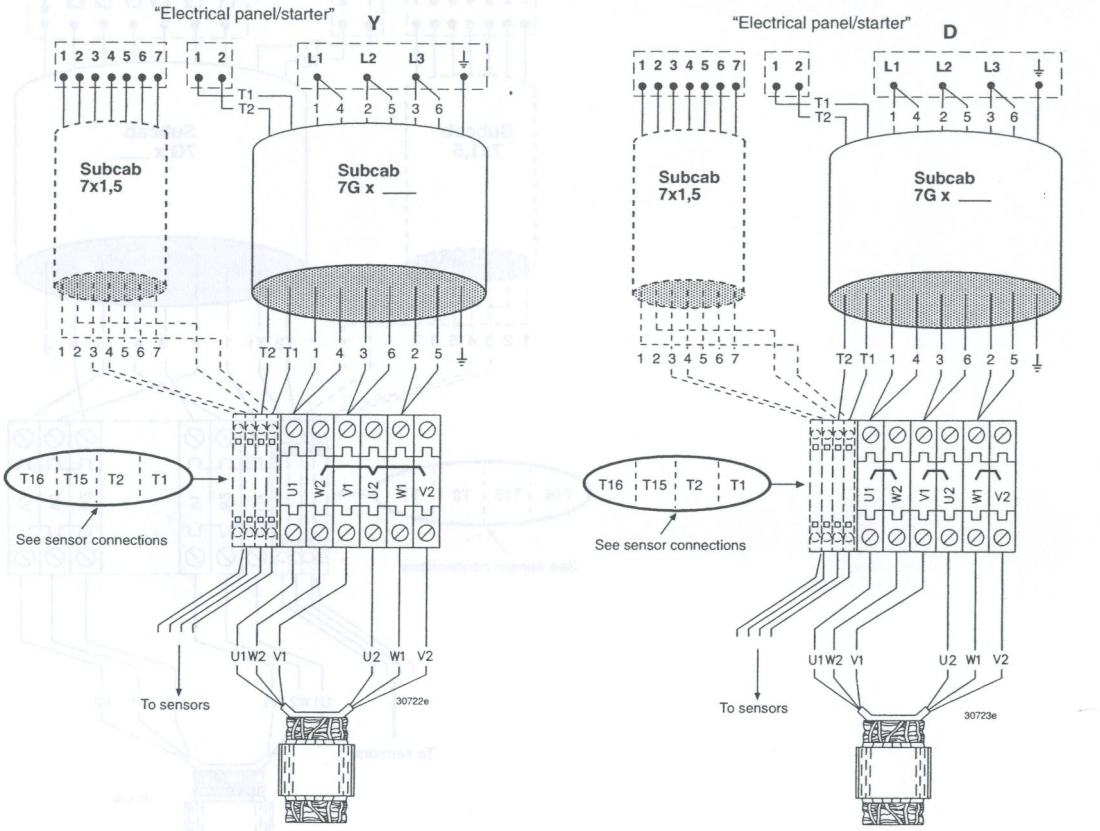
SUBCAB 4G/SUBCAB AWG



Mains	Lead	Pump terminal board	Stator leads connection: Stator lead	Pump terminal board
L1	brown/(red*)	U1	U1, red	U1
L2	blue/alt. grey (white*)	W1	W2, black	W2
L3	black (black*)	V1	V1, brown	V1
Earth (Ground)	yellow/green	⏚	U2, green	U2
Groundcheck (GC)	yellow*)		W1, yellow	W1
			V2, blue	V2
Control	Cable lead			
T1	T1 black/orange*			
T2	T2 black/blue*			

* SUBCAB AWG

SUBCAB 7G



Mains	Lead	Pump terminal board
L1	1 black	U1
L2	2 black	W1
L3	3 black	V1
L1	4 black	U1
L2	5 black	W1
L3	6 black	V1
Earth (Ground)	yellow/green	⏚
Control	Cable lead	
T1	T1/black	
T2	T2/black	

Stator leads connection: Stator lead	Pump terminal board
U1, red	U1
W2, black	W2
V1, brown	V1
U2, green	U2
W1, yellow	W1
V2, blue	V2

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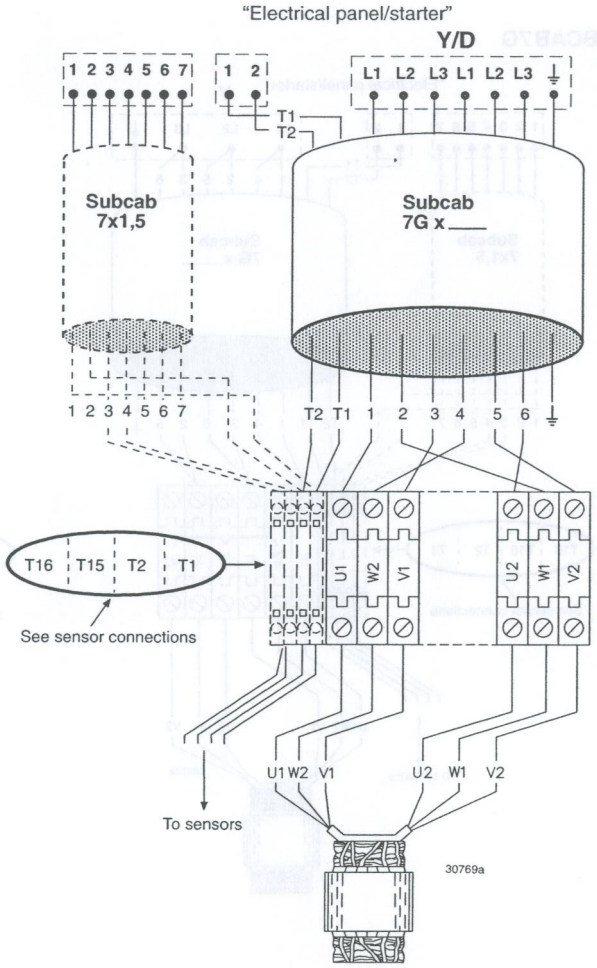
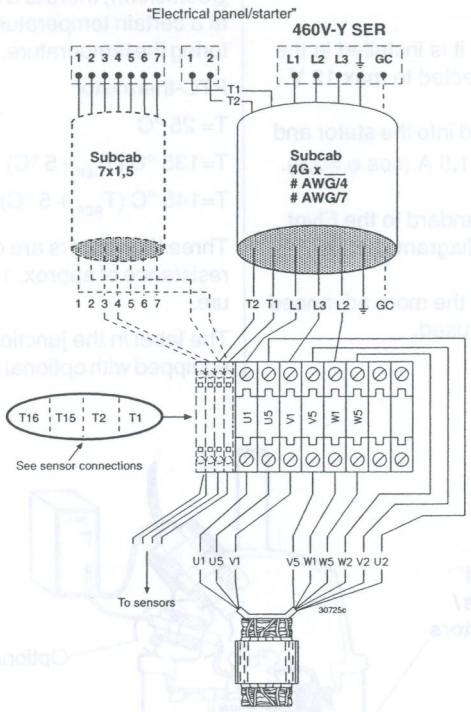


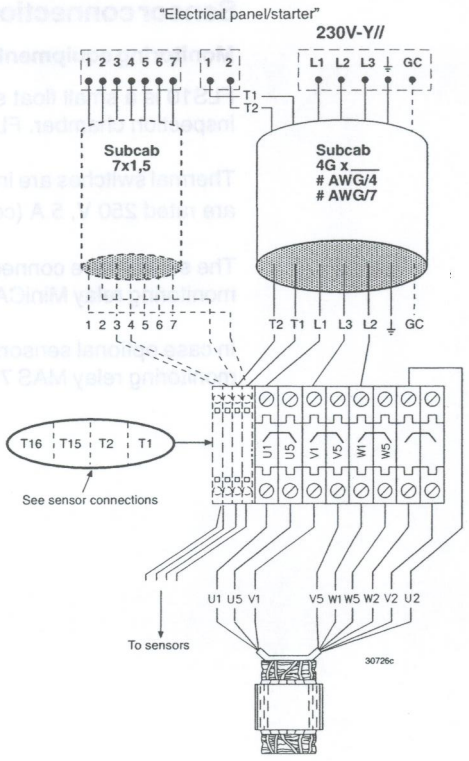
Main	Lead	Pump terminal board
L1	1 black	U1
L2	2 black	W1
L3	3 black	V1
L1	4 black	W2
L2	5 black	V2
L3	6 black	U2
Earth (Ground)	yellow/green	⏚

Stator leads connection: Stator lead	Pump terminal board
U1, red	U1
W2, black	W2
V1, brown	V1
U2, green	U2
W1, yellow	W1
V2, blue	V2

Control	Cable lead
T1	T1/black
T2	T2/black

SUBCAB 4G/SUBCAB AWG





Mains	Lead	Pump terminal board
L1	brown/(red*)	U1
L2	blue/alt. grey (white*)	W1
L3	black (black*)	V1
Earth (Ground)	yellow/green	⏚
Groundcheck (GC)	yellow*)	

Stator leads **460V-Y SER** connection:	
Stator lead	Pump terminal board
U1, red	U1
W2, black	W2
V1, brown	V1
U2, green	U2
W1, yellow	W1
V2, blue	V2
V5, brown	
W5, yellow	
U5, red	

Control	Cable lead
T1	T1 black/orange*
T2	T2 black /blue*

Mains	Lead	Pump terminal board
L1	brown/(red*)	U1
L2	blue/alt. grey (white*)	W1
L3	black (black*)	V1
Earth (Ground)	yellow/green	⏚
Groundcheck (GC)	yellow*)	

Stator leads **230V-Y//** connection:	
Stator lead	Pump terminal board
U1, red	U1
U5, red	U5
V1, brown	V1
V5, brown	V5
W1, yellow	W1
W5, yellow	W5
U2, green	
V2, blue	
W2, black	

Control	Cable lead
T1	T1 black/orange*
T2	T2 black/blue*

* SUBCAB AWG

23.5

Sensor connections

Monitoring equipment

FLS10 is a small float switch and it is installed in the inspection chamber. FLS is connected to max 12 V.

Thermal switches are incorporated into the stator and are rated 250 V, 5 A (cos φ =1) / 1,6 A (cos φ =0,6).

The sensors are connected as standard to the Flygt monitoring relay MiniCAS II (see diagrams below).

In case optional sensors are used the more advanced monitoring relay MAS 711 can be used.

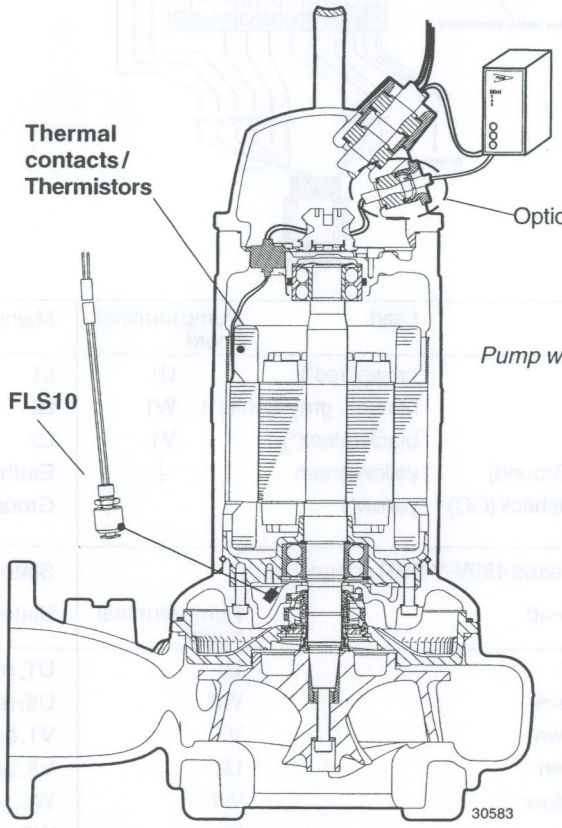
For a **PTC-thermistor** (PTC = Positive Temperature Coefficient), there is a significant increase in resistance at a certain temperature that can be utilized for monitoring the temperature.

PTC-thermistor

T= 25 °C	$R \leq 100$ Ohm
T=135 °C (T_{REF} - 5 °C)	$R \leq 550$ Ohm
T=145 °C (T_{REF} + 5 °C)	$R \geq 1330$ Ohm

Three thermistors are connected in series and have a resistance of approx. 150-300 ohms at room temperature.

The label in the junction box shows if the pump is equipped with optional sensors.

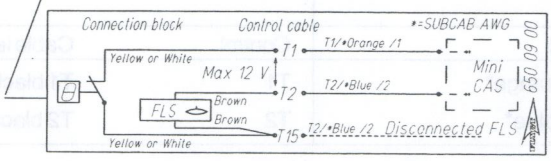


Pump without cooling jacket

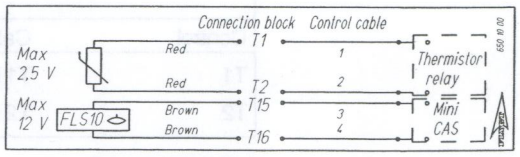
Sensor connection for standard configuration

In standard execution the pump is equipped with either thermal contacts or thermistors.

A) Thermal contacts



B) Thermistors



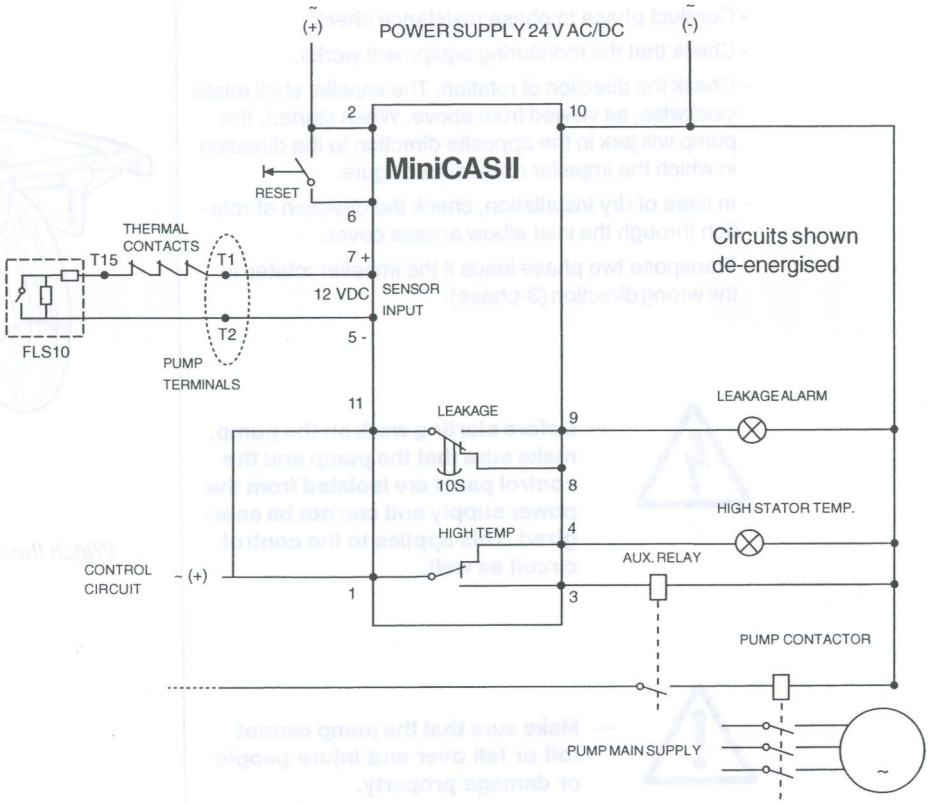
FLS10 + thermal contacts

0 mA = *Overtemperature*

10 mA = *OK*

28 mA = *Leakage*

Tolerance 10%



Sensor Connection Table

(For further information please contact Flygt representative.)

Sensor	Sensor lead	Thermal connection	Control cable	Connected to
Thermal contacts + FLS10	White	T1	T1/*Orange	Mini CAS II
	Brown	T2	T2/*Blue	Mini CAS II
	White+Brown	T15	= SubCab /* SubCabAWG	
Thermistors + FLS10	Red	T1	1	Thermistor relay
	Red	T2	2	Thermistor relay
	Brown	T15	3	Mini CAS II
	Brown	T16	4	Mini CAS II

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Before starting

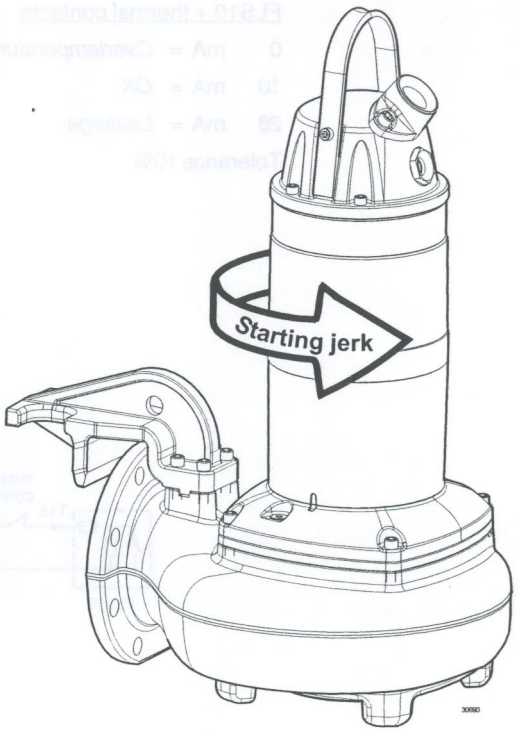
- Check that the visible parts of the pump and installation are undamaged and in good condition.
- Remove the fuses or open the circuit breaker and check that the impeller can be rotated freely.
- Verify that the supply voltage matches the pump data plate voltage rating.
- Conduct insulation integrity check.
- Conduct phase to phase resistance check.
- Check that the monitoring equipment works.
- Check the direction of rotation. The impeller shall rotate clockwise, as viewed from above. When started, the pump will jerk in the opposite direction to the direction in which the impeller rotates. See figure.
- In case of dry installation, check the direction of rotation through the inlet elbow access cover.
- Transpose two phase leads if the impeller rotates in the wrong direction (3-phase).

— **Before starting work on the pump, make sure that the pump and the control panel are isolated from the power supply and can not be energized. This applies to the control circuit as well.**

— **Make sure that the pump cannot roll or fall over and injure people or damage property.**

— **In some installations the pump surface and the surrounding liquid may be hot. Bear in mind the risk of burn injuries.**

— **In some installations and at certain operating points on the performance curve, the noise level of 70 dB or the noise level specified for the actual pump may be exceeded.**



Watch the starting jerk which can be powerful.

Service/Inspection

ITT Flygt recommends a preventive maintenance program based on Intermediate and Major Services at regular intervals. For standard sewage applications where FLS 10 is correctly connected and in use and the temperature of the pumped liquid is 40°C (104°F) or less an *Intermediate Service* should be performed every 8000 hours or every 2 years, whichever occurs first.

The time between *Major Service* could vary considerably depending on operating conditions and the need for a Major Service will be determined during the regular Intermediate Services.
However, a minimum of 20 000 hours of operation could be anticipated.

For applications other than sewage water or for specific operating conditions, other service intervals may be recommended.

Pump	**Intermediate Service running 8 000 h or 2 years**
Junction box	Check that it is clean and dry.
Terminal board	Check that the connections are properly tightened.
Insulation check	Check that the resistance between earth and phase lead is more than 5 M Ω Conduct phase to phase resistance check.
Cable	Check that the rubber sheating (jacket) is undamaged.
Seal housing	Fill up with new coolant if necessary. Check freezing point (lower than –13°C, 9°F).
Inspection chamber	Drain all liquid if any. Check the resistance. Normal value approx.1200 Ω, alarm approx. 430 Ω
O-rings	Always replace the O-rings of the filling plugs and at the junction cover. Always grease new O-rings.
Thermal contacts	Check the resistance. Normally closed circuit; interval 0 – 1 Ω
Thermistor	Check the resistance 20 – 250 Ω, (measuring voltage max 2 V DC).
Impeller	Check impeller clearance and adjust if necessary.
Lifting handle	Check the screws and the status of the lifting handle.
Rotation direction	Check the rotation of the impeller.
Lifting device	Check that local safety regulations are followed.
Voltage and amperage	Check running values.
Pump station	**Intermediate Service running 8 000 h or 2 years**
Electrical cabinets/ panels	Check that they are clean and dry.
Connection to power	Check that the connections are properly tightened.
Overload and other protections	Check correct settings.
Personnel safety	Check guard rails, covers and other protections.
Level regulators	Check condition and function.
Pump	**Major Service**
Support and main bearing.	Replace with new bearings.
Mechanical seal unit.	Replace with new seal units.
Pumpstations same as Intermediate Service	

If any indication of alarm between inspections, please see instructions below.	Actions
FLS10	Drain the fluid in the inspection chamber. Fill with new coolant if necessary. Check freezing point (lower than –13°C, 9°F). Check the inspection chamber again after one week of operation. If leakage has occured, drain the fluid and change the mechanical seal unit and replace with new coolant.
Thermistor/Thermal-contact	Check coolant level. (pump with cooling jacket) Check start and stop levels.
Overload protection	Check that the impeller can rotate freely.

The following points are important in connection with work on the pump:

— Make sure that the pump cannot roll or fall over and injure people or damage property.

— Check every year that the lifting equipment is in good condition.

The pump is designed for use in liquids which can be a health risk. In order to prevent injury to the eyes and skin, observe the following points when working on the pump:

— Make sure that the pump has been thoroughly cleaned.

— Beware of the risk of infection.

— Follow local safety regulations.

— Always wear goggles and rubber gloves.

— Rinse the pump thoroughly with clean water before starting work.

— Rinse the components in water after dismantling.

— The coolant chamber may be under pressure. Hold a rag over the filling plug to prevent splatter.

Proceed as follows if fluids have splashed into your eyes:

— Rinse your eyes immediately in running water for 15 minutes. Hold your eyelids apart with your fingers.

— Contact an eye specialist.

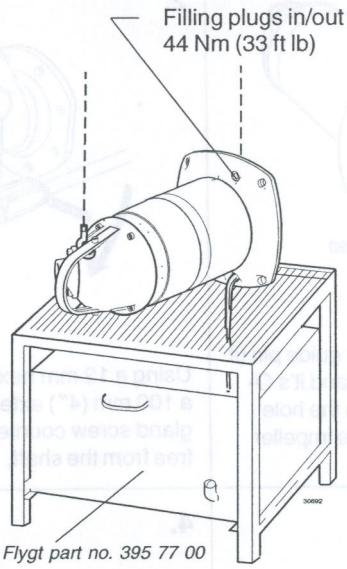
On your skin:

— Remove contaminated clothes.

— Wash your skin with soap and water.

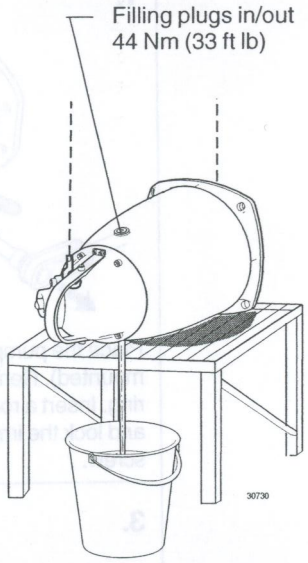
— Seek medical attention, if required.

Emptying coolant
(without cooling jacket)



Relief table Flygt part no. 395 77 00

Emptying coolant
(with cooling jacket)



1. Lift the pump horizontally with an overhead crane and place on relief table.

2. Turn the pump so that one of the filling plugs holes faces downwards.
   WARNING! If the mechanical seal unit leaks, the seal housing may be under pressure. Hold a rag over the filling plug to prevent splatter.

3. Unscrew the filling plug. It is easier to drain the water-glycol if the other filling plug is also removed.

4. Pump **without** cooling jacket. Raise the pump to an upright position. Fill with coolant to the same level as the filling plugs; approx. 2,2 litres (2.3 US quarts).
   Pump **with** cooling jacket; approx. 10,5 litres (11.2 US quarts)
   Coolant: a mix of water and stabilized monopropy-leneglycol in a mixture ratio of 70/30 % volume part.

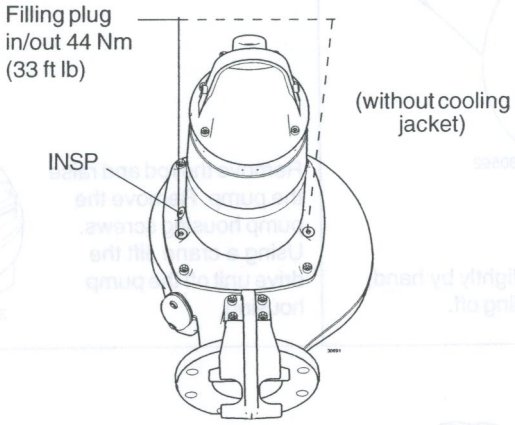
   Known trade marks of monopropyleneglycol are: Dowcal N (individual components are approved by FDA), Dowcal 20. These are non-poisonous, heat-and-cold resistant and inhibiting of corrosion.

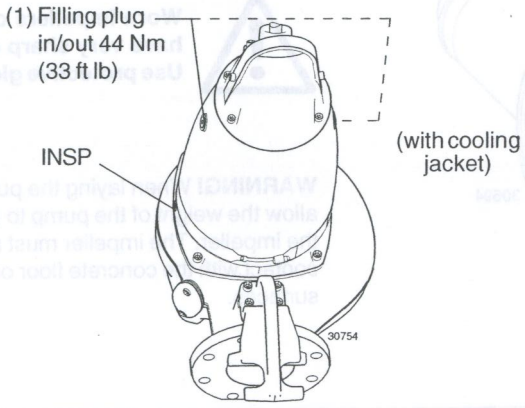
   Use of other type of glycol jeopardize the function of the pump.

   If there is no risk of freeezing even clean water with anti-corrosive is acceptable as coolant.

5. Always replace the O-rings of the filling plugs. Put the plugs back and tighten them.

Filling coolant





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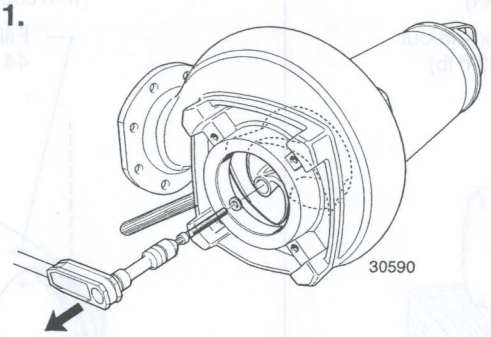
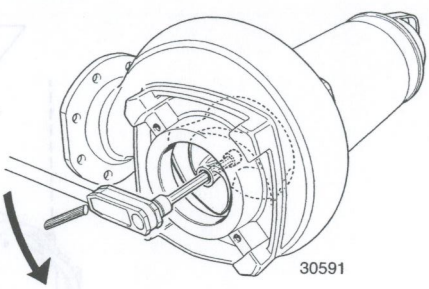
1.



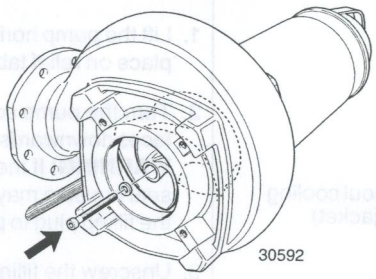
Place the pump horizontally. Remove the guide pin (if mounted). Remove the flush valve cover and it's O-ring. Insert a rod (wood or plastic) through the hole and lock the impeller in place. Remove the impeller screw.

2.



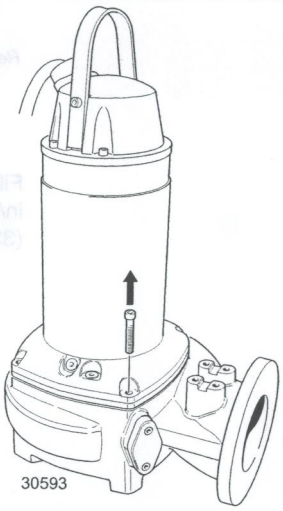
Using a 12 mm hexagon bit adaptor (allen socket) with a 100 mm (4″) extension (minimum length) turn the gland screw counter clockwise until the impeller breaks free from the shaft.

3.



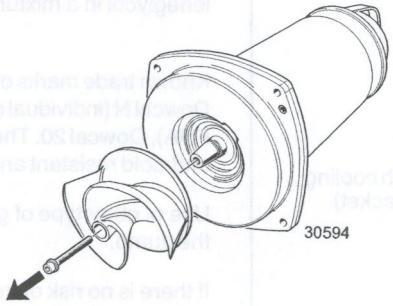
Install the impeller screw. Tighten lightly by hand, just to prevent the impeller from falling off.

4.



Remove the rod and raise the pump. Remove the pump housing screws. Using a crane, lift the drive unit off the pump housing.

5.

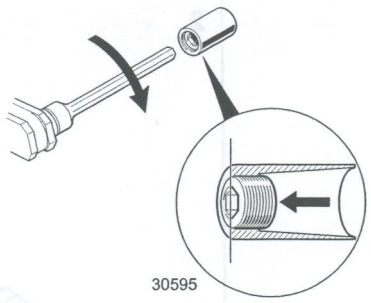


Place the drive unit horizontally. Remove the impeller screw.

Worn impellers can have very sharp edges. Use protective gloves!

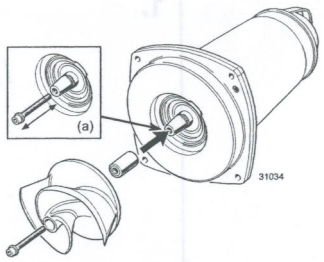
WARNING! When laying the pump on its side do not allow the weight of the pump to rest on any portion of the impeller. The impeller must not be allowed to make contact with the concrete floor or other hard and rough surfaces.

1.



Make sure that the end of the shaft is clean and free from burrs. Polish off any flaws with fine emery cloth. Grease end of shaft, conical sleeve and the threads of the gland screw and the impeller screw. Align the edge of the gland screw with the edge of the conical sleeve so that they are flush.

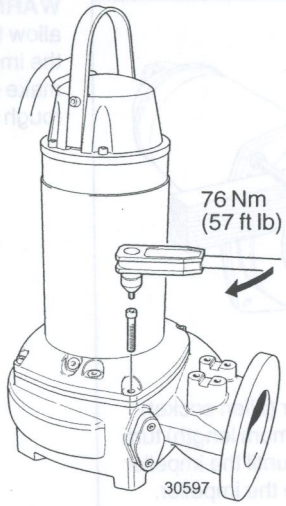
2.



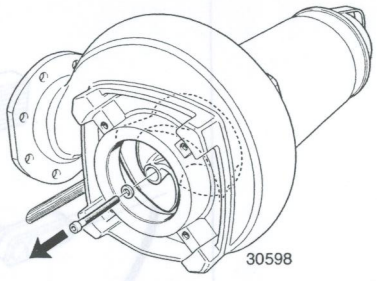
Before assembling, check that the impeller screw is clean and easy to screw into the shaft end (a). This to prevent the shaft to rotate with the impeller screw. Assemble the conical sleeve and the impeller onto the shaft. Fit the impeller screw onto the shaft. Tighten the impeller screw lightly by hand, just to prevent the impeller from falling off.

3.

Fit the drive unit to the pump housing. Adjust its position so that the inspection hole is on the same side as the hole for the flush valve. Tighten the screws in diagonally opposite pairs.

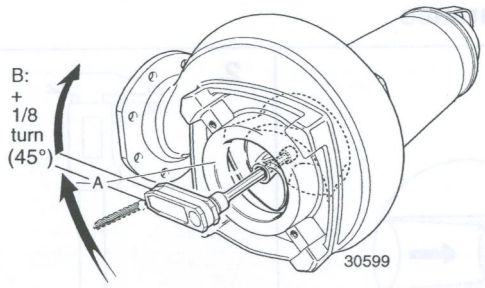


4.



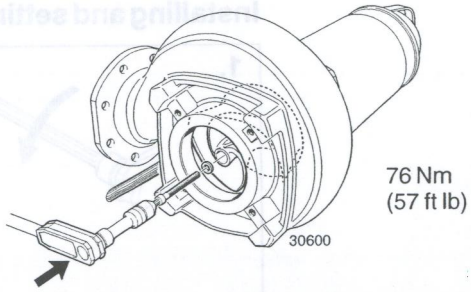
Place the pump horizontally.
Remove the flush valve cover and it's O-ring. Insert a rod (wood or plastic) through the hole and lock the impeller in place. Remove the impeller screw.

5.



Turn the gland screw clockwise until the impeller makes contact with the pump housing. Tighten it a further 1/8 turn, 45°. This will insure the correct clearance between the impeller and the bottom of the pump housing in the next step.

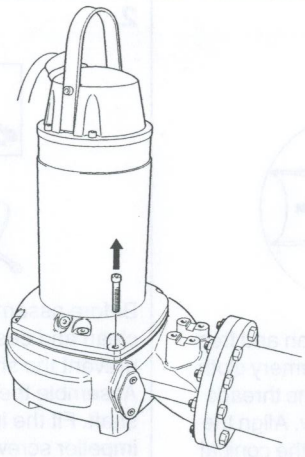
6.



Fit the washer and the greased impeller screw and tighten, torque to 76 Nm (57 ft lb). Remove the rod used to lock the impeller. Fit the O-ring, flush valve cover and secure with screws, torque to 44 Nm (33 ft lb).
SH-version - if applicable: Fit the guide pin and adjust the clearance to 0,2 - 0,8 mm (0,008-0,032") between the guide pin and the impeller.

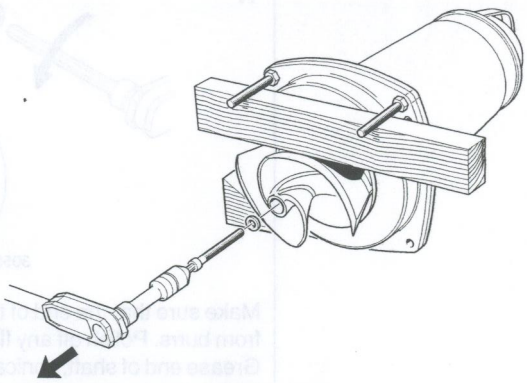
version, NT

1.



Remove the drive unit from the pump housing.

2.

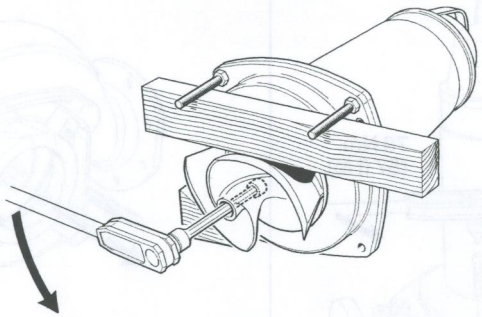


Place the drive unit horizontally. Lock the impeller in place and remove the impeller screw.

WARNING! 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.

Worn impellers can have very sharp edges. Use protective gloves!

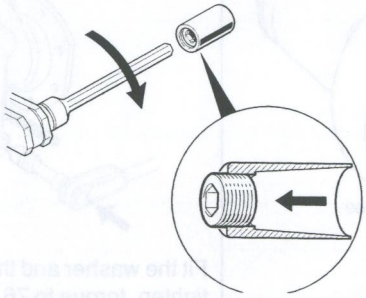
3.



Using a 12 mm hexagon bit adaptor (allen socket) with a 100 mm (4") extension (minimum length) turn the gland screw counter clockwise until the impeller breaks free from the shaft. Remove the impeller.

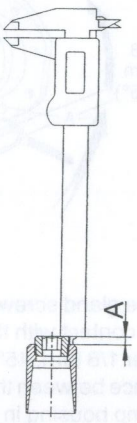
Installing and setting clearance

1.



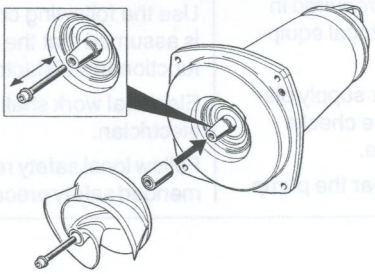
Make sure that the end of the shaft is clean and free from burrs. Polish off any flaws with fine emery cloth. Grease end of shaft, conical sleeve and the threads of the gland screw and the impeller screw. Unscrew the gland screw approximately 5 mm.

2.



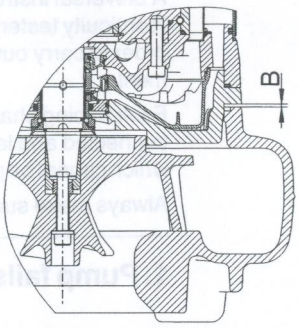
Measure and note the distance A.

3.



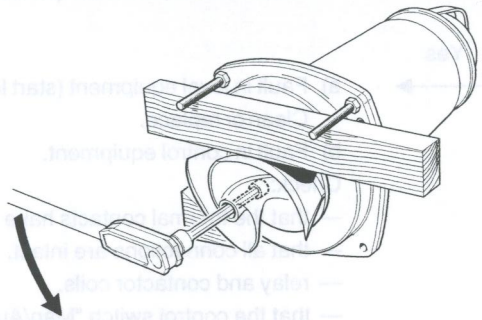
Before assembling, check that the impeller screw is clean and easy to screw into the shaft end (a). This to prevent the shaft to rotate with the impeller screw. Assemble the conical sleeve and the impeller onto the shaft. Fit the impeller screw with washer onto the shaft and tighten to 76 Nm (57 ft lb).

4.



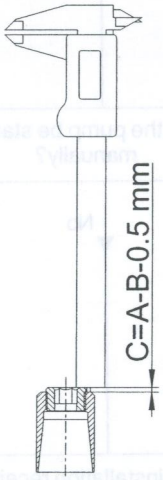
Make sure that the O-ring is removed from the seal housing cover. Place the drive unit in the pump housing. Check the distance between the seal housing cover and the pump housing with a feeler gauge. Check diametrically at four points.
Note the largest measured distance, B. See fig.

5.



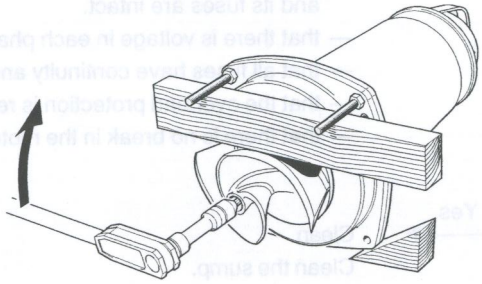
Lift the drive unit out of the pump housing and remove the impeller and conical sleeve.

6.



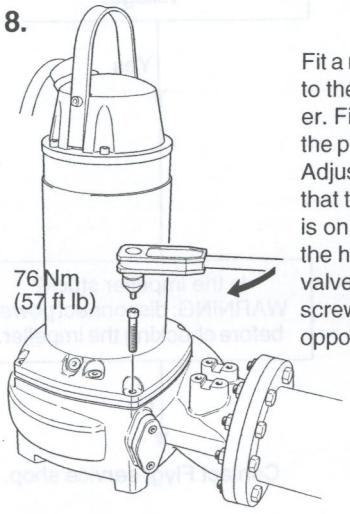
Calculate the measure C according to formula:
C = A - B - 0,5mm
Unscrew the gland screw until C is reached.

7.



Fit the conical sleeve, impeller and impeller screw with washer and tighten to 76 Nm (57 ft lb).

8.



Fit a new greased O-ring to the seal housing cover. Fit the drive unit to the pump housing. Adjust its position so that the inspection hole is on the same side as the hole for the flush valve. Tighten the screws in diagonally opposite pairs.

23.5

A universal instrument multimeter (VOM), a test lamp (continuity tester) and wiring diagram are required in order to carry out fault tracing on the electrical equipment.

Fault tracing shall be done with the power supply disconnected and locked off, except for those checks which cannot be performed without voltage.

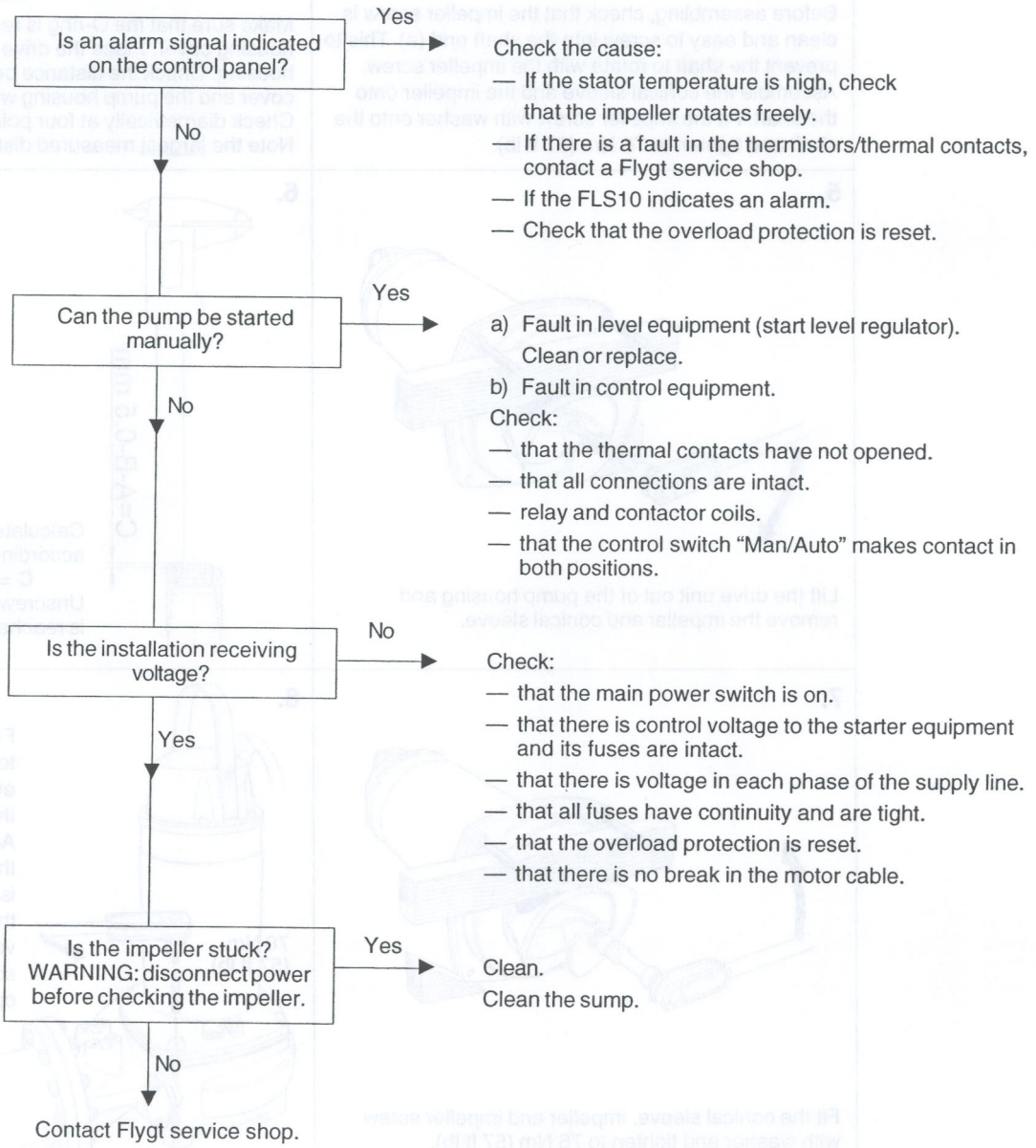
Always make sure that there is no one near the pump when the power supply is turned on.

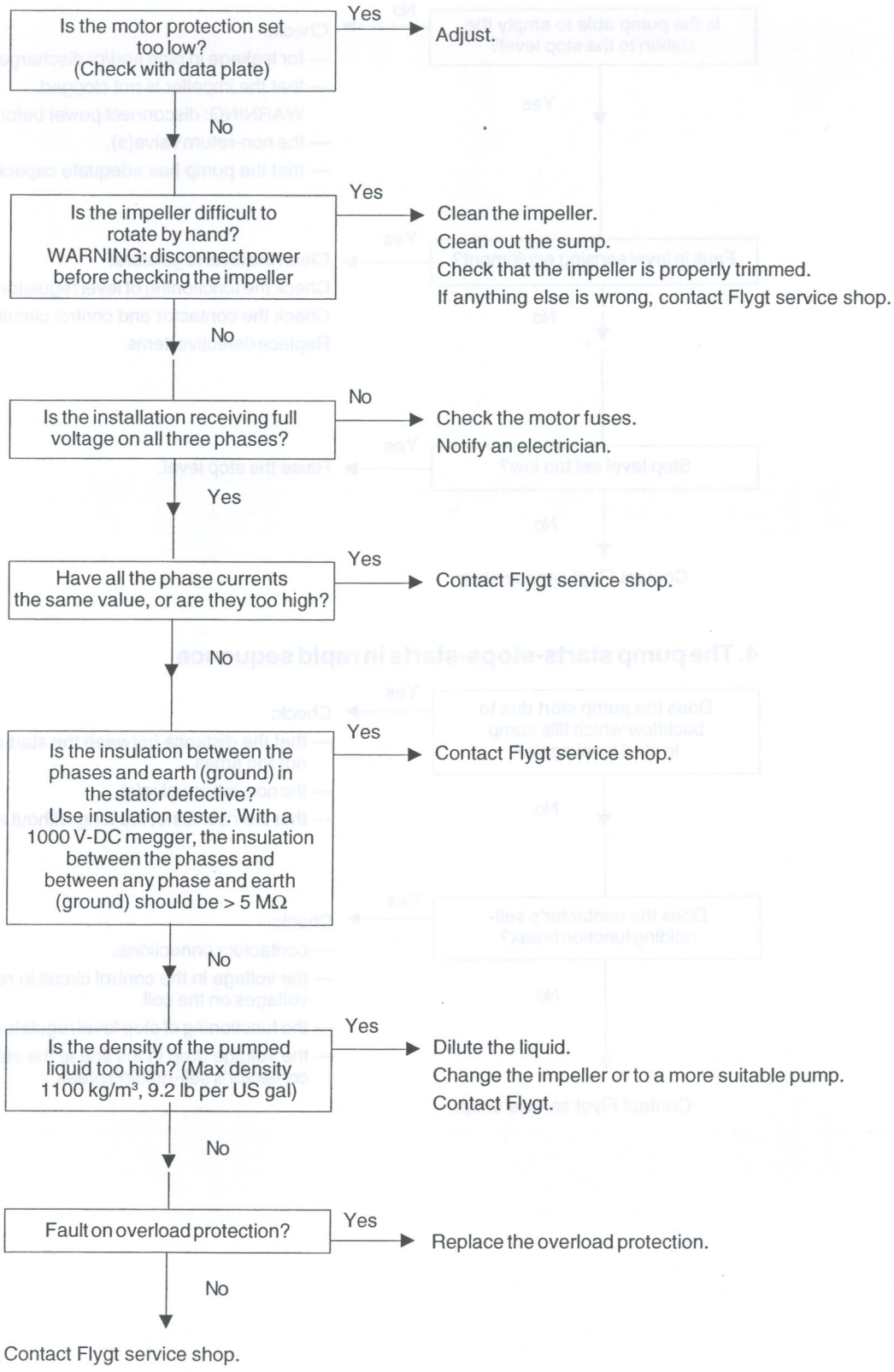
Use the following checklist as an aid to fault tracing. It is assumed that the pump and installation have formerly functioned satisfactorily.

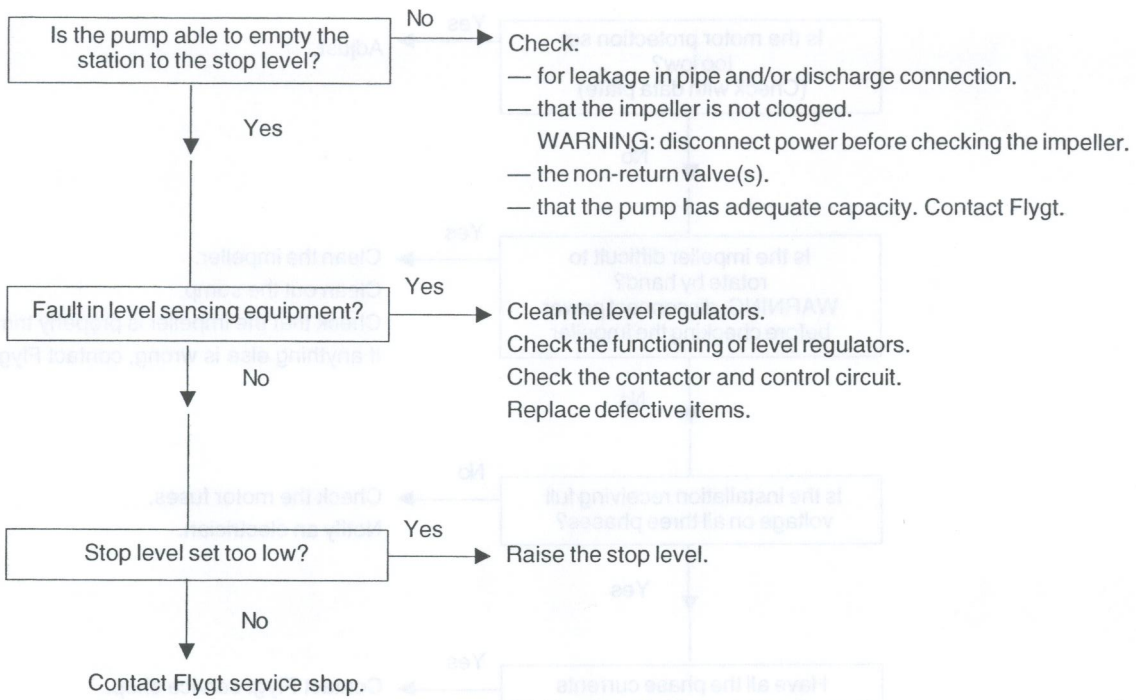
Electrical work shall be performed by an authorized electrician.

Follow local safety regulations and observe recommended safety precautions.

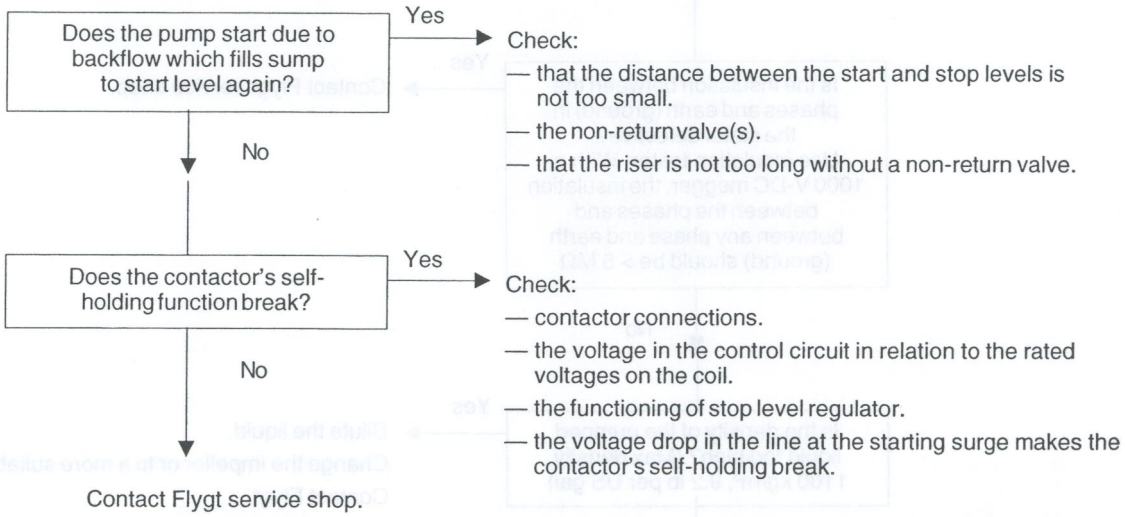
1. Pump fails to start




Is the motor protection set too low? (Check with data plate)
Yes
Adjust.
No
Is the impeller difficult to rotate by hand? WARNING: disconnect power before checking the impeller
Yes
Clean the impeller.
Clean out the sump.
Check that the impeller is properly trimmed.
If anything else is wrong, contact Flygt service shop.
No
Is the installation receiving full voltage on all three phases?
No
Check the motor fuses.
Notify an electrician.
Yes
Have all the phase currents the same value, or are they too high?
Yes
Contact Flygt service shop.
No
Is the insulation between the phases and earth (ground) in the stator defective? Use insulation tester. With a 1000 V-DC megger, the insulation between the phases and between any phase and earth (ground) should be > 5 MΩ
Yes
Contact Flygt service shop.
No
Is the density of the pumped liquid too high? (Max density 1100 kg/m³, 9.2 lb per US gal)
Yes
Dilute the liquid.
Change the impeller or to a more suitable pump.
Contact Flygt.
No
Fault on overload protection?
Yes
Replace the overload protection.
No
Contact Flygt service shop.



4. The pump starts-stops-starts in rapid sequence



5. Pump runs but delivers too little or no water

Check:

— direction of rotation of pump, see "Before starting".
— that valves are open and intact.
— that pipes and impeller are not clogged.
— that the impeller rotates freely.
— that the suction lift has not been altered.
— for leakage in the pump installation.
— for wear on the impeller, pump and casing/flange.

See also under "Inspection".

Do not override the motor protection repeatedly if it has tripped.

SERVICE LOG

Most recent service date	Pump No.	Hours of operation	Remarks	Sign.

FLYGT

www.flygt.com

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FLYGT

FLYGT SUBMERSIBLE PUMP

PARTS LIST NP 3153 MT

SERIAL NO 3153.181 0560258

ITT FLYGT
A DIV. OF ITT IND. OF CANADA LTD
300 LABROSSE AVENUE

POINTE CLAIRE, QUEBEC H9R 4V5
CANADA
TELEPHONE NO: 5146-950100

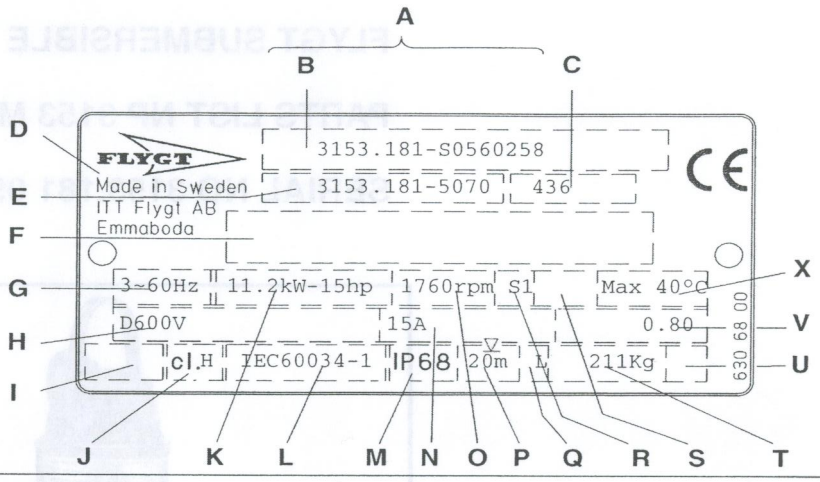
1/11 pag

23.5

FLYGT NP 3153 MT

DATE: 2005-09-23

SERIAL NO: 3153.181 0560258



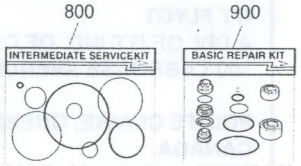
Dataplate Interpretation:

A Serial number
B Product code + Number
C Curve code/Propeller code
D Country of origin
E Product number
F Additional information
G Phase; Type of current; Frequency
H Rated voltage
I Thermal protection
J Themal class
K Rated shaft power
L International standard
M Degree of protection
N Rated current
O Rated speed
P Max. submergence
Q Direction of rotation: L=left, R=right
R Duty class
S Duty factor
T Product weight
U Locked rotor code letter
V Power factor
X Max. ambient temperature

(1 kg = 2.2 pound, 1 lit = 0.26 US gallon, 1 lit = 0,22 UK gallon)

Recommended spare parts:
See Rec. column: I = Intermediate Service Kit; parts for inspection and maintenance.
B = Basic Repair Kit; parts for major overhaul.

For service:
Pos number 800; O-rings kit intended for Intermediate Service.
Pos number 900; contains of a shaft seal unit, bearings and O-rings.



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.

FLYGT NP 3153 MT

SERIAL NO 3153.181 0560258

Item no	Partno	Rec	Denomination	Qty/ord.
1	642 15 00		Lifting handle	1
2	83 04 56		Hex.socket hd screw M10X35-A4-80	2
7	83 45 59		Cable tie 200X2,4 PA 6/6 -55+105	1
8	630 68 00		Data plate USE 6306801 AS SPARE PART	2
9	83 93 50		Marking strip 5-GW(T1;T2;T15;T16)	1
9	83 93 51		Marking strip W2;V2;U2;W5;W1;V5;V1U5;U1	1
9	650 09 00		Connection plate	1
9	650 22 00		Connection plate	1
10	82 20 88		Drive screw 4X5	4
14	94 20 41	(s)	Motor cable SUBC 4G 1.5 MM2	16.6 m
15	397 81 00		Gland screw	1
21.1	82 40 61		Plain washer 24.5X35X2 (22)-24	2
21.2	84 17 90		Seal sleeve (10)-12 MM	1
21.3	398 98 00		Cable clamp PA 12, 10-12MM	1
23	94 21 03	(s)	Motor cable SUBC 12 AWG/4	16.6 m
24	642 17 00		Entrance flange	1
25	84 41 09		Plate	1
26	83 04 53		Hex.socket hd screw M12X45-A4-80	2
31	82 74 63		O-ring 49,5X3,0 NBR	1
32	642 14 04		Entrance cover	1
33	82 78 35		O-ring 175,0X3,0 NBR	1
35	83 04 56		Hex.socket hd screw M10X35-A4-80	4
45	82 00 11		Hex.socket hd screw M6X12	2
53	82 00 11		Hex.socket hd screw M6X12	2
53	82 00 11		Hex.socket hd screw M6X12	2
54	642 08 00		Rail	1
56	642 16 00		Earthing plate	2
60	82 56 25		Spring washer 71,5X59,0X6,5	1
61	83 30 16		Ball bearing 3306A-2Z/C3WT	1
69	642 09 00		Stator housing	1
72	82 74 94		O-ring 209,3X5,7 NBR	1
73	641 98 05		Shaft unit	1
79	641 94 08		Stator 21-15-4a	1
79.1	84 50 50		Thermal detectors	1
82	608 12 01		Cooling jacket OUTER	1

Ordered by:

Company:.....Ref:.....Tel:.....Date:.....

23,5

Item no	Partno	Rec	Denomination	Qty/ord.
83	82 78 49		O-ring 221,84X3,53 NBR	1
84	82 75 01		O-ring 279,3X5,7 NBR	1
88	649 38 01		Cable entry unit (17)-20MM	1
88.18	82 40 81		Plain washer (14)-20 MM	4
88.19	84 18 01		Seal sleeve (17)-20 MM	2
88.20	597 98 02		Ring	1
101	650 51 00		Cable unit FLS10	1
103	663 04 00		Level sensor FLS10	1
105	642 10 00		Bearing holder	1
107	82 59 06		Retaining ring SGA 40	1
108	82 44 15		Supporting washer	1
109	83 30 18		Ball bearing 3308A-2Z/C3WT	1
110	83 07 62		Retaining ring JB 90	1
120	642 13 00		Inspection screw	1
122	82 76 85		O-ring 17,0X3,0 NBR	1
122	82 76 85		O-ring 17,0X3,0 NBR	3
129	642 12 00		Seal housing cover	1
130	82 78 39		O-ring 230,0X3,0 NBR	1
131	82 75 01		O-ring 279,3X5,7 NBR	1
133	83 04 56		Hex.socket hd screw M10X35-A4-80	6
141	641 50 00		Mechanical seal DIAM.35	1
145	83 04 53		Hex.socket hd screw M12X45-A4-80	4
158	642 34 65		Impeller	1
162	82 37 05		Plain washer	1
169	83 04 55		Hex.socket hd screw M12X110-A4 80	1
200	643 63 00		Pump housing	1
202	83 04 56		Hex.socket hd screw M10X35-A4-80	2
203	648 00 00		Cover	1
204	82 81 93		O-ring 44,2X5,7 FPM	1
209	651 07 00		Sliding bracket	1
210	83 04 53		Hex.socket hd screw M12X45-A4-80	4
229	667 40 01		Sticker	2
232	83 53 58		Terminal clamp WEIDMüLLER WDU6/10	3
233	83 53 61		Terminal clamp WDU16,1000 V	6
234	83 53 67		Cross connection WQV 16/2	3
234	650 20 02		Cross connection	1
235	83 53 54		End support WEW 35/2	2
236	83 53 50		Partition	1
239	443 69 00		El-lead through	1
240	607 48 00		Spring	1
241	82 78 35		O-ring 175,0X3,0 NBR	1

Ordered by:

Company:.....Ref:.....Tel:.....Date:.....

PARTS LIST

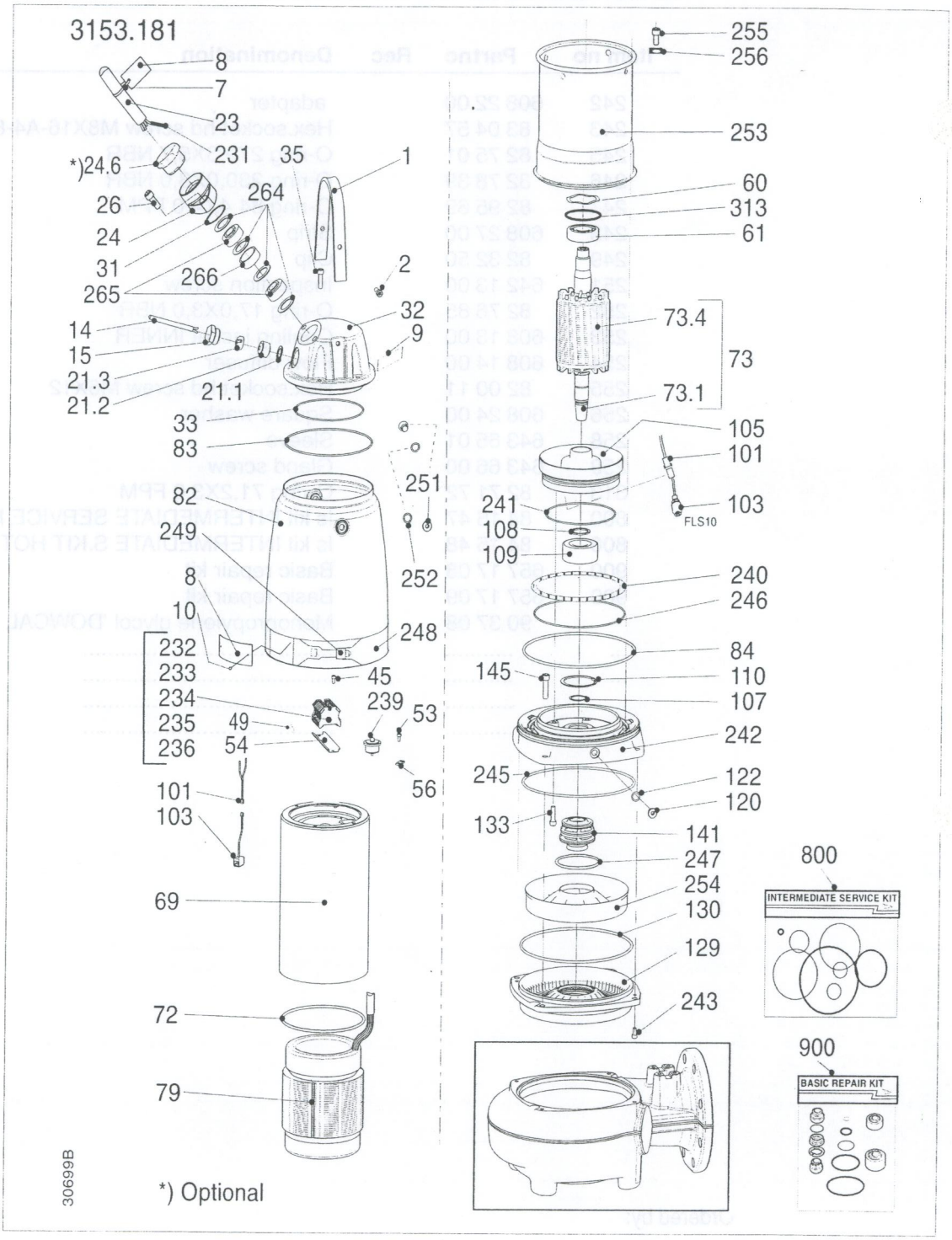
Item no	Partno	Rec	Denomination	Qty/ord.
242	608 22 00		adapter	1
243	83 04 57		Hex.socket hd screw M8X16-A4-80	2
245	82 75 01		O-ring 279,3X5,7 NBR	1
246	82 78 39		O-ring 230,0X3,0 NBR	1
247	82 95 69		O-ring 84,4X4,0 FPM	1
248	608 27 00		Strip	1
249	82 32 50		Clip	1
251	642 13 00		Inspection screw	2
252	82 76 85		O-ring 17,0X3,0 NBR	2
253	608 13 00		Cooling jacket INNER	1
254	608 14 00		Flow diffuser	1
255	82 00 11		Hex.socket hd screw M6X12	4
256	608 24 00		Square washer	4
258	643 65 01		Sleeve	1
259	643 66 00		Gland screw	1
313	82 71 72		O-ring 71,2X3,0 FPM	1
800	84 15 47		Is kit INTERMEDIATE SERVICE KIT	1
800	84 15 48		Is kit INTERMEDIATE S.KIT HOT W	1
900	657 17 08		Basic repair kit	1
900	657 17 09		Basic repair kit	1
	90 37 08		Monopropylene glycol 'DOWCAL N'	3.15 l
...	.....		.....	....
...	.....		.....	....
...	.....		.....	....
...	.....		.....	....

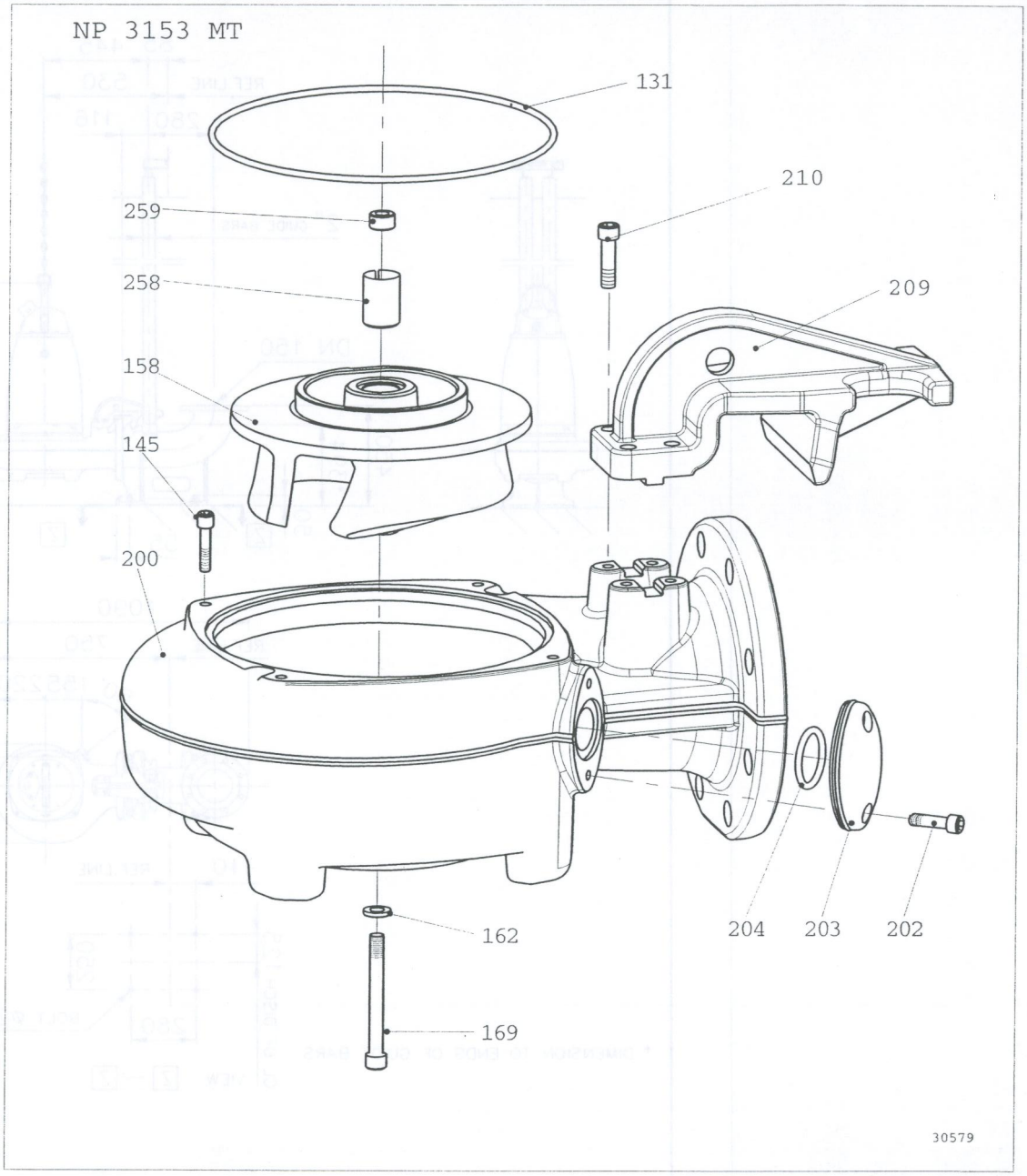
Ordered by:

Company:.....Ref:.....Tel:.....Date:.....

23.5

EXPLODED VIEW




NP 3153 MT
131
210
259
258
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162
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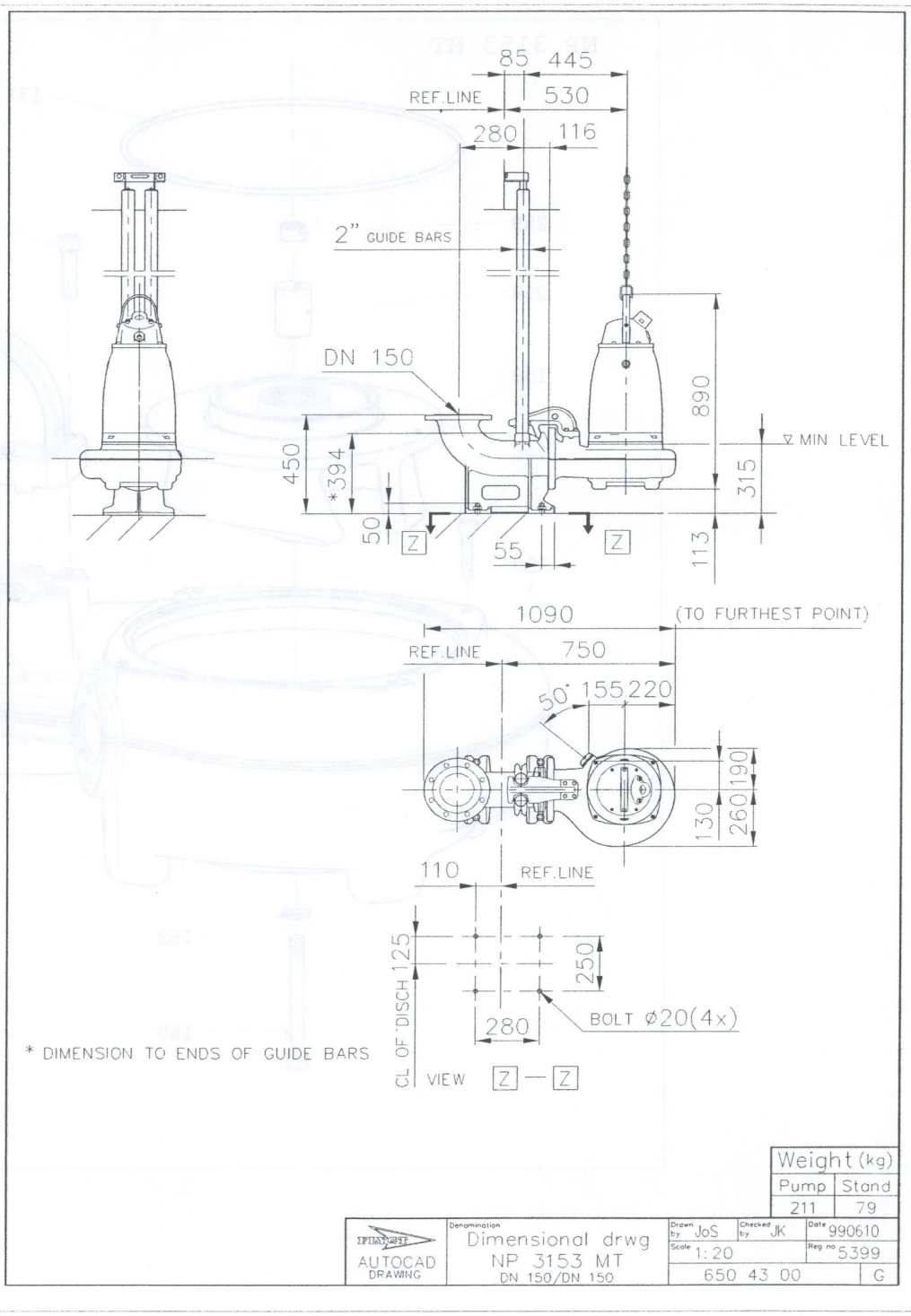
169
30579

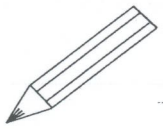
23.5

DIMENSIONAL DRAWING



Weight (kg)	
Pump	Stand
211	79

AUTOCAD DRAWING	Denomination: Dimensional drwg NP 3153 MT DN 150/DN 150	Drawn by JoS	Checked by JK	Date 990610
		Scale 1:20		Reg no 5399
		650 43 00		G



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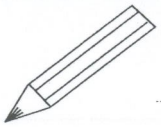
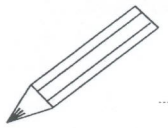




23.5

Flygt

ITT Industries

www.flygt.com

Chapter 24PUMPS

MANUFACTURER/DISTRIBUTOR:

VIKING
2925, PITFIELD
ST-LAURENT,QUE. H4S 1L6
PH:514-593-6666 FAX:8831

24.1 FIRE EXTINGUISHER 20 POUNDS

24.2 CABINET FOR FIRE EXTINGUISHER

END OF CHAPTER 24

FLAG FIRE

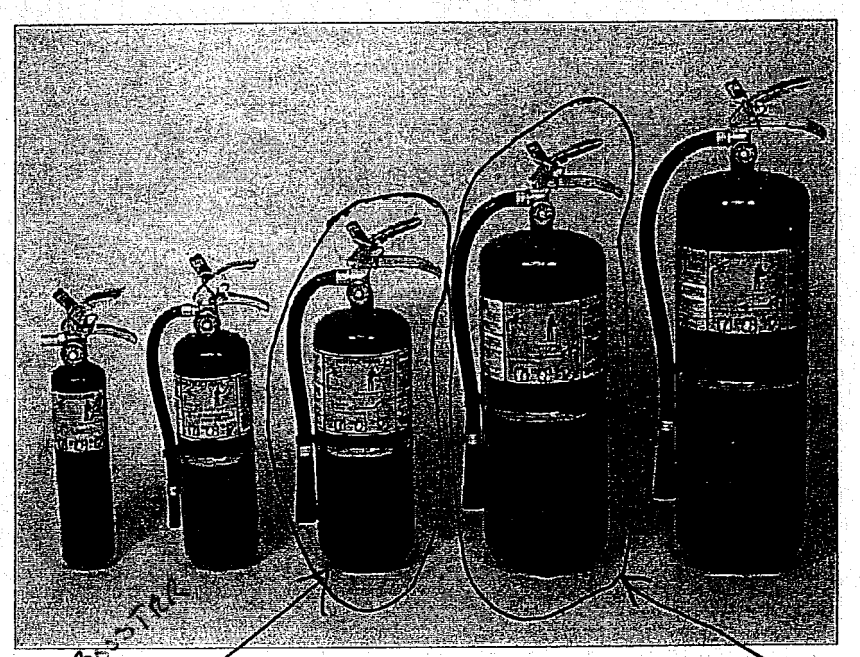
STORED PRESSURE DRY CHEMICAL

6 YEAR WARRANTY

SIZES 2.5 LB. (1.14 KG.) TO 30 LB. (13.6 KG.)

TYPES:

- ABC – Multipurpose (ammonium phosphate) Powder
- PKD – Purple K (potassium bicarbonate) Powder
- PDC – Standard (sodium bicarbonate) Powder



FEATURES:

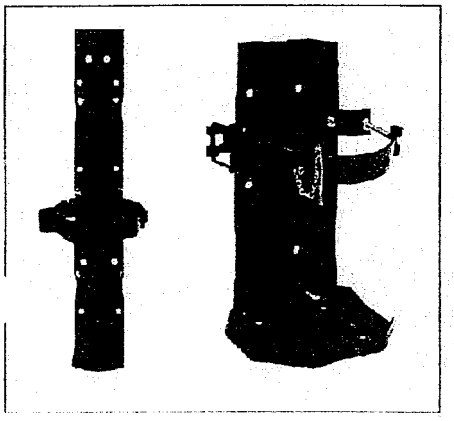
- Squeeze grip operation.
- Positive On/Off operation.
- Heavy duty steel cylinders.
- Pull pin safety locks.
- Glossy corrosion resistant red polyester powder paint finish.
- Water proof stainless steel gauge.
- Anodized aluminum valve.
- Units complete with wall brackets.
- Easy service valve construction –
  1. Remove valve and pick up tube.
  2. Remove spring and valve stem.
  3. Clean, Fill and reassemble.

OPTIONS:

- Corrosion control Primer Coatings can be applied for marine or offshore applications.

- 2-1/2 and 5 lb. vehicle brackets available.

- 10 lb. to 30 lb. units are available with heavy duty running board brackets, primed and painted for years of trouble free service in outside environments.



U.S.C.G. Approved and Underwriters Laboratories Inc. UL for

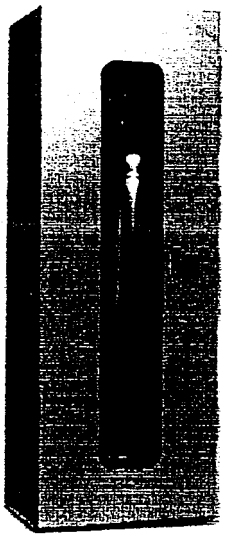
CLASS A - B - C FIRES

SPECIFICATIONS

MODEL	UL RATING	RANGE	CAPACITY	DISC.TIME	DIA.	WIDTH	HEIGHT
ABC-025V	1A, 10-B.C.	8 pi - 10 pi	2 1/2 lb	8 - 10 sec.	3 po	4,5 po	16 po
ABC-025W	1-A, 10-B.C.	8 pi - 10 pi	2 1/2 lb	8 - 10 sec.	3 po	4,5 po	16 po
ABC-050E-SH	3-A, 10-B.C.	10 pi - 15 pi	5 lb	13 - 15 sec.	4,25 po	5,5 po	16,5 po
ABC-050HW-SH	3-A, 10-B.C.	10 pi - 15 pi	5 lb	13 -15 sec.	4,25 po	5,5 po	16,5 po
*ABC-050V-LG	3-A, 40-B.C.	10 pi - 15 pi	5 lb	13 - 15 sec.	4,25 po	5,5 po	17,8 po
*ABC-050HW-LG	3-A, 40-B.C.	10 pi - 15 pi	5 lb	13 - 15 sec.	4,25 po	5,5 po	17,8 po
ABC-10G	4-A, 60-B.C.	10 pi - 15 pi	10 lb.	20 - 22 sec.	5,5 po	9 po	20 po
*ABC-10H	6-A, 80-B.C.	10 pi - 15 pi	10 lb	20 - 22 sec.	5,5 po	9 po	20 po
*ABC-20G	10-A, 120-B.C.	12 pi - 18 pi	20 lb	26 - 30 sec.	7 po	10 po	24 po
*ABC-30G	10-A, 120-B.C.	12 pi - 18 pi	27 lb	26 - 30 sec.	7 po	10 po	28 po
PKD-050G	30-B.C.	10 pi - 15 pi	5 lb	11 - 14 sec.	4,25 po	5,5 po	17,8 po
PKD-10G	80-B.C.	10 pi - 15 pi	10 lb	20 - 22 sec.	5,5 po	9 po	20 po
PKD-20G	120-B.C.	12 pi - 18 pi	20 lb	26 - 30 sec.	7 po	10 po	24 po
PKD-30G	160-B.C.	12 pi - 18 pi	28 lb	31 - 34 sec.	7 po	10 po	28 po
PDC-025V	5-B.C.	8 pi - 10 pi	2 1/2 lb	8 - 10 sec.	3 po	4,5 po	16 po
PDC-025W	5-B.C.	8 pi - 10 pi	2 1/2 lb	8 - 10 sec.	3 po	4,5 po	16 po
*PDC-060V	40-B.C.	10 pi - 15 pi	6 lb	13 - 15 sec.	4,25 po	5,5 po	17,8 po
*PDC-060HW	40-B.C.	10 pi - 15 pi	6 lb	13 - 15 sec.	4,25 po	5,5 po	17,8 po
PDC-10G	60-B.C.	10 pi - 15 pi	10 lb	17 - 20 sec.	5,5 po	9 po	20 po
PDC-20G	120-B.C.	12 pi - 18 pi	20 lb	26 - 30 sec.	7 po	10 po	24 po

Bill William's Corporation

Cabinet — Modèle 927-8



✔	Cabinet:	-To receive a fire extinguisher which contains dry chemical of 10lb or 2½ gallons of water or 20 lbs
✔	Dimensions:	-9" x 27" x 8" (228 x 686 x203 mm)
✔	Door:	-Full glace viewing panel
✔	Box:	An 18 caliber with facade of 18 caliber
✔	Facade:	-Riveted to the box, styled hinges like a "piano", 180 degrees opening door, cabinet paddle latch
✔	Finish:	-Grey baked enamel finish

OPTIONS

☐	-Break glass door and lock
☐	-Full metal doors
☐	-Stainless steel 304 satin finish N° 4
☐	-Other finishes available
☑	6 M.M. WIRED GLASS

dg 24.2

Chapter 25 GENERATOR CONTROL

MANUFACTURER/DISTRIBUTOR:

Westburne Québec (CUTLER-HAMMER)
890 Munck,
Vimont, QC
PONE. : 450-663-5333

MANUFACTURER/DISTRIBUTOR:

ENERTEC (BATTERY CHARGER)
2284, CHEMIN ST-FRANCOIS
DORVAL,QUE. H9P 1K2
PH:514-421-7077 FAX:7078

MANUFACTURER/DISTRIBUTOR:

VENTIL EXPERT
9855, LOUIS-H LAFONTAINE
ANJOU,MTL.QUE.
H1J 2A3
PH:514-355-4540 FAX:4346

25.1 ROBONIC AUTOMATIC TRANSFER SWITCH

25.2 GENERATOR ROOM DAMPERS

25.3 FUEL DAY TANK(ZCL COMPOSITES)

25.4 T775E REMOTE TEMPERATURE CONTROLLER HONEYWELL

25.5 BELIMO DAMPERS ACTUATOR AF24-RS (MORE ON CD)

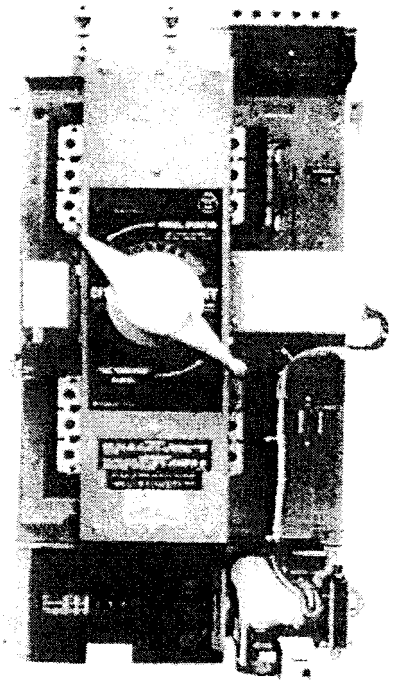
25.6 ENERTEC AUTOMATIC BATTERY CHARGER (24 VOLTS).

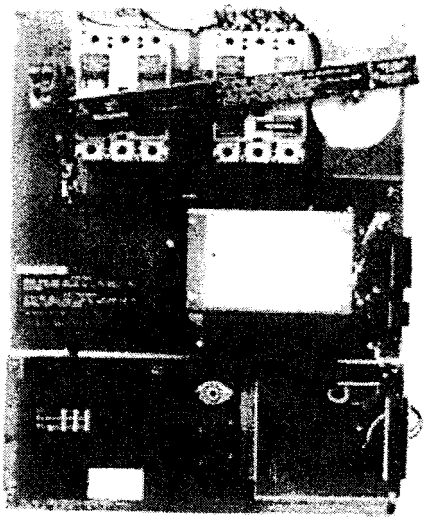
END OF CHAPTER 25

Robonic Automatic Transfer Switches Operation and Maintenance Manual

Instruction leaflet
IL 30-471 (E)

November, 1995
Supersedes issue dated October, 1994





CUTLER-HAMMER CANADA
→Cutler-Hammer Products
Burlington, Ontario

INDEX

Robonic TRANSFER SWITCH

1/23 pages

WARRANTY

The Company warrants the apparatus to be supplied hereunder to be of the kind designated or specified. The Company shall repair or replace any defective part or parts, f.o.b. the Company's factory, repair shop or warehouse, which prove to be defective under normal and proper use within one year from the date of shipment, provided that the Purchaser gives the Company immediate written notice of any such defect or defects. In no event (including, but not limited to the negligence of the Company, its employees or agents) shall the Company be liable for special or consequential damages or damages for loss of use and on expiration of the Warranty period, any liability of the Company shall terminate. This constitutes the only warranty of the Company and no other warranty or condition, statutory or otherwise, shall be implied.

IMPORTANT

'Check equipment for shipping damage immediately on receipt. In case of damage call the carriers concerned at once for inspection, and request an inspection report. Do not write to us first - notify the carrier instead. If this precaution is not taken we cannot assist you in recovering the amount of the claim against the carrier.'

GENERAL DESCRIPTION

CSA Standard C22.2 No. 178-1978 defines an automatic transfer switch as, "self acting equipment for transferring one or more load conductor connections from one power source to another." The same Standard also gives definitions for type A and type B automatic transfer switches.

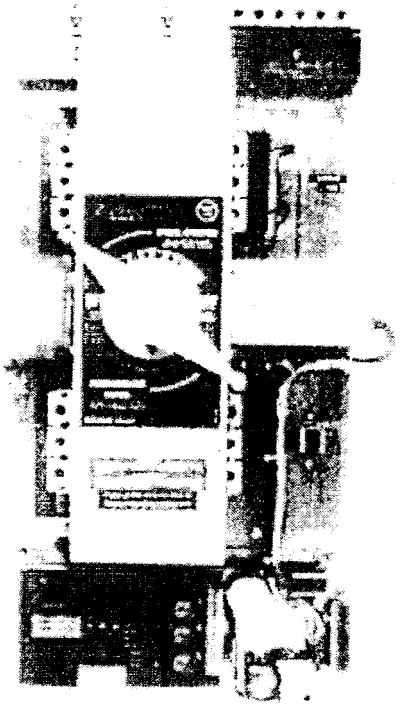
"Transfer switch type A means an automatic transfer switch that does not employ integral overcurrent devices." "Transfer switch, type B means an automatic transfer switch that (does) employ integral overcurrent protection." Westinghouse Robonic automatic transfer switches are available in both types. Robonics in type A are equipped with special instantaneous magnetic only interrupter. The trip settings of these special interrupters are set (and fixed) at higher than standard values. They are intended to trip only if the upstream protective device fails to clear a fault. Incorporating these special magnetic only interrupters, a type A Robonic operates in exactly the same way as a transfer switch not having this feature. In the event that both devices trip, the Robonic's control circuitry will automatically initiate transfer to the alternate source. The transfer operation will reset the "tripped" magnetic only interrupter. Information on Interrupting, Closing and Withstand ratings, for type A Robonics, are given in table 1 on page 5. Type B 'Robonics' are equipped with standard thermal-magnetic breakers which will provide the required overload and short circuit protection. Type B Robonics can also be built using electronic breakers which could include ground fault tripping as well as overload and short circuit protection. For application information or assistance with type B Robonics, refer to Cutler-Hammer.

The Robonic provides automatic transfer of an electrical load to a standby power supply in the event of drop or loss of voltage of any or all phases of the normal power supply. Upon the restoration of the normal supply, the electrical load is automatically retransferred to the normal power supply.

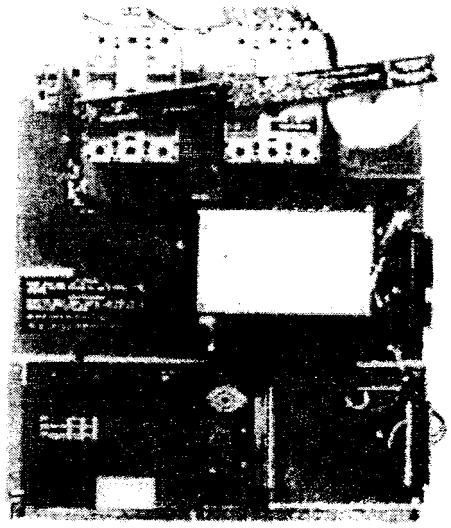
The transfer motor utilizes the power from the source to which the electrical load is being transferred. The mechanism provides a positive mechanical interlock to prevent both breakers being closed at the same time. The mechanism is also designed to leave both breakers trip free in the closed position, permitting incorporation of thermal and short-circuit protection in either or both breakers. In the higher ampacity, type B 'Robonics' models, type RO and SPB type an alarm switch contact is supplied. This contact is connected in the transfer motor circuit to lock the motor circuit out of operation when the breaker(s) trip on an overload or short-circuit condition. Then the breaker has to be manually reset. Instructions for the reset procedure are located on the front of the operating mechanism.

All of the control modules in the Solid State Logic Control Panel are plug-in units which are easily replaced.

MECHANICAL COMPONENT IDENTIFICATION



Type RO



Type LRO

TYPE "LRO" ROBONIC AUTOMATIC TRANSFER SWITCH

Rated 30 amperes through 100 amperes at 600 volts Ac maximum 50 or 60 Hertz.

The mechanism is a lever operated device controlled by a 120 volt unidirectional motor.

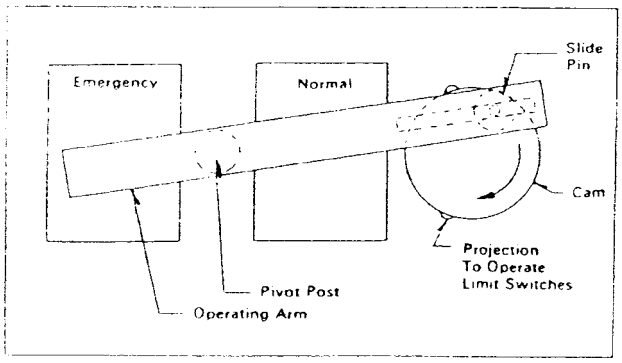
The transfer motor drives a nylon cam which in turn operates a steel lever by sliding a pin along a slot in the back of the lever. The lever, in turn, operates the two breaker handles.

In type A 'LRO Robonics' there are two micro switches (NLS, ELS) inside the breakers which are operated by the breaker's main contacts to disconnect the transfer motor power supply and allow the brake to operate. In type B' LRO Robonics' the distance travelled is determined by two projections on the cam. These projections operate two micro switches (NLS, ELS) which in turn disconnect the power to the transfer motor causing a brake to operate.

The type LRO has three operating positions. They are the normal breaker closed and the emergency breaker open, the emergency breaker closed and the normal breaker open or both the normal and emergency breakers open but never both normal and emergency breakers closed.

The type LRO can also be easily manually operated. Open the lever cover, remove the slide pin and place it in the hole supplied in the lever cover and close the cover. Then the lever can be manually operated for whatever position desired without interference by the automatic control. For automatic control again, simply align the lever slot with the hole in the operating cam and replace the slide pin.

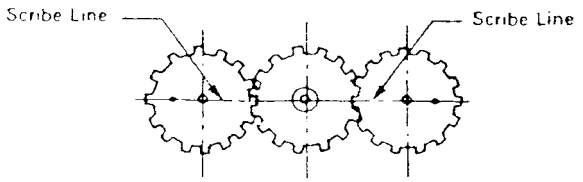
The various automatic control components are described under the section titled "Logic Control".



TYPE "RO" ROBONIC AUTOMATIC TRANSFER SWITCH

A complete line rated from 150 amperes through 1000 amperes at 600 volts Ac 50 or 60 Hertz.

The transfer mechanism consists of the transfer motor, a gear train and two breaker operating cams.



SPUR GEAR MESHING RELATIONSHIP
(Bottom View of Top Cover)

The transfer motor drives the center gear which in turn operates the two secondary gears. There is a projection in the secondary gears which slides in a groove in the operating cams moving the cams from side to side. The breaker handles are set inside two outer guides of the cam and are also moved from side to side. There are two micro switches (NLS, ELS) inside the breakers which are operated by the breaker's main contacts to disconnect the transfer motor power supply and allow the brake to operate.

The type "RO" transfer switch has three operating positions, the normal breaker closed and the emergency breaker open, the emergency breaker closed and the normal breaker open or both the normal and the emergency breakers open but never both the normal and emergency breakers closed at the same time.

The type "RO" transfer switch is also easy to operate manually. Simply remove the transfer motor fuse and turn the operating handle on the front of the transfer mechanism in a counter clockwise direction until you hear the breakers operated and the indicator is in the desired position. There will be no interference from the solid state control. For automatic control again, replace the transfer motor fuse and the Robonic transfer switch will seek the power available.

The various control components are described under the sections titled Logic Control Panels.

TYPE "SPB" ROBONIC AUTOMATIC TRANSFER SWITCH

Rated 1200 amperes through 3000 amperes at 600 volts Ac, 50 or 60 Hertz.

The SPB Automatic Transfer Switch consists of two basic elements:

1. The power switching panel contains the main power contacts and transfer mechanism. The main power contacts connect and disconnect the load to and from the sources of power. The transfer operation is accomplished by the electrically driven, stored energy mechanism of the Systems Pow-R Devices.

2. The logic control panel provides the intelligence/supervisory circuits which constantly monitor the condition of the power sources thus providing the intelligence necessary for the operation of the transfer switch.

The transfer mechanism is energized electrically from the available source and both breakers read "charged" indicating transfer switch is ready for transfer operation. The transfer switch is prepared for the next operation after electrical charging which takes only three seconds after transfer. Manual charging is available if for any reason the transfer switch is not energized. This is done by making either four full strokes on the charging handle, or several partial inching strokes. The transfer switch then can be manually operated.

The switching devices are interlocked to prevent them from being ep, closed at the same time. This is done by means of two mechanical interlocks. Each interlock is connected between the tripping (opening) mechanism of one device and the latching (closing) mechanism of the other device. Therefore if one device is closed its interlock will prevent the other from latching and closing. Both devices cannot be simultaneously connected to the load by either electrical or manual means.

Auxiliary switches are used in remote control circuits for interlocks, indicating lights, and signal contacts to indicate the open or closed position of the breaker main contacts.

The type "SPB" transfer switch has three operating positions, the normal breaker closed and the emergency breaker open, the emergency breaker closed and the normal breaker open or both the normal and the emergency breakers open but never both the normal and emergency breakers closed at the same time.

The type "SPB" Robonic Automatic Transfer Switch is also easy to operate manually.

MANUAL OPERATION FROM NORMAL TO EMERGENCY:

For SPB Automatic Transfer Switches with the four position selector switch, isolate the transfer circuit and engine starting circuit by placing the "FPSS" in the "OFF" position.

For SPB Automatic Transfer Switches without the four position selector switch, isolate the transfer circuit by disconnecting the two inter-connection plugs. Once that is done, push the red "Pushto-Open" button on the Normal Breaker (NB) to open the breaker, then push the green "Push-to-Close" button on the Emergency Breaker (EB) to close the breaker.

With normal source power available, the transfer switch will return to normal when the "FPSS" is returned to the "AUTO" position or when the two control plugs are re-connected.

The various control components are described under the section titled "Logic Control".

Since type A Robonics employ magnetic only breakers, their interrupting, closing and withstand ratings are the same value. Under fault conditions, with its "normal" breaker closed, a Robonic is required to withstand the energy let through of the normal service protective device while the fault is being cleared. At the same time, should the normal voltage fall below the voltage sensing relay's selected value, - and if the alternate source were available, the Robonic could transfer before the normal service protective device cleared the fault.

This would require that the Robonic be capable of interrupting the protective device's let through current. In addition, the Robonic could be required to close in on a fault. Thus can be seen the need for Robonics to have, interrupting, closing and withstand ratings.

The interrupting, closing and withstand ratings shown in Table 1 are those for standard typea Robonics. For higher values, consideration can be given to use of Robonics built with Tri-Pac or Current Limiting breakers.

Table I **Interrupting, Closing and Withstand Rating - Robonic Type A**

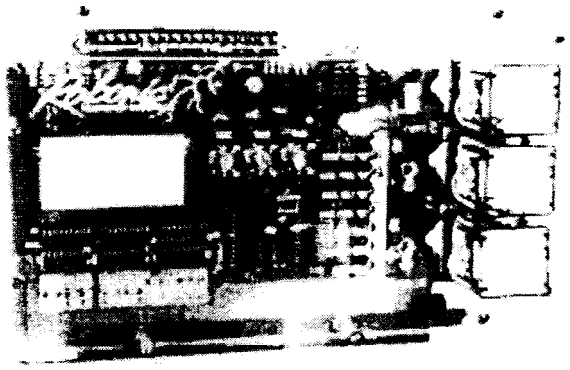
Robonic Continuous Rating	Type	rms symmetrical amperes		
		600 Vac	480 Vac	120,208,240 Vac
30 to 100 amps	LRO	25,000	65,000	100,000
150 to 400 amps	RO	35,000	65,000	100,000
600 lo 1000 amps	RO	25,000	35,000	65,000
1200 to 3000 amps	SPB	85,000	100,000	100,000

Table 2 - Recommended Upstream Circuit Protective Device for e A Robonics, All Classes of Loads

Robonic		Maximum Upstream	Maximum Upstream Fuse-Rating*	
Type	Continuous Rating (amps)	Breaker Frame Size	Class J or L	Class K5 or R
LRO	30	HFD, FDC, HJD, JDC, FB-P	100	100
LRO	70		100	100
LRO	100		100	100
RO	150	JDC, HKDL, HKD, KDC, HLD, LDC,	225	225
RO	200	LA-P	225	225
RO	225	HKD, KDC, HLD, LDC, LA-P	225	225
	250	HKD, KDC, HLD, LDC, LA-P	400	400
RO	300	HKD, KDC, HLD, LDC, LA-P	400	400
RO	400	HLA, HLC, LD, HLD, NB-P	400	400
RO	600	HMA, HMC, HMD, ND, HND, HNB, NB-P	600	600
RO	800	HNB, ND, HND, HNC, PB, PC, PB-P	800	....
RO	1000	PB, PC, PB-P	1200	....
SPB	800, 1200	PB, PC, PB-P, SPB	2000 (L)	....
SPB	1600, 2000	PB, PC, SPB	3000 (L)	....
SPB	2000, 3000	SPB	4000 (L)	....

*Fuse ratings given are as allowed by CEC. If other ratings are desired, refer to CEC.

MICROPROCESSOR BASED LOGIC CONTROL PANEL



INTRODUCTION

Cutler Hammer's Westinghouse brand of Automatic Transfer Switch Single Board Controller is a microcontroller based transfer switch logic control package. The hardware and software of the controller contains the intelligence / supervisory circuits which constantly monitor the condition of the power sources. It provides the intelligence necessary for the operation of the transfer switch. The single board controller may be used as a replacement for the solid state logic control panel in the existing older version of the Robonic Transfer Switches.

SPECIFICATION

The ATS controller has an operating temperature range of -20 deg. C to +75 deg. C.

The controller circuit board is protected by an insulating conformal coating.

The specification under normal operating condition are as follows:

Tolerance for Voltage Sensing function: +/-2% of setting.
Tolerance for Frequency Sensing function: +/-0.2 Hz of setting.
Accuracy of Time Delay Range: +/-2% of setting.
Dial settings for Delay Time are +/-5% of indication.

OVERALL FUNCTIONAL DESCRIPTION

There are four main groups of functions included in the ATS single board controller.

1. Voltage Sensing Functions

Choices of voltage sensing functions are selectable for Normal and Emergency sources as follows by means of factory programming.

- 1 phase or 3 phase sensing
- Either or both the undervoltage and overvoltage sensing.

Dip switches are used to select the pickup and dropout points for Normal UV, Normal OV, Emergency UV and Emergency OV functions.

For undervoltage sensing function:

- Available pickup settings: 100%, 95%, 90% and 85% of normal;
- Available dropout settings: 5%, 10%, 15%, and 20% from pickup setting.

For overvoltage sensing function:

- Available pickup settings: 105%, 110%, 115% and 120% of normal;
- Available dropout settings: 5%,10%, 15% and 20% from pick-up setting.

2. Frequency Sensing Functions

The controller can be programmed to include either or both the Underfrequency and Overfrequency sensing for the Normal and Emergency Sources.

Dip switches are used to select the normal frequency of the power sources and the pickup points.

The normal frequency settings are 50 Hz or 60 Hz. The dropout points are fixed at 2 Hz differential.

Available pickup settings for the under frequency function are:

- at 60 Hz nominal = 56, 57, 58, 59 Hz
- at 50 Hz nominal = 46, 47, 48, 49 Hz.

Available pickup settings for the over frequency function are:

- at 60 Hz nominal = 61, 62, 63, 64 Hz
- at 50 Hz nominal = 51, 52, 53, 54 Hz.

3. Time Delay Functions

The controller can be programmed to include three different time delay functions - TDNE, TDEN and TDEC. Each timing function has four different timing ranges as shown below. It can be set to any one of the ranges by moving the appropriate dip switches.

- 0.1 sec. to 60 sec.
- 0.16 min. to 10 min.
- 1 min. to 60 min.
- 3 min. to 200 min.

4. On Board Indicators

Ten 'LED" type indicators are installed on the controller's circuit board for the following functions.

Norm Volt	-- LED on indicates the voltage level of the Normal Source is within preset limits.
Norm. Freq	-- LED on indicates the frequency of the Normal Source is within preset limits. -- LED flashes indicate the frequency of the Norma(Source is out of preset limits. -- LED off indicates the Normal frequency sensing option is not installed.
Emer. Volt	-- LED on indicates the voltage level of the Emergency Source is within preset limits.
Emerg. Freq	-- LED on indicates the frequency of the Emergency Source is within preset limits. -- LED flashes indicate the frequency of the Emergency Source is out of preset limits. -- LED off indicates the Emergency frequency sensing option is not installed.
TDNE RUN	-- LED flashes indicate TDNE time delay function is in progress.
TDEN RUN	-- LED flashes indicate TDEN time delay function is in progress.
TDEC RUN	-- LED flashes indicate TDEC time delay function is in progress.
NR ON	-- LED on indicates the output relay NR is energized.
ER ON	-- LED on indicates the output relay ER is energized.
ECR ON	-- LED on indicates the output relay ECR is energized.

ON-BOARD PROGRAMMABLE OPTIONS

ATS Single Board controller can be pre-programmed in the factory with the following ATS control functions on board:

1) Undervoltage sensing on Normal Source
2) Overvoltage sensing on Normal Source
3) Underfrequency sensing on Normal Source
4) Overfrequency sensing on Normal Source.
5) Undervoltage sensing on Emergency Source
6) Overvottage sensing on Emergency Source
7) Underfrequency sensing on Emergency Source
8) Overfrequency sensing on Emergency Source
9) Time Delay Normal to Emergency
10) Time Delay Emergency to Normal
11) Time Delay Engine Cool Down
12) Preferred Source Selection

If a Robonic transfer switch has been installed in the field, any of these options/functions can be added on site by using the factory programmed "Option Key". Once the choice options are activated by the installed "option key"; the parameter of each function can be setup by positioning the DIP switches labelled SW1, SW2 and SW3 on the controller circuit board. This allows easy field modification of the control parameter settings at the user's discretion.

Both the pickup, dropout values of the sensing functions and the timing ranges of the time delay functions may be easily changed by following the instructions provided in the later sections.
Controllers shipped from the factory are programmed to the user's original specification or to the standard pickup and dropout values as follows:

FUNCTION	PICKUP	DROPOUT
Undervoltage	90%	80%
Overvoltage	105%	115%
Underfrequency (60Hz)	58 Hz	56 Hz
Overfrequency (60Hz)	62 Hz	64 Hz
Underfrequency (50Hz)	48 Hz	46 Hz
Overfrequency (50Hz)	52 Hz	54 Hz

Operating Note:

If the controller is to be used as a replacement for the solid state logic control package in an existing Robonic transfer switch, please check the style number labelled on the transformer module. For the Robonic 11 with a control transformer module style No. marked as 16OD997GO1--G24, please replace it with transformer module with style No.3932D65GO1--G26.

CAUTION:

If the controller is to be used for THREE PHASE sensing, you must insure that the sensing signals (Normal or Emergency) are fed by a three phase transformer package. On the Westinghouse brand three phase units sold by Cutler Hammer, the standard is three phase sensing on NORMAL, and single phase sensing on EMERGENCY.

THREE PHASE SENSING ON EMERGENCY IS AVAILABLE ONLY ASA FACTORY INSTALLED OPTION. If in doubt, please contact the factory for assistance.

Instruction for DIP Switch Setting

The DIP switches located and accessed from the bottom-left portion of the control board must be property set according to application requirements. The three DIP switches are labelled from left to right as SW1, SW2 and SW3. All switches are turned ON or OFF by sliding the switch. As you face the DIP switches, slide:

- > To the TOP to turn the switch ON
- > To the BOTTOM to turn the switch OFF

Always look for the ON and OFF designations on the hardware or printed circuit board to be sure you are setting the switches correctly.

The following table shows the selection groupings that can be provided by the three DIP switches.

DIP Switch	Side Switch	Description
SW1	1 2 3 4	Pickup and Dropout values selection for the Normal Source UNDERVOLTAGE SENSING. Refer to Table I
	5 6 7 8	Pickup and Dropout values selection for the Normal Source OVERVOLTAGE SENSING. Refer to Table 2
	9	Line frequency selection ON=60 Hz OFFHz
SW2	1 2 3 4	Pickup and Dropout values selection for the Emerg, Source UNDERVOLTAGE SENSING. Refer to Table 3
	5 6 7 8	Pickup and Dropout values selection for the Emerg, Source OVERVOLTAGE SENSING. Refer to Table 4.
SW3	9 1	Pickup and Dropout values selection for the Normal source Underfrequency or/and Overfrequency sensing. Refer to Table 5 and 6.
	2 3	Pickup and Dropout values selection for the Emerg. source Underfrequency or/and Overfrequency sensing. Refer to table 7 and 8.
	4 5	Delay Timing Ranges selection for TDNE function. Refer to Table 9
	6 7	Delay Timing selection for TDEN function. Refer to Table 10.
	8 9	Delay Timing Ranges selection for TDEC function. Refer to Table 11.

NOTE: Table 12 serves as a quick reference for finding the actual voltage level that relates to the percentage of the normal system voltage.

NORMAL SOURCE
Undervoltage Sensing Programming

Table 1
Undervoltage Pickup and Dropout

Pickup (%)	Dropout (%)	SW1-1	SW1-2	SW1-3	SW1-4
100	95	ON	ON	ON	ON
	90	ON	ON	OFF	ON
	85	ON	ON	ON	OFF
	80	0N	0N	0FF	0FF
95	90	OFF	ON	ON	ON
	85	OFF	ON	ON	ON
	80	OFF	ON	OFF	OFF
	75	OFF	ON	OFF	OFF
90	85	ON	OFF	ON	ON
	80	ON	OFF	OFF	ON
	75	ON	OFF	ON	OFF
	70	ON	OFF	OFF	OFF
85	80	OFF	OFF	ON	ON
	75	OFF	OFF	OFF	ON
	70	OFF	OFF	ON	OFF
	65	OFF	OFF	OFF	OFF

EMERGENCY SOURCE
Undervoltage Sensing Programming

Table 3
Undervoltage Pickup and Dropout

Pickup (%)	Dropout (%)	SW2-1	SW2-2	SW2-3	SW2-4
100	95	ON	ON	ON	ON
	90	ON	ON	OFF	ON
	85	ON	ON	ON	OFF
	80	0N	0N	0FF	0FF
95	90	OFF	ON	ON	ON
	85	OFF	ON	ON	ON
	80	OFF	ON	OFF	OFF
	75	OFF	ON	OFF	OFF
90	85	ON	OFF	ON	ON
	80	ON	OFF	OFF	ON
	75	ON	OFF	ON	OFF
	70	ON	OFF	OFF	OFF
85	80	OFF	OFF	ON	ON
	75	OFF	OFF	OFF	ON
	70	OFF	OFF	ON	OFF
	65	OFF	OFF	OFF	OFF

Overvoltage Sensing Programming

Table 2
Overvoltage Pickup and Dropout

Pickup (%)	Dropout (%)	SW1-5	SW1-6	SW1-7	SW1-8
105	110	ON	ON	ON	ON
	115	ON	ON	OFF	ON
	120	ON	ON	ON	OFF
	125	0N	0N	0FF	0FF
110	115	OFF	ON	ON	ON
	120	OFF	ON	OFF	ON
	125	OFF	ON	OFF	OFF
	130	OFF	ON	ON	OFF
115	120	ON	OFF	ON	ON
	125	ON	OFF	OFF	ON
	130	ON	OFF	ON	OFF
	135	ON	OFF	OFF	OFF
120	125	OFF	OFF	ON	ON
	130	OFF	OFF	OFF	ON
	135	OFF	OFF	ON	OFF
	140	OFF	OFF	OFF	OFF

Overvoltage Sensing Programming

Table 4
Overvoltage Pickup and Dropout

Pickup (%)	Dropout (%)	SW2-5	SW2-6	SW2-7	SW2-8
105	110	ON	ON	ON	ON
	115	ON	ON	OFF	ON
	120	ON	ON	ON	OFF
	125	0N	0N	0FF	0FF
110	115	OFF	ON	ON	ON
	120	OFF	ON	OFF	ON
	125	OFF	ON	OFF	OFF
	130	OFF	ON	ON	OFF
115	120	ON	OFF	ON	ON
	125	ON	OFF	OFF	ON
	130	ON	OFF	ON	OFF
	135	ON	OFF	OFF	OFF
120	125	OFF	OFF	ON	ON
	130	OFF	OFF	OFF	ON
	135	OFF	OFF	ON	OFF
	140	OFF	OFF	OFF	OFF

ORMAL SOURCE
Underfrequency Sensing Programming

Table 5
Underfrequency Pickup and Dropout

Pickup (Hz)	Dropout (Hz)	SW2-9	SW3-1
59	57	ON	ON
58	56	OFF	ON
57	55	ON	OFF
56	54	OFF	OFF
49	47	ON	ON
48	46	OFF	ON
47	45	ON	OFF
46	44	OFF	OFF

Overfrequency Sensing Programming

Table 6
Overfrequency Pickup and Dropout

Pickup (Hz)	Dropout (Hz)	SW2-9	SW3-1
61	63	ON	ON
62	64	OFF	ON
63	65	ON	OFF
64	66	OFF	OFF
51	53	ON	ON
52	54	OFF	ON
53	55	ON	OFF
54	56	OFF	OFF

NOTE:
Underfrequency sensing and/or Overfrequency sensing functions may be programmed into the ATS Controller through the "Option Program Key". In the case which both "Uf" and Of" Sensing functions are activated, the same DIP switch settings will be applied to both functions. Two equivalent sizes of sensing hysteresises will be assigned to below and above the system line frequency respectively.

EMERGENCY SOURCE
Underfrequency Sensing Programming

Table 7
Underfrequency Pickup and Dropout

Pickup (Hz)	Dropout (Hz)	SW3-2	SW3-3
59	57	ON	ON
58	56	OFF	ON
57	55	ON	OFF
56	54	OFF	OFF
49	47	ON	ON
48	46	OFF	ON
47	45	ON	OFF
46	44	OFF	OFF

Overfrequency Sensing Programming

Table 8
Overfrequency Pickup and Dropout

Pickup (Hz)	Dropout (Hz)	SW3-2	SW3-3
61	63	ON	ON
62	64	OFF	ON
63	65	ON	OFF
64	66	OFF	OFF
51	53	ON	ON
52	54	OFF	ON
53	55	ON	OFF
54	56	OFF	OFF

NOTE:
Underfrequency sensing and/or Overfrequency sensing functions may be programmed into the ATS Controller through the "Option Program Key". In the case which both "Uf" and Of" Sensing functions are activated, the same DIP switch settings will be applied to both functions. Two equivalent sizes of sensing hysteresises will be assigned to below and above the system line frequency respectively.

DELAY FUNCTION PROGRAMMING

TDNE - Time Delay Normal To Emergency

Table 9
TDNE Range Select

RANGE	SW3-4	SW3-5
0.1 sec. to 60 sec.	ON	ON
0.16 min. to 10 min.	OFF	ON
1.0 min. to 60 min.	ON	OFF
3.0 min. to 200 min.	OFF	OFF

TDEN - Time Delay Emergency To Normal

Table 10
TDEN Range Select

RANGE	SW3-6	SW3-7
0.1 sec. to 60 sec.	ON	ON
0.16 min. to 10 min.	OFF	ON
1.0 min. to 60 min.	ON	OFF
3.0 min. to 200 min.	OFF	OFF

TDEC - Time Delay Engine Cool Down

Table 11
TDEC Range Select

RANGE	SW3-8	SW3-9
0. 1 sec. to 60 sec.	ON	ON
0.16 min. to 10 min.	OFF	ON
1.0 min. to 60 min.	ON	OFF
3.0 min. to 200 min.	OFF	OFF

Table 12
Normal System Voltage

	120	208	220	240	380	400	415	480	600	
65%	78	135	143	156	247	260	270	312	390	
70%	84	146	154	168	266	280	291	336	420	
75%	90	156	165	180	285	300	311	360	450	
80%	96	166	176	192	304	320	332	384	480	Std. UV Dropout
85%	102	177	187	204	323	340	353	408	510	
90%	108	187	198	216	342	360	374	432	540	Std. UV Pickup
95%	114	198	209	228	361	380	394	456	570	
100%	120	208	220	240	380	400	415	480	600	
105%	126	218	231	252	399	420	435	504	630	Std. OV Pickup
110%	132	229	242	264	418	440	457	528	660	
115%	138	239	253	276	437	460	477	552	690	Std. OV Dropout
120%	144	249	264	288	456	480	498	576	720	
125%	150	260	275	300	475	500	519	600	750	
130%	156	270	286	312	494	520	540	624	780	
135%	162	281	297	324	513	540	560	648	810	

ADDING EXTRA ON-BOARD PROGRAMMABLE OPTIONS:

When it is desired, extra on-board programmable control options can be added to a Robonic with the single board controller. The list of the installable on-board options are as follows;

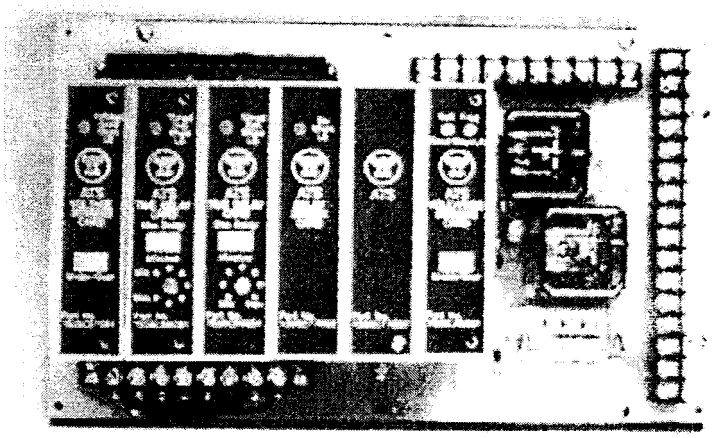
1. Overvoltage sensing on Normal Source.
2. Underfrequency sensing on Normal Source.
3. Overfrequency sensing on Normal Source.
4. Overvoltage sensing on Emergency Source.
5. Overfrequency sensing on Emergency Source.
6. Time Delay Normal to Emergency.
7. Time Delay Emergency to Normal.
8. Time Delay Engine Cool Down.
9. Preferred Source Selection.

After the factory programmed "Option Key" which contains the choice option(s) and the associated parts, if required, are received, turn off the Normal Source and make sure to disable the Emergency Source by turning the Gen set start control to manual. Plug the 'Option Key" into the 1 0-pin socket (J2) that is located in the centre of the controller circuit board. The Key is not polarized and can be plugged in either way. Install any extra parts if supplied. Turn the Normal Source back on. The new option function(s) will be programmed into the single board controller.

NOTE:

The DIP switches located and accessed from the bottom-left portion of the control board must be properly set according to application requirements for the added control option(s). Please refer to the section that contains the instruction for DIP Switch Setting.

SOLID STATE LOGIC CONTROL PANEL



LOGIC CONTROL
VOLTAGE SENSING MODULE

Style Number 782OC97GO1

The module can be programmed to use with 1Ø or 3Ø systems and perform either the undervoltage or the overvoltage sensing function. It is applicable to both emergency and normal source monitoring.

1Ø Undervoltage 3Ø Undervoltage
For undervoltage sensing, this card is normally set at an 80% dropout and a 90% pickup.

1Ø Overvoltage 3Ø Overvoltage
For overvoltage sensing, this card is normally set at a 105% pickup and a 115% dropout.

COMBINATION VOLTAGE/ FREQUENCY SENSING MODULE

Style Number 782OC99GO1

The module is designed for use with 1Ø or 3Ø systems and can be programmed for either undervoltage or overvoltage and either Underfrequency or Overfrequency. It is applicable to both emergency and normal source monitoring.

1Ø Undervoltage 3Ø Undervoltage
For undervoltage sensing, this card is normally set at an 80% dropout and a 90% pickup.

1Ø Overvoltage 3Ø Overvoltage
For overvoltage sensing, this card is normally set at a 105% pickup and a 115% dropout.

1Ø Underfrequency 1Ø Overfrequency
For underfrequency or overfrequency sensing, the card is factory calibrated at 50 or 60 Hz. The standard values of pickup and dropout are as follows:

Type	System Frequency Hz	Pickup Hz	Dropout Hz
Underfrequency	60	58	56
Underfrequency	50	48	46
Overfrequency	60	62	64
Overfrequency	50	52	54

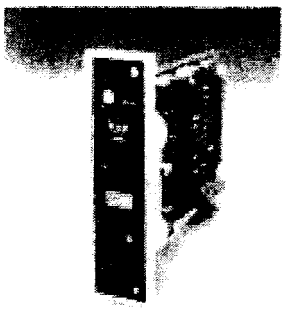
TIME DELAY MODULE

Style Number 782OC96GO1

Module can be programmed for any one of five timing ranges:

1 - 60 sec. timer
4 -240 sec. timer
0.13- 8 min. timer
0.5 - 32 min. timer
1 - 64 min. timer

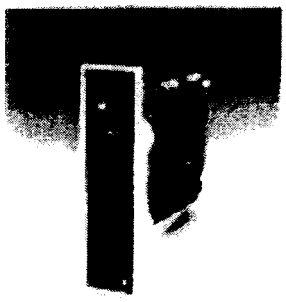
All can be used to accomplish TDEC, TDEN and TDNE functions.



RELAY DRIVER

Style Number 1266C77GO2

This card is used in place of any of the timing modules when instantaneous operation is required.



BLANK

Style Number 1266C77GO1

Use to cover any unused card slots.

All Cards Mechanically Interlocked

All cards are interlocked mechanically to prevent insertion into the wrong function slot. All cards have a repeat accuracy over a 20 to + 60°C temperature change of ± 3%. Dial settings are ± 10% of indication.

After making adjustments, tighten mounting screws (screws are not captive).

Programming and adjustments for plug-in sensing ntrol modules.

TIME DELAY MODULE

Style Number 782OC96GO1

The Timer Card is a multi-range timer. The card may be used as a replacement for older single range timer cards in existing equipment.

The card may be "programmed" for any one of five timing ranges by simply moving a jumper to the appropriate position. The actual time desired is then set with a front accessible potentiometer.

Programming the Timer Card

1. If the Timer Card must be removed from a Transfer Switch that is in service, it is a good idea to disable the logic first by separating the logic disconnect plug, so that a possibly undesired transfer is avoided.

   CAUTION: Disconnecting the logic WILL cause the Engine Generator to start unless it has been disabled.

2. The card is supplied with a single jumper, which must be placed on the Range Select Terminals as follow:

RANGE SELECT	TIMING RANGE *
1	1 - 60 Seconds
4	4 - 240 Seconds (.07 - 4 Min.)
8	8 - 480 Seconds (.13 - 8 Min.)
32	.5 - 32 Minutes
64	1 - 64 Minutes

*NOTE: Timing ranges shown are guaranteed. Actual available range may be slightly larger.

VOLTAGE SENSING MODULE

Style Number 782OC97GO1

The card may be used as a replacement for older versions of the plug-in cards in existing equipment.

The card may be "programmed" to perform a voltage sensing function, either undervoltage or overvoltage.

Programming of the card is accomplished by positioning jumpers on the positions labelled J1 through J7 on the board itself. This allows easy filed modification of the card at the user's discretion. Both the function and the pickup and dropout values may be easily changed by following the instructions provided.

Cards shipped from the factory are programmed to the user's original specification, or to the standard pickup and dropout values as follows:

FUNCTION	PICKUP	DROPOUT
Undervoltage	90%	80%
Overvoltage	105%	115%

Programming the card

Reprogramming of the card may be accomplished by using the attached instructions with Table 13 and 14 or Table 13A and 14A.

It is recommended that you remove ALL jumpers from JI through J7. As supplied from the factory there are erictigh jur-npers to program the card for any function and value.

The card may be programmed for either UNDERVOLTAGE or OVERVOLTAGE. Attempting to program the card for both voltage sensing functions at the same time **WILL CAUSE THE CARD TO MALFUNCTION AND POSSIBLY DAMAGE THE ELECTRONICS ON THE CARD!!**

NOTE:
If the card is to be used as a replacement for older versions of the plug-in cards in existing equipment, please check the Date Code that is stamped on the nameplate of the Control Transformer Module (16OD997GO1-G24).

* For Robonics with control transformer module's date code dated AFTER Sept. 1/92, follow Table 13 and 14 to program the voltage sensing function.

* For Robonics with control transformer module's date code dated BEFORE Sept. 1/92, follow Table 13A and 14A to programme the sensing function.

COMBINATION VOLTAGE/FREQUENCY SENSING MODULE

Style No. 782OC99GO1

The card may be used as a replacement for older versions of the plug-in cards in existing equipment.

The card may be "programmed" to perform a voltage sensing function, either undervoltage or overvoltage; and a frequency sensing function, either underfrequency or overfrequency.

Programming of the card is accomplished by positioning jumpers on the positions labeled JI through J12 on the board itself. This allows easy field modification of the card at the user's discretion. Both the function and the pickup and dropout values may be easily changed by following the instructions provided.

Cards shipped from the factory are programmed to the user's original specification, or to the standard pickup and dropout values as follow:

FUNCTION	PICKUP	DROPOUT
Undervoltage	90%	80%
Overvoltage	105%	115%
Underfrequency (60 Hz)	58 Hz	56 Hz
Overfrequency (60 Hz)	62 Hz	64 Hz
Underfrequency (50 Hz)	48 Hz	46 Hz
Overfrequency (50 Hz)	52 Hz	54 Hz

Programming the card

Reprogramming of the card may be accomplished by using the attached instructions with table 13, 14, 13A, 14A, 15 and 16.

It is recommended that you remove ALL jumpers from JI through J12. As supplied from the factory, there are enough jumpers to program the card for any function and value.

The card may be programmed for either UNDERVOLTAGE or OVERVOLTAGE, and either UNDERFREQUENCY or OVERFREQUENCY. Attempting to program the card for two voltage sensing or two frequency functions ... **WILL CAUSE THE CARD TO MALFUNCTION AND POSSIBLY DAMAGE THE ELECTRONICS ON THE CARD!!**

NOTE:
If the card is to be used as a replacement for older versions of the plug-in cards in existing equipment, please check the Date Code that is stamped on the nameplate of the Control Transformer Module (16OD997GO1 - G24).

* For Robonics with control transformer module's date code dated AFTER Sept. 1/92, follow Table 13 and 14 to program the voltage sensing function.

* For Robonics with control transformer module's date code dated BEFORE Sept. 1/92, follow Table 13A and 14A to program the voltage sensing function.

UNDERVOLTAGE PROGRAMMING

1. Place a jumper on J6.
2. Insure that there is NOT a jumper on J7.
3. Choose the desired pickup and dropout values from TABLE 13 and place jumpers on the pins indicated.
4. For THREE PHASE sensing, place jumper on JI (see CAUTION below).

Table 13
Undervoltage Pickup and Dropout

PICKUP (%)	DROPOUT(%)	JUMPERS
95	90	J2
	85	J2, J4
	80	J2, J5
	75	J2, J4, J5
90	85	J3
	80	J3, J4
	75	J3, J5
	70	J3, J4, J5
85	80	J2, J3
	75	J2, J3, J4
	70	J2, J3, J5
	65	J2, J3, J4, J5

CAUTION:
If the card is to be used the THREE PHASE sensing, you must insure that the sensing signals (Normal or Emergency) are fed by a three phase transformer package. On Westinghouse brand three phase unit sold by Cutler-Hammer, the standard is three phase sensing on NORMAL, and single phase sensing on EMERGENCY.

THREE PHASE SENSING ON EMERGENCY IS AVAILABLE ONLY AS A FACTORY INSTALLED OPTION. If in doubt, contact the factory for assistance.

OVERVOLTAGE PROGRAMMING

1. Place a jumper on J7.
2. Insure that there is NOT a jumper on J6.
3. Choose the desired pickup and dropout values from TABLE 14 and place jumpers on the pins indicated.
4. For THREE PHASE sensing, place jumper on JI (see CAUTION below).

Table 14
Overvoltage Pickup and Dropout

PICKUP (%)	DROPOUT(%)	JUMPERS
105	110	none
	115	J4
	120	J5
	125	J4, J5
110	115	J2
	120	J2, J4
	125	J2, J5
	130	J2, J4, J5
115	120	J3
	125	J3, J4
	130	J3, J5
	135	J3, J4, J5
120	125	J2, J3
	130	J2, J3, J4
	135	J2, J3, J5
	140	J2, J3, J4, J5

CAUTION:
If the card is to be used the THREE PHASE sensing, you must insure that the sensing signals (Normal or Emergency) are fed by a three phase transformer package. On Westinghouse brand three phase unit sold by Cutler-Hammer, the standard is three phase sensing on NORMAL, and single phase sensing on EMERGENCY.

THREE PHASE SENSING ON EMERGENCY IS AVAILABLE ONLY AS A FACTORY INSTALLED OPTION. If in doubt, contact the factory for assistance.

UNDERVOLTAGE PROGRAMMING

1. Place a jumper on J6.
2. Insure that there is NOT a jumper on J7.
3. Choose the desired pickup and dropout values from TABLE 13A and place jumpers on the pins indicated.
4. For THREE PHASE sensing, place jumper on JI (see CAUTION below).

Table 13A
Undervoltage Pickup and Dropout

PICKUP (%)	DROPOUT(%)	JUMPERS
95	90	none
	85	J4
	80	J5
	75	J4, J5
90	85	J2
	80	J2, J4
	75	J2, J5
	70	J2, J4, J5
85	80	J3
	75	J3, J4
	70	J3, J5
	65	J3, J4, J5

CAUTION:
If the card is to be used the THREE PHASE sensing, you must insure that the sensing signals (Normal or Emergency) are fed by a three phase transformer package. On Westinghouse brand three phase unit sold by Cutler-Hammer, the standard is three phase sensing on NORMAL, and single phase sensing on EMERGENCY.

THREE PHASE SENSING ON EMERGENCY IS AVAILABLE ONLY AS A FACTORY INSTALLED OPTION. If in doubt, contact the factory for assistance.

OVERVOLTAGE PROGRAMMING

1. Place a jumper on J7.
2. Insure that there is NOT a jumper on J6.
3. Choose the desired pickup and dropout values from TABLE 14A and place jumpers on the pins indicated.
4. For THREE PHASE sensing, place jumper on JI (see CAUTION below).

Table 14A
Overvoltage Pickup and Dropout

PICKUP (%)	DROPOUT(%)	JUMPERS
105	110	J2
	115	J2, J4
	120	J2, J5
	125	J2, J4, J5
110	115	J3
	120	J3, J4
	125	J3, J5
	130	J3, J4, J5
115	120	J2, J3
	125	J2, J3, J4
	130	J2, J3, J5
	135	J2, J3, J4, J5

CAUTION:
If the card is to be used the THREE PHASE sensing, you must insure that the sensing signals (Normal or Emergency) are fed by a three phase transformer package. On Westinghouse brand three phase unit sold by Cutler-Hammer, the standard is three phase sensing on NORMAL, and single phase sensing on EMERGENCY.

THREE PHASE SENSING ON EMERGENCY IS AVAILABLE ONLY AS A FACTORY INSTALLED OPTION. If in doubt, contact the factory for assistance.

UNDERFREQUENCY PROGRAMMING

1. Place a jumper on J8.
2. Insure that there is NOT a jumper on J9.
3. Choose the desired pickup and dropout values from TABLE 15 and place jumpers on the pins indicated.

Table 15
Overvoltage Pickup and Dropout

PICKUP (Hz)	DROPOUT(Hz)	JUMPERS
46	44	none
47	45	J11
48	46	J12
49	47	J11, J12
56	54	J10
57	55	J10, J11
58	56	J10, J12
59	57	J10, J11, J12

OVERFREQUENCY PROGRAMMING

1. Place a jumper on J9.
2. Insure that there is NOT a jumper on J8.
3. Choose the desired pickup and dropout values from TABLE 16 and place jumpers on the pins indicated.

Table 16
Overfrequency Pickup and Dropout

PICKUP (Hz)	DROPOUT(Hz)	JUMPERS
51	53	none
52	54	J11
53	55	J12
54	56	J11, J12
61	63	J10
62	64	J10, J11
63	65	J10, J12
64	66	J10, J11, J12

NOTE:
Please refer to Table 12 (Normal System Voltage) in the previous section. It serves as a quick reference for finding the actual voltage level that related to the percentage of the normal system voltage.

~T AND DTM TIME DELAY RELAYS

Option # 32A and 32B

Ratings -

2 Watts Power Consumption
Input coil Voltage - 120 volts at 50/60 Hertz
Contact Rating - 10 amperes resistive at 120 volts
Operating Temperature Rating - - 30°C to + 65°C
Time Ratings - Various available

The relay is incorporated in the control scheme to stop the transfer switch with both breakers open, This is to allow residual load voltage to decay prior to closing on another supply which could be out of phase. When the timing cycle is complete, the relay reinitiates transfer to the available source.

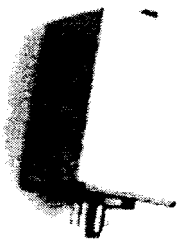
'ME DELAY ENGINE STARTING RELAY

Option # 2A, 2B and 2C

Ratings -

0.75 Watts Power Consumption
Input coil voltage - 120 volts at 50/60 Hertz
Contact Rating - 10 amperes resistive at 120 volts
Time Range - Various available (see below)
Operating Temperature Range - - 30°C to + 65°C

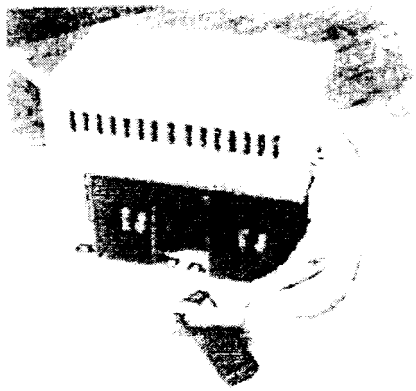
0.5 - 15 sec. time range	S# 5086AOIGOI	Option #2A
4 - 120 sec. time range	S# 5086AOIGO2	Option #2B
10 - 300 sec. time range	S# 5086AOIGO3	Option #2C



TRANSFORMER MODULES

Modules include all necessary control, voltage sensing and logic transformers.

Two versions are available. The standard module has three phase monitoring of the normal source and one phase monitoring of the emergency source. The optional module has three phase monitoring on both the normal and emergency sources.



PLANT EXERCISER

Option # 23A, 23B and 23C

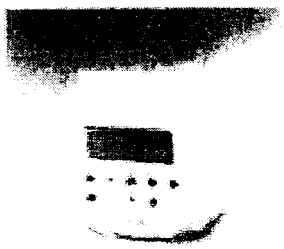
Ratings - Input voltage 120 volts
Contact rating 16 Amps at 250 VAc, 45 - 60 Hz.

150 hour battery back-up
Operating Temperature Range: - 10°C to + 55°C
Accuracy: +/- 4 minutes per year

Description

The Plant Exerciser utilizes a programmable electronic time switch. It incorporates a seven day time base, therefore each day of the week can be uniquely programmed. For convenience, Block Programming is also provided, whereby up to seven days can be grouped together if the "on" and "off" times are the same.

In case of power failure, the built-in nickel-cadmium timer battery maintains the time of day, program storage and LCD display for 150 hours (six days). During this time, output relays are de-energized.



APPLICATION

The Plant Exerciser is a Program Time Switch which functions to start and stop the engine-generator set and transfer switch automatically at pre-selected intervals or times. This electronic timer can be programmed to operate the switch at specific times of the day daily or specific days of the week. The cycle repeats weekly. The Plant Exerciser may be used in two different ways as an accessory for transfer switches.

1. It may be used to simulate an interruption in the normal source of supply at selected intervals, at least once per week, causing the transfer switch components to function, including start-up of the engine-generator set and transfer of load to the generator supply. At the end of the interval it will initiate the transfer back to normal supply and shut down the engine-generator.
   or
2. It may be used to start up an engine-generator set at selected intervals, at least once per week, but without causing the transfer switch to operate and transfer the load to the generator supply. At the end of the interval it will cause the engine-generator to shut-down.

INSTRUCTIONS: TO OPERATE THE ENGINE FOR AN INTERVAL ONCE EACH WEEK, WITH OR WITHOUT OPERATION OF THE TRANSFER SWITCH ...

1. Follow the programming instructions that come with the time switch, set up the actual time of day and the day of the week.

2. Determine the time of day and the day of the week for this test. Program the "ON" command by pressing "CHI" once, and the display will show "CHI ON" and indicate "- - : - -" for the time.

3. Press the "DAY" key to select the desired day of the week.

4. Insert the hour and minutes at which time the "ON" command is to take place, then press the "CHI" key to enter the program.

5. The display will indicate "CHI OFF" and "- - : - -". Program the "OFF" command by using the steps outlined above

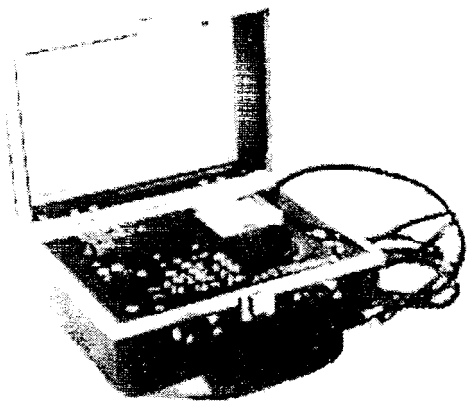
6. Press the " ⏲ " key to return to actual time of day display. After the time switch is programmed, it will automatically "look back" and assume the correct "ON" or "OFF" switch position.

NOTE:

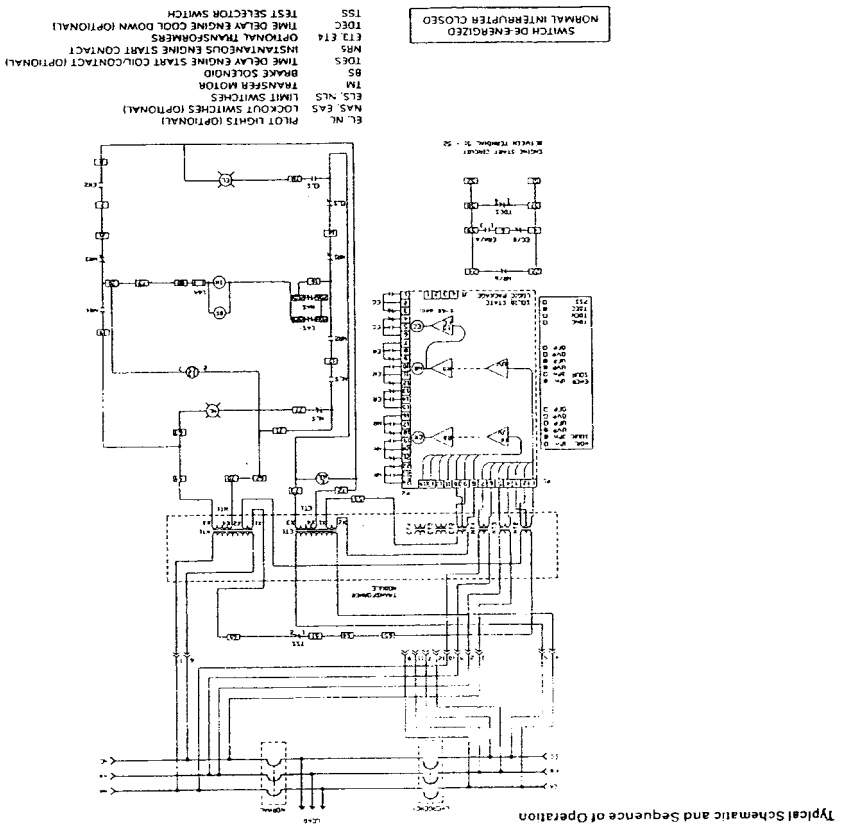
Regarding changing, checking or canceling programs and manual over-ride switch operations, please refer to the instructions that are provided with the Electronic Time Switch.

PORTABLE TEST KIT

An inexpensive, portable test kit, # 1278C67GO1, is available for convenient field testing and calibration of all plug-in cards and output relays. The only power source required is a 120V convenience outlet. A selector switch allows the operator to test individual cards or to simulate ATS operation by having the source monitoring cards drive the time delay cards which in turn drive the output relays, exactly as in actual use. Calibration checks or changes can thus be accomplished without the necessity of energizing the alternate power source.



TYPICAL SCHEMATIC AND SEQUENCE OF OPERATION



EL, NL	PILOT LIGHTS (OPTIONAL)
NAS, EAS	LOCKOUT SWITCHES (OPTIONAL)
ELS, NLS	LIMIT SWITCHES
TM	TRANSFER MOTOR
BS	BRAKE SOLENOID
TDES	TIME DELAY ENGINE START COIL/CONTACT (OPTIONAL)
NR5	INSTANTANEOUS ENGINE START CONTACT
ET3, ET4	OPTIONAL TRANSFORMERS
TDEC	TIME DELAY ENGINE COOL DOWN (OPTIONAL)
TSS	TEST SELECTOR SWITCH

SWITCH DE-ENERGIZED
NORMAL INTERRUPTER CLOSED

Consider the Robonic in the normal operating position, with normal power available and the normal interrupter closed. The following are energized: U.V. (undervoltage module), TDES (time delay engine start), and NR (normal relay).

The U.V., monitoring all 3 phases of the normal power, senses a dip or loss of voltage which instantly causes NR to deenergize. Contacts NR2 and NR4 open, and contacts NR1 and NR3 close. TDES times out, closing its contact and initiating the emergency system start up. When the emergency system reaches correct levels of voltage and frequency, ER is energized and contact ER2 closes. This completes the emergency control circuit, and TM (transfer motor) begins to operate.

First, The normal interrupter is opened, and then the emergency interrupter is closed. At this point, the ELS (emergency limit switch) contacts change state, and the BS (motor brake) closes, preventing TM over travel. The NLS (normal limit switch) contacts change state in preparation for re-transfer to the normal power source.

Upon return of stabilized normal power, NR is re-energized disabling the emergency control circuit, and enabling normal control circuit. The TM operates, opening the emergency interrupter and closing the normal interrupter. When the re-transfer is completed, the NLS contacts change state isolating TM, and BS closes. TDES becomes energized opening its contacts. TDEC times out to allow the emergency generator to run unloaded and cool off before shutting down. The Robonic is now ready to react to another normal power failure.

REPLACING PARTS

The Robonic Automatic Transfer Switch has been designed to have all components accessible and readily removable from the front of the panels. The Robonic Transfer Switch is divided into two basic sections. The upper section consists of the main contacts and transfer mechanism, the lower section consists of all the automatic control devices.

CAUTION

When replacing any parts of the mechanism, control transformers or breakers, isolate the Robonic Transfer Switch from any possible source of power.

To remove the transfer mechanism of the LRO transfer switch, first open the cover and remove the slide pin from the operating cam, then remove the centre bolt, the mechanism will lift straight off. The breakers and transfer motor bracket are held by four screws for ease of removal and replacement. When replacing the mechanism, first set it on the Robonic with the breaker handles in the holes provided and then fasten the centre bolt reasonably tight with the mechanism fully movable with an equivalent swing distance up and down.

To remove the transfer mechanism of the RO transfer switch, remove the four bolts holding it, taking note of which holes the bolts were in, then lift the mechanism straight off. The breakers are held by two bolts at one end and the bus connectors on the other end. The transfer motor is mounted to the transfer mechanism cover and centre drive gear. When replacing any part of the transfer mechanism, be sure that the scribe lines of the gears are in a straight row (example shown on page 5)

To prevent operation of the transfer switch while replacing the mechanism or components, disconnect all sources of power.

When replacing the mechanism move it about until the breaker toggles fit between the mechanism fingers and then fasten the bolts tightly. To test for proper operation, first operate manually and then connect 120 volt, 60 Hertz. supply to motor leads and observe operation for free movement and proper breaker operation.

All Robonic transfer switch breakers and mechanisms have allowed some adjustments for mounting to assure proper operation without slipping or binding. Be sure all hardware is tightened sufficiently before re-energizing any transfer switch.

To replace any of the octal plug-in relays, pull old units straight out and insert the replacement unit. Due to the tight fit of the receptacle and pins, you may have to move the relay about a little to pull it out. **DO NOT INTERCHANGE ANY RELAY WITH ANY OTHERS!**

To replace any solid state logic modules, pullstraight out and insert the replacement unit.

Parts List

Part Name	Style No.
Parts Common to Robonic	
Single Board Controller	
Controller main board c/w standard protection	IB27390H0I
Output relay, used for NR, ER and ECR	3A84214H0I
LEXAN Cover	3A84223H0I
Solid State Logic Control Panel Plug-in Modules	
Timer adjustable, for TDEN, TDEC, TDNE with ranges of 1-60 sec., 4-240 sec., 0.13-8 min. 0.5-32 min., 1-64 min.	7820C96G01
Relay driver - used in place of timers, for instantaneous operation	1266C77GO2
1Ø Frequency sensing module, "UF" or "OF" for "Normal" or "Emergency"	7820C99G01
Frequency/Voltage sensing module	7820C99G01
Voltage sensing module, "IØ" or "3Ø","UV" or "OV" for "Normal" or "Emergency"	7820C97G01
Blank cover, for unused module space	1266C77G01
Instantaneous relay, used for NR, ER, and EC	7070A59H0I
Options	
Time delay relay for engine starting, adjustable 0.5-15 sec.	5086A0IG0I
Time delay relay for engine starting, adjustable 4-120 sec.	5086A01G02
Time delay relay for engine starting, adjustable 10-300 sec.	5086A0IG03
DT/DTM Time Delay relay	5086A03H03
Plant Exerciser	IA00815H01
Battery Charger 12V	1259C26G01
Battery Charger 24V	1259C26G03
4 Position s/s fixed	7070A56H01
4 Position s/s keyed	7070A56H02

Transformer Modules	Standard	Optional
600V, for LRO, RO	3932D65G25	3932D65G26
480V, for LRO, RO	3932D65G04	3932D65GI4
416V, for LRO, RO	3932D65G03	3932D65GI3
400V, for LRO, RO	3932D65G22	3932D65G24
380V, for LRO, RO	3932D65G21	3932D65G23
240V, for LRO, RO	3932D65G02	3932D65GI2
208V, for LRO, RO	3932D65G01	3932D65GII

For Type LRO Robonic	
Mechanism - FD	833C224G01
Mechanism - CA	833C224G02
Motor Assembly c/w Limit Switch	833C223G01
Motor Assembly no Limit Switch	833C223G02
Motor	IA00684H0I
Operating Cam	688A548G01
Slide Pin	688A731H0I
Limit Switch	688A747H0I

For Type RO Robonic	
Mechanism 150 to 300A	833C226G51
Mechanism 150 to 400A	833C226G01
Mechanism 600 to 1000A	833C226G02
Motor	688A749H03
Solenoid	688A740H01
Brake Shoe Assembly	688A739GO1
Operating Cam - MA/NB	623B814H0I
Operating Cam - KA/LA	572B774H0I
Auxiliary & Limit Switch	688A747H0I

TROUBLE SHOOTING

The Robonic is energized; proceed with care!

A. Gen-Set Does Not Start When Test Switch is Operated and Held in "Test" Position.

1. *Check Operation.* Make sure the Test Selector Switch is held in "test" position longer than the TDES time delay.

2. *Check Engine Controls.* Make sure control is in "Automatic" position. Make sure batteries are charged and connected. Make sure engine start circuit is wired.

3. *Check Wiring.* Make sure the start signal wires from the engine controls are connected to the correct terminals on the Control Panel. See the Schematic/ Wiring Diagram.

4. *Check Signal Circuit.* Disconnect and tape start signal wires. Connect the ohmmeter between the control panel terminals 51 and 52. The reading should indicate an open circuit. Turn the Test Selector Switch to "Test" position. After TDES time delay, the ohmmeter should indicate a closed circuit.

Robonic Does Not Retransfer the Load After Normal Source is Returned or After Test Switch is returned to "Auto' position.

1. *Check Operation.* Make sure time has passed to allow for TDEN time delay.

2. *Check Normal Source Voltage Levels.* On a three phase system voltmeter should read phase to phase voltage.

3. *Check Signal Circuit.* Confirm that the Test Switch has reclosed to measuring 0 volts between terminals T60 and T61.

C. With Gen-Set Running, Robonic Does Not Transfer the Load to Emergency.

1. *Check Operation.* Make sure time has passed to allow for TDNE time delay.

2. *Check Engine Controls.* Check generator output frequency and voltage. Output should be at least 90% of nominal voltage and 95% of nominal frequency. Make sure generator output circuit breaker is closed.

3. *Check Wiring.* Voltmeter should read phase to phase voltage between Transfer Switch EA and EB.

D. Robonic Retransfers the Load, but Gen-Set Continues to Run.

1. *Check Operation.* Make sure time has passed to allow for TDEC time delay.

2. *Check Engine Controls.* Make sure engine starting control is in the "Automatic" position.

3. *Check Signal Circuit.* Disconnect and tape start signal wires which are connected to the control panel terminals 51 and 52. Connect ohmmeter between these terminals; reading should indicate an open circuit.

RECOMMENDED MAINTENANCE

1. DO NOT perform dielectric tests on the equipment with the control components in the circuit.

2. DO NOT use loctite.

3. Check lubricant in high speed bearings of the motor and the low speed bearings of the gear box. For lubrication use Dow Corning Silicon DC44 or equivalent on the high speed bearings and Aero Shell No. 6 grease or equivalent in gear box after 5000 operations.

4. Check if control components are tight in sockets.

5. Periodically inspect all terminals (load, line and control) for tightness. Re-tighten all bolts, nuts and accessible hardware. Clean or replace any contact surfaces which are dirty, corroded or pitted.

6. Robonics should be in clean, dry and moderately warm locations. If signs of moisture are present, dry and clean transfer switch. If there is corrosion try to clean it off. If cleaning is unsuitable, replace the corroded parts. Should dust and/or debris gather on the transfer switch, brush, vacuum or wipe clean. DO NOT blow dirt into breaker or terminals.

7. Test the transfer switch operation. While the Robonic is exercising, check for freedom of movement, hidden dirt or corrosion and any excessive wear on the mechanical operating parts. Clean, lubricate or replace parts where necessary.

8. Check all adjustable control components (time delay and voltage sensing relays) for correct settings.

9. If the type "RO" mechanism is removed be sure that the scribe lines on the gears are in line. When reassembling the drive mechanisms, be sure that they are fastened to the correct holes in the frame and that the breaker handles are between the cam fingers. (One breaker has to be on and the other off.)

10. Voltage and/or frequency cards may be removed from a ROBONIC (for servicing, etc.) without disruption of power supply to the connected load. Output relays NR and ER, in combination with their timers or drivers, will continue to provide partial protection. Drop-out voltage is 50%; pickup voltage is 70%.

Note:

When servicing logic control, or transformer module, disable the motor circuit.

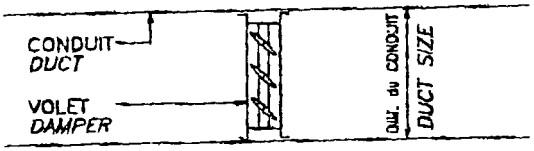
TYPE LRO ROBONICS

CAUTION

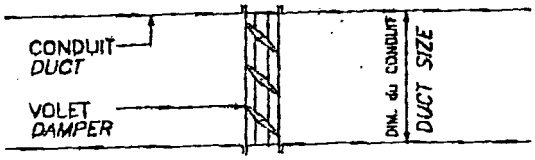
Do not overtighten the pivot screw inside the operating arm. This screw was correctly adjusted at the factory to provide low friction movement of the operating arm without excessive play.

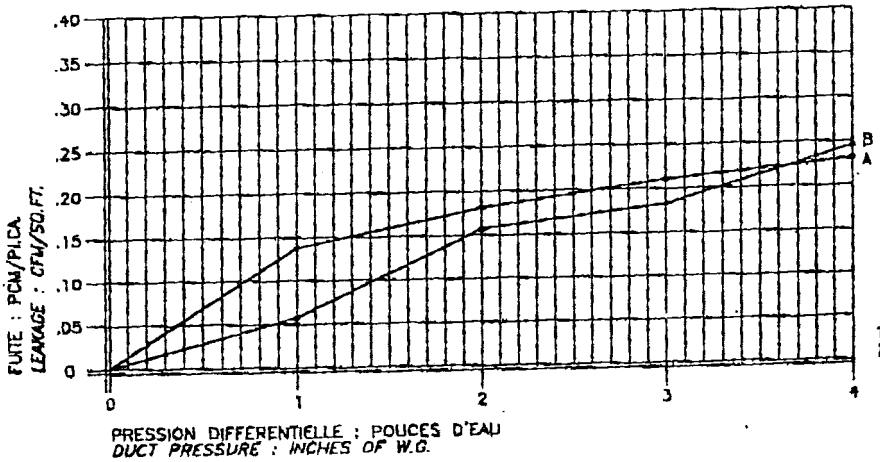
Do not overtighten the set screw holding the operating cam on the motor shaft.

À INSERTION
INSTALLED IN DUCT



À BRIDE
FLANGED TO DUCT





TESTS EXÉCUTÉS PAR:
TESTS CONDUCTED BY:
CALTECH DIV. A.H.L. Inc.

A: VOLETS EN EXTRUSION D'ALUMINIUM, ISOLÉ, LAMES PARALLÈLES, 30" X 30"
EXTRUDED ALUMINIUM, INSULATED DAMPER, PARALLEL BLADES, 30" X 30"

B: VOLETS EN EXTRUSION D'ALUMINIUM, ISOLÉ, LAMES OPPOSÉES, 30" X 30"
EXTRUDED ALUMINIUM, INSULATED DAMPER, OPPOSED BLADES, 30" X 30"

MAINTENANCE DES VOLETS TROLEC

Lorsque les volets sont exposés à des conditions de chantier pénibles tels les poussières de ciment il est parfois nécessaire de lubrifier les pièces mécaniques afin d'obtenir un rendement maximum Nous recommandons une huile équivalente à "Valvoline" no.271 (sans détergent). Cette huile à engrenag est normalement distribuée dans les Auto Parts.

Par la même occasion, nous vous informons que tous les volets "TROLEC" sont soigneusement ins pectés avant la livraison. Toutefois, des mesures appropriées doivent etre prises durant l'installatic pour assurer un rendement maximum.

TROLEC INC., ne peut être tenu responsable des dommages provenants d'un usage abusif de ses produi ou d'une application inadéquate.

TROLEC DAMPERS MAINTENANCE

When the dampers are used in rough yard conditions, it is sometime necessary to lubricate mech nicals parts used in our dampers construction, to assure maximum performance. We recommand oil equivalent to "Valvoline" no.271 (without detergent). This gearing oil is normally distribute in Au Parts.

Also note that all "TROLEC" dampers are carefully inspected by our quality control department bef shipment. Appropriates measures must be taken during installation (by others) to ensure air leak will be acceptable.

TROLEC INC., shall not to be liable for damages resulting from misaplication or misuse of its produ

15999
VOLETS

ZONIC

trolec

ique du bâtiment

DISTRIBUTION VENTIL-X-PERT INC.

TEL.: (514) 355-4540

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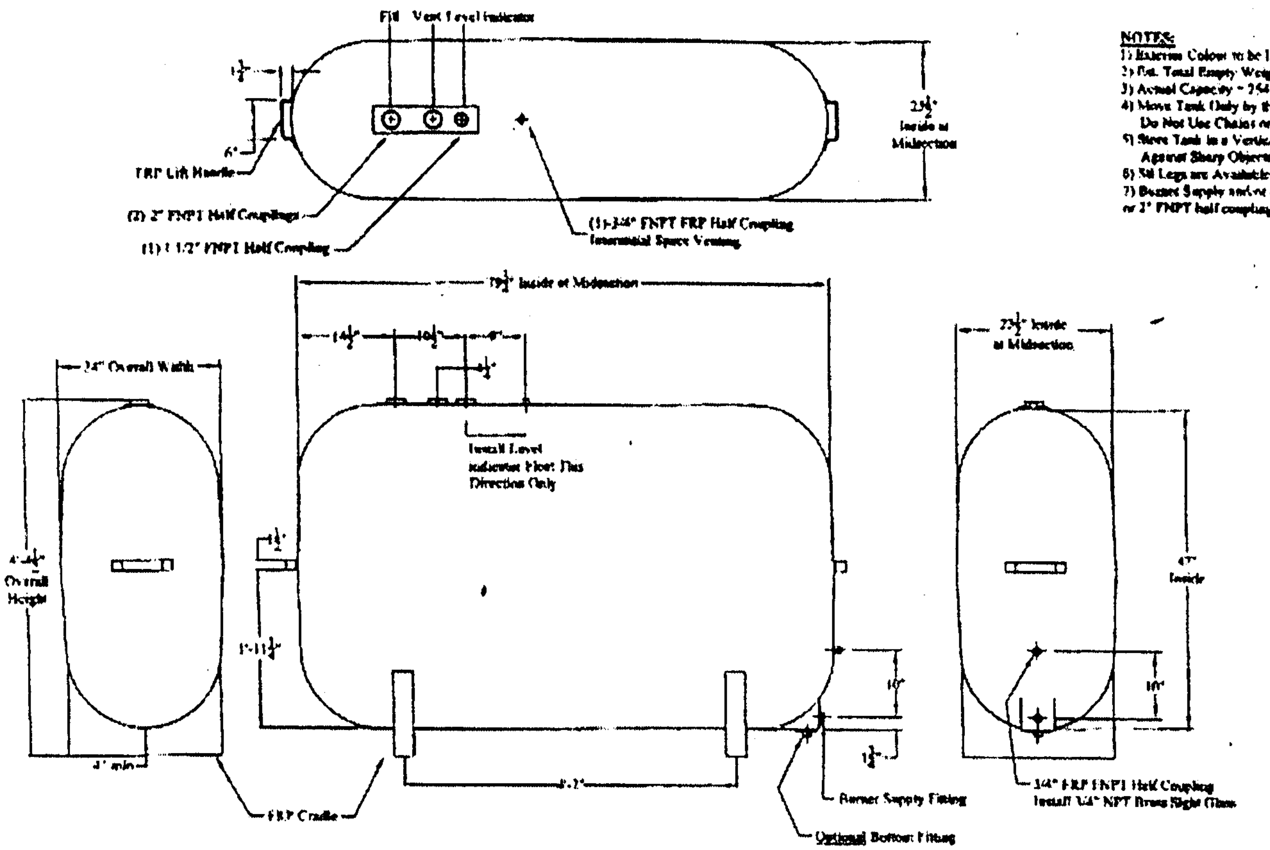
25.2

REVIEWED ACCORDING TO THE REQUIREMENTS OF THE GENERAL CONDITIONS OF THE CONTRACT. ANY ACTION INDICATED IS SUBJECT TO THESE REQUIREMENTS.

- [x] NO EXCEPTIONS TAKEN
- [ ] MAKE NOTED CORRECTIONS
- [ ] REVISE & RESUBMIT
- [ ] REJECTED

DATE AUG 17 2005 BY SW

EARTH TECH (CANADA) INC.



NOTES:
1) Exterior Colour to be Industrial Grey
2) Est. Total Empty Weight - 215 lbs.
3) Actual Capacity - 254 Imp. Gallons
4) Move Tank Only by the Lifting Handles Provided. Do Not Use Chains or Cables Around Tank
5) Store Tank in a Vertical Position. Do Not Rest Against Sharp Objects
6) Sil Legs are Available (REF dwg. A7911-003)
7) Burner Supply and/or bottom fitting may be a 1/2" or 2" FNPT half coupling.

No.	Description	Date	By
[illegible]	[illegible] fitting to 1 1/2"	May [illegible]	[illegible]
[illegible]	modified [illegible] to 1/2"	Dec [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Aug [illegible]	[illegible]
[illegible]	Modified [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Revision or Issue

TITLE
FRP FUEL OIL TANK - FRP CRADLE
250 IMP. GAL. NOMINAL CAPACITY
DOUBLE WALL TANK
SIGHT GLASS MONITORING

ZCL COMPOSITES INC. PHONE: 1-800-661-8265 FAX: 1-780-466-6126

Scale 1" = 1'

Date	Drawn
Nov. 20, 1999	RR
Designer: FR / Checked: HH	Approved: FR
Work Order No. ---	Sheet of 1/1
Drawing No. C9912-004-07	Revision 0

25.3
chap 25

1/1

DAMPER CONTROL
GENERATOR

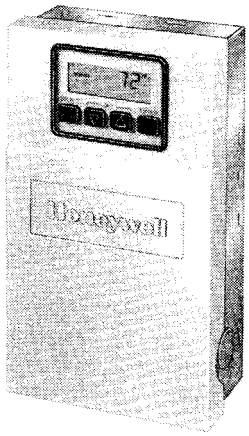
EXTRA WWTP

Honeywell

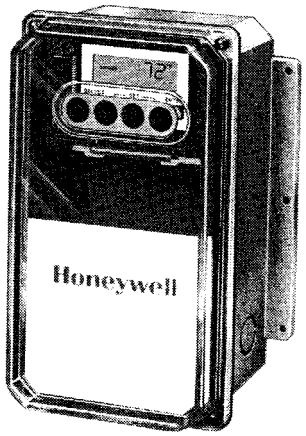
T775E,F,G
Remote Temperature Controller

The T775 family of Electronic Remote Temperature Controllers provides electronic Series 90, 4 to 20 mA, or 0 to 18 Vdc proportional plus integral (P+I) modulating control for hot water, steam, or chilled water valves, dampers and other applications where electronic accuracy, in addition to remote sensing, is desired.

In addition, certain models of the T775 family of controllers provide on-off temperature control of heating, cooling, and ventilating systems in agricultural confinement buildings, storage areas and heavy industrial applications.



T775E,F



T775G

- T775E models provide P+I modulating control with one temperature input and either 4 to 20 mA, 0 to 18 Vdc, or Electronic Series 90[a] modulating output and zero to three relay output stages.
- T775F models provide P+I modulating control with two temperature inputs and either 4 to 20 mA, 0 to 18 Vdc, or Electronic Series 90[a] modulating output and zero to three relay output stages.
- T775G models provide P+I modulating control with one temperature input and either 4 to 20 mA, 0 to 18 Vdc, or Electronic Series 90[a] modulating output and zero to three relay output stages.
- T775G meets National Electric Code (Article 547) requirements for animal confinement buildings.
- T775G Typical applications include barns, brooder houses, poultry houses, hog houses, pump houses, and crop storage houses.
- NEMA 4X enclosure resists oil, water, dust and corrosion.
- Setpoint temperature range is -40°F to +220°F (-40°C to +104°C).
- Ambient temperature range is -30°F to +140°F (-22°C to +60°C) for T775E models and -30°F to +125°F (-22°C to +52°C) for T775F and T775G models.
- Linear platinum temperature sensor with T775E,F.
- Adjustable temperature range and differential.
- LCD indication for mode and output status.
- Keypad provides ease of programming and operation.
- Accuracy is within +/- 1°F/C at nominal input voltage, nominal sensor ambient temperature (77°F [25°C] operating ambient). Accuracy may vary as parameters deviate from nominal.
- Stage(s) independently programmed for heating or cooling.
- 24/120/240 Vac input voltage.
- Spdt relay outputs.

[a] The Electronic Series 90 output provided with certain T775 models cannot drive electromechanical slidewire devices.

IMPORTANT: *The T775 is an operating control, not a limit or safety control. When used in applications requiring safety or limit controls, use a separate safety or limit control device in conjunction with the T775.*

1/28 pages

CONTENTS

G. R. • 3-95 •

63-2490

Specifications

IMPORTANT: *The specifications given in this publication do not include normal manufacturing tolerances. Therefore, an individual unit may not exactly match the listed specifications. Also, this product is tested and calibrated under closely controlled conditions and some minor difference in performance can be expected if those conditions are changed.*

MODELS: The T775E,F,G family of Electronic Temperature Controllers provides 4 to 20 mA, 0 to 18 Vdc, or Electronic Series 90[a] Proportional plus Integral (P+I) modulating control for hot water, steam, or chilled water valves, dampers, and other applications where electronic accuracy, in addition to remote sensing, is desired.

Model Number	Number of Inputs	Output Modulation Type	Number of Relay Outputs
T775E1015	1	Electronic Series 90	1
T775E1056	1	4 to 20 mA	1
T775E1064	1	4 to 20 mA	2
T775E1072	1	4 to 20 mA	3
T775E1098	1	0 to 18 Vdc	1
T775E1114	1	0 to 18 Vdc	3
T775F1022	2	Electronic Series 90	3
T775F1055	2	4 to 20 mA	3
T775F1089	2	0 to 18 Vdc	3
T775G1005	1	Electronic Series 90	3
T775G013	1	4-20 mA	3
T775G1021	1	0 to 18 Vdc	3

T775E: P+I modulating control with one temperature input and either 4 to 20 mA, 0 to 18 Vdc, or Electronic Series 90[a] modulating output and zero to three relay output stages.

T775F: P+I modulating control with two temperature inputs and either 4 to 20 mA, 0 to 18 Vdc, or Electronic Series 90[a] modulating output and zero to three relay output stages.

T775G: P+I modulating control with one temperature input and either 4 to 20 mA, 0 to 18 Vdc, or Electronic Series 90[a] modulating output and zero to three relay output stages.

[a] The Electronic Series 90 output provided with certain T775 models can not drive electromechanical slidewire devices.

ELECTRICAL RATINGS:
Voltage Input: 24/120/240 Vac, 50/60 Hz.
Power Consumption:
For one and two stage units:
8 VA maximum at 60 Hz.
10 VA maximum at 50 Hz.
For three and four stage units:
13 VA maximum at 60 Hz.
20 VA maximum at 50 Hz.

CONTACT RATINGS:
1/2 hp; 9.8 FLA, 58.8 LRA at 120 Vac.
1/2 hp; 4.9 FLA, 29.4 LRA at 240 Vac.
125 VA pilot duty at 120/240 Vac.
10A at 24 Vac (resistive).

SENSOR: Positive coefficient platinum type, 4.8 ohms/°/F, 1000 ft maximum distance between sensor and solid state controller (requires calibration over 400 ft). Sensor Range: -40°F to +220°F (-40°C to +104°C). To maintain NEMA 4X rating, use environmental proof cable and 203401B Waterproof Sensor.

Ordering Information

When ordering replacement and modernization products from your wholesaler or distributor, refer to the price sheets for complete ordering number.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Home and Building Control Sales Office (check the white pages of your phone directory).
2. Home and Building Control Customer Logistics
   Honeywell Inc., 1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386 (612) 951-1000

   In Canada—Honeywell Limited/Honeywell Limitée, 740 Ellesmere Road, Scarborough, Ontario M1P 2V9. International Sales and Service offices in all principal cities of the world.

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TEMPERATURE ACCURACY:
+/-1°F (at nominal input voltage, 77°F [25°C] operating ambient, nominal sensor ambient).
Accuracy may vary based on deviation from nominal values of input voltage, operating ambient and sensor ambient.

DISPLAY RESOLUTION: Sensed temperature and other operating parameters are displayed via a liquid crystal display (LCD) with a resolution of 1°F or 1°C.

SETPOINT ADJUSTMENT RANGE: -40°F to 220°F (-40°C to 104°C).

DIFFERENTIAL: Adjustable from 1 to 35 degrees (F or C).

OPERATING AMBIENT TEMPERATURE:
One and Two Stage Units: -30°F to 140°F (-35°C to +60°C).
Three and Four Stage Units: -30°F to 125°F (-35°C to +52°C).

OPERATING HUMIDITY: 5% to 95% relative humidity (RH) noncondensing.

APPROVALS:
Underwriters Laboratories Inc. Listed: File No. E4436.
Canadian Standards Association Certified: File No. LR47125.

DIMENSIONS: See Fig. 1 and 2.

MOUNTING: Mounts on any suitable horizontal or vertical surface (see Fig. 3 and 4 for mounting hole locations).

MAIN FEATURES: See Fig. 3 and 4.

Fig. 1—Approximate dimensions of T775E,F in in. (mm).

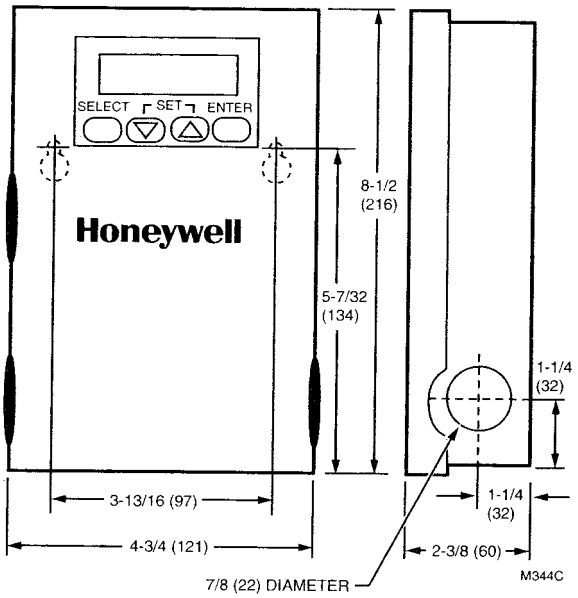


Fig. 2—Approximate dimensions of T775G in in. (mm).

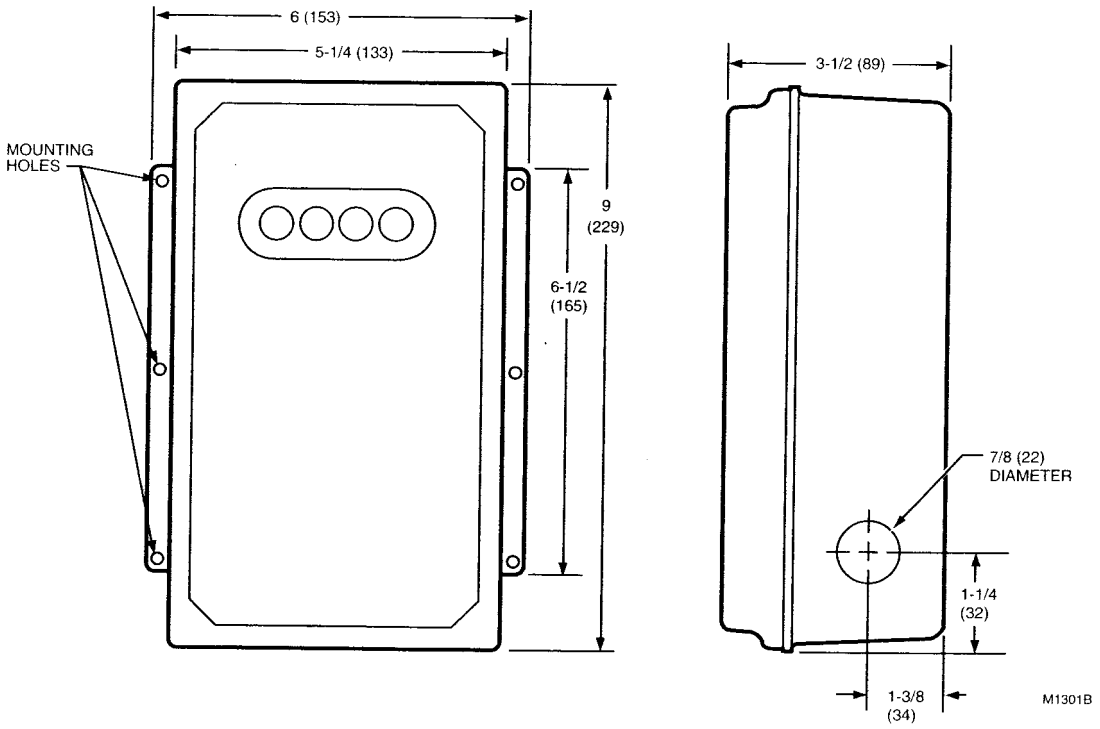


Fig. 3—Feature locations, T775E,F.

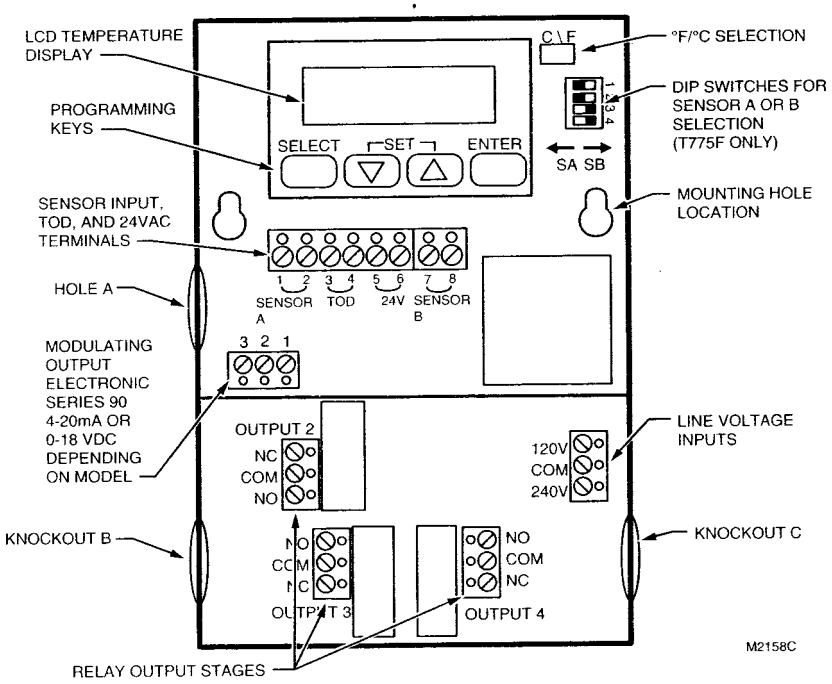
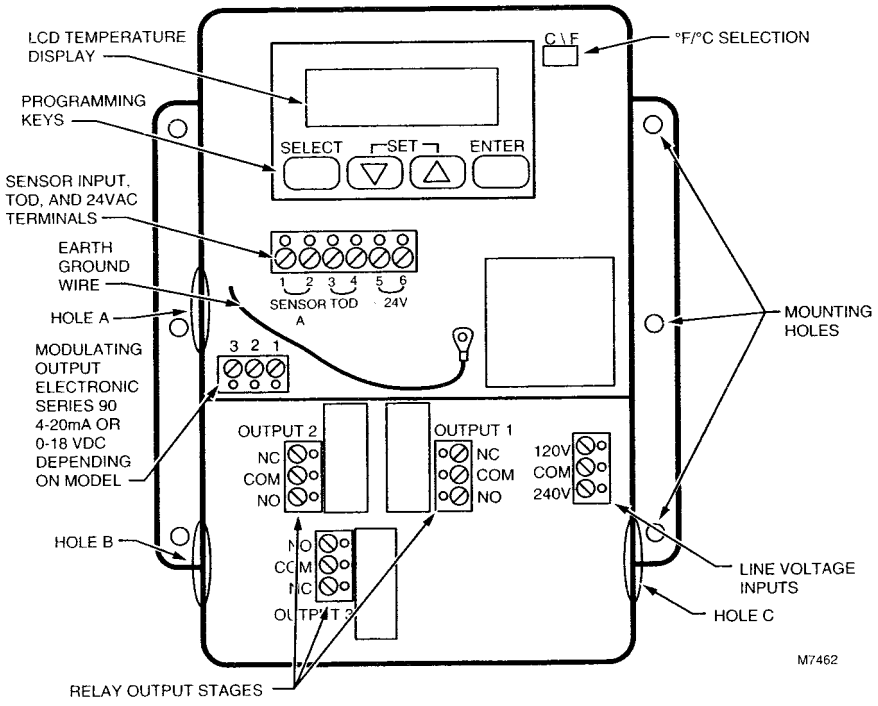


Fig. 4—Feature locations, T775G.



ACCESSORIES:

T775E,F:

C7100C1003 Duct Mount Averaging Sensor[a].
T7047C1090 Wall Mounted Sensor Case.
107324A Bulb Holder, duct insertion.
121371A Copper Immersion Well.
121371E Stainless Steel Well.
107048 Heat Conduction Compound, 4 ounce.
C7043A1098 Case and Immersion Well for running conduit to sensor.
203531A Panel Mount Kit

T775G:

121371A Copper Immersion Well.
121371E Stainless Steel Well.
107408 Heat Conduction Compound, 4 ounce.
203401B Waterproof Sensor
A775A1003 Sensor Simulator
202026D NEMA 4 Replacement Cover Kit (T775G only).

[a] Accuracy decreases to +/-2°F.

Installation

WHEN INSTALLING THIS PRODUCT...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out the product operation as provided in these instructions.

⚠ WARNING

Disconnect power before installation to prevent electrical shock or equipment damage.

LOCATION AND MOUNTING

Mount the T775E,F Controller on any convenient interior location using the two mounting holes provided in the back of the metal enclosure (mounting screws are not provided and must be obtained separately). Mount the T775G Controller on any convenient interior location using the six mounting holes provided along the sides of the NEMA 4X enclosure (mounting screws are not included). Use controller dimensions in Fig. 1 (T775E,F) or Fig. 2 (T775G) as a guide.

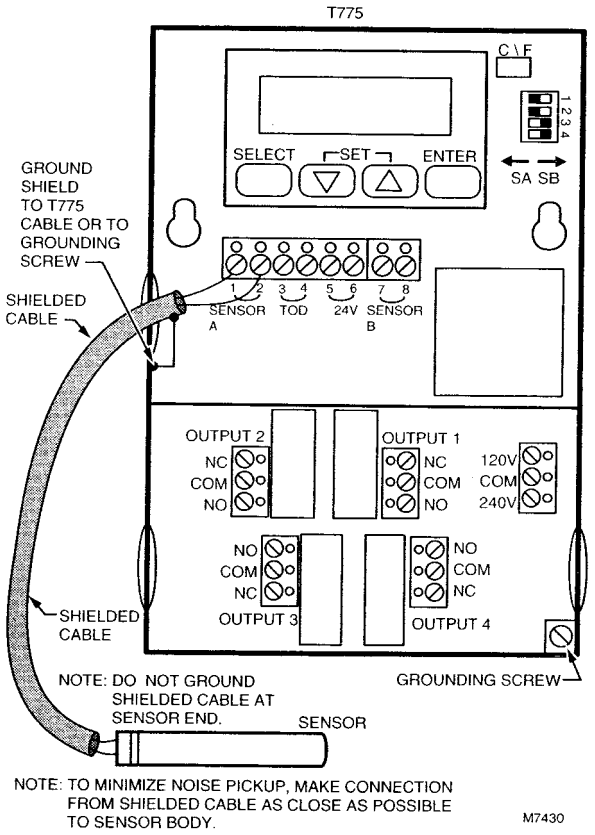
SENSOR LOCATION

Locate the 193987GA Sensor up to 1000 feet (304 meters) from the T775 using standard AWG 18/2 unshielded wire. For cable runs longer than 25 feet shielded cable is recommended. See Fig. 5. It may be located on pipes, in an immersion well, in a wall mount case or on a bulb holder. See Fig. 6 for nomenclature. The 193987GA is not a water tight or water resistant sensor. For wet applications, see the Accessories list in the Specifications section.

Multiple sensors can be parallel-series wired to sense average temperatures in large spaces.

To maintain control accuracy, the number of parallel-series wired sensors must be of the n^2 power (4, 9, 16, etc). See Fig. 7.

Fig. 5—Using shielded cable for cable runs longer than 25 feet.



SENSOR MOUNTING

Sensors can be mounted on a wall or panel for sensing space temperature (Fig. 6), strapped to a pipe or inserted in a well (Fig. 8) for hot/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 leadwire holes, mount the sensor with the leadwires exiting the bottom of the sensor.

NOTE: Use heat conductive compound in immersion wells. See Optional Accessories in the Specifications section.

Fig. 6—Sensor mounted on wall.

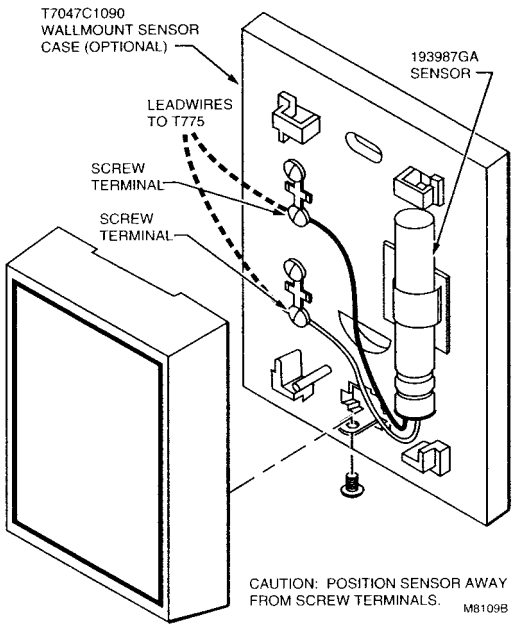


Fig. 7—Parallel-series wiring of sensors.

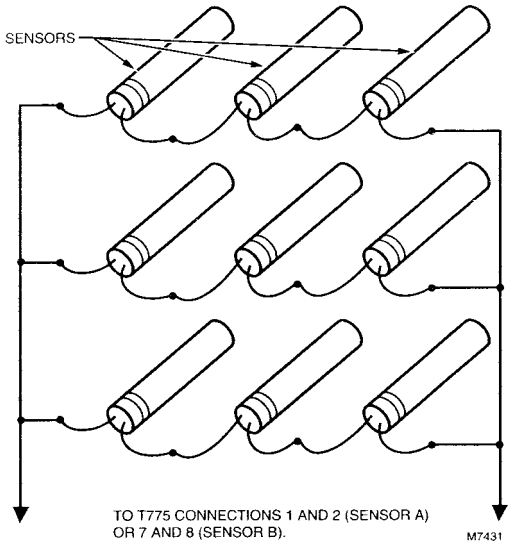
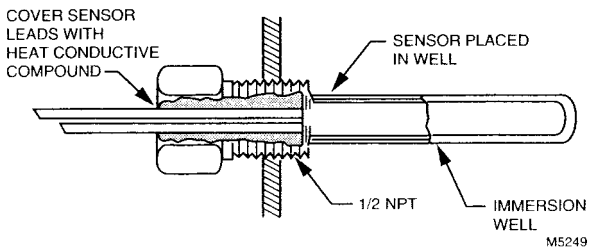


Fig. 8—Sensor inserted in immersion well.



WIRING

WARNING

Disconnect power before installation to prevent electrical shock or equipment damage.

Disconnect external power before wiring to prevent electrical shock or equipment damage. All wiring must comply with applicable codes and ordinances.

IMPORTANT: *The T775 is an operating control, not a limit or safety control. When used in applications requiring safety or limit controls, use a separate safety or limit control device in conjunction with the T775.*

WARNING

Do not use 24 Vac power at terminals 5 and 6 to power any external loads when 120 Vac or 240 Vac is used to power the T775.

Refer to Fig. 3 or 4 for locating the appropriate power inputs, remote sensor input, relay and modulating output terminals, contact closure input and sensor selection switch. Gain access to the terminals through standard conduit knockouts (A-C) located around the perimeter of the enclosure.

NOTE: Use hole A only for sensor, low-voltage and contact closure wiring and access to modulating output.

When wiring the input power, apply only one source of power to the T775 (24 Vac or 120 Vac or 240 Vac). Use knockouts B and C to gain access to 120 Vac or 240 Vac input terminals and the load relay output terminals.

To improve static protection for the T775G, connect earth ground to the center ground screw. See Fig. 4.

Use the T775 to control damper and valve actuators that accept Electronic Series 90, 4 to 20 mA, or 0 to 18 Vdc modulating inputs as well as controlling up to three On/Off loads. Depending on the application and the motor or actuator being used, the T775 can control up to three Modutrol Motors by using resistor kits that are available as accessory parts for existing motors. Using specified resistor kits can also allow the user to control an Electronic Series 90 Motor with a 4 to 20 mA controller. Information regarding these kits can be found in the TRADELINE® Catalog, motor specification, or from your local distributor. See Fig. 9 through 18 for typical T775 wiring applications.

Fig. 9—Wiring T775 for 24 Vac input and up to 24 Vac loads.

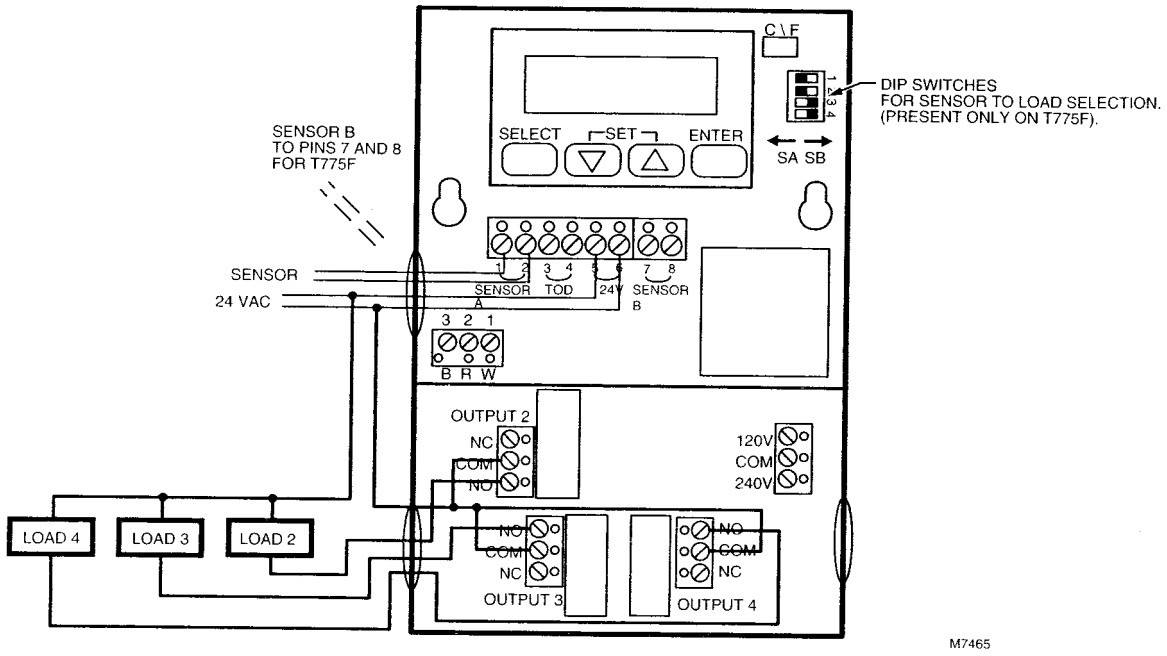


Fig. 10—Wiring T775 for 120 Vac input and up to three 120 Vac loads.

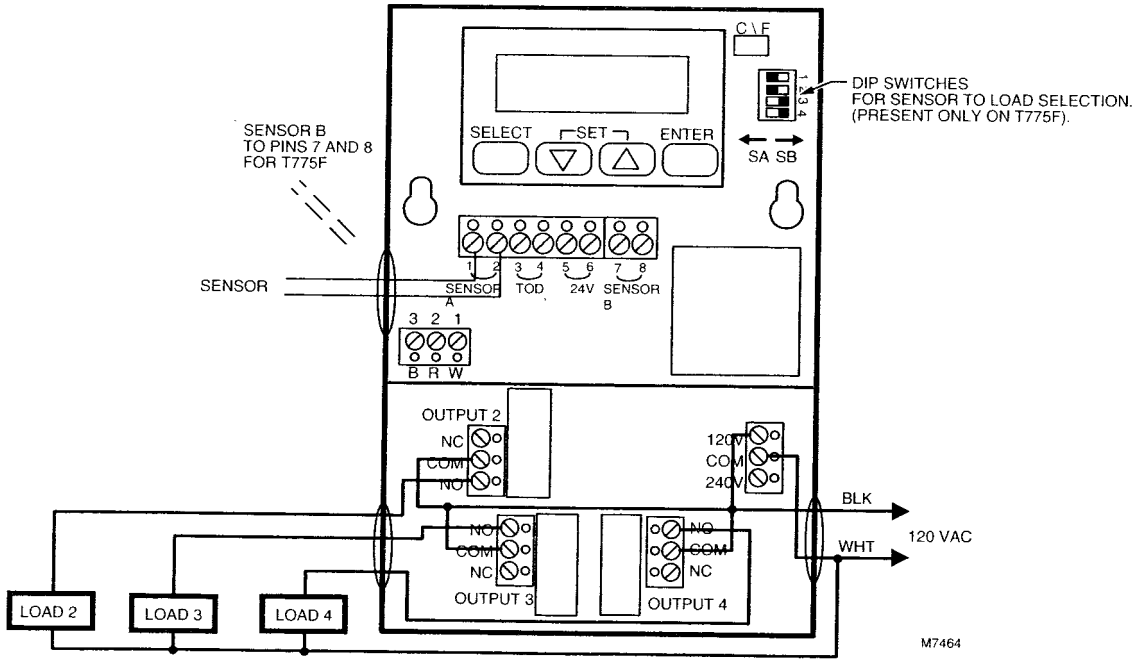


Fig. 11—Wiring T775 for 240 Vac and up to three 240 Vac loads.

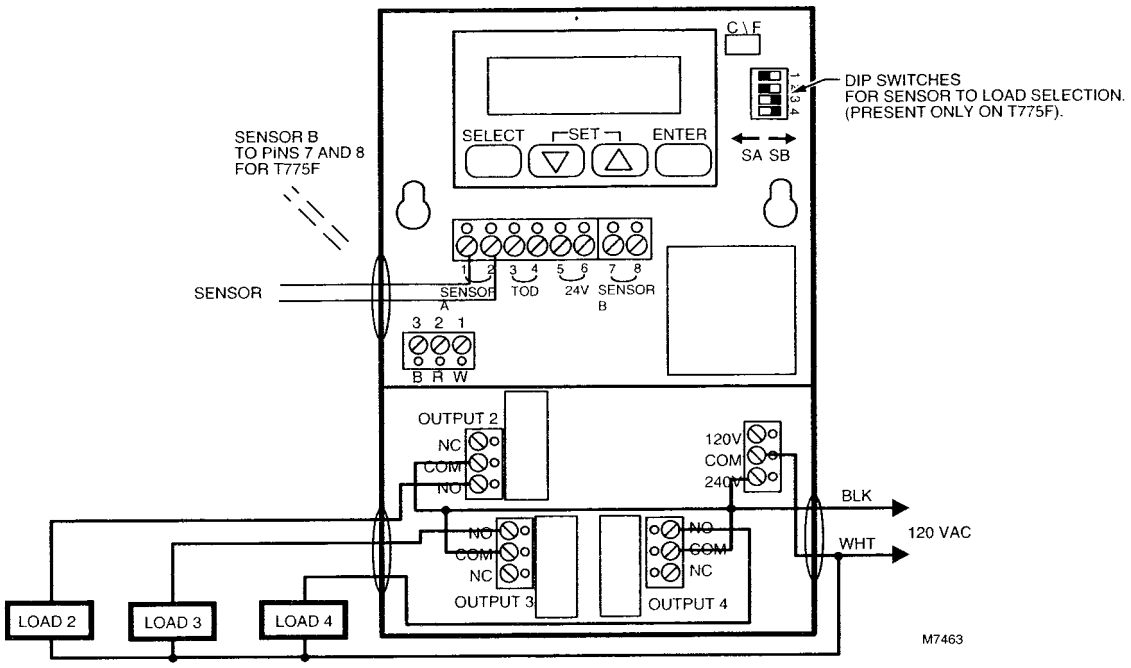


Fig. 12—Wiring T775 to electronic Series 90 Modutrol Motor control.

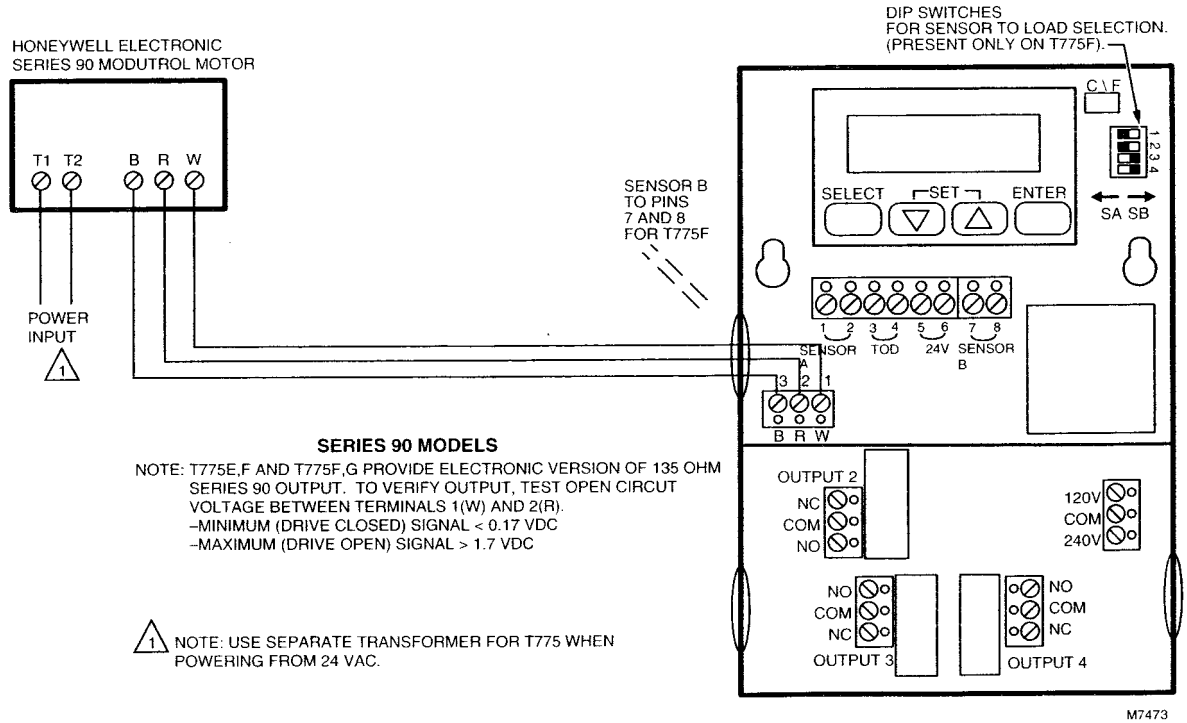


Fig. 13—Changeover relay and minimum position potentiometer used with Series 90 Modutrol Motors.

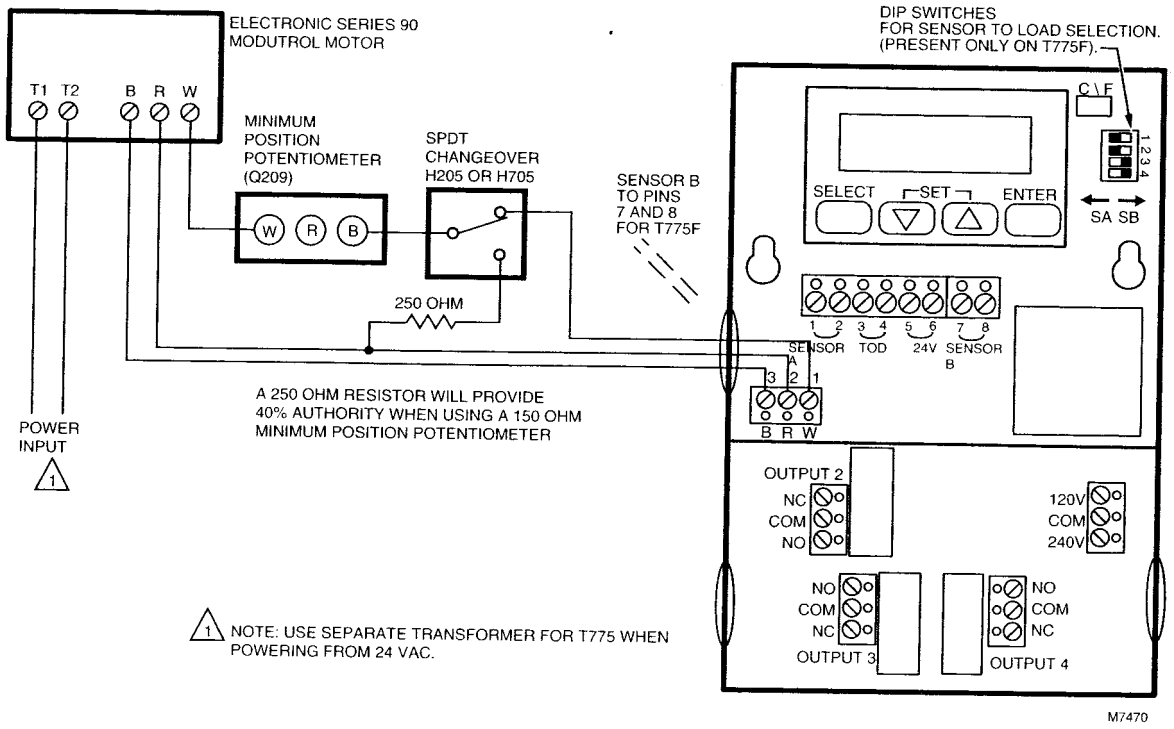


Fig. 14—T991 used with Series 90 Modutrol Motor and T775 to provide modulating low limit.

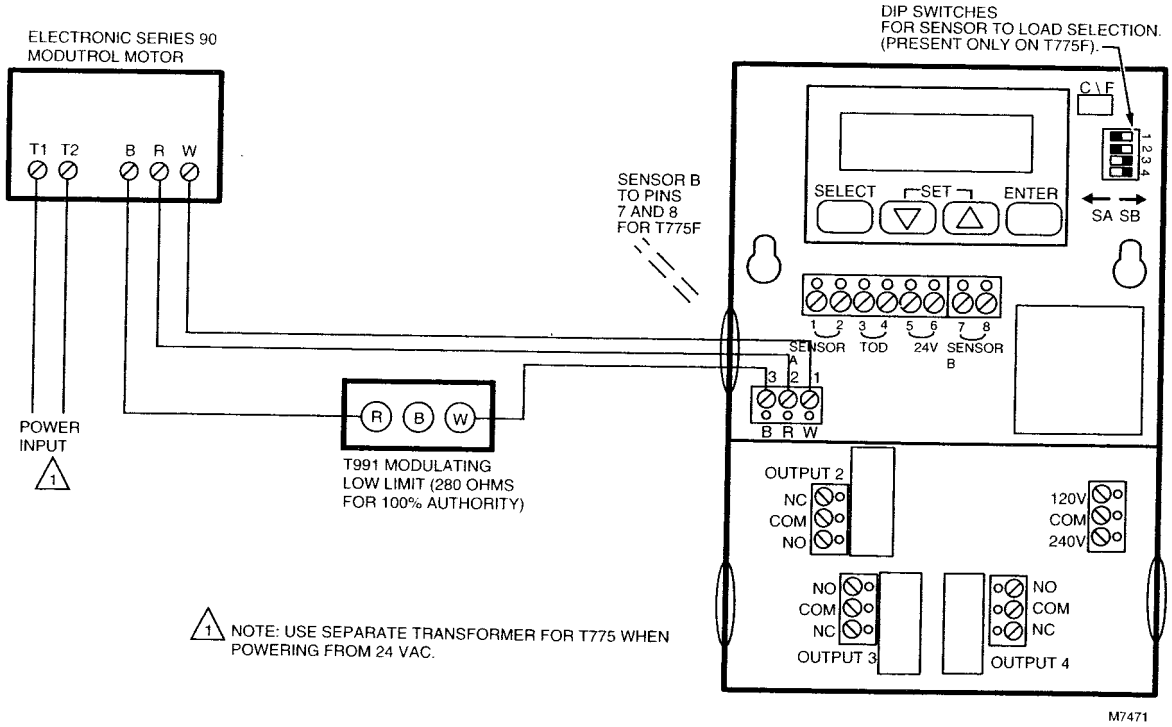


Fig. 15—Wiring T775 to ML984 Valve Actuator.

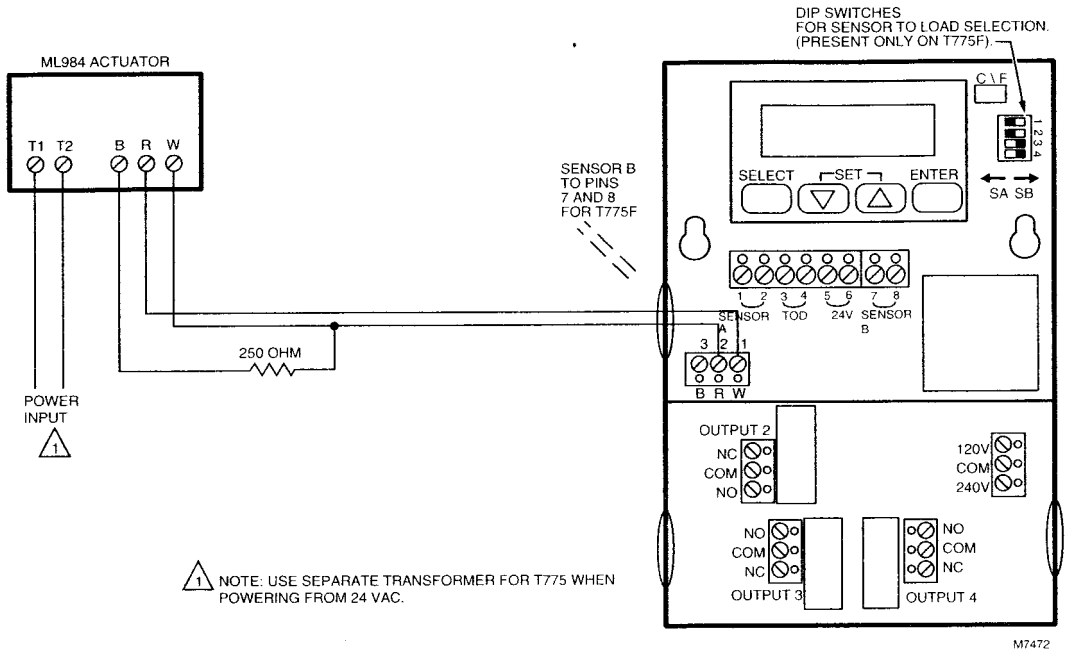


Fig. 16—Wiring T775 with up to 3 Series 90 Modutrol Motors.

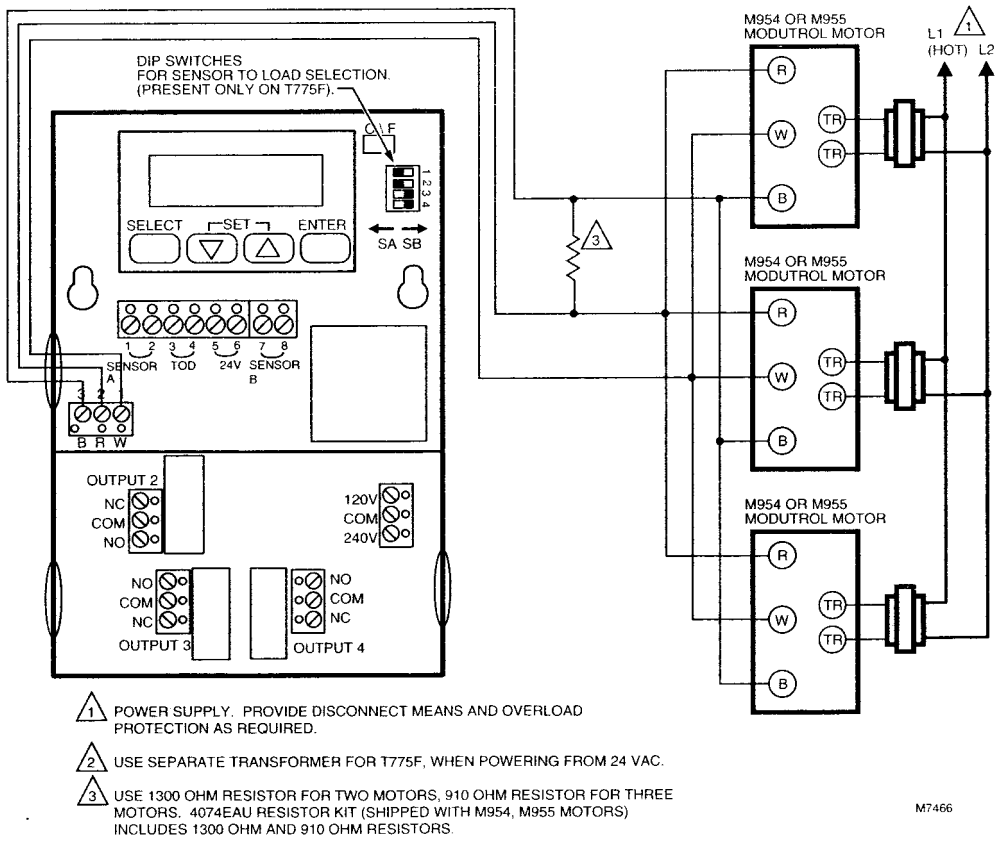


Fig. 17—Wiring T775 to 4 to 20 mA actuator.

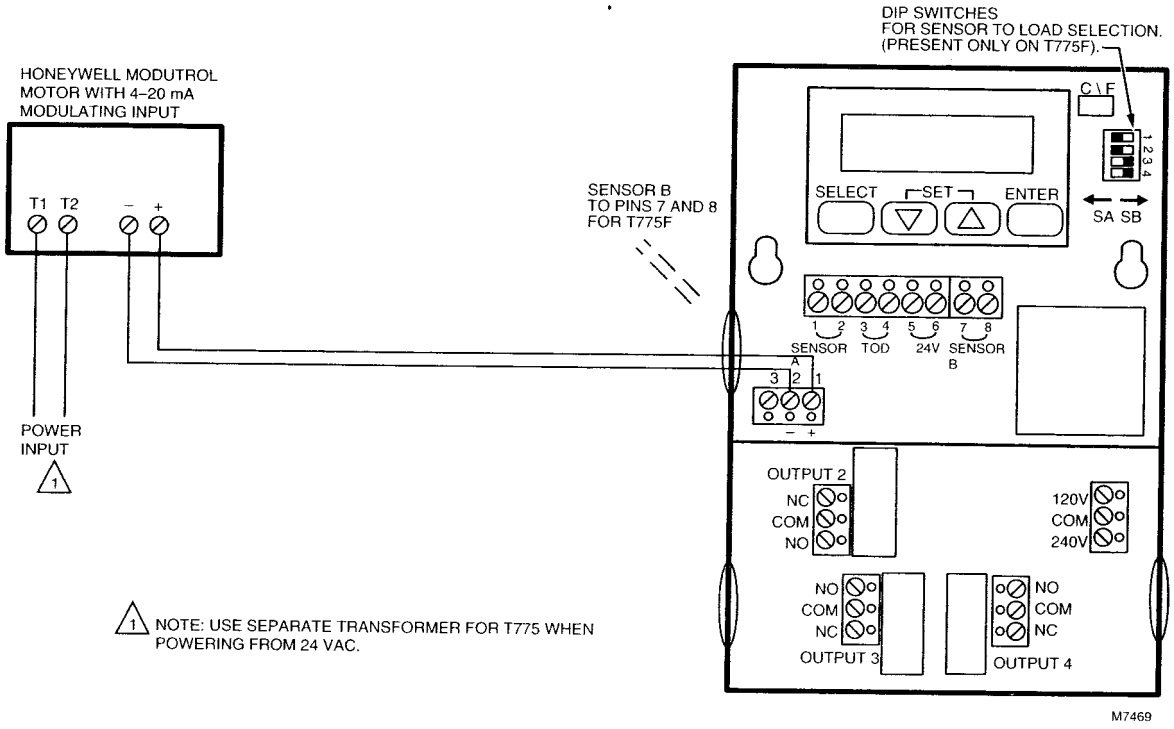


Fig. 18—Wiring T775 with modulating actuator with voltage control input.

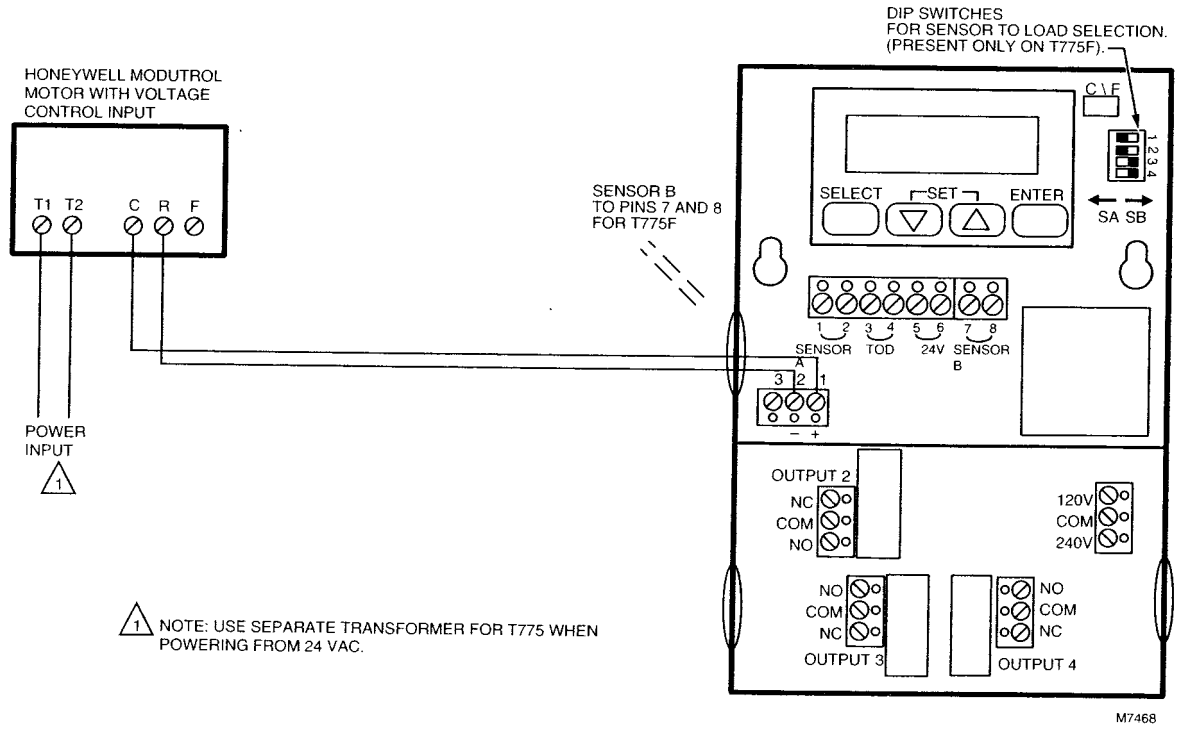
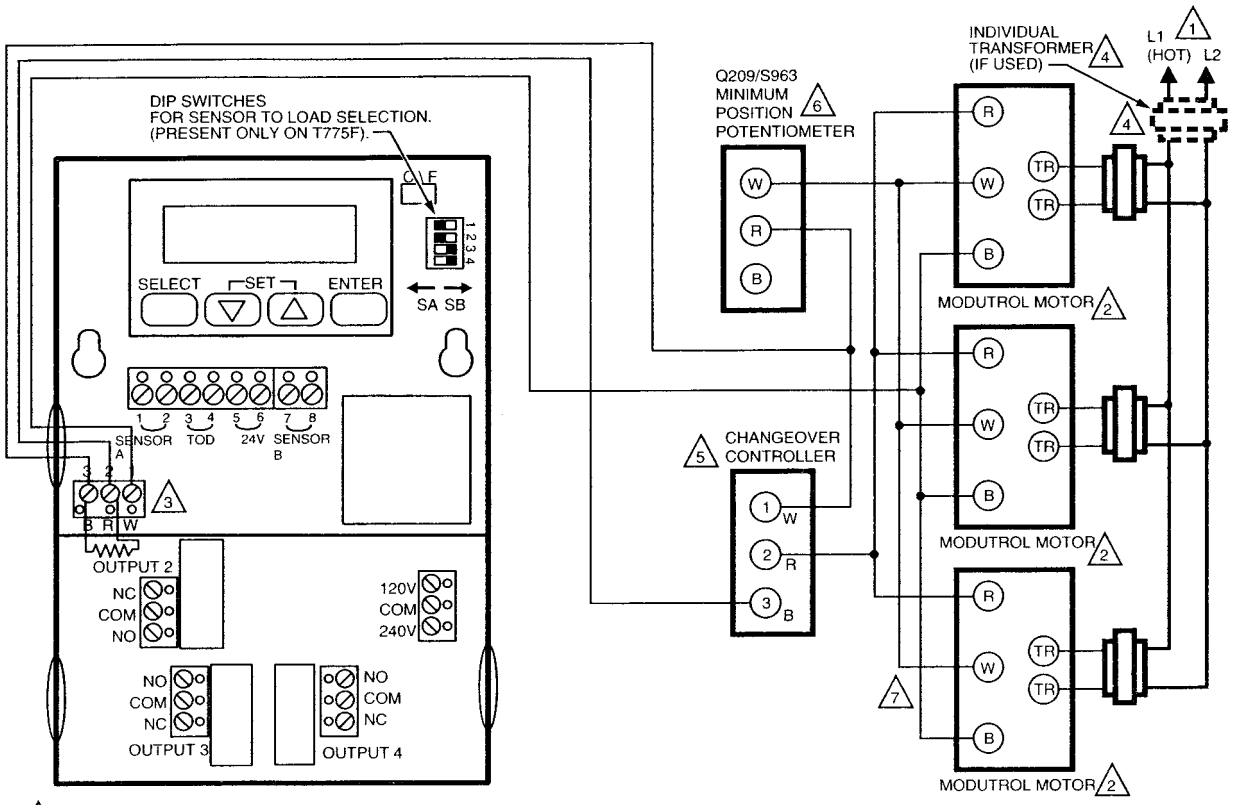


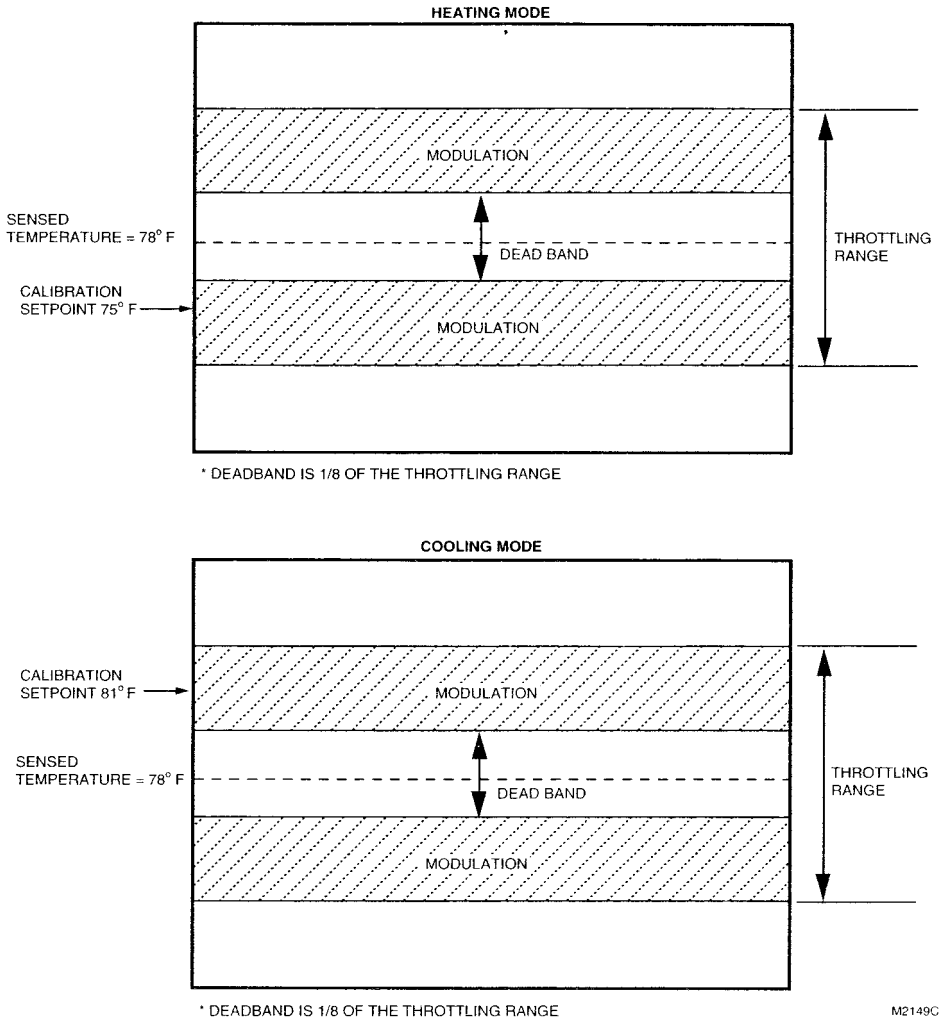
Fig. 19—Unison control of M9185 Modutrol IV Motor using one minimum position potentiometer for all motors. System is shown connected for cooling; for heating, reverse the W and B leads at the controller.



1. POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. UP TO 6 SIMILAR MOTORS CAN BE CONNECTED IN UNISON.
3. USE RESISTOR BETWEEN R AND B ON T775E, F, AND G:
   A. 1300 OHMS FOR TWO MOTORS.
   B. 910 OHMS FOR THREE MOTORS (4074EAU KIT).
4. IF COMMON TRANSFORMER IS USED, ALL MOTORS MUST BE IN PHASE. CONNECT SAME TRANSFORMER LEAD TO T1 ON EACH MOTOR, CONNECT OTHER TRANSFORMER LEAD TO T2 ON EACH MOTOR.
5. USE TEMPERATURE CONTROLLER, SUCH AS H205, H705, OR T675A FOR CHANGEOVER CONTROL.
6. AUTHORITY OF MINIMUM POSITION POTENTIOMETER, IF USED, INCREASES WITH NUMBER OF MOTORS PARALLELED. WITH 1 MOTOR, 50 PERCENT STROKE; WITH TWO MOTORS, 100 PERCENT STROKE: WITH 3 MOTORS, 100 PERCENT STROKE WITH 1/3 OF FULL POTENTIOMETER ROTATION.
7. REVERSING B AND W TERMINALS ON ONE OR MORE MOTORS WILL NOT AFFECT CONTROL PERFORMANCE ON OTHER MOTORS. SYSTEM CAN BE CONFIGURED TO HAVE SOME MOTORS REVERSE ACTING AND OTHER MOTORS DIRECT ACTING.
8. USE SEPARATE TRANSFORMER FOR T775, WHEN POWERING FROM 24 VAC.

M7467

Fig. 20—Explanation of calibration setpoints for heating and cooling modes.



See Fig. 20 for definitions of modulating setpoint temperatures and temperature/load diagrams.

IMPORTANT: *To assure proper operation, avoid poor wiring practices listed below that can cause erratic temperature readings from the 193987GA or 203401B Sensor.*

a. Do not route temperature sensor wiring with building power wiring.

b. Do not locate temperature sensor wiring next to control contactors.

c. Do not locate temperature sensor wiring near electrical motors.

d. Do not locate temperature sensor wiring near welding equipment.

e. Make sure good mechanical connections are made to both the sensor and the controller.

f. Do not mount the sensor with the leadwire end (wire end) pointing up in an area where condensation can occur.

If any of the above conditions cannot be avoided, use shielded cable. See Fig. 5.

DEVICE SETUP

1. Determine the loads to be controlled and the operating mode (heat or cool) and enter in the Device Programming Worksheet.

For example: Load 2: Compressor 1 (cool)

Setpt 1	_____	On at	_____
Diff 1	_____	Off at	_____

2. For two sensor models (T775F) determine which loads are controlled from sensor A or sensor B and enter on the worksheet.

For example: Load 2: Compressor 1 (cool)—Sensor A

Setpt 1	_____	On at	_____
Diff 1	_____	Off at	_____

3. Determine the setpoint (Setpt) and the throttling range for Load 1 and the switching differential (Diff) for each On/Off load and enter on the worksheet.

For example: Load 2: Compressor 1 (cool)—Sensor A

Setpt 1	78°F	On at	_____
Diff 1	4°F	Off at	_____

4. Refer to the Control Algorithm section to calculate the load on and off temperatures and enter on the worksheet. Remember that the On/Off outputs are off at setpoint in both the heating and cooling operating modes. When in cooling mode, the load turns off at setpoint plus the differential. When in heating mode, the load turns on at setpoint minus the differential.

For example: Load 1: Compressor 1 (cool)—Sensor A

Setpt 1	78°F	On at	82°F
Diff 1	4°F	Off at	78°F

⚠ CAUTION

The T775 will not allow the user to program for both heating and cooling loads to be energized at the same time.

If this situation results, cooling loads will be energized and heating loads will be prevented from also energizing. The number (1,2,3,4) of these nonenergized loads flashes along with the word HEAT to indicate a call for both heating and cooling loads controlled by one sensor has occurred and to alert the user to reprogram the affected control values.

5. Remove the T775 cover and enter the values listed on the worksheet and the date in the first column on the label inside the T775 cover.

Device Programming Worksheet	
Load 1: SetPt 1 _____ Throttling Range _____	On at _____ Off at _____
Load 2: Setpt 2 _____ Diff 2 _____	On at _____ Off at _____
Load 3: Setpt 3 _____ Diff 3 _____	On at _____ Off at _____
Load 4: Setpt 4 _____ Diff 4 _____	On at _____ Off at _____

DEVICE PROGRAMMING

Factory Default Values

. When power is initially applied to the T775 the control points are at their default value set at the factory. Default values are:

	Setpoint (°F)	Differential (°F)	Operating Mode
Stage 1	72	2	Heat
Stage 2	70	2	Heat
Stage 3	68	2	Heat
Stage 4	66	2	Heat

1. For the T775F, assign the loads to the appropriate sensor by setting the DIP switch in the upper right corner of the T775 (See DIP Switch Selection, Fig. 23).
2. Before programming the T775, verify that the °F/°C selection jumper is properly installed. The T775 is shipped from the factory with the jumper installed in the °F position. When °C is desired, remove the jumper.
3. Apply power to the device. The device begins counting down from 210. This countdown sequence lasts for approximately 3-1/2 minutes.
4. To override this time delay, press Select.
5. Press Select and Enter keys simultaneously to begin programming the load operating mode (Heat or Cool).
6. Press the Set (down arrow) to change to cooling. The Set (up arrow) changes back to heating.
7. Press Enter to program the displayed mode into memory.
8. Press Select to go to the next stage.
9. Repeat steps 6 through 8 for additional stages.
10. Pressing Select after the last stage is set up returns to the display of the sensed temperature.

PROGRAMMING STAGE CONTROL VALUES

IMPORTANT: *If you have a 0 to 18 Vdc output T775, go to the Calibration Procedure for 0 to 18 Vdc Output T775 section before continuing to program the stage control values. The Electronic Series 90 and 4 to 20 mA output devices require no calibration; proceed to step 1.*

IMPORTANT: *When programming all stages, the first stage designated on the LCD is always the modulating output.*

1. Press Select to display the current stage setpoint.
2. Press Set (up arrow) to increase or Set (down arrow) to decrease to the desired setpoint.
3. Press Enter to enter the displayed value into memory.
4. Press Select to display the current stage throttling range or switching differential.
5. Press Set (up arrow) to increase or Set (down arrow) to decrease to the desired throttling range or switching differential.
6. Press Enter to enter the displayed value into memory.
7. Repeat steps 1 through 6 to program each additional stage.
8. For the T775E, press Select/Select (two times) to return to stage 1 parameters. For the T775F, press Select/Select/Select/Select (four times) to return to stage 1 parameters. For the T775G, press Select to return to stage 1 parameters. Scroll through the programming loop a second time to confirm that the appropriate values were entered into memory by pressing Select.

NOTE: The T775F has three options for displaying the sensed temperature:
1. Sensor A only.
2. Sensor B only.
3. Alternating between Sensors A and B.

For the T775F only:

9. Press Select after viewing the switching differential for the final stage to display Sensor A temperature only.
10. Press Select again to display Sensor B temperature only.
11. Press Select again to alternate the display between Sensor A and Sensor B temperatures at approximately five-second intervals.
12. Before replacing the cover on the T775, check to verify that the control values are recorded on the label on the backside of the cover.

IMPORTANT: *For the T775E and T775G only: After initial programming, altering the setpoints for stage 1 up or down will result in a change in setpoints 2, 3, and 4 by the same number of degrees and in the same direction. When increasing or decreasing the setpoint for stage 1 results in exceeding the control limits (-40°F to +220°F [-40°C to +104°C]) for subsequent stages, the control will not allow the user to enter a value for stage 1 higher or lower than this limit. This will allow for easy sequential output staging to be modified, while keeping the margin intact between setpoints.*

NOTE: The control values programmed into memory will not be lost in event of a power failure.

CALIBRATION PROCEDURE FOR 0 TO 18 Vdc OUTPUT T775

NOTE: The 0 to 18 Vdc output T775 models have field selectable starting voltages and spans and will require calibration. The 135-ohm, Series 90 and 4 to 20 mA output T775 models require no calibration.

1. Disconnect power to the device.
2. Remove the device cover and disconnect the load from the plus and minus outputs. Connect a dc voltmeter to the plus and minus modulating outputs of the T775 (see Fig. 21).
3. Loosen the screw in the upper right corner of the T775 approximately six turns with a screwdriver (see Fig. 22).

Fig. 21—Modulating output terminal.

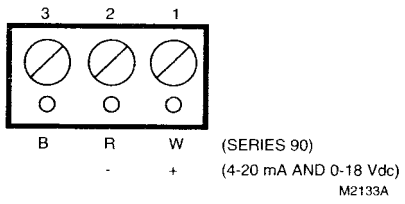
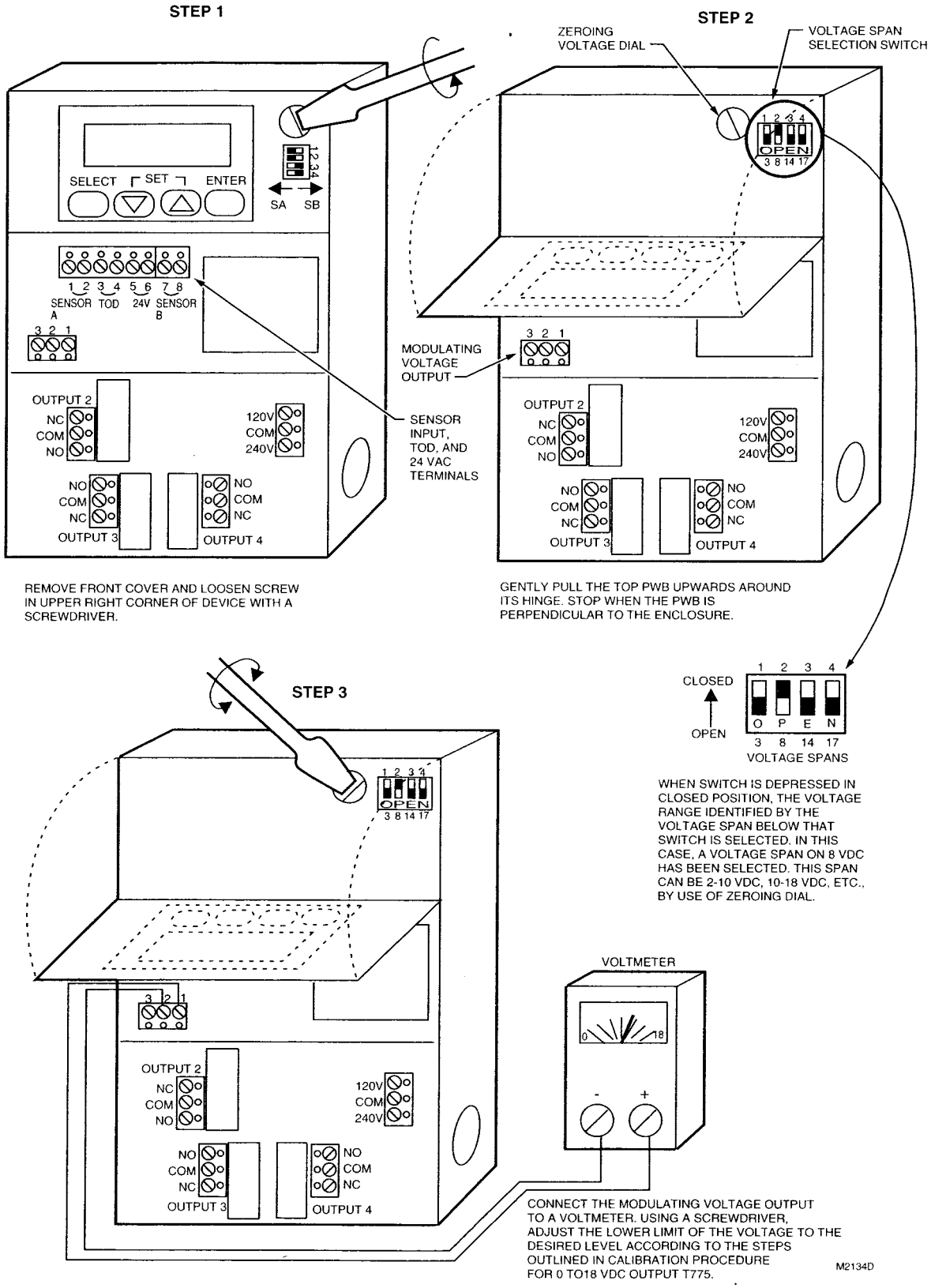


Fig. 22—Output voltage span selection.



Description/Operation

CONTROL ALGORITHM

Proportional plus Integral Modulating Control

Proportional + Integral (P+I) control provides fast, responsive operation of the controlled devices in reacting to temperature changes by providing an output signal proportional to the deviation between setpoint and actual temperature. An integral proportion also provides a time dependent output signal that is dependent on the length of time the deviation existed between actual setpoint and sensed temperature.

The P+I algorithm places the control setpoint in the middle of the throttling range. A deadband exists around setpoint and is proportional to the throttling range. For the T775, this deadband is one-eighth of the throttling range.

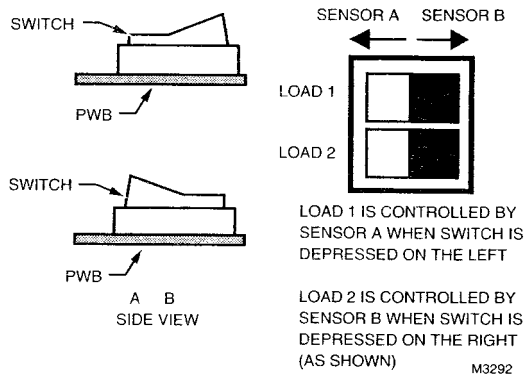
Modulating Control

There are three modulation options available for the T775. These options are:

- Electronic Series 90: This output provides an electronic signal equivalent to an electronic 135-ohm potentiometer. It is intended to drive Electronic Series 90 Modutrol® Motors for control of dampers and valves. This electronic signal does *not* drive electromechanical slidewire devices.
- 4 to 20 mA: This is a general purpose current mode output which can drive a 600-ohm maximum load without output current degradation. This modulation output can be used with Honeywell Modutrol® Motors that accept an input signal of 4 to 20 mA (M744S,T,Y and the M745S,T, and Y) or other Honeywell motors with the use of resistor kits.
- 0 to 18 Vdc (has series 100-ohm output resistor): This output module is intended as a general purpose voltage output and can drive a 2000-ohm load minimum. The span of voltage output is user selectable via a dual inline package (DIP) switch. (See Fig. 23) The spans offered are 3, 8, 14, and 17 volts. A zero adjustment dial is provided allowing the user to select starting voltage for common ranges such as 4 to 7 Vdc, 6 to 9 Vdc, 2 to 10 Vdc, 10.5 to 13.5 Vdc, 14.5 to 17.5 Vdc, 1 to 15 Vdc, and 1 to 18 Vdc. This modulation output can be used with Honeywell Modutrol® Motors that accept a voltage span comparable to any of the above. The device is factory set at the 2 to 10 Vdc range. The 0 to 18 Vdc output has an output rating to 20K ohms at rated voltages and to 2K ohms with a -5% voltage shift.

The T775E and G operate with one temperature input supplied by the remote sensor, while the T775F has two temperature inputs. The T775E and G are capable of providing up to four outputs, the first one of which is modulating. Each stage of the T775E and G has its own independent setpoint, which can be configured to operate in the cooling or heating mode. The mode of operation for each stage is user determined by the programming keys.

Fig. 23—DIP switch settings for sensor selection.



CONTROLLER DESCRIPTION OPERATION

- The throttling range is the range around which the T775 attempts to control the setpoint.

Heating Mode Operation

- The throttling range is centered around the setpoint.
- Modulating outputs are at their minimum or closed position at setpoint plus one-half of the throttling range.
- Modulating outputs are at their maximum or open position at setpoint minus one-half of the throttling range.
- Relay outputs are energized at setpoint minus differential and are de-energized at setpoint.

Cooling Mode Operation

- The throttling range is centered around the setpoint.
- Modulating outputs are at their minimum or closed position at setpoint minus one-half of the throttling range.
- Modulating outputs are at their maximum or open position at setpoint plus one-half of the throttling range.
- Relay outputs are energized at setpoint plus differential and de-energized at setpoint.
- Relay outputs are de-energized at temperature setpoint value.

The T775F has dual sensor inputs and allows two separate controllers to exist within one enclosure. Selection of the stage parameters (operation mode, setpoints, throttling range, and differentials) is the same as that for a single sensor device once each stage has been assigned to its operating sensor. This assignment is hardware driven via a set of four DIP switches. An explanation of the DIP switch assignments is shown in Fig. 23.

Contact Closure Override Input

A two-terminal input is provided to allow the user to override a relay energized condition on all outputs. When used with modulating devices, a contact closure override input causes the output to return to its minimum position. This function is generated by using a contact closure between terminal pins 3 and 4 of the terminal block for sensor input shown in Fig. 3 and 4. This can be achieved manually or by using an Energy Management System (EMS) controller or time clock with normally open contacts (W7505 or S7005, for example).

When this override is active, the display shows the numbers of the stages that would have been energized and the words STAGE ENERGIZED flash on the display.

°F/°C Selection

A single jumper plug controls °F/°C indication of the displayed temperature value. The location of this jumper is shown in Fig. 3 and 4. The unit is shipped with the jumper installed in the °F mode. To operate the device in the °C mode, remove the jumper.

DIP Switch Selections

On the T775F, the DIP switches are provided for assignment of each relay output stage to its operating sensor. When an individual switch is depressed toward its corresponding load number (1-4 on DIP switch) or to the right, Sensor B is the controlling sensor for that output stage. When an individual switch is depressed to the left, Sensor A is the controlling sensor for the output stage. An example of the switches and their corresponding positioning is shown in Fig. 23.

A second set of DIP switches is present for voltage range selection on 0 to 18 Vdc modulating devices. On the printed wiring board below each switch is the span corresponding to each switch. Fig. 22 shows the location of this switch, zeroing dial and how to set the voltage span.

KEYPAD PROGRAMMING AND DISPLAY

The T775 uses a Liquid Crystal Display (LCD) for interactive prompting during programming and display of sensed and assigned setpoint and differential values. User programming of the T775 is accomplished using the four programming keys.

Programming Keys

The four programming keys are the Select, Up arrow, Down arrow and Enter keys.

- Select key sequentially prompts the user for what parameter is being displayed: setpoint, differential, stage energized, heat or cool (operation mode), 1,2,3,4 (indicating assigned stage). Once the last parameter value is viewed, pressing the Select key displays the control values again from the beginning of the display loop.
- Up and Down arrow keys allow the displayed parameter to be increased or decreased. After pressing the Select key, a control value can be changed using the arrow keys. Control values are increased or decreased by 1°F or 1°C each time the arrow key is depressed.
- Enter key places the new value into the memory of the microprocessor.

IMPORTANT: *A control value or operation is not entered into the memory of the microprocessor until the Enter key is pressed.*

Control values and operation selection remain in the device memory even after the power is removed.

- Press the Select and Enter keys at the same time to change the control algorithm from heating to cooling or from cooling to heating. The heating and cooling parameters are not displayed during the normal Select key sequences. The only parameters displayed after pressing the Select and Enter keys at the same time are the stage indication and the word heat or cool. To change the operation from heating to cooling or vise versa for a desired output stage, use the arrow keys. Once the mode is changed, pressing the Enter key is necessary to enter this change into the microprocessor memory. The next stage of heat or cool assignment appears after the Select key is pressed. When all stages are programmed, the display reverts back to sensed temperature and load energized status.

Display

Once power is applied or restored to the device, the display counts down from 210 until the display reads zero, during which time any previously energized outputs are de-energized. This is intended to protect compressors in the event of a power outage.

To avoid viewing this entire countdown, press the Select key. The LCD display now shows what it normally reads: load (sensed) temperature, stages energized, and which sensor (Sensor A or Sensor B) is being read for two sensor devices. At any time during the programming procedure, 60 seconds after the last key closure, the display reverts back to showing the sensed temperature and stage status indication.

For two sensor applications, the user has three options for what is displayed. The display can be configured to alternatively indicate Sensor A and Sensor B sensed temperature at a five second rate or lock on to Sensor A or Sensor B sensed temperature continuously.

This selection is accomplished by stopping at Sensor A or Sensor B sensed temperature points in the Select screen scrolling loop. To lock on to either sensor, the user must scroll the Select key through the loop to the sensed temperature prompt of interest. The display sticks to that parameter until the Select key is activated to advance the loop. When the loop is stopped at any other prompt, the display alternatively indicates Sensors A and B sensed temperature after 60 seconds from the last key closure or immediately after the Select key has been pressed at the end of the programming sequence.

Error Messages

There are seven error messages that can be displayed in response to software or hardware problems with the T775. The error Codes that can be seen flashing on the display are:

SF—Sensor Failure

If the display shows a flashing SF, this indicates an out of range or defective sensor. Make sure that the sensors are connected properly. For the T775E and G, all loads will be de-energized when this message is flashing.

For the T775F, the loads controlled by the out-of-range sensor will be de-energized. The display flashes SF to indicate which sensor is defective or in error. In the event that only one sensor is defective, the remaining sensor and its load(s) operate normally. Only the load(s) controlled by the defective or unconnected sensor will be de-energized.

IMPORTANT: *A sensor value of less than -40°F or greater than 220°F is out of range and will display SF and de-energize the loads assigned to this sensor when this condition occurs.*

EF—EEPROM Failure

The values read back from the EEPROM are not the same as what was written into the EEPROM. This error cannot be field repaired. Replace the device. The EEPROM is not intended to be field repaired.

CF—Calibration Failure

A calibration resistor reading was not within the range of the Analog to Digital converter. This error cannot be field repaired. Replace the device.

OF—Stray Interrupt Failure

An unused interrupt occurred. This error cannot be field repaired. Replace the device.

CE—Configuration Error

The device hardware was configured to a nonexistent device. This error cannot be field repaired. Replace the device.

OE—ROM Error

The internal Read Only Memory (ROM) of the microprocessor is defective. This error cannot be field repaired. Replace the device.

AE—RAM Error

The internal Random Access Memory (RAM) of the microprocessor is defective. This error cannot be field repaired. Replace the device.

Setpoint Calibration

To maintain temperature accuracy, sensor wires should be 18 AWG two-conductor. If the length of the sensor wire exceeds 400 feet, recalibration will be necessary to maintain accuracy. Table 1 shows the corresponding temperature calibration offset that should be used for different sensor wire lengths. Add this offset to the desired temperature setpoint for these applications. Refer to programming instructions for entering temperature setpoints in the Device Programming section.

TABLE 1—CALIBRATION OFFSET FOR SENSOR WIRE LENGTH.

Sensor Wire Length	Temperature Calibration Offset
0-399 ft	none required
400-599 ft	1 degree
600-799 ft	2 degrees
800-1000 ft	3 degrees

Checkout

After the controller is installed and wired, apply power. Make desired initial adjustments and settings.

1. As illustrated in the example in Fig. 24, record the sensed temperatures for both Sensors A and B as displayed on the device. Use the Select key to advance through the programming loop to determine and then write on the Checkout Table (in Fig. 24) the loads that are controlled by each sensor.

2. Write the operating mode (heat or cool) for each stage in the Checkout Table.

3. Write the sensed temperature for each load on the Sensed Temperature line.

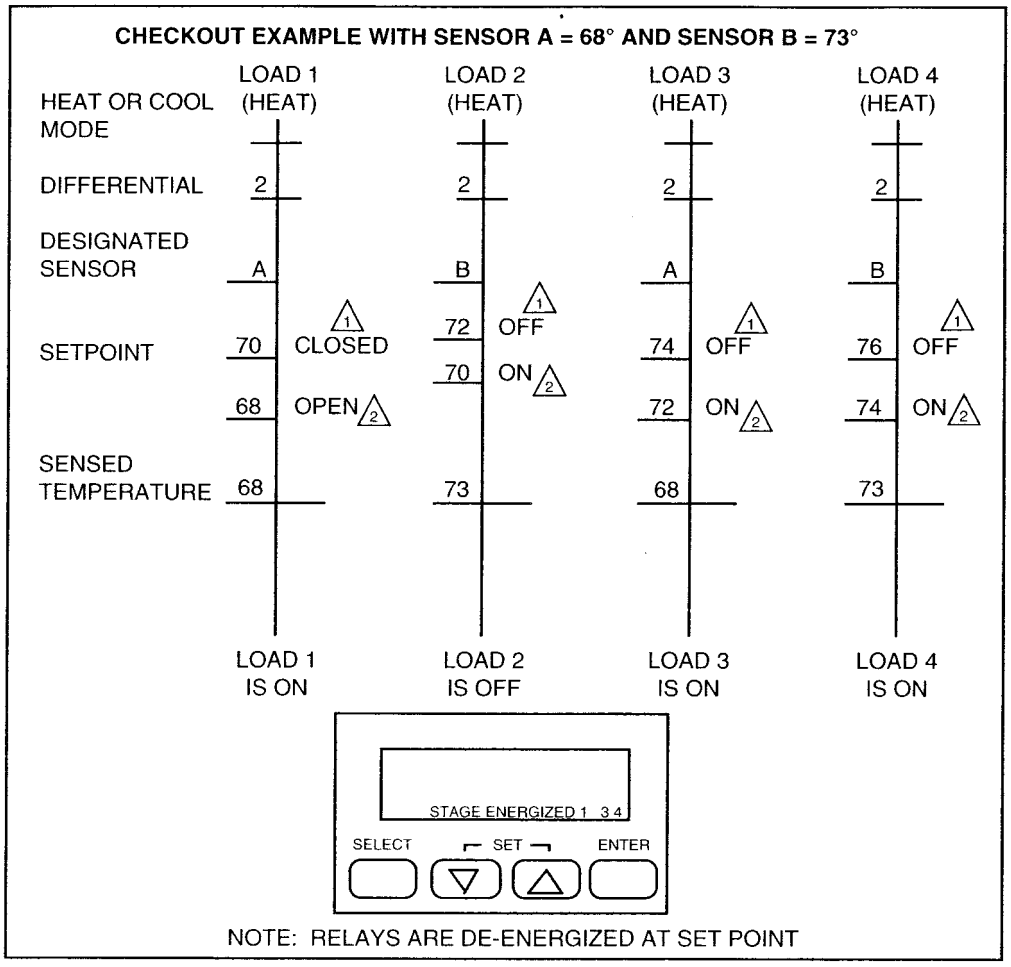
4. Plot the on and off (open/closed) values at which the device energizes and de-energizes each output load by referring to the Device Programming Worksheet.

5. Verify which loads are energized by using the Checkout Table. As shown in the example, the display indicates , in the lower right corner, which stages are energized. If no stages are energized, the words "stage energized" will not appear.

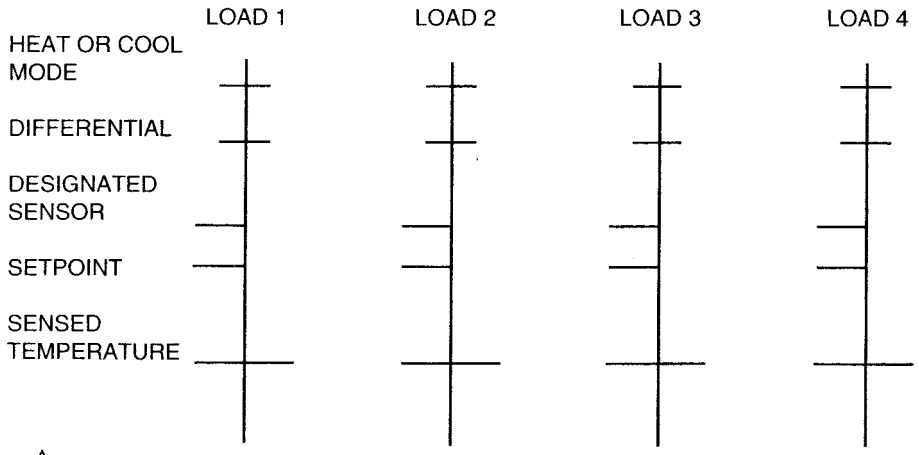
NOTE: If the sensed temperature is between the on and off temperatures, the load may be either energized or de energized. Refer to the Control Algorithm section for further explanation.

6. If an error message flashes, refer to the Error Messages section. If SF flashes, check the sensor connections; if properly connected and SF continues to flash, check the sensor location to make sure it is located in an ambient condition within the sensor capability (-40°F to +220°F).

Fig. 24—Checkout Table and checkout example with Sensor A = 68°F and Sensor B = 73°F.



CHECKOUT TABLE



1 INDICATES LOAD STATUS WHEN SENSED TEMPERATURE REACHES SETPOINT.

2 INDICATES LOAD STATUS WHEN SENSED TEMPERATURE REACHES SETPOINT MINUS DIFFERENTIAL (HEAT MODE).

M7426A

Fig. 25—Two-stage control, 120 or 240 Vac input; 120 or 240 Vac load.

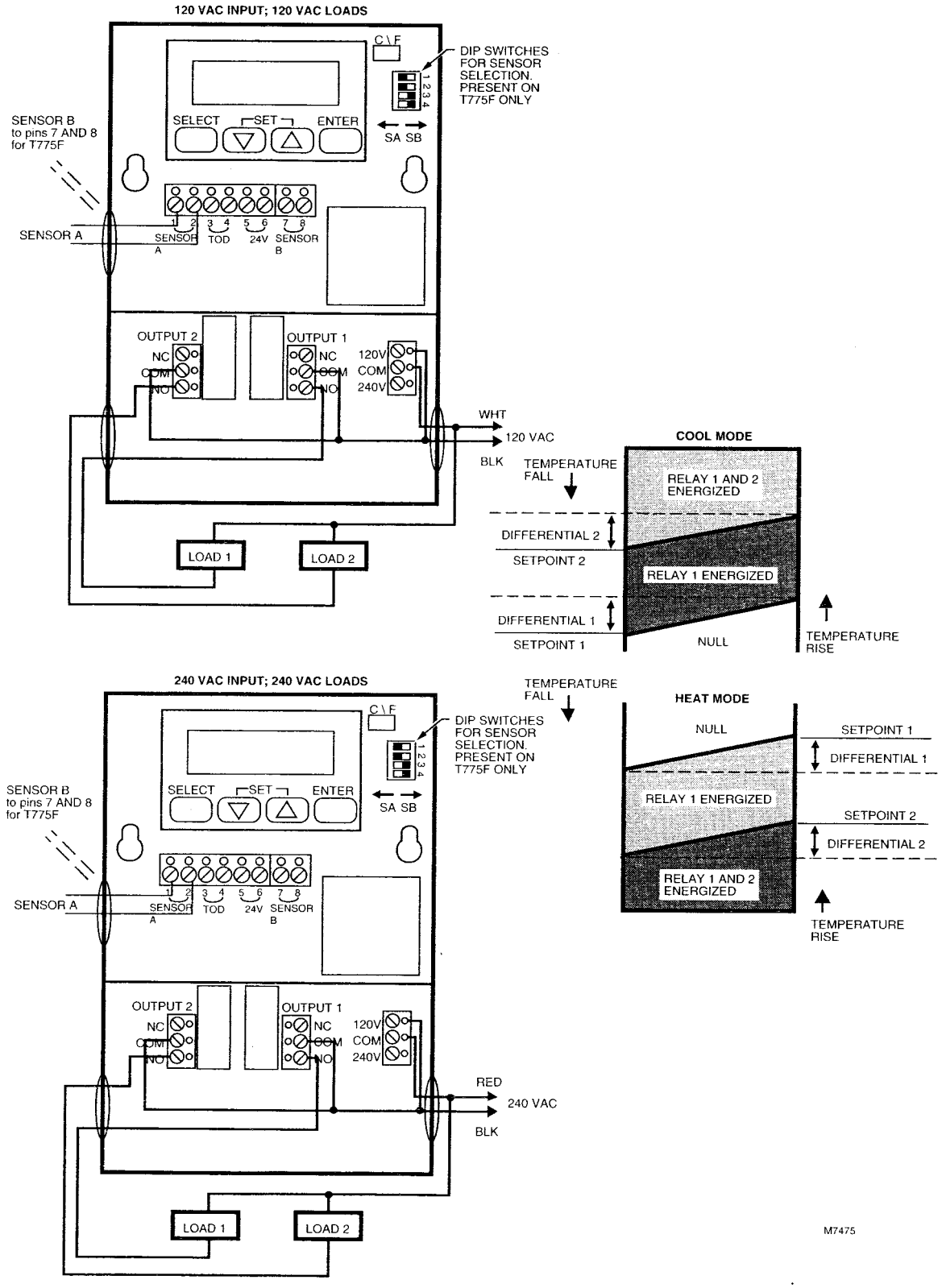


Fig. 26—Two-stage control, 24 Vac input, 24 Vac load.

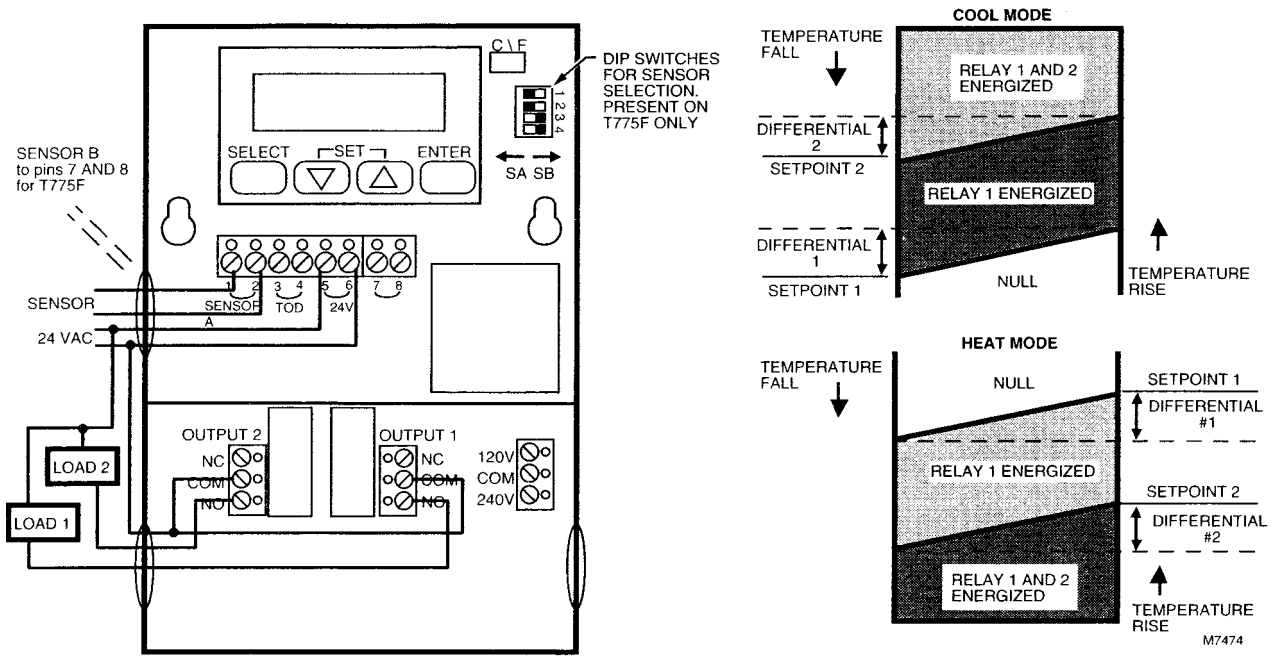


Fig. 27—Four stage control, 120 or 240 Vac input, 120 or 240 Vac load.

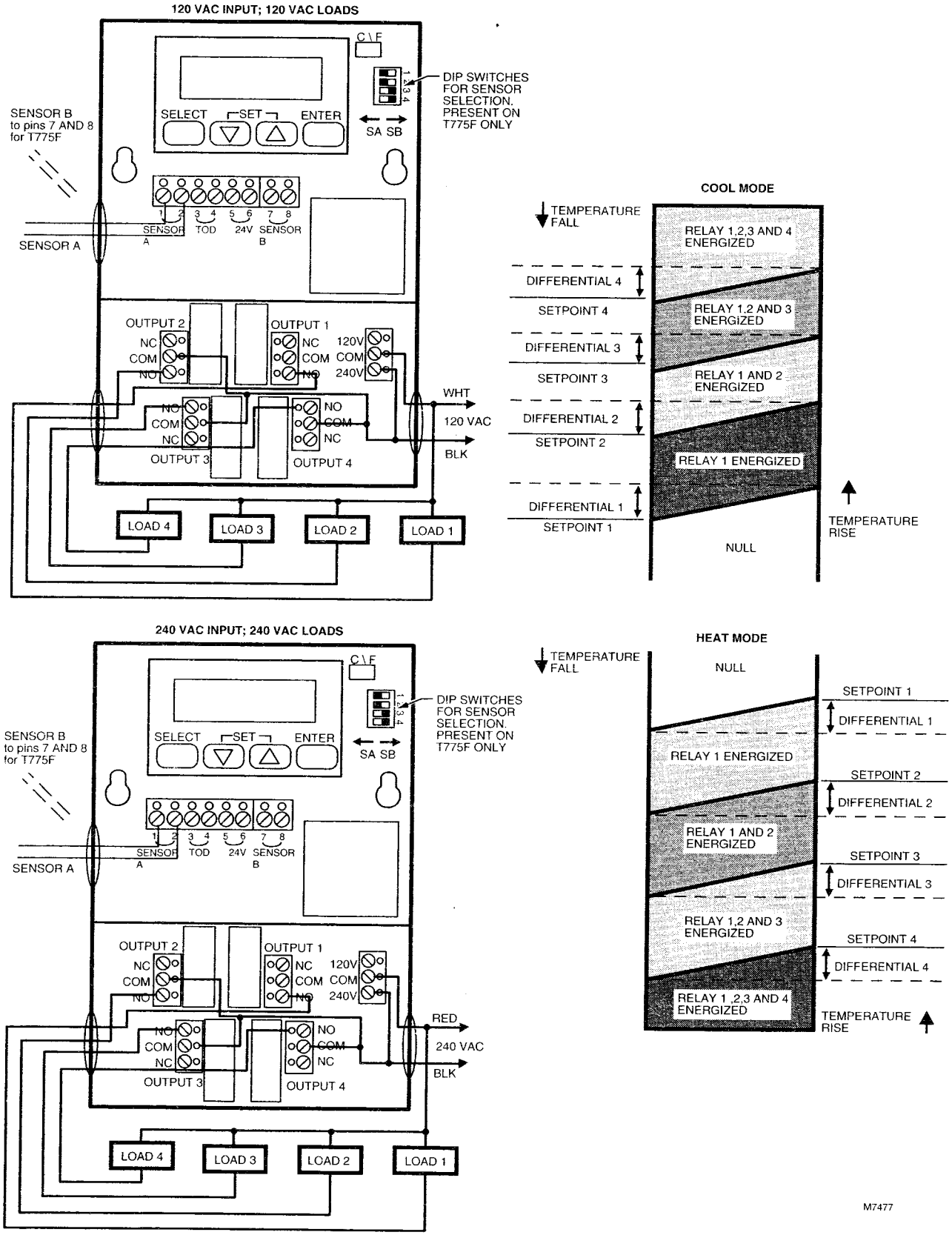
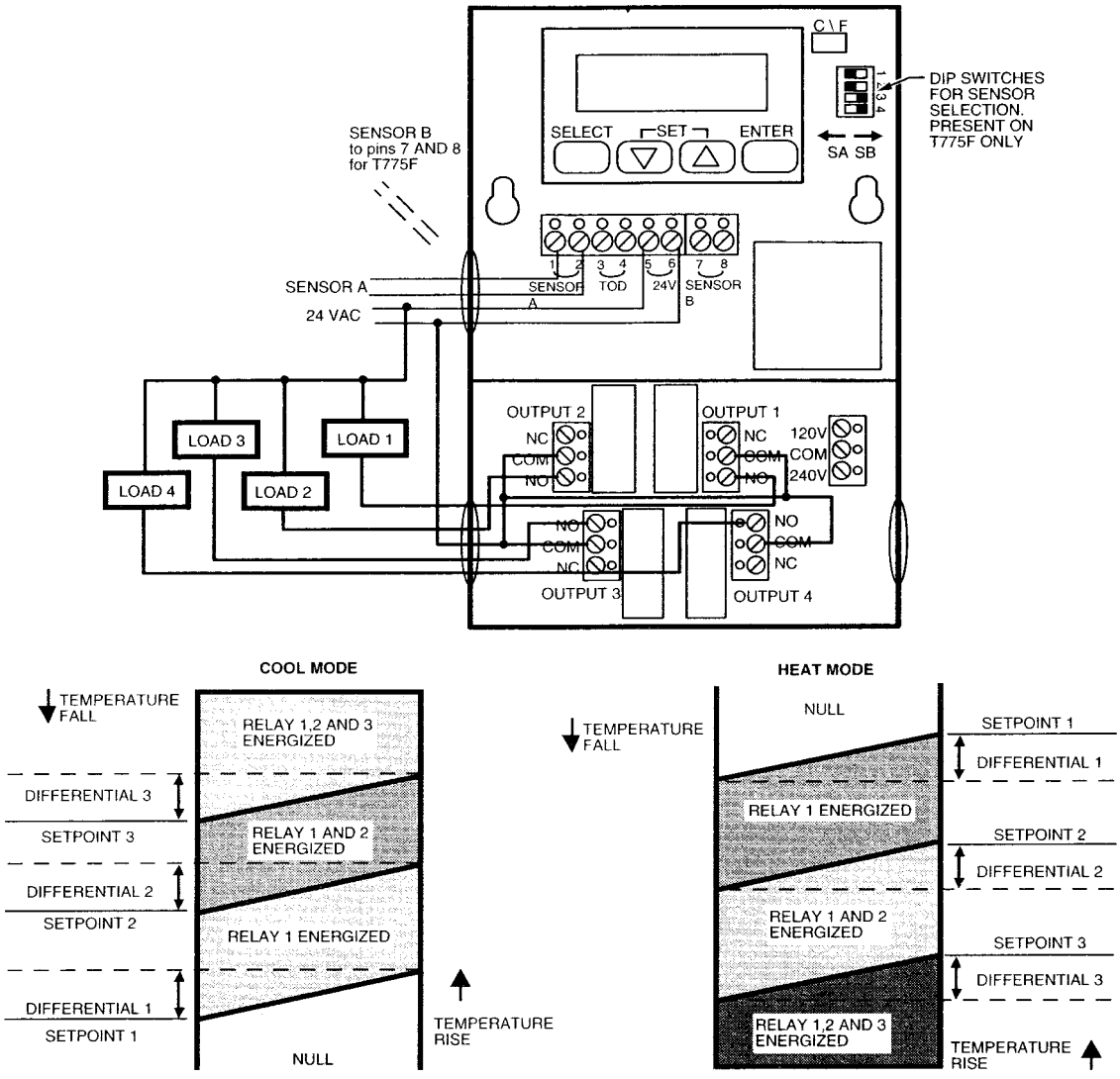


Fig. 28—Four-stage control, 24 Vac input; 24 Vac load.



N OTE: FOR THERMOSTAT APPLICATIONS, CONNECT NO CONTACT OF COOLING STAGE TO Y1 (AND SECOND STAGE TO Y2) CONNECT NO CONTACT OF HEATING STAGE TO W1 (AND SECOND STAGE TO W2). M7476

Honeywell

T775E,F,G Remote Temperature Controller Form 63-2490 Addendum

This document, 63-A2490, updates the T775E,F,G Remote Temperature Controller Specifications (form 63-2490, dated 3-95) to correct the wiring in Fig. 25 and 27. Fig. 25 originally illustrated a 240 Vac hookup to the 120 Vac T775, which would have damaged or destroyed the T775. Fig. 27 originally illustrated a 120 Vac hookup to a 240 Vac T775, which would prevent the operation of the T775.

WARNING

Disconnect power before wiring to prevent electrical shock or equipment damage.

WARNING

Do not use 24 Vac power at terminals 5 and 6 to power any external loads when 120 Vac or 240 Vac is used to power the T775.

Fig. 25—Two-stage control, 120 or 240 Vac input; 120 or 240 Vac load.

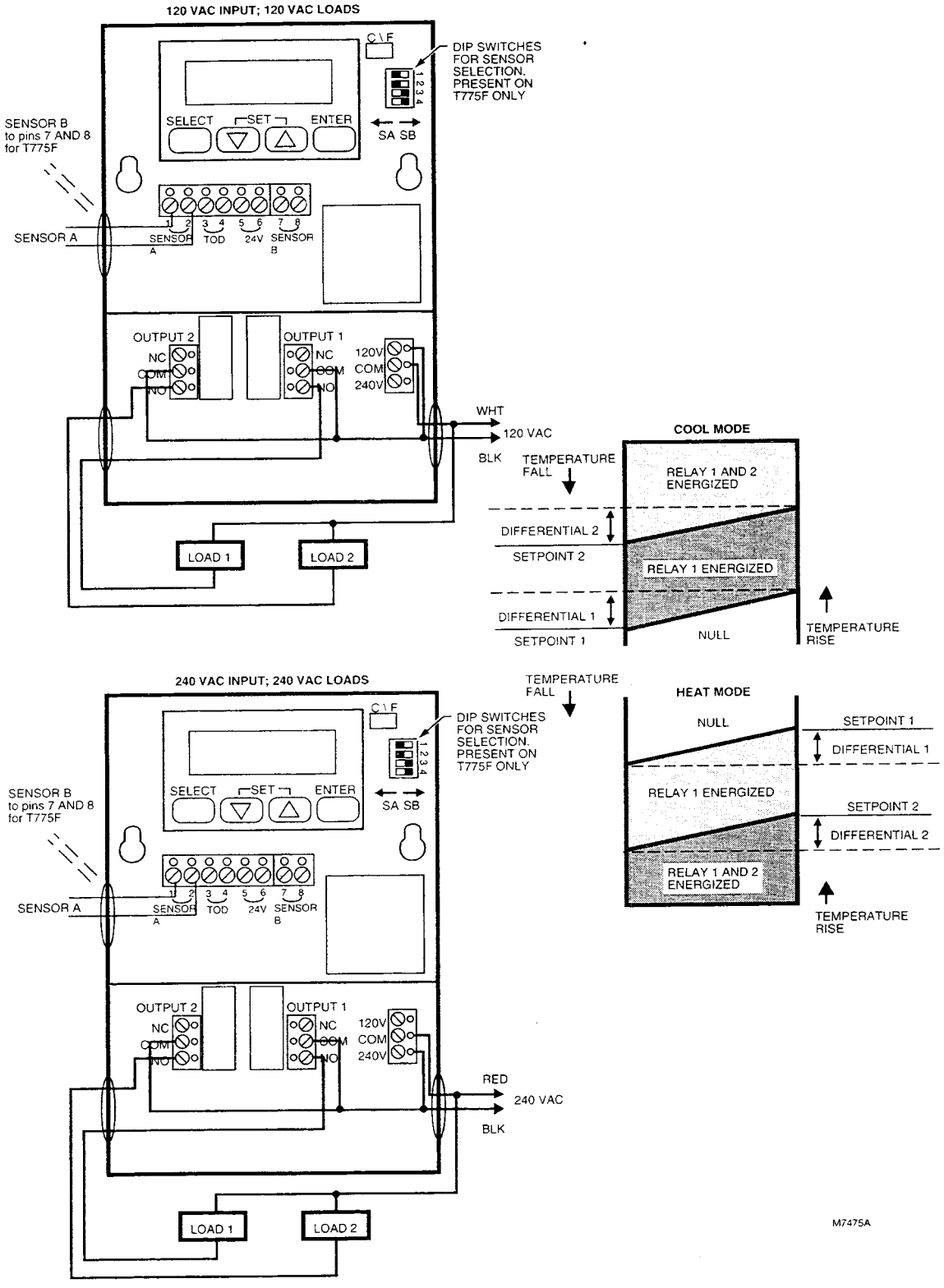
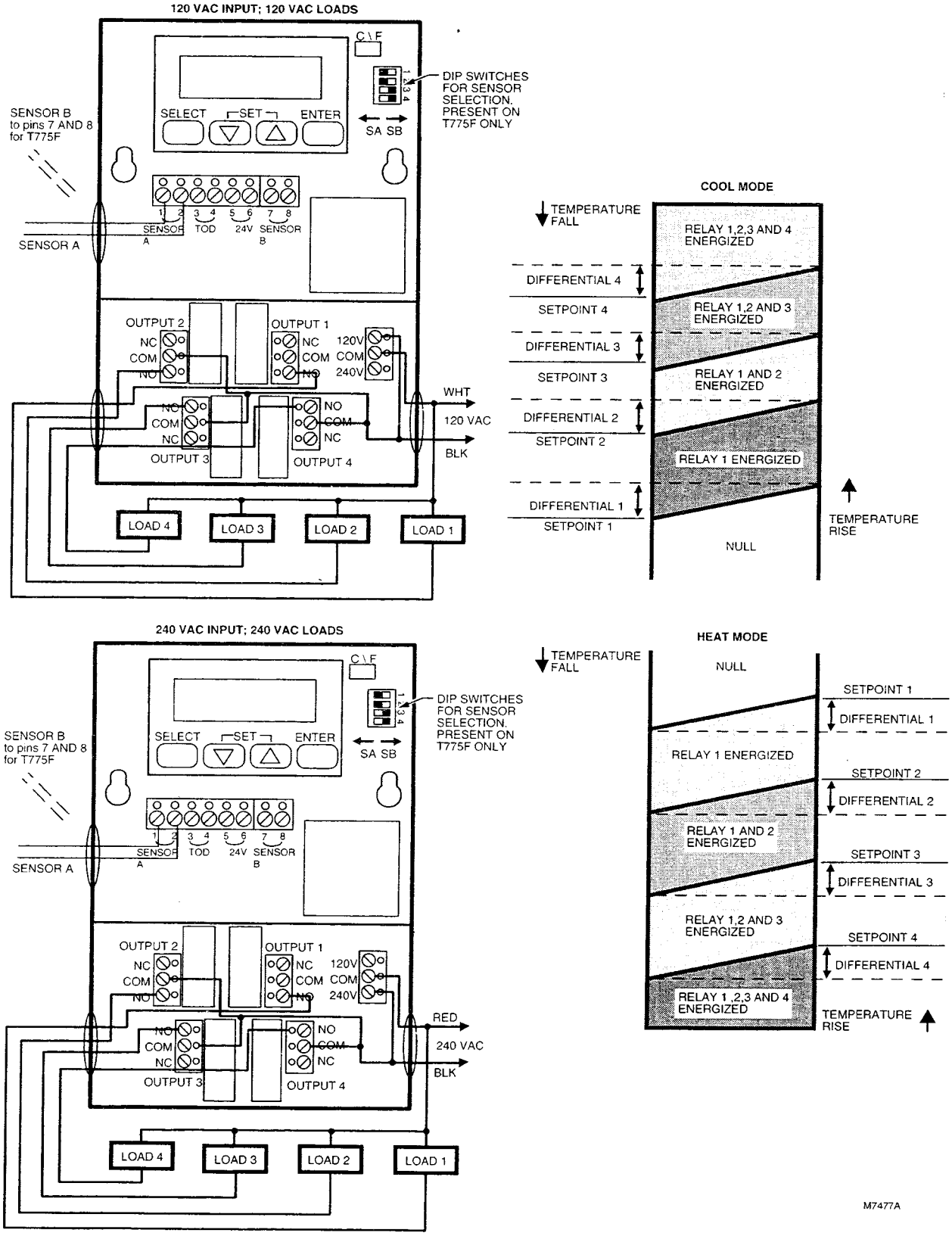


Fig. 27—Four stage control, 120 or 240 Vac input, 120 or 240 Vac load.



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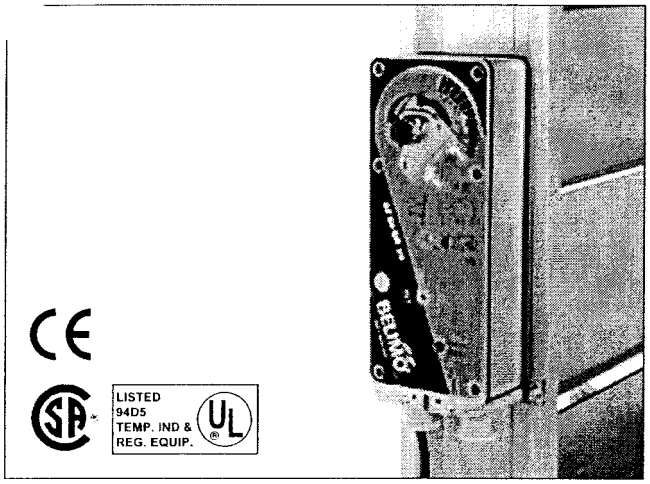
Helping You Control Your World

QUALITY IS KEY

Printed in U.S.A.

AF24-SR US, AFR24-SR US

Proportional damper actuator, spring return safety, 24 V for 2 to 10 VDC, 0 to 20 V phasecut and 4 to 20 mA control signal. Output signal of 2 to 10 VDC for position indication



Torque min. 133 in-lb, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crankarm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication or master-slave applications.

Operation

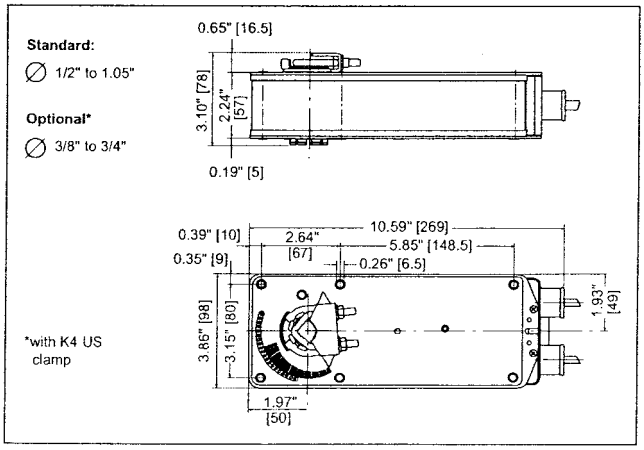
The AF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The AF series provides 95° of rotation and is provided with a graduated position indicator showing -5 to 90°. The AF has a unique manual positioning mechanism which allows the setting of any damper position within its 95° of rotation. When power is applied to the AFR series its "one time use" mechanism is released. The actuator is shipped in the zero position (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is applied, the manual mechanism is released and the actuator drives toward the full fail-safe position. The actuator will memorize the angle where it stops rotating and use this point for its zero position for its normal control operations. The manual override can also be released physically by the use of a crank supplied with the actuator.

The AF uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact zero position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

Technical Data	AF24-SR US
Power supply	24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power consumption	running: 6 W ; holding: 2 W
Transformer sizing	10 VA (class 2 power source)
Electrical connection	3 ft, 18 GA appliance cable 1/2" conduit connector
Overload protection	electronic throughout 0 to 95° rotation
Operating range	2 to 10 VDC, 4 to 20 mA
Input impedance	100 kΩ (0.1 mA), 500Ω
Feedback output "U"	2 to 10 VDC (max. 0.5 mA) for 95°
Angle of rotation	mechanically limited to 95°
Torque	133 in-lb [15 Nm] constant
Direction of rotation	spring return reversible with CW/CCW mounting. Control direction selected by switch: CW=CW with decrease in signal CCW=CCW with a decrease in signal
Position indication	visual indicator, -5° to 90° (-5° is spring return position)
Manual override	3mm hex crank (shipped w/actuator)
Running time	150 sec. constant, independent of load, spring return < 20 sec
Humidity	5 to 95% RH non-condensing
Ambient temperature	-22°F to +122°F [-30°C to +50°C]
Storage temperature	-40°F to +176°F [-40°C to +80°C]
Housing	NEMA type 2 / IP54
Housing material	zinc coated metal
Agency listings	UL 873 listed, CSA C22.2 No. 24 certified
Noise level	max. 45 dB (A)
Servicing	maintenance free
Quality standard	ISO 9001
Weight	6.0 lbs (2.7 kg.)
	AFR24-SR US (same as above except)
Position indication	-5° to 95°
Manual override	**Not available**

Dimensions (All numbers in brackets are metric.)



25.51/2 B

AF24-SR US, AFR24-SR US

Proportional damper actuator, spring return safety, 24 V for 2 to 10 VDC and 4 to 20 mA control signal. Output signal of 2 to 10 VDC for position indication

Accessories

AV 10-18	Shaft extension
IND-AF2	Damper position indicator
K4 US	Universal clamp for 3/8" to 3/4" shafts
K4-1 US	Universal clamp for up to 1.05" dia jackshafts
K4-H	Universal clamp for hexshafts 3/8" to 5/8"
KH-AF	Crankarm for up to 3/4" round shaft (Series 2)
KH-AF-1	Crankarm for up to 1.05" jackshaft (Series 2)
KH-AFV	V-bolt kit for KH-AF and KH-AF-1
Tool-01	10 mm wrench
SGA24	Min. and/or man. positioner in NEMA 4 housing
SGF24	Min. and/or man. positioner for flush panel mounting
ZG-R01	500Ω resistor for 0 to 20 mA control signal
ZDB-AF2	Angle of rotation limiter
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-102	Multiple actuator mounting bracket
ZG-103	Universal mounting bracket
ZG-104	Universal mounting bracket
ZG-106	Mounting bracket for Honeywell® Mod IV replacement or new crankarm type installations
ZG-107	Mounting bracket for Honeywell® Mod III or Johnson® Series 100 replacement or new crankarm type installations
ZG-108	Mounting bracket for Barber Colman® MA 3../4.., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crankarm type installations
ZG-AF	Crankarm adaptor kit for AF/NF
ZG-AF108	Crankarm adaptor kit for AF/NF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

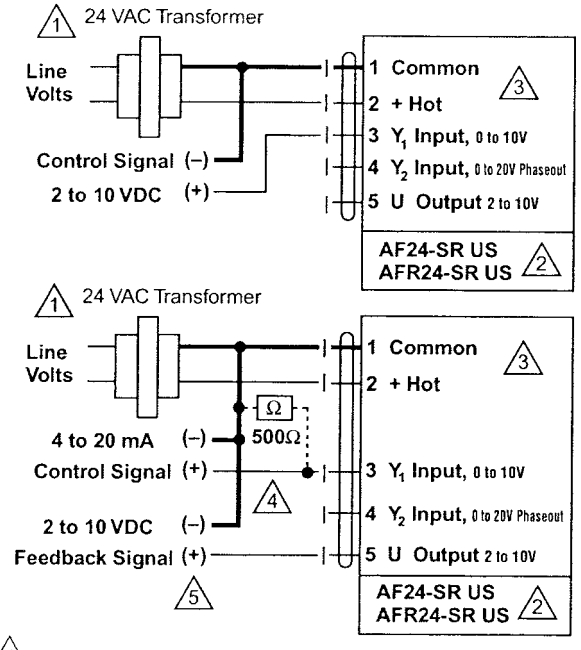
For an overview of how to apply the accessories see pages 16 - 19. More detailed specifications can be found in our Mechanical Accessories section, page 132. Refer to our Mounting Methods Guide for application details.

Note: When using AFR24-SR US actuators, only use accessories listed on this page.

AFR24-SR US Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crankarm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counter-clockwise fail-safe operation. Actuators shall have control direction of rotation switch accessible on its cover. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback or master-slave applications. Actuators shall be UL listed and CSA certified, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring diagrams



1 Provide overload protection and disconnect as required.

2 Actuators may be connected in parallel. Power consumption and input impedance must be observed.

3 Actuator may also be powered by 24 VDC.

4 The ZG-R01 500Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

5 Only connect common to neg. (—) leg of control circuits

B
25/5/2/2

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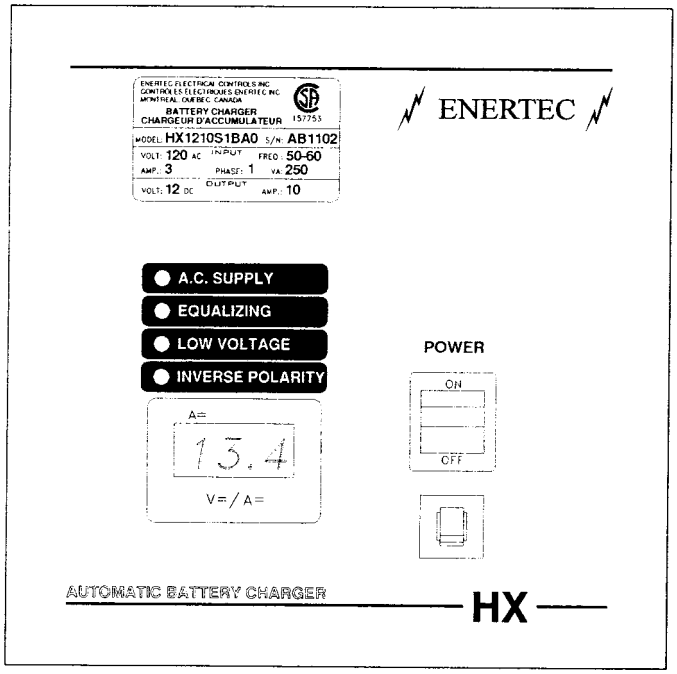
AUTOMATIC BATTERY CHARGER

OPERATING



HX

3/6/10 AMPS

Model 12 volts: HX12
Model 24 volts: HX24

MANUAL

1/10 pages

25.6

Publication: M–HX-A Rev. 2006-06-16

SAFETY PRECAUTIONS

This manual includes warnings instruction to indicate potentially dangerous conditions for operator or equipment. Read this manual carefully and know when these conditions exist. Then take the necessary action to protect personnel and the equipment.

⚠ CAUTION

IMPORTANT SAFETY INSTRUCTIONS

(a) *SAVE THESE INSTRUCTIONS. THIS MANUAL CONTAINS IMPORTANT SAFETY AND OPERATING INSTRUCTIONS;*

(b) *WORKING IN THE VICINITY OF A LEAD-ACID BATTERY IS DANGEROUS. BATTERIES GENERATE EXPLOSIVE GASES DURING NORMAL BATTERY OPERATION. FOR THIS REASON IT IS OF THE UTMOST IMPORTANCE THAT EACH TIME BEFORE USING YOUR CHARGER, YOU READ AND FOLLOW THE INSTRUCTIONS PROVIDED EXACTLY;*

(c) *TO REDUCE RISK OF BATTERY EXPLOSION, FOLLOW THESE INSTRUCTIONS AND THOSE MARKED ON THE BATTERY;*

(d) *NEVER SMOKE OR ALLOW AN OPEN SPARK OR FLAME IN THE VICINITY OF THE BATTERY OR ENGINE;*

(e) *USE CHARGER FOR CHARGING A LEAD-ACID BATTERY ONLY. IT IS NOT INTENDED TO SUPPLY POWER TO AN EXTRA LOW-VOLTAGE ELECTRICAL SYSTEM OR TO CHARGE DRY-CELL BATTERIES. CHARGING DRY-CELL BATTERIES MAY CAUSE THEM TO BURST AND CAUSE INJURY TO PERSONS AND DAMAGE TO PROPERTY;*

(f) *NEVER CHARGE A FROZEN BATTERY;*

(g) *IF IT IS NECESSARY TO REMOVE BATTERY FROM VEHICLE TO CHARGE IT, ALWAYS REMOVE GROUNDED TERMINAL FROM BATTERY FIRST. MAKE SURE ALL ACCESSORIES IN THE VEHICLE ARE OFF IN ORDER TO PREVENT AN ARC;*

(h) *STUDY ALL BATTERY MANUFACTURER'S SPECIFIC PRECAUTIONS SUCH AS REMOVING OR NOT REMOVING CELL CAPS WHILE CHARGING AND RECOMMENDED RATES OF CHARGE;*

(i) *FOR A CHARGER HAVING AN OUTPUT VOLTAGE SELECTOR SWITCH REFER TO THE CAR OWNER'S MANUAL IN ORDER TO DETERMINE THE VOLTAGE OF THE BATTERY AND TO MAKE SURE THE OUTPUT VOLTAGE IS SET AT THE CORRECT VOLTAGE. IF AN OUTPUT VOLTAGE SELECTOR SWITCH 15 NOT PROVIDEDV DO NOT USE THE BATTERY CHARGER UNLESS THE BATTERY VOLTAGE MATCHES THE OUTPUT VOLTAGE RATING OF THE CHARGER;*

(j) *NEVER PLACE THE CHARGER DIRECTLY ABOVE OR BELOW THE BATTERY BEING CHARGED; GASES OR FLUIDS FROM THE BATTERY WILL CORRODE AND DAMAGE THE CHARGER. LOCATE THE CHARGER AS FAR AWAY FROM THE BATTERY AS DC CABLES PERMIT;*

(k) *DO NOT OPERATE CHARGER IN A CLOSED-IN AREA OR RESTRICT VENTILATION IN ANY WAY;*

(l) *CONNECT AND DISCONNECT DC OUTPUT CLIPS ONLY AFTER SETTING ANY CHARGER SWITCHES TO THE OFF POSITION AND REMOVING AC CORD FROM THE ELECTRIC OUTLET. NEVER ALLOW CLIPS TO TOUCH EACH OTHER;*

(m) *FOLLOW THESE STEPS WHEN BATTERY IS INSTALLED IN VEHICLE. A SPARK NEAR BATTERY MAY CAUSE A BATTERY EXPLOSION. TO REDUCE RISK OF A SPARK NEAR BATTERY:*

I. POSITION AC AND DC CORDS TO REDUCE RISK OF DAMAGE BY HOOD, DOOR, OR MOVING ENGINE PART;

II. STAY CLEAR OF FAN BLADES, BELTS, PULLEYS, AND OTHER PARTS THAT CAN CAUSE INJURY TO PERSONS;

III. CHECK POLARITY OF BATTERY POSTS. A POSITIVE (POS, P, +) BATTERY POST USUALLY RAS A LARGER DIAMETER TRAN A NEGATIVE (NEG, N, -) POST;

IV. DETERMINE WHICH POST OF BATTERY IS GROUNDED <CONNECTED) TO THE CHASSIS. IF NEGATIVE POST IS GROUNDED TO CHASSIS (AS IN MOST VEHICLES), SEE ITEM (v). IF POSITIVE POST IS GROUNDED TO THE CHASSIS, SEE ITEM (vi);

V. FOR A NEGATIVE-GROUNDED VEHICLE, CONNECT THE POSITIVE (RED) CLIP FROM BATTERY CHARGER TO POSITIVE (POS, P, +) UNGROUNDED POST OF BATTERY. CONNECT THE NEGATIVE (BLACK) CLIP TO VEHICLE CHASSIS OR ENGINE BLOCK AWAY FROM BATTERY. DO NOT CONNECT CLIP TO CARBURETOR, FUEL LINES, OR SHEET-METAL BODY PARTS. CONNECT TO A HEAVY GAUGE METAL PART OF THE FRAME OR ENGINE BLOCK;

VI. FOR A POSITIVE-GROUNDED VEHICLE, CONNECT THE NEGATIVE (BLACK) CLIP FROM BATTERY CHARGER TO NEGATIVE (NEG, N, -) UNGROUNDED POST OF BATTERY. CONNECT THE POSITIVE (RED) CLIP TO VEHICLE CHASSIS OR ENGINE BLOCK AWAY FROM BATTERY. DO NOT CONNECT CLIP TO CARBURETOR, FUEL LINES, OR SHEET-METAL BODY PARTS. CONNECT TO A HEAVY GAUGE METAL PART OF THE FRAME OR ENGINE BLOCK;

VII. CONNECT CHARGER AC SUPPLY CORD TO ELECTRIC OUTLET;

VIII. WHEN DISCONNECTING CHARGER, TURN SWITCHES TO OFF, DISCONNECT AC CORD, REMOVE CLIP FROM VEHICLE CHASSIS, AND THEN REMOVE CLIP FROM BATTERY TERMINAL;

(n) *FOLLOW THESE STEPS WHEN BATTERY IS OUTSIDE VEHICLE. A SPARK NEAR THE BATTERY MAY CAUSE A BATTERY EXPLOSION. TO REDUCE RISK OF A SPARK NEAR BATTERY:*

I. CHECK POLARITY OF BATTERY POSTS. A POSITIVE (POS, P, +) BATTERY POST USUALLY HAS A LARGER DIAMETER TRAN A NEGATIVE (NEG, N, -) POST;

II. ATTACH AT LEAST A 60 mm 6-GAUGE (AWG) INSULATED BATTERY CABLE TO A NEGATIVE (NEG, N, -) BATTERY POST;

III. CONNECT THE POSITIVE (RED) CHARGER CLIP TO THE POSITIVE (POS, P, +) POST OF BATTERY;

IV. POSITION YOURSELF AND THE FREE END OF CABLE AS FAR AWAY FROM BATTERY AS POSSIBLE, THEN CONNECT NEGATIVE (BLACK) CHARGER CLIP TO FREE END OF CABLE;

V. DO NOT FACE BATTERY WHEN MAKING FINAL CONNECTION;

VI. CONNECT CHARGER AC SUPPLY CORD TO ELECTRIC OUTLET;

VII. WHEN DISCONNECTING CHARGER, ALWAYS DO SO IN REVERSE SEQUENCE OF CONNECTING PROCEDURE AND BREAK FIRST CONNECTION WHILE STANDING AS FAR AWAY FROM BATTERY AS PRACTICAL;

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INTRODUCTION

This manual covers the installation and the adjustment of battery chargers of the economic HX series. These chargers use the SCR technology and they are automatic equalization type. Although the installation is simple, it is preferable to read attentively this manual.

Some options are available for this series such as the volt/ ampere module display and a dry contact output for the low voltage alarm. These options are specified in the different paragraphs of this manual.

Model type

Here are the different models covered in this manual:

HX- aa- bb- c- d- e- f- g

DC VOLTAGE	aa:	output voltage **12, 24** or 48 volts nominal.
CURRENT:	bb:	Maximum current (12 volts = **06** or **10** amp., 24 volts = **03** or **10** amp., 48 volts = **05**)
PRECISION:	c:	**S** = standard model, **H** = variation of Vin of ±10% for a variation of Vout of ± ½ % at full charge.
AC VOLTAGE	d:	**1** = 120 Vac, **2** = 240 Vac
MOUNTING:	e:	**B** = with cabinet, **F** = without cabinet (transfo. fixed on the back plate), **D** = remote transformer (terminals on the back plate for interconnection), **P** = Portable with cable
DISPLAY:	f:	**0** = without volt / ampere digital display, **A** = with volt / ampere digital display.
CONTACT:	g:	**0** = no relay, **1** = with one contact set for *low battery voltage* and *AC voltage lost* alarm, **2** = with two contact sets for same faults of "1" plus *high voltage*. **B** = with two contact sets, *low battery voltage* and *AC voltage lost* alarm

Example:

Model HX2403S1BA1 = 24 volts, 3 amperes, standard specification, 120 Vac input voltage, with cabinet, with V/A display and with one dry contacts set for the *low voltage* and *AC voltage lost* faults.

Note:

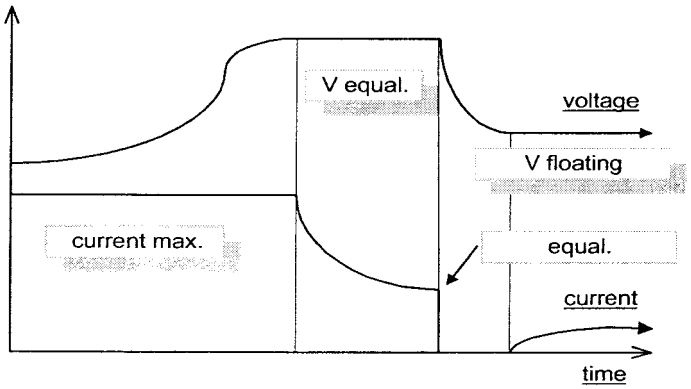
The model number is registered on the CSA identification plate in the front of the charger.

OPERATIONS

Battery chargers of the HX series allow the automatic equalization of cells of battery (one or more) when they lose their load. Upon loss of charge, the charger increases the current to its maximum capacity. Voltage is then decreased to keep the maximum current value constant, for as long as it takes to reach the equalization voltage.

Once the equalization voltage is reached, the current decreases gradually to reach the current limit of the *equalization mode*, which is 50% of the maximum value of the charge.

At this level of charge, voltage drops to the value of *floating voltage*.



Graph 1 - Current versus voltage variation.

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COMPONENTS DESCRIPTION

Green indicator "A.C. SUPPLY"

Function: Indicates when AC power is present at the output side of the power transformer. The breaker and the switch control this feed. If the indicator "*Equalizing*" is not active then the system is in *floating mode.*

Yellow indicator "EQUALIZING"

Function: This mode is switched on immediately when the current exceeds the equalization charge limit. The voltage is then increased to the equalization voltage limit that is set by the potentiometer "EQ" on the HX control card.

If the maximum current (fixed in factory to the maximum capacity of the model) is reached, the equalization voltage will not be reached as long as this current equals the maximum current limit. Then, the current will decrease gradually as the battery charges. When the current reaches the equalization *current threshold* (normally adjusted in factory to half of the maximal current), the voltage is going to fall to the floating voltage value.

Red indicator "LOW VOLTAGE"

Function: The indicator is activated when the battery voltage is under the low voltage limit for a duration of approximately 2 minutes.

A set of form C relay contacts is available in option for this function.

Red indicator "INVERSE POLARITY"

Function: Determine if the connection between the battery charger and the battery is inverted.

Switch / breaker "POWER"

Function: Feeds the charger with alternating current. The breaker protects the AC circuit against overload and short-circuits.

Display module Vdc / Adc (option)

Function: Displays alternately (period of 3 sec.) the DC voltage and the current. A dot in upper left of the window indicates the display of the current.

Fault relay for LOW BATTERY VOLTAGE or AC VOLTAGE LOST (option)

Function: Provides the remote information by contact relay.

The relay is energized if the battery voltage is higher then low voltage limit or if the low voltage delay (approx. 2 minutes) is not reached, and the AC supply circuit is well energized (after PT and diodes).

Fault relay for HIGH BATTERY VOLTAGE (option)

Function: Provides the remote information by contact relay.

The relay is energized if the battery voltage is higher then 0.5 Vdc of the Equalization voltage limit.

Remote battery voltage sensing (option)

Function: DC output voltage compensation for the loss of voltage in the battery lead connection.

The DC output voltage increases to have the same voltage at the battery terminal as the voltage setting.

When used, the display shows the voltage at the battery.

NOTE: For an optimal performance, use the same length and gauge for the + and – leads, and use the wire length & gauge values in the wire table (p.5).

Manual Equalizing (option)

Function: Forces the charger to stay in the Equalizing mode

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INSTALLATION

Assembly

Warning: *The front panel is in aluminum and it promotes the heat dissipation coming from SCRs and from the transformer, when the transformer is on. It is therefore normal that the temperature of the front panel becames hot when the current nears the maximum capacity of the charger.*

The charger has to be installed in a ventilated environment, without excessive humidity, without vibration and temperature superior to 40°C.

Model without a enclosure

The front panel can be installed according to the cutout diagram of figure 2. For the model with the transformer mounted outside (10 amps model), it's better to install the transformer as close as possible to the control panel and use a minimum wire gauge of 14 AWG for a distance of 15 feet.

Model with enclosure

Although this charger can operate at high enough temperature and if you use an enclosure not supplied by the manufacturer, be sure there are sufficient openings for airing.

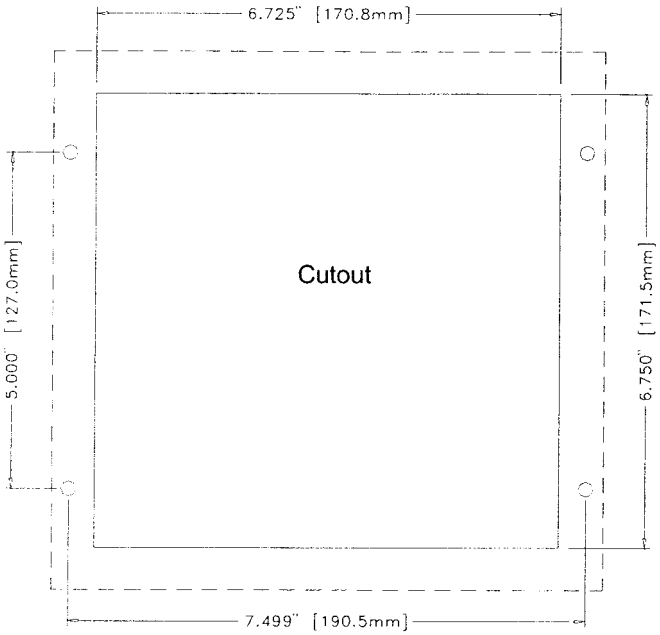

Figure 2 – Cutout for the control panel installation.

Connection

Length and wire size for battery connection.

It is preferable to use the largest gauge and shortest possible wire length for the connection between the charger and the battery. The loss of voltage caused by the wire resistance increases the recharge time of the battery.

Here is the wire size recommended between the charger and the battery for a charger of 12 nominal volts:

LENGTH	10 AMP.	6 AMP.	3 AMP.
between 0' & 15'	12 AWG min.	14 AWG min.	14 AWG min.
between 15' & 25'	10 AWG min.	12 AWG min.	14 AWG min.

The voltage loss is the same for models with different voltage. Therefore, the loss of voltage is relatively less important for 24 volts models.

Example: A Voltage of 13.3 Vdc to the charger output, a wire with 25 feet long and 10 AWG in size:

The voltage loss in wires (- and +) is 0.50 Vdc for a current of 10 amps and 0.05 Vdc if the current is 1 amp. Therefore, for a current of 10 amps the voltage to the battery terminals is 12.8 Vdc for these conditions.

Power circuit

DANGER The gas coming from a battery can cause serious injuries and explosion of the battery if a flame or a spark comes in contact with these gases.

1) Make sure the AC voltage and DC voltage are according to charger specifications.
2) Be sure the charger switch is in the "off" position.
3) Connect a grounding wire to the charger. It can be connected either on one of the mounting stud of the front plate or in the terminal for the model with a separate transformer.
4) Connect the AC power wires (16 AWG minimum gauge) on terminal L1 and N.
5) Connect the terminal of the battery to the charger with the recommended wires. The positive terminal (+) first.
6) Be sure the polarity is not inverted by looking at the indicator.
7) Press the button "Power" to supply the AC voltage to the system.

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LOW DC VOLTAGE with CA VOLTAGE LOST alarm circuit (option)

The output terminals for the contact relay are on the HX card (3 & 6 amps) or in the enclosure (10 amps).

1) Connect the common on the "C" terminal.
2) Connect the contact "Normally opened" on the "NO" terminal. It is open in fault.
3) Connect the contact "Normally closed" on the "NC" terminal. It is close in fault.

HIGH DC VOLTAGE alarm circuit (option)

The output terminals for the contact relay are on the HX card (3 & 6 amps) or in the enclosure (10 amps).

1) Connect the common on the "C" terminal.
2) Connect the contact "Normally opened" on the "NO" terminal. It is close in fault.
3) Connect the contact "Normally closed" on the "NC" terminal. It is open in fault.

MANUAL EQUALIZATION circuit (option)

The "EQ" terminal need positive voltage to manually active the equalizing mode. A minimum wire gauge of 20 AWG is needed if the length is less then 15 feet's (See the Electrical Schematic above).

REMOTE BATTEY VOLTAGE SENSING Circuit (option)

The "S" terminal needs to be connected directly on the negative battery terminal. A minimum wire gauge of 20 AWG is needed if the length is less then 15 feet's (See the Electrical Schematic above).

Electrical schematic

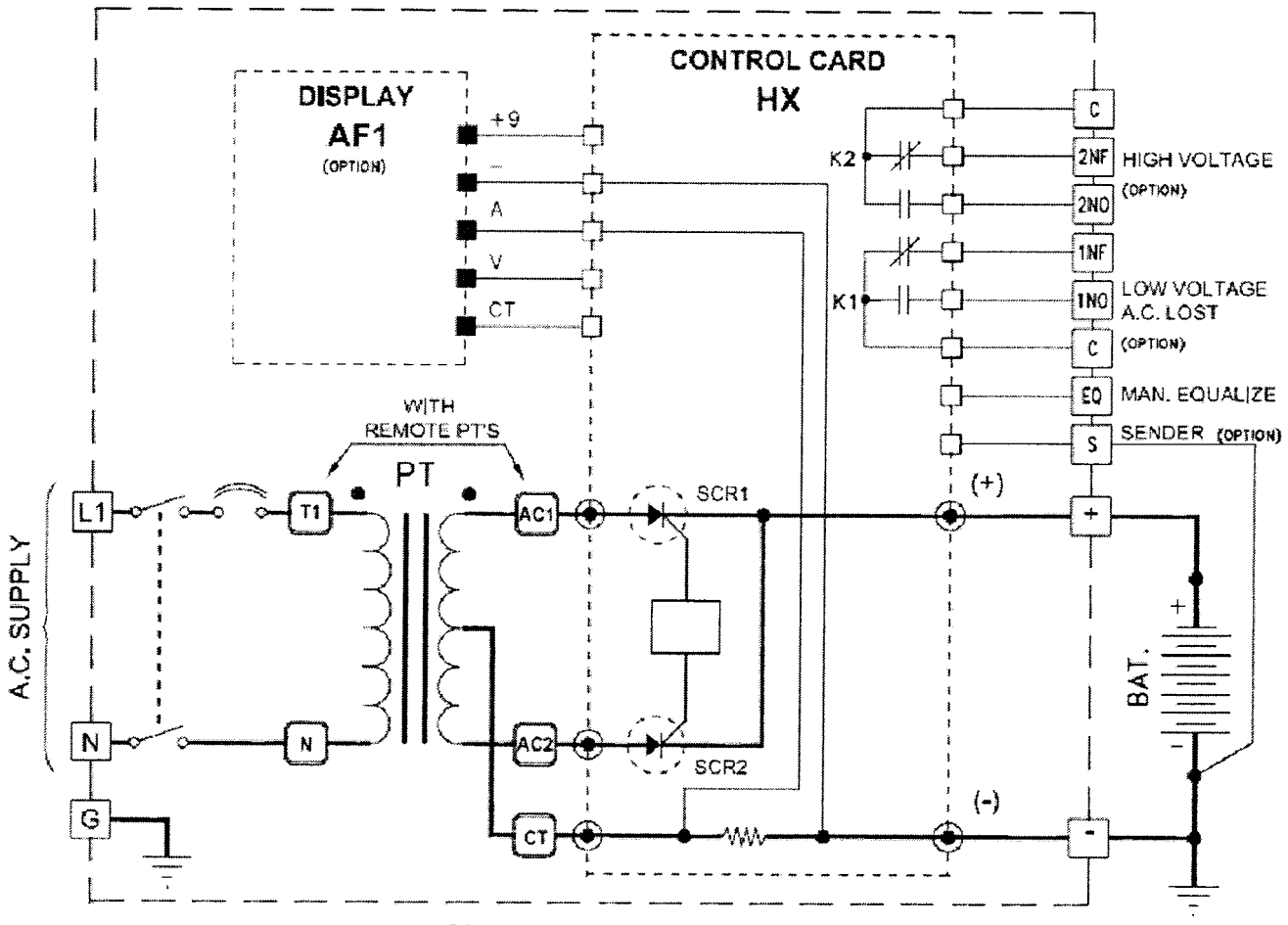

Diagram 1 – Electrical schematic

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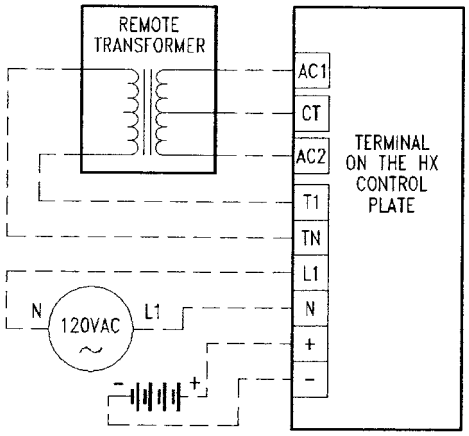
Terminal Connection – for the remote PT model



ADJUSTMENT

Normally, you have no adjustment to make if you have specified the battery type during the purchase. The adjustment of several parameters of the system is made through a potentiometer. Some parameters are fixed in factory, but can be changed when you purchase the charger or by returning it to the manufacturer.

⚠ WARNING

VOLTAGE WITHIN THE CHARGING SYSTEM CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.

KEEP AWAY FROM MOVING PARTS WHEN THE ENGINE STARTS OR IS RUNNING.

General Points

Connection for the adjustment readings

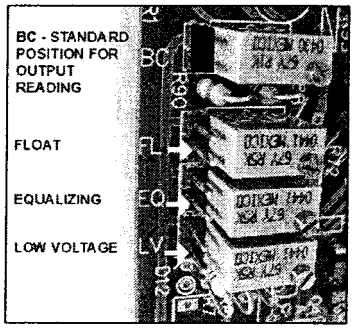
One can to read the calibration voltage either with the display module (± 0.1V precision) or with an external multimeter (± 0.01V precision)

With a multimeter:

To take the readings, use a calibrated multimeter with a minimum of 10M ohms of impedance. Connect the negative lead on the terminal (-) of the terminal block TB1 and the positive lead on the lower pin (or the solder hold, for the model without display) beside the potentiometer to calibrate. *Take care to never touch the traces on the PCB card.*

With the display module:

Use the *display jumper* on the "HX" card to select the potentiometer to calibrate (in normal mode, on "BC" position).



NOTE: After the calibration, do not forget to connect the jumper on the "BC" position for the output voltage reading.

Voltage adjustments

NOTE: Once the voltage is set, it will remain set as long as you do not change it.

If you use a multimeter:

(The best way)

For a 12 volt system, the voltage reading is half (½) of the desired voltage.

For a 24 volts system, the voltage reading is the quarter (¼) of the desired voltage.

Example: For 24Vdc system, you want 26.3Vdc

⇨ you read 6.57Vdc

If you use the display module:

NOTE: The voltage shown by the display module is read at the charger output and it does not take into account the voltage loss in the wire connection between the charger and the battery.

Adjust directly the desired voltage value at the display module, when the voltage is displayed.

Potentiometer adjustments

CAUTION *The Equalizing or Float voltage value of the battery type must be met for these adjustments. See the battery manufacturer specs. A bad setup could result in some premature wear*

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caused by the overheating of cells. This overheating can cause evaporation of the liquid contained in the battery.

These fumes are very harmful and can cause serious injuries.

NOTES:

- The charger does not have to be connected to a battery for the adjustment of potentiometers "FL","EQ" and "LV".
- To increase the voltage reading, turn the potentiometer screw clockwise.
- The use of a small screwdriver with a guide is recommended.

Floating voltage (FL)

Location:

FL potentiometer on the HX card

Method:

1. Connection to the potentiometer in expectation of a reading (to see "connection for the adjustment readings" in this section).
2. Adjust the desired voltage (see "voltage adjustments" in this section).

Default adjustment:

12 volts model = 13.3 Vdc,

24 volts model = 26.6 Vdc

Equalization voltage (EQ)

NOTE: The features of the battery are very important for the adjustment of this potentiometer. In case of overvoltage, the battery is going to overheat and dry out its cells. In case of under - voltage, the battery will not be loaded to its full charge.

Location:

EQ potentiometer on the HX card

Method:

1. Connect yourself to the potentiometer in expectation of a reading (see "connection for the adjustment reading" in this section).
2. Adjust the desired voltage (see "voltage adjustments" in this section).

Default adjustment:

12 volts model = 14.0 Vdc,

24 volts model = 28.0 Vdc

Low voltage (LV)

Location:

LV Potentiometer on the HX card

Method:

1. Connect yourself to the potentiometer in expectation of a reading (see "connection for the calibration reading" in this section).
2. Adjust the desired voltage (see "voltage adjustments" in this section).

Default adjustment:

12 volts model = 12.4 Vdc,

24 volts model = 24.8 Vdc

Calibration of the voltage

NOTE: Normally, this adjustment is done once in factory and would not have to be modified. This adjustment has to be done only if the HX card has been repaired.

Location:

BC potentiometer on the HX card

Method:

1. Calibration of the float and equalization voltage to desired values (see the method above).
2. Connect the charger to the battery.

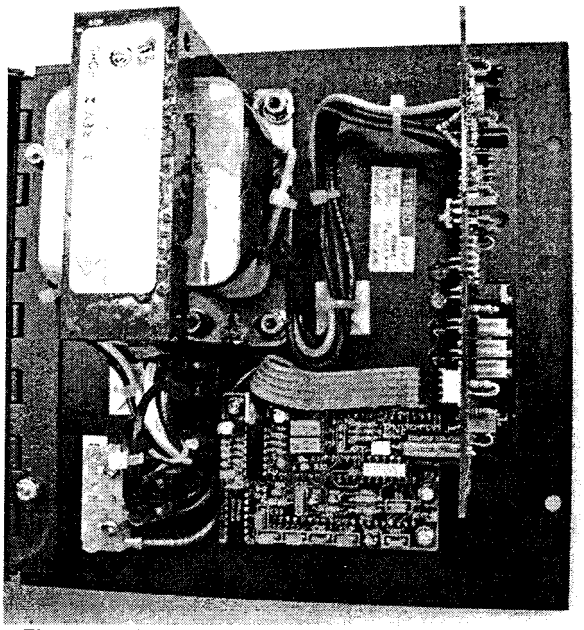

Figure 1 – Back view of the front panel of a model with a display module and transformer integrated on the panel.

3. Connect the probes of a multimeter calibrated such as the negative on the pin (-) and the positive on the pin (+) of the HX card (figure 1).
4. Adjust the output voltage by using the potentiometer BC so as to obtain as precisely as possible, double the voltage that you read at the point PT4 on the HX card. For a system of 24 volts, the voltage to read is four times the voltage read at point PT4.

Maximum current limit

Set in factory:

Fixed to the maximum of the charger capacity.

Equalisation charge threshold

Set in factory:

Fixed to half of the charger capacity.

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TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	VERIFICATION & SOLUTION
No DC voltage output.	1. The switch / breaker is not on. (the green LED is not lit).	*Engage the switch / breaker.*
	2. The switch / breaker is tripped in overload (the green LED is not lit).	*Correct the overload problem and engage the breaker after a certain cooling period.*
	3. The wiring connection of the battery is inverted (the "inverted polarity" LED should be lit).	*Re-connect wires properly.*
	4. Defective transformer.	*The secondary voltage of the transformer should have a voltage of 11.5 to 14.5 Vac. (system 12 Vdc) and 23 to 29 Vac (system 24 Vdc). Replace if defective.*
	5. Defective SCR or the control circuit (HX card)	*Verify by the replacement.*
	6. The charger output is short-circuited.	*Connect the output correctly.*
Low output DC voltage. (the "low voltage" LED can light up)	1. The floating mode or the equalization mode is too low.	*Increase the voltage of the mode. Refer to the voltage adjustment procedure.*
	2. The battery is defective or is of the inadequate type for this charger.	*Replace the battery.*
	3. Defective SCR or the control circuit (HX card).	*Verify by replacing the part.*
The equalization mode does not engage.	1. SCR or the control circuit (HX card) is defective.	*Verify by the replacement of the HX card.*
	2. The battery is defective or is of the inadequate type for this charger.	*Replace the battery.*
Always in equalization mode. (The "equalization" LED is lit)	1. The equalisation voltage adjustment is too high for this type of battery.	*Decrease the voltage limit of the equalization mode. Refer to the voltage adjustment procedure.*
	2. The battery charger is not enough powerful for your demand.	*Verify the auxiliary current demand, and use a bigger battery charger if you cannot drop the load.*
	3. Output of the charger is short-circuited.	*Connect the output properly.*
	4. The control circuit (HX card) is defective.	*Verify by replacing the part.*

SPECIFICATIONS

Model of charger:	HX1206S	HX1210S	HX1210H	HX2403S	HX2410S	HX2410H
Full load:	n/a	n/a	n/a	n/a	n/a	n/a
Output current:	6 amp.	10 amp.	10 amp.	3 amp.	10 amp.	10 amp.
Minimum adjust at floating mode (Vdc):	12.6	12.6	12.6	25.2	25.2	25.2
Max. adjust at floating mode (Vdc):	13.5	13.5	13.5 Vdc	27.0 Vdc	27.0 Vdc	27.0 Vdc
Min. adjust at equalizing mode (Vdc):	13.5 Vdc	13.5 Vdc	13.5 Vdc	27.0 Vdc	27.0 Vdc	27.0 Vdc
Maximum adjust at equalizing mode:	14.5 Vdc	14.5 Vdc	14.5 Vdc	29.0 Vdc	29.0 Vdc	29.0 Vdc
Δ Vin / Δ Vout of ½% at full load:	± 5.8% Vin nominal	± 5.7% Vin nominal	± 10% Vin nominal	n/a	n/a	± 10% Vin nominal
Δ Vin / Δ Vout of ½% at 80% of the load:	± 9.8% Vin	± 9.8% Vin	n/a	± 5.8% Vin	n/a	n/a
Δlout of 0 to 100%	Δ Vout = ½%	Δ Vout = ½%	Δ Vout = ½%	Δ Vout = ½%	Δ Vout = ½%	Δ Vout = ½%
Weight without case:	2.5 kg/ 5.5	4.0 kg / 8.8	n/a	2.5 kg / 5.5	5.4 kg / 12.0	n/a
Weight with case:	4.1 kg/ 9.0	8.2 kg / 18.1	n/a	4.1 kg/ 9.0	9.7 kg / 21.3	n/a
Max. temp. of operation:	-30 to 40°C					
Display module V/A						
Digit:	3					
Precision:	voltage = ±0.1 volt, current = ±0.1 amp.					
Max. temp. of operation:	-35 to 50°C					
Low voltage relay						
Type:	DPDT connect in parallel					
Contacts:	1A @ 30 Vdc or 120 Vac					

ENERTEC
WWW.ENERTEC.QC.CA

Made in Canada

ENERTEC Inc., 2284 chemin St-Francois, Dorval, Quebec, Canada H9P 1K2
(514) 421-7077, FAX: 421-7078

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Chapter 26 FEW HOT WATER BOOSTER

MANUFACTURER/DISTRIBUTOR:

WOSELEY
4200, Hickmore
St-Laurent, Qué., H4T 1K2
PH: (514) 344-9378 FAX: 9341

26.1 CALORITECH FEW HOT WATER BOOSTER.(CONTROL SCHEMATICS)

26.2 CALORITECH FEW HOT WATER BOOSTER.(TYPICAL INSTALLATION)

26.3 ITT, McDONNEL & MILLER LOW WATER CUT OFF.

26.4 AMTROL EXPANSION TANK.

26.5 GIANT ELECTRIC HOT WATER HEATER. (STORAGE)

26.6 WHITE RODGERS HOT WATER CONTROL.

26.7 BELIMO VALVE ACTUATOR.

26.8 AUTOMATIC BACKWASH FILTER AND CONTROL.

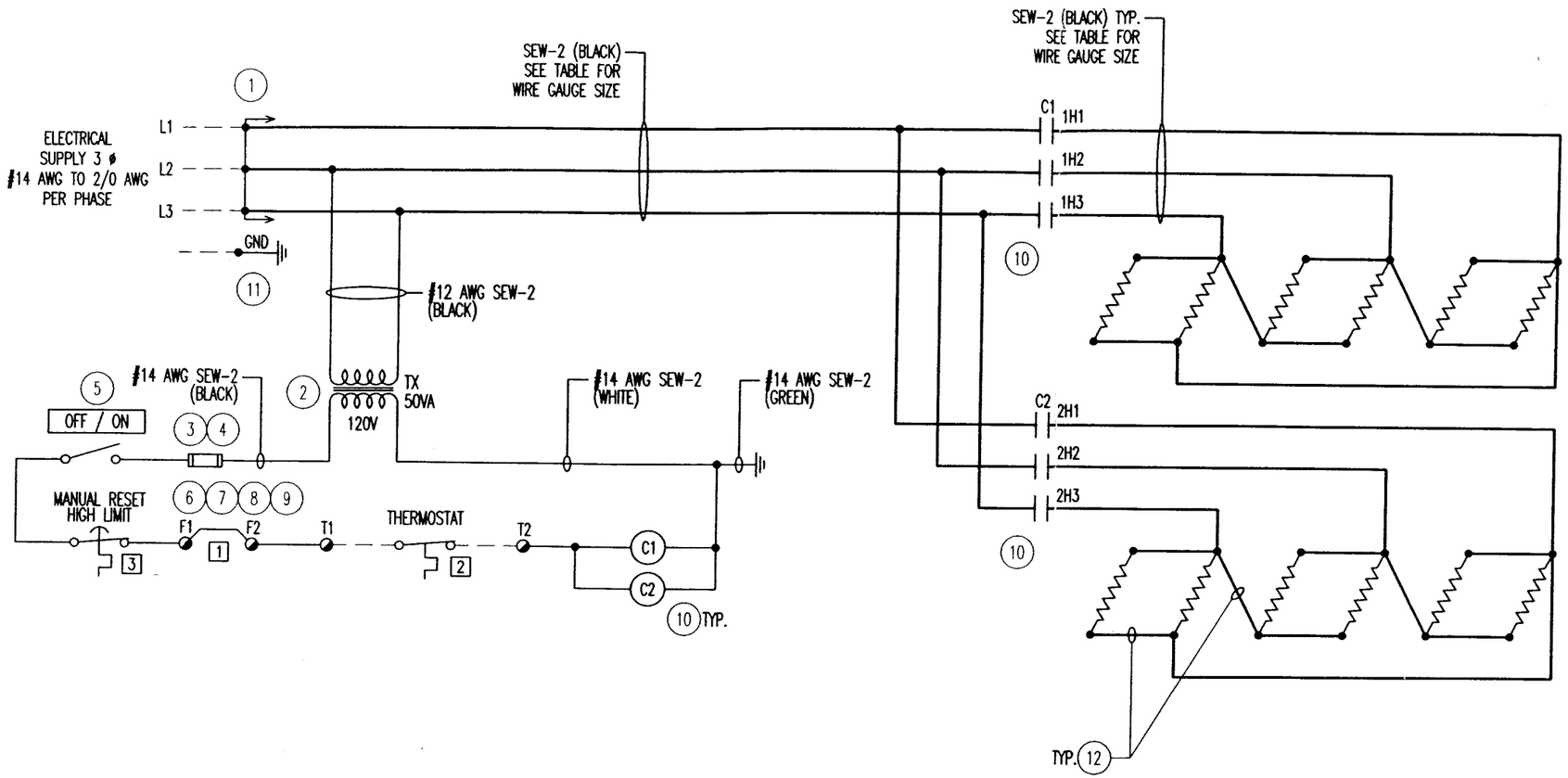
26.9 HEAT EXCHANGER PERFORMANCE SPECIFICATION.

26.10 ROUGHLYTE OUTSIDE LAMP. (FEW INDICATION).

26.11 KTECH SM4001-CD LEVEL VALVE (FUTURE USE).

END OF CHAPTER 26

NO.	REVISION	DATE	BY/PAR
1	HI LIMIT TEMP (NOTE 3) REMOVED, #12 AWG SEW-2 WAS #14 AWG	DEC 12/02	E.D./D.T
2	DET. 3 DESCRIPTION WAS CERAMIC FUSE.	FEB 12/03	D.D./E.D
3	DET. 5 PART. NO. WAS E10T115AS, DET. 9 PART. NO. REVISED.	APR 8/03	D.D./E.D
4	DET. 13 TO 16 AND NOTES 4 & 5 DELETED.	MAR 21/05	



ITEM NO.	VOLTS	KW	TRANSFORMER (DET.2) PART NO.	GROUND LUG (DET.11) PART NO.	HEATER CIRCUIT WIRE GAUGE
88	600	60	600/120V 50VA	B10243-01 (KLU-35)	10
87		42-54			12
86	480	48-60	480/120V 50VA	B10243-02 (KLU-70)	10
85		36-42		B10243-01 (KLU-35)	12
84	416	54-60	416/120V 50VA	B10243-02 (KLU-70)	8
83		36-48			10
	380	48-60	380/120V 50VA		8
		36-42			10

NOTES:

1. AUXILIARY INTERLOCK PROVIDED FOR CONNECTION OF FLOW SWITCH. IF REQUIRED REMOVE JUMPER.
2. THERMOSTAT SUPPLIED LOOSE. SEE MECHANICAL DRAWINGS C14921 (CWCB-XX-1) OR C14922 (CWCB-XX-2) FOR DETAILS.
3. MANUAL RESET HIGH LIMIT. SEE MECHANICAL DRAWINGS C14921 (CWCB-XX-1) OR C14922 (CWCB-XX-2) FOR DETAILS.

DET	DESCRIPTION	PART NO. NO. PIECE	QTY. QTE
12	BUS BAR COPPER	A10247-05	16
11	GROUND LUG	SEE TABLE	1
10	CONTACTOR - 50A	42CF35AF	2
9	MOUNTING RAIL	A14015-32	3 IN
8	TERMINAL BLOCK STOPPER	A14015-19	2
7	TERMINAL BLOCK END	A14015-11	1
6	TERMINAL BLOCK - 25A	A14015-01	4
5	TOGGLE SWITCH - 2 POS. SPST EATON	7500K14	1
4	FUSE HOLDER PANEL MOUNT	HKP-HH	1
3	SECONDARY FUSE - 6/10A 250V	MDL-6/10	1
2	TRANSFORMER - (SEE TABLE)	SEE TABLE	1
1	SPLITTER BLOCK - 175A	B11086-01	1

BILL OF MATERIAL / LISTE DE MATERIEL

TITLE: WIRING DIAGRAM CWCB-XX-1/2 HEATERS 26.1

NO.: B14350 SHEET 4 — REV.: 4

REF.:

S.O.:

TOLERANCE UNLESS NOTED OTHERWISE

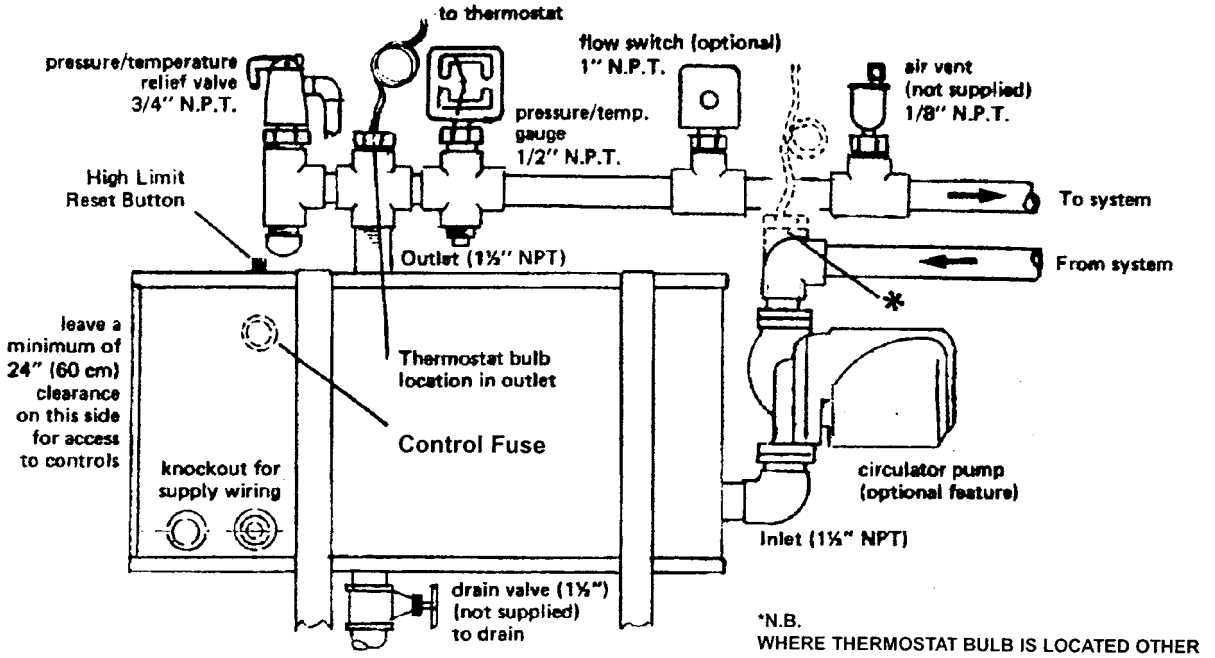
SCALE: ECHELLE: NTS

± ANGULAR | ± DECIM. | ± FRACT. | ± METRIC

DRAWN BY:	E.D.	DEC 10/02
CHECKED BY:	D.T.	DEC 11/02
APPROVED BY:	D.T.	DEC 11/02
DIST.	1	DATE

Caloritech
Division CCI Thermal Technologies Inc.

Figure 2
TYPICAL INSTALLATION



2.7.4 A pressure relief valve is a safety feature which is intended to open when the system malfunctions or is improperly operated or maintained. Units equipped with a pressure relief valve should be fitted with piping to direct the discharge down and away from personnel or equipment. NEVER INSTALL A SHUT OFF VALVE ON EITHER SIDE OF A PRESSURE RELIEF VALVE.

2.7.5 Optional expansion tank (for closed loop systems) is mounted in the outlet piping.

2.7.6 A 1½" NPT drain plug is fitted at the bottom of the heater. We recommend use of a drain valve to simplify clean-out of sludge which may accumulate in the vessel. Sludge build-up can cause heating element failure.

2.7.7 For flow rates greater than 50 gpm, to reduce tank erosion, a bypass loop with regulating valve is recommended.

2.7.8 Closed loop systems require an air bleed valve, preferably installed at the highest point in the piping loop.

3.0 START UP AND OPERATION

3.1 The CW heater is designed to heat water in a non-hazardous environment. In some closed loop systems chemically stabilized ethylene glycol may be added to the water for freeze protection or to elevate the boiling point. If you are unsure as to suitability of glycol to your heating loop contact the factory.

3.2 Check the electrical system for loose connections and tighten if required.

3.3 After all piping is installed turn the thermostat to its lowest setting and operate the circulating pump for up to 1/2 hour to check for leaks and to remove air pockets. In closed loop systems use the air bleed valve to remove entrapped air. An air lock in the heater vessel could cause the heaters to run dry and fail prematurely.

3.4 Set the thermostat to the desired temperature. The temperature rise through the unit will depend on the flow rate and the heater kilowatt (kw) rating.

$$\text{For water: } GPM_{imp} = \frac{5.69 \text{ kw}}{\text{Temp. Rise (°F)}}$$

Example: For a 30 kw heater and a 10°F temperature rise the flow required in imperial gallons per minute is:

$$GPM_{imp} = \frac{(5.69)(30)}{10} = 17$$

Adjust the thermostat differential to give the desired cycling rate. It is best to use the maximum acceptable differential so as to minimize cycling and prolong component service life. However, if the system requires close control a narrow differential setting will be necessary.

3.5 For systems using a by-pass loop, open the by-pass valve to reduce the load on the pump but not enough to cause the limit thermostat to open. For pool heating, the ideal by-pass opening will result in water leaving the heater at not more than 90°F.

26.2
1/

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INSTALLATION AND OPERATING INSTRUCTIONS FOR CWCB WATER CIRCULATION HEATERS

1.0 INITIAL INSPECTION

1.1 Upon receipt from the carrier, inspect the heater for possible damage in transit. If necessary, immediately report damage to shipping company.

1.2 Verify that the nameplate voltage, phase, wattage and catalog number comply with the order.

1.3 The CWCB, when configured:
- as a swimming pool heater, has a catalog number CWCB-XX-1;
- as a domestic water or dishwasher water booster heater, has a catalog number CWCB-XX-2;
- as a hot water furnace for comfort or process water heating, has a catalog number CWCB-XX-3.

These units differ in trim package, i.e. auxiliary controls. For this reason IT IS IMPORTANT THAT THE UNITS BE USED ONLY FOR THE SPECIFIC APPLICATIONS AS STATED ABOVE.

2.0 INSTALLATION

2.1 The heater must be installed by qualified personnel to code requirements.

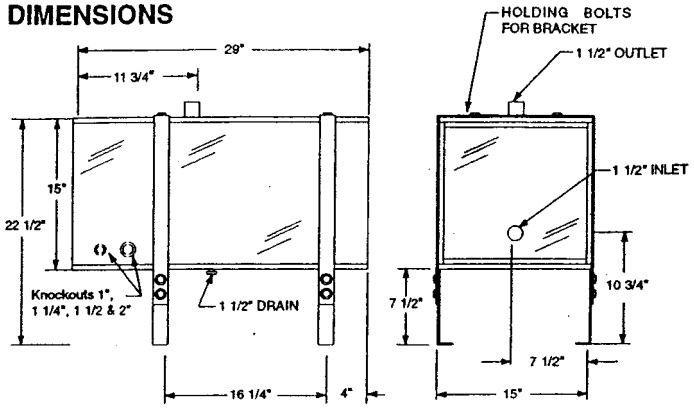
2.2 Ensure that the electrical power supply is the same voltage and phase as the heater with sufficient current capacity.

2.3 The heater must be installed in a horizontal position with the outlet at the top and the drain at the bottom.

2.4 The mounting hardware, as provided, is suitable for either floor or ceiling mounting. Note that each mounting bracket is to be attached at the top of the heating housing by two holding bolts (see Fig.1). Remove the two bolts and install the first mounting bracket prior to removing the second two bolts to install the second mounting bracket. If all bolts are removed at once the tank may shift which will increase installation time.

2.5 Please refer to Figure 1 for dimensions. Be sure to provide adequate space to facilitate installation and maintenance. Leave a minimum of 60cm (24") clearance at the control compartment (opposite side to the inlet). If the unit is to be mounted under a table or cabinet a minimum of 75cm (30") from the floor to the underside of the cabinet is required for piping.

Figure 1
DIMENSIONS



2.6 Allow space at sides for the conduit used for power supply and for thermostat or optional equipment wiring.

2.7 Please refer to Figure 2 for component location and note the following:

2.7.1 The circulation pump outlet is connected to the heater inlet located at the end of the unit opposite to the controls compartment.

2.7.2 A flow switch (optional) is to ensure that the heater will not be energized if the flow is interrupted. Installations requiring a flow switch include:
(a) Swimming pool heating systems where the heater is positioned above the pool water surface.
(b) Whenever the plumbing allows for the heater to be isolated by shut off valves on the inlet and outlet.
(c) Systems where the heater vessel is allowed to drain when flow is interrupted. (Without water the built-in limit will not perform as intended).
(d) Systems where the temperature control bulb is located away from the outlet.

If a flow switch is not used, and also for pool heating, it is best to allow the circulating pump to run continuously.

2.7.3 Wire both flow switch and control thermostat to contacts designated *"normally open"* and *"common"*. *"Normally open"* contacts open on temperature rise on thermostat and close on flow through switch.

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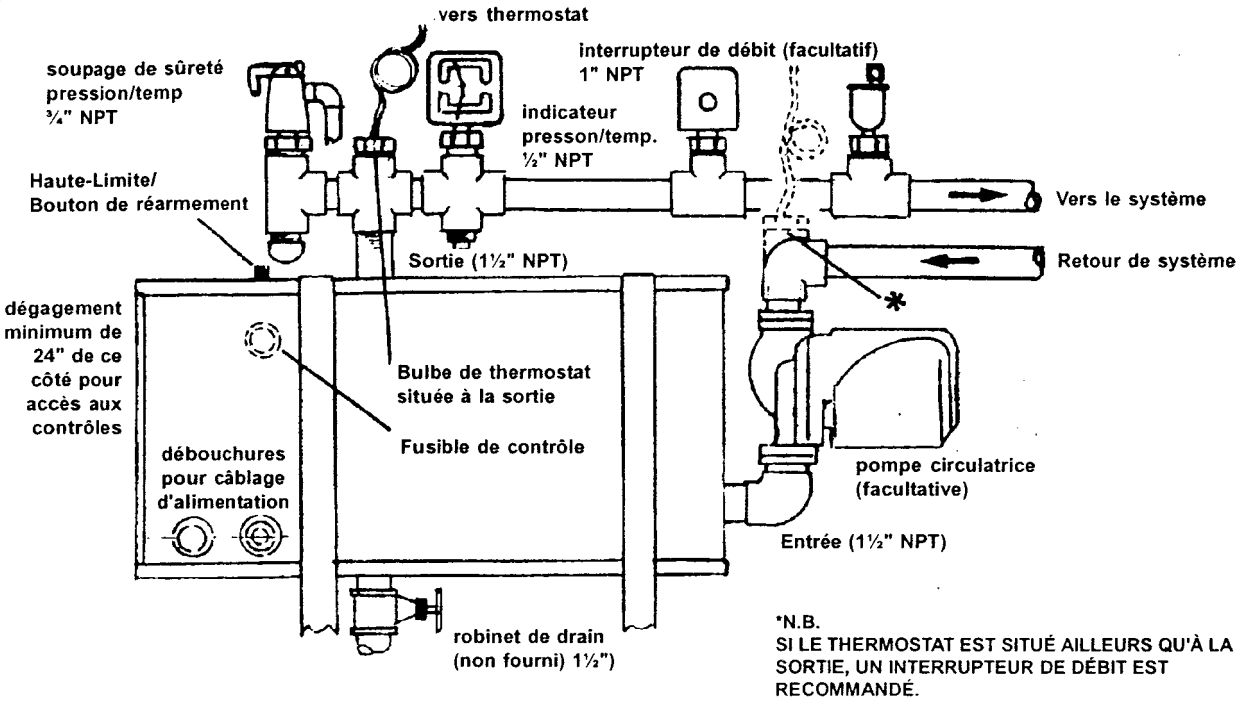
Figure 2
INSTALLATION TYPIQUE



2.7.4 Une soupape de sûreté est un mécanisme sécuritaire qui ouvre lorsque le système ne fonctionne pas bien ou n'est pas opéré ou entretenu correctement. Installée sur un système, une soupape de sûreté doit être raccordée à une tuyauterie d'évacuation dirigée vers le sol et hors d'atteinte du personnel et de l'équipement. NE JAMAIS INSTALLER UN ROBINET DE FERMETURE DE QUELQUE CÔTÉ QUE CE SOIT D'UNE SOUPAPE DE SÛRETÉ.
2.7.5 Le réservoir d'expansion facultatif (pour les boucles fermées) est installé sur la tuyauterie de sortie d'eau.
2.7.6 Un bouchon de drainage 1½" N.P.T. est en place sous l'appareil. Nous recommandons l'installation d'un robinet de drainage pour faciliter le nettoyage du calcaire qui pourrait s'accumuler dans le réservoir. Une accumulation excessive du calcaire peut provoquer la rupture des éléments chauffants.
2.7.7 Pour réduire l'érosion du réservoir lorsque le débit est supérieur à 50 GPM, un circuit de dérivation avec un robinet régulateur est fortement recommandé.
2.7.8 Les boucles fermées nécessitent un évent installé au plus haut niveau de la tuyauterie de la boucle.

3.0 DÉMARRAGE ET OPÉRATION

3.1 Le modèle CW est conçu pour le chauffage de l'eau dans un environnement classifié non dangereux. Dans certains systèmes, à boucle fermée, une solution stable d'éthylène-glycol peut être additionnée à l'eau comme protection antigel ou pour élever le point d'ébullition. Si vous êtes incertains de l'utilisation du glycol dans votre boucle de chauffage, communiquer avec l'un de nos représentants.

3.2 Vérifier les raccordements électriques de votre système et les resserrer si requis.

3.3 Lorsque la tuyauterie est terminée, régler le thermostat à son plus bas et démarrer la pompe circulatrice. Laisser fonctionner la pompe pour environ 1/2 heure et vérifier s'il y a des fuites et évacuer l'air du système. Dans une boucle fermée, utiliser l'évent pour éliminer les trappes d'air. Une trappe d'air au niveau du réservoir pourrait entraîner le fonctionnement à sec des éléments et une rupture prématurée.

3.4 Régler le thermostat à la temprérature désirée. L'élévation de température, entre l'entrée et la sortie, dépend du débit et de la puissance (kw) de l'appareil.

$$\text{Pour l'eau: } GPM_{imp} = \frac{5.69 \text{ kw}}{\text{Temp. Rise (°F)}}$$

Exemple: Pour un appareil de 30 kW et une élévation de température de 10°F, le débit requis (GPM_{imp}) est:

$$GPM_{imp} = \frac{(5.69)(30)}{10} = 17$$

Régler le différentiel du thermostat pour obtenir le cyclage désiré. Un différentiel maximum est désirable car il réduit le cyclage et prolonge la vie des composants. Cependant, si le système requiert un contrôle plus précis, un différentiel minimum est nécessaire.

3.5 Pour un système avec tuyauterie de dérivation, ouvrir le robinet de dérivation pour réduire le travail de la pompe; pas trop cependant, afin d'éviter l'ouverture de la haute-limite intégrée. Pour une piscine, l'ouverture idéale du robinet de dérivation permettra une température de sortie d'eau n'excédant pas 90°F.

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INSTRUCTIONS D'INSTALLATION ET D'OPÉRATION
RÉCHAUFFEURS À CIRCULATION POUR L'EAU MODÈLE CWCB

1.0 VÉRIFICATION INITIALE

1.1 Sur réception de votre marchandise via le transporteur, vérifier si l'appareil est endommagé et rapporter immédiatement tout dommage visible à la compagnie de transport.

1.2 Vérifier la plaque signalétique. Les caractéristiques tension, phase, puissance et numéro de catalogue doivent être identiques à celles de votre commande d'achat.

1.3 Le modèle CWCB, selon la configuration, est utilisé:
• comme chauffe-eau de piscine, porte le numéro de catalogue CWCB-XX-1;
• comme chauffe-eau domestique ou surchauffeur pour lave-vaisselle, porte le numéro de catalogue CWCB-XX-2;
• comme fournaise de confort ou chauffe-eau de procédés, porte le numéro de catalogue CWCB-XX-3.

Ces appareils diffèrent dans leur ensemble, i.e. de par leurs contrôles auxiliaires. Pour cette raison, IL EST IMPORTANT QUE L'APPAREIL UTILISÉ SOIT SPÉCIFIQUE À L'APPLICATION CI-HAUT MENTIONNÉE.

2.0 INSTALLATION

2.1 L'appareil doit être installé par un personnel qualifié et selon les exigences des réglementations en vigueur.

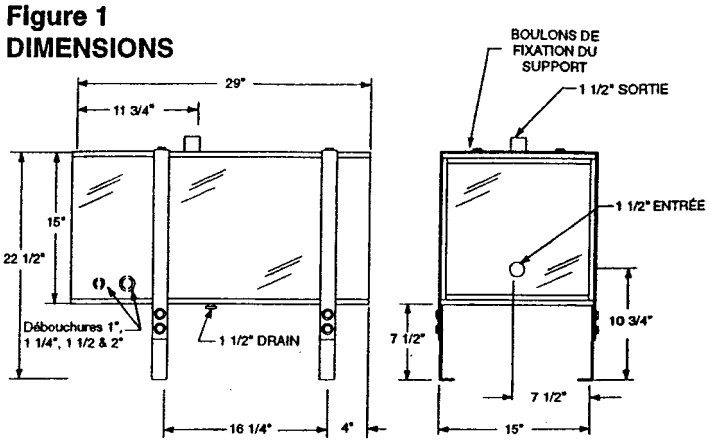
2.2 Vous assurer que l'alimentation électrique est identique à la tension de l'appareil et qu'elle est également suffisante en courant.

2.3 Installer l'appareil en position horizontale avec la sortie sur le dessus et le drain en-dessous.

2.4 Les accessoires de montage, tel que fournis, permettent une installation au plancher ou au plafond. À noter que chacun des supports de montage doit être fixé sur le dessus du cabinet à l'aide des deux boulons de fixation (voir Fig.1). Retirer les deux boulons pour y installer le premier support. Ne pas retirer les boulons du deuxième support avant de compléter l'installation du premier support, car le réservoir pourrait bouger hors-position, ce qui prolongerait le temps d'installation.

2.5 Veuillez référer à la Figure 1 pour les dimensions. Prévoir des dégagements adéquats pour faciliter l'installation et l'entretien. Un dégagement minimum de 60cm (24") est requis pour l'accès aux contrôles (bout opposé à l'entrée d'eau). Si vous installez l'appareil sous une table ou un cabinet, un dégagement minimum de 75cm (30") est requis entre le plancher et le dessous du cabinet (ou de la table) pour la tuyauterie.

Figure 1
DIMENSIONS



2.6 Laisser suffisamment d'espace de chaque côté pour les conduits de l'alimentation électrique, du thermostat ou pour le câblage des accessoires facultatifs.

2.7 Veuillez référer à la Figure 2 pour la localisation des composantes et noter ce qui suit:

2.7.1 La sortie d'eau de la pompe circulatrice se raccorde à l'entrée d'eau de l'appareil, i.e. le bout opposé au compartiment contenant les contrôles.

2.7.2 Un interrupteur de débit (facultatif) permet d'éviter que les éléments chauffants soient énergisés lors d'une interruption du débit d'eau. Les installations qui requièrent un interrupteur de débit sont:
(a) Chauffage d'une piscine lorsque le chauffe-eau est situé au dessus du niveau d'eau de la piscine.
(b) Lorsque la tuyauterie permet d'isoler le chauffe-eau par la fermeture de robinets d'entrée et sortie d'eau.
(c) Les systèmes où le réservoir est drainé lorsque le débit est interrompu. (Sans eau dans le réservoir, la protection haute-limite ne fonctionne pas comme prévu).
(d) Les systèmes où la sonde du thermostat est située loin de la sortie d'eau.

Sans interrupteur de débit, également pour un chauffe-piscine, il est préférable que la pompe circulatrice demeure continuellement en opération.

2.7.3 Raccorder l'interrupteur de débit et le thermostat aux contacts désignés *"Normalement Ouvert"* et *"Commun"*. Les contacts *"Normalement Ouvert"* ouvrent sur une élévation de température et ferment avec un débit détecté par l'interrupteur de débit.

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3.6 The built-in temperature high limit is factory set at 180°F (82°C). This control works best when it is set about 40°F (22°C) above the water outlet temperature. To adjust the limit control setting remove the small panel on the limit control to access the adjustment screw. Under normal operation the heater should not cycle on the limit control.

3.7 If the limit trips it must be manually reset before the heater will operate. Prior to reset, the condition(s) which caused the trip shall be corrected.

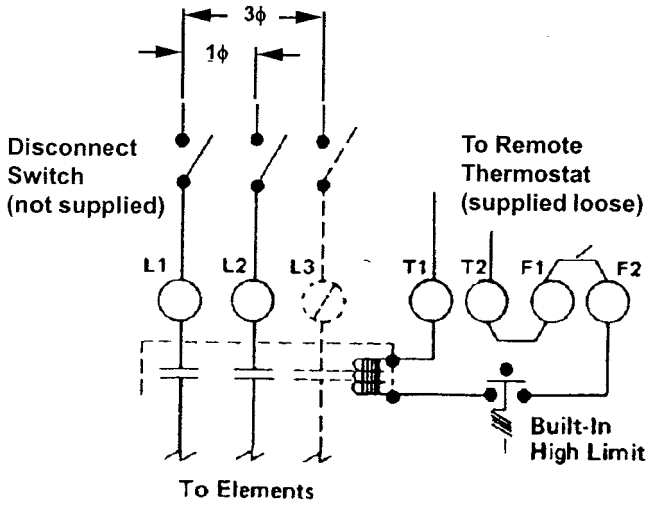
4.0 MAINTENANCE

4.1 Service to the unit shall only be done when the power is disconnected at the mains.

4.2 After the first few days of operation, and periodically thereafter, inspect for piping leaks and loose electrical connections.

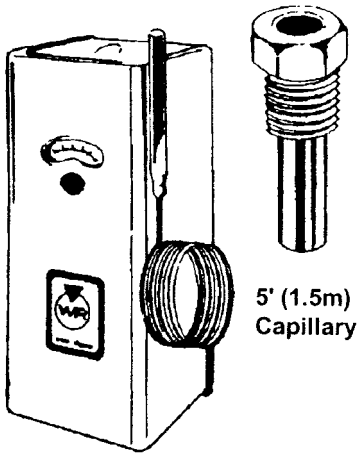
4.3 The CWCB-XXX-2 unit, because it is used in an open loop water heating system, may be subject to sludge build-up if the water is hard and untreated. This unit must be drained at regular intervals (depending on water conditions and operating time) to remove sludge. Once a year a flange heater must be removed and the vessel inspected and cleaned as required. Local conditions may cause this inspection time to vary.

Figure 3
Wiring Diagram



N.B.
REMOVE JUMPER IF OPTIONAL FLOW SWITCH IS USED.

Figure 4
Accessories



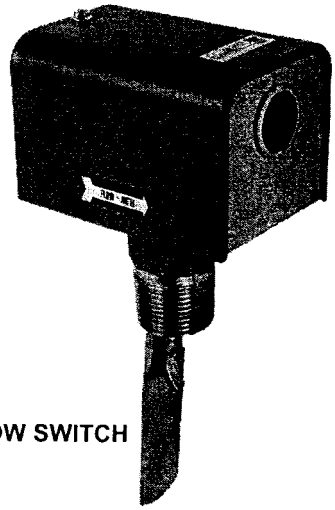
Protective Well CWI-6

1/2" NPT

5' (1.5m) Capillary

Thermostat 11B06-1

Control Circuit Fuse:
208 & 240V: 2 x MDA 3, 3 AMP,
277 to 600V: 1 x MDA 5, 5 AMP



TYPE F61KB FLOW SWITCH (Optional)

26.2 5/

3.6 La protection haute-limite intégrée est préréglée en usine à 180°F (82°C). Ce contrôle opère très bien lorsqu'il est réglé à environ 40°F (22°C) au dessus de la température de sortie d'eau. Pour ajuster le point de consigne de la haute-limite, retirer le petit boîtier de cette dernière, pour avoir accès à la vis de réglage. En opération normale, l'appareil ne devrait pas cycler dû à la haute-limite.

3.7 Si la haute-limite ouvre, un réarmement manuel s'impose avant que l'appareil redémarre. Avant de réarmer, la cause de ce mauvais fonctionnement doit être corrigée.

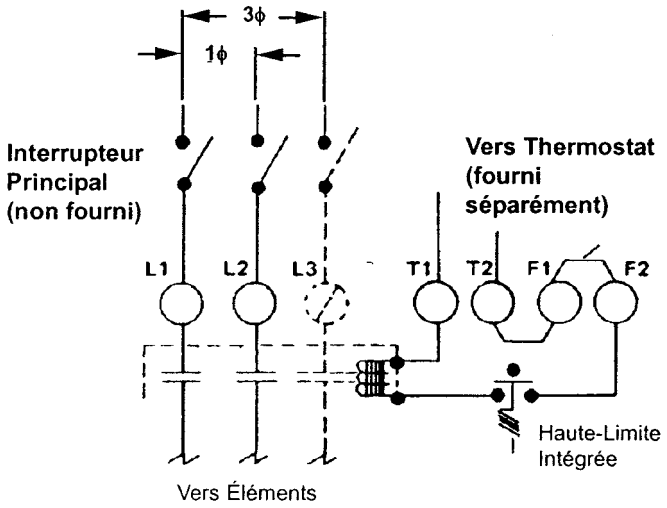
4.0 ENTRETIEN

4.1 Avant d'entreprendre l'entretien de l'appareil, vous devez couper l'alimentation électrique à l'interrupteur principal.

4.2 Après quelques jours d'opération, et périodiquement par la suite, vérifier s'il y a des fuites dans la tuyauterie et resserrer les raccordements électriques.

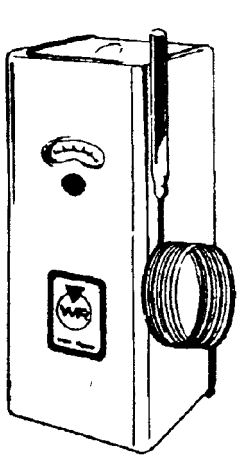
4.3 Le modèle CWCB-XXX-2, parce qu'utilisé dans une boucle ouverte de chauffage de l'eau, est sujet à une accummulation de calcaires si l'eau est dure et non-traitée. Cet appareil doit être purgé à intervalles réguliers (selon les conditions de l'eau et les périodes d'opération) pour draîner les dépôts causés par l'eau. Une fois par année, retirer un thermoplongeur à bride pour vérifier le réservoir et le nettoyer si requis. Des conditions locales particulières peuvent raccourcir les périodes entre chacune des inspections.

Figure 3
Câblage



N.B.
ENLEVER LE CAVALIER, SI L'INTERRUPTEUR DE DÉBIT (FACULTATIF) EST UTILISÉ

Figure 4
Accessoires



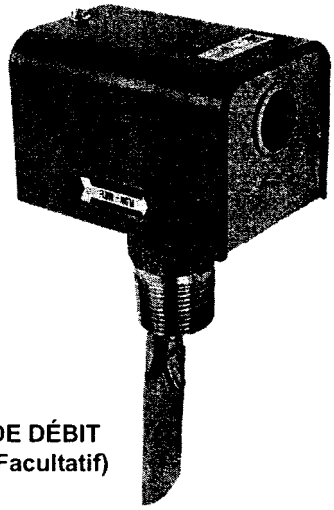
Puits de Thermostat CWI-6

1/2" N.P.T.

5' (1.5m) Capillaire

Thermostat 11B06-1

Fusible Circuit de Contrôle:
208 & 240V: 2 x MDA 3, 3 AMP,
277 à 600V: 1 x MDA 5, 5 AMP



INTERRUPTEUR DE DÉBIT MODÈLE F61KB (Facultatif)

Installation & Maintenance
Instructions MM-202(K)

McDonnell & Miller

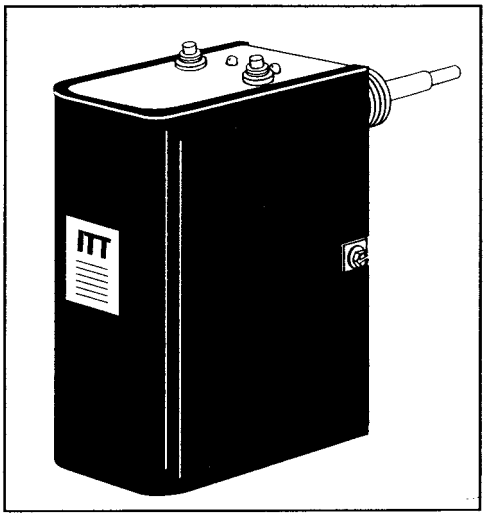
ITT Industries

Series PS-801 for Steam Boilers

Series PS-851 GUARDDOG® for Hot Water Boilers

Probe Type Low Water Cut-Offs

U.S. Pat. No. 6,571,625

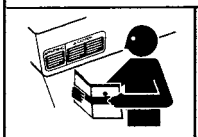


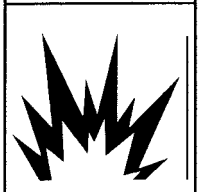
Applications:

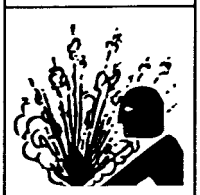
Residential and Commercial

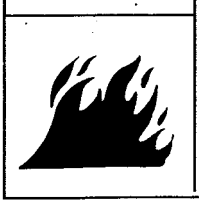
PS-851 models can be used as secondary low water cut-offs on steam boilers with pressures up to 15 psi

⚠ WARNING









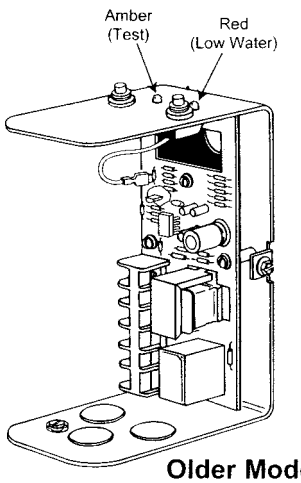
26.3

- Before using this product read and understand instructions.
- Save these instructions for future reference.
- All work must be performed by qualified personnel trained in the proper application, installation, and maintenance of plumbing, steam, and electrical equipment and/or systems in accordance with all applicable codes and ordinances.
- To prevent flooding, do not use manual reset models with electric automatic water feeders.
- To prevent electrical shock, turn off the electrical power before making electrical connections.
- This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.
- We recommend that secondary (redundant) Low Water Cut-Off controls be installed on all steam boilers with heat input greater than 400,000 BTU/hour or operating above 15 psi of steam pressure. At least two controls should be connected in series with the burner control circuit to provide safety redundancy protection should the boiler experience a low water condition. Moreover, at each annual outage, the low water cut-offs should be dismantled, inspected, cleaned, and checked for proper calibration and performance.
- When installing jumper wire make sure you are not introducing a second voltage source into the burner circuit and thereby bypassing other safety, limit, and operating controls.
- When using mixed voltages, remove the factory installed jumper between terminal (H) and (C), or between (1) and (3) on old Series PS-801/PS-851 models.

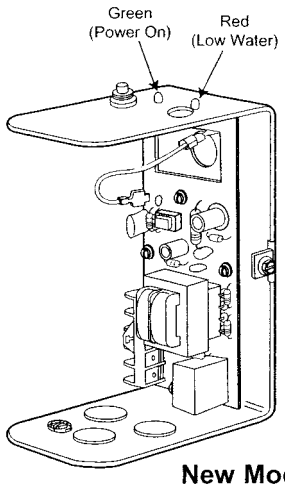
Failure to follow this warning could cause property damage, personal injury or death.

SPECIFICATIONS

The Series 800 controls provide continuous protection against low water conditions for residential, commercial and industrial applications. Newer models feature increased probe sensitivity to prevent nuisance shutdowns, and a new test feature that diagnoses shorted probe problems at installation. The user-friendly diagnostic LEDs simplify installation and troubleshooting, ensuring proper operation and saving time.



Older Models



New Models

Temperature:
Storage: -40˚F to 120˚F (-40˚C to 49˚C)
Ambient: 32˚F to 120˚F (0˚C to 49˚C)
Humidity: 85% (non-condensing)

Series PS-801 for Steam Boilers

Preset time delays prevent nuisance burner cycling:

15 second Delay on Make (DOM)

10 second Delay on Break (DOB)

Conductive liquid required
(water/glycol mixtures up to 50% concentration may be used)

Automatic reset after power outage

Maximum Pressure: 15 psi (1kg/cm^2)

All models include a provision for adding an alarm or automatic water feeder.

Series PS-851 for Hot Water Boilers

No time delays provided

Conductive liquid required
(water/glycol mixtures up to 50% concentration may be used)

Automatic reset after power outage

Maximum Water Pressure: 160 psi (11.2kg/cm^2)

Maximum Water Temperature: 250˚F (121˚C).

All models include a provision for adding an alarm or automatic water feeder.

Electrical Ratings

Model	Voltage	Motor Switch Rating (Amperes)		Pilot Duty
		Full Load	Locked Rotor	
120 VAC	120 VAC	7.5	43.2	125 VA at 120 or 240 VAC 50 or 60 Hz
	240 VAC	3.75	21.6	

Electrical Enclosure Rating: NEMA 1 General Purpose

Control Voltage: 120 VAC

HZ: 50/60

Probe Sensitivity:
For models with red (low water) and amber (test) lights: 3,000 ohm

For models with red (low water) and green (power) lights: 7,000 ohm

Control Power Consumption:
For models with red (low water) and amber (test) lights: 3 VA

For models with red (low water) and green (power) lights: 3.6 VA

INSTALLATION

TOOLS NEEDED:
One (1) flathead screwdriver, and one (1) pipe wrench.

For Remote Installations a level and power drill will be required.

STEP 1 - Locating and Installing the Probe

a. Based on the following criteria locate a suitable position for the probe (A):

For all Applications:

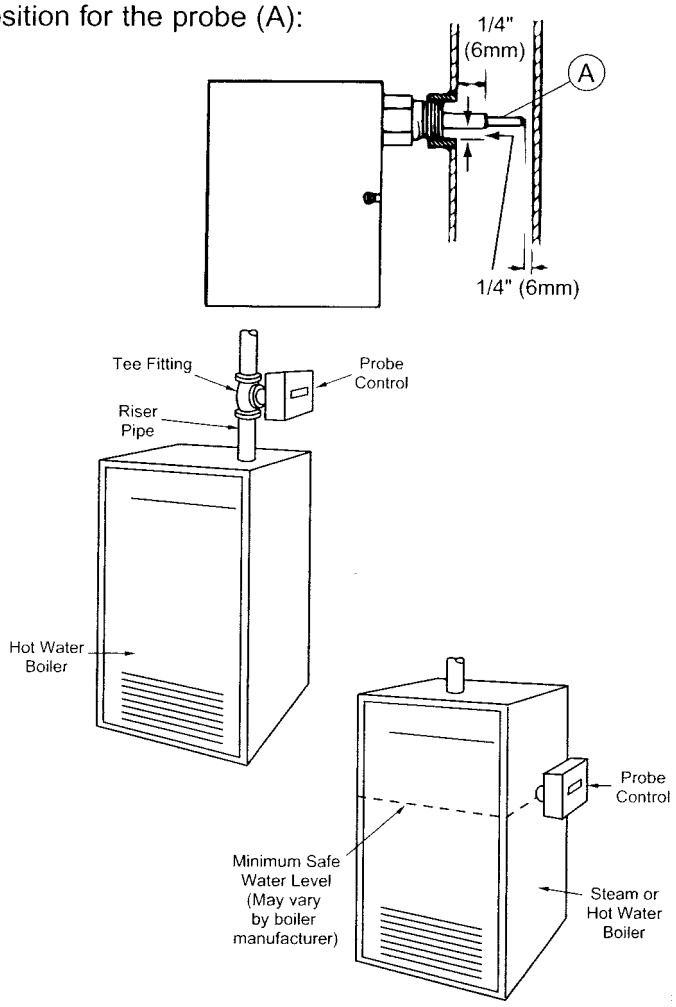
1. Make sure probe is installed above minimum safe water line as determined by the boiler manufacturer.
2. Make sure that ends and sides of the probe are at least 1/4" (6.4mm) from all internal metal surfaces.
3. Make sure the probe is positioned to shut off the boiler before the water level falls below the lowest visible part of the gauge glass.

For Steam Boilers:

1. Refer to boiler manufacturers instructions to determine suitable tapping for the probe.

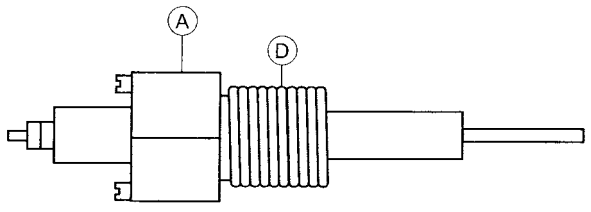
For Hot Water Boilers:

1. Refer to boiler manufacturers instructions to determine suitable tapping for the probe.
2. Locate probe in supply piping using a tee fitting.

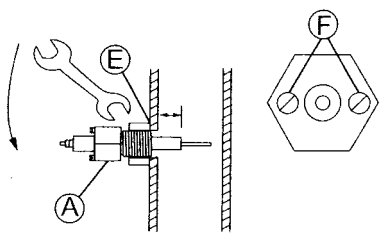


b. Sparingly, apply pipe sealant to the external threads (D) of the probe (A).

IMPORTANT: Do not use Teflon® tape. Only use pipe sealant.

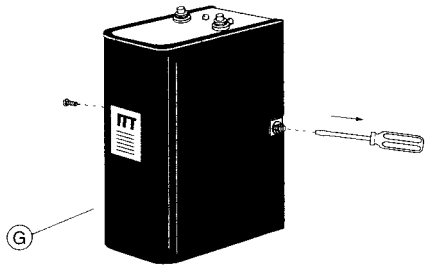


c. Using a wrench, tighten the probe (A) into the tapped connection (E) that was determined in Step 1 of these instructions. Tighten to 47 ft•lb (64 N•m).
NOTE: Be sure to align the probe so that the mounting screws (F) are in a horizontal position.



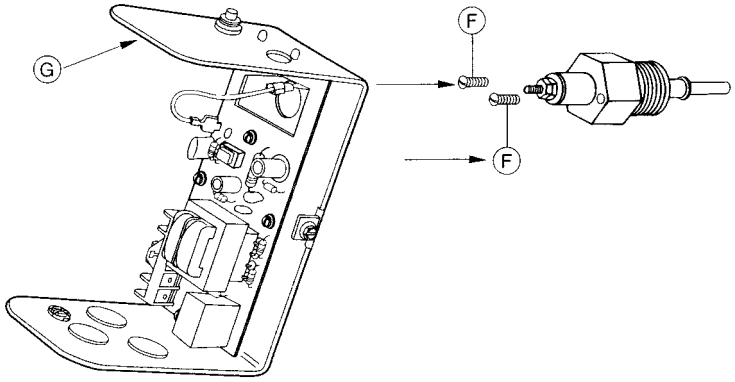
STEP 2 - Installing Control Box

a. Using a flathead screwdriver, loosen the two (2) screws that secure the cover (G) to the control about 1-1/2 turns and remove cover.

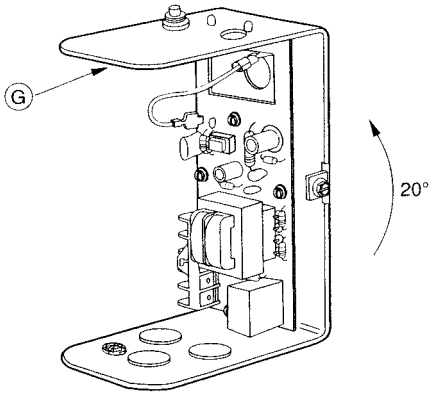


Direct Mounting

b. Using a flathead screwdriver, loosen the probe mounting screws (F) 1/8" (3mm) about 1-1/2 turns and slip the control housing (G) over these two screws at a 20° angle.



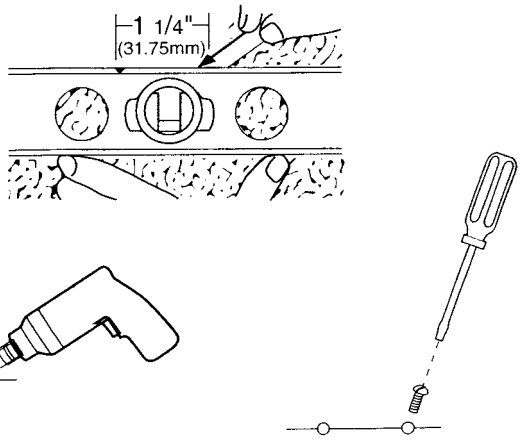
c. Rotate the control housing (G) 20° counter-clockwise so that the slots in the control base are firmly under the screw heads. Tighten the mounting screws (F) to approximately 2 ft•lb (2.6 N•m).



Remote Mounting

d. Identify a desirable location to mount the control assembly (G) and comply with the following steps:

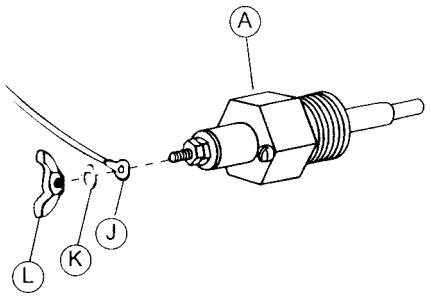
1. Using a level, draw a horizontal line at the location and mark two positions 1-1/4" (31.75 mm) apart on the horizontal line.
2. Drill a 0.113 dia. hole 1/2" (13 mm) deep in each position on the horizontal line.
3. Insert the two (2) sheet metal screws (provided) into the two holes. Using a flathead screwdriver, tighten the screws so that the base of the screw head is 1/8" from the mounting surface.
   * Repeat Steps 2b. and 2c. above.



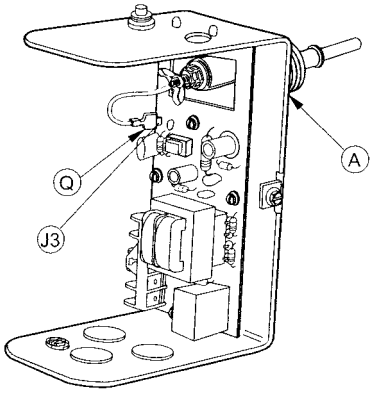
STEP 3 - Probe Wiring

Direct Mounted Probe

a. Slip the ring terminal lead (J) followed by the lockwasher (K) over the threaded end of the probe (A). Tighten the wing nut (L) onto the probe to approximately 1/2 ft•lb (.65 N•m).



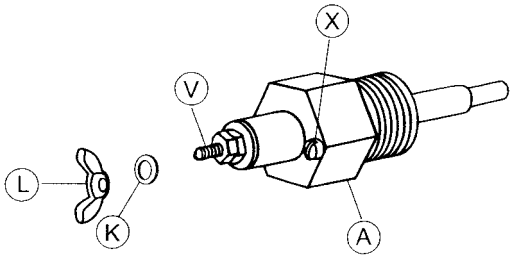
b. Connect the probe (A) to the wiring circuit by sliding the female quick-connect terminal of the probe wire onto the male spade terminal J3 probe (terminal may be marked J7 on older units).

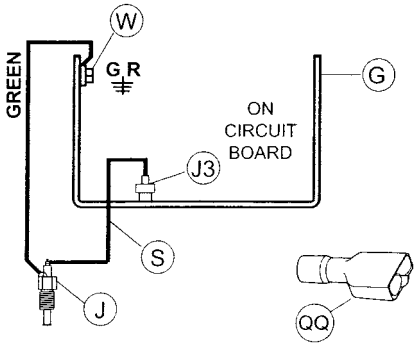


Remote Mounted Probe

c. Connect the probe (A) to the wiring circuit by:

1. Connecting a suitable 16 AWG wire (not provided) to the threaded end (V) of the probe (A).
2. Place the lockwasher (K) and wing nut (L) (provided) over the threaded end of the probe and tighten the wing nut to 1/2 ft•lb (.65 N•m).
3. Using a flathead screwdriver, attach a suitable green 16 AWG wire (not provided) to the green ground screw (X) (provided) at the base of the probe.
4. Route the two wires through a protected wire way to the control unit (G) through the conduit knock-outs in the base of the control.
5. Using the female quick-connect terminal (QQ) provided, connect the wire, from step 1, to the male spade terminal marked "PROBE" (J3). On older units, use the "P" terminal block or (J2) terminal spade connection.
6. Using a flathead screwdriver, connect the green wire, from Step 3, to the green ground screw (W) on the housing of the control.





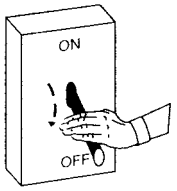
STEP 4 - Control Wiring

⚠ WARNING

- **To prevent electrical shock, turn off the electrical power before making electrical connections.**
- **This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.**
- **All work must be performed by qualified personnel trained in the proper application, installation, and maintenance of plumbing, steam, and electrical equipment and/or systems in accordance with all applicable codes and ordinances.**

Failure to follow this warning could cause electrical shock, an explosion and/or fire, which could result in property damage, personal injury or death.

a. Turn off all power to boiler and boiler controls.



b. Electrical Conduit Connection

- Connect electric conduit using knockouts provided.
- Follow accepted electrical practices when installing fittings and making connections.
- Refer to and follow local codes and standards when selecting the types of electrical fittings and conduit.

⚠ CAUTION

Do not use "manual reset" models with electric automatic water feeders.

Failure to follow this caution can cause flooding and property damage.

c. Based on the Boiler's Control Circuit voltage and the required input voltage of the LWCO, select proper wiring diagram and proceed to that page.

Models with Red (low water) and Amber (test) Lights			**Models with Red (low water) and Green (power) Lights**		
LWCO Model	Boiler Circuit Voltage	Page	LWCO Model	Boiler Circuit Voltage	Page
PS-801-120	120V	7	PS-801-120	120V	8
PS-801-120	24V	7	PS-801-120	24V	8
PS-851-120	120V	7	PS-851-120	120V	8
PS-851-120	24V	7	PS-851-120	24V	8

⚠ IMPORTANT

Boiler manufacturer schematics should always be followed. In the event that the boiler manufacturer's schematic does not exist, or is not available from the boiler manufacturer, refer to the schematics provided in this document.

⚠ WARNING

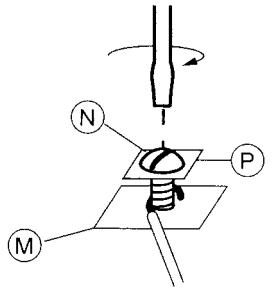
To prevent an electrical fire or equipment damage, electrical wiring must have a rating of 167˚F (75˚C) if the liquid's temperature exceeds 180˚F (82˚C).
Failure to follow this warning could cause property damage, personal injury or death.

Wiring Diagram Legends

1. Bold lines indicate action to be taken in Step shown.
2. Dotted black lines indicate internal wiring.

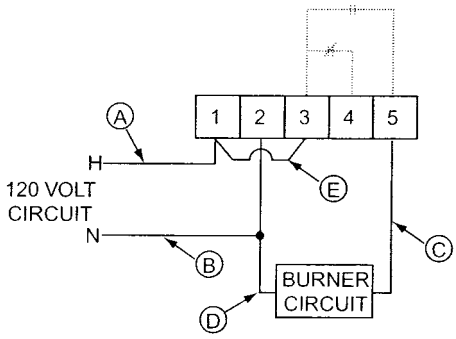
d. For all wire connections to the terminal block (M).

1. Strip about 1/3" (8.5 mm) of insulation from the wire.
2. Loosen the terminal screw (N) but DO NOT REMOVE. Move the wire clamping plate (P) back until the plate touches the back side of the screw head.
3. Insert the stripped end of the wire under the wire clamping plate (P) and securely tighten the terminal screw (N).



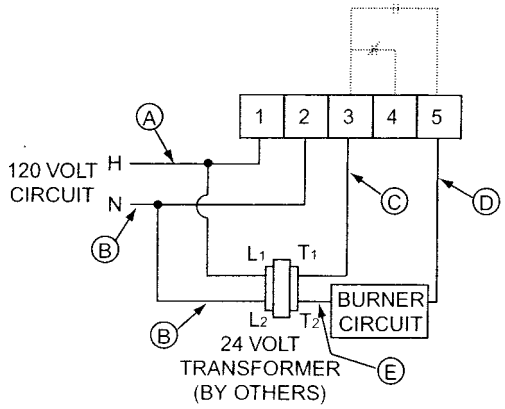
PS-801/851 with 120 Volt Burner Circuit with Red (Low Water) and Amber (Test) Lights

- Hot wire (A) of 120 volt circuit to terminal (1).
- Connect Neutral wire (B) of 120 volt circuit to terminal (2).
- Connect wire (C) from beginning of Burner circuit (thermostat, gas valve, limits, etc.) to terminal (5).
- Connect wire (D) from end of Burner circuit to terminal (2).
- Install wire (E) connecting (1) and (3).



PS-801/851 with 24 Volt Burner Circuit with Red (Low Water) and Amber (Test) Lights

- Connect wire (A) of 120 volt circuit to terminal (1) and terminal (L_1) of transformer.
- Connect wire (B) of 120 volt circuit to terminal (2) and terminal (L_2) of transformer.
- Connect wire (C) to terminal (3) and terminal (T_1) of transformer.
- Connect wire (D) from beginning of Burner circuit (thermostat, gas valve, limits, etc.) to terminal (5).
- Connect wire (E) from end of Burner circuit to terminal (T_2) of transformer.



26.3

Troubleshooting

If control fails to operate as required, perform the following diagnostic checks:

1. Check to be sure that the water level in the boiler is at or above the level of the probe.
2. Re-check all wiring to ensure proper connections as specified in boiler manufacturer's wiring diagrams or these instructions.
3. Check to ensure that Teflon® tape has not been used on the threaded connection of the electrode to the boiler.
4. Re-check the electrical ground connection for the remote sensor and control unit.
5. Check the quality of the boiler water to ensure adequate conductance.

⚠ CAUTION

Replace Probe if:
- **Teflon® insulator is cracked or worn.**
- **Probe is loose.**

Failure to follow this caution could cause property damage, personal injury or death.

MAINTENANCE

SCHEDULE:

- **Inspect probe annually or more frequently for scale build-up and clean or replace if necessary.** Make certain there is no scale or build-up on the probe or its white Teflon® insulator. Be careful not to damage the Teflon® insulator.
- **Replace probe every 10 years.** More frequent replacement of the probe is required if it is used in locales where significant water treatment is required, or in applications with high make-up water requirements.
- **Replace the low water cut-off every 15 years.**

NOTE

Clean probe by wiping with non-abrasive cloth and rinsing with clean water. DO NOT use sharp instruments to remove any accumulations of rust or scale.

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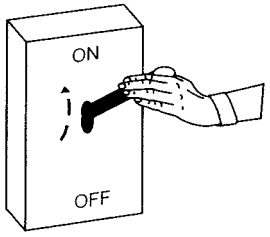
STEP 5 - Testing

All Models with Red (Low Water) and Amber (Test) Lights

a. Before filling the system, turn on the electric power to the boiler. Set the room thermostat to "heat".

For Series PS-801 the burner will come on briefly (10 second or less) and then shut off which verifies proper operation. The burner **will not** operate without water in the system. The low water cut-off's red LED should be illuminated.

For Series PS-851 the burner will come on briefly and then shut off, verifying proper operation. The burner **will not** operate without water in the system. The low water cut-off's red LED should be illuminated.



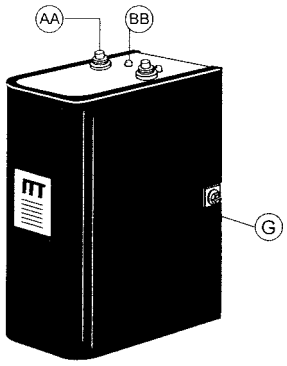
b. Fill the system with water.

For Series PS-801 the low water cut-off's red LED should shut off in about 15 seconds, after the water contacts the probe.

For Series PS-851 the low water cut-off's red LED should shut off after the water contacts the probe.

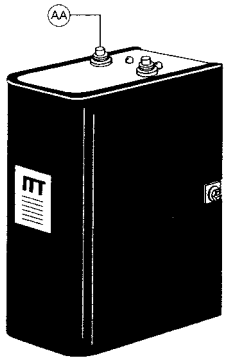
c. Hold the test switch (AA) down while noting the amber LED (BB) on top of the control housing (G).

1. ***If the amber LED (BB) glows dimly,*** the water level is above the probe.
2. ***If the amber LED (BB) is off,*** the water level may be below the probe or the water is too pure and may require the addition of boiler water treatment.
3. ***If the amber LED (BB) glows brightly,*** it could indicate a grounded (non-operable) probe. If this is the case, proceed to "Troubleshooting".



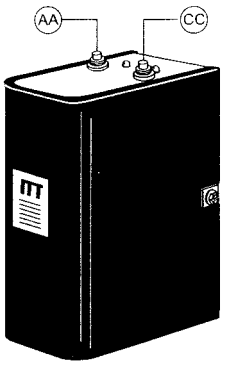
d. Test for correct burner circuit wiring.

1. Hold down the test switch (AA) while the burner is running for more than:
   - 12 seconds for PS-801
   - 2 seconds for PS-851
2. If the burner shuts off while the test switch is depressed, the burner circuit is wired correctly.



e. ***For the automatic reset models*** **-** Release the test switch (AA) and the burner should resume firing provided that the boiler water is in contact with the probe.

For the manual reset models **-** The burner will not return to normal operation until the reset switch (CC) is set.

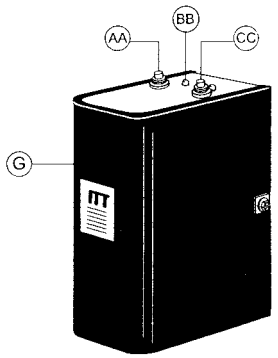


f. Check for proper operation of all of the limit and operating controls, before leaving the site.

g. If you believe the probe to be grounded, follow the following steps for a control (G) with a test switch (AA):

1. Make sure that the liquid level is below the probe.

2. Depress the test switch (AA). If the amber LED (BB) turns "ON" the probe may be grounded. If so, replace the grounded probe.



For Series PS-801 & PS-801-M with Red (Low Water) and Green (Power) Lights

Start-Up

a. Before filling the system, turn on the electric power to the boiler. Set the thermostat to "heat".

For all Series PS-801

1. Upon initial power up, the Green and Red lights will flash simultaneously 4 times.
2. The Green light will turn "ON".
3. The Red light will continue to flash for 10-seconds Delay on Break (DOB) and then turn "ON".
4. If a water feeder has been installed and does not have a time delay, it will turn "ON".
5. The burner will never turn "ON" during power up, if water is off the probe.

b. Now fill the boiler with water.

For Series PS-801 (auto reset units only)

1. When water touches the probe, the Red light will start flashing for 15-seconds Delay on Make (DOM) and then turn "OFF".
2. The burner will turn "ON" as long as there is water on the probe.
3. If a water feeder has been installed it will turn "OFF".

For Series PS-801-M (manual reset units only)

(When water returns to the probe, nothing will happen until the manual reset button is depressed.)

1. After depressing manual reset button, the Green and Red lights will flash simultaneously 4 times.
2. Then the Green light will turn "ON".
3. The Red light will continue to flash for 15-seconds (DOM) and then turn "OFF".
4. The burner will turn "ON" as long as there is water on the probe.

(Warning: To prevent flooding, never use a "water feeder" with a manual reset low water cut-off.)

Manually Testing Control

c. Slowly drain the boiler of water.

For all Series PS-801 (both auto and manual reset units)

1. When water drops off the probe, the Red light will start flashing for 10-seconds (DOB) and then turn "ON".
2. The burner will turn "OFF".
3. If a water feeder has been installed and does not have a time delay, it should turn "ON".

(Warning: To prevent flooding, never use a "water feeder" with a manual reset low water cut-off.)

Troubleshooting

If control fails to operate as required, perform the following diagnostic checks:

1. Check to be sure that the water level in the boiler is at or above the level of the probe.
2. Re-check all wiring to ensure proper connections as specified in boiler manufacturer's wiring diagrams or these instructions.
3. Check to ensure that Teflon® tape has not been used on the threaded connection of the electrode to the boiler.
4. Re-check the electrical ground connection for the remote sensor and control unit.
5. Check the quality of the boiler water to ensure adequate conductance.

⚠ CAUTION

Replace Probe if:
- **Teflon® insulator is cracked or worn.**
- **Probe is loose.**

Failure to follow this caution could cause property damage, personal injury or death.

MAINTENANCE

SCHEDULE:

- **Inspect probe annually or more frequently for scale build-up and clean or replace if necessary.** Make certain there is no scale or build-up on the probe or its white Teflon® insulator. Be careful not to damage the Teflon® insulator.
- **Replace probe every 10 years.** More frequent replacement of the probe is required if it is used in locales where significant water treatment is required, or in applications with high make-up water requirements.
- **Replace the low water cut-off every 15 years.**

NOTE

Clean probe by wiping with non-abrasive cloth and rinsing with clean water. DO NOT use sharp instruments to remove any accumulations of rust or scale.

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AMTROL INC.
® West Warwick, Rhode Island 02893

INSTALLATION & OPERATION INSTRUCTIONS
THERM-X-TROL®
Thermal Expansion Absorbers (ST SERIES)

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

INSTALLER: Leave this manual with the customer.

⚠WARNING READ CAREFULLY THE PRODUCT INSTALLATION, OPERATING AND MAINTENANCE MANUAL. FAILURE TO FOLLOW THE INSTRUCTIONS AND WARNINGS IN THE MANUAL MAY RESULT IN SERIOUS OR FATAL INJURY AND/OR PROPERTY DAMAGE, AND WILL VOID THE PRODUCT WARRANTY. THIS PRODUCT MUST BE INSTALLED BY A QUALIFIED PROFESSIONAL. FOLLOW ALL APPLICABLE LOCAL AND STATE CODES AND REGULATIONS, IN THE ABSENCE OF SUCH CODES, FOLLOW THE CURRENT EDITIONS OF THE NATIONAL PLUMBING CODE AND NATIONAL ELECTRIC CODE, AS APPLICABLE.

⚠ THIS IS THE SAFETY ALERT SYMBOL. IT IS USED TO ALERT YOU TO POTENTIAL PERSONAL INJURY AND OTHER HAZARDS. OBEY ALL SAFETY MESSAGES THAT FOLLOW THIS SYMBOL TO REDUCE THE RISK OF PERSONAL INJURY AS WELL AS PROPERTY DAMAGE.

⚠WARNING This Product, like most Products under pressure, may over time corrode. weaken and burst or explode, causing serious or fatal injury, leaking or flooding and/or property damage. To minimize risk, a licensed professional must install and periodically inspect and service the Product. A drip pan connected to an adequate drain must be installed if leaking or flooding could cause property damage. Do not locate in an area where leaking could cause property damage.

⚠WARNING **RUPTURE OR EXPLOSION HAZARD** A relief valve must be installed to prevent pressure in excess of local code requirement or maximum working pressure designated in the Product Manual, whichever is less. Do not expose Product to freezing temperatures or temperatures in excess of 200° F. Do not adjust the pre-charge or re-pressure this Product except for any adjustments required at the time of initial installation, especially if Product corroded, damaged or with diminished integrity. Adjustments to pre-charge must be done at ambient temperature only. Failure to properly size the Product or follow these instructions may result in excessive strain on the system lead to Product failure, serious or fatal personal injury, leakage and/or property damage.

⚠WARNING **Chlorine & Aggressive Water:** The water quality can significantly influence the life of this Product. You should test for corrosive elements, acidity, total solids and other relevant contaminants, including chlorine and treat your water appropriately to insure satisfactory performance and prevent premature failure.

Note: Inspect for shipping damage and notify freight carrier or store where purchased immediately if damage present. To avoid risk of personal injury and property damage, if the product appears to be malfunctioning or shows signs of corrosion, call a qualified professional immediately. Current copies of the Product manual can be viewed at www.amtrol.com. Use proper safety equipment when installing.

⚠WARNING Use only with potable water system. Do not operate in a setting with freezing temperatures or where the temperature can exceed 200°F and do not exceed the maximum working pressure specified for this Product in the Manual. Mount vertically only.

⚠WARNING **CALIFORNIA PROPOSITION 65 WARNING!** This product contains a chemical known by the State of California to cause cancer and to cause birth defects or other reproductive harm. (California Installer/Contractor - California law requires that this notice be given to consumer/end user of this product.) **For more information: www.amtrol.com/prop65.htm**

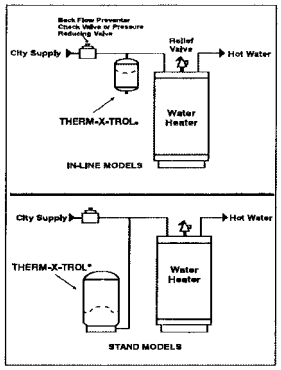
Pre-Installation

1. Remove plastic cap from air valve.
2. Adjust pre-charge to equal incoming pressure.
3. Replace and tighten plastic cap on air valve.

Installation

1. Install the THERM-X-TROL® on the city supply line to the water heater at a point between the water heater and backflow preventer, check valve or pressure reducing valve (see Figure 1).
2. Once the THERM-X-TROL® is installed, check the city supply line for any leakage. Make repairs if necessary.
3. Before the initial firing of the water heater, open any hot water fixture and draw water until all air is removed from the system. Turn the water heater temperature control to desired ending temperature level, (see water heater instructions).
4. To relieve initial thermal expansion, slightly open a hot water faucet. Continue until water heater aquastat temperature is satisfied. Once heater is at its operating range, no further bleeding of expanded water is required.
5. The water heater and THERM-X-TROL® will now be operational. The THERM-X-TROL® will control pressure increases caused by thermal expansion to a level well below the water heater relief valve setting.

Figure 1.



RESIDENTIAL SIZING

Water Heater Size (gals.)	Static Supply Pressure (psi)		
	40	60	80
40	ST-5	ST-5	ST-5
50	ST-5	ST-5	ST-8
60	ST-8	ST-8	ST-8
80	ST-8	ST-8	ST-12
120	ST-12	ST-12	ST-25V

Max. Temp. Setting 150°F

COMMERCIAL SIZING

Water Heater Size (gals.)	Static Supply Pressure (psi)		
	40	60	80
40	ST-8	ST-8	ST-8
50	ST-8	ST-8	ST-12
60	ST-8	ST-12	ST-25V
80	ST-12	ST-25V	ST-25V
120	ST-25V	ST-25V	ST-25V

Max. Temp. Setting 180°F

Maintenance

1. A professional plumber should check the complete system, including the THERM-X-TROL®, yearly and more frequently as the system ages.

Operation

1. The THERM-X-TROL® is installed in the supply line between the backflow preventer and the water heater. Its sealed-in air pre-charge prevents water from entering it until the system pressure exceeds the pre-charge pressure.
2. As the water temperature rises, expanded water enters the THERM-X-TROL®'s non-corrosive water reservoir.
3. As hot water is used, the pressure in the air chamber forces water back into the system until the THERM-X-TROL® is empty.

NOTE: Models ST-5, ST-12, and ST-25V are IAPMO listed (International Association of Plumbing and Mechanical Officials). All models are listed (ST-5 thru ST-210V) under ANSI/NSF Std 61.

NOTE: ST-25V through ST-240V are floor standing only.

MARK OF THE ORIGINATOR

*** The ST-5, ST-8, ST-12 and ST-25 models come with a 5 year warranty. All other ST Series models come with a 1 year warranty See reverse side for warranty information.**

AMTROL® INC. LIMITED PRODUCT WARRANTY

Products covered: all Products manufactured by AMTROL® Inc. ("AMTROL").

This warranty cannot be transferred – it is extended only to the original Purchaser or First User of the Product. By accepting and keeping this Product you agree to all of the warranty terms and limitations of liability described below.

IMPORTANT WARNING – READ CAREFULLY THE INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS MANUAL ("MANUAL") to avoid serious personal injury and/or property damage and to ensure safe use and proper care of this product.

Who Receives AMTROL®'s Product Warranty

All purchasers or first users of the new Product. The Warranty is non-transferable.

What is covered by this Warranty

AMTROL® warrants to the purchaser or first user of the new Product that at the time of manufacture, the Product is free from defects in material and workmanship. **Any warranty claim must be made within one (1) year unless another time period is set forth in the Manual, measured from the time the Product was purchased.**

What AMTROL® Will Do If You Have a Covered Warranty Claim

In the event of a breach of the foregoing warranty, AMTROL® will at its option either make repairs to correct any defect in material or workmanship or supply and ship either new or used replacement parts or products. AMTROL® will not accept any claims for labor or other costs.

What This Warranty Does Not Cover — Exclusions and Limitations

This Warranty does not cover any failure or problem unless it was caused by a defect in material or workmanship. In addition, this Warranty shall not apply:

- if the Product is not correctly installed, operated, repaired or maintained as described in the Manual provided with the Product;
- to any failure or malfunction resulting from abuse (including freezing); improper or negligent: handling, shipping (by anyone other than AMTROL®), storage, use, operation, accident; or alteration, lightning, flood or any other environmental condition;
- to any failure or problem resulting from the use of the Product for any purpose other than those specified in the accompanying Manual or alteration of any part of the product;
- if the Product is used anywhere except the United States, its territories or possessions, or Canada;
- this Warranty does not cover labor costs, shipping charges, service charges, delivery expenses, administrative fees or any costs incurred in removing or reinstalling the Product;
- this Warranty does not cover any claims submitted to AMTROL® or an AMTROL®-authorized distributor or retailer more than 30 days after expiration
  of the applicable warranty time period described in this Warranty;
- this Warranty also does not cover repair or replacement costs not authorized in advance by AMTROL®.

Additional Warranty Limitations

ALL IMPLIED WARRANTIES, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE SPECIFICALLY DISCLAIMED. Some states do not allow limitations on how long an implied Warranty lasts, so the above limitation may not apply to you.

Limitations of Remedies

THE REMEDIES CONTAINED IN THIS WARRANTY ARE THE PURCHASER'S OR FIRST USER'S EXCLUSIVE REMEDIES. IN NO CIRCUMSTANCES WILL AMTROL® BE LIABLE FOR MORE THAN, AND PURCHASER-FIRST USER'S REMEDIES SHALL NOT EXCEED, THE PRICE PAID FOR THE PRODUCT. IN NO CASE SHALL AMTROL® BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM NONDELIVERY OR FROM THE USE, MISUSE, OR INABILITY TO USE THE PRODUCT OR FROM DEFECTS IN THE PRODUCT OR FROM AMTROL®'S OWN NEGLIGENCE OR OTHER TORT. This exclusion applies regardless of whether such damages are sought for breach of warranty, breach of contract, negligence, strict liability, in tort or under any other legal theory. Such damages include, but are not limited to, inconvenience, loss or damage to property, mold, loss of profits, loss of savings or revenue, loss of use of the Products or any associated equipment, facilities, buildings or services, downtime, and the claims of third parties including customers. Some states do not allow the exclusion or the limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

What To Do If You Have a Problem Covered By This Warranty

Any covered Warranty service must be authorized by AMTROL®. Contact the person from whom you purchased the Product, who **must** receive authorization from an AMTROL® distributor or AMTROL®. If you do not receive a prompt response, call AMTROL® directly at 877-517-9673. Notice of a Warranty claim should be submitted by the authorized distributor to AMTROL® at the following address:

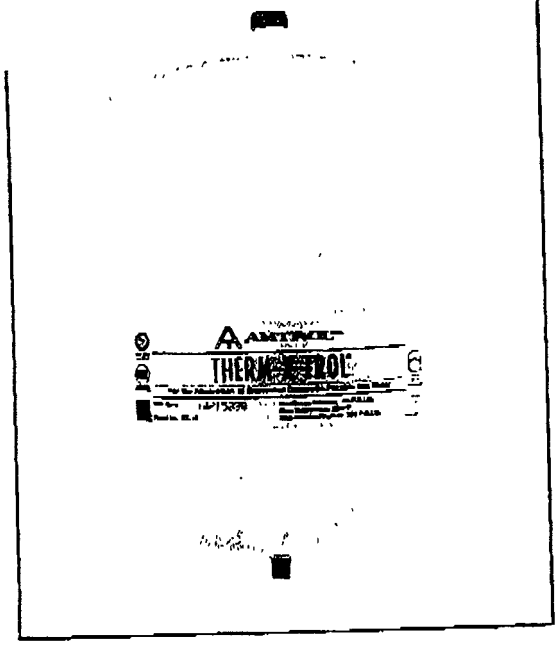
AMTROL® Inc.
Warranty Claim Dept.
1400 Division Rd.
West Warwick, RI 02893

Before AMTROL® determines to provide any replacement part or Product, it may as a pre-condition to making such a determination require that the warranty claimant ship the Product, postage prepaid to an authorized AMTROL® distributor, or to AMTROL® and provide proof of purchase evidenced by the original sales receipt or Product registration.

Replacement Product Warranty

In case of replacement of a Product or any component part, AMTROL® reserves the right to make changes in the design, construction, or material of the substitute components or products, which shall be subject to all of the terms and limitations of this Warranty, except that the applicable warranty periods shall be reduced by the amount of time the warranty claimant owned the product prior to submitting notification of the warranty claim.

AMTROL INC. *Plumbing & Heating*



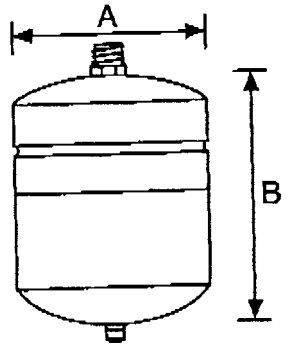
Therm-X-Trol

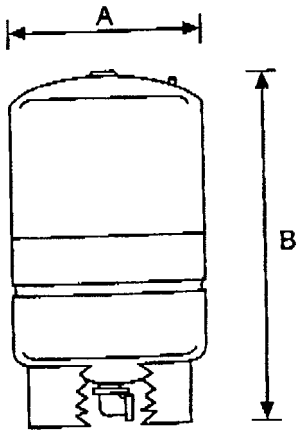
Features

- Diaphragm-Type
- Pre-pressurized Expansion Tank
- Designed for Potable Hot Water Systems
- Eliminates Relief Valve Spills
- Controls Pressure Build-up
- Protects plumbing Fixtures
- Extends Water Heater Life
- Eliminates Hot Water Waste

SPECIFICATION CHART

Model No.	Total Volume Gals.	Diameter A	Height B	System Connection	Ship Weight Lbs
ST-5	2.0	12 5/8"	8"	3/4" NPTM	5
ST-12	4.4	15"	11"	3/4" NPTM	9
ST-25V	10.3	15 3/8"	19 1/4"	1" NPT	23
ST-30V	14.0	15 3/8"	23 7/8"	1" NPT	25
ST-42V	20.0	15 3/8"	31 5/8"	1" NPT	33
ST-60V	34.0	22"	29 5/8"	1 1/4" NPT	61
ST-80V	44.0	22"	36"	1 1/4" NPT	69
ST-120V	62.0	22"	46 3/4"	1 1/4" NPT	92
ST-210V	86.0	26"	47 1/4"	1 1/4" NPT	123





SPECIFICATIONS

Deep Drawn Steel Construction

Diaphragm - Heavy Butyl Rubber

Liner - Propylene

System Connection - Bronze

Factory Charged to 40 psig

MAXIMUM OPERATING CONDITIONS

Operating Temperature – 200°F

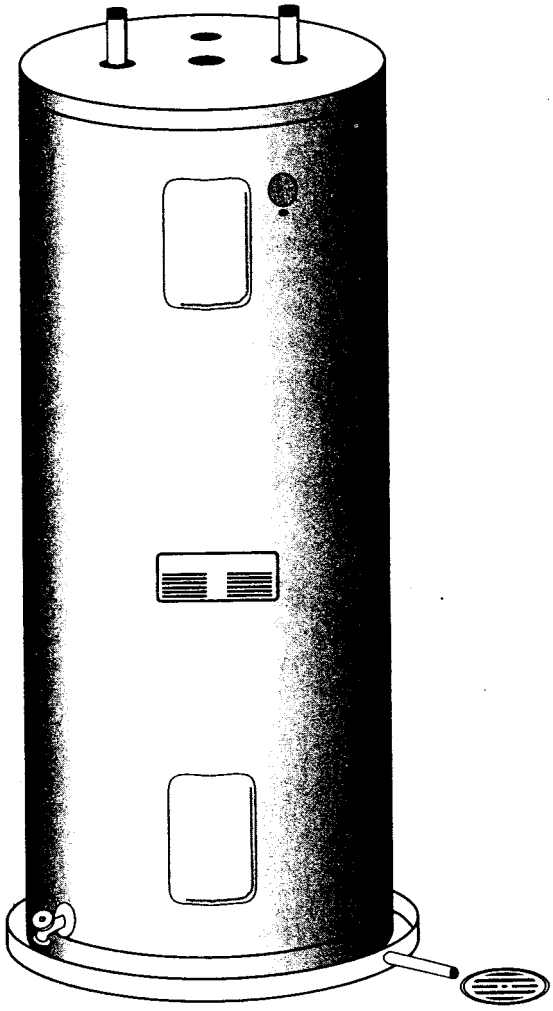
Working Pressure – 150 psig (10.5 kg/cm²)

26.4

ELECTRIC WATER HEATER

OWNER'S MANUAL

INSTALLATION AND OPERATING INSTRUCTIONS



WARNING

IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE CAN CAUSE SERIOUS PERSONAL INJURY AND/OR PROPERTY DAMAGE. REFER TO THIS MANUAL FOR ASSISTANCE OR FOR ADDITIONAL INFORMATION, PLEASE CONSULT A QUALIFIED INSTALLER, SERVICE AGENCY, ENERGY SUPPLIER OR CALL THE MANUFACTURER OF THIS WATER HEATER AS LISTED ON THE WARRANTY CARD.

FOR YOUR SAFETY

- DO NOT REMOVE THE ACCESS PANELS BEFORE THE POWER TO THE WATER HEATER IS TURNED OFF.
- DO NOT ATTEMPT ANY REPAIRS WITHOUT VERIFYING THAT THERE IS NO VOLTAGE AT THE WATER HEATER.
- DO NOT USE THE WATER HEATER ON A VOLTAGE OTHER THAN THAT SPECIFIED ON THE RATING PLATE.
- DO NOT CONNECT THE POWER SUPPLY TO ANYWHERE OTHER THAN THE MAIN SUPPLY CONNECTION ON THE WATER HEATER
- DO NOT TURN ON THE POWER TO THE WATER HEATER UNLESS IT IS FULL OF WATER.
- DO NOT DRAIN THE WATER HEATER UNLESS POWER TO THE WATER HEATER HAS BEEN TURNED OFF.
- DO NOT STORE OR USE GASOLINE OR OTHER FLAMMABLE, OR CORROSIVE LIQUIDS OR VAPORS IN THE VICINITY OF THIS WATER HEATER.

WHAT TO DO IF YOU SMELL SMOKE

- IMMEDIATELY TURN OFF THE POWER TO THE WATER HEATER.
- IF AFTER TURNING OFF THE POWER THE SMOKE CONTINUES, CALL YOUR LOCAL FIRE DEPARTMENT.
- WHEN THE SMOKE HAS STOPPED, CALL A QUALIFIED SERVICE TECHNICIAN FOR IDENTIFICATION OF THE PROBLEM AND REPAIR.

IMPORTANT

Read these instructions carefully before beginning the installation. Proper installation will provide safe & efficient service, and avoid needless expense not covered by the warranty. Should you have any questions please contact your local dealer or call the customer service department of the manufacturer as listed on the warranty card.

SAVE THIS MANUAL FOR FUTURE REFERENCE AND PLEASE READ THE MANUFACTURER'S PRODUCT WARRANTY CONTAINED IN THIS MANUAL.

C US

ISO 9002 CERTIFICATION

WARNING

These instructions have been written as a guide for the proper installation and operation of your water heater, and the manufacturer of this water heater will not accept any liability when these instructions have not been followed. However, for your safety and to avoid damage caused by impropé installation, this water heater should be installed by a Certified Licensed Professional, and meet all provincial and national building codes.

LOCATION

Location should be as close as possible to a power supply and to the main use of hot water. This location must not be subject to freezing temperatures, and **must be close to a suitable free flowing floor drain.** The water heater should be positioned, so that there is easy access to the controls and drain valve. Where a floor drain is not adjacent to the water heater, a suitable drain pan must be installed under the water heater. This drain pan should be at least 4 inches larger than the diameter of the water heater, and at least 1 inch deep providing access to the drain valve. This pan must be piped to a suitable drain to prevent damage to property in the event of a water leak from the piping, the relief valve, or the water heater. Sooner or later, all water heaters leak. The manufacturer, based on national building codes CSA C652 has given the necessary advice to prevent damage to the building. Under no circumstances is the manufacturer to be held liable for any water damage in connection with this water heater.

CAUTION

Should this water heater be installed on carpeting, the carpeting must be protected by a wood or metal panel beneath the water heater, which must extend at least 3 inches beyond the width and depth of the water heater. Should the water heater be installed in an alcove or closet, the entire floor area must be covered by the panel.

WATER PIPING

Refer to figure 1 for a typical water piping layout. Use of this layout should provide a trouble free installation for the life of the water heater. Before the piping connections are made, ensure that the dip tube is in the cold water inlet. Have the installer show you where the water heater shut off valve is located, so that you know how to shut off the water. When assembling the hot and cold piping, it is imperative that open flame is not applied to the inlet and outlet fittings as heat will damage or destroy the plastic lined fittings supplied by the manufacturer. THIS WILL RESULT IN PREMATURE FAILURE OF THE NIPPLES WHICH IS NOT COVERED BY THE WARRANTY. When making these connections, use a good food grade of pipe joint compound, and make sure that all fittings are tight.

TEMPERATURE and PRESSURE RELIEF VALVE

To protect from excessive pressure and/or temperature, a temperature and pressure relief valve **MUST BE** installed by the installer when it has not been factory installed. The relief valve piping must terminate not less than 6 inches and not more than 12 inches above a floor drain. DO NOT THREAD, CAP, OR IN ANYWAY RESTRICT THE END OF THIS OUTLET. DO NOT connect this outlet directly to a drain. In the event of excessive temperature or pressure, this valve will discharge very hot water at a high pressure. DO NOT RESTRICT.

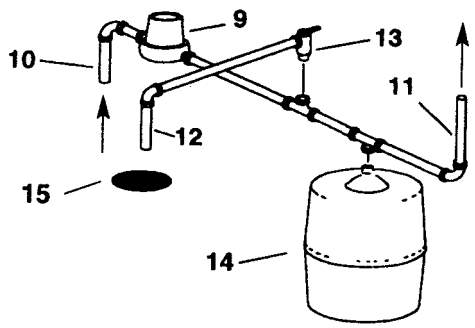
The Discharge Line:

1. Must not be smaller than the outlet pipe size of the relief valve.
2. Must not be restricted in any way.
3. Must be of a material capable of withstanding 210°F without distortion.
4. Must be installed to allow complete drainage.
5. Must terminate at an adequate free flowing drain.

Pressure Build-up in a Water System

When the water heater operates, the heated water expands creating a pressure build-up. This is a natural function and is one of the reasons for installing a temperature and pressure relief valve. If the cold water supply line has a built in water meter, check valve or pressure reducing valve, a suitable device to prevent pressure build-up or water hammer effect must be installed otherwise the warranty is void (see fig. 2). Ex: THERMXtrol. An indication of pressure build-up is frequent discharges of water from the relief valve. This is a safety feature, however if the valve relieves water on a continuous basis, it may indicate a malfunction of the valve and a qualified service technician must be called to have the system checked, and the problem corrected.

Figure 2



9 Check valve or water meter or pressure reducing valve
10 Incoming cold water supply
11 Cold water supply to distribution system
12 Cold water supply relief valve overflow
13 Cold water supply relief valve (pressure adjustable type)
14 Expansion tank
15 Floor drain

WARNING

This water heater must not be operated with the cold inlet valve closed. Also, manually operate the temperature and pressure relief valve at least once a year, STANDING CLEAR OF THE OUTLET AS THE WATER RELEASED WILL BE HOT. Lift and release the operating lever on the temperature and pressure valve to make the valve operate freely.

NEVER OPERATE THE WATER HEATER IF IT IS NOT COMPLETELY FILLED WITH WATER. TO MAKE SURE THE WATER HEATER IS FILLED, OPEN AN UPSTAIRS HOT WATER FAUCET UNTIL THERE IS A FULL FLOW OF WATER, WITH NO AIR ESCAPING. IF THIS INSTRUCTION IS NOT FOLLOWED, PERMANENT DAMAGE WILL OCCUR TO THE ELEMENT. YOU CAN IDENTIFY A DRY-FIRED ELEMENT IF THE COPPER TUBING HAS TURNED A REDDI[illegible] COLOR AND IS SOFT WHICH MAKES IT EASY TO BEND.

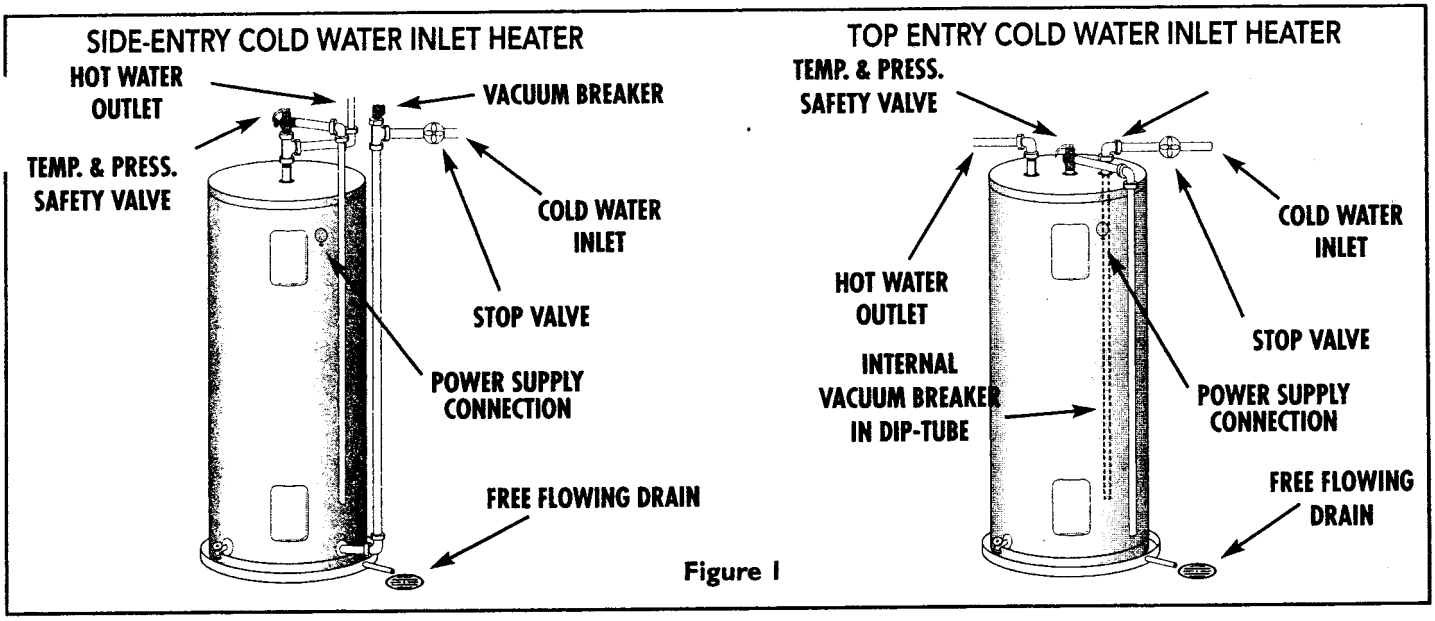


Figure 1

Cathodic Protection (Anode)

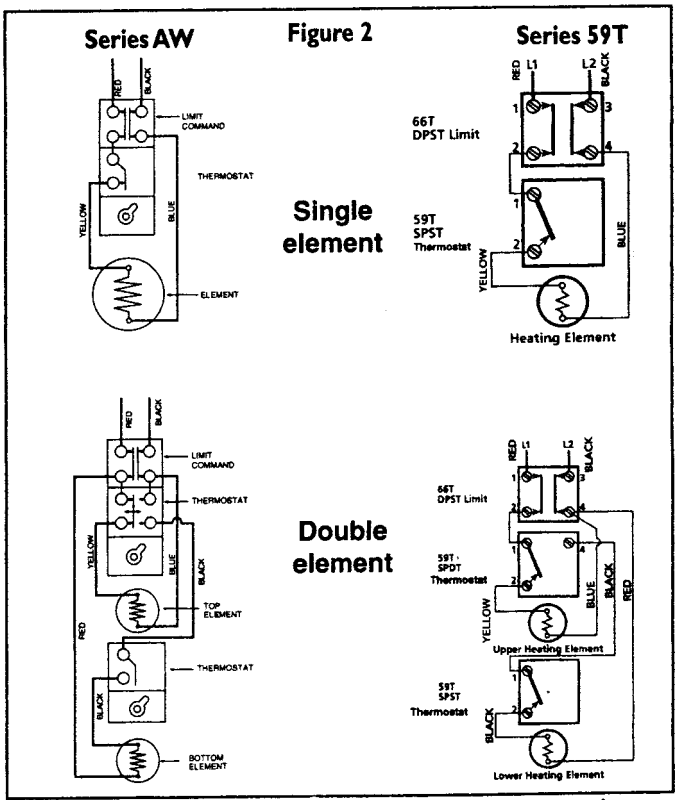
This water heater is equipped with an anode rod which is designed to prolong the life of the glass lined tank. The anode, through electrolytic action, is slowly consumed protecting the glass lined tank (cathode). The amount of protection given is dependent on local water conditions. If your water is very low in mineral content (soft), consumption of the anode is slow. If your local water is high in mineral content (hard), anode consumption is rapid. Where a water softener is introduced to fight hard water, the life expectancy of the water heater is reduced as outlined on the warranty card. In hard waters, it is desirable to check the anode periodically and replace it when necessary to extend the life of the water heater. This replacement would normally be undertaken by a plumber, and, while it is not under warranty, replacement does extend tank life. In some waters, and generally in times of non usage, the anode and water combination can produce hydrogen sulfide. This water smells like rotten eggs and is prevalent in well systems. It can normally be cured by chlorinating the well and the water tank and in severe cases by changing the anode to a type more suitable for these conditions (aluminum anode). A sign of hydrogen sulfide production is spurting at the faucet when it is opened. This gas in itself is flammable, and must not be exposed to an open flame. Run the water until the gas is purged from the system. Under no circumstances should the anode be removed from the water heater on a permanent basis, as **this action will void the warranty**. Call your plumber for advice on local water conditions. The sodium salts generated by a water softener makes this water extremely conductive therefore the anode becomes ineffective within one year. See warranty restriction to this effect.

Filling the water heater

1) Check that all the piping connections have been made.
2) Check that the drain valve is fully closed.
3) Open the shut-off valve in the cold water supply line, then open a hot water faucet.
4) When water runs from the hot water faucet, the tank is full. It is desirable to open all hot water faucets on the system (individually) to release any air trapped in the lines.
5) Once completed go to the wiring section.

Wiring installation

1) Check the rating plate on the water heater for element wattage and voltage.
2) Check the wire size needed to supply this water heater (see table 1)
3) Verify that the incoming wire corresponds to the required wire.
4) Connect the power supply wiring to the red and black (L1 &L2 figure 2) wires attached to the top thermostat. NEVER CONNECT THE POWER SUPPLY DIRECTLY ONTO THE THERMOSTAT.
5) For any installation, a separate fuse branch circuit must be provided, and all wiring must conform to local codes. The chart provides recommended wire and fuse sizes; however, it is advisable to check with your local electrical utility and confirm that these sizes meet local requirements.



Installation Check List Check Here

1. Have the wiring connections been properly secured ? . . . ☐
2. Is the fuse or circuit breaker size correct ? . . . . . ☐
3. Are the wires supplying the water heater of the correct wire size & attached to the power supply connection ? . . ☐
4. Is the ground wire properly secured ? . . . . . ☐
5. Is a drain available or has a pan been installed? . . . . . ☐
6. Has the drain pan been connected to a sewer ? . . . . . ☐
7. Was the dip tube installed in the cold water inlet (top entry only)?. . . . . ☐
8. Is the water heater completely full of water?. . . . . ☐
9. Are the relief valve and relief valve drain installed ?. . . . . ☐
10. Are the hot and cold water lines connected correctly ? . . ☐
11. Is there adequate clearance for maintenance around the water heater ?. . . . . ☐

***** If all answers are "YES" start-up. *****

START-UP AND SAFETY INSTRUCTIONS

WARNING

To avoid property damage and/or serious personal injury, please read the following precautions:

FOR YOUR SAFETY

- DO NOT REMOVE THE ACCESS PANELS BEFORE THE POWER TO THE WATER HEATER IS TURNED OFF.
- DO NOT ATTEMPT ANY REPAIRS WITHOUT VERIFYING THAT THERE IS NO VOLTAGE AT THE WATER HEATER.
- DO NOT USE THE WATER HEATER ON A VOLTAGE OTHER THAN THAT SPECIFIED ON THE RATING PLATE.
- DO NOT CONNECT THE POWER SUPPLY TO ANYWHERE OTHER THAN THE MAIN POWER SUPPLY CONNECTION ON THE WATER HEATER.
- DO NOT TURN ON THE POWER TO THE WATER HEATER UNLESS IT IS FULL OF WATER.
- DO NOT DRAIN THE WATER HEATER UNLESS POWER TO THE WATER HEATER HAS BEEN TURNED OFF.
- DO NOT STORE OR USE GASOLINE OR OTHER FLAMMABLE, OR CORROSIVE LIQUIDS OR VAPORS. IN THE VICINITY OF THIS WATER HEATER.

WHAT TO DO IF YOU SMELL SMOKE

- IMMEDIATELY TURN OFF THE POWER TO THE WATER HEATER.
- IF AFTER TURNING OFF THE POWER THE SMOKE CONTINUES, CALL YOUR LOCAL FIRE DEPARTMENT.
- WHEN THE SMOKE HAS STOPPED, CALL A QUALIFIED SERVICE TECHNICIAN.

Water temperature regulation

Single element water heaters are equipped with one combined thermostat energy cut off (ECO). Double element water heaters are equipped with one upper combination thermostat energy cut-off (ECO), and one lower thermostat. These thermostats are factory set at 60°C (140° F). In double element water heaters, only one element heats at a time. If the tank is completely cold, the top element is energized first; when the top portion of the tank reaches temperature, the power is switched to the bottom element which will complete the heating cycle.

WARNING

The higher the setting , the greater the risk of scalding. Hot water can cause third degree burns in 6 seconds at 60°C (140°F), and in 30 seconds at 54°C (130°F). In households where there are children, physically challenged individuals, or elderly persons, mixing valves at the point of use are recommended as a means to reduce the scalding potential of hot water. Use the vacation setting for prolonged absences.

Start-up procedure

1) Have you filled out the installation checklist?
2) Are the thermostats adjusted to your desired temperature (factory set at 60°C (140°F))?
3) Turn on the breaker at the main service panel.
4) Make sure that the fuse box (if one exists) next to the water heater is pushed to "ON".
5) If you smell smoke, refer to above smoke warning.
6) Wait one (1) hour. At this time, hot water should be available at the faucet.
7) If after one (1) hour you do not have any hot water, check that all fuses and breakers are in working condition.
8) Wait for another hour. If at this time you still do not have any hot water, call a qualified service technician.

NOTE: If after one hour (1) you receive only a very small amount of hot water, check that the plumbing connections are not reversed.

ELEMENT AND THERMOSTAT REPLACEMENT

WARNING

Before attempting any electrical repairs or replacements, **turn off** the power to the water heater. Failure to do so could result in electrical shock and/or severe injury or death of the person doing the work.

Replacing an element

1) **Turn off** the power and drain all the water from the water heater.
2) Remove the element access cover(s).
3) Carefully turn back the insulation.
4) Disconnect the wires from the element terminals.

5) Remove the element.
6) Replace the element with a new O.E.M. element of the same type. Make sure that the gasket surfaces are clean and that the element has been re-installed water-tight.
7) Re-connect the wiring and tighten securely.
8) Re-fill the water heater with water. Eliminate any air in the water heater by opening a hot water faucet, and check for leaks at the element face.
9) Replace the fiberglass and the element access cover and turn on the power to the water heater.

Replacing a thermostat

1) **Turn off** the power to the water heater.
2) Remove the element access cover(s).
3) Carefully turn back the insulation.
4) Disconnect the wire from the terminals.
5) Lift the securing prongs and slide the thermostat up to remove it.
6) Check the thermostat model number.
7) Replace the thermostat with a new one of the same manufacturer and type.
8) Check that the wiring corresponds to the wiring diagram in figure 3.
9 Set the thermostat at the desired temperature.
10) Replace the insulation and the element access cover.
11) Turn on the power to the water heater.

Table 1

Recommended wire and fuse size

Element size		Recommended Wire Size *		Recommended Fuse Size **	
120V	240V	120V	240V	120V	240V
1000		# 14	# 14	15 A	10 A
1500		# 12	# 14	20 A	10 A
2000		# 12	# 14	25 A	15 A
3000		# 10	# 12	30 A	20 A
3800 / 240V		---	# 12	- --	25 A
4500 / 240V		---	# 10	----	25 A

* Should conform to Local Codes.
** Based on non-simultaneous operation of thermostats

The water heater must be grounded; a green ground screw is provided to achieve this.

HARD WATER PROBLEMS

With hard waters, heating the water causes minerals mainly in the form of lime scale to build up in the water heater and on the elements themselves. Scale on the elements can cause a hissing sound during operation. While this condition is not dangerous, it does reduce the life expectancy of the element. It is advisable to call a qualified service technician to clean or replace the elements. Scale that falls to the bottom of the tank can be controlled by periodically draining water through the drain valve to the floor drain. When these flushing or cleaning operations are being performed, it is good practice to check the operation of the pressure relief valve for safe operation. This is performed by lifting the manual lever of the valve and releasing a small amount of water through the valve. If the valve fails to operate, or will not reset properly (continues to let water flow), have your qualified service technician install a new valve. Never attempt to clean a valve, as this may cause damage that could result in a malfunction. Water released through the relief valve will be at a temperature equivalent to the maximum temperature thermostat setting, and a danger of scalding exists: it is imperative that the water released goes directly to a suitable drain. If there is any doubt at all, have a qualified service technician perform this operation.

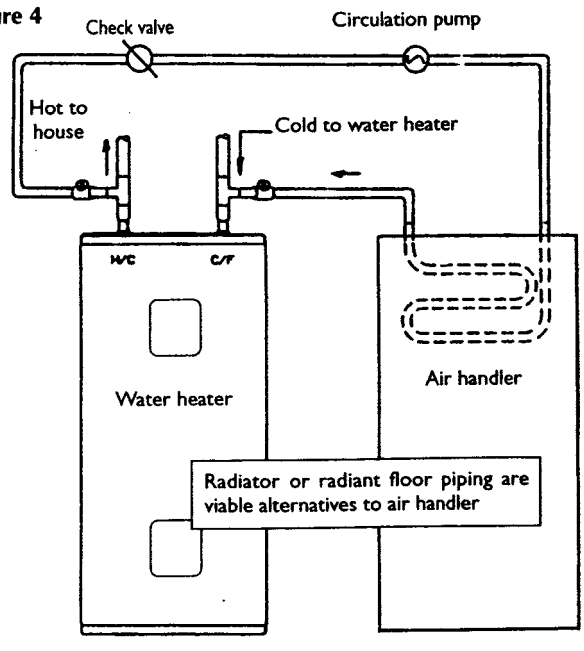
Installation Instructions for Water Heaters Approved for Space Heating & Potable Water Heating

When using a water heater in a combination space and potable water heating system, instructions provided in this manual, and with the air handling unit must be strictly adhered to. In Particular:

1) All piping and components that are used in the system, must be of a non ferrous type, suitable for potable water. This also applies to any sealant used.
2) When used as a dual purpose water heater, it must not be connected to any system that has been previously used for non potable water heating. This includes any piping, because in all probability, existing piping would have been in the past, treated with chemicals for cleaning or sealing the system.
3) Do not use a domestic water heater to replace an existing boiler system.
4) Do not use toxic chemicals to clean the potable water heating system.
5) Where water temperature in excess of 60°C (140°F) is required for a space heating application, a mixing valve must be installed in the potable side of the system. This will temper the water, and reduce the risk of scalding.
6) If the incoming water line to the water heater is equipped with a check valve, water meter or pressure reducing valve, an expansion tank must be installed in the system. This will prevent weeping from the water heater relief valve and premature failure of the water heater due to expansion of the water during the heating cycle.
7) Before acquisition of a water heater for space heating application, it is necessary to have the area of intended use sized by a qualified technician, to ensure that adequate water heating capacity will be available for both heating and potable water supply and to ensure that the application will meet all local codes and public utility requirements.

Note: It is good practice to oversize the water heater, to ensure that all of the potential hot water requirements are available (see fig. 4 for a typical installation layout).

Figure 4



STANDARD BASIC LIMITED WARRANTY
ON RESIDENTIAL AND POINT-OF-USE WATER HEATERS

GENERAL

The manufacturer warrants that, subject to verification of a warranty claim within the warranty period as described below, it will take the necessary corrective action to either repair or replace a water heater or component part which is determined to be defective in material or workmanship subject to the terms and conditions outlined in this document. Further, any replacement water heater or component part supplied under warranty will carry only the unexpired portion of the original water heater's warranty. The number of replacement water heaters is limited to one (1) per original unit purchased. If due to some extremely unusual circumstance, a replacement water heater or component part is found by our inspection & testing department to be defective, another heater or component part will be supplied to fulfill the obligation of the warranty of the original heater.

THE INNER TANK

If the inner tank fails within *SIX (6) years after the date of the original installation (*THREE (3) years in Newfoundland), a replacement water heater will be provided to the party from whom the unit was originally purchased. If the water heater is installed in other than a single family dwelling, the tank warranty is limited to ONE (1) year. If an exact replacement is not available, the manufacturer reserves the right to furnish a comparable model water heater. The warranty reply card must be completed and sent back to the manufacturer within forty-five (45) days of the installation date. If said warranty card is not returned, the date indicated on the model serial plate will prevail.

COMPONENT PARTS

If any component part is found to be defective within *ONE (1) year from the date of original installation, provided said defective part is an in-house factory made piece or an original factory approved OEM piece, the manufacturer will furnish a replacement part after the receipt and testing of the part claimed to be defective. *FIVE (5) years on the elements for "CASCADE" models.

THIS WARRANTY WILL NOT APPLY

1) To defects or malfunctions resulting from failure to properly install, operate, or maintain the unit in accordance with the printed instructions.
2) If the installation does not conform to CSA &/or ETL Standards as well as any applicable national or local building codes.
3) To any damage or failure caused by abuse, accident, fire, floods, freezing, or other acts of God.
4) To any damage or failure caused by operating the heater without an approved pressure & temperature relief valve having been installed.
5) To any damage or failure caused by operating the heater with an empty or partially empty inner tank or sediment build-up resulting in dry firing of the heating elements.
6) To any damage or failure caused by utilizing the heater in conjunction with any other energy saving device or other source(s) of energy not approved by the manufacturer; or for other than use with potable water without any additives such as salt, chlorine, or chemicals other than those added for the purpose of rendering the water fit to drink.
7) To any damage or failure caused by the removal of the anode &/or by not assuring that there is a working anode in the tank at all times. All anodes must be checked at least once every two years & replaced if necessary
8) To any damages or failure caused by having affixed to the heater any non-factory made or factory approved replacement part(s) such as elements, controls, dip-tubes, relief valves, etc...
9) To any damage caused by not having the water heater installed adjacent to a free flowing drain in the event of water leakage.
10) If the heater is operated at water temperatures exceeding the maximum setting of the operating &/or high limit control or the heater is not supplied with potable water, free to circulate at all times.
11) If the heater has experienced the effect of thermal expansion due to excessive pressure (exceeding 300PSI). The result of excessive pressure usually reverses the bottom of the inner tank and can occur with the addition of a pressure reducing valve &/or a check valve in the municipal water supply system in a single family dwelling.
12) If the heater is installed outside of Canada or the United States.

SERVICE LABOUR RESPONSIBILITY

This warranty does not cover any labour expense for service, removal, or re-installation of a replacement heater. All such expenses are your responsibility.

SHIPPING COSTS

If a water heater or component part is deemed to be replaced, the manufacturer will pay the transportation costs of the replacement unit to a convenient authorized distributor or retailer as selected by us. You must pay any local cartage including the cost of returning the replaced item to the authorized distributor or retailer from whom the replacement is coming from.

HOW TO MAKE A CLAIM

Any claim for warranty service should be made to your contractor, wholesaler, or retailer from whom the water heater was purchased. In turn, said contractor, wholesaler, or retailer will contact the manufacturer from whom they purchased the heater. If this procedure cannot be followed, contact any other local contractor, wholesaler, or retailer handling our water heaters. Also, for warranty information you may call the manufacturer's customer service department at (514) 645-8893 or 1-800-363-9354, ext. 240. We suggest that prior to calling the factory, that you make sure to have the model number & serial number that is to be found on the outside casing of the heater. Proof of purchase showing the date, name, and place of the business from whom the water heater was purchased is essential to settle any warranty claim dispute over the length of the period of installation.

MISCELLANEOUS

No one is authorized to make any other warranties on the manufacturer's behalf. Any implied warranties of any nature offered by a third party other than what is stated in this Standard Basic Limited Warranty will not be honoured. No claims for incidental or consequential damages (including damages from leakage) will be accepted. If you do not return the warranty card, a proof of purchase showing the name, date, and location of the original source of purchase is a necessity to process a warranty claim. Failure to produce this documentation will result in the lesser or the warranty periods being offered. In order to avoid any confusion &/or disputes, we suggest that the warranty card be completed and mailed back no later than forty-five (45) days after installation.

EXTENDED WARRANTIES

For information on some premium quality residential gas & electric water heaters, contact your local licensed plumber, or look for them at selected retailers.

Hot Water Controls

Remote Type

INSTALLATION INSTRUCTIONS

WHITE-RODGERS

Operator: Save these instructions for future use!

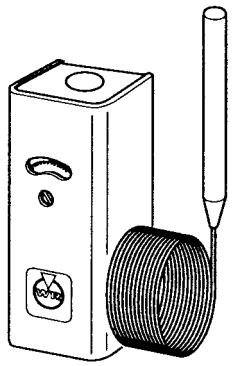
FAILURE TO READ AND FOLLOW ALL INSTRUCTIONS CAREFULLY BEFORE INSTALLING OR OPERATING THIS CONTROL COULD CAUSE PERSONAL INJURY AND/OR PROPERTY DAMAGE.

DESCRIPTION

These hot water controls were designed for use on hot water heating installations but they may be used on other heating applications to control the temperature of other fluids. The fluid they are to be used with must not be corrosive to copper.

These controls have capillary tubing between the temperature sensitive bulb and the switch mechanism so that the switch mechanism can be mounted at any convenient location while the temperature sensitive bulb is located in the fluid to be controlled.

These controls have special contacts which are suitable for use on low voltage and millivolt (thermocouple generator type) circuits as well as line voltage equipment such as gas valves, oil burner motors, etc.



PRECAUTIONS

THESE CONTROLS MUST BE INSTALLED BY A QUALIFIED INSTALLER

Do not exceed the specification ratings.

All wiring must conform to local and national electrical codes and ordinances.

This control is a precision instrument, and should be handled carefully. Rough handling or distorting components could cause the control to malfunction.

This control has been accurately calibrated at the factory. any attempt to calibrate this control will void the White-Rodgers warranty.

⚠WARNING

Do not use on circuits exceeding specified voltage. Higher voltage will damage control and could cause shock or fire hazard.

⚠CAUTION

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

Following installation or replacement, follow appliance manufacturer's recommended installation and/or service instructions to insure proper operation.

⚠CAUTION

To prevent electrical shock and/or equipment damage, disconnect electric power to system at main fuse or circuit breaker box until installation is complete.

Shut off main gas to heating system until installation is complete.

INSTALLATION

If the equipment manufacturer recommends a control location, follow such recommendations. If none is offered, the following recommendations should be observed.

When used to control the temperature of a vat or tank, locate the control bulb in a place representative of the average temperature. Make certain that the fluid being controlled is not injurious to the copper element.

When used for high limit service on a heating boiler, the control should be installed in the riser close to the boiler, or in a boiler tapping that is near the top or hottest section of the boiler. If the boiler is also used to heat domestic hot water, make sure that the high limit control is not in that section of the boiler that contains the heat exchanger or piping for domestic hot water.

When used for low limit or operator service, the control should be located near that section of the boiler that contains the heat exchanger or piping for domestic hot water.

Be careful to avoid damage to the capillary tubing between the control and the temperature sensitive bulb. This tubing should be led over a path that will protect it from cuts, blows, wear due to vibration, etc.

⚠CAUTION

Do not dent or bend the bulb as this will change the control calibration and cause it to cycle at a temperature lower than the dial setting.

EMERSON

WHITE-RODGERS DIVISION
EMERSON ELECTRIC CO.
9797 REAVIS RD., ST. LOUIS, MO. 63123
(314) 577-1300, FAX (314) 577-1517
9999 HWY. 48, MARKHAM, ONT. L3P 3J3
(905) 475-4653, FAX (905) 475-4625

Printed in U.S.A.

PART NO. 37-0882C
Replaces 37-0882B & 37-9025
9546

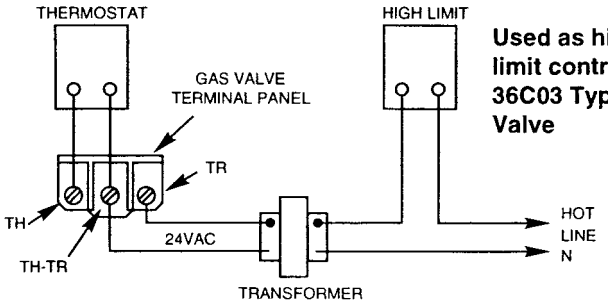
WIRING

NOTE

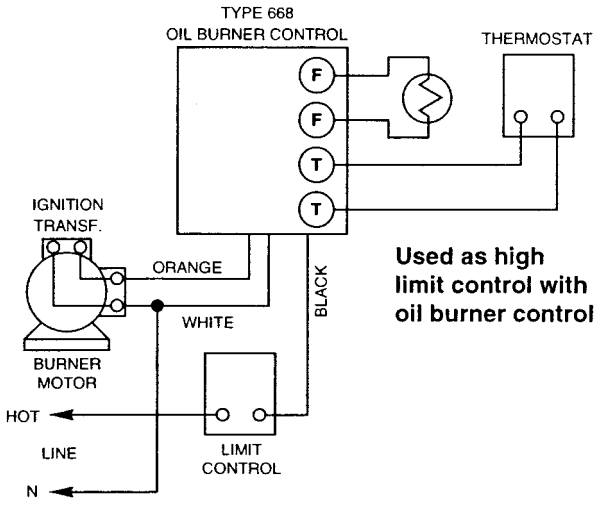
All wiring should be done according to local and national electrical codes.

If the boiler or burner manufacturer recommends a wiring diagram, then follow such recommendations.

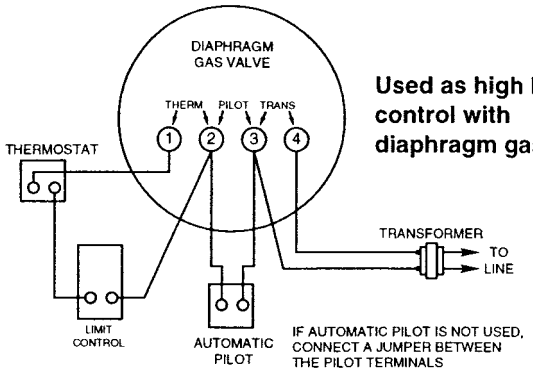
If none is offered, these diagrams show suggested circuits.



Used as high limit control with 36C03 Type Gas Valve

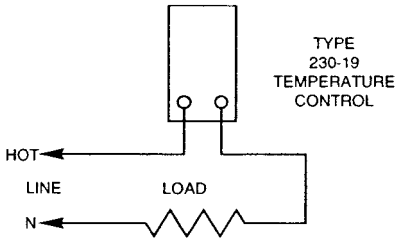


Used as high limit control with oil burner control



Used as high limit control with diaphragm gas valve

Used as operating control for electrically heated tank



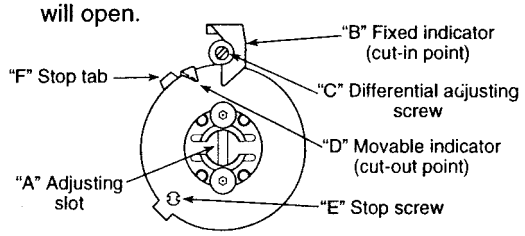
SETTING THE CONTROL

CONTROLS WITH ADJUSTABLE DIFFERENTIAL

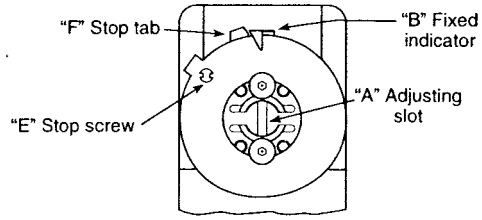
The movable indicator points to the temperature at which the contacts open. The fixed indicator points to the temperature at which the contacts close. The difference between these two indicators is the differential.

To set the control:

1. Use a screwdriver in the adjusting slot (A) on the front of the control to turn the dial so that the fixed indicator (B) points to the temperature at which the contacts will close.
2. Turn the differential adjusting screw (C) until the movable indicator (D) points to the temperature at which the contacts will open.



ADJUSTABLE DIFFERENTIAL



FIXED DIFFERENTIAL

CONTROLS WITH A FIXED DIFFERENTIAL

The indicator (B) points to the temperature at which the contacts open.

To set the control:

Use a screwdriver in the adjusting slot (A) on the front of the control to rotate dial until the desired temperature at which the contacts will open is positioned directly under the indicator (B).

CONTROLS WITH ADJUSTABLE STOPS

⚠ CAUTION

Setting stop higher than control being replaced could cause personal injury and/or property damage.

1. Loosen stop screw (E) with enclosed wrench.
2. Set dial to original equipment manufacturer's specification.
3. Without moving the dial, move stop tab (F) against indicator.
4. Retighten stop screw (E).

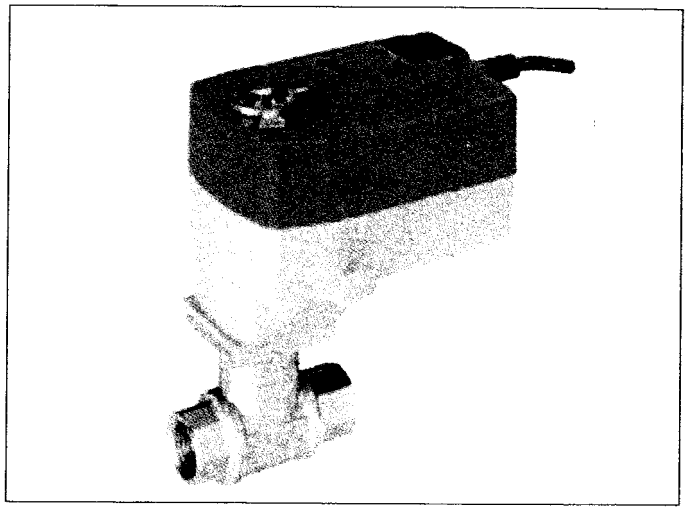
BELIMO

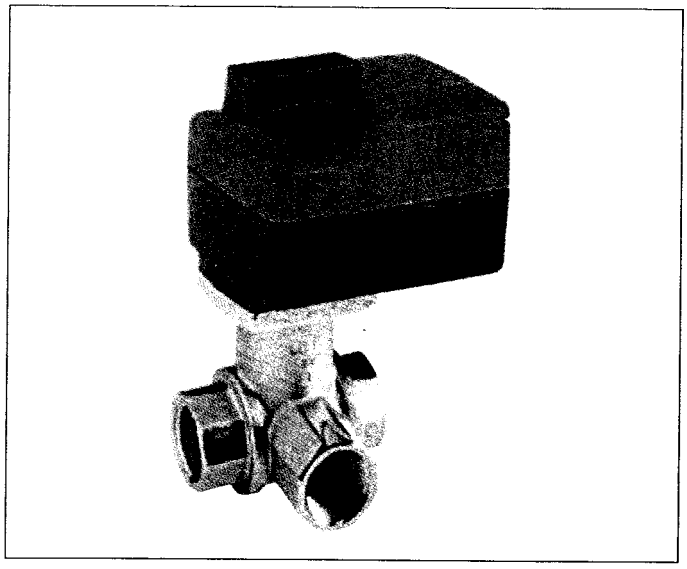
Electronic Characterized Control Valves™ (CCV)

B2 (B) Series Characterized Control Valves

Two-way Valve with Stainless Steel Ball and Stem, Chrome Plated Brass Ball and Stem (B) 1/2" and 3/4" **NPT female ends**

Service:	Chilled or Hot Water, 60% Glycol
Flow Characteristic:	A port equal percentage
Media Temp Range:	0°F to 212°F [-18°C to 100°C]
Maximum Differential Pressure (ΔP):	For Characterized A-port 20 psi for typical applications 30 psi max for quiet service For full flow versions only (no A-Disc) On/Off control 150 psi
Ambient Temp Range:	-22°F to 122°F [-30°C to 50°C]
Leakage	0% for A to AB





B3 (B) Series Characterized Control Valves

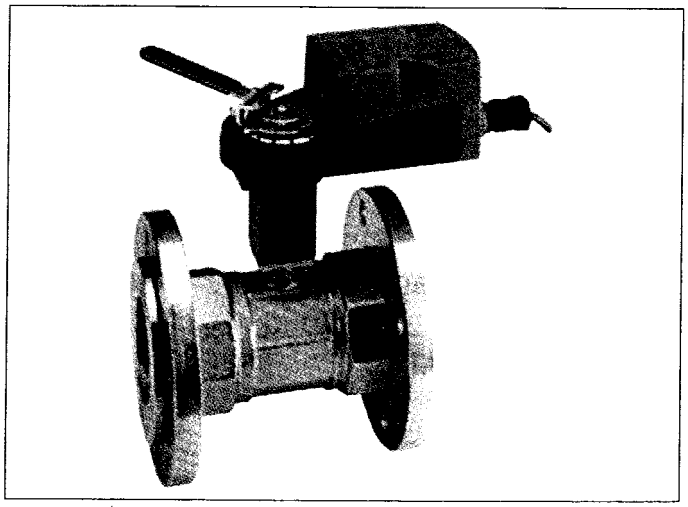
Three-way Valve with Stainless Steel Ball and Stem, Chrome Plated Brass Ball and Stem (B) 1/2" and 3/4" **NPT female ends**

Service:	Chilled or Hot Water, 60% Glycol
Flow Characteristic:	A port equal percentage B port modified linear for constant flow
Media Temp Range:	0°F to 212°F [-18°C to 100°C]
Maximum Differential Pressure (ΔP):	For Characterized A-port 20 psi for typical applications 30 psi max for quiet service For full flow versions only (no A-Disc) On/Off control 150 psi
Ambient Temp Range:	-22°F to 122°F [-30°C to 50°C]
Leakage	0% for A to AB 0.5% to 2.0% B to AB

B6 Series Flanged Characterized Control Valves

Two-way Valve with Stainless Steel and Stem, **Pattern to mate with ANSI 125 Flanges**

Service:	Chilled or Hot Water, 60% Glycol
Flow Characteristic:	A port equal percentage
Media Temp Range:	0°F to 212°F [-18°C to 100°C]
Maximum Differential Pressure (ΔP):	For Characterized A-port 20 psi for typical applications 30 psi max for quiet service For full flow versions only (no A-Disc) On/Off control 150 psi
Ambient Temp Range:	-22°F to 122°F [-30°C to 50°C]
Leakage	0% for A to AB



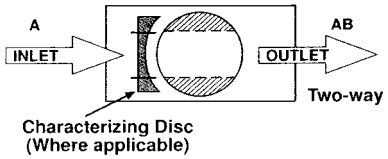
26.7

Electronic Characterized Control Valves™ (CCV)

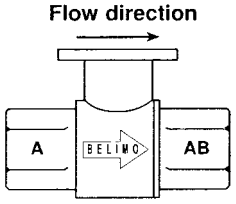
BELIMO

Flow Pattern

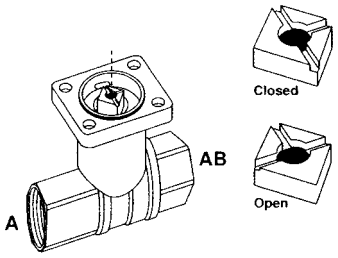
Two-way Characterized Control Valves™ (Belimo B2 (B) Series) (Belimo B6 Series)



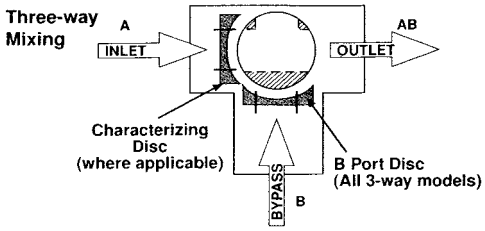
*Two-way valves should be installed with the disc upstream.



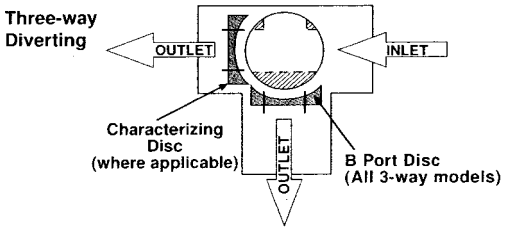
Valve should be installed with the disc upstream. If installed with disc downstream, Cv will be 5% reduced and flow curve will be deeper. If installed "backwards" it is NOT necessary to remove and change. No damage of control problems will occur.



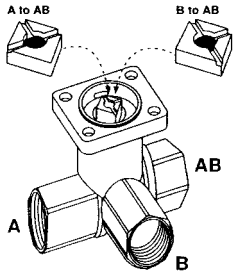
Three-way Characterized Control Valves™ (Belimo B3 (B) Series)



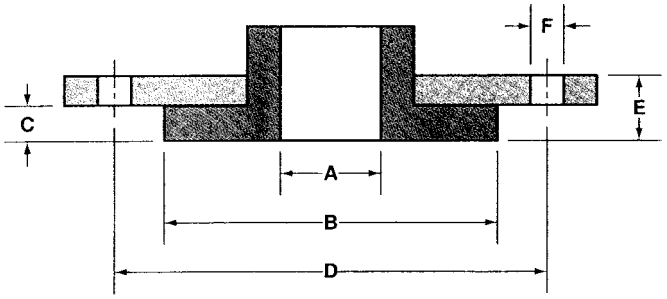
*The A port must be piped to the coil to maintain proper control.
*The B port yields 70% of the A port flow.



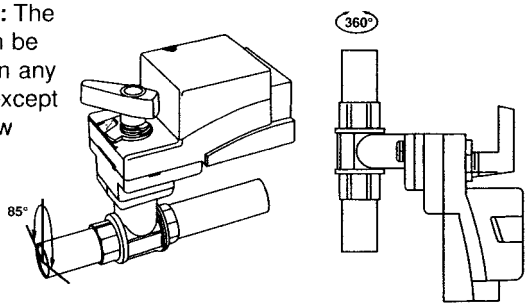
*The B port should be piped as the bypass port.



Flange Detail for B6 Valves



Mounting: The valves can be mounted in any position, except stem below horizontal.



Nominal Pipe Size	Raised Face			Flange			
	A	B	C	D	E	F	
	Face I.D.	Face O.D.	Face Height	Bolt Circle Diameter	Total Flange Thickness	Bolt Hole Diameter	Number of Bolt Holes
2-1/2"	2.50" [63]	4.75" [120]	0.25" [6]	5.50" [140]	0.95 [24]	0.75" [19]	4
3"	3" [75]	5.125" [130]		6" [152]	1" [25]		

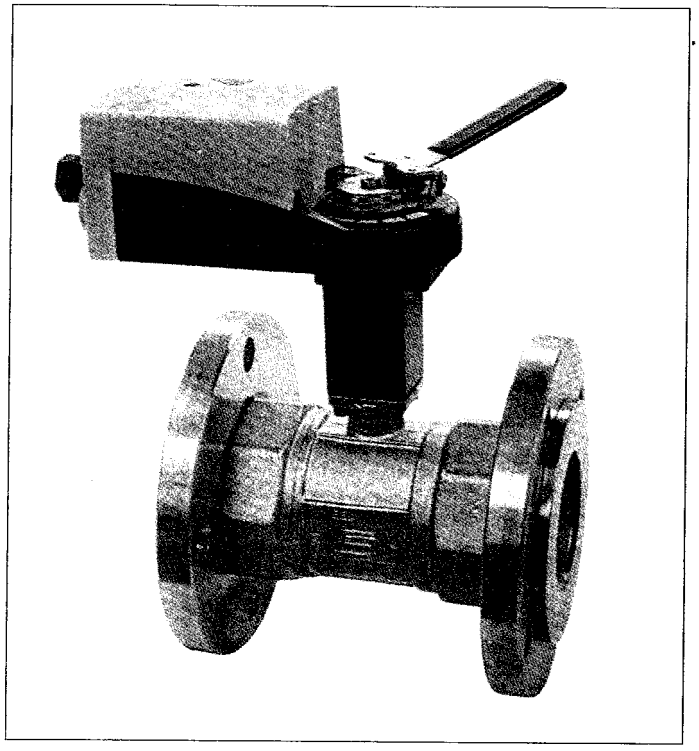
NOTES:

1) Flange Bolt Pattern matches ANSI 125# flanges. (not ANSI/ASME rated)
2) Maximum Allowable Working Pressure: 100 PSIG
3) It is not recommended to connect raised-face flanges to flat-faced flanges!
4) **Materials:**
   Flange: A 105 Carbon Steel (zinc plated)
   Raised Face: Brass (nickel plated)

BELIMO

CCV-EXT-KIT

CCV Valve Neck Extension Kit

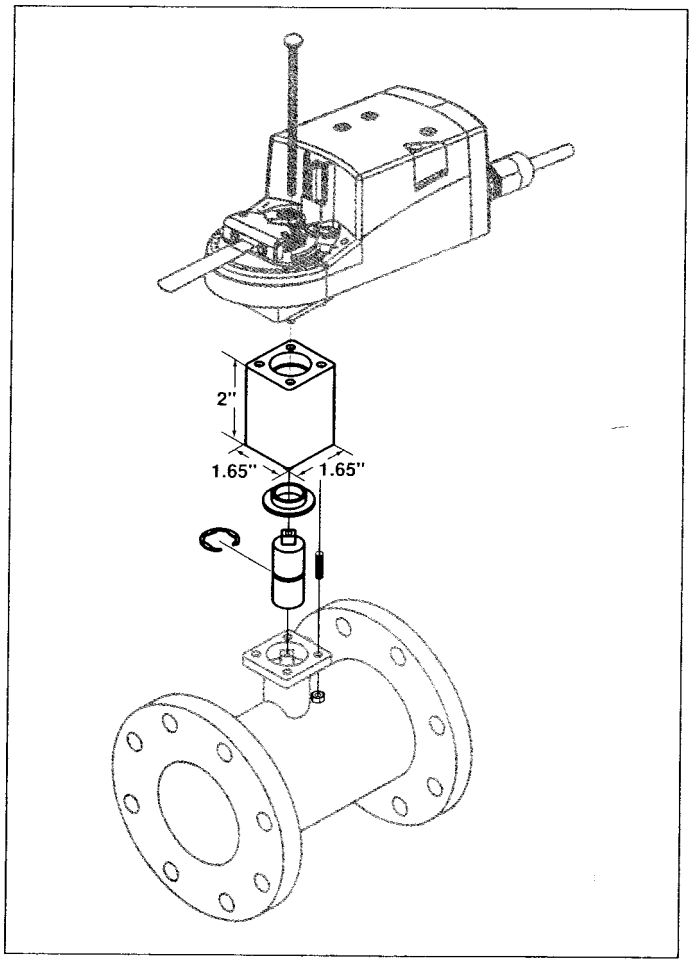


*Available for previous NF assemblies.

Application

The CCV-EXT-KIT can be used with most CCV's* in order to achieve a large clearance over the pipe. The Extension Kit will provide an additional 2" of space between the top of the valve and the base of the actuator. The bracket is made from aluminum and is not intended as a thermal block.

– Extension kit will be automatically assembled with any Flanged CCV assembly.



Technical Data:	
Extension Height	2"
Total Weight	0.7 lb
Material:	
Extension Housing	Aluminum - Anodized
Shaft	Stainless Steel
Threaded Hardware	Stainless Steel
Bearing	Oil Light Bearing
Retaining Clip	Stainless Steel

	LR	NM	AM	LF	NF*	AF
Extension Bracket CCV-EXT-KIT	•	•	•	•	•	•

*CCV-EXT-KIT cannot be used with any valve smaller than the B212 (B) and B312 (B).

26.73

Electronic Characterized Control Valves™

BELIMO

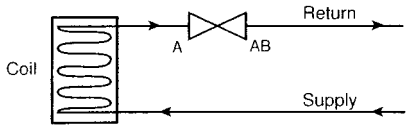
B2 (B)/B3 (B) Series Characterized Control Valves™

Operation/Installation

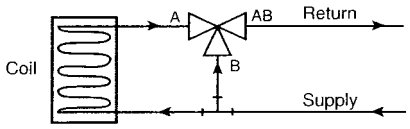
Correct Piping:

2-way valves should be installed with the disc upstream. If installed with disc downstream, flow curve will be deeper. If installed "backwards" it is NOT necessary to remove and change. No damage or control problems will occur.

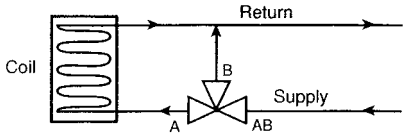
Two-Way Valve Piping Diagram
(1 Input, 1 Output)



Three-Way Mixing Valve Piping Diagram
(2 Inputs, 1 Output)



Three-Way Diverting Valve Piping Diagram
(1 Input, 2 Outputs)



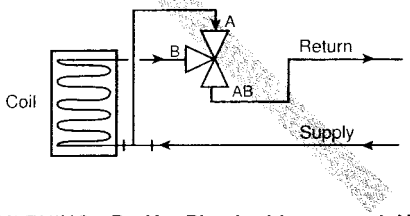
3-way valves must be piped correctly. **They can be mixing or diverting. Mixing is the preferred piping arrangement.**

The BELIMO Characterized Control Valve is a CONTROL valve, not a manual valve adapted for actuation. The control port is the A port. It is similar to the globe valve in that the middle port is the B or bypass port. The common port AB is on the main opposite the A port. These diagrams are for typical applications only. Consult engineering specification and drawings for particular circumstances.

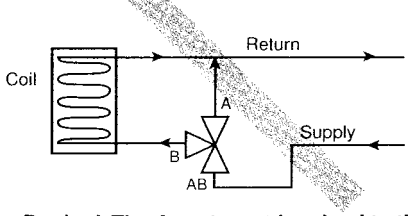
The A port must be piped to the coil to maintain proper control. The B port restricts flow by 30% of A port value.

Incorrect Piping:

Three-Way Mixing Valve Piping Diagram
(2 Inputs, 1 Output)



Three-Way Diverting Valve Piping Diagram
(1 Input, 2 Outputs)



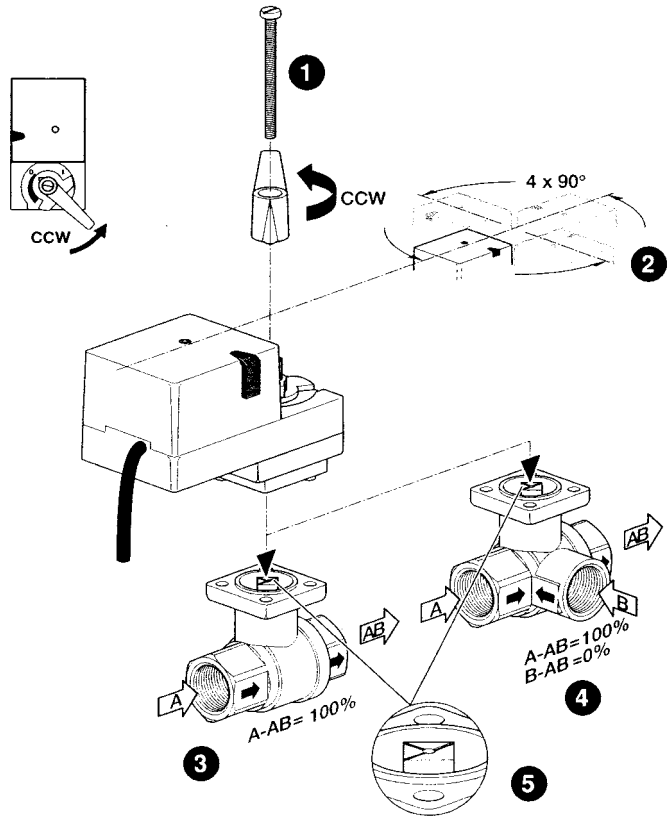
WARNING! **Do Not Pipe in this manner! Note Valve Porting! The A port must be piped to the coil! Not the B port!**

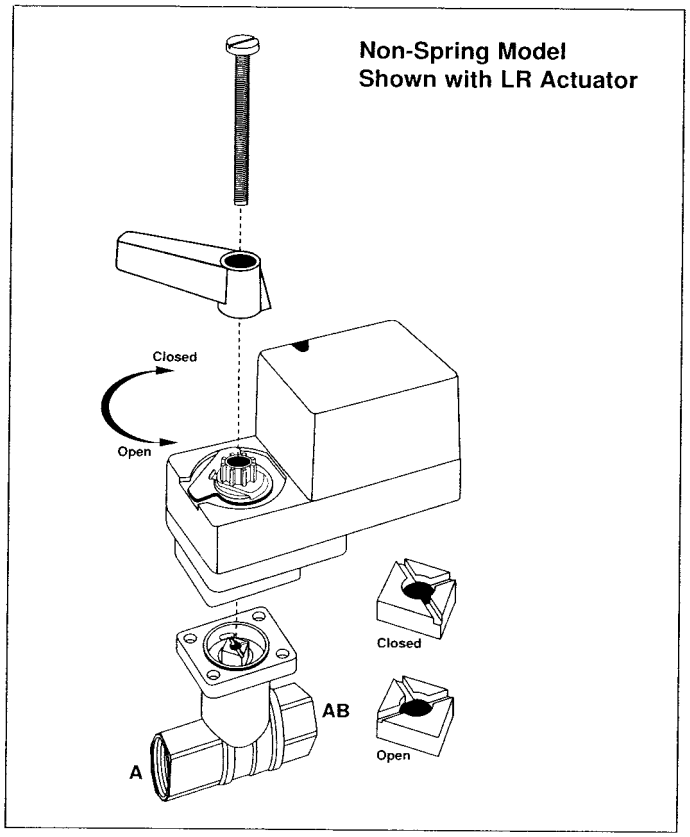
Flow is not possible from A to B. If AB port is not piped as the common port, the valve must be re-piped. It is good practice to install a balancing valve in the bypass line. These valves are intended for closed loop systems. Do not install in an open loop system or in an application that is open to atmospheric pressure.

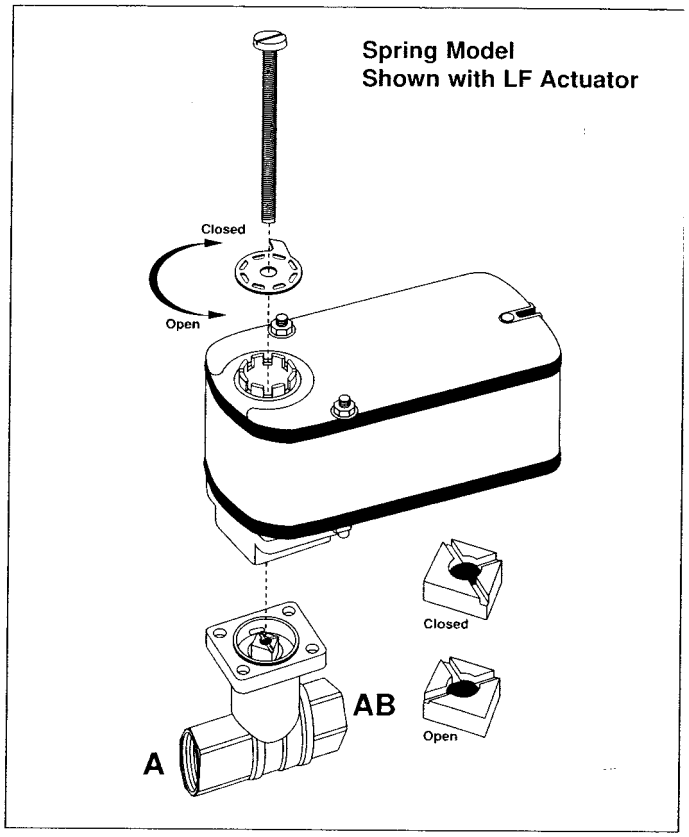
Assembly:

1. One screw attaches actuator to valve
2. Four actuator mounting positions
3. 2-way flow pattern
4. 3-way flow pattern (mixing shown)
5. Top of valve stem indicates direction of flow (Flow A to AB shown)

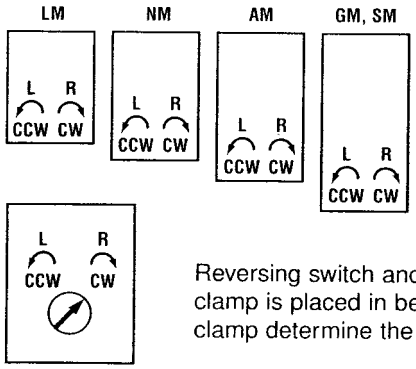
Note: For diverting flow, flow enters in AB and diverts to A and B ports.







Non-Spring Return



Reversing switch and the direction the clamp is placed in before tightening the clamp determine the NO, NC relations.

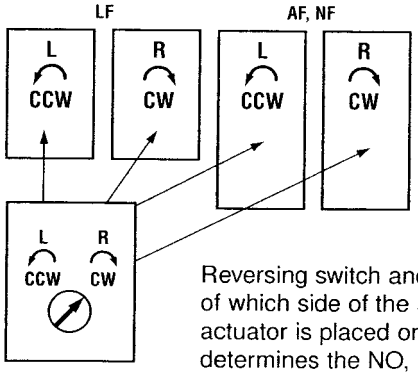
All directions are looking down onto top of valve and actuator.

Non-Spring Actuators:

CW	CCW
→	←
R	L
Y = 0	Y = 0

Y is the signal voltage.

Spring Return



Reversing switch and the choice of which side of the actuator to the actuator is placed on the valve determines the NO, NC relations.

Spring Return Actuators must be mounted so that the spring brings the actuator to the failsafe position the reversing switch does not affect the spring. It has an effect only on electrical NO, NC signal direction.

When replacing other valves note that the port designations may not be the same as the Belimo nomenclature. "NO, NC, Common" or "In and Out" and variations of the Belimo designated may exist.

DO NOT USE THE REVERSING SWITCH TO ATTEMPT TO COMPENSATE FOR INCORRECT MECHANICAL MOUNTING.

Electronic Characterized Control Ball Valves

BELIMO

Installation instructions

Warning!

Valve should not be used for combustible gas applications. Gas leaks and explosions may result. Do not install in systems, which exceed the ratings of the valve.

- Avoid installations where valve may be exposed to excessive moisture, corrosive fumes, vibration, high ambient temperatures, elements, or high traffic areas with potential for mechanical damage.
- Valve assembly location must be within ambient ratings of actuator. If temperature is below -22°F a heater is required.
- The valve assembly will require heat shielding, thermal isolation, or cooling if combined effect of medium and ambient temperatures – conduction, convection, and radiation– is above 122°F for prolonged time periods at the actuator.
- Following standard procedure, a strainer should be installed before the coil and valve or in another appropriate place in the system.
- Visual access must be provided. Assembly must be accessible for routine schedule service. Contractor should provide unions for removal from line and isolation valves.
- Avoid excessive stresses. Mechanical support must be provided where reducers have been used and the piping system may have less structural integrity than full pipe sizes.
- Sufficient upstream and downstream piping runs must be provided to ensure proper valve capacity and flow response. Five diameters in each direction are recommended.
- Life span of valve stems and O-rings is dependent on maintaining non-damaging conditions. Poor water treatment or filtration, corrosion, scale, other particulate can result in damage to trim components. A water treatment specialist should be consulted.
- Normal thread engagement between male pipe thread and valve body should be observed. Pipe run that is in too far will damage the valve.

Valve Size (NPT)	Normal	Valve Size (NPT)	Normal
1/2"	1/2"	1-1/2"	11/16"
3/4"	9/16"	2"	3/4"
1"	11/16"	2-1/2"	15/16"
1-1/4"	11/16"	3"	1"

1. Inspect shipping package, valve, linkage, and actuator for physical damage. If shipping damage has occurred notify appropriate carrier. Do not install.
2. If a replacement, remove existing valve, linkage and actuator from the piping system.
3. If actuator and linkage are removed, they must be reinstalled correctly. The actuator must be rotated so that the valve seats properly for close off.
4. Install valve with the proper ports as inlets and outlets. See drawings on page 2 and 4. Check that inlet and outlet of 2-way valves are correct; check that the "A", "B", and "AB" ports of three-way valves are piped correctly. Flow direction arrows must be correct.
5. Blow out all piping and thoroughly clean before valve installation.
6. Clean male pipe threads with wire brush and rag. If threads have been damaged or exposed to weather, running a tap or die over the threads may straighten them. Clean pipes, threads, and valve threads before installation; check for any foreign material that can become lodged in trim components. Strainers should be cleaned after initial startup.
7. Pipe sealing compound should be applied sparingly after cleaning and may not be applied to the two lead threads of a screwed pipe, which are innermost inside the valve. Sealing compound is to be placed on male threads only. The purpose is to lubricate the pipes when tightening.
8. Valve must be installed with the stem towards the vertical, not below horizontal.
9. Start the connection by turning the valve or pipe by hand as far as possible. Be certain the threads mate by the "feel" of the connection.
10. Use wrenches to tighten the valve to the pipe. Do not over tighten or strip the threads. Two wrenches are necessary to avoid damaging the valve.
11. Two-way valve Normally Open or Closed configurations must be verified by examining both the mechanical drawings and the valve and actuator. See details on page 2.
12. Three-way valve Normally Open or Closed configurations for the Control Port and the Bypass Port must be verified by examining both the mechanical drawings and the valve and actuator. See details on page 2.

Mounting

The flange allows the actuator to be either parallel or perpendicular to the pipe; there are four orientations possible.

If field installing a spring return actuator, disconnect power and allow actuator to spring closed. Flip actuator over if necessary to achieve proper rotation direction. DO NOT USE THE REVERSING SWITCH TO DO THIS.

Two-way Valves Mounting

For NORMALLY CLOSED operation:
The ball of the valve must be rotated so that the ball is CLOSED to flow. The actuator should be mounted with the clamp fully rotated CW (R). Spring return actuators will show the CW (R) symbol near the clamp and position indicator. Depressing the gear release to move the clamp rotates non-spring return actuators.

For NORMALLY OPEN operation:
The ball of the valve must be rotated so that the ball is OPEN to flow. The actuator should be mounted with the clamp fully rotated CCW (L). Spring return actuators will show the CCW (L) symbol near the clamp and position indicator. Depressing the gear release to move the clamp rotates non-spring return actuators. There are marks on the top of the valve stem, which indicate the port directions. See the drawings on the following pages.

Three-way Valves Mounting

The control port is ALWAYS the straight main run. The bypass port is ALWAYS the branch tee.

For NORMALLY CLOSED Control Port operation:
The ball of the valve must be rotated CW (R) so that the "A" port is CLOSED to flow. The actuator should be full CW (R) rotation of the clamp. Spring return actuators will show the CW (R) symbol near the clamp and position indicator. CCW (L) rotation of the actuator will open the control port and close the bypass port.

For NORMALLY OPEN operation:
The ball of the valve must be rotated CCW (L) so that the "A" port is OPEN to flow. The actuator should be full CCW (L) rotation of the clamp. Spring return actuators will show the CCW (L) symbol near the clamp and position indicator. CW (R) rotation of the actuator will close the control port and open the bypass port. There are marks on the top of the valve stem which indicate the port directions. See the drawings on the following pages.

Then the actuator-linkage can be set onto the valve. The square hole of the adapter fits easily onto the square stem extension. Rotate the ball as necessary using a wrench.

Do not force. Do not use the actuator to turn the pipe or the stem. Do not use any toothed tool such as pliers, which may damage the stem.

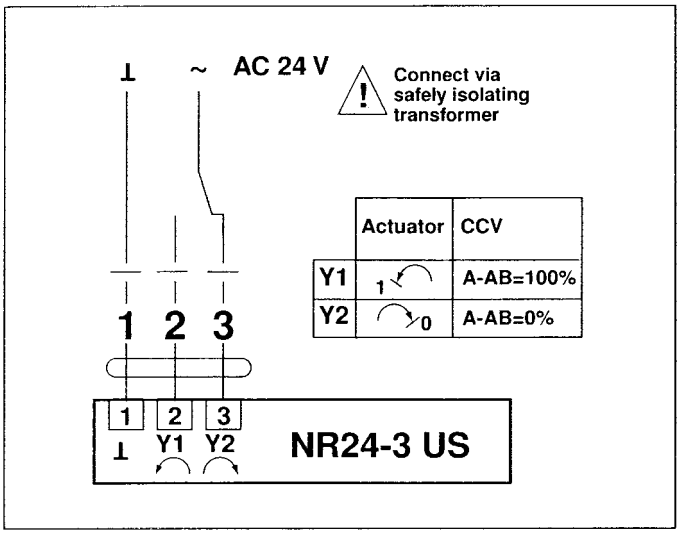
- Check that the actuator rotates so that the valve seats for close off and also rotates open to achieve full Cv. Use the gear release or the AF crank to verify. For LF or NF models apply power and control signal if necessary.
- Verify that CCW (L) rotation of the actuator will open the ball to flow.
- Install and tighten the hold down screw not more than 1/2 turn beyond the point where resistance is felt.

Abbreviated Specs for Non-Spring Return Actuators

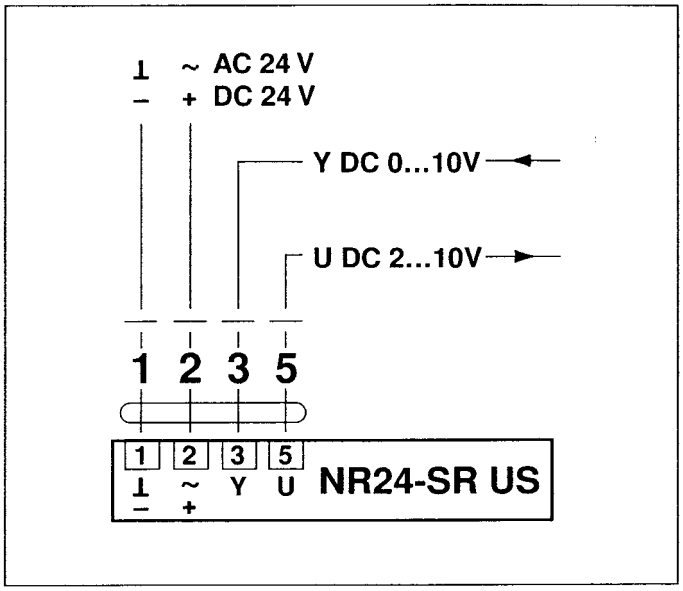
Actuator	Control Signal	Input Impedence	RunTime	Transformer Sizing (Class 2 Power Source)	Ambient Temp Rating
TR24-3(-T) US	On/Off, Floating	—	90 sec @ 60 hz, 108 sec @ 50 hz	1 VA	19F to 122F
TR24-SR US	Proportional	100kΩ	90 seconds		
LR24-3 US	On/Off, Floating	3.9kΩ			
LR24-SR US	Proportional	100kΩ			
LR24-MFT US	MFT	100kΩ for 2 to 10 VDC (0.1 mA), 500Ω for 4 to 20 mA, 750Ω for PWM 1500Ω for on/off and floating	95 seconds	3 VA (LR24-3 US), 4 VA (others)	-22F to 122F
NR24-3 US	On/Off, Floating	—	140 seconds	1.5 VA	32F to 160F
NR24-SR US	Proportional	100kΩ	140 seconds	2.5 VA	32F to 160F
NM24 US	On/Off, Floating	—			
NM24-SR US	Proportional	100kΩ			
NM24-MFT US	MFT	100kΩ for 2 to 10 VDC (0.1 mA), 500Ω for 4 to 20 mA, 750Ω for PWM 1500Ω for on/off and floating	75 to 150 sec (NM24 US) 150 seconds (others)	3.5 VA	-4F to 122F
AM24 US	On/Off, Floating	—			
AM24-MFT US	MFT	100kΩ for 2 to 10 VDC (0.1 mA), 500Ω for 4 to 20 mA, 750Ω for PWM 1500Ω for on/off and floating	100 to 150 sec (AM24 US) 150 sec (AM24-MFT US)	4.5 VA (AM24 US), 5 VA (AM24-MFT US)	-22F to 122F

Abbreviated Specs for Spring Return Actuators

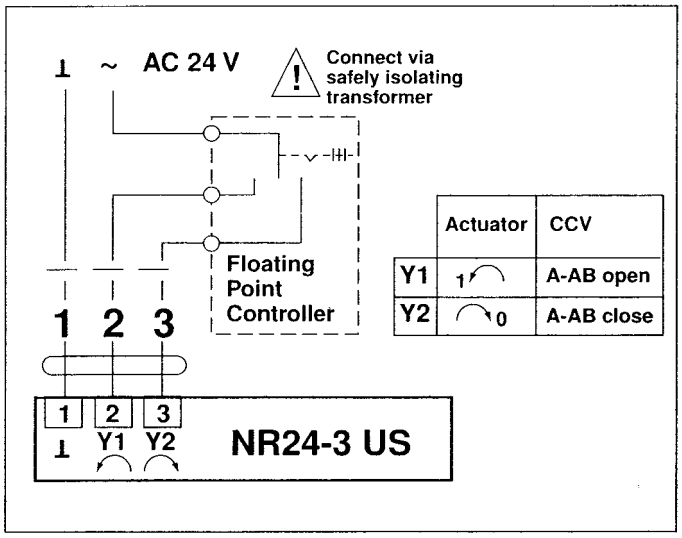
Actuator	Control Signal	Input Impedence	RunTime	Transformer Sizing (Class 2 Power Source)	Ambient Temp Rating
TF24 US TF120 US	On/Off	—	<75 sec motor (On/Off), <95 sec motor (others), <25 sec spring	5 VA (On/Off), 4 VA (others)	-22F to 122F
TF24-3 US	Floating	1kΩ			
TF24-SR US	Proportional	100kΩ			
LF24 US LF120 US	On/Off	—	40-75 sec motor (On/Off), 150 sec motor (others), <25 sec spring	7 VA (LF24 US), 7.5 VA (LF120 US), 5 VA (others)	-22F to 122F
LF24-3 US	Floating	1kΩ			
LF24-SR US	Proportional	100kΩ			
LF24-MFT US	MFT	100kΩ for 2 to 10 VDC (0.1 mA), 500Ω for 4 to 20 mA, 750Ω for PWM 1500Ω for on/off and floating			
AF24 US AF120 US	On/Off	—	150 sec motor, <20 sec spring	10 VA	-22F to 122F
AF24-MFT US	MFT	100kΩ for 2 to 10 VDC (0.1 mA), 500Ω for 4 to 20 mA, 750Ω for PWM 1500Ω for on/off and floating			



On/Off, Non-Spring Return, 24V
Actuator: NR24-3 US
Note: NR24-3 US must be powered by 24 VAC.
NR24-3 US actuators cannot be wired in parallel.



Proportional, Non-Spring Return, 24V
Actuator: NR24-SR US



Floating Point, Non-Spring Return, 24V
Actuator: NR24-3 US
Note: NR24-3 US must be powered by 24 VAC.
NR24-3 US actuators cannot be wired in parallel.

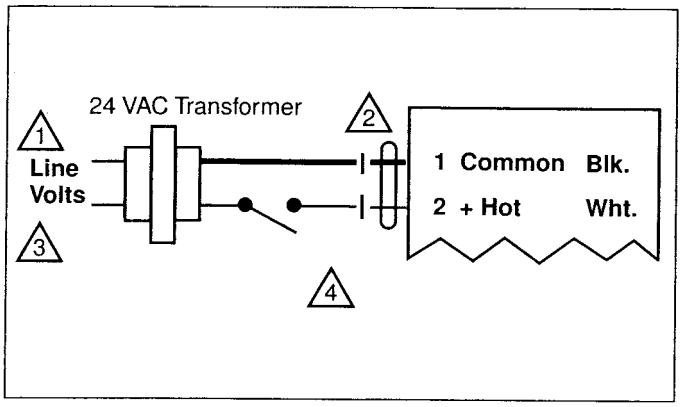
26.7

Wiring for Damper Actuators and Control Valves

On/Off, and Floating Point, Spring Return, 24V and 120V

BELIMO

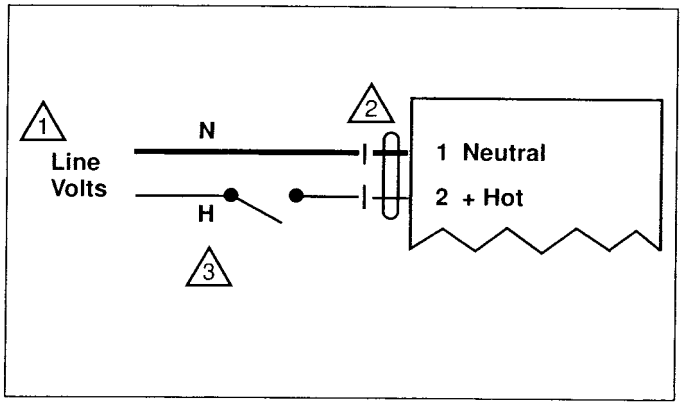
On/Off, Spring Return, 24V Actuators: AF24 US, LF24 US, TF24 US



Notes:

1. Provide overload protection and disconnect as required.
2. Actuators may be connected in parallel. Power consumption must be observed.
3. May also be powered by 24 VDC.
4. Meets cULus or UL and CSA requirements without the need of an electrical ground connection.

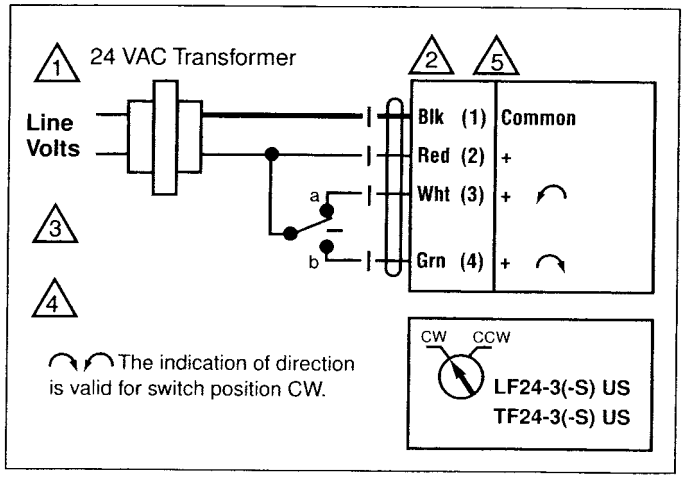
On/Off, Spring Return, 120V Actuators: AF120 US, LF120 US, TF120 US



Notes:

1. Provide overload protection and disconnect as required.
2. Actuators may be connected in parallel. Power consumption must be observed.
3. Meets cULus or UL and CSA requirements without the need of an electrical ground connection.

Floating Point, Spring Return, 24V Actuators: LF24-3 (-S) US, TF24-3 (-S) US

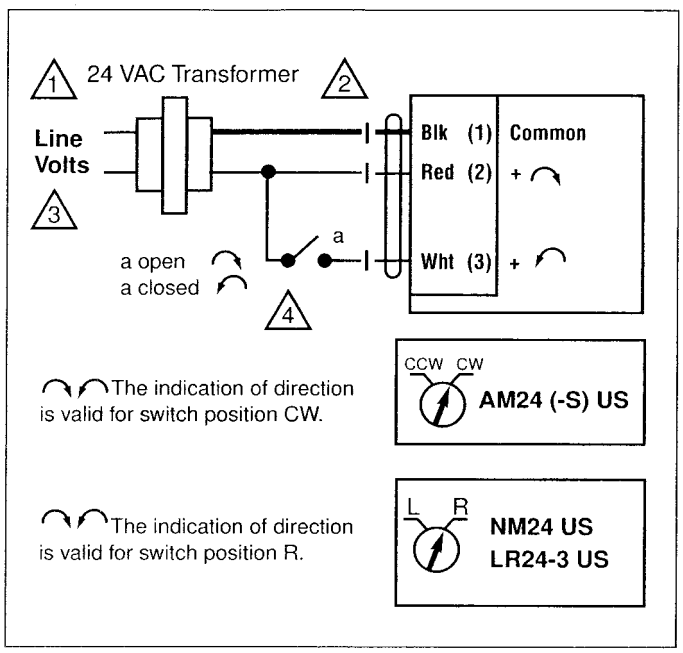


Notes:

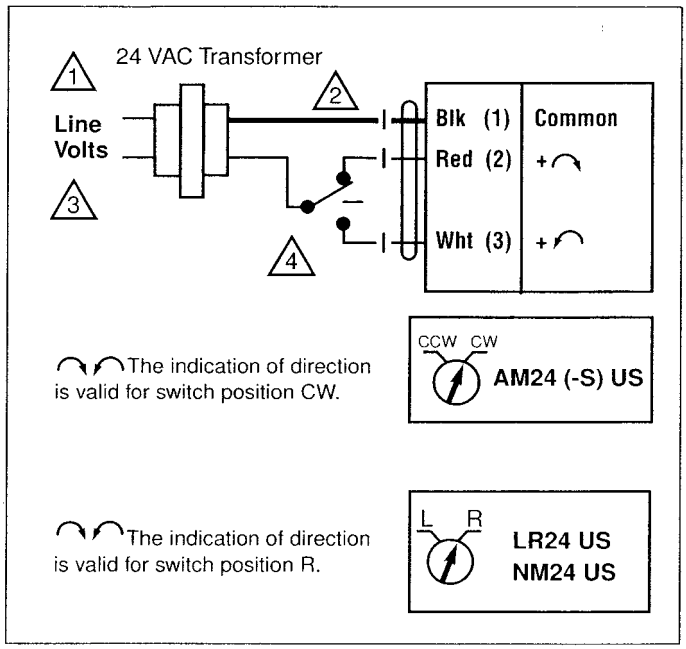
1. Provide overload protection and disconnect as required.
2. Actuators may be connected in parallel. Power consumption must be observed.
3. May also be powered by 24 VDC. **Note:** TF24-3(S) must be powered by 24 VAC.
4. Meets cULus, or UL or CSA requirements without the need of an electrical ground connection.
5. Actuators with plenum rated cable do not have numbers on wires; use color coded instead. Actuators with appliance rated cable use numbers.

On/Off and Floating Point, Non-Spring Return, 24V
Actuators: AM24 US, NM24 US, LR24-3 US

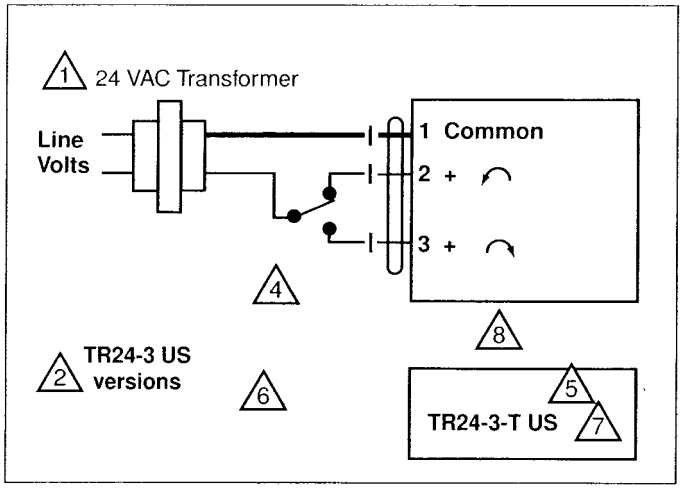
On/Off



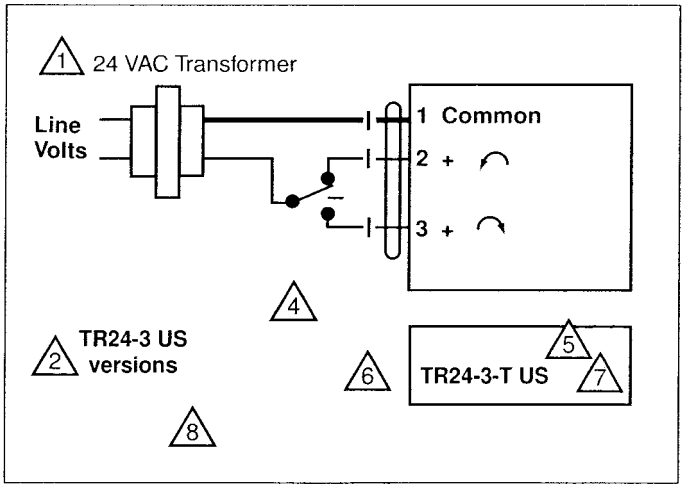
Floating Point



On/Off, Non-Spring Return, 24V
Actuators: TR24-3-T US, TR24-3 US



Floating Point, Non-Spring Return, 24V
Actuators: TR24-3-T US, TR24-3 US



Notes:

1. Provide overload protection and disconnect as required.
2. Actuators are provided with color coded wires. Wire numbers are provided for reference.
3. Actuators may also be powered by 24 VDC.
4. Meets cULus or UL and CSA requirements without the need of an electrical ground connection.
5. The TR24-3-T US actuators are provided with a numbered screw terminal strip instead of cable.
6. Switch wires 2 and 3 to change rotation direction of TR24-3-T US, TR24-3 US, (does not have CW/CCW or L/R external switch).
7. TR24-3-T US, TR24-3 US, actuators cannot be wired in parallel.
8. TR24-3-T US, TR24-3 US, actuators need to be powered by 24 VAC.

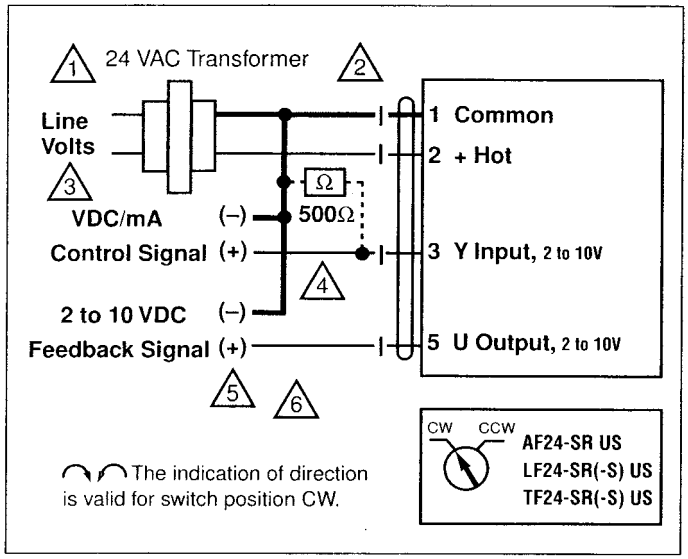
26.7

Wiring for Damper Actuators and Control Valves

BELIMO

2 to 10 VDC and 4 to 20 mA, Spring Return and Non-Spring Return, 24V

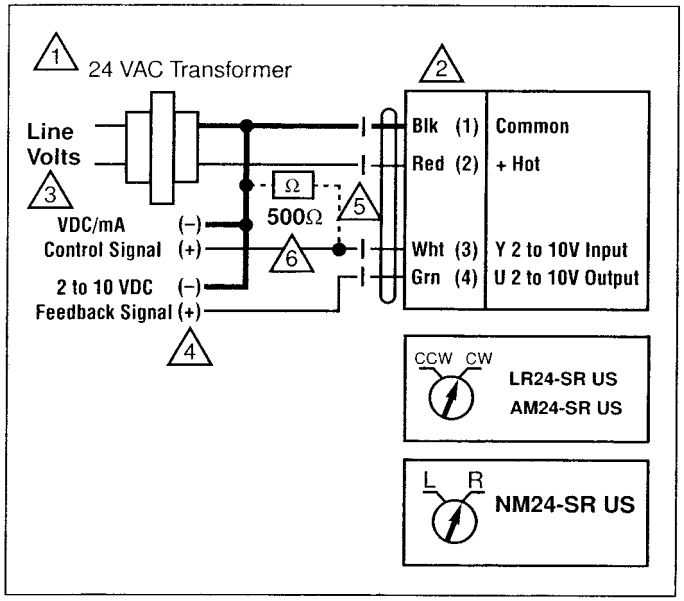
2 to 10 VDC and 4 to 20 mA, Spring Return 24V
Actuators: AF24-SR US, LF24-SR US, and TF24-SR US

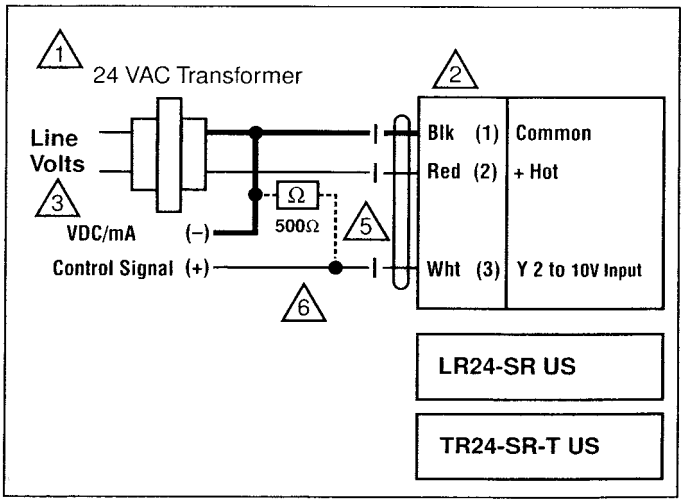


Notes:

1. Provide overload protection and disconnect as required.
2. Up to four actuators may be connected in parallel with four actuators wired to one 500Ω resistor. Power consumption must be observed.
3. Actuator may also be powered by 24 VDC.
4. A 500Ω resistor converts the 4 to 20mA control signal to 2 to 10 VDC. (ZG-R01)
5. Only connect common to neg. (—) leg of control circuits.
6. TF24-SR (-S) US does not have feedback output.

2 to 10 VDC and 4 to 20 mA, Non-Spring Return 24V
Actuators: AM24-SR US, NM24-SR US, LR24-SR US, and TR24-SR US





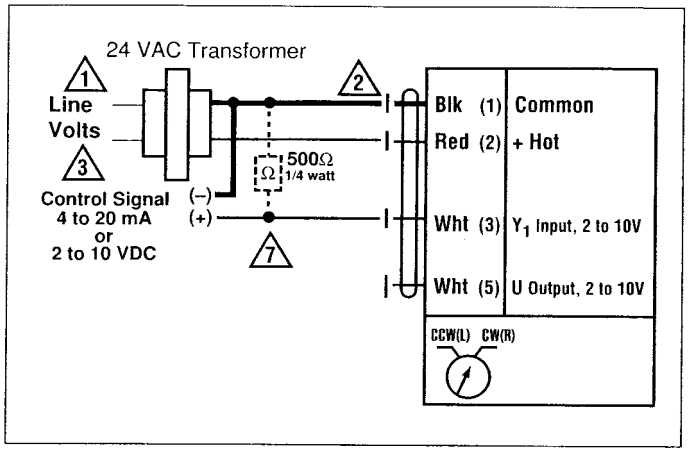
Notes:

1. Provide overload protection and disconnect as required.
2. Actuators are provided with color coded wires. Wire numbers are provided for reference.
3. May also be powered by 24 VDC.
4. Connect actuator common (Wire 1) to Negative (–) leg of control circuits only.
5. The 500Ω resistor converts the 4 to 20mA control signal to 2 to 10 VDC..
6. Up to 4 actuators may be connected in parllel, with 4 actuators wired to one 500Ω resistors. Power consumption must be observed.

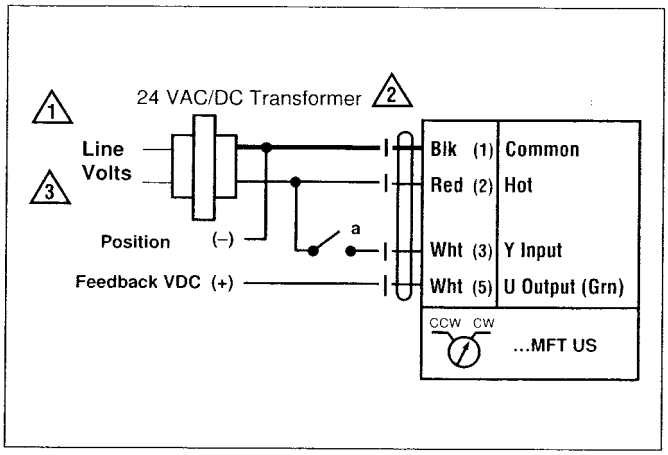
Wiring for Damper Actuators and Control Valves

MFT, Spring and Non-Spring Return

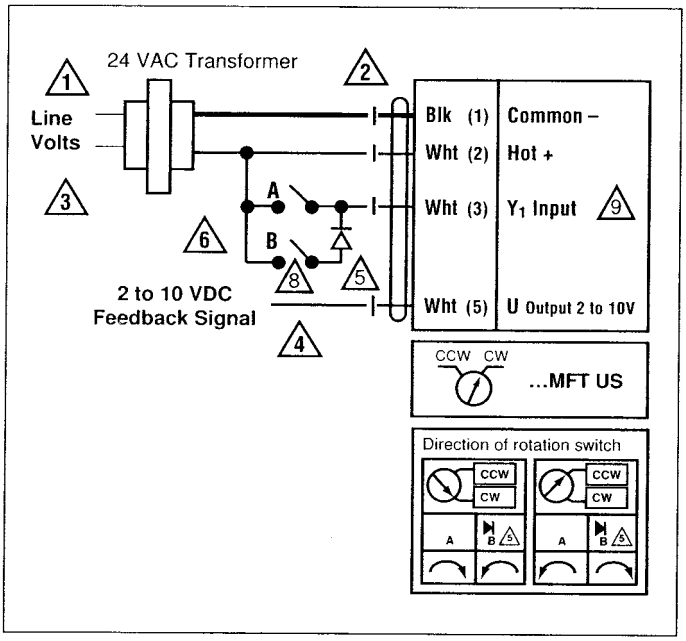
VDC/4-20 mA



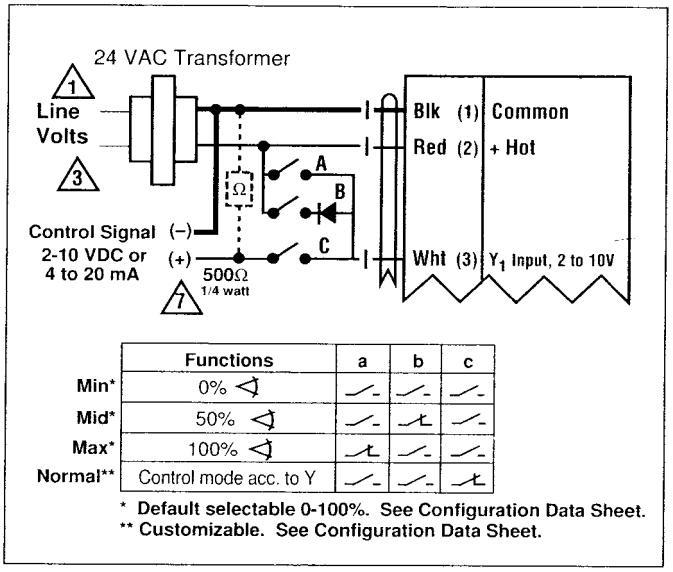
Two Position



Floating Point



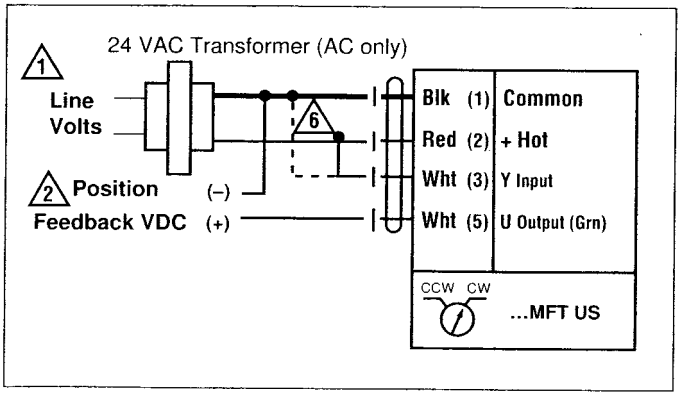
Override control to min, mid, max, positions



	Functions	a	b	c
Min*	0%			
Mid*	50%			
Max*	100%			
Normal**	Control mode acc. to Y			

* Default selectable 0-100%. See Configuration Data Sheet.
** Customizable. See Configuration Data Sheet.

PWM



Notes:

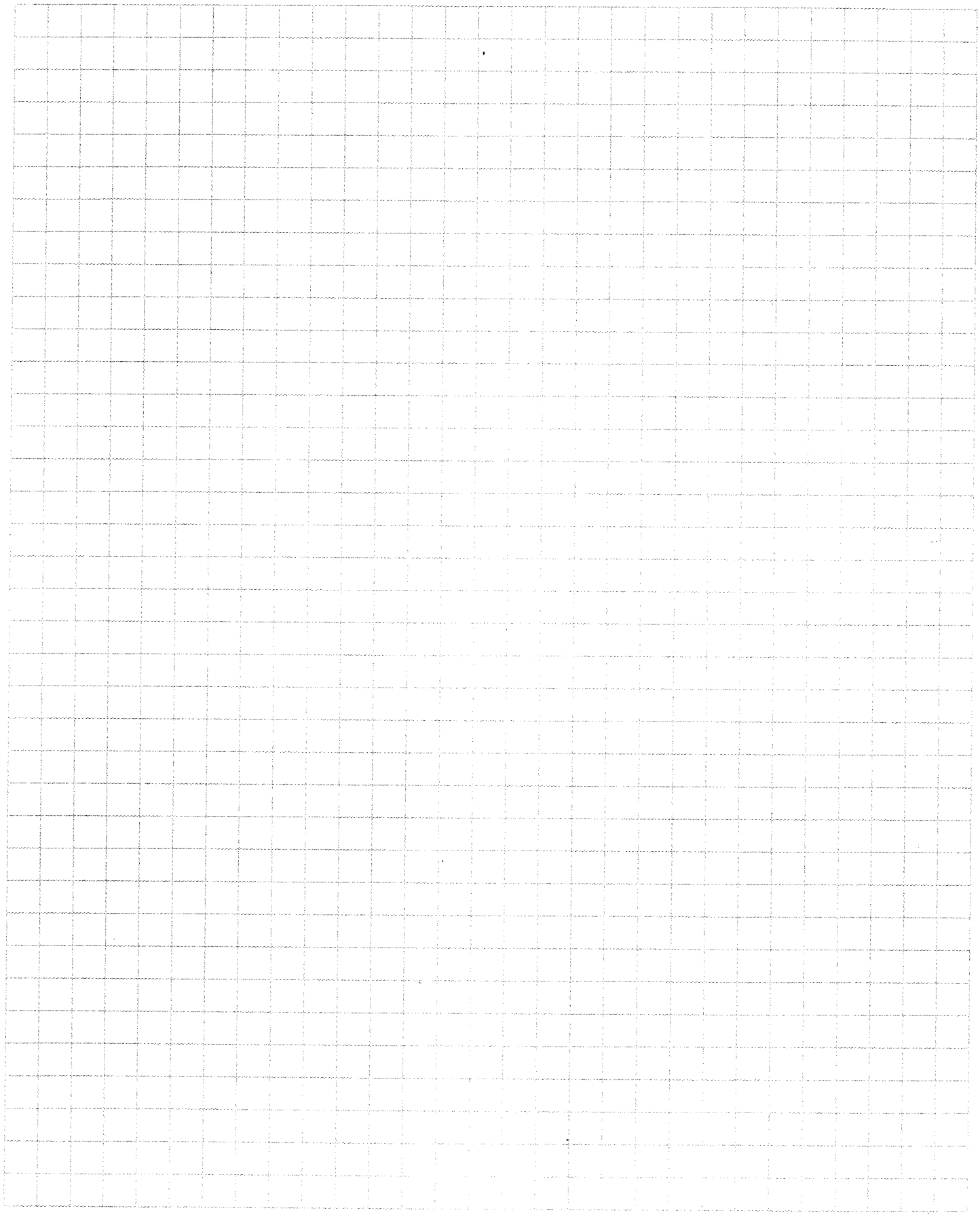
1. Provide overload protection and disconnect as required.
2. Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
3. Actuators may also be powered by 24 VDC.
4. Position feedback cannot be used with a Triac sink controller. The actuator internal common reference is not compatiable.
5. IN4004 or IN4007 diode. (IN4007 supplied, Belimo part number 40155)

Triac A and B can also be contact closures.

6. Control signal may be pulsed from either the Hot (Source) or Common (Sink) 24 VAC line.
7. ZG-R01 may be used.
8. Contact closures A & B also can be triacs. A & B should both be closed for triac source and open for triac sink.
9. For triac sink the common connection from the actuator must be connected to the hot connection of the controller.

26.7

BELIMO



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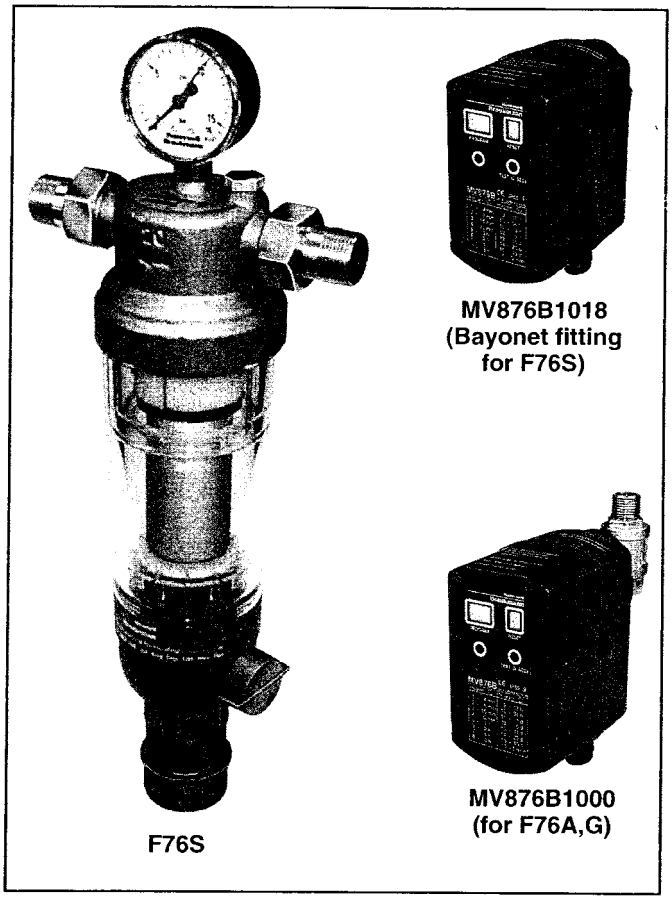
Honeywell

Braukmann

F76S Water Filters and MV876B Automatic-Backwash Controls

PRODUCT DATA



FEATURES

F76

- **Built-in backwash impeller provides efficient cleaning with supply pressures as low as 22 psi.**
- **Increased flow capacity on 1/2 in. to 1-1/4 in. models provides lower pressure drop.**
- **Robust backwash mechanism.**
- **No shut-off or disassembly is required for cleaning.**
- **During backwash, the F76S continues to supply filtered water without interruption through a secondary screen.**
- **Memory ring indicates when the next manual backwash is due.**

MV876

- **MV876B1018 bayonet fitting simplifies upgrade to automatic backwash.**
- **16 field-selectable backwash intervals (from every four minutes to once every three months) on the MV876B eliminate need for external timer.**
- **Connections for external control on the MV876B provide for use in automated systems and differential pressure control.**
- **MV876B can be turned manually to initiate backwash.**
- **Battery (AA) backup to insure completion of backwash cycle in spite of power loss.**

APPLICATION

The F76S is a high flow capacity water filter used at point-of-entry (POE) to remove sediment and debris from residential or commercial water systems. Used as a prefilter, the F76S protects elements of the water system, including specialized treatment devices such as taste/odor or reverse osmosis (R/O) or other common fixtures and appliances. The flow, filtering capacity, and ease of cleaning make the F76S the ideal filter for the most demanding applications.

The MV876 Automatic-Backwash Control is available as an accessory. This control is fitted to the drain valve and is programmed by the user to automatically perform the back-wash function according to the desired interval.

Contents

CE

62-3015-4

SPECIFICATIONS

F76S:

Models:
Water filters with 100 micron screens and hose connections.
F76S1007: 1/2 in. sweat and NPT threaded tailpieces.
F76S1015: 3/4 in. sweat and NPT threaded tailpieces.
F76S1023: 1 in. sweat and NPT threaded tailpieces.
F76S1031: 1-1/4 in. sweat and NPT threaded tailpieces.
F76S1049: 1-1/2 in. NPT threaded tailpieces.
F76S1056: 2 in. NPT threaded tailpieces.

Dimensions: See Fig. 1.

Materials of Construction:
Body: Brass.
Screen: Stainless Steel.
Internal Construction: Acetal Copolymer.
Seals: NBR.
Ball Valve: Brass with PTFE Seals.
Sump: Engineered Plastic.

NOTE: Bronze sump available.

Inlet Pressure:
Minimum: 22 psi (with unrestricted backwash discharge).
Maximum:
Plastic Sump: 232 psi.
Bronze Sump: 400 psi.

NOTE: Pressures above 200 psi require an inlet pressure gauge with a range wider than the standard.

Differential: Maximum Recommended: 42 psi.

Operating Pressure Drop: Maximum Recommended: 3 psi (with clean screen).

Temperature (maximum):
Plastic Sump: 104°F (40°C).
Bronze Sump: 158°F (70°C).

Pipe Sizes (in in.): 1/2, 3/4, 1, 1-1/4, 1-1/2, and 2.

Connections: Union on inlet and outlet: External NPT threaded or sweat.

Capacity: See Table 1.

Screen Sizes:
Shipped with Device: 100 microns.
Available Kits: 20, 50, and 200 microns.

NOTE: 20 microns = 900 mesh (approximate).
50 microns = 350 mesh (approximate).
100 microns = 175 mesh (approximate).
200 microns = 70 mesh (approximate).

MV876 Automatic-Backwash Controls:

Models:
MV876B1000: Valve with 24 Vac motor and timer replaces ball valve drain port for automatic backwash at preprogrammed intervals. 24V transformer not included. For use with F76A,G Filters *only*.
MV876B1018: Bayonet mounted shaft of 24 Vac motor and timer replaces ball valve manual control for automatic backwash at preprogrammed intervals. 24V transformer not included. For use with F76S Filters *only*.

Specifications:
Power: 4 VA.
Current: 170 mA.
Voltage: 24 Vac.
Cycle time: 20 seconds (approximate).
Timer: Variable. See Table 2.

Accessories (for F76S *only* except where noted):
0900747 Sump O Ring Kit (10 O rings) for 1/2 to 1-1/4 in. F76S.
0900748 Sump O Ring Kit (10 O rings) for 1-1/2 to 2 in. F76S.
0901444 Gasket Package (10 gaskets) for any 1/2 in. and 3/4 in. F76.
0901445 Gasket Package (10 gaskets) for any 1 in. F76.
0901446 Gasket Package (10 gaskets) for any 1-1/4 in. F76.
0901447 Gasket Package (10 gaskets) for any 1-1/2 in. F76.
0901448 Gasket Package (10 gaskets) for any 2 in. F76.
AF11S-1A Screen insert (100 microns) for 1/2 to 1-1/4 in. F76S.
AF11S-112A Screen insert (100 microns) for 1-1/2 to 2 in. F76S.
AF11S-1B Screen insert (20 microns) for 1/2 to 1-1/4 in. F76S.
AF11S-112B Screen insert (20 microns) for 1-1/2 to 2 in. F76S.
AF11S-1C Screen insert (50 microns) for 1/2 to 1-1/4 in. F76S.

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Home and Building Control Sales Office (check white pages of your phone directory).
2. Home and Building Control Customer Logistics
Honeywell Inc., 1885 Douglas Drive North
Minneapolis, Minnesota 55422-4386 (612) 951-1000

In Canada—Honeywell Limited/Honeywell Limitée, 155 Gordon Baker Road, North York, Ontario M2H 3N7.
International Sales and Service Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.

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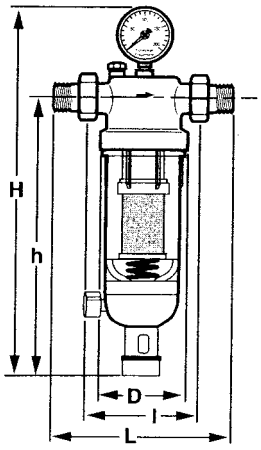
Accessories (continued):

AF11S-112C Screen insert (50 microns) for 1-1/2 to 2 in. F76S.
AF11S-1D Screen insert (200 microns) for 1/2 to 1-1/4 in. F76S.
AF11S-112D Screen insert (200 microns) for 1-1/2 to 2 in. F76S.
KF11S-1A Clear Plastic Filter Sump Kit for 1/2 to 1-1/4 in. F76S.
KF11S-112A Clear Plastic Filter Sump Kit for 1-1/2 to 2 in. F76S.
FT09RS-1A Bronze Filter Sump Kit for 1/2 to 1-1/4 in. F76S.
FT09RS-112A Bronze Filter Sump Kit for 1-1/2 to 2 in. F76S.
KH11S-1A Ball Valve Assembly for 1/2 to 2 in. F76S.
M76K-200 Pressure Gauge, 200 psi maximum.
M76K-400 Pressure Gauge, 400 psi maximum.
U76S5007 Sweat Tailpiece for any 1/2 in. F76.
U76S5015 Sweat Tailpiece for any 3/4 in. F76.
U76S5023 Sweat Tailpiece for any 1 in. F76.
U76S5031 Sweat Tailpiece for any 1-1/4 in. F76.
U76S5039 Sweat Tailpiece for any 1-1/2 in. F76.
U76S5047 Sweat Tailpiece for any 2 in. F76.
U76T1004 Threaded Tailpiece for any 1/2 in. F76.
U76T1014 Threaded Tailpiece for any 3/4 in. F76.
U76T1022 Threaded Tailpiece for any 1 in. F76.
U76T1030 Threaded Tailpiece for any 1-1/4 in. F76.
U76T1038 Threaded Tailpiece for any 1-1/2 in. F76.
U76T1046 Threaded Tailpiece for any 2 in. F76.
ZR10K-1 Sump Wrench for any 1 in. or 1-1/4 in. F76.
ZR10K-112 Sump Wrench for any 1-1/2 in. or 2 in. F76.
ZR10K-12 Sump Wrench for 1/2 in. and 3/4 in. F76A,G.
ZR10K-34 Sump Wrench for 1/2 in. and 3/4 in. F76S.



SIZE	L [1]	I [1]	D [1]	H [1]	h [1]	WEIGHT [2]
1/2 INCH	6-11/16 (170)	4-5/16 (110)	3-13/16 (97)	17-11/16 (449)	13-13/16 (350)	6.4 (2.9)
3/4 INCH	7 (178)	4-5/16 (110)	3-13/16 (97)	17-11/16 (449)	13-13/16 (350)	6.4 (2.9)
1 INCH	8-1/4 (209)	5-1/8 (130)	3-13/16 (97)	17-7/8 (453)	13-13/16 (350)	6.8 (3.1)
1-1/4 INCH	8-3/4 (222)	5-1/8 (130)	3-13/16 (97)	17-7/8 (453)	13-13/16 (350)	7.3 (3.3)
1-1/2 INCH	9-11/16 (246)	5-15/16 (150)	4-3/4 (119)	20-15/16 (532)	16-7/16 (417)	8.8 (4.0)
2 IINCH	10-1/2 (267)	5-15/16 (150)	4-3/4 (119)	20-15/16 (532)	16-7/16 (417)	10.6 (4.8)

[1] DIMENSIONS IN INCHES AND (MILLIMETERS).
[2] WEIGHT IN POUNDS AND (KILOGRAMS).

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Fig. 1. F76S Dimensions.

Table 1. Capacity in Gallons Per Minute (gpm).

Pressure Drop (psi) Across Filter	Pipe Size (in.)					
	1/2	3/4	1	1-1/4	1-1/2	2
1	8	11	18	20	26	30
2	12	16	25	28	36	42
3	14	19	31	35	44	51
4	16	22	36	40	51	59
5	18	25	40	45	57	66
15	32	43	70	78	99	114
Flow Volume for 15 sec backwash at 60 psi inlet						
—	3.2	3.2	4.0	4.0	4.7	4.7

NOTE: C_V is equal to capacity at 1 psi pressure drop.

Table 2. MV876B Timer Selections.

Program Value	Backwash Interval
1	4 minutes
2	8 minutes
3	16 minutes
4	32 minutes
5	1 hour
6	2 hours
7	4 hours
8	8 hours
9	17 hours
10	34 hours
11	3 days
12	6 days
13	11 days
14	23 days
15	45 days
16	3 months

PLANNING THE INSTALLATION

The F76S should be sized based on the required flow rate and the resulting pressure drop across the filter. As a guideline for most applications, the F76S should be sized to avoid pressure drops exceeding 3 psi.

EXAMPLE: What size F76S is required to provide a flow rate of 30 gpm? Reading across Table 1 at 3 psi pressure drop, a 1 in. filter can provide 31 gpm without exceeding 3 psi pressure drop.

An increased pressure drop across the filter results when higher velocities are maintained to increase the capacity through any given size filter. Severe pressure drops will be encountered as capacity approaches that of the pipe size. To ensure the backwash cycle operates properly and cleaning action is not reduced, follow all recommendations in Fig. 2. Refer to Fig. 2a for an ideal installation.

NOTE: All filter installations are different. The size, type, and amount of dirt and debris and the flow rate must always be considered when choosing a screen and deciding to install multiple F76 Water Filters in parallel.

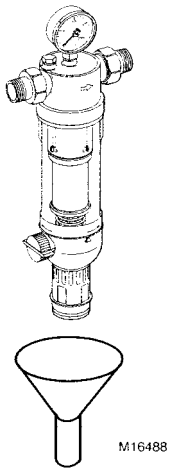

Fig. 2a. Ideal F76S installation. A funnel mounted directly under the backwash port is the best installation layout.

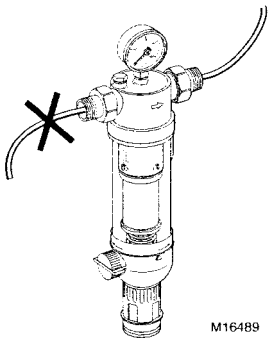

Fig. 2b. Ensure the inlet pipe is not downsized. Do not use 1/4 or 3/8 inch tubing on 1/2 or 3/4 inch models.

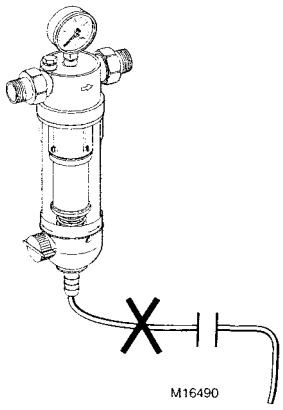

Fig. 2c. Ensure the backwash outlet pipe is not downsized, long, or crimped. Instead, install a short oversized pipe on the backwash outlet. Do not use a low capacity solenoid valve to automate the backwash cycle.

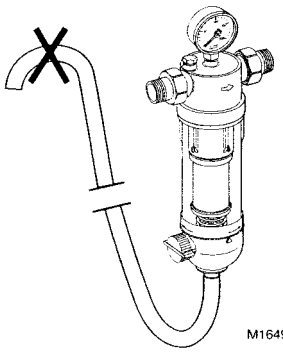

Fig. 2d. Ensure the backwash outlet is not raised above the F76S. If the backwash outlet must be raised above the F76S, increase inlet pressure 5 psi for every 10 feet that it is raised.

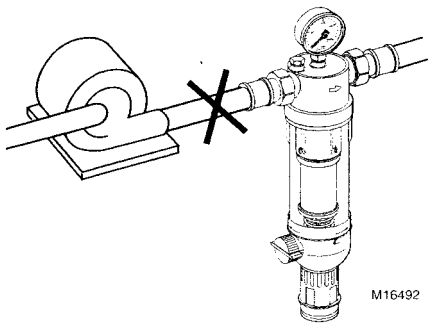

Fig. 2e. Ensure the F76S is not used with an undersized pump. An undersized pump may not provide proper pressure or flow.

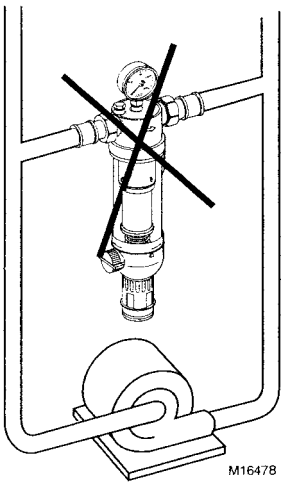

Fig. 2f. Ensure the F76S is not installed in a bypass across a pump.

Fig. 2. Installation recommendations.

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Commercial and Industrial Installations (1-1/2 and 2 in. models)

Commercial and industrial installations have high flow requirements. For proper operation, limit flow across the F76S screen. For example, a two-inch pipe may have a 120 gpm flow at 12 fps linear velocity across a clean screen. High linear velocity impacts dirt deeply into the screen, making it difficult to backwash and causing the screen to plug up quickly. In these situations, install multiple F76 filters in parallel. See Fig. 3.

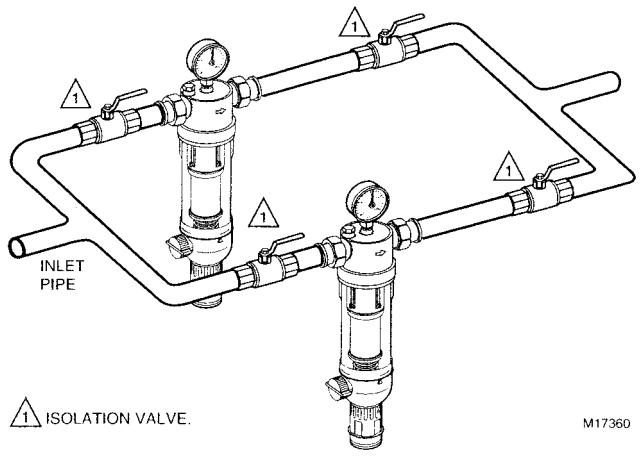

Fig. 3. Parallel installation of three F76S Water Filters.

Advantages of parallel installation:
- Increased cleaning capacity. Backwash interval is reduced.
- Elimination of system downtime. Can backwash one F76S while the others maintain required flow.

Another consideration in commercial and industrial installations is the backwash interval. Because of the high flow requirements, screens need cleaning on a regular basis. An MV876 Automatic-Backwash Control can be installed to backwash the F76S automatically.

INSTALLATION

⚠ CAUTION

Equipment Damage Hazard.
Excessive pressure or temperature can damage the device.
Ensure water temperature and pressure are below maximum ratings specified.

⚠ CAUTION

Equipment Damage Hazard.
Excessive heating can damage internal parts.
Before sweating, separate the tailpieces and nuts from the filter body.

F76S

When installing an F76S, use the following procedure:

1. Shut off water supply by closing the water supply valve.
2. Install the F76S in the water line with the arrow pointing in the direction of water flow.
3. Install pressure gauge in the F76S center port (see Fig. 4).

IMPORTANT

When using an MV876, stop here and install the MV876.

4. Ensure the F76S air vent is open.
5. Slowly open the water supply valve.
6. Once the F76S sump fills with water, close the air vent and fully open the water supply valve.

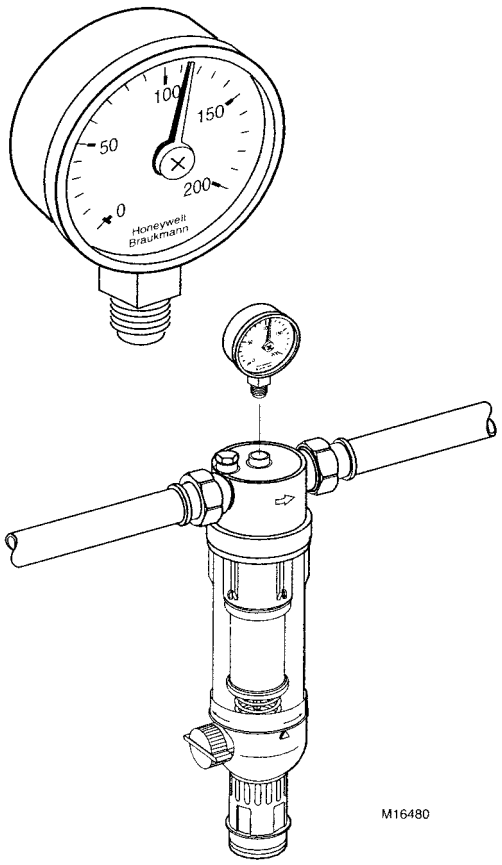

Fig. 4. Installing the F76S.

MV876

When adding an MV876 to an existing F76, the procedure can vary depending on the F76 model.

Installation on an F76S

1. Open the backwash outlet ball valve.
2. Remove the backwash outlet handle.
3. Install the MV876. See Fig. 5 and 6.

   NOTE: When you rotate the MV876, it closes the backwash outlet ball valve.

4. Ensure the F76S air vent is open.
5. Slowly open the water supply valve.
6. Once the F76S sump fills with water, close the air vent and fully open the water supply valve.
7. Program the desired backwash interval by pushing the program button until the desired interval number appears in the display.

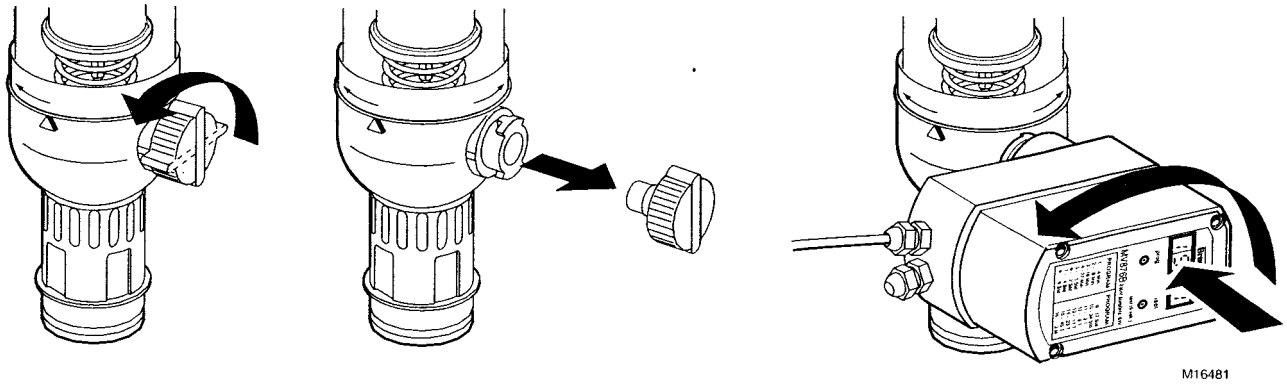

Fig. 5. Installing the MV876.

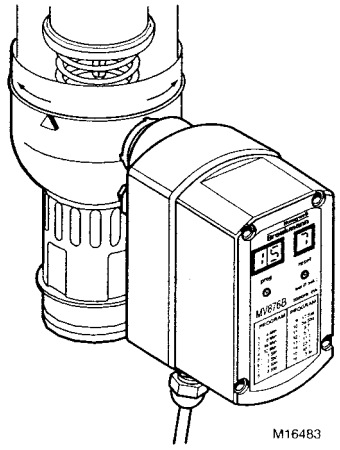

Fig. 6. Final position of MV876 and F76S components.

Installation on an F76A

1. Close the water supply valve to shut off water supply.
2. Drain all water from the F76A by opening both a fixture downstream, and the backwash outlet; loosen the air vent on top of the F76A.
3. Remove the backwash outlet (see Fig. 7):
   a. Grip the F76A fixture with a wrench.
   b. Using another wrench, turn the outlet counterclockwise ↶ (viewed from the bottom).
4. Connect the MV876 to the F76A (see Fig. 7):
   a. Ensure a plastic washer is placed between the filter sump and the backwash outlet.
   b. Connect the externally threaded portion of the MV876 backwash outlet to the internally threaded F76A connection.
5. Connect the hose fitting to the MV876 backwash outlet (see Fig. 7).

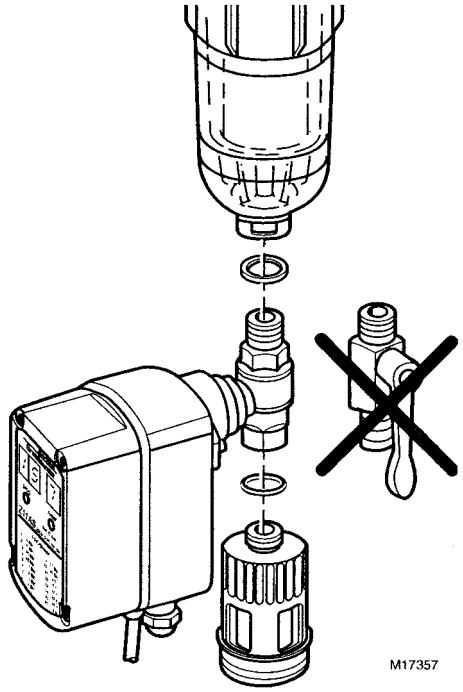

Fig. 7. Installing the MV876B on the F76A.

Set Pressure Gauge Needles

The black needle on the pressure gauge measures the F76S outlet pressure. When the F76S is running with clean screens, there is a small pressure drop across the F76S (3 psi at maximum recommended flow).

The red needle is a stationary needle that helps monitor backwash interval.

NOTE: The following assumes a constant inlet pressure. If inlet pressure is variable, another gauge on the inlet piping, or the air vent will provide more information regarding actual pressure differential.

1. Backwash F76S once to ensure the screens are clean.
2. With the F76S in operation, rotate the clear gauge cover to set the red needle to match the black needle.

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As the F76S operates, screens become plugged. Backwash the F76S when the black needle measures about five psi lower than the red needle. However, each installation is different. Residential applications can require backwash only once a week, or once every few weeks. Industrial applications can require backwash several times a day. To determine the backwash interval, see Determining Backwash Interval in the Operation section.

NOTE: For residential applications, backwash the F76S once a week regardless of need is an excellent guideline to follow to ensure F76S peak operating efficiency.

Fitting Batteries and Fuses

The batteries (not included) provide power to the MV876 in the event of a power loss. This is desirable especially when power loss occurs during the reverse rinsing cycle. To provide this, the MV876 requires four AA alkaline batteries. Install these batteries in the cover of the MV876:

⚠ CAUTION

Electrical Shock or Equipment Damage Hazard. Can shock individuals or short equipment circuitry.
Disconnect power supply before installation.

1. Unscrew the four housing screws and set them aside. (see Fig. 8).

IMPORTANT

Ensure that the connecting cable is protected from damage while the MV876 cover is loose.

2. Remove the MV876 cover (see Fig. 8).
3. Insert four AA alkaline batteries (see Fig. 9).
4. Replace the cover.
5. Replace and tighten the four housing screws.

NOTES:

1. To avoid unnecessary battery drainage, connect the MV876 to power as soon as possible after inserting new batteries.
2. To ensure the availability of battery power, replace the batteries after a power loss.

If the 800 mA fuse blows, replace it:

⚠ CAUTION

Electrical Shock or Equipment Damage Hazard. Can shock individuals or short equipment circuitry.
Disconnect power supply before installation.

1. Unscrew the four housing screws and set them aside. (see Fig. 8).

IMPORTANT

Ensure that the connecting cable is protected from damage while the MV876 cover is loose.

2. Remove the MV876 cover (see Fig. 8).
3. Remove and discard the old fuse (see Fig. 10).
4. Insert a new 800 mA fuse (see Fig. 10).
5. Replace the cover.
6. Replace and tighten the four housing screws.
7. Reconnect the power supply.

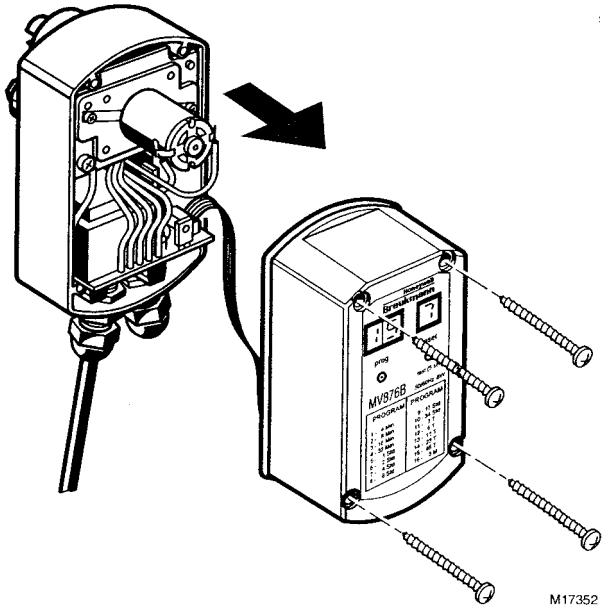

Fig. 8. Removing the MV876 cover.

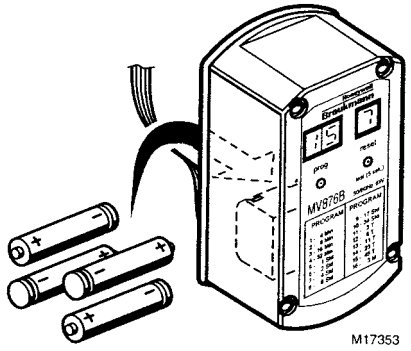

Fig. 9. Installing batteries in the MV876.

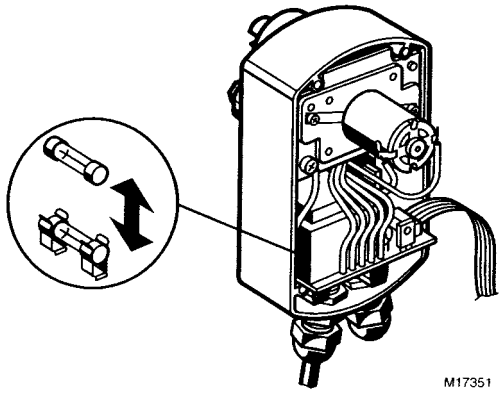

Fig. 10. Replacing the MV876 fuse.

WIRING

⚠ CAUTION

Electrical Shock or Equipment Damage Hazard.
Can shock individuals or short equipment circuitry.
Disconnect power supply before installation.

IMPORTANT

All wiring must comply with applicable codes and ordinances.

MV876

1. Mount the AT140A1034 Transformer and wire as shown in Fig. 11.
2. Ensure the F76 air vent is open.
3. Slowly open the water supply valve.
4. Once the F76 sump fills with water, close the air vent and fully open the supply valve.
5. Reconnect power to the system. When the system is powered, the MV876 will run through one backwash cycle (approximately 20 seconds).
6. Set MV876 backwash interval to the desired setting. See the Operation section.
7. Check MV876 operation by interrupting primary power to the transformer. When power is switched back on, the MV876 will backwash the F76 once.

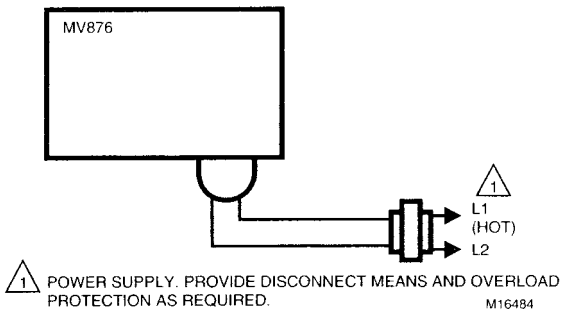

Fig. 11. Wiring diagram for F76 with MV876.

OPERATION

The F76S Water Filter removes sediment and debris from the water using an upper and lower screen. During normal operation, no water passes through the upper screen. Water is filtered as it flows through the lower screen. (See Fig. 12a.)

With continued operation, the lower screen becomes obstructed, reducing efficiency and creating a pressure drop across the F76S. Backwash the F76S periodically. Suggested interval is either once per week (residential applications) or when the black needle measures about five psi lower than the red needle.

To backwash the F76S manually, open the backwash outlet on the F76S bottom. This forces the entire filter insert downwards. Water flow to the lower screen outer side is blocked. The upper filter removes sediment and debris from the water.

While the upper screen filters the water. Some of the water passing through the upper screen is directed through the impeller to backwash the lower screen (from inside to outside). Remaining filtered water meets the needs downstream.

Water jets from the rapidly spinning impeller enhance the reversed water flow. The reverse flow removes trapped sediment and debris from the lower filter. This sediment drains out the backwash outlet. Cleaning the lower screen requires approximately 20 seconds. See Fig. 12b.

The F76S requires no maintenance if backwashed at the proper interval.

Determining Backwash Interval

All F76S applications are different and require backwashing at different intervals. Backwash interval is directly proportional to:
— The level and type of sediment in the local water supply.
— Water usage.

EXAMPLE:In northern states, water usage is higher in summer months than in winter months due to lawn watering in the summer. Therefore, the F76S should be backwashed more often in summer months than in winter months.

By accurately determining a proper backwash interval, the F76S will operate at a higher efficiency.

To determine the F76S backwash interval:

1. Backwash the system once to ensure the lower screen is clean.
2. The black pressure gauge needle measures outlet pressure. With clean screens, inlet pressure equals outlet pressure because of negligible pressure drop across the F76S.
3. Rotate the clear gauge cover to set the red needle to match the black needle.
4. Record the date and time.
5. Monitor the F76S closely. Over time, the screens become obstructed and outlet pressure drops.

   NOTE: The F76S requires a backwash when the black needle measures about five psi lower than the red needle. Installations do vary and can require a backwash at different times.

6. Record date and time again. Residential applications can require an F76S backwash only once every few weeks to once per week. Industrial applications can require an F76S backwash several times a day.
7. Backwash the F76S regularly at the determined interval. A backwash can be done manually or automatically.
   a. Manual Backwash: Open the backwash outlet for approximately 30 seconds.

      NOTE: The amount of time required varies among installations. However, 30 seconds is the standard guideline to clean the lower screen.

   b. Automatic Backwash: Install an MV876 Automatic-Backwash Valve and select the backwash interval. See the Operation section.

M 6/13

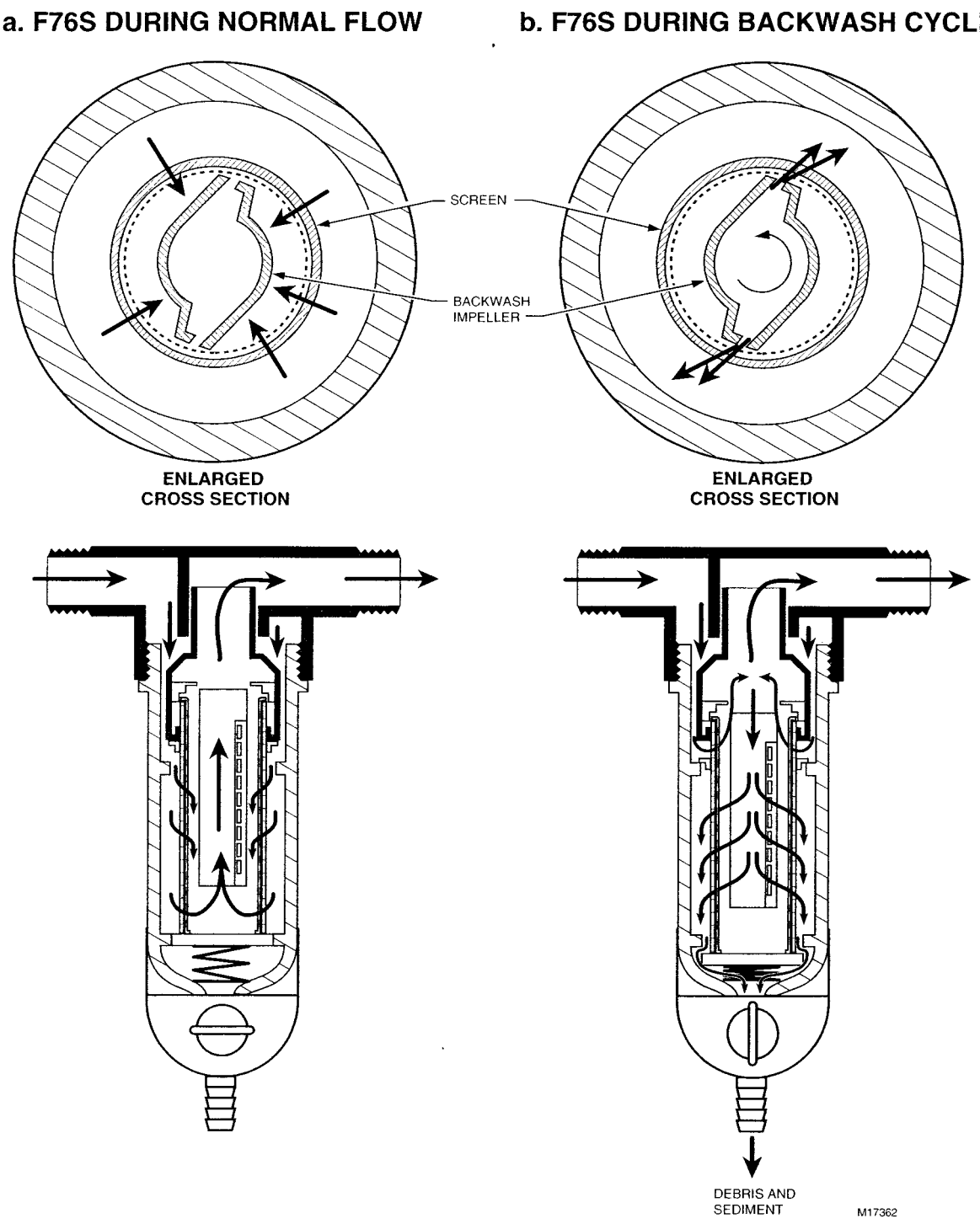

Fig. 12. Water flow through the F76S.

F76S REPLACEMENT PARTS LIST (SEE FIG. 13)

PARTS AND ACCESSORIES FOR NEW STYLE F76S FILTERS:

Description	1/2 inch	3/4 inch	1 inch	1-1/4 inch	1-1/2 inch	2 inch
(A) Pressure Gauge (new style F76S only)						
Standard Pressure (230 psi)	M76K-200	M76K-200	M76K-200	M76K-200	M76K-200	M76K-200
High Pressure (400 psi)	M76K-400	M76K-400	M76K-400	M76K-400	M76K-400	M76K-400
(B) Tailpieces (same for new and old style)						
Sweat	U76S5007	U76S5015	U76S5023	U76S5031	U76S5039	U76S5047
Threaded (shown)	U76T1004	U76T1014	U76T1022	U76T1030	U76T1038	U76T1046
(C) Union Nuts	N/A	N/A	N/A	N/A	N/A	N/A
(D) Tailpiece Gaskets (sold in packs of 10)	0901444	0901444	0901445	0901446	0901447	0901448
(E) Guide Barrel	N/A	N/A	N/A	N/A	N/A	N/A
Screen Insert Complete (new style only)						
20 Micron	AF11S-1B	AF11S-1B	AF11S-1B	AF11S-1B	AF11S-112B	AF11S-112B
50 Micron	AF11S-1C	AF11S-1C	AF11S-1C	AF11S-1C	AF11S-112C	AF11S-112C
100 Micron	AF11S-1A	AF11S-1A	AF11S-1A	AF11S-1A	AF11S-112A	AF11S-112A
200 Micron	AF11S-1D	AF11S-1D	AF11S-1D	AF11S-1D	AF11S-112D	AF11S-112D
Includes: (F) Barrel O Ring (G) Impeller and Screen Assembly (J) Chamber O Ring						
(H) Base Spring	N/A	N/A	N/A	N/A	N/A	N/A
(J) Chamber O Ring (sold in packs of 10)	0900747	0900747	0900747	0900747	0900748	0900748
Filter Sump Kits (new style only)						
Clear Plastic	KF11S-1A	KF11S-1A	KF11S-1A	KF11S-1A	KF11S-112A	KF11S-112A
Bronze	FT09RS-1A	FT09RS-1A	FT09RS-1A	FT09RS-1A	FT09RS-112A	FT09RS-112A
Includes: (J) Chamber O-Ring (K) Sump (L) Ball Valve O-Ring (M) Integrated Ball Valve (N) Memory Ring (P) Ball Valve Bowl (Q) Ball Valve Knob (R) Joint Ring Seal (S) Drain Connector						
Ball Valve Assembly (new style only) Includes: (M) Ball Valve (L) Ball Valve O-Ring	KH11S-1A	KH11S-1A	KH11S-1A	KH11S-1A	KH11S-1A	KH11S-1A
Sump Wrench	ZR10K-34	ZR10K-34	ZR10K-1	ZR10K-1	ZR10K-112	ZR10K-112

N/A = Part number not available at time of printing.

[a] Sold in packs of ten.

M 10/13

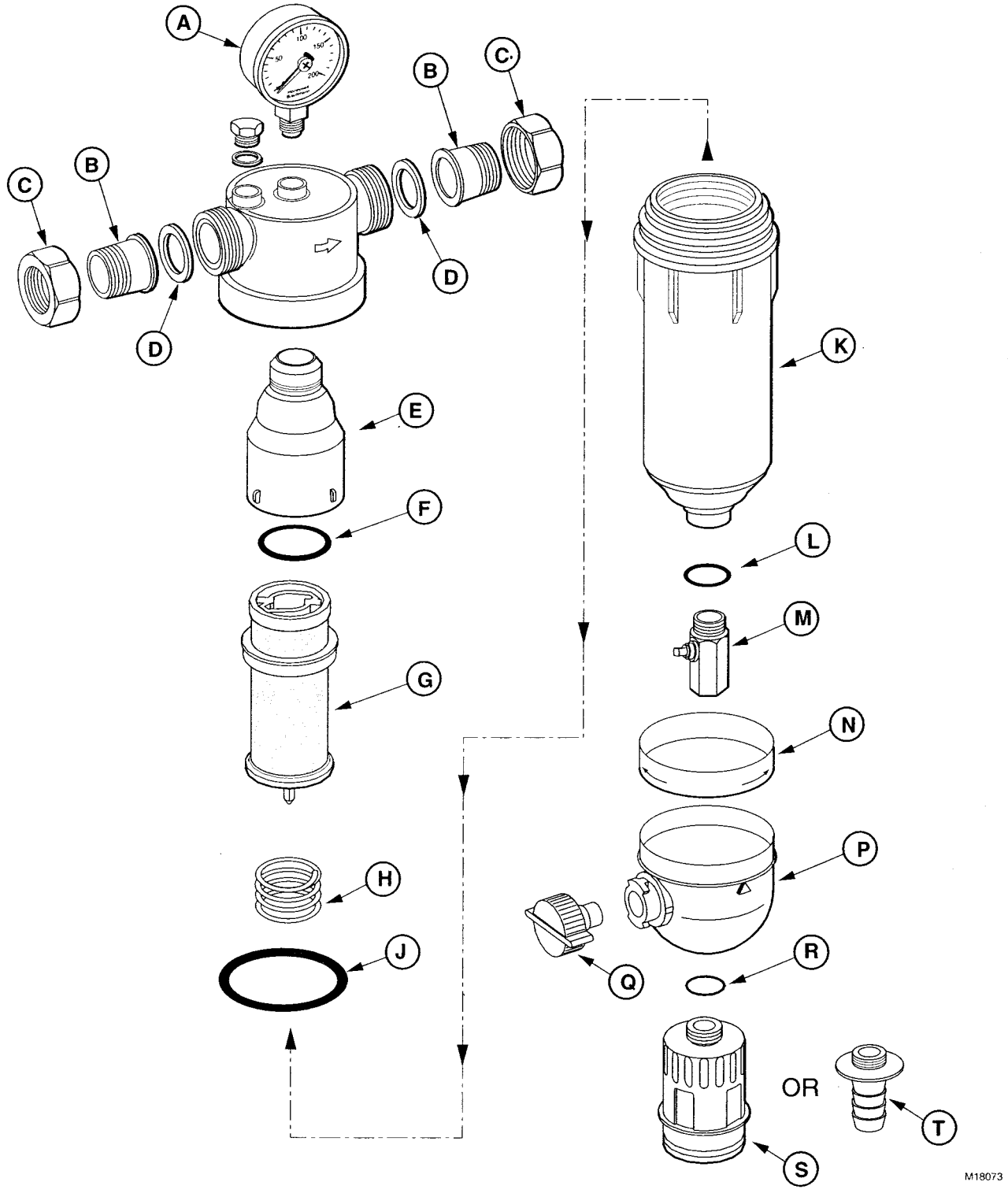

Fig. 13. F76S exploded view. Parts are keyed to F76S Replacement Parts List.

F76A,G REPLACEMENT PARTS LIST (SEE FIG. 14)

Description	1/2 inch	3/4 inch	1 inch	1-1/4 inch	1-1/2 inch	2 inch
(A) Pressure Gauge						
F76A & F76B	0901537	0901537	0901537	0901537	0901537	0901537
F76G & F76H	5267400	5267400	5267400	5267400	5267400	5267400
(B) Tailpieces (for new and old style)						
Sweat	U76S5007	U76S5015	U76S5023	U76S5031	U76S5039	U76S5047
Threaded (shown)	U76T1004	U76T1014	U76T1022	U76T1030	U76T1038	U76T1046
(C) Union Nuts	N/A	N/A	N/A	N/A	N/A	N/A
(D) Tailpiece Gaskets[a]	0901444	0901444	0901445	0901446	0901447	0901448
(E) Ring (plastic)	N/A	N/A	N/A	N/A	N/A	N/A
Screen Kit						
20 Micron	QF76Q2007	QF76Q2007	QF76Q2015	QF76Q2015	QF76Q2023	QF76Q2023
50 Micron	QF76R2030	QF76R2030	QF76R2038	QF76R2038	QF76R2046	QF76R2046
100 Micron	QF76S2051	QF76S2051	QF76S2059	QF76S2059	QF76S2067	QF76S2067
200 Micron	QF76T2074	QF76T2074	QF76T2082	QF76T2082	QF76T2090	QF76T2090
Includes: (F) Upper Screen (H) Barrel O Ring (L) Lower Screen						
Internal Seal Kit Includes: (H) Barrel O Ring (K) Screen Seal (Q) Chamber O Ring (S) Joint Ring Seal	N/A	N/A	N/A	N/A	N/A	N/A
Filter Insert Kit (F) Upper Screen (G) Upper Guide Barrel (H) Barrel O Ring (J) Lower Guide Barrel (K) Screen Seal (L) Lower Screen (M) Impeller (N) Lower Screen Support (P) Conical Base Spring (Q) Chamber O Ring	QF76G2053	QF76G2053	QF76G2061	QF76G2061	QF76G2069	QF76G2069
Filter Sump Kits						
Clear Plastic	PF76C1007	PF76C1007	PF76C1015	PF76C1015	PF76C1023[b]	PF76C1023[b]
Bronze	202913	202913	202914	202914	202915	202915
Includes: (Q) Chamber O-Ring (R) Sump (S) Joint Ring Seal (T) Drain Tap (Backwash Outlet)[b] (U) Red Handle and Screw[b]						
(U) Red Handle and Screw	251550	251550	251550	251550	251550	251550
Sump Wrench	ZR10K-12	ZR10K-12	ZR10K-1	ZR10K-1	ZR10K-112	ZR10K-112

N/A = Part number not available at time of printing.

[a]Sold in packs of ten.

[b]PF76C1023 does not include drain tap and red handle and screw.

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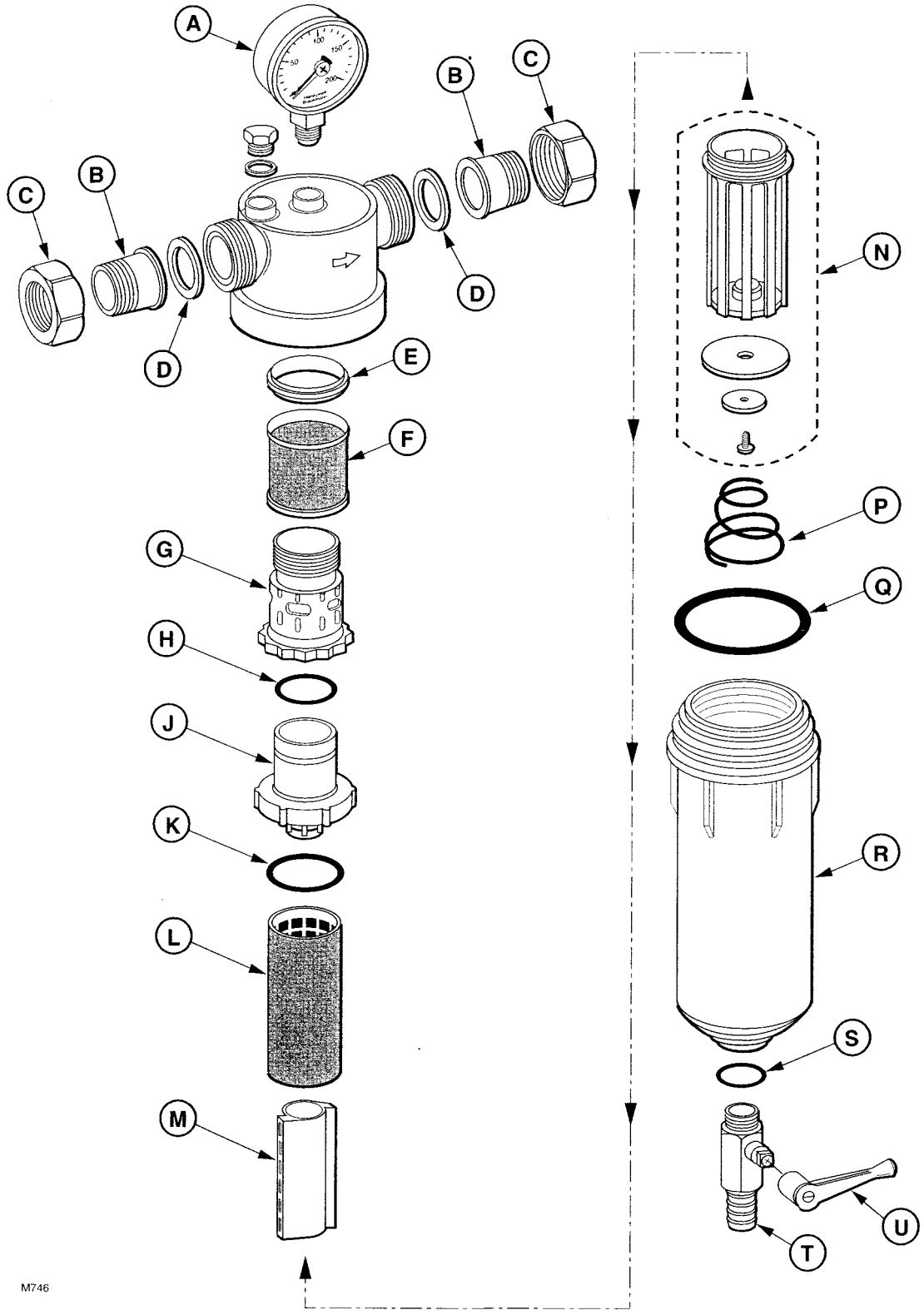
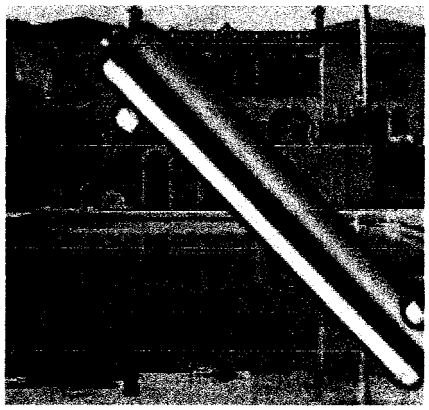


Fig. 14. F76A,G exploded view. Parts are keyed to F76A,G Replacement Parts List.

ELISTANT FEW HEATHING

Pool Heaters - B-Series



The **B-Series pool heaters** provide a simple method of heating swimming pool water indirectly from a central heating boiler. To select the right model for your pool see our Quick Sizing Reference Table. Click here for Nominal Values and Dimensions

Click here for a quick overview of a typical B-Series pool heater installation

Features of the B-Series Pool Heater:

- All B-Series **pool heaters** are manufactured entirely of Stainless Steel 316L to ensure corrosion resistance to chlorinated pool and spa water and longer equipment life.
- Due to the high flow rates through the heat exchangers, it inherently is a self cleaning equipment.
- With the high flow rate of the pool water going through the shell and boiler water through the tubes, low pre drop is achievable.
- Easy selection based on pool volume - please see quick select guide below
- Units kept in stock for immediate delivery.

Quick Sizing Reference

Use this table to determine which pool heater model is best suited for your pool.

Model	Pool Capacity (USGAL)
B 45	3,000
B 70	6,000
B 130	11,000
B 180	16,000
B 250	22,000
B 300	27,000
B 500	44,000
B 1000	88,000

Heat Exchangers Nominal Peformance

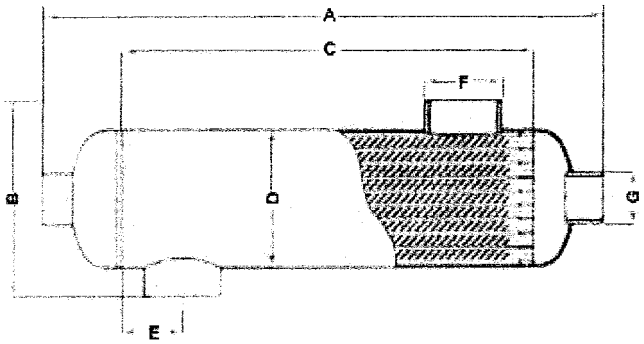
Heat Exchanger Type	Nominal Capacity		Hot WaterCold Water								Heat Transfer	
			Flow		Pressure Drop		Flow		Pressure Drop			
	kW	Btu/hr	l/min	USGPM	kPa	psig	l/min	USGPM	kPa	psig	m2	ft2
B 45	13	45,000	23	6.08	6.2	0.09	150	39.63	7.4	1.07	0.150	1.62
B 70	20	70,000	25	6.60	7.5	1.09	170	44.91	9.2	1.33	0.246	2.64
B 130	38	130,000	27	7.13	8.1	1.17	200	52.83	11.4	1.65	0.339	3.64
B 180	53	180,000	30	7.93	2.7	0.40	210	55.48	7.5	1.10	0.440	4.70
B 250	73	250,000	35	9.25	4.2	0.60	270	71.33	12.0	1.70	0.630	6.80

26.9

H 1/2

B 300	88	300,000	40	10.57	6.4	0.90	300	79.25	17.0	2.50	0.840	9.00
B 500	146	500,000	55	14.53	9.2	1.30	360	95.10	22.0	3.20	1.560	16.80
B 1000	293	1,000,000	95	25.10	16.2	2.35	705	185.24	29.1	4.22	1.970	21.21

Nominal values are based on 60°C temperature between incoming heating and heated water.



*The dimensions of the heat exchanger are listed in the table below.

Dimensions

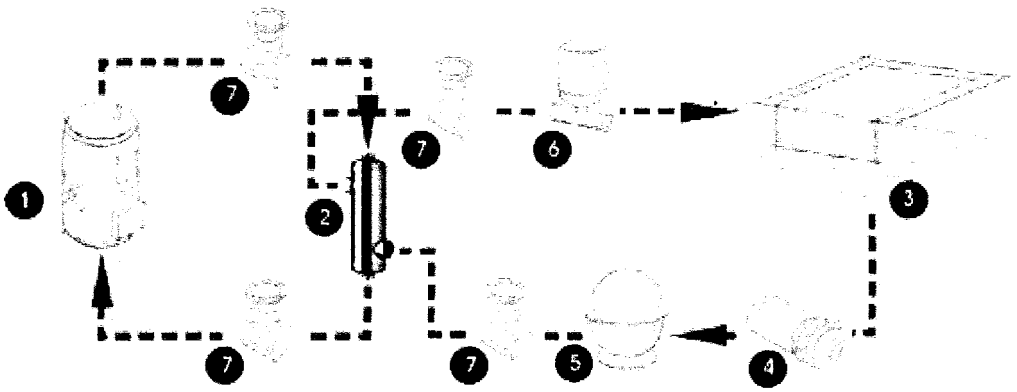
All dimensions are in inches.

Type	A	B	C	D	E	F	G
B 45	302 (11.89)	45,000	150 (5.91)	80.0 (3.15)	37.7 (1.48)	1" NPTF	3/4" NPT
B 70	402 (15.83)		250 (9.84)			1 1/2" NPTF	
B 130	440 (17.31)		304 (11.96)		1.17		
B 180	386 (15.19)	250,000	276 (10.87)	101.6 (4.00)	41.5 (1.63)		1" NPTF
B 250	512 (20.15)		406 (15.98)				
B 300	646 (25.43)		534 (21.02)				
B 500	1106 (43.54)		1000 (39.37)		58.0 (2.28)	2" NPTF	
B 1000	969 (38.15)	1,000,000	794 (31.26)	139.7 (5.50)	100.0 (3.94)	2" NPT	2" NPT

Our pool heaters are designed, tested and manufactured to ASME Code sec. VIII, Div I. SECESPOL heat exchangers are certified by many internation national technical inspection authorities and are ISO-9002 registered and have obtained CRN in the Canadian provinces.

A Typical Pool Heater Installation

H 2/2 26°C



1 Boiler - **2** Heat Exchanger - **3** Swimming Pool - **4** Pump - **5** Filter - **6** Chlorine Feeder - **7** Gate Valve

Please note that all pool heaters are available for immediate delivery.

Do you still have questions? We invite you to call or email us today for more information. We'll be happy to provide with a heat exchanger that matches your specific needs.

Call us today: **416.557.1067** or by Email: info@heatexchangersonline.com

a

a

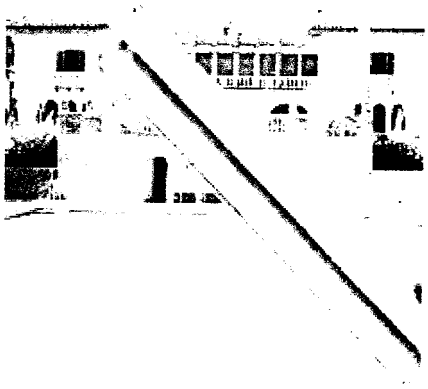
a

Thermal Solutions Inc ~ P.O. Box 12033 ~ 2B-848 Burnhamthorpe Road W ~ Mississauga ~ ON ~ L5C 4R7
Phone: 416.557.1067 ~ Email: info@heatexchangersonline.com

Extra 1/2

- applications:

Pool Heaters - B-Series



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- Easy selection based on pool volume - please see
- Units kept in stock for immediate delivery.

Quick Sizing Reference

Use this table to determine which pool heater model is best suited for your pool

Extra 2/2

15300 sect 2.4 1/2

(9)

ROUGHLYTE™ Series Accessories

Roughlyte™ Round Box

Roughlyte™ Round Plug

4" ROUND BOXES & PLUGS

Die-cast aluminum for use with conduit, Stonco ceiling, surface and wall fixtures and flood lights.

Four side and one back hole tapped 3/4" or 1/2", as shown. Heavy-duty gasket (except on VXL1), screws, four aluminum five-threaded plugs. No cover.

Catalog No.	Tap Size	Description	Catalog No.	NPT Size	Description
VXL1	1/2"	Mounting Box	V12	1/2"	Plug
VXL13	3/4"	Mounting Box	V13	3/4"	Plug

VGC100 Clear Glass Globe

VGP100 Clear Prismatic Globe

VGR100 Ruby Glass Globe

VPRC10 Prismatic Lexan Globe

COLORED & SPECIALTY GLOBES

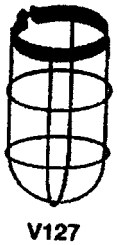
Full molded threads. Fit all Stonco housings.
Globes for vertical mounting only.

Catalog No.	Description	Catalog No.	Description
3-1/2" GLOBE DIA. GLASS		**4-3/8" GLOBE DIA. GLASS**	
VGC100	Clear*	VGC200	Clear*
VGCH100	Clear, heat tempered	VGCH200	Clear, heat tempered
VGP100	Clear, prismatic	VGP200	Clear, prismatic
VGA100	Amber	VGA200	Amber
VGB100	Blue (60W Max.)	VGB200	Blue (75W Max.)
VGG100	Green	VGG200	Green
VGR100	Ruby	VGR200	Ruby
3-1/2" GLOBE DIA. LEXAN		**4-3/8" GLOBE DIA. LEXAN**	
VPRC5	Clear, prismatic (60W Max.)	VPRC10	Clear, prismatic (75W Max.)

*Standard with all incandescent glass fixtures.
NOTE: Use of colored globes will down-rate wattage.

⇒VGB100 RED

REVIEWED ACCORDING TO THE REQUIREMENTS OF THE GENERAL CONDITIONS OF THE CONTRACT. ANY ACTION INDICATED IS SUBJECT TO THESE REQUIREMENTS.
☒ NO EXCEPTIONS TAKEN
☐ MAKE NOTED CORRECTIONS
☐ REVISE & RESUBMIT
☐ REJECTED
BY
EARTH TECH (CANADA) INC.



V127 Plated Wire Guard

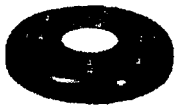
V131 Cast Aluminum Guard

GUARDS

Wire guards are clamp-on type. Cast aluminum guards are twist on/off bayonet type, includes allen head security screws. Shipped with threaded ring adapter for use with standard threaded bases or the new RoughLyte bases.

WIRE GUARD		CAST GUARD	
Catalog No.	Fits Globe Diameter	Catalog No.	Fits Globe Diameter
V127	3-1/2"	V131	3-1/2"
V128	4-3/8"	V132	4-3/8"

VCN Adapter



VCA1 Recessed Box Adapter
For use with VW and HID Series only.

ADAPTER PLATES

Permits easy box mounting over various size boxes and plumb alignment. Heavy-gauge aluminum. Complete with gasket, screws.

Catalog No.	Use With	For Mounting On
VCP	VK Series	4" octagon boxes
VCP	VW Series	3-1/2" round boxes
VCN	VK & VW Series	4" octagon boxes
VCA1	VW Series and HID Series	Recessed boxes

26.10

NOTE: Roughlyte™ fixtures are NOT for use in hazardous locations.

Crescent Stonco

R 1/1

Ktech INDUSTRIAL PRODUCTS INC.

Model SM4001-CX Installation Instructions

CAUTION: REFER TO INSTRUCTIONS BEFORE OPERATING OR SERVICING SWITCH
The SM4001-C is all 316 stainless steel. It has a 1/2" NPT fitting for mounting in the side of a tank. The contact arrangement can be changed from Normally Open (NO) to Normally Closed (NC). The nut is marked with NC and NO. Tighten the switch such that the desired arrangement is indicated on the top face of the nut.
DO NOT CONNECT THE SWITCH DIRECTLY ACROSS THE POWER SUPPLY

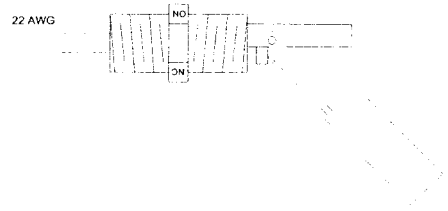
Specifications

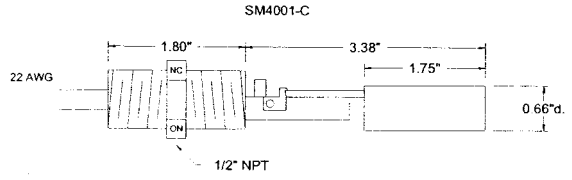
Meets Standards:
Class 1 Division 1,Groups B,C,D
CSA C22.2 No. 1010-1 and ANSI /I SA S82-03
CSA C22.2 No. 30 and UL1203

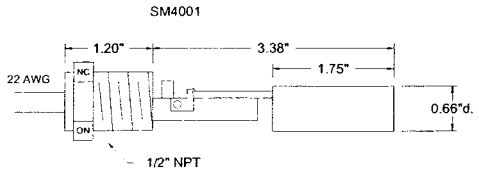
9700099

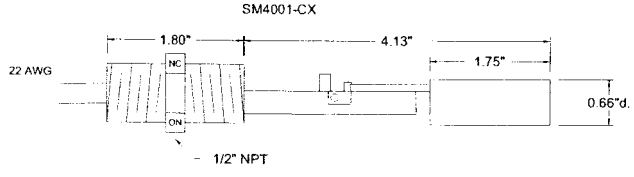
Maximum Switching Voltage VOLTS DC/AC	250
Maximum Switching Current AMPS DC/AC	1.0
Maximum Switching Power WATTS DC/AC	50
Max. Operating Temp. Standard Max. Operating Temp. Optional *	90°C 125 °C
Maximum Pressure P.S.I.	400
Specific Gravity	0.8

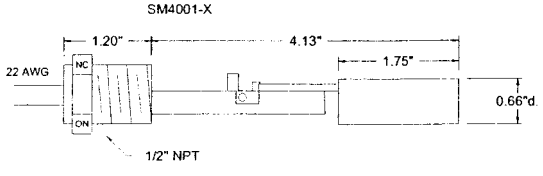
* Note: The optional 125 °C temperature rating has teflon leads.











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Ktech Industrial Products, 20 Regan Road, Unit 11, Brampton, Ontario. L7A 1C3 Phone (905) 840-7106 Fax (905) 840-6172