IQALUIT WATER TREATMENT PLANT

OPERATION & MAINTENANCE MANUAL

IQALUIT, NU

PROJECT NO. SC711
2018

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General Site Information and Guide

For the

Iqaluit Water Treatment Plant

Iqaluit, Nunavut

Year of Completion - 2004

Original Scope - Design and upgrade existing Water Treatment Plant to meet current and future demands.

Revision History:

Date	**Description of Change**
December, 2018	This section is a new addition to incorporate information regarding plant standards and procedures for site inspections, personnel training and emergency response plans.

Iqaluit Water Treatment Plant Upgrade

Project History

The City of Iqaluit:	City of Iqaluit Public Works & Engineering P.O. Box 460 Iqaluit, NU X0A 0H0 Matthew Hamp, Director of Public Works & Engineering Phone: (867) 979-5653 m.hamp@city.iqaluit.nu.ca
Project Engineer:	**2004 Upgrades** Earth Tech Canada Inc. (Currently AECOM) 4916 47th Street P.O. Box 1259 Yellowknife, NT X1A 2N9 Phone: 1 (867) 873-6316 **2017 Upgrades** Glenn Prosko, Project Manager Nunami-Stantec 10160 112 Street Edmonton AB T5K 2L6 Phone: (780) 969-3258 Glenn.Prosko@stantec.com
General Contractor:	**2004 Upgrades** 90 North Construction & Development Ltd. (No longer in operation) Suite 106, 6131-6th Street S.E. Calgary, AB T2H 1L9 **2017 Upgrades** Maxime Gaudreau, Project Manager Kudlik Construction Ltd. P.O. Box 727, 1519 Federal Road Iqaluit, NU X0A 0H0 Phone: (418) 802-8224 mgaudreau@kudlik.biz

Electrical Subcontractor:	**2004 Upgrades** KRT Electric 1505 Federal Rd, Iqaluit, NU P.O. Box 1259 Iqaluit, NU X0A 0H0 Phone: 1 (867) 979-2639 **2017 Upgrades** Carl Fauteux, Vice-President Sifec North Inc. P.O. Box 556, Rankin Inlet, NU, X0C 0C0, Phone: (855) 437-4001 carl@sifec.ca
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General Information

For the City of Iqaluit Water Treatment Plant

Iqaluit, Nunavut

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Chapter 3 O&M Manual Guide

3.1 Use of this Manual

The intent of this Operations and Maintenance (O&M) manual is to provide the operations and maintenance personnel with a clear and concise understanding of how the City of Iqaluit Water Treatment Plant (WTP) operates, and the steps that must be followed to ensure that the facility is running safely and efficiently.

The primary goal of this manual and of all personnel operating in and around the WTP is loss prevention, the prevention of personnel injury and property damage. To meet this objective, the operation and maintenance program includes:

- General site information and purpose of the WTP.
- Specific operating instructions (divided into individual O&M Manual sections) pertaining to Architectural & Structural, Process, Mechanical and Electrical and Instrumentation components of the WTP to be learned and followed at all times to promote safe and efficient operation. These also include, but are not limited to information for the following:
    - Operational procedures for storage, treatment and distribution of potable water.
    - Waste streams generated as part of the water treatment process.
    - Hazardous substances found on site and their respective handling requirements.
    - Water quality sampling and monitoring.
- Site inspections and routine maintenance of all the facility's systems and structures.
- Detailed inspections of all equipment, facilities, system and structures as well as reporting and correction of deficiencies.
- Emergency procedures to be followed in the event of spills or accidents.
- Proper record keeping.
    - The appendices for each specific technical O&M section contain construction documents (record drawings, specifications and shop drawings).
- Maintaining a supply of parts, spare materials and equipment necessary to keep the facility running safely and efficiently.

Personnel must review and be familiar with all chapters of the manual to ensure that they have a thorough working knowledge of the Water Treatment Plant. This will enable them to turn directly to the correct chapter should a reference be required.

Chapter 4 Site Inspections

4.1 General Site Inspections

The City of Iqaluit Water Treatment Plant (WTP) is located south of Geraldine Lake, which also provides the raw water source for potable water treatment at the WTP. With the exception of the occasional algal blooms during the summer, Geraldine Lake provides relatively good quality raw water. The WTP has a gross design capacity of 9,500 m^3/day.

Site inspections are performed daily to ensure that all equipment and systems within the are operating and properly functioning, as well as ensure the housekeeping aspects are in place (such as tidiness and accessibility). On-shift operators perform daily rounds throughout the WTP in a 24-hour cycle. In the event an equipment is identified to be deficient, it is tagged and logged for maintenance, or where required, replacement. Refer to the Process, Mechanical, Electrical and Instrumentations Operations and Maintenance Manuals for further details on the maintenance schedule and requirements for operating equipment on site.

The observations for the daily site inspections are logged in the inspection's logbook.

Chapter 5 Personnel Training

5.2 Personnel Training Requirements

Personnel training is done in-house by the City of Iqaluit. Topics that are covered as part of the training process include, but are not limited to the following:

- Site safety and orientation.
- Operating procedures for each of the process units on site.
- WHIMIS.
- Confined space.
- First Aid.

New operating personnel are expected to shadow an experienced operator as part of the training process.

Chapter 6 Emergency Response

6. 1 General

During the event of an onsite emergency, the first point of contact would be the local dispatch emergency service. On-shift operators would be expected to take appropriate action and respond to emergencies on site. There are also back-up procedures that must be followed (the framework for which will be developed at a later time).

In the event of an emergency, there are muster points on site located throughout the exterior of the plant (details to be added at a later time).

Table 6-1 presents the strobe/beacon colour codes or alarm horns and their respective corresponding emergency scenarios *(details to be added at a later time):*

Table 6 - 1 Strobe Colour Codes for Emergency Scenarios

Strobe/ Beacon Light Colour/ Alarm Horn	Emergency Scenario
-	Fire
-	Chlorine Leak
-	Carbon Monoxide

6.2 Fire

For this section, details will be added at a later time to address the following information:

- *The designated muster points in the event of a fire.*
- *The primary responder during a fire event (e.g., apart from the local City fire department, operators may also be trained to address fires on site).*
- *Locations of all the manual fire alarm pull stations in the WTP.*

6.3 Spills

In the event of a chemical spill, all operators on shift must be notified, and action must be taken to contain the spill as soon as possible. Depending on the nature and location of the chemical spill, the local and territorial environmental agencies may need to be notified.

Proper PPE must be worn when addressing the spills. Depending on the degree of the chemical spill hazard, appropriate PPE would generally consist of the following:

- Suits (ranging from regular coveralls to Hazmat protection)
- Gloves
- Goggles or face shields
- Respirators
- Rubber Boots

Spills waste materials must be stored in a safe location until it can be safely disposed of through sea-lift services.

6.4 Operational and Controls Alarms

In 2018, the City of Iqaluit WTP commenced a project to carry out a water and wastewater facilities-wide PLC and SCADA radio communications upgrade to allow all the water and wastewater facilities to communicate directly with one other and allow for the control of the different communications systems City-wide. The main control center is located within the WTP. As part of the implementation of the new PLC and communications system, when PLC alarms are triggered, the Plant Superintendent will be notified, along with the designated operators. This is to allow for timely response to the alarm and for plant personnel to take appropriate action to rectify any process related emergencies. The upgraded PLC and SCADA system is expected to be fully implemented and functional by the summer of 2020.

Electrical & Instrumentation Operation & Maintenance Manual

for the

City of Iqaluit Water Treatment Plant

Iqaluit, Nunavut

Year of Completion: 2004

Original Scope: Expand existing water treatment facility to meet city's requirements and Canadian Drinking Water Quality Guidelines.

Date	Description of Change
August 21, 2018	Addition to include newly installed or replaced equipment from the 2017 Water and Wastewater Facilities Improvement Project.

Iqaluit Water Treatment Plant

Project History

The City of Iqaluit:	City of Iqaluit Public Works & Engineering P.O. Box 460 Iqaluit, NU X0A 0H0 Matthew Hamp, Director of Public Works & Engineering Phone: (867) 979-5653 m.hamp@city.iqaluit.nu.ca
Project Engineer:	**2004 Upgrades** Earth Tech Canada Inc. (Currently AECOM) 4916 47th Street P.O. Box 1259 Yellowknife, NT X1A 2N9 Phone: 1 (867) 873-6316 **2017 Upgrades** Glenn Prosko, Project Manager Nunami-Stantec 10160 112 Street Edmonton AB T5K 2L6 Phone: (780) 969-3258 Glenn.Prosko@stantec.com
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Instrumentation Subcontractor:	**2004 Upgrades** Vector Electric & Controls 3524-78 Avenue Edmonton, AB X1A 2P4 Phone: (780) 469-7900 **2017 Upgrades** Carl Fauteux, Vice-President Sifec North Inc. P.O. Box 556, Rankin Inlet, NU, X0C 0C0, Phone: (855) 437-4001 carl@sifec.ca

Electrical & Instrumentation Operation & Maintenance Manual

for the

Iqaluit Water Treatment Plant

Iqaluit, Nunavut

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I-6: PFD – Waste Tankage

I-7: PFD – Service Water Pumps

Chapter 3

BACKGROUND AND DESIGN DATA

3.1 General

The discussion in this document includes the background and design data for the electrical and instrumentation systems provided in the Iqaluit Water Treatment Plant.

3.2 Background

Electrical power to the facility is provided from the community's NTPC grid. The electrical supply and distribution equipment is configured to provide a continuous power source for entire facility.

3.3 Power Source

A 400A, 347/600 Volt overhead service is provided to the facility from utility pole mounted transformer. The facility's utility metering is located on the interior wall at the south corner of the building. From this point power is routed through the customer's meter cabinet before reaching the main distribution panel.

3.4 Facility Power Distribution

3.4.1 Main Distribution Panel

A single 1200 A, main distribution panel feeds all facility panels. The major panels fed from the main distribution panel include distribution panel 2A, distribution panel 2B, distribution panel 6A and the motor control center. In addition, the main distribution panel feeds a 200A splitter which in turn feeds two UV control panels. Lower level electrical loads are fed from distribution panel 2A. Upper level loads are fed from distribution panels 2B and 6B.

3.4.2 Distribution Panel 2A

A 120/208 V, 60 circuit distribution panel feeds the lower level loads. The lower level loads include lower level receptacles, unit heaters, sodium hypochlorite pumps,

motorized valves, lower floor PLC panels, Clearwell level loads, battery packs and tunnel lighting.

3.4.3 Distribution Panel 2B

A 120/208 V, 60 circuit distribution panel feeds the majority of the upper level loads. The upper level loads include upper level receptacles, unit heaters, exhaust fans, motorized valves, upper floor PLC panels, chlorinators, zinc orthophosphate dosing pumps, hydrofluorosilicic pumps, fire alarm panel, exit lighting and battery packs.

3.4.4 Distribution Panel 6A

A 347/600 V, 24 circuit distribution panel feeds the 347/600 V loads. The 347/600 V loads include exterior and interior lighting and air handling unit AHU-2.

3.4.5 Motor Control Center

The motor control center is configured to operate various process and mechanical equipment.

Refer to Chapter 6 of this Manual for the water treatment process operating procedures.

3.5 Water Treatment Process Controls and Alarms

The overall water treatment process is controlled utilizing PLC control with multiple HMI interfaces. The facility main control panels are the upper PLC cabinet, the lower PLC cabinet and the motor control center. Each PLC cabinet will control and operate the water treatment process instrumentation devices located on the same level as the PLC cabinet. The lower PLC module rack is interfaced with the upper PLC via a bus extension cable; the PLC operates using a single processor module located in the Upper PLC cabinet. HMI interface terminals located in the upper and lower PLC cabinets are identical in the make and model, and both allow complete access to all elements of the plant control system.

Refer to Chapter 6 of this Manual for the water treatment process operating procedures.

3.5.1 Water Treatment Process Control

The water treatment process control consists of UV disinfection, filtration, chlorination, fluoridation, pH adjustment and orthophosphate addition.

The water treatment plant will be capable of operating on a continuous basis and in an automatic mode. Overall, the water treatment plant will be started and stopped via the level within the off-site reservoir. When the plant is called to start, and the equipment is in automatic mode, the PLC will control and operate the plant.

Refer to Drawings I-1 through I-7 at the end of Chapter 4 of this Manual for the overall water treatment process instrumentation schematic.

Refer to the Appendix for water treatment process control philosophy.

3.5.2 Water Treatment Process Alarms

The PLC continuously monitors the water treatment plant's process, mechanical and electrical operating systems. System or equipment failure alarms are indicated on the Versaview HMI screen. Various conditions of alarms will be detected and reported to the PLC, some will shut the plant down and others will turn on back up equipment.

Refer to Chapter 6 of this Manual for the water treatment process alarms.

3.6 Chlorine Detection & Monitoring

The Chlorination Room is continuously monitored for chlorine leak. As part of the upgrades and maintenance done in the 2017 Water and Wastewater Facilities Improvement project, the exhaust fan in the Chlorination Room was replaced with a new TwinCity Exhaust model. The Chlorine Gas Detection System was also replaced with a Wallace & Tiernan model.

Refer to Chapter 6 of this Manual for the chlorine detection alarms.

3.7 Telecommunications/Alarm Dialer

The water treatment plant has a dedicated phone line for the facility alarm dialer. When the facility is unoccupied alarms requiring operator intervention will be annunciated on both the PLC and to the operator via an auto dialer.

Refer to Chapter 6 of this manual lists of major alarms and their associated annunciations.

3.8 Fire Alarm

The water treatment plant fire alarm system consists of smoke detectors, thermal detectors and alarm pull stations. All devices are wired back to the facility control panel mounted to the right of the main entrance door.

3.9 Electrical Wiring

The plant electrical and controls system wiring is provided by Teck cabling or wiring contained in conduit.

END OF CHAPTER 3

Chapter 4

SCHEMATICS AND FUNCTIONAL DATA

4.1 Power Distribution Schematic (Refer to Drawings E-1 and E-2 and E-3 at the end of this section)

Power Distribution Schematic

No.	Component	Location	Function Performed	Remarks
1	Utility Transformer	South exterior power pole	Provide power to facility	
2	Weatherhead	South upper floor adjacent to new office	Overhead utility service entrance.	
3	Utility Meter Cabinet	South exterior wall	Utility billing is based on this meter.	
4	Customer Meter Cabinet	Interior wall, adjacent to new office	Customer check for utility billing.	
5	400A Main Distribution	Main Distribution Panel, adjacent to new office	Provides service to facility.	
6	Distribution Panel 6B	Upper Level	Provides distribution and overcurrent protection for exterior and upper floor lighting.	
7	75 kVA Transformer to Panel 2A	Lower Level	Provide power to panel 2A.	
8	Distribution Panel 2A	Lower Level	Provides distribution and overcurrent protection for lower level loads.	
9	40 kVA Transformer to Panel 2B	Upper Level	Provide power to panel 2B.	
10	Distribution Panel 2B	Upper Level	Provides distribution and overcurrent protection for upper level loads.	
11	Motor Control Center	Mechanical Mezzanine 201	Starts and controls facility motors.	

Power Distribution Schematic

No.	Component	Location	Function Performed	Remarks
12	37.5 kVA Transformer to 200A Splitter	Upper Level	Provides power to UV control panels.	
13	200A Splitter	Upper Level	Provides service to UV control panels.	
14	100A Fused Disconnect	Upper Level, UV Control Panel	Disconnects UV Control Panel from utility power.	
15	UV Control Panel	Upper Level	Operates UV Package: SV-1201 & SV-1211 UV Reactors #1 & #2 X-120 & X-121 FCV-1009 & FCV-1012	
16	Ground Grid	Facility Exterior	Grounding of facility electrical system.	

4.2 PLC Control Schematic
(Refer to Drawings I-1 to I-7 & E-4 to E-6 at the end of this section)

PLC Control Schematic

No.	Component	Location	Function Performed	Remarks
1	Raw Water Turbidity (Inlet) AIT-1001	Pre-Treatment Process	Measure raw water turbidity into water treatment plant.	Recorded once every minute.
2	Raw Water PH (Inlet) AIT-1002	Pre-Treatment Process	Measure raw water pH into water treatment plant.	Recorded once every 15 minutes.
3	Raw Water Flow (Inlet) FIT-1001	Pre-Treatment Process	Measure raw water flow into water treatment plant.	
4	Raw Water Pressure Transmitter (Inlet) PIT-5001	RW Intake Piping inside the Plant, Main Floor	Measures pressure on influent raw water and transmits to PLC.	
5	Raw Water Valve (Inlet) FCV-1001	Pre-Treatment Process	Control flow of raw water into water treatment plant.	Valve is driven closed by a dedicated UPS in the event of a utility power failure.

PLC Control Schematic

No.	Component	Location	Function Performed	Remarks
5	UV System CPP #1 & #2	Pre-Treatment Process	Control and monitoring of disinfection reactors X-120 & X-121.	UV control panels can be controlled manually or by the PLC. Even wear on lamp assemblies facilitated by reactor rotation. Rotation shall not exceed 4 per day.
6	Filter Inlet Valve FCV-2101 FCV-2111 FCV-2121 FCV-2131	Filtration Process	Control flow of pre-treated water into rapid gravity filters.	P&ID shows one of four filter assemblies.
7	Filter Water Level LIT-2101 LIT-2111 LIT-2121 LIT-2131	Filtration Process	Measure filtered water level in the rapid gravity filters.	P&ID shows one of four filter assemblies.
8	Pressure Drop Across Filter PIT-2101 PIT-2111 PIT-2121 PIT-2131	Filtration Process	Measures the pressure drop across the filter media.	P&ID shows one of four filter assemblies.
9	Filtered Water Turbidity AIT-2102 AIT-2112 AIT-2122 AIT-2132	Filtration Process	Measure filtered water turbidity.	P&ID shows one of four filter assemblies.
10	Air Scour Inlet Valve FCV-2107 FCV-2117 FCV-2127 FCV-2137	Filtration Process	Controls flow of air into rapid gravity filter.	P&ID shows one of four filter assemblies.
11	Filter to Waste Valve LCV-2103 LCV-2113 LCV-2123 LCV-2133	Filtration Process	After backwash sequence valve modulates to maintain level in rapid gravity filter.	P&ID shows one of four filter assemblies.

PLC Control Schematic

No.	Component	Location	Function Performed	Remarks
12	Filtered Water Valve LCV-2104 LCV-2114 LCV-2124 LCV-2134	Filtration Process	After filter to waste sequence valve modulates to maintain level in Clearwell.	P&ID shows one of four filter assemblies.
13	Backwash Supply Valve FCV-2105 FCV-2115 FCV-2125 FCV-2135	Filtration Process	Controls the backwash supply to the rapid gravity filter.	P&ID shows one of four filter assemblies.
14	Backwash Waste Valve FCV-2106 FCV-2116 FCV-2126 FCV-2136	Filtration Process	Allows backwash waste to leave the rapid gravity filter.	P&ID shows one of four filter assemblies.
15	Air Scour Blowers C-200 & C-201	Filtration Process	Used in backwash sequence to clear rapid gravity filters.	Pump duty switched every month by PLC.
16	Backwash Pumps P-205 & P-206	Clearwell & Backwash Supply Process	In backwash sequence pumps filtered water back through the rapid gravity filter.	Pump duty switched every month by PLC.
17	Backwash Pumping Chamber Level LIT-2501	Clearwell & Backwash Supply Process	Measurement of water level within backwash pumping chamber.	
18	Treated Water to Storage FCV-2501	Clearwell & Backwash Supply Process	Controls the flow of treated water to the storage reservoir.	
19	Treated Water Analysis AIT-2501	Clearwell & Backwash Supply Process	Measure treated water turbidity and pH.	
21	Facility Horn	Exterior of Chlorination Room	Warn facility of chlorine leak.	
22	Facility Beacon	Exterior of Chlorination Room	Warn facility of chlorine leak.	
23	Gas Chlorinators X-340 & X-341	Chlorine Supply Process	Chlorination of water.	Chlorination system comes complete with controls.

PLC Control Schematic

No.	Component	Location	Function Performed	Remarks
24	Chlorinated Water Injection Flow Switch	Chlorine Supply Process	Detects flow of chlorinated water to ensure chlorination of filtered water	No manual operation required. Flow switch incorporated into PLC/HMI software to automatically alarm during low flow.
25	Zinc Orthophosphate Dosing Pumps P-303 & P-304	Fluoride & Orthophosphate & Hydrofluorosilicic Acid Supply Process	Treat water.	Pump duty switched every month by PLC.
26	Hydrofluorosilicic Dosing Pumps P-305 & P-306	Fluoride & Orthophosphate & Hydrofluorosilicic Acid Supply Process	Treat water.	Pump duty switched every month by PLC.
27	Backwash to Sewer Tank Level LIT-4001	Fluoride & Orthophosphate Supply Process	Measure level in backwash storage tank.	Level indicated in meters.
28	Backwash to Sewer Flow FIT-4001	Fluoride & Orthophosphate Supply Process	Measure flow from backwash storage tank to sewer.	
29	Backwash to Sewer Valve FCV-4001	Fluoride & Orthophosphate Supply Process	Control flow of backwash water to sewer.	
30	Filter to Waste Tank Level LIT-4011	Fluoride & Orthophosphate Supply Process	Measure level in filter to waste storage tank.	Level indicated in meters.
31	Filter to Waste Flow FIT-4011	Fluoride & Orthophosphate Supply Process	Measure filtered water to waste storage tank flow.	
32	Filter to Waste Valve FCV-4011	Fluoride & Orthophosphate Supply Process	Control flow of filtered water to waste storage tank.	
33	Service Pumps P-410 & P-411	Service Water Pumps Process	Pump raw water.	Pump duty switched every month by PLC.
34	Service Water Pumps Switch PSL-4112	Service Water Pumps Process	Indicate low pressure in chlorination supply.	
35	Reservoir Discharge Flow Meter (FIT5001)	Reservoir Water Process	Measures reservoir discharge flow	

4.3 Lower PLC Cabinet (Refer to Drawing E-7 at the end of this section)

Lower PLC Cabinet

No.	Component	Location	Function Performed	Remarks
1	Power Supply (Rack Mount)	Lower PLC Cabinet (Interior)	Provide power to rack mounted modules.	
2	PLC Rack (13 Slot)	Lower PLC Cabinet (Interior)	Provide location for module installation.	
3	Digital Input Module	Lower PLC Cabinet (Interior)	Provide connection for PLC discrete inputs.	
4	Digital Output Module	Lower PLC Cabinet (Interior)	Provide connection for PLC discrete outputs.	
5	Analog Input Module	Lower PLC Cabinet (Interior)	Provide connection for PLC analog inputs.	
6	Analog Output Module	Lower PLC Cabinet (Interior)	Provide connection for PLC analog outputs.	
7	Remote I/O Scanner	Lower PLC Cabinet (Interior)		
8	Power Supply (24VDC)	Lower PLC Cabinet (Interior)		
9	HMI	Lower PLC Cabinet (Exterior)	Interface between operator and PLC.	
10	Light Switch	Lower PLC Cabinet (Interior)	Turn on PLC enclosure light.	
11	Fluorescent Luminaire	Lower PLC Cabinet (Interior)	Illuminate PLC enclosure.	
12	120VAC Receptacle	Lower PLC Cabinet (Interior)	Provide receptacle power for operator at panel location.	
13	End Bracket	Lower PLC Cabinet (Interior)	Provide end point for din rail mounted devices.	
14	Fuse Holder (AC)	Lower PLC Cabinet (Interior)	Provide location for AC fuse.	
15	Fuse Holder (DC)	Lower PLC Cabinet (Interior)	Provide location for DC fuse.	

Lower PLC Cabinet

No.	Component	Location	Function Performed	Remarks
16	Ground Terminal	Lower PLC Cabinet (Interior)	Provide ground to rail mounted devices.	
17	Terminal Block	Lower PLC Cabinet (Interior)	Provide connection point to electrician.	
18	Wireway	Lower PLC Cabinet (Interior)	Provide space to store all PLC enclosure wiring.	
19	Vapor Corrosion Inhibiter	Lower PLC Cabinet (Interior)		
20	120VAC Interposing Relay	Lower PLC Cabinet (Interior)		
21	Relay Base	Lower PLC Cabinet (Interior)	Provide connection point for relay.	

4.4 Upper PLC Cabinet (Refer to Drawing E-8 at the end of this section)

Upper PLC Cabinet

No.	Component	Location	Function Performed	Remarks
1	Power Supply	Upper PLC Cabinet (Interior)	Provide power to rack mounted modules.	
2	PLC Rack (13 Slot)	Upper PLC Cabinet (Interior)	Provide location for module installation.	
3	SLC 5/05	Upper PLC Cabinet (Interior)		
4	Digital Input Module	Upper PLC Cabinet (Interior)	Provide connection for PLC discrete inputs.	
5	Digital Output Module	Upper PLC Cabinet (Interior)	Provide connection for PLC discrete outputs.	
6	Analog Input Module	Upper PLC Cabinet (Interior)	Provide connection for PLC analog inputs.	
7	Isolated Output Relay	Upper PLC Cabinet (Interior)		

Upper PLC Cabinet

No.	Component	Location	Function Performed	Remarks
8	Analog Output Module	Upper PLC Cabinet (Interior)	Provide connection for PLC analog outputs.	
9	Remote I/O Scanner	Upper PLC Cabinet (Interior)		
10	Power Supply (24VDC)	Upper PLC Cabinet (Interior)		
11	HMI	Upper PLC Cabinet (Exterior)	Interface between operator and PLC.	
12	8 Port EtherNET Switch	Upper PLC Cabinet (Interior)		
13	Modular Slot Filler	Upper PLC Cabinet (Interior)		
14	Fuse Holder (AC)	Upper PLC Cabinet (Interior)	Provide location for AC fuse.	
15	Fuse Holder (DC)	Upper PLC Cabinet (Interior)	Provide location for DC fuse.	
16	Ground Terminal	Upper PLC Cabinet (Interior)	Provide ground to rail mounted devices.	
17	Terminal Block	Upper PLC Cabinet (Interior)	Provide connection point to electrician.	
18	Wireway	Upper PLC Cabinet (Interior)	Provide space to store all PLC enclosure wiring.	
19	UPS	Upper PLC Cabinet (Interior)	Provide uninterruptible power supply.	
20	Light Switch	Upper PLC Cabinet (Interior)	Turn on PLC enclosure light.	
21	Fluorescent Luminaire	Upper PLC Cabinet (Interior)	Illuminate PLC enclosure.	
22	120VAC Receptacle	Upper PLC Cabinet (Interior)	Provide receptacle power for operator at panel location.	
23	End Bracket	Upper PLC Cabinet (Interior)	Provide end point for din rail mounted devices.	

Upper PLC Cabinet

No.	Component	Location	Function Performed	Remarks
24	Vapor Corrosion Inhibitor	Upper PLC Cabinet (Interior)		
25	Voice Dialer	Upper PLC Cabinet (Interior)	Dials preset number	
26	120VAC Interposing Relay	Upper PLC Cabinet (Interior)		
27	Relay Base	Upper PLC Cabinet (Interior)	Provide connection point for relay.	
28	EEPROM Memory Module	Upper PLC Cabinet (Interior)		

4.5 Motor Control Centre (Refer to Drawing E-9 at the end of this section)

Motor Control Centre

No.	Component	Location	Function Performed	Remarks
1	Incoming Lugs	MCC Cabinet	Connection to field devices.	
2	Spare	MCC Cabinet	Allows for future expansion.	
3	Air Handling Unit AHU-1	MCC Cabinet	Refer to Mechanical O&M Manual.	
4	Space for Future Expansion	MCC Cabinet	Allows for future expansion.	
5	Exhaust Fan EF-3	MCC Cabinet	Refer to Mechanical O&M Manual.	
6	Potable Water Pump P-1 & P-2	MCC Cabinet	Refer to Process O&M Manual.	
7	Glycol Heating Pump P-3 & P-4	MCC Cabinet	Refer to Mechanical O&M Manual.	
8	Air Scourer AS-1 & AS-2	MCC Cabinet	Refer to Process O&M Manual.	

Motor Control Centre

No.	Component	Location	Function Performed	Remarks
9	Backwash Pump BP-1 & BP-2	MCC Cabinet	Refer to Process O&M Manual.	
10	Existing Boiler B-1 & B-2	MCC Cabinet	Refer to Mechanical O&M Manual.	
11	Terminal Control Section	MCC Cabinet	Connection to PLC and field devices.	

END OF CHAPTER 4

Chapter 5

COMPONENT DETAILS

5.1 Power Distribution Schematic (Refer to Drawings E-1 and E-2 and E-3 at the end of Chapter 4)

Power Distribution Schematic

No.	Component	Details	Setting	Remarks
1	Utility Transformer			
2	Weatherhead			
3	Utility Meter Cabinet			
4	Customer Meter Cabinet			
5	1200A Main Distribution Panel	Cuttler Hammer PRL3000	Main Breaker set @ 400A Trip	1200A Main Bus Rating 347/600 Volts
6	Distribution Panel 6B	Cuttler Hammer PL3a		24 Circuits 250 Amperes 347/600 Volts
7	75 kVA Transformer to Panel 2A	Hammond MK075PBC		NEMA-3R Enclosure
8	Distribution Panel 2A	Cuttler Hammer PL3a		42 Circuits 225 Amperes 120/208 Volts
9	40 kVA Transformer to Panel 2B			
10	Distribution Panel 2B	Cuttler Hammer PL3a		42 Circuits 225 Amperes 120/208 Volts
11	Motor Control Center	Cuttler Hammer		
12	37.5 kVA Transformer to 200A Splitter	Hammond MF037PEC		NEMA-3R Enclosure
13	200A Splitter			
14	100A Fused Disconnect			

Power Distribution Schematic

No.	Component	Details	Setting	Remarks
15	UV Control Panel			
16	Ground Grid			

5.2 PLC Control Schematic (Refer to Drawings I-1 to I-7 & E-4 to E-6 at the end of Chapter 4)

PLC Control Schematic

No.	Component	Details	Setting	Remarks
1	Raw Water Turbidity (Inlet) AIT-1001	AE-1001 Hach TU5300sc Turbidimeter Cat# 52001-00	Scaled 0-20 NTU	w/ sc200 Universal Controller
2	Raw Water PH (Inlet) AIT-1002	c/wAE-1002 Depolox 3 Plus D5CPT Residual Analyzer	Scaled pH: 4-10	
3	Raw Water Flow (Inlet) FIT-1001	c/w FE 1001 Endress & Hauser PROMAG 50W DN 200/8”	Scaled 0-120 L/sec	
4	Raw Water Valve (Inlet) FCV-1001			
5	UV System CPP #1 & #2	Refer to Process O&M Manual		
6	Filter Inlet Valve FCV-2101 FCV-2111 FCV-2121 FCV-2131	14” Bray Series 30-111 c/w Bray S70-0501 electric actuator, 120VAC power supply	Valve operating time is 30 seconds	
7	Filter Water Level LIT-2101 LIT-2111 LIT-2121 LIT-2131	c/w LE-2101, LE-2111, LE-2121, LE-2131 Milltronics Level System XPS-10 Series		

PLC Control Schematic

No.	Component	Details	Setting	Remarks
8	Pressure Drop Across Filter PIT-2101 PIT-2111 PIT-2121 PIT-2131	Endress & Hauser Deltabar S PMD235 PMD235-2U4F9EH1B	Scaled 0-4.00 meters water	
9	Filtered Water Turbidity AIT-2102 AIT-2112 AIT-2122 AIT-2132	c/w AE-2101, AE-2111, AE-2121, AE-2131 Hach TU5300sc Turbidimeters	Scaled 0-20 NTU	w/ sc2000 Universal Controller
10	Air Scour Inlet Valve FCV-2107 FCV-2117 FCV-2127 FCV-2137	4” Bray Series 30-109 c/w Bray S70-0031 electric actuator, 120VAC power supply	Valve operating time 30 seconds	
11	Filter to Waste Valve LCV-2103 LCV-2113 LCV-2123 LCV-2133	8” Bray Series 30-109 c/w Bray S70-0121 electric actuator, 120 VAC power supply & 4-20mA input		
12	Filtered Water Valve LCV-2104 LCV-2114 LCV-2124 LCV-2134	8” Bray Series 30-109 c/w Bray S70-0121 electric actuator, 120 VAC power supply & 4-20mA input		
13	Backwash Supply Valve FCV-2105 FCV-2115 FCV-2125 FCV-2135	12” Bray Series 30-111 c/w Bray S70-0301 electric actuator, 120VAC power supply	Valve operating time is 30 seconds	
14	Backwash Waste Valve FCV-2106 FCV-2116 FCV-2126 FCV-2136	16” Bray Series 30-111 c/w Bray S70-0501 electric actuator, 120VAC power supply	Valve operating time is 30 seconds	
15	Air Scour Blowers C-200 & C-201	Refer to Process O&M Manual		

PLC Control Schematic

No.	Component	Details	Setting	Remarks
16	Backwash Pumps P-205 & P-206	Refer to Process O&M Manual		
17	Backwash Pumping Chamber Level LIT-2501	c/w LE-2501 Milltronics Level System XPS-10 Series		
18	Treated Water to Storage FCV-2501	12" Bray Series 30-111 c/w Bray S70-0301 electric actuator, 120VAC power supply	Valve operating time is 30 seconds	
19	Treated Water Analysis AIT-2501	c/w AE-2501 (Chlorine Cell) AE-2502 (pH Sensor) Wallace & Tiernan Depolox 3 Plus D5CPT	Free Chlorine Residual Scaled 0-5.0 mg/L pH Scaled 4.0-10	
20	Chlorine Gas Detection System AIT-3401	c/w AE-3401 Wallace & Tiernan Acutec 35	Detection Range: 0-10 ppm	
21	Facility Horn	Edwards		
22	Facility Beacon	Edwards		
23	Gas Chlorinators X-340 & X-341	Refer to Process O&M Manual		
24	Zinc Orthophosphate Dosing Pumps P-303 & p-304	Refer to Process O&M Manual		
25	Hydro Fluorosilicic Dosing Pumps P-305 & P-306	Refer to Process O&M Manual		
26	Backwash to Sewer Tank Level LIT-4001	c/w LE-4001 Milltronics Level System XPS-10 Series		
27	Backwash to Sewer Flow FIT-4001	c/w FE-4001 Endress & Hauser Promag 50W DN 100/4" 50W1H-UL0A1RC1B4AA	Scaled 0-12 L/sec	

PLC Control Schematic

No.	Component	Details	Setting	Remarks
28	Backwash to Sewer Valve FCV-4001	4” Bray Series 30-109 c/w Bray S70-0031 electric actuator, 120VAC power supply, 4-20 mA input		
29	Filter to Waste Tank Level LIT-4011	LIT-4011 Endress & Hauser Process Transmitter RMA 421 RMA421-A11A4A LE-4011 Endress & Hauser Waterpilot FMX167 FMX167-F2AMC1C1	Scaled 0-4.00 meters	
30	Filter to Waste Flow FIT-4011	c/w FE-4011 Endress & Hauser Promag 50W DN 100/4” 50W1H-UL0A1RC1B4AA	Scaled 0-5 L/sec	
31	Filter to Waste Valve FCV-4011	4” Bray Series 30-109 c/w Bray S70-0031 electric actuator, 120VAC power supply, 4-20 mA input		
32	Service Pumps P-410 & P-411	Refer to Process O&M Manual		
33	Service Water Pumps Switch PSL-4112	Asco S-Series	SP = 206.85 kPa (30psi)	Contacts open on decreasing pressure

5.3 Lower PLC Cabinet (Refer to Drawing E-7 at the end of Chapter 4)

Lower PLC Cabinet

No.	Component	Details	Setting	Remarks
1	Power Supply (Rack Mount)	Allen Bradley 1746-P2		
2	PLC Rack (13 Slot)	Allen Bradley 1746-A13		
3	Digital Input Module	Allen Bradley 1746-IA16		
4	Digital Output Module	Allen Bradley 1746-OA16		
5	Analog Input Module	Allen Bradley 1746-NI8		
6	Analog Output Module	Allen Bradley 1746SC-NO8I		
7	Remote I/O Scanner	Allen Bradley 1747-ASB		
8	Power Supply (24VDC)	Weidmuller 9925340024		
9	HMI	Allen Bradley 6182H-15BEH4B		15” RAC6186 w/ Versaview
10	Light Switch	800T-J2		
11	Fluorescent Luminaire	Hammond FLK48 & FLK48MM		
12	120VAC Receptacle			
13	End Bracket	Weidmuller WEW 35/2		
14	Fuse Holder (AC)	Weidmuller 101440		c/w Indicator
15	Fuse Holder (DC)	Weidmuller 101470		c/w Indicator

Lower PLC Cabinet

No.	Component	Details	Setting	Remarks
16	Ground Terminal	Weidmuller		
17	Terminal Block	Weidmuller		
18	Wireway	Panduit G3x4WH6 & C3WH6 G2x4WH6 & C2WH6		c/w Cover
19	Vapor Corrosion Inhibiter	Hammond XC110		
20	120VAC Interposing Relay	Allen Bradley 700-HK32A1		
21	Relay Base	Allen Bradley 722-HN122		

5.4 Upper PLC Cabinet (Refer to Drawing E-8 at the end of Chapter 4)

Upper PLC Cabinet

No.	Component	Details	Setting	Remarks
1	Power Supply	Allen Bradley 1746-P2		
2	PLC Rack (13 Slot)	Allen Bradley 1746-A13		
3	SLC 5/05	Allen Bradley 1747-L552		
4	Digital Input Module	Allen Bradley 1746-IA16		
5	Digital Output Module	Allen Bradley 1746-OA16		
6	Analog Input Module	Allen Bradley 1746-NI8		
7	Isolated Output Relay	Allen Bradley 1746-OX8		

Upper PLC Cabinet

No.	Component	Details	Setting	Remarks
8	Analog Output Module	Allen Bradley 1746SC-NO8I		
9	Remote I/O Scanner	Allen Bradley 1747-SN		
10	Power Supply (24VDC)	Weidmuller 9925340024		
11	HMI	Allen Bradley 6182H-15BEH4B		c/w Versaview 6181P 15” Integrated Display
12	8 Port EtherNET Switch	Allen Bradley ENET Switch		
13	Modular Slot Filler	Allen Bradley 1746-N2		
14	Fuse Holder (AC)	Weidmuller 101440		c/w Indicator
15	Fuse Holder (DC)	Weidmuller 101470		c/w Indicator
16	Ground Terminal	Weidmuller		
17	Terminal Block	Weidmuller		
18	Wireway	Panduit G3x4WH6 & C3WH6 G2x4WH6 & C2WH6		c/w Cover
19	UPS	Always On GES-202L	1400W 2000VA	
20	Light Switch			
21	Fluorescent Luminaire	Hammond FUK48MM		2 x 48”
22	120VAC Receptacle			

Upper PLC Cabinet

No.	Component	Details	Setting	Remarks
23	End Bracket	Weidmuller WEW 35/2		
24	Vapor Corrosion Inhibitor	Hammond XC110		
25	Voice Dialer	Barnett B1290		
26	120VAC Interposing Relay	Allen Bradley 700-HK32A1		
27	Relay Base	Allen Bradley 722-HN122		
28	EEPROM Memory Module	Allen Bradley 1747-M13		

5.5 Motor Control Centre (Refer to Drawing E-9 at the end of Chapter 4)

Motor Control Centre

No.	Component	Details	Setting	Remarks
1	Incoming Lugs			
2	Spare	Cuttler Hammer E1A20612		
3	Air Handling Unit AHU-1	Cuttler Hammer E1A20612	2 HP 2.7 FLA	
4	Space for Future Expansion			
5	Exhaust Fan EF-3	Cuttler Hammer E1A20612	2 HP 2.7 FLA	
6	Potable Water Pump P-1 & P-2	Cuttler Hammer E1A20612	5 HP 6.1 FLA	
7	Glycol Heating Pump P-3 & P-4	Cuttler Hammer E1A20612	3 HP 3.9 FLA	

Motor Control Centre

No.	Component	Details	Setting	Remarks
8	Air Scourer AS-1 & AS-2	Cuttler Hammer E2A20612	20 HP 22 FLA	
9	Backwash Pump BP-1 & BP-2	Cuttler Hammer E2A20612	25 HP 27 FLA	
10	Existing Boiler B-1 & B-2	Cuttler Hammer BFAHFD12		30A Trip
11	Terminal Control Section			

END OF CHAPTER 5

Chapter 6

OPERATING PROCEDURES

6.1 General

The operations portion of this manual should be read in conjunction with Chapter 6 of the Process and Mechanical Operations and Maintenance Manuals. The operating procedures described in this section will relate to the electrical and water treatment process controls systems.

6.2 Facility Power and Standby Power System

The building power is supplied by a 400 Amp, 347/600 Volts utility service. This electrical power services all the water treatment process controls and alarm systems, auxiliary electrical systems, lighting and mechanical systems.

Utility power availability is continuously monitored by the PLC. In the event of a utility power failure, the raw water intake control valve (FCV-1001) and the plant treated water outlet valve (FVC 2501) will be driven closed by a dedicated uninterruptible power supply shutting down the water treatment operation. All other facility valves will fail to their last position.

Upon resumption of utility power and with no alarms, the water treatment plant and process will automatically restart.

6.3 Water Treatment Controls Systems

The water treatment plant will be capable of operating on a continuous basis and in an automatic mode. The automated control of the plant is based on the need to treat water as determined by the level in the off site reservoir.

6.3.1 Pre-Treatment (Refer to Drawing I-1 at the end of Chapter 4)

Raw water entering the water treatment plant is measured for level of turbidity and pH. AE-1001 is a continuous on-line turbidity meter. The continuous measurements are transmitted to the PLC via AIT-1001, recorded once per minute and stored for archive purposes. AI-1001 will display the raw water turbidity on the PLC. The raw water sample line leading to AE-1001 will be equipped with an electric solenoid valve SV-1001. During plant operation SV-1001 will be energized open, during plant shut down SV-1001 will de-energize and the valve will close. AE-1002 provides continuous on-line pH monitoring of the raw water. The continuous measurements are transmitted to the PLC via AIT-1002, recorded once per 15 minutes and stored for archive purposes. AI-1002 will display the raw water pH on the PLC. The raw water sample line leading to AE-1002 will be equipped with an electric solenoid valve SV-1002. During plant operation SV-1002 will be energized open, during plant shut down SV-1002 will de-energize and the valve will close.

Raw water flow entering the water treatment plant is measured by FE-1001. FIT-1001 transmits the flow to the PLC. FIT-1001 has a calibrated range of 0-60 L/s corresponding to a 4-20 mA output signal. FI-1001 will display the raw water flow on the PLC. FAL-1001 is a low flow alarm for the raw water inlet. If the plant is called into operation and no raw water flow is detected FAL-1001 will alarm on the PLC.

The flow of raw water into the water treatment plant is controlled by FCV-1001. This valve is equipped with both REMOTE-OFF-LOCAL (ROL) and OPEN-STOP-CLOSE (OSC) hand switches labelled HS-1001A and HS-1001B respectively. When HS-1001A is in the LOCAL position, HS-1001B is used to open and close the valve as required. When HS-1001A is in the OFF position FCV-1001 will not operate. The position of FCV-1001 when HS-1001A is the in the REMOTE position will be controlled based on the flow detected by FE-1001 and a desired plant production rate chosen by the plant operator. FCV-1001 is equipped with a position indicator ZI-1001 that detects the position of the valve. ZI-1001 is expressed on the PLC as a percentage open from 0-100% based on the 4-20 mA signal.

Upon loss of utility power FCV-1001 is driven closed by a dedicated uninterruptible power supply, therefore shutting down the water treatment process. FCV-1001 is the only valve in the facility to be powered in this manner. All other valves fail to their last position upon a loss of utility power.

The UV disinfection reactors X-120 and X-121 disinfect the raw water. The plant PLC is connected to each reactors dedicated control panel via Ethernet. Each of the reactors is controlled manually (at the UV control panel) or remotely at the PLC. Under normal conditions (remote PLC control), the WTP is called to produce water by the level sensor in the reservoir. The plant PLC will call for the duty UV reactor to start. From this point onwards the reactor controller determines control of start-up, normal operation and shutdown of the UV reactor. In the event of duty reactor failure the PLC manages the switchover to the standby reactor.

Both X-120 and X-121 are associated with an influent valve, effluent valve and drain valve. Influent valves (V-1007 and V-1008) are manually operated to isolate the UV reactors. V-1007 and V-1008 remain fully open unless a UV reactor is out of service. Effluent control valves (FCV-1009 and FCV-1012) will be controlled (on/off) and monitored (open/closed) by the UV control panels based on the requirements established by Trojan Technologies. Drain valves (SV-1201 and SV-1211) provide cooling water to the UV reactors during start-up and shut down sequences. SV-1201 and SV-1211 are controlled by the UV control panels. Cooling water is monitored by FE-1001.

X-120 and X-121 are continuously monitored by the dedicated control panels supplied with the equipment. The control panels will monitor various parameters with minor, major and critical common alarms being communicated to the plant PLC via Ethernet.

To facilitate even wear on the lamp assemblies a “reactor rotation” timer shall be provided in the PLC. Designation of the current standby reactor shall rotate between the reactors. The PLC shall designate of the reactor positions that shall be regularly rotated into and out of service. The rotation timer shall be set at an initial setting of 168 hours (one week). This timer shall be fully adjustable to suit operator preferences but shall not

exceed 4 rotations per day. It shall be possible for the operator to manually reset the timer.

6.3.2 Filtration (Refer to Drawing I-2 at the end of Chapter 4)

The filters will operate in several different modes, filtration mode, backwash mode and filter to waste mode. A description of each operation is included here as references to these modes are used throughout this section.

6.3.2.1 Filtration Mode

This mode is the normal operating regime of each of the filters. The operator will select which filters will be in operation via the PLC based on the desired plant production rate. During filtration:

- Filter inlet valve (FCV-2101) will be fully open
- Backwash waste valve (FCV-2106) will be closed
- Air scour inlet valve (FCV-2107) will be closed
- Backwash supply valve (FCV-2105) will be closed
- Filter to waste valves (LCV-2103) will be closed
- The filtered water valve (LCV-2104) will modulate to maintain a constant level within the filter based on the level in the rapid gravity filter (LE-2101).

Filtration will continue until one of the following conditions occurs at which time the backwash mode will be started:

- Filtered water turbidity > 0.3 NTU
- Filtered water valve is fully open
- Filter media differential pressure
- Operator enables the backwash sequence on the PLC
- Elapsed time (variable set in the PLC)

6.3.2.2 Backwash Mode

This mode will begin based on the above conditions, these conditions indicate that the filter is dirty and needs to be cleaned. Prior to the initiation of the backwash sequence the PLC will confirm that the following conditions are met. If the reservoir level is calling for the plant to run the PLC confirms that the filter inlet valve, and the filter to clear well valve for at least one of the three other filters are proven as open. This ensures that a backwash cannot be initiated if the reservoir requires water. At least one filter must be available for normal use. Once a backwash has been triggered the following events will happen sequentially:

- Filter inlet control valve will close and prove as such, allowing the water level in the filter to decrease.
- The filtered water valve will close when the water level reaches 150 mm above the filter media as measured by LE-2101 and prove as such.
- The air scour valve will prove open, followed by the starting of one of the air scour blowers. Air will be delivered to the filter for approximately 5 minutes followed by the blower shutting down, then the air scour valve closing and proving as such.
- The backwash pump will be started with PRV-2501 fully open. (pilot solenoid de-energized).
- The backwash waste valve and backwash supply valves will now be opened.
- After a delay of 3 minutes the PRV-2501 pilot solenoid will be energized allowing this valve to close slowly, thereby closing the pump bypass allowing backwash water to be introduced into the filter.
- The backwash pump will deliver water to the filter 10 minutes.
- PRV-2501 pilot solenoid will be de-energized allowing PRV-2501 to return to bypass mode.

- Backwash supply and backwash waste valves will be closed.

- The backwash pump will be shut down following 2 minutes after PRV-2501 is fully open and valve status is confirmed for all backwash related vales, the filter is ready to enter to waste mode at which time the filter will be ripened.

6.3.2.3 Filter to Waste Mode

This mode allows the filter to ripen following the backwash sequence and pass filtered water with excess turbidity to storage. This will be accomplished by the following:

- Filter influent valve will open.

- Filter to waste valve will be modulated to maintain the filter water level. This will require that the valve be closed for some time so the filter has time to fill up.

- Filter to waste will continue for a pre-set time (~ 10-15 minutes) or until the turbidity of the filtered water is < 0.3 NTU.

- The filtered water valve will open and the filter to waste valve will close, thereby placing the filter into filtration mode.

Filtered water turbidity from the rapid gravity filter F-210 is measured by AE-2102. The continuous measurements are transmitted to the PLC via AIT-2102, recorded once per minute and stored for archive purposes. Alarm AE-2102 will display F-210 filtered water turbidity on the PLC. AAH-2102 will be used to notify the operations staff that the filtered water turbidity is high and a backwash is required. The filtered water sample line leading to AE-2102 will be equipped with an electric solenoid valve (SV-2102). During filtration SV-2102 will be energized open, when F-210 is in a backwash sequence or the plant is not in operation SV-2102 will de-energize and the valve will close.

Pressure drop across the filter media is monitored by PIT-2101. The reference leg of the transmitter is located above the filter media, and represents a constant pressure value. The measuring leg of the transmitter is located at the under drain piping outlet, and will see

lower pressure as the filter media becomes occluded. The differential pressure required to initiate a backwash will be set during commissioning.

The filter inlet valve on F-210, FCV-2101, is equipped with a HAND-OFF-AUTO (HOA) switch HS-2101A and an OPEN-CLOSE (OC) switch HS-2101B. FCV-2101 will be equipped with position switches ZSO-2101 and ZSC-2101 to detect the valve open and closed position respectively. When HS-2101A is in the OFF position the valve will not operate. When HS-2101A is the in HAND position the valve position can be opened and closed using HS-2101B. When HS-2101A is the in AUTO position, the PLC controls FCV-2101.

When the filter is in filtration mode FCV-2101 is signalled to open. When the filter is in backwash mode or is out of service (as determined by the operator on the PLC) FCV-2101 is signalled closed. ZSO-2101 and ZSC-2101 display the open/closed status of the filter inlet valve on the PLC. In the event that FCV-2101 is signalled to open and ZSO-2101 fails, a failure to open alarm annunciates. In the event that FCV-2101 is signalled to close and ZSC-2101 is not activated, the backwash sequence will be disabled for F-210, LCV-2103 and LCV-2104 will be closed and a failure to close alarm annunciates.

Water level within F-210 is continuously measured by LE-2101. LIT-2101 provides local level indication and transmits the level within F-210 to the PLC. LI-2101 displays the level within F-210 on the PLC. LIT-2101 monitors the filter level and alarms on a high level (300mm above operating level). The occurrence of a high level alarm indicates a downstream blockage or valve closure and results in the closure of FCV-2101.

The filter to waste valve (LCV-2103) is equipped with position indicator ZT-2103. Following the backwash sequence, LCV-2103 will open and modulate to maintain the water level within F-210 as detected by LE-2101. The filter to waste valve will continue to modulate until the turbidity (measured by AE-2102) is below 0.3 NTU. ZI-2103 provides display of the position status of the filter to waste valve on the PLC. The filter is disabled in the event that LCV-2103 is signalled to close and the valve fails to close or when LCV-2103 is signalled to open and the valve fails to open, FCV-2101 is closed and valve close/open failure alarm annunciates.

LCV-2103 will be equipped with a ROL switch HS-2103A and an OC switch HS-2103B. When HS-2103A is in the OFF position the valve will not operate. When HS-2103A is the in LOCAL position the valve position can be opened and closed using HS-2103B. When HS-2103A is the in REMOTE position, the PLC will control LCV-2103.

The filtered water valve (LCV-2104) is equipped with position indicator ZT-2104. Following the filer to waste sequence, the filter to waste valve will be closed and the filtered water valve will open. The filtered water valve will continue to modulate allowing filtered water to enter the clearwell. Once a condition is met that requires backwashing (see filtration mode description), the filtered water valve will close. ZI-2104 provides display of the position of the filtered water valve on the PLC. The filter is disabled in the event that LCV-2104 is signalled to close and the valve fails to close or when LCV-2104 is signalled to open the valve fails to open, FCV-2101 is closed and a valve close/open failure alarm annunciates. If ZI-2004 indicates that the valve is fully open in order to maintain the water level in the filter, a backwash is required.

LCV-2104 will be equipped with a ROL switch HS-2104A and an OC switch HS-2104B. When HS-2104A is in the OFF position the valve will not operate. When HS-2104A is the in LOCAL position the valve can be opened and closed using HS-2104B. When HS-2104A is the in REMOTE position, the PLC will control LCV-2104.

The backwash water supply to F-210 is controlled by FCV-2105. The valve is equipped with position switches ZSO-2105 and ZSC-2105 to detect the valve open and closed position respectively. During the backwash sequence, FCV-2105 will open and allow the backwash water to enter the filter following air scour. ZSO-2105 and ZSC-2105 provide display of the open/closed status of the filter to waste valve on the PLC. In the event that FCV-2105 is signalled to open and ZSO-2105 fails, a failure to open alarm annunciates. This results in a failure of the backwash sequence, that disables F-210 from coming back online. In the event that FCV-2105 is signalled to close and ZSC-2105 is not activated, the filter will be disabled, a failure to close annunciates.

FCV-2105 will be equipped with a HOA switch HS-2105A and an OC switch HS-2105B. When HS-2105A is in the OFF position the valve will not operate. When HS-2105A is

the in HAND position the valve position can be opened and closed using HS-2105B. When HS-2105A is the in AUTO position, the PLC will control FCV-2105.

The backwash waste valve on F-210 is controlled by FCV-2106. The valve is equipped with position switches ZSO-2106 and ZSC-2106 to detect the valve open and closed position respectively. During the backwash sequence, FCV-2106 will open and allow the backwash waste to leave the filter. ZSO-2106 and ZSC-2106 provide display of the open/closed status of the filter to waste valve on the PLC. In the event that FCV-2106 is signalled to open and ZSO-2106 fails, a failure to open alarm annunciates. This results in a failure of the backwash sequence, that disables F-210 from coming back online. If ZOA-2006 is active the backwash pumps, P-205/206 will be disabled. In the event that FCV-2106 is signalled to close and ZSC-2106 is not activated, the filter will be disabled, a failure to close alarm annunciates.

FCV-2106 will be equipped with a HOA switch HS-2106A and an OC switch HS-2106B. When HS-2106A is in the OFF position the valve will not operate. When HS-2106A is the in HAND position the valve position can be opened and closed using HS-2106B. When HS-2106A is the in AUTO position, the PLC will control FCV-2106.

The air scour valve on F-210 is controlled by FCV-2107. The valve is equipped with position switches ZSO-2107 and ZSC-2107 to detect the valve open and closed position respectively. During the backwash sequence, FCV-2107 will open and prove as such, enabling the air scour blower start, which will allow the air to enter the filter. Upon completion of the air scour the operational sequence will shut down the blower prior to sending the FCV-2107 close signal. ZSO-2107 and ZSC-2107 provide display of the open/closed status of the air scour valve on the PLC. In the event that FCV-2107 is signalled to open and ZSO-2107 fails, a failure to open alarm annunciates. This results in a failure of the backwash sequence, that disables F-210 from coming back online. If ZOA-2007 is active the air scour blowers, C-200/C-201 will be disabled. In the event that FCV-2107 is signalled to close and ZSC-2107 is not activated, the filter will be disabled, a failure to close alarm annunciates.

FCV-2107 will be equipped with a HOA switch HS-2107A and an OC switch HS-2107B. When HS-2107A is in the OFF position the valve will not operate. When HS-2107A is the in HAND position the valve position can be opened and closed using HS-2107B. When HS-2107A is the in AUTO position, the PLC will control FCV-2107.

HS-2001 and HS-2011 are HOA manual switches associated with air scour blowers C-200 and C-201 respectively. HS-2001 and HS-2011 are located in the MCC. When HS-2001 is in HAND position, blower C-200 starts and continues to run disregarding any other condition. In the OFF position, the blower is off disregarding any other condition. In the AUTO position the blower starts and stops as called for by the PLC. Running status of the blowers will be displayed on the PLC along with fault status and automatic operation. Running lights for each blower will be located on the plant MCC. C-200 and C-201 will be alternated automatically by the PLC once per month or in the case of fault with the duty blower. All controls are similar for both C-200 and C-201.

6.3.3 Clearwell and Backwash Supply (Refer to Drawing I-3 at the end of Chapter 4)

HS-2051 and HS-2061 are HOA switches associated with backwash pumps P-205 and P-206 respectively. HS-2051 and HS-2061 are located locally at P-205 and P-206. When HS-2051 is in HAND position, pump P-205 starts and continues to run disregarding other condition. In the OFF position, the pump will not operate. In the AUTO position the pump starts and stops as called for by the PLC. Running status, fault status and automatic operation of the pumps is displayed on the PLC. Running lights for each pump are located on the plant MCC. P-205 and P-206 will be alternated automatically by the PLC once per month or in the case a duty pump fault. P-205 and P-206 operate when required by the backwash mode. All controls are similar for both P-205 and P-206.

Water level within the backwash pumping chamber is continuously monitored by LE-2501. LIT-2501 provides local level indication and transmits the level within the pumping chamber to the PLC. LI-2501 displays the level within the clearwell on the PLC. LAL-2501 provides a low level alarm, which disables the backwash pumps. LAL-2501 will also indicate that the water treatment plant needs to start or there is problem

with water getting to the off-site reservoir. LAH-250 will indicate a failure of the level control within the reservoir or a valve closure between the water treatment plant and the offsite reservoir.

The treated water supply to the storage reservoir is controlled by FCV-2501. FCV-2501 ensures that treated water exiting the plant meets the quality criteria dictated by AIT-2501. An alarm generated by AIT-2501 will result in a plant stop condition closing FCV-1001 and FCV-2501. Once the plant conditions that initiated the AIT-2501 alarm are addressed the PLC allows the plant to restart and FCV-2501 to re-open. At this point AIT-2501 alarms are bypassed for 10 minutes to allow a treated water sample to reach the analyzer. The valve will be equipped with position switches ZSO-2501 and ZSC-2501 to detect the valve open and closed position respectively. During normal plant operations, FCV-2501 is open and allows the treated water to enter the storage reservoir. ZSO-2501 and ZSC-2501 provide display of the open/closed status of the plant outlet valve on the PLC. In the event that FCV-2501 is signalled to open and ZSO-2501 is not activated, a failure to close alarm annunciates. This results in a failure of the plant to produce water and a plant major alarm dial out occurs. In the event that FCV-2501 is signalled to close and ZSC-2501 is not activated, a failure to close alarm annunciates and a plant major alarm dial out occurs.

FCV-2501 will be equipped with a HOA switch HS-2501A and an OC switch HS-2501B. When HS-2501A is in the OFF position the valve will not operate. When HS-2501A is the in HAND position the valve position can be opened and closed using HS-2501B. When HS-2501A is the in AUTO position, the PLC will control FCV-2501.

6.3.4 Chlorination (Refer to Drawing I-4 at the end of Chapter 4)

The ambient chlorine gas detection sensor, AE-3401, alarms on the detection of chlorine gas within the chlorination room. AAH-3401 is the chlorine alarm that is annunciated on the PLC. Alarm horn, HN-3401 and alarm beacon, BA-3401 mounted outside of the chlorine room external to the water treatment plant will both be activated if AAH-3401 alarms.

The chlorination system is supplied by US Filter and comes complete with controls, refer to US Filter documentation. The plant PLC will feed gas chlorinators X-340 and X-341 with the raw water flow measured by FE-1001.

6.3.5 Fluoride, Orthophosphate and Hypochlorite (Refer to Drawing I-5 at the end of Chapter 4)

Each chemical dosing system will be set up with two dosing pumps, P-303 and 304 for orthophosphate, P-305 and 306 for fluoride and P-362 and 363 for the temporary hypochlorite and ultimate caustic soda. Each pump will operate in the same manner and therefore only one set of pumps is described herein.

HS-3031 and HS-3041 are HOA switches located on the MCC control panel, associated with raw water pumps P-303 and P-304 respectively. When HS-3031 is in HAND position, pump P-303 starts and continues to run disregarding any other condition. In the OFF position, the pump will not operate. In the AUTO position the pump starts and stops as called for by the PLC. The PLC provides a flow signal (raw water flow FE-1001) for flow pacing of each pump. P-303 is monitored for Auto status, operational status and fault signals. The pump duty will be alternated automatically from the PLC every month. Similarly for HS-3041 and P-304.

6.3.6 Waste Tankage (Refer to Drawing I-6 at the end of Chapter 4)

Water level in the backwash storage tank is measured by LE-4001. LIT-4001 is the local level indicating transmitter. LI-4001 will indicate the level in the tank on the PLC in meters (0-3.5m). LAH-4001 will be a high level alarm indicating a high backwash level that will disable any further backwashing of filters.

The flow of backwash water to the sewer is controlled my FCV-4001. This valve will be equipped with both ROL and OSC switches, HS-4001A and HS-4001B respectively. When HS-4001A is in the LOCAL position, HS-4001B can be used to open and close the valve as required. When HS-4001A is in the OFF position the valve will not operate. When HS-4001A is in the REMOTE position the PLC controls the position of FCV-4001. The plant PLC indicates the position of HS-4001A.

The position of FCV-4001 when HS-4001A is the in the REMOTE position will be controlled based on the flow detected via FE-4001 and an operator input flow set point. FCV-4001 is equipped with a position indicator ZI-4001, to detect the position of the valve and therefore to detect fully open and fully closed positions. During operation of the WTP, the operator will input the desired outlet of backwash water rate via the PLC. ZI-4001 will be expressed on the PLC as a percentage open from 0-100% based on the 4-20 mA signal.

Water level in the filter to waste storage tank is measured by LE-4011. LIT-4011 is the local level indicating transmitter. LI-4011 indicates the level in the tank on the PLC in meters (0-3.5m). LAH-4011 will be a high level alarm indicating a high filter to waste level that will disable any filter to waste functions at the filters.

The flow of backwash water to the sewer is controlled by FCV-4011. This valve will be equipped with both ROL and OSC switches, HS-4011A and HS-4011B respectively. When HS-4011A is in the LOCAL position, HS-4011B can be used to open and close the valve as required. When HS-4011A is in the OFF position the valve will not operate. When HS-4011A is in the REMOTE position the PLC controls the position of FCV-4011. The plant PLC will indicate the position of HS-4011A.

The position of FCV-4011 when HS-4011A is the in the REMOTE position is controlled based on the flow detected via FE-4011 and an operator input flow set point. FCV-4011 is equipped with a position indicator ZI-4011, to detect the position of the valve and therefore to detect fully open and fully closed positions. During operation of the water treatment plant, the operator will input the desired outlet of backwash water rate via the PLC. ZI-4011 will be expressed on the PLC as a percentage open from 0-100% based on the 4-20 mA signal.

6.3.7 Service Water Pumps (Refer to Drawing I-7 at the end of Chapter 4)

HS-4101 and HS-4111 are HOA switches located on the MCC control panel, associated with raw water pumps P-410 and P-411 respectively. When HS-4101 is in HAND position, pump P-410 starts and continues to run disregarding other condition. In the OFF position, the pump will not operate. In the AUTO position the pump starts and stops

as called for by the PLC, either P-410 or P-411 will be in operation at all times. P-410 will be monitored for its Auto status, operational status and fault signals. The pump duty will be alternated automatically by the PLC every month. Similarly, for HS-4111 and P-411.

PSL-4112 is a pressure switch mounted in the service water header. This switch indicates low pressure in the supply, which will feed water to the chlorination system and the duty of the pumps.

6.4 Troubleshooting

6.4.1 Alarms

The PLC continuously monitor the water treatment plant's process, mechanical and electrical operating systems. System or equipment failure alarms are indicated on the HMI screen. Various process and facility alarm conditions are detected by the PLC, some will shut the plant down and others will turn on back up equipment.

The following tables list the alarm tag #'s, the alarm function descriptions and the form of annunciation. All alarms will be stored in memory and will be downloaded as a single file to HMI PC hard drive in the plant office once a week. The alarm log file will use a file name that includes the date upon which the file is written to disk. Information saved will be date, time, alarm descriptor No., Tripped by, and Acknowledgement date and time. Alarms are also printed on a dot matrix printer in the plant office to provide a continuous record of all PLC system alarms in chronological order.

Unless otherwise noted in the tables below, water treatment process alarms will be held out when equipment is selected as out of service or the plant is off line due to a full level in the storage reservoir.

6.4.1.1 Pre-Treatment Alarms

Pre-Treatment Alarms

No.	Alarm Tag	Alarm Description	Set Point	Consequence
1	FAL-1001	Low flow in raw water supply header *Alarm held out or 5minutes on plant start sequence*	2 L/s	Plant Shut Down & Plant Dial Out
2	X-120 Minor Alarm	X-120 UV System #1 Control Panel	Various Conditions	None
3	X-120 Major Alarm	X-120 UV System #1 Control Panel	Various Conditions	Duty/Standby reactor change over
4	X-120 Critical Alarm	X-120 UV System #1 Control Panel	Various Conditions	Duty/Standby reactor change over & Plant Dial Out
5	X-121 Minor Alarm	X-120 UV System #2 Control Panel	Various Conditions	None
6	X-121 Major Alarm	X-120 UV System #2 Control Panel	Various Conditions	Duty/Standby reactor change over
7	X-121 Critical Alarm	X-120 UV System #2 Control Panel	Various Conditions	Duty/Standby reactor change over & Plant Dial Out
8	LAL-5001	Low level in the existing reservoir	3.5 m	WTP Start
9	LAH-5001	High level in the existing reservoir	4.46 m	WTP Stop
10	LAL-2501	Low level in the backwash pumping chamber	1.6 m	WTP Start
11	LAH-2501	High level in the backwash pumping chamber	3.6 m	WTP Stop

6.4.1.2 Filtration Alarms

Filtration Alarms

No.	Alarm Tag	Alarm Description	Set Point	Consequence
1	AAH-2101	Filtration Mode – High filtered water turbidity Filter to Waste Mode – High filtered water turbidity	>0.3 NTU <0.3 NTU	Backwash sequence initiated Change to filtration mode
2	ZOA-2101	Failure of filter influent valve to open		Filter will not enter filtration or filter to waste mode
3	ZCA-2101	Failure of filter influent valve to close		Filter will not enter backwash mode
4	ZOA-2103	Filter to waste valve is fully open		Filter shutdown. Backwash was not effective.
5	ZCA-2103	Filter to waste valve has failed to open		Filter shutdown. Filter to waste cannot occur
6	ZOA-2104	Filtered water valve is fully open		Backwash required.
7	ZCA-2104	Filtered water valve has failed to open		Filtration cannot proceed
8	ZOA-2105	Failure of backwash water supply valve to open		Backwash pumps (P-205/206) cannot start, backwash cannot proceed
9	ZCA-2105	Failure of backwash water supply valve to close		Filter to waste cannot proceed
10	ZOA-2106	Failure of backwash waste valve to open		Backwash pumps (P-205/206) cannot start, backwash cannot proceed
11	ZCA-2106	Failure of backwash waste valve to close		Filter to waste cannot proceed, filter influent valve remains closed
12	ZOA-2107	Failure of air scour valve to open		Air scour blowers (C-200/201) cannot start, backwash cannot proceed
13	ZCA-2107	Failure of air scour valve to close		Backwash cannot proceed.

Filtration Alarms

No.	Alarm Tag	Alarm Description	Set Point	Consequence
14	UA-2001	Fault in Air Scour Blower C-200		If duty blower, set C-201 as duty pump.
15	UA-2011	Fault in Air Scour Blower C-201		If duty blower, set C-200 as duty pump.
16	LAH 2101	High level in filter	300mm above normal operating level	FCV 2101 filter inlet valve closed

6.4.1.3 Clearwell & Backwash Supply Alarms

Clearwell & Backwash Supply Alarms

No.	Alarm Tag	Alarm Description	Set Point	Consequence
1	UA-2051	Fault with Backwash Pump P-205		If duty pump, set P-206 as duty pump. If UA-2061 active, plant shut down & Plant Dial Out
2	UA-2061	Fault with Backwash Pump P-206		If duty pump, set P-205 as duty pump. If UA-2051 active, plant shut down & Plant Dial Out
3	LAL-2501	Low level in backwash pumping chamber		Backwash sequence disabled
4	LAH-2501	High level in backwash pumping chamber		Plant shut down

6.4.1.4 Chlorination Alarms

Chlorination Alarms

No.	Alarm Tag	Alarm Description	Set Point	Consequence
1	AAH-3401 Chlorine alarms are always active	Chlorine Leak	2 ppm	Ventilation in chlorine room stops. HN-3401 starts BA-3401 starts & Plant Dial Out

6.4.1.5 Fluoride, Orthophosphate & Hypochlorite Alarms

Fluoride, Orthophosphate & Hypochlorite Alarms

No.	Alarm Tag	Alarm Description	Set Point	Consequence
1	UA-3031	Zinc Orthophosphate Dosing Pump failure P-303		P-304 starts Plant Dial Out if UA-3041 is also active
2	UA-3041	Zinc Orthophosphate Dosing Pump failure P-304		P-303 starts Plant Dial Out if UA-3031 is also active
3	UA-3051	Hydro Fluorosilicic Pump failure P-305		P-306 starts Plant Dial Out if UA-3061 is also active
4	UA-3061	Hydro Fluorosilicic Pump failure P-306		P-305 starts Plant Dial Out if UA-3051 is also active
5	UA-3621	Caustic Soda Pump failure		P-363 starts
6	UA-3631	Caustic Soda Pump failure		P-362 starts

6.4.1.6 Waste Tankage Alarms

Waste Tankage Alarms

No.	Alarm Tag	Alarm Description	Set Point	Consequence
1	LAH-4001	High level in the backwash waste tank	3.1 m	Filters are locked out from backwashing and P-205 and P-206 shutdown & Plant Dial Out
2	LAH-4011	High level in the filter to waste tank	3.1 m	Filters are locked out from filter to waste mode & Plant Dial Out
3	FAH-4001	High flow out of backwash tank	10 L/s	FCV-4001 closes
4	FAH-4011	High flow out of filter to waste tank	5 L/s	FCV-4001 closes

6.4.1.7 Service Water Pumps Alarms

Service Water Pumps Alarms

No.	Alarm Tag	Alarm Description	Set Point	Consequence
1	UA-4101	Service Pump failure P-411		P-411 starts Plant Shutdown Plant Dial Out if UA-4011 is also active
2	UA-4111	Service Pump failure P-410		P-410 starts Plant Shutdown Plant Dial Out if UA-4101 is also active
3	PAL-4112	Low Pressure in service water	245 kPag	Plant Shutdown & Plant Dial Out

END OF CHAPTER 6

Chapter 7

MAINTENANCE

7.1 General Maintenance

7.1.1 Uninterruptable Power Supplies

Each of the uninterruptable power supplies (total of 4 – PLC cabinet, Plant PC, FCV 1001, and FCV2501) contains sealed lead acid batteries. These batteries will require annual inspection, and **replacement every 3 to 5 years**. Failure to do so will result in diminished or non performance of these power supplies and a resulting loss of control over the treatment process in event of a utility power failure. Refer to the UPS system manufacturers data for testing and battery replacement information.

7.1.2 pH analyzers (AIT 1002, 2502)

pH analyzers require routine calibration and maintenance. The unit should be inspected for leaks daily, and all leaks should be rectified immediately. Weekly checks should be performed to ensure there are sufficient grit particles in the measuring cell to keep the electrodes clean; grit particles should be added as necessary if there are insufficient amounts present. The grit particles have a two-month lifespan and should be replaced accordingly. The strainer in the sample water supply line leading to the unit should be removed and cleaned monthly to prevent contamination of the sampling water. The manufacturer's manual recommends removing and cleaning the pH electrode with diluted hydrochloric acid (at concentrations of 10% or less), then rinsing with water on a monthly basis. Following cleaning, the pH electrode will need to be recalibrated. The pH probe itself will have a fixed service life and will require regular replacement after two years of use. If the pH probe cannot be calibrated or the calibration of the probe drifts after calibration, the probe will also require replacement. Every two months, the potassium chloride electrolyte should be checked to ensure that the electrolyte solution is level with the bottom of the electrolyte reservoir neck. The reference electrolyte will need to be replaced every six months. Following two months of use, the two membranes in the electrode case should be checked, and if there are signs of discoloration, they should be

replaced. The manufacturers data provides detailed, step-by-step information on both calibration procedures and probe replacement procedures. A last note of caution is to not keep more than one spare probe on hand as the probes will also use up their shelf life while sitting unused.

7.1.3 Turbidimeters (AIT-1001, 2101, 2111, 2121, 2131)

Turbidity analyzers require routine calibration and maintenance. As a minimum, once every 2 months the turbidity analyzer should be cleaned and calibrated. Tubing should be replaced as necessary and the vial compartment cleaned as needed. Both the vial and desiccant cartridge should be replaced every two years. The turbidity measurement is performed using an optic technique, and the quality of the measurement is directly related to the cleanliness of the analyzer optics. Process conditions will further determine if the above-mentioned maintenance interval is sufficient. Clean analyzer optics and perform analyzer calibration in accordance with the manufactures instructions.

7.1.4 Chlorine Gas Detection (AIT 3401)

To ensure the safety of plant personnel, the chlorine gas detection system should be routinely tested to verify proper operation. At a minimum, the chlorine gas detection system should be tested and calibrated using actual chlorine gas on a monthly basis. Calibration can be done using a zero potentiometer. The battery vent should be cleaned monthly, and the battery backup should be verified to be in working order by removing the AC power. Testing should include the operation of alarm horn, beacon and the alarm dial out system. Testing and calibration should be performed in accordance with Section 4 of the manufacturers service manual. For additional reference, the manufacturer's manual also includes detailed, step-by-step instructions.

7.1.5 Residual Chlorine Analyzer (AIT 2501)

In order to ensure the accuracy of the residual chlorine measurement the residual chlorine analyzer must be regularly maintained. As the residual chlorine analyzer is in a combined arrangement with the pH analyzer unit, the maintenance requirements will be similar to that of the pH analyzer. The unit should be inspected for leaks daily, and all leaks should be rectified immediately. Weekly checks should be performed to ensure there are

sufficient grit particles in the measuring cell to keep the electrodes clean; grit particles should be added as necessary if there are insufficient amounts present. The grit particles have a two-month lifespan and should be replaced accordingly. The strainer in the sample water supply line leading to the unit should be removed and cleaned monthly to prevent contamination of the sampling water. Every two months, the potassium chloride electrolyte should be checked to ensure that the electrolyte solution is level with the bottom of the electrolyte reservoir neck. The reference electrolyte will need to be replaced every six months. Following two months of use, the two membranes in the electrode case should be checked, and if there are signs of discoloration, they should be replaced. The manufacturers data provides detailed, step-by-step information on both calibration and probe replacement procedures. A last note of caution is to not keep more than one spare probe on hand as the probes will also use up their shelf life while sitting unused. Performance of these routine maintenance intervals will require electrolytes and other consumable items. Ensure sufficient quantities of the required maintenance items are kept on hand. Testing and calibration should be performed in accordance with Section 4 of the manufacturers service manual.

7.1.6 Chlorinated Water Injection Flow Switch

The probe of the flow switch should be cleaned on a required basis by soaking or spraying with a solvent or detergent and water. Accumulated lime deposits can be safely removed by soaking in 20% hydrochloric acid. The manufacturer’s manual should be consulted for further details and troubleshooting procedures.

END OF CHAPTER 7

Chapter 8

TESTING AND CERTIFICATION DATA

8.1 General

Testing and certification data of relevant newly installed or replaced equipment as per the 2017 Water and Wastewater Facilities Improvement Upgrade are appended at the end of this chapter.

END OF CHAPTER 8

CERTIFICATIONS

INSPECTION & COMMISSIONING SHEETS

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Air Scour Blower #1

Tag #: C-200

Manufacturer		**Input**	
Make:	Delta Blower	Voltage (V):	575
Model:	GM 15L	Phase:	3
Description		Frequency (Hz):	60
Serial #:	804858	Nominal Current (A):	22.3
Explosion Proof:		Power (HP/W):	25 HP
Dust-Ignition Proof:		RPM:	3530
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

See attached detailed report with pictures.

System cannot be repaired and must be completely replaced.

Date of Inspection:	1 nov. 2017
Inspected By:	Robert Boudria
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Backwash Pump #2

Tag #: P-206

Manufacturer		**Input**	
Make:	Verti-line	Voltage (V):	230/460 Crossed out, 575
Model:	1200 14FHH	Phase:	3
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	65/32.5
Explosion Proof:		Power (HP/W):	25 HP
Dust-Ignition Proof:		RPM:	1175
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:	597 V	Current - Phase A:	19,5 A
Voltage - Phase B or B-C:	598 V	Current - Phase B:	20,2 A
Voltage - Phase C or C-A:	597 V	Current - Phase C:	19,5 A
Megger Phase A or A-B:	347 V	Rotation (CW, CCW):	
Megger Phase B or B-C:	347 V	RPM:	
Megger Phase C or C-A:	347 V	Overload Set (A):	

Inspection Comments & Recommendations

After inspection, the pump is good working order.
No mechanical or electrical issues were identified.
Pump #2 performance was found to be similar to #1.
The HMI was also tested and was found to be working well.
The PLC does not automatically switch between pumps. This must be done manually.

Worthwhile to note, the motor's nameplate has been modified.
Initially the voltage indicated was "230/460", but this has been scratched out and "575" has been inscribed beside it. See attached picture. The "Amps" has not been updated to this new voltage.

Date of Inspection:	31 oct. 2017
Inspected By:	~~Pierre~~ Luc Lajoie / Robert Boudreau / Krasimir Mitev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Service Water Pump #1 - Pump End

Tag #:

Manufacturer		**Input**	
Make:	Myers	Voltage (V):	—
Model:	6bP590	Phase:	—
Description		Frequency (Hz):	—
Serial #:	9990699 or 9990810	Nominal Current (A):	—
Explosion Proof:		Power (HP/W):	5HP
Dust-Ignition Proof:		~~RPM~~: GPM:	90
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

The pump end was found defective:
- 3 out of 4 impellers are broken.
- The center shaft broke off.

Sifec recommands to replace the entire unit (pump + motor) and keep motor for spare part / backup.

See attached pictures.

Date of Inspection:	11/15/2017
Inspected By:	Robert Boudria
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Service Water Pump #1 - Motor

Tag #:

Manufacturer		**Input**	
Make:	Franklin Electric	Voltage (V):	575
Model:	2366209020	Phase:	3
Description		Frequency (Hz):	60
Serial #:	25 0147	Nominal Current (A):	6.6
Explosion Proof:		Power (HP/W):	5
Dust-Ignition Proof:		RPM:	3450
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	3.9 (no-load)
Voltage - Phase B or B-C:		Current - Phase B:	4.0 (no-load)
Voltage - Phase C or C-A:		Current - Phase C:	3.9 (no-load)
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

After motor was disconnected from pump head, and motor was cleaned, it was found to be servicable.

The coupling parts between pump and motor were found in bad condition and must be replaced.

Sifec recommends to replace the complete unit (pump + motor), but keep this motor on the shelf for spare part or backup.

See attached pictures.

Date of Inspection:	11/15/2017
Inspected By:	Robert Boudria
Signature:	

SIPEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Turbidity METER Filter-2

Tag #: AIT - 2112

Manufacturer		**Input**	
Make:	HACH	Voltage (V):	100-240 VAC +/-10%
Model:	SC200	Phase:	
Description		Frequency (Hz):	50-60Hz
Serial #:	1708C0149722	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver	4 to 20 mA	Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

4 - 20 mA
0 - 20 NTU

Date of Inspection:	08-17-2017
Inspected By:	Pierre-Luc Lajoie
Signature:	

ISO 9001 Certified

CALIBRATION TEST CERTIFICATE
SC200 Controller

Model	Serial Number	Date	SW Ver	Result
LXV404.99.00552	1708C0149722	08/17/2017	2.04	PASS

Tested Characteristic	Min	Max	Value	
Probe Recognition			-	PASS
Display			-	PASS
Keypad			-	PASS
Relays			-	PASS
Dielectric Withstanding (Hipot)			-	PASS
4-20mA Output 1 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 1 @ 20mA	19.95	20.05	19.98mA	PASS
4-20mA Output 2 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 2 @ 20mA	19.95	20.05	19.98mA	PASS

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Filter 2

ISO 9001 Certified

TU5300 sc

Certificate of Final Inspection

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Part No.	Gerätenummer, n°d'appareil	**LXG445.99.10112**
Serial No.	Seriennummer, numéro de série	***1693967***
Method Compliance		EPA
General Function	Allgemeine Funktion, fonction générale :	
SC Communication		ok
Lid Detection		ok
Humidity protection system		ok
RFID Function		N. A.
Factory Calibration	Werkskalibrierung, Etalonnage d'usine:	
StablCal® Calibration Curve	StablCal® Kalibrierung, StablCal® Courbe d'étalonnage	
20 NTU and 600 NTU	20 NTU und 600 NTU, 20 NTU et 600 NTU	ok
Turbidity Data	Trübungswerte, data turbidité:	
Secondary Turbidity Standard >20 NTU	Sekundär Trübungsstandard >20 NTU, Etalon secondaire de turbidité >20 NTU	
set number	Satznummer; set de contrôle	*0001*
Reference Instrument	Referenzgerät, instrument de référence	29.3 NTU
Tolerance	Toleranz, tolérance:	± 5 %
E.U.T	Prüfling, objet d'essai	**29.4 NTU**
Secondary Turbidity Standard <0.1 NTU	Sekundär Trübungsstandard <0.1 NTU, Etalon secondaire de turbidité <0.1 NTU	
set number	Satznummer; set de contrôle	*0035*
Reference Instrument	Referenzgerät, instrument de référence	0.012 NTU
Tolerance	Toleranz, tolérance:	± 0.007 NTU
E.U.T	Prüfling, objet d'essai	**0.011 NTU**
Date	Datum, date:	Oct 25, 2016
Inspector	Bearbeiter, opérateur:	*Rene Zabel*
Sign	Unterschrift, signature :	Rene Zabel

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This document contains information which is only required for the export of this instrument into the People's Republic of China.

Ce document contient les informations nécessaires pour l'exportation d'instruments vers la République Populaire de Chine.

本手册只包含出口到中华人民共和国的仪器的必要信息。

P/N: LXG445.xx.xxxxx Model: TU 5300sc/TU5400sc

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
CPU PCB (TU) CPU PCB	x	O	O	O	O	O
Enclosure 机壳	x	O	O	O	O	O
Measuring Unit 测量单元	x	O	O	O	O	O
Sensorcable 传感器电缆	x	O	O	O	O	O
Pumps/Motors/Actuators 泵/电机/励磁器	x	O	O	O	O	O
Metal Tubing and Fittings 金属管和接头	x	O	O	O	O	O
Accessory 附件	x	O	O	O	O	O
Drying Cartridge 干燥筒	x	O	O	O	O	O

○：表示该项目中涉及的所有物料，其包含的有害物质的含量低于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572-2011).

×：表示该项目中涉及的所有物料中至少有一种，其包含的有害物质的含量高于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in at least one Homogeneous Material of the part exceeds the concentration limit requirement as described in GB/T 26572-2011)

对销售之日的所售产品，本表显示，朗讯供应链的电子信息产品可能包含这些物质。注意：在所售产品中可能会也可能不会含有所有所列的部件
This table shows where these substances may be found in the supply chain of "Company" electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product.

除非另外特别的标注，此标志为针对所涉及产品的环保使用期标志. 某些可更换的零部件会有一个不同的环保使用期(例如，电池单元模块)贴在其产品上.
此环保使用期限只适用于产品是在产品手册中所规定的条件下工作.
The Environmentally Friendly Use Period (EFUP) for all enclosed products and their parts are per the symbol shown here, unless otherwise marked. Certain field-replaceable parts have a different EFUP (for example, battery modules) and so are marked to reflect such. The Environmentally Friendly Use Period is valid only when the product is operated under the conditions defined in the product manual.

HDQ927 Rev. 02

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EC-Declaration of Conformity

EG-Konformitätserklärung / CE-Declaración de conformidad / CE- Déclaration de Conformité / CE-Dichiarazione di Conformità

Manufacturer/Hersteller/Fabricante/Fabricant/Produttore:

HACH LANGE GmbH, Königsweg 10, 14163 Berlin; Germany – Tel. +49 (0)30-80986-0 - **www.de.hach.com**

Part Number/Artikelnummer/ Numéro de artículo/Numéro article/Codice articolo:	**Model**/Modell/ Modelo/Modèle/Modello:	**Designation**/Beschreibung/ Designación/Désignation/Denominazione:
LXG445.xx.x01x2 / LXG445.xx.x11x2	**TU5300 sc (EPA/ISO)**	**Turbidity sensor without RFID** (3.0mNTU)
LXG445.xx.x02x2 / LXG445.xx.x12x2	**TU5400 sc (EPA/ISO)**	**Turbidity sensor without RFID** (0.3mNTU)
Including optional accessories /inklusive optionales Zubehör/ Incluyendo accesorios opcionales / Incluant les accessoires optionnels / Compresi gli accessori opzionali:		*)

The product complies with the essential requirements of the following Directive(s) / Das bezeichnete Produkt entspricht den wesentlichen Anforderungen der nachfolgend bezeichneten Richtlinie(n) / El producto es conforme con los requisitos esenciales de la (s) siguientes Directiva (s) / Le produit est conforme aux exigences essentielles de la (des) Directive(s) suivante(s) / Il prodotto è conforme ai requisiti essenziali della seguente Direttiva (e).

2014/30/EU	**EMC Directive**
2006/42/EC	**Machinery Directive**

The following harmonized standards were used to meet the requirements of the stated Directive(s) / Die folgende(n) harmonisierte(n) Norm(en) wurde(n) zur Einhaltung der Anforderungen der genannten Richtlinie(n) angewendet / Para cumplir los requisitos de las directivas mencionadas se han aplicado las siguientes normas armonizadas / Les normes harmonisées suivantes ont été utilisées pour satisfaire aux exigences de la (des) Directive(s) mentionnée(s) / Le seguenti norme armonizzate sono state usate per soddisfare i requisiti della Direttiva (e) indicate.

EN 61326-1: 2013-01	**Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements**

In addition the following standards have been applied in the development of the product / Darüber hinaus wurde(n) folgende(n) Norm(en) bei der Entwicklung des Produktes angewendet / Además, durante el desarrollo del producto, se han aplicado las siguientes normas / En complément, les normes suivantes ont été utilisées pour le développement du produit / Inoltre, sono stati applicati i seguenti Standard nello sviluppo del prodotto.

EN 61010-1: 2010-10	**Safety requirements for electrical equipment – General requirements**
EN 60825-1: 2014-08	**Safety of laser products - Part 1: Equipment classification and requirements**

*) See separate Declaration of Conformity of the optional accessories / Siehe separate Konformitätserklärung für das optionale Zubehör / Ver la Declaración de Conformidad para los accesorios opcionales / Voir déclaration de conformité des accessoires optionnels / Vedi dichiarazione di conformità separata delle accessori opzionali.

Authorised Person to compile the technical file / Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen / Persona autorizada para elaborar el expediente técnico / Personne autorisée à constituer le dossier technique / Persona autorizzata a costituire il fascicolo tecnico:

Michael Schuster – Product Compliance EU - HACH LANGE GmbH; Willstätter Str.11; 40549 Düsseldorf

This statement applies to all versions of the named product, which are prepared by the necessary technical documentation / Diese Erklärung gilt für alle Ausführungen des genannten Produktes, die nach der erforderlichen technischen Dokumentation hergestellt werden / Esta declaración se aplica a todas las versiones del producto designado, que son preparadas por la documentación técnica necesaria / Cette déclaration s'applique à toutes les versions du produit mentionné / Questa dichiarazione si applica a tutte le versioni del prodotto indicato, che sono stati preparati dalla documentazione tecnica necessaria.

Year of primary CE marking of the product / Jahr der ersten CE Kennzeichnung des Produktes / Año de la primera marca CE del producto / Année du premier marquage CE du produit / Anno del primo prodotto CE: **2014**

LXC445.xx.x1xx2 Rev.03

Düsseldorf, 2016/May/11

ppa. _____
Director Operations ppa. Christian Kraatz

i.V. _____
CE Coordinator i.V. Michael Schuster

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SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Cl2/PH Meter WTP (Raw Water)

Tag #: A.I.-1001

Manufacturer		**Input**	
Make:	EVOQUA	Voltage (V):	115V
Model:	EH Depolox 3 PLUS	Phase:	
Description		Frequency (Hz):	50/60
Serial #:	7105977	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	14W
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver	4@20 Mah	Limit Switch	
		HP/CL	03-12-2017 CF

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Output 1 To Cl2
Output 2
Output 3 PH → 4 To 20 Mah = PH4 To PH10

Date of Inspection:	08-11-2017
Inspected By:	Pierre-Luc Lajoie
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: CL/PH Meter WTP (Treated Water)

Tag #: A.T - 2501/2502

Manufacturer		**Input**	115V
Make:	EVOQUA	Voltage (V):	
Model:	EM Depolox 3 PLUS	Phase:	
Description		Frequency (Hz):	50/60
Serial #:	7105976	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	14W
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver		Limit Switch	
		PH/CL	08-12-2017 CA

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Output 1 T° → T° @ 5 Mg/L = 4 To 20 Mah → I: 09/00

Output 2 CL

Output 3 PH → 4 @ 10 PH = 4 To 20 Mah → I: 09/01

Date of Inspection:	08-12-2017
Inspected By:	Pierre Lebaje
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Flow Meter

Tag #: A.T-5000

Manufacturer		**Input**	
Make:	Endress and Hauser	Voltage (V):	24V
Model:	PROMAG W	Phase:	
Description		Frequency (Hz):	
Serial #:	MB 007716000	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Max 7500 USGal/Min
10" cl 150

Date of Inspection:	08-12-2017
Inspected By:	Pierre-Luc Tétreault
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Flow Switch CL WTP

Tag #: N/A

Manufacturer		**Input**	
Make:	Magnetrol	Voltage (V):	24 DC
Model:	TD-2000-030/Tec-A110-004	Phase:	
Description		Frequency (Hz):	
Serial #:	789772-01-004	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Date of Inspection:	08-11-2017
Inspected By:	Pierre-Luc Lajoie
Signature:	

SIPEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Turbidity METER Filter - 1

Tag #: AIT - 2102

Manufacturer		**Input**	
Make:	HACH	Voltage (V):	100 - 240 VAC +/- 10%.
Model:	SC200	Phase:	
Description		Frequency (Hz):	50 - 60 Hz
Serial #:	1610C0138351	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver	4 to 20 mA	Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

4 - 20 mA
0 - 20 NTU

Date of Inspection:	06-12-2017
Inspected By:	Pierre-Luc Lajoie
Signature:	

ISO 9001 Certified

CALIBRATION TEST CERTIFICATE
SC200 Controller

Model	Serial Number	Date	SW Ver	Result
LXV404.99.00552	1610C0138351	10/10/2016	2.01	PASS

Tested Characteristic	Min	Max	Value	
Probe Recognition			-	PASS
Display			-	PASS
Keypad			-	PASS
Relays			-	PASS
Dielectric Withstanding (Hipot)			-	PASS
4-20mA Output 1 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 1 @ 20mA	19.95	20.05	19.98mA	PASS
4-20mA Output 2 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 2 @ 20mA	19.95	20.05	20.00mA	PASS

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Filter 1

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Certificate of Final Inspection

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Part No.	Gerätenummer, n°d'appareil	**LXG445.99.10112**
Serial No.	Seriennummer, numéro de série	***1694338***
Method Compliance		EPA
General Function	Allgemeine Funktion, fonction générale :	
SC Communication		ok
Lid Detection		ok
Humidity protection system		ok
RFID Function		N. A.
Factory Calibration	Werkskalibrierung, Etalonnage d'usine:	
StablCal® Calibration Curve	StablCal® Kalibrierung, StablCal® Courbe d'étalonnage	
20 NTU and 600 NTU	20 NTU und 600 NTU, 20 NTU et 600 NTU	ok
Turbidity Data	Trübungswerte, data turbidité:	
Secondary Turbidity Standard >20 NTU	Sekundär Trübungsstandard >20 NTU, Etalon secondaire de turbidité >20 NTU	
set number	Satznummer; set de contrôle	*0001*
Reference Instrument	Referenzgerät, instrument de référence	29.3 NTU
Tolerance	Toleranz, tolérance:	± 5 %
E.U.T	Prüfling, objet d'essai	**29.7 NTU**
Secondary Turbidity Standard <0.1 NTU	Sekundär Trübungsstandard <0.1 NTU, Etalon secondaire de turbidité <0.1 NTU	
set number	Satznummer; set de contrôle	*0035*
Reference Instrument	Referenzgerät, instrument de référence	0.012 NTU
Tolerance	Toleranz, tolérance:	± 0.007 NTU
E.U.T	Prüfling, objet d'essai	**0.011 NTU**
Date	Datum, date:	Oct 26, 2016
Inspector	Bearbeiter, opérateur:	*Rene Zabel*
Sign	Unterschrift, signature :	Rene Zabel

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This document contains information which is only required for the export of this instrument into the People's Republic of China.

Ce document contient les informations nécessaires pour l'exportation d'instruments vers la République Populaire de Chine.

本手册只包含出口到中华人民共和国的仪器的必要信息。

P/N: LXG445.xx.xxxxx Model: TU 5300sc/TU5400sc

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
CPU PCB (TU) CPU PCB	x	O	O	O	O	O
Enclosure 机壳	x	O	O	O	O	O
Measuring Unit 测量单元	x	O	O	O	O	O
Sensorcable 传感器电缆	x	O	O	O	O	O
Pumps/Motors/Actuators 泵/电机/励磁器	x	O	O	O	O	O
Metal Tubing and Fittings 金属管和接头	x	O	O	O	O	O
Accessory 附件	x	O	O	O	O	O
Drying Cartridge 干燥筒	x	O	O	O	O	O

○：表示该项目中涉及的所有物料，其包含的有害物质的含量低于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572-2011).

×：表示该项目中涉及的所有物料中至少有一种，其包含的有害物质的含量高于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in at least one Homogeneous Material of the part exceeds the concentration limit requirement as described in GB/T 26572-2011)

对销售之日的所售产品，本表显示，朗讯供应链的电子信息产品可能包含这些物质。注意：在所售产品中可能会也可能不会含有所有所列的部件
This table shows where these substances may be found in the supply chain of "Company" electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product.

除非另外特别的标注，此标志为针对所涉及产品的环保使用期标志. 某些可更换的零部件会有一个不同的环保使用期(例如，电池单元模块)贴在其产品上.
此环保使用期限只适用于产品是在产品手册中所规定的条件下工作.
The Environmentally Friendly Use Period (EFUP) for all enclosed products and their parts are per the symbol shown here, unless otherwise marked. Certain field-replaceable parts have a different EFUP (for example, battery modules) and so are marked to reflect such. The Environmentally Friendly Use Period is valid only when the product is operated under the conditions defined in the product manual.

HDQ927 Rev. 02

EUROPE:
HACH LANGE GMBH • Willstätterstraße 11 • D-40549 Düsseldorf • Germany • Phone +49(0)211-5288-0 • Fax +49(0)211-5288-143 • info-de@hach.com
USA and Rest of World:
Hach Company • P.O. Box 389 • Loveland • Colorado • 80539-0389 • USA • Tel 800-227-4224 • Fax: 970-669-2932 • techhelp@hach.com

EC-Declaration of Conformity

EG-Konformitätserklärung / CE-Declaración de conformidad / CE- Déclaration de Conformité / CE-Dichiarazione di Conformità

Manufacturer/Hersteller/Fabricante/Fabricant/Produttore:

HACH LANGE GmbH, Königsweg 10, 14163 Berlin; Germany – Tel. +49 (0)30-80986-0 - **www.de.hach.com**

Part Number/Artikelnummer/ Numéro de articulo/Numéro article/Codice articolo:	**Model**/Modell/ Modelo/Modèle/Modello:	**Designation**/Beschreibung/ Designación/Désignation/Denominazione:
LXG445.xx.x01x2 / LXG445.xx.x11x2	**TU5300 sc (EPA/ISO)**	**Turbidity sensor without RFID** (3.0mNTU)
LXG445.xx.x02x2 / LXG445.xx.x12x2	**TU5400 sc (EPA/ISO)**	**Turbidity sensor without RFID** (0.3mNTU)
Including optional accessories /inklusive optionales Zubehör/ Incluyendo accesorios opcionales / Incluant les accessoires optionnels / Compresi gli accessori opzionali:		*)

The product complies with the essential requirements of the following Directive(s) / Das bezeichnete Produkt entspricht den wesentlichen Anforderungen der nachfolgend bezeichneten Richtlinie(n) / El producto es conforme con los requisitos esenciales de la (s) siguientes Directiva (s) / Le produit est conforme aux exigences essentielles de la (des) Directive(s) suivante(s) / Il prodotto è conforme ai requisiti essenziali della seguente Direttiva (e).

2014/30/EU	**EMC Directive**
2006/42/EC	**Machinery Directive**

The following harmonized standards were used to meet the requirements of the stated Directive(s) / Die folgende(n) harmonisierte(n) Norm(en) wurde(n) zur Einhaltung der Anforderungen der genannten Richtlinie(n) angewendet / Para cumplir los requisitos de las directivas mencionadas se han aplicado las siguientes normas armonizadas / Les normes harmonisées suivantes ont été utilisées pour satisfaire aux exigences de la (des) Directive(s) mentionnée(s) / Le seguenti norme armonizzate sono state usate per soddisfare i requisiti della Direttiva (e) indicate.

EN 61326-1: 2013-01	**Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements**

In addition the following standards have been applied in the development of the product / Darüber hinaus wurde(n) folgende(n) Norm(en) bei der Entwicklung des Produktes angewendet / Además, durante el desarrollo del producto, se han aplicado las siguientes normas / En complément, les normes suivantes ont été utilisées pour le développement du produit / Inoltre, sono stati applicati i seguenti Standard nello sviluppo del prodotto.

EN 61010-1: 2010-10	**Safety requirements for electrical equipment – General requirements**
EN 60825-1: 2014-08	**Safety of laser products - Part 1: Equipment classification and requirements**

*) See separate Declaration of Conformity of the optional accessories / Siehe separate Konformitätserklärung für das optionale Zubehör / Ver la Declaración de Conformidad para los accesorios opcionales / Voir déclaration de conformité des accessoires optionnels / Vedi dichiarazione di conformità separata delle accessori opzionali.

Authorised Person to compile the technical file / Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen / Persona autorizada para elaborar el expediente técnico / Personne autorisée à constituer le dossier technique / Persona autorizzata a costituire il fascicolo tecnico:

Michael Schuster – Product Compliance EU - HACH LANGE GmbH; Willstätter Str.11; 40549 Düsseldorf

This statement applies to all versions of the named product, which are prepared by the necessary technical documentation / Diese Erklärung gilt für alle Ausführungen des genannten Produktes, die nach der erforderlichen technischen Dokumentation hergestellt werden / Esta declaración se aplica a todas las versiones del producto designado, que son preparadas por la documentación técnica necesaria / Cette déclaration s'applique à toutes les versions du produit mentionné / Questa dichiarazione si applica a tutte le versioni del prodotto indicato, che sono stati preparati dalla documentazione tecnica necessaria.

Year of primary CE marking of the product / Jahr der ersten CE Kennzeichnung des Produktes / Año de la primera marca CE del producto / Année du premier marquage CE du produit / Anno del primo prodotto CE: **2014**

LXC445.xx.x1xx2 Rev.03

Düsseldorf, 2016/May/11

ppa. _____
Director Operations ppa. Christian Kraatz

i.V. _____
CE Coordinator i.V. Michael Schuster

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Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Raw Turbity Meter WTP

Tag #: AIT - 601

Manufacturer		**Input**	
Make:	Hach	Voltage (V):	100 - 240
Model:	SC 200	Phase:	
Description		Frequency (Hz):	50/60
Serial #:	1708C015905	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:	4-20 mA	Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

4/- 20 mA 0 - 20 NTU

Date of Inspection:	08-12-2017
Inspected By:	Pierre-Luc Joyce
Signature:	

ISO 9001 Certified

CALIBRATION TEST CERTIFICATE
SC200 Controller

Model	Serial Number	Date	SW Ver	Result
LXV404.99.00552	1708C0159005	08/17/2017	2.04	PASS

Tested Characteristic	Min	Max	Value	
Probe Recognition			-	PASS
Display			-	PASS
Keypad			-	PASS
Relays			-	PASS
Dielectric Withstanding (Hipot)			-	PASS
4-20mA Output 1 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 1 @ 20mA	19.95	20.05	19.99mA	PASS
4-20mA Output 2 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 2 @ 20mA	19.95	20.05	19.98mA	PASS

Test Equipment used for the verification of Hach manufactured instruments is calibrated using standards traceable to the National Institute of Standards and Technology (NIST).

For Technical Service, Price Information and Ordering in the U.S.A. call toll-free 1-800-227-4224. Outside the U.S.A. contact the Hach Office or Distributor serving you. On the Worldwide Web visit www.hach.com; E-mail: techhelp@hach.com

ISO 9001 Certified

TU5300 sc

Certificate of Final Inspection

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Part No.	Gerätenummer, n°d'appareil	**LXG445.99.10112**
Serial No.	Seriennummer, numéro de série	***1762282***
Method Compliance		EPA
General Function	Allgemeine Funktion, fonction générale :	
SC Communication		ok
Lid Detection		ok
Humidity protection system		ok
RFID Function		N. A.
Factory Calibration	Werkskalibrierung, Etalonnage d'usine:	
StablCal® Calibration Curve	StablCal® Kalibrierung, StablCal® Courbe d'étalonnage	
20 NTU and 600 NTU	20 NTU und 600 NTU, 20 NTU et 600 NTU	ok
Turbidity Data	Trübungswerte, data turbidité:	
Secondary Turbidity Standard >20 NTU	Sekundär Trübungsstandard >20 NTU, Etalon secondaire de turbidité >20 NTU	
set number	Satznummer; set de contrôle	*0002*
Reference Instrument	Referenzgerät, instrument de référence	29.8 NTU
Tolerance	Toleranz, tolérance:	± 5 %
E.U.T	Prüfling, objet d'essai	**29.4 NTU**
Secondary Turbidity Standard <0.1 NTU	Sekundär Trübungsstandard <0.1 NTU, Etalon secondaire de turbidité <0.1 NTU	
set number	Satznummer; set de contrôle	*0141*
Reference Instrument	Referenzgerät, instrument de référence	0.011 NTU
Tolerance	Toleranz, tolérance:	± 0.007 NTU
E.U.T	Prüfling, objet d'essai	**0.011 NTU**
Date	Datum, date:	Oct 13, 2017
Inspector	Bearbeiter, opérateur:	*Marcel Fritzlar*
Sign	Unterschrift, signature :	

Please add this certificate to your documents.
Bitte verwahren Sie dieses Zertifikat bei Ihren Unterlagen auf.
S'il vous plaît, conservez scrupuleusement ce certificat dans vos archives.

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P/N: LXG445.xx.xxxxx Model: TU 5300sc/TU5400sc

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
CPU PCB (TU) CPU PCB	x	O	O	O	O	O
Enclosure 机壳	x	O	O	O	O	O
Measuring Unit 测量单元	x	O	O	O	O	O
Sensorcable 传感器电缆	x	O	O	O	O	O
Pumps/Motors/Actuators 泵/电机/励磁器	x	O	O	O	O	O
Metal Tubing and Fittings 金属管和接头	x	O	O	O	O	O
Accessory 附件	x	O	O	O	O	O
Drying Cartridge 干燥筒	x	O	O	O	O	O

O：表示该项目中涉及的所有物料，其包含的有害物质的含量低于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572-2011).

×：表示该项目中涉及的所有物料中至少有一种，其包含的有害物质的含量高于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in at least one Homogeneous Material of the part exceeds the concentration limit requirement as described in GB/T 26572-2011)

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HDQ927 Rev. 02

EUROPE:
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Hach Company • P.O. Box 389 • Loveland • Colorado • 80539-0389 • USA • Tel 800-227-4224 • Fax: 970-669-2932 • techhelp@hach.com

EU-Declaration of Conformity

EU-Konformitätserklärung / UE-Declaración de conformidad / UE- Déclaration de Conformité / UE-Dichiarazione di Conformità

Manufacturer/Hersteller/Fabricante/Fabricant/Produttore:

HACH LANGE GmbH, Königsweg 10, 14163 Berlin; Germany – Tel. +49(0)30-80 986-0 - **www.de.hach.com**

Part Number/Artikelnummer/ Numéro de artículo/Numéro article/Codice articolo:	**Model**/Modell/ Modelo/Modèle/Modello:	**Designation**/Beschreibung/ Designación/Dèsignation/Denominazione:
LXG445.xx.x01x2 / LXG445.xx.x11x2	**TU5300 sc (EPA/ISO)**	**Turbidity sensor without RFID**
LXG445.xx.x02x2 / LXG445.xx.x12x2	**TU5400 sc (EPA/ISO)**	**Turbidity sensor without RFID**
Including optional accessories /inklusive optionales Zubehör/ Incluyendo accesorios opcionales / Incluant les accessoires optionnels / Compresi gli accessori opzionali:		*)

The product complies with the essential requirements of the following Directive(s) / Das bezeichnete Produkt entspricht den wesentlichen Anforderungen der nachfolgend bezeichneten Richtlinie(n) / El producto es conforme con los requisitos esenciales de la (s) siguientes Directiva (s) / Le produit est conforme aux exigences essentielles de la (des) Directive(s) suivante(s) / Il prodotto è conforme ai requisiti essenziali della seguente Direttiva (e).

2011/65/EU	**RoHS Directive**
2006/42/EC	**Machinery Directive**
2014/30/EU	**EMC Directive**

The following harmonized standards were used to meet the requirements of the stated Directive(s) / Die folgende(n) harmonisierte(n) Norm(en) wurde(n) zur Einhaltung der Anforderungen der genannten Richtlinie(n) angewendet / Para cumplir los requisitos de las directivas mencionadas se han aplicado las siguientes normas armonizadas / Les normes harmonisées suivantes ont été utilisées pour satisfaire aux exigences de la (des) Directive(s) mentionnée(s) / Le seguenti norme armonizzate sono state usate per soddisfare i requisiti della Direttiva (e) indicate.

EN 50581: 2012	**Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances**
EN 61326-1: 2013	**Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements**

In addition the following standards have been applied in the development of the product / Darüber hinaus wurde(n) folgende(n) Norm(en) bei der Entwicklung des Produktes angewendet / Además, durante el desarrollo del producto, se han aplicado las siguientes normas / En complément, les normes suivantes ont été utilisées pour le développement du produit / Inoltre, sono stati applicati i seguenti Standard nello sviluppo del prodotto.

EN 61010-1: 2010	**Safety requirements for electrical equipment – General requirements**
EN 60825-1: 2014	**Safety of laser products - Part 1: Equipment classification and requirements**

*) See separate Declaration of Conformity of the optional accessories / Siehe separate Konformitätserklärung für das optionale Zubehör / Ver la Declaración de Conformidad para los accesorios opcionales / Voir déclaration de conformité des accessoires optionnels / Vedi dichiarazione di conformità separata delle accessori opzionali.

Authorised Person to compile the technical file / Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen / Persona autorizada para elaborar el expediente técnico / Personne autorisée à constituer le dossier technique / Persona autorizzata a costituire il fascicolo tecnico:

Michael Schuster – Product Compliance EU - HACH LANGE GmbH; Willstätterstrasse 11; 40549 Düsseldorf

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Year of primary CE marking of the product / Jahr der ersten CE Kennzeichnung des Produktes / Año de la primera marca CE del producto / Année du premier marquage CE du produit / Anno del primo prodotto CE: **2014**

Berlin, 2017/March/01

ppa.

Director Operations ppa. Christian Kraatz

i.V.

CE Coordinator i.V. Michael Schuster

LXG445.xx.x1xx2 Rev.04

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Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Pressur TRANSMITER RAW WATER - PIT 1001

Tag #: _____

Manufacturer		**Input**	
Make:	ENDRESS + HAUSER	Voltage (V):	11,5 ÷ 45 V DC
Model:	PMC 71 - 34538/101	Phase:	
Description		Frequency (Hz):	
Serial #:	MA037C1509C	Nominal Current (A):	4 ÷ 20 mA
Explosion Proof:	—	Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
/oltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

MWP- 2,7 MPa
4 ÷ 20 mA HART
SPAN - 0,01/1 MPa
CaL /Adj. - 0 ÷ 750 K Pa ← REAL SETTING
Ext. ord. cod - PMC71-XCC1PERDAAU+Z1
Mat. - AL203 1,4404/316L TYPE 4X/6P
P: -100 ÷ 1000 K Pa

Date of Inspection:	08/11/2017
Inspected By:	KRASIMIR MITREV
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: HydroFluorAsiLicic pump ACiD
Tag #: P-305

Manufacturer	LMI	**Input**	
Make:	ROYTRONIC EXCEL	Voltage (V):	95-240 VAC
Model:	AD941-920SI	Phase:	
Description		Frequency (Hz):	50/60 HZ
Serial #:	171143848 19-1	Nominal Current (A):	1.4 AMP
Explosion Proof:		Power (HP/W):	20 W
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

MAX Flow .50 GPH 250 PSI
1.89 L/H 17.237 BAR

ANALOG output: 4-20 mA = 0-120 SPM

Date of Inspection:	10-12-2017
Inspected By:	STEPHAN GAGNE
Signature:	

SIPEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: HYDROFluoRAsilicic pump ACID
Tag #: P-306

Manufacturer	LMI	**Input**	
Make:	ROYTRONIC EXCEL	Voltage (V):	95-240 VAC
Model:	AD941-920SI	Phase:	
Description		Frequency (Hz):	50/60 HZ
Serial #:	1711384819-2	Nominal Current (A):	1.4 Amp
Explosion Proof:		Power (HP/W):	20W
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

MAX Flow .50 GPH 250 PSI
1.89 l/H 17.237 BAR

ANALOG OUTPUT 4-20 mA = 0-120 SPM

Date of Inspection:	10-12-2017
Inspected By:	STEPHAN GAGNE
Signature:	Steph Gagné

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Cl2 GAS MONITOR WTP

Tag #:

Manufacturer	EVOQUA	**Input**	
Make:		Voltage (V):	10-15 - VDC 10-15 VDC
Model: KIT	W2T11692	Phase:	
Description		Frequency (Hz):	
Serial #:	A14-11-22701-HC	Nominal Current (A):	0-3 Amp
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	
RELAY	: 10A 120 VAC - 5A 250 VAC	OUTPUT	4-20 MA - 1000 ohm MAX

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Cl2 Monitor Module S/N A14-11-22701-HC
Cl2 TRANSMITTER S/N A-11-11-36259-OC
Cl2 SENSOR S/N A10-11-66685

Date of Inspection:	10-12-2017
Inspected By:	STEPHAN GAGNE
Signature:	

SIPEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711
Equipment: Soude caustique Pump - Microprocessor Dosing pump
Tag #: P-362

Manufacturer	LMI MILTON ROY	**Input**	
Make:		Voltage (V):	120 volts AC
Model:	B931-362SI	Phase:	
Description		Frequency (Hz):	50/60 HZ
Serial #:	171143848 24-2	Nominal Current (A):	1.50 Amp
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

MAX GPH 4.50
PSI 50

Date of Inspection:	10-12-2017
Inspected By:	STEPHAN GAGNE
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Soude Caustique Pump - Microprocessor Dosing pump

Tag #: P-363

Manufacturer	LMI MILTON ROY	**Input**	
Make:		Voltage (V):	120 Volts AC
Model:	B931-362SI	Phase:	
Description		Frequency (Hz):	50/60 HZ
Serial #:	17114384824-1	Nominal Current (A):	1.50 AMP
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

PSI - 50

MAX GPH - 4.50

Date of Inspection:	10-12-2017
Inspected By:	STEPHAN GAGNE
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves

Tag #: FCV - 1001

Manufacturer		**Input**	
Make:	Bray Serie 70	Voltage (V):	120
Model:	70-0121-11340-536	Phase:	
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17
Analog output 4@20Mah => open to close		Led Light Panphead	Nov 17

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service Raw Water
Torque 1200 lb/pi
Speed 30 sec / 1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	K Rasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves

Tag #: V-1012

Manufacturer		**Input**	
Make:	Bray Series 70	Voltage (V):	120
Model:	70-6651-113A0-536	Phase:	
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	3
Explosion Proof:		Power (HP/W):	8
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017
Digital output I:0		Led Light Replaced	Nov 2017

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service Raw Water OV
Torque 6500 lb-/pi
Speed 30 sec / 1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	KRASIMIR MITREV
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: V-1009

Manufacturer		**Input**	
Make:	Bray Serie 70	Voltage (V):	120
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017
Digital output open/close		Led ~~Switch~~ Light	Nov 2017

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service Raw Water UV
Torque 6500 lb-in
Speed 30 sec / 1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2101

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2.3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 KM
Digital output open/Close		Led Light installed	Nov 2017 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Raw Water filter 1
Torque: 6500 lb/pi
Speed: 30 sec / 1/4 Turn

Date of Inspection:	10-11-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2101

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2.3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KA
Digital output Open/Close		Led Light installed	Nov 17 KA

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: River water filter 2
Torque: 6500 lb/in
Speed: 30 sec/1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	KRASimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2121

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 RM
Digital output open/close		Led Light installed	Nov 17 RM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Raw water filter 3
Torque 6500 lbf/pi
speed 30 sec / 1/4 turn

Date of Inspection:	10-11-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuators

Tag #: FCV-2131

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-113AO-536	Phase:	
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KH
Digital output open/close		Led Light installed	Nov 17 KH

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Raw water filter 4
Torque: 6500 lb/in
Speed: 30 sec / 1/4 Turn

Date of Inspection:	10-11-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2103

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-021-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7 / 2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 RH
Analog output 4@20 Mah close to open		Led Light installed	Nov 17 KM

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 1 filtered water to Waste Tank
Torque : 1200 lb/pi
Speed : 30sec/1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2113

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0121-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7/2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KH
Analog output 4@20 mah = close to open		Led Light installed	Nov 17 KH

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 2 filtered water to Waste Tank
Torque: 1200 lb/in
speed: 30 sec / 1/4 turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2123

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0121-113A0-636	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7/2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Row 17 KH
analog output 4@20 mA => close to open		Led Light installed	Row 17 KH

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 3 Filtered Water to waste tank
Torque: 1200 lb-pi
Speed: 30 sec / 1/4 turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2133

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120V
Model	70-0121-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7/2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KM
analog output 4 to 20mA => close to open		Led Light installed	Nov 17 KM

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 4 filtered Water to waste Tank
Torque: 1200 lb/pi
Speed: 30 sec/pi

Date of Inspection:	10-12-2017
Inspected By:	KRASIMIR MITREV
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Bray Control valve actuators

Tag #: FCV-2164

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0121-1130-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7 / 2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver		Limit Switch	Nov 17 KH
analog output 4 To 20mA = 7 close to open		Led Light installed	Nov 17 KH

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 1 filtered Water To Clearwell inlet chamber
Torque: 1200 lb/pi
Speed: 30 sec/pi

Date of Inspection:	10-11-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control valves actuator

Tag #: FCV-2114

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0121-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7/2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Raw 207 Km
analog output 4@20mA		Led Light installed	Raw 17 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 2 filtered water to clearwell inlet chamber
Torque: 1200 lb/pi
Speed: 30sec/¼ Turn

Date of Inspection:	10-12-2017
Inspected By:	K Rasmus Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray control valves actuator

Tag #: FCV-2124

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0121-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7/2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KM
analog output 4 to 20 mA => close to open		Led Light installed	Nov 17 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Filter 3 filtered water To clearwell intet Chamber
Torque : 1200 lbf/in
Speed : 30 sec/1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray control valve actuator

Tag #: FCV-2134

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0121-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7 / 2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KM
Analog output 4 to 20 mA => close to open		Led light installed	Nov 17 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Filter 4 Filtered Water to clear well inlet Chamber
Torque : 1200 lb-in
Speed : 30 sec / 1/4 turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valve actuator

Tag #: FCV-2105

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-C651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2.3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KM
analog output 4 To 20 mA => Close to open		Led Light installed	Nov 17 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Backwash water To Filter 1
Torque 6500 Lb/pi
Speed 30 sec / 1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	~~Ryan~~ Krasimir Mitrev
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray control Valve actuator

Tag #: FCV-2105

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-1130-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,3 / 3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov. 2017 KH
Digital output close/open		Led Light installed	Nov. 2017 K.H

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Backwash Water To Filter 2
Torque : 6500 lbf/in
Speed : 30 sec / 1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Hristev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valve actuator

Tag #: FCV -2125

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-1310-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2.3 / 3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 K.M.
Digital output open/close		Led Light installed	Nov 2017 K.M.

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Backwash Water To Filter 3
Torque : 6500 lb/in
Speed : 30 sec/¼ turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control valve actuator

Tag #: TCV-2106

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0451-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,3 / 3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 KM
Digital output open/close		Led Light Replaced	Nov 2017 KM

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Backwash waste Chanel Filter / To Waste storage Tank
Torque : 6500 Lbf/in
Speed : 30 sec/return

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valve actuator

Tag #: FCV-2116

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120V
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,3 / 3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 KM
Digital output open/close		Led Light Replaced	Nov 2017 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 2 backwash waste channel to waste storage Tank
Torque: 6500 lb/pi
speed: 30 sec Turn 1/4

Date of Inspection:	10-11-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray control valve actuator

Tag #: FCV - 2126

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-11340-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 KH
Digital output open/close		Led Light replaced	Nov 2017 KH

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Filter 3 backwash waste channel To waste Storage Tank
Torque : 6500 lb/pi
Speed : 30 sec / 1/4 turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray control Valve actuator

Tag #: FCV-2136

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2.3 / 3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 KM
Digital Output open/close		Led light replaced	Nov 2017 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Filter 4 backwash waste channel to waste storage Tank
Torque : 6600 lb/pi
Speed : 30 sec/1/4 Turn

Date of Inspection:	10-11-2017
Inspected By:	Krasimir Metrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valve actuator

Tag #: FCV-2135

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2.3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 K.H.
digital output open/close		Led Light remplaced	Nov 17 K.H.

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Backwash Water To Filter 4
Torque : 6500 lb/in
Speed : 30 sec/turn

Date of Inspection:	10-13-2017
Inspected By:	KRASIMIR MITREV
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Bray Control Valve actuator

Tag #: FCV-2107

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-6051-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0,8
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 K.M.
Digital output open/close		Led light Remplaced	Nov 17 K.M.

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Backwash air To Filter 1

Torque : 500 lb-pi

Speed : 30 sec 1/4 Turn

Digital output On/off

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray control valve Actuator

Tag #: FCV-2117

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0051-1130-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0,8
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017
Digital output open/close		Led Light Reqplaced	Nov 2017

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Air Scour To Filter 2
Torque : 500 lb/in
Speed : 30 sec / 1/4 Turn
Digital output : I/O

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valve actuator

Tag #: FCV-2127

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0051-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0,8
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017
Digital output 1:0		Led Light Replacement	Nov 2017

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Air Scour To Filter 3
Torque: 500 lb/pi
Speed: 30 sec / 1/4 Turn
Digital Output 1:0

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711
Equipment: Bray Control Valve actuator
Tag #: FCV-2137

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0051-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0,8
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 KH
Digital output 1:0		Led Light Replaced	Nov 2017 KH

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Air steam to Filter 3
Torque : lbf/pi 500
Speed : 30 sec / 1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Service pump #1 (Pump)

Tag #: P-410

Manufacturer			
Make:		V):	
Model:			
Description		y (Hz):	
Serial #:		Current (A):	
Explosion Proof:		HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Franklin Electric
100JS5S6-PE MODEL/MODELE
94810003 ORDER NO./ NO. DECOMMANDE
SN 17M190100055P
Date Code 17M19
SUBMERSIBLE PUMP

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

3" FNPT

Date of Inspection:	17-12-17
Inspected By:	Pierre-Luc Lajoie
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Service pump #1 (Motor)

Tag #: P-410

Manufacturer		**Input**	
Make:	Franklin electric	Voltage (V):	575
Model:	2366209220	Phase:	3
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	6
Explosion Proof:		Power (HP/W):	5 HP
Dust-Ignition Proof:		RPM:	3450
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:	587 V	Current - Phase A:	5.8 A
oltage - Phase B or B-C:	587 V	Current - Phase B:	5.9 A
Voltage - Phase C or C-A:	584 V	Current - Phase C:	5.8 A
Megger Phase A or A-B:	0 MΩ / A - ∞	Rotation (CW, CCW):	V
Megger Phase B or B-C:	0 MΩ / B - ∞	RPM:	
Megger Phase C or C-A:	0 MΩ / C - ∞	Overload Set (A):	6.3 A

Inspection Comments & Recommendations

Date of Inspection:	12-12-2017
Inspected By:	KRASIMIR MITREV
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Zinc Orthophosphate dosing pump

Tag #: P-303

Manufacturer		**Input**	
Make:	LMI	Voltage (V):	
Model:		Phase:	
Description		Frequency (Hz):	
Serial #:		Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Date of Inspection:	
Inspected By:	
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Zinc Orthophosphate Dosing pump
Tag #: P-304

Manufacturer		**Input**	
Make:	LMI	Voltage (V):	
Model:		Phase:	
Description		Frequency (Hz):	
Serial #:		Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Date of Inspection:	
Inspected By:	
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Exaust Fan Cl2 Room

Tag #: EF-03

Manufacturer		**Input**	
Make:	Twin City	Voltage (V):	
Model:	RBA - 909	Phase:	
Description		Frequency (Hz):	
Serial #:	17-594693-1-1	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	1695
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

947 CFM
Total eff: 66%
Belt driven CCW

Date of Inspection:	11-12-2017
Inspected By:	Pierre-Luc Lagoie
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Exaust Fan Motor WTP

Tag #: EF-3

Manufacturer		**Input**	
Make:	WEG	Voltage (V):	575
Model:	0218ET3H145T-S	Phase:	3
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,18
Explosion Proof:		Power (HP/W):	2 HP 1,5 KW
Dust-Ignition Proof:		RPM:	1745
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:	588 V	Current - Phase A:	1,71 A
Voltage - Phase B or B-C:	585 V	Current - Phase B:	1,74 A
Voltage - Phase C or C-A:	583 V	Current - Phase C:	1,78 A
Megger Phase A or A-B:	0 MΩ | A - ⏚ - ∞ MΩ	Rotation (CW, CCW):	CCW
Megger Phase B or B-C:	0 MΩ | B - ⏚ - ∞ MΩ	RPM:	
Megger Phase C or C-A:	0 MΩ | C - ⏚ - ∞ MΩ	Overload Set (A):	2,2 A

Inspection Comments & Recommendations

Nema nom eff. 86,5%

Date of Inspection:	12-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Turbidity Meter (Filter -4)

Tag #: AIT - 2132

Manufacturer		**Input**	
Make:	HACH	Voltage (V):	100-240 VAC +/- 10%, 50/60 Hz
Model:	sc200	Phase:	
Description		Frequency (Hz):	
Serial #:	1708C0159009	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:	4 to 20 mA	Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

4 - 20 mA

0 - 20 NTU

Date of Inspection:	08-12-2017
Inspected By:	Pierre-Luc Lajoie
Signature:	

ISO 9001 Certified

CALIBRATION TEST CERTIFICATE
SC200 Controller

Model	Serial Number	Date	SW Ver	Result
LXV404.99.00552	1708C0159009	08/17/2017	2.04	PASS

Tested Characteristic	Min	Max	Value	
Probe Recognition			-	PASS
Display			-	PASS
Keypad			-	PASS
Relays			-	PASS
Dielectric Withstanding (Hipot)			-	PASS
4-20mA Output 1 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 1 @ 20mA	19.95	20.05	19.99mA	PASS
4-20mA Output 2 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 2 @ 20mA	19.95	20.05	19.99mA	PASS

Test Equipment used for the verification of Hach manufactured instruments is calibrated using standards traceable to the National Institute of Standards and Technology (NIST).

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FILTER #4

ISO 9001 Certified

TU5300 sc

Certificate of Final Inspection

HACH®
Be Right™

Part No.	Gerätenummer, n°d'appareil	**LXG445.99.10112**
Serial No.	Seriennummer, numéro de série	***1762753***
Method Compliance		EPA
General Function	Allgemeine Funktion, fonction générale :	
SC Communication		ok
Lid Detection		ok
Humidity protection system		ok
RFID Function		N. A.
Factory Calibration	Werkskalibrierung, Etalonnage d'usine:	
StablCal® Calibration Curve	StablCal® Kalibrierung, StablCal® Courbe d'étalonnage	
20 NTU and 600 NTU	20 NTU und 600 NTU, 20 NTU et 600 NTU	ok
Turbidity Data	Trübungswerte, data turbidité:	
Secondary Turbidity Standard >20 NTU	Sekundär Trübungsstandard >20 NTU, Etalon secondaire de turbidité >20 NTU	
set number	Satznummer; set de contrôle	*0001*
Reference Instrument	Referenzgerät, instrument de référence	29.5 NTU
Tolerance	Toleranz, tolérance:	± 5 %
E.U.T	Prüfling, objet d'essai	**28.8 NTU**
Secondary Turbidity Standard <0.1 NTU	Sekundär Trübungsstandard <0.1 NTU, Etalon secondaire de turbidité <0.1 NTU	
set number	Satznummer; set de contrôle	*0154*
Reference Instrument	Referenzgerät, instrument de référence	0.012 NTU
Tolerance	Toleranz, tolérance:	± 0.007 NTU
E.U.T	Prüfling, objet d'essai	**0.011 NTU**
Date	Datum, date:	Oct 16, 2017
Inspector	Bearbeiter, opérateur:	*Barbara Bohnig*
Sign	Unterschrift, signature :	B Bohnig

Please add this certificate to your documents.
Bitte verwahren Sie dieses Zertifikat bei Ihren Unterlagen auf.
S'il vous plaît, conservez scrupuleusement ce certificat dans vos archives.

Dieses Informationsblatt enthält Angaben, die ausschließlich für den Export dieses Gerätes in die Volksrepublik China erforderlich sind.

This document contains information which is only required for the export of this instrument into the People's Republic of China.

Ce document contient les informations nécessaires pour l'exportation d'instruments vers la République Populaire de Chine.

本手册只包含出口到中华人民共和国的仪器的必要信息。

P/N: LXG445.xx.xxxxx Model: TU 5300sc/TU5400sc

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
CPU PCB (TU) CPU PCB	x	O	O	O	O	O
Enclosure 机壳	x	O	O	O	O	O
Measuring Unit 测量单元	x	O	O	O	O	O
Sensorcable 传感器电缆	x	O	O	O	O	O
Pumps/Motors/Actuators 泵/电机/励磁器	x	O	O	O	O	O
Metal Tubing and Fittings 金属管和接头	x	O	O	O	O	O
Accessory 附件	x	O	O	O	O	O
Drying Cartridge 干燥筒	x	O	O	O	O	O

○：表示该项目中涉及的所有物料，其包含的有害物质的含量低于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572-2011).

×：表示该项目中涉及的所有物料中至少有一种，其包含的有害物质的含量高于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in at least one Homogeneous Material of the part exceeds the concentration limit requirement as described in GB/T 26572-2011)

对销售之日的所售产品，本表显示，朗讯供应链的电子信息产品可能包含这些物质。注意：在所售产品中可能会也可能不会含有所有所列的部件
This table shows where these substances may be found in the supply chain of "Company" electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product.

除非另外特别的标注，此标志为针对所涉及产品的环保使用期标志. 某些可更换的零部件会有一个不同的环保使用期(例如，电池单元模块)贴在其产品上.
此环保使用期限只适用于产品是在产品手册中所规定的条件下工作.
The Environmentally Friendly Use Period (EFUP) for all enclosed products and their parts are per the symbol shown here, unless otherwise marked. Certain field-replaceable parts have a different EFUP (for example, battery modules) and so are marked to reflect such. The Environmentally Friendly Use Period is valid only when the product is operated under the conditions defined in the product manual.

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EU-Konformitätserklärung / UE-Declaración de conformidad / UE- Déclaration de Conformité / UE-Dichiarazione di Conformità

Manufacturer/Hersteller/Fabricante/Fabricant/Produttore:

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Part Number/Artikelnummer/ Numéro de artículo/Numéro article/Codice articolo:	**Model**/Modell/ Modelo/Modèle/Modello:	**Designation**/Beschreibung/ Designación/Désignation/Denominazione:
LXG445.xx.x01x2 / LXG445.xx.x11x2	**TU5300 sc (EPA/ISO)**	**Turbidity sensor without RFID**
LXG445.xx.x02x2 / LXG445.xx.x12x2	**TU5400 sc (EPA/ISO)**	**Turbidity sensor without RFID**
Including optional accessories /inklusive optionales Zubehör/ Incluyendo accesorios opcionales / Incluant les accessoires optionnels / Compresi gli accessori opzionali:		*)

The product complies with the essential requirements of the following Directive(s) / Das bezeichnete Produkt entspricht den wesentlichen Anforderungen der nachfolgend bezeichneten Richtlinie(n) / El producto es conforme con los requisitos esenciales de la (s) siguientes Directiva (s) / Le produit est conforme aux exigences essentielles de la (des) Directive(s) suivante(s) / Il prodotto è conforme ai requisiti essenziali della seguente Direttiva (e).

2011/65/EU	**RoHS Directive**
2006/42/EC	**Machinery Directive**
2014/30/EU	**EMC Directive**

The following harmonized standards were used to meet the requirements of the stated Directive(s) / Die folgende(n) harmonisierte(n) Norm(en) wurde(n) zur Einhaltung der Anforderungen der genannten Richtlinie(n) angewendet / Para cumplir los requisitos de las directivas mencionadas se han aplicado las siguientes normas armonizadas / Les normes harmonisées suivantes ont été utilisées pour satisfaire aux exigences de la (des) Directive(s) mentionnée(s) / Le seguenti norme armonizzate sono state usate per soddisfare i requisiti della Direttiva (e) indicate.

EN 50581: 2012	**Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances**
EN 61326-1: 2013	**Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements**

In addition the following standards have been applied in the development of the product / Darüber hinaus wurde(n) folgende(n) Norm(en) bei der Entwicklung des Produktes angewendet / Además, durante el desarrollo del producto, se han aplicado las siguientes normas / En complément, les normes suivantes ont été utilisées pour le développement du produit / Inoltre, sono stati applicati i seguenti Standard nello sviluppo del prodotto.

EN 61010-1: 2010	**Safety requirements for electrical equipment – General requirements**
EN 60825-1: 2014	**Safety of laser products - Part 1: Equipment classification and requirements**

*) See separate Declaration of Conformity of the optional accessories / Siehe separate Konformitätserklärung für das optionale Zubehör / Ver la Declaración de Conformidad para los accesorios opcionales / Voir déclaration de conformité des accessoires optionnels / Vedi dichiarazione di conformità separata delle accessori opzionali.

Authorised Person to compile the technical file / Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen / Persona autorizada para elaborar el expediente técnico / Personne autorisée à constituer le dossier technique / Persona autorizzata a costituire il fascicolo tecnico:

Michael Schuster – Product Compliance EU - HACH LANGE GmbH; Willstätterstrasse 11; 40549 Düsseldorf

This statement applies to all versions of the named product, which are prepared by the necessary technical documentation / Diese Erklärung gilt für alle Ausführungen des genannten Produktes, die nach der erforderlichen technischen Dokumentation hergestellt werden / Esta declaración se aplica a todas las versiones del producto designado, que son preparadas por la documentación técnica necesaria / Cette déclaration s'applique à toutes les versions du produit mentionné / Questa dichiarazione si applica a tutte le versioni del prodotto indicato, che sono stati preparati dalla documentazione tecnica necessaria.

Year of primary CE marking of the product / Jahr der ersten CE Kennzeichnung des Produktes / Año de la primera marca CE del producto / Année du premier marquage CE du produit / Anno del primo prodotto CE: **2014**

Berlin, 2017/March/01

ppa.
Director Operations ppa. Christian Kraatz

i.V.
CE Coordinator i.V. Michael Schuster

LXG445.xx.x1xx2 Rev.04

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SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Turbidity Meter Filter-3

Tag #: AIT-2122

Manufacturer		**Input**	
Make:	HACH	Voltage (V):	100-240V AC
Model:	sc200	Phase:	
Description		Frequency (Hz):	50/60Hz (+/- 10%)
Serial #:	1610C0146753	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver	4 to 20 mA	Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

4 - 20 mA
0 - 20 NTU

Date of Inspection:	08-11-2014
Inspected By:	
Signature:	

ISO 9001 Certified

CALIBRATION TEST CERTIFICATE
SC200 Controller

Model	Serial Number	Date	SW Ver	Result
LXV404.99.00552	1610C0146753	10/10/2016	2.01	PASS

Tested Characteristic	Min	Max	Value	
Probe Recognition			-	PASS
Display			-	PASS
Keypad			-	PASS
Relays			-	PASS
Dielectric Withstanding (Hipot)			-	PASS
4-20mA Output 1 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 1 @ 20mA	19.95	20.05	19.98mA	PASS
4-20mA Output 2 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 2 @ 20mA	19.95	20.05	20.00mA	PASS

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Filter 3

ISO 9001 Certified

TU5300 sc

Certificate of Final Inspection

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Part No.	Gerätenummer, n°d'appareil	**LXG445.99.10112**
Serial No.	Seriennummer, numéro de série	***1694186***
Method Compliance		EPA
General Function	Allgemeine Funktion, fonction générale :	
SC Communication		ok
Lid Detection		ok
Humidity protection system		ok
RFID Function		N. A.
Factory Calibration	Werkskalibrierung, Etalonnage d'usine:	
StablCal® Calibration Curve	StablCal® Kalibrierung, StablCal® Courbe d'étalonnage	
20 NTU and 600 NTU	20 NTU und 600 NTU, 20 NTU et 600 NTU	ok
Turbidity Data	Trübungswerte, data turbidité:	
Secondary Turbidity Standard >20 NTU	Sekundär Trübungsstandard >20 NTU, Etalon secondaire de turbidité >20 NTU	
set number	Satznummer; set de contrôle	*0001*
Reference Instrument	Referenzgerät, instrument de référence	29.3 NTU
Tolerance	Toleranz, tolérance:	± 5 %
E.U.T	Prüfling, objet d'essai	**30.4 NTU**
Secondary Turbidity Standard <0.1 NTU	Sekundär Trübungsstandard <0.1 NTU, Etalon secondaire de turbidité <0.1 NTU	
set number	Satznummer; set de contrôle	*0035*
Reference Instrument	Referenzgerät, instrument de référence	0.012 NTU
Tolerance	Toleranz, tolérance:	± 0.007 NTU
E.U.T	Prüfling, objet d'essai	**0.011 NTU**
Date	Datum, date:	Oct 25, 2016
Inspector	Bearbeiter, opérateur:	*Rene Zabel*
Sign	Unterschrift, signature :	Rene Zabel

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Ce document contient les informations nécessaires pour l'exportation d'instruments vers la République Populaire de Chine.

本手册只包含出口到中华人民共和国的仪器的必要信息。

P/N: LXG445.xx.xxxxx Model: TU 5300sc/TU5400sc

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
CPU PCB (TU) CPU PCB	x	O	O	O	O	O
Enclosure 机壳	x	O	O	O	O	O
Measuring Unit 测量单元	x	O	O	O	O	O
Sensorcable 传感器电缆	x	O	O	O	O	O
Pumps/Motors/Actuators 泵/电机/励磁器	x	O	O	O	O	O
Metal Tubing and Fittings 金属管和接头	x	O	O	O	O	O
Accessory 附件	x	O	O	O	O	O
Drying Cartridge 干燥筒	x	O	O	O	O	O

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(indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572-2011).

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HDQ927 Rev. 02

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Manufacturer/Hersteller/Fabricante/Fabricant/Produttore:

HACH LANGE GmbH, Königsweg 10, 14163 Berlin; Germany – Tel. +49 (0)30-80986-0 - **www.de.hach.com**

Part Number/Artikelnummer/ Numéro de articulo/Numéro article/Codice articolo:	**Model**/Modell/ Modelo/Modèle/Modello:	**Designation**/Beschreibung/ Designación/Désignation/Denominazione:
LXG445.xx.x01x2 / LXG445.xx.x11x2	**TU5300 sc (EPA/ISO)**	**Turbidity sensor without RFID** (3.0mNTU)
LXG445.xx.x02x2 / LXG445.xx.x12x2	**TU5400 sc (EPA/ISO)**	**Turbidity sensor without RFID** (0.3mNTU)
Including optional accessories /inklusive optionales Zubehör/ Incluyendo accesorios opcionales / Incluant les accessoires optionnels / Compresi gli accessori opzionali:		*)

The product complies with the essential requirements of the following Directive(s) / Das bezeichnete Produkt entspricht den wesentlichen Anforderungen der nachfolgend bezeichneten Richtlinie(n) / El producto es conforme con los requisitos esenciales de la (s) siguientes Directiva (s) / Le produit est conforme aux exigences essentielles de la (des) Directive(s) suivante(s) / Il prodotto è conforme ai requisiti essenziali della seguente Direttiva (e).

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2006/42/EC	**Machinery Directive**

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EN 61326-1: 2013-01	**Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements**

In addition the following standards have been applied in the development of the product / Darüber hinaus wurde(n) folgende(n) Norm(en) bei der Entwicklung des Produktes angewendet / Además, durante el desarrollo del producto, se han aplicado las siguientes normas / En complément, les normes suivantes ont été utilisées pour le développement du produit / Inoltre, sono stati applicati i seguenti Standard nello sviluppo del prodotto.

EN 61010-1: 2010-10	**Safety requirements for electrical equipment – General requirements**
EN 60825-1: 2014-08	**Safety of laser products - Part 1: Equipment classification and requirements**

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Authorised Person to compile the technical file / Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen / Persona autorizada para elaborar el expediente técnico / Personne autorisée à constituer le dossier technique / Persona autorizzata a costituire il fascicolo tecnico:

Michael Schuster – Product Compliance EU - HACH LANGE GmbH; Willstätter Str.11; 40549 Düsseldorf

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Year of primary CE marking of the product / Jahr der ersten CE Kennzeichnung des Produktes / Año de la primera marca CE del producto / Année du premier marquage CE du produit / Anno del primo prodotto CE: **2014**

LXC445.xx.x1x2 Rev.03

Düsseldorf, 2016/May/11

ppa. _____
Director Operations ppa. Christian Kraatz

i.V. _____
CE Coordinator i.V. Michael Schuster

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CALIBRATION TEST CERTIFICATE
SC200 Controller

Model	Serial Number	Date	SW Ver	Result
LXV404.99.00552	1610C0138341	10/10/2016	2.01	PASS

Tested Characteristic	Min	Max	Value	
Probe Recognition			-	PASS
Display			-	PASS
Keypad			-	PASS
Relays			-	PASS
Dielectric Withstanding (Hipot)			-	PASS
4-20mA Output 1 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 1 @ 20mA	19.95	20.05	20.00mA	PASS
4-20mA Output 2 @ 4mA	3.98	4.02	3.99mA	PASS
4-20mA Output 2 @ 20mA	19.95	20.05	19.98mA	PASS

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Part No.	Gerätenummer, n°d'appareil	**LXG445.99.10112**
Serial No.	Seriennummer, numéro de série	***1694357***
Method Compliance		EPA
General Function	Allgemeine Funktion, fonction générale :	
SC Communication		ok
Lid Detection		ok
Humidity protection system		ok
RFID Function		N. A.
Factory Calibration	Werkskalibrierung, Etalonnage d'usine:	
StablCal® Calibration Curve	StablCal® Kalibrierung, StablCal® Courbe d'étalonnage	
20 NTU and 600 NTU	20 NTU und 600 NTU, 20 NTU et 600 NTU	ok
Turbidity Data	Trübungswerte, data turbidité:	
Secondary Turbidity Standard >20 NTU	Sekundär Trübungsstandard >20 NTU, Etalon secondaire de turbidité >20 NTU	
set number	Satznummer; set de contrôle	*0001*
Reference Instrument	Referenzgerät, instrument de référence	29.3 NTU
Tolerance	Toleranz, tolérance:	± 5 %
E.U.T	Prüfling, objet d'essai	**30.5 NTU**
Secondary Turbidity Standard <0.1 NTU	Sekundär Trübungsstandard <0.1 NTU, Etalon secondaire de turbidité <0.1 NTU	
set number	Satznummer; set de contrôle	*0035*
Reference Instrument	Referenzgerät, instrument de référence	0.012 NTU
Tolerance	Toleranz, tolérance:	± 0.007 NTU
E.U.T	Prüfling, objet d'essai	**0.011 NTU**
Date	Datum, date:	Oct 26, 2016
Inspector	Bearbeiter, opérateur:	*Rene Zabel*
Sign	Unterschrift, signature :	Rene Zabel

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P/N: LXG445.xx.xxxxx Model: TU 5300sc/TU5400sc

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
CPU PCB (TU) CPU PCB	x	O	O	O	O	O
Enclosure 机壳	x	O	O	O	O	O
Measuring Unit 测量单元	x	O	O	O	O	O
Sensorcable 传感器电缆	x	O	O	O	O	O
Pumps/Motors/Actuators 泵/电机/励磁器	x	O	O	O	O	O
Metal Tubing and Fittings 金属管和接头	x	O	O	O	O	O
Accessory 附件	x	O	O	O	O	O
Drying Cartridge 干燥筒	x	O	O	O	O	O

○：表示该项目中涉及的所有物料，其包含的有害物质的含量低于 GB/T 26572-2011. 标准的限制要求
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EC-Declaration of Conformity

EG-Konformitätserklärung / CE-Declaración de conformidad / CE- Déclaration de Conformité / CE-Dichiarazione di Conformità

Manufacturer/Hersteller/Fabricante/Fabricant/Produttore:

HACH LANGE GmbH, Königsweg 10, 14163 Berlin; Germany – Tel. +49 (0)30-80986-0 - **www.de.hach.com**

Part Number/Artikelnummer/ Numéro de artículo/Numéro article/Codice articolo:	**Model**/Modell/ Modelo/Modèle/Modello:	**Designation**/Beschreibung/ Designación/Désignation/Denominazione:
LXG445.xx.x01x2 / LXG445.xx.x11x2	**TU5300 sc (EPA/ISO)**	**Turbidity sensor without RFID** (3.0mNTU)
LXG445.xx.x02x2 / LXG445.xx.x12x2	**TU5400 sc (EPA/ISO)**	**Turbidity sensor without RFID** (0.3mNTU)
Including optional accessories /inklusive optionales Zubehör/ Incluyendo accesorios opcionales / Incluant les accessoires optionnels / Compresi gli accessori opzionali:		*)

The product complies with the essential requirements of the following Directive(s) / Das bezeichnete Produkt entspricht den wesentlichen Anforderungen der nachfolgend bezeichneten Richtlinie(n) / El producto es conforme con los requisitos esenciales de la (s) siguientes Directiva (s) / Le produit est conforme aux exigences essentielles de la (des) Directive(s) suivante(s) / Il prodotto è conforme ai requisiti essenziali della seguente Direttiva (e).

2014/30/EU	**EMC Directive**
2006/42/EC	**Machinery Directive**

The following harmonized standards were used to meet the requirements of the stated Directive(s) / Die folgende(n) harmonisierte(n) Norm(en) wurde(n) zur Einhaltung der Anforderungen der genannten Richtlinie(n) angewendet / Para cumplir los requisitos de las directivas mencionadas se han aplicado las siguientes normas armonizadas / Les normes harmonisées suivantes ont été utilisées pour satisfaire aux exigences de la (des) Directive(s) mentionnée(s) / Le seguenti norme armonizzate sono state usate per soddisfare i requisiti della Direttiva (e) indicate.

EN 61326-1: 2013-01	**Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements**

In addition the following standards have been applied in the development of the product / Darüber hinaus wurde(n) folgende(n) Norm(en) bei der Entwicklung des Produktes angewendet / Además, durante el desarrollo del producto, se han aplicado las siguientes normas / En complément, les normes suivantes ont été utilisées pour le développement du produit / Inoltre, sono stati applicati i seguenti Standard nello sviluppo del prodotto.

EN 61010-1: 2010-10	**Safety requirements for electrical equipment – General requirements**
EN 60825-1: 2014-08	**Safety of laser products - Part 1: Equipment classification and requirements**

*) See separate Declaration of Conformity of the optional accessories / Siehe separate Konformitätserklärung für das optionale Zubehör / Ver la Declaración de Conformidad para los accesorios opcionales / Voir déclaration de conformité des accessoires optionnels / Vedi dichiarazione di conformità separata delle accessori opzionali.

Authorised Person to compile the technical file / Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen / Persona autorizada para elaborar el expediente técnico / Personne autorisée à constituer le dossier technique / Persona autorizzata a costituire il fascicolo tecnico:

Michael Schuster – Product Compliance EU - HACH LANGE GmbH; Willstätter Str.11; 40549 Düsseldorf

This statement applies to all versions of the named product, which are prepared by the necessary technical documentation / Diese Erklärung gilt für alle Ausführungen des genannten Produktes, die nach der erforderlichen technischen Dokumentation hergestellt werden / Esta declaración se aplica a todas las versiones del producto designado, que son preparadas por la documentación técnica necesaria / Cette déclaration s'applique à toutes les versions du produit mentionné / Questa dichiarazione si applica a tutte le versioni del prodotto indicato, che sono stati preparati dalla documentazione tecnica necessaria.

Year of primary CE marking of the product / Jahr der ersten CE Kennzeichnung des Produktes / Año de la primera marca CE del producto / Année du premier marquage CE du produit / Anno del primo prodotto CE: **2014**

LXC445.xx.x1x2 Rev.03

Düsseldorf, 2016/May/11

ppa. _____
Director Operations ppa. Christian Kraatz

i.V. _____
CE Coordinator i.V. Michael Schuster

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Be Right™

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Turbidity Meter WTP

TAG NO: Ait-1001, Ait-2102, Ait-2112, Ait-2122, Ait-2132

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

Georges Jean Tanoé — 15-12-2017
CONTRACTOR'S REPRESENTATIVE — DATE

A. Cook — 14 Dec 2017
ENGINEER — DATE

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl/PH Meter WTP

TAG NO: Ait-1001, Ait-2501/2502

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

Terry-Lee Jones — 15-11-2017
CONTRACTOR'S REPRESENTATIVE — DATE

D. Cook — 4 Dec, 2017
ENGINEER — DATE

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Meter (Reservoir)

TAG NO: A,T-5000

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Switch CL WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

Pierre-Luc Tessier — 15-11-2017

CONTRACTOR'S REPRESENTATIVE — DATE

D. Cook — 14 Dec 2017

ENGINEER — DATE

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Bray controle Valve actuator WTP

TAG NO: All WTP Control Valves

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 10/12/2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Soude caustique pump
Microprocessor Dosing pump x 2 WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 9-10-2017

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl_2 GAS MONITOR WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

STEPHAN GAGNE

CONTRACTOR'S REPRESENTATIVE — DATE 10-12-2017

D. Cook

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Hydrofluorasilicic Acid Pump X2 WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 8-12-2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Zinc Orthophosphate Dosing pump

TAG NO: P-303, P-304

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE _____ DATE _____

CONTRACTOR'S REPRESENTATIVE _____ DATE _____

D. Ceah
ENGINEER

14 Dec, 2017
DATE

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan Cl_2 Room WTP

TAG NO: EF-3

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 11-12-2017

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Pressure Transmitter Raw Water WTP

TAG NO: PT-1001

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 30-11-2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Service pump #1

TAG NO: P-100

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 12-17-2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Turbidity Meter WTP

TAG NO: Ait-1001, Ait-2102, Ait-2112, Ait-2132, Ait-2122

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: CL/PH Meter WTP

TAG NO: A.i.t-1001, A.i.t-2501/2502

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 13, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Meter (Reservoir)

TAG NO: A.T - 5001

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 13, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Switch CL WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 13, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Bray Control Valve actuator

TAG NO: All WTP Control valve actuators

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: 50UDE caustique pump
Microprocessor Dosing pump x2 WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 9-10-2017

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl2 GAS MONITOR WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Hydrofluorasilicic Acid Pump x2
WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 8-12-2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Zinc Orthophosphate dosing pump

TAG NO: P-303, P304

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE

D. Cook — 14 Dec, 2017

ENGINEER — DATE

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan Cl_2 Room WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: DEC 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Pressure Transmitter Raw Water WTP

TAG NO: PIT-1001

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Service pump P-401

TAG NO: P-401

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Turbidity Meter WTP

TAG NO: Ait-1001, Ait-2102, Ait-2112, Ait-2122, Ait-2132

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 9, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl2/pH Meter WTP

TAG NO: Ait-1001, Ait-2501/2502

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 6, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Meter (Reservoir)

TAG NO: Ait-5000

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 08-12-2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Switch CL WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Bray Control Valve actuator WTP

TAG NO: All WTP Control valve actuators

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 14, 2017

ENGINEER — DATE: 14. Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: SOUDE CAUSTIQUE PUMP Microprocessor DOSING PUMP x2 WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 9-10-2017

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl2 Gas Monitor WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 13, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Hydrofluorasilicic Acid Pump x2
WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 8-12-2017

ENGINEER — DATE: 14 Dec 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Zinc Orthophosphate Dosing pump

TAG NO: P-303, P304

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE

W. Coade — 14 Dec, 2017

ENGINEER — DATE

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan CL_2 Room

TAG NO: EF-3

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE	DATE
CONTRACTOR'S REPRESENTATIVE	Dec 12, 2017 DATE
ENGINEER	14 Dec, 2017 DATE

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Pressure Transmitter Low Water WTP

TAG NO: P.T- 1001

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 1, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Service Pump #1 WTP

TAG NO: P-410

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14, Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: CL/pH Meter WTP

TAG NO: Ait-1001, Ait-2501/2502

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE	DATE
CONTRACTOR'S REPRESENTATIVE	Dec 10, 2017 DATE
D. Cook ENGINEER	14 Dec. 2017 DATE

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Meter (Reservoir)

TAG NO: A,T-5000

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE	DATE
CONTRACTOR'S REPRESENTATIVE	Dec 10, 2017 DATE
ENGINEER	08-12-2017 DATE
D. Cook	14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Switch CL WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

Pierre-Luc Fajoie — CONTRACTOR'S REPRESENTATIVE

08-12-2017 — DATE

D. Cook — ENGINEER

14 Dec, 2017 — DATE

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Bray control valves actuator

TAG NO: All WTP Control Valve Actuators

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: SOUDE caustique Pump Microprocessor Dosing pump x2 WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 9-10-2017

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl_2 GAS MONITOR @ WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 11, 2017

ENGINEER — DATE: 14 Dec 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Hydrofluorasilicic Acid Pump x2
WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 8-12-2017

ENGINEER — DATE: 14, Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Zinc Orthophosphate dosing pump

TAG NO: P-303, P-304

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE _____ DATE _____

CONTRACTOR'S REPRESENTATIVE _____ DATE _____

D. Cook
ENGINEER

14 Dec, 2017
DATE

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Turbidity Meter WTP

TAG NO: Ait-1001, Ait-2102, Ait-2112 Ait-2122, Ait-2132

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 8-12-2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan Cl_2 Room WTP

TAG NO: EF-3

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Pressure Transmitter Low Water WTP

TAG NO: PIT-1001

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 3, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Service pump #1 WTP

TAG NO: P-400

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 13, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Turbidity Meter WTP

TAG NO: Ait-1001, Ait-2102, Ait-2112, Ait-2122, Ait-2132

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 18-11-2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl/PH Meter WTP

TAG NO: AIT-1001, AIT-2501/2502

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 28-11-2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Meter

TAG NO: AIT-5000

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

Pierre-Luc Tejore — 20-11-2017

CONTRACTOR'S REPRESENTATIVE — DATE

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Switch CL WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

Pierre-Luc Tjoie — 08-12-2017

CONTRACTOR'S REPRESENTATIVE — DATE

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Gray Control Valves actuator

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 10/12/2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Soude caustique Pump
Microprocessor dosing pump x2 WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 9-10-2007

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl_2 GAS MONITOR

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 12-12-17

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Hydrofluorasilicic Acid Pump x2
WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 8-12-2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Zinc Orthophosphate Dosing pump

TAG NO: P-303, P304

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE DATE

CONTRACTOR'S REPRESENTATIVE DATE

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan CL_2 Room WTP

TAG NO: EF-3

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE Dec 12/17

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Pressure Transmitter Raw Water WTP

TAG NO: P,T - 1001

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 06-11-2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Service pump #1 WTP

TAG NO: P-4100

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 12-12-2017

P.O. Box 556, Rankin Inlet, NU, X0C 0G0, Tel: 1-866-437-4001

March 1st, 2018

Matthew Hemp
Director of Public Works & Engineering
City of Iqaluit
P.O. Box 460
Iqaluit, Nunavut X0A 0H0
(867) 899-7317
m.hamp@city.iqaluit.ca

SUBJECT: ***City of Iqaluit – Water/Wastewater Facilities Improvements Project #SC711***
Completion Date – February 27th, 2018

SIFEC NORTH INC. warranties the mechanical, electrical systems and related equipment according to the contract herein before mentioned, for a one year period effective from date of the interim inspection.

Carl Fauteux
Vice-President

Chapter 9

MANUFACTURER DATA AND SERVICE INFORMATION

9.1 General

Manufacturer data and service information of relevant newly installed or replaced equipment as per the 2017 Water and Wastewater Facilities Improvement Upgrade are appended at the end of this chapter.

END OF CHAPTER 9

MECHANICAL &
ELECTRICAL

Volume 1 of 1

OPERATION & MAINTENANCE
MANUAL

CITY OF IQALUIT
WATER&WASTEWATER FACILITIES IMPROVEMENTS

IQALUIT, Nunavut

Project #:
SC711

December 2017

OWNER:	**CITY OF IQALUIT**
CONTRACT ADMINISTRATOR:	**COLLIERS PROJECT LEADERS**
CONSULTING ENGINEER:	**NUNAMI-STANTEC**
GENERAL CONTRACTOR:	**KUDLIK CONSTRUCTION INC.**
MECHANICAL & ELECTRICAL CONTRACTOR:	**SIFEC NORTH INC.**

MECHANICAL & ELECTRICAL

VOLUME 1 OF 1

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Chapter 1 DOCUMENT VERSION

Year of Completion: **2017**
Original Scope: **ELECTRICAL & MECHANICAL**

Date	Description of Change
12-11-2017	PRELIMINARY

MECHANICAL & ELECTRICAL

Project History

Owner:	**Matthew Hamp, Director of Public Works & Engineering** **City of Iqaluit** **P.O. Box 460** **Iqaluit, Nunavut X0A 0H0** **P: (867) 899-7317** **F: (867) 899-7328** **m.hamp@city.iqaluit.ca**
Contract Administrator:	**Dixon Weir, Project Manager** **Colliers Project Leaders** **150 Isabella Street** **Ottawa, Ontario K1S 1V7** **P: (613) 216-4345, Ext #3224** **Dixon.Weir@Colliersprojectleaders.com**
Project Engineer:	**Glenn Prosko, Project Manager** **Nunami-Stantec** **10160 112 Street** **Edmonton AB T5K 2L6** **P: (780) 969-3258** **Glenn.Prosko@stantec.com**
General Contractor:	**Maxime Gaudreau, Project Manager** **Kudlik Construction Ltd.** **P.O. Box 727, 1519 Federal Road** **Iqaluit, NU X0A 0H0** **P: (418) 802-8224** **mgaudreau@kudlik.biz**
Mechanical & Electrical Subcontractor:	**Carl Fauteux, Vice-President** **Sifec North Inc.** **P.O. Box 556,** **Rankin Inlet, NU, X0C 0C0,** **P: (855) 437-4001** **carl@sifec.ca**

Chapter 2 INTRODUCTION

2.1 GENERAL INFORMATION

This project consists of work for improvements to existing City of Iqaluit facilities. The work involves a variety of equipment from the following fields: Plumbing, HVAC, Automation, Electrical and Process. The project provides improvements at the following facilities:

- Water Treatment Plant
- ~~Booster Station #1~~
- ~~Booster Station #2~~
- ~~Lift Station #1~~
- ~~Lift Station #2~~

All the faulty & defective equipment that was part of this project were replaced with new units. This includes new analyzers, gas detectors, control valves, flow meters, fans, blowers, pumps, piping, etc.

The project also involved installation of a few new instruments, such as new pressure transmitters, new generator cooling line control valves & flow switches.

2.2 WATER TREATMENT PLANT

The following items are part of the scope at the Water Treatment Plant:

- A new replacement TwinCity exhaust fan in the Chlorine Room.
- 5 new Hach TU5300sc Turbidity Meter.
- 2 new Wallace & Tiernan Depolox 3 Plus Chlorine & pH analyzers.
- A new replacement Wallace & Tiernan Chlorine Gas Detection System for Chlorine Room.
- All Bray control valves were inspected, maintained & repaired. New Bray valves were supplied for spare parts.

- A new flow switch was installed on the chlorinated water injection line in Chlorine Room. This include PLC low flow alarm.
- A new pressure transmitter was installed and incorporated in the PLC/HMI.
- A new replacement electromagnetic flow meter was installed for reservoir discharge flow.
- Air scour blower #1 was inspected and deemed unrepairable. Under CO#2, it was replaced.
- Backwash Pump #2 was inspected and found to be functioning. No repairs needed.
- The 6 chemical metering pumps were replaced, including new skid and piping (Hydrofluorosilic acid, Zinc Orthophostate, Caustic soda).
- Service water pump #1 was replaced under CO#3.

2.3 BOOSTER STATION #1 & #2

The following items are part of the scope at Booster Stations:

- 2 new Hach TU5300sc Turbidity Meter.
- 2 new Wallace & Tiernan Depolox 3 Plus Chlorine analyzers.
- New ½" stainless sampling line at BS#1
- New generator/fire pump cooling line control system, including new solenoid control valves and new flow switches. All incorporated in the PLCs.
- New underfloor sanitary drain system at BS#2, including repairs to the underslab heating system.
- A new replacement for the recirculation pump #1.

2.4 LIFT STATION #1 & #2

The following items are part of the scope at the Lift Stations:

- 3 new MSA Gas Detection Systems, including probes for H2S and Combustible Gases.
- A new replacement discharge flow meter at LS#1
- Inspection of the generator ventilation damper controls. It was found to be working as per scope of work requirements. At LF#2.

- ~~Inspection & repairs of all pump room wall openings to ensure CEC compliance.~~
- ~~Inspection & replacement of all material to ensure properly rated for pump room, except duplex receptacle.~~

2.5 AS-BUILT PLANS OVERVIEW

2.5.1 Mechanical plans

Plan M1

2.5.2 Electrical plans

Plan E1

Plan E2

Plan E3

Plan E4

Plan E5

Chapter 3 OPERATION OF NEW EQUIPMENT

3.1 Flow Switch for Chlorinated Water Injection (Water Treatment Plant)

The new flow switch requires no manual operation. It has been incorporated in the PLC/HMI software, and will automatically display an alarm when a low flow is detected. The alarm also triggers a call by the autodialer.

3.2 Raw Water Pressure Transmitter PIT-1001 (WTP)

The new pressure transmitter requires no manual operations. It has been incorporated in the PLC/HMI software on the “Process Overview” page. It can be found on the top left of the screen.

~~3.3 Cooling Line Modifications for Fire Pump & Emergency Generator (Booster Station #1 & #2)~~

~~The fire pump & emergency generator cooling line modifications are the same for both stations. They include parallel solenoid control valves to control the flow, as well as a flow switch. These items do not require manual operation. They have been incorporated in the station PLC/HMI. The flow switch makes sure there is **flow** to the cooling line when the generator is online, and makes sure there is **no flow** when the generators are offline. An alarm is created when an issue is detected.~~

Chapter 4 MAINTENANCE

Below you will find a summary of the maintenance information that can be found in the individual O&M Manuals of the equipment. Further information, including schematics and step-by-step guides, can be found in the equipment's respective manual. These can be found in Chapters 6 to 15 below.

4.1 Exhaust Fan Chlorine Room (TwinCity Fan) – WTP

- General: Keep motor clean & dry
- 5-Months: Keep fan drive bearing lubricated (every 5 months, as per sticker on unit)
- 5-Years: Lubricate motor every 5 years
- As-Necessary: Inspect shaft and wheel, keep clean of dirt buildups, and for signs of fatigue
- As-Necessary: Inspect points of attachments to structure for signs of fatigue or loose connections
- As-Necessary: Inspect motor belt, re-tension or replace when necessary
- Refer to Manual attached to this document for further details and step-by-step instructions

4.2 Chlorine & pH Analyzers (Wallace & Tiernan Depolox 3 Plus) – WTP~~/BS#1/BS#2~~

- Daily: Inspect unit for leaks, including all pipe connections. Rectify all leaks immediately.
- Daily: Measure chlorine and pH using an external device, to ensure unit is properly calibrated.
- Weekly: With sample water turned on, check that there is sufficient "grit" in the measuring cell to keep electrode clean. Add more grit as necessary to keep probe clean
- Monthly: Remove and clean the strainer in the sample water supply line.
- Monthly: Remove and clean pH electrode, using diluted hydrochloric acid (10% max) and then rinsed in water. Recalibrate pH electrode.
- 2-Months: Check the zero point to ensure no drift has occurred
- 2-Months: Check potassium chloride electrolyte is level with the bottom of the electrolyte reservoir neck
- 2-Months: The particles of grit have a 2 month lifespan, and should be replaced after this period
- 2-Months: Inspect the 2 membrane in the electrode case. They should be white, and should be replaced if showing any signs of discoloration
- 6-Months: Replace the reference electrolyte.
- 2-Years: Replace pH electrode
- Refer to Manual attached to this document for further details and step-by-step instructions

4.3 Turbidity Analyzers (Hach TU5300sc) - WTP~~/BS#1/BS#2~~

- 2-Months: Clean the vial
- 2-Years: Replace the vial
- 2-Years: Replace the desiccant cartridge
- As Necessary: Clean the vial compartment
- As Necessary: Replace the tubing
- Refer to Manual attached to this document for further details and step-by-step instructions

4.4 Chlorine gas Detector (Wallace & Tiernan Accutech 35) – WTP

- Monthly: Test the sensor with actual gas. Calibrate using the zero potentiometer.
- Monthly: Clean the battery vent.
- Monthly: Verify the battery backup works by removing AC power.
- Refer to Manual attached to this document for further details and step-by-step instructions

4.5 Control Valves (Bray Series 70) – WTP

- No periodic maintenance required per manufacturer
- Refer to Manual attached to this document for further details & troubleshooting guide

4.6 Flow Switch (Magnetrol TD-1) – WTP~~/BS#1/BS#2~~

- As-Necessary: Probe may be cleaned by soaking/spraying with solvent or detergent and water. Lime deposits may be safely removed by soaking in 20% hydrochloric acid.
- Refer to Manual attached to this document for further details and troubleshooting guide

4.7 Solenoid Control Valves (ASCO series 8210G & GC Series S21)

- No periodic maintenance required per manufacturer

4.8 Pressure Transmitter (Endress & Hauser Cerepar PMC71) – WTP

- No periodic maintenance required per manufacturer

4.9 WTP Reservoir Discharge Flow Meter (Endress & Hauser Promag 400) – WTP

- No periodic maintenance required per manufacturer

4.10 Air Scour Blower (Delta Blower GM15L) – WTP

- After first 500h of operation, replace the lube oil & change the grease of drive shaft
- Weekly: Check the intake filter for contamination
- Weekly: Check the oil level
- Weekly: Check the belt guard for damage and contamination. Ensure it is totally stable
- 6-Months: Check the belts, replace if necessary
- 6-Months: Inspect the sheaves for wear, for alignment and for stability, replace if necessary
- 6-Months: Check that the pressure valve is operating correctly and clean it
- 6-Months: Replace the lube oil at a discharge temperature of over 140˚C
- 6-Months: Replace the grease of drive shaft at temperature of over 140˚C
- Yearly: Replace the intake filter
- Yearly: Replace the lube oil
- Yearly: Replace the grease of drive shaft
- 2-Years: Replace the belts
- 2-Years: Check alignment of the sheaves, correct if necessary
- 2-Years: Check non-return flap for wear and tightness, replace if necessary
- 2-Years: Check flexibe pipe connections on discharge and intake sides for tightness, replace if necessary
- 3-Years: Check hose lines for tightness, replace if necessary
- 3-Years: Complete machine check
- 7-Years: Lubricate the motor
- Refer to Manual attached to this document for further details and step-by-step instructions

4.11 Service Water Pump (Franklin Electric 6” 100GPM) – WTP

- No periodic maintenance required per manufacturer
- Refer to Manual attached to this document for further details and troubleshooting guide

4.12 Chemical Metering Pumps (LMI Series AD/B/C) – WTP

- Yearly: Replace the cartridge valve, O-rings, injection check valve spring
- Refer to Manual attached to this document for further details and step-by-step instructions

4.13 **Recirculation Pump (Aurora 382-BF) – BS#2**

- No specific maintenance schedule required for pump. It is recommended to be removed from well for inspection and cleaning periodically.
- Refer to Manual attached to this document for further details and step-by-step instructions

4.14 **Gas Detection System H2S & Combustible (MSA UltimaX5000) – LS#1/LS#2**

- Keep sensor window clean, free of particulate, oil, water, dirt. Clean using a cotton swab moistened with distilled water (or isopropyl alcohol if necessary) then dry using a separate dry cotton swab. After, make sure to remove any excessive water/alcohol to ensure completely clean surface.
- Periodically verify if sensors are properly calibrated
- Refer to Manual attached to this document for further details and step-by-step instructions

4.15 **Lift station Discharge Flow Meter (Endress & Hauser Promag 10W) – LS#1**

- No periodic maintenance required per manufacturer

MANUFACTURER/DISTRIBUTOR:

VENTES CENTECH INC.
Josée Gagnon
122 rue St-Laurent, Suite 200
St-Eustache, QC, J7P 5G1
Phone: (450) 473-4550
Fax: (450) 473-5525
jgagnon@centech.ca

6.1 TwinCity Chlorine Room Fan (WTP)

Twin City Exhaust Fan RBA909, corrosion resistant, spark resistant

FAN DETAILS

Job Name: Sifec

Twin City Fan & Blower
A Twin City Fan Company
Ventes Centech inc.
122 St-Laurent, St-Eustache (Qc) J7P 5G1
Tel: (450) 473-4550 Fax: (450) 473-5525
email: info@centech.ca
ISO 9001 CERTIFIED

Tag: N/A
Customer:
Job ID: 2017-09-13-1
Date: September 14, 2017

Description

Quantity	1
Model	RBA
Size	909
Width	SWSI
Arrangement	9A
Class	22
Rotation	CCW
Discharge	TAU
Wheel Diameter (in)	15.6
Drive method	Belt
Percentage width	100%
Percentage diameter	100%
Motor position	L

Performance

Volumetric Flow CFM	947
Operating SP (in WC)	3.000
Standard SP (in WC)	3.022
RPM	1595
Tip Speed (FPM)	6525
Oper. Power BHP	0.74
Standard Power BHP	0.75
Outlet Area (sq.ft)	0.44
Outlet Velocity (FPM)	2152
Max RPM for Class	4134
Static Efficiency	60.26%
Total Efficiency	66.00%
FEI	1.35
FEP (KW)	0.72
System FEI	N/A
System FEP (KW)	N/A

Air/Gas Properties

Altitude above sea level (ft)	0
Inlet Pressure (in WC)	-3.000
Inlet Temperature(°F)	70
Design Temperature (°F)	70
Gas Type	Operating air
Estimated Density (lb/ft³)	0.0744

Motor Data

Power (HP)	1-1/2
Enclosure	TEFC
Speed (RPM)	1800
Voltage	575V
Phase	3
Frequency	60Hz
Frame Size	145T

Modifiers

Apply Compressibility.

Sound

Octave Bands	1	2	3	4	5	6	7	8	LwA
Level at Inlet	89	85	83	78	70	65	59	53	79

-12

Sound Power Levels in dB re.10 Watts:

Dis	ft	1	3	5	10
dBA at inlet		83	73	69	63

Estimated sound pressure level in dBA (re: 0.0002 microbar) based on a single * ducted installation:

*To estimate dBA level for ducted inlet and ducted outlet (into and out of the room) type installation, deduct 20 from the LwA value shown. Using a directivity factor of 2. Estimated Sound Pressure based on free field, spherical (Q = 2) radiation at stated distance.

Definitions:

LwA The overall (single value) fan sound power level, 'A' weighted.

dBA The environment for each fan installation influences its measured sound value, therefore dBA levels cannot be guaranteed. Consult AMCA Publication 303 for further details. A fan's dBA is influenced by nearby reflective surfaces.

Twin City Exhaust Fan RBA909, corrosion resistant, spark resistant

FAN DETAILS

Job Name: Sifec

Twin City Fan & Blower
A Twin City Fan Company
Ventes Centech inc.
122 St-Laurent, St-Eustache (Qc) J7P 5G1
Tel: (450) 473-4550 Fax: (450) 473-5523
email: info@centech.ca
ISO 9001 CERTIFIED

Tag: N/A
Customer:
Job ID: 2017-09-13-1
Date: September 14, 2017

Pricing Detail

RBA 909, Class 22, Arrangement 9A Bare fan	244lb
Drain W/ Plug	0 lb
Flange - Inlet, Punched	0 lb
Flange - Outlet, Punched	0 lb
Guard - Belt, OSHA Type	15 lb
Guard - Shaft & Bearing	11 lb
Spark Resistant Construction - Type A	0 lb
Shaft Seal - Std Type	0 lb
Spec Matl: Airstream - Aluminum	0 lb
Extended Lube Lines to Drive Side	0 lb
Spcl Paint on all Guards - OSHA Yellow	0 lb
Coating: Entire Fan; Epoxy Mastic; Carboguard 890 Series - Wash; Prep: Tool Clean & Wash; Curing: Air Dry	0 lb
Motor 1-1/2 HP, 1800 RPM, 575V, 3Ph, 60Hz , TEFC - Premium , 145T	86 lb
Variable Speed V-Belt Drive, 1.5 SF	5 lb
Mount TCF Motor	0 lb

Each Weight	361 lb
Extended Weight	361 lb

Twin City Exhaust Fan RBA909, corrosion resistant, spark resistant

FAN DETAILS

Job Name: Sifec

Twin City Fan & Blower
A Twin City Fan Company
Ventes Centech inc.
122 St-Laurent, St-Eustache (Qc) J7P 5G1
Tel: (450) 473-4550 Fax: (450) 473-5523
email: info@centech.ca
ISO 9001 CERTIFIED

Customer:
Job ID: 2017-09-13-1
Date: September 14, 2017

AMCA Statements

Tag:

1. Twin City Fan certifies that the model RBA is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Certified Ratings Program.
2. Performance certified is for Installation Type D: Ducted inlet, Ducted outlet.
3. Power rating (BHP) does not include transmission losses.
4. The AMCA licensed air performance data has been modified for installation, appurtenances or accessories, etc. not included in the certified data. The modified performance is not AMCA licensed but is provided to aid in selection and applications of the product.
5. dBA levels are not licensed by AMCA International.

DOE Statements

Note that the Fan Energy Index (FEI) is an overall efficiency (wire-to-air) metric which includes not only the impact of the fan efficiency, but also each of the drive components used to operate the fan.

The Fan Electrical Input Power (FEP) is the amount of power of a given fan at an operating point characterized by a value of flow and pressure.

Twin City Exhaust Fan RBA909, corrosion resistant, spark resistant

Job Name: Sifec

Fans & Blowers Twin City

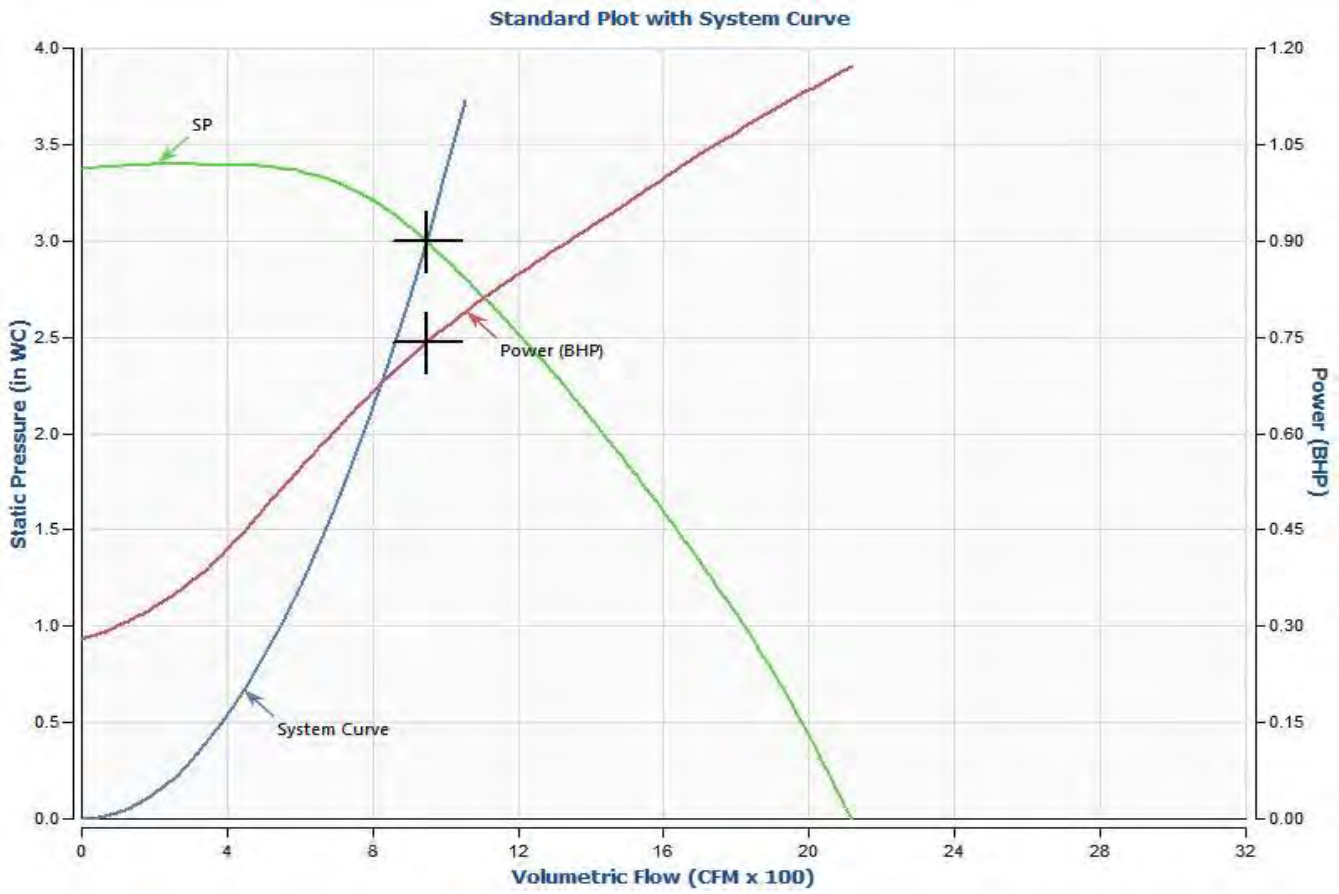
Customer:
Job ID: 2017-09-13-1
Date: September 14, 2017

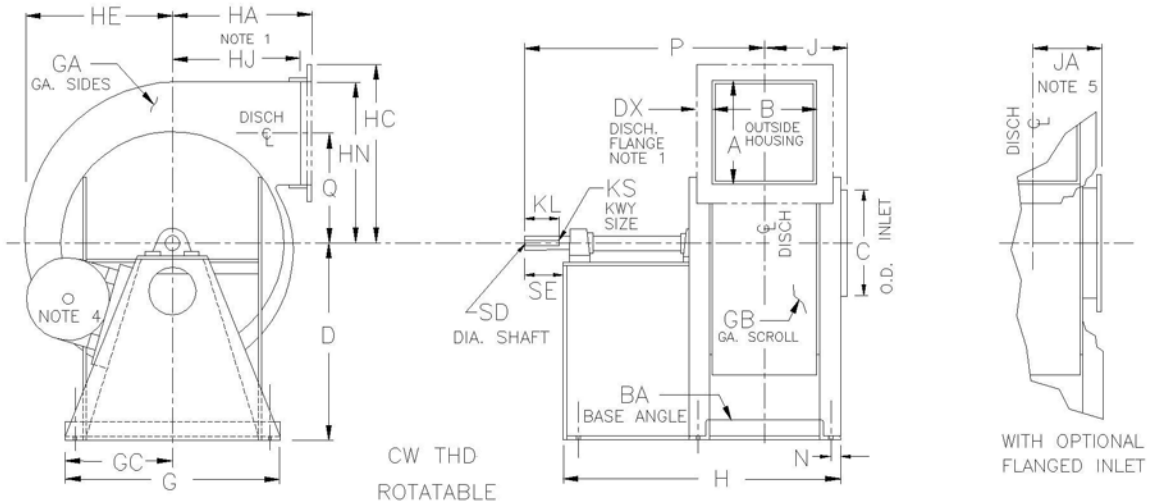
Tag:

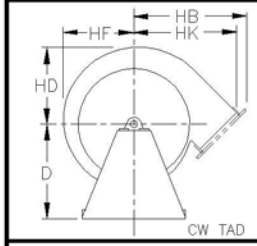
Fan information

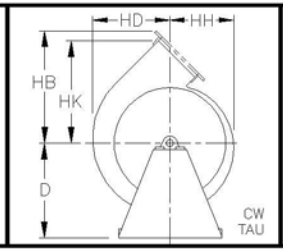
Size/Model 909/RBA	Class 22	Outlet Vel (FPM) 2152
Volumetric Flow (CFM) 947	Speed (RPM) 1595	Density (lb/ft³) 0.0744
SP (in WC) 3	Max Speed . . 4,134 RPM @ 70 °F	
	Power (BHP) 0.74	

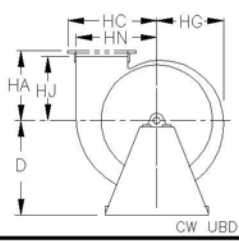
Adjusted for Apply Compressibility, Inlet Pres: -3 WC

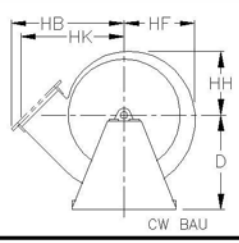


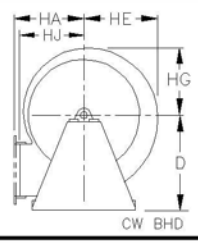










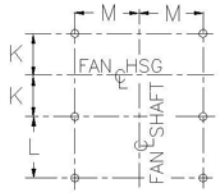


NOTES:

1. OUTLET FLANGES ARE OPTIONAL. FLANGES ARE PUNCHED PER AC15146.
2. 'CW' ROTATION IS SHOWN. 'CCW' IS SIMILAR BUT OPPOSITE.
3. FOR 'DBD' (DOWNBLAST) SEE DRAWING AC15071.
4. MOTOR LOCATION IS 'LEFT' FOR 'CW' ROT. AND 'RIGHT' FOR 'CCW' ROTATION. DIM. 'FR' IS MAX. MOTOR FRAME.
5. OPTIONAL FLANGED INLET PER DRAWING AC15143.

FOUNDATION PLAN

SIX 'BH' DIA BASE HOLES



'RBO', 'RBA', & 'RBW' ARR. NO. 9A & 9B CLASS 22

TWIN CITY FAN & BLOWER
MINNEAPOLIS, MINNESOTA 55442

DRAWN 8/10/94
REVISED
DWG NO AC-15074

JOB:

LOC.

ENG./ARCH.

CERT. BY:

S.O. NO.

SIZE	CLASS	DISCH	ROT.	MOTOR HP	MOT. LOC.	UNIT NO.

CFM	SP	RPM	BHP	OV	TS

ACCESSORIES REQ'D

SIZE	A	B	BA	BH	C	D 9A	D 9B	DX	FR 9A	FR 9B	G	GA	GB	GC	H 9A	H 9B	HA	HB	HC	HD	HE	SIZE
907	6.81	6.06	1.5X1.5	0.44	7.00	18.50	21.50	1.25	184T	215T	14.25	12	12	7.13	24.81	28.44	8.81	14.63	11.81	10.13	9.69	907
909	8.63	7.69	1.5X1.5	0.44	9.00	18.50	24.50	1.25	184T	256T	17.75	12	12	8.88	26.44	34.94	11.13	18.31	14.75	12.94	12.38	909
911	10.56	9.44	2.0X2.0	0.56	11.00	21.50	25.00	1.50	215T	256T	20.25	10	10	10.13	32.81	37.69	13.50	22.25	17.94	15.75	15.06	911
913	12.44	11.13	2.0X2.0	0.56	13.00	21.75	27.75	1.50	215T	286T	23.25	10	10	11.63	34.50	41.75	15.88	26.06	20.94	18.63	17.81	913
915	14.31	12.81	2.5X2.5	0.56	15.00	25.25	28.25	1.50	256T	286T	26.25	10	10	13.13	42.06	44.44	18.25	29.81	23.88	21.44	20.50	915
917	16.25	14.50	2.5X2.5	0.56	17.00	28.25	32.00	1.50	256T	326T	29.50	10	10	14.75	43.75	48.63	20.63	33.63	26.88	24.31	23.25	917
919	18.06	16.13	2.5X2.5	0.56	19.00	31.25	35.50	2.00	286T	365T	31.25	10	10	15.63	47.75	51.75	22.94	37.63	30.25	27.06	25.88	919

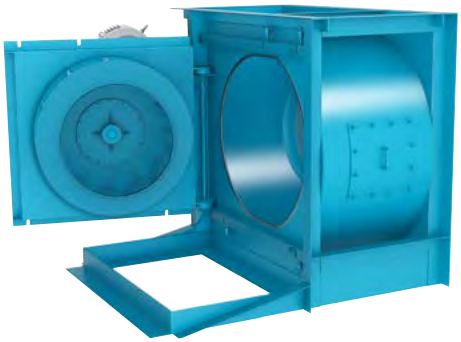
SIZE	HF	HG	HH	HJ	HK	HN	J	JA	K	KL	KS	L 9A	L 9B	M	N	P 9A	P 9B	Q	SD	SE	WHL DIA	SIZE
907	9.25	8.81	8.38	8.31	13.38	10.56	4.69	5.69	4.06	4.50	.38X.19	15.19	18.81	6.38	0.63	24.88	28.50	7.19	1.437	4.75	12.25	907
909	11.81	11.25	10.69	10.63	17.06	13.50	5.50	6.50	4.88	5.00	.38X.19	15.19	23.69	8.13	0.63	26.44	34.94	9.19	1.437	5.50	15.63	909
911	14.38	13.69	13.00	13.00	20.88	16.44	6.88	8.38	6.00	5.00	.38X.19	18.81	23.69	9.13	0.88	31.44	36.31	11.19	1.687	5.50	19.13	911
913	17.00	16.19	15.38	15.38	24.63	19.44	7.69	9.19	6.81	5.50	.38X.19	18.88	26.13	10.63	0.88	32.81	40.06	13.25	1.687	6.00	22.63	913
915	19.56	18.63	17.69	17.75	28.38	22.38	9.06	10.06	7.94	5.50	.50X.25	23.69	26.06	11.88	1.13	39.00	41.38	15.25	2.187	6.00	26.13	915
917	22.19	21.13	20.06	20.13	32.19	25.38	9.88	10.88	8.75	6.00	.50X.25	23.75	28.63	13.50	1.13	40.88	45.75	17.25	2.187	7.00	29.63	917
919	24.69	23.50	22.31	22.44	35.88	28.25	10.69	11.69	9.56	7.00	.50X.25	26.13	30.13	14.38	1.13	44.56	48.56	19.25	2.187	7.50	33.00	919

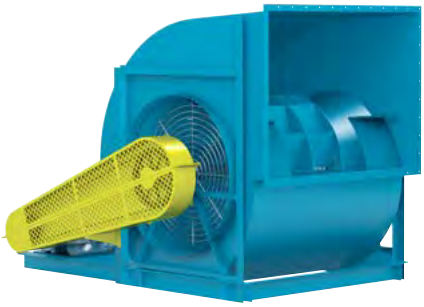
Twin City Exhaust Fan
RBA909, corrosion
resistant, spark resistant

IM-995
September 2017

Centrifugal Fans

Installation, Operation & Maintenance Manual





Review AMCA Bulletin 410 Prior to Installation

This bulletin has been prepared to guide the users of industrial centrifugal fans in the proper installation, operation and maintenance procedures to insure maximum equipment life with trouble-free operation. For safe installation, startup and operational life of this equipment, it is important that all involved with the equipment be well versed in proper fan safety practices and read this bulletin. It is the user's responsibility to make sure that all requirements of good safety practices and any applicable safety codes are strictly adhered to. Because of the wide variety of equipment covered in this bulletin, the instructions given here are general in nature. Additional product and engineering information is available at www.tcf.com.

SAFETY NOTICE

Refer to the safety section(s) in this manual prior to installing or servicing the fan. The most current version of this installation and maintenance manual can be found on our website at www.tcf.com/resources/installation-maintenance-manuals.

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Fan & Blower Twin City

Centrifugal Fan Arrangements - Single Width, Single Inlet (SWSI)

Arrangement 1
Belt Driven or Direct Drive

Arrangement 3
Belt Driven

Arrangement 3F
Belt Driven

Arrangement 3SI
Belt Driven or Direct Drive

Arrangement 4
Direct Drive

Arrangement 4S
Direct Drive
(Swingout Door)

Arrangement 4VI
Direct Drive
(Vertical Inlet)

Arrangement 4HI
Direct Drive
(Horizontal Inlet)

Arrangement 7
Direct Drive

Arrangement 7SI
Direct Drive

Arrangement 8
Direct Drive

Arrangement 9
Belt Driven

Arrangement 9F
Belt Driven

Arrangement 9H
Belt Driven

Arrangement 9SS
Belt Driven
(Swingout Door)

Arrangement 9ST
Belt Driven
(Swingout Door)

Arrangement 10
Belt Driven

Centrifugal Fan Arrangements - Double Width, Double Inlet (DWDI)

Arrangement 3
Belt Driven or Direct Drive

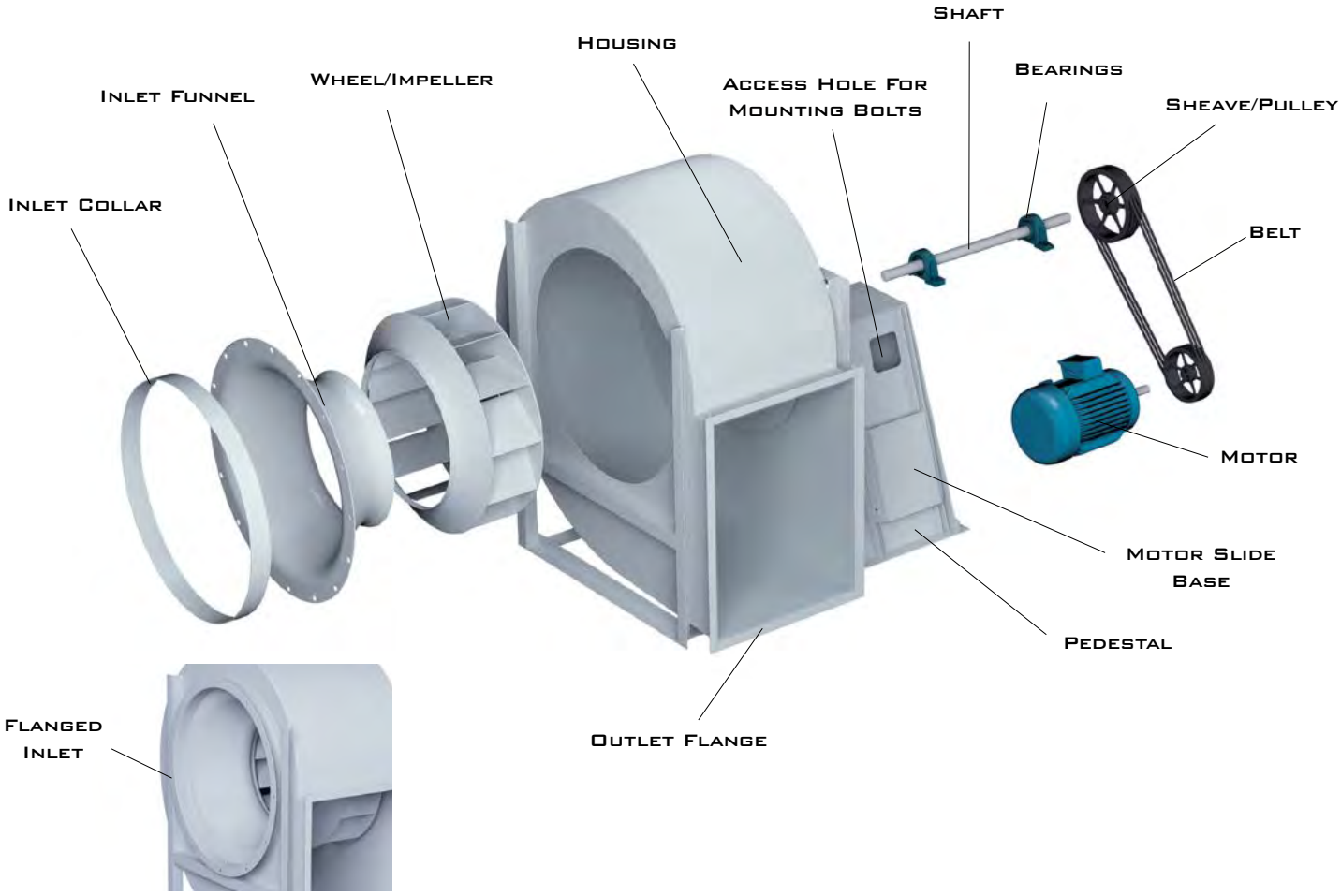
Arrangement 3F
Belt Driven

Arrangement 3DI
Belt Driven or Direct Drive

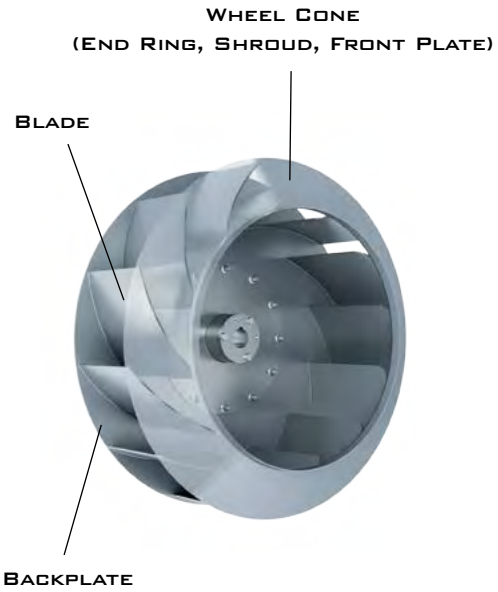
Arrangement 7
Direct Drive

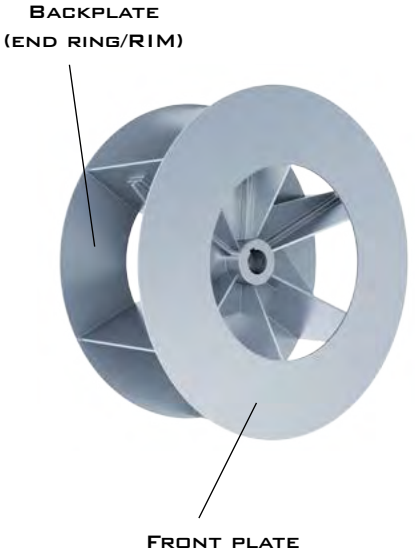
Arrangement 7DI
Direct Drive

Exploded View - Centrifugal Fans



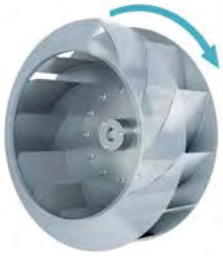
Wheel (Impeller) Nomenclature



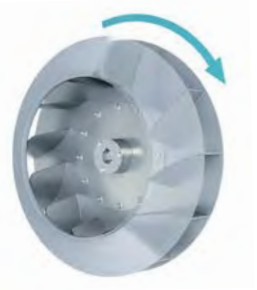


SWSI Wheel Types

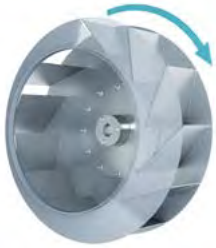
Airfoil



Backward Curved



Radial Tip



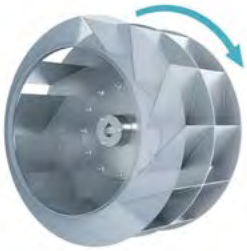
Backward Inclined

Radial Bladed

Forward Curved

DWDI Wheel Types

Airfoil



Backward Inclined

Forward Curved

Wheel Rotation

Rotation View From Drive Side

CLOCKWISE (CW)
EXAMPLE SHOWN

SWSI Centrifugal Fans

DWDI Centrifugal Fans

Safety & Hazard Warnings

For general safety practices for air moving equipment, see AMCA Bulletin 410. Twin City Fan & Blower offers many safety accessories. These safety devices include (but are not limited to) belt guards, shaft guards, inlet and discharge screens. The use and suitability of safety devices is the responsibility of the purchaser.

Facility related safety conditions include fans' accessibility and location. How easily can non-service personnel access the unit? Is the fan in a hazardous duty environment? Was the unit ordered for this duty? Other concerns must also be addressed. All fans should be powered through switches which are easily accessible to service personnel from the fan. Fan power must have the ability to be "locked out" by service personnel trained in lockout/tagout procedures per OSHA requirements (29CFR1910.147). When performing lockout, be aware of factors, such as building pressure and additional fans in the system that can influence unwanted fan rotation (wind milling). If you have any doubt about your ability to perform a task, seek a person qualified to do that task. Before any work is done on a fan, ensure that the fan is isolated from the electrical supply using a 'lockout/tagout system.'

Note: A stationary, non-rotating fan does not mean that the fan is isolated from the electrical supply. A non-rotating fan could be subject to controls or other circuit protection devices that may start the fan without notice.

The following safety precautions should be followed, where applicable:

- Do not attempt to slow a rotating impeller even when it is isolated from the electrical supply. Fan impellers have a high inertia and injury could result from an attempt to stop it. It is recommended that the impeller is isolated by closing off the inlet or outlet to prevent wind-driven rotation. If an impeller is chocked to prevent rotation, ensure that the chocks are removed prior to start up.
- Wear appropriate personal protective equipment. This may include protective clothing, eye protection, ear protection, respiratory equipment, hand and foot protection when installing or servicing the fan.
- Always use caution when entering a fan's air path. High velocity airflow can cause you to lose your balance.
- Motor, bearings and drives can be hot, and similarly if the fan is subject to processes that are hot, the fan housing could be hot.
- Fans are often used to move hazardous materials that could be dangerous. Always wear protective clothing and take precautions not to inhale dust/gases. If hazardous chemical vapors are present, respiratory equipment may be required.
- Sharp edges – wear protective gloves when handling, installing, or servicing a fan.
- Fans can operate at high decibel sound levels. Wear proper ear protection to protect from excessive noise levels.
- Access Doors – Do not open access doors when fan is in operation. The effects of suction and air pressure could result in injury.
- When working around pulleys and belts, keep hands away from pinch points. This pertains to when the fan is under or off power.

Throughout this manual, there are a number of HAZARD WARNINGS that must be read and adhered to in order to prevent possible personal injury and/or damage to equipment. Two signal words "WARNING" and "CAUTION" are used to indicate the severity of a hazard and are preceded by the safety alert symbol. It is the responsibility of all personnel involved in installation, operation and maintenance to fully understand the warning and caution procedures by which hazards are to be avoided.

WARNING: Used when serious injury or death MAY result from misuse or failure to follow specific instructions.

CAUTION: Used when minor or moderate injury or product / equipment damage MAY result from misuse or failure to follow specific instructions.

NOTICE: Indicates information considered important, but not hazard-related.

Shipping & Receiving

All Twin City Fan & Blower products are carefully constructed and inspected before shipment to insure the highest standards of quality and performance. Compare all components with the bill of lading or packing list to verify that the proper unit was received. Check each unit for any damage that may have occurred in transit. Any damage should be reported immediately to the carrier and the necessary damage report filed. Damage should be noted on the bill of lading.

Handling

Handling of all air moving equipment should be conducted by trained personnel and be consistent with safe handling practices. Verify the lift capacity and operating condition of handling equipment. When using hoisting equipment, only qualified and trained personnel should operate the equipment.

Units shipped completely assembled may be lifted with slings and spreader bars. (Use well-padded chains, cables or nylon straps, rated to lift the required weight.) On most units, lifting lugs are designed to protect the fan and fan housing from damage. Never lift a fan by the inlet or discharge flange, shafting or drives, wheel or impeller, motor or motor base, or in any other manner that may bend or distort parts. Never lift with slings or timbers passed through the fan inlets.

For fans provided without lifting lugs, use a forklift or pallet jack to handle the equipment. Consult a qualified person before lifting.

⚠ CAUTION

1. **Maintain handling equipment to avoid serious personal injury and do not stand under the load.**
2. **If supplied, only use the provided lifting lugs to lift the equipment.**
3. **Ensure that the lifting equipment is rated for the capacity to be lifted.**

Lifting lugs are provided on most units.

Lift fans mounted to a Unitary Base as shown

Partial or disassembled units require special handling. All parts should be handled in a method which protects the coatings and parts from damage. Components should be handled such that forces are not concentrated to avoid bending or distortion.

The housing should be lifted using suitably rated spreader bars and padded Chains or straps. Do not distort housing or side plates when lifting.

The shaft and wheel assembly may be lifted using a hoist and a spreader with slings around the shaft at either side of the wheel. Use the spreader bar to ensure that the slings do not push against the sides of the wheel as this may distort the wheel. Take care not to damage the shaft where the wheel or bearings will be mounted. Never lift or support the assembly by the wheel. Always support the assembly by the shaft when lifting or storing (see the section regarding proper storage of equipment.) Do not support the shaft or the wheel on the housing sides. See the Fan Installation section for additional details.

Wheels shipped separately can be lifted by slings running between the blades or through the hub. Never lift the wheel by a single blade or single point on the flange/shroud. Do not to put a chain within the hub bore. Always transport wheels by lifting, do not roll the wheel as this can damage coatings and change the balance of the wheel.

Bent shafting is a source of vibration and bearing failure, so be sure to handle the shaft with care. If the shaft is bent, replace the shaft. Any scratches on the shaft may be repaired with fine emery cloth or a stone. Remove only the displaced metal that forms a high point at the edge of the scratch.

⚠ CAUTION

1. **Bearing pedestals should be lifted using straps or padded chains. Under no circumstance should an attached or separated bearing pedestal be lifted by the shaft, bearings, drives, motor or wheel.**
2. **Note some rotor assemblies may have an off-center CoG and therefore a qualified person should be consulted before lifting.**

Unit Storage

If fan installation is to be delayed, store the unit in an environmentally stable and protected area. During storage, the fan should not be subjected to vibration from external sources or bearing damage may occur. The unit should be reasonably protected from any accidental impacts. Cover the fan to protect coatings and to prevent any foreign material or moisture from entering the inlet or discharge. Take care to protect the motor, drives and bearings.

Extended storage requires monthly inspections. Check for corrosion or damage to the unit and for debris within the fan.

Bearings tend to take on moisture if the atmosphere in which they are stored is not at a constant temperature. To avoid corrosion, it is necessary to keep the bearings full of grease and to rotate them periodically. Even when full of grease, bearings will take on moisture, so it is necessary to purge the bearings with new grease to expel moisture every thirty days. It is recommended that the bearings be purged with grease while being rotated by hand. Do not use high pressure greasers as they may ruin the bearing seals. Spherical roller bearings with split pillow block housings must be opened up and grease removed before start-up. Remove old/excess grease and regrease the bearing in accordance with the bearing manufacturer's instructions.

The drives and belts should be removed if the fan is to be stored for a prolonged period. The drives should be labeled for service and stored in a dry place. Belts should be removed, coiled without kinks, placed in a heavy carton, and stored in a dry, well-ventilated place. To prevent belt deterioration storage conditions should not exceed 85°F and 70% humidity. If belts show signs of deterioration, they should be replaced prior to startup.

Motors should be stored in a clean, dry, vibration-free location. The packaging should be opened up enough to allow air circulation around the motor. The winding temperature should be kept slightly above that of the surroundings to prevent condensation. This can be accomplished by energizing the internal heaters, if the motor is so equipped, or by using space heaters. If it is impossible to heat the windings, the motor should be wrapped tightly with a waterproof material which also encloses several bags of desiccant. Replace the desiccant regularly to prevent moisture problems. The motor rotor should also be rotated regularly (monthly) to assure the bearing parts are well greased. Shafts on motors equipped with shaft grounding rings must remain rust free. Failure to do so renders the grounding feature inoperative and may result in bearing failure under VFD operation. Consult the motor manufacturer for further detail on motor storage and start up after longer periods of storage. It may be necessary to regrease the bearings. If the fan's bearings or motor bearings have extended lubrication lines, it will be necessary to replace the grease by detaching from the motor/bearing and purging the line with new grease.

Fan & Blower
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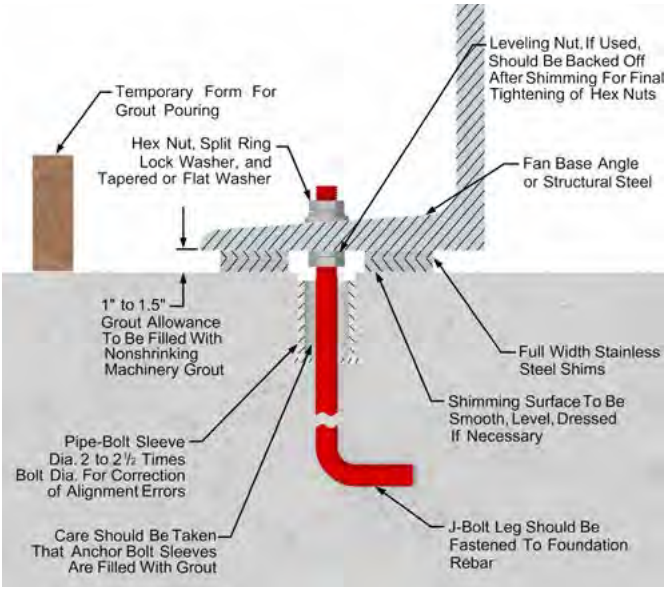
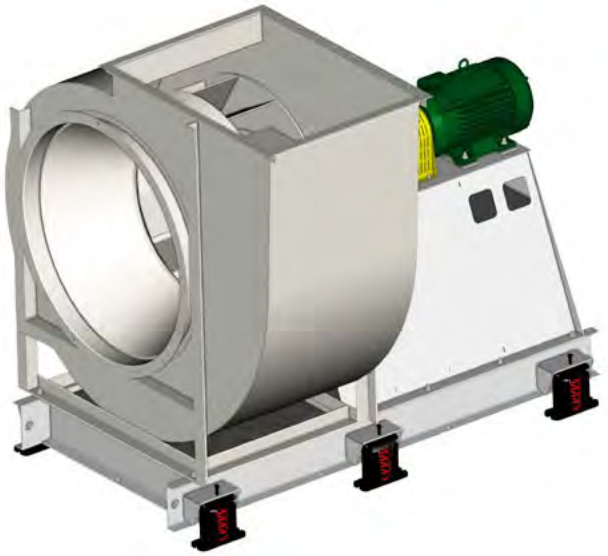
WARNING

Refer to handling section prior to lifting equipment.

Foundations & Supporting Structures (refer to lifting/safety section)

The best means of floor mounting a fan is on a well-designed, flat, level concrete foundation. The foundation should have a mass of at least three times that of the supported assembly. Rigid foundation stiffness must be between $1x10^6$ lbs./in. to $4x10^6$ lbs./in. depending upon size and speed. The foundation should extend 6" beyond the outer dimensions of the fan and driver; however, it should be no more than twice the area required for the equipment. If it is made larger, the mass should be increased accordingly to resist rocking modes of vibration. Anchor bolts should be carefully located by a competent tradesman as wheel to inlet, bearing location and motor location are critical to final fan alignment. J or T type anchor bolts of sufficient size should be used and should be tied into the reinforcing bar for the foundation. Pipe sleeves may be incorporated when pouring the concrete. After the concrete is poured, a pipe sleeve with a diameter of 2 to 2½ times the anchor bolt diameter should be provided around the anchor bolt for final adjustment. The mounting surface of the foundation should be smooth for good shim contact. When deciding the thickness of the foundation, approximately 1 to 1½" height should be allowed for shimming, grouting, leveling, washers, nuts, etc. The above represents industry best practice. Actual foundation design should be entrusted to a qualified engineer. Anchor bolts should be accurately placed to coincide with the predetermined fan securing holes, or the manufactured base, to ensure that the fan is not distorted (this may impact alignment and vibration.)





Fan mounted on an Inertia Base
Base and pedestal shown filled with reinforced concrete.

Fans mounted on a sub-floor or mezzanine must have adequate stiffness or be mounted on an inertia base with springs properly selected. An inertia base is recommended for arrangement 8 fans to ensure alignment of the rotor and drive.

If a structural steel base or platform is to be used, the structure must be designed for the weight of the fan, live loads imposed by rotation of the rotor and driver, and any external live loads. The structure should be designed to ensure that no natural frequency will occur within 30% of the fan speed. This is especially true if the structure supports more than one fan. Inertia bases are generally recommended to provide adequate mass and stiffness for fan operation.

Any ducting should have independent support. Do not use the fan to support ducting as the housing or pedestal may become distorted. The fan frame can be designed to carry some external loads. Consult the factory if this is a concern. Isolating the fan from ductwork with flex connections eliminates transmission of vibration. Fans handling hot gases require expansion joints at both the inlet and discharge to prevent excessive loads caused by thermal growth.

Fan Installation – Factory Assembled Units (refer to lifting/safety section)

All fan wheels are statically and dynamically balanced using state of the art equipment in the factory. Final trim balancing is performed on factory assembled fans, unless the specified electrical characteristics of the motor are outside the limits of the factory test equipment. If the motor and drives are supplied, the complete assembly is run tested and balanced. Infrequently, fans are supplied with unusual electrical characteristics and cannot be tested with the motor. In this situation the fans are run and balanced using a factory driver. Likewise, if motors and/or drives are not supplied, the fan is tested with the factory driver. Final balancing, at the buyer's expense, should be performed in the field after the motor and/or drives are installed. This service is available from TCF, otherwise this should be entrusted to a qualified technician.

Follow proper handling instructions as given earlier.

1. Move the fan to the final mounting position.
2. Remove skid, crates and packing materials carefully.
3. If vibration isolation is to be used, place isolation base on mounting bolts. Line up holes in fan base with bolts. See Item 10 in the "Optional Accessories" section for preparing inertia bases for use.
4. Place the fan on mounting structure. Carefully level the unit (checking the level on the shaft) on the foundation and shim as necessary using stainless steel shims on both sides of each anchor bolt. Back off leveling nuts if used. Be careful not to force the fan to the mounting structure/ foundation. This may cause the bearings to become misaligned or pinched causing vibration and premature failure.
5. Check the alignment of the bearings. Shim or reposition the bearings if necessary.
6. Check alignment of sheaves on belt driven fans.
7. Check tension of belts to see if it is sufficient. Sheaves on belt driven fans are often provided with taperlock bushings. When tightening bushing bolts, proceed in a progressive manner to avoid cocking the tapered surfaces between the bushing and the sheave. Torque per tables on the right.

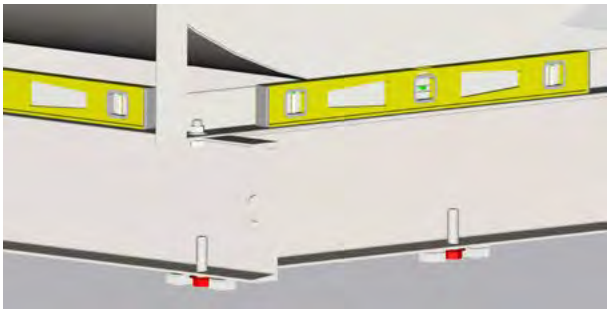
Click To View Our Sheave Installation video

8. Check alignment of factory mounted couplings, as they are subject to misalignment during shipment and installation. Realign to within 0.002" offset and parallel. Allow for thermal growth of the motor by setting the motor 0.001" low for each inch of shaft up to 0.005".

NOTICE

Most couplings need lubrication.

9. Check the tightness of the wheel on the shaft. Check the tightness of foundation bolts, motor bolts, sheaves, and bearings. Make sure there is no rubbing or binding and that the wheel-inlet cone clearances and overlap are correct.
10. Check that bearings are fully lubricated and check the oil level in the static oil lube systems. For spherical roller bearings with split pillow block housings, the bottom half of the housings should be 1/3 full of grease. For oil lube bearings, the oil level should submerge the bottom-most roller halfway into the oil.
11. Install any accessories shipped loose from the factory.



Carefully level the fan on the foundation

Tightening Torque

SIZE	FASTENER - TIGHTENING TORQUE (Ft. Lbs.)		
	GRADE 2	GRADE 5	GRADE 8
#10	—	—	—
¼-20	5.5	8	12
5/16-18	11	17	25
⅜-16	22	30	45
7/16-14	30	50	70
½-13	55	75	110
9/16-12	—	—	—
⅝-11	100	150	200
¾-10	150	270	380
⅞-9	165	430	600
1-8	250	645	900
1¼-7	500	1120	1500

SIZE	TAPER BUSHINGS - TIGHTENING TORQUE (Ft. Lbs.)		
	SPLIT		QD
	IN IRON	IN ALUM. HUB	FOR DRIVE
#10	—	—	6
¼-20	7.9	7.5	9
5/16-18	16	13	15
⅜-16	29	24	30
7/16-14	—	—	—
½-13	70	—	60
9/16-12	—	—	75
⅝-11	140	112	135
¾-10	—	—	—
⅞-9	—	—	—
1-8	—	—	—
1¼-7	—	—	—

The above torque values are for nonlubricated fasteners and Browning Bushings. For bearing setscrews, use manufacturer's recommendations. If other bushings are used, utilize bushing manufacturer's specifications.

Tolerance: +/- 5%
For wheel setscrews use Grade 2 values.

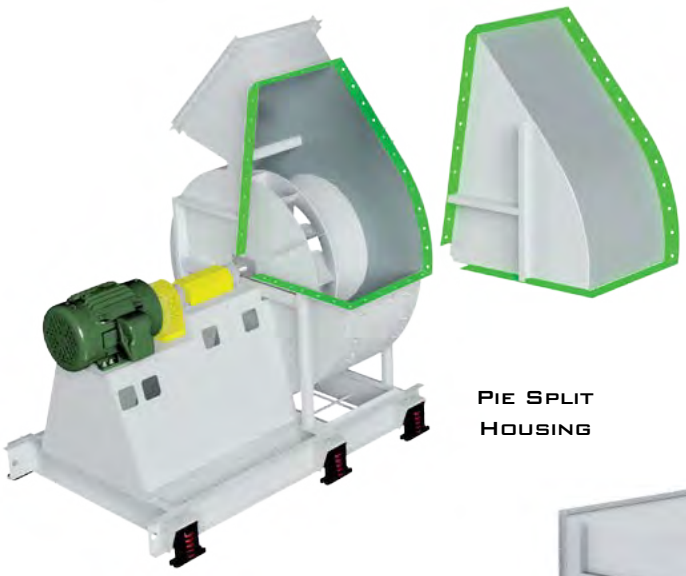
Fan Installation – Disassembled Units With Split Housings

(refer to lifting/safety section)

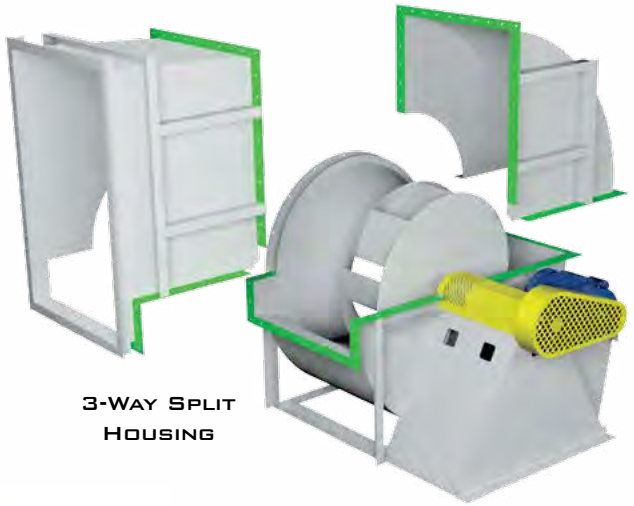
A unit is considered "disassembled" if any component required for proper operation is shipped or supplied separately or in pieces. Reference earlier instructions concerning proper handling of fan components and general safety. Wheel rotation is important. Rotation is viewed from the drive side unless otherwise noted on the drawing.

All units where assembly of the fan housing or bearing pedestal or drive stand is required will have tags or matchmarks on adjacent parts. These are used to identify which components are joined together. Units which require extensive assembly may require additional instructions located in other sections of this manual. Special instructions for some components and accessories are sent with the shipment.

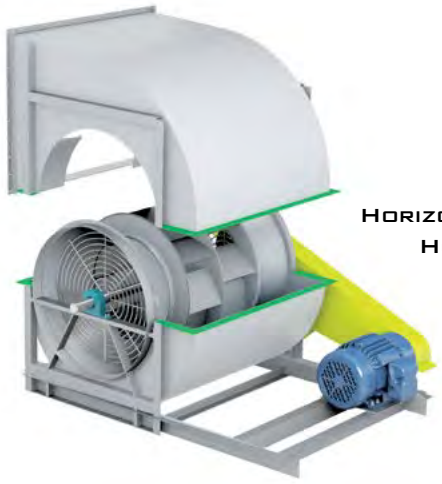
1. Move the lower half of the housing to its mounting location.
2. Remove skids, crates, and packing materials carefully.
3. If vibration isolation is to be used, place the vibration isolation base on mounting bolts. Line up holes in fan base with bolts. See Item 10 in the "Optional Accessories" section for preparing inertia bases for use.
4. Place the lower housing on the mounting structure. Carefully level the lower housing on the foundation and shim as necessary using stainless steel shims on both sides of each anchor bolt. **IMPORTANT: Back off leveling nuts if used.**
5. If the bearing pedestal(s) are separated they should be installed next.
   a. Move bearing pedestal(s) to mounting location.
   b. Set pedestal(s) on bolt(s).
   c. Do not distort bearing pedestal by forcing it to align with a non-level foundation. (The concrete foundation should be properly dressed.) Place shims on either side of the foundation studs and back off leveling nuts.
   d. Check the bearing centerline height. Adjust the height to match centerline height of the housing. High temperature units may require a lower housing centerline/inlet when cold so that it will be centered when hot.
   e. Bring the bearing pedestal into square with the housing using careful measurements or a large square.
   f. Shim and bolt the pedestal into position.



Pie Split Housing



3-Way Split Housing



Horizontal Split Housing

Fan Installation – Disassembled Units With Split Housings (Cont.)

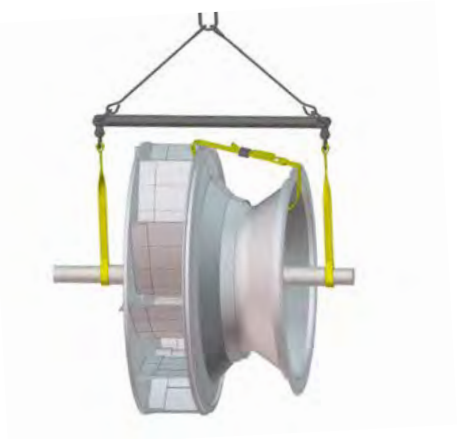
(refer to lifting/safety section)

6. If the wheel and shaft were shipped unassembled, you must now install the shaft in the wheel.
   a. First use solvent to clean the protective coating off the shaft. Check all surfaces for corrosion or nicks and clean if necessary with fine emery cloth or a stone. After thoroughly cleaning the shaft with solvent, do not touch it with bare hands as perspiration can cause rust or pitting over time.
   b. Remove keys from the shaft.
   c. Clean the inside of the wheel bore with solvent. Make sure the setscrews will not interfere when inserting the shaft into the wheel bore.
   d. Insert the shaft into the wheel from the back side of the wheel.
   e. When the shaft is flush with the wheel hub (Arr. 1, 9 and 8), dress the key if necessary, insert into the keyway and tighten the wheel setscrews.
   f. For Arrangement 3 fans, refer to the drawing for appropriate wheel and shaft dimensional relationship.
   g. Check the assembly drawing to make sure that the wheel and shaft have been assembled correctly.

Click To View Our Wheel Installation/Removal Video

Click To View Our Rotor Installation/Removal Video

7. The rotor can now be installed in the housing. Slide the bearings on if they are solid pillow blocks or loosely mount the bottom halves if they are split. Inlet vanes and/or inlet funnels may need to be installed over the shaft before installing and bolting the bearings to their supports (Arr. 3 and 7). Insert the inlets into the wheel inlet and tie them off for lifting and placing in the housing. Refer to steps 8 and 9 for order of assembly of components for double width and single width fans. The shaft should be cleaned and oiled where it will contact the bearings. Carefully lower the shaft assembly into the bearings. Use care when lowering the shaft onto the bearings so thrust bearings, collars, and liners are not damaged due to misalignment. The bearing housing should be parallel to the axis of the shaft to prevent loads caused by misalignment. Precision shim bearings as required. Lock bearings. Be sure expansion bearing (if supplied) is set to allow for thermal growth. Refer to bearing installation instructions in this installation manual.



8. Arrangement 3 (split-housed) units:
   a. Parts on a DWDI unit are assembled in the following order as viewed from opposite drive side: bearing bar assembly (or independent pedestal) and opposite bearing, funnel (housing side), wheel (housing side), funnel, drive side bearing bar assembly (pedestal), drive bearing and sheaves or coupling. Mount bearing bar assembly to housing. Center wheel in funnels.
   b. Assemble parts in above order on shaft.
   c. Proceed with connection of the shaft assembly to supports in step 7 above.
9. Parts on a SWSI unit are assembled in the following order as viewed from opposite drive side: bearing bar assembly and opposite bearing, funnel (housing side), wheel (housing side), drive side bearing bar assembly, drive bearing and sheaves. Mount bearing bar assembly to housing. **Refer to the wheel-funnel overlap section.**
   a. Assemble parts in above order on shaft.
   b. Proceed with connection of the shaft assembly to supports in step 7.
10. Install motor on the base if applicable. Carefully align shafts for drive installation.

Fan & Blower Twin City

Bearing Installation (refer to safety section)

The following section gives some general instructions on bearing installation. If bearings are to be field installed, the specific installation manual for the bearings will be provided and should be followed carefully. If provided, check the assembly drawings and bearing manufacturer's instructions for location of the fixed and expansion bearings. The positions of these bearings cannot be interchanged. Always follow the bearing manufacturer's instructions.

Solid Pillow Block

1. Lightly lubricate the bearing bore and slide bearing into the proper position on the shaft. Sling the rotor assembly into place and loosely bolt the bearings in place.
2. When bearings are in place, shim appropriately and torque the base bolts using values from the Tightening Torque table on page 9. Tighten the collar setscrews to manufacturer's specification. The setscrews on both bearings should be aligned with one another. If the bearing has an adapter mount, hand tighten the locknut to establish the "zero" point. Next, tighten the number of turns per the instructions furnished with the bearing. Rotate by hand to be sure the bearings and shaft rotate freely.
3. Ensure the expansion bearing is centered within its housing. If bearings need to forced onto the shaft then apply force on the inner race/collar only (does not apply to adapter mount.) If an expansion bearing has been supplied, it should not be bolted to the pedestal until the fixed bearing has been bolted and locked. After locking the expansion bearing to the shaft, position the pillowblock to allow for axial expansion, approximately centered in the pillowblock, then bolt to the pedestal.
4. Unless the user orders differently, bearings are lubricated in the factory with a lithium complex, NLGI grade 2 grease. **Refer to the bearing lubrication schedule on the next page.**

Solid Pillow Block Bearings

Split Pillow Block Bearings

Spherical Roller Bearings with Split Pillow Block Housings

1. The bearings should be disassembled, taking care not to interchange parts between bearings. Tops of housings are not interchangeable with the bottom half pillowblock from another bearing. Pins locate the top half of the housing to prevent it from being installed in the reverse.
2. The lower bearing housing should be bolted loosely to the pedestal and seals; bearing and adapter sleeve should be placed loosely on the shaft.
3. The rotor assembly with the seals and bearings should next be positioned over the housings and carefully placed into the lower housings.
4. The stabilizing ring, sometimes referred to as the "C" ring, is installed in the bearing closest to the drive sheave or coupling unless otherwise noted in the drawing. The bearing race should be centered in the expansion bearing. The exception may be on Arrangement 3 or 7 fans with a high operating temperature. Refer to the fan drawing for location. The "C" ring is not used in the expansion bearing.
5. When installing adapter sleeves, tighten for reduction in clearance per manufacturer's instructions.
6. Bend down a tab on the lockwasher after finishing adjustment. Some brands of bearings do not utilize a lockwasher. Instead you will find allen-head setscrews in the locknut outside diameter. Tighten the setscrew after reduction in clearance is attained.
7. Grease or oil according to manufacturer's instructions. Grease/Lube will likely include the partial fill of the housing internal cavities.
8. Install the bearing housing cap bolts and bearing mounting bolts. Tighten bearing housing cap bolts and bearing mounting bolts. Torque to bearing manufacturer's instructions.

Sleeve Bearings

1. The bearings should be disassembled and cleaned with appropriate solvent, taking care not to interchange parts between bearings. Parts of one bearing are generally not interchangeable with parts from another bearing. Bearing caps are matched to the bottom half of the pillowblock and are not interchangeable with other pillowblocks.
2. The lower bearing housings should be bolted loosely to the pedestal. The lower liner should then be placed in the housing.
3. Oil the lower liners per manufacturer's instructions and carefully sling the rotor assembly into place, being very careful not to damage the bearing liners.
4. Install thrust collars and thrust plates in the fixed bearing
5. Make sure to install the oil slinger rings in their correct location and peen the ring screws in place.
6. When handling the liners, be careful not to damage the surfaces, as they are babbitted and are fragile.
7. The housings are generally tapped with a number of ports. Be sure the oil level gauge, circulating oil supply and discharge, thermocouples, etc., are correctly placed for accessibility.
8. Make sure that proper oil type and quantity is used. Refer to the fan general assembly drawing.
9. Make sure that the thrust collar screws, liner screws, cap bolts, and plunger are torqued to manufacturer's specifications. Bearing instructions are shipped with the fan. Instructions can also be found on the bearing manufacturer's website.

Safety & Bearing Lubrication Instructions

WARNING

1. **This equipment must not be operated without proper guarding of all moving parts. While performing maintenance be sure remote power switches are locked off. See installation manual for recommended safety practices.**
2. **Before starting: Check all setscrews for tightness and rotate wheel by hand to make sure it has not moved in transit.**

Fans with Unit Roller Bearings

Relubrication Schedule (Months)* Spherical Roller Bearing - Solid Pillow Blocks									
Shaft DIA	Speed (RPM)								
	500	1000	1500	2000	2500	3000	3500	4000	4500
1" thru 1 7/16" (25 – 35)	6	4	4	2	1	1	1	1	1/2
1 11/16" thru 2 3/16" (40 – 55)	4	2	1 1/2	1	1/2	1/2	1/2	1/2	1/2
2 7/16" thru 3 3/16" (60 – 85)	3	1 1/2	1	1/2	1/2	1/4	1/4		
3 15/16" thru 4 15/16" (90 – 125)	2 1/2	1	1/2	1/4					

*Suggested lubrication interval under ideal continuous operating conditions. Relubricate while running, if safety permits, until some purging occurs at seals. Adjust lubrication frequency depending on conditions of purged grease. Use one-half of listed interval for vertical shaft applications or for 24 hour operation. Hours of operation, temperature, and surrounding conditions will affect the relubrication frequency required.

1. Lubricate with a high quality NLGI No. 2 lithium-base grease having rust inhibitors and antioxidant additives, and a minimum oil viscosity of 500 SUS at 100°F (38°C). Some greases having these properties are:
   Shell - Gadus S2 V100 2 — Mobil - Ronex MP
   Mobil - Mobilith SHC100 — Mobil - Mobilith SHC220
2. Lubricate bearings prior to extended shutdown or storage and rotate shaft monthly to aid corrosion protection.

Fans with Ball Bearings

Relubrication Schedule (Months)* Ball Bearing Pillow Blocks									
Shaft DIA	Speed (RPM)								
	500	1000	1500	2000	2500	3000	3500	4000	4500
1/2" thru 1 11/16" (13 – 45)	6	6	5	3	3	2	2	2	1
1 15/16" thru 2 7/16" (50 – 60)	6	5	4	2	2	1	1	1	1
2 1/16" thru 2 15/16" (65 – 75)	5	4	3	2	1	1	1		
3 3/16" thru 3 15/16" (80 – 100)	4	3	2	1	1				

*Suggested lubrication interval under ideal continuous operating conditions. Relubricate while running, if safety permits, until some purging occurs at seals. Adjust lubrication frequency depending on conditions of purged grease. Use one-half of listed interval for vertical shaft applications or for 24 hour operation. Hours of operation, temperature, and surrounding conditions will affect the relubrication frequency required.

1. Lubricate with a high quality NLGI No. 2 lithium-base grease having rust inhibitors and antioxidant additives, and a minimum oil viscosity of 500 SUS at 100°F (38°C). Some greases having these properties are:
   Shell - Gadus S2 V100 2 — Mobil - Ronex MP
   Mobil - Mobilith SHC100 — Mobil - Mobilith SHC220
2. Lubricate bearings prior to extended shutdown or storage and rotate shaft monthly to aid corrosion protection.

Fans with Spherical Roller Bearings with Split Pillow Block Housings

Relubrication Schedule (Months)* Spherical Roller Bearing - Split Pillow Blocks										Grease to be added at each interval
Shaft DIA	Speed (RPM)									
	500	750	1000	1500	2000	2500	3000	3500	4000	
1 7/16" thru 1 15/16" (35 – 50)	6	4 1/2	4	4	3 1/2	2 1/2	2 1/2	1	1	0.50 oz.
2 3/16" thru 2 13/16" (55 – 70)	5	4 1/2	4	2 1/2	2 1/2	1 1/2	1/2	1/4	1/4	0.75 oz.
2 15/16" thru 3 15/16" (75 – 100)	4 1/2	4	3 1/2	2 1/2	1 1/2	1	1/2			2.00 oz.
4 7/16" thru 4 15/16" (110 – 135)	4	4	2 1/2	1	1/2					4.00 oz.
5 7/16" thru 6 15/16" (140 – 180)	4	2 1/2	1 1/2							8.5 oz.

*Suggested lubrication interval under ideal continuous operating conditions. Remove bearing cap and observe condition of used grease after lubricating. Adjust lubrication frequency as needed. Use one-half of listed interval for vertical shaft applications or for 24 hour operation. Hours of operation, temperature, and surrounding conditions will affect the relubrication frequency required. Clean and repack bearings annually. Remove old grease, pack bearing full and fill housing reservoir on both sides of bearings to bottom of shaft.

1. Lubricate with a high quality NLGI No. 2 lithium-base grease having rust inhibitors and antioxidant additives, and a minimum oil viscosity of 500 SUS at 100°F (38°C). Some greases having these properties are:
   Shell - Gadus S2 V100 2 — Mobil - Ronex MP
   Mobil - Mobilith SHC100 — Mobil - Mobilith SHC220
2. Lubricate bearings prior to extended shutdown or storage and rotate shaft monthly to aid corrosion protection.
3. Purge or remove old grease when changing lubrication brands or types.

Static Oil Lubrication

1. Use only high quality mineral oil with a VG grade indicated on the customer submittal drawing.
2. Static oil level should be at the center of the lower-most roller. (Do not overfill.)
3. Complete lubrication change should be made annually.

Fan & Blower Twin City

Drive Mounting
(refer to safety section)

Mount drives as follows:

1. Slip (do not pound) proper sheave onto corresponding shaft. Most drives utilize tapered bushings. Draw the bushing up evenly tightening in steps. To minimize bearing loading, mount sheaves as close to bearings as possible. It is preferable to use alignment tools that align the grooves of the sheave.

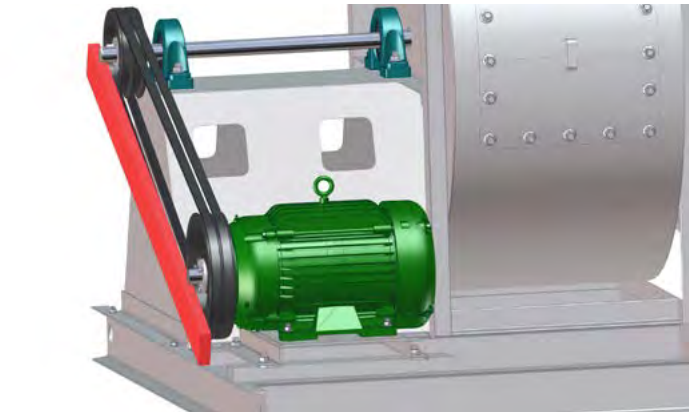
2. Laser alignment is common. The mechanic must be familiar with the alignment tool he is using. Otherwise, align sheaves with straightedge extended along sheaves, just making contact in two places on outside perimeters of both sheaves. This "four-point" alignment may also be checked with a string tied to the shaft behind one of the sheaves. The string is then pulled taut over the faces of the sheaves to check the alignment at the four points at the outside perimeters. Each sheave should be rotated about one-half revolution during this check to look for excessive runout or a bent shaft. Unless there is a bent shaft, runout can be corrected by adjustments to the bolt torque of the taper bushing.

3. Install and tighten the belts. Run the drive for a few minutes to seat the belts. When fitting the belts, slide the motor in to fit the belts on. Do not use a pry bar, as this may damage the belt cords. Tighten the belts to the proper tension. Ideal tension is just enough tension so that the belts do not slip under peak load or acceleration. Many drives are provided with tensioning data which identifies the load to apply at the center of the span and the allowable deflection from this force. A belt tension gauge is recommended for precise tensioning.

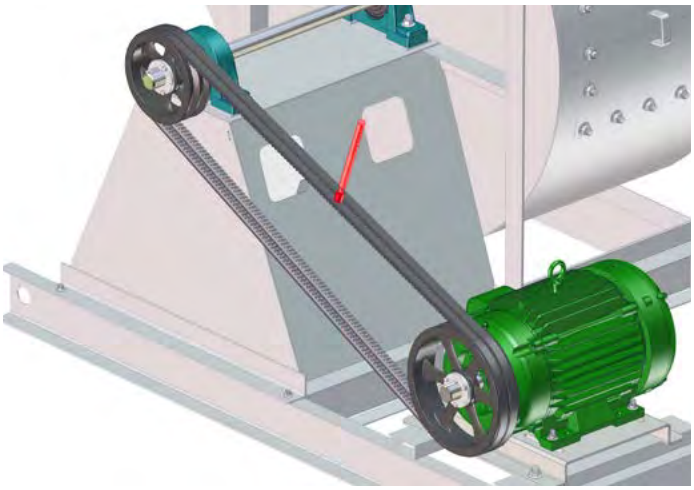
4. After initial installation of belts, recheck belt tension again after a few days of operation to adjust belt tension. (New belts require a break-in period of operation.)

WARNING

When working around belts and pulleys, keep hands away from pinch points.



Click To View Our
Sheave Installation video



CAUTION

Placing fan sheave on motor can overspeed wheel and cause structural failure.

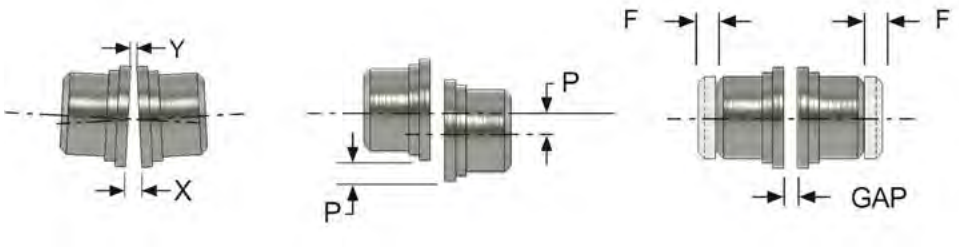
Fan & Blower
Twin City

Flexible Couplings (refer to safety section)

These instructions are general for the installation of several types of flexible couplings and should not be used as a substitute for more specific manufacturer's instructions. The coupling manufacturer's installation data is available and will give specific dimensions for alignment limits, lubricants, etc. Refer to Item 7 in "Factory Assembled Units" section for coupling alignment requirements.

Before preparing to mount the coupling, make sure that all bearings, inlet vanes, shaft seals, or other components have been installed on the shaft.

When mounting and keying the coupling halves to the shaft, follow supplied instructions for heating and shrink fitting. Set the coupling halves for the normal gap specified by the manufacturer. Coupling gap is illustrated below. It is advisable to set the motor on the pedestal first to better determine the placement of the coupling on the shaft.



ANGULAR MISALIGNMENT | **PARALLEL MISALIGNMENT** | **GAP AND END FLOAT**

X-Y = ANGULAR MISALIGNMENT
P = PARALLEL OFFSET (MISALIGNMENT)
F = END FLOAT*

The two types of misalignment are illustrated above. Alternatively angular alignment is checked with feeler gauges between the hub faces. When angular alignment has been adjusted to manufacturer's specification, parallel alignment can be checked with a dial indicator on the hub or a straightedge and feeler gauges on the hub halves' O.D. When shimming has brought parallel alignment within specification, angular alignment and gap should again be checked, and adjustments made if necessary. A dial indicator or laser alignment may be used to more accurately take the measurements described above.

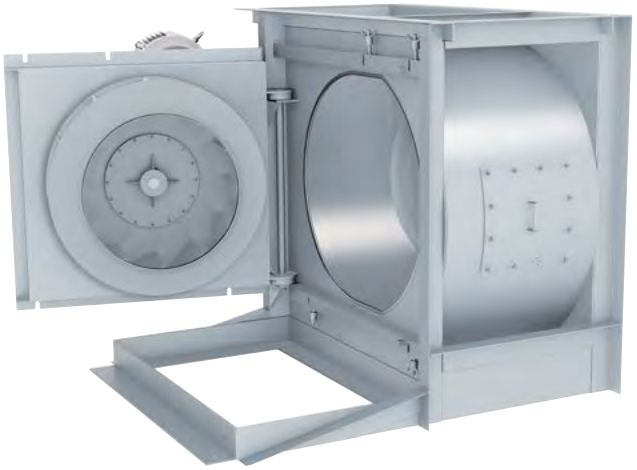
Special adjustments may need to be made for couplings used with some equipment. As an example, when used with motors with sleeve bearings, couplings may require provisions for limiting end float. Larger drivers may grow in operation (due to heat expansion) requiring the driver side to be set slightly low when not operating. A good rule of thumb is to set the motor low by 0.001 inches per inch of motor shaft diameter up to 0.005". Refer to specific instruction manuals or assembly drawings.

Thoroughly clean the coupling halves after completion of alignment. Reassemble the coupling and tighten bolts, washers and locknuts. Lubricate per manufacturer's recommendations.

* 1. End float is the permissible axial movement of the coupling hub(s) within the sleeves of the coupling
2. End float will allow for thermal movement
3. Limited end float couplings are often required in applications using Motors with sleeve bearings

Maintenance (refer to safety section)

Develop a regular maintenance schedule according to your needs and the criticality of the fan. Periodic inspections, lubrication, observations of sound and vibration will help prolong the life of the fan. If changes are noted check bolt tightness, foundation integrity, cleanliness of the wheel and or motor, bearing lubrication, drive components. Always keep records of the maintenance that is performed.



CAUTION

1. **Swingout fans should be opened for wheel cleaning and inspection only and should be closed immediately after cleaning. Isolate from the electrical supply before opening.**
2. **Do not run swingout fans the fan in the open position.**

Motor Maintenance

The three basic rules of motor maintenance are:

1. Keep the motor clean.
2. Keep the motor dry.
3. Keep the motor properly lubricated.

Blow dust off periodically (with low pressure air) to prevent motor from overheating.

Motor Lubrication Schedule

Motors Less than 10HP Running 8 Hrs/Day (clean environments)	Motors Between 15-40HP (clean environments)	Motors Running 24/7 or if in dirty/dusty environments
Lube every 5 Years	Lube every 3 years	Divide the service interval by 4

Do not over lubricate.

Some smaller motors are lubricated for life. Lubrication requirements are normally attached to the motor. Use the motor manufacturer's recommendations for relubrication. Often motor lubricants are not the same as the fan bearings. If this information is not available, the following schedule may be used.

Shaft grounding rings are recommended for some VFD applications. If the motor is equipped with a shaft grounding ring a yearly inspection for wear and shaft corrosion is recommended. Replace the ring if it is making minimal contact with the shaft. If corrosion is present, treat the shaft with colloidal silver per the ring manufacturer's instructions.

Drive Maintenance (refer to safety section)

V-belt drives need periodic inspection, retensioning and occasional belt replacement. When inspecting drives, look for dirt buildup, burrs or obstructions that can cause premature belt or drive replacement. If burrs are found, use fine emery cloth or a stone to remove them. Be careful that dust does not enter the bearings.

WARNING

When working around belts and pulleys, keep hands away from pinch points.

Check sheaves for wear. Excessive slippage of belts on sheaves can cause wear and vibration. Replace worn sheaves with new ones. Carefully align sheaves to avoid premature sheave failure. If fraying or other wear is observed to be mostly on one side of the belts, the drives may be misaligned. Realign and reinstall new belts. Tighten sheave bolts (or setscrews if appropriate).

When replacing belts, replace the entire set. Never use belt dressing on any belts, as it may cause belt wear.

Fan Bearing Maintenance (refer to safety section)

Proper lubrication of the fan drive bearings helps assure maximum bearing life. All fans are equipped with decals indicating the recommended relubrication intervals for normal operating conditions. **Refer to the Bearing Installation section for the lubrication schedules for ball bearings, solid pillow block spherical roller bearings and split pillow block spherical roller bearings.** Note that all speeds shown do not apply to all shaft sizes in that group. Consult the factory if in doubt of maximum speed for a particular bearing. Note that every installation is different and the frequency of relubrication should be adjusted accordingly.

Use 1/2 to 1/3 of the listed lubrication interval for high moisture applications. For vertical shaft mounts or dirty conditions use 1/2 the lubrication schedule.

Observation of the conditions of the grease expelled from unit ball or roller bearings at the time of relubrication is the best guide as to whether regreasing intervals and amount of grease added should be altered. Spherical roller bearings with split pillow block housings should not be lubricated until grease purges or overheating may result. Follow the lubrication interval and amount noted in the Bearing Installation section. Spherical roller bearings with split pillow block housings should be serviced once per year. Remove cap, clean out old grease and replace by filling the bottom half of the housing 1/3 full.

Greases are made with different bases. There are synthetic base greases, lithium base, sodium base, etc. Avoid mixing greases with different bases. They could be incompatible and result in rapid deterioration or breakdown of the grease. The lubrication sticker identifies a list of acceptable lubricants. All bearings are filled with a lithium complex grease before leaving the factory. When the fans are started, the bearings may discharge excess grease through the labrinth seals for a short period of time. Do not replace the initial discharge because leakage will cease when the excess grease has worked out. Sometimes the bearings have a tendency to run hotter during this period. This is no reason for alarm unless it lasts over 48 hours or temperatures exceed 200°F. When relubricating, use a sufficient amount of grease to purge the seals. Rotate bearings by hand during relubrication. If extended lubrication lines are fitted, lubricate the bearings while the fan is operating if it is safe to do so.

Wheel and Shaft Maintenance (refer to safety section)

Periodically inspect the shaft and wheel for dirt buildup, corrosion, and signs of excess stress or fatigue. Clean the components. If the wheel is removed for any reason, make sure that it is securely attached to the shaft before restarting the fan.

Structural Maintenance (refer to safety section)

All structural components or devices used to support or attach the fan to a structure should be checked at regular intervals. Vibration isolators, bolts, foundations, etc., are all subject to failure from corrosion, erosion, and other causes. Improper mounting can lead to poor operation characteristics or fan fatigue and failure. Check metallic components for corrosion, cracks, or other signs of stress. Concrete should be checked to insure the structural integrity of the foundation.

Duct Connections
(refer to safety section)

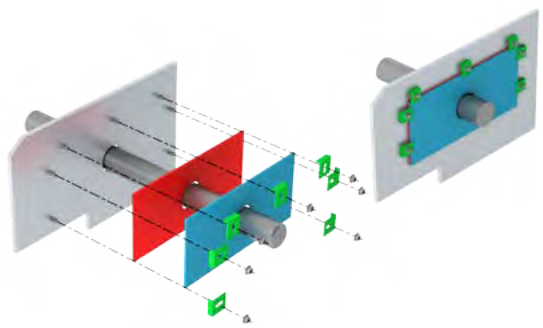
The fan support structure is normally not designed to carry loads imposed by the weight of ducts, silencers, stacks, etc. Supporting these loads on the fan can cause housing distortion and may cause performance or vibration problems. Use of flexible connections is recommended for all fans and imperative when using vibration isolation or handling high temperature gases.

Centrifugal Fan with Vibration Isolation & Flexible Duct Connectors

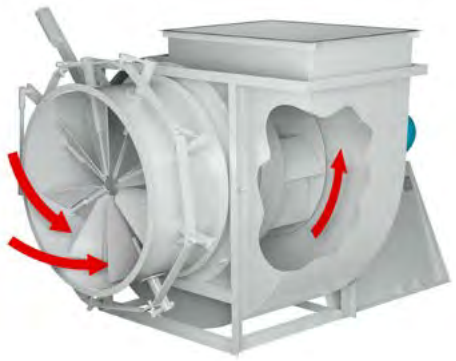
Optional Accessories

1. **Turning Gear** — A turning gear is sometimes used in high temperature applications where the fan is exposed to high temperature gases when not in operation. The wheel and shaft can expand unevenly due to the temperature when sitting idle, which can cause vibration at startup and/or a permanent set to the rotor. The turning gear slowly turns the fan from the outboard side while it is not operating, providing for even thermal expansion. It starts automatically when the fan shuts down and disengages automatically when the fan starts up again. More specific information will be provided for each application.

2. **Shaft Seals** — The standard shaft seal is a wire inserted fiberglass tacky cloth element retained with an aluminum retaining plate and clips. Other configurations of shaft seals are available for special applications, such as when it is necessary to keep the shaft seal as gas tight as possible. Shaft seal application manuals are provided in Fan Engineering FE-700 available on www.tcf.com. Other seals such as stuffing boxes, mechanical seals and carbon ring seals need special attention. It is imperative that after the fan has been leveled, shimmed, fastened to the foundation and ducted the shaft and seal be checked for concentricity and angularity. The seal must not bind when the shaft is rotated. Stuffing box packing material must not be compressed too tight by the gland or overheating will occur. Monitor temperature for a period of time. Connect a purge if specified. Carbon ring seals have pins which prevent ring rotation.



3. **Variable Inlet Vanes** — Variable inlet vanes are provided as assemblies internally in the inlet cone or externally in a flanged cylinder. The vanes are used to control volume and save power in installations where different volumetric operating conditions are used. Installation manuals are provided in other engineering supplements for specific fan types. Variable inlet vanes may be provided with powered operators in which case the manufacturer's installation and operating manuals will be provided. Inlet vanes are unidirectional. Vanes should be stroked periodically to prevent binding and possible seizure.



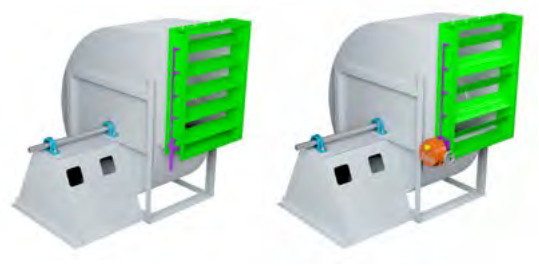
Orientation of Inlet Vanes Relative to Fan Rotation

4. **Inlet Box and Inlet Box Dampers** — Inlet boxes may be provided to allow transition from a duct to the fan inlet. Inlet box dampers may also be provided for volumetric regulation similar to inlet vanes. Dampers are usually provided as a complete assembly and are installed with the damper axles parallel to the fan shaft. They should be installed to pre-spin the air in the direction of fan rotation. Damage may occur if the fan is operated regularly with damper settings less than 30% open. Operation below 30% should be limited to start-up or occasional periods of low duration.

Orientation of Damper Blades As Related to Fan Rotation

Optional Accessories (cont.)

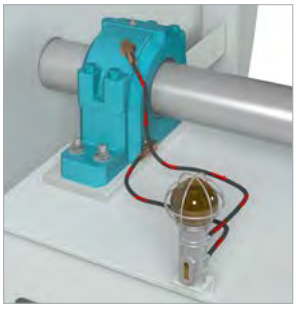
5. **Outlet Dampers** — Outlet dampers are usually provided completely assembled like the inlet dampers. The damper is bolted to the fan discharge for volume control.



6. **Shaft Cooler** — Also referred to as "heat slingers" or "cooling wheels," these are small, radially bladed aluminum wheels that are split and bolted for installation between the inboard bearing and fan housing. The cooling fins face the bearing for grease applications and away from the bearing for oil applications to prevent oil from being drawn out of the bearing.

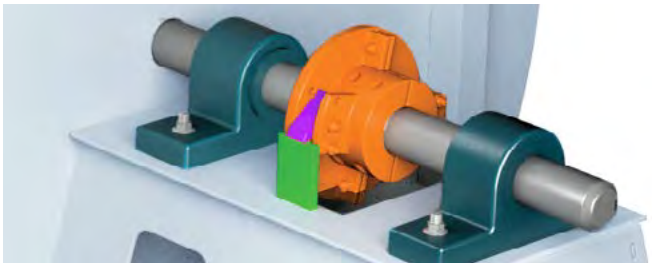
7. **Oil Circulating Systems** — Usually the following modifications will have to be made to the bearing if an oil circulating system is used.
   a. Four drain holes will be drilled in the bearing, two on each side of the bearing. Because of this, the bearing may be drained from either side. (Drain from both holes on one side of the bearing.)
   b. The bearing will be packed with grease to prevent corrosion until installed and started up. The drain holes will be plugged with plastic covers to make sure they are open. The customer MUST REMOVE most of the grease using solvent and remove the plastic covers prior to starting the oil circulating system.
   c. A wet sump can be added in case of circulating oil pump failure. Seals will be provided to accommodate the resultant splashing.
   d. The zerk on top of the bearing will be removed for that hole to be used as the oil inlet.

Oil Mist Lubrication System



Static Oil Lubrication System

8. **Anti-Rotation Clutch** — Damage will occur if the fan is operated in the wrong rotation. Run the motor uncoupled from the fan to establish the proper rotation.



Optional Accessories (cont.)

9. **Site-Feed Oilers** — Fans provided with optional, site-feed oilers, the oil level is to be set as indicated by the manufacturer's installation instructions provided with the fan.

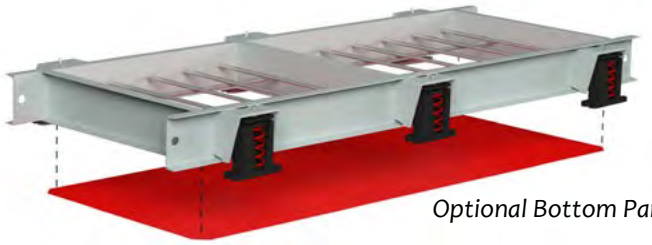
10. **Concrete Filled Bases:**

Inertia Bases – Inertia bases are spring isolated bases specifically designed to be filled with concrete (by others). The following instructions are a guide for filling a base with concrete. Remember to use safe practices when filling concrete into the base. It is best to fill concrete at or near the base's final resting area to reduce injury while transferring to the permanent location.

An inertia base is supplied with steel mesh or rebar added within the base frame with the intent of being filled with concrete and then mounted on springs. Bases may be supplied with or without an optional bottom pan (sealer sheet).

When an optional bottom pan is supplied from the factory, the base must be set on a flat, level surface with the bottom pan directly on the surface fully supporting the pan to maintain flatness on the bottom side. Pour concrete into the base and remove excess concrete on the top side of the base to maintain an even mounting surface for fan mounting. Be sure that the concrete has cured before lifting the base. Install isolators per the isolator installation manual.

Click To View Our
Inertia Base Installation Video

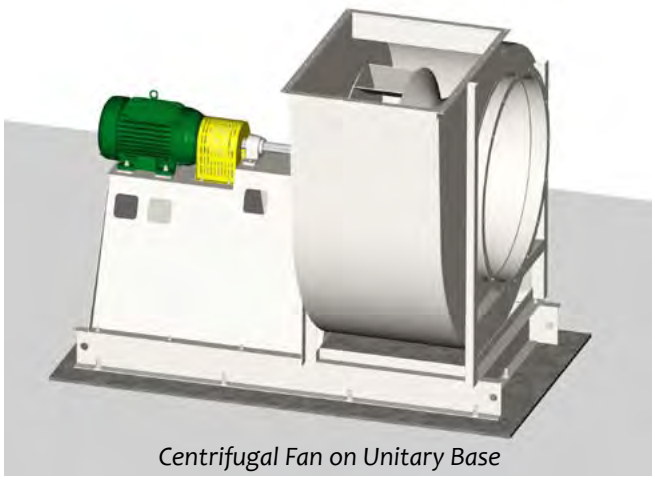


Optional Bottom Pan

When the optional bottom pan is not supplied, the base must be set on a flat, level surface that can fully support the weight of the concrete. Place a sheet of heavy-mil poly-film between the flat surface and the base frame. Pour concrete into the base and remove excess concrete on the top side of the base to maintain an even mounting surface for fan mounting. Be sure that the concrete has cured before lifting the base. Install isolators per the isolator installation manual.

Unitary Bases – Unitary bases are rigidly mounted to a foundation. Situations may arise where the base my require concrete to dampen vibration or increased stiffness. In situations where concrete must be added to the base the following guide must be utilized.

1. Rebar must be added to the cross section of the base (by others) so the concrete will have good adhesion points throughout the sections of the base. Typically rebar is installed at 12" centers however the placement of rebar should be reviewed for each individual application by a Civil Engineer if required.
2. Bases should be located in their final resting area prior to being filled with concrete. Bases should be shimmed and grouted. Once the grout is cured, concrete may be added. Pour concrete (by others) into the base and remove excess concrete on the top side of the base to maintain an even mounting surface for fan mounting.



Centrifugal Fan on Unitary Base

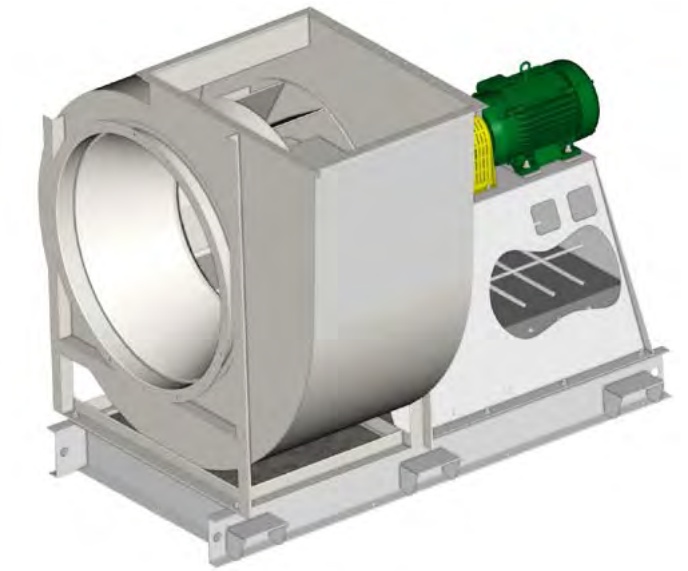
Click To View Our
Unitary Base Installation Video

Optional Accessories (cont.)

11. **Concrete Filled Pedestals** — Fans may require the bearing and/or motor pedestals to be filled with concrete (by others) for additional stiffness and rigidity, refer to the fan's drawing for requirements. Fans must utilize rebar in the pedestals so the concrete will have good adhesion points throughout.

    To fill the pedestal, the pedestal must be set on flat, level ground before concrete is added. It is recommended to locate the fan at the final location. The fan should be leveled, shimmed, and grouted prior to adding concrete.

    An optional bottom pan is available for the pedestal if it is unfeasible to add concrete at the final location. Pedestals must be placed on the ground for filling until the concrete cures. If no bottom pan is provided, a piece of plywood covered in plastic may be placed under the base while filling with concrete. Fill the pedestal with concrete (by others) to the level indicated on the drawings. After the concrete cures the fan may be installed. Do not utilize the fan's lifting lugs after concrete has been added to the fan. The lifting lugs are designed to lift the fan as it was shipped from the factory.

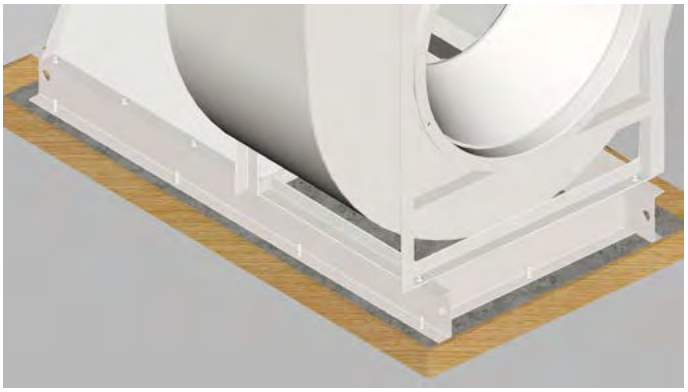


NOTICE

Concrete cure time varies depending on the base size, ambient temperature and cement mixture requested. Be sure concrete is 100% cured prior to moving equipment.

Grouting

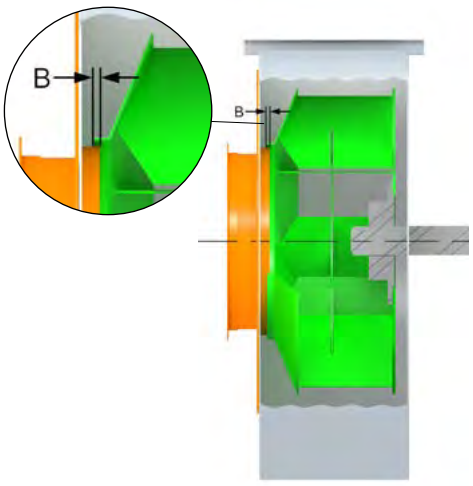
Grouting is the final installation step. Check all shims before grouting to make sure that the fan is resting evenly on all points with anchor bolts secured to hold the shim. Back off leveling nuts if used. Use forms with sufficient space allowed for working the grout. The concrete foundation should be clean and well moistened before pouring grout. Use a commercial grade nonshrinking grout and be especially sure when pouring grout that the anchor bolt sleeves are filled. Prior to grouting, set a section of pipe (conduit, steel pipe or plastic) through the grout as a form in the low point which is able to wick/drain out the excess moisture. Refer to the Foundations and Supporting Structures section in the installation manual for a detail of a proper foundation, grout allowance and anchor bolt sleeves.



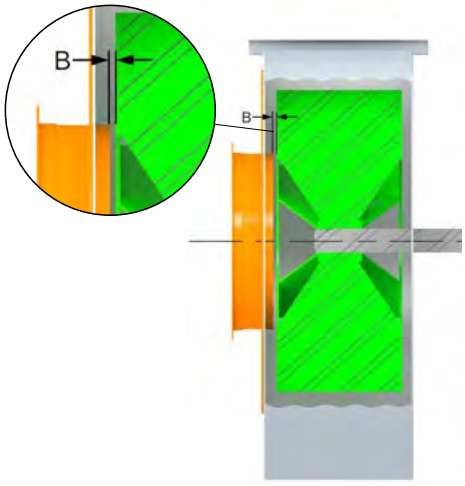
Serial Number & Fan Type

The serial number and fan type can be found on our permanent nameplate of the fan.

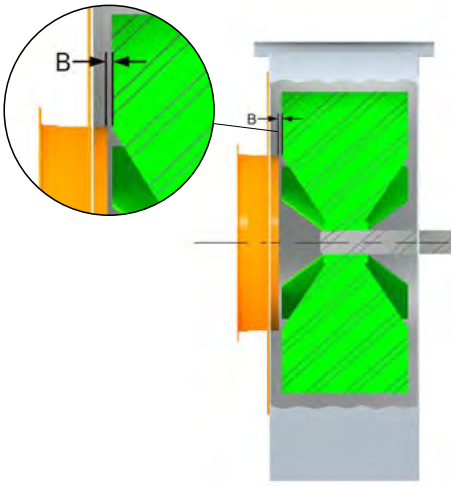
Wheel Placement



Model RBA



Model RBR

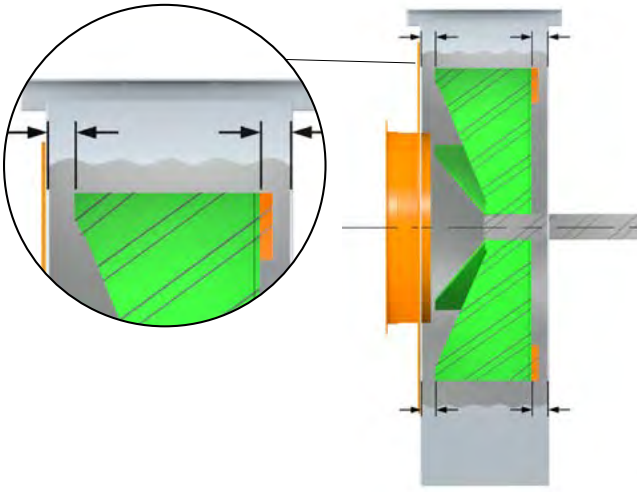


Model RBO

RBA Wheel Overlap																		
Size	907	909	911	913	915	917	919	921	923	926	929	933	937	941	945	949	954	960
B	0.25	0.38	0.47	0.53	0.59	0.69	0.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

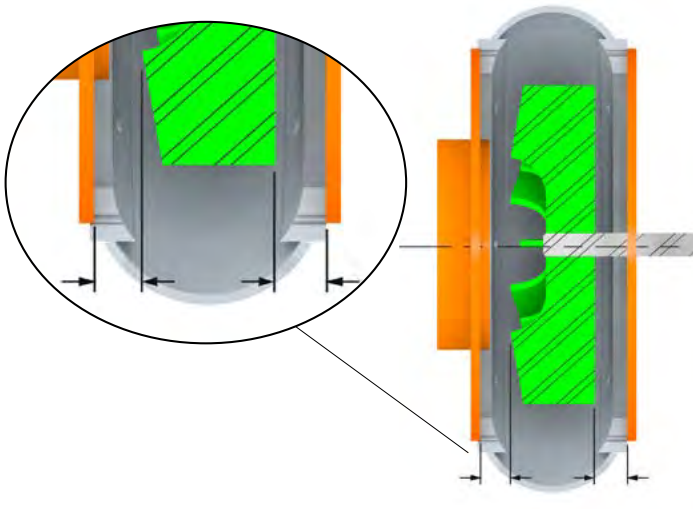
RBO, RBR Wheel Gap															
Size	913	915	917	919	921	923	926	929	933	937	941	945	949	954	960
B	0.53	0.53	0.59	0.69	0.78	0.88	0.97	1.03	1.22	1.38	1.56	1.69	1.81	1.88	2.16

Note: On Sizes 905-911 RBO and RBR wheel is to be centered in housing.



Model JRW, RBW, RBP

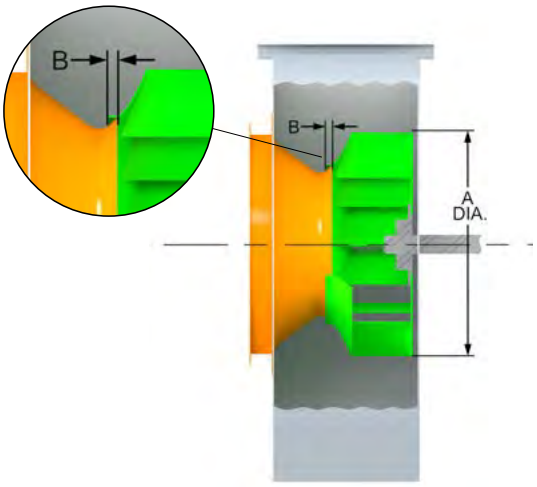
JRW, RBW, RBP Wheel Placement
Center wheel in housing. Do not include the backplate fins for centering.



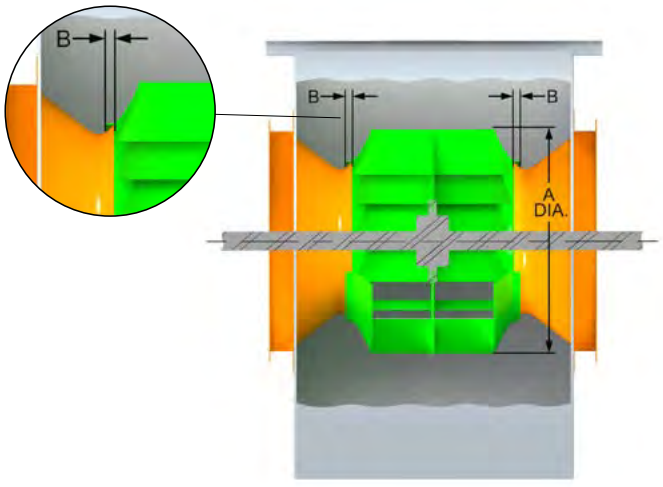
Model CIW

CIW Wheel Placement
Center wheel in housing.

Wheel Placement



Models BC-SW, BAF-SW, BAE-SW, BCS, HIB, BAV, RTF, HRT, HAF, BCV, DCV, TCBI



Models BC-DW, BAF-DW, BAE-DW

BC-SW, BC-DW, BAF SWSI & DWDI, BCS, BCV (Class I & II), DCV Wheel Overlap																					
Size	105	122	135	150	165	182	200	222	245	270	300	330	365	402	445	490	542	600	660	730	807	890
A	10.50	12.25	13.50	15.00	16.50	18.25	20.00	22.25	24.50	27.00	30.00	33.00	36.50	40.25	44.50	49.00	54.25	60.00	66.00	73.00	80.75	89.00
B	0.28	0.31	0.34	0.38	0.38	0.47	0.52	0.55	0.59	0.67	0.75	0.82	0.72	0.90	1.00	1.10	1.25	1.24	1.36	1.88	2.09	2.28

BAV, BAE-SW & BAE-DW Wheel Overlap																						
Size	122	135	150	165	182	200	222	245	270	300	330	365	402	445	490	542	600	660	730	807	890	982
A	12.25	13.50	15.00	16.50	19.00	20.82	23.16	25.51	28.11	31.23	34.36	38.00	41.90	46.33	51.01	56.48	62.47	68.71	73.00	80.75	89.00	98.25
B	0.31	0.34	0.38	0.44	0.38	0.41	0.45	0.50	0.55	0.61	0.67	0.75	0.82	0.91	1.00	1.11	1.23	1.35	1.50	1.65	1.82	2.02

Note: On swingout fans, the wheel and funnel should be positioned as close as possible (max gap 1/8") such that the door can be opened without the wheel and funnel interfering.

BCV (Class L) Wheel Overlap	
Size	B
090-105	0.28
122	0.31
135	0.34
150	0.38
165	0.44
182	0.56
200	0.63
222	0.69
245	0.75
270	0.88
300	0.97
330	1.06
365	1.31

HRT Wheel Overlap			
Size	A	B (Design 19)	B (Design 23)
270	27.00	0.50	0.50
300	30.00	0.69	0.69
330	33.00	0.69	0.69
360	36.50	0.81	0.81
400	40.25	1.03	0.97
450	44.50	1.13	1.06
490	49.00	1.25	1.13
540	54.25	1.38	1.25
600	60.00	1.31	1.31
660	66.00	1.56	1.44
730	73.00	1.75	1.63
800	80.75	1.06	1.31

HAF Wheel Overlap		
Size	A	B
220	25.00	0.50
240	27.50	0.55
270	30.38	0.61
300	33.50	0.67
330	37.00	0.74
360	41.00	0.75
400	45.25	0.83
450	50.00	0.91
490	55.13	1.01
540	61.00	1.12
600	67.50	1.23
660	74.25	1.36
730	82.00	1.50
800	90.75	1.66

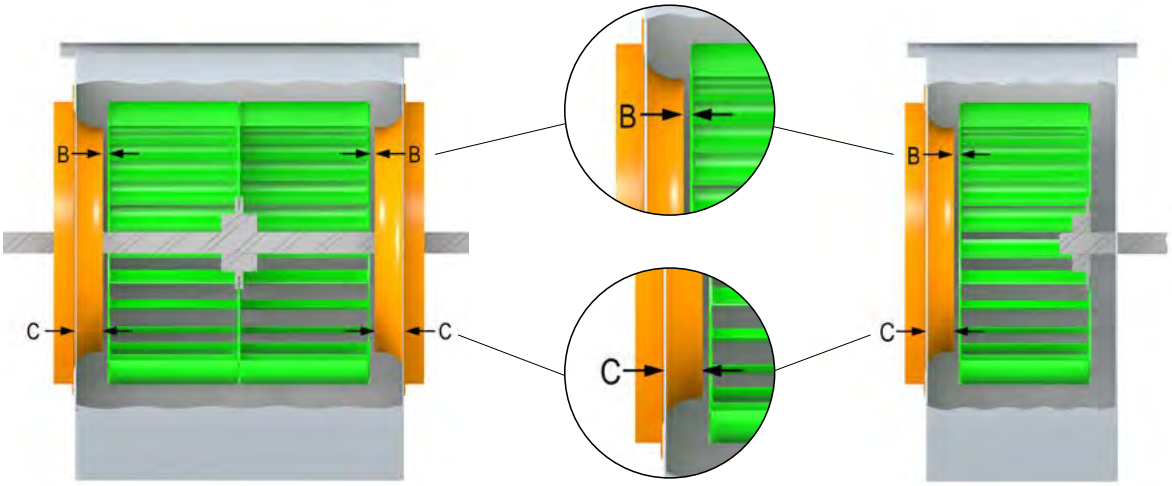
HIB, RTF Wheel Overlap					
Size	A	B	Size	A	B
180	20.50	0.31	400	45.25	0.69
200	22.50	0.34	450	50.00	0.75
220	25.00	0.38	490	55.13	0.81
240	27.50	0.44	540	61.00	0.91
270	30.38	0.47	600	67.50	1.00
300	33.50	0.50	660	74.25	1.13
330	37.00	0.56	730	82.00	1.22
360	41.00	0.63	800	90.75	1.34

TCBI (60 Hz) Wheel Overlap	
Size	B
3	0.34
5	0.38
7.5	0.38
10	0.38
15	0.31
20	0.31
25	0.31
30	0.31

TCBI (50 Hz) Wheel Overlap	
Size	B
3-50	0.56
5-50	0.56
7.5-50	0.56
10-50	0.56
15-50	0.56
20-50	0.63
25-50	0.63
30-50	0.63

Fan & Blower Twin City

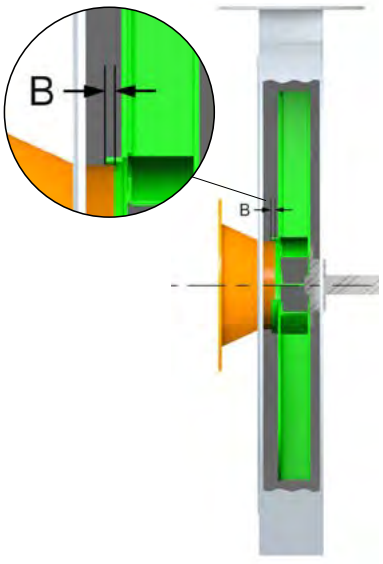
Wheel Placement



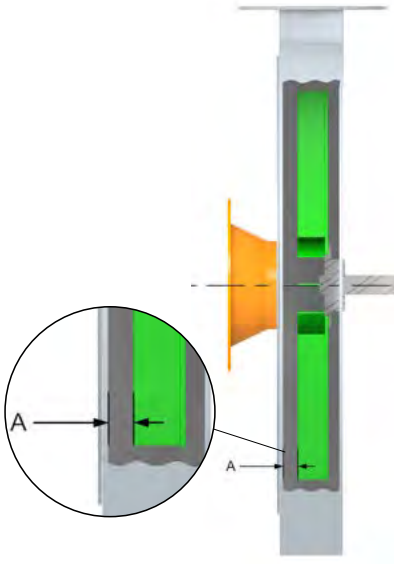
Models FC-DW, NFC-DW

Models FCV, NFC-SW

FCV, FC-DW, NFC-SW, NFC-DW Wheel Gap					
Size	B	C	Size	B	C
10.5	0.47	0.69	30	0.75	4.38
12	0.25	1.88	33	0.81	5.00
15	0.44	2.19	36	0.75	5.00
18	0.50	2.25	39	1.06	6.38
21	0.69	2.88	42	1.69	7.50
24	0.81	3.00	48	1.50	7.13
27	0.69	3.13	54	1.00	10.50



Model HRS



Model HRO

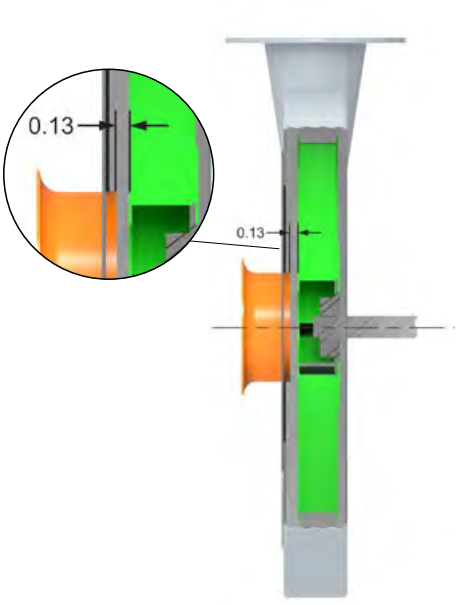
HRS Wheel Overlap		
Fan Size	Wheel Size	B
125	25	0.31
225		0.28
325		0.27
130	30	0.38
230		0.33
330		0.32
135	35	0.44
235		0.39
335		0.37
140	40	0.50
240		0.44
340		0.43
145	45	0.56
245		0.50
345		0.48

HRS Wheel Overlap		
Fan Size	Wheel Size	B
150	50	0.63
250		0.56
350		0.54
155	55	0.69
255		0.61
355		0.59
160	60	0.75
260		0.67
360		0.65
165	65	0.81
265		0.72
365		0.70
170	70	0.88
270		0.78
370		0.75

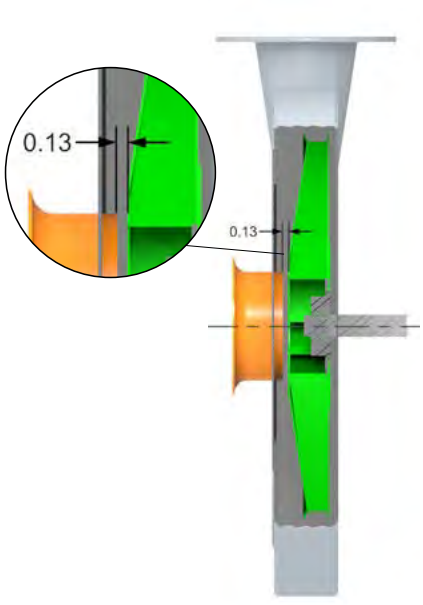
HRO Wheel Gap		
Fan Size	Wheel Size	B
125	25	0.82
325		0.80
130	30	0.99
330		0.99
135	35	1.14
335		1.12
140	40	1.32
340		1.29
145	45	1.46
345		1.42

HRO Wheel Gap		
Fan Size	Wheel Size	B
150	50	0.99
350		1.59
155	55	0.99
355		1.59
160	60	0.99
360		0.99
165	65	0.99
365		2.09
170	70	2.31
370		2.26

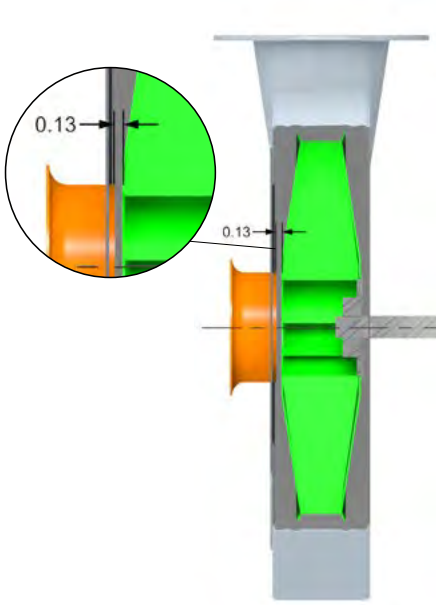
Wheel Placement



Models TBNS

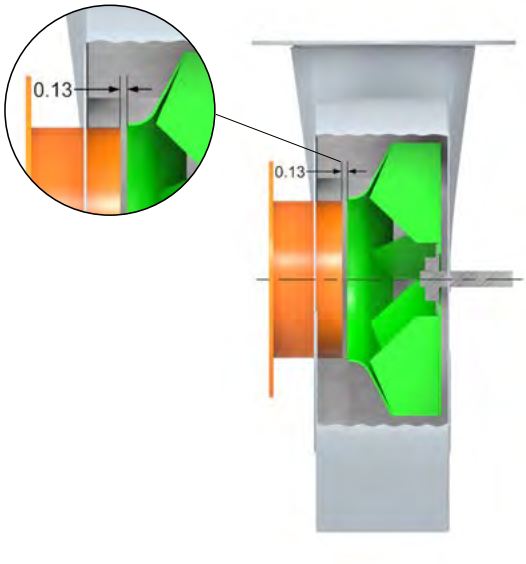


Models TBNA
"N" Series Wheel

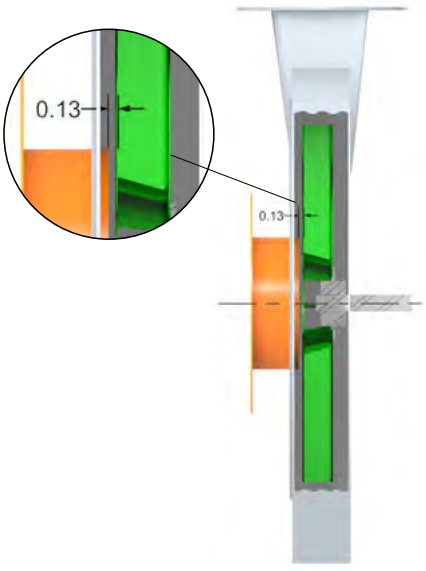


Models TBNA
"W" Series Wheel

TBNA, TBNS Wheel Gap
0.13" gap on all sizes



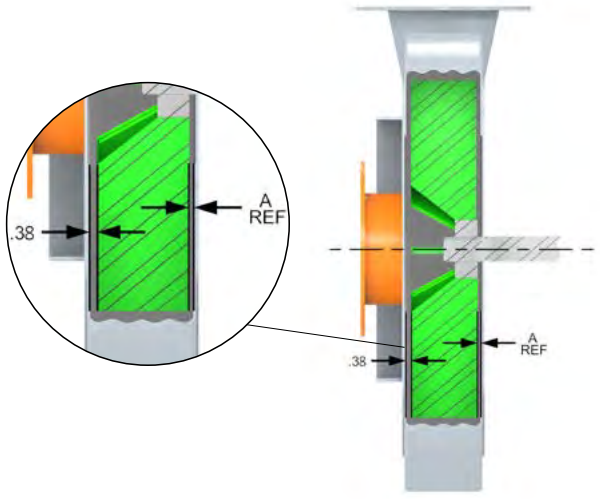
Model TBA



Model TBR

TBA, TBR Wheel Gap
0.13" gap on all sizes

Wheel Placement

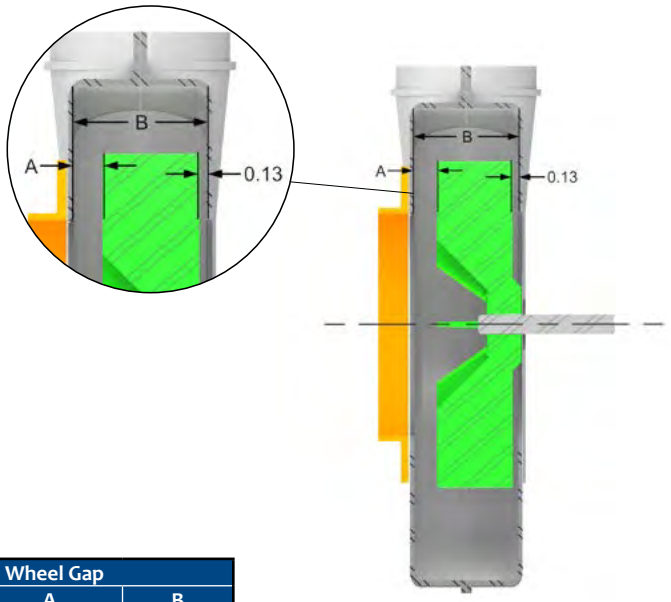


Model PBW

PBW Wheel Gap		
Housing Size	Wheel Size	A (REF)
3	19 & 22	0.36
4		
5	21 & 22	0.61
	23 & 26	0.36
6	21 & 22	0.86
	23 & 26	0.36

Note: *Distance from inside surface of housing to wheel blade is constant on all sizes and arrangements.*

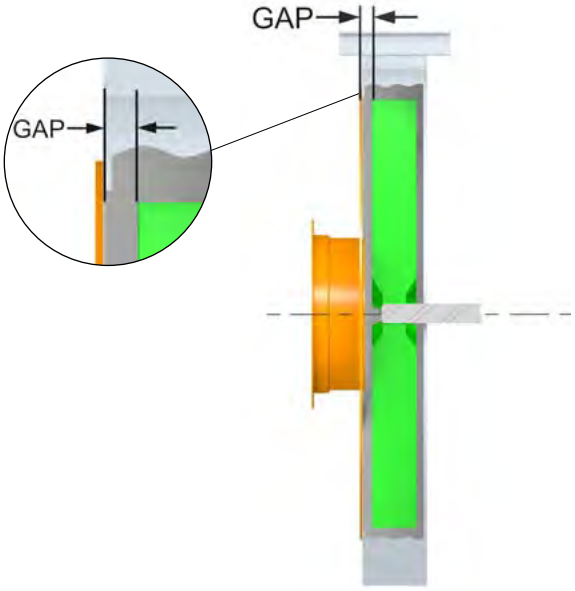
TPD, TPB Wheel Placement		
Wheel Size	A	B
8" Housing / Width		
R7 X 2.44	0.58	3.14
R8 X 2.50	0.52	
9" Housing / Width		
R8 X 2.50	0.56	3.18
R8.5 X 2.75	0.30	
R9 X 2.88	0.19	
R9.75 X 2.88	0.31	
R10.63 X 2.63	0.46	
BC10.25 X 3	0.25	
10" Housing / Width		
R9 x 2.88	0.23	3.22
R9.75 x 2.88	0.35	
R10.63 x 2.63	0.50	
R11 x 2.75	0.28	
R11.5 x 2.88	0.27	
R12 x 2.88	0.23	
R12.25 x 2.88	0.21	
BC10.25 x 3	0.29	
BC11 x 3	0.29	
12" Housing / Width		
R10.63 x 2.63	1.22	3.94
R11 x 2.75	1.00	
R11.5 x 2.88	0.99	
R12 x 2.88	0.95	
R12.25 x 2.88	0.93	
R13 x 3.25	0.55	
R14 x 3.25	0.61	
BC11 x 3	1.01	
BC13 x 3.25	0.57	
BC14 x 3.25	0.57	
14" Housing / Width		
R12.25 x 2.88	1.59	4.60
R13 x 3.25	1.21	
R14 x 3.25	1.27	
R14.75 x 4	0.48	
BC13 x 3.25	1.23	
BC14 x 3.25	1.23	



Model TPD, TPB

TPD, TPB Wheel Gap		
Wheel Size	A	B
15" Housing / Width		
R14 x 3.25	2.49	5.82
R15.5 x 5	0.70	
R16.5 x 4.38	1.37	
BC14 x 3.25	2.45	
BC15.5 x 5	0.81	
BC16.5 x 4.38	1.45	
18" Housing / Width		
R14 x 3.25	1.31	4.64
R16.5 x 4.38	0.19	
R18 x 4.38	0.36	
BC14 x 3.25	1.27	
BC16.5 x 4.38	0.27	
BC18 x 4.38	0.14	

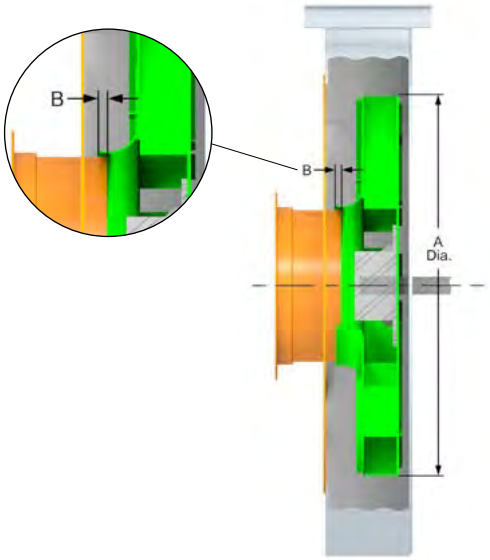
Wheel Placement



Models MBO, MBW, MBR

MBW, MBO, MBR Wheel Gap											
Size	196	224	252	280	308	336	365	421	477	533	589
MBW	0.50	0.44	0.38	0.25	0.38	0.44	0.56	0.63	0.75	0.75	0.88
MBO	0.50	0.44	0.38	0.25	0.38	0.44	0.56	0.63	0.75	0.75	0.88
MBR	0.25	0.25	0.25	0.25	0.25	0.38	0.50	see note below			

Note: *On Sizes 421-589 wheel is to be centered in housing.*



Model BCN

BCN Wheel Overlap						
Size	270	300	330	365	402	445
A	27.00	30.00	33.00	36.50	40.25	44.50
B	0.09	0.09	0.13	0.13	0.13	0.16

Size	490	542	600	660	730
A	49.00	54.25	60.00	66.00	73.00
B	0.16	0.19	0.22	0.22	0.25

Troubleshooting Guidelines

Use current safety practices when investigating fan or system performance problems. General safe practices and performance troubleshooting guidelines can be found in AMCA Publications 410 and 202, respectively. Fan application and field measurement procedures can be found in AMCA Publications 201 and 203.

Below is a list of possible areas to check when air or sound values do not match expectations. Most fan problems can be pinpointed to one of these common causes.

Air Capacity Problems

1. Resistance of the system is not at design rating. If resistance is lower than expected, both airflow and horsepower may be up. If resistance is higher than anticipated, air volume will be down.
2. Fan speed is not at design speed.
3. Air density is not at the design value. Also check air performance measurement techniques/procedures.
4. Devices for air modulation are closed or plugged. Also check filters.
5. Wheel mounted improperly or is rotating in reverse.
6. Parts of the system or fan have been damaged or need cleaning.

Noise Problems

1. Air performance is incorrect and the fan is not at design point of operation. Fan is being forced to operate in an unstable flow region near peak or to the left of the peak of the curve.
2. Bearing failure. Check bearings (lubrication).
3. Supply voltage high or inconsistent supply frequency. Adjustable frequency controllers can generate motor noise.
4. Objects which are installed in a high velocity airstream can generate noise. This includes flow sensors, turning vanes, etc.
5. Poor fan inlet conditions.
6. Acoustics or sound measurement procedure incorrect.

Vibration Problems

1. Misalignment of drive components. Check belt or coupling.
2. Poor foundation or mounting structure (resonances).
3. Foreign material attached to rotating components.
4. Damaged rotating components (bearings, shaft, fan, wheel, sheaves).
5. Broken, loose, or missing setscrews.
6. Loose bolts.
7. Vibration transmitted by another source.
8. Water accumulating in airfoil blades.
9. Fan is operating in stall or unstable flow region.

Motor Problems

1. Incorrect wiring.
2. Speed of fan too high.
3. Parts improperly installed; binding.
4. Bearings improperly lubricated.
5. WR^2 capability of motor too low for application.
6. Protection devices may be improperly sized.
7. VFD compatible electrically? Effective shaft grounding?
8. Is cabling and grounding correct?

Drive Problems

1. Belts improperly tensioned.
2. Drive alignment is poor. Check belt or coupling.
3. Coupling lubrication.

NOTICE

All fans manufactured by Twin City Fan & Blower are factory balanced prior to shipment. Installation variables, handling, and movement of the fan during shipment may cause the rotating assembly to shift. Balance should be checked once the fan is installed. If a final trim balance is required, it is the end user's responsibility to bring the fan back to factory specifications. Final trim balancing is not the responsibility of Twin City Fan & Blower. Refer to the Vibration Guidelines table below.

Vibration Guidelines

Condition	Fan Application Category	Rigidly Mounted mm/s (in./s)	Flexibly Mounted mm/s (in./s)
Start-up	BV-3	6.4 (0.25)	8.8 (0.35)
	BV-4	4.1 (0.16)	6.4 (0.25)
Alarm	BV-3	10.2 (0.40)	16.5 (0.65)
	BV-4	6.4 (0.25)	10.2 (0.40)
Shutdown	BV-3	12.7 (0.50)	17.8 (0.70)
	BV-4	10.2 (0.40)	15.2 (0.60)

Values shown are peak velocity, mm/s (inches/s), Filter out. Table taken from ANSI/AMCA Standard 204-05, Table 6.3. AMCA defines BV-3 for applications up to 400 HP; BV-4 for applications over 400 HP.

Fan & Blower Twin City

Installation/Start-up Checklist

Become familiar with the equipment by looking at the fan assembly drawing for special instructions and accessories.

Initial Fan Check

- ☐ Inspect fan for damage
- ☐ Check foundation
- ☐ Is the fan shimmed
- ☐ Are the bolts tight
- ☐ Check to see if the fan is distorted
  Note: Applies to direct or isolation mount.
- ☐ Check fan interior for debris & standing water

Fan Wheel

- ☐ Wheel clearance checked
- ☐ Wheel overlap checked
- ☐ Fasteners tight
- ☐ Wheel rotates freely

Springs (if equipped)

- ☐ Springs adjusted properly
- ☐ Flex joints allow movement
- ☐ Electrical conduit allows movement

Bearings

- ☐ Bearings aligned
- ☐ Bearings greased
  Note: Rotate while greasing
- ☐ Setscrews tight (if equipped)

Lube Lines

- ☐ Lube lines been charged with grease prior to connecting to bearings

V-Belts (if equipped)

- ☐ V-belt drives aligned
- ☐ Sheaves retightened
- ☐ Belt tension correct
- ☐ Motor bolts retightened

Couplings (if equipped)

- ☐ Coupling aligned
- ☐ Coupling gap checked
- ☐ Coupling lubricated

Accessories

- ☐ Guards installed correctly, do not rub
- ☐ VIV/damper rotates freely (if equipped)
- ☐ Other accessories per drawing

WARNING

Verify that proper safety precautions have been followed. Electrical power must be locked off.

Electrical Components

- ☐ Motor wired for proper voltage and starter
- ☐ Motor grounded
- ☐ Appropriate starter and heaters
- ☐ Leads are properly insulated
- ☐ Accessories wired per instructions supplied.

Energize

- ☐ Energize motor long enough to start assembly rotating, shut down
- ☐ Verify direction of wheel rotation, Rewire if necessary *Note: Refer to wheel rotation section*
- ☐ Run the fan up to speed
- ☐ Check for excess vibration and listen for unusual noise. Refer to the Vibration Guidelines table in the troubleshooting guidelines section for vibration limits
- ☐ Bearing temperatures should stabilize after a few hours. Less than 200°F
  Note: Use sense of smell to identify possible electrical, belt issues.

After one Week

- ☐ Verify bolt tightness.
- ☐ Verify belt tension and adjust as necessary

NOTICE

Always observe site specific and regulatory safety precautions.

Serial Number: _____

Completed By: _____

Date Completed: _____

Fan Maintenance Log

Model Number_____

Serial Number _____

Date	Completed Maintenance	Performed By	Comments

Fan Maintenance Log

Model Number_____

Serial Number _____

Date	Completed Maintenance	Performed By	Comments

TWIN CITY FAN & BLOWER | WWW.TCF.COM

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Chapter 7 – Water Quality Analyzers (Division 25)

MANUFACTURER/DISTRIBUTOR:

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Phone: (514) 334-7230
hugo.sabourin@veolia.com

Chloratech (Wallace & Tiernan)
Marie-Chantale Boudreault
212 rue Pierre-Couture
St-Augustin-de-Desmaures, QC, G3A 0A4
Phone: (418) 872-4200
pieces@chloratech.ca

7.1 Hach TU5300sc Turbidity Meter System (WTP, BS#1, BS#2)

TU5 SERIES TURBIDIMETERS

Applications
- Drinking Water
- Power
- Beverage
- Pharmaceutical

The next standard in the evolution of turbidity

Only the new TU5 Series Lab & Process Turbidimeters with 360° x 90° Detection™ deliver unprecedented confidence that a change in your reading is a change in your water.

Groundbreaking 360° x 90° Detection™ Technology

The TU5 Series employs a patented optical design that sees more of your sample than any other turbidimeter, delivering the best low level precision and sensitivity while minimizing variability from test to test.

Matching lab and online results

For the first time you will be able to remove the uncertainty of which measurement to trust, thanks to identical 360° x 90° Detection™ Technology in both instruments.

Everything about turbidity – faster

The TU5 Series dramatically reduces the time needed to get a turbidity measurement you can rely on, with 98% less online sample surface area to clean, sealed vials for calibration, and the elimination of the need for indexing and silicone oil in the lab. Not to mention, a smaller online sample volume means you will detect events almost immediately.

No surprises

Prognosys™ monitors your TU5 Series online instrument, proactively alerting you to maintenance needs before your measurement becomes questionable. And a Hach Service Agreement protects your investment and helps ensure that you stay in compliance and on budget.

USEPA and ISO 7027 reporting: The TU5 Series Turbidimeters apply the instrument design and meet performance criteria established by EPA Approved Hach Method 10258 and ISO 7027-1:2016, making them suitable for regulatory reporting.

HACH®
Be Right™

Technical Data*

TU5200

Light Source	Class 2 laser product, with embedded 650 nm (EPA 0.43 mW) or Class 1 laser product, with embedded 850 nm (ISO), max. 0.55 mW (complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50)
Range	EPA: 0 - 700 NTU / FNU / TE/F / FTU 0 - 100 mg/L 0 - 175 EBC ISO: 0 - 1000 NTU / FNU / TE/F / FTU 0 - 100 mg/L 0 - 250 EBC
Accuracy	±2 % plus 0.01 NTU from 0 - 40 NTU; ±10 % of reading from 40 - 1000 NTU based on Formazin primary standard (at 25 °C)
Resolution	0.0001 NTU / FNU / TE/F / FTU / EBC / mg/L
Repeatability	<40 NTU: Better than 1% of reading or ±0.002 NTU on Formazin at 25 °C, whichever is greater >40 NTU: Better than 3.5% of reading on Formazin at 25 °C
Stray Light	<10 mNTU
Units	NTU, FNU, TE/F, FTU, EBC; mg/L if calibrated with Degrees calibration curve
Operating Temperature Range	10 - 40 °C (50 - 104 °F)
Operating Humidity	80% at 30 °C (non condensing)
Sample Temperature	4 - 70 °C (39 - 158 °F)
Storage Conditions	-30 - 60 °C (-22 - 140 °F)
Power Requirements (Voltage)	100 - 240 VAC
Power Requirements (Hz)	50/60 Hz
Certifications	CE compliant US FDA accession number: 1420493-000 EPA version, 1420492-000 ISO version Complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50) Australian ACMA Marking
Dimensions (H x W x D)	195 mm x 409 mm x 278 mm
Weight	2.4 kg (5.29 lbs.)
Warranty	1 year

TU5300 sc / TU5400 sc

Light Source	Class 2 laser product, with embedded 650 nm (EPA 0.43 mW) or Class 1 laser product, with embedded 850 nm (ISO), max. 0.55 mW (complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50)
Range	EPA: 0 - 700 NTU / FNU / TE/F / FTU 0 - 100 mg/L 0 - 175 EBC ISO: 0 - 1000 NTU / FNU / TE/F / FTU 0 - 100 mg/L 0 - 250 EBC
Accuracy	±2% or 0.01 NTU from 0 - 40 NTU ±10% of reading from 40 - 1000 NTU based on Formazin primary standard
Resolution	0.0001 NTU / FNU / TE/F / FTU / EBC
Repeatability	Better than 1% of reading or ±0.002 NTU (TU5300) or ±0.0006 NTU (TU5400) on Formazin at 25 °C (77 °F), whichever is greater
Stray Light	<10 mNTU
Units	NTU, FNU, TE/F, FTU, EBC
Signal Average Time	5 - 90 seconds
Response Time	T90 <30 seconds at 100 mL/min
Sample Temperature	2 - 60 °C (35 - 140 °F)
Sample Pressure	6 bar (87 psi) maximum, compared to air at sample temperature range from 2 - 40 °C (35.6 - 104 °F)
Sample Flow Rate	100 - 1000 mL/min; optimal flow rate: 200 - 500 mL/min
Operating Temperature Range	0 - 50 °C (32 - 122 °F)
Operating Humidity	Relative humidity: 5 - 95% at different temperatures, non-condensing
Storage Conditions	-40 - 60 °C (-40 - 140 °F)
Certifications	CE compliant US FDA accession number: 1420493-000 EPA version, 1420492-000 ISO version Complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50) Australian ACMA Marking
Dimensions (H x W x D)	249 mm x 268 mm x 190 mm
Weight	5.95 lbs. (2.7 kg); 11 lbs. (5.0 kg) with all accessories
Warranty	1 year

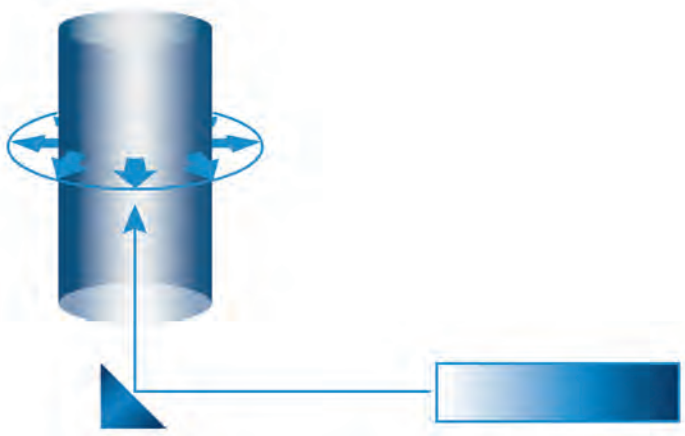
**Subject to change without notice.*

Principle of Operation

The TU5 Series turbidimeters measure turbidity by directing a laser into a sample to scatter off suspended particles. The light that is scattered at a 90° angle from the incident beam is reflected through a conical mirror in a 360° ring around the sample before it is captured by a detector.

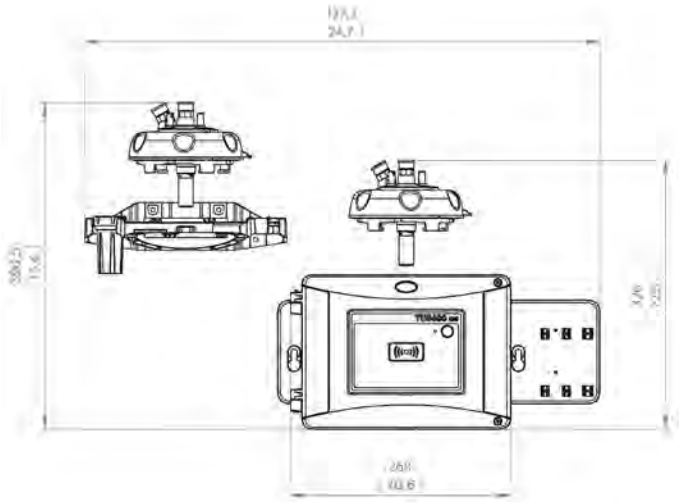
The amount of light scattered is proportional to the turbidity of the sample. If the turbidity of the sample is negligible, little light will be scattered and detected by the photocell and the turbidity reading will be low. High turbidity, on the other hand, will cause a high level of light scattering and result in a high reading.

The 360° x 90° optics of the TU5 series were optimized for high accuracy at low turbidity ranges and therefore the TU5 does not include ratio technology. Ratio technology is only applicable for high turbidity applications which have interference from color and large particles.

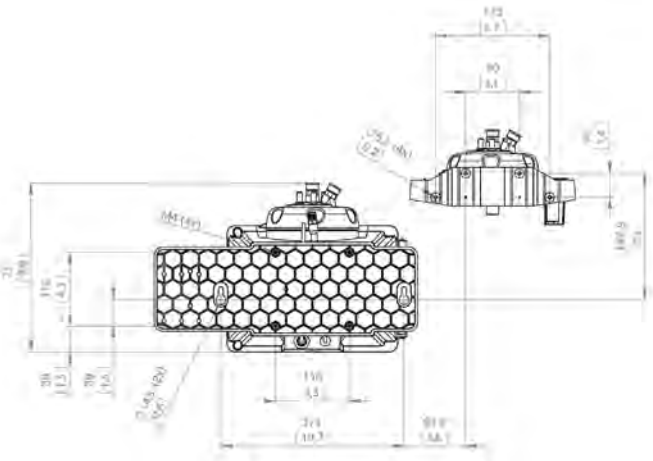


Dimensions

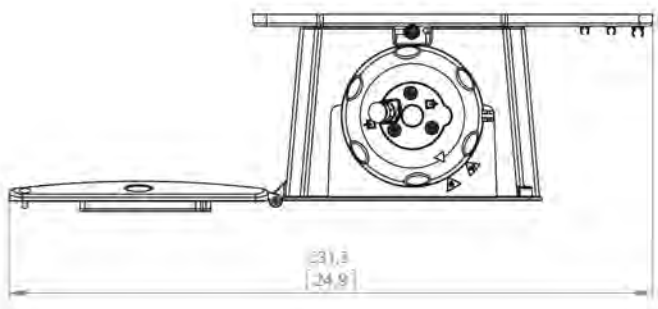
TU5300 sc and TU5400 sc front view



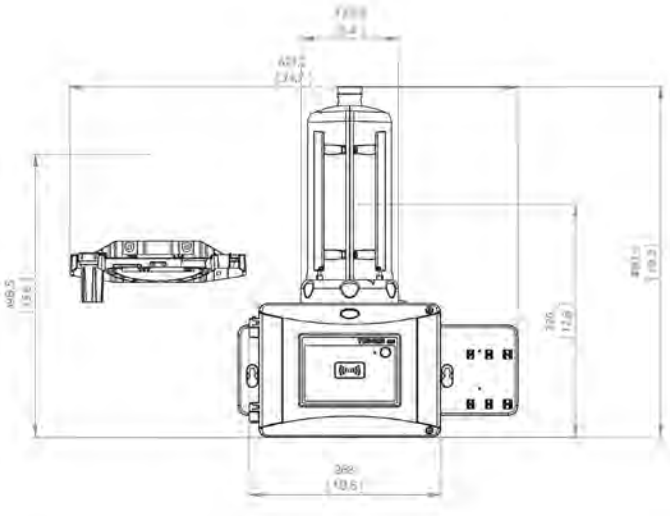
TU5300 sc and TU5400 sc rear view



TU5300 sc and TU5400 sc top view



TU5300 sc and TU5400 sc with automatic cleaning module



Order Information

TU5200 Benchtop Laser Turbidimeters

LPV442.99.03012 TU5200 Benchtop Laser Turbidimeter with RFID, EPA Version

LPV442.99.01012 TU5200 Benchtop Laser Turbidimeter without RFID, EPA Version

LPV442.99.03022 TU5200 Benchtop Laser Turbidimeter with RFID, ISO Version

LPV442.99.01022 TU5200 Benchtop Laser Turbidimeter without RFID, ISO Version

TU5300 sc/TU5400 sc Online Laser Turbidimeters

LXV445.99.10112 TU5300 sc Low Range Laser Turbidimeter, EPA Version

LXV445.99.10212 TU5400 sc Ultra-High Precision Low Range Laser Turbidimeter, EPA Version

LXV445.99.53112 TU5300 sc with Flow Sensor, Automatic Cleaning, RFID, and System Check, EPA Version

LXV445.99.53212 TU5400 sc with Flow Sensor, Automatic Cleaning, RFID, and System Check, EPA Version

Please note: Other turbidimeter configurations are available and RFID may not be available in all areas. Please contact your local Hach representative.

Please note: an SC controller is required for operation of the TU5300 sc or TU5400 sc.

Calibration and Verification

LZY835 StablCal® Calibration Set with RFID

LZY898 StablCal® Calibration Set without RFID

LZY901 Glass Rod Secondary Turbidity Standard <0.1 NTU/FNU

LZY834 Replacement Vial for TU5300 sc and TU5400 sc

LZV946 Sample Vials for TU5200

TU5 Series Accessories

LQV159.97.00002 Automatic Cleaning Module for TU5300 sc and TU5400 sc

LQV160.99.00002 Flow Sensor for TU5300 sc and TU5400 sc

LZY876 Desiccant Cartridge for TU5300 sc and TU5400 sc

LZY907.97.00002 Maintenance Kit for TU5300 sc and TU5400 sc

LQV157.99.50002 SIP10 Sipper Unit for TU5200

LZY903 Manual Vial Wiper for TU5200, TU5300 sc, and TU5400 sc

Service Options

Start-Up:

Instrument start-up, Basic instrument training to help you learn how to use your instrument from the first day you use it.

Service Agreement:

Hach offers a wide range of agreements for bench or field service to help you maximize your measurement reliability and instrument uptime.

Contact us to learn about what Hach Service option is right for you.

DOC050.53.10053.Mar17

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Outside United States: 970-669-3050 tel 970-461-3939 fax int@hach.com

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In the interest of improving and updating its equipment, Hach Company reserves the right to alter specifications to equipment at any time.

HACH®

Be Right™

sc200™ UNIVERSAL CONTROLLER

Applications
- Drinking Water
- Wastewater
- Industrial Water
- Power

One Controller for the Broadest Range of Sensors.

Choose from 30 digital and analog sensor families for up to 17 different parameters.

Maximum Versatility

The sc200 controller allows the use of digital and analog sensors, either alone or in combination, to provide compatibility with Hach's broad range of sensors, eliminating the need for dedicated, parameter-specific controllers.

Ease of Use and Confidence in Results

Large, high-resolution, transreflective display provides optimal viewing resolution in any lighting condition. Guided calibration procedures in 19 languages minimize complexity and reduce operator error. Password-protected SD card reader offers a simple solution for data download and transfer. Visual warning system provides critical alerts.

Wide Variety of Communication Options

Utilize two to five analog outputs to transmit primary and secondary values for each sensor, or integrate Hach sensors and analyzers into MODBUS RS232/RS485, Profibus® DP, and HART networks.

Password protected SD card reader offers a simple solution for data download and transfer, and sc200 and digital sensor configuration file duplication and backup.

HACH®
Be Right™

Controller Comparison

Features	Previous Models sc100™ Controller	Previous Models GLI53 Controller	sc200™ Controller	Benefits
Display	64 x 128 pixels 33 x 66 mm (1.3 x 2.6 in.)	64 x 128 pixels 33 x 66 mm (1.3 x 2.6 in.)	160 x 240 pixels 48 x 68 mm (1.89 x 2.67 in.) Transreflective	• Improved user interface—50% bigger • Easier to read in daylight and sunlight
Data Management	irDA Port/PDA Service Cable	N/A	SD Card Service Cable	• Simplifies data transfer • Standardized accessories/max compatibility
Sensor Inputs	2 Max Direct Digital Analog via External Gateway	2 Max Analog Depending on Parameter	2 Max Digital and/or Analog with Sensor Card	• Simplifies analog sensor connections • Works with analog and digital sensors
Analog Inputs	N/A	N/A	1 Analog Input Signal Analog 4-20mA Card	• Enables non-sc analyzer monitoring • Accepts mA signals from other analyzers for local display • Consolidates analog mA signals to a digital output
4-20 mA Outputs	2 Standard	2 Standard	2 Standard Optional 3 Additional	• Total of five (5) 4-20 mA outputs allows multiple mA outputs per sensor input
Digital Communication	MODBUS RS232/RS485 Profibus DP V1.0	HART	MODBUS RS232/RS485 Profibus DP V1.0 HART 7.2	• Unprecedented combination of sensor breadth and digital communication options

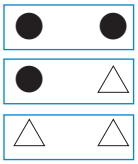
Choose from Hach's Broad Range of Digital and Analog Sensors

Parameter	Sensor	Digital or Analog
Ammonia	AMTAX™ sc, NH4D sc, AISE sc, AN-ISE sc	●
Chlorine	CLF10 sc, CLT10 sc, 9184 sc	●
Chlorine Dioxide	9185 sc	●
Conductivity	GLI 3400 Contacting, GLI 3700 Inductive	△
Dissolved Oxygen	LDO® Model 2, 5740 sc	●
Dissolved Oxygen	5500	△
Flow	U53, F53 Sensors	△
Nitrate	NITRATAX™ sc, NO3D sc, NISE sc, AN-ISE sc	●
Oil in Water	FP360 sc	●
Organics	UVAS sc	●
Ozone	9187 sc	●
pH/ORP	pHD	●
pH/ORP	pHD, pH Combination, LCP	△
Phosphate	PHOSPHAX™ sc	●
Sludge Level	SONATAX™ sc	●
Suspended Solids	SOLITAX™ sc, TSS sc	●
Turbidity	1720E, FT660 sc, SS7 sc, ULTRATURB sc, SOLITAX sc, TSS sc	●
Ultra Pure Conductivity	8310, 8311, 8312, 8315, 8316, 8317 Contacting	△
Ultra Pure pH/ORP	8362	△

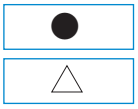
● = Digital △ = Analog

Connect up to two of any of the sensors listed above, in any combination, to meet your application needs. The diagrams below demonstrate the potential configurations. Operation of analog sensors requires the controller to be equipped with the appropriate sensor module. Contact Hach Technical Support for help with selecting the appropriate module.

2 Channel Configurations



1 Channel Configurations



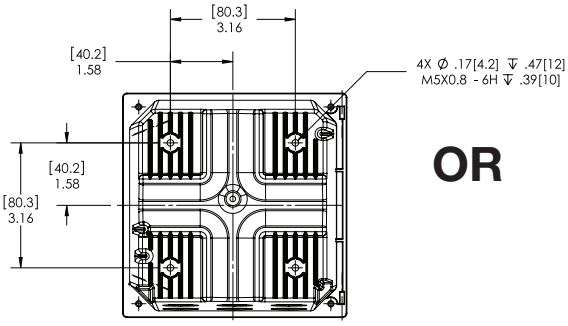
Specifications*

Dimensions (H x W x D)	5.7 in x 5.7 in x 7.1 in (144 mm x 144 mm x 181 mm)
Display	Graphic dot matrix LCD with LED backlighting, transreflective
Display Size	1.9 x 2.7 in. (48 mm x 68 mm)
Display Resolution	240 x 160 pixels
Weight	3.75 lbs. (1.70 kg)
Power Requirements (Voltage)	100 - 240 V AC, 24 V DC
Power Requirements (Hz)	50/60 Hz
Operating Temperature Range	-20 to 60 °C , 0 to 95% RH non-condensing
Analog Outputs	Two (Five with optional expansion module) to isolated current outputs, max 550 Ω , Accuracy: ± 0.1% of FS (20mA) at 25 °C, ± 0.5% of FS over -20 °C to 60 °C range Operational Mode: measurement or calculated value
Analog Output Functional Mode	Linear, Logarithmic, Bi-linear, PID
Security Levels	2 password-protected levels
Mounting Configurations	Wall, pole, and panel mounting
Enclosure Rating	NEMA 4X/IP66
Conduit Openings	1/2 in NPT Conduit
Relay: Operational Mode	Primary or secondary measurement, calculated value (dual channel only) or timer
Relay Functions	Scheduler (Timer), Alarm, Feeder Control, Event Control, Pulse Width Modulation, Frequency Control, and Warning
Relays	Four electromechanical SPDT (Form C) contacts, 1200 W, 5 A
Communication	MODBUS RS232/RS485, PROFIBUS DPV1, or HART 7.2 optional
Memory Backup	Flash memory
Electrical Certifications	EMC CE compliant for conducted and radiated emissions: - CISPR 11 (Class A limits) - EMC Immunity EN 61326-1 (Industrial limits) Safety cETLus safety mark for: - General Locations per ANSI/UL 61010-1 & CAN/CSA C22.2. No. 61010-1 - Hazardous Location Class I, Division 2, Groups A,B,C & D (Zone 2, Group IIC) per FM 3600 / FM 3611 & CSA C22.2 No. 213 M1987 with approved options and appropriately rated Class I, Division 2 or Zone 2 sensors cULus safety mark - General Locations per UL 61010-1 & CAN/CSA C22.2. No. 61010-1

Subject to change without notice.

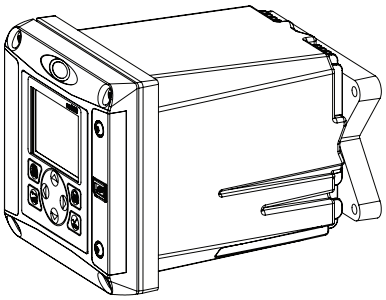
Dimensions

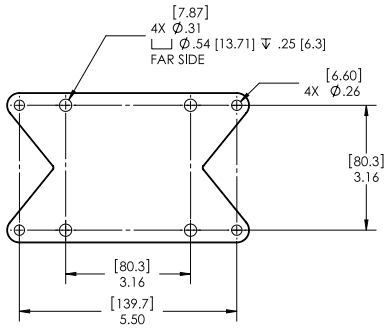
Surface Mounting Dimensions



Mounting Dimensions
(Rear View)

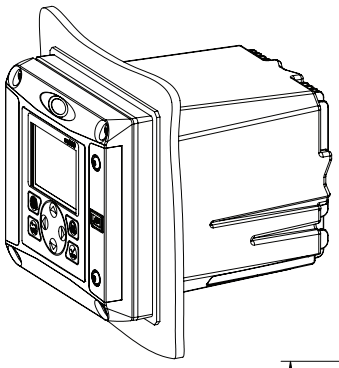
OR

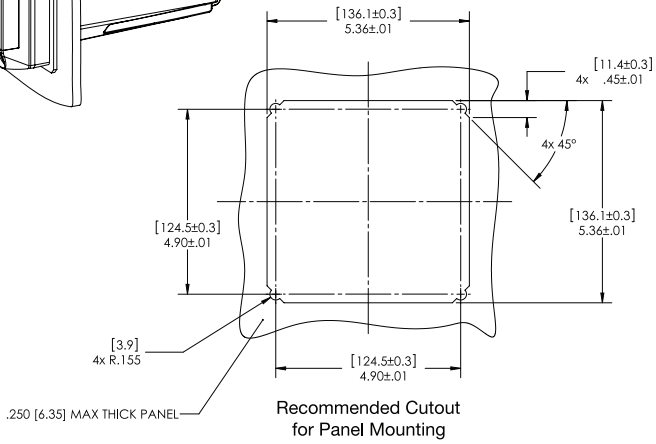




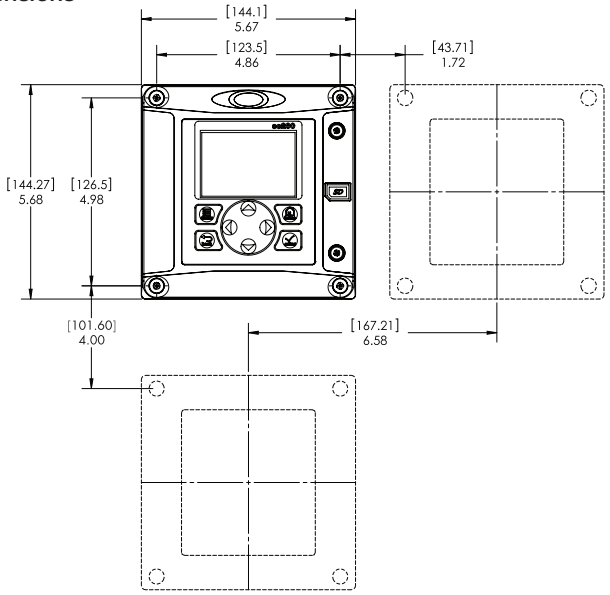
Bracket (supplied) for Surface Mounting
(Not compatible with Weather and Sun Shield p/n 9220600 when surface mounting.)

Panel Mounting Dimensions



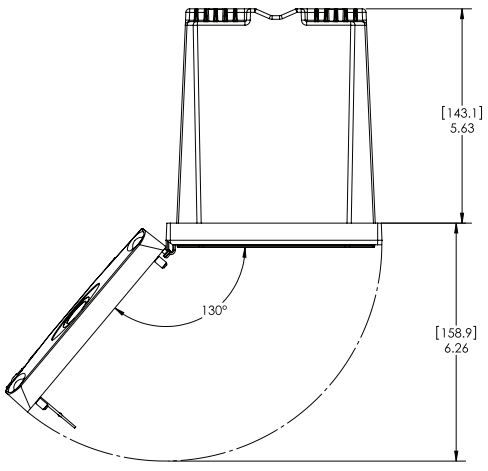


Recommended Cutout
for Panel Mounting

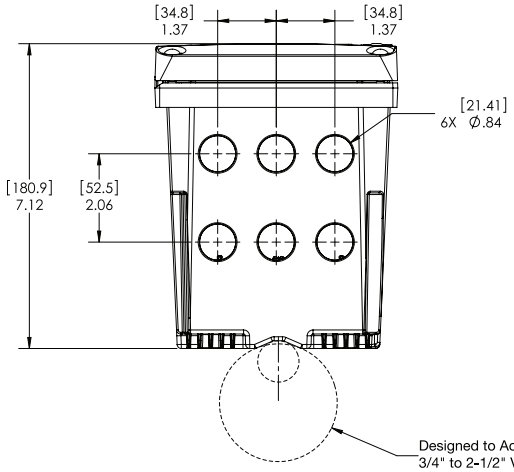


Minimum Spacing Dimensions
for Group Mounting

Top and Bottom Views



Door Opening Details



Ordering Information

sc200 for Hach Digital and Analog Sensors

LXV404.99.00552	sc200 controller, 2 channels, digital
LXV404.99.00502	sc200 controller, 1 channel, digital
LXV404.99.00102	sc200 controller, 1 channel, pH/DO
LXV404.99.00202	sc200 controller, 1 channel, Conductivity
LXV404.99.01552	sc200 controller, 2 channels, digital, Modbus RS232/RS485
LXV404.99.00112	sc200 controller, 2 channel, pH/DO

Note: Other Sensor combinations are available. Please contact Hach Technical Support or your Hach representative.

Note: Communication options (MODBUS, Profibus DPV1, and HART) are available. Please contact Hach Technical Support or your Hach representative.

sc200 for Ultrapure Sensors

9500.99.00602	sc200 controller, 1 channel, ultrapure conductivity
9500.99.00702	sc200 controller, 1 channel, ultrapure pH
9500.99.00662	sc200 controller, 2 channel, ultrapure conductivity
9500.99.00772	sc200 controller, 2 channel, ultrapure pH

Sensor and Communication Modules

9012900	Analog pH/ORP and DO module for GLI Sensors
9013000	Analog Conductivity module for GLI Sensors
9012700	Flow module
9012800	4-20 mA Input Module
9525700	Analog pH/ORP Module for Polymetron Sensors
9525800	Analog Conductivity Module for Polymetron Sensors
9013200	Modbus 232/485 Module
9173900	Profibus DP Module
9328100	HART Module
9334600	4-20 mA Output Module (Provides 3 additional mA Outputs)

Accessories

9220600	sc200 Weather and Sun Shield with UV Protection Screen
8809200	sc200 UV Protection Screen
9218200	SD card reader (USB) for connection to PC
9218100	4 GB SD card

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Hach Company reserves the right to alter specifications to equipment at any time.

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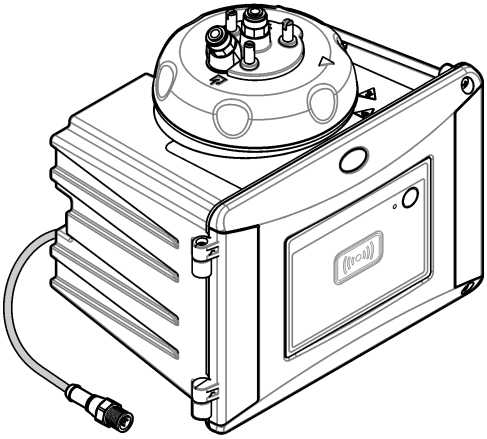
DOC023.53.90501

TU5300 sc/TU5400 sc

03/2017, Edition 4

Basic User Manual



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Troubleshooting on page 27

Additional information

An expanded user manual is available on the manufacturer's website. Videos on how to install, operate and do maintenance and troubleshooting on the TU5300 sc and the TU5400 sc turbidimeters are available on the *TU5 Series Turbidimeters* playlist at http://www.youtube.com/user/hachcompany.

Specifications

Specifications are subject to change without notice.

Specification	Details
Measurement method	Nephelometry with scattered light collected at a 90-degree angle to the incident light and 360 degrees around the sample vial
Primary compliance method	EPA approved Hach Method 10258[1]
Enclosure	Material: ASA Luran S 777K / RAL7000, TPE RESIN Elastocon® STK40, Thermoplastic Elastomer TPS-SEBS (60 Shore) and stainless steel
Dimensions (W x D x H)	268 x 249 x 190 mm (10.6 x 9.8 x 7.5 in.)
Weight	Instrument with the process head: 2.7 kg (6.0 lb); Instrument with the optional automatic cleaning module: 5.0 kg (11.0 lb)
Power requirements	12 VDC, 14 VA supplied by the SC controller
Protection class	III
Pollution degree	2
Installation category	II
Mounting	Indoor on a wall
Operating temperature	0 to 50 °C (32 to 122 °F)
Storage temperature	–40 to 60 °C (–40 to 140 °F)
Humidity	5 to 95% relative humidity, non-condensing
Sensor cable length	1.6 m (5.25 ft)[2]
Laser	**Class 2 laser product:** Contains a non user-serviceable class 2 laser.
Optical light source	650 nm, maximum 0.43 mW
Fittings	Sample inlet and outlet: ¼-in. OD tubing

1 http://www.hach.com

2 Extension cables are available. The maximum sensor cable length is 50 m (164 ft) when no accessories are connected to the instrument.

Specification	Details
Tubing requirements	Polyethylene, polyamide or polyurethane tubing. Calibrated ¼ in. OD, +0.03 or –0.1 mm (+0.001 or –0.004 in.)
Measurement units	TU5300 sc: NTU, FNU, TE/F, EBC or FTU; TU5400 sc: NTU, mNTU[3], FNU, mFNU, TE/F, EBC, FTU or mFTU.
Range	0 to 700 NTU, FNU, TE/F and FTU; 0 to 175 EBC
Method detection limit	TU5300 sc: 0.002 NTU at 25 °C (77 °F) (< 0.025 NTU range); TU5400 sc: 0.0001 NTU at 25 °C (77 °F) (< 0.025 NTU range)
Response time	T90 < 30 seconds at 100 mL/min
Accuracy	± 2% or ± 0.01 NTU (the larger value) from 0 to 40 NTU ± 10% of reading from 40 to 700 NTU based on Formazin primary standard at 25 °C (77 °F)
Linearity	Better than 1% for 0 to 40 NTU based on Formazin primary standard at 25 °C (77 °F).
Repeatability	TU5300 sc: 0.002 NTU or 1% (the larger value) at 25 °C (77 °F) (> 0.025 NTU range); TU5400 sc: 0.0006 NTU or 1% (the larger value) at 25 °C (77 °F) (> 0.025 NTU range)
Stray light	< 0.01 NTU
Resolution	0.0001 NTU (0.0001 to 0.9999/1.000 to 9.999/10.00 to 99.99/100.0 to 700 NTU) Default: TU5300 sc: 0.001 NTU and TU5400 sc: 0.0001 NTU
Air bubble compensation	Physical, mathematical
Sample requirements	Temperature: 2 to 60 °C (35.6 to 140 °F) Conductivity: 3000 µS/cm maximum at 25 °C (77 °F) Flow rate[4]: 100 to 1000 mL/min; optimal flow rate: 200 to 500 mL/min Pressure: 6 bar (87 psi) maximum compared to air, 2 to 40 °C (35.6 to 104 °F) sample; 3 bar (43.5 psi) maximum compared to air, 40 to 60 °C (104 to 140 °F) sample
Calibration options	StablCal® or Formazin: 1-point calibration (20 NTU) for 0 to 40 NTU measurement range, 2-point calibration (20 and 600 NTU) for 0 to 700 NTU (full) measurement range or 2- to 6-point custom calibration for a measurement range of 0 NTU to the highest calibration point.
Verification options	Glass verification rod (solid secondary standard) ≤ 0.1 NTU, StablCal or Formazin
Verification (RFID or Link2SC®)	Verification of the measurement value by comparison of the process and lab measurements with RFID or Link2SC.
Certifications	CE compliant; US FDA accession number: 1420493-xxx. This product complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50. Australian RCM.
Warranty	1 year (EU: 2 years)

General information

In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual. The manufacturer reserves the right to

[3] 1 mNTU = 0.001 NTU

[4] For the best results, operate the instrument at a flow rate of 200 mL/min when the maximum particle size is 20 µm. For larger particles (150 µm maximum), the best flow rate is 350 to 500 mL/min.

make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

Safety information

NOTICE

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

Use of hazard information

⚠ DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

Precautionary labels

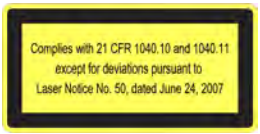
Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.
	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	This symbol indicates the need for protective eye wear.
	This symbol indicates a laser device is used in the equipment.

	This symbol indicates that the marked item can be hot and should not be touched without care.
	This symbol identifies a risk of chemical harm and indicates that only individuals qualified and trained to work with chemicals should handle chemicals or perform maintenance on chemical delivery systems associated with the equipment.
	This symbol indicates radio waves.

Class 2 laser product

DANGER	
	Personal injury hazard. Never remove covers from the instrument. This is a laser-based instrument and the user risks injury if exposed to the laser.

	Class 2 laser product, IEC60825-1:2014, 650 nm, maximum 0.43 mW Location: Rear of the instrument.
	Conforms to U.S. regulations 21 CFR 1040.10 and 1040.11 in accordance with Laser Notice No. 50. Location: Rear of the instrument.
	Caution—Class 2 laser radiation when the lid is open. Do not look into the laser beam. Location: Top of the vial compartment.

This instrument is a Class 2 Laser product. There is only visible laser radiation when the instrument is defective and when the instrument lid is open. This product complies with EN 61010-1, "Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use" and with IEC/EN 60825-1, "Safety of Laser Products" and with 21 CFR 1040.10 in accordance with Laser Notice No. 50. Refer to the labels on the instrument that supply laser information.

RFID module

Instruments with the optional RFID module receive and transmit information and data. The RFID module operates with a frequency of 13.56 MHz.

RFID technology is a radio application. Radio applications are subject to national conditions of authorization. The use of instruments with the optional RFID module is currently permitted in the regions that follow:

EU (European Union) countries, EFTA (European Free Trade Association) countries, Turkey, Serbia, Macedonia, Australia, Canada, US, Chile, Ecuador, Venezuela, Mexico, Brazil, South Africa, India, Singapore, Argentina, Columbia, Peru and Panama

The use of instruments with the optional RFID module outside of the above-mentioned regions can violate national laws. The manufacturer reserves the right also to get authorization in other countries. In case of doubt, contact the manufacturer.

Safety information for RFID modules

⚠ WARNING

Multiple hazards. Do not disassemble the instrument for maintenance. If the internal components must be cleaned or repaired, contact the manufacturer.

⚠ WARNING

Electromagnetic radiation hazard. Do not use the instrument in dangerous environments.

NOTICE

This instrument is sensitive to electromagnetic and electromechanical interference. These interferences can have an effect on the analysis performance of this instrument. Do not put this instrument near equipment that can cause interference.

Obey the safety information that follows to operate the instrument in accordance with local, regional and national requirements.

- Do not operate the instrument in hospitals and equivalent establishments or near medical equipment, such as pace makers or hearing aids.
- Do not operate the instrument near highly flammable substances, such as fuels, highly flammable chemicals and explosives.
- Do not operate the instrument near combustible gases, vapors or dust.
- Keep the instrument away from strong vibration or shock.
- The instrument can cause interference in immediate proximity to televisions, radios and computers.
- The warranty does not cover improper use or wear.

FCC conformance for RFID

This instrument may contain a registered radio frequency identification device (RFID). Refer to Table 1 for the Federal Communications Commission (FCC) registration information.

Table 1 Registration information

Parameter	Value
FCC identification number (FCC ID)	YCB-ZBA987
IC	5879A-ZBA987
Frequency	13.56 MHz

Certification

Canadian Radio Interference-Causing Equipment Regulation, IECS-003, Class A:

Supporting test records reside with the manufacturer.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

FCC Part 15, Class "A" Limits

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

1. Disconnect the equipment from its power source to verify that it is or is not the source of the interference.
2. If the equipment is connected to the same outlet as the device experiencing interference, connect the equipment to a different outlet.
3. Move the equipment away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

Product overview

⚠ DANGER	
	Chemical or biological hazards. If this instrument is used to monitor a treatment process and/or chemical feed system for which there are regulatory limits and monitoring requirements related to public health, public safety, food or beverage manufacture or processing, it is the responsibility of the user of this instrument to know and abide by any applicable regulation and to have sufficient and appropriate mechanisms in place for compliance with applicable regulations in the event of malfunction of the instrument.

The TU5300 sc and the TU5400 sc turbidimeters are used with an SC controller to measure low-range turbidity mostly in finished drinking water applications. Refer to Figure 1.

The TU5300 sc and the TU5400 sc turbidimeters measure scattered light at an angle of 90° in a 360° radius around the axis of the incident light beam.

An optional RFID module and an automatic system check option are available[5]. The RFID module is shown in Figure 1. The RFID module lets process and laboratory turbidity measurements be easily compared. A description of the automatic system check option is given in the expanded user manual on the manufacturer's website.

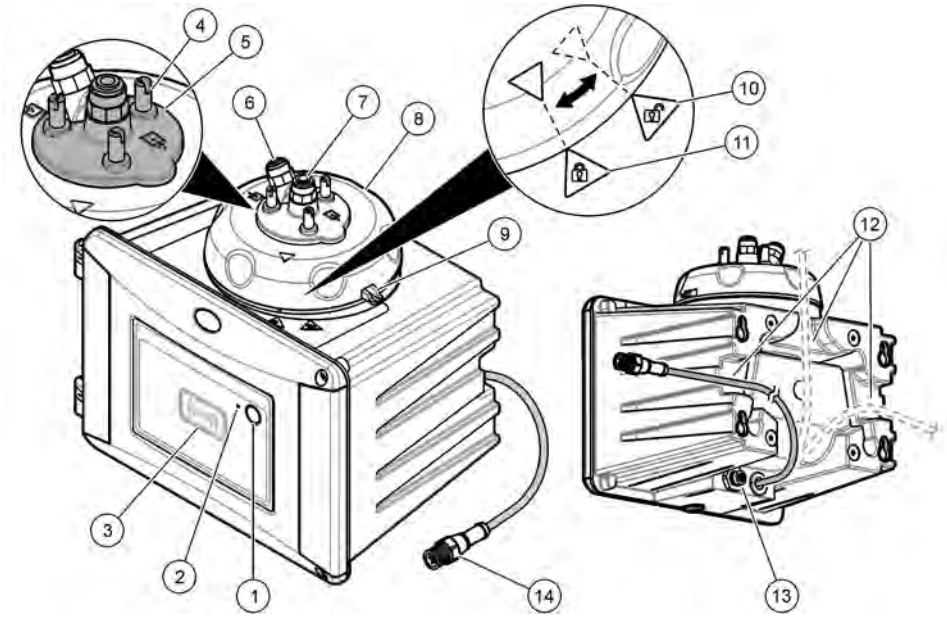
PROGNOSYS predictive diagnostic software is available for the TU5300 sc and TU5400 sc turbidimeters. To use PROGNOSYS, connect the turbidimeter to an SC controller with PROGNOSYS.

Videos on how to install, operate and do maintenance and troubleshooting on the TU5300 sc and the TU5400 sc turbidimeters are available on the *TU5 Series Turbidimeters* playlist at http://www.youtube.com/user/hachcompany.

For the accessories, refer to the expanded user manual on the manufacturer's website.

[5] The RFID module and automatic system check option is only available at the time of purchase.

Figure 1 Product overview



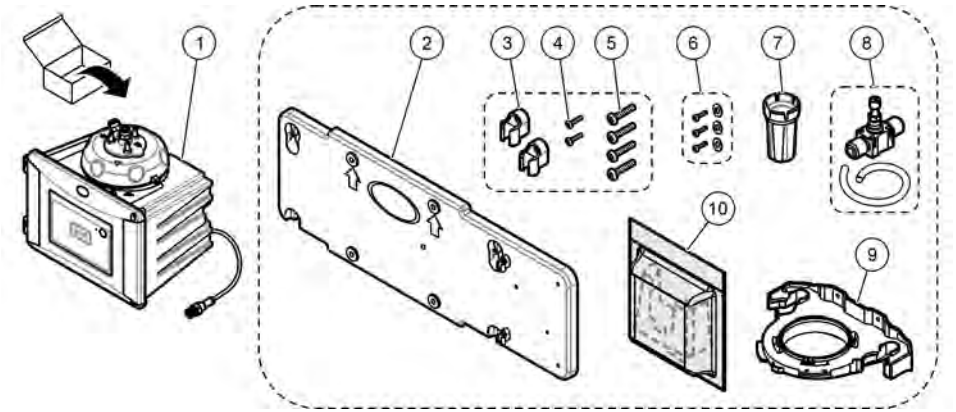
1 Programmable button	**8** Process head
2 Status indicator light[6]	**9** Overflow drain
3 RFID module indicator (optional)	**10** Process head (open)
4 Cleaning lid screws (3x)	**11** Process head (closed)
5 Cleaning lid	**12** Channels for cables
6 Sample inlet	**13** Extension connector for accessories
7 Sample outlet	**14** Sensor cable

Product components

Make sure that all components have been received. Refer to Figure 2. If any items are missing or damaged, contact the manufacturer or a sales representative immediately.

[6] Shows the instrument status. Refer to the expanded user manual on the manufacturer's website for more information.

Figure 2 Product components



1 TU5300 sc or TU5400 sc	**6** Cleaning lid screws and washers for hot water applications
2 Wall mount bracket (two tubing clips on bracket)	**7** Vial replacement tool
3 Tubing clips	**8** Flow regulator
4 Tubing clip screws, 2.2 x 6 mm	**9** Service bracket
5 Mounting screws, 4 x 16 mm	**10** Desiccant cartridge

Installation

⚠ CAUTION

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

Installation guidelines

NOTICE

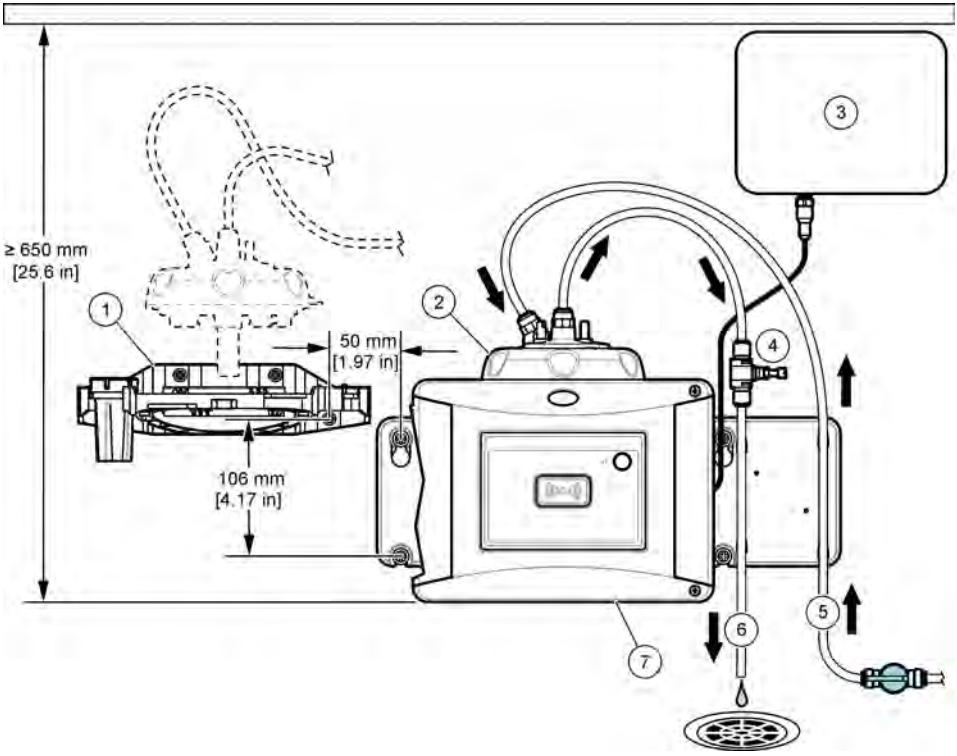
Make sure that there is a floor drain near the instrument. Examine the instrument daily for leaks.

This instrument is rated for an altitude of 3100 m (10,710 ft) maximum. Use of this instrument at an altitude higher than 3100 m can slightly increase the potential for the electrical insulation to break down, which can result in an electric shock hazard. The manufacturer recommends that users with concerns contact technical support.

Installation overview

Figure 3 shows the installation overview with no accessories and the clearances necessary. Refer to the expanded manual on the manufacturer's website for the system overview with all of the accessories.

Figure 3 Installation overview with no accessories



1 Service bracket	**5** Sample inlet
2 Process head	**6** Sample outlet
3 SC controller	**7** TU5300 sc or TU5400 sc
4 Flow regulator	

Wall mount

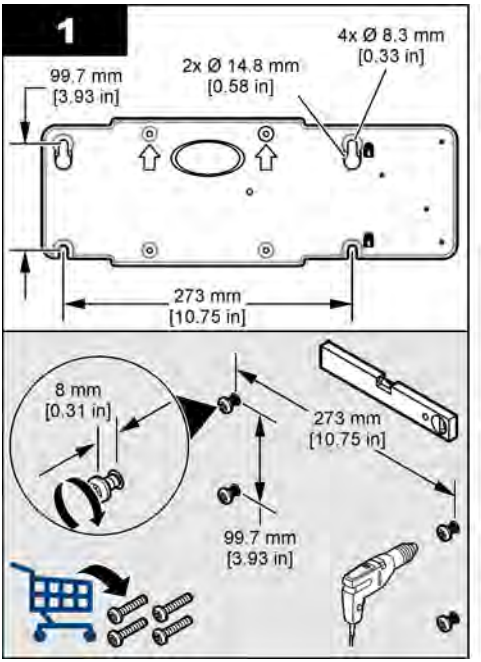
Install the instrument on a wall in a vertical position. Install the instrument so that it is level.

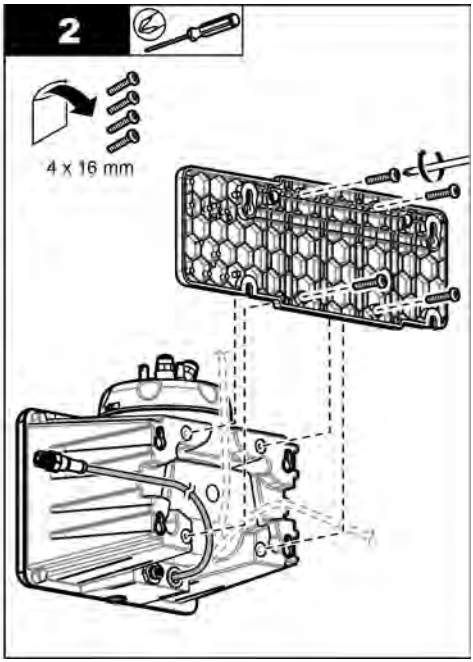
Install with the wall mount bracket

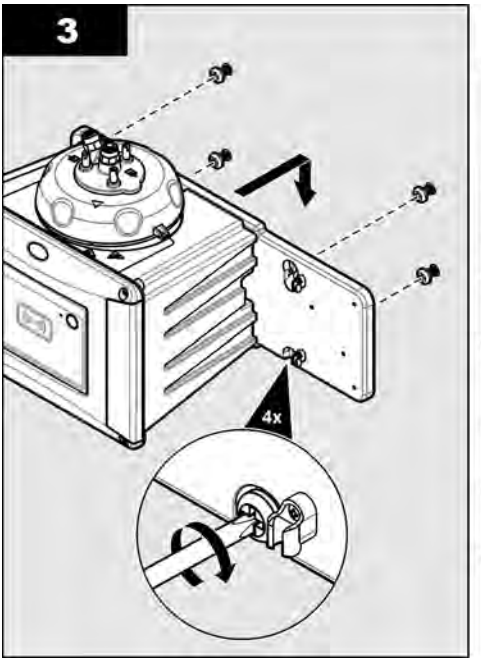
Refer to the illustrated steps that follow to install the instrument on a wall with the wall mount bracket. The mounting hardware to install the wall mount bracket on a wall is supplied by the user.

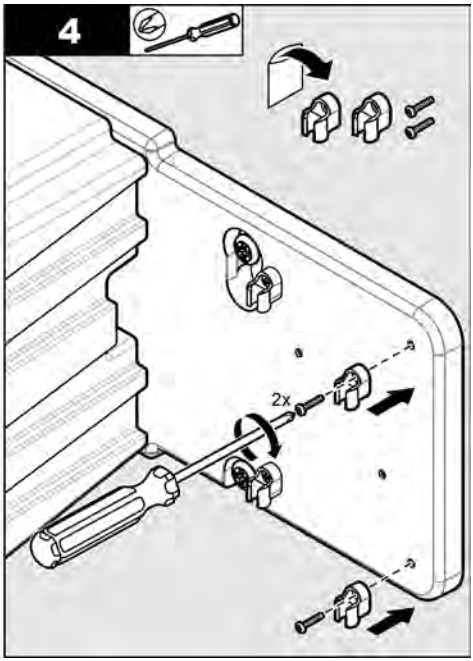
If a 1720D, 1720E, or FT660 instrument is replaced, remove the instrument from the wall. Then do steps 2 to 4 of the illustrated steps that follow to install the instrument on the existing hardware.

Note: *When the accessories are used, the installation location of the tubing clips is different. Refer to the documentation supplied with the accessories for tubing clip installation.*


1
99.7 mm
[3.93 in]
2x Ø 14.8 mm
[0.58 in]
4x Ø 8.3 mm
[0.33 in]
273 mm
[10.75 in]
8 mm
[0.31 in]
273 mm
[10.75 in]
99.7 mm
[3.93 in]

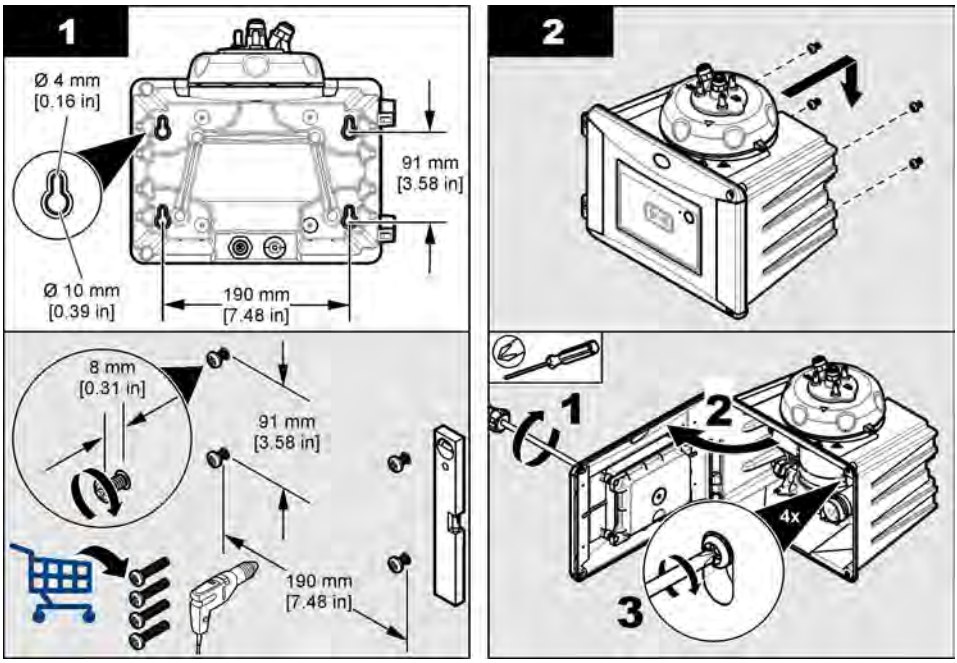

2
4 x 16 mm


3
4x


4
2x

Install directly on a wall

As an alternative, refer to the illustrated steps that follow to install the instrument directly on a wall. The mounting hardware is supplied by the user. Remove the thin, plastic film from the mounting holes on the back of the instrument.



Install the desiccant cartridge

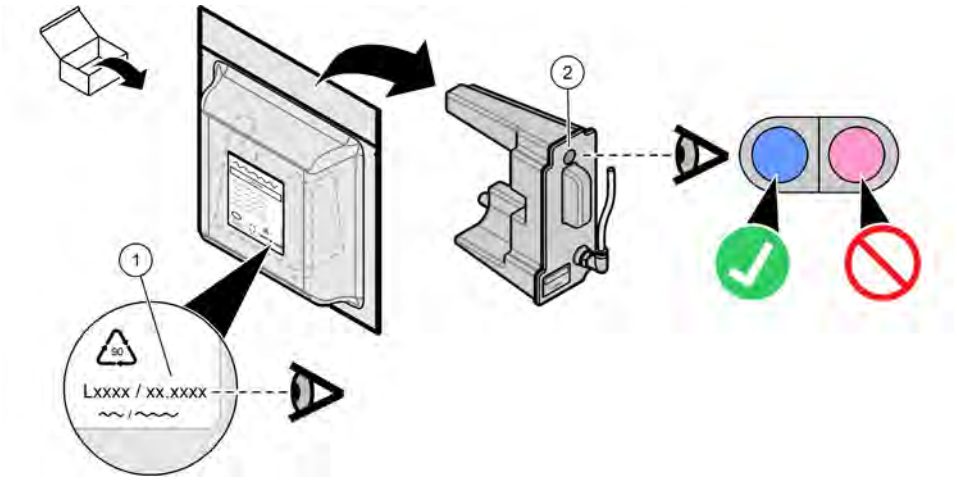
NOTICE

Make sure that the desiccant cartridge is installed or damage to the instrument will occur.

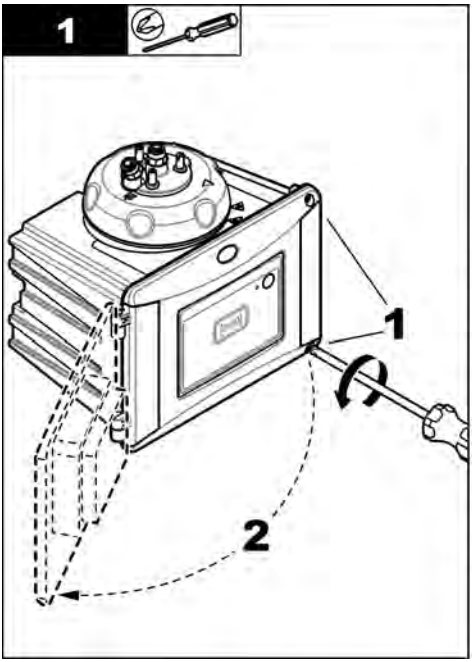
For initial installation, complete the steps below. For replacement, refer to the documentation supplied with the desiccant cartridge.

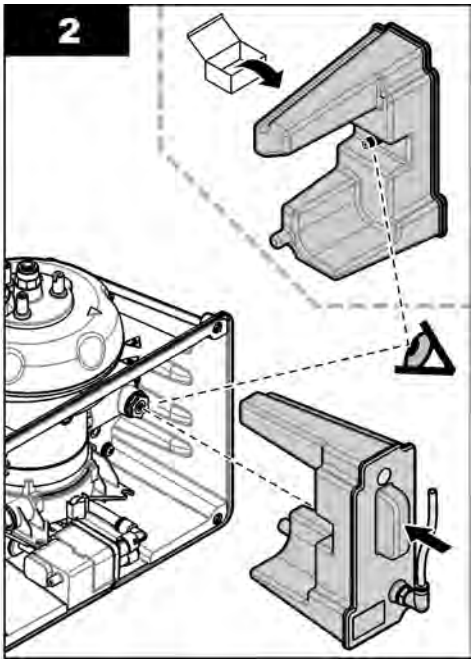
1. Look at the install by date on the packaging. Refer to Figure 4. Do not use if the current date is past the install by date.
2. Make sure that the indicator on the new desiccant cartridge is blue. Refer to Figure 4.
3. Install the new desiccant cartridge. Refer to the illustrated steps that follow.

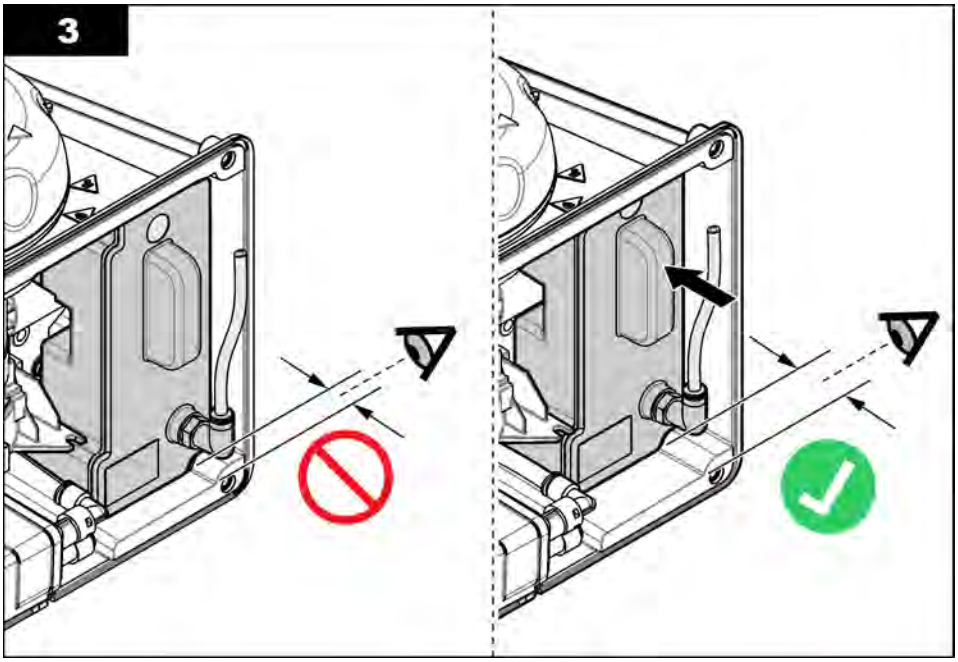
Figure 4 Examine the desiccant cartridge

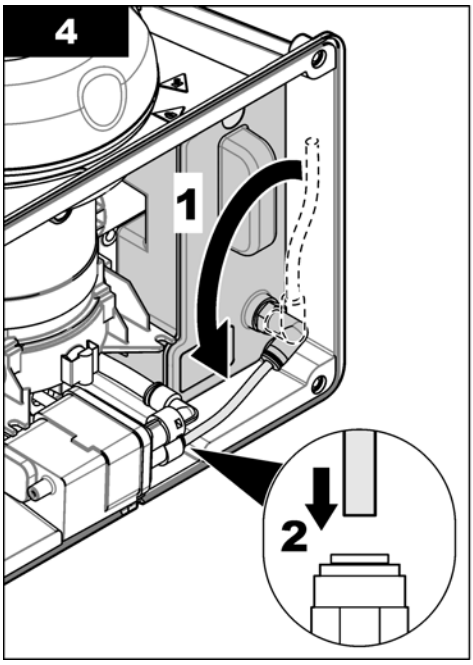


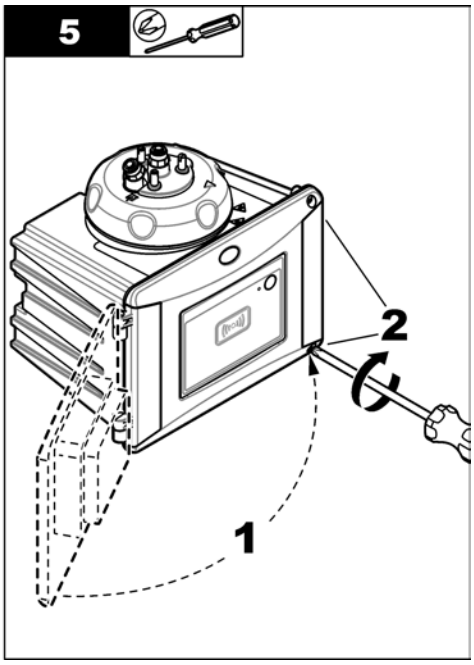
1 Install by date (mm.yyyy = month and year)	**2** Indicator (blue = not expired, pink = expired)






3


4
1
2


5
2
1

Replace the cleaning lid screws

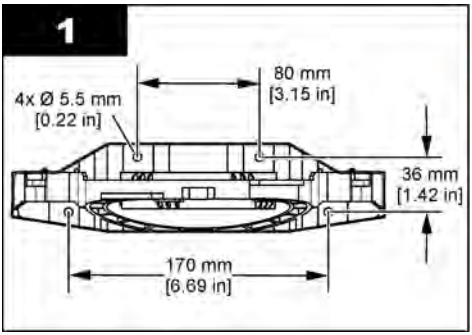
NOTICE
Do not overtighten the screws or breakage will occur. Hand tighten the screws.

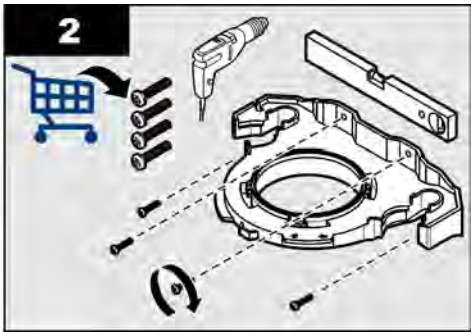
If the sample temperature is 40 to 60 °C (104 to 140 °F), the cleaning lid screws will become hot. To prevent burns, replace the standard cleaning lid screws with the cleaning lid screws and washers for hot water. Refer to Figure 1 on page 9 for the location of the cleaning lid screws.

Install the service bracket

The service bracket holds the process head (or the optional automatic cleaning module) when it is not installed on the instrument.

Refer to Installation overview on page 10 to install the service bracket the correct distance from the instrument. Refer to the illustrated steps that follow to install the service bracket.





Install the flow sensor (optional)

The optional flow sensor identifies if the sample flow is within specifications. A warning shows on the controller display and the status indicator light when a no flow, low flow or high flow warning occurs.

Install the optional flow sensor. Refer to the documentation supplied with the optional flow sensor.

Install the automatic cleaning module (optional)

The automatic cleaning module cleans the inside of the process vial at a selected time interval. Install the optional automatic cleaning module. Refer to the documentation supplied with the automatic cleaning module.

Connect to an SC controller

⚠ CAUTION	
	Personal injury hazard. Do not look into the vial compartment when the instrument is connected to power.

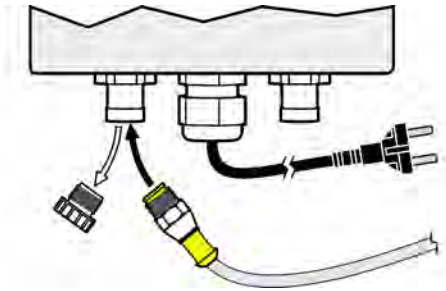
1. Install the latest software version on the SC controller before the instrument is connected to the SC controller. Get the latest software version from www.hach.com.

   Refer to the software installation instructions supplied in the box or supplied in the software download for the SC controller.
2. Remove power to the SC controller.
3. Connect the sensor cable to the quick-connect fitting of the SC controller. Refer to Figure 5. Keep the connector cap for later use.
4. Supply power to the SC controller.

   The SC controller looks for the instrument.
5. When the SC controller finds the instrument, push **enter**.

   On the main screen, the controller shows the turbidity value measured by the turbidimeter.

Figure 5 Connect the sensor cable to the SC controller



Plumbing

Plumb the instrument

⚠ WARNING

Explosion hazard. Make sure that the drain tube is free of all obstructions. If the drain tube has a blockage or is pinched or bent, high pressure can build up in the instrument.

⚠ WARNING

Personal injury hazard. The sample line contains water under high water pressure that can burn skin if hot. Qualified personnel must remove the water pressure and wear personal protective equipment during this procedure.

NOTICE

Do not let water get in the vial compartment or instrument damage will occur. Before the process head is installed on the instrument, make sure that there are no water leaks. Make sure that all tubing is fully seated. Make sure that the vial nut is tight.

NOTICE

Before the instrument is plumbed, make sure that the desiccant cartridge and vial are installed.

Items supplied by the user:

- Flow shutoff valve

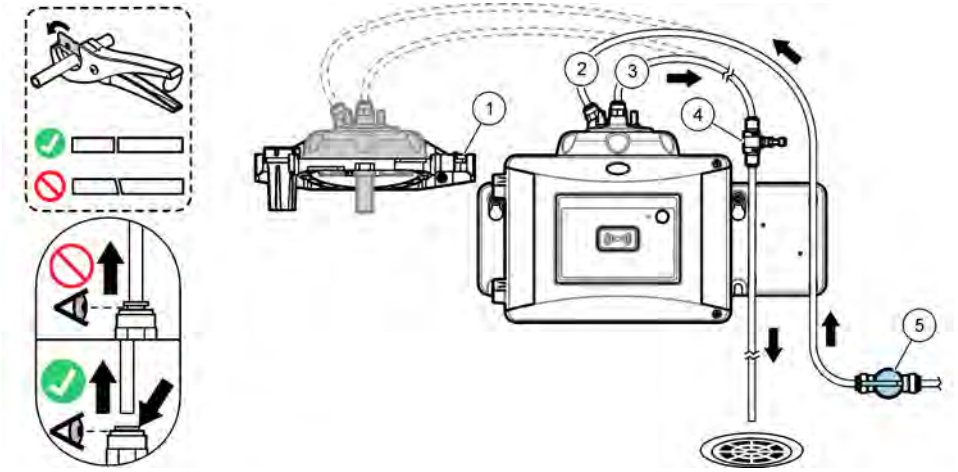
- Tubing[7]
- Tubing cutter

1. Plumb the instrument. Refer to the illustrated steps that follow and Figure 6.

   Note: *To plumb the instrument with accessories, refer to the documentation supplied with the accessories.*
2. If a service bracket is not installed near the instrument, do the steps that follow:

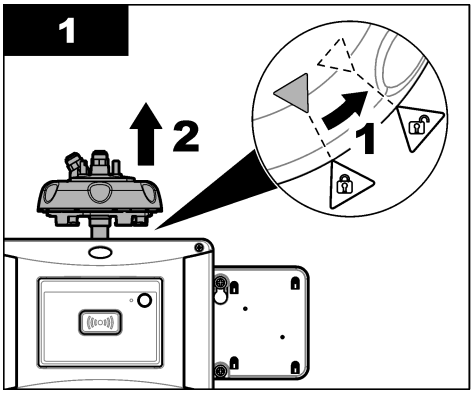
   a. Do not do illustrated steps 1 and 2.
   b. Do illustrated steps 3 and 4 with the process head on the instrument.
   c. Before step 5, remove the process head from the instrument.
   d. Hold the process head so that it is not above the instrument or put the process head on the optional process head holder.
   e. Do illustrated steps 5 and 6.
   f. When there are no leaks from the process head or the flow regulator, install the process head on the instrument (illustrated step 8).

Figure 6 Plumbing overview – no accessories



1 Service bracket	**4** Flow regulator
2 Sample inlet	**5** Flow shutoff valve
3 Sample outlet	

[7] Refer to Specifications on page 3 for the tubing requirements.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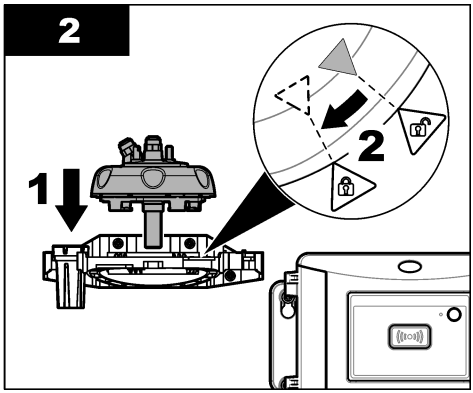
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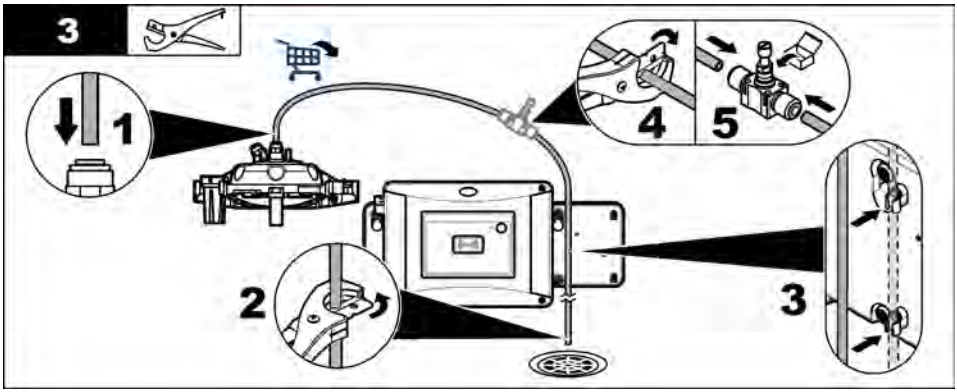
2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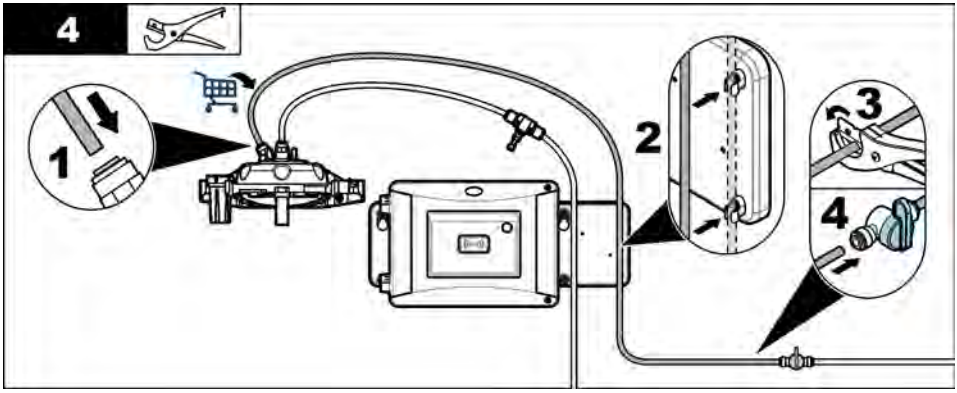
1
4
5
2
3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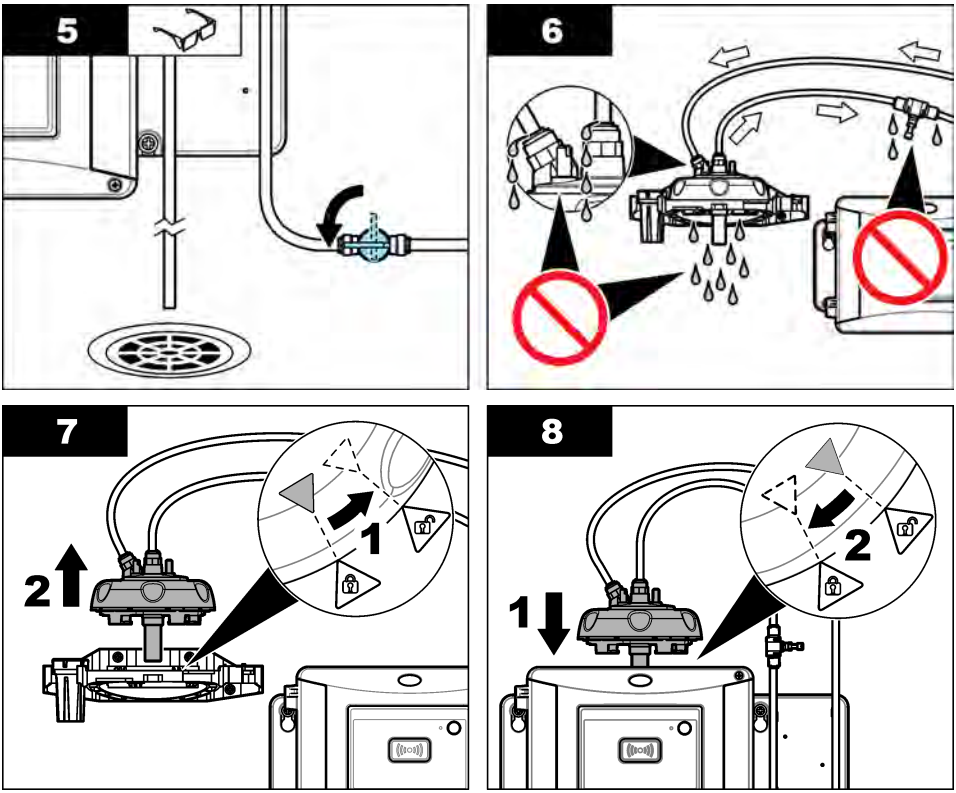
4



Set the flow rate

1. Measure the flow with the flow regulator fully open. Make sure that the flow is in the middle of the flow specification. Refer to Specifications on page 3.
2. Slowly close the flow regulator until the flow decreases by 20 to 30%.
   Note: *The flow regulator causes back pressure in the tubing and decreases the quantity of bubbles that can form in the vial.*

User navigation

Refer to the controller documentation for keypad description and navigation information.

Operation

Refer to the expanded user manual on the manufacturer's website to configure the instrument settings and to compare process and lab measurements.

Calibration

⚠ WARNING

Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current safety data sheets (MSDS/SDS) for safety protocols.

When the instrument is used for US EPA regulatory reporting, calibrations must be done according to US EPA guidance documents and methodologies. Contact local regulating authorities for additional compliance regulations.

The instrument is factory calibrated and the laser light source is stable. The manufacturer recommends that a calibration verification be done periodically to make sure that the system operates as intended. The manufacturer recommends calibration as local regulations require and after repairs or comprehensive maintenance work.

Use the optional calibration lid and a vial(s) with a StablCal standard or Formazin standard to calibrate the instrument. As an alternative, use a syringe and StablCal standard or Formazin standard to calibrate the instrument.

Refer to the expanded user manual on www.hach.com to calibrate the instrument and configure the calibration settings.

Verification

Use the optional calibration lid and a sealed-vial 10-NTU StablCal standard (or a StablCal 10 NTU standard and a syringe) to do a primary calibration verification. As an alternative, use the optional calibration lid and the optional glass verification rod (< 0.1 NTU) to do a secondary calibration verification.

Do a calibration verification immediately after each calibration to measure the verification standard and record the measured value to the instrument.

Do calibration verifications between calibrations according to the regulatory recommendations to identify if the instrument operates correctly and is calibrated.

When a calibration verification is done between calibrations, the verification standard is measured. The measured value is compared to the recorded value of the verification standard.

Refer to the expanded user manual on www.hach.com to do a verification and configure the verification settings.

Maintenance

⚠ WARNING

Burn hazard. Obey safe handling protocols during contact with hot liquids.

⚠ CAUTION

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

⚠ CAUTION

Personal injury hazard. Never remove covers from the instrument. This is a laser-based instrument and the user risks injury if exposed to the laser.

⚠ CAUTION

Personal injury hazard. Glass components can break. Handle with care to prevent cuts.

NOTICE

Do not disassemble the instrument for maintenance. If the internal components must be cleaned or repaired, contact the manufacturer.

NOTICE

Stop the sample flow to the instrument and let the instrument become cool before maintenance is done.

To set the output behavior during maintenance, push **menu** and select SENSOR SETUP>TU5x00 sc>DIAG/TEST>MAINTENANCE>OUTPUT MODE.

Maintenance schedule

Table 2 shows the recommended schedule of maintenance tasks. Facility requirements and operating conditions may increase the frequency of some tasks.

Table 2 Maintenance schedule

Task	1 to 3 months	1 to 2 years	As necessary
Clean the vial on page 23 ***Note:*** *The cleaning interval is dependent on the water quality.*	X		
Clean the vial compartment on page 24			X
Replace the vial on page 25		X	
Replace the desiccant cartridge on page 27 ***Note:*** *The replacement interval is dependent on the ambient humidity, ambient temperature and sample temperature.*		X[8]	
Replace the tubing on page 27			X

Clean spills

⚠ CAUTION

Chemical exposure hazard. Dispose of chemicals and wastes in accordance with local, regional and national regulations.

1. Obey all facility safety protocols for spill control.
2. Discard the waste according to applicable regulations.

Clean the instrument

NOTICE

Do not use solvents to clean the instrument.

The instrument is maintenance free. Regular cleaning is not necessary for normal operation. If the exterior of the instrument becomes dirty, wipe the instrument surfaces with a clean, moist cloth.

[8] Two years or as identified by instrument notification.

Clean the vial

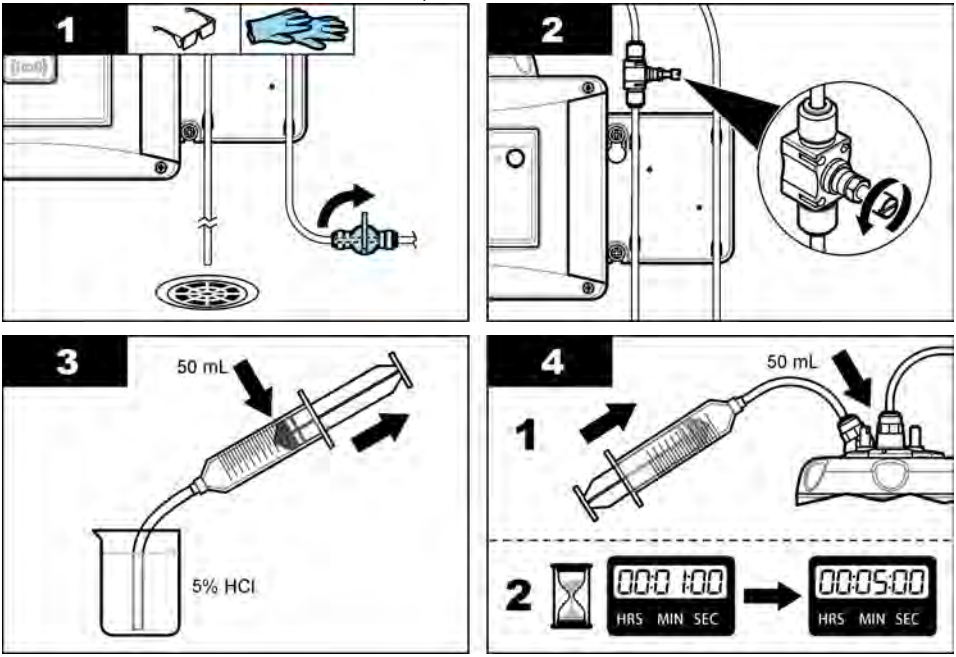
⚠ WARNING

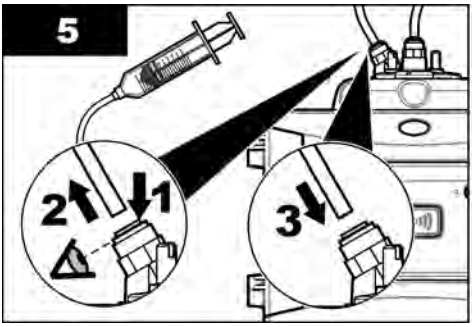
Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current safety data sheets (MSDS/SDS) for safety protocols.

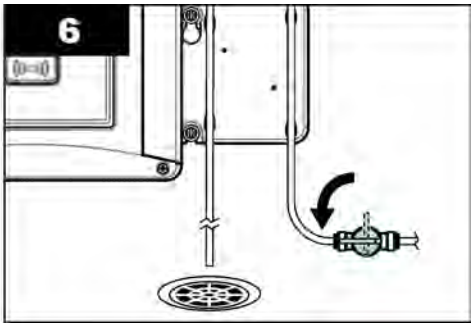
When the turbidity reading shows that there is contamination in the process vial or "VIAL CLARITY" shows on the controller display, clean the vial.

1. Push **menu**.
2. Select SENSOR SETUP>TU5x00 sc>DIAG/TEST>MAINTENANCE>VIAL CLEANING.
3. Complete the steps that show on the controller display. The date the vial was cleaned is automatically saved after the last screen shows.
4. If the optional automatic cleaning module is installed, push **menu** and select SETUP>TU5x00 sc>START WIPE to start the automatic cleaning process.
5. If the optional automatic cleaning module is not installed, clean the vial with the optional vial wiper if available. Refer to Clean the vial with the optional wiper on page 24.
6. If the turbidity readings do not go back to the original values, do the illustrated steps that follow to clean the vial.

   Note: *Hold the output values of the SC controller as necessary before the illustrated steps are done. Refer to the SC controller documentation to hold the outputs.*





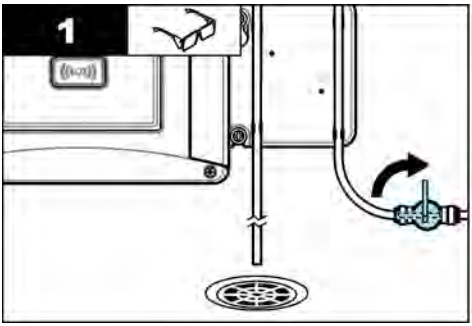


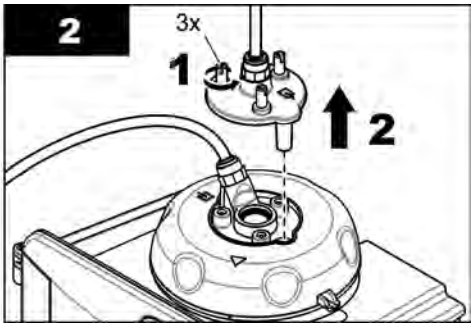
Clean the vial with the optional wiper

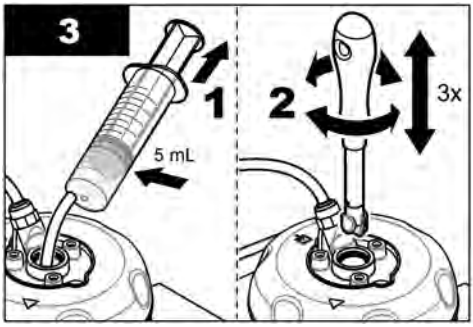
NOTICE

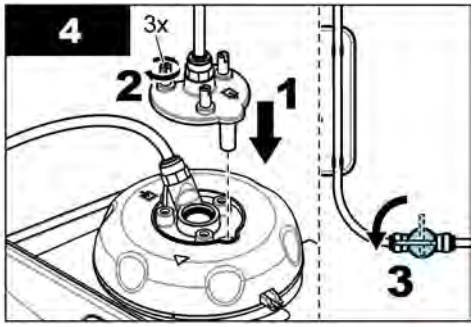
Carefully remove most of the water in the vial. Carefully put the vial wiper into the process vial so that no water spills out.

Clean the process vial with the optional vial wiper as shown in the illustrated steps that follow.









Clean the vial compartment

Clean the vial compartment only when the compartment has contamination. Make sure that the tool to clean the vial compartment has a soft surface and does not damage the instrument. Table 3 shows the options on how to clean the vial compartment.

Table 3 Cleaning options

Contaminant	Options
Dust	Vial compartment wiper, micro fiber cloth, lint-free cloth
Liquid, oil	Cloth, water and cleaning agent

Replace the vial

NOTICE

Keep water out of the vial compartment or instrument damage will occur. Before the automatic cleaning module is installed on the instrument, make sure that there are no water leaks. Make sure that all tubing is fully seated. Make sure that the vial nut is tight.

NOTICE

Hold the automatic cleaning module vertically when it is installed on the instrument or the vial can break. If the vial breaks, water will get in the vial compartment and instrument damage will occur.

NOTICE

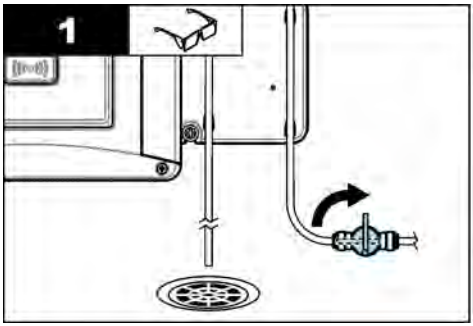
Do not to touch or scratch the glass of the process vial. Contamination or scratches on the glass can cause measurement errors.

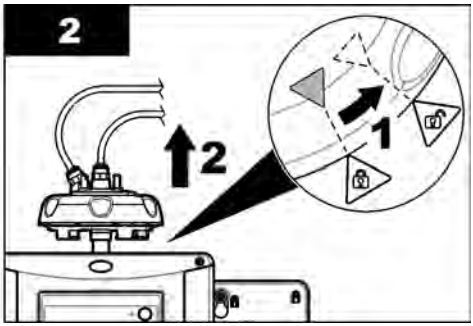
Note: *Make sure that no particles fall into the vial compartment.*

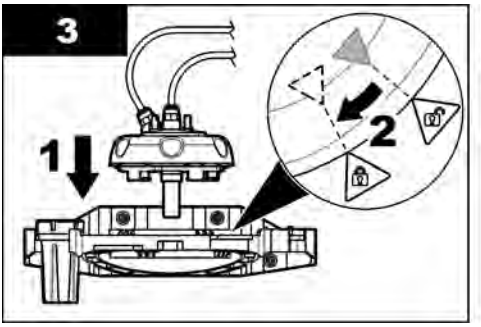
1. Push **menu**.
2. Select SENSOR SETUP>DIAG/TEST>MAINTENANCE>VIAL REPLACEMENT.
3. Complete the steps that show on the controller display. The date the vial was replaced is automatically saved after the last screen shows.

   Refer to the illustrated steps that follow to replace the vial. To protect the new vial from contamination, use the vial replacement tool to install the vial.

   At illustrated step 3, put the process head on its side on a flat surface if a service bracket is not installed near the instrument.



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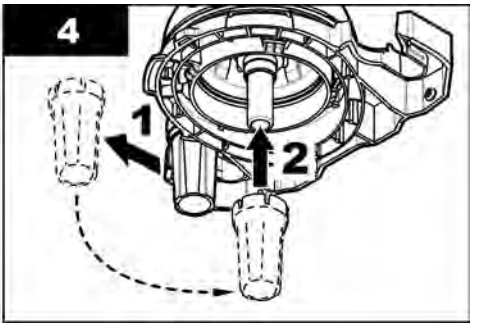
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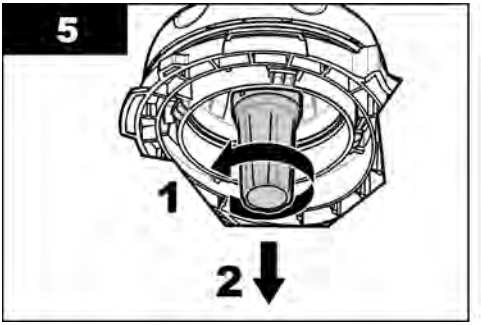
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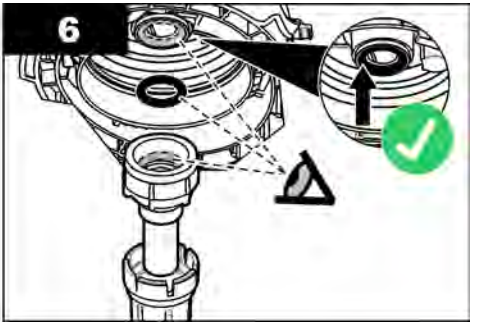
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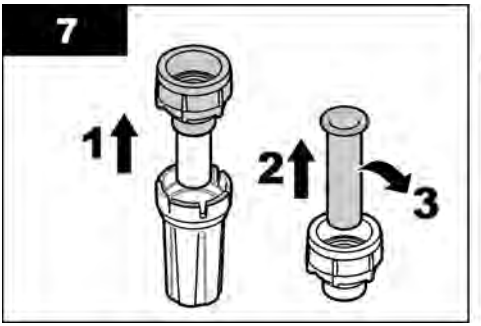
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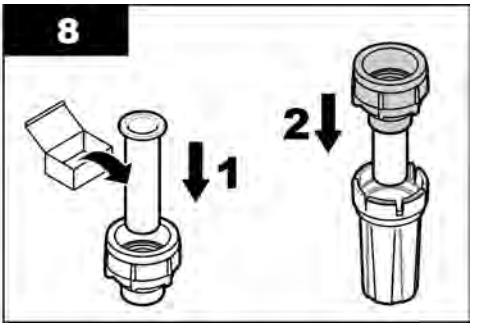
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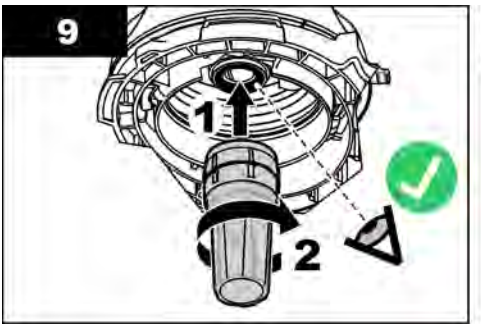
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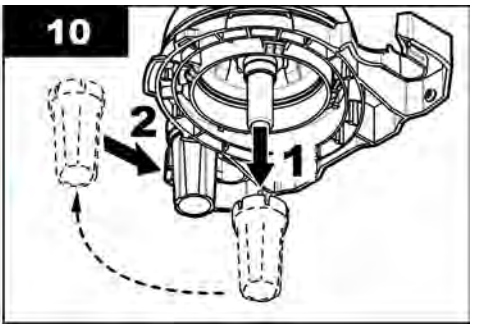
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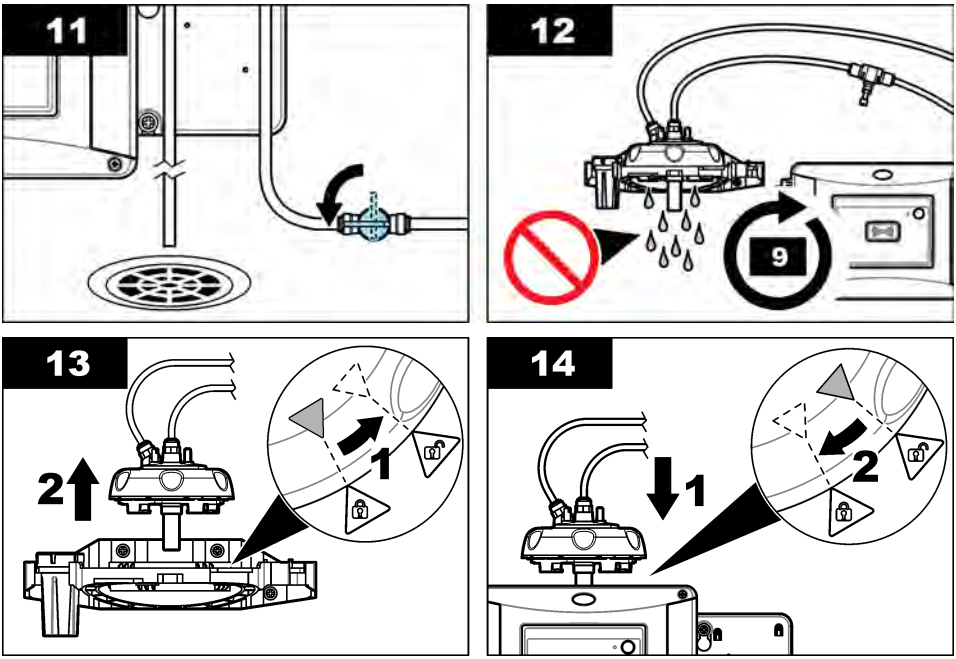

Replace the desiccant cartridge

The controller display will show when a desiccant cartridge replacement is due. Refer to the documentation included in the desiccant cartridge bag to replace the desiccant cartridge.

Replace the tubing

Replace the tubing when the tubing has a blockage or has damage.

Turn the flow shutoff valve to stop flow to the instrument. Then refer to Plumb the instrument on page 17 to replace the tubing.

Troubleshooting

Refer to the expanded user manual on www.hach.com for troubleshooting information.

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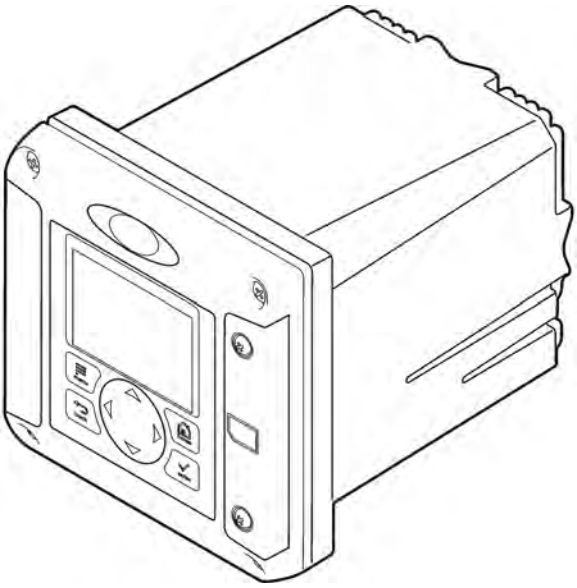
sc200 Controller

07/2016, Edition 8

User Manual



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Specifications

Specifications are subject to change without notice.

Specification	Details
Component description	Microprocessor-controlled and menu-driven controller that operates the sensor and displays measured values.
Operating temperature	-20 to 60 ºC (-4 to 140 ºF); 95% relative humidity, non-condensing with sensor load <7 W; -20 to 50 ºC (-4 to 104 ºF) with sensor load <28 W
Storage temperature	-20 to 70 ºC (-4 to 158 ºF); 95% relative humidity, non-condensing
Enclosure[1]	NEMA 4X/IP66 metal enclosure with a corrosion-resistant finish
Power requirements	**AC powered controller:** 100-240 VAC ±10%, 50/60 Hz; Power 50 VA with 7 W sensor/network module load, 100 VA with 28 W sensor/network module load (optional Modbus, RS232/RS485, Profibus DPV1 or HART network connection).
	24 VDC powered controller: 24 VDC—15%, + 20%; Power 15 W with 7 W sensor/network module load, 40 W with 28 W sensor/network module load (optional Modbus, RS232/RS485, Profibus DPV1 or HART network connection).
Altitude requirements	Standard 2000 m (6562 ft) ASL (Above Sea Level)
Pollution degree/Installation category	Polution Degree 2; Installation Category II
Outputs	Two analog (0-20 mA or 4-20 mA) outputs. Each analog output can be assigned to represent a measured parameter such as pH, temperature, flow or calculated values. Optional module supplies three additional analog outputs (5 total).
Relays	Four SPDT, user-configured contacts, rated 250 VAC, 5 Amp resistive maximum for the AC powered controller and 24 VDC, 5A resistive maximum for the DC powered controller. Relays are designed for connection to AC Mains circuits (i.e., whenever the controller is operated with 115 - 240 VAC power) or DC circuits (i.e., whenever the controller is operated with 24 VDC power).
Dimensions	½ DIN—144 x 144 x 180.9 mm (5.7 x 5.7 x 7.12 in.)
Weight	1.7 kg (3.75 lb)
Compliance information[2]	CE approved (with all sensor types). Listed for use in general locations to UL and CSA safety standards by ETL (with all sensor types). Certain AC mains powered models are listed for use in general safety locations to UL and CSA safety standards by Underwriters Laboratories (with all sensor types).
Digital communication	Optional Modbus, RS232/RS485, Profibus DPV1 or HART network connection for data transmission
Data logging	Secure Digital Card (32 GB maximum) or special RS232 cable connector for data logging and performing software updates. The controller will keep approximately 20,000 data points per sensor.
Warranty	2 years

General information

In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual. The manufacturer reserves the right to

[1] Units that have the Underwriters Laboratories (UL) certification are intended for indoor use only and do not have a NEMA 4X/IP66 rating.

[2] DC powered units are not listed by UL.

make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

Safety information

NOTICE

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

Use of hazard information

⚠ DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	This symbol indicates that a risk of electrical shock and/or electrocution exists.
	This symbol indicates the presence of devices sensitive to Electro-static Discharge (ESD) and indicates that care must be taken to prevent damage with the equipment.
	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.

Certification

Canadian Radio Interference-Causing Equipment Regulation, IECS-003, Class A:

Supporting test records reside with the manufacturer.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

FCC Part 15, Class "A" Limits

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

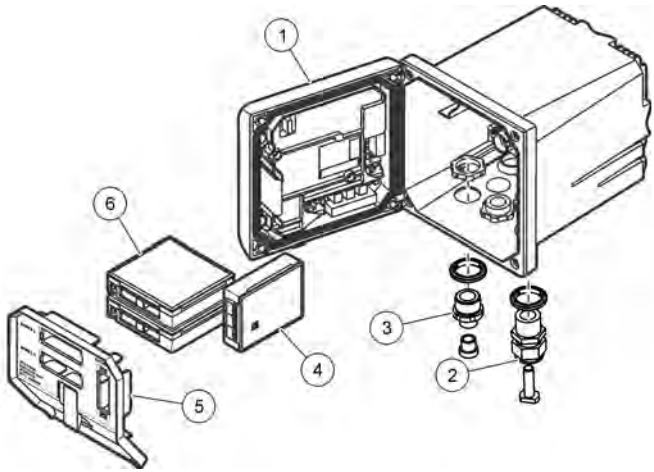
1. Disconnect the equipment from its power source to verify that it is or is not the source of the interference.
2. If the equipment is connected to the same outlet as the device experiencing interference, connect the equipment to a different outlet.
3. Move the equipment away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

Product overview

The controller displays sensor measurements and other data, can transmit analog and digital signals, and can interact with and control other devices through outputs and relays. Outputs, relays, sensors and sensor modules are configured and calibrated through the user interface on the front of the controller.

Figure 1 shows the product components. Components may vary according to controller configuration. Contact the manufacturer if parts are damaged or missing.

Figure 1 System components



1 Controller	**4** Network module (optional)
2 Strain relief assembly (optional depending on controller version)	**5** High-voltage barrier
3 Digital connection fitting (optional depending on controller version)	**6** Sensor modules (optional)

Sensors and sensor modules

The controller accepts up to a maximum of two sensor modules or two digital sensors (depending on the controller configuration), along with one communication module. A single digital sensor and a single sensor module can be installed in combination. A variety of sensors can be wired to the sensor modules. Sensor wiring information is given in the specific sensor manuals and in the user instructions for specific modules.

Relays outputs and signals

The controller has four configurable relay switches and two analog outputs. An optional analog output module can increase the number of analog outputs to five.

Device scans

With two exceptions, the controller automatically scans for connected devices without user input when it is powered on. The first exception is when the controller is powered on for the first time before initial use. The second exception is after the controller configuration settings have been set to their default values and the controller is powered on. In both cases, the controller first displays the language, date and time edit screens. After the language, date and time entries are accepted, the controller performs a device scan. Refer to Connect a digital sc sensor on page 20 for instructions about how to scan for devices when the controller is already powered on.

Controller enclosure

The controller enclosure is NEMA 4X/IP66-rated and has a corrosion-resistant finish designed to withstand corrosive environmental constituents such as salt spray and hydrogen sulfide. Protection against environmental damage is strongly recommended for outdoor use.
Note: *Units that have the Underwriters Laboratories (UL) certification are intended for indoor use only and do not have a NEMA 4X/IP66 rating.*

Controller mounting options

The controller can be mounted to a panel, to a wall or to a vertical or horizontal pipe. A neoprene sealing gasket is included and can be used to reduce vibration. The gasket can be used as a template for panel mounting before the inner gasket component is separated.

Installation

Mounting components and dimensions

⚠ CAUTION

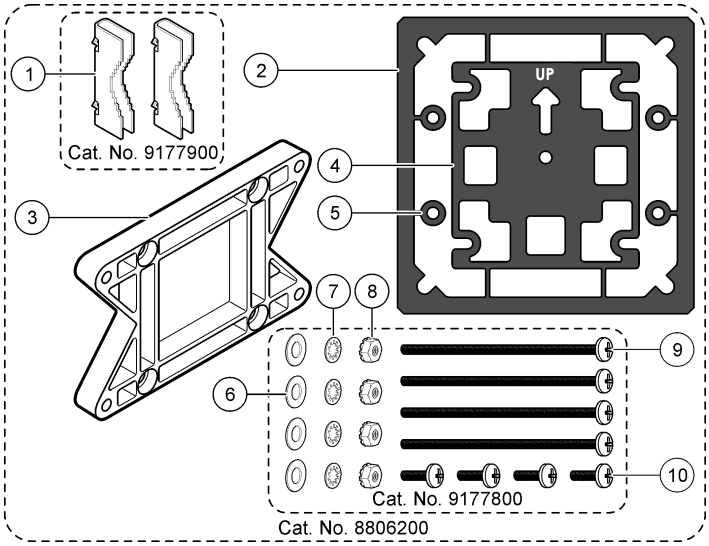
Personal injury hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

The controller can be installed on a surface, panel or pipe (horizontal or vertical). For mounting options and instructions, refer to Figure 2, Figure 3 on page 8, Figure 4 on page 9, Figure 5 on page 10 and Figure 6 on page 11.

For horizontal pipe mounts, the mounting feet (Figure 2) must be attached to the mounting bracket in a vertical position.

For both horizontal and vertical pipe mounts, attach the mounting bracket to the controller as shown in Figure 5 on page 10.

Figure 2 Mounting components



1 Mounting foot (2x)	**6** Flat washer, ¼-inch ID (4x)
2 Sealing gasket for panel mount, Neoprene	**7** Lock washer, ¼-inch ID (4x)
3 Bracket for wall and pipe mounting	**8** M5 x 0.8 Keps hexnut (4x)
4 Vibration isolation gasket for pipe mount	**9** Pan head screws, M5 x 0.8 x 100mm (4x) (Used for variable diameter pipe mount installations)
5 Vibration isolation washer for pipe mount (4x)	**10** Pan head screws, M5 x 0.8 x 15 mm (4x)

Note: *A bracket for panel mounting is available as an optional accessory.*

Controller mounting

Figure 3 Surface mounting dimensions

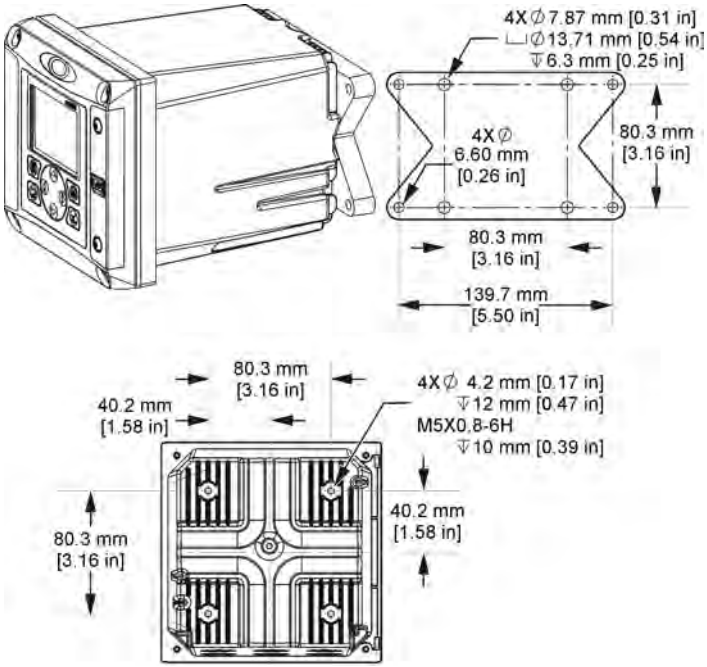
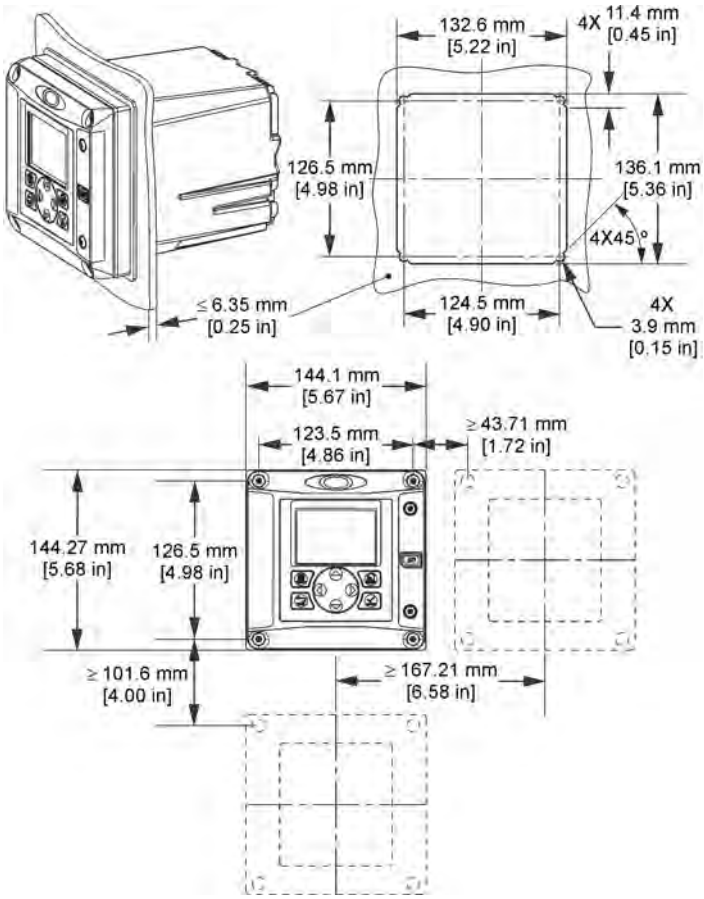


Figure 4 Panel mounting dimensions



Note: *If using the bracket (optional) for panel mounting, push the controller through the hole in the panel and then slide the bracket over the controller on the back side of the panel. Use the four 15 mm pan head screws (supplied) to attach the bracket to the controller and secure the controller to the panel.*

Figure 5 Pipe mounting (vertical pipe)

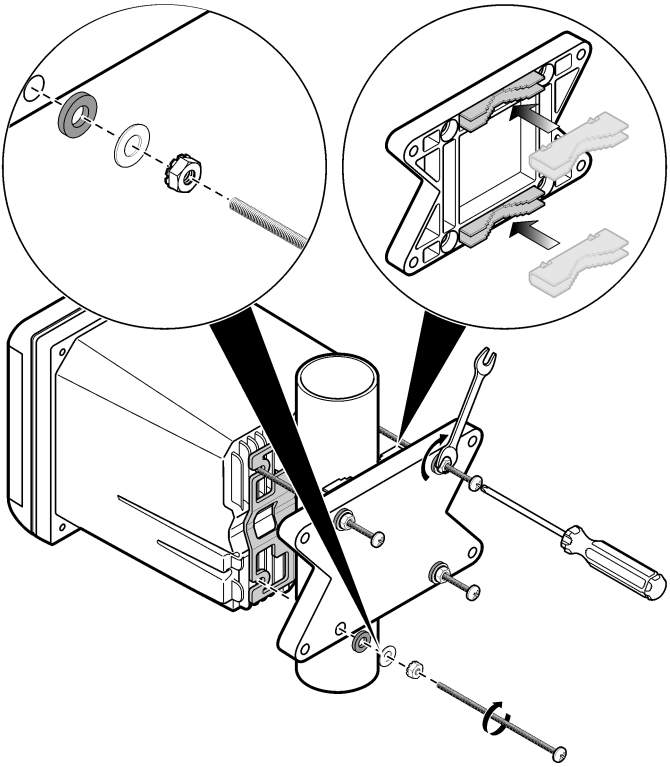
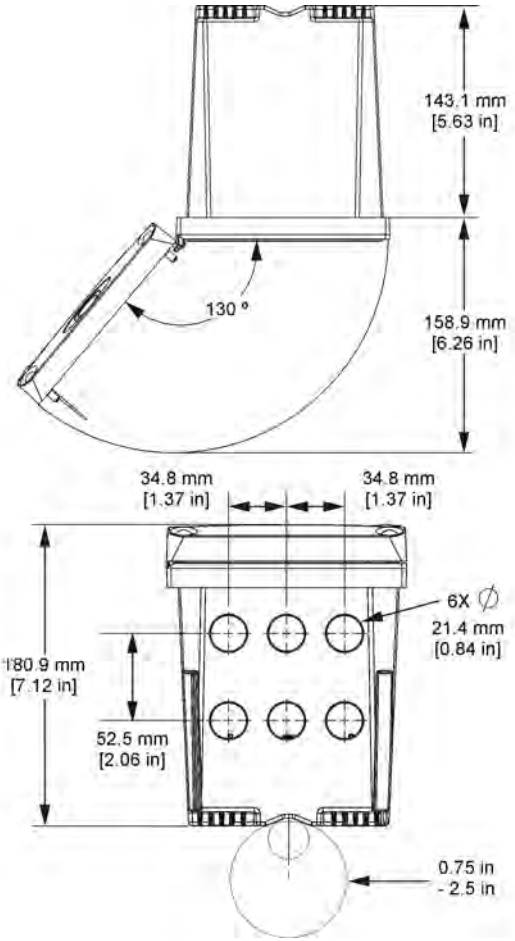


Figure 6 Top and bottom views



High-voltage barrier

High-voltage wiring for the controller is located behind the high-voltage barrier in the controller enclosure. The barrier must remain in place except when installing modules or when a qualified installation technician is wiring for power, alarms, outputs or relays. Do not remove the barrier while power is applied to the controller.

Electrostatic discharge (ESD) considerations

NOTICE	
	Potential Instrument Damage. Delicate internal electronic components can be damaged by static electricity, resulting in degraded performance or eventual failure.

Refer to the steps in this procedure to prevent ESD damage to the instrument:

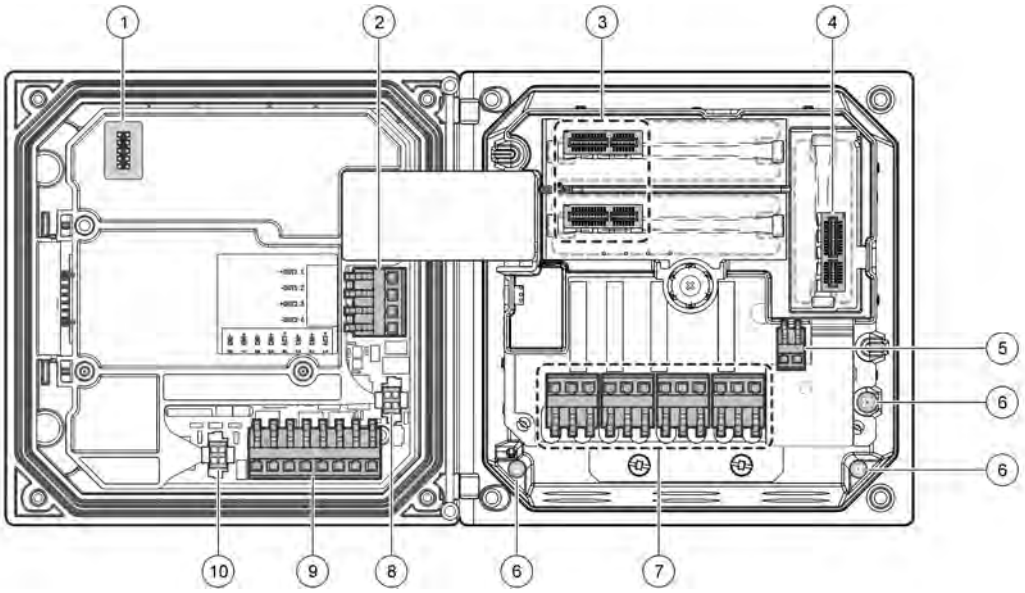
- Touch an earth-grounded metal surface such as the chassis of an instrument, a metal conduit or pipe to discharge static electricity from the body.

- Avoid excessive movement. Transport static-sensitive components in anti-static containers or packages.
- Wear a wrist strap connected by a wire to earth ground.
- Work in a static-safe area with anti-static floor pads and work bench pads.

Wiring overview

Figure 7 shows an overview of the wiring connections inside the controller with the high voltage barrier removed. The left side of the figure shows the back side of the controller cover.
Note: *Remove connector caps from the connectors before module installation.*

Figure 7 Wiring connections overview



1 Service cable connection	**5** AC and DC power connector[3]	**9** Discrete input wiring connector[3]
2 4-20 mA output[3]	**6** Ground terminals	**10** Digital sensor connector[3]
3 Sensor module connector	**7** Relay connections[3]	
4 Communication module connector (e.g., Modbus, Profibus, HART, optional 4-20 mA module, etc.)	**8** Digital sensor connector[3]	

Wiring for power

⚠ WARNING

Potential Electrocution Hazard. Always disconnect power to the instrument when making electrical connections.

[3] Terminals can be removed for improved access.

⚠ WARNING

Potential Electrocution Hazard. If this equipment is used outdoors or in potentially wet locations, a **Ground Fault Interrupt** device must be used for connecting the equipment to its mains power source.

⚠ DANGER

Electrocution Hazard. Do not connect AC power to a 24 VDC powered model.

⚠ WARNING

Potential Electrocution Hazard. A protective earth (PE) ground connection is required for both 100-240 VAC and 24 VDC wiring applications. Failure to connect a good PE ground connection can result in shock hazards and poor performance due to electromagnetic interferences. ALWAYS connect a good PE ground to the controller terminal.

NOTICE

Install the device in a location and position that gives easy access to the disconnect device and its operation.

The controller can be purchased as either a 100-240 VAC powered model or a 24 VDC powered model. Follow the appropriate wiring instructions for the purchased model.

The controller can be wired for line power by hard-wiring in conduit or wiring to a power cord. Regardless of the wire used, the connections are made at the same terminals. A local disconnect designed to meet local electrical code is required and must be identified for all types of installation. In hard-wired applications, the power and safety ground service drops for the instrument must be 18 to 12 AWG.

Notes:

- The voltage barrier must be removed before making any electrical connections. After making all connections, replace the voltage barrier before closing the controller cover.
- A sealing type strain relief and a power cord less than 3 meters (10 feet) in length with three 18-gauge conductors (including a safety ground wire) can be used to maintain the NEMA 4X/IP66 environmental rating.
- Controllers can be ordered with AC power cords pre-installed. Additional power cords may also be ordered.
- The DC power source that supplies power to the 24 VDC powered controller must maintain voltage regulation within the specified 24 VDC-15% +20% voltage limits. The DC power source must also provide adequate protection against surges and line transients.

Wiring procedure

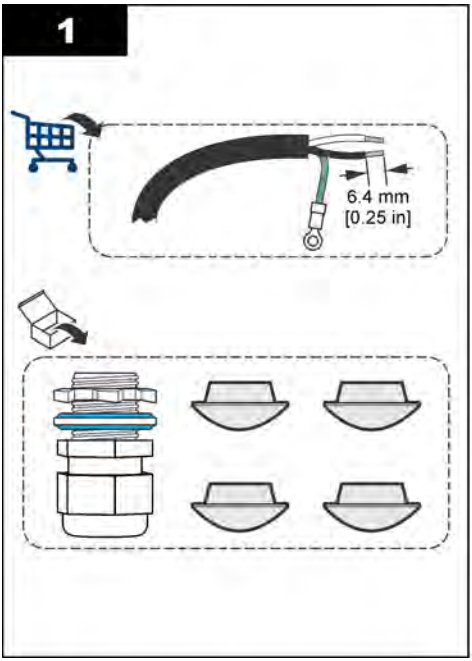
Refer to the illustrated steps that follow and Table 1 or Table 2 to wire the controller for power. Insert each wire into the appropriate terminal until the insulation is seated against the connector with no bare wire exposed. Tug gently after insertion to make sure that there is a secure connection. Seal any unused openings in the controller box with conduit opening sealing plugs.

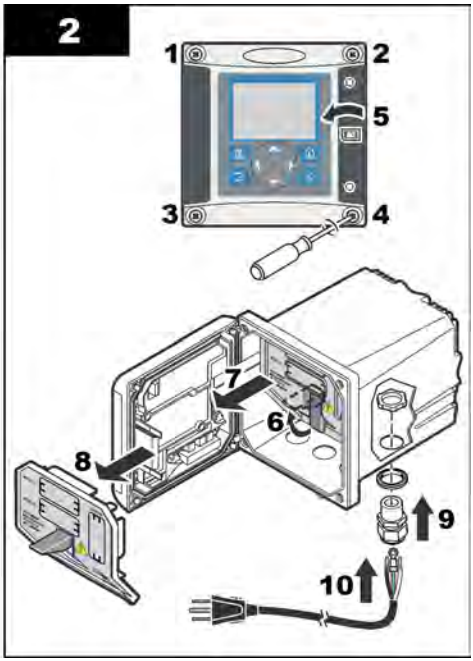
Table 1 AC power wiring information (AC powered models only)

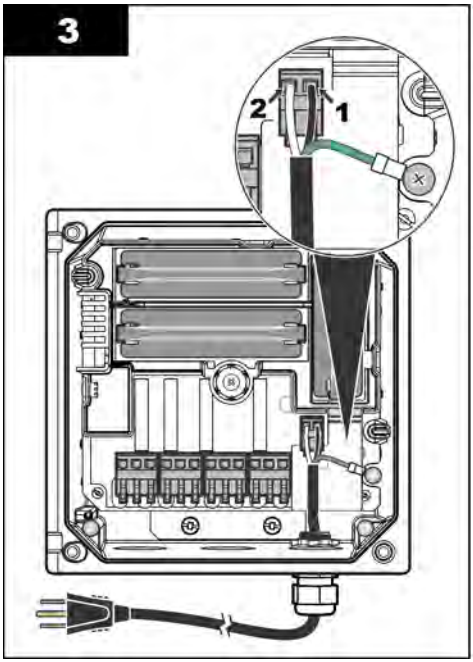
Terminal	Description	Color—North America	Color—EU
1	Hot (L1)	Black	Brown
2	Neutral (N)	White	Blue
—	Protective Earth (PE) Ground lug	Green	Green with yellow stripe

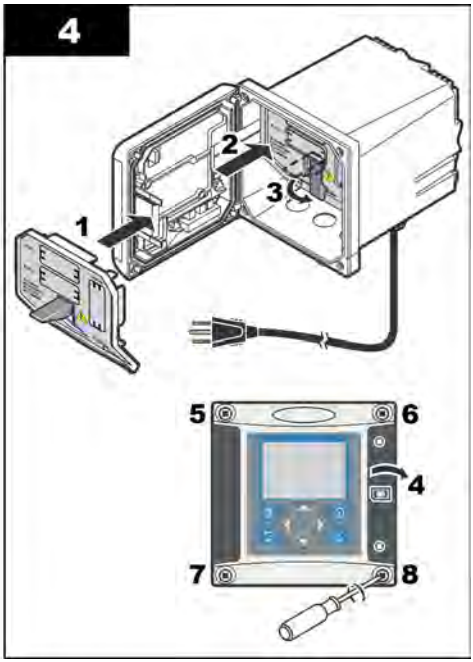
Table 2 DC power wiring information (DC powered models only)

Terminal	Description	Color—North America	Color—EU
1	+24 VDC	Red	Red
2	24 VDC return	Black	Black
—	Protective Earth (PE) Ground lug	Green	Green with yellow stripe









Alarms and relays

The controller is equipped with four unpowered, single pole relays rated 100-250 VAC, 50/60 Hz, 5 amp resistive maximum. Contacts are rated 250 VAC, 5 amp resistive maximum for the AC powered controller and 24 VDC, 5A resistive maximum for the DC powered controller. The relays are not rated for inductive loads.

Wiring relays

⚠ WARNING
Potential Electrocution Hazard. Always disconnect power to the instrument when making electrical connections.

⚠ WARNING
Potential fire hazard. The relay contacts are rated 5A and are not fused. External loads connected to the relays must have current limiting devices provided to limit current to < 5 A.

⚠ WARNING
Potential fire hazard. Do not daisy-chain the common relay connections or jumper wire from the mains power connection inside the instrument.

⚠ WARNING
Potential electrocution hazard. In order to maintain the NEMA/IP environmental ratings of the enclosure, use only conduit fittings and cable glands rated for at least NEMA 4X/IP66 to route cables in to the instrument.

AC line (100—250 V) powered controllers

The wiring compartment is not designed for voltage connections in excess of 250 VAC.

24 VDC powered controllers

⚠ WARNING

Potential electrocution hazard. AC mains powered controllers (115 V–230 V) are designed for relay connections to AC mains circuits (i.e., voltages greater than 16 V-RMS, 22.6 V-PEAK or 35 VDC).

⚠ WARNING

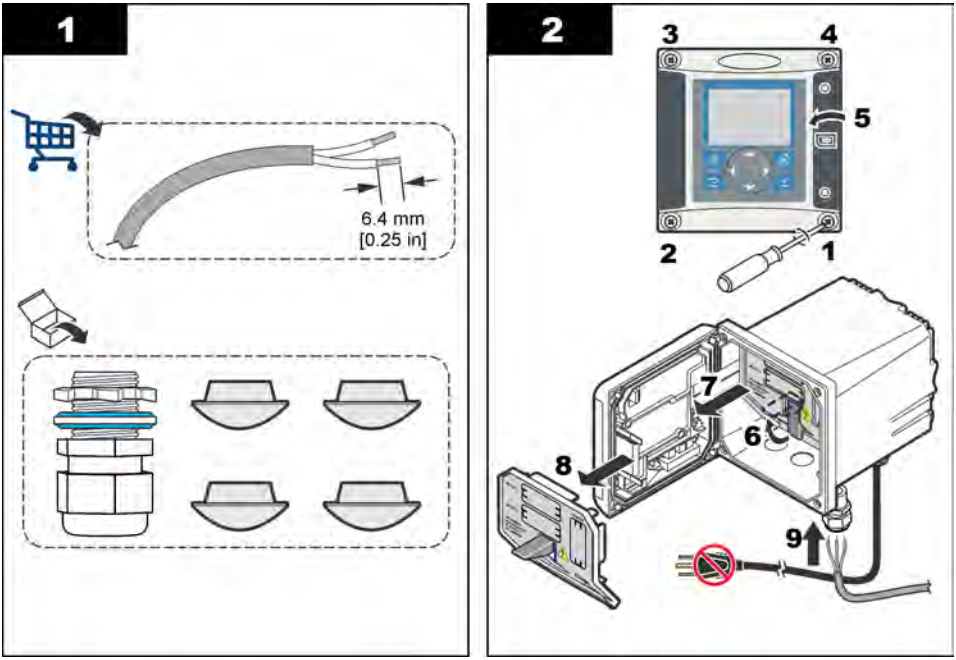
Potential electrocution hazard. 24 V powered controllers are designed for relay connections to low voltage circuits (i.e., voltages less than 16 V-RMS, 22.6 V-PEAK or 35 VDC).

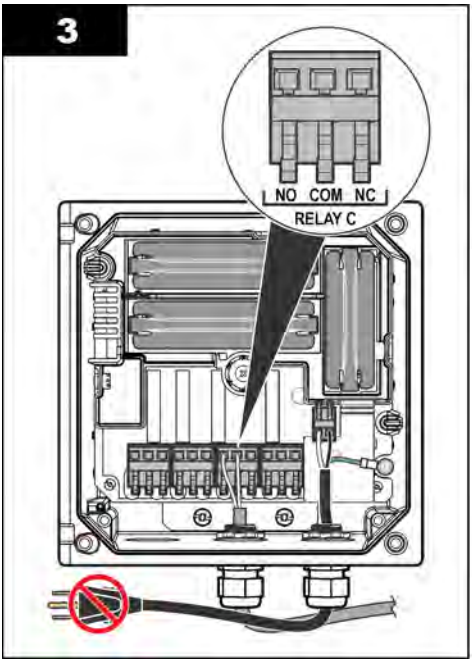
The 24 VDC controller relays are designed for the connection to low voltage circuits (i.e., voltages less than 30 V-RMS, 42.2 V-PEAK or 60 VDC). The wiring compartment is not designed for voltage connections above these levels.

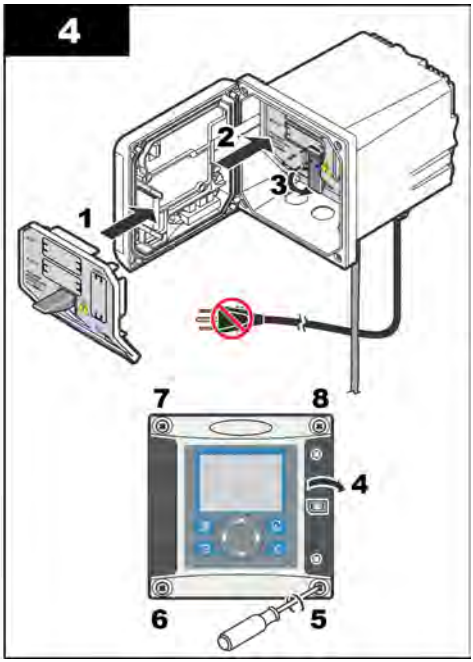
The relay connector accepts 18–12 AWG wire (as determined by load application). Wire gauge less than 18 AWG is not recommended.

The Normally Open (NO) and Common (COM) relay contacts will be connected when an alarm or other condition is active. The Normally Closed (NC) and Common relay contacts will be connected when an alarm or other condition is inactive (unless the Fail Safe is set to Yes) or when power is removed from the controller.

Most relay connections use either the NO and COM terminals or the NC and COM terminals. The numbered installation steps show connection to the NO and COM terminals.







Analog output connections

⚠ WARNING

Potential Electrocution Hazard. Always disconnect power to the instrument when making electrical connections.

⚠ WARNING

Potential electrocution hazard. In order to maintain the NEMA/IP environmental ratings of the enclosure, use only conduit fittings and cable glands rated for at least NEMA 4X/IP66 to route cables in to the instrument.

Two isolated analog outputs (1 and 2) are provided (Figure 8). Such outputs are commonly used for analog signaling or to control other external devices.

Make wiring connections to the controller as shown in Figure 8 and Table 3.
Note: *Figure 8 shows the back of the controller cover and not the inside of the main controller compartment.*

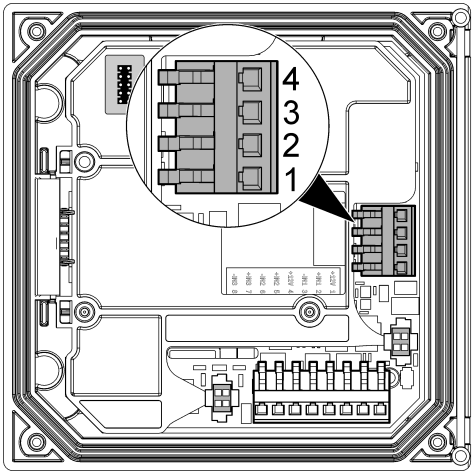
Table 3 Output connections

Recorder wires	Circuit board position
Output 2–	4
Output 2+	3
Output 1–	2
Output 1+	1

1. Open the controller cover.
2. Feed the wires through the strain relief.
3. Adjust the wire as necessary and tighten the strain relief.

4. Make connections with twisted-pair shielded wire and connect the shield at the controlled component end or at the control loop end.
   - Do not connect the shield at both ends of the cable.
   - Use of non-shielded cable may result in radio frequency emission or susceptibility levels higher than allowed.
   - Maximum loop resistance is 500 ohm.
5. Close the controller cover and tighten the cover screws.
6. Configure outputs in the controller.

Figure 8 Analog output connections



Discrete input wiring connections

⚠ WARNING

Potential Electrocution Hazard. Always disconnect power to the instrument when making electrical connections.

⚠ WARNING

Potential electrocution hazard. In order to maintain the NEMA/IP environmental ratings of the enclosure, use only conduit fittings and cable glands rated for at least NEMA 4X/IP66 to route cables in to the instrument.

Three discrete inputs are provided for switch closure inputs or logic level voltage inputs. Make wiring connections and configure jumper settings to the controller as shown in Figure 9, Table 4 and Figure 10.

Note: Figure 9 *shows the back of the controller cover and not the inside of the main controller compartment.*

Figure 9 Discrete input wiring connections

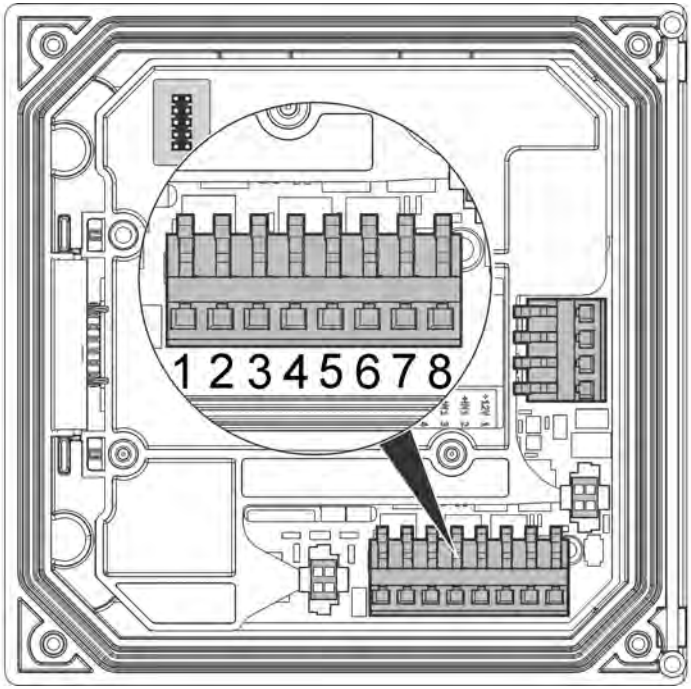
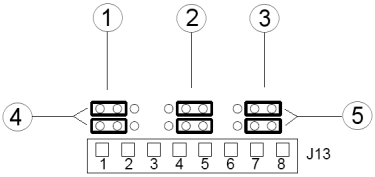


Table 4 Input connections

Discrete inputs	Connector position - Switch input	Connector position - Voltage input
Input 1+	3	2
Input 1-	2	3
Input 2+	6	5
Input 2-	5	6
Input 3+	8	7
Input 3-	7	8

Figure 10 Jumper settings



1 Input 1 configuration jumpers	**4** Jumpers positioned to the left for switch inputs
2 Input 2 configuration jumpers	**5** Jumpers positioned to the right for voltage inputs
3 Input 3 configuration jumpers	

1. Open the controller cover.
2. Feed the wires through the cable gland.
3. Adjust the wire as necessary and tighten the cable gland.
4. The jumpers are positioned immediately behind the connector. Remove the connector for improved access to the jumpers and configure the jumper settings according to the type of input as shown in Figure 10.
5. Close the controller cover and tighten the cover screws.
6. Configure inputs in the controller.

Note: *In* ***switch input*** *mode the controller supplies 12 volts to the switch and is not isolated from the controller. In* ***voltage input*** *mode the inputs are isolated from the controller (user input voltage from 0 to 30 volts).*

Connect a digital sc sensor

Note: *To connect an analog sensor, refer to the instructions supplied in the module or sensor manual.*

A digital sc sensor can be connected to the controller using the keyed quick-connect fitting (Figure 11). A digital sensor can be connected with the controller powered on or off.

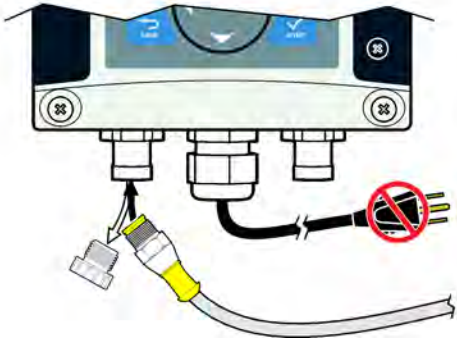
When a sensor is connected with the controller powered on, the controller does not automatically perform a device scan. To make the controller perform a device scan, navigate to the Test/Maintenance menu and select Scan Devices. If a new device is found, the controller performs the installation process without further user action.

When a sensor is connected with the controller powered off, the controller will perform a device scan when it is powered on again. If a new device is found, the controller performs the installation process without further user action.

Retain the connector cap to seal the connector opening in case the sensor must be removed.

Figure 11 Digital sensor quick connect

1.



Connect the optional digital communication output

The manufacturer supports Modbus RS485, Modbus RS232, Profibus DPV1 and HART communication protocols. The optional digital output module is installed in the location indicated by item 4 in Figure 7 on page 12. Refer to the instructions supplied with the network module for more details.

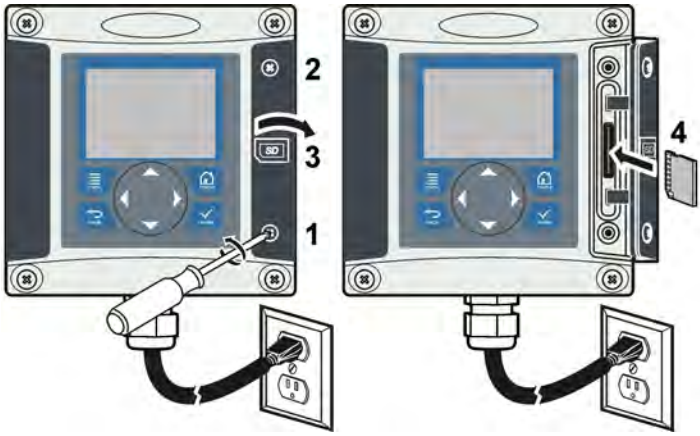
For information about Modbus registers, go to http://www.de.hach.com or http://www.hach.com and search *Modbus registers* or go to any sc200 product page.

Install a Secure Digital (SD) memory card

For instructions on how to install an SD card in the controller, refer to Figure 12. Information on how to use the SD memory card can be found in Using the secure digital memory (SD) card on page 42.

To remove an SD card, push down on the edge of the card and release, then pull the card up and out of the slot. After the card is removed, close the slot cover and tighten the cover screws.

Figure 12 SD card installation

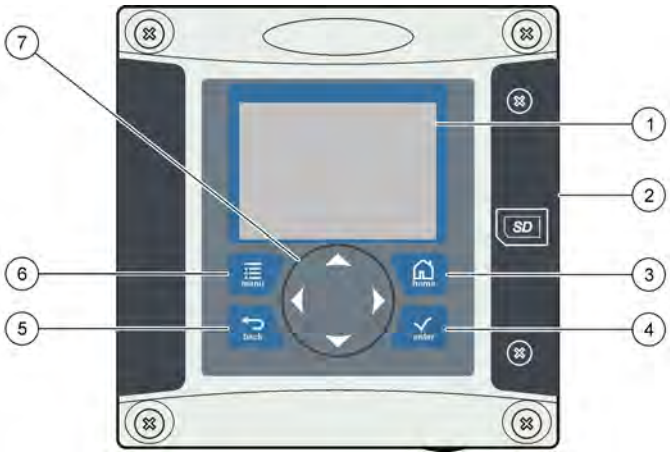


User interface and navigation

User interface

The keypad has four menu keys and four directional keys as shown in Figure 13.

Figure 13 Keypad and front panel overview



1 Instrument display	**5** **BACK** key. Moves back one level in the menu structure.
2 Cover for secure digital memory card slot	**6** **MENU** key. Moves to the Settings Menu from other screens and submenus.
3 **HOME** key. Moves to the Main Measurement screen from other screens and submenus.	**7** Directional keys. Used to navigate through the menus, change settings, and increment or decrement digits.
4 **ENTER** key. Accepts input values, updates, or displayed menu options.	

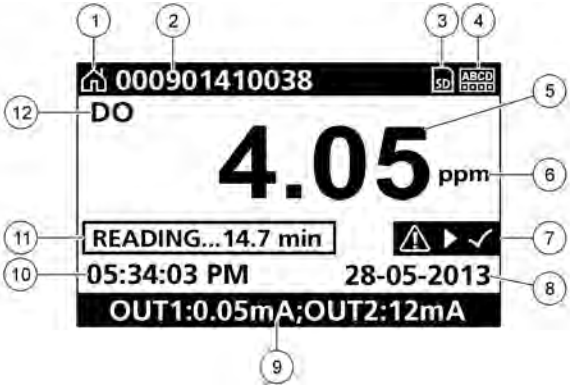
Inputs and outputs are set up and configured through the front panel using the keypad and display screen. This user interface is used to set up and configure inputs and outputs, create log information and calculated values, and calibrate sensors. The SD interface can be used to save logs and update software.

Display

Figure 14 shows an example of the main measurement screen with a DO sensor connected to the controller.

The front panel display screen shows sensor measurement data, calibration and configuration settings, errors, warnings and other information.

Figure 14 Example of Main Measurement screen



1 Home screen icon	**7** Warning status bar
2 Sensor name	**8** Date
3 SD Memory card icon	**9** Analog output values
4 Relay status indicator	**10** Time
5 Measurement value	**11** Progress bar
6 Measurement unit	**12** Measurement parameter

Table 5 Icon descriptions

Icon	Description
Home screen	The icon may vary depending on the screen or menu being displayed. For example, if an SD card is installed, an SD card icon appears here when the user is in the SD Card Setup menu.
SD memory card	This icon appears only if an SD card is in the reader slot. When a user is in the SD Card Setup menu, this icon appears in the upper left corner.
Warning	A warning icon consists of an exclamation point within a triangle. Warning icons appear on the right of the main display below the measurement value. Push the **ENTER** key then select the device to view any problems associated with that device. The warning icon will no longer be displayed once all problems have been corrected or acknowledged.
Error	An error icon consists of an exclamation point within a circle. When an error occurs, the error icon and the measurement screen flash alternately in the main display. To view errors, push the **MENU** key and select **Diagnostics**. Then select the device to view any problems associated with that device.

Additional display formats

- From the Main Measurement screen push the **UP** and **DOWN** arrow keys to switch between measurement parameters
- From the Main Measurement screen push the **RIGHT** arrow key to switch to a split display of up to 4 measurement parameters. Push the **RIGHT** arrow key to include additional measurements. Push the **LEFT** arrow key as needed to return to the Main Measurement screen
- From the Main Measurement screen push the **LEFT** arrow key to switch to the graphical display (see Graphical display on page 23 to define the parameters). Push the **UP** and **DOWN** arrow keys to switch measurement graphs

Graphical display

The graph shows concentration and temperature measurements for each channel in use. The graph supplies easy monitoring of trends and shows changes in the process.

1. From the graphical display screen use the up and down arrow keys to select a graph and push the **HOME** key.
2. Select an option:

Option	Description
MEASUREMENT VALUE	Set the measurement value for the selected channel. Select between Auto Scale and Manually Scale. For manual scaling enter the minimum and maximum measurement values
DATE & TIME RANGE	Select the date and time range from the available options

System startup

When initially powered up, the Language, Date Format and Date/Time screens appear in order. After these options are set, the controller performs a device scan and displays the message **Scanning for devices. Please wait...** If a new device is found, the controller performs an installation process before displaying a main measurement screen.

If the scan finds previously installed devices without configuration changes, the main measurement screen of the device in the number one position appears immediately after the scan is complete.

If a device has been removed from the controller or is not found during the next power-cycled or menu-driven scan, the controller displays a **Device missing** message and prompts to delete the missing device.

If no sensor is connected to an installed analog module, the controller will indicate an error. If devices are connected but not found by the controller, refer to Troubleshooting on page 46.

Set the language, date and time for the first time

The controller displays the language, date and time edit screens when the controller is powered on for the first time, and when it is powered on after the configuration settings have been set to their default values.
After the language, date and time options are set for the first time, update the options as necessary through the sc200 setup menu.

1. In the Language screen, highlight a language in the options list and push the **ENTER** key. English is the default language for the controller.
   The selected language is saved. The Date Format screen appears.
2. In the Date Format screen, highlight a format and push the **ENTER** key.
   The date and time format is saved. Next, the Date /Time screen appears.
3. In the Date/Time screen, push the **RIGHT** or **LEFT** arrow keys to highlight a field, then push the **UP** and **DOWN** arrow keys to update the value in the field. Update the other fields as necessary.
4. Push the **ENTER** key.
   The changes are saved and the controller performs a start-up scan for devices. If connected devices are found, the controller displays the main measurement screen for the device in the number one position. If the controller fails to find connected devices, refer to Troubleshooting on page 46.

Controller configuration information

General information about configuration options is listed in the table.

1. To navigate to the menu options, from the Settings Menu, select sc200 Setup.

Option	Description
Security setup	Sets the passcode preferences (refer to Security setup on page 25)
Output setup	Configures the controller analog outputs (refer to Configure the controller analog outputs on page 27)

Option	Description
Relay setup	Configures the controller relays (refer to Configure relays on page 30)
Display setup	Configures the controller display (refer to Display setup on page 39)
Set Date/Time	Sets the controller time and date (refer to Update the date and time on page 40)
Datalog setup	Configures data logging options. Available only if Calculation has been setup. At least one sensor must be attached to enter a calculation (refer to Set the datalog mode and interval on page 40)
Manage Data	Select the device from the list of installed components to view the data or event log
Error Hold Mode	**Hold Outputs**—Holds outputs at last known value when controller loses communication with the sensor. **Transfer Outputs**—Switches to transfer mode when controller loses communication with the sensor. Outputs transfer to a pre-defined value.
Calculation	Configures the controller math function (refer to Set up a calculation on page 40)
sc200 Information	**S/W VER:**—Displays the current version of controller software **Bootloader VER:**—Displays the current Bootloader version. The Bootloader is a file that loads the main operating system for the controller **S/N:**—Displays the controller serial number **Version:**—Displays the current version of controller hardware
Discrete Input Setup	Configures three discrete input channels (refer to Set up the discrete inputs on page 41)
Language	Assigns the language used in the controller (refer to Update the display language on page 42)

2. Select an option and push **ENTER** to activate the menu item.

Advanced operation

Security setup

Enable or disable the passcode

By default the passcode option is disabled and all configuration settings and calibrations can be changed. When the passcode function is enabled, access to Sensor calibration and Test/Maint menus requires a passcode.
To enable the passcode:

1. From the Settings Menu, select sc200 Setup and push the **ENTER** key.
2. Select Security Setup and push the **ENTER** key.
3. Select Set Passcode and push the **ENTER** key.
4. Select Disabled or Enabled and push the **ENTER** key.
   The passcode is enabled.
5. Push the **BACK** key to return to the sc200 Setup Menu, or push the **MENU** key to return to the Settings Menu.

Edit the passcode

The passcode is factory set to SC200. The Edit Passcode menu option appears in the Security Setup menu only after the passcode feature is enabled and a valid passcode has been entered.
A passcode consists of up to six upper or lower-case alpha, numeric and special characters. Passcodes are case-sensitive.

To edit the passcode:

1. Make sure the passcode is enabled. Refer to Enable or disable the passcode on page 25 for information on how to enable the passcode.
2. From the Settings menu, select Security Setup and push **ENTER**.
3. Use the arrow keys to enter the current valid passcode and push **ENTER**.
   The Edit Passcode option appears in the Security Setup menu.
4. Select Edit Pass Code and push **ENTER**.
   The Edit Pass Code screen appears.
5. Use the arrow keys to edit the passcode and push **ENTER**.
   The new passcode is saved and the Security Setup menu appears.
   Note: *All menus stay accessible until the* ***HOME*** *key is pushed or the controller is restarted.*
6. Push the **HOME** key or perform a controller restart.
   The new passcode settings are saved, and the new passcode is required to enter the Security Setup, Datalog Setup and Test/Maint menus.

Protect features

This option is only displayed if an analyzer or sensor that supports this feature is connected to the controller. Security categories are displayed that are defined by the connected analyzer or sensor. The user can then enable or disable password protection against individual menu options within these categories.

Configure a 4-20 mA input module

An analog module must be installed in the controller.

1. Determine what output the connected device is using (0-20 mA or 4-20 mA). This information will be used to set the scale.
2. Determine what the 20 mA value is equal to (e.g, 100 psi).
3. Determine what the low end (0 or 4 mA) value is equal to (e.g., 10 psi). This information will be used to set the display range.
4. From the Settings Menu, select Sensor Setup.
5. Select Configure.
6. Update the options.
   a. Highlight an option and push **ENTER**.
   b. Make a selection or update the entries.
   c. Push **ENTER** to save the changes.

Option	Description
Edit name	Edits the module name
Edit units	Edits the measurement units
Edit parameter	Edits the parameter name
Display range **For the 0-20 mA scale:** • **Set the 20 mA value** • **Set the 0 mA value** **For the 4-20 mA scale:** • **Set the 20 mA value** • **Set the 4 mA value**	Sets the values used for the selected scale (0-20 mA or 4-20 mA)

Option	Description
Signal average	Sets how often signals are averaged. Higher values produce a smoother signal but increase the time it takes for a signal to respond to a change in the process value.
Set resolution— **X.XXX, XX.XX, XXX.X, XXXX**	Sets the number of decimal places used in the display.
Select scale— **4-20 mA or 0-20 mA**	Sets scale used for the 4-20 mA input
Data log interval—5 sec, 30 sec, 1 min, 2 min, 5 min, 10 min, 15 min, 30 min, 60 min	Sets how often data is logged to the internal controller memory.
Reset defaults—Push ENTER to reset configuration settings or push the BACK key to cancel.	Resets configuration settings to the default values.

For additional information, refer to the *sc200 4–20 Analog Input Module User Manual*.

Configure a 4-20 mA output module

The Network Setup option appears in the Settings Menu only if an analog output module or other network module such as Modbus or Profibus is installed in the controller.

Outputs for analog output modules are set at 4-20 mA. Outputs can be assigned to represent a measured parameter such as pH, temperature, flow or calculated values.

1. From the Settings menu, select Network Setup.
2. Select Edit Name and enter a name for the module. Push **ENTER** to save the name.
3. Select an output (A, B, C, D) and push **ENTER**.
   a. Highlight an option and push **ENTER**.
   b. Make a selection from the list or update the entries.
   c. Push **ENTER** to save the changes.

Option	Description
Select Source	Selects the output to configure—None, sensor 1 name, sensor 2 name, calculation (if set up). For sensor output, Select Parameter sets the measurement options. When the measurement is autorange, Set Range sets the range.
Set Low Value	Sets the 4 mA value (default: 0.000). (Range and units depend on sensor)
Set High Value	Sets the 20 mA value (default: 1.000). (Range and units depend on sensor)
Set Transfer	Sets the transfer value. Range 3.0 to 25.0 mA (default 4.000).
Set Filter	Sets a time-average filter value of 0 (default) to 120 seconds.

For additional information, refer to the *sc200 4-20 Output Module User Manual*.

Configure the controller analog outputs

The controller analog outputs can be assigned to represent the measured parameter or secondary measurements such as temperature and calculations. To configure the options, highlight a menu option, push **ENTER** and select an option or update the entries. Push **ENTER** after an option is selected or the entries are updated.

1. From the Settings menu, select sc200 Setup.
2. Select Output Setup.
3. Select Output 1 or Output 2.

4. Choose Select Source and select a source from the list. Typically the source is one of the sensors attached to the system. If an analog input card is installed, the analog input may be used as a source.
5. From the Output Setup menu, choose Select Parameter and choose an option from the list. Parameters will vary depending on the type of sensors installed.
6. From the Output Setup menu, select Set Function and choose a function. Further setup options will vary depending on which function is chosen.

Option	Description
Linear	Signal is linearly dependent on the process value
PID	Signal works as a PID (Proportional, Integral, Derivative) controller
Logarithmic	Signal is represented logarithmically within the process variable range
Bilinear	Signal is represented as two linear segments within the process variable range

7. From the Output Setup menu, select Activation. Use the information in the table below the chosen function to configure the options.
8. If Transfer is or will be selected as the Error Hold Mode, or if the Transfer will be used during calibration or other functions within the sensor menu, select Set Transfer from the Output Setup menu and enter the transfer value.
9. From the Output Setup menu, select Set Filter and enter the filter value.
10. From the Output Setup menu, select Scale and choose the scale (0-20 mA or 4-20 mA).

- **Linear**

Option	Description
Set low value	Sets the low endpoint of the process variable range
Set high value	Sets the high endpoint of the process variable range

- **PID**

Option	Description
Set mode (Auto or Manual)	Auto—the signal is automatically controlled by the algorithm within the analyzer using proportional, integral, and derivative inputs. Manual—the signal is controlled by the user through manual adjustment of the % change value. This option is shown as Manual Output after the manual set mode is selected.
Phase (Direct or Reverse)	The direction in which the signal responds to process change. Direct—signal increases as the process increases. Reverse—signal increases as process decreases.
Set setpoint	Creates a desired control point of process
Prop band	A function of the difference between the measured signal and the desired setpoint.
Integral	The period of time from the injection point of a reagent to contact with the measuring device.
Derivative	Used to compensate for the 2nd order effects of the process. The majority of applications can be controlled without the use of the derivative setting.
Transit time	Stops all PID control for a selected period of time as the sample travels from the control pump to the measurement sensor.

- **Logarithmic**

Option	Description
Set 50% value	Sets the value corresponding to 50% of the process variable range.
Set high value	Sets the upper value of the process variable range.

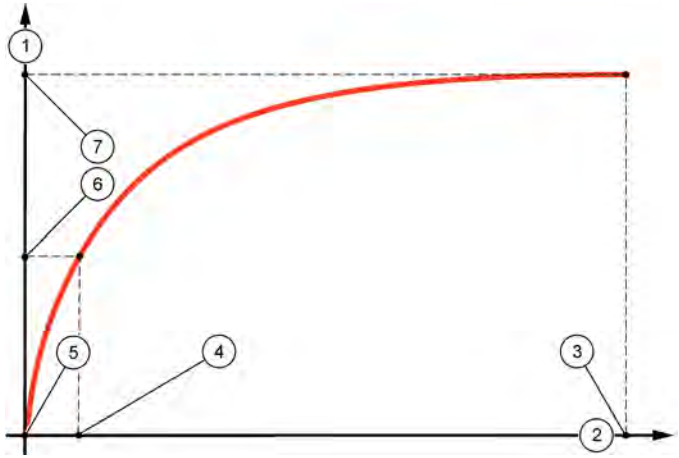
- **Bilinear**

Option	Description
Set low value	Sets the low endpoint value of the process variable range.
Set high value	Sets the high endpoint value of the process variable range.
Set knee point value	Sets the value at which the process variable range divides into another linear segment.
Set knee point current	Sets the value of the current at the knee point value.

Logarithmic output mode

Figure 15 shows in graph form the operation of the logarithmic output mode.

Figure 15 Logarithmic output

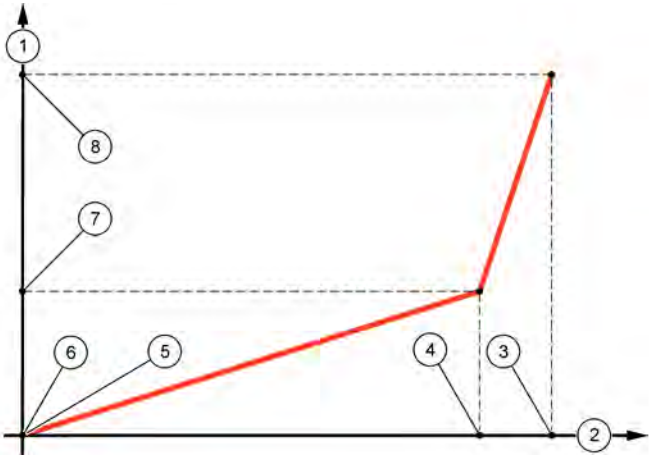


1 Output current axis	**5** Minimum output current (0-4 mA)
2 Source value axis	**6** 50% output current
3 High value	**7** Maximum output current (20 mA)
4 50% value	

Bilinear output mode

Figure 16 shows in graph form the operation of the bilinear output mode.

Figure 16 Bilinear output



1 Output current axis	**5** Low value
2 Source value axis	**6** Minimum output current (0-4 mA)
3 High value	**7** Knee point current
4 Knee point value	**8** Maximum output current (20 mA)

Configure relays

The Normally Open (NO) and Common (COM) relay contacts will be connected when an alarm or other condition is active. The Normally Closed (NC) and Common relay contacts will be connected when an alarm or other condition is inactive (unless the Fail Safe is set to Yes), or when power is removed from the controller. To select a menu option, highlight the option and push **ENTER**.

1. From the sc200 Setup menu, select Relay Setup.
2. Select a relay from the list.
3. From the Relay Setup menu, choose Select Source and push **ENTER**. Normally, a source is one of the sensors attached to the system, but the controller can also function as a source. If an analog input module is installed, the source may be the analog input.
4. From the Relay Setup menu, select Set Parameter and choose from the list of parameters. The list of parameter options will vary with the type of attached sensor.
5. From the Relay Setup menu, select Set Function and choose from the list. Further setup will depend on the function chosen.

Option	Description
Scheduler Function (available if the controller is selected as the relay source)	Relay switches at certain times independently of any process value
Alarm Function	Relay activates when upper or lower alarm value is exceeded
Feeder Control Function	Relay indicates if a process value exceeds or falls below a setpoint
Event Control Function	Relay toggles if a process value reaches an upper or lower limit
Pulse Width Modulation (PWM) Control Function	Relay uses a Pulse Width Modulation control depending on a process value

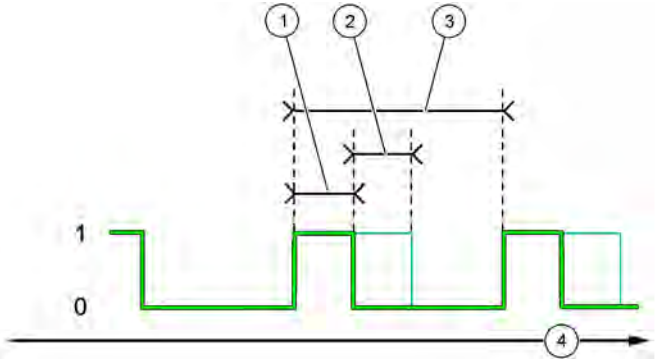
Option	Description
Frequency control	Relay switches with a frequency depending on a process value
Warning	Relay indicates warning and error conditions in probes

6. From the Relay Setup menu, select Set Transfer and choose Active or Inactive.
7. From the Relay Setup menu, select Fail Safe and choose Yes or No.
8. From the Relay Setup menu, select Activation.
   The activation options for the selected function appear. Use the information in the table below each function to update the options.
9. Test the relay function to make sure it is properly energizing the connected device. To do relay testing, go to the Setting menu, then select **Test/Maint>Test Relay**.

- **Scheduler Function (refer to Figure 17)**

Option	Description
Hold outputs	Holds outputs in the present ON or OFF state
Run days	Sets the weekday(s) that the relay operates. Options: Sunday, Monday, Tuesday., Wednesday, Thursday, Friday, Saturday
Start time	Sets the start time.
Interval	Sets the time between activation cycles (Default value: 5 min).
Duration	Sets the period of time the relay is energized (Default value: 30 sec).
Off delay	Sets the time for additional hold/output time after the relay has been turned off.

Figure 17 Scheduler function



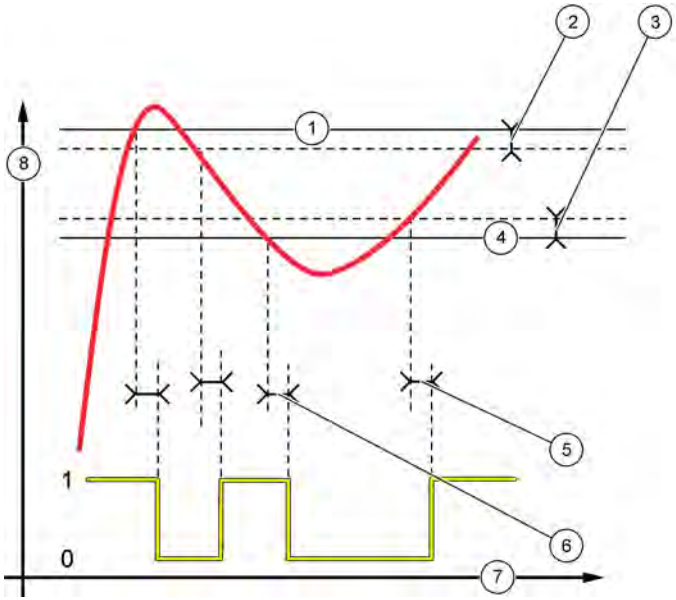
1 Duration	**3** Interval
2 OFF delay	**4** Time (x-axis)

- **Alarm Function (refer to Figure 18)**

Option	Description
Low alarm	Sets the value where the relay will turn on in response to decreasing measured value. For example, if the low alarm is set for 1.0 and the measured value drops to 0.9, the relay activates.
High alarm	Sets the value where the relay will turn on in response to increasing measured value. For example, if the high alarm is set for 1.0 and the measured value increases to 1.1, the relay activates.

Option	Description
Low deadband	Sets the range where the relay remains on after the measured value increases above the low alarm value. For example, if the low alarm is set for 1.0 and the low deadband is set for 0.5, the relay remains on between 1.0 and 1.5. Default is 5% of the range.
High deadband	Sets the range where the relay remains on after the measured value decreases below the high alarm value. For example, if the high alarm is set for 4.0 and the high deadband is set for 0.5, the relay remains on between 3.5 and 4.0. Default is 5% of the range.
Off delay	Sets a time (0-300 seconds) to delay the relay from normally turning off (Default: 0 seconds).
On delay	Sets a delay time for the relay to turn on (Default: 0 seconds).

Figure 18 Alarm function



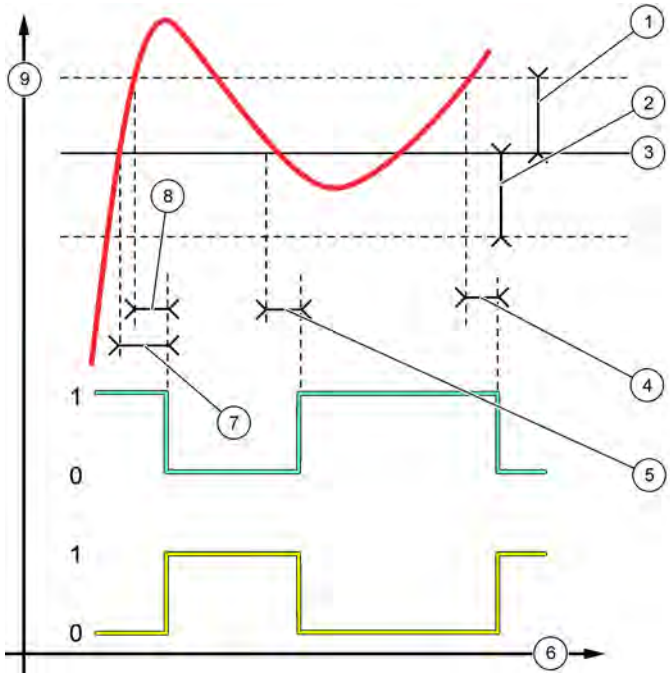
1 High alarm	**5** ON delay
2 High deadband	**6** OFF delay
3 Low deadband	**7** Time (x-axis)
4 Low alarm	**8** Source (y-axis)

- **Feeder Control Function (refer to Figure 19 and Figure 20)**

Option	Description
Phase	Defines the relay status if the process value exceeds the setpoint. High (default)—turns the relay on when the process value exceeds the setpoint. Low—turns the relay on when the process value falls below the setpoint.
Set setpoint	Sets the process value at which the relay toggles. The default value is different for each sensor.
Deadband	Sets the area for an amount of change necessary after the relay setpoint is reached in order to satisfy a condition.

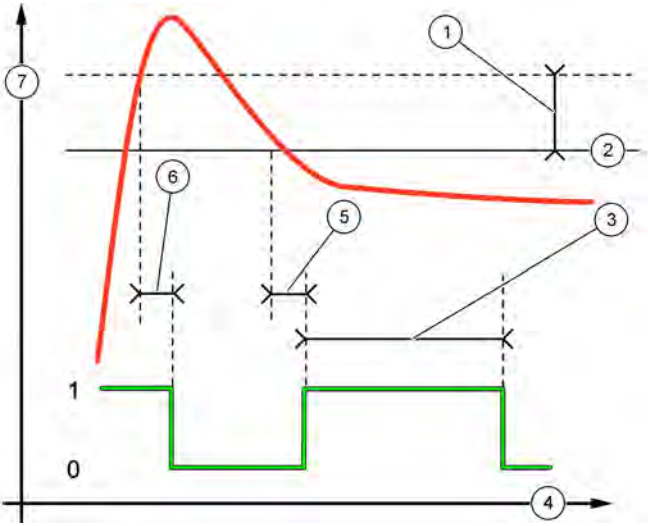
Option	Description
Overfeed timer	Sets a time period for de-activating an active relay if the process setpoint cannot be reached. Once an overfeed alarm is present, it must be manually reset.
Off delay	Sets a delay time for the relay to turn off (default: 0 seconds).
On delay	Sets a delay time for the relay to turn on (default: 0 seconds).

Figure 19 Feeder control function



1 Deadband (Phase = Low)	**6** Time (x-axis)
2 Deadband (Phase = High)	**7** ON delay (phase set high)
3 Setpoint	**8** OFF delay (phase set low)
4 OFF delay (phase set high)	**9** Source (y-axis)
5 ON delay (phase set low)	

Figure 20 Feeder control function (Phase low, Overfeed timer)

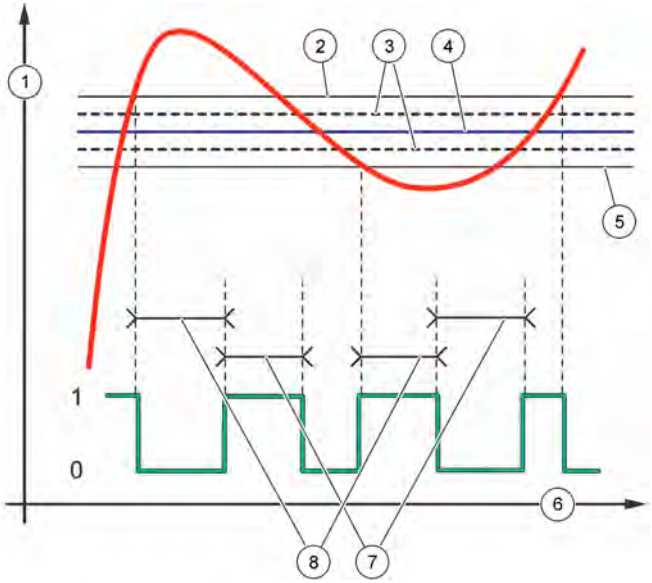


1 Deadband	**5** ON delay
2 Setpoint	**6** OFF delay
3 Overfeed timer	**7** Source (y-axis)
4 Time (x-axis)	

- **Event Control Function (refer to Figure 21, Figure 22 and Figure 23)**

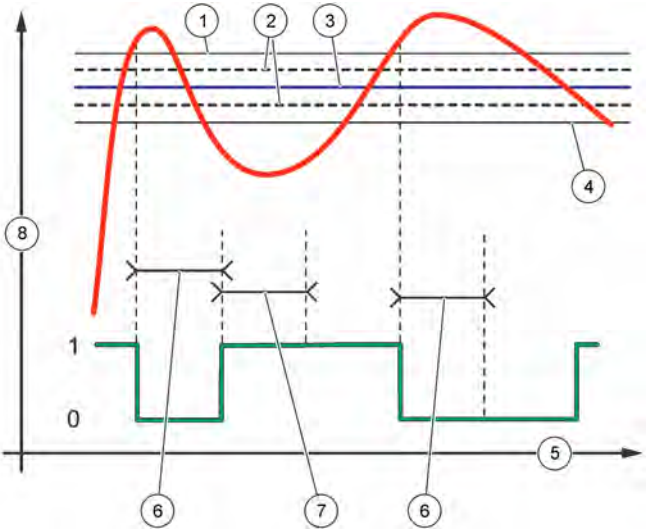
Option	Description
Set setpoint	Sets the value where the relay will turn on.
Deadband	Sets a hysteresis so the relay will not swing unregulated when the process value converges to the setpoint.
OnMax timer	Sets the maximum time the relay can stay on independent from the measured value (default: + 0 min).
OffMax timer	Sets the maximum time the relay can stay off independent from the measured value (default: + 0 min).
OnMin timer	Sets the minimum time the relay can stay on independent from the measured value (default: + 0 min).
OffMin timer	Sets the minimum time the relay can stay off independent from the measured value (default: + 0 min).

Figure 21 Event control function (no delay)



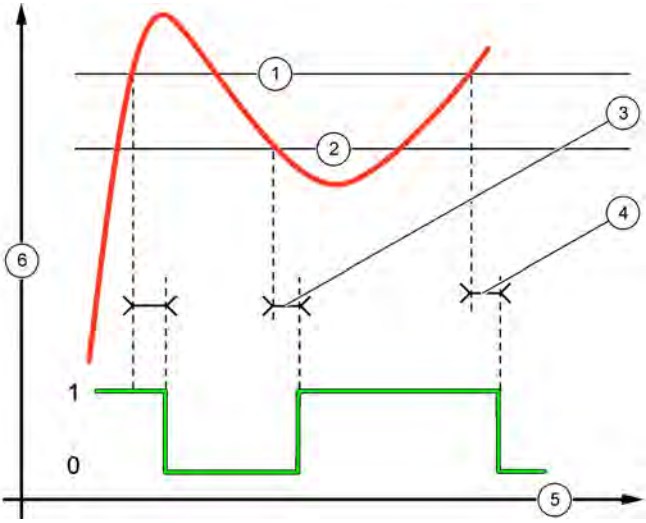
1 Source (y-axis)	**5** Low alarm
2 High alarm	**6** Time (x-axis)
3 Deadband	**7** OnMax-time
4 Setpoint	**8** OffMax-time

Figure 22 Event control function (OnMin timer, OffMin timer)



1 High alarm	**5** Time (x-axis)
2 Deadband	**6** OffMin timer
3 Setpoint	**7** OnMin timer
4 Low alarm	**8** Source (y-axis)

Figure 23 Event control function (ON/OFF delay)

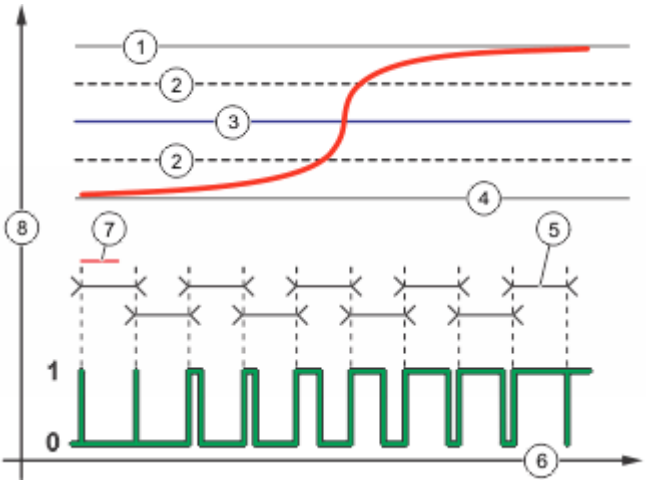


1 High alarm	**4** OFF delay
2 Low alarm	**5** Time (x-axis)
3 ON delay	**6** Source (y-axis)

- **Pulse Width Modulation Control Function (refer to Figure 24)**

Option	Description
Set mode	Auto—the relay output works as a PID controller. Manual—the signal is controlled by the user through manual adjustment of the % change value. This option is shown as Manual Output after the manual set mode is selected.
Phase	Reverses the leading sign of the control deviation for the PID controller (default: Reverse). The phase selects whether the relay will operate at the first part of a cycle (direct phase) or the second part (reverse phase).
Set setpoint	Creates a setpoint value.
Dead zone	The range above and below the setpoint. In this set range, the PID controller does not take action to change the Pulse Width Modulation On/Off Ratio output signal until the limits of the dead zone are reached.
Period	Sets the cycle duration of the PWM output signal (default: 5 seconds).
Min width	Sets the minimum PWM ratio (default: 1.0 second).
Max width	Sets the maximum PWM ratio (default: 4.0 seconds).
Prop band	Sets the proportional part of the PID controller. The proportional part of the controller supplies an output signal which is linearly dependent to the control deviation. The proportional part reacts on any changes at the input but starts to oscillate easily if the value is set high. The proportional part cannot completely compensate for disturbances.
Integral	Sets the integral part of the PID controller (default: 000 minutes). The integration part of the controller supplies an output signal. The output signal increases linearly if the control deviation is constant. The integration part responds slower than the proportional part and can completely compensate disturbances. The higher the integration part, the slower it responds. If the integration part is set too low, it starts to oscillate.

Figure 24 Pulse Width Modulation function (linear mode)

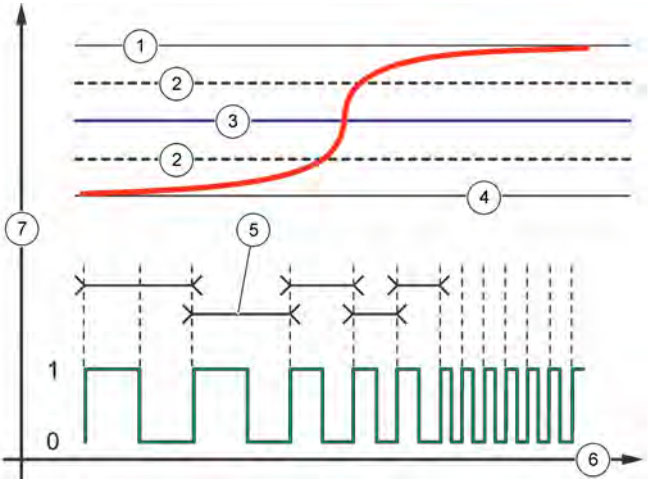


1 High alarm	**5** Period
2 Deadband	**6** Time (x-axis)
3 Setpoint	**7** Phase
4 Low alarm	**8** Selected source (y-axis)

- **Frequency Control Function (refer to Figure 25)**

Option	Description
Set mode	Auto—The relay works as a PID controller. Manual—the signal is controlled by the user through manual adjustment of the % change value. This option is shown as Manual Output after the manual set mode is selected.
Phase	Reverses the leading sign of the control deviation for the PID controller (default: Reverse). The phase selects whether the relay will operate at the first part of a cycle (direct phase) or the second part (reverse phase).
Set setpoint	Sets the process value which is controlled by the PID controller.
Dead zone	In this set range, the PID controller does not take action to change the output frequency until within the limits of the dead zone.
Pulse width	Sets the cycle duration (0-600 seconds) of the PWM output signal. (default: 0.5 seconds) The cycle duration is equal to the duty cycle of the output signal.
Minimum pulses	Sets the minimum number of pulses per minute at which the relay can operate. Range: 0.001–4.000 (default: 1.000)
Maximum pulses	Sets the maximum number of pulses per minute at which the relay can operate. Range: 0.001–60.000 (default: 04.000). This value cannot be set lower than Minimum Pulses value.
Prop band	Sets the proportional part of the PID controller. The proportional part of the controller supplies an output signal which is linearly dependent to the control deviation. The proportional part reacts on any changes at the input but starts to oscillate easily if the value is set high. The proportional part cannot fully compensate for disturbances.
Integral	Sets the derivative part of the PID controller (default: 000 minutes). The integration part of the controller generates an output signal. The output signal increases linearly if the control deviation is constant. The integration part responds slower than the proportional part and can fully compensate disturbances. The higher the integration part, the slower it responds. If the integration part is set too low, it starts to oscillate.

Figure 25 Frequency control function



1 High limit	**5** Cycle duration
2 Deadband	**6** Time (x-axis)
3 Setpoint	**7** Selected source (y-axis)
4 Low limit	

- **Warning Function**

Option	Description
Warning	Sets the level for warning activation. Refer to the sensor manual for the numbers for individual warning messages.

Display setup

Configures the controller display.

1. From the Settings menu, select sc200 Setup and push **ENTER**.
2. Select Display Setup and push **ENTER**.

Option	Description
Adjust Order	View and modify the measurement display order. • **See Current Order**—View the current display order • **Add Measurements**—Add selected measurements to the display • **Remove Measurements**—Remove selected measurements from the display • **Reorder List**—Select one or more measurements and change their order in the display • **See Default Order**—View the default display order • **Set to Default**—Set the display order to the default configuration ***Note:*** *Some of the above will not be available if no adjustment is possible for that option (e.g.* ***Reorder List*** *and* ***Remove Measurements*** *will not be available if only one measurement is selected for display).*
Display Contrast	Adjust the contrast to a value between the minimum of +1 and the maximum of +9
Edit Name	Assigns a name to the controller

Update the date and time

1. From the Settings menu, select sc200 Setup and push **ENTER**.
2. Select Set Date/Time and push **ENTER**.
3. Select Date Format from the Set Date/Time screen and push **ENTER**.
4. Select a format and push **ENTER**.
5. Select Date/Time from the Set Date/Time screen and push **ENTER**.
6. Update the entries.
   a. Use the right and left arrow keys to highlight a field.
   b. Use the up and down arrow keys to change the values in the field and push **ENTER**.
   c. At the end of the date field, push the right arrow to wrap down to the time fields.
   d. Use the up and down and arrow keys to update the time fields.
7. Push **ENTER** to save the changes.
   The controller returns to the Set Date/Time menu.

Set the datalog mode and interval

Datalog Setup is available if a calculation has been set up.

1. From the Settings menu, select sc200 Setup and push **ENTER**.
2. Select Datalog Setup and push **ENTER**.
3. Select Set Mode and push **ENTER**.
4. Select an option (Snap Shot, Average, Maximum, Minimum) and push **ENTER**.
5. From the Datalog Setup menu, select Set Interval and push **ENTER**.
6. Select an interval from the list and push **ENTER**.

Set up a calculation

1. From the Settings menu, select sc200 Setup and push **ENTER**.
2. Select Calculation and push **ENTER**. Select a menu option and choose from the displayed list or update the entry. Refer to the table below for more information about each option.

Option	Description
Set variable X	Selects the sensor for the x variable
Set parameter X	Selects the sensor measurement for the x variable
Set variable Y	Selects the sensor for the y variable
Set parameter Y	Selects the sensor measurement for the y variable
Set formula	Select the math function to implement: • **None**—Disables the math function • **X-Y**—Subtraction function • **X+Y**—Addition function • **X/Y**—Division function • **[X/Y]%**—Percentage function • **[X+Y]/2**—Average function • **[X*Y]**—Multiplication function • **[X-Y]%/X**—Difference function
Display format	Selects the number of digits and decimal points

Option	Description
Set units	Selects the units for the calculated reading
Set parameter	Selects the parameter for the calculated reading

3. Push **ENTER** to save the selection or setting and return to the Calculation menu.

Set up the discrete inputs

Use these inputs to switch closure inputs or logic level voltage inputs.

1. Press the **MENU** key.
2. Select sc200 Setup and push **ENTER**.
3. Select Discrete Input Setup and push **ENTER**.
4. Select the desired channel (Input 1, Input 2 or Input 3) and push **ENTER**.
5. Select a control logic option and push **ENTER**.

Option	Description
Disable	This channel is disabled and not used.
On/High	This channel is active when either the switch input is On (or closed), or the logic level voltage input is at a High level.
Off/Low	This channel is active when either the switch input is Off (or opened), or the logic level voltage input is at a Low level.

6. Select a warning option and push **ENTER**.

Option	Description
Off	An active discrete input does not trigger a device warning.
On	An active discrete input triggers a device warning.

7. Select an output mode option and push **ENTER**.

Option	Description
Active	Output level continues to represent operating conditions.
Hold	Output level is held static.
Transfer	Output level moves to a pre-configured value.

8. Select the sensors that will have their outputs (analog and relay) affected when one of the discrete inputs becomes active. Push **ENTER**.
9. Use the arrows to select the On Delay value (the duration time delay between the discrete input activation and the configured response of the controller). Push **ENTER**.
10. Use the arrows to select the Off Delay value (the duration time delay between the discrete input de-activation and the configured response of the controller). Push **ENTER**.
11. Repeat steps 4–10 for each desired channel.
12. If a discrete input needs to be changed after initially set up:
    a. Repeat steps 1–4 and an Input Settings menu appears with the following options:
       - Control Logic
       - Set Warning
       - Output Mode
       - On Delay
       - Off Delay
    b. Select the desired option and push **ENTER**.

c. Make the desired changes and push **ENTER** to save the changes and return to the Inputs Setting menu.

Update the display language

The display language can be changed through the Setup menu.

1. From the Settings Menu, select sc200 Setup and push **ENTER**.
2. Select Language and push **ENTER**.
   The list of language options appears. English is the default language for the controller.
3. Highlight the language to be used for the controller and push **ENTER**.
   The selected language is saved and is used for the controller display. The display returns to the sc200 Setup menu.

Using the secure digital memory (SD) card

An SD card must be installed in the controller.

- The SD card can be used to update software and firmware and to download event and data logs. If the SD card is installed while the controller is in the Settings Menu, push the **HOME** key and then the **MENU** key to verify the option is visible. The SD icon will also be visible in the upper status bar of the main measurement screen when a card is installed.
- Data log files on the SD card are available in XML and binary formats.
- DataCom is used to convert files from binary to CSV format. Refer to the DataCom manual for more information on how to use the application. For a copy of the DataCom manual, software updates or other downloadable resources, go to http://www.de.hach.com or http://www.hach.com. Search *DataCom* or go to any sc200 product page.

Updating software

Notes:

- The controller does not automatically transfer information to or from an SD card.
- When the SD card is put in multiple controllers, each controller has a separate set of folders in the SD card memory. To make sure software updates are in the correct folder for the controller in use, it is best to use a separate dedicated SD card for each controller.

1. From the Settings Menu, select SD Card Setup and push the **ENTER** key.
2. Select Upgrade Software and push the **ENTER** key.

   Note: *If the Upgrade Software option does not appear, do the steps in* Firmware updates with SD cards on page 44.
3. Select a device from the list and push the **ENTER** key. The list of options includes the controller and all connected devices that have software placed in the appropriate folder on the SD card.
4. If more than one version of the upgrade software is available, select the version with the highest number and push the **ENTER** key.
5. Push the **ENTER** key to begin the software transfer.
   The display will show "Transferring files. Please wait..." The percentage of completion appears in the bottom left corner of the display. The upgrade cannot be halted once it has begun.

   - When the transfer is successful, the display will show "Transfer complete" along with a prompt to push **ENTER** to restart the controller or to push the **BACK** key and exit to the SD Card Setup menu. Controller updates take effect when the controller is restarted. A restart is not necessary for sensor updates.
   - If the transfer is unsuccessful, the display will show "Transfer failed" and an error message. Press the **ENTER** key to acknowledge the warning and exit out of the menu. Error messages are different for each sensor. Refer to the applicable sensor manual.

Saving data and event logs with SD cards

Notes:

- Data and event logs can be downloaded to an SD card and viewed with any device capable of reading an SD card.
- Data logs store the measurement data at selected intervals in a packed binary format (.flg file).
- Event logs store a variety of events that occur on the devices such as configuration changes, alarms and warning conditions. Event logs are set up during the sensor or module configuration process. Event logs are stored in a CSV format.

1. From the Settings Menu, select SD Card Setup and push the **ENTER** key.
2. Select Save Logs and push the **ENTER** key.
3. If more than one device appears on the screen, all devices are selected by default. To deselect an item, highlight the selection and push the left arrow key. Select the devices from which logs will be saved and push the **ENTER** key.
4. Select the time period from which logs are to be saved.

Option	Description
Last Day	All logs from the last full 24 hours, starting from 12:00 a.m., and any additional time remaining on the current day
Last Week	All logs from the last full week (7 days) starting from 12:00 a.m., and any additional time remaining on the current day
Last Month	All logs from the last full month (30 days) starting from 12:00 a.m., and any additional time remaining on the current day
All	Save all logs in memory
New	All logs that are new since the last time logs were saved to the SD card

5. Push the **ENTER** key to confirm the choice, and push the **ENTER** key again to begin the file transfers.
6. Allow time for the files to transfer. The display will show Transferring files. Please wait... and the percentage of files transferred.
   If the transfer is successful, the display will show "Transfer complete." If the transfer is not successful, the display will show "Transfer failed."
7. Do one of the following:
   a. Push the **ENTER** key to exit back to the SD Card Setup menu.
   b. Push the **HOME** key to return to the measurement screen.
   c. Push the **BACK** keys to return to the Settings Menu.

Access data and event log files on the SD card

A PC with an SD Card reader device or USB adapter is necessary to view the event and data logs kept on the SD Card. Excel 2003 or higher (for XML files) or the Data Com application (for binary flg files) is necessary to open the event and data logs.
Data logs have the following structure: Device Name, Device Serial Number, Device Identification, Data Log, Time Stamp.

Event logs have the following structure: Device Name, Device Serial Number, Device Identification, Event Log, Time Stamp.

To view data or event log files stored on the SD card:

1. Attach the card reader device to the PC (if necessary) and install the SD card that contains the files in the reader device.
2. In the SD card directory, open the HACH folder.
3. Select the Logs folder.
4. Select a device folder.

The event and data log files in the folder are shown.

5. To view XML data log files:
   a. Make sure the HachDatalog.xsl style sheet exists in the device folder.
   b. Open the Excel application.
   c. Go to File, Open.
   d. Select the data log file.
   e. In the Import XML dialog box, select **Open the file with the following style sheet applied** and select **HachDatalog.xml**.
   f. Click OK to view the data.
6. To view binary data log (.flg) files:
   a. Make sure the device driver (.flg.drv) file exists in the device folder.
   b. Open Data Com.
   c. In the File Viewer section, click Open.
   d. Select the data log file.
   The data log file is shown in the box and a comma separated values (csv) file with the same file name is created. This csv file can be opened in Excel.

Firmware updates with SD cards

The latest firmware updates can be placed on an SD card. The SD card can then be used to update the controller or device firmware.

A PC and a USB card reader or other device capable of reading an SD card are necessary.

1. Find the zip file at http://www.hach-lange.com or http://www.hach.com and copy it to the PC.
2. Extract file(s) from the zip folder and save them to the SD card.
3. Remove the SD card and update the controller and device firmware. Refer to Updating software on page 42.

Backup settings to an SD card

Saves the configuration of a device to the SD card.

1. Push the **MENU** key.
2. Select SD Card Setup and push **ENTER**.
3. Select Manage Configuration and push **ENTER**.
4. Select Backup Settings and push **ENTER**.
5. Select the devices to be backed up. All devices are selected by default. To deselect an item, highlight the selection and push the left arrow key. Push **ENTER** to begin the file transfers. If backup files already exist on the SD card, a confirmation window appears. Select the devices again and push **ENTER**. Wait for the "Transfer complete" message.
6. Push **ENTER** again to return to the Manage Configuration menu.

Restore settings to the controller

This menu selection only appears if a (serial number-specific) backup file for the controller or one of the sensors connected to it exists on the SD Card. This menu selection loads the configuration of a specific device from the SD card to the same device (serial number-controlled function).

1. Push the **MENU** key.
2. Select SD Card Setup and push **ENTER**.
3. Select Manage Configuration and push **ENTER**.
4. Select Restore Settings and push **ENTER**.
5. Select the device that will be restored. All devices are selected by default. To deselect an item, highlight the selection and push the left arrow key. Push **ENTER** to begin the file transfers.

6. When the transfer is complete, push **ENTER**.
7. To have the settings take effect immediately, restart the controller. Push the **BACK** key to exit the Manage Configuration menu.

Transfer settings to another device

All device settings including calibration, sensor name, selected temperature and measurement units and data logging settings are transferred.

1. Push the **MENU** key.
2. Select SD Card Setup and push **ENTER**.
3. Select Manage Configuration and push **ENTER**.
4. Select Transfer Settings and push **ENTER**. Two options appear:
   - Retrieve Settings
   - Copy Settings
5. To retrieve settings from the controller (or a device connected to it) and put the settings on the SD card:
   a. Select Retrieve Settings and push **ENTER**.
   b. Select the devices that contain the information to be transferred. All devices are selected by default. To deselect an item, highlight the selection and push the left arrow key. Push **ENTER** to begin the file transfers. Wait for the "Transfer complete" message.
   c. If files already exist on the SD card, a confirmation window appears. Select the devices again and push **ENTER**. Wait for the "Transfer complete" message.
   d. Push **ENTER** to return to the Manage Configuration menu.
6. To copy settings from the SD card to a controller (or a device connected to it):
   a. Select Transfer Settings and push **ENTER**.
   b. Select Copy Settings and push **ENTER**.
   c. Select the devices on the SD card. All devices are selected by default. To deselect an item, highlight the selection and push the left arrow key. Push **ENTER** to begin the file transfers.
7. When the transfer is complete, push **ENTER** to restart the connected devices.
8. Push **ENTER** to restart the controller or push **BACK** to return to the Manage Configuration menu.

Using the service port

The service port is used to download data files from the controller and install new versions of controller and sensor firmware. To download data and update software, use the service port in combination with DataCom and a service cable (LZX887).

Using DataCom

When using the service port, it is necessary to use DataCom. DataCom is a PC Application Utility that downloads data log and event log files from the controller and installed sensors. Files are downloaded from the controller through the controller service port or they can be placed on a Secure Digital Memory (SD) card installed in the controller. In addition, DataCom is used to upload software for the controller and sensors. The DataCom application must be installed on a PC to read the files.

Refer to the DataCom manual for more information on how to use the application. The DataCom manual, software updates and other downloadable resources are available at http://www.de.hach.com or http://www.hach.com on any sc200 product page.

Maintenance

⚠ DANGER

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

Cleaning the controller

⚠ DANGER

Always remove power from the controller before performing maintenance activities.

Note: *Never use flammable or corrosive solvents to clean any part of the controller. Use of these solvents may degrade the environmental protection of the unit and may void the warranty.*

1. Make sure the controller cover is securely closed.
2. Wipe the controller exterior with a cloth dampened with water, or with a mixture of water and mild detergent.

Fuse replacement

Fuses are not user-serviceable items. The need for fuse replacement in controllers indicates severe technical failure and is therefore considered to be a service activity. If a blown fuse is suspected, contact Technical Support.

Battery replacement

The lithium ion backup battery is not user replaceable. Contact technical support for replacement.

Troubleshooting

Problem	Resolution
No current output	Verify current output configuration.
	Test current output signal using the Test/Maintenance submenu. Input a current value and verify the output signal at the controller connections.
	Contact Technical Support.
Incorrect current output	Verify current output configuration.
	Test current output signal using the Test/Maintenance submenu. Input a current value and verify the output signal at the controller connections. If the output is incorrect, perform an output calibration.

Problem	Resolution
No relay activation	Make sure relay connections are secure.
	If using an external power source, make sure the relay wiring is correct.
	Make sure the relay configuration is correct.
	Test the relay activation through the Test/Maintenance menu. The relay should energize and de-energize as selected.
	Make sure the controller is not in calibration mode and that the relay is not being held.
	Reset the Overfeed Timer to make sure the timer has not expired.
Secure Digital Memory (SD) card not recognized by the controller	Make sure the SD card is properly oriented. The copper traces should face toward the controller display.
	Make sure the SD card is fully seated in the slot and the spring lock is engaged.
	Make sure the SD card is properly formatted with a Fat 32 format. The MMC format is not supported. Follow the instructions of the card manufacturer to format the SD card on a PC.
	Make sure the card is not larger than 32 GB.
	Make sure an SD card is being used. Other types of cards (such as xSD, micro SD, mini SD) will not work properly.
Information not saving, or not saving properly to the SD card.	Make sure the SD card is properly formatted with the FAT 32 format. The MMC format is not supported. Follow the instructions of the card manufacturer to format the SD card on a PC.
	If the SD card has previously been in use, format the card with the Fat 32 format, install the card in the controller, and try downloading files.
	Try a different SD card.
SD card full	Read the SD card with a PC or other card reader device. Save important files and then delete some or all of the files on the SD card.
Controller cannot find software updates on the SD card.	Make sure an appropriate folder is created by installing the SD card in the controller. An update folder will automatically be created.
	Install the SD card on a PC and make sure the software files are located in the appropriate update folder.
	If the same SD card is used with multiple controllers, each controller will have a separate folder on the system. Make sure the software updates are in the folder dedicated to the controller in use.
Display is lit but shows no characters or characters are faint or blurry.	Adjust the display contrast
	Make sure protective film has been removed from display.
	Clean the outside of the controller, including the display screen.

Problem	Resolution
Controller will not power up, or powers up intermittently	Make sure the AC power connections are properly terminated in the controller.
	Make sure the power strip, line power, wall plug are all properly plugged in.
	Contact Technical Support
Network or sensor module not recognized	Make sure the module is properly installed.
	Make sure the module selector switch is set to the proper number.
	Remove sensor module and install the module into the second analog slot. Apply power to the controller and allow the controller to perform a device scan.
	Contact Technical Support.
Sensor not recognized ***Note:*** *Example of possible display message: *****	If the sensor is an analog sensor and a corresponding module is installed in the controller, refer to the instructions supplied with the Network or Sensor Module.
	Make sure the digital connector wiring harness is seated on the inside of the door assembly and that the wiring harness is not damaged.
	If the digital sensor is connected to the controller with a digital termination box, user supplied junction box, digital extension cables, or a user-supplied extension cable, connect the sensor directly to the controller and perform a device scan. If the controller recognizes the sensor, check that all the wiring in the junction boxes or extension cables is correct.
	Make sure that only two sensors are installed in the controller. Although two analog module ports are available, if a digital sensor and two analog modules are installed, only two of the three devices will be seen by the controller.
	Contact Technical Support
Device Missing error message appears	Perform a Device Scan from the Test/Maintenance menu.
	Power cycle the controller

Test and Maintenance menu

1. From the Settings Menu, select Test/Maint and push **ENTER**.

Option	Description
Scan devices	Performs a scan for active and missing devices.
Output cal • **Output 1** • **Output 2**	Lets the user calibrate the 4–20 mA outputs with a 250 ohm resistor in series to the mA output terminals. The settings for each output are adjusted until the correct value (4 mA or 20 mA) is supplied. Calibrate 4 mA output (Min: 0 Max: 25000) Calibrate 20 mA output (Min: 35000 Max: 65533)
Hold outputs	Sets the value the controller sends to an external system for a defined period of time. After the time period, the instrument goes back to reporting real time values. Set activation—Launch or release Set Outmode—Hold Outputs (default) or Transfer Outputs Set Channels—All (default) or select from hardware list

Option	Description
Test output • **Output 1** • **Output 2**	Lets the user select a mA value that is sent by the controller for verification. Min: 0 mA (default +04.00) Max: 25.00 mA
Status	View status of all modules, sensors and relays.
Test relay—A, B, C, D	Energize or De-energize the selected relay
Overfeed reset	Resets the Overfeed Timer.
Reset default config	Resets the controller configuration settings to the default values (language, date and time, relay function and data output function).
Restart sc200	Performs a controller restart
Simulation (only displays if sensors or modules are connected)	After the sim value is entered, the controller outputs this value as if it was the value sent from the sensor. The simulation stops after the user exits the screen. Source- • <Module 1> • <Module 2> (Footer displays current source selection) Parameter—Source measurement type (footer displays current source selection) Sim value—Use arrow keys to change value (footer displays current source selection)
Modbus stats	Displays Error and Good count stats for selected port. • Sensor port 1, 2, 3 or 4 • Network port • Service port • Clear stats
System data	Displays the current system current, temperature and voltage data.

Warning and error conditions

Follow the steps below to acknowledge controller warnings.

1. From the Settings menu, select Diagnostics and push **ENTER**.
2. Select the device (controller, sensor, network card) with the warning or error and push **ENTER**.
3. Select the warning, error or event list and push **ENTER**.
4. Select Yes and push **ENTER** to acknowledge the warning.
   Note: *Errors cannot be acknowledged.*
5. For more information on a specific warning, error or event, refer to the device manual.

Device scan information

Display message	Action
Installing device...please wait	The controller has found a new device. No action is necessary. The controller automatically performs an installation process for the new device and displays the main measurement screen of the device installed in the number one position.
Device missing <device id>	A previously installed device has been removed from the controller or is not detected. • Push the **Enter** key to continue. • Push the left arrow key to select or de-select a missing device. • Push the **Enter** key to delete the missing device. The controller will display the main measurement screen for the device in the number one position. ***Note:*** *This message also displays when a device is missing and a new device has been installed. After the missing device is deleted, the controller automatically installs the new device and displays Installing device...please wait. The controller then displays the main measurement screen for the device installed in the number one position.*

Replacement parts and accessories

Note: *Product and Article numbers may vary for some selling regions. Contact the appropriate distributor or refer to the company website for contact information.*

Description	Item number
4 GB Secure Digital Memory (SD) card	9218100
Connector kit for digital sensor	9201000
Controller installation kit	8806200
DataCom cable	LZX887
Mounting bracket inserts	9177900
Plug, conduit opening (set of 3)	5868700
Power cord kit, with strain relief, 125 VAC, U.S.-style plug	9202900
Power cord kit, with strain relief, 230 VAC, European-style plug	9203000
Screw driver	6134300
SD card reader	9218200
SD card cover kit for sc200 controller	9200900
Screws for controller installation kit	9177800
Cord grip kit (1)	9178000
Sealing washer for cord grip assembly	1033814
UV protection screen	8809200
Weather and sun shield w/ UV protection screen	9220600
Sensor and communication modules	
Conductivity module	9013000

Description	Item number
Flow module	9012700
4-20 mA input module	9012800
pH and DO module	9012900
4-20 mA output module	9334600
HART network module kit	9328100
Modbus network module	9013200
Profibus network module	9173900
Profibus M12 connector kit	9178500
Profibus M12 socket (hard wire to quick connector adapter)	9178200
Profibus M12 T-splitter	9178400

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7.2 Wallace & Tiernan Depolox 3 Plus Chlorine & pH Analyzer (WTP, BS#1, BS#2)

Wallace & Tiernan/Siemens Chlorine Analyzer w/ pH & Temperature Probes

Depolox 3 Plus D5CPT

DEPOLOX® 3 PLUS RESIDUAL ANALYZER

WALLACE & TIERNAN® ANALYZERS/CONTROLLERS

The DEPOLOX® 3 plus residual analyzer continuously measures free or total (combined) chlorine, chlorine dioxide or ozone in drinking water applications. Utilizing proven and universally accepted amperometric measurement technology, this analyzer directly measures these disinfectant residuals and provides a 4-20 mA output signal for control or recording purposes. Integral alarm relays are provided. The analyzer is also available in an arrangement for measuring temperature and pH or fluoride.

FEATURES

Three electrode measuring cell

For disinfectant measurement, a three electrode technology measuring cell is used. This cell eliminates the need for the constant zero adjustment typical of other analyzers. Reliability and stability are vastly improved while maintenance is dramatically reduced. This technology is used in both the bare-electrode and membrane-type cells.

Reagentless chlorine measurement

The internally buffered membrane-type sensor measures free or total chlorine without the need for reagents. This includes samples with varying pH. With no chemical addition, the sample can be added back to the supply or simply drained without concern for discharge restrictions.

Flexible arrangements

There are two electronic control configurations: a single input version for disinfectant only measurement and a dual-input version for disinfectant and pH or fluoride measurement. In addition, a sample temperature output signal is available from both the single and dual input arrangements, dependent on the choice of flow cell. There are a total of five flow cell configurations: two that incorporate the integral bare-electrode measuring cell (DEPOLOX 3 plus and DEPOLOX 5 flow cell); two that accommodate the membrane-type measuring

Key Benefits

- Chlorine measurement without reagents
- Flexible arrangements - four flow cell and two electronic control units are available
- Advanced electronics housed in a NEMA 4X enclosure
- Reliable and stable measurement of residuals
- User-friendly menu driven access to set-up, calibration and diagnostics

Wallace & Tiernan/Siemens Chlorine Analyzer w/ pH & Temperature Probes

Depolox 3 Plus D5CPT

cell (DEPOLOX 3 plus membrane-type and VariaSens™ flow cell); and a simple Y-type flow-thru probe holder for fluoride only measurement.

Advanced electronics

Housed in a NEMA 4X enclosure, the analyzer controls provide up to three isolated 4-20 mA output signals for disinfectant residual, temperature, and pH or fluoride. Configurable alarm relays and an RS 485 digital interface are also available. A backlit LCD display and a six-button keypad provide for a wide range of information, setup, calibration and diagnostic menus.

Choice of flow cell technology

To ensure a stable, representative measurement signal, a constant flow rate is required. This is provided by a choice of flow cells, dependant on the type of measurement technology that is used:

Bare-electrode type cell for free chlorine

This measurement technology features an integral, bare-electrode flow cell for free chlorine. Utilizing the three electrode cell design described above, this unique combination of analyzer/sensor provides a very quick response time (90% change < 20 sec.) with high accuracy (±2% F.S.) to meet fluctuating disinfection demands or applications where there is a high degree of hardness, which prohibits the use of a membrane-type sensor. The well-proven principle of hydromechanical grit cleaning of the electrode surfaces maintains the sensitivity of the bare-electrode sensors extending the interval time between calibrations. A sample with a constant pH is required. Alternatively, the addition of a pH sensor, utilizing the dual input electronic package, provides for a pH-compensated free Cl_2 measurement without the need to buffer the sample.

DEPOLOX® 3 plus flow cell

This economical flow block assembly consists of a transparent Plexiglas body with an integral flow regulator to supply a consistent sample flow to the measuring electrodes. An integral PT 100 sensor provides for temperature compensation of the chlorine residual reading as well as a temperature measurement output signal. An additional sensor probe for pH or Fluoride can be added through the flow cell cover.

DEPOLOX® 5 flow cell

This deluxe flow block assembly includes all of the features of the above DEPOLOX® 3 plus cell, except that an integral multi-sensor provides a PT 1000 temperature measurement and output and monitors sample flow to provide a loss-of-flow alarm contact.

Membrane-type cell

There are four disinfectant specific, membrane-type sensors available for measuring either free chlorine, total chlorine, chlorine dioxide, or ozone. Utilizing the three electrode measurement technology, these sensors incorporate a membrane for diffusion of the oxidant into the working electrode. An internal, buffered electrolyte reduces the effect of pH on chlorine measurement. Therefore, external pH buffering or pH compensation is not required for samples with a varying pH. Temperature compensation of the chlorine residual reading is built into the sensor.

DEPOLOX 3 plus membrane - type flow cell

This simple flow block housing is designed to provide a constant flow of water past the membrane surface of the removable sensor. Sensors can easily be changed to monitor different disinfectants. A water jet, designed into the flow block, removes any bubbles from the membrane surface, which can affect accuracy and stability. An additional sensor probe for pH or Fluoride can be added through the flow cell cover. Note that a measured temperature output is not available with this flow cell.

VariaSens™ Flow Cell

In addition to the above, this flow block assembly utilizes an integral flow regulator to maintain the sample flow at a constant 33 l/h. An integral multi-sensor provides a PT 1000 temperature measurement and output and monitors sample flow to provide a loss-of-flow alarm contact.

Fluoride-Only Measurement

If fluoride is the only parameter to be measured, then a simple, flowthrough probe assembly can be provided. This consists of a Y-type flow-thru probe holder and a sample valve. Note that temperature measurement and output is not available with this configuration.

BARE-EL. MEASURING CELL

DEPOLOX® 5 CELL

MEMBRANE MEASURING CELL

VARIASENS™ FLOW CELL

TECHNICAL DATA – DISINFECTANT MEASUREMENT

Measurand	Free C l_2 (membrane)	Total Cl_2	ClO_2	O_3	Free Cl_2 (bare electrode)
Range	0-0.20 to 0-20 mg/l	0-0.20 to 0-20 mg/l	0-0.20 to 0-20 mg/l	0-0.20 to 0-10 mg/l	0-0.20 to 0-20 mg/l
Accuracy	0.05 mg/l or ± 6% F.S. Whichever is greater	0.05 mg/l or ± 6% F.S. Whichever is greater	0.05 mg/l or ± 6% F.S. Whichever is greater	0.05 mg/l or ± 6% F.S. Whichever is greater	0.01 mg/l or ± 2% F.S. Whichever is greater
Sensitivity	0.01 mg/l or ± 1% F.S. Whichever is greater	0.01 mg/l or ± 1% F.S. Whichever is greater	0.01 mg/l or ± 1% F.S. Whichever is greater	0.01 mg/l or ± 1% F.S. Whichever is greater	0.01 mg/l or ± 1% F.S. Whichever is greater
Repeatability	0.02 mg/l or ± 3% F.S. Whichever is greater	0.02 mg/l or ± 3% F.S. Whichever is greater	0.02 mg/l or ± 3% F.S. Whichever is greater	0.02 mg/l or ± 3% F.S. Whichever is greater	0.01 mg/l or ± 2% F.S. Whichever is greater
Stability	± 5% F.S. under typ. Conditions for 1 month	± 5% F.S. under typ. Conditions for 1 month	± 5% F.S. under typ. Conditions for 1 month	± 5% F.S. under typ. Conditions for 1 month	2% F.S. under typ. Conditions for 1 month
Response Time	90% change < 5 minutes	90% change < 5 minutes	90% change < 20 seconds	90% change < 50 seconds	90% change < 20 seconds
Sample Temperature	41° to 113° F (+ 5° to 45° C)	41° to 113° F (+ 5° to 45° C)	41° to 113° F (+ 5° to 45° C)	41° to 113° F (+ 5° to 45° C)	41° to 122° F (+ 5° to 50° C)
Sample Flow (Potable Water Only)	6 l/h to 35 l/h constant	6 l/h to 35 l/h constant	6 l/h to 35 l/h constant	6 l/h to 35 l/h constant	33 l/h ± 5 liter, constant
Inlet Pressure	2 to 60 psi	2 to 60 psi	2 to 60 psi	2 to 60 psi	2 to 60 psi
Outlet Pressure	0 psi	0 psi	0 psi	0 psi	0 psi
Conductivity	> 10 mS/cm up to 2500 mS/cm	> 10 mS/cm up to 2500 mS/cm	> 1 mS/cm up to 40 mS/cm	> 1 mS/cm up to 40 mS/cm	> 250 mS/cm up to 100 mS/cm

pH dependence

Bare-Electrode sensor – pH 4 to pH 9 – must be stable; pH compensation available with dual input unit membrane-type sensor (free and total chlorine) – usable range pH 6 to pH 10; maximum interference 5% per pH unit membrane-type sensor (ClO_2 and O_3) - none

pH Measurement

Measurement Range: pH 4 to 10 (standard);
pH 0 to 14 (optional)

Sample Temperature Range:

-23ºF to 176ºF (-5ºC to 80ºC)

Sensitivity: 0.01 pH

Conductivity: >300µS/cm

Fluoride Measurement

Measurement Range: 0.2 to 2.0 mg/l
Sample Temperature Range:
32ºF to 176ºF (0ºC to 80ºC)
Sensitivity: 0.01 mg/l fluoride
Conductivity: >300µS/cm

Electronics

Power Requirements: 115 V
±10%, 50/60 Hz, 14VA or 230 V
±10%, 50/60 Hz, 14VA
Ambient Temperature: 32ºF to 122ºF (0ºC to 50ºC)
Enclosure Rating: NEMA 4X
Readout: 16-character, two-line, backlit LCD display

Electronics

Output Signal: 4-20 mA max. 1000 ohm load, electrically isolated for up to 50 V to ground
1 for Disinfection Sensor
1 for Temperature (where available from flow cell)
1 for pH or Fluoride (dual input arrangement only)

External Alarms: Two electromechanical relays, user configurable (high, low, high/low, gen. fault, or off), for disinfectant. Selectable for N.O. or N.C. and latching or non-latching operation; (Optional)
Two electromechanical relays, user configurable for pH or fluoride.

Relay Contact Ratings: 5A 1/6 HP 125, 250 VAC or 5A 30 VDC 30 Watt max.

Digital Input: One dry contact input for sample water or circulating pump monitoring.

Digital Communication: RS485 interface for connection to programmable controller or central instrumentation and control systems via RS485 W&T protocol.

Access Code: A three-digit security code can be entered via the keypad to prevent unauthorized access to the operating parameters.

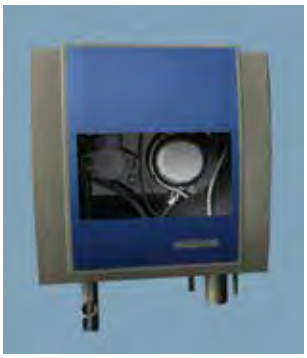
Wallace & Tiernan/Siemens Chlorine Analyzer w/ pH & Temperature Probes

Depolox 3 Plus D5CPT

FLOW SWITCH

STOP VALVE

MICRO/2000® RESIDUAL ANALYZER



DEOX/2000® DECHLORINATION ANALYZER

Options

Sensor Cable Length: DEPOLOX® 3 plus bare-electrode and DEPOLOX® 5 flow cells: 3.3 ft (1 m) standard.

DEPOLOX® 3 plus membrane and VariaSens™ flow cells: Disinfectant membrane-type sensors - 6'6" ft (2 m) standard; 16'3" (5 m), 32'8" (10 m), 49'2" (15m), 82'0" (25 m) and 164'0" (50 m) optional; pH and Fluoride sensors – 4'10' (1.5 m) standard; 16'3" (5 m), 32'8" (10 m) and 49'2" (15 m) optional.

Flow Switch: Mounts on the inlet to the DEPOLOX® 3 plus bare-electrode and membrane flow cells. Provides alarm to electronic controls when there is a loss of sample to the flow cell. Not required with DEPOLOX® 5 and VariaSens flow cells.

Stop Valve: Mounts on the inlet to the wetside or on the flow switch. Provides easy shut-off of the sample flow for maintenance and service.

Chart Recorders: Available as circular chart type. Supplied with 400 24-hour or 100 7-day circular charts, one year's supply of fiber-tip pens. Available chart ranges: 0-0.2; 0-0.5; 0-1.00; 0-2.00; 0.5.00; 0-10.0; and 0-20.0.

Shipping Weight: Membrane wetside - 5 lbs.

Bare electrode wetside - 9 lbs.

Electronic enclosure (single or dual input) - 8 lbs.

Other residual analyzers available from Evoqua Water Technologies

Micro/2000® residual analyzer: A high-accuracy, extremely reliable monitoring and control instrument for potable water, wastewater, and cooling water treatment. Suitable for measuring free and total chlorine, chlorine dioxide, and potassium permanganate residuals.

Deox/2000® dechlorination analyzer: A precise instrument for accurately measuring both SO_2 and total chlorine residuals in wastewater effluent.

Wallace & Tiernan/Siemens Chlorine Analyzer w/ pH & Temperature Probes

Depolox 3 Plus D5CPT

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Depolox® 3 *plus* RESIDUAL ANALYZER

FOR MEASURING CHLORINE, CHLORINE DIOXIDE, OZONE, AND/OR pH OR FLUORIDE

BOOK NO. WT.050.560.001.UA.IM.0714

W3T140188 - U.S.
W3T172611/Issue 06 - Germany

Depolox® 3 *plus*
RESIDUAL ANALYZER
FOR MEASURING CHLORINE, CHLORINE DIOXIDE, OZONE, AND/OR pH OR FLUORIDE

BOOK NO. WT.050.560.001.UA.IM.0714

W3T140188 - U.S.

W3T172611/Issue 06 - Germany

EQUIPMENT SERIAL NO. _____

DATE OF START-UP _____

START-UP BY _____

Prompt service available from nationwide authorized service contractors.

ORDERING INFORMATION

In order for us to fill your order immediately and correctly, please order material by description and part number, as shown in this book. Also, please specify the serial number of the equipment on which the parts will be installed.

WARRANTY

Seller warrants for a period of one year after shipment that the equipment or material of its manufacture is free from defects in workmanship and materials. Corrosion or other decomposition by chemical action is specifically excluded as a defect covered hereunder, except this exclusion shall not apply to chlorination equipment. Seller does not warrant (a) damage caused by use of the items for purposes other than those for which they were designed, (b) damage caused by unauthorized attachments or modifications, (c) products subject to any abuse, misuse, negligence or accident, (d) products where parts not made, supplied, or approved by Seller are used and in the sole judgment of the Seller such use affects the products' performance, stability or reliability, and (e) products that have been altered or repaired in a manner in which, in the sole judgment of Seller, affects the products' performance, stability or reliability. **SELLER MAKES NO OTHER WARRANTY OF ANY KIND, AND THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS OF THE MATERIAL OR EQUIPMENT FOR ANY PARTICULAR PURPOSE EVEN IF THAT PURPOSE IS KNOWN TO SELLER.** If Buyer discovers a defect in material or workmanship, it must promptly notify Seller in writing; Seller reserves the right to require the return of such defective parts to Seller, transportation charges prepaid, to verify such defect before this warranty is applicable. In no event shall such notification be received by Seller later than 13 months after the date of shipment. No action for breach of warranty shall be brought more than 15 months after the date of shipment of the equipment or material.

LIMITATION OF BUYER'S REMEDIES. The **EXCLUSIVE REMEDY** for any breach of warranty is the replacement f.o.b. shipping point of the defective part or parts of the material or equipment. Any equipment or material repaired or replaced under warranty shall carry the balance of the original warranty period, or a minimum of three months. Seller shall not be liable for any liquidated, special, incidental or consequential damages, including without limitation, loss of profits, loss of savings or revenue, loss of use of the material or equipment or any associated material or equipment, the cost of substitute material or equipment, claims of third parties, damage to property, or goodwill, whether based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory; provided, however, that such limitation shall not apply to claims for personal injury.

Statements and instructions set forth herein are based upon the best information and practices known to Evoqua Water Technologies, but it should not be assumed that every acceptable safety procedure is contained herein. Of necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

725 Wooten Road
Colorado Springs, Co 80915

INTRODUCTION

The Depolox® 3 *plus* Residual Analyzer is a low cost economical analyzer for potable water that continuously measures either free or total chlorine, chlorine dioxide or ozone residuals using proven amperometric measurement technology. There is also an arrangement available for measuring pH or flouride. All arrangements include a temperature measuring and monitoring device.

The Depolox® 3 *plus* analyzer consists of two separate components: a "wet side" package containing the sensor/cell and an electronic control package.

The electronic package is available for either 115 or 230 volt operation. A single input arrangement is used when only a disinfectant measurement (free or total chlorine, chlorine dioxide, ozone) is required. A dual input arrangement is available when either pH or fluoride measurement is required in addition to a disinfectant measurement. Note that for pH- or fluoride-only measurement, the dual input electronic package is required and the dual input cannot be used for two disinfectant measurements. All arrangements have temperature measurement. The electronic package provides for operator input via plain-text-assisted, self-explanatory menus and a sealed keypad. The large, two-line (16 characters each) display of disinfectant residual alternates every five seconds with the disinfectant value, temperature, and either pH or fluoride values when the analyzer is set up for these measurements.

There are two wetside configurations available: Membrane and Bare Electrode. Both consist of a flow-through cell with a transparent plexiglass body that houses one or two measuring sensors. The cell's transparency permits visual checks on the flow of sample water and measuring conditions. The Membrane wetside can be fitted with any one of four membrane-type sensors (free chlorine, total chlorine, chlorine dioxide or ozone) for disinfectant measurement. A second sensor can be added for pH or fluoride measurement. The bare electrode wetside is available for free chlorine measurement only. This arrangement can be used where a quick response time is required or if there is a high hardness in the sample water that could foul a membrane sensor. A second sensor can be added for pH or fluoride measurement. Note that free chlorine measurement by this wetside is affected by changes in pH. It is possible to compensate for pH changes by using a dual input arrangement with the pH sensor option for automatically calculating the residual value in response to changes in pH between 6.00 to 8.75.

Refer to Table A for part numbers for the various analyzer combinations.

Table A - Analyzer Type Selection Sheet Using Package Numbers

ELECTRONIC PACKAGE (Select one)	PART #
Chlorine ONLY (SINGLE SENSOR)	
115V	W2T365288
230V	W2T365292
Chlorine AND/OR pH OR Fluoride (DUAL SENSOR)	
115V	W2T365290
230V	W2T365293
SENSOR 1 - DISINFECTANT (SINGLE OR DUAL) (Select one unless using pH or Fluoride alone)	
Depolox® 3 *plus* Bare Electrode (With PT100 Temperature Sensor)	
Free Chlorine Measurement Package (For Fluctuating pH, Dual Electronics with pH Recommended)	W2T9694
OR	
Depolox® 5 Bare Electrode (With PT1000 Temperature Sensor)	
Free Chlorine Measurement Package (For Fluctuating pH, Dual Electronics with pH Recommended)	W2T7957
OR	
Depolox® 3 *plus* Membrane Sensor	
Membrane Flow Block Assembly	W2T9681
OR	
VariaSens™	
Membrane Flow Block Assembly	W2T7958
CO2 Buffer Package (For Free Chlorine)	W3T138155
AND (SELECT 1)	
Free Cl2 Probe FC1	W2T8665
Total Cl2 ProbeTC1	W2T9687
ClO2 Probe CD7	W2T8664
Ozone Probe OZ7	W2T8666
AND (SELECT 1)	
2m Cable	W2T416786
5m Cable	W2T420222
10m Cable	W3T149888
15m Cable	W2T416799
25m Cable	W3T149743
50m Cable	W3T149744

Table A - Analyzer Type Selection Sheet Using Package Numbers (Cont'd)

AND/OR (Options for Bare and Membrane)	
(For use with Depolox® 3 *plus* wetsides only)	
Flow Switch Alarm	W2T9690
Stop Valve	W2T9689
Note: Flow Switch and Stop Valve are integral to Depolox® 5 Bare Electrode and VariaSens™ Wet Side.	
SENSOR 2 (FOR DUAL INPUT ONLY)	
pH Sensor	W2T12126
OR	
Fluoride Kit - Refillable	W2T417005
OR	
Fluoride Kit - Gel Type	W3T124078
OR	
Impedence Converter	W2T9651
OR (If Fluoride or pH ONLY)	
Fluoride/pH Standalone Wetside	W2T12125
Note: The standard 1 meter cable for the pH and fluoride probes is provided pre-attached to the dual electronics. No additional cable is required.	

Options:

- Flow switch (to provide alarm for loss of sample water)
  (Integral to Depolox® 5 bare electrode and VariaSens™ wetside)
- Stop valve (to shut off sample flow)
  (Integral to Depolox® 5 bare electrode and VariaSens™ wetside)
- Impedance transformer (for pH or Fluoride probe)

NOTE: When ordering material, always specify model and serial number of apparatus.

Electromagnetic Compatibility and Other Requirements

Depolox® 3 *plus* devices conform with the following requirements:

- EN 61326-1: 2006 (EMC)
- EN 61010-1: 2006 (LVD)

Depolox® 3 *plus* devices are designed for use in industry, domestic, business, and trade sectors.

Declaration of Conformity

Depolox® 3 *plus* devices comply with the requirements of the EU directives 2006/95/EC "Low Voltage Directive" and 2004/108/EC "Electromagnetic Compatibility" and the harmonized European Standards listed therein.

Intended Use

The Depolox® 3 *plus* consists of one or two combined measuring and reference sensors for chlorine, chlorine dioxide, ozone, temperature, pH, and fluoride; a measuring water monitoring device; and an electronics module. The system is for measuring the concentration of chlorine, chlorine dioxide, ozone and temperature as well as pH or fluoride, and to display and transmit measurements, in potable water.

WARNING: TO AVOID INJURY TO PERSONS CAUSED BY ELECTRICITY ONLY AUTHORIZED AND QUALIFIED ELECTRICIANS MAY INSTALL THE DEVICE AND OPEN THE HOUSING. THE DEVICE MAY ONLY BE OPERATED WHEN THE HOUSING IS CLOSED AND MUST BE CONNECTED TO THE PROTECTIVE CONDUCTOR. MODIFICATIONS TO THE DEVICE WHICH EXCEED THOSE DESCRIBED IN THIS MANUAL ARE NOT PERMISSIBLE.

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Very Important Safety Precautions SP-1,-2
Regional Offices 1.010-1
Technical Data ..... Section 1
Installation ..... Section 2
Operation ..... Section 3
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Illustrations ..... Section 5
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VERY IMPORTANT SAFETY PRECAUTIONS

This page provides very important safety information related to safety in installation, operation, and maintenance of this equipment.

WARNING

TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, OBSERVE THE FOLLOWING:

ALL USERS OF THIS EQUIPMENT SHOULD BE MADE AWARE OF THE PROBLEMS ASSOCIATED WITH HANDLING HAZARDOUS MATERIALS IN EITHER LIQUID OR GASEOUS FORM AND OF THE EFFECTS OF EXPOSURE TO THEIR FUMES. REFERENCE SHOULD BE MADE TO THE LITERATURE AVAILABLE FROM THE SUPPLIERS OF THESE CHEMICALS, PARTICULAR ATTENTION BEING PAID TO THE INFORMATION AND ADVICE ON PROTECTIVE CLOTHING.

THIS EQUIPMENT IS CONNECTED TO LINE VOLTAGE. IT IS ESSENTIAL THAT THE UTMOST CARE IS TAKEN WHEN WORK IS CARRIED OUT ON EQUIPMENT WHERE LINE VOLTAGES ARE PRESENT. IT IS RECOMMENDED THAT ALL POWER SUPPLIES ARE SWITCHED OFF WHENEVER POSSIBLE.

WHEN DEALING WITH HAZARDOUS MATERIAL, IT IS THE RESPONSIBILITY OF THE EQUIPMENT USER TO OBTAIN AND FOLLOW ALL SAFETY PRECAUTIONS RECOMMENDED BY THE MATERIAL MANUFACTURER.

DO NOT DISCARD THIS INSTRUCTION BOOK UPON COMPLETION OF INSTALLATION. INFORMATION PROVIDED IS ESSENTIAL TO PROPER AND SAFE OPERATION AND MAINTENANCE.

ADDITIONAL OR REPLACEMENT COPIES OF THIS INSTRUCTION BOOK ARE AVAILABLE FROM:

Evoqua Water Technologies
725 Wooten Road
Colorado Springs, CO 80915
Phone: (800) 524-6324

NOTE

Minor part number changes may be incorporated into Evoqua Water Technologies products from time to time that are not immediately reflected in the instruction book. If such a change apparently has been made in your equipment and does not appear to be reflected in your instruction book, contact your local Evoqua Water Technologies sales office for information.

Please include the equipment serial number in all correspondence. It is essential for effective communication and proper equipment identification.

REGIONAL OFFICES

INSTALLATION, OPERATION, MAINTENANCE, AND SERVICE INFORMATION

Direct any questions concerning this equipment that are not answered in the instruction book to the Reseller from whom the equipment was purchased. If the equipment was purchased directly from Evoqua Water Technologies, Colorado Springs, CO contact the office indicated below.

UNITED STATES

725 Wooten Road
Colorado Springs, CO 80915
TEL: (800) 524-6324

CANADA

If the equipment was purchased directly from Evoqua Water Technologies, Canada, contact the nearest office indicated below.

ONTARIO

Evoqua Water Technologies Ltd.
2045 Drew Road
Mississauga, Ontario
L5S 1S4
(905) 944-2800

QUEBEC

Evoqua Technologies des Eaux Itee
505 Levy Street
St. Laurent, Quebec
H4R 2N9
(450) 582-4266

SECTION 1

SECTION 1 - TECHNICAL DATA

List of Contents

PARA. NO.

Depolox® 3 *plus* Electronics 1.1
Sensor Feature List 1.2
pH Sensor 1.3
Fluoride Sensor Kit 1.4

1.1 Depolox® 3 *plus* Electronics

Power supply	115 V ± 10%, 50 - 60 Hz, 14 VA F1 Fuse T630 mA, 5 x 20 mm or 230 V ± 10%, 50 - 60 Hz, 14 VA F1 Fuse T630 mA, 5 x 20 mm
Input A: Disinfectant measuring ranges	Free and Total Chlorine 0.20 / 0.50 / 1.00 / 2.00 / 5.00 / 10.0 / 20.0 mg/l
Input A: Chlorine Dioxide ranges	0.20 / 0.50 / 1.00 / 2.00 / 5.00 / 10.0 / 20.0 mg/l
Input A: Ozone ranges	0.20 / 0.50 / 1.00 / 2.00 / 5.00 / 10.0 / 20.0 mg/l
Input A: Sample water temperature range	Depolox® 3 plus and Depolox® 5 Bare Electrode 41 to 122°F (5 to 50°C) Membrane Probes 41 to 113°F (5 to 45°C)
Input B: pH measuring ranges (Dual sensor)	pH 4.00 to pH 10.00, pH 0 to pH 14.00 (Effective range for internal pH compensation pH 6.0 to pH 8.75)
Input B: Fluoride measuring range (Dual sensor)	0.20 to 2.00 mg/l
Measurement inputs	1 x disinfection sensor 1 x temperature 1 x pH or fluoride sensor (Dual Input only) electrically isolated for up to 50 V to ground
mA outputs 4 - 20 mA	1x for disinfection 1 x temperature 1x for pH or fluoride (with Dual Sensor) max. 1000 ohm load, electrically isolated for up to 50 V to ground
Relay outputs	2 freely configurable alarm contacts for disinfectant signal 2 for ph or fluoride (with Dual Sensor) Electrically isolated up to 500 V to ground
Relay Contact Rating	5A 1/6 HP 125, 250 V AC or 5A 30 V DC 30 W max. Interference suppression via suppressor diodes.

3x Digital input	Dry contact input Electrically non-isolated
Interface	RS485 for connection to programmable controller or central instrumentation and control systems via RS485 Evoqua Water Technologies protocol.
Ambient operating temperature	32 to 122°F (0 to 50°C)
IP Rating	IP66

1.2 Sensor Feature List

	free C12 (bare electrode)	FC1 (membrane type)	TC1 (membrane type)
Principle of operation	Potentiostatic 3-electrode-amperometric, bare electrode	Potentiostatic 3-electrode-amperometric, membrane type	Potentiostatic 3-electrode-amperometric, membrane type
Measurand	free chlorine Cl	free chlorine Cl	total chlorine Cl
Application	Potable water, high hardness and fast response requirements	Potable water, prefered for low conductivity and variable pH	Potable water, prefered for low conductivity and variable pH
Range	0 to 20 ppm	0 to 20 ppm	0 to 20 ppm
Zero cal.	Required	Not required	Not required
Accuracy	0.01 mg/l or 2% F.S. whichever is greater	0.05 mg/l or 6% F.S. whichever is greater	0.05 mg/l or 6% F.S. whichever is greater
Sensitivity	0.01 mg/l or 1% F.S. whichever is greater	0.01 mg/l or 1 % F.S. whichever is greater	0.01 mg/l or 1% F.S. whichever is greater
Repeatability	0.01 mg/l or 2% F.S. whichever is greater	0.02 mg/l or 3% F.S. whichever is greater	0.02 mg/l or 3% F.S. whichever is greater
Stability	2% F.S. under typical conditions for 1 month	5% F.S. under typical conditions for 1 month	5% F.S. under typical conditions for 1 month
Response time (T_{90})	90% change in less than 20 seconds	90% change in less than 5 minutes	90% change in less than 5 minutes
Sample temp.	41 to 122° F (+5 to 50° C)	41 to 113° F (+5 to 45° C)	41 to 113° F (+5 to 45° C)
Storage temp.	14 to 140° F (-10 to 60° C)	14 to 122° F (-10 to +50° C)	14 to 122° F (-10 to +50° C)
pH dependence	pH 4 to pH 9 must have stable pH (max. pH variation 0.l pH); pH compensation available with dual input units.	Usable range pH 6 to pH 10; maximum interference 5% per pH unit.	Usable range pH 6 to pH 10; maximum interference 5% per pH unit.
Conductivity	> 250 µS/cm	>10 µS/cm up to 2500 µS/cm	> 10 µS/cm up to 2500 µS/cm
Sample water flow	33 1/h +/- 5 liter, constant	6 1/h to 35 1/h, constant	6 l/h to 35 1/h, constant
Inlet pressure	2 to 60 psi (0.15 to 4 bar)	2 to 60 psi (0.15 to 4 bar)	2 to 60 psi (0.15 to 4 bar)
Outlet pressure	0 psi	0 psi	0 psi
Temperature compensation	Yes, Pt 100 or Pt 1000 sensor	Yes, Pt 1000	Yes, Pt 1000
Flow switch (opt.)	Yes	Yes	Yes
Flow regulator	Yes	Yes	Yes
Reagents	None	None	None
Cleaning	Dynamic grit	None	None
Typical life time	membrane: 1 year electrolyte: 6 months	membrane: 1 year electrolyte: 6 months	membrane: 1 year electrolyte: 6 months

1.2 Sensor Feature List (Cont'd)

	CD7 (membrane type)	OZ7 (membrane type)
Principle of operation	Potentiostatic 2-electrode-amperometric-, membrane type	Potentiostatic 2-electrode-amperometric-, membrane type
Measurand	Chlorine Dioxide (ClO_2)	Ozone (O_3)
Application	All water with suspended solids less than 0.8 mm	All water with suspended solids less than 0.8 mm
Interference	Ozone and periacetic acid	Chlorine Dioxide and peri-acetic acid
Range	0 to 20 ppm	0 to 20 ppm
Zero cal.	Not required	Not required
Accuracy	0.05 mg/l or 6% F.S. whichever is greater	0.05 mg/l or 6% F.S. whichever is greater
Sensitivity	0.01 mg/l or 1 % F.S. whichever is greater	0.01 mg/l or 1 % F.S. whichever is greater
Repeatability	0.02 mg/l or 3% F.S. whichever is greater	0.02 mg/l or 3% F.S. whichever is greater
Stability	± 5% F.S. under typical conditions for 1 month	± 5% F.S. under typical conditions for 1 month
Response time (T90)	90% change in less than 20 seconds	90% change in less than 50 seconds
Sample temp.	41 to 113° F (+5 to 45° C)	41 to 113° F (+5 to 45° C)
Storage temp.	14 to 122° F (-10 to +50° C)	14 to 122° F (-10 to +50° C)
pH dependence	None	None
Conductivity	> 1 µS/cm up to 40 mS/cm	> 1 µS/cm up to 40 mS/cm
Sample water flow	6 l/h to 35 l/h, constant	6 l/h to 35 l/h, constant
Inlet pressure	2 to 60 psi (0.15 to 4 bar)	2 to 60 psi (0.15 to 4 bar)
Outlet pressure	0 psi	0 psi
Temperature compensation	Yes	Yes
Flow switch (opt.)	Yes	Yes
Flow regulator	Yes	Yes
Reagents	None	None
Cleaning	None	None
Typical life time	membrane: 1 year electrolyte: 6 month	membrane: 1 year electrolyte: 6 month

1.3 pH Sensor

Range	pH 0 to pH 14, pH 4 to pH 10
Temperature range	32 to 122° F (0 to 50° C) for the sample water
Pressure	max. 60 psig (4 bar)
Conductivity	>300µS/cm

NOTE: When used for pH compensated Free chlorine measurement, the pH range must be between 6 and 8.75. pH compensation available with Free chlorine bare electrode only.

NOTE: Where the standard 1.5-meter sensor cable is not long enough (for special installations up to 50-meter cable length), an impedance transformer is used to convert the very high-resistance electrode signal of the pH to a low-resistance signal. The impedance transformer is screwed onto the pH sensor cable. The impedance transformer is powered by an integral battery. Battery lifetime is approximately five years.

1.4 Fluoride Sensor Kit (Refillable and Gel Type)

Range	0.20 to 2.00 mg/L
pH Range	pH 5 to pH 8
Temperature Range	32 to 122° F (0 to 50° C)
Pressure	max. 60 psig (4 bar)
Conductivity	>300µS/cm

NOTE: An impedance transformer is used to convert the very high-resistance electrode signal of the fluoride sensor to a low-resistance signal. The impedance transformer is screwed onto the fluoride sensor cable. It is powered by an integral battery. Battery lifetime is approximately five years.

SECTION 2

SECTION 2 - INSTALLATION

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- Adjust Line Voltage/Change Fuse 2.1.3
- Select Sensor Types 2.1.4
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Bare Electrode (Free Chlorine) Sensor Kit 2.2
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  - VariaSens™ Membrane Measuring Cell 50.560.100.060
  - Fluoride/pH Standalone Wetside 50.560.100.040
- Wiring
  - Bare Electrode Sensor Kit 50.560.155.010
  - Membrane Sensor Kit 50.560.155.020
  - Alarm Relay Connections; Main and mA 50.560.155.060

2.1 Depolox® 3 *plus*

NOTE: For safe and effective installation a knowledge of the connected devices is required with respect to operation, electrical connections, measurement signals, cable assignment, fuses and the safety regulations which have to be observed. The installation of the device therefore is only to be done by qualified and authorized skilled electricians.
Incorrectly connected devices may be damaged or destroyed when switching on or during operation, or may cause malfunctions in other devices. Be careful not to confuse measuring cables and other cables and not to let them come into contact with one another. Do not connect or disconnect live cables.

2.1.1 Unpacking

Check the transport packing for damage. Notify the carrier immediately if there is damage, otherwise your claim for compensation will be nullified.

If the device has suffered damage, get into touch with the responsible Evoqua Water Technologies representative immediately. Keep the packaging until the system has been properly installed and is in operation.

2.1.2 Check Voltages

The line voltage of the Depolox® 3 *plus* is set at the factory in accordance with the instructions given at the time of the order (230 V or 115 V).

Check this setting from the rating plate immediately after unpacking the device, and in any case before it is installed.

If the line voltage setting does not match your supply, the setting will have to be altered (refer to paragraph 2.1.3, Adjust Line Voltage/Change the Fuse).

2.1.3 Adjust Line Voltage/Change Fuse

The rating plate on the top of the device shows the line voltage which was set at the factory. If this does not match the voltage at the site of installation, the device will have to be adjusted.

NOTE: Operating the device with the wrong voltage can lead to the device fuse blowing or other damage or malfunction. Adjustment of the line voltage must take place before installation and before the connection of cables. The device may be opened and adjusted by an electrician only.

For connection to power with two hot wires (L1, L2), replace the metal pin on the F2 socket by a fuse corresponding to the voltage (see Figure 2.1).

The switch to adjust the voltage is inside the housing. To open up the housing, unscrew the screws on each side of the cover and lift off the cover of the housing, being careful not to damage the ribbon cable. The cables must not be twisted. Unlock ribbon cable from circuit board and place cover aside while setting the switch selections and making all electrical connections.

After completing all selections and connections, reattach the cover ribbon cable to the circuit board and tighten cover screws.

<u>WARNING</u>: DO NOT USE POWER TOOLS TO TIGHTEN COVER SCREWS. DO NOT EXCEED 0.5 LBSFT/FT TORQUE IN TIGHTENING THE COVER SCREWS.

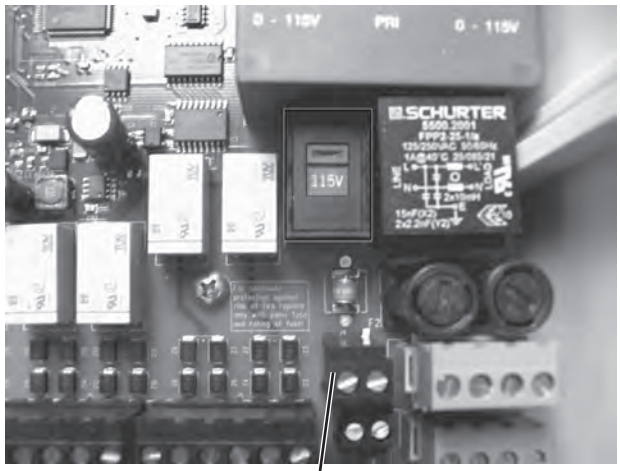


Figure 2.1 - Rating Plate

The slide switch to adjust the voltage allows a choice between 230 V and 115 V.

2.1.4 Select Sensor Types

The setting for the measuring signal of the disinfection sensors must correspond to the connected sensor. Select the sensor at the ten-position DIP switch S3 on the board (factory setting is for Bare Electrode).

WARNING: DO NOT CHANGE SWITCH SETTINGS UNTIL UNIT IS DISCONNECTED FROM LINE POWER. CHANGING THE SWITCH SETTINGS WHILE THE UNIT IS POWERED UP WILL DAMAGE THE ELECTRONICS AND LOCK UP THE SYSTEM PROGRAM, AND VOID SYSTEM WARRANTY.

WARNING: WRONG SETTING CAN CAUSE DAMAGE TO THE SENSOR AND THE DEPOLOX® 3 *PLUS* ELECTRONICS.

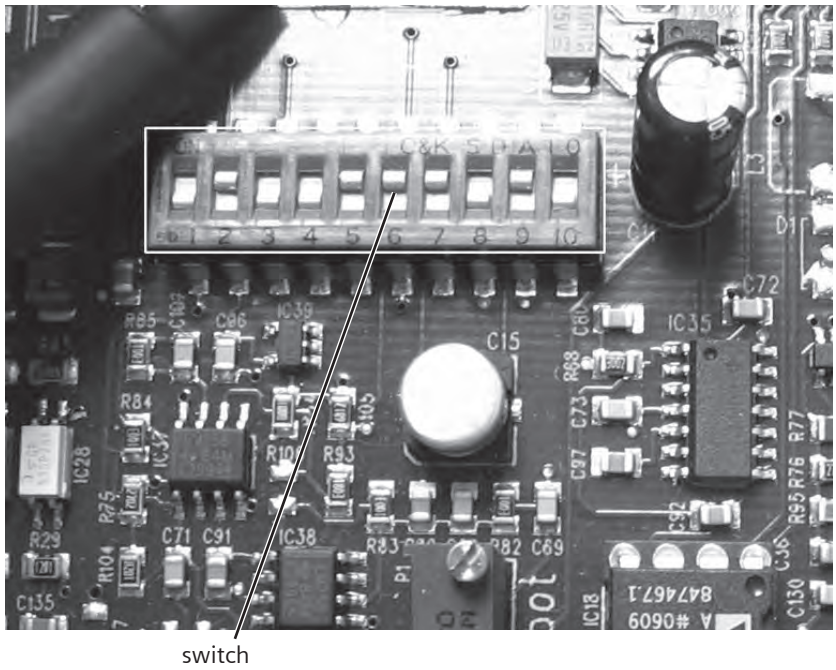
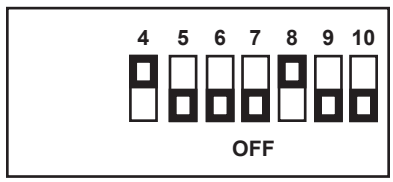


Figure 2.2 - DIP Switch

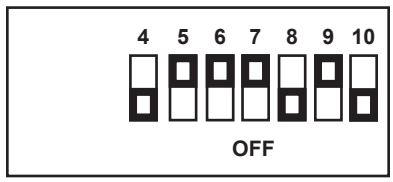
NOTE: Disconnect line power before changing DIP switch settings. Failure to disconnect power will damage electronics and void warranty.

3-Elect. "Depolox® 3 *plus*"
(Bare Electrode):
(Default factory setting)



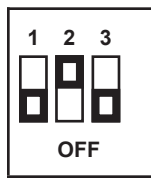
NOTE: Disconnect line power before changing DIP switch settings. Failure to disconnect power will damage electronics and void warranty.

All membrane sensors:
(FC1, TC1, CD7, OZ7)

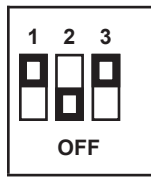


In case the cell current is >200µA (e.g., in waters with high conductivity), change the setting of positions 1 through 3 as follows:

DIP Switch (default 200µA):



DIP Switch
(only if sensor current >200µA to max. 1000 µA):



The other positions remain as before.

2.1.5 Installing the Depolox® 3 *plus* Electronics Module

The Depolox® 3 *plus* electronics module is built in a wall-mounted housing and should be mounted near the flow-through assembly.

2.1.6 Electrical Connections

Connect the sensor cables, alarm signal lines and the power cable according to the wiring diagrams (see Dwgs. 50.560.155.010, .020 and .050).

Do not switch on the power.

WARNING: ONLY AUTHORIZED AND QUALIFIED ELECTRICIANS ARE PERMITTED TO INSTALL THE DEVICE AND OPEN THE HOUSING. THE UNIT MAY ONLY BE PUT INTO OPERATION WHEN THE HOUSING IS CLOSED, AND MUST BE CONNECTED TO EARTH GROUND. MODIFICATIONS TO THE UNIT THAT GO BEYOND THOSE DESCRIBED IN THE MANUAL ARE NOT PERMISSIBLE.

CAUTION: To ensure safe and correct start up, knowledge of the operation, connected electrical load, measurement signals, cable assignment and fuse protection of the connected devices and machines and the relevant safety regulations is required. Start up of the unit may therefore only be performed by qualified and authorized electricians.

Incorrectly connected devices can be damaged, possibly irreparably, or cause faults in other equipment when they are switched on or in operation. Ensure that the measuring and control cables are not confused or make contact with one another. Never connect or disconnect any cables to which high voltage is applied!

NOTE: The power supply line must have a 6A fuse.
Recommendation: Provide an on/off facility for the unit at the installation site.

WARNING: A WARNING IS GIVEN IN INSTANCES WHERE FAILURE TO OBSERVE THE INSTRUCTION COULD RESULT IN INJURY TO PERSONNEL.

CAUTION: Cautions are given where failure to observe the instruction may result in equipment damage, or pollution to an allied system.

2.1.7 Digital Input

The flow switch (optional) must be connected to the digital input terminals 1-2 DI1, 3-4 DI2, 5-6 DI3.

The digital input “Digital IN” is set for a potentially isolated external contact, e.g., for the flow switch.

If the flow switch is not used, jumper unused terminals, otherwise, “Digital IN” error will occur.

2.1.8 Start-Up

WARNING: THE DEPOLOX® 3 *PLUS* MODULE HAS NO POWER SWITCH OF ITS OWN AND IS IN OPERATION AS SOON AS THERE IS A CONNECTION TO THE POWER SUPPLY. CONNECTED DEVICES HAVE TO BE SWITCHED OFF DURING INPUT OF OPERATING DATA IN ORDER TO PREVENT UNCONTROLLED START-UP OR MALFUNCTIONS. ONLY WHEN THE OPERATING DATA IS INPUT AND CHECKED MAY OTHER DEVICES BE SWITCHED ON.

Start-up can only be effected after correct installation of the sample water line, leak test, and electrical connection to the systems.

Start operation of the measuring cell (refer to paragraph 3.3.1, Start-Up of the Measuring Cell, or to paragraph 2.3, Membrane Sensors.

Check that the setting of the 10-position DIP switch, S3, “Chlorine Cell” (refer to paragraph 2.1.4, Select Sensor Type) is correct. Start by switching on the mains power to the control module.

WARNING: DO NOT CHANGE SWITCH SETTINGS UNTIL UNIT IS DISCONNECTED FROM LINE POWER. CHANGING THE SWITCH SETTINGS WHILE THE UNIT IS POWERED UP WILL DAMAGE THE ELECTRONICS AND LOCK UP THE SYSTEM PROGRAM, AND VOID SYSTEM WARRANTY.

First, the program version is displayed, for example:

EAE1053
FRG 49
V:X_XX/XX
Free Chlorine

Continue as follows (refer to Section 3 - Operation, as necessary):

a. Select measuring range in the SETUP menu.

b. Select pH/Fluoride measuring range.

c. Select code definition.

d. Select hold function.

e. Select language.

f. Select the bus address in the SETUP menu (if operated in a bus system).

g. Select disinfectant.

h. Select pH or Fluoride mode (optional, SETUP).

i. Select temperature.

2.2 Bare Electrode (Free Chlorine) Sensor Kit

The flow block assembly with the sensors should be installed in a frost-protected location and, where possible, in a heated room.

The sample water should provide a minimum of approximately 2 psi (0.2 bar) water gauge pressure at the measuring cell inlet.

The sample water line should be as short as possible. In the water line to the measuring cell a strainer (size 0.5 mm) must be installed.

The sample water inlet must be connected to a stop valve (connection 1/4" - 18 NPT). The tapping point for the sample water must be positioned to ensure a bubble-free flow of water and a complete mixing of the disinfectant.

The drain line must be unpressurized.

2.3 Membrane Sensors (See Dwg. 50.560.160.020 in Section 3)

WARNING: DO NOT TOUCH THE REFERENCE ELECTRODE! DO NOT TOUCH THE MEMBRANE!

Before unscrewing the membrane cap, remove the elastomer seal to allow air into the vent hole. Not doing this will cause a vacuum to occur which will damage the membrane when unscrewing the cap. Do not remove the yellow-grey layer on the reference electrode.

Unscrew the membrane cap from the electrode shaft and fill it to the top with the enclosed electrolyte. Strike the electrode shaft against the membrane cap to remove air bubbles. Clean the gold working electrode with the enclosed lapping paper (special abrasive paper). To do this, place the special abrasive paper on a paper towel. While holding on to a corner of the paper move the tip of the electrode of the vertically held probe one or two times over the rough side of the special abrasive paper. Ensure that the elastomer seal completely covers the vent hole. While holding the electrode shaft in a vertical position, screw on the cap onto the shaft. Surplus electrolyte will escape through the vent hole in the membrane cap below the elastomer seal. Do not hold the vent hole or press on the elastomer seal! If you detect air bubbles in the electrolyte, repeat the filling process. Wash away the escaped electrolyte with water.

NOTE: The membrane cap must be completely screwed to the electrode shaft so that no gap remains between membrane cap and electrode shaft. The sensor requires a one- to two-hour run in time before a first calibration can be performed. The final calibration should be done after one day.

2.3.1 Insert Membrane Sensor Into Flow Block Assembly

Position the sensor through the flow block cap such that the sensor body touches the bottom of the water inlet assembly. The water flow should point directly to the membrane. It may be necessary to turn the flow block cap to find the correct position for the sensor in the water inlet assembly. Remove any air bubbles from the membrane as they disturb the measurement. Connect the sensor cables to the electronic module.

Under these conditions the sensor should give proper readings for three to six months.

For connection to the Depolox® 3 *plus* electronics, refer to Dwgs. 50.560.155.020.

The sensor requires a one to two hour run in time before a first calibration can be performed. The final calibration should be done after one day.

2.4 pH Sensor

NOTE: This is required for pH-compensated Free chlorine measurement when used with the Bare Electrode Cell.

To insert the pH sensor into the flow block assembly, remove the cap from the pH sensor, attach the impedance transformer (if required) to the top of the sensor, connect the cable to the impedance transformer (or probe if not used), and put the sensor into the smaller hole in the flow block assembly cover or standalone wetside.

The cable for the pH and Fluoride probe is pre-attached to the dual electronics unit. Connect cable end to probe. No additional wiring is required.

2.5 Fluoride Sensor Kit

To insert the fluoride sensor into the flow block assembly, prepare the sensor as described in paragraph 3.6.2, Preparation of the Electrode.

Connect the end of the sensor cable to the impedance transformer, attach the cable to the other side of impedance converter, add electrolyte to the sensor (if required), and place the sensor into the hole in the flow block assembly cover or standalone wetside.

The cable for the pH and Fluoride probe is pre-attached to the dual electronics unit. Connect cable end to probe. No additional wiring is required.

2.6 Flow Switch (Optional) (Depolox® 3 *plus* Wet Side Only)

In general, the flow switch is only connected to the digital input of the Depolox® 3 *plus*. In case of other applications, ensure that the rating of this Reed contact (100 V AC and 0.5 A) is not exceeded even for a short time. In case inductive loads (e.g., relays or contactors) are switched, the contact has to be protected against induction sparks.

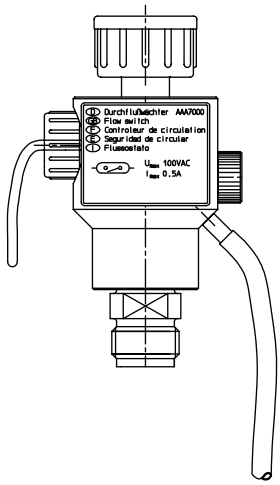


Figure 2.3 - Flow Switch

See Dwgs. 50.560.100.020 and .030 for flow switch location.

2.7 Stop Valve (Optional) (Depolox® 3 *plus* Wet Side Only)

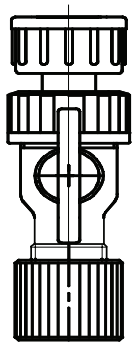
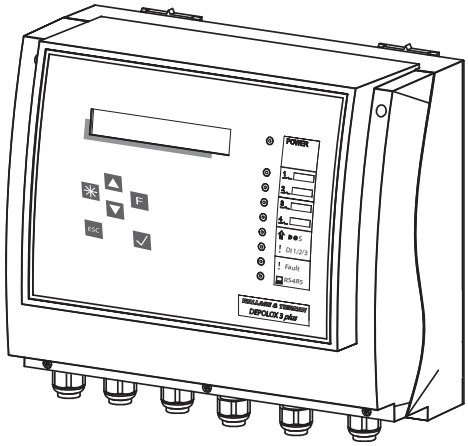
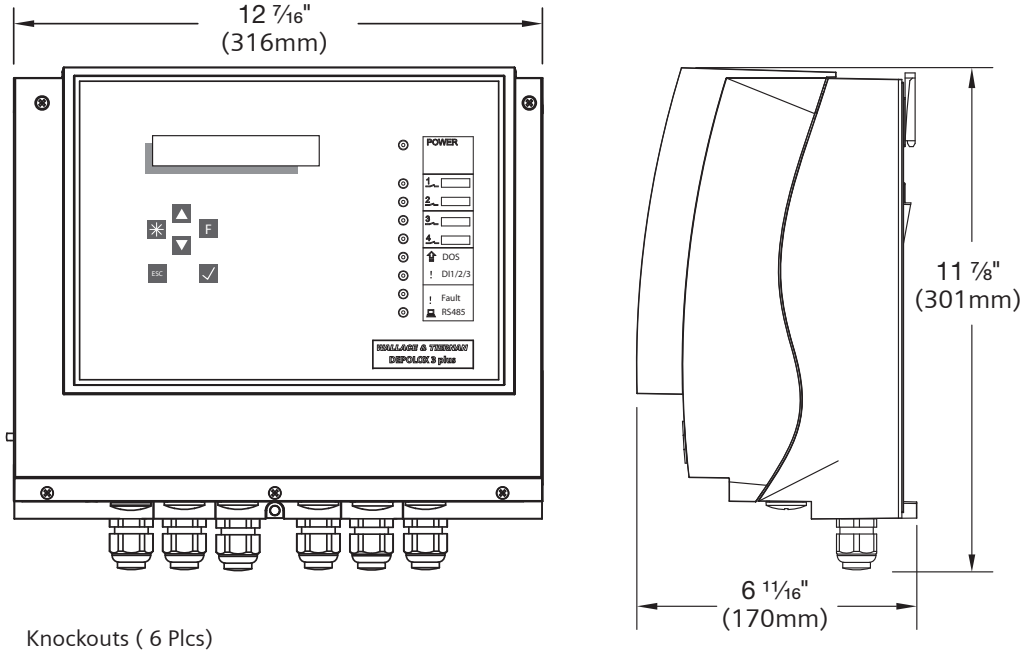
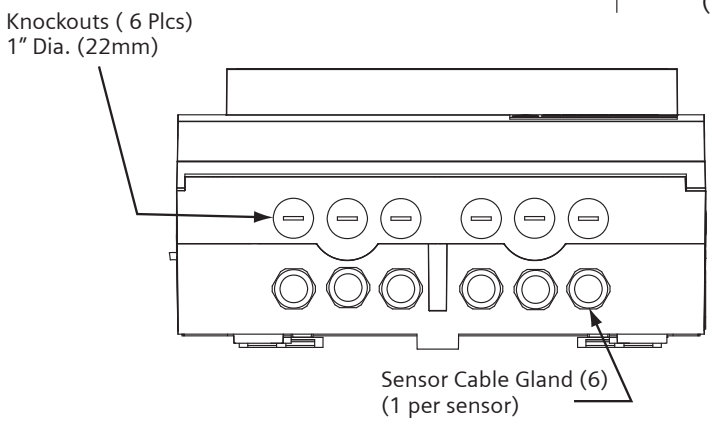


Figure 2.4 - Stop Valve

See Dwgs. 50.560.100.020 and .030 for stop valve location.



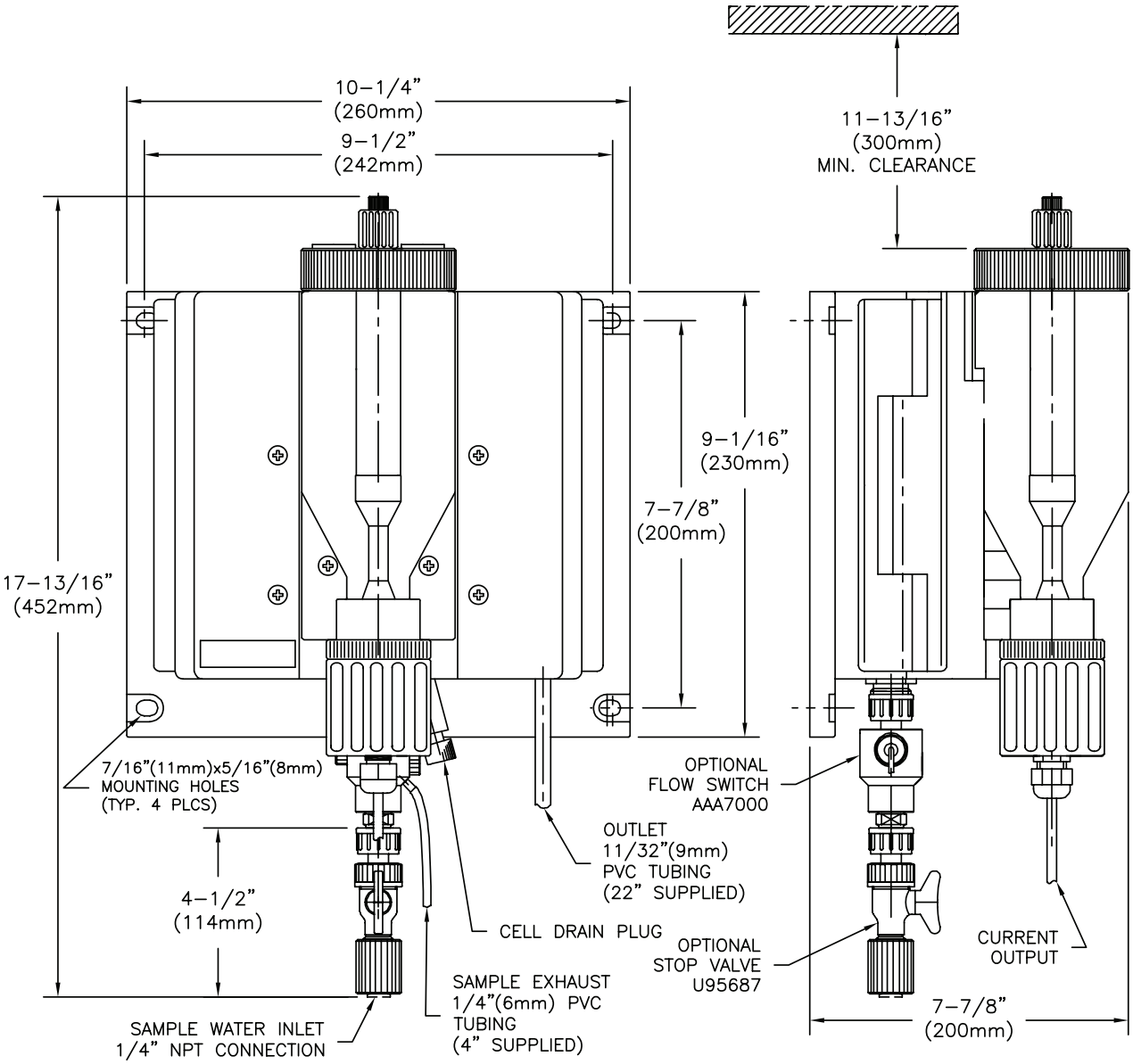




DEPOLOX® 3 *plus* ELECTRONIC MODULE - DIMENSIONS

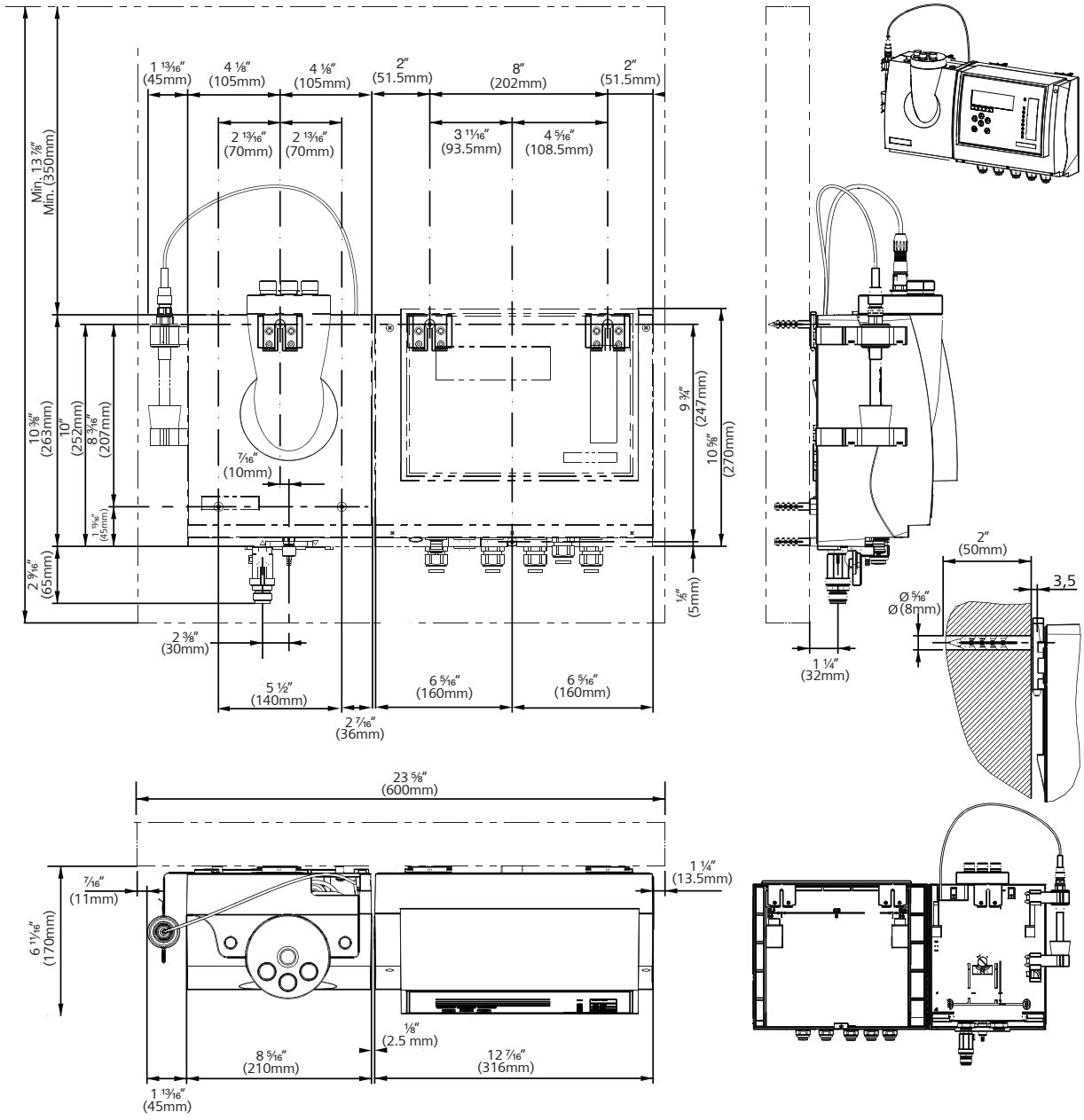
50.560.100.010

ISSUE 2 7-14



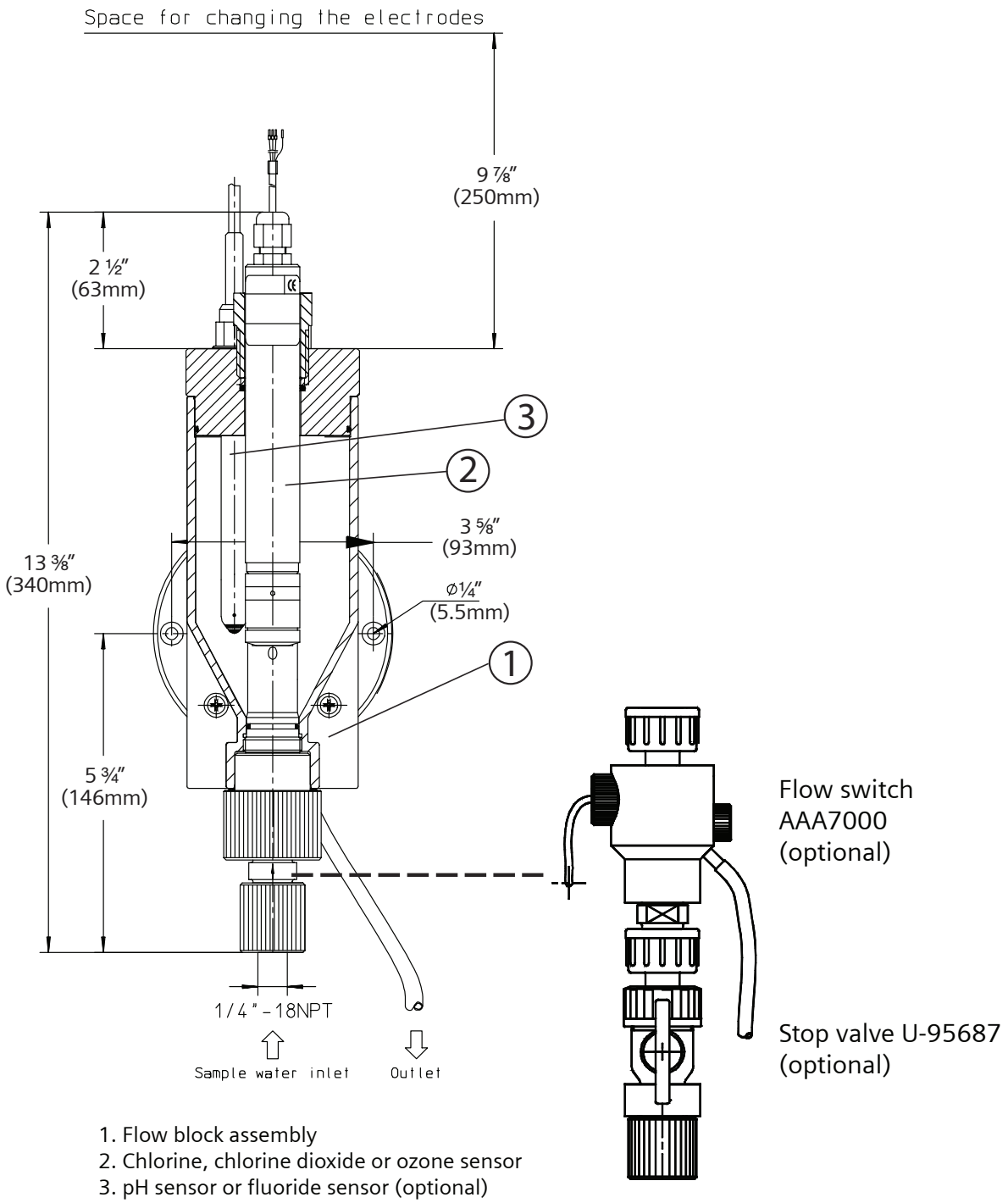
W2T9694 DEPOLOX® 3 *plus* BARE ELECTRODE MEASURING CELL - DIMENSIONS
(With PT 100 Temperature Sensor)

50.560.100.020
ISSUE 4 7-14



W2T7957 DEPOLOX® 5 BARE ELECTRODE MEASURING CELL - DIMENSIONS
(With PT 1000 Temperature Sensor)

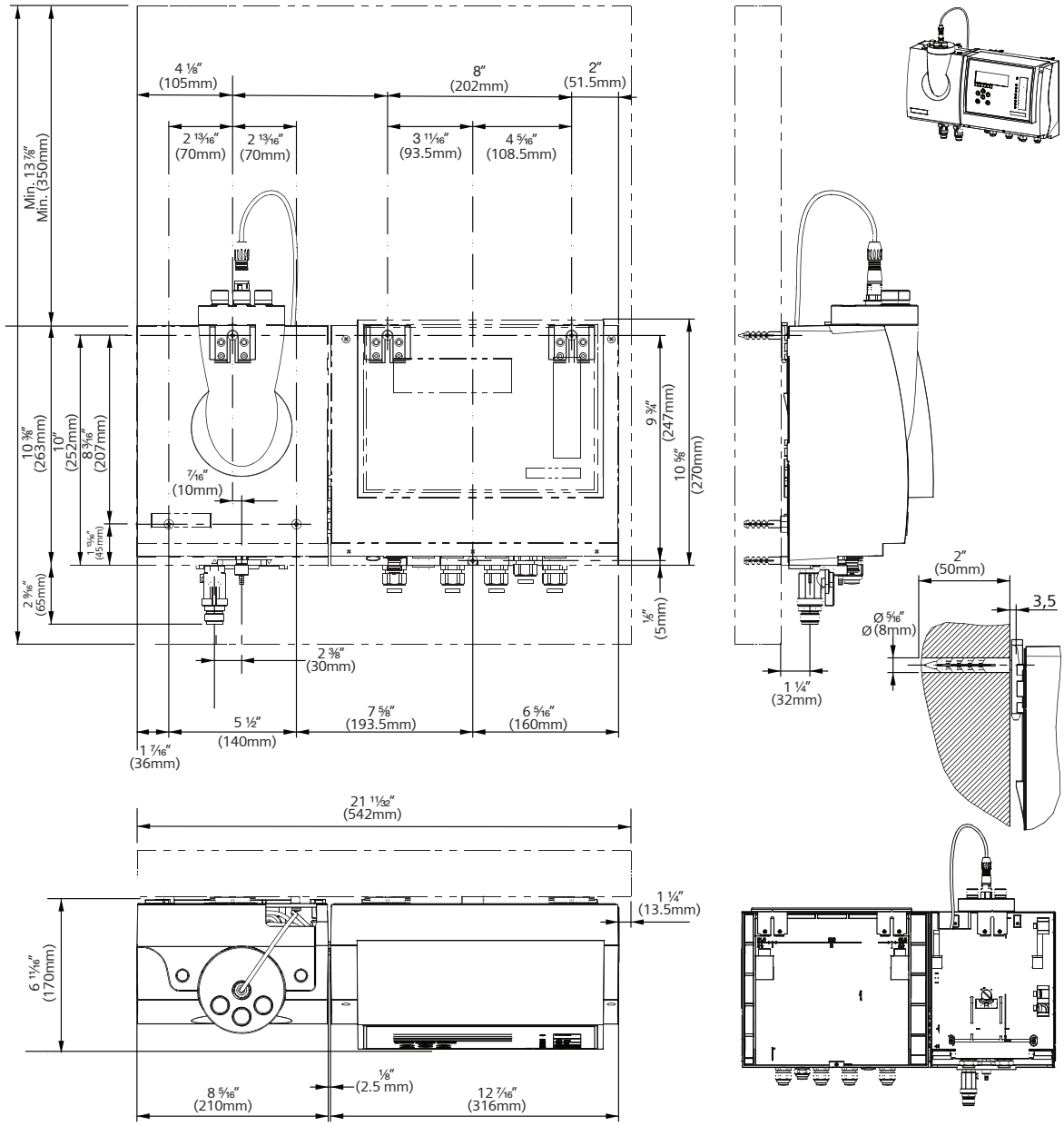
50.560.100.050
ISSUE 2 8-10



1. Flow block assembly
2. Chlorine, chlorine dioxide or ozone sensor
3. pH sensor or fluoride sensor (optional)

W2T9681 DEPOLOX® 3 *plus* MEMBRANE MEASUREMENT PACKAGE - DIMENSIONS
Sensors & Flow Block Assembly

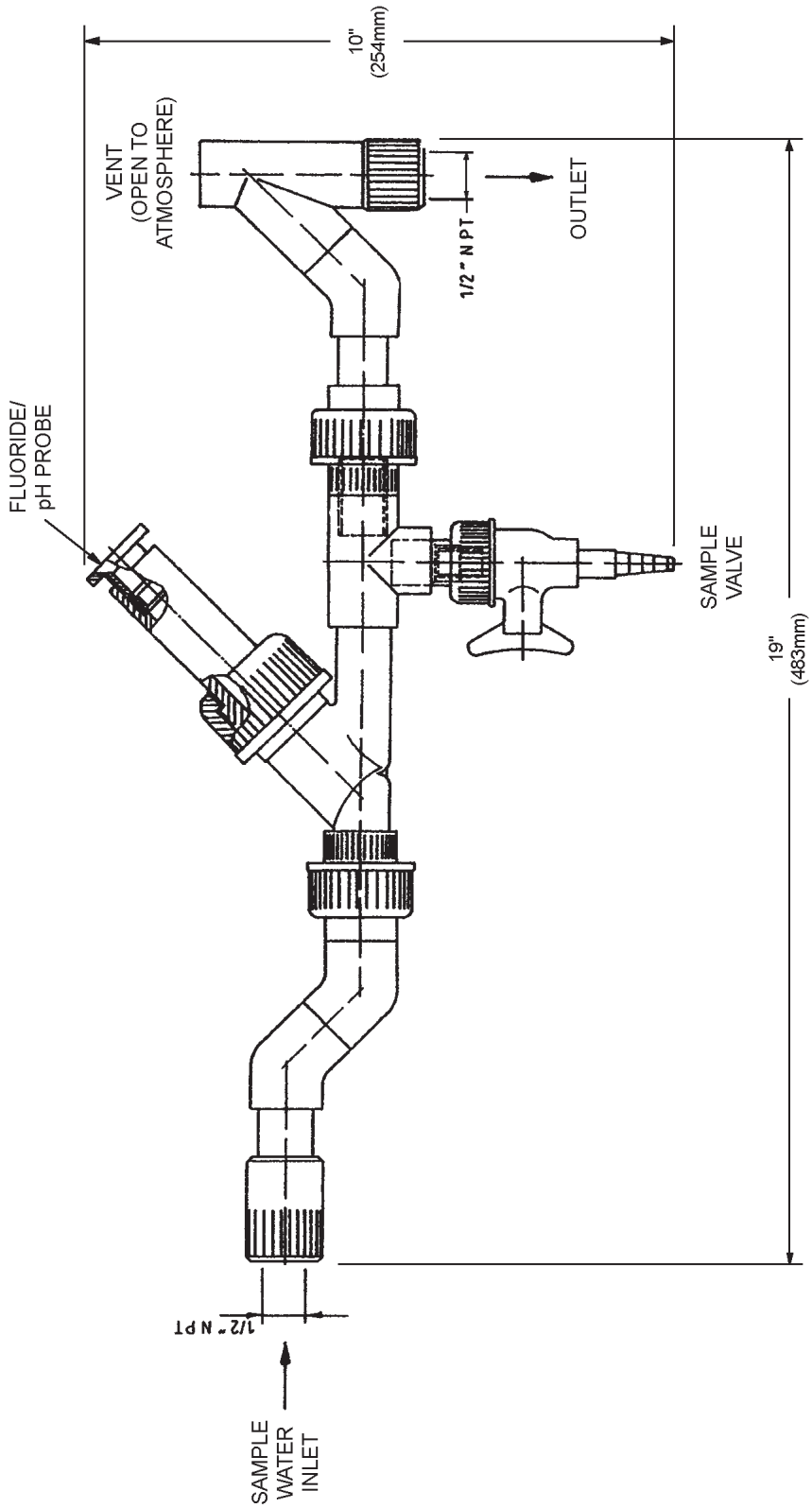
50.560.100.030
ISSUE 5 7-14



W2T7958 VARIASENS™ MEMBRANE MEASURING CELL - DIMENSIONS

50.560.100.060

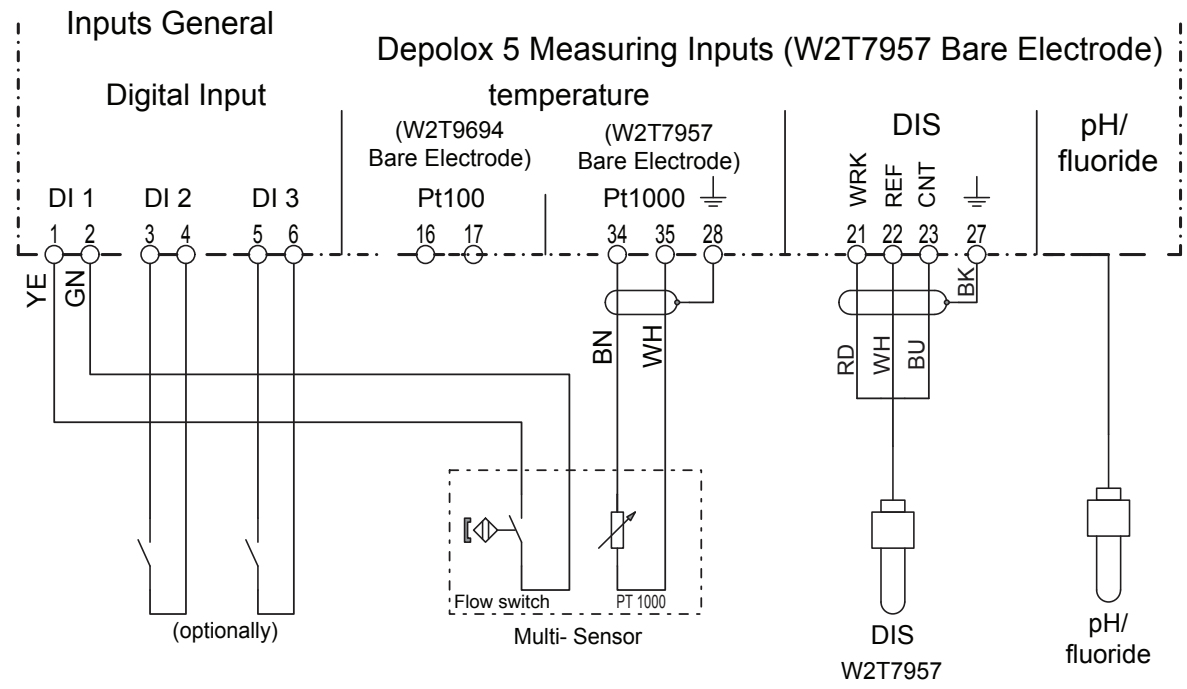
ISSUE 2 8-10

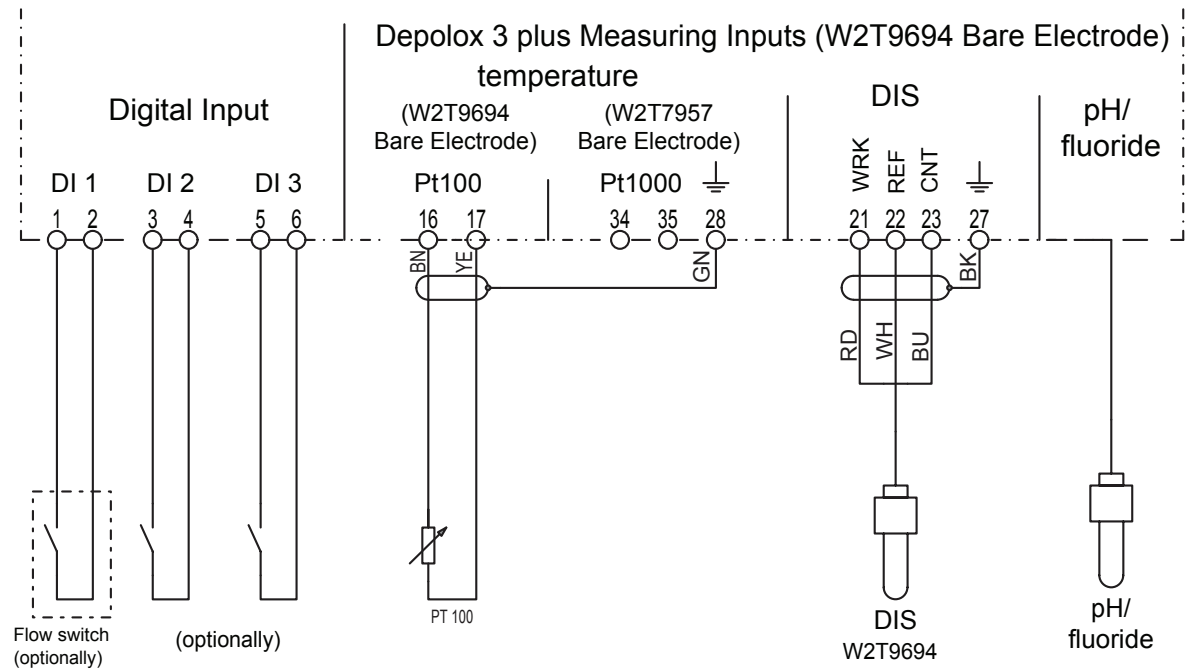


W2T12125 FLUORIDE/pH STANDALONE WETSIDE - DIMENSIONS

50.560.100.040

ISSUE 2 7-10





NOTE: FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

Depolox® ANALYZERS WITH BARE ELECTRODE SENSOR KIT - WIRING

50.560.155.010

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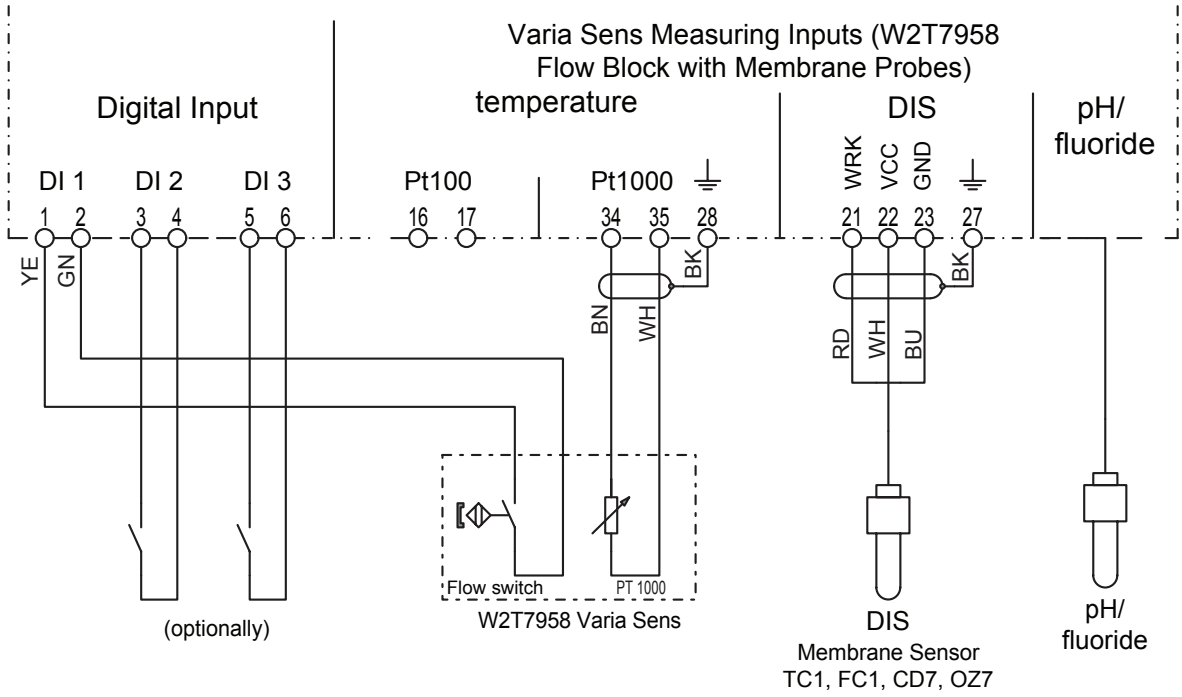

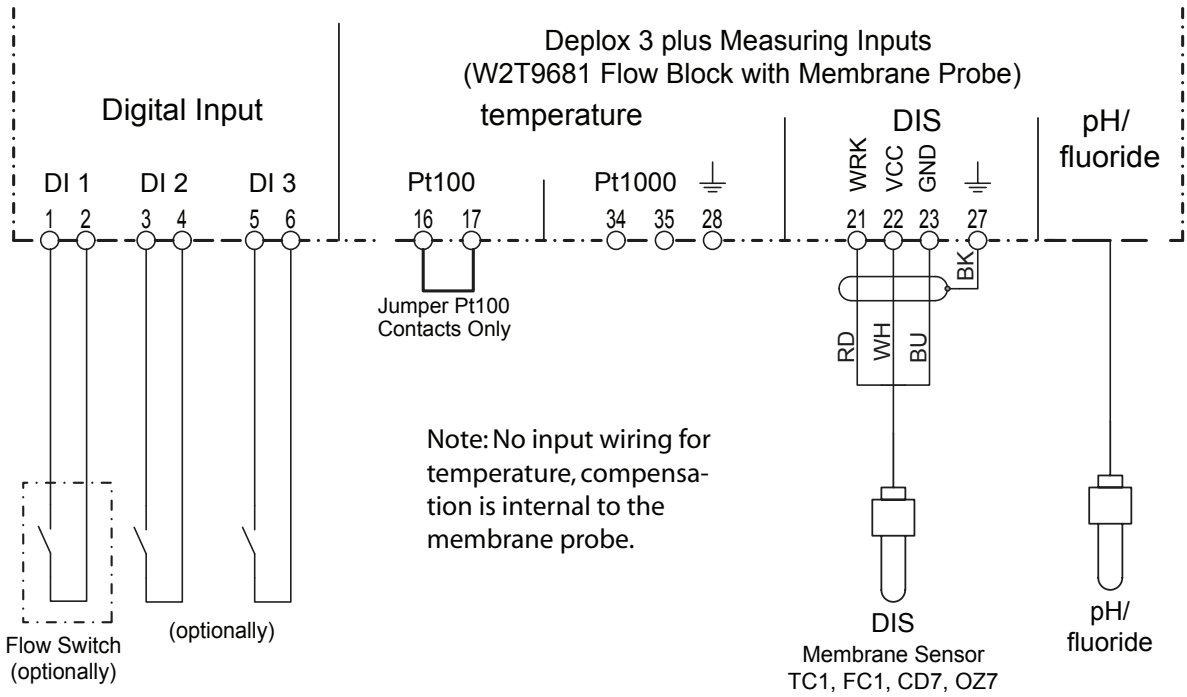

NOTE: FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

Depolox® ANALYZERS WITH MEMBRANE SENSOR KIT - WIRING

50.560.155.020
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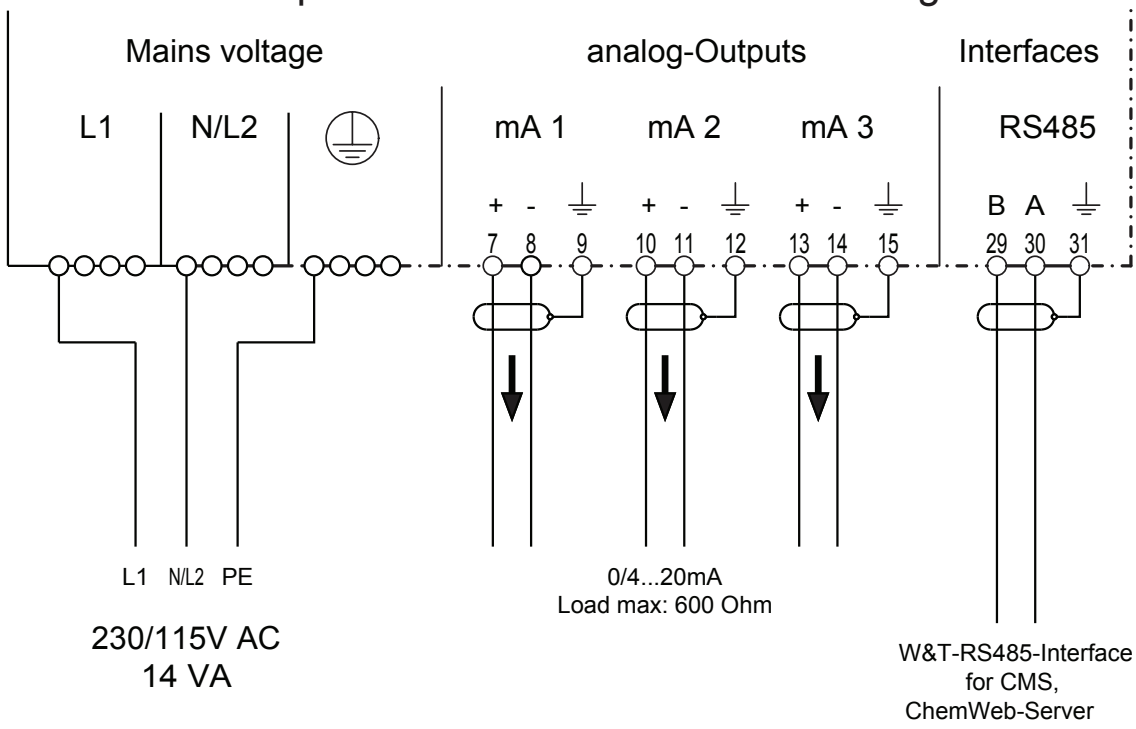
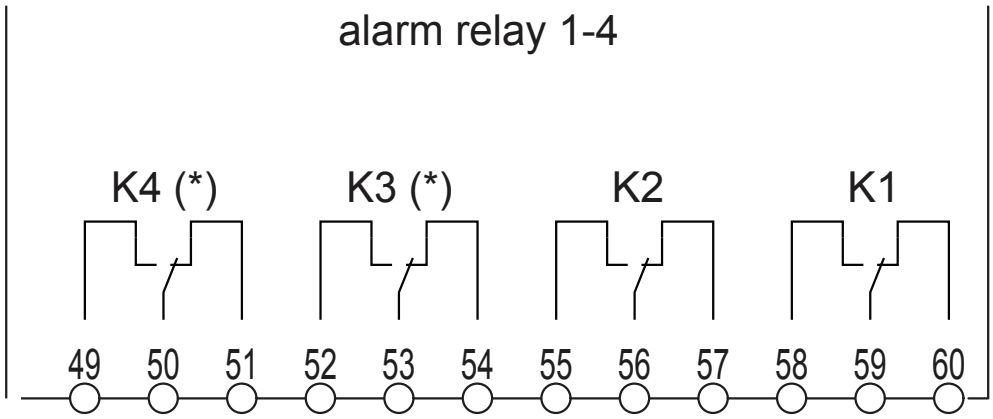
Depolox 3 Plus Main and mA - Wiring



NOTE: When mA outputs are activated, all three outputs are active.
Install jumper across "+" and "-" terminals of any unused output.

---

alarm relay 1-4



(*) only on dual electronics

NOTE: FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

Depolox® 3 *PLUS* - ALARM RELAY CONNECTIONS; MAIN AND mA - WIRING

50.560.155.050
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SECTION 3

SECTION 3 - OPERATION

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Illustrations
Bare Electrode Sensor Kit - Assembly 50.560.160.010
Membrane Sensor and Flowblock - Assembly 50.560.160.015
Membrane Sensor Kit - Assembly 50.560.160.020
pH/Fluoride Sensor Kit - Assembly 50.560.160.030

3.1 Depolox® 3 *plus* - Operation

3.1.1 General Description

The Depolox® 3 *plus* module is a microprocessor-controlled electronic amplifier for the measurement of Disinfectants, and/or for pH value or fluoride in water.

The built-in RS485 interface can be used to transfer the measured values and operating modes to a PC or SCADA system.

3.1.2 Display and Keypad

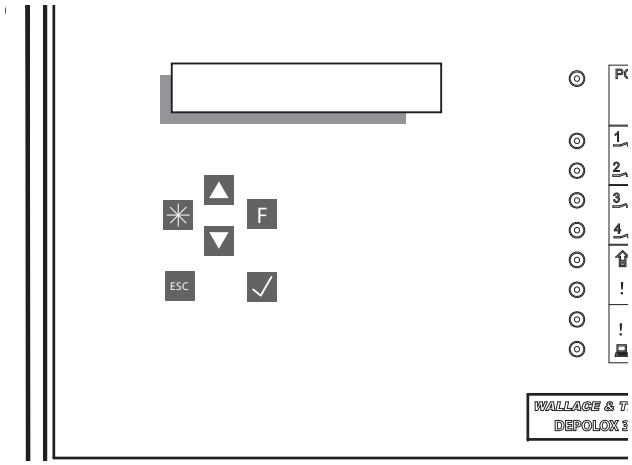


Figure 3.1 - Display and Keypad

3.1.2.1 Keypad Functions

ACKNOWLEDGE ALARM - De-energize the alarm relays (this does not reset the alarm message)

ESCAPE - Terminate input without saving new value. Jump back to the menu title and return to basic display by pressing the key once more.

UP ARROW - Skip one level upwards, increase value or display previous option.

DOWN ARROW - Skip one level downwards, reduce value or display next option.

Display next menu (jump from menu title to menu title)

ENTER - change into change mode (“>” is displayed before the value), - save new setting.

NOTE: Check that any alterations have been ENTERED before exiting the menu. Protect the menus from unauthorized operation with a code number of your choice (1 to 999) (refer to paragraph 3.1.3, Code Number).

Press the keypads only with the fingers, do not use hard or pointed objects like pencils, etc., as these could damage the sealed keypad.

3.1.2.2 Selecting the Menus

- From the basic display, access to the other menu paths is achieved by pressing the **F** key.
- Sub menus are accessed using the keys ▲ and ▼. To exit from a sub menu to a main menu and then to the basic display press the **ESC** key.

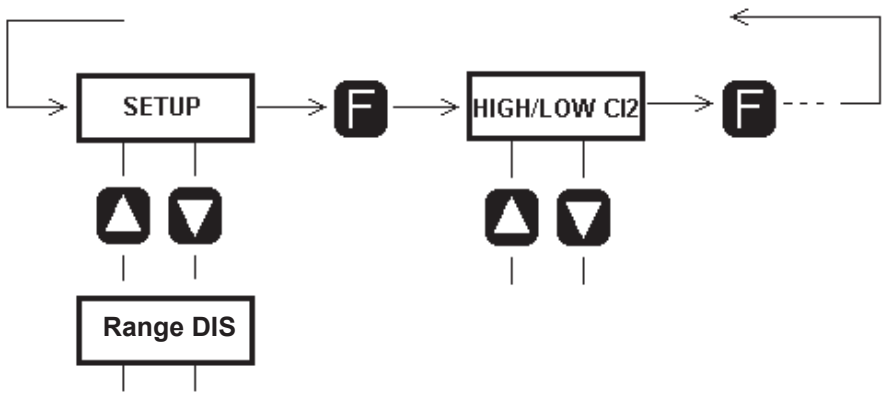


Figure 3.2 - Menu Selection

3.1.2.3 Changing the Settings

a. Select the menu to be changed.

b. Press the ✓ key, “>” is displayed.

c. Using the arrow keys increase or decrease the value or skip to the next selection.

d. Store the changed setting by pressing the ✓ key.

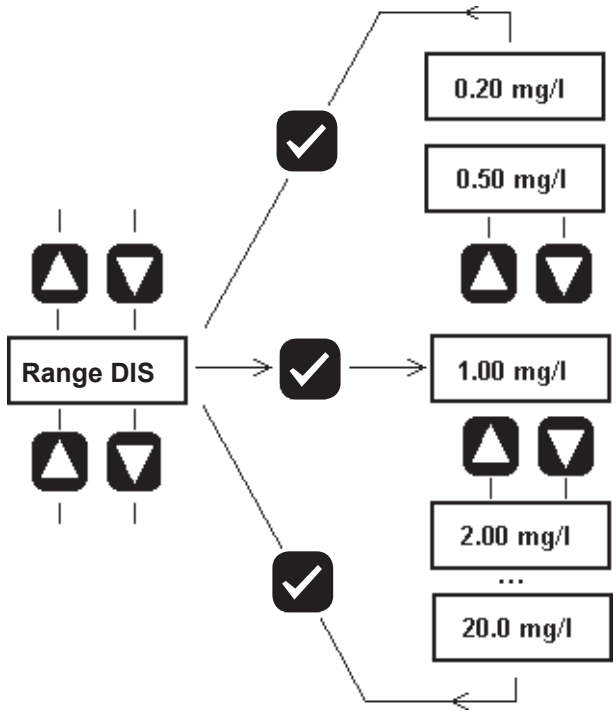


Figure 3.3 - Setting Changes

As long as the new value has not been stored by pressing the ✓ key, pressing the **ESC** key will return to the former setting. Select the next menu to be accessed with the arrow keys ▲ and ▼.

3.1.3 Menu Summaries

These summaries contain all menus of the respective versions. Depending on the setting a few menus are not necessary and therefore not displayed.

Table 3.1 - Menu List / Disinfection Only

ROOT	CALIBRATION	HIGH/LOW	ALARM RELAY 1/2	ALARM RELAY 3/4	SETUP	SETUP mA	SIGNAL DIAG.	SYSTEM DIAG.
DIS Value	DIS zero *	DIS min	Relay Assign 1	Relay Assign 3	Range DIS	mA Output	Cell DIS	Keypad Test
Temperature*	DIS span	DIS max	Relay Function 1	Relay Function 3		mA 1 Assign	Temperature *	Display Test
Menu Extend		DIS setpoint	Relay Delay 1	Relay Delay 3		mA 2 Assign		System Reset
		DIS deadband	Relay Assign 2	Relay Assign 4	Code Definition	mA 3 Assign	mA Out 1	System Shutdown
			Relay Function 2	Relay Function 4	Hold Function		mA Out 2	RS485
			Relay Delay 2	Relay Delay 4	Language		mA Out 3	Software Release
					RS485 addr. DIS		Local Operation	
					DIS Sensor		Rel.: 1 2 3 4	
					Select		DI: 1 2 3	
					Temperature		VF Conv. 1	

* Bare Electrode only.

Table 3.2 - Menu List / Disinfection + pH

ROOT	CALIBRATION	HIGH/LOW DIS	ALARM RELAY 1/2	ALARM RELAY 3/4	SETUP	SETUP mA	SIGNAL DIAG.	SYSTEM DIAG.
DIS Value	DIS zero*	DIS max.	Relay Assign 1	Relay Assign 3	Range DIS	Cal. code	Cell DIS	Keypad Test
pH Value	DIS span	DIS min.	Relay Function 1	Relay Function 3	Range pH	Cal. DIS 4mA	pH sensor	Display Test
Temperature	Offset pH	DIS Setpoint	Relay Delay 1	Relay Delay 3	Code Definition	Cal. DIS 20mA	Temperature	System Reset
Menu Extent	Calibr. at pH 7.00	DIS Deadband	Relay Assign 2	Relay Assign 4	Hold Function	Cal. pH 4mA	mA Out 1	System Shutdown
	Calibration pH	pH max.	Relay Function 2	Relay Function 4	Language	Cal. pH 20mA	mA Out 2	RS485
	Calibration Temp.	pH min.	Relay Delay 2	Relay Delay 4	RS485 addr.	mA output	mA Out 3	Software Release
		pH Deadband			DIS Sensor	mA 1 Assign.	Local Operation	
					Select (pH)	mA 2 Assign.	Rel.: 1 2 3 4	
					Mode Cl2 free*	mA 3 Assign.	DI: 1 2 3	
					Temperature		VF Conv. 1	
							VF Conv. 2 *	
							VF Conv. 3 (temp)	

* Bare Electrode only.

Table 3.3 - Menu List / Disinfection + Fluoride

ROOT	CALIBRATION	HIGH/LOW	ALARM RELAY 1/2	ALARM RELAY 3/4	SETUP	SETUP mA	SIGNAL DIAG.	SYSTEM DIAG.
DIS Value	DIS zero*	DIS max.	Relay Assign 1	Relay Assign 3	Range DIS	mA Output	Cell DIS	Keypad Test
	DIS span	DIS min.	Relay Function 1	Relay Function 3	Code Definition	mA 1 Assign	Fluor Sensor	Display Test
Fluor Value		DIS Setpoint	Relay Delay 1	Relay Delay 3	Hold Function	mA 2 Assign	Temperature	System Reset
Temperature	Fluor offset	DIS Deadband	Relay Assign 2	Relay Assign 4	Language	mA 3 Assign	mA Output 1	System Shutdown
Menu Extend	Fluor zero	Fluor max.	Relay Function 2	Relay Function 4	RS485 addr.		mA Output 2	RS485
	Fluor span	Fluor min.	Relay Delay 2	Relay Delay 4	DIS Sensor		mA Output 3	Software Release
	Calibration Temp	Fluor Deadband			Select (Fluoride)		Local Operation	
					Temperature		Rel.: St:	
							Di: St:	
							VF Conv. AE1	
							VF Conv. AE2	
							A/D AE3	

* Bare Electrode only.

3.1.3.1 Display Menu

Display	Value Range (defaults bold)	Description
Free Chlorine **0.00mg/l**	range	**1. measurement with unit and sensor type** Free Chlorine Total Cl_2 TC1 Free Cl_2 FC1 Ozone OZ7 Chlorine Dioxide
pH-value **7.00pH** or **Fluor** **0.00mg/l**	range	**2. measurement with unit** selectable between pH or fluor measurement
Temperature **20°C**	range	**3. measurement with unit**
menu	short **long**	**menu length** - short menu; only main display and calibration is shown - leng menu: all menus are shown
Code	**000** 999	**Code** input of the code number Only if this value is the same as defined in “Code-Def.” - menu, you can adjust settings. If not the error message “code ???” is shown. This menu only appears if the user code is not 000.

3.1.3.2 Calibration Menu

Display	Value Range (defaults bold)	Description
CALIBRATION		**Calibration-Menu** All calibration settings take place via this menu path.
DIS zero	range	**Disinfection - zero adjustment** Pressing the Check-button sets the disinfection reading to zero.
DIS span	range	**Disinfection - span adjustment** You put in the result of the Comparison measurement to calibrate the disinfection span.
offset pH	-1.00 pH +1.00 pH **0.00 pH**	**pH-Offset-Adjustment** (only in case of pH-selection) This value is added to the actual pH reading.
calibr. at pH7	range	**pH-Calibration** (only in case of pH-selection) First point of the pH-calibration.
calibration pH	range	**pH-Calibration** (only in case of pH-selection) Second point of the pH-calibration.
offset fluor	-1.00 mg/l +1.00 mg/l **0.00** mg/l	**Fluoride-Offset-Adjustment** (only in case of fluoride-selection) This value is added to the actual fluoride reading.
Fluor zero	range	**Fluoride-Calibration** (only in case of fluoride-selection) First point of the fluoride-calibration (two point calibration).
Fluor span	range	**Fluoride-Calibration** (only in case of fluoride-selection) Second point of the fluoride-calibration (two point calibration).
calibration temp	**20.0°C** -5.0°C +5.0°C	**Calibration of sample water temperature** You can adjust the reading of the sample water measurement (-5...+5°C).

3.1.3.3 High/Low Menu

Display	Value Range (defaults bold)	Description
HIGH/LOW		**High/Low - Limits**
DIS max	range **0.80 mg/l**	**Max. limit-value for the disinfection measurement**
DIS min	range **0.10 mg/l**	**Min. limit-value for the disinfection measurement**
DIS setpoint	range **0.10 mg/l**	**Dosing contact**
DIS deadband	1 Digit 25 Digit **3 Digit**	**Deadband for the disinfection limits**
pH max	range **7.80 pH**	**Max. limit-value for the pH measurement** (only in case of pH-selection)
pH min	range **6.80 pH**	**Min. limit-value for the pH measurement** (only in case of pH-selection)
pH deadband	1 Digit 25 Digit **3 Digit**	**Deadband for the pH limits** (only in case of pH-selection)
Fluor max	range **2.00 mg/l**	**Max. limit-value for the fluoride measurement** (only in case of fluoride-selection)
Fluor min	range **0.20 mg/l**	**Min. limit-value for the fluoride measurement** (only in case of fluoride-selection)
Fluor deadband	1 Digit 25 Digit **3 Digit**	**Deadband for the fluoride limits** (only in case of fluoride-selection)

3.1.3.4 Alarm Relay 1/2 Menu

Display	Value Range (defaults bold)	Description
ALARM RELAY 1/2		**Definitions for alarm realy 1 and 2**
relay assign. 1	DIS max DIS min pH max pH min Fluor max Fluor min DI1 DI2 DI3 gen. fault dosing cont.	**Assignment for alarm relay 1** (multiple selection possible)
realy function 1	**N.O. unlatched** N.C. unlatched N.O. latched res N.C. latched res N.O. latched ack N.C. latched ack	**Operation mode and function for alarm relay 1** N.O.: normally open N.C.: normally closed unlatched: relay not latching latched res.: latching, reset latched ack.: latching, reset with acknowledge (not visible when dosing contact is selected)
relay delay 1	**0 min** 600 min	**Delay time for alarm relay 1** (not visible when dosing contact is selected)
relay assign. 2	DIS max DIS min pH max pH min Fluor max Fluor min DI1 DI2 DI3 gen. fault	**Assignment for alarm relay 2** (multiple selection possible)
realy function 2	N.O. unlatched N.C. unlatched N.O. latched res N.C. latched res N.O. latched ack N.C. latched ack	**Operation mode and function for alarm relay 2** N.O.: normally open N.C.: normally closed unlatched: relay not latching latched res.: latching, reset latched ack.: latching, reset with acknowledge
relay delay 2	**0 min** 600 min	**Delay time for alarm relay 2**

3.1.3.5 Alarm Relay 3/4 Menu

Display	Value Range (defaults bold)	Description
ALARM RELAY 3/4		**Definitions for alarm realy 3 and 4**
relay assign. 3	DIS max DIS min pH max pH min Fluor max Fluor min DI1 DI2 DI3 gen. fault	**Assignment for alarm relay 3** (multiple selection possible)
realy function 3	**N.O. unlatched** N.C. unlatched N.O. latched res N.C. latched res N.O. latched ack N.C. latched ack	**Operation mode and function for alarm relay 3** N.O.: normally open N.C.: normally closed unlatched: relay not latching latched res.: latching, reset latched ack.: latching, reset with acknowledge
relay delay 3	**0 min** 600 min	**Delay time for alarm relay 3**
relay assign. 4	DIS max DIS min pH max pH min Fluor max Fluor min DI1 DI2 DI3 gen. fault	**Assignment for alarm relay 4** (multiple selection possible)
realy function 4	N.O. unlatched N.C. unlatched N.O. latched res N.C. latched res N.O. latched ack N.C. latched ack	**Operation mode and function for alarm relay 4** N.O.: normally open N.C.: normally closed unlatched: relay not latching latched res.: latching, reset latched ack.: latching, reset with acknowledge
relay delay 4	**0 min** 600 min	**Delay time for alarm relay 4**

3.1.3.6 Setup Menu

Display	**Value Range** (defaults bold)	Description
SETUP		**Setup-menu**
range DIS	0 - 0.20 mg/l 0 - 0.50 mg/l 0 - 1.00 mg/1 0 - 2.00 mg/l **0 - 5.00 mg/l** 0 - 10.0 mg/l 0 - 20.0 mg/l	**Range for the disinfection measurement**
range pH	**4 - 10.00 pH** 0 - 14.00 pH	**Range for the pH measurement**
code definition	**000** 999	**Definition of the lock code**
hold function	**on** off	**Hold-Function** If switched on, the readings of the measurements are frozen as long as you stay in the calibration (no peeks on the line recorder, no switching of the alarm relays).
language	german **english** french spanish	**Language of the menus**
RS485 address	00 31	**Bus address for RS485-Mode**
DIS-sensor	3-electr.system Membrane sensor TC1 FC1 OZ7 CD7 Off	**Selection of the connected disinfection sensor** Selection of membrane sensor or 3 electrode system (bare electrode) on the PCB with dip switches.
select	**pH** Fluor Off	**Selection of the second input sensor**
temperature	PT100 **PT1000** Off	**Selection of the used temperature sensor** Depolox® 3 *plus* - PT100, Depolox® 5 - PT1000, Membrane Probes - Off.
mode Cl2 free	**normal** pH compensated	**Selection of the calculation for the disinfection sensor** (only in case of 3-electr.system + pH + temperature on)

3.1.3.7 Setup mA Menu

Display	**Value Range** (defaults bold)	Description
SETUP mA		**Setup-Menu** (general setup, communication connections)
mA output	0 - 20 mA 4 - 20 mA **AUS**	**Mode of the mA-Outputs** AUS = Off
mA1-assign.	**DIS** pH Fluor temperature	**Assignment of the mA-output 1**
mA2-assign.	DIS **pH** Fluor temperature	**Assignment of the mA-output 2**
mA3-assign.	DIS pH Fluor **temperature**	**Assignment of the mA-output 3**

3.1.3.8 Signal Diagnosis Menu

Display	Value Range (defaults bold)	Description
SIGNAL DIAG.		**Signal Diagnosis Menu**
cell DIS	+3.5 µA 5µA/mg/l (1µA) 0 h	**Informations about the DIS-cell** With pressing the Check-Button, you can step between following informations: - actual reading of the cell current - calibration data (zero and span) - past hours since the last calibration
pH sensor	+59 mV 59mV/pH (+5mV) 0 h	**Informations about the pH-sensor** With pressing the Acknowledge-Button, you can step between following informations: - actual reading of the cell voltage - calibration data (zero and span) - past hours since the last calibration
fluor sensor	+59 mV 59mV/pH (+5mV) 0 h	**Informations about the fluor-sensor** With pressing the Acknowledge-Button, you can step between following informations: - actual reading of the cell voltage - calibration data (zero and span) - past hours since the last calibration
temperature	21.3° C (+2.7° C) 0 h	**Informations about the temperature measurement** With pressing the Acknowledge-Button, you can step between following informations: - actual reading of the uncalibrated temperature - calibration offset - past hours since the last calibration
mA output 1 **4 mA 0%**		**Informations about mA-output 1** The output value is shown in mA and in %
mA output 2 **4 mA 0%**		**Informations about mA-output 2** The output value is shown in mA and in %
mA output 3 **4 mA 0%**		**Informations about mA-output 3** The output value is shown in mA and in %
local operation	**normal** service	**Special mode for system service** Relay outputs are frozen in non-alarm states. mA output is frozen. Analyzer will not return to main display. Operating mode is automatically set to normal when leaving the diagnostics menu group or cycling power.

Signal Diagnosis Menu (Cont'd)

Display	Value Range (defaults bold)	Description
REL: 1 2 3 4 **St: 1 0 0 0**		**Informations about the relay status** 1: alarm relay 1 (0: unpowered/1: powered) 2: alarm relay 2 3: alarm relay 3 4: alarm relay 4 Press Enter and then the up or down arrow to select the relay, to change the relay state for testing press Enter. After leaving this menu the relay goes back to previous state.
DI: 1 2 3 **St: 1 0 0**		**Informations about the digital status** 1: digital input 1 0: closed (inactive) 2: digital input 2 1: open (active) 3: digital input 3
VF Conv. AE1 **14.07 kHz**		**Actual measurement of the input 1** (disinfection)
VF Conv. AE2 **14.07 kHz**		**Actual measurement of the input 2** (pH or fluoride)
A/D (PT1000) AE3 **356 Digit** **or** **A/D (PT100) AE3** **356 Digit**		**Actual measurement of the input 3** (temperature)

3.1.3.9 System Diagnostics Menu

Display	Value Range (defaults bold)	Description
SYSTEM DIAG.		**System Diagnosis Menu**
keypad test	press Acknowl. press Up press Down press Star press ESC press F	**Test of all buttons of the keypad**
display test		**Test of the display** All dots of the matrix display are on.
system restart	**no** yes	**Restart of the system (RESET)**
system shutdown	**no** yes	**Shutdown the system** All functions are disabled, only a dot is shown in the display. Wakeup is initialized with pressing any button.
RS485		**Informations about the RS485 Communication** A valid communication on the RS485 interface is shown with the message “RxD”, “TxD” and INT”.
softwarerelease	V: 1.00 19.JUL.2006 EAE1053 FRG 49	**Informations about the internal software release** Alternating display

3.1.4 Code Number

To protect the settings against unauthorized access or an inadvertent change, the settings should be locked using a freely selectable code number. The settings can be displayed, but not changed. If an attempt is made, then “Code???” is displayed before reverting to the former setting.

After switching on, after a RESET or generally after one hour without pressing a key, the code number is set to 0. If the unit is locked, settings can only be changed after entry of the correct code number. Locking can be selected in the “Lock Setting” menu.

To alter the number again, enter the new code number in the SETUP menu under “Lock code set”. If you then want to block access to unauthorized operators, immediately change the code in the SETUP menu to another number and set to “Locked” in the “Lock Setting menu”.

In order to provide general access, select “Unlocked”. This means that changes are possible at any time without having to enter a code. Code is no longer displayed in the main menu. However, another code number can now be entered and access denied to all those operators who do not know the new number.

The unit is delivered with the “Lock code set” = 0, “Lock setting” = Unlocked. If the code number is forgotten enter the back entry code 911.
You can only alter the values in the protected menus once you have set the correct code number in the SETUP menu and thus proved that you are an authorized operator.

3.1.5 High - Low Alarms

The Depolox® 3 *plus* has independent alarms that can be allocated to the measured values for chlorine (and optionally for pH or fluoride).

Menu Setting	Alarm Condition	Action
High	X ≥ alarm value	alarm message on
	X ≤ (alarm value - deadband)	alarm message off
Low	X ≤ alarm value	alarm message on
	X ≥ (alarm value - deadband)	alarm message off

The deadband can be set in the range of one to 25 digits.

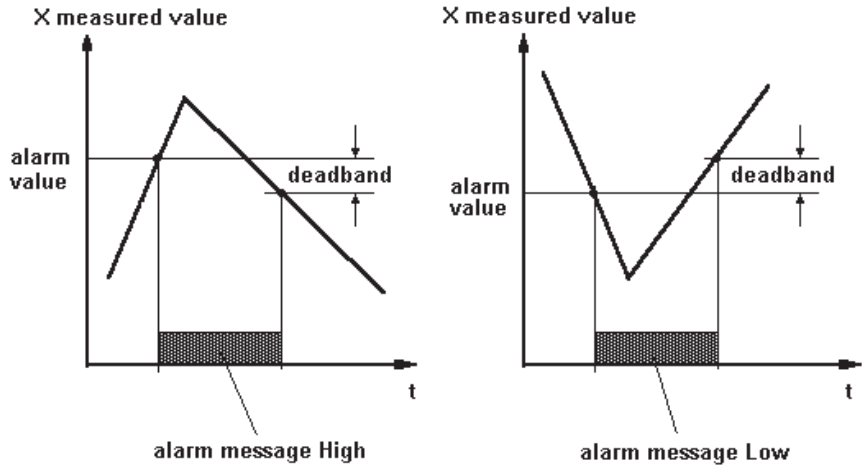


Figure 3.4 - High / Low Alarms

3.1.6 Alarm Relays

Depolox® 3 *plus* features the following alarm relays:

- Two relays in single electronics unit.
- Four relays in dual electronics unit.

Definitions for switching the relays:

DIS max:	relay reacts to the set value
DIS min:	relay reacts to the set value
pH max:	relay reacts to the set value
pH min:	relay reacts to the set value
Fluor max:	relay reacts to the set value
Fluor min:	relay reacts to the set value
DI1, DI2, DI3:	relay is activated as long as there is a signal on the digital input
general fault:	relay is activated as long as there is an alarm message
dosing contact:	relay is energized as long as the actual value is below the setpoint (for relay 1 only)

Selections:

normally open (N.O.):	relay is energized in case of an alarm.
fail safe (N.C.):	relay is de-energized in case of an alarm
non latching:	relay is de-energized as soon as the alarm condition has ceased
latching:	relay stays energized after the alarm until the star key "✳" is pressed to acknowledge the alarm

3.1.7 Dosing Contact for Chlorine

The chlorine alarm relay 1 can be used to switch-on a pump or solenoid valve for dosing chlorine.

The relay is energized if "AR 1 Definition" is set to "dosing contact" and the actual value is < setpoint.

3.1.8 mA Outputs

For each sensor there is an mA current signal output (e.g., for connecting an additional display). The range fixed at 4...20mA corresponds to the measuring range. For example, for a Membrane range of 0 to 5 mg/l:

0 mg/l: 4 mA
5 mg/l: 20 mA

The signal that is output corresponds to the measured value. The connected impedance must not be higher than 1000 Ohm. Broken wires or open mA loops will be detected.

3.1.9 Restoring Factory Settings (Initialize)

If the instrument does not respond correctly to software adjustments or corrections, or if software or hardware conditions have changed significantly, the operator may restore factory settings to return the software to normal operating parameters by performing the following operation.

Remove power to the electronics. Return power, while pressing and holding the ✳ button until "INIT" appears, then release. Factory settings have now been restored.

NOTE: Restoring the factory settings does not guarantee correct operation and may produce a reduced accuracy, until calibration, if operation does occur.

3.2 Depolox® 3 *plus* - Calibration

3.2.1 Free Chlorine (W2T9694 and W2T7957 Bare Electrode) Calibration

When calibrating with the pH compensation option, note that the pH value must be calibrated or verified first so that the subsequent Cl_2 calibration is automatically adjusted by the correct pH value.

To achieve this, the prompt "pH correct, yes/no?" appears in the menu. When confirmed by "Yes," direct access is granted to chlorine calibration "Zero Calibration," below. If answered with "No," pH calibration follows.

NOTE: The relays and mA outputs follow the measured values. If necessary, switch off the alarm relays.

- Zero Calibration

  a. Starting from the basic display press the **F** key until the "CALIBRATION" menu is displayed. Press the ▼ key until the "Cl_2 zero" menu is found.

  b. Close the shut-off valve at the flow block assembly, stopping all flow to unit. Wait until the displayed value ceases changing.

  c. Press the ✓ key twice in order to set the display to "0.00".

  d. Go to the root menu. Display will be 0.00 mg/l

     In case of calibration error *Cal. Cl_2?*: Ensure that the sample water is completely stopped and repeat calibration. If the calibration er-

ror condition continues, it may be necessary to adjust the cell voltage Upot: Go to SIGNAL DIAG. and menu "Cl_2 cell current".

NOTE: New units are factory calibrated. No Upot adjustments are required on new units during initial calibrations.

If the display still does not read 0.00 mg/l after calibration, adjust the potentiometer Upot so that the displayed cell current is ±0.5 µA (turning clockwise reduces the current) (see Figure 3.5). The current will change very slowly. Wait one half hour and check again. Perform calibration again.

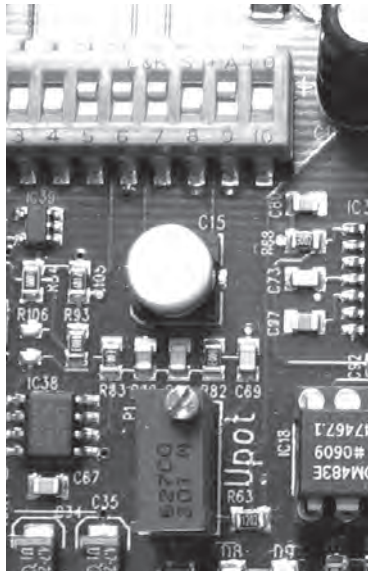


Figure 3.5 - Upot Adjustment

e. Let the sample water flow again.

NOTE: When there is no key pressed for five minutes, the Depolox® 3 *plus* returns to the basic display.

- Span calibration

a. After zero calibration wait at least two minutes. Then take a sample at the measuring cell. Determine the residual value of this sample.

b. Press the ▼ key until the menu "DIS span" is reached. Press the ✓ key to open the menu.

c. Press keys ▼ or ▲ until the displayed value agrees with the manually measured value.

d. Store the value using the ✓ key. The chlorine measuring cell is now calibrated. In case of an error message, refer to paragraph 4.1.1, Errors.

e. Return to the basic display by pressing the **ESC** key twice.

3.2.2 Membrane Sensor Calibration (All Membrane Types)

a. Take a sample at the measuring cell. Determine the residual value of this sample.

b. Starting from the basic display, press the **F** key until the "Calibration" menu is displayed.

c. Press the ▼ key until the menu "DIS span" is reached. Press the ✓ key to open the menu.

d. Press keys ▼ or ▲ until the displayed value agrees with the manually measured value.

e. Store the value using the ✓ key. The disinfectant measuring cell is now calibrated. In case of an error message refer to paragraph 4.1.1, Errors.

f. Return to the basic display by pressing the **ESC** key twice.

3.2.3 pH Calibration

NOTE: pH measurement is optional.

WARNING: DO NOT CONTINUE TO USE BUFFER SOLUTIONS AFTER USE-BY DATE. BUFFER SOLUTIONS THAT HAVE BEEN OPENED CAN ONLY BE KEPT FOR A LIMITED PERIOD. READ THE LABEL ON THE BOTTLE.

NOTE: Sample water and buffer solution should have the same temperature.

In case sample water temperature deviates from the reference temperature of 77° F (25° C), calibrate the resp. value shown in the temperature table (see label on buffer solution).

There are two methods for pH calibration. The first adjusts the zero and the span settings for the pH range. The second calibration is an "offset," in which the pH sensor is exposed to a known pH solution and the displayed value is adjusted, up or down, to match the known value. This calibration can also be performed on the process water with the sensor in the flow cell. Verify that the pH of the process water has been accurately determined.

NOTE: The offset calibration is typically all that is recommended to calibrate pH when first starting the unit or replacing the sensor. The Depolox® 3 *plus* zero and span values are factory set in order to properly work with the sensor. Complete the zero and span calibrations, if there is a problem, only after completing the offset calibration.

- pH OFFSET Calibration

  a. With sensor in flow block, test sample pH.

  b. Press the **F** key until the "CALIBRATION" menu is displayed. Press the ▼ key until the "pH offset" menu is found.

  c. Press the ✓ key.

  d. Press ▼ or ▲ keys until the offset value is the difference of the displayed pH value compared to the manually measured value. Store this value using the ✓ key. (Example: For pH7 solution, the basic display reads 7.15pH. The offset value will be adjusted to -0.15 because the value is to come down from 7.15pH to 7.00pH.)

  e. Return to the basic display by pressing the **ESC** key twice.

- pH Zero Calibration (Isothermal Intersection, pH7):

  a. Starting at the basic display press the **F** key until the "CALIBRATION" menu is displayed. Press the ▼ key until the "pH zero" menu is found.

  b. Withdraw the pH sensor. Fill 10 to 20 ml "pH7.00" buffer solution into a 100 ml beaker. Dip the sensor at least 20mm deep in the buffer solution pH7.00 and agitate lightly until the displayed pH value remains constant.

  c. Press the ✓ key.

  d. Press the ▼ or ▲ keys until the displayed value agrees with the value of the pH buffer solution. Store this value using the ✓ key.

- pH Span Calibration:

  a. Rinse the sensor in distilled water (in order to avoid spreading the buffer solution).

  b. Press the key ▼ until the "pH span" menu is reached.

  c. Pour 10 to 20ml pH4 or pH10 buffer solution into another beaker. Dip the pH sensor at least 20mm deep in the buffer solution and agitate lightly until the displayed pH value remains constant. (In case another buffer solution is used: the pH value of the buffer solution must be less than pH6 or greater than pH8.)

  d. Press the ✓ key to open the "pH Span" menu.

e. Press keys ▼ or ▲ until the displayed value agrees with the value of the pH buffer solution. Store this value using the ✓ key. The measuring cell is now calibrated.

f. Replace the sensor into the flow block.

g. Dispose of the buffer solutions, rinse with enough water.

h. Return to the basic display by pressing the **ESC** key twice or skip to fluoride calibration.

In case of error, both calibration points must be calibrated again.

3.2.4 Fluoride Calibration

NOTE: Fluoride measurement is optional.

WARNING: DO NOT CONTINUE TO USE BUFFER SOLUTIONS AFTER USE-BY DATE. BUFFER SOLUTIONS WHICH HAVE BEEN OPENED CAN ONLY BE KEPT FOR A LIMITED PERIOD. READ THE LABEL ON THE BOTTLE.

NOTE: Sample water and buffer solution should have the same temperature.

In case sample water temperature deviates from the reference temperature of 77° F (25° C), calibrate the resp. value shown in the temperature table (see label on buffer solution).

There are two methods for fluoride calibration. The first adjusts the zero and the span settings for the fluoride range. The second calibration is an “offset,” in which the fluoride sensor is exposed to a known fluoride concentration solution and the displayed value is adjusted, up or down, to match the known value. This calibration can also be performed on the process water with the sensor in the flow cell. Verify that the fluoride concentration of the process water has been accurately determined.

NOTE: The offset calibration is typically all that is recommended to calibrate fluoride when first starting the unit or replacing the sensor. The Depolox® 3 *plus* zero and span values are factory set in order to properly work with the sensor. Complete the zero and span calibrations, if there is a problem, only after completing the offset calibration.

- Fluoride OFFSET Calibration

  a. With sensor in flow block, test sample Fluoride residual.

  b. Press the **F** key until the “CALIBRATION” menu is displayed. Press the ▼ key until the “Fluoride offset” menu is found.

c. Press the ✓ key.

d. Press ▼ or ▲ keys until the offset value is the difference of the displayed fluoride value compared to the manually measured fluoride solution value. Store this value using the ✓ key. (Example: The flow is measured at 0.20 mg/l fluoride solution. The basic display reads 0.28 mg/l fluoride. The offset value will be adjusted to "- 0.08 mg/l fluoride" because the value is to come down from 0.28 mg/l to 0.20 mg/l.)

e. Return to the basic display by pressing the **ESC** key twice.

- Calibration at 0.20 mg/l:

a. Starting at the basic display press the **F** key until the "CALIBRATION" menu is displayed. Press the ▼ key until the "Fluor zero" menu is found.

b. Withdraw the fluoride sensor. Fill 10 to 20 ml "0.20 mg/l" buffer solution into a 100 ml beaker. Dip the sensor at least 20mm deep in the buffer solution 0.20 mg/l and agitate lightly until the displayed value remains constant.

c. Press the ✓ key.

d. Press keys ▼ or ▲ until the displayed value agrees with the value of the buffer solution. Store this value using the ✓ key.

- Calibration at 2.00 mg/l:

a. Rinse the sensor in distilled water (in order to avoid spreading the buffer solution).

b. Press the key ▼ until the "Fluor span" menu is reached.

c. Fill 10 to 20ml "2.00 mg/l" buffer solution into another beaker. Dip the fluoride sensor at least 20mm deep in the buffer solution and agitate lightly until the displayed value remains constant.

d. Press the ✓ key to open the "Fluor Span" menu.

e. Press keys ▼ or ▲ until the displayed value agrees with the value of the buffer solution. Store this value using the ✓ key. The measuring cell is now calibrated.

f. Refit the sensor into the flow block.

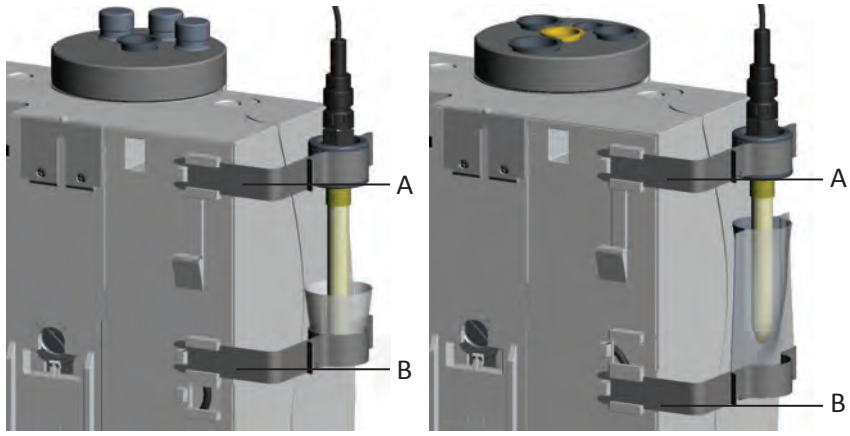
g. Dispose of the buffer solutions, rinse with enough water.

h. Return to the basic display by pressing the **ESC** key twice.

In case of error both calibration points must be calibrated again.

Calibration Aids

Two clips are installed in the housing cover of the Depolox® 5 Bare Electrode and the VariaSens™. These clips can be inserted into the rear panel of the housing. The clip (A) for the sensor will be inserted into the upper catch. When the electrodes are calibrated in the beaker with the calibration solution, the second clip (B) will be inserted into the catch (left figure). The lower clip position is provided for calibrating with the calibration solution bag (right figure).



A	Upper clip
B	Lower clip

3.2.5 Temperature Calibration

1. Starting from the basic display in the main menu select the “Calibration” menu.

2. Select the “Temperature” menu item

The “Calibr. temperature” window appears on the graphic display.

3. Select “Cal. temperature”.

4. Use the arrow keys to enter the correct value.

5. Press “Enter” key to confirm entry.

NOTE: °C or °F can be selected in the “Temp. unit” menu. In the “PT1000“ menu, the automatic temperature compensation with the multi-sensor can be switched on or off.

3.3 Free Chlorine (W2T9694 Bare Electrode) Sensor Kit

3.3.1 Start-Up of the Measuring Cell

a. Unscrew nut (2) and remove cover (3) (see Dwg. 50.560.000.010 in Section 5).

b. Hold electrode assembly together with electrolyte reservoir (4-11) at the cover (10) and pull it out of the cell block (13) without turning.

c. Remove felt ring (transport protection of the membrane, 6)

d. Exchange plug (4) with separately supplied plug fitted with membrane for venting the electrolyte reservoir.

e. Place electrode assembly with electrolyte reservoir back into the cell block. Keying pin in the electrode assembly must snap into position.

f. Fill a half capful of grit into the cell block.

g. Place cover (3) and tighten by nut (2).

h. Allow sample water flow by opening the inlet valve(s).

i. After one hour the measuring signal has stabilized so far that a first calibration should be made as function test.

NOTE: For the first starting-up: After 24 hours of running time a further calibration is necessary. Air bubbles building up at the inner surface of the cell block and preventing somewhat the rotation of the grit will disappear after a running-in period of 24 to 48 hours.

3.3.2 Adjusting the Flow Regulator

The flow regulator is adjusted to a flow of 33 l/h (=0.55 l/min.). If necessary adjust the regulator as follows:

NOTE: Units are factory calibrated. Adjustment is only required if maintenance is performed on the flow valve.

a. Remove the left or right hinge pin at the measuring cell and tilt the housing front to the side.

b. At the inner side of the front is the flow regulator. In the middle of the regulator is the adjusting screw. Turn the screw with a coin or a screwdriver (>10 mm). Turn to the right to reduce flow; turn to the left to increase flow.

c. Check flow and reassemble.

d. Perform calibration.

3.3.3 Free Chlorine (Depolox® 5 Bare Electrode) Flow Block Assemby

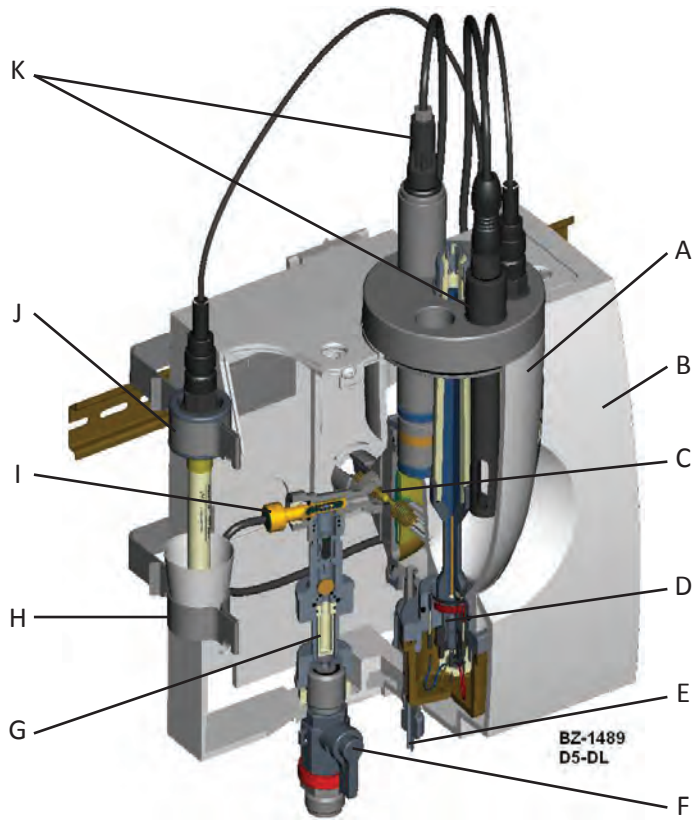
The Depolox® 5 bare electrode flow block assembly contains the following:

- Cell body with cover
- Flow control valve
- 3 electrode cell for Cl_2, ClO_2, O_3, or $KMnO_4$
- Multi-sensor
- Drain
- Fine filter (For use only when membrane sensors are used.)
- Sample water inlet with check valve and ball valve

Two clips are installed in the housing cover. These are used to facilitate pH and fluoride calibration. Insert these clips into the rear panel of the housing. Insert one clip into the upper catch to attach the sensor. Insert the second clip into the center catch inorder to measure the buffer or calibration solution using the plastic cups provided.

The cell body can be equipped with up to five sensors.

A	Cell body with cover
B	Plastic housing
C	Flow control valve
D	3 electrode cell for Cl_2, ClO_2, O_3 or $KMnO_4$
E	Drain
F	Ball valve
G	Fine filter
H	Lower clip and cup
I	Multi-sensor
J	Upper clip
K	Sensors



3.3.4 Adding Grit (Depolox® 5 Bare Electrode)

1. Remove the protection plugs on the cell body cover of the Depolox® 5 flow block.

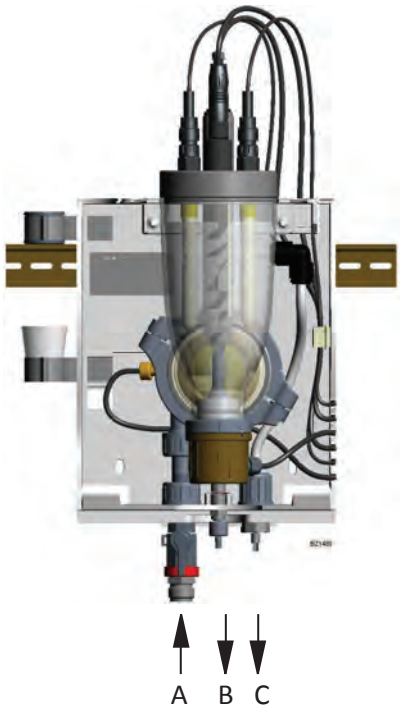
2. Fill half a cap from the plastic bottle with grit and pour it into the cell body (approx. 1/2 cm^3 grit).

3. Replace the protection plugs on the cell body cover of the Depolox® 5 flow block.

NOTE: Make sure that the opening is clean; rinse off with distilled water, if necessary.

NOTE: The system must be recalibrated approx. 4 hours after each time the grit is replaced. The calibration must be checked after one day.

3.3.5 Connecting the Sample Water (Depolox® 5 Bare Electrode and VariaSens™ Flow Block)



A	Sample water inlet with ball valve
B	Drain on the drain screw
C	Sample water outlet

Connecting the sample water inlet:

1. Never use copper tubing.

2. The pressure in the sample water inlet must always be within a range of min. 3 to max. 58 psi. At the same time, the pressure in the sample water inlet must generally be 3 psi higher than in the sample water outlet.

- If the preliminary pressure is below 3 psi, a pressure booster pump must be used.
- If the pressure exceeds 58 psi, a pressure reducing valve must be used.

3. To prevent long loop lag times, ensure that the pipes in the sample water inlet are as short as possible.

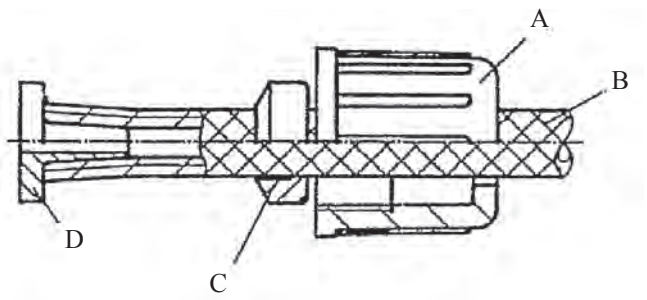
4. An external strainer with a mesh width of 0.02 inch is provided for the sample water inlet.

With hose connection:

<u>NOTE:</u> The water-tightness of the hose screw connection is only guaranteed if the following installation instructions are followed!

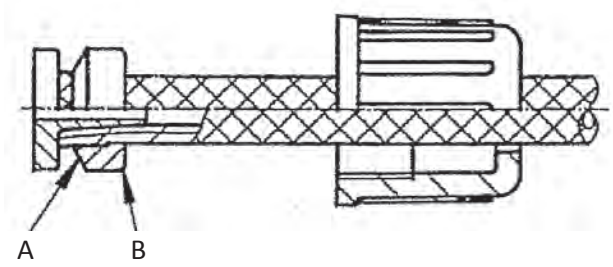
1. Release the union nut (A) on the hose screw connection.

2. Insert the hose (B) until it hits the hose bushing (D).



A	Union nut
B	Hose
C	Locking ring
D	Hose bushing

3. Push the locking ring out until the union nut engages the connecting threads.



A	30° pitch on this side
B	Rounding on this side

Locking ring for PVC hose with 2 clamping points:

With rigid pipework:

1. Connect the sample water pipework to the ball valve connection threads.

2. Ensure that the sample water pipework is installed without mechanical stress.

Connecting the sample water outlet:

NOTE: Never use copper tubing.

1. No back-pressure is permitted in the cell body. The sample water outlet must be open.

2. The sample water outlet must be installed so that no siphon effect can occur.

Recommendation: Position the outlet above the drain line opening.

With hose connection:

See hose connection instructions described in sample water inlet connection.

With rigid pipework:

1. Connect the sample water pipework to the connection nozzle.

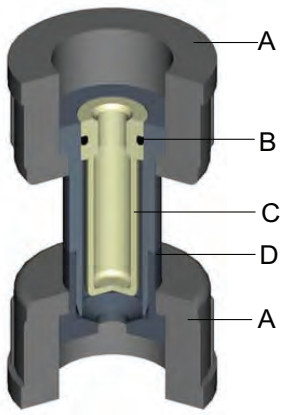
2. Ensure that the sample water pipework is installed without mechanical stress.

Connecting the drain:

1. Ensure that the drain screw is always closed.

3.3.6 Installing the Fine Filter

NOTE: A fine filter must only be installed when membrane sensors are employed. The fine filter (C) is included in the enclosed accessory set.



1. Release both knurled nuts (A).
2. Remove complete filter unit (D).
3. Place the fine filter (C) into the filter unit. Ensure that the O-ring (B) is seated correctly in the groove on the fine filter.
4. Reinstall the complete filter unit (D). Ensure that it is seated in the correct position.
5. Retighten both knurled nuts (A).

3.3.7 Bare Electrode Theory of Operation

The free chlorine that is measured in water for disinfection purposes comes in three forms. Free chlorine consists of elemental chlorine (Cl_2), hypochlorous acid (HClO), and hypochlorite ions (ClO-).

Hypochlorous acid is found in the acidic to neutral pH range undissociated in water. Only when the pH value rises does it break down into H+ and ClO- ions.

To understand the mode of functioning of chlorine as a disinfectant, it is necessary to know the chemical reactions that take place when water is chlorinated. Firstly there is the hydrolysis of the chlorine. This is the reaction of the chlorine with water. When chlorine gas is dissolved in water the formation of hypochlorous acid and hydrochloric acid results. All other disinfectants based on chlorine also react with water and form hypochlorous acid. The hypochlorous acid is the active substance for the disinfection process. Figure 3.6 shows the dependence of the form of chlorine on the pH value of the water. With rising

pH value, the share of hypochlorous acid decreases by dissociating to form H3O+ and ClO-. In other words, the hypochlorous acid needed as the active substance in disinfection becomes less with increasing pH value while the share of ClO- ions that are meaningless for disinfection rises.

The Free Chlorine (Bare Electrode) measuring cell consists of a three-electrode system with external potentiostatic closed-loop control. The working electrode and the counter electrode of the half-ring type are made of a platinum alloy. A silver/silver-chloride electrode serves as reference electrode; the contact between reference electrode and sample water is established by two membranes. The reference electrode is mounted in PVC brackets and completely submerged in electrolyte.

The electrolyte container is transparent, thus enabling a visual check to be made of the amount of electrolyte in the reservoir. Replenishment of the electrolyte is possible without shutting down the measuring cell system. A membrane in the plug of the electrolyte reservoir provides the necessary equalization of pressure.

The measuring cell is connected to a digital measuring amplifier which maintains an adjustable constant potential (Upot) between working and reference electrodes by means of potentiostatic closed-loop control.

About 33 l/hr of the water to be analyzed flows past this system of electrodes. The current generated in the measuring cell is directly proportional to the concentration of the oxidizing agent in the sample water. This current is then passed to the microprocessor-based electronic system Depolox® 3 *plus* for processing. A flow switch gives a signal to the Depolox® 3 *plus* if the flow is reduced (optional).

The surfaces of the electrodes are continuously cleaned by a special kind of cleaning grit in the electrode cell. The transparent plexiglass body of the cell makes it possible to observe the circulation of the grit in the cell.

If a double input electronics is used, a pH-value measurement will be inserted into the hole in the removable cover of the measuring cell. With the pH valve, used in conjunction with the chlorine measurement, it is possible to correct for variations caused by shifting pH.

The following features ensure accurate, repeatable measured data and reduce the frequency of zero point recalibration:

- potentiostatic control
- continuous hydromechanical electrode cleaning system
- regulated sample water flow.

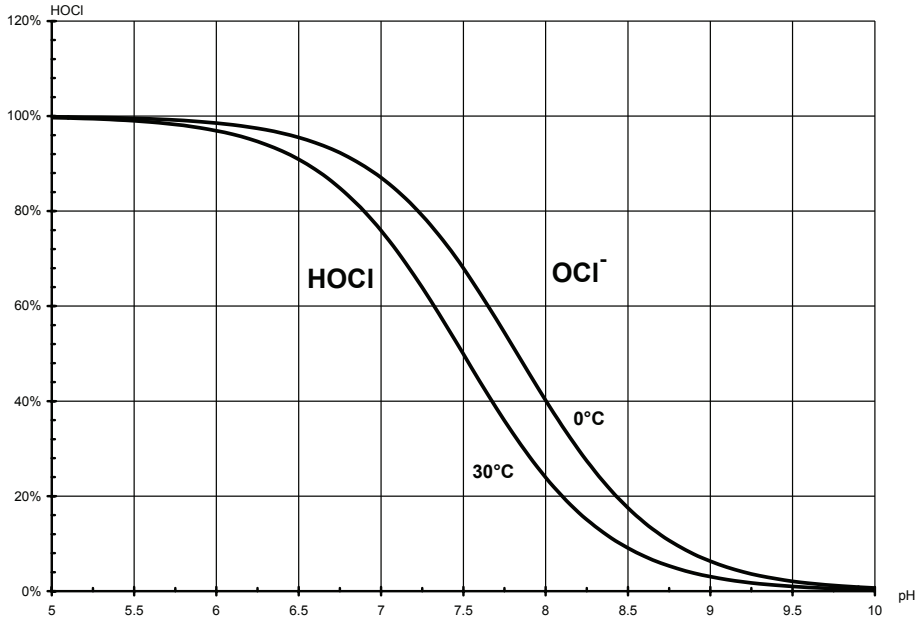


Figure 3.6 - Dissociation characteristics of HOCl and ClO- with pH value and showing effects of temperature

3.4 Membrane Sensor Kits

3.4.1 Start-Up the Flow Block Assembly

On completion of plant installation by trained, qualified personnel and prior to start-up, check that the sample water pipeline is securely connected and tested for leakage and that the sensor(s) are in place.

a. Open the sample water supply.

b. Check that the sample water stream directly points to the membrane of the Membrane sensor, if necessary turn the cover of the flow block assembly. Do not tolerate any air bubbles at the membrane of the sensor.

Start the Depolox® 3 *plus* module as described in paragraph 2.1.8, Start-Up.

3.4.2 System Shut-Down

- To switch-off the system for the short term:

  Switch off the electrical supply and close the sample water shut-off valve.

- To switch-off the system for the long term, for repairs, etc.:

  a. Switch off the entire system and isolate from the electrical supply

  b. Close the water shut-off valve on the flow block inlet

c. Allow water to drain from the flow block.

d. Remove one sensor after the other from the flow block.

e. Clean the sensors and store them as described below.

f. Cover the holes in the cover of the flow block with the protective caps.

To re-start the system, refer to paragraph 2.3, Membrane Sensor.

- To store the sensors after use:

  Remove the elastomer seal from the vent hole. Unscrew the membrane cap. Rinse the membrane and the reference electrode with distilled water. Carefully dry the reference electrode with a paper towel. Let the cap dry in a dust free place. Screw the dry membrane cap loosely onto the sensor. The membrane must not touch the gold working electrode.

3.4.3 VariaSens™ Flow Block Assembly

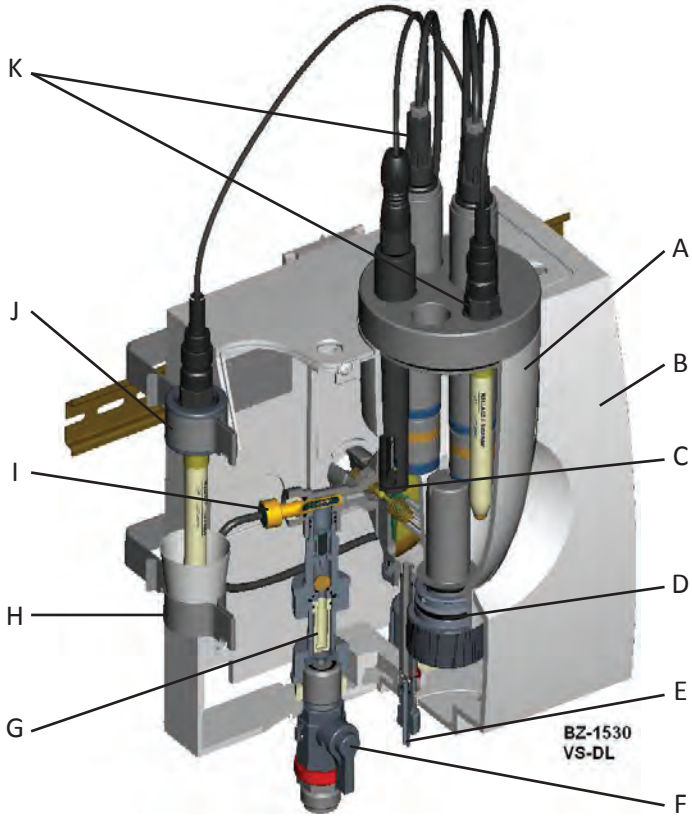
The VariaSens™ flow block assembly contains the following:

- Cell body with cover
- Flow control valve
- Multi-sensor
- Drain
- Fine filter (For use only when membrane sensors are used.)
- Sample water inlet with check valve and ball valve

Two clips are installed in the housing cover. These are used to facilitate pH and fluoride calibration. Insert these clips into the rear panel of the housing. Insert one clip into the upper catch to attach the sensor. Insert the second clip into the center catch inorder to measure the buffer or calibration solution using the plastic cups provided.

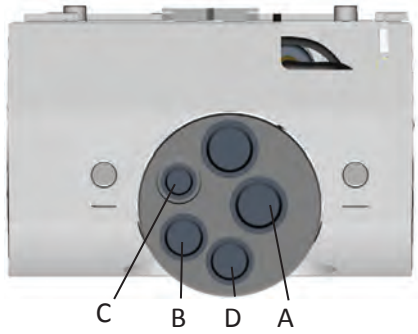
The cell body can be equipped with up to five sensors.

A	Cell body with cover
B	Plastic housing
C	Flow control valve
D	Drain
E	Ball valve
F	Fine filter
G	Lower clip and cup
H	Multi-sensor
I	Upper clip
J	Sensors



3.4.4 Insert the Sensors and Connect

Arrangement of the sensors:



AAD4165 VariaSens™

A	Membrane sensor: FC1, CD7, OZ7, TC1
B, C, D	Fluoride / pH

1. Remove the protection caps from the sensors.

2. Install sensors (see figure above) in the cell body cover.

The sensors are marked as follows:

Membrane sensor for free chlorine, chlorine dioxide, ozone and total chlorine (A)

pH: Sensor for fluoride or pH value, marked "F^-" or "pH" (B, C, D)

Keep the dust protection caps and watering caps of the sensors for subsequent use.

Cable extension:
The sensor cable for free chlorine and total chlorine may be extended to a max. of 50 m.

If the pH or fluoride sensor cables must be extended (max. 50 m), an impedance converter must be attached to the sensor. The impedance converter converts the very high-resistance sensor signal into a low-resistance signal. The impedance converter is supplied by an installed battery. The life of the battery is approx. 5 years; the impedance converter should be sent to the factory for battery replacement.

3.4.5 Decommissioning

CAUTION: Danger of uncontrolled dosing of chlorine or pH correction medium: Shut down dosing system, close positioner!

If the installation site of the flow block assembly is not frost-free, the system must be shut down prior to any possible frost formation.

1. Switch off the power supply.

2. Drain the sample water supply line and drainage line (hold container underneath).

3. Empty cell bodies and remove grit.

4. Dismantle the filter housing and the check valve housing.

5. When the remaining water has drained from the flow control valve, refit the filter housing and the check valve housing.

6. Remove the sensors from the cell body cover and disconnect from the cable (see section 2.3 "Membrane sensors").

7. Apply a KCl solution to the protection caps of the pH electrodes and fit onto the electrodes.

   The fluoride electrodes can be stored wet in the short term in a 100 mg/l fluoride solution at pH 7. Fill the electrodes in the tank with 100 mg/l fluoride solution and mount on the electrodes. However, the electrodes should be stored in a dry condition if they are to be warehoused for several months. In this case, drain the fill solution from the electrode chamber and wash the membrane and chamber with distilled water.

8. Store the sensors in a frost-free place.

   The water must be drained if frost occurs.

   Insert electrode in a beaker with water or electrolyte and store in a frost-free place.

9. Procedure for membrane sensors, see section 2.3 “Membrane sensors”.

   “Storing the membrane sensor for free chlorine FC1”
   “Storing the membrane sensor for chlorine dioxide CD7”
   “Storing the membrane sensor for ozone OZ7”
   “Storing the membrane sensor for total chlorine TC1”

3.4.6 Membrane Sensor Theory of Operation

The Membrane Sensor Kit consists of a flow through cell with a transparent Plexi-glass body that houses the chlorine sensors (and optionally the pH or the fluoride sensor). The cell’s transparency permits visual checks on the flow of sample water and measuring conditions.

The Membrane Sensor measures the sum of free chlorine and chloramines. The Sensor includes a membrane-covered potentiostatic 3 electrode system. The silver/silver-iodide reference electrode and gold working electrode are positioned inside the membrane cap filled with a potassium iodide electrolyte solution. The stainless steel counter electrode is located outside the membrane cap for added stability. Chlorine, diffusing through the membrane, causes a reaction at the working electrode, creating a current, which is a direct measure of Total Chlorine. An amplifier in the electrode shaft conditions this signal including temperature compensation and passes it to the microprocessor-based electronic system Depolox® 3 *plus* for processing.

Air bubbles on the membrane may prevent chlorine from passing through the membrane, resulting in a false reading of the probe. A water jet, designed into the flow block assembly, is used to remove any potential air bubbles from the membrane.

The sensor has a very low dependence on pH-value, so you can use it in water with varying pH-value. The sensor should be used only in potable water applications.

The sensor is designed such that a zero residual chlorine will yield zero current. Therefore only a single point calibration is needed.

The flow block assembly, housing the Membrane Sensor, is designed to provide a constant flow of water past the membrane surface. This and the potentiostatic three-electrode system ensure accurate and repeatable measured data.

- **FC1, OZ7, CD7:** The FC1 for Free Chlorine, the OZ7 for Ozone, and the CD7 for Chlorine Dioxide all work similarly, however, they utilize a silver/silver chloride reference electrode, a different electrolyte, and a different membrane to allow for the selectivity required for the different measurands.

3.4.6.1 Membrane Sensor for Free Chlorine FC1

The FC1 membrane sensor is a special sensor for measuring the concentration of free chlorine in water. The sensor incorporates a pH buffer in the electrolyte and is suitable for water with various pH values. The sensor may only be used in clear water of potable water quality.

CAUTION: The electrode fingers (reference electrodes) and membrane are extremely sensitive! Do not touch, soil or damage! Before unscrewing the filled membrane cap, push the elastomer seal to one side to permit the inflow of air through the vent underneath it! Otherwise, the membrane may be damaged due to developing negative pressure. Do not sand down the light yellowish-gray deposit of the electrode finger or wipe it in the direction of the gold working electrode! The electrolyte may spray out of the valve opening. Flush eyes and skin immediately with water after contact. Rinse away spilled electrolyte with water. The electrolyte contains potassium halide and is acidic.

Commissioning the Membrane Sensor for Free Chlorine FC1

1. Unscrew the membrane cap from the electrode shaft.

2. Place the membrane cap and the G-holder on a clean, non-absorbent pad and fill both with the included electrolyte bubble-free up to the top thread on the inside of the cap.

3. Rub gold working electrode with the included lapping paper (special emery). To do this, lay the lapping paper on a paper towel, take hold of the corner and while holding the measuring cell vertically (without G-holder), slide the electrode end two to three times over the rough side of the lapping paper.

4. Check whether the elastomer seal completely closes the valve opening.

5. Hold the electrode shaft vertically and carefully push the electrode finger into the filled G-holder.

6. Then place the electrode shaft on the filled membrane cap and slowly screw the membrane cap in place by hand.

<u>CAUTION</u>: Because excess electrolyte escapes through the valve opening, do not clamp it shut and do not press on the elastomer seal.

7. Rinse away the escaped electrolyte with water.

<u>NOTE</u>: The membrane cap must be completely screwed onto the electrode shaft so that there is no gap between the two! After approximately one hour, the membrane sensor is sufficiently run in so that it can be initially calibrated. The calibration must be repeated after approx. one day.

Inserting the Membrane Sensor for Free Chlorine FC1 Into the Flow-Through Adapter

1. Push the sensor through the cover into the flow-through adapter until it touches the inflow mating connector. It may be necessary to position the flow-through adapter cover correctly by turning it.

NOTE: Remove air bubbles from the surface of the membrane, bubbles on the membrane will interfere with the measurement!

2. Connect the measuring signal cable to the FC1.

Storing the Membrane Sensor for Free Chlorine FC1

1. Lift elastomer seal and unscrew membrane cap.

2. Remove G-holder (with tweezers, if necessary) and rinse together with the membrane cap and electrode finger with clean (distilled) water. Leave in a dust-free place to dry.

3. Then loosely screw the dry membrane cap onto the electrode shaft (place G-holder loosely into the membrane cap; not attached to electrode finger).

NOTE: The membrane may not touch the gold working electrode.

Restarting: Refer to “Commissioning the membrane sensor for free chlorine FC1”.

Error in Membrane Sensor for Free Chlorine FC1

Trouble-shoot and debug if the measuring signal is too low or irregular:

1. Remove air bubbles on the membrane (e.g. tap the inflow mating connector); air bubbles prevent the chlorine from diffusing through the membrane and distort the measurement.

NOTE: Air bubbles on the remaining parts of the sensor are normal after initial commissioning or restarting; they evaporate after one or two days.

2. Replenish electrolyte.

3. Open membrane sensor. To do this, push the elastomer seal to one side to permit the inflow of air and unscrew the membrane cap.

CAUTION: Do not unscrew the membrane holder from the membrane cap under any circumstances!

4. As a rule, the G-holder remains in the membrane cap.

5. Pour out the electrolyte.

6. Wash the electrode finger with clean (distilled) water and allow it to air dry.

7. Rub gold working electrode with the included lapping paper (special emery). To do this, lay the lapping paper on a paper towel, take hold of the corner and while holding the measuring cell vertically, slide the electrode end two to three times over the rough side of the lapping paper.

For further procedure, see "Commissioning the membrane sensor for free chlorine FC1". If the sensor's measuring signal is still too low or irregular, a new membrane cap must be used. The measuring cell requires one to two hours before it can be calibrated.

3.4.6.2 Membrane Sensor for Chlorine Dioxide CD7

The CD7 membrane sensor enables the chlorine dioxide content in all types of water to be determined selectively, without cross-sensitivity to chlorine, bromine and hydrogen peroxide, however, with cross-sensitivity to ozone and peracetic acid. The sensor does not demonstrate a pH value dependency and is therefore very suitable for water with various pH values.

CAUTION: The electrode fingers (reference electrodes) and membrane are extremely sensitive! Do not touch, soil or damage! Before unscrewing the filled membrane cap, push the elastomer seal to one side to permit the inflow of air through the vent underneath it! Otherwise, the membrane may be damaged due to developing negative pressure. Do not sand down the light yellowish-gray deposit of the electrode finger or wipe it in the direction of the gold working electrode!

Commissioning the Membranesensor for Chlorine Dioxide CD7

1. Screw off the membrane cap from the electrode shaft and fill with the included gel electrolyte.

2. Tap on the membrane cap with the electrode shaft until air bubbles are removed.

3. Rub gold working electrode with the included lapping paper (special emery). To do this, lay the lapping paper on a paper towel, take hold of the corner and while holding the measuring cell vertically, slide the electrode end one to two times over the rough side of the lapping paper.

4. Check whether the elastomer seal completely closes the valve opening.

5. Then place the electrode shaft on the filled membrane cap and slowly screw the membrane cap in place by hand.

NOTE: Because excess electrolyte escapes through the hose valve, do not clamp it shut and do not press on the elastomer seal.

6. Rinse way the escaped electrolyte with water.

NOTE: The membrane cap must be completely screwed onto the electrode shaft so that there is no gap between the two! After approximately two hours, the membrane sensor is sufficiently run in so that it can be initially calibrated. The calibration must be repeated after approx. one day.

Inserting the Membrane Sensor for Chlorine Dioxide CD7 Into the Flow-Through Adapter

1. Push the sensor through the cover into the flow-through adapter until it touches the inflow mating connector. It may be necessary to position the flow-through adapter cover correctly by turning it.

NOTE: Remove air bubbles from the surface on the membrane, bubbles on the membrane will interfere with the measurement!

2. Connect the measuring signal cable to the CD7.

Storing the Membrane Sensor for Chlorine Dioxide CD7

1. Lift elastomer seal and unscrew membrane cap.

2. Wash the membrane cap and electrode finger with clean (distilled) water.

3. Leave the electrode finger to dry in a dust-free place.

4. Leave the cap to dry in a dust-free place.

5. Then screw the dry membrane cap loosely onto the electrode shaft.

CAUTION: The membrane may not touch the gold working electrode.

Restarting: Refer to "Commissioning the membranesensor for chlorine dioxide CD7".

Error in Membrane Sensor for Chlorine Dioxide CD7

Trouble-shoot and debug if the measuring signal is too low or irregular:

1. Remove air bubbles on the membrane (e.g. tap the inflow mating connector); air bubbles prevent the chlorine dioxide from diffusing through the membrane and distort the measurement.

NOTE: Air bubbles on the remaining parts of the sensor are normal after initial commissioning or restarting; they disapate after one or two days.

2. Replenish electrolyte.

3. Open membrane sensor. To do this, push the elastomer seal to one side to permit the inflow of air and unscrew the membrane cap.

4. Pour out the electrolyte.

5. Wash the electrode finger and the membrane cap with clean (distilled) water and allow it to air dry.

For further procedure, see "Commissioning the membranesensor for chlorine dioxide CD7".

If the sensor's measuring signal is still too low or irregular, a new membrane cap must be used. The measuring cell requires one to two hours before it can be calibrated.

3.4.6.3 Membrane Sensor for Ozone OZ7

The OZ7 membrane sensor enables the ozone content in all types of water to be determined selectively, without cross-sensitivity to chlorine, bromine and hydrogen peroxide, however, with cross-sensitivity to chlorine dioxide and peracetic acid. The sensor does not demonstrate a pH value dependency and is therefore very suitable for water with various pH values.

CAUTION: The electrode fingers (reference electrodes) and membrane are extremely sensitive! Do not touch, soil or damage! Before unscrewing the filled membrane cap, push the elastomer seal to one side to permit the inflow of air through the vent underneath it! Otherwise, the membrane may be damaged due to developing negative pressure. Do not sand down the light yellowish-gray deposit of the electrode finger or wipe it in the direction of the gold working electrode!

Commissioning the Membrane Sensor for Ozone OZ7

CAUTION: When unscrewing the filled membrane cap, both elastomer seals lying one on top of the other above the type imprint must be pushed to the side to allow air to flow into the electrolyte chamber, otherwise the membrane will be destroyed due to developing negative pressure.

1. Remove the black insulating tube from the electrode finger.

2. Open the container with the membrane cap, empty out the water and remove the membrane cap.

3. Fill the membrane cap up to the top of the threads inside the cap with the included gel electrolyte.

NOTE: Ensure that only one elastomer seal is in the slot and that the valve opening closes.

4. Rub gold working electrode with the included lapping paper (special emery). To do this, lay the lapping paper on a paper towel, take hold of the corner and while holding the measuring cell vertically, slide the electrode end one to two times over the rough side of the lapping paper.

5. Then place the electrode shaft on the filled membrane cap and slowly screw the membrane cap in place by hand.

NOTE: Because the excess electrolyte escapes through the hose valve, do not clamp it shut.

6. Then push the second elastomer seal in the slot over the first one.

NOTE: The elastomer seals may not form creases.

7. Rinse away the escaped electrolyte with water.

NOTE: The membrane cap must be completely screwed onto the electrode shaft so that there is no gap between the two! After approximately two hours, the membrane sensor is sufficiently run in so that it can be initially calibrated. The calibration must be repeated after approx. one day.

Inserting the Membrane Sensor for Ozone OZ7 into the Flow-Through Adapter

1. Push the sensor through the cover into the flow-through adapter until it touches the inflow mating connector. It may be necessary to position the flow-through adapter cover correctly by turning it.

NOTE: Remove air bubbles from the surface of the membrane, bubbles on the membrane will interfere with the measurement!

2. Connect the measuring signal cable to the OZ7.

Storing the Membrane Sensor for Ozone OZ7

1. Lift elastomer seal and unscrew membrane cap.

2. Wash the membrane cap and electrode finger with clean (distilled) water.

3. Allow the electrode finger and the cap to dry in a dust-free place.

4. Then screw the dry membrane cap loosely onto the electrode shaft.

NOTE: Ensure that the membrane never touches the measuring electrode.

Restarting: Refer to “Commissioning the membrane sensor for ozone OZ7”.

Error in Membrane Sensor for Ozone OZ7

Trouble-shoot and debug if the output signal is too low or irregular:

1. Remove air bubbles on the membrane (e.g. tap the inflow mating connector); air bubbles prevent the ozone from diffusing through the membrane and distort the measurement.

NOTE: Air bubbles on the remaining parts of the sensor are normal after initial commissioning or restarting; they disapate after one or two days.

2. Replenish electrolyte.

3. Open membrane sensor. To do this, push the elastomer seal to one side to permit the inflow of air and unscrew the membrane cap. Pour out the electrolyte.

4. Wash the electrode finger and the membrane cap with clean (distilled) water and allow to air dry.

For further procedure, see “Commissioning the membrane sensor for ozone OZ7”.

If the sensor's measuring signal is still too low or irregular, a new membrane cap must be used. The measuring cell requires one to two hours before it can be calibrated.

3.4.6.4 Membrane Sensor for Total Chlorine TC1

The membrane sensor measures the total amount of free and combined chlorine (chloramine). The sensor incorporates a pH buffer in the electrolyte and is suitable for water with various pH values. The sensor may only be used in clear water of potable water quality.

CAUTION: The electrode fingers (reference electrodes) and membrane are extremely sensitive! Do not touch, soil or damage! Before unscrewing the filled membrane cap, push the elastomer seal to one side to permit the inflow of air through the vent underneath it! Otherwise, the membrane may be damaged due to developing negative pressure. Do not sand down the light yellowish-gray deposit of the electrode finger or wipe it in the direction of the gold working electrode!

Commissioning the Membrane sensor for Total Chlorine TC1

1. Screw off the membrane cap from the electrode shaft and fill to the top of the threads on inside of cap with the included gel electrolyte.

2. Rub gold working electrode with the included lapping paper (special emery). To do this, lay the lapping paper on a paper towel, take hold of the corner and while holding the measuring cell vertically, slide the electrode end one to two times over the rough side of the lapping paper.

3. Check whether the elastomer seal completely closes the valve opening.

4. Then place the electrode shaft on the filled membrane cap and slowly screw the membrane cap in place by hand.

NOTE: Because excess electrolyte escapes through the hose valve, do not clamp it shut and do not press on the elastomer seal.

5. Rinse away the escaped electrolyte with water.

NOTE: The membrane cap must be completely screwed (hand-tight) onto the electrode shaft so that there is no gap between the two! After approximately one hour, the membrane sensor is sufficiently run in so that it can be initially aligned. The alignment must be repeated after one day.

Inserting the Membrane Sensor for Total Chlorine TC1 Into the Flow-Through Adapter

1. Push the sensor through the cover into the flow-through adapter until it touches the inflow mating connector.It may be necessary to position the flow-through adapter cover correctly by turning it.

NOTE: Remove air bubbles from the surface of the membrane, bubbles on the membrane will interfere with the measurement!

2. Connect the measuring signal cable to the measuring device.

Storing the Membrane Sensor for Total Chlorine TC1

1. Lift elastomer seal and unscrew membrane cap.

2. Wash the membrane cap and electrode finger with clean (distilled) water. Allow the electrode finger to air dry.

3. Leave the cap to dry in a dust-free place.

4. Then screw the dry membrane cap loosely onto the electrode shaft.

CAUTION: The membrane may not touch the gold working electrode.

Restarting: Refer to “Commissioning the membranesensor for total chlorine TC1”.

5. Store the conductivity sensor in a dry place.

6. To restart, follow the instructions to start up the corresponding sensors.

Error in Membrane Sensor for Total Chlorine TC1

Trouble-shoot and debug if the measuring signal is too low or irregular:

1. Remove air bubbles on the membrane (e.g. tap the inflow mating connector); air bubbles prevent the chlorine from diffusing through the membrane and distort the measurement.

NOTE: Air bubbles on the remaining parts of the sensor are normal after initial commissioning or restarting; they disapate after one or two days.

2. Replenish electrolyte.

3. Open membrane sensor. To do this, push the elastomer seal to one side to permit the inflow of air and unscrew the membrane cap.

4. Pour out the electrolyte.

5. Wash the electrode finger and the membrane cap with clean (distilled) water and allow to dry in a dust-free place.

For further procedure, see "Commissioning the membrane sensor for total chlorine TC1".

If the sensor's measuring signal is still too low or irregular, a new membrane cap must be used. Thereafter, the measuring cell requires one to two hours before it can be calibrated.

WARNING: DO NOT TOUCH THE REFERENCE ELECTRODE! BEFORE UNSCREWING THE MEMBRANE CAP, REMOVE THE ELASTOMER SEAL TO ALLOW AIR INTO THE VENT HOLE. NOT DOING THIS WILL CAUSE A VACUUM TO OCCUR WHICH WILL DAMAGE THE MEMBRANE WHEN UNSCREWING THE CAP. DO NOT REMOVE THE YELLOW-GREY LAYER ON THE REFERENCE ELECTRODE.

NOTE: It is important that the membrane is in the direct sample water flow. Because of this the flow-through assembly has a special form where the sensor fits in.

3.5 pH Sensor

3.5.1 Description

The Wallace & Tiernan® pH sensor has a ceramic diaphragm and a silver/silver-chloride reference electrode. The 3.0 mol KCl gel electrolyte does not require replenishment.

To protect the sensitive measuring membrane the sensor is shipped with a protection cap over its glass tip. This cap contains 3 mol KCl solution to keep the sensor in a constant state of readiness. Leave the cap in place on the sensor until it is about to be installed. Do not discard the cap but keep it and use it to protect the sensor whenever it is removed from service. Then fill the cap with water (not distilled) and place it over the tip of sensor.

The pH sensor has a threaded plug-in head. Care must be taken to ensure that the O-ring is present when connecting the head. A standard 1.5 m long, shielded coaxial (measuring) cable is supplied with the pH sensor. At one end the cable has a special plug which is screwed on to the threaded plug-in head of the sensor. The other end of the shielded special cable is connected directly to the intended terminal connection in the control module.

3.6 Fluoride Sensor Kit

3.6.1 Description

The fluoride sensor (refillable and gel type) is equipped with a rubber cap over the fluoride sensitive membrane. Lift the cap before placing the electrode into the sample water. Soak the probe in 100 ppm standard solution for 24 hours prior to use to saturate membrane.

NOTE: Do not touch or scratch the membrane, the electrode could be damaged.

If the sensor is not used for a long period of time, place the cap again on the electrode with some reference electrode filling solution in it.

As a standard, a shielded coax cable, 1.5 m long, is supplied together with the sensor.

3.6.2 Preparation of the Electrode

See instructions included with sensor.

3.7 RS485 Interface

3.7.1 Printer Facility

The Depolox® 3 *plus* is not able to send data directly to a printer.

3.7.2 Description of the RS485 Bus Interface

The serial RS485 bus interface of the Depolox® 3 *plus*, built-in as a standard, is used for data transmission to a PC, to an external plant control or to the MF485 interface card (e.g., for connection to a printer).

The serial RS485 bus interface of the Depolox® 3 *plus* is designed as a symmetrical two-wires bus line to EIA RS 485 (DIN 66259 part 4 resp. ISO 8482), that enables data transfer with high transfer rate (19.2 KBaud) and long distances (up to 1200 m).

Characteristics:

- Data transfer in both directions
- twin wire connection (half duplex)
- Bus structure (addressable interface, up to 32 bus users)

The interface works with differential voltage signals, ensuring high interference susceptibility.

The bus system consists of a maximum of 32 passive users and one active user. Only the active user (computer system) is entitled to start communication. The Depolox® 3 *plus* is always a passive user.

3.7.2.1 Cable

A shielded and twisted two-wire cable (twisted pair) is to be used. The shield improves the electromagnetic compatibility. An unshielded cable can be used if acceptable within the surroundings, that means, if no electromagnetic interferences are expected.

The bus cable is connected from one user to the next. Stub cables of a maximum length of 0.3 m are allowed. The surge impedance of the cable should be between 100 and 130 ohm, the cable capacitance preferably <60 pF/m and the cross section 0.22 mm² (e.g., Li2CY(TP) 2x0.22 mm²). If using a shielded cable we recommend to connect the shield on both sides with low resistance (large cross sections and short cables) to protection ground, to have optimum interference compatibility.

3.7.2.2 Interface Connection

The bus cable for the communication with the Depolox® 3 *plus* should be connected to the following terminals:

Bus line A: Terminal 28
Bus line B: Terminal 27

NOTE: The RS485 interface of the Depolox® 3 *plus* is not galvanically isolated. Each Depolox® 3 *plus* occupies two bus addresses of its own (e.g., 0 for chlorine, 1 for pH or for fluoride). This means that in a bus system with Depolox® 3 *plus*-modules, each of the modules behaves as two separate bus users.

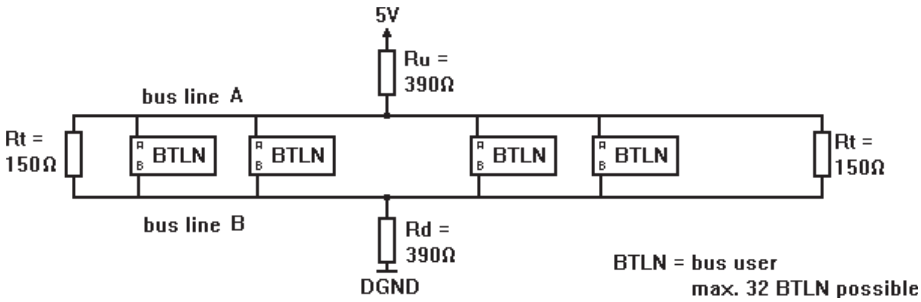


Figure 3.7 - Interface Connection

Both ends of the bus cable must be connected to a moving load Rt (150 Ohm). Symmetry is assured at only one point of the bus. With a voltage supply of 5 V, the resistors Rd and Ru (390 Ohm each) connect to ground and 5 V. These resistor values fit for transmission of up to 19200 Bit/s and a maximum bus length of 1200 m. Symmetry and bus ends should be executed in the same way at potentially isolated and non-isolated bus systems.

Resistors may be switched on via DIP switch in the terminals box. (See Figure 3.8.)

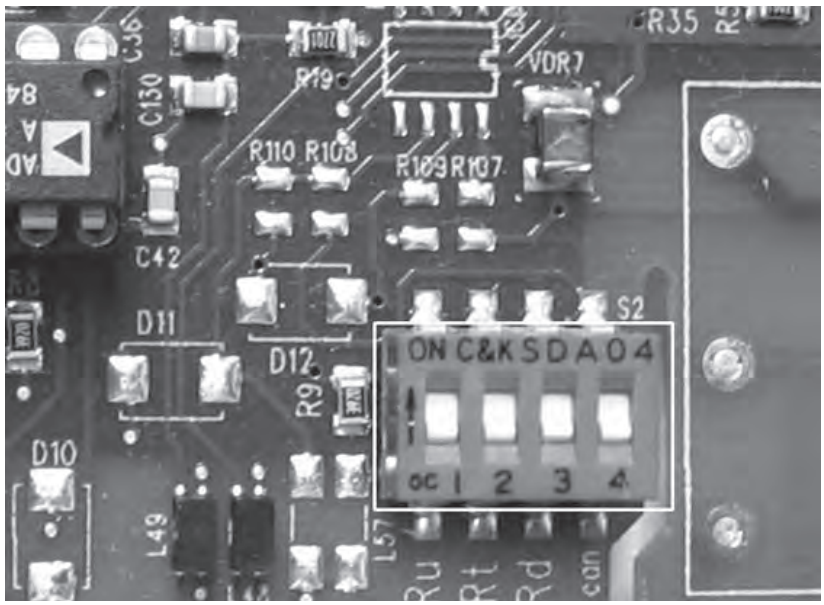


Figure 3.8 - Terminals Box

3.7.2.3 Bus Connection

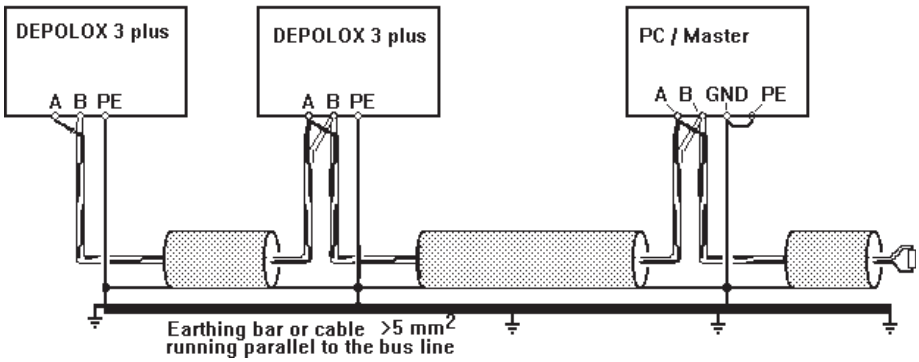


Figure 3.9 - Potentially Not Isolated RS485 Bus System

3.7.3 Specification of Bus Interface

1	Synchronization mode:	Asynchronous	
2	Transmission rate:	19200 Baud	
3	Data format (asynchronous):	- Start bit:	1 Bit
		- Data bit:	8 Bit
		- Parity bit:	even
		- Stop bit:	1 Bit
4	Signal polarity:	Differential voltage interface Logical “1” = (A-B >= 0.2V) Logical “0” = (A-B <= -0.2V)	
5	Handshake:	No handshake because of request control with fixed blocks	
6	Transmission code:	Evoqua Water Technologies-Protocol (master-slave) multipoint communication, maximum 32 users	
7	Galvanically not isolated		

3.7.4 Transmission Protocol

For the communication between master (active user, e.g., computer) and slave (passive user), two different kinds of frames are used:

- Request - Frame
- Set - Frame

The slave answers to these frames with the following frames:

- Answer frame
- Positive confirmation
- Negative confirmation

The bytes of these frames always have the same formats:

- 1 Start bit (always “0”)
- 8 Data bits
- 1 Parity bit (even)
- 1 Stop bit (always “1”)

3.7.4.1 Description of the Bytes of the Frames

- Synchronization bytes: Used for the synchronization of the user units to the others.

- Start byte (SB): Marks the begin of a frame.

  The value depends on the type of the frame:

Request frame	10H
Set frame	68H
Answer frame	68H
Positive confirmation	A2H
Negative confirmation	DCH

- Slave address: To every module in the RS485 bus a special bus address is allocated (slave address). The address can be a number between 0 and 31 Dec.

NOTE: The Depolox® 3 *plus* module uses up to two bus addresses because of the two-fold function of the module (Cl_2 measurement, pH or fluoride measurement).

- Destination address: Determines the transmission variable in the address reference list, that is to be read or written.

- Check byte: Determines the type of information to be read from the slave. Also the data format is defined.

  Data format of the check byte (Bit 0 through 3):

Bit (3210)	Dez.	Format:
0000	0	Default (to address reference list)
0001	1	Default (to address reference list)
0010	2	Boolean
0011	3	Boolean
0100	4	unsigned Character
0101	5	signed Character
0110	6	unsigned Integer
0111	7	signed Integer
1000	8	unsigned long Integer
1001	9	signed long Integer
1010	10	Floating Point
1011	11	Floating Point
1100	12	ASCII
1101	13	ASCII
1110	14	Mixed data format
1111	15	Mixed data format

Additional functions of the check byte (Bit 4 through 7):

Bit (7654)	Function
1000	Minimum value of the variable
0100	Maximum value of the variable
0010	Default value of the variable
0001	additional information of the variable

If no bit is set in bits 5 through 7, the actual value is written or read. Otherwise the corresponding additional information is sent by the slave.

- Special case: With “negative confirmation,” the check byte includes an additional information about the error occurred. With “positive confirmation,” the check byte is set to 00Hex.

Value:	Function:
01H	End of address table
02H	Wrong data format
04H	Additional information not available
08H	Variable to set not within min. and max. limits
10H	reading access not permitted
20H	reading access permitted but wrong password
40H	writing access not permitted
80H	writing access permitted but wrong password
C0H	writing access not permitted (wrong operation mode)

- Number byte: Defines the number of bytes to read or to write.

- Frame Check: The sum of the control bytes of a frame is stored in the frame check.

  FC = (unsigned char) SB + SA + ZA + KB + AB

- Data unit: Includes data informations be sent by slave or master.

- Data check: The check sum of the data bytes of a frame is stored in the data check.

  CD = (unsigned char) sum of DU

- End byte: Marks the end of a frame. Value is always 16Hex.

3.7.4.2 Request - Frame

This is necessary to read data or additional information from a slave.

Format of the request frame:

Byte:	0-2	3	4	5	6	7	8	9
Name:	SYN	SB	SA	ZA	KB	AB	FC	EB

Byte:	Name:	occupied by:
0-2	SYN	Synchronization bytes
3	SB	Start byte 10H
4	SA	Slave address
5	ZA	destination address
6	KB	check byte
7	AB	number of bytes
8	FC	frame Check
9	EB	end byte 16H

With the request frame, single words, values covering more addresses, or additional information of the destination address can be read. If the contents of a single destination address are requested, the number byte is set to 00Hex. In the answer frame, the data format and the number of bytes are entered from the address reference list to the check byte and the number byte.

If a number byte is set in the request frame (request covering more addresses), the data format in the answer frame is set to 04Hex (unsigned char). The number byte of the answer frame receives the value of the number byte of the request frame. A data format eventually entered in the request frame is ignored.

If the additional information of a destination address is requested, the check byte must include the identification for this additional information. The data format and the number byte are ignored. The check byte and the answer byte are set according to the reference list. Valid request frames are answered with an answer frame. Invalid request frames are answered with "negative confirmation."

Example: Requesting the contents of destination address 02H from slave 07H:

00H	00H	00H	10H	07H	02H	00H	00H	19H	16H
	SYN		SB	SA	ZA	KB	AB	FC	EB

3.7.4.3 Set - Frame

The set frame is used for writing data to a slave.

Format of the set frame:

Byte:	0-2	3	4	5	6	7	8	9-X	Y	Z
Name:	SYN	SB	SA	ZA	KB	AB	FC	DU	DC	EB

Byte:	Name:	Function:
0-2	SYN	Synchronization bytes
3	SB	Start byte 68H
4	SA	Slave address
5	ZA	Destination address
6	KB	Check byte
7	AB	Number byte
8	FC	Frame Check
9-X	DU	Data bytes
Y	DC	Data Check
Z	EB	End byte 16H

With the set frame, single words, values covering more addresses, or additional information can be written.

If the contents of a single destination address are written, the number byte must correspond to the number byte of the address reference list. The data format must be set to “default” or to the data format from the address reference list.

If more variables are to be set covering more addresses, the data format must be set to “default.” The number byte means the number of bytes to write; only whole variables have to be written. Valid set frames are answered with a “positive confirmation.” Invalid set frames are answered with “negative confirmation.”

Example: Setting the contents of destination address 02H of the slave 07H to 904 (Dec).

0H	00H	00H	68H	07H	02H	06H	02H	79H	03H	88H	8BH	16H
	SYN		SB	SA	ZA	KB	AB	FC	DU		DC	EB

3.7.4.4 Answer - Frame

The answer frame is transmitted by the slave because of a request frame of the master.

Format of the answer frame:

Byte:	0-2	3	4	5	6	7	8	9-X	Y	Z
Name:	SYN	SB	SA	ZA	KB	AB	FC	DU	DC	EB

Byte:	Name:	Function:
0-2	SYN	Synchronization bytes
3	SB	Start byte 68H
4	SA	Slave address
5	ZA	Destination address
6	KB	Check byte
7	AB	Number byte
8	FC	Frame Check
9-X	DU	Data bytes
Y	DC	Data Check
Z	EB	End byte 16H

If no data format and no number of bytes (AB) is set in the request frame in the check byte, the data format and the number of bytes are entered into the answer frame from the address list.

Example: Request frame

00H	00H	00H	10H	07H	02H	00H	00H	19H	16H
	SYN		SB	SA	ZA	KB	AB	FC	EB

Answer to the example Request - Frame:

00H	00H	00H	68H	07H	02H	06H	02H	79H	00H	00H	8BH	16H
	SYN		SB	SA	ZA	KB	AB	FC	DU		DC	EB

3.7.4.5 Positive and Negative Confirmation

The “positive confirmation” is transmitted by the slave, if a set frame of the master has been executed validly. A “negative confirmation” is transmitted by the slave, if a set frame or a request frame couldn’t be executed validly.

Format of the positive/negative confirmation:

Byte:	0-2	3	4	5	6	7	8	9
Name:	SYN	SB	SA	ZA	KB	AB	FC	EB

Byte:	Name:	Function:	
0-2	SYN	Synchronization bytes	
3	SB	Positive:	Start byte A2H
		Negative:	Start byte DCH
4	SA	Slave address	
5	ZA	Ziel address	
6	KB	Check byte	
7	AB	Number byte	
8	FC	Frame Check	
9	EB	End byte 16H	

The check byte is occupied by 00Hex for positive confirmation and by an error code for negative confirmation.

Example: Positive confirmation

00H	00H	00H	A2H	07H	02H	00H	00H	ABH	16H
	SYN		SB	SA	ZA	KB	AB	FC	EB

Example: Negative confirmation

00H	00H	00H	DCH	07H	02H	02H	00H	A5H	16H
	SYN		SB	SA	ZA	KB	AB	FC	EB

3.7.5 Address Reference List

<u>NOTE</u>: To each Depolox® 3 *plus* two addresses are allocated. Each of the two addresses lead to a corresponding address reference list (e.g., Adr00 for Cl_2 measurement, Adr01 for pH or fluoride measurement).

KEY	
Abbreviations of the data formats	BOOL-boolean, UCHAR-unsigned char, SCHAR-signed char, USINT-unsigned integer, SINT-signed integer, ULONG-unsigned long, SLONG-signed long, FLOAT- float, ASCII-ASCII-code, MIX-mixed format
Abbreviations of access	L-read, S-write, LP-read with password, SP-write with password
Data structure 1	Byte1-2: Measured valuet (signed int), Byte3-4: range-start (signed int), Byte 5-6: range-end (signed int), Byte7-11: unit (ASCII), Byte12: divider (character)

Table 3.4 - Address Reference List

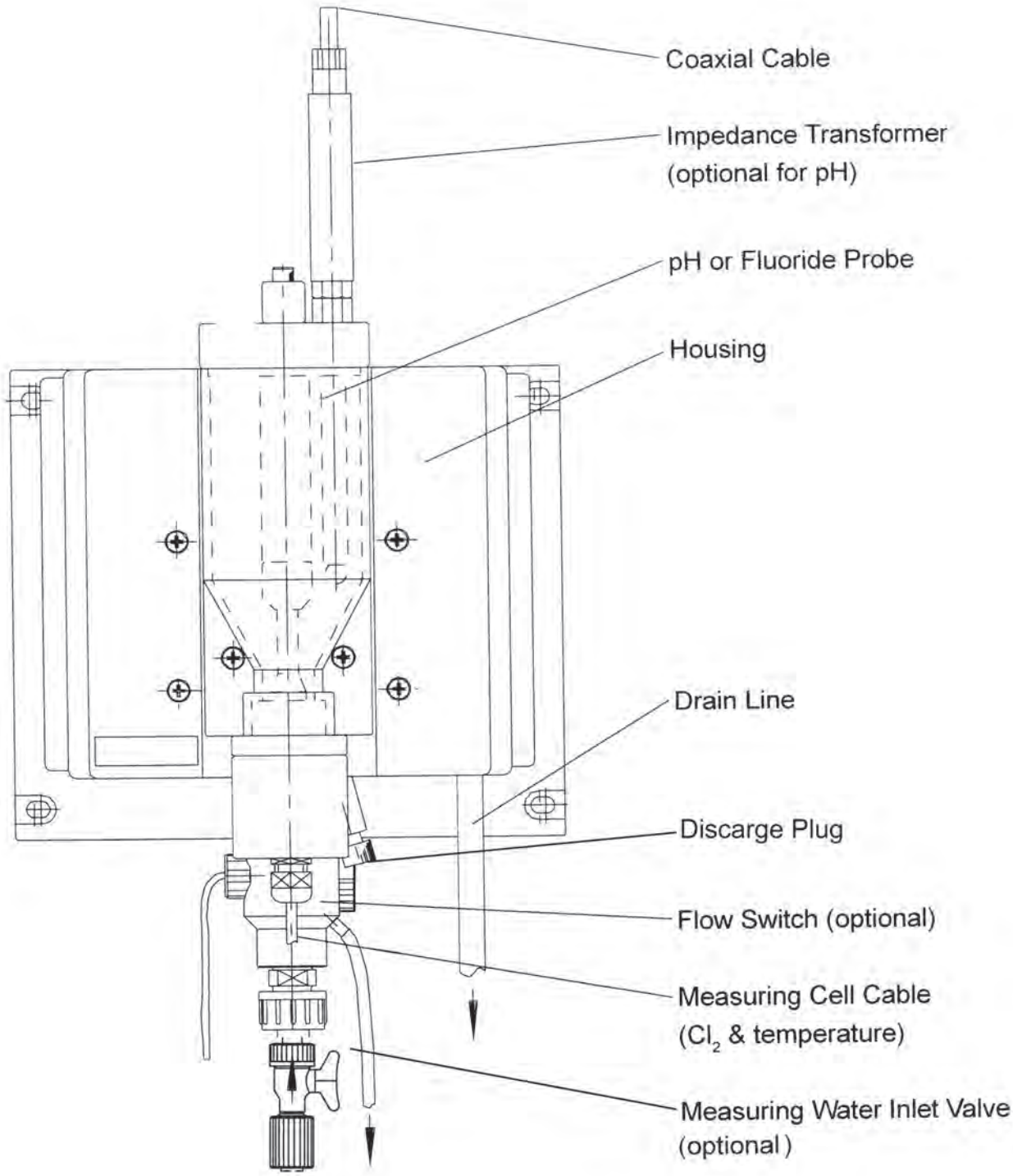
ADDR.	DESCRIPTION	FORMAT	LENGTH	RANGE	UNIT	FACTOR	STATUS	DESCRIPTION	BYTES
0.	Date of software version	ASCII	12	-	-	-	L	-	0
1.	Module name	ASCII	28	-	-	-	L	-	12
2.	Password of interface	USINT	2	0...999	-	1.0	L, S	-	40
3.	Module type	ASCII	12	1	-	-	L	-	42
4.	Measurement value DES	USCHAR	12	Meas. range	mg/l	0.10 0.01	L	Data Structure 1	54
5.	Measurement value pH/Fluoride	USCHAR	12	Meas. range	pH mg/l	0.01	L	Data Structure 1	66
6.	Measurement value temperature	USCHAR	12	Meas. range	°C	0.10	L	Data Structure 1	78
7.	Errors	USLONG	4	-	-	-	L	0x00000001: Digital input 1 0x00000002: Digital input 2 0x00000004: Digital input 3 0x00000008: Calibration error DES 0x00000010: Calibration error pH 0x00000020: Calibration error Fluor 0x00000040: Cell error 0x00000080: Cell error pH 0x00000100: Cell error Fluor 0x00000200: Temperature 0x00000400: Load mA output 0x00000800: ADU1 0x00001000: ADU2 0x00002000: ADU3 0x00004000: Values out of range 0x00008000: Max DES 0x00010000: Min DES 0x00020000: Max pH 0x00040000: Min pH 0x00080000: Max Fluor 0x00100000: Min Fluor 0x00200000: System 0x00400000: OVR DES 0x00800000: OVR pH 0x01000000: OVR Fluor 0x02000000: HOCl pH 0x04000000: -- 0x08000000: -- 0x10000000: -- 0x20000000: -- 0x40000000: -- 0x80000000: --	90
8.	Cell current DES	FLOAT	4	-	µA	1.0	L	-	94
9.	Cell voltage pH/Fluor	FLOAT	4	-	mV	1.0	L	-	98
10.	State of LEDs and DI and relays	USINT	2	-	-	-	L	0x0001: LED Alarm 1 0x0002: LED Alarm 2 0x0004: LED Alarm 3 0x0008: LED Alarm 4 0x0010: LED DOS 0x0020: LED DI 0x0040: LED Failure 0x0080: DI1 0x0100: DI2 0x0200: DI3 0x0400: Relay K1 0x0800: Relay K2 0x1000: Relay K3 0x2000: Relay K4	102
11.	Menu language	USCHAR	1	-	-	-	L, SP	0x01: German 0x02: English 0x04: French 0x08: Spanish	104
12.	Function mA output	USCHAR	1	-	-	-	L, SP	0x01: Off 0x02: 0-20mA 0x04: 4-20mA	105

Table 3.4 - Address Reference List (Cont'd)

ADDR.	DESCRIPTION	FORMAT	LENGTH	RANGE	UNIT	FACTOR	STATUS	DESCRIPTION	BYTES
13.	mA 1 assign	USCHAR	1	-	-	-	L, SP	0x01: DES 0x02: pH/Fluor 0x04: Temperature	106
14.	mA 2 assign	USCHAR	1	-	-	-	L, SP	Adr. 13	107
15.	mA 3 assign	USCHAR	1	-	-	-	L, SP	Adr. 13	108
16.	RS485 address	SINT	2	0...31	-	1.0	L, SP	-	109
17.	Relay assign Alarm 1	USINT	2	-	-	-	L, SP	0x0001: DES max 0x0002: DES min 0x0004: pH max 0x0008: pH min 0x0010: Fluor max 0x0020: Fluor min 0x0040: DI1 0x0080: DI2 0x0100" DI3 0x0200: Error 0x400: Dosing contact	111
18.	Relay function Alarm 1	USCHAR	1	-	-	-	L, SP	0x01: N.O. n.sp. 0x02: N.C. n.sp. 0x04: N.O. sp.reset 0x08: N.C. sp.reset 0x10: N.O. sp.acknowledge 0x20: N.C. sp.acknowledge 0x80: Dosing contact	113
19.	Alarm 1 delay	USINT	2	0...600	min	1.0	L, SP	-	114
20.	Relay assign alarm 2	USINT	2	-	-	-	L, SP	0x0001: DES max 0x0002: DES min 0x0004: pH max 0x0008: pH min 0x0010: Fluor max 0x0020: Fluor min 0x0040: DI1 0x0080: DI2 0x0100: DI3 0x0200: Error	116
21.	Relay function Alarm 2	USCHAR	1	-	-	-	L, SP	See Adr. 18	118
22.	Delay Alarm 2	USINT	2	0...600	min	1.0	L, SP	-	119
23.	Relay assign Alarm 3	USINT	2	-	-	-	L, SP	See Adr. 20	121
24.	Relay function Alarm 3	USCHAR	1	-	-	-	L, SP	See Adr. 18	123
25.	Delay Alarm 3	USINT	2	0...600	min	1.0	L, SP	-	124
26.	Relay assign Alarm 4	USINT	2	-	-	-	L, SP	See Adr. 20	126
27.	Relay function Alarm 4	USCHAR	1	-	-	-	L, SP	See Adr. 18	128
28.	Delay Alarm 4	USINT	2	0-600	min	1.0	L, SP	-	129
29.	Limit DES max	SINT	2	Meas. range	mg/l	0.10 0.01	L, SP	-	131
30.	Limit DES min	SINT	2	Meas. range	mg/l	0.10 0.01	L, SP	-	133
31.	DES setpoint	SINT	2	Meas. range	mg/l	0.10 0.01	L, SP	-	135
32.	DES hysteresis	SINT	2	1...25	Digit	1.0	L, SP	-	317
33.	Limit pH max	SINT	2	Meas. range	pH	0.01	L, SP	-	139
34.	Limit pH min	SINT	2	Meas. range	pH	0.01	L, SP	-	141
35.	pH hysteresis	SINT	2	1...25	Digit	1.0	L, SP	-	143
36.	Limit Fluor max	SINT	2	Meas. range	mg/l	0.01	L, SP	-	145
37.	Limit Fluor min	SINT	2	Meas. range	mg/l	0.01	L, SP	-	147
38.	Fluor hysteresis	SINT	2	1...25	Digit	1.0	L, SP	-	149
39.	Range DES	USCHAR	1	-	-	-	L, SP	0x01: 0-20.0 mg/l 0x02: 0-10.0 mg/l 0x04: 0-5.00 mg/l 0x08: 0-2.00 mg/l 0x10: 0-1.00 mg/l 0x20: 0-0.50 mg/l 0x40: 0-0.20 mg/l	151
40.	Range pH	USCHAR	1	-	-	-	L, SP	0x01: 4-10.00 pH 0x02: 0-14.00 pH	152
41.	Hold function	USCHAR	1	-	-	-	L, SP	0x01: Off 0x02: On	153
42.	DES-Sensor	USCHAR	1	-	-	-	L, SP	0x01: 3pot cell 0x02: TC1 0x04: FC1 0x08: OZ7 0x10: CD7 0x20: Off	154

Table 3.4 - Address Reference List (Cont'd)

ADDR.	DESCRIPTION	FORMAT	LENGTH	RANGE	UNIT	FACTOR	STATUS	DESCRIPTION	BYTES
43.	Input 2	USCHAR	1	-	-	-	L, SP	0x01: pH 0x02: Fluor 0x04: Off	155
44.	Temperature	USCHAR	1	-	-	-	L, SP	0x01: PT1000 0x02: PT100 0x04: Off	156
45.	Mode Cl2 free	USCHAR	1	-	-	-	L, SP	0x01: Normal 0x02: pH compensated	157
46.	Local Operation	USCHAR	1	-	-	-	L, SP	0x01: Normal 0x02: Service	158
47.	Menu	USCHAR	1	-	-	-	L, SP	0x01: Short 0x02: Long	159
48.	Software number	ASCII	16	-	-	-	L	-	160
49.	Software version	ASCII	16	-	-	-	L	-	176
50.	Software date	ASCII	16	-	-	-	L	-	192
51.	Calibration values DES	ASCII	16	-	-	-	L	-	208
52.	Calibration values pH/Fluor	ASCII	16	-	-	-	L	-	224
53.	Calibration values Temperature	ASCII	16	-	-	-	L	-	240
54.	Interval DES	SINT	2	0...5000	h	h	L	-	256
55.	Interval pH/Fluor	SINT	2	0...5000	h	h	L	-	258
56.	Interval Temperature	SINT	2	0...5000	h	h	L	-	260
57.									262
58.									
59.									



W2T9694 DEPOLOX® 3 *plus* BARE ELECTRODE SENSOR KIT - ASSEMBLY

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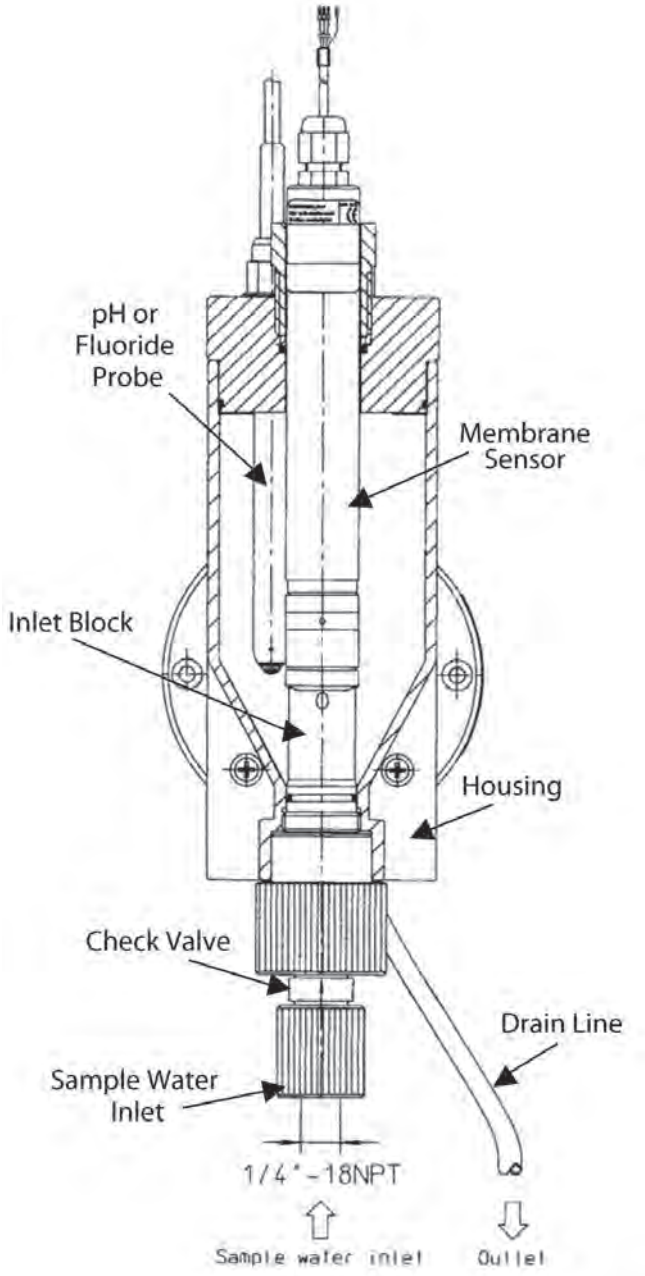

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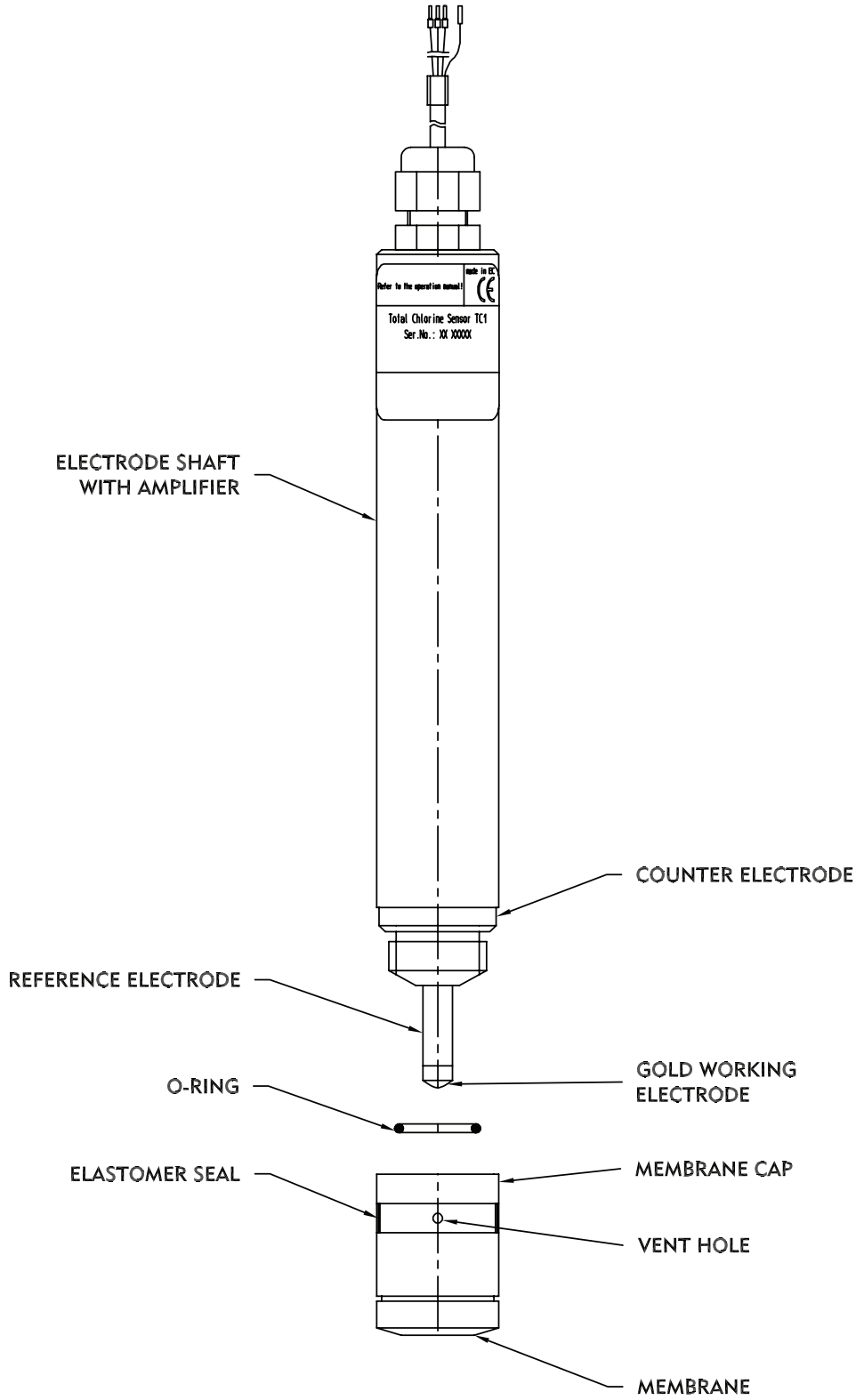
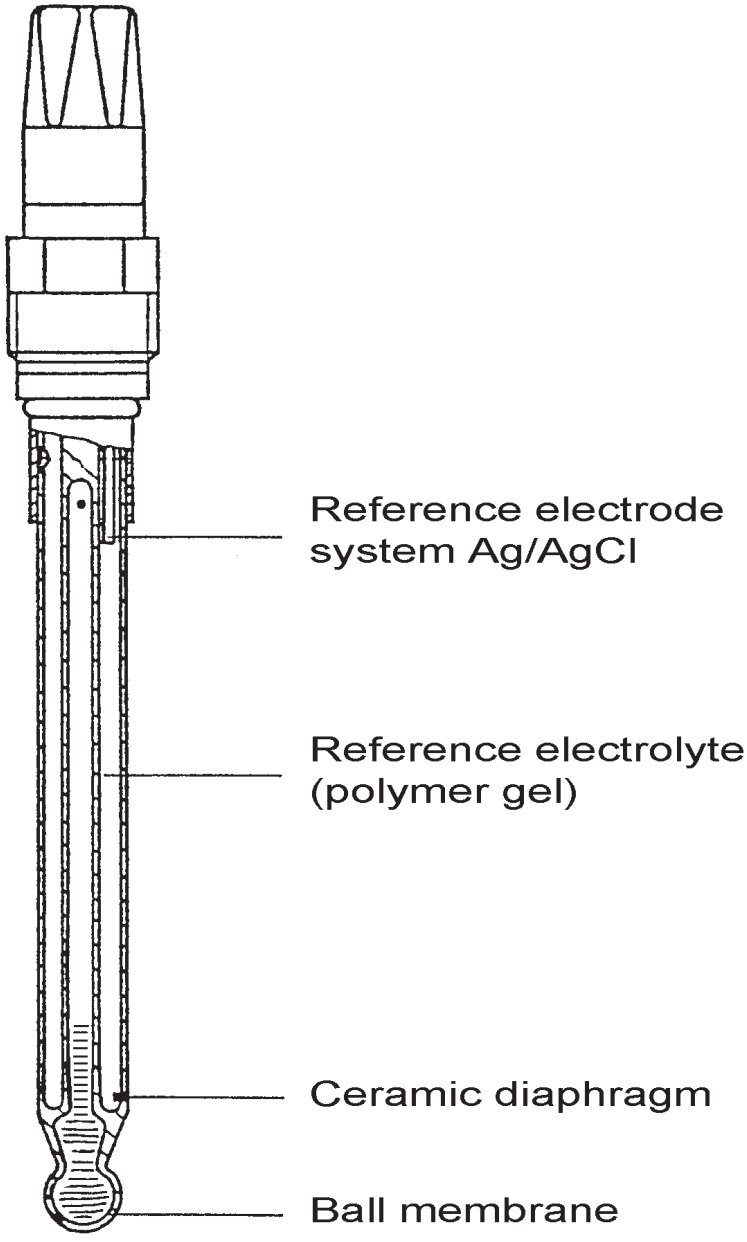


MEMBRANE SENSOR KIT - ASSEMBLY

50.560.160.020

ISSUE 3 7-14



pH/FLUORIDE SENSOR - ASSEMBLY

50.560.160.030

ISSUE 2 11-07

SECTION 4

SECTION 4 - SERVICE

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4.1 Depolox® 3 *plus*

Table 4.1 - Errors

Error Message	Cause	Remedy
High/Low Alarms:		
*min DIS ? * *max DIS ? * *min pH ? * *max pH ? * *min Fluor ? * *max Fluor ? *	Alarm value exceeded	Check dosing Check sample water flow
General Faults:		
*mA-output? *	mA loop impedance too high Loop interrupted	Check mA loop <1000 ohm Jump if not used
*cell DIS ? * *cell pH ? *	Sensor wrongly connected Sensor cables interchanged or (In ph compensated mode) pH is out of range	Check wiring Perform calibration or Adjust pH
*cell Fluor ? *	Sensor defective	Replace sensor
*Circ.Fail. ? *	Internal failure	Contact Evoqua Water Technologies
*temperature ? *	Temperature failure	Check temp. Sensor, wiring
<u>Warnings</u> *Range ? *	Alarm value out of range Range changed subsequently Setpoint Cl_2 out of range	Adjust range or limit value Adjust range or setpoint
*ADU 1 ? * *ADU 2 ? * *ADU 3 ? *	Internal failure	Call Evoqua Water Technologies service
*Cal. DIS ? * *Cal. pH ? * *Cal. Fluor ? *	Calibration error	Perform new calibration Check buffer solutions Replace electrolyte
*OVR DIS ? * *OVR pH ? * *OVR Fluor ? *	Value exceeds range Range does not fit Dosing too high	Check range and dosing
*DI1 ? * *DI2 ? * *DI3 ? *	Signal at the digital input	Check for the origin of the signal, e.g., sample water flow too low Jump if not used

Table 4.1 - Errors (Cont'd)

Error Message	Cause	Remedy
Additional Errors		
Device has no display	No mains power Defective fuse or wrong setting of mains voltage	Turn on external mains switch Check voltage setting and replace fuse, see paragraph 2.1.3
Displayed/output value wrong	Wrong calibration Old electrolyte or clogged membrane Wrong wiring or setting	New calibration Sensor maintenance Check sensor, wiring and setting
Device not responding correctly to software adjustments or corrections.	Incorrect software programming or corrupted memory.	Initialize software, see paragraph 3.1.9.

In case of an alarm:

- the alarm LED will become illuminated
- the display will detail the specific alarm every five seconds for one second for each alarm.
- if an alarm relay is associated to the alarm condition, the delay time will begin. At the end of the delay time the relay will be triggered.

NOTE: Refer to Table 4.2 - Relay / Display Operation During Alarm Conditions, for details.

Table 4.2 - Relay / Display Operation During Alarm Conditions

Alarm / ErrorType	Assigned to Relay	Alarm Status Sequence	Relay Type Latch / Non-latch	Press Alarm Ack key	Relay	Display	LED
Hi / Lo Alarm	yes	no alarm	Non-latch	NA	non-alarm state	no message	off
		alarm		NA	Alarm State	alarm message	on
		no alarm		NA	non-alarm state	no message	off
Hi / Lo Alarm	yes	no alarm	Latch	no	non-alarm state	no message	off
		alarm		no	alarm state	alarm message	on
		alarm		yes	non-alarm state	alarm message	blink
		no alarm		no	non-alarm state	no message	off
Hi / Lo Alarm	yes	no alarm	Latch	no	non-alarm state	no message	off
		alarm		no	alarm state	alarm message	on
		no alarm		no	alarm state	alarm message	on
		no alarm		yes	non-alarm state	no message	off
Hi / Lo Alarm	no	no alarm	NA	NA	NA	no message	off
		alarm	NA	NA	NA	alarm message	blink
		no alarm	NA	NA	NA	no message	off
General Fault	yes	no alarm	Non-latch	NA	non-alarm state	no message	off
		alarm		NA	Alarm State	alarm message	on
		no alarm		NA	non-alarm state	no message	off
General Fault	yes	no alarm	Latch	no	non-alarm state	no message	off
		alarm		no	alarm state	alarm message	on
		alarm		yes	non-alarm state	alarm message	blink
		no alarm		no	non-alarm state	no message	off
General Fault	yes	no alarm	Latch	no	non-alarm state	no message	off
		alarm		no	alarm state	alarm message	on
		no alarm		no	alarm state	alarm message	on
		no alarm		yes	non-alarm state	no message	off
General Fault	no	no alarm	NA	NA	NA	no message	off
		alarm	NA	NA	NA	alarm message	blink
		no alarm	NA	NA	NA	no message	off
Warning	no	no alarm	NA	NA	NA	no message	off
		alarm		NA	NA	alarm message	on
		no alarm		NA	NA	no message	off
Digital Input	yes	no alarm	Non-latch	NA	non-alarm state	no message	off
		alarm		NA	Alarm State	alarm message	on
		no alarm		NA	non-alarm state	no message	off
Digital Input	yes	no alarm	Latch	no	non-alarm state	no message	off
		alarm		no	alarm state	alarm message	on
		alarm		yes	non-alarm state	message	blink
		no alarm		no	non-alarm state	no message	off
Digital Input	yes	no alarm	Latch	no	non-alarm state	no message	off
		alarm		no	alarm state	alarm message	on
		no alarm		no	alarm state	alarm message	on
		no alarm		yes	non-alarm state	no message	off
Digital Input	no	no alarm	NA	NA	NA	no message	off
		alarm		NA	NA	alarm message	blink
		no alarm		NA	NA	no message	off

4.2 Maintaining W2T9694 Bare Electrode Flow Block Assembly

4.2.1 Maintenance

- Daily checks

  Each day check the complete unit for leaks, including all pipe unions and glands, and rectify all leaks immediately.

NOTE: All air leaks must receive immediate attention as they will have a detrimental effect on the operation of the cell unit. Should an air leak occur upstream of the measuring cell assembly, bubbles are seen passing through the cell block. With a leak down stream of the cell assembly, bubbles are seen only in the drain hose from the cell block.

Measure the actual free chlorine residual by any standard colorimetric or titration method ensuring the equipment manufacturers instructions are strictly observed.

Draw the sample water from the sample drain nipple (see Dwg. 50.560.160.010 in Section 3).

NOTE: It is very important to obtain consistent results when measuring the residual value of the test sample and it is recommended that precisely the same method is used every time a sample is tested.

If the indicated residual on the controller or amplifier display varies from the measured residual by more than is acceptable to the user, carry out the calibration procedure referred to in paragraph 3.2.1, Free Chlorine (Bare Electrode) Calibration.

If the variation still remains after recalibration, refer to “Bimonthly check,” below.

- Weekly checks

  With the sample water turned on, check that there is sufficient grit in the measuring cell block to keep the electrodes clean. This will be indicated by the amount of grit being swirled about in the vortex of the cell. Lack of grit will lead to insufficient cleaning and more grit must be added.

NOTE: When fresh grit is added to the cell block a temporary rise in cell output will normally occur which, generally, will last for two to three hours. It is important that no calibration adjustments are made during this period.

- Monthly checks

  Remove and clean, if fitted, the detachable element of the strainer in the sample water supply line. Check the calibration of the cell (refer to paragraph 3.2.1, Free Chlorine (Bare Electrode) Calibration)

- Bimonthly checks (see Dwg. 50.560.000.010)

  a. Check the zero point to ensure no drift has occurred.

  b. Check that the potassium chloride electrolyte is level with the bottom of the electrolyte reservoir neck and top up if necessary. This operation can be carried out by removing the plug (4) in the top of the electrolyte reservoir and filling with a syringe.

  c. The particles of grit used for continuous electrode cleaning take approximately two months to wear down. After this period of time the grit should be replaced. The procedure for grit replacement is detailed later.

  d. The membranes in the electrode case (6) form an interface between the reference electrolyte and the sample water. If the quality of the water passing through the cell is poor, especially if the water has a high iron content, inspect the two porous membranes (6) located in the electrode case. They should be white in color and any obvious discoloration is a sign that the membranes are becoming clogged up and should be replaced.

- Semi-annual checks

  Every six months the reference electrolyte should be replaced. Electrolyte replacement can be incorporated into a grit replacement operation. Having removed the reservoir (see steps a through f in the procedure on Grit Replacement that follows), the electrolyte should be discarded safely and the reservoir thoroughly washed in distilled water. Check the condition of the porous membranes and replace if needed. Refill the reservoir to the neck with fresh electrolyte and continue from step g in the Grit Replacement procedure.

- Grit Replacement (See Dwg. 50.560.000.010)

  When they become worn, grit particles should be replaced by taking the following steps:

  a. Close the shut-off valve at the cell inlet.

  b. Drain the cell by unscrewing the drain plug.

c. When the cell block is empty, install the drain plug.

d. Unscrew the electrolyte reservoir clamping nut (2) and remove the cell cover (3).

e. Withdraw the complete electrode/electrolyte reservoir assembly (4 to 11) from its housing. This can be achieved by exerting a gentle pressure at the top of the electrolyte reservoir. Rinse off the reservoir to remove any remaining grit particles.

f. Being careful of the cable connector, replace the assembly ensuring that the keying pin in the base of the cell block locates into its corresponding hole in the electrode housing (8).

g. Empty a half capful of grit into the cell block and replace the cover. The assembly should then be secured in its housing with the clamping nut.

h. Open the sample water shut-off valve at the inlet to the measuring cell assembly.

i. Leave the cell running for an hour, to allow the system to settle down, and then carry out the zero calibration procedure. This procedure may be repeated after 24 hours if required.

- Electrode and membrane replacement

The membranes, which form the contact point between reference electrode and sample water, cannot be cleaned. With very good water quality, membrane life may extend for up to three years continuous use. After this period of time however, they should be replaced. Where the quality of the sample water is particularly poor, fouling of the membranes may occur with a corresponding loss in cell efficiency (Refer to the note in “Bimonthly check,” above, for further details).

With the electrode/electrolyte reservoir assembly withdrawn from the cell block as described above, the electrodes may be removed and replaced as follows (see Dwg. 50.560.000.010):

a. Slacken the cable gland locking nut and unscrew the cable gland (11) taking care to avoid rotating the cable.

b. Unscrew the cover (10) and remove the push-fit connections from each electrode (and the temperature sensor if fitted).

c. Unscrew the nut (9) which clamps the electrolyte reservoir to the electrode housing (8) and separate the two items.

d. If the reference electrode (7) is to be replaced, hold the electrolyte reservoir vertical with the electrode uppermost. The electrode may now be unscrewed, by holding it just below the wire stem, and replaced.

e. To replace the two membranes (6) in the reservoir housing a pair of pointed tweezers (or similar) should be used. Insert the points into the holes in the pvc body of the membrane and gently pull and turn until the membrane is removed.

f. Fit new membrane using the same technique.

NOTE: The two half ring type platinum electrodes are arranged one above the other in the top recess of the electrode housing (8), with the counter electrode uppermost. To replace the working electrode it is necessary to first remove the counter electrode.

g. Gently push the stem (blue spot) of the counter electrode until the half ring can be grasped and the electrode removed from the housing.

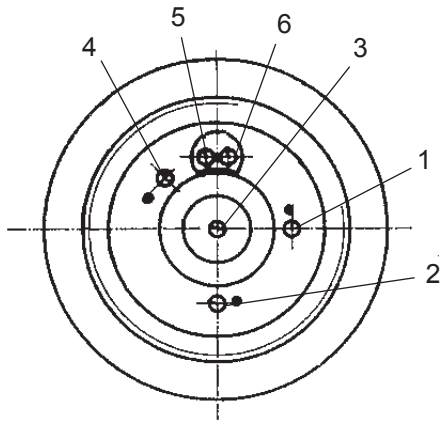
h. If the working electrode (red spot) is to be replaced repeat step g with the working electrode.

i. Carefully clean any grit or other deposits from the electrode recess in the upper housing ensuring no moisture enters the electrode stem bore.

j. Fit the replacement working electrode into thetop of the housing and gently (to avoid disturbing the 'O' rings in the bore) push the electrode down into position.

k. Repeat step j with the counter electrode.

l. Reassemble the reservoir to the electrode housing and, ensuring the bottom cover (10) is on the cable, reconnect the signal wires as shown in Figure 4.1:



(1) Counter electrode (blue spot) blue wire
(2) Working electrode (red spot) pink wire
(3) Reference electrode white wire
(4) Earth grey wire
(5) Temperature sensor brown wire
(6) Temperature sensor yellow & green wire

Figure 4.1

m. Reassemble the cover (10) and cable gland (11) to the electrode housing.

n. Refit the electrode/electrolyte reservoir assembly and secure with the clamping nut (2).

o. Reconnect the water inlet line, outlet line and the cell drain line.

p. Leave the cell running for an hour, to allow the system to settle down, and then carry out the zero calibration procedure. This procedure may be repeated after 24 hours if required.

4.2.2 Troubleshooting

The following troubleshooting table is provided for determining and correcting most common troubles.

Table 4.3 - Troubleshooting - Free Chlorine (Bare Electrode) Sensor Kit

FAULT CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
Insufficient sample water flow	drain hose free fall restricted	Ensure 1500mm free fall
	dirt in cell unit	clean cell
	air bubbles	check lines
	blocked strainer	clean strainer
	shut-off valve closed	open
	regulating valve not working correctly	strip and clean regulator
Air leaks	faulty o-rings	grease or replace
	faulty pipe connections	check and make good where needed
	booster	check and make good where needed
Electrode current too low	dirty electrodes	clean with fine sand paper, add more grit
	worn electrodes	replace
	electrodes touching	adjust
Unsteady output from electrodes	membrane clogged	replace
	air bubbles on inner surface of membrane	adjust
Zero or span not adjustable	zero current too high or too low	wait until 24-hour running-in period is completed
		measure the electrode voltage across terminals 30 and 31 and adjust Upot to 0.25V. Zero current must be <±5µA
		shut-off valve not closed at zero calibration
	cell current too low or too high	check µA-range
		increase sample water flow
		see also “Electrode current too low,” above
Indicated value oscillates considerably at constant chlorine concentration	considerable fluctuations in water pressure	check pressure
	fluctuation in pH value	check pH value
	inlet to cell body or flow regulator clogged	clean inlet or flow regulator
	flow regulator defective	check or replace

4.3 Maintaining W2T7957 Bare Electrode Flow Block Assembly

Replacing Cell Sand in W2T7957 Three-Electrode Cell

The cell sand required for constant cleaning of the electrodes grinds itself down over time until it is very fine. It must be replaced regularly. Cell sand is delivered in a plastic bottle:

1. Remove flow block assembly cover.
2. Close the ball valve on the sample water inlet.
3. Open the drain valve and drain the cell body (hold container underneath).
4. Close the drain valve when the cell body is empty.
5. Remove the sensors. Loosen the cable union (hold the cable while doing this as it may not be allowed to rotate).
6. Loosen the lower cap on the 3 electrode cell.
7. Remove the signal cable.
8. Unscrew the upper knurled nut on the electrolyte container.
9. Remove the electrolyte tank out of the cell body from below using the electrode mount.
10. Wash the cell sand out of the electrode mount.
11. Insert the electrode mount back into the cell body using the electrolyte container.
12. The cell body's dowl pin must be locked into place in the appropriate hole in the electrode mount.

NOTE: Screw the upper knurled nut back onto the electrolyte container.

13. Reconnect the signal cable acc. to color.

CNT	Counter electrode	Blue point	Blue cable
WRK	Working electrode	Red point	Pink cable
Ref	Reference electrode (middle)		White cable

14. Screw the cap back on.
15. Fill half a cap from the plastic bottle with cell sand and pour it into the cell body (approx. 1/2 cm^3 cell sand) (see section 3.3.4 "Adding Grit (Bare Electrode)").

16. Reinsert electrodes.

17. Reopen the check valve on the sample water inlet.

18. Perform calibration after approximately three hours running-in time.

NOTE: You must calibrate each time the cell sand is replaced. The calibration must be checked after one day. We recommend checking and, if necessary, replacing the electrodes and diaphragms when replacing the cell sand (see "Replacing electrolyte, electrodes and porous membranes").

W2T7957 Three-Electrode Cell Check Electrolyte Level

1. Check whether the electrolyte is filled approx. 3 cm over the water level (narrowing of the KCL container) and replenish, if necessary.

2. To do this, remove the plug in the upper part of the electrolyte tank and inject the electrolyte (use the syringe in the accessory set). The porous membranes in the electrolyte tank form the connection between the reference electrolytes and the sample water. If the sample water quality is poor (e.g. high iron content), both porous membranes in the electrolyte housing should be replaced. The porous membranes should be white (any coloration is an indication that the porous membranes are clogged and should be replaced).

3. Calibrate after approximately three hours.

NOTE: The calibration must be checked after one day.

Replacing Electrolyte, Electrodes and Porous Membranes

1. Remove flow block assembly cover.

2. Close the ball valve on the sample water inlet.

3. Open the drain valve and drain the cell body (hold container underneath).

4. Close the drain valve when the cell body is empty.

5. Remove the sensors. Loosen the cable union (hold the cable while doing this as it may not be allowed to rotate).

6. Loosen the lower cap on the 3 electrode cell.

7. Remove the signal cable.

Replace Electrolyte

8. Unscrew the upper knurled nut on the electrolyte container.

9. Remove the electrolyte tank out of the cell body from below using the electrode mount.

10. Remove the electrolyte container from the electrode mount. To do this, unscrew the knurled nut in the electrode mount.

11. Remove the electrolyte container out the electrode mount from the top.

12. Remove the drain plug from the electrolyte container.

13. Turn the electrolyte container upside down and drain the electrolytes by lightly shaking it.

Replacing Reference Electrode

14. If necessary, replace the reference electrode. The reference electrode can be unscrewed from the electrolyte container. Lightly wet the O-ring before installinga new reference electrode.

Replacing Porous Membranes

15. The porous membranes, which form the contact between the reference electrodes and sample water, cannot be cleaned. If the water quality is very good, the porous membranes can remain installed for up to three years; they should be replaced thereafter (no exceptions). If the sample water quality is poor, the porous membranes may be soiled. This influences the measuring accuracy.

16. Remove both porous membranes from the electrolyte container using a suitable tool (e.g. tweezers).

17. Push new porous membranes into the electrolyte container. Lightly wet the O-rings.

18. Insert the electrolyte container back into the electrode mount. Lightly wet the O-ring here as well.

19. Fill the container with fresh electrolyte (approx. 3 cm above the water level or narrowing of the electrolyte container).

20. Insert the drain plug into the electrolyte container.

21. Insert the electrode mount back into the cell body using the electrolyte container.

NOTE: The cell body's dowl pin must be locked into place in the appropriate hole in the electrode mount.

22. Screw the upper knurled nut back onto the electrolyte container.

23. Reconnect the signal cable acc. to colour.

CNT	Counter electrode	Blue point	Blue cable
WRK	Working electrode	Red point	Pink cable
Ref	Reference electrode (middle)		White cable

24. Screw the cap back on.

25. Fill half a cap from the plastic bottle with cell sanc and pour it into the cell body (approx. 1/2 cm³ cell sand) (see section 3.3.4 “Adding Grit (Bare Electrode)”).

26. Reinsert electrodes.

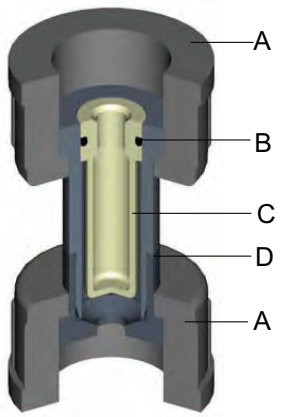
27. Reopen the check valve on the sample water inlet.

28. Perform calibration after approximately three hours running-in time.

NOTE: Perform a calibration after one hour running-in time and, if required, after 24 hours. You must calibrate each time the cell sand is replaced. The calibration must be checked after one day. Note the electrolyte’s expiration date. We recommend replacing the cell sand when replacing the electrodes and porous membranes.

Cleaning/Replacing the Fine Filter

A fine filter must only be installed when membrane sensors are employed. The fine filter must be cleaned or replaced in order to protect the membrane sensor’s delicate membrane against soiling or damage.



A	Knurled nut
B	O-ring
C	Fine filter
D	Filter unit

1. Release both knurled nuts (A)

2. Remove complete filter unit (D)

3. Remove the fine filter (C)

To do this, screw the M6 screw slightly into the fine filter and pull the fine filter out of the filter unit.
OR
Press the fine filter (C) with a suitable tool (not pointed) out of the filter unit.

4. Rinse the fine filter (C) with water, replace if necessary.

5. Place the fine filter (C) into the filter unit (D).

6. Ensure that the O-ring is fitted correctly (insert as far as possible).

7. Fit the filter unit (D). Ensure that it is fitted in the correct position.

8. Tighten both knurled nuts (A).

4.3.1 Maintaining Membrane Sensors

For the membrane sensor maintenance procedure, see section 2.3 “Membrane sensors”.

- “Membrane sensor for free chlorine FC1”
- “Membrane sensor for chlorine dioxide CD7”
- “Membrane sensor for ozone OZ7”
- “Membrane sensor for total chlorine TC1”

To keep the sensor in a constant state of readiness, leave the cap in place on the sensor until it is about to be installed. Do not discard the cap, but keep it and use it to protect the sensor whenever it is removed from service. Then fill the cap with water (not distilled) and place it over the tip of sensor.

The pH sensor has a threaded plug-in head. Care must be taken to ensure that the O-ring is present when connecting the head. A standard 1.5 m long, shielded coaxial (measuring) cable is supplied with the pH sensor. At one end the cable has a special plug which is screwed on to the threaded plug-in head of the sensor. The other end of the shielded special cable is connected directly to the intended terminal connection in the control module.

4.3.2 Maintaining pH Electrode

Clean and calibrate if there are fluctuations in the measured values. A routine schedule cannot be given here because the cleaning schedule depends heavily on the general condition of the sample water. In general, calibrate approx. every 4 weeks. Remove dirt on the glass membrane and diaphragm to prevent measuring errors. In particular, the ceramic electrode diaphragm may also be soiled or coated with lime deposits.

Remove contaminants deposited on the surface of the membrane glass; use diluted hydrochloric acid (up to 10%), if necessary. The electrodes should not

be cleaned in a dry state because this is more likely to smear the layer of dirt over the surface rather than removing it. Under no circumstances may the membrane be treated with abrasive cleaning agents.

The electrode must be rinsed subsequently with nothing other than water.

Remove lime deposits on the glass membrane and the diaphragm by immersing the electrode into hydrochloric acid (up to 10%). Rinse thoroughly with water or distilled water here as well; pH electrodes age. This is often the cause for a slow display of the pH value or a drop in the slope. pH electrodes typically last 1 to 2 years. However, routine maintenance of the electrodes recommended.

4.3.3 Maintaining Fluoride Electrode

If using the refillable electrolyte probe, routinely check the electrolyte level in the electrode (at least once per week). The fill level should always be just under the filling hole, approx. 25mm above the sample water. Replenish the electrolyte, if necessary. Routinely calibrate the measuring system to guarantee safe operation and accuracy.

If using the gel electrolyte probe, remove contaminants deposited on the surface of the membrane glass; use diluted hydrochloric acid (up to 10%), if necessary. The electrodes should not be cleaned in a dry state because this is more likely to smear the layer of dirt over the surface rather than removing it. Under no circumstances may the membrane be treated with abrasive cleaning agents.

Do not touch the glass surfaces with the cloth.

4.4 Membrane Sensor Kit

4.4.1 Maintenance

Daily: Check the entire system including all screw fittings for leakage and repair any leaks immediately. Using the cell outlet (see Dwg. 50.560.100.030 in Section 2), carry out a manual measurement every day.

NOTE: The same test method should always be used in order to obtain consistent comparisons between results. Air bubbles at the membrane effect the accuracy of measurement. The cause must be determined and rectified.

When there is an obvious difference between the displayed value and the manually measured value then a calibration must be performed (refer to paragraph 3.2.2, Membrane Calibration). If the deviation remains, even after calibration, then the electrodes should be cleaned in accordance with the manufacturers instructions (see instruction sheet contained in the sensor packaging).

Monthly: Perform a calibration.

4.4.2 Maintenance of the Membrane Probes

NOTE: Do not touch the membrane or reference electrode.

Before unscrewing the membrane cap, remove the elastomer seal to allow air into the vent hole. Unscrew the membrane cap, clean the reference electrode with distilled water and then dry with a clean paper towel. Cover the vent hole with the elastomer seal. Refill the cap with new electrolyte (refer to paragraph 2.3, Membrane Sensor). If the signal is still low or unstable, it may be necessary to replace the cap with a new one (refer to Section 6 - Spare Parts List).

After this procedure, the probe requires a run-in time of about one to two hours before recalibration.

4.4.3 Troubleshooting

The following troubleshooting table is provided for determining and correcting most common troubles.

Table 4.4 - Troubleshooting - Membrane Sensor Kit

FAULT CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
Insufficient flow of measuring water	free runoff prevented; back pressure too high	check for free drain or return
	dirt in cell	clean measuring cell
	air bubbles	check sample water take-off
	screen in water inlet blocked	clean
	inlet valve closed	open valve
Air bubbles	leaking O-rings	replace O-rings
	incorrect fittings	check and if necessary tighten or replace
DIS Electrode current too low	electrolyte exhausted	perform sensor maintenance
	membrane defective	replace membrane cap
DIS Span cannot be adjusted	measuring cell gives insufficient current	perform sensor maintenance
		The minimum current difference between un-chlorinated and chlorinated water with 1 mg/l residual DIS must be at least >2µA. If the difference is smaller, carry out maintenance.
Strong fluctuations in display, though chlorine concentration is constant	sample water flow too low	check; if necessary, clean inlet
	electrolyte exhausted	perform sensor maintenance

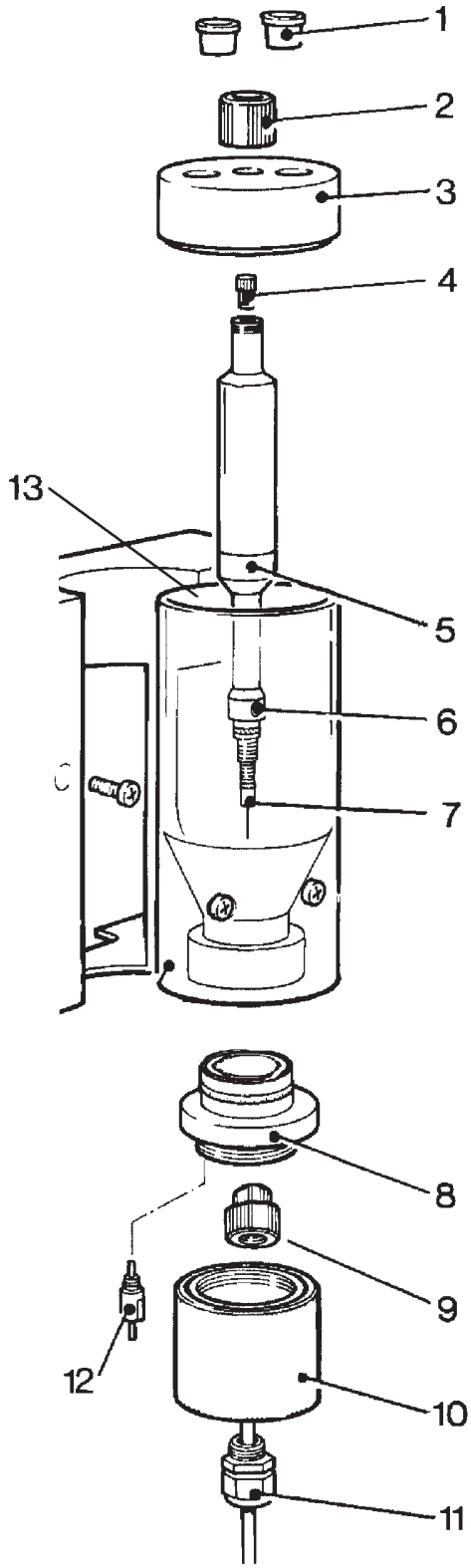
SECTION 5

SECTION 5 - ILLUSTRATIONS

List Of Contents

DWG. NO.

Parts
W2T9694 Bare Electrode Sensor Kit..... 50.560.000.010A&B
W2T9694 Bare Electrode Residual Analyzer 50.560.000.020A-E
W2T9681 Membrane Flow Block Assembly..... 50.560.000.030A&B
W2T7957 Depolox® 5..... 50.580.000.010A-D
W2T7958 VariaSens™..... 50.580.000.020A-C



NOTE: FOR PARTS LIST, SEE DWG. 50.560.000.010B.

W2T9694 BARE ELECTRODE SENSOR KIT - PARTS

50.560.000.010A

ISSUE 3 8-10

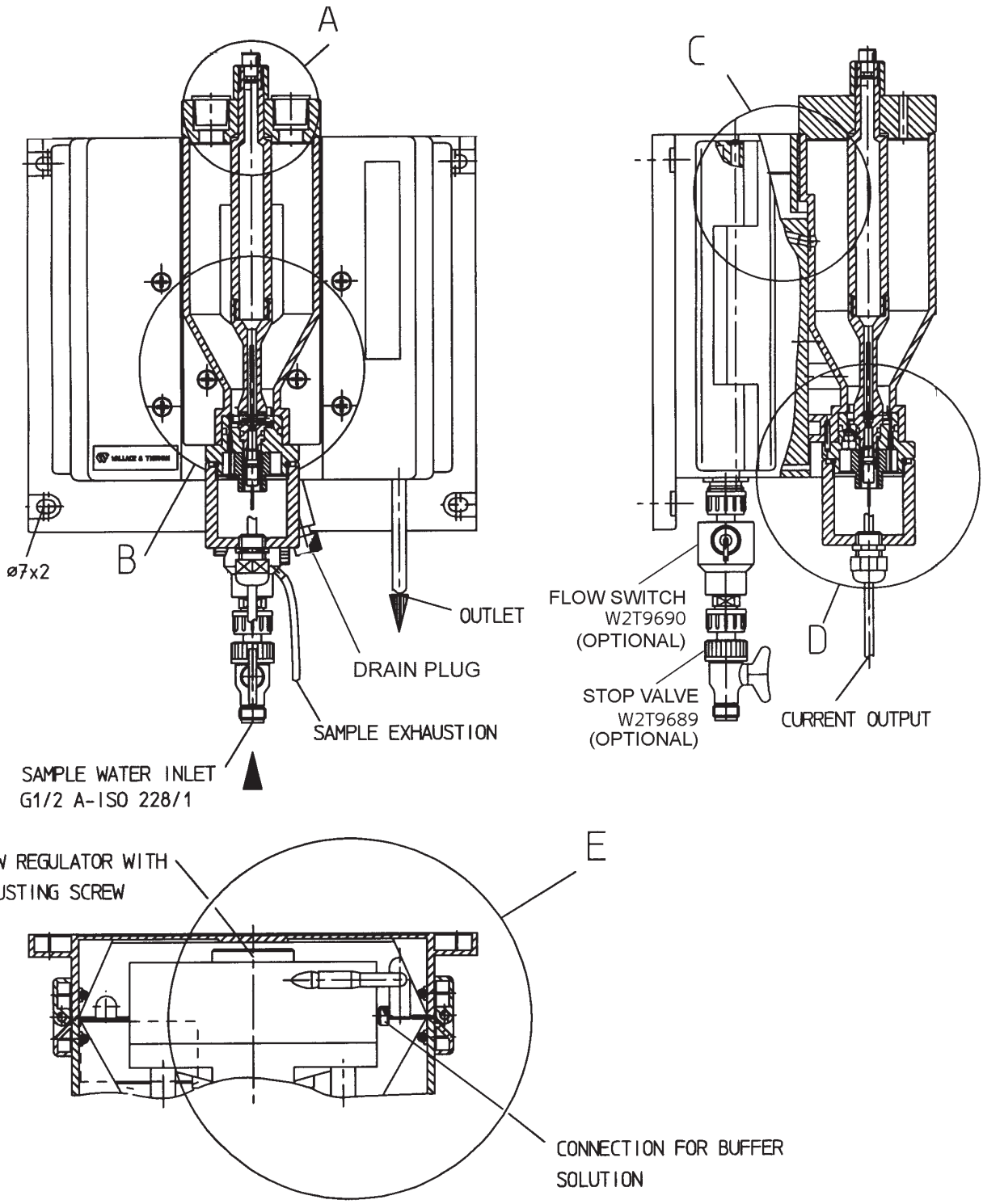
KEY NO.	PART NO.	QTY.	DESCRIPTION
1	W2T9673	2	CAP
2	W2T9645	1	NUT
3	W2T9643	1	COVER
4	W2T9652	1	PLUG
5	W2T9653	1	ELECTROLYTE RESERVOIR
6	W2T11582	2	MEMBRANE
7	W2T11581	1	REFERENCE ELECTRODE
8	W2T11012	1	ELECTRODE HOUSING (W/ WORKING & COUNTER ELECTRODE)
9	W2T9644	1	NUT
10	W2T418060	1	COVER
11	W2T418190	1	CABLE CONNECTOR
12	W2T9674	1	TEMPERATURE SENSOR
13	W2T9804	1	CELL BLOCK

WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

W2T9694 BARE ELECTRODE SENSOR KIT - PARTS LIST

50.560.000.010B

ISSUE 3 8-10

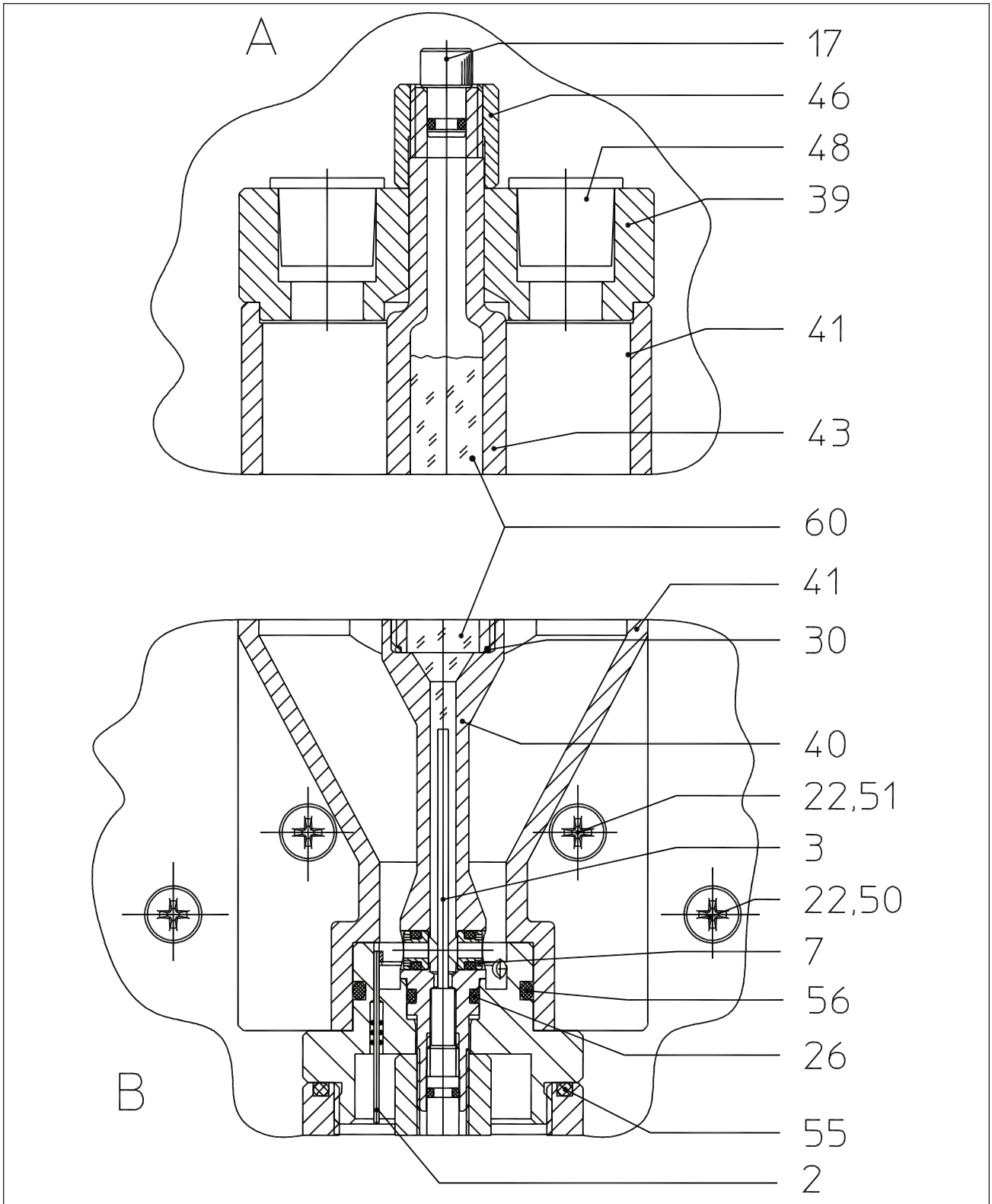


NOTE: FOR PARTS LIST, SEE DWG. 50.560.000.020E.

W2T9694 BARE ELECTRODE RESIDUAL ANALYZER - PARTS

50.560.000.020A

ISSUE 4 8-10

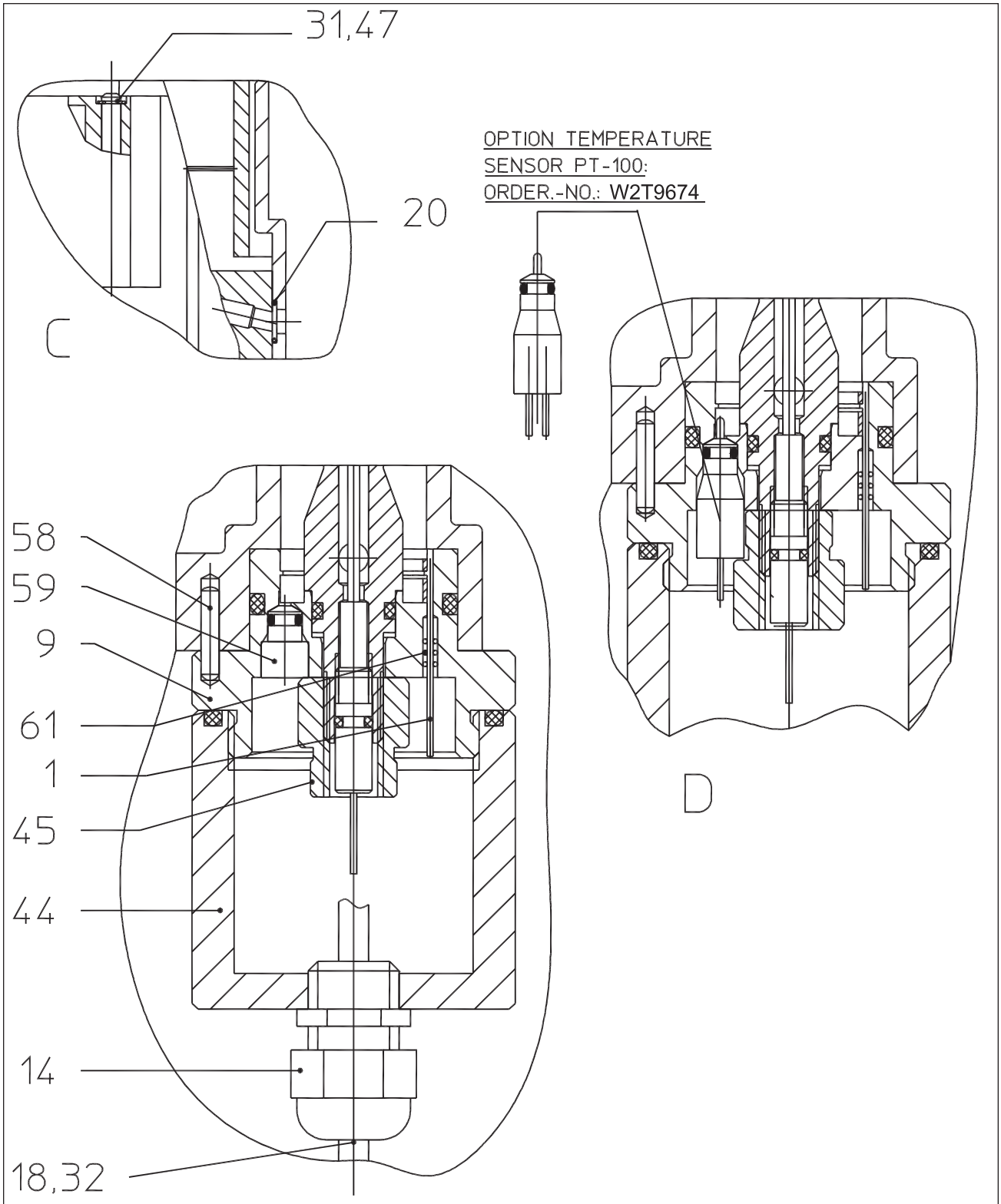


NOTE: FOR PARTS LIST, SEE DWG. 50.560.000.020E.

W2T9694 BARE ELECTRODE RESIDUAL ANALYZER - PARTS

50.560.000.020B

ISSUE 3 8-10

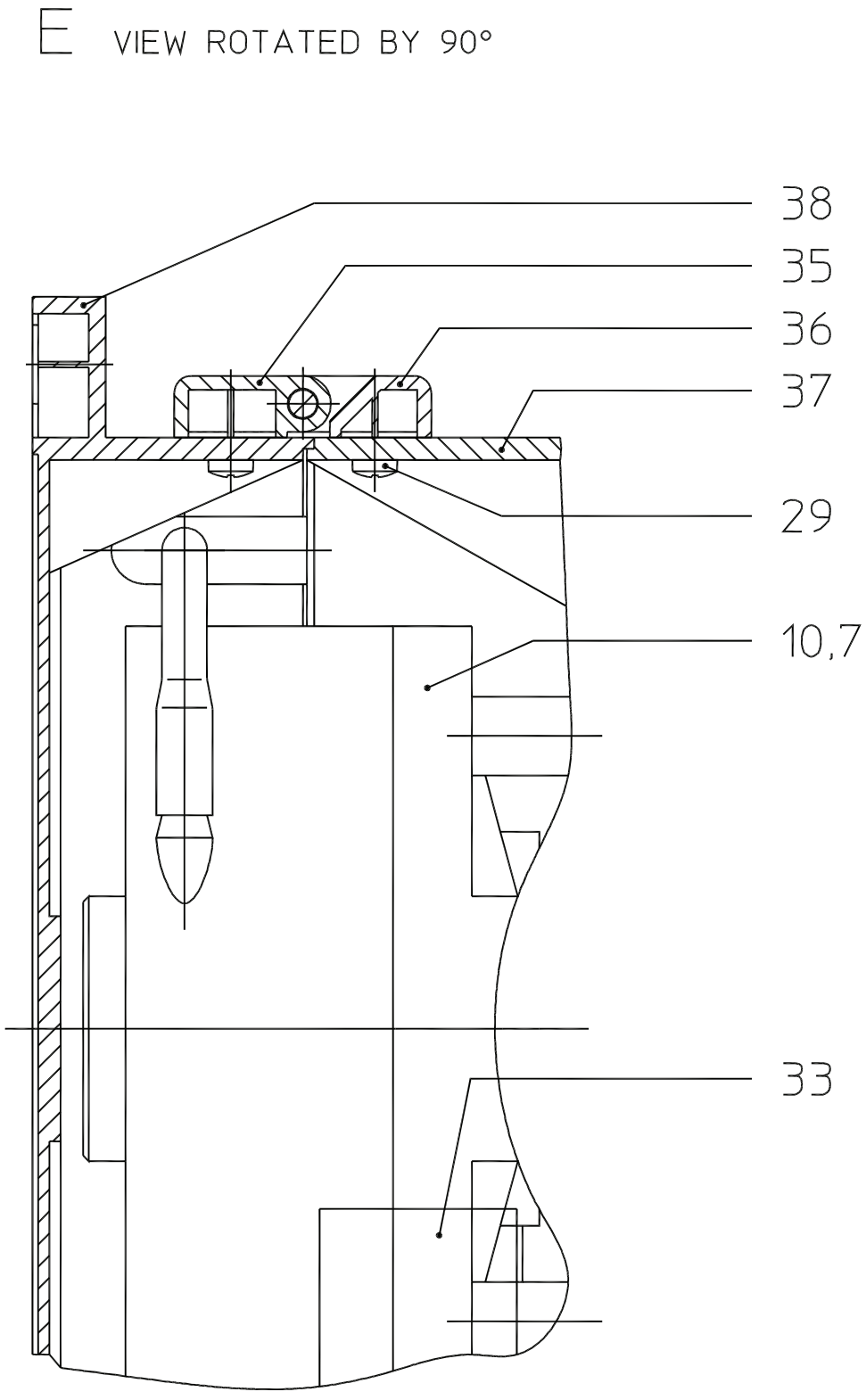


NOTE: FOR PARTS LIST, SEE DWG. 50.560.000.020E.

W2T9694 BARE ELECTRODE RESIDUAL ANALYZER - PARTS

50.560.000.020C

ISSUE 3 8-10



NOTE: FOR PARTS LIST, SEE DWG. 50.560.000.020E.

W2T9694 BARE ELECTRODE RESIDUAL ANALYZER - PARTS

50.560.000.020D

ISSUE 3 8-10

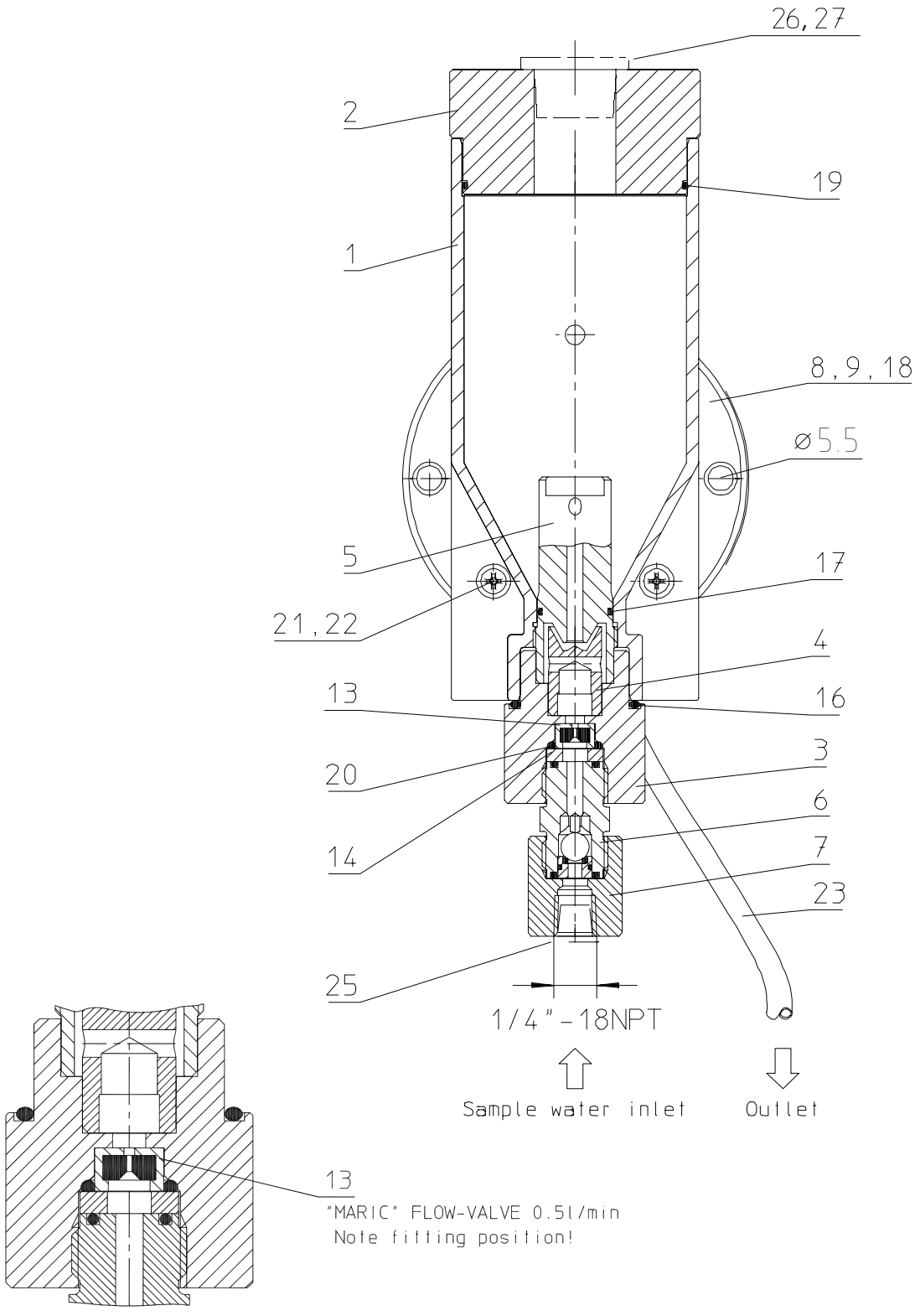
KEY NO.	PART NO.	QTY.	DESCRIPTION
▲ 1	W3T127848	1	ELECTRODE
▲ 2	W3T127849	1	ELECTRODE
3	W2T11581	1	ELECTRODE
7	W2T11582	2	MEMBRANE COMPLETE
▲ 9	W3T149176	1	ELECTRODES PICK UP
10	W2T418189	1	FLOW CONTROL VALVE
14	W2T418190	1	CABLE TERMINAL SCREW
17	W2T9652	1	PLUG UNIT
18	W2T440058	1	CELLULAR CABLE
20	W2T18570	2	O-RING
22	W2T11355	6	WASHER
26	W2T9670	1	O-RING
29	W2T499222	20	EJOT PT-SCREW
30	W2T438267	1	O-RING
31	W2T479373	2	WASHER
32	W2T499252	1	CABLE CLAMP
33	W3T149177	1	NAME PLATE
● 34	W2T499254	1	CAP
35	W3T149178	2	HINGE
36	W3T149179	2	HINGE
37	W3T149180	1	HOUSING UPPER PART
38	W3T149261	1	HOUSING LOWER PART
39	W2T9643	1	CELLULAR COVER
40	W3T139776	1	ELECTRODE CASE
41	W2T9804	1	CELL BLOCK
43	W3T149262	1	TANK
44	W2T418060	1	COVER
45	W2T9644	1	KNURLED NUT
46	W2T9645	1	NUT
47	W2T418061	2	CONNECTING PIECE
● 48	W2T9673	2	CAP
50	W2T11146	4	SCREW
51	W2T419109	2	SCREW
● 53	W3T149263	1	FELT WASHER
55	W2T9671	1	O-RING
▲ 56	W2T11147	1	O-RING
58	W2T9672	1	CYLINDER PIN
▲ 59	W3T149264	1	PLUG
60	W2T9646	0.031	KCl ELECTROLYTE (PART OF KCl ELECTROLYTE SET)
▲ 61	W2T12058	6	O-RING

NOTE: ▲ INCLUDED IN ELECTRODE HOUSING.
● ONLY FOR TRANSPORT.

WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

W2T9694 BARE ELECTRODE RESIDUAL ANALYZER - PARTS LIST

50.560.000.020E
ISSUE 3 10-10



NOTE: FOR PARTS LIST, SEE DWG. 50.560.000.030B.

W2T9681 MEMBRANE FLOW BLOCK ASSEMBLY - PARTS

50.560.000.030A

ISSUE 3 8-10

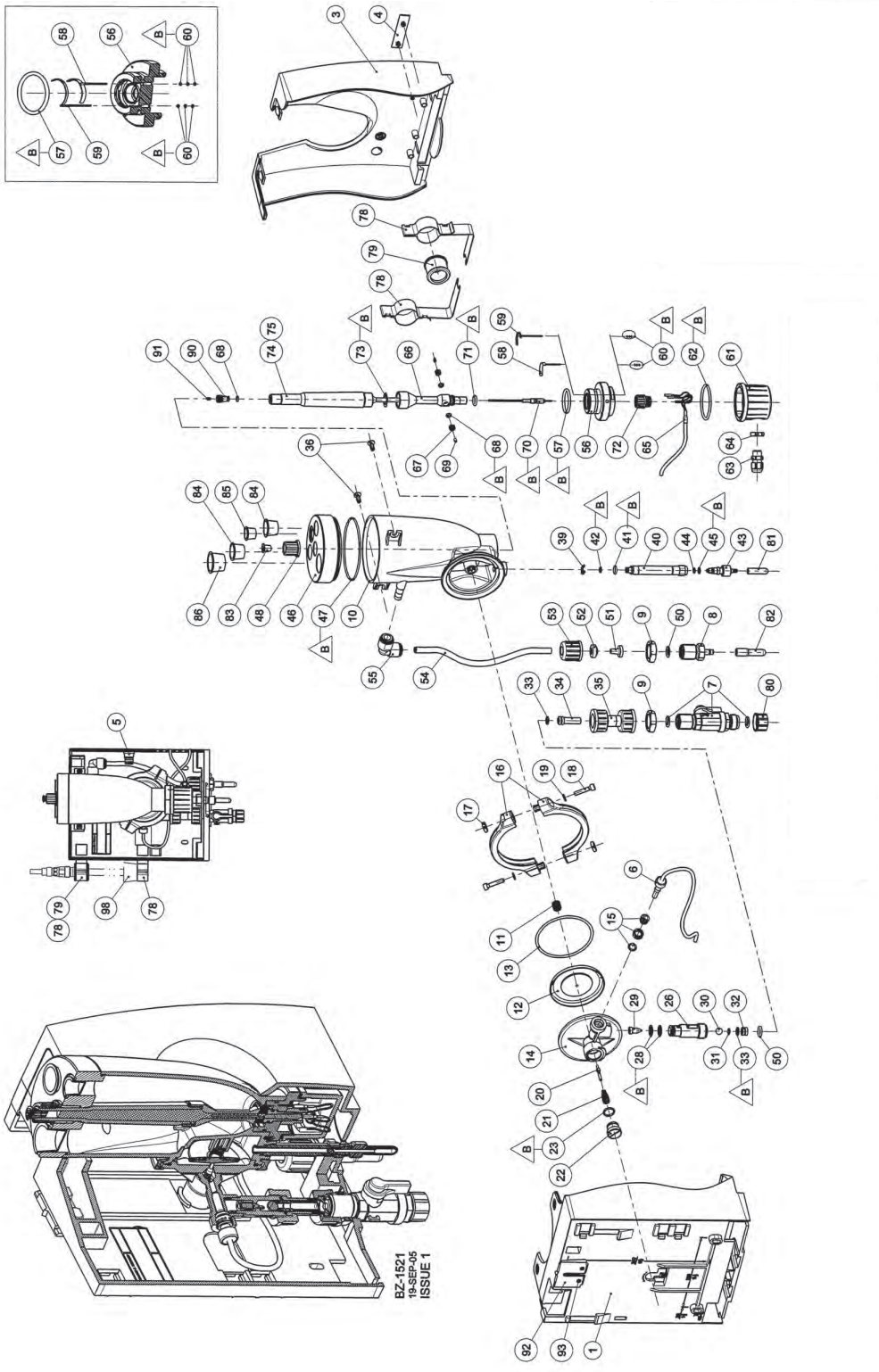
KEY NO.	PART NO.	QTY.	DESCRIPTION
1	W2T9663	1	CELL BLOCK
2	W3T149265	1	CELL COVER
5	W3T149266	1	INLET BLOCK
6	W2T9665	1	CHECK VALVE
7	W2T9666	1	ADAPTOR
8	W3T149267	1	EXHAUSTION
9	W2T499033	1	UNION
13	W2T9983	1	FLOW VALVE
14	W2T9664	1	CLAMPING RING
16	W2T12574	1	O-RING
17	W2T9667	1	O-RING
18	W2T18570	1	O-RING
19	W2T9668	1	O-RING
20	W2T17826	1	O-RING
21	W2T419109	2	SCREW
22	W2T11355	2	PLAIN WASHER
23	W2T8534	0.3m	TUBE
25	W2T19352	1	PLUG
26	W2T12043	1	PLUG
27	W2T16513	1	PLUG

WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

W2T9681 MEMBRANE FLOW BLOCK ASSEMBLY - PARTS LIST

50.560.000.030B

ISSUE 3 10-10



NOTE: FOR PARTS LIST, SEE DWGS. 50.580.000.010B-D.

W2T7957 DEPOLOX® 5 - PARTS

50.580.000.010A
ISSUE 1 8-10

KEY NO.	PART NO.	DESCRIPTION
1	W3T149386	BASE HOUSING
1,92,93	W3T149385	BASE HOUSING, PRE-ASSEMBLED
3	W3T149387	HOUSING COVER
4	W3T149388	PRODUCT ID
5	W2T499035	CABLE CLIP
6	W2T416793	MULTI SENSOR
7	W2T420400	SHUT-OFF VALVE
8	W3T149389	OUTLET CONNECTION
9	W2T499055	LOW CROWN NUT
10	W2T416781	CELL BODY
11	W3T149390	COMPRESSION RING
12	W2T116782	MEMBRANE UNIT
13	W2T499041	O-RING
14	W3T149661	CONTROL VALVE BODY
15	W2T416386	PLASTIC CARTRIDGE
16	W3T149662	V PROFILE CLAMP
17	W3T149663	SQUARE NUT
18	W2T442619	PAN HEAD SCREW
19	W2T11355	WASHER
20	W3T149664	VALVE NEEDLE
21	W3T149665	COMPRESSION RING
22	W3T149666	ADJUSTING SCREW
23	W3T149667	O-RING
26	W3T149668	CHECK VALVE HOUSING
28	W2T13117	O-RING
29	W3T149669	FLOAT, INCLUDES MAGNET
30	W3T149670	BALL
31	W3T149671	O-RING
32	W3T149672	UNION END
33	W3T149673	O-RING
34	W3T149674	FINE FILTER
33,34	W3T149675	FINE FILTER, COMPLETE
35	W2T361801	FILTER HOUSING
36	W2T499042	PLASTIC SELF-TAPPING SCREW
39	W2T416444	SECURING RING
40	W2T416597	DRAIN TUBE

WHEN ORDERING MATERIAL ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS

W2T7957 DEPOLOX® 5 - PARTS LIST

50.580.000.010B

ISSUE 1 10-10

KEY NO.	PART NO.	DESCRIPTION
41	W2T416529	O-RING
42	W2T416530	O-RING
43	W2T416783	DRAIN SCREW
44	W3T149682	FLAT GASKET
45	W2T18871	O-RING
46	W2T420306	CELL BODY COVER
47	W2T416528	O-RING
48	W2T9645	KNURLED NUT
50	W2T12552	O-RING
51	W3T149683	HOSE BUSHIN G
52	W3T149684	LOCKING RING
53	W3T149685	UNION NUT
50-53	W3T149686	HOSE CONNECTION PARTS
54	W3T149687	HOSE
55	W2T499043	REDUCING ELBOW
56	W3T127850	ELECTRODE MOUNT
57	W2T11147	O-RING
58	W3T127848	WORKING ELECTRODE
59	W3T127849	COUNTER ELECTRODE
60	W2T12058	O-RING
61	W3T149688	SEALING CAP
62	W2T9671	O-RING
63	W3T149689	CABLE UNION
64	W2T499056	HEXAGON NUT
65	W3T149690	CONNECTOR CABLE COMBINATION
66	W3T139776	ELECTRODE CASE
67-69	W2T11582	DIAPHRAGM COMPLETE
70	W2T11581	REFERENCE ELECTRODE
71	W2T9670	O-RING
72	W2T9644	KNURLED NUT
73	W2T438267	FLAT GASKET
74	W2T11564	KCL ELECTRODE SET, 100ml
75	W3T149262	CONTAINER
78	W3T149721	CLIP, COATED
79	W3T149722	ELECTRODE MOUNT
80	W2T499247	SCREW CAP

WHEN ORDERING MATERIAL ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS

W2T7957 DEPOLOX® 5 - PARTS LIST

50.580.000.010C

ISSUE 1 10-10

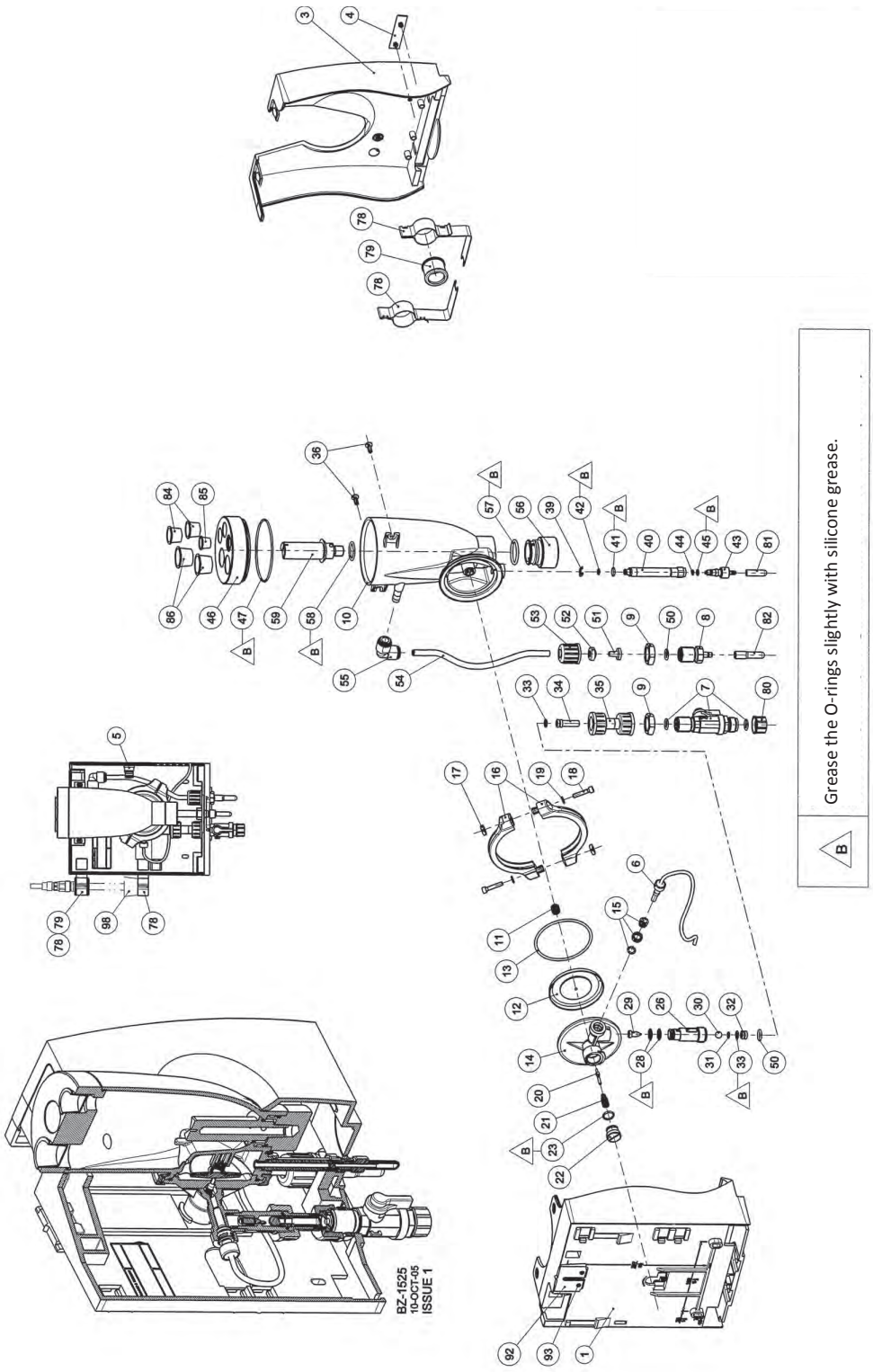
KEY NO.	PART NO.	DESCRIPTION
81	W2T499046	PROTECTION CAP
82	W2T499047	PROTECTION CAP
83	W2T499254	PROTECTION CAP
84	W2T9673	PROTECTION CAP
85	W2T499050	PROTECTION CAP
86	W2T499051	PROTECTION CAP
68,90,91	W2T9652	PLUG COMPLETE
92	W3T149723	WALL HOOKS
93	W2T499245	SHEET METAL SCREW
98	W2T499052	BREAKER, 1 PC
98	W3T149724	BREAKER, 75 PC
Accessories	W3T149263	FELT WASHER, TRANSPORT LOCK
Accessories	W3T149686	HOSE CONNECTION PARTS, ID 6 x WDG 1
Accessories	W3T149725	HOSE CONNECTION PARTS, ID 6 x WDG 3
Accessories	W2T416995	ELECTRODE CLEANING SAND “QK”
Accessories	W3T149726	MOUNTING SET

WHEN ORDERING MATERIAL ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS

W2T7957 DEPOLOX® 5 - PARTS LIST

50.580.000.010D

ISSUE 1 10-10



NOTE: FOR PARTS LIST, SEE DWGS. 50.580.000.020B&C.

W3T158742 VARIASENS™ WETSIDE - PARTS

50.580.000.020A

ISSUE 2 2-11

KEY NO.	PART NO.	DESCRIPTION
1	W3T160628	BASE HOUSING
1,92,93	W3T164571	BASE HOUSING, PRE-ASSEMBLED
3	W3T160629	HOUSING COVER
4	W3T160908	PRODUCT ID
5	W2T499035	CABLE CLIP
6	W3T172029	MULTI SENSOR
7	W3T166170	SHUT-OFF VALVE
8	W3T158593	OUTLET CONNECTION
9	W2T499055	LOW CROWN NUT
10	W3T158561	CELL BODY
11	W3T164226	COMPRESSION RING
12	W3T158569	MEMBRANE UNIT
13	W3T160654	O-RING
14	W3T158595	CONTROL VALVE BODY
15	W2T504209	PLASTIC CARTRIDGE
16	W3T160649	V PROFILE CLAMP
17	W3T158567	SQUARE NUT
18	W2T442619	PAN HEAD SCREW
19	W2T11355	WASHER
20	W3T158572	VALVE NEEDLE
21	W2T376069	COMPRESSION RING
22	W3T158573	ADJUSTING SCREW
23	W3T160357	O-RING
26	W3T160648	CHECK VALVE HOUSING
28	W2T13117	O-RING
29	W3T169827	FLOAT, INCLUDES MAGNET
30	W3T149670	BALL
31	W3T149671	O-RING
32	W3T149672	UNION END
33	W3T149673	O-RING
34	W3T168189	FINE FILTER
33,34	W3T150633	FINE FILTER, COMPLETE
35	W3T158602	FILTER HOUSING
36	AAC5002	PLASTIC SELF-TAPPING SCREW
39	W3T172041	SECURING RING
40	W3T158576	DRAIN TUBE

WHEN ORDERING MATERIAL ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS

W3T158742 VARIASENS™ WETSIDE - PARTS LIST

50.580.000.020B

ISSUE 1 2-11

KEY NO.	PART NO.	DESCRIPTION
41	PXC95968	O-RING
42	AAC7126	O-RING
43	W3T158575	DRAIN SCREW
44	W3T166261	FLAT GASKET
45	W2T18871	O-RING
46	W3T158738	CELL BODY COVER
47	AAC4906	O-RING
50	W2T12552	O-RING
51	W3T149683	HOSE BUSHING
52	W3T169815	LOCKING RING
53	W3T149685	UNION NUT
50-53	W3T149686	HOSE CONNECTION PARTS
54	W3T158601	HOSE
55	W2T505093	REDUCING ELBOW
56	W3T158740	PRESS-OUT PLUG
57	W2T11147	O-RING
58	W3T167941	O-RING
59	W3T158793	FLOW BODY
78	W3T166169	CLIP, COATED
79	W3T172045	ELECTRODE MOUNT
80	W2T499247	SCREW CAP
81	W2T499046	PROTECTION CAP
82	W2T499047	PROTECTION CAP
84	W2T9673	PROTECTION CAP
85	W2T499050	PROTECTION CAP
86	W2T499051	PROTECTION CAP
92	W3T160627	WALL HOOKS
93	W2T499245	SHEET METAL SCREW
98	W2T499052	BREAKER, 1 PC
98	W3T158600	BREAKER, 75 PC
Accessories	W3T149686	HOSE CONNECTION PARTS, ID 6 x WDG 1
Accessories	W3T149725	HOSE CONNECTION PARTS, ID 6 x WDG 3
Accessories	W3T149726	MOUNTING SET

WHEN ORDERING MATERIAL ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS

W3T158742 VARIASENS™ WETSIDE - PARTS LIST

50.580.000.020C

ISSUE 1 2-11

SECTION 6

SECTION 6 - SPARE PARTS LIST

List Of Contents

PARA. NO.

W2T9694 Free Chlorine (Bare Electrode) Sensor Kit 6.1
Membrane Sensor Kits 6.2
W2T7957 Bare Electrode Retrofit Set 6.2.1
W2T7958 VariaSens Retrofit Set 6.2.2
pH Sensor 6.3
Fluoride Sensor Kits 6.4
Fluoride/pH Cables 6.5
Fuses 6.6
Circuit Boards 6.7

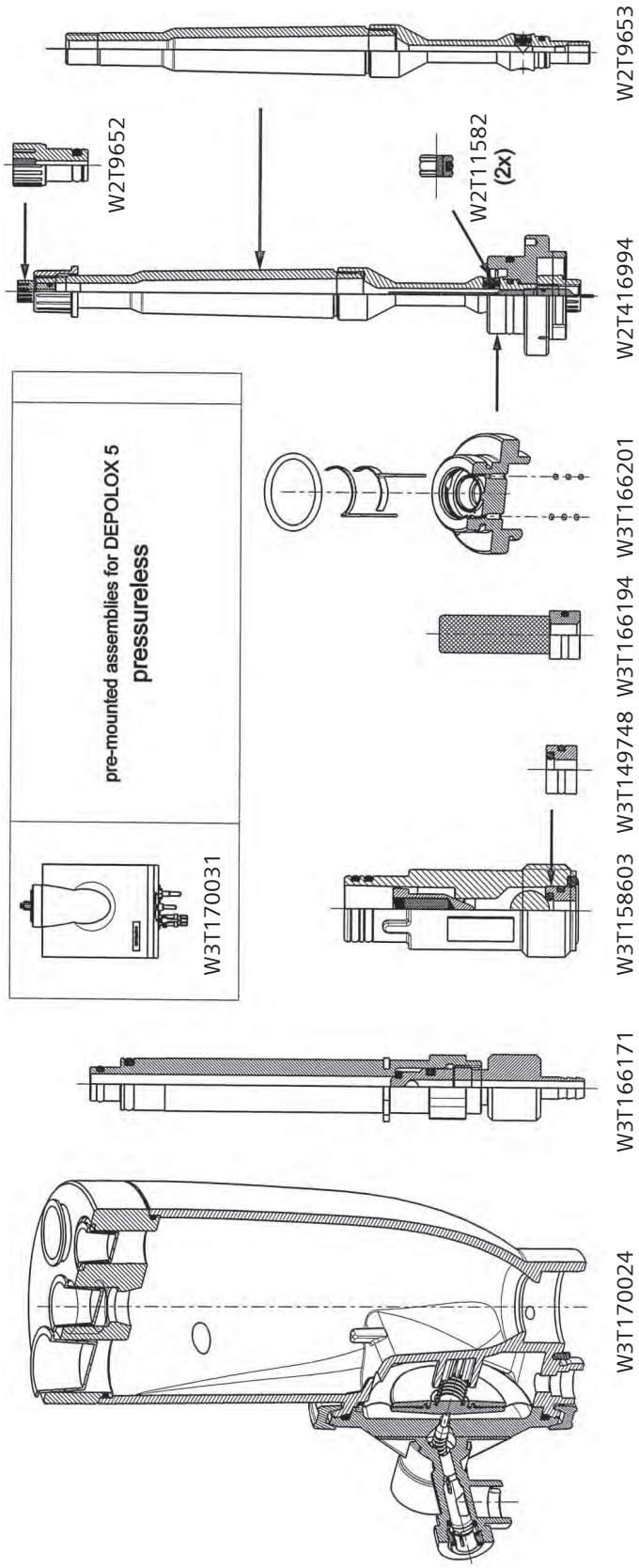
6.1 W2T9694 Free Chlorine (Bare Electrode) Sensor Kit

DESCRIPTION	PART NO.
Spare part set for two years operation	W2T9012
Spare part set for five years operation	W2T9013
Individual spare parts:	
Electrode housing (with working and counter electrode)	W2T11012
Membrane (two required)	W2T11582
Electrolyte for reference electrode	W2T9646
Grit (25 g)	W2T9647
PT100 Temperature Sensor	W2T9674

6.2 Membrane Sensor Kits

DESCRIPTION	PART NO.
Mem Sen Pack TCl (Total Chlorine) PM Kit (includes membrane cap, elastomer seal, O-ring, electrolyte, abrasive paper, instruction)	W2T9688
Mem Sen Pack FC1 (Free Chlorine) PM Kit	W2T8663
Mem Sen Pack OZ7 (Ozone) PM Kit	W2T8661
Mem Sen Pack CD7 (Chlorine Dioxide) PM Kit	W3T134190
2m Cable	W2T416786
5m Cable	W2T420222
10m Cable	W3T149888
15m Cable	W2T416799
25m Cable	W3T149743
50m Cable	W3T149744

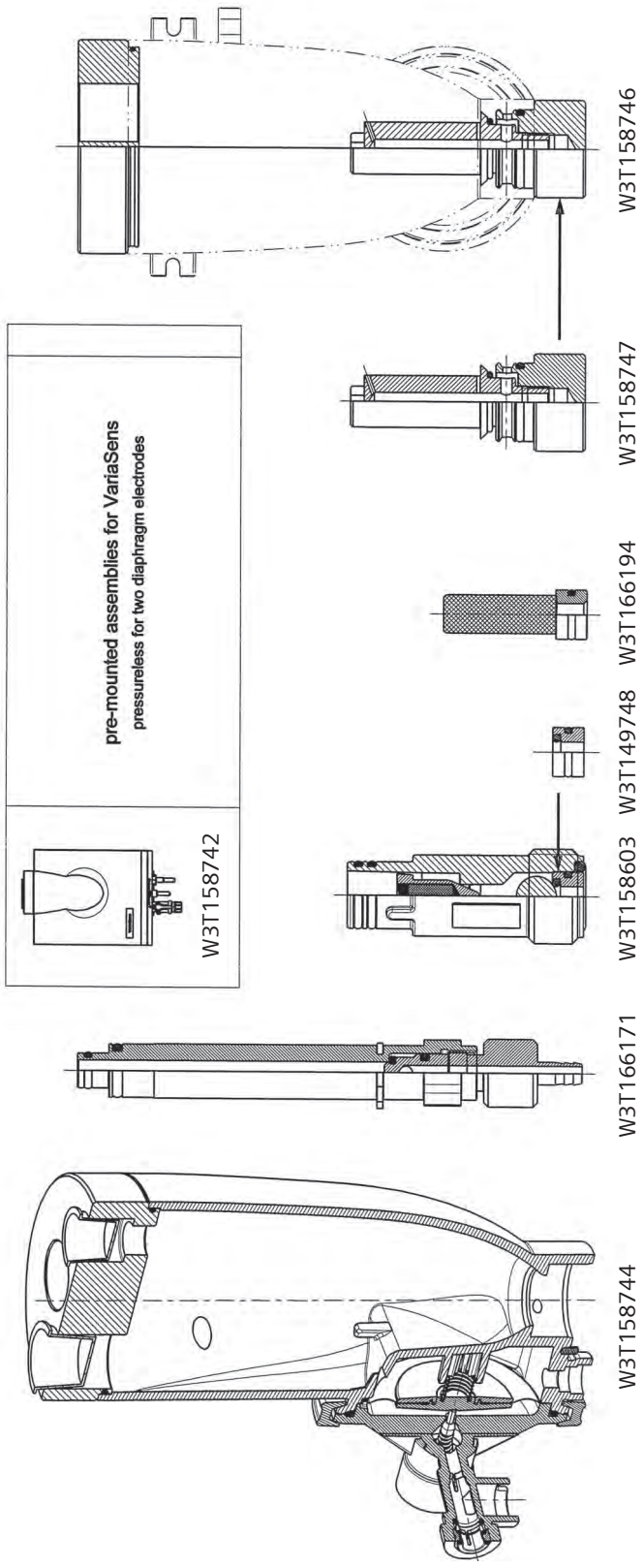
6.2.1 Bare Electrode Retrofit Set W2T7957



6.2.1.1 Bare Electrode Retrofit Set Parts List W2T7957

Part. No.	Description
W2T7957	Flow block assembly
W3T149745	Cell body D5-DL, complete
W3T149746	Drain unit
W3T149747	Back pressure unit
W3T149748	Ball seat, complete
W3T149675	Fine filter
W3T149749	Electrode support, complete
W2T416994	Electrode cell, complete, electrode not included
W2T9652	Plug complete
W2T11582	Diaphragm complete
W2T9653	Electrode housing
W2T350531	Spare parts set, BASIS-KIT
W3T129462	Spare parts set, 4 years Operation

6.2.2 VariaSens™ Retrofit Set W2T7958



6.2.2.1 VariaSens™ Retrofit Set Parts List W2T7958

Part. No.	Description
W2T7958	Flow block assembly
W3T149750	Cell body VS-DL, complete
W3T149746	Drain unit
W3T149747	Back pressure unit
W3T149748	Ball seat, complete
W3T149675	Fine filter
W3T149751	Flow body, complete
W3T149752	Retrofit kit D5-DL/VS-DL
W2T350531	Spare parts set, BASIS-KIT
W3T129463	Spare parts set, 4 years Operation

6.3 pH Sensor

DESCRIPTION	PART NO.
pH sensor	W2T12126
Impedance transformer (optional)	W2T9651

6.4 Fluoride Sensor Kits

DESCRIPTION	PART NO.
Complete Refillable Fluoride Sensor Kit (W2T9656 & W2T9651)	W2T417005
Refillable Fluoride sensor	W2T9656
Complete Gel Fluoride Sensor Kit (W2T8660 & W2T9651)	W3T124078
Gel Fluoride sensor	W2T8660
Impedance transformer	W2T9651
100 mg/l calibration solution	W2T18257
Fluoride filling solution	W2T8827

6.5 Fluoride/pH Cables

DESCRIPTION	PART NO.
Fluoride/pH Cable - 5m	W3T115466
Fluoride/pH Cable - 10m	W3T127847
Fluoride/pH Cable - 15m	W3T150921
Fluoride/pH Cable - 25m	W3T150922
Fluoride/pH Cable - 50m	W3T150923

6.6 Fuses

DESCRIPTION	PART NO.
Fuse, 115V and 230V Electronics	W2T420282

6.7 Circuit Boards

DESCRIPTION	PART NO.
Single Channel Electronics	W2T416999
Dual Channel Electronics	W2T417000

NOTE: Circuit boards shipped with voltage set at default 230V. See section 2.1.3 for instruction on changing voltage if necessary.

MANUFACTURER/DISTRIBUTOR:

Chloratech (Wallace & Tiernan)
Marie-Chantale Boudreault
212 rue Pierre-Couture
St-Augustin-de-Desmaures, QC, G3A 0A4
Phone: (418) 872-4200
pieces@chloratech.ca

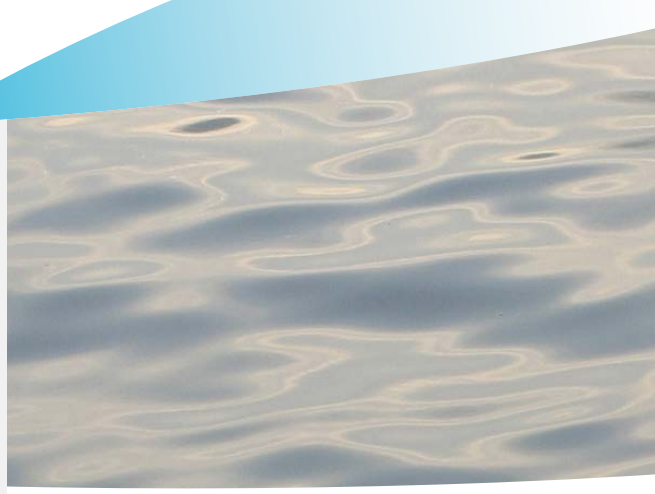
~~**ControValve (MSA)**~~
~~Raymond Butz~~
~~9610 Rue B. Ignace~~
~~Brossard, QC, J4Y 2R4~~
~~Phone: (450) 444-5858~~
~~wferreira@controvalve.com~~

8.1 Wallace & Tiernan Acutec 35 Gas Monitor System (WTP)

Wallace & Tiernan/Siemens
Chlorine Gas Detector

Acutec 35

EVOQUA
WATER TECHNOLOGIES



WALLACE & TIERNAN® SYSTEMS ACUTEC™ 35 GAS DETECTION SYSTEM

The Acutec™ 35 system utilizes the latest on-line gas monitoring technology to provide a flexible and reliable, self-testing detection system in a compact modular design. With sensors to detect the presence of chlorine, ammonia, or sulfur dioxide gases in ambient air, the Acutec 35 system is ideal for detecting leaks from storage containers, process piping, or gas feed equipment in any type of water, wastewater, or industrial plant environment.

THE BEST GAS DETECTION SYSTEM UNDER THE SUN

The Acutec 35 system's modular design allows for a wide range of configurations that can be simply and neatly installed, using standard enclosures.

The receiver module is available in a choice of either a Detector or Monitor version, which has an LED display, and an mA output signal. Both provide two selectable levels of alarm. A low level warning alarm may simply indicate transient leak conditions, whereas a second alarm can initiate a full alert in the event of more serious leaks. And, for real peace of mind, there is an optional Auto-Test unit. This incorporates an integral gas generator that automatically tests the sensor each day, sounding alarms in the event of sensor failure. This added safety feature also reduces the costs incurred with manual procedures.

Combine the features of the Acutec 35 system with the fact that it comes with the backing and technical support of one of the world's most respected chemical feed and disinfection companies, and you will see why the Acutec 35 system is the best gas detection system under the sun. Every single component in the Acutec 35 system is precision manufactured and vigorously tested to ensure accuracy and reliability.

KEY BENEFITS

- Gas detection for Chlorine, Ammonia or Sulfur Dioxide
- Simple and neat installation of module components
- Easy access to control panel via a hinged cover on the NEMA 4X enclosure
- Audible horn to provide local warning.
- Choice of Detector or Monitor version
- Sunlight readable 4 digit LED on the monitor
- Single or multipoint gas detection systems
- Automatic integral gas generator

Wallace & Tiernan/Siemens
Chlorine Gas Detector

Acutec 35

INSTALLATION

The flexibility of the modular system allows for simple installation of single or multipoint gas detection systems. Each point of detection requires the installation of one sensor/transmitter and one receiver module. The sensor/transmitter is installed in the area to be monitored and the receiver module can be located up to 1000 feet away. A power supply module, sufficient for use with up to two receivers, is housed with the Receivers in a NEMA 4X enclosure.

All enclosures are provided with knockouts on all four sides to facilitate wiring using the 1/2" FNPT (12.7 mm) conduit hubs provided. Equally suitable for indoor or outdoor applications, these NEMA 4X-rated polystyrene enclosures are fitted with a tough hinged polycarbonate window for clear visibility of all indicators and easy access to the control panel. Included within the enclosure is a piezoelectric horn to provide audible local warning.

Receiver Module

Two versions of the receiver are available. The detector signals the presence of specified gas and includes two gas alarm set points and three configurable and assignable gas alarm relays. It is also supplied with a separate sensor alarm and relay. The monitor provides, in addition to the above, an LED display of gas concentrations in PPM and an isolated 4-20mA output.

Each module is switch-programmable for full scale range. A single switch on the front panel provides alarm acknowledgement, reset functions, alarm relay inhibition, on-demand activation of Auto-Test, and LED indicator testing. In addition, LED light bars provide a visual indication of alarm status.

Power Supply Mode

This module, designed for installation alongside the receiver module, can accept any AC input between 85-25, 5 VAC, transforming the supply to a 12 VDC output for the receiver module without and modification or adjustment. Loss of input power is indicated by a built-in power failure alarm relay. One module provides the power to operate one or two receiver modules, an integral audible alarm and the charging of the optional battery back-up.

Control Enclosure

A single or dual point standard enclosure is provided for housing the power supply module and either one or two receiver modules. The enclosure is rated NEMA 4X with a ringed polycarbonate window. An integral audible alarm horn is included as standard.

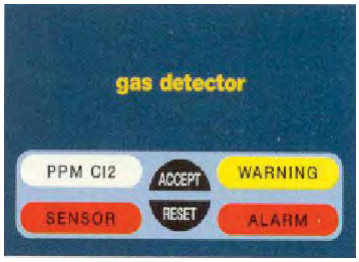
Sensor/Transmitter

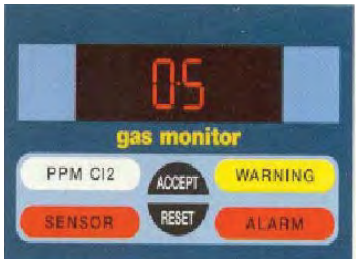
A highly efficient electrochemical gas sensor for location in areas where gas leakage could occur is combined with an equally efficient transmitter; both housed in a NEMA 4X enclosure. Digitally converted measurements of gas concentrations are then sent to the receiver module located anywhere up to 1000 feet away.

An optional auto-test facility is available for fitting to a sensor. Consisting of an electrochemical generator, it automatically tests the sensor everyday, triggering an alarm if a fault is found. The auto-test option also provided early warning of reduced sensitivity that can occur over time, allowing users to determine when sensors need replacing.

Battery Back-Up System

The battery back-up option consists of a sealed lead-acid battery mounted in its own enclosure. In the event of power failure, it will maintain all receiver functions for a minimum of 12 hours on a single point system, or six hours on a dual point system. Battery charging is fully automatic and continuous through the power supply module.





Wallace & Tiernan/Siemens
Chlorine Gas Detector

Acutec 35

TECHNICAL DATA

Gases Detected Chlorine, Sulfur Dioxide, Ammonia

Gas Ranges

	Std. Range	Min. Range	Max. Range
Cl_2	0-10 ppm	0-5 ppm	0-50 ppm
SO_2	0-20 ppm	0-10 ppm	0-100 ppm
NH_3	0-100 ppm	0-50 ppm	0-500 ppm

Power Requirements

85-255 VAC, 50/60 HZ 1 Amp - Self-regulating

Ambient Temperature
0° to 105°F (-18° to 40°C) continuous
-10° to 120°F (-23° to 49°C) intermittent

Humidity 0-99% non-condensing

Gas Alarm Setpoints
2 independent setpoints
Warning Level - adjustable from 5% to 100% of range
Alarm Level - adjustable from 5% to 100% of range

Alarm Indicators High intensity LED bars

Function
- WARNING indicator non-latching
- Alarm indicator latching

Alarm Relays
Three assignable alarm relays for either alarm setpoint 10A at 120 VAC, 5A at 250 VAC, resistive, SPDT configurable for normal/fail-safe, latching/non-latching, and fast/slow operation.

Alarm Relay and Indicator Reset
Activated from front panel switch or through remote reset.

Sensor Alarm
Indicates loss of sensor/transmitter input or failure of Optional sensor Auto-Test.

Sensor Alarm Relay and Indicator
Front panel LED indicator and relay; 10A, at 120 VAC, 5A at 250 VAC, resistive SPDT factory set to fail-safe operation.

Monitor Concentration Display
4-digit LED, sunlight readable.

Monitor Concentration Output Signal
Isolated 4-20 mA DC, 1000 ohms maximum load.

Power Supply Output Voltage

Regulated 13.7 VDC, 1A supplied to 1 or 2 receivers. Also, for recharging external battery, audible back-up and for integral Alarm horn power.

Audible Alarm Horn
Weatherproof 12 VDC piezoelectric horn 85-dB output Signal for local alarming.

Power Failure Alarm Relay
Loss of AC input power.
1 relay 10A at 120 VAC, 5A at 250 VAC, SPDT resistive.

Enclosure
NEMA 4X Polystyrene with knockouts on four sides for 1/2" (12.7 mm) FNPT conduit hubs.
Four single point enclosure -4 conduit hubs are provided.
Four dual point enclosure -7 conduit hubs are provided.

Gas Sensor Type
Electrochemical gas diffusion

Gas Sensor Connection Distance
Up to 1000 feet (300 m) to receiver.

Two wire cable.
For a dual point unit, 50 ft. (15 m) of cable is provided.
For a single point unit, 25 ft. (8 m) of cable is provided.

Sensor Operating Life 2 years

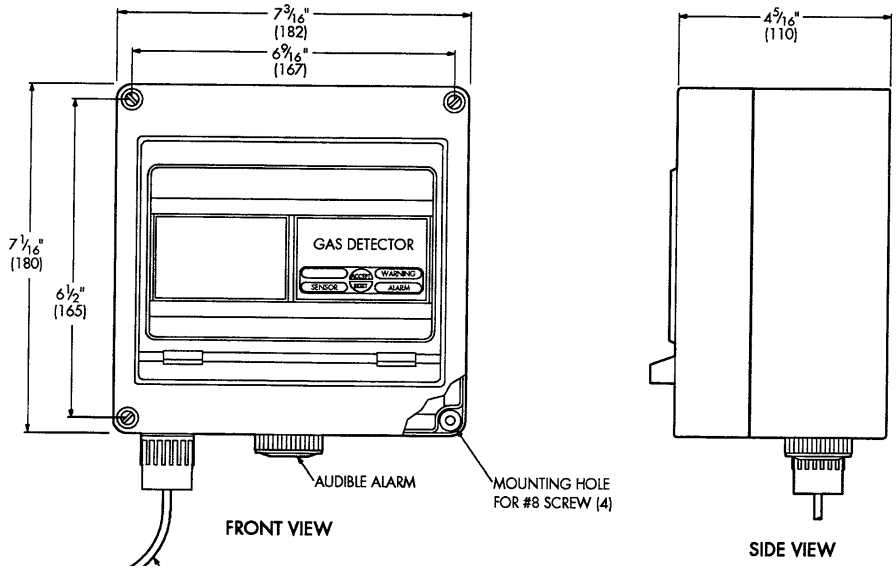
Sensor Storage Life 5 years

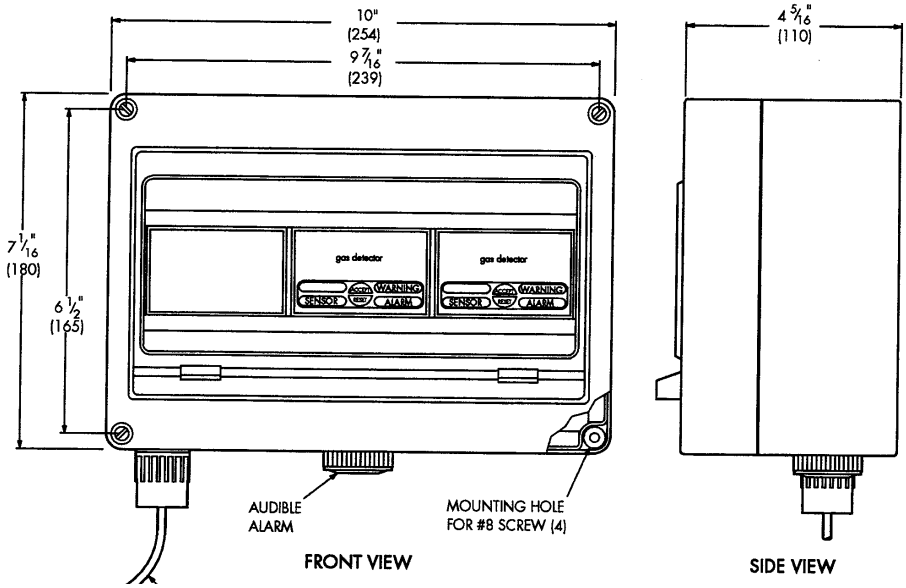
Optional Battery Back-Up

Battery Type:	12 VDC, 4 Amp HR sealed lead acid
Battery Capacity:	For single point unit, min. 12 hrs. (avg.24 hrs.) For dual point unit, min. 6 hrs. (avg. 12 hrs.)
Charge Control:	Current limited to 0.75A max.
Charge Time:	10 hours typically from fully discharged
Low Voltage Cutoff:	Relay disconnect at 10 VDC
Fault Protection:	Relay disconnect on shorted charger wiring
Battery Life:	Min. 3 yrs. in operation

Wallace & Tiernan/Siemens
Chlorine Gas Detector

Acutec 35





* For complete dimensions, see WT.050.130.100 for single point, WT.050.130.102 for dual point, and WT.050.130.104 for battery backup.

181 Thorn Hill Road, Warrendale, PA 15086

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an EVOQUA brand

ACUTEC™ 35
GAS DETECTION SYSTEM

BOOK NO. WT.050.130.000.UA.IM.0614

ACUTEC™ 35
GAS DETETECTION SYSTEM

BOOK NO. WT.050.130.000.UA.IM.0614

W3T129671

EQUIPMENT SERIAL NO. _____

DATE OF START-UP _____

START-UP BY _____

Prompt service available from nationwide authorized service contractors.

ORDERING INFORMATION

In order for us to fill your order immediately and correctly, please order material by description and part number, as shown in this book. Also, please specify the serial number of the equipment on which the parts will be installed.

WARRANTY

Seller warrants for a period of one year after shipment that the equipment or material of its manufacture is free from defects in workmanship and materials. Corrosion or other decomposition by chemical action is specifically excluded as a defect covered hereunder, except this exclusion shall not apply to chlorination equipment. Seller does not warrant (a) damage caused by use of the items for purposes other than those for which they were designed, (b) damage caused by unauthorized attachments or modifications, (c) products subject to any abuse, misuse, negligence or accident, (d) products where parts not made, supplied, or approved by Seller are used and in the sole judgment of the Seller such use affects the products' performance, stability or reliability, and (e) products that have been altered or repaired in a manner in which, in the sole judgment of Seller, affects the products' performance, stability or reliability. **SELLER MAKES NO OTHER WARRANTY OF ANY KIND, AND THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS OF THE MATERIAL OR EQUIPMENT FOR ANY PARTICULAR PURPOSE EVEN IF THAT PURPOSE IS KNOWN TO SELLER.** If Buyer discovers a defect in material or workmanship, it must promptly notify Seller in writing; Seller reserves the right to require the return of such defective parts to Seller, transportation charges prepaid, to verify such defect before this warranty is applicable. In no event shall such notification be received by Seller later than 13 months after the date of shipment. No action for breach of warranty shall be brought more than 15 months after the date of shipment of the equipment or material.

LIMITATION OF BUYER'S REMEDIES. The **EXCLUSIVE REMEDY** for any breach of warranty is the replacement f.o.b. shipping point of the defective part or parts of the material or equipment. Any equipment or material repaired or replaced under warranty shall carry the balance of the original warranty period, or a minimum of three months. Seller shall not be liable for any liquidated, special, incidental or consequential damages, including without limitation, loss of profits, loss of savings or revenue, loss of use of the material or equipment or any associated material or equipment, the cost of substitute material or equipment, claims of third parties, damage to property, or goodwill, whether based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory; provided, however, that such limitation shall not apply to claims for personal injury.

Statements and instructions set forth herein are based upon the best information and practices known to Evoqua Water Technologies, but it should not be assumed that every acceptable safety procedure is contained herein. Of necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

725 Wooten Road
Colorado Springs, Co 80915

INTRODUCTION

The Evoqua Water Technologies Series 50-130 Acutec™ 35 Gas Detection system is an on-line monitoring system for the detection of chlorine (Cl_2), sulfur dioxide (SO_2), or ammonia (NH_3) gas in ambient air. Alarm contacts are provided to transfer at user selectable setpoints. Monitor modules provide a digital readout of gas level and a 4-20 mA output. Single or Dual Units are available, using any combination of gas detectors and monitors or alarm units.

One Receiver Module is connected to each gas Sensor/Transmitter with a two-conductor cable, and provides information on the gas concentration in the sensor area. Receivers are powered by the Power Supply Module supplied with the Gas Detector system.

The Series 50-130 Sensor/Transmitter consists of an electrochemical gas sensor and an electronic amplifier that transmits a gas concentration signal to a Receiver Module located in the Control Unit. An optional gas generator may be ordered which enables the Receiver to automatically test the sensor every 24 hours.

NOTE: When ordering material always specify model and serial number of apparatus.

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Very Important Safety Precautions SP-1,-2
Regional Offices 1.010-1
Technical Data ..... Section 1
Installation ..... Section 2
Operation ..... Section 3
Service ..... Section 4
Parts Illustrations ..... Section 5
Spare Parts List ..... Section 6

VERY IMPORTANT SAFETY PRECAUTIONS

This page titled "Very Important Safety Precautions" provides, in brief, information of urgent importance relative to safety in the installation, operation, and maintenance of this equipment.

WARNING

TO AVOID POSSIBLE SEVERE PERSONAL INJURY AND EQUIPMENT DAMAGE, OBSERVE THE FOLLOWING PRECAUTIONS:

GASES DETECTED ARE HAZARDOUS SUBSTANCES, AND IF BREATHED IN HIGH CONCENTRATIONS CAN CAUSE DEATH. THE OPERATION OF THIS DETECTOR MUST BE CHECKED AND VERIFIED FREQUENTLY ON A REGULAR SCHEDULE.

TO AVOID INJURY FROM ELECTRICAL SHOCK, TURN POWER SOURCES OFF BEFORE SERVICING EQUIPMENT.

TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO EQUIPMENT, THIS PRODUCT SHOULD ONLY BE USED WITH POWER SUPPLIES THAT HAVE A SINGLE HOT WIRE WITH RESPECT TO EARTH. THE WIRE CONNECTED TO POWER SUPPLY TERMINAL "N" MUST BE NEUTRAL. POWER AND EARTH GROUND MUST BE PROPERLY CONNECTED AS SHOWN.

THE GENERAL SENSOR RESPONSE TEST, AS DESCRIBED IN THIS MANUAL, MUST BE PERFORMED WHENEVER A NEW SENSOR IS INSTALLED.

AFTER ANY MAINTENANCE THE DETECTOR SHOULD BE TESTED FOR RESPONSE TO ASSURE NORMAL OPERATION.

REPLACE SENSOR IMMEDIATELY IF SENSOR FAILS GAS TEST.

HANDLE BATTERIES WITH CARE, BEING CERTAIN NOT TO SHORT TERMINALS, AS SEVERE ARCING OR EXPLOSION COULD OCCUR.

TO ENSURE PROPER AND SAFE OPERATION OF THIS EQUIPMENT, USE ONLY EVOQUA WATER TECHNOLOGIES LISTED PARTS EXCEPT COMMERCIALLY AVAILABLE PARTS AS IDENTIFIED BY COMPLETE DESCRIPTION ON PARTS LIST. THE USE OF UNLISTED PARTS CAN RESULT IN EQUIPMENT MALFUNCTIONS CAUSING POSSIBLE SEVERE PERSONAL INJURY.

THIS EQUIPMENT SHOULD BE INSTALLED, OPERATED AND SERVICED ONLY BY TRAINED, QUALIFIED PERSONNEL WHO ARE THOROUGHLY FAMILIAR WITH THE ENTIRE CONTENTS OF THIS INSTRUCTION BOOK.

VERY IMPORTANT SAFETY PRECAUTIONS (CONT'D)

DO NOT DISCARD THIS INSTRUCTION BOOK UPON COMPLETION OF INSTALLATION. INFORMATION PROVIDED IS ESSENTIAL TO PROPER AND SAFE OPERATION AND MAINTENANCE.

ADDITIONAL OR REPLACEMENT COPIES OF THIS INSTRUCTION BOOK ARE AVAILABLE FROM:

Evoqua Water Technologies
725 Wooten Road
Colorado Springs, CO 80915
Phone: (800) 524-6324

NOTE

Minor part number changes may be incorporated into Evoqua Water Technologies products from time to time that are not immediately reflected in the instruction book. If such a change apparently has been made in your equipment and does not appear to be reflected in your instruction book, contact your local Evoqua Water Technologies sales office for information.

Please include the equipment serial number in all correspondence. It is essential for effective communication and proper equipment identification.

REGIONAL OFFICES

INSTALLATION, OPERATION, MAINTENANCE, AND SERVICE INFORMATION

Direct any questions concerning this equipment that are not answered in the instruction book to the Reseller from whom the equipment was purchased. If the equipment was purchased directly from Evoqua Water Technologies, Colorado Springs, CO contact the office indicated below.

UNITED STATES

725 Wooten Road
Colorado Springs, CO 80915
TEL: (800) 524-6324

CANADA

If the equipment was purchased directly from Evoqua Water Technologies, Canada, contact the nearest office indicated below.

ONTARIO

Evoqua Water Technologies Ltd.
2045 Drew Road
Mississauga, Ontario
L5S 1S4
(905) 944-2800

QUEBEC

Evoqua Technologies des Eaux Itee
505 Levy Street
St. Laurent, Quebec
H4R 2N9
(450) 582-4266

SECTION 1

SECTION 1 – TECHNICAL DATA

List Of Contents

PARA./DWG. NO.

Technical Data..... 1.1
Interferences 1.2

1.1 Technical Data

Gas Ranges			
Gas	**Standard Range**	**Minimum Range**	**Maximum Range**
Chlorine	0 - 10 ppm	0 - 5 ppm	0 - 50 ppm
Sulfur Dioxide	0 - 20 ppm	0 - 10 ppm	0 - 100 ppm
Ammonia	0 - 100 ppm	0 - 50 ppm	0 - 500 ppm

Gas sensors are shipped factory set to standard ranges, but may be calibrated to other ranges as shown.

Setpoints	Adjustable, 5 - 100% of Range
Enclosure Ratings	NEMA 4X (except battery enclosure)
Distance, Transmitter to Receiver	1000 ft. (maximum)
Operating Temperature	0 to 105 °F, continuous -10 to 120 °C, intermittent
Humidity	0 - 99%, non-condensing
Power	85 - 255 VAC, 50/60 Hz, 15 W
Contacts	Alarm (configurable): 3 SPDT Trouble: 1 SPDT Power Failure: 1 SPDT
Contact Rating	10 A at 120 VAC, 5 A at 250 VAC, Resistive
Battery Back-up (optional)	12 V, 4 A/hr, 6 Hrs minimum
Analog Output (optional)	4-20 mA, Isolated, 1000 ohms maximum
Sensor Life	2 years (maximum)
Gas Generator Life	1 year

NOTE: The Auto-Test option is for indoor use only, and should only be used with detectors set to the standard range or lower, as shown in the GAS RANGES table. If used with higher ranges, the generator may not produce enough gas to test the sensor.

1.2 Interferences

Electrochemical sensors are, by nature, not 100% selective; therefore, they can exhibit response to other gases present in ambient air.

The following tables list the possible interferences that may occur when using the different gas sensors. The tables indicate the relative response of the sensor to 1 ppm of the listed gas, expressed in terms of relative ppm signal. For example: exposure of a chlorine sensor to a gas sample containing 1 ppm of nitrogen dioxide (NO_2) would produce a signal equal to 0.4 ppm of chlorine. A negative sign (-) indicates an interference that can cause low gas measurements if there is a mixture of the measured gas and another gas.

CHLORINE	
Interference Gas	**Response**
Bromine	1.0
Fluorine	1.0
Chlorine Dioxide	1.0
Ozone	1.0
Nitrogen Dioxide	0.4
Hydrogen Sulfide	-0.1
Hydrogen Cyanide	-0.05
Methyl Mercaptan	-0.04
Sulfur Dioxide	-0.01

SULFUR DIOXIDE	
Interference Gas	**Response**
Nitrogen Dioxide	0.8
Hydrogen Cyanide	0.15
Nitric Oxide	0.04
Acetylene	0.02
Ethanol	0.05
Hydrogen	0.005
Bromine	-0.1
Fluorine	-0.1
Chlorine Dioxide	-0.1
Ozone	-0.1

AMMONIA	
Interference Gas	**Response**
Methyl Mercaptan	7
Hydrogen Sulfide	2
Hydrogen	0.1
Nitrogen Dioxide	-0.2
Chlorine	-0.2

SECTION 2

SECTION 2 – INSTALLATION

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  Dual Point Detection System..... 50.130.100.002
  Sensor/Transmitter..... 50.130.100.003
  Battery Back-up 50.130.100.004
  Installation Wiring
    Single Point Detection System 50.130.130.001
    Dual Point Detection System..... 50.130.130.002

2.1 Overview

The Series 50-130 Gas Detection System consists of modular components that can be used in a variety of configurations to fit specific application requirements. Following is a brief description of the major system components. More detailed information follows later in this manual.

- BASE UNIT: Includes a Power Supply Module housed in a NEMA 4X enclosure. Single-Point Units accepts one Receiver Module, and Dual-Point Units accept two Receiver Modules. All units are provided with an audible horn.

- POWER SUPPLY MODULE: Provides power for one or two Receiver Modules, for the audible horn, and for charging an external Battery Back-up. The power supply accepts 85 to 255 volts, ac (50/60 Hz) and mounts on a DIN rail.

- DETECTOR RECEIVER MODULE: Receives a signal from a one Sensor/Transmitter, can be set for two alarm levels and provides three alarm contacts. The Receiver Module mounts on a standard DIN rail. Receiver Modules include a Reset/Acknowledge button, provide power for Sensor/Transmitters, and control Autotest Generators.

- MONITOR RECEIVER MODULE: Same as the Detector Module, but also includes a digital display of gas level and a 4-20 mA output.

- SENSOR/TRANSMITTER: Consists of an electrochemical gas sensor connected to a NEMA 4X transmitter, which sends a signal to a Receiver Module.

- AUTOTEST GENERATOR: An electrochemical gas generator which attaches to Sensor/Transmitters and automatically tests sensor response daily.

NOTE: The Auto-Test option is for indoor use only, and should only be used with detectors set to the standard range or lower, as shown in Section 1.1 – Technical Data. If used with higher ranges, the generator may not produce enough gas to test the sensor.

- BATTERY BACK-UP: The Battery Back-up option for gas detection systems consists of a separate wall-mounted enclosure which houses a battery and a control circuit board. The battery is a sealed, lead-acid type and is rated four ampere-hours.

2.2 General Installation

NOTE: Power supply or Receiver modules may be shipped with protective transparent plastic covers. These covers should be peeled off and discarded.

System enclosures, Battery Back-up units, and Sensor/Transmitters are all designed for surface mounting using screws or bolts inserted through the recessed mounting holes at each corner of the enclosures. Mounting hole dimensions are shown on the appropriate diagram. Included with each system enclosure are mounting hole templates which can be used to mark hole centers on walls or mounting panels. Mounting recesses are suitable for #8 machine screws or wood screws.

Refer to paragraph 3.4.1, Sensor Installation, for specific information on locating gas sensors.

Enclosures are supplied with conduit hubs and seal rings for water-tight connection of 1/2" NPT threaded conduit. Plastic cable glands may also be purchased to connect cables without conduit.

Install the 1/2" conduit hubs in any enclosure knockout labeled PG16. Note that some knockouts have more than one designation, such as PG11/16. Those with two designations will have concentric circles for knockouts. The inner circle marks the lower PG number while the outer circle marks the higher number. Place a thin bladed screwdriver into the circular slot or the desired knockout size and tap firmly with a hammer (see Figure 2.1). Place the seal over the hub threads on the outside of the enclosure and attach the hub with the supplied nut.

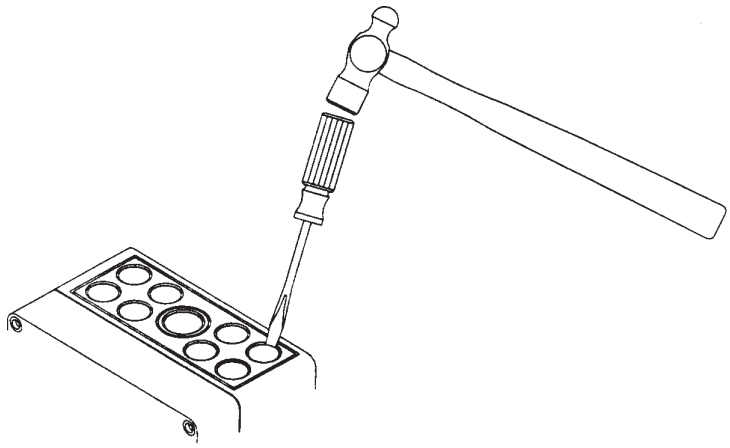


Figure 2.1

The Acutec™ unit should not be exposed to direct sunlight. Continuous ambient temperature should not exceed 105 °F. When this temperature is likely to be approached, it is recommended that relays be used in the non-energized mode, and the display be set to normal intensity (Monitor Units only). See Section 3 for details.

2.3 Mounting Power Supply and Receiver Modules (See Dwg. 50.130.000.001)

Power Supply and Receiver Modules are mounted to a standard 35 x 7.5 mm DIN rail in the detection system enclosure. The spring loaded clip with the loop holds the module to the rail. To install modules, first slide the bottom of the module under the rail. Then pull the loop out with a small screwdriver while lowering the top of the module onto the rail. To remove modules, reverse this procedure.

2.4 Electrical Connections (See Dwgs. 50.130.130.001 And 50.130.130.002)

Field wiring required for the Detection System includes connection of ac power, connection of two-conductor cable between the Receiver and the Sensor/Transmitter, connection of the Battery Back-up unit (when purchased), and connection of the audible horn to Receiver Modules. A 25-foot length of two-conductor cable is supplied for each Sensor/Transmitter. Longer lengths of up to 1000 feet may be used when required.

The ac input power is connected to the lower left of the Power Module, as shown in the Installation Wiring drawings. A ground terminal is provided on the mounting track for connection of earth ground. For safe operation and to avoid noise interference, it is important that earth ground be connected to this terminal first, and then to the power input earth ground terminal on the Power Supply Module, as shown.

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO EQUIPMENT, THIS PRODUCT SHOULD ONLY BE USED WITH POWER SUPPLIES THAT HAVE A SINGLE HOT WIRE WITH RESPECT TO EARTH. THE WIRE CONNECTED TO POWER SUPPLY TERMINAL "N" MUST BE NEUTRAL. POWER AND EARTH GROUND MUST BE PROPERLY CONNECTED AS SHOWN.

NOTE: Field wiring must conform to local electrical codes.

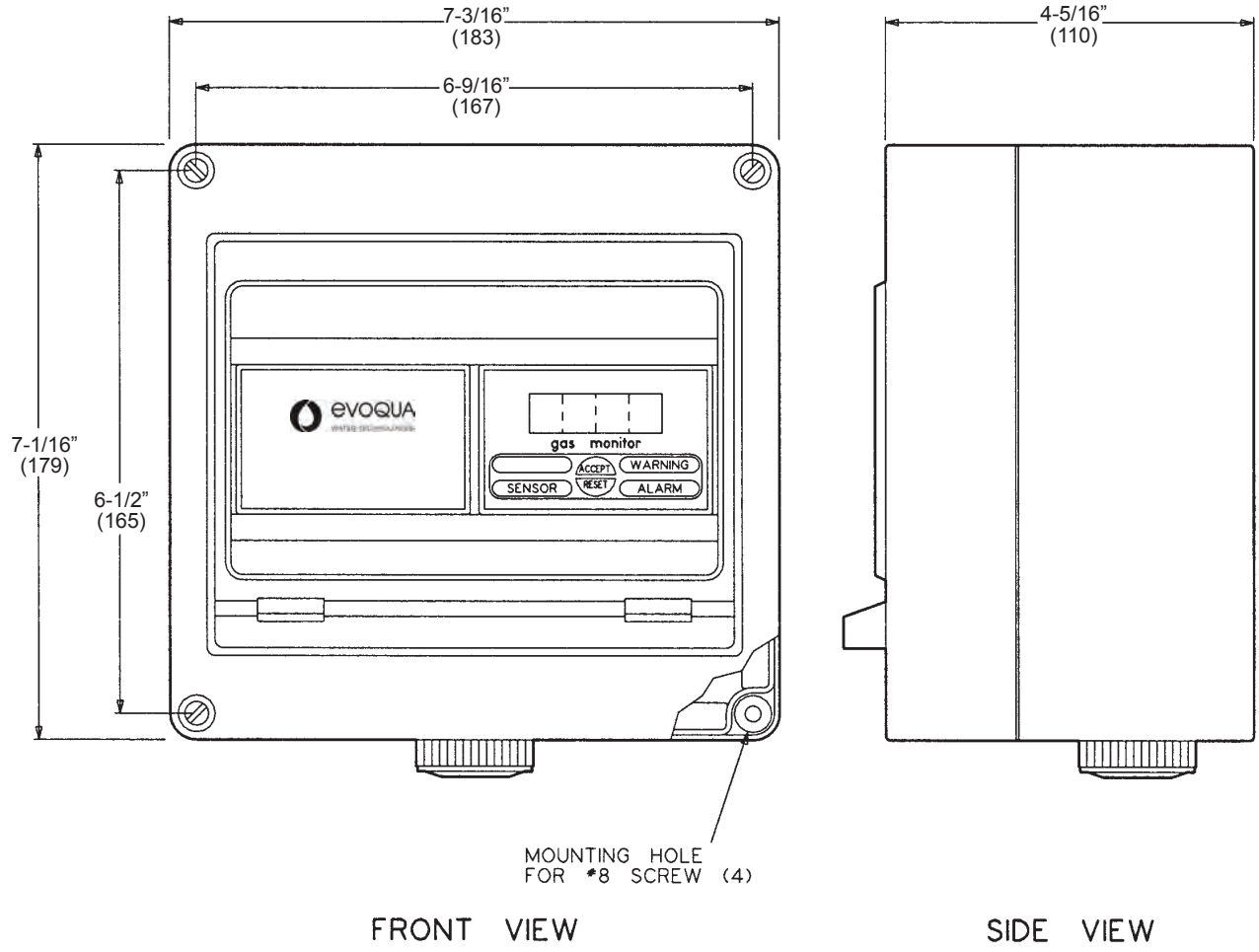
The wiring drawings show internal wiring of the systems. Sensor/Transmitter connections are shown in paragraph 3.4.1, Sensor Installation.

All terminal blocks are plug-in type, and can be unplugged allowing replacement of modules without removing individual wires.

Electrical connection is made between the Battery Back-up unit and the Power Supply Module. The circuit board mounted on the battery contains a two-position plug-in terminal block marked plus and minus. The plus terminal is connected to terminal B+ of the power supply and the minus terminal is connected to B- of the power supply.

2.5 Installation of Power Supply Module

The Power Supply Module used in the gas detection system operates on ac supplies of 85 volts to 255 volts, at 50/60 Hz. No adjustments or modifications are required of the user.



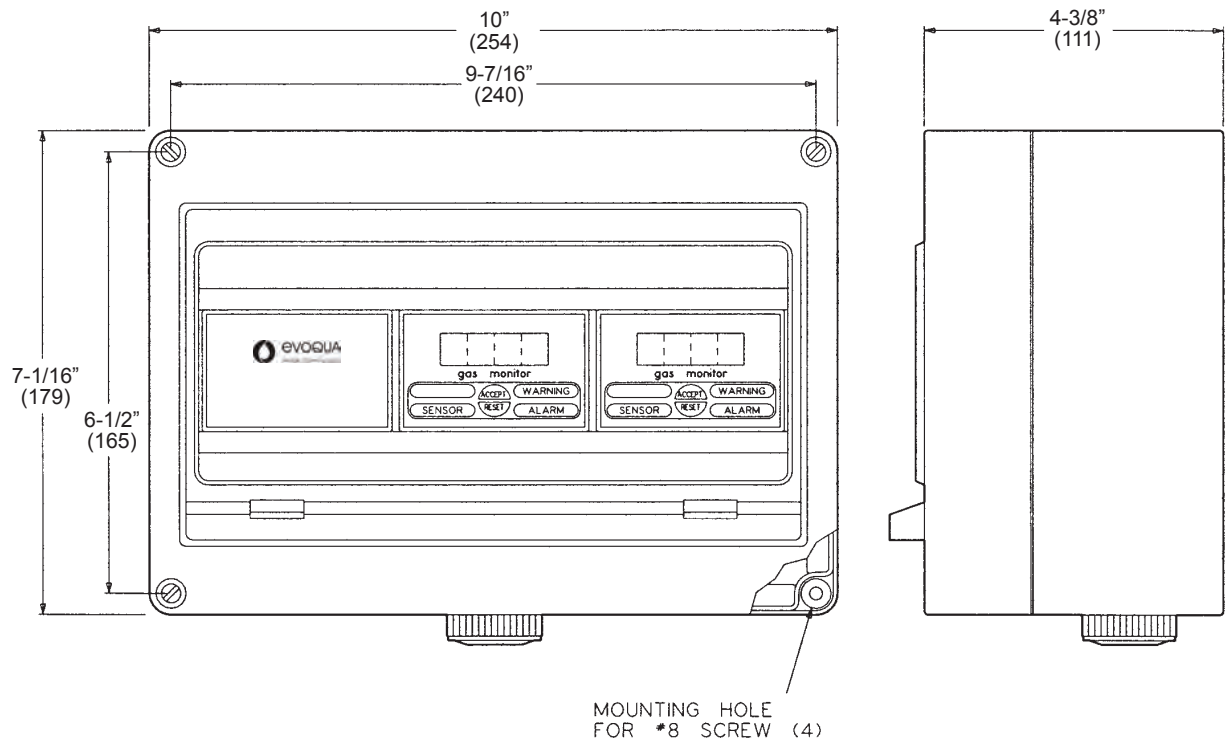
FRONT VIEW

SIDE VIEW

NOTE: ( ) INDICATES DIMENSIONS IN MILLIMETERS.

SINGLE POINT DETECTION SYSTEM - DIMENSIONS

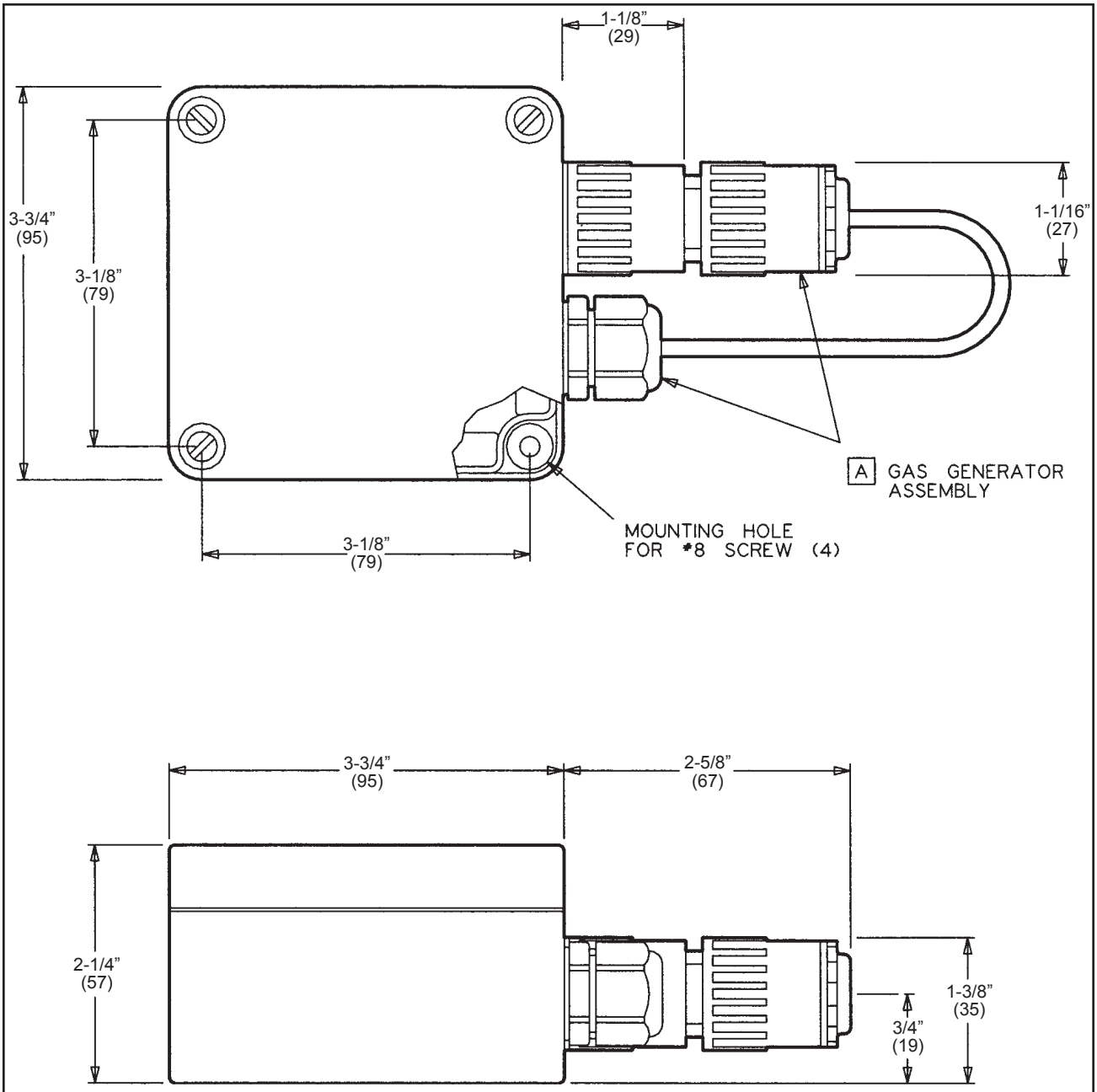
50.130.100.001
ISSUE 4 6-14



NOTE: ( ) INDICATES DIMENSIONS IN MILLIMETERS.

DUAL POINT DETECTION SYSTEM - DIMENSIONS

50.130.100.002
ISSUE 4 6-14



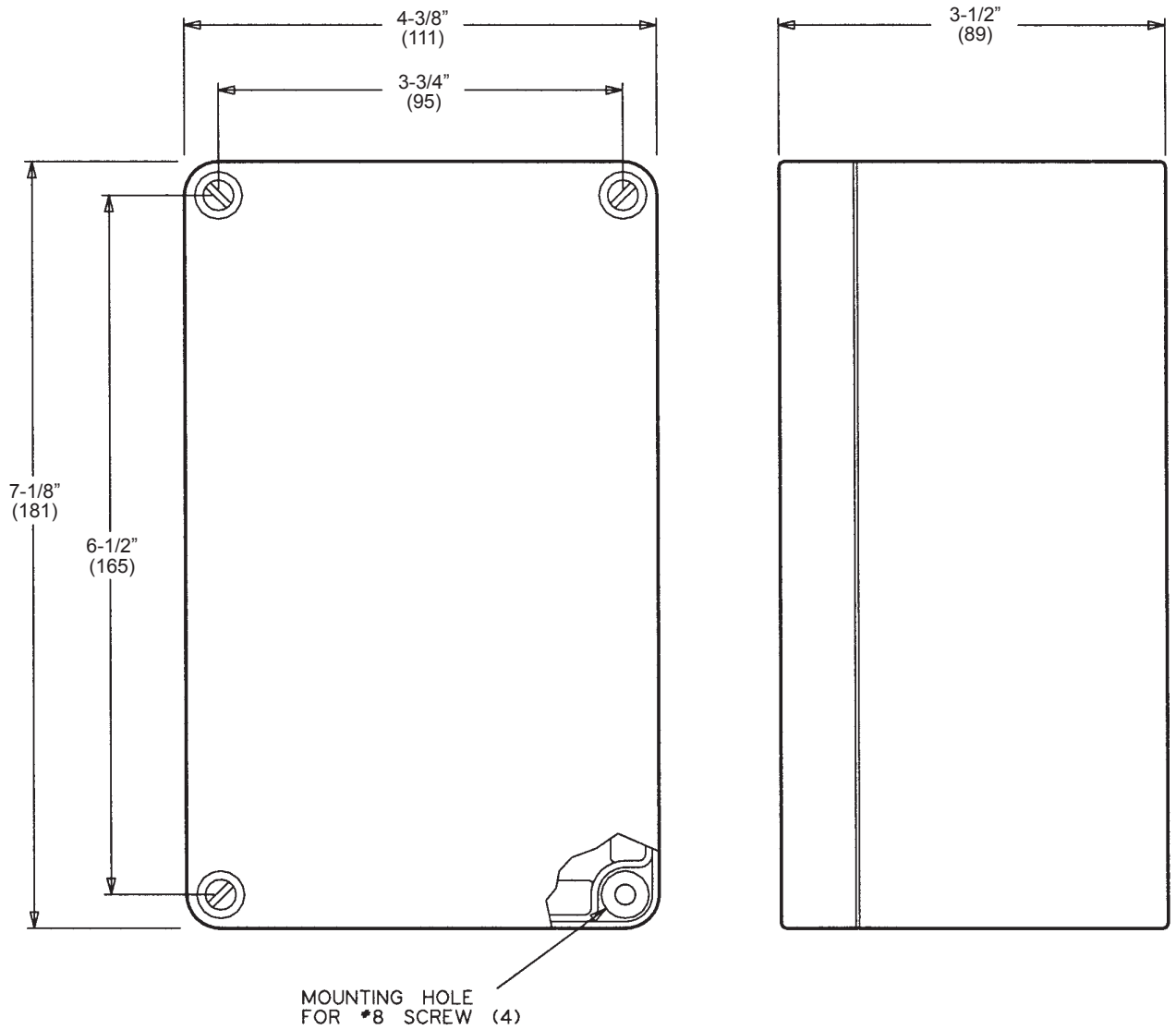
NOTE: ( ) INDICATES DIMENSIONS IN MILLIMETERS.

A ACCESSORY ITEM FURNISHED ONLY IF SPECIFICALLY LISTED IN QUOTATION.

WHEN THE GAS GENERATOR IS USED, THE UNIT MUST BE MOUNTED AS SHOWN.

SENSOR/TRANSMITTER - DIMENSIONS
With Generator

50.130.100.003
ISSUE 2 7-98



FRONT VIEW

SIDE VIEW

NOTE: ( ) INDICATES DIMENSIONS IN MILLIMETERS.

BATTERY BACK-UP - DIMENSIONS

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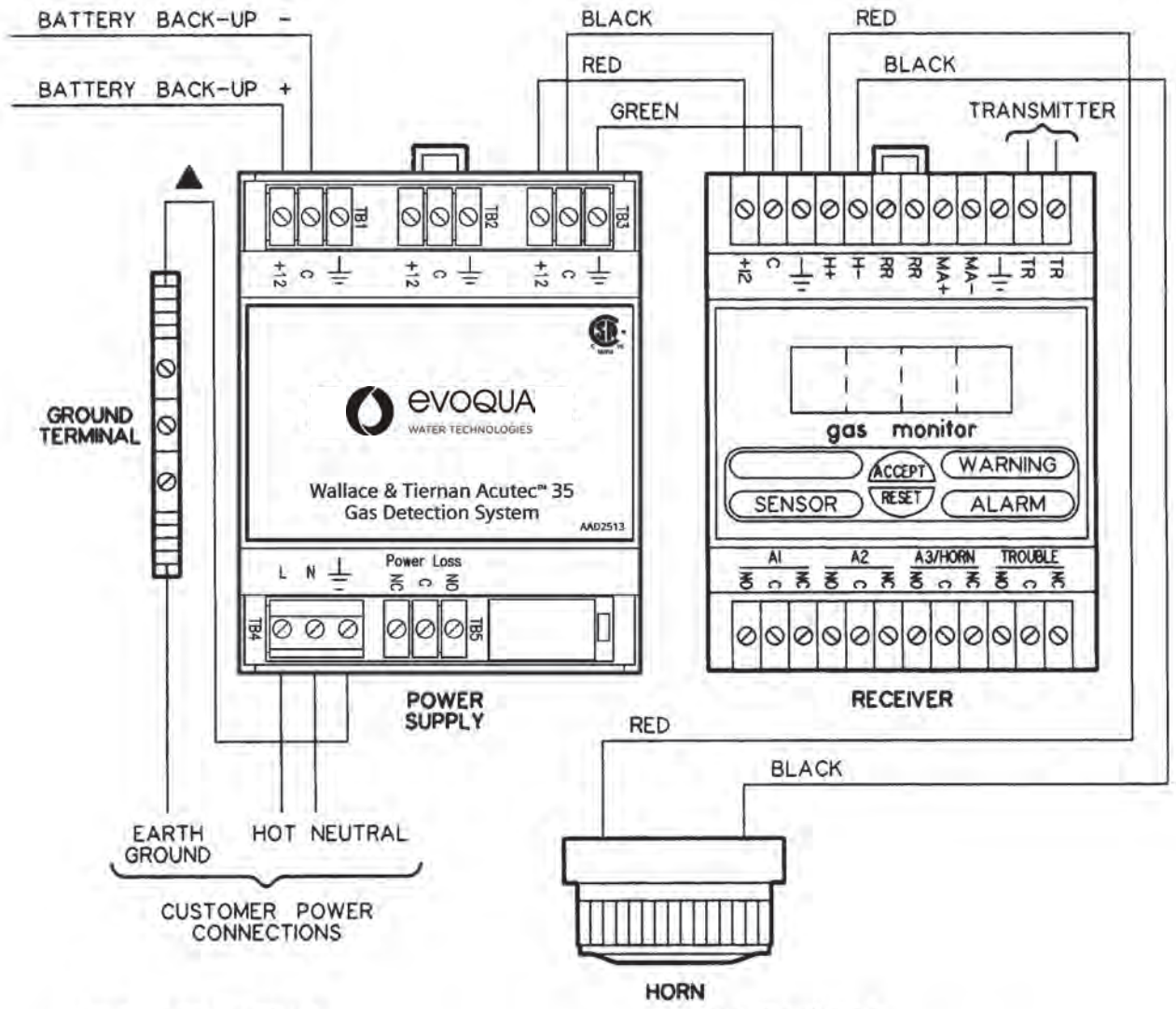

POWER SUPPLY MODULE

H: AC "HOT"
N: AC "NEUTRAL"
⏚: EARTH GROUND

POWER LOSS
NC: NORMALLY CLOSED
C: COMMON
NO: NORMALLY OPEN

+12: DC SUPPLY, POSITIVE
C: DC SUPPLY, COMMON
⏚: EARTH GROUND

RECEIVER MODULE

+12: DC SUPPLY, POSITIVE
C: DC SUPPLY, COMMON
⏚: EARTH GROUND
H+: HORN, POSITIVE
H-: HORN, NEGATIVE
RR: REMOTE RESET
RR: REMOTE RESET
MA+: mA OUT, POSITIVE
MA-: mA OUT, NEGATIVE
⏚: EARTH GROUND
TR: TRANSMITTER INPUT
TR: TRANSMITTER INPUT

OUTPUT CONTACTS

A1
NO: ALARM 1 NORMALLY OPEN
C: ALARM 1 COMMON
NC: ALARM 1 NORMALLY CLOSED

A2
NO: ALARM 2 NORMALLY OPEN
C: ALARM 2 COMMON
NC: ALARM 2 NORMALLY CLOSED

A3/HORN
NO: ALARM 3 NORMALLY OPEN
C: ALARM 3 COMMON
NC: ALARM 3 NORMALLY CLOSED

TROUBLE
NC: TROUBLE NORMALLY CLOSED
C: TROUBLE COMMON
NO: TROUBLE NORMALLY OPEN

NOTE: ▲ WIRING BY EVOQUA WATER TECHNOLOGIES.
— FIELD WIRING MUST CONFIRM TO LOCAL ELECTRICAL CODES.

SINGLE POINT DETECTION SYSTEM - INSTALLATION WIRING

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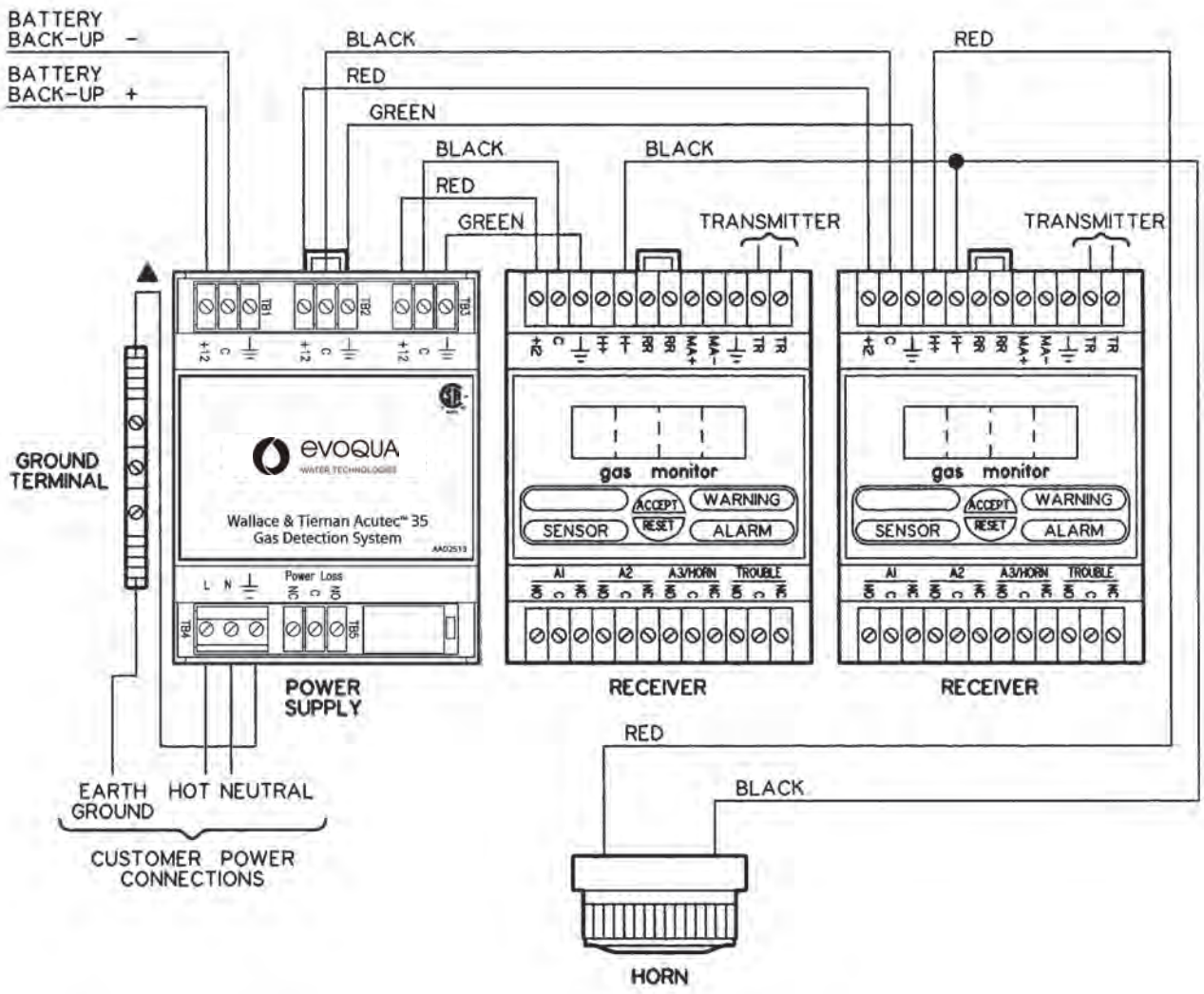

POWER SUPPLY MODULE

H: AC "HOT"
N: AC "NEUTRAL"
⏚: EARTH GROUND

POWER LOSS
NC: NORMALLY CLOSED
C: COMMON
NO: NORMALLY OPEN

+12: DC SUPPLY, POSITIVE
C: DC SUPPLY, COMMON
⏚: EARTH GROUND

RECEIVER MODULE

+12: DC SUPPLY, POSITIVE
C: DC SUPPLY, COMMON
⏚: EARTH GROUND
H+: HORN, POSITIVE
H-: HORN, NEGATIVE
RR: REMOTE RESET
RR: REMOTE RESET
MA+: mA OUT, POSITIVE
MA-: mA OUT, NEGATIVE
⏚: EARTH GROUND
TR: TRANSMITTER INPUT
TR: TRANSMITTER INPUT

OUTPUT CONTACTS

A1
NO: ALARM 1 NORMALLY OPEN
C: ALARM 1 COMMON
NC: ALARM 1 NORMALLY CLOSED

A2
NO: ALARM 2 NORMALLY OPEN
C: ALARM 2 COMMON
NC: ALARM 2 NORMALLY CLOSED

A3/HORN
NO: ALARM 3 NORMALLY OPEN
C: ALARM 3 COMMON
NC: ALARM 3 NORMALLY CLOSED

TROUBLE
NC: TROUBLE NORMALLY CLOSED
C: TROUBLE COMMON
NO: TROUBLE NORMALLY OPEN

NOTE: ▲ WIRING BY EVOQUA WATER TECHNOLOGIES.
— FIELD WIRING MUST CONFIRM TO LOCAL ELECTRICAL CODES.

DUAL POINT DETECTION SYSTEM - INSTALLATION WIRING

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SECTION 3

SECTION 3 – OPERATION

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3.1 Power Supply Operation (See Dwg. 50.130.000.001)

The power supply provides a regulated 13.7 Vdc to Receiver Modules and to the Battery Back-up through three sets of terminals at the top of the module. Total output current is rated at one amp.

The power supply provides a SPDT relay contact which de-energizes when ac power is lost.

3.2 Receiver Module Operation

Receiver Modules provide the following features:

- LED power on indicator with gas symbol designation.
- LED indicator lamps for WARNING and ALARM.
- Three SPDT alarm relays, switch programmable to operate on Warning or Alarm level, for latching or non-latching operation, and to be maintained normally energized or normally de-energized. In addition, Alarm Relay 3 may be configured to control an external horn.
- LED indicator lamp for SENSOR TROUBLE condition.
- One SPDT Trouble Relay, for remotely indicating a SENSOR TROUBLE condition.
- Isolated remote reset input terminals for remote alarm acknowledgement.
- Supplies power for operation of a Sensor/Transmitter up to 1000 feet away.
- Controls the Autotest Gas Generator.

In addition, Monitor type Receivers provide the following functions:

- LED digital display of gas concentration in ppm.
- Isolated 4-20 mA output signal proportional to gas concentration.

3.2.1 Configuration Switches

Receivers for different gases are identical except for the gas symbol attached to the green power LED. Operating range, setpoints, relay configuration, display intensity, alarm delay, and Auto-Test activation are selectable using four banks of DIP switches located on the configuration circuit board inside the Receiver module.

The configuration switches can be adjusted as follows:

<u>CAUTION</u>: To protect internal components from possible damage, this procedure should be performed in a static free environment.

a. Remove all power from the gas detector unit.

b. Unplug the terminal connectors on the top and bottom of the receiver module. Refer to Figure 3.1.

c. Remove the receiver module from the enclosure by pulling out the plastic clip at the top of the module while removing the module from the rail in the back of the enclosure.

d. Turn the receiver module over. There are four plastic tabs on the back side of the unit. Gently spread the plastic tabs out and lift the back panel off the receiver, being careful not to break the tabs.

e. Gently push up on the terminal connectors. This will allow the electronic assembly to be lifted out of the housing.

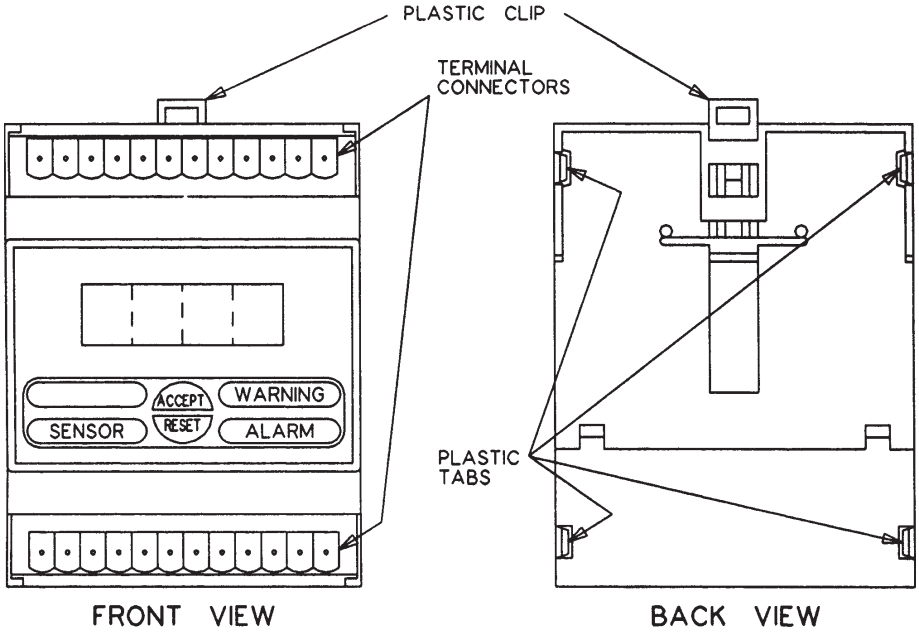


Figure 3.1 - Front and Back Views of Receiver Module

f. Position the electronic assembly as shown in Figure 3.2. Identify DIP SWITCH BANKS A through D.

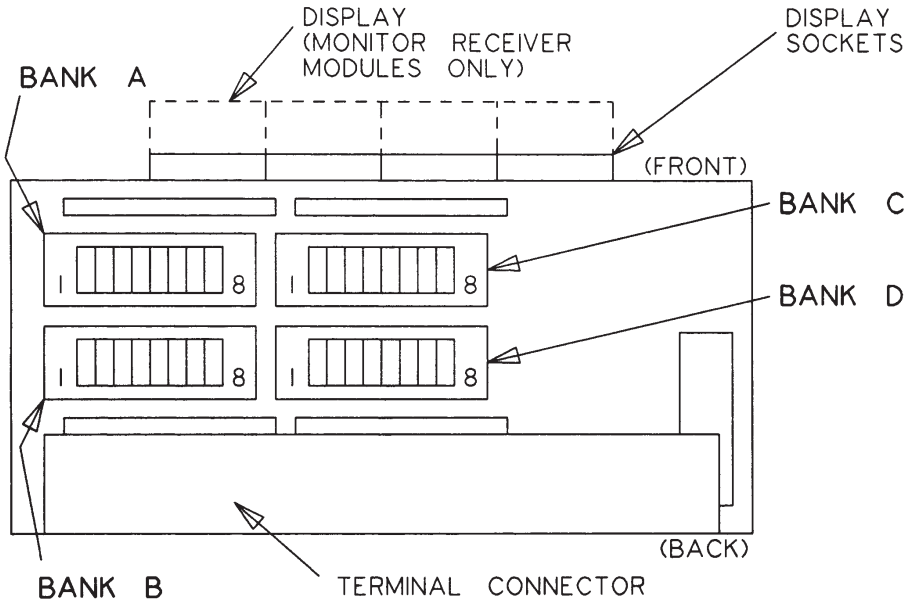


Figure 3.2 - Top View of Module Electronics Without Housing

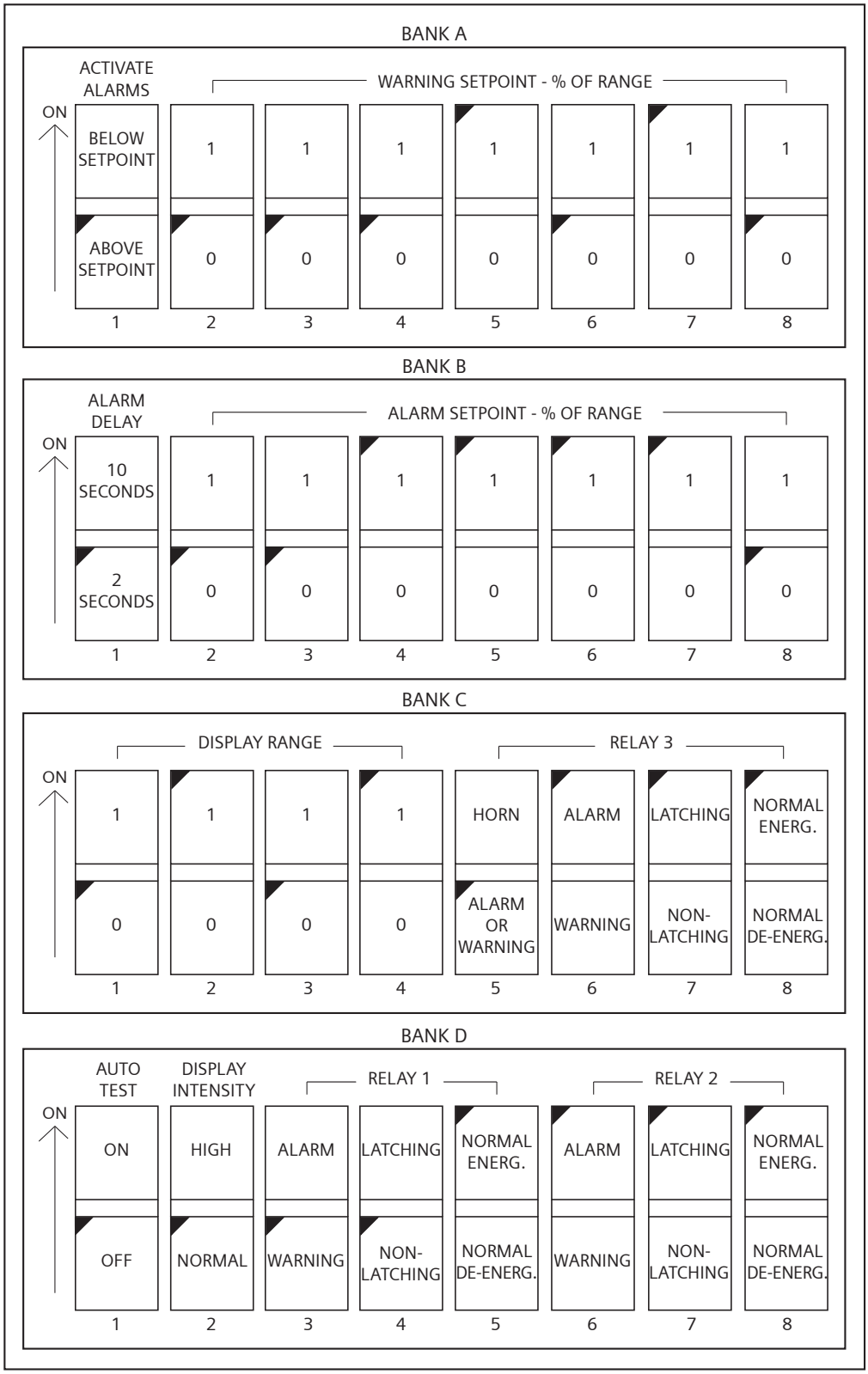
g. Adjust the Receiver DIP switch functions as needed, by referring to the Figure 3.3.

Switches can be set using the tip of a ball point pen or other tool with a small point on one end. Switches are two-position, up indicating “on” or a value of “1” and down indicating “off” or a value of “0”.

h. After adjusting the DIP switches, reassemble the receiver by repeating steps a through e in the reverse order, while observing the following:

(1) When returning the electronic assembly to the housing, the LEDs and displays must line up with the module enclosure windows.

(2) The bottom panel must be installed with the plastic clip at the top of the receiver module.



◤ **Shows Factory Settings**

Figure 3.3 - Receiver Dip Switch Functions

3.2.2 Range Selection

Receivers are factory configured for the Standard Operating Range and Setpoints as listed below.

Factory Settings of Range and Setpoints			
Gas	**Standard Range**	**Warning Setpoint**	**Alarm Setpoint**
Chlorine	0 - 10 ppm	1 ppm	3 ppm
Sulfur Dioxide	0 - 20 ppm	2 ppm	5 ppm
Ammonia	0 - 100 ppm	25 ppm	35 ppm

Display range selection is made using binary numbers to represent the full scale operating range for the receiver. The RANGE SELECTION table, below, provides the proper switch settings for the ranges available on each receiver. Range selection is made using switches C1 to C4. The 4-20mA output signal is proportional to the selected range.

Range Selection	
Display Range	**Switch Settings**
0 - 1.00	0000
0 - 2.00	0001
0 - 3.00	0010
0 - 4.0	0011
0 - 5.0	0100
0 - 10.0	0101
0 - 20.0	0110
0 - 25.0	0111
0 - 50	1000
0 - 100	1001
0 - 200	1010
0 - 500	1011

3.2.3 Setpoint Selection

The Warning and Alarm setpoints are factory configured to the values shown in FACTORY SETTINGS OF RANGE AND SETPOINTS table, above, and can be changed by using the configuration switches identified in the DIP SWITCH FUNCTIONS chart. The Warning setpoint is set using switches A2 to A8 and the Alarm setpoint is set using switches B2 to B8. A binary number is used to select setpoints as a percent of operating range.

For instance, if you have a receiver range of 0 to 10 ppm and want to adjust a setpoint for 3 ppm, set the appropriate DIP switches to the binary number for 30% from the SETPOINT SELECTION table, below.

Setpoint Selection					
%	Switch Pos.	%	Switch Pos.	%	Switch Pos.
5	0000101	37	0100101	69	1000101
6	0000110	38	0100110	70	1000110
7	0000111	39	0100111	71	1000111
8	0001000	40	0101000	72	1001000
9	0001001	41	0101001	73	1001001
10	0001010	42	0101010	74	1001010
11	0001011	43	0101011	75	1001011
12	0001100	44	0101100	76	1001100
13	0001101	45	0101101	77	1001101
14	0001110	46	0101110	78	1001110
15	0001111	47	0101111	79	1001111
16	0010000	48	0110000	80	1010000
17	0010001	49	0110001	81	1010001
18	0010010	50	0110010	82	1010010
19	0010011	51	0110011	83	1010011
20	0010100	52	0110100	84	1010100
21	0010101	53	0110101	85	1010101
22	0010110	54	0110110	86	1010110
23	0010111	55	0110111	87	1010111
24	0011000	56	0111000	88	1011000
25	0011001	57	0111001	89	1011001
26	0011010	58	0111010	90	1011010
27	0011011	59	0111011	91	1011011
28	0011100	60	0111100	92	1011100
29	0011101	61	0111101	93	1011101
30	0011110	62	0111110	94	1011110
31	0011111	63	0111111	95	1011111
32	0100000	64	1000000	96	1100000
33	0100001	65	1000001	97	1100001
34	0100010	66	1000010	98	1100010
35	0100011	67	1000011	99	1100011
36	0100100	68	1000100	100	1100100

The Gas Detector is factory set to alarm when gas concentrations above the chosen setpoints are exceeded; however, if switch A1 is set to the ON position, alarms will be initiated when gas concentration is below the setpoint.

3.2.4 Relay Configuration

- **FACTORY CONFIGURATION OF RELAYS** —

  * Relay 1 – Configured to trip above the Warning setpoint and set for normally energized, non-latching operation.
  * Relay 2 – Configured to trip above the Alarm setpoint and set for normally energized, latching operation.
  * Relay 3 – Configured to trip above the Alarm setpoint and set for normally energized, latching operation, not for horn operation.
  * Alarm Delay – Configured for two-second delay.

- **WARNING OR ALARM** — Each relay can be assigned to either the Warning or Alarm setpoint. As shown in the DIP SWITCH FUNCTIONS chart, switches D3, D6, and C6 configure each relay. When Warning is selected, the relay will activate when the Warning lamp on the front panel lights. When Alarm is selected, the relay will activate with the Alarm lamp on the front panel.

- **NORMALLY ENERGIZED/DE-ENERGIZED** — Relays one through three are factory set to the normally energized mode, providing “Fail-Safe” operation. This means the relays are energized in a normal condition and will de-energize for a Warning or Alarm condition, or if power is lost to the system. However, operation in this mode will reduce the period of operation on Battery Back-up. The relays may be set to the normally de-energized mode by setting switches C8, D5, and D8 to the off position. To avoid battery drain and internal heat generation, unused relays should be set to Normally De-Energized.

- **LATCHING OR NON-LATCHING** — Relays may be either Latching or Non-latching. A latching relay activates when gas concentration exceeds the setpoint, but will only de-activate when the push-button on the front of the receiver is pressed after the gas concentration has fallen below the setpoint. A non-latching relay will automatically de-activate when the gas concentration falls below the setpoint. Selection of the latch/non-latch function uses switches D4, D7, and C7.

- **EXTERNAL HORN RELAY** — Relay 3 provides an additional configuration option not available on relays 1 or 2. Switch C5 allows Relay 3 to be configured for use in activating an external audible horn. When switch C5 is on, any external horn tied to Relay 3 will sound intermittently when the warning setpoint is exceeded and will go to steady-on when the alarm setpoint is exceeded. The relay will de-activate when the push-button switch is pressed or when the remote reset terminals are connected, silencing the external horn.

3.2.5 Alarm Delay

A time delay precedes the activation of alarm relays to eliminate false alarms due to electrical transients. The delay is factory set to two seconds, but can be changed to 10 seconds with switch B1. The delay time affects both the alarm indicator lamps and the associated relays.

3.2.6 Display Intensity (Monitor Units Only)

The LED numeric display is factory set in the normal intensity mode, and can be set for high intensity by the user; however, to avoid internal heating, and battery drain, it is recommended that the display remain at normal intensity. Switch D2 is used to select normal or high intensity display mode.

3.2.7 Auto-Test Enable

The receiver module is shipped from the factory with the Auto-Test option disabled. If the Autotest Gas Generator (optional) is installed on the system, the receiver module cover must be removed and the autotest switch (D1) must be moved to the “on” position.

NOTE: The Auto-Test option is for indoor use only, and should only be used with detectors set to the standard range or lower, as listed in Section 1.1 – Technical Data. If used with higher ranges, the generator may not produce enough gas to test the sensor.

3.3 Receiver Module Startup

Receiver front panels contain three LED bars which indicate Warning, Alarm, and Sensor Trouble conditions. A fourth, green bar LED is marked with the type of gas which the receiver operates with. Monitor type receivers have a four digit numeric LED display which indicates gas concentration in ppm.

When power is first applied, all alarm functions will be inhibited for five minutes while the system is allowed to stabilize. This is indicated by Warning and Alarm lamps flashing in an alternating pattern. Monitors will display the Full Scale Range setting for three seconds, then the Warning Setpoint for three seconds, followed by the Alarm Setpoint for three seconds. The display will then indicate the detected gas level, which will appear to be high until the sensor stabilizes.

NOTE: It is strongly recommended that sensors be powered overnight upon initial startup before adjustments are made and before connections are made to alarm relays. Sensors which are powered for the first time may remain in an alarm state beyond the five minute inhibit period and may take several hours to fully stabilize.

3.3.1 Alarm Acknowledge and Reset

The front panel of the Receiver contains one push-button, marked Accept/ Reset, which is used for a number of different functions. When the Receiver is in normal operation, a gas leak that exceeds the warning setpoint will cause the Warning indicator to flash and the internal horn to sound intermittently. If the alarm setpoint is exceeded, the Alarm indicator will flash and the horn will sound steadily. Pressing the button the first time will silence the audible horn, and will change the Warning and Alarm indicators from flash to steady-on. The Warning indicator will automatically shut off when gas concentration falls below the setpoint, but the Alarm indicator will remain on. Pressing the button after the gas has cleared will reset the Alarm indicator.

Operation of the alarm relays depends on the configuration selected for each one (see paragraph 3.2.1, Configuration Switches).

3.3.2 Sensor Trouble Alarm and Relays

Receivers contain a Trouble Relay which is associated with the Sensor Trouble indicator. A Sensor Trouble Alarm will be activated if the transmitter input is disconnected or shorted or if the Detector fails to pass an auto-test. If these conditions occur, the Sensor Trouble indicator will light, the horn will sound intermittently, and the Trouble Relay will change state. Note that the Trouble Relay is a fail-safe relay. Under normal conditions, the coil of this relay is energized, and it de-energizes when a Sensor Trouble Alarm occurs or if power fails. After the trouble condition clears, press the push-button or close the remote reset contacts to reset the Sensor Trouble Alarm.

3.3.3 Auto-Test Function

NOTE: The Auto-Test option is for indoor use only, and should only be used with detectors set to the standard range or lower, as listed in Section 1.1 – Technical Data. If used with higher ranges, the generator may not produce enough gas to test the sensor.

The optional Auto-Test feature verifies the proper operation of gas detection systems automatically. It is enabled when configuration switch D1 is in the “on” position. Auto-Test uses an electrochemical Gas Generator attached to the gas sensor and controlled from the receiver. Every 24 hours, the microcomputer in the receiver activates the Gas Generator and monitors the output of the gas sensor.

During the time when an Auto-Test is in progress, the alarm relays are inhibited. This is indicated by the warning and alarm indicators alternately flashing. Typically, an auto-test will last only a few seconds. After completion of the test the alarm response will be delayed to allow gas to clear from the sensor/ generator and for the sensor to recover. The system will be fully inhibited for

two minutes, followed by an eight minute period during which the detector will respond only to gas levels of greater than 50% of full scale.

When the Auto-Test is activated, the generator will turn on for a maximum of five minutes. If no sensor response is detected during this time, the generator will turn off and the receiver will wait for 15 minutes before initiating another Auto-Test. If it fails this second test, a Sensor Trouble Alarm will be initiated, as described earlier. The Receiver will auto-test two more times at one hour intervals. If the sensor passes either of these tests, the Sensor Trouble Alarm will reset.

3.3.4 Lamp and Horn Test

When the Receiver is in the normal mode, pressing the push-button and holding it for two seconds will illuminate all digital display segments and LED indicator bars, and will sound the internal horn. Upon releasing the button, the receiver will return to its previous state.

3.3.5 Relay Inhibit

Alarm relays in the Receiver can be inhibited for up to four hours to allow calibration or testing of Sensor/Transmitters without activating external alarm or control devices.

To initiate the inhibit mode, with the Receiver in the normal mode, press and hold the push-button for approximately five seconds. The lamp test will occur first, but continue to hold the button down. Once the lamps have shut off, release the button. The warning and alarm lamps will begin to flash alternately for a few seconds. If the Auto-Test configuration switch is in the “on” position and the push-button is not pressed, the Sensor trouble lamp will flash after the Alarm/Warning lamps have stopped flashing. If no action is taken, the Receiver will return to the normal mode.

If the push-button is pressed and released while the warning and alarm lamps are in alternating flash, the Receiver will go into the relay inhibit mode. The warning and alarm lamps will continue their alternating rapid flash, and the Receiver will remain in inhibit for four hours or until the button is pressed again. During this period, the display will indicate gas concentration, and the 4-20 mA output will be held at the level it was at before inhibit was initiated, but the relays will not activate. Transmitters may be calibrated while the inhibit is on without setting off external alarms.

When the receiver is in inhibit, the display reads the actual signal down to 0 ppm, and will read negative if the sensor is out of calibration. Normally, the microcomputer sets the display to zero when the signal is less than two percent of full scale, to avoid false readings due to drift and environmental conditions. Because relays are inhibited and the display blanking is bypassed, the inhibit mode is convenient for calibrating the Sensor/Transmitter.

3.3.6 Manual Auto-Test

Gas detection systems purchased with the optional Autotest Generator may be tested by manual activation of the Generator from the receiver module. This function will operate only if the Auto-Test configuration switch D1 is “on”. To manually start the Auto-Test function, with the Receiver in the normal mode, follow the sequence described in paragraph 3.3.5, Relay Inhibit, but press the push-button when the Sensor trouble lamp is flashing. The horn will sound a quick beep and the green gas indicator will begin to flash, indicating that the generator is running. The system will go through a normal Auto-Test sequence, exactly the same as the sequence used every 24 hours. The display will show increasing gas values as the sensor begins to respond. When the microcomputer identifies a successful test, the horn will sound one beep. The relay inhibit indication will remain on until the sensor has had time to recover.

If the test fails, a Sensor trouble response will be initiated. Pressing the push-button will silence the horn, but the Sensor trouble contact and light will remain latched on, and cannot be reset until after a 10-minute period. The Sensor/Transmitter should be checked. Either the Sensor or Generator has failed, or something is physically blocking the path between the two. Methods for testing individual gas sensors can be found in Section 4 – Service.

3.3.7 Remote Reset

Receivers are provided with input terminals for connection of a remote reset switch. The remote reset input provides horn silence and alarm reset functions using a switch located at any remote point. When receivers are located at sites with telemetry equipment, the remote reset input may be connected to a relay contact in the telemetry system.

The remote reset input accomplishes the same acknowledge and reset functions as the push-button on the front panel. When a switch closure is detected across the remote reset terminals, the detector horn will silence and any latching relays will reset, provided that the gas condition has cleared. The remote reset input will not activate any of the testing or inhibit functions of the receiver.

3.3.8 Analog Output

Monitor Receivers provide an isolated 4-20 mA output signal for interface with recorders, data loggers, or computer systems. The span of the 4-20 mA signal is the same as the range of the receiver selected during the receiver configuration. The output will drive loads of 0 to 1000 ohms.

3.4 Sensor/Transmitter Operation

Gas sensors are attached directly to transmitter boxes with a water-tight seal. A short sensor cable plugs into the transmitter circuit board. The optional Gas Generator is attached to the sensor and connects to a terminal block on the circuit board.

The Receiver provides power to the Sensor/Transmitter through a two-conductor cable, which is also used to transmit the signal back to the Receiver. The Sensor/Transmitter may not be used with a separate power source.

3.4.1 Sensor Installation (See Dwg. 50.130.150.001)

Sensor/Transmitters must be mounted with the sensor horizontal.

NOTE: Gas sensors are shipped with a protective red plastic cap over the end. This cap should be left in place to avoid damage to the sensor physically or from chemical vapors, until ready for service. This cap must be removed when the sensor is placed in service.

Installation wiring requires connection of a two-conductor cable from the receiver to TB1 as shown. This connection is not polarity sensitive; either conductor can be connected to either terminal.

The Autotest Generator is connected to TB2. Polarity must be observed as shown.

NOTE: The Auto-Test option is for indoor use only, and should only be used with detectors set to the standard range or lower, as listed in Section 1.1 – Technical Data. If used with higher ranges, the Generator may not produce enough gas to test the sensor.

It is recommended that when first installed, a sensor should be connected to a Receiver and allowed to stabilize for approximately 12 hours. The sensor should then be zeroed as described in Section 4 – Service.

3.4.2 Sensor Location (Chlorine, Sulfur Dioxide, And Ammonia)

Chlorine and Sulfur Dioxide gases are heavier than air and will tend to accumulate near the floor in a closed room with little air movement. Ideally, these sensors should be located one to two feet off the floor in closed storage rooms, but may be located at higher elevations where good air flow will quickly mix any leaking gas throughout the space.

Ammonia gas is lighter than air and will tend to accumulate near the ceiling in a closed room with little air movement. Ideally, this sensor should be located near the ceiling in closed storage rooms, but may be located at lower elevations where good air flow will quickly mix any leaking gas throughout the space.

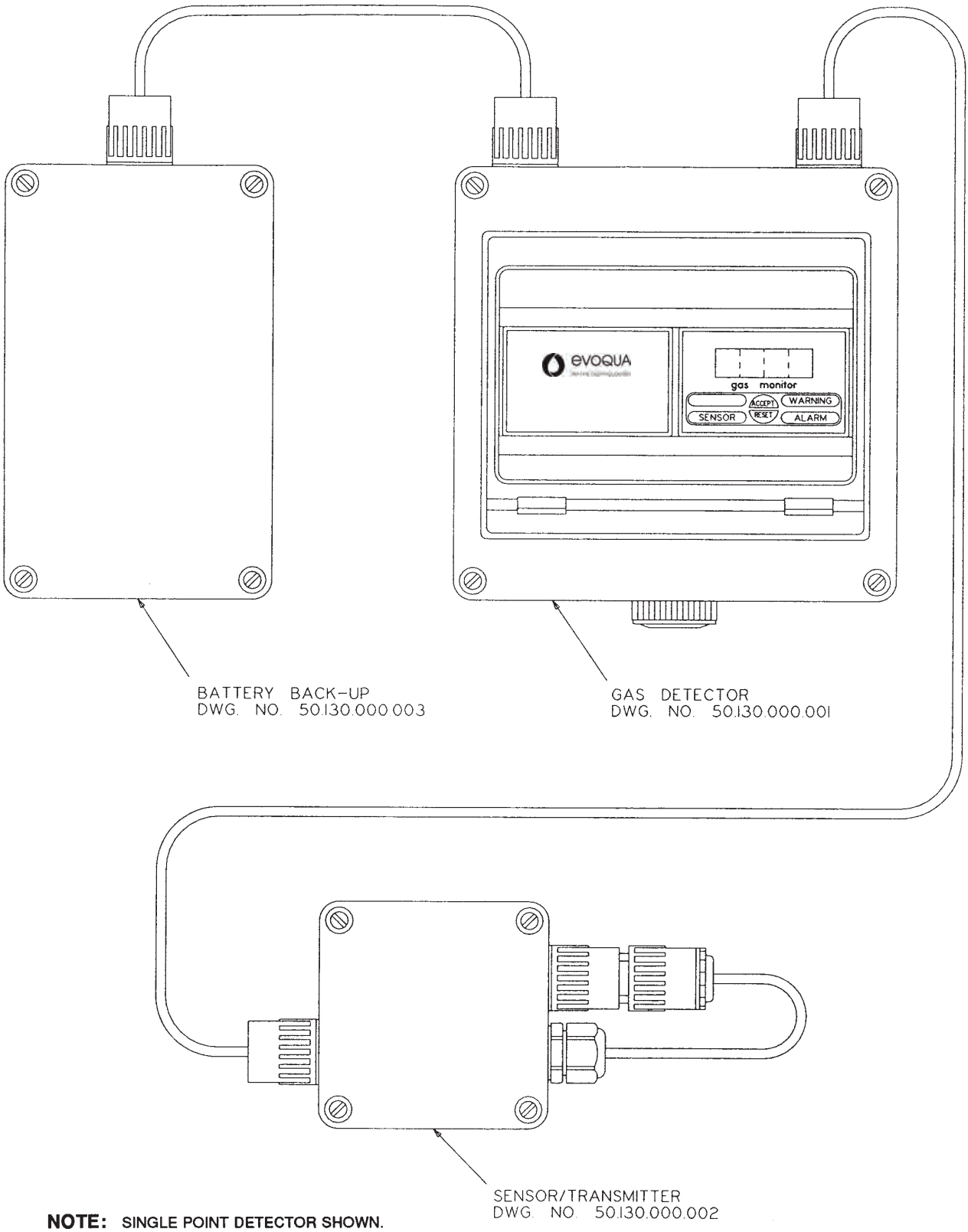
Outdoor sensor locations require that prevailing wind patterns, likely personnel work areas, and most probable leak sources all be evaluated to determine where sensors will detect gas most reliably. Autotest Generators are not for outdoor use. However, because of outside influences, such as wind direction, outside operation is questionable.

3.5 Battery Back-Up Operation

When power is applied to the power supply module, a relay on the Battery Back-up circuit board energizes and places the Battery Back-up into operation. To unlatch battery, see paragraph 4.1, Removing Unit From Service. There are no user adjustments in the Battery Back-up unit. If the battery is not fully charged, the power supply will begin supplying charge current to the battery, and will float charge the battery as long as the power supply is on.

If the power supply loses its input power, the Battery Back-up will immediately supply power to receiver modules to maintain detection system operation without interruption. The back-up period varies depending on whether the detector is single or dual channel, on whether displays are in normal or high intensity mode, and on how many relays are configured for fail-safe operation. Minimum expected Battery Back-up is 12 hours for single channel and six hours for dual channel.

The circuit board attached to the battery serves two functions. First, it limits battery charging current to a maximum of 0.75 amps. This prevents possible damage to the battery due to an excessively high charge current. Second, a low-voltage drop-out relay isolates the battery from the detection system when the battery voltage falls below 10 volts. This protects the battery against damage caused by the deep discharge.



NOTE: SINGLE POINT DETECTOR SHOWN.

GAS DETECTOR SYSTEM - ASSEMBLY

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  Service – Sensor/Transmitter 50.130.150.001

4.1 Removing Unit From Service

The low-voltage drop-out relay on the Battery Back-up unit is energized as soon as power is applied to the power supply module. Once energized, the coil current is supplied from the power supply module initially, but will be supplied from the battery if power is removed from the power supply module, or if the module is disconnected from the battery. If the gas detection system supported by the Battery Back-up is started up for testing and then shut down, the Battery Back-up relay should be de-energized manually; otherwise, the relay coil will continue to drain the battery until the 10 volt level is reached. This will shorten the life of the battery, and the battery will be discharged when the detection system is started up again.

To de-energize the relay, slide the control circuit board off the battery terminals until the relay coil drops out (there will be a click), and then slide it back on. As soon as the battery connection is broken, the relay coil will drop out, and will not energize until power is again applied to the power supply module. This procedure is recommended any time the detection system is removed from service.

4.2 Sensor Service

4.2.1 General Sensor Response Test

Gas sensors should be checked regularly for proper response. For systems not equipped with Auto-Test, at least monthly manual sensor response testing is recommended.

The sensor response test described below should also be used if the Auto-Test system detects a sensing failure and lights the Sensor trouble lamp. If the sensor responds to manually applied gas but not to the Autotest Generator, replace the generator.

The sensor response test will activate alarm relays unless they are inhibited as described in paragraph 3.3.5, Relay Inhibit. Sensor response to the test gas may be observed by: viewing the digital display on Monitor Receivers, by monitoring the voltage at the test points in the transmitter, by viewing the Warning and Alarm lights on the Receiver, or by observing the operation of alarm relays in the receiver.

4.2.2 Chlorine Sensor Response Test

A high concentration of chlorine gas can be obtained from powdered calcium hypochlorite (HTH) available from any swimming pool supply. Place a teaspoon of calcium hypochlorite into a plastic bottle and keep the bottle capped until ready to test the sensor. Open the bottle and place the mouth near the sensor. After the sensor response has been verified, immediately remove the bottle

as prolonged exposure to high concentrations of chlorine will shorten the life of the sensor. If no response is observed, the sensor may need to be replaced. See paragraph 4.8, Troubleshooting.

4.2.3 Sulfur Dioxide Sensor Response Test

Sulfur Dioxide sensors can be tested with fresh powdered sodium bisulfite placed in a squeeze bottle. A vapor of a few ppm can be squeezed toward the sensor. If the sensor does not respond, it may need to be replaced. See paragraph 4.8, Troubleshooting.

NOTE: If the sodium bisulfite is not fresh, it may not produce a high enough concentration to test the sensor.

4.2.4 Ammonia Sensor Response Test

Ammonia sensors can be tested using ordinary ammonia solution used for cleaning. Open a bottle of ammonia solution and carefully move the mouth of the bottle near the sensor. Do not splash liquid ammonia solution on the sensor or it could damage the sensor. When the mouth of the bottle is approximately one inch from the sensor, a rapid response should be observed. Immediately remove the ammonia bottle as prolonged exposure to high concentrations of ammonia will shorten the life of the sensor. If the sensor does not respond it may need to be replaced. See paragraph 4.8, Troubleshooting.

4.3 Sensor Replacement (See Dwg. 50.130.150.001)

Open the Transmitter and unplug the Sensor cable from the transmitter circuit board. Unscrew the Sensor from the nut on the inside of the enclosure and screw in the replacement Sensor.

Connect the new Sensor to the pins on the transmitter board and replace the Transmitter cover. After a new Sensor has been connected, allow 12 hours for the new Sensor to completely stabilize. Then perform zero and span adjustments as described in this section.

WARNING: THE GENERAL SENSOR RESPONSE TEST, AS DESCRIBED ABOVE, MUST BE PERFORMED WHENEVER A NEW SENSOR IS INSTALLED.

NOTE: It is strongly recommended that sensors be powered overnight upon initial startup before adjustments are made and before connections are made to alarm relays. Sensors that are powered for the first time may remain in an alarm state beyond the five-minute inhibit period and may take several hours to fully stabilize.

4.4 Gas Generator Replacement (See Dwg. 50.130.150.001)

To replace, disconnect the Generator leads from the terminal block marked TB2. Loosen the cable gland, pull the wires out of the enclosure, and unscrew the Generator from the sensor. Reverse the process to install the new Generator. Observe the wiring polarity when installing the new Generator.

Once installed, the new Generator should be tested by running the Manual Auto-Test procedure described in paragraph 3.3.6. If no sensor response is observed, recheck the Generator connection to be sure the polarity is correct and that switch D1 in the Receiver Module is in the "on" position. If the sensor still does not respond, test the sensor with the appropriate Sensor Response Test described in paragraph 4.2. If the sensor does not respond, replace it. If the sensor responds properly, contact Evoqua Water Technologies for assistance with the Generator.

4.5 Sensor Calibration (See Dwg. 50.130.150.001)

The zero may drift with temperature, and it is recommended that the sensor zero be adjusted upon initial installation and every month after. At minimum, seasonal adjustments should be made to avoid false alarms due to zero drift.

For applications where precise indication of gas level is required, Sensor/Transmitters should be spanned every three to six months. The best calibration sources are generally 10% accurate, and a Sensor/Transmitter will normally change sensitivity by less than 25% over 12-months time. If on-site calibration is not practical, it is recommended that a new, factory calibrated Sensor/Transmitter be purchased every two years.

NOTE: It is essential that the transmitter zero and span adjustments be re-calibrated whenever sensors or transmitter circuit boards are replaced independently.

Calibration of the Sensor/Transmitter requires a digital volt meter (DVM), a source of calibration gas and a calibration adapter for the sensor.

For CHLORINE, electrochemical generators are typically used for calibration gas. SULFUR DIOXIDE gas can be obtained in disposable cylinders from specialty gas suppliers. AMMONIA calibration gas can be obtained in refillable high pressure cylinders from specialty gas suppliers. For more information on calibration gas equipment, contact your Evoqua Water Technologies equipment distributor.

Proper tubing should be used to connect gas sources to sensors, particularly chlorine. Polyethylene tubing is recommended for all gases.

Prior to calibration, remove the cover from the Sensor/Transmitter enclosure and connect a DVM to the test points as shown in Figure 4.1. The test points will provide a 0-1.00 Vdc signal proportional to transmitter range. For example, a range of 0 to 10 ppm, 0 ppm is 0.00 volts and 10.0 ppm is 1.00 volts.

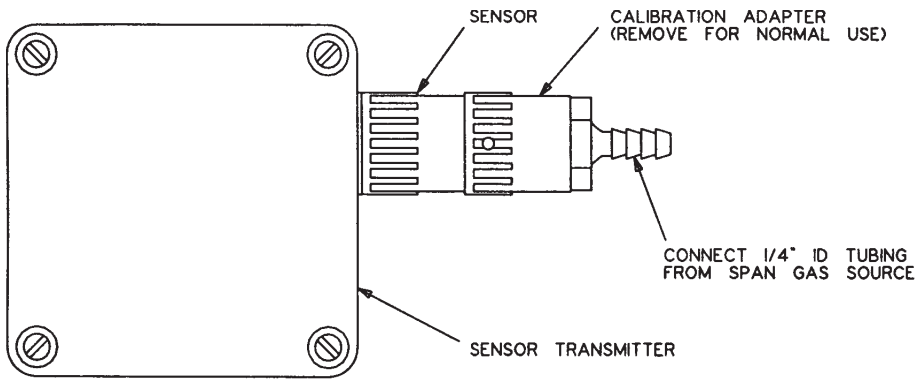


Figure 4.1 - Sensor/Transmitter Enclosure

NOTE: If alarm relays at the receiver are connected to devices that should not be activated during calibration, place the receiver into "alarm inhibit" as described in paragraph 3.3.5, Relay Inhibit, prior to calibrating the Sensor/ Transmitter.

4.5.1 Zero Adjustment (See Dwg. 50.130.150.001)

Before adjusting the zero, allow the sensor to fully stabilize by leaving it on for approximately 12 hours. Ambient air must be "clean".

The zero can be adjusted with just a DVM. Connect the meter to the test points, and adjust the zero potentiometer until a stable value of 0.00 volts is obtained.

4.5.2 Transmitter Span (See Dwg. 50.130.150.001)

Before adjusting the span, the sensor must be fully stabilized and the zero adjusted. See paragraph 4.5.1, Zero Adjustment.

If a Sensor/Transmitter is equipped with an Autotest Generator, it must first be unscrewed from the sensor. The Calibration Adapter can then be attached to the sensor.

The calibration gas is connected to the calibration adapter with an appropriate tube. When used, gas generators must be allowed to stabilize according to the manufacturer's directions. Calibration gas is applied at approximately 500 cc/min and should be allowed to flow to the sensor for 10 minutes before adjusting the span.

Connect the DVM to the transmitter test points. Adjust the span potentiometer until a stable voltage reading is obtained according to the following equation:

V = Span Gas Concentration ÷ Transmitter Range

As an example, if the calibration gas is 3 ppm and the Sensor/Transmitter range is 0 to 5 ppm, the voltage should be adjusted to 3 ÷ 5 = 0.6V.

If the receiver was placed in the "inhibit" mode prior to calibration, press the pushbutton switch on the receiver to return the system to normal operation.

4.5.3 Range Adjustment (See Dwg. 50.130.150.001)

Sensor/Transmitters are factory calibrated at the Standard Ranges as listed in Section 1.1 – Technical Data, but can be changed within the limits listed in that Section.

The range can be changed by first setting the range configuration switches, C1 to C4, in the Receiver Module as described in paragraph 3.2, Receiver Module Operation. The transmitter span must then be adjusted as described above.

4.6 Battery Replacement (See Dwg. 50.130.000.003)

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, HANDLE BATTERIES WITH CARE, BEING CERTAIN NOT TO SHORT TERMINALS, AS SEVERE ARCING OR EXPLOSION COULD OCCUR.

Remove the battery enclosure cover. Pull the plug off the circuit board. Cut the strap holding the battery in place, then pull the battery out. Slide circuit board off battery terminals.

To install the new battery, reverse above procedure. A new strap is supplied with replacement batteries. The battery should be installed with the terminals to the rear of the enclosure.

4.7 Routine Service

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, DUE TO UNDETECTED LEAKS OF DANGEROUS GAS, THE FOLLOWING SERVICE MUST BE PERFORMED TO VERIFY OPERATION OF THIS GAS DETECTOR.

- **MONTHLY**

  a. Test sensor response with actual gas if Autotest Generator is not installed. However, if a higher degree of confidence is desired, the sensor may be tested more often.

  b. Adjust sensor zero potentiometer.

  c. Clean battery vent.

  d. Verify that the Battery Back-up works by removing ac power.

- **QUARTERLY**

  Adjust the sensor span potentiometer (optional—requires a gas calibration device). (Not supplied by Evoqua Water Technologies.)

NOTE: Span adjustment is recommended only when a precise indication of gas level is required.

4.8 Troubleshooting

Trouble	Remedy
Receiver LEDs and indicators do not light when power is applied to the system.	1. Check the fuse. If the fuse is blown, replace the fuse. If not, go to step 2. 2. Check wiring from the Power Supply Module to the Receiver Module (see Dwgs. 50.130.130.001 and 50.130.130.002). Be sure polarity is correct. If wiring is correct, go to step 3. 3. With a voltmeter, check the power supply at the "+12" terminal (positive) and "C" terminal (negative) on the Receiver. If the reading is between 13.6 to 13.9 Vdc, replace the Receiver. If the voltage is above 13.9 V, go to step 5. If the voltage is below 13.6 V, go to step 4. 4. Measure the ac input voltage at the Power Supply Module. If the voltage is not within the rated range (see Section 1.1 - Technical Data), check ac supply. If the voltage is within the rated range, replace the Power Supply Module. 5. If the voltage measured in step 3 is above 13.9 V, connect another Receiver Module or a resistive load of approximately 100 ohm and 2 watts to the Power Supply output terminals. If the voltage drops to within 13.6 - 13.9 V, replace the Receiver. If not, replace the Power Supply Module.
Receiver module powers up correctly, but does not respond when test gas is applied to sensor/transmitter.	1. Disconnect the Transmitter connections at the two "TR" terminals of the Receiver. Check the voltage on the terminals with a voltmeter. The voltage should be approximately 12 Vdc. If this voltage is not present, replace the Receiver Module. If it is measured, go to step 2. 2. Connect a milliamp meter between the two "TR" terminals of the Receiver. The current should be 15 to 25 mA. If this current is not measured, replace the Receiver Module. If it is measured, refer to the Sensor/Transmitter paragraphs in this Section.

WARNING LABELS AND TAGS

The following warning labels and tags are attached to the equipment.

P60391: Gases detected are hazardous substances, and if breathed in high concentrations can cause death. To maintain normal operation of this detector you must observe the following precautions.

1. DETECTOR OPERATION MUST BE CHECKED AND VERIFIED FREQUENTLY ON A REGULAR SCHEDULE.
2. To avoid injury from electrical shock, turn power sources off before servicing this equipment.
3. The Evoqua Water Technologies instruction book provided with this detector DETAILS installation, operation and maintenance.
4. Operation AND maintenance of this equipment must be restricted to trained, qualified personnel who are completely familiar with these instructions.

P60402: PERSONAL INJURY OR DEATH MAY RESULT FROM EXPOSURE TO THE DESIGNATED GAS. TEST ASSEMBLY WITH DESIGNATED GAS UPON START-UP, MONTHLY, AND IF EXPOSED TO CHEMICALS. REPLACE OR REPAIR ASSEMBLY IMMEDIATELY UPON TEST FAILURE. REFER TO THE EVOQUA WATER TECHNOLOGIES MANUAL.

P60392: *TO AVOID INJURY FROM ELECTRICAL ARCING, TURN POWER SOURCES OFF BEFORE SERVICING THIS EQUIPMENT.

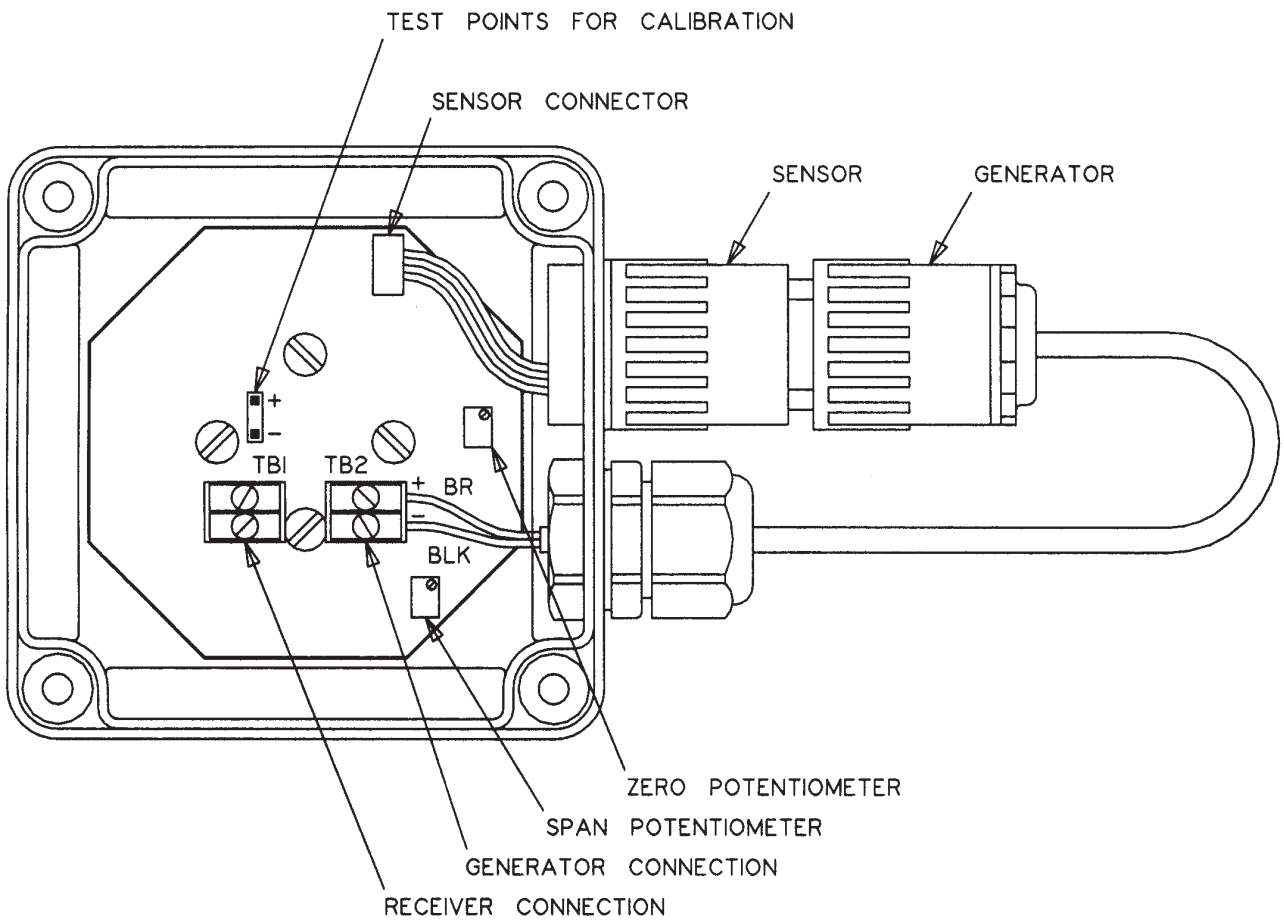
CAUTION LABEL

The following caution label is attached to the equipment.

P60392: *LEAD ACID BATTERY, DISPOSE OF PROPERLY.

---

* Both on same label.



NOTE: GAS SENSORS ARE SHIPPED WITH A PROTECTIVE RED PLASTIC CAP OVER THE END. THIS CAP SHOULD BE LEFT IN PLACE TO AVOID DAMAGE TO THE SENSOR PHYSICALLY OR FROM CHEMICAL VAPORS, UNTIL READY FOR SERVICE. THIS CAP MUST BE REMOVED WHEN THE SENSOR IS PLACED IN SERVICE.

SENSOR/TRANSMITTER - SERVICE

50.130.150.001
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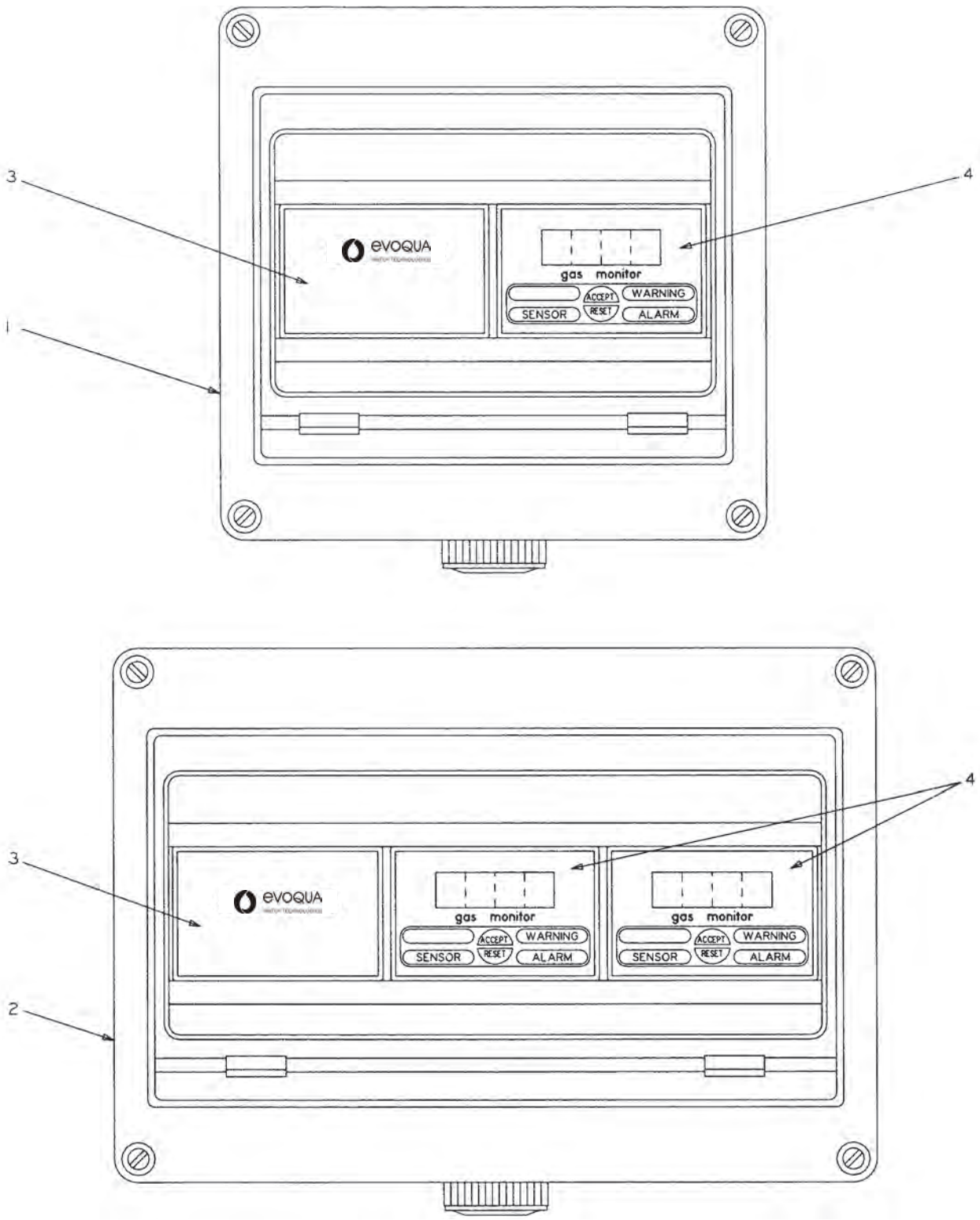
SECTION 5

SECTION 5 – ILLUSTRATIONS

List Of Contents

DRAWING NO.

Parts
Gas Detector System..... 50.130.000.001A&B
Sensor/Transmitter Unit 50.130.000.002
U29319 Battery Back-Up..... 50.130.000.003



NOTE: MONITOR UNITS SHOWN.

GAS DETECTOR SYSTEM - PARTS

50.130.000.001A

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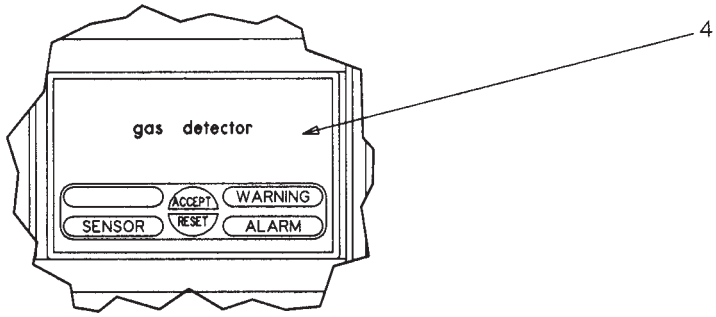


TYPICAL DETECTOR UNIT

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	U29317	1	Single Point Detector, Base Unit
2	U29318	1	Dual Point Detector, Base Unit
3	U29316	1	Power Supply Modual
4	----	1	Receiver (See Table Below)
-	P60391	2	Warning Label (Not Shown)

GAS DETECTION SYSTEM PART NUMBERS

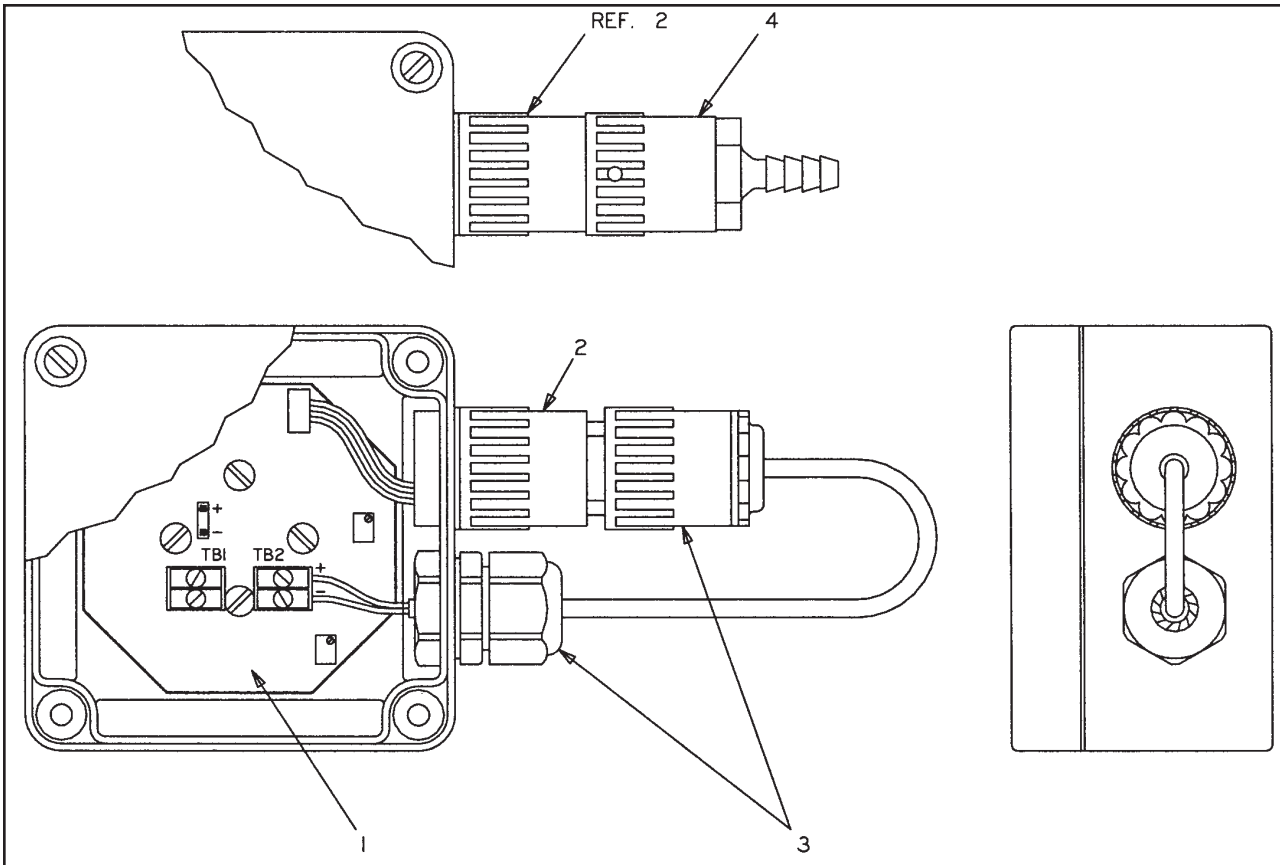
SYSTEM	GAS TYPE	RECEIVER TYPE	RECEIVER	SENSOR/ ▲ TRANSMITTER
U29360	Cl_2	Detector	U29320	U29335
U29361	Cl_2	Monitor	U29323	U29335
U29362	SO_2	Detector	U29322	U29337
U29363	SO_2	Monitor	U29325	U29337
U29364	NH_3	Detector	U29321	U29336
U29365	NH_3	Monitor	U29324	U29336

NOTE: ▲ These parts shown on drawing 50.130.000.002.

WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

GAS DETECTOR SYSTEM - PARTS LIST

50.130.000.001B
ISSUE 2 8-08

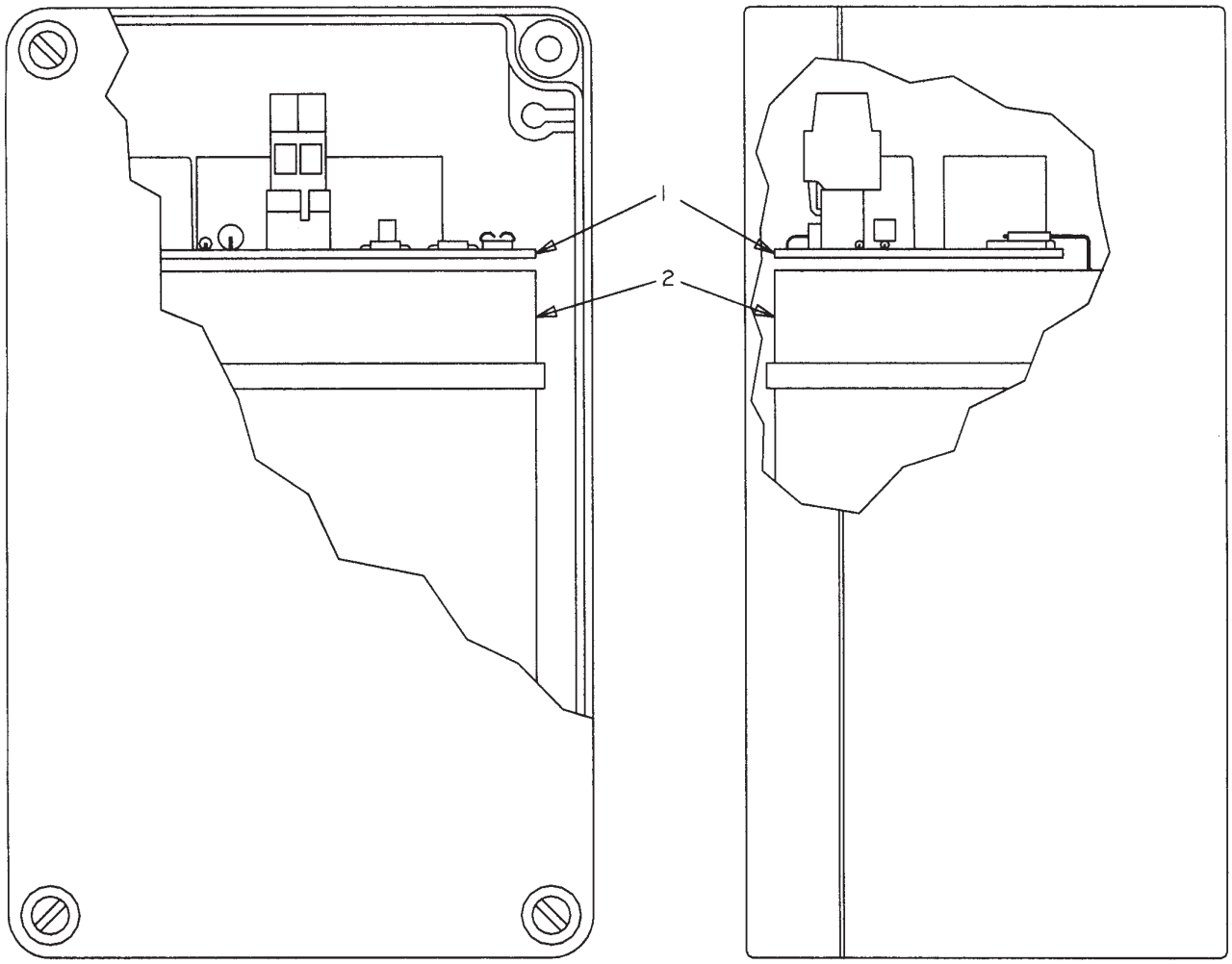


KEY NO.	PART NO.	QTY.	DESCRIPTION
1	◊ U29332	1	CHLORINE SENSOR CIRCUIT BOARD
	OR		
	□ U29334	1	SULFUR DIOXIDE SENSOR CIRCUIT BOARD
	OR		
	★ U29333	1	AMMONIA SENSOR CIRCUIT BOARD
2	◊ U29329	1	CHLORINE SENSOR
	OR		
	□ U29331	1	SULFUR DIOXIDE SENSOR
	OR		
	★ U29330	1	AMMONIA SENSOR
▲ 3	U29326	1	CHLORINE GAS GENERATOR
	OR		
	U29328	1	SULFUR DIOXIDE GAS GENERATOR
	OR		
	U29327	1	AMMONIA GAS GENERATOR
▲ 4	P60394	1	CALIBRATION ADAPTER
--	P60402	1	WARNING LABEL (NOT SHOWN)

NOTE: ◊ PART OF U29335. □ PART OF U29337. ★ PART OF U29336.
▲ NOT PART OF U29335, U29337 OR U29336.

U29335 - CHLORINE; U29337 - SULFUR DIOXIDE; U29336 - AMMONIA
SENSOR/TRANSMITTER UNIT - PARTS

50.130.000.002
ISSUE 0 11-93



FRONT VIEW

SIDE VIEW

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	U29315	1	BATTERY CIRCUIT BOARD
2	U29314	1	BATTERY
--	P60392	1	WARNING LABEL (NOT SHOWN)

U29319 BATTERY BACK-UP - PARTS

50.130.000.003
ISSUE 0 11-93

SECTION 6

SECTION 6 – SPARE PARTS LIST

QTY	DESCRIPTION	PART NO.
1	Calibration Adapter	P 60394
1	Battery	U 29314
1	Chlorine Sensor (Cl_2)	U 29329
1	Sulfur Dioxide Sensor (SO_2)	U 29331
1	Ammonia Sensor (NH_3)	U 29330
1	Chlorine Generator (Cl_2)	U 29326
1	Sulfur Dioxide Generator (SO_2)	U 29328
1	Ammonia Generator (NH_3)	U 29327
Specify Feet	Transmitter Cable	P 40231

MANUFACTURER/DISTRIBUTOR:

DM Valve (Bray)
Oscar Castillo
3540 Rue Poirier
St-Laurent, QC, H4R 2J5
Phone: (514) 332-4260
Oscar@dmvalve.com

Deschênes – Trois-Rivières (ASCO, GC Valve)
Martin Cormier
2204 Rue Louis Allyson
Trois-Rivières, QC, G8Z 4P3
Phone: (819) 693-2244
mcormier@deschenes.qc.ca

9.1 Bray Series 70 Valve Actuator (WTP)

Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

SERIES 70

ELECTRIC ACTUATORS TECHNICAL MANUAL

Bray®

BRAY.COM

THE HIGH PERFORMANCE COMPANY

Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

Technical Manual - Table of Contents

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Battery Backup Unit (BBU) 24V Specifications 4
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Actuator Mounting 6
Imperial (in) 6
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Standard Drawings 7

Sizes 003-065

Sizes 130-180

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Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

Specifications

CONSTRUCTION	
Housing	ASTM B85 pressure die cast aluminum Polyester powder coated Seacorr coated (optional)
Exposed Fasteners	Stainless steel
Travel Stops	Externally adjustable at both 0 and 90 degrees
Conduit Entries	S70-003 to S70-006: 2 x 1/2" NPT or 2 x M20 S70-008 to S70-180: 2 x 3/4" NPT or 2 x M25
Worm Gearing	Worm: Chromoly, self locking Worm gear: Aluminum bronze
Spur Gearing	AGMA class 9, nitride hardened alloy steel
Bearings	Indicator shaft and motor gear: Permanently sealed ball bearing Worm shaft: Sintered bronze bushing with heavy duty thrust bearing
Lubrication	High temperature synthetic grease
Motor	120/220 VAC: Single phase, reversible, permanent split capacitor induction motor 24V: Permanent magnet-brush DC motor
Capacitor	110/220 VAC: Metalized polyester
Heater	Optional, 5 watt PTC style
Terminal Strip	Switch Plate: 12 - 22 AWG (2.0 - 0.65mm) Servo: 14 - 24 AWG (1.63 - 0.51mm)
Torque Limiting	Optional, open and close preset at factory
Limit Switches	SPDT: 120VAC -10A-1/3 HP 220VAC -10A-1/2 HP 250VDC - 1/4A 12VDC - 2A

PERFORMANCE	
Output Torque	See Torque Chart
Voltages	See Motor Chart
Ambient Temperature	-20°F to 150°F (-29°C to 65°C)
Motor Insulation	120/ 220 VAC: Class F, 311°F (155°C) thermal trip at 275°F (135°C) 24V: Class B, slow blow fuse 5A@250VAC
Continuous Duty	Will operate continuously at a max. ambient temperature of 104°F (40°C)
Intermittent Duty (25%):	One motor-on period followed by three motor-off periods
Manual Operation	Pull to engage, push to disengage
Enclosure	Designed to meet NEMA Type 4, 4x and IP65 specifications
Certifications	UL, CSA and CE approved (most models) UL approved (USA & Canadian Std) for hazardous location S70-708 to S70-720: 120VAC Class I, DIV 1 & 2, Group C, D Class II, DIV 1 & 2, Group E, F, G

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Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

Battery Backup Unit (BBU) 24V Specifications

CONSTRUCTION AND PERFORMANCE	
Housing	ASTM B85 pressure die cast aluminum Polyester powder coated Seacorr coated (optional)
Exposed Fasteners	Stainless steel
Batteries	Two 12V 1.4AH sealed lead acid batteries wired in series
Battery Monitoring	Local LED indicator and voltage free 2-wire normally open contact for remote monitoring
Battery Charging	Automatic smart charge
Battery Conservation	Shut-off batteries after one minute or when actuator stops
Operating Temperature	-4°F (-20°C) to 122°F (50°C) LED light may not function below -20°F (-29°C)
Power Protection	Two 5 amp fuses, one for the external power output circuit and the other for the battery output circuit
Current Draw @ 24 VAC	BBU only maximum 10mA standby (0.25 VA) Max. 420mA charging (10 VA)
Current Draw of Actuator with BBU	600 lb-in - 1.9A (with load) 2,000 lb-in - 2.7A (with load) 5,000 lb-in - 4.1A (with load)
Power Requirements	24-27VAC or 30-38VDC (the minimum voltage is required to provide proper battery charging) Use dedicated Class 2 non-bonded transformer rated 100VA per BBU
Power Output	BBU output with 24VAC supply is 30-38 VDC On failure of AC supply, battery output is 24-25.5 VDC BBU will provide fail open or fail close operation

BATTERY SPECIFICATIONS	
Batteries	Two 12 volt 1.4 ampere-hour (AH) rechargeable sealed lead acid battery wired in series
Features	Valve regulated, spill proof construction allows safe operation in any position Rugged impact resistant ABS case and cover (UL94-HB) U.L. Recognized under file number MH 20845
Specifications	Battery case: ABS plastic Maximum discharge current (7 minutes): 4.2 amperes Shelf Life (% of nominal capacity at 68°F (20°C) 1 month = 97% 3 months = 91% 6 months = 83%
Operating Temperature	Charge: -4°F to 122°F (-20°C to 50°C) Discharge: -40°F to 140°F (-40°C to 60°C) The BBU should be powered up for a minimum of 12 hours

Although charging will not work at -4°F (-20°C), the batteries will still hold their charge for an extended period of time as described under Shelf Life. See Bray Series 70 BBU Operation and Maintenance Manual for detailed information.

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Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

Torque and Motor Data

		S70-003	S70-006	S70-008 S70-708*	S70-012 S70-712*	S70-020 S70-720*	S70-030	S70-050	S70-065	S70-130	S70-180
Torque	lb-in	300	600	800	1200	2000	3000	5000	6500	13000	18000
	Nm	34	68	90	136	226	339	565	734	1469	2034
Actuator Weight Approx.	lbs	11	11	25	25	25	45	45	45	118	118
	kg	5	5	11	11	11	20	20	20	54	54
MANUAL OVERRIDE											
Handwheel Dia.	in	3.5	3.5	8	8	8	12	12	12	12	12
	mm	89	89	203	203	203	300	300	300	300	300
Gear Ratio		30:1	30:1	30:1	30:1	30:1	30:1	30:1	30:1	90:1	90:1
Rim Pull	lbs	16	32	18	28	46	37	62	80	80	80
	kg	7.2	14.5	8.2	12.7	20.8	16.8	28.1	36.3	36.3	36.3

* Hazardous Location Units

120VAC

Travel Time 90° (Sec)		S70-003		S70-006		S70-008 S70-708*		S70-012 S70-712*		S70-020 S70-720*		S70-030		S70-050		S70-065		S70-130		S70-180	
		Current Draw in Amps																			
60 Hz	50 Hz	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA
10	12					1.20	2.10	1.40	2.30												
15	18					0.78	2.10	1.20	2.10	1.70	2.30										
18	22											1.80	3.00	2.30	3.10						
30	36	0.60	1.00	0.80	1.00	0.60	2.10	0.78	2.10	1.00	2.10	1.20	3.00	1.60	3.00	2.30	3.10				
110	132																	2.30	3.10	2.50	3.10

* Hazardous Location Units

220VAC

Travel Time 90° (Sec)		S70-003		S70-006		S70-008 S70-708		S70-012 S70-712		S70-020 S70-720		S70-030		S70-050		S70-065		S70-130		S70-180	
		Current Draw in Amps																			
60 Hz	50 Hz	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA
10	12					0.50	0.76	0.60	0.81												
15	18					0.38	0.90	0.50	0.76	0.55	0.90										
18	22											0.78	1.40	1.10	1.40						
30	36	0.60	0.75	0.65	0.75	0.38	0.90	0.45	0.90	0.50	0.81	0.75	1.2	0.90	1.40	1.10	1.40				
110	132																	1.30	2.70	1.50	2.70

FLA - Full Load Amperage
LRA - Locked Rotor Amperage

24VAC

Travel Time 90° (Sec)		S70-006	S70-020	S70-050
		Current Draw in Amps		
60 Hz	50 Hz	FLA	FLA	FLA
60	72	1.80	2.00	4.00

24VDC

Travel Time 90° (Sec)	S70-006	S70-020	S70-050
	Current Draw in Amps		
	FLA	FLA	FLA
40	1.80		
60		2.00	4.00

Travel Time - Motors

30, 40, 60, 110 second motors are continuous duty
10, 15, 18 second motors are intermittent duty

For all other information such as dimensional drawings, wiring diagrams, and EDS files please visit bray.com or contact your local Bray representative.

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Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

Actuator Mounting

Imperial (in)

Actuator Size	Inner Bolt Circle				Outer Bolt Circle				Stem Hole			
	Bolt Circle		No. Holes	Bolt Size	Bolt Circle		No. Holes	Bolt Size	Dia.	Across Flats	Depth	Keyway Width
S70-003	F07	2.76	4	5/16 - 18	-	-	-	-	0.75	0.51	1.75	-
S70-006	F07	2.76	4	5/16 - 18	-	-	-	-	0.75	0.51	1.75	-
S70-008 S70-708	F07	2.76	4	5/16 - 18	F12	4.92	4	1/2 - 13	1.18	0.87	2.20	-
S70-012 S70-712	F07	2.76	4	5/16 - 18	F12	4.92	4	1/2 - 13	1.18	0.87	2.20	-
S70-020 S70-720	F07	2.76	4	5/16 - 18	F12	4.92	4	1/2 - 13	1.18	0.87	2.20	-
S70-030	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	1.97	-	2.60	2 x 7/16
S70-050	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	1.97	-	2.60	2 x 7/16
S70-065	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	1.97	-	2.60	2 x 7/16
S70-130	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	1.97	-	5.40	4 x 7/16
S70-130	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	2.50	-	5.40	4 x 5/8
S70-180	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	1.97	-	5.40	4 x 7/16
S70-180	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	2.50	-	5.40	4 x 5/8

Metric (mm)

Actuator Size	Inner Bolt Circle				Outer Bolt Circle				Stem Hole			
	Bolt Circle		No. Holes	Bolt Size	Bolt Circle		No. Holes	Bolt Size	Dia.	Across Flats	Depth	Keyway Width
S70-003	F07	70	4	M8 x 1.25	-	-	-	-	19	13	44.5	-
S70-006	F07	70	4	M8 x 1.25	-	-	-	-	19	13	44.5	-
S70-008	F07	70	4	M8 x 1.25	F12	125	4	M12 x 1.25	30	22	55.9	-
S70-012	F07	70	4	M8 x 1.25	F12	125	4	M12 x 1.25	30	22	55.9	-
S70-020	F07	70	4	M8 x 1.25	F12	125	4	M12 x 1.25	30	22	55.9	-
S70-030	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	50.04	-	66	2 x 12.0
S70-050	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	50.04	-	66	2 x 12.0
S70-065	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	50.04	-	66	2 x 12.0
S70-130	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	50.04	-	137.2	4 x 12.0
S70-130	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	63.50	-	137.2	4 x 16.0
S70-180	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	50.04	-	137.2	4 x 12.0
S70-180	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	63.50	-	137.2	4 x 16.0

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Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

Standard Drawings

Standard Dimensional Drawings	
Imperial Standard	GA-17500
Metric Standard	GA-17499
Imperial Hazardous Location	ES11A-0526
Imperial 13,000-18,000 lb-in	ES11A-0708
Metric 13,000-18,000 lb-in	ES12A-0708

Standard Wiring Diagrams	
120/220 VAC On/Off w/ IRB	WD-000044
120/220 VAC Servo NXT	WD-000338
120/220 VAC Servo Pro	WD-000116
24 VAC On/Off w/Aux Switch - S70-003 to 006	WD-000276
24 VAC On/Off w/Aux Switch - S70-008 to 020	WD-000234
24 VAC On/Off w/Aux Switch - S70-030 to 065	WD-000111
24 VAC Servo Pro	WD-000145
BBU 24V On/Off w/ Aux Switch - S70-003 to 006	WD-000285
BBU 24V On/Off w/ Aux Switch - S70-008 to 020	WD-000289
BBU 24V On/Off w/ Aux Switch - S70-030 to 065	WD-000270
BBU 24V Servo Pro w/ Aux Switch - S70-003 to 006	WD-000159
BBU 24V Servo Pro w/ Aux Switch - S70-008 to 065	WD-000266

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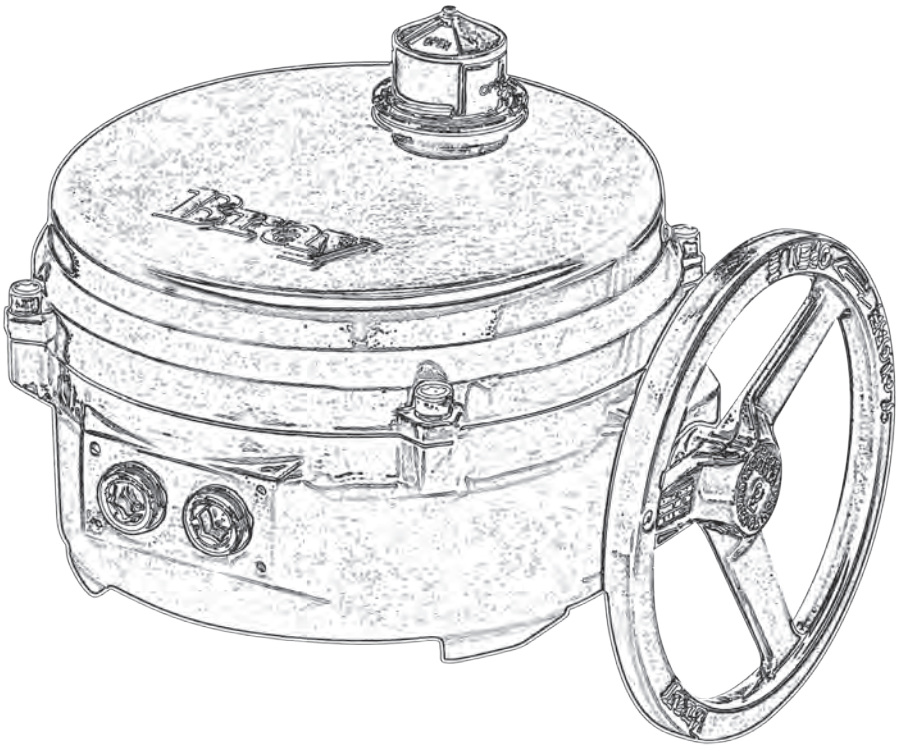
Bray

Your Global Flow Control Partner™

Series 70
24V On/Off Electric Actuator
Operation and Maintenance Manual



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FOR MORE INFORMATION ON THIS PRODUCT AND OTHER BRAY PRODUCTS PLEASE VISIT OUR WEBSITE – www.bray.com

Read and Follow These Instructions
Save These Instructions

1. Definition of Terms

WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	Used without the safety alert symbol indicates a potential situation which, if not avoided, may result in an undesirable result or state, including property damage.

2. Safety

This device left the factory in proper condition to be safely installed and operated in a hazard-free manner. The notes and warnings in this document must be observed by the user to ensure hazard-free operation of this device.

All necessary precautions need to be taken to prevent damage due to rough handling, impact, or improper storage. Do not use abrasive compounds to clean the device, or scrape its surfaces with any objects.

Configuration and setup procedures for this device are described in this manual. Proper configuration and setup are required for the safe operation of this device.

The control system in which this device is installed must have proper safeguards to prevent injury to personnel, or damage to equipment, should a failure of system components occur.

WARNING

Installation, commissioning, operation and maintenance of the unit must be performed under strict observation of all applicable codes, standards and safety regulations.

The actuator must only be installed, commissioned, operated and repaired by qualified personnel.

As per this document, a qualified person is one who is trained in:

- The operation and maintenance of electrical equipment and systems in accordance with established safety practices.
- Procedures to energize, de-energize, ground, tag and lockout electrical circuits and equipment in accordance with established safety practices.
- The proper use and care of personal protective equipment (PPE) in accordance with established safety practices.

This document does not cover every detail about every version of the product described. It does not take into account every potential occurrence concerning the installation, operation, maintenance and use of this device.

If situations transpire that are not documented in sufficient detail, please request the required information from the Bray Distributor or Representative responsible for your area.

3. Storage

Store units on a shelf or wooden pallet in order to protect against floor dampness.

Cover the units to protect against dust and dirt.

To prevent condensation inside these units, maintain a near constant external temperature and store in a well-ventilated, clean, dry room away from vibration. For units with an internal heater, power should be supplied to the heater via conduit entry with an appropriate sealing gland.

WARNING

Actuators are not weatherproof unless they are properly installed on the valve or prepared for storage. Bray will not accept responsibility for deterioration caused on-site.

4. Operating your Actuator

4.1. Operating by Hand

To engage the manual override, simply pull the handwheel to its outermost position. A yellow stripe is revealed to visually indicate manual override engagement as shown in Figure 1.

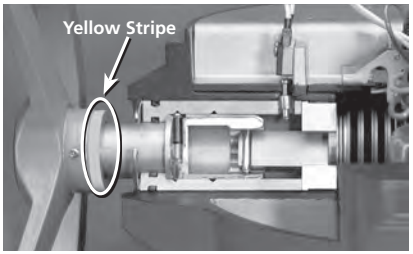

Figure 1. Handwheel is engaged, revealing the yellow stripe.

Once the manual override is engaged, rotating the handwheel in the clockwise direction will rotate the output shaft in the clockwise (close) direction and vice-versa.

To disengage the manual override, the handhwheel needs to be pushed towards the actuator until the 'yellow stripe' is hidden.

CAUTION

A label on the handwheel hub warns users not to exceed a specific 'rim pull' force, for each size of actuator.

If the 'rim pull' force is exceeded, the roll pin securing the handwheel onto the manual override shaft is designed to shear, thus preventing serious internal gearing damage.

4.2. Operating Electrically

To control the actuator remotely from a process controller, user must apply 24 VAC or 24 VDC to the actuator. This control signal voltage can be applied locally or remotely from a process controller.

CAUTION

Verify that the main electric power supplied to the actuator is in compliance with the specifications on the actuator label

Engaging the handwheel before or during the application of a control signal voltage will prevent the actuator motor from operating.

If torque switches are installed in the actuator, an overtorque condition will also prevent the actuator motor from operating.

5. Mounting the Actuator

All Bray Series 70 electric actuators are suitable for direct mounting on Bray butterfly valves. With proper mounting hardware, the S70 actuator can be installed onto other quarter-turn valves or devices as well.

NOTICE

The standard mounting position for the actuator is to orient the base of the actuator parallel to the pipeline.

If the actuator is to be mounted on a vertical pipe, it is recommended that the unit be positioned with the conduit entries on the bottom to prevent condensation entering the actuator through its conduits.

Follow the steps below to mount the actuator onto the valve.

1. Manually operate the actuator until the output shaft of the actuator is in line with the valve stem. If possible, select an intermediate position for both the valve and actuator.
2. If required, place the proper adapter onto the valve stem. It is recommended that a small amount of 'anti-seize' lubricant be applied to the adapter to ease assembly.
3. Mount the actuator onto the valve stem. It may be necessary to operate the actuator manually to align the valve and actuator bolt patterns.
4. Install the furnished mounting studs by threading them all the way into the actuator base.
5. Fasten the mounting studs in place with furnished hex nuts and lock washers.

6. Commissioning

6.1. Wiring Your Actuator

WARNING

Turn off all power and lockout/tagout service panel before installing or modifying any electrical wiring.

1. Take the actuator cover off and place it in a safe location.
2. Each actuator is provided with two conduit entries. Use one for power and the other for control wiring.
3. Wire the actuator as per the wiring diagram attached to the inside of the actuator cover.

NOTICE

a. A minimum of 18 AWG wire is recommended for all field wiring.

b. The terminals on the actuator switch plate, On/Off Controller or Servo NXT accepts wire sizes ranging from 14 to 22 AWG.

c. The conduit connections must be properly sealed to maintain the weatherproof integrity of the actuator enclosure.

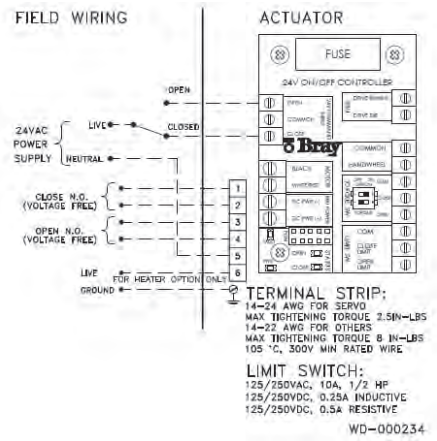

Figure 2. Sample field wiring diagram for Series 70 24V On/Off Actuator with auxiliary switches.

6.2. Setting Travel Limit Switches Cams

Bray uses its patented cam design along with 2 SPDT mechanical switches to set the 'Open' and 'Close' position of the valve.

The green cam actuates the 'open' switch when the actuator reaches the 'open' position. Similarly, the red cam actuates the 'close' switch when the actuator reaches the 'close' position.

Standard factory setting of the travel limit switches allows 90° travel between open and close positions. Cams for each switch are adjustable for applications where less than 90° degree travel is desired between the open and closed positions.

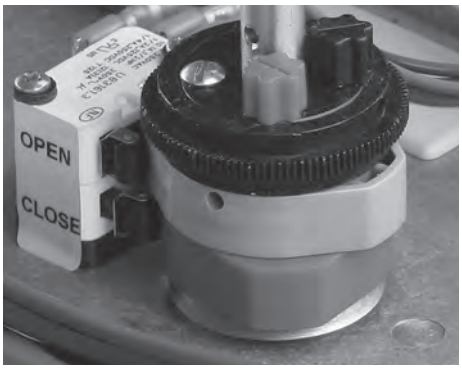

Figure 3. Two SPDT Travel Limit Switches.

Follow the steps below to adjust the travel limit cams.

1. Remove the indicator rotor by pulling it away from the indicator shaft as shown in Figure 4.

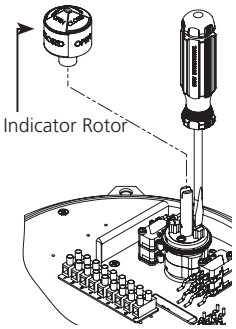

Figure 4. Indicator rotor pulled up from the indicator shaft.

2. Manually operate the actuator clockwise until the valve reaches the desired 'close' position.
3. Loosen the cam locking screw shown in Figure 5.

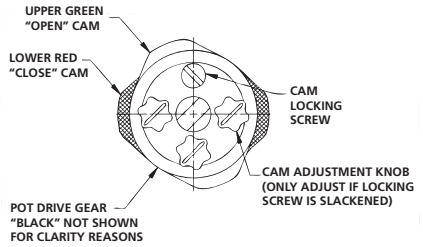

Figure 5. Top view of the indicator cam shaft.

NOTE: It is possible that the rotation of one cam will move the other cam. If this occurs, hold the other knobs or cams during adjustment.

4. Rotate the red cam adjustment knob by hand or with a flat head screwdriver until the red cam lobe activates (depresses) the 'close' switch from a clockwise direction.
5. Manually operate the actuator counterclockwise until the valve reaches the desired 'open' position.
6. Rotate the green cam adjustment knob until the green cam lobe activates (depresses) the 'open' switch from a counterclockwise direction.
7. After both travel switch adjustments have been completed, tighten the cam locking screw and place the indicator rotor back on the indicator shaft.

6.3. Setting Mechanical Travel Stops

Mechanical travel stops are designed to prevent overtravel while manually operating the actuator. They are not designed to stop the electric motor.

Mechanical travel stops are located outside the actuator base for easy readjustment. Stainless steel lock nuts with O-ring seals hold the travel stops securely in place as shown in Figure 6.

Figure 6. Mechanical Travel Stops (CW Close).

Follow the steps below to set the mechanical travels stops.

1. Manually drive the actuator to the closed position.
2. Once the actuator is in the closed position, rotate the handwheel clockwise:
   - ½ turn for Housing Size 6.
   - 1 turn for Housing Size 12.
   - ½ turn for Housing Size 30.

NOTE:

Maximum Actuator Torque	Housing Size
600 Lb-In	6
2000 Lb-In	12
5000 Lb-In	30

3. Adjust the closed travel stop bolt until it contacts the output segment gear and lock it in position with the locknut.
4. Manually drive the actuator to the open position.
5. Once the actuator is in the open posiiton, rotate the handwheel counterclockwise:
   - ½ turn for Housing Size 6.
   - 1 turn for Housing Size 12.
   - ½ turn for Housing Size 30.
6. Adjust the open travel stop bolt until it contacts the output segment gear and lock it in position with the locknut.

6.4 Configuring your 24V On/Off Controller

Every Series 70 24V On/Off Actuator is fitted with a 24V On/Off Controller as shown in Figure 7.

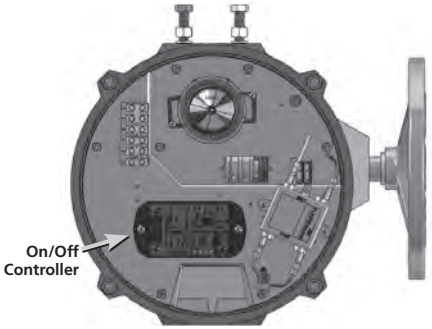

Figure 7. S70 24V On/Off Actuator.

The 24V On/Off Controller offers 3-wire control for the actuator.

To drive the actuator in the open direction, 24 VDC or 24 VAC power must be applied between the 'Open' and 'Common' terminals of the controller.

Similarly, to drive the actuator in the close direction, 24VDC or 24VAC power must be applied to the 'Close' and 'Common' terminals of the controller.

When the command signal is first applied, the Controller will wait for 1 second before powering the actuator motor. This delay is necessary to prevent a simultaneous reversal of the motor if an abrupt change in command signal direction occurs (instant reverse delay).

Once the actuator has reached the 'Open' or 'Close' position, the travel limit switch is activated and the controller turns off power to the motor.

NOTICE
Verify that the main electric power supplied to the actuator is in compliance with the specifications on the product label

6.5 DIP Switch Setting

The DIP switches on the 24V On/Off Controller are dependent on the installation of mechanical torque switches in the actuator. Table 1 shows the DIP switch settings for the 24V On/Off Controller.

Table 1

Mechanical Torque Switches installed	DIP Switch 1	DIP Switch 2
YES	OFF	ON
NO	OFF	OFF

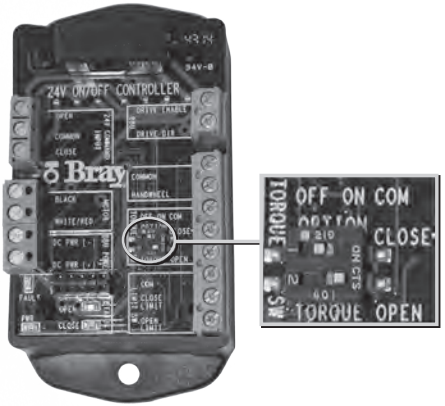

Figure 8. DIP switch settings when mechanical torque switches are installed in an actuator.

NOTICE
An engaged torque switch will prevent the actuator motor from operating in the over torque direction.

The 24V On/Off Controller has four LED's for status and fault indication as shown in Figure 9.

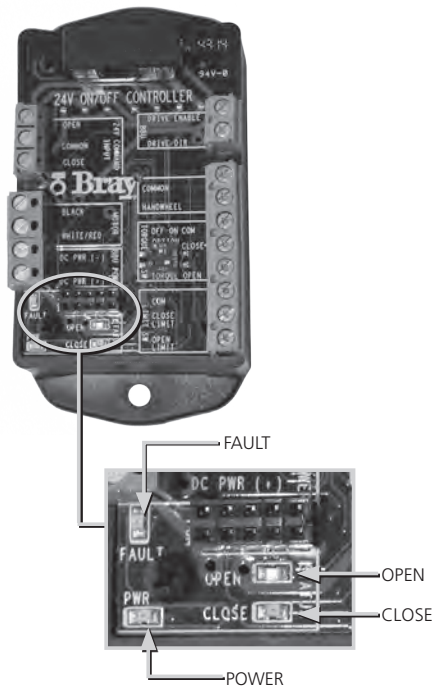

Figure 9. 24V On/Off Controller LEDs.

The LED flash codes for the 24V On/Off Controller are described in Table 2 below.

Table 2

LED Behavior	Meaning
'Pwr' LED flashes green every ½ second	The actuator has power and is operational.
'Fault' LED glows red	Hand-wheel is engaged/ pulled out
	The Open or Close Torque switch is engaged
	Both the travel limit switches are engaged at the same time
'Open' LED glows green	Actuator is being driven in the open direction.
'Close' LED glows red	Actuator is being driven in the close direction

7. Field or Factory Installable Options

7.1. Heater

To prevent condensation from forming inside the actuator, Bray offers an optional heater as a field or a factory installable option.

The heater is thermostatically controlled. It self-regulates by increasing or decreasing its electrical resistance relative to its temperature.

Figure 10. Heater installed on an S70 switch plate.

NOTICE

a. The heater must have a constant power supply to be effective.

b. The heater surface can reach temperatures in excess of 200° Celsius.

WARNING

The heater surface can reach temperatures in excess of 200° Celsius

7.2. Control Station

Bray's Control Station gives the operator the ability to locally drive the actuator with electrical power; overriding the control signal from the process controller.

The control station has a red (close) and green (open) light to provide end of travel indication. It also has two 3-position switches as shown in Figure 11.

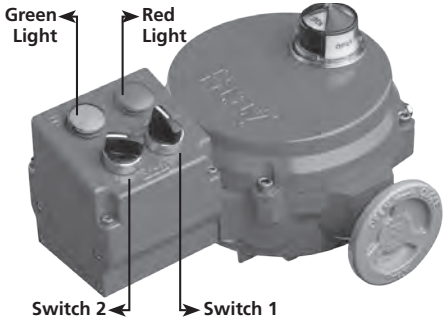

Figure 11. S70 with the Control Station.

Switch 1 lets the operator choose between the following three modes of operation:

1. **Local:** In this mode, using switch 2 the operator can drive the actuator to open or close position, or stop the actuator; overriding any control signal from the process controller.
2. **Off:** In this mode, the actuator can only be operated manually.
3. **Remote:** In this mode, the Actuator is controlled remotely from a process controller using a 24 VDC or 24 VAC signal.

NOTE:

a. Control Station can also be ordered with key lockable switches.

b. Control Station requires a dedicated set of auxiliary switches. These switches are required for turning on or off the lights on the control station to locally indicate actuator position.

c. Control Station does not contain terminal strips. All wiring is done directly to the switches and lights via 2 x 3/4" NPT holes in the bottom of the control station housing. Wire the process controller to the control station in accordance to the wiring diagram provided.

d. Ordering the Control Station with optional pin connector receptacles will eliminate the necessity of field wiring.

7.3. Auxiliary Switches

Auxiliary switches are a pair of dry-contact (voltage free) SPDT mechanical switches used to indicate travel position to remote customer control systems.

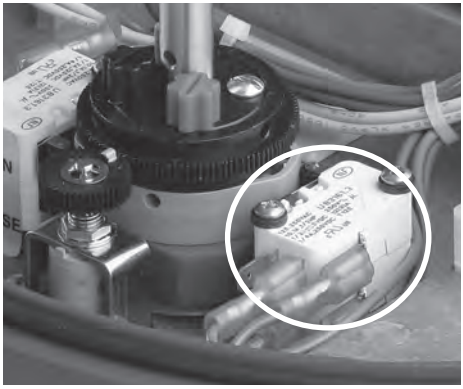

Figure 12. Fixed auxiliary switches installed in an actuator.

NOTE:

a. Fixed Auxiliary switches activate 3° before the travel limit switches. They are available as a factory and field installable option.

b. Adjustable auxiliary switches can be set to any position. They are available as a factory or field installable option.

7.4. Torque Switches

Mechanical Torque switches are designed to interrupt power to the motor windings when the actuator torque exceeds the calibrated factory setting.

Mechanical Torque switches are a factory installed and calibrated option available for all Series 70 units.

7.5. Battery Backup Unit

To meet customer needs, Bray offers a Battery Backup Unit (BBU) for the 24 V Series 70 Electric Actuator.

In the event of power failure, the BBU will switch the actuator to battery power to reach its fail position. After the actuator has reached its fail position, the BBU goes to 'Standby Mode' until external power is restored.

Once external power has been restored, the actuator returns to the position corresponding to the control signal present.

Figure 13. S70 with Battery Backup Unit.

Battery Backup Unit is available as a factory installable option. For more information, please refer to the 'S70 24V Actuator with BBU' Manual. This manual is available on the company website (www.bray.com).

7.6. Spinner

A spinner is available as an attachment to the actuator handwheel to ease and speed the manual operation of the actuator.

Figure 14. S70 with Handwheel Spinner Attached.

NOTE:

Care should be exercised in the use of spinner equipped handwheels.

Rapid operation of the handwheel to close the valve may cause water hammer.

Rapid travel into a travel stop may also cause damage.

7.7. Receptacles (Quick Connectors)

For quick and easy field wiring, Bray offers plug-in receptacles. Cordsets to fit these connectors can also be ordered in several lengths.

Figure 15. S70 with a 5-pin receptacle and the corresponding cordset.

Appendix A

A.1. Troubleshooting Guide

The Series 70 24V On/Off actuator is easy to configure and operate, but if problems do occur, the following guide can assist in troubleshooting.

The first step is to observe the 'Pwr' LED on the 24V On/Off Controller to verify that proper electrical power has been connected. If the 'Pwr' LED is flashing green, it means that the actuator has been powered correctly.

Next, observe the Fault LED. If the 'Fault' LED on the 24V On/Off Controller is turned on red, refer to Table 2 on page 7 of the manual to determine the root cause of the fault. After the root cause of the fault has been addressed, the 'Fault' LED should turn off.

If the problem still persists refer to the Actuator Troubleshooting Chart below.

A.2. Actuator Troubleshooting Chart

Problem	Possible Cause	Solutions
Actuator motor does not run in either direction and the 'Pwr' LED on the 24V On/Off Controller is flashing green	Manual override/handwheel is engaged.	Push handwheel in all the way
	Wiring is incorrect	Check wiring and power supply
Actuator operates in reverse directions	Field wiring is reversed	Rewire field wiring per wiring diagram
Actuator does not fully close valve (or open valve)	Limit switches are set incorrectly	Readjust travel limit switches
	Mechanical travel stops are set incorrectly	Adjust mechanical travel stops
	Valve torque requirement is higher than actuator output	Manually override out of seat, try angle seating or larger actuator
	Optional torque switches are activating	Valve torque exceeds actuator torque rating - consult factory
	Voltage power supply is low	Check power source
Corrosion inside unit	Water leaking in	Check all seals and possible water entry through conduit
Actuation only runs in one direction	Wiring is incorrect	Correct field wiring
	Incorrect control signal	Check/correct the control signal wire

A.3. Troubleshooting Example

The following example demonstrates a typical troubleshooting process.

Assume these starting conditions:

1. The handwheel is engaged (pulled away from the actuator).
2. The 24V On/Off Controller has been configured to enable torque switches but torque switches are not physically installed on the actuator.
3. 24VAC signal has been properly applied between the 'Open' and 'Close' terminals of the 24V On/Off Controller. The 'Pwr' LED is flashing indicating the control signal has been properly applied.

The 'Fault' LED on the 24V On/Off Controller is turned on red. Evaluate all possible reasons for the 'Fault' LED to be turned on as per Table 2 on page 7 of this manual.

1. Observe if the handwheel is engaged. In this case, the handwheel is engaged. Disengage the handwheel by pushing it in to eliminate a possible reason for the 'Fault' LED to be turned on red.
2. Evaluate if the limit switches have been correctly wired.
3. Check if the 24V On/Off Controller has been configured correctly to enable or disable the torque switches. In this case, torque switches have not been installed in the actuator but the 24V On/Off Controller has been configured to enable the torque switches. Correctly configure the 24V On/Off controller correctly to disable the toque switches as per Table 1 (on page 6).
4. The 'Fault' LED on the 24V On/Off Controller turns off and the actuator is now ready for service.

Appendix B

B.1. Basic Tools

Common To All Units	
Terminal connections, cam adjustment	Screwdriver, ¼" tip flat tip blade
All switches, terminal strip, torque switch plate	Screwdriver, No.1 Phillips
Switchplate screws	Screwdriver, No. 2 Phillips
Housing Size 6	
Mounting nuts	Wrench, ½"
Cover captivated capscrews	Hex key, ¼"
Travel stop adjusting bolts	Wrench, 7/16"
Travel stop jam nuts	Wrench, 7/16"
Conduit Entry Plug (½" NPT)	Hex key, ⅜"
Housing Size 12	
Mounting nuts (small pattern)	Wrench, ½"
Mounting nuts (large pattern)	Wrench, ¾"
Cover captivated capscrews	Hex key, 5/16"
Travel stop adjusting bolts	Wrench, 9/16"
Travel stop jam nuts	Wrench, 9/16"
Conduit Entry Plug (¾" NPT)	Hex key, 9/16"
Housing Size 30	
Mounting nuts (small pattern)	Wrench, ¾"
Mounting nuts (large pattern)	Wrench, 1⅛"
Cover captivated capscrews	Hex Key, ⅜"
Travel stop adjusting bolts	Wrench, ¾"
Travel stop jam nuts	Wrench, ¾"
Conduit Entry Plug (¾" NPT)	Hex key, 9/16"

Bray CONTROLS

A Division of BRAY INTERNATIONAL, Inc.
13333 Westland East Blvd. • Houston, Texas 77041
Tel: 281.894.5454 Fax: 281.894.9499 www.bray.com

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Chapter 10 Flow Switch (Division 25)

MANUFACTURER/DISTRIBUTOR:

Conval Québec
Lysane Guindon
9485 Transcanadienne Ouest
Montréal, QC, H4S 1V3
Phone: (514) 332-2301
lguindon@convalquebec.com

10.1 Magnetrol TD1 Flow Switch (WTP, ~~BS#1, BS#2)~~

Magnetrol Flow Switch TD1-2D00-030 w/ TEC-A110-004

Instrument Data Sheet

www.magnetrol.com - 705 Enterprise Street-Aurora, IL 60504 USA 630-969-4000 Fax 630-969-9489

Conval Québec
9485 Transcanadienne Ouest
Montréal, QC H4S 1V3
Phone Number 514-332-2301 Fax Number 514-636-0104

Thermal Dispersion

Rev.	Date	Approved By
0	2017-07-2	

SWITCH INFORMATION	SUPPLY VOLTAGE	DC - 19.2 to 28.8 VDC
	MOUNTING	INTEGRAL
	AMBIENT TEMP. RANGE	-40°F to +160°F (-40°C to +71°C)
	TIME DELAY	None
	OUTPUT RELAY	(1) DPDT Relay with Gold Flash Contacts
	RELAY RATING(Resistive)	8A@120/250 VAC, 8A@30 VDC, 0.5A@125 VDC
	ENCLOSURE MATERIAL	Aluminium (A356)
	ELECTRICAL ENTRY	(2) x 3/4" NPT(F)
	ENCLOSURE CLASS	FM or CSA (XP, NI, GP), NEMA 4X/7/9, IP66
PROBE INFORMATION	PROBE TYPE	TWIN TIP
	PROBE MATERIAL	316/316L SS
	PROCESS CONNECTION	3/4" NPT, 316/316L SS
	NORMAL RATING	1850 psig(127,6 barg)@100°F(38°C)
	RATING @ MAXIMUM TEMP.	1585 psig(109,3 barg)@250°F(121°C)
	INSERTION LENGTH*	4,00 (102)
	MAGNETROL MODEL NUMBER	TD1-2D00-030 with TEC-A110-004

Notes:

*Units are inches(millimeters) unless otherwise noted.

Magnetrol Flow Switch
TD1-2D00-030 w/ TEC-A110-004

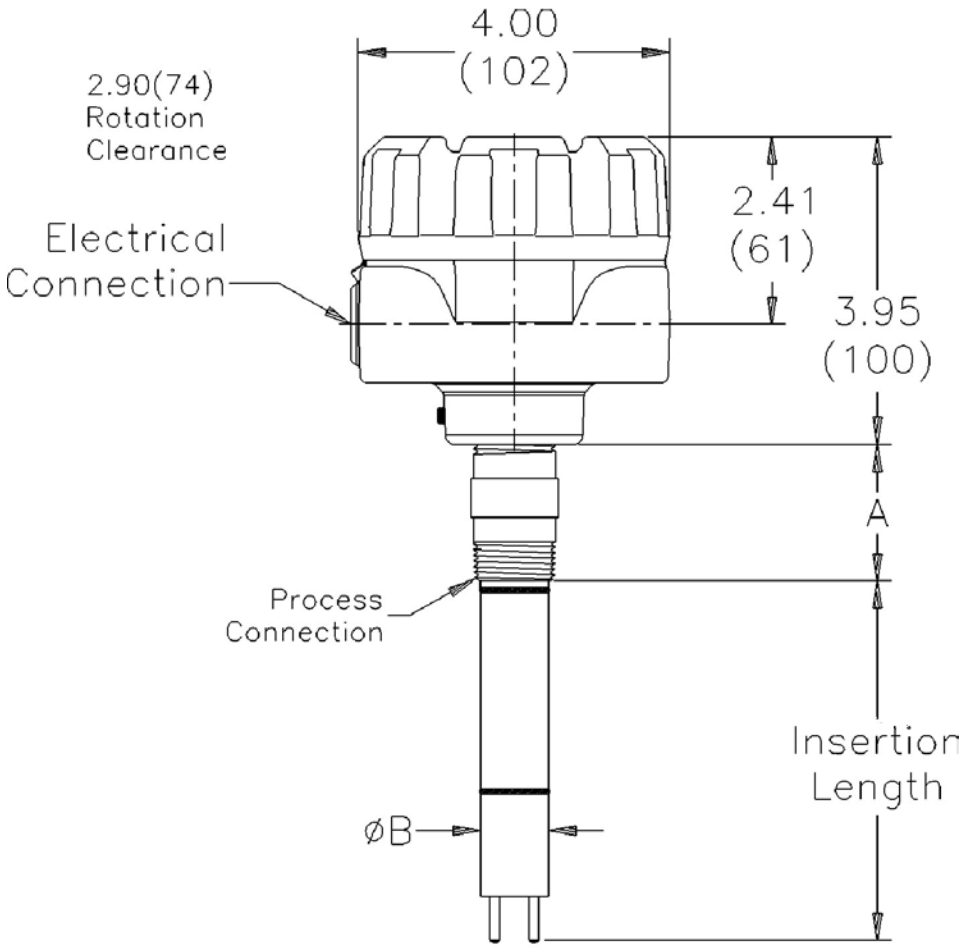
Dimensional Drawing

www.magnetrol.com - 705 Enterprise Street-Aurora, IL 60504 USA 630-969-4000 Fax 630-969-9489

MODEL # : TD1-2D00-030 with TEC-A110-004

ITEM NUMBER: 1 QUANTITY: 1

Revision	Date
0	2017-07-25



TAG NUMBERS:

ELECTRICAL CONNECTION

(2) x 3/4" NPT(F)

PROCESS CONNECTION

3/4" NPT

INSERTION LENGTH

4,00 (102)

SIGNIFICANT DIMENSIONS

A = 1,75(44)

B = 0,88(23)

CUSTOMER NAME: Les Entreprise Sifec Nord Inc.

CUSTOMER REFERENCE:

PROJECT NAME:

CERTIFIED BY: For quotation reference only

(Not for construction unless certified)

Date: 2017-07-26

Units are inches(millimeters) unless otherwise noted.

THERMATEL®
MODEL TD1/TD2

Installation and Operating Manual

Model TD1
with twin tip sensor

Model TD2
with spherical tip sensor

Thermal Dispersion

Flow/Level/Interface

Switch

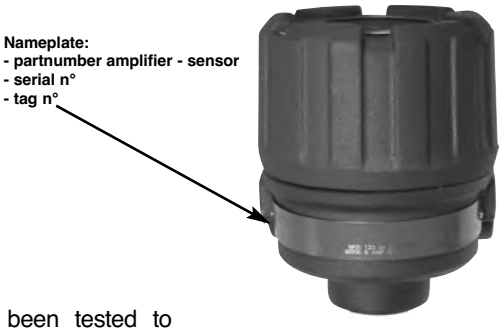
Model TD2
with hygienic
stainless steel enclosure &
spherical tip sensor

Model TD2
with low flow body sensor

Magnetrol®

UNPACKING

Unpack the instrument carefully. Make sure all components have been removed from the foam protection. Inspect all components for damage. Report any concealed damage to the carrier within 24 hours. Check the contents of the carton/crates against the packing slip and report any discrepancies to Magnetrol. Check the nameplate model number to be sure it agrees with the packing slip and purchase order. Check and record the serial number for future reference when ordering parts.

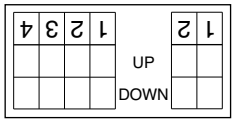


CE 0038 0344

These units are in compliance with:

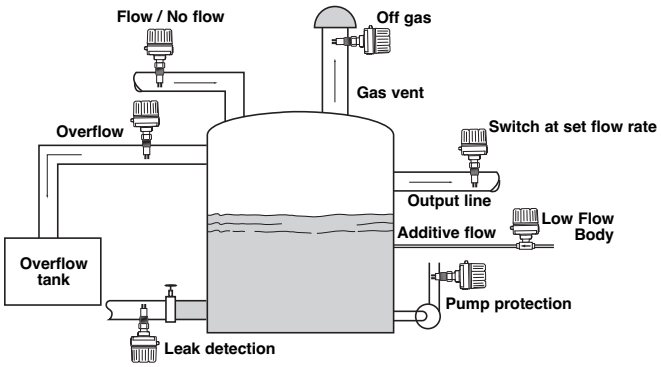
1. The EMC directive 2004/108/EC. The units have been tested to EN 61326: 1997 + A1 + A2.
2. Directive 94/9/EC for equipment or protective system intended for use in potentially explosive atmospheres. EC-type examination certificate number ISSeP13ATEX024X or ISSeP13ATEX025X. Standards applied EN60079-0:2012, EN60079-1:2007, EN60079-11:2012 and EN60079-26:2007.
3. The PED directive 97/23/EC (pressure equipment directive). Safety accessories per category IV module H1.

Set up Sticker



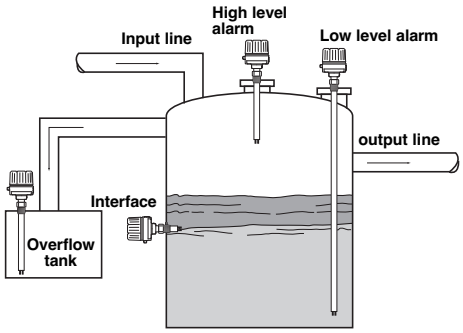
MOUNTING

FLOW

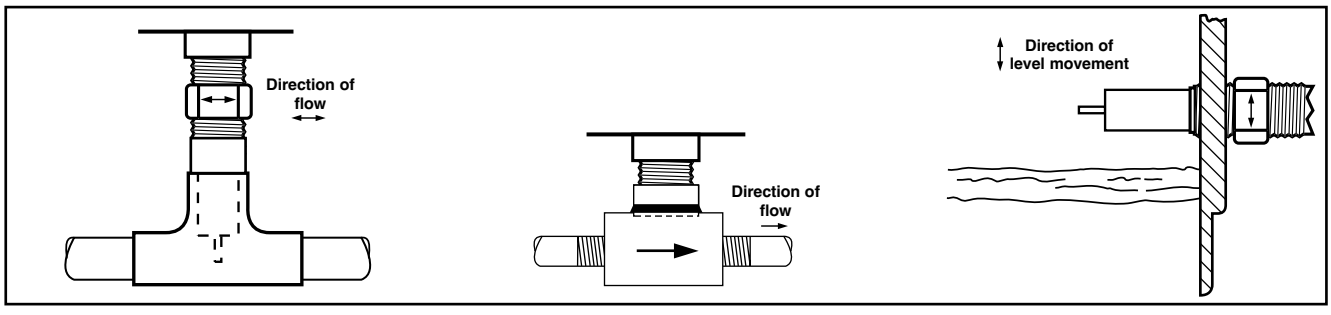


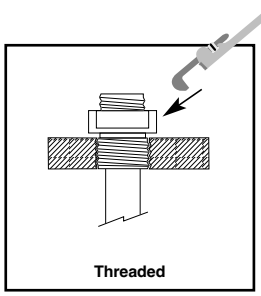
- Liquid or Gas flow detection
- Maintain a minimum flow rate
  - Pump protection
  - Cooling air/water
  - Lubrication systems
  - Chemical feed pumps
- Detect presence of flow
  - Relief valves / Flare lines
- Water for Injection (WFI)
- Filtration systems
- Separation systems
- CIP systems
- Air, CO_2, N_2 flow

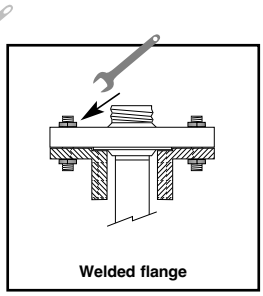
LEVEL

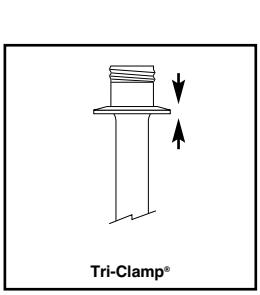


- High level or Low level
- Interface between different media
  - Oil/water
  - Liquid/foam
- Suitable for any liquid level detection including: High viscosity, High solids content, Aeration, Foam
- Insensitive to dielectric, specific grafity, viscosity




Threaded


Welded flange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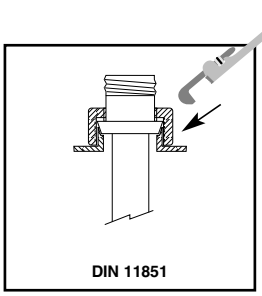
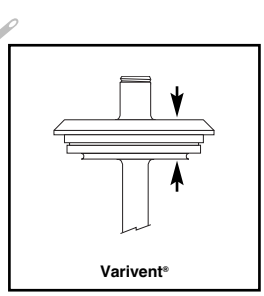
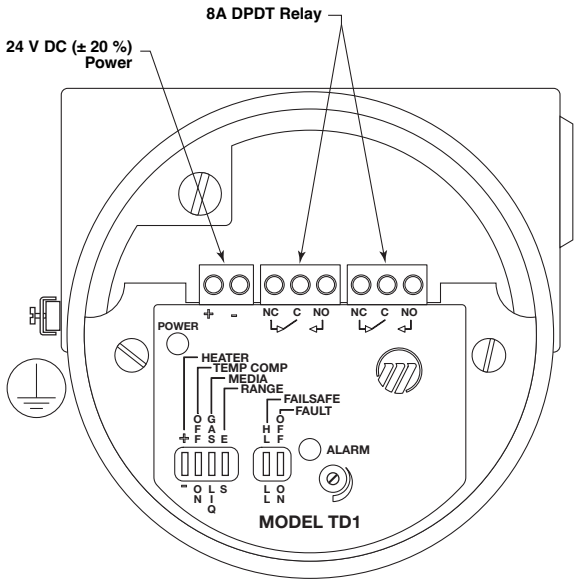
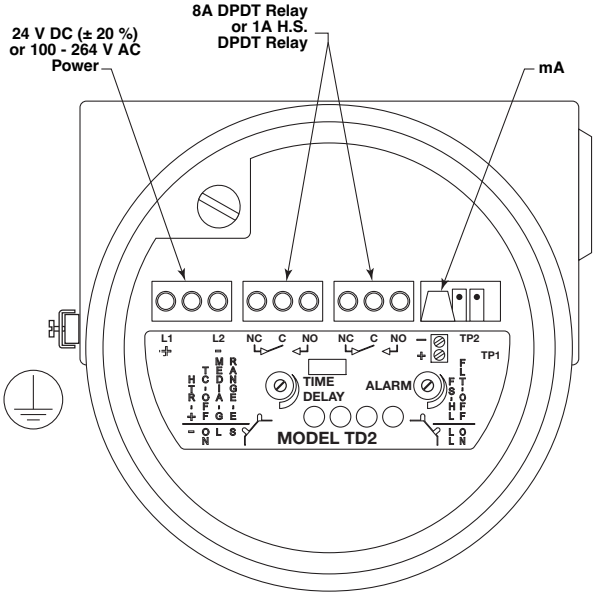

DIN 11851


Varivent®

WIRING

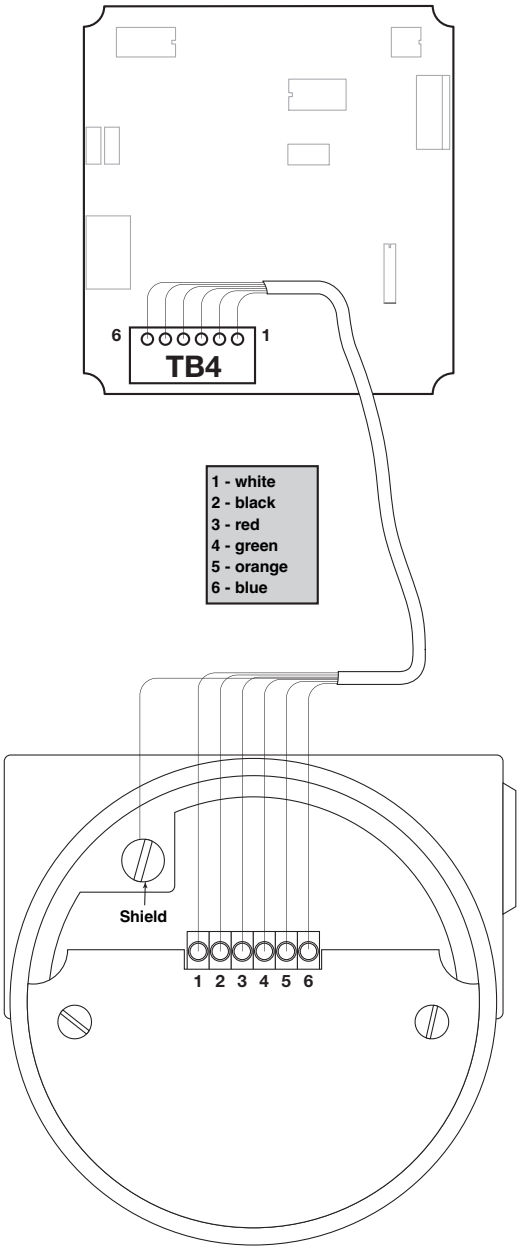


TD1 Wiring



Integral TD2 Wiring

Note: For ATEX II 1G / zone 0: mA signal can only be connected when a Thermatel sensor of 1 mm wall thickness is used.



Remote TD2 Wiring

RELAY CONNECTIONS

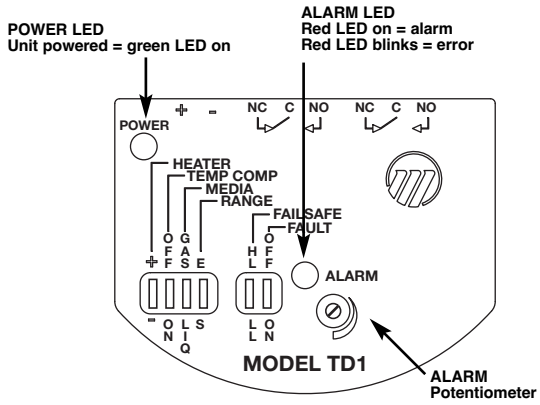
Power	*Level*	*Fail-safe position*	*Relay coil*	*Relay terminals*	
				NC to C	*NO to C*
On	High	HLFS	De-energized	Closed	Open
		LLFS	Energized	Open	Closed
	Low	HLFS	Energized	Open	Closed
		LLFS	De-energized	Closed	Open
Fail	High	HLFS	De-energized	Closed	Open
		LLFS	De-energized	Closed	Open
	Low	HLFS	De-energized	Closed	Open
		LLFS	De-energized	Closed	Open

CHART NOTES AND DEFINITIONS:

1. Equipment controlled by Thermatel® relays is assumed to be powered from one source, while the Thermatel® unit itself is assumed to be powered from a different source.
2. “Fail” means a loss of power to the Thermatel® unit.
3. HLFS (High Level Fail-safe) means a flow rate or level which is equal to or above the set point.
4. LLFS (Low Level Fail-safe) means a flow rate or level which is equal to or below the set point.
5. When the relay coil is de-energized, a connection is made between the terminals COM (common) and NC (normally closed), and there is no connection between COM and NO (normally open).
6. When the relay coil is energized, a connection is made between the terminals COM and NO, and there is no connection between COM and NC.

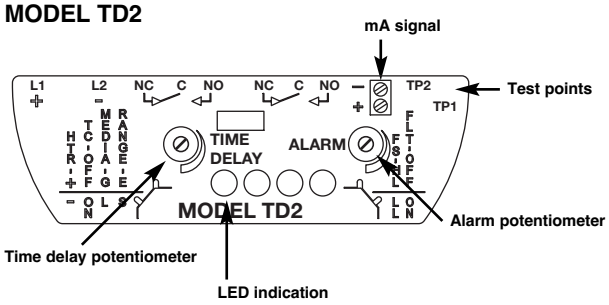
Indication and functions

MODEL TD1



Note: during initial power-on, red LED will blink slowly.

MODEL TD2



Note: during initial power-on, all LED's will turn on and individually OFF = unit ready.

ALARM (TD1/TD2)

FAIL-SAFE (TD1/TD2):

HLFS (High Level Fail-safe):
Relay is energized when flow < setpoint or sensor dry (or in the low conductive liquid).
Relay is de-energized when flow ≥ setpoint or sensor is immerged (or in the higher conductive liquid).

LLFS (Low Level Fail-safe):
Relay is energized when flow > setpoint or sensor is immerged (or in the higher thermal conductive liquid).
Relay is de-energized when flow ≤ setpoint or sensor dry (or in the lower thermal conductive liquid).

mA SIGNAL (TD2):

The mA is a non linear signal of the actual process conditions;
- for flow: mA output increases as the flow rate increases
- for level: mA output increases when in a wet condition.

The mA value depends upon sensor and application.

Error reporting is determined by setting of the Fail Safe mode;
- failsafe low ≤ 3,6 mA
- failsafe high ≥ 22 mA

TESTPOINTS (TD2):

Measure and record the voltage between TP1 and TP2. This voltage will change as the set point potentiometer is adjusted. Voltage readings will be between 0 and 5 VDC. This value may be used for future reference or adjustment of set point. This value can be recorded and checked in the future to ensure that the set point has not changed since last calibration.

TIME DELAY POTENTIOMETER (TD2):

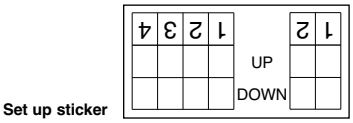
Before calibration, turn fully counterclockwise until click (max. 30 turns) = 0 s.

LED INDICATION (TD1/TD2):
(in accordance with fail-safe mode)

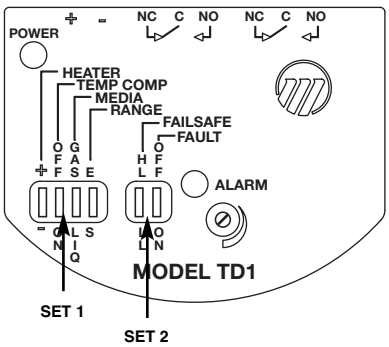
green	LED ON = safe (one or more of the 2 green LED's) (TD2)
yellow	LED ON = reaching switch point (TD2)
Red	LED ON = alarm (TD1/TD2)
	LED BLINKS = error (TD1/TD2).

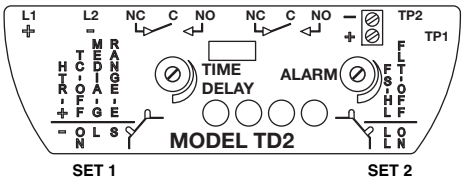
Switch setup

The TD1/TD2 switch settings are pre-set from factory. The factory default settings are marked on the sticker on the electronics. These positions may need to be changed, depending upon the application – consult the following table.



Set up sticker





SET 1

TD1/TD2	Purpose	Settings
HEATER / HTR (4)	Control heat to sensor	+ for flow applictions - for level applications
TEMP COMP / TC (3)	De-activate temperature compensation	OFF: use only in case recommended by factory ON: default setting
MEDIA (2)	Gas or Liquid	G: Gases L: Liquids, default setting for TMH/TML sensors
RANGE (1)	Increase sensitivity	E: for water flow applications S: default setting

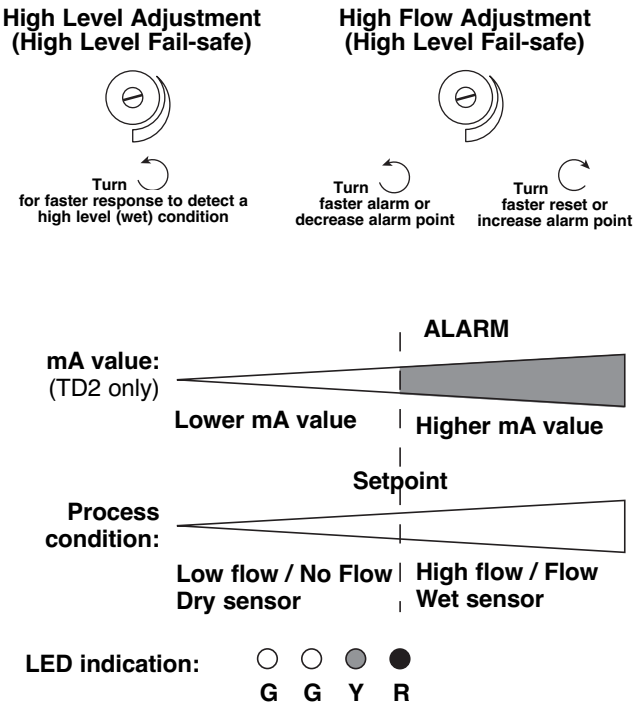
SET 2

TD1/TD2	Purpose	Settings
FAILSAFE / FS (2)	Failsafe setting	HL: High Level Fail-safe LL: Low Level Fail-safe
FAULT / FLT (1)	De-activate fault indication	OFF: use only in case recommended by factory ON: default setting

CALIBRATION

NOTE: Ensure that settings on page 3 have been verified before calibrating this unit.
Adjust level, interface or flow to the desired alarm condition of the actual liquid or gas. Units are preferably field calibrated under operating conditions or bench calibrated if the real conditions can be simulated. Consult factory when this cannot be established.

High flow / High level - Interface



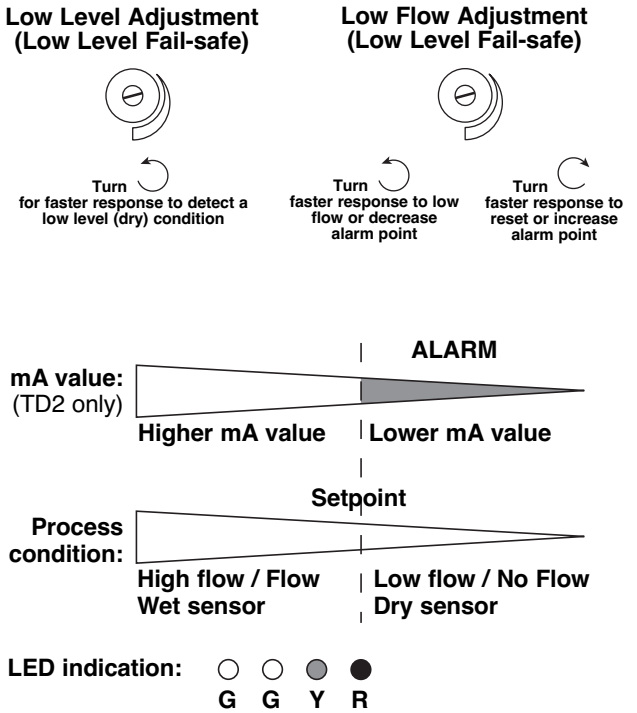
1. Set Time delay to minimum (turn max 30 turns counterclockwise or until a clicking sound is heard) - only TD2.
2. Set Failsafe switch in “High” mode.
3. Set Alarm potentiometer until red LED is ON. Allow some time for the switch to stabilize (check mA output - only TD2).

   Relay will be de-energized, if flow or level is higher than the actual set point or the unit sees the most thermal conductive media.
4. Reset Alarm potentiometer until Red LED is OFF and both green LED’s (only TD2) light UP (turn clockwise) – tweek the potentiometer slowly back and forth until the desired set point is reached = Red LED ON.
5. Only for level applications: turn alarm potentiometer counterclockwise one additional turn.

   Typical response time for level is within 3 - 5 s.

   Typical response time for flow is within 2 - 15 s, depending on the appliction.

Low flow / No flow / Low level - Interface



1. Set Time delay to minimum (turn max 30 turns counterclockwise or until a clicking sound is heard) - only TD2.
2. Set Failsafe switch in “Low” mode
3. Set Alarm potentiometer until: (turn counterclockwise) red LED is ON. Allow some time for the switch to stabilize (check mA output - only TD2).

   Relay will be de-energized, if flow or level is lower than the actual set point or the unit sees the least thermal conductive media.
4. Reset Alarm potentiometer until Red LED is OFF and both green LED’s (only TD2) light UP (turn clockwise) – tweek the potentiometer slowly back and forth until the desired set point is reached = Red LED ON.
5. Only for level applications: turn alarm potentiometer clockwise ½ additional turn.

   Typical response time for level is within 5 - 10 s.

   Typical response time for flow is within 2 - 15 s, depending on the appliction.

FAULT INDICATION

TD1/TD2 have continuous diagnostics to ensure that the signal from the sensor is within a select range. If the electronics detect an “out of range” signal, the switch has registered an instrument error.

TD1: Alarm LED blinks and the relay de-energizes.

TD2: 3,6 mA signal when unit is set for low level fail-safe.
22 mA signal when unit is set for high level fail-safe.
Alarm LED blinks and the relay de-energizes.

If a fault is detected, refer to section “TROUBLESHOOTING”.

TROUBLESHOOTING

The TD1/TD2 switches have various settings to handle a wide variety of flow and level applications. If the switch is not performing properly, check the switch settings on page 4 or the following:

Symptom	Problem	Solution / Action
Red LED does not go ON	Switch point cannot be established for air flow detection	Check whether probe is extended into the flow. Change Heater to “-”
Green LED OFF (TD1) All LED’s OFF (TD2)	No power	1. Check power supply 2. Check wiring at wiring terminals
Red LED blinks and ≤ 3,6 mA or ≥ 22 mA (TD2)	An instrument error has been registered	By changing the switch settings, the unit may return to normal operation mode. If not, consult factory.

Symptom	Application	Action*
Unable to adjust set point to obtain alarm Fault LED blinks	Air Flow Detection	Ensure that the probe is extended into the flow Change HEATER (Model TD1) / HTR (Model TD2) to “–”
Switch indicates a fault (red LED will blink)	Liquid Level – Sensor Wet	Verify HEATER (TD1) / HTR (TD2) is set to “–” Change HEATER/HTR to “+” Light goes off—contact factory to discuss application. Light stays on—check resistance to determine if a problem exists with the probe or electronics. Refer to Section “RESISTANCE VALUES”. Probe and/or electronics may need to be replaced.
	Liquid Level – Sensor Dry	Verify HEATER (TD1) / HTR (TD2) is set to “–” Turn off FAULT (TD1) / FLT (TD2) Light goes off—operate in this mode Light stays on—check resistance to determine if a problem exists with the probe or electronics. Refer to Section “RESISTANCE VALUES”. Probe and/or electronics may need to be replaced.
	Liquid Flow – Sensor Dry or No Air Flow	Turn off FAULT (TD1) / FLT (TD2) Light goes off—run HEATER/HTR at “+” and FAULT/FLT “off” or run HEATER/HTR at “-” Light stays on—check resistance to determine if a problem exists with the probe or electronics. Refer to Section “RESISTANCE VALUES”. Probe and/or electronics may need to be replaced.
	Liquid Flow – Sensor Wet No Flow	Switch HEATER/HTR to “-” Light goes off—run HEATER/HTR at “+” and FAULT/FLT “off” or run HEATER/HTR at “-” Light stays on—check resistance to determine if a problem exists with the probe or electronics. Refer to Section “RESISTANCE VALUES”. Probe and/or electronics may need to be replaced.

TROUBLESHOOTING

Symptom	Application	Action*
Switch indicates a fault (red LED will blink)	Liquid Flow – Flow Present	Turn off TEMP COMP (TD1) / TC (TD2) Light goes off—operate in this mode Light stays on—check resistance to determine if a problem exists with the probe or electronics. Refer to Section “RESISTANCE VALUES”. Probe and/or electronics may need to be replaced.
	Air Flow – Flow Present	Switch HEATER/HTR to “-” Light goes off—Operate at lower heater power (with less sensitivity). Turn TEMP COMP/TC off if problem continues (requires re-calibration) or operate at HEATER/HTR “+” and make sure FAULT/FLT switch is “off” Light stays on—Return HEATER/HTR switch to "+" and turn TEMP COMP/TC "off". If light goes off then recalibrate and operate in this mode. If light stays on check resistance to determine if a problem exists with the probe or electronics. Refer to Section “RESISTANCE VALUES”. Probe and/or electronics may need to be replaced.

* Changing HEATER/HTR, TEMP COMP/TC or media switch position requires recalibration.

RESISTANCE VALUES

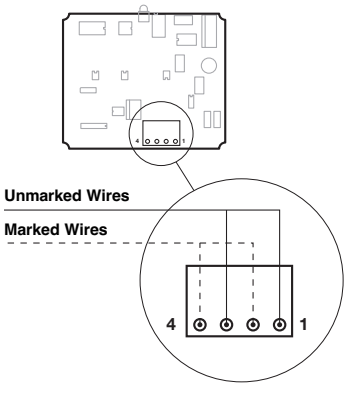
The following tables provide the expected resistance values for the sensor. Refer to the indicated figures for pin locations. Refer to section “REPLACEMENT PARTS / Probe replacement” for removing bezel and circuit boards.

TD1

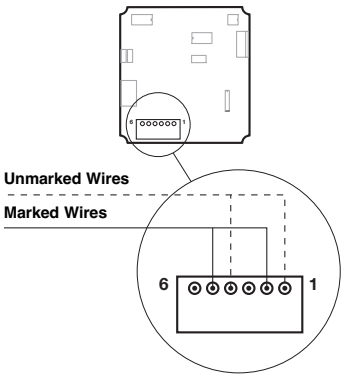
Pin	Expected Resistance
1 to 3	90 to 180 ohms (275 ohms with high temperature probe)
2 to 4	90 to 180 ohms (275 ohms with high temperature probe)

TD2 – Integral Electronics
TD2 – Remote Electronic Enclosure

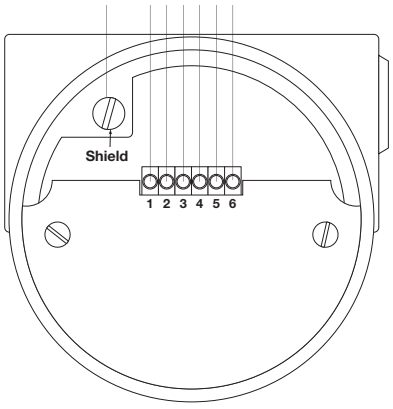
Pin	Expected Resistance
1 to 3 or 4	90 to 180 ohms (90 to 275 ohms with high temperature probe)
2 to 5 or 6	90 to 180 ohms (90 to 275 ohms with high temperature probe)
1 to 2, 3 to 4, 5 to 6	0 to 12 ohms



TD1 Probe Connections



TD2 Integral Probe Connections



TD2 Remote Probe Connections

MAINTENANCE

Cleaning

The probe may be cleaned by soaking, spraying solvents or detergent and water onto the sensor tubes, or by ultrasonic cleaning. Lime deposits may be safely removed by soaking in 20 % hydrochloric acid. Warming to +65 °C (+150 °F) is permissible to speed this process.

For unusual cleaning problems, contact the factory and determine the exact materials of construction and chemical compatibility before using strong acids or unusual cleansers.

REPLACEMENT PARTS

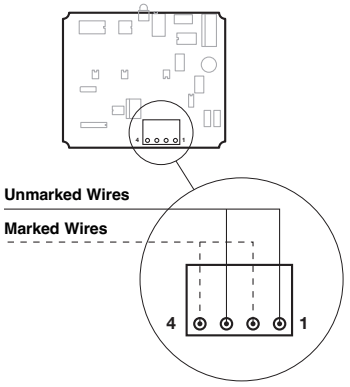
Note: The switch will require recalibration (see page 5) following probe or electronics replacement.

Probe replacement

INTEGRAL ELECTRONICS

Removal of probe

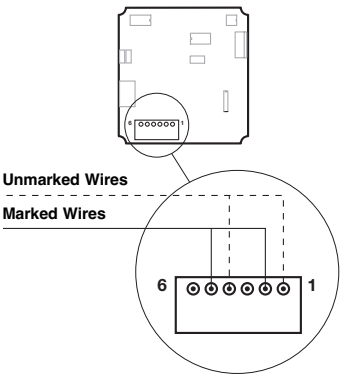
1. Make sure the power source is turned off.
2. Unscrew and remove housing cover.
3. Remove the bezel by:
   a. TD1 – removing the fastening screws.
   b. TD2 – put a screwdriver blade through hole in center and gently pull the handle away from the terminal strips.
4. Remove the fastening screws for the bracket. Remove bracket and attached circuit boards.
5. Loosen the screws on the terminal block to remove the four leads from the probe. Note that the TD1 uses a four position terminal block and the TD2 uses a six position terminal block.
6. Unscrew probe from enclosure.



TD1 Probe Connections

Installation of replacement probe

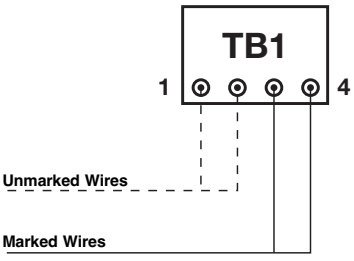
1. The probe's leads have been separated at the factory.
   One set of leads is marked with a "1," the second set is unmarked. Connect leads from RTD #1:
   TD1 – Connect between terminals 1 and 3.
   TD2 – Connect between terminals 2 and 5.
2. Connect the second set of leads:
   TD1 – Connect between terminals 2 and 4.
   TD2 – Connect between terminals 1 and 4.
3. Replace bezel and housing cover.
   TD1 – Replace bezel and refasten screws.
   TD2 – Reinstall bracket assembly. Ensure that the tab at the bottom of the bracket engages in the hole in the bottom of housing. Reinstall bracket mounting screws. Replace bezel by gently pressing down on the center of the bezel. Ensure that the outer edge of bezel is evenly seated in the housing.
4. Replace housing cover.
5. Apply power.
6. Recalibrate as described on page 5.



TD2 Integral Probe Connections

REMOTE ELECTRONICS (TD2 ONLY)

1. Make sure the power source is turned off.
2. Remove the cover from the sensor enclosure.
3. Loosen the screws on the four position terminal block (TB1) to remove the leads from the probe.
4. Unscrew probe from enclosure.
   a. The probe's leads have been separated at the factory. Connect leads from RTD #1, which are grouped and marked, to pins 3 & 4 (the two terminals on TB1 closest to the sensor label).
   b. Connect the other pair of leads, which are not marked, to pins 1 & 2 (the remaining two positions on TB1).
5. Replace housing cover.
6. Apply power.
7. Recalibrate as described on page 5.



TD2 Remote Probe Connections

REPLACEMENT PARTS

Replacement parts – Model TD1

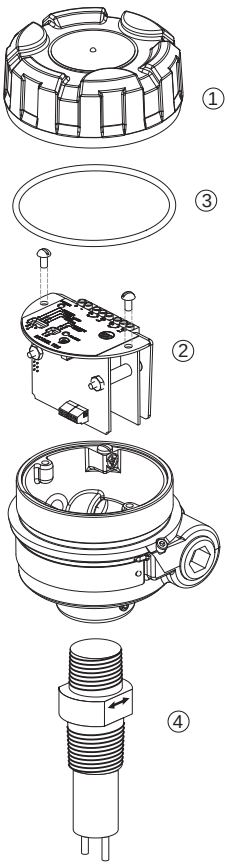
Partn°: T D 1 – – – – – – – –

Digit in partn°: X 1 2 3 – 4 5 6 7 – 8 9 10

X = product with a specific customer requirement

Serial n°: – – – – – – – – – – – –

See nameplate, always provide complete partn° and serial n° when ordering spares.



(1) Housing cover	
Digit 10	**Replacement part**
0 or 1	004-9193-003
2 or 3	004-9193-007

	Replacement part
(2) Electronic module	089-7250-001
(3) "O"-ring	012-2201-237
(4) Sensor	consult factory

REPLACEMENT PARTS

Replacement parts – Model TD2

Partn°: T D 2 – – – – – – –

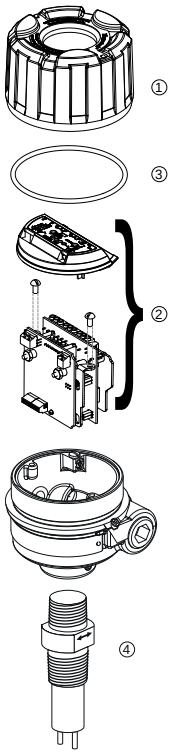
Digit in partn°: X 1 2 3 – 4 5 6 7 – 8 9 10

X = product with a specific customer requirement

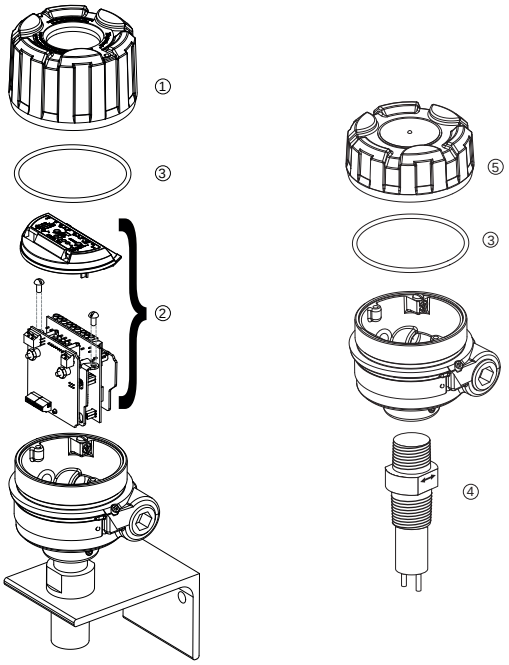
Serial n°: – – – – – – – – – – –

See nameplate, always provide complete partn° and serial n° when ordering spares.

INTEGRAL ELECTRONICS



REMOTE ELECTRONICS



(1) Housing cover		
Digit 7	**Digit 10**	**Replacement part**
0	0 or 1	004-9192-009
	2 or 3	004-9192-011
	4 or 5	036-5702-003
1	0 or 1	036-4410-010
	2 or 3	not applicable
	4 or 5	036-5702-002

(3) "O"-ring	
Digit 10	**Replacement part**
0, 1, 2 or 3	012-2201-237
4 or 5	012-2201-155

	Replacement part
(4) Sensor	consult factory

(5) Housing cover		
Digit 8	**Digit 10**	**Replacement part**
1	0 or 1	004-9193-003
	2 or 3	004-9193-007
	4 or 5	not applicable

(2) Electronic module					
Digit 4	**Digit 5**	**Digit 8**	**Digit 9**	**Digit 10**	**Replacement part**
7	D	0	3 or G	0, 1, 2 or 3	089-7250-002
			C		089-7250-010
			7	4 or 5	089-7253-001
		1	3 or G	0, 1, 2 or 3	089-7250-004
			C		089-7250-012
			7	4 or 5	not applicable
	H	0	3 or G	0, 1, 2 or 3	089-7250-006
			C		
			7	4 or 5	089-7253-003
		1	3 or G	0, 1, 2 or 3	089-7250-008
			C		
			7	4 or 5	not applicable
8	D	0	3 or G	0, 1, 2 or 3	089-7250-003
			C		089-7250-011
			7	4 or 5	089-7253-002
		1	3 or G	0, 1, 2 or 3	089-7250-005
			C		089-7250-013
			7	4 or 5	not applicable
	H	0	3 or G	0, 1, 2 or 3	089-7250-007
			C		
			7	4 or 5	089-7253-004
		1	3 or G	0, 1, 2 or 3	089-7250-009
			C		
			7	4 or 5	not applicable

MODEL IDENTIFICATION

A complete measuring system consists of:

1. THERMATEL® electronics
2. Connecting cable (only applicable for remote mount TD2 units)
3. THERMATEL® sensor
4. Optional: Order code for thread-on mounting flanges
5. Optional: Retractable probe assembly, consult factory for details
6. Optional: Factory calibration, consult factory

TD1

TD2

1. Code for Thermatel® TD1 electronics

T D 1 - 2 D 0 0 - 0	Integral mount electronics for 24 V DC power supply and with 1 DPDT 8 A DPDT output relay

APPROVAL

3	Weatherproof
C	ATEX/IEC flameproof enclosure with intrinsically safe probe circuitry

HOUSING / CABLE ENTRY

0	IP66, Cast aluminium, 3/4" NPT cable entry (2 entries - 1 plugged)
1	IP66, Cast aluminium, M20 x 1,5 cable entry (2 entries - 1 plugged)

	T	D	1	2	D	0	0	0		

complete code for Thermatel® TD1 electronics

X = product with a specific customer requirement

MODEL IDENTIFICATION

1. Code for Thermatel® TD2 electronics with housing for industrial use

T D 2	Electronics with continuous LED indication and mA output

POWER SUPPLY

7	240 V AC (100-264 V AC)
8	24 V DC (± 20 %)

OUTPUT

D 0	8 A DPDT relay
H 0	1 A Hermetically sealed DPDT relay

ACCESSORIES

0	Blind housing cover
1	Housing cover with glass window (for aluminium housings only)

MOUNTING CONFIGURATION

0	Integral electronics
1	Remote electronics

APPROVAL ①

3	Weatherproof
C	Zone 0 – for level applications ATEX/IEC flameproof enclosure with intrinsically safe probe circuitry - no mA output available - only available with 8 A DPDT relay option
G	Zone 1 – for level and flow applications ATEX/IEC flameproof enclosure

① Consult factory for zone 0 applications in combination with hermetically sealed relay.

HOUSING / CABLE ENTRY

0	IP66, Cast aluminium, 3/4" NPT cable entry (2 entries - 1 plugged)
1	IP66, Cast aluminium, M20 x 1,5 cable entry (2 entries - 1 plugged)
2	IP66, Cast stainless steel, 3/4" NPT cable entry (2 entries - 1 plugged)
3	IP66, Cast stainless steel, M20 x 1,5 cable entry (2 entries - 1 plugged)

[ ]	T	D	2			0		

complete code for Thermatel® TD2 electronics with housing for industrial use

X = product with a specific customer requirement

MODEL IDENTIFICATION

1. Code for Thermatel® electronics with housing for hygienic use

T D 2	Electronics with continuous LED indication and mA output

POWER SUPPLY

7	240 V AC (100-264 V AC)
8	24 V DC (± 20 %)

OUTPUT

D 0	8 A DPDT relay
H 0	1 A Hermetically sealed DPDT relay

ACCESSORIES

0	Blind housing cover
1	Housing cover with glass window

MOUNTING / HOUSING MATERIAL / APPROVAL
Integral mount electronics
304 SST – IP 67

0 7	Weatherproof

CABLE ENTRY

5	M20 x 1,5 (2 entries – 1 plugged)
4	1/2" NPT (1 entry)

[ ] T D 2 – [ ] [ ] 0 [ ] – 0 7 [ ] **complete code for Thermatel® electronics with housing for hygienic use**

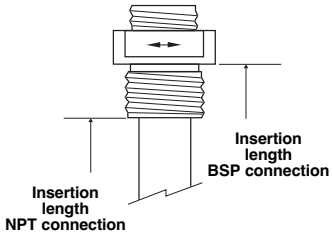
→ X = product with a specific customer requirement

2. Code for connecting cable used with weatherproof remote mount TD2 electronics (6-wire cable/shielded). Consult factory for cable suitable for flameproof enclosure.

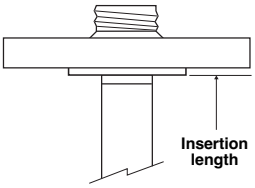
0 0 3 - 1 5 0	From 3 m (10 ft) min. to 150 m (500 ft) max. Specify in increments of 1 m (3.28 ft)

0 3 7 – 3 1 9 8 – [ ] [ ] [ ] **complete code for connecting cable**

CONNECTIONS

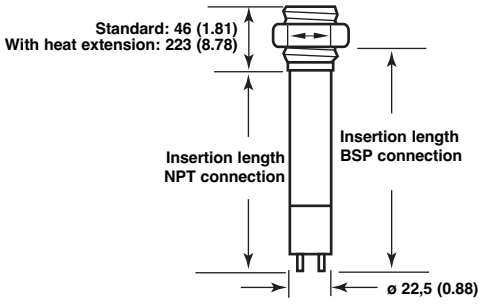


Threaded

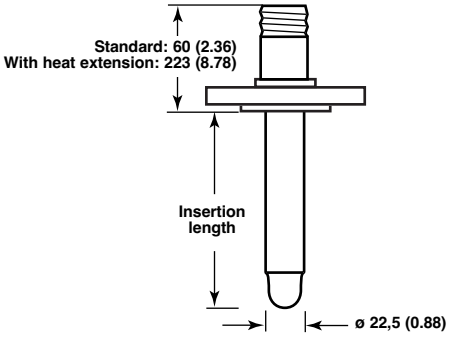


Welded flange ANSI - EN (DIN)

DIMENSIONS IN mm (inches) – TMA/TMB/TMC/TMD



Threaded Sensor

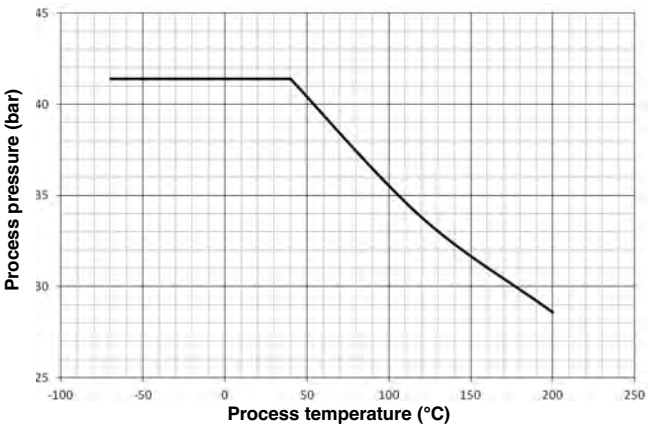


Flanged Sensor

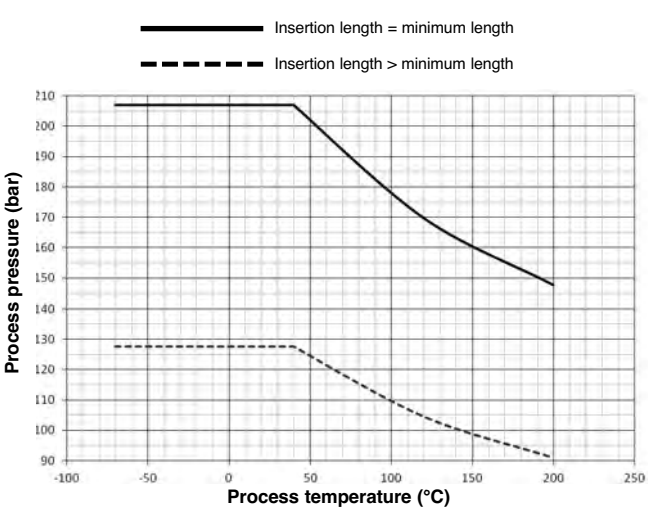
PRESSURE/TEMPERATURE RATING – TMA/TMB/TMC/TMD

Sensor	Material code	Insertion length	Maximum process pressure @ +40 °C (+100 °F)	@ +120 °C (+250 °F)	@ +200 °C (+400 °F)
TMA, TMB	A	All	41,4 bar (600 psi)	33,8 bar (490 psi)	28,6 bar (415 psi)
TMC, TMD	A, D	= minimum length	207 bar (3000 psi)	170 bar (2460 psi)	148 bar (2140 psi)
		> minimum length	128 bar (1850 psi)	105 bar (1517 psi)	91,0 bar (1320 psi)
TMC, TMD	B	= minimum length	207 bar (3000 psi)	181 bar (2627 psi)	161 bar (2340 psi)
		> minimum length	103 bar (1500 psi)	90,6 bar (1313 psi)	80,7 bar (1170 psi)
TMC, TMD	C	= minimum length	172 bar (2500 psi)	147 bar (2125 psi)	137 bar (1980 psi)
		> minimum length	82,8 bar (1200 psi)	70,3 bar (1020 psi)	65,5 bar (950 psi)

TMA/TMB sensors



TMC/TMD sensors with material code A or D



MODEL IDENTIFICATION

3. Code for Thermatel® TD1/TD2 – STANDARD SENSOR

T M A	Spherical tip	- standard	max +120 °C (+250 °F)①
T M B	Spherical tip	- with heat extension	max +200 °C (+400 °F)
T M C	Twin tip	- standard	max +120 °C (+250 °F)①
T M D	Twin tip	- with heat extension	max +200 °C (+400 °F)

① TMA/TMC sensors can handle process temperatures up to +200 °C (+400 °F) with remote electronics.

MATERIAL OF CONSTRUCTION FOR SENSOR AND PROCESS CONNECTION①

A	316/316L (1.4401/1.4404) stainless steel②	
B	Hastelloy® C (2.4819)	– TMC/TMD only
C	Monel® (2.4360)	– TMC/TMD only
D	316/316L (1.4401/1.4404) stainless steel	– TMC/TMD only

① Sensors with material code B or C are not available with retractable probe assembly.
② Not suitable for zone 0 applications in combination with hermetically sealed relay.

PROCESS CONNECTION – SIZE/TYPE

Threaded

1 1 0	3/4" NPT
2 1 0	1" NPT
2 2 0	1" BSP (G 1")

ANSI flanges

2 3 0	1"	150 lbs ANSI RF
2 4 0	1"	300 lbs ANSI RF
2 5 0	1"	600 lbs ANSI RF
3 3 0	1 1/2"	150 lbs ANSI RF
3 4 0	1 1/2"	300 lbs ANSI RF
3 5 0	1 1/2"	600 lbs ANSI RF
4 3 0	2"	150 lbs ANSI RF
4 4 0	2"	300 lbs ANSI RF
4 5 0	2"	600 lbs ANSI RF

EN (DIN) flanges

B B 0	DN 25	PN 16/25/40	EN 1092-1	Type A
B C 0	DN 25	PN 63/100	EN 1092-1	Type B2
C B 0	DN 40	PN 16/25/40	EN 1092-1	Type A
C C 0	DN 40	PN 63/100	EN 1092-1	Type B2
D A 0	DN 50	PN 16	EN 1092-1	Type A
D B 0	DN 50	PN 25/40	EN 1092-1	Type A
D D 0	DN 50	PN 63	EN 1092-1	Type B2
D E 0	DN 50	PN 100	EN 1092-1	Type B2

INSERTION LENGTH – Specify per cm (0.39") increment

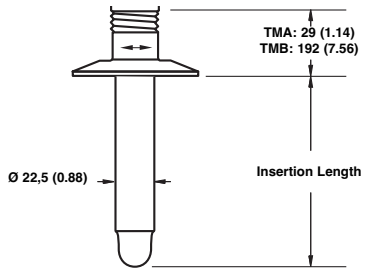
0 0 5	Minimum 5 cm (2")	– sensors with NPT/flanged connection
0 0 8	Minimum 8 cm (3.15")	– sensors with BSP connection
3 3 0	Maximum 330 cm (130")	

	T	M					0			

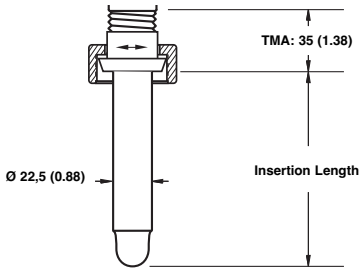
complete code for Thermatel® TD1/TD2 STANDARD SENSOR

→ X = product with a specific customer requirement

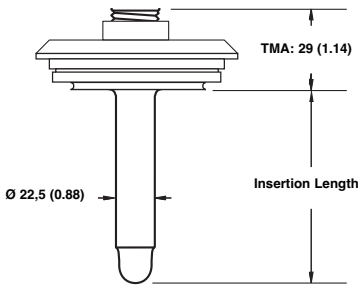
DIMENSIONS IN mm (inches) – HYGIENIC TMA/TMB



Tri-Clamp®



DIN 11851

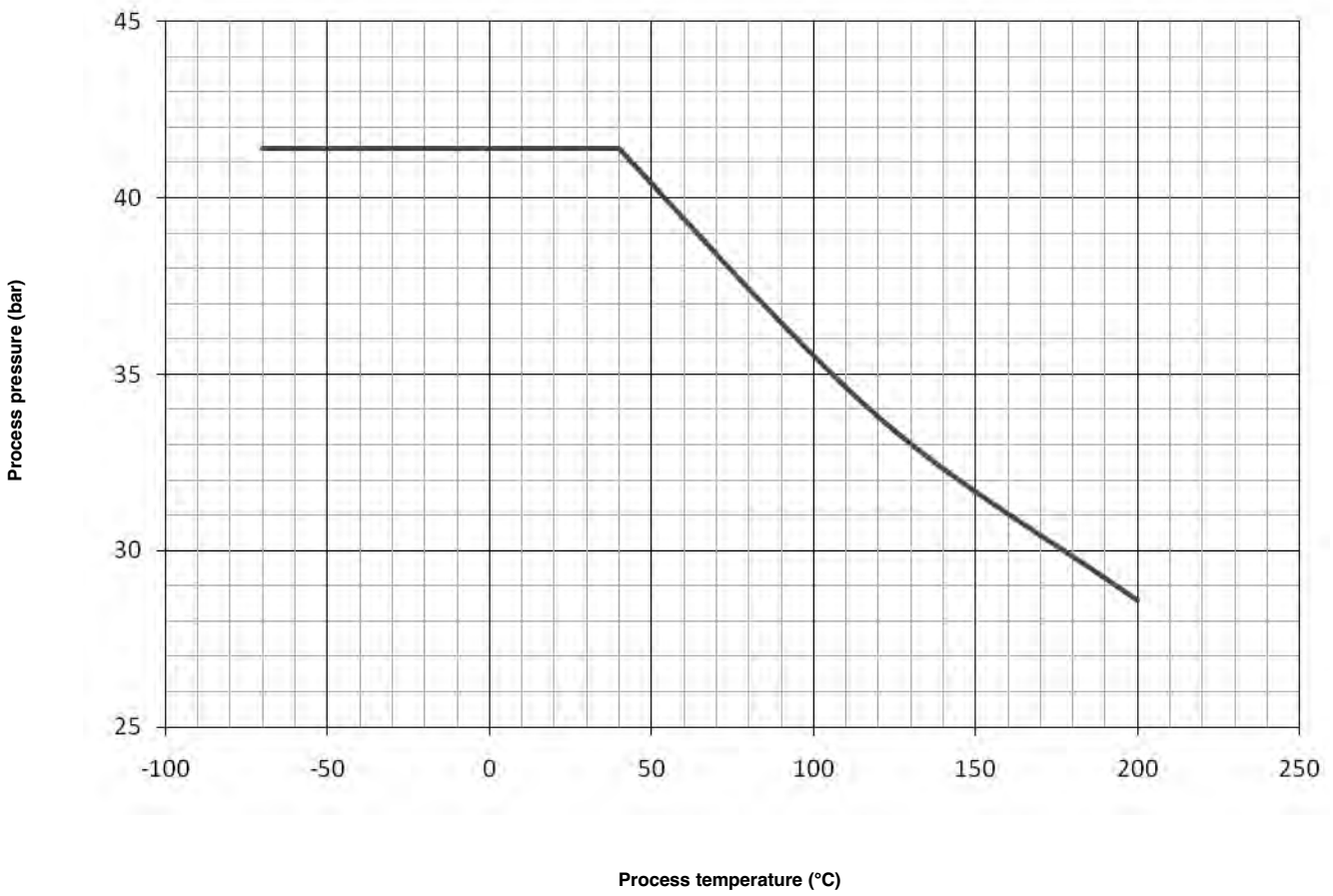


Varivent®

PRESSURE/TEMPERATURE RATING – HYGIENIC TMA/TMB

Note: max. process pressure is downrated to the design pressure of the selected process connection.

Maximum process pressure		
@ +40 °C (+100 °F)	@ +120 °C (+250 °F)	@ +200 °C (+400 °F)
41,4 bar (600 psi)	33,8 bar (490 psi)	28,6 bar (415 psi)



3. Code for Thermatel® TD2 – HYGIENIC SENSOR

T M A	Spherical tip - standard	max +120 °C (+250 °F)
T M B	Spherical tip - with heat extension	max +200 °C (+400 °F)

SENSOR MATERIAL (0,82 μm Ra (32 Ra) surface finish)

A	316/316L (1.4401/1.4404) stainless steel

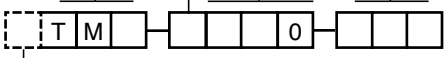
PROCESS CONNECTION – SIZE/TYPE ①

3 T 0	1 1/2" Tri-Clamp®
4 T 0	2" Tri-Clamp®
B S 0	DN 25 DIN 11851 - only available with TMA
C S 0	DN 40 DIN 11851 - only available with TMA
D S 0	DN 50 DIN 11851 - only available with TMA
V V 0	DN 65 Varivent® type N - only available with TMA

① Consult factory for other process connections (NEUMO BioControl®, G1A, ...)

INSERTION LENGTH – Specify per cm (0.39") increment

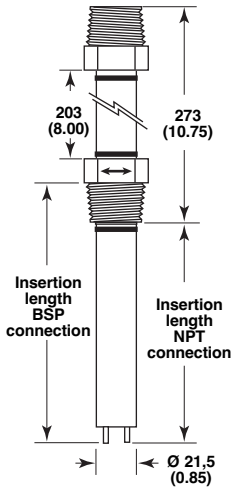
0 0 7	Minimum 7 cm (2.76")
3 3 0	Maximum 330 cm (130")

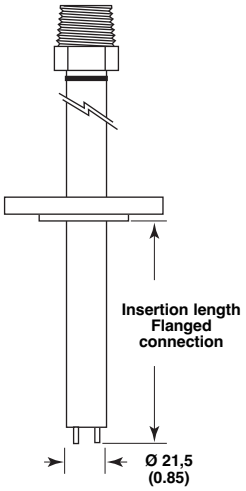


complete code for Thermatel® TD2 HYGIENIC SENSOR

X = product with a specific customer requirement

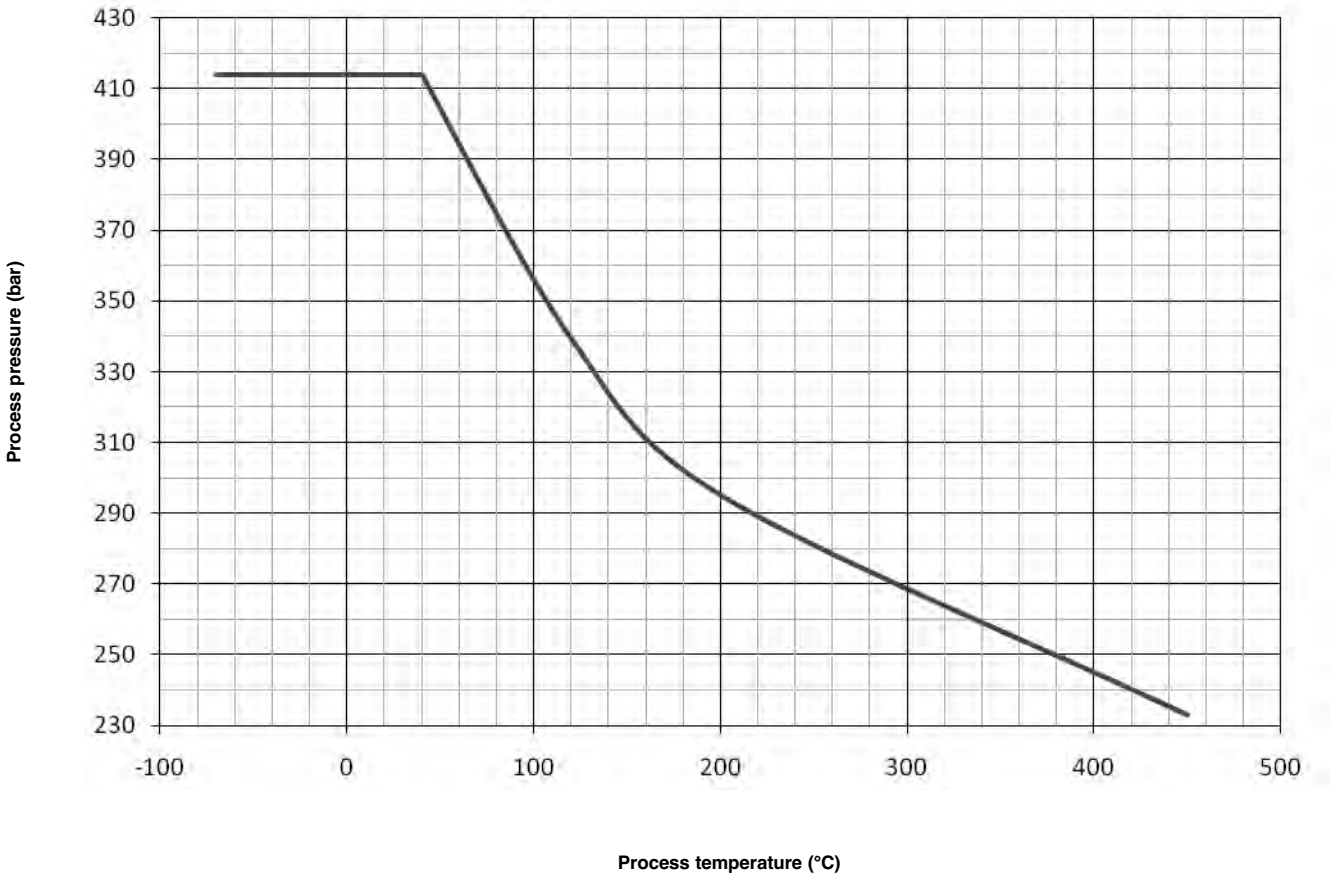
DIMENSIONS IN mm (inches) – TMH





PRESSURE/TEMPERATURE RATING – TMH

Maximum process pressure			
@ +40 °C (+100 °F)	@ +120 °C (+250 °F)	@ +200 °C (+400 °F)	@ +450 °C (+850 °F)
414 bar (6000 psi)	339 bar (4920 psi)	295 bar (4280 psi)	233 bar (3380 psi)



3. Code for Thermatel® TD1/TD2 – HIGH TEMPERATURE / HIGH PRESSURE SENSOR

T M H	High temperature / high pressure twin tip – max +450 °C (+850 °F) / max 414 bar (6000 psi)①

① Not available with retractable probe assembly.

MATERIAL OF CONSTRUCTION FOR SENSOR AND PROCESS CONNECTION

A	316/316L (1.4401/1.4404) stainless steel①
B	Hastelloy® C (2.4819)
D	316/316L (1.4401/1.4404) stainless steel

① Not suitable for zone 0 applications in combination with hermetically sealed relay.

PROCESS CONNECTION – SIZE/TYPE

Threaded

1 1 0	3/4" NPT
2 1 0	1" NPT
2 2 0	1" BSP (G 1")

ANSI flanges

2 3 0	1"	150 lbs	ANSI RF
2 4 0	1"	300 lbs	ANSI RF
2 5 0	1"	600 lbs	ANSI RF
2 7 0	1"	900/1500 lbs	ANSI RF
3 3 0	1 1/2"	150 lbs	ANSI RF
3 4 0	1 1/2"	300 lbs	ANSI RF
3 5 0	1 1/2"	600 lbs	ANSI RF
3 7 0	1 1/2"	900/1500 lbs	ANSI RF
3 8 0	1 1/2"	2500 lbs	ANSI RF
4 3 0	2"	150 lbs	ANSI RF
4 4 0	2"	300 lbs	ANSI RF
4 5 0	2"	600 lbs	ANSI RF
4 7 0	2"	900/1500 lbs	ANSI RF
4 8 0	2"	2500 lbs	ANSI RF

EN (DIN) flanges

B B 0	DN 25	PN 16/25/40	EN 1092-1 Type A
B C 0	DN 25	PN 63/100	EN 1092-1 Type B2
B G 0	DN 25	PN 250	EN 1092-1 Type B2
C B 0	DN 40	PN 16/25/40	EN 1092-1 Type A
C C 0	DN 40	PN 63/100	EN 1092-1 Type B2
C G 0	DN 40	PN 250	EN 1092-1 Type B2
C J 0	DN 40	PN 400	EN 1092-1 Type B2
D A 0	DN 50	PN 16	EN 1092-1 Type A
D B 0	DN 50	PN 25/40	EN 1092-1 Type A
D D 0	DN 50	PN 63	EN 1092-1 Type B2
D E 0	DN 50	PN 100	EN 1092-1 Type B2
D G 0	DN 50	PN 250	EN 1092-1 Type B2
D J 0	DN 50	PN 400	EN 1092-1 Type B2

INSERTION LENGTH – Specify per cm (0.39") increment

0 0 5	Minimum 5 cm (2")	– sensors with NPT/flanged connection
0 0 8	Minimum 8 cm (3.15")	– sensors with BSP connection
0 9 1	Maximum 91 cm (36")	

complete code for Thermatel® TD1/TD2 HIGH TEMPERATURE /HIGH PRESSURE SENSOR

X = product with a specific customer requirement

MODEL IDENTIFICATION

3. Code for Thermatel® TD1/TD2 – MINI SENSOR

T M M	Mini twin tip – max +120 °C (+250 °F)①

① TMM sensors can handle process temperatures up to +200 °C (+400 °F) with remote electronics.

MATERIAL OF CONSTRUCTION FOR SENSOR AND PROCESS CONNECTION

A	316/316L (1.4401/1.4404) stainless steel①

① Not suitable for zone 0 applications in combination with hermetically sealed relay.

PROCESS CONNECTION – SIZE/TYPE
Threaded

0 1 0	1/2" NPT
1 1 0	3/4" NPT
2 1 0	1" NPT

INSERTION LENGTH – **STANDARD**

0 0 3	2,5 cm (1")

INSERTION LENGTH – **SELECTABLE** – Specify per cm (0.39") increment

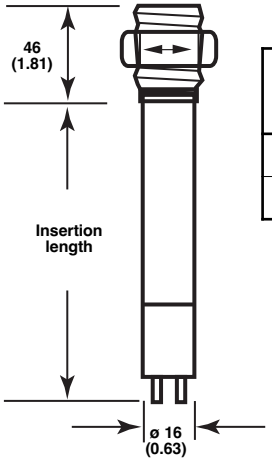
0 0 5	Minimum 5 cm (2")
3 3 0	Maximum 330 cm (130")

	T	M	M	A		1	0		

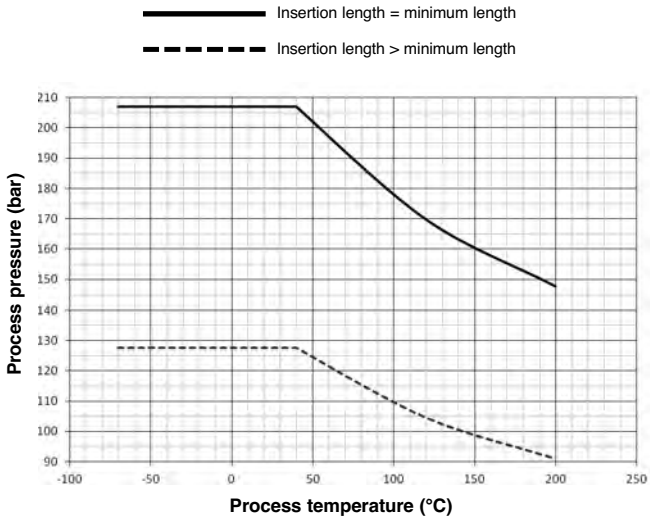
complete code for Thermatel® TD1/TD2 MINI SENSOR

X = product with a specific customer requirement

DIMENSIONS IN mm (inches) & PRESSURE/TEMPERATURE RATING – TMM



Insertion length	Maximum process pressure		
	@ +40 °C (+100 °F)	@ +120 °C (+250 °F)	@ +200 °C (+400 °F)
= 2,5 cm (1")	207 bar (3000 psi)	170 bar (2460 psi)	148 bar (2140 psi)
> 2,5 cm (1")	128 bar (1850 psi)	105 bar (1517 psi)	91,0 bar (1320 psi)



RECOMMENDED FLOW RANGES – TMM

Size	Water	Air
1/2" "T"	0,75 to 680 l/h (0.2 to 180 GPH)	0,85 to 120 Nm³/h (0.5 to 70 SCFM)
3/4" "T"	2 to 900 l/h (0.5 to 240 GPH)	2,5 to 170 Nm³/h (1.5 to 100 SCFM)
1" "T"	3,8 to 1600 l/h (1 to 420 GPH)	5 to 290 Nm³/h (3 to 170 SCFM)

MODEL IDENTIFICATION

3. Code for Thermatel® TD1/TD2 – LOW FLOW BODY SENSOR

T M L	Low flow body – max +120 °C (+250 °F)① / max 400 bar (5800 psi)

① TML sensors can handle process temperatures up to +200 °C (+400 °F) with remote electronics.

MATERIAL OF CONSTRUCTION FOR SENSOR AND PROCESS CONNECTION

A	316/316L (1.4401/1.4404) stainless steel ①

① Not suitable for zone 0 applications in combination with hermetically sealed relay.

PROCESS CONNECTION – SIZE/TYPE
Threaded

T 1 0	1/4" NPT-F
V 1 0	1/2" NPT-F
T 0 0	1/4" BSP (G 1/4")
V 0 0	1/2" BSP (G 1/2")

MOUNTING BRACKET

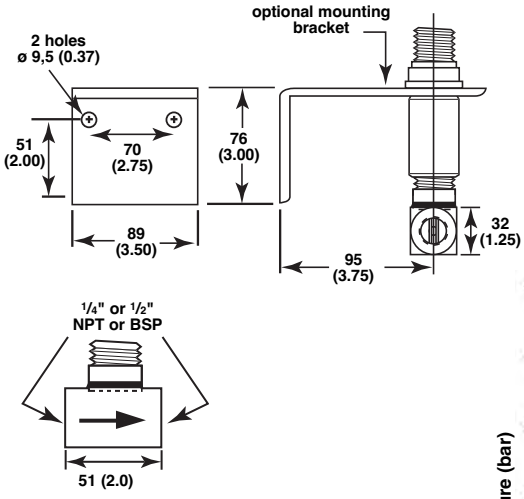
0 0 0	None
1 0 0	With carbon steel mounting bracket

	T	M	L	A			0		0	0

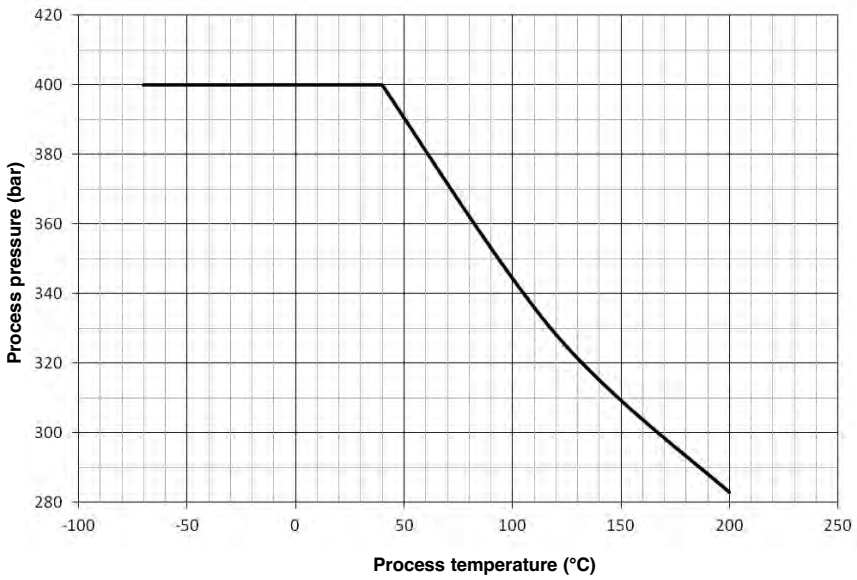
complete code for Thermatel® TD1/TD2 LOW FLOW BODY SENSOR

X = product with a specific customer requirement

DIMENSIONS IN mm (inches) & PRESSURE/TEMPERATURE RATING – TML



Maximum process pressure		
@ +40 °C (+100 °F)	@ +120 °C (+250 °F)	@ +200 °C (+400 °F)
400 bar (5800 psi)	328 bar (4760 psi)	283 bar (4100 psi)



RECOMMENDED FLOW RANGES – TML

Size	Water	Air
1/4" flow body	0,02 to 5,7 l/h (0.0055 to 1.5 GPH)	0,006 to 5,75 Nm³/h (0.21 to 200 SCFH)
1/2" flow body	0,04 to 11,5 l/h (0.01 to 3 GPH)	0,015 to 11,5 Nm³/h (0.53 to 400 SCFH)

MODEL IDENTIFICATION

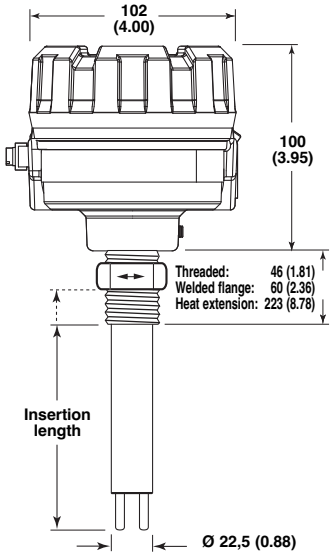
4. Optional sensor mounting flanges

Thread-on mounting flanges can only be used in combination with 3/4" NPT process connection sensor. Consult factory for other sizes or materials.

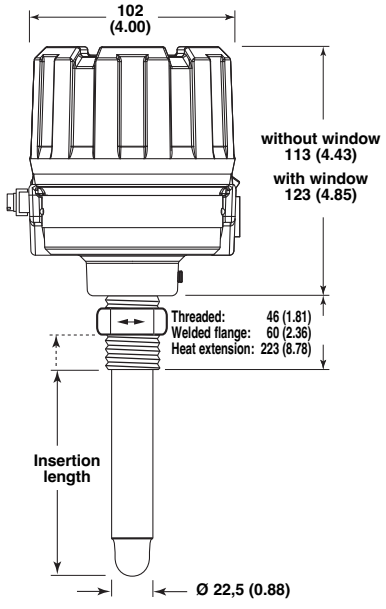
Thread-on flanges for use with 3/4" NPT-M connections

ANSI B16.5 flanges		Part No.		
		Carbon steel	316/316L SST	Hastelloy C
1"	150 lbs RF	004-5867-041	004-5867-043	004-5867-052
1 1/2"	150 lbs RF	004-5867-021	004-5867-001	004-5867-031
2"	150 lbs RF	004-5867-022	004-5867-002	004-5867-032
3"	150 lbs RF	004-5867-023	004-5867-003	004-5867-033
4"	150 lbs RF	004-5867-024	004-5867-004	004-5867-034
6"	150 lbs RF	004-5867-025	004-5867-005	004-5867-035
1"	300 lbs RF	004-5867-042	004-5867-044	004-5867-053
1 1/2"	300 lbs RF	004-5867-026	004-5867-006	004-5867-036
2"	300 lbs RF	004-5867-027	004-5867-007	004-5867-037
3"	300 lbs RF	004-5867-028	004-5867-008	004-5867-038
4"	300 lbs RF	004-5867-029	004-5867-009	004-5867-039
6"	300 lbs RF	004-5867-030	004-5867-010	004-5867-040
1"	600 lbs RF	004-5867-051	004-5867-050	consult factory
1 1/2"	600 lbs RF	004-5867-046	004-5867-045	consult factory
2"	600 lbs RF	004-5867-049	004-5867-048	consult factory

DIMENSIONS IN mm (inches) – WITH HOUSING FOR INDUSTRIAL USE

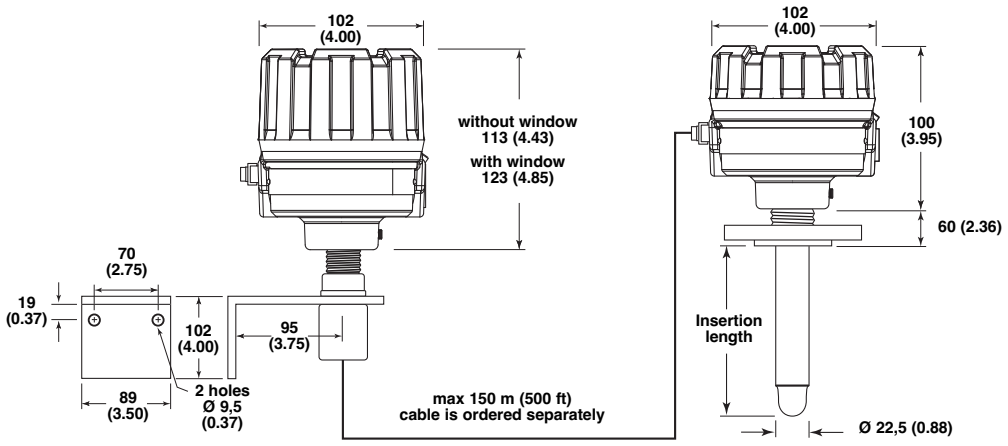


Model TD1 with TMC/TMD twin tip sensor



Model TD2 with integral electronics and TMA/TMB spherical tip sensor

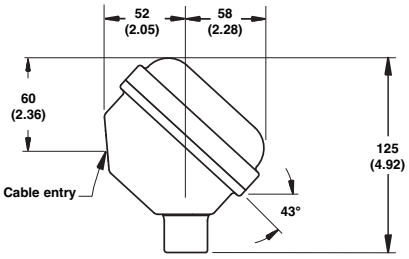
DIMENSIONS IN mm (inches) – WITH HOUSING FOR INDUSTRIAL USE

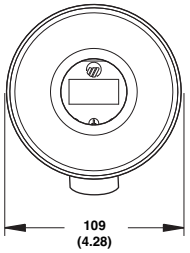


Model TD2 with remote electronics

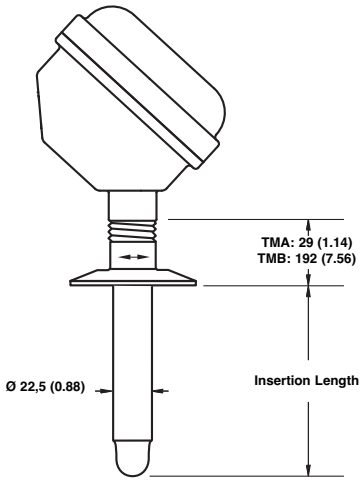
Remote TMA spherical tip sensor with flanged connection

DIMENSIONS IN mm (inches) – WITH HOUSING FOR HYGIENIC USE

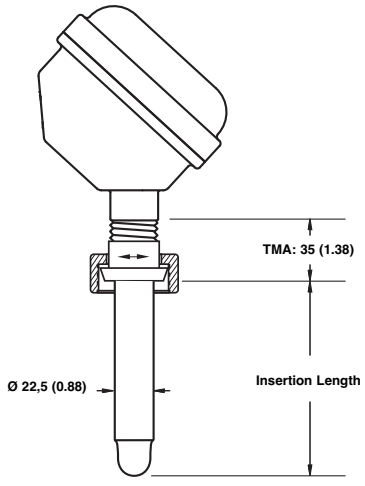




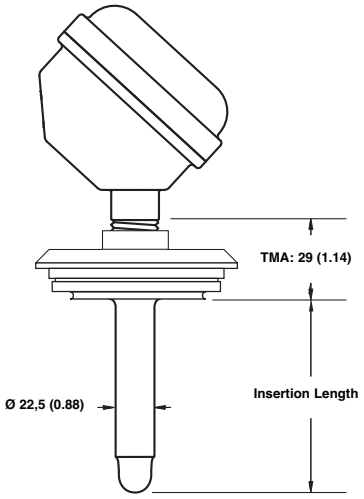
43° View



Tri-Clamp®



DIN 11851



Varivent®

SPECIFICATIONS

Electronics specifications – with housing for industrial use

Description		*TD1*	*TD2*
Power supply		19,2 to 28,8 V DC	19,2 to 28,8 V DC 100 to 264 V AC, 50-60 Hz
Power consumption		3,5 W @ 24 V DC	4 W @ 24 V DC or 5 W @ 264 V AC
Flow range		TMA-A, TMB-A, TMC-A, TMD-A, TMM:	0,003 to 1,5 m/s (0.01 to 5.0 FPS) – water 0,03 to 150 m/s (0.1 to 500 FPS) – air
		TMM installed in a"T"-piece:	see table on page 20
		TMC-B, TMC-C, TMC-D, TMD-B, TMD-C,TMD-D, TMH:	0,003 to 0,3 m/s (0.01 to 1.0 FPS) – water 0,03 to 150 m/s (0.1 to 500 FPS) – air
		TML:	see table on page 21
Output	Alarm	DPDT relay: 8 A @ 120 V AC / 250 V AC 8 A @ 30 V DC; 0,5 A @ 125 V DC	
		Hermetically sealed relay not available	Hermetically sealed DPDT relay: 1A @ 28 V DC; 0,5 A @ 125 V DC
	Continuous	Not applicable	non linear mA for trending (not for all models - see electronics part number on page 12)
	Error	Via alarm relay	3,6 mA (Low Level Fail-safe) – 22 mA (High Level Fail-safe) and alarm relay
Time delay		Not available	0 to 100 s adjustable (in addition to sensor response time)
User interface		- Local switches for gain setting, function setting and High/Low Level Fail-safe - Calibration and time delay via potentiometer	
Display		LED's for Power/Alarm status	2 green LED's (safe condition), 1 yellow LED (alarm setpoint being approached) 1 red LED (alarm condition)
Approvals		ATEX II 2 G Ex d IIC T5..T4 Gb, flameproof enclosure - TD2 for zone 1 ATEX II 1/2 G Ex d+ib, d [ib] IIC T5..T4 Ga/Gb, flameproof enclosure - TD1 & TD2 (TD2 only with 8A DPDT relay) IEC Ex d + ib, d [ib] IIC T5/T4 Gb/Ga - TD1 & TD2 IEC Ex d IIC T5/T4 Gb - TD2 only Other approvals are available, consult factory for more details	
SIL (Safety Integrity Level)		Functional safety to SIL1 as 1oo1 / SIL2 as 1oo2 in accordance to IEC 61508 – SFF of 69,3 % (TD1) and 73 % (TD2) – full FMEDA reports and declaration sheets available	
Housing material		IP66/Aluminium A356T6 (<0.20 % copper) or stainless steel	
Net weight		Aluminium: 1,1 kg (2.4 lbs) - integral electronics only Stainless steel: 2,6 kg (5.7 lbs) - integral electronics only	

Electronics specifications – with housing for hygienic use

Description		*Specification*
Power supply		19,2 to 28,8 V DC 100 to 264 V AC, 50-60 Hz
Power consumption		4 W @ 24 V DC or 5 W @ 264 V AC
Flow range		0,003 to 1,5 m/s (0.01 to 5.0 FPS) – water 0,03 to 150 m/s (0.1 to 500 FPS) – air
Output	Alarm	8 A DPDT relay @ 30 V DC / 250 V AC 1 A hermetically sealed DPDT relay @ 28 V DC
	Continuous	non-linear mA for trending
	Error	3,6 mA (Low Level Fail-safe) – 22 mA (High Level Fail-safe) and alarm relay
Time delay		0 to 100 s adjustable (in addition to sensor response time)
User interface		- Local switches for gain setting, function setting and High/Low Level Fail-safe - Calibration and time delay via potentiometer
Display		2 green LED's (safe condition) 1 yellow LED (alarm setpoint being approached) 1 red LED (alarm condition)
Approvals		EHEDG (per TNO) and 3A certification
SIL (Safety Integrity Level)		Functional safety to SIL1 as 1oo1 in accordance to IEC 61508 – SFF of 73 % Full FMEDA reports and declaration sheets available at request
Housing material		304 stainless steel, IP 67
Net weight		1,1 kg (2.4 lbs) - electronics only

SPECIFICATIONS

Performance

Description	*Specification*
Response time	1-10 s typical (dependent on sensor type, application and set point)
Repeatability	< 1 % @ constant temperature
Ambient temperature	ATEX/IEC Ex d - T4 & non Ex: -40 °C to +70 °C (-40 °F to +160 °F) ATEX/IEC Ex d - T5: -40 °C to +40 °C (-40 °F to +104 °F) Storage: -50 °C to +75 °C (-58 °F to +170 °F)
Humidity	0-99 %, non-condensing
Electromagnetic compatibility	Meets CE requirements (EN 61326: 1997 + A1 + A2)

Sensor specifications

Description	*Spherical tip - Twin tip sensors INDUSTRIAL TMA/TMB - TMC/TMD*	*HTHP sensor TMH*
Materials	316/316L (1.4401/1.4404) Hastelloy® C (2.4819) – TMC/TMD only Monel® (2.4360) – TMC/TMD only	316/316L (1.4401/1.4404) Hastelloy® C (2.4819)
Sensor diameter	22,5 mm (0.88")	21,5 mm (0.85")
Process connection	Threaded: NPT or BSP Flanged: various ANSI or EN (DIN) flanges	
Sensor length	5 - 330 cm (2" - 130")	5 - 91 cm (2" - 36")
Process temperature	TMA/TMC①: -70 °C to +120 °C (-100 °F to +250 °F) TMB/TMD: -70 °C to +200 °C (-100 °F to +400 °F)	-70 °C to +450 °C (-100 °F to +850 °F)
Max process pressure	See info on page 14	See info on page 18

① Use remote electronics (TD2) for temperatures > +120 °C (+250 °F) up to max +200 °C (+400 °F) or sensors with heat extension (TMB/TMD) when using integral electronics.

Description	*Mini twin tip sensor TMM*	*Low flow body TML*
Materials	316/316L (1.4401/1.4404)	
Sensor diameter	16 mm (0.63")	1/4" or 1/2" pipe size
Process connection	Threaded: 1/2", 3/4" or 1" NPT	Threaded: 1/4" or 1/2" NPT-F or BSP
Sensor length	2,5 - 330 cm (1" - 130")	Not applicable
Process temperature	-70 °C to +120 °C (-100 °F to +250 °F)①	
Max process pressure	See info on page 20	See info on page 21

① Use remote electronics (TD2) for temperatures > +120 °C (+250 °F) up to max +200 °C (+400 °F).

Description	*Spherical tip sensors HYGIENIC TMA/TMB*
Materials	316/316L (1.4401/1.4404)
Surface finish	0,82 µm Ra (32 Ra)
Sensor diameter	22,5 mm (0.88")
Process connection	Tri-Clamp®, DIN 11851, Varivent®
Sensor length	7 - 330 cm (2.76" - 130")
Process temperature	TMA: -70 °C to +120 °C (-100 °F to +250 °F) TMB: -70 °C to +200 °C (-100 °F to +400 °F)
Max process pressure	See info on page 16

IMPORTANT

SERVICE POLICY

Owners of Magnetrol products may request the return of a control; or, any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Magnetrol International will repair or replace the control, at no cost to the purchaser, (or owner) ***other than transportation cost*** if:

a. Returned within the warranty period; and,
b. The factory inspection finds the cause of the malfunction to be defective material or workmanship.

If the trouble is the result of conditions beyond our control; or, is **NOT** covered by the warranty, there will be charges for labour and the parts required to rebuild or replace the equipment.
In some cases, it may be expedient to ship replacement parts; or, in extreme cases a complete new control, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the control to be replaced. In such cases, credit for the materials returned, will be determined on the basis of the applicability of our warranty.
No claims for misapplication, labour, direct or consequential damage will be allowed.

RETURNED MATERIAL PROCEDURE

So that we may efficiently process any materials that are returned, it is essential that a “Return Material Authorisation” (RMA) form will be obtained from the factory. It is mandatory that this form will be attached to each material returned. This form is available through Magnetrol’s local representative or by contacting the factory. Please supply the following information:

1. Purchaser Name
2. Description of Material
3. Serial Number and Ref Number
4. Desired Action
5. Reason for Return
6. Process details

Any unit that was used in a process must be properly cleaned in accordance with the proper health and safety standards applicable by the owner, before it is returned to the factory.
A material Safety Data Sheet (MSDS) must be attached at the outside of the transport crate or box.
All shipments returned to the factory must be by prepaid transportation. Magnetrol ***will not accept*** collect shipments.
All replacements will be shipped Ex Works.

BULLETIN N°: BE 54-610.6
EFFECTIVE: OCTOBER 2013
SUPERSEDES: June 2012

UNDER RESERVE OF MODIFICATIONS

Magnetrol®

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Chapter 11 Pressure/Flow Measurement (Division 25)

MANUFACTURER/DISTRIBUTOR:

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Montréal, QC, H4T 2A7
Phone: (514) 940-2293
freddy.gutierrez-vega@ca.endress.com

11.1 Endress & Hauser Cerebar PMC71 Pressure Transmitter (WTP)

Item	Qty.	Unit	Ordercode Description	Unit Price CAD	Total Net CAD
0010	1	PC	PMC71-3U538/101 PMC71-XCC1PERDAAU+ Z1 **Cerabar S PMC71** Pressure, capacitive. Compact. Application: pressure/level. Membrane: Ceraphire, dry, vacuum proof. :: Mechanically robust, overload resistant. :: High reliability through process monitoring. :: High long term stability. :: Modular.		
			additional specifications Low range value 0.000 kPa Upper range value 750.000 kPa Display main line cont. Measured value[PV] Damping [s] 2 If CRN is required, check availability in technical documentation! Tag plate Stainless Steel 52006326 PIT 1001		
		X	Approval: CSA C/US General Purpose		
		C	Output; Operating: 4-20mA HART; inside		
		C	Housing; Cover Sealing; Cable Entry: T14 Alu IP66/67 NEMA6P; EPDM; NPT1/2 thread, T14 = side cover		
		1P	Sensor Range; Sensor Overload Limit: 10bar/1MPa/150psi gauge; 40bar/4MPa/600psi		
		E	Calibration; Unit: Customised pressure; see additional spec.		
		RD	Process Connection: Thread ANSI MNPT1/2 hole 11.4mm, 316L		
		A	Seal: FKM Viton		
		A	Additional Option 1: Not selected		
		U	Additional Option 2: Mounting bracket, wall/pipe, 316L		
		Z1	> > Marking: Tagging (TAG), see additional spec.		
			Production Time: 7 Day(s). Delivery time extra.		
0020	1	PC	71098440 **2-valve manifold**		

Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Cerabar S PMC71, PMP71, PMP75

Process pressure measurement
Pressure transmitter with ceramic and metal sensors
Overload-resistant and function-monitored; Communication via HART, PROFIBUS PA or FOUNDATION Fieldbus

Application

The Cerabar S pressure transmitter is used for the following measuring tasks:
- Absolute pressure and gauge pressure in gases, steams or liquids in all areas of process engineering and process measurement technology
- Level, volume or mass measurements in liquids
- High process temperature
  - without diaphragm seals up to 150 °C (302 °F)
  - with typical diaphragm seals up to 400 °C (752 °F)
- High pressure up to 700 bar (10500 psi)
- International usage thanks to a wide range of approvals

Your benefits

- Very good reproducibility and long-term stability
- High reference accuracy: up to ±0.075 %, as PLATINUM version: ±0.05 %
- Turn down up to 100:1, higher on request
- Used for process pressure monitoring up to SIL3, certified to IEC 61508 by TÜV SÜD
- HistoROM®/M-DAT memory module
- Function-monitored from the measuring cell to the electronics
- Continuous modularity for differential pressure, hydrostatics and pressure (Deltabar S – Deltapilot S – Cerabar S), e.g.
  - replaceable display
  - universal electronics
- Quick commissioning with Quick Setup menu
- Menu-guided operation
- Extensive diagnostic functions
- Device versions compliant with ASME-BPE

TI383P/00/EN/05.10
No 71111803

Endress+Hauser
People for Process Automation

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Warm-up period – PMC71 20
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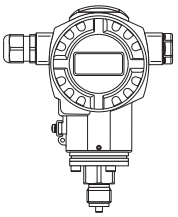
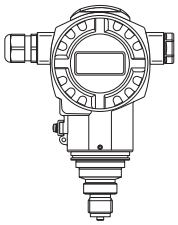
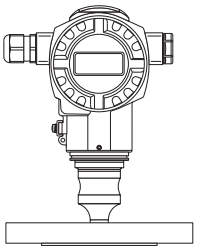
Function and system design

Device selection

Cerabar S – Product family	**PMC71**  P01-PMC71xxx-16-xx-xx-xx-000 **With capacitance measuring cell and ceramic process isolating diaphragm (Ceraphire®)**	**PMP71**  P01-PMP71xxx-16-xx-xx-xx-000 **With piezoresistive measuring cell and metal welded process isolating diaphragm**	**PMP75**  P01-PMP75xxx-16-xx-xx-xx-000 **With diaphragm seal**
Field of application	– Gauge pressure and absolute pressure – Level		
Process connections	– Diverse thread – DN 32 – DN 80 – ANSI 1 1/2" – 4" – JIS 50 A – 100 A	– Diverse thread – DN 25 – DN 80 – ANSI 1 1/2" – 4" – JIS 25 A – 100 A – Oval flange adapter – Prepared for diaphragm seal mount	– Wide range of diaphragm seals
Measuring ranges	From –100/0 to 100 mbar (–1.5/0 to 1.5 psi) to –1/0 to 40 bar (–15/0 to 600 psi)	From –100/0 to 100 mbar (–1.5/0 to 1.5 psi) to –1/0 to 700 bar (–15/0 to 10500 psi)	From –400/0 to 400 mbar (–6/0 to 6 psi) to –1/0 to 400 bar (–15/0 to 6000 psi)
OPL [1]	Max. 60 bar (900 psi)	Max. 1050 bar (15750 psi)	Max. 600 bar (9000 psi)
Process temperature range	–25 to +125°C (-13 to +257 °F)/ –20 to +150 °C (-4 to 302 °F)[2]	–40 to +125 °C (-40 to +257 °C)	-70 to 400 °C (-94 to 752 °F) Dependent on the filling oil
Ambient temperature range	■ Without LCD display: –40 to +85 °C (–40 to +185 °F)[3] ■ With LCD display: –20 to +70 °C (–4 to +158 °F) ■ Separate housing: -20 to +50 °C (-4 to +122 °F) ■ Diaphragm seal systems depending on the version		
Reference accuracy	– Up to ±0.075 % of the set span – PLATINUM version: up to ±0.05 % of the set span		Up to ±0.075 % of the set span
Supply voltage	– Version for non-hazardous areas: 10.5 to 45 V DC – Ex ia: 10.5 to 30 V DC		
Output	4 to 20 mA with superimposed HART protocol, PROFIBUS PA or FOUNDATION Fieldbus		
Options	– PMP71, PMP75: gold-rhodium coated process isolating diaphragm – PMP71, PMP75: NACE-compliant materials – PMC71, PMP71, PMP75: inspection certificate 3.1 – HistoROM®/M-DAT memory module – Separate housing		
Specialties	– Metal-free measurement with PVDF connection – Special cleaning of the transmitter to remove paint-wetting substances, for use in paint shops	– Process connections with minimum oil volume – Gas-tight, elastomer-free	– Wide range of diaphragm seals – For high medium temperatures – Process connections with minimum oil volume – Completely welded versions

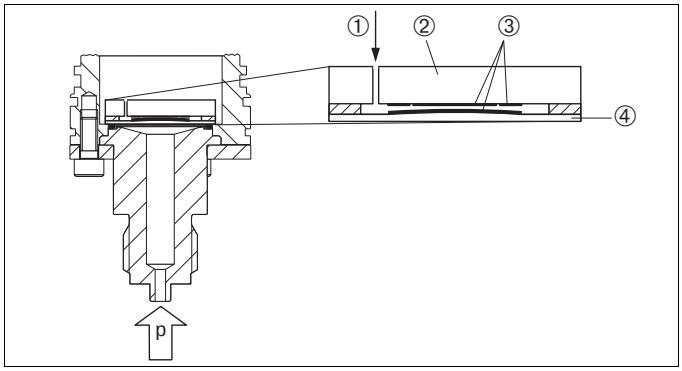
1) OPL: over pressure limit; dependent on the lowest-rated element, with regard to pressure, of the selected components

2) High-temperature version "T" for feature 100 "Additional option 1" or for feature 110 "Additional option 2"

3) PMP71 and PMP75: lower temperatures on request

Measuring principle

Ceramic process isolating diaphragm used for PMC71 (Ceraphire®)

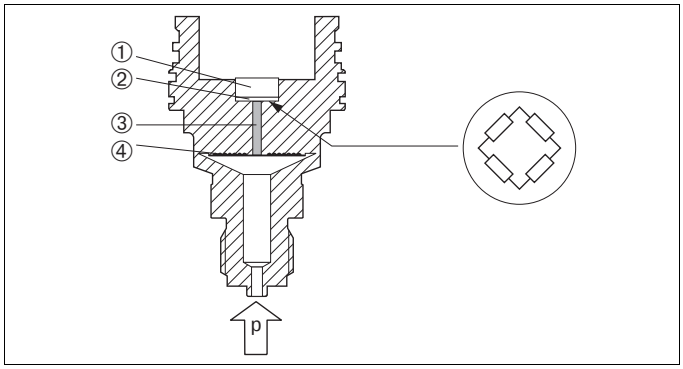


P01-PMC71xxx-03-xx-xx-xx-000

Ceramic sensor

1 *Air pressure (gauge pressure sensors)*
2 *Ceramic substrate*
3 *Electrodes*
4 *Ceramic process isolating diaphragm*

Metal process isolating diaphragm used for PMP71 and PMP75



P01-PMP7xxxx-03-xx-xx-xx-000

Metal sensor

1 *Silicon measuring element, substrate*
2 *Wheatstone bridge*
3 *Channel with fill fluid*
4 *Metal process isolating diaphragm*

Ceramic process isolating diaphragm used for PMC71 (Ceraphire®)

The ceramic sensor is a dry sensor, i.e. the process pressure acts directly on the robust ceramic process isolating diaphragm and deflects it. A pressure-dependent change in capacitance is measured at the electrodes of the ceramic substrate and the process isolating diaphragm. The measuring range is determined by the thickness of the ceramic process isolating diaphragm.

Advantages:
- Guaranteed overload resistance up to 40 times the nominal pressure
- Thanks to ultrapure 99.9% ceramic (Ceraphire®, see also "www.endress.com/ceraphire")
  – extremely high chemical stability, comparable with Alloy
  – less relaxation
  – high mechanical stability
- Suitable for vacuums
- Secondary containment for enhanced integrity
- Process temperatures up to 150 °C (302 °F)

Metal process isolating diaphragm used for PMP71 and PMP75

PMP71

The operating pressure deflects the process isolating diaphragm and a fill fluid transfers the pressure to a resistance bridge (semiconductor technology). The pressure-dependent change in the bridge output voltage is measured and evaluated.

Advantages:
- Can be used for process pressures up to 700 bar (10500 psi) absolute pressure
- High long-term stability
- Guaranteed overload resistance up to 4 times the nominal pressure
- Secondary containment for enhanced integrity
- Significantly less thermal effect compared to diaphragm seal systems

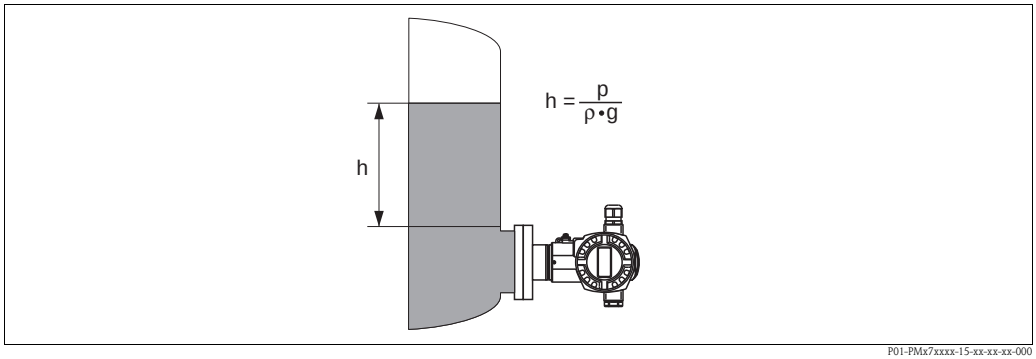
PMP75

The operating pressure acts on the process isolating diaphragm of the diaphragm seal and is transferred to the process isolating diaphragm of the sensor by a diaphragm seal fill fluid. The process isolating diaphragm is deflected and a fill fluid transfers the pressure to a resistance measuring bridge. The pressure-dependent change in the bridge output voltage is measured and evaluated.

Advantages:
- Depending on the version, can be used for process pressures up to 400 bar (6000 psi) and extreme process temperatures
- High long-term stability
- Guaranteed overload resistance up to 4 times the nominal pressure
- Secondary containment for enhanced integrity

Level measurement (level, volume and mass)

Design and operation mode



Level measurement

h *Height (level)*
p *Pressure*
ρ *Density of the medium*
g *Gravitation constant*

Your benefits

- Selection of the level operating mode which is optimum for your application in the device software.
- Volume and mass measurements in any tank shapes by means of a freely programmable characteristic curve.
- Choice of diverse level units with automatic unit conversion.
- A specific unit can be defined.
- Has a wide range of uses, even in the following cases:
  - in the event of foam formation
  - in tanks with agitators of screen fittings
  - in the event of liquid gases

Communication protocol

- 4 to 20 mA with HART communication protocol
- PROFIBUS PA
  - The Endress+Hauser devices meet the requirements of the FISCO model.
  - Due to the low current consumption of 13 mA ± 1 mA, the following number of devices can be operated on one bus segment if installing as per FISCO:
    - up to 7 Cerabar S for Ex ia, CSA IS and FM IS applications
    - up to 27 Cerabar S for all other applications, e.g. in non-hazardous areas, Ex nA etc.

  Further information on PROFIBUS PA can be found in Operating Instructions BA034S "PROFIBUS DP/PA: Guidelines for planning and commissioning" and in the PNO Guideline.
- FOUNDATION Fieldbus
  - The Endress+Hauser devices meet the requirements of the FISCO model.
  - Due to the low current consumption of 15 mA ± 1 mA, the following number of devices can be operated on one bus segment if installing as per FISCO:
    - up to 6 Cerabar S for Ex ia, CSA IS and FM IS applications
    - up to 24 Cerabar S for all other applications, e.g. in non-hazardous areas, Ex nA etc.

  Further information on FOUNDATION Fieldbus, such as requirements for bus system components can be found in Operating Instructions BA013S "FOUNDATION Fieldbus Overview".

Input

Measured variable

Absolute pressure and gauge pressure, from which level (level, volume or mass) is derived

Measuring range

PMC71 – with ceramic process isolating diaphragm (Ceraphire®) for gauge pressure

Nominal value	Range limit		Smallest calibratable span [4]	MWP [1]	OPL [2]	Vacuum resistance	Versions in the order code [3]
	lower (LRL)	upper (URL)					
	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar_{abs} (psi_{abs})]	
100 mbar (1.5 psi)	–0.1 (–1.5)	+0.1 (+1.5)	0.005 (0.075)	2.7 (40.5)	4 (60)	0.7 (10.5)	1C
250 mbar (4 psi)	–0.25 (–4)	+0.25 (+4)	0.005 (0.075)	3.3 (49.5)	5 (75)	0.5 (7.5)	1E
400 mbar (6 psi)	–0.4 (–6)	+0.4 (+6)	0.005 (0.075)	5.3 (79.5)	8 (120)	0	1F
1 bar (15 psi)	–1 (–15)	+1 (+15)	0.01 (0.15)	6.7 (100.5)	10 (150)	0	1H
2 bar (30 psi)	–1 (–15)	+2 (+30)	0.02 (0.3)	12 (180)	18 (270)	0	1K
4 bar (60 psi)	–1 (–15)	+4 (+60)	0.04 (0.6)	16.7 (250.5)	25 (375)	0	1M
10 bar (150 psi)	–1 (–15)	+10 (+150)	0.1 (1.5)	26.7 (400.5)	40 (600)	0	1P
40 bar (600 psi)	–1 (–15)	+40 (+600)	0.4 (0.6)	40 (600)	60 (900)	0	1S

PMC71 – with ceramic process isolating diaphragm (Ceraphire®) for absolute pressure

Nominal value	Range limit		Smallest calibratable span [4]	MWP [1]	OPL [2]	Versions in the order code [3]
	lower (LRL)	upper (URL)				
	[bar_{abs} (psi_{abs})]	[bar_{abs} (psi_{abs})]	[bar (psi)]	[bar_{abs} (psi_{abs})]	[bar_{abs} (psi_{abs})]	
100 mbar (15 psi)	0	+0.1 (+1.5)	0.005 (0.075)	2.7 (40.5)	4 (60)	2C
250 mbar (4 psi)	0	+0.25 (+4)	0.005 (0.075)	3.3 (49.5)	5 (75)	2E
400 mbar (6 psi)	0	+0.4 (+6)	0.005 (0.075)	5.3 (79.5)	8 (120)	2F
1 bar (15 psi)	0	+1 (+15)	0.01 (0.15)	6.7 (100.5)	10 (150)	2H
2 bar (30 psi)	0	+2 (+30)	0.02 (0.3)	12 (180)	18 (270)	2K
4 bar (60 psi)	0	+4 (+60)	0.04 (0.6)	16.7 (250.5)	25 (375)	2M
10 bar (150 psi)	0	+10 (+150)	0.1 (1.5)	26.7 (400.5)	40 (600)	2P
40 bar (600 psi)	0	+40 (+600)	0.4 (0.6)	40 (600)	60 (900)	2S

1) The MWP (maximum working pressure) for the measuring device depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection (→ 32 ff) has to taken into consideration in addition to the measuring cell (→ see Table above). Also observe pressure-temperature dependency. For the appropriate standards and further information, see → 31, "Pressure specifications" section.
2) OPL: over pressure limit depends on the lowest-rated element, with regard to pressure, of the selected components.
3) Version in the order code → see also → 76 ff, feature 40 "Sensor range; Sensor over pressure limit (= OPL)"
4) Turn down > 100:1 on request or can be set at the device

PMP71 and PMP75 – metal process isolating diaphragm for gauge pressure

Nominal value	Range limit		Smallest calibratable span [5]	MWP [1]	OPL [2]	Vacuum resistance [3]	Versions in the order code [4]
	lower (LRL)	upper (URL)				Silicone oil/ Inert oil	
	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar_{abs} (psi_{abs})]	
400 mbar (6 psi)	–0.4 (–6)	+0.4 (+6)	0.005 (0.075)	4 (60)	6 (90)	0.01/0.04 (0.15/0.6)	1F
1 bar (15 psi)	–1 (–15)	+1 (+15)	0.01 (0.15)	6.7 (100)	10 (150)		1H
2 bar (30 psi)	–1 (–15)	+2 (+30)	0.02 (0.3)	13.3 (200)	20 (300)		1K
4 bar (60 psi)	–1 (–15)	+4 (+60)	0.04 (0.6)	18.7 (280.5)	28 (420)		1M
10 bar (150 psi)	–1 (–15)	+10 (+150)	0.1 (1.5)	26.7 (400.5)	40 (600)		1P
40 bar (600 psi)	–1 (–15)	+40 (+600)	0.4 (6)	100 (1500)	160 (2400)		1S
100 bar (1500 psi)	–1 (–15)	+100 (+1500)	1.0 (15)	100 (1500)	400 (6000)		1U
400 bar (6000 psi)	–1 (–15)	+400 (+6000)	4.0 (60)	400 (6000)	600 (9000)		1W
700 bar (10500) [6]	–1 (–15)	+700 (+10500)	7.0 (105)	700 (10500)	1050 (15750)		1X

PMP71 and PMP75 – metal process isolating diaphragm for absolute pressure

Nominal value	Range limit		Smallest calibratable span [5]	MWP [1]	OPL [2]	Vacuum resistance [3]	Versions in the order code [4]
	lower (LRL)	upper (URL)				Silicone oil/ Inert oil	
	[bar_{abs}]	[bar_{abs}]	[bar]	[bar_{abs}]	[bar_{abs}]	[bar_{abs}]	
400 mbar (6 psi)	0	+0.4 (+6)	0.005 (0.075)	4 (60)	6 (90)	0.01/0.04 (0.15/0.6)	2F
1 bar (15 psi)	0	+1 (+15)	0.01 (0.15)	6.7 (100)	10 (150)		2H
2 bar (30 psi)	0	+2 (+30)	0.02 (0.3)	13.3 (200)	20 (300)		2K
4 bar (60 psi)	0	+4 (+60)	0.04 (0.6)	18.7 (280.5)	28 (420)		2M
10 bar (150 psi)	0	+10 (+150)	0.1 (1.5)	26.7 (400.5)	40 (600)		2P
40 bar (600 psi)	0	+40 (+600)	0.4 (6)	100 (1500)	160 (2400)		2S
100 bar (1500 psi)	0	+100 (+1500)	1.0 (15)	100 (1500)	400 (6000)		2U
400 bar (6000 psi)	0	+400 (+6000)	4.0 (60)	400 (6000)	600 (9000)		2W
700 bar (10500) [6]	0	+700 (+10500)	7.0 (105)	700 (10500)	1050 (15750)		2X

1) The MWP (maximum working pressure) for the measuring device depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection (→ 🖹 32 ff) has to taken into consideration in addition to the measuring cell (→ see Table above). Also observe pressure-temperature dependency. For the appropriate standards and further information, see → 🖹 31, "Pressure specifications" section.
2) OPL: over pressure limit depends on the lowest-rated element, with regard to pressure, of the selected components.
3) The vacuum resistance applies for the measuring cell under reference operating conditions. The pressure and temperature application limits of the selected filling oil must also be observed for the PMP75. → 🖹 72, "Filling oil" section.
4) Version in the order code → 🖹 76 ff, feature 40 "Sensor range; Sensor over pressure limit (= OPL)"
5) Turn down > 100:1 on request or can be set at the device
6) PMP71 only, PMP75 on request

Explanation of terms

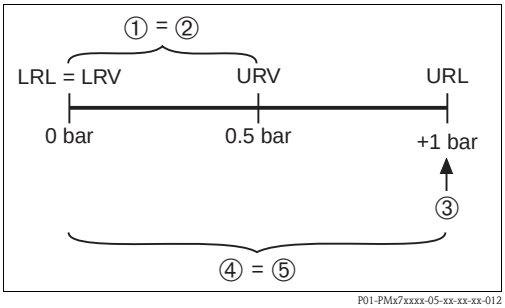
Explanation of the terms "turn down (TD)", "set span" and "zero-based span"

Case 1:
- |Lower range value (LRV)| ≤ |Upper range value (URV)|

Example:
- Lower range value (LRV) = 0 bar
- Upper range value (URV) = 0.5 bar (7.5 psi)
- Nominal value (URL) = 1 bar (15 psi)

Turn down:
- TD = URL / |URV| = 2:1

Set span:
- URV – LRV = 0.5 bar (7.5 psi)
  This span is based on the zero point.



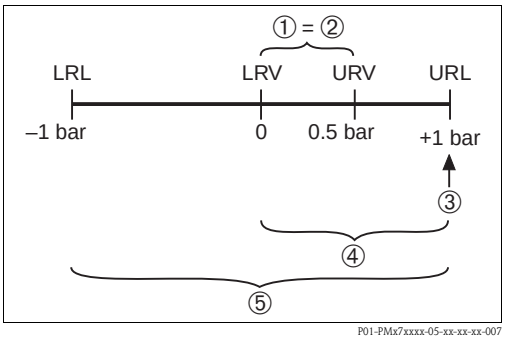
Example: 1 bar (15 psi) measuring cell

Case 2:
- |Lower range value (LRV)| ≤ |Upper range value (URV)|

Example:
- Lower range value (LRV) = 0 bar
- Upper range value (URV) = 0.5 bar (7.5 psi)
- Nominal value (URL) = 1 bar (15 psi)

Turn down:
- TD = URL / |URV| = 2:1

Set span:
- URV – LRV = 0.5 bar (7.5 psi)
  This span is based on the zero point.



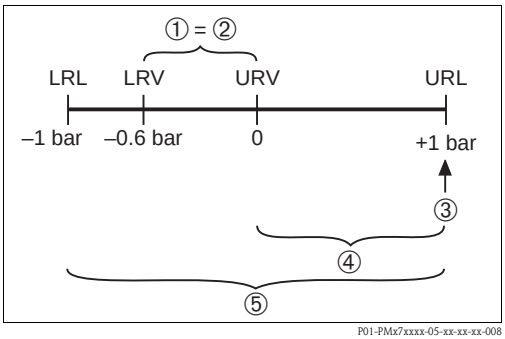
Example: 1 bar (15 psi) measuring cell

Case 3:
- |Lower range value (LRV)| ≥ |Upper range value (URV)|

Example:
- Lower range value (LRV) = –0.6 bar (–9 psi)
- Upper range value (URV) = 0 bar
- Nominal value (URL) = 1 bar (15 psi)

Turn down:
- TD = URL / |LRV| = 1.67:1

Set span:
- URV – LRV = 0.6 bar (9 psi)
  This span is based on the zero point.



Example: 1 bar (15 psi) measuring cell

1 Set span
2 Zero-based span
3 Nominal value ≙ upper range limit (URL)
4 Nominal measuring range
5 Sensor measuring range
LRL Lower range limit
URL Upper range limit
LRV Lower range value
URV Upper range value

Output

Output signal

- 4 to 20 mA with superimposed digital communication protocol HART 5.0, 2-wire
- Digital communication signal PROFIBUS PA (Profile 3.0), 2-wire
  - signal coding: Manchester Bus Powered (MBP): Manchester II
  - data transmission rate: 31.25 KBit/s voltage mode
- Digital communication signal FOUNDATION Fieldbus, 2-wire
  - signal coding: Manchester Bus Powered (MBP): Manchester II
  - data transmission rate: 31.25 KBit/s voltage mode

Signal range – 4 to 20 mA HART

3.8 mA to 20.5 mA

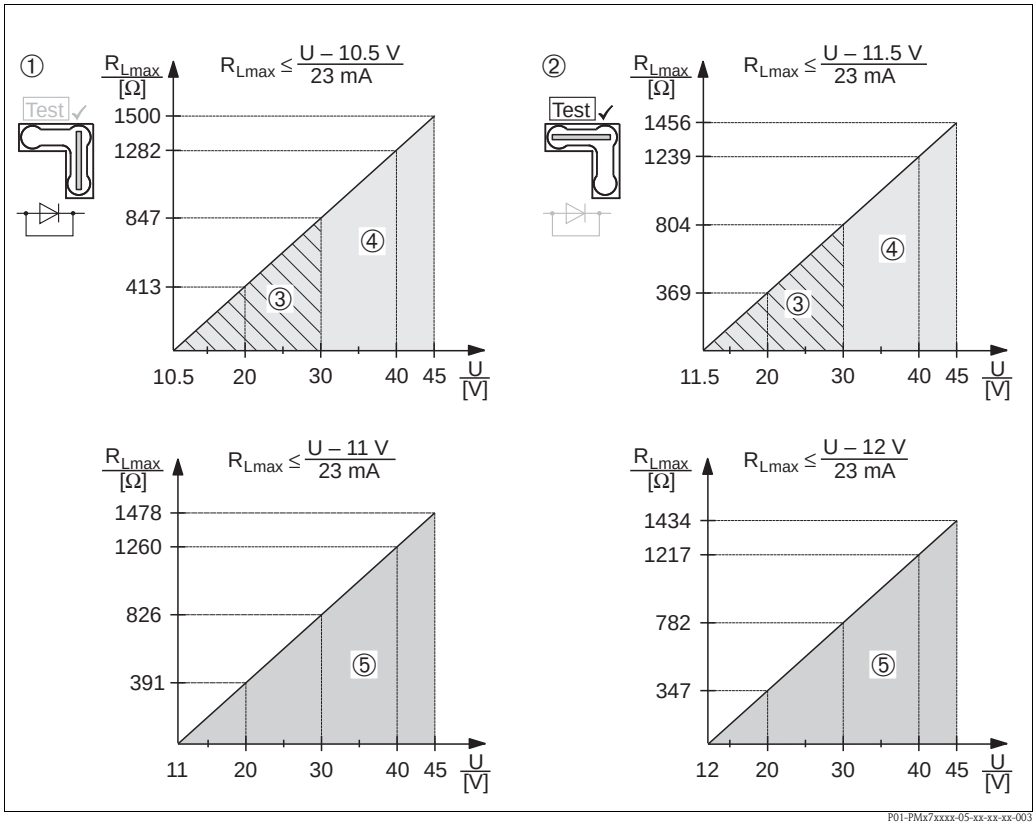
Signal on alarm

As per NAMUR NE43

- 4 to 20 mA HART
  Options:
  - Max. alarm*: can be set from 21 to 23 mA
  - Hold measured value: last measured value is held
  - Min. alarm: 3.6 mA

  * Factory setting: 22 mA
- PROFIBUS PA: can be set in the Analog Input block,
  Options: Last Valid Out Value, Fsafe Value (factory setting), Status Bad
- FOUNDATION Fieldbus: can be set in the Analog Input block,
  Options: Last Good Value, Fail Safe Value (factory setting), Wrong Value

Load – 4 to 20 mA HART



Load diagram, observe the position of the jumper and the explosion protection (→ See also Page 17, "Measuring a 4 to 20 mA test signal" section.)

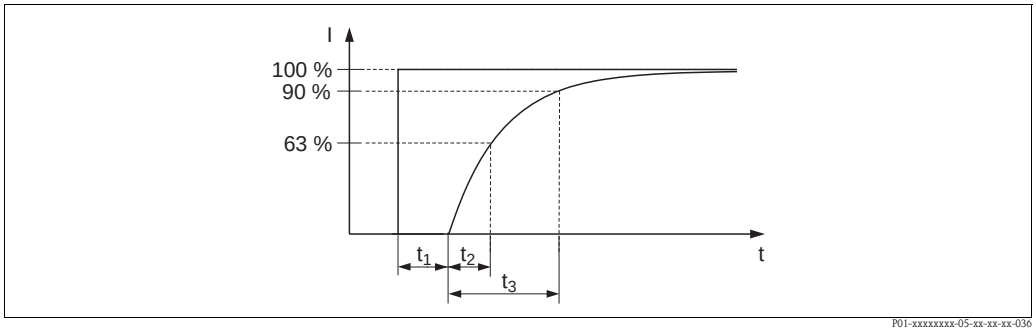
1 Jumper for 4 to 20 mA test signal set to "Non-test" position
2 Jumper for 4 to 20 mA test signal set to "Test" position
3 Power supply 10.5 (11.5) to 30 V DC for 1/2 G, 1 GD, 1/2 GD, FM IS, CSA IS, IECEx ia, NEPSI Ex ia
4 Power supply 10.5 (11.5) to 45 V DC for devices for non-hazardous areas, 1/2 D, 1/3 D, 2 G Ex d, 3 G Ex nA, FM XP, FM DIP, FM NI, CSA XP, CSA dust ignition proof, NEPSI Ex d
5 Power supply 11 (12) to 45 V DC for PMC71, Ex d[ia], NEPSI Ex d[ia]
R_{Lmax} Maximum load resistance
U Supply voltage

Note!
When operating via a handheld terminal or via a PC with an operating program, a minimum communication resistance of 250 Ω must exist within the loop.

Resolution

- Current output: 1 μA
- Display: can be set (factory setting: presentation of the maximum accuracy of the transmitter)

Dead time, time constant



Presentation of the dead time and the time constant

Dynamic behavior, current output

Type	Dead time t_1	Time constant (T63), t_2	Time constant (T90), t_3
PMC71	90 ms	120 ms	276 ms
PMP71	45 ms	■ 400 mbar (6 psi) measuring cell: 70 ms ■ Measuring cells ≥ 1 bar (15 psi): 35 ms	■ 400 mbar (6 psi) measuring cell: 161 ms ■ Measuring cells ≥ 1 bar (15 psi): 81 ms
PMP75	PMP71 + influence of the diaphragm seal		

Dynamic behavior, HART

Type	Dead time t_1	Time constant (T63), t_2	Time constant (T90), t_3
PMC71	340 ms	120 ms	276 ms
PMP71	295 ms	■ 400 mbar (6 psi) measuring cell: 70 ms ■ Measuring cells ≥ 1 bar (15 psi): 35 ms	■ 400 mbar (6 psi) measuring cell: 161 ms ■ Measuring cells ≥ 1 bar (15 psi): 81 ms
PMP75	PMP71 + influence of the diaphragm seal		

Reading cycle

- HART commands: 3 to 4 per second on average.
  The Cerabar S commands the BURST MODE function for cyclic value transmission via the HART communication protocol.

Response time

≤ 250 ms

Cycle time (update time)

On average 250 to 330 ms.

Dynamic behavior, PROFIBUS PA

A typical cyclic parametrization for the PLC of 20 values per second results in the following behavior:

Type	Dead time t_1	Time constant (T63), t_2	Time constant (T90), t_3
PMC71	340 ms	120 ms	620 ms
PMP71	295 ms	■ 400 mbar (6 psi) measuring cell: 70 ms ■ Measuring cells ≥ 1 bar (15 psi): 35 ms	■ 400 mbar (6 psi) measuring cell: 161 ms ■ Measuring cells ≥ 1 bar (15 psi): 81 ms
PMP75	PMP71 + influence of the diaphragm seal		

Response time

- Cyclic: approx. 10 ms per request
- Acyclic: < 50 ms

All values are typical values.

Cycle time (update time)

The cycle time in a bus segment in cyclic data communication depends on the number of devices, on the segment coupler used and on the internal PLC cycle time.

Dynamic behavior, FOUNDATION Fieldbus

A typical configuration for the macro cycle time (host system) of 250 ms results in the following behavior:

Type	Dead time t_1	Time constant (T63), t_2	Time constant (T90), t_3
PMC71	340 ms	120 ms	620 ms
PMP71	295 ms	■ 400 mbar (6 psi) measuring cell: 70 ms ■ Measuring cells ≥ 1 bar (15 psi): 35 ms	■ 400 mbar (6 psi) measuring cell: 161 ms ■ Measuring cells ≥ 1 bar (15 psi): 81 ms
PMP75	PMP71 + influence of the diaphragm seal		

Reading cycle

- Cyclic: up to 5/s, dependent on the number and type of function blocks used in a closed-control loop
- Acyclic: 10/s

Response time

- Cyclic: < 80 ms
- Acyclic: < 40 ms

All values are typical values.

Cycle time (update time)

250 ms

Damping

A damping affects all outputs (output signal, display).

- Via onsite display, handheld terminal or PC with operating program, continuous from 0 to 999 s
- Additionally for HART and PROFIBUS PA: via DIP switch on the electronic insert, switch position "on" = set value and "off"
- Factory setting: 2 s

Data of the FOUNDATION Fieldbus interface

Basic data

Device Type	1007F (hex)
Device Revision	06 (hex)
DD Revision	01 (hex)
CFF Revision	01 (hex)
ITK Version	5.0
ITK Certification Driver No.	IT054600
Link-Master (LAS) capable	Yes
Link Master / Basic Device selectable	Yes; Factory setting: Basic Device
Number of VCRs	44
Number of Link Objects in VFD	50

Virtual communication references (VCRs)

Permanent Entries	44
Client VCRs	0
Server VCRs	5
Source VCRs	8
Sink VCRs	0
Subscriber VCRs	12
Publisher VCRs	19

Link settings

Slot time	4
Min. inter PDU delay	12
Max. response delay	10

Transducer Blocks

Block	Content	Output values
TRD1 Block	Contains all parameters related to the measurement	■ Pressure or level (channel 1) ■ Process temperature (channel 2)
Service Block	Contains service information	■ Pressure after damping (channel 3) ■ Pressure peakhold indicator (channel 4) ■ Counter for max. pressure transgressions (channel 5)
Diagnostic Block	Contains diagnostic information	Error code via DI channels (channel 0 to 16)
Display Block	Contains parameters to configure the onsite display	No output values

Function blocks

Block	Content	Number of blocks	Execution time	Functionality
Resource Block	The Resource Block contains all the data that uniquely identify the device. It is an electronic version of a nameplate of the device.	1		enhanced
Analog Input Block 1 Analog Input Block 2	The AI Block receives the measuring data from the Sensor Block, (selectable via a channel number) and makes the data available to other function blocks at its output. Enhancement: digital outputs for process alarms, fail safe mode.	2	45 ms	enhanced
Digital Input Block	This block contains the discrete data of the Diagnose Block (selectable via a channel number 0 to 16) and provides them for other blocks at the output.	1	40 ms	standard
Digital Output Block	This block converts the discrete input and thus initiates an action (selectable via a channel number) in the DP Flow Block or in the Service Block. Channel 1 resets the counter for max. pressure transgressions.	1	60 ms	standard
PID Block	The PID Block serves as a proportional-integral-derivative controller and is used almost universally for closed-loop-control in the field including cascade and feedforward. Input IN can be indicated on the display. The selection is performed in the Display Block (DISPLAY_MAIN_LINE_CONTENT).	1	120 ms	standard
Arithmetic Block	This block is designed to permit simple use of popular measurement math functions. The user does not have to know how to write equations. The math algorithm is selected by name, chosen by the user for the function to be performed.	1	50 ms	standard
Input Selector Block	The Input Selector Block facilitates the selection of up to four inputs and generates an output based on the configured action. This block normally receives its inputs from AI Blocks. The block performs maximum, minimum, average and 'first good' signal selection. Inputs IN1 to IN4 can be indicated on the display. The selection is performed in the Display Block (DISPLAY_MAIN_LINE_CONTENT).	1	35 ms	standard
Signal Characterizer Block	The Signal Characterizer Block has two sections, each with an output that is a non-linear function of the respective input. The non-linear function is generated by a single look-up table with 21 arbitrary x-y pairs.	1	30 ms	standard
Integrator Block	The Integrator Block integrates a variable as a function of the time or accumulates the counts from a Pulse Input Block. The block may be used as a totalizer that counts up until reset or as a batch totalizer that has a setpoint, where the integrated or accumulated value is compared to pre-trip and trip settings, generating a binary signal when the setpoint is reached.	1	35 ms	standard
Analog Alarm Block	This block contains all process alarm conditions (working like a comparator) and represents them at the output.	1	35 ms	standard

Additional function block information:

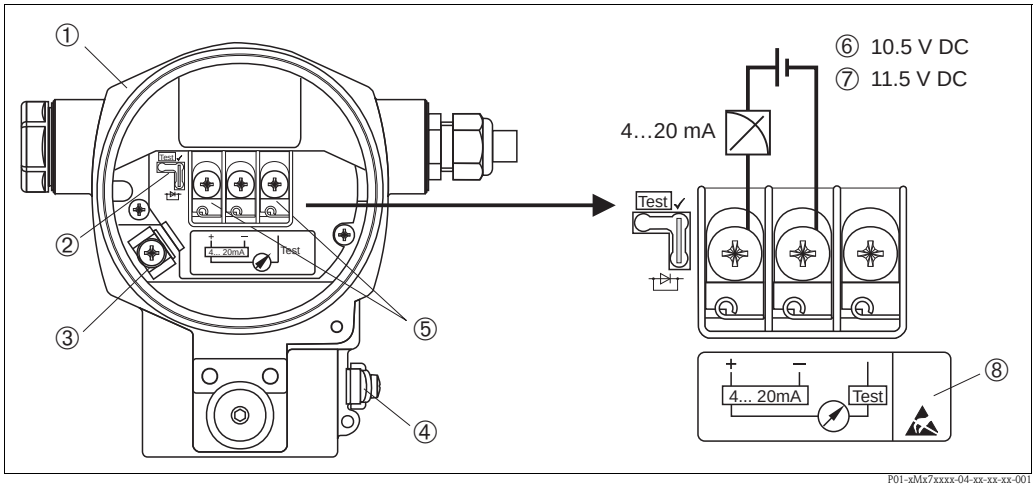
Instantiate Function Block	YES
Number of instantiate blocks	15

Power supply

Electrical connection

Note!
- When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.
  → 89 ff, "Safety Instructions" and "Installation/Control Drawings" sections.
- Devices with integrated overvoltage protection must be grounded. → 29.
- Protective circuits against reverse polarity, HF influences and overvoltage peaks are installed.

4 to 20 mA HART



Electrical connection 4 to 20 mA HART

1 Housing
2 Jumper for 4 to 20 mA test signal
→ 17, "Measuring a 4 to 20 mA test signal" section.
3 Internal ground terminal
4 External ground terminal
5 4 to 20 mA test signal between positive and test terminal
6 Minimum supply voltage = 10.5 V DC, jumper is set as illustrated in the diagram.
7 Minimum supply voltage = 11.5 V DC, jumper is set to "Test" position.
8 Devices with integrated overvoltage protection are labeled OVP (overvoltage protection) here (→ 29).

PROFIBUS PA

The digital communication signal is transmitted to the bus via a 2-wire connection. The bus also provides the power supply. For further information on the network structure and grounding, and for further bus system components such as bus cables, see the relevant documentation, e.g. Operating Instructions BA034S "PROFIBUS DP/PA: Guidelines for planning and commissioning" and the PNO Guideline.

Cable specifications:
- Use a twisted, shielded two-wire cable, preferably cable type A

Note!
For further information on the cable specifications, see Operating Instructions BA034S "PROFIBUS DP/PA: Guidelines for planning and commissioning", the PNO Guideline 2.092 PROFIBUS PA User and Installation Guideline" and IEC 61158-2 (MBP).

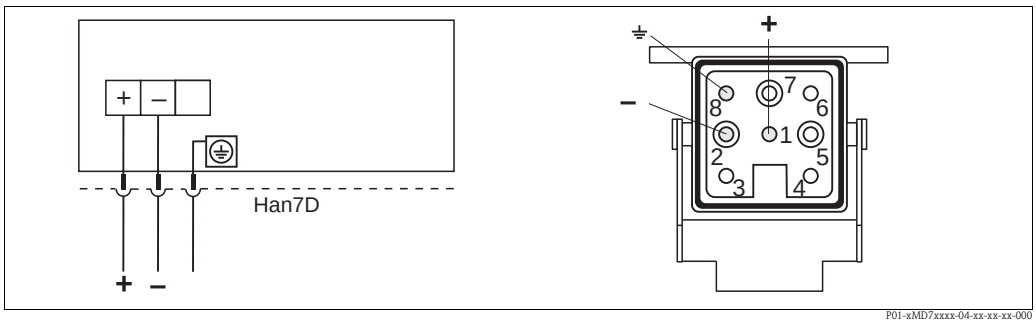
FOUNDATION Fieldbus

The digital communication signal is transmitted to the bus via a 2-wire connection. The bus also provides the power supply. For further information on the network structure and grounding and for further bus system components such as bus cables, see the relevant documentation, e.g. Operating Instructions BA013S "FOUNDATION Fieldbus Overview" and the FOUNDATION Fieldbus Guideline.

Cable specifications:
- Use a twisted, shielded two-wire cable, preferably cable type A

Note!
For further information on the cable specifications, see Operating Instructions BA013S "FOUNDATION Fieldbus Overview", FOUNDATION Fieldbus Guideline and IEC 61158-2 (MBP).

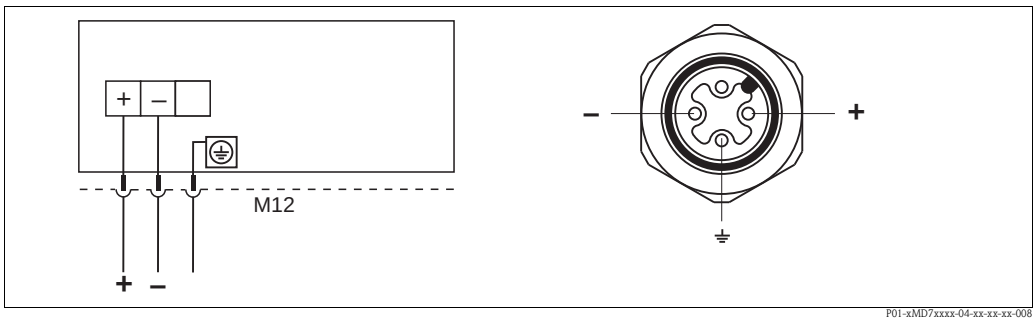
Devices with Harting plug Han7D



Left: electrical connection for devices with Harting plug Han7D
Right: view of the plug connector at the device

Material: CuZn

Devices with M12 plug



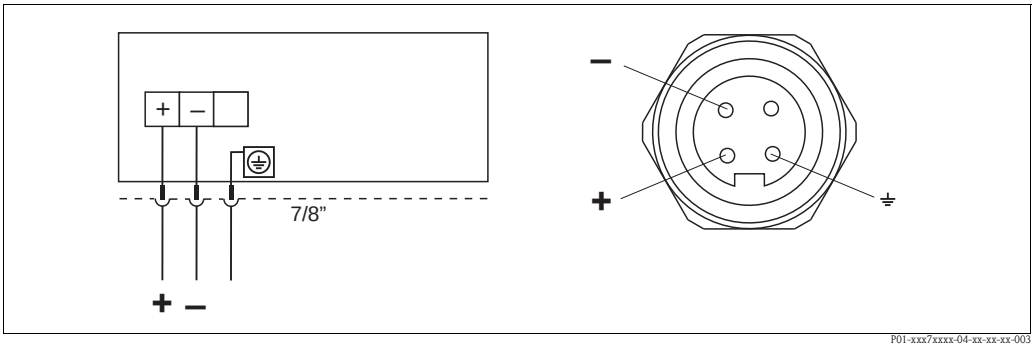
Left: electrical connection for devices with M12 plug
Right: view of the plug at the device

Endress+Hauser offers the following accessories for devices with an M12 plug:
Plug-in jack M 12x1, straight
- Material: body PA; coupling nut CuZn, nickel-plated
- Degree of protection (fully locked): IP67
- Order number: 52006263

Plug-in jack M 12x1, elbowed
- Material: body PBT/PA; coupling nut GD-Zn, nickel-plated
- Degree of protection (fully locked): IP67
- Order number: 71091284

Cable 4x0.34 mm² (20 AWG) with M12 socket, elbowed, screw plug, length 5 m (16 ft)
- Material: body PUR; coupling nut CuSn/Ni; cable PVC
- Degree of protection (fully locked): IP67
- Order number: 52010285

Devices with 7/8" plug



Left: electrical connection for devices with 7/8" plug
Right: view of the plug at the device

External thread: 7/8 - 16 UNC
- Material: housing / body CuZn, nickel-plated
- Protection: IP68
- Order number: 52010285

Cable gland

Approval	Type	Clamping area
Standard, II1/2G Exia, IS	Plastic M20x1.5	5 to 10 mm (0.2 to 0.39 in)
ATEX II1/2D, II1/3D, II1/2GD Exia, II1GD Exia, II3G Ex nA	Metal M20x1.5 (Ex e)	7 to 10.5 mm (0.28 to 0.41 in)

Terminals

For wire cross-sections of 0.5 to 2.5 mm² (20 to 14 AWG)

Measuring a 4 to 20 mA test signal

A 4 to 20 mA test signal may be measured via the positive and test terminal without interrupting the measurement. The minimum supply voltage of the device can be reduced by simply changing the position of the jumper. As a result, operation is also possible with lower voltage sources. Observe the position of the jumper in accordance with the following table.

Jumper position for test signal	Description
	– Measuring 4 to 20 mA test signal via the plus and test terminal: possible. (Thus, the output current can be measured without interruption via the diode.) – Delivery status – Minimum supply voltage: 11.5 V DC
	– Measuring 4 to 20 mA test signal via the plus and test terminal: not possible. – Minimum supply voltage: 10.5 V DC

Supply voltage

Note!
- When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.
- All explosion protection data are given in separate documentation which is available upon request. The Ex documentation is supplied as standard with all devices approved for use in explosion hazardous areas.
  → 📄 89 ff, "Safety Instructions" and "Installation/Control Drawings" sections.

4 to 20 mA HART

- Version for non-hazardous areas, jumper for 4 to 20 mA test signal in "Test" position (delivery status): 11.5 to 45 V DC
- Version for non-hazardous areas, jumper for 4 to 20 mA test signal in "Non-test" position: 10.5 to 45 V DC

PROFIBUS PA

- Version for non-hazardous areas: 9 to 32 V DC

FOUNDATION Fieldbus

- Version for non-hazardous areas: 9 to 32 V DC

Current consumption

- PROFIBUS PA: 13 mA ± 1 mA, switch-on current corresponds to IEC 61158-2, Clause 21
- FOUNDATION Fieldbus: 15 mA ± 1 mA, switch-on current corresponds to IEC 61158-2, Clause 21

Cable entry

→ 📄 76 ff, feature 30 "Housing; Cable entry; Protection".

Cable specification

- Endress+Hauser recommends using shielded, twisted-pair two-wire cables.
- Terminals for core cross-sections 0.5 to 2.5 mm^2 (20 to 14 AWG)
- Cable outer diameter: 5 to 9 mm (0.2 to 0.35 in)

Residual ripple

Without influence on 4 to 20 mA signal up to ± 5 % residual ripple within the permitted voltage range [according to HART hardware specification HCF_SPEC-54 (DIN IEC 60381-1)]

Influence of power supply

≤ 0.0006% of URL/1 V

Performance characteristics – general

Reference operating conditions

- As per IEC 60770
- Ambient temperature T_U = constant, in the range of: +21 to +33 °C (+70 to 91 °F)
- Humidity φ = constant, in the range of: 5 to 80 % rH
- Ambient pressure p_A = constant, in the range of: 860 to 1060 mbar (12.47 to 15.37 psi)
- Position of the measuring cell = constant, in range: horizontally ±1°
- Input of LOW SENSOR TRIM and HIGH SENSOR TRIM for lower range value and upper range value
- Zero based span
- Material of process isolating diaphragm PMC71: Al_2O_3 (aluminum oxide ceramic)
- Material of process isolating diaphragm PMP71 and PMP75: AISI 316L/1.4435
- Filling oil PMP71 and PMP75: silicone oil
- Supply voltage: 24 V DC ± 3 V DC
- Load with HART: 250 Ω

Uncertainty of measurement for small absolute pressure ranges

The smallest extended uncertainty of measurement that can be returned by our standards is:
- 0.4% of the measured value in the range 1 to 30 mbar (0.0145 to 0.435 psi)
- 1% of the measured value in the range < 1 mbar (0.0145 psi)

Long-term stability

PMC71/PMP75:
- For measuring ranges ≥ 1 bar (15 psi): ± 0.05 % of URL/year

PMC71:
- 100 mbar to 40 bar (1.5 psi to 600 psi): ±0.2 % of URL/10 years
- 100 mbar to 40 bar (1.5 psi to 600 psi) (absolute pressure sensor): ±0.3 % of URL/10 years

PMP71 gauge pressure sensors:

	1 year	5 years	10 year
Measuring ranges [bar (psi)]	**% of URL**		
1 (15)	±0.020	±0.080	±0.180
10 (150)	±0.025	±0.050	±0.075
40 (600)	±0.025	±0.075	±0.100
100 (1500)	±0.050	±0.150	±0.200
400 (6000)	±0.050	–	±1

Influence of the installation position

- PMC71 [1]: ≤ 0.18 mbar (3 psi)
- PMP71 [1, 2]
  - Process connections thread G 1 A, G 1 1/2, G 2, 1 1/2 MNPT, 2 MNPT, M 44x1,25, EN/DIN, ANSI and JIS flanges: ≤ 10 mbar (0.15 psi)
  - Process connections thread: G 1/2, 1/2 MNPT, JIS G 1/2, JIS R 1/2, M20x1.5: ≤ 4 mbar (0.06 psi)

1) Device rotated 180°, process connection pointing upwards.
2) The value is doubled for devices with inert oil.

Note!
Position-dependent zero shift can be corrected. → 🖹 24, "General installation instructions" section and → 🖹 72 ff, "Installation instructions, diaphragm seal systems" section

Performance characteristics – ceramic process isolating diaphragm

Reference accuracy – PMC71

The reference accuracy comprises the non-linearity (terminal based), hysteresis and non-reproducibility as per IEC 60770. The data refer to the calibrated span.

Measuring cell	Gauge pressure sensor	Absolute pressure sensor
100 mbar (1.5 psi)	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD	■ TD 1:1 to TD 5:1 = ±0.075 ■ TD > 5:1 = ±0.015 x TD
250 mbar (4 psi)	■ TD 1:1 to TD 15:1 = ±0.075 ■ TD > 15:1 = ±0.005 x TD	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD
400 mbar (6 psi), 1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi)	■ TD 1:1 to TD 15:1 = ±0.075 ■ TD > 15:1 = ±0.005 x TD	■ TD 1:1 to TD 15:1 = ±0.075 ■ TD > 15:1 = ±0.005 x TD
40 bar (600 psi)	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD
Platinum version: 1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi)	■ TD 1:1 = ±0.05	■ TD 1:1 = ±0.05

Total performance – PMC71

The "Total performance" specification comprises the non-linearity including hysteresis, non-reproducibility as well as the thermal change in the zero point.
For devices with NBR or HNBR seals, the values must be multiplied by a factor of 3.
All specifications apply to the temperature range –10 to +60 °C (+14 to +140 °F) and a turn down of 1:1.

Measuring cell	PMC71	PMC71 high-temperature version
	% of URL	
100 mbar (1.5 psi), 250 mbar (4 psi), 400 mbar (6 psi)	±0.2	±0.46
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi)	±0.15	±0.46

Total error - PMC71

The total error comprises the long-term stability and the total performance.
For devices with NBR or HNBR seals, the values must be multiplied by a factor of 3.
All specifications apply to the temperature range –10 to +60 °C (+14 to +140 °F) and a turn down of 1:1.

Measuring cell	PMC71	PMC71 high-temperature version
	% of URL/year	
100 mbar (1.5 psi), 250 mbar (4 psi), 400 mbar (6 psi)	±0.25	±0.51
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi)	±0.2	±0.51

Warm-up period – PMC71

- 4 to 20 mA HART: < 10 s
- PROFIBUS PA: 6 s
- FOUNDATION Fieldbus: 50 s

Thermal change of the zero output and the output span – PMC71

PMC71

Measuring cell	**–10 to +60°C (+14 to +140 °F)**	**–20 to –10 °C, +60 to +125 °C (–4 to +14°F, +140 to +257°F)**
	% of the set span	
100 mbar (1.5 psi), 250 mbar (4 psi), 400 mbar (6 psi)	±(0.088 x TD + 0.088)	±(0.138 x TD + 0.138)
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi)	±(0.088 x TD + 0.04)	±(0.175 x TD + 0.075)

PMC71 high-temperature version

Gauge pressure measuring cell	**–10 to +60°C (+14 to +140°F)**	**to +150°C (to +302°F)**
	% of the set span	
100 mbar (1.5 psi), 250 mbar (4 psi), 400 mbar (6 psi)	±(0.088 x TD + 0.088)	±(0.75 x TD)
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi)	±(0.088 x TD + 0.040)	±(0.50 x TD)
Absolut pressure measuring cell		
100 mbar (1.5 psi)	±(0.088 x TD + 0.088)	±(1.25 x TD)
250 mbar (4 psi), 400 mbar (6 psi)	±(0.088 x TD + 0.088)	±(0.75 x TD)
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi)	±(0.088 x TD + 0.040)	±(0.75 x TD)
40 bar (600 psi)	±(0.088 x TD + 0.040)	±(0.50 x TD)

Performance characteristics – metal process isolating diaphragm

Reference accuracy – PMP71, PMP75

The reference accuracy comprises the non-linearity (terminal based), hysteresis and non-reproducibility as per IEC 60770. The data refer to the calibrated span.

Measuring cell	Sensor	PMP71 and PMP75 without capillary	PMP75 with capillary
400 mbar (6 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 = ±0.15 ■ TD > 1:1 = ±0.15 x TD	■ TD 1:1 = ±0.15 ■ TD > 1:1 = ±0.15 x TD
1 bar (15 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 to TD 2.5:1 = ±0.075 ■ TD > 2.5:1 = ±0.03 x TD	■ TD 1:1 to TD 2.5:1 = ±0.1 ■ TD > 2.5:1 = ±0.04 x TD
2 bar (30 psi)	Gauge pressure	■ TD 1:1 to TD 5:1 = ±0.075 ■ TD > 5:1 = ±0.015 x TD	■ TD 1:1 to TD 2.5:1 = ±0.1 ■ TD > 2.5:1 = ±0.04 x TD
2 bar (30 psi)	Absolute pressure	■ TD 1:1 to TD 5:1 = ±0.075 ■ TD > 5:1 = ±0.015 x TD	■ TD 1:1 to TD 5:1 = ±0.075 ■ TD > 5:1 = ±0.015 x TD
4 bar (60 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD
10 bar (150 psi), 40 bar (600 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 to TD 15:1 = ±0.075 ■ TD > 15:1 = ±0.005 x TD	■ TD 1:1 to TD 15:1 = ±0.075 ■ TD > 15:1 = ±0.005 x TD
100 bar (1500 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD
400 bar (6000 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 to TD 5:1 = ±0.15 ■ TD > 5:1 = ±0.03 x TD	■ TD 1:1 to TD 5:1 = ±0.15 ■ TD > 5:1 = ±0.03 x TD
700 bar (10500 psi)	Absolute pressure	■ TD 1:1 to TD 5:1 = ±0.15 ■ TD > 5:1 = ±0.03 x TD	—
Platinum version [1] 1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi), 100 bar (1500 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 = ±0.05	—

1) Platinum version not for flush-mounted process connections G 1/2 and M20.

Total performance – PMP71

The "Total performance" specification comprises the non-linearity including hysteresis, non-reproducibility as well as the thermal change of the zero point.
All specifications apply to the temperature range –10 to +60 °C (+14 to +140 °F) and a turn down of 1:1.

Measuring cell	PMP71	PMP71 with gold-rhodium-coated process isolating diaphragm
	% of URL	
400 mbar (6 psi)	±0.25	±1.25
1 bar (15 psi)	±0.15	±0.75
2 bar (30 psi)	±0.15	±0.45
4 bar (60 psi)	±0.15	±0.3
10 bar (150 psi), 40 bar (600 psi)	±0.15	±0.15
100 bar (1500 psi)	±0.25	±0.25
400 bar (6000 psi)	±0.3	±0.3
700 bar (10500 psi)	±0.3	±0.3

Total error - PMP71

The total error comprises the total performance and long-term stability.
All specifications apply to the temperature range –10 to +60 °C (+14 to +140 °F) and a turn down of 1:1.

Measuring cell	% of URL/year
400 mbar (6 psi)	■ ±0,3
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi)	■ ±0.2
100 bar (1500 psi)	■ ±0.3
400 bar (6000 psi)	■ ±0.35
700 bar (10500 psi)	■ ±0.35

Warm-up period – PMP71, PMP75

- 4 to 20 mA HART: < 10 s
- PROFIBUS PA: 6 s
- FOUNDATION Fieldbus: 50 s

Thermal change of the zero output and the output span – PMP71 and PMP75

Note!
When using a PMP75, the influence from the respective diaphragm seal must be taken into account.
(→ 🖹 70 ff "Planning instructions, diaphragm seal systems".

PMP71 and PMP75 (basic device), internal process isolating diaphragm

Measuring cell	Material of the process isolating diaphragm		–10 to +60°C (+14 to +140 °F)	–40 to –10 °C, +60 to +85 °C (–40 to +14 °F, +140 to +185 °F)
	316 L	Gold-rhodium	% of the set span	
400 mbar (6 psi)	x	x	±(0.2 x TD + 0.015)	±(0.4 x TD + 0.03)
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi)	x	x	±(0.1 x TD + 0.01)	±(0.4 x TD + 0.02)
40 bar (600 psi)	x	-	±(0.1 x TD + 0.01)	±(0.4 x TD + 0.02)
100 bar (1500 psi)	x	-	±(0.2 x TD + 0.015)	±(0.4 x TD + 0.03)
400 bar (6000 psi)	x	-	±(0.35 x TD + 0.02)	±(0.7 x TD + 0.04)
700 bar (10500 psi)	x	-	±(0.4 x TD + 0.03)	±(0.7 x TD + 0.04)

PMP71, flush-mounted process isolating diaphragm made of 316L with gold-rhodium coating

Measuring cell	–10 to +60°C (+14 to +140 °F)	–40 to –10 °C, +60 to +85 °C (–40 to +14 °F, +140 to +185 °F)
	% of the set span	
400 mbar (6 psi)	±(0.2 x TD + 0.015) x 5	±(0.4 x TD + 0.03) x 5
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi)	±(0.1 x TD + 0.01) x 5	±(0.4 x TD + 0.02) x 5
100 bar (1500 psi)	±(0.2 x TD + 0.015) x 5	±(0.4 x TD + 0.03) x 5
400 bar (6000 psi)	±(0.35 x TD + 0.02) x 5	±(0.7 x TD + 0.04) x 5
700 bar (10500 psi)	±(0.4 x TD + 0.03) x 5	±(0.7 x TD + 0.04) x 5

Operating conditions (Installation)

General installation instructions

- For PMP75: See → 📄 72, "Installation instructions" section.
- The position-dependent zero point shift can be corrected directly at the device via operating keys, and also in hazardous areas in the case of devices with external operation. Diaphragm seals also shift the zero point, depending on the installation position
  (→ See also → 📄 72, "Installation instructions" section).
- The housing of the Cerabar S can be rotated 380°. See → 📄 26, "Turning the housing" section.
- Endress+Hauser offers a mounting bracket for installing the device on pipes or walls.
  → See also → 📄 25, "Wall and pipe-mounting" section.
- Use flushing rings for flange and cell diaphragm seals if buildup or clogging can be expected at the diaphragm seal connection. The flushing ring can be fitted between the process connection and diaphragm seal. Material buildup in front of the process isolating diaphragm can be flushed away, and the pressure chamber vented, via the two lateral flushing holes.

Measuring arrangement for devices without diaphragm seals – PMC71, PMP71

Cerabar S transmitters without diaphragm seals are mounted as per the norms for a manometer (DIN EN 837-2). We recommend the use of shutoff devices and siphons. The orientation depends on the measuring application.

Pressure measurement in gases

- Mount Cerabar S with shutoff device above the tapping point so that any condensate can flow into the process.

Pressure measurement in steams

- Mount Cerabar S with siphon below the tapping point.
  The siphon reduces the temperature to almost the ambient temperature.
- Fill the siphon with liquid before commissioning.

Pressure measurement in liquids

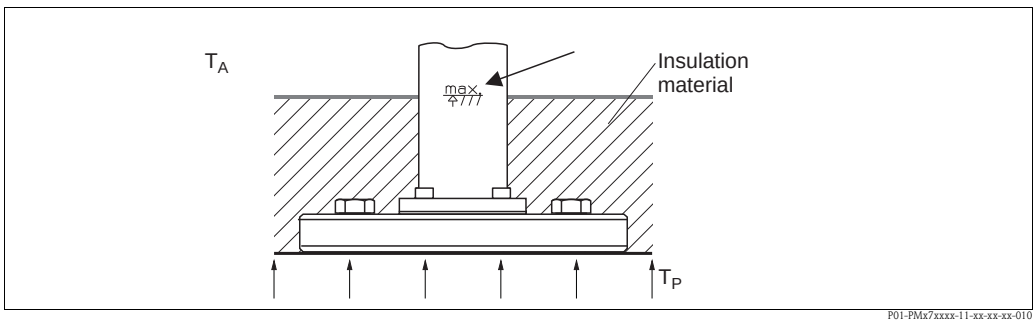
- Mount Cerabar S with shutoff device below or at the same level as the tapping point.

Level measurement

- Mount Cerabar S below the lowest measuring point.
- Do not mount the device at the following positions:
  In the filling curtain, in the tank outlet or at a point in the container which could be affected by pressure pulses from an agitator or a pump.
- The adjustment and functional test can be carried out more easily if you mount the device downstream of a shutoff device.

Heat insulation – PMC71 high-temperature version

The PMC71 high-temperature version must only be insulated up to a certain height. The maximum permitted insulation height is indicated on the devices and applies to an insulation material with a heat conductivity ≤ 0.04 W/(m x K) and to the maximum permitted ambient and process temperature (→ see table below). The data were determined under the most critical application "quiescent air".



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Maximum insulation height, here indicated on a PMC71 with a flange

	PMC71 high-temperature version
Ambient temperature (T_A)	≤ 70 °C (158 °F)
Process temperature (T_P)	≤ 150 °C (302 °F)

Measuring arrangement for devices with diaphragm seals – PMP75

- See → 📄 70, "Planning instructions, diaphragm seal systems" section.

Wall and pipe-mounting

Endress+Hauser offers a mounting bracket for installing the device on pipes or walls.
See also → 📄 76 ff, feature 110, "Additional option 2" or separate accessory (part number: 71102216).
For the dimensions, see → 📄 60.

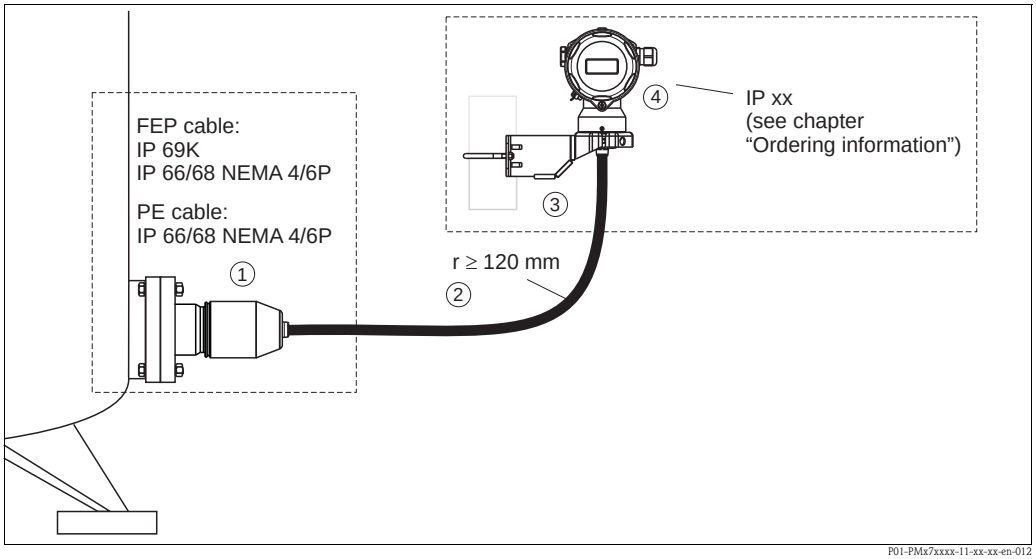
"Separate housing" version

With the "separate housing" version, you are able to mount the housing with the electronics insert at a distance from the measuring point. This version facilitates trouble-free measurement:
- Under particularly difficult measuring conditions (at installation locations that are cramped or difficult to access)
- If rapid cleaning of the measuring point is required
- If the measuring point is exposed to vibrations
- For compact installations

You can choose between different cable versions:
- PE (2 m (6.6 ft), 5 m (16 ft) and 10 m (33 ft))
- FEP (5 m (16 ft)).

→ 📄 78 ff, feature 110, "Additional option 2", version "G".

For the dimensions, → 📄 60.



In the case of the "separate housing" version, the sensor is delivered with the process connection and cable ready mounted. The housing and a mounting bracket are enclosed as separate units. The cable is provided with a socket at both ends. These sockets are simply connected to the housing and the sensor.

1 Process connection with sensor
2 Cable, both ends are fitted with a socket
3 Mounting bracket provided, suitable for pipe and wall mounting
4 Housing with electronic insert

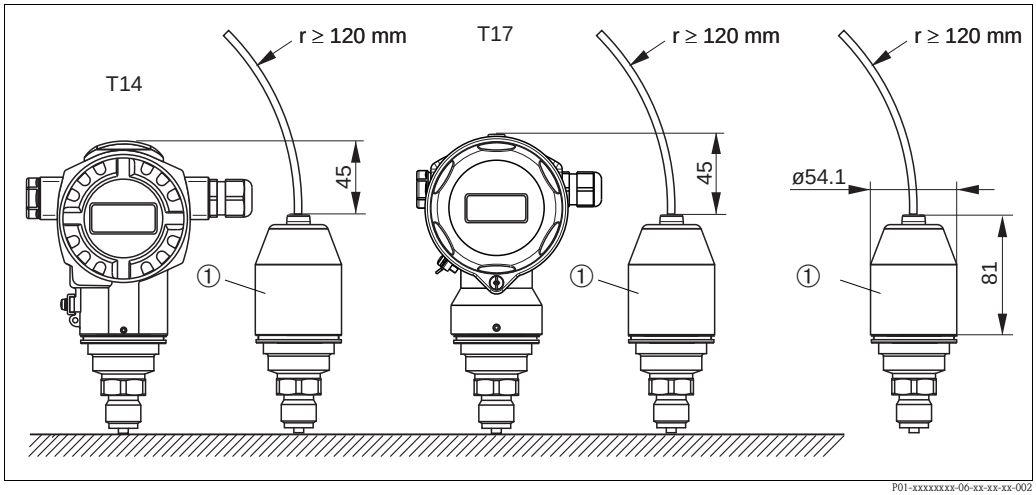
Degree of protection for the process connection and sensor with the use of
- FEP cable:
  - IP 69K
  - IP 66 NEMA 4/6P
  - IP 68 (1.83 mH_2O for 24 h) NEMA 4/6P
- PE cable:
  - IP 66 NEMA 4/6P
  - IP 68 (1.83 mH_2O for 24 h) NEMA 4/6P

Technical data of the PE and FEP cable:
- Minimum bending radius: 120 mm (4.72 in)
- Cable extraction force: max. 450 N (101 lbf)
- Resistance to UV light

Use in hazardous area:
- Intrinsically safe installations (Ex ia/IS)
- FM/CSA IS: for Div. 1 installation only

Reduction of the installation height

If the separate housing is used, the installation height of the process connection is reduced compared to the dimensions of the standard version.

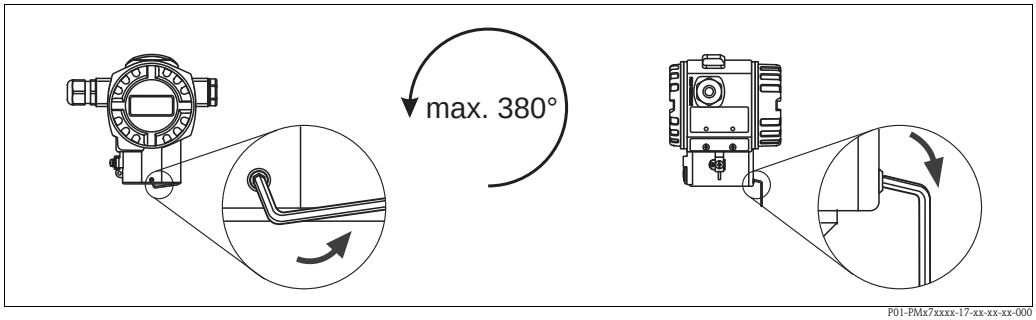


Reduction of the installation height of the process connection when using the separate housing.
1 Process connection adapter.

Turning the housing

The housing can be rotated 380° by loosening the Allen screw.

Your benefits
- Simple mounting by optimally aligning the housing
- Good, accessible device operation
- Optimum readability of the onsite display (optional).



Aligning the housing by releasing the setscrew
T14 housing: 2 mm (0.08 in) Allen screw; T17 housing: 3 mm (0.12 in) Allen screw

Oxygen applications

Oxygen and other gases can react explosively to oils, grease and plastics, such that, among other things, the following precautions must be taken:
– All components of the system, such as measuring devices, must be cleaned in accordance with the BAM (DIN 19247) requirements.
– Dependent on the materials used, a certain maximum temperature and a maximum pressure for oxygen applications must not be exceeded.

The devices suitable for gaseous oxygen applications are listed in the following table with the specification p_{max}.

Order code for devices [1]cleaned for oxygen applications	p_{max} for oxygen applications	T_{max} for oxygen applications
PMC71 – * * * ** * ** 2 * *, Devices with sensors, nominal value < 10 bar (150 psi)	Over pressure limit (OPL) of sensor[2, 3]	60 °C (140 °F)
PMC71 – * * * ** * ** 2 * *, Devices with sensors, nominal value ≥ 10 bar (150 psi)	30 bar (450 psi)	60 °C (140 °F)
PMP71 – * * * ** * * ** N * *	Dependent on the lowest-rated element, with regard to pressure, of the selected components: over pressure limit (OPL) of the sensor[1], process connection (1.5 x PN) or fill fluid (160 bar (2400 psi))	85 °C (185 °F)
PMP75 – * * * ** * * * ** N * *	Dependent on the lowest-rated element, with regard to pressure, of the selected components: over pressure limit (OPL) of the sensor[1], process connection (1.5 x PN) or fill fluid (160 bar (2400 psi))	85 °C (185 °F)

1) Only devices, not accessories or enclosed accessories.

2) → 📄 76 ff "Ordering information", feature 40 "Sensor range; Sensor over pressure limit (= OPL)

3) PMC71 with PVDF thread or flange p_{max} = 15 bar (225 psi)

Silicone-free applications

Special cleaning of the transmitter to remove paint-wetting substances, for use in paint shops → 📄 78 "Ordering information PMC71", feature 80 "Seal", version "L" and "M".

Ultrapure gas applications

Endress+Hauser also offers devices for special applications, such as ultrapure gas, cleaned from oil and grease. No special restrictions regarding the process conditions apply to these devices.

→ 📄 76, "Ordering information PMC71", feature 80 "Seal" or → 📄 82, "Ordering information PMP71", feature 90 "Fill fluid".

Applications with hydrogen

With regard to materials in which hydrogen formation takes place, hydrogen atoms can diffuse through the metal process isolating diaphragm. This can result in incorrect measurement results.
Endress+Hauser offers process isolating diaphragms with gold-rhodium coating for this application.

→ 📄 80 "Ordering information PMP71" and → 📄 84 "Ordering information PMP75", feature 60 "Membrane material" version "6".

Operating conditions (Environment)

Ambient temperature range

Version	PMC71 high-temperature version	PMC71	PMP71 [1]	PMP75 [1]
Without LCD display	–20 to +70 °C (-4 to +158 °F)	–40 to +85 °C (-40 to +185 °F)		
With LCD display [2]		–20 to +70 °C (-4 to +158 °F)		
With M12 connector, elbowed		-25 to +85 °C (-13 to +185 °F)		
With separate housing	–20 to +50 °C (-40 to +140 °F) (installation without insulation)			—
Diaphragm seal systems	—	—	—	→ 🖹 70

1) Lower temperatures on request

2) Extended temperature application range (-40 °C to +85 °C (-40 °F to +185 °F)) with restrictions in optical properties such as display speed and contrast

Note!
For high-temperature applications, either a PMP75 with a temperature isolator or with a capillary can be used. If vibrations also occur in the application, Endress+Hauser recommends using a PMP75 with a capillary. If a PMP75 with a temperature isolator or capillary is used, we recommend a suitable retaining unit for mounting (see "Wall and pipe-mounting" section on → 🖹 25).

For devices for use in hazardous areas, see Safety Instructions, Installation or Control Drawing. (→ 🖹 89 ff, "Safety Instructions" and "Installation/Control Drawings" sections)

Storage temperature range

- –40 to +90 °C (-40 to +194 °F)
- Onsite display: –40 to +85 °C (-40 to +185 °F)
- Separate housing: -40 to +60 °C (-40 to +140 °F)

Degree of protection

- → See Page 76 ff, feature 30 "Housing; Cable entry; Protection".
- Degree of protection IP 68 for T17 housing: 1.83 mH_2O for 24 h
- Separate housing → 🖹 25

Climate class

Class 4K4H (air temperature: –20 to 55 °C (-4 to 131 °F), relative humidity: 4 to 100 %)
fulfilled as per DIN EN 60721-3-4 (condensation possible. With PMC71, avoid condensate in the device).

Vibration resistance

Device/accessory	Test standard	Vibration resistance
PMC71 [1]	GL	Guaranteed for 3 to 25 Hz: ±1.6 mm (0.063 in); 25 to 100 Hz: 4 g in all 3 planes
PMP71		
PMP75 [2, 3]		
With mounting bracket	IEC 61298-3	Guaranteed for 10 to 60 Hz: ±0.15 mm (0.0059 in); 60 to 500 Hz: 2 g in all 3 planes

1) Not for high-temperature version with Ex d[ia], CSA XP or FM XP

2) With aluminum T14 housing only

3) For high-temperature applications, either a PMP75 with a temperature isolator or with a capillary can be used. If vibrations also occur in the application, Endress+Hauser recommends using a PMP75 with a capillary. If a PMP75 with a temperature isolator or capillary is used, it must be mounted with a mounting bracket (→ 🖹 25).

Electromagnetic compatibility

- Electromagnetic compatibility to EN 61326 and NAMUR recommendation EMC (NE21). For details refer to the Declaration of Conformity.
- With enhanced immunity against electromagnetic fields as per EN 61000-4-3: 30 V/m with closed cover [1]
- Maximum deviation: < 0.5 % of span
- All EMC measurements were performed with a turn down (TD) = 2:1.

1) For devices with T14 housing

Overvoltage protection (optional)

- Overvoltage protection:
  - Nominal functioning DC voltage: 600 V
  - Nominal discharge current: 10 kA
- Surge current check $\hat{i}$ = 20 kA as per DIN EN 60079-14: 8/20 µs satisfied
- Arrester AC current check I = 10 A satisfied

→ 📄 76 ff, feature 100 "Additional option 1" and feature 110 "Additional option 2", version "M Overvoltage protection".

Note!
Devices with integrated overvoltage protection must be grounded.

Operating conditions (Process)

Process temperature limits

PMC71 (with ceramic process isolating diaphragm)

- –25 to +125 °C (–13 to +257 °F)
- High-temperature version: –20 to +150 °C (–4 to +302 °F); → 76, feature 100 "Additional option 1", version "T".
- With applications involving saturated steam, a Cerabar S with a metal process isolating diaphragm must be used, or a siphon for temperature isolation should be provided during installation.
- Observe the process temperature range of the seal in the following table.

Versions for feature 80 in the order code	Seal	Process temperature range
A, L	FKM Viton	–25 to +125 °C/150 °C (-13 to +257 °F/302 °F) [1]
B[2]	EPDM (FDA 21CFR177.2600; 3A Class II; USP Class VI) DVGW (KTW, W270, W534), WRAS, ACS, NSF61	–20 to +125 °C/150 °C (-13 to +257 °F/302 °F) [1]
B	EPDM	–20 to +125 °C (-4 to +257 °F)
D, M	Kalrez, Compound 4079	+5 to +125 °C/150 °C (-41 to +257 °F/302 °F) [1]
E	Chemraz, Compound 505	–10 to +125 °C/150 °C (14 to +257 °F/302 °F) [1]
F[2]	HNBR (FDA 21CFR177.2600; 3A Class II; KTW; AFNOR; BAM)	–25 to +125 °C (-13 to +257 °F
F	NBR	–10 to +100 °C (14 to +212 °F)
G	FKM Viton, FDA	–5 to +125 °C (-23 to +257 °F)
1	FKM Viton, cleaned from oil and grease	–10 to +125 °C/150 °C (14 to +257 °F/302 °F) [1]
2	FKM Viton, cleaned for oxygen service	–10 to +60 °C (14 to +140 °F)
The process temperature ranges specified here refer to permanent application of the PMC71. They may be exceeded for a short time (e.g. for cleaning).		

1) 150 °C (302 °F): for high-temperature version

2) These seals are used for devices with 3A-approved process connections.

Applications with jumps in temperature

Extreme jumps in temperature can result in temporary measuring errors. Temperature compensation takes effect after several minutes. Internal temperature compensation is faster the smaller the jump in temperature and the longer the time interval involved.
For further information please contact your local Endress+Hauser Sales Center.

PMP71 (with metal process isolating diaphragm)

Description	Temperature operating range
Process connections with internal process isolating diaphragm	–40 to +125 °C (-40 to +257 °F) (+150 °C (302 °F) for max. one hour)
Process connections with flush-mounted process isolating diaphragm, G 1 A, G 1 1/2 A, G 2 A, 1 NPT, 1 1/2 NPT, 2 NPT, M 44 x 1.25, EN/DIN, ANSI and JIS flanges	–40 to +100 °C (-40 to +212 °F)
Process connections with flush-mounted process isolating diaphragm, G 1/2 A, M20x1.5	–20 to +85 °C (-4 to 185 °F)

PMP75 (with diaphragm seal)

- Depending on the diaphragm seal and filling oil from -70 °C (-94 °F) to +400 °C (+752 °F). Observe the temperature application limits → 🖹 70.

Note!
- Do not use diaphragm seals with 0.09 mm (0.0035 in) PTFE foil on AISI 316L (1.4435/1.4404) for vacuum applications, upper temperature limit +204 °C (+399 °F).
- For oxygen applications, observe → 🖹 27, "Oxygen applications" section.

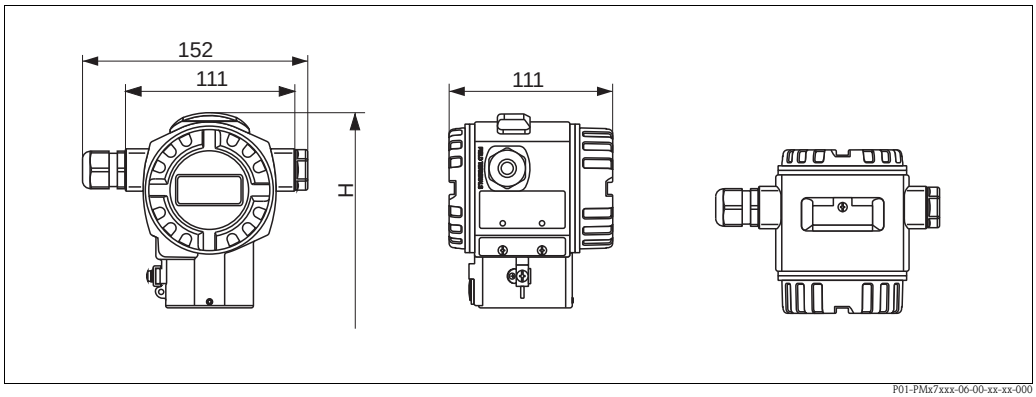
Pressure specifications

- The maximum pressure for the measuring device depends on the lowest-rated element with regard to pressure.
  See the following sections:
  – → 🖹 7 ff, "Measuring range" section
  – "Mechanical construction" section.
  The MWP (maximum working pressure) is specified on the nameplate. This value refers to a reference temperature of 20°C (68°F), or 100°F (38 °C) for ANSI flanges, and may be applied to the device for an unlimited time. Observe the temperature dependency of the MWP.
- The pressure values permitted at higher temperatures can be found in the following standards:
  – EN 1092-1: 2001 Tab. 18 [1]
  – ASME B 16.5a – 1998 Tab. 2-2.2 F316
  – ASME B 16.5a – 1998 Tab. 2.3.8 N10276
  – JIS B 2220
- The test pressure corresponds to the over pressure limit of the device (OPL = 1.5 x MWP [2]) and may be applied for only a limited time period in order to avoid permanent damage.
- The Pressure Equipment Directive (EC Directive 97/23/EC) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the measuring device.
- In the case of sensor range and process connections where the over pressure limit (OPL) of the process connection is smaller than the nominal value of the sensor, the device is set at the factory, at the very maximum, to the OPL value of the process connection. If you want to use the entire sensor range, select a process connection with a higher OPL value (1.5 x PN; MWP = PN).
- In oxygen applications, the values for "p_{max} and T_{max} for oxygen applications" as per → 🖹 27, "Oxygen applications" may not be exceeded.

1) With regard to their stability-temperature property, the materials 1.4435 and 1.4404 are grouped together under 13EO in EN 1092-1: 2001 Tab. 18. The chemical composition of the two materials can be identical.
2) The equation does not apply for PMP71 and PMP75 with a 40 bar (600 psi) or 100 bar (1500 psi) measuring cell.

Mechanical construction

Dimensions of T14 housing, optional display on the side



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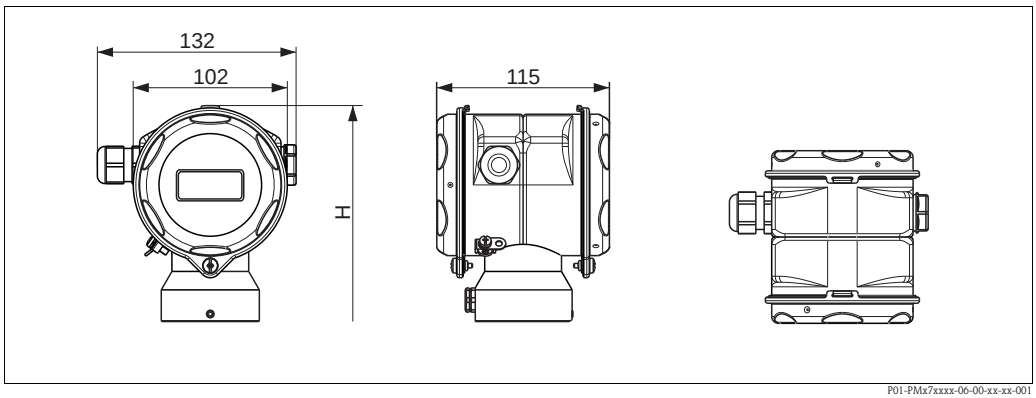
Front view, left-hand side view, top view
→ Installation height H, see process connection in question. Housing weight → 60.

Dimensions of T17 housing (hygienic), optional display on the side



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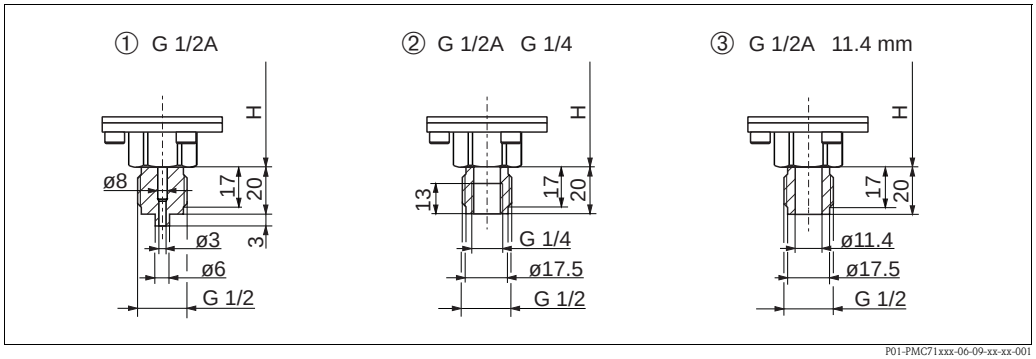
Front view, left-hand side view, top view
→ Installation height H, see process connection in question. Housing weight → 60.

Process connections PMC71 (with ceramic process isolating diaphragm)

Thread, internal process isolating diaphragm

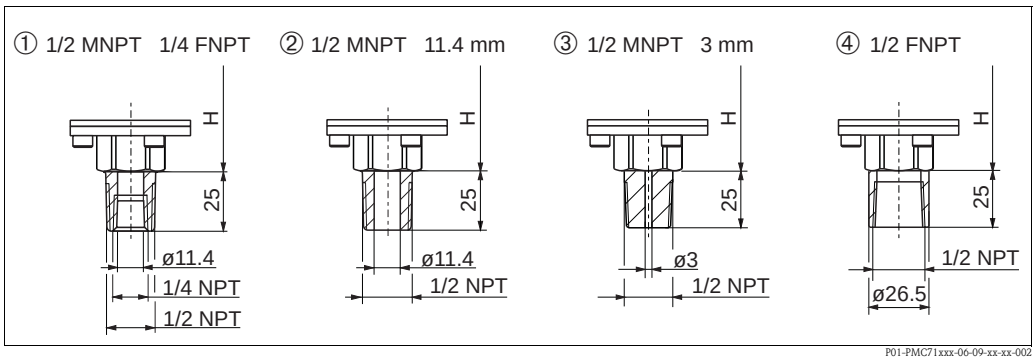


Process connections PMC71, thread ISO 228
Installation height → 📄 34.

1 Thread ISO 228 G 1/2 A EN 837;
Material version GA: AISI 316L, version GB: Alloy C276, version GC: Monel,
version GD: PVDF (max.: 15 bar (225 psi), –10 to +60 °C/+14 to +140 °F), only mount version "GD" with a mounting bracket (→ see also Page 25); weight: 0.63 kg (1.39 lbs)

2 Thread ISO 228 G 1/2 A G 1/4 (female);
Material version GE: AISI 316L, version GF: Alloy C276, version GG: Monel;
Weight: 0.63 kg (1.39 lbs)

3 Thread ISO 228 G 1/2 A hole 11.4 mm;
Material version GH: AISI 316L, version GJ: Alloy C276, version GK: Monel;
Weight: 0.63 kg (1.39 lbs)



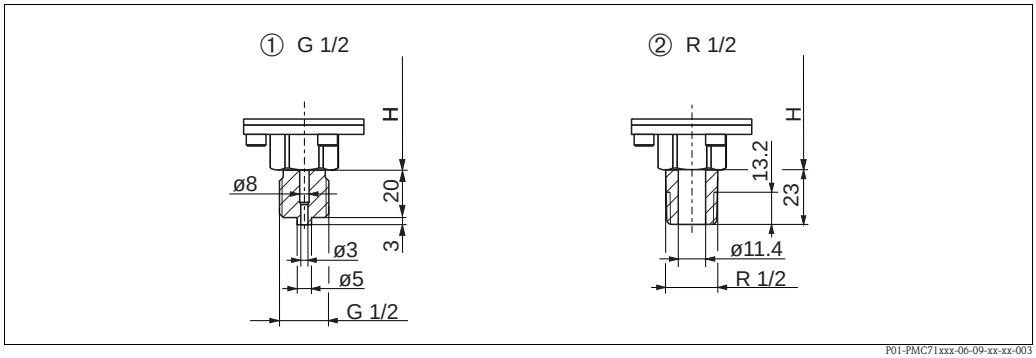
Process connections PMC71, thread ANSI
Installation height → 📄 34.

1 Thread ANSI 1/2 MNPT 1/4 FNPT;
Material version RA: AISI 316L, version RB: Alloy C276, version RC: Monel;
Weight: 0.63 kg (1.39 lbs)

2 Thread ANSI 1/2 MNPT hole 11.4 (0.45 in);
Material version RD: AISI 316L, version RE: Alloy C276, version RF: Monel;
Weight: 0.63 kg (1.39 lbs)

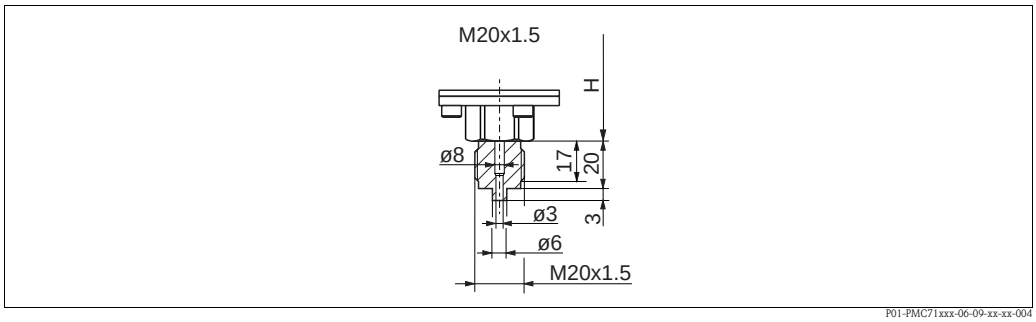
3 Thread ANSI 1/2 MNPT hole 3 mm (0.12 in);
Material version RG: PVDF (max.: 15 bar (225 psi), –10 to +60 °C/+14 to +140 °F) - only mount with a mounting bracket
(→ 📄 25); Weight: 0.63 kg (1.39 lbs)

4 Thread ANSI 1/2 FNPT;
Material version RH: AISI 316L, version RJ: Alloy C276, version RK: Monel;
Weight: 0.63 kg (1.39 lbs)



Process connections PMC71, thread JIS
Installation height H → 🖹 34.

1 Version GL: thread JIS B0202 G 1/2 (male), material: AISI 316L; weight: 0.63 kg (1.39 lbs)
2 Version RL: thread JIS B0203 R 1/2 (male), material: AISI 316L; weight: 0.63 kg (1.39 lbs)

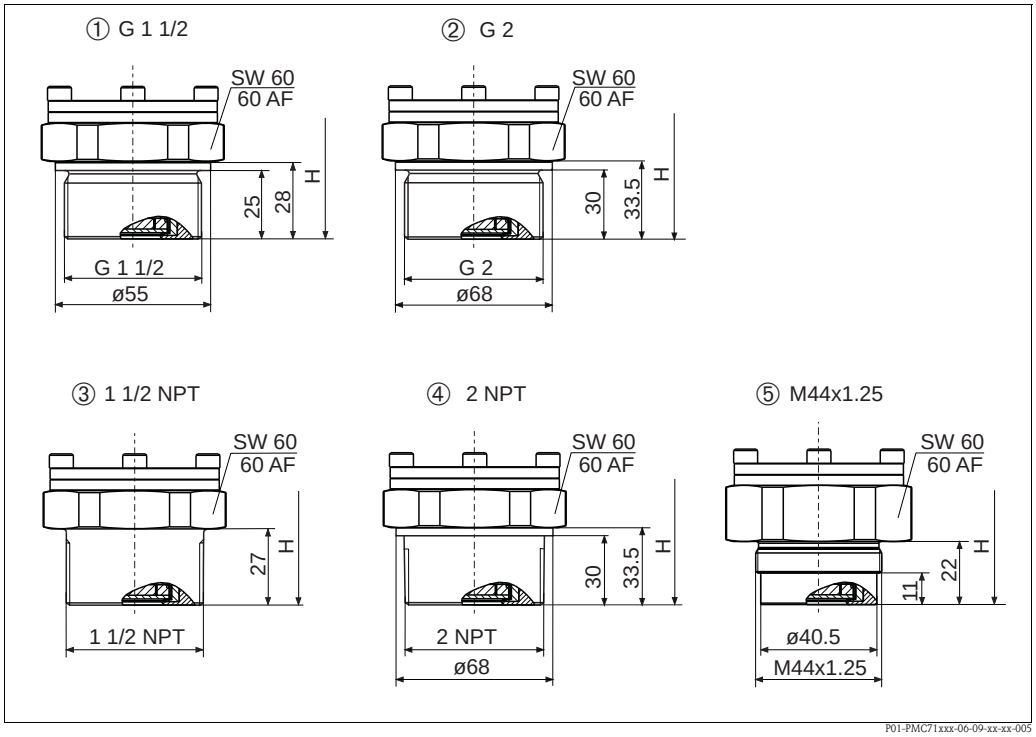


Process connections PMC71 thread DIN 13 M 20x1.5 hole 3 mm (0.12 in)
Material version GP: AISI 316L, version GQ: Alloy C276; weight: 0.63 kg (1.39 lbs)
Installation height H → 🖹 34.

Installation height H for devices with threaded connection and internal process isolating diaphragm

Description	T14 housing	T17 housing
PMC71	155 mm (6.1 in)	171 mm (6.73 in)
PMC71 with Ex d[ia], CSA XP or FM XP	225 mm (8.86 ft)	241 mm (9.94 in) (Ex d = 311 mm (12.2 in))
PMC71 high-temperature version	235 mm (9.25 in)	251 mm (9.88 in)
PMC 71 high-temperature version with Ex d[ia], CSA XP or FM XP	305 mm (12 in)	321 mm (12.6 in) (Ex d = 391 mm (15.4 in))

Thread, flush-mounted process isolating diaphragm



Process connections PMC71,
→ Installation height see table below.

1 Thread ISO 228 G 1 1/2 A;
Material version 1G: AISI 316L, version 1H: Alloy C276, version 1J: Monel;
Weight: 0.63 kg (1.39 lbs)

2 Thread ISO 228 G 2 A;
Material version 1K: AISI 316L, version 1L: Alloy C276, version 1M: Monel;
Weight: 0.63 kg (1.39 lbs)

3 Thread ANSI 1 1/2 MNPT;
Material version 2D: AISI 316L, version 2E: Alloy C276, version 2F: Monel;
Weight: 0.63 kg (1.39 lbs)

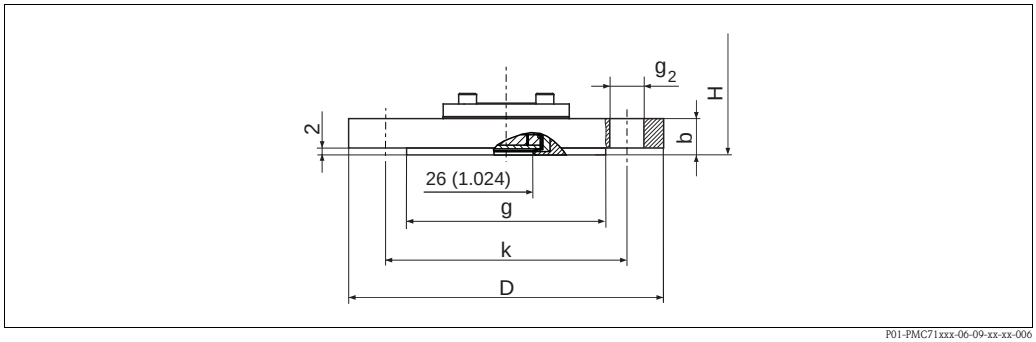
4 Thread ANSI 2 MNPT;
Material version 2G: AISI 316L, version 2H: Alloy C276, version 2J: Monel;
Weight: 0.63 kg (1.39 lbs)

5 Thread DIN 13 M 44x1.25;
Material version 1R: AISI 316L, version 1S: Alloy C276; weight: 0.63 kg (1.39 lbs)

Installation height H for devices with threaded connection and flush-mounted process isolating diaphragm

Description	T14 housing	T17 housing
PMC71/PMC71 high-temperature version	215 mm (8.46 in)	231 mm (9.09 in)
PMC71/PMC71 high-temperature version: with Ex d[ia], CSA XP or FM XP	280 mm (11 in)	296 mm (11.7 in)

EN/DIN flanges, connection dimensions as per EN 1092-1/DIN 2527



Process connection PMC71, EN/DIN flange with raised face (flush-mounted process isolating diaphragm)
Installation height H → 📄 38.

	Flange [1]							Boltholes			
Version	**Material**	**Nominal diameter**	**Nominal pressure**	**Shape[2]**	**Diameter** **D** [mm]	**Thickness** **b** [mm]	**Raised face** **g** [mm]	**Quantity**	**Diameter** **g_2** [mm]	**Hole circle** **k** [mm]	**Flange weight [3]** [kg]
CP	AISI 316L	DN 32	PN 10-40	B1 (D)	140	18	77	4	18	100	1.9
CQ	AISI 316L	DN 40	PN 10-40	B1 (D)	150	18	87	4	18	110	2.2
BR	PVDF [4]	DN 50	PN 10-16	B1 (D)	165	21.4	102	4	18	125	0.6
B3	AISI 316L	DN 50	PN 10-40	B1 (D)	165	20	102	4	18	125	3.0
C3	AISI 316L	DN 50	PN 63 (64)	B2 (D)	180	26	102	4	22	135	4.6
BS	PVDF[4]	DN 80	PN 10-16	B1 (D)	200	21.4	138	8	18	160	1.0
B4	AISI 316L	DN 80	PN 10-40	B1 (D)	200	24	138	8	18	160	5.4

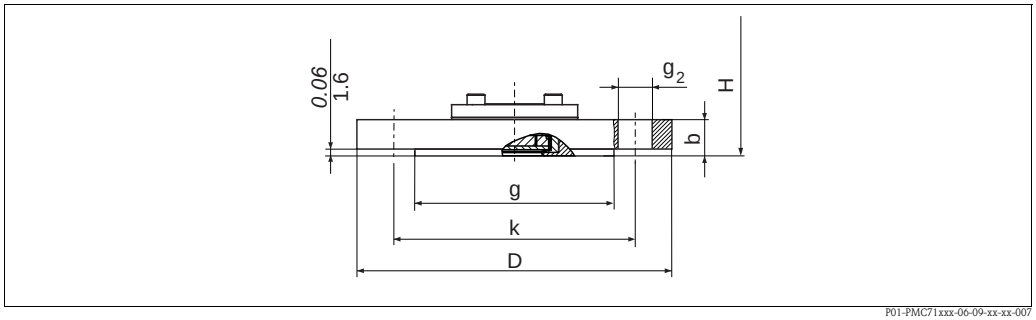
1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Hastelloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

2) Designation as per DIN 2527 in brackets

3) Housing weight → 📄 60

4) Max.: 15 bar (225 psi), –10 to +60 °C (+14 to +140 °F)

ANSI flanges, connection dimensions as per ANSI B 16.5, raised face RF



Process connection PMC71, ANSI flange with raised face RF (flush-mounted process isolating diaphragm)
Installation height H → 🖹 38.

	Flange [1]						Boltholes			
Version	**Material**	**Nominal diameter**	**Class**	**Diameter D**	**Thickness b**	**Raised face g**	**Quantity**	**Diameter g_2**	**Hole circle k**	**Flange weight [2]**
		[in]	[lb./sq.in]	[in (mm)]	[in (mm)]	[in (mm)]		[in (mm)]	[in (mm)]	[kg]
AE	AISI 316/316L [3]	1 1/2	150	5 (127)	0.69 (17.5)	2.88 (73.2)	4	0.62 (15.7)	3.88 (98.6)	1.0
AQ	AISI 316/316L [3]	1 1/2	300	6.12 (155.4)	0.81 (20.6)	2.88 (73.2)	4	0.88 (22.4)	4.5 (114.3)	2.6
AF	AISI 316/316L[3]	2	150	6 (152.4)	0.75 (19.1)	3.62 (91.9)	4	0.75 (19.1)	4.75 (120.7)	2.4
JR	ECTFE [4]	2	150	6 (152.4)	0.75 (19.1)	3.62 (91.9)	4	0.75 (19.1)	4.75 (120.7)	2.4
A3	PVDF[5]	2	150	6 (152.4)	0.75 (19.1)	3.62 (91.9)	4	0.75 (19.1)	4.75 (120.7)	0.5
AR	AISI 316/316L [3]	2	300	6.5 (165.1)	0.88 (22.4)	3.62 (91.9)	8	0.75 (19.1)	5 (127)	3.2
AG	AISI 316/316L [3]	3	150	7.5 (190.5)	0.94 (23.9)	5 (127)	4	0.75 (19.1)	6 (152.4)	4.9
JS	ECTFE [4]	3	150	7.5 (190.5)	0.94 (23.9)	5 (127)	4	0.75 (19.1)	6 (152.4)	4.9
A4	PVDF[5]	3	150	7.5 (190.5)	0.94 (23.9)	5 (127)	4	0.75 (19.1)	6 (152.4)	0.9
AS	AISI 316/316L [3]	3	300	8.25 (209.5)	1.12 (28.4)	5 (127)	8	0.88 (22.4)	6.62 (168.1)	6.8
AH	AISI 316/316L [3]	4	150	9 (228.6)	0.94 (23.9)	6.19 (157.2)	8	0.75 (19.1)	7.5 (190.5)	7.1
JT	ECTFE [4]	4	150	9 (228.6)	0.94 (23.9)	6.19 (157.2)	8	0.75 (19.1)	7.5 (190.5)	7.1
AT	AISI 316/316L [3]	4	300	10 (254)	1.25 (31.8)	6.19 (157.2)	8	0.88 (22.4)	7.88 (200.2)	11.6

1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Hastelloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

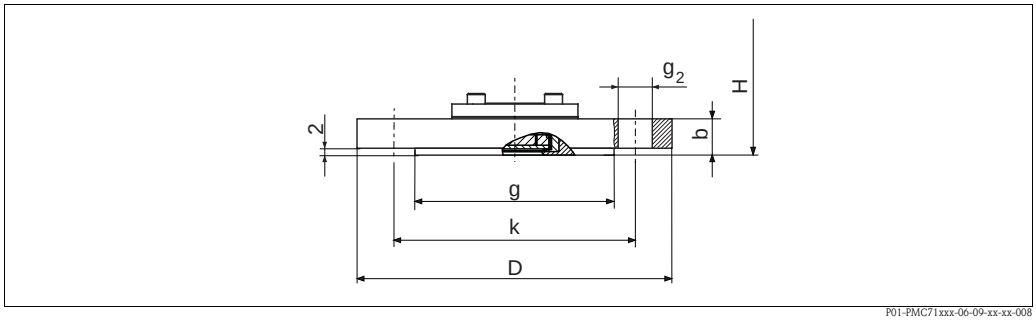
2) Housing weight → 🖹 60

3) Combination of AISI 316 for required pressure resistance and AISI 316L for required chemical resistance (dual rated)

4) ECTFE coating on AISI 316/316L. When operating in hazardous areas, avoid electrostatic charge of the plastic surfaces.

5) Max.: 15 bar (225 psi), –10 to +60 °C (+14 to +140 °F)

JIS flanges, connection dimensions as per JIS B 2220 BL, raised face RF



Process connection PMC71, JIS flange with raised face RF (flush-mounted process isolating diaphragm), material: AISI 316L (1.4435)
→ Installation height H, see table below.

	Flange [1]					Boltholes			
Version	**Nominal diameter**	**Nominal pressure**	**Diameter** **D** [mm]	**Thickness** **b** [mm]	**Raised face** **g** [mm]	**Quantity**	**Diameter** **g_2** [mm]	**Hole circle** **k** [mm]	**Flange weight [2]** [kg]
KF	50 A	10 K	155	16	96	4	19	120	2.0
KL	80 A	10 K	185	18	127	8	19	150	3.3
KH	100 A	10 K	210	18	151	8	19	175	4.4

1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Alloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

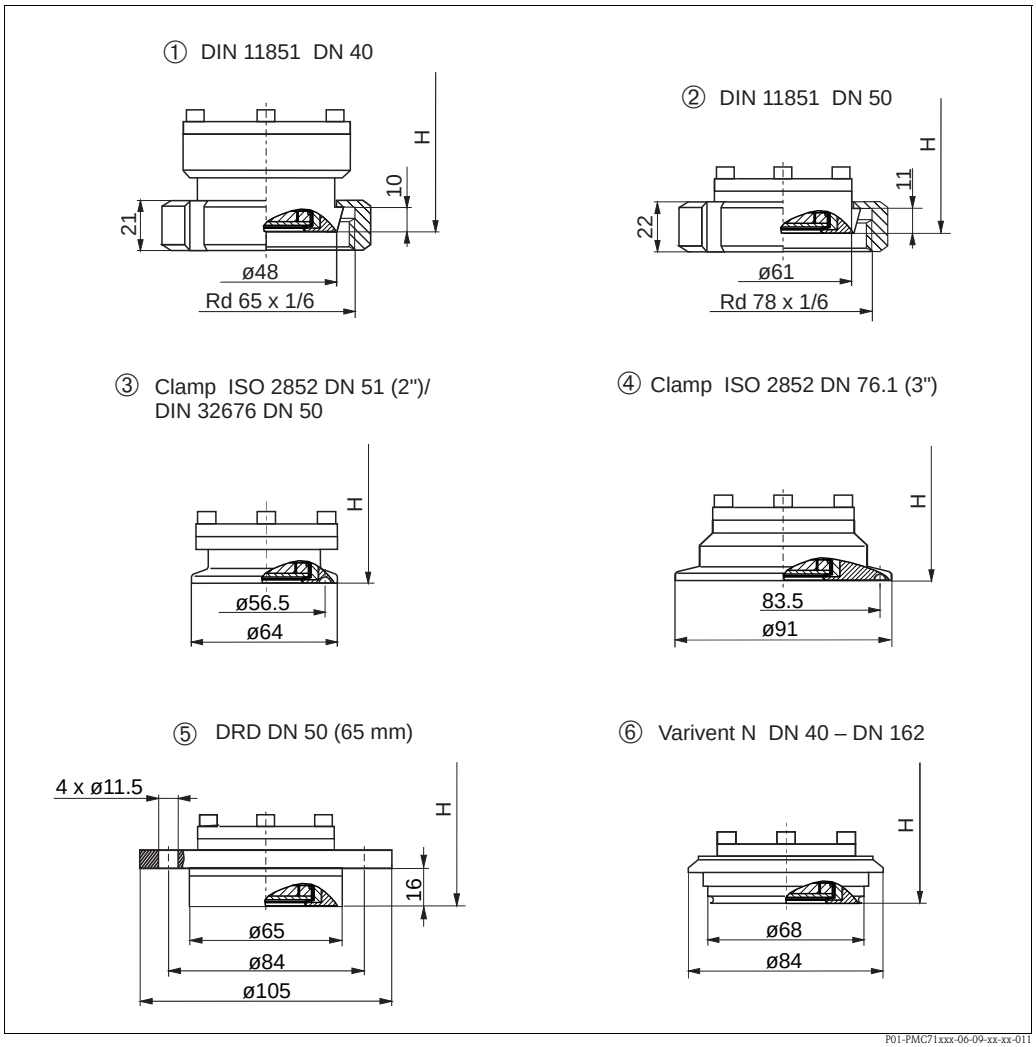
2) Housing weight see → 🗎 60

Installation height H for devices with flange

Description	T14 housing	T17 housing
PMC71	215 mm (8.46 in)	231 mm (9.09 in)
PMC71 with Ex d[ia], CSA XP or FM XP	280 mm (11 in)	296 mm (11.7 in)

Hygienic connections, flush-mounted process isolating diaphragm

Note!
Many process connections with an EPDM or HNBR seal are approved for the PMC71 in accordance with the guidelines of the 3A Sanitary Standard. To ensure that the 3A approval is valid for the PMC71 version, a 3A-approved process connection together with an EPDM or HNBR seal must be selected when ordering → 🖹 78 "Ordering information PMC71", feature 80 "Seal", version B or F.



Process connections PMC71, hygienic connections, material AISI 316L
Surface roughness of the surfaces in contact with the medium $R_a \leq 0.8\,\mu m$ (31.5 µin) as standard. Lower surface roughness on request.

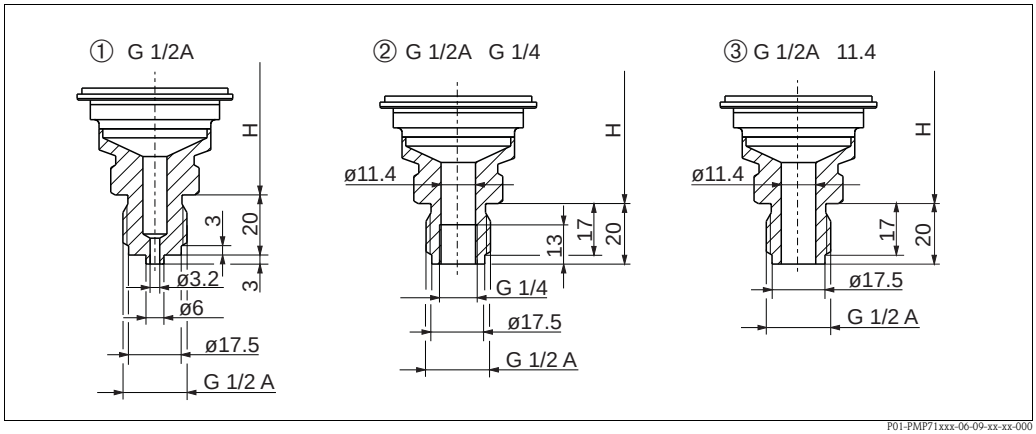
1 Version MP: DIN 11851 DN 40 PN 25, 3A with HNBR or EPDM seal
2 Version MR: DIN 11851 DN 50 PN 25, 3A with HNBR or EPDM seal
3 Version TD: Tri-Clamp ISO 2852 (2"), DIN 32675 DN 50, 3A with HNBR or EPDM seal
4 Version TF: Tri-Clamp ISO 2852 (3"), 3A with HNBR or EPDM seal
5 Version TK: DRD DN 50 (65 mm) PN 25, 3A with HNBR or EPDM seal
6 Version TR: Varivent type N for pipes 40 – 162, PN 40, 3A with HNBR or EPDM seal

Installation height H for devices with hygienic connection and flush-mounted process isolating diaphragm

Description	T14 housing	T17 housing
PMC71/PMC71 high-temperature version	215 mm (8.46 in)	231 mm (9.09 in)
PMC71/PMC71 high-temperature version: with Ex d[ia], CSA XP or FM XP	280 mm (11 in)	296 mm (11.7 in)

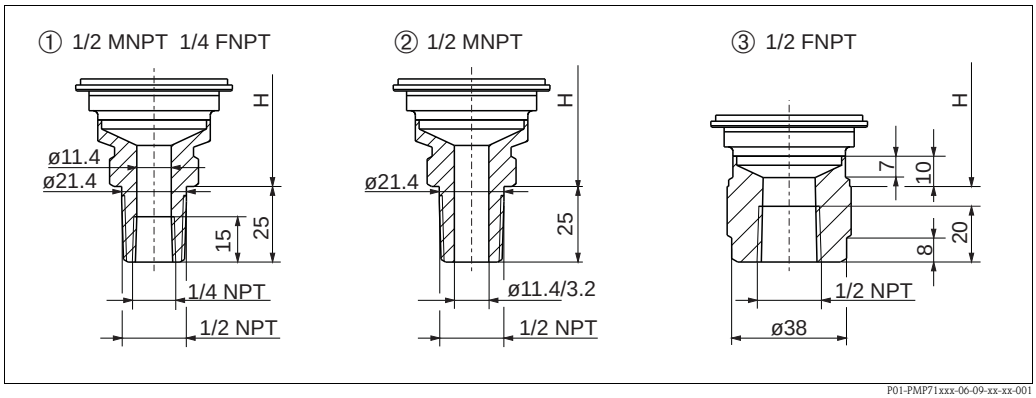
Process connections PMP71 (with metal process isolating diaphragm)

Thread, internal process isolating diaphragm



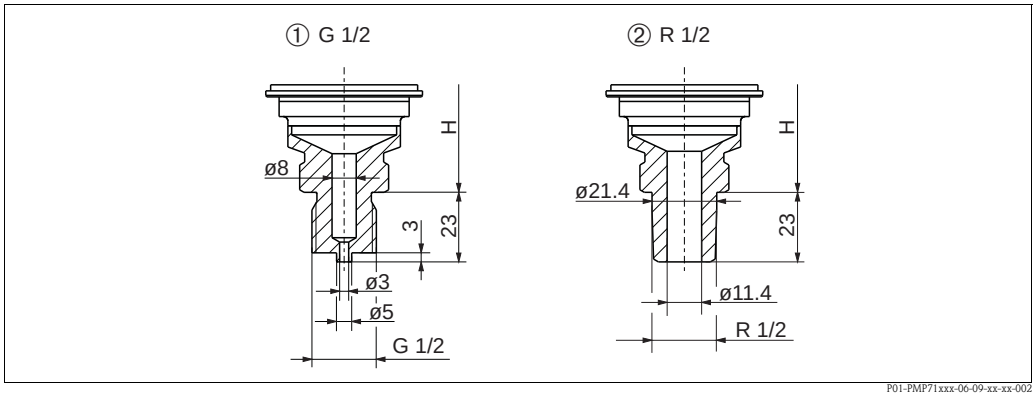
Process connections PMP71, thread ISO 228
Installation height H → 🖹 41.

1 Thread ISO 228 G 1/2 A EN 837;
Material version GA: AISI 316L, version GB: Alloy C276; weight: 0.6 kg (1.32 lbs)
2 Thread ISO 228 G 1/2 A G 1/4 (female);
Material version GE: AISI 316L, version GF: Alloy C276; weight: 0.6 kg (1.32 lbs)
3 Thread ISO 228 G 1/2 A hole 11.4 mm (0.45 in);
Material version GH: AISI 316L, version GJ: Alloy C276; weight: 0.6 kg (1.32 lbs)



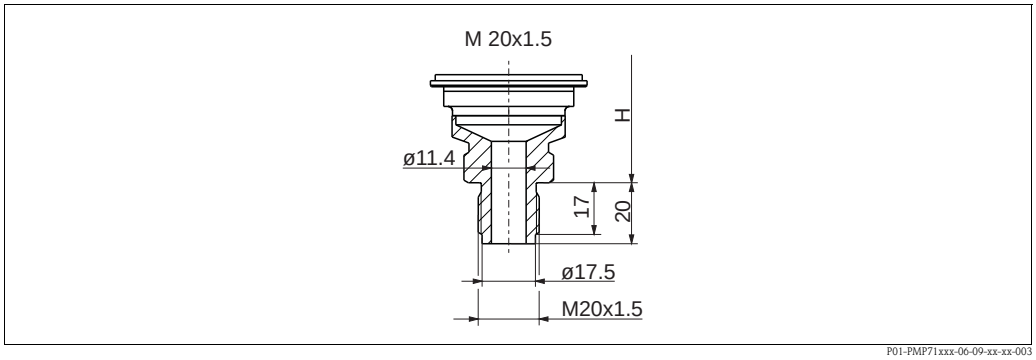
Process connections PMP71, thread ANSI
Installation height H → 🖹 41.

1 Thread ANSI 1/2 MNPT 1/4 FNPT;
Material version RA: AISI 316L, version RB: Alloy C276; weight: 0.6 kg (1.32 lbs)
2 Thread ANSI 1/2 MNPT hole: 400 bar (6000 psi) = 11.4 mm (0.45 in);
700 bar (10500 pis) = 3.2 mm (0.13 in)
Material version RD: AISI 316L, version RE: Alloy C276; weight: 0.6 kg (1.32 lbs)
3 Thread ANSI 1/2 FNPT;
Material version RH: AISI 316L, version RJ: Alloy C276; weight: 0.7 kg (1.54 lbs)



Process connections PMP71, thread JIS
→ Installation height H see table below.

1 Version GL: thread JIS B0202 G 1/2 (male), material: AISI 316L; weight: 0.6 kg (1.32 lbs)
2 Version RL: thread JIS B0203 R 1/2 (male), material: AISI 316L; weight: 0.6 kg (1.32 lbs)

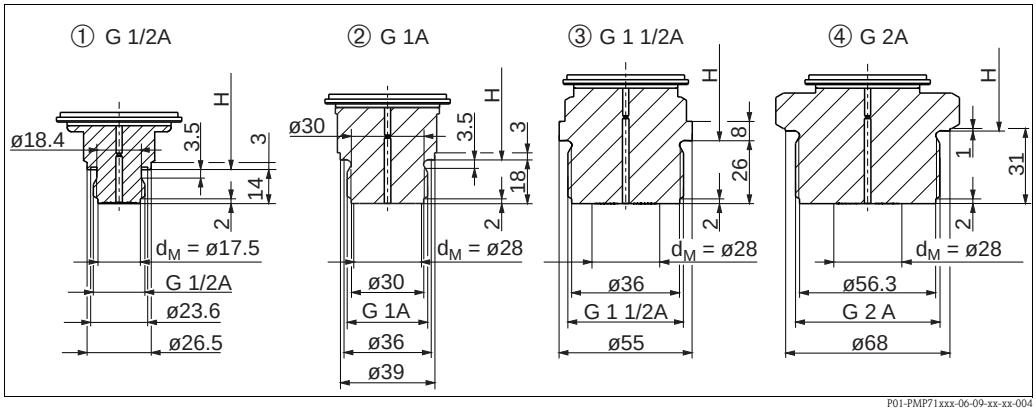


Process connections PMP71 thread DIN 13 M 20x1.5 hole 11.4 mm (0.45 in)
Material version GP: AISI 316L, version GQ: Alloy C276; weight: 0.6 kg (1.32 lbs)
→ Installation height H, see table below.

Installation height H for devices with threaded connection and internal process isolating diaphragm

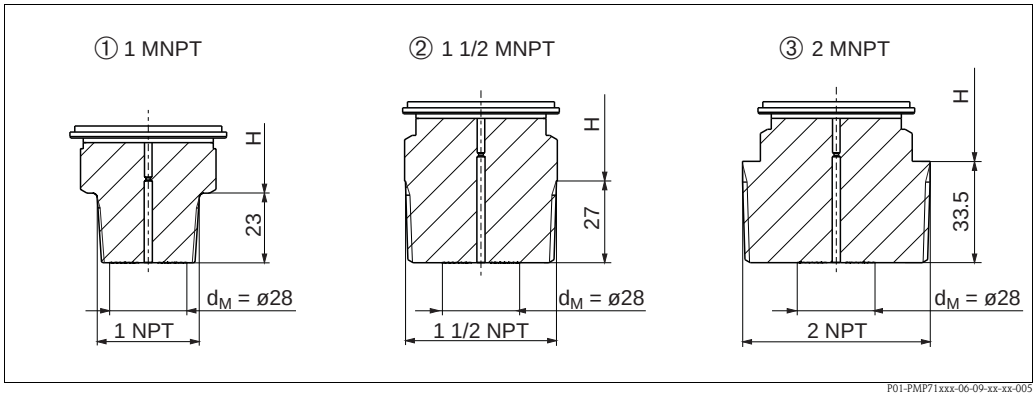
	T14 housing	**T17 housing**
Height H	165 mm (6.5 in)	181 mm (7.13 in)
	Note! The versions with a 700 bar (10500 psi) sensor are approx. 20 mm (0.79 in) higher.	

Thread, flush-mounted process isolating diaphragm



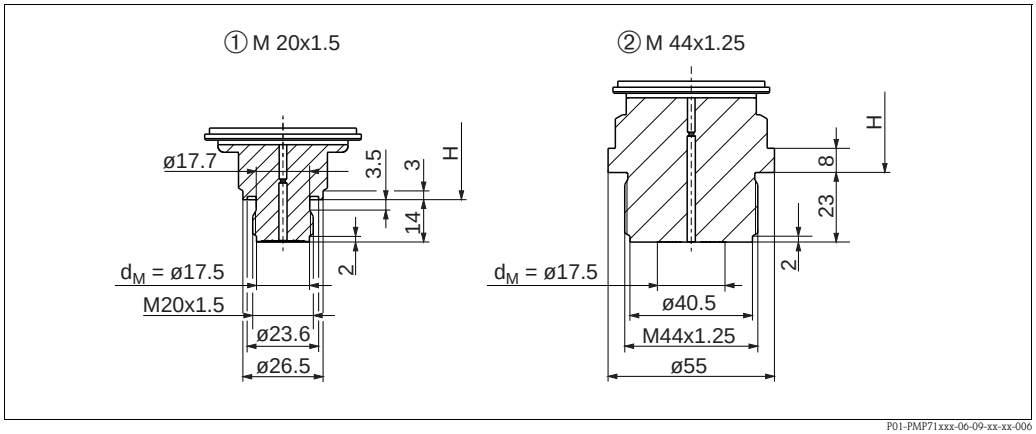
Process connections PMP71, thread ISO 228
Installation height H → 🖹 43.

1 Thread ISO 228 G 1/2 A DIN 3852 (Viton seal included);
Material version 1A: AISI 316L, version 1B: Alloy C276; weight: 0.4 kg (0.88 lbs)
2 Thread ISO 228 G 1 A;
Material version 1D: AISI 316L, version 1E: Alloy C276; weight: 0.7 kg (1.54 lbs)
3 Thread ISO 228 G 1 1/2 A
Material version 1G: AISI 316L, version 1H: Alloy C276; weight: 1.1 kg (2.43 lbs)
4 Thread ISO 228 G 2 A
Material version 1K: AISI 316L, version 1L: Alloy C276; weight: 1.5 kg (3.31 lbs)



Process connections PMP71, thread ANSI
Installation height H → 🖹 43.

1 Thread ANSI 1 MNPT;
Material version 2A: AISI 316L, version 2B: Alloy C276; weight: 0.7 kg (1.54 lbs)
2 Thread ANSI 1 1/2 MNPT;
Material version 2D: AISI 316L, version 2E: Alloy C276; weight: 1.0 kg (2.21 lbs)
3 Thread ANSI 2 MNPT
Material version 2G: AISI 316L, version 2H: Alloy C276; weight: 1.3 kg (2.87 lbs)



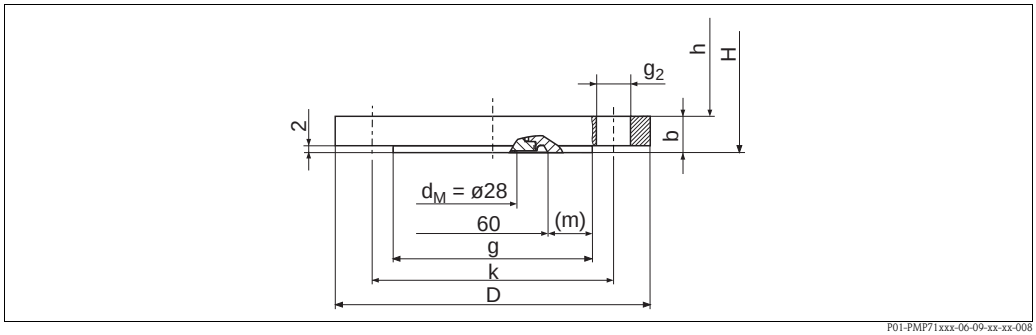
Process connections PMP71, thread DIN
→ Installation height H see table, below.

1 Thread DIN 16288 M20;
Material version 1N: AISI 316L, version 1P: Alloy C276; weight: 0.4 kg (0.88 lbs)
2 Thread DIN 13 M 44 x 1.25;
Material version 1R: AISI 316L, version 1S: Alloy C276; weight: 1.1 kg (2.43 lbs)

Installation height H for devices with threaded connection and flush-mounted process isolating diaphragm

Description	T14 housing	T17 housing
G 1/2	163 mm (6.42 in)	179 mm (7.05 in)
G 1	167 mm (6.57 in)	183 mm (7.2 in)
G 1 1/2 A	163 mm (6.42 in)	179 mm (7.05 in)
G 2 A	162 mm (6.38 in)	178 mm (7.01 in)
1 MNPT	162 mm (6.38 in)	178 mm (7.01 in)
1 1/2 MNPT	165 mm (6.5 in)	181 mm (7.13 in)
2 MNPT	159 mm (6.26 in)	175 mm (6.89 in)
M 20x1.5	163 mm (6.42 in)	179 mm (7.05 in)
M 44x1.25	170 mm (6.69 in)	186 mm (7.32 in)

EN/DIN flanges, connection dimensions as per EN 1092-1/DIN 2527



Process connection PMP71, EN/DIN flange with raised face, material AISI 316L

H: device height = height of the device without flange h + flange thickness b
Height h → 🖹 45.

	Flange [1]							Boltholes			
Version	**Nominal diameter**	**Nominal pressure**	**Shape [2]**	**Diameter D** [mm]	**Thickness b** [mm]	**Raised face g** [mm]	**Width of raised face (m)** [mm]	**Quantity**	**Diameter g_2** [mm]	**Hole circle k** [mm]	**Flange weight [3]** [kg]
CN	DN 25	PN 10-40	B1 (D)	115	18	68 [4]	4	4	14	85	1.2
CP	DN 32	PN 10-40	B1 (D)	140	18	78 [4]	9	4	18	100	1.9
CQ	DN 40	PN 10-40	B1 (D)	150	18	88 [4]	14	4	18	110	2.2
B3	DN 50	PN 10-40	B1 (D)	165	20	102	-	4	18	125	3.0
B4	DN 80	PN 10-40	B1 (D)	200	24	138	-	8	18	160	5.3

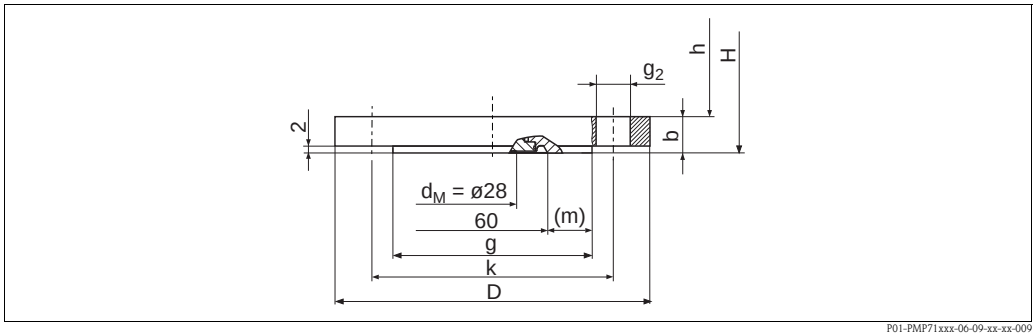
1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Alloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

2) Designation as per DIN 2527 in brackets

3) Housing weight → 🖹 60

4) With these process connections the raised face is smaller than described in the standard. Due to a smaller raised face a special seal must be used. Refer to a manufacturer of seals or your local Endress+Hauser Sales Center.

ANSI flanges, connection dimensions as per ANSI B 16.5, raised face RF
JIS flanges, connection dimensions as per B 2220 BL, raised face RF



Process connection PMP71, ANSI flange or JIS flange with raised face RF (see table below)

H: device height = height of device without flange h + flange thickness b. For the height h → 🖹 45.

	Flange [1]							Boltholes			
Version	**Material**	**Nominal diameter**	**Class/ nominal pressure**	**Diameter** **D** [in (mm)]	**Thickness** **b** [in (mm)]	**Diameter of raised face** **g** [in (mm)]	**Width of raised face** **(m)** [in (mm)]	**Quantity**	**Diameter** **g_2** [in (mm)]	**Hole circle** **k** [in (mm)]	**Flange weight [2]** [kg]
ANSI flanges											
AN	AISI 316/316L [3]	1 in	300 lb./sq.in	4.88 (124)	0.69 (17.5)	2.76 [4] (70)	0.2 (5)	4	0.75 (19.1)	3.5 (88.9)	1.3
AE	AISI 316/316L [3]	1 1/2 in	150 lb./sq.in	5 (127)	0.69 (17.5)	2.88 [4] (73.2)	0.52 (6.6)	4	0.62 (15.7)	3.88 (98.6)	1.5
AQ	AISI 316/316L [3]	1 1/2 in	300 lb./sq.in	6.12 (155.4)	0.81 (20.6)	2.88 [4] (73.2)	0.52 (6.6)	4	0.88 (22.4)	4.5 (114.3)	2.6
AF	AISI 316/316L [3]	2 in	150 lb./sq.in	6 (152.4)	0.75 (19.1)	3.62 (91.9)	-	4	0.75 (19.1)	4.75 (120.7)	2.4
AR	AISI 316/316L [3]	2 in	300 lb./sq.in	7.5 (190.5)	0.88 (22.3)	3.62 (91.9)	-	8	0.75 (19.1)	5 (127)	3.2
AG	AISI 316/316L [3]	3 in	150 lb./sq.in	7.5 (190.5)	0.94 (23.9)	5 (127)	-	4	0.75 (19.1)	6 (152.4)	4.9
AS	AISI 316/316L [3]	3 in	300 lb./sq.in	8.25 (209.5)	1.12 (28.4)	5 (127)	-	8	0.88 (22.4)	6.62 (168.1)	6.7
AH	AISI 316/316L [3]	4 in	150 lb./sq.in	9 (228.6)	0.94 (23.9)	6.19 (157.2)	-	8	0.75 (19.1)	7.5 (190.5)	7.1
AT	AISI 316/316L [3]	4 in	300 lb./sq.in	10 (254)	1.25 (31.8)	6.19 (157.2)	-	8	0.88 (22.4)	7.88 (200.2)	11.6
JIS flanges											
KA	AISI 316L	25 A	20 K	*125*	*16*	67 [4]	0.14 (3.5)	4	*19*	*90*	1.5
KF	AISI 316L	50 A	10 K	*155*	*16*	*96*	-	4	*19*	*120*	2.0
KL	AISI 316L	80 A	10 K	*185*	*18*	*127*	-	8	*19*	*150*	3.3
KH	AISI 316L	100 A	10 K	*210*	*18*	*151*	-	8	*19*	*175*	4.4

1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Alloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

2) Housing weight → 🖹 60

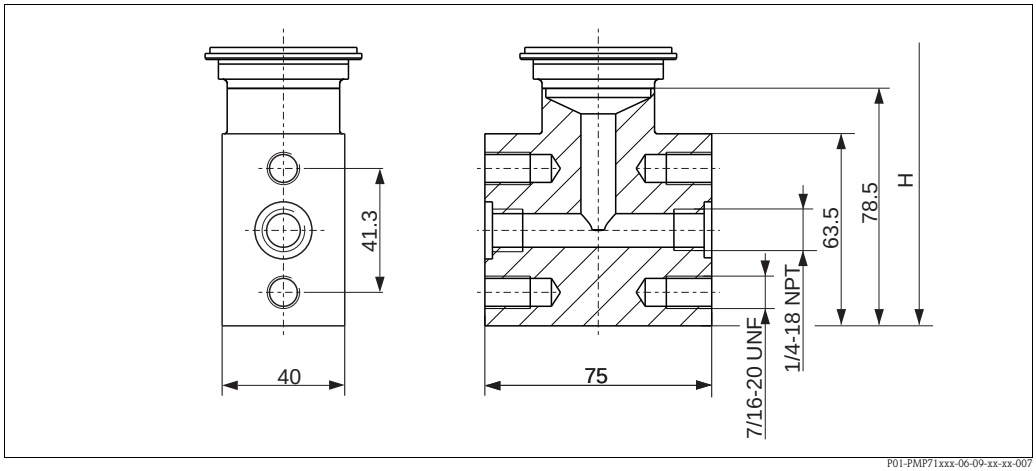
3) Combination of AISI 316 for required pressure resistance and AISI 316L for required chemical resistance (dual rated)

4) With these process connections the raised face is smaller than described in the standard. Due to a smaller raised face a special seal must be used. Refer to a manufacturer of seals or your local Endress+Hauser Sales Center.

Height h for devices with flange

	T14 housing	**T17 housing**
Height h	165 mm (6.5 in)	181 mm (7.13 in)

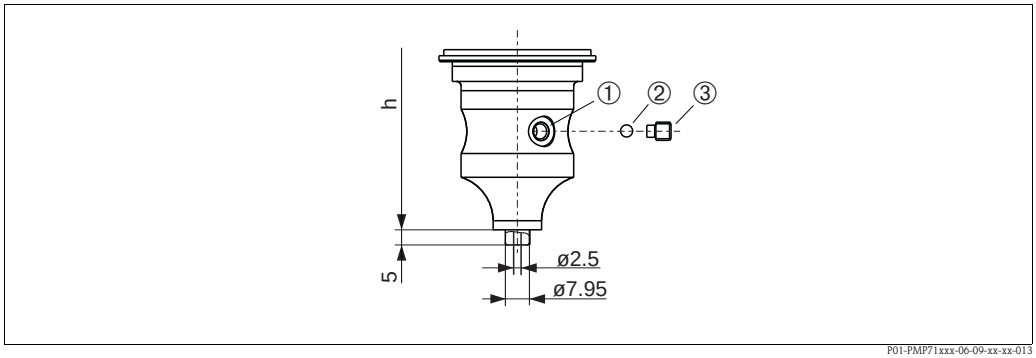
Oval flange



Version UR: oval flange adapter 1/4-18 NPT as per IEC 61518, material 316L (1.4404), mounting: 7/16-20 UNF; Weight: 1.9 kg (4.19 lbs)

	T14 housing	**T17 housing**
Height H	199 mm (7.83 in)	215 mm (8.46 in)

Prepared for diaphragm seal mount

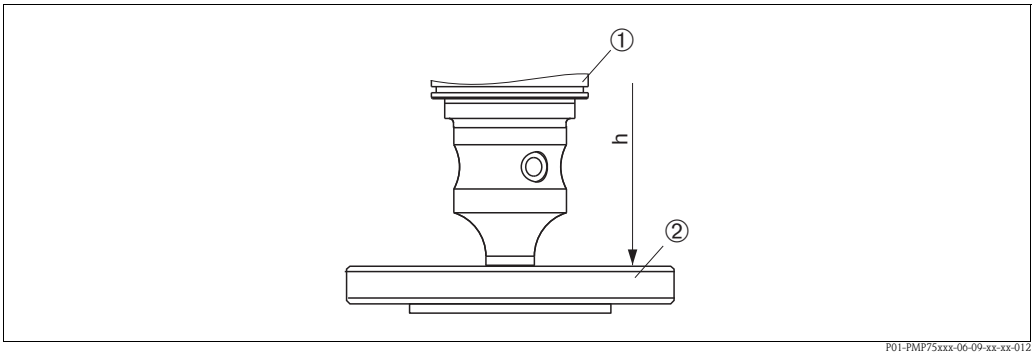


Version U1: material AISI 316L (1.4404), prepared for diaphragm seal mount

1 Hole for filling fluid
2 Bearing DIN 5401 (1.3505)
3 Setscrew with hexagonal recess 4 mm (0.16 in), material A2-70

	T14 housing	**T17 housing**
Height h	190 mm (7.48 in)	204 mm (8.03 in)

PMP75 basic device



PMP75 basic device with diaphragm seal

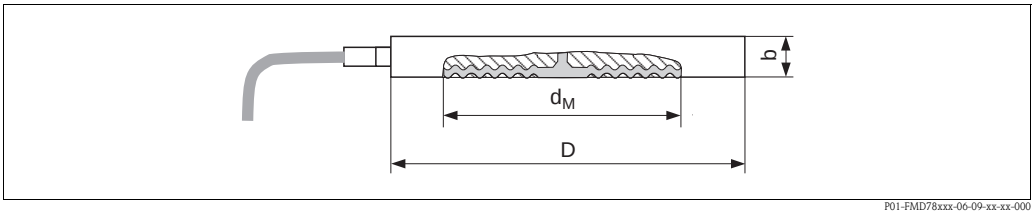
1 PMP75 basic device
2 Diaphragm seal, here e.g. flange diaphragm seal

	T14 housing	T17 housing
Height h	190 mm (7.48 in)	204 mm (8.03 in)

Process connections PMP75 (with diaphragm seal)

Note!
- The weights of the diaphragm seals are given in the tables. See → 60 for the weight of the housing.
- The following drawings are drawings that illustrate how the system works in principle. In other words, the dimensions of a diaphragm seal supplied can deviate from the dimensions given in this document.
- With the use of high-temperature oils the design can deviate strongly.
- Observe the information in the "Planning instructions, diaphragm seal systems" section → 70 ff.
- For further information please contact your local Endress+Hauser Sales Center.

Diaphragm seal cell structure

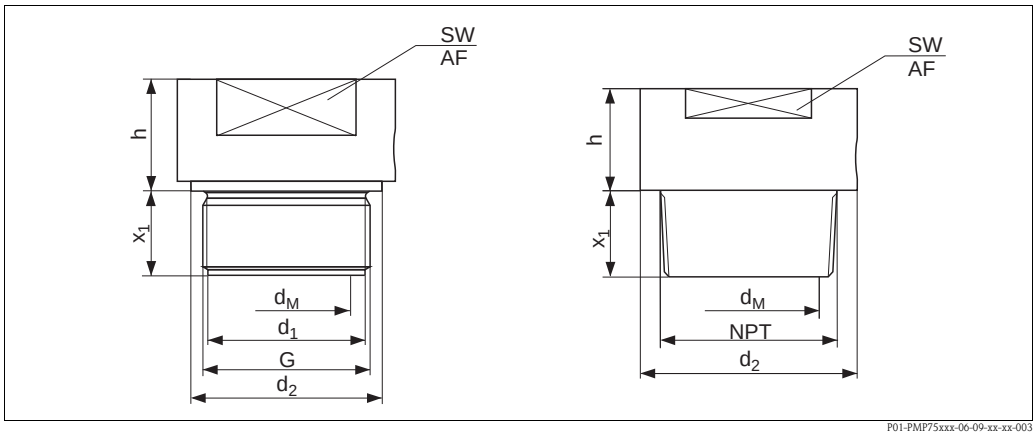


Process connection PMP75, material AISI 316L

	Flange				Diaphragm seal	
Version	**Nominal diameter**	**Nominal pressure** [1]	**Max. diameter D** [mm]	**Thickness b** [mm]	**Max. diameter of the process isolating diaphragm d_M** [mm]	**Weight of two diaphragm seals** [kg]
UI	DN 50	PN 16-400	102	20	59	2.6
UJ	DN 80	PN 16-400	138	20	89	4.6
UK	DN 100	PN 16-400	162	20	89	6.2
	[in]	[lb/sq.in]	[in (mm)]	[in (mm)]	[in (mm)]	[kg]
UL	2	150-2500	4.01 (102)	0.79 (20)	2.32 (59)	2.6
UM	3	150-2500	5.35 (136)	0.79 (20)	3.50 (89)	4.6
UR	4	150-2500	6.22 (158)	0.79 (20)	3.50 (89)	6.2

1) The specified nominal pressure applies to the diaphragm seal. The maximum pressure for the measuring device is dependent on the lowest-rated element, with regard to pressure, of the selected components. See also → 31, "Pressure specifications" section.

Thread, flush-mounted process isolating diaphragm

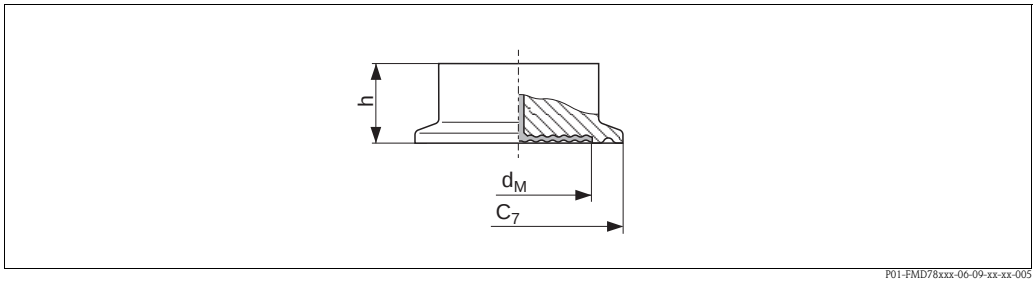


Process connections PMP75, left: thread ISO 228, right: thread ANSI

Threaded connections								Diaphragm seal		
Version	**Material**	**Thread**	**Nominal pressure**	**Diameter**	**Diameter**	**Screw-in length**	**Across flats**	**Max. diameter of the process isolating diaphragm**	**Height**	**Diaphragm seal weight**
			PN	**d_1**	**d_2**	**x_1**	**SW/AF**	**d_M**	**h**	
				[mm]	[mm]	[mm]		[mm]	[mm]	[kg]
1D	AISI 316L	G 1 A	400	30	39	21 [1]	41	30	19	0.4
1E	Alloy C276									0.5
1G	AISI 316L	G 1 1/2 A	400	44	55	30	50	42	20	0.9
1H	Alloy C276									1.0
1K	AISI 316L	G 2	400	56	68	30	65	50	20	1.9
1L	Alloy C276									2.1
2A	AISI 316L	1 MNPT	400	–	48	28	41	24	37	0.6
2B	Alloy C276									0.7
2D	AISI 316L	1 1/2 MNPT	400	–	60	30	41	36	20	0.9
2E	Alloy C276									1.0
2G	AISI 316L	2 MNPT	400	–	78	30	65	38	35	1.8
2H	Alloy C276									2.0

1) 28 mm (1.1 in) in conjunction with high-temperature oil

Tri-Clamp ISO 2852

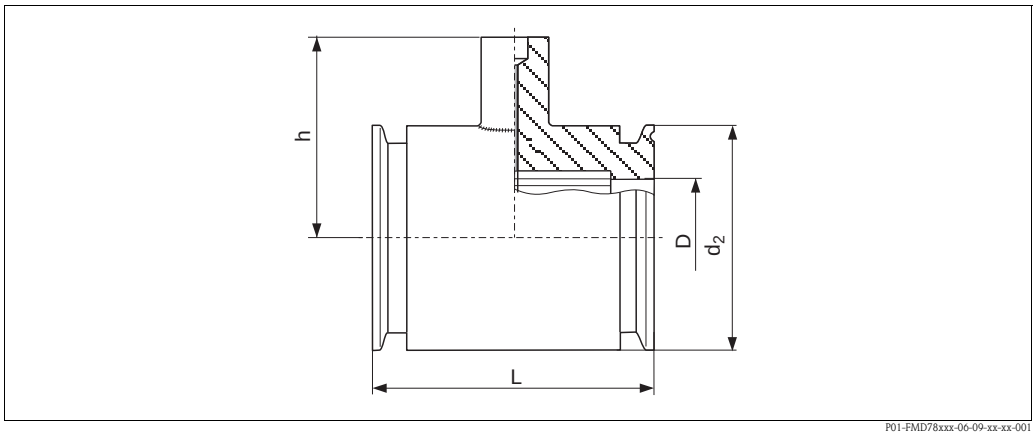


Process connection PMP75, material: AISI 316L, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard.

Version	Nominal diameter ISO 2852	Nominal diameter DIN 32676	Nominal diameter [in]	Diameter C_7 [mm]	Max. diameter of the process isolating diaphragm d_M [mm]	Height h [mm]	Diaphragm seal weight [kg]
TB	DN 25	DN 25	1	50.5	24	37	0.32
TC[1]	DN 38	DN 40	1 1/2	50.5	34	30	1.0
TD [1]	DN 51	DN 50	2	64	48	30	1.1
TF	DN 76.1	–	3	91	73	30	1.2

1) Diaphragm seal versions optionally in conformity with ASME-BPE for use in biochemical processes, wetted surfaces $R_a \leq 0.38$ µm, electropolished; to be ordered using feature 110 "Additional option", version "P" in the order code.

Tri-Clamp pipe diaphragm seal ISO 2852

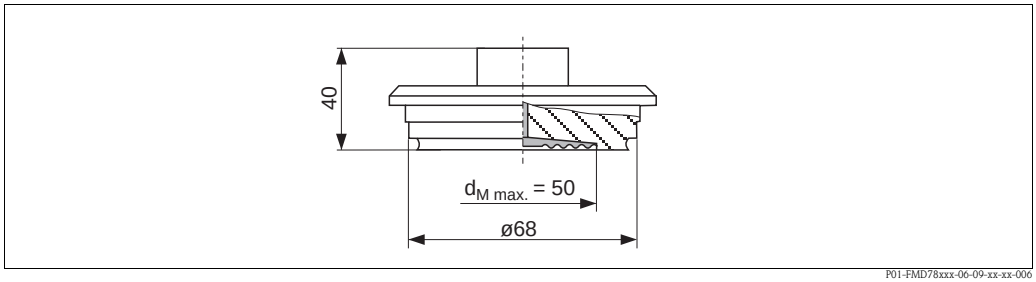


Process connection PMP75, material AISI 316L, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard. Lower surface roughness on request.

Version	Nominal diameter ISO 2852	Nominal diameter	Diameter D [in]	Diameter d_2 [mm]	Height h [mm]	Face-to-face length L [mm]	Diaphragm seal weight [kg]
SB	DN 25	1	22.5	50.5	67	126	1.7
SC[1]	DN 38	1 1/2	35.5	50.5	67	126	1.0
SD [1]	DN 51	2	48.6	64	79	100	1.7

1) Including 3.1 and pressure test as per Pressure Equipment Directive, category II

Varivent N for pipes DN 40 – DN 162

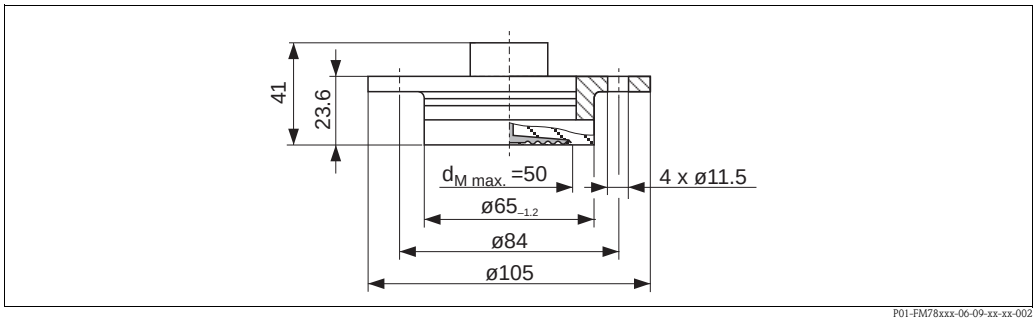


Process connection PMP75, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard.

Version	Material	Nominal pressure	Diaphragm seal weight [kg]
TR [1]	AISI 316L	PN 40	1.3

1) Diaphragm seal versions optionally in conformity with ASME-BPE for use in biochemical processes, wetted surfaces $R_a \leq 0.38$ µm (15 µin), electropolished; to be ordered using feature 110 "Additional option", version "P" in the order code.

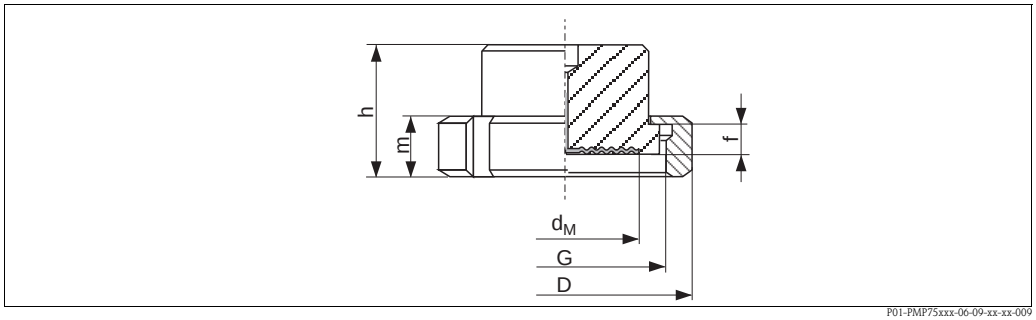
DRD DN50 (65 mm)



Process connection PMP75, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard. Lower surface roughness on request.

Version	Material	Nominal pressure	Diaphragm seal weight [kg]
TK	AISI 316L	PN 25	0.75

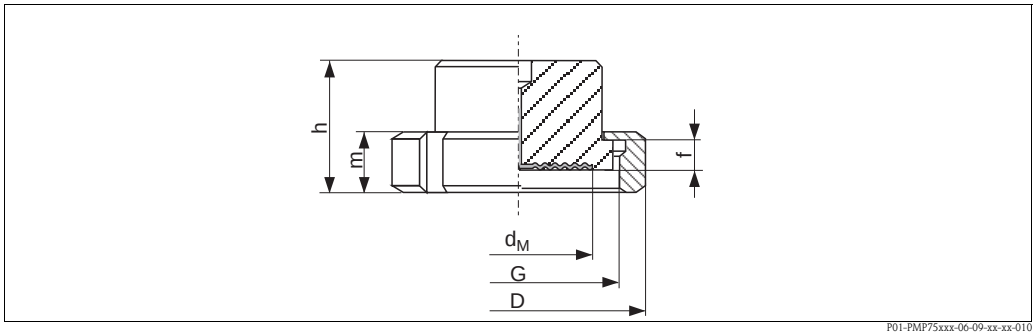
SMS nozzles with coupling nut



Process connection PMP75, material AISI 316L, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard. Lower surface roughness on request.

Version	Nominal diameter	Nominal pressure	Diameter	Adapter height	Thread	Height	Height	Max. diameter of the process isolating diaphragm	Diaphragm seal weight
			D	f	G	m	h	d_M	
	[inch]	[bar]	[mm]	[mm]		[mm]	[mm]	[mm]	[kg]
TG	1	PN 25	54	3.5	Rd 40 – 1/6	20	42.5	24	0.25
TH	1 1/2	PN 25	74	4	Rd 60 – 1/6	25	57	36	0.65
TI	2	PN 25	84	4	Rd 70 – 1/6	26	62	48	1.05

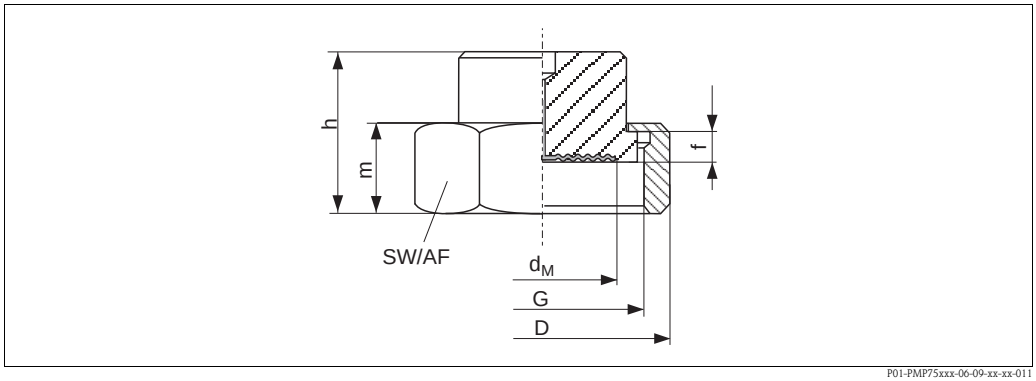
APV-RJT nozzles with coupling nut



Process connection PMP75, material AISI 316L, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard. Lower surface roughness on request.

Version	Nominal diameter	Nominal pressure	Diameter	Adapter height	Thread	Height	Height	Max. diameter of the process isolating diaphragm	Diaphragm seal weight
		PN	D	f	G	m	h	d_M	
	[inch]	[bar]	[mm]	[mm]		[mm]	[mm]	[mm]	[kg]
TL	1	PN 40	77	6.5	1 13/16 – 1/8"	22	42.6	21	0.45
TM	1 1/2	PN 40	72	6.4	2 5/16 – 1/8"	22	42.6	28	0.75
TN	2	PN 40	86	6.4	2 7/8 – 1/8"	22	42.6	38	1.2

APV-ISS nozzles with coupling nut

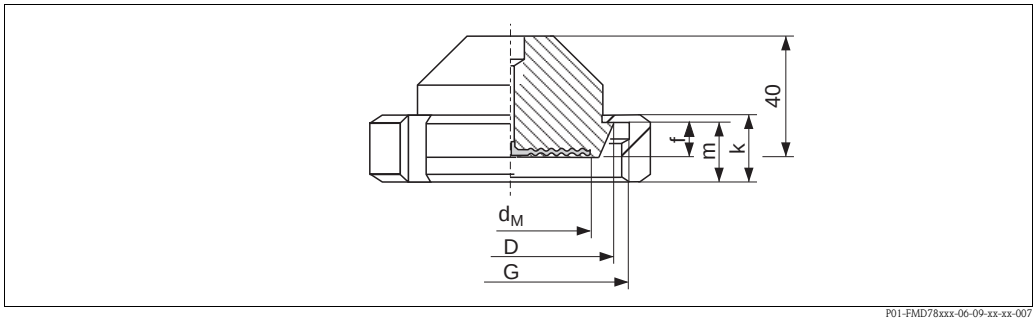


P01-PMP75xxx-06-09-xx-xx-011

Process connection PMP75, material AISI 316L, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8\ \mu m$ (31.5 µin) as standard. Lower surface roughness on request.

Version	Nominal diameter	Nominal pressure	Diameter	Adapter height	Thread	Height	Across flats	Height	Max. diameter of the process isolating diaphragm	Diaphragm seal weight
			D	f	G	m	AF	h	d_M	
	[inch]	[bar]	[mm]	[mm]		[mm]		[mm]	[mm]	[kg]
TP	1	PN 40	54.1	4	1 1/2" – 1/8"	30	46.8	50	24	0.4
TQ	1 1/2	PN 40	72	4	2" – 1/8"	30	62	50	34	0.6
TS	2	PN 40	89	4	2 1/2" – 1/8"	30	77	50	45	1.1

Taper adapter with coupling nut, DIN 11851

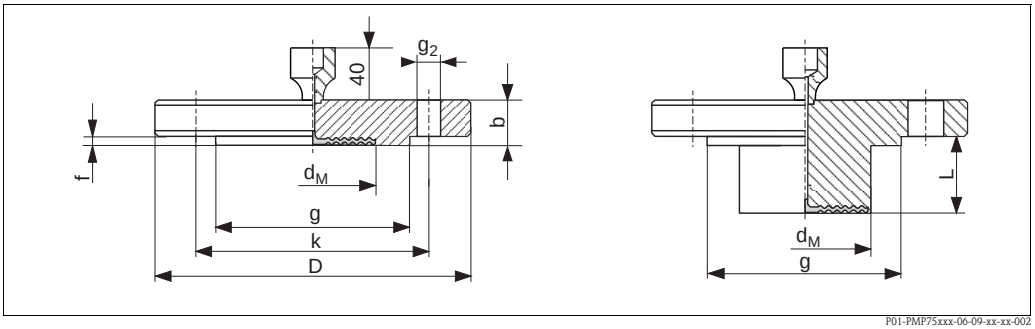


P01-FMD78xxx-06-09-xx-xx-007

Process connection PMP75, material AISI 316L, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8\ \mu m$ (31.5 µin) as standard. Lower surface roughness on request.

	Taper adapter				Slotted nut			Diaphragm seal	
Version	Nominal diameter	Nominal pressure	Diameter	Adapter height	Thread	Height	Height	Max. diameter of the process isolating diaphragm	Diaphragm seal weight
			D	f	G	k	m	d_M	
			[mm]	[mm]		[mm]	[mm]	[mm]	[kg]
MR	DN 50	PN 25	68.5	11	Rd 78 x 1/6"	22	19	52	1.1
MS	DN 65	PN 25	86	12	Rd 95 x 1/6"	35	21	66	2.0
MT	DN 80	PN 25	100	12	Rd 110 x 1/4"	30	26	81	2.55

EN/DIN flanges, connection dimensions as per EN 1092-1/DIN 2527 and DIN 2501-1



Process connection PMP75, EN/DIN flange with flush-mounted process isolating diaphragm, material AISI 316L

	Flange [1]							Boltholes			Diaphragm seal	
Version	Nominal diameter	Nominal pressure	Shape[2]	Diameter D [mm]	Thickness b [mm]	Raised face g [mm]	Raised face f [mm]	Quantity	Diameter g_2 [mm]	Hole circle k [mm]	Max. diameter of the process isolating diaphragm d_M [mm]	Diaphragm seal weight [kg]
CN	DN 25	PN 10-40	B1 (D)	115	18	68	3	4	14	85	32	2.1
DN	DN 25	PN 63-160	E	140	24	68	2	4	18	100	28	2.5
EN	DN 25	PN 250	E	150	28	68	2	4	22	105	28	3.7
E1	DN 25	PN 400	E	180	38	68	2	4	26	130	28	7.0
CP	DN 32	PN 10-40	B1 (D)	140	18	77	2.6	4	18	100	34	1.9
CQ	DN 40	PN 10-40	B1 (D)	150	18	87	2.6	4	18	110	48	2.2
B3	DN 50	PN 10-40	B1 (D)	165	20	102	3	4	18	125	59	3.0
C3	DN 50	PN 63	B2 (E)	180	26	102	3	4	22	135	59	4.6
EF	DN 50	PN 100-160	E	195	30	102	3	4	26	145	59	6.2
ER	DN 50	PN 250	E	200	38	102	3	8	26	150	59	7.7
E3	DN 50	PN 400	E	235	52	102	3	8	30	180	59	14.7
B4	DN 80	PN 10-40	B1 (D)	200	24	138	3.5	8	18	160	89	5.3
C4	DN 80	PN 100	B2 (E)	230	32	138	4	8	24	180	89	8.9
C5	DN 100	PN 100	B2 (E)	265	36	175	5	8	30	210	89	13.7
D3 [3]	DN 50	PN 10-40	B1 (D)	165	20	102	3	4	18	125	47	[3]
D4 [3]	DN 80	PN 10-40	B1 (D)	200	24	138	3.5	8	18	160	72	[3]

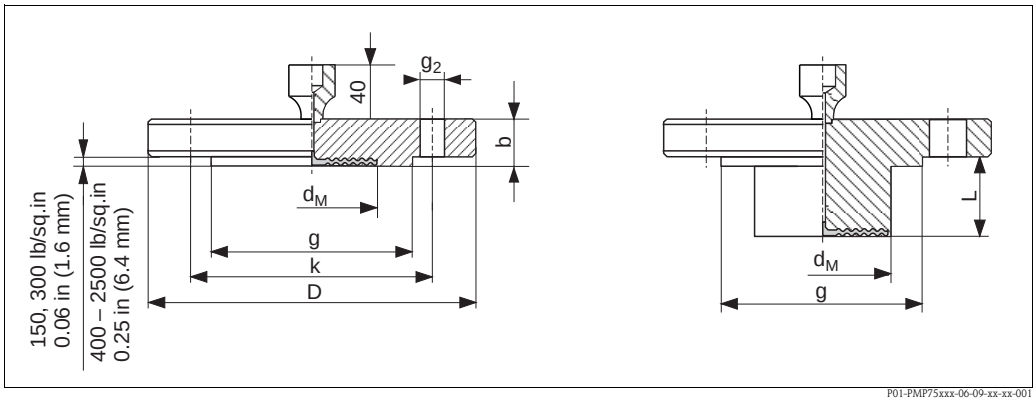
1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Hastelloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

2) Designation as per DIN 2527 in brackets

3) Available with 50 mm (1.97 in), 100 mm (3.94 in) and 200 mm (7.87 in) extended diaphragm seal, for extended diaphragm seal diameter and weight see the following table

Version	Nominal diameter	Nominal pressure	Extended diaphragm seal length [mm]	Extended diaphragm seal diameter d_3 [mm]	Diaphragm seal weight [kg]
D3	DN 50	PN 10-40	50 / 100 / 200	48.3	3.2 / 3.8 / 4.4
D4	DN 80	PN 10-40	50 /100 / 200	76	6.2 / 6.7 / 7.8

ANSI flanges, connection dimensions as per ANSI B 16.5, raised face RF



Process connection PMP75, ANSI flange with and without extended diaphragm seal

	Flange [1]						Boltholes			Diaphragm seal	
Version	**Material[2]**	**Nominal diameter**	**Class**	**Diameter** **D**	**Thickness** **b**	**Raised face** **g**	**Quantity**	**Diameter** **g_2**	**Hole circle** **k**	**Max. diameter of the process isolating diaphragm** **d_M**	**Diaphragm seal weight**
		[in]	[lb./sq.in]	[in (mm)]	[in (mm)]	[in (mm)]		[in (mm)]	[in (mm)]	[in (mm)]	[kg]
AC	AISI 316/316L	1	150	4.25 (108)	0.56 (14.2)	2 (50.8)	4	0.62 (15.7)	3.12 (79.2)	1.26 (32)	1.2
AN	AISI 316/316L	1	300	4.88 (124)	0.69 (17.5)	2.76 (70)	4	0.75 (19.1)	3.5 (88.9)	1.26 (32)	1.3
HC	AISI 316/316L	1	400/600	4.88 (124)	0.69 (17.5)	2 (50.8)	4	0.75 (19.1)	3.5 (88.9)	1.26 (32)	1.4
HN	AISI 316/316L	1	900/1500	5.88 (149.4)	1.12 (28.4)	2 (50.8)	4	1 (25.4)	4 (101.6)	1.26 (32)	3.2
HO	AISI 316/316L	1	2500	6.25 (158.8)	1.38 (35.1)	2 (50.8)	4	1 (25.4)	4.25 (108)	1.26 (32)	4.6
AE	AISI 316/316L	1 1/2	150	5 (127)	0.69 (17.5)	2.88 (73.2)	4	0.62 (15.7)	3.88 (96.6)	1.89 (48)	1.5
AQ	AISI 316/316L	1 1/2	300	6.12 (155.4)	0.81 (20.6)	2.88 (73.2)	4	0.88 (22.4)	4.5 (114.3)	1.89 (48)	2.6
AF	AISI 316/316L	2	150	6 (152.4)	0.75 (19.1)	3.62 (91.9)	4	0.75 (19.1)	4.75 (120.7)	2.32 (59)	2.2
J3 [3]	AISI 316/316L	2	150	6 (152.4)	0.75 (19.1)	3.62 (91.9)	4	0.75 (19.1)	4.75 (120.7)	1.85 (47)	[3]
AR	AISI 316/316L	2	300	6.5 (165.1)	0.88 (22.4)	3.62 (91.9)	8	0.75 (19.1)	5 (127)	2.32 (59)	3.4
HF	AISI 316/316L	2	400/600	6.5 (165.1)	1 (25.4)	3.62 (91.9)	8	0.75 (19.1)	5 (127)	2.32 (59)	4.3
HR	AISI 316/316L	2	900/1500	8.5 (215.9)	1.5 (38.1)	3.62 (91.9)	8	1 (25.4)	6.5 (165.1)	2.32 (59)	10.3
H3	AISI 316/316L	2	2500	9.25 (235)	2 (50.8)	3.62 (91.9)	8	1.12 (28.4)	6.75 (171.5)	2.32 (59)	15.8
AG	AISI 316/316L	3	150	7.5 (190.5)	0.94 (23.9)	5 (127)	4	0.75 (19.1)	6 (152.4)	3.50 (89)	5.1
AS	AISI 316/316L	3	300	8.25 (209.5)	1.12 (28.4)	5 (127)	8	0.75 (19.1)	6 (152.4)	3.50 (89)	7.0
J4[3]	AISI 316/316L	3	150	7.5 (190.5)	0.94 (23.9)	5 (127)	4	0.75 (19.1)	6 (152.4)	2.83 (72)	[3]
J7 [3]	AISI 316/316L	3	300	8.25 (209.5)	1.12 (28.4)	5 (127)	8	0.88 (22.4)	6.62 (168.1)	2.83 (72)	[3]
AH	AISI 316/316L	4	150	9 (228.6)	0.94 (23.9)	6.19 (157.2)	8	0.75 (19.1)	7.5 (190.5)	3.50 (89)	7.2
AT	AISI 316/316L	4	300	10 (254)	1.25 (31.8)	6.19 (157.2)	8	0.88 (22.4)	7.88 (200.2)	3.50 (89)	11.7
J5[3]	AISI 316/316L	4	150	9 (228.6)	0.94 (23.9)	6.19 (157.2)	8	0.75 (19.1)	7.5 (190.5)	3.50 (89)	[3]
J8 [3]	AISI 316/316L	4	300	10 (254)	1.25 (31.8)	6.19 (157.2)	8	0.88 (22.4)	7.88 (200.2)	3.50 (89)	[3]

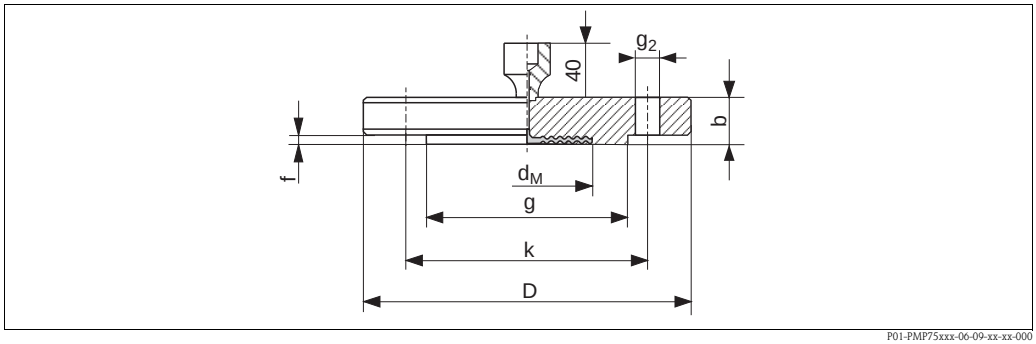
1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Alloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

2) Combination of AISI 316 for required pressure resistance and AISI 316L for required chemical resistance (dual rated)

3) xxAvailable with 2", 4", 6" or 8" extended diaphragm seal, for extended diaphragm seal diameter and weight see the following table

Version	**Nominal diameter** [in]	**Class** [lb./sq.in]	**Extended diaphragm seal length (L)** [in (mm)]	**Extended diaphragm seal diameter d_3** [in (mm)]	**Diaphragm seal weight** [kg]
J3	2	150	2 (50.8)	1.9 (48.3)	3.0
			4 (101.6)		3.4
			6 (152.4)		3.9
			8 (203.2)		4.4
J4	3	150	2 (50.8)	2.99 (75.9)	6.0
			4 (101.6)		6.6
			6 (152.4)		7.1
			8 (203.2)		7.8
J7	3	300	2 (50.8)	2.99 (75.9)	7.9
			4 (101.6)		8.5
			6 (152.4)		9.0
			8 (203.2)		9.6
J5	4	150	2 (50.8)	3.7 (94)	8.6
			4 (101.6)		9.9
			6 (152.4)		11.2
			8 (203.2)		12.4
J8	4	300	2 (50.8)	3.7 (94)	13.1
			4 (101.6)		14.4
			6 (152.4)		15.7
			8 (203.2)		16.9

JIS flanges, connection dimensions as per JIS B 2220 BL, raised face RF



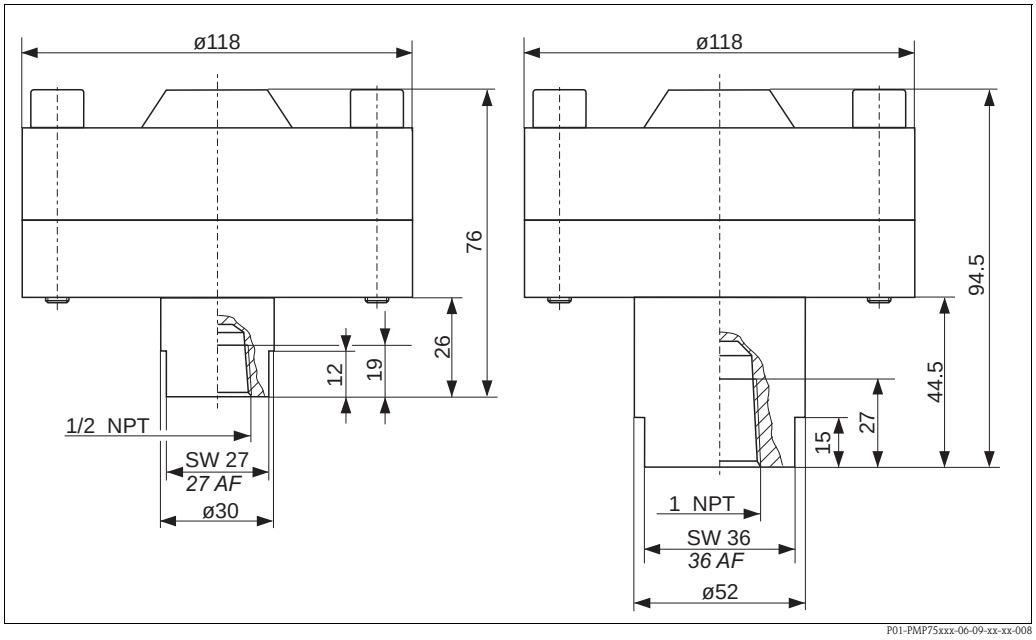
Process connection PMP75, JIS flange with raised face RF, material AISI 316L

	Flange [1]						Boltholes			Diaphragm seal	
Version	**Nominal diameter**	**Nominal pressure**	**Diameter** **D** [mm]	**Thickness** **b** [mm]	**Diameter raised face** **g** [mm]	**Raised face height** **f** [mm]	**Quantity**	**Diameter** g_2 [mm]	**Hole circle** **k** [mm]	**Max. diameter of the process isolating diaphragm** d_M [mm]	**Diaphragm seal weight** [2] [kg]
KC	25 A	10 K	125	14	67	1	4	19	90	32	1.5
KF	50 A	10 K	155	16	96	2	4	19	120	59	2.3
KL	80 A	10 K	185	18	127	2	8	19	150	89	3.3
KH	100 A	10 K	210	18	151	2	8	19	175	89	4.4

1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Alloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

2) Housing weight → 🖹 60

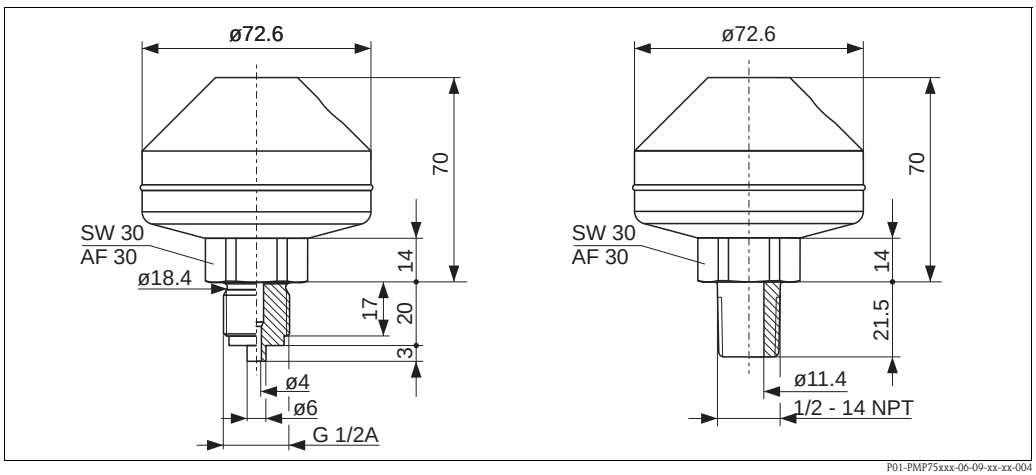
Thread 1/2 NPT and 1 NPT, separator



Process connection PMP75, versions "UG" and "UH", threaded, material AISI 316L, seal Viton

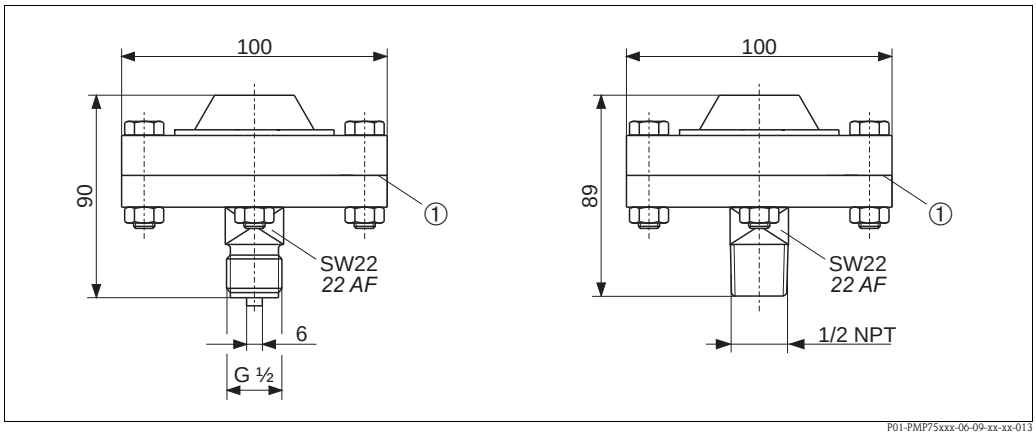
Version	Description	Nominal pressure	Diaphragm seal weight [kg]
UG	1/2 NPT	PN 250	4.75
UH	1 NPT	PN 250	5.0

Thread ISO 228 G 1/2 A and ANSI 1/2 MNPT, separator



Process connection PMP75, versions "UA" and "UB", welded, material AISI 316L

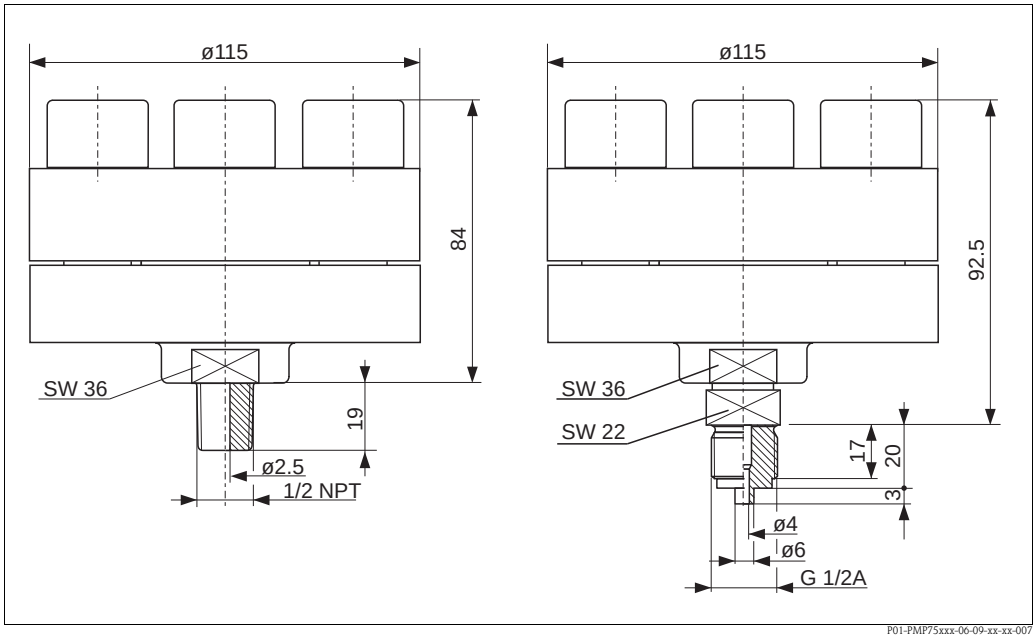
Version	Description	Nominal pressure	Diaphragm seal weight [kg]
UA	ISO 228 G 1/2 A	PN 160	1.43
UB	ANSI 1/2 MNPT	PN 160	1.43



Process connection PMP75, left: version "UC" with threaded connection ISO 228 G 1/2 B, right: version "UD" with threaded connection ANSI 1/2 MNPT
Materials: AISI 316L (1.44.04), screws made of 1.4571

1 PTFE seal as standard max. 260 °C (500 °F) (higher temperatures on request)

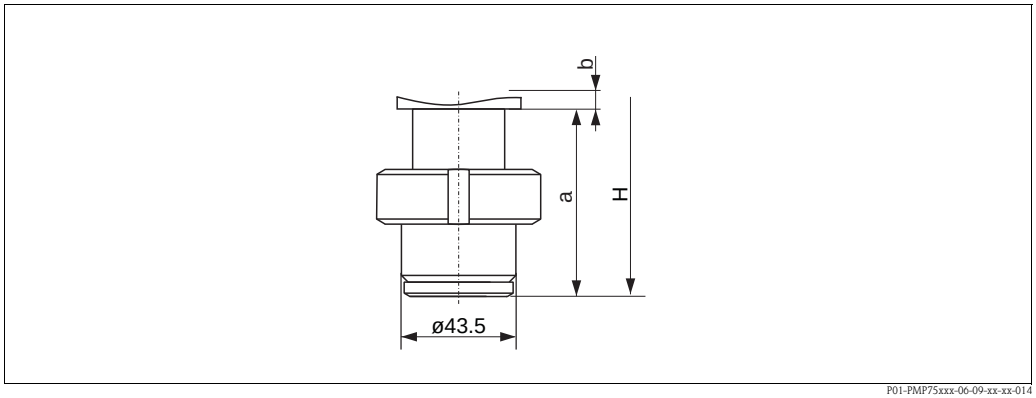
Version	Measuring range	Description	Nominal pressure	Diaphragm seal weight [kg]
UC	≤ 40 bar	ISO 228 G 1/2 B	PN 40	1.43
UD	≤ 40 bar	ANSI 1/2 MNPT	PN 40	1.43



Process connection PMP75, versions "UC" and "UD", threaded, with integrated sealing lip
Materials: AISI 316L (1.44.04), screws made of 1.4571

Version	Measuring range	Description	Nominal pressure	Diaphragm seal weight [kg]
UC	> 40 bar	ISO 228 G 1/2 A	PN 400	4.75
UD	> 40 bar	ANSI 1/2 MNPT	PN 400	4.75

Universal process adapter



Process connection PMP75, material: b = top section AISI 316L (1.4404), a = bottom section AISI 316L (1.4435); Surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard. Lower surface roughness on request.

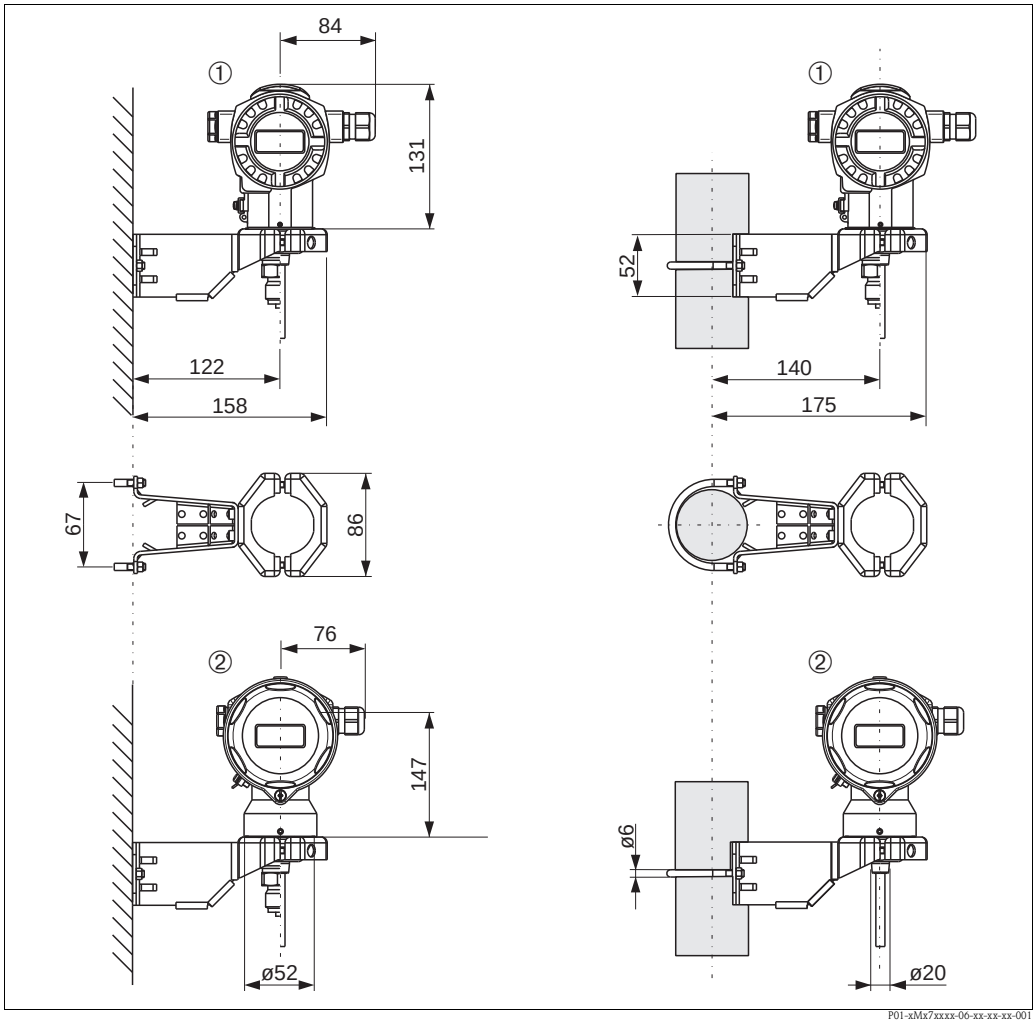
Version 00 [1]: universal process adapter incl. silicone molded seal FDA 21CFR177.2600/USP Class VI-70C, EHEDG, 3A

Installation height H for devices with universal process adapter

Description	Device height H, universal process adapter
T14 housing, optional display on the side	197 mm (7.76 in)
T15 housing without display, flat cover	203 mm (7.99 in)
T15 housing with display, high cover	215.5 mm (8.48 in)
T17 housing, optional display on the side	213 mm (8.39 in)

1) Endress+Hauser supplies these slotted nuts in stainless steel AISI 304 (DIN/EN material number 1.4301) or in AISI 304L (DIN/EN material number 1.4307).

Wall and pipe mounting with mounting bracket



① *Dimensions of T14 housing, optional display on the side. For the weight, see the following section.*

② *Dimensions of T17 housing, optional display on the side. For the weight, see the following section.*

Weight

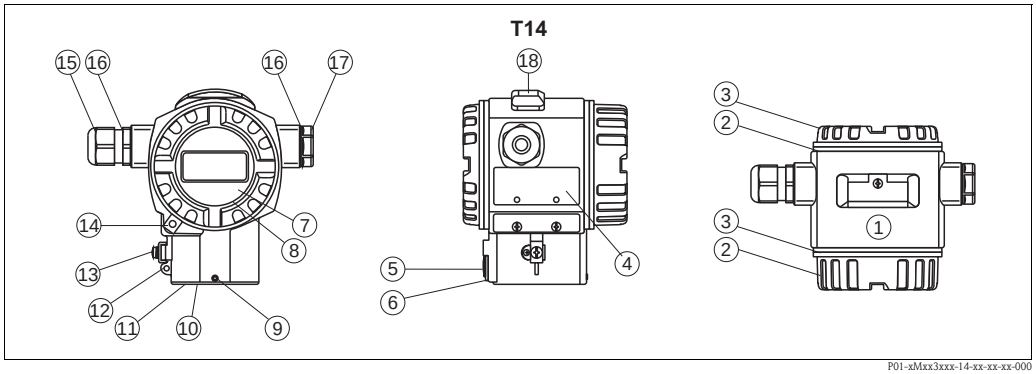
Housing

	T14		T17	Separate housing
	Aluminum	AISI 316L	AISI 316L	
With electronic insert and display	1.2 kg (2.65 lbs)	2.1 kg (4.63 lbs)	1.2 kg (2.65 lbs)	Weight of housing + 0.5 kg (1.10 lbs). Weight of sensor + 0.5 kg (1.10 lbs).
With electronic insert without display	1.1 kg (2.43 lbs)	2.0 kg (4.41 lbs)	1.1 kg (2.43 lbs)	

Process connections

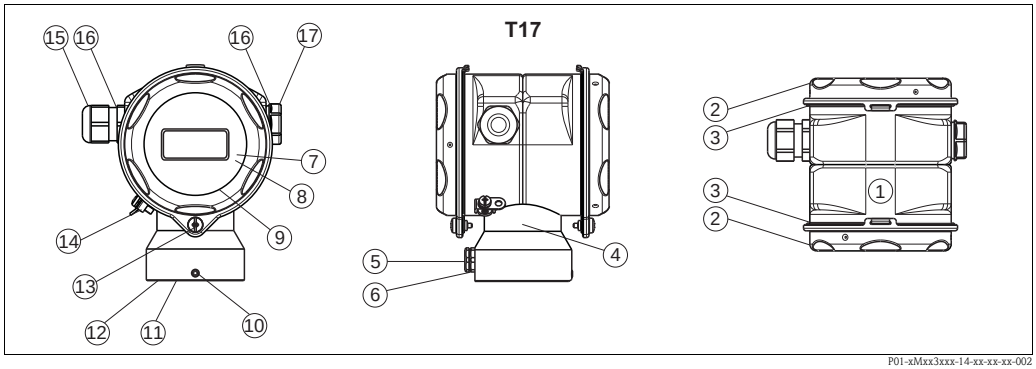
- Process connections PMC71 (with ceramic process isolating diaphragm): → 📄 33 ff
- Process connections PMP71 (with metal process isolating diaphragm): → 📄 40 ff
- Process connections PMP75 (with diaphragm seal): → 📄 47 ff

Material (not wetted) **Housing**



Front view, left-hand side view, top view

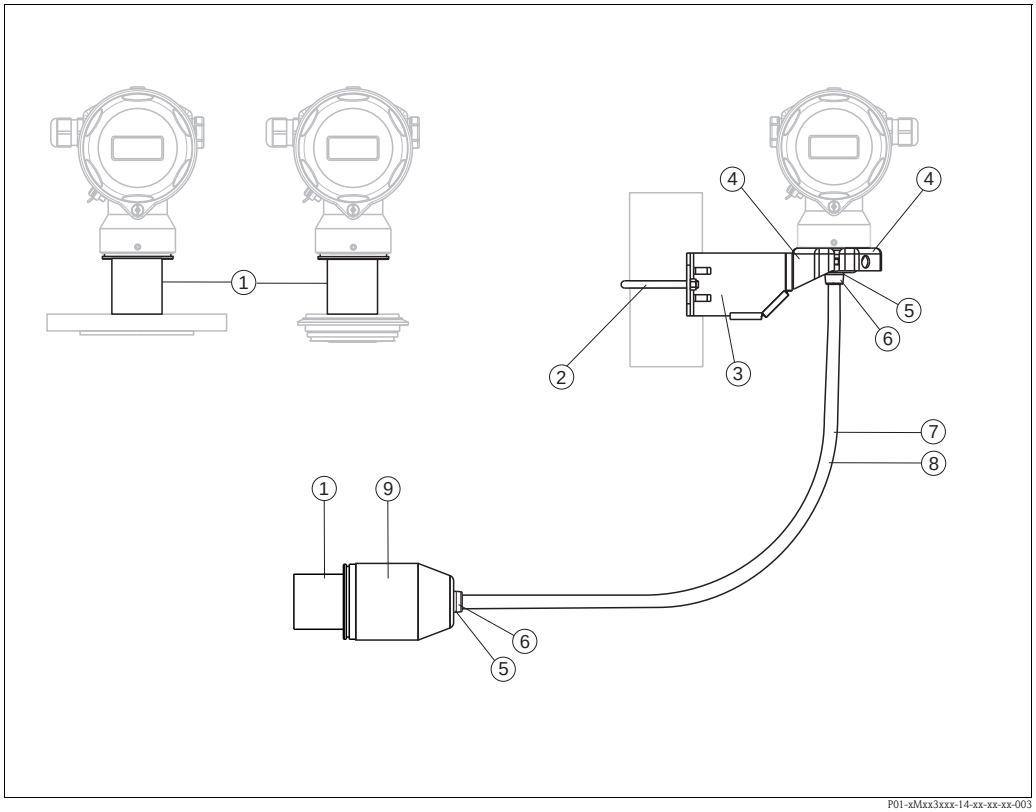
Item number	Component part	Material
1	T14 and T15 housing, RAL 5012 (blue)	Die-cast aluminum with protective powder-coating on polyester base
	T14 housing	Precision cast AISI 316L (1.4435)
2	Cover, RAL 7035 (gray)	Die-cast aluminum with protective powder-coating on polyester base
	Cover	Precision cast AISI 316L (1.4435)
3	Cover seal	EPDM
4	Nameplates	AISI 304 (1.4301)
5	Pressure compensation filter	PA6 GF10
6	Pressure compensation filter, O-ring	Silicone (VMQ)
7	Sight glass	Mineral glass
8	Sight glass seal	Silicone (VMQ)
9	Screw	A4
10	Sealing ring	EPDM
11	Snap ring	PA66-GF25
12	Snap ring for nameplates	AISI 304 (1.4301)/ AISI 316 (1.4401
13	External ground terminal	AISI 304 (1.4301)
14	Cover clamp	Clamp AISI 316L (1.4435, screw A4
15	Cable gland	Polyamide (PA)
16	Seal of cable gland and blind plug	Silicone (VMQ)
17	Blind plug	PBT-GF30 FR, for dust ignition-proof: AISI 316L (1.4435)
18	External operation (keys and key cover), RAL 7035 (gray)	Polycarbonate PC-FR, screw A4



Front view, left-hand side view, top view

Item number	Component part	Material
1	T17 housing	AISI 316L (1.4404)
2	Cover	
3	Cover seal	EPDM
4	Nameplates	Lasered
5	Pressure compensation filter	PA6 GF10
6	Pressure compensation filter, O-ring	Silicone (VMQ)
7	Sight glass for non-hazardous area, ATEX Ex ia, NEPSI Zone 0/1 Ex ia, IECEx Zone 0/1 Ex ia, FM NI, FM IS, CSA IS	Polycarbonate (PC)
8	Sight glass for ATEX 1/2 D, ATEX 1/3 D, ATEX 1 GD, ATEX 1/2 GD, ATEX 3 G, FM DIP, CSA dust ignition-proof	Mineral glass
9	Sight glass seal	EPDM
10	Screw	A2-70
11	Sealing ring	EPDM
12	Snap ring	PA6
13	Screw	A4-50
14	External ground terminal	AISI 304 (1.4301)
15	Cable gland	Polyamide PA, for dust ignition-proof: CuZn nickel-plated
16	Seal of cable gland and blind plug	Silicone (VMQ)
17	Blind plug	PBT-GF30 FR, for dust ignition-proof: AISI 316L (1.4435)

Connecting parts



Front view, left-hand side view, top view

Item number	Component part	Material
1	Connection between the housing and process connection	AISI 316L (1.4404)
2	Mounting bracket	Bracket AISI 304 (1.4301), AISI 304L (1.4306
3		Screw and nuts A2-70
4		Half-shells: AISI 304L (1.4306)
5	Seal for cable from separate housing	EPDM
6	Gland for cable from separate housing	AISI 316L (1.4404)
7	PE cable for separate housing	Abrasion-proof cable with strain-relief Dynema members; shielded using aluminum-coated film; insulated with polyethylene (PE-LD), black; copper wires, twisted, UV-resistant
8	FEP cable for separate housing	Abrasion-proof cable; shielded using galvanized steel wire netting; insulated with fluorinated ethylene propylene (FEP), black; copper wires, twisted, UV-resistant
9	Process connection adapter for separate housing	AISI 316L (1.4404)

Filling oil

See "Ordering information" (→ 🖹 76)

Miscellaneous:

- Diaphragm seal capillary: AISI 316 Ti (1.4571)
- Protective hose for diaphragm seal capillary: AISI 304 (1.4301)

Material (wetted)

Note!
Process-wetted device components are listed in the "Mechanical construction" (→ 🖹 32) and "Ordering information" (→ 🖹 76) sections.

TSE Certificate of Suitability

The following applies to all process wetted device components:
- They do not contain any materials derived from animals.
- No additives or operating materials derived from animals are used in production or processing.

Process connections

- "Clamp connections" and "Hygienic connections" (see also "Ordering information" section): AISI 316L (DIN/EN material number 1.4435)
- Endress+Hauser supplies process connections with threaded connections and DIN/ EN flanges made of stainless steel as per AISI 316L (DIN/EN material number 1.4404 (AISI 316) or 14435). With regard to their stability-temperature property, the materials 1.4404 and 1.4435 are grouped together under 13E0 in EN 1092-1 Tab.18. The chemical composition of the two materials can be identical.
- Some process connections are also available in the material Alloy C276 (DIN/EN material number 2.4819). See the information in the "Mechanical construction" section.

Process isolating diaphragm

- PMC71: Al_2O_3 aluminum oxide ceramic (FDA 21CFR186.1256, USP Class VI), ultrapure 99.9 % (→ see also www.endress.com/ceraphire)
- PMP71:
  - AISI 316L (DIN/EN material number 1.4435)
  - AISI 316L with gold-rhodium coating
  - Alloy C276 (DIN/EN material number 2.4819)
- PMP75:
  - AISI 316L (DIN/EN material number 1.4435)
  - AISI 316L with gold-rhodium coating
  - AISI 316L with 0.09 mm PTFE foil (not for vacuum applications)
  - AISI 316L with 0.25 mm PTFE foil (not for vacuum applications, only for non-hazardous areas)
  - Alloy C276 (DIN/EN material number 2.4819)
  - Monel
  - Tantalum

Seals

See ordering information, → 🖹 76 ff

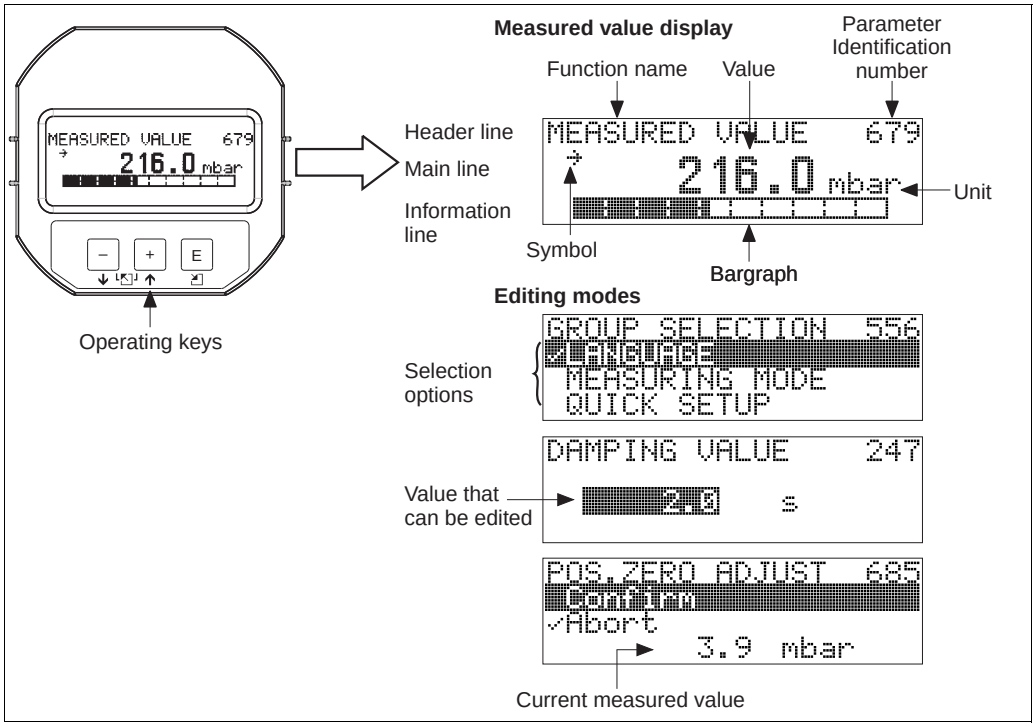
Human interface

Operating elements

Onsite display (optional)

A 4-line liquid crystal display (LCD) is used for display and operation. The onsite display shows measured values, dialog text as well as fault and notice messages in plain text, thereby supporting the user in every stage of operation. The display of the device can be turned in 90° steps.
Depending on the installation position of the device, this makes it easy to operate the device and read the measured value.

Functions:
- 8-digit measured value display including sign and decimal point, bar graph for 4 to 20 mA HART as current display; or for PROFIBUS PA as graphic display of the standardized value of the AI Block; for FOUNDATION Fieldbus as graphic display of the transducer output.
- Simple and complete menu guidance thanks to separation of the parameters into several levels and groups.
- Each parameter is given a 3-digit ID number for easy navigation.
- Option for configuring the display according to individual requirements and preferences, such as language, alternating display, display of other measured values such as sensor temperature, contrast setting.
- Comprehensive diagnostic functions (fault and warning message, peak-hold indicators, etc.).
- Rapid and safe commissioning with the Quick Setup menus.



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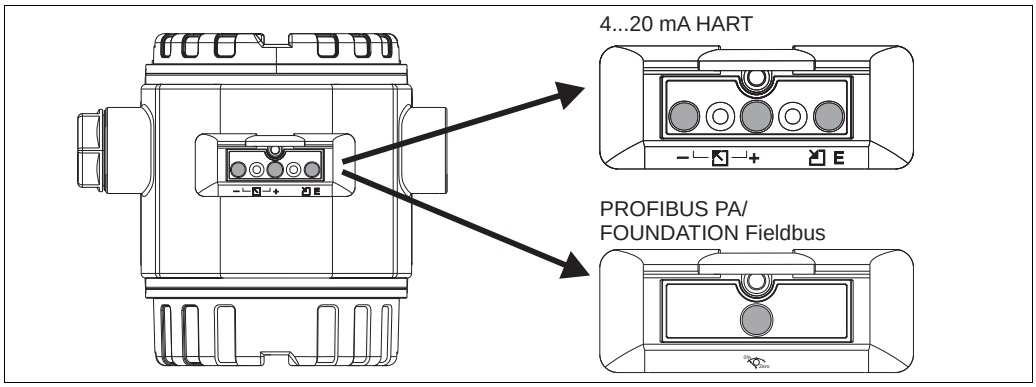
Operating elements

Operating keys on the exterior of the device

With the T14 housing (aluminum or stainless steel), the operating keys are located either outside of the housing, under the protection cap or inside on the electronic insert. With the T17 housing (stainless steel), the operating keys are located inside the housing on the electronic insert.



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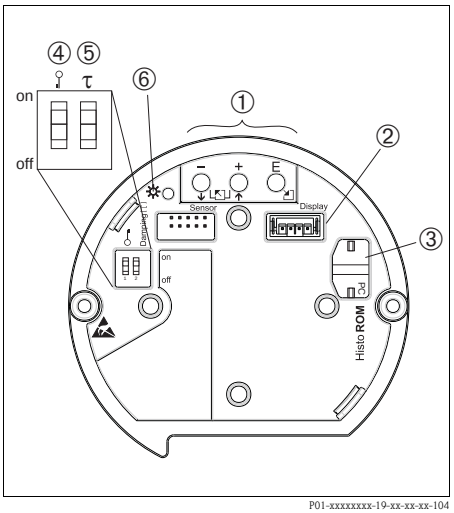
The operating keys located externally on the device work on the Hall sensor principle. As a result, no additional openings are required in the device. This guarantees:
- Complete protection against environmental influences such as moisture and contamination.
- Simple operation without any tools.
- No wear.

Operating keys and elements located internally on the electronic insert



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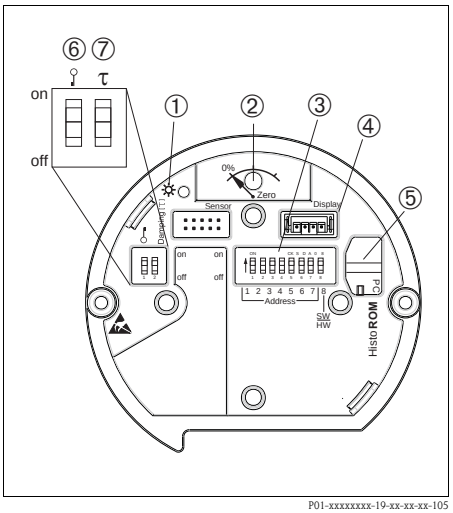
Electronic insert HART

1 *Operating keys*
2 *Slot for optional display*
3 *Slot for optional HistoROM®/M-DAT*
4 *DIP-switch for locking/unlocking parameters relevant to the measured values*
5 *DIP-switch for damping on/off*
6 *Green LED to indicate value being accepted*



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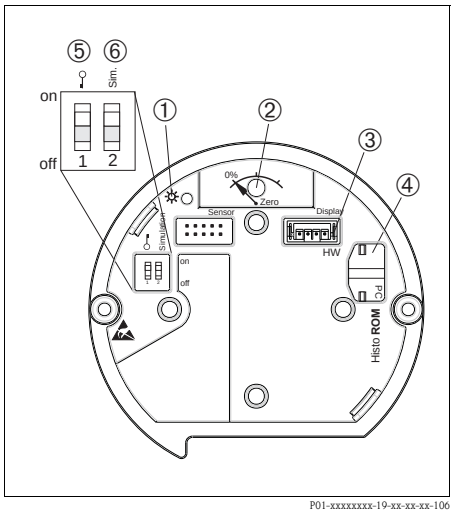
Electronic insert PROFIBUS PA

1 *Green LED to indicate value being accepted*
2 *Key for position adjustment and device reset*
3 *DIP-switch for bus address*
4 *Slot for optional display*
5 *Slot for optional HistoROM®/M-DAT*
6 *DIP-switch for locking/unlocking parameters relevant to the measured values*
7 *DIP-switch for damping on/off*



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Electronic insert FOUNDATION Fieldbus

1 *Green LED to indicate value being accepted*
2 *Key for position adjustment and device reset*
3 *Slot for optional display*
4 *Slot for optional HistoROM®/M-DAT*
5 *DIP-switch for locking/unlocking parameters relevant to the measured values*
6 *DIP-switch for simulation mode on/off*

Local operation

Function	External operation (operating keys, optional, not T17 housing)	Internal operation (electronic insert)	Display (optional)
Position adjustment (zero point correction)	X	X	X
Setting lower-range value and upper-range value – reference pressure present at the device	X (HART only)	X (HART only)	X
Device reset	X	X	X
Locking and unlocking parameters relevant to the measured value	- - -	X	X
Value acceptance indicated by green LED	X	X	X
Switching damping on and off	- - -	X (HART and PA only)	X
Setting bus address (PA)	- - -	X	X
Switching simulation mode on and off (FOUNDATION Fieldbus)	- - -	X	X

Remote operation

Depending on the position of the write protection switch on the device, all software parameters are accessible.

HART

Remote operation via:
- Handheld terminal Field Communicator 375 (see "Hardware and software for onsite and remote operation" section → 68)
- FieldCare (see "Hardware and software for onsite and remote operation" section → 68 ff) with Commubox FXA195 (see "Hardware and software for onsite and remote operation" section → 68 ff)
- Field Xpert:
  Field Xpert is an industrial PDA with integrated 3.5" touchscreen from Endress+Hauser based on Windows Mobile. It communicates via wireless with the optional VIATOR Bluetooth modem connected to a HART device point-to-point or wireless via WiFi and Endress+Hauser's Fieldgate FXA520. Field Xpert also works as a stand-alone device for asset management applications. For details, refer to BA060S/04/EN.

PROFIBUS PA

Remote operation via:
- FieldCare (see "Hardware and software for onsite and remote operation" section → 68 ff)
  – Profiboard: For connecting a PC to PROFIBUS
  – Proficard: For connecting a laptop to PROFIBUS

FOUNDATION Fieldbus

Remote operation via:
- Handheld terminal Field Communicator 375 (see "Hardware and software for onsite and remote operation" section → 68 ff)
- Use an FF-configuration program for example NI-FBUS Configurator, to
  – connect devices with "FOUNDATION Fieldbus signal" into an FF-network
  – set FF-specific parameters
  Operation with NI-FBUS Configurator:
  The NI-FBUS Configurator is an easy-to-use graphical environment for creating linkages, loops, and a schedule based on the fieldbus concepts.
  You can use the NI-FBUS Configurator to configure a fieldbus network as follows:
  – Set block and device tags
  – Set device addresses
  – Create and edit function block control strategies (function block applications)
  – Configure vendor-defined function and transducer blocks
  – Create and edit schedules
  – Read and write to function block control strategies (function block applications)
  – Invoke Device Description (DD) methods

– Display DD menus
– Download a configuration
– Verify a configuration and compare it to a saved configuration
– Monitor a downloaded configuration
– Replace a virtual device by a real device
– Save and print a configuration

Note!
For further information please contact your local Endress+Hauser Sales Center.

Hardware and software for onsite and remote operation

Commubox FXA195

For intrinsically safe HART communication with FieldCare via the USB interface. For details refer to TI404F/00/EN.

Commubox FXA291

The Commubox FXA291 connects Endress+Hauser field devices with a CDI interface (=Endress+Hauser Common Data Interface) to the USB interface of a personal computer or a notebook. For details refer to TI405C/07/EN.

Note!
For the following Endress+Hauser devices you need the "ToF adapter FXA291" as an additional accessory:

- Cerabar S PMC71, PMP7x
- Deltabar S PMD7x, FMD7x
- Deltapilot S FMB70

ToF adapter FXA291

The ToF adapter FXA291 connects the Commubox FXA291 with devices of the ToF platform, pressure equipment and the Gammapilot via the USB port of a computer or laptop. For details refer to KA271F.

Field Communicator 375

With a handheld terminal, all the parameters can be configured anywhere along the bus line via menu operation.

HistoROM®/M-DAT (optional)

HistoROM®/M-DAT is a memory module which can be attached to every electronic insert. The HistoROM®/M-DAT can be retrofitted at any stage (order number: 52027785).

Your benefits

- Quick and safe commissioning of the same measuring points by copying the configuration data of one transmitter to another transmitter.
- Reliable process monitoring thanks to cyclical recording of pressure and sensor temperature measured values.
- Simple diagnosis by recording diverse events such as alarms, configuration changes, counters for measuring range undershoot and overshoot for pressure and temperature as well as user limit overshoot and undershoot for pressure and temperature etc.
- Analysis and graphic evaluation of the events and process parameters via software (contained in scope of supply).

HistoROM®/M-DAT can be ordered via feature 100 "Additional option 1" or feature 110 "Additional option 2" or as a spare part. → 🖹 76 ff. A CD with an Endress+Hauser operating program is also included in the scope of delivery.
You can copy data from one transmitter to another transmitter when operating a FOUNDATION Fieldbus device via an FF configuration program. You need the Endress+Hauser FieldCare operating program and the Commubox FXA291 service interface and the ToF adapter FXA291 to be able to access the data and events saved in the HistoROM®/M-DAT.
FieldCare and the service interface Commubox FXA291 and the ToF adapter FXA291.

FieldCare

FieldCare is an Endress+Hauser asset management tool based on FDT technology. With FieldCare, you can configure all Endress+Hauser devices as well as devices from other manufacturers that support the FDT standard.

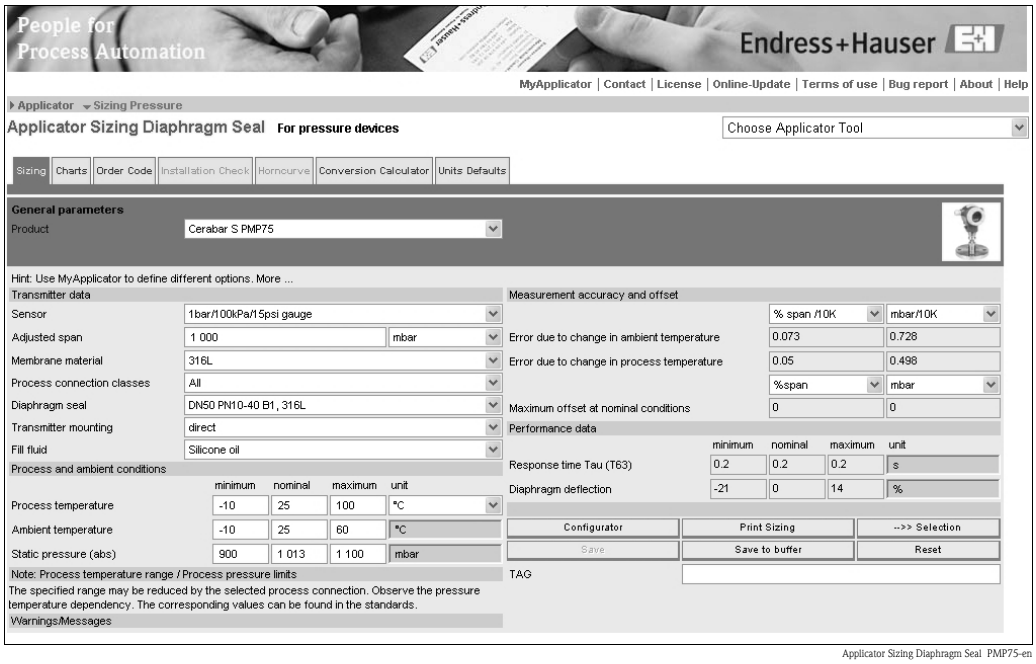
FieldCare supports the following functions:
- Configuration of transmitters in offline and online mode
- Loading and saving device data (upload/download)
- HistoROM®/M-DAT analysis
- Documentation of the measuring point

Connection options:
- HART via Commubox FXA195 and the USB port on a computer
- PROFIBUS PA via segment coupler and PROFIBUS interface card
- Service interface with Commubox FXA291 and ToF adapter FXA291 (USB).

For further information → www.endress.com

Planning instructions, diaphragm seal systems

Note!
The performance and the permitted range of application of a diaphragm seal system depend on the process isolating diaphragm used, the filling oil, the coupling, the unit design and on the process and ambient conditions present in the individual application.
To help you select the right diaphragm seal system for your applications, Endress+Hauser provides its customers with the free "Applicator Sizing Diaphragm Seal" tool, which is available on CD or online at "www.endress.com/applicator".



Applicator Sizing Diaphragm Seal PMP75-en

For more detailed information or the layout of the optimum diaphragm seal solution for your application, please contact your local Endress+Hauser Sales Center.

Applications

Diaphragm seal systems should be used if the process and the device should be separated. Diaphragm seal systems offer clear advantages in the following instances:
- In the case of extreme process temperatures
- For aggressive media
- In the case of process media that crystallize
- In the case of corrosive or highly various process media or process media with solids content
- In the case of heterogeneous and fibrous process media
- If extreme measuring point cleaning is necessary, or for very humid mounting locations
- If the measuring point is exposed to severe vibrations
- For mounting locations that are difficult to access

Design and operation mode

Diaphragm seals are separating equipment between the measuring system and the process.

A diaphragm seal system consists of:
- A diaphragm seal
- A capillary tube or temperature isolator if necessary
- Fill fluid
- A pressure transmitter

The process pressure acts via the process isolating diaphragm of a diaphragm seal on the liquid-filled system, which transfers the process pressure onto the sensor of the pressure transmitter.
Endress+Hauser delivers all diaphragm seal systems as welded versions. The system is hermetically sealed, which ensures the highest reliability.

The diaphragm seal determines the application range of the system by:
- The process isolating diaphragm diameter
- The process isolating diaphragm stiffness and material
- The design (oil volume)

Diameter of the process isolating diaphragm

The greater the diameter of the process isolating diaphragm (less stiff), the smaller the temperature effect on the measurement result.

Process isolating diaphragm stiffness

The stiffness depends on the diameter of the process isolating diaphragm, the material, any existing coating and the thickness and shape of the process isolating diaphragm. The process isolating diaphragm thickness and the shape are determined by the design. The stiffness of a process isolating diaphragm of a diaphragm seal influences the temperature operating range and the measuring error caused by temperature effects.

Capillary

Capillaries with an internal diameter of 1 mm (0.04 in) are used as standard.
The capillary tube influences the thermal change, the ambient temperature operating range and the response time of a diaphragm seal system as a result of its length and internal diameter.

Filling oil

When selecting the filling oil, the medium and ambient temperature as well as the operating pressure are of crucial importance. Observe the temperatures and pressures during commissioning and cleaning. A further selection criterion is the compatibility of the filling oil with the requirements of the process medium. For this reason, only filling oils that are harmless to health are used in the food industry, such as vegetable oil or silicone oil.
→ See also the following section "Diaphragm seal filling oils".
The filling oil used influences the thermal change, the temperature operating range of a diaphragm seal system and the response time. A temperature change results in a volume change of the filling oil. The volume change is dependent on the expansion coefficient and the volume of the filling oil at calibration temperature (constant in the range: +21 to +33 °C (+70 to 91 °F)).
For example, the filling oil expands in the event of a temperature increase. The additional volume presses against the process isolating diaphragm of a diaphragm seal. The stiffer a diaphragm is, the greater its return force, which counteracts a volume change and acts on the measuring cell together with the operating pressure, thus shifting the zero point.

Pressure transmitter

The pressure transmitter influences the temperature operating range, the T_K zero point and the response time as a result of its volume change. The volume change is the volume that has to be shifted to pass through the complete measuring range.
Pressure transmitters from Endress+Hauser are optimized with regard to minimum volume change.

Diaphragm seal filling oils

Version [1]	Filling oil	Permissible temperature range [2] at 0.05 bar (0.725 psi) ≤ p_{abs} ≤ 1 bar (14.5 psi)	Permissible temperature range [2] at p_{abs} ≥ 1 bar (14.5 psi)	Density [g/cm³] / [SGU]	Viscosity [mm²/s] / [cSt] at 25 °C (77 °F)]	Coefficient of thermal expansion [1/K]	Notes
A, H, 1 or 2	Silicone oil	–40 to +180°C (–40 to +356°F)	–40 to +250°C (–40 to +482 °F)	0.96	100	0.00096	Suitable for foods FDA 21 CFR 175.105
G, 3 or 4	High-temperature oil	–10 to +200°C (+14 to +392 °F)	–10 to +400°C (+14 to +752 °F)	1.07	37	0.0007	High temperatures
F or N	Inert oil	–40 to +80°C (–40 to +176 °F)	–40 to +175°C (–40 to +347 °F)	1.87	27	0.000876	For ultrapure gas and oxygen applications
D, 5 or 6	Vegetable oil	–10 to +120°C (+14 to +248 °F)	–10 to +200°C (+14 to +392 °F)	0.94	9.5	0.00101	Suitable for foods FDA 21 CFR 172.856
7 or 8	Low-temperature oil	–70 to +80°C (–94 to +176 °F)	–70 to +180°C (–94 to +349 °F)	0.92	4.4	0.00108	Low temperatures

1) Version for feature 90 in the order code (→ 🖹 84 ff)

2) Observe temperature limits of the device (→ 🖹 30) and the system (→ 🖹 70).

Installation instructions

Diaphragm seal systems

- Endress+Hauser offer flushing rings as accessories to clean process isolating diaphragms without taking the transmitters out of the process.
  For further information please contact your local Endress+Hauser Sales Center.
- The diaphragm seal together with the transmitter form a closed, calibrated system, which is filled through ports in the diaphragm seal and in the measuring system of the transmitter. These ports are sealed and must not be opened.
- For devices with a temperature isolator or capillary, a suitable fastening device (mounting bracket) is recommended.
- For more detailed installation instructions, Endress+Hauser provides its customers with the free "Applicator Sizing Diaphragm Seal" tool, which is available on CD or can be downloaded online at "www.endress.com/applicator".

Capillary

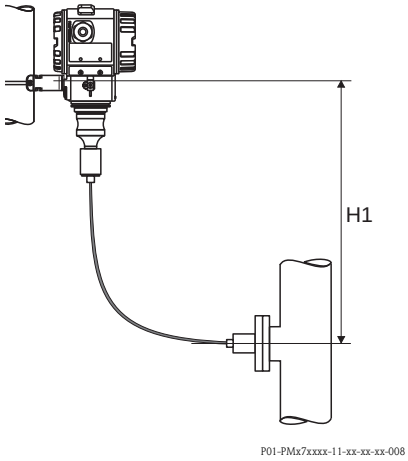
In order to obtain more precise measurement results and to avoid a defect in the device, mount the capillaries as follows:

- vibration-free (in order to avoid additional pressure fluctuations)
- not in the vicinity of heating or cooling lines
- insulate if the ambient temperature is below or above the reference temperature
- with a bending radius of ≥ 100 mm (3.94 in).
- When using diaphragm seal systems with capillaries, sufficient strain relief must be allowed for in order to prevent the capillary bending down (capillary bending radius ≥ 100 mm (3.94 in)).
- In the case of devices with diaphragm seals and capillaries, the zero point shift caused by the hydrostatic pressure of the filling liquid column in the capillaries must be taken into account when selecting the measuring cell. If a measuring cell with a small measuring range is selected, a position adjustment can cause range violation.

Vacuum applications

For applications under vacuum, Endress+Hauser recommends mounting the pressure transmitter below the diaphragm seal. This prevents vacuum load of the diaphragm seal caused by the presence of fill fluid in the capillary.

When the pressure transmitter is mounted above the diaphragm seal, the maximum height difference H1 in accordance with the illustration below must not be exceeded. The maximum height difference is dependent on the density of the filling oil and the smallest ever pressure that is permitted to occur at the diaphragm seal (empty tank), see the following illustration, on the right.



Installation above the diaphragm seal

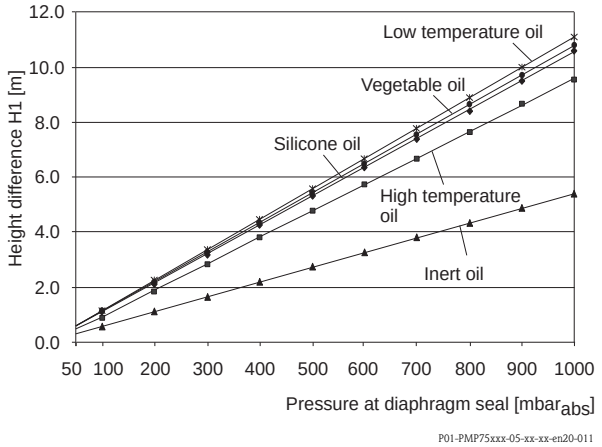
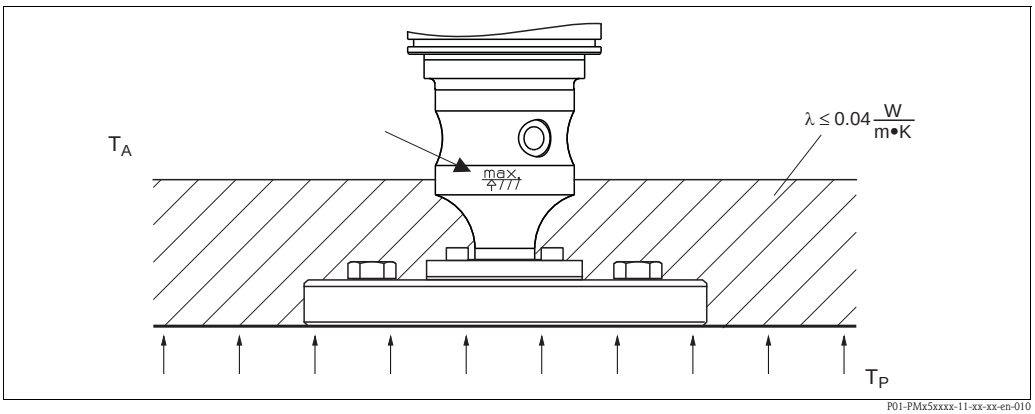


Diagram of maximum installation height above the diaphragm seal for vacuum applications

Heat insulation

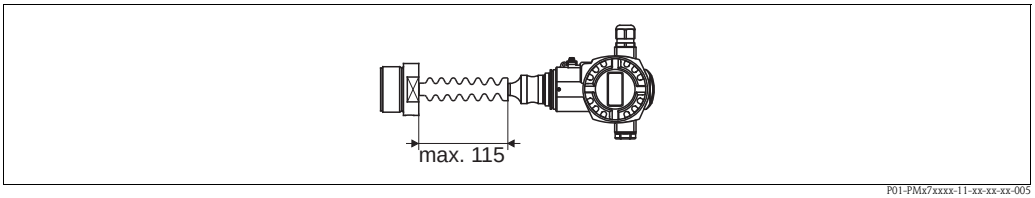
The PMP75 must only be insulated up to a certain height. The maximum permitted insulation height is indicated on the devices and applies to an insulation material with a heat conductivity ≤ 0.04 W/(m x K) and to the maximum permitted ambient and process temperature. The data were determined under the most critical application "quiescent air".



Maximum insulation height, here indicated on a PMP75 with a flange

Mounting with temperature isolator

Endress+Hauser recommends the use of temperature isolators in the event of constant extreme medium temperatures which cause the maximum permissible electronics temperature of +85 °C (185 °F) to be exceeded.
Depending on the filling oil used, diaphragm seal systems with temperature isolators can be used for maximum temperatures of up to 260 °C (500 °F). → Temperature application limits, see → 72, "Diaphragm seal filling oils" section.
To minimize the influence of rising heat, Endress+Hauser recommends the device be mounted horizontally or with the housing pointing downwards.
The additional installation height also brings about a zero point shift of maximum 21 mbar (0.315 psi) due to the hydrostatic column in the temperature isolator. You can correct this zero point shift at the device.



PMP75 with temperature isolator, material 316L (1.4404)

Certificates and approvals

CE mark

The device meets the legal requirements of the relevant EC directives.
Endress+Hauser confirms that the device has been successfully tested by applying the CE mark.

Ex approvals

- ATEX
- FM
- CSA
- NEPSI
- IECEx
- TIIS
- GOST
- Also combinations of different approvals

All explosion protection data are given in separate documentation which is available upon request. The Ex documentation is supplied as standard with all devices approved for use in explosion hazardous areas.
→ 89 ff, "Safety Instructions" and "Installation/Control Drawings" sections.

Suitability for hygienic processes

The Cerabar S is suitable for use in hygienic processes.
Overview of suitable process connections from Page 33.
Many versions meet the requirements of 3A-Sanitary Standard No. 74 and are certified by the EHEDG.
Suitable fittings and seals must be used to ensure hygiene-compliant design according to the specifications of 3A and EHEDG.

Note!
The gap-free connections can be cleaned without residue using the usual cleaning methods.

Marine certificate

- GL
- ABS

Functional safety SIL/ IEC 61508 Declaration of Conformity (optional)

The Cerabar S devices with a 4 to 20 mA output signal have been developed in accordance with the IEC 61508 standard. These devices can be used to monitor the process level and pressure up to SIL 3.
For a detailed description of the safety functions with Cerabar S, settings and functional safety data, see the "Functional safety manual – Cerabar S" SD190P.
For devices up to SIL 3 / IEC 61508 Declaration of Conformity, see → 76 ff, feature 100 "Additional option 1" and feature 110 "Additional option 2" version E "SIL / IEC 61508 Declaration of Conformity".

Overfill protection

WHG

CRN approvals

Some device versions have CRN approval. For a CRN-approved device, a CRN-approved process connection (→ 32 ff, "Process connection") has to be ordered with a CSA approval (→ 76 ff, feature 10 "Approval").
PMP75 devices with a capillary are not CRN-approved. These devices are fitted with a separate plate bearing the registration number 0F10525.5C.

Pressure Equipment Directive (PED)

The devices PMC71, PMP71 and PMP75 correspond to Article 3 (3) of the EC directive 97/23/EC (Pressure Equipment Directive) and have been designed and manufactured according to good engineering practice.

The following also applies:
– PMP71 with threaded connection and internal process isolating diaphragm PN > 200 as well as oval flange adapter PN > 200:
  Suitable for stable gases in group 1, category I
– PMP75 with pipe diaphragm seal ≥ 1.5"/PN 40:
  Suitable for stable gases in group 1, category II
– PMP75 with separators PN > 200 ≥ 1.5"/PN40:
  Suitable for stable gases in group 1, category I
– PMP75 with threaded connection PN > 200

Standards and guidelines

DIN EN 60770 (IEC 60770):
Transmitters for use in industrial-process control systems
Part 1: Methods for performance evaluation

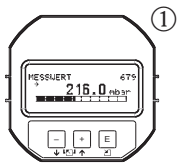
DIN 16086:
Electrical pressure measuring instruments, pressure sensors, pressure transmitters, pressure measuring instruments, concepts, specifications on data sheets

EN 61326-X:
EMC product family standard for electrical equipment for measurement, control and laboratory use.

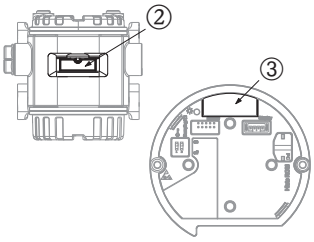
Ordering information

PMC71

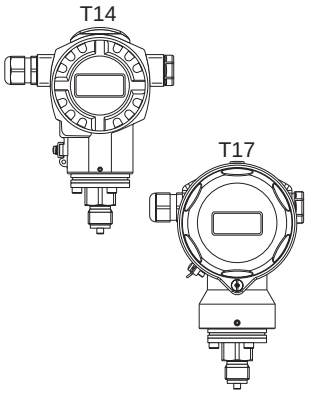
This overview does not mark options which are mutually exclusive.



10	Approval:	
	A	For non-hazardous areas
	E	Combined certificates ATEX II Ex ia + FM IS + CSA IS ATEX II 1/2G Ex ia IIC T6 + FM/CSA IS Class I, II, III Division 1 Group A - G
	1	ATEX II 1/2 G Ex ia IIC T6
	6	ATEX II 1/2 G Ex ia IIC T6, overfill protection WHG
	2	ATEX II 1/2 D Ex ia IIC T6
	8	ATEX II 1 GD Ex ia IIC T6
	3	ATEX II 1/2 GD Ex ia IIC T6
	5	ATEX II 2 G Ex d[ia] IIC T6
	7	ATEX II 3 G Ex nA II T6
	S	FM IS, Class I, II, III Division 1, Groups A – G; NI Class I Division 2, Groups A – D; AEx ia
	T	FM XP, Class I Division 1, Groups A – D; AEx d
	R	FM NI, Class I, Division 2, Groups A – D
	U	CSA IS, Class I, II, III Division 1, Groups A – G; Class I Division 2, Groups A – D, Ex ia
	V	CSA XP, Class I Division 1, Groups B – D; Ex d
	G	NEPSI Ex d[ia] IIC T4/T6
	H	NEPSI Ex ia IIC T6
	L	TIIS Ex d (ia) IIC T6
	M	TIIS Ex d (ia) IIC T4
	I	IECEx Zone 0/1 Ex ia IIC T6



20		Output; Operation:	
	A	4 to 20 mA HART, operation outside, LCD (→ see Fig. ①, ②)	
	B	4 to 20 mA HART, operation inside, LCD (→ see Fig. ①, ③)	
	C	4 to 20 mA HART, operation inside (→ see Fig. ③)	
	M	PROFIBUS PA, operation outside, LCD (→ see Fig. ①, ②)	
	N	PROFIBUS PA, operation inside, LCD (→ see Fig. ①, ③)	
	O	PROFIBUS PA, operation inside (→ see Fig. ③)	
	P	FOUNDATION Fieldbus, operation outside, LCD (→ see Fig. ①, ③)	
	Q	FOUNDATION Fieldbus, operation inside, LCD (→ see Fig. ①, ③)	
	R	FOUNDATION Fieldbus, operation inside (→ see Fig. ③)	



30			Housing; Cable entry; Protection:	
		A	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Gland M 20x1.5	
		B	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread G 1/2	
		C	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread 1/2 NPT	
		D	Aluminum T14 housing, optional display on the side, IP66/67/NEMA 4X/ 6P, M 12x1 PA plug,	
		E	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, 7/8" FF plug	
		F	Aluminum T14 housing, optional display on the side, IP 65/NEMA 4X, Han7D plug, 90°	
		1	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Gland M 20x1.5	
		2	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread G 1/2	
		3	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread 1/2 NPT	
		4	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, M 12x1 PA plug	
		5	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, 7/8" FF plug	
		6	AISI 316L T14 housing, optional display on the side, IP 65/NEMA 4X, Han7D plug, 90°	
		R	T17 316L Hygiene IP66/68 NEMA6P; M20 gland, T17 = side cover	
		S	T17 316L Hygiene IP66/68 NEMA6P; G1/2 thread, T17 = side cover	
		T	T17 316L Hygiene IP66/68 NEMA6P; NPT1/2 thread, T17 = side cover	
		U	T17 316L Hygiene IP66/68 NEMA6P; M12 plug, T17 = side cover	
		V	T17 316L Hygiene IP66/68 NEMA6P; 7/8" plug, T17 = side cover	

40				Sensor range; Sensor over pressure limit (= OPL):	
				Sensors for gauge pressure	
				Measurement limits: –100 % (–1 bar) to +100 % of sensor nominal value	
				Sensor rated value (URL)	**OPL (over pressure limit)**
			1C	100 mbar/10 kPa/1.5 psi g	4 bar/400 kPa/60 psi g
			1E	250 mbar/25 kPa/3.75 psi g	5 bar/500 kPa/75 psi g
			1F	400 mbar/40 kPa/6 psi g	8 bar/800 kPa/120 psi g
			1H	1 bar/100 kPa/15 psi g	10 bar/1 MPa/150 psi g
			1K	2 bar/200 kPa/30 psi g	18 bar/1.8 MPa/270 psi g
			1M	4 bar/400 kPa/60 psi g	25 bar/2.5 MPa/375 psi g
			1P	10 bar/1 MPa/150 psi g	40 bar/4 MPa/600 psi g
			1S	40 bar/4 MPa/600 psi g	60 bar/6 MPa/900 psi g

40 Sensor range; Sensor over pressure limit (= OPL):

Sensors for absolute pressure

	Sensor rated value (URL)	OPL (over pressure limit)
2C	100 mbar/10 kPa/1.5 psi abs	4 bar/400 kPa/60 psi abs
2E	250 mbar/25 kPa/3.75 psi abs	5 bar/500 kPa/75 psi abs
2F	400 mbar/40 kPa/6 psi abs	8 bar/800 kPa/120 psi abs
2H	1 bar/100 kPa/15 psi abs	10 bar/1 MPa/150 psi abs
2K	2 bar/200 kPa/30 psi abs	18 bar/1.8 MPa/270 psi abs
2M	4 bar/400 kPa/60 psi abs	25 bar/2.5 MPa/375 psi abs
2P	10 bar/1 MPa/150 psi abs	40 bar/4 MPa/600 psi abs
2S	40 bar/4 MPa/600 psi abs	60 bar/6 MPa/900 psi abs

50 Calibration; Unit:

1	Sensor range; mbar/bar
2	Sensor range; kPa/MPa
3	Sensor range; mmH_2O/mH_2O
4	Sensor range; inH_2O/ftH_2O
6	Sensor range; psi
B	Customer-specific; see additional specification
C	Factory calibration certificate, 5-point; see additional specification
D	DKD certificate; see additional specification
K	Platinum; see additional specification
L	Platinum and factory calibration certificate, 5-point; see additional specification
M	Platinum and DKD certificate; see additional specification

70 Process connection; Material:

	Thread, internal process isolating diaphragm
GA	Thread ISO 228 G 1/2 A EN 837, AISI 316L (CRN)
GB	Thread ISO 228 G 1/2 A EN 837, Alloy C (CRN)
GC	Thread ISO 228 G 1/2 A EN 837, Monel
GD	Thread ISO 228 G 1/2 A EN 837, PVDF (max. 15 bar/225 psi, –10 to +60°C/+14 to +140°F)
GE	Thread ISO 228 G 1/2 A G 1/4 (female), AISI 316L (CRN)
GF	Thread ISO 228 G 1/2 A G 1/4 (female), Alloy C (CRN)
GG	Thread ISO 228 G 1/2 A G 1/4 (female), Monel
GH	Thread ISO 228 G 1/2 A hole 11.4 mm, AISI 316L (CRN)
GJ	Thread ISO 228 G 1/2 A hole 11.4 mm, Alloy C (CRN)
GK	Thread ISO 228 G 1/2 A hole 11.4 mm, Monel
RA	Thread ANSI 1/2 MNPT 1/4 FNPT, AISI 316L (CRN)
RB	Thread ANSI 1/2 MNPT 1/4 FNPT, Alloy C (CRN)
RC	Thread ANSI 1/2 MNPT 1/4 FNPT, Monel
RD	Thread ANSI 1/2 MNPT, hole 11.4 mm, AISI 316L (CRN)
RE	Thread ANSI 1/2 MNPT, hole 11.4 mm, Alloy C (CRN)
RF	Thread ANSI 1/2 MNPT, hole 11.4 mm, Monel
RG	Thread ANSI 1/2 MNPT hole 3 mm, PVDF (max. 15 bar/225 psi, –10 to +60°C/+14 to +140°F)
RH	Thread ANSI 1/2 FNPT, AISI 316L (CRN)
RJ	Thread ANSI 1/2 FNPT, Alloy C
RK	Thread ANSI 1/2 FNPT, Monel
GL	Thread JIS B0202 G 1/2 (male), AISI 316L
RL	Thread JIS B0203 R 1/2 (male), AISI 316L
GP	Thread DIN 13 M 20x1.5 EN 837 hole 3 mm, AISI 316L
GQ	Thread DIN 13 M 20x1.5 EN 837 hole 3 mm, Alloy C
	Thread, flush-mounted process isolating diaphragm
1G	Thread ISO 228 G 1 1/2 A, AISI 316L
1H	Thread ISO 228 G 1 1/2 A, Alloy C
1J	Thread ISO 228 G 1 1/2 A, Monel
1K	Thread ISO 228 G 2 A, AISI 316L
1L	Thread ISO 228 G 2 A, Alloy C
1M	Thread ISO 228 G 2 A, Monel
2D	Thread ANSI 1 1/2 MNPT, AISI 316L (CRN)
2E	Thread ANSI 1 1/2 MNPT, Alloy C (CRN)
2F	Thread ANSI 1 1/2 MNPT, Monel (CRN)
2G	Thread ANSI 2 MNPT, AISI 316L (CRN)
2H	Thread ANSI 2 MNPT, Alloy C
2J	Thread ANSI 2 MNPT, Monel
1R	Thread DIN 13 M 44x1.25, AISI 316L
1S	Thread DIN 13 M 44x1.25, Alloy C
	EN/DIN flanges, flush-mounted process isolating diaphragm
CP	DN 32 PN 10-40 B1, AISI 316L

70	Process connection; Material:
CQ	DN 40 PN 10-40 B1, AISI 316L
BR	DN 50 PN 10-16 A, PVDF (max. 15 bar/225 psi, –10 to +60°C/+14 to +140°F)
B3	DN 50 PN 10-40 B1, AISI 316L
C3	DN 50 PN 63 B2, AISI 316L
BS	DN 80 PN 10-16 A, PVDF (max. 15 bar/225 psi, –10 to +60°C/+14 to +140°F)
B4	DN 80 PN 10-40 B1, AISI 316L
	ANSI flanges, flush-mounted process diaphragms
AE	1 1/2" 150 lbs RF, AISI 316/316L (CRN)
AQ	1 1/2" 300 lbs RF, AISI 316/316L (CRN)
AF	2" 150 lbs RF, AISI 316/316L (CRN)
JR	2" 150 lbs RF, AISI 316L with ECTFE-coating
A3	2" 150 lbs RF, PVDF (max. 15 bar/225 psi, –10 to +60°C/+14 to +140°F)
AR	2" 300 lbs RF, AISI 316/316L (CRN)
AG	3" 150 lbs RF, AISI 316/316L (CRN)
JS	3" 150 lbs RF, AISI 316L with ECTFE-coating
A4	3" 150 lbs RF, PVDF (max. 15 bar/225 psi, –10 to +60°C/+14 to +140°F)
AS	3" 300 lbs RF, AISI 316/316L (CRN)
AH	4" 150 lbs RF, AISI 316/316L (CRN)
JT	4" 150 lbs RF, AISI 316L with ECTFE-coating
AT	4" 300 lbs RF, AISI 316/316L (CRN)
	JIS flanges, flush-mounted process isolating diaphragm
KF	10K 50A RF, AISI 316L
KL	10K 80A RF, AISI 316L
KH	10K 100A RF, AISI 316L
	Hygienic connections, flush-mounted process isolating diaphragm
MP	DIN 11851 DN 40 PN 25, AISI 316L, slotted nut, EHEDG, 3A with HNBR/EPDM seal (CRN)
MR	DIN 11851 DN 50 PN 25, AISI 316L, slotted nut, EHEDG, 3A with HNBR/EPDM seal (CRN)
TD	Tri-Clamp ISO 2852 DN 51 (2"), AISI 316L, EHEDG, 3A with HNBR/EPDM seal (CRN)
TF	Tri-Clamp ISO 2852 DN 76.1 (3"), AISI 316L, EHEDG, 3A with HNBR/EPDM seal (CRN)
TK	DRD DN50 (65 mm), PN 25, AISI 316L, with HNBR/EPDM seal
TR	Varivent type N for tubes DN 40 – DN 162, PN 40, AISI 316L, EHEDG, 3A with HNBR/EPDM seal (CRN)

80	Seal:
A	FKM Viton
B	EPDM
D	Kalrez
E	Chemraz
F	NBR (FDA)/3A: HNBR (FDA)
L	FKM Viton, cleaned for silicone-free applications
M	Kalrez, cleaned for silicone-free applications
1	FKM Viton, cleaned from oil and grease
2	FKM Viton, cleaned for oxygen service Note application limits pressure/temp.

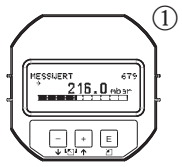
100	Additional option 1:
A	Not selected
E	SIL/IEC 61508 Declaration of Conformity
T	High-temperature version
B	Material test certificate for wetted components, inspection certificate as per EN 10204 3.1 acc. to specification 52005759
M	Overvoltage protection
J	Software setting, see additional spec. Min alarm current HART burst mode PV Min alarm current + HART burst mode PV
N	HistoROM/M-DAT
S	GL/ABS marine certificate
V	Mounting on shut-off valve from above
2	Test report acc. to EN 10204 2.2
3	Routine test with certificate, inspection certificate as per EN 10204 3.1
4	Overpressure test with certificate, inspection certificate as per EN 10204 3.1

110	Additional option 2:
A	Not selected
E	SIL2/IEC61508 Declaration of Conformity
G	Separate housing, cable length see additional spec. + mounting bracket, wall/pipe, 316L

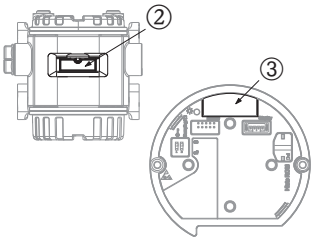
110										**Additional option 2:**	
										T	High-temperature version
										M	Overvoltage protection
										J	Software setting, see additional spec.
											Min alarm current
											HART burst mode PV
											Min alarm current + HART burst mode PV
										N	HistoROM/M-DAT
										S	GL/ABS marine certificate
										U	Mounting bracket for wall/pipe, AISI 304
										2	Test report acc. to EN10204 2.2
										3	Routine test with certificate, inspection certificate as per EN 10204 3.1
										4	Overpressure test with certificate, inspection certificate as per EN 10204 3.1
										5	Helium leak test EN 1518 with test certificate, inspection certificate as per EN 10204 3.1
995											**Identification:**
										1	Measuring point TAG, see additional specification
										2	Bus address, see additional specification
PMC71											Order code

PMP71

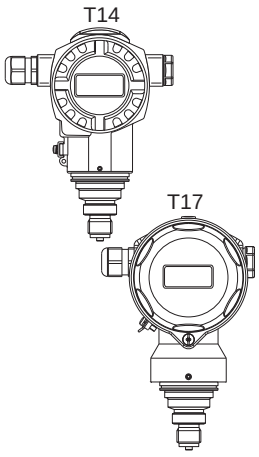
This overview does not mark options which are mutually exclusive.



10	Approval:
A	For non-hazardous areas
1	ATEX II 1/2 G Ex ia IIC T6
6	ATEX II 1/2 G Ex ia IIC T6, overfill protection WHG
2	ATEX II 1/2 D
4	ATEX II 1/3 D
8	ATEX II 1 GD Ex ia IIC T6
3	ATEX II 1/2 GD Ex ia IIC T6
5	ATEX II 2 G Ex d IIC T6
7	ATEX II 3 G Ex nA II T6
S	FM IS, Class I, II, III Division 1, Groups A – G; NI Class I Division 2, Groups A – D; AEx ia
T	FM XP, Class I Division 1, Groups A – D; AEx d
Q	FM DIP, Class II, III Division 1, Groups E – G
R	FM NI, Class I, Division 2, Groups A – D
U	CSA IS, Class I, II, III Division 1, Groups A – G; Class I Division 2, Groups A – D, Ex ia
V	CSA XP, Class I Division 1, Groups B – D; Ex d
W	CSA Class II, III Division 1, Groups E – G (Dust-Ex)
G	NEPSI Ex d IIC T6
H	NEPSI Ex ia IIC T6
L	TIIS Ex d IIC T6
I	IECEx Zone 0/1 Ex ia IIC T6
B	Combined certificates: ATEX II 1/2 G Ex ia IIC T6 + II 2 G Ex d IIC T6
C	Combined certificates: FM IS and XP Class I Division 1, Groups A – D
D	Combined certificates: CSA IS and XP Class I Division 1, Groups A – D
E	Combined certificates: FM/CSA IS and XP Class I Division 1, Groups A – D
F	Combined certificates: ATEX II Ex ia / Ex d + FM/CSA IS + XP ATEX II 1/2G Ex ia IIC T6+ ATEX II 2G Ex d IIC T6+ FM/CSA IS + XP Cl.I Div.1 Gr.A-D



20		Output; Operation:
A	4 to 20 mA HART, operation outside, LCD (→ see Fig. ①, ②)
B	4 to 20 mA HART, operation inside, LCD (→ see Fig. ①, ③)
C	4 to 20 mA HART, operation inside (→ see Fig. ③)
M	PROFIBUS PA, operation outside, LCD (→ see Fig. ①, ②)
N	PROFIBUS PA, operation inside, LCD (→ see Fig. ①, ③)
O	PROFIBUS PA, operation inside (→ see Fig. ③)
P	FOUNDATION Fieldbus, operation outside, LCD (→ see Fig. ①, ③)
Q	FOUNDATION Fieldbus, operation inside, LCD (→ see Fig. ①, ③)
R	FOUNDATION Fieldbus, operation inside (→ see Fig. ③)



30			Housing; Cable entry; Protection:
A	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Gland M 20x1.5
B	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread G 1/2
C	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread 1/2 NPT
D	Aluminum T14 housing, optional display on the side, IP66/67/NEMA 4X/ 6P, M 12x1 PA plug,
E	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, 7/8" FF plug
F	Aluminum T14 housing, optional display on the side, IP 65/NEMA 4X, Han7D plug, 90°
1	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Gland M 20x1.5
2	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread G 1/2
3	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread 1/2 NPT
4	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, M 12x1 PA plug
5	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, 7/8" FF plug
6	AISI 316L T14 housing, optional display on the side, IP 65/NEMA 4X, Han7D plug, 90°
R	T17 316L Hygiene IP66/68 NEMA6P; M20 gland, T17 = side cover
S	T17 316L Hygiene IP66/68 NEMA6P; G1/2 thread, T17 = side cover
T	T17 316L Hygiene IP66/68 NEMA6P; NPT1/2 thread, T17 = side cover
U	T17 316L Hygiene IP66/68 NEMA6P; M12 plug, T17 = side cover
V	T17 316L Hygiene IP66/68 NEMA6P; 7/8" plug, T17 = side cover

40				Sensor range; Sensor over pressure limit (= OPL):	
Sensors for gauge pressure		
Measurement limits: –100 % (–1 bar) to +100 % of sensor nominal value		
				Sensor rated value (URL)	**OPL (over pressure limit)**
1F	400 mbar/40 kPa/6 psi g	6 bar/600 kPa/90 psi g
1H	1 bar/100 kPa/15 psi g	10 bar/1 MPa/150 psi g
1K	2 bar/200 kPa/30 psi g	20 bar/2 MPa/300 psi g

40				Sensor range; Sensor over pressure limit (= OPL):	
			1M	4 bar/400 kPa/60 psi g	28 bar/2.8 MPa/420 psi g
			1P	10 bar/1 MPa/150 psi g	40 bar/4 MPa/600 psi g
			1S	40 bar/4 MPa/600 psi g	160 bar/16 MPa/2400 psi g
			1U	100 bar/10 MPa/1500 psi g	400 bar/40 MPa/6000 psi g
			1W	400 bar/40 MPa/6000 psi g	600 bar/60 MPa/9000 psi g
			1X	700 bar/70 MPa/10500 psi g	1050 bar/105 MPa/15700 psi g
			Sensors for absolute pressure		
				Sensor rated value (URL)	**OPL (over pressure limit)**
			2F	400 mbar/40 kPa/6 psi abs	6 bar/600 kPa/90 psi abs
			2H	1 bar/100 kPa/15 psi abs	10 bar/1 MPa/150 psi abs
			2K	2 bar/200 kPa/30 psi abs	20 bar/2 MPa/300 psi abs
			2M	4 bar/400 kPa/60 psi abs	28 bar/2.8 MPa/420 psi abs
			2P	10 bar/1 MPa/150 psi abs	40 bar/4 MPa/600 psi abs
			2S	40 bar/4 MPa/600 psi abs	160 bar/16 MPa/2400 psi abs
			2U	100 bar/10 MPa/1500 psi abs	400 bar/40 MPa/6000 psi g
			2W	400 bar/40 MPa/6000 psi g	600 bar/60 MPa/9000 psi g
			2X	700 bar/70 MPa/10500 psi g	1050 bar/105 MPa/15700 psi g

50						Calibration; Unit:
					1	Sensor range; mbar/bar
					2	Sensor range; kPa/MPa
					3	Sensor range; mmH_2O/mH_2O
					4	Sensor range; inH_2O/ftH_2O
					6	Sensor range; psi
					B	Customer-specific; see additional specification
					C	Factory calibration certificate, 5-point; see additional specification
					D	DKD certificate; see additional specification
					K	Platinum; see additional specification
					L	Platinum and factory calibration certificate, 5-point; see additional specification
					M	Platinum and DKD certificate; see additional specification

60							Material of the process isolating diaphragm:
						1	AISI 316L
						2	Alloy C276
						6	AISI 316L with gold-rhodium coating

70								Process connection; Material:
								Thread, internal process isolating diaphragm:
							GA	Thread ISO 228 G 1/2 A EN 837, AISI 316L
							GB	Thread ISO 228 G 1/2 A EN 837, Alloy C
							GE	Thread ISO 228 G 1/2 A G 1/4 (female), AISI 316L
							GF	Thread ISO 228 G 1/2 A G 1/4 (female), Alloy C
							GH	Thread ISO 228 G 1/2 A hole 11.4 mm, AISI 316L
							GJ	Thread ISO 228 G 1/2 A hole 11.4 mm, Alloy C
							RA	Thread ANSI 1/2 MNPT 1/4 FNPT, AISI 316L (CRN)
							RB	Thread ANSI 1/2 MNPT 1/4 FNPT, Alloy C (CRN)
							RD	Thread ANSI 1/2 MNPT hole, AISI 316L (CRN)
							RE	Thread ANSI 1/2 MNPT hole, Alloy C (CRN)
							RH	Thread ANSI 1/2 FNPT, AISI 316L (CRN)
							RJ	Thread ANSI 1/2 FNPT, Alloy C
							GL	Thread JIS B0202 G 1/2 (male), AISI 316L
							RL	Thread JIS B0203 R 1/2 (male), AISI 316L
								Thread, internal process isolating diaphragm
							GP	Thread DIN 13 M 20x1.5 EN 837 hole 11.4 mm, AISI 316L
							GQ	Thread DIN 13 M 20x1.5 EN 837 hole 11.4 mm, Alloy C
								Thread, flush-mounted process isolating diaphragm
							1A	Thread ISO 228 G 1/2 A, DIN 3852, AISI 316L
							1B	Thread ISO 228 G 1/2 A, DIN 3852, Alloy C
							1D	Thread ISO 228 G 1 A, AISI 316L
							1E	Thread ISO 228 G 1 A, Alloy C
							1G	Thread ISO 228 G 1 1/2 A, AISI 316L
							1H	Thread ISO 228 G 1 1/2 A, Alloy C
							1K	Thread ISO 228 G 2 A, AISI 316L
							1L	Thread ISO 228 G 2 A, Alloy C
							2A	Thread ANSI 1 MNPT, AISI 316L
							2B	Thread ANSI 1 MNPT, Alloy C (CRN)
							2D	Thread ANSI 1 1/2 MNPT, AISI 316L (CRN)
							2E	Thread ANSI 1 1/2 MNPT, Alloy C (CRN)
							2G	Thread ANSI 2 MNPT, AISI 316L (CRN)

70	Process connection; Material:
	2H Thread ANSI 2 MNPT, Alloy C
	1N Thread DIN 16288 M 20x1.5, AISI 316L
	1P Thread DIN 16288 M 20x1.5, Alloy C
	1R Thread DIN 13 M 44x1.25, AISI 316L
	1S Thread DIN 13 M 44x1.25, Alloy C
	EN/DIN flanges, flush-mounted process isolating diaphragm
	CN DN 25 PN 10-40 B1, AISI 316L
	CP DN 32 PN 10-40 B1, AISI 316L
	CQ DN 40 PN 10-40 B1, AISI 316L
	B3 DN 50 PN 10-40 B1, AISI 316L
	B4 DN 80 PN 10-40 B1, AISI 316L
	ANSI flanges, flush-mounted process isolating diaphragm
	AN 1" 300 lbs RF, AISI 316/316L (CRN)
	AE 1 1/2" 150 lbs RF, AISI 316/316L (CRN)
	AQ 1 1/2" 300 lbs RF, AISI 316/316L (CRN)
	AF 2" 150 lbs RF, AISI 316/316L (CRN)
	AR 2" 300 lbs RF, AISI 316/316L (CRN)
	AG 3" 150 lbs RF, AISI 316/316L (CRN)
	AS 3" 300 lbs RF, AISI 316/316L (CRN)
	AH 4" 150 lbs RF, AISI 316/316L (CRN)
	AT 4" 300 lbs RF, AISI 316/316L (CRN)
	JIS flanges, flush-mounted process isolating diaphragm
	KA 20K 25A RF, AISI 316L
	KF 10K 50A RF, AISI 316L
	KL 10K 80A RF, AISI 316L
	KH 10K 100A RF, AISI 316L
	Other
	UR Oval flange adapter 1/4-18 NPT, mounting: 7/16-20 UNF, AISI 316L (CRN)
	U1 Prepared for diaphragm seal mount, AISI 316L (CRN)

90	Fill fluid:
	A Silicone oil
	F Inert oil
	K Inert oil, cleaned from oil and grease
	N Inert oil, cleaned for oxygen service (observe application limits pressure/temperature)

100	Additional option 1:
	A Not selected
	E SIL/IEC 61508 Declaration of Conformity
	B Material test certificate for wetted components, inspection certificate as per EN 10204 3.1 acc. to specification 52005759
	C NACE MR0175 (wetted parts)
	D Material test certificate for wetted components as per EN 10204 3.1 and NACE MR0175 material, inspection certificate as per EN 10204 acc. to specification 52010806
	M Overvoltage protection
	V Mounting on shut-off valve from above
	J Software setting, see additional spec. Min alarm current HART burst mode PV Min alarm current + HART burst mode PV
	N HistoROM/M-DAT
	S GL/ABS marine certificate
	2 Test report acc. to EN10204 2.2
	3 Routine test with certificate, inspection certificate as per EN 10204 3.1
	4 Overpressure test with certificate, inspection certificate as per EN 10204 3.1

110	Additional option 2:
	A Not selected
	E SIL/IEC 61508 Declaration of Conformity
	G Separate housing, cable length see additional spec. + mounting bracket, wall/pipe, 316L
	M Overvoltage protection
	J Software setting, see additional spec. Min alarm current HART burst mode PV Min alarm current + HART burst mode PV
	N HistoROM/M-DAT
	S GL/ABS marine certificate

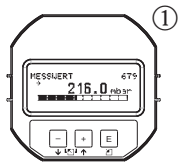
110											**Additional option 2:**	
											U	Mounting bracket for wall/pipe, AISI 304
											2	Test report acc. to EN 10204 2.2
											3	Individual testing with test certificate, inspection certificate as per EN10204 3.1
											4	Overpressure test with certificate, inspection certificate as per EN 10204 3.1
											5	Helium leak test EN 1528 with test certificate, inspection certificate as per EN 10204 3.1

995												**Identification:**
											1	Measuring point TAG, see additional specification
											2	Bus address, see additional specification

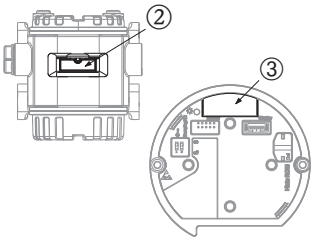
PMP71											Order code

PMP75

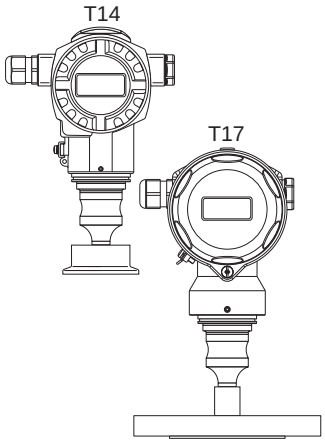
This overview does not mark options which are mutually exclusive.



10	Approval:
A	For non-hazardous areas
1	ATEX II 1/2 G Ex ia IIC T6
6	ATEX II 1/2 G Ex ia IIC T6, overfill protection WHG
2	ATEX II 1/2 D
4	ATEX II 1/3 D
8	ATEX II 1 GD Ex ia IIC T6
3	ATEX II 1/2 GD Ex ia IIC T6
5	ATEX II 2 G Ex d IIC T6
7	ATEX II 3 G Ex nA II T6
S	FM IS, Class I, II, III Division 1, Groups A – G; NI Class I Division 2, Groups A – D; AEx ia
T	FM XP, Class I Division 1, Groups A – D; AEx d
Q	FM DIP, Class II, III Division 1, Groups E – G
R	FM NI, Class I, Division 2, Groups A – D
U	CSA IS, Class I, II, III Division 1, Groups A – G; Class I Division 2, Groups A – D, Ex ia
V	CSA XP, Class I Division 1, Groups B – D; Ex d
W	CSA Class II, III Division 1, Groups E – G (Dust-Ex)
G	NEPSI Ex d IIC T6
H	NEPSI Ex ia IIC T6
L	TIIS Ex d IIC T6
I	IECEx Zone 0/1 Ex ia IIC T6
B	Combined certificates: ATEX II 1/2 G Ex ia IIC T6 + II 2 G Ex d IIC T6
C	Combined certificates: FM IS and XP Class I Division 1, Groups A – D
D	Combined certificates: CSA IS and XP Class I Division 1, Groups A – D
E	Combined certificates: FM/CSA IS and XP Class I Division 1, Groups A – D
F	Combined certificates: ATEX II Ex ia / Ex d + FM/CSA IS + XP ATEX II 1/2G Ex ia IIC T6+ ATEX II 2G Ex d IIC T6+ FM/CSA IS + XP Cl.I Div.1 Gr.A-D



20	Output; Operation:
A	4 to 20 mA HART, operation outside, LCD (→ see Fig. ①, ②)
B	4 to 20 mA HART, operation inside, LCD (→ see Fig. ①, ③)
C	4 to 20 mA HART, operation inside (→ see Fig. ③)
M	PROFIBUS PA, operation outside, LCD (→ see Fig. ①, ②)
N	PROFIBUS PA, operation inside, LCD (→ see Fig. ①, ③)
O	PROFIBUS PA, operation inside (→ see Fig. ③)
P	FOUNDATION Fieldbus, operation outside, LCD (→ see Fig. ①, ③)
Q	FOUNDATION Fieldbus, operation inside, LCD (→ see Fig. ①, ③)
R	FOUNDATION Fieldbus, operation inside (→ see Fig. ③)



30	Housing; Cable entry; Protection:
A	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Gland M 20x1.5
B	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread G 1/2
C	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread 1/2 NPT
D	Aluminum T14 housing, optional display on the side, IP66/67/NEMA 4X/ 6P, M 12x1 PA plug,
E	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, 7/8" FF plug
F	Aluminum T14 housing, optional display on the side, IP 65/NEMA 4X, Han7D plug, 90°
1	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Gland M 20x1.5
2	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread G 1/2
3	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread 1/2 NPT
4	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, M 12x1 PA plug
5	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, 7/8" FF plug
6	AISI 316L T14 housing, optional display on the side, IP 65/NEMA 4X, Han7D plug, 90°
R	T17 316L Hygiene IP66/68 NEMA6P; M20 gland, T17 = side cover
S	T17 316L Hygiene IP66/68 NEMA6P; G1/2 thread, T17 = side cover
T	T17 316L Hygiene IP66/68 NEMA6P; NPT1/2 thread, T17 = side cover
U	T17 316L Hygiene IP66/68 NEMA6P; M12 plug, T17 = side cover
V	T17 316L Hygiene IP66/68 NEMA6P; 7/8" plug, T17 = side cover

40	Sensor range; Sensor over pressure limit (= OPL):		
	Sensors for gauge pressure		
	Measurement limits: −100 % (−1 bar) to +100 % of sensor nominal value		
		Sensor rated value (URL)	**OPL (over pressure limit)**
1F		400 mbar/40 kPa/6 psi	6 bar/600 kPa/90 psi
1H		1 bar/100 kPa/15 psi	10 bar/1 MPa/150 psi
1K		2 bar/200 kPa/30 psi	20 bar/2 MPa/300 psi
1M		4 bar/400 kPa/60 psi	28 bar/2.8 MPa/420 psi

40	Sensor range; Sensor over pressure limit (= OPL):		
	1P	10 bar/1 MPa/150 psi	40 bar/4 MPa/600 psi
	1S	40 bar/4 MPa/600 psi	160 bar/16 MPa/2400 psi
	1U	100 bar/10 MPa/1500 psi	400 bar/40 MPa/6000 psi
	1W	400 bar/40 MPa/6000 psi	600 bar/60 MPa/9000 psi
	Sensors for absolute pressure		
		Sensor rated value (URL)	**OPL (over pressure limit)**
	2F	400 mbar/40 kPa/6 psi abs	6 bar/600 kPa/90 psi abs
	2H	1 bar/100 kPa/15 psi abs	10 bar/1 MPa/150 psi abs
	2K	2 bar/200 kPa/30 psi abs	20 bar/2 MPa/300 psi abs
	2M	4 bar/400 kPa/60 psi abs	28 bar/2.8 MPa/420 psi abs
	2P	10 bar/1 MPa/150 psi abs	40 bar/4 MPa/600 psi abs
	2S	40 bar/4 MPa/600 psi abs	160 bar/16 MPa/2400 psi abs
	2U	100 bar/10 MPa/1500 psi abs	400 bar/40 MPa/6000 psi g
	2W	400 bar/40 MPa/6000 psi g	600 bar/60 MPa/9000 psi g

50	Calibration; Unit:	
	1	Sensor range; mbar/bar
	2	Sensor range; kPa/MPa
	3	Sensor range; mmH_2O/mH_2O
	4	Sensor range; inH_2O/ftH_2O
	6	Sensor range; psi
	B	Customer-specific; see additional specification
	C	Factory calibration certificate, 5-point; see additional specification
	D	DKD calibration: see additional specification

60	Material of the process isolating diaphragm:	
	1	AISI 316L
	2	Alloy C276
	3	Monel
	5	Tantalum
	6	AISI 316L with gold-rhodium coating
	7	AISI 316L with 0.09 mm PTFE foil (not for vacuum applications)
	8	AISI 316L with 0.25 mm PTFE foil (not for vacuum applications, only for non-hazardous areas)

70	Process connection, material:	
		Thread, flush-mounted process isolating diaphragm
	1D	Thread ISO 228 G 1 A, AISI 316L
	1E	Thread ISO 228 G 1 A, Alloy C
	1G	Thread ISO 228 G 1 1/2 A, AISI 316L
	1H	Thread ISO 228 G 1 1/2 A, Alloy C
	1K	Thread ISO 228 G 2 A, AISI 316L
	1L	Thread ISO 228 G 2 A, Alloy C
	2A	Thread ANSI 1 MNPT, AISI 316L
	2B	Thread ANSI 1 MNPT, Alloy C (CRN)
	2D	Thread ANSI 1 1/2 MNPT, AISI 316L (CRN)
	2E	Thread ANSI 1 1/2 MNPT, Alloy C (CRN)
	2G	Thread ANSI 2 MNPT, AISI 316L (CRN)
	2H	Thread ANSI 2 MNPT, Alloy C (CRN)
		Clamp connections
	TB	Tri-Clamp, ISO 2852 DN 25 (1"), DIN 32676 DN 25, AISI 316L (CRN), EHEDG
	TC	Tri-Clamp, ISO 2852 DN 38 (1 1/2"), DIN 32676 DN 40, AISI 316L (CRN), EHEDG
	TD	Tri-Clamp, ISO 2852 DN 51 (2")/DN 50, AISI 316L (CRN), EHEDG
	TF	Tri-Clamp, ISO 2852 DN 76.1 (3"), AISI 316L (CRN), EHEDG
		Pipe diaphragm seal Clamp connections
	SB	Tri-Clamp, ISO 2852 DN 25 (1"), AISI 316L (CRN)
	SC	Tri-Clamp, ISO 2852 DN 38 (1 1/2"), AISI 316L, 3.1 + Pressure test acc. to PED Cat.II (CRN)
	SD	Tri-Clamp, ISO 2852 DN 51 (2"), AISI 316L, 3.1 + Pressure test acc. to PED Cat.II (CRN)
		Hygienic connections
	MR	DIN 11851 DN 50 PN 25, slotted nut, AISI 316L, EHEDG, 3A
	MS	DIN 11851 DN 65 PN 25, slotted nut, AISI 316L, EHEDG, 3A
	MT	DIN 11851 DN 80 PN 25, slotted nut, AISI 316L, EHEDG, 3A
	M3	DIN 11851 DN 50 PN 25, threaded adapter, AISI 316L, EHEDG
	M4	DIN 11851 DN 65 PN 25, threaded adapter, AISI 316L, EHEDG
	M5	DIN 11851 DN 80 PN 25, threaded adapter, AISI 316L, EHEDG
	TG	SMS 1" PN 25, AISI 316L, EHEDG
	TH	SMS 1 1/2" PN 25, AISI 316L, EHEDG
	TI	SMS 2" PN 25, AISI 316L, EHEDG
	TL	APV-RJT 1" PN 40, AISI 316L

70		Process connection, material:
	TM	APV-RJT 1 1/2" PN 40, AISI 316L
	TN	APV-RJT 2" PN 40, AISI 316L
	TP	APV-ISS 1" PN 40, AISI 316L
	TQ	APV-ISS 1 1/2" PN 40, AISI 316L
	TS	APV-ISS 2" PN 40, AISI 316L
	TK	DRD DN50 (65 mm) PN 25, AISI 316L
	TR	Varivent Type N for pipes DN 40 – DN 162 PN 40, AISI 316L, EHEDG
	00	Universal process adapter 44 mm including silicon molded seal, EHEDG, 3A (CRN)
		EN/DIN flanges, flush-mounted process isolating diaphragm
	CN	DN 25 PN 10-40 B1, AISI 316L
	DN	DN 25 PN 63-160 E, AISI 316L
	EN	DN 25 PN 250 E, AISI 316L
	E1	DN 25 PN 400 E, AISI 316L
	CP	DN 32 PN 10-40 B1, AISI 316L
	CQ	DN 40 PN 10-40 B1, AISI 316L
	B3	DN 50 PN 10-40 B1, AISI 316L
	C3	DN 50 PN 63 B2, AISI 316L
	EF	DN 50 PN 100-160 E, AISI 316L
	ER	DN 50 PN 250 E, AISI 316L
	E3	DN 50 PN 400 E, AISI 316L
	B4	DN 80 PN 10-40 B1, AISI 316L
	C4	DN 80 PN 100 B2, AISI 316L
	C5	DN 100 PN 100 B2, AISI 316L
		EN/DIN flanges with extended diaphragm seal, flush-mounted process isolating diaphragm
	D3	DN 50 PN 10-40 B1, extended diaphragm seal 50 mm/100 mm/200 mm, AISI 316L
	D4	DN 80 PN 10-40 B1, extended diaphragm seal 50 mm/100 mm/200 mm, AISI 316L
		ANSI flanges, flush-mounted process isolating diaphragm
	AC	1" 150 lbs RF, AISI 316/316L (CRN)
	AN	1" 300 lbs RF, AISI 316/316L (CRN)
	HC	1" 400/600 lbs RF, AISI 316/316L (CRN)
	HN	1" 900/1500 lbs RF, AISI 316/316L (CRN)
	H0	1" 2500 lbs RF, AISI 316/316L (CRN)
	AE	1 1/2" 150 lbs RF, AISI 316/316L (CRN)
	AQ	1 1/2" 300 lbs RF, AISI 316/316L (CRN)
	AF	2" 150 lbs RF, AISI 316/316L (CRN)
	AR	2" 300 lbs RF, AISI 316/316L (CRN)
	HF	2" 400/600 lbs RF, AISI 316/316L (CRN)
	HR	2" 900/1500 lbs RF, AISI 316/316L (CRN)
	H3	2" 2500 lbs RF, AISI 316/316L
	AG	3" 150 lbs RF, AISI 316/316L (CRN)
	AS	3" 300 lbs RF, AISI 316/316L (CRN)
	AH	4" 150 lbs RF, AISI 316/316L (CRN)
	AT	4" 300 lbs RF, AISI 316/316L (CRN)
		ANSI flanges with extended diaphragm seal, flush-mounted process isolating diaphragm
	J3	2" 150 lbs RF, extended diaphragm seal 2"/4"/6"/8", AISI 316/316L (CRN)
	J4	3" 150 lbs RF, extended diaphragm seal 2"/4"/6"/8", AISI 316/316L (CRN)
	J7	3" 300 lbs RF, extended diaphragm seal 2"/4"/6"/8", AISI 316/316L (CRN)
	J5	4" 150 lbs RF, extended diaphragm seal 2"/4"/6"/8", AISI 316/316L (CRN)
	J8	4" 300 lbs RF, extended diaphragm seal 2"/4"/6"/8", AISI 316/316L (CRN)
		JIS flanges, flush-mounted process isolating diaphragm
	KC	10K 25A RF, AISI 316L
	KF	10K 50A RF, AISI 316L
	KL	10K 80A RF, AISI 316L
	KH	10K 100A RF, AISI 316L
		Other
	UA	Thread ISO 228 G 1/2 A PN 160, separator, EN 837, welded, AISI 316L
	UB	Thread ANSI 1/2 MNPT PN 160, separator, welded, AISI 316L (CRN)
	UC	Thread ISO 228 G 1/2 B, separator, EN 837, threaded, AISI 316L
	UD	Thread ANSI 1/2 MNPT, separator, threaded, AISI 316L
	UG	Thread 1/2 NPT PN 250, separator, threaded, AISI 316L
	UH	Thread 1 NPT PN 250, separator, threaded, AISI 316L

90		Fill fluid, temperature isolation:
	A	Silicone oil
	B	...m capillary, inert oil
	C	...ft capillary, inert oil
	D	Vegetable oil

90	Fill fluid, temperature isolation:
F	Inert oil
G	High-temperature oil, temp. isolator 100 mm
H	Silicone oil, temp. isolator 100 mm
K	Inert oil, cleaned from oil and grease
N	Inert oil, cleaned for oxygen services
1	... m capillary, silicone oil
2	... ft capillary, silicone oil
3	... m capillary, high-temperature oil
4	... ft capillary, high-temperature oil
5	... m capillary, vegetable oil
6	... ft capillary, vegetable oil
7	... m capillary, low-temperature oil
8	... ft capillary, low-temperature oil

100	Additional option 1:
A	Not selected
E	SIL2/IEC61508 Declaration of Conformity
B	Material test certificate for wetted components, inspection certificate as per EN 10204 3.1 acc. to specification 52005759
C	NACE MR0175 (wetted parts)
D	Material test certificate for wetted parts, inspection certificate as per EN 10204 3.1 and NACE MR0175 material, inspection certificate as per EN 10204 acc. to specification 52010806
M	Overvoltage protection
J	Software setting, see additional spec.
	Min alarm current
	HART burst mode PV
	Min alarm current + HART burst mode PV
N	HistoROM/M-DAT
S	GL/ABS marine certificate
2	Test report acc. to EN10204 2.2
3	Routine test with certificate, inspection certificate as per EN 10204 3.1
4	Overpressure test with certificate, inspection certificate as per EN 10204 3.1

110	Additional option 2:
A	Not selected
E	SIL2/IEC61508 Declaration of Conformity
G	Separate housing, cable length see additional spec. + mounting bracket, wall/pipe, 316L
M	Overvoltage protection
J	Software setting, see additional spec.
	Min alarm current
	HART burst mode PV
	Min alarm current + HART burst mode PV
N	HistoROM/M-DAT
P	Ra < 0.38 µm/15.75 µin, electropolished + EN10204-3.1 material (wetted) inspection certificate; in conjunction with process connection versions "TC", "TD" and "TR" please order roughness test separately
S	GL/ABS marine certificate
U	Mounting bracket for wall/pipe, AISI 304
2	Test report acc. to EN 10204 2.2
3	Routine test with certificate, inspection certificate as per EN 10204 3.1
4	Overpressure test with certificate, inspection certificate as per EN 10204 3.1

995	Identification:
1	Measuring point TAG, see additional specification
2	Bus address, see additional specification

PMP75	Order code

Additional documentation

Field of Activities	■ Pressure measurement, powerful instruments for process pressure, differential pressure, level and flow: FA004P/00/EN
Technical Information	■ Deltabar S: TI382P/00/EN ■ Deltapilot S: TI416P/00/EN ■ EMC test procedures TI241F/00/EN
Operating Instructions	4 to 20 mA HART: ■ Cerabar S: BA271P/00/EN ■ Description of device functions Cerabar S/Deltabar S/Deltapilot S: BA274P/00/EN PROFIBUS PA: ■ Cerabar S: BA295P/00/EN ■ Description of device functions Cerabar S/Deltabar S/Deltapilot S: BA296P/00/EN FOUNDATION Fieldbus: ■ Cerabar S: BA302P/00/EN ■ Description of device functions Cerabar S/Deltabar S/Deltapilot S: BA303P/00/EN
Brief Operating Instructions	■ 4 to 20 mA HART, Cerabar S: KA1019P/00/EN ■ PROFIBUS PA, Cerabar S: KA1022P/00/EN ■ FOUNDATION Fieldbus, Cerabar S: KA1025P/00/EN
Functional safety manual (SIL)	■ Cerabar S (4 to 20 mA): SD190P/00/EN

Safety Instructions

Certificate/type of protection	Device	Electronics	Documentation	Version in the order code
ATEX II 1/2 G Ex ia IIC T6	PMC71, PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XA244P	1
ATEX II 1/2 D	PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– XA246P – XA289P	2
ATEX II 1/2 D Ex ia IIC	PMC71	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– XA247P – XA290P	2
ATEX II 1/3 D	PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– XA248P – XA291P	4
ATEX II 2 G Ex d IIC T6	PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XA249P	5
ATEX II 2 G Ex d[ia] IIC T6	PMC71	– 4 to 20 mA HART, PROFIBUS PA., FOUNDATION Fieldbus	– XA250P	5
ATEX II 3 G Ex nA II T6	PMC71, PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XA251P	7
ATEX II 1/2 GD Ex ia IIC T6	PMC71, PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XA253P	3
ATEX II 1 GD Ex ia IIC T6	PMC71, PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XA276P	8
ATEX II 1/2 G Ex ia IIC T6 + ATEX II 2 G Ex d IIC T6	PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XA252P	B

Certificate/type of protection	Device	Electronic insert	Documentation	Version in the order code
IECEx Zone 0/1 Ex ia IIC T6	PMC71, PMP71, PMP75	– 4 to 20 mA HART	– XB005P	I

Certificate/type of protection	Device	Electronic insert	Documentation	Version in the order code
NEPSI Ex ia IIC T6	PMC71, PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XC003P	H
NEPSI Ex d IIC T6	PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XC005P	G
NEPSI Ex d[ia] IIC T6	PMC71	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XC005P	G

Certificate/type of protection	Device	Electronics	Documentation	Version in the order code
TIIS Ex d [ia] IIC T6	PMC71	– 4 to 20 mA HART	– TC17436	L
TIIS Ex d [ia] IIC T4	PMC71	– 4 to 20 mA HART	– TC17398, TC17399	M
TIIS Ex d IIC T6	PMP71 (700 bar version)	– 4 to 20 mA HART	– TC17445	L
TIIS Ex d IIC T6	PMP71, PMP75	– 4 to 20 mA HART	– TC17446	L

Installation/Control Drawings

Certificate/type of protection	Device	Electronics	Documentation	Version in the order code
FM IS Class I, II, III, Division 1, Groups A – G; NI, Class I Division 2, Groups A – D; AEx ia	PMC71, PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– ZD147P – ZD188P	S
CSA IS Class I, II, III, Division 1, Groups A – G; Class I Division 2, Groups A – G	PMC71, PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– ZD148P – ZD189P	U
FM IS + XP Class I, Division 1, Groups A – D	PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– ZD187P – ZD190P	C
CSA IS + XP Class I Division 1, Groups A – D	PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– ZD154P – ZD191P	D
FM/CSA IS + XP Class I Division 1, Groups A – D	PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– ZD154P + ZD187P – ZD190P + ZD191P	E
CSA +XP Class I Division 1, Groups B - D, Class II Division 1, Groups E - G, Class III	PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– Under development	-

Overfill protection

- WHG: ZE260P/00/DE

Instruments International

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Endress+Hauser
People for Process Automation

TI383P/00/EN/05.10
No 71111803
CSS/FM+SGML 6.0

71111803

11.2 Endress & Hauser Promag 400 Flow Meter (WTP)

Item	Qty.	Unit	Ordercode Description	Unit Price CAD	Total Net CAD
			Production time upon request		
0022	1	PC	5W4C2F-70M0/101 5W4C2F-C6ALHA0DUA1K0B+ ACDADBLDL4Z1 **Promag W 400, 5W4C2F, DN250 10"** Electromagnetic flowmeter Inline version. The specialist in the water and wastewater industry for the most demanding applications. International drinking water approvals. Installation length: DVGW/ISO conform. Corrosion-resistant transmitter version. Same housing for compact/remote version. :: Certified corrosion protection (optional); state-of-the-art transmitter for W + WW. :: For direct underground installation or permanent underwater use (optional).		

additional specifications

Curr. output 1	Volume flow	
Current span	4...20 mA NAMUR	
Value 0/4 mA	0.00000	m3/h
Value 20 mA	1,440.00000	m3/h
Failsafe mode current output	Max.	
Damping output 1	1.00000	s
Operating mode	Pulse	
Assign pulse output	Volume flow	
Pulse value (per pulse)	1.00000	m3
Pulse width	100.000	ms
Failsafe mode pulse output	No pulses	
1x TAG-stainless steel label	50105107 FIT-5001	

C6 Approval: CSA C/US NI Cl.I Div.2 Gr. ABCD
A Design: Insertion length short ISO/DVGW until DN400, DN450-2000 1:1
L Power Supply: 100-240VAC/24VAC/DC
H Output; Input: 4-20mA HART, pulse/freq.,switch output
A Housing: Compact, alu, coated
0 Cable, Remote Version: Not used
D Electrical Connection: Thread NPT1/2
U Liner: Polyurethane
A1K Process Connection: Cl.150, carbon steel, flange ASME B16.5

Item	Qty.	Unit	Ordercode Description	Unit Price CAD	Total Net CAD
			0 Electrodes: 1.4435/316L B Calibration Flow: 0.2% AC > Operation Language Display: French DA > > Customized Parameterization: Output 1 DB > > Customized Parameterization: Output 2 LD > > Additional Approval: CRN L4 > > Additional Approval: NSF 61 Drinking water approval Z1 > > Marking: Tagging (TAG), see additional spec. Production Time: 2 Weeks(s). Delivery time extra.		
0023	2	PC	DK5GD-2FAUL **Promag, disque de masse/de protection** Includes 1 grounding disc/protection disc 2FA Nominal Diameter: DN250 10", 1.4435/316L U Liner: Polyurethane L Process Connection: Cl.150 ANSI B16.5 Production Time: 7 Day(s). Delivery time extra.		
0026	1	PC	10W1H-ULGA1RG5B4AA **Promag 10W1H, DN100 4"** Electromagnetic flowmeter		

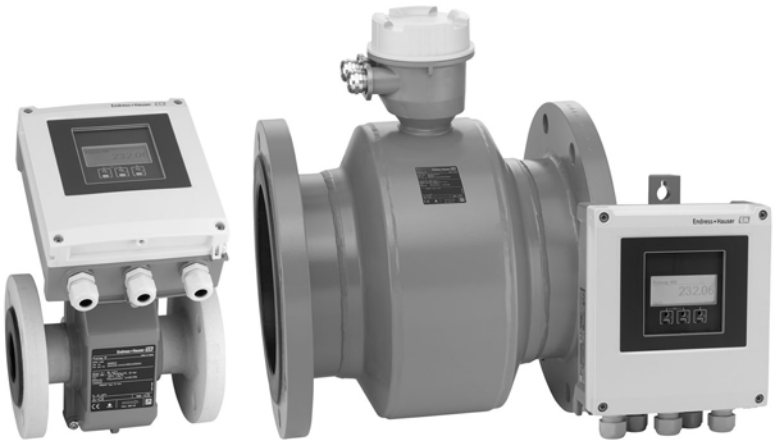
additional specifications

Language	English	
Assign line 1	Volume flow	
Assign line 2	Totalizer 1	
Assign current output	Volume flow	
Current span	4-20 mA HART US	
Value 20 mA	300.000	USgal/min
Time constant	1.000	s
Assign pulse output	Volume flow	
Pulse value (per pulse)	2.00000	USgal
Pulse width	100.000	ms
Output signal	Passive - negative	
Failsafe mode current/pulse output	Min. value	
Assign totalizer 1	Volume flow	
Unit totalizer 1		USgal
1x TAG-stainless steel label	50105107	
TAG a confirmer		

U Liner: Polyurethane
L Process Connection: Cl.150, A105, flange ANSI

Technical Information
Proline Promag W 400

Electromagnetic flowmeter



The flowmeter with integrated web server & sensor with EN ISO 12944 corrosion protection

Application

- The measuring principle is practically independent of pressure, density, temperature and viscosity
- The specialist for very demanding applications in the water and wastewater industry

Device properties
- International drinking water approvals
- Degree of protection IP68 (Type 6P enclosure)
- Approved for custody transfer to MI-001/OIML R49
- Transmitter housing made of durable polycarbonate or aluminum
- Same housing concept for compact/remote version
- Integrated data logger for measured values monitoring

Your benefits

- For direct underground installation or permanent underwater use
- Safe, reliable long-term operation – robust and completely welded sensor
- Energy-saving flow measurement – no pressure loss due to cross-section constriction
- Maintenance-free – no moving parts
- Safe operation – no need to open device thanks to touch control display, backlighting
- Time-saving local operation without additional software and hardware – integrated web server
- Integrated verification – Heartbeat Technology™

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Symbols used

Electrical symbols

Symbol	Meaning	Symbol	Meaning
⎓	Direct current	~	Alternating current
⎓~	Direct current and alternating current	⏚	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
⊜	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.	⏚	**Equipotential connection** A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice.

Symbols for certain types of information

Symbol	Meaning
✓	**Permitted** Procedures, processes or actions that are permitted.
✓✓	**Preferred** Procedures, processes or actions that are preferred.
✗	**Forbidden** Procedures, processes or actions that are forbidden.
ℹ	**Tip** Indicates additional information.
📖	Reference to documentation
📄	Reference to page
🖼	Reference to graphic
👁	Visual inspection

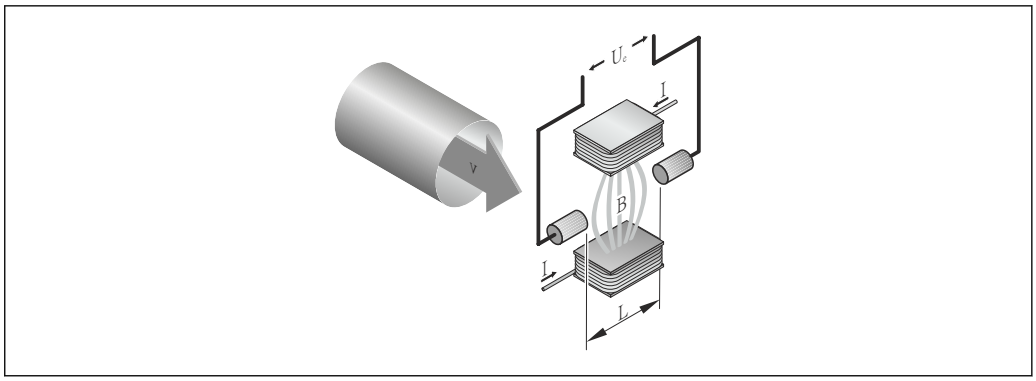
Symbols in graphics

Symbol	Meaning	Symbol	Meaning
1, 2, 3,...	Item numbers	1., 2., 3., ...	Series of steps
A, B, C, ...	Views	A-A, B-B, C-C, ...	Sections
EX	Hazardous area	EX	Safe area (non-hazardous area)
≈➡	Flow direction		

Function and system design

Measuring principle

Following *Faraday's law of magnetic induction*, a voltage is induced in a conductor moving through a magnetic field.



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Ue Induced voltage
B Magnetic induction (magnetic field)
L Electrode spacing
I Current
v Flow velocity

In the electromagnetic measuring principle, the flowing medium is the moving conductor. The voltage induced (U_e) is proportional to the flow velocity (v) and is supplied to the amplifier by means of two measuring electrodes. The flow volume (Q) is calculated via the pipe cross-section (A). The DC magnetic field is created through a switched direct current of alternating polarity.

Formulae for calculation

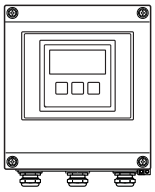
- Induced voltage $U_e = B \cdot L \cdot v$
- Volume flow $Q = A \cdot v$

Measuring system

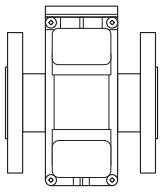
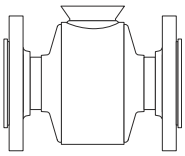
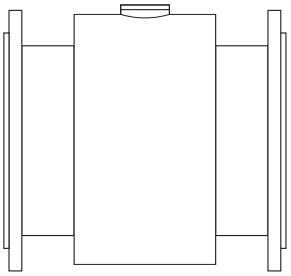
The device consists of a transmitter and a sensor.

Two device versions are available:
- Compact version - transmitter and sensor form a mechanical unit.
- Remote version - transmitter and sensor are mounted in separate locations.

Transmitter

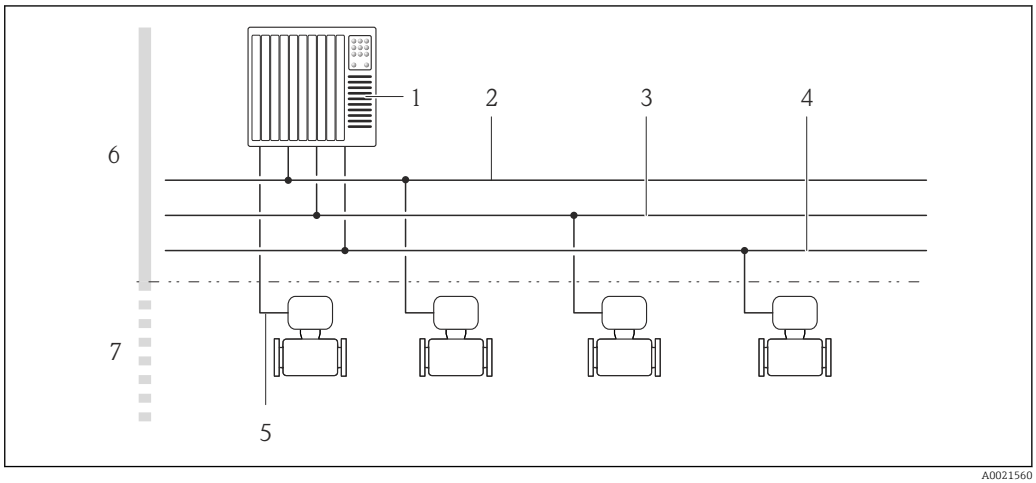
Promag 400  A0017117	Device versions and materials ▪ Compact version: compact housing – Polycarbonate plastic – Aluminum, AlSi10Mg, coated ▪ Remote version: wall-mount housing – Polycarbonate plastic – Aluminum, AlSi10Mg, coated Configuration: ▪ External operation via four-line, illuminated local display with touch control and guided menus ("Make-it-run" wizards) for applications ▪ Via operating tools (e.g. FieldCare) ▪ Via Web browser (e.g. Microsoft Internet Explorer) ▪ Also for device version with EtherNet/IP output: – Via Add-on Profile Level 3 for automation system from Rockwell Automation – Via Electronic Data Sheet (EDS) ▪ Also for device version with PROFIBUS DP output: Via PDM driver for Siemens automation system

Sensor

Promag W *Fixed flange: DN 25 to 300 (1 to 12")*  A0017040 *Fixed flange: DN 25 to 300 (1 to 12")*  A0022673 *Fixed flange: DN 350 to 2000 (14 to 78")*  A0017041	▪ Nominal diameter range: DN 25 to 2000 (1 to 78") ▪ Materials: – Sensor housing: aluminum, AlSi10Mg, coated; carbon steel with protective varnish – Sensor connection housing (standard): aluminum, AlSi10Mg, coated Sensor connection housing (option): polycarbonate – Measuring tubes [1]: DN 25 to 300 (1 to 12"): stainless steel, 1.4301/1.4306/304/304L DN 350 to 2000 (14 to 78"): stainless steel, 1.4301/304 – Liner: hard rubber, polyurethane – Electrodes: stainless steel, 1.4435 (316L); Alloy C22, 2.4602 (UNS N06022); tantalum – Process connections: Stainless steel, 1.4404/1.4571/F316L Carbon steel, A105/A181/A350LF2/A515(70)/FE410WB/S235JRG2/S235J+N/S275JR/P235GH/P250GH/P265GH – Seals: as per DIN EN 1514-1 – Ground disks: stainless steel, 1.4435 (316L); Alloy C22, 2.4602 (UNS N06022); tantalum

1) For carbon steel flange material with Al/Zn protective coating (DN 25 to 300 (1 to 12")), protective varnish (IP68) (DN 50 to 300 (2 to 12")) or protective varnish ≥ DN 350 (14")

Equipment architecture



1 *Possibilities for integrating measuring devices into a system*

1 *Control system (e.g. PLC)*
2 *EtherNet/IP*
3 *PROFIBUS DP*
4 *Modbus RS485*
5 *4-20 mA HART, pulse/frequency/switch output*
6 *Non-hazardous area*
7 *Non-hazardous area and Zone 2/Div. 2*

Safety

IT security

We only provide a warranty if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the device settings.

IT security measures in line with operators' security standards and designed to provide additional protection for the device and device data transfer must be implemented by the operators themselves.

Input

Measured variable

Direct measured variables

- Volume flow (proportional to induced voltage)
- Electrical conductivity

In custody transfer: only volume flow

Calculated measured variables

Mass flow

Measuring range

Typically v = 0.01 to 10 m/s (0.03 to 33 ft/s) with the specified accuracy

Electrical conductivity: 5 to 10 000 µS/cm

Flow characteristic values in SI units

Nominal diameter		Recommended flow	Factory settings		
		Min./max. full scale value (v ~ 0.3/10 m/s)	Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cut off (v ~ 0.04 m/s)
[mm]	[in]	[m³/h]	[m³/h]	[m³]	[m³/h]
25	1	9 to 300 dm³/min	75 dm³/min	0.5 dm³	1 dm³/min
32	–	15 to 500 dm³/min	125 dm³/min	1 dm³	2 dm³/min

Nominal diameter		Recommended flow	Factory settings		
		Min./max. full scale value (v ~ 0.3/10 m/s)	Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cut off (v ~ 0.04 m/s)
[mm]	[in]	[m³/h]	[m³/h]	[m³]	[m³/h]
40	1 ½	25 to 700 dm³/min	200 dm³/min	1.5 dm³	3 dm³/min
50	2	35 to 1 100 dm³/min	300 dm³/min	2.5 dm³	5 dm³/min
65	–	60 to 2 000 dm³/min	500 dm³/min	5 dm³	8 dm³/min
80	3	90 to 3 000 dm³/min	750 dm³/min	5 dm³	12 dm³/min
100	4	145 to 4 700 dm³/min	1 200 dm³/min	10 dm³	20 dm³/min
125	–	220 to 7 500 dm³/min	1 850 dm³/min	15 dm³	30 dm³/min
150	6	20 to 600	150	0.025	2.5
200	8	35 to 1 100	300	0.05	5
250	10	55 to 1 700	500	0.05	7.5
300	12	80 to 2 400	750	0.1	10
350	14	110 to 3 300	1 000	0.1	15
375	15	140 to 4 200	1 200	0.15	20
400	16	140 to 4 200	1 200	0.15	20
450	18	180 to 5 400	1 500	0.25	25
500	20	220 to 6 600	2 000	0.25	30
600	24	310 to 9 600	2 500	0.3	40
700	28	420 to 13 500	3 500	0.5	50
750	30	480 to 15 000	4 000	0.5	60
800	32	550 to 18 000	4 500	0.75	75
900	36	690 to 22 500	6 000	0.75	100
1 000	40	850 to 28 000	7 000	1	125
–	42	950 to 30 000	8 000	1	125
1 200	48	1 250 to 40 000	10 000	1.5	150
–	54	1 550 to 50 000	13 000	1.5	200
1 400	–	1 700 to 55 000	14 000	2	225
–	60	1 950 to 60 000	16 000	2	250
1 600	–	2 200 to 70 000	18 000	2.5	300
–	66	2 500 to 80 000	20 500	2.5	325
1 800	72	2 800 to 90 000	23 000	3	350
–	78	3 300 to 100 000	28 500	3.5	450
2 000	–	3 400 to 110 000	28 500	3.5	450

Flow characteristic values in US units

Nominal diameter		Recommended flow	Factory settings		
		Min./max. full scale value (v ~ 0.3/10 m/s)	Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cut off (v ~ 0.04 m/s)
[in]	[mm]	[gal/min]	[gal/min]	[gal]	[gal/min]
1	25	2.5 to 80	18	0.2	0.25
–	32	4 to 130	30	0.2	0.5
1 ½	40	7 to 190	50	0.5	0.75
2	50	10 to 300	75	0.5	1.25
–	65	16 to 500	130	1	2
3	80	24 to 800	200	2	2.5
4	100	40 to 1250	300	2	4
–	125	60 to 1950	450	5	7
6	150	90 to 2650	600	5	12
8	200	155 to 4850	1200	10	15
10	250	250 to 7500	1500	15	30
12	300	350 to 10600	2400	25	45
14	350	500 to 15000	3600	30	60
15	375	600 to 19000	4800	50	60
16	400	600 to 19000	4800	50	60
18	450	800 to 24000	6000	50	90
20	500	1000 to 30000	7500	75	120
24	600	1400 to 44000	10500	100	180
28	700	1900 to 60000	13500	125	210
30	750	2150 to 67000	16500	150	270
32	800	2450 to 80000	19500	200	300
36	900	3100 to 100000	24000	225	360
40	1000	3800 to 125000	30000	250	480
42	–	4200 to 135000	33000	250	600
48	1200	5500 to 175000	42000	400	600
54	–	9 to 300 Mgal/d	75 Mgal/d	0.0005 Mgal/d	1.3 Mgal/d
–	1400	10 to 340 Mgal/d	85 Mgal/d	0.0005 Mgal/d	1.3 Mgal/d
60	–	12 to 380 Mgal/d	95 Mgal/d	0.0005 Mgal/d	1.3 Mgal/d
–	1600	13 to 450 Mgal/d	110 Mgal/d	0.0008 Mgal/d	1.7 Mgal/d
66	–	14 to 500 Mgal/d	120 Mgal/d	0.0008 Mgal/d	2.2 Mgal/d
72	1800	16 to 570 Mgal/d	140 Mgal/d	0.0008 Mgal/d	2.6 Mgal/d
78	–	18 to 650 Mgal/d	175 Mgal/d	0.0010 Mgal/d	3.0 Mgal/d
–	2000	20 to 700 Mgal/d	175 Mgal/d	0.0010 Mgal/d	2.9 Mgal/d

To calculate the measuring range, use the *Applicator* sizing tool → 109

Recommended measuring range

"Flow limit" section → 🖹 43

For custody transfer, the applicable approval determines the permitted measuring range and the pulse value.

Operable flow range

Over 1000 : 1

For custody transfer, the operable flow range is 100 : 1 to 250 : 1, depending on the nominal diameter. Further details are specified by the applicable approval.

Input signal

External measured values

Various pressure transmitters and temperature measuring devices can be ordered from Endress +Hauser: see "Accessories" section → 🖹 109

It is recommended to read in external measured values to calculate the following measured variables: Corrected volume flow

HART protocol

The measured values are written from the automation system to the measuring device via the HART protocol. The pressure transmitter must support the following protocol-specific functions:
- HART protocol
- Burst mode

Fieldbuses

The measured values can be written from the automation system to the measuring via:
- PROFIBUS DP
- Modbus RS485
- EtherNet/IP

Status input

Maximum input values	▪ DC 30 V ▪ 6 mA
Response time	Adjustable: 5 to 200 ms
Input signal level	▪ Low signal: DC –3 to +5 V ▪ High signal: DC 12 to 30 V
Assignable functions	▪ Off ▪ Reset totalizers 1-3 separately ▪ Reset all totalizers ▪ Flow override

Output

Output signal

Current output

Current output	Can be set as: ▪ 4-20 mA NAMUR ▪ 4-20 mA US ▪ 4-20 mA HART ▪ 0-20 mA
Maximum output values	▪ DC 24 V (no flow) ▪ 22.5 mA
Load	0 to 700 Ω
Resolution	0.5 µA

Damping	Adjustable: 0.07 to 999 s
Assignable measured variables	▪ Volume flow ▪ Mass flow ▪ Flow velocity ▪ Conductivity ▪ Electronic temperature

Pulse/frequency/switch output

Function	▪ With the order code for "Output; Input", option **H**: output 2 can be set as a pulse or frequency output ▪ With the order code for "Output; Input", option **I**: output 2 and 3 can be set as a pulse, frequency or switch output ▪ With the order code for "Output; Input", option **J**: output 2 firmly assigned as certified pulse output
Version	Passive, open collector
Maximum input values	▪ DC 30 V ▪ 250 mA
Voltage drop	For 25 mA: ≤ DC 2 V
Pulse output	
Pulse width	Adjustable: 0.05 to 2 000 ms
Maximum pulse rate	10 000 Impulse/s
Pulse value	Adjustable
Assignable measured variables	▪ Volume flow ▪ Mass flow
Frequency output	
Output frequency	Adjustable: 0 to 12 500 Hz
Damping	Adjustable: 0 to 999 s
Pulse/pause ratio	1:1
Assignable measured variables	▪ Volume flow ▪ Mass flow ▪ Conductivity ▪ Flow velocity ▪ Electronic temperature
Switch output	
Switching behavior	Binary, conductive or non-conductive
Switching delay	Adjustable: 0 to 100 s
Number of switching cycles	Unlimited
Assignable functions	▪ Off ▪ On ▪ Diagnostic behavior ▪ Limit value: – Off – Volume flow – Mass flow – Conductivity – Flow velocity – Totalizer 1-3 – Electronic temperature ▪ Flow direction monitoring ▪ Status – Empty pipe detection – Low flow cut off

PROFIBUS DP

Signal encoding	NRZ code
Data transfer	9.6 kBaud...12 MBaud

Modbus RS485

Physical interface	In accordance with EIA/TIA-485-A standard
Terminating resistor	Integrated, can be activated via DIP switch on the transmitter electronics module

EtherNet/IP

Standards	In accordance with IEEE 802.3

Signal on alarm

Depending on the interface, failure information is displayed as follows:

Current output

4-20 mA

Failure mode	Selectable (as per NAMUR recommendation NE 43): ▪ Minimum value: 3.6 mA ▪ Maximum value: 22 mA ▪ Defined value: 3.59 to 22.5 mA ▪ Actual value ▪ Last valid value

0-20 mA

Failure mode	Choose from: ▪ Maximum alarm: 22 mA ▪ Defined value: 0 to 22.5 mA

HART

Device diagnostics	Device condition can be read out via HART Command 48

Pulse/frequency/switch output

Pulse output

Failure mode	Choose from: ▪ Actual value ▪ No pulses

Frequency output

Failure mode	Choose from: ▪ Actual value ▪ 0 Hz ▪ Defined value: 0 to 12 500 Hz

Switch output

Failure mode	Choose from: ▪ Current status ▪ Open ▪ Closed

PROFIBUS DP

Status and alarm messages	Diagnostics in accordance with PROFIBUS PA Profile 3.02

Modbus RS485

Failure mode	Choose from: ▪ NaN value instead of current value ▪ Last valid value

EtherNet/IP

Device diagnostics	Device condition can be read out in Input Assembly

Local display

Plain text display	With information on cause and remedial measures
Backlight	Red backlighting indicates a device error.

Status signal as per NAMUR recommendation NE 107

Operating tool

- Via digital communication:
  - HART protocol
  - PROFIBUS DP
  - Modbus RS485
  - EtherNet/IP
- Via service interface

Plain text display	With information on cause and remedial measures

Additional information on remote operation → 101

Web browser

Plain text display	With information on cause and remedial measures

Light emitting diodes (LED)

Status information	Status indicated by various light emitting diodes The following information is displayed depending on the device version: ▪ Supply voltage active ▪ Data transmission active ▪ Device alarm/error has occurred ▪ EtherNet/IP network available ▪ EtherNet/IP connection established

Low flow cut off

The switch points for low flow cut off are user-selectable.

Galvanic isolation

The following connections are galvanically isolated from each other:
- Inputs
- Outputs
- Power supply

Protocol-specific data

HART

Manufacturer ID	0x11
Device type ID	0x67
HART protocol revision	7
Device description files (DTM, DD)	Information and files under: www.endress.com
HART load	Min. 250 Ω
Dynamic variables	Read out the dynamic variables: HART command 3 The measured variables can be freely assigned to the dynamic variables. **Measured variables for PV (primary dynamic variable)** ▪ Off ▪ Volume flow ▪ Mass flow ▪ Conductivity ▪ Flow velocity ▪ Electronic temperature **Measured variables for SV, TV, QV (secondary, tertiary and quaternary dynamic variable)** ▪ Volume flow ▪ Mass flow ▪ Conductivity ▪ Flow velocity ▪ Electronic temperature ▪ Totalizer 1 ▪ Totalizer 2 ▪ Totalizer 3
Device variables	Read out the device variables: HART command 9 The device variables are permanently assigned. A maximum of 8 device variables can be transmitted: ▪ 0 = volume flow ▪ 1 = mass flow ▪ 2 = conductivity ▪ 3 = flow velocity ▪ 4 = electronic temperature ▪ 5 = totalizer 1 ▪ 6 = totalizer 2 ▪ 7 = totalizer 3

PROFIBUS DP

Manufacturer ID	0x11
Ident number	0x1562
Profile version	3.02
Device description files (GSD, DTM, DD)	Information and files under: ▪ www.endress.com ▪ www.profibus.org
Output values (from measuring device to automation system)	**Analog input 1 to 4** ▪ Mass flow ▪ Volume flow ▪ Flow velocity ▪ Conductivity ▪ Electronic temperature **Digital input 1 to 2** ▪ Empty pipe detection ▪ Low flow cut off ▪ Verification status **Totalizer 1 to 3** ▪ Mass flow ▪ Volume flow

Input values (from automation system to measuring device)	**Analog output 1 (fixed assignment)** External density **Digital output 1 to 2 (fixed assignment)** ▪ Digital output 1: switch positive zero return on/off ▪ Digital output 2: start verification **Totalizer 1 to 3** ▪ Totalize ▪ Reset and hold ▪ Preset and hold ▪ Stop ▪ Operating mode configuration: – Net flow total – Forward flow total – Reverse flow total
Supported functions	▪ Identification & Maintenance Simplest device identification on the part of the control system and nameplate ▪ PROFIBUS upload/download Reading and writing parameters is up to ten times faster with PROFIBUS upload/download ▪ Condensed status Simplest and self-explanatory diagnostic information by categorizing diagnostic messages that occur
Configuration of the device address	▪ DIP switches on the I/O electronics module ▪ Via operating tools (e.g. FieldCare)

Modbus RS485

Protocol	Modbus Applications Protocol Specification V1.1
Device type	Slave
Slave address range	1 to 247
Broadcast address range	0
Function codes	▪ 03: Read holding register ▪ 04: Read input register ▪ 06: Write single registers ▪ 08: Diagnostics ▪ 16: Write multiple registers ▪ 23: Read/write multiple registers
Broadcast messages	Supported by the following function codes: ▪ 06: Write single registers ▪ 16: Write multiple registers ▪ 23: Read/write multiple registers
Supported baud rate	▪ 1 200 BAUD ▪ 2 400 BAUD ▪ 4 800 BAUD ▪ 9 600 BAUD ▪ 19 200 BAUD ▪ 38 400 BAUD ▪ 57 600 BAUD ▪ 115 200 BAUD
Data transfer mode	▪ ASCII ▪ RTU
Data access	Each device parameter can be accessed via Modbus RS485. For Modbus register information

EtherNet/IP

Protocol	▪ The CIP Networks Library Volume 1: Common Industrial Protocol ▪ The CIP Networks Library Volume 2: EtherNet/IP Adaptation of CIP		
Communication type	▪ 10Base-T ▪ 100Base-TX		
Device profile	Generic device (product type: 0x2B)		
Manufacturer ID	0x49E		
Device type ID	0x1067		
Baud rates	Automatic $^{10}/_{100}$ Mbit with half-duplex and full-duplex detection		
Polarity	Auto-polarity for automatic correction of crossed TxD and RxD pairs		
Supported CIP connections	Max. 3 connections		
Explicit connections	Max. 6 connections		
I/O connections	Max. 6 connections (scanner)		
Configuration options for measuring device	▪ DIP switches on the electronics module for IP addressing ▪ Manufacturer-specific software (FieldCare) ▪ Add-on Profile Level 3 for Rockwell Automation control systems ▪ Web browser ▪ Electronic Data Sheet (EDS) integrated in the measuring device		
Configuration of the EtherNet interface	▪ Speed: 10 MBit, 100 MBit, auto (factory setting) ▪ Duplex: half-duplex, full-duplex, auto (factory setting)		
Configuration of the device address	▪ DIP switches on the electronics module for IP addressing (last octet) ▪ DHCP ▪ Manufacturer-specific software (FieldCare) ▪ Add-on Profile Level 3 for Rockwell Automation control systems ▪ Web browser ▪ EtherNet/IP tools, e.g. RSLinx (Rockwell Automation)		
Device Level Ring (DLR)	No		
Fix Input			
RPI	5 ms to 10 s (factory setting: 20 ms)		
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0x66	56
	T → O configuration:	0x64	32
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0x66	56
	T → O configuration:	0x64	32
Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0xC7	-
	T → O configuration:	0x64	32
Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0xC7	-
	T → O configuration:	0x64	32

Input Assembly	▪ Current device diagnostics ▪ Volume flow ▪ Mass flow ▪ Conductivity ▪ Totalizer 1 ▪ Totalizer 2 ▪ Totalizer 3		
Configurable Input			
RPI	5 ms to 10 s (factory setting: 20 ms)		
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0x66	56
	T → O configuration:	0x65	88
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0x66	56
	T → O configuration:	0x65	88
Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0xC7	-
	T → O configuration:	0x65	88
Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0xC7	-
	T → O configuration:	0x65	88
Configurable Input Assembly	▪ Volume flow ▪ Mass flow ▪ Electronic temperature ▪ Conductivity ▪ Totalizer 1 to 3 ▪ Flow velocity ▪ Volume flow unit ▪ Mass flow unit ▪ Temperature unit ▪ Conductivity unit ▪ Unit totalizer 1-3 ▪ Flow velocity unit ▪ Verification result ▪ Verification status The range of options increases if the measuring device has one or more application packages.		
Fix Output			
Output Assembly	▪ Activation of reset totalizers 1-3 ▪ Activation of reference density compensation ▪ Reset totalizers 1-3 ▪ External density ▪ Density unit ▪ Activation verification ▪ Start verification		

Configuration	
Configuration Assembly	Only the most common configurations are listed below. ▪ Software write protection ▪ Mass flow unit ▪ Mass unit ▪ Volume flow unit ▪ Volume unit ▪ Density unit ▪ Conductivity ▪ Temperature unit ▪ Totalizer 1-3: – Assignment – Unit – Operating mode – Failure mode ▪ Alarm delay

Power supply

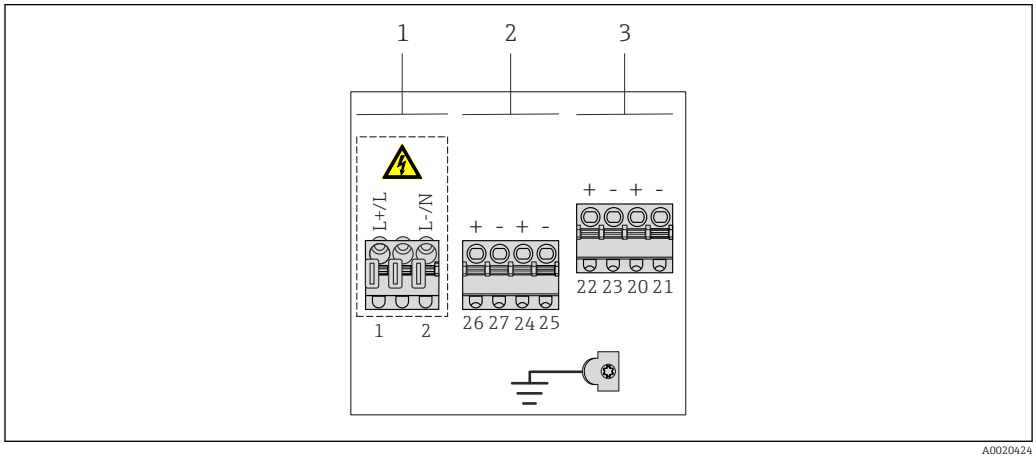
Terminal assignment

Transmitter

0-20 mA/4-20 mA HART connection version with additional outputs and inputs

The sensor can be ordered with terminals.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	**Power supply**	
Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"



A0020424

1 *Supply voltage*
2 *Output 1 (26/27) and output 2 (24/25)*
3 *Output 3 (22/23) and input 1 (20/21)*

Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+/L)	2 (L-/N)
Option **L** (wide range power unit)	AC100 to 240 V	
	AC/DC24 V	

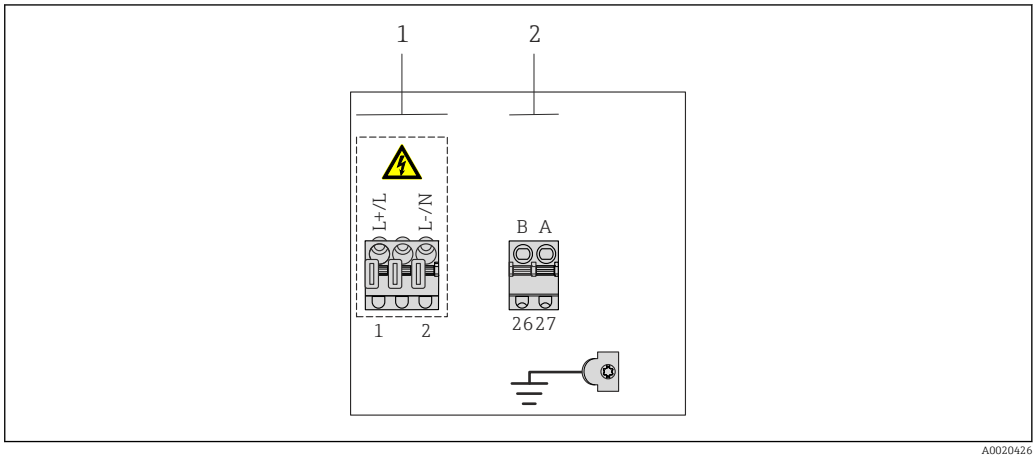
Signal transmission 0-20 mA/4-20 mA HART with additional outputs and inputs

Order code for "Output" and "Input"	Terminal numbers							
	Output 1		Output 2		Output 3		Input	
	26 (+)	27 (-)	24 (+)	25 (-)	22 (+)	23 (-)	20 (+)	21 (-)
Option **H**	▪ 4-20 mA HART (active) ▪ 0-20 mA (active)		Pulse/frequency output (passive)		Switch output (passive)		-	
Option **I**	▪ 4-20 mA HART (active) ▪ 0-20 mA (active)		Pulse/frequency/ switch output (passive)		Pulse/frequency/ switch output (passive)		Status input	
Option **J**	▪ 4-20 mA HART (active) ▪ 0-20 mA (active)		Permanently assigned Pulse output adjusted (passive)		Pulse/frequency/ switch output (passive)		Status input	

PROFIBUS DP connection version

The sensor can be ordered with terminals.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	Power supply	
Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"



1 Supply voltage (wide range power unit)
2 PROFIBUS DP

Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+/L)	2 (L-/N)
Option **L** (wide range power unit)	AC100 to 240 V	
	AC/DC24 V	

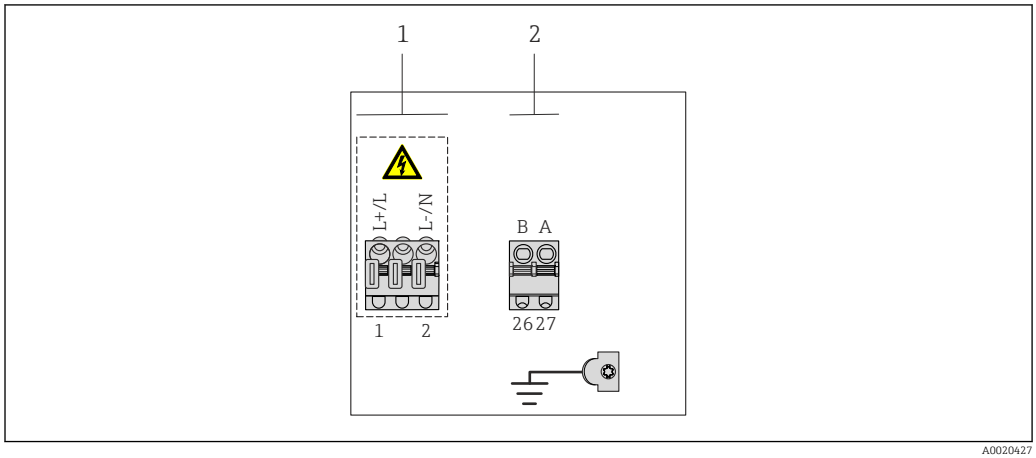
PROFIBUS DP signal transmission

Order code for "Output" and "Input"	Terminal numbers	
	26 (RxD/TxD-P)	27 (RxD/TxD-N)
Option **L**	B	A
Order code for "Output": Option L: PROFIBUS DP, for use in non-hazardous areas and Zone 2/div. 2		

Modbus RS485 connection version

The sensor can be ordered with terminals.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	Power supply	
Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"



1 *Supply voltage (wide range power unit)*
2 *Modbus RS485*

Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+/L)	2 (L-/N)
Option **L** (wide range power unit)	AC100 to 240 V	
	AC/DC24 V	

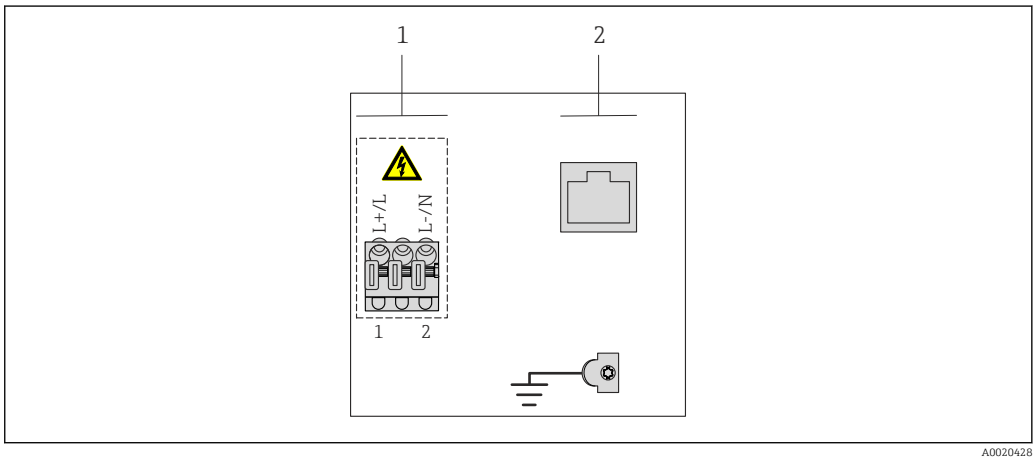
Signal transmission Modbus RS485

Order code for "Output" and "Input"	Terminal numbers	
	26 (+)	27 (-)
Option **M**	B	A

EtherNet/IP connection version

The sensor can be ordered with terminals or a device plug.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	Power supply	
Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"
Device plug	Terminals	▪ Option **L**: plug M12x1 + thread NPT ½" ▪ Option **N**: plug M12x1 + coupling M20 ▪ Option **P**: plug M12x1 + thread G ½" ▪ Option **U**: plug M12x1 + thread M20



1 Supply voltage (wide range power unit)
2 EtherNet/IP

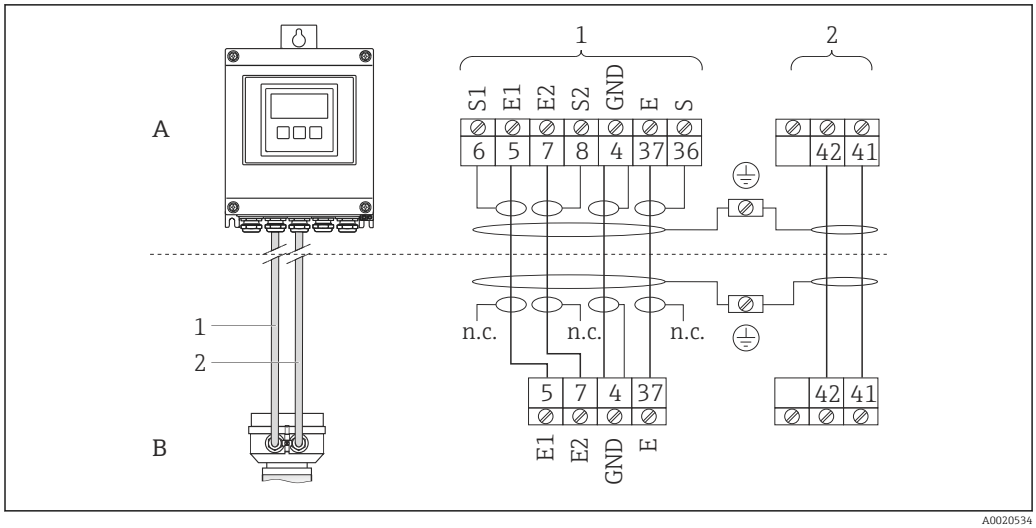
Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+/L)	2 (L-/N)
Option **L** (wide range power unit)	AC100 to 240 V	
	AC/DC24 V	

EtherNet/IP signal transmission

Order code for "Output"	Connection via
Option **N**	EtherNet/IP connector

Remote version



2 *Remote version terminal assignment*

A Transmitter wall-mount housing
B Sensor connection housing
1 Electrode cable
2 Coil current cable
n.c. Not connected, insulated cable shields

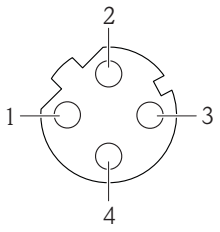
Terminal No. and cable colors: 6/5 = brown; 7/8 = white; 4 = green; 36/37 = yellow

Pin assignment, device plug

Order codes for the M12x1 connectors, see the "Order code for electrical connection" column: EtherNet/IP

EtherNet/IP

Device plug for signal transmission (device side)



Pin		Assignment	Coding	Plug/socket
1	+	Tx	D	Socket
2	+	Rx		
3	-	Tx		
4	-	Rx		

Recommended plug:
- Binder, series 763, part no. 99 3729 810 04
- Phoenix, part no. 1543223 SACC-M12MSD-4Q
- When using the device in a hazardous location, use a suitably certified plug.

Supply voltage

Transmitter

Order code for "Power supply"	Terminal voltage	Frequency range
Option **L**	AC100 to 240 V	50/ 60 Hz, ±4 Hz
	AC/DC24 V	50/ 60 Hz, ±4 Hz

Power consumption

Order code for "Output"	Maximum power consumption
Option **H**: 4-20mA HART, pulse/frequency/switch output, switch output	30 VA/8 W
Option **I**: 4-20mA HART, 2 x pulse/frequency/switch output, status input	30 VA/8 W

Order code for "Output"	Maximum power consumption
Option **J**: 4-20mA HART, certified pulse output, pulse/ frequency/switch output, status input	30 VA/8 W
Option **L**: PROFIBUS DP	30 VA/8 W
Option **M**: Modbus RS485	30 VA/8 W
Option **N**: EtherNet/IP	30 VA/8 W

Current consumption

Transmitter

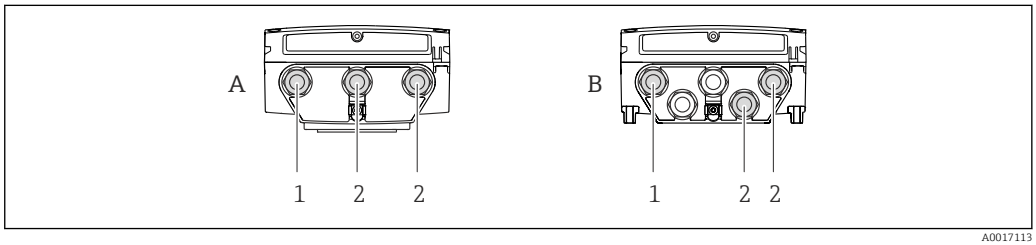
Order code for "Power supply"	Maximum Current consumption	Maximum switch-on current
Option **L**: AC 100 to 240 V	145 mA	25 A (< 5 ms)
Option **L**: AC/DC 24 V	350 mA	27 A (< 5 ms)

Power supply failure

- Totalizers stop at the last value measured.
- Configuration is retained in the plug-in memory (HistoROM DAT).
- Error messages (incl. total operated hours) are stored.

Electrical connection

Connecting the transmitter



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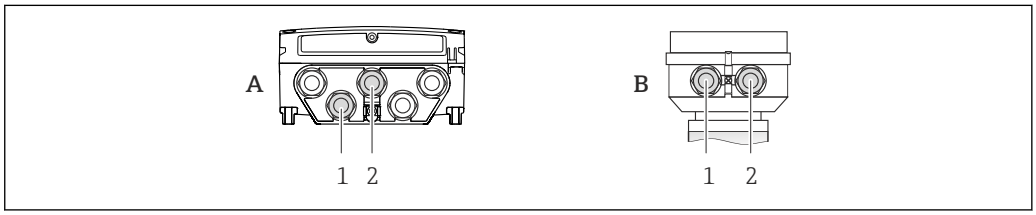
3 Supply voltage and signal transmission connection

A Compact version
B Remote version wall-mount housing
1 Cable entry for supply voltage
2 Cable entry for signal transmission

Remote version connection

Connecting cable



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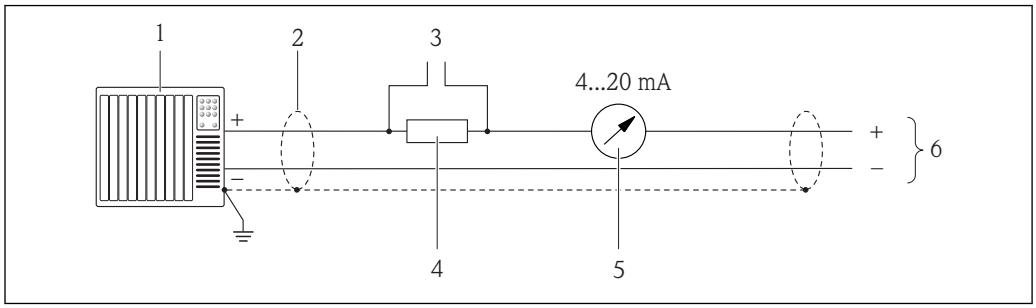
4 Connecting cable connection: electrode and coil current cable

A Transmitter wall-mount housing
B Sensor connection housing
1 Electrode cable
2 Coil current cable

- Fix the cable run or route it in an armored conduit.
  Cable movements can influence the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalization between sensor and transmitter .

Connection examples

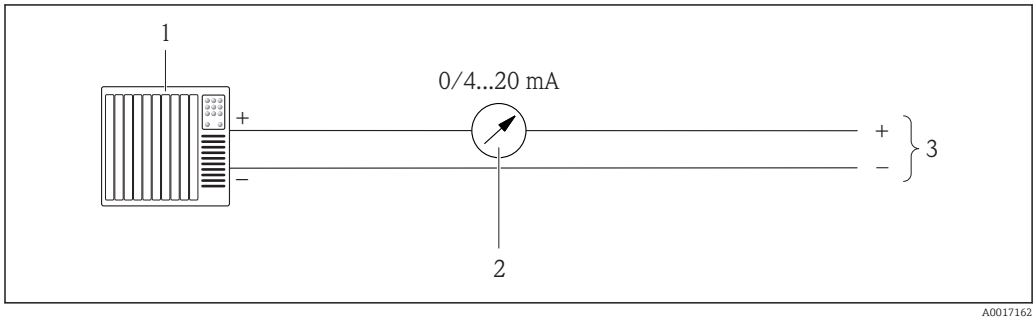
Current output 4-20 mA HART



5 Connection example for 4-20 mA HART current output (active)

1 Automation system with current input (e.g. PLC)
2 Cable shield, observe cable specifications → 29
3 Connection for HART operating devices
4 Resistor for HART communication (≥ 250 Ω): observe maximum load
5 Analog display unit: observe maximum load
6 Transmitter

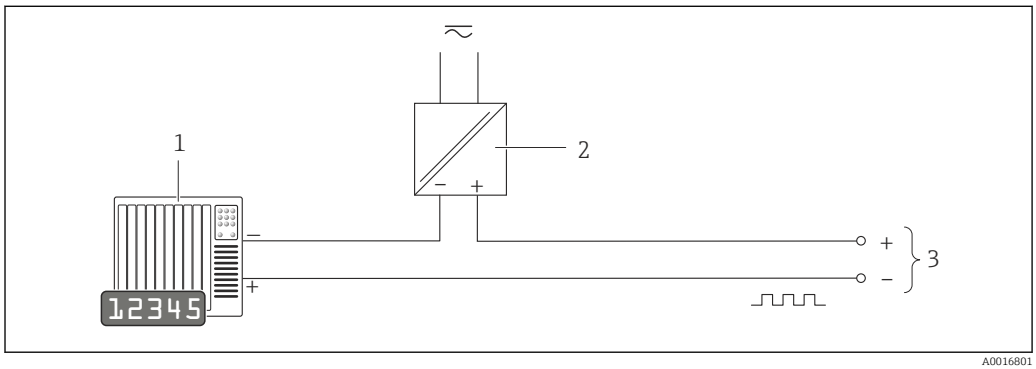
Current output 4-20 mA



6 Connection example for 0-20 mA current output (active) and 4-20 mA current output (active)

1 Automation system with current input (e.g. PLC)
2 Analog display unit: observe maximum load
3 Transmitter

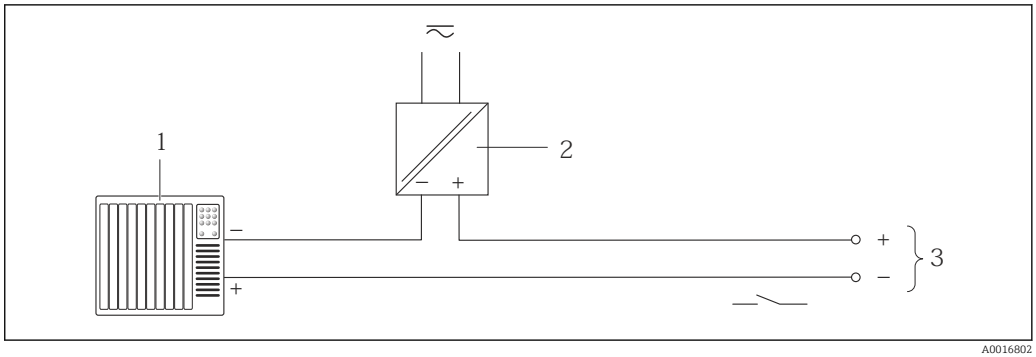
Pulse/frequency output



7 Connection example for pulse/frequency output (passive)

1 Automation system with pulse/frequency input (e.g. PLC)
2 Power supply
3 Transmitter: observe input values

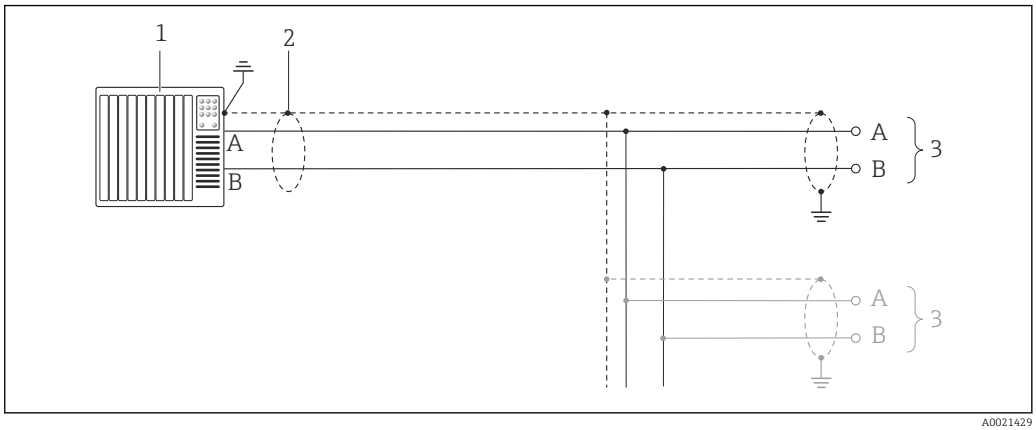
Switch output



8 Connection example for switch output (passive)

1 Automation system with switch input (e.g. PLC)
2 Power supply
3 Transmitter: observe input values

PROFIBUS DP

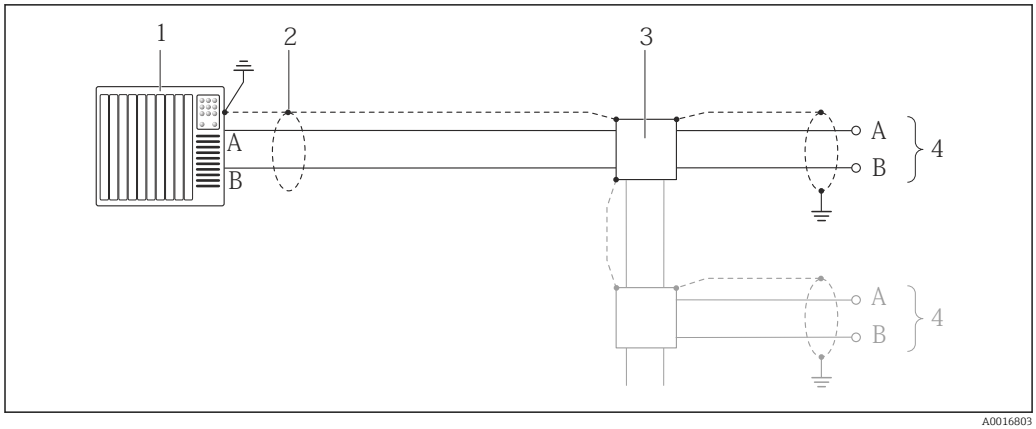


9 Connection example for PROFIBUS DP, non-hazardous area and Zone 2/Div. 2

1 Control system (e.g. PLC)
2 Cable shield: the cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications → 29
3 Transmitter

If baud rates > 1.5 MBaud an EMC cable entry must be used and the cable shield must continue as far as the terminal wherever possible.

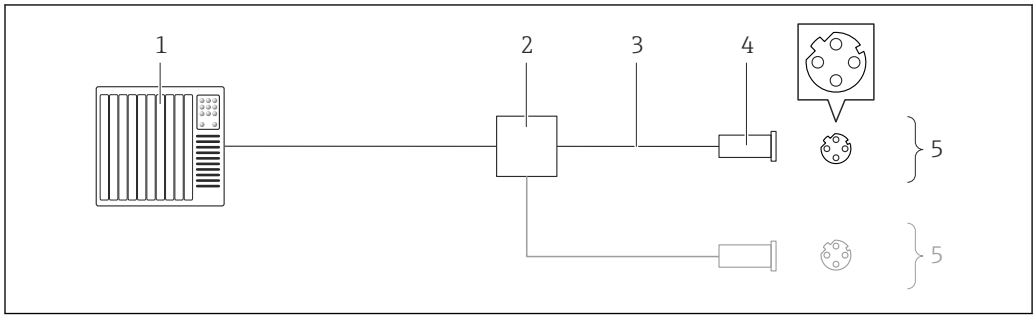
Modbus RS485



10 Connection example for Modbus RS485, non-hazardous area and Zone 2/Div. 2

1 *Control system (e.g. PLC)*
2 *Cable shield: the cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications → 29*
3 *Distribution box*
4 *Transmitter*

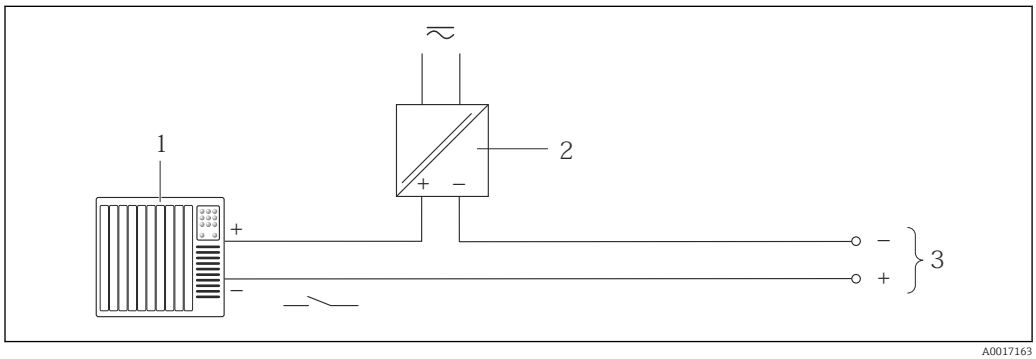
EtherNet/IP



11 Connection example for EtherNet/IP

1 *Control system (e.g. PLC)*
2 *Ethernet switch*
3 *Observe cable specifications → 30*
4 *Device plug*
5 *Transmitter*

Status input



12 Connection example for status input

1 *Automation system with status output (e.g. PLC)*
2 *Power supply*
3 *Transmitter: observe input values*

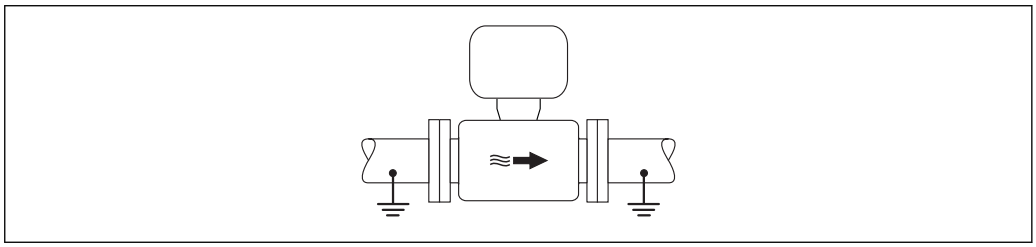
Potential equalization

Requirements

Please consider the following to ensure correct measurement:
- Same electrical potential for the fluid and sensor
- Remote version: same electrical potential for the sensor and transmitter
- Company-internal grounding concepts
- Pipe material and grounding

Connection examples for standard situations

Metal, grounded pipe



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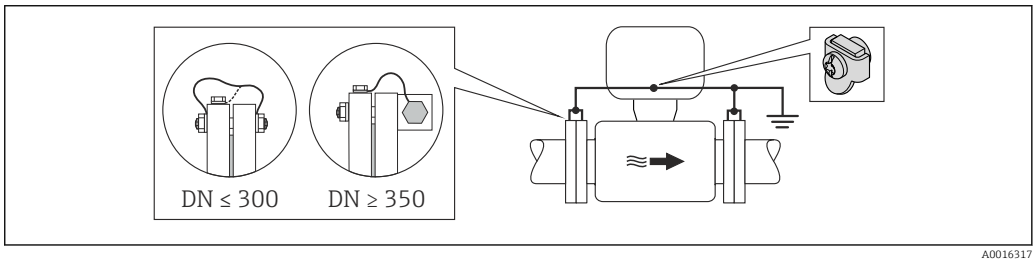
13 *Potential equalization via measuring tube*

Connection example in special situations

Unlined and ungrounded metal pipe

This connection method also applies in situations where:
- The customary potential equalization is not used
- Equalizing currents are present

Ground cable	Copper wire, at least6 mm² (0.0093 in²)



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14 *Potential equalization via ground terminal and pipe flanges*

Note the following when installing:
- Connect both sensor flanges to the pipe flange via a ground cable and ground them.
- Connect the connection housing of the transmitter or sensor to ground potential by means of the ground terminal provided for the purpose. To mount the ground cable:
  - If DN ≤ 300 (12"): Mount the ground cable directly on the conductive flange coating of the sensor with the flange screws.
  - If DN ≥ 350 (14"): Mount the ground cable directly on the metal transport bracket.

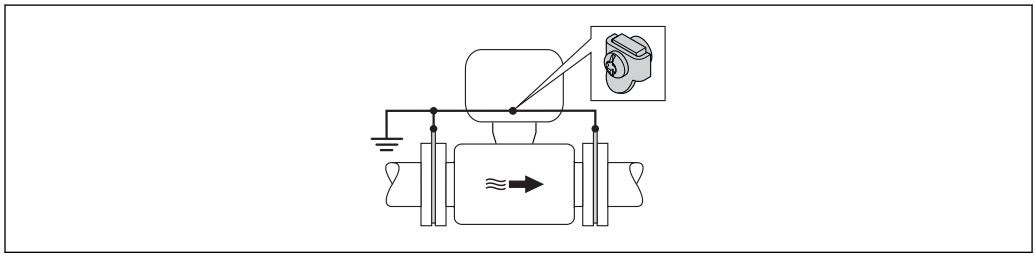
For remote device versions, the ground terminal in the example always refers to the sensor and **not** to the transmitter.

The necessary ground cable can be ordered from Endress+Hauser .

Plastic pipe or pipe with insulating liner

This connection method also applies in situations where:
- The customary potential equalization is not used
- Equalizing currents are present

Ground cable	Copper wire, at least6 mm² (0.0093 in²)



15 *Potential equalization via ground terminal and ground disks*

Note the following when installing:
The ground disks must be connected to the ground terminal via the ground cable and be connected to ground potential.

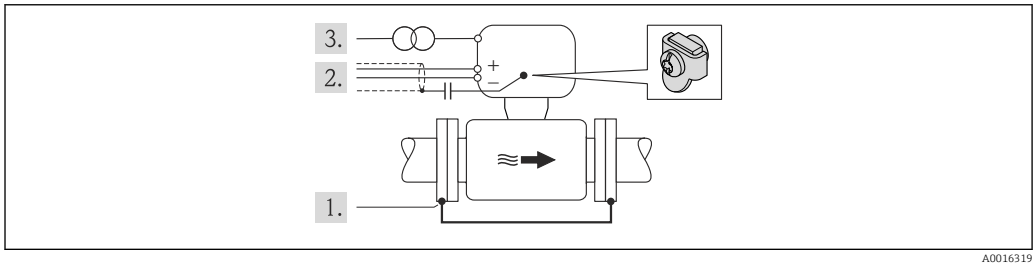
For remote device versions, the ground terminal in the example always refers to the sensor and **not** to the transmitter.

The ground cable and ground disks can be ordered from Endress+Hauser → 108.

Pipe with a cathodic protection unit

This connection method is only used if the following two conditions are met:
- Metal pipe without liner or pipe with electrically conductive liner
- Cathodic protection is integrated in the personal protection equipment

Ground cable	Copper wire, at least6 mm² (0.0093 in²)



Prerequisite: The sensor is installed in the pipe in a way that provides electrical insulation.

1. Connect the two flanges of the pipe to one another via a ground cable.
2. Guide the shield of the signal lines through a capacitor.
3. Connect the measuring device to the power supply such that it is floating in relation to the protective ground (isolation transformer).

For remote device versions, the ground terminal in the example always refers to the sensor and **not** to the transmitter.

The necessary ground cable can be ordered from Endress+Hauser .

Terminals

Transmitter
- Supply voltage cable: plug-in spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)
- Signal cable: plug-in spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)
- Electrode cable: spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)
- Coil current cable: spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)

Sensor connection housing
Spring terminals for wire cross-sections0.5 to 2.5 mm² (20 to 14 AWG)

Cable entries

Cable entry thread

- M20 x 1.5
- Via adapter:
  - NPT ½"
  - G ½"

Cable gland

- For standard cable: M20 × 1.5 with cable ϕ6 to 12 mm (0.24 to 0.47 in)
- For reinforced cable: M20 × 1.5 with cable ϕ9.5 to 16 mm (0.37 to 0.63 in)

If metal cable entries are used, use a grounding plate.

Cable specification

Permitted temperature range

- −40 °C (−40 °F) to +80 °C (+176 °F)
- Minimum requirement: cable temperature range ≥ ambient temperature +20 K

Power supply cable

Standard installation cable is sufficient.

Signal cable

Current output

- For 0-20 mA and 4-20 mA: standard installation cable is sufficient.
- For 4-20 mA HART: Shielded cable recommended. Observe grounding concept of the plant.

Pulse/frequency/switch output

Standard installation cable is sufficient.

Status input

Standard installation cable is sufficient.

PROFIBUS DP

The IEC 61158 standard specifies two types of cable (A and B) for the bus line which can be used for every transmission rate. Cable type A is recommended.

Cable type	A
Characteristic impedance	135 to 165 Ω at a measuring frequency of 3 to 20 MHz
Cable capacitance	<30 pF/m
Wire cross-section	>0.34 mm² (22 AWG)
Cable type	Twisted pairs
Loop resistance	≤110 Ω/km
Signal damping	Max. 9 dB over the entire length of the cable cross-section
Shielding	Copper braided shielding or braided shielding with foil shield. When grounding the cable shield, observe the grounding concept of the plant.

Modbus RS485

The EIA/TIA-485 standard specifies two types of cable (A and B) for the bus line which can be used for every transmission rate. Cable type A is recommended.

Cable type	A
Characteristic impedance	135 to 165 Ω at a measuring frequency of 3 to 20 MHz
Cable capacitance	<30 pF/m
Wire cross-section	>0.34 mm² (22 AWG)
Cable type	Twisted pairs

Loop resistance	≤110 Ω/km
Signal damping	Max. 9 dB over the entire length of the cable cross-section
Shielding	Copper braided shielding or braided shielding with foil shield. When grounding the cable shield, observe the grounding concept of the plant.

EtherNet/IP

The standard ANSI/TIA/EIA-568-B.2 Annex specifies CAT 5 as the minimum category for a cable used for EtherNet/IP. CAT 5e and CAT 6 are recommended.

For more information on planning and installing EtherNet/IP networks, please refer to the "Media Planning and Installation Manual. EtherNet/IP" of ODVA Organization.

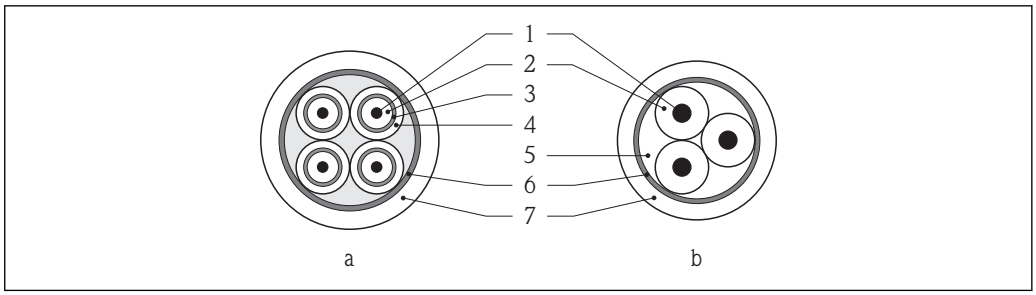
Connecting cable for remote version

Electrode cable

Standard cable	3 ×0.38 mm² (20 AWG) with common, braided copper shield (ϕ ~7 mm (0.28 in) and individual shielded cores
Cable for empty pipe detection (EPD)	4 ×0.38 mm² (20 AWG) with common, braided copper shield (ϕ ~7 mm (0.28 in) and individual shielded cores
Conductor resistance	≤50 Ω/km (0.015 Ω/ft)
Capacitance: core/shield	≤420 pF/m (128 pF/ft)
Operating temperature	–20 to +80 °C (–68 to +176 °F)

Coil current cable

Standard cable	2 ×0.75 mm² (18 AWG) with common, braided copper shield (ϕ ~ 7 mm (0.28")) and individually shielded cores
Conductor resistance	≤37 Ω/km (0.011 Ω/ft)
Capacitance: core/core, shield grounded	≤120 pF/m (37 pF/ft)
Operating temperature	–20 to +80 °C (–68 to +176 °F)
Test voltage for cable insulation	≤ AC 1433 V r.m.s. 50/60 Hz or ≥ DC 2026 V



16 *Cable cross-section*

a *Electrode cable*
b *Coil current cable*
1 *Core*
2 *Core insulation*
3 *Core shield*
4 *Core jacket*
5 *Core reinforcement*
6 *Cable shield*
7 *Outer jacket*

A connecting cable can be ordered from Endress+Hauser for IP68:
- Pre-terminated cables that are already connected to the sensor.
- Pre-terminated cables, where the cables are connected by the customer onsite (incl. tools for sealing the connection compartment)

Reinforced connecting cables

Reinforced connecting cables with an additional, reinforcing metal braid should be used for:
- When laying the cable directly in the ground
- Where there is a risk of damage from rodents
- If using the device below IP68 degree of protection

Reinforced connecting cables with an additional, reinforcing metal braid can be ordered from Endress+Hauser .

Operation in zones of severe electrical interference

The measuring system meets the general safety requirements → 106 and EMC specifications → 40.

Grounding is by means of the ground terminal provided for the purpose inside the connection housing. The stripped and twisted lengths of cable shield to the ground terminal must be as short as possible.

Performance characteristics

Reference operating conditions

In accordance with DIN EN 29104
- Medium temperature: +28 ± 2 °C (+82 ± 4 °F)
- Ambient temperature: +22 ± 2 °C (+72 ± 4 °F)
- Warm-up period:30 min

Installation
- Inlet run > 10 × DN
- Outlet run > 5 × DN
- Sensor and transmitter grounded.
- The sensor is centered in the pipe.

No special requirements must be observed at the inlet and outlet runs to keep within the in-service maximum permissible errors for custody transfer.

To calculate the measuring range, use the *Applicator* sizing tool → 109

Maximum measured error

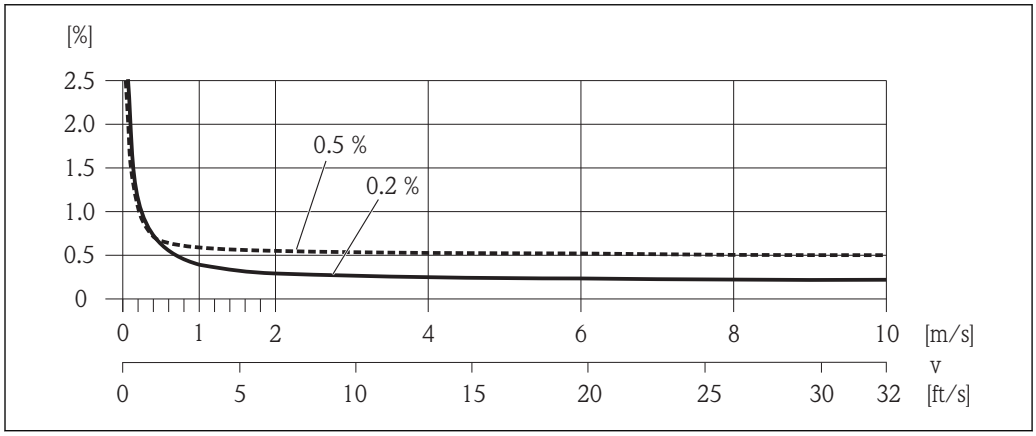
Error limits under reference operating conditions

o.r. = of reading

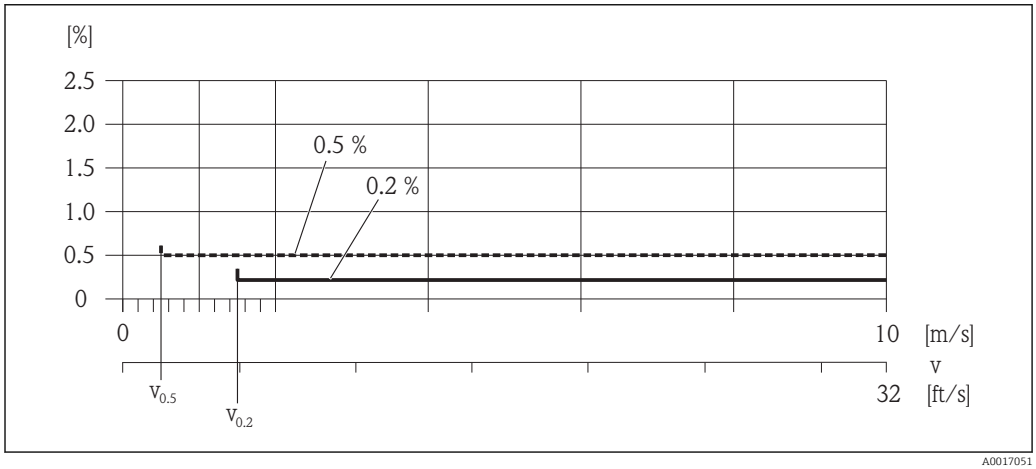
Volume flow

- ±0.5 % o.r. ± 1 mm/s (0.04 in/s)
- Optional: ±0.2 % o.r. ± 2 mm/s (0.08 in/s)

Fluctuations in the supply voltage do not have any effect within the specified range.



17 *Maximum measured error in % o.r.*



18 *Flat Spec in % o.r.*

Flat Spec flow values0.5 %

Nominal diameter		$v_{0.5}$	
[mm]	[in]	[m/s]	[ft/s]
25 to 600	1 to 24	0.5	1.64

Flat Spec flow values0.2 %

Nominal diameter		$v_{0.2}$	
[mm]	[in]	[m/s]	[ft/s]
25 to 600	1 to 24	1.5	4.92

Electrical conductivity

Max. measured error not specified.

Accuracy of outputs

o.r. = of reading

The outputs have the following base accuracy specifications.

Current output

Accuracy	Max. ±5 µA

Pulse/frequency output

Accuracy	Max. ±50 ppm o.r. (across the complete ambient temperature range)

Repeatability

o.r. = of reading

Volume flow
max. ±0.1 % o.r. ± 0.5 mm/s (0.02 in/s)

Electrical conductivity
Max. ±5 % o.r.

Influence of ambient temperature

o.r. = of reading

Current output

Temperature coefficient	Max. ±0.005% o.r./°C

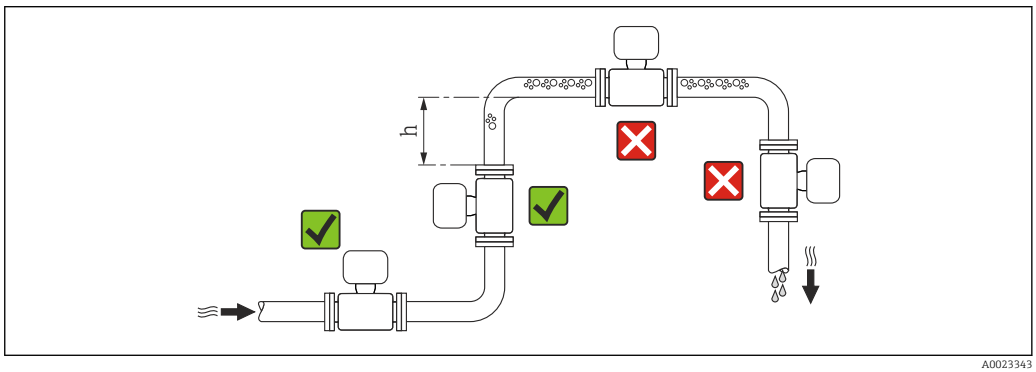
Pulse/frequency output

Temperature coefficient	No additional effect. Included in accuracy.

Installation

No special measures such as supports are necessary. External forces are absorbed by the construction of the device.

Mounting location



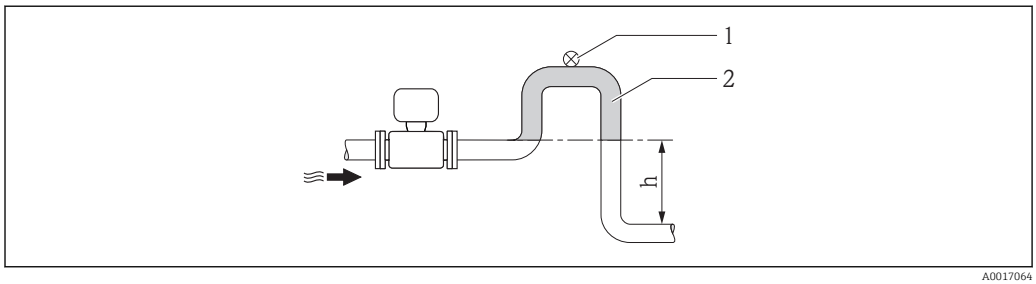
Preferably install the sensor in an ascending pipe, and ensure a sufficient distance to the next pipe elbow: h ≥ 2 × DN

To prevent measuring errors arising from accumulation of gas bubbles in the measuring tube, avoid the following mounting locations in the pipe:
- Highest point of a pipeline.
- Directly upstream of a free pipe outlet in a down pipe.

Installation in down pipes

Install a siphon with a vent valve downstream of the sensor in down pipes whose length h ≥ 5 m (16.4 ft). This precaution is to avoid low pressure and the consequent risk of damage to the measuring tube. This measure also prevents the system losing prime.

For information on the liner's resistance to partial vacuum

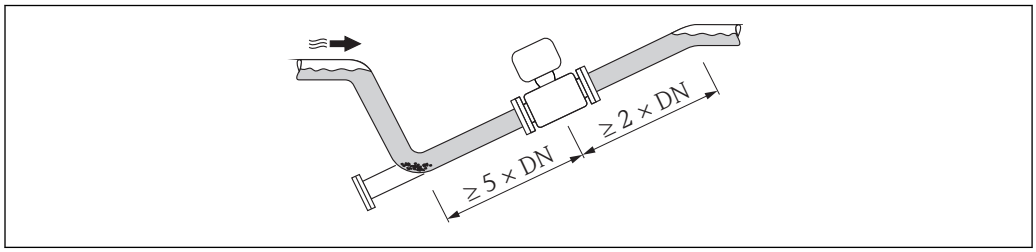


19 *Installation in a down pipe*

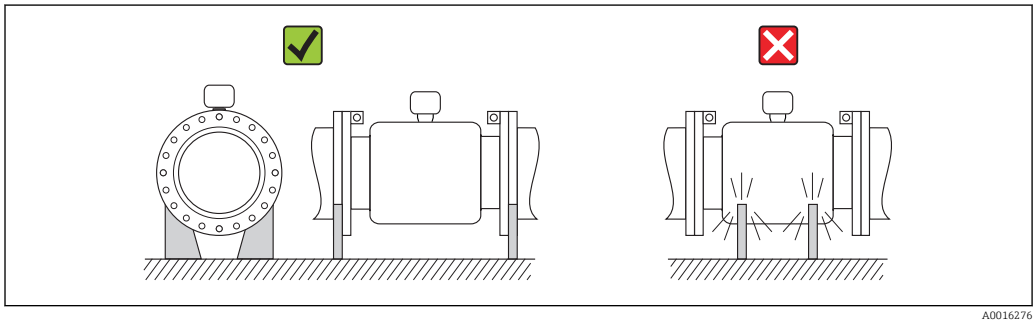
1 *Vent valve*
2 *Pipe siphon*
h *Length of down pipe*

Installation in partially filled pipes

A partially filled pipe with a gradient necessitates a drain-type configuration. The empty pipe detection (EPD) function offers additional protection by detecting empty or partially filled pipes.



For heavy sensors DN ≥ 350 (14")



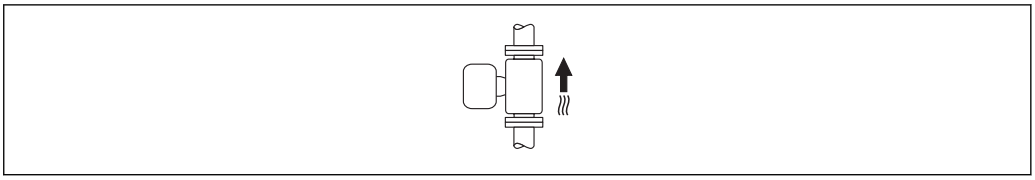
Orientation

The direction of the arrow on the sensor nameplate helps you to install the sensor according to the flow direction (direction of medium flow through the piping).

An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube.

The measuring device also offers the empty pipe detection function to detect partially filled measuring pipes in the event of outgassing fluids or variable process pressures.

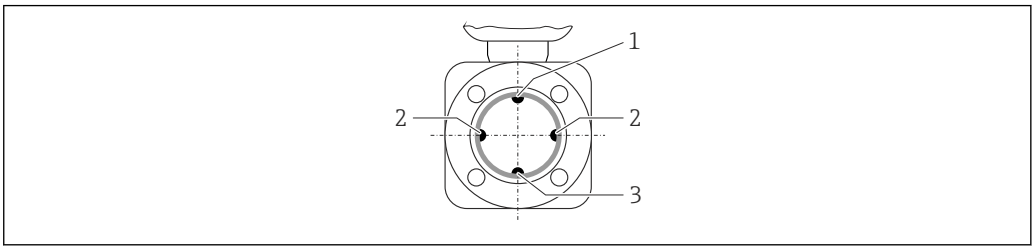
Vertical



A0015591

Optimum for self-emptying pipe systems and for use in conjunction with empty pipe detection.

Horizontal



A0016260

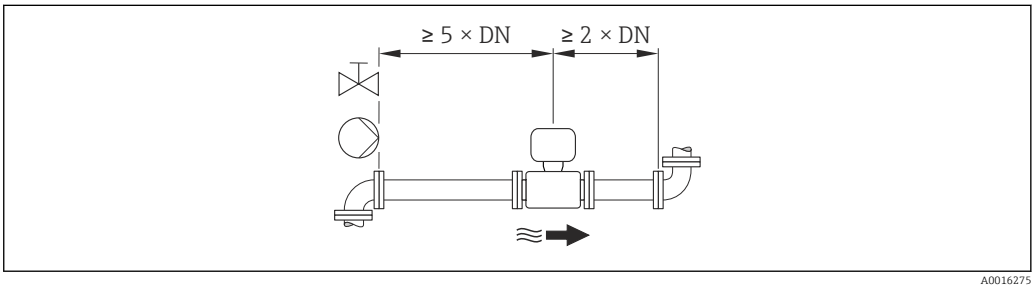
1 *EPD electrode for empty pipe detection*
2 *Measuring electrodes for signal detection*
3 *Reference electrode for potential equalization*

- The measuring electrode plane must be horizontal. This prevents brief insulation of the two measuring electrodes by entrained air bubbles.
- Empty pipe detection only works if the transmitter housing is pointing upwards as otherwise there is no guarantee that the empty pipe detection function will actually respond to a partially filled or empty measuring tube.

Inlet and outlet runs

If possible, install the sensor upstream from fittings such as valves, T-pieces or elbows.

Observe the following inlet and outlet runs to comply with accuracy specifications:



A0016275

To keep within the in-service maximum permissible errors for custody transfer no additional requirements apply with regard to the graphic illustrated above.

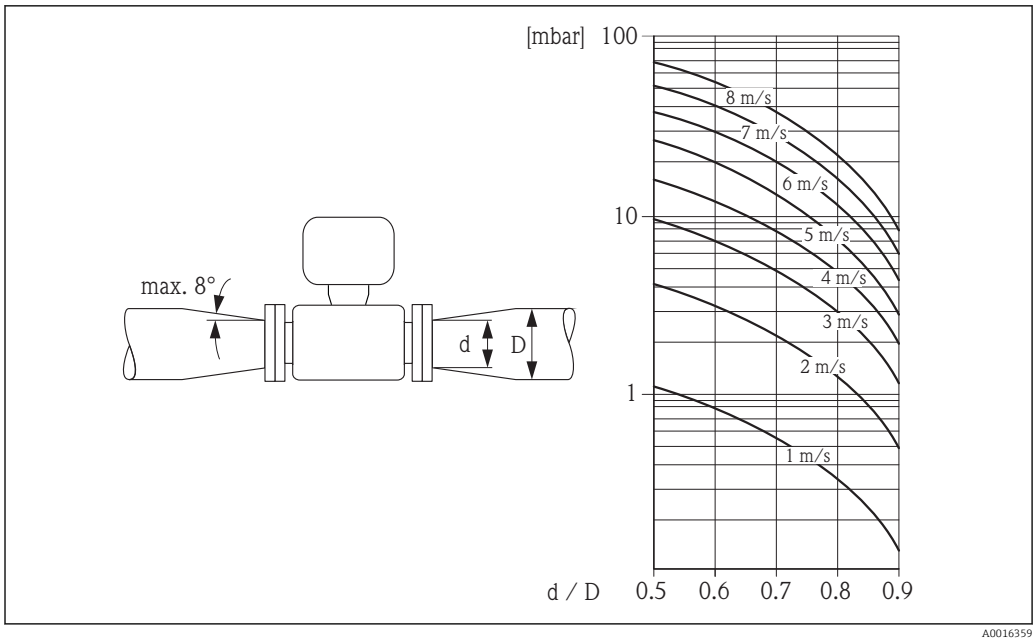
Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids.

The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders:

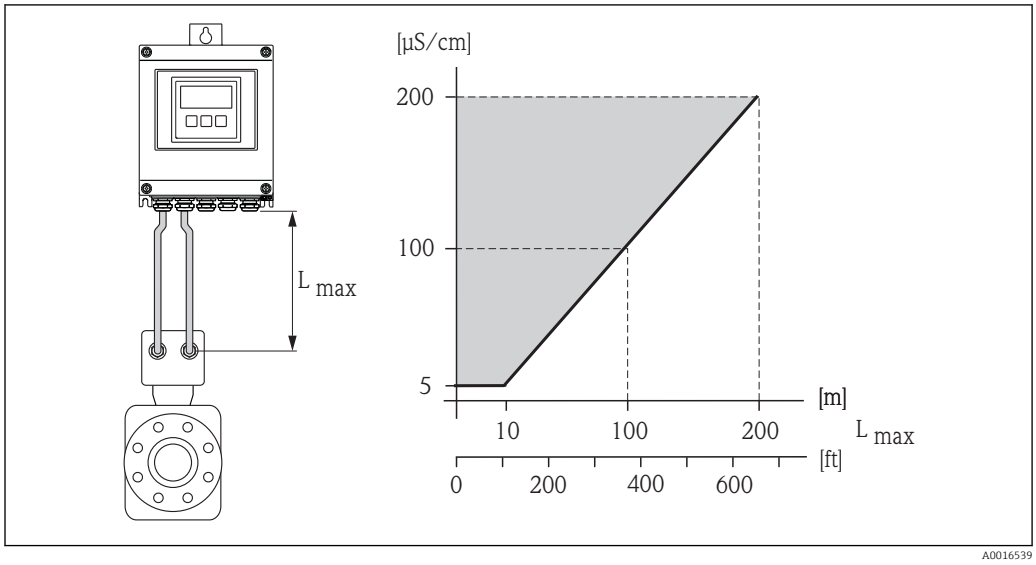
- Calculate the ratio of the diameters d/D.
- From the nomogram read off the pressure loss as a function of flow velocity (downstream from the reduction) and the d/D ratio.

The nomogram only applies to liquids with a viscosity similar to that of water.



Length of connecting cable

To ensure correct measuring results when using the remote version, observe the maximum permitted cable length L_{max}. This length is determined by the conductivity of the fluid.
If measuring liquids in general: 5 µS/cm

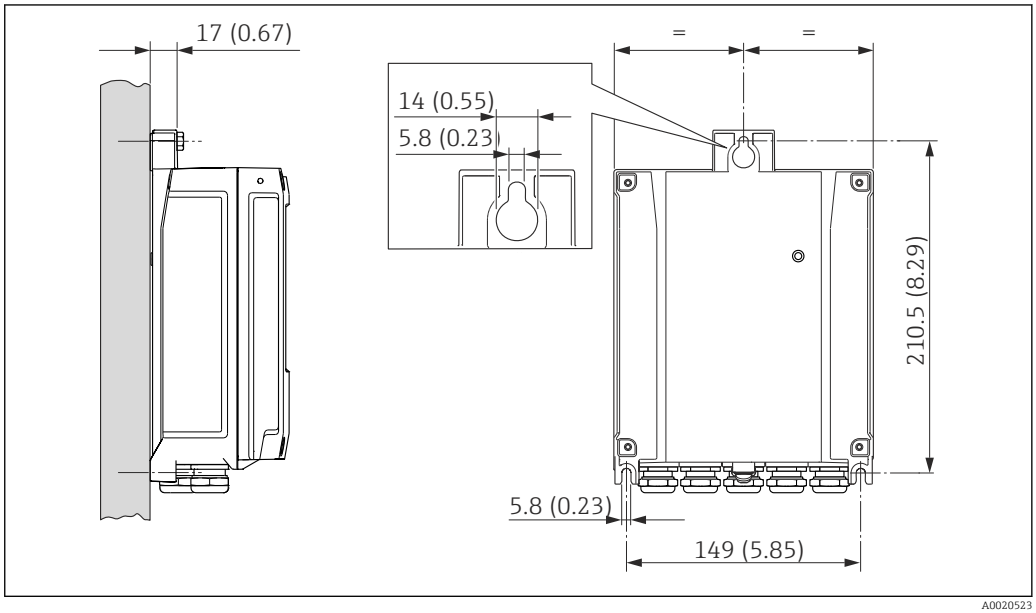


20 *Permitted length of connecting cable for remote version*

Area shaded gray = permitted range
L_{max} = length of connecting cable in [m] ([ft])
[µS/cm] = fluid conductivity

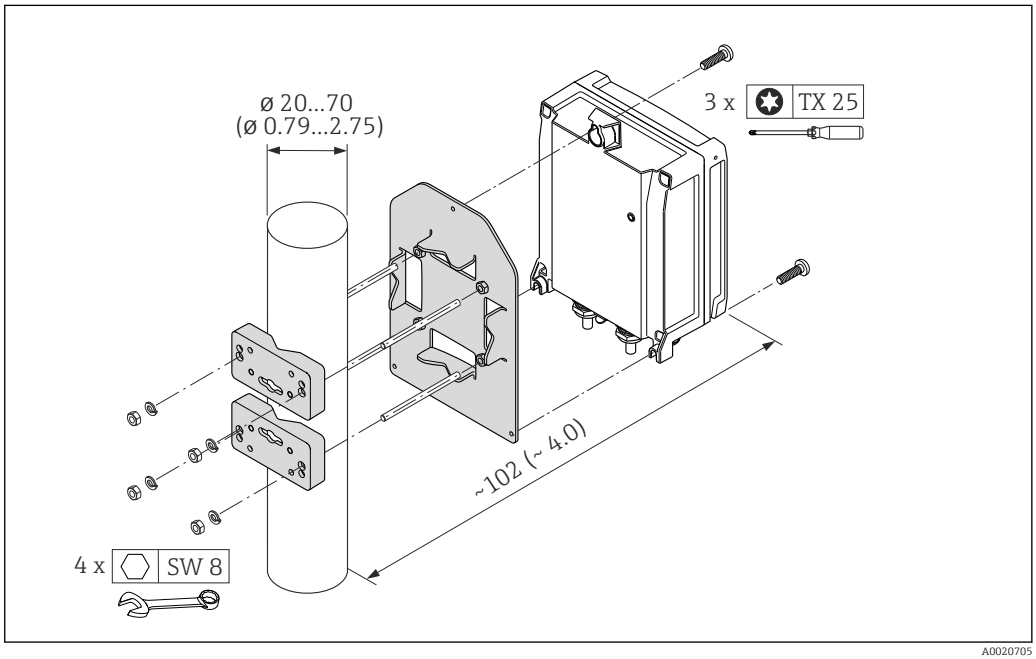
Installing the wall-mount housing

Wall mounting



21 *Engineering unit mm (in)*

Post mounting



22 *Engineering unit mm (in)*

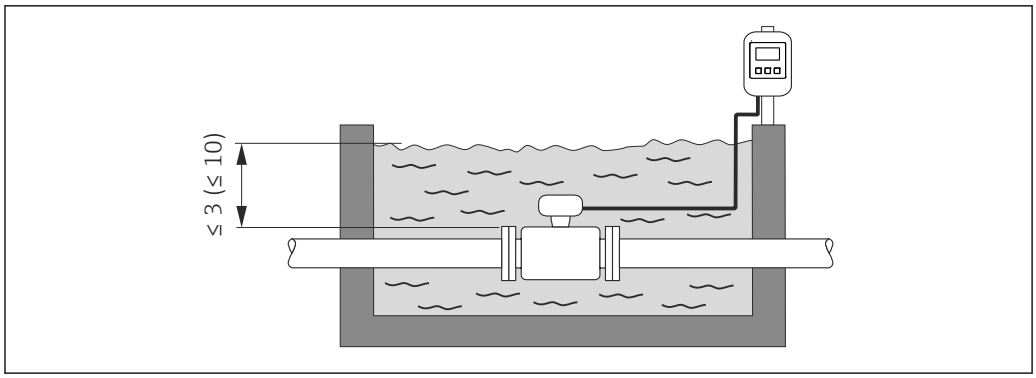
Special mounting instructions

Display protection

To ensure that the optional display protection can be easily opened, maintain the following minimum head clearance: 350 mm (13.8 in)

Permanent immersion in water

A fully welded remote version with IP68 protection is optionally available for permanent immersion in water ≤ 3 m (10 ft) or in exceptional cases for use for up to 48 hours at ≤ 10 m (30 ft). The measuring device meets the requirements of corrosion categories C5-M and Im1/Im2/Im3. The fully welded design along with the connection compartment sealing system ensure that moisture cannot enter the measuring device.



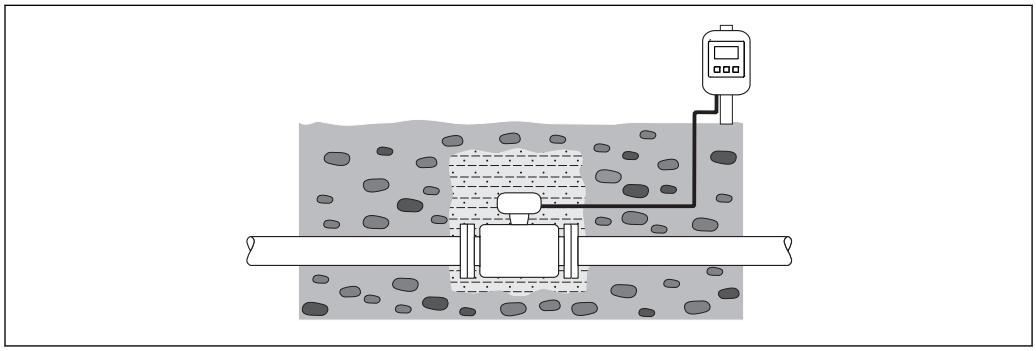
A0017296

23 Engineering unit in m(ft)

Replacement of cable gland on connection housing → 29

Buried applications

A remote version with IP68 protection is optionally available for buried applications. The measuring device satisfies the certified corrosion protection Im1/Im2/Im3 in accordance with EN ISO 12944. It can be used directly underground without the need for additional protective measures. The device is mounted in accordance with the usual regional installation regulations (e.g. EN DIN 1610).



A0017298

Environment

Ambient temperature range

Transmitter	−40 to +60 °C (−40 to +140 °F)
Local display	−20 to +60 °C (−4 to +140 °F), the readability of the display may be impaired at temperatures outside the temperature range.
Sensor	▪ Process connection material, carbon steel: −10 to +60 °C (+14 to +140 °F) ▪ Process connection material, stainless steel: −40 to +60 °C (−40 to +140 °F) Mount the transmitter separately from the sensor if both the ambient and fluid temperatures are high.
Liner	Do not exceed or fall below the permitted temperature range of the liner .

If operating outdoors:
- Install the measuring device in a shady location.
- Avoid direct sunlight, particularly in warm climatic regions.
- Avoid direct exposure to weather conditions.

- If the compact version of the device is insulated at low temperatures, the insulation must also include the device neck.
- Protect the display against impact.
- Protect the display from abrasion by sand in desert areas.

A display protector can be ordered from Endress+Hauser: "Accessories" section → 108

Storage temperature

The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.

- Protect the measuring device against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Select a storage location where moisture cannot collect in the measuring device as fungus or bacteria infestation can damage the liner.
- If protection caps or protective covers are mounted these should never be removed before installing the measuring device.

Atmosphere

If a plastic transmitter housing is permanently exposed to certain steam and air mixtures, this can damage the housing.

If you are unsure, please contact your Endress+Hauser Sales Center for clarification.

Degree of protection

Transmitter
- As standard: IP66/67, type 4X enclosure
- When housing is open: IP20, type 1 enclosure

Sensor
- As standard: IP66/67, type 4X enclosure
- Optionally available for remote version:
  - IP66/67, type 4X enclosure; fully welded, with protective varnish EN ISO 12944 C5-M. Suitable for use in corrosive atmospheres.
  - IP68, type 6P enclosure; fully welded, with protective varnish as per EN ISO 12944 C5-M. Suitable for permanent immersion in water ≤3 m (10 ft) or 48 hours at depths ≤10 m (30 ft).
  - IP68, type 6P enclosure; fully welded, with protective varnish as per EN ISO 12944 Im1/Im2/Im3. Suitable for permanent immersion in saline water ≤3 m (10 ft) or 48 hours at depths ≤ 10 m (30 ft) or in buried applications.

Shock resistance

Compact version
6 ms 30 g, according to IEC 60068-2-27

Remote version
- Transmitter: 6 ms 30 g, according to IEC 60068-2-27
- Sensor: 6 ms 50 g, according to IEC 60068-2-27

Vibration resistance

Compact version
- Vibration sinusoidal, 1 g peak, according to IEC 60068-2-6
- Vibration broad-band random, 1.54 g rms, according to IEC 60068-2-64

Remote version
- Transmitter
  - Vibration sinusoidal, 1 g peak, according to IEC 60068-2-6
  - Vibration broad-band random, 1.54 g rms, according to IEC 60068-2-64
- Sensor:
  - Vibration sinusoidal, 2 g peak, according to IEC 60068-2-6
  - Vibration broad-band random, 2.70 g rms, according to IEC 60068-2-64

Mechanical load

- Protect the transmitter housing against mechanical effects, such as shock or impact; the use of the remote version is sometimes preferable.
- Never use the transmitter housing as a ladder or climbing aid.

Electromagnetic compatibility (EMC)

- As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21)
- Complies with emission limits for industry as per EN 55011 (Class A)
- Device version with PROFIBUS DP: Complies with emission limits for industry as per EN 50170 Volume 2, IEC 61784

The following applies for PROFIBUS DP: If baud rates > 1.5 MBaud an EMC cable entry must be used and the cable shield must continue as far as the terminal wherever possible.

For details refer to the Declaration of Conformity.

Process

Medium temperature range

- 0 to +80 °C (+32 to +176 °F) for hard rubber, DN 50 to 2000 (2 to 78")
- –20 to +50 °C (–4 to +122 °F) for polyurethane, DN 25 to 1200 (1 to 48")

In custody transfer mode, the permitted fluid temperature is 0 to +50 °C (+32 to +122 °F).

Conductivity

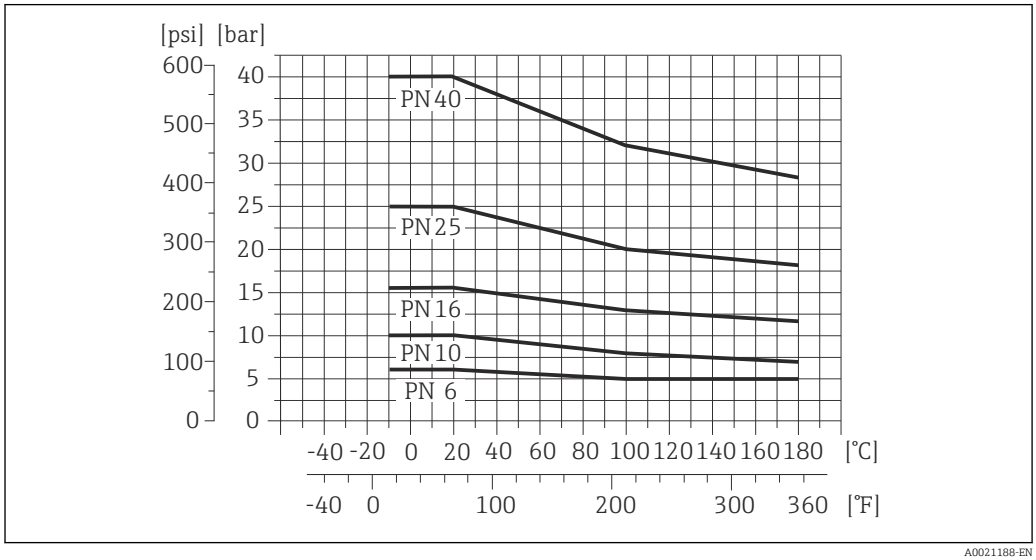
≥ 5 µS/cm for liquids in general

Note that in the case of the remote version, the requisite minimum conductivity also depends on the cable length → 36.

Pressure-temperature ratings

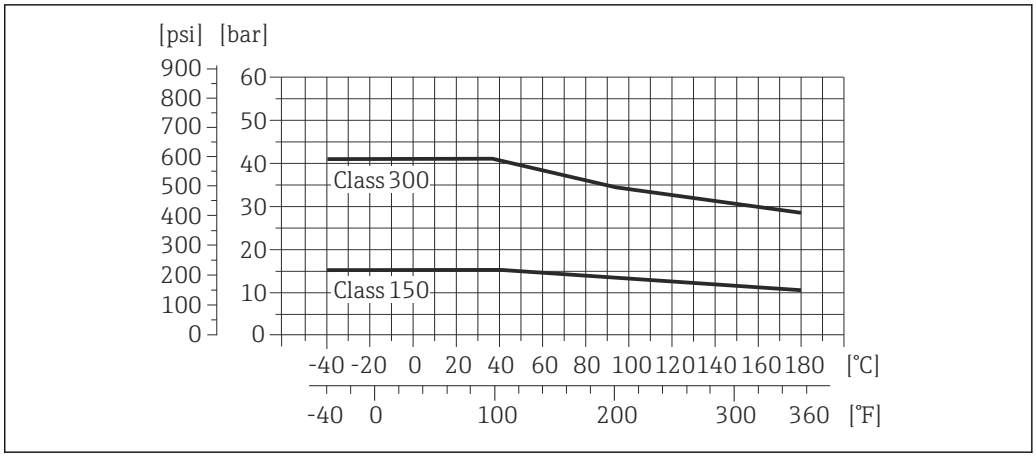
The following pressure-temperature ratings refer to the entire device and not just the process connection.

Process connection: fixed flange according to EN 1092-1 (DIN 2501)

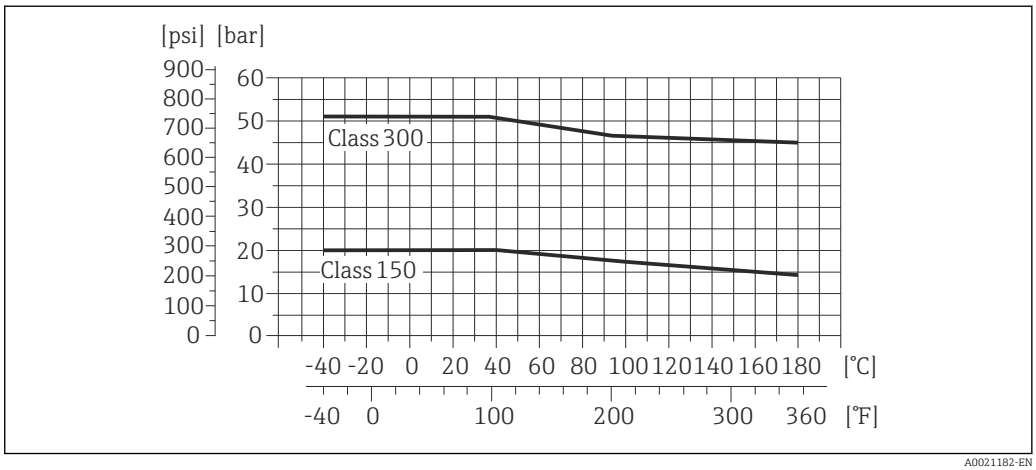


24 Process connection material: stainless steel, 1.4404/1.4571/F316L; carbon steel, A105/FE410WB/P250GH/S235JRG2/S235JR+N

Process connection: fixed flange according to ASME B16.5

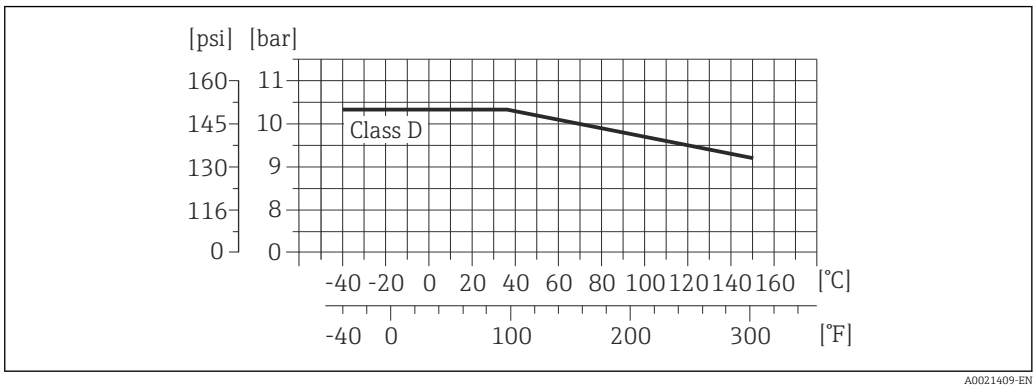


25 *Process connection material: stainless steel, F316L similar to 1.4404*



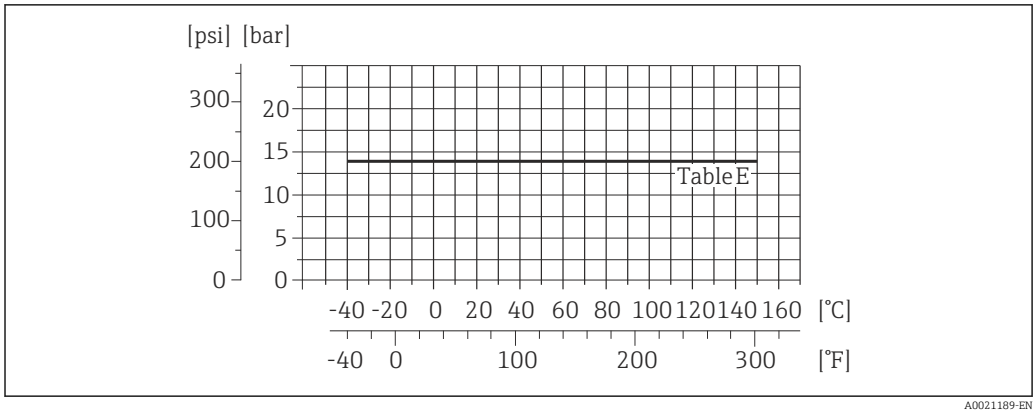
26 *Process connection material: carbon steel, A105/A515(70)*

Process connection: fixed flange according to AWWA C207



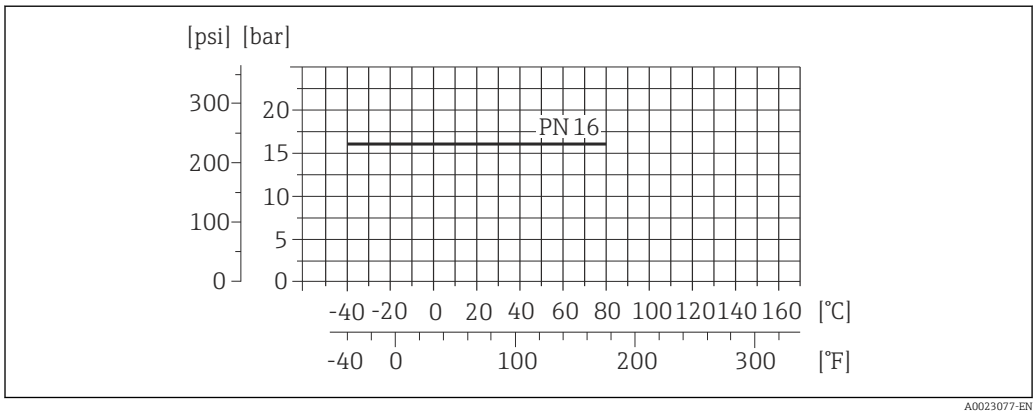
27 *Process connection material: carbon steel, A105/A181/P265GH/S275JR*

Process connection: fixed flange according to AS 2129



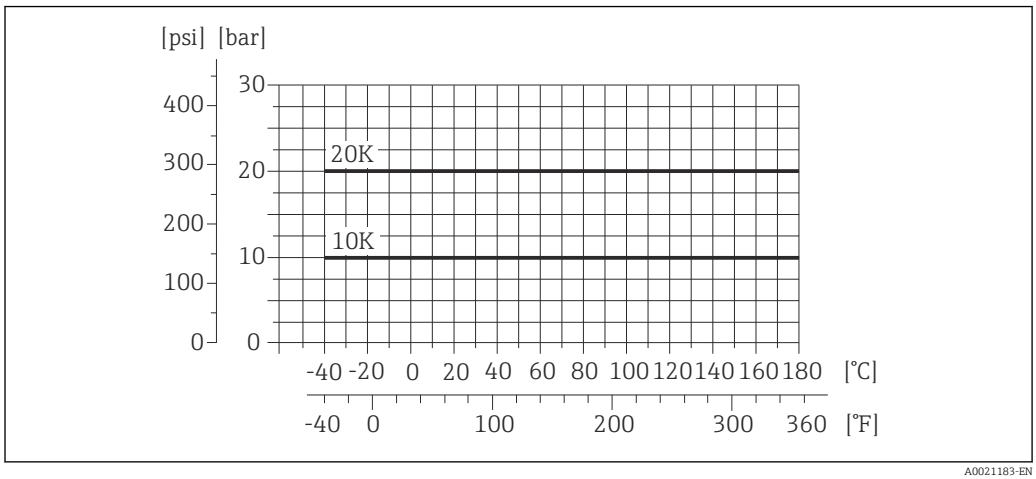
28 Process connection material: carbon steel, A105/FE410WB/P235GH/P265GH/S235JRG2

Process connection: fixed flange according to AS 4087



29 Process connection material: carbon steel, A105/P265GH/S275JR

Process connection: fixed flange according to JIS B2220



30 Process connection material: stainless steel, F316L similar to 1.4404; carbon steel, A105/A350LF2

Pressure tightness

Liner: hard rubber

Nominal diameter		Limit values for absolute pressure in [mbar] ([psi]) for fluid temperatures:		
[mm]	[in]	+25 °C (+77 °F)	+50 °C (+122 °F)	+80 °C (+176 °F)
50…2000	2…78	0 (0)	0 (0)	0 (0)

Liner: polyurethane

Nominal diameter		Limit values for absolute pressure in [mbar] ([psi]) for fluid temperatures:	
[mm]	[in]	+25 °C (+77 °F)	+50 °C (+122 °F)
25...1200	1...48	0 (0)	0 (0)

Flow limit

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum velocity of flow is between 2 to 3 m/s (6.56 to 9.84 ft/s). Also match the velocity of flow (v) to the physical properties of the fluid:
- v < 2 m/s (6.56 ft/s): for abrasive fluids (e.g. potter's clay, lime milk, ore slurry)
- v > 2 m/s (6.56 ft/s): for fluids producing buildup (e.g. wastewater sludges)

A necessary increase in the flow velocity can be achieved by reducing the sensor nominal diameter.

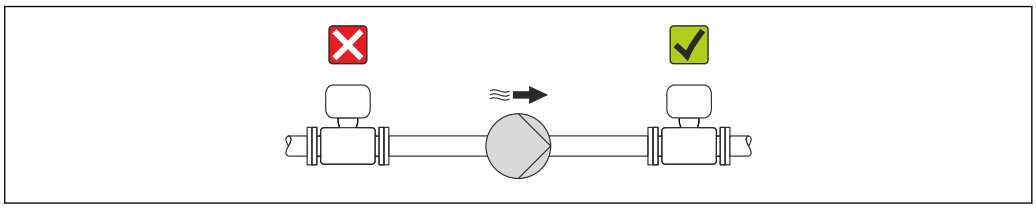
For an overview of the measuring range full scale values, see the "Measuring range" section → 7

For custody transfer, the applicable approval determines the permitted measuring range.

Pressure loss

- No pressure loss occurs if the sensor is installed in a pipe with the same nominal diameter.
- Pressure losses for configurations incorporating adapters according to DIN EN 545 → 35

System pressure



A0015594

Never install the sensor on the pump suction side in order to avoid the risk of low pressure, and thus damage to the liner.

Furthermore, install pulse dampers if reciprocating, diaphragm or peristaltic pumps are used.

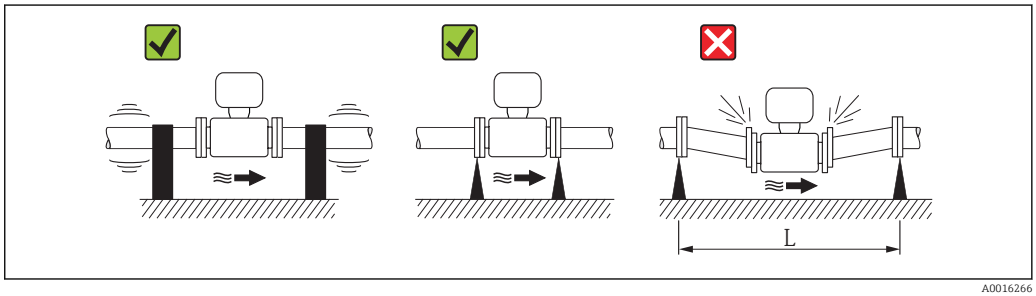
- For information on the liner's resistance to partial vacuum → 42
- For information on the shock resistance of the measuring system → 39
- For information on the vibration resistance of the measuring system → 39

Vibrations

In the event of very strong vibrations, the pipe and sensor must be supported and fixed.

It is also advisable to mount the sensor and transmitter separately.

- For information on the shock resistance of the measuring system → 39
- For information on the vibration resistance of the measuring system → 39



A0016266

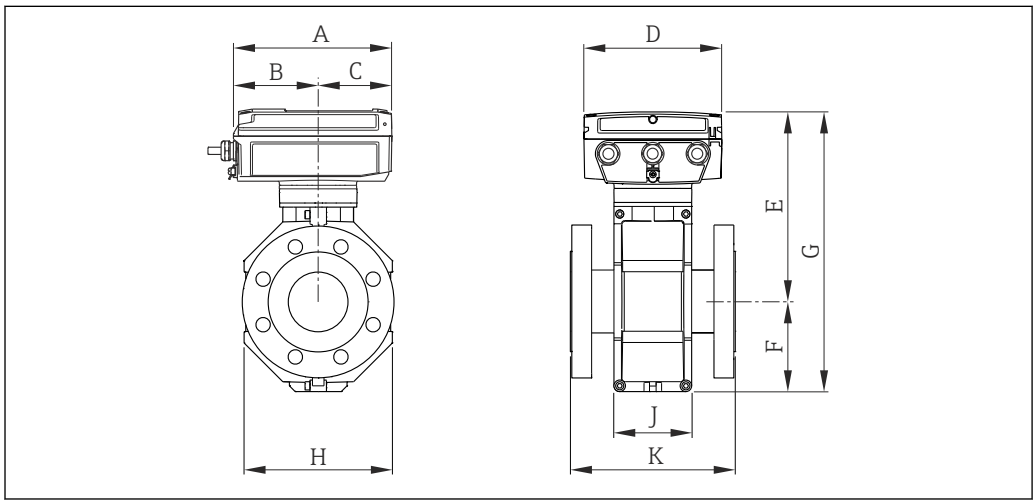
31 *Measures to avoid device vibrations (L > 10 m (33 ft))*

Mechanical construction

Dimensions in SI units

Compact version

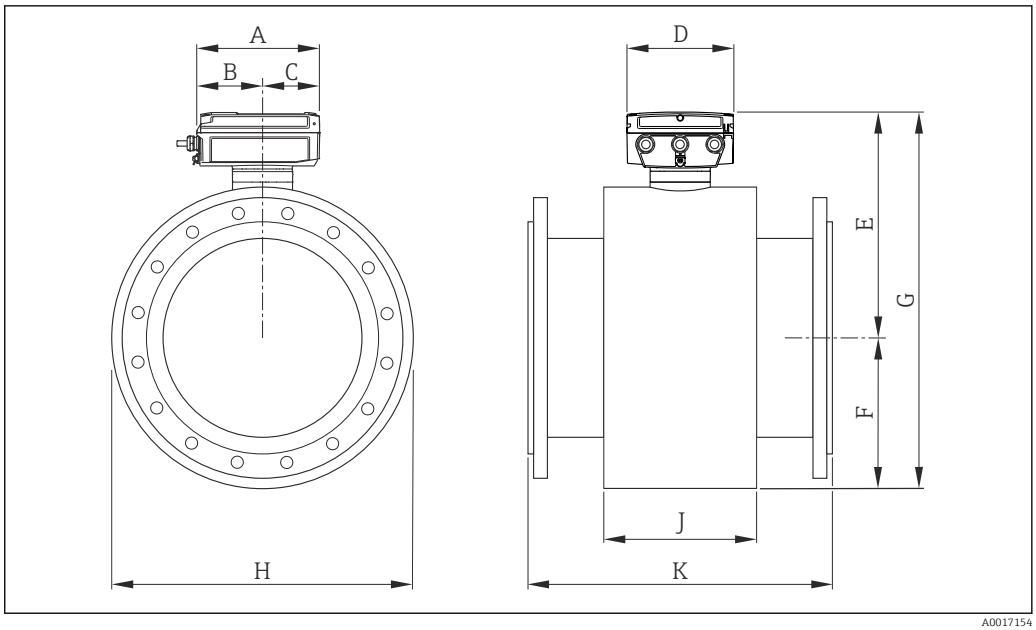
Order code for "Housing", option M "Compact, polycarbonate" or option A "Compact, aluminum, coated"



A0020352

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	J [mm]	K [2] [mm]
25	193	103	90	167	222	84	306	120	94	200
32	193	103	90	167	222	84	306	120	94	200
40	193	103	90	167	222	84	306	120	94	200
50	193	103	90	167	222	84	306	120	94	200
65	193	103	90	167	247	109	356	180	94	200
80	193	103	90	167	247	109	356	180	94	200
100	193	103	90	167	247	109	356	180	94	250
125	193	103	90	167	287	150	437	260	140	250
150	193	103	90	167	287	150	437	260	140	300
200	193	103	90	167	312	180	492	324	156	350
250	193	103	90	167	337	205	542	400	166	450
300	193	103	90	167	362	230	592	460	166	500

1) EN (DIN), AS, JIS; For flanges according to AS, only nominal diameters DN 80, 100 and 150 to 300 are available.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

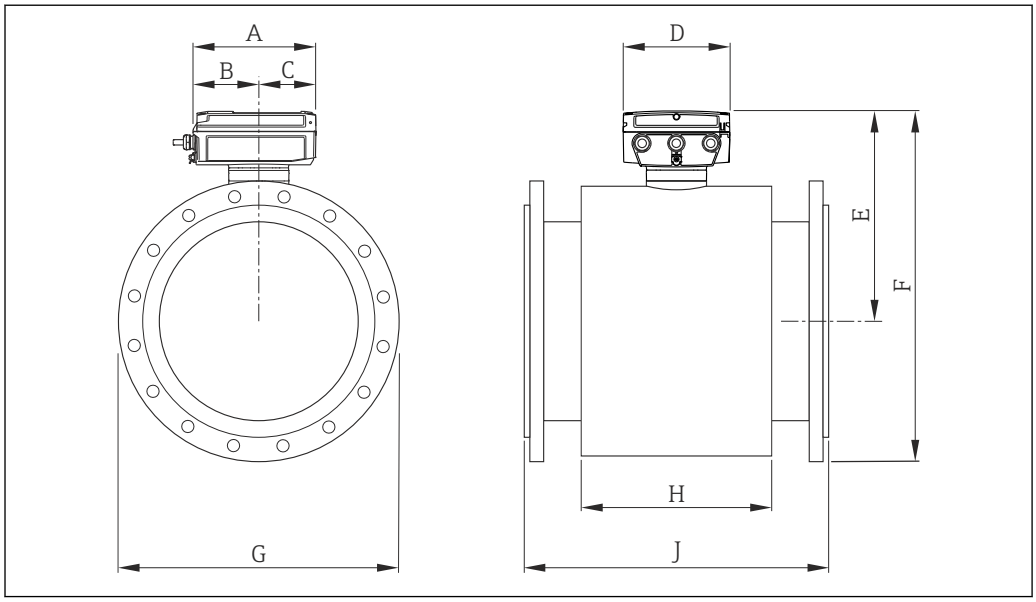


A0017154

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	J [mm]	K [2] [mm]
350	193	103	90	167	432	282	714	564	276	550
375	193	103	90	167	458	308	766	616	276	600
400	193	103	90	167	458	308	766	616	276	600
450	193	103	90	167	483	333	816	666	292	650
500	193	103	90	167	508	359	867	717	292	650
600	193	103	90	167	560	410	970	821	402	780
700	193	103	90	167	662	512	1174	1024	589	910
750	193	103	90	167	662	512	1174	1024	626	975
800	193	103	90	167	683	534	1217	1067	647	1040
900	193	103	90	167	760	610	1370	1220	785	1170
1000	193	103	90	167	836	686	1522	1372	862	1300
1050	193	103	90	167	862	712	1574	1424	912	1365
1200	193	103	90	167	961	811	1772	1622	992	1560
1350	193	103	90	167	1062	912	1974	1824	1252	1755
1400	193	103	90	167	1137	987	2124	1974	1252	1820
1500	193	103	90	167	1161	1011	2172	2022	1392	1950
1600	193	103	90	167	1206	1056	2262	2112	1482	2080
1650	193	103	90	167	1243	1093	2336	2186	1482	2145
1800	193	103	90	167	1338	1188	2526	2376	1632	2340
2000	193	103	90	167	1388	1238	2626	2476	1732	2600

1) EN (DIN), AS; For flanges according to AS, only nominal diameters DN 350, 400, 500 and 600 are available.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Housing", option M "Compact, polycarbonate" or option A "Compact, aluminum, coated"; order code for "Design", option A "Insertion length short"

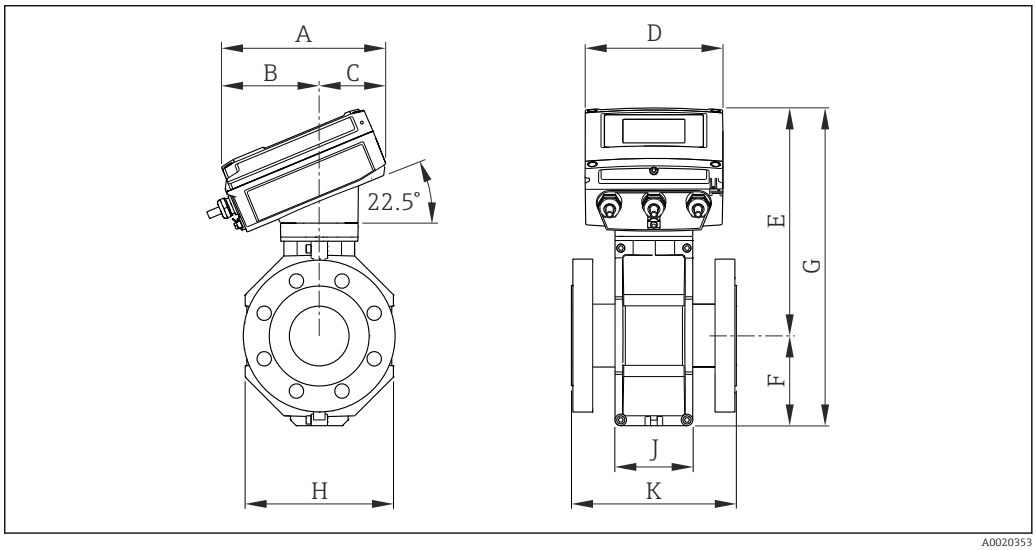


A0017153

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	H [mm]	J [mm]
350	193	103	90	167	386	290	550
375	193	103	90	167	412	290	600
400	193	103	90	167	412	290	600
450	193	103	90	167	440	290	600
500	193	103	90	167	465	290	600
600	193	103	90	167	506	290	600
700	193	103	90	167	571	424	700
750	193	103	90	167	608	454	750
800	193	103	90	167	627	500	800
900	193	103	90	167	677	580	900
1000	193	103	90	167	727	660	1000
1050	193	103	90	167	763	755	1050
1200	193	103	90	167	841	828	1200
1350	193	103	90	167	953	1008	1350
1400	193	103	90	167	953	1008	1400
1500	193	103	90	167	1053	1147	1500
1600	193	103	90	167	1053	1147	1600
1650	193	103	90	167	1104	1284	1650
1800	193	103	90	167	1161	1379	1800
2000	193	103	90	167	1272	1569	2000

DN [mm]	Dimension F					Dimension G				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]
350	631	638	702	653	648	490	505	520	533	525
375	–	–	–	–	687	–	–	–	–	550
400	682	694	760	710	702	540	565	580	597	580
450	737	747	823	757	760	595	615	640	635	640
500	787	800	926	814	817	645	670	715	699	705
600	883	896	1026	912	918	755	780	840	813	825
700	1001	1018	1145	1034	1026	860	895	910	927	910
750	–	–	–	1100	1106	–	–	–	984	995
800	1115	1135	1240	1157	1157	975	1015	1025	1060	1060
900	1215	1235	1240	1261	1265	1075	1115	1125	1168	1175
1000	1315	1342	1355	1372	1355	1175	1230	1225	1289	1255
1050	–	–	–	1436	–	–	–	–	1346	–
1200	1544	1569	1584	1597	1586	1405	1455	1255	1511	1490
1350	–	–	–	1795	–	–	–	–	1683	–
1400	1768	1791	1796	–	–	1630	1675	1685	–	–
1500	–	–	–	1980	–	–	–	–	1854	–
1600	1968	2011	2019	–	–	1830	1915	1930	–	–
1650	–	–	–	2120	–	–	–	–	2032	–
1800	2183	2218	2226	2259	–	2045	2115	2130	2197	–
2000	2404	2434	2444	2453	–	2265	2325	2345	2362	–

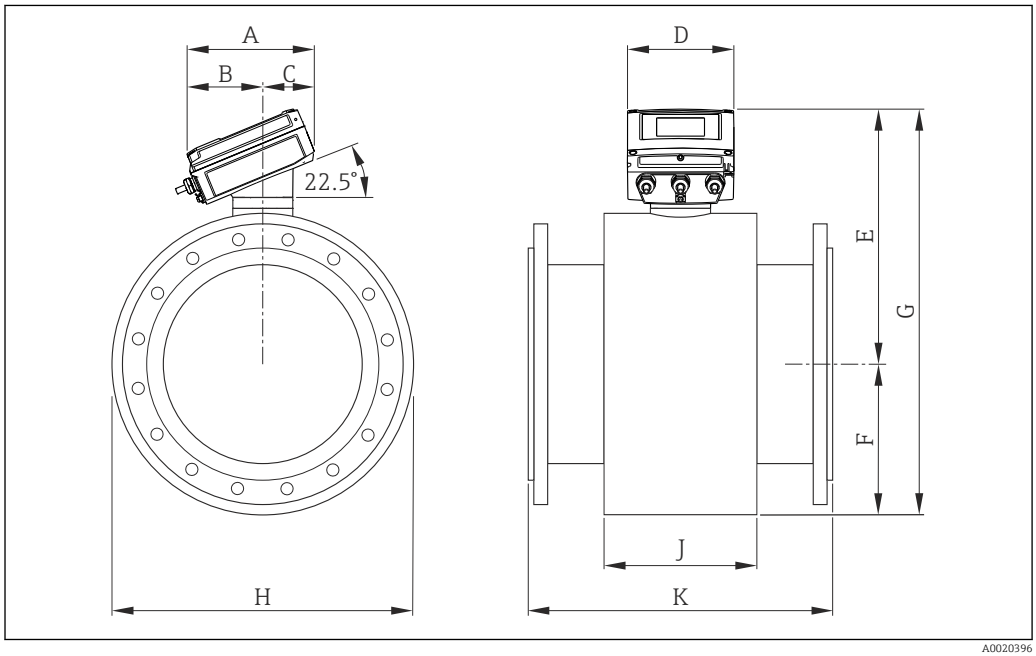
Order code for "Housing", option Q "Compact, polycarbonate, inclined" or option R "Compact, aluminum, coated, inclined"



A0020353

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	J [mm]	K [2] [mm]
25	199	119	80	167	267	84	351	120	94	200
32	199	119	80	167	267	84	351	120	94	200
40	199	119	80	167	267	84	351	120	94	200
50	199	119	80	167	267	84	351	120	94	200
65	199	119	80	167	292	109	401	180	94	200
80	199	119	80	167	292	109	401	180	94	200
100	199	119	80	167	292	109	401	180	94	250
125	199	119	80	167	332	150	482	260	140	250
150	199	119	80	167	332	150	482	260	140	300
200	199	119	80	167	357	180	537	324	156	350
250	199	119	80	167	382	205	587	400	166	450
300	199	119	80	167	407	230	637	460	166	500

1) EN (DIN), AS, JIS; For flanges according to AS, only nominal diameters DN 80, 100 and 150 to 300 are available.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.



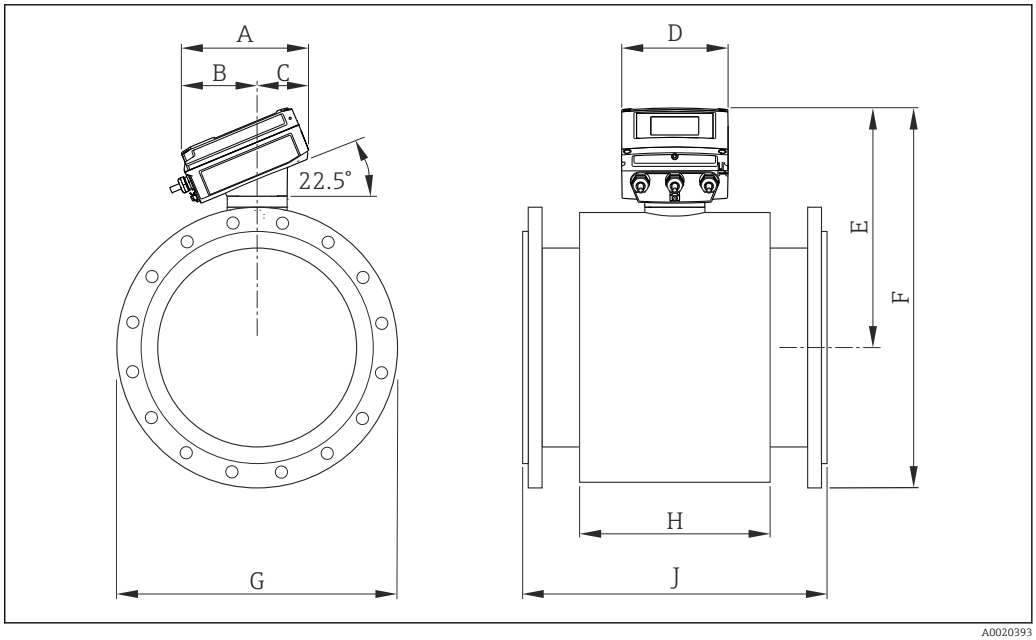
A0020396

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	J [mm]	K [2] [mm]
350	199	119	80	167	477	282	759	564	276	550
375	199	119	80	167	503	308	811	616	276	600
400	199	119	80	167	503	308	811	616	276	600
450	199	119	80	167	528	333	861	666	292	650
500	199	119	80	167	553	359	912	717	292	650
600	199	119	80	167	605	410	1015	821	402	780
700	199	119	80	167	707	512	1219	1024	589	910
750	199	119	80	167	707	512	1219	1024	626	975

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	J [mm]	K [2] [mm]
800	199	119	80	167	728	534	1262	1067	647	1040
900	199	119	80	167	805	610	1415	1220	785	1170
1000	199	119	80	167	881	686	1567	1372	862	1300
1050	199	119	80	167	907	712	1619	1424	912	1365
1200	199	119	80	167	1006	811	1817	1622	992	1560
1350	199	119	80	167	1107	912	2019	1824	1252	1755
1400	199	119	80	167	1182	987	2169	1974	1252	1820
1500	199	119	80	167	1206	1011	2217	2022	1392	1950
1600	199	119	80	167	1251	1056	2307	2112	1482	2080
1650	199	119	80	167	1288	1093	2381	2186	1482	2145
1800	199	119	80	167	1383	1188	2571	2376	1632	2340
2000	199	119	80	167	1433	1238	2671	2476	1732	2600

1) EN (DIN), AS; For flanges according to AS, only nominal diameters DN 350, 400, 500 and 600 are available.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Housing", option Q "Compact, polycarbonate, inclined" or option R "Compact, aluminum, coated, inclined"; order code for "Design", option A "Insertion length short"



A0020393

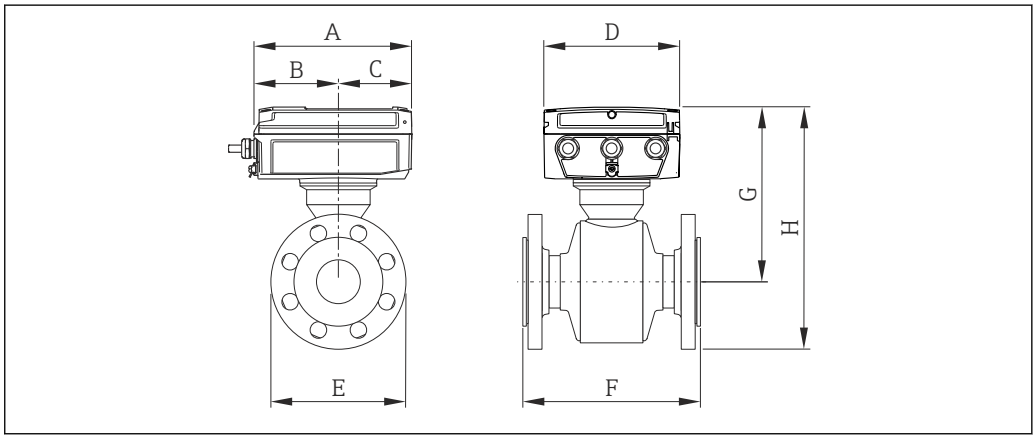
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	H [mm]	J [mm]
350	199	119	80	167	431	290	550
375	199	119	80	167	457	290	600
400	199	119	80	167	457	290	600
450	199	119	80	167	485	290	600
500	199	119	80	167	510	290	600
600	199	119	80	167	551	290	600

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	H [mm]	J [mm]
700	199	119	80	167	616	424	700
750	199	119	80	167	653	454	750
800	199	119	80	167	672	500	800
900	199	119	80	167	722	580	900
1000	199	119	80	167	772	660	1000
1050	199	119	80	167	808	755	1050
1200	199	119	80	167	886	828	1200
1350	199	119	80	167	998	1008	1350
1400	199	119	80	167	953	1008	1400
1500	199	119	80	167	1098	1147	1500
1600	199	119	80	167	1098	1147	1600
1650	199	119	80	167	1149	1284	1650
1800	199	119	80	167	1206	1379	1800
2000	199	119	80	167	1317	1569	2000

	Dimension F					Dimension G				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN [mm]	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]
350	676	683	618	698	693	490	505	520	533	525
375	–	–	–	–	732	–	–	–	–	550
400	727	739	672	755	747	540	565	580	597	580
450	782	792	732	802	805	595	615	640	635	640
500	832	845	795	859	862	645	670	715	699	705
600	928	941	898	957	963	755	780	840	813	825
700	1046	1063	1008	1079	1071	860	895	910	927	910
750	–	–	–	1145	1151	–	–	–	984	995
800	1160	1180	1112	1202	1202	975	1015	1025	1060	1060
900	1260	1280	1212	1306	1310	1075	1115	1125	1168	1175
1000	1360	1387	1327	1417	1400	1175	1230	1225	1289	1255
1050	–	–	–	1481	–	–	–	–	1346	–
1200	1589	1614	1556	1642	1631	1405	1455	1255	1511	1490
1350	–	–	–	1840	–	–	–	–	1683	–
1400	1813	1836	1768	–	–	1630	1675	1685	–	–
1500	–	–	–	2025	–	–	–	–	1854	–
1600	2013	2056	1991	–	–	1830	1915	1930	–	–
1650	–	–	–	2165	–	–	–	–	2032	–
1800	2228	2263	2198	2304	–	2045	2115	2130	2197	–
2000	2449	2479	2416	2498	–	2265	2325	2345	2362	–

Order code for "Sensor option", option CA in combination with order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N

- Order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N available for order in conjunction with order code for "Housing", option M "Compact, polycarbonate"
- Order code for "Calibration flow", options H/K also available for order in conjunction with order code for "Housing", option A "Compact, aluminum, coated"



A0021328

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	F [mm]	G [mm]
25	193	103	90	167	200	188
32	193	103	90	167	200	188
40	193	103	90	167	200	188
50	193	103	90	167	200	188
65	193	103	90	167	200	200
80	193	103	90	167	200	205
100	193	103	90	167	250	218
125	193	103	90	167	250	231
150	193	103	90	167	300	252
200	193	103	90	167	350	278
250	193	103	90	167	450	311
300	193	103	90	167	500	336

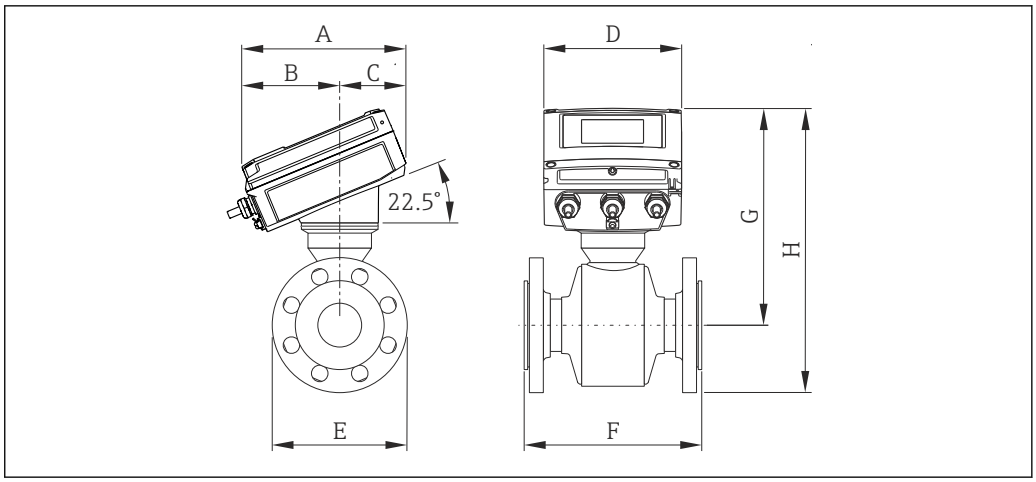
Dimension E										
	EN (DIN)				ASME		AS		JIS	
DN [mm]	PN 10 [mm]	PN 16 [mm]	PN 25 [mm]	PN 40 [mm]	Class 150 [mm]	Class 300 [mm]	Table E [mm]	PN 16 [mm]	10K [mm]	20K [mm]
25	–	–	–	140	140	140	140	–	140	140
32	–	–	–	140	–	–	–	–	140	140
40	–	–	–	150	140	155	–	–	140	140
50	–	–	–	165	153	165	150	150	155	155
65	–	185	–	185	–	–	–	–	175	175
80	–	200	–	200	191	210	185	185	185	200
100	–	220	–	325	229	254	215	215	210	225

Dimension E										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
125	–	250	–	270	–	–	–	–	250	270
150	–	285	–	300	280	318	280	280	280	305
200	340	340	360	–	343	–	335	335	330	350
250	395	405	425	–	407	–	405	405	400	430
300	445	460	485	–	483	–	455	455	445	480

Dimension H										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	–	–	–	258	258	258	258	–	258	258
32	–	–	–	258	–	–	–	–	258	258
40	–	–	–	262	258	265	–	–	258	258
50	–	–	–	270	263	270	262	262	265	265
65	–	293	–	293	–	–	–	–	288	288
80	–	305	–	305	300	309	298	298	298	305
100	–	328	–	380	331	344	325	325	323	330
125	–	355	–	365	–	–	–	–	355	365
150	–	394	–	402	391	410	393	393	393	404
200	448	448	458	–	448	–	445	445	443	452
250	508	513	523	–	514	–	513	513	511	526
300	558	566	578	–	578	–	563	563	558	576

Order code for "Sensor option", option CA in combination with order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N

- Order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N available for order in conjunction with order code for "Housing", option Q "Compact, polycarbonate, inclined"
- Order code for "Calibration flow", options H/K also available for order in conjunction with order code for "Housing", option R "Compact, aluminum, coated, inclined"



A0021329

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	F [mm]	G [mm]
25	199	119	80	167	200	232
32	199	119	80	167	200	232
40	199	119	80	167	200	232
50	199	119	80	167	200	232
65	199	119	80	167	200	244
80	199	119	80	167	200	249
100	199	119	80	167	250	262
125	199	119	80	167	250	275
150	199	119	80	167	300	296
200	199	119	80	167	350	322
250	199	119	80	167	450	355
300	199	119	80	167	500	380

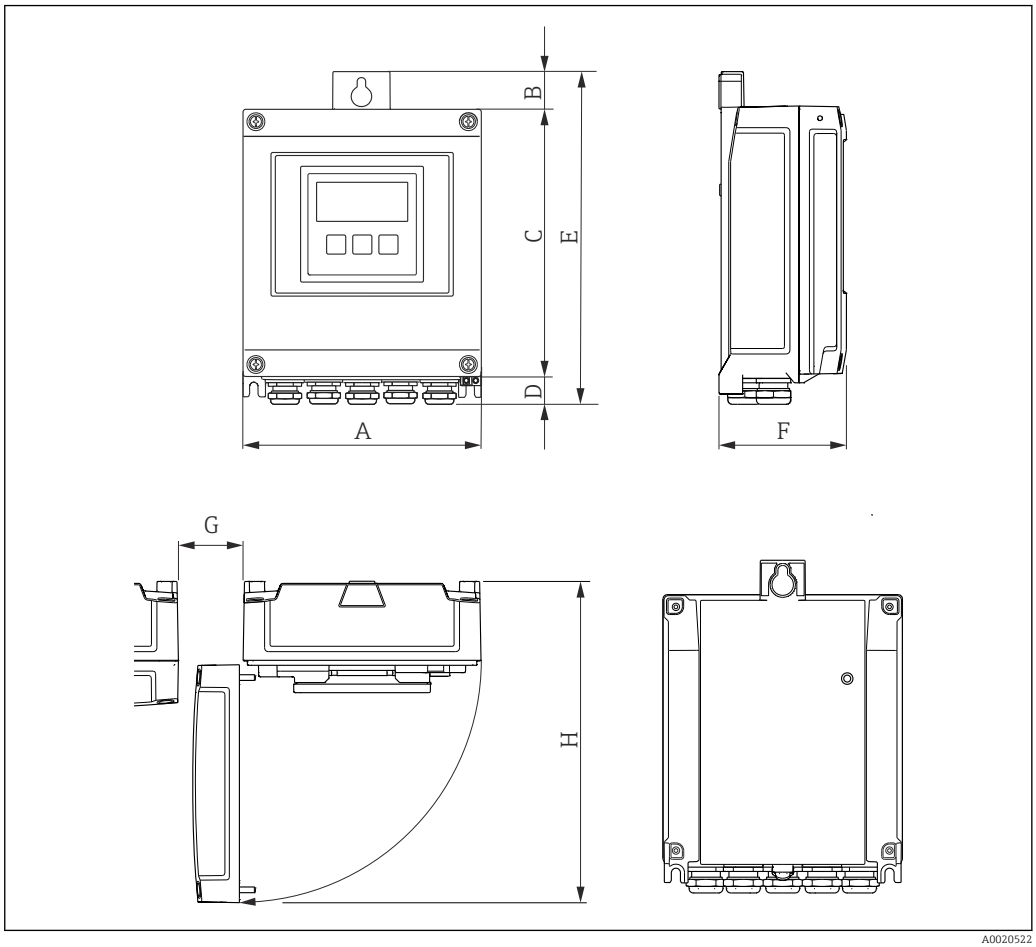
Dimension E										
	EN (DIN)				ASME		AS		JIS	
DN [mm]	PN 10 [mm]	PN 16 [mm]	PN 25 [mm]	PN 40 [mm]	Class 150 [mm]	Class 300 [mm]	Table E [mm]	PN 16 [mm]	10K [mm]	20K [mm]
25	–	–	–	140	140	140	140	–	140	140
32	–	–	–	140	–	–	–	–	140	140
40	–	–	–	150	140	155	–	–	140	140
50	–	–	–	165	153	165	150	150	155	155
65	–	185	–	185	–	–	–	–	175	175
80	–	200	–	200	191	210	185	185	185	200
100	–	220	–	325	229	254	215	215	210	225
125	–	250	–	270	–	–	–	–	250	270
150	–	285	–	300	280	318	280	280	280	305
200	340	340	360	–	343	–	335	335	330	350

Dimension E										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
250	395	405	425	–	407	–	405	405	400	430
300	445	460	485	–	483	–	455	455	445	480

Dimension H										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	–	–	–	302	302	302	302	–	302	302
32	–	–	–	302	–	–	–	–	302	302
40	–	–	–	307	302	310	–	–	302	302
50	–	–	–	315	309	315	307	307	310	310
65	–	337	–	337	–	–	–	–	332	332
80	–	349	–	349	345	354	342	342	342	349
100	–	372	–	425	377	389	370	370	367	375
125	–	400	–	410	–	–	–	–	400	410
150	–	439	–	446	436	455	436	436	436	449
200	492	492	502	–	494	–	490	490	487	497
250	553	558	568	–	559	–	558	558	555	570
300	603	610	623	–	622	–	608	608	603	620

Transmitter remote version

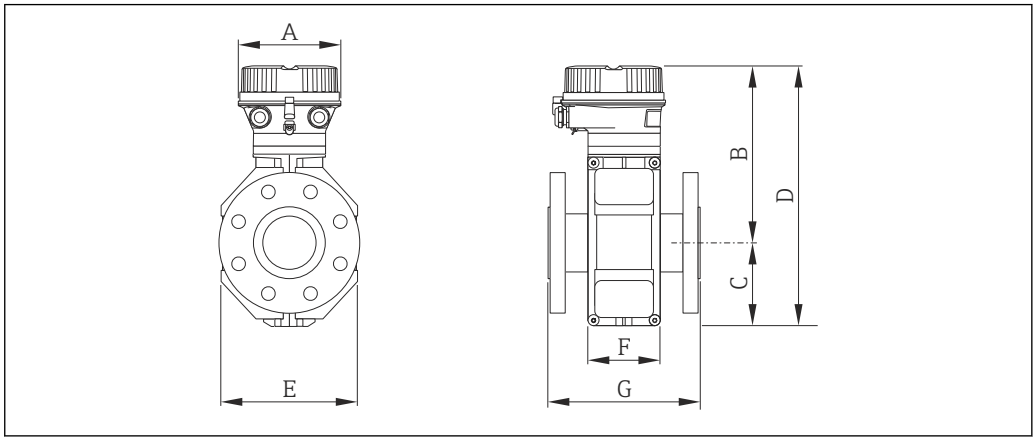
Order code for "Housing", option N "Remote, polycarbonate" or option P "Remote, aluminum coated"



A0020522

A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]
167	24	187	21	232	80	50	240

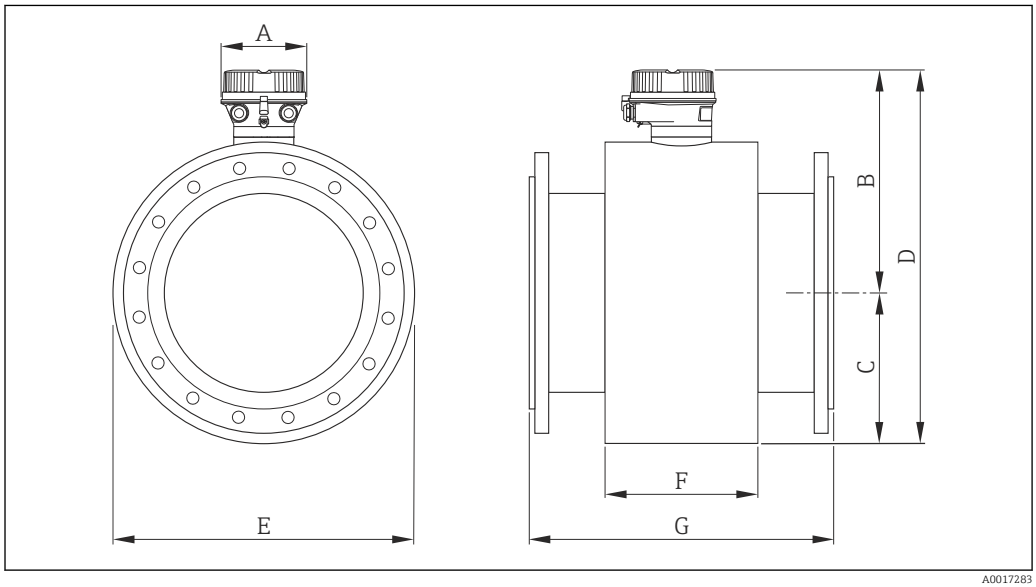
Sensor remote version



A0017282

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [2] [mm]
25	136	207	84	291	120	94	200
32	136	207	84	291	120	94	200
40	136	207	84	291	120	94	200
50	136	207	84	291	120	94	200
65	136	232	109	341	180	94	200
80	136	232	109	341	180	94	200
100	136	232	109	341	180	94	250
125	136	272	150	422	260	140	250
150	136	272	150	422	260	140	300
200	136	297	180	477	324	156	350
250	136	322	205	527	400	156	450
300	136	347	230	577	460	166	500

1) EN (DIN), AS, JIS; For flanges according to AS, only nominal diameters DN 80, 100 and 150 to 300 are available.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.



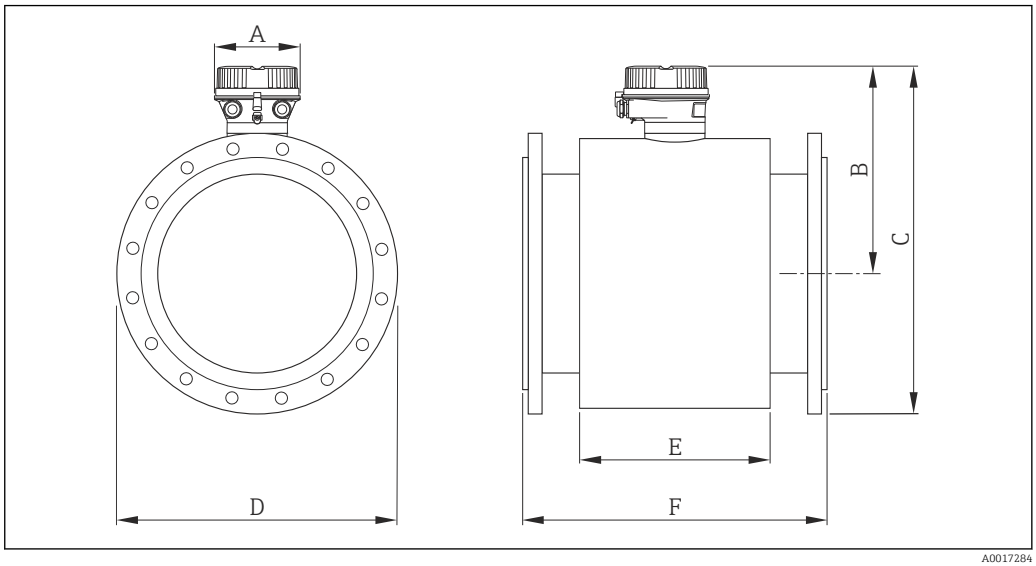
A0017283

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [2] [mm]
350	136	407	282	689	564	276	550
375	136	433	308	741	616	276	600
400	136	433	308	741	616	276	600
450	136	458	333	791	666	292	650
500	136	483	359	842	717	292	650
600	136	535	411	946	821	402	780
700	136	637	512	1149	1024	589	910
750	136	637	512	1149	1024	626	975
800	136	658	534	1192	1067	647	1040

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [2] [mm]
900	136	735	610	1345	1220	785	1170
1000	136	811	686	1497	1372	862	1300
1050	136	837	712	1549	1424	912	1365
1200	136	936	811	1747	1622	992	1560
1350	136	1037	912	1949	1824	1252	1755
1400	136	1112	987	2099	1974	1252	1820
1500	136	1136	1011	2147	2022	1392	1950
1600	136	1181	1056	2237	2112	1482	2080
1650	136	1218	1093	2311	2186	1482	2145
1800	136	1313	1188	2501	2376	1632	2340
2000	136	1363	1238	2601	2476	1732	2600

1) EN (DIN), AS; For flanges according to AS, only nominal diameters DN 350, 400, 500 and 600 are available.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Design", option A "Insertion length short"



A0017284

DN [mm]	A [mm]	B [mm]	E [mm]	F [mm]
350	136	358	290	550
375	136	384	290	600
400	136	384	290	600
450	136	412	290	600
500	136	437	290	600
600	136	478	290	600
700	136	543	424	700
750	136	579	454	750
800	136	599	500	800
900	136	649	580	900

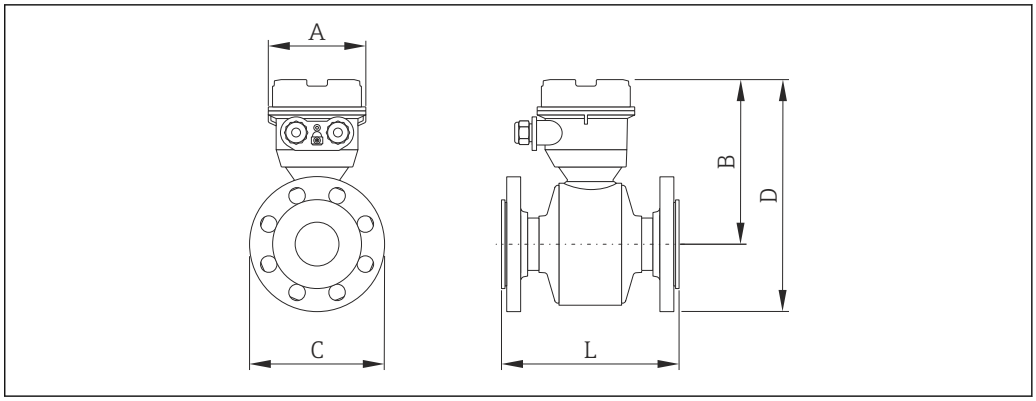
DN [mm]	A [mm]	B [mm]	E [mm]	F [mm]
1000	136	699	660	1000
1050	136	735	755	1050
1200	136	813	828	1200
1350	136	925	1008	1350
1400	136	925	1008	1400
1500	136	1025	1147	1500
1600	136	1025	1147	1600
1650	136	1076	1284	1650
1800	136	1133	1379	1800
2000	136	1244	1569	2000

	Dimension C					Dimension D				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN	PN 6	PN 10	PN 16	AWWA		PN 6	PN 10	PN 16	AWWA	
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
350	603	610	616	625	620	490	505	520	533	525
375	–	–	–	–	659	–	–	–	–	550
400	654	666	672	682	674	540	565	580	597	580
450	709	719	729	729	732	595	615	640	635	640
500	759	772	791	786	789	645	670	715	699	705
600	855	868	903	884	890	755	780	840	813	825
700	973	990	1009	1006	998	860	895	910	927	910
750	–	–	–	1072	1078	–	–	–	984	995
800	1087	1107	1123	1129	1129	975	1015	1025	1060	1060
900	1187	1207	1223	1233	1237	1075	1115	1125	1168	1175
1000	1287	1314	1338	1344	1327	1175	1230	1225	1289	1255
1050	–	–	–	1408	–	–	–	–	1346	–
1200	1516	1541	1567	1569	1558	1405	1455	1255	1511	1490
1350	–	–	–	1767	–	–	–	–	1683	–
1400	1740	1763	1779	–	–	1630	1675	1685	–	–
1500	–	–	–	1952	–	–	–	–	1854	–
1600	1940	1983	2002	–	–	1830	1915	1930	–	–
1650	–	–	–	2092	–	–	–	–	2032	–
1800	2155	2190	2209	2231	–	2045	2115	2130	2197	–
2000	2376	2406	2427	2425	–	2265	2325	2345	2362	–

Order code for "Sensor option", option CA...CE "Corrosion protection"

Option	Description
CA	IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M
CB	IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CC	IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3

Option	Description
CD	Buried IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 Im2/Im3
CE	Buried IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 Im2/Im3



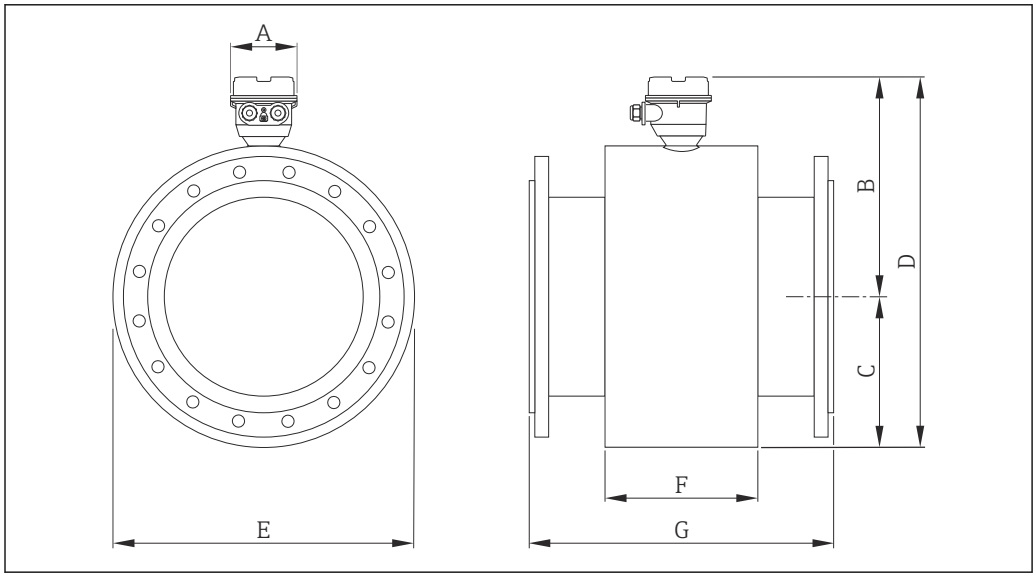
A0020399

DN [mm]	A [mm]	B [mm]	L [mm]
25	112	189	200
32	112	189	200
40	112	189	200
50	112	189	200
65	112	202	200
80	112	207	200
100	112	219	250
125	112	232	250
150	112	254	300
200	112	279	350
250	112	313	450
300	112	338	500

Dimension C										
	EN (DIN)				ASME		AS		JIS	
DN [mm]	PN 10 [mm]	PN 16 [mm]	PN 25 [mm]	PN 40 [mm]	Class 150 [mm]	Class 300 [mm]	Table E [mm]	PN 16 [mm]	10K [mm]	20K [mm]
25	–	–	–	140	110	140	140	–	140	140
32	–	–	–	140	–	–	–	–	140	140
40	–	–	–	150	125	155	–	–	140	140
50	–	–	–	165	150	165	150	150	155	155
65	–	185	–	185	–	–	–	–	175	175
80	–	200	–	200	190	209.6	185	185	185	200
100	–	220	–	325	230	254	215	215	210	225
125	–	250	–	270	–	–	–	–	250	270
150	–	285	–	300	280	317.5	280	280	280	305

Dimension C										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
200	340	340	360	–	345	–	335	335	330	350
250	395	405	425	–	405	–	405	405	400	430
300	445	460	485	–	485	–	455	455	445	480

Dimension D										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	–	–	–	260	260	260	260	–	260	260
32	–	–	–	260	–	–	–	–	260	260
40	–	–	–	264	260	267	–	–	260	260
50	–	–	–	272	265	272	264	264	267	267
65	–	295	–	295	–	–	–	–	290	290
80	–	307	–	307	302	311	300	300	300	307
100	–	330	–	382	333	346	327	327	325	332
125	–	357	–	367	–	–	–	–	357	367
150	–	396	–	404	393	412	395	395	395	406
200	450	450	460	–	450	–	447	447	445	454
250	510	515	525	–	516	–	515	515	513	528
300	560	568	580	–	580	–	565	565	560	578



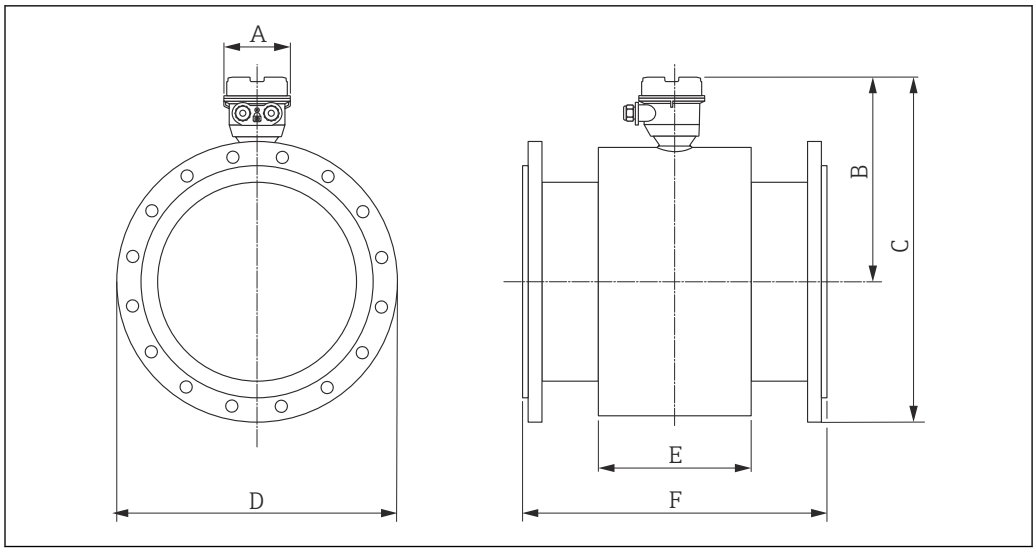
A0020435

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [1] [mm]
350	112	395	282	677	564	276	550
375	112	421	308	729	616	276	600
400	112	421	308	729	616	276	600
450	112	446	333	779	666	292	650
500	112	472	359	830	717	292	650
600	112	524	411	934	821	402	780
700	112	625	512	1137	1024	589	910
750	112	625	512	1137	1024	626	975
800	112	647	534	1180	1067	647	1040
900	112	723	610	1333	1220	785	1170
1000	112	799	686	1485	1372	862	1300
1050	112	825	712	1537	1424	912	1365
1200	112	924	811	1735	1622	992	1560
1350	112	1025	912	1937	1824	1252	1755
1400	112	1100	987	2087	1974	1252	1820
1500	112	1124	1011	2135	2022	1392	1950
1600	112	1169	1056	2225	2112	1482	2080
1650	112	1206	1093	2299	2186	1482	2145
1800	112	1301	1188	2489	2376	1632	2340
2000	112	1351	1238	2589	2476	1732	2600

1) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Design", option A "Insertion length short" and order code for "Sensor option", option CA…CE "Corrosion protection"

Option	Description
CA	IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M
CB	IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CC	IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CD	Buried IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 Im2/Im3
CE	Buried IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 Im2/Im3



A0018158

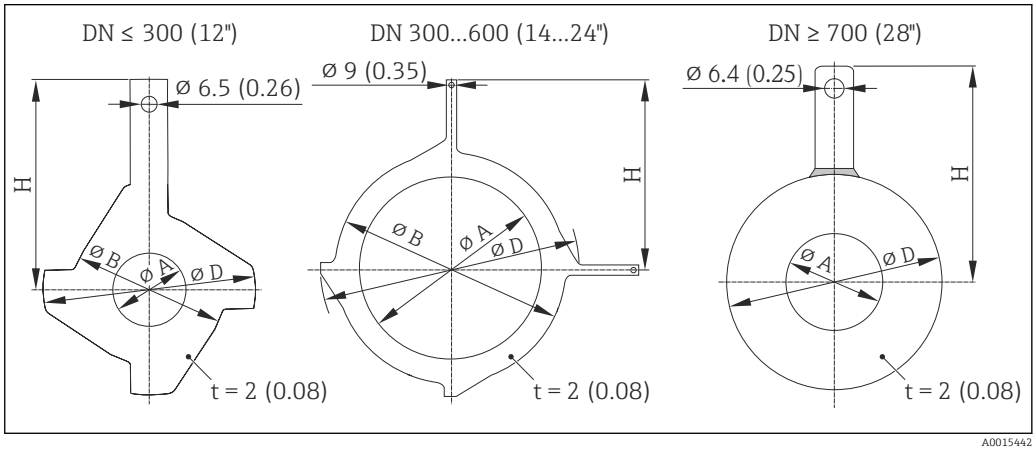
DN [mm]	A [mm]	B [mm]	E [mm]	F [mm]
350	112	350	290	550
375	112	376	290	600
400	112	376	290	600
450	112	403	290	600
500	112	428	290	600
600	112	478	290	600
700	112	549	424	700
750	112	586	454	750
800	112	605	500	800
900	112	655	580	900
1000	112	705	660	1000
1050	112	741	755	1050
1200	112	819	828	1200
1350	112	931	1008	1350
1400	112	931	1008	1400
1500	112	1031	1147	1500
1600	112	1031	1147	1600
1650	112	1082	1284	1650
1800	112	1139	1379	1800
2000	112	1250	1569	2000

	Dimension C					Dimension D				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN [mm]	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]
350	595	603	610	–	613	490	505	520	–	525
375	–	–	–	–	651	–	–	–	–	550

DN [mm]	Dimension C					Dimension D				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]
400	646	659	666	–	666	540	565	580	–	580
450	701	711	723	–	723	595	615	640	–	640
500	751	763	786	–	781	645	670	715	–	705
600	856	868	898	–	891	755	780	840	–	825
700	979	996	1004	1012	1004	860	895	910	927	910
750	–	–	–	1078	1084	–	–	–	984	995
800	1093	1113	1118	1135	1135	975	1015	1025	1060	1060
900	1193	1213	1218	1239	1243	1075	1115	1125	1168	1175
1000	1293	1320	1333	1350	1333	1175	1230	1225	1289	1255
1050	–	–	–	1414	–	–	–	–	1346	–
1200	1522	1547	1562	1575	1564	1405	1455	1255	1511	1490
1350	–	–	–	1773	–	–	–	–	1683	–
1400	1746	1769	1774	–	–	1630	1675	1685	–	–
1500	–	–	–	1958	–	–	–	–	1854	–
1600	1946	1989	1997	–	–	1830	1915	1930	–	–
1650	–	–	–	2098	–	–	–	–	2032	–
1800	2161	2196	2204	2237	–	2045	2115	2130	2197	–
2000	2382	2412	2422	2431	–	2265	2325	2345	2362	–

Accessories

Ground disks for flange connections



32 Engineering unit mm (in)

DN [mm]	Pressure rating	A [mm]	B [mm]	D [mm]	H [mm]
25	1)	26	62	77.5	87.5
32	1)	35	80	87.5	94.5
40	1)	41	82	101	103

DN [mm]	Pressure rating	A [mm]	B [mm]	D [mm]	H [mm]
50	1)	52	101	115.5	108
65	1)	68	121	131.5	118
80	1)	80	131	154.5	135
100	1)	104	156	186.5	153
125	1)	130	187	206.5	160
150	1)	158	217	256	184
200	1)	206	267	288	205
250	1)	260	328	359	240
300	1)	312	375	413	273
350	DIN, PN 6	343	433	479	365
350	DIN, PN 10	343	400	479	365
350	ASME, Class 150	343	400	479	365
400	DIN, PN 6	393	470	542	395
400	DIN, PN 10	393	469	542	395
400	ASME, Class 150	393	469	542	395
450	DIN, PN 6	439	525	583	417
450	DIN, PN 10	439	535	583	417
450	ASME, Class 150	439	535	583	417
500	DIN, PN 6	493	575	650	460
500	DIN, PN 10	493	588	650	460
500	ASME, Class 150	493	588	650	460
600	DIN, PN 6	593	676	766	522
600	DIN, PN 10	593	688	766	522
600	ASME, Class 150	593	688	766	522
700	DIN, PN 6	697	–	786	460
700	DIN, PN 10	693	–	813	480
700	AS, PN 16	687	–	807	490
700	AWWA, Class D	693	–	832	494
750	AWWA, Class D	743	–	833	523
800	DIN, PN 6	799	–	893	520
800	DIN, PN 10	795	–	920	540
800	AS, PN 16	789	–	914	550
800	AWWA, Class D	795	–	940	561
900	DIN, PN 6	897	–	993	570
900	DIN, PN 10	893	–	1020	590
900	AS, PN 16	886	–	1014	595
900	AWWA, Class D	893	–	1048	615
1000	DIN, PN 6	999	–	1093	620
1000	DIN, PN 10	995	–	1127	650

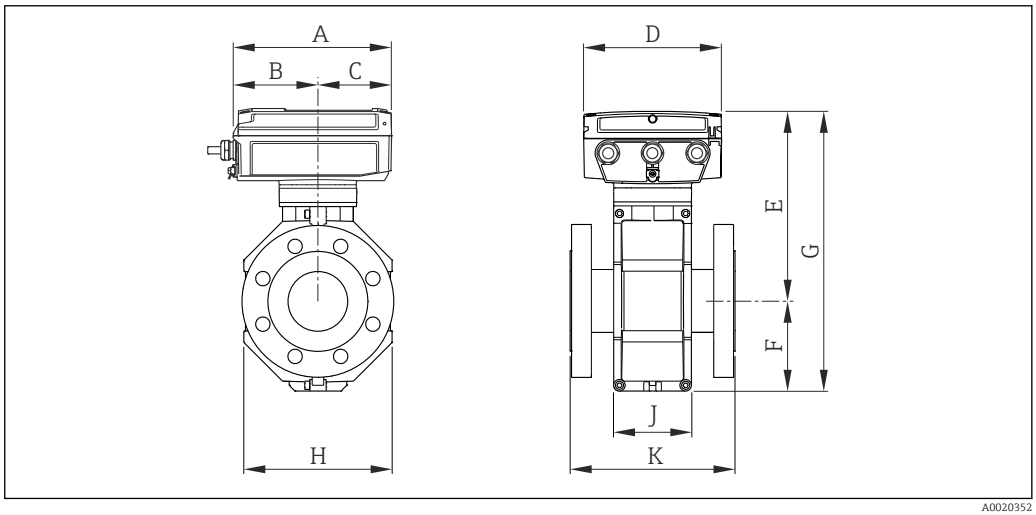
DN [mm]	Pressure rating	A [mm]	B [mm]	D [mm]	H [mm]
1000	AS, PN 16	988	–	1131	660
1000	AWWA, Class D	995	–	1163	675
1050	AWWA, Class D	1044	–	1220	704
1200	DIN, PN 6	1203	–	1310	733

1) Ground disks can be used for all the flange standards/pressure ratings which can be supplied in the standard version.

Dimensions in US units

Compact version

Order code for "Housing", option M "Compact, polycarbonate" or option A "Compact, aluminum, coated"



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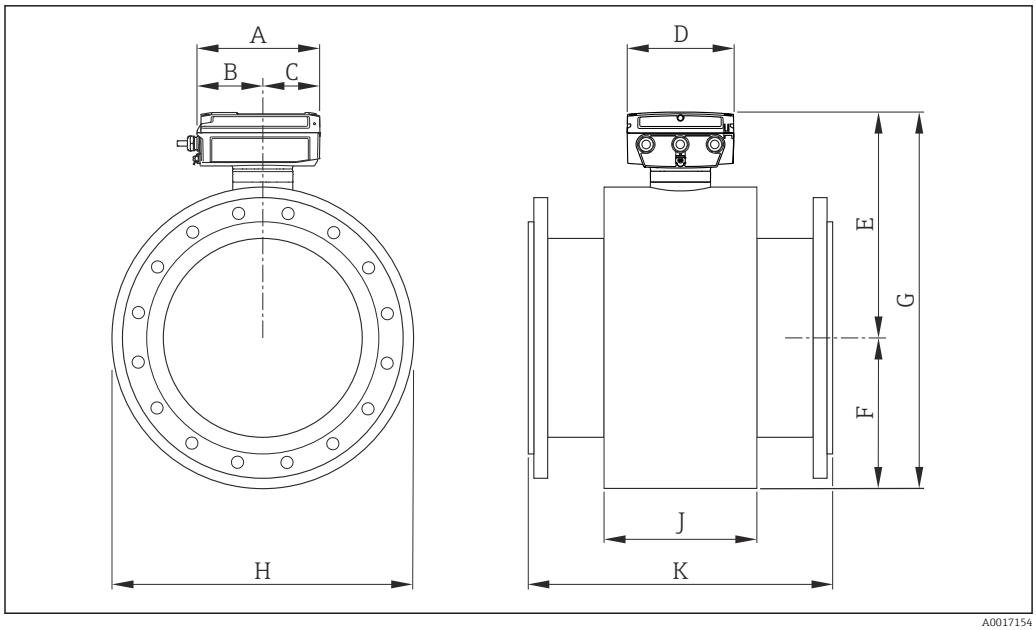
DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	J [in]	K [2] [in]
1	7.60	4.06	3.54	6.57	8.74	3.31	12.1	4.72	3.70	7.87
1 ½	7.60	4.06	3.54	6.57	8.74	3.31	12.1	4.72	3.70	7.87
2	7.60	4.06	3.54	6.57	8.74	3.31	12.1	4.72	3.70	7.87
3	7.60	4.06	3.54	6.57	9.72	4.29	14.0	7.09	3.70	7.87
4	7.60	4.06	3.54	6.57	9.72	4.29	14.0	7.09	3.70	9.84
6	7.60	4.06	3.54	6.57	11.3	5.91	17.2	10.2	5.51	11.8
8	7.60	4.06	3.54	6.57	12.3	7.09	19.4	12.8	6.14	13.8
10	7.60	4.06	3.54	6.57	13.3	8.07	21.4	15.8	6.14	17.7
12	7.60	4.06	3.54	6.57	14.3	9.06	23.4	18.1	6.54	19.7

1) ASME
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

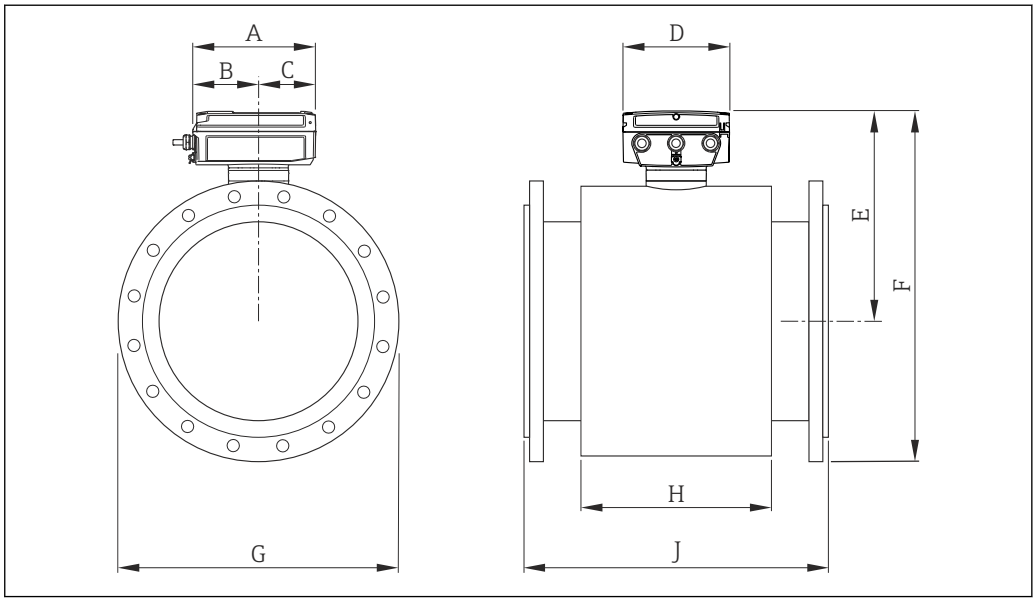


A0017154

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	J [in]	K [2] [in]
14	7.60	4.06	3.54	6.57	17.0	11.1	28.1	22.2	10.9	21.7
15	7.60	4.06	3.54	6.57	18.0	12.1	30.1	24.2	10.9	23.6
16	7.60	4.06	3.54	6.57	18.0	12.1	30.1	24.2	10.9	23.6
18	7.60	4.06	3.54	6.57	19.0	13.1	32.1	26.2	11.5	25.6
20	7.60	4.06	3.54	6.57	20.0	14.1	34.1	28.2	11.5	25.6
24	7.60	4.06	3.54	6.57	22.1	16.2	38.3	32.3	15.8	30.7
28	7.60	4.06	3.54	6.57	26.1	20.1	46.2	40.3	23.2	35.8
30	7.60	4.06	3.54	6.57	26.1	20.1	46.2	40.3	24.6	38.4
32	7.60	4.06	3.54	6.57	26.9	21.0	47.9	42.0	25.5	40.9
36	7.60	4.06	3.54	6.57	29.9	24.0	53.9	48.0	30.9	46.0
40	7.60	4.06	3.54	6.57	32.9	27.0	59.9	54.0	33.9	51.2
42	7.60	4.06	3.54	6.57	33.9	28.0	61.9	56.0	35.9	53.7
48	7.60	4.06	3.54	6.57	37.8	31.9	69.7	63.8	39.0	61.4
54	7.60	4.06	3.54	6.57	41.8	35.9	77.7	71.8	42.3	69.1
60	7.60	4.06	3.54	6.57	45.7	39.8	85.5	79.6	54.8	76.8
66	7.60	4.06	3.54	6.57	48.9	43.0	91.9	86.0	58.4	84.4
72	7.60	4.06	3.54	6.57	52.7	46.8	99.5	93.5	64.2	92.1
78	7.60	4.06	3.54	6.57	54.7	48.7	103.4	97.5	68.2	102.3

1) ASME, AWWA; flanges ≤ 24 in only available according to ASME, flanges ≥ 28 in only available according to AWWA.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Housing", option M "Compact, polycarbonate" or option A "Compact, aluminum, coated"; order code for "Design", option A "Insertion length short"



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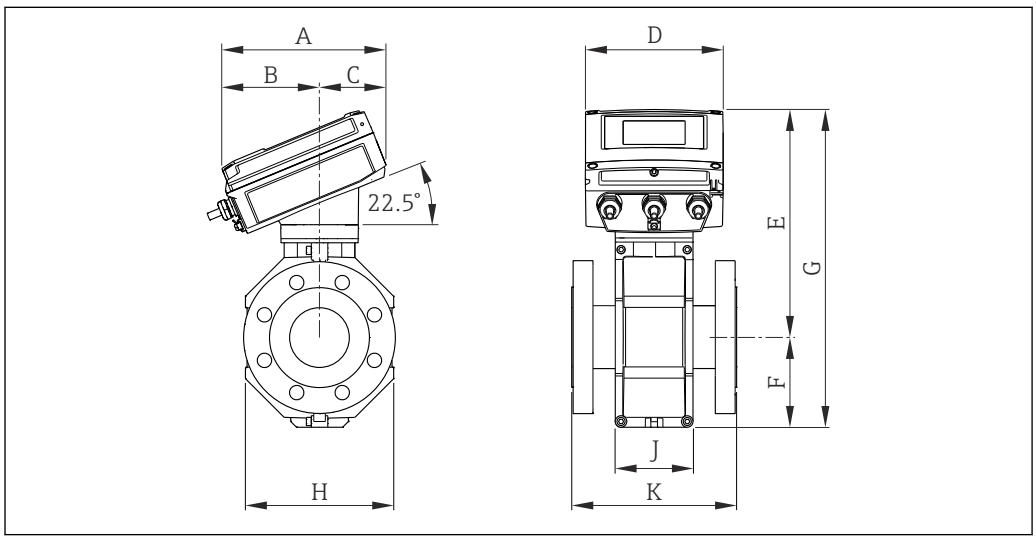
DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	H [in]	J [in]
14	7.60	4.06	3.54	6.57	15.2	11.4	21.6
15	7.60	4.06	3.54	6.57	16.2	11.4	23.6
16	7.60	4.06	3.54	6.57	16.2	11.4	23.6
18	7.60	4.06	3.54	6.57	17.3	11.4	23.6
20	7.60	4.06	3.54	6.57	18.3	11.4	23.6
24	7.60	4.06	3.54	6.57	19.9	11.4	23.6
28	7.60	4.06	3.54	6.57	22.5	16.7	27.6
30	7.60	4.06	3.54	6.57	23.9	17.9	29.5
32	7.60	4.06	3.54	6.57	24.7	19.7	31.5
36	7.60	4.06	3.54	6.57	26.6	22.8	35.4
40	7.60	4.06	3.54	6.57	28.6	26.0	39.4
42	7.60	4.06	3.54	6.57	30.0	29.7	41.3
48	7.60	4.06	3.54	6.57	33.1	32.6	47.2
54	7.60	4.06	3.54	6.57	37.5	39.7	53.1
60	7.60	4.06	3.54	6.57	41.4	45.2	59.0
66	7.60	4.06	3.54	6.57	43.4	50.6	64.9
72	7.60	4.06	3.54	6.57	45.7	54.3	70.8
78	7.60	4.06	3.54	6.57	50.1	61.8	78.7

	Dimension F					Dimension G				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN	PN 6	PN 10	PN 16	AWWA		PN 6	PN 10	PN 16	AWWA	
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
14	24.8	25.1	27.6	25.7	25.5	19.3	19.9	20.5	21.0	20.7
15	–	–	–	–	27	–	–	–	–	21.7
16	26.8	27.3	30.0	27.0	27.6	21.3	22.2	22.8	23.5	22.8
18	29.0	29.4	32.4	29.8	29.9	23.4	24.2	25.2	25.0	25.2
20	31.0	31.5	36.5	32.0	32.1	25.4	26.4	28.1	27.5	27.8
24	34.7	35.3	40.4	35.9	36.1	29.7	30.7	33.1	32.0	32.5
28	39.4	40.1	45.1	40.7	40.4	33.9	35.2	35.8	36.5	35.8
30	–	–	–	43.3	43.5	–	–	–	38.7	39.2
32	43.9	44.7	48.8	45.5	45.5	38.4	40.0	40.4	41.7	41.7
36	47.8	48.6	48.8	49.6	49.8	42.3	43.9	44.3	46.0	46.3
40	51.7	52.8	53.4	54.0	53.3	46.3	48.4	48.2	50.7	49.4
42	–	–	–	56.5	–	–	–	–	53.0	–
48	60.8	61.7	62.4	62.9	62.4	55.3	57.3	49.4	59.5	58.7
54	–	–	–	70.6	–	–	–	–	66.3	–
60	–	–	–	77.9	–	–	–	–	73.0	–
66	–	–	–	83.4	–	–	–	–	80.0	–
72	85.9	87.3	87.6	88.9	–	80.5	83.3	83.9	86.5	–
78	94.6	95.8	96.2	96.6	–	89.2	91.5	92.3	93.0	–

Order code for "Housing", option Q "Compact, polycarbonate, inclined" or option R "Compact, aluminum, coated, inclined"



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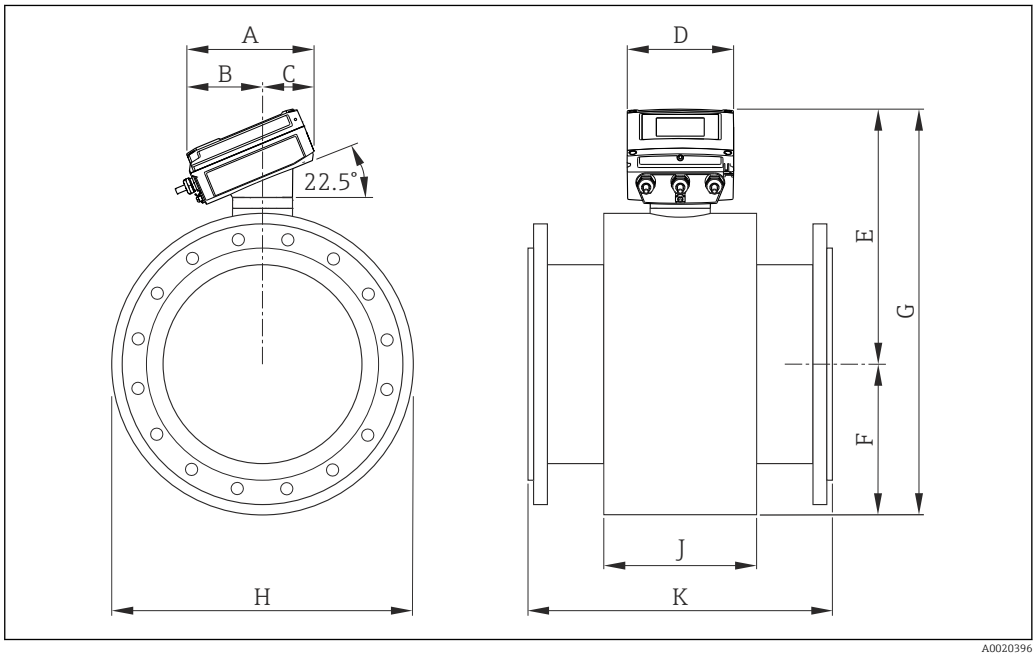
DN [1]	A	B	C	D	E	F	G	H	J	K [2]
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
1	7.83	4.69	3.15	6.57	10.5	3.31	13.8	4.72	3.70	7.87
1 ½	7.83	4.69	3.15	6.57	10.5	3.31	13.8	4.72	3.70	7.87
2	7.83	4.69	3.15	6.57	10.5	3.31	13.8	4.72	3.70	7.87

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	J [in]	K [2] [in]
3	7.83	4.69	3.15	6.57	11.5	4.29	15.8	7.09	3.70	7.87
4	7.83	4.69	3.15	6.57	11.5	4.29	15.8	7.09	3.70	9.84
6	7.83	4.69	3.15	6.57	13.1	5.91	19.0	10.2	5.51	11.8
8	7.83	4.69	3.15	6.57	14.0	7.09	21.1	12.8	6.14	13.8
10	7.83	4.69	3.15	6.57	15.0	8.07	23.1	15.8	6.14	17.7
12	7.83	4.69	3.15	6.57	16.0	9.06	25.1	18.1	6.54	19.7

1) ASME
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.



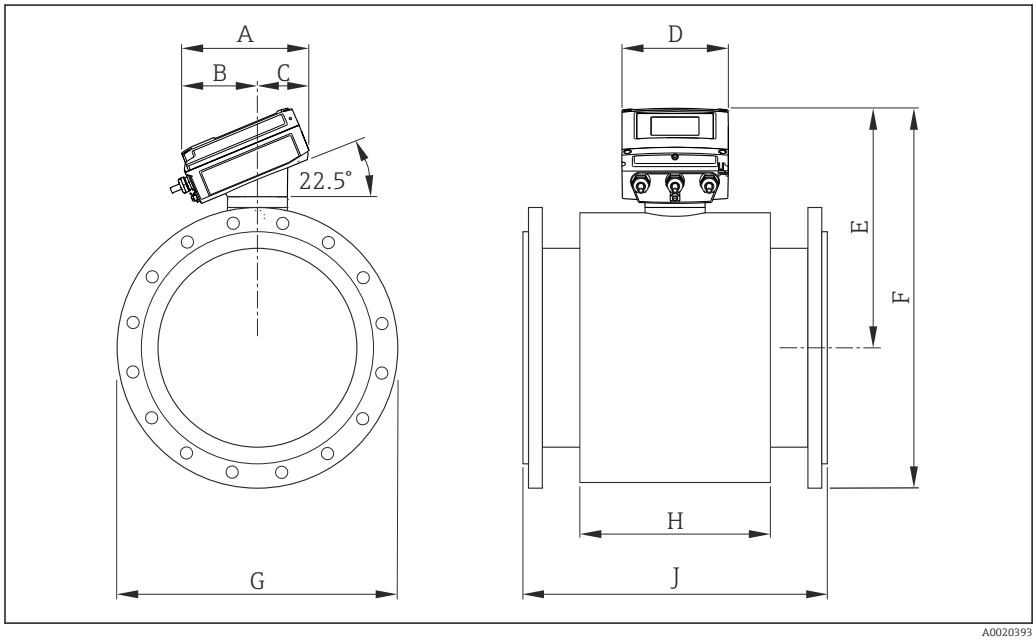
A0020396

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	J [in]	K [2] [in]
14	7.83	4.69	3.15	6.57	18.8	11.1	29.9	22.2	10.9	21.7
15	7.83	4.69	3.15	6.57	19.8	12.1	31.9	24.2	10.9	23.6
16	7.83	4.69	3.15	6.57	19.8	12.1	31.9	24.2	10.9	23.6
18	7.83	4.69	3.15	6.57	20.8	13.1	33.9	26.2	11.5	25.6
20	7.83	4.69	3.15	6.57	21.8	14.1	35.9	28.2	11.5	25.6
24	7.83	4.69	3.15	6.57	23.8	16.2	40.0	32.3	15.8	30.7
28	7.83	4.69	3.15	6.57	27.8	20.2	48.0	40.3	23.2	35.8
30	7.83	4.69	3.15	6.57	27.8	20.2	48.0	40.3	24.6	38.4
32	7.83	4.69	3.15	6.57	28.7	21.0	49.7	42.0	25.5	40.9
36	7.83	4.69	3.15	6.57	32.7	24.0	55.7	48.0	30.9	46.0
40	7.83	4.69	3.15	6.57	34.7	27.0	61.7	54.0	33.9	51.2
42	7.83	4.69	3.15	6.57	35.7	28.0	63.7	56.0	35.9	53.7
48	7.83	4.69	3.15	6.57	39.6	31.9	71.5	63.8	39.0	61.4
54	7.83	4.69	3.15	6.57	43.6	35.9	79.5	71.8	42.3	69.1

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	J [in]	K [2] [in]
60	7.83	4.69	3.15	6.57	47.5	39.8	87.3	79.6	54.8	76.8
66	7.83	4.69	3.15	6.57	50.7	43.0	93.7	86.0	58.4	84.4
72	7.83	4.69	3.15	6.57	54.4	46.8	101.2	93.5	64.2	92.1
78	7.83	4.69	3.15	6.57	56.4	48.8	105.2	97.5	68.2	102.3

1) ASME, AWWA; flanges ≤ 24 in only available according to ASME, flanges ≥ 28 in only available according to AWWA.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Housing", option Q "Compact, polycarbonate, inclined" or option R "Compact, aluminum, coated, inclined"; order code for "Design", option A "Insertion length short"



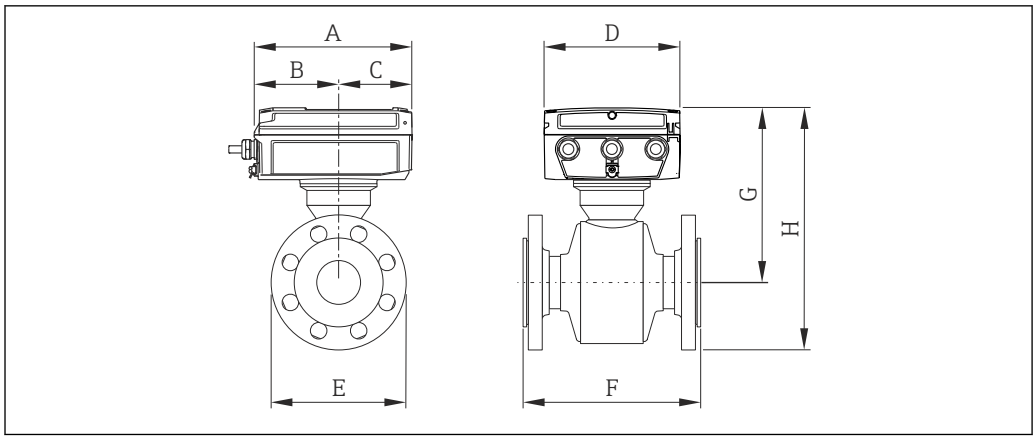
DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	H [in]	J [in]
14	7.83	4.69	3.15	6.57	17.0	11.4	21.6
15	7.83	4.69	3.15	6.57	18.0	11.4	23.6
16	7.83	4.69	3.15	6.57	18.0	11.4	23.6
18	7.83	4.69	3.15	6.57	19.1	11.4	23.6
20	7.83	4.69	3.15	6.57	20.1	11.4	23.6
24	7.83	4.69	3.15	6.57	21.7	11.4	23.6
28	7.83	4.69	3.15	6.57	24.3	16.7	27.6
30	7.83	4.69	3.15	6.57	25.7	17.9	29.5
32	7.83	4.69	3.15	6.57	26.5	19.7	31.5
36	7.83	4.69	3.15	6.57	28.4	22.8	35.4
40	7.83	4.69	3.15	6.57	30.4	26.0	39.4
42	7.83	4.69	3.15	6.57	31.8	29.7	41.3
48	7.83	4.69	3.15	6.57	34.9	32.6	47.2
54	7.83	4.69	3.15	6.57	39.3	39.7	53.1

DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	H [in]	J [in]
60	7.83	4.69	3.15	6.57	43.2	45.2	59.0
66	7.83	4.69	3.15	6.57	45.2	50.6	64.9
72	7.83	4.69	3.15	6.57	47.5	54.3	70.8
78	7.83	4.69	3.15	6.57	51.9	61.8	78.7

	Dimension F					Dimension G				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN [in]	PN 6 [in]	PN 10 [in]	PN 16 [in]	AWWA [in]	[in]	PN 6 [in]	PN 10 [in]	PN 16 [in]	AWWA [in]	[in]
14	26.6	26.9	24.3	27.5	27.3	19.3	19.9	20.5	21.0	20.7
15	–	–	–	–	28.8	–	–	–	–	21.7
16	28.6	29.1	26.5	28.8	29.4	21.3	22.2	22.8	23.5	22.8
18	30.8	31.2	28.8	31.6	31.7	23.4	24.2	25.2	25.0	25.2
20	32.8	33.3	31.3	33.8	33.9	25.4	26.4	28.1	27.5	27.8
24	36.5	37.1	35.4	37.7	37.9	29.7	30.7	33.1	32.0	32.5
28	41.2	41.9	39.7	42.5	42.2	33.9	35.2	35.8	36.5	35.8
30	–	–	–	45.1	45.3	–	–	–	38.7	39.2
32	45.7	46.5	43.8	47.3	47.3	38.4	40.0	40.4	41.7	41.7
36	49.6	50.4	47.7	51.4	49.8	42.3	43.9	44.3	46.0	46.3
40	53.5	54.6	52.2	55.8	55.1	46.3	48.4	48.2	50.7	49.4
42	–	–	–	58.3	–	–	–	–	53.0	–
48	62.6	63.5	61.3	64.7	64.2	55.3	57.3	49.4	59.5	58.7
54	–	–	–	72.4	–	–	–	–	66.3	–
60	–	–	–	79.7	–	–	–	–	73.0	–
66	–	–	–	85.2	–	–	–	–	80.0	–
72	87.7	89.1	86.5	90.7	–	80.5	83.3	83.9	86.5	–
78	96.4	97.6	95.1	98.4	–	89.2	91.5	92.3	93.0	–

Order code for "Sensor option", option CA in combination with order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N

- Order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N available for order in conjunction with order code for "Housing", option M "Compact, polycarbonate"
- Order code for "Calibration flow", options H/K also available for order in conjunction with order code for "Housing", option A "Compact, aluminum, coated"



A0021328

DN [in]	A [in]	B [in]	C [in]	D [in]	F [in]	G [in]
1	7.60	4.06	3.54	6.57	7.87	7.40
2	7.60	4.06	3.54	6.57	7.87	7.40
3	7.60	4.06	3.54	6.57	7.87	8.07
4	7.60	4.06	3.54	6.57	9.84	8.58
6	7.60	4.06	3.54	6.57	11.8	9.92
8	7.60	4.06	3.54	6.57	13.8	10.9
10	7.60	4.06	3.54	6.57	17.7	12.2
12	7.60	4.06	3.54	6.57	19.7	13.2

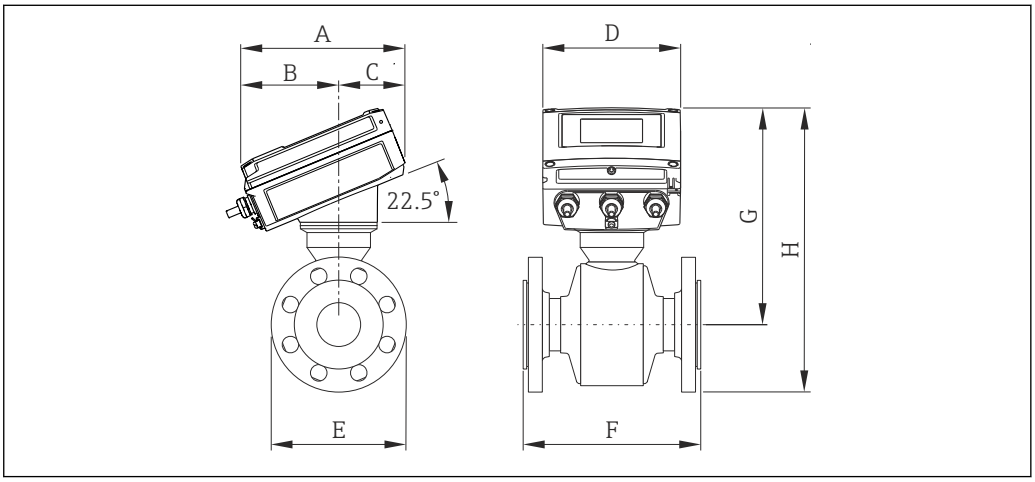
Dimension E										
	EN (DIN)				ASME		AS		JIS	
DN [in]	PN 10 [in]	PN 16 [in]	PN 25 [in]	PN 40 [in]	Class 150 [in]	Class 300 [in]	Table E [in]	PN 16 [in]	10K [in]	20K [in]
1	–	–	–	5.51	5.51	5.51	5.51	–	5.51	5.51
2	–	–	–	6.50	6.02	6.50	5.91	5.91	6.10	6.10
3	–	7.87	–	7.87	7.52	8.27	7.28	7.28	7.28	7.87
4	–	8.66	–	12.8	9.02	10.0	8.46	8.46	8.27	8.86
6	–	11.2	–	11.8	11.0	12.5	11.0	11.0	11.0	12.0
8	13.4	13.4	14.2	–	13.5	–	13.2	13.2	13.0	13.8
10	15.6	15.9	16.7	–	16.0	–	15.9	15.9	15.8	16.9
12	17.5	18.1	19.1	–	19.0	–	17.9	17.9	17.5	18.9

Dimension H										
	EN (DIN)				ASME		AS		JIS	
DN [in]	PN 10 [in]	PN 16 [in]	PN 25 [in]	PN 40 [in]	Class 150 [in]	Class 300 [in]	Table E [in]	PN 16 [in]	10K [in]	20K [in]
1	–	–	–	10.2	10.2	10.2	10.2	–	10.2	10.2
2	–	–	–	10.6	10.4	10.6	10.3	10.3	10.4	10.4

Dimension H										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
3	–	12	–	12	11.8	12.2	11.7	11.7	11.7	12
4	–	12.9	–	15	13	13.5	12.8	12.8	12.7	13
6	–	15.5	–	15.8	15.4	16.1	15.5	15.5	15.5	15.9
8	17.6	17.6	18	–	17.6	–	17.5	17.5	17.4	17.8
10	20	20.2	20.6	–	20.2	–	20.2	20.2	20.1	20.7
12	22	22.3	22.8	–	22.8	–	22.2	22.2	22	22.7

Order code for "Sensor option", option CA in combination with order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N

- Order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N available for order in conjunction with order code for "Housing", option Q "Compact, polycarbonate, inclined"
- Order code for "Calibration flow", options H/K also available for order in conjunction with order code for "Housing", option R "Compact, aluminum, coated, inclined"



A0021329

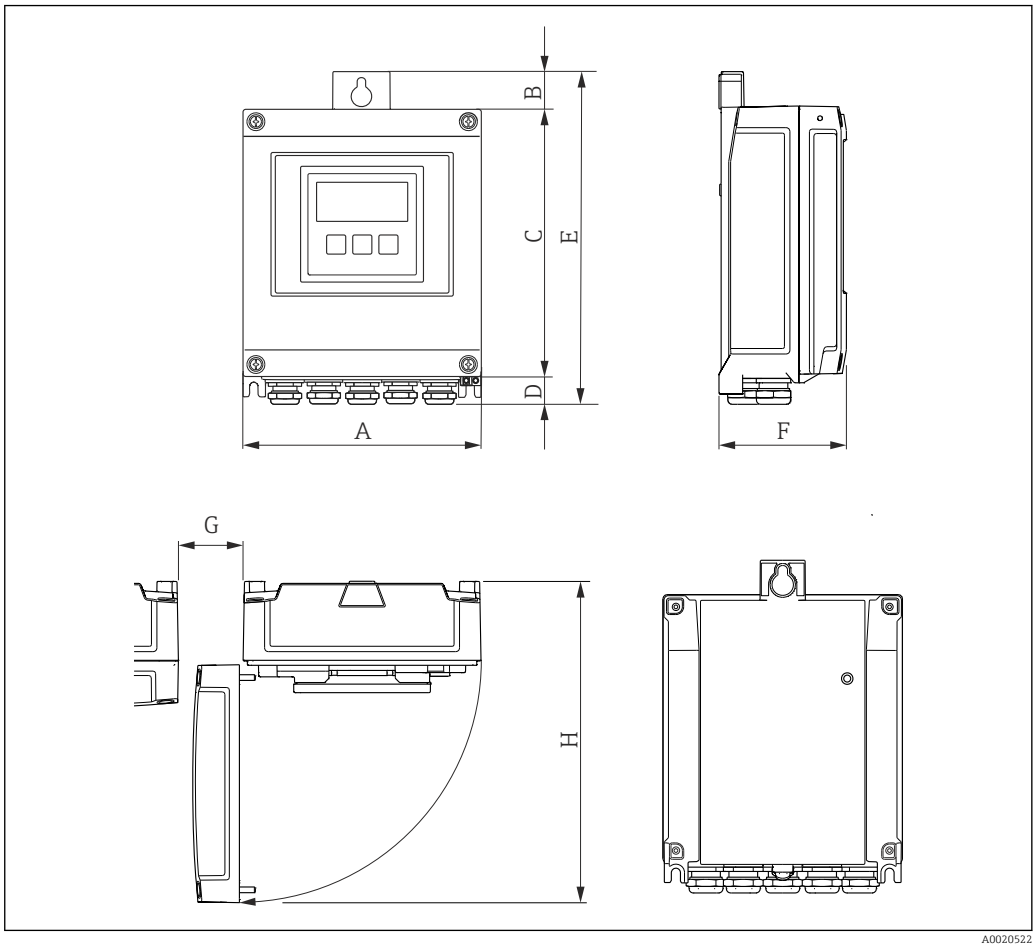
DN	A	B	C	D	F	G
[in]	[in]	[in]	[in]	[in]	[in]	[in]
1	7.83	4.69	3.15	6.57	7.87	9.13
2	7.83	4.69	3.15	6.57	7.87	9.13
3	7.83	4.69	3.15	6.57	7.87	9.80
4	7.83	4.69	3.15	6.57	9.84	10.3
6	7.83	4.69	3.15	6.57	11.8	11.7
8	7.83	4.69	3.15	6.57	13.8	12.7
10	7.83	4.69	3.15	6.57	17.7	14.0
12	7.83	4.69	3.15	6.57	19.7	15.0

Dimension E										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
1	–	–	–	5.51	5.51	5.51	5.51	–	5.51	5.51
2	–	–	–	6.50	6.02	6.50	5.91	5.91	6.10	6.10
3	–	7.87	–	7.87	7.52	8.27	7.28	7.28	7.28	7.87
4	–	8.66	–	12.8	9.02	10.0	8.46	8.46	8.27	8.86
6	–	11.2	–	11.8	11.0	12.5	11.0	11.0	11.0	12.0
8	13.4	13.4	14.2	–	13.5	–	13.2	13.2	13.0	13.8
10	15.6	15.9	16.7	–	16.0	–	15.9	15.9	15.7	16.9
12	17.5	18.1	19.1	–	19.0	–	17.9	17.9	17.5	18.9

Dimension H										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
1	–	–	–	11.9	11.9	11.9	11.9	–	11.9	11.9
2	–	–	–	12.4	12.2	12.4	12.1	12.1	12.2	12.2
3	–	13.7	–	13.7	13.6	13.9	13.5	13.5	13.5	13.7
4	–	14.6	–	16.7	14.8	15.3	14.6	14.6	14.4	14.8
6	–	17.3	–	17.6	17.2	17.9	17.2	17.2	17.2	17.7
8	19.4	19.4	19.8	–	19.4	–	19.3	19.3	19.2	19.6
10	21.8	22.0	22.4	–	22.0	–	22.0	22.0	21.9	22.4
12	23.7	24.0	24.5	–	24.5	–	23.9	23.9	23.7	24.4

Transmitter remote version

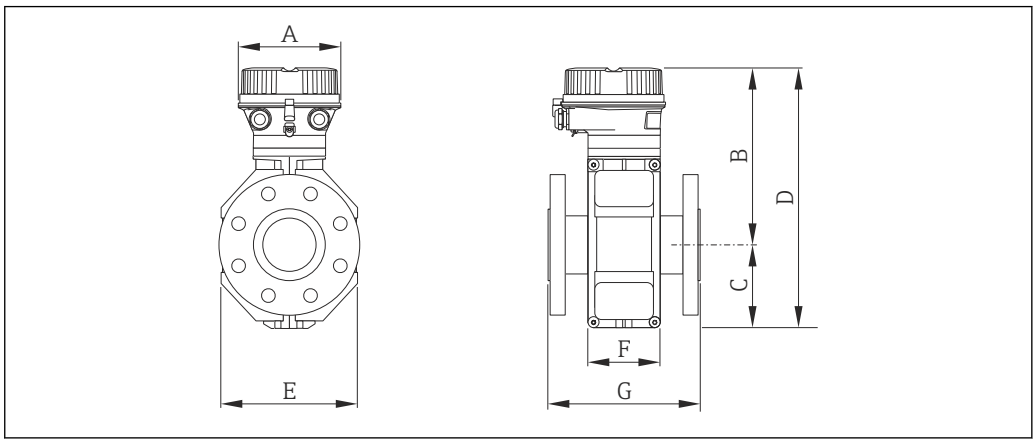
Order code for "Housing", option N "Remote, polycarbonate" or option P "Remote, aluminum coated"



A0020522

A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]
6.57	0.94	7.36	0.83	9.13	3.15	1.97	9.5

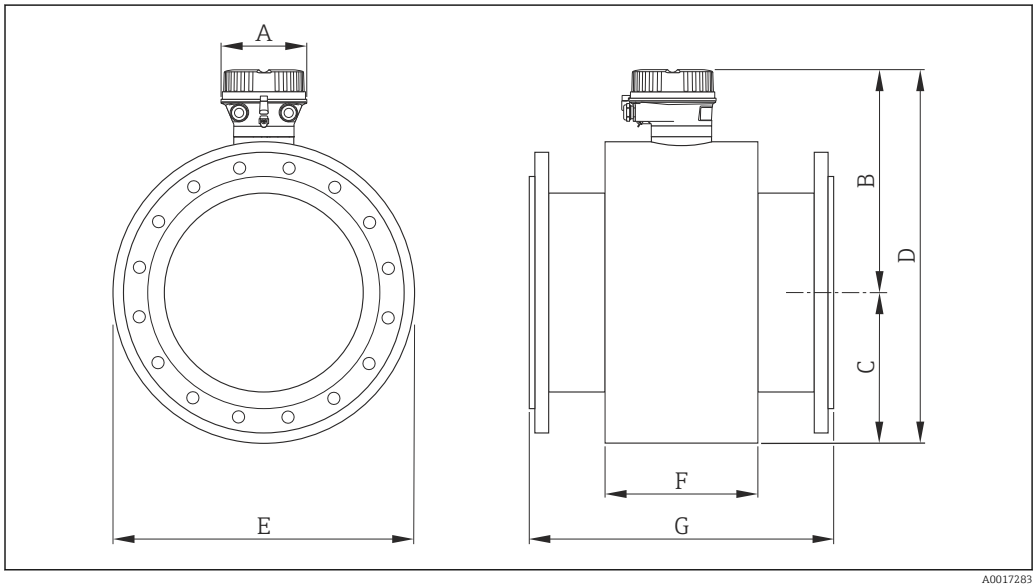
Sensor remote version



A0017282

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [2] [in]
1	5.35	8.15	3.31	11.5	4.72	3.70	7.87
1 ½	5.35	8.15	3.31	11.5	4.72	3.70	7.87
2	5.35	8.15	3.31	11.5	4.72	3.70	7.87
3	5.35	9.13	4.29	13.4	7.09	3.70	7.87
4	5.35	9.13	4.29	13.4	7.09	3.70	9.84
6	5.35	10.7	5.91	16.6	10.2	5.51	11.8
8	5.35	11.7	7.09	18.8	12.8	6.14	13.8
10	5.35	12.7	8.07	20.8	15.8	6.14	17.7
12	5.35	13.7	9.06	22.8	18.1	6.54	19.7

1) ASME
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.



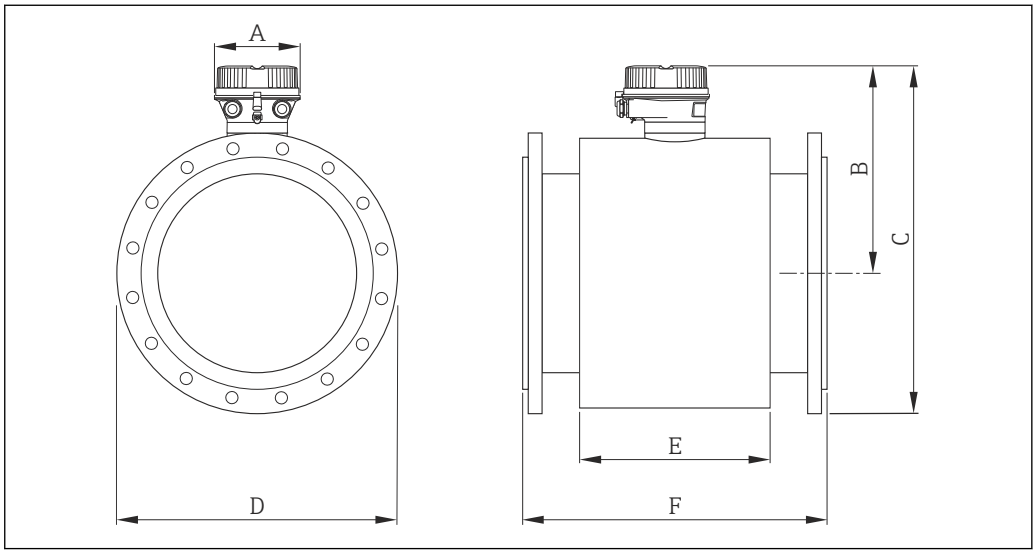
A0017283

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [2] [in]
14	5.35	16.0	11.1	29.3	22.2	10.9	21.7
15	5.35	17.0	12.1	31.3	24.2	10.9	23.6
16	5.35	17.0	12.1	31.3	24.2	10.9	23.6
18	5.35	18.0	13.1	33.3	26.2	11.5	25.6
20	5.35	19.0	14.1	35.3	28.2	11.5	25.6
24	5.35	21.1	16.2	39.4	32.3	15.8	30.7
28	5.35	25.1	20.1	45.2	40.3	23.2	35.8
30	5.35	25.1	20.1	45.2	40.3	24.6	38.4
32	5.35	25.9	21.0	46.9	42.0	25.5	40.9
36	5.35	28.9	24.0	52.9	48.0	30.9	46.0
40	5.35	31.9	27.0	58.9	54.0	33.9	51.2
42	5.35	32.9	28.0	60.9	56.0	35.9	53.7
48	5.35	36.8	31.9	68.7	63.8	39.0	61.4

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [2] [in]
54	5.35	40.8	35.9	76.7	71.8	42.3	69.1
60	5.35	44.7	39.8	84.5	79.6	54.8	76.8
66	5.35	47.9	43.0	91.0	86.0	58.4	84.4
72	5.35	51.7	46.8	98.4	93.5	64.2	92.1
78	5.35	53.6	48.7	102.4	97.5	68.2	102.3

1) ASME, AWWA; flanges ≤ 24 in only available according to ASME, flanges ≥ 28 in only available according to AWWA.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Design", option A "Insertion length short"



A0017284

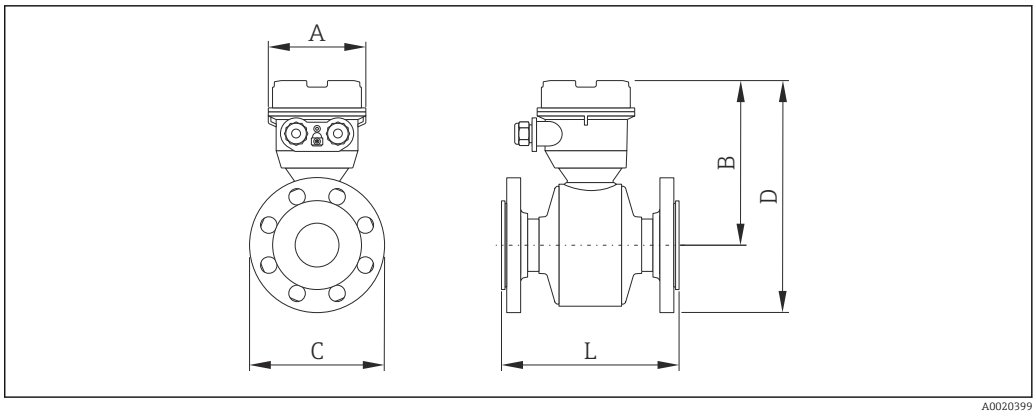
DN [in]	A [in]	B [in]	E [in]	F [in]
14	5.35	14.1	11.4	21.6
15	5.35	15.1	11.4	23.6
16	5.35	15.1	11.4	23.6
18	5.35	16.2	11.4	23.6
20	5.35	17.2	11.4	23.6
24	5.35	18.8	11.4	23.6
28	5.35	21.6	16.7	27.6
30	5.35	23.0	17.9	29.5
32	5.35	23.6	19.7	31.5
36	5.35	25.6	22.8	35.4
40	5.35	27.5	26.0	39.4
42	5.35	28.9	29.7	41.3
48	5.35	32.0	32.6	47.2
54	5.35	36.4	39.6	53.1
60	5.35	40.4	45.2	59.0
66	5.35	42.4	50.6	64.9

DN [in]	A [in]	B [in]	E [in]	F [in]
72	5.35	44.6	54.2	70.8
78	5.35	49.0	61.8	78.7

	Dimension C					Dimension D				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN	PN 6	PN 10	PN 16	AWWA		PN 6	PN 10	PN 16	AWWA	
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
14	23.7	24.0	24.3	24.6	24.4	19.3	19.9	20.5	21.0	20.7
15	–	–	–	–	25.9	–	–	–	–	21.7
16	25.8	26.2	26.5	26.9	26.5	21.3	22.2	22.8	23.5	22.8
18	27.9	28.3	28.7	28.7	28.8	23.4	24.2	25.2	25.0	25.2
20	29.9	30.4	31.1	30.9	31.1	25.4	26.4	28.1	27.5	27.8
24	33.7	34.2	35.6	34.8	35.0	29.7	30.7	33.1	32.0	32.5
28	38.5	39.2	39.7	39.8	39.5	33.9	35.2	35.8	36.5	35.8
30	–	–	–	42.4	42.4	–	–	–	38.7	39.2
32	43.0	43.8	44.2	44.6	44.6	38.4	40.0	40.4	41.7	41.7
36	46.9	47.7	48.2	48.7	48.9	42.3	43.9	44.3	46.0	46.3
40	50.8	51.9	52.7	53.1	52.4	46.3	48.4	48.2	50.7	49.4
42	–	–	–	55.6	–	–	–	–	53.0	–
48	59.9	60.8	61.7	62.0	61.5	55.3	57.3	49.4	59.5	58.7
54	–	–	–	69.6	–	–	–	–	66.3	–
60	–	–	–	76.9	–	–	–	–	73.0	–
66	–	–	–	82.4	–	–	–	–	80.0	–
72	84.9	86.3	87.0	87.9	–	80.5	83.3	83.9	86.5	–
78	93.6	94.7	95.6	95.5	–	89.2	91.5	92.3	93.0	–

Order code for "Sensor option", option CA...CE "Corrosion protection"

Option	Description
CA	IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M
CB	IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CC	IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CD	Buried IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 Im2/Im3
CE	Buried IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 Im2/Im3



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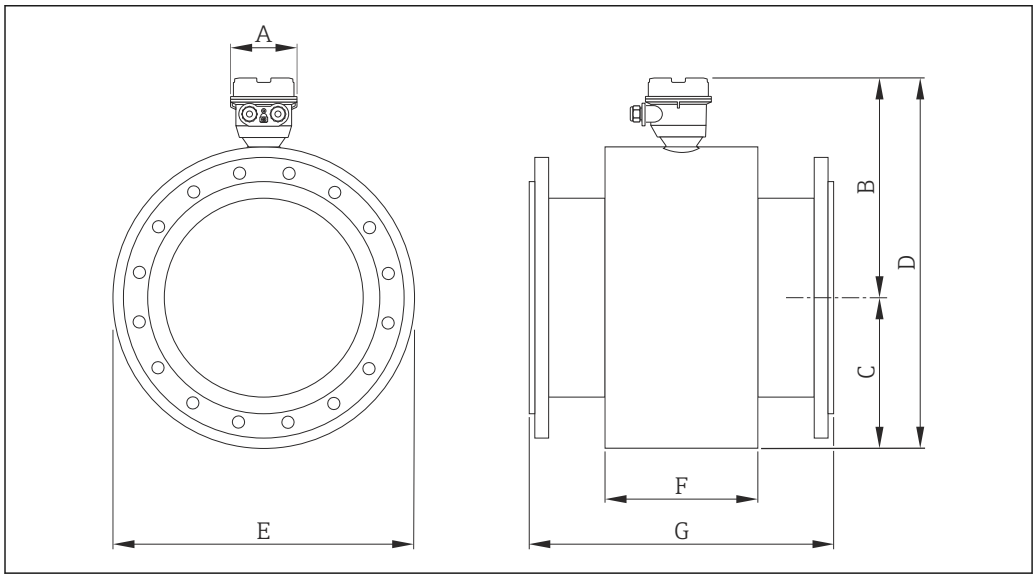
DN [in]	A [in]	B [in]	E [in]
1	4.41	7.44	7.87
2	4.41	7.44	7.87
3	4.41	8.15	7.87
4	4.41	8.62	9.84
6	4.41	10.0	11.8
8	4.41	11.0	13.8
10	4.41	12.3	17.7
12	4.41	13.3	19.7

Dimension C										
	EN (DIN)				ASME		AS		JIS	
DN [in]	PN 10 [in]	PN 16 [in]	PN 25 [in]	PN 40 [in]	Class 150 [in]	Class 300 [in]	Table E [in]	PN 16 [in]	10K [in]	20K [in]
1	–	–	–	5.51	4.33	5.51	5.51	–	5.51	5.51
2	–	–	–	6.50	5.91	6.50	5.91	5.91	6.10	6.10
3	–	7.87	–	7.87	7.48	8.25	7.28	7.28	7.28	7.87
4	–	8.66	–	12.8	9.06	10.0	8.46	8.46	8.27	8.86
6	–	11.2	–	11.8	11.0	12.5	11.0	11.0	11.0	12.0
8	13.4	13.4	14.2	–	13.6	–	13.2	13.2	13.0	13.8
10	15.6	15.9	16.7	–	16.0	–	15.9	15.9	15.8	16.9
12	17.5	18.1	19.1	–	19.1	–	17.9	17.9	17.5	18.9

Dimension D										
	EN (DIN)				ASME		AS		JIS	
DN [in]	PN 10 [in]	PN 16 [in]	PN 25 [in]	PN 40 [in]	Class 150 [in]	Class 300 [in]	Table E [in]	PN 16 [in]	10K [in]	20K [in]
1	–	–	–	10.2	10.2	10.2	10.2	–	10.2	10.2
2	–	–	–	10.7	10.4	10.7	10.4	10.4	10.5	10.5
3	–	12.1	–	12.1	11.9	12.2	11.8	11.8	11.8	12.1

Dimension D										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
4	–	13.0	–	15.0	13.1	13.6	12.9	12.9	12.8	13.1
6	–	15.6	–	15.9	15.5	16.2	15.6	15.6	15.6	16.0
8	17.7	17.7	18.1	–	17.7	–	17.6	17.6	17.5	17.9
10	20.1	20.3	20.7	–	20.3	–	20.3	20.3	20.2	20.8
12	22.0	22.4	22.8	–	22.8	–	22.2	22.2	22.0	22.8



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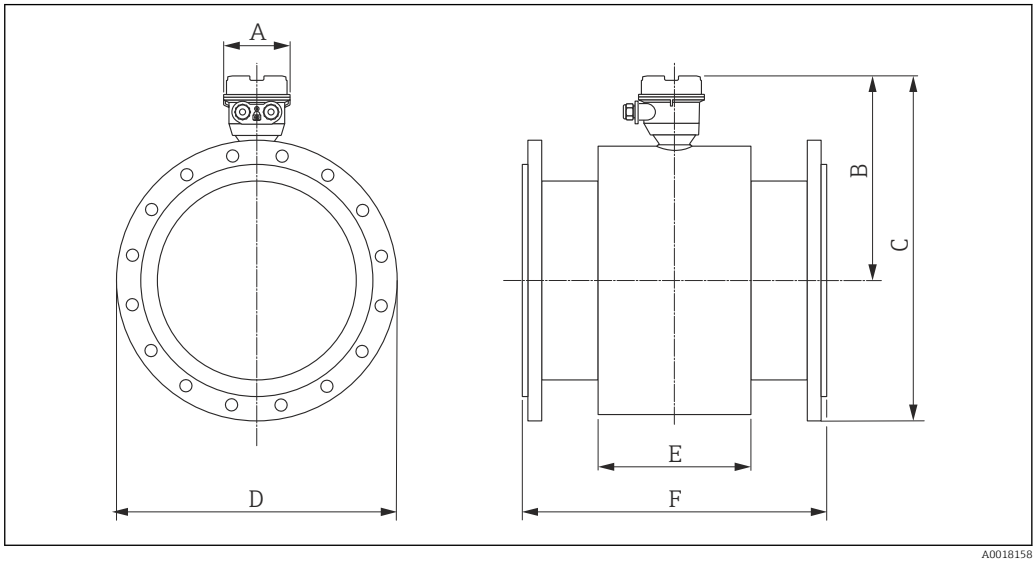
DN	A	B	C	D	E	F	G [1)]
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
14	4.41	15.6	11.1	26.7	22.2	10.9	21.7
15	4.41	16.6	12.1	28.7	24.2	10.9	23.6
16	4.41	16.6	12.1	28.7	24.2	10.9	23.6
18	4.41	17.6	13.1	30.7	26.2	11.5	25.6
20	4.41	18.6	14.1	32.7	28.2	11.5	25.6
24	4.41	20.6	16.2	36.8	32.3	15.8	30.7
28	4.41	24.6	20.2	44.8	40.3	23.2	35.8
30	4.41	24.6	20.2	44.8	40.3	24.6	38.4
32	4.41	25.5	21.0	46.5	42.0	25.5	40.9
36	4.41	28.5	24.0	52.5	48.0	30.9	46.0
40	4.41	31.5	27.0	58.5	54.0	33.9	51.2
42	4.41	32.5	28.0	60.5	56.0	35.9	53.7
48	4.41	36.4	31.9	68.3	63.8	39.0	61.4
54	4.41	40.4	35.9	76.3	71.8	42.3	69.1
60	4.41	44.3	39.8	84.1	79.6	54.8	76.8
66	4.41	47.5	43.0	90.5	86.0	58.4	84.4

DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [1] [in]
72	4.41	51.2	46.8	98.0	93.5	64.2	92.1
78	4.41	53.2	48.7	101.9	97.5	68.2	102.3

1) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Design", option A "Insertion length short" and order code for "Sensor option", option CA...CE "Corrosion protection"

Option	Description
CA	IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M
CB	IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CC	IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CD	Buried IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 Im2/Im3
CE	Buried IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 Im2/Im3



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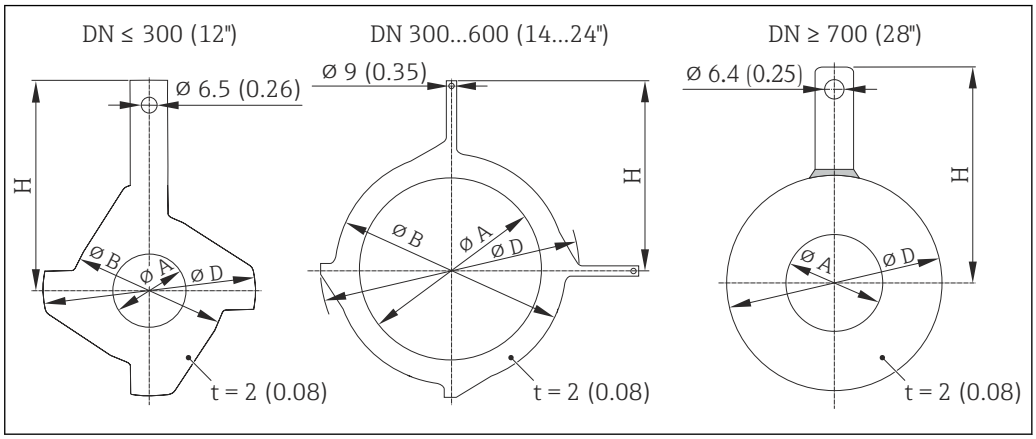
DN [in]	A [in]	B [in]	E [in]	F [in]
14	4.41	13.8	11.4	21.7
15	4.41	14.8	11.4	23.6
16	4.41	14.8	11.4	23.6
18	4.41	15.9	11.4	23.6
20	4.41	16.9	11.4	23.6
24	4.41	18.8	11.4	23.6
28	4.41	21.6	16.7	27.6
30	4.41	23.1	17.9	29.5
32	4.41	23.8	19.7	31.5
36	4.41	25.8	22.8	35.4
40	4.41	27.8	26.0	39.4
42	4.41	29.2	29.7	41.3

DN [in]	A [in]	B [in]	E [in]	F [in]
48	4.41	32.2	32.6	47.2
54	4.41	36.7	39.7	53.2
60	4.41	40.6	45.2	59.1
66	4.41	42.6	50.6	65.0
72	4.41	44.8	54.3	70.9
78	4.41	49.2	61.8	78.7

	Dimension C					Dimension D				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN [in]	PN 6 [in]	PN 10 [in]	PN 16 [in]	AWWA [in]	[in]	PN 6 [in]	PN 10 [in]	PN 16 [in]	AWWA [in]	[in]
14	23.4	23.7	24.0	–	24.1	19.3	19.9	20.5	–	20.7
15	–	–	–	–	25.6	–	–	–	–	21.7
16	25.4	25.9	26.2	–	26.2	21.3	22.2	22.8	–	22.8
18	27.6	28.0	28.5	–	28.5	23.4	24.2	25.2	–	25.2
20	29.6	30.0	30.9	–	30.7	25.4	26.4	28.1	–	27.8
24	33.7	34.2	35.4	–	35.1	29.7	30.7	33.1	–	32.5
28	38.5	39.2	39.5	39.8	39.5	33.9	35.2	35.8	36.5	35.8
30	–	–	–	42.4	42.7	–	–	–	38.7	39.2
32	43.0	43.8	44.0	44.7	44.7	38.4	40.0	40.4	41.7	41.7
36	47.0	47.8	48.0	48.8	48.9	42.3	43.9	44.3	46.0	46.3
40	50.9	52.0	52.5	53.1	52.5	46.3	48.4	48.2	50.7	49.4
42	–	–	–	55.7	–	–	–	–	53.0	–
48	59.9	60.9	61.5	62.0	61.6	55.3	57.3	49.4	59.5	58.7
54	–	–	–	69.8	–	–	–	–	66.3	–
60	–	–	–	77.1	–	–	–	–	73.0	–
66	–	–	–	82.6	–	–	–	–	80.0	–
72	85.1	86.5	86.8	88.1	–	80.5	83.3	83.9	86.5	–
78	93.8	95.0	95.4	95.7	–	89.2	91.5	92.3	93.0	–

Accessories

Ground disks for flange connections



33 *Engineering unit mm (in)*

DN [in]	Pressure rating	A [in]	B [in]	D [in]	H [in]
1	1)	1.02	2.44	3.05	3.44
1 ¼	1)	1.38	3.15	3.44	3.72
1 ½	1)	1.61	3.23	3.98	4.06
2	1)	2.05	3.98	4.55	4.25
2 ½	1)	2.68	4.76	5.18	4.65
3	1)	3.15	5.16	6.08	5.31
4	1)	4.09	6.14	7.34	6.02
5	1)	5.12	7.36	8.13	6.30
6	1)	6.22	8.54	10.1	7.24
8	1)	8.11	10.5	11.3	8.07
10	1)	10.2	12.9	14.1	9.45
12	1)	12.3	14.8	16.3	10.8
14	DIN, PN 6	13.5	16.5	18.9	14.4
14	DIN, PN 10	13.5	15.8	18.9	14.4
14	ASME, Class 150	13.5	15.8	18.9	14.4
16	DIN, PN 6	15.5	18.5	21.3	15.6
16	DIN, PN 10	15.5	18.5	21.3	15.6
16	ASME, Class 150	15.5	18.5	21.3	15.6
18	DIN, PN 6	17.3	20.7	23.0	16.4
18	DIN, PN 10	17.3	21.1	23.0	16.4
18	ASME, Class 150	17.3	21.1	23.0	16.4
20	DIN, PN 6	19.4	23.3	25.6	18.1
20	DIN, PN 10	19.4	23.2	25.6	18.1
20	ASME, Class 150	19.4	23.2	25.6	18.1

DN [in]	Pressure rating	A [in]	B [in]	D [in]	H [in]
24	DIN, PN 6	23.4	27.3	30.2	20.6
24	DIN, PN 10	23.4	27.1	30.2	20.6
24	ASME, Class 150	23.4	27.1	30.2	20.6
28	DIN, PN 6	27.4	–	30.9	18.1
28	DIN, PN 10	27.3	–	32.0	18.9
28	AS, PN 16	27.1	–	31.8	19.3
28	AWWA, Class D	27.3	–	32.8	19.5
30	AWWA, Class D	29.3	–	32.8	20.6
32	DIN, PN 6	31.5	–	35.2	20.5
32	DIN, PN 10	31.3	–	36.2	21.3
32	AS, PN 16	31.1	–	36.0	21.7
32	AWWA, Class D	31.3	–	37.0	22.1
36	DIN, PN 6	35.3	–	39.1	22.4
36	DIN, PN 10	35.2	–	40.2	23.2
36	AS, PN 16	34.9	–	39.9	23.4
36	AWWA, Class D	35.2	–	41.3	24.2
40	DIN, PN 6	39.3	–	43.0	24.4
40	DIN, PN 10	39.2	–	44.4	25.6
40	AS, PN 16	38.9	–	44.5	26.0
40	AWWA, Class D	39.2	–	45.8	26.6
42	AWWA, Class D	41.1	–	48.0	27.7
48	DIN, PN 6	47.4	–	51.6	28.9

1) Ground disks can be used for all the flange standards/pressure ratings which can be supplied in the standard version.

Weight

Compact version

Weight data:
- Including the transmitter
  - Order code for *"Housing"*, option M, Q: 1.3 kg (2.9 lb)
  - Order code for *"Housing"*, option A, R: 2.0 kg (4.4 lb)
- Excluding packaging material

Weight in SI units

Standard version

EN 1092-1 (DIN 2501)			
DN [mm]	Pressure rating	Weight [kg]	
		Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
25	PN 40	5	5.7
32	PN 40	6	6.7
40	PN 40	8	8.7
50	PN 40	9	9.7
65	PN 16	10	10.7

EN 1092-1 (DIN 2501)			
DN [mm]	Pressure rating	Weight [kg]	
		Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
80	PN 16	12	12.7
100	PN 16	14	14.7
125	PN 16	20	20.7
150	PN 16	24	24.7
200	PN 10	43	43.7
250	PN 10	63	63.7
300	PN 10	68	68.7
350	PN 6	105	105.7
375	PN 6	120	120.7
400	PN 6	120	120.7
450	PN 6	161	161.7
500	PN 6	156	156.7
600	PN 6	208	208.7
700	PN 6	304	304.7
800	PN 6	357	357.7
900	PN 6	485	485.7
1 000	PN 6	589	589.7
1 200	PN 6	850	850.7
1 400	PN 6	1 300	1 300.7
1 600	PN 6	1 700	1 700.7
1 800	PN 6	2 200	2 200.7
2 000	PN 6	2 800	2 800.7

AS 4087, PN 16		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
80	12	12.7
100	14	14.7
150	24	24.7

JIS B2220, 10K		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
25	5	5.7
32	5	5.7
40	6	6.7
50	7	7.7
65	9	9.7

JIS B2220, 10K		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
80	11	11.7
100	13	13.7
125	19	19.7
150	23	23.7
200	40	40.7
250	68	68.7
300	70	70.7

Order code for "Design", option A

Option A *"Insertion length short; ISO/DVGW to DN400, DN450-2000 1:1"*

EN 1092-1 (DIN 2501)			
DN [mm]	Order code for "Housing", option M, Q Polycarbonate plastic [1]		
	Weight [kg]		
	PN 6	PN 10	PN 16
450	100	113	139
500	115	133	179
600	156	163	224
700	191	241	288
800	241	316	350
900	309	394	441
1000	360	469	563
1200	530	718	840
1400	785	1115	1201
1600	1059	1625	1842
1800	1419	2108	2354
2000	1878	2631	2926

1) Values for aluminum transmitter, AlSi10Mg, coated: + 0.7 kg

AS 2129, Table E		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
450	144	144.7
500	183	183.7
600	261	261.7
700	347	347.7
750	434	434.7
800	494	494.7
900	691	691.7

AS 2129, Table E		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
1000	762	762.7
1200	1238	1238.7

AS 4087, PN 16		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
450	134	134.7
500	183	183.7
600	261	261.7
700	368	368.7
750	446	446.7
800	504	504.7
900	703	703.7
1000	760	760.7
1200	1220	1220.7

Order code for "Calibration flow", options H and K, or options H/K or order code for "Sensor option", option CA

Option	Description
H	MID Type Examination Cert MI-001
K	OIML R49 Class 2
CA	IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M

EN 1092-1 (DIN 2501)			
DN [mm]	Pressure rating	Weight [kg]	
		Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
25	PN 40	9	9.7
32	PN 40	10	10.7
40	PN 40	11	11.7
50	PN 40	12	12.7
65	PN 16	13	13.7
80	PN 16	15	15.7
100	PN 16	17	17.7
125	PN 16	22	22.7
150	PN 16	27	27.7
200	PN 10	38	38.7
250	PN 10	51	51.7
300	PN 10	60	60.7

AS 2129, PN 16		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
80	15	15.7
100	17	17.7
125	22	22.7
150	27	27.7

JIS B2220, 10K		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
25	9	9.7
32	10	10.7
40	10	10.7
50	11	11.7
65	12	12.7
80	13	13.7
100	15	15.7
125	20	20.7
150	25	25.7
200	34	34.7
250	50	50.7
300	57	57.7

Weight in US units

Standard version

ASME B16.5, Class 150		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
1	11	12.5
1½	18	19.5
2	20	21.5
3	26	27.5
4	31	32.5
6	53	54.5
8	95	96.5
10	161	162.5
12	238	239.5
14	386	387.5
16	452	453.5
18	562	563.5

ASME B16.5, Class 150		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
20	628	629.5
24	893	894.5

AWWA C207, Class D		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
28	882	883.5
30	1014	1015.5
32	1213	1214.5
36	1764	1765.5
40	1985	1986.5
42	2426	2427.5
48	3087	3088.5
54	4851	4852.5
60	5954	5955.5
66	8159	8160.5
72	9041	9042.5
78	10143	10144.5

Order code for "Design", option A

Option A *"Insertion length short; ISO/DVGW to DN400, DN450-2000 1:1"*

ASME B16.5, Class 150		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
18	423	424.5
20	505	506.5
24	668	667.5

AWWA C207, Class D		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
28	589	590.5
30	703	704.5
32	847	848.5
36	1039	1040.5
40	1297	1298.5
42	1480	1481.5

AWWA C207, Class D		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
48	1989	1990.5
54	2809	2810.5
60	3517	3518.5
66	4701	4702.5
72	5665	5666.5
78	6866	6867.5

Order code for "Sensor option", option CA

Option CA *"IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M*

ASME B16.5, Class 150	
DN [in]	Weight [lbs]
1	17.6
1½	19.8
2	24.3
3	33.1
4	41.9
6	61.7
8	97.0
10	134.5
12	189.6

Transmitter remote version

Wall-mount housing

Depends on the material of the wall-mount housing:
- Polycarbonate plastic: 1.3 kg (2.9 lb)
- Aluminum, AlSi10Mg, coated: 2.0 kg (4.4 lb)

Sensor remote version

Weight data:
- Including sensor connection housing
- Excluding the connecting cable
- Excluding packaging material

Weight in SI units

Standard version

EN 1092-1 (DIN 2501)		
DN [mm]	Pressure rating	Weight [kg]
25	PN 40	5
32	PN 40	6
40	PN 40	7

EN 1092-1 (DIN 2501)		
DN [mm]	**Pressure rating**	**Weight [kg]**
50	PN 40	9
65	PN 16	10
80	PN 16	12
100	PN 16	14
125	PN 16	20
150	PN 16	24
200	PN 10	43
250	PN 10	63
300	PN 10	68
350	PN 6	103
375	PN 6	118
400	PN 6	118
450	PN 6	159
500	PN 6	154
600	PN 6	206
700	PN 6	302
800	PN 6	355
900	PN 6	483
1 000	PN 6	587
1 200	PN 6	848
1 400	PN 6	1298
1 600	PN 6	1698
1 800	PN 6	2198
2 000	PN 6	2798

AS 4087, PN 16	
DN [mm]	**Weight [kg]**
80	12
100	14
125	20
150	24

JIS B2220, 10K	
DN [mm]	**Weight [kg]**
25	5
32	5
40	6
50	7
65	9

JIS B2220, 10K	
DN [mm]	**Weight [kg]**
80	11
100	13
125	19
150	23
200	40
250	67
300	70

Order code for "Design", option A

Option A *"Insertion length short; ISO/DVGW to DN400, DN450-2000 1:1"*

EN 1092-1 (DIN 2501)			
DN [mm]	**Weight [kg]**		
	PN 6	**PN 10**	**PN 16**
450	98	111	139
500	113	131	179
600	154	161	224
700	190	240	288
800	240	315	350
900	308	393	441
1000	359	468	563
1200	529	717	840
1400	784	1114	1200
1600	1058	1624	1841
1800	1418	2107	2353
2000	1877	2630	2925

AS 2129, Table E	
DN [mm]	**Weight [kg]**
450	142
500	181
600	259
700	346
750	433
800	493
900	690
1000	761
1200	1237

AS 4087, PN 16	
DN [mm]	**Weight [kg]**
450	132
500	181
600	259
700	367
750	445
800	503
900	702
1000	759
1200	1219

Order code for "Calibration flow", options H and K or order code for "Sensor option", option CA

Option	Description
H	MID Type Examination Cert MI-001
K	OIML R49 Class 2
CA	IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M

EN 1092-1 (DIN 2501)		
DN [mm]	**Pressure rating**	**[kg]**
25	PN 40	6.5
32	PN 40	8
40	PN 40	8.5
50	PN 40	10
65	PN 16	11
80	PN 16	13
100	PN 16	15
125	PN 16	20
150	PN 16	25
200	PN 10	36
250	PN 10	49
300	PN 10	58

AS 4087, PN 16	
DN [mm]	**[kg]**
80	13
100	15
150	25

JIS B2220, 10K	
DN [mm]	**Weight [kg]**
25	6.5
32	7.5
40	7.5
50	9
65	10
80	11
100	13
125	18
150	23
200	32
250	48
300	55

Weight in US units

Standard version

ASME B16.5, Class 150	
DN [in]	**Weight [lbs]**
1	11
1½	15
2	20
3	26
4	31
6	53
8	95
10	161
12	238
14	381
16	448
18	558
20	624
24	889

AWWA C207, Class D	
DN [in]	**Weight [lbs]**
28	878
30	1010
32	1208
36	1760
40	1980

AWWA C207, Class D	
DN [in]	**Weight [lbs]**
42	2421
48	3083
54	4847
60	5949
66	8154
72	9036
78	10139

Order code for "Design", option A

Option A *"Insertion length short; ISO/DVGW to DN400, DN450-2000 1:1"*

ASME B16.5, Class 150	
DN [in]	**Weight [lbs]**
18	420
20	501
24	664

AWWA C207, Class D	
DN [in]	**Weight [lbs]**
28	587
30	701
32	845
36	1036
40	1294
42	1477
48	1987
54	1273
60	3515
66	4699
72	5662
78	6864

Order code for "Sensor option", option CA

Option CA *"IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M"*

ASME B16.5, Class 150	
DN [in]	**Weight [lbs]**
1	13
1½	15.5
2	20

ASME B16.5, Class 150	
DN [in]	Weight [lbs]
3	29
4	37
6	57
8	93
10	130
12	185

Measuring tube specification

Nominal diameter		Pressure rating				Measuring tube internal diameter			
		EN (DIN)	ASME AWWA	AS 2129 AS 4087	JIS	Hard rubber		Polyurethane	
[mm]	[in]					[mm]	[in]	[mm]	[in]
25	1	PN 40	Class 150	–	20K	–	–	24	0.94
32	–	PN 40	–	–	20K	–	–	32	1.26
40	1 ½	PN 40	Class 150	–	20K	–	–	38	1.50
50	2	PN 40	Class 150	Table E, PN 16	10K	50	1.97	50	1.97
65	–	PN 16	–	–	10K	66	2.60	66	2.60
80	3	PN 16	Class 150	Table E, PN 16	10K	79	3.11	79	3.11
100	4	PN 16	Class 150	Table E, PN 16	10K	102	4.02	102	4.02
125	–	PN 16	–	–	10K	127	5.00	127	5.00
150	6	PN 16	Class 150	Table E, PN 16	10K	156	6.14	156	6.14
200	8	PN 10	Class 150	Table E, PN 16	10K	204	8.03	204	8.03
250	10	PN 10	Class 150	Table E, PN 16	10K	258	10.2	258	10.2
300	12	PN 10	Class 150	Table E, PN 16	10K	309	12.2	309	12.2
350	14	PN 6	Class 150	Table E, PN 16	–	342	13.5	342	13.5
375	15	–	–	PN 16	–	392	15.4	–	–
400	16	PN 6	Class 150	Table E, PN 16	–	392	15.4	392	15.4
450	18	PN 6	Class 150	–	–	437	17.2	437	17.2
500	20	PN 6	Class 150	Table E, PN 16	–	492	19.4	492	19.4
600	24	PN 6	Class 150	Table E, PN 16	–	594	23.4	594	23.4
700	28	PN 6	Class D	Table E, PN 16	–	692	27.2	692	27.2
750	30	–	Class D	Table E, PN 16	–	742	29.2	742	29.2
800	32	PN 6	Class D	Table E, PN 16	–	794	31.3	794	31.3
900	36	PN 6	Class D	Table E, PN 16	–	891	35.1	891	35.1
1000	40	PN 6	Class D	Table E, PN 16	–	994	39.1	994	39.1
–	42	–	Class D	–	–	1043	41.1	1043	41.1
1200	48	PN 6	Class D	Table E, PN 16	–	1197	47.1	1197	47.1
–	54	–	Class D	–	–	1339	52.7	–	–
1400	–	PN 6	–	–	–	1402	55.2	–	–
–	60	–	Class D	–	–	1492	58.7	–	–
1600	–	PN 6	–	–	–	1600	63.0	–	–
–	66	–	Class D	–	–	1638	64.5	–	–

Nominal diameter		Pressure rating				Measuring tube internal diameter			
		EN (DIN)	ASME AWWA	AS 2129 AS 4087	JIS	Hard rubber		Polyurethane	
[mm]	[in]					[mm]	[in]	[mm]	[in]
1 800	72	PN 6	Class D	–	–	1 786	70.3	–	–
2 000	78	PN 6	Class D	–	–	1 989	78.3	–	–

Materials

Transmitter housing

Compact version, standard

- Order code for "Housing", option **A** "Compact, aluminum coated": Aluminum, AlSi10Mg, coated
- Order code for "Housing", option **M**: polycarbonate plastic
- Window material:
  - For order code for "Housing", option **A**: glass
  - For order code for "Housing", option **M**: plastic

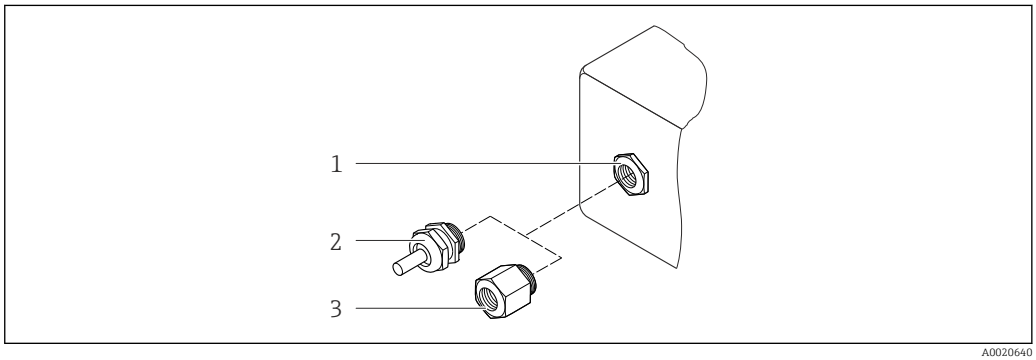
Compact version, inclined

- Order code for "Housing", option **R** "Compact, aluminum coated": Aluminum, AlSi10Mg, coated
- Order code for "Housing", option **Q**: polycarbonate plastic
- Window material:
  - For order code for "Housing", option **R**: glass
  - For order code for "Housing", option **Q**: plastic

Remote version (wall-mount housing)

- Order code for "Housing", option **P** "Compact, aluminum coated": Aluminum, AlSi10Mg, coated
- Order code for "Housing", option **N**: polycarbonate plastic
- Window material:
  - For order code for "Housing", option **P**: glass
  - For order code for "Housing", option **N**: plastic

Cable entries/cable glands



34 *Possible cable entries/cable glands*

1 *Cable entry in transmitter housing, wall-mount housing or connection housing with internal thread M20 x 1.5*
2 *Cable gland M20 x 1.5*
3 *Adapter for cable entry with internal thread G ½" or NPT ½"*

Compact and remote versions and sensor connection housing

Cable entry/cable gland	Material
Cable gland M20 × 1.5	Plastic
Remote version: cable gland M20 × 1.5 Option of reinforced connecting cable	▪ Sensor connection housing: Nickel-plated brass ▪ Transmitter wall-mount housing: Plastic
Adapter for cable entry with internal thread G ½" or NPT ½"	Nickel-plated brass

Device plug

Electrical connection	Material
Plug M12x1	▪ Socket: Stainless steel, 1.4404 (316L) ▪ Contact housing: Polyamide ▪ Contacts: Gold-plated brass

Connecting cable for remote version

Electrode and coil current cable
- Standard cable: PVC cable with copper shield
- Reinforced cable: PVC cable with copper shield and additional steel wire braided jacket

Sensor housing

- DN 25 to 300 (1 to 12"):
  - Aluminum, AlSi10Mg, coated
  - Carbon steel with Al/Zn protective coating
- DN 50 to 300 (2 to 12"):
  Carbon steel with protective varnish (IP68)
- DN 350 to 2000 (14 to 78"):
  Carbon steel with protective varnish

Sensor connection housing

- Standard: aluminum, AlSi10Mg, coated (IP66/67)
- Option:
  - Polycarbonate for IP68 with DN 50 to 300 (2 to 12")
  - Polycarbonate for order code "Sensor option", option CA...CE "Corrosion protection" with DN 350 to 2000 (14 to 78")

Measuring tubes

- DN 25 to 300 (1 to 12") [1]: stainless steel, 1.4301/1.4306/304/304L
- DN 350 to 1200 (14 to 48") [1]: stainless steel, 1.4301/304
- DN 1350 to 2000 (54 to 78") [1]: stainless steel, 1.4301 similar to 304

Liner

- DN 25 to 1200 (1 to 48"): polyurethane
- DN 50 to 2000 (2 to 78"): hard rubber

Electrodes

- Stainless steel, 1.4435 (316L)
- Alloy C22, 2.4602 (UNS N06022)
- Tantalum

1) For carbon steel flange material with Al/Zn protective coating (DN 25 to 300 (1 to 12")), protective varnish (IP68) (DN 50 to 300 (2 to 12")) or protective varnish ≥ DN 350 (14")

Process connections

EN 1092-1 (DIN 2501)

- DN 25 to 1200 [1]:
  - Stainless steel, 1.4404/1.4571/F316L
  - Carbon steel, A105/FE410WB/P250GH/S235JRG2/S235JR+N
- DN 1350 to 2000 [1]:
  - Stainless steel ,1.4404/1.4571
  - Carbon steel, P250GH/S235JRG2
- DN 450 to 2000 [2]:
  Carbon steel, A105/S235JRG2

EN 1092-1 (DIN 2501), PN6:
DN 350 to 1000 [1]:
Carbon steel, A105/FE410WB/S235JRG2

ASME B16.5

- DN 25 to 1200 (1 to 48"):
  Stainless steel, F316L similar to 1.4404
- DN 25 to 300 (1 to 12") [2]:
  Carbon steel, A105 similar to 1.0432
- DN 350 to 1200 (14 to 48") [2]:
  Carbon steel, A105/A515 Grade 70

AWWA C207

- DN 48":
  Carbon steel, A105/A181/P265GH/S275JR
- DN 54 to 72":
  Carbon steel, P265GH similar to 1.0425
- DN 48 to 78" [2]:
  Carbon steel, A105/A181/P265GH/S275JR

AS 2129

- DN 50 to 1200:
  Carbon steel, A105/S235JRG2
- DN 350 to 1200 [2]:
  Carbon steel, A105/FE410WB/P235GH/P265GH/S235JRG2

AS 4087

- DN 50 to 1200:
  Carbon steel, A105/S275JR
- DN 350 to 1200 [2]:
  Carbon steel, A105/P265GH/S275JR

JIS B2220

- Stainless steel, F316L similar to 1.4404
- Carbon steel, A105/A350LF2 [1]

Seals

In accordance with DIN EN 1514-1

Accessories

Display protection

Stainless steel, 1.4301 (304L)

2) Order Code for "Design", Option A "Insertion length short"

Ground disks

- Stainless steel, 1.4435 (316L)
- Alloy C22, 2.4602 (UNS N06022)
- Tantalum

Fitted electrodes

Measurement, reference and empty pipe detection electrodes available as standard with:
- 1.4435 (316L)
- Alloy C22, 2.4602 (UNS N06022)
- Tantalum

Optionally available with DN 350 to 2000 (14 to 78"):
Exchangeable measuring electrodes made from 1.4435 (316L)

Process connections

- EN 1092-1 (DIN 2501) [3]
  - DN ≤ 300: fixed flange (PN 10/16/25/40) = form A
  - DN ≥ 350: fixed flange (PN 6/10/16/25) = flat face
  - DN 450 to 2000 [4]: fixed flange (PN 6/10/16) = flat face
- ASME B16.5
  - DN 25 to 600 (1 to 24"): fixed flange (Class 150)
  - DN 350 to 2000 (14 to 78") [4]: fixed flange (Class 150)
  - DN 25 to 150 (1 to 6"): fixed flange (Class 300)
- AWWA C207
  - DN 48 to 72": fixed flange (Class D)
  - DN 48 to 78" [4]: fixed flange (Class D)
- AS 2129
  - DN 50 to 1200: fixed flange (Table E)
  - DN 350 to 1200 [4]: fixed flange (Table E)
- AS 4087
  - DN 50 to 1200): fixed flange (PN 16)
  - DN 350 to 1200 [4]: fixed flange (PN 16)
- JIS B2220
  - DN 50 to 300: fixed flange (10K)
  - DN 25 to 300: fixed flange (20K)

For information on the materials of the process connections → 99

Surface roughness

Electrodes with 1.4435 (316L); Alloy C22, 2.4602 (UNS N06022); tantalum:
≤ 0.3 to 0.5 µm (11.8 to 19.7 µin)
(All data relate to parts in contact with fluid)

Operability

Operating concept

Operator-oriented menu structure for user-specific tasks
- Commissioning
- Operation
- Diagnostics
- Expert level

Quick and safe commissioning
- Guided menus ("Make-it-run" wizards) for applications
- Menu guidance with brief explanations of the individual parameter functions

3) Dimensions as per DIN 2501, DN 65 (2 ½") PN 16 and DN 600 (24") PN 16 only as per EN 1092-1
4) Order code for "Design", option A "Insertion length short"

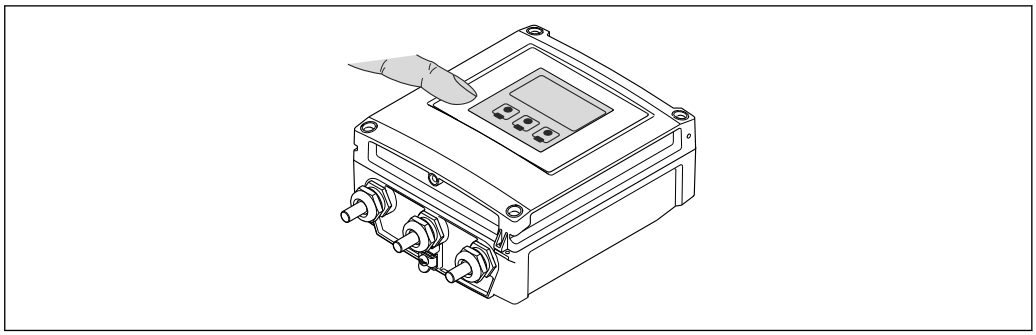
Reliable operation
- Operation in the following languages:
  - Via local display:
    English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Bahasa (Indonesian), Vietnamese, Czech
  - Via "FieldCare" operating tool:
    English, German, French, Spanish, Italian, Chinese, Japanese
  - Via integrated Web browser (only available for device versions with HART, PROFIBUS DP and EtherNet/IP):
    English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Bahasa (Indonesian), Vietnamese, Czech
- Uniform operating philosophy applied to device, operating tools and Web browser
- If replacing the electronic module, transfer the device configuration via the plug-in memory (HistoROM DAT) which contains the process and measuring device data and the event logbook. No need to reconfigure.

Efficient diagnostics increase measurement availability
- Troubleshooting measures can be called up via the device, operating tools and Web browser
- Diverse simulation options, logbook for events that occur and optional line recorder functions

In custody transfer mode, operation is only possible to a limited extent once the device has been put into circulation or has been lead-sealed.

Local operation

Via display module



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Display elements
- 4-line display
- White background lighting; switches to red in event of device errors
- Format for displaying measured variables and status variables can be individually configured
- Permitted ambient temperature for the display: –20 to +50 °C (–4 to +122 °F)
  The readability of the display may be impaired at temperatures outside the temperature range.

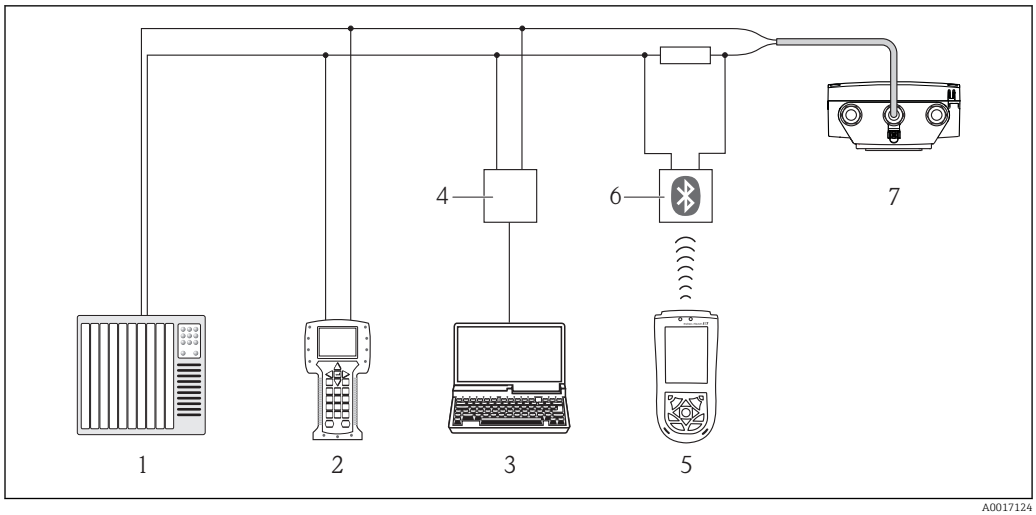
Operating elements
External operation via touch control; 3 optical keys: ⊕, ⊖, Ⓔ

Additional functionality
- Data backup function
  The device configuration can be saved in the display module.
- Data comparison function
  The device configuration saved in the display module can be compared to the current device configuration.
- Data transfer function
  The transmitter configuration can be transmitted to another device using the display module.

Remote operation

Via HART protocol

This communication interface is available in device versions with a HART output.

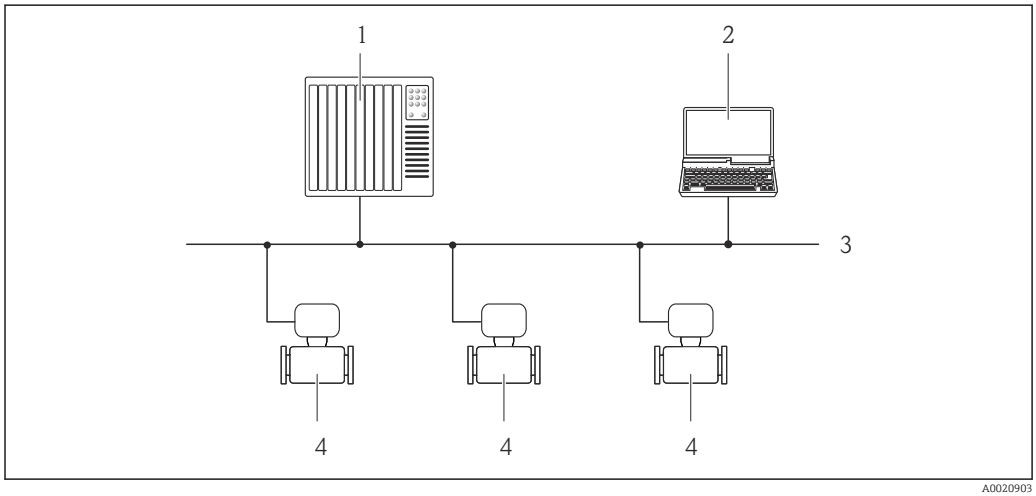


35 Options for remote operation via HART protocol

1 Control system (e.g. PLC)
2 Field Communicator 475
3 Computer with operating tool (e.g. FieldCare, AMS Device Manager, SIMATIC PDM)
4 Commubox FXA195 (USB)
5 Field Xpert SFX350 or SFX370
6 VIATOR Bluetooth modem with connecting cable
7 Transmitter

Via PROFIBUS DP network

This communication interface is available in device versions with PROFIBUS DP.

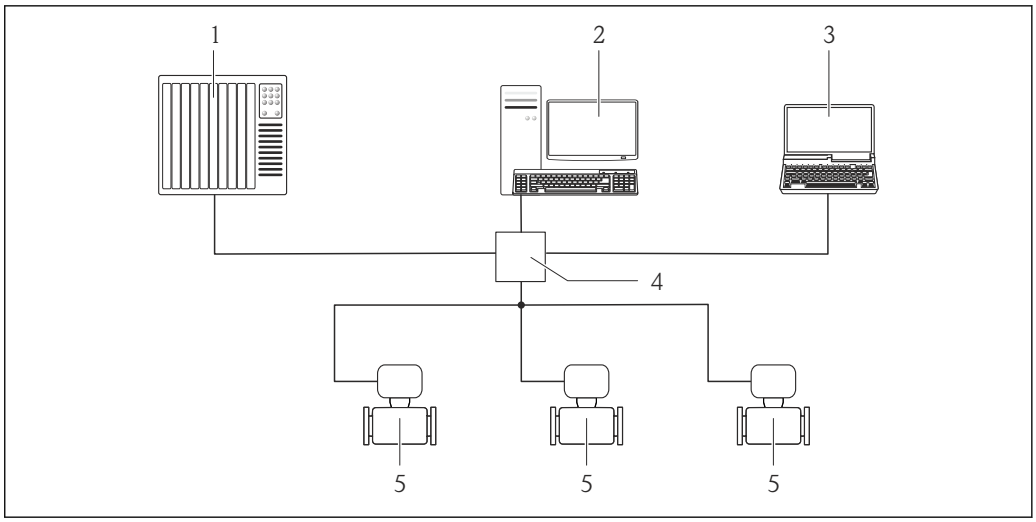


36 Options for remote operation via PROFIBUS DP network

1 Automation system
2 Computer with PROFIBUS network card
3 PROFIBUS DP network
4 Measuring device

Via Ethernet-based fieldbus

This communication interface is available in device versions with EtherNet/IP.



37 *Options for remote operation via Ethernet-based fieldbus*

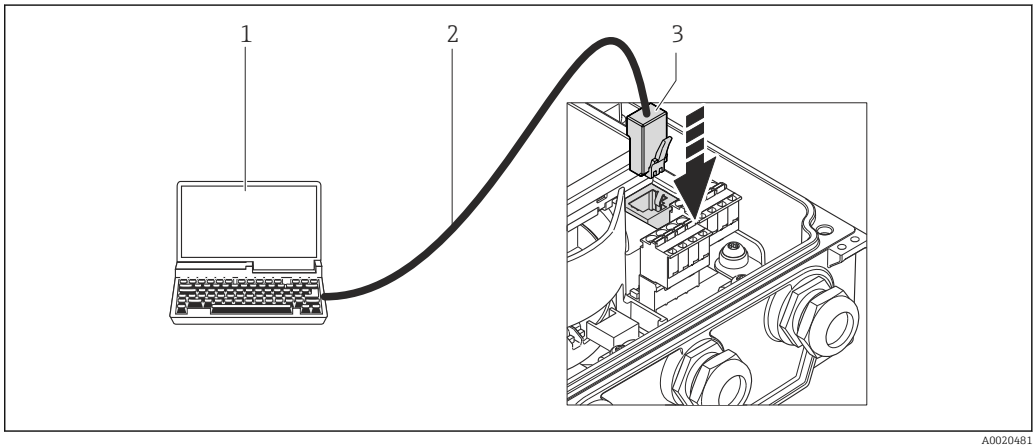
1 *Control system, e.g. "RSLogix" (Rockwell Automation)*
2 *Workstation for measuring device operation: with Add-on Profile Level 3 for "RSLogix 5000" (Rockwell Automation) or with Electronic Data Sheet (EDS)*
3 *Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"*
4 *Ethernet switch*
5 *Measuring device*

Service interface

Via service interface (CDI-RJ45)

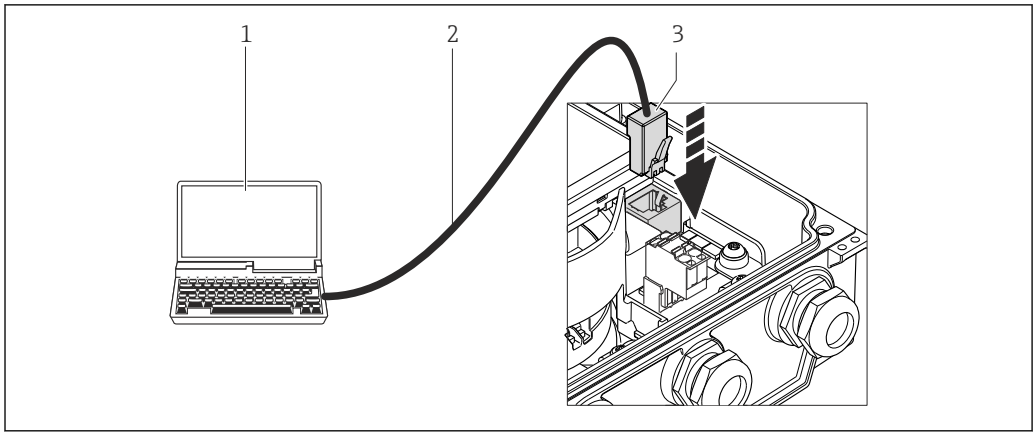
This communication interface is present in the following device version:
- Order code for "Output", option **H**: 4-20/0-20 mA HART, pulse/frequency/switch output
- Order code for "Output", option **I**: 4-20/0-20 mA HART, pulse/frequency/switch output, status input
- Order code for "Output", option **L**: PROFIBUS DP
- Order code for "Output", option **N**: EtherNet/IP
- Order code for "Output", option **M**: Modbus RS485

HART



1 *Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"*
2 *Standard Ethernet connecting cable with RJ45 plug*
3 *Service interface (CDI -RJ45) of the measuring device with access to the integrated Web server*

PROFIBUS DP



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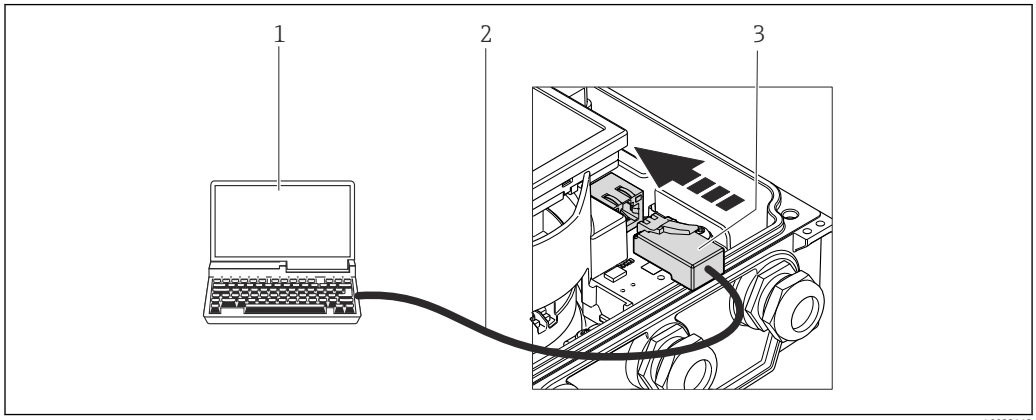
1 Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"
2 Standard Ethernet connecting cable with RJ45 plug
3 Service interface (CDI -RJ45) of the measuring device with access to the integrated Web server

EtherNet/IP



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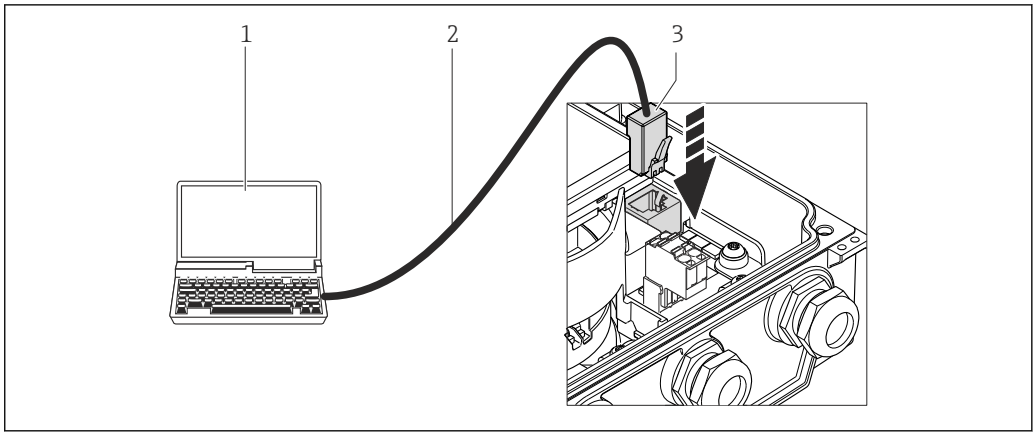
1 Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"
2 Standard Ethernet connecting cable with RJ45 plug
3 Service interface (CDI -RJ45) of the measuring device with access to the integrated Web server

Modbus RS485



1 Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"
2 Standard Ethernet connecting cable with RJ45 plug
3 Service interface (CDI -RJ45) of the measuring device with access to the integrated Web server

Certificates and approvals

CE mark

The measuring system is in conformity with the statutory requirements of the applicable EC Directives. These are listed in the corresponding EC Declaration of Conformity along with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

C-Tick symbol

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

Ex approval

The measuring device is certified for use in hazardous areas and the relevant safety instructions are provided in the separate "Safety Instructions" (XA) document. Reference is made to this document on the nameplate.

The separate Ex documentation (XA) containing all the relevant explosion protection data is available from your Endress+Hauser sales center.

ATEX, IECEx

Currently, the following versions for use in hazardous areas are available:

Drinking water approval

- ACS
- KTW/W270
- NSF 61
- WRAS BS 6920

Certification PROFIBUS

PROFIBUS interface

The measuring device is certified and registered by the PROFIBUS User Organization (PNO). The measuring system meets all the requirements of the following specifications:
- Certified in accordance with PROFIBUS PA Profile 3.02
- The device can also be operated with certified devices of other manufacturers (interoperability)

Modbus RS485 certification

The measuring device meets all the requirements of the MODBUS/TCP conformity test and has the "MODBUS/TCP Conformance Test Policy, Version 2.0". The measuring device has successfully passed all the test procedures carried out and is certified by the “MODBUS/TCP Conformance Test Laboratory” of the University of Michigan.

EtherNet/IP certification

The measuring device is certified and registered by the ODVA (Open Device Vendor Association). The measuring system meets all the requirements of the following specifications:
- Certified in accordance with the ODVA Conformance Test
- EtherNet/IP Performance Test
- EtherNet/IP PlugFest compliance
- The device can also be operated with certified devices of other manufacturers (interoperability)

Measuring instrument approval

Promag W 400 is (optionally) approved as a cold water meter (MI-001) for volume measurement in service subject to legal metrological control in accordance with the European Measuring Instruments Directive 2004/22/EC (MID).

Promag W 400 is qualified to OIML R49 and has an OIML Certificate of Conformity (optional).

Other standards and guidelines

- EN 60529
  Degrees of protection provided by enclosures (IP code)
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC/EN 61326
  Emission in accordance with Class A requirements. Electromagnetic compatibility (EMC requirements).
- ANSI/ISA-61010-1 (82.02.01): 2004
  Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1 General Requirements
- CAN/CSA-C22.2 No. 61010-1-04
  Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1 General Requirements
- NAMUR NE 21
  Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment
- NAMUR NE 32
  Data retention in the event of a power failure in field and control instruments with microprocessors
- NAMUR NE 43
  Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53
  Software of field devices and signal-processing devices with digital electronics
- NAMUR NE 105
  Specifications for integrating fieldbus devices in engineering tools for field devices
- NAMUR NE 107
  Self-monitoring and diagnosis of field devices
- NAMUR NE 131
  Requirements for field devices for standard applications

Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser web site: www.endress.com → Choose your country → Products → Select measuring technology, software or components → Select product (picklists: measurement method, product family etc.) → Device support (right-hand column): Configure the selected product → The Product Configurator for the selected product is opened.
- From your Endress+Hauser Sales Center: www.addresses.endress.com

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Product generation index

Release date	Product root	Modification
01.06.2012	8S1B	Original
01.01.2015	8S1C	DN 08 to 50 measuring tube material 1.4435/316L DN 40 to 50 reduction in length DN 40 to 50 reduction in weight

Additional information is available from your sales center or at:
www.service.endress.com → Downloads

Application packages

Many different application packages are available to enhance the functionality of the device. Such packages might be needed to address safety aspects or specific application requirements.

The application packages can be ordered with the device or subsequently from Endress+Hauser. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Cleaning

Package	Description
Electrode cleaning circuit (ECC)	The electrode cleaning circuit (ECC) function has been developed to have a solution for applications where magnetite (Fe_3O_4) deposits frequently occur (e.g. hot water). Since magnetite is highly conductive this build up leads to measuring errors and ultimately to the loss of signal. The application package is designed to AVOID build up of highly conductive matter and thin layers (typical of magnetite).

Diagnostics functions

Package	Description
HistoROM extended function	Comprises extended functions concerning the event log and the activation of the measured value memory. Event log: Memory volume is extended from 20 message entries (basic version) to up to 100 entries. Data logging (line recorder): ▪ Memory capacity for up to 1000 measured values is activated. ▪ 250 measured values can be output via each of the 4 memory channels. The recording interval can be defined and configured by the user. ▪ Data logging is visualized via the local display or FieldCare.

Heartbeat Technology

Package	Description
Heartbeat Verification +Monitoring	**Heartbeat Monitoring:** Continuously supplies monitoring data, which are characteristic of the measuring principle, for an external condition monitoring system. This makes it possible to: ▪ Draw conclusions - using these data and other information - about the impact the measuring application has on the measuring performance over time. ▪ Schedule servicing in time. ▪ Monitor the product quality, e.g. gas pockets. **Heartbeat Verification:** Makes it possible to check the device functionality on demand when the device is installed, without having to interrupt the process. ▪ Access via onsite operation or other operating interfaces, such as FieldCare for instance. ▪ End-to-end, traceable documentation of the verification results, including report. ▪ Makes it possible to extend calibration intervals in accordance with operator's risk assessment.

Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Device-specific accessories

For the transmitter

Accessories	Description
Display protection	Is used to protect the display against impact or scoring from sand in desert areas. For details, see Special Documentation SD00333F
Connecting cable for remote version	Coil current and electrode cables, various lengths, reinforced cables available on request.
Ground cable	Set, consisting of two ground cables for potential equalization.
Post mounting kit	Post mounting kit for transmitter.
Compact → remote conversion kit	For converting a compact device version to a remote device version.
Promag 50/53 → Promag 400 conversion kit	For converting a Promag with transmitter 50/53 to a Promag 400.

For the sensor

Accessories	Description
Ground disks	Are used to ground the fluid in lined measuring tubes to ensure proper measurement. For details, see Installation Instructions EA00070D

Communication-specific accessories

Accessories	Description
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface. For details, see "Technical Information" TI00404F
HART Loop Converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values. For details, see "Technical Information" TI00429F and Operating Instructions BA00371F
Wireless HART adapter SWA70	Is used for the wireless connection of field devices. The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity. For details, see Operating Instructions BA00061S
Fieldgate FXA320	Gateway for the remote monitoring of connected 4-20 mA measuring devices via a Web browser. For details, see "Technical Information" TI00025S and Operating Instructions BA00053S
Fieldgate FXA520	Gateway for the remote diagnostics and remote configuration of connected HART measuring devices via a Web browser. For details, see "Technical Information" TI00025S and Operating Instructions BA00051S

Field Xpert SFX350	Field Xpert SFX350 is a mobile computer for commissioning and maintenance. It enables efficient device configuration and diagnostics for HART and FOUNDATION Fieldbus devices in the **non-Ex area**. For details, see Operating Instructions BA01202S
Field Xpert SFX370	Field Xpert SFX370 is a mobile computer for commissioning and maintenance. It enables efficient device configuration and diagnostics for HART and FOUNDATION Fieldbus devices in the **non-Ex area** and the **Ex area**. For details, see Operating Instructions BA01202S

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: ▪ Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, accuracy or process connections. ▪ Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters throughout the entire life cycle of a project. Applicator is available: ▪ Via the Internet: https://wapps.endress.com/applicator ▪ On CD-ROM for local PC installation.
W@M	Life cycle management for your plant W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle. The application already contains the data of your Endress+Hauser device. Endress +Hauser also takes care of maintaining and updating the data records. W@M is available: ▪ Via the Internet: www.endress.com/lifecyclemanagement ▪ On CD-ROM for local PC installation.
FieldCare	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition. For details, see Operating Instructions BA00027S and BA00059S
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop. For details, see "Technical Information" TI00405C

System components

Accessories	Description
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all relevant measured variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a SD card or USB stick. For details, see "Technical Information" TI00133R and Operating Instructions BA00247R

Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- The CD-ROM provided for the device (depending on the device version, the CD-ROM might not be part of the delivery!)
- The *W@M Device Viewer* : Enter the serial number from the nameplate (www.endress.com/deviceviewer)
- The *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2-D matrix code (QR code) on the nameplate.

Standard documentation

Brief Operating Instructions

Measuring device	Documentation code
Promag W 400	KA01114D

Operating Instructions

Measuring device	Documentation code			
	HART	PROFIBUS DP	Modbus RS485	EtherNet/IP
Promag W 400	BA01063D	BA01234D	BA01231D	BA01214D

Supplementary device-dependent documentation

Special documentation

Contents	Documentation code
Modbus RS485 Register Information	SD01379D
Heartbeat Technology	SD01183D
Information on Custody Transfer Measurement	SD01230D

Installation Instructions

Contents	Documentation code
Installation Instructions for spare part sets	Specified for each individual accessory

Registered trademarks

HART®
Registered trademark of the HART Communication Foundation, Austin, USA

PROFIBUS®
Registered trademark of the PROFIBUS User Organization, Karlsruhe, Germany

Modbus®
Registered trademark of SCHNEIDER AUTOMATION, INC.

EtherNet/IP™
Trademark of ODVA, Inc.

Microsoft®
Registered trademark of the Microsoft Corporation, Redmond, Washington, USA

Applicator®, FieldCare®, Field Xpert™, HistoROM®, Heartbeat Technology™
Registered or registration-pending trademarks of the Endress+Hauser Group

www.addresses.endress.com

Endress+Hauser

People for Process Automation

Chapter 12 Rotary Lobe Blower (Division 43)

MANUFACTURER/DISTRIBUTOR:

Aerzen
Hicham Bouyakhf
1995 Montée Labossière
Vaudreuil-Dorion, J7V 8P2
Phone: (450) 424-3966
hicham.bouyakhf@aerzen.ca

12.1 **Aerzen/Delta Blower GM15L Air Scour Blower (WTP)**

Aerzen Canada
1995 Montée Labossière, Vaudreuil-Dorion, Québec J7V 8P2

Customer Reference: Iqaluit - remplacement Delta Blower 15 L
Aerzen Reference: SQ-17-019256

Submitted by: Hicham Bouyakhf
hichamb@aerzen.ca

SCOPE OF SUPPLY

1 Aerzen Generation 5 Blower Package - GM 15L DN 100 - Pressure - including:

Aerzen GM 15L Blower
Drive Motor: 25hp, 1800rpm, TEFC, 575V/60Hz

Base with integrated reactive type discharge silencer
Intake filter silencer
Hinged motor support as automatic belt tensioning device
Set of vibration isolation mounts
Narrow v-belt drive with guard - 1 set
Spring loaded relief valve preset to: 750 mbar
Discharge manifold with externally accessible integrated check valve
Flexible connector with clamps for schedule 40 pipe, discharge

Instruments
Pressure gauge c/w isolation ball valve (1x)
Dirty filter indicator (1x)

Optional Spare Parts
1 Year Spare Kit

Connection Points:
Intake Connection: Local
Discharge Connection: DN 100 - 4"

Exclusions: See page 2

Aerzen Canada
1995 Montée Labossière, Vaudreuil-Dorion, Québec J7V 8P2

Customer Reference: Iqaluit - remplacement Delta Blower 15 L
Aerzen Reference: SQ-17-019256

PERFORMANCE DATA

Aerzen Blower Package - GM 15L DN 100 - Pressure

Configuration: **G5**

Conditions:		1			
Flow at inlet conditions	m³/min	14			
	Icfm	494			
Inlet pressure (abs.)	bar	1.010			
	Psi	14.6			
Pressure differential	mbar(g)	480			
	Psig	7.0			
Inlet temperature	°C	20			
Discharge temperature	°C	68			
Blower speed	RPM	4008			
Blower maximum speed	RPM	4800			
% of maximum blower speed		84%			
Power required at shaft (with accessories) **	kW	15.3			
	HP	20.5			
Motor rating	HP	25.0			

Noise level without acoustic hood	dB(A)	92
Noise level with acoustic hood	dB(A)	71

Tolerances as per EN 10204, in accordance with standard ISO 1217:
Flow at inlet conditions / Power required at shaft +/- 5%

Blower package noise level:
Free field measurement at 1m from the complete blower package (tolerance +/- 2 dB(A))

Tests and measurements:
Blower stage: 1.5 hour flow test at the factory (Germany) on a calibrated test bed, at maximum operating conditions and according to DIN 1945. acceptance tolerance: +/- 5%.
A complete test report is available upon request.

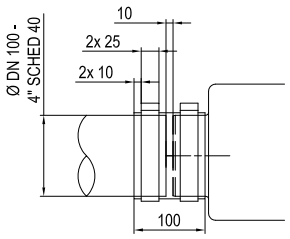
On Site Commissioning
Available upon request, charges to be advised.
- Any commissioning activity is subject to two weeks prior notice and completion of commissioning checklist.
- Any on-site activity outside the time indicated will be billed according to the Aerzen Standard Rate Sheet

Exclusions
Control Panels, Motor Starters, Piping and Electrical Connections
* Unloading valves are required for reduced voltage starters

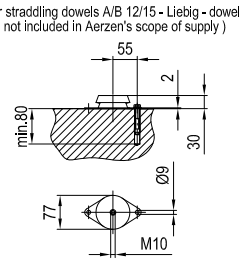
Warranty
Blowers including accessories are warranted for a period of 12mo / max 18mo after delivery and after provisional acceptance of the work against defects in workmanship and design. This warranty does not cover wearing parts unless such parts are defective during shipping / commissioning.
As per Aerzen standard warranty terms.

** Power at shaft excludes drive motor and belt drive

NOTICE: THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF AERZEN CANADA INC. AND ITS SUBSIDIARIES AND SHALL NOT BE REPRODUCED BY ANY MEANS IN WHOLE OR IN PART OR USED AS THE BASIS FOR MANUFACTURE WITHOUT WRITTEN PERMISSION.

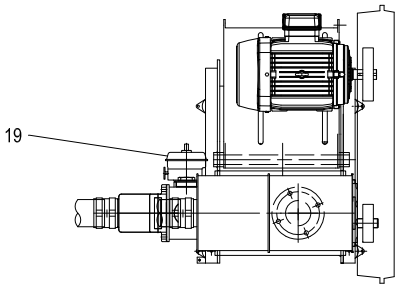


CONNECTION DETAILS



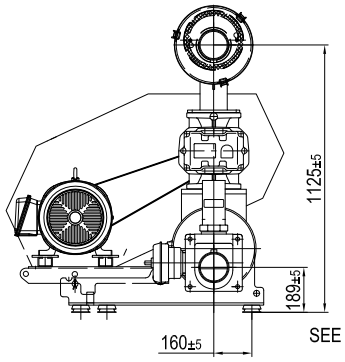
ANCHORING BY OTHER ANCHORING DETAILS

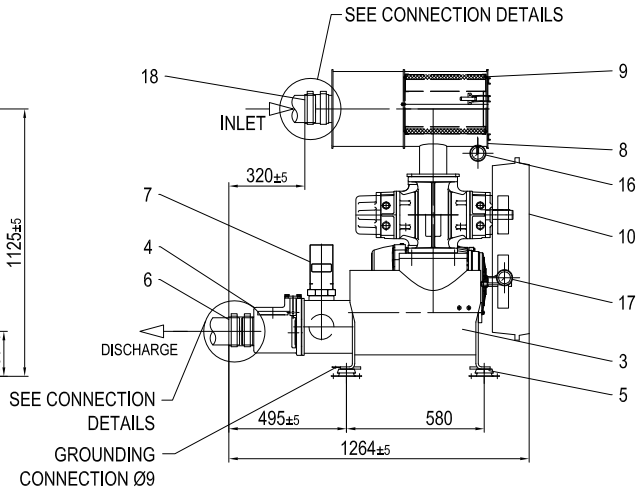
NOTE	QTY.	POS	DESCRIPTION
	1	1	BLOWER - GM 15L - 120 KG
D	1	2	ELECTRIC MOTOR - WEG 250T REPRESENTED
	1	3	BASE FRAME / DISCHARGE SILENCER - DN 100
	1	4	CONNECTION HOUSING WITH CHECK VALVE - DN 100
	4	5	VIBRATION ISOLATORS - DN 100
	1	6	DISCHARGE FLEXIBLE SLEEVE - DN 100 / 4" SCHED. 40
	1	7	PRESSURE RELIEF VALVE - DN 80 - SET TO 750 mbar
	1	8	INLET FILTER / SILENCER ASSEMBLY - DN 100
	1	9	INLET FILTER ELEMENT
	1	10	BELT GUARD
	1	11	DRIVER SHEAVE
E	1	12	DRIVER BUSHING
	1	13	DRIVEN SHEAVE
E	1	14	DRIVEN BUSHING
	1	15	V-BELT SET
	1	16	FILTER MAINTENANCE INDICATOR -MANN
	1	17	DISCHARGE PRESSURE GAUGE W/ ISOLATION BALL VALVE - WIKA
G	1	18	INLET FLEXIBLE SLEEVE - DN 100 / 4" SCHED. 40
G	1	19	UNLOADING VALVE

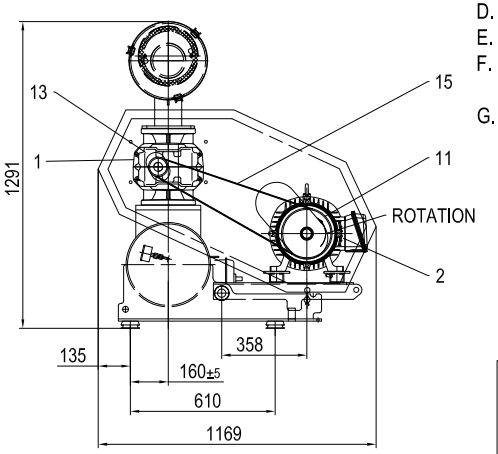


NOTES:

A. ASSEMBLY WEIGHT WITHOUT MOTOR: 357KG
B. PAINT: AERZEN STANDARD BLUE
C. 1M OF FREE SPACE AT THE FRONT OF THE PACKAGE IS RECOMENDED FOR MAINTENANCE ACCESS
D. MOTOR: WEG 250T REPRESENTED
E. NOT SHOWN ON DRAWING
F. FOR VARIABLE SPEED APPLICATIONS, CONSTANT TORQUE VFD ARE REQUIRED
G. OPTIONAL







AERZEN
AERZEN CANADA INC
1995 MONTEE LABOSSIERE, VAUDREUIL QC J7V 8P2
(450) 424-3966 PH, (450) 424-3985 FX

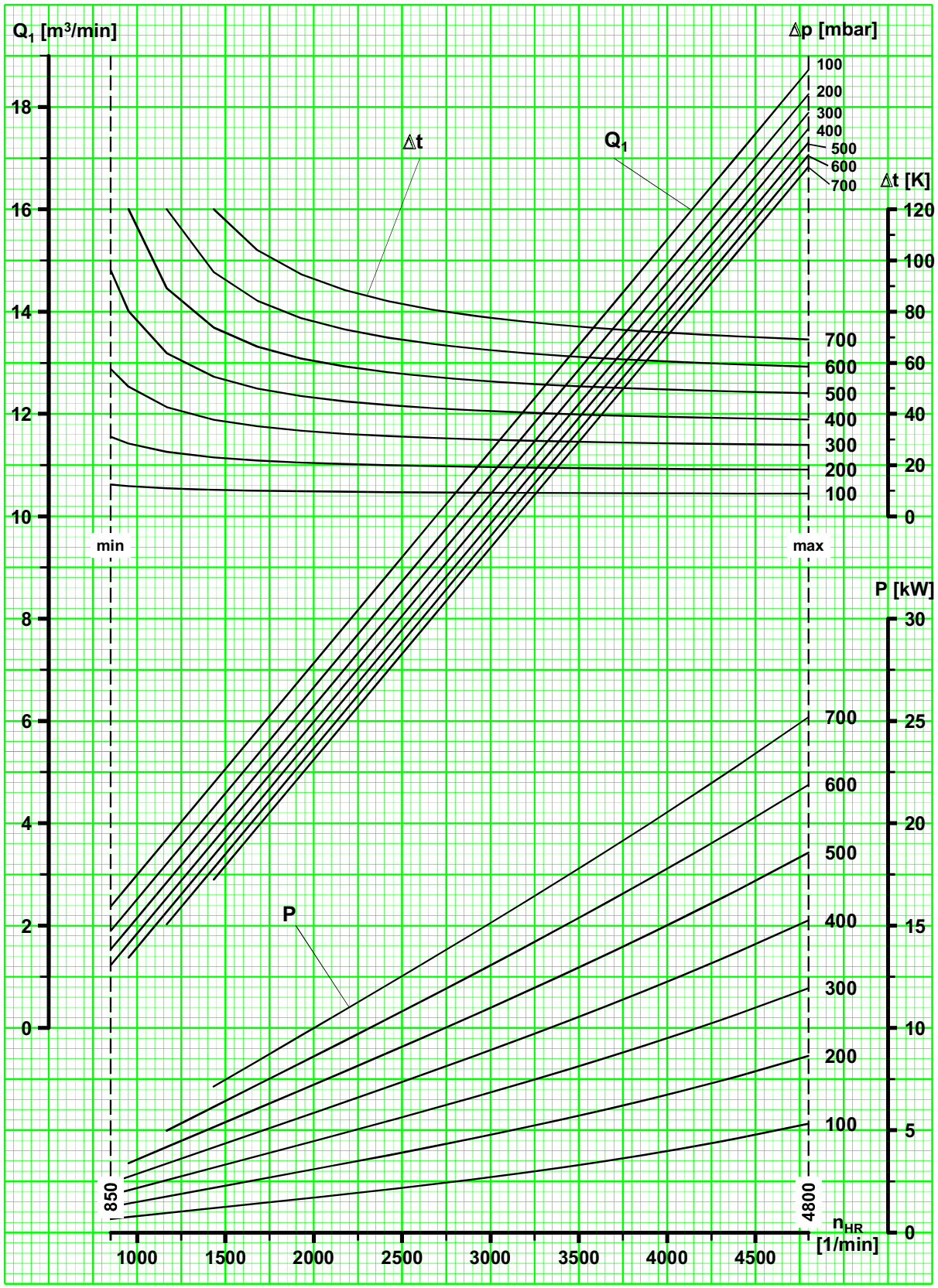
THIRD ANGLE PROJECTION

REVISION DETAILS						
REV	DRAWN BY	DATE	REVIEWED	DATE	DETAILS	AREA
B	LPM	16-10-12	LPM	16-10-12	UPDATE DIM GENERAL ARRANGMENT DRAWING	
A	D.L.	08/02/11	D.L.	02/08/11	RELEASE	-

TITLE: G5 - GM 15L DN 100 - PRESSURE
DWG NO.: 2ZG-9173
DRAWN BY: D. LEVESQUE
REVIEWED BY: D. LEVESQUE
DATE: FEBRUARY 08, 2011
REV: B
SCALE: NONE
SIZE: A
SHEET: 1 OF 1

Aerzener Maschinenfabrik GmbH
Reherweg 28 - D-31855 Aerzen - Telefon (0 51 54) 81 0 - info@aerzener.de - www.aerzener.com

4000323911 | ZTD | 00



Q_1 : Ansaugvolumenstrom (Luft) bei p_1 = 1,0 bar und t_1 = 20°C	intake volume flow (air) at p_1 = 1.0 bar and t_1 = 20°C	débit aspiré (air) pour p_1 = 1,0 bar et t_1 = 20°C
n_{HR} : Hauptrotordrehzahl	main rotor speed	vitesse du rotor principal
n_V : Antriebswellendrehzahl	drive shaft speed	vitesse de l'arbre d'entraînement
P : Leistungsbedarf an der Kupplung	power required at the coupling	puissance absorbée à l'accouplement
t : Temperaturerhöhung	temperature rise	élévation de température
p : Druckerhöhung	pressure difference	pression différentielle

Leistungsdiagramm - Überdruck - für Drehkolbengebläsestufe
performance diagram - overpressure - for stage of rotary piston blower
courbes de fonctionnement - fonctionnement en pression - pour étage de surpresseur à pistons rotatifs

GM 15 L

n_V / n_{HR} = 1	04/2016 TRD - Hallemann	G2 - 410 - XL SAP - 4000323911 - 00

TECO Westinghouse MOTORS (CANADA) INC.	
	Date: October 19, 2015

Technical Documentation

PDH02545

Optim TEFC | AEHH8N

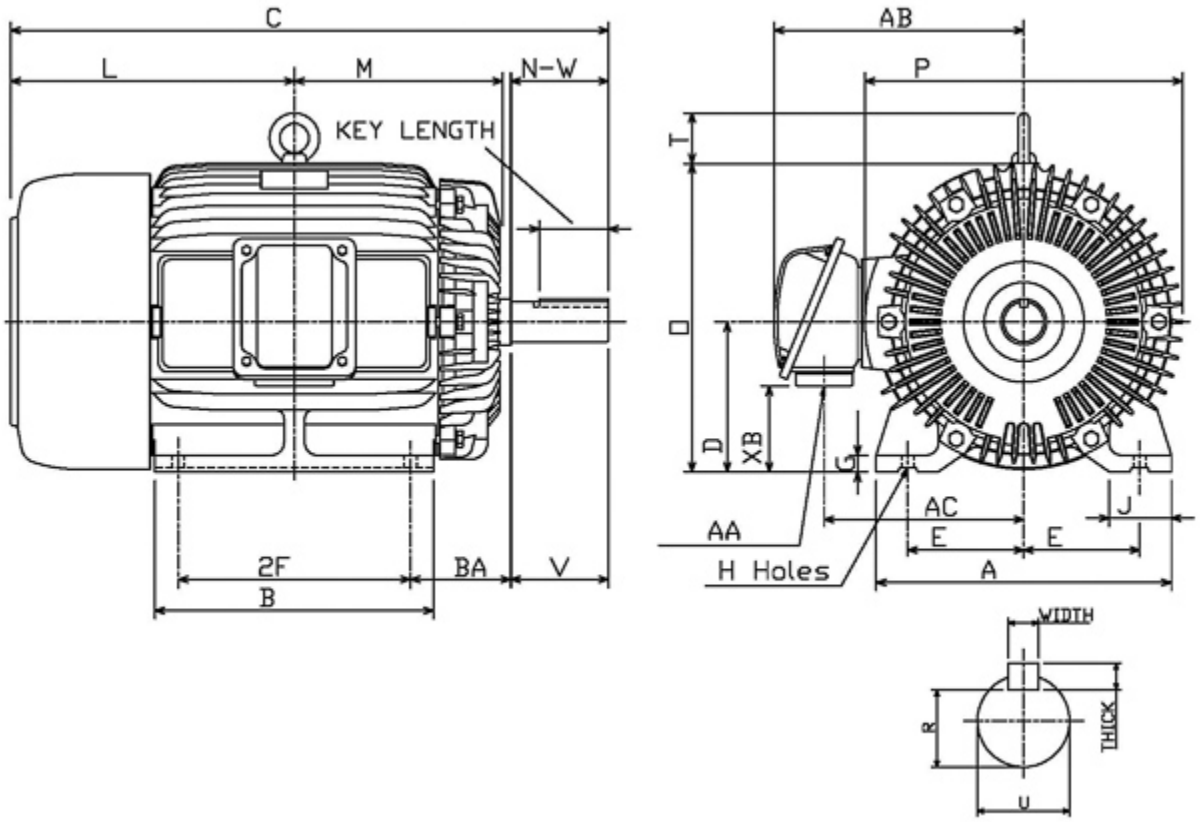
Date: October 19, 2015

TECO Westinghouse
MOTORS (CANADA) INC.

Date: October 19, 2015

Dimensional Drawing

Catalogue	Model	HP	Pole	kW	Rating	Voltage	Hz	RPM
PDH02545	AEHH8N	25	4	19	Continuous	575 V	60	1800



Frame Size	Mounting					A	B	C	CD	D
	E	2F	2F2	H	BA					
284T	5.5	9.5		0.53	4.75	14	11.7	26.8		7

G	J	K	L	M	O	P	T	Key			Keyseat
								Width	Thick	Length	R
0.7	2.95		12.68	9.23	14.52	15.04	1.97	0.5	0.5	3.28	1.591

Terminal Housing				Aux Box		C/D Flange					
AA	AB	AC	XB	AE	AX	BB	AH	AK	BD	AJ	BF
1.25 NPT	12.28	9.84	3.97								

Shaft Extension			Bearings		Approx. Weight Lbs	SPL dBA/3ft	Ins. Class	S.F.	Drive Method	Dimensions
N-W	U	V	DE	NDE						
4.62	1.875	4.5	6311ZZ	6310ZZ	464	68	F	1.15	Direct Coupling / Belt Drive	Inches

TECO Westinghouse
MOTORS (CANADA) INC.

Date: October 19, 2015

Technical Data Sheet

Motor Type: AEHH8N	Catalogue No: PDH02545

Nameplate Information

HP	Pole	RPM	Frame	Voltage	Hz	Phase
25	4	1765	284T	575	60	3
Enclosure	Ins. Class	Service Factor	Time Rating	NEMA Design	Rated Amb.	Rated Altitude
TEFC	F	1.15	Continuous	C	-40 to 40 °C	<3300 ft

Typical Performance

Efficiency (%)				Power Factor (%)		
Full Load		3/4 Load	1/2 Load	Full Load	3/4 Load	1/2 Load
Nom.	Min.					
93.6	92.4	93.6	93.6	86.0	83.0	77.0

Torque				Current (A)		
Full Load (lb-ft)	Locked Rotor (% FLT)	Pull Up (% FLT)	Break Down (% FLT)	No Load	Full Load	Locked Rotor
74.37	205	165	240	5.7	23.3	146

NEMA KVA Code	Inertia (WR^2)			Safe Stall Time (s)		Noise Level Sound Press. dB(A)
	Rotor ($lb\text{-}ft^2$)	NEMA Load ($lb\text{-}ft^2$)	Max. Allowable ($lb\text{-}ft^2$)	Cold	Hot	
G	4.586	122.0	255.0	28	20	68

VFD Duty Information

Speed Range			VFD		S.F.
Constant Torque	Variable Torque	Constant Power	Carrier	Type	
6-60Hz	3-60Hz	60-120Hz	≤ 5 kHz	VPWM or CPWM	1.0 Only

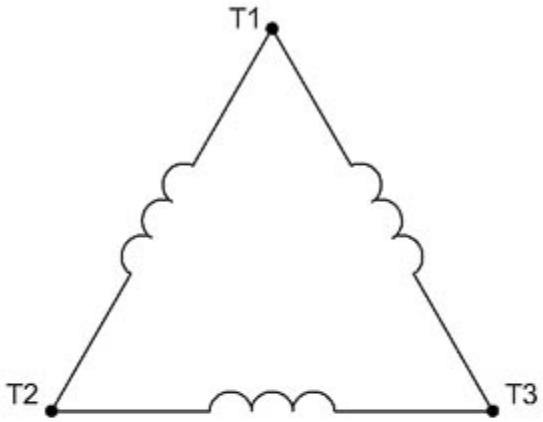
Additional Information

Bearings		Approx. Weight
DE	NDE	lbs
6311ZZ	6310ZZ	464

Hazardous Locations Information

CSA Certified	
Class I, Div 2, Groups B, C & D Class I, Zone 2, Groups IIB+H2, IIB & IIA	
Temp Code (Sinewave / VFD)	T3C / T3B

Connection Diagram



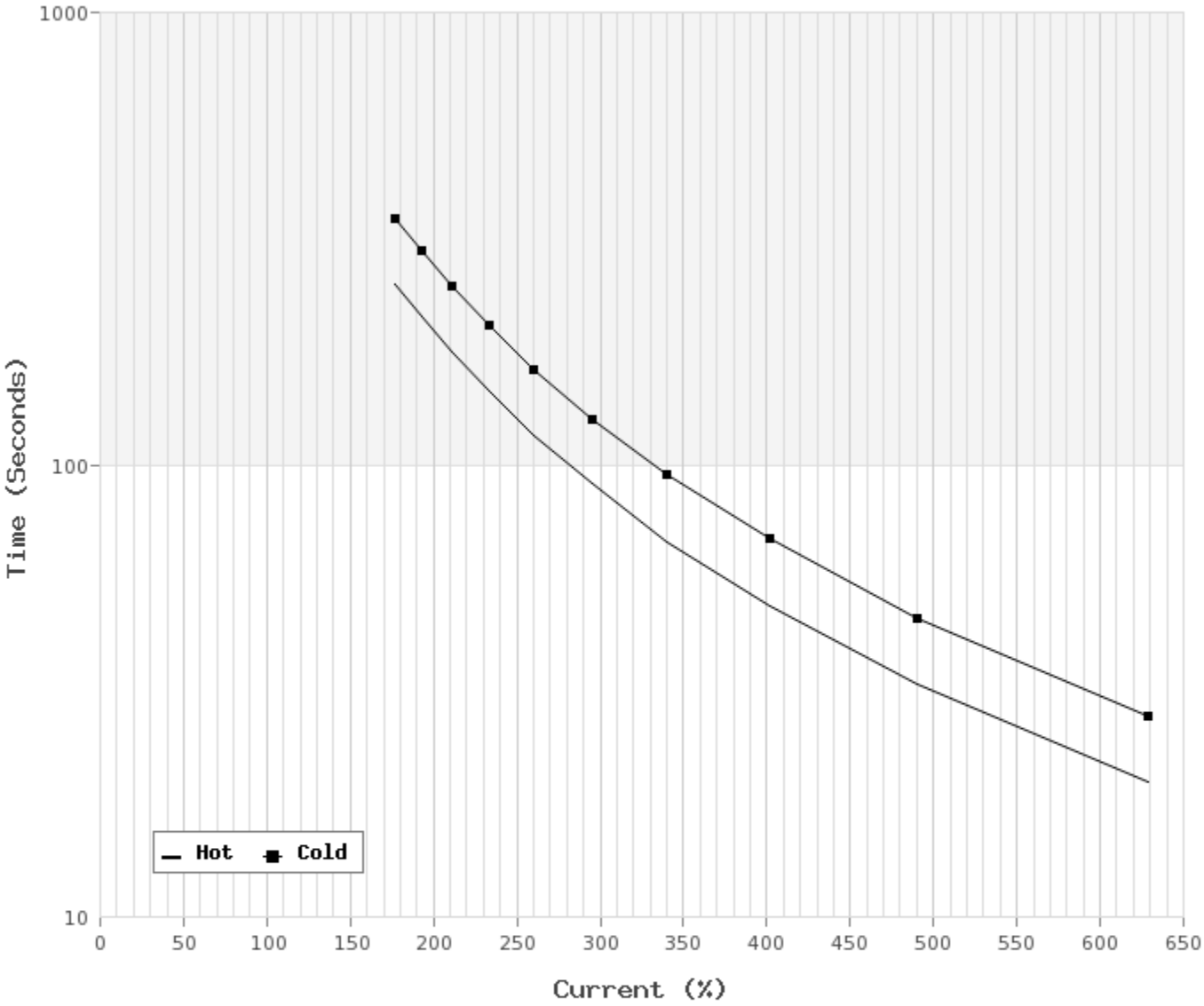
3 LEAD SINGLE VOLTAGE DELTA					
VOLTAGE	CONN.	L1	L2	L3	
-	DELTA	1	2	3	

WD_3D

TECO Westinghouse MOTORS (CANADA) INC.	
	Date: October 19, 2015

Thermal Limit Curves

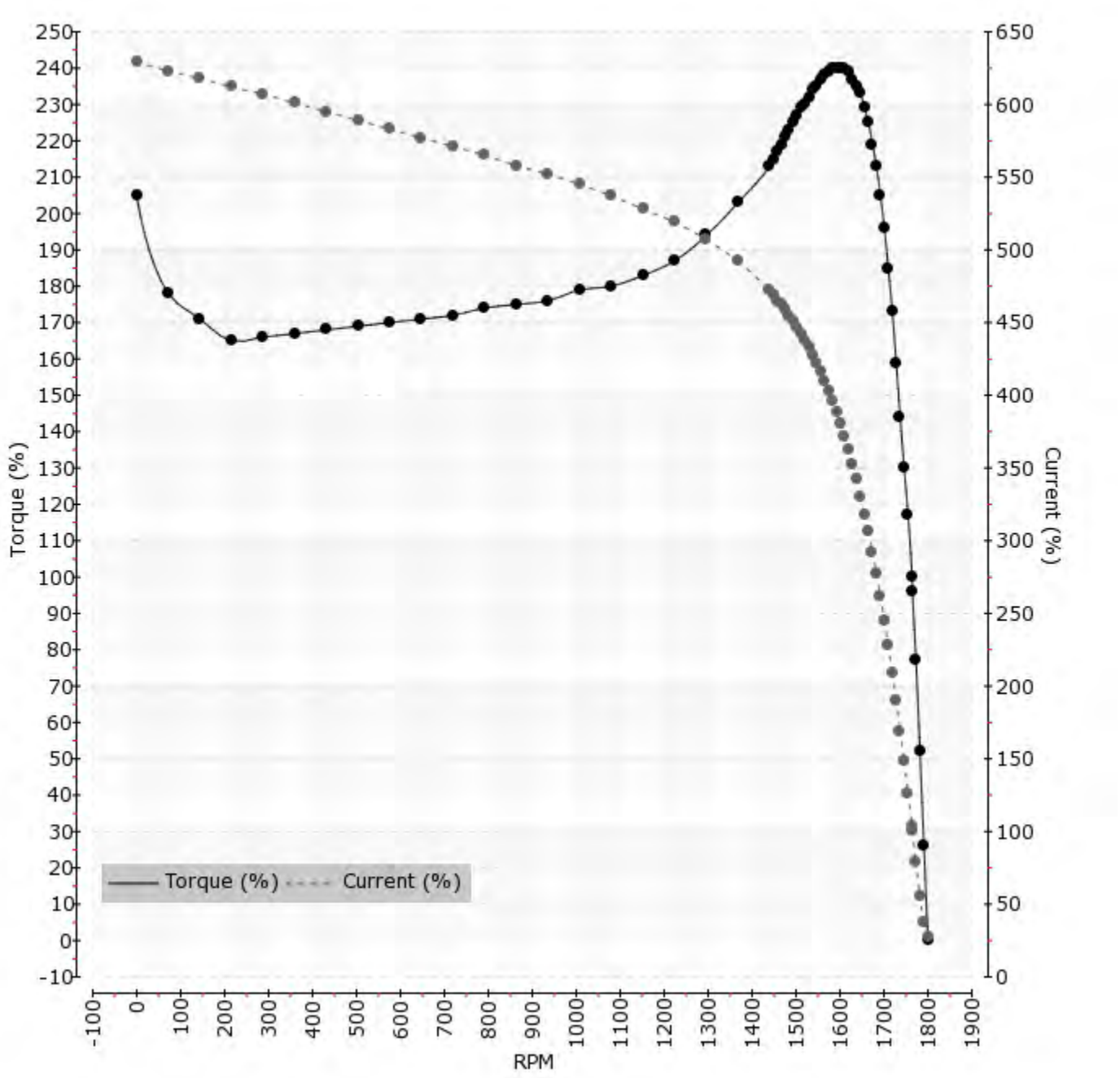
Motor Type: AEHH8N		Catalogue No: PDH02545		Family: Optim TEFC	
HP	25	Safe Stall Time		Full Load A	0.0 / 23.3 A
Voltage	0 / 575V 60Hz	Hot	20 s	Locked Rotor A	628 %
RPM	1800	Cold	28 s	Locked Rotor A	0.0 / 146 A



TECO Westinghouse MOTORS (CANADA) INC.	
	Date: October 19, 2015

T-N and I-N Curves

Motor Type: AEHH8N		Catalogue No: PDH02545		Family: Optim TEFC	
HP	25	Full Load T	74.37 lb-ft	Full Load A	23.3 A
Voltage	575V 60Hz	Locked Rotor T	205 %	Locked Rotor A	146.0 A
RPM	1800	Pull Up T	165 %	Break Down T	240 %



OPERATING INSTRUCTIONS

ROTARY PISTON BLOWER
DELTA BLOWER

Read the instructions prior to performing any task!
Keep for future reference!

G4-006 P EN

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Heiko Nickel / Angela Pedack

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1 General Information

1.1 Information about these instructions

These instructions allow for the safe and efficient handling of this machine. These instructions are an integral part of the machine and must be kept in the immediate vicinity of the machine so that it is accessible for personnel at all times. Keep these instructions in a safe place for future reference.

Personnel must read these instructions carefully and have understood them before beginning work. A fundamental requirement for working safely is compliance with all specified safety notes and guidelines in these instructions.

In addition, the local occupational health and general safety regulations apply to the machine's range of applications.

The diagrams in these instructions serve to provide the user with a basic understanding and may deviate somewhat from the actual design.

The following is a list of additional, supplementary documents:

Declaration of Conformity pursuant to the Machinery Directive	CE MRL 1012-1
Installation drawing	
Drive motor instruction manual	
Pressure valve instruction manual	G4-002...
Lube oil safety data sheet: only when using an AERZEN lube oil	SDB...
Further documentation as per the order confirmation	

1.2 Explanation of symbols

Safety instructions

Safety instructions in this manual are illustrated using symbols. The safety instructions are organised into signalling words which designate the level of danger posed.

DANGER!
This combination of symbol and signalling word points to an imminently dangerous situation that could be fatal or lead to serious injury if it is not avoided.

WARNING!
This combination of symbol and signalling word points to a potentially dangerous situation that could be fatal or lead to serious injury if it is not avoided.

CAUTION!
This combination of symbol and signalling word points to a potentially dangerous situation that could lead to minor injuries if it is not avoided.

NOTICE!
This combination of symbol and signalling word points to a potentially dangerous situation that could lead to material damage if it is not avoided.

ENVIRONMENT!
This combination of symbol and signalling word points to a potential risk for the environment.

Safety instructions as part of operating guidelines

Safety instructions may relate to certain individual operating guidelines. These safety instructions are integrated into the operating guidelines themselves so as to simplify the task of reading while carrying out work. The signalling words mentioned above are used.

For example:

1. Loosen screw.
2. **CAUTION!**
   Pinch hazard on the cover!

   Close cover carefully.
3. Tighten screw.

Tips and recommendations

This symbol draws attention to useful tips and recommendations as well as information about efficient and trouble-free operation.

Special safety instructions

To draw attention to exceptional hazards, the following symbols are used as part of the safety instructions:

Warning signs	Type of danger
	Warning – automatic start-up.
	Warning – hand injuries.
	Warning – high-voltage.
	Warning – flammable substances.
	Warning – danger zone.

Additional designations

To draw attention to operating guidelines, events, listings, references and other elements in this manual, the following designations are used:

Designation	Explanation
1., 2., 3. ...	Step-by-step operating guidelines
	References to sections of this manual and to relevant documentation
	Lists without a designated sequence
[push-button]	Control elements (e.g. push-buttons, switches), display elements (e.g. signal lamps)
'Display'	Screen elements (e.g. buttons, allocation of function keys)

1.3 Copyright protection

The contents of this manual is protected by copyright. The use of this manual is permitted within the framework of machine use. Any other use is excluded unless there is written approval by the manufacturer.

1.4 Addresses

1.4.1 Manufacturer

Manufacturer

Address	Aerzener Maschinenfabrik GmbH Reherweg 28 31855 Aerzen Germany
Telephone	+49 (0) 51 54 8 10
Fax	+49 (0) 51 54 8 11 91
E-mail	info@aerzener.de
Internet	www.aerzen.com

1.4.2 Customer service

Our customer service staff are on hand to provide you with technical information:

After sales service/service contact

Address	Aerzener Maschinenfabrik GmbH Reherweg 28 31855 Aerzen Germany
Service hotline	+49 171 3 51 18 34
E-mail	info@aerzener.de
Internet	www.aerzen.com

In addition, we are always interested in receiving information and feedback pertaining to machine use that could be useful in helping us improve our products.

2 Safety

This section gives an overview of all important safety aspects relevant to the protection of persons and to safe and trouble-free operation. Further task-based safety instructions are contained in the section on the individual phases of the machine's service life.

Non-compliance with the handling and safety instructions provided in this manual can lead to serious hazards.

The following section outlines the residual risks and hazards during the service life of the product that may arise as a result of non-compliance with safety instructions or the disabling of safety devices.

In order to reduce health and safety risks and to avoid dangerous situations, observe the safety and warning notes in this manual.

2.1 Residual risks / fundamental risks

The following section states the general residual risks that have been established on the basis of a risk analysis.

- To reduce the risk of personal injury, property damage and environmental contamination and to avoid dangerous situations, observe the safety instructions described here and the safety instructions in the chapters on machine use.

2.1.1 Electrical hazards

Electric current

DANGER!

Risk of fatal injury from electric current!

Coming into contact with live parts poses an immediate and potentially fatal risk of an electric shock. Damage to insulation or individual components can prove fatal.

- Work on the electrical system should only be carried out by qualified electrical personnel.
- If the power supply's insulation is damaged, switch off the machine immediately and have the damage repaired.
- Before starting to work on active parts of the electrical systems and operating equipment, ensure that the machine is completely disconnected from any power source and remains so for the for the duration of the work.

  When doing this observe the following 5 safety rules:
  - Disconnect the machine completely.
  - Secure the machine against restarting.
  - Confirm that the machine is completely disconnected from any power source.
  - Earth and short-circuit the device.
  - Cover or shut off adjacent live parts.
- Never bypass or deactivate fuses.
- When changing fuses, comply with the correct specified amperage.
- Keep moisture away from live parts. Moisture can cause the machine to short-circuit.

Stored charges

DANGER!

There is a risk of fatal injury from stored charges!

Electrical charges can be stored in electronic components and maintained even after the deactivation and separation of the electric power supply. Coming into contact with these components can lead to fatal injuries.

- Observe all applicable safety rules.
- Before performing any work on the listed components, disconnect them completely from the power supply.
- Observe a waiting period of 15 minutes under all circumstances! This will allow the internal capacitors to discharge.
- Measure to ensure there is no live voltage!

Operating faults caused by short-circuiting

WARNING!

Risk of injury from operating faults!

If the electrical system short circuits this can render the entire system inoperable. Operating faults can lead to serious injuries.

– Connect the machine's earthing connections and acoustic hood to the local equipotential bonding rail.
– Install a fault-current circuit breaker in order to prevent sparks and contact voltage in the event of a fault.
– After all work on the machine has been carried out, ensure that the earthing connection and equipotential bonding are connected correctly.

2.1.2 Hazards associated with the acoustic hood

Inside the acoustic hood

DANGER!

Risk of injury if the acoustic hood is open during operation!

By opening the acoustic hood while the machine is in operation there is a risk of direct contact with hazardous zones, e.g. hot surfaces or rotating or moving components.

– Never open the acoustic hood while the machine is in operation or in stand-by mode.
– Never stand on or reach into the acoustic hood while the machine is in operation.
– Always lock the acoustic hood with the key provided and keep it locked.
– Only allow authorised personnel access to the key.

Falling parts

CAUTION!

Risk of injury from unsecured parts of the acoustic hood!

Unsecured parts of the acoustic hood can lead to injuries if they fall from the machine.

– Secure loose elements against falling.
– Always wear protective gear.
– Have a second person help you.

Air flow at the air outlet

CAUTION!

Risk of injury from the strong air flow at the air outlet of the acoustic hood!

Strong air flows at the air outlet on the acoustic hood can suck in dirt particles from the environment and disperse them.

– Avoid standing in the direct vicinity of the air flow.
– Wear safety goggles and a safety mask.

Noise

WARNING!

Risk of injury from noise!

The noise level present at the installation area can cause hearing damage. The magnitude of the noise level is dependent on operational data, among other factors.

– Never undertake measures to bypass or deactivate sound insulation.
– Wear hearing protection while working.
– Only stand in the high-noise-level area if it is absolutely necessary.

Risk of falling

CAUTION!

Risk of injury from standing on the acoustic hood!

Standing on the acoustic hood carries with it a risk of injury from the potential collapse of the roof elements. Persons could fall into the internal area of the machine.

– Never stand on the acoustic hood.
– Never exert pressure on roof elements.

Spark-generating work

WARNING!

Risk of fire and injury / damage to property from spark-generating work in the immediate vicinity of the machine!

Welding or cutting work on the machine or in the immediate vicinity of the machine can cause fire to break out. This can result in damage to property or personal injury.

Sparks and incandescent or flammable objects could be sucked in through the air openings on the acoustic hood or through the intake silencer. The ventilator can fan flames leading to the formation of smouldering objects. The insulation material may, under unfavourable conditions, begin to smoulder.

– Avoid allowing sparks to fly in the direction of the machine.
– Never carry out work that generates sparks while the machine is in operation.

Risk of fire and injury

WARNING!

Risk of fire from easily-flammable materials that are sucked into the machine!

Easily-flammable material, fluids or gases can be sucked into the machine and cause it to catch fire. This can lead to serious or fatal injuries.

– Never allow flammable materials to be sucked into the machine.
– In case of emergencies, have extinguishing agents (fire blanket, fire extinguisher, fire-extinguishing powder for fire class A, B, C) at hand.
– Immediately report suspicious materials, liquids or gases to the responsible persons.
– In case of fire, stop your work immediately and make an emergency call.

Use of non-original belts

WARNING!

Risk of fire and injury from using non-original belts!

If, for a number of possible reasons, the machine is running sluggishly or is blocked, the belts may slip if non-original belts are being used. This results in heat generation which may lead to a fire.

– Only use original belts from the machine manufacturer.
– Adhere strictly to the designated belt type, as only this type will have the required characteristics.
– Never select and use random belts.
– Activate motor overload protection and observe the setting values.

2.1.3 Risks of machines with belt guard

Lärm

WARNING!

Risk of injury from noise!

The noise level present at the installation area can cause severe hearing damage. The magnitude of the noise level is dependent on operational data, among other factors.

– Never undertake measures to bypass or deactivate sound insulation.
– Wear hearing protection while working.
– Only stand in the high-noise-level area if it is absolutely necessary.

Spark-generating work

WARNING!

Risk of fire and injury / damage to property from spark-generating work in the immediate vicinity of the machine!

Welding or cutting work on the machine or in the immediate vicinity of the machine can cause fire.

Sparks and incandescent or flammable objects could be sucked in through the intake silencer. The air flow can fan flames leading to the formation of smouldering objects. The insulation material may, under unfavourable conditions, begin to smoulder.

– Avoid allowing sparks to fly in the direction of the machine.
– Never carry out work that generates sparks while the machine is in operation.

Risk of fire and injury

WARNING!

Risk of fire from easily-flammable materials that are sucked into the machine!

Easily-flammable material, fluids or gases can be sucked into the machine and cause it to catch fire. This can lead to serious or fatal injuries.

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- Only use original belts from the machine manufacturer.
- Adhere strictly to the designated belt type, as only this type will have the required characteristics.
- Never select and use random belts.
- Activate motor overload protection and observe the setting values.

2.1.4 Hazards at the installation and operating areas

Securing the machine against restarting

DANGER!

An unauthorised or unregulated restart can have fatal consequences.

An unauthorised or unregulated restart of the machine can lead to serious or fatal injuries. There may be people located in the hazard zone. Activating the energy supply and starting the machine could result in those people being fatally injured.

- Prevent the machine from restarting by:
  - disconnecting the electrical power supply.
  - activating the EMERGENCY STOP function
  - operating the main circuit breaker
  - attaching a padlock to the main circuit breaker
  - checking and ensuring that the machine is completely disconnected from the power source
  - displaying a sign on the machine that prohibits a machine start
  - displaying a sign on the remote station that prohibits a machine start
- Before restarting, ensure that safety devices are installed and functioning correctly and that there are no potential hazards to the safety of any persons.

Water contact with live components

DANGER!

Risk of fatal injury from water contact with live components!

Risk of fatal injury from cleaning operations using water. Water may be brought into contact with live components through inattention. Water spray may enter electrical and electronic components.

- Do not use water.
- When performing cleaning operations, proceed with care and make sure that no water comes into contact with live components.
- Water spray must not enter electrical and electronic components.
- Respective areas must under no circumstances be cleaned using a high-pressure jet.

Unexpected machine start

WARNING!

Risk of injury or personal shock if the machine starts suddenly!

For example, an upstream control command could be sent to the machine so that it starts operating!

- Deactivate the machine for all work and secure it against restarting.
- Be prepared for a machine start to occur at any time. Be prepared to react calmly to surprises.

Sharp edges and corners

CAUTION!

Risk of injury from sharp edges and corners!

Sharp edges and corners can cause excoriations and cuts on the skin.

- If working in the vicinity of sharp edges and corners, proceed with caution.
- If in doubt, wear protective gloves.

Intake components

WARNING!

Risk of injury from intake components!

Intake-side silencers, at their inlets, suck in ambient air with great force.

- During operation, never place body parts or objects in front of the inlet of the silencer.
- Maintain a safe distance from intake components.

Sudden gas emission

CAUTION!

Risk of injury from the sudden gas emission!

Components such as intake pressure valves and start-up relief devices may open suddenly during operation and emit hot compressed gas. Dust particles may be blown around.

- Never attempt to look inside the blow-off opening.
- Wear safety goggles when in the immediate vicinity of these components.
- Never close the blow-off opening.
- Always keep the blow-off opening clean.

Vibrations

WARNING!

Risk of injury from vibrations!

Vibrations may, in the long term, lead to injuries and chronic damage to personal health. The vibration source is decoupled from the surrounding environment by means of a vibration damper.

- Do not deactivate the vibration damper.
- Avoid coming into contact with vibrating areas.

Build-up of fluids

CAUTION!

Risk of injury from slipping as a result of a build-up of fluids!

Slipping on fluids that have built up on the floor area may lead to a fall. A fall may result in injury.

– Immediately remove built-up fluids with a suitable medium.
– Wear non-slip safety shoes.
– Place a warning notice and mandatory sign on or in the vicinity of any area where there could be a build-up of fluids on the floor area.

2.1.5 Mechanical hazards

Rotating components

WARNING!

Risk of injury from rotating components!

Rotating components may cause serious injury.

– During operation never reach into or perform work on rotating components.
– Never open covers during operation.
– Observe the lag time: before opening covers, make sure that no components are still moving.
– When in a hazard area, wear tight-fitting protective work clothing with minimal tensile strength.

Risk of crushing and shearing injuries

WARNING!

Risk of crushing and shearing injury from the hinged motor support!

Risk of injury from moving or adjusting the hinged motor support!

– When transporting the machine, always have the hinged motor support fixed in place.
– Never step or reach into the swivelling range of the hinged motor support.

2.1.6 Thermal hazards

Hot surfaces

WARNING!

Risk of injury from hot surfaces!

Component surfaces may become very hot during operation. Skin contact with hot surfaces causes serious burns.

- For all work performed in the vicinity of hot surfaces, always wear protective work clothing and protective gloves.
- Before beginning any work, ensure that all surfaces have cooled down to the environment temperature.

Hot media

WARNING!

There is a risk of injury from the sudden emission of hot media from the valve, e.g. a pressure valve!

The emission of hot media may lead to scalding.

- Never stand in the immediate vicinity of the outlet vent.
- Never attempt to look inside the outlet vent.
- Never close or cover the outlet vent.

2.1.7 Risks from pressurised components

Pressurised components

WARNING!

Risk of injury from compressed conveyed materials!

When disassembling pressurised components, or in the case of a fault in a pressurised component such as pipes, containers, hoses or valves, hot conveying material can escape with a strong gas flow. This can result in serious injury.

- Before beginning work, fully relieve pressurised components of pressure.
- Check that components are not pressurised.
- Replace malfunctioning components immediately.
- Only disassemble pressurised components when they are not under pressure.

Noise during disassembly

CAUTION!

Risk of injury from noise during the disassembly of pressurised gas pipes!

For the disassembly of pressurised components, such as pipes, containers, hoses or valves, hot conveying material is released, resulting in noise. This can cause hearing damage.

– Before beginning work, fully relieve pressurised components of pressure.
– Check that components are not pressurised.
– Only disassemble pressurised components when they are not under pressure.

2.1.8 Risks from hazardous substances

Hazardous substances

WARNING!

Risk of poisoning from hazardous substances! Risk of skin irritation and allergic reactions!

Substances such as lubricants and cleaning agents contain hazardous ingredients. These may lead to serious poisoning, skin irritation or allergic reactions.

– Observe the safety data sheets.
– Avoid shaking these substances and avoid fog formation.
– If inhalation occurs, bring the affected person out into the fresh air immediately. Seek medical help.
– If a substance is swallowed, seek medical help immediately. The mouth must be rinsed out thoroughly with water.
– Avoid skin and eye contact:
  Before working with these substances apply suitable hand protection cream.
  Wear plastic or rubber protective gloves.
– Remove contamination of the workspace correctly and in an environmentally friendly way. Lubricants and cleaning agents must not enter the sewerage system or run into soil.
– When working with these substances do not eat, drink or smoke.

Hazardous dust

WARNING!

Risk of injury from rising dust!

Dust deposits may rise during machine operation.

Inhaling this dust may, in the long term, lead to lung damage or other health problems.

– Avoid the relevant hazardous area.
– For all work in the hazard zone wear light respiratory protection.

2.1.9 Risks from flammable substances

Fire hazard

WARNING!

Risk of fire from spark-generating work and ignition sources in the immediate vicinity of the machine!

Easily-flammable substances, fluids or gases may catch fire and cause serious or fatal injury.

– Take measures to protect against the build-up of steam in deep-lying or closed areas.
– Take measures to protect against electro-static pressure charging.
– Do not smoke in the hazard zone or in the direct vicinity of the machine.
  Do not use naked lights, fire or ignition sources of any kind.
– Immediately report suspicious materials, liquids or gases to the responsible persons.
– Have extinguishing agents (fire-extinguishing powder) for fire class A, B, and C at hand.
– In case of fire, stop your work immediately. Leave the hazard zone until it is safe to return and notify the fire brigade.

Improper fire protection

WARNING!

There is a risk of injury and material damage from limited or improper fire protection!

If, in case of fire, the fire extinguisher is not operational or not suited to the specific class of fire, there is a risk of serious or fatal injury and considerable material damage.

- Ensure that only suitable fire extinguishers (fire-extinguishing powder for fire class A, B, and C) are at hand.
- Inspect fire extinguishers every two years to ensure they are functioning correctly.
- Refill a fire extinguisher after each use.
- Only use extinguishing agents and replacement parts that correspond to the specified, recognised model on the fire extinguisher.
- In case of use, observe the safety and operating instructions on the fire extinguisher.

2.1.10 Risks associated with conveyance of nitrogen

Leaking gas

DANGER!

Risk of suffocation from build-up of leaking gases during nitrogen conveyance!

Gaseous nitrogen displaces the oxygen in the room. High concentrations can cause persons to suffocate. Symptoms here include the loss of physical mobility and loss of consciousness. The person affected do not notice that they are “suffocating”. Escaped nitrogen can accumulate in recesses, wells, acoustic hoods etc.

- Avoid the occurrence of leaks.
- Ventilate the installation site properly.
- Set the lag time for the fan of the acoustic hood and pay close attention to it.
- After a machine downtime, ventilate the machine for a period.
- Guide leaking gases directly out of the machine.
- Guide leaking gases directly into a collective line.

Leaking gases during machine downtime

DANGER!

Risk of suffocation from build-up of leaking gases during machine downtime!

Depending on the type of sealing used, gaseous nitrogen can escape into the environment during machine downtime. This can lead to a build-up of gases inside the acoustic hood or at the installation site. High concentrations can cause persons to suffocate.

– Interrupt the flow of nitrogen into the conveying system.
– Guide nitrogen away using a collective line.
– Ventilate the installation site properly.

Build-up of gas

DANGER!

Risk of suffocation from build-up of nitrogen during conveyance!

The opening of the valve releases nitrogen from the system. There may be a build-up of gas with high concentrations of nitrogen.

Gaseous nitrogen displaces the oxygen in the room. High concentrations of nitrogen can cause persons to suffocate. Symptoms here include the loss of physical mobility and loss of consciousness. The persons affected do not notice that they are “suffocating”.

Escaped nitrogen can accumulate in recesses, wells, acoustic hoods etc.

– Avoid a build-up of gas
– Guide gases directly out of the machine.
– Guide gases directly into a collective line.
– Ventilate the installation site properly.

2.2 Intended use

Fig. 1: Correct use

The **positive displacement blower** machine is intended for conveying and compressing air and non-flammable gases.

The **positive displacement blower** machine is intended for operation with non-flammable gases in a non-explosive atmosphere.

The **positive displacement blower** machine has been designed and constructed solely for its “intended use” in the industrial field, as described here.

Observe and comply with the job-based operating data and operational limits!

This intended use also includes compliance with all information in this instruction manual.

Any application that deviates from the intended use, or any other type of non-standard application, is considered misuse.

Operating data that deviate from the standard must be coordinated with the manufacturer.

2.3 Foreseeable misuse

Serious injury

DANGER!

Danger in case of misuse! Dangerous situations could occur that may lead to fatal or serious injury!

- Never disregard the instructions for “intended use”.
- Never operate the machine in an operating area other than the one intended.
- Never convey or compress gases that are not listed in the order confirmation and the technical data.
- Never disregard the following information on misuse.

Serious material damage

NOTICE!

Danger in case of misuse! Dangerous situations could occur that may lead to serious machine damage!

- Never disregard the instructions for “intended use”.
- Never operate the machine in an operating area other than the one intended.
- Never convey or compress gases that are not listed in the order confirmation and the technical data.
- Never disregard the following information on misuse.

Misuse

Fig. 2: Prohibited use

The machine is not intended for:

- Conveying media in solid, liquid or powder form.
- Conveying caustic media.
- Conveying corrosive media.
- Conveying flammable or poisonous gases, vapours or mists.
- Alteration, retrofitting or modification of the overall design or of individual equipment parts, with the aim of altering the field of application or scope of use.

Further examples of misuse

The following operating modes/applications and uses are considered improper and must be avoided!

- **Operation:**
  - outside the scope of intended use.
  - outside the scope of the intended operating data.
  - using gases other than those originally intended.
  - with the machine operating in the incorrect direction of rotation.
  - in a potentially-explosive atmosphere.
  - with closed flange connections.
  - with missing or damaged components.
  - without a correctly connected control system, fault transmitter, EMERGENCY STOP function.
  - without any or with damaged protective equipment.
  - with contaminated intake filter/starting strainer.
  - without sufficient ventilation of the room.
  - activation while the machine is coming to a stop or when it is rotating backwards.
  - pole changing to a lower rotational speed before the drive motor has come to a standstill.
  - non-compliance with maintenance intervals.
  - filling beyond the maximum oil level.
- **Operation without:**
  - air filter
  - pressure valve
  - intake silencer
  - oil
- **Applications:**
  - using the machine to “purge” blockages in the conveying pipes. exceeding the maximum permissible discharge pressure.
  - using the pressure valve to regulate the operating data.

- **Installation:**
  - installation on inclined, sloped or lamellar surfaces.
  - installation outdoors without due consideration of particular protective measures for avoiding the effects of weather conditions.
  - attachment of transportation equipment to the acoustic hood.
  - open flames or spark formation in the immediate vicinity of the machine.

2.4 Responsibility of the operator

Operator

The operator is the person who operates the machine himself, for commercial or business purposes, or who assigns the use/application of the machine to a third party. During operation, the operator holds legal responsibility pertaining to the product, for the protection of the user, personnel or third party.

Operator's obligations

The machine is used for commercial purposes. The operator of the machine is thus subject to the applicable legal obligations for occupational safety.

Alongside the safety instructions in this instruction manual, the safety, occupational and environmental regulations relevant to the field of application must also be complied with.

The operator is obligated to:

- Inform himself about the applicable occupational protection regulations. As part of a hazard assessment, the operator must also establish the hazards that could result from special working conditions at the machine location. He must implement these for the operation of the machine in the form of operating instructions. The necessary safety data sheets can be obtained from the relevant manufacturer.
- During the entire service life of the machine, check that the operating instructions created by the manufacturer correspond to the current status of the applicable regulations. If necessary, adjust the operating instructions accordingly.
- Clearly structure and specify the responsibilities for installation, operation, fault rectification, maintenance and cleaning.
- Ensure that all persons who come into contact with the machine have read and understood these instructions. in addition, the operator must regularly provide personnel training as pertains to machine use and inform personnel of the related hazards.
- Provide personnel with the necessary protective equipment and communicate to personnel that the wearing of this protective equipment is compulsory.

In addition, the operator is responsible for ensuring that the machine is in perfect technical condition.

For this reason the following applies:

- The maintenance intervals described in this instruction manual must be complied with.
- All safety devices must be regularly inspected to ensure they are in good working order.

Additional obligations

The operator must ensure that the following requirements are complied with and put into practice:

- The machine is only operated in its original delivered condition. In cases where the operator adds his own fittings or makes modifications, the manufacturer's declaration of conformity is rendered void.
- Any working behaviour that jeopardises the safety of the machine is prohibited.
- The machine must always be kept in a technically-perfect and operationally-safe condition. Replace damaged or non-operational components immediately. If in doubt, be sure to contact the manufacturer or the responsible contact person.
- Do not operate the machine when the protective equipment has been disassembled or disabled.
- Observe all warnings and notices displayed on the machine and make sure they are readable. You must replace loose or illegible signs. Ask the manufacturer for replacements.
- Install the separately provided components listed in the scope of delivery onto the machine and incorporate these into the overall safety concept.
- Do not disassemble or incorrectly fit any electrical, mechanical or hydraulic connections.
- For protection against potential damage caused by lightning, make sure a suitable earthing system is in place.
- If the conveyed medium tends to form condensate, the condensate must be bled off (e.g. using discharge tanks, residual gas pipes or by briefly opening the lower condensation holes).
- Separate dusty material before it enters the machine. Material that collects in the conveying chamber or the rotors presents a particular danger for the working safety of the machine.

Operator's obligations at the installation site

The operator must ensure that the following requirements are complied with and put into practice:

- Machine use only in a stable three-phase power supply. Voltage fluctuations / drops beyond the tolerance level may cause serious damage to the drive system.
- Activate motor overload protection.

- For system variants without a main circuit breaker featuring an EMERGENCY STOP function, the safety circuit of the machine should be incorporated into the EMERGENCY STOP concept for the overall system. Ensure the accessibility of additional EMERGENCY STOP switches in the vicinity of the machine.
  The machine must be equipped with one or more EMERGENCY STOP command devices for the purposes of operation.
  The EMERGENCY STOP function must be available and operational at all times, independent of the operating mode.
- It must not be possible for a powered-down machine to start automatically.
- For the purposes of operation, the machine must be equipped with a command device that shuts down the machine in dangerous situations.
  The power supply to the motor must be cut off.
  If this is not possible, the “standstill” operating condition must be monitored and maintained.
- Avoid electrostatic charges. Connect an equipotential bonding.
- For accidents and emergencies, incorporate emergency measures for the machine into the overall emergency measures. Make particular efforts to integrate these measures into the evacuation and rescue plan and the fire warning plan.

2.5 Replacement parts

Use of incorrect replacement parts

CAUTION!

Safety risk from using incorrect replacement parts!

Incorrect, defective or unsuitable replacement parts or copies of original components may endanger personal safety and lead to damage, faults or the total failure of the machine.

– Only use the manufacturer’s original replacement parts or parts approved by the manufacturer.
– If in doubt, always contact the manufacturer.

Purchase replacement parts from an authorized dealer or from the manufacturer directly. For contact information see Customer service *on page 11*.

Replacement parts

Replacement parts that have not been provided by AERZEN have not been tested or approved. They do not correspond to the original components. The use of such products can potentially have an effect on the default design characteristics of the system. The manufacturer assumes no liability for damage resulting from the use of non-original components.

2.6 Requirements for personnel

2.6.1 Qualifications

The various tasks described in this instruction manual represent a variety of requirements in terms of the qualifications of the persons responsible for carrying out these tasks.

Insufficient qualifications

WARNING!

Risk if persons are not sufficiently qualified!

Insufficiently qualified persons are unable to gauge the risks presented by the use the machine and put themselves, and others, at risk of serious or fatal injury.

- Only allow work to carried out by suitably qualified persons.
- Observe the information on qualifications in this manual.
- Keep insufficiently qualified persons away from the operating range of the machine.

For the purposes of all work with this machine, only allow persons who are expected to carry out their work reliably to do so. Persons whose reaction times have been impaired, e.g. through drug or alcohol consumption or medication, must not be permitted to work.

This instruction manual contains the following qualification requirements for the various tasks:

Authorised electricians
Authorised electricians, on the basis of their field-specific training, expertise, experience and knowledge of the relevant standards and requirements, are able to carry out their work on electrical systems safely while independently recognising and avoiding hazards.

Authorised electricians are specially trained for the environment in which they work and are familiar with the relevant standards and requirements.

Authorised electricians with additional qualifications
Authorised electricians have the additional qualifications needed for working in the field of frequency converters and EMC. Authorised electricians are familiar with the relevant standards and requirements.

Written documentation acts as proof of a completed safety instructional course and evidence of the necessary additional knowledge.

Due to their additional qualifications, these authorised electricians are able to carry out work on electrical systems with frequency converters and can independently recognise and avoid possible hazards. The additional skills that constitute this qualification should be taught through regular practical application.

Manufacturer's customer service division
Certain work may only be performed by the customer service division of the manufacturer. On the basis of its special, field-specific training, expertise and experience, the customer service division is up to the task of performing highly-skilled work.

The customer service division is a competent point of contact for all stages of the machine's service life. It is able to perform all work on the machine with the highest efficiency.

Service personnel
Service personnel are able to carry out their work on the basis of their field-specific training, expertise, experience and knowledge of the relevant standards and requirements. Personnel recognise hazards independently and avoid risks.

Service personnel in particular possess practical experience and extensive field-specific expertise for the variety of tasks.

- Transport
- Set-up / installation
- Commissioning
- Maintenance
- Fault rectification
- Disassembly

Depending on the designated job, the person must have additional qualifications:

- Operation and handling of compressors.
- Parameterisation of compressors.
- Optimisation work within the persmissible operating data range.

Skilled staff for industrial waste
Skilled staff for industrial waste posses comprehensive, field-specific expertise relating to the disposal and recycling of industrial waste. Skilled staff transports the industrial waste to the waste disposal company and holds responsibility for proper sorting of waste. The staff incorporates this sorting into the recycling and disposal processes.

Trained persons
A trained person has been expressly instructed and, if necessary, trained on site by the responsible management about the tasks delegated to him or her and the risks that are posed by improper behaviour. A trained person has been instructed regarding the necessary protective equipment and protective measures. He or she is in a position to work cautiously and to recognise hazards and react accordingly. The trained person may not interfere with the handling and operation of the machine.

Depending on the designated job, the person must have the following expertise:

- Transport and handling of packaged units.
- Ability to perform visual inspections of the machine.

User
The machine user is trained by the system operator in terms of operation, maintenance work and basic fault rectification. He or she is informed of possible operational hazards and improper behaviour. Tasks that go beyond those for which the machine user is trained or instructed may only be carried out if these tasks are listed in this instruction manual and the operator has expressly designated these tasks to the user.

2.6.2 Unauthorised personnel

Unauthorised personnel in the installation area

WARNING!

Risk of fatal injury for unauthorised persons in the installation area!

Unauthorised persons who do not fulfil the requirements described here, are not familiar with the hazards in the installation area. Therefore, unauthorised persons are at risk of serious or fatal injury.

- Keep unauthorised persons away from the installation area.
- If in doubt, instruct such persons to leave the installation area.
- Stop all work as long as unauthorised persons are in the installation area.

2.6.3 Training

The operator must regularly provide safety training for personnel. For tracking purposes, a training report must be drafted with the following mandatory content:

- Date of training
- Name of the training participant
- Content of the training
- Name of the training instructor
- Signatures of the participant and instructor

Date	Name	Type of training	Training requirements are:	a signature

2.7 Personal protective equipment

Personal protective equipment serves to protect persons from breaches of safety and health hazards when working.

Personnel, when working near or with the machine, must wear the personal protective equipment described separately in the various sections of this instruction manual.

Description of personal protective equipment

The following is a description of the personal protective equipment:

Hearing protection
Hearing protection serves to protect against hearing damage from noise generation.

Industrial hard hat
Industrial hard hats protect the head against falling or stray objects and loads and from collisions against stationary objects.

Protective gloves
Protective gloves protect hands from friction, abrasion, puncture hazards or more serious injuries and from contact with hot surfaces.

They are oil-resistant and protect hands from coming into contact with lubricants.

Protective work clothing
Protective work clothing is tight-fitting work clothing with minimal tensile strength, tight sleeves and without protruding parts.

Safety goggles
Safety goggles serve to protect the eyes against flying particles and splashing liquids.

Safety shoes
Safety shoes protect feet from being crushed, from falling objects and from slipping on slippery surfaces.

2.8 Safety devices

Correct functioning of safety devices

WARNING!

Risk of fatal injury from non-functioning safety devices!

Non-functioning or deactivated safety devices may cause serious or fatal injury.

– Before beginning work, check that all safety devices are functioning correctly and are correctly installed.
– Never deactivate or bypass safety devices.
– Ensure that all safety devices are accessible at all times.

2.8.1 EMERGENCY STOP function

The EMERGENCY STOP function serves, in cases where there is a hazard or when one is averting a hazard, to bring the machine quickly to a safe stop (standstill).

Depending on the customer's specifications, machine variants are available with or without a power circuit breaker system.

Depending on the model, the machine:

- may not feature a control system
- may not feature an EMERGENCY STOP function

Before operating the machine:

Check whether the EMERGENCY STOP function is in place and installed.

It must function perfectly.

EMERGENCY STOP control device

Fig. 3: Example: EMERGENCY STOP control device

An EMERGENCY STOP control device includes a special command unit which is connected to the control system.

The EMERGENCY STOP function allows for the machine to be shut down safely and immediately in case of a potential or existing hazard.

The power supply to all turning components is interrupted immediately when the EMERGENCY STOP function is activated.

It is also possible to install additional EMERGENCY STOP control devices.

Without a power circuit breaker system

- For this variant, an EMERGENCY STOP control device is not installed on the machine at the factory.
- The machine is delivered without an EMERGENCY STOP apparatus.
- The operator must provide a power circuit breaker system with electrical overload protection, an On/Off command unit and an EMERGENCY STOP function.
- Activate Stop Category 0.
- Detail the performance data of the electrical installation in accordance with the operating data of the motor. Take into consideration the necessary data, for example: voltage, current, frequency.
- The connection to the power supply is made using the installed and delivered power cabinet.
- The lines running to the power supply are fed directly to the electric motor and are connected inside a terminal box.
- Feed the connection lead through the cable conduit to the terminal box.
- Protect the motor against overheating.
- A main circuit breaker must be installed.

With a power circuit breaker system

- Depending on the model, an EMERGENCY STOP control device is installed at the factory in the power circuit breaker system.
  - If the factory-installed power circuit breaker system *does not* feature an EMERGENCY STOP command device, this must be provided by the operator.
    Activate Stop Category 0.
  - If the factory-installed power circuit breaker system *does* feature an EMERGENCY STOP command device, Stop Category 0 is performed.
- A main circuit breaker must be installed if it is not part of the power circuit breaker system.
- The power supply is connected at the power cabinet.
- Observe the wiring diagram!

Notes on installation by the operator

The EMERGENCY STOP facility must:

- be installed and integrated into the safety line of the system controller.
- be clearly recognisable, highly visible and quickly accessible.
- shut down dangerous operation quickly without causing any additional risks.
- if necessary, trigger specific safety measures or authorise the triggering of safety measures.
- be installed in such a way that the machine user can activate it immediately in an emergency.
- be designed in such a way that, in cases where there is an interruption in the power supply or the power supply is activated after an interruption, no situations can occur in which there is a threat of personal injury or material damage.
- supplement other protective measures without acting as a substitute for them.

Requirements for installation by the operator

The EMERGENCY STOP function must be available and operational at all times, independent of the operating mode.

The EMERGENCY STOP facility must not require the entire machine to be voltage-free. In situations where a risk is detected, it must be possible for the user to stop the machine in order to protect against a hazard. For the purposes of a controlled shut-down, electrical voltage may be necessary. The electrical system is still under voltage.

If several EMERGENCY STOP devices are in place, all of these devices must be able to shut down the machine.

The EMERGENCY STOP function must, after being triggered, remain effective until authorisation is given for a restart.

It must not be possible to attempt to block the EMERGENCY STOP device without a “stop” command being issued.

Ensure that it is only be possible to release the EMERGENCY STOP device by means of authorised activation.

This authorisation must not cause the machine to start operating again automatically but rather it should make a machine restart possible.

2.8.2 Hinged support with lifting device

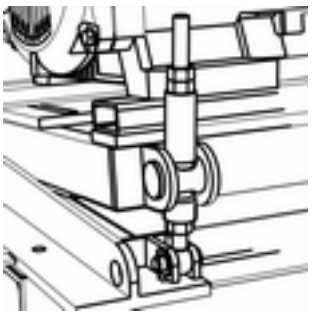


Fig. 4: Hinged support

The hinged support serves to protect against mechanical hazards.

- The hinged support holds the motor hinge in place during transport and assembly. It prevents uncontrolled movement of the motor hinge.
- When operating the machine, the hinged support must be released and positioned accordingly.

2.8.3 Acoustic hood

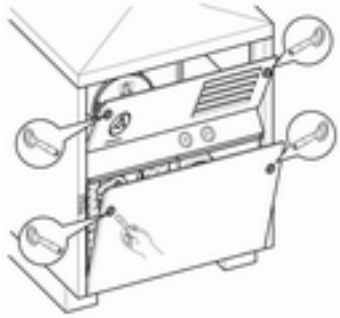


Fig. 5: Acoustic hood, front view (example)

The acoustic hood serves to protect against mechanical and thermal hazards.

- The acoustic hood is an essential safety component of the product.
- The elements of the acoustic hood must be locked with the provided special locks during operation and in stand-by mode.
- Operation with an open acoustic hood is not permissible.
- The locking key for the acoustic hood is a component of the overall safety concept. Access to the key must only be possible for personnel who have been briefed in the safe operation of the machine and the contents of the instruction manual.

Fig. 6: Acoustic hood, rear view (example)

2.8.4 Belt guard

Belt guard

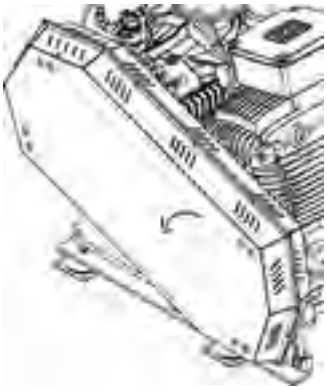


Fig. 7: Belt guard

The belt guard serves to protect against rotating components.

- A belt guard is always used in machines without an acoustic hood. It serves to protect against rotating components.

2.8.5 Cover of the belt pulley

Cover of the belt pulley

Fig. 8: Cover

The cover serves to protect against rotating components.

- The belt guard features two plastic covers.
- These serve to protect the rotating belt pulleys and prevent persons from reaching directly into the belt drive.

2.9 Safety classification

The following symbols and notices are displayed on the machine. They relate to the immediate vicinity in which they are located.

Unreadable signage

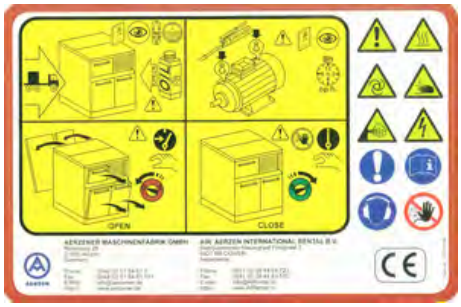
WARNING!

There is a risk from unreadable signage!

There is a risk of injury resulting from dirty or unreadable signs. It may be impossible to recognise hazards and to follow the necessary operating information.

– Keep all safety, warning and operating information in a thoroughly readable condition.
– Replace damaged signs or stickers immediately.

Safety and warning signs

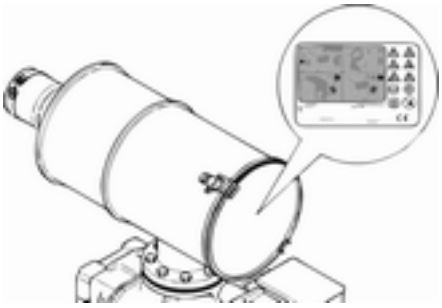


The layout of warning signs involves a set of stickers affixed to the machine. These constitute warning, instruction and prohibition signs. Furthermore, signs relating to lubricants and their handling are only visible when the acoustic hood is closed.

Fig. 9: Layout of warning signs

Placement of the sticker set on the acoustic hood.

Fig. 10: Position on the acoustic hood



Placement of the sticker set on the intake silencer.

Fig. 11: Position on the belt guard model

Warning sign on the AERZEN pressure valve.

Fig. 12: Position on the AERZEN pressure valve

Access for unauthorised persons forbidden

Only persons given authorisation by the operator may enter the hazard area.

Electrical voltage

Only qualified electrical personnel may work in the signposted working area.

Unauthorised persons are not permitted to enter the signposted working area or open the signposted cabinet.

Automatic start-up

The sudden start-up of operational machines in the rest position is possible at any time.

Take heed of the stand-by mode! A sudden start is possible.

Hot surfaces

Hot surfaces, such as hot machine parts, containers or materials - but also hot liquids - are not always noticeable. Do not touch them without protective gloves.

Hand injuries

Keep hands away from areas that carry this warning sign.

There is a risk that hands could be crushed, trapped or injured in some other way.

Gas emission

Risk from sudden gas emission.

The opening of the pressure valve results in the emission of gas and accompanying noise emissions. There is a risk of hearing damage and injuries to eyes or skin.

Pressure in the piping

Pipelines may be placed under pressure.

Before carrying out disassembly work, deactivate the pressure in the pipelines.

Draw-in of gas

Pipelines can suck in large volumes of air in the immediate vicinity of the intake openings.

Avoid the air-intake area. Shut down the machine before undertaking any activities in this area.

2.10 Instruction signs

Wear hearing protection

In areas where this symbol is displayed there is a risk of hearing damage. Therefore, wear hearing protection when in these areas.

Information on wearing hearing protection	
< 80 dBA	Hearing protection is not prescribed as mandatory but should be worn as a matter of personal responsibility.
80 to 85 dBA	Hearing protection is recommended
> 85 dBA	**Hearing protection must be worn**

Observe the instruction manual

Only use the labelled machine once you have read the instruction manual.

2.11 Hazards in the operating and/or display area

Hazard area
Operating and/or display area

The hazard area is located in the marked zone (in the acoustic hood interior zone). The opening of acoustic hood elements and protective covers during operation is not permissible. Opening is permissible only for maintenance work or for troubleshooting and provided all safety precautions are observed. The operating and/or display area is the position marked in green (example).

Fig. 13: Hazard area and operating and/or display area (top-down view)

Hazard area
Operating and/or display area

The hazard area is located in the marked zone. The opening of the protective cover is not permissible. The operating and/or display area is the position marked in green (example).

Fig. 14: Hazard area and operating and/or display area (top-down view)

2.12 Securing the machine against restarting

Sudden restart

DANGER!

An unauthorised or unregulated restart can have fatal consequences.

An unauthorised or unregulated restart of the machine can lead to serious or fatal injuries. There may be people located in the hazard zone. Activating the energy supply and starting the machine could result in those people being fatally injured.

- Prevent the machine from restarting by:
  - disconnecting the electrical power supply.
  - activating the EMERGENCY STOP function
  - operating the main circuit breaker
  - attaching a padlock to the main circuit breaker
  - checking and ensuring that the machine is completely disconnected from the power source
  - displaying a sign on the machine that prohibits a machine start
  - displaying a sign on the remote station that prohibits a machine start
- Before restarting, ensure that safety devices are installed and functioning correctly and that there are no potential hazards to the safety of any persons.

EMERGENCY STOP button (option)

1. Press the EMERGENCY STOP button
   ⇨ The power supply is shut off.
2. Activate the main circuit breaker.
   ⇨ The machine is free of current.
3. Attach a padlock to the main circuit breaker.
4. Ensure that the machine is completely disconnected from the power source.
5. Inform supervisory personnel of work in the hazard area.
6. Place a sign on the machine and (where applicable) remote station that notifies persons of the work being carried out in the hazard area and forbids activation of the machine. The sign must contain the following information:
   - Shut-down on:
   - Shut-down at:
   - Shut-down by:
   - Important: Do not switch on!
   - Important: Only switch on the machine once it has been ensured that there is no risk to personal safety.

EMERGENCY STOP feature (operator-installed)

The particular approach to preventing a restart is dependent on the operator-installed EMERGENCY STOP feature.

1. Secure the machine against restarting in accordance with the operator's instructions.
2. Follow the instructions of the responsible supervisory personnel.
3. Once all work has been completed, ensure that there is no risk to personal safety.
4. Ensure that all safety and protective equipment is installed and operational.

2.13 Environmental protection

Environmentally hazardous materials

ENVIRONMENT!

Improper handling of environmentally hazardous materials presents a threat to the environment!

Incorrect handling of environmentally hazardous materials, particularly in the case of improper disposal, can cause considerable damage to the environment.

– Always observe the information below on the handling of environmentally hazardous materials and their disposal.
– If environmentally hazardous materials are inadvertently released into the environment, take appropriate action immediately. If in doubt, inform the responsible local authority about the damage and seek advice on taking appropriate measures.

The following environmentally hazardous materials are used:

Lubricants

Lubricants such as greases and oils contain poisonous substances. They must not be released into the environment. Disposal must be carried out by a certified waste management company.

AERtronic batteries

Batteries contain poisonous heavy metals. They require special waste treatment and must be deposited at local collection points or disposed of by specialist companies.

Insulation fibres

The insulation fibres in insulation material and insulation mats are carcinogenic. Disposal of insulation fibres must be carried out by a certified waste management operator.

Electronics

Electrical and electronic components may contain poisonous material. These components must be collected separately and deposited at local collection points or disposed of by specialist companies.

Anti-corrosion agents

Anti-corrosion agents may contain poisonous substances. They must not be released into the environment. Disposal must be carried out by a certified waste management company.

3 Design and operation

3.1 Overview of assemblies

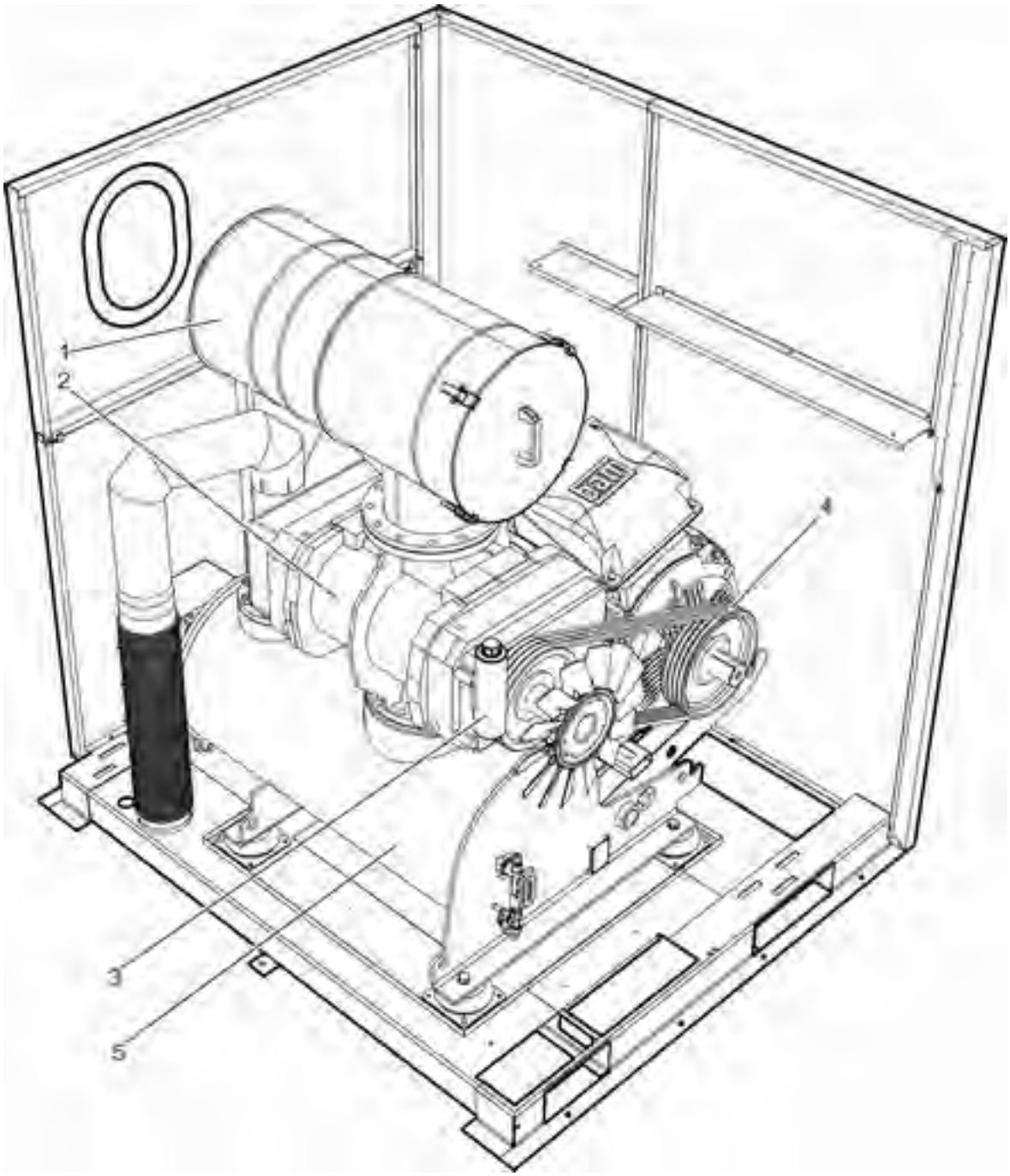


Fig. 15: Overview

1 Intake side
2 Machine stage
3 Oil system
4 Drive system
5 Discharge side

3.2 Overview of assemblies

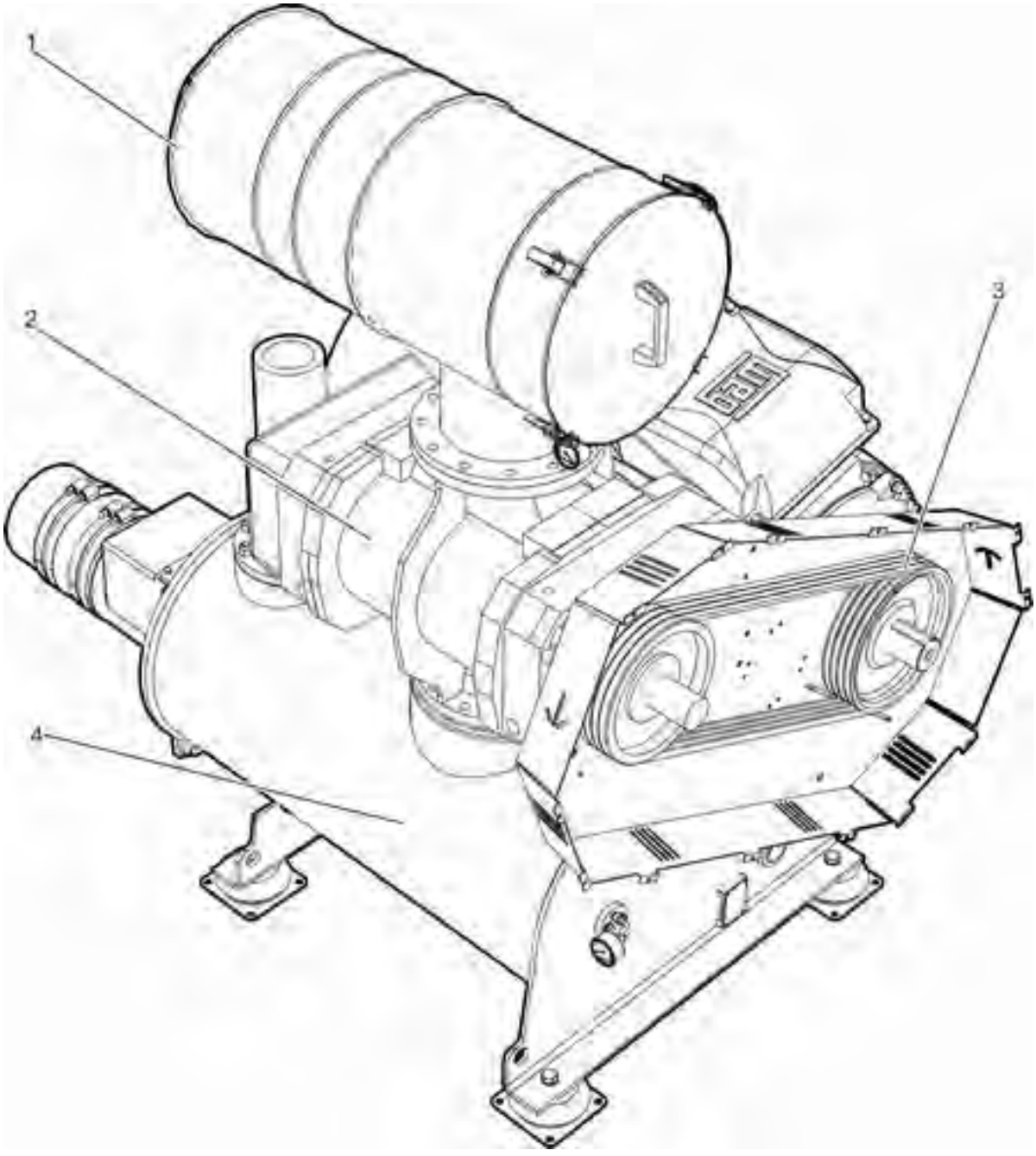


Fig. 16: Overview

1 Intake side
2 Machine stage
3 Drive system
4 Discharge side

3.3 Operating principle

The medium to be conveyed is connected using an elastic rubber sleeve or the compensator of the discharge-side connecting casing.

The medium to be conveyed enters through the intake silencer. This offers the possibility of a intake-side pipe connection. There is a replaceable filter element located inside the intake silencer. Dirt levels in the filter element can be displayed using a service indicator or the control system display.

The positive displacement blower conveys and compresses the medium to be conveyed. The medium then flows through the discharge silencer, via a non-return flap, into the customer's system. The positive displacement blower is powered by a drive motor using a belt drive. The belt drive derives tension automatically from the weight of the motor. The drive motor is powered by connecting its power lines in the terminal box.

A pressure valve is installed on the base support or on the connection housing. The working pressure can be displayed by a pressure gauge or in the control system screen.

The acoustic hood is ventilated by a fan. This is installed at the shaft end of the machine stage.

3.4 Operating modes

On-site operation

Operation of the machine is carried out directly on site.

Remote operation

Operation of the machine is carried out via control station.

Automatic operation

Automatic operation of the machine is carried out by sensors or a system switch.

Load operation

Load operation is the operating mode in which the machine processes the specified operating data.

3.5 Operating methods

3.5.1 Operating information for pneumatic conveyance

Pneumatic conveyance

When the machine is being used for the purposes of pneumatic conveyance, pressure surges must not occur when switching between different delivery lines.

Pressure surges can be prevented by making the switching process for the intake-side and discharge-side valves take at least five seconds. This pre-accelerates the gas column in the pipework. The gas can no longer accelerate suddenly. This prevents damage to the machine.

The distance between the switchover valve and the intake-side flange must be at least 10 x DN. DN = nominal diameter of the pipework.

This safety note applies to both pressure and vacuum mode.

3.5.2 Operating information for air-separation systems

Operating information for air-separation systems

When the machine is being used in air-separation systems with alternating air-separation columns, pressure surges must not occur when switching between different delivery lines.

Pressure surges can be prevented by making the switching process for the intake-side and discharge-side valves take at least five seconds. This pre-accelerates the gas column in the pipework. The gas can no longer accelerate suddenly. This prevents damage to the machine.

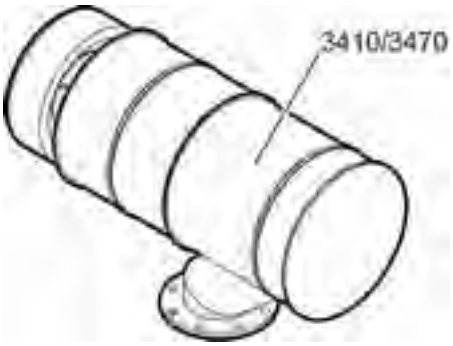
The distance between the switchover valve and the intake-side flange must be at least 10 x DN. DN = nominal diameter of the pipework.

This safety note applies to both positive pressure and vacuum pressure mode.

3.5.3 Description of assemblies

For the purposes of explaining its functionality, the machine is divided into several assemblies. Each assembly consists of a number of components which, combined, perform a specific machine function. One assembly can consist of sub-assemblies and additional components.

3.5.3.1 Intake side

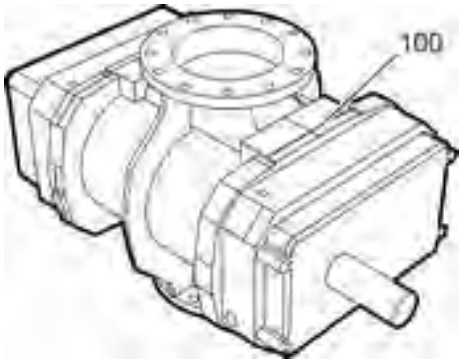


3410 Intake silencer, housing
3470 Intake silencer, filter element

The intake-side assembly comprises the components of the conveying system's intake side. The intake-side assembly includes all components located upstream of the machine stage gas inlet. The medium to be conveyed is drawn into the machine stage by these components. An intake silencer serves to reduce noise emissions. A filter ensures clean intake gas.

Fig. 17: Intake side

3.5.3.2 Machine stage

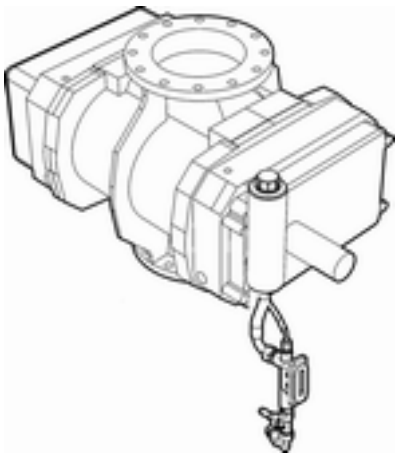


100 Machine stage

The machine stage is the core of the machine and includes all components for gas compression. The gas compression process takes place in the machine stage.

Fig. 18: Machine stage

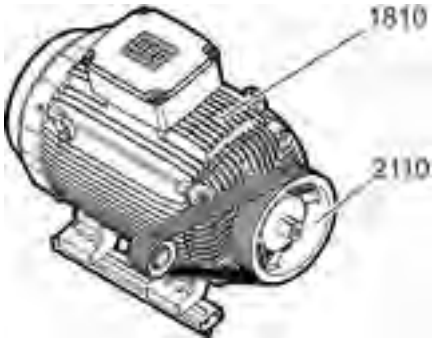
3.5.3.3 Oil system



The oil system contains all components necessary for providing lube oil to the machine stage.

Fig. 19: Oil system

3.5.3.4 Drive system

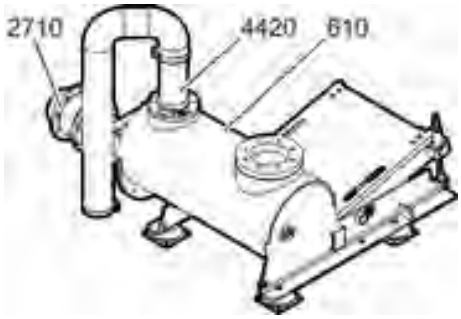


1810 Motor
2110 Belt drive

The drive system comprises the drive motor and the drive elements, e.g. the belts and sheaves. The drive system provides a high revolution speed for the rotational motion of the machine stage.

Fig. 20: Drive system

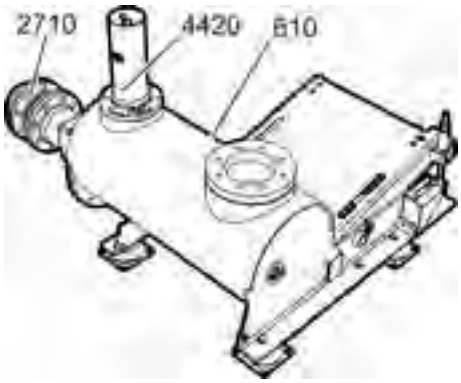
3.5.3.5 Discharge side



610 Base support
4420 Pressure valve
2710 Flexible pipe connection

The discharge-side assembly represents the components of the discharge-side conveying system. The discharge-side assembly includes all components fitted downstream from the machine stage gas outlet. All components are pressurised during operation and have hot surfaces. A discharge silencer serves to reduce noise emissions.

Fig. 21: Discharge side with base support



610 Base support
4420 Pressure valve
2710 Flexible pipe connection

The discharge-side assembly represents the components of the discharge-side conveying system. The discharge-side assembly includes all components fitted downstream from the machine stage gas outlet. All components are pressurised during operation and have hot surfaces. A discharge silencer serves to reduce noise emissions.

Fig. 22: Discharge side with base support

3.6 Control elements (optional)

3.6.1 Factory-installed control element

Factory-installed control element

Observe the AERtronic instruction manual.

The AERtronic instruction manual is included with the product.

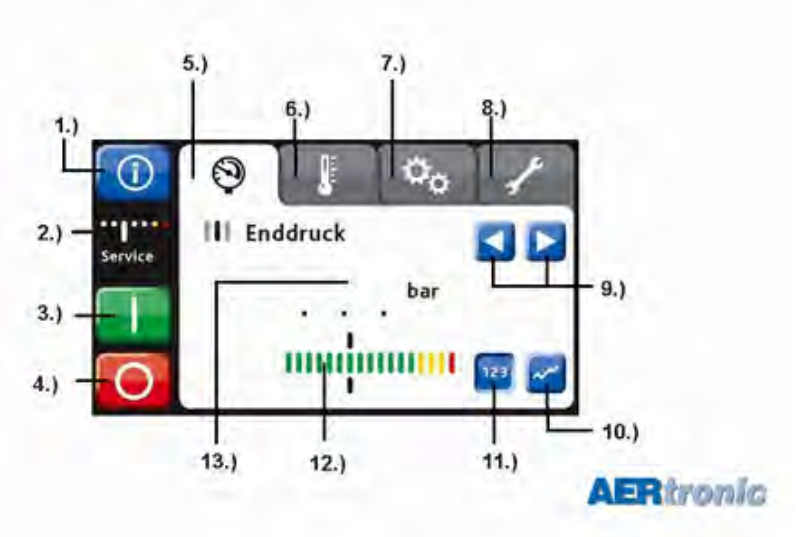


Fig. 23: Operator interface

1 Information menu
2 Service display
3 Local/ LOCATION / START
4 Local/ LOCATION / STOP
5 Pressure ranges register
6 Temperature ranges register
7 Additional operating parameters register
8 Service and setup register
9 Selection buttons of the given display menu within a register
10 Graphic representation
11 Numerical representation
12 Bar graph display
13 Measurement value display

3.6.2 Customer-installed control element

Customer-installed control element

Depending on the model and version - with or without a corresponding controller - the control elements are not part of the scope of delivery. The installation and design of the control elements is then the responsibility of the customer.

3.7 Accessories

The accessories are the total collection of components belonging to the machine or to the supplementary equipment.

3.7.1 Drive motor

Motor connection requirements

The cable and lead sheathing must be resistant to the normal wear expected due to the movement of the hinged motor support and the effects of contaminants in the atmosphere.

General requirements

- Fine-core cable is recommended for the connecting leads.
- The connecting hardware must be suitable for the cross-section and type of the connecting leads.
- Cables, leads and connections must not be subjected to excessive bending and tensile forces. Install the connecting cable via a stayed cable bridge (not provided) to prevent the terminal box being subjected to forces or stress.
- Install cables and leads in such a way that they cannot sustain any external damage.
- Avoid contact with the machine, excessive friction and excessive radiant heat.
- The connecting cable must be resistant to light movements, e.g. the changes in the rotational speed of the motor.

General requirements

- Fine-core cable is recommended for the connecting leads.
- The connecting hardware must be suitable for the cross-section and type of the connecting leads.
- It may be necessary to remove the intake console and the acoustic hood cover to connect the motor, depending on the size and output of the machine.
- Cables, leads and connections must not be subjected to excessive bending and tensile forces. Install the connecting cable via a stayed cable bridge (not provided) to prevent the terminal box being subjected to forces or stress.
- Install cables and leads in such a way that they cannot sustain any external damage.
- Avoid contact with the machine, excessive friction and excessive radiant heat.
- The connecting cable must be resistant to light movements, e.g. the changes in the rotational speed of the motor.

Requirements for the electricity network

NOTICE!

There is a risk of material damage from voltage fluctuations / drops!

Voltage fluctuations / drops beyond the tolerance interval may lead to serious damage to the drive system.

Requirements for operating positive displacement machines with electric induction motors in a three-phase AC supply system:

– Use suitable protective equipment that will shut the motor down and safeguard it against an automatic restart if impermissible electrical operating data is detected.
– Connect the motor and control voltage to a stable common network to ensure that the power contactor is no longer latched if the power supply fails.
– Comply with voltage and frequency limits. *Chapter 11.9.1 'Voltage fluctuations' on page 185*

Connection

- Only authorised electricians may perform the connection.
- Electricians must observe all applicable regulations when connecting the drive motor.
- Observe the tightening torques of the terminal screws.
- Secure all connections against inadvertent release or loosening.
- Ensure that the nominal electrical data is complied with during operation.

Permissible starting frequency

up to 160 kW	6 starts per hour
from 200 kW	3 cold starts or 2 warm starts per hour

Refer to the operating manual provided by the drive motor manufacturer for further specifications and information.

3.7.1.1 Drive motor - factory installation

Factory installation

Observe the information on the type plate and in the drive motor instruction manual.

Refer to the drive motor instruction manual for electrical operating data, maintenance intervals and suitable lubricants.

3.7.2 AERtronic

AERtronic

Fig. 24: AERtronic Display

The AERtronic is used as a control device and as a display and monitoring device.

The AERtronic is fitted with a colour graphics display with a touch-screen interface.

When starting for the first time, these settings can be changed.

Other handling and operation of the controller is defined on the display; the user is guided through the menu by prompts in a structured manner.

The AERtronic includes all the functions necessary for start and shut-down procedures and displays the operating parameters and prompts.

Observe the operating manual for the purposes of commissioning and operation!

AERZEN reserves the right to change, expand or improve the hardware and software of this product as required. This does not include any obligation to update units already shipped.

3.7.3 Instrumentation

The instrumentation consists of several assemblies.

1.) Pressure and temperature sensors in conjunction with the AERZEN AERtronic controller.

2.) Pressure and temperature switches in conjunction with the display instruments.

Shut-down locking

- The shut-down devices are set at the factory.
- All shut-downs must be self-locking. Once the shut-down has been given clearance, the machine must not be able to start automatically.
- Prior to a restart, the cause of the fault must be determined and eliminated. Start-up must then take place manually.

NOTICE!
The switching points of the switches/sensors are fixed and must not be changed.

Pressure and temperature switches

If, to safeguard the machine, an intake pressure, discharge pressure or discharge temperature switch is used, it must also be ensured that the drive motor switches off when the limit switch is triggered.

Contacts open →Drive motor off.

Pressure switch (optional)

It is also possible to use an additional pressure switch. A calibrated gauge is used to adjust the switching limit point. The scale on the switch only serves as a guide.

3.7.4 Frequency converter / operation

Assembly group description

Observe the frequency converter manufacturer's operating manual!

NOTICE!

- If the electric motor is driven by frequency converters, we strongly recommend using an engine throttle and power choke. These are specifically designed for the frequency converter and filter dangerous harmonics from the drive current. This prevents damage to the motor winding. The electromagnetic compatibility of the system is also improved. Reactions of the frequency converter in the current are reduced.
- The maximum current limit of the motor must not be exceeded. Observe the information on the motor name plate.
- To prevent operational faults the function "Interception circuit" must not be parameterised in the control of the frequency converter. When the frequency converter is switched off, a restart should only be possible after a complete shut-down of the blower or compressor.
- The machine must shutdown without braking. The activation of a brake ramp or quick stop is not permissible.

For machine use, observe the following

- Take into account the electrical and mechanical properties of the drive motor.
- The minimum frequency must always be fixed. This frequency must never fall below the fixed minimum during operation.
- The maximum frequency is to be set by taking into account the maximum rotational speed of the motor and the maximum machine speed.
- The run-up time of the drive motor from standstill up to minimum speed can be 3 to 6 seconds.
- The frequency converter must be designed with a constant load moment for operation with a working machine.

- Rotational speeds must not fall below minimum nor exceed maximum values.
- When exceeding the value, e.g. due to excessively long cables, frequency converter type etc. a motor throttle / motor filter coil to match the frequency converter is to be used.

NOTICE!
Not using these components can lead to damage of the motor isolation and a motor breakdown.

- The highest admissible voltage increase speed of the motor is 1,200 V/µs.
- The maximum rotational changeover speed must not exceed 1 Hz per second during operation.
- Minimum frequency = 20 Hz // maximum frequency = 50 Hz results in a control time of 30 seconds from minimum to maximum.

Pole changing

For a motor speed changeover from a high to a low speed, the drive motor must have reached zero rotational speed each time.

Changeover from a low to a high speed can take place directly and instantaneously.

3.7.5 Machine terminal box

Terminal box

The machine's terminal box contains the electrical and electronic components that are not located directly on the machine (e.g. sensors).

It contains terminals for connecting electrical and electronic components with the external power supply.

When the terminal box is closed, accidental or unintended contact with voltage-carrying components is not possible.

The distribution cabinet is locked due to internal components which are charged with dangerous voltage. It can only be opened using special tools (distribution cabinet key, triangular/ square wrench).

3.7.6 Intake pressure gauge

Vacuum pressure mode

The gauge displays the intake pressure.

It is a display instrument without a switching function.

The gauge is connected on the intake side.

Fig. 25: Gauge

3.7.7 Discharge pressure gauge

Positive pressure mode

The gauge displays the discharge pressure of the compressed gas.

It is a display instrument without a switching function.

The gauge is connected on the discharge side.

Fig. 26: Gauge

3.7.8 Nitrogen gauge

Nitrogen mode

The gauge is used when conveying nitrogen.

The gauge displays the pressure in the inlet pipe.

It is a display instrument without a switching function.

The gauge is connected on the intake side.

Fig. 27: Gauge

3.7.9 Maintenance indicator

Positive pressure mode

The maintenance indicator shows the dirt levels in the intake filter.

The maintenance requirements of the intake filter depend on the dirt levels of the medium taken in.

Replace the filter element when the following display values are reached and no later:

Fig. 28: Variation a)

At -45 mbar (red display field): replace intake filter

After the filter has been changed, reset the pointer to its initial position by “pressing” the reset button.

Fig. 29: Variation b)

When the level of contamination increases, the red trailing pointer will be pulled over with the black pointer and stay at the maximum intake pressure.

Replace the filter element when the trailing pointer reaches the red area of the scale.

Once the filter has been replaced, reposition the trailing pointer between 0 and -10 mbar.

3.7.10 Intake silencer

Intake silencer

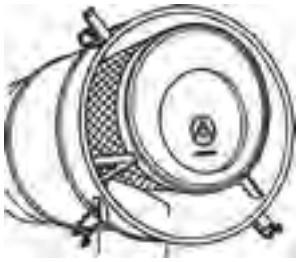


Fig. 30: Opening intake silencer with filter

The intake silencer contains the intake filter. The intake filter prevents harmful particulate matter entering the conveying chamber of the machine.

The intake filter corresponds to filter class G4

NOTICE!
Risk of machine damage! Never operate the machine without the intake filter.

Machine damage caused by the intake filter

NOTICE!

There is a risk of machine damage from the use of contaminated, damaged or non-original intake filters!

Heavily contaminated or damaged intake filters reduce performance, affect functionality and may cause machine damage. Copies and reproductions of intake filters do not have the necessary properties.

– Inspect for damage.
– Comply with maintenance intervals.
– Only use original replacement parts.

3.7.11 Discharge silencer

Discharge silencer

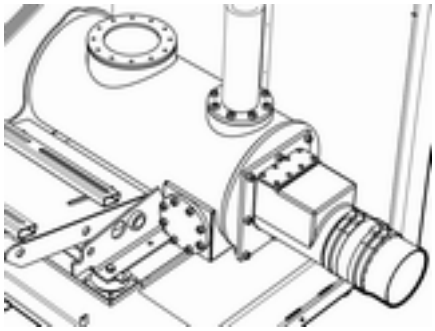


Fig. 31: Discharge silencer

The base support serves as the base for the whole bodywork of the machine. The base support also acts as a discharge silencer. The discharge silencer is an absorbtion-agent-free component. The acoustic energy inside the discharge silencer is reduced by means of air deflection.

3.7.12 Pressure valve

AERZEN pressure valve

Fig. 32: Pressure valve

Observe the valve instruction manual. It is included with the product.

The pressure valve is used in the conveyance of air.

The pressure valve is set at the factory.

If the set value is exceeded, the valve opens and releases excess conveyed material into the atmosphere.

The pressure valve is NOT a control component and is not to be used as such.

The pressure valve can be used up to a temperature of 200°C.

NOTICE!

Risk of premature wear and tear and breakdown! The valve is not intended for controlling the operating data!

The deactivation of the valve, e.g. by increasing the opening pressure, may lead to serious material damage! Risk of total machine failure!

The valve outlet must not be made narrower or closed. Keep the cross-section unobstructed!

3.7.13 Non-return flap

Non-return flap

Fig. 33: Non-return flap

The non-return flap prevents the compressed conveyed medium from entering the machine stage once the compressor has been switched off. This prevents the machine stage from running "in reverse".

3.7.14 Start-up relief device for DN50 to DN80

Start-up relief device

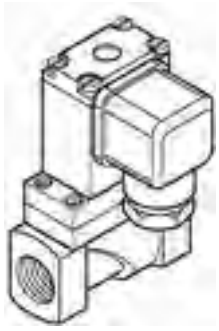


Fig. 34: DN 50 / 80

NOTICE!
Risk of premature wear and tear and breakdown! The start-up relief device is not intended for controlling the operating data!

A solenoid valve offers the possibility of relieved start-up for DN 50/80 (“star-delta connection”). The valve closes if voltage is present.

The valve may only close after the switch from “star to delta”.

For pole changing: In “star-double-star starting”, the solenoid valve is to be switched so that it opens before the high-speed operation and closes after ramping up.

The start-up relief device is not necessary for drives with frequency converters.

3.7.15 Start-up relief device for DN80 to DN400

Start-up relief device

Fig. 35: DN 80 to DN 400

NOTICE!
Risk of premature wear and tear and breakdown! The start-up relief is not intended for controlling the operating data!

The use of the start-up relief device as a controller for operating data leads to premature wear and tear and breakdown!

The start-up relief device can be used in machines that are run by an electric motor with a “star-delta connection”.

This allows for a relieved start-up against existing mains pressure.

In the case of drives with pole-changing motors, it is also possible to use a start-up relief device with a solenoid valve.

This provides a relieved start-up at higher speeds.

After a correct set-up, the start-up relief device operates maintenance-free.

The start-up relief is not necessary for drives with frequency converters.

3.7.16 Belt drive

Belt drive

Fig. 36: Belt drive

The belt pulleys are mostly fitted and aligned in the factory.

The belt pulley for the machine stage is fitted to the drive shaft using a taper interference fit. The position and orientation of this belt pulley therefore affects the alignment of the drive motor belt pulley.

Check the alignment:

- Before first commissioning
- According to the maintenance plan
- After replacing the pulley(s)

The maximum permitted belt pulley offset is 0.5 mm.

It is extremely important that only original replacement parts be used for the purposes of belt-pulley operation!

Only use replacement parts that are recommended and approved by AERZEN!

Original replacement parts

NOTICE!

Risk of material damage! Pulleys must only come from one manufacturer and from one production batch.

– Otherwise varying belt tensions can occur which can result in uneven running and premature wear.
– As a result of a risk of snapping, the belt pulleys must be suitable for the peripheral speed encountered!

3.7.17 Acoustic hood

Acoustic hood

Fig. 37: Acoustic hood, version diagram

The acoustic hood serves to reduce noise and acts as an isolating safety device.

The acoustic hood is a component for product safety with lockable door elements.

Always keep the acoustic hood closed during operation.

The key must only be accessible for authorised personnel.

An earthing strap or threaded hole is located on the outer edge of the floor tray.

Lock

Operation with an open acoustic hood is not permissible!

- *Always lock the elements of the acoustic hood with the key provided.*
- *The key must only be accessible for trained persons.*

Fan

The acoustic hood is ventilated by a mechanical fan.

The fan is connected at the factory. The fan is activated in parallel with a machine start.

Intake from a pipeline

The acoustic hood makes intake-side suction possible from the system pipeline.

The pipeline is guided through the acoustic hood to the machine through prefabricated openings.

The following steps must be complied with: *Chapter 5.3 'Installation' on page 90*

Acoustic hood heater

NOTICE!

There is a risk of material damage from low ambient temperatures!

Provide acoustic hood heating at ambient temperatures of under -10°C!

This prevents damage to the machine by heating up the housing and preheating the lube oil and medium to be conveyed.

3.8 Required tools

The following tools are required:

Auxiliary materials, aids
including collection containers for oil, drain hose, cleaning rags.

Conveyor rails
The conveyor rails must be made of steel. They act as slide-in modules in the forklift tunnel of the acoustic hood. The cables are pulled by the conveyor rails and joined above the machine using the lifting beams.

Drills
Drills for making fastening holes.

Electric drill
Electric drills, e.g. for drilling fixing holes.

General measurement tools and equipment
For example a steel ruler, plumb line, folding yardstick, spirit level.

General tool kit
including various screwdrivers, combination wrenches, set of socket spanners, set of Allen wrenches, hammers.

Lifting beams
Transverse truss required for crane transport for absorbing cable force.

Lifting equipment
For lifting loads, e.g. ropes, belt anchorages, shackles, eyebolts with nuts.

Locking key
The locking key is a component of the overall safety concept. This must be stored safely and should only be made accessible to trained personnel. It is intended for the proper opening and closing of the acoustic hood elements.

Oil funnel
The oil funnel is used for the precise filling of lubricant oil.

Ratchet wrench
The ratchet wrench is used to adjust the hinged motor support fastener.

Test pump
The test pump is used to simulate system pressure in the measurement lines during commissioning. This allows for the operation of the pressure switch or the pressure sensors to be checked.

Tools for authorised electricians
Basic electrical engineering equipment, e.g. multimeter, voltage detector, insulated tools.

Transport equipment
for transporting packaged units and the machine, e.g. with lift trucks, forklifts.

4 Transport, packaging and storage

4.1 Transport

4.1.1 Safety instructions

Improper transport

WARNING!

Risk of injury and damage from improper transport!

Improper transport may result in personal injury.

- Proceed with caution upon delivery and unloading of the machine and during in-house transport.
- Observe the symbols and information on the packaging.
- Only use the intended anchorage points.
- Observe the machine's centre of gravity.
- Attach lifting equipment accordingly and hang the load so that it is balanced.
- Remove the packaging shortly before setting up the machine.

Industrial trucks

WARNING!

There is a risk of fatal injury from industrial trucks!

Transport with industrial trucks can result in objects and other loads falling accidentally and causing serious or fatal injury. There is also the risk of the driver failing to see persons and running them over.

- Industrial trucks should only be operated by trained drivers (e.g. forklift drivers).
- Only walk past an industrial truck if the driver has signalled that he has recognised the person in his path.
- Only use approved industrial vehicles with sufficient load carrying capacity.
- Never transport materials over persons or the areas in which persons are located.

Suspended loads

WARNING!

There is a risk of fatal injury from suspended loads!

During lifting work, loads may come loose and fall. This can result in serious or fatal injury.

- Never walk under or into the range of a suspended load.
- Move loads under supervision only.
- Observe lashing points.
- Ensure that the lashing equipment is fitted securely.
- Do not hang lashing equipment on protruding machine parts or on the lugs of attached components.
- Only use approved hoists and lashing equipment with sufficient load carrying capacity.
- Do not use torn or scoured hoists such as ropes or pulleys.
- Do not attach hoists such as ropes or belts to sharp edges and corners and do not tie or twist them.
- Set down the load when leaving the work area.

Disregard for the machine's centre of gravity

WARNING!

There is a risk of the unit toppling and falling over if there is disregard for the machine's centre of gravity!

If the machine's centre of gravity is disregarded the packaged unit may topple and cause life-threatening injury.

- Take into account the machine's centre of gravity.
- Observe the packaging information on the machine's centre of gravity.
- Attach lashing equipment in such a way that it is located above the centre of gravity.
- Raise the load carefully and ensure that it does not topple. If necessary, change the position of the lashing equipment.

Risk of slipping

CAUTION!

There is a risk of injury from slipping on the packaging foil!

The packaging foil features a slippery surface that can cause persons to slip if they stand on it. Moisture, creases, edges and tension straps on the packaging foil carry the risk of slipping or stumbling. The packaging foil is not suitable for supporting weight. A fall may result in injury.

– Never stand on the packaging foil.
– Never lean on the packaging foil or use it for support.

Requirements for staff

Requirements for transport:

Transport of packaged units

Personnel:
- Trained persons

Transport of unpacked machines

Personnel:
- Service personnel

Protective equipment

Requirements for transport:

Protective equipment:
- Protective work clothing
- Safety shoes
- Protective gloves

Special tools

Requirements for transport:

NOTICE!

Risk of damage to the machine! Chains, steel cables and similar equipment are not suitable lifting equipment.

Special tool:
- Lifting equipment
- Transport equipment

Special tool:
- Lifting beams
- Locking key
- Conveyor rails

Dimensions of the transport beams

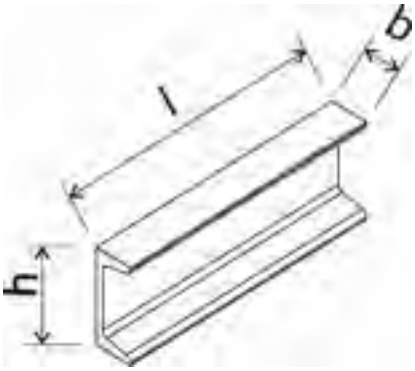


Fig. 38: U-beam

Nominal diameter Discharge nozzles	U-beam dimensions h x b x t (mm)	Profile length (mm)
DN 50	80 x 60 x min. 4	950
DN 80	80 x 60 x min. 4	1285
DN 100	100 x 80 x min. 4	1500
DN 125	100 x 80 x min. 4	1500
DN 150	120 x 80 x min. 5	1950
DN 200	120 x 80 x min. 5	2210
DN 250	120 x 80 x min. 5	2350
DN 300	120 x 80 x min. 7	3000
Material: S 235 JR		

U-beam length of min. 150 mm longer than the dimensions of the acoustic hood.

4.1.2 Delivery method

4.1.2.1 Delivery of the machine

The machine is shipped using a freight forwarder. In accordance with the given requirements the machine is sealed in foil and may be additionally packed in wood.

Transport on a truck

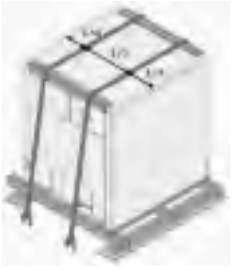


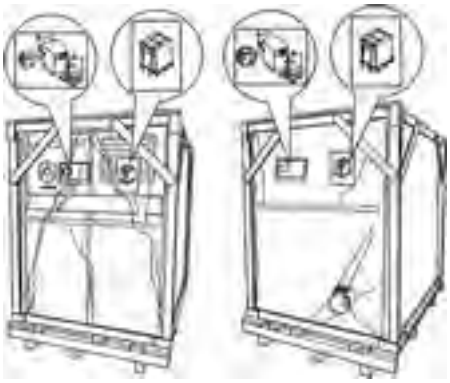
Fig. 39: Transport on a truck

1. Strap the packaged unit to the truck in accordance with the diagram.
2. Always use appropriate edge protection to avoid damage to the packaged unit.

4.1.3 Packaging

4.1.3.1 Symbole auf der Verpackung

Symbols on the packaging



The following symbols are displayed on the packaging. Always observe these symbols during transport.

Fig. 40: Symbols on the front/rear side

Explanations

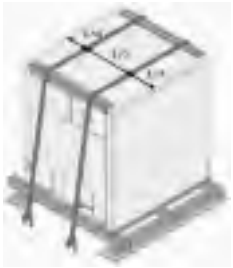
Centre of gravity

1. Displays the centre of gravity and weight of the machine.

   Observe the location of the centre of gravity for lifting work and transport.

Fig. 41: Centre of gravity

Transport on a truck



2. Strap the packaged unit to the truck in accordance with the diagram.
3. Always use appropriate edge protection to avoid damage to the packaged unit.

Fig. 42: Transport on a truck

Explanations

Comply with the order (pos.1-pos.3) of the work stages.

Transport without a palette

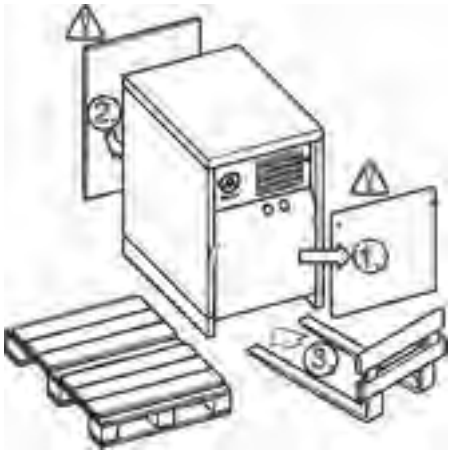


Fig. 43: Transport without a palette

1. Open the operating side of the acoustic hood (pos.1).
2. Open the rear side of the acoustic hood (pos.2).
3. Separate the machine from the transport palette by removing the holding screws.
4. Drive the fork of the forklift under the machine (pos.3).

WARNING!
Risk of injury if the machine topples or falls!
Observe the machine's centre of gravity.

5. Determine the machine's centre of gravity by raising it carefully.
6. Transport the machine so that it is balanced. The machine must not lean to one side.
7. Remove the lifting equipment at the installation area.

4.1.3.2 Handling packaging

Handling packaging

The various packaged items are packed in accordance with the anticipated transport conditions. In as far as it is possible, environmentally-friendly materials are used for the packaging.

The packaging is intended to protect individual components from transport damage, corrosion and other forms of damage. For this reason, do not destroy the packaging and only remove it shortly before assembly.

Only remove packaging for transport to the installation area if it has been expressly permitted.

Removing packaging

Packaging materials made of solid wood (e.g. wooden palettes, wooden crates) comply with the IPPC standard. This material is re-usable. When disposing of the material, national and local requirements must be complied with.

From the machine

1. **CAUTION!**
Risk of injury from rough packaging material and protruding nails!

Remove packaging material.

2. First detach the packaging and then remove it.

3. Separate the machine from the transport pallet by removing the holding screws.
4. **ENVIRONMENT!**
   Packaging material is valuable. It can be used several times or processed and then re-used. The improper disposal of packaging material can present a risk to the environment.
5. Sort packaging according to the material used and dispose of it properly. *Chapter 10.3 'Disposal' on page 164*

From the machine

1. First detach the packaging and then remove it.
2. Separate the machine from the transport pallet by removing the holding screws.
3. **ENVIRONMENT!**
   Packaging material is valuable. It can be used several times or processed and then re-used. The improper disposal of packaging material can present a risk to the environment.
4. Sort packaging according to the material used and dispose of it properly. *Chapter 10.3 'Disposal' on page 164*

4.1.4 Transport inspection

Completeness

Checking for completeness
Check the goods for completeness immediately after delivery. Register missing parts and contact the manufacturer.

Check the delivery for completeness on the basis of the packing slip.

- The packing slip is provided with the product.

Transport damage

Transport damage
Register transport damage claims as soon as damage is discovered. Compensation claims for damage are only valid within the applicable claim periods.

Check the delivery immediately for transport damage.

In case of perceptible external damage, proceed as follows:

- Do not accept the delivery or only accept it under certain conditions.
- Note the scope of the damage in the transport documents or on the delivery docket provided by the carrier.
- Register the claim.

4.1.5 Transport of packaged units

4.1.5.1 Transport using industrial vehicles

Fig. 44: Transport with acoustic hood

1. **NOTICE!**
   Risk of toppling loads! The transport of packaged units may only be carried out using lifting equipment that reaches under the machine and fits into the transport palette fully.
2. Insert the equipment into the provided opening in the transport palette.
3. Take into account the centre of gravity! See the labelling on the packaging.
4. **DANGER!**
   Risk of fatal injury from toppling components!

   Determine the packaged unit's centre of gravity by raising it carefully.
5. Transport the machine so that it is balanced. The packaged unit must not lean to one side.

4.1.5.2 Transport using a crane

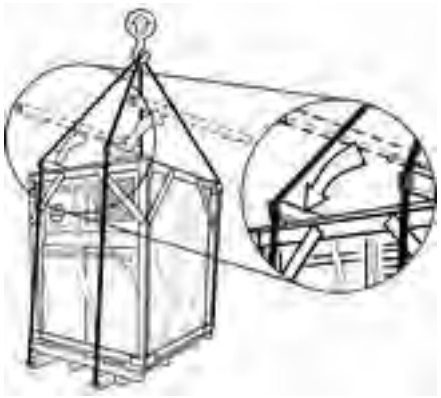


Fig. 45: Transport of packaged units

1. Guide the conveyor rails through the openings of the transport palette.
2. Place the lifting beams on to the acoustic hood. Span length of a minimum of 150 mm longer than the dimensions of the acoustic hood.
3. Guide lifting equipment, such as cables or straps through the conveyor rails and join them above the machine using the lifting beams.
4. Take into account the centre of gravity! See the labelling on the packaging.
5. **DANGER!**
   Risk of fatal injury from toppling components!

   Determine the packaged unit's centre of gravity by raising it carefully.
6. Transport the machine so that it is balanced. The packaged unit must not lean to one side.

4.1.5.3 Transport using industrial vehicles

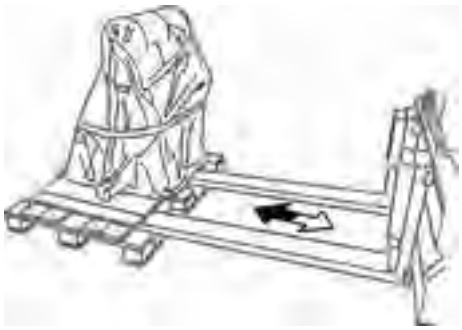


Fig. 46: Transport with belt guards

1. **NOTICE!**
   Risk of toppling loads! The transport of packaged units may only be carried out using lifting equipment that reaches under the machine and fits into the transport palette fully.
2. Insert the equipment into the provided opening in the transport palette.
3. Take into account the centre of gravity! See the labelling on the packaging.
4. **DANGER!**
   Risk of fatal injury from toppling components!

   Determine the packaged unit's centre of gravity by raising it carefully.
5. Transport the machine so that it is balanced. The packaged unit must not lean to one side.

4.1.5.4 Transport using a crane

Fig. 47: Transport of packaged units

DANGER!
Risk of fatal injury from toppling components!

NOTICE!
Risk of damage to the machine from lifting equipment such as cables or straps.

Transport of the packaged unit with a crane is not permissible! The transport palette is not designed for crane transport.

4.1.6 Transport to the installation site

4.1.6.1 Transport using industrial vehicles

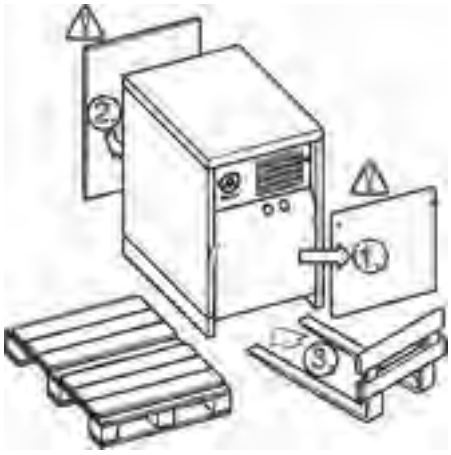


Fig. 48: Transport with acoustic hood

1. Completely remove packaging material.
2. Open the operating side of the acoustic hood (pos.1).
3. Open the rear side of the acoustic hood (pos.2).
4. Separate the machine from the transport palette by removing the holding screws.
5. Drive the transport fork under the machine (pos.3).
6. Take into account the centre of gravity! See the labelling on the packaging.
7. **DANGER!**
   Risk of fatal injury from toppling components!

   Determine the machine's centre of gravity by raising it carefully.
8. Transport the machine so that it is balanced. The machine must not lean to one side.
9. Remove the lifting equipment at the installation area.

4.1.6.2 Transport using a crane

Fig. 49: Transport with acoustic hood

1. Completely remove packaging material.
2. Remove the front and rear elements of the acoustic hood and store them safely.
3. Guide the conveyor rails through the openings of the forklift tunnel.
4. Place the lifting beams on to the acoustic hood. Span length of a minimum of 150 mm longer than the dimensions of the acoustic hood.
5. Guide lifting equipment, such as cables or straps through the conveyor rails and join them above the machine using the lifting beams.
6. Separate the machine from the transport palette by removing the holding screws.
7. Take into account the centre of gravity! See the labelling on the packaging.
8. **DANGER!**
   Risk of fatal injury from toppling components!

   Determine the machine's centre of gravity by raising it carefully.
9. Transport the machine so that it is balanced. The machine must not lean to one side.
10. Remove the lifting equipment at the installation area.

4.1.6.3 Transport using industrial vehicles

DANGER!
Risk of fatal injury from toppling components!

Transport of the packaged unit using an industrial vehicle is not permissible!

4.1.6.4 Transport using a crane

Fig. 50: Transport with belt guards

1. Completely remove packaging material.
2. Separate the machine from the transport palette by removing the holding screws.
3. **NOTICE!**
   Risk of machine damage if the material in the intake nozzle falls! Inspect for cleanliness.

   Dismantle the intake silencer on the flange joint.
4. **NOTICE!**
   Risk of damage from the force exerted by lifting equipment on accessory components!

   Only transport the machine with the hinged motor support fixed in place.

   Attach the lifting equipment carefully to the fastening device.
5. Take into account the centre of gravity! See the labelling on the packaging.
6. **DANGER!**
   Risk of fatal injury from toppling components!

   Determine the machine's centre of gravity by raising it carefully.
7. Transport the machine so that it is balanced. The machine must not lean to one side.
8. Remove the lifting equipment at the installation area.
9. Mount the intake silencer.

4.2 Storage and preservation

4.2.1 Storage

Storage notes

Store the packaged unit under the following conditions:

- Keep flange connections closed. Avoid entry of foreign substances.
- Do not store outdoors.
- Store in a dry and dust-free place.
- Do not expose it to any agressive media.

- Protect the packaged unit from exposure to the sun.
- Avoid mechanical vibrations.
- Avoid extreme temperature fluctuations.
- Avoid adverse water affects.
- Storage temperature: -10 to +40 °C.
- Relative humidity: maximum 80 %.
- If a vibration-free storage area is not available, move the movable components by 2 - 3 rotations every 6 - 8 weeks.

NOTICE!
Risk of corrosion! To avoid potential damage to the machine, an inspection of the overall scope of supply should be undertaken by the manufacturer every 2 years.

There may be information on the packaged unit regarding storage that goes beyond the requirements listed here. Comply with this information.

Storage information for periods of over 12 months

Additional measures:

- Packaging with VPI paper.
- Sealed in PVC foil.

Storage information for periods of over 12 months in a tropical climate

Additional measures:

- Drying agent (VPI power in a bag) inside the packaging.
- Packaging with VPI paper.
- Sealed in PVC foil.

Storage in air-conditioned spaces with minimal humidity has a positive influence on corrosion protection!

Packaging during storage

- Inspect the general condition of the packaging regularly. Immediately rectify damage to the packaging. If necessary, refresh or replace the anti-corrosion protection *'Carrying out preservation treatment' on page 84*
- After opening the packaging:
  - Inspect uncoated parts for sufficient corrosion protection.
  - Protect against humidity and damaging environmental influences.
  - Sealing flaps from the connection openings must not be removed.
- Replace the drying agent regularly in accordance with climactic conditions.

NOTICE!
Risk of corrosion! Customised packaging is required for tropical climate zones and in the case of special customer requirements.

Damaged packaging

NOTICE!
Risk of corrosion! As a result of damaged packaging, moisture and damaging environmental influences could directly affect the product.

Measures in case of damaged packaging

- Immediately rectify damage to the packaging. If necessary, refresh or replace the preservation material.
- Dry the machine, if necessary.
- Inspect the drying agent, replace if necessary.
- Repair or replacement of the packaging.

4.2.2 Preservation

Preservation

Factory preservation protects the product for a certain time period in accordance with the relevant storage and packaging information.

Factory preservation/standard		
Conveying chamber	BIO-CHEM food tech oil	biodegradable, does not contaminate groundwater
Oil chamber	Mobil SHC 626	operating lubricant oil
Shelf-life	up to 12 months	with compliance with storage conditions
Repeat	after 12 months	
Extended shelf-life (no standard)	more than 12 months	only with suitable long-term preservation and packaging

Preservation from assembly to commissioning		
Treat the conveying chamber and move the rotors by 2-3 rotations.	more than 6 weeks of non-use	avoidance of corrosive and standstill damage

Preservation after period of non-use		
Preservation of conveying chamber, oil chamber	more than 6 months	special preservation measures necessary

Carrying out preservation treatment

Preservation measures:

1. Open the packaging. Check the machine for good accessibility.
2. **WARNING!**
   Risk of poisoning from inhaling oil vapour! Wear a mouthguard, protective gloves and protective clothing.

   Preservation treatment of the conveying chamber: spray suitable preservative oil over the intake nozzle at the machine stage.

   NOTICE!
   Risk of filter damage! Do not spray preservative oil into the intake filter. Filter elements must not be treated with preservative oil.
3. **WARNING!**
   Risk of poisoning from inhaling oil vapour! Wear a mouthguard, protective gloves and protective clothing.

   Preservation treatment of the oil chamber: Spray suitable preservative oil over the oil fill opening / oil drain opening at the machine stage.

   ⇨ Let excess preservative oil flow out of the oil drain opening.
4. Close the oil fill opening / oil drain opening.
5. **WARNING!**
   Risk of poisoning from inhaling oil vapour! Wear a mouthguard, protective gloves and protective clothing.

   Treat the outer, uncoated surfaces with suitable preservative oil.
6. Inspect the sealing flaps.

7. Inspect and fix the packaging.

5 Set-up/installation

5.1 Safety instructions

Improper set-up/installation

WARNING!

Risk of injury from improper set-up / installation!

Improper set-up / installation may lead to serious personal or material damage.

- Before beginning work ensure there is sufficient space for installation.
- Check the tidiness and cleanliness of the working site.
- Only use commercially-available tools or, if necessary, special tools.
  Unsuitable or damaged tools may cause injury!
- Secure parts against falling during installation.
- Mount parts correctly.
  Comply with the specified screw-tightening torques.

Electrical system

DANGER!

Risk of fatal injury from electrical current!

There is a risk of fatal injury from touching live components. Live electrical components may make uncontrolled movements and cause extremely serious, or even fatal injury.

- Before beginning work, switch off the electric power supply and secure it against restarting.

Electrostatic charges

WARNING!

Risk of injury from electrostatic charges!

The belt drive may generate electrostatic charges.

- Before commissioning put in place equipotential bonding.
- Only use electrically-conductive belts.

Requirements for staff

Requirements for set-up and installation:

Set-up and installation of electrical components

Personnel: ■ Authorised electricians

Set-up and installation of mechanical components

Personnel: ■ Service personnel

Protective equipment

Requirements for set-up and installation:

Protective equipment:
- ■ Protective work clothing
- ■ Safety shoes
- ■ Protective gloves
- ■ Safety goggles
- ■ Industrial hard hat

Special tools

Requirements for set-up and installation:

Special tool:
- ■ Tools for authorised electricians
- ■ Electric drill
- ■ Drills
- ■ General tool kit
- ■ General measurement tools and equipment

Special tool: ■ Locking key

5.2 Requirements for the installation site

Ground properties

Inspect the ground properties. These should be as follows:

- stable
- even
- free of vibrations
- without any incline
- without holes

NOTICE!
Risk of deformation of the acoustic hood substructure! Do not install or mount the machine on “hollow” or lamellar foundations.

Subsurface requirements for the cement floor.
The cement floor should have a recommended surface pressure resistance of 30 - 40 N/mm².

Flatness tolerance according to DIN 18202						
	Distance between measuring points in (m)					
	0.1	1	4	10	>15	/
Dimension tolerance in (mm)	2	4	10	12	15	/

Angular tolerance according to DIN 18202						
	Distance between measuring points in (m)					
	up to 1	over 1 up to 3	over 3 up to 6	over 6 up to 15	over 15 up to 30	over 30
Dimension tolerance in (mm)	±6	±8	±12	±16	±20	±30

Surroundings

- Ensure there is a suitable fresh air supply.
- Avoid heat accumulation.

NOTICE!
Risk of corrosion! There must not be any excessive levels of dust, acids, steam or explosive or flammable gases at the installation site!

Installation with belt guards

The machine is only suitable for indoor installation.

Machine installation site

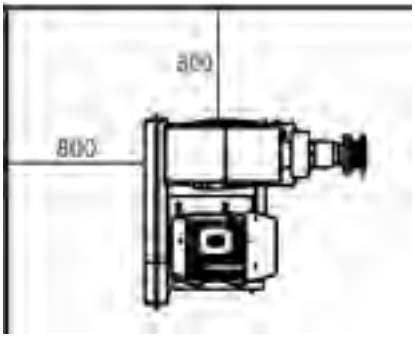


Fig. 51: Overall dimensions

- Comply with the overall dimensions for maintenance work. Observe the installation drawing.
- Provide measures for sound insulation.
- Take the following precautionary measures:
  - If possible, switch off the machine before entering the operating area. Otherwise wear hearing protection.
  - Provide appropriate signage at the installation site.
  - The installation site must only be accessible for trained persons.
  - Choose an installation site where the duration of time persons spend in the immediate vicinity of the machine is extremely limited.

Installation with acoustic hood

The machine is suitable for indoor installation.

Outdoor installation of the machine is not permitted! For this, there are particular protective measures for avoiding the effects of weather conditions. Machines with acoustic hoods are appropriately designed for this purpose.

Machine installation site

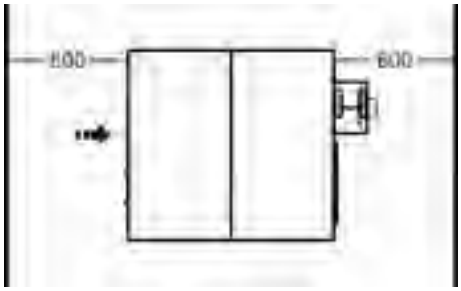


Fig. 52: Overall dimensions

- Comply with the overall dimensions for maintenance work. Also consult the installation drawing.
- Take the following precautionary measures:
  - If possible, switch off the machine before entering the operating area.
  - Otherwise wear hearing protection.
  - The installation site must only be accessible for trained persons.
  - Provide appropriate signage at the installation site.
  - Choose an installation site where the duration of time persons spend in the immediate vicinity of the machine is extremely limited.

5.3 Installation

Models with acoustic hoods; aligning/dowelling

Fig. 53: Spirit level alignment

1. Carefully align the machine.
2. Position it so that it is balanced.

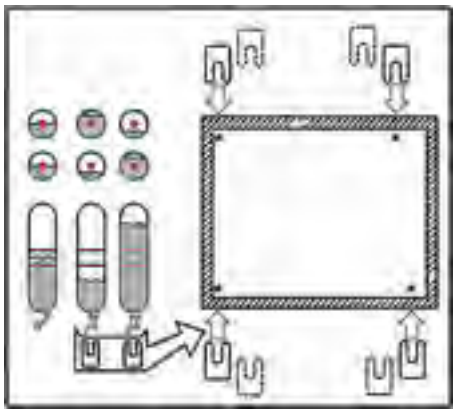


Fig. 54: Shim alignment

3.

NOTICE!
Risk of total machine damage! Installing a machine at an angle may, as a result of an undefined oil level, can lead to a total machine loss. Observe the level and angle tolerances.

If necessary, use the intended shims on the bolting surfaces.

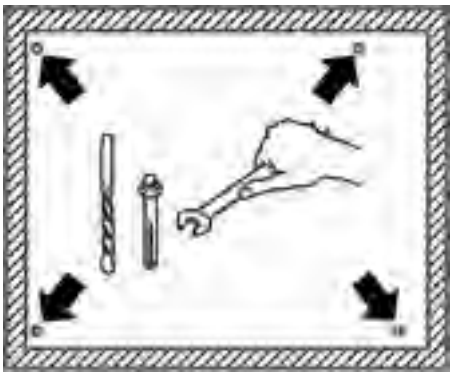


Fig. 55: Mounting holes

4. Recommendation: Drill and dowel four mounting holes and screw the machine into these.

Models without acoustic hoods; aligning/dowelling

1. Carefully align the machine.
2. Position it so that it is balanced.
3. **NOTICE!**
   Risk of total machine damage! Installing a machine at an angle may, as a result of an undefined oil level, can lead to a total machine loss. Observe the level and angle tolerances.

   If necessary, use the intended shims on the bolting surfaces.
4. A single bolt per machine foot is sufficient. Drilling, dowelling and screwing tight the mounting holes

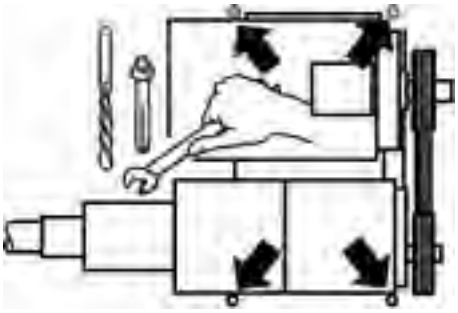


Fig. 56: Mounting holes

5.4 Connecting the system pipeline

System pipeline

NOTICE!
Risk of machine damage! The connected pipeline must not exert forces or moments that affect the machine.

Secure and fasten the system pipeline.

Observe the labelling and dimensions on the installation drawing.

1. Remove the sealing cover from the connection openings.

Bushings/2 clamps

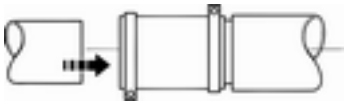


Fig. 57: 2 clamps

2. Connect the system pipeline.
   ⇨ Make sure that the clamps are offset by 180° to one another.

Bushings/4 clamps

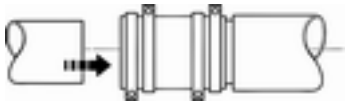


Fig. 58: 4 clamps

3. Connect the system pipeline.
   ⇨ Make sure that the clamps are offset by 180° to one another.

Connection of a compensator

Fig. 59: Connection of a compensator

4. Connect the system pipeline.
5. Close off the pipeline duct using a shim.

5.5 Connecting the drive motor

5.5.1 Preparing the connection

Preparation with acoustic hood

1. *Chapter 3.7.1 'Drive motor' on page 57*
2. **DANGER!**
   Risk of fatal injury in the case of incorrect electrical connection data!

   Compare the electrical connection data of the drive motor with those of the operator-side grid.
3. Shut down the power from the operator-side grid.
4. Observe the cable routing on the installation drawing!

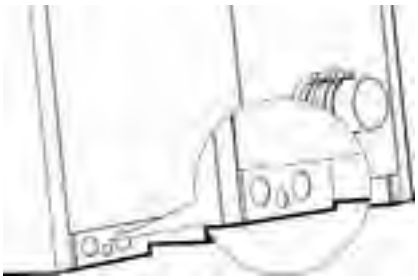


Fig. 60: Position on the acoustic hood

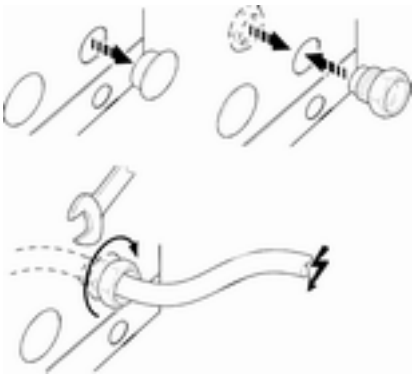


Fig. 61: Preparation

5. Prepare the cable feedthroughs.
6. **DANGER!**
   Risk of fatal injury from electric current!

   Check that there is no live current in the connection cable.
7. Lay the connection cable through the cable feedthroughs.

5.5.2 Routing cables

Routing the connection cable

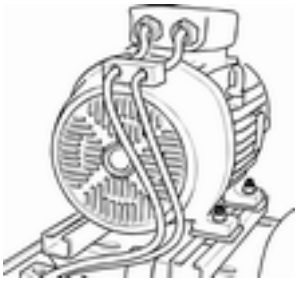


Fig. 62: Cable laying alignment

1. Route the connection cable in accordance with the installation drawing.
2. **NOTICE!**
   Risk of damage! The minimum bending radius must not be undershot!

   Observe the bending radii.

   ⇨ Bending radius of the connection cable = 15 x cable sheath diameter

5.5.3 Connecting the drive motor

Motor connection

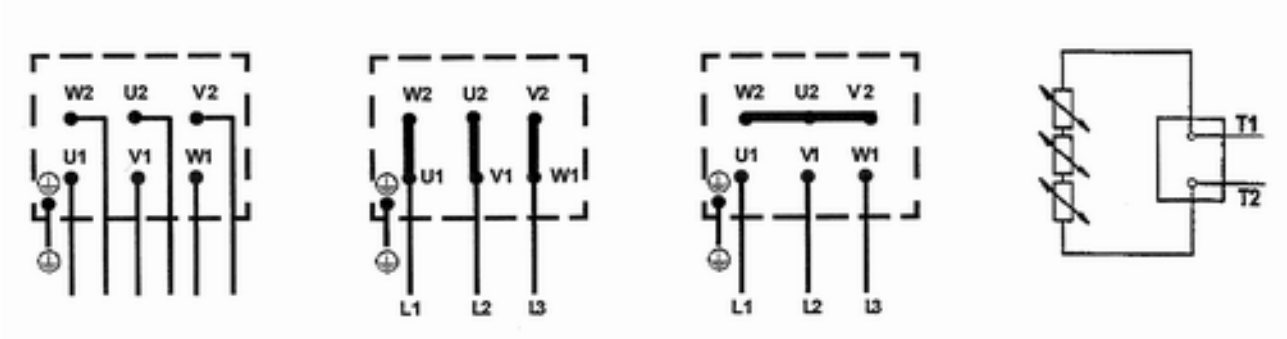


Fig. 63: Connection layout

Star-delta connection	Delta connection	Star connection	Thermal winding shield

1. Open the motor terminal box.
2. Check the alignment of the terminal box.
   ⇨ The terminal box must be aligned with openings for the cable feedthroughs facing in the direction of the motor fan.
3. Attach a screwed cable gland to the terminal box.
4. Guide the motor cable through the screwed cable gland.
5. Connect the cable connections with the motor terminals correctly, in accordance with the connection layout.
6. Close the terminal box.
7. Ensure that the connection cable is not damaged by the movement of the hinged motor support.

5.6 Connecting the drive motor

5.6.1 Preparing the connection

Preparation with belt guards

1. *Chapter 3.7.1 'Drive motor' on page 57.*
2.

   DANGER!
   Risk of fatal injury in the case of incorrect electrical connection data!

   Compare the electrical connection data of the drive motor with those of the grid operator.
3. Shut down the power from the operator-side grid.
4.

   DANGER!
   Risk of fatal injury from electric current!

   Check that there is no live current in the connection cable.

5.6.2 Routing cables

Routing the connection cable

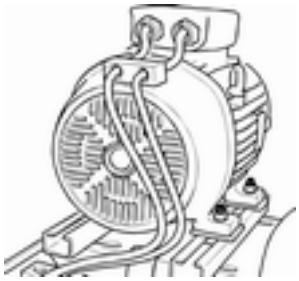


Fig. 64: Routing cables

1. Route the connection cable in accordance with the installation drawing.
2.

> **NOTICE!**
> Risk of damage! The minimum bending radius must not be undershot!

Observe the bending radii.

⇨ Bending radius of the connection cable = 15 x cable sheath diameter

5.6.3 Connecting the drive motor

Motor connection

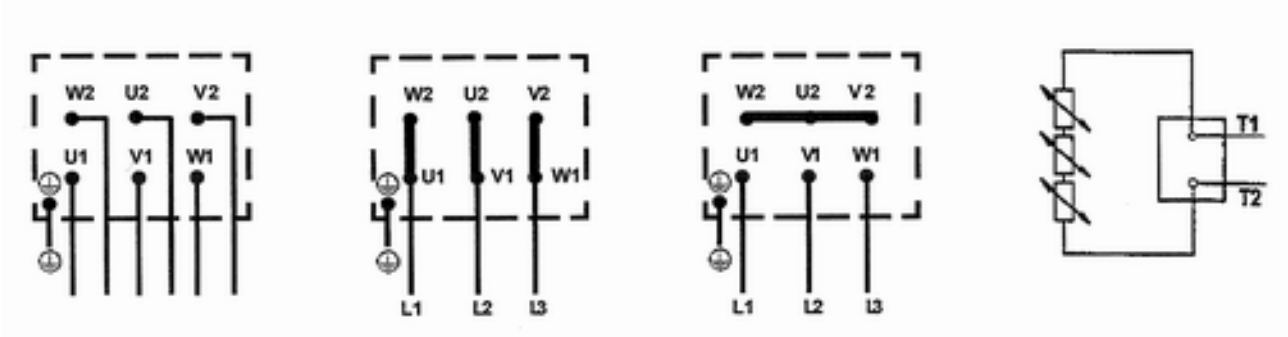


Fig. 65: Connection layout

Star-delta connection	Delta connection	Star connection	Thermal winding shield

1. Open the motor terminal box.
2. Check the alignment of the terminal box.
   ⇨ The terminal box must be aligned with openings for the cable feedthroughs facing in the direction of the motor fan.
3. Attach a screwed cable gland to the terminal box.
4. Guide the motor cable through the screwed cable gland.
5. Connect the cable connections with the motor terminals correctly, in accordance with the connection layout.
6. Close the terminal box.
7. Ensure that the connection cable is not damaged by the movement of the hinged motor support.

5.7 Connecting the machine's terminal strip

Machine terminal strip

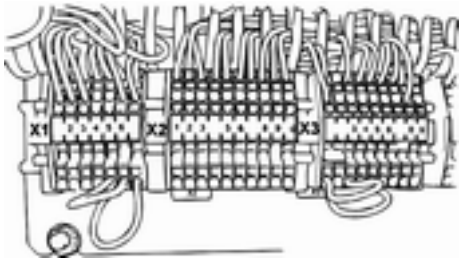


Fig. 66: Terminal box connections

1. Open the terminal box.
2. Observe the wiring scheme.

   The wiring scheme can be found in the terminal box or in the product documentation.
3. **DANGER!**
   Risk of fatal injury from electrical current!

   Ensure that the connecting cable is not live.
4. *Connection layout according to the AERZEN wiring scheme!*

   Guide the external connecting cable to the terminal box.
5. Guide the connecting cable correctly through the cable entry (dummy cover) to the terminals.
6. The cable entry (dummy cover) can be equipped on site with screwed cable glands.
7. Close the terminal box properly.

5.8 Connecting the earthing

Connecting the earthing

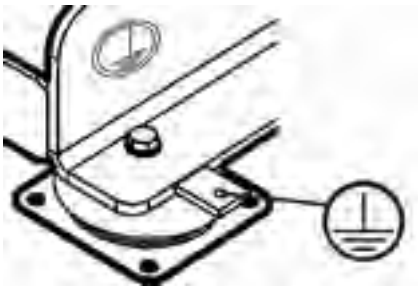


Fig. 67: Example connection

1. *The exact position of these connections can be found in the installation drawing.*

   Earth the machine on the provided connections.
2. Observe the cross-sections of the earthing strap! ↳ *Chapter 11.9.2 'Earthing strap cross-section ' on page 185*.
3. Beware of uncovered metal contact surfaces.
4. Screw contacts tightly together.

5.9 Connecting the earthing

Connecting the earthing

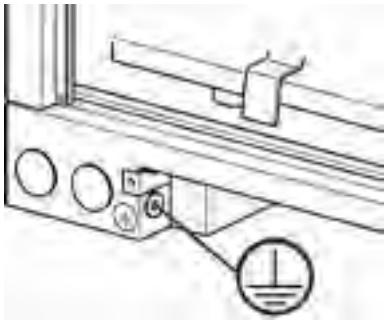


Fig. 68: Example connection

1. *The exact position of these connections can be found in the installation drawing.*

   Earth the machine on the provided connections.
2. Observe the cross-sections of the earthing strap!.
   See *Chapter 11.9.2 'Earthing strap cross-section ' on page 185*.
4. Beware of uncovered metal contact surfaces.
5. Screw contacts tightly together.

5.10 Laying the insulation mat

Laying the insulation mat

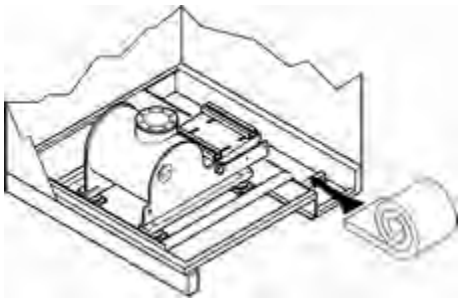


Fig. 69: Laying of the insulation mat

- Depending on the scope of delivery, the insulation mat is delivered separately.
- Lay the insulation mat in the exhaust duct of the acoustic hood.

6 Initial start-up

6.1 Safety instructions

Improper commissioning

WARNING!

Risk of injury from improper commissioning!

Improper commissioning may lead to serious injury and considerable material damage.

– Before commissioing, ensure that all installation work has been carried out and completed in accordance with the information and notes in this instruction manual.
– Before commissioing, ensure that there are no persons in the hazard area.

Requirements for staff

Requirements for commissioning:

Commissioning of electrical components

Personnel:
- Authorised electricians

Commissioning of mechanical components

Personnel:
- Service personnel

Protective equipment

Requirements for commissioning:

Protective equipment:
- Protective work clothing
- Safety shoes
- Hearing protection
- Protective gloves
- Safety goggles
- Industrial hard hat

Special tools

Requirements for commissioning:

Special tool:
- Ratchet wrench
- Oil funnel
- Test pump
- General tool kit
- General measurement tools and equipment
- Tools for authorised electricians

Special tool:
- Locking key

6.2 Preparation for commissioning

Preparation

1. Check that the machine has been correctly installed. See requirements at the installation site ↳ *Chapter 5.2 'Requirements for the installation site' on page 88*.
2. Check that the packaging has been fully removed.
3. Check that all seals and covers on the piping connections have been removed.
4. Check that the piping connections are clean. Remove any dirt, dust or foreign matter from the intake area.
5. Ensure that the supply air and exhaust air openings on the acoustic hood are unobstructed.

Ventilation

6. *Take the ambient temperature into consideration. Operating conditions ↳ Chapter 11.4 'Technical performance data' on page 170*

   Ensure that the installation site is adequately ventilated.

Take noise protection into consideration.

7. *Natural vibrations and sound emissions may be induced in piping and foundations!*

   Prevent natural vibrations and associated sound emissions with suitable measures, e.g. insulation.

Ventilating the manometer

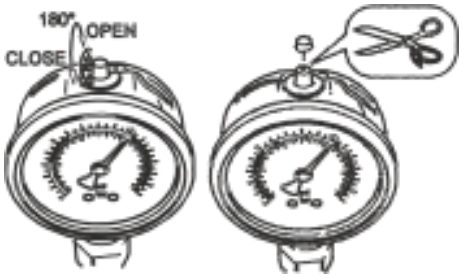


Fig. 70: Ventilating the manometer

8. Prepare the manometer in line with its specific design.

- Cut off the rubber connections on the upper section.
- Turn the bleeder flap to OPEN.

Maintenance indicator (a)

Fig. 71: Variation a)

9. Set to zero.

- Press the front reset button and set the pointer to the zero position.

Maintenance indicator

Fig. 72: Variation b)

10. Set to zero.

- Remove the plugs on the front.
- Adjust the set screw using a screwdriver.
- Observe the “+” and “-” markings.
- Position the red trailing pointer between 0 and -10 mbar.

Aligning the sheaves

11. Check the alignment of the sheaves.

- The maximum permitted sheave offset is 0.5 mm.

Connecting the piping

12. Connect the depressurised system piping.

Preparing the hinged motor support

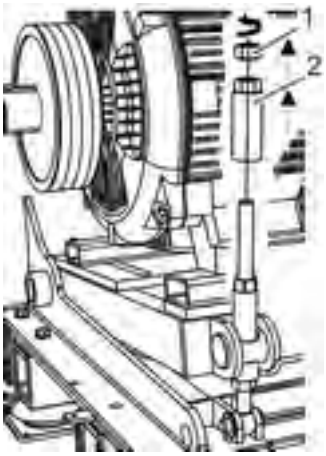


Fig. 73: Hinged motor support preparation

13. Remove counternut (pos.1) and locking sleeve (pos.2.

Removing sealing plugs

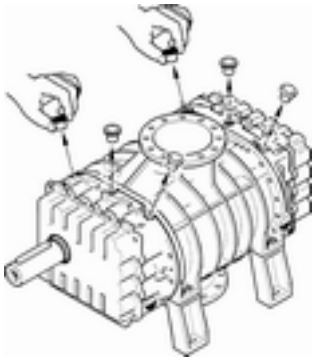


Fig. 74: Sealing plug configuration

14. Remove the sealing plugs from the balancing holes.

The sealing plugs may be coated in machine paint as part of the manufacturing process.

The number of sealing plugs varies depending on the machine type!

Depending on the design, they may already have been removed before shipping.

NOTICE!
Risk of damage if sealing plugs are not removed! If sealing plugs are not removed, there is a risk that the machine will start to leak oil. Lube oil could enter the conveying chamber.

No lube oil

Fig. 75: Do not fill with lubricant oil

15.

NOTICE!
Risk of damage! Lube oil must not enter these bore holes!

These bore holes are solely intended to discharge leaking gases. Filling with oil results in the need for considerable repairs.

Checking the acoustic hood fan

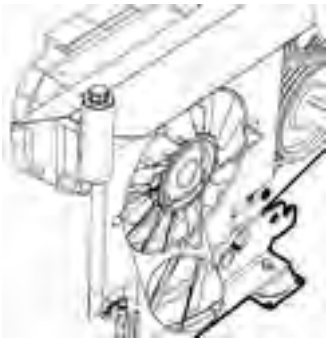


Fig. 76: Fan cover

16. Check the fan wheel for smooth movement and contact-free operation.

    If necessary, adjust the cover plate.

Frequency converter installation and connection

17.

> *Observe the manufacturer's instruction manual!*

Position and assemble the frequency converter.

- Connect it according to the manufacturer's instructions.
- See also the assembly group description for frequency converters. *Chapter 3.7.4 'Frequency converter / operation' on page 60*

Checking the EMERGENCY STOP function

18. Check whether the EMERGENCY STOP function is in place and installed.

- Check for correct operation.
- Enter the test result in the test book.

6.3 Starting commissioning

Oil filling

1. Open the maintenance elements of the acoustic hood.

Models with acoustic hoods

Fig. 77: Filling with oil

2.

> *When working with operating materials such as lube oil, wear personal protective equipment.*

> **ENVIRONMENT!**
> Environmental risks from incorrect handling of lubricants!

Fill with lube oil. *Chapter 8.3.1 'First oil filling' on page 130*

Checking the oil level

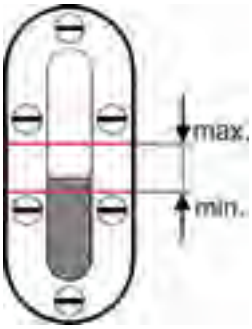


Fig. 78: Sight glass for oil level display

3. Check the lube oil level and correct it if necessary.

Models without acoustic hoods

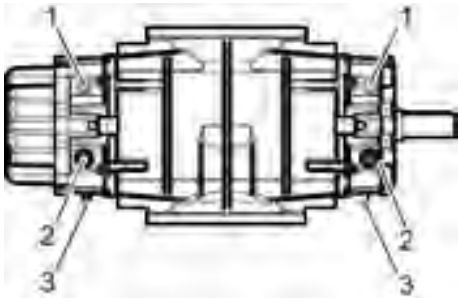


Fig. 79: GM3S-GM80L

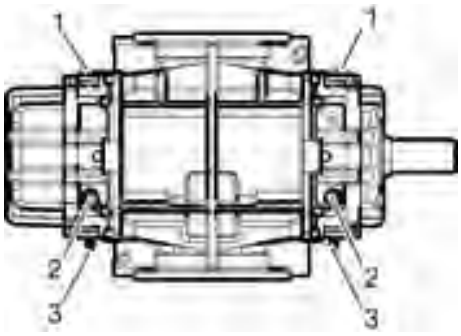


Fig. 80: GM90L-GM400L

4.

When working with operating materials such as lube oil, wear personal protective equipment.

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Loosen the RED-marked locking screw (pos. 1). Fill with lube oil. *'Filling with oil (models without acoustic hoods)' on page 131*

Checking the oil level

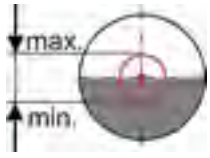


Fig. 81: Oil level display (Pos. 2)

5. Check the lube oil level and correct it if necessary.

Establishing an electrical connection

6. **DANGER!**
Risk of fatal injury from electric current!

Supply electrical components with electricity.

See *Chapter 5.5 'Connecting the drive motor' on page 92*.

7. Connect and activate motor overload protection. *Chapter 11.9.3 ' Motor overload protection' on page 185*

8. Observe the permissible starting frequency of the drive motor. *'Permissible starting frequency' on page 58*

Checking direction of rotation/ models with acoustic hood

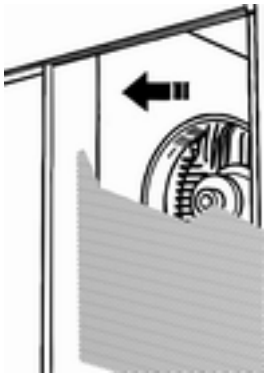


Fig. 82: Motor direction of rotation

9. **WARNING!**
Risk of injury from rotating components!

NOTICE!
Risk of machine damage from incorrect direction of rotation!

Check the direction of rotation **without belts** in place.

- If in place, remove the perforated plate cover of the drive motor's sheave.
- Observe the rotational direction signage on the machine stage and on the drive motor.
- Start the drive motor briefly (approx. 1 to 2 seconds).
- Viewed towards the front of the drive shaft, the drive motor turns anti-clockwise.
  - Direction of rotation is correct = continue commissioning.
- From the viewing position, the drive motor turns right in front of the drive shaft.
  - Direction of rotation is incorrect = correct the electrical connection.
- Where applicable, attach the perforated plate cover of the drive motor.

Checking the direction of rotation/ models without acoustic hood

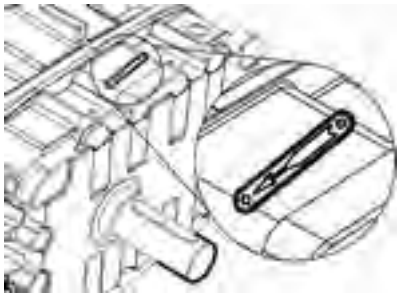


Fig. 83: Direction of rotation

10.

WARNING!
Risk of injury from rotating components!

NOTICE!
Risk of machine damage from incorrect direction of rotation!

Inspect the direction of rotation **without belts** in place.

- Remove the cover from the belt guard.
- Observe the rotational direction signage on the machine stage.
- Start the drive motor briefly (approx. 1 to 2 seconds).
- Viewed towards the front of the drive shaft, the drive motor turns anti-clockwise.
  - Direction of rotation is correct = continue commissioning.
- From the viewing position, the drive motor turns right in front of the drive shaft.
  - Direction of rotation is incorrect = correct the electrical connection.
- Mount the cover of the belt guard.

Disconnecting the electrical power supply

11.

WARNING!
Risk of injury from an automatic start-up!

Deactivate the machine and secure it against restarting.

Fitting the belt

12.

For designs with a lifting device, the hinged motor support can be found in the corresponding position. The belt can be fitted directly.

Pre-tensioning the belts

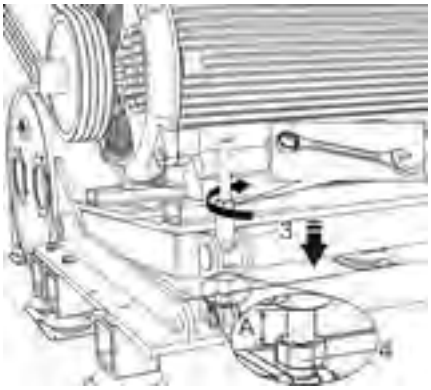


Fig. 84: Pre-tensioning belts

13. **CAUTION!**
Risk of injury from tensioning components!

Turn guide bushing (pos.3) clockwise with the ratchet wrench until the belts are pre-tensioned.

⇨ The hinged motor support is partly held by the belt drive and rests lightly on the guide bushing (pos.3).

Adjusting the guide bushing

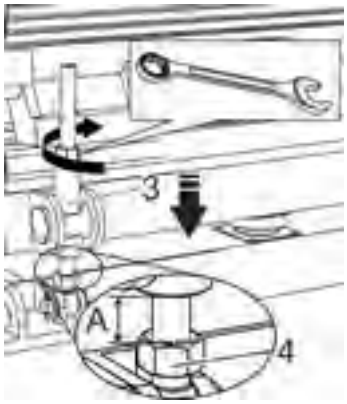


Fig. 85: Adjusting the gauge of the guide bushing

14. Set gauge A.

- Set self-locking nut (pos.4) to gauge A. Turn guide bushing (pos.3) on to the self-locking nut (pos.4) using the ratchet wrench.

DN/discharge side	Gauge A in mm
80	20
100	25
125	30
150	35
200	40
250	45
300	50
Delta Blower G5	

Tensioning the belts

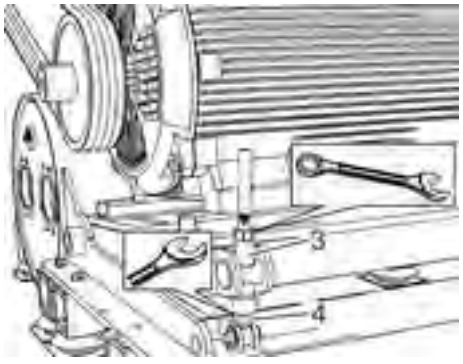


Fig. 86: Tensioning the belts

15. **CAUTION!**
Risk of injury from moving and rotating components!

Tension the belts.

- Secure the guide bushing (pos.3) with the self-locking nut (pos.4).
- The hinged motor support is supported entirely by the belt drive.

Carrying out a test run

16. **CAUTION!**
Risk of injury from moving components!

Carry out a test run of the belt drive and check that it is operating correctly.

Characteristics:

- quiet, even operation.
- even load.
- no excessive vibrations.
- no whistling noises.
- no increased wear.

Checking the protective cover/ models without acoustic hood

Fig. 87: Protective cover

17. Check the spacing of the pre-mounted protective cover for the motor drive shaft.
    - The protective cover should be at a distance of approx. 10 mm from the motor drive shaft.
    - By loosening the fastening screws, the protective cover can be moved.
    - Check the protective cover for firm seating and, if necessary, tighten it.

Adjusting the protective cover/ models without acoustic hood

Fig. 88: Adjusting the protective cover

18. If the protective cover is supplied separately, adjust the cover plates accordingly. The cover plates can be snapped off at the required length.

Assembling and adjusting the protective cover/models without acoustic hood

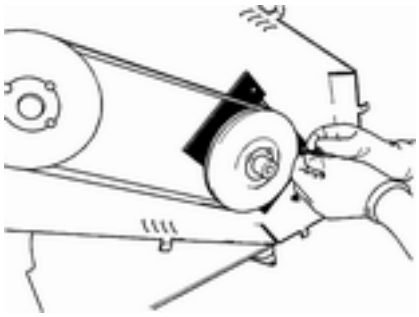


Fig. 89: Assembly/adjusting

19. **WARNING!**
Risk of injury from rotating components!

Assemble the protective cover after tensioning the belts.

- The protective cover should be at a distance of approx. 10 mm from the motor drive shaft.
- Operation is only permissible with a mounted cover!

Assembling the acoustic hood

20. Close the maintenance element of the acoustic hood.

Connecting the power supply

21. **WARNING!**
Risk of injury from electric current!

Supply electrical components with electricity.

Inspecting shut-downs

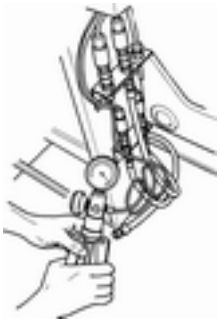


Fig. 90: Test pump

22. Check the correct operation of all pressure switches/sensors that can trigger a shut-down.
    - Connect the test pump to the corresponding measurement line.
    - Simulate the tripping pressure.
    - Check to see if a shut-down process is triggered.
    - Remove the measurement line from the test pump.
    - Fit the measurement line to the measuring point on the machine.

Opening the system line

23. Open valves on the system side.

Starting briefly

24.

WARNING!
Risk of injury from rotating components!

WARNING!
Risk of injury from pressurised components!

Do not loosen or remove any locking screws or pipe connections.

Switch on the drive motor.

- After approx. 20 seconds, switch it off.
- Make sure the motor coasts down smoothly.

Checking the frequency converter for correct operation

25.

Read and follow the manufacturer's operating instructions!

DANGER!
Risk of fatal injury from electric current and residual energy for all work performed on frequency converters!

See also the assembly group description for frequency converters. ↳ *Chapter 3.7.4 'Frequency converter / operation' on page 60*

Starting the drive motor

26.

WARNING!
Risk of injury from rotating components!

As long as there are no malfunctions: restart the drive motor.

- Check the EMERGENCY STOP function.
- Check the machine's protective equipment.

Checking after first commissioning

27.

WARNING!
Risk of injury from pulling or opening pressurised lubricating and control oil pipes.

Perform the following checks:

↳ *Chapter 6.4 'Performing checks after commissioning' on page 111*

Acoustic hood protection

28.

WARNING!
Risk of injury if protective equipment is not present.

Correctly close the elements of the acoustic hood.

- Store the acoustic hood key safely.
- Only allow access for authorised personnel.

Belt protection

29.

WARNING!
Risk of injury if protective equipment is not present.

Mount the belt protection cover.

Operational readiness

30. If there are no malfunctions, the machine is ready for operation.

After the first few hours of operation, preservative oil may gather in the parting faces as a result of the machine warming up.

6.4 Performing checks after commissioning

Inspection	After the first 3 op. hrs	After the first 25 op. hrs
Screws	after the machine has cooled down re-tighten if necessary	
Pressure valve	check for correct operation	
Oil level	check, correct if necessary	check, correct if necessary
Aligning the sheaves		check, correct if necessary
Condition of the belts		check, change if necessary, establish cause
Control system, fault transmitter, pressure and temperature sensors	check for correct operation	
Motor overload protection	connected and active	
Accumulation of preservative oil		check, remove if necessary
op. hrs = operating hours		

7 Operation

7.1 Safety instructions

Improper operation

WARNING!

Risk of injury from improper operation!

Improper operation may lead to serious injury and considerable material damage.

- Carry out all activities in accordance with the information and notes in this instruction manual.
- Before beginning work, observe the following:
  - Ensure that all covers and safety devices are installed and operating correctly.
  - Ensure that there are no persons in the hazard area.
- Never deactivate or bypass safety devices during operation.

Open acoustic hood

WARNING!

Risk of injury from operation with an open acoustic hood!

Open acoustic hoods may lead to dangerous situations and cause injury during machine operation.

- Always keep the acoustic hood closed during operation.

Adjusting valves

DANGER!

Risk of injury when adjusting valves!

When the machine is running and an attempt is made to adjust a valve, body parts may be injured by rotating components. Take into account the stand-by mode and/or automatic start-up

Only make adjustments if:

- The machine is not running.
- The machine is secured against a restart.

Explosion and fire hazards

DANGER!

There is a risk of explosion and fire from ignition hazards!

Avoid allowing ignition hazards (open flames, flying sparks, weld spatter) into the vicinity of the machine. Sparks and incandescent or flammable objects could be sucked in through the supply air openings on the acoustic hood or through the intake silencer. The fan may ignite these elements causing fire or an explosion.

– Avoid ignition hazards.
– Never carry out work that generates sparks while the machine is in operation.
– Ventilate the installation site properly.

Requirements for staff

Requirements for operation:

Operating the machine

Personnel:
- User

Adjusting valves

Personnel:
- User
- Authorised electricians

Protective equipment

Requirements for operation:

Protective equipment:
- Protective work clothing
- Safety shoes
- Hearing protection

Special tools

Adjusting valves:

Special tool:
- Locking key

7.2 Shut-down in case of emergency

In hazardous situations, the movements of components must be stopped as quickly as possible and the electric power supply must be shut off.

Shut-down in case of emergency

In an emergency, proceed as follows:

1. Activate the EMERGENCY STOP immediately.
2. Inform the responsible staff.

3. Switch off the main circuit breaker and secure it against restarting.
4. Assign qualified personnel the task of rectifying the fault.
5. **WARNING!**
   An unauthorised or unregulated restart can have fatal consequences.

   Before commissioning, ensure that all safety devices are installed and operational.

7.3 Switching on

Operating modes

Depending on the operating mode, the machine can be switched on in the following ways:

When starting and stopping the drive motor, observe all of the machine's protective measures. Power take-offs must be actuated by a potential-free contact or be actuated directly. The start-up of the power take-offs runs in parallel to the drive motor.

AERtronic

The starting and stopping of the drive motor must be carried out by AERtronic. A potential-free contact is already in place.

7.3.1 On-site operation

On-site manual operation

DANGER!
Risk of injury if protective equipment is missing!

Manually activate the starter switch on the machine on site.

⇨ The machine starts and comes on stream.

7.3.2 Remote operation

Via remote station

DANGER!
Risk of fatal injury if protective equipment is missing!

WARNING!
Risk of injury if the machine starts suddenly!

Activate the starter switch in the remote station.

⇨ The machine is started remotely and comes on stream.

Remote station with AERtronic

- Remotely via potential-free contact
- Remotely via MODBUS RTU
- Remotely via PROFIBUS DP

7.3.3 Automatic operation

Automatic activation

DANGER!
Risk of fatal injury if protective equipment is missing!

WARNING!
Risk of injury if the machine starts suddenly!

The starting command is carried out by sensors or a system switch.

⇨ The machine starts automatically and comes on stream.

7.4 Displaying operating parameters

AERtronic (optional)

A detailed explanation is contained in the separate operating manual AS-002.

Fig. 91: AERtronic display

Analogue instruments (optional)

Depending on their deisgn, analogue instruments display the given operating data, e.g. discharge pressure, discharge temperature, oil pressure.

Control system (optional)

Depending on the customer's control system, additional operating parameters can be recorded and displayed.

7.5 Switching off

Operating mode

Depending on the operating setup, the machine can be switched off in the following ways:

7.5.1 Switching off on site

Switching off manually (on site)

WARNING!
Risk of injury from unbraked shut-down!

Manually activate the cut-out switch on the machine.

⇨ The machine is switched off and shuts down. The machine does not stop immediately.

7.5.2 Switching off remotely

Via remote station

WARNING!
Risk of injury from unbraked shut-down!

Activate the cut-out switch in the remote station.

⇨ The machine is switched off and shuts down. The machine does not stop immediately.

7.5.3 Switching off automatically

Switching off automatically

WARNING!
Risk of injury from unbraked shut-down!

The shut-down command is carried out by sensors or a system switch.

⇨ The machine is switched off and shuts down. The machine does not stop immediately.

7.5.4 Switching off in nitrogen operation

Switching off in nitrogen operation

1. *Switch off as described above!*

Switch off the machine.

2. **DANGER!**
Risk of fatal injury from gas leaks!

For longer downtimes disconnect the unit from the gas network.

⇨ Otherwise there is a possibility that gas leaks will occur during downtime.

7.6 Decommissioning

Decommissioning means the shut-down of a machine for a longer period.

Measures

1. Switch off the machine properly and secure it against an unintentional start.
2. Disconnect fuses.
3. Close the shut-off valves of the delivery lines.
4. Prevent condensate from entering the machine.
5. For a downtime of over six weeks: preserve the conveying chamber.

Avoiding damage caused by down-time and corrosion

For a downtime of over six weeks
Preserve the conveying chamber. *'Preservation' on page 83*
Move the rotors every six weeks by 2-3 rotations.

7.7 Measures for recommissioning

7.7.1 Commissioning after adjustment works

after adjustments

Work stages *'Commissioning' on page 121*

7.7.2 Commissioning after maintenance work

after maintenance

Work stages *Chapter 8.5 'Commissioning after maintenance' on page 155*

7.7.3 Commissioning after fault rectification

After fault rectification

Work stages *Chapter 9.5 'Commissioning after fault rectification' on page 160*

7.8 Adjusting valves

DANGER!
Risk of injury when adjusting valves or equipment!

Preparation/models with acoustic hood

1. Agree adjustments with the responsible staff at the location.
2. Switch off the machine.
3. Activate the EMERGENCY STOP function.
4. Switch off the main circuit breaker and secure it against restarting.
5. Ensure there is no live electricity.
6. Open the maintenance elements.

Preparation/models without acoustic hood

1. Agree adjustments with the responsible staff at the location.
2. Switch off the machine.
3. Activate the EMERGENCY STOP function.
4. Switch off the main circuit breaker and secure it against restarting.
5. Ensure there is no live electricity.
6. Disassemble the belt guard.

7.8.1 Adjusting the start unloading device

DN 80 to DN 400

Fig. 92: Start unloading device

The start unloading device is preset with a maximum closing time at the factory. An adjustment is only necessary if the start unloading device does not close or the closing time is too long.

↳ *Chapter 11.10.3 'Start-up unloading device DN 80 to DN 400' on page 186*

Settings with star-delta starting

The start unloading device closes fully after:

- *the switch from star to delta.*
- *the nominal speed is reached.*

The closing procedure can be both heard and seen (on the gauge for discharge pressure).

Setting the closing time

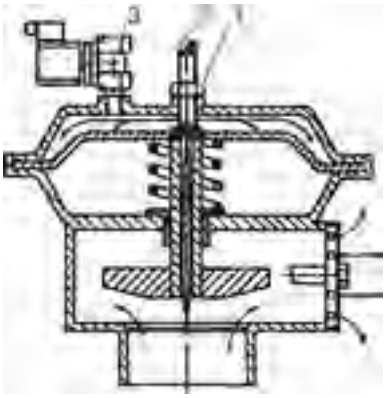


Fig. 93: Start unloading device positions

1. Open the maintenance elements.
2. Loosen the counternut (pos.1).
3. Move the spindle (pos.2) clockwise.
   ⇨ The closing time is reduced.
4. Move the spindle (pos.2) anti-clockwise.
   ⇨ The closing time is extended.
5. Set the closing time.
6. Tighten counternut (pos.1).
7. Mount all protective hardware and covers.
8. Close the maintenance elements.
9. **NOTICE!**
   Risk of damage! Observe the starting frequency of the drive motor!

   Start the machine.
10. Check the closing time.
11. If the closing time is in the permissible adjustment range:
    ⇨ adjustments are complete.
12. If the closing time is not in the permissible adjustment range:
    ⇨ repeat the adjustment steps.

Settings for pole changing

Set start unloading device to a lower speed in accordance with star-delta starting.

The closing time in the lower speed range must be set as long as possible, so that an acceptably long closing time is still available for the upper speed range.

If this is not possible, then an additional solenoid valve is used.

The solenoid valve (pos.3) keeps the start unloading device open to the atmosphere when ramping up to “high-speed” mode directly.

Reasons for the above:

- The differences in conveyed amounts are too large.
- High-speed operation is started from low-speed operation in “star-double-star starting“.

The solenoid valve (pos.3) keeps the start unloading device open to the atmosphere during star-double-star starting.

The solenoid valve closes after ramping up.

7.8.2 Commissioning after adjustments

Commissioning

1. Inform the responsible on-site person about the result of the work carried out and agree commissioning steps with that person.
2. Check all previously loosened screw connections for tightness.
3. Ensure that there are no persons in the hazard area.
4. Re-attach all safety hardware.
5. Remove all used tools, materials and other equipment from the workspace.
6. Release the safety on the main circuit breaker and activate it.
7. Release the EMERGENCY STOP function.
   ⇨ Start operation in accordance with the instruction in the “Operation” chapter. *Chapter 7.3 ‘Switching on’ on page 114*
8. Inform the responsible on-site person about the result of the work carried out.

8 Maintenance

8.1 Safety instructions

Improperly performed maintenance work

WARNING!

Risk of injury from improper maintenance work!

Improper maintenance may lead to serious personal or material damage.

- Only perform maintenance work when the machine has been taken out of commission.
- Secure the machine against restarting.
- Allow the machine to cool down to the ambient temperature.
- Before beginning work, ensure there is sufficient space for installation work.
- Check the tidiness and cleanliness of the work area.
- Only perform maintenance work with suitable tools.
- Ensure removed components are re-installed correctly.
- Re-install all fastening elements and observe the screw tightening torques.

Securing the machine against restarting

WARNING!

An unauthorised or unregulated restart can have fatal consequences.

An unauthorised or unregulated restart of the machine can lead to serious or fatal injuries. There may be people located in the hazard area.

- Before beginning work, switch off the energy supply and secure it against restarting.

Electrical system

DANGER!

Risk of fatal injury from electrical current!

There is a risk of fatal injury from touching live components. Live electrical components may make uncontrolled movements and cause extremely serious injury.

- Before beginning work, switch off the electric power supply and secure it against restarting.

Rotating or moving components

WARNING!

Risk of injury from rotating or moving components!

Rotating or moving components can cause serious injury.

- Never touch rotating or moving components.
- Never reach into the area of the belts that could cause injury by crushing.
- Keep a safe distance from rotating or moving components.
- When in a hazard area, wear tight-fitting protective work clothing with minimal tensile strength.

Hot operating materials

WARNING!

Risk of injury from hot operating substances!

Operating substances may reach high temperatures during operation. Skin contact with hot operating substances causes serious burns.

- For all work performed with hot operating substances, always wear protective work clothing and protective gloves.
- Before any work with operating substances, check whether they are hot. If necessary, allow them to cool down to the ambient temperature.

Requirements for staff

The maintenance work described here may only be performed by the designated personnel. The personnel entrusted with the respective maintenance tasks are listed in the maintenance plan.

For the preparation of the maintenance plan, the following is necessary:

Personnel:
- Authorised electricians
- Service personnel

For cleaning after maintenance, the following is necessary:

Personnel:
- User

Commissioning after maintenance requires:

Personnel:
- Authorised electricians
- Service personnel

Protective equipment

For maintenance, the following is necessary:

Protective equipment:
- Protective work clothing
- Safety shoes
- Protective gloves
- Safety goggles
- Industrial hard hat

Special tools

For maintenance, the following is necessary:

Special tool:
- Ratchet wrench
- Oil funnel
- General tool kit
- General measurement tools and equipment
- Auxiliary materials, aids

Special tool:
- Locking key

8.2 Maintenance schedule

The following section describes the maintenance work that is required for optimal and fault-free operation of the machine.

If regular inspections reveal an increased level of abrasion, reduce the maintenance intervals in accordance with the signs of wear and tear. For questions on maintenance work and intervals contact the manufacturer. See contact details.

8.2.1 Maintenance schedule for normal operation

Interval	Maintenance work	Personnel
After the first 500 op. hrs	Replace the lube oil. *This interval is skipped when using Delta Lube lube oil.* ↳ *Chapter 8.3.5 'Changing oil' on page 141* For a gas-tight shaft seal, change the grease. ↳ *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139*	Service personnel
Weekly	Check the intake filter for contamination. (display unit, max. permissible -45 mbar)	User
	Check the oil level. ↳ *Chapter 8.3.2 'Checking the oil level' on page 132* Correct if necessary. ↳ *Chapter 8.3.3 'Correcting the oil level' on page 134*	User
	If the maximum value (-45 mbar) is exceeded, change the intake filter. ↳ *Chapter 8.3.6 'Replacing the intake filter' on page 147*	Service personnel
	Check the belt guard for total stability and for damage and contamination. ↳ *Chapter 8.3.15 'Checking the belt guard' on page 154* Remove any dirt from the outer belt guard.	User
	If it is insufficiently stable or damaged, contact customer service.	Manufacturer's customer service division
Drive motor relubrication intervals	Observe the instruction manual and signage of the drive motor!	Service personnel
After every 4,000 op. hrs or every 6 months	Check and clean the inlet and exhaust air openings on the acoustic hood. ↳ *Chapter 8.3.14 'Checking the inlet and exhaust air openings on the acoustic hood' on page 153* Check the condition of the belts. If necessary, replace them. ↳ *Chapter 8.3.9 'Replacing belts' on page 148* Inspect the sheaves for unusual wear and tear or obvious damage. Inspect for alignment and stability. ↳ *Chapter 8.3.7 'Checking the sheaves' on page 147* Check that the pressure valve is operating correctly and clean it. ↳ *Chapter 8.3.10 'Checking the pressure valve' on page 150* Replace the lube oil at a discharge temperature of over 140 °C. *This interval is skipped when using Delta Lube 06 lube oil.* ↳ *Chapter 8.3.5 'Changing oil' on page 141* When using AERZEN special rotary piston oil with a gas-tight shaft seal, replace the grease at a discharge temperature of over 140 °C. ↳ *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139* Replace grease when using lube oil with an ISO VG 220 viscosity class in conjunction with a gas-tight shaft seal. ↳ *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139*	Service personnel

Interval	Maintenance work	Personnel
	If necessary, replace the sheaves.	Manufacturer's customer service division
	Check that the pressure valve is operating correctly. ↳ *Chapter 8.3.10 'Checking the pressure valve' on page 150*	Service personnel
After every 8,000 op. hours or every 12 months	Replace the intake filter. ↳ *Chapter 8.3.6 'Replacing the intake filter' on page 147* Replace the lube oil. *Observe the following specifications regarding DELTA LUBE 06!* ↳ *Chapter 8.3.5 'Changing oil' on page 141* Lube oil: Replace Delta Lube 06: only for pressure differentials > 800 mbar ↳ *Chapter 8.3.5 'Changing oil' on page 141* Replace the grease. ↳ *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139*	Service personnel
	Check the control system for correct operation.	Manufacturer's customer service division
After every 16,000 op. hrs or every 2 years	Lube oil: Replace Delta Lube 06. ↳ *Chapter 8.3.5 'Changing oil' on page 141* Replace the belts. ↳ *Chapter 8.3.9 'Replacing belts' on page 148* Check the alignment of the sheaves. If necessary, correct it. ↳ *Chapter 8.3.7 'Checking the sheaves' on page 147* Check non-return flap for wear and tightness. Replace if necessary. ↳ *Chapter 8.3.12 'Checking the non-return flap' on page 151* Check flexible pipe connections on the discharge and intake sides for tightness. Replace if necessary. ↳ *Chapter 8.3.16 'Checking pipelines for tightness.' on page 154*	Service personnel
After every 20,000 op. hrs or every 3 years	Check hose lines for tightness. Replace if necessary. Recommendation: replace hose lines every 6 years.	Service personnel
	Recommended main inspection/maintenance. Inspection, changing of replacement and expendable parts. Entire machine check.	Manufacturer's customer service division

op. hrs = operating hours

8.2.2 Maintenance schedule for arduous operating conditions

For example:

- year-round ambient temperatures over 30°C
- high dust levels

Interval	Maintenance work	Personnel
After the first 500 op. hrs	Change the oil. *This interval is skipped when using Delta Lube lube oil.* ↳ *Chapter 8.3.5 'Changing oil' on page 141* For a gas-tight shaft seal, change the grease. ↳ *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139*	Service personnel
Weekly	Check the intake filter for contamination. (display unit, max. permissible -45 mbar)	User
	Check the oil level. ↳ *Chapter 8.3.2 'Checking the oil level' on page 132* Correct if necessary. ↳ *Chapter 8.3.3 'Correcting the oil level' on page 134*	User
	If the maximum value (-45 mbar) is exceeded, change the intake filter. ↳ *Chapter 8.3.6 'Replacing the intake filter' on page 147*	Service personnel
	Check the belt guard for total stability and for damage and contamination. ↳ *Chapter 8.3.15 'Checking the belt guard' on page 154* Remove any dirt from the outer belt guard.	User
	If the belt guard is not completely stable or is damaged, contact customer service.	Manufacturer's customer service division
After every 2,000 op. hrs or every 3 months	Replace the intake filter. ↳ *Chapter 8.3.6 'Replacing the intake filter' on page 147* Check that the pressure valve is operating correctly and clean it. ↳ *Chapter 8.3.10 'Checking the pressure valve' on page 150*	Service personnel
Drive motor relubrication intervals	Observe the instruction manual and signage of the drive motor!	Service personnel
After every 4,000 op. hrs or every 6 months	Check and clean the inlet and exhaust air openings on the acoustic hood. ↳ *Chapter 8.3.14 'Checking the inlet and exhaust air openings on the acoustic hood' on page 153* Check the condition of the belts. If necessary, replace them. ↳ *Chapter 8.3.9 'Replacing belts' on page 148* Inspect the sheaves for unusual wear and tear or obvious damage. Inspect for alignment and stability. ↳ *Chapter 8.3.7 'Checking the sheaves' on page 147* Replace the lube oil at a discharge temperature of over 140 °C. *This interval is skipped when using Delta Lube 06 lube oil.* ↳ *Chapter 8.3.5 'Changing oil' on page 141*	Service personnel

Interval	Maintenance work	Personnel
	When using AERZEN special rotary piston oil with a gas-tight shaft seal, replace the grease at a discharge temperature of over 140 °C. *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139* Replace grease when using lube oil with an ISO VG 220 viscosity class in conjunction with a gas-tight shaft seal. *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139*	
	If necessary, replace the sheaves.	Manufacturer's customer service division
	Check that the pressure valve is operating correctly. *Chapter 8.3.10 'Checking the pressure valve' on page 150*	Service personnel
After every 8,000 op. hours or every 12 months	Replace the intake filter. *Chapter 8.3.6 'Replacing the intake filter' on page 147* Replace the lube oil. *Chapter 8.3.5 'Changing oil' on page 141* Lube oil: Replace Delta Lube 06. *Chapter 8.3.5 'Changing oil' on page 141* Replace the grease. *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139* Check non-return flap for wear and tightness. Replace if necessary. *Chapter 8.3.12 'Checking the non-return flap' on page 151*	Service personnel
	Check the control system for correct operation.	Manufacturer's customer service division
After every 16,000 op. hrs or every 2 years	Replace the belts. *Chapter 8.3.9 'Replacing belts' on page 148* Check the alignment of the sheaves. If necessary, correct it. *Chapter 8.3.7 'Checking the sheaves' on page 147* Check flexible pipe connections on the discharge and intake sides for tightness. Replace if necessary. *Chapter 8.3.16 'Checking pipelines for tightness.' on page 154*	Service personnel
After every 20,000 op. hrs or every 3 years	Check hose lines for tightness. Replace if necessary. Recommendation: replace hose lines every 6 years.	Service personnel
	Recommended main inspection/maintenance. Inspection, changing of replacement and expendable parts. Entire machine check.	Manufacturer's customer service division

op. hrs = operating hours

8.3 Maintenance work

Preparation

1. Agree maintenance work with the responsible staff at the location.
2. Switch off the machine.
3. Activate the EMERGENCY STOP function.
4. Switch off the main circuit breaker and secure it against restarting.
5.

   DANGER!
   Risk of injury from electric current!

   Ensure there is no live electricity.
6.

   DANGER!
   Risk of injury during maintenance work!

   Open the maintenance elements.
7.

   DANGER!
   Risk of injury during maintenance work!

   Open the belt guard cover.

8.3.1 First oil filling

Filling oil/models with acoustic hood

Fig. 94: Filling with oil

1. Check the drain valve for firm seating.
2. Check that the sealing cap of the drain valve is firmly in place.
3. Open the oil container.
4. Ensure that the ventilation pipe in the oil filling container is unobstructed.
5.

CAUTION!
Risk of skin irritation from lube oil!

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Observe the oil quantity ↳ *Chapter 11.7.4 'Lubricant quantities' on page 182* and specification ↳ *Chapter 11.7.1 'Lubricant oil specifications' on page 177*.

First, fill 3/4 of the listed quantity of oil.

6. Wait 5 - 10 minutes. The lube oil continues to flow.
   ⇨ The oil level regulates itself in the oil system and in the oil chambers.
7. Check the oil level.
8. Fill the rest of the lube oil up to the mark on the sight glass. Observe the after-run time of the lube oil.
   ⇨ The oil level is correct when it is between min. and max.
9. Close the oil filling container.
10.

ENVIRONMENT!
Risk of environmental damage from incorrect storage of lube oil!

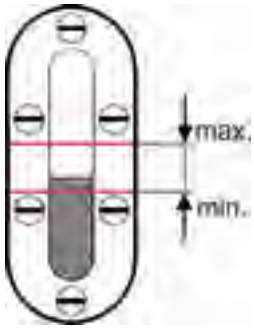


Fig. 95: Sight glass for oil level display

Clean the workspace thoroughly.

Dispose of residual lube oil in an environmentally-friendly way.

Clean all auxiliary equipment.

Filling with oil (models without acoustic hoods)

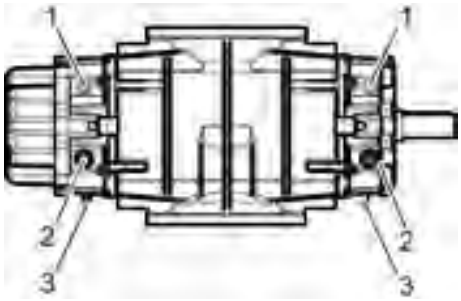


Fig. 96: GM 3S - GM 80L

1 Oil fill openings, marked in red
2 Oil level displays
3 Drain valves

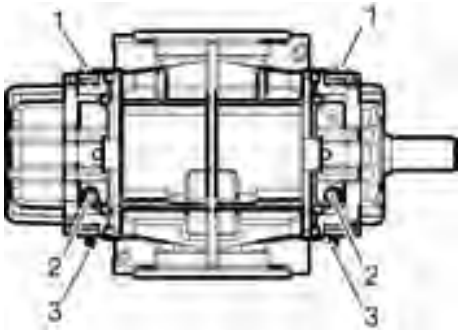


Fig. 97: GM 90S - GM 400L

1. Check the drain valves (pos. 3) for firm seating.

2. Check the sealing caps of the drain valves (pos. 3) for firm seating.

3. Open the oil fill openings (pos.1) – the RED-marked locking screws.

4. Observe the oil quantity distribution.

Guide value:

- 1/3 of the entire lube oil quantity in the driving side.
- 2/3 of the entire lube oil quantity in the wheel side.
  The display in the oil level sight glass is crucial.

5.

CAUTION!
Risk of skin irritation from lube oil!

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Observe the oil quantity ↳ *Chapter 11.7.4 'Lubricant quantities' on page 182* and specification ↳ *Chapter 11.7.1 'Lubricant oil specifications' on page 177*.

Fill with lube oil. To do this, fill with approx. 3/4 of the entire oil quantity. Fill this reduced total oil quantity according to the oil quantity distribution (approx. 1/3 driving side, approx. 2/3 wheel side) into both oil chambers.

6. Observe the oil level. Wait 5 - 10 minutes. The lube oil continues to flow.

⇨ The oil level regulates itself in the oil system and in the oil chambers.

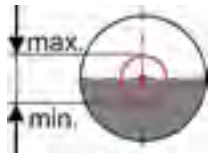


Fig. 98: Sight glass for oil level display (pos. 2)

7. Check the lube oil level.
8. Fill the rest of the lube oil up to the mark on the sight glass.
   ⇨ The oil level is correct when it is between min. and max.
9. Close the oil fill opening (pos. 1) tightly with a seal.
10. **ENVIRONMENT!**
    Risk of environmental damage from incorrect storage of lube oil!

    Clean the workspace thoroughly.

    Dispose of residual lube oil in an environmentally-friendly way.

    Clean all auxiliary equipment.

8.3.2 Checking the oil level

Oil system/models with acoustic hood

Fig. 99: Oil system

1 Oil fill opening (oil filling container)
2 Oil level display
3 Oil drain

Checking the oil level

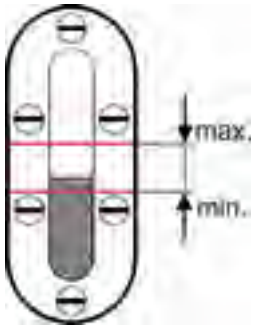
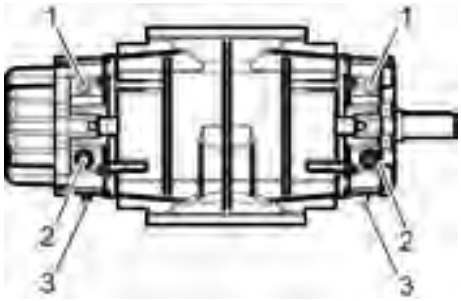


Fig. 100: Sight glass for oil level display

Check the lube oil level, correct if necessary.

Oil system/models without acoustic hood



1 Oil fill openings, marked in red
2 Oil level displays
3 Drain valves

Fig. 101: GM 3S - GM 80L

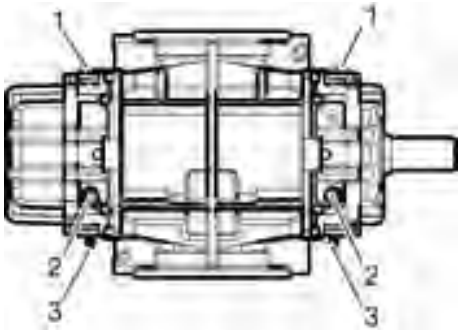


Fig. 102: GM 90S - GM 400L

Checking the oil level

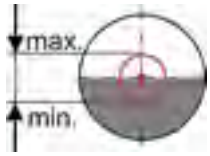


Fig. 103: Sight glass for oil level display

→ Check the lube oil level and correct it if necessary.

8.3.3 Correcting the oil level

8.3.3.1 Oil level too high

Oil drainage (models with acoustic hood)

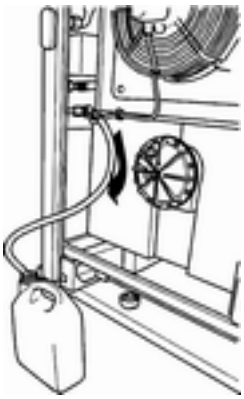


Fig. 104: Draining oil

1. **WARNING!**
   Risk of scalding from hot lube oil!

   NOTICE!
   Material damage to the drain hose from lube oil temperatures over 60°C!

   Allow the lube oil to cool down to the ambient temperature.

2. *Observe the volume of the waste oil and the oil-resistant receptacle.* ↳ *'Machine lube oil levels' on page 182*

   Have a receptacle ready.

3. Open the oil opening on the oil filling container.

   ⇨ Lube oil flows out more evenly from the oil drain.

4. Feed the drain hose into the receptacle.

Fig. 105: Fitting the drain hose

5. **CAUTION!**
   Risk of skin irritation from old lube oil!

   Remove the sealing cap from the drain valve.

   Twist the drain hose onto the drain valve.

   ⇨ The drain valve opens automatically.

6. **CAUTION!**
   Risk of slipping from oil spillage!

   Guide excess lube oil into the receptacle.

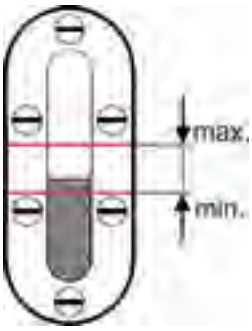


Fig. 106: Sight glass for oil level display

7. Observe and check the oil level.
8. If the permissible oil level is reached, remove the drain hose.
   ⇨ The drain valve closes automatically.
9. Screw the sealing cap onto the drain valve.
10. Close the oil fill opening.
11. **ENVIRONMENT!**
    Risk of environmental damage from waste oil!

    Collect waste lube oil and residual oil properly and dispose of it in an environmentally-friendly manner.

    Clean the workspace thoroughly.

    Clean all auxiliary equipment.

Oil drainage (models without acoustic hoods)

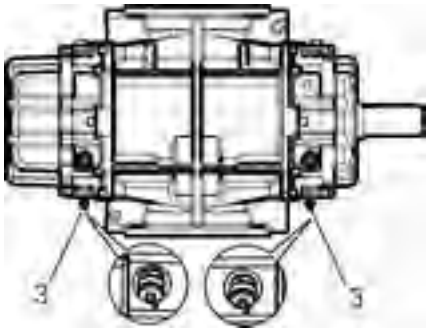


Fig. 107: Oil drain

3 Drain valves

1. **WARNING!**
   Risk of scalding from hot lube oil!

   Allow the lube oil to cool down to the ambient temperature.
2. *Observe the volume of the waste oil and the oil-resistant receptacle.* ↳ *'Machine lube oil levels' on page 182.*

   Have a receptacle ready.
3. Select an oil chamber with an excessively high filling capacity.
4. Open the oil fill opening.
   ⇨ Lube oil flows out more evenly from the oil drain.

5. **CAUTION!**
Risk of skin irritation from old lube oil!

A locking screw or a shut-off valve can be used as an alternative to the drain valve.

The oil chamber can be opened by:

– *removing the locking screw*
or by
– *removing the sealing plug on the shut-off valve. Open the shut-off valve.*

Remove the sealing cap from the drain valve.

If the sealing cap is very tightly in place, secure the drain valve using a wrench and loosen the sealing cap with an additional wrench.

6. **NOTICE!**
Material damage to the drain hose from lube oil temperatures over 60°C!

Feed the drain hose into the receptacle.

7. Twist the drain hose onto the drain valve.

⇨ The drain valve opens automatically.

8. **CAUTION!**
Risk of slipping from oil spillage!

Guide any excess lube oil into the receptacle.

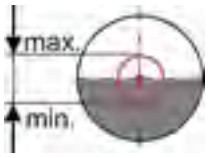


Fig. 108: Sight glass for oil level display

9. Observe and check the oil level.

10. If the oil level has been corrected, remove the drain hose.

⇨ The drain valve closes automatically.

A sealing screw or a shut-off valve can be used as an alternative to the drain valve.

The oil chamber can be closed by:

– *mounting the locking screw with a new sealing ring*
or by
– *closing the shut-off valve. Seal the output of the shut-off valve with sealing plugs.*

11. Screw the sealing cap onto the drain valve.
12. Close the oil fill opening.
13. **ENVIRONMENT!**
Risk of environmental damage from waste oil!

Collect waste lube oil and residual oil properly and dispose of it in an environmentally-friendly manner.

Clean the workspace thoroughly.

Clean all auxiliary equipment.

8.3.3.2 Oil level too low

Oil drainage/models with acoustic hood

Fig. 109: Filling with oil

1. Check the drain valve for firm seating.
2. Check the sealing cap of the drain valve for firm seating.
3. Open the oil filling container.
4. Ensure that the ventilation pipe in the oil filling container is unobstructed.
5. **CAUTION!**
Risk of skin irritation from lube oil!

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Specifications ↳ *Chapter 11.7.1 'Lubricant oil specifications' on page 177*

Fill the lube oil in stages and in small quantities.

6. Observe the oil level. Wait 5 - 10 minutes. The lube oil continues to flow.
   ⇨ The oil level regulates itself in the oil system and in the oil chambers.

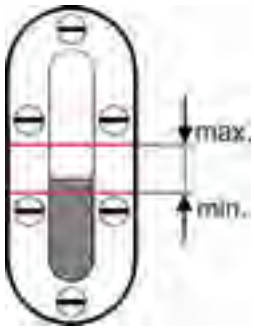


Fig. 110: Sight glass for oil level display

7. Check the oil level.
8. If the lube oil level is between the min.-/max. marks:
   ⇨ the oil level is OK.
9. If the lube oil level is beyond the min.-/max. marks:
   ⇨ Correct the oil level.
10. Close the oil filling container.
11. **ENVIRONMENT!**
    Risk of environmental damage from incorrect storage of lube oil!

    Clean the workspace thoroughly.

    Dispose of residual lube oil in an environmentally-friendly way.

    Clean all auxiliary equipment.

Filling with oil (models without acoustic hoods)

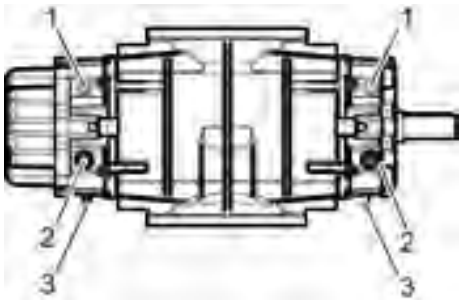


Fig. 111: GM 3S - GM 80L

1 Oil fill openings, marked in red
2 Oil level displays
3 Drain valves

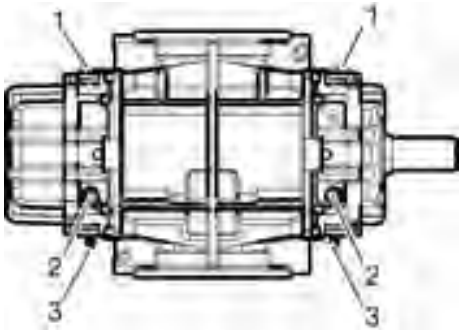


Fig. 112: GM 90S - GM 400L

1. Select the required oil chamber.
2. Check the drain valve (pos. 3) for firm seating.
3. Check sealing cap of the drain valve (pos. 3) for firm seating.
4. Open the oil fill opening, the RED-marked locking screw.

5. **CAUTION!**
Risk of skin irritation from lube oil!

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Observe the specifications *Chapter 11.7.1 'Lubricant oil specifications' on page 177*.

Fill the lube oil in stages and in small quantities.

6. Observe the oil level. Wait 5 - 10 minutes. The lube oil continues to flow.

⇨ The oil level regulates itself in the oil system and in the oil chambers.

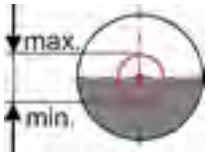


Fig. 113: Sight glass for oil level display (pos. 2)

7. Check the lube oil level.
8. If the lube oil level is between the min.-/max. marks:

⇨ the oil level is OK.

9. If the lube oil level is beyond the min.-/max. marks:

⇨ Correct the oil level.

10. Close the oil fill opening tightly with a seal.
11. If necessary, repeat the process at the other oil chamber.
12. **ENVIRONMENT!**
Risk of environmental damage from incorrect storage of lube oil!

Clean the workspace thoroughly.

Dispose of residual lube oil in an environmentally-friendly way.

Clean all auxiliary equipment.

8.3.4 Replacing the grease on gas-tight drive shafts

The replacement of grease is only required for the gas-tight version of the drive shaft (optional).

Press the grease a few operating hours before the lubricating oil change. The used, excess grease reaches the oil chamber of the machine stage and is discharged with the lubricating oil change.

Pressing the grease

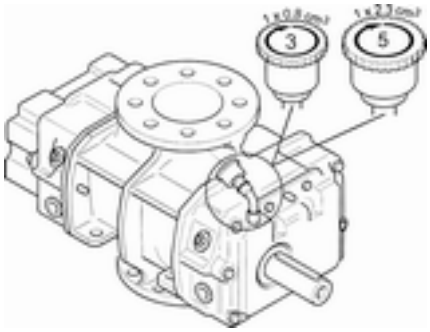


Fig. 114: Stauffer lubricator

1. **WARNING!**
   Risk of burning from hot housing surfaces!

   Allow the housing surfaces to cool down to ambient temperature.
2. Press the grease by turning the Stauffer lubricator.

   CAUTION!
   Risk of skin irritation from escaping grease!

   Observe the grease amount and number of turns. *'Grease filling quantity for machine stage' on page 183*
3. After pressing the required amount of grease, turn the Stauffer lubricator one revolution backwards. The volume of grease can then expand when it is heated.
4. Open the Stauffer lubricators and fill them with grease. Observe the specification of the grease. *Chapter 11.7.3 'Grease specifications' on page 180*

8.3.5 Changing oil

Oil drainage (models with acoustic hood)

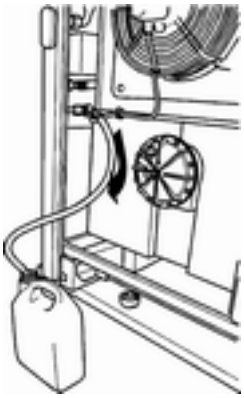


Fig. 115: Draining oil

1. **WARNING!**
   Risk of scalding from hot lube oil!

   NOTICE!
   Material damage to the drain hose from lube oil temperatures over 60°C!

   Allow the lube oil to cool down to the ambient temperature.
2. *Observe the volume of the waste oil and the oil-resistant receptacle.* ↬ *'Machine lube oil levels' on page 182*

   Have a receptacle ready.
3. Open the oil opening on the oil filling container.
   ⇨ Lube oil flows out more evenly from the oil drain.
4. Feed the drain hose into the receptacle.
5. **CAUTION!**
   Risk of skin irritation from old lube oil!

   Remove the sealing cap from the drain valve.

   Twist the drain hose onto the drain valve.

   ⇨ The drain valve opens automatically.

Fig. 116: Fitting the drain hose

6. **CAUTION!**
   Risk of slipping from oil spillage!

   Guide all emerging lube oil into the receptacle.
7. Remove the drain hose.
   ⇨ The drain valve closes automatically.
8. Screw the sealing cap onto the drain valve.
9. Close the oil filling container.

10. **ENVIRONMENT!**
Risk of environmental damage from waste oil!

Collect waste lube oil and residual oil properly and dispose of it in an environmentally-friendly manner.

Clean the workspace thoroughly.

Clean all auxiliary equipment.

Filling with oil

Fig. 117: Filling with oil

1. Check the drain valve for firm seating.
2. Check the sealing cap of the drain valve for firm seating.
3. Open the oil filling container.
4. Ensure that the ventilation pipe in the oil filling container is unobstructed.
5. **CAUTION!**
Risk of skin irritation from lube oil!

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Observe the oil quantity ↳ *Chapter 11.7.4 'Lubricant quantities' on page 182* and specification ↳ *Chapter 11.7.1 'Lubricant oil specifications' on page 177*.

First, fill 3/4 of the listed total quantity of lube oil.

6. Wait 5 - 10 minutes. The lube oil continues to flow.

⇨ The oil level regulates itself in the oil system and in the oil chambers.

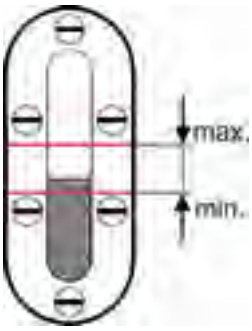


Fig. 118: Sight glass for oil level display

7. Check the oil level.
8. If the lube oil level is between the min.-/max. marks:
   ⇨ The oil level is OK.
9. If the lube oil level is beyond the min.-/max. marks:
   ⇨ Correct the oil level.
10. Close the oil filling container.
11. **ENVIRONMENT!**
    Risk of environmental damage from incorrect storage of lube oil!

    Clean the workspace thoroughly.

    Dispose of residual lube oil in an environmentally-friendly way.

    Clean all auxiliary equipment.

Oil drainage (models without acoustic hoods)

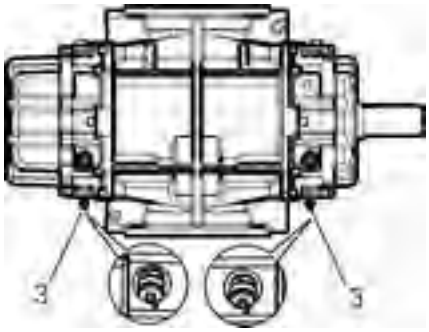


Fig. 119: Oil drain

1. **WARNING!**
   Risk of scalding from hot lube oil!

   Allow the lubricating oil to cool down to ambient temperature.
2. *Observe the volume of the waste oil and the oil-resistant receptacle.* ↳ *'Machine lube oil levels' on page 182*

   Have a receptacle ready.
3. Open the oil fill opening.
   ⇨ Lube oil flows out more evenly from the oil drain.

4. **CAUTION!**
Risk of skin irritation from old lube oil!

Remove the sealing cap from the drain valve.

A locking screw or a shut-off valve can be used as an alternative to the drain valve.

The oil chamber can be opened by:

– *removing the locking screw*
or by
– *removing the sealing plug on the shut-off valve. Open the shut-off valve.*

5. **NOTICE!**
Material damage to the drain hose from lubricating oil temperatures over 60°C!

Place the drain hose into the receptacle.

6. Twist the drain hose onto the drain valve.
⇨ The drain valve opens automatically.

7. **CAUTION!**
Risk of slipping from oil spillage!

Guide all emerging lube oil into the receptacle.

8. Remove the drain hose.
⇨ The drain valve closes automatically.

A sealing screw or a shut-off valve can be used as an alternative to the drain valve.

The oil chamber can be closed by:

– *mounting the locking screw with a new sealing ring*
or by
– *closing the shut-off valve. Seal the output of the shut-off valve with sealing plugs.*

9. Screw the sealing cap onto the drain valve.

10. Close the oil fill opening.

11. **ENVIRONMENT!**
Risk of environmental damage from waste oil!

Collect waste lube oil and residual oil properly and dispose of it in an environmentally-friendly manner.

Clean the workspace thoroughly.

Clean all auxiliary equipment.

Filling with oil

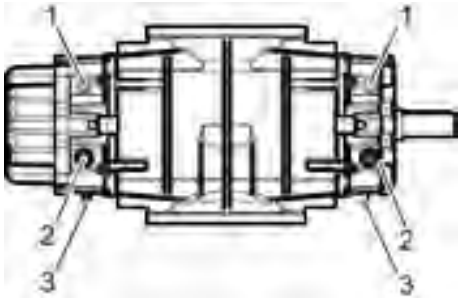


Fig. 120: GM 3S - GM 80L

1 Oil fill openings, marked in red
2 Oil level displays
3 Drain valves

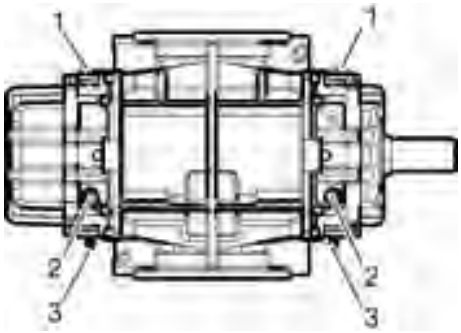


Fig. 121: GM 90S - GM 400L

1. Check the drain valves (pos. 3) for firm seating.

2. Check the sealing caps of the drain valves (pos. 3) for firm seating.

3. Open the oil fill openings (pos.1), the RED-marked locking screws.

4. Observe the oil quantity distribution.

Guide value:

- 1/3 of the entire lube oil quantity in the driving side.
- 2/3 of the entire lube oil quantity in the wheel side.
  The display in the oil level sight glass is crucial.

5. **CAUTION!**
Risk of skin irritation from lube oil!

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Observe the oil quantity *Chapter 11.7.4 'Lubricant quantities' on page 182* and specification *Chapter 11.7.1 'Lubricant oil specifications' on page 177*.

Fill with lube oil. To do this, fill with approx. 3/4 of the entire oil quantity. Fill this reduced total oil quantity according to the oil quantity distribution (approx. 1/3 driving side, approx. 2/3 wheel side) into both oil chambers.

6. Observe the oil level. Wait 5 - 10 minutes. The lube oil continues to flow.

   ⇨ The oil level regulates itself in the oil system and in the oil chambers.

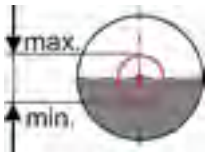


Fig. 122: Sight glass for oil level display (pos. 2)

7. Check the lube oil level.
8. Fill the rest of the lube oil up to the mark on the sight glass.

   ⇨ The oil level is correct when it is between min. and max.

9. Close the oil fill opening (pos. 1) tightly with a seal.
10. **ENVIRONMENT!**
Risk of environmental damage from incorrect storage of lube oil!

Clean the workspace thoroughly.

Dispose of residual lube oil in an environmentally-friendly way.

Clean all auxiliary equipment.

8.3.6 Replacing the intake filter

Replacing the intake filter

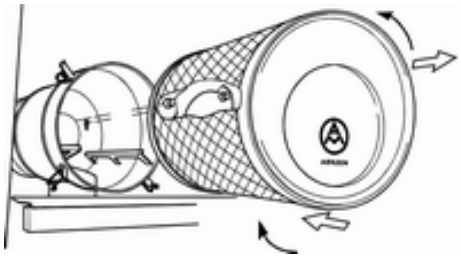


Fig. 123: Replacing the intake filter

1. **CAUTION!**
   Risk of air contamination from scattered dust particles.

   Open the cap locks of the intake silencer.
2. Remove the maintenance flap.
3. Loosen the intake filter by turning it anti-clockwise and remove it.
4. **NOTICE!**
   Risk of machine damage from objects inside the intake silencer that enter the intake opening.

   Remove residual dust inside the intake silencer.
5. Replace the intake filter.
6. Fasten the intake filter in place by turning it clockwise. Check that it is aligned correctly.
7. Fasten the maintenance flap on the housing of the intake silencer using the catch.
8. Reset the maintenance indicator (in accordance with the given variation).

8.3.7 Checking the sheaves

For wear and tear and damage

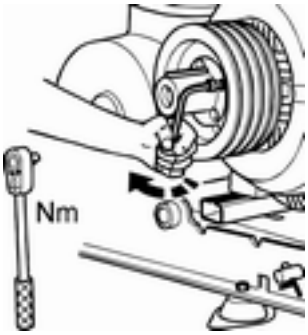


Fig. 124: Sheaves

1. Check for unusual wear and tear or obvious damage.
2. Check for correct alignment and stability.
3. If necessary, replace the sheaves.
4. Assemble the sheaves.
5. Fit the belt.

8.3.8 Moving/checking the protective cover of the sheaves

Moving on models without acoustic hood

Fig. 125: Protective cover

1. Loosen the fitting of the protective cover before lifting the hinged motor support.
   ⇨ The protective cover can now be moved.
2. Lift the hinged motor support, e.g. for changing the belts.
3. Lower the hinged motor support.
   ⇨ The weight of the motor creates tension in the belts.
4. Push the protective cover in the direction of the motor shaft and tighten it.

Testing on models without acoustic hood

1. Check the spacing of the protective cover of the motor shaft.
   During operation, the protective cover should be at a distance of approx. 10 mm from the motor drive shaft.
2. Check the protective cover for firm seating and, if necessary, tighten it.

8.3.9 Replacing belts

Raising the hinged motor support

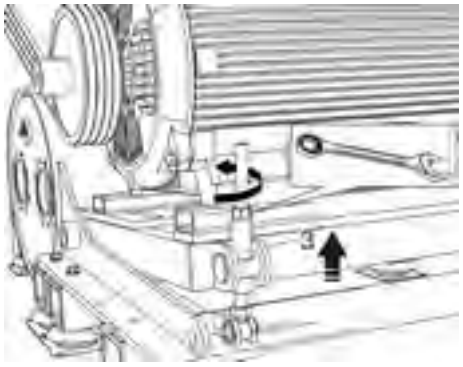


Fig. 126: Raising the hinged motor support

1. **WARNING!**
   Risk of injury from moving or rotating components!
   Lift the hinged motor support using the hinge jig.
2. Turn guide bushing (pos.3) anti-clockwise using the ratchet wrench.
   ⇨ The hinged motor support is raised.
3. Raise the hinged motor support until the belts are fully relieved of tension.
4. *Only replace belts as a set!*

5. Replace belts.

WARNING!
Risk of getting caught by rotating sheaves!

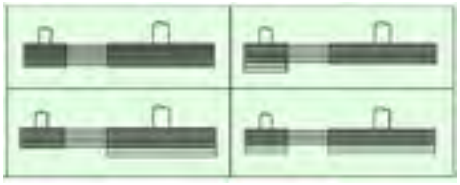


Fig. 127: Permissible belt layout

6. Observe the permissible groove layout.

Pre-tensioning the belts

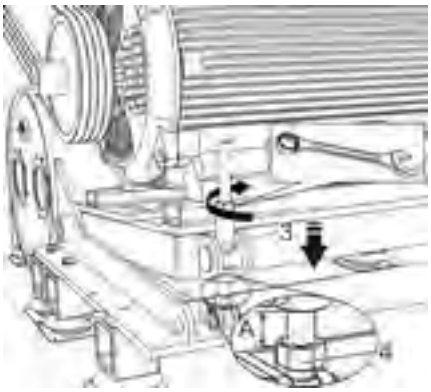


Fig. 128: Pre-tensioning the belts

7.

CAUTION!
Risk of injury from tensioning components!

Turn guide bushing (pos.3) clockwise with the ratchet wrench until the belts are pre-tensioned.

⇨ The hinged motor support is partly held by the belt drive and rests lightly on the guide bushing (pos.3).

Adjusting the guide bushing

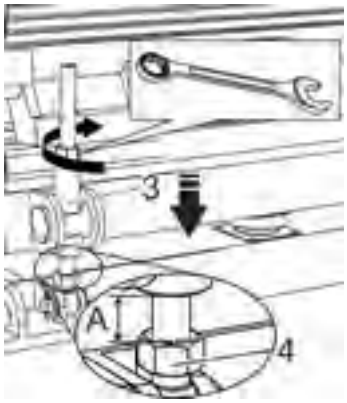


Fig. 129: Adjusting the gauge of the guide bushing

8. Set gauge A.

- Set self-locking nut (pos.4) to gauge A. Turn guide bushing (pos.3) on to the self-locking nut (pos.4) using the ratchet wrench.

DN/discharge side	Gauge A in mm
80	20
100	25
125	30
150	35
200	40
250	45
300	50
Delta Blower G5	

Tensioning the belts

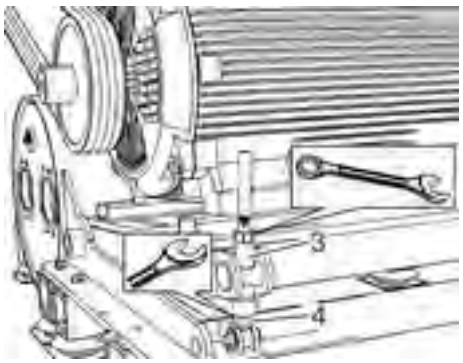


Fig. 130: Tensioning the belts

9. ▶

CAUTION!
Risk of injury from moving and rotating components!

Tension the belts.

- Secure the guide bushing (pos.3) with the self-locking nut (pos.4).
- The hinged motor support is supported entirely by the belt drive.

Checking the protective cover

Fig. 131: Protective cover of the sheaves

10. ▶ Check the spacing of the protective cover of the motor shaft.

The protective cover should be at a distance of approx. 10 mm from the motor drive shaft.

By loosening the fastening screws, the protective cover can be moved.

Check the protective cover for firm seating and, if necessary, tighten it.

8.3.10 Checking the pressure valve

Movement test

- G2", G3", DN 50, DN 80, DN 125

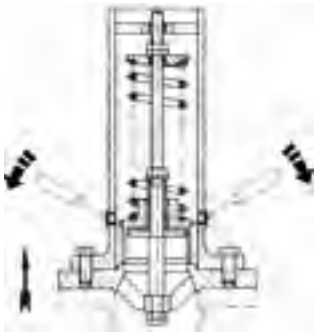


Fig. 132: using a screwdriver

1. ▶ Remove the protective caps or locking screws from the maintenance holes in the protective cylinder.

2. ▶ Guide a screwdriver into each hole.

3. ▶ Raise the valve bell with the screw drivers using leverage force.

⇨ The valve's opening function must be operational and the valve must move.

4. ▶ Lower the valve bell.

5. ▶ Remove the screwdrivers.

⇨ An intact valve will close.

6. ▶ Insert the protective caps or sealing screws into the maintenance holes in the protective cylinder.

Movement test

- DN 150, DN 200, DN 300

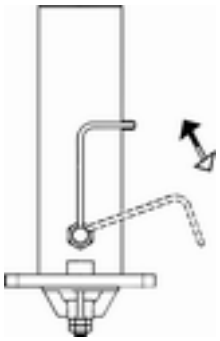


Fig. 133: using the stirrup

1. Raise the valve bell using the stirrup.
   ⇨ The valve's opening function must be operational and the valve must move.
2. Release the pressure on the stirrup and lower the valve bell.
   ⇨ An intact valve will close.

8.3.11 Checking that sealing plugs have been removed

Ensuring that the balancing holes are unobstructed

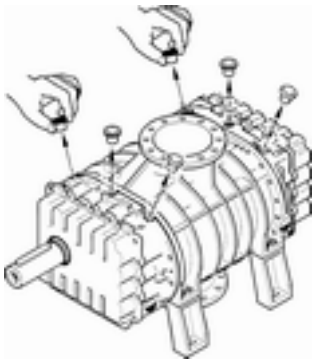


Fig. 134: Sealing plug configuration

1. Check that the (plastic) sealing plugs have been removed from the balancing holes.

   The sealing plugs are coated in machine-colour paint as part of the manufacturing process.

   The number of sealing plugs varies depending on the machine type!

   Depending on the design, they may already have been removed before shipping or during preparations for commissioning.

   ⇨ If there are no more sealing plugs in place: Finish the check.
2. The balancing holes are sealed.
   ⇨ Remove the sealing plugs. Finish the check.

8.3.12 Checking the non-return flap

Checking for wear and tear and tightness

Fig. 135: Non-return flap

1. Loosen the fastening screws.

   Light impact on the flange cover of the non-return flap loosens the sealing and makes disassembly easier.
2. Remove the non-return flap from the housing.
3. Carry out a visual inspection.

4. If no damage and/or hardening is visible, the sealing is acceptable.

   ⇨ Re-use the non-return flap.

5. If damage and/or hardening is visible, the sealing is not acceptable.

   ⇨ Replace the non-return flap.

Assembling the non-return flap

1. Remove dirt, grease and used sealing agent from the flange surface.
2. Apply sealing agent (liquid surface sealant) to the flange surface of the housing.
3. Guide the non-return flap into the housing.

Remove any bleeding sealing agent with a cloth. Observe the curing time of the sealing material!

4. Screw on the flange cover.

8.3.13 Cleaning the nozzle of the start-up relief device

Cleaning the nozzle

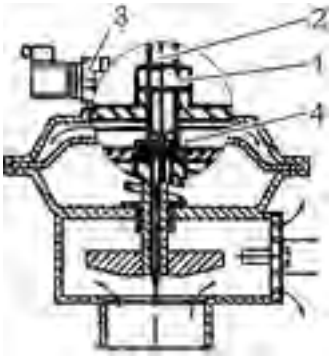


Fig. 136: Start-up relief device

1. Loosen the counternut (pos. 1).
2. Remove the spindle (pos. 2).

   ⇨ The nozzle (pos. 4) in the hole is accessible.

3. **WARNING!**
   Risk of injury from escaping dirt particles!

   Blow compressed air into the nozzle (pos. 4).

   ⇨ Unobstructed cross-section of the nozzle.

4. Mount the spindle (pos. 2).
5. Setting the closing time of the start-up relief device. *Chapter 11.10.3 'Start-up unloading device DN 80 to DN 400' on page 186*
6. Secure the spindle (pos. 2) with the nut (pos. 1).

8.3.14 Checking the inlet and exhaust air openings on the acoustic hood

Checking the inlet and exhaust air openings

1. Visual inspection of the supply air and exhaust air openings on the acoustic hood.
2. Clean the openings. Remove dirt.

Checking fan operation

1. Check the direction of flow in the operating position with a closed acoustic hood. Observe the information in the installation drawing.
2. If exhaust air is extracted from the acoustic hood, the check is finished.
   ⇨ The acoustic hood fan is operating correctly.
3. If no exhaust air emerges from the acoustic hood, the fan is malfunctioning.
   ⇨ Replace the fan.

Replacing the fan

1. Open the maintenance elements of the acoustic hood.
2.

   WARNING!
   Risk of injury from rotating components!

   Loosen the screws for attaching the fan.
3. Pull the fan from the shaft and replace it.
4. Seal the screw for attaching with liquid thread locker.
5. Screw on the fan.
6. Close the maintenance elements of the acoustic hood.
7. Check the cooling air flow during machine operation.

8.3.15 Checking the belt guard

Damage and stability

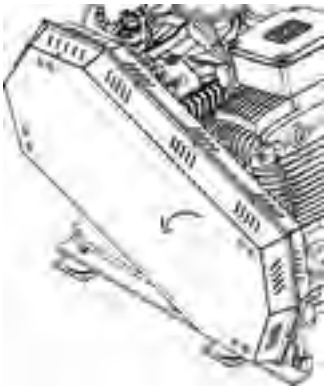


Fig. 137: Belt guard

1. **WARNING!**
   Risk of injury from hot surfaces!

   Check for damage and thorough stability.

   (stable on the base support and machine stage)
2. Remove dirt from the belt guard.
3. If necessary, tighten the belt guard fastener. If damaged, replace it.
4. Beware of any lubricant bleeding out of the drive motor. If lubricant bleeds out, inform the responsible staff at the location.

   Seal any leaks.

8.3.16 Checking pipelines for tightness.

Checking discharge-side pipelines for tightness

1. Check pipelines for tightness (visual inspection).

   Ensure that the pipelines have been depressurised!
2. If there are leaks
   ⇨ Replace seals or bushing.
3. Reinforce the pipelines if necessary.
4. Disassemble leaking pipe connections.
5. Use new seals or bushing.
6. Assemble pipe connections.

8.4 Cleaning after maintenance

Cleaning after maintenance work

1. **NOTICE!**
   Risk of damage! Do not used high pressure cleaners, steam jet pumps, grease removal agents, thinners, compressed air etc. as cleaning methods.
2. Dust and dirt must be cleaned with suitable cloths.

3. Clean components susceptible to scratches, display units and touch panels of control systems, gauges etc. with a soft, wet towel.
4. Remove all cleaning agents from the immediate vicinity of the machine before commissioning.
5. Dispose of cloths in an environmentally-friendly way.

8.5 Commissioning after maintenance

Commissioning after maintenance

1. Inform the responsible on-site person about the result of the work carried out and agree commissioning steps with that person.
2. Check all previously loosened screw connections for tightness.
3. Mount all protective hardware and covers that were previously removed.
4. Remove all used tools, materials and other equipment from the workspace.
5. Clean the workspace. Remove operating substances, operating material, processing material and similar materials and dispose of them appropriately.
6. Ensure that there are no persons in the hazard area.
7. Release the main circuit breaker and activate it.
8. Release the EMERGENCY STOP function.
   ⇨ Start operation in accordance with the instructions in the “Operation” chapter.
9. Inform the responsible on-site person about the result of the work carried out.

8.6 Checks after maintenance work

Inspection	After the first 3 op. hrs	After the first 25 op. hrs
Pressure valve	check for correct operation	
Oil level	check, correct if necessary	check, correct if necessary
Aligning the sheaves		check, correct if necessary
op. hrs = operating hours		

9 Malfunctions

The following chapters describe possible causes of faults and steps to be taken to rectify them.

If faults cannot be rectified using the following instructions, contact the manufacturer.

9.1 Safety instructions

Improper fault rectification

WARNING!

Risk of injury from improper operation fault rectification!

Improper fault rectification may lead to serious personal or material damage.

- Only perform maintenance work when the machine has been taken out of commission.
- Secure the machine against restarting.
- Allow the machine to cool down to the ambient temperature.
- Before beginning work, ensure that there is sufficient space for installation work.
- Check the tidiness and cleanliness of the workspace.
- Only attempt to rectify faults with suitable tools.
- Ensure removed components are re-installed correctly.
- Re-install all fastening elements and observe the screw tightening torques.
- Before restarting, check that:
  - all safety and protective equipment is installed and functioning correctly.
  - there are no persons in the hazard area.

Electrical system

DANGER!

Risk of fatal injury from electrical current!

There is a risk of fatal injury from touching live components. Live electrical components may make uncontrolled movements and cause extremely serious injury.

- Before beginning work, switch off the electric power supply and secure it against restarting.

Securing the machine against restarting

WARNING!

An unauthorised or unregulated restart can have fatal consequences.

An unauthorised or unregulated restart of the machine can lead to serious or fatal injuries. There may be people located in the hazard area.

– Before beginning work, switch off the energy supply and secure it against restarting.

Requirements for staff

The fault rectification work described here may only be performed by the designated personnel. The personnel entrusted with the respective fault rectification tasks are listed in the table of fault descriptions in addition to their designated tasks.

Requirements in the event of malfunctions and for preparations for fault rectification work:

Personnel:
- Authorised electricians
- Service personnel

For commissioning after rectification of a malfunction, the following is necessary:

Personnel:
- Authorised electricians
- Service personnel

Protective equipment

For fault rectification work the following is necessary:

Protective equipment:
- Protective work clothing
- Protective gloves
- Safety shoes

Special tools

For fault rectification work the following is necessary:

Special tool:
- General tool kit
- Ratchet wrench
- Tools for authorised electricians
- General measurement tools and equipment

Special tool:
- Locking key

Behaviour in the event of faults

1. **DANGER!**
   Risk of injury during fault rectification!
2. In the event of a malfunction, activate the EMERGENCY STOP immediately.
3. Switch off the main circuit breaker and secure it.
4. Immediately inform the responsible staff on location about the fault.
5. **DANGER!**
   Risk of fatal injury from electric current!
6. Ensure there is no live current.
7. Ground and short-circuit the unit.
8. Cover or shut off adjacent live parts.
9. Establish the cause of the fault.

9.2 Fault displays

AERtronic (optional) fault message

Fig. 138: AERtronic display

A detailed explanation of fault messages is contained in the separate operating manual AS-002.

Control system fault message

Depending on the customer's control system, additional fault messages can be recorded and displayed.

9.3 Fault diagnosis and troubleshooting

If, among the faults listed here, a fault occurs that can only be rectified by the manufacturer, contact customer service immediately. *Chapter 1.4.2 'Customer service' on page 11*

Fault description	Cause	Remedy	Personnel
Abnormal running sounds	Sheaves are not aligned properly.	Check and, if necessary, correct alignment. ↳ *Chapter 8.3.7 'Checking the sheaves' on page 147*	Service personnel
	Bearing damage.	Replace bearings.	Manufacturer's customer service division
	Foreign bodies in gear wheels.	Check gear wheels, rectify the damaged areas and if necessary, replace them.	Manufacturer's customer service division
	Shaft deflection.	Locate shaft deflection, replace it.	Manufacturer's customer service division
Start unloading device does not close.	Nozzle is contaminated.	Clean the nozzle. ↳ *Chapter 8.3.13 'Cleaning the nozzle of the start-up relief device' on page 152*	Service personnel
The machine becomes too hot.	Intake filter contaminated (display unit: max. -45 mbar).	Replace the intake filter. ↳ *Chapter 8.3.6 'Replacing the intake filter' on page 147*	Service personnel
	The ambient temperature is too high.	Ensure there is adequate ventilation.	User
	Openings of the acoustic hood for supply air and exhaust air are contaminated.	Clean the openings. ↳ *Chapter 8.3.14 'Checking the inlet and exhaust air openings on the acoustic hood' on page 153*	User
	The acoustic hood fan is malfunctioning.	Replace the fan. ↳ *'Replacing the fan' on page 153*	Service personnel
	The permissible operating data have been exceeded.	Check operating data, comply with correct data. ↳ *Chapter 11.3 'Operating data' on page 170*	User
	Foreign bodies on the belt guard.	Remove dirt.	User
Oil present in conveyed medium.	Wear and tear on seals.	Replace seals.	Manufacturer's customer service division
	Oil level too high.	Correct the oil level. ↳ *Chapter 8.3.3 'Correcting the oil level' on page 134*	Service personnel
	Balancing holes are sealed.	Remove the sealing cap. ↳ *Chapter 8.3.11 'Checking that sealing plugs have been removed' on page 151*	Service personnel
Intake volume is too low.	Intake filter contaminated (display unit: max. -45 mbar).	Replace the intake filter. ↳ *Chapter 8.3.6 'Replacing the intake filter' on page 147*	Service personnel
Intake volume is too low.	Intake piping is leaking.	Seal intake piping.	Service personnel

Fault description	Cause	Remedy	Personnel
The motor requires too much power.	The operating data differs from the order data.	Check operating data, comply with correct data.	User
	Mechanical damage.	Replace malfunctioning components.	Service personnel
Belts are vibrating.	Wear and tear on belts.	Replace the belts. ↳ *Chapter 8.3.9 'Replacing belts' on page 148*	Service personnel
	Sheaves are not aligned properly.	Check and, if necessary, correct them. ↳ *Chapter 8.3.7 'Checking the sheaves' on page 147*	Service personnel
Machine turns in reverse after being shut down.	Non-return flap is leaking or malfunctioning.	Replace the component. ↳ *Chapter 8.3.12 'Checking the non-return flap' on page 151*	Service personnel

9.4 Status and error messages (component suppliers)

Control system fault message

Depending on the customer's control system, additional fault messages can be recorded and displayed.

9.5 Commissioning after fault rectification

Commissioning after fault rectification

1. Check all previously loosened screw connections for tightness.
2. Mount all protective hardware and covers that were previously removed.
3. Remove all used tools, materials and other equipment from the workspace.
4. Clean the workspace. Remove operating substances, operating material, processing material and similar materials and dispose of them appropriately.
5. Inform the responsible on-site person about the result of the fault.
6. Ensure that there are no persons in the hazard area.
7. Release the main circuit breaker and activate it.
8. Release the EMERGENCY STOP function.
9. Confirm the removal of the fault in the control system.
10. Start operation in accordance with the instructions in the "Operation" chapter. ↳ *Chapter 7.3 'Switching on' on page 114*
11. Inform the responsible on-site person about the result of the work carried out

9.6 Checks after malfunction rectification

Inspection	After the first 3 op. hrs	After the first 25 op. hrs
Pressure valve	check for correct operation	
Oil level	check, correct if necessary	check, correct if necessary
Aligning the belt pulley		check, correct if necessary
op. hrs = operating hours		

10 Disassembly and disposal

Protecting the environment and conserving resources are among AERZEN'S foremost priorities.

Once the machine's service life is over, it must be disassembled and disposed of in an environmentally-friendly way. The following is a set of recommendations for environmentally-friendly disposal.

10.1 Safety instructions

Improper disassembly

WARNING!

Risk of injury from improper disassembly!

Stored residual energy, sharp components, edges and corners on or in the machine or on the necessary tools can cause injury.

- Before beginning work, ensure there is sufficient space.
  Allow the machine to cool down to the ambient temperature.
- Proceed with caution when working with open, sharp-edged components.
- Ensure the tidiness and cleanliness of the work-space! Components and tools that are loosely stacked or lying around can cause accidents.
- Disassemble components correctly. Take into consideration the weight of each component. If necessary, use hoists.
- Secure components, so they do not topple or fall.
- If in doubt, contact the manufacturer.

Electric current

DANGER!

Risk of fatal injury from electrical current!

Disassembly of live components can cause serious or fatal injury.

- Switch off the power to the operating cable.
- Check there is no live current.

Disassembling the delivery line

WARNING!

Risk of injury from compressed conveyed materials!

For the disassembly of pressurised components such as pipes, containers, hoses or valves, hot conveying material escapes with a strong gas flow. This can result in serious injury.

– Before beginning work, fully relieve pressurised components of pressure.
– Check that components are not pressurised.
– Only disassemble pressurised components when they are not under pressure.

Requirements for staff

Requirements for disassembly:

Disassembly of electrical components

Personnel:
- Authorised electricians

Personnel:
- Authorised electricians with additional qualifications

Requirements for disassembly:

Disassembly of mechanical components

Personnel:
- Service personnel

Protective equipment

Requirements for disassembly:

Protective equipment:
- Protective work clothing
- Safety shoes
- Hearing protection
- Protective gloves
- Safety goggles
- Industrial hard hat

Special tools

Requirements for disassembly:

Special tool:
- General tool kit
- Tools for authorised electricians
- Auxiliary materials, aids
- Lifting equipment
- Transport equipment

Special tool:
- Locking key

10.2 Disassembly

Preparing for disassembly:

1. Immediately inform the responsible staff on site about the disassembly.
2. Switch off the machine and secure it against restarting.
3. Seal off the pressure line and remove it.
4. Physically separate the entire electric power supply from the machine. Release stored residual energy.
5. If necessary, disconnect the machine control system from a connected process control system.
6. Remove operating and auxiliary materials and residual processing materials and dispose of them in an environmentally-friendly way.
7. In addition, clean assemblies and components thoroughly. Dismantle them in accordance with local regulations for occupational safety and environmental protection.
8. Remove the machine's foundation bolts.
9. During disassembly, there should be a general sorting of parts in accordance with disposal categories. *'Categories for sorting' on page 166*

10.3 Disposal

The machine is composed primarily of steel, casting material and various non-ferrous metals. In general, metallic materials are fully recyclable.

Proper disposal

In as far as no agreement has been made on the return or disposal of the machine, send dismantled components for recycling:

- Scrap metals.
- Send plastics for recycling.
- Sort and dispose of other components according to material composition.

Improper disposal

ENVIRONMENT!

Environmental risk from improper disposal!

Improper disposal can present a risk to the environment.

– Have insulating material, electronic waste, electronic components, auxiliary materials and chemicals disposed of by a professional waste disposal company.
– If in doubt, contact the local authorities or specialist companies for information on environmentally-friendly waste disposal.

Oil and lubricants

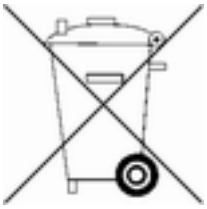
ENVIRONMENT!

Environmental risk from oil!

The improper disposal of oil and lubricants can present a risk to the environment.

– Collect oil carefully, store it and dispose of it properly or recycle it.
– If in doubt, contact the local authorities or specialist waste disposal companies for information on environmentally-friendly waste disposal.

Battery



ENVIRONMENT!

Environmental risk from batteries!

The improper disposal of batteries, e.g. from the control system, can present a risk to the environment.

– Collect batteries and dispose of them properly at local collection points.
– If in doubt, contact the local authorities or specialist waste disposal companies for information on environmentally-friendly waste disposal.

Requirements for personnel

Disposal requirements:

Personnel: ■ Skilled staff for industrial waste

Protective equipment

Disposal requirements:

Protective equipment:
- Protective work clothing
- Safety shoes
- Hearing protection
- Protective gloves
- Safety goggles
- Industrial hard hat

Special tools

Disposal requirements:

Special tool:
- Lifting equipment

Categories for sorting

Scrap iron	Non-ferrous metal (except for scrap iron)	Insulation material	Electronic waste (encoder electronics)	Auxiliary materials and chemicals
Scrap ■ Scrap steel ■ Foundry scrap ■ Scrap from non-rusting steels ■ Stainless steel scrap	Aluminium	Various isolators (in terminal boxes)	Electrical tools	Lubricant and gear oils Grease
Used metal/2A materials ■ Steel beams ■ Steel sheets	Copper	Voltage and current transformers	Measurement, control and regulatory systems	Cleaning agents and solvents
Machines made of metal ■ Without electronics	Brass	Electric cables and leads		Paint residue
	Motor windings	Instrument wiring		Anti-corrosion agents
		Surge absorbers		Cloths (soaked in agents or chemicals)

Scrap iron	Non-ferrous metal (except for scrap iron)	Insulation material	Electronic waste (encoder electronics)	Auxiliary materials and chemicals
		Heat insulation materials		AERtronic batteries
This does not include: ■ Hazardous adhesions ■ Sealed hollow parts (due to danger of deflagration or hazardous contents)	Valve disposal ■ Remove the medium before disposal! Neutralise residual medium in the valves.		This does not include: ■ PCB capacitors	■ Solvents, cleaning agents and paint residue must not be allowed to mix! ■ Sort oils separately according to emulsions and solvents. ■ Agents and chemicals must be collected in separate, labelled containers.

Disposal of accessories

Motor

- For safety reasons, disposal may only be carried out by specialists for industrial waste or by return to the manufacturer!
- The encoder electronics are electronic waste.

Frequency inverter

- For safety reasons, disposal may only be carried out by specialists for industrial waste or by return to the manufacturer!
- The encoder electronics are electronic waste.

DANGER!
Danger due to explosion of the capacitor and the formation of toxic gases!

11 Technical specifications

11.1 Dimensions and weights

General information

The following dimensions and weights relate to standard variants and can vary depending on the specific design.

Exact details can be found on the installation drawing.

Information on weight can be found on the packing note and the designation on the type plate.

Dimensions, including packaging, are included in the forwarding order.

Dimensions and weights

Positive pressure operation						
Size	**Width (W) mm**	**Depth (D) mm**	**Height (H) mm**	**Nominal diameter DN**	**Weight without acoustic hood, without motor and without belt drive approx. kg**	**Weight with acoustic hood, excluding motor and belt drive approx. kg**
GM 3 S	800	800	1055	50	160	220
GM 4 S	925	1135	1280	80	210	320
GM 7 L	925	1135	1280	80	210	320
GM 10 S / DN80	925	1135	1280	80	240	350
GM 10 S / DN100	1250	1350	1500	100	350	510
GM 15 L	1250	1350	1500	100	360	530
GM 25 S	1250	1350	1500	125	420	580
GM 30 L	1500	1800	1900	150	660	980
GM 35 S	1500	1800	1900	150	760	1040
GM 50 L / DN150	1500	1800	1900	150	810	1130
GM 50 L / DN200	1700	2055	2111	200	840	1310
GM 60 S	1700	2055	2111	200	1000	1460
These dimensions and weights relate to the standard design and are approximate values. The information can vary depending on the order.						

Positive pressure operation						
Size	**Width (W) mm**	**Depth (D) mm**	**Height (H) mm**	**Nominal diameter DN**	**Weight without acoustic hood, without motor and without belt drive approx. kg**	**Weight with acoustic hood, excluding motor and belt drive approx. kg**
GM 80 L	1900	2200	2308	250	2720	3570
GM 90 S	1900	2200	2308	250	2780	3630
GM 130 L	2100	2850	2345	300	2265	3230
GM 150 S	2100	2850	2345	300	2510	3470
These dimensions and weights relate to the standard design and are approximate values. The information can vary depending on the order.						

11.2 Dimension specifications sheet

An accompanying dimension specifications sheet is provided with the product documentation.

These documents contain important dimensions for installation and set-up.

11.3 Operating data

11.4 Technical performance data

Operating and application limits

Positive pressure operation			
Size	**Differential pressure max. mbar**	**volume flow max. m^3/h**	**Motor rating max. kW**
GM 3 S	1000	247	7.5
GM 4 S	1000	282	15
GM 7 L	700	493	15
GM 10 S / DN80	1000	542	22
GM 10 S / DN100	1000	696	30
GM 15 L	700	1038	30
GM 25 S	1000	1452	55
GM 30 L	700	2082	75
GM 35 S	1000	2418	90
GM 50 L / DN150	700	2610	75
GM 50 L / DN200	700	3306	90
GM 60 S	1000	3540	132
GM 80 L	700	5034	160
GM 90 S	1000	5418	200
GM 130 L	700	8040	200
GM 150 S	1000	9120	355
These operating limits are maximum values. Difficult operating conditions can adversely affect these data.			

Environmental limits

Data	Value	Unit
Temperature range	-10 to 40	°C
Relative humidity	0 to 80	%
Chemical-free atmosphere		

Maximum installation elevation

Data	Value	Unit
max. installation elevation above NN*	1000	m

In case of deviations in installation heights, observe the order-specific design data sheet.

Environmental limits

Data	Value	Unit
Temperature range	-10 to 40	°C
Mounting of acoustic hood heating	less than -10	°C
Relative humidity	0 to 80	%
Chemical-free atmosphere		

operating period

Data	Value	Unit
Maximum continuous operating period	24	hrs
Pause until next operation	/	hrs

11.5 Type plate(s) and placement

Placement on the machine stage

Manufacturer/type plate on the machine stage.

Pos.1 Manufacturer plate
Pos.2 Type plate

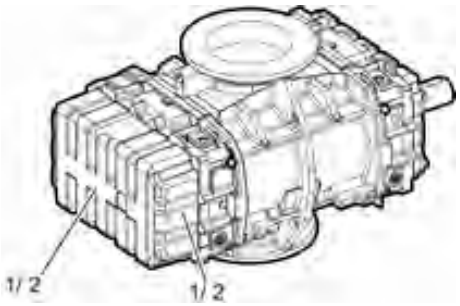


Fig. 139: Layout example

Manufacturer plate - Pos. 1

Manufacturer plate

Fig. 140: Manufacturer plate

Type plate - Pos. 2

Fig. 141: Type plate

Pos.1 Machine type
Pos.2 Factory/serial number
Pos.3 Order no.
Pos.4 Machine rotational speed
Pos.5 Power consumption
Pos.6 Year of manufacture
Pos.7 Weight
Pos.8 Motor rotational speed
Pos.9 Conveyed amount
Pos.10 Intake pressure (absolute) - p1
Pos.11 Positive pressure, discharge - p2e

Placement on the acoustic hood

The manufacturer/type plate is on the operating side of the acoustic hood.

Pos.1 / acoustic hood Manufacturer and type plate

Fig. 142: Acoustic hood signage

Manufacturer/type plate - pos. 1

Fig. 143: Acoustic hood manufacturer/performance data plate

Pos.1 Manufacturer, including address
Pos.2 Machine type
Pos.3 Customer order no.
Pos.4 Factory/serial number
Pos.5 Year of manufacture
Pos.6 Intake volume flow
Pos.7 Max. intake pressure (absolute)-p1
Pos.8 max. Discharge pressure (absolute) -p2
Pos.9 Nominal power of motor
Pos.10 Machine weight (total)

Type designation

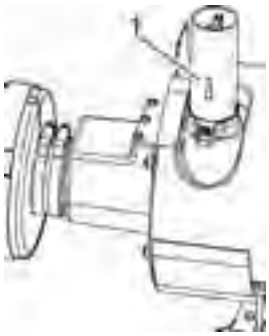
The type designation is derived from the following table:

Explanation using example: GM 90 S

Designation	Explanation	Details
GM	Product designation	Positive displacement blower
90	Maximum flow volume in m³/min (approx.)	
S	Design	L: Pressure differences up to 700 mbar
		S: Pressure differences up to 1000 mbar

Pressure valve signage

When using the AERZEN pressure valve, the type plate is on the valve housing.



Pos.1/pressure valve Manufacturer and type plate

Fig. 144: Pressure valve signage

Pressure valve type plate

Fig. 145: Pressure valve, manufacturer/performance data plate

Pos.1 Manufacturer, including address
Pos.2 Material
Pos.3 Nominal diameter
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11.6 Noise emissions

Information on noise emissions

This information is determined in accordance with the performance data. ↳ *Chapter 11.4 'Technical performance data' on page 170*.

No-load operation or operation below the maximum performance values reduces noise emissions.

Machines without an acoustic hood have considerably higher noise emissions. Observe the measures for noise emission reduction ↳ *Chapter 5.2 'Requirements for the installation site' on page 88*

Measurement requirements

- applied basic standard DIN EN ISO 2151
- measured according to basic standard DIN EN ISO 3744
- with acoustic hood
- connected, insulated pipelines
- tolerance: ±2 dB(A)

Positive pressure

Size	A-weighted sound pressure level, L_{pA}dB(A)
GM 3 S	72
GM 4 S	72
GM 7 L	72
GM 10 S / DN 80	74
GM 10 S / DN 100	74
GM 15 L	75
GM 25 S	75
GM 30 L	77
GM 35 S	77
GM 50 L / DN 150	77
GM 50 L / DN 200	78
GM 60 S	80
GM 80 L	82
GM 90 S	83
GM 130 L	86
GM 150 S	86

11.7 Operating materials

11.7.1 Lubricant oil specifications

Lube oil specification

Choice of lubricants

When operating the machine, only use lubricants that comply with this specification!

The quality of lube oil has a considerable effect on the service life of the machine.

When selecting the type of lube oil, the application conditions and the relevant additives and viscosity class are decisive.

Taking the operating conditions into account, only use the following oils with the corresponding viscosities and additives.

* Ambient temperature = the temperature in the immediate vicinity of the machine all year round.

Low-load operation

Using these machines for **"low-load operation with minor pressure differences"** requires prior consultation with AERZEN Customer Service or the sales company. To select a suitable lubricant, the operating conditions, load and operating data need to be taken into account.

Lube oil properties

General requirements of the lube oil properties

Kinematic viscosity at operating oil temperature.	min. 10 - 13 cSt (mm^2/s)
Kinematic viscosity at -10°C	min. ≤ 3,500 cSt (mm^2/s)

Minimum properties of the oil additive

EP wear-protection additives for use in rolling bearing drives
Oxidisation stability up to 110°C oil sump temperature
Foam suppressor
Detergent for deposit solutions
Neutrality with regard to seal materials of fluoropolymer elastomer (Viton)
Neutrality with regard to one-component resin primers
Sufficient shear stability

11.7.1.1 Lube oils

Standard first oil filling

Delta Lube 06	
Intake temperature (machine stage)	up to 50°C
Final compression temperature (machine stage)	up to 140°C
Ambient temperature*	no constraints
Order No.	178 132
This lube oil is used as initial oil filling for standard use conditions.	

11.7.1.1.1 Alternative lube oils

One or two-shift operation/intermittent operation

AERZEN special rotary piston oil	
Intake temperature (machine stage)	up to 50°C
Final compression temperature (machine stage)	up to 140°C
Ambient temperature*	no constraints
Order No.	160 755 002

Continuous operation: 24 hours a day

ISO VG 150	
Fully-synthetic poly-alpha-olefin (PAO), drive or compressor oil	
Intake temperature (machine stage)	up to 50°C
Final compression temperature (machine stage)	up to 140°C
Ambient temperature*	no constraints
Example: MOBIL SHC 629	

Operation with a final compression temperature of over 140°C

ISO VG 220	
Synthetic lube oil with a base oil of type polyglycol	
Continuous oil temperature	120°C - 140°C
Final compression temperature (machine stage)	over 140°C
Ambient temperature*	no constraints
Example: ESSO Glycolube 220, ARAL Degol GS 220	

11.7.1.2 Changing oil types

Delta Lube 06, AERZEN special rotary piston oil --> fully synthetic PAO lubricants

The AERZEN lubricants (Delta Lube 06, AERZEN special rotary piston oil) are fully compatible with fully synthetic PAO lubricants.

Measures: If you change to another oil type, no specific measures need be taken. However, to preserve the working properties of the new oil, the oil that is replaced should be drained completely and, after 100 operating hours and in addition to any scheduled oil changes, a full oil change including oil filter change (if there are any filters) should be performed. Only oil of the same type should be used for topping up.

Delta Lube 06, AERZEN special rotary piston oil, fully synthetic PAO lubricants --> polyglycol oils (PAG)

The AERZEN lubricants (Delta Lube 06, AERZEN special rotary piston oil) as well as PAO lubricants are ***not*** compatible with polyglycol oils (PAG) or perfluorinated polyether oils, e.g. Fomblin.

Measures: In order to change the oil type, the machine must be completely dismantled and the entire oil system thoroughly cleaned of residue. A rinsing is recommended before first commissioning. Only oil of the same type should be used for topping up.

11.7.2 Lubricant oil in the food and pharmaceutical industry

For rotary piston blowers, lubricating oils can be used which have approval according to the specification USDA H1.

Operational experience is **only** available for the following lubricating oils.

AERZEN issues no approval for any other oils.

It is recommended that you carry out an oil analysis after 1,000 op. hrs in coordination with the oil manufacturer.

ISO VG 100	
Continuous oil temperature	up to 100°C
Compressor discharge temperature	up to 120°C
Lubricant to be used: **Klüberöl 4UH1-100 N**	

ISO VG 220	
Continuous oil temperature	over 100°C
Compressor discharge temperature	over 120°C
Lubricant to be used: **Klüberöl 4UH1-220 N**	

11.7.3 Grease specifications

Only for the gas-tight version of the drive shaft!

Greases for the gasket of the drive shaft

Grease KHC-2P-30	
Using the lubricating oils according to AERZEN lubricating oil specification, *excluding polyglycols*	
Filling at the factory	**KLÜBER PETAMO GHY 133 N**

Grease MPG2K-40	
Using the a polyglycol oil according to AERZEN lubricating oil specification	
Filling at the factory	**KLÜBER SYNTHESO PROBA 270**

Information on grease

- Avoid mixing different greases.
- Lubrication is only permitted with the same grease.
- If these greases are not available, completely remove the grease and replace it with another grease in accordance with KHC-2P-30 or MPG2K-40.
- Observe the seal compatibility with Viton!

11.7.4 Lubricant quantities

Machine lube oil levels

The following values for lube oil levels are guide values. The main factor in determining the oil fill quantity is the displays of the relevant oil level pointer.

Models with acoustic hoods

Total oil quantity Oil level middle sight glass on the acoustic hood			
Operating material	**Machine type**	**Filling quantity, approx.**	**Unit**
Lube oil	GM 3 S	0.55	Litre (l)
	GM 4 S	1.00	
	GM 7 L	1.00	
	GM 10 S	1.40	
	GM 15 L	1.40	
	GM 25 S	1.75	
	GM 30 L	1.75	
	GM 35 S	3.75	
	GM 50 L	4.50	
	GM 60 S	7.50	
	GM 80 L	7.50	
	GM 90 S	12.50	
	GM 130 L	12.50	
	GM 150 S	12.00	

Models without acoustic hoods

Total oil quantity Oil level at centre of sight glasses on machine stage			
Operating material	**Machine type**	**Filling quantity, approx.**	**Unit**
Lube oil	GM 3 S	0.55	Litre (l)
	GM 4 S	0.55	
	GM 7 L	0.55	
	GM 10 S	0.86	
	GM 15 L	0.86	

Total oil quantity Oil level at centre of sight glasses on machine stage			
Operating material	**Machine type**	**Filling quantity, approx.**	**Unit**
	GM 25 S	1.20	
	GM 30 L	1.20	
	GM 35 S	3.00	
	GM 50 L	3.50	
	GM 60 S	6.50	
	GM 80 L	6.50	
	GM 90 S	11.50	
	GM 130 L	11.50	
	GM 150 S	11.00	

Grease filling quantity for machine stage

Only for the gas-tight version of the drive shaft!

Operating material	Machine type	Filling quantity, approx.	Unit
Grease	GM 3 S	5	cm^3
	GM 4 S	5	
	GM 7 L	5	
	GM 10 S	5	
	GM 15 L	5	
	GM 25 S	5	
	GM 30 L	5	
	GM 35 S	10	
	GM 50 L	10	
	GM 60 S	10	
	GM 80 L	10	
	GM 90 S	10	
	GM 130 L	10	
	GM 150 S	20	

Stauffer lubricators

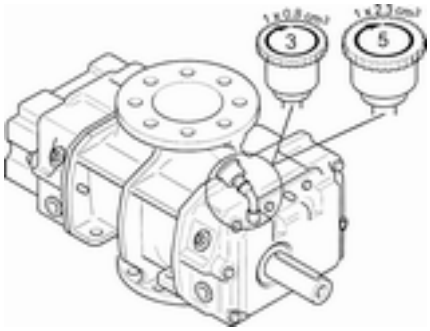

Fig. 146: Stauffer lubricator

Grease amount per Stauffer lubricator for each rotation

Stauffer lubricator size	Rotation	Grease amount in cm^3
3	1	0.8
5	1	2.3

Drive motor grease quantity

Observe the separate motor documentation and the information on the type plate of the motor.

Operating substance	Motor size	Filling quantity, approx.	Unit
Grease	Observe the information in the motor documentation and on the type plate!		

11.8 Coatings

Corrosion protection

The housing surfaces receive the following coatings to protect them against corrosion:

Standard coating	
Undercoat	Corrosion protection on alkyd resin basis
End coating	Alkyd resin surface coating

Coating for heightened corrosion protection	
Undercoat	Corrosion protection on 2-component, epoxy resin, micaceous iron oxide basis
Intermediate coating	
End coating	Polyurethane surface coating

11.9 Electrical details

11.9.1 Voltage fluctuations

Permissible voltage fluctuations

Permissible voltage fluctuations are described in the international standard IEC 60038 subject to country-specific supply voltage tolerances.

Machine use only in a stable three-phase power supply. Voltage fluctuations / drops beyond the tolerance level may cause serious damage to the drive system.

11.9.2 Earthing strap cross-section

Earthing strap

	kW	mm²
to	55	14
to	200	70
to	315	2 x 70

11.9.3 Motor overload protection

Installation value

max. ... % value, nominal engine current
110 %

11.10 Accessory information

11.10.1 Intake filter

Technical data

Intake filter		Unit
Filter resistance in clean condition	> 10	mbar
max. filter resistance	45	mbar

11.10.2 Start-up relief device DN 50 to DN 80

Technical data

Start-up relief device DN 50 to DN 80		
Voltage	230	V
Frequency	50	Hz
Protection type	IP 65	

Start-up relief device DN 50 to DN 80		
Output	8	W
open without current		

11.10.3 Start-up unloading device DN 80 to DN 400

Technical data

Start-up unloading device DN 80 to DN 400		Unit
Voltage	230	V
Frequency	50	Hz
Protection type	IP 65	
Power	8	W
closed without current		

11.10.4 Balancing grade

Balancing type

The vibration behaviour of the machines is determined not only by the balancing grade of the drive shafts but also by the balancing grade of the drive elements.

The drive shafts of the pistons and rotors are balanced according to the half-key principle. Belt pulleys and couplings must therefore correspond to balancing type “H”.

12 Notes on the Declaration of Conformity

This document is provided for informational purposes only and gives an account of the contents of the Declaration of Conformity. The original document is provided with the product or is sent in a separate document.

AERZEN

CE MRL 1012_1

Declaration of Conformity

pursuant to the EC Machinery Directive 2006/42/EC, Annex II 1A	
Translation of Original Declaration of conformity	CE
Manufacturer	**Representative pursuant to the Machinery Directive** **Representative for technical documentation**
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Internet: www.aerzen.com	E-mail: info@aerzener.de
Reherweg 28	Internet: www.aerzen.com
31855 Aerzen, Germany	Reherweg 28
	31855 Aerzen, Germany

Product	
Designation	
Type	
Serial no.	
Order no.	
Year of construction	

We hereby declare that the above product complies with all applicable provisions of the Machinery Directive 2006/42/EC.

The aforementioned product fulfils the requirements of the following applicable directives:

► Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast) 2006/42/EC

The following harmonised standards were applied:

► DIN EN ISO 12100:2011-03 Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010) 2011-03 DIN EN ISO 12100:2011-03

► DIN EN 1012-1:2011-02 Compressors and vacuum pumps - Safety requirements - Part 1: Air compressors; German version EN 1012-1:2010 2011-02 DIN EN 1012-1:2011-02

Information on Signatory	Managing director	Signature	Location, date of issue

27.10.2014, Docld CE MRL 1012_1 01_2014, 1, en_GB

13 Glossary

•Bar chart display

A bar chart display is a display method which uses a scale to represent the size of a signal with a representative bar that changes in length depending on the signal size.

•Belt run

The belt section between two sheaves is termed a “belt run”.

•Discharge temperature

Temperature measured at the discharge sockets of the machine stage.

•EMERGENCY STOP function

A function intended to alleviate the danger of impending hazards in terms of injury or damage to persons and machines during operation or to reduce the danger of hazards that are already present.

A function that is activated by one single action by an individual person.

The purposeful shut-down of the machine to avoid a dangerous situation. Voltage-carrying components are still active.

Emergency stop.

•Machine

A machine is an assembly of linked parts or components, at least one of which moves. A machine is fitted or intended to be fitted with a drive system. The machine has a proper intended use and is assembled for a specific purpose. Another technical term for “machine” is “unit”.

•Machine stage

A machine stage is an incomplete machine. It is an assembly that almost constitutes a machine, but that does not fulfil a specific function. A machine stage is only intended to be installed in and added to other machines or other incomplete machines.

•Modbus RTU

Modbus RTU transfers data in binary form. This ensures a good data throughput rate. The data cannot be evaluated directly by persons, rather they must first be converted into a readable format.

•PROFIBUS-DP

PROFIBUS DP involves the communication of central control equipment via a fast serial connection with decentralized input /output modules.

•Sentinel filter

Another filter downstream from a filter

It fulfils an end cleaning function and a safety function.

•Stop category 0

Stop category 0.

Shut-down by means of immediate interruption of the power supply to the machine.

Shut-down by means of mechanical separation (uncoupling) of components that pose a danger and their mechanical drive elements and, if necessary, by means of a braking procedure.

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Chapter 13 Chemical Metering Pumps (Division 43)

MANUFACTURER/DISTRIBUTOR:

York Fluid Controls Limited
Gavin MacDonald
2 Westwyn Court
Brampton, Ontario, L6T 4T5
Phone: (705) 822-8182
gavin@yorkfluid.com

13.1 LMI Series B/C Metering Pumps (WTP)

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

Metering Pumps

LMI
MILTON ROY

Excellence through Versatility

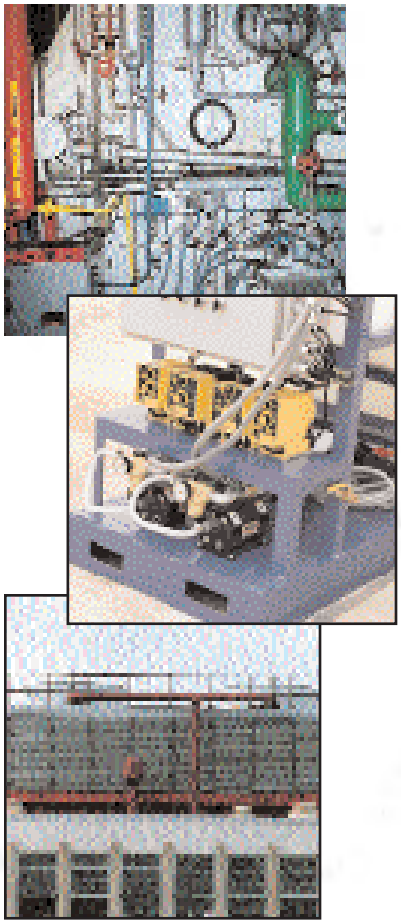
Liquid Metronics Incorporated has been providing quality products and service to the water treatment industry worldwide for over 25 years.

Leading the way in the metering pump industry, LMI introduced the first full line of electronic metering pumps and accessories. The breadth of LMI's product line extends from low-cost metering pumps for domestic potable water treatment to highly sophisticated custom designs for specific customer applications.

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

Today, LMI continues to shape the future of the industry by offering the next generation of our trademark yellow and black metering pumps, the LiquiPro™ Series. This series of electronic metering pumps offers simple installation and maintenance with its unique cartridge valve design, as well as quick and easy "hands free" priming three, four function and auto prime valves.

Utilizing superior designs and industry experience, as well as a state-of-the-art facility and highly trained service representatives, LMI offers Water Treatment Professionals the quality and reliability they've come to expect.



Waste Water Treatment

Cooling Water Treatment

Boiler Water Treatment

Municipal Water Treatment

Fertilizer Injection

Laboratory Fluid Metering

Fluoridation

Paper Chemical Feed

Domestic Potable Water

Swimming Pool

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

How A Metering Pump Works

LMI's solenoid-driven metering pumps are used for the precise injection of chemicals i system. The mechanically actuated diaphragm design has only one moving part whic lubricated. The simplicity and efficiency of this design results in a pump that consum enabling the pump to be totally enclosed in a chemically resistant housing for installat environments.

Durable Stroke Adjustment Mechanism

A rigid stroke bracket and large stroke knob offer precise, repeatable performance and simple adjustment over entire output range.

NEMA 4X/ IP65 Housings

Totally enclosed, chemically resistant polypropylene housing for the ultimate protection against corrosive environments.

EPU

LMI's Electromagnetic Power Unit (EPU) is designed for efficiency and consistent performance over a wide operating and temperature range.

Multi-Function Valves

The industry standard for over 25 years, features Fluorofilm™ diaphragms for long life and ramp style knobs for "hands free" priming with standard 3FV or optional 4FV. The auto prime valve option offers auto degassing for pumping chemicals prone to gassing.

Fluorofilm™ Liquiframs™

The unique manufacturing process of LMI diaphragms ensures outstanding chemical resistance and flexibility for long life.

Cartridge Valves

Unique cartridge valves have closely guided balls and triple sequential valve seats for optimum performance over entire pressure range.

Variety of Liquid Ends

A wide selection of liquid handling assemblies including PVDF, PVC, Acrylic, Polypropylene, 316 SS, and UHMWPE. Configurations for viscous chemicals and slurries provide flexibility in all applications.

Accurate Speed Control

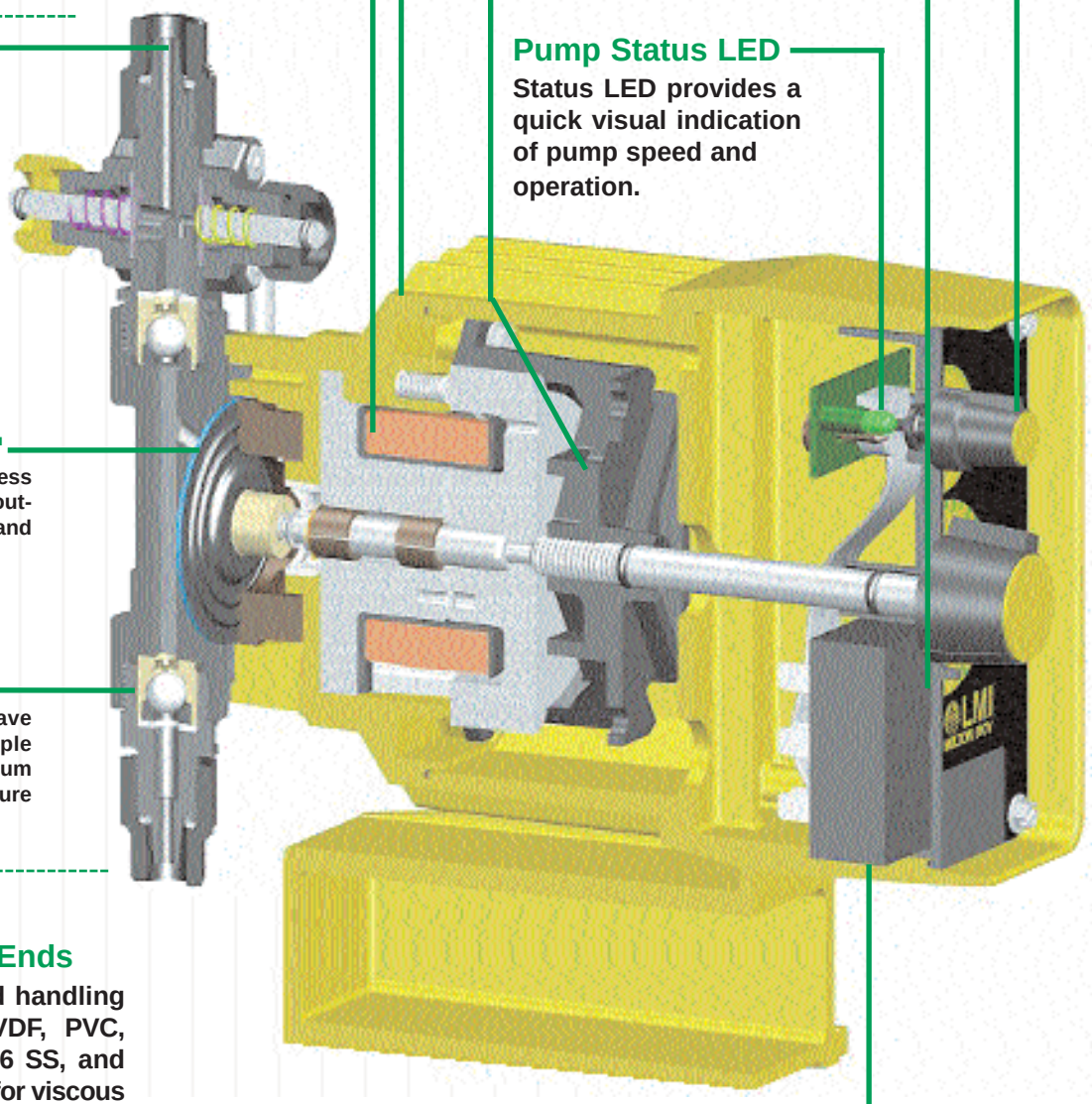
Provides precise stroke rate and a turndown ratio up to 1000:1 for unmatched versatility.

Fully Encapsulated Electronics

Completely enclosed electronics provide protection against moisture, corrosive atmospheres and damage from vibration or mechanical shock.

Pump Status LED

Status LED provides a quick visual indication of pump speed and operation.



Manual or External Control

Dual-manual control of speed and stroke length or external control by means of a 4-20 mA or pulse input for flow proportional applications and system integration.

Electronic Metering Pumps

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

LMI's family of electronic metering pumps offer:

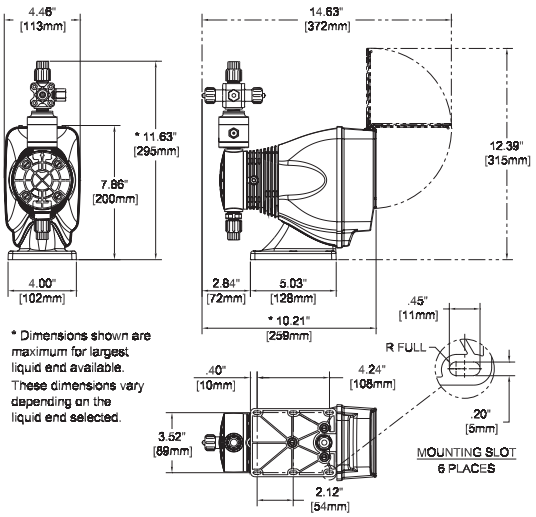
- Adjustable stroke frequency and the flexibility of up to 1000:1 turndown ratio
- Manually adjustable stroke length provides accurate pump output adjustment
- NEMA 4X / IP65 enclosures for protection against corrosive environments
- Time tested electronics for reliable, repeatable performance
- Totally encapsulated electronics for protection against moisture and corrosive conditions
- Priming valves with Flourofilm™ diaphragms and ramp style knobs for **"**hands free**"** priming

Series AA

Key Features / Benefits

- Rigid stroke bracket assembly for highly accurate/consistent dosing performance
- Advanced control options for simplified system integration (pulse multiply/divide, 4-20 mA, remote on/off)
- 5-level power control option to reduce system shock and extend the life of the pump
- External pacing for flow proportional applications

	Max Output		Max Pressure	
Model	GPH	l/h	PSI	Bar
AAX4	0.58	2.2	250	17.3
AAX5	1.0	3.8	110	7.6
AAX6	2.0	7.6	50	3.5
AAX7	0.42	1.6	140	9.7
AAX8	0.75	2.8	80	5.5



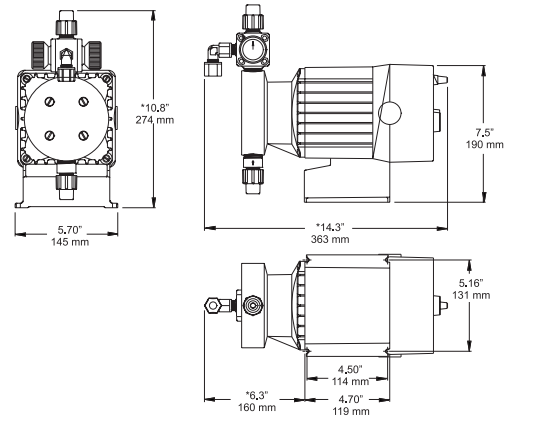
Series B / Series C

Series B

	Max Output		Max Pressure	
Model	GPH	l/h	PSI	Bar
BX1	1.6	6.1	150	10.3
BX2	2.5	9.5	100	6.9
BX3	4.5	17.0	50	3.5
BX4	7.0	26.5	30	2.07

Series C

	Max Output		Max Pressure	
Model	GPH	l/h	PSI	Bar
CX0	1.3	4.9	300	20.7
CX1	2.5	9.5	150	10.3
CX2	4.0	15.1	100	6.9
CX3	8.0	30.3	60	4.1
CX4	20.0	75.7	25	1.7
C76	4.0	15.1	175	12.1
C77	10.0	38.0	80	5.5
C78	25.0	95.0	30	2.07

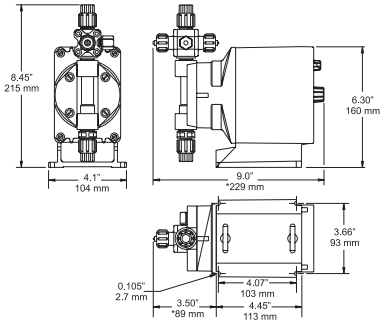


Series P

Key Features/Benefits

- High quality construction for durability
- Compact size; ideal for OEM applications
- Fixed speed versions for simple, low cost applications

	Max Output		Max Pressure	
Model	GPH	l/h	PSI	Bar
PX2	0.21	0.79	150	10.3
PX3	0.42	1.6	110	7.6
PX4	0.58	2.2	250	17.3
PX5	1.0	3.8	110	7.6
PX6	2.0	7.6	50	3.5



Liquid Handling Assemblies

LMI offers a wide selection of liquid handling assemblies with flexible tubing and pipe thread connections. Configurations for viscous chemicals and slurries provide total flexibility in all applications

- PVC
- Acrylic
- Polypropylene
- PVDF
- UHMWPE
- 316 SS

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

Repair & Preventative Maintenance Kits

RPM Pro Pac™ kits include the recommended replacement parts for the LiquiPro™ Series Metering Pumps. These kits provide an easy, economical solution to annual pump maintenance.

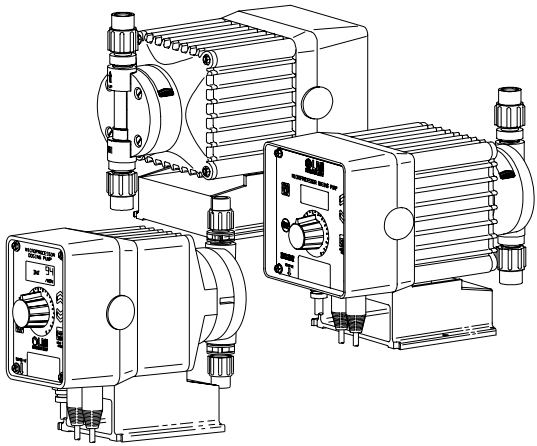
Accessories

LMI offers a complete line of accessories to customize and complete your installation.

- Auto prime valve 4FV/3FV/Bleed 4FV
- Agitators
- Back Pressure Valves
- Calibration Cylinders
- Conduit Connection Kit
- Corp Stop & Nozzle Assemblies
- Digi-Pulse™ Flow Monitors
- Extension Cable Assemblies
- Flow Indicator
- Fluoride Saturator
- Flowmeter
- Remote Programmable Flowmeter
- Liquid & Low Level Switches
- Micropace™ Control Modules
- Pressure Relief Valves
- Primer Flush Kit
- Pulse Transmitter
- Pump Mounting Accessories
- Remote Auto Flush Controllers
- Seal Ring Kit
- Splash Guard
- Suction Tubing Accessories
- Syphon Breaker
- Tanks
- Tubing Connector Assemblies

Instruction Manual

Series A9, B9, and C9
Electronic Metering Pumps



For file reference, please record the following data:

Model No: _____

Serial No: _____

Installation Date: _____

Installation Location: _____

When ordering replacement parts for your LMI Series A9, B9 and C9 Metering Pump or Accessory, please include complete Model Number and Serial Number of your unit.

LMI
LIQUID METRONICS DIVISION
MILTON ROY
A unit of Sundstrand Corporation

8 Post Office Square
Acton, MA 01720 USA
TEL: (978) 263-9800
FAX: (978) 264-9172
http://www.lmipumps.com

Replaces same of Rev. A 8/96
1796. B 11/97

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1.0 Introduction

The Series A9, B9 and C9 electronic metering pumps offer an extensive range of features, including microprocessor control for accurate and flexible automation in response to instrument signals. The microprocessor design employs a customized liquid crystal display (LCD) and tactile response keypad. The “state-of-the-art” surface mount electronics are fully encapsulated to ensure protection in its working environment. All external inputs and outputs are opto-isolated from the microprocessor.

This manual supplement describes programming and operation. It also describes details of the pumps external inputs and outputs and how they are connected.

For complete details on Installation, Maintenance and Troubleshooting, please refer to Electronic Metering Pumps Manual (P/N 1615).

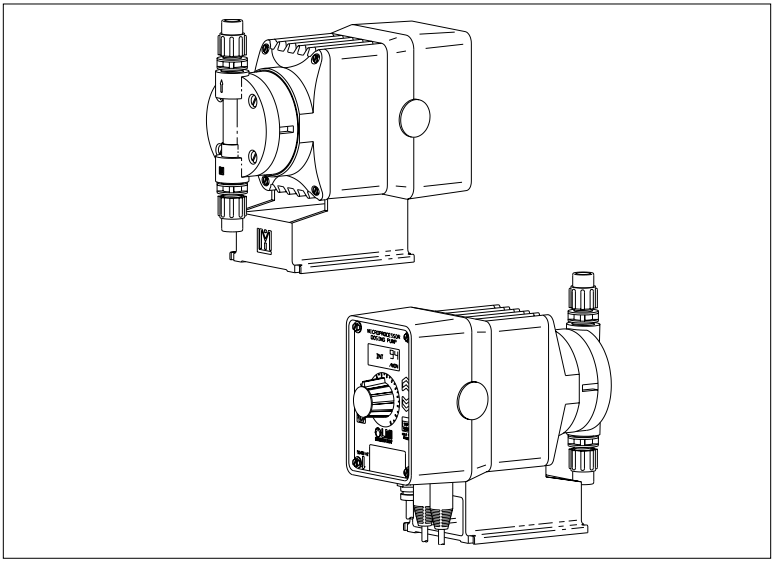
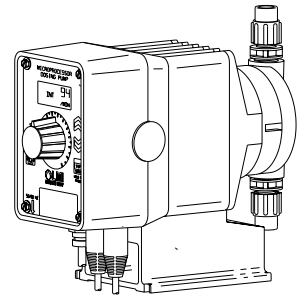


Figure 1: LMI Series A9 Electronic Metering Pump

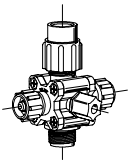
2.0 Unpacking

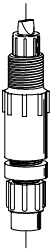
You should find the following items in the box:



Electronic
Metering Pump

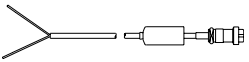
Four Function Valve
(optional)



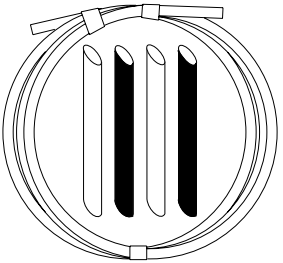


Injection
Check Valve

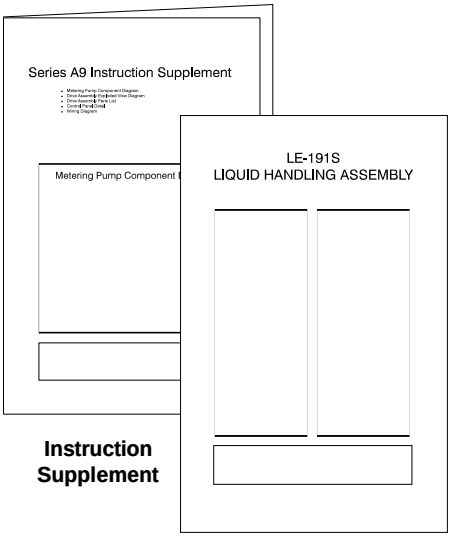
Foot Valve



Milliamp Input Cable
(P/N 33807)

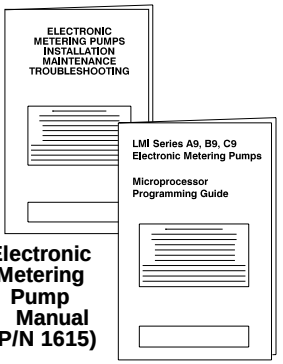


Tubing &
Suction Tubing
Straightener



Instruction
Supplement

Liquid Handling
Assembly Sheet



Electronic
Metering
Pump
Manual
(P/N 1615)

A9, B9, C9
Supplement
to Manual
(P/N 1796)

Figure 2: Unpacking Items

3.0 Features

- ☐ Stroke frequency adjustment from 0 SPH (strokes per hour) to 100 SPM (strokes per minute)
- ☐ Internal (manual) or external mode select
- ☐ Flexible slope adjustable response to mA input signals
- ☐ Divide or multiply (batch) incoming pulses (1 to 999)
- ☐ Batch accumulate option
- ☐ Integral blowdown controller feature
- ☐ Keypad locking
- ☐ Low-level shutoff with alarm output
- ☐ Programmable flow monitoring with alarm output (with FM-200-9 Digi-Pulse™)
- ☐ 6-level pressure control
- ☐ Continuous non-volatile memory (EEPROM)--no battery required
- ☐ Remote ON/OFF control
- ☐ Pulse (pacing) output
- ☐ Automatic line voltage compensation and over voltage protection
- ☐ Programmable menu for optional features/parameters
- ☐ Serial communication interface option for computer control (LiquiComm™)

4.0 How to Interpret the Model Number

The silver data plate (located on the front of the pump) tells you how your pump is configured.

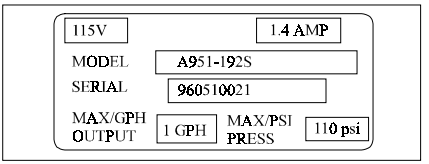


Figure 3a : Data Plate

Included on the data plate is the model number of the pump. Each number in the model number represents the following in Figure 3b.

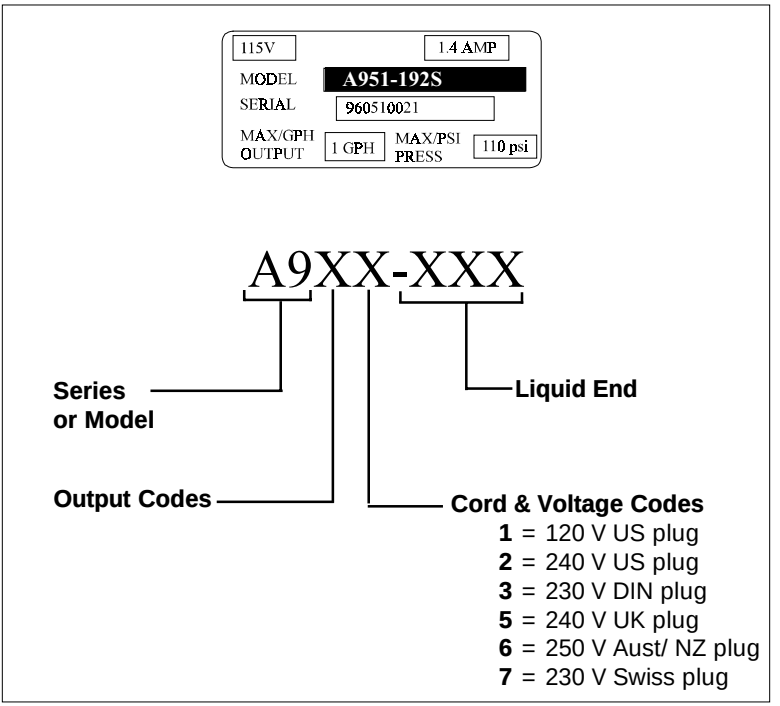


Figure 3b : Part Number Representation

5.0 Pre-Installation and Installation Instructions

Specific precautions should be taken when working with all LMI metering pumps.

Please read Section 3.0 in the Electronic Metering Pumps manual (P/N 1615) for pre-installation instructions.

For complete installation instructions, see Section 4.0 in the same manual.

6.0 Accessories

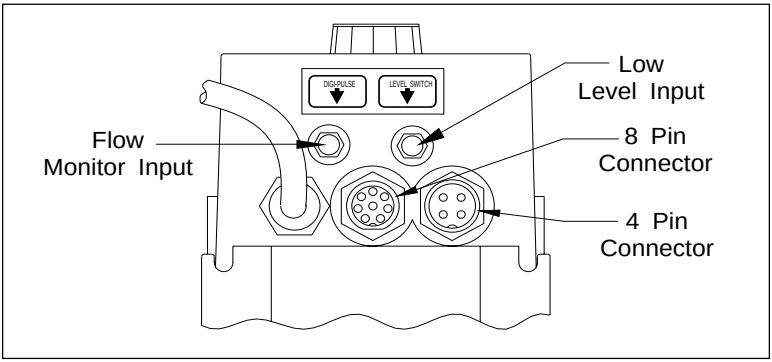
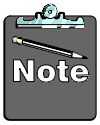


Figure 4: External Input and Output Connections



For specific descriptions of pump inputs and outputs, see Appendix A in the rear of this manual.

6.1 MilliAmp Input Cable (P/N 33807)

Each pump includes a 2-conductor cable assembly which connects to the 8-pin connector. It is available for pacing in response to a 0 to 20 mA (4-20 mA) instrument signal only.

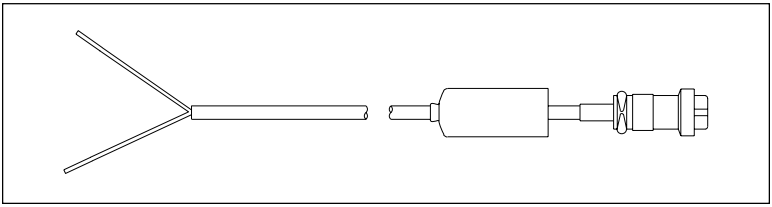


Figure 5: 2-Conductor Cable (P/N 33807)

PIN	WIRE	SIGNAL
3	White	+0-20 mA (+) Input
4	Black	-0-20 mA (-) Input

Table 1: Pin Out Table - milliAmp Input Cable

6.2 Optional 4-Pin Cable (P/N 33796)

The optional 4-pin external cable is used for connecting incoming pulse or pacing signals such as those triggered by a manual switch, reed switch, opto-coupler or by NPN or PNP transistors. The remote ON/OFF input is also accessed through the standard 4-pin connector.

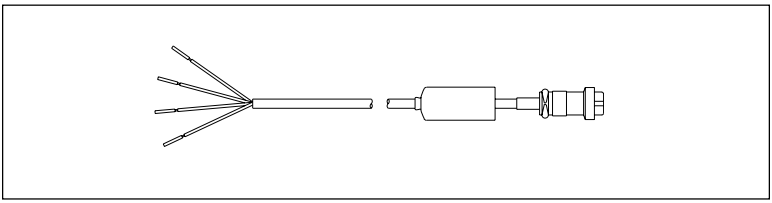


Figure 6: 4-Pin Cable (P/N 33796)

PIN	WIRE	SIGNAL
1	White	+15V Output
2	Black	Pacing input
3	Green	+15V Ground
4	Red	Remote ON/OFF & Computer Input

Table 2: Pin Out Table - 4-Pin Cable (P/N 33796)

6.3 Optional 8-Pin Cable (P/N 33738)

The optional 8-pin external cable assembly can be used to control stroke frequency in response to a 0 to 20 mA or 4 to 20 mA instrument signal. It provides an input for "flow monitoring." This cable assembly also provides output signals for pacing (pulse output), alarm (general) and computer alarm.

If a 0 to 20 or 4 to 20 mA signal is the only signal functioning, it is suggested that you use the Milliamp Input Cable, which is discussed on page 8.

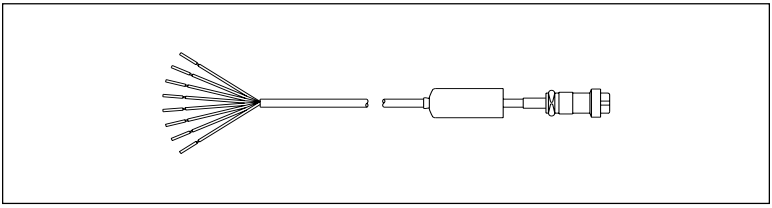


Figure 7: 8-Pin Cable (P/N 33738)

PIN	WIRE	SIGNAL
1	Red	+15V Output
2	Black	+15V Ground
3	Violet	+0-20 or 4-20 mA (+) Input
4	Green	-0-20 or 4-20 mA (-) Input
5	Orange	Pulse Output
6	Yellow	Alarm Output
7	Brown	Flow Input
8	Blue	Computer Alarm Output & Computer Output

Table 3: Pin Out Table - 8-Pin Cable (P/N 33738)

6.4 Optional "Hall Effect" Cable (P/N 33833)

An optional cable assembly is available for pacing your pump directly from an LMI Flowmeter fitted with a Hall Effect sensor. This cable connects to the Flowmeter as shown in Figure 8 (there is no need for a Programmable Divider; its function is built into the pump).

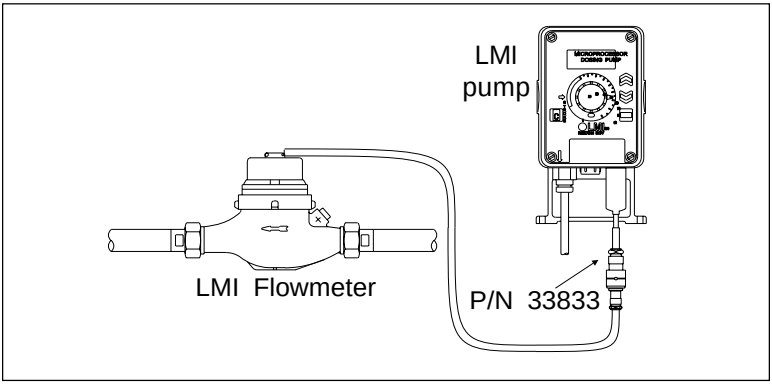


Figure 8: Optional "Hall Effect" Cable (P/N 33833)

6.5 LiquiComm™ Computer Interface Package

The optional LiquiComm™ package may be used to control and monitor up to 32 pumps from a computer over a serial RS485 interface as shown in Figure 9. Please contact LMI for further details.

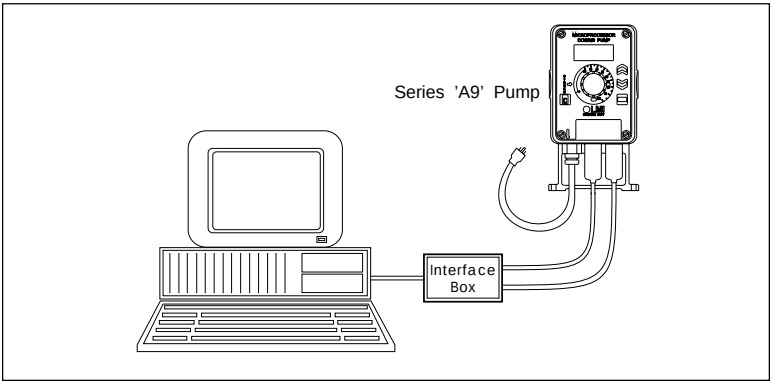


Figure 9: LiquiComm™ Computer Interface

7.0 Keypad/Display: Description and Function

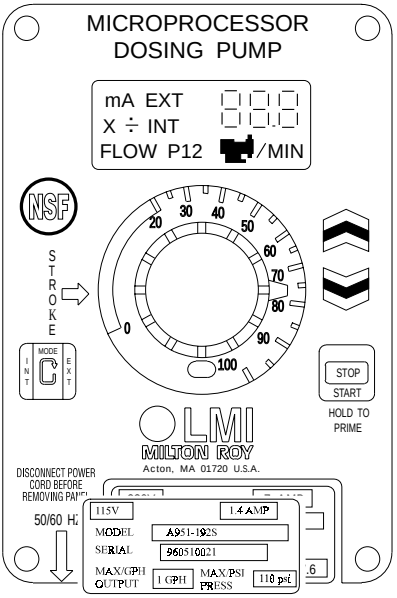


Figure 10: A9 Keypad

7.1 LCD Screen

The LCD screen is the window in which all values and menu choices are displayed (see Figure 11).

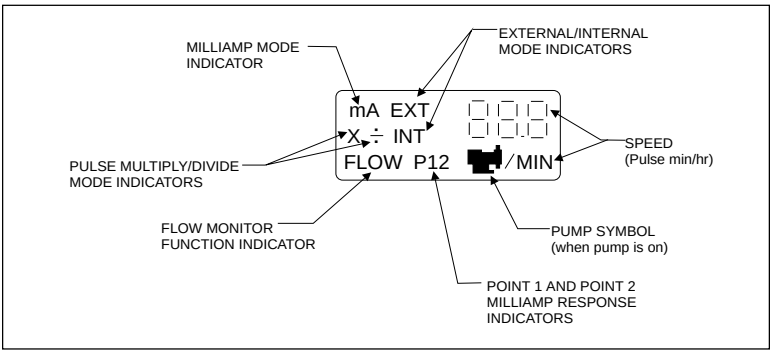


Figure 11: Liquid Crystal Display

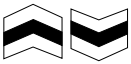
7.2 Start/Stop

The

(Start/Stop) key turns the pump on or off. If the pump is not running, pressing this key will cause the pump to start running. The symbol appears on the display while the pump is running. Each time the pump strokes, the symbol clears. If the pump is running, pressing the

(Start/Stop) key will stop the pump. The

(Start/Stop) key is also used to prime the pump as described on page 15.

7.3 Up and Down Key 

Use the (Up) and (Down) keys when: changing the stroke frequency; altering the pressure level; activating and deactivating the keypad lock; programming the divide and multiply values and milliamp response; accessing the setup menu; and changing certain parameters included in the setup menu. All of these functions are covered in greater detail later in this supplement.

7.4 Mode Key

Use the

(Mode) key when: changing to or from external or internal mode; accessing the pressure level; activating and deactivating the keypad lock; and accessing specific advanced features in the setup menu.

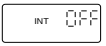
8.0 Operation of the Series A9, B9, and C9

These pumps feature EEPROM nonvolatile memory. The pump will always power up in the last used mode. When shipped from the factory the pump will power up in the "Internal" (manual) mode, with the pump OFF and a speed setting of 100 SPM.

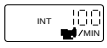
If the power to the pump is cut less than 15 seconds after the last programmed values have been set, the latest changes will NOT be stored in nonvolatile memory. Allow at least 15 seconds before disconnecting from power to ensure that the latest changes are stored.

8.1 Pump Start/Stop

Press the

(Start/Stop) key to start or stop the pump. When the pump is OFF, the LCD screen will alternate between 

and

every 16 seconds. When you start the pump, the
symbol appears on the LCD 

. Each time the pump strokes, the
symbol disappears. Press the

(Start/Stop) key again to stop the pump.

"INT" signifies that the pump is in the"Internal" (Manual) mode.

8.2 Speed

The speed may be changed with the pump ON or OFF. To increase or decrease the speed, press or hold the (Up) or (Down) key. The range runs from 0 SPH to 100 SPM. While normally the speed will be set in SPM, if settings of SPH are desired, hold the (Down) key until the display reads 0, then continue to hold it for an additional three (3) seconds. The display will then show H60, which is 60 SPH. The speed can be further reduced to 0 SPH with the (Down) key.

For example:

8.3 Priming

The priming function allows a fixed-time prime period of one (1) minute and enables priming of the pump in either Internal or External control modes. The priming function overrides the need for an external signal to cause the pump to stroke while in the External mode. Press and hold the (Start/Stop) key STOP START for three (3) seconds. The pump will start running at a speed of 60 SPM. If desired, alter the speed as noted above. The pump will stop one (1) minute from the time the STOP START (Start/Stop) key was last pressed, or you can stop the pump by pressing the STOP START (Start/Stop) key again. The display alternates between the pump speed and /MIN.

Flow Monitoring (see page 26) is inactive in the Prime mode.

8.4 Pressure Level Control

The maximum pressure rating of your pump can be adjusted to reduce pulsation shock in your discharge line. The pumps have a 6-point pressure control scale. The minimum setting is 0 and the maximum is 5. To access the pressure setting, press the

(Mode) key and (Up) key at the same time and hold for two (2) seconds. The current pressure setting

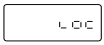
may be altered using the (Up) or (Down) keys.

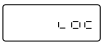
The pressure may be changed with the pump ON or OFF and in either Internal or External mode.

8.5 Keypad Lock

The pump has two (2) lock modes to prevent casual tampering. The small "LOC" de-activates all key functions *except*

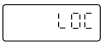
(Start/Stop) and Prime. To activate this "LOC" mode, press the

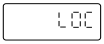
(Mode) key and (Down) key at the same time and hold for two (2) seconds. The LCD will read 

for five (5) seconds and then return to the previous display. This display 

re-appears when any key except the

(Start/Stop) key is pressed.

The large "LOC" disables *all* keypad entries, including Start/Stop. Activate this by pressing the Mode, Down, and Up keys at the same time and holding for two (2) seconds. The LCD will read 

for five (5) seconds and then return to the previous display. This display 

re-appears whenever any key is pressed.

To de-activate either lock mode, press the (Mode) key and (Down) key at the same time, and hold for two (2) seconds. The or will disappear.

8.6 Low-Level Switch (P/N 29190 or 29190E)

When the Low-Level Switch is fitted to the pump and a fault condition exists, the "E1" error code will flash on the LCD screen .

For more information on the Low-Level Switch, see the Low-Level Switch Assembly information sheet (P/N 1368) and page 30 of this supplement.

When a fault condition exists, the pump is stopped and the alarm and computer alarm lines are activated to allow remote monitoring. After clearing the fault (by filling the tank), the pump will automatically restart.

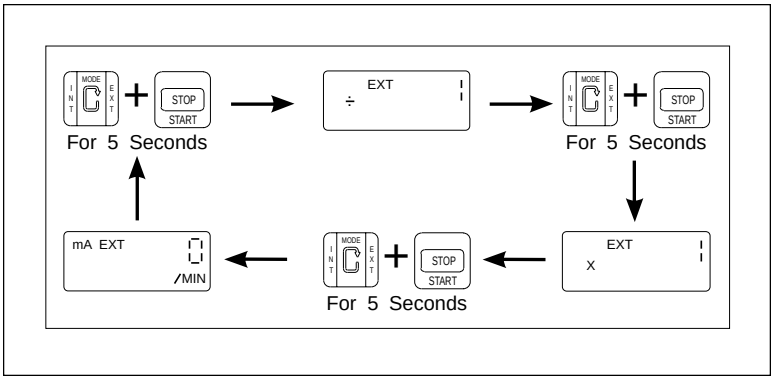
9.0 External Control Modes

To access the pulse divide, pulse multiply or milliamp response, the pump must be changed from Internal (manual) mode to External mode. To do this, first be sure the pump is stopped. Press the (Mode) key and hold it for three (3) seconds. The LCD screen displays the last External mode that was programmed. If this is the first time the pump has been put in the External mode, the factory default will be displayed on the LCD screen. The factory default mode is "External Pulse Divide" with a divide value of one (1) . The display will alternate between SPM and OFF.

External Mode Select: Pulse Divide, Pulse Multiply, and mA Response

Any of three external modes may be selected when the pump is stopped by pressing and holding the (Mode) key and (Start/Stop) key for five (5) seconds, then releasing. As noted above, the default is Pulse Divide. Pressing and releasing these keys brings you to the Pulse Multiply mode . In this mode, the LCD screen alternates between the pulse multiply value and OFF. Pressing and releasing these keys one more time brings you to the third external mode, mA response . In this mode the LCD screen alternates between SPM and the mA value.

Summary of External Mode Select



9.1 Programming the Pulse Divide Value

The divide value is altered by using the (Up) and (Down) keys. To do this, the pump must be in the External Divide mode and be OFF. The valid range for the divide value runs from 1 to 999. With the pump running in the Divide mode, the speed in SPM is calculated based on the rate of incoming pulses and the divide value, and displayed on the LCD screen .

If the calculated speed is less than one (1) SPM, the LCD screen will display 0 SPM. If the calculated speed is GREATER THAN 100 SPM, the E3 error code will be displayed periodically until the fault condition is corrected

. This error does NOT activate the alarm outputs or stop the pump.

9.2 Programming the Pulse Multiply (Batch) Value

The multiply value is altered by using the (Up) and (Down) keys to change the value. The pump must be OFF and in the External Multiply mode. Like the divide value, the valid range for the multiply value runs from 0 to 999 pulses. When the pump is ON, a single external pulse will initiate a batch of pump strokes. The number of remaining pulses are displayed on the LCD screen

. When 0 is reached, the display resets to the multiply value. The pump is now ready for another pulse input.

If a pulse is received before the countdown to 0 is complete, the E4 error code is displayed, and the pump batch count resets to the programmed multiply value. The batch countdown then continues from its programmed value. As the countdown continues, the E4 error code

will be displayed intermittently until the fault is corrected. The strokes that remained from the first batch are *NOT* accounted for. To clear the fault display, the pump must be stopped and restarted.

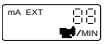
To allow true flow proportioning, the speed in the Multiply mode is equal to the speed set in the Internal (manual) mode. That is, if the Internal mode speed is set at 60 SPM, in the External Multiply mode the pump counts down at 60 SPM.

Batch Accumulate

The Batch Accumulate function allows you to opt to have any extra input pulses received in the multiply mode accumulate up to a maximum batch of 999. If Batch Accumulate is enabled and a pulse is received during the countdown, the programmed multiply value will be added to the current displayed value. Pulses causing the maximum batch of 999 to be exceeded will result in an E4 error message. When Batch Accumulate is enabled, the LCD screen alternates between the current multiply value and "ACC" . The Batch Accumulate function is activated in the Setup Menu (see "Advanced Features and Setup Menu" on page 25).

9.3 Programming the mA Response

The pump accepts a 0-20 mA or 4-20 mA signal directly. The response to this signal is fully programmable. In the mA mode, the pump speed is determined by the programmed response curve, as defined by points "P1" and "P2." The factory default set values for P1 and P2 are (4 mA, 0 SPM) and (20 mA, 100 SPM) respectively. This is illustrated in Figure 12.

While in the mA mode, the pump speed  and the mA value are displayed alternately every four (4) seconds while the pump is running.

9.4 Programming Points 1 and 2 (SPM)

To program points P1 and P2, first ensure the pump is in the mA mode and OFF. If you wish to program the response in "SPM",

switch to the internal mode. The speed must be set to a SPM value [INT 100 /MIN]. Return to the External mA mode.

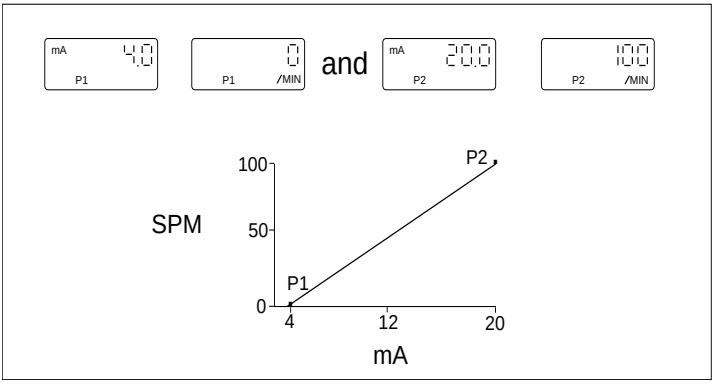


Figure 12

Press either the (Up) or (Down) key. The LCD screen will display [Pro]. After five (5) seconds, the display will show the mA value for P1 [mA 4.0 P1]. This value may be altered using the (Up) or (Down) key within five (5) seconds (i.e. [mA 6.0 P1]). Five (5) seconds following the last key press, the stroke rate for P1 will be displayed [0 P1 /MIN]. This value may be altered within five (5) seconds using the Up or Down key (i.e. [80 P2 /MIN]).

Five (5) seconds after the last key press, the mA value for P2 is displayed [mA 20.0 P2]. Edit as described in the above paragraph (i.e. [mA 18.0 P2]). Likewise, five (5) seconds after the last key press the stroke rate for P2 is displayed. Edit as described above (i.e. [10 P2 /MIN]).

The above examples would result in the inverse control profile shown in Figure 13.

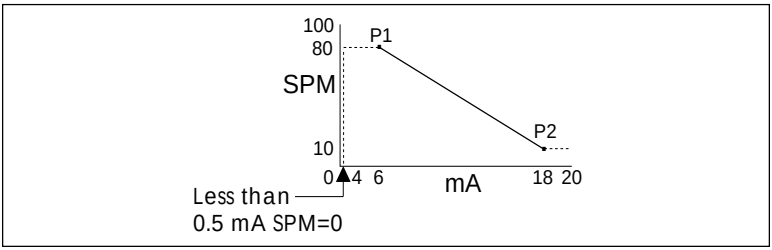


Figure 13

If the mA input goes below the value programmed for P1 or above the P2 value, the response will "plateau," as indicated by the dotted lines above.

The valid input range is from 0.5 to 21 mA. Below 0.5 mA, the pump will be off. Above 21 mA, the E5 error code will be displayed intermittently EXT E5 .

9.5 Programming Points 1 and 2 (SPH)

If you wish to program the response in strokes per hour, start by being in the External mA mode. Next, switch to the Internal mode. If the Internal setting is in strokes per minute, change to strokes per hour by holding the (Down) key until the display reads 0 SPM. Continue to hold it for another three (3) seconds. The display will now read SPH INT H50. Set the speed to any SPH value (the actual setting has no bearing on mA response). Return to the External mA mode.

In the External mA mode, pressing the (Down) key or (Up) key will change the display to . After five (5) seconds, the display will show the mA value for P1 . This value may be altered by using the (Up) key or (Down) key within five (5) seconds (i.e.). Five (5) seconds following the last key press, the stroke rate for P1 will be displayed . This value may be altered within five (5) seconds using the (Up) or (Down) key (i.e.).

Five (5) seconds after the last key press, the mA value for P2 will be displayed . Edit as described above (i.e.). Likewise, five (5) seconds after the last keypress, the stroke rate for P2 is displayed and may be altered as above (i.e.).

The above example would result in the inverse control profile shown in Figure 14.

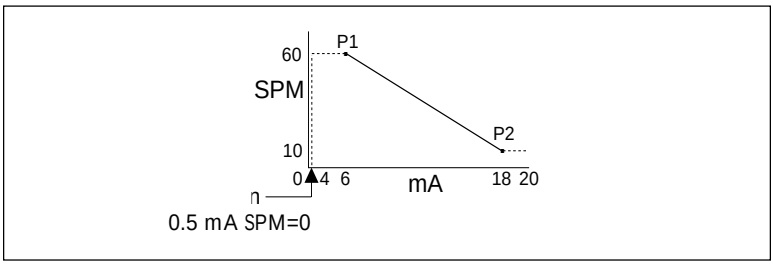


Figure 14

The valid input range is from 0.5 to 21 mA. Below 0.5 mA, the pump will be off. Above 21 mA, the E5 error code will be displayed intermittently .

When programming strokes per hour, the maximum rate is 60. P1 and P2 must BOTH BE SPM or BOTH BE SPH.

10.0 Advanced Features and the Setup Menu

Advanced features such as Batch Accumulate, Computer Interfacing, Automatic Voltage Compensation, Flow Monitoring and Integral Blowdown may be selected and altered in the Setup Menu of the Series A9, B9, and C9. The following configuration chart describes each menu item, its description, and available settings.

Menu Item	Description/ Function	Setting	Notes
	Software Revision	Read Only	
1	Batch Accumulate	0 = Disable 1 = Enable	Applies to External Multiply mode
2	Computer Communication	0 = Disable 1 = Enable	Allows computer interface to be established with LiquComm™ software. Remote Start/Stop and Computer Alarm lines are used in communication.
3	Automatic Voltage Compensation	0 = Disable 1 = Enable	Becomes active two (2) minutes after power up.
4	Flow Monitoring	0 = Disable 1 = Enable	Used in conjunction with FM-200 Digi-Pulse™ Flow Monitors. "Flow" displayed and flashes with each pulse from FM-200.
5	Flow Monitoring Pulse Detection Pulse Detection Setting	1 to 255	Sets the number of missing pulses before alarm output is activated. Menu item number is not included with LCD display. This setting is displayed irrespective of Menu Item 4 setting.
6	Input Pulse Width	0-15	Allows pulse widths of 1 to 60 mSec to be set. Setting of 0 gives a debounce time of approximately 1 mSec.
7	Integral Blowdown	0 = Disable 1 = Enable	Allows Activation of the integral blowdown feature.
8	Integral Blowdown Solenoid ON Time (Seconds)	0 to 255	Set solenoid ON time in seconds.
9	Integral Blowdown Pump ON Time (Seconds)	0 to 255	Set pump ON time in seconds.
	Note: Allow 15 seconds after programming before disconnecting from power to ensure latest changes are stored in nonvolatile memory.		

10.1 Accessing the Setup Menu

To access the Setup Menu, ensure that the pump is OFF and in the Internal mode. Using the (Up) key, bring the stroke rate to 100 SPM. At this point, keep the (Up) key pressed for five (5) seconds. The LCD screen then displays the current software revision, indicating that you have entered the Setup Menu mode . Press the (Mode) key to scroll through the Menu Items. Use the (Up) or (Down) key to enable or disable menu functions and program values.

To exit the Menu mode, press the (Start/Stop) key. Or, if no keys are pressed for 13 seconds, the display reverts to .

10.2 Menu Items

10.2.1 Menu Item 1: Batch Accumulate Enable/Disable

Batch Accumulate may be enabled (1) or disabled (0) . Use the (Up) or (Down) key to change the selection.

10.2.2 Menu Item 2: Computer Communication

Press the Mode key to get to Menu Item 2, Computer Communication. Setting the value to one (1) enables computer communication using the LiquiComm™ Interface Box and Software.

When Computer Communication is enabled, the Remote Start/ Stop and Computer Alarm lines are deactivated and used for the computer communication link.

10.2.3 Menu Item 3: Automatic Voltage Compensation

Menu Item 3 enables (1) or disables (0) automatic voltage compensation. This unique feature allows a constant power level to be delivered to the EPU of the pump, even when the voltage of the external power source is fluctuating. This results in smooth pump output in spite of fluctuating voltage and prevents overheating.

Automatic voltage compensation becomes active two minutes after power up.

10.2.4 Menu Items 4 and 5: Flow Monitoring

This feature is used in conjunction with the LMI Series FM-200-9 Digi-Pulse™ Flow Monitor (refer to Digi-Pulse™ Flow Monitor Instructions P/N 1708). This device is designed to monitor the output flow from a pump. It may be set to deliver a pulse signal output for each successful pump stroke registered. If the flow stops or lessens, the pulse outputs will cease. With the FM-200-9 connected to the flow monitor input, the presence or lack of pulses can be detected (see Figure 15).

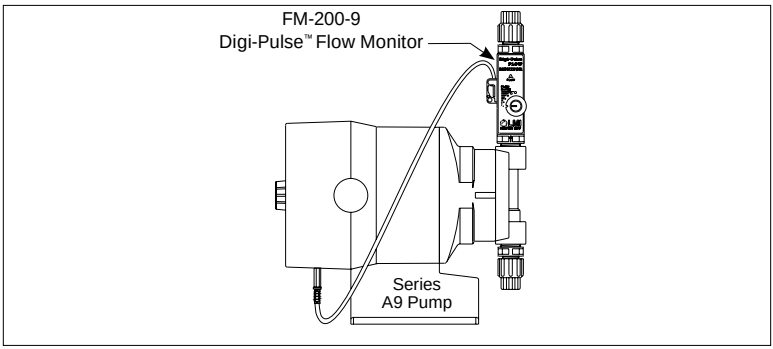


Figure 15

Press the (Mode) key a fourth time and then the (Up) or (Down) key to allow flow monitoring to be enabled (1) or disabled (0). When flow monitoring is enabled, "Flow" is displayed on the LCD screen. Again, pressing the (Mode) key displays the number of missing pulses to be detected. This may be set to any value from 1 to 255. The factory default is 8. A setting of 1 is the most sensitive, a setting of 255 the least sensitive.

For example, if the setting is 5, and five (5) strokes of the pump occur without any pulse being received from the FM-200-9, the LCD screen will display an E2 error code. The pump will stop, and the alarm outputs will be activated (i.e.). Pressing the (Start/Stop) key clears the error.

The word "Flow" blinks every time the A9 , B9, or C9 receives a signal from the Digi-Pulse™. This serves as an aid in setting up the Digi-Pulse™ itself .

10.2.5 Menu Item 6: Input Signal Pulse Width (Debounce)

Menu Item 6 determines the "debounce" period (pulse width) to be applied to incoming pulse (pacing) signals. The default value is 15, which corresponds to a debounce value of 60 mSec . Each unit corresponds to approximately 4 mSec. This means that in order to be recognized, an input signal must be at least 60 mSec in duration. This setting may need to be reduced from its maximum setting for high frequency input pulse signals such as those from a Hall Effect flowmeter.

10.2.6 Menu Items 7, 8 and 9 Activate the Integral Blowdown Feature

These Menu Items will require additional accessories and customer supplied components. For complete details please refer to A9, B9 and C9 with Integral Blowdown (P/N 1753).

This Integral Blowdown feature provides cooling tower control from your LMI microprocessor pump when used in conjunction with a pulse output type flowmeter (batch mode) or 4-20 mA signal (milliamp mode). These signals can then be input into the pump to provide activation of both the pump and a customer supplied solenoid valve.

LMI's Relay Pack, Model RP-100A, must be ordered separately to provide power to the customer supplied solenoid.

A. Batch Mode

Programming Menu

Menu Item 1 Batch Accumulate: Select 0 = (Disable) or 1= (Enable)

Menu Item 7 Integral Blowdown: Select 1 = (Enable)

Menu Item 8 Solenoid ON time: Select 0 to 255 (Seconds)

Select "INT" mode and set the manual strokes per minute.

Select "EXT X" (multiply) mode (batch mode) and program stroke count.

On receipt of a pulse from the flowmeter, the pump strokes the programmed number of pulses. The batch value (multiply [X] value) and manual SPM determines the length of time the pump will be on.

On receipt of a pulse from the flowmeter, the solenoid valve is opened. The solenoid remains open for the length of time programmed in Menu Item 8. If another flowmeter pulse is received before the above is completed the solenoid ON time is extended by the time programmed in Menu Item 8.

B. Milliamp Mode

Programming Menu

Menu Item 7 Integral Blowdown: Select 1 = (Enable)
Menu Item 8 Solenoid ON time: Select 0 to 255 (seconds)
Menu Item 9 Pump ON time: Select 0 to 255 (seconds)
Select EXT mA mode (milliamp mode) and program the mA response (Point 1 and Point 2).

The pump strokes at a rate determined by the mA input signal for the length of time determined by Menu Item 9. The solenoid remains open for the length of time programmed in Menu Item 8 of the menu. The cycle time for this operation is determined by the longer of solenoid ON time or the pump ON time.

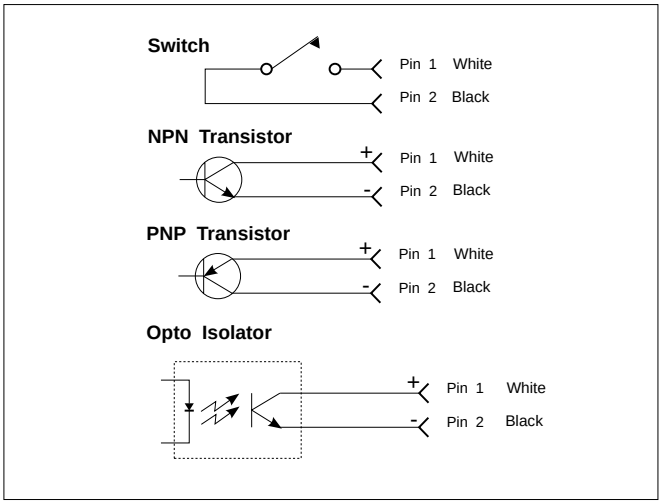
Appendix A: Input/Output Description

4-Pin Connector

Pacing (Pulse) Input / Opto-isolated Input

Methods of Triggering Series A9, B9, and C9 Pumps

Reference: 4-Pin Cable (P/N 33796)

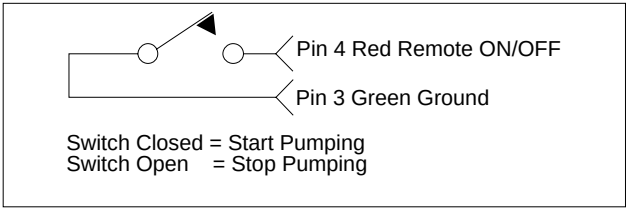


Switch or transistor must be capable of switching 2 mA at 15 VDC. When in the Divide mode, the switch must close then open to trigger.
Minimum time in low impedance state (i.e. switch closed) is 60 mSec by default.
Setup Menu Item 6 sets this value in multiples of 4 mSec.
Example: Default = 4 x 15 = 60 mSec

Remote On/Off (Opto-isolated Input)

Switching this line to ground starts the pump. Releasing this line, stops the pump. The (Start/Stop) key will always override the Remote Start/Stop.

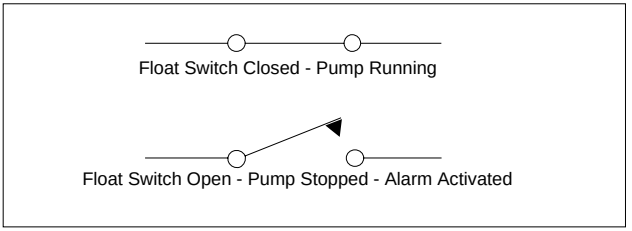
Reference: 4-Pin Cable (P/N 33796)



Switch must be capable of switching 2 mA at +15 VDC. Minimum time in low impedance state (i.e. Switch closed) is approximately one (1) second.

Low-Level Input (P/N 29190 and 29190E)

Opening the float switch (i.e. breaking the line from ground) stops the pump and activates the alarm output.



Switch must be capable of switching 2 mA at +15 VDC.

Minimum time in low impedance state (i.e. switch closed) is approximately 1 second. (For use with LMI Float Switches [P/N 29190 and 29190 E]. For further information, please refer to instructions included with the switches and to page 17 of this supplement.)

8-Pin Connector

Analog 0-20 mA Input

+0 to 20 mA White
-0 to 20 mA Black

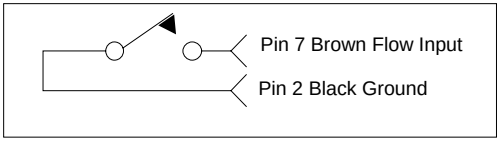
+0 to 20 mA Violet
- 0 to 20 mA Green

This is reverse polarity protected with a 22 Ohm impedance, a resolution or 0.1 mA and an accuracy of +/- 0.2 mA typically.

Flow Input (Opto-isolated Input)
(See also Flow Monitoring on page 26)

If an FM-200-9 is used, use the Digi-Pulse™ phone jack. If some other device is used, this function can be accessed as shown below.

Reference: 8-Pin Cable (P/N 33738)



Switch must closed for approximately three (3) mSec and then open for the input to be accepted (i.e. switch to ground, then release).

Switch must be capable of switching 2 mA at +15 VDC.

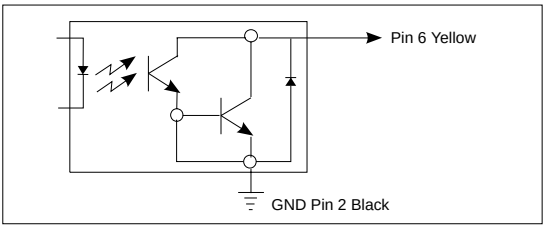
15V Output

The +15V Output (pin 1 Red) is regulated and capable of delivering 30 mA current.

Alarm Output

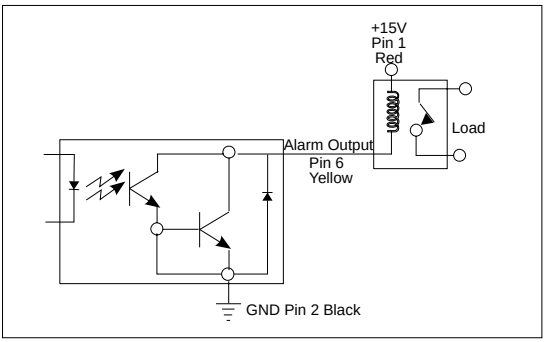
This is an opto-isolated open collector Darlington pair capable of switching 25 mA at +24 VDC to within 1V of ground typically.

Reference: 8-Pin Cable (P/N 33738)



The output pair turns ON when an alarm condition occurs (i.e. low level or missing pulse) and remains ON until the alarm condition is cleared.

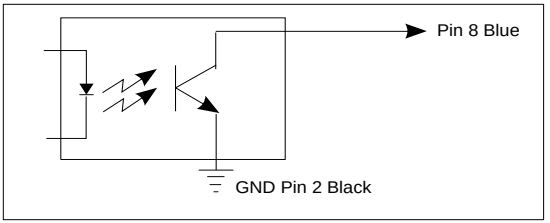
Application: Relay Switching



Computer Alarm Output

This is an opto isolated, open collector output capable of switching 2 mA at +24 VDC to within 0.4V of ground typically.

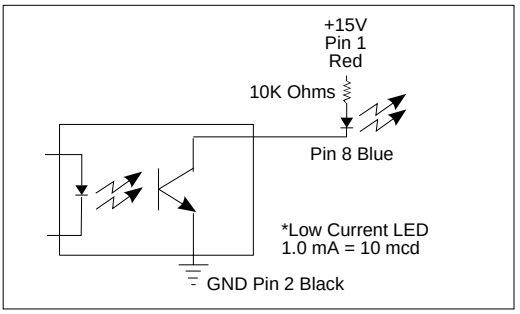
Reference: 8-Pin Cable (P/N 33738)



This output tracks the alarm output (i.e. the conditions for activating and de-activating this output are the same as for the alarm output).

This output may be used to directly switch small loads such as computer inputs and low current LEDs. It may also be used to initiate switching of larger loads if suitable buffer circuitry is provided.

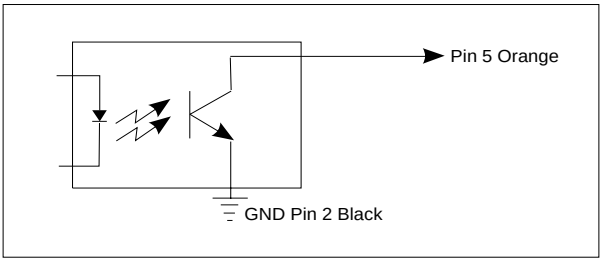
Application: Low Current LED Switching



This is an opto-isolated, open collector output capable of switching 2 mA at +24 VDC to within 0.4V of ground typically.

Pacing Output (Opto-isolated Output)

Reference: 8-Pin Cable (P/N 33738)



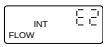
The output transistor turns ON at the start of a stroke and remains ON for approximately 100 mSec.

Appendix B: Summary of Error Messages

E1

is caused by a Low-Level fault with a Low-Level Switch connected to the pump. The pump is stopped and the alarm outputs are activated. This operates in all Internal and External modes. The pump automatically restarts when the fault is cleared.

E2



indicates that the pump has lost prime (or the flow had reduced) when an FM200-9 is connected and Flow Monitoring is enabled. Again, the pump is stopped and output alarms activated. Restart the pump when the fault is cleared.

E3

is displayed in the External mode if the stroke rate exceeds 100 SPM. The pump is NOT stopped and NO alarm outputs are activated with this fault. To stop E3 flashing, clear the fault condition, then stop and restart the pump.

E4

is displayed in the External X (Batch) mode in two situations: 1) If "Batch Accumulate" is disabled and a pulse signal is received while the pump is counting down. The pump is not stopped, and the alarms are not activated. To clear the E4 message, the pump must be stopped and restarted. 2) If "Batch Accumulate" is enabled and the cumulative batch value exceeds 999, E4 will be displayed. The E4 message can only be cleared if the pump is stopped and restarted.

E5

is displayed in the mA External mode if the mA input value exceeds 21.0 mA, whether the pump is running or stopped. Again, the alarms are NOT activated. Once the mA signal goes below 21.0 mA, the E5 error message is cleared.

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13.2 LMI Series AD Metering Pumps (WTP)

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

Data Sheet

ROYTRONIC EXCEL™ Series AD Electronic Metering Pumps

Model AD

Model Code Configuration

Drive

Control Code

2 - Dual Manual Control
Stroke frequency and length manually adjustable, LCD display, low level indication (remote input). Display configurable to indicate theoretical pump flow.

8 - Pulse/Analog Input w/ Dual Manual Control
Pulse or 4-20 mA signal input controls frequency, LCD display, manual stroke length control, frequency manually adjustable when in local control, pulse multiply/divide functions, 24 V output for remote device. Includes dual low level float switch input. Display configurable to indicate theoretical pump flow.

9 - Pulse/Analog Input w/Dual Manual Control & Enhanced Controls
Advanced Features - Pulse or 4/20 mA signal input controls frequency, graphical display, manual stroke length control, Frequency manually adjustable when in local control, Pulse multiply/divide functions, 24 V output for remote device, dual low level float switch input, Remote on/off signal input. Outputs include: 4-20 mA, pulse, & Alarm. Remote internal/external mode input. Display configurable to indicate theoretical pump flow.

Output Code with FastPrime™ Liquid End

Max Capacity	Max Pressure
1 - 0.21 GPH (0.8 l/h)	250 psi (17.2 Bar)
4 - 0.5 GPH (1.9 l/h)	250 psi (17.2 Bar)
5 - 1.0 GPH (3.8 l/h)	110 psi (7.6 Bar)
6 - 2.0 GPH (7.6 l/h)	50 psi (3.4 Bar)

Voltage Code

1 – 110-120V US Plug
2 – 220-240V US Plug
3 – 220-240V DIN Plug
5 – 220-240V UK Plug
6 – 220-240V Aust/NZ Plug
7 – 220-240V Swiss Plug
8 – 110-120V No Plug

Liquid End

Liquid End Code

See Accompanying Pages for Options

Liquifram™ Size Code

1 – 0.2 in²
2 – 0.4 in²
3 – 0.8 in²
4 – 1.6 in²

Material Code

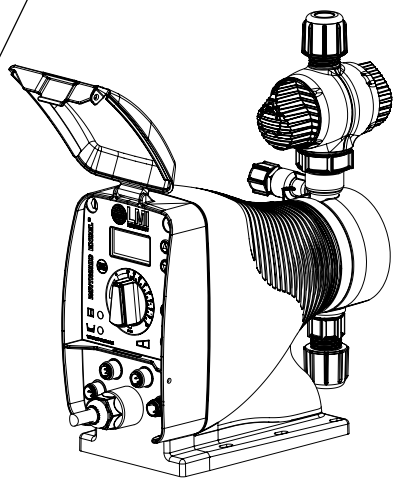
See Accompanying Pages for Options

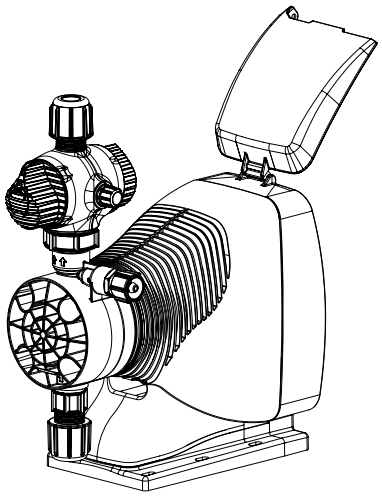
Head/Valve Code

S – FastPrime™ Head + 4FV
N – FastPrime™ Head
H – AutoPrime™ Head + 4FV
A – AutoPrime™ Head
V – High Viscosity Head
P – High Viscosity with Ported Head

Connection Code

I – Inch Tube connections with tubing
M – Metric Tube connection without tubing
U – Inch Tube connection with Black UV resistant suction/discharge tubing
P – 1/2" NPT - 1/2" BSP Pipe (SS 1/4" NPT)





Certified to NSF/ANSI 61 & 372

Certified to NSF/ANSI Standard 50

Specifications

Series	Strokes Per Minute (Adjustable) Min	Max	Stroke Length (Adjustable) Recommended Minimum	Average Input Power @ Max Speed and Pressure	Max. Shipping Weight
AD 2X* AD 8X* AD 9X*	1	120	20%	25 watts	10 lbs (4.75 kg)

* where X = output code

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Replaces same of Rev.D 6/2012
2039.E 11/2014

Standard FastPrime™ Liquid End Configuration Data & Materials of Construction

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquifram™	Seat/O-Ring	Accs. Valve	Tubing & Connections Discharge & Suction
AD91 ■ AD81 ■ AD21 ■	910SI†	1	Acrylic/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	915SI†	1	PP/PP	Ceramic	Fluorofilm™	PTFE	4FV	PE 1/4" O.D.
	918SI†	1	PVC/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	919SI†	1	Acrylic/PVDF	PTFE	Fluorofilm™	Polyprel®	4FV	PE 1/4" O.D.
	917NP	1	316ss/316ss	316ss	Fluorofilm™	316ss/PTFE	—	1/4" NPT
	812SI†	1	PVDF/PVDF	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	813SI†	1	PVDF/PVDF	Ceramic	Fluorofilm™	PTFE	4FV	PE 1/4" O.D.
	818SI†	1	PVC/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	718SI†	1	PVC/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquifram™	Seat/O-Ring	Accs. Valve	Tubing & Connections Discharge & Suction
AD94 ■ AD84 ■ AD24 ■	920SI†	2	Acrylic/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	925SI†	2	PP/PP	Ceramic	Fluorofilm™	PTFE	4FV	PE 1/4" O.D.
	928SI†	2	PVC/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	929SI†	2	Acrylic/PVDF	PTFE	Fluorofilm™	Polyprel®	4FV	PE 1/4" O.D.
	927NP	2	316ss/316ss	316ss	Fluorofilm™	316ss/PTFE	—	1/4" NPT
	822SI†	2	PVDF/PVDF	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	823SI†	2	PVDF/PVDF	Ceramic	Fluorofilm™	PTFE	4FV	PE 1/4" O.D.
	828SI†	2	PVC/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	728SI†	2	PVC/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	624VI*	2	PP/PP	316ss	Fluorofilm™	PTFE	—	PE.5"O.D. Vinyl.938"O.D.
	626VI	2	Acrylic/PP	316ss	Fluorofilm™	PTFE	—	PE.5"O.D. Vinyl.938"O.D.

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquifram™	Seat/O-Ring	Accs. Valve	Tubing & Connections Discharge & Suction
AD95 ■ AD85 ■ AD25 ■	930SI†	3	Acrylic/PVC	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	935SI†	3	PP/PP	Ceramic	Fluorofilm™	PTFE	4FV	PE 3/8" O.D.
	938SI†	3	PVC/PVC	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	939SI†	3	Acrylic/PVDF	PTFE	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	937NP	3	316ss/316ss	316ss	Fluorofilm™	316ss/PTFE	—	1/4" NPT
	832SI†	3	PVDF/PVDF	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	833SI†	3	PVDF/PVDF	Ceramic	Fluorofilm™	PTFE	4FV	PE 3/8" O.D.
	838SI†	3	PVC/PVC	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	738SI†	3	PVC/PVC	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	634VI*	3	PP/PP	316ss	Fluorofilm™	PTFE	—	PE.5"O.D. Vinyl.938"O.D.
	636VI	3	Acrylic/PP	316ss	Fluorofilm™	PTFE	—	PE.5"O.D. Vinyl.938"O.D.

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquifram™	Seat/O-Ring	Accs. Valve	Tubing & Connections Discharge & Suction
AD96 ■ AD86 ■ AD26 ■	940SI†	4	Acrylic/PVC	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	945SI†	4	PP/PP	Ceramic	Fluorofilm™	PTFE	4FV	PE 3/8" O.D.
	948SI†	4	PVC/PVC	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	949SI†	4	Acrylic/PVDF	PTFE	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	947NP	4	316ss/316ss	316ss	Fluorofilm™	316ss/PTFE	—	1/4" NPT
	842SI†	4	PVDF/PVDF	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	843SI†	4	PVDF/PVDF	Ceramic	Fluorofilm™	PTFE	4FV	PE 3/8" O.D.
	848SI†	4	PVC/PVC	Ceramic	Fluorofilm™	Polyprel®		
	748SI†	4	PVC/PVC	Ceramic	Fluorofilm™	Polyprel®		
	644VI*	4	PP/PP	316ss	Fluorofilm™	PTFE		
	646VI	4	Acrylic/PP	316ss	Fluorofilm™	PTFE		

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

Output Information with FastPrime™ Liquid End

Series	Gallons per Hour Min	Gallons per Hour Max	Liters per Hour Min	Liters per Hour Max	mL/cc per Minute Min	mL/cc per Minute Max	mL/cc per Stroke Min	mL/cc per Stroke Max	Maximum Injection Pressure
ADX1	0.002	0.21	0.01	0.8	0.132	13.2	0.011	0.11	250 psi (17.2 Bar)
ADX4	0.005	0.5	0.02	1.9	0.315	31.5	0.026	0.26	250 psi (17.2 Bar)
ADX5	0.01	1.0	0.04	3.8	0.630	63.0	0.053	0.53	110 psi (7.6 Bar)
ADX6	0.02	2.0	0.08	7.6	1.260	126.0	0.105	1.05	50 psi (3.4 Bar)

(Where X = Control Code 2,8,9).

AutoPrime™ Liquid End Configuration Data & Materials of Construction

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquiframm™	Seat/O-Ring	Accs. Valve	Tubing & Connections
AD91 ■ AD81 ■ AD21 ■	A10HI†	1	Acrylic/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	A18HI†	1	PVC/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquiframm™	Seat/O-Ring	Accs. Valve	Tubing & Connections
AD94 ■ AD84 ■ AD24 ■	A20HI†	2	Acrylic/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	A28HI†	2	PVC/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquiframm™	Seat/O-Ring	Accs. Valve	Tubing & Connections
AD95 ■ AD85 ■ AD25 ■	A30HI†	3	Acrylic/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 3/8" O.D.
	A38HI†	3	PVC/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 3/8" O.D.

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquiframm™	Seat/O-Ring	Accs. Valve	Tubing & Connections
AD96 ■ AD86 ■ AD26 ■	A40HI†	4	Acrylic/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 3/8" O.D.
	A48HI†	4	PVC/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 3/8" O.D.

Output Information with AutoPrime™ Liquid End — Estimated

Series	Gallons per Hour Min	Gallons per Hour Max	Liters per Hour Min	Liters per Hour Max	mL/cc per Minute Min	mL/cc per Minute Max	mL/cc per Stroke Min	mL/cc per Stroke Max	Maximum Injection Pressure
ADX1	0.0015	0.15	0.006	0.6	0.095	9.5	0.008	0.079	250 psi (17.2 Bar)
ADX4	0.0033	0.33	0.012	1.2	0.21	20.8	0.017	0.17	250 psi (17.2 Bar)
ADX5	0.008	0.8	0.030	3.0	0.50	50.5	0.042	0.42	110 psi (7.6 Bar)
ADX6	0.018	1.8	0.068	6.8	1.14	113.6	0.095	0.95	50 psi (3.4 Bar)

(Where X = Control Code 2,8,9).

AUTOPRIME™ liquid ends have 3 check valves: suction on the bottom; discharge on the front; autoprime bleed on the top. By design, a repeatable portion of the process fluid continuously bleeds through the top check valve to be returned to the chemical supply. The result is the assurance that any gas in the head is automatically relieved thus eliminating air-binding. Depending on application, output may be reduced up to 50%. Variables include supplier piping, stroke length and speed setting.

■ See front page for voltage code specifications.

† To specify black, UV resistant tubing, change 'I' to 'U'. To specify head only and no 4FV, change S to N for FastPrime or change H to A for AutoPrime. To specify 1/2" NPT Male, change "I" to "P".

* To specify Ported Head, change "V" to "P".

** Autoprime™ cartridge ball is Hastelloy.

4FV indicates that the pump is equipped with an LMI Four Function Valve. This diaphragm type, anti-syphon/pressure relief valve is installed on the pump head. It provides anti-syphon protection and aids priming, even under pressure.

Fluorofilm™ is a copolymer of PTFE and PFA. Polyprel® is an elastomeric PTFE copolymer.

Polyprel is a regist

Fluorofilm and Liqu

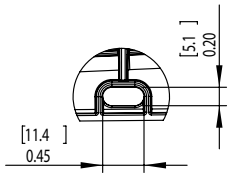
Viton® is a register

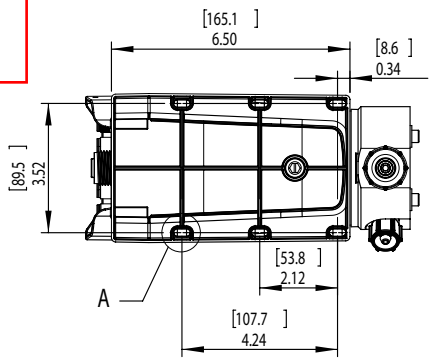
LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

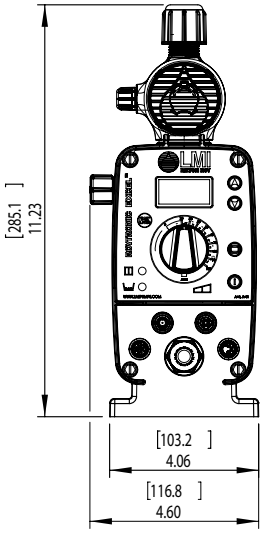
MOUNTING INFORMATION

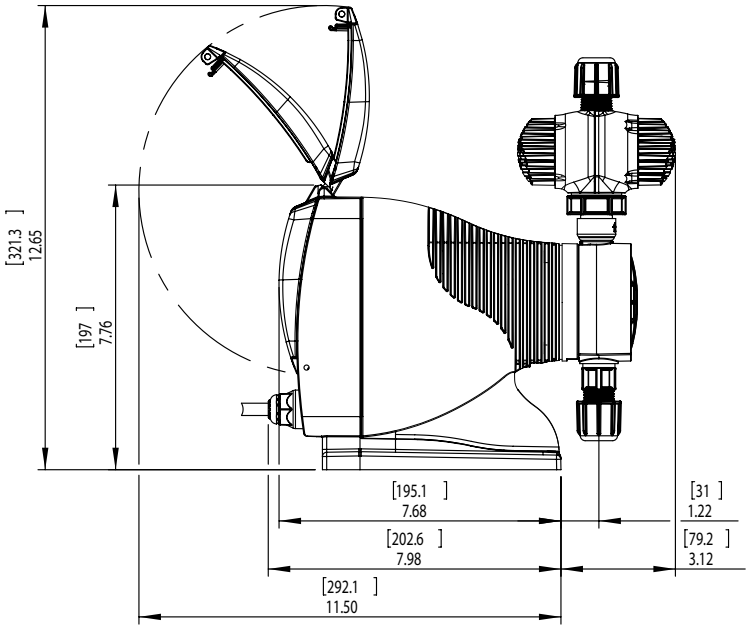
VIEW A



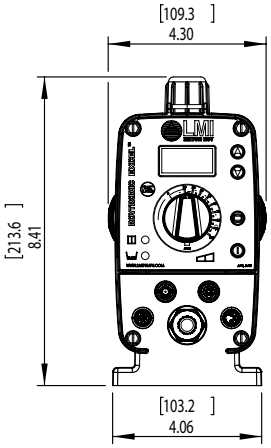


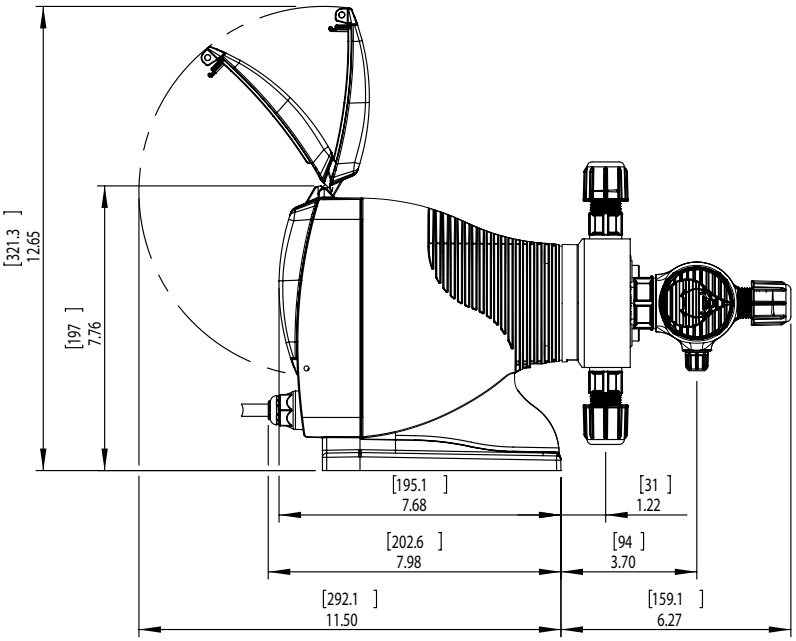
FASTPRIME LIQUID ENDS





AUTOPRIME LIQUID ENDS





NOTE: ALL DIMENSIONS ARE IN INCHES [MM]. DIMENSIONS SHOWN ARE FOR LARGEST LIQUID END. DIMENSIONS WILL VARY DEPENDING ON LIQUID END SELECTED.

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LMI®

an Accudyne Industries brand

ROYTRONIC EXCEL™ Series AD

Electronic Metering Pumps

Instruction Manual/Programming Guide

Manual No : 2024
Rev. : E
Rev. Date : 11/2015

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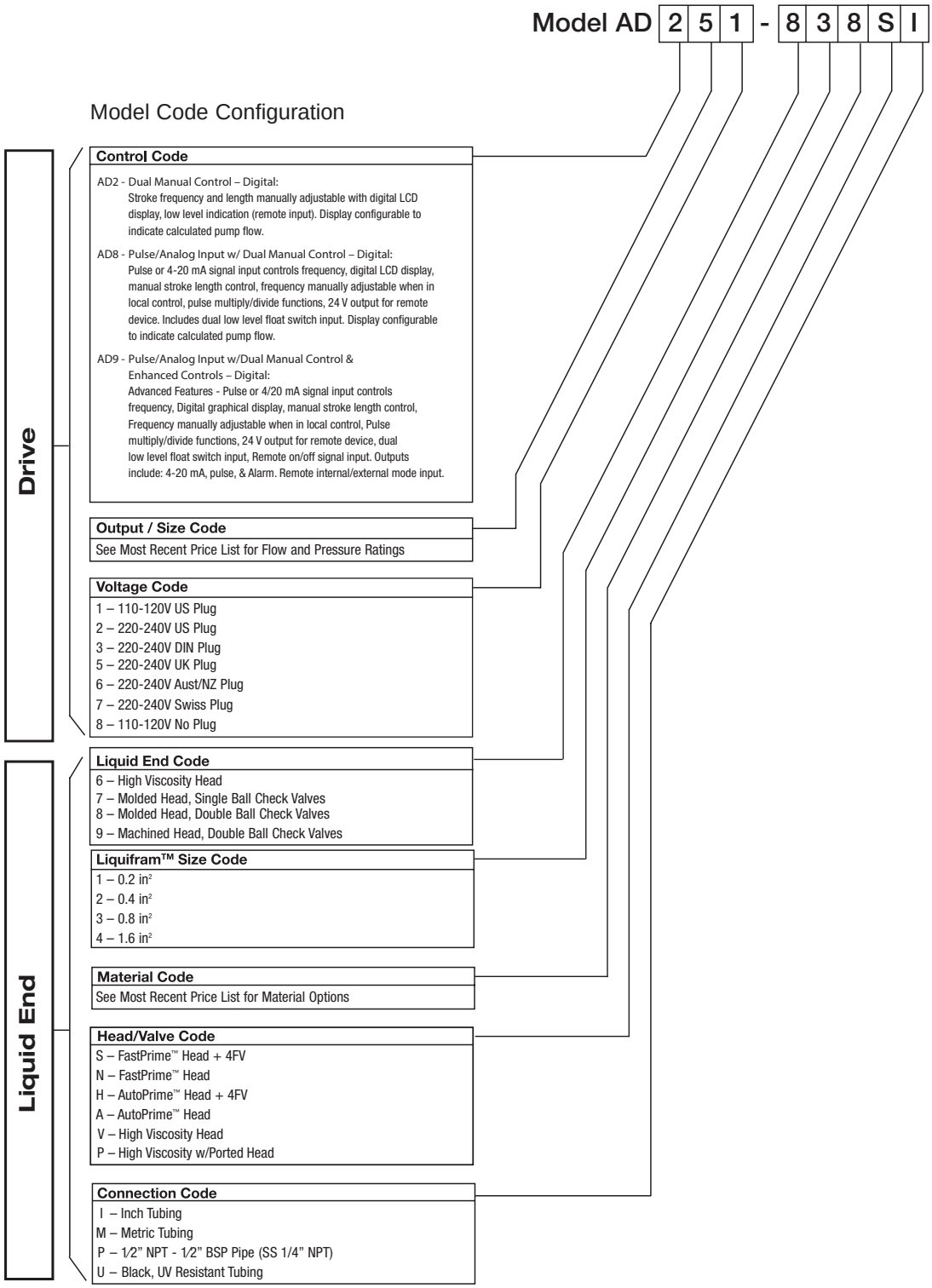

**Note: Not all configurations are available. Please See your local distributor or price list for available options.*

ROYTRONIC EXCEL™ Series AD

PRECAUTIONS

The following precautions should be taken when working with LMI® metering pumps.
Please read this section carefully prior to installation.

Protective Clothing

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on the solution being pumped. Refer to SDS precautions from your solution supplier.

Water Pre-Prime

All LMI® pumps are pre-primed with water when shipped from the factory. If your solution is not compatible with water, disassemble the Pump Head Assembly. Thoroughly dry the pump head, valves, seal rings, balls and LIQUIFRAM™ (diaphragm). Reassemble head assembly tightening screws in a crisscross pattern. Refill the pump head with the solution to be pumped before priming the pump. (This will aid in priming.)

Liquid Compatibility

The evaluation performed by UL was tested with water only. LMI® pumps are tested to NSF 50 for use on muriatic acid (40%) and sodium hypochlorite (12.5%). The pumps are certified to NSF 61 with: sodium hypochlorite (12.5%), sulfuric acid (98.5%), sodium hydroxide (50%), and hydrochloric acid (30%). Determine if the materials of construction included in the liquid handling portion of your pump are adequate for the solution (chemical) to be pumped. Always refer to the solution supplier and the LMI® Chemical Resistance Chart for compatibility of your specific LMI® metering pump. Contact your local LMI® distributor for further information.

Tubing Connections

Inlet and outlet tubing or pipe sizes must not be reduced. Make certain that all tubing is SECURELY ATTACHED to fittings prior to start-up (see Section 2.3, Tubing Connections). ALWAYS use LMI® supplied tubing with your pump, as the tubing is specifically designed for use with the pump fittings. It is recommended that all tubing be shielded to prevent possible injury in case of rupture or accidental damage. If tubing is exposed to sunlight, black UV resistant tubing should be installed. Check tubing frequently for cracks and replace as necessary.

Vinyl Tubing

Your carton may contain a roll of clear vinyl tubing; this is only for connection to the return line of the FASTPRIME™ Head and must not be used as discharge tubing.

Fittings and Machine Threads

All fittings should be hand-tightened. An additional 1/8 - 1/4 turn after the fitting is snug may be necessary to provide a leak-proof seal. Excessive overtightening or use of a pipe wrench can cause damage to the fittings, seals, or pump head.

Most LMI® pumps have straight screw machine threads on the head and fittings and are sealed by the O-rings. DO NOT use PTFE tape or pipe dope to seal threads. PTFE Tape may only be used on the 1/2" NPT thread side of the Injection Check Valve, the stainless steel liquid end connections, except for the head's discharge port, or if piping is directly connected to the pipe threads of the suction or discharge fittings.

Plumbing

Always adhere to your local plumbing codes and requirements. Be sure installation does not constitute a cross connection. Check local plumbing codes for guidelines. LMI® is not responsible for improper installations.

Back Pressure / Anti-Syphon Valve

If you are pumping downhill or into low or no system pressure, a back pressure/anti-syphon device such as LMI®'s Four Function Valve should be installed to prevent over pumping or syphoning. Contact your LMI® distributor for further information.

Electrical Connections

To reduce the risk of electrical shock, the metering pump must be plugged into a properly grounded grounding-type receptacle with ratings conforming to the data on the pump control panel. The pump must be connected to a good ground. DO NOT USE ADAPTERS! All wiring must conform to local electrical codes. If the supply cord is damaged, it must be replaced by the manufacturer, stocking distributor, or authorized repair center in order to avoid a hazard.

Fuse (all models) and Battery (AD9 only)

Caution, Battery may explode if mistreated. Do not recharge, disassemble or dispose of in fire. The battery and fuse are internal, factory serviceable parts, and must be replaced by the factory or a qualified distributor with parts of the same type and rating.

Flooding

Install this pump in a location where flooding cannot occur.

Ground Fault Circuit Interrupter

To reduce the risk of electric shock, install only on a circuit protected by a Ground Fault Circuit Interrupter (GFCI).

Line Depressurization

To reduce the risk of chemical splash during disassembly or maintenance, all installations should be equipped with line depressurization capability. Using LMI®'s Four-Function Valve (4 FV) is one way to include this feature.

Over Pressure Protection

To ensure safe operation of the pump it is recommended that some type of safety/pressure relief valve be installed to protect the piping and other system components from failing due to excessive pressure.

Chemical Concentration

There is a potential for elevated chemical concentration during periods of no flow, for example, during backwash in the system. Steps, such as turning the pump off, should be taken during operation or installation to prevent this. See your distributor about other external control options to help mitigate this risk.

Retightening Components

Plastic materials will typically exhibit creep characteristics when under pressure over a period of time and to insure a proper fit it may be necessary to retighten the head bolts periodically. To insure proper operation, we recommend tightening the bolts to 25 inch-pounds after the first week of operation and on a monthly basis thereafter.

Flow Display

The default flow value as shown on the pump display is accurate at maximum pressure and 100% stroke length. If your operating conditions differ from this, then calibration is necessary in order to display an accurate measure of the flow.

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SECTION 1 - INTRODUCTION

LMI® is the world's most versatile manufacturer of economical and efficient metering pumps. This manual addresses the installation, maintenance and troubleshooting procedures for manually and externally controlled pumps. LMI® has a worldwide network of stocking representatives and authorized repair centers to give you prompt and efficient service.

Note:

Please review this manual carefully. Pay particular attention to warnings and precautions. Always follow good safety procedures, including the use of proper clothing, eye and face protection.

1.1 SPECIFICATIONS

	AD2XY (where X is any number; where Y is 1, or 8)	AD2XY (where X is any number; where Y is 2,3,4,5,6,7, or 9)	AD8XY, or AD9XY (where X is any number; where Y is any number)
Operating Temperature	14 to 113°F –10 to 45°C	14 to 113°F –10 to 45°C	14 to 113°F –10 to 45°C
Voltage	110 to 120 V	220 to 240 V	95 to 240 V
Frequency	50 to 60 Hz	50 to 60 Hz	50 to 60 Hz
Max. Current	2.0 A	1.0 A	1.4 A
Wattage	25 W	22 W	20 W

Table 1

	AD2	AD8	AD9
Battery	N/A	N/A	Panasonic BR1225 or Renata CR1225 or Energizer/Eveready CR1220
Fuse	Bel Fuse 5HT1.25-R Time-lag, 5mm x 20mm	Bel Fuse 5HT 2-R Time-lag, 5mm x 20mm	Bel Fuse 5H 2-R Time-lag, 5mm x 20mm

Table 2

Note:

The battery and fuse are internal, factory serviceable parts, and must be replaced by the factory or a qualified distributor with parts of the same type and rating.

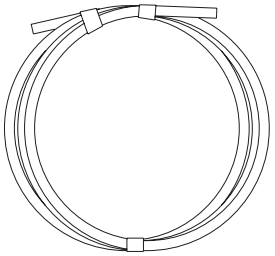
SECTION 1 - INTRODUCTION

1.2 UNPACKING CHECK LIST

Your carton will contain many or all of the following items. Please notify the carrier immediately if there are any signs of damage to the pump or its parts.

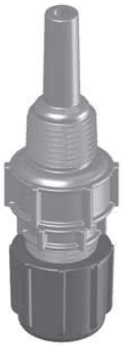
Metering Pump

Foot Valve



Tubing (0 to 3 Rolls)

Ceramic Foot Valve Weight



Injection Check Valve

Four-Function Valve (Optional)

External Control Cable (0, 1, or 2 Cables)

Tube Connection Hardware

Figure 1. Unpacking Check Sheet

SECTION 2 - INSTALLATION

2.1 PUMP LOCATION AND INSTALLATION

Locate pump in an area convenient to solution tank and electrical supply.

The pump should be accessible for routine maintenance, and should not be operated in ambient temperatures above 113°F (45°C). If the pump will be exposed to direct sunlight, LMI® black, UV resistant tubing should be installed.

This pump is cord connected and not intended for permanent mounting to a building. However, temporary mounting to stabilize the pump during operation may be necessary as long as tools are not required for the installation or removal of the pump.

2.2 PUMP MOUNTING

The pump can be mounted in one of two ways:

A. FLOODED SUCTION (ideal installation); or

B. SUCTION LIFT - when suction lift is less than 5 feet (1.5 m) for solutions having a specific gravity of water or viscosity of less than 100 cSt (centistokes). For denser or more viscous solutions, consult distributor.

Note that suction conditions can affect the performance of the pump. This effect is more pronounced with lower pressure pumps. Consult your distributor for additional information.

Your LMI® metering pump must be mounted so that the suction and discharge valves are vertical. **NEVER position pump head and fittings horizontally**.

2.2.1 Flooded Suction

For flooded suction the pump is mounted at the base of the storage tank. This installation is the most trouble-free, and is recommended for very low outputs, solutions that gasify, and high-viscosity solutions. Since the suction tubing is filled with solution, priming is accomplished quickly and the chance of losing prime is reduced. A foot valve is not necessary in a flooded suction installation.

When pumping downhill or into low or no pressure system, a back pressure/anti-syphon device should be installed to prevent overpumping or syphoning. Although popular for all solutions, LMI® recommends flooded suction installations for all high-viscosity fluid applications.

INCORRECT
Avoid this type of false flooded suction

CORRECT

Figure 2. Flooded Suction Pump Mounting

2.2.2 Suction Lift - Wall Bracket Mount

The pump may be mounted using an LMI® Wall Mount Bracket Assembly (part no. 34643) directly above the solution tank. A pump mounted in this manner allows for easy changing of solution tanks or drums.

2.2.3 Suction Lift - Tank Mount

The pump may be mounted on a LMI® 10-gallon tank (part no. 27421), 35-gallon tank (part no. 27400), and 50-gallon tank (part no. 26350).

2.2.4 Suction Lift - Shelf Mount

The pump may be mounted on a shelf (customer supplied) maintaining a suction lift of less than 5 ft (1.5 m).

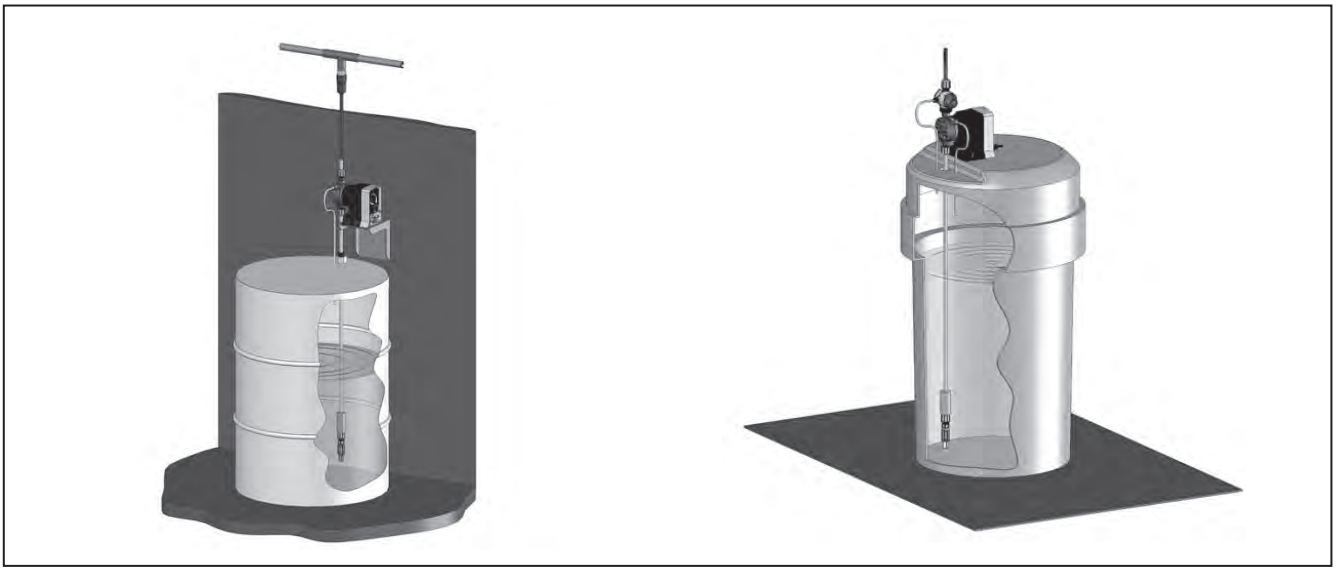


Figure 3

SECTION 2 - INSTALLATION

2.3 TUBING CONNECTIONS

1. Insert tubing through Coupling Nut. Tubing should enter the smaller end of the Coupling Nut first, orienting the larger opening of the Coupling Nut toward the tubing end.

2a. For 1/4” OD tubing: Position the Female Ferrule so that 1/4” to 3/8” (5-10 mm) of tubing protrudes from the Female Ferrule. Orient the raised collar of the Ferrule toward the Coupling Nut (reference *Figure 4*).

2b. For 3/8” or 1/2” OD tubing: Position a Female Ferrule about 1 inch (25 mm) from end of tubing. Orient the raised collar of the Female Ferrule toward the Coupling Nut. Then, insert the Male Ferrule onto the end of the tube, pushing the tube into the bottom of the groove in the Male Ferrule. Then slide the Female Ferrule down the tubing and with your fingers, press tightly into the Male Ferrule (reference *Figure 5*).

3. Firmly hand tighten the Coupling Nut onto the fitting.

Note:
Tightening with pliers may cause the Ferrules to break.

⚠ CAUTION

A. USE ONLY LMI® TUBING. ALWAYS USE LMI® SUPPLIED TUBING WITH YOUR PUMP, AS THE TUBING IS SPECIFICALLY DESIGNED FOR USE WITH THE PUMP FITTINGS.

B. DO NOT USE CLEAR VINYL TUBING ON THE DISCHARGE SIDE OF THE PUMP. THE PRESSURE CREATED BY THE PUMP CAN RUPTURE VINYL TUBING.

C. BEFORE INSTALLATION, ALL TUBING MUST BE CUT WITH A CLEAN SQUARE END.

D. VALVE AND HEAD CONNECTIONS FROM THE FACTORY ARE CAPPED OR PLUGGED TO RETAIN PRE-PRIME WATER. REMOVE AND DISCARD THESE CAPS OR PLUGS BEFORE CONNECTING TUBING.

DO NOT USE PLIERS OR PIPE WRENCH ON COUPLING NUTS OR FITTINGS.

DO NOT REUSE FERRULES. USE ONLY NEW FERRULES.

Replacement Ferrules, and Coupling Nuts are available as the following kit numbers.

Tube Size	Kit Number
1/2” Tube	77382
3⁄8” Tube	77383
1/2” Tube	77384
3 x 6 mm Tube	77378
6 x 8 mm Tube	77379
9 x 12 mm Tube	77380
*One kit is needed for each end of the tube.	

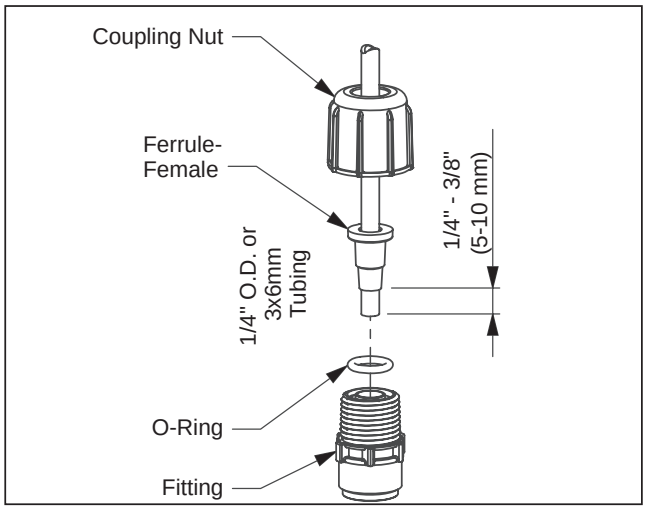


Figure 4

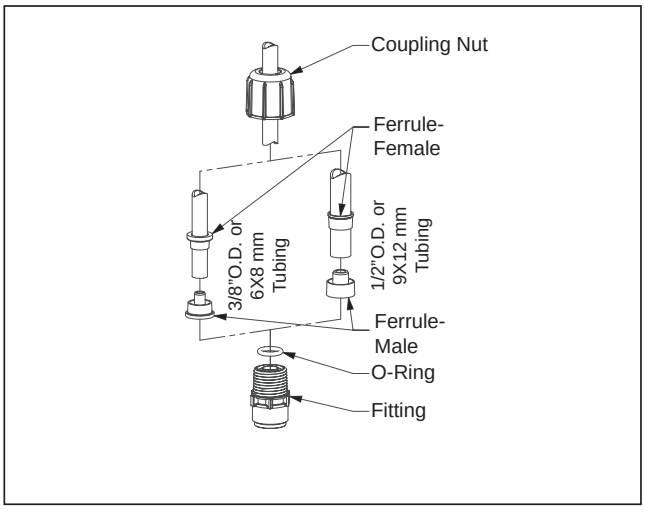
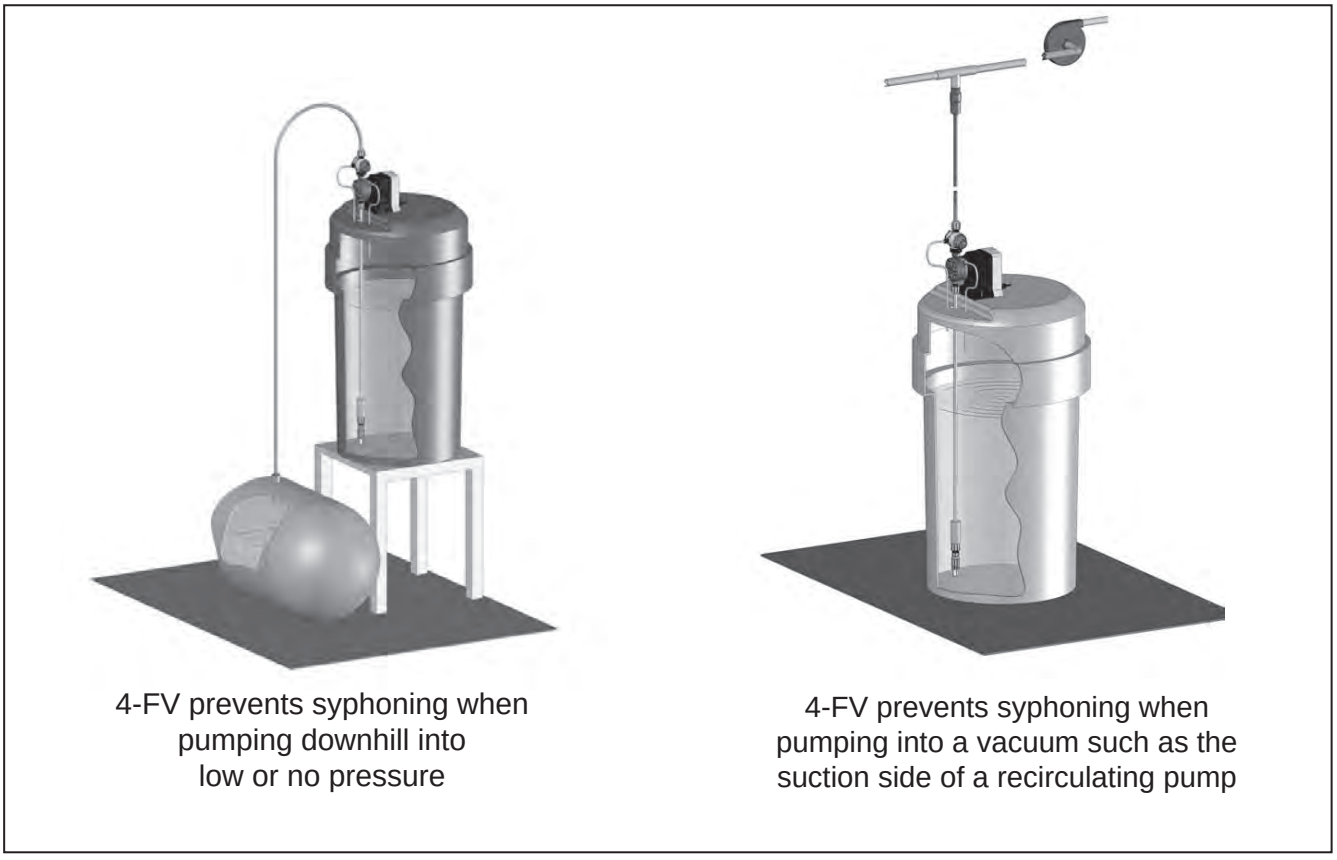


Figure 5

2.4 FOUR-FUNCTION VALVES (4-FV)

Your pump may be equipped with a 4-FV, or standard discharge valve. If your pump is not equipped with a four-function valve and you feel it is needed in your application, it can be purchased as an accessory. Contact your local LMI® stocking distributor. The features of a 4-FV are listed below.

1. **Pressure Relief:** If the discharge line is over pressurized, the valve opens sending solution back to the supply tank.
2. **Line Depressurization:** Opening the relief knob provides line drain back to the supply tank.
3. **Anti-Syphon:** Prevents syphoning when pumping solution downhill or into a vacuum.
4. **Back Pressure:** Supplies approximately 20 psi back pressure to prevent overpumping when little or no system back pressure is present.



4-FV prevents syphoning when pumping downhill into low or no pressure

4-FV prevents syphoning when pumping into a vacuum such as the suction side of a recirculating pump

Figure 6. Typical Installations Requiring the Anti-Syphon Feature of a Four-Function Valve

SECTION 2 - INSTALLATION

2.5 FOUR-FUNCTION VALVE INSTALLATION

To install a 4-FV, the 4-FV Fitting and Coupling Nut should be assembled with the appropriate cartridges into the discharge port of the pump. Use a 13/16” or 20 mm socket to tighten fitting. Tightening to 50 inch-pounds is recommended. Do not over tighten.

To assemble the Four-Function Valve Body, insert the large opening on the Four-Function Valve Body into the 4-FV Coupling Nut and hand tighten. You can position the valve to have the Bleed Nut pressure relief port in any convenient location by tightening the 4-FV Coupling Nut with the Bleed Nut positioned 90º CCW from desired location, then holding the 4-FV Coupling Nut stationary while turning the 4-FV Body the final 90º to desired position. Next, insert the ¼” tubing through the Bleed Nut. Ensure that about ¼” (6 mm) of tubing is protruding through the tip of the Bleed Nut. Firmly hand tighten the Bleed Nut in the hole on the side of the 4-FV. This tubing should be routed back to the supply tank. To ensure proper function of the priming function, the end of this tubing should not be submerged in the solution.

⚠ CAUTION **THIS RETURN LINE TUBING MUST BE SECURED TO ENSURE PUMPED SOLUTION WILL SAFELY RETURN TO SUPPLY.**

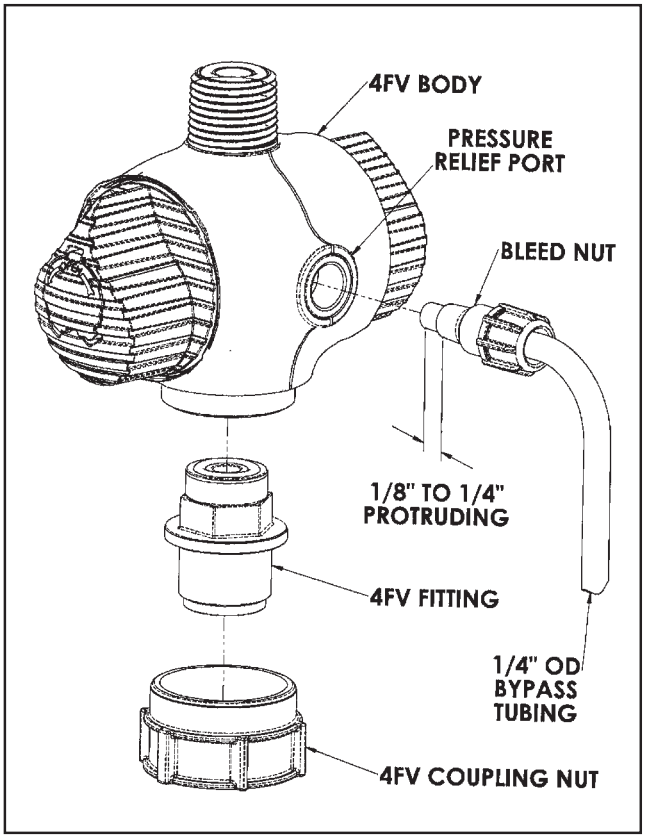


Figure 7. Four-Function Valve Tubing Connection

SECTION 2 - INSTALLATION

2.6 FASTPRIME™

The FASTPRIME™ Head is equipped with a valve that allows for opening the head to atmospheric pressure. When installing a pump equipped with a FASTPRIME™ Head connect the 3/8” outer diameter clear vinyl tubing provided with the pump to the barbed nozzle. Route the vinyl return line back to the solution tank. This tubing must not be submerged in the solution.

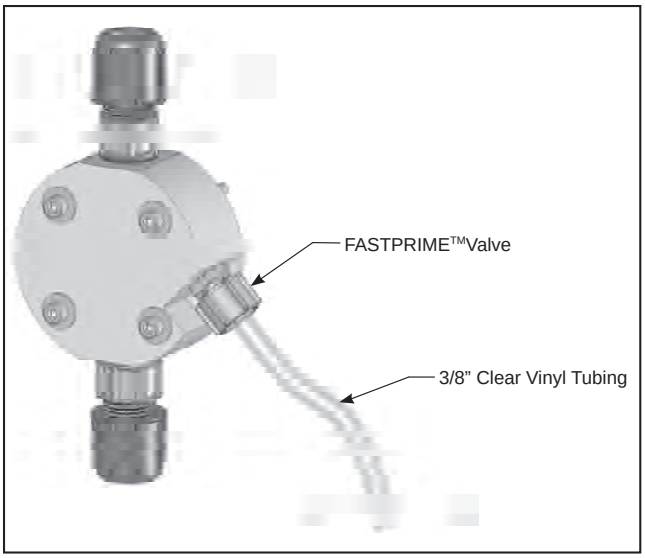


Figure 8. FASTPIME™ Head

2.7 AUTOPRIME™

Pumps installed with the AUTOPRIME™ Liquid End are equipped with a valve that allows for constant removal of vapors and gasses inherent with effervescent chemicals such as Sodium Hypochlorite and Hydrogen Peroxide. The valve keeps the pump primed automatically. When installing a pump equipped with an AUTOPRIME™ Liquid End, connect the 1/2” OD Polyethylene tubing to the top vertical fitting, and route this line back to the supply tank. To ensure priming, this tubing should not be submerged in the solution. The horizontal fitting is the discharge, and the bottom vertical fitting is the suction.

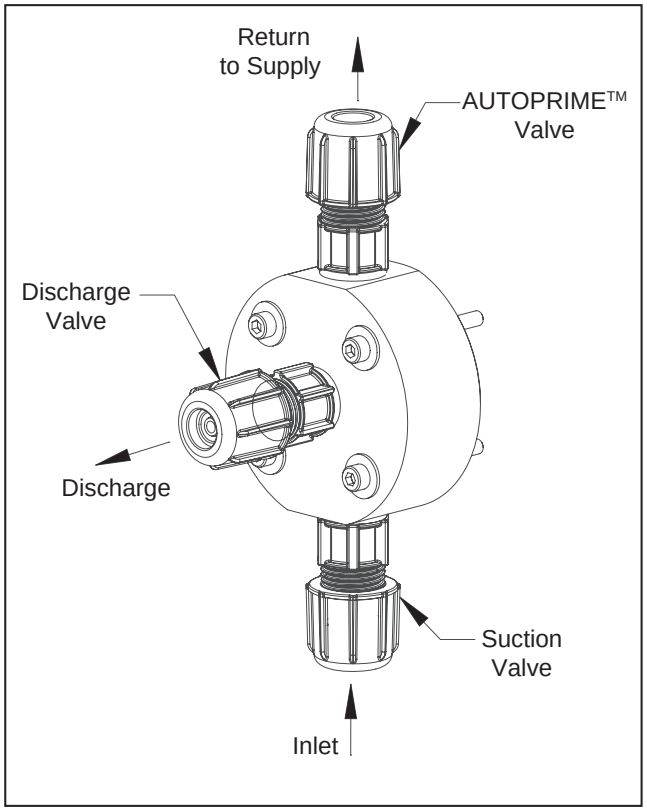


Figure 9. AUTOPRIME™ Liquid End Example

SECTION 2 - INSTALLATION

2.8 FOOT VALVE / SUCTION TUBING INSTALLATION

The Foot Valve acts as a check valve to keep the pump primed in suction lift applications.

The foot valve is designed to be submersed in the solution tank or drum and must sit in a vertical position at the bottom. Position approximately 2 inches (50 mm) off the bottom if the tank or drum contains sediment.

Note:

Pump models equipped with high-viscosity liquid ends are not equipped with foot valves. Flooded suction is recommended. A 1/2" NPT connector is included for flooded suction installations.

The ceramic weight, when installed, positions the foot valve in a vertical position.

1. Attach the foot valve to one end of the suction tubing (see Tubing Connections, Section 2.3).
2. Slide the ceramic weight over the tubing end until it contacts the top of the foot valve coupling nut.
3. Place foot valve and tubing into the solution tank. Check that the foot valve is vertical and approximately 2 inches (50 mm) from the bottom of the tank or drum (see illustration). Connect the other end of the tubing to the suction side of the pump head (bottom side) (see Tubing Connections, Section 2.3).

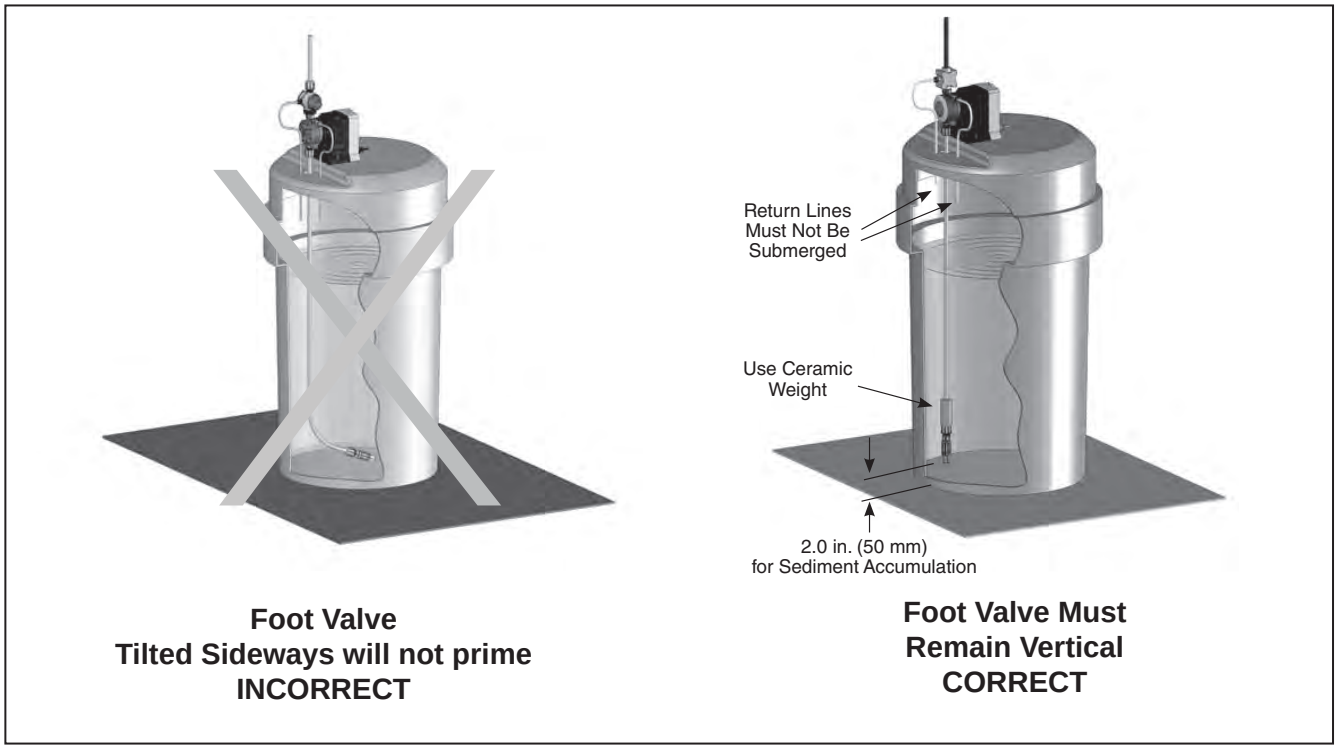


Figure 10. Foot Valve / Suction Tubing Installation

2.9 INJECTION CHECK VALVE AND DISCHARGE TUBING INSTALLATION

The Injection Check Valve prevents backflow from a treated line. Install the injection check valve at the location where chemical is being injected into the system. Any size Female NPT fitting or pipe tee with a reducing bushing to ½" Female NPT will accept the injection check valve. PTFE tape should only be used on threads that are connected with pipes.

When installing the Injection Check Valve, be sure to position it so that the valve enters the bottom of your pipe in a vertical position. Variations left and right within 80° acceptable (See illustration).

After cutting an appropriate length of tubing, connect tubing to the injection check valve then back to the discharge side of the pump head. Make sure it does not crimp or come into contact with hot or sharp surfaces (see Tubing Connections, Section 2.3).

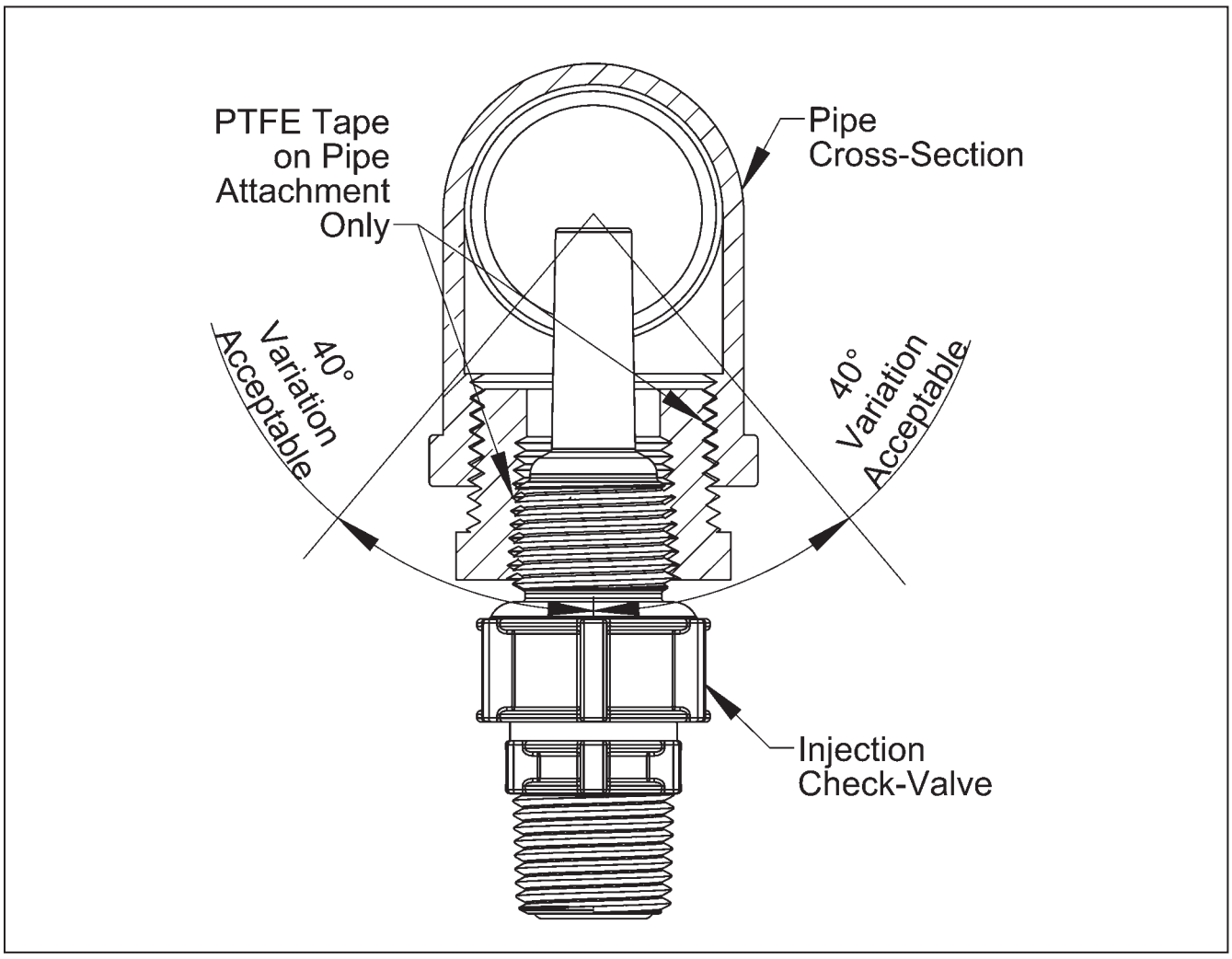


Figure 11. Typical Injection Check Valve Installation

SECTION 3 - OPERATION

3.1 OUTPUT ADJUSTMENT CONTROLS

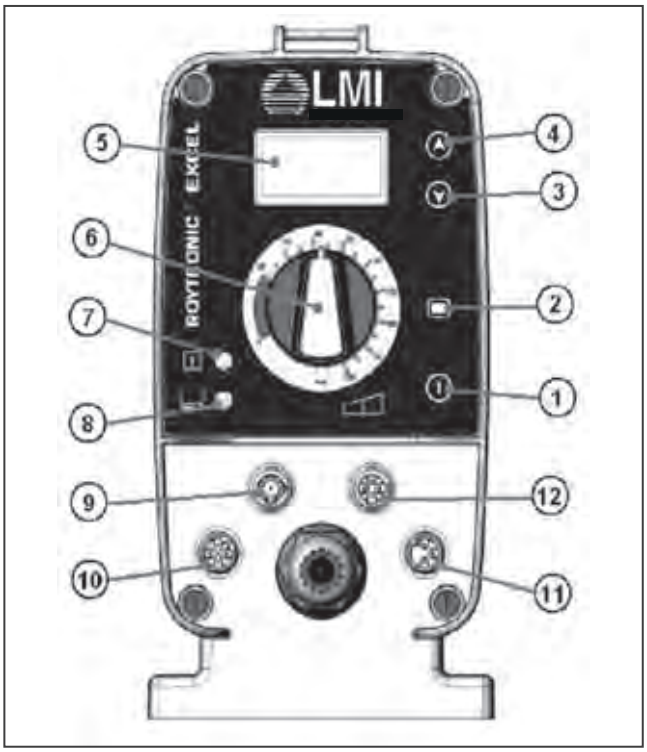
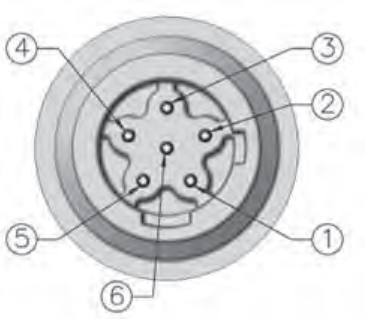


Figure 12

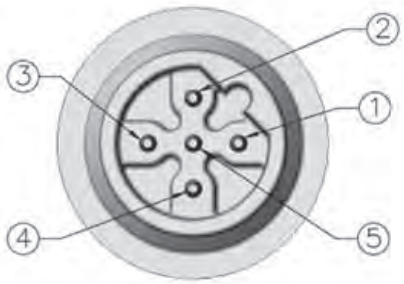
1. ⏻ **Power Button:** This button allows convenient starting and stopping of the pump.
2. ▭ **Mode Selection Button:** For pumps with external control capability (AD8, AD9) this button switches pump operation between internal and external modes. When operating in internal mode the Pulse Indicator Light will flash green while pumping. When operating in external mode the Pulse Indicator Light will flash yellow while pumping.
3. ▼ **Down Button:** This button reduces the stroke speed of the pump. It will reduce the stroke speed by 1 each time it is pressed. If this button is held down, it will rapidly reduce the stroke speed. When a speed of 1 stroke per minute (SPM) is reached the speed can be further reduced by pressing this button again to enter stroke per hour settings.
4. ▲ **Up Button:** This button increases the stroke speed of the pump. It will increase the stroke speed by 1 each time it is pressed. If this button is held down, it will rapidly increase the stroke speed. When a speed of 59 strokes per hour (SPH) is reached the speed can be further increased by pressing this button again to enter stroke per minute settings.
5. **LCD Display:** This display will show the stroke speed of the pump. Pumps with theoretical (AD2, AD8, AD9) or actual (AD9 when combined with a flow meter) flow will display the flow here.
6. **Stroke Adjustment Knob:** This knob provides adjustment of the stroke length. Turning this knob clockwise ↻ increases the stroke length, which results in a higher amount of chemical displaced per stroke. It is recommended that the stroke range stay between 20% and 100%.
7. **Pulse Indicator Light:** This light will flash green when pumping in internal mode and will flash yellow when pumping in external mode. The light is on between strokes and off during the actual stroke.
8. **Low-Level Indicator Light:** For units with Single-Level Float Sensors this light will turn red when the Low-Level Sensor registers empty. This will turn the pump off. For units compatible with Dual-Level Sensors (AD8, AD9) the light will turn yellow when a low level is registered, and red when an empty level is registered. The pump will turn off when it registers an empty level.

9. Output, Alarm & Remote Mode Connector (6-Pin): This connector is used for the special functions associated with the AD9 controls. For the AD9 this connector is associated with the 4-20ma out, Alarm Out, and Internal/ External remote modes.



1. Alarm Out (Red/White) - Programmed as either an Alarm Output or Internal/External mode indicator. As an Alarm Output, pins 1 and 2 will give a closure (solid state) triggered by: empty tank indication, input pulse error, exceed batch error, or flow switch activation.For remote mode indication it is open for internal mode and closed for external.
2. Alarm Return (Red) - Return side for the above pin 1 Alarm Out.
3. Remote Internal/External Mode (AD9) (Green) - This pin is programmed as Internal/ External remote mode control for an AD9. If programmed as the Internal/External control, a closure will put the AD9 into external mode.
4. Pulse Out (AD9) (Red/Yellow) - On the AD9 this pin gives a 100ms pulse output for each pump stroke.
5. 4-20mA Out (AD9) (Red/Black) - On the AD9 this pin is the positive 4-20ma output. This output will show you 4ma when the pump is idle, 20ma at max stroke speed.
6. Ground/Return Connection (Red / Blue) - Common Ground

10. External Control Connector (5-Pin):

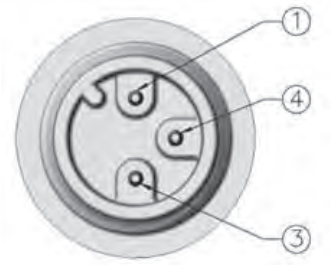


This connector is for the connection of various options and accessories that can be used to externally control the pump. The pin functions (and the wire color for the standard LMI® external control cable) are as follows:

1. Remote On/Off Signal (Brown)
2. Ground/Return Connection (White)
3. External Pulse Signal (Blue)
4. 24V 75 mA* Power Supply (Black)
5. 4-20mA Input Signal (Green/Yellow)

SECTION 3 - OPERATION

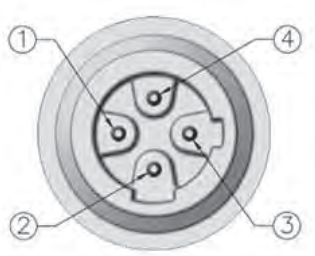
11. Low-Level Connector (3-Pin):



This connector is for the connection of a Low-Level Sensor (49246) or a Dual-Level Sensor (49249). The Tank Empty input connections are always active for all models in all functional modes. The Tank Low input connections are always active for models equipped with dual level functionality (AD8, AD9). If the fluid level drops below the top float on a Dual-Level Sensor, the Low-Level Indicator Light will turn yellow. If the fluid level drops below the float on a Low-Level Sensor, or the bottom float on a Dual-Level Sensor, the Low-Level Indicator Light will turn red, and the pump will stop. The pump is designed to recognize an open circuit as full and a closed circuit as low or empty. There is a five second delay between triggering the sensor, and the pump's reaction. This is intended to avoid triggering during refilling your supply tank. The pin functions are as follows:

1. Tank Empty Signal
3. Tank Low Signal
4. Ground/Return Connection

12. Flow Monitor / Meter Connector (4-Pin):



This connector will be used with a Milton Roy flow meter or the Milton Roy DIGI-PULSE™ flow monitor (FM-ROY-9). The pin functions are as follows:

1. Flow Meter In – A closure between this pin and ground registers a pulse for the flow meter/monitor.
2. 24 Volt 75 mA* Supply – Supply voltage for a Milton Roy flow meter.
3. Ground/Return Connection – Common ground
4. Flow Meter Sense – The condition of this pin will set the pump into the Digipulse or Flow Meter mode. This will automatically occur when the Milton Roy device is connected. A connection to ground indicates the use of a flow meter, while an open circuit indicates a flow monitor.

Note:

The total current output of the 5-pin and 4-pin connectors should not exceed 75 mA.

3.2 START-UP AND ADJUSTMENT

1. The pump is normally self-priming if suction lift is 5 ft (1.5m) or less and the steps below are followed.
2. Pumps are shipped from the factory with water in the pump head to aid in priming.

3.2.1 Start-Up/Priming for FASTPRIME™ Heads (LE-XXXNX)

⚠ CAUTION **READ THIS ENTIRE SECTION COMPLETELY BEFORE PROCEEDING.**

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now start priming the pump.

1. Plug in or switch the pump on.
2. While the pump is running, set the Speed Adjustment Knob and the Stroke Adjustment Knob at 100%.
3. Turn The FASTPRIME™ knob 1 to 2 turns counter-clockwise ↺.
4. The suction tubing should begin to fill with solution from the tank.
5. A small amount of solution will begin to discharge out the return line of the FASTPRIME™ valve. Once this happens, turn the knob clockwise ↻ until hand tight and **SHUT THE PUMP OFF**.
6. The pump is now primed.
7. Proceed to output adjustment, Section 3.3.

Note:

If the pump does not self-prime, remove the fitting on the discharge side of the pump head. Remove the check valve and pour water or solution into the port until the head is filled. Replace valve, then follow start up/priming steps.

3.2.2 Start-Up/Priming for Pump Supplied with 4-FV (LE-XXXSX or LE-XXXHX)

⚠ CAUTION **READ THIS ENTIRE SECTION COMPLETELY BEFORE PROCEEDING.**

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now start priming the pump.

1. Plug in or switch the pump on.
2. While the pump is running, set the Speed Adjustment Knob and the Stroke Adjustment Knob at 100%.
3. Open the relief side (black knob) of the 4-FV by turning to the stop (about 1/8 turn).
4. The suction tubing should begin to fill with solution from the tank.
5. A small amount of solution will begin to discharge out the return line of the 4-FV. Once this happens, return the knob to the 12:00 position and **SHUT THE PUMP OFF**.
6. The pump is now primed.
7. Proceed to output adjustment, Section 3.3.

Note:

If the pump does not self-prime, remove the 4-FV on the discharge side of the pump head. Remove the check valve and pour water or solution into the port until the head is filled. Replace valve, then follow start up / priming steps.

SECTION 3 - OPERATION

3.2.3 Start-Up/Priming for AUTOPRIME™ Heads (LE-XXXAX or LE-XXXHX)

CAUTION **READ THIS ENTIRE SECTION COMPLETELY BEFORE PROCEEDING.**

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may prime the pump.

1. Plug in or switch on the pump.
2. While the pump is running, set the speed knob and the stroke knob at 100%.
3. The suction tubing should begin to fill with solution from the tank as the AUTOPRIME™ valve purges air from the pump head.
4. Once the solution begins to exit the pump head through both the discharge valve and the AUTOPRIME™ valve, **SHUT THE PUMP OFF**.
5. The pump is now primed.
6. Proceed to output adjustment, Section 3.3.

3.3 OUTPUT ADJUSTMENT

Once the pump has been primed, an appropriate output adjustment MUST be made. Pump output should be calculated and adjustments made accordingly.

3.3.1 Total Pump Output

Calculate the approximate output of the pump as follows:

PUMP OUTPUT :
MAX PUMP OUTPUT X % SPEED X % STROKE
Example: AD251-938SI

Use Max Output (from dataplate on side of pump) = 1 GPH (1 gallon per hour).

If the pump is set at 60 strokes per minute (out of a possible 120 SPM) and 70% stroke length, the approximate pump output is:

1.0 x 60/120 x 0.70 = 0.35 GPH.

Multiply by 24 (hours in one day) to calculate in gallons per day.

Note:

When converting between different units, remember these conversion factors:

1 Gallon = 3.785 Liters

1 Day = 1,440 Minutes

120 SPM = 7,200 SPH

CAUTION **IT IS IMPORTANT TO NOTE THAT THIS IS ONLY AN APPROXIMATE OUTPUT AND IT DOES NOT ACCOUNT FOR TOLERANCE VARIATIONS IN PUMP COMPONENTS OR FLOW VARIATIONS DUE TO PRESSURE SENSITIVITY, OR VISCOSITY EFFECTS. VARIATIONS DUE TO THESE EFFECTS CAN BE SIGNIFICANT, NECESSITATING CALIBRATION FOR YOUR PUMP.**

3.3.2 Calibrating the Displayed Flow (AD2, AD8)

The Roytronic Excel Pumps are equipped to display a theoretical flow rate based upon the pump's stroke speed and stroke length. These calculations are based upon factory test conditions which may be significantly different from your application. It is necessary for the user to perform the following calibration procedure when the pump is connected to your system, and using the actual chemical. This one-point calibration procedure will greatly improve the accuracy of the pump's calculated flow. The closer the pump's stroke length is to the typical use stroke length, the more accurate the result. We recommend using the approximate settings determined in section 3.3.1 as a starting point for calibration.

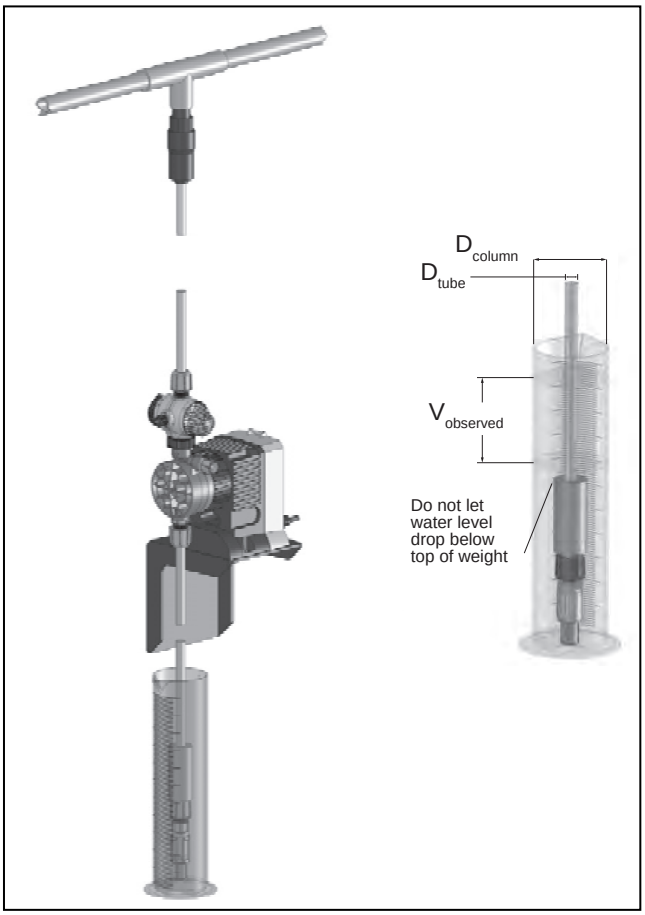


Figure 13

1. Prepare a flow measuring device such as a graduated cylinder or a scale sensitive to a gram.
2. Ensure the pump is primed following the procedures in 3.2.
3. Put the pump into Internal Mode and use the Power Button ⏻ to turn the pump off.
4. Hold the Up Button ▲ and Down Button ▼ in at the same time for 8 seconds until 'CAL' is displayed on the LCD Display, then release the buttons. Note 'FLO' will be displayed first. Continue to press the buttons until 'CAL' is displayed.
5. Push the Power Button ⏻ and release until a "0" is displayed.
6. Note the reading on the calibration device. If using a graduated cylinder note the starting liquid level. If using a scale note the displayed weight, or reset the scale's display to zero.
7. Push the Power Button ⏻ and release to start the pump. Notice that the display will count the total number of strokes. (The screen will show SPH).
8. Allow the pump to run; the accuracy will improve with more strokes. Use the Power Button ⏻ to stop the pump. The number of strokes will be displayed up to 999 strokes. If you will be pacing the pump externally, note the number of strokes.
9. Press and release the Power Button ⏻ again. This will display the pump's estimated volume pumped in mL. (The screen will show ml/h).

SECTION 3 - OPERATION

10. Use the Up Ⓐ and Down Ⓥ Buttons to match the displayed volume to the measured volume. If using a graduated cylinder, the presence of the tubing will cause the measurement to be slightly higher than actual. The measurement should be adjusted using the formulas shown below. If using a scale, the number of grams can be divided by the specific gravity of your chemical to determine the number of mL pumped. If the pump will be controlled externally, the output volume per stroke can be determined by dividing the measured output by the number of strokes.
11. Once the displayed value has been adjusted, hold and release the Power Button ⏻ to return the pump to internal mode.

$$V_{Actual} = V_{Observed} * R$$

where $$R = 1 - (D_{Tubes} / D_{Column})^2$$

For accuracy, it is important that the water level does not drop below the top of the ceramic foot valve weight.

Note:

If you will be using the pump at a different stroke length, or pressure, the pump should be recalibrated under those conditions using the procedure above to ensure accuracy.

3.4 METHODS OF EXTERNALLY TRIGGERING OR PACING AD8 AND AD9 PUMPS

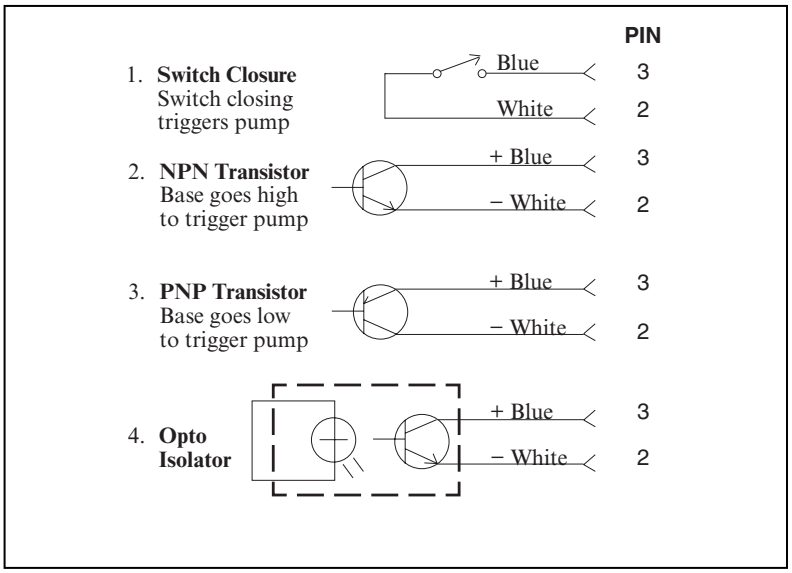
Method of Triggering AD8 and AD9 Pumps through External Control Connector.

Switch or transistors must be capable of switching 24V DC at 15 milliamperes. Minimum time in low impedance state (ON) is 25 milliseconds. Minimum time in high impedance state (OFF) is 50 milliseconds.

The remote on/off input (using pins 1 and 2) is active in all modes. In the out-of-box configuration, the pump will run when contacts are open. The pump is monitoring these pins for a change in closure condition. Regardless of the pump being on or off, when the contacts close, then the pump will turn on. When the contacts open, the pump will turn off.

The Power Button overrides the remote on/off and can still be used to turn the pump on and off. If the contacts are closed when the on/off button is pressed, the pump will turn off. To restart the pump remotely, the contacts must be opened and then closed again.

These pumps have two operating modes: Local (Pulse Indicator Light flashes green) and Remote (Pulse Indicator Light flashes yellow). Pressing the Mode Selection Button switches between Local and Remote modes. The default configuration for operating mode is Local mode.



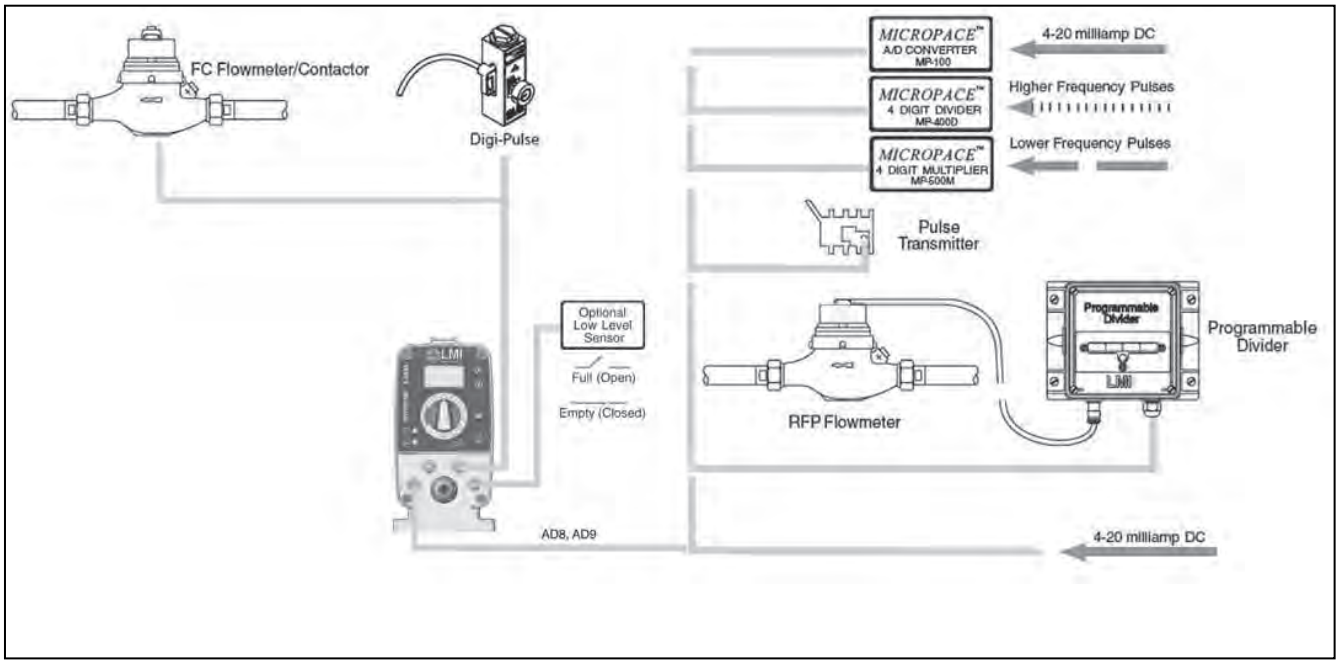


Figure 14. Methods of Externally Triggering or Pacing AD8 and AD9 Pumps

SECTION 3 - OPERATION

3.4.1 Control Modes

3.4.1.1 Local/Internal Mode

1. When in local mode Roytronic Excel pumps run at the speed indicated on the LCD Display.
2. The stroking speed can be adjusted from the maximum speed of 120 strokes per minute (SPM) down to 1 stroke per hour (SPH).

3.4.1.2 Changing Displayed Flow Units (AD2, AD8)

1. When in Internal Mode use the Power Button to turn the pump off.
2. Hold the Up Button and Down Button in at the same time until 'FLO' is displayed on the LCD Display, then release the buttons.
3. Use the Up or Down Buttons to select the desired units of measure.
4. Press the Power Button and the pump will return to internal mode with the desired units displayed.

3.4.1.3 Remote Mode (for AD8)

In Remote mode the pump can be controlled in a variety of ways: pulse divide, pulse multiply, or analog milliamp input. To cycle through the available modes, start in external mode, then press and hold the Power Button and Mode Selection Button simultaneously for about five seconds.

3.4.1.3.1 Divide Mode (for AD8)

The pump is in Divide Mode when a division symbol (÷) is shown on the left-hand side of the LCD Display. Use the Up Button and Down Button to select the number of incoming pulses received before a stroke occurs. Once the Power Button is pushed to turn the pump on, the LCD Display will show the approximate stroke rate of the pump based on the incoming pulses.

If it is necessary to change the pulse duration required to recognize a pulse from the factory default of 60 ms, hold both the Up Button and Down Button until a number appears followed by the letter 'm'. This number is the minimum required time in milliseconds needed to count as a pulse. Use the Up Button and Down Button to adjust this number as needed. If no button is pressed for about 4 seconds, the pump will save the value and return to the previous screen.

3.4.1.3.2 Multiply Mode (for AD8)

The pump is in Multiply Mode when a multiplication symbol (X) is shown on the left-hand side of the LCD Display. Use the Up Button and Down Button to select the number of strokes that will occur for each incoming pulse. Once the Power Button is pushed to turn the pump on, the LCD Display will count down the number of strokes starting at the multiplier value each time a pulse input is recognized. The strokes will occur every half second until it has counted down to zero. The pump will then wait for the next pulse input.

If it is necessary to change the pulse duration required to recognize a pulse from the factory default of 60 ms, hold both the Up Button and Down Button until a number appears followed by the letter 'm'. This number is the minimum required time in milliseconds needed to count as a pulse. Use the Up Button and Down Button to adjust this number as needed. If no button is pressed for about 4 seconds, the pump will save the value and return to the previous screen.

3.4.1.3.3 Analog Mode (for AD8)

The pump is in Analog Mode when ‘mA’ is shown on the left-hand side of the LCD Display.

Pressing the Up or Down Button will display ‘P1’ and the milliamp input that corresponds to zero strokes. The Up and Down Buttons can be used to adjust this value. Pressing the Power Button (or waiting for about 8 seconds) will display ‘P2’ and the milliamp input that corresponds to max stroke rate. Note that the maximum stroke rate will be either 120 strokes per minute or 59 strokes per hour. This depends on the stroke speed set in Internal Mode.

SECTION 4 - MAINTENANCE

4.0 SPARE PARTS REPLACEMENT AND ROUTINE MAINTENANCE

LMI® metering pumps are designed for trouble-free operation, yet routine maintenance of elastomeric parts is essential for optimum performance. This involves replacing the LIQUIFRAM™, cartridge valves, O-rings, and the injection check valve spring. LMI® recommends replacing these parts at least once a year; however, frequency will depend on your particular application.

4.1 DEPRESSURIZING THE DISCHARGE LINE (FOR PUMPS EQUIPPED WITH A 4-FV ONLY)

⚠ CAUTION **ALWAYS WEAR PROTECTIVE CLOTHING, FACE SHIELD, SAFETY GLASSES AND GLOVES WHEN PERFORMING ANY MAINTENANCE OR REPLACEMENT ON YOUR PUMP.**

⚠ CAUTION **TO REDUCE THE RISK OF CHEMICAL SPLASH DURING DISASSEMBLY OR MAINTENANCE, ALL INSTALLATIONS SHOULD BE EQUIPPED WITH LINE DEPRESSURIZATION CAPABILITY. USING LMI®'S FOUR-FUNCTION VALVE (4-FV) IS ONE WAY TO INCLUDE THIS FEATURE.**

⚠ CAUTION **READ STEPS 1 AND 2 BELOW BEFORE PROCEEDING.**

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

⚠ CAUTION **BE SURE YOUR RELIEF TUBING IS CONNECTED TO YOUR 4-FV AND RUNS BACK TO YOUR SOLUTION DRUM OR TANK.**

2. Turn the black knob on the 4-FV 1/8 turn to the stop. Turn and hold the yellow knob for a few seconds. The discharge line is now depressurized. Keep both valve knobs open until solution drains back down the discharge tubing into the solution tank or drum. Then release the yellow knob, and turn the black knob to its normal position.

4.2 DEPRESSURIZING THE DISCHARGE LINE (FOR DOUBLE BALL FASTPRIME™ HEADS ONLY)

⚠ CAUTION **ALWAYS WEAR PROTECTIVE CLOTHING, FACE SHIELD, SAFETY GLASSES AND GLOVES WHEN PERFORMING ANY MAINTENANCE OR REPLACEMENT ON YOUR PUMP.**

⚠ CAUTION **READ STEPS 1 AND 2 BELOW BEFORE PROCEEDING.**

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

⚠ CAUTION **BE SURE YOUR RELIEF TUBING IS CONNECTED TO YOUR FASTPRIME™ VALVE AND RUNS BACK TO YOUR SOLUTION DRUM OR TANK.**

2. Turn the FASTPRIME™ knob one-and-a-half turns counter-clockwise. The discharge line is now depressurized. Keep valve open until solution drains back down the discharge tubing into solution drum or tank. Then turn the knob clockwise to tighten knob to closed position.

4.3 LIQUIFRAM™ (DIAPHRAGM) REPLACEMENT

⚠ CAUTION **ALWAYS WEAR PROTECTIVE CLOTHING, FACE SHIELD, SAFETY GLASSES AND GLOVES WHEN WORKING NEAR OR PERFORMING ANY MAINTENANCE OR REPLACEMENT ON YOUR PUMP. SEE SDS INFORMATION FROM SOLUTION SUPPLIER FOR ADDITIONAL PRECAUTIONS.**

LMI® metering pumps are designed for trouble-free operation, yet routine maintenance of elastomeric parts is essential for optimum performance. This involves replacing the LIQUIFRAM™, cartridge valves, O-rings and the injection check valve spring. LMI® recommends replacing these parts at least once a year; however, frequency will depend on your particular application.

When replacing the LIQUIFRAM™, the cartridge valves, or O-rings, the injection check valve spring should also be replaced (see next Section 4.4). A Spare Parts Kit or RPM PRO PAC™ kit containing these parts may be obtained from your local distributor.

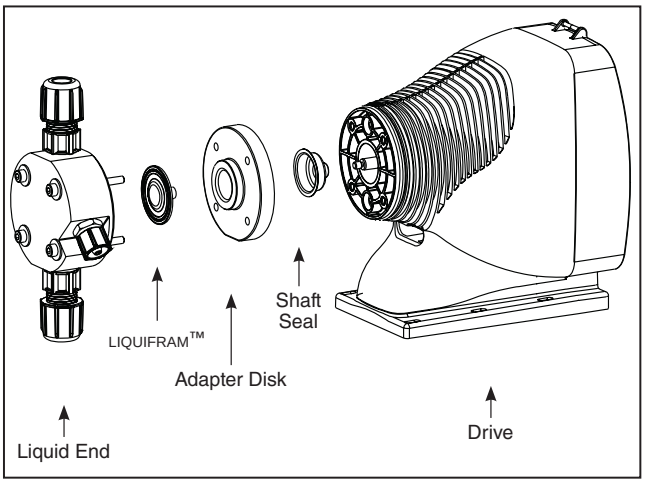


Figure 15. LIQUIFRAM™ (Diaphragm) Replacement

Replacing the LIQUIFRAM™:

1. Carefully depressurize, drain, and disconnect the discharge line (see previous sections in this manual).
2. Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump head has been flushed, lift the Foot Valve out of the solution and continue to pump air into the pump head until the pump head is purged of water or neutralizing solution.

Note:

If the liquid cannot be pumped due to LIQUIFRAM™ rupture, carefully disconnect the suction and discharge tubing using protective clothing, gloves and face shield, immerse the head in water or other neutralizing solution.

3. Remove the four metric screws and washers from the head using an M4 Allen wrench.
4. Start the pump. While running, set the Stroke Adjustment Knob to 0% and then turn the pump off.
5. With the unit off, unscrew the LIQUIFRAM™ by carefully grasping the outer edge and turning it counter-clockwise ↺. Discard old LIQUIFRAM™. Remove the Adapter Disk (located behind the LIQUIFRAM™) and ensure that the diameter of the raised section is the same as the diameter of the replacement LIQUIFRAM™.
6. Check condition of the Shaft Seal. Replace Shaft Seal if necessary.
7. Replace the Adapter Disk so that the drain hole of the disk is oriented downward, and the mounting holes line up with the mounting holes of the pump.

⚠ CAUTION **BE CAREFUL NOT TO SCRATCH THE FLUOROFILM™ FACE OF THE NEW LIQUIFRAM™.**

8. Screw on the new LIQUIFRAM™ clockwise until turned all the way in. Start the pump and turn the stroke knob to 100%. Stop the pump.
9. Remount the pump head using the four (4) screws and washers. Tighten in a criss-cross pattern. Torque screws to 25 inch-pounds. After one week of operation, recheck the screws and tighten if necessary.

SECTION 4 - MAINTENANCE

4.4 CARTRIDGE VALVE AND O-RING REPLACEMENT

⚠ CAUTION **ALWAYS WEAR PROTECTIVE CLOTHING, FACE SHIELD, SAFETY GLASSES AND GLOVES WHEN WORKING ON OR PERFORMING ANY MAINTENANCE OR REPLACEMENT ON YOUR PUMP. SEE SDS INFORMATION FROM SOLUTION SUPPLIER FOR ADDITIONAL PRECAUTIONS.**

Refer to the LMI® Metering Pump Price List for the proper Spare Parts Kit or RPM PRO PAC™ kit number or contact your local LMI® stocking distributor.

1. Carefully depressurize and disconnect the discharge line (see Section 4.1 or 4.2 in this manual).
2. Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump has been flushed, lift the Foot Valve out and continue to pump to let air into the pump head until pump is purged of water or neutralizing solution.

Note:

If the liquid cannot be pumped due to LIQUIFRAM™ rupture, carefully disconnect the suction and discharge tubing using protective clothing, gloves and face shield. Remove the four screws and washers from the head and immerse the head in water or other neutralizing solution.

Spare part replacement kits include specific instructions for valve replacement. Please follow the instructions included with the replacement kit.

3. Carefully disconnect one tubing connection and fitting at a time, then remove and replace the worn valve and O-rings. If necessary, carefully loosen stuck valves by prying side to side using a small screwdriver through the center hole of the valve.

Note:

Before disassembling the check valves, note the orientation of the valve.

4. Install new check valves in each location. Ensure that the cartridges are oriented correctly.

4.5 INJECTION CHECK VALVE PARTS REPLACEMENT

⚠ CAUTION **DEPRESSURIZE AND DRAIN PIPELINE (OR ISOLATE INJECTION CHECK VALVE POINT USING VALVES) SO THAT INJECTION CHECK VALVE CAN SAFELY BE DISASSEMBLED.**

⚠ CAUTION **ALWAYS WEAR PROTECTIVE CLOTHING, FACE SHIELD, SAFETY GLASSES AND GLOVES WHEN WORKING NEAR OR PERFORMING ANY MAINTENANCE OR REPLACEMENT ON YOUR PUMP. SEE SDS INFORMATION FROM SOLUTION SUPPLIER FOR ADDITIONAL PRECAUTIONS.**

Refer to the LMI® Metering Pump Price List for the proper Spare Parts Kit or RPM PRO PAC™ kit number or contact your local LMI® stocking distributor.

1. Isolate Injection Check Valve and depressurize pipe or drain pipeline.
2. Carefully depressurize and disconnect the discharge line (see Section 5.1 or 5.2 in this manual).

Spare part replacement kits include specific instructions for valve replacement. Please follow the instructions included with the replacement kit.

3. Carefully disconnect the tubing leading to the Injection Check Valve, then remove the Injection Check Valve Fitting. Remove and replace the worn spring, seat, ball, and O-ring.

Note:
Before disassembling the check valves, note the orientation of the valve.

4. Install a new spring, seat, ball, and O-ring. Ensure that the parts are oriented correctly.

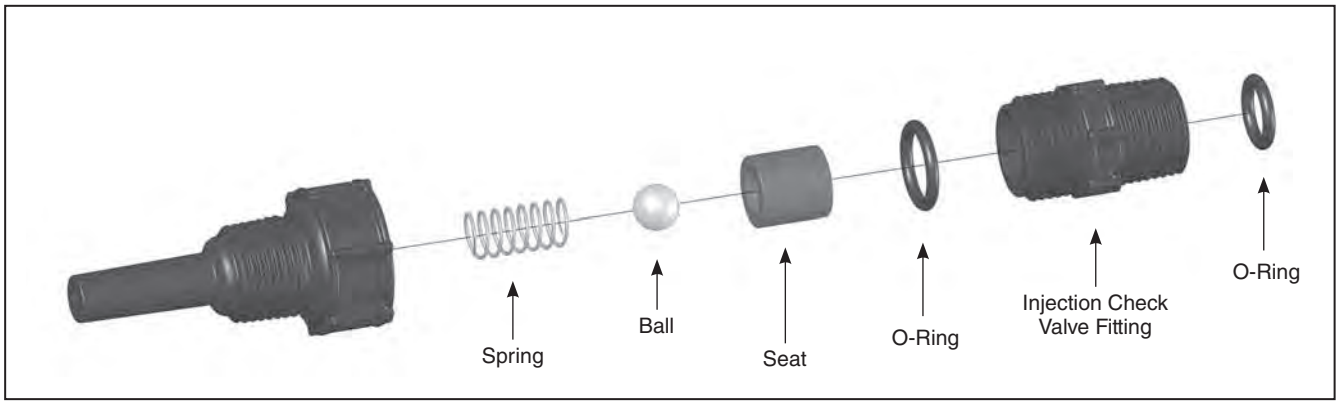


Figure 16. Injection Check Valve Parts Replacement

SECTION 4 - MAINTENANCE

4.6 FASTPRIME™ VALVE O-RING REPLACEMENT

⚠ CAUTION **ALWAYS WEAR PROTECTIVE CLOTHING, FACE SHIELD, SAFETY GLASSES AND GLOVES WHEN PERFORMING ANY MAINTENANCE OR REPLACEMENT ON YOUR PUMP.**

Refer to the LMI® Metering Pump Price List for the proper Spare Parts Kit or RPM PRO PAC™ kit number or contact your local LMI® stocking distributor.

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

⚠ CAUTION **BE SURE YOUR RELIEF TUBING IS CONNECTED TO YOUR FASTPRIME™ VALVE AND RUNS BACK TO YOUR SOLUTION DRUM OR TANK.**

2. Turn the FASTPRIME™ Knob one-and-a-half turns counter-clockwise. This will depressurize the head. Keep valve open. Carefully remove the return line by gently pulling tubing and moving it from side to side to gradually back tubing off of the barbed fitting.
3. Hold return line tubing upright until solution drains back into solution drum or tank.
4. Using a 3/4” (or 19mm) socket or wrench remove Retaining Nut, and pull out the entire FASTPRIME™ Valve assembly. Remove and replace the two small O-rings.
5. Reinsert the FASTPRIME™ Valve assembly and retighten the Retaining Nut. Then turn the FASTPRIME™ Knob clockwise to tighten knob to closed position. To avoid damaging the parts, it is important that the flange on the FASTPRIME™ Valve is flush with the Retaining Nut prior to reassembly.
6. Recut 1 to 2 inches off the tip of the return line and ensure the end is squared. Press the return line tubing on completely past the barbs.

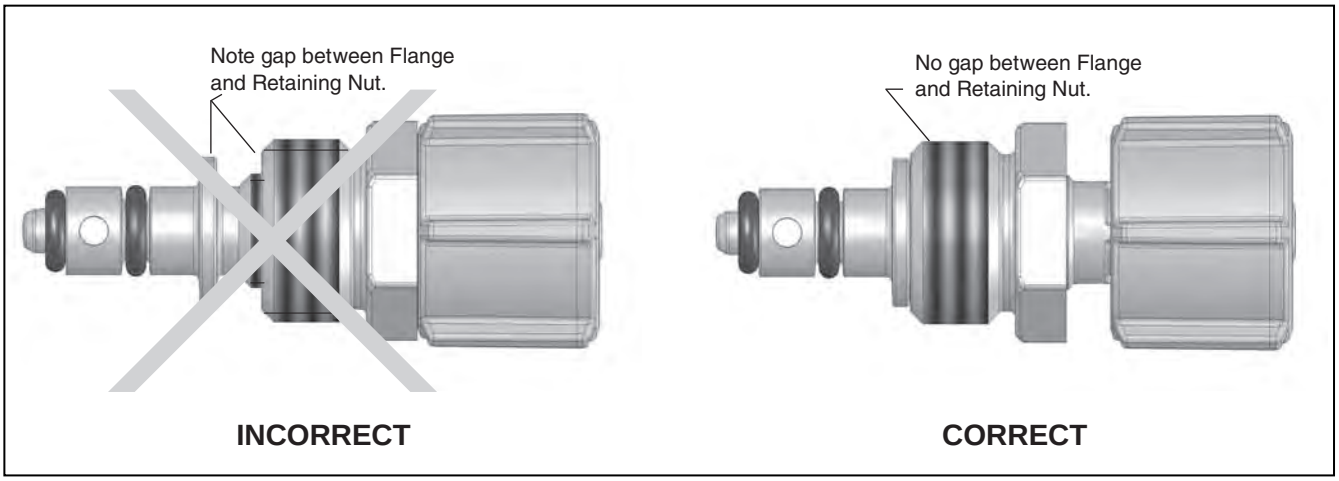


Figure 17a

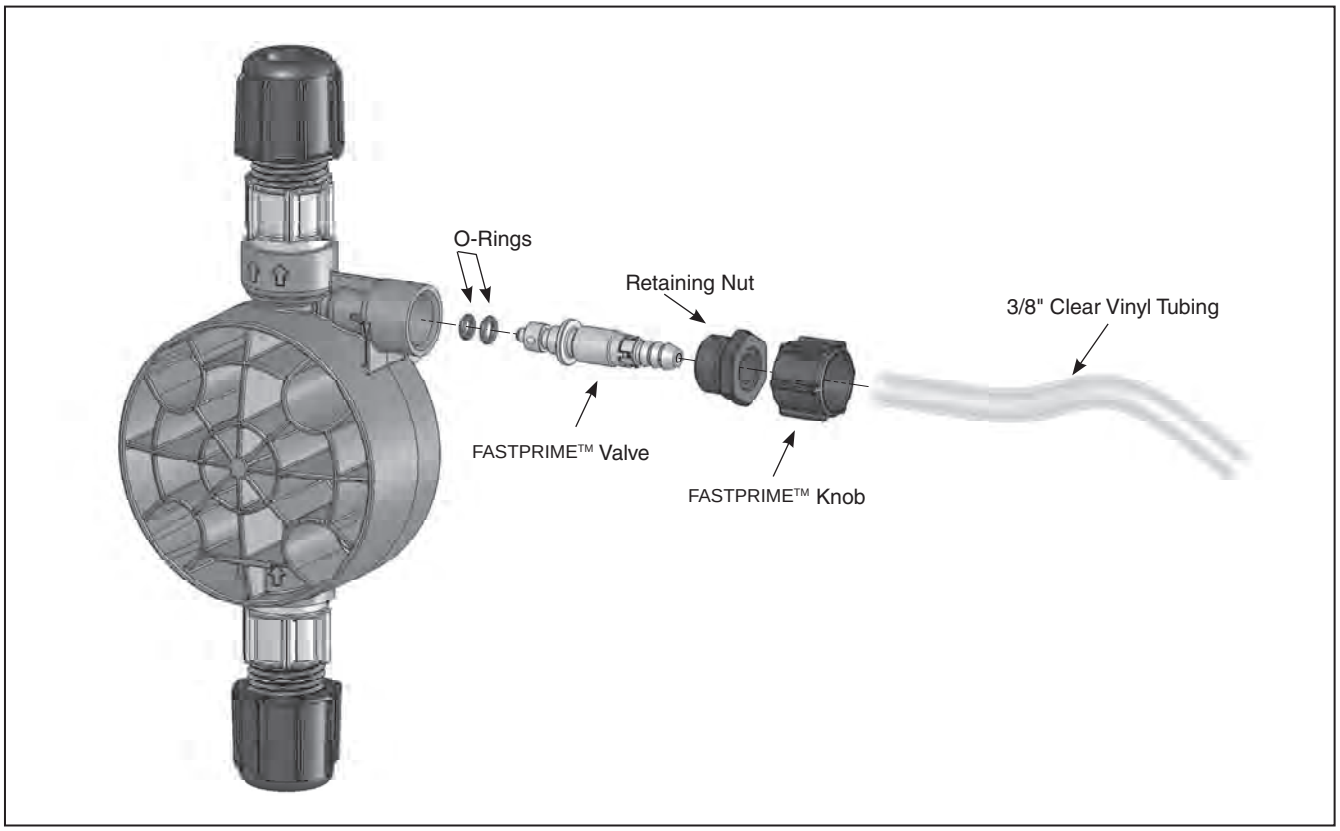


Figure 17b. FASTPRIME™ Valve O-Ring Replacement

SECTION 4 - MAINTENANCE

4.7 DRIVE PARTS LIST

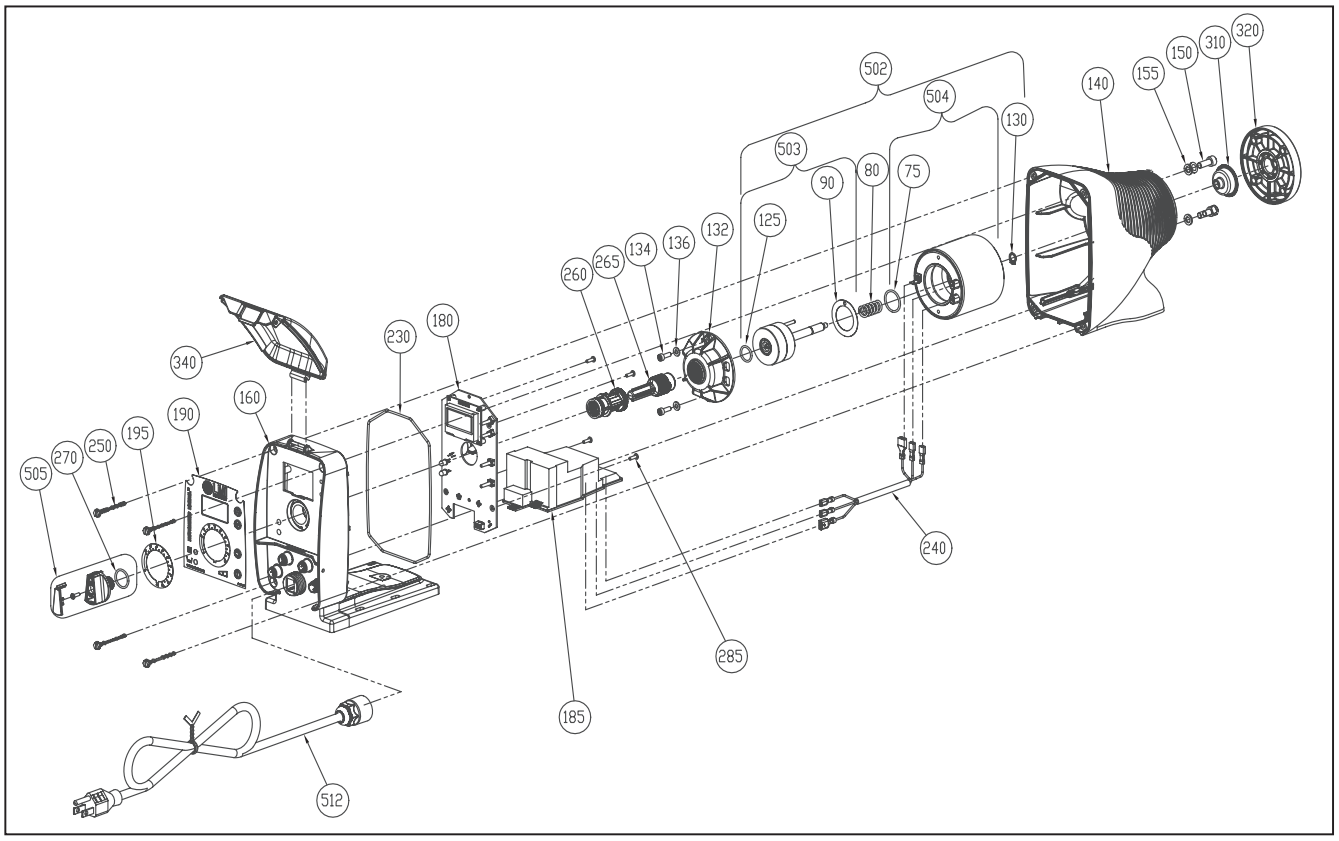


Figure 18. Drive Parts List

Bubble Number	Description
75	EPU O-Ring
80	EPU Return Spring
90	EPU Shim
125	Plunger O-Ring
130	Retaining Ring
132	Stroke Bracket
134	Stroke Bracket Screw
136	Stroke Bracket Washer
140	Drive Housing
150	EPU Attachment Bolt
155	EPU Attachment Washer
160	Control Panel
180	Control Board
185	Power Board
190	Nameplate

Bubble Number	Description
195	Stroke Dial
230	Control Panel O-Ring
240	Wire Harness
250	Drive Assembly Screws
260	Female Stroke Shaft
265	Male Stroke Shaft
270	Stroke Shaft O-Ring
285	PCB Attachment Screw
310	Shaft Seal
320	Adapter Disk
340	Clear Cover
502	EPU Assembly
503	Plunger Assembly
504	Pole Piece Assembly
505	Stroke Knob Assembly
512	Power Cord Assembly

Table 3. Drive Parts List

4.8 EPU WIRING DIAGRAM

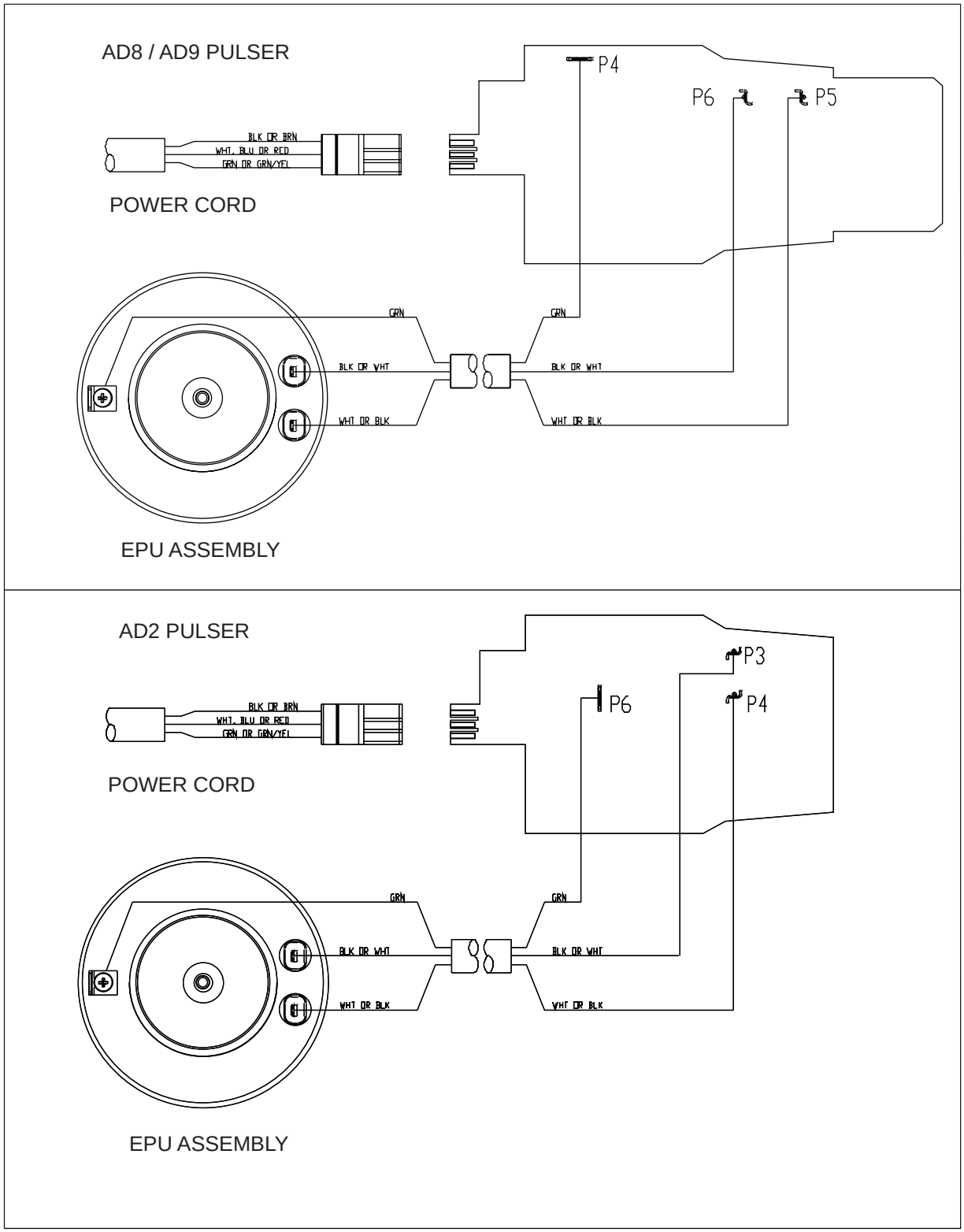


Figure 19. EPU Wiring Diagram

SECTION 4 - MAINTENANCE

4.9 LIQUID END PARTS

For the latest and most accurate information on your liquid end, please refer to the Liquid End Sheets available in the LMI® Online Library at: www.lmipumps.com.

1. Select “Online Literature Library” in the Navigation Bar on left.
2. Once on Online Literature Library use “Product” drop down to select “Liquid Handling Assemblies.”
3. Select “Gallery” or ”Index” to view Liquid End sheets.

The following images are for reference and may not represent your particular liquid end.

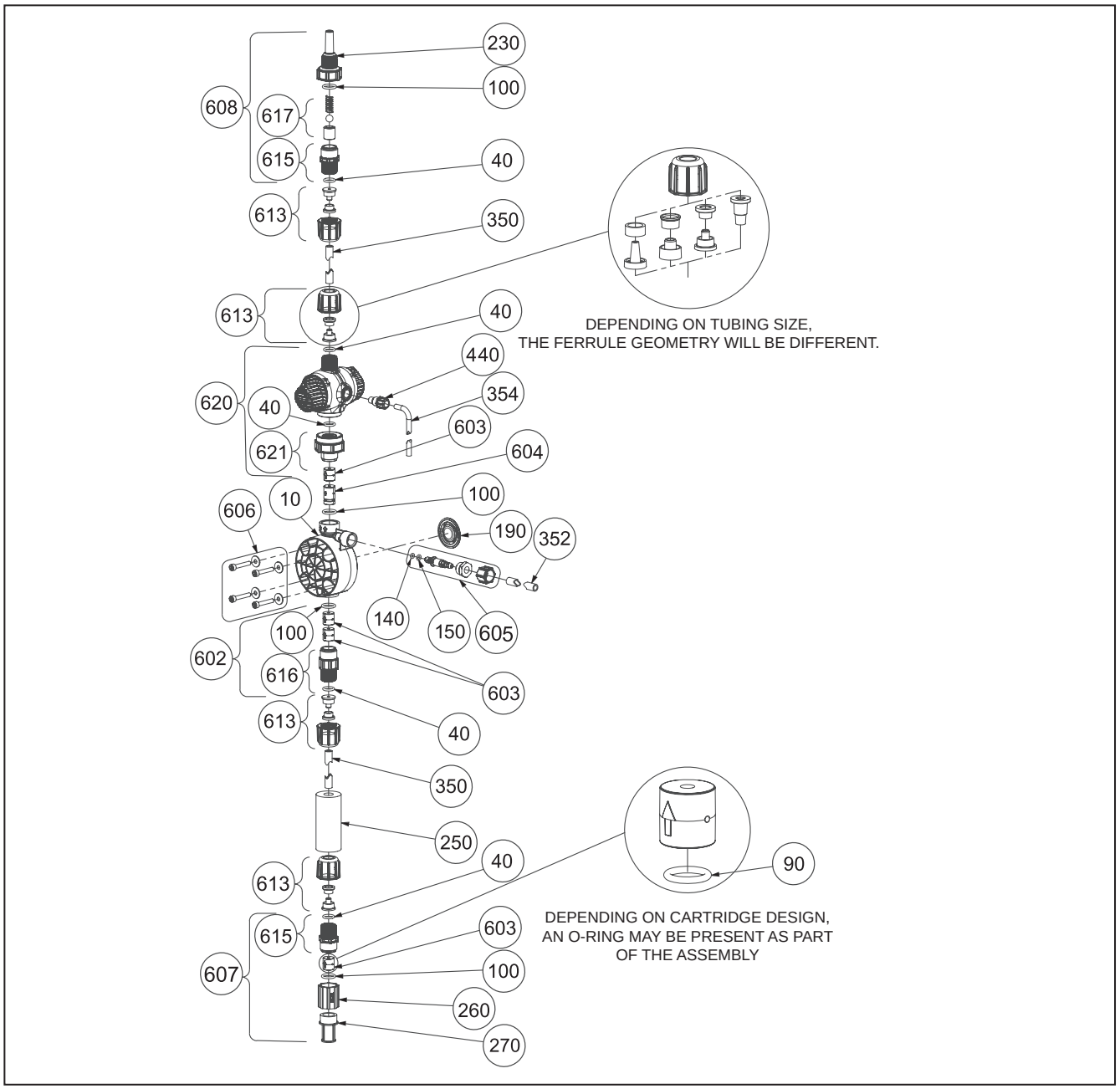


Figure 20. FASTPRIME™ Liquid End Assembly

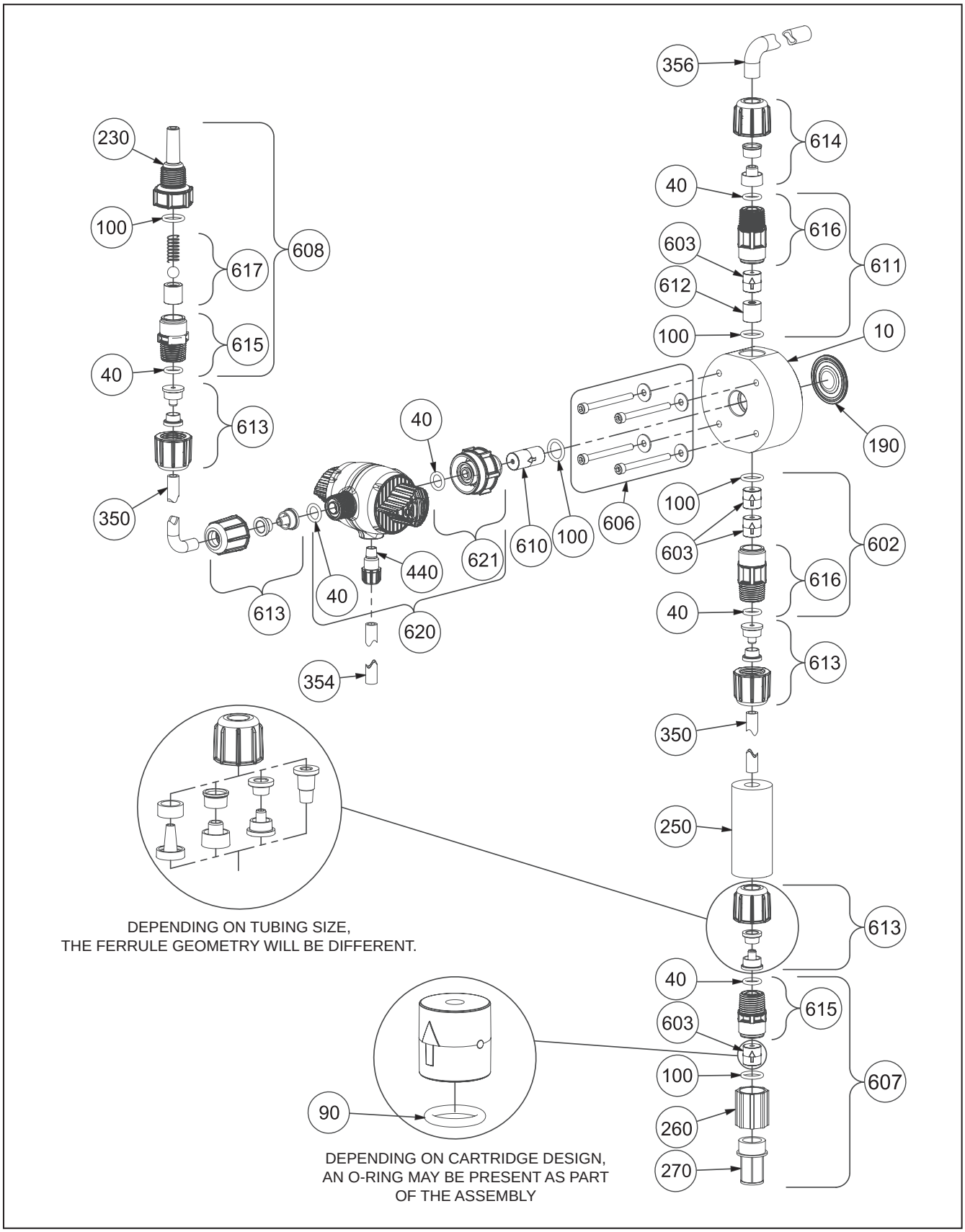


Figure 21. AUTOPRIME™ Liquid End Assembly

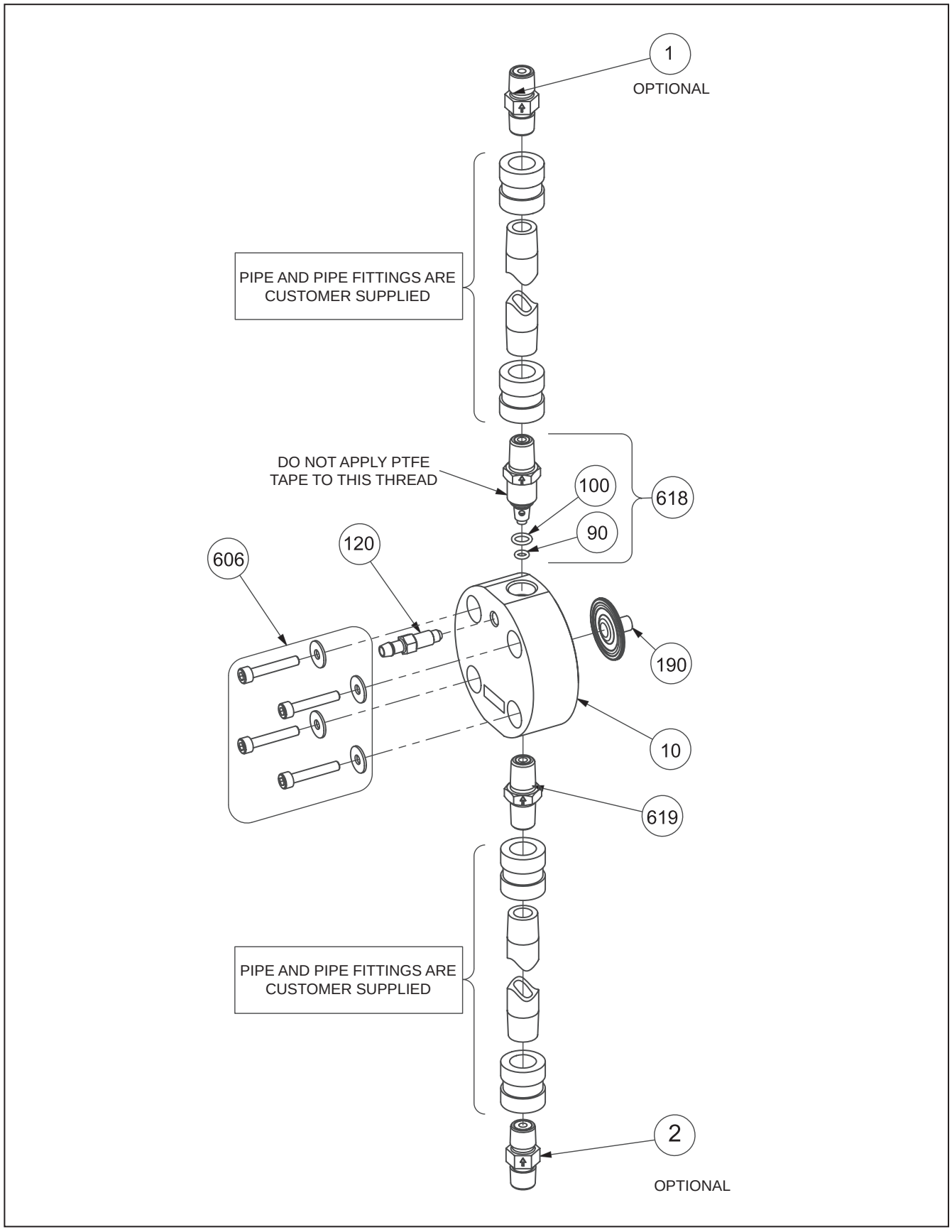
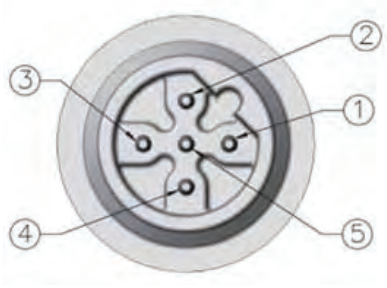


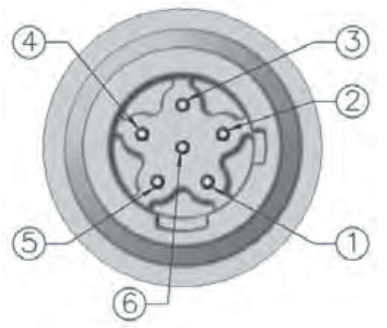
Figure 22. Stainless Steel Liquid End Assembly



5 PIN CONNECTOR

USE 5 PIN CABLE (LMI P/N 48414)

PIN	WIRE	SIGNAL
1	Brown	Remote On-Off
2	White	Ground-Return
3	Blue	External Pulse Input
4	Black	Power Supply, 24V 75 mA
5	Green-Yellow	4-20 mA Input



6 PIN CONNECTOR

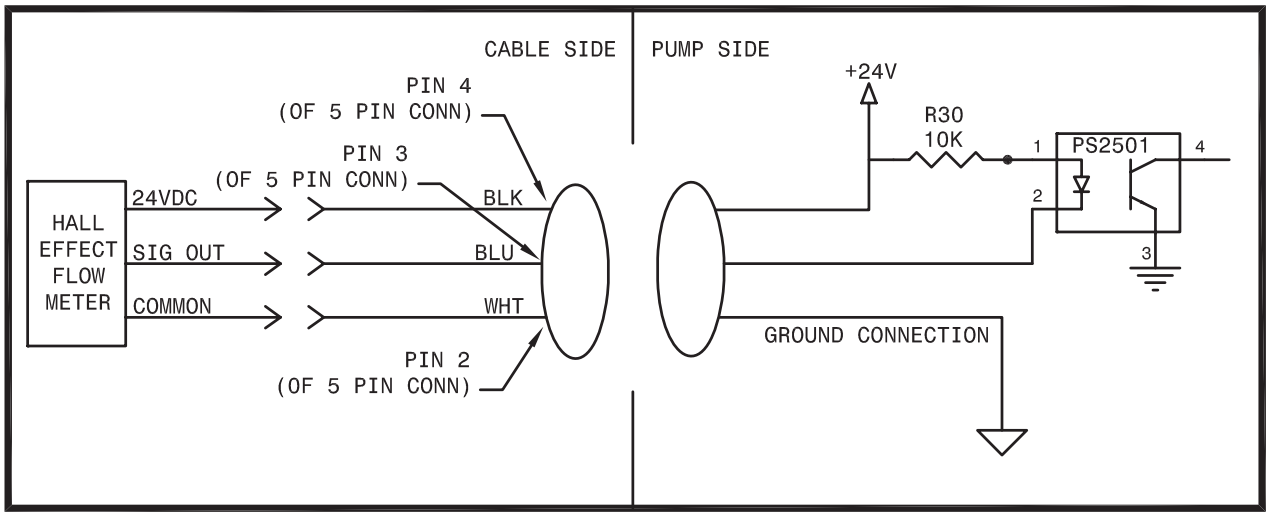
USE 6 PIN CABLE (LMI P/N 49035)

PIN	WIRE	SIGNAL
1	Red-White	Alarm Output or Internal-External indicator
2	Red	Alarm Return
3	Green	Remote Internal-External mode
4	Red-Yellow	Pulse Output
5	Red-Black	4-20 mA Output
6	Red-Blue	Ground-Return

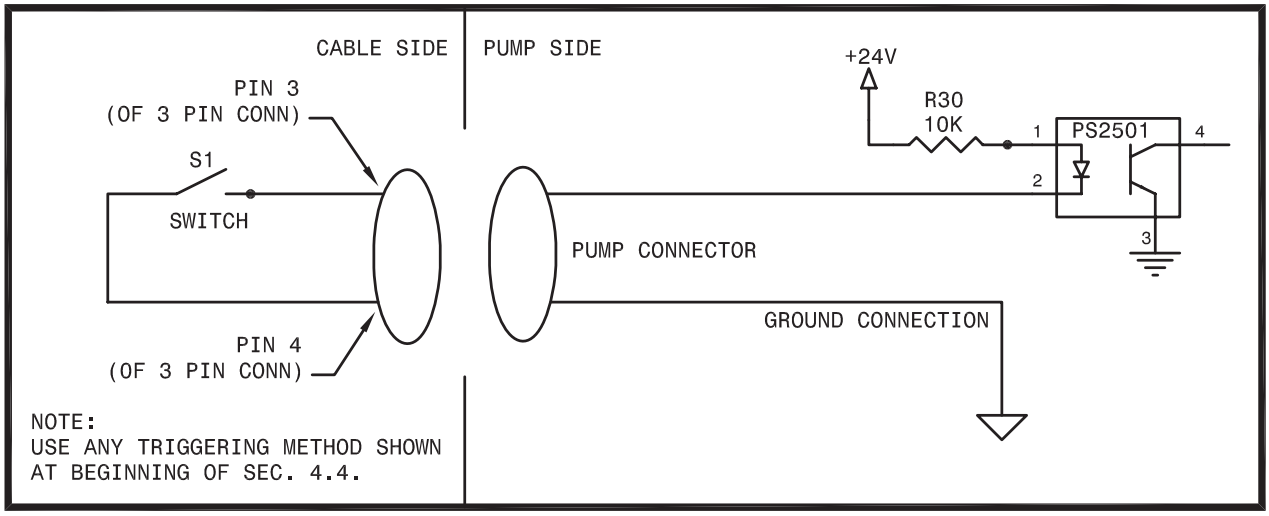
SECTION 5 - WIRING DIAGRAMS

INPUT WIRING DIAGRAM

HALL EFFECT FLOWMETER
INPUT CONNECTION REFERENCE:



TANK ON
INPUT CONNECTION REFERENCE:



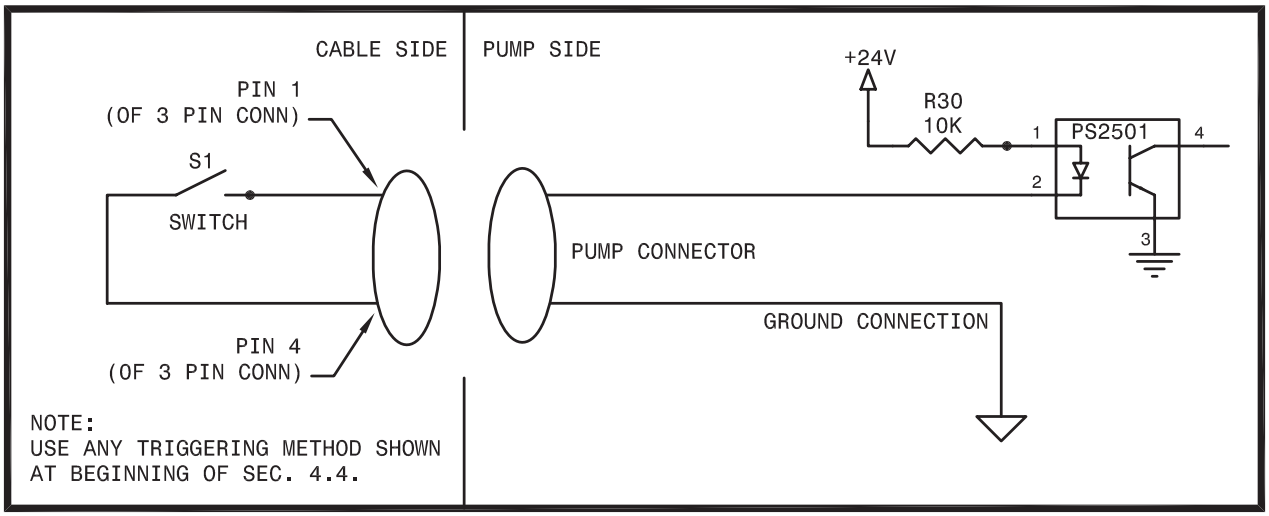
NOTE:

A Cable Cord set for this application is included with an optional LMI® dual switch assembly P/N 49249.

SECTION 5 - WIRING DIAGRAMS

INPUT WIRING DIAGRAM

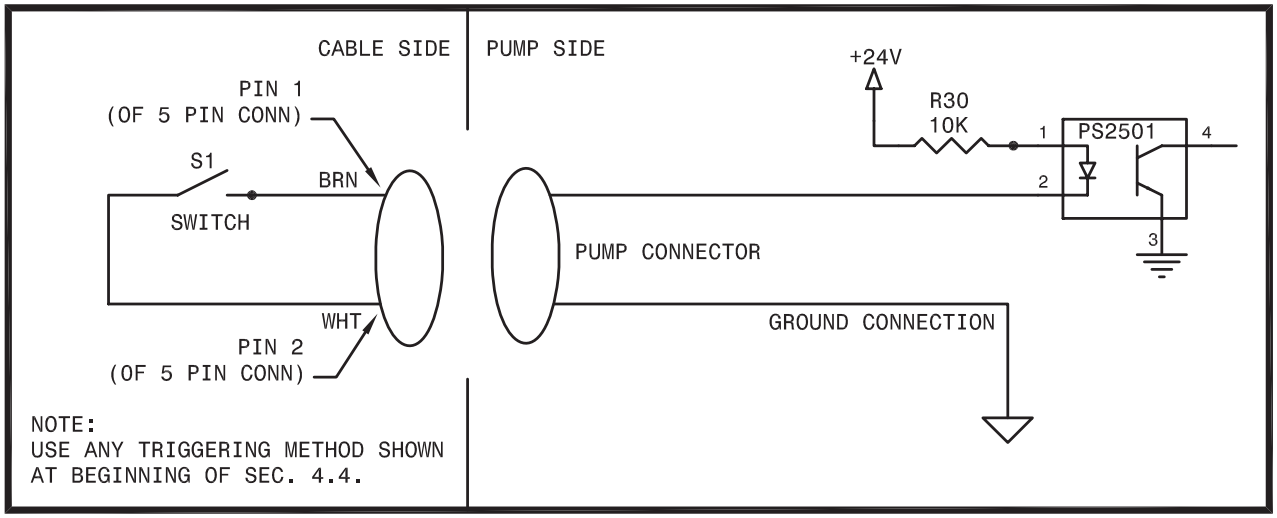
TANK EMPTY
INPUT CONNECTION REFERENCE:



NOTE:

A Cable cord set for this application is included with an optional LMI® low level switch assembly P/N 49246 or a LMI® dual level switch assembly P/N 49249.

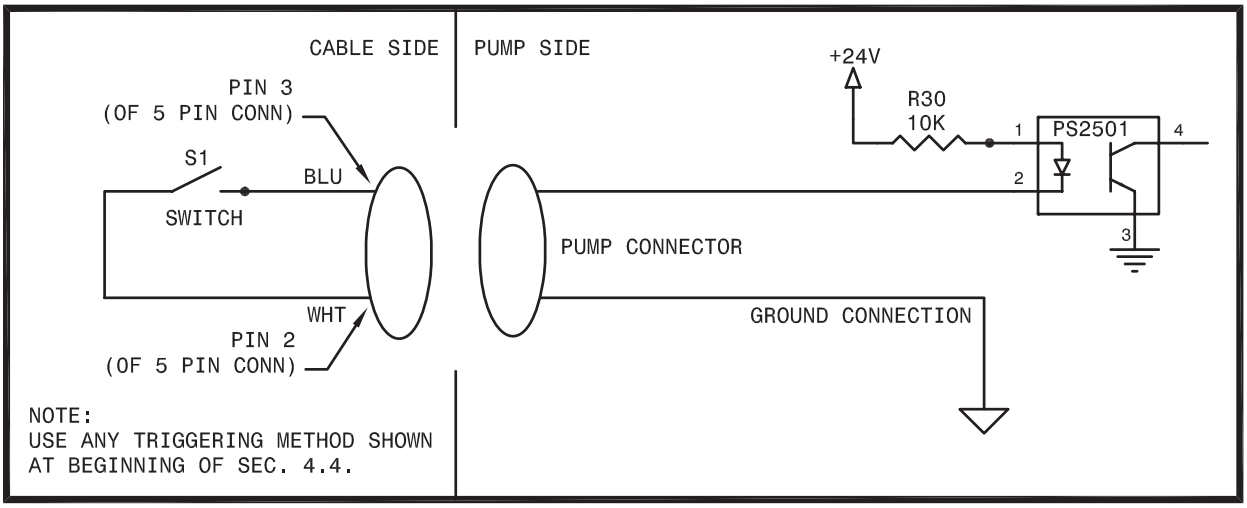
REMOTE ON-OFF
INPUT CONNECTION REFERENCE:



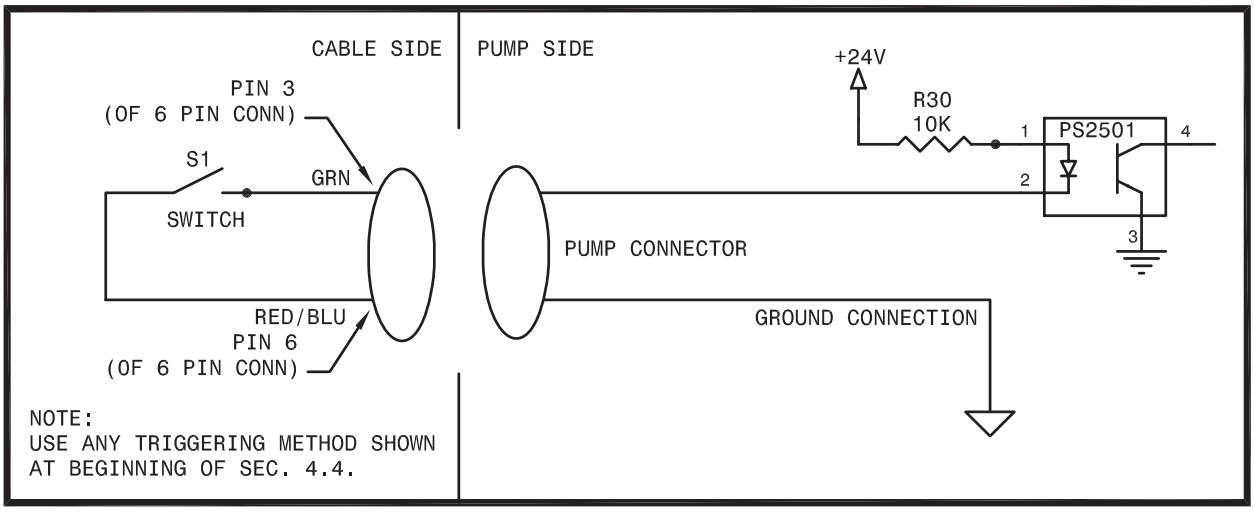
SECTION 5 - WIRING DIAGRAMS

INPUT WIRING DIAGRAM

EXTERNAL PULSE INPUT CONNECTION REFERENCE:



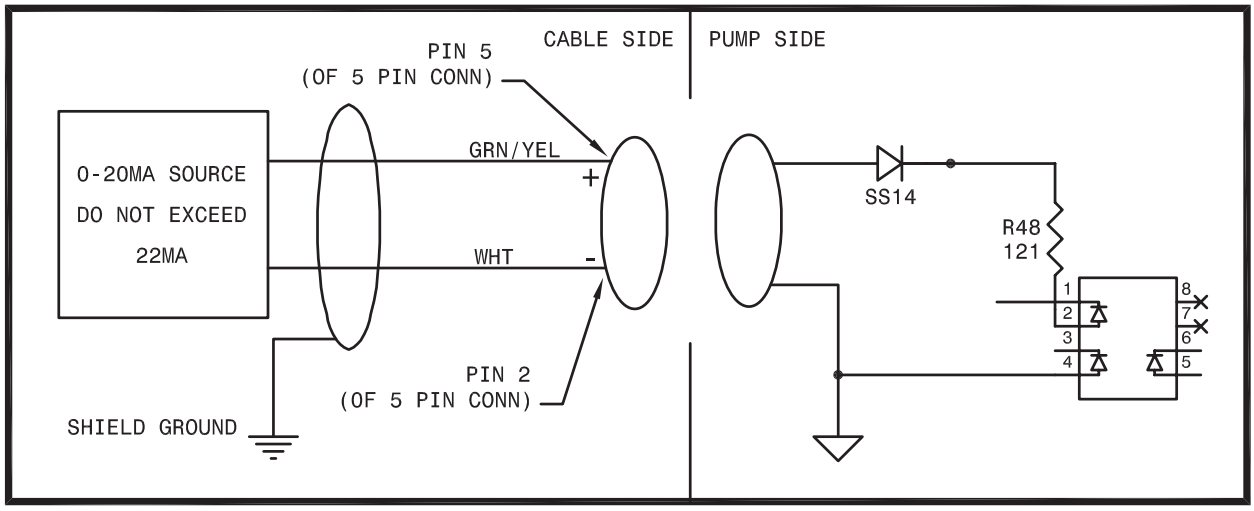
INTERNAL / EXTERNAL CONTROL INPUT CONNECTION REFERENCE:



SECTION 5 - WIRING DIAGRAMS

INPUT WIRING DIAGRAM

4 - 20 MA
INPUT CONNECTION REFERENCE:



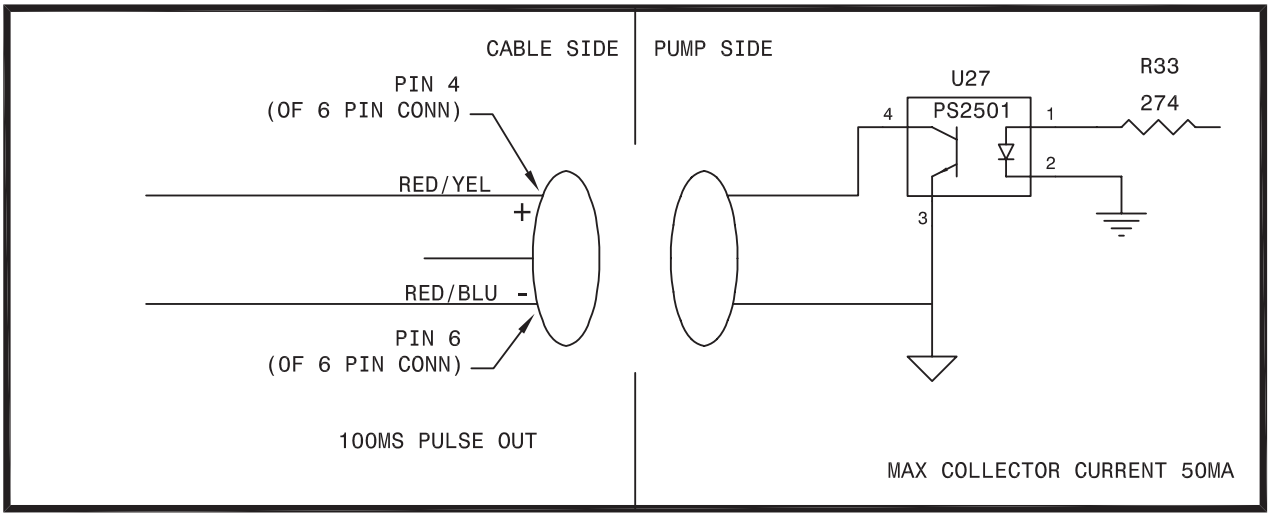
NOTE:

0 to 20 input impedence is dynamic and will work with supply currents needing 130 Ohm or above impedence.

SECTION 5 - WIRING DIAGRAMS

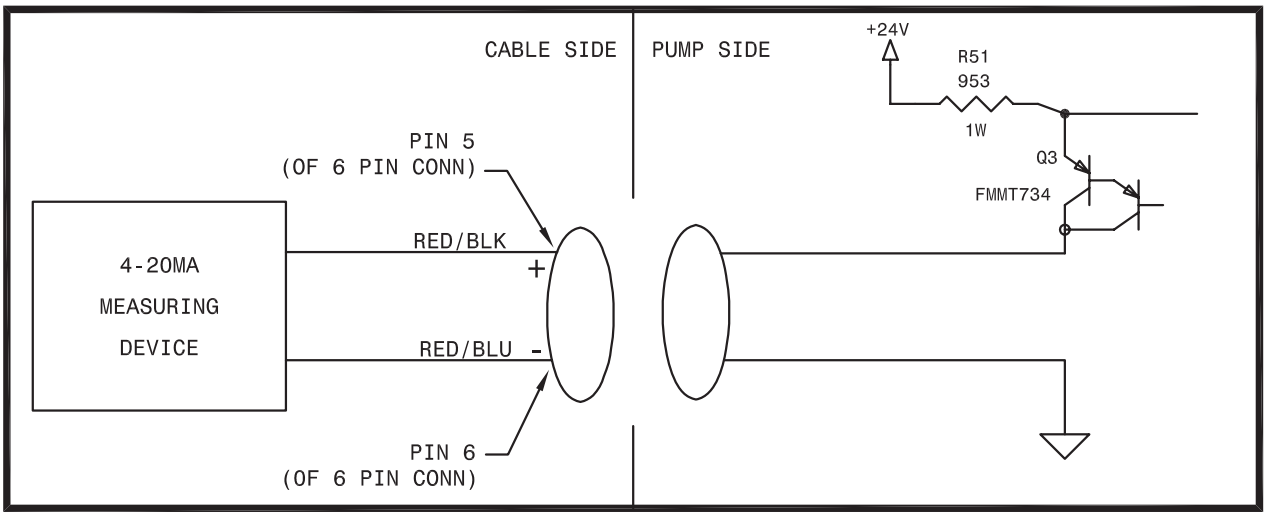
OUTPUT WIRING DIAGRAM

PULSE
OUTPUT CONNECTION REFERENCE:



NOTE:
When using a "PULL UP" option use a 10K resistor and a 24VDC source (can be used with Pin 5 of 5 Pin CONN).

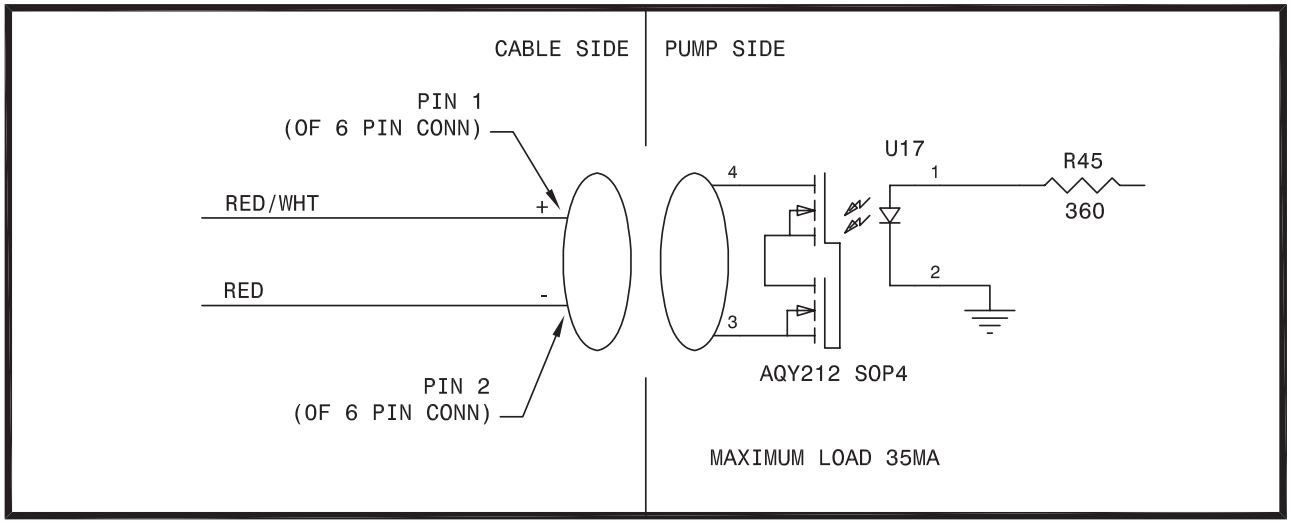
4 TO 20 MA
OUTPUT CONNECTION REFERENCE:



SECTION 5 - WIRING DIAGRAMS

OUTPUT WIRING DIAGRAM

ALARM
OUTPUT CONNECTION REFERENCE:



NOTE:

Use to switch on 24V source or less. Do not use to switch on AC line Voltage without Relay. Relay coils should be 24VDC or less with maximum Current of 35 mA.

SECTION 6 - TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	SOLUTION
Pump Will Not Prime	1. Pump not turned on or plugged in.	1. Turn on pump/plug in pump.
	2. Output dials not set properly.	2. Always prime pump with speed and stroke at 100%.
	3. Foot Valve not in vertical position on bottom of tank.	3. Foot Valve must be vertical *(see Foot Valve Installation, Section 2.7)*.
	4. Pump suction lift too high.	4. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	5. Suction tubing is curved or coiled in tank.	5. Suction tubing must be vertical. Use LMI® ceramic weight supplied with pump *(see Section 2.7)*.
	6. Fittings are over tightened.	6. Do not overtighten fittings. This causes seal rings to distort and not seat properly which causes pump to leak back or lose prime.
	7. Air trap in suction valve tubing.	7. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! *(see Section 2.2.1)*.
	8. Too much pressure at discharge (Pumps without multi-function valve.)	8. Shut off valves in pressurized line. Disconnect tubing at injection check valve *(see Priming Section 3.2)*. When pump is primed, reconnect discharge tubing.
	9. Air leak around fitting.	9. Check for missing or damaged O-rings at ends of fittings.
Pump Loses Prime	1. Solution container ran dry.	1. Refill container with solution and reprime *(see Section 3.2)*.
	2. Foot Valve is not in a vertical position on the bottom of the tank.	2. Foot Valve must be vertical *(see Foot Valve Installation, Section 2.7)*.
	3. Pump suction lift is too high.	3. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	4. Suction tubing is curved or coiled in tank.	4. Suction tubing must be vertical. Use LMI® ceramic weight supplied with pump *(see Section 2.7)*.
	5. Fittings are over tightened.	5. DO NOT OVERTIGHTEN FITTINGS. This causes seal rings to distort and not seat properly which causes pump to leak back or lose prime.
	6. Air trap in suction valve tubing.	6. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! *(see Section 2.2.1)*.
	7. Air leak on suction side.	7. Check for pinholes, cracks. Replace if necessary.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Leakage at tubing	1. Worn tubing ends.	1. Cut about 1 in (25 mm) off tubing and then replace as before.
	2. Loose or cracked fitting.	2. Replace fitting if cracked. Carefully hand tighten fittings. **DO NOT USE PIPE WRENCH**. An additional 1/8 or 1/4 turn may be necessary.
	3. Worn seal rings.	3. Replace balls and seal rings*(see Section 4.4*).
	4. Solution attacking Liquid Handling Assembly.	4. Consult your local distributor for alternate materials.
Low Output or Failure to Pump Against Pressure	1. Pump's maximum pressure rating is exceeded by injection pressure.	1. Injection pressure cannot exceed pump's maximum pressure. See pump data plate.
	2. Worn Seal Rings.	2. Worn seal rings or cartridge valves may need replacement *(see Section 4.4)*.
	3. Ruptured LIQUIFRAM™.	3. Replace LIQUIFRAM™ *(see Section 4.3)*.
	4. Incorrect stroke length.	4. Recalibrate Output *(see Section 3.3.2)*.
	5. Tubing run on discharge may be too long.	5. Longer tubing runs may create frictional losses sufficient to reduce pump's pressure rating Consult factory for more information.
	6. Clogged Foot Valve strainer.	6. Remove Foot Valve strainer when pumping slurries or when solution particles cause strainer to clog.
Failure to Run	1. Pump not turned on or plugged in.	1. Turn on or plug in pump.
	2. EPU failure.	2. Disassemble pump and measure resistance across the EPU terminals. If this measures as an open circuit then the EPU should be replaced. *(see Section 4.8)*.
	3. Pulser failure.	3. The pulser should be replaced if EPU checks out OK. Consult supplier or factory.
Excessive Pump Output	1. Syphoning. (Pumping downhill without a multi-function valve).	1. Move injection point to a pressurized location or install an LMI® 4-FV *(see Section 2.4)*.
	2. Little or no pressure at injection point.	2. If pressure at injection point is less than 25 psi (1.7 Bar), an LMI® 4-FV should be installed *see Section 2.4)*.
	3. Excessive strokes per minute.	3. Replace pulser or resistor. Consult factory.

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LMI®

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ROYTRONIC EXCEL™
Series AD9 Programming Guide
Electronic Metering Pumps

Manual No : 2032
Rev. : D
Rev. Date : 11/2015

LMI®

an Accudyne Industries brand

SECTION 1 - INTRODUCTION

The Series AD9 electronic metering pump offers an extensive range of features, including microprocessor control for accurate and flexible automation in response to instrument signals. The microprocessor design employs a graphical display and tactile response keypad. All external inputs and outputs are opto-isolated from the microprocessor.

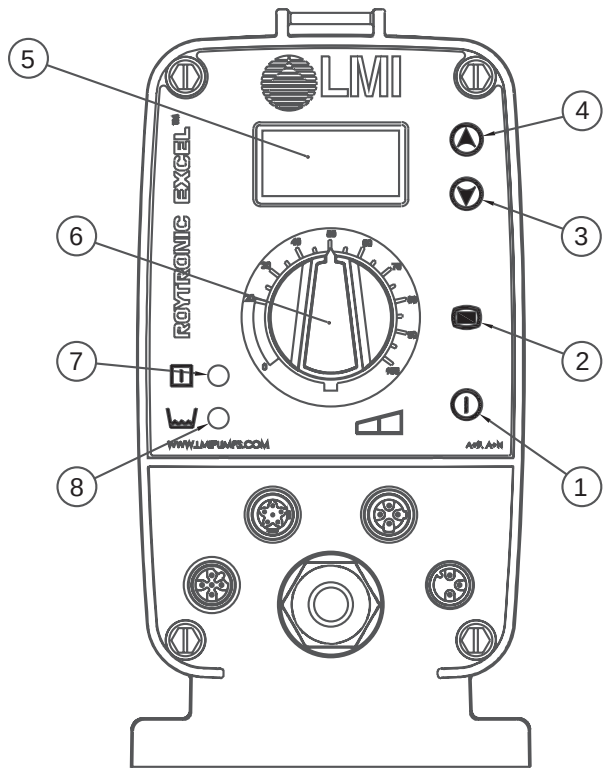
This manual is a supplement which describes programming and operation for the AD9 series. For complete details on Installation, Maintenance and Troubleshooting, please refer to the ROYTRONIC EXCEL™ Instruction Manual (P/N 2024).

⚠ CAUTION **SPECIFIC PRECAUTIONS SHOULD BE TAKEN WHEN WORKING WITH ALL LMI® METERING PUMPS. PLEASE REFER TO THE PRECAUTIONS SECTION, SEC. 1.0, OF THE ROYTRONIC EXCEL™ INSTRUCTION MANUAL (P/N 2024).**

SECTION 2 - FEATURES

1. Stroke speed adjustment 1-59 SPH (strokes per hour) to 1-120 SPM (strokes per minute).
2. Operating mode selection.
3. Flexible slope adjustable response to mA input signals.
4. Divide or multiply (batch) incoming pulses (1 to 9999).
5. Batch accumulation option.
6. Timed event mode for internal operation.
7. Percent-of-time operation for internal and external modes.
8. Keypad locking.
9. Low-level warning and empty-level shutoff with alarm output.
10. Programmable flow monitoring with alarm output (with FM-ROY-9 DIGI-PULSE™).
11. Continuous non-volatile memory (EEPROM)-no battery required.
12. Remote ON/OFF control.
13. Remote Internal/External mode control.
14. Pulse (pacing) output.
15. Universal voltage input (95-240V) with automatic line voltage compensation and over voltage protection.
16. Programmable menu for optional features parameters.
17. Theoretical flow display.
18. Single-Point and Two-Point calibration.
19. Fixed-time priming mode.
20. Configurable output alarms.
21. 4-20mA output for remote monitoring of stroke speed.

SECTION 3 - KEYPAD/DISPLAY: DESCRIPTION AND FUNCTION



1. POWER Button
2. MODE Button
3. DOWN Button
4. UP Button
5. Graphical Display
6. Stroke Adjustment Knob
7. Pump ON/OFF LED
8. Low-Level Indicator LED

Figure 1. ROYTRONIC EXCEL™ Series AD9 Control Panel

3.1 POWER BUTTON

The POWER button turns the pump ON or OFF. If the pump is not running, pressing this button will cause the pump to start running. If the pump is running, pressing the POWER button will stop the pump. The POWER button is also used to prime the pump as described in *Sec. 4.3.* When in a programming screen or a selection menu, the POWER button is generally used to enter/select the associated item.

3.2 MODE SELECTION BUTTON

The MODE button is used to enter the main selection menu. The MODE button can also often be used to exit the current programming menu. Details of its use will be covered in greater detail later in this supplement.

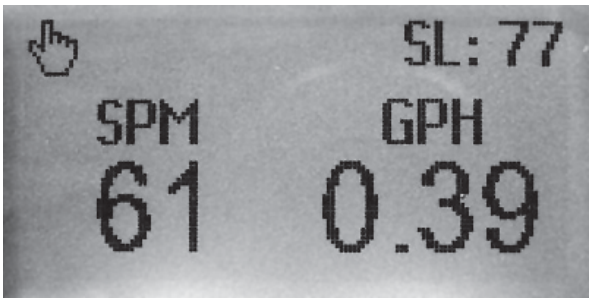
3.3 UP AND DOWN BUTTONS

The UP and DOWN buttons are used to change parameters (i.e. stroke frequency) as well as to navigate the selection menus. These functions are covered in greater detail later in this supplement.

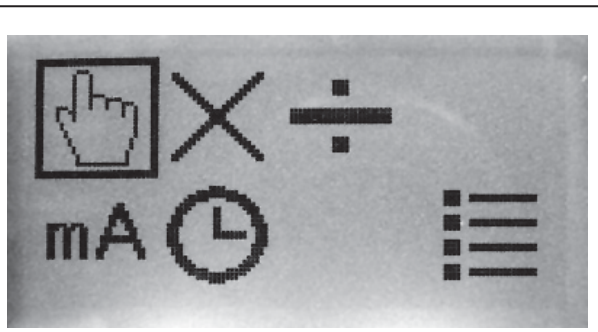
SECTION 3 - KEYPAD/DISPLAY: DESCRIPTION AND FUNCTION

3.4 GRAPHICAL DISPLAY

A graphical display is used to show the current operational state of the pump as well as a variety of specialized programming menus.



Manual Operating Mode Display



Control Mode Selection Display

3.5 STROKE ADJUSTMENT KNOB

The Stroke Adjustment Knob is used to adjust the stroke length of the pump. As this knob is adjusted, the stroke length and associated flow will be displayed on the current operating mode display.

3.6 PUMP ON/OFF LED

When the pump is started, the Pump ON/OFF LED will be green when in internal mode and yellow when in an external mode. The LED will also briefly pulse OFF during an actual pump stroke. When the pump is not running, the Pump ON/OFF LED will be OFF.

3.7 LOW LEVEL INDICATOR LED

The Low Level Indicator LED will normally be OFF. However, in the event that an external level sensor is connected to the pump, the LED will turn yellow if a Tank Low input signal is detected or red if a Tank Empty input signal is detected. If both Tank Low and Tank Empty conditions are present, the Tank Empty takes priority. The pump will not stroke when in a Tank Empty condition.

SECTION 4 - OPERATION OF THE SERIES AD9

This pump features EEPROM nonvolatile memory. The pump will always power up in the last used mode. When shipped from the factory the pump will power up in the Manual mode (*see Sec. 5.1*), with the pump OFF and a speed setting of 120 SPM.

NOTE:

If the power to the pump is cut less than 15 seconds after the last programmed values have been set, the latest changes will NOT be stored in nonvolatile memory. Allow at least 15 seconds before disconnecting from power to ensure that the latest changes are stored.

4.1 PUMP START/STOP

Press the ⏻ POWER button to start or stop the pump. When the pump is OFF, the I Pump ON/OFF LED will be OFF. When the pump is ON, the I Pump ON/OFF LED will illuminate. Each time the pump strokes, the I Pump ON/OFF LED will flash OFF.

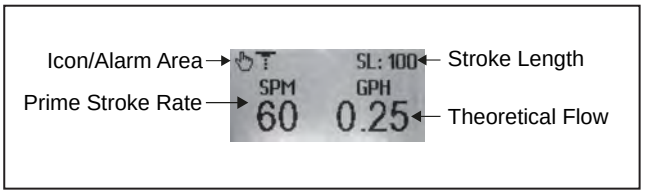
4.2 PUMP SPEED

The speed may be changed with the pump ON or OFF. To increase or decrease the speed, press or hold the ▲ UP or ▼ DOWN button. The range runs from 0 SPH to 120 SPM. While normally the speed will be set in SPM, if settings of SPH are desired, hold the ▼ DOWN button until the display reads 1 SPM, then continue to hold it down. The display will then show SPH 59. The speed can be further reduced to 1 SPH with the ▼ DOWN button.

4.3 PRIMING THE PUMP

The priming function allows a fixed-time prime period of 60 seconds and enables priming of the pump in any control mode. To begin priming, hold down the ⏻ POWER button for approximately 5 seconds. The pump will begin operating. Use the ▲ UP and ▼ DOWN buttons to vary the stroking speed. To stop priming before the priming cycle is complete, push the ⏻ POWER button. The pump will automatically stop after 60 seconds, and revert to the last used control mode.

Display Overview:



1. **Icon/Alarm Area:** The T icon indicates the pump is in prime mode. Depending on advanced pump configuration options and any alarms alerts detected, other icons may be present as well (*see Sec. 4.5*).
2. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
3. **Prime Stroke Rate:** Indicates the stroke speed of the pump while priming (1-120 SPM).
4. **Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

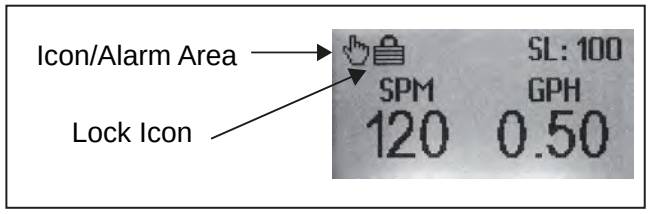
NOTE:

The prime stroke rate is independent of the current control mode stroke rate.

SECTION 4 - OPERATION OF THE SERIES AD9

4.4 LOCKING/UNLOCKING THE PUMP

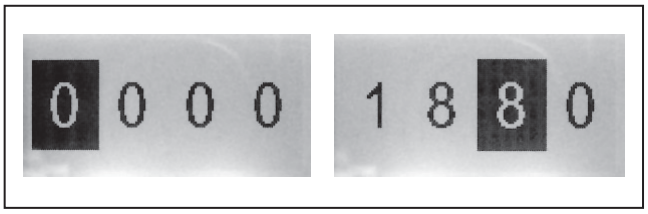
The pump has several lock modes to prevent casual tampering. For a complete description of the lock modes and how to configure them, *see Sec. 6.4*. A Lock Icon in the Icon/Alarm Area indicates that the pump has been locked.



To activate the pump lock, depress the ▼ DOWN and ▬ MODE buttons simultaneously for about 1 second until the Lock Icon appears in the Icon/Alarm area.

To unlock a locked pump, depress the ▼ DOWN and ▬ MODE buttons simultaneously for about 1 second until the Lock Icon disappears in the Icon/Alarm area or until prompted for the unlock pass code (*see below*).

To enter the unlock pass code, use the ▲ UP and ▼ DOWN buttons to edit each digit. Use the ⏻ POWER button to advance to the next digit. If the pass code is incorrect, the pump will remain locked.



Example of entering an unlock pass code

NOTE:

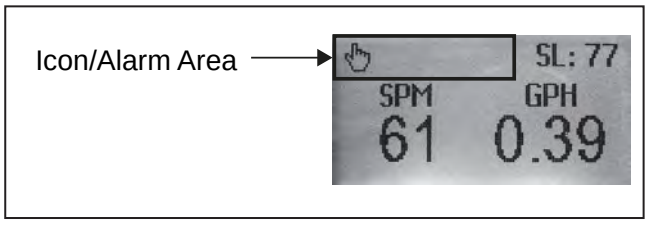
Activating the pump lock is effective immediately. Do not activate unless you have made note of the unlock pass code, which is configured in Sec. 6.4. If the pass code is misplaced while the lock is active, the pump must be returned to the factory in order to be reset.

After approximately 2 minutes of inactivity, the unlock pass code display will close and revert back to the current control mode display.

SECTION 4 - OPERATION OF THE SERIES AD9

4.5 ALARM/ICON AREA

The upper left portion of every Control Mode Display contains an icon/alarm notification area, which graphically displays operational information. If no alarm conditions exist, the display will only show configuration information. If one or multiple alarm conditions exist, the display will alternate every few seconds between showing configuration information and showing alarm information. Alarm information will always be preceded by the ⚠ icon.



Configuration Icon Definitions:

ICON	NAME	DESCRIPTION
	Manual Control Mode	Pump is in Manual Control Mode (See Sec. 5.1)
	Pulse Multiply Control Mode	Pump is in Pulse Multiply Control Mode (See Sec. 5.2)
	Pulse Divide Control Mode	Pump is in Pulse Divide Control Mode (See Sec. 5.3)
	Analog Control Mode	Pump is in Analog Control Mode (See Sec. 5.4)
	Timed Event Control Mode	Pump is in Timed Event Control Mode (See Sec. 5.5)
	Prime	The pump is priming (See Sec. 4.3)
	Keypad Locked	The keypad is locked (See Sec. 4.4)
	Digi-Pulse™ Flow Monitoring	Digi-Pulse™ flow switch monitoring is enabled (See Sec. 6.9)
	Percent-of-Time	Percent-of-Time Functionality Enabled (See Sec. 6.10)
	Batch Mode	Batch Mode Enabled (See Sec. 6.2)
	1-Point Calibration	Pump user-calibrated : 1-point (See Sec. 6.6.1)
	2-Point Calibration	Pump user-calibrated : 2-point (See Sec. 6.6.2)

Table1. Configuration Icon Definitions

SECTION 4 - OPERATION OF THE SERIES AD9

Alarm Icon Definitions:

ICON	NAME	DESCRIPTION
	Stroke length alarm	The pump is user-calibrated and the stroke length is operating outside the allowable range
	Digi-Pulse™ flow switch alarm **	Digi-Pulse™ Flow Monitoring is enabled and the missed strokes threshold has been reached
	Analog input alarm	The 4-20ma input current exceeds 21.5 mA
	Incoming pulse rate alarm	The input pulse rate results in a stroke rate exceeding 120 SPM
	Batch alarm	Pulses are received before current batch action is completed
	Low tank alarm	Corresponds to the external Tank Level Low input
	Empty tank alarm**	Corresponds to the external Tank Empty input

*** = The pump will stop stroking in this condition*

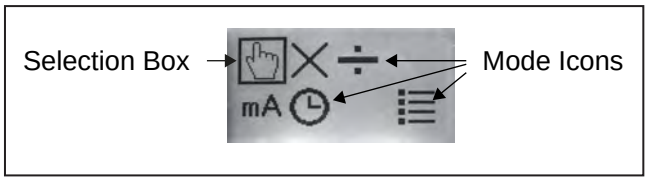
Table 2. Alarm Icon Definitions

SECTION 5 - CONTROL MODE SELECTION MENU

This menu is used to select the control mode or enter into the advanced configuration menu. There are 2 internal control modes and 3 external control modes. In order to operate the pump in an external control mode, a remote device must be connected to the pump through the 5-Pin connector.

With the pump turned OFF, push the ▭ MODE button to bring up the Control Mode Selection Menu. Use the ▲ UP and ▼ DOWN buttons to scroll through the modes. Once the desired mode is selected, use the ⏻ POWER button to enter that mode. Push and hold the ▭ MODE button for approximately 2 seconds to exit the menu.

Display Overview:



Control Mode Selection Menu

1. **Mode Icons:** Each icon represents a different control mode, as follows:
   - = Manual Mode - Internal (*Sec. 5.1*).
   - = Pulse Multiply Mode - External (*Sec. 5.2*).
   - = Pulse Divide Mode - External (*Sec. 5.3*).
   - mA = Analog mA Mode - External (*Sec. 5.4*).
   - = Timed Event Mode - Internal (*Sec. 5.5*).
   - = Advanced Configuration Options (*Sec. 6.0*).
2. **Selection Box:** Indicates the currently selected item.

NOTE:

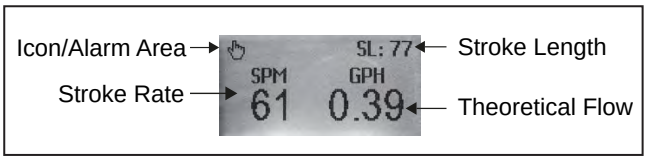
After approximately 2 minutes of inactivity, the mode selection menu will automatically close and revert back to the prior display.

While in this menu, all external outputs will return to their default "OFF" state and all external inputs will be ignored.

5.1 MANUAL MODE (INTERNAL)

This mode is used when external devices are not being used to control the pump. While in manual mode, the stroke speed is varied by using the ▲ UP and ▼ DOWN buttons. To turn the pump ON or OFF, push the ⏻ POWER button or toggle the remote ON/OFF. The I Pump ON/OFF LED will illuminate green when the pump is ON.

Display Overview:



Manual Mode Display

1. **Icon/Alarm Area:** The ☝ icon indicates the pump is in the manual mode. Depending on advanced pump configuration options and any alarms alerts detected, other icons may be present as well (*see Sec. 4.5*).
2. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
3. **Stroke Rate:** Indicates the stroke speed of the pump (1-59SPH or 1-120 SPM).
4. **Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

SECTION 5 - CONTROL MODE SELECTION MENU

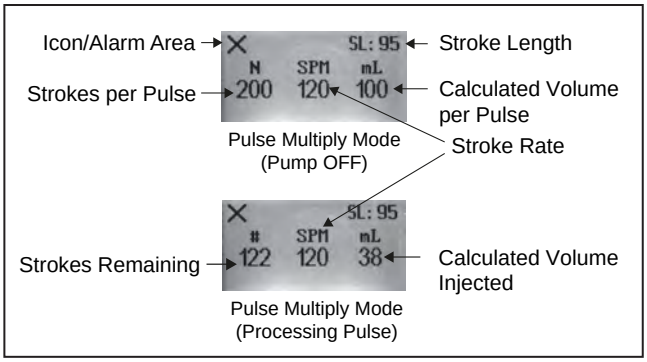
5.2 PULSE MULTIPLY MODE (EXTERNAL)

This mode is used to control the pump with an external device connected to the appropriate contacts of the 5-Pin connector. With the pump OFF, use the ▲ UP and ▼ DOWN buttons to vary the strokes-per-pulse parameter. To turn the pump ON or OFF, push the ⏻ POWER button, or toggle the remote ON/OFF. The I Pump ON/OFF LED will illuminate yellow when the pump is ON. With the pump turned ON, and a pulse is received, the pump will begin running, with the remaining pulses counting down on the display.

If a pulse is received before the countdown is complete and Batch Mode is OFF (*see Sec. 6.2*), the error code (*see Sec. 4.5*) is displayed and the pump batch count then restarts from the strokes-per-pulse setpoint. The fault will be corrected when the pump completes the current batch OR the pump is stopped.

If a pulse is received before the countdown is complete and Batch Mode is ON (*see Sec. 6.2*), the pump will accumulate strokes (up to a maximum of 9999), allowing all strokes to be accounted for.

Display Overview:

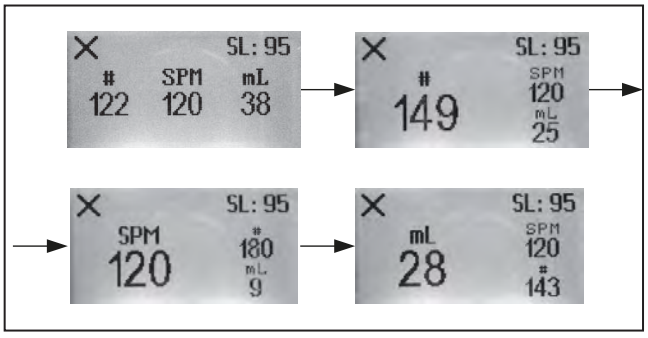


1. **Icon/Alarm Area:** The ✕ icon indicates the pump is in the pulse multiply mode. Depending on advanced pump configuration options and any alarms/alerts detected, other icons may be present as well (*see Sec. 4.5*).
2. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
3. **Stroke Rate:** Indicates the stroke speed of the pump (1-59 SPH or 1-120 SPM). To allow true flow proportioning, this is set in manual mode (*see Sec. 5.1*).
4. **Strokes per Pulse (Pump OFF only):** Number of strokes (1-9999) to occur for each valid pulse input. *See Sec. 6.3* to define a valid pulse.
5. **Strokes Remaining (Pump ON only):** Number of strokes remaining for the current batch cycle.
6. **Calculated Volume per Pulse (Pump OFF only):** The calculated flow based on stroke count, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).
7. **Calculated Volume Injected (Pump ON only):** The calculated flow based on strokes made, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

NOTE:

The pump will ignore the pulse input while the pump is OFF.

Depressing the ▲ UP and ▼ DOWN buttons simultaneously will cycle through alternate display formats , as shown below:

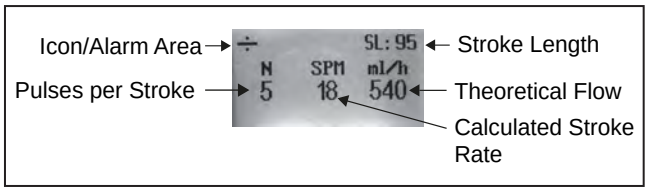


SECTION 5 - CONTROL MODE SELECTION MENU

5.3 PULSE DIVIDE MODE (EXTERNAL)

This mode is used to control the pump with an external device connected to the appropriate contacts of the 5-Pin connector. With the pump OFF, use the ⏫ UP and ⏬ DOWN buttons to vary the pulses-per-stroke parameter. To turn the pump ON or OFF, push the ⏻ POWER button or toggle the remote ON/OFF. The I Pump ON/OFF LED will illuminate yellow when the pump is ON. With the pump turned ON, the pump will pulse after the programmed number of pulses has been received.

Display Overview:



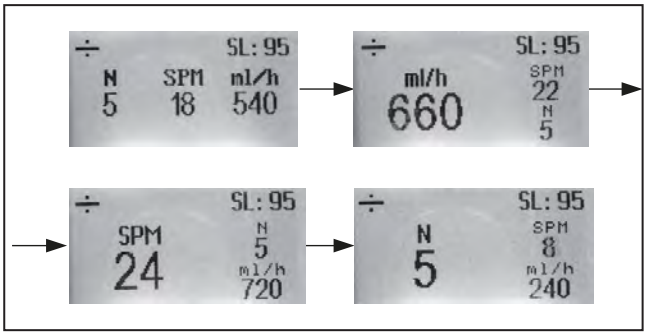
1. **Icon/Alarm Area:** The ÷ icon indicates the pump is in the pulse divide mode. Depending on advanced pump configuration options and any alarms/alerts detected, other icons may be present as well (*see Sec. 4.5*).
2. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
3. **Calculated Stroke Rate:** Indicates the calculated stroke rate of the pump (0-120 SPM) based on the rate of incoming pulses and the divide value.
4. **Pulses per Stroke:** Number (1-9999) of valid pulses to detect before performing a pump stroke. *See Sec. 6.3* to define a valid pulse.
5. **Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

NOTE:

The pump will display the calculated stroke rate and theoretical flow with the pump ON and OFF.

A ⚠ fault will be indicated if the calculated stroke rate exceeds 120 SPM (see Sec. 4.5).

Depressing the ⏬ UP and ⏫ DOWN buttons simultaneously will cycle through alternate display formats, as shown below:

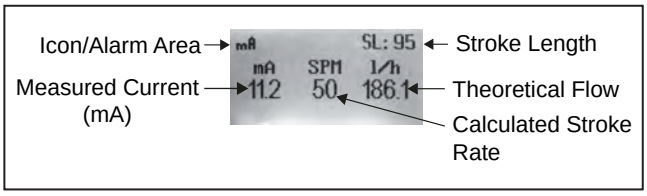


SECTION 5 - CONTROL MODE SELECTION MENU

5.4 ANALOG MODE (EXTERNAL)

This mode is used to control the pump with an external device connected to the appropriate contacts of the 5-Pin connector. With the pump OFF, press the ▲ UP or ▼ DOWN button to change the response curve (*see Sec. 5.4.1*). To manually turn the pump ON or OFF, push the ⏻ POWER button or toggle the remote ON/OFF. The I Pump ON/OFF LED will illuminate yellow when the pump is ON.

Display Overview:



1. **Icon/Alarm Area:** The **mA** icon indicates the pump is in the analog mode. Depending on advanced pump configuration options and any alarms/alerts detected, other icons may be present as well (*see Sec. 4.5*).
2. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
3. **Calculated Stroke Rate:** Indicates the calculated stroke speed of the pump (0-59 SPH, 0-120 SPM) based on the analog set points and measured current.
4. **Measured Current:** Measured current value (0-24.0 mA).
5. **Theoretical Flow:** The theoretical flow based on calculated stroke speed, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

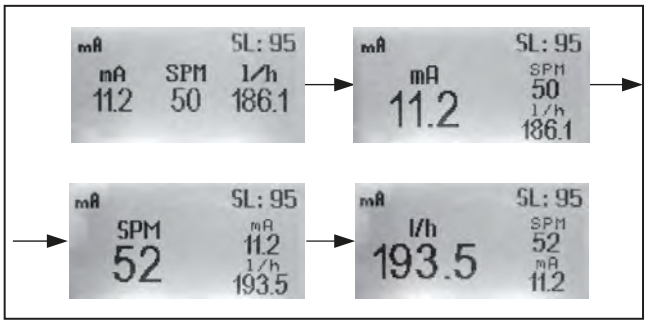
NOTE:

The pump will display the calculated stroke rate and theoretical flow with the pump ON and OFF.

A >mA fault (see Sec. 4.5) will be indicated if the 4-20mA input exceeds 21.5mA.

The pump will not stroke if the 4-20ma input signal is 0.5mA or less.

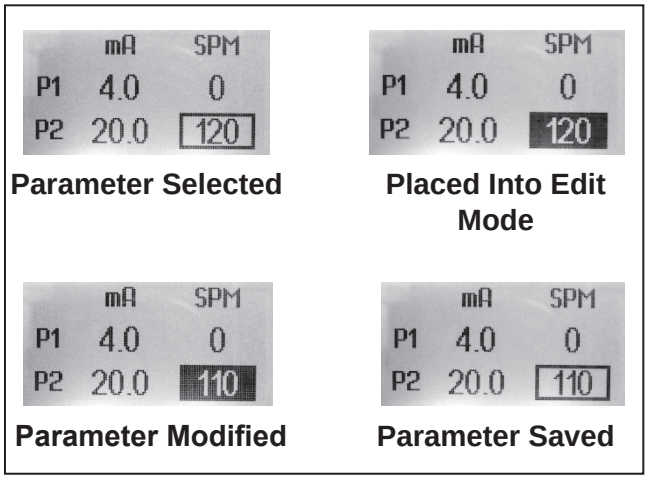
Depressing the ▲ UP and ▼ DOWN buttons simultaneously will cycle through alternate display formats, as shown below:



SECTION 5 - CONTROL MODE SELECTION MENU

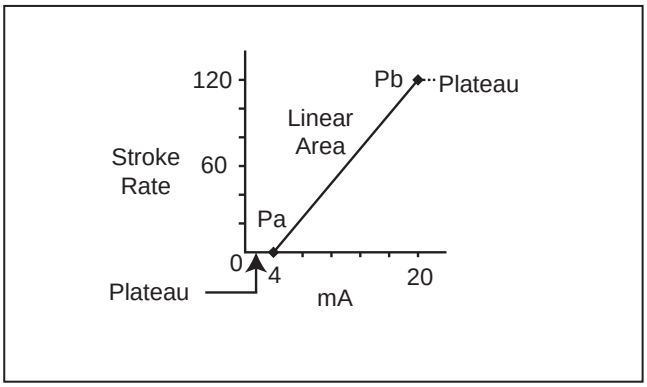
5.4.1 Programming the Analog Mode Response Curve

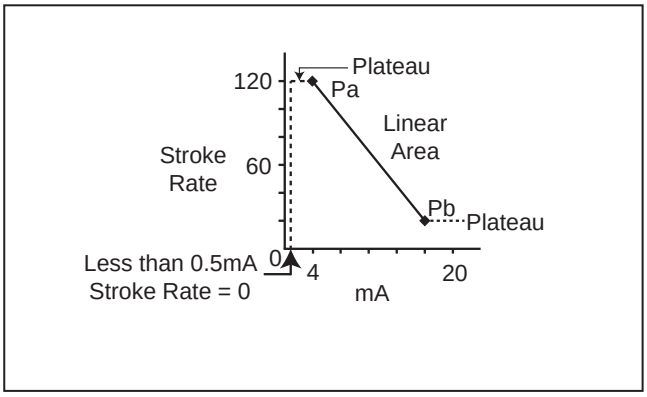
Use the ▲ UP or ▼ DOWN button to move the selection box to the parameter you wish to change. Use the ⏻ POWER button to toggle to the parameter's edit mode - a black background indicates the parameter is in edit mode. While in edit mode, use the ▲ UP and ▼ DOWN buttons to set the value. Use the ⏻ POWER button to exit edit mode and save the setting.



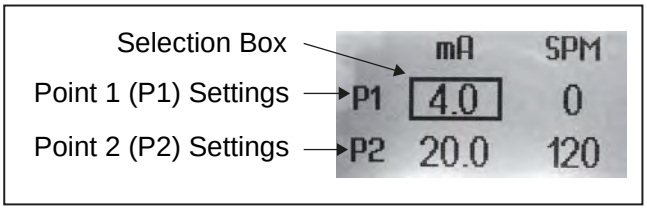
Use either the ▭ MODE button or navigate using the ▲ UP or ▼ DOWN buttons to exit the programming mode. The valid range for the mA value is 0.0 to 20.0 mA. The valid range for the SPM value is 0 to 120 SPM or 0-59 SPH.

The programming of points P1 and P2 when plotted will result in a graph similar to one of the 2 charts below (Pa = lowest programmed mA value; Pb = highest programmed mA value). The pump will vary its stroke speed linearly between points Pa and Pb based on the mA input signal. If the mA input signal exceeds Pb, the stroke speed will remain (plateau) at the speed corresponding to Pb. If the mA input drops to less than Pa, the stroke speed will remain (plateau) at the speed corresponding to Pa. Regardless of settings, if the mA input drops to 0.5 mA or below, the pump will stop stroking.





Display Overview:



1. **Selection Box:** indicates the currently selected item.
2. **Point 1 (P1) Settings:** the settings (mA and stroke rate) corresponding to set point P1.
3. **Point 2 (P2) Settings:** the settings (mA and stroke rate) corresponding to set point P2.

NOTE :

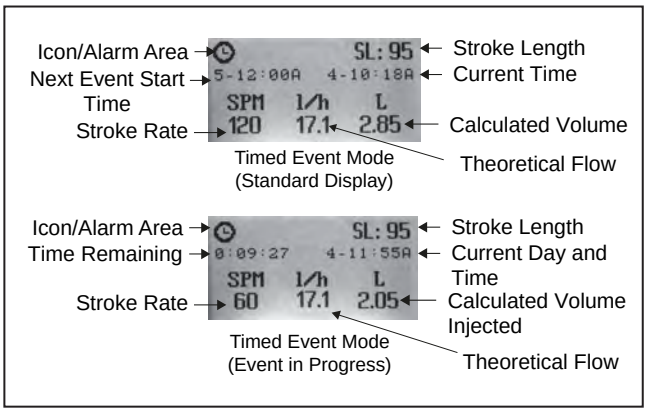
Parameter changes are saved when editing is complete and go into effect immediately.

SECTION 5 - CONTROL MODE SELECTION MENU

5.5 TIMED EVENT MODE (INTERNAL)

With the pump OFF, press the ▲ UP or ▼ DOWN button to view and/or program the timed events (*see Section. 5.5.1*). To turn the pump ON or OFF, push the ⏻ POWER button or toggle the remote ON/OFF. The I Pump ON/OFF LED will illuminate green when the pump is ON.

Display Overview:



1. **Icon/Alarm Area:** The ◷ icon indicates the pump is in the Timed Event mode. Depending on advanced pump configuration options and any alarms/alerts detected, other icons may be present as well (*see Sec. 4.5*).
2. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
3. **Next Event Start Day and Time:** The Day and Time of the next timed event. See below for the displayed format. The '*' character in this field indicates that no events are enabled (*see Sec. 5.5.1 for event programming information*).
4. **Current Day and Time:** The current Day and Time (*see below for time format description*).
5. **Stroke Rate:** Indicates the stroke speed of the pump (1-59SPH or 1-120 SPM) for the currently running event or the next scheduled event.
6. **Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).
7. **Calculated Volume:** The calculated volume based on event duration, stroke rate, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).
8. **Time Remaining (Event in Progress Only):** Remaining time of event.
9. **Calculated Volume Injected (Event in Progress Only):** The calculated volume based on strokes made, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

NOTE:

The displayed format for time is: D – H:MMx, where D = Day of Week (1-7), H = Hour (1-12), MM = Minute (0-59), x = A for AM or P for PM.

SECTION 5 - CONTROL MODE SELECTION MENU

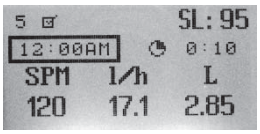
5.5.1 Programming Timed Events

One timed event may be programmed to execute for each of 7 days. Each event has a uniquely programmable start time, duration, and stroke rate.

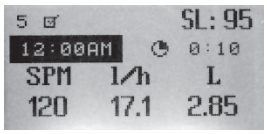
Use the ▲ UP or ▼ DOWN button to move the selection box to the parameter you wish to change. Use the ⏻ POWER button to toggle the parameter's edit mode. A black background indicates the parameter is in edit mode. The Event Enabled parameter will be toggled ON/OFF rather than going into an edit mode.

While in edit mode, use the ▲ UP and ▼ DOWN buttons to set the value. The valid range for the day value is 1-7. As the day value is changed, the start time, duration, and stroke rate will be updated to reflect the programming for the selected day. A checked event enabled box indicates that the currently displayed event is enabled. The valid range for the duration value is 1 minute to 24 hours. The valid range for the SPM value is 0 to 120 SPM or 0-59 SPH.

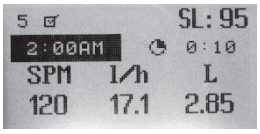
Use the ⏻ POWER button to exit the edit mode and save the setting. Use the ▭ MODE button to exit the programming mode.



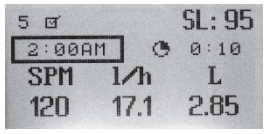
Parameter Selected



Placed Into Edit Mode

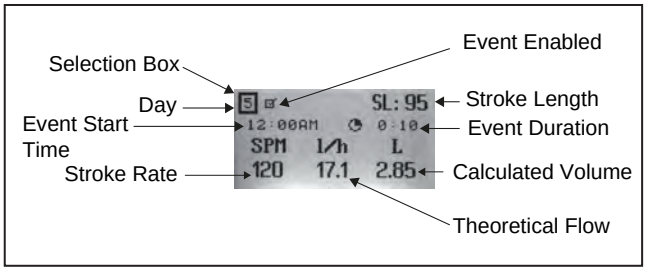


Parameter Modified



Parameter Saved

Display Overview:



1. **Selection Box:** Indicates the currently selected item.
2. **Day:** Day of currently displayed event.
3. **Event Enabled:** Indicates whether currently displayed event is enabled (checked = enabled).
4. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
5. **Event Start Time:** The Day and Time of the next timed event (*see Sec. 5.5 for time format*).
6. **Event Duration:** Duration / Run-Time of currently displayed event (format Hours:Minutes).
7. **Stroke Rate:** Indicates the stroke speed of the pump (1-59SPH or 1-120 SPM) for the currently running event or the next scheduled event.
8. **Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).
9. **Calculated Volume:** The calculated based on event duration, stroke rate, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

NOTE:

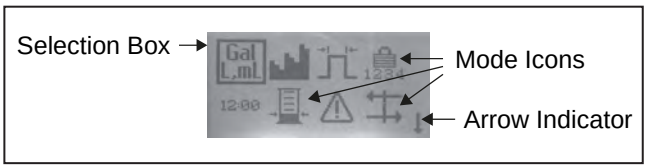
Parameter changes are saved when editing is complete and go into effect immediately.

After approximately 2 minutes of inactivity, the programming menu will automatically close and revert back to the main analog mode display.

SECTION 6 - ADVANCED CONFIGURATION MENU

Use the ▲ UP and ▼ DOWN buttons to select the desired mode. Push and hold the ⏻ POWER button for approximately 1 second to select the desired mode. Push and hold the MODE button for approximately 2 seconds to exit the menu.

Display Overview:



1. **Mode Icons:** Each icon represents a different control mode, as follows:
   - = Set Units (Sec. 6.1)
   - = Set Batch Mode (Sec. 6.2)
   - = Set Pulse Width (Sec. 6.3)
   - = Set Lock Mode Configuration (Sec. 6.4)
   - = Set Clock (Sec. 6.5)
   - = Calibrate Pump (Sec. 6.6)
   - = Set Alarm / Internal-External Output (Sec. 6.7)
   - = Set Remote Internal-External Mode Input (Sec. 6.8)
   - = Digi-Pulse™ Setup (Sec. 6.9)
   - = Set Percent-of-Time Operation (Sec. 6.10)
   - = Load Factory Defaults (Sec. 6.11)
   - = View Pump Information (Sec. 6.12)
2. **Selection Box:** Indicates the currently selected item.
3. **Arrow Indicator:** An arrow appearing on the upper or lower right of the display indicates that more icons are available via scrolling.

NOTE:

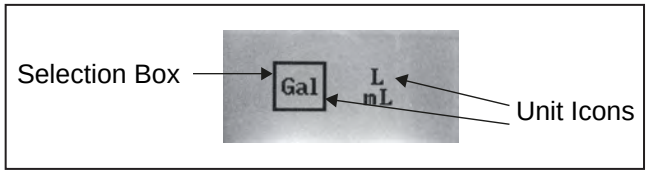
Parameter changes are saved when editing is complete and go into effect immediately.

After approximately 2 minutes of inactivity, the mode selection menu will automatically close and revert back to the most recent control mode display.

6.1 SET UNITS

Use the ▲ UP and ▼ DOWN buttons to select the desired units. Push the ⏻ POWER button to selected the item and return to the advanced configuration menu.

Display Overview:



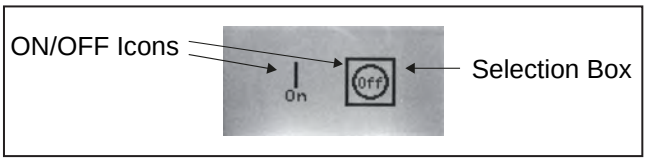
1. **Unit Icons:**
   - Gal = English Units (i.e. Gallons per hour - GPH).
   - L / mL = Metric Units (i.e. Liters, milliliters).
2. **Selection Box:** Indicates the currently selected item.

SECTION 6 - ADVANCED CONFIGURATION MENU

6.2 SET BATCH MODE

Batch mode applies only to the Pulse Multiply Mode (*see Section. 5.2*). Use the ▲ UP and ▼ DOWN buttons to select On or Off. Push the ⏻ POWER button to select the item and return to the advanced configuration menu. Use the ▭ MODE button to return to the advanced configuration menu without saving changes.

Display Overview:

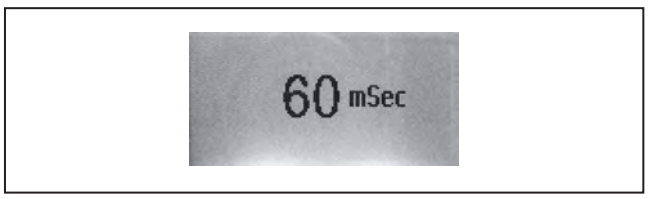


1. **ON/OFF Icons:**
   - On = Batch Mode ON (Stroke counter will accumulate when pulses are detected during an existing pump cycle)
   - Off = Batch Mode OFF (Stroke counter will reset if a pulse is detected during an existing pump cycle)
2. **Selection Box:** Indicates the currently selected item.

6.3 SET PULSE WIDTH

Use the ▲ UP and ▼ DOWN arrows to change the value for the pulse width. The valid range is 4 mSec - 60 mSec (in 4 mSec increments). Push the ⏻ POWER button to save the value and return to the advanced configuration menu. Use the ▭ MODE button to return to the advanced configuration menu without saving changes.

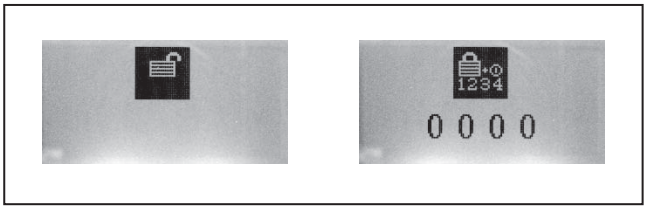
Display Overview:



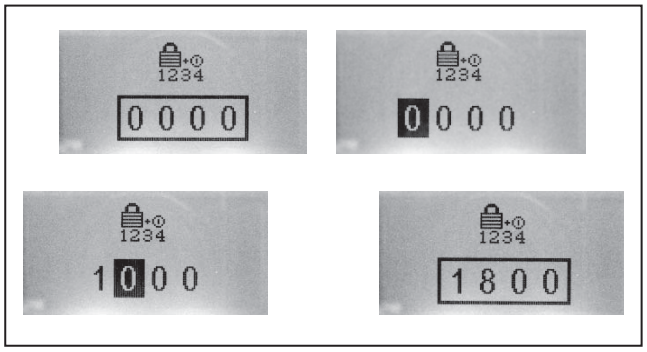
Pulse width (in milliseconds)

6.4 SET LOCK MODE CONFIGURATION

This menu is used to select the desired lock mode and to set the pass code; when you exit this menu, the lock is not activated (*see Sec. 4.4 to activate the lock*). Use the ▲ UP or ▼ DOWN button to select the desired parameter. Use the ⏻ POWER button to toggle to parameter's edit mode. A black background indicates the parameter is in edit mode. While in edit mode, use the ▲ UP and ▼ DOWN buttons to set the value. While setting the unlock pass code, use the POWER button to advance to the next digit, and the ▭ MODE button to go back to the prior digit. Use the ▭ MODE button to return to the advanced configuration menu.



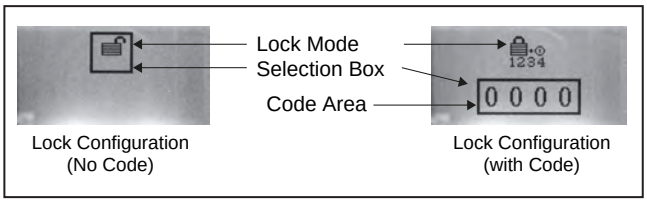
Example: Editing Lock Mode



Example: Editing Unlock Pass Code

SECTION 6 - ADVANCED CONFIGURATION MENU

Display Overview:



1. Lock Mode:

The icon corresponding to the current lock mode configuration.

= Always unlocked (default).

= All buttons locked out except the ⏻ POWER button.

= All buttons locked out.

= All buttons locked out except the ⏻ POWER button and an unlock pass code required to unlock pump.

= All buttons locked out and an unlock pass code required to unlock pump.

2. Code Area (on appropriate lock modes only): Displays 4-digit unlock pass code.

3. Selection Box: Indicates the currently selected item.

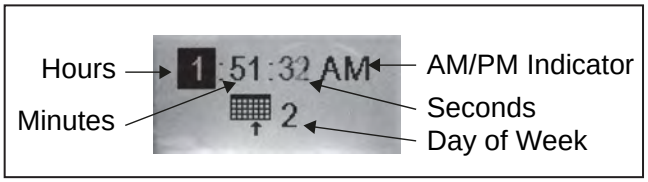
NOTE:

Make note of the pass code you have selected. This will be required to unlock the pump. If the pass code is misplaced and the lock is activated, the pump must be returned to the factory in order to be reset (see Section 4.4 to unlock the pump).

6.5 12:00 SET CLOCK

The clock will only be displayed when operating in Timed Event Mode (*see Sec. 5.5*). Use the ▲ UP or ▼ DOWN button to edit the highlighted parameter. Use the ⏻ POWER button to advance to the next parameter. Use the ▭ MODE button to go back to the prior parameter.

Display Overview:



1. Hours (1-12).
2. Minutes (0-59).
3. Seconds (0-59).
4. AM/PM Indicator (AM or PM).
5. Day of Week (1-7).

SECTION 6 - ADVANCED CONFIGURATION MENU

6.6 PUMP CALIBRATION

Pump calibration will increase the accuracy of the various displayed flow rates and volumes. In Single-Point Calibration (*see first diagram below*), the pump is calibrated to a specific stroke length and flow rate (P1), changing the slope of the flow line as indicated in the diagram. The "Calibration Region" extends to +/- 10% of the calibrated stroke length. As a result, the Single-Point Calibration should only be used if the stroke-length is to be maintained within 10% of the calibration setting.

In Two-Point Calibration (*see second diagram below*), the pump is calibrated to two specific stroke length and flow rate combinations (Pa and Pb), changing the slope and the offset of the flow line as indicated in the diagram. Pa and Pb stroke lengths must differ by at least 10%. The "Calibration Region" extends from -10% of Pa to +10% of Pb stroke lengths. The Two-Point Calibration will always result in a larger "Calibration Region" than the Single-Point Calibration.

When a pump has been calibrated, the 1 or 2 icon is displayed in the Icon/Alarm area of the display (*see Sec. 4.5*). If the stroke length is adjusted outside the calibration region, the **SL** alarm icon will be displayed in the Icon/Alarm area of the display.

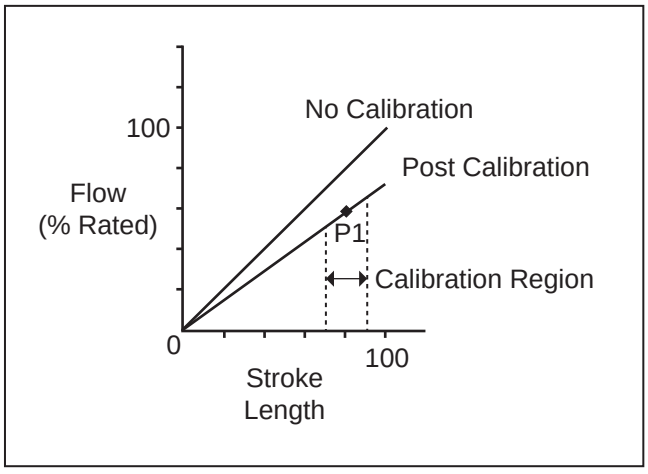


Figure 2. Single-Point Calibration

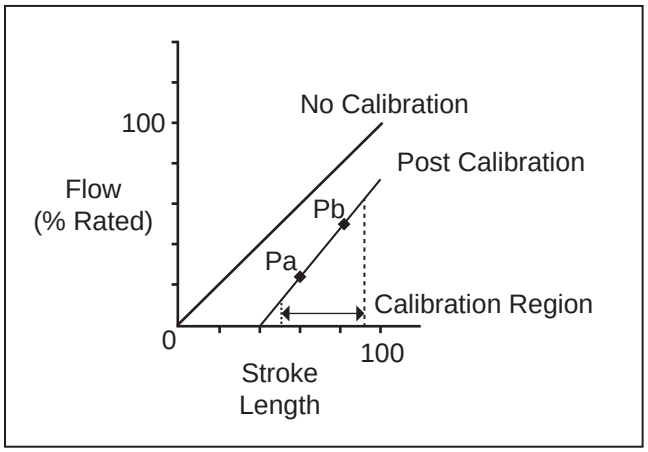
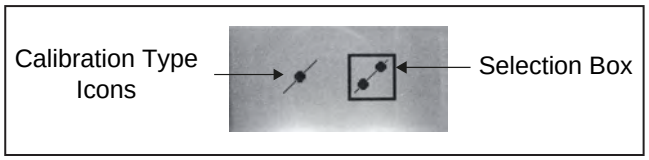


Figure 3. Two-Point Calibration

Use the ▲ UP or ▼ DOWN button to select the desired calibration mode. Use the ⏻ POWER button to select the mode (*see Sec. 6.6.1 for single-point calibration procedure or Sec. 6.6.2 for two-point calibration procedure*). Use the ▭ MODE button to return to the advanced configuration menu without making changes.

Display Overview:



1. **Calibration Type Icons:** The icons corresponding to the following calibration types:

   = Single-Point Calibration

   = Two-Point Calibration
2. **Selection Box:** Indicates the currently selected item.

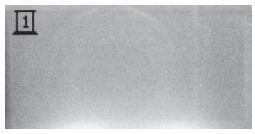
SECTION 6 - ADVANCED CONFIGURATION MENU

6.6.1 Single-Point Calibration Procedure

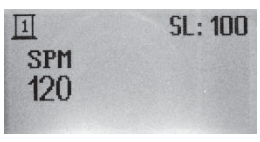
During calibration, accuracy improves as stroke count increases. As a result, a minimum of 100 strokes should be used to calibrate the pump. The maximum number of strokes in the calibration process is 9999. The stroke length cannot be changed during calibration step 3 below. If the stroke length is changed, a **SL** error icon will display, the pump will stop, and the stroke count and pump output will be reset to zero. Stroke speed may only be adjusted in step 2. In general, the ⊟ MODE button may be used to step back in the calibration procedure.

Procedure:

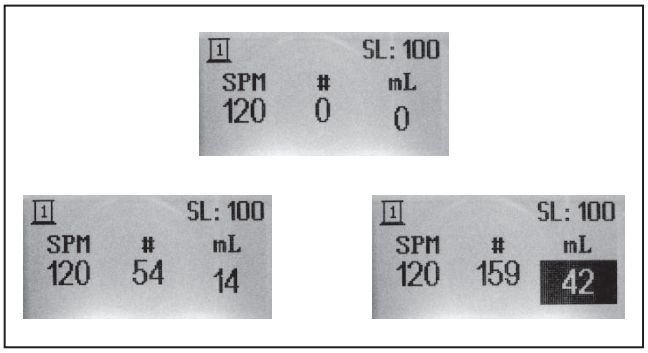
1. Upon selecting single-point calibration, the [1] icon will be displayed indicating that pump is ready to begin calibration.



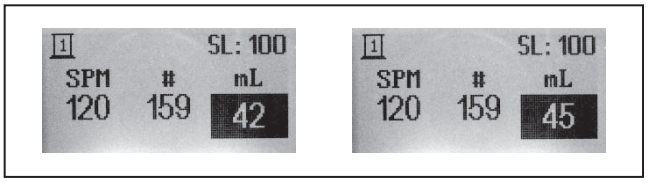
2. Press the ⏻ POWER button. The pump will begin pulsing. Adjust the stroke length knob to the desired setting for calibration. Use the ▲ UP or ▼ DOWN buttons to adjust the stroke speed to the desired setting for calibration. Press the ⏻ POWER button when adjustments are complete. The pump will stop pulsing.



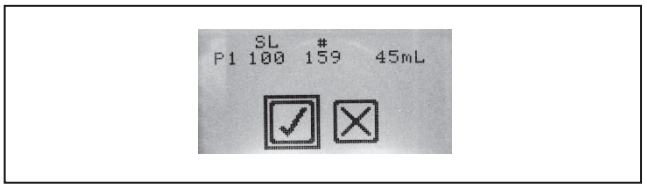
3. Press the ⏻ POWER button to begin calibration of the pump. The pump will start pulsing. The display will begin counting the strokes and displaying the accumulated volume. The volume displayed is based upon the pre-existing settings. Press the ⏻ POWER button when the desired number of strokes has occurred.



4. Use the ▲ UP or ▼ DOWN buttons to edit the highlighted volume as necessary. Press the ⏻ POWER button when complete.



5. Use the ▲ UP or ▼ DOWN buttons to select whether to ☑ (Save) or ☒ (abandon) the displayed calibration settings. Press the ⏻ POWER button to accept the selection and then return to the main calibration menu.



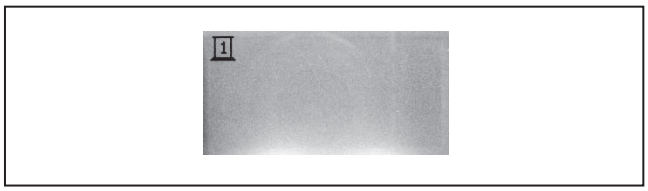
SECTION 6 - ADVANCED CONFIGURATION MENU

6.6.2 Two-Point Calibration Procedure

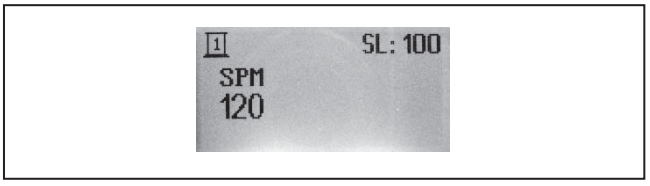
During calibration, accuracy improves as stroke count increases. As a result, a minimum of 100 strokes should be used to calibrate the pump. The maximum number of strokes in the calibration process is 9999. The stroke length cannot be changed during calibration steps 3 and 7. If the stroke length is changed, a **SL** error icon will display, the pump will stop, and the stroke count and pump output will be reset to zero. Stroke speed may only be adjusted in calibration steps 2 and 6. In general, the MODE button may be used to move back in the calibration procedure.

Procedure:

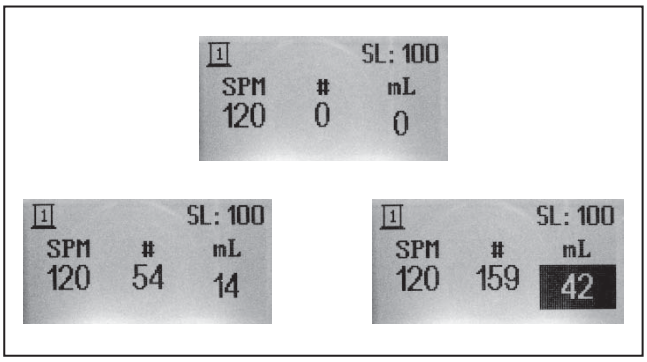
1. Upon selecting two-point calibration, the 1 icon will be displayed indicating that the pump is ready to begin calibration of point one.



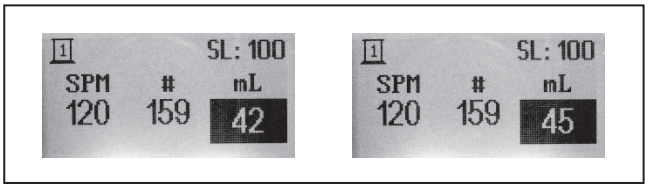
2. Press the ⏻ POWER button. The pump will begin pulsing. Adjust the stroke length knob to the desired setting for calibration of point 1. Use the ▲ UP or ▼ DOWN buttons to adjust the stroke speed to the desired setting for calibration of point 1. Press the ⏻ POWER button when adjustments are complete. The pump will stop pulsing.



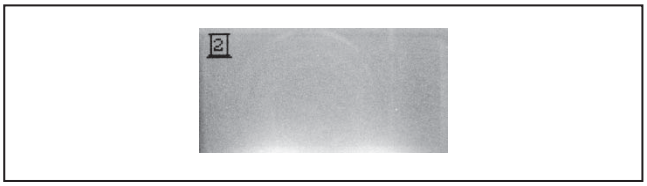
3. Press the ⏻ POWER button to begin the calibration of point 1. The pump will start pulsing. The display will begin counting the strokes and displaying the accumulated volume. The volume displayed is based upon the pre-existing settings. Press the ⏻ POWER button when the desired number of strokes has occurred.



4. Use the ▲ UP or ▼ DOWN buttons to edit the highlighted volume as necessary. Press the ⏻ POWER button when complete.

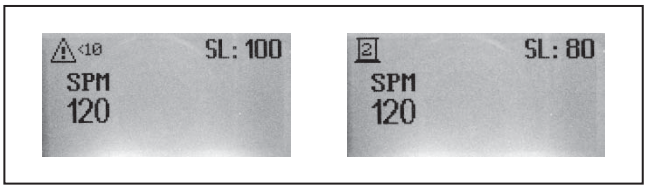


5. The 2 icon will now be displayed, indicating that the pump is ready to begin calibration of point two.

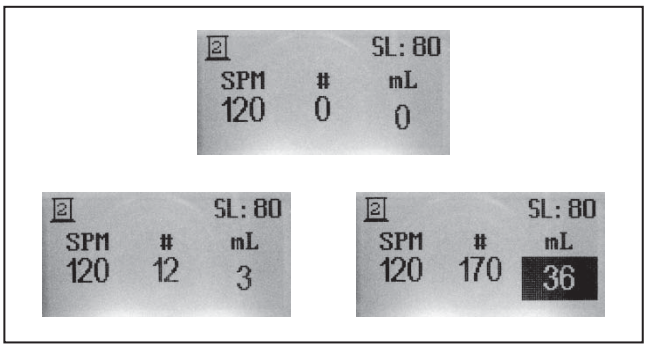


SECTION 6 - ADVANCED CONFIGURATION MENU

6. Press the ⏻ POWER button. The pump will begin pulsing. Adjust the stroke length knob to the desired setting for calibration of point 2. Use the ▲ UP or ▼ DOWN buttons to adjust the stroke speed to the desired setting for calibration of point 2. Press the ⏻ POWER button when adjustments are complete. The pump will stop pulsing. The two stroke length settings must be at least 10% apart. If not, a <10 error icon will display.

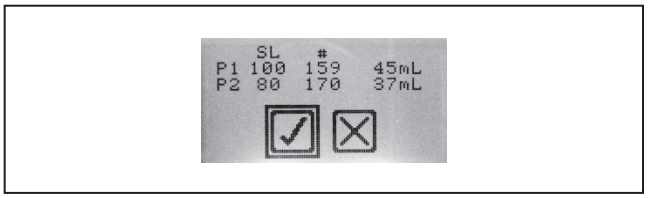


7. Press the ⏻ POWER button to begin calibration of point 2. The pump will start pulsing. The display will begin counting the strokes and displaying the accumulated volume. The volume displayed is based upon the pre-existing settings. Press the ⏻ POWER button when the desired number of strokes has occurred.



8. Use the ▲ UP or ▼ DOWN buttons to edit the highlighted volume as necessary. Press the ⏻ POWER button when complete.

9. Use the ▲ UP or ▼ DOWN buttons to select whether to ☑ (Save) or ☒ (abandon) the displayed calibration settings. Press the ⏻ POWER button to accept the selection and then return to the main calibration menu.



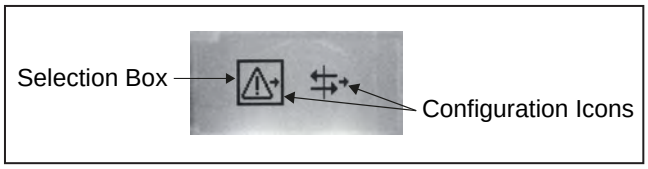
SECTION 6 - ADVANCED CONFIGURATION MENU

6.7 ⚠ CONFIGURE ALARM OUTPUT

This feature is used to configure the alarm output, which is indicated on the appropriate contacts of the 6-Pin connector. The alarm output can be configured in one of two ways: it can be used to indicate the alarm status or it can be used to indicate whether the pump is in an internal or external control mode. If the alarm output is configured to indicate the alarm status, then open contacts indicate that there is no alarm. When an alarm is active, the contacts will be closed. If the alarm output is configured to indicate the internal external mode status, then open contacts indicates the pump is in an internal mode; closed contacts indicates the pump is in an external mode.

Use the ▲ UP or ▼ DOWN button to select the desired configuration. Use the ⏻ POWER button to select the configuration. If alarm output indicates alarm status is selected, the Alarm Output Mask configuration menu will display next (*see Sec. 6.7.1*). Use the ▭ MODE button to return to the advanced configuration menu without making changes.

Display Overview:



1. **Configuration Icons:**

   ⚠→ = Alarm output indicates alarm status.

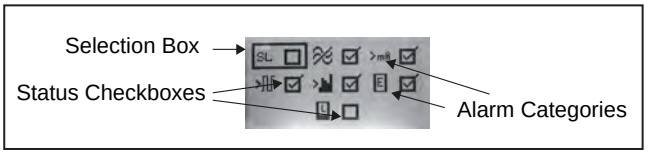
   ⇄→ = Alarm output indicates Internal/External Mode status.

2. **Selection Box:** Indicates the currently selected item

6.7.1 Configure Alarm Output Mask

Use the ▲ UP or ▼ DOWN button to select the desired alarm to enable/disable. Use the ⏻ POWER button to toggle the associated status check box. Use either the ▭ MODE button or navigate using the ▲ UP or ▼ DOWN buttons to save the data and return to the configure alarm output menu.

Display Overview:



1. **Alarm Categories** (*see Sec. 4.5 for descriptions of each alarm condition*)

   SL = Stroke length alarm.

   = DIGI-PULSE™ flow switch alarm.

   = Analog input alarm.

   = Incoming pulse rate alarm.

   = Batch alarm.

   E = Empty tank alarm.

   L = Low tank alarm.

2. **Status Check boxes:** Indicates if the alarm output will be enabled (checked) or ignored (unchecked) when the associated alarm condition is detected.
3. **Selection Box:** Indicates the currently selected item.

SECTION 6 - ADVANCED CONFIGURATION MENU

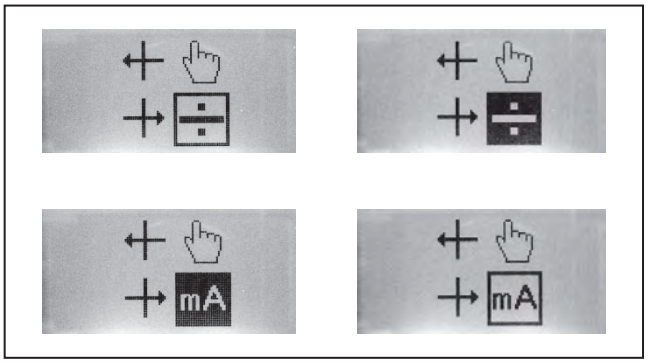
6.8 SET REMOTE INTERNAL-EXTERNAL MODE INPUT

This feature is used to switch from an internal control mode to an external control mode remotely by using the appropriate contacts of the 6-Pin connector. There are two internal control modes and 3 external control modes (*see Sec. 5.0*). The remote internal/external inputs are only monitored when the contacts are switched from open to closed, or vice versa. As a result, the control mode can always be changed from the pump, regardless of the closure status of these contacts.

If the pump is in an internal mode and the contacts on the remote internal/external input are closed, the pump will switch to the programmed external mode. If the pump is in an external mode and the contacts are opened, the pump will switch to the programmed internal mode.

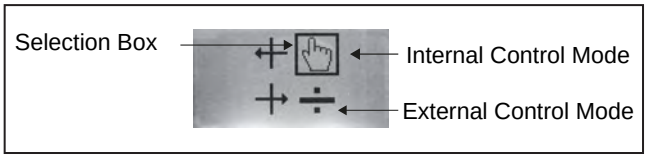
If the pump is in an internal mode and the contacts are opened, no action will be taken-the pump will remain in the pre-existing control mode. In this case, if the pre-existing control mode differs from the programmed control mode, the pre-existing control mode takes priority. Conversely, if the pump is in an external mode and the contacts are closed, no action will be taken.

Use the ⏻ POWER button to toggle to parameter's edit mode. A black background indicates the parameter is in edit mode. While in edit mode, use the ▲ UP and ▼ DOWN buttons to set the value. Use the POWER button to exit edit mode and save the setting. Use the ▭ MODE button to return to the advanced configuration menu.



Example: Editing the External Control Mode Parameter

Display Overview:



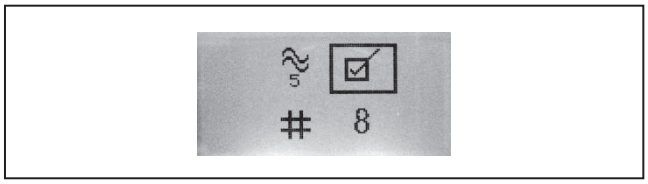
1. **Internal Control Mode:** The following are valid internal type control modes:
   - = Manual
   - = Timed Event
2. **External Control Mode:** The following are valid external type control modes:
   - = Pulse Multiply
   - = Pulse Divide
   - mA = Analog (mA)
3. **Selection Box:** Indicates the currently selected item.

SECTION 6 - ADVANCED CONFIGURATION MENU

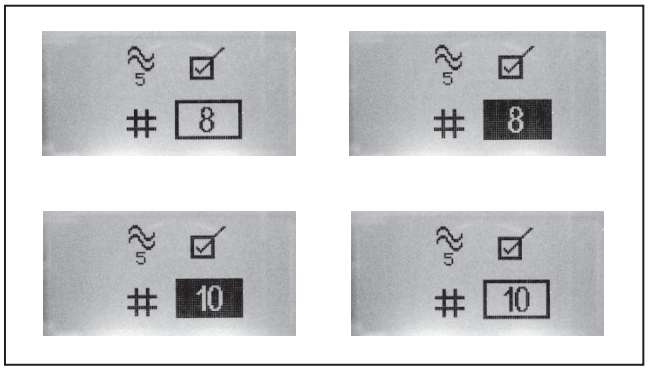
6.9 DIGI-PULSE™ FLOW MONITORING SETUP

This feature is used in conjunction with the LMI® Series FM-ROY-9 Digi-Pulse™ Flow Monitor (refer to DIGI-PULSE™ Flow Monitor Instructions P/N 1865). This device is designed to monitor the output flow from a pump. It may be set to deliver a pulse signal output for each successful pump stroke registered. If the flow stops or lessens, the pulse outputs will cease. With the FMROY- 9 connected to the 4-Pin connector, the presence or lack of pulses can be detected.

Use the ⏫ UP or ⏬ DOWN button to select the icon. Use the ⏻ POWER button to toggle the Function Enabled Indicator. Use the ⏻ POWER button to toggle the Missing Pulses parameter's edit mode. While in edit mode, use the ⏫ UP and ⏬ DOWN buttons to set the value. Use the ▭ MODE button to return to the advanced configuration menu.

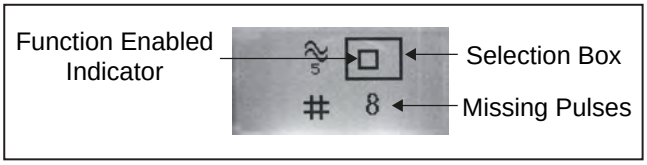


Example: Enabling the Function



Example: Editing the Missing Pulses Parameter

Display Overview:



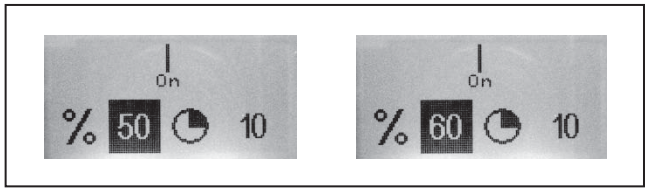
1. **Function Enabled Indicator:** Check box indicating if DIGI-PULSE™ Flow Monitoring functionality is enabled (checked=enabled).
2. **Missing Pulses:** Number of missing pulses to detect before issuing pump alarm. The valid range is 0-255. The factory default is 8. A setting of 1 is the most sensitive; a setting of 255 is the least sensitive.
3. **Selection Box:** Indicates the currently selected item.

When flow monitoring is enabled, the icon is displayed in the Icon/Alarm area of the display (*see Sec. 4.5*). If, for example, the Missing Pulses parameter is set to 5 and 5 strokes of the pump occur without any pulse being received from the FM-ROY-9, the alarm icon will be displayed in the Alarm/Icon area of the display (*see Sec. 4.5*). The pump will stop and the alarm outputs will be activated, if enabled (*see Sec. 6.7*). Pressing the ⏻ POWER button clears the alarm.

SECTION 6 - ADVANCED CONFIGURATION MENU

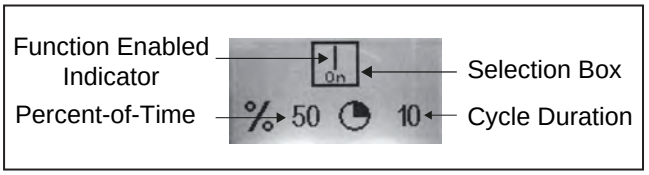
6.10 % SET PERCENT-OF-TIME OPERATION

This feature allows time-based cycling of the pump in Manual, Pulse Divide, and Analog Control Modes. The pump cycles on and off based on the configuration parameters. Use the ▲ UP or ▼ DOWN button to select the % icon. Use the ⏻ POWER button to toggle the Function Enabled Indicator. Use the ⏻ POWER button to toggle the parameter's edit mode (Percent of Time and Cycle Duration parameters). While in edit mode, use the ▲ UP and ▼ DOWN buttons to set the value. Use the ▭ MODE button to return to the advanced configuration menu.



Example: Editing Percent-of-Time Parameter

Display Overview:



1. **Function Enabled Indicator:** Indicates if Percent-of-Time functionality is enabled.
   Off = Function OFF / Disabled.
   On = Function ON / Enabled.
2. **Percent of Time (Function ON only):** Percent of time cycle to enable pump stroking (0-100).
3. **Cycle Duration (Function ON only):** Total cycle time in minutes (1-1440).
4. **Selection Box:** Indicates the currently selected item.

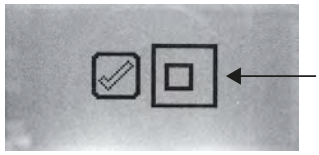
For example, if % = 20 and ◔ = 10, then the pump will cycle continuously as follows: run for 2 minutes, stop for 8 minutes. When this feature is enabled, the % icon is displayed in the Icon/Alarm area of the display (*see Sec. 4.5*).

SECTION 6 - ADVANCED CONFIGURATION MENU

6.11 LOAD FACTORY DEFAULTS

This feature will return the pump parameters to their factory default settings. Push the ⏻ POWER button to highlight the confirmation box. Push the ▲ UP or ▼ DOWN button to check or uncheck the box. Push the ⏻ POWER button to load factory defaults and return pump to default state (*see Sec. 4.0*). Use the ▭ MODE button to return to the advanced configuration menu without saving changes.

Display Overview:

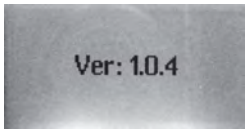


1. **Confirmation Box:** Check this box to confirm operation

6.12 VIEW PUMP INFORMATION

This feature displays the pump firmware version. Use the ▭ MODE button to return to the advanced configuration menu.

Display Overview:



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DIGI-PULSE™ is a trademark of Milton Roy, LLC.
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LMI®
an Accudyne Industries brand

Chapter 14 Submersible Water Pump (Division 43)

MANUFACTURER/DISTRIBUTOR:

Atlantis Pompe St-Foy
Éric Forbes
1844 Boul. Hamel Ouest
Québec, QC, G1N 3Z2
Phone: (418) 681-7301
eforbes@atlantispompe.com

14.1 Franklin Electric Submersible Water Pump 6” 5HP 575V (WTP)

Franklin Electric
Pump End
#94810003
5HP, 100GPM, 6"

J-CLASS SandHandler

6" High Capacity Pumps

Ideal for farm, home, irrigation, industry, municipal and commercial applications, equipped with the power, performance and reliability you expect from Franklin Electric.

Flow ratings of 50, 75, 100 and 125 gpm with TDH up to 1200 ft.

Horsepower ranges from 1-1/2 to 40 hp.

Features:

- Heavy-duty stainless steel discharge head and motor bracket
- Stainless steel shaft, shell, intake screen and cable guard provides corrosion resistance and longer pump life
- Glass-filled Noryl®* impeller stage assemblies provide exceptional strength and durability
- Ceramic shaft sleeve and rubber discharge bearing minimize bearing wear and shaft misalignment
- 3" NPT tapping in heavy-duty stainless steel discharge head
- Modular motor bracket enabling 4" or 6" motor mount for 5-10 horsepower units
- One-year unconditional warranty against failure from sand locking in abrasive well conditions

* Noryl® is a registered trademark of G.E.

System Solutions

Franklin Electric
The Company You Trust Deep Down

Franklin Electric
Pump End
#94810003
5HP, 100GPM, 6"

Ordering Information

6" Pump Ends:

1.5 - 25 HP 6" PUMP ENDS							
GPM	HP	STAGES	MOTOR FIT	ORDERING INFO.		DIMENSIONS	WT.
				MODEL NO.	ORDER NO.	PEA	
50	1.5	3	4"	50JS15S6-PE	94815003	13.51	30
	2	4	4"	50JS2S6-PE	94815004	15.13	31
	3	5	4"	50JS3S6-PE	94815005	16.76	32
	5	8	4" & 6"	50JS5S6-PE	94815008	21.63	36
	7.5	11	4" & 6"	50JS75S6-PE	94815011	26.51	40
	10	15	4" & 6"	50JS10S6-PE	94815015	32.94	46
75	3	3	4"	75JS3S6-PE	94817503	13.51	30
	5	5	4" & 6"	75JS5S6-PE	94817505	16.76	32
	7.5	7	4" & 6"	75JS75S6-PE	94817507	20.01	35
	10	9	4" & 6"	75JS10S6-PE	94817509	23.26	38
	15	13	6"	75JS15S6-PE	94817513	29.76	43
	20	17	6"	75JS20S6-PE	94817517	36.19	48
	25	23	6"	75JS25S6-PE	94817523	46.00	54
100	5	3	4" & 6"	100JS5S6-PE	94810003	14.62	30
	7.5	5	4" & 6"	100JS7S6-PE	94810005	18.51	32
	10	6	4" & 6"	100JS10S6-PE	94810006	20.49	34
	15	9	6"	100JS15S6-PE	94810009	26.31	38
	20	13	6"	100JS20S6-PE	94810013	34.07	43
	25	16	6"	100JS25S6-PE	94810016	39.94	47
125	5	2	4" & 6"	125JS5S6-PE	94812502	12.94	29
	7.5	3	4" & 6"	125JS7S6-PE	94812503	15.05	30
	10	4	4" & 6"	125JS10S6-PE	94812504	17.13	31
	15	7	6"	125JS15S6-PE	94812507	23.37	35
	20	9	6"	125JS20S6-PE	94812509	27.54	38
	25	11	6"	125JS25S6-PE	94812511	31.70	40
	30	13	6"	125JS30S6-PE	94812513	35.87	43
	40	18	6"	125JS40S6-PE	94812518	46.27	48

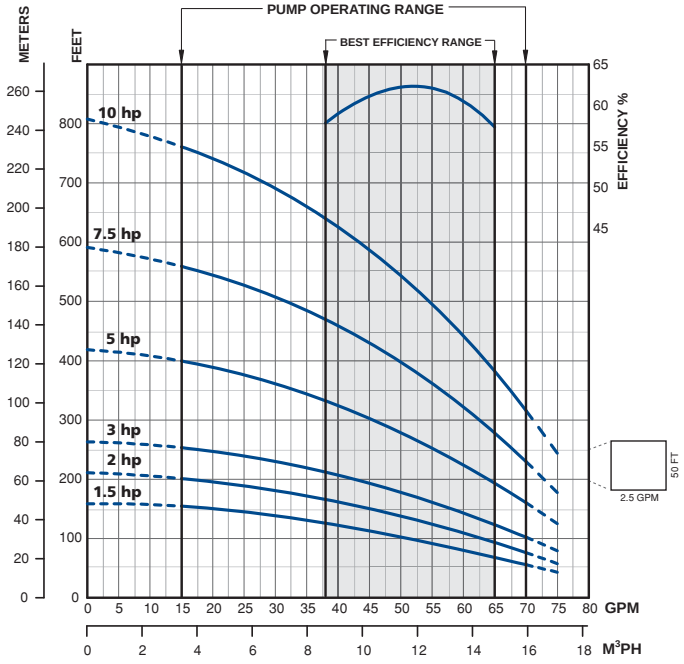
Note: All dimensions are in inches. Discharge is 3" NPT. Maximum diameter across cable guard is 5.5" on all models. Weight in pounds.

6" High Capacity P

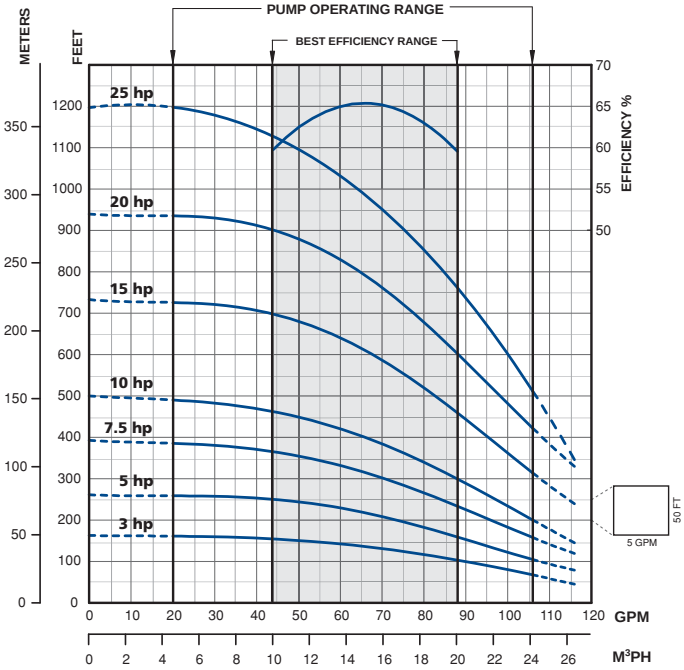
Franklin Electric
Pump End
#94810003
5HP, 100GPM, 6"

Perfomance Curves:

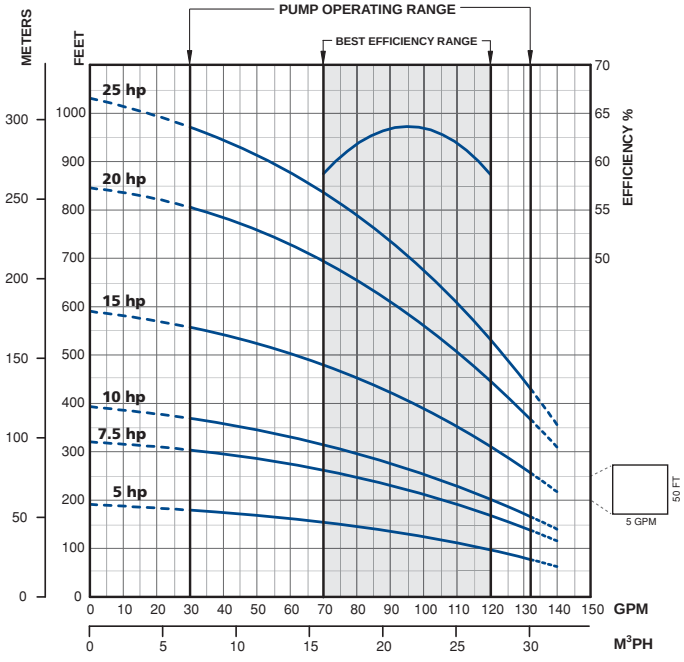
50 gpm:



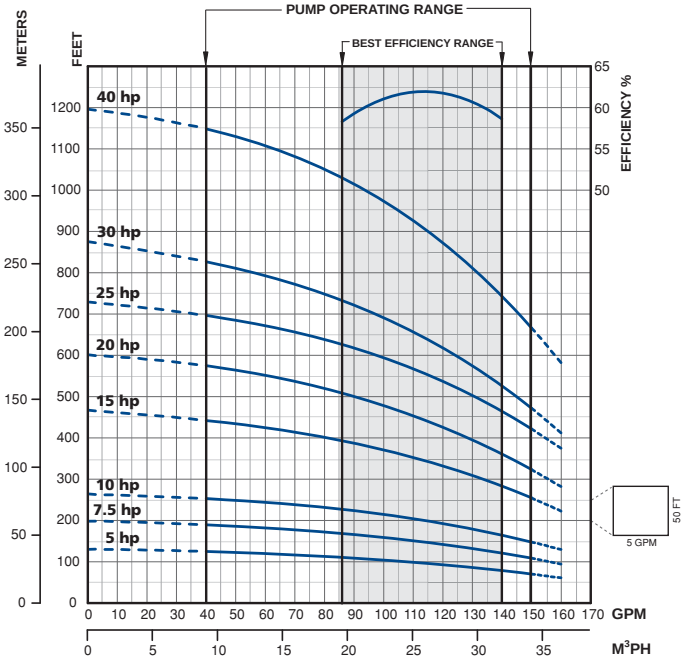
75 gpm:



100 gpm:



125 gpm:



Franklin Electric
The Company You Trust Deep Down

Franklin Electric
Pump End
#2366209020
5HP, 575V

6" SUBMERSIBLE MOTORS

These motors are built for dependable operation in 6" diameter or larger water wells.

BASIC FEATURES

- Double flanged NEMA mounting design
- Stainless steel splined shaft
- StatorShield™, Franklin's six-feature encapsulation system
- High-capacity, Kingsbury-type, water-lubricated thrust bearing
- Factory-filled with Franklin's non-toxic water soluble fill solution
- Field replaceable lead using Franklin's exclusive Water-Bloc™ technology
- Full 3,450 rpm 60 Hz design point
- External sand slinger on shaft
- Mechanical face seal at shaft exit
- Copper bar rotor
- All models variable frequency drive (VFD) compatible
- Single-phase models must be used with a Franklin Electric control box

SPECIAL FEATURES

- Sand Fighter™ and 316 stainless steel models are equipped with Franklin's exclusive Sand Fighter™ sealing system for sand or other abrasives, as well as Franklin's exclusive on-winding SubTrol™ heat sensor for use with SubMonitor™
- Consult factory for other voltage, hertz, and horsepower ratings not listed in this catalog
- Specifications are subject to change without notice; contact Franklin Electric if current materials are required for bid specifications
- Overmolded motor leads on all 10 GA leads

Franklin Electric
Pump End
#2366209020
5HP, 575V

6" SUBMERSIBLE MOTORS - SPECIFICATIONS AND MATERIALS

MOTOR SPECIFICATIONS

Hz	Model	Phase	HP Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
50	Standard*	1	5 - 15	3.7 - 11	2	2875	86 °F / 30 °C	Continuous*
50		3	5 - 40	3.7 - 45			86 °F / 30 °C	
50		3	50 - 60	37 - 45			122 °F / 50 °C	
50	High-Temp 90°C**	3	5 - 40	3.7 - 30			195 °F / 90 °C	
60		1	5 - 15	3.7 - 11		3450	86 °F / 30 °C	
60	Standard*	3	5 - 40	3.7 - 30			86 °F / 30 °C	
60		3	50 - 60	37 - 45			122 °F / 50 °C	
60	High-Temp 90°C**	3	5 - 40	3.7 - 30			195 °F / 90 °C	

At 0.5 ft/sec flow past motor; motors are rated for continuous duty up to 86°F (30 °C) water temperature

**At 0.5 ft/sec flow past motor, motors are rated for continuous duty up to 195°F (90 °C) water temperature and up to 86 °F (30 °C) water temperature with NO FLOW in lakes or in wells 12 inches or larger in diameter.*

CONSTRUCTION MATERIALS

Component	Construction Type				
	Standard Water Well	Sand Fighter™	Corrosion Resistant (316 SS)	Hi-Temp 90°C (300 SS Shell)	Hi-Temp 90°C (316 SS)
UL Insulation Class Rating	Class F	Per standard water well	Per standard water well	Class F	Class F
Motor Ambient Temp. Rating	86 °F / 30 °C (5-40 hp) 122 °F / 50 °C (50-60 hp)			194 °F / 90 °C (5-40 hp)	194 °F / 90 °C (5-40 hp)
Stator Resin Type	Standard (5-40 hp) / Hi-Temp (50-60 hp)			FE Hi-Temp	FE Hi-Temp
Motor Fill Solution (Water Soluble/Non-Toxic)	FES91			FES92	FES92
Top End Bell & Thrust Housing	Epoxy-coated gray iron		316 SS	Epoxy-coated gray iron	316 SS
On Winding SubTrol™ heat sensor	No (5-40 hp) / Yes (50-60 hp)	Yes	Yes	Not Available	Not Available
Stator Shell	300 series SS	Per standard water well	316 SS	300 series SS	316 SS
Stator Ends	Carbon steel			Carbon steel	316 SS
Shaft Extension	300 Series SS (5-30 hp) / 17-4 SS (40-60 hp)		17-4 SS	300 SS (5-20 hp), 17-4 SS (25-40 hp)	17-4 SS
Bushing	Bronze		316 SS	Bronze	316 SS
Bushing Retainer	300 series SS			300 series SS	316 SS
Shaft Mechanical Seal	Carbon ceramic (5-40 hp) Sand Fighter™ Seal System (50-60 hp)	Sand Fighter™ Seal System	Sand Fighter™ Seal System	Sand Fighter™ Seal System	Sand Fighter™ Seal System
Mechanical Seal / Rubber Components	Nitrile (5-40 hp) / FKM (50-60 hp)	Per standard water well	Per standard water well	FKM	FKM
Diaphragm Material	Nitrile (5-40 hp) / FKM (50-60 hp)			FKM	FKM
Diaphragm Plate	300 series SS		316 SS	300 series SS	316 SS
Diaphragm Spring	300 series SS		25-6 MO SS	300 series SS	25-6 MO SS
Shaft Slinger	Nitrile (5-40 hp) / FKM (50-60 hp)		Nitrile	FKM	FKM
Lead Wire	Overmolded		Per standard water well	XLPO	XLPO
Lead Potting	Epoxy			Epoxy	Epoxy
Lead Jam Nut	Brass		316 SS	Brass	316 SS
Thrust Bearing Rating (86 °F / 30 °C)	3500 lbs (5-30 hp) 6000 lbs (40-60 hp)		Per standard water well	Standard 5-20 hp • 4,500 lbs Standard 25-40 hp • 7,500 lbs	Standard 5-20 hp • 4,500 lbs Standard 25-40 hp • 7,500 lbs
Method Of Connecting System Ground To Motor	Ground wire in power lead connector			Ground wire in power lead connector	Ground wire in power lead connector

NOTE: Specifications subject to change without notice; contact Franklin Electric if current material types are required for bid specifications

Franklin Electric
Pump End
#2366209020
5HP, 575V

6" SUBMERSIBLE MOTORS - ORDERING INFORMATION

SINGLE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	In Stock	Thrust Rating	Wt. (lbs)
	Water Well	230	60	1.15	DOL (3)	2261109020	Yes	3500	110
5	Sand Fighter™	230	60	1.15	DOL (3)	2261108020	Yes	3500	110
	316 SS	230	60	1.15	DOL (3)	2261103920	-	3500	110
7.5	Water Well	230	60	1.15	DOL (3)	2261119020	Yes	3500	123
	Sand Fighter™	230	60	1.15	DOL (3)	2261118020	Yes	3500	123
	316 SS	230	60	1.15	DOL (3)	2261113920	-	3500	123
10	Water Well	230	60	1.15	DOL (3)	2261129020	Yes	3500	141
	Sand Fighter™	230	60	1.15	DOL (3)	2261128020	Yes	3500	141
	316 SS	230	60	1.15	DOL (3)	2261123920	-	3500	141
15	Water Well	230	60	1.15	DOL (3)	2261139020	Yes	3500	154
	Sand Fighter™	230	60	1.15	DOL (3)	2261138020	Yes	3500	154
	316 SS	230	60	1.15	DOL (3)	2261133920	-	3500	154

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	In Stock	Thrust Rating	Wt. (lbs)
	Water Well	200	60	1.15	DOL (3)	2366509020	Yes	3500	101
		220	50	1.0	DOL (3)	2366809020	-	3500	101
		230	60	1.15	DOL (3)	2366009020	Yes	3500	101
		230	60	1.15	Y-Δ (6)	2367209020	-	3500	106
		380	60	1.15	DOL (3)	2366609020	-	3500	101
		380	60	1.15	Y-Δ (6)	2367809020	-	3500	106
		415	50	1.0	DOL (3)	2366909020	-	3500	101
		460/380	60/50	1.15/1.0	DOL (3)	2366109020	Yes	3500	101
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367109020	-	3500	106
		575	60	1.15	DOL (3)	2366209020	-	3500	101
5	Sand Fighter™	200	60	1.15	DOL (3)	2366508120	Yes	3500	101
		220	50	1.0	DOL (3)	2366808120	-	3500	101
		230	60	1.15	DOL (3)	2366008120	Yes	3500	101
		380	60	1.15	DOL (3)	2366608120	-	3500	101
		460/380	60/50	1.15/1.0	DOL (3)	2366108120	Yes	3500	101
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367108120	-	3500	106
		575	60	1.15	DOL (3)	2366208120	Yes	3500	101
	316 SS w/SubTrol™	200	60	1.15	DOL (3)	2366504020	-	3500	101
		230	60	1.15	DOL (3)	2366004020	Yes	3500	101
		380	60	1.15	DOL (3)	2366604020	-	3500	101
		460/380	60/50	1.15/1.0	DOL (3)	2366104020	Yes	3500	101
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367104020	-	3500	106
		575	60	1.15	DOL (3)	2366204020	-	3500	101
	Hi-Temp 90°C	200	60	1.15	DOL (3)	2766500003	-	4500	116
		230	60	1.15	DOL (3)	2766000003	-	4500	116
		380	60	1.15	DOL (3)	2766600003	-	4500	116
		460/380	60/50	1.15/1.0	DOL (3)	2766100003	-	4500	116
		460/380	60/50	1.15/1.0	Y-Δ (6)	2767100003	-	4500	121
		575	60	1.15	DOL (3)	2766200003	-	4500	116
	Hi-Temp 90°C - 316 SS	200	60	1.15	DOL (3)	2766503003	-	4500	116
		230	60	1.15	DOL (3)	2766003003	-	4500	116
		380	60	1.15	DOL (3)	2766603003	-	4500	116
		460/380	60/50	1.15/1.0	DOL (3)	2766103003	-	4500	116
		575	60	1.15	DOL (3)	2766203003	-	4500	116

2015 EDITION

AIM MANUAL

SUBMERSIBLE MOTORS

APPLICATION | INSTALLATION | MAINTENANCE

60 Hz, Single-Phase and Three-Phase Motors

franklinwater.com

Franklin Electric

COMMITMENT **TO QUALITY**

FRANKLIN ELECTRIC GLOBAL HEADQUARTERS &
ENGINEERING DEVELOPMENT CENTER, FORT WAYNE, INDIANA

Franklin Electric is committed to provide customers with defect free products through our program of continuous improvement. Quality shall, in every case, take precedence over quantity.

ATTENTION!
IMPORTANT INFORMATION FOR INSTALLERS OF THIS EQUIPMENT!

THIS EQUIPMENT IS INTENDED FOR INSTALLATION BY TECHNICALLY QUALIFIED PERSONNEL. FAILURE TO INSTALL IT IN COMPLIANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES, AND WITHIN FRANKLIN ELECTRIC RECOMMENDATIONS, MAY RESULT IN ELECTRICAL SHOCK OR FIRE HAZARD, UNSATISFACTORY PERFORMANCE, AND EQUIPMENT FAILURE. FRANKLIN INSTALLATION INFORMATION IS AVAILABLE FROM PUMP MANUFACTURERS AND DISTRIBUTORS, AND DIRECTLY FROM FRANKLIN ELECTRIC. CALL FRANKLIN TOLL FREE 800-348-2420 FOR INFORMATION.

WARNING

SERIOUS OR FATAL ELECTRICAL SHOCK MAY RESULT FROM FAILURE TO CONNECT THE MOTOR, CONTROL ENCLOSURES, METAL PLUMBING, AND ALL OTHER METAL NEAR THE MOTOR OR CABLE, TO THE POWER SUPPLY GROUND TERMINAL USING WIRE NO SMALLER THAN MOTOR CABLE WIRES. TO REDUCE RISK OF ELECTRICAL SHOCK, DISCONNECT POWER BEFORE WORKING ON OR AROUND THE WATER SYSTEM. DO NOT USE MOTOR IN SWIMMING AREAS.

ATTENTION!
INFORMATIONS IMPORTANTES POUR L'INSTALLATEUR DE CET EQUIPEMENT.

CET EQUIPEMENT DOIT ETRE INTALLE PAR UN TECHNICIEN QUALIFIE. SI L'INSTALLATION N'EST PAS CONFORME AUX LOIS NATIONALES OU LOCALES AINSI QU'AUX RECOMMANDATIONS DE FRANKLIN ELECTRIC, UN CHOC ELECTRIQUE, LE FEU, UNE PERFORMANCE NON ACCEPTABLE, VOIRE MEME LE NON-FONCTIONNEMENT PEUVENT SURVENIR. UN GUIDE D'INSTALLATION DE FRANKLIN ELECTRIC EST DISPONIBLE CHEZ LES MANUFACTURIERS DE POMPES, LES DISTRIBUTEURS, OU DIRECTEMENT CHEZ FRANKLIN. POUR DE PLUS AMPLES RENSEIGNEMENTS, APPELEZ SANS FRAIS LE 800-348-2420.

AVERTISEMENT

UN CHOC ELECTRIQUE SERIEUX OU MEME MORTEL EST POSSIBLE, SI L'ON NEGLIGE DE CONNECTER LE MOTEUR, LA PLOMBERIE METALLIQUE, BOITES DE CONTROLE ET TOUT METAL PROCHE DU MOTEUR A UN CABLE ALLANT VERS UNE ALIMENTATION D'ENERGIE AVEC BORNE DE MISE A LA TERRE UTILISANT AU MOINS LE MEME CALIBRE QUE LES FILS DU MOTEUR. POUR REDUIRE LE RISQUE DE CHOC ELECTRIQUE. COUPER LE COURANT AVANT DE TRAVAILLER PRES OU SUR LE SYSTEM D'EAU. NE PAS UTILISER CE MOTEUR DANS UNE ZONE DE BAIGNADE.

ATENCION!
INFORMACION PARA EL INSTALADOR DE ESTE EQUIPO.

PARA LA INSTALACION DE ESTE EQUIPO, SE REQUIERE DE PERSONAL TECNICO CALIFICADO. EL NO CUMPLIR CON LAS NORMAS ELECTRICAS NACIONALES Y LOCALES, ASI COMO CON LAS RECOMENDACIONES DE FRANKLIN ELECTRIC DURANTE SU INSTALACION, PUEDE OCASIONAR, UN CHOQUE ELECTRICO, PELIGRO DE UN INCENDIO, OPERACION DEFECTUOSA E INCLUSO LA DESCOMPOSTURA DEL EQUIPO. LOS MANUALES DE INSTALACION Y PUESTA EN MARCHA DE LOS EQUIPOS, ESTAN DISPONIBLES CON LOS DISTRIBUIDORES, FABRICANTES DE BOMBAS O DIRECTAMENTE CON FRANKLIN ELECTRIC. PUEDE LLAMAR GRATUITAMENTE PARA MAYOR INFORMACION AL TELEFONO 800-348-2420.

ADVERTENCIA

PUEDE OCURRIR UN CHOQUE ELECTRICO, SERIO O FATAL DEBIDO A UNA ERRONEA CONECCION DEL MOTOR, DE LOS TABLEROS ELECTRICOS, DE LA TUBERIA, DE CUALQUIER OTRA PARTE METALICA QUE ESTA CERCA DEL MOTOR O POR NO UTILIZAR UN CABLE PARA TIERRA DE CALIBRE IGUAL O MAYOR AL DE LA ALIMENTACION. PARA REDUCIR EL RIESGO DE CHOQUE ELECTRIC, DESCONECTAR LA ALIMENTACION ELECTRICA ANTES DE INICIAR A TRABAJAR EN EL SISTEMA HIDRAULICO. NO UTILIZAR ESTE MOTOR EN ALBERCAS O AREAS EN DONDE SE PRACTIQUE NATACION.

60 Hz, Single-Phase and Three-Phase

SUBMERSIBLE MOTOR

Application • Installation • Maintenance Manual

The submersible motor is a reliable, efficient and trouble-free means of powering a pump. Its needs for a long operational life are simple. They are:

1. A suitable operating environment
2. An adequate supply of electricity
3. An adequate flow of cooling water over the motor
4. An appropriate pump load

All considerations of application, installation, and maintenance of submersible motors relating to these four areas are presented in this manual. Franklin Electric's web page, www.franklin-electric.com, should be checked for the latest updates.

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Storage

Franklin Electric submersible motors are a water-lubricated design. The fill solution consists of a mixture of deionized water and Propylene Glycol (a non-toxic antifreeze). The solution will prevent damage from freezing in temperatures to -40 °F (-40 °C); motors should be stored in areas that do not go below this temperature. The solution will partially freeze below 27 °F (-3 °C), but no damage occurs. Repeated freezing and thawing should be avoided to prevent possible loss of fill solution.

There may be an interchange of fill solution with well water during operation. Care must be taken with motors removed from wells during freezing conditions to prevent damage.

When the storage temperature does not exceed 100 °F (37 °C), storage time should be limited to two years. Where temperatures reach 100° to 130 °F, storage time should be limited to one year.

Loss of a few drops of liquid will not damage the motor as an excess amount is provided, and the filter check valve will allow lost liquid to be replaced by filtered well water upon installation. If there is reason to believe there has been a considerable amount of leakage, consult the factory for checking procedures.

Frequency of Starts

The average number of starts per day over a period of months or years influences the life of a submersible pumping system. Excessive cycling affects the life of control components such as pressure switches, starters, relays, and capacitors. Rapid cycling can also cause motor spline damage, bearing damage, and motor overheating. All these conditions can lead to reduced motor life.

The pump size, tank size, and other controls should be selected to keep the starts per day as low as practical for longest life. The maximum number of starts per 24-hour period is shown in Table 3.

Motors should run a minimum of one minute to dissipate heat build up from starting current. Six inch and larger motors should have a minimum of 15 minutes between starts or starting attempts.

Table 3 Number of Starts

MOTOR RATING		MAXIMUM STARTS PER 24 HR PERIOD	
HP	KW	SINGLE-PHASE	THREE-PHASE
Up to 0.75	Up to 0.55	300	300
1 thru 5.5	0.75 thru 4	100	300
7.5 thru 30	5.5 thru 22	50	100*
40 and over	30 and over	-	100

* Keeping starts per day within the recommended numbers provides the best system life. However, when used with a properly configured Reduced Voltage Starter (RVS) or Variable Frequency Drive (VFD), 7.5 thru 30 hp three-phase motors can be started up to 200 times per 24 hour period.

Mounting Position

Franklin submersible motors are designed primarily for operation in the vertical, shaft-up position.

During acceleration, the pump thrust increases as its output head increases. In cases where the pump head stays below its normal operating range during startup and full speed condition, the pump may create upward thrust. This creates upward thrust on the motor upthrust bearing. This is an acceptable operation for short periods at each start, but running continuously with upthrust will cause excessive wear on the upthrust bearing.

With certain additional restrictions as listed in this section and the Inline Booster Pump Systems sections of this manual, motors are also suitable for operation in positions from shaft-up to shaft-horizontal. As the mounting position becomes further from vertical and closer to horizontal, the probability of shortened thrust bearing life increases. For normal motor life expectancy with motor positions other than shaft-up, follow these recommendations:

1. Minimize the frequency of starts, preferably to fewer than per 24-hour period. Six and eight inch motors should have a minimum of 20 minutes between starts or starting attempts
2. Do not use in systems which can run even for short periods at full speed without thrust toward the motor.

Transformer Capacity - Single-Phase or Three-Phase

Distribution transformers must be adequately sized to satisfy the kVA requirements of the submersible motor. When transformers are too small to supply the load, there is a reduction in voltage to the motor.

Table 4 references the motor horsepower rating, single-phase and three-phase, total effective kVA required, and the smallest transformer required for open or closed three-phase systems. Open systems require larger transformers since only two transformers are used.

Other loads would add directly to the kVA sizing requirements of the transformer bank.

Table 4 Transformer Capacity

MOTOR RATING		TOTAL EFFECTIVE KVA REQUIRED	SMALLEST KVA RATING-EACH TRANSFORMER	
HP	KW		OPEN WYE OR DELTA 2- TRANSFORMERS	CLOSED WYE OR DELTA 3- TRANSFORMERS
1.5	1.1	3	2	1
2	1.5	4	2	1.5
3	2.2	5	3	2
5	3.7	7.5	5	3
7.5	5.5	10	7.5	5
10	7.5	15	10	5
15	11	20	15	7.5
20	15	25	15	10
25	18.5	30	20	10
30	22	40	25	15
40	30	50	30	20
50	37	60	35	20
60	45	75	40	25
75	55	90	50	30
100	75	120	65	40
125	93	150	85	50
150	110	175	100	60
175	130	200	115	70
200	150	230	130	75

NOTE: Standard kVA ratings are shown. If power company experience and practice allows transformer loading higher than standard, higher loading values may be used to meet total effective kVA required, provided correct voltage and balance is maintained.

Effects of Torque

During starting of a submersible pump, the torque developed by the motor must be supported through the pump, delivery pipe or other supports. Most pumps rotate in the direction which causes unscrewing torque on right-handed threaded pipe or pump stages. All threaded joints, pumps and other parts of the pump support system must be capable of withstanding the maximum torque repeatedly without loosening or breaking. Unscrewing joints will break electrical cable and may cause loss of the pump-motor unit.

To safely withstand maximum unscrewing torques with a minimum safety factor of 1.5, tightening all threaded joints to at least 10 lb-ft per motor horsepower is recommended (Table 4A). It may be necessary to tack or strap weld pipe joints on high horsepower pumps, especially at shallower settings.

Table 4A Torque Required (Examples)

MOTOR RATING		MINIMUM SAFE TORQUE-LOAD
HP	KW	
1 hp & Less	0.75 kW & Less	10 lb-ft
20 hp	15 kW	200 lb-ft
75 hp	55 kW	750 lb-ft
200 hp	150 kW	2000 lb-ft

Use of Engine Driven Generators – Single-Phase or Three-Phase

Table 5 lists minimum generator sizes based on typical 80 °C rise continuous duty generators, with 35% maximum voltage dip during starting, for Franklin's three-wire motors, single- or three-phase.

This is a general chart. The generator manufacturer should be consulted whenever possible, especially on larger sizes.

There are two types of generators available: externally and internally regulated. Most are externally regulated. They use an external voltage regulator that senses the output voltage. As the voltage dips at motor start-up, the regulator increases the output voltage of the generator.

Internally regulated (self-excited) generators have an extra winding in the generator stator. The extra winding senses the output current to automatically adjust the output voltage.

Generators must be sized to deliver at least 65% of the rated voltage during starting to ensure adequate starting torque. Besides sizing, generator frequency is important as the motor speed varies with the frequency (Hz). Due to pump affinity laws, a pump running at 1 to 2 Hz below motor nameplate frequency design will not meet its performance curve. Conversely, a pump running at 1 to 2 Hz above may trip overloads.

Generator Operation

Always start the generator before the motor is started and always stop the motor before the generator is shut down. The motor thrust bearing may be damaged if the generator is allowed to coast down with the motor running. This same condition occurs when the generator is allowed to run out of fuel.

Follow generator manufacturer's recommendations for de-rating at higher elevations or using natural gas.

Table 5 Engine Driven Generators

NOTE: This chart applies to 3-wire or 3-phase motors. For best starting of 2-wire motors, the minimum generator rating is 50% higher than shown.

MOTOR RATING		MINIMUM RATING OF GENERATOR			
		EXTERNALLY REGULATED		INTERNALLY REGULATED	
HP	KW	KW	KVA	KW	KVA
1/3	0.25	1.5	1.9	1.2	1.5
1/2	0.37	2	2.5	1.5	1.9
3/4	0.55	3	3.8	2	2.5
1	0.75	4	5.0	2.5	3.13
1.5	1.1	5	6.25	3	3.8
2	1.5	7.5	9.4	4	5
3	2.2	10	12.5	5	6.25
5	3.7	15	18.75	7.5	9.4
7.5	5.5	20	25.0	10	12.5
10	7.5	30	37.5	15	18.75
15	11	40	50	20	25
20	15	60	75	25	31
25	18.5	75	94	30	37.50
30	22	100	125	40	50
40	30	100	125	50	62.5
50	37	150	188	60	75
60	45	175	220	75	94
75	55	250	313	100	125
100	75	300	375	150	188
125	93	375	469	175	219
150	110	450	563	200	250
175	130	525	656	250	313
200	150	600	750	275	344

WARNING: To prevent accidental electrocution, automatic or manual transfer switches must be used any time a generator is used as standby or back up on power lines. Contact power company for use and approval.

Use of Check Valves

It is recommended that one or more check valves always be used in submersible pump installations. If the pump does not have a built-in check valve, a line check valve should be installed in the discharge line within 25 feet of the pump and below the draw down level of the water supply. For deeper settings, check valves should be installed per the manufacturer's recommendations. More than one check valve may be required, but more than the recommended number of check valves should not be used.

Swing type check valves are **not** acceptable and should never be used with submersible motors/pumps. Swing type check valves have a slower reaction time which can cause water hammer (see next page). Internal pump check valves or spring loaded check valves close quickly and help eliminate water hammer.

Check valves are used to hold pressure in the system when the pump stops. They also prevent backspin, water hammer and upthrust. Any of these can lead to early pump or motor failure.

NOTE: Only positive sealing check valves should be used in submersible installations. Although drilling the check valves or using drain-back check valves may prevent back spinning, they create upthrust and water hammer problems.

A. **Backspin –** With no check valve or a failed check valve, the water in the drop pipe and the water in the system can flow down the discharge pipe when the motor stops. This can cause the pump to rotate in a reverse direction. If the motor is started while it is backspinning, an excessive force is placed across the pump-motor assembly that can cause impeller damage, motor or pump shaft breakage, excessive bearing wear, etc.

B. **Upthrust –** With no check valve, a leaking check valve, or drilled check valve, the unit starts under a zero head condition. This causes an uplifting or upthrust on the impeller-shaft assembly in the pump. This upward movement carries across the pump-motor coupling and creates an upthrust condition in the motor. Repeated upthrust can cause premature failure of both the pump and the motor.

C. **Water Hammer –** If the lowest check valve is more than 30 feet above the standing (lowest static) water level, or a lower check valve leaks and the check valve above holds, a vacuum is created in the discharge piping. On the next pump start, water moving at very high velocity fills the void and strikes the closed check valve and the stationary water in the pipe above it, causing a hydraulic shock. This shock can split pipes, break joints and damage the pump and/or motor. Water hammer can often be heard or felt. When discovered, the system should be shut down and the pump installer contacted to correct the problem.

All Motors

APPLICATION

Wells – Large Diameter, Uncased, Top Feeding and Screened Sections

Franklin Electric submersible motors are designed to operate with a cooling flow of water over and around the full length of the motor.

If the pump installation does not provide the minimum flow shown in Table 6, a flow inducer sleeve (flow sleeve) must be used. The conditions requiring a flow sleeve are:

- Well diameter is too large to meet Table 6 flow requirements
- Pump is in an open body of water
- Pump is in a rock well or below the well casing
- The well is "top-feeding" (a.k.a. cascading)
- Pump is set in or below screens or perforations

Water Temperature and Flow

Franklin Electric's standard submersible motors, except Hi-Temp designs (see note below), are designed to operate up to maximum service factor horsepower in water up to 86 °F (30 °C). A flow of 0.25 ft/s for 4" motors rated 3 hp and higher, and 0.5 ft/s for 6" and 8" motors is required for proper cooling. Table 6 shows minimum flow rates, in gpm, for various well diameters and motor sizes.

If a standard motor is operated in water over 86 °F (30 °C), water flow past the motor must be increased to maintain safe motor operating temperatures. See HOT WATER APPLICATIONS on page 7.

NOTE: Franklin Electric offers a line of Hi-Temp motors designed to operate in water at higher temperatures or lower flow conditions. Consult factory for details.

Table 6 Required Cooling Flow

MINIMUM GPM REQUIRED FOR MOTOR COOLING IN WATER UP TO 86 °F (30 °C)			
CASING OR SLEEVE ID INCHES (MM)	4" MOTOR (3-10 HP) 0.25 FT/S GPM (L/M)	6" MOTOR 0.50 FT/S GPM (L/M)	8" MOTOR 0.50 FT/S GPM (L/M)
4 (102)	1.2 (4.5)	-	-
5 (127)	7 (26.5)	-	-
6 (152)	13 (49)	9 (34)	-
7 (178)	20 (76)	25 (95)	-
8 (203)	30 (114)	45 (170)	10 (40)
10 (254)	50 (189)	90 (340)	55 (210)
12 (305)	80 (303)	140 (530)	110 (420)
14 (356)	110 (416)	200 (760)	170 (645)
16 (406)	150 (568)	280 (1060)	245 (930)

0.25 ft/s = 7.62 cm/sec 0.50 ft/s = 15.24 cm/sec 1 inch = 2.54 cm

Flow Inducer Sleeve

If the flow rate is less than specified, then a flow inducer sleeve must be used. A flow sleeve is always required in an open body of water. FIG. 1 shows a typical flow inducer sleeve construction.

EXAMPLE: A 6" motor and pump that delivers 60 gpm will be installed in a 10" well.

From Table 6, 90 gpm would be required to maintain proper cooling. In this case adding an 8" or smaller flow sleeve provides the required cooling.

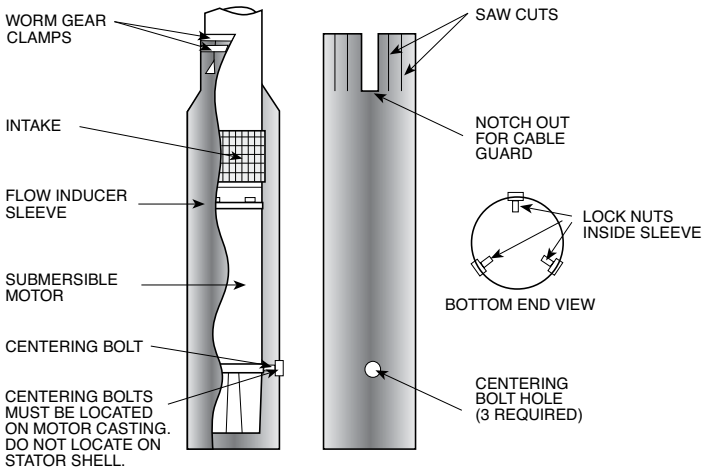

FIG. 1

Head Loss From Flow Past Motor

Table 7 lists the approximate head loss due to flow between an average length motor and smooth casing or flow inducer sleeve.

Table 7 Head Loss in Feet (Meters) at Various Flow Rates

MOTOR DIAMETER		4"	4"	4"	6"	6"	6"	8"	8"
CASING ID IN INCHES (MM)		4 (102)	5 (127)	6 (152)	6 (152)	7 (178)	8 (203)	8.1 (206)	10 (254)
Flow Rate in gpm (l/m)	25 (95)	0.3 (.09)							
	50 (189)	1.2 (.37)							
	100 (378)	4.7 (1.4)	0.3 (.09)		1.7 (.52)				
	150 (568)	10.2 (3.1)	0.6 (.18)	0.2 (.06)	3.7 (1.1)				
	200 (757)		1.1 (.34)	0.4 (.12)	6.3 (1.9)	0.5 (.15)		6.8 (2.1)	
	250 (946)		1.8 (.55)	0.7 (.21)	9.6 (2.9)	0.8 (.24)		10.4 (3.2)	
	300 (1136)		2.5 (.75)	1.0 (.30)	13.6 (4.1)	1.2 (.37)	0.2 (.06)	14.6 (4.5)	
	400 (1514)				23.7 (7.2)	2.0 (.61)	0.4 (.12)	24.6 (7.5)	
	500 (1893)					3.1 (.94)	0.7 (.21)	37.3 (11.4)	0.6 (0.2)
	600 (2271)					4.4 (1.3)	1.0 (.30)	52.2 (15.9)	0.8 (0.3)
	800 (3028)								1.5 (0.5)
	1000 (3785)								2.4 (0.7)

Hot Water Applications (Standard Motors)

Franklin Electric offers a line of Hi-Temp motors which are designed to operate in water with various temperatures up to 194 °F (90 °C) without increased flow. When a standard pump-motor operates in water hotter than 86 °F (30 °C), a flow rate of at least 3 ft/s is required. When selecting the motor to drive a pump in over 86 °F (30 °C) water, the motor horsepower must be de-rated per the following procedure.

1. Using Table 7A, determine pump gpm required for different well or sleeve diameters. If necessary, add a flow sleeve to obtain at least 3 ft/s flow rate.

Table 7A Minimum gpm (l/m) Required for 3 ft/s (.91 m/sec) Flow Rate

CASING OR SLEEVE ID		4" HIGH THRUST MOTOR		6" MOTOR		8" MOTOR	
INCHES	(MM)	GPM	(L/M)	GPM	(L/M)	GPM	(L/M)
4	(102)	15	(57)				
5	(127)	80	(303)				
6	(152)	160	(606)	52	(197)		
7	(178)			150	(568)		
8	(203)			260	(984)	60	(227)
10	(254)			520	(1970)	330	(1250)
12	(305)					650	(2460)
14	(356)					1020	(3860)
16	(406)					1460	(5530)

Continued on next page

2. Determine pump horsepower required from the pump manufacturer's curve.

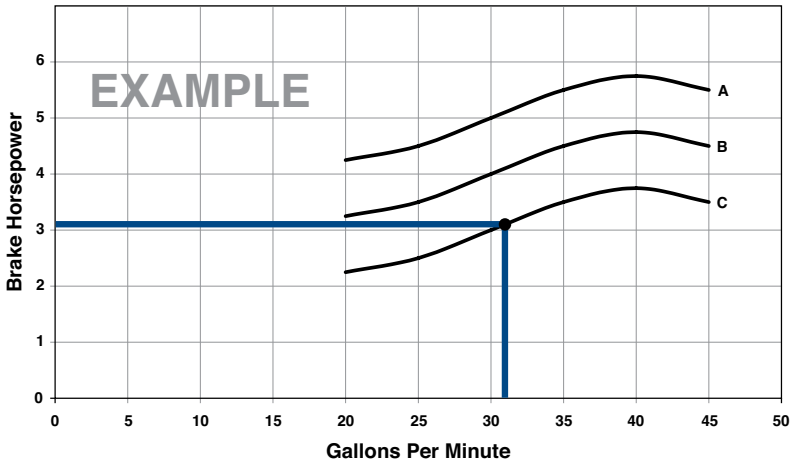

FIG. 2 MANUFACTURER'S PUMP CURVE

3. Multiply the pump horsepower required by the heat factor multiplier from Table 8.

Table 8 Heat Factor Multiplier at 3 ft/s (.91 m/sec) Flow Rate

MAXIMUM WATER TEMPERATURE	1/3 - 5 HP .25 - 3.7 KW	7 1/2 - 30 HP 5.5 - 22 KW	OVER 30 HP OVER 22 KW
140 °F (60 °C)	1.25	1.62	2.00
131 °F (55 °C)	1.11	1.32	1.62
122 °F (50 °C)	1.00	1.14	1.32
113 °F (45 °C)	1.00	1.00	1.14
104 °F (40 °C)	1.00	1.00	1.00
95 °F (35 °C)	1.00	1.00	1.00

4. Select a rated hp motor on Table 8A whose Service Factor Horsepower is at least the value calculated in Item 3.

Table 8A Service Factor Horsepower

HP	KW	SFHP	HP	KW	SFHP	HP	KW	SFHP	HP	KW	SFHP
1/3	0.25	0.58	3	2.2	3.45	25	18.5	28.75	100	75	115.00
1/2	0.37	0.80	5	3.7	5.75	30	22.0	34.50	125	93	143.75
3/4	0.55	1.12	7.5	5.5	8.62	40	30.0	46.00	150	110	172.50
1	0.75	1.40	10	7.5	11.50	50	37.0	57.50	175	130	201.25
1.5	1.10	1.95	15	11.0	17.25	60	45.0	69.00	200	150	230.00
2	1.50	2.50	20	15.0	23.00	75	55.0	86.25			

Hot Water Applications - Example

EXAMPLE: A 6" pump end requiring 39 hp input will pump 124 °F water in an 8" well at a delivery rate of 140 gpm. From Table 7A, a 6" flow sleeve will be required to increase the flow rate to at least 3 ft/s.

Using Table 8, the 1.62 heat factor multiplier is selected because the hp required is over 30 hp and water temperature is above 122 °F. Multiply 39 hp x 1.62 (multiplier), which equals 63.2 hp. This is the minimum rated service factor horsepower usable at 39 hp in 124 °F. Using Table 8A, select a motor with a rated service factor horsepower above 63.2 hp. A 60 hp motor has a service factor horsepower of 69, so a 60 hp motor may be used.

Drawdown Seals

Allowable motor temperature is based on atmospheric pressure or higher surrounding the motor. “Drawdown seals,” which seal the well to the pump above its intake to maximize delivery are not recommended, since the suction created can be lower than atmospheric pressure.

Grounding Control Boxes and Panels

The National Electrical Code requires that the control box or panel-grounding terminal always be connected to supply ground. If the circuit has no grounding conductor and no metal conduit from the box to supply panel, use a wire at least as large as line conductors and connect as required by the National Electrical Code, from the grounding terminal to the electrical supply ground.

WARNING: Failure to ground the control frame can result in a serious or fatal electrical shock hazard.

Grounding Surge Arrestors

An above ground surge arrestor must be grounded, metal to metal, all the way to the lowest draw down water strata for the surge arrestor to be effective. GROUNDING THE ARRESTOR TO THE SUPPLY GROUND OR TO A DRIVEN GROUND ROD PROVIDES LITTLE OR NO SURGE PROTECTION FOR THE MOTOR.

Control Box, Pumptec Products, and Panel Environment

Franklin Electric control boxes, Pumptec products and three-phase panels meet UL requirements for NEMA Type 3R enclosures. They are suitable for indoor and outdoor applications within temperatures of +14 °F (-10 °C) to 122 °F (50 °C). Operating control boxes below +14 °F can cause reduced starting torque and loss of overload protection when overloads are located in control boxes.

Control boxes, Pumptec products, and three-phase panels should never be mounted in direct sunlight or high temperature locations. This will cause shortened capacitor life (where applicable) and unnecessary tripping of overload protectors. A ventilated enclosure painted white to reflect heat is recommended for an outdoor, high temperature location.

A damp well pit, or other humid location, accelerates component failure from corrosion.

Control boxes with voltage relays are designed for vertical upright mounting only. Mounting in other positions will affect the operation of the relay.

Equipment Grounding

WARNING: Serious or fatal electrical shock may result from failure to connect the motor, control enclosures, metal plumbing, and all other metal near the motor or cable to the power supply ground terminal using wire no smaller than motor cable wires.

The primary purpose of grounding the metal drop pipe and/or metal well casing in an installation is safety. It is done to limit the voltage between nonelectrical (exposed metal) parts of the system and ground, thus minimizing dangerous shock hazards. Using wire at least the size of the motor cable wires provides adequate current-carrying capability for any ground fault that might occur. It also provides a low resistance path to ground, ensuring that the current to ground will be large enough to trip any overcurrent device designed to detect faults (such as a ground fault circuit interrupter, or GFCI).

Normally, the ground wire to the motor would provide the primary path back to the power supply ground for any ground fault. There are conditions, however, where the ground wire connection could become compromised. One such example would be the case where the water in the well is abnormally corrosive or aggressive. In this example, a grounded metal drop pipe or casing would then become the primary path to ground.

However, the many installations that now use plastic drop pipes and/or casings require further steps to be taken for safety purposes, so that the water column itself does not become the conductive path to ground.

When an installation has abnormally corrosive water AND the drop pipe or casing is plastic, Franklin Electric recommends the use of a GFCI with a 10 mA set-point. In this case, the motor ground wire should be routed through the current-sensing device along with the motor power leads. Wired this way, the GFCI will trip only when a ground fault has occurred AND the motor ground wire is no longer functional.

3-Wire Control Boxes

Single-phase three-wire submersible motors require the use of control boxes. Operation of motors without control boxes or with incorrect boxes can result in motor failure and voids warranty.

Control boxes contain starting capacitors, a starting relay, and, in some sizes, overload protectors, running capacitors, and contactors.

Ratings through 1 hp may use either a Franklin Electric solid state QD or a potential (voltage) type starting relay, while larger ratings use potential relays.

Potential (Voltage) Relays

Potential relays have normally closed contacts. When power is applied, both start and main motor windings are energized, and the motor starts. At this instant, the voltage across the start winding is relatively low and not enough to open the contacts of the relay.

As the motor accelerates, the increasing voltage across the start winding (and the relay coil) opens the relay contacts. This opens the starting circuit and the motor continues to run on the main winding alone, or the main plus run capacitor circuit. After the motor is started the relay contacts remain open.

CAUTION: The control box and motor are two pieces of one assembly. Be certain that the control box and motor hp and voltage match. Since a motor is designed to operate with a control box from the same manufacturer, we can promise warranty coverage only when a Franklin control box is used with a Franklin motor.

2-Wire Motor Solid State Controls

BIAC Switch Operation

When power is applied the bi-metal switch contacts are closed, so the triac is conducting and energizes the start winding. As rpm increases, the voltage in the sensor coil generates heat in the bi-metal strip, causing the bi-metal strip to bend and open the switch circuit. This removes the starting winding and the motor continues to run on the main winding alone.

Approximately 5 seconds after power is removed from the motor, the bi-metal strip cools sufficiently to return to its closed position and the motor is ready for the next start cycle. If, during operation, the motor speed drops, the lowered voltage in the sensor coil allows the bi-metal contacts to close, and bring the motor back to operating speed.

Rapid Cycling

The BIAC starting switch will reset within approximately 5 seconds after the motor is stopped. If an attempt is made to restart the motor before the starting switch has reset, the motor may not start; however, there will be current in the main winding until the overload protector interrupts the circuit. The time for the protector to reset is longer than the reset of the starting switch. Therefore, the start switch will have closed and the motor will operate.

A waterlogged tank will cause fast cycling. When a waterlogged condition does occur, the user will be alerted to the problem during the off time (overload reset time) since the pressure will drop drastically. When the waterlogged tank condition is detected, the condition should be corrected to prevent nuisance tripping of the overload protector.

Bound Pump (Sandlocked)

When the motor is not free to turn, as with a sandlocked pump, the BIAC switch creates a “reverse impact torque” in the motor in either direction. When the sand is dislodged, the motor will start and operate in the correct direction.

CAUTION: Restarting the motor within 5 seconds after power is removed may cause the motor overload to trip.

QD Relays (Solid State)

There are two elements in the relay: a reed switch and a triac. The reed switch consists of two tiny rectangular blade-type contacts, which bend under magnetic flux. It is hermetically sealed in glass and is located within a coil, which conducts line current. When power is supplied to the control box, the main winding current passing through the coil immediately closes the reed switch contacts. This turns on the triac, which supplies voltage to the start winding, thus starting the motor.

Once the motor is started, the operation of the QD relay is an interaction between the triac, the reed switch, and the motor windings. The solid state switch senses motor speed through the changing phase relationship between start winding current and line current. As the motor approaches running speed, the phase angle between the start current and the line current becomes nearly in phase. At this point, the reed switch contacts open, turning off the triac. This removes voltage from the start winding and the motor continues to run on the main winding only. With the reed switch contacts open and the triac turned off, the QD relay is ready for the next starting cycle.

Single-Phase Motors

APPLICATION

2- or 3-Wire Cable, 60 Hz (Service Entrance to Motor - Maximum Length In Feet)

Table 11

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE												
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000
115	1/2	.37	100	160	250	390	620	960	1190	1460	1780	2160	2630	3140	3770
230	1/2	.37	400	650	1020	1610	2510	3880	4810	5880	7170	8720			
	3/4	.55	300	480	760	1200	1870	2890	3580	4370	5330	6470	7870		
	1	.75	250	400	630	990	1540	2380	2960	3610	4410	5360	6520		
	1.5	1.1	190	310	480	770	1200	1870	2320	2850	3500	4280	5240		
	2	1.5	150	250	390	620	970	1530	1910	2360	2930	3620	4480		
	3	2.2	**120**	190	300	470	750	1190	1490	1850	2320	2890	3610		
	5	3.7	0	0	**180**	280	450	710	890	1110	1390	1740	2170	2680	
	7.5	5.5	0	0	0	**200**	310	490	610	750	930	1140	1410	1720	
	10	7.5	0	0	0	0	**250**	390	490	600	750	930	1160	1430	1760
	15	11	0	0	0	0	**170**	**270**	340	430	530	660	820	1020	1260

Table 11A

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE												
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000
115	1/2	.37	100	160	250	390	620	960	1190	1460	1780	2160	2630	3140	3770
230	1/2	.37	400	650	1020	1610	2510	3880	4810	5880	7170	8720			
	3/4	.55	300	480	760	1200	1870	2890	3580	4370	5330	6470	7870	9380	
	1	.75	250	400	630	990	1540	2380	2960	3610	4410	5360	6520	7780	9350
	1.5	1.1	190	310	480	770	1200	1870	2320	2850	3500	4280	5240	6300	7620
	2	1.5	150	250	390	620	970	1530	1910	2360	2930	3620	4480	5470	6700
	3	2.2	**120**	190	300	470	750	1190	1490	1850	2320	2890	3610	4470	5550
	5	3.7	0	**110**	180	280	450	710	890	1110	1390	1740	2170	2680	3330
	7.5	5.5	0	0	**120**	200	310	490	610	750	930	1140	1410	1720	2100
	10	7.5	0	0	0	**160**	250	390	490	600	750	930	1160	1430	1760
	15	11	0	0	0	0	**170**	270	340	430	530	660	820	1020	1260

1 Foot = .3048 Meter

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors 60 °C or 75 °C in free air or water, not in magnetic enclosures, conduit or direct buried.

Lengths NOT in bold meet the NEC ampacity requirements for either individual conductors or jacketed 60 °C or 75 °C cable and can be in conduit or direct buried. Flat molded and web/ribbon cable are considered jacketed cable.

If any other cable is used, the NEC and local codes should be observed.

Cable lengths in Tables 11 & 11A allow for a 5% voltage drop running at maximum nameplate amperes. If 3% voltage drop is desired, multiply Table 11 and 11A lengths by 0.6 to get maximum cable length.

The portion of the total cable length, which is between the supply and single-phase control box with a line contactor, should not exceed 25% of total maximum allowable to ensure reliable contactor operation. Single-phase control boxes without line contactors may be connected at any point in the total cable length.

Tables 11 & 11A are based on copper wire. If aluminum wire is used, it must be two sizes larger than copper wire and oxidation inhibitors must be used on connections.

EXAMPLE: If Tables 11 & 11A call for #12 copper wire, #10 aluminum wire would be required.

Contact Franklin Electric for 90 °C cable lengths.

See pages 15, 50, and 51 for applications using 230 V motors on 208 V power systems.

Single-Phase Motors

APPLICATION

Two or More Different Cable Sizes Can Be Used

Depending on the installation, any number of combinations of cable may be used.

For example, in a replacement/upgrade installation, the well already has 160 feet of buried #10 cable between the service entrance and the wellhead. A new 3 hp, 230-volt, single-phase motor is being installed to replace a smaller motor. The question is: Since there is already 160 feet of #10 AWG installed, what size cable is required in the well with a 3 hp, 230-volt, single-phase motor setting at 310 feet?

From Tables 11 & 11A, a 3 hp motor can use up to 300 feet of #10 AWG cable.

The application has 160 feet of #10 AWG copper wire installed.

Using the formula below, 160 feet (actual) ÷ 300 feet (max allowable) is equal to 0.533. This means 53.3% (0.533 x 100) of the allowable voltage drop or loss, which is allowed between the service entrance and the motor, occurs in this wire. This leaves us 46.7% (1.00 - 0.533 = 0.467) of some other wire size to use in the remaining 310 feet "down hole" wire run.

The table shows #8 AWG copper wire is good for 470 feet. Using the formula again, 310 feet (used) ÷ 470 feet (allowed) = 0.660; adding this to the 0.533 determined earlier; 0.533 + 0.660 = 1.193. This combination is greater than 1.00, so the voltage drop will not meet US National Electrical Code recommendations.

Tables 11 & 11A show #6 AWG copper wire is good for 750 feet. Using the formula, 310 ÷ 750 = 0.413, and using these numbers, 0.533 + 0.413 = 0.946, we find this is less than 1.00 and will meet the NEC recommended voltage drop.

This works for two, three or more combinations of wire and it does not matter which size wire comes first in the installation.

$$\text{Formula:} \quad \frac{\text{Actual Length}}{\text{Max Allowed}} + \frac{\text{Actual Length}}{\text{Max Allowed}} = 1.00$$

EXAMPLE: 3 hp, 230-Volt, Single-Phase Motor

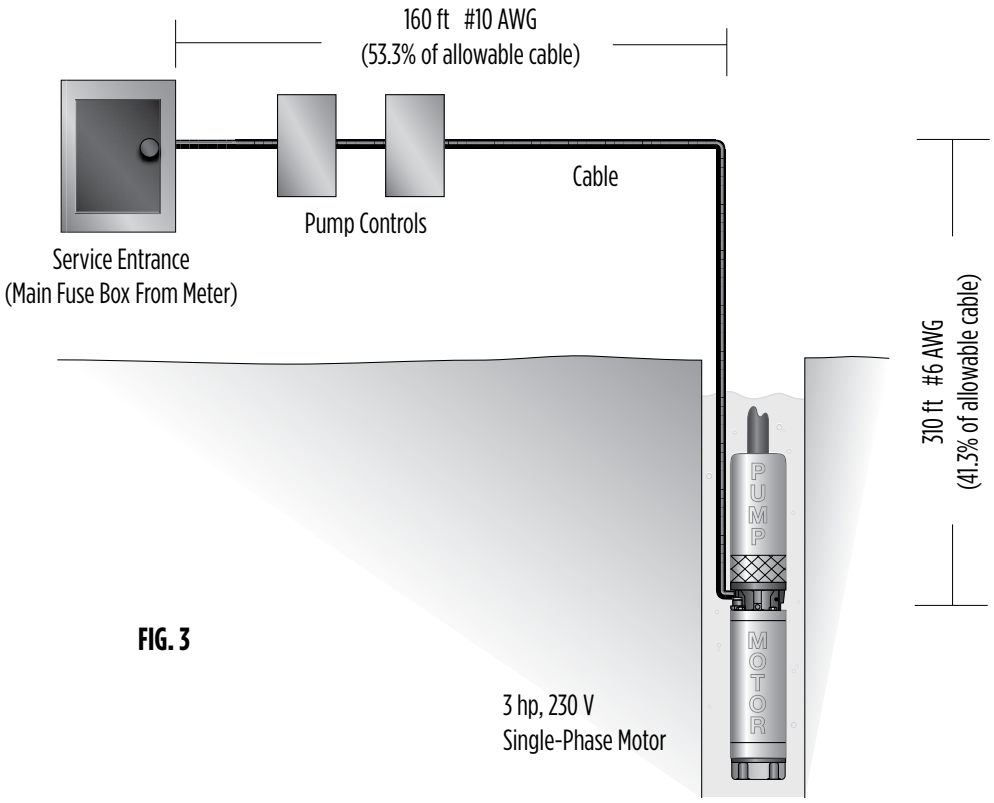

FIG. 3

Single-Phase Motors

APPLICATION

Table 13 Single-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		WINDING (1) RES. IN OHMS	EFFICIENCY %		POWER FACTOR %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	(2) AMPS	WATTS	(2) AMPS	WATTS	M=MAIN RES. S=START RES.	S.F.	F.L.	S.F.	F.L.		
4" 2-WIRE	244504	1/2	0.37	115	60	1.6	10.0	670	12.0	960	1.0-1.3	62	56	73	58	64.4	R
	244505	1/2	0.37	230	60	1.6	5.0	670	6.0	960	4.2-5.2	62	56	73	58	32.2	R
	244507	3/4	0.55	230	60	1.5	6.8	940	8.0	1310	3.0-3.6	64	59	74	62	40.7	N
	244508	1	0.75	230	60	1.4	8.2	1210	10.4	1600	2.2-2.7	65	62	74	63	48.7	N
	244309	1.5	1.1	230	60	1.3	10.6	1770	13.1	2280	1.5-2.1	64	63	83	76	66.2	M
4" 3-WIRE	214504	1/2	0.37	115	60	1.6	Y10.0 B10.0 R0	670	Y12.0 B12.0 R0	960	M1.0-1.3 S4.1-5.1	62	56	73	58	50.5	M
	214505	1/2	0.37	230	60	1.6	Y5.0 B5.0 R0	670	Y6.0 B6.0 R0	960	M4.2-5.2 S16.7-20.5	62	56	73	58	23	M
	214507	3/4	0.55	230	60	1.5	Y6.8 B6.8 R0	940	Y8.0 B8.0 R0	1310	M3.0-3.6 S10.7-13.1	64	59	74	62	34.2	M
	214508	1	0.75	230	60	1.4	Y8.2 B8.2 R0	1210	10.4 10.4 R0	1600	M2.2-2.7 S9.9-12.1	65	62	74	63	41.8	L
4" 3-WIRE W/CRC CB	214505	1/2	0.37	230	60	1.6	Y3.2 B3.7 R2.0	655	Y4.3 B4.0 R2.0	890	M4.2-5.2 S16.7-20.5	67	57	90	81	23	M
	214507	3/4	0.55	230	60	1.5	Y4.4 B5.0 R3.2	925	Y5.7 B5.2 R3.1	1220	M3.0-3.6 S10.7-13.1	69	60	92	84	34.2	M
	214508	1	0.75	230	60	1.4	Y5.6 B5.7 R3.4	1160	Y8.1 B6.2 R3.3	1490	M2.2-2.7 S9.9-12.1	70	64	92	86	41.8	L
4" 3-WIRE	214508 W/1-1.5 CB	1	0.75	230	60	1.4	Y6.6 B6.6 R1.3	1130	Y8.0 B7.9 R1.3	1500	M2.2-2.7 S9.9-12.1	70	66	82	72	43	L
	224300	1.5	1.1	230	60	1.3	Y10.0 B9.9 R1.3	1620	Y11.5 B11.0 R1.3	2080	M1.7-2.1 S7.5-9.2	70	69	85	79	51.4	J
	224301	2	1.5	230	60	1.25	Y10.0 B9.3 R2.6	2025	Y13.2 B11.9 R2.6	2555	M1.8-2.3 S5.5-7.2	73	74	95	94	53.1	G
	224302 (3)	3	2.2	230	60	1.15	Y14.0 B11.2 R6.1	3000	Y17.0 B12.6 R6.0	3400	M1.1-1.4 S4.0-4.8	75	75	99	99	83.4	H
	224303 (4)	5	3.7	230	60	1.15	Y23.0 B15.9 R11.0	4830	Y27.5 B19.1 R10.8	5500	M.71-.82 S1.8-2.2	78	77	100	100	129	G
6"	226110 (5)	5	3.7	230	60	1.15	Y23.0 B14.3 R10.8	4910	Y27.5 B17.4 R10.5	5570	M.55-.68 S1.3-1.7	77	76	100	99	99	E
	226111	7.5	5.5	230	60	1.15	Y36.5 B34.4 R5.5	7300	Y42.1 B40.5 R5.4	8800	M.36-.50 S.88-1.1	73	74	91	90	165	F
	226112	10	7.5	230	60	1.15	Y44.0 B39.5 R9.3	9800	Y51.0 B47.5 R8.9	11300	M.27-.33 S.80-.99	76	77	96	96	204	E
	226113	15	11	230	60	1.15	Y62.0 B52.0 R17.5	13900	Y75.0 B62.5 R16.9	16200	M.17-.22 S.68-.93	79	80	97	98	303	E

(1) Main winding - yellow to black Start winding - yellow to red

(2) Y = Yellow lead - line amps
B = Black lead - main winding amps
R = Red lead - start or auxiliary winding amps

(3) Control Boxes date coded 02C and older have **35 MFD** run capacitors. Current values should be Y14.0 @ FL and Y17.0 @ Max Load.
B12.2 B14.5
R4.7 R4.5

(4) Control Boxes date coded 01M and older have **60 MFD** run capacitors and the current values on a 4" motor will be Y23.0 @ FL - Y27.5 @ Max Load.
B19.1 B23.2
R8.0 R7.8

(5) Control Boxes date coded 01M and older have **60 MFD** run capacitors and the current values on a 6" motor will be Y23.0 @ FL -Y27.5 @ Max Load.
B18.2 B23.2
R8.0 R7.8

Performance is typical, not guaranteed, at specified voltages and specified capacitor values. Performance at voltage ratings not shown is similar, except amps vary inversely with voltage.

Single-Phase Motors

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Table 14 Single-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
4" 2-WIRE	244504	1/2	0.37	115	35	20	30	30	15	30
	244505	1/2	0.37	230	20	10	15	15	8	15
	244507	3/4	0.55	230	25	15	20	20	10	20
	244508	1	0.75	230	30	20	25	25	11	25
	244309	1.5	1.1	230	35	20	30	35	15	30
4" 3-WIRE	214504	1/2	0.37	115	35	20	30	30	15	30
	214505	1/2	0.37	230	20	10	15	15	8	15
	214507	3/4	0.55	230	25	15	20	20	10	20
	214508	1	0.75	230	30	20	25	25	11	25
4" 3-WIRE W/CRC CB	214505	1/2	0.37	230	20	10	15	15	8	15
	214507	3/4	0.55	230	25	15	20	20	10	20
	214508	1	0.75	230	30	20	25	25	11	25
4" 3-WIRE	214508 W/ 1-1.5 CB	1	0.75	230	30	20	25	25	11	25
	224300	1.5	1.1	230	35	20	30	30	15	30
	224301	2	1.5	230	30	20	25	30	15	25
	224302	3	2.2	230	45	30	40	45	20	40
	224303	5	3.7	230	80	45	60	70	30	60
6"	226110	5	3.7	230	80	45	60	70	30	60
	226111	7.5	5.5	230	125	70	100	110	50	100
	226112	10	7.5	230	150	80	125	150	60	125
	226113	15	11	230	200	125	175	200	90	175

Single-Phase Motors

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Auxiliary Running Capacitors

Added capacitors must be connected across "Red" and "Black" control box terminals, in parallel with any existing running capacitors. The additional capacitor(s) should be mounted in an auxiliary box. The values of additional running capacitors most likely to reduce noise are given below. The tabulation gives the **max.** S.F. amps normally in each lead with the added capacitor.

Although motor amps decrease when auxiliary run capacitance is added, the load on the motor does not. If a motor is overloaded with normal capacitance, it will still be overloaded with auxiliary run capacitance, even though motor amps may be within nameplate values.

Table 15 Auxiliary Capacitor Sizing

MOTOR RATING		NORMAL RUNNING CAPACITOR(S)	AUXILIARY RUNNING CAPACITORS FOR NOISE REDUCTION			MAXIMUM AMPS WITH RUN CAP		
HP	VOLTS	MFD	MFD	MIN. VOLTS	FRANKLIN PART	YELLOW	BLACK	RED
1/2	115	0	60(1)	370	TWO 155327101	8.4	7.0	4.0
1/2	230	0	15(1)	370	ONE 155328101	4.2	3.5	2.0
3/4		0	20(1)	370	ONE 155328103	5.8	5.0	2.5
1		0	25(1)	370	ONE EA. 155328101 155328102	7.1	5.6	3.4
1.5		10	20	370	ONE 155328103	9.3	7.5	4.4
2		20	10	370	ONE 155328102	11.2	9.2	3.8
3		45	NONE	370		17.0	12.6	6.0
5		80	NONE	370		27.5	19.1	10.8
7.5		45	45	370	ONE EA. 155327101 155328101	37.0	32.0	11.3
10		70	30	370	ONE 155327101	49.0	42.0	13.0
15		135	NONE			75.0	62.5	16.9

(1) Do not add running capacitors to 1/3 through 1 hp control boxes, which use solid state switches or QD relays. Adding capacitors will cause switch failure. If the control box is converted to use a voltage relay, the specified running capacitance can be added.

Buck-Boost Transformers

When the available power supply voltage is not within the proper range, a buck-boost transformer is often used to adjust voltage to match the motor. The most common usage on submersible motors is boosting a 208 volt supply to use a standard 230 volt single-phase submersible motor and control. While tables to give a wide range of voltage boost or buck are published by transformer manufacturers, the following table shows Franklin's recommendations. The table, based on boosting the voltage 10%, shows the minimum rated transformer kVA needed and the common standard transformer kVA.

Table 15A Buck-Boost Transformer Sizing

MOTOR HP	1/3	1/2	3/4	1	1.5	2	3	5	7.5	10	15
LOAD KVA	1.02	1.36	1.84	2.21	2.65	3.04	3.91	6.33	9.66	11.70	16.60
MINIMUM XFMR KVA	0.11	0.14	0.19	0.22	0.27	0.31	0.40	0.64	0.97	1.20	1.70
STANDARD XFMR KVA	0.25	0.25	0.25	0.25	0.50	0.50	0.50	0.75	1.00	1.50	2.00

Buck-Boost transformers are power transformers, not control transformers. They may also be used to lower voltage when the available power supply voltage is too high.

Three-Phase Motors

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Table 16 Three-Phase 60 °C Cable, 60 Hz (Service Entrance to Motor) Maximum Length in Feet

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	710	1140	1800	2840	4420													
	3/4	0.55	510	810	1280	2030	3160													
	1	0.75	430	690	1080	1710	2670	4140	5140											
	1.5	1.1	310	500	790	1260	1960	3050	3780											
	2	1.5	240	390	610	970	1520	2360	2940	3610	4430	5420								
	3	2.2	180	290	470	740	1160	1810	2250	2760	3390	4130								
	5	3.7	**110**	170	280	440	690	1080	1350	1660	2040	2490	3050	3670	4440	5030				
	7.5	5.5	0	0	200	310	490	770	960	1180	1450	1770	2170	2600	3150	3560				
	10	7.5	0	0	0	**230**	370	570	720	880	1090	1330	1640	1970	2390	2720	3100	3480	3800	4420
	15	11	0	0	0	**160**	**250**	390	490	600	740	910	1110	1340	1630	1850	2100	2350	2570	2980
	20	15	0	0	0	0	**190**	**300**	380	460	570	700	860	1050	1270	1440	1650	1850	2020	2360
	25	18.5	0	0	0	0	0	**240**	**300**	**370**	460	570	700	840	1030	1170	1330	1500	1640	1900
	30	22	0	0	0	0	0	0	**250**	**310**	**380**	470	580	700	850	970	1110	1250	1360	1590
230 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	930	1490	2350	3700	5760	8910												
	3/4	0.55	670	1080	1700	2580	4190	6490	8060	9860										
	1	0.75	560	910	1430	2260	3520	5460	6780	8290										
	1.5	1.1	420	670	1060	1670	2610	4050	5030	6160	7530	9170								
	2	1.5	320	510	810	1280	2010	3130	3890	4770	5860	7170	8780							
	3	2.2	240	390	620	990	1540	2400	2980	3660	4480	5470	6690	8020	9680					
	5	3.7	**140**	230	370	590	920	1430	1790	2190	2690	3290	4030	4850	5870	6650	7560	8460	9220	
	7.5	5.5	0	**160**	260	420	650	1020	1270	1560	1920	2340	2870	3440	4160	4710	5340	5970	6500	7510
	10	7.5	0	0	**190**	310	490	760	950	1170	1440	1760	2160	2610	3160	3590	4100	4600	5020	5840
	15	11	0	0	0	**210**	330	520	650	800	980	1200	1470	1780	2150	2440	2780	3110	3400	3940
	20	15	0	0	0	0	**250**	400	500	610	760	930	1140	1380	1680	1910	2180	2450	2680	3120
	25	18.5	0	0	0	0	0	**320**	400	500	610	750	920	1120	1360	1540	1760	1980	2160	2520
	30	22	0	0	0	0	0	**260**	**330**	**410**	510	620	760	930	1130	1280	1470	1650	1800	2110
380 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	2690	4290	6730															
	3/4	0.55	2000	3190	5010	7860														
	1	0.75	1620	2580	4060	6390	9980													
	1.5	1.1	1230	1970	3100	4890	7630													
	2	1.5	870	1390	2180	3450	5400	8380												
	3	2.2	680	1090	1710	2690	4200	6500	8020	9830										
	5	3.7	400	640	1010	1590	2490	3870	4780	5870	7230	8830								
	7.5	5.5	270	440	690	1090	1710	2640	3260	4000	4930	6010	7290	8780						
	10	7.5	**200**	**320**	510	800	1250	1930	2380	2910	3570	4330	5230	6260	7390	8280	9340			
	15	11	0	0	**370**	590	920	1430	1770	2170	2690	3290	4000	4840	5770	6520	7430	8250	8990	
	20	15	0	0	0	**440**	700	1090	1350	1670	2060	2530	3090	3760	4500	5110	5840	6510	7120	8190
	25	18.5	0	0	0	**360**	570	880	1100	1350	1670	2050	2510	3040	3640	4130	4720	5250	5740	6590
	30	22	0	0	0	0	**470**	730	910	1120	1380	1700	2080	2520	3020	3430	3920	4360	4770	5490
	40	30	0	0	0	0	0	**530**	660	820	1010	1240	1520	1840	2200	2500	2850	3170	3470	3990
	50	37	0	0	0	0	0	0	**540**	**660**	820	1000	1220	1480	1770	2010	2290	2550	2780	3190
	60	45	0	0	0	0	0	0	0	**560**	**690**	850	1030	1250	1500	1700	1940	2150	2350	2700
	75	55	0	0	0	0	0	0	0	0	**570**	**700**	**860**	1050	1270	1440	1660	1850	2030	2350
	100	75	0	0	0	0	0	0	0	0	0	**510**	**630**	**760**	910	1030	1180	1310	1430	1650
	125	93	0	0	0	0	0	0	0	0	0	0	0	**620**	**740**	**840**	**950**	1060	1160	1330
	150	110	0	0	0	0	0	0	0	0	0	0	0	0	**620**	**700**	**790**	**880**	**960**	1090
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	0	**650**	**750**	**840**	**920**	1070
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**630**	**700**	**760**	**880**

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

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Three-Phase Motors

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Table 17 Three-Phase 60 °C Cable (Continued)

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
460 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	3770	6020	9460															
	3/4	0.55	2730	4350	6850															
	1	0.75	2300	3670	5770	9070														
	1.5	1.1	1700	2710	4270	6730														
	2	1.5	1300	2070	3270	5150	8050													
	3	2.2	1000	1600	2520	3970	6200													
	5	3.7	590	950	1500	2360	3700	5750												
	7.5	5.5	420	680	1070	1690	2640	4100	5100	6260	7680									
	10	7.5	310	500	790	1250	1960	3050	3800	4680	5750	7050								
	15	11	0	**340**	540	850	1340	2090	2600	3200	3930	4810	5900	7110						
	20	15	0	0	**410**	650	1030	1610	2000	2470	3040	3730	4580	5530						
	25	18.5	0	0	0	**530**	830	1300	1620	1990	2450	3010	3700	4470	5430					
	30	22	0	0	0	**430**	680	1070	1330	1640	2030	2490	3060	3700	4500	5130	5860			
	40	30	0	0	0	0	**500**	790	980	1210	1490	1830	2250	2710	3290	3730	4250			
	50	37	0	0	0	0	0	**640**	800	980	1210	1480	1810	2190	2650	3010	3420	3830	4180	4850
	60	45	0	0	0	0	0	**540**	**670**	**830**	1020	1250	1540	1850	2240	2540	2890	3240	3540	4100
	75	55	0	0	0	0	0	0	0	**680**	**840**	1030	1260	1520	1850	2100	2400	2700	2950	3440
	100	75	0	0	0	0	0	0	0	0	**620**	**760**	**940**	1130	1380	1560	1790	2010	2190	2550
	125	93	0	0	0	0	0	0	0	0	0	0	**740**	**890**	**1000**	1220	1390	1560	1700	1960
	150	110	0	0	0	0	0	0	0	0	0	0	0	**760**	**920**	**1050**	**1190**	1340	1460	1690
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	**810**	**930**	**1060**	**1190**	1300	1510
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	**810**	**920**	**1030**	**1130**	1310
575 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	5900	9410																
	3/4	0.55	4270	6810																
	1	0.75	3630	5800	9120															
	1.5	1.1	2620	4180	6580															
	2	1.5	2030	3250	5110	8060														
	3	2.2	1580	2530	3980	6270														
	5	3.7	920	1480	2330	3680	5750													
	7.5	5.5	660	1060	1680	2650	4150													
	10	7.5	490	780	1240	1950	3060	4770	5940											
	15	11	**330**	530	850	1340	2090	3260	4060											
	20	15	0	**410**	650	1030	1610	2520	3140	3860	4760	5830								
	25	18.5	0	0	**520**	830	1300	2030	2530	3110	3840	4710								
	30	22	0	0	**430**	680	1070	1670	2080	2560	3160	3880	4770	5780	7030	8000				
	40	30	0	0	0	**500**	790	1240	1540	1900	2330	2860	3510	4230	5140	5830				
	50	37	0	0	0	0	**640**	1000	1250	1540	1890	2310	2840	3420	4140	4700	5340	5990	6530	7580
	60	45	0	0	0	0	0	**850**	1060	1300	1600	1960	2400	2890	3500	3970	4520	5070	5530	6410
	75	55	0	0	0	0	0	**690**	**860**	**1060**	1310	1600	1970	2380	2890	3290	3750	5220	4610	5370
	100	75	0	0	0	0	0	0	0	**790**	**970**	**1190**	1460	1770	2150	2440	2790	3140	3430	3990
	125	93	0	0	0	0	0	0	0	0	**770**	**950**	**1160**	1400	1690	1920	2180	2440	2650	3070
	150	110	0	0	0	0	0	0	0	0	0	**800**	**990**	**1190**	1440	1630	1860	2080	2270	2640
	175	130	0	0	0	0	0	0	0	0	0	0	**870**	**1050**	**1270**	**1450**	1650	1860	2030	2360
	200	150	0	0	0	0	0	0	0	0	0	0	0	**920**	**1110**	**1260**	**1440**	1620	1760	2050

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See 11 for additional details.

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Three-Phase Motors

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Table 18 Three-Phase 60 °C Cable (Continued)

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	160	250	420	660	1030	1620	2020	2490	3060	3730	4570	5500	6660	7540				
	7.5	5.5	110	180	300	460	730	1150	1440	1770	2170	2650	3250	3900	4720	5340				
	10	7.5	**80**	130	210	340	550	850	1080	1320	1630	1990	2460	2950	3580	4080	4650	5220	5700	6630
	15	11	0	0	**140**	240	370	580	730	900	1110	1360	1660	2010	2440	2770	3150	3520	3850	4470
	20	15	0	0	0	**170**	280	450	570	690	850	1050	1290	1570	1900	2160	2470	2770	3030	3540
	25	18.5	0	0	0	**140**	**220**	360	450	550	690	850	1050	1260	1540	1750	1990	2250	2460	2850
	30	22	0	0	0	0	**180**	294	370	460	570	700	870	1050	1270	1450	1660	1870	2040	2380
230 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	210	340	550	880	1380	2140	2680	3280	4030	4930	6040	7270	8800	9970				
	7.5	5.5	150	240	390	630	970	1530	1900	2340	2880	3510	4300	5160	6240	7060	8010	8950	9750	
	10	7.5	**110**	180	280	460	730	1140	1420	1750	2160	2640	3240	3910	4740	5380	6150	6900	7530	8760
	15	11	0	0	**190**	310	490	780	970	1200	1470	1800	2200	2670	3220	3660	4170	4660	5100	5910
	20	15	0	0	**140**	230	370	600	750	910	1140	1390	1710	2070	2520	2860	3270	3670	4020	4680
	25	18.5	0	0	0	**190**	300	480	600	750	910	1120	1380	1680	2040	2310	2640	2970	3240	3780
	30	22	0	0	0	**150**	**240**	390	490	610	760	930	1140	1390	1690	1920	2200	2470	2700	3160
380 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	600	960	1510	2380	3730	5800	7170	8800										
	7.5	5.5	400	660	1030	1630	2560	3960	4890	6000	7390	9010								
	10	7.5	300	480	760	1200	1870	2890	3570	4360	5350	6490	7840	9390						
	15	11	210	340	550	880	1380	2140	2650	3250	4030	4930	6000	7260	8650	9780				
	20	15	**160**	260	410	660	1050	1630	2020	2500	3090	3790	4630	5640	6750	7660	4260	9760		
	25	18.5	0	**210**	330	540	850	1320	1650	2020	2500	3070	3760	4560	5460	6190	7080	7870	8610	9880
	30	22	0	0	**270**	430	700	1090	1360	1680	2070	2550	3120	3780	4530	5140	5880	6540	7150	8230
	40	30	0	0	0	**320**	510	790	990	1230	1510	1860	2280	2760	3300	3750	4270	4750	5200	5980
	50	37	0	0	0	**250**	**400**	630	810	990	1230	1500	1830	2220	2650	3010	3430	3820	4170	4780
	60	45	0	0	0	0	**340**	540	660	840	1030	1270	1540	1870	2250	2550	2910	3220	3520	4050
	75	55	0	0	0	0	0	**450**	550	690	855	1050	1290	1570	1900	2160	2490	2770	3040	3520
	100	75	0	0	0	0	0	0	**420**	**520**	640	760	940	1140	1360	1540	1770	1960	2140	2470
	125	93	0	0	0	0	0	0	0	**400**	**490**	**600**	730	930	1110	1260	1420	1590	1740	1990
	150	110	0	0	0	0	0	0	0	0	**420**	**510**	**620**	750	930	1050	1180	1320	1440	1630
	175	130	0	0	0	0	0	0	0	0	**360**	**440**	**540**	660	780	970	1120	1260	1380	1600
	200	150	0	0	0	0	0	0	0	0	0	0	**480**	**580**	**690**	790	940	1050	1140	1320
460 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	880	1420	2250	3540	5550	8620												
	7.5	5.5	630	1020	1600	2530	3960	6150	7650	9390										
	10	7.5	460	750	1180	1870	2940	4570	5700	7020	8620									
	15	11	310	510	810	1270	2010	3130	3900	4800	5890	7210	8850							
	20	15	**230**	380	610	970	1540	2410	3000	3700	4560	5590	6870	8290						
	25	18.5	**190**	310	490	790	1240	1950	2430	2980	3670	4510	5550	6700	8140					
	30	22	0	**250**	410	640	1020	1600	1990	2460	3040	3730	4590	5550	6750	7690	8790			
	40	30	0	0	**300**	480	750	1180	1470	1810	2230	2740	3370	4060	4930	5590	6370			
	50	37	0	0	0	**370**	590	960	1200	1470	1810	2220	2710	3280	3970	4510	5130	5740	6270	7270
	60	45	0	0	0	**320**	**500**	810	1000	1240	1530	1870	2310	2770	3360	3810	4330	4860	5310	6150
	75	55	0	0	0	0	**420**	660	810	1020	1260	1540	1890	2280	2770	3150	3600	4050	4420	5160
	100	75	0	0	0	0	0	**500**	**610**	760	930	1140	1410	1690	2070	2340	2680	3010	3280	3820
	125	93	0	0	0	0	0	0	**470**	**590**	**730**	880	1110	1330	1500	1830	2080	2340	2550	2940
	150	110	0	0	0	0	0	0	0	**510**	**630**	**770**	950	1140	1380	1570	1790	2000	2180	2530
	175	130	0	0	0	0	0	0	0	0	**550**	**680**	**830**	1000	1220	1390	1580	1780	1950	2270
	200	150	0	0	0	0	0	0	0	0	0	**590**	**730**	**880**	1070	1210	1380	1550	1690	1970
575 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	1380	2220	3490	5520	8620													
	7.5	5.5	990	1590	2520	3970	6220													
	10	7.5	730	1170	1860	2920	4590	7150	8910											
	15	11	490	790	1270	2010	3130	4890	6090											
	20	15	370	610	970	1540	2410	3780	4710	5790	7140	8740								
	25	18.5	**300**	490	780	1240	1950	3040	3790	4660	5760	7060								
	30	22	**240**	400	645	1020	1600	2500	3120	3840	4740	5820	7150	8670						
	40	30	0	**300**	480	750	1180	1860	2310	2850	3490	4290	5260	6340	7710	8740				
	50	37	0	0	**380**	590	960	1500	1870	2310	2830	3460	4260	5130	6210	7050	8010	8980	9790	
	60	45	0	0	0	**500**	**790**	1270	1590	1950	2400	2940	3600	4330	5250	5950	6780	7600	8290	9610
	75	55	0	0	0	**420**	**660**	1030	1290	1590	1960	2400	2950	3570	4330	4930	5620	6330	6910	8050
	100	75	0	0	0	0	**400**	**780**	960	1180	1450	1780	2190	2650	3220	3660	4180	4710	5140	5980
	125	93	0	0	0	0	0	**600**	**740**	920	1150	1420	1740	2100	2530	2880	3270	3660	3970	4600
	150	110	0	0	0	0	0	0	**650**	**800**	**990**	1210	1480	1780	2160	2450	2790	3120	3410	3950
	175	130	0	0	0	0	0	0	0	**700**	**860**	1060	1300	1570	1910	2170	2480	2780	3040	3540
	200	150	0	0	0	0	0	0	0	0	**760**	**930**	1140	1370	1670	1890	2160	2420	2640	3070

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

Three-Phase Motors

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Table 19 Three-Phase 75 °C Cable, 60 Hz (Service Entrance to Motor) Maximum Length in Feet

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	710	1140	1800	2840	4420													
	3/4	0.55	510	810	1280	2030	3160													
	1	0.75	430	690	1080	1710	2670	4140	5140											
	1.5	1.1	310	500	790	1260	1960	3050	3780											
	2	1.5	240	390	610	970	1520	2360	2940	3610	4430	5420								
	3	2.2	180	290	470	740	1160	1810	2250	2760	3390	4130								
	5	3.7	**110**	170	280	440	690	1080	1350	1660	2040	2490	3050	3670	4440	5030				
	7.5	5.5	0	0	200	310	490	770	960	1180	1450	1770	2170	2600	3150	3560				
	10	7.5	0	0	**150**	230	370	570	720	880	1090	1330	1640	1970	2390	2720	3100	3480	3800	4420
	15	11	0	0	0	**160**	250	390	490	600	740	910	1110	1340	1630	1850	2100	2350	2570	2980
	20	15	0	0	0	0	**190**	300	380	460	570	700	860	1050	1270	1440	1650	1850	2020	2360
	25	18.5	0	0	0	0	0	**240**	300	370	460	570	700	840	1030	1170	1330	1500	1640	1900
	30	22	0	0	0	0	0	**200**	**250**	310	380	470	580	700	850	970	1110	1250	1360	1590
230 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	930	1490	2350	3700	5760	8910												
	3/4	0.55	670	1080	1700	2580	4190	6490	8060	9860										
	1	0.75	560	910	1430	2260	3520	5460	6780	8290										
	1.5	1.1	420	670	1060	1670	2610	4050	5030	6160	7530	9170								
	2	1.5	320	510	810	1280	2010	3130	3890	4770	5860	7170	8780							
	3	2.2	240	390	620	990	1540	2400	2980	3660	4480	5470	6690	8020	9680					
	5	3.7	**140**	230	370	590	920	1430	1790	2190	2690	3290	4030	4850	5870	6650	7560	8460	9220	
	7.5	5.5	0	**160**	260	420	650	1020	1270	1560	1920	2340	2870	3440	4160	4710	5340	5970	6500	7510
	10	7.5	0	0	**190**	310	490	760	950	1170	1440	1760	2160	2610	3160	3590	4100	4600	5020	5840
	15	11	0	0	0	**210**	330	520	650	800	980	1200	1470	1780	2150	2440	2780	3110	3400	3940
	20	15	0	0	0	**160**	**250**	400	500	610	760	930	1140	1380	1680	1910	2180	2450	2680	3120
	25	18.5	0	0	0	0	**200**	320	400	500	610	750	920	1120	1360	1540	1760	1980	2160	2520
	30	22	0	0	0	0	0	**260**	330	410	510	620	760	930	1130	1280	1470	1650	1800	2110
380 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	2690	4290	6730															
	3/4	0.55	2000	3190	5010	7860														
	1	0.75	1620	2580	4060	6390	9980													
	1.5	1.1	1230	1970	3100	4890	7630													
	2	1.5	870	1390	2180	3450	5400	8380												
	3	2.2	680	1090	1710	2690	4200	6500	8020	9830										
	5	3.7	400	640	1010	1590	2490	3870	4780	5870	7230	8830								
	7.5	5.5	270	440	690	1090	1710	2640	3260	4000	4930	6010	7290	8780						
	10	7.5	**200**	320	510	800	1250	1930	2380	2910	3570	4330	5230	6260	7390	8280	9340			
	15	11	0	0	370	590	920	1430	1770	2170	2690	3290	4000	4840	5770	6520	7430	8250	8990	
	20	15	0	0	**280**	440	700	1090	1350	1670	2060	2530	3090	3760	4500	5110	2840	6510	7120	8190
	25	18.5	0	0	0	**360**	570	880	1100	1350	1670	2050	2510	3040	3640	4130	4720	5250	5740	6590
	30	22	0	0	0	**290**	470	730	910	1120	1380	1700	2080	2520	3020	3430	3920	4360	4770	5490
	40	30	0	0	0	0	0	**530**	660	820	1010	1240	1520	1840	2200	2500	2850	3170	3470	3990
	50	37	0	0	0	0	0	**440**	**540**	660	820	1000	1220	1480	1770	2010	2290	2550	2780	3190
	60	45	0	0	0	0	0	**370**	**460**	**560**	690	850	1030	1250	1500	1700	1940	2150	2350	2700
	75	55	0	0	0	0	0	0	0	**460**	**570**	700	860	1050	1270	1440	1660	1850	2030	2350
	100	75	0	0	0	0	0	0	0	0	**420**	**510**	**630**	760	910	1030	1180	1310	1430	1650
	125	93	0	0	0	0	0	0	0	0	0	0	**510**	**620**	**740**	840	950	1060	1160	1330
	150	110	0	0	0	0	0	0	0	0	0	0	0	**520**	**620**	**700**	**790**	880	960	1090
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	**560**	**650**	**750**	**840**	920	1070
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	**550**	**630**	**700**	**760**	880

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

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Three-Phase Motors

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Table 20 Three-Phase 75 °C Cable (Continued)

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
460 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	3770	6020	9460															
	3/4	0.55	2730	4350	6850															
	1	0.75	2300	3670	5770	9070														
	1.5	1.1	1700	2710	4270	6730														
	2	1.5	1300	2070	3270	5150	8050													
	3	2.2	1000	1600	2520	3970	6200													
	5	3.7	590	950	1500	2360	3700	5750												
	7.5	5.5	420	680	1070	1690	2640	4100	5100	6260	7680									
	10	7.5	310	500	790	1250	1960	3050	3800	4680	5750	7050								
	15	11	0	**340**	540	850	1340	2090	2600	3200	3930	4810	5900	7110						
	20	15	0	0	410	650	1030	1610	2000	2470	3040	3730	4580	5530						
	25	18.5	0	0	**330**	530	830	1300	1620	1990	2450	3010	3700	4470	5430					
	30	22	0	0	**270**	430	680	1070	1330	1640	2030	2490	3060	3700	4500	5130	5860			
	40	30	0	0	0	**320**	**500**	790	980	1210	1490	1830	2250	2710	3290	3730	4250			
	50	37	0	0	0	0	**410**	640	800	980	1210	1480	1810	2190	2650	3010	3420	3830	4180	4850
	60	45	0	0	0	0	0	**540**	**670**	830	1020	1250	1540	1850	2240	2540	2890	3240	3540	4100
	75	55	0	0	0	0	0	**440**	**550**	**680**	840	1030	1260	1520	1850	2100	2400	2700	2950	3440
	100	75	0	0	0	0	0	0	0	**500**	**620**	**760**	940	1130	1380	1560	1790	2010	2190	2550
	125	93	0	0	0	0	0	0	0	0	0	**600**	**740**	**890**	1000	1220	1390	1560	1700	1960
	150	110	0	0	0	0	0	0	0	0	0	0	**630**	**760**	**920**	1050	1190	1340	1460	1690
	175	130	0	0	0	0	0	0	0	0	0	0	0	**670**	**810**	**930**	1060	1190	1300	1510
	200	150	0	0	0	0	0	0	0	0	0	0	0	**590**	**710**	**810**	**920**	1030	1130	1310
575 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	5900	9410																
	3/4	0.55	4270	6810																
	1	0.75	3630	5800	9120															
	1.5	1.1	2620	4180	6580															
	2	1.5	2030	3250	5110	8060														
	3	2.2	1580	2530	3980	6270														
	5	3.7	920	1480	2330	3680	5750													
	7.5	5.5	660	1060	1680	2650	4150													
	10	7.5	490	780	1240	1950	3060	4770	5940											
	15	11	**330**	530	850	1340	2090	3260	4060											
	20	15	0	**410**	650	1030	1610	2520	3140	3860	4760	5830								
	25	18.5	0	0	520	830	1300	2030	2530	3110	3840	4710								
	30	22	0	0	**430**	680	1070	1670	2080	2560	3160	3880	4770	5780	7030	8000				
	40	30	0	0	0	**500**	790	1240	1540	1900	2330	2860	3510	4230	5140	5830				
	50	37	0	0	0	**410**	**640**	1000	1250	1540	1890	2310	2840	3420	4140	4700	5340	5990	6530	7580
	60	45	0	0	0	0	**540**	850	1060	1300	1600	1960	2400	2890	3500	3970	4520	5070	5530	6410
	75	55	0	0	0	0	0	**690**	860	1060	1310	1600	1970	2380	2890	3290	3750	5220	4610	5370
	100	75	0	0	0	0	0	0	**640**	**790**	970	1190	1460	1770	2150	2440	2790	3140	3430	3990
	125	93	0	0	0	0	0	0	0	**630**	**770**	**950**	1160	1400	1690	1920	2180	2440	2650	3070
	150	110	0	0	0	0	0	0	0	0	**660**	**800**	**990**	1190	1440	1630	1860	2080	2270	2640
	175	130	0	0	0	0	0	0	0	0	0	**700**	**870**	**1050**	1270	1450	1650	1860	2030	2360
	200	150	0	0	0	0	0	0	0	0	0	0	**760**	**920**	**1110**	1260	1440	1620	1760	2050

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

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Three-Phase Motors

APPLICATION

Table 21 Three-Phase 75 °C Cable

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	160	250	420	660	1030	1620	2020	2490	3060	3730	4570	5500	6660	7540				
	7.5	5.5	110	180	300	460	730	1150	1440	1770	2170	2650	3250	3900	4720	5340				
	10	7.5	**80**	130	210	340	550	850	1080	1320	1630	1990	2460	2950	3580	4080	4650	5220	5700	6630
	15	11	0	0	140	240	370	580	730	900	1110	1360	1660	2010	2440	2770	3150	3520	3850	4470
	20	15	0	0	**120**	170	280	450	570	690	850	1050	1290	1570	1900	2160	2470	2770	3030	3540
	25	18.5	0	0	0	**140**	220	360	450	550	690	850	1050	1260	1540	1750	1990	2250	2460	2850
	30	22	0	0	0	**120**	**180**	294	370	460	570	700	870	1050	1270	1450	1660	1870	2040	2380
230 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	210	340	550	880	1380	2140	2680	3280	4030	4930	6040	7270	8800	9970				
	7.5	5.5	150	240	390	630	970	1530	1900	2340	2880	3510	4300	5160	6240	7060	8010	8950	9750	
	10	7.5	**110**	180	280	460	730	1140	1420	1750	2160	2640	3240	3910	4740	5380	6150	6900	7530	8760
	15	11	0	**130**	190	310	490	780	970	1200	1470	1800	2200	2670	3220	3660	4170	4660	5100	5910
	20	15	0	0	**140**	230	370	600	750	910	1140	1390	1710	2070	2520	2860	3270	3670	4020	4680
	25	18.5	0	0	**120**	190	300	480	600	750	910	1120	1380	1680	2040	2310	2640	2970	3240	3780
	30	22	0	0	0	**150**	240	390	490	610	760	930	1140	1390	1690	1920	2200	2470	2700	3160
380 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	600	960	1510	2380	3730	5800	7170	8800										
	7.5	5.5	400	660	1030	1630	2560	3960	4890	6000	7390	9010								
	10	7.5	300	480	760	1200	1870	2890	3570	4360	5350	6490	7840	9390						
	15	11	210	340	550	880	1380	2140	2650	3250	4030	4930	6000	7260	8650	9780				
	20	15	**160**	260	410	660	1050	1630	2020	2500	3090	3790	4630	5640	6750	7660	4260	9760		
	25	18.5	0	**210**	330	540	850	1320	1650	2020	2500	3070	3760	4560	5460	6190	7080	7870	8610	9880
	30	22	0	0	**270**	430	700	1090	1360	1680	2070	2550	3120	3780	4530	5140	5880	6540	7150	8230
	40	30	0	0	**210**	320	510	790	990	1230	1510	1860	2280	2760	3300	3750	4270	4750	5200	5980
	50	37	0	0	0	**250**	400	630	810	990	1230	1500	1830	2220	2650	3010	3430	3820	4170	4780
	60	45	0	0	0	0	**340**	540	660	840	1030	1270	1540	1870	2250	2550	2910	3220	3520	4050
	75	55	0	0	0	0	**290**	450	550	690	855	1050	1290	1570	1900	2160	2490	2770	3040	3520
	100	75	0	0	0	0	0	**340**	**420**	520	640	760	940	1140	1360	1540	1770	1960	2140	2470
	125	93	0	0	0	0	0	0	**340**	**400**	**490**	600	730	930	1110	1260	1420	1590	1740	1990
	150	110	0	0	0	0	0	0	0	**350**	**420**	**510**	620	750	930	1050	1180	1320	1440	1630
	175	130	0	0	0	0	0	0	0	0	**360**	**440**	**540**	660	780	970	1120	1260	1380	1600
	200	150	0	0	0	0	0	0	0	0	0	**410**	**480**	**580**	690	790	940	1050	1140	1320
460 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	880	1420	2250	3540	5550	8620												
	7.5	5.5	630	1020	1600	2530	3960	6150	7650	9390										
	10	7.5	460	750	1180	1870	2940	4570	5700	7020	8620									
	15	11	310	510	810	1270	2010	3130	3900	4800	5890	7210	8850							
	20	15	230	380	610	970	1540	2410	3000	3700	4560	5590	6870	8290						
	25	18.5	**190**	310	490	790	1240	1950	2430	2980	3670	4510	5550	6700	8140					
	30	22	0	**250**	410	640	1020	1600	1990	2460	3040	3730	4590	5550	6750	7690	8790			
	40	30	0	0	**300**	480	750	1180	1470	1810	2230	2740	3370	4060	4930	5590	6370			
	50	37	0	0	**250**	370	590	960	1200	1470	1810	2220	2710	3280	3970	4510	5130	5740	6270	7270
	60	45	0	0	0	**320**	500	810	1000	1240	1530	1870	2310	2770	3360	3810	4330	4860	5310	6150
	75	55	0	0	0	0	**420**	660	810	1020	1260	1540	1890	2280	2770	3150	3600	4050	4420	5160
	100	75	0	0	0	0	**310**	**500**	610	760	930	1140	1410	1690	2070	2340	2680	3010	3280	3820
	125	93	0	0	0	0	0	**390**	**470**	**590**	730	880	1110	1330	1500	1830	2080	2340	2550	2940
	150	110	0	0	0	0	0	0	**420**	**510**	**630**	770	950	1140	1380	1570	1790	2000	2180	2530
	175	130	0	0	0	0	0	0	0	**450**	**550**	**680**	830	1000	1220	1390	1580	1780	1950	2270
	200	150	0	0	0	0	0	0	0	0	**480**	**590**	**730**	880	1070	1210	1380	1550	1690	1970
575 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	1380	2220	3490	5520	8620													
	7.5	5.5	990	1590	2520	3970	6220													
	10	7.5	730	1170	1860	2920	4590	7150	8910											
	15	11	490	790	1270	2010	3130	4890	6090											
	20	15	370	610	970	1540	2410	3780	4710	5790	7140	8740								
	25	18.5	**300**	490	780	1240	1950	3040	3790	4660	5760	7060								
	30	22	**240**	400	645	1020	1600	2500	3120	3840	4740	5820	7150	8670						
	40	30	0	**300**	480	750	1180	1860	2310	2850	3490	4290	5260	6340	7710	8740				
	50	37	0	0	**380**	590	960	1500	1870	2310	2830	3460	4260	5130	6210	7050	8010	8980	9790	
	60	45	0	0	**330**	500	790	1270	1590	1950	2400	2940	3600	4330	5250	5950	6780	7600	8290	9610
	75	55	0	0	0	**420**	660	1030	1290	1590	1960	2400	2950	3570	4330	4930	5620	6330	6910	8050
	100	75	0	0	0	0	**400**	780	960	1180	1450	1780	2190	2650	3220	3660	4180	4710	5140	5980
	125	93	0	0	0	0	0	**600**	740	920	1150	1420	1740	2100	2530	2880	3270	3660	3970	4600
	150	110	0	0	0	0	0	**520**	**650**	800	990	1210	1480	1780	2160	2450	2790	3120	3410	3950
	175	130	0	0	0	0	0	0	**570**	**700**	860	1060	1300	1570	1910	2170	2480	2780	3040	3540
	200	150	0	0	0	0	0	0	**500**	**610**	**760**	930	1140	1370	1670	1890	2160	2420	2640	3070

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

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Table 22 Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
4"	234501	1/2	0.37	200	60	1.6	2.8	585	3.4	860	6.6-8.4	70	64	17.5	N
	234511			230	60	1.6	2.4	585	2.9	860	9.5-10.9	70	64	15.2	N
	234541			380	60	1.6	1.4	585	2.1	860	23.2-28.6	70	64	9.2	N
	234521			460	60	1.6	1.2	585	1.5	860	38.4-44.1	70	64	7.6	N
	234531			575	60	1.6	1.0	585	1.2	860	58.0-71.0	70	64	6.1	N
	234502	3/4	0.55	200	60	1.5	3.6	810	4.4	1150	4.6-5.9	73	69	24.6	N
	234512			230	60	1.5	3.1	810	3.8	1150	6.8-7.8	73	69	21.4	N
	234542			380	60	1.5	1.9	810	2.5	1150	16.6-20.3	73	69	13	N
	234522			460	60	1.5	1.6	810	1.9	1150	27.2-30.9	73	69	10.7	N
	234532			575	60	1.5	1.3	810	1.6	1150	41.5-50.7	73	69	8.6	N
	234503	1	0.75	200	60	1.4	4.5	1070	5.4	1440	3.8-4.5	72	70	30.9	M
	234513			230	60	1.4	3.9	1070	4.7	1440	4.9-5.6	72	70	26.9	M
	234543			380	60	1.4	2.3	1070	2.8	1440	12.2-14.9	72	70	16.3	M
	234523			460	60	1.4	2	1070	2.4	1440	19.9-23.0	72	70	13.5	M
	234533			575	60	1.4	1.6	1070	1.9	1440	30.1-36.7	72	70	10.8	M
	234504	1.5	1.1	200	60	1.3	5.8	1460	6.8	1890	2.5-3.0	76	76	38.2	K
	234514			230	60	1.3	5	1460	5.9	1890	3.2-4.0	76	76	33.2	K
	234544			380	60	1.3	3	1460	3.6	1890	8.5-10.4	76	76	20.1	K
	234524			460	60	1.3	2.5	1460	3.1	1890	13.0-16.0	76	76	16.6	K
	234534			575	60	1.3	2	1460	2.4	1890	20.3-25.0	76	76	13.3	K
	234305	2	1.5	200	60	1.25	7.7	1960	9.3	2430	1.8-2.4	76	76	50.3	K
	234315			230	60	1.25	6.7	1960	8.1	2430	2.3-3.0	76	76	45.0	K
	234345			380	60	1.25	4.1	1960	4.9	2430	6.6-8.2	76	76	26.6	K
	234325			460	60	1.25	3.4	1960	4.1	2430	9.2-12.0	76	76	22.5	K
	234335			575	60	1.25	2.7	1960	3.2	2430	14.6-18.7	76	76	17.8	K
	234306	3	2.2	200	60	1.15	10.9	2920	12.5	3360	1.3-1.7	77	77	69.5	K
	234316			230	60	1.15	9.5	2920	10.9	3360	1.8-2.2	77	77	60.3	K
	234346			380	60	1.15	5.8	2920	6.6	3360	4.7-6.0	77	77	37.5	K
	234326			460	60	1.15	4.8	2920	5.5	3360	7.2-8.8	77	77	31.0	K
	234336			575	60	1.15	3.8	2920	4.4	3360	11.4-13.9	77	77	25.1	K
	234307	5	3.7	200	60	1.15	18.3	4800	20.5	5500	.68-.83	78	78	116	K
	234317			230	60	1.15	15.9	4800	17.8	5500	.91-1.1	78	78	102	K
	234347			380	60	1.15	9.6	4800	10.8	5500	2.6-3.2	78	78	60.2	K
	234327			460	60	1.15	8.0	4800	8.9	5500	3.6-4.4	78	78	53.7	K
	234337			575	60	1.15	6.4	4800	7.1	5500	5.6-6.9	78	78	41.8	K
	234308	7.5	5.5	200	60	1.15	26.5	7150	30.5	8200	.43-.53	78	78	177	K
	234318			230	60	1.15	23.0	7150	26.4	8200	.60-.73	78	78	152	K
	234348			380	60	1.15	13.9	7150	16.0	8200	1.6-2.0	78	78	92.7	K
	234328			460	60	1.15	11.5	7150	13.2	8200	2.3-2.8	78	78	83.8	K
	234338			575	60	1.15	9.2	7150	10.6	8200	3.6-4.5	78	78	64.6	K
	234549	10	7.5	380	60	1.15	19.3	10000	21.0	11400	1.2-1.6	75	75	140	L
	234595			460	60	1.15	15.9	10000	17.3	11400	1.8-2.3	75	75	116.0	L
	234598			575	60	1.15	12.5	10000	13.6	11400	2.8-3.5	75	75	92.8	L
	234646	15	11	380	60	1.15	27.6	14600	31.2	16800	.86-1.1	77	76	178	J
	234626			460	60	1.15	22.8	14600	25.8	16800	1.2-1.5	77	76	147	J
	234636			575	60	1.15	18.2	14600	20.7	16800	1.9-2.4	77	76	118	J

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Table 23 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
4"	234501	1/2	0.37	200	10	5	8	10	4	15
	234511			230	8	4.5	6	8	4	15
	234541			380	5	2.5	4	5	2	15
	234521			460	4	2.25	3	4	2	15
	234531			575	3	1.8	3	3	1.4	15
	234502	3/4	0.55	200	15	7	10	12	5	15
	234512			230	10	5.6	8	10	5	15
	234542			380	6	3.5	5	6	3	15
	234522			460	5	2.8	4	5	3	15
	234532			575	4	2.5	4	4	1.8	15
	234503	1	0.75	200	15	8	15	15	6	15
	234513			230	15	7	10	12	6	15
	234543			380	8	4.5	8	8	4	15
	234523			460	6	3.5	5	6	3	15
	234533			575	5	2.8	4	5	2.5	15
	234504	1.5	1.1	200	20	12	15	20	8	15
	234514			230	15	9	15	15	8	15
	234544			380	10	5.6	8	10	4	15
	234524			460	8	4.5	8	8	4	15
	234534			575	6	3.5	5	6	3	15
	234305	2	1.5	200	25	15	20	25	11	20
	234315			230	25	12	20	25	10	20
	234345			380	15	8	15	15	6	15
	234325			460	15	6	10	11	5	15
	234335			575	10	5	8	10	4	15
	234306	3	2.2	200	35	20	30	35	15	30
	234316			230	30	17.5	25	30	12	25
	234346			380	20	12	15	20	8	15
	234326			460	15	9	15	15	6	15
	234336			575	15	7	10	11	5	15
	234307	5	3.7	200	60	35	50	60	25	50
	234317			230	50	30	40	45	20	40
	234347			380	30	17.5	25	30	12	25
	234327			460	25	15	20	25	10	20
	234337			575	20	12	20	20	8	20
	234308	7.5	5.5	200	90	50	70	80	35	70
	234318			230	80	45	60	70	30	60
	234348			380	45	25	40	40	20	40
	234328			460	40	25	30	35	15	30
	234338			575	30	17.5	25	30	12	25
	234349	10	7.5	380	70	40	60	60	25	60
	234329			460	60	30	45	50	25	45
	234339			575	45	25	35	40	20	35
	234549			380	70	35	60	60	25	60
	234595			460	60	30	45	50	25	45
	234598			575	45	25	35	40	20	35
	234646	15	11	380	90	50	70	80	35	70
	234626			460	80	45	60	70	30	60
	234636			575	60	35	50	60	25	50

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Table 24 Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
6" STD.	236650	5	3.7	200	60	1.15	17.5	4700	20.0	5400	.77-.93	79	79	99	H
	236600			230	60	1.15	15	4700	17.6	5400	1.0-1.2	79	79	86	H
	236660			380	60	1.15	9.1	4700	10.7	5400	2.6-3.2	79	79	52	H
	236610			460	60	1.15	7.5	4700	8.8	5400	3.9-4.8	79	79	43	H
	236620			575	60	1.15	6	4700	7.1	5400	6.3-7.7	79	79	34	H
	236651	7.5	5.5	200	60	1.15	25.1	7000	28.3	8000	.43-.53	80	80	150	H
	236601			230	60	1.15	21.8	7000	24.6	8000	.64-.78	80	80	130	H
	236661			380	60	1.15	13.4	7000	15	8000	1.6-2.1	80	80	79	H
	236611			460	60	1.15	10.9	7000	12.3	8000	2.4-2.9	80	80	65	H
	236621			575	60	1.15	8.7	7000	9.8	8000	3.7-4.6	80	80	52	H
	236652	10	7.5	200	60	1.15	32.7	9400	37	10800	.37-.45	79	79	198	H
	236602			230	60	1.15	28.4	9400	32.2	10800	.47-.57	79	79	172	H
	236662			380	60	1.15	17.6	9400	19.6	10800	1.2-1.5	79	79	104	H
	236612			460	60	1.15	14.2	9400	16.1	10800	1.9-2.4	79	79	86	H
	236622			575	60	1.15	11.4	9400	12.9	10800	3.0-3.7	79	79	69	H
	236653	15	11	200	60	1.15	47.8	13700	54.4	15800	.24-.29	81	81	306	H
	236603			230	60	1.15	41.6	13700	47.4	15800	.28-.35	81	81	266	H
	236663			380	60	1.15	25.8	13700	28.9	15800	.77-.95	81	81	161	H
	236613			460	60	1.15	20.8	13700	23.7	15800	1.1-1.4	81	81	133	H
	236623			575	60	1.15	16.6	13700	19	15800	1.8-2.3	81	81	106	H
	236654	20	15	200	60	1.15	61.9	18100	69.7	20900	.16-.20	82	82	416	J
	236604			230	60	1.15	53.8	18100	60.6	20900	.22-.26	82	82	362	J
	236664			380	60	1.15	33	18100	37.3	20900	.55-.68	82	82	219	J
	236614			460	60	1.15	26.9	18100	30.3	20900	.8-1.0	82	82	181	J
	236624			575	60	1.15	21.5	18100	24.2	20900	1.3-1.6	82	82	145	J
	236655	25	18.5	200	60	1.15	77.1	22500	86.3	25700	.12-.15	83	83	552	J
	236605			230	60	1.15	67	22500	76.4	25700	.15-.19	83	83	480	J
	236665			380	60	1.15	41	22500	46	25700	.46-.56	83	83	291	J
	236615			460	60	1.15	33.5	22500	38.2	25700	.63-.77	83	83	240	J
	236625			575	60	1.15	26.8	22500	30	25700	1.0-1.3	83	83	192	J
	236656	30	22	200	60	1.15	90.9	26900	104	31100	.09-.11	83	83	653	J
	236606			230	60	1.15	79	26900	90.4	31100	.14-.17	83	83	568	J
	236666			380	60	1.15	48.8	26900	55.4	31100	.35-.43	83	83	317	J
	236616			460	60	1.15	39.5	26900	45.2	31100	.52-.64	83	83	284	H
	236626			575	60	1.15	31.6	26900	36.2	31100	.78-.95	83	83	227	J
	236667	40	30	380	60	1.15	66.5	35600	74.6	42400	.26-.33	83	83	481	J
	236617			460	60	1.15	54.9	35600	61.6	42400	.34-.42	83	83	397	J
	236627			575	60	1.15	42.8	35600	49.6	42400	.52-.64	83	83	318	H
	236668	50	37	380	60	1.15	83.5	45100	95	52200	.21-.25	82	83	501	H
	236618			460	60	1.15	67.7	45100	77	52200	.25-.32	82	83	414	H
	236628			575	60	1.15	54.2	45100	61.6	52200	.40-.49	82	83	331	H
	276668			380	60	1.15	82.4	45100	94.5	52200	.21 - .25	82	83	501	H
	276618			460	60	1.15	68.1	45100	78.1	52200	.25 - .32	82	83	414	H
	276628			575	60	1.15	54.5	45100	62.5	52200	.40 - .49	82	83	331	H
	276029	60/50	37/45	380	60	1.15	98.1	53500	111.8	61700	.15 - .18	84	84	627	H
	276009			460	60	1.15	81.0	53500	92.3	61700	.22 - .27	84	84	518	H
	276059			575	60	1.15	64.8	53500	73.9	61700	.35 - .39	84	84	414	H
	236669	60	45	380	60	1.15	98.7	53500	111	61700	.15-.18	84	84	627	H
	236619			460	60	1.15	80.5	53500	91	61700	.22-.27	84	84	518	H
	236629			575	60	1.15	64.4	53500	72.8	61700	.35-.39	84	84	414	H
	276669			380	60	1.15	98.1	53500	111.8	61700	.15 - .18	84	84	627	H
	276619			460	60	1.15	81.0	53500	92.3	61700	.22 - .27	84	84	518	H
	276629			575	60	1.15	64.8	53500	73.9	61700	.35 - .39	84	84	414	H

Model numbers above are for three-lead motors. Six-lead motors with different model numbers have the same running performance, but when Wye connected for starting have locked rotor amps 33% of the values shown. Six-lead individual phase resistance = table X 1.5.

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Table 25 6" Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
6" HI-TEMP 90 °C	276650	5	3.7	200	60	1.15	17.2	5200	19.8	5800	.53 - .65	73	72	124	K
	276600			230	60	1.15	15.0	5200	17.2	5800	.68 - .84	73	72	108	K
	276660			380	60	1.15	9.1	5200	10.4	5800	2.0 - 2.4	73	72	66.0	K
	276610			460	60	1.15	7.5	5200	8.6	5800	2.8 - 3.4	73	72	54.0	K
	276620			575	60	1.15	6.0	5200	6.9	5800	4.7 - 5.7	73	72	43.0	K
	276651	7.5	5.5	200	60	1.15	24.8	7400	28.3	8400	.30 - .37	77	76	193	K
	276601			230	60	1.15	21.6	7400	24.6	8400	.41 - .50	77	76	168	K
	276661			380	60	1.15	13.1	7400	14.9	8400	1.1 - 1.4	77	76	102	K
	276611			460	60	1.15	10.8	7400	12.3	8400	1.7 - 2.0	77	76	84.0	K
	276621			575	60	1.15	8.6	7400	9.9	8400	2.6 - 3.2	77	76	67.0	K
	276652	10	7.5	200	60	1.15	32.0	9400	36.3	10700	.21 - .26	80	79	274	L
	276602			230	60	1.15	27.8	9400	31.6	10700	.28 - .35	80	79	238	L
	276662			380	60	1.15	16.8	9400	19.2	10700	.80 - .98	80	79	144	L
	276612			460	60	1.15	13.9	9400	15.8	10700	1.2 - 1.4	80	79	119	L
	276622			575	60	1.15	11.1	9400	12.7	10700	1.8 - 2.2	80	79	95.0	L
	276653	15	11	200	60	1.15	48.5	14000	54.5	15900	.15 - .19	81	80	407	L
	276603			230	60	1.15	42.2	14000	47.4	15900	.19 - .24	81	80	354	L
	276663			380	60	1.15	25.5	14000	28.7	15900	.52 - .65	81	80	214	L
	276613			460	60	1.15	21.1	14000	23.7	15900	.78 - .96	81	80	177	L
	276623			575	60	1.15	16.9	14000	19.0	15900	1.2 - 1.4	81	80	142	L
	276654	20	15	200	60	1.15	64.9	18600	73.6	21300	.10 - .12	80	80	481	K
	276604			230	60	1.15	56.4	18600	64.0	21300	.14 - .18	80	80	418	K
	276664			380	60	1.15	34.1	18600	38.8	21300	.41 - .51	80	80	253	K
	276614			460	60	1.15	28.2	18600	32.0	21300	.58 - .72	80	80	209	K
	276624			575	60	1.15	22.6	18600	25.6	21300	.93 - 1.15	80	80	167	K
	276655	25	18.5	200	60	1.15	80.0	22600	90.6	25800	.09 - .11	83	82	665	L
	276605			230	60	1.15	69.6	22600	78.8	25800	.11 - .14	83	82	578	L
	276665			380	60	1.15	42.1	22600	47.7	25800	.27 - .34	83	82	350	L
	276615			460	60	1.15	34.8	22600	39.4	25800	.41 - .51	83	82	289	L
	276625			575	60	1.15	27.8	22600	31.6	25800	.70 - .86	83	82	231	L
	276656	30	22	200	60	1.15	95.0	28000	108.6	31900	.07 - .09	81	80	736	K
	276606			230	60	1.15	82.6	28000	94.4	31900	.09 - .12	81	80	640	K
	276666			380	60	1.15	50.0	28000	57.2	31900	.23 - .29	81	80	387	K
	276616			460	60	1.15	41.3	28000	47.2	31900	.34 - .42	81	80	320	K
	276626			575	60	1.15	33.0	28000	37.8	31900	.52 - .65	81	80	256	K
	276667	40	30	380	60	1.15	67.2	35900	76.0	42400	.18 - .23	84	83	545	L
	276617			460	60	1.15	55.4	35900	62.8	42400	.23 - .29	84	83	450	L
	276627			575	60	1.15	45.2	35900	50.2	42400	.34 - .43	84	83	360	L

Model numbers above are for three-lead motors. Six-lead motors with different model numbers have the same running performance, but when Wye connected for starting have locked rotor amps 33% of the values shown. Six-lead individual phase resistance = table X 1.5.

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Table 26 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX		RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
	STD	HI-TEMP	HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
6" STD. & HI-TEMP	236650	276650	5	3.7	200	60	35	45	50	25	45
	236600	276600			230	45	30	40	45	20	40
	236660	276660			380	30	17.5	25	30	12	25
	236610	276610			460	25	15	20	25	10	20
	236620	276620			575	20	12	15	20	8	15
	236651	276651	7.5	5.5	200	80	45	70	80	35	70
	236601	276601			230	70	40	60	70	30	60
	236661	276661			380	45	25	35	40	20	35
	236611	276611			460	35	20	30	35	15	30
	236621	276621			575	30	17.5	25	25	11	25
	236652	276652	10	7.5	200	100	60	90	100	45	90
	236602	276602			230	90	50	80	90	40	80
	236662	276662			380	60	35	45	50	25	45
	236612	276612			460	45	25	40	45	20	40
	236622	276622			575	35	20	30	35	15	30
	236653	276653	15	11	200	150	90	125	150	60	125
	236603	276603			230	150	80	110	125	60	110
	236663	276663			380	80	50	70	80	35	70
	236613	276613			460	70	40	60	60	30	60
	236623	276623			575	60	30	45	50	25	45
	236654	276654	20	15	200	200	110	175	175	80	175
	236604	276604			230	175	100	150	175	70	150
	236664	276664			380	100	60	90	100	45	90
	236614	276614			460	90	50	70	80	35	70
	236624	276624			575	70	40	60	70	30	60
	236655	276655	25	18.5	200	250	150	200	225	100	200
	236605	276605			230	225	125	175	200	90	175
	236665	276665			380	125	80	110	125	50	110
	236615	276615			460	110	60	90	100	45	90
	236625	276625			575	90	50	70	80	35	70
	236656	276656	30	22	200	300	175	250	300	125	250
	236606	276606			230	250	150	225	250	100	200
	236666	276666			380	150	90	125	150	60	125
	236616	276616			460	125	70	110	125	50	100
	236626	276626			575	100	60	90	100	40	80
	236667	276667	40	30	380	200	125	175	200	90	175
	236617	276617			460	175	100	150	175	70	150
	236627	276627			575	150	80	110	125	60	110
	236668	276668	50	37	380	250	150	225	250	110	225
	236618	276618			460	225	125	175	200	90	175
	236628	276628			575	175	100	150	175	70	150
	236669	276669	60	45	380	300	175	250	300	125	250
	236619	276619			460	250	150	225	250	100	225
	236629	276629			575	200	125	175	200	80	175

Three-Phase Motors

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Table 27 Three-Phase Motor Specifications (60 Hz) 3525 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	KILOWATTS	AMPS	KILOWATTS		S.F.	F.L.		
8" STD.	239660	40	30	380	60	1.15	64	35	72	40	.16-.20	86	86	479	J
	239600			460	60	1.15	53	35	60	40	.24-.30	86	86	396	J
	239610			575	60	1.15	42	35	48	40	.39-.49	86	86	317	J
	239661	50	37	380	60	1.15	79	43	88	49	.12-.16	87	87	656	K
	239601			460	60	1.15	64	43	73	49	.18-.22	87	87	542	K
	239611			575	60	1.15	51	43	59	49	.28-.34	87	87	434	K
	239662	60	45	380	60	1.15	92	52	104	60	.09-.11	88	87	797	K
	239602			460	60	1.15	76	52	86	60	.14-.17	88	87	658	K
	239612			575	60	1.15	61	52	69	60	.22-.28	88	87	526	K
	239663	75	55	380	60	1.15	114	64	130	73.5	.06-.09	88	88	1046	L
	239603			460	60	1.15	94	64	107	73.5	.10-.13	88	88	864	L
	239613			575	60	1.15	76	64	86	73.5	.16-.21	88	88	691	L
	239664	100	75	380	60	1.15	153	85	172	97.5	.05-.06	89	89	1466	L
	239604			460	60	1.15	126	85	142	97.5	.07-.09	89	89	1211	L
	239614			575	60	1.15	101	85	114	97.5	.11-.13	89	89	969	L
	239165	125	93	380	60	1.15	202	109	228	125	.03-.04	87	86	1596	K
	239105			460	60	1.15	167	109	188	125	.05-.07	87	86	1318	K
	239115			575	60	1.15	134	109	151	125	.08-.11	87	86	1054	K
	239166	150	110	380	60	1.15	235	128	266	146	.02-.03	88	87	1961	K
	239106			460	60	1.15	194	128	219	146	.04-.05	88	87	1620	K
	239116			575	60	1.15	164	128	182	146	.06-.08	88	87	1296	K
	239167	175	130	380	60	1.15	265	150	302	173	.02-.04	88	88	1991	J
	239107			460	60	1.15	219	150	249	173	.04-.05	88	88	1645	J
	239117			575	60	1.15	175	150	200	173	.06-.08	88	88	1316	J
	239168	200	150	380	60	1.15	298	169	342	194	.02-.03	88	88	2270	J
	239108			460	60	1.15	246	169	282	194	.03-.05	88	88	1875	J
	239118			575	60	1.15	197	169	226	194	.05-.07	88	88	1500	J

Table 27A 8" Three-Phase Motor Specifications (60 Hz) 3525 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	KILOWATTS	AMPS	KILOWATTS		S.F.	F.L.		
8" HI-TEMP	279160	40	30	380	60	1.15	69.6	38	78.7	43	.11 - .14	79	78	616	M
	279100			460	60	1.15	57.5	38	65.0	43	.16 - .19	79	78	509	M
	279110			575	60	1.15	46.0	38	52.0	43	.25 - .31	79	78	407	M
	279161	50	37	380	60	1.15	84.3	47	95.4	53	.07 - .09	81	80	832	M
	279101			460	60	1.15	69.6	47	78.8	53	.11 - .14	81	80	687	M
	279111			575	60	1.15	55.7	47	63.0	53	.18 - .22	81	80	550	M
	279162	60	45	380	60	1.15	98.4	55	112	62	.06 - .07	83	82	1081	N
	279102			460	60	1.15	81.3	55	92.1	62	.09 - .11	83	82	893	N
	279112			575	60	1.15	65.0	55	73.7	62	.13 - .16	83	82	715	N
	279163	75	56	380	60	1.15	125	68	141	77	.05 - .06	83	82	1175	L
	279103			460	60	1.15	100	68	114	77	.07 - .09	83	82	922	L
	279113			575	60	1.15	80	68	92	77	.11 - .14	83	82	738	L
	279164	100	75	380	60	1.15	159	88	181	100	.04 - .05	86	85	1508	M
	279104			460	60	1.15	131	88	149	100	.05 - .07	86	85	1246	M
	279114			575	60	1.15	105	88	119	100	.08 - .10	86	85	997	M
	279165	125	93	380	60	1.15	195	109	223	125	.03 - .04	86	85	1793	L
	279105			460	60	1.15	161	109	184	125	.04 - .06	86	85	1481	L
	279115			575	60	1.15	129	109	148	125	.07 - .09	86	85	1185	L
	279166	150	110	380	60	1.15	235	133	269	151	.02 - .03	85	84	2012	K
	279106			460	60	1.15	194	133	222	151	.03 - .05	85	84	1662	K
	279116			575	60	1.15	155	133	178	151	.05 - .07	85	84	1330	K

Model numbers above are for three-lead motors. Six-lead motors with different model numbers have the same running performance, but when Wye connected for starting have locked rotor amps 33% of the values shown. Six-lead individual phase resistance = table X 1.5.

Three-Phase Motors

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Table 28 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
8" STD.	239660	40	30	380	200	125	175	200	80	175
	239600			460	175	100	150	175	70	150
	239610			575	150	80	110	125	60	110
	239661	50	37	380	250	150	200	225	100	200
	239601			460	200	125	175	200	80	175
	239611			575	175	90	150	150	70	150
	239662	60	45	380	300	175	250	300	125	250
	239602			460	250	150	200	225	100	200
	239612			575	200	110	175	175	80	175
	239663	75	55	380	350	200	300	350	150	300
	239603			460	300	175	250	300	125	250
	239613			575	250	150	200	225	100	200
	239664	100	75	380	500	275	400	450	200	400
	239604			460	400	225	350	400	175	350
	239614			575	350	200	300	300	125	300
	239165	125	93	380	700	400	600	600	250	600
	239105			460	500	300	450	500	225	450
	239115			575	450	250	350	400	175	350
	239166	150	110	380	800	450	600	700	300	600
	239106			460	600	350	500	600	250	500
	239116			575	500	300	400	450	200	400
	239167	175	130	380	800	500	700	800	350	700
	239107			460	700	400	600	700	300	600
	239117			575	600	350	450	600	225	450
	239168	200	150	380	1000	600	800	1000	400	800
	239108			460	800	450	700	800	350	700
	239118			575	600	350	500	600	250	500

Table 28A 8" Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
8" HI-TEMP	279160	40	30	380	225	125	175	200	90	175
	279100			460	175	110	150	175	70	150
	279110			575	150	90	125	125	60	125
	279161	50	37	380	250	150	225	225	110	225
	279101			460	200	125	175	200	90	175
	279111			575	175	100	150	150	70	150
	279162	60	45	380	300	175	250	300	125	250
	279102			460	275	150	225	250	100	225
	279112			575	200	125	175	175	80	175
	279163	75	56	380	400	200	350	350	150	350
	279103			460	300	175	275	300	125	275
	279113			575	275	150	225	225	100	225
	279164	100	75	380	500	300	450	450	200	450
	279104			460	400	250	350	400	175	350
	279114			575	350	200	300	300	125	300
	279165	125	93	380	700	400	600	600	250	600
	279105			460	500	300	450	500	225	450
	279115			575	450	250	350	400	175	350
	279166	150	110	380	800	450	600	700	300	600
	279106			460	600	350	500	600	250	500
	279116			575	500	300	400	450	200	400

Three-Phase Motors

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Overload Protection of Three-Phase Submersible Motors

Class 10 Protection Required

The characteristics of submersible motors are different than standard motors and special overload protection is required.

If the motor is locked, the overload protection must trip within 10 seconds to protect the motor windings. Subtrol/ SubMonitor, a Franklin-approved adjustable overload relay, or a Franklin-approved fixed heater must be used.

Fixed heater overloads must be the ambient-compensated quick-trip type to maintain protection at high and low air temperatures.

All heaters and amp settings shown are based on total line amps. When determining amperage settings or making heater selections for a six-lead motor with a Wye-Delta starter, divide motor amps by 1.732.

Pages 29, 30 and 31 list the correct selection and settings for some manufacturers. Approval for other manufacturers' types not listed may be requested by calling Franklin's Technical Service Hotline at 800-348-2420.

Refer to notes on page 30.

Table 29 - 60 Hz 4" Motors

HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
				FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
1/2	0.37	200	00	K31	L380A	3.2	3.4
		230	00	K28	L343A	2.7	2.9
		380	00	K22	L211A	1.7	1.8
		460	00	-	L174A	1.4	1.5
		575	00	-	-	1.2	1.3
3/4	0.55	200	00	K34	L510A	4.1	4.4
		230	00	K32	L420A	3.5	3.8
		380	00	K27	L282A	2.3	2.5
		460	00	K23	L211A	1.8	1.9
		575	00	K21	L193A	1.5	1.6
1	0.75	200	00	K37	L618A	5.0	5.4
		230	00	K36	L561A	4.4	4.7
		380	00	K28	L310A	2.6	2.8
		460	00	K26	L282A	2.2	2.4
		575	00	K23	L211A	1.8	1.9
1.5	1.1	200	00	K42	L750A	6.3	6.8
		230	00	K39	L680A	5.5	5.9
		380	00	K32	L420A	3.3	3.6
		460	00	K29	L343A	2.8	3.0
		575	00	K26	L282A	2.2	2.4
2	1.5	200	0	K50	L111B	8.6	9.3
		230	0	K49	L910A	7.5	8.1
		380	0	K36	L561A	4.6	4.9
		460	00	K33	L463A	3.8	4.1
		575	00	K29	L380A	3.0	3.2
3	2.2	200	0	K55	L147B	11.6	12.5
		230	0	K52	L122B	10.1	10.9
		380	0	K41	L750A	6.1	6.6
		460	0	K37	L618A	5.1	5.5
		575	0	K34	L510A	4.1	4.4
5	3.7	200	1	K62	L241B	19.1	20.5
		230	1	K61	L199B	16.6	17.8
		380	0	K52	L122B	10.0	10.8
		460	0	K49	L100B	8.3	8.9
		575	0	K42	L825A	6.6	7.1
7.5	5.5	200	1	K68	L322B	28.4	30.5
		230	1	K67	L293B	24.6	26.4
		380	1	K58	L181B	14.9	16.0
		460	1	K55	L147B	12.3	13.2
		575	1	K52	L122B	9.9	10.6
10	7.5	380	1	K62	L241B	19.5	21.0
		460	1	K60	L199B	16.1	17.3
		575	1	K56	L165B	12.9	13.6
15	11	380	2 (1)	K70	L322B	29	31.2
		460	2 (1)	K67	L265B	24.0	25.8
		575	2 (1)	K62	L220B	19.3	20.7

Three-Phase Motors

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Table 30 – 60 Hz 6" Standard & Hi-Temp Motors

HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
				FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
5	3.7	200	1	K61	L220B	17.6	19.1
		230	1	K61	L199B	15.4	16.6
		380	0	K52	L122B	9.4	10.1
		460	0	K49	L100B	7.7	8.3
		575	0	K42	L825A	6.1	6.6
7.5	5.5	200	1	K67	L322B	26.3	28.3
		230	1	K64	L293B	22.9	24.6
		380	1	K57	L165B	13.9	14.9
		460	1	K54	L147B	11.4	12.3
		575	1	K52	L111B	9.1	9.8
10	7.5	200	2(1)	K72	L426B	34.4	37.0
		230	2(1)	K70	L390B	29.9	32.2
		380	1	K61	L220B	18.1	19.5
		460	1	K58	L181B	15.0	16.1
		575	1	K55	L147B	12.0	12.9
15	11	200	3(1)	K76	L650B	50.7	54.5
		230	2	K75	L520B	44.1	47.4
		380	2(1)	K68	L322B	26.7	28.7
		460	2(1)	K64	L265B	22.0	23.7
		575	2(1)	K61	L220B	17.7	19.0
20	15	200	3	K78	L787B	64.8	69.7
		230	3(1)	K77	L710B	56.4	60.6
		380	2	K72	L426B	34.1	36.7
		460	2	K69	L352B	28.2	30.3
		575	2	K64	L393B	22.7	24.4
25	18.5	200	3	K86	L107C	80.3	86.3
		230	3	K83	L866B	69.8	75.0
		380	2	K74	L520B	42.2	45.4
		460	2	K72	L426B	34.9	37.5
		575	2	K69	L352B	27.9	30.0
30	22	200	4(1)	K88	L126C	96.7	104.0
		230	3	K87	L107C	84.1	90.4
		380	3(1)	K76	L650B	50.9	54.7
		460	3(1)	K74	L520B	42.0	45.2
		575	3(1)	K72	L390B	33.7	36.2
40	30	380	3	K83	L866B	69.8	75.0
		460	3	K77	L710B	57.7	62.0
		575	3	K74	L593B	46.1	49.6
50	37	380	3	K87	L107C	86.7	93.2
		460	3	K83	L950B	71.6	77.0
		575	3	K77	L710B	57.3	61.6
60	45	380	4(1)	K89	L126C	102.5	110.2
		460	4(1)	K87	L107C	84.6	91.0
		575	4(1)	K78	L866B	67.7	72.8

Footnotes for Tables 29, 30, 31, and 31A

NOTE 1: Furnas intermediate sizes between NEMA starter sizes apply where (1) is shown in tables, size 1.75 replacing 2, 2.5 replacing 3, 3.5 replacing 4, and 4.5 replacing 5. Heaters were selected from Catalog 294, table 332 and table 632 (starter size 00, size B). Size 4 starters are heater type 4 (JG). Starters using these heater tables include classes 14, 17, and 18 (inNOVA), classes 36 and 37 (reduced voltage), and classes 87, 88, and 89 (pump and motor control centers). Overload relay adjustments should be set no higher than 100% unless necessary to stop nuisance tripping with measured amps in all lines below nameplate maximum. Heater selections for class 16 starters (Magnetic Definite Purpose) will be furnished upon request.

NOTE 2: General Electric heaters are type CR123 usable only on type CR124 overload relays and were selected from Catalog GEP-1260J, page 184. Adjustment should be set no higher than 100%, unless necessary to stop nuisance tripping with measured amps in all lines below nameplate maximum.

NOTE 3: Adjustable overload relay amp settings apply to approved types listed. Relay adjustment should be set at the specified SET amps. Only if tripping occurs with amps in all lines measured to be within nameplate maximum amps should the setting be increased, not to exceed the MAX value shown.

NOTE 4: Heaters shown for ratings requiring NEMA size 5 or 6 starters are all used with current transformers per manufacturer standards. Adjustable relays may or may not use current transformers depending on design.

Three-Phase Motors

APPLICATION

Table 31 - 60 Hz 8" Motors

MOTOR MODEL PREFIX	HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
					FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
239660	40	30	380	3	K78	L866B	68	73
239600			460	3	K77	L710B	56	60
239610			575	3	K73	L520B	45	48
239661	50	37	380	3	K86	L107C	81	87
239601			460	3	K78	L866B	68	73
239611			575	3	K77	L710B	56	60
239662	60	45	380	4(1)	K89	L126C	101	108
239602			460	4(1)	K86	L107C	83	89
239612			575	4(1)	K78	L787B	64	69
239663	75	55	380	4	K92	L142C	121	130
239603			460	4(1)	K89	L126C	100	107
239613			575	4(1)	K85	L950C	79	85
239664	100	75	380	5(1)	K28	L100B	168	181
239604			460	4	K92	L155C	134	144
239614			575	4	K90	L142C	108	116
239165	125	93	380	5	K32	L135B	207	223
239105			460	5(1)	K29	L111B	176	189
239115			575	5(1)	K26	L825A	140	150
239166	150	110	380	5	-	L147B	248	267
239106			460	5(1)	K32	L122B	206	221
239116			575	5(1)	K28	L100B	169	182
239167	175	130	380	6	K26	-	270	290
239107			460	5	K33	L147B	233	250
239117			575	5	K31	L111B	186	200
239168	200	150	380	6	K27	-	316	340
239108			460	5	K33	L165B	266	286
239118			575	5	K32	L135B	213	229

Table 31A - 60 Hz 8" Hi-Temp 75°C Motors

MOTOR MODEL PREFIX	HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
					FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
279160	40	30	380	3	K83	L866B	73	79
279100			460	3	K77	L710B	60	65
279110			575	3	K74	L593B	48	52
279161	50	37	380	3	K87	L107C	89	95
279101			460	3	K83	L866B	73	79
279111			575	3	K77	L710B	59	63
279162	60	45	380	4(1)	K89	L126C	104	112
279102			460	4(1)	K87	L107C	86	92
279112			575	4(1)	K78	L866B	69	74
279163	75	56	380	4	K92	L155C	131	141
279103			460	4(1)	K89	L126C	106	114
279113			575	4(1)	K87	L950C	86	92
279164	100	75	380	5(1)	K28	L100B	168	181
279104			460	5(1)	K26	L825A	139	149
279114			575	4	K90	L142C	111	119
279165	125	93	380	5	K32	L135B	207	223
279105			460	5(1)	K29	L111B	171	184
279115			575	5(1)	K26	L825A	138	148
279166	150	110	380	5	-	L147B	250	269
279106			460	5(1)	K32	L122B	206	222
279116			575	5(1)	K28	L100B	166	178

Note: Other relay types from these and other manufacturers may or may not provide acceptable protection, and they should not be used without approval of Franklin Electric.

Some approved types may only be available for part of the listed motor ratings. When relays are used with current transformers, relay setting is the specified amps divided by the transformer ratio.

Recommended Adjustable Overload Relays

Advance Controls: MDR3 Overload

AEG Series: B17S, B27S, B27-2

ABB Type: RVH 40, RVH65, RVP160, T25DU, T25CT, TA25DU

AGUT: MT03, R1K1, R1L0, R1L3, TE set Class 5

Allen Bradley: Bulletin 193, SMP-Class 10 only

Automatic Switch Types: DQ, LR1-D, LR1-F, LR2 Class 10

Benshaw: RSD6 (Class 10) Soft Start

Bharita C-H: MC 305 ANA 3

Clipsal: 6CTR, 6MTR

Cutler-Hammer: C316F, C316P, C316S, C310-set at 6 sec max, Advantage Class10

Fanal Types: K7 or K7D through K400

Franklin Electric: Subtrol-Plus, SubMonitor, IPS, SSP, IPS-RV, and SPS-RV

Fuji Types: TR-0Q, TR-0QH, TR-2NQ, TR- 3NQ, TR-4NQ, TR-6NQ, RCa 3737-ICQ & ICQH

Furnas Types: US15 48AG & 48BG, 958L, ESP100-Class 10 only, 3RB10-Class 10

General Electric: CR4G, CR7G, RT*1, RT*2, RTF3, RT*4, CR324X-Class 10 only

Kasuga: RU Set Operating Time Code = 10 & time setting 6 sec max

Klockner-Moeller Types: Z00, Z1, Z4, PKZM1, PKZM3 & PKZ2

Lovato: RC9, RC22, RC80, RF9, RF25 & RF95

Matsushita: FKT-15N, 15GN, 15E, 15GE, FT-15N, FHT-15N

Mitsubishi: ET, TH-K12ABKP, TH-K20KF, TH-K20KP, TH-K20TAKF, TH-K60KF, TH-K60TAKF

Omron: K2CM Set Operating Timing Code = 10 & time setting 6 sec max, SE-KP24E time setting 6 sec max

Riken: PM1, PM3

Samwha: EOCRS Set for Class 5, EOCR-ST, EOCR-SE, EOCR-AT time setting 6 sec max

Siemens Types: 3UA50, -52, -54, -55, -58, -59, -60, -61, -62, -66, -68, -70, 3VUI3, 3VE, 3UB (Class 5)

Sprecher and Schuh Types: CT, CT1, CTA 1, CT3K, CT3-12 thru CT3-42, KTA3, CEF1 & CET3 set at 6 sec max, CEP 7 Class 10, CT4, 6, & 7, CT3, KT7

Square D/Telemecanique: Class 9065 Types: TD, TE, TF, TG, TJ, TK, TR, TJE &TJF (Class 10), LR1-D, LR1-F, LR2 Class 10, Types 18A, 32A, SS-Class 10, SR-Class 10 and 63-A-LB Series. Integral 18,32,63, GV2-L, GV2-M, GV2-P, GV3-M (1.6-10 amp only) LR9D, SF Class 10, ST Class 10, LT6 (Class 5 or 10), LRD (Class 10), Motor Logic (Class10)

Toshiba Type: 2E RC820, set at 8 sec max.

WEG: RW2

Westinghouse Types: FT13, FT23, FT33, FT43, K7D, K27D, K67D, Advantage (Class 10), MOR, IQ500 (Class 5)

Westmaster: 0LWR00 and 0LWT00 suffix D thru P

Form 2207 – Action Facts

SUBMERSIBLE MOTOR INSTALLATION RECORD

INFORMATION SUPPLEMENT

1.0 MOTOR

1.1 Verify motor nameplate data meets the application – hp, voltage, phase, and Hertz.

1.2 Check that the motor shaft rotates freely by hand on the second of two complete rotations. (On large motors, this usually requires a motor coupling with a cheater handle welded to it.)

1.3 Check that the motor lead assembly is not damaged.

1.4 Measure insulation resistance to ground at 500 volts – BEFORE SUBMERGED. It should be a minimum of 200 megohms or 200,000,000 ohms.

1.5 Measure insulation resistance to ground at 500 volts – AFTER SUBMERGED. It should be a minimum of 0.5 megohms or 500,000 ohms.

1.6 Verify the system is operating within the ±10% of nameplate voltage requirement.

1.7 Verify the system will not ever operate in excess of the maximum amps indicated on the nameplate.

1.8 Verify the system is operating at 5% or less current unbalance.

Notice:

- If current unbalance exceeds 5%, the maximum operating amps must be derated to the nameplate Full Load Amps.
- Warning - System current unbalance can not exceed 10% without causing heating and mechanical wear issues.
- The submersible motor amperage % unbalance is typically 6x greater than its voltage % unbalance.
- Thus, 0.8% voltage unbalance = greater than 5% current unbalance, and 1.7% voltage unbalance = greater than 10% current unbalance.

2.0 PUMP

2.1 Verify the pump nameplate and curve data meets the application hp, rpm, and flow/TDH requirements.

2.2 Verify the pump NPSH requirement will be met at all times.

2.3 Check that the pump shaft rotates freely by hand before installation.

2.4 Check that the pump shaft moves up about ¼ inch when it is coupled to the motor.

2.5 Check that the pump guard is not pinching the motor leads, especially where it enters and exits the guard.

Notice:

- Pumps and motors 5 hp and above should be assembled in a vertical position to ensure correct alignment.
- A motor-pump assembly 5 hp and above should never be lifted from a non-vertical position by the pump discharge because it can bend the shaft in one or both of the products.

3.0 POWER SUPPLY (3-PHASE)

3.1 Verify the transformer kVA rating is adequate for the motor per the Franklin Application (AIM) manual requirement.

3.2 Verify that all transformers have the same kVA rating.

3.3 Verify the 3-Ph pump panel fuses or its circuit breaker are correctly sized per the Franklin Application (AIM) manual requirement.

3.4 Verify the 3-Ph pump panel motor contactor is correctly sized per the Franklin Application (AIM) manual requirement.

3.5 Verify the 3-Ph pump panel motor overload is ambient compensated.

3.6 Verify the 3-Ph pump panel motor overload has a NEMA Class 10 trip curve.

3.7 Verify the 3-Ph pump panel motor overload heaters or its dial setting are correctly selected based on the system's operating point and not just arbitrarily set at the maximum motor operating amps.

3.8 At no time should the system operating amps or the motor overload system running point setting be higher than the motor nameplate maximum amp rating.

Notice:

- Electronic overloads should be set at the normal system operation point.
- Electronic overloads have a built-in multiplier of 115-125% times the input amps to determine the overload trip point.

4.0 POWER SUPPLY (1-PHASE)

4.1 Verify the transformer kVA rating is adequate for the motor per the Franklin Application (AIM) manual requirement.

Form 2207 – Action Facts

SUBMERSIBLE MOTORS INSTALLATION RECORD

4.2 Verify the motor control box and the motor are made by the same manufacturer.

4.3 Verify the motor control box hp rating and its voltage match the motor rating exactly. If not, a premature failure of the control box or motor should be expected.

5.0 HIGH SURGE PROTECTION

5.1 Verify the submersible motor has a dedicated surge arrestor.
All submersible motors require a dedicated surge arrestor.
Motors 5 hp and smaller marked "Equipped with Lightning Arrestors", have a built-in surge arrestor.

5.2 Verify the surge arrestor is mounted as close to the motor as practical.
The location is usually in the pump panel, but sometimes it is placed at the well head in a separate electrical box.

5.3 Verify the surge arrestor is grounded below the lowest drawdown water level.
This is usually accomplished by attaching the drop cable ground wire to the motor lead or the motor ground lug.

5.4 Verify the ground conductor size meets the minimum requirements of the National Electric Code and all other relevant national, state, regional and local codes.

5.5 Verify the motor is connected to both the electrical system ground and the motor.

6.0 ELECTRICAL DROP CABLE

6.1 Verify the temperature rating of the drop cable – typically 60 °C, 75 °C, 90 °C or 125 °C.

6.2 Verify if the cable is single conductor or jacketed conductor. Web cable is considered jacketed cable by regulating agencies.

6.3 Verify the conductor size – typically AWG, MCM or mm^2.

6.4 Verify if the conductor material is copper; if not, determine the material and contact the factory for acceptability.

6.5 Verify the drop cable meets or exceeds the requirements of the Franklin Application (AIM) manual.

Notice:

- If the service entrance to pump panel or the pump panel to motor cable is not a copper material, contact the factory for the correct length derating factors.

7.0 MOTOR COOLING

7.1 Verify that the well water temperature does not exceed the maximum ambient temperature indicated on the nameplate of the motor.

7.2 Verify there is a minimum of 10 feet of clear water between the bottom of the motor and the bottom of the well.

7.3 Verify that all water entering the well is coming from below the lowest part of the motor.

7.4 Verify the system pumping rate will never deliver less flow than is required by the Franklin Application (AIM) manual to flow by-and-around the full length of the motor for cooling purposes.

7.5 Verify that 3-phase motors above 7.5 hp in a vertical potable water well should not exceed 100 starts in 24 hours and each start should include a minimum of 3 minutes ON and 10 minutes OFF.

Notice:

- If any water is entering the well above the lowest part of the motor, a flow sleeve is required.

8.0 MOTOR-PUMP INSTALLATION

8.1 Verify that the drop cable is supported to the drop pipe every 10 feet.

8.2 Verify at least one spring loaded (non-drilled) check valve is in the drop pipe.
Preferably, the first check valve should be located at the top of the first pipe joint above the pump discharge (~20 feet) if the pump does not have a check built in to its discharge.

8.3 Verify all pipe joints are as tight as practical.
The minimum torque should never be less than 10 foot-pounds times the motor nameplate hp rating.

8.4 Verify the rotation of the pump is correct.
It is preferable to do this by checking the flow and current in both directions on 3-phase motors.
This can be done by having the electrician swap any two leads.
This is considered "best practice" since pumps under some conditions can supply amp readings and a visual flow observation that can be extremely misleading.

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SUBMERSIBLE MOTORS INSTALLATION RECORD

RMA Number

KEY DEALER #

DISTRIBUTOR	INSTALLER	END USER
Name:	Name:	Name:
City:	City:	City:
State: Zip:	State: Zip:	State: Zip:

Well ID or GPS: _____ _____ _____ Water Temperature: _____ ☐ °F ☐ °C

Application/Water Use (e.g. potable water, irrigation, municipal, fountain, etc.): _____

Date Installed (mm/yy): _____ Date Failed (mm/yy): _____ Motor Position Shaft-Up: ☐ Yes ☐ No

Operating Cycle: ON Time Per Start _____ ☐ Hrs. ☐ Mins. Time OFF Between Stop & Restart _____ ☐ Hrs. ☐ Mins.

MOTOR

Model: _____ Serial Number: _____ Date Code (if updated): _____

MOTOR OVERLOAD

System Typical Operating Current: _____ Amps @ _____ Volts

Overload: ☐ FE SubMonitor Input Amps _____ D3 Attached ☐ Yes ☐ No Fault Settings Attached ☐ Yes ☐ No

☐ Other Manufacturer Model: _____ Dial Set at: _____ or Heater# _____

NEMA Class: ☐ 10 ☐ 20 ☐ 30 Ambient Compensated: ☐ Yes ☐ No

Power to Motor by: ☐ Full Volt Starter ☐ VFD ☐ Soft Starter VFD or Soft Starter Mfr. & Model: _____

PUMP

Manufacturer: _____

Model: _____

Stages: _____

Design Rating: _____ gpm @ _____ ft TDH

Horsepower Required by Pump End: _____

Actual Pump Delivery: _____ gpm @ _____ psi

What Controls When System Runs & Stops:

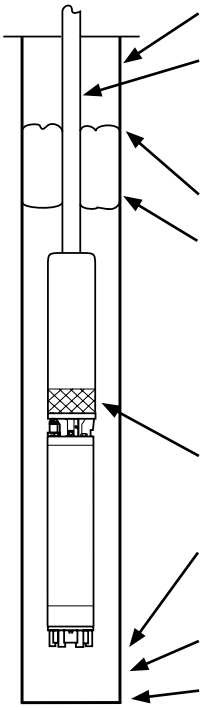
_____

(e.g. pressure, level, flow, manual on/off, timer, time clock etc.)

YOUR NAME / DATE

_____ / _____

WELL DATA (All measurements from well head down.)



Casing Diameter _____ in

Drop Pipe Diameter _____ in

Drop Pipe Material _____ PVC _____ Steel _____ Poly _____ Other

Number of Sticks of Drop Pipe _____

Static Water Level _____ ft

Drawdown (pumping) Water Level _____ ft

Spring Assist Check Valves:
(Measured from Well Head Down)

#1 _____ #2 _____ #3 _____ #4 _____ ft

☐ Solid ☐ Drilled Poppet ☐ Break-Off Plug

Pump Inlet Setting _____ ft

Flow Sleeve ☐ No ☐ Yes, Dia. _____ in

Case Ends _____ ft

☐ Well Screen ☐ Perforated Casing

#1 from ____ to ____ ft & #2 from ____ to ____ ft

Well Depth _____ ft

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Franklin Electric

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SUBMERSIBLE MOTORS INSTALLATION RECORD

RMA Number

TRANSFORMERS

Number of Transformers: ☐ Two ☐ Three Transformers Supply Motor Only: ☐ Yes ☐ No ☐ Unsure

Transformer #1: _____ kVA Transformer #2: _____ kVA Transformer #3: _____ kVA

POWER CABLES & GROUND WIRE

1 **Service Entrance to Pump Control Panel:**

Length: _____ ft. & Gauge: _____ AWG/MCM

Material: ☐ Copper ☐ Aluminum Construction: ☐ Jacketed ☐ Individual Conductors ☐ Web ☐ Twisted

Temperature Rating of Cable: ☐ 60C ☐ 75C ☐ 90C ☐ 125C or Insulation Type: _____ (e.g. THHN)

2 **Pump Control Panel to Motor:**

Length: _____ ft. & Gauge: _____ AWG/MCM

Material: ☐ Copper ☐ Aluminum Construction: ☐ Jacketed ☐ Individual Conductors ☐ Web ☐ Twisted

Temperature Rating of Cable: ☐ 60C ☐ 75C ☐ 90C ☐ 125C or Insulation Type: _____ (e.g. THHN)

3 **Ground Wire Size:** From Control Panel to Motor: _____ AWG/MCM

Control Grounded to (mark all that apply):

☐ Well Head ☐ Metal Casing ☐ Motor ☐ Driven Rod ☐ Power Supply

INCOMING VOLTAGE

No Load L1-L2 _____ L2-L3 _____ L1-L3 _____

Full Load L1-L2 _____ L2-L3 _____ L1-L3 _____

RUNNING AMPS & CURRENT BALANCE

Full Load L1 _____ L2 _____ L3 _____

% Unbalance: _____

CONTROL PANEL

1 **Pump Panel Manufacturer/Fabricator:** _____

2 **Short Circuit Protection – Fuses or Circuit Breaker**

Option #1 – Fuse

Manufacturer: _____ Model: _____ Rating: _____ Amps

Type: ☐ Time-Delay ☐ Standard

Option #2 – Circuit Breaker

Manufacturer: _____ Model: _____ Rating: _____ Amps Setting: _____

3 **Starter – Full Voltage, Reduced Voltage, Soft-Starter or VFD (Variable Frequency Drive)**

Option #1 – Full Voltage

Manufacturer: _____ Model: _____ Size: _____ Contacts: ☐ NEMA ☐ IEC

Option #2 – Reduced Voltage

Manufacturer: _____ Model: _____ Ramp Time to Full Voltage: _____ sec.

Option #3 – Soft-Starter or VFD

Manufacturer: _____ Model: _____ Max. Continuous Amp Output Rating: _____

Min. Setting: _____ Hz & GPM: _____ Max. Setting: _____ Hz & GPM: _____

Start Ramp Time to 30 Hz: _____ sec. Stop Mode: ☐ Power Off Coast ☐ 30-0 Hz Ramp _____ sec.

Special Output Filter Purchased: ☐ Yes ☐ No

Output Filter Manufacturer: _____ Model: _____ % Reactance: _____

4 **Surge Arrestor:** ☐ No ☐ Yes, Manufacturer: _____ Model: _____

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Franklin Electric

Booster Install Record

SUBMERSIBLE MOTOR

RMA Number

Date _____/_____/_____ Filled In By _____

INSTALLATION

Owner/User _____ Telephone (_____) _____

Address _____ City _____ State _____ Zip _____

Installation Site, If Different _____

Contact _____ Telephone (_____) _____

System Application _____

_____

_____

System Manufactured By _____ Model _____ Serial No. _____

System Supplied By _____ City _____ State _____ Zip _____

Is this a "HERO" system (10.0 - 10.5 PH)? ☐ Yes ☐ No

MOTOR

Model No. _____ Serial No. _____ Date Code _____

Horsepower _____ Voltage _____ ☐ Single-Phase ☐ Three-Phase Diameter _____ in.

Slinger Removed? ☐ Yes ☐ No Check Valve Plug Removed? ☐ Yes ☐ No

Motor Fill Solution ☐ Standard ☐ DI Water Model No. _____ Serial No. _____ Date Code _____

PUMP

Manufacturer _____ Model _____ Serial No. _____

Stages _____ Diameter _____ Flow Rate Of _____ gpm At _____TDH

Booster Case Internal Diameter _____ Material _____

CONTROLS AND PROTECTIVE DEVICES

SubMonitor? ☐ Yes ☐ No If Yes, Warranty Registration No. _____

If Yes, Overload Set? ☐ Yes ☐ No _____ Set At _____

Underload Sets? ☐ Yes ☐ No _____ Set At _____

VFD or Reduced Voltage Starter? ☐ Yes ☐ No If Yes, Type _____

Mfr. _____ Setting _____ % Full Voltage In _____ sec

Pump Panel? ☐ Yes ☐ No If Yes, Mfr. _____ Size _____

Magnetic Starter/Contactor Mfr. _____ Model _____ Size _____

Heaters Mfr. _____ No. _____ If Adjustable Set At _____

Fuses Mfr. _____ Size _____ Type _____

Surge Arrestor Mfr. _____ Model _____

Controls Are Grounded to _____ with No. _____ Wire

Inlet Pressure Control	☐ Yes	☐ No	If Yes, Mfr. _____	Model _____	Setting _____ psi	Delay _____ sec
Inlet Flow Control	☐ Yes	☐ No	If Yes, Mfr. _____	Model _____	Setting _____ gpm	Delay _____ sec
Outlet Pressure Control	☐ Yes	☐ No	If Yes, Mfr. _____	Model _____	Setting _____ psi	Delay _____ sec
Outlet Flow Control	☐ Yes	☐ No	If Yes, Mfr. _____	Model _____	Setting _____ gpm	Delay _____ sec
Water Temperature Control	☐ Yes	☐ No	If Yes, Mfr. _____	Model _____		Delay _____ sec

Set At _____ °F or _____ °C Located _____

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Franklin Electric

Booster Installation Record

SUBMERSIBLE MOTOR

INSULATION CHECK

Initial Megs: Motor & Lead Only	Black (T1/U1)_____	Yellow (T2/V1)_____	Red (T3/W1)_____
Installed Megs: Motor, Lead, & Cable	Black (T1/U1)_____	Yellow (T2/V1)_____	Red (T3/W1)_____

VOLTAGE TO MOTOR

Non-Operating:	B-Y (T1/U1 - T2/V1)_____	Y-R (T2/V1 - T3/W1)_____	R-B (T3/W1 - T1/U1)_____
At Rated Flow of _____gpm	B-Y (T1/U1 - T2/V1)_____	Y-R (T2/V1 - T3/W1)_____	R-B (T3/W1 - T1/U1)_____
At Open Flow _____gpm	B-Y (T1/U1 - T2/V1)_____	Y-R (T2/V1 - T3/W1)_____	R-B (T3/W1 - T1/U1)_____

AMPS TO MOTOR

At Rated Flow of _____gpm	Black (T1/U1)_____	Yellow (T2/V1)_____	Red (T3/W1)_____
At Open Flow _____gpm	Black (T1/U1)_____	Yellow (T2/V1)_____	Red (T3/W1)_____
At Shut-Off*	Black (T1/U1)_____	Yellow (T2/V1)_____	Red (T3/W1)_____

*Do **NOT** run at Shut-Off more than two (2) minutes.

Inlet Pressure _____psi Outlet Pressure _____psi Water Temperature _____ °F or _____ °C

If you have any questions or problems, call the Franklin Electric Toll-Free Hot Line: 1-800-348-2420

Comments: _____

_____

_____

_____

PLEASE SKETCH THE SYSTEM

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Franklin Electric

Three-Phase Motors

APPLICATION

SubMonitor Three-Phase Protection

Applications

SubMonitor is designed to protect 3-phase pumps/motors with service factor amp ratings (SFA) from 5 to 350 A (approx. 3 to 200 hp). Current, voltage, and motor temperature are monitored using all three legs and allows the user to set up the SubMonitor quickly and easily.

Protects Against

- Under/Overload
- Under/Overvoltage
- Current Unbalance
- Overheated Motor (if equipped with Subtrol Heat Sensor)
- False Start (Chattering)
- Phase Reversal

This product is lead free.

Power Factor Correction

In some installations, power supply limitations make it necessary or desirable to increase the power factor of a submersible motor. Table 32 lists the capacitive kVAR required to increase the power factor of large Franklin three-phase submersible motors to the approximate values shown at maximum input loading.

Capacitors must be connected on the line side of the overload relay, or overload protection will be lost.

Table 32 kVAR Required 60 Hz

MOTOR		KVAR REQUIRED FOR PF OF:		
HP	KW	0.90	0.95	1.00
5	3.7	1.2	2.1	4.0
7.5	5.5	1.7	3.1	6.0
10	7.5	1.5	3.3	7.0
15	11	2.2	4.7	10.0
20	15	1.7	5.0	12.0
25	18.5	2.1	6.2	15.0
30	22	2.5	7.4	18.0
40	30	4.5	11.0	24.0
50	37	7.1	15.0	32.0
60	45	8.4	18.0	38.0
75	55	6.3	18.0	43.0
100	75	11.0	27.0	60.0
125	93	17.0	36.0	77.0
150	110	20.0	42.0	90.0
175	130	9.6	36.0	93.0
200	150	16.0	46.0	110.0

Values listed are total required (not per phase).

Three-Phase Motors

APPLICATION

Three-Phase Starter Diagrams

Three-phase combination magnetic starters have two distinct circuits: a power circuit and a control circuit.

The power circuit consists of a circuit breaker or fused line switch, contacts, and overload heaters connecting incoming power lines L1, L2, L3 and the three-phase motor.

The control circuit consists of the magnetic coil, overload contacts, and a control device such as a pressure switch. When the control device contacts are closed, current flows through the magnetic contactor coil, the contacts close, and power is applied to the motor. Hand-Off-Auto switches, start timers, level controls, and other control devices may also be in series in the control circuit.

Line Voltage Control

This is the most common type of control encountered. Since the coil is connected directly across the power lines L1 and L2, the coil must match the line voltage.

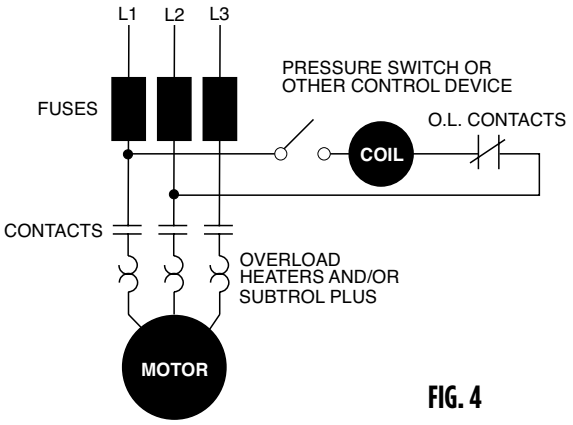


FIG. 4

Low Voltage Transformer Control

This control is used when it is desirable to operate push buttons or other control devices at some voltage lower than the motor voltage. The transformer primary must match the line voltage and the coil voltage must match the secondary voltage of the transformer.

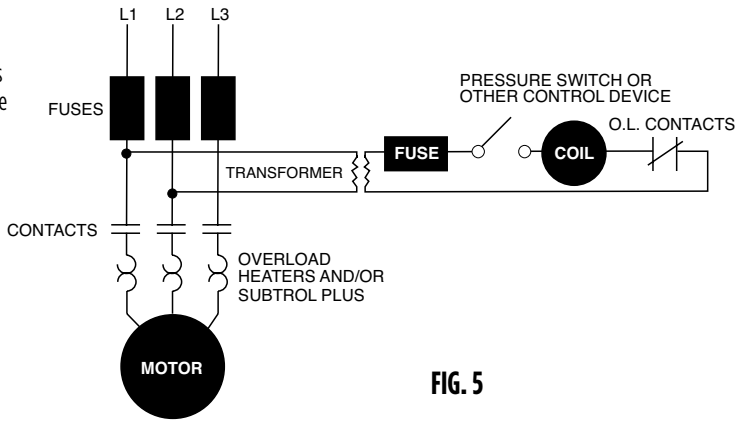


FIG. 5

External Voltage Controls

Control of a power circuit by a lower circuit voltage can also be obtained by connecting to a separate control voltage source. The coil rating must match the control voltage source, such as 115 or 24 volts.

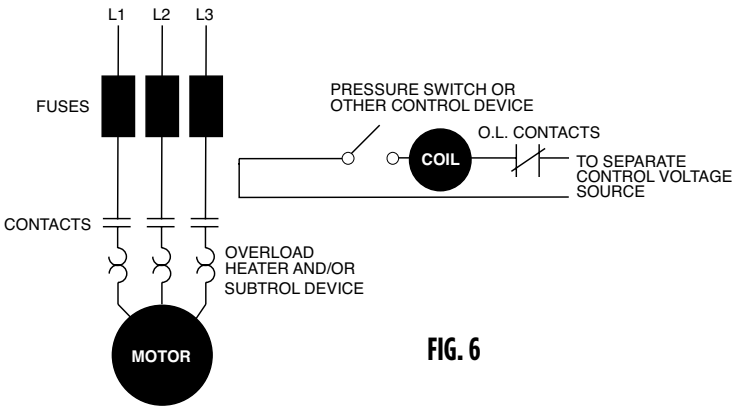


FIG. 6

Three-Phase Motors

APPLICATION

Three-Phase Power Unbalance

A full three-phase supply is recommended for all three-phase motors, consisting of three individual transformers or one three-phase transformer. So-called "open" Delta or Wye connections using only two transformers can be used, but are more likely to cause problems, such as poor performance, overload tripping or early motor failure due to current unbalance.

Transformer rating should be no smaller than listed in Table 4 for supply power to the motor alone.

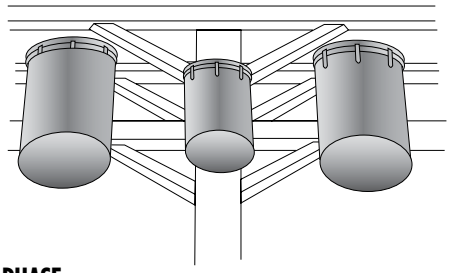


FIG. 7
FULL THREE-PHASE

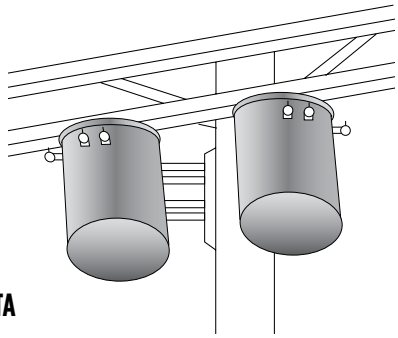


FIG. 8
OPEN DELTA

Checking and Correcting Rotation and Current Unbalance

1. Establish correct motor rotation by running the motor in both directions. Normal rotation is CCW viewing the shaft end. Rotation can be changed by interchanging any two of the three motor leads. The rotation that gives the most water flow is typically the correct rotation.
2. After correct rotation has been established, check the current in each of the three motor leads and calculate the current unbalance as explained in 3 below.

   If the current unbalance is 2% or less, leave the leads as connected.

   If the current unbalance is more than 2%, current readings should be checked on each leg using each of three possible hook-ups. Roll the motor leads across the starter in the same direction to prevent motor reversal.
3. To calculate percent of current unbalance:
   - A. Add the three line amps values together
   - B. Divide the sum by three, yielding average current
   - C. Pick the amp value which is furthest from the average current (either high or low)
   - D. Determine the difference between this amp value(furthest from average) and the average
   - E. Divide the difference by the average. Multiply the result by 100 to determine percent of unbalance
4. Current unbalance should not exceed 5% at max amp load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the "power side" of the system. If the reading farthest from average moves with the same motor lead, the primary source of unbalance is on the "motor side" of the starter. In this instance, consider a damaged cable, leaking splice, poor connection, or faulty motor winding.

Phase designation of leads for CCW rotation viewing shaft end.

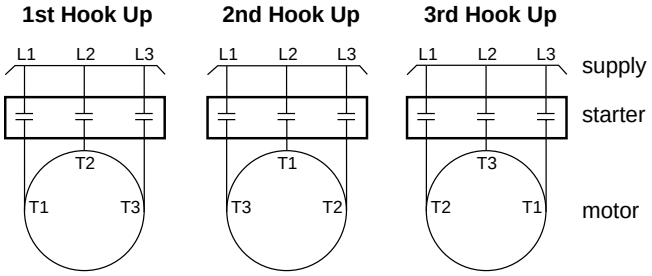
To reverse rotation, interchange any two leads.

Phase 1 or "A" - Black, T1, or U1

Phase 2 or "B" - Yellow, T2, or V1

Phase 3 or "C" - Red, T3, or W1

NOTICE: Phase 1, 2, and 3 may not be L1, L2, and L3.



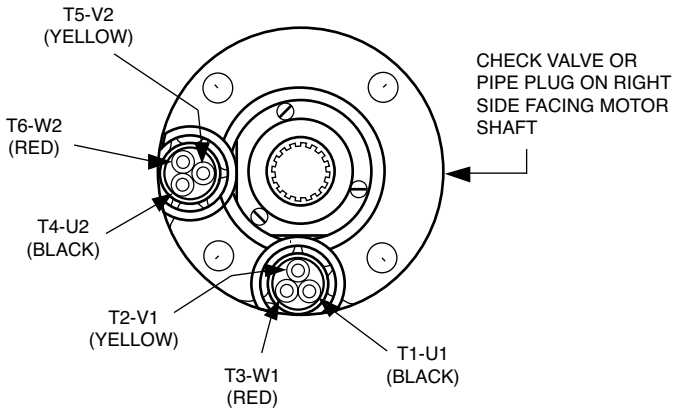
EXAMPLE:

T1 = 51 amps	T3 = 50 amps	T2 = 50 amps T2 = 46
amps	T1 = 49 amps	T3 = 48 amps T3 = 53
+ amps	+ T2 = 51 amps	+ T1 = 52 amps
Total = 150 amps	Total = 150 amps	Total = 150 amps
$\frac{150}{3}$ = 50 amps	$\frac{150}{3}$ = 50 amps	$\frac{150}{3}$ = 50 amps
50 - 46 = 4 amps	50 - 49 = 1 amp	50 - 48 = 2 amps
$\frac{4}{50}$ = 0.08 or 8%	$\frac{1}{50}$ = 0.02 or 2%	$\frac{2}{50}$ = 0.04 or 4%

Three-Phase Motor Lead Identification

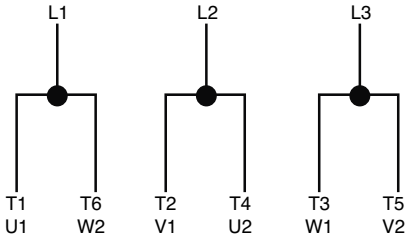
WARNING: When installing 6-lead motors extra care must be used to ensure lead identification at the surface. Leads must be marked and connected per diagram. Motor leads are not connected red to red, yellow to yellow, etc.

Line Connections — Six-Lead Motors

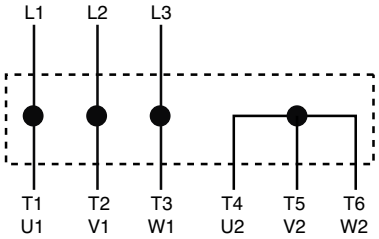


90° Lead Spacing

Connections for across-the-line starting, running, and any reduced voltage starting except WYE-DELTA type starters.



WYE-DELTA starters connect the motor as shown below during starting, then change to the running connection shown at the left.



Each motor lead is numbered with two markers, one near each end. To reverse rotation, interchange any two line connections.

Phase Converters

There are a number of different types of phase converters available. Each generates three-phase power from a single-phase power line.

In all phase converters, the voltage balance is critical to current balance. Although some phase converters may be well balanced at one point on the system-operating curve, submersible pumping systems often operate at differing points on the curve as water levels and operating pressures fluctuate. Other converters may be well balanced at varying loads, but their output may vary widely with fluctuations in the input voltage.

The following guidelines have been established for submersible installations to be warrantable when used with a phase converter.

1. Limit pump loading to rated horsepower. Do not load into motor service factor.
2. Maintain at least 3 ft/s flow past the motor. Use a flow sleeve when necessary.
3. Use time delay fuses or circuit breakers in pump panel. Standard fuses or circuit breakers do not provide secondary motor protection.
4. SubMonitor will not work with electronic solid state or electro mechanical phase converters.
5. Current unbalance must not exceed 10%.

Reduced Voltage Starters

All Franklin three-phase submersible motors are suitable for full-voltage starting. Under this condition the motor speed goes from zero to full speed within a half second or less. The motor current goes from zero to locked rotor amps, then drops to running amps at full speed. This may dim lights, cause momentary voltage dips to other electrical equipment, and shock power distribution transformers.

In some cases the power companies may require reduced-voltage starters to limit this voltage dip. There are also times when reduced-voltage starters may be desirable to reduce motor starting torque thus reducing the stress on shafts, couplings, and discharge piping. Reduced-voltage starters also slow the rapid acceleration of the water on start-up to help control upthrust and water hammer.

Reduced-voltage starters may not be required if the maximum recommended cable length is used. With maximum recommended cable length there is a 5% voltage drop in the cable at running amps, resulting in about 20% reduction in starting current and about 36% reduction in starting torque compared to having rated voltage at the motor. This may be enough reduction in starting current so that reduced-voltage starters are not required.

Three-Lead Motors: Autotransformer or solid-state reduced-voltage starters may be used for soft-starting standard three-phase motors.

When autotransformer starters are used, the motor should be supplied with at least 55% of rated voltage to ensure adequate starting torque. Most autotransformer starters have 65% and 80% taps. Setting the taps on these starters depends on the percentage of the maximum allowable cable length used in the system. If the cable length is less than 50% of the maximum allowable, either the 65% or the 80% taps may be used. When the cable length is more than 50% of allowable, the 80% tap should be used.

Six-Lead Motors: Wye-Delta starters are used with six-lead Wye-Delta motors. All Franklin 6" and 8" three-phase motors are available in six-lead Wye-Delta construction. Consult the factory for details and availability. Part winding starters are not compatible with Franklin Electric submersible motors and should not be used.

Wye-Delta starters of the open-transition type, which momentarily interrupt power during the starting cycle, are not recommended. Closed-transition starters have no interruption of power during the start cycle and can be used with satisfactory results.

Reduced-voltage starters have adjustable settings for acceleration ramp time, typically preset at 30 seconds. They must be adjusted so the motor is at full voltage within THREE SECONDS MAXIMUM to prevent excessive radial and thrust bearing wear.

If Subtrol-Plus or SubMonitor is used the acceleration time must be set to TWO SECONDS MAXIMUM due to the 3 second reaction time of the Subtrol-Plus or SubMonitor.

Solid-state starters AKA soft starts may not be compatible with Subtrol-Plus/ SubMonitor. However, in some cases a bypass contactor has been used. Consult the factory for details.

During shutdown, Franklin Electric's recommendation is for the power to be removed, allowing the pump/motor to coast down. Stopping the motor by ramping down the voltage is possible, but should be limited to three (3) seconds maximum.

Inline Booster Pump Systems

Franklin Electric offers three different types of motors for non-vertical applications.

1. The **Booster** motors are specifically designed for booster applications. They are the **"Best Choice" for sealed Reverse Osmosis applications.** These motors are the result of two years of focused development and bring additional value and durability to booster module systems. These motors are only available to OEMs or Distributors who have demonstrated capability in Booster Module systems design and operation and adhere to Franklin's Application Manual requirements.

2. The **Hi-Temp** motors have many of the internal design features of the Booster motor. It's additional length allows for higher temperature handling and the Sand Fighter sealing system provides greater abrasion resistance. One or both of these conditions are often experienced in open atmosphere applications such as lakes, ponds, etc.

3. The **Standard Vertical Water Well** (40-125 hp) motors can be adapted to non-vertical applications when applied per the below guidelines. However, they will be more sensitive to application variances than the other two designs.

All of the above motors must be applied per the guidelines listed below. In addition, for all applications where the motor is applied in a sealed system, a Submersible Motor Booster Installation Record (Form 3655) or its equivalent must be completed at start-up and received by Franklin Electric within 60 days. A sealed system is one where the motor and pump intake are mounted in a sleeve and the water feeding the pump intake is not open to the atmosphere.

Continued on next page

Inline Booster Pump Systems (Continued)

Design And Operational Requirements

1. **Non-Vertical Operation:** Vertical Shaft-up (0°) to Horizontal (90°) operation is acceptable as long as the pump transmits "down-thrust" to the motor within 3 seconds after start-up and continuously during operation. However, it is best practice to provide a positive slope whenever it is possible, even if it is only a few degrees.

2. **Motor, Sleeve, and Pump Support System:** The booster sleeve ID must be sized according to the motor cooling and pump NPSHR requirements. The support system must support the motor's weight, prevent motor rotation, and keep the motor and pump aligned. The support system must also allow for thermal axial expansion of the motor without creating binding forces.

3. **Motor Support Points:** A minimum of two support points are required on the motor. One in the motor/pump flange connection area and one in the bottom end of the motor area. The motor castings, not the shell area, are recommended as support points. If the support is a full length support and/or has bands in the shell area, they must not restrict heat transfer or deform the shell.

4. **Motor Support Material and Design:** The support system shall not create any areas of cavitation or other areas of reduced flow less than the minimum rate required by this manual. They should also be designed to minimize turbulence and vibration and provide stable alignment. The support materials and locations must not inhibit the heat transfer away from the motor.

5. **Motor and Pump Alignment:** The maximum allowable misalignment between the motor, pump, and pump discharge is 0.025 inch per 12 inches of length (2 mm per 1000 mm of length). This must be measured in both directions along the assembly using the motor/pump flange connection as the starting point. The booster sleeve and support system must be rigid enough to maintain this alignment during assembly, shipping, operation, and maintenance.

6. **Lubrication and Heat Resistance:** The best motor lubrication and heat resistance is obtained with the factory based propylene glycol fill solution. Only when an application MUST HAVE deionized (DI) water should the factory fill solution be replaced. When a deionized water fill is required, the motor must be derated as indicated on the below chart. The exchange of the motor fill solution to DI water must be done by an approved Franklin service shop or representative using a vacuum fill system per Franklin's Motor Service Manual instruction. The motor shell then must be permanently stamped with a D closely behind the Serial Number.

   The maximum pressure that can be applied to the motor internal components during the removal of the factory fill solution is 7 psi (0.5 bar.)

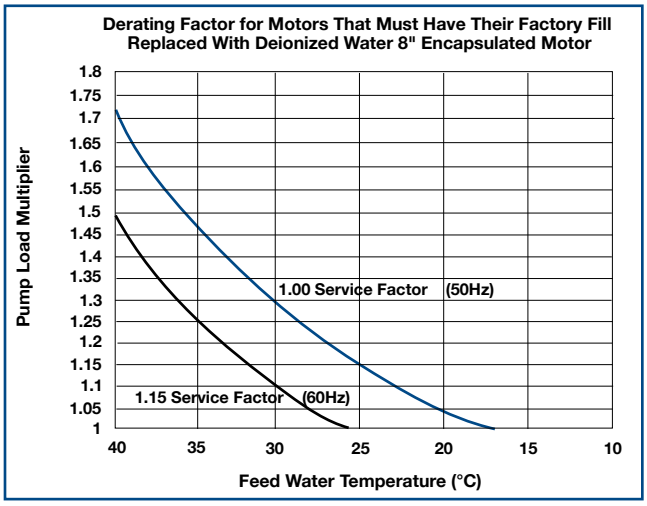


FIG. 9

First: Determine maximum Feed Water Temperature that will be experienced in this application. If the feed water exceeds the maximum ambient of the motor, both the DI water derating and a hot water application derating must be applied.

Second: Determine the Pump Load Multiplier from the appropriate Service Factor curve. (Typical 1.15 Service Factor is for 60 Hz ratings & 1.00 Service Factor for 50 Hz ratings).

Third: Multiply the Pump Load Requirement times the pump load multiplier number indicated on the vertical axis to determine the Minimum Motor Nameplate Rating.

Fourth: Select a motor with a nameplate equal or higher than the above calculated value.

7. **Motor Alterations - Sand Slinger & Check Valve Plug:** On 6" and 8" motors, the rubber sand slinger located on the shaft must be removed. If a pipe plug is covering the check valve, it must be removed. The special Booster motor already has these modifications.

8. **Frequency of Starts:** Fewer than 10 starts per 24-hour period are recommended. Allow at least 20 minutes between shutdown and start-up of the motor.

9. **Controls-Soft Starters and VFDs:** Reduced voltage starters and variable speed drives (inverter drives) may be used with Franklin three-phase submersible motors to reduce starting current, upthrust, and mechanical stress during start-up. The guidelines for their use with submersible motors are different than with normal air cooled motor applications. Refer to the Franklin Electric Application, Installation, and Maintenance (AIM) manual Reduced Voltage Starters section or Variable Speed Submersible Pump Operation, Inverter Drives sections for specific details including required filtering.

Continued on next page

Inline Booster Pump Systems (Continued)

10. **Motor Overload Protection:** Submersible motors require properly sized ambient compensated Class 10 quick-trip overloads per Franklin's AIM manual guidelines to protect the motor. Class 20 or higher overloads are NOT acceptable. Franklin's SubMonitor is strongly recommended for all large submersibles since it is capable of sensing motor heat without any additional wiring to the motor. Applications using Soft Starters with a SubMonitor require a start-up bypass - consult the factory for details. SubMonitor can not be used in applications using a VFD control.

11. **Motor Surge Protection:** Properly sized, grounded and dedicated motor surge arrestors must be installed in the supply line of the booster module as close to the motor as possible. This is required on all systems including those using soft-starters and variable speed drives (inverter drives).

12. **Wiring:** Franklin's lead assemblies are only sized for submerged operation in water to the motor nameplate maximum ambient temperature and may overheat and cause failure or serious injury if operated in air. Any wiring not submerged must meet applicable national and local wiring codes and Franklin Cable Chart Tables 16-21. (Notice: wire size, wire rating, and insulation temperature rating must be known when determining its suitability to operate in air or conduit. Typically, for a given size and rating, as the insulation temperature rating increases its ability to operate in air or conduit also increases.)

13. **Check Valves:** Spring-loaded check valves must be used on start-up to minimize motor upthrusting, water hammer, or in multiple booster (parallel) applications to prevent reverse flow.

14. **Pressure Relief Valves:** A pressure relief valve is required and must be selected to ensure that, as the pump approaches shut-off, it never reaches the point that the motor will not have adequate cooling flow past it.

15. **System Purge (Can Flooding):** An air bleeder valve must be installed on the booster sleeve so that flooding may be accomplished prior to booster start-up. Once flooding is complete, the booster should be started and brought up to operating pressure as quickly as possible to minimize the duration of an upthrust condition. At no time should air be allowed to gather in the booster sleeve because this will prevent proper cooling of the motor and permanently damage it.

16. **System Flush – Must Not Spin Pump:** Applications may utilize a low flow flushing operation. Flow through the booster sleeve must not spin the pump impellers and the motor shaft. If spinning takes place, the bearing system will be permanently damaged and the motor life shortened. Consult the booster pump manufacturer for maximum flow rate through the pump when the motor is not energized.

17. **Open Atmosphere Booster Pump Systems:** When an open booster is placed in a lake, tank, etc. that is open to atmospheric pressure, the water level must provide sufficient head pressure to allow the pump to operate above its NPSHR requirement at all times and all seasons. Adequate inlet pressure must be provided prior to booster start-up.

Table 38 Franklin Cable chart (See item 12 Wiring above)

CABLE TEMP. RATING (°C)	MOTOR NAMEPLATE RATED AMPS FULL LOAD	#10 AWG		#8 AWG		#6 AWG		#4 AWG		#2 AWG	
		IN AIR	IN CONDUIT	IN AIR	IN CONDUIT	IN AIR	IN CONDUIT	IN AIR	IN CONDUIT	IN AIR	IN CONDUIT
75	3-LEAD (DOL)	40A	28A	56A	40A	76A	52A	100A	68A	136A	92A
	6-LEAD (Y-Δ)	69A	48A	97A	69A	132A	90A	173A	118A	236A	159A
90	3-LEAD (DOL)	44A	32A	64A	44A	84A	60A	112A	76A	152A	104A
	6-LEAD (Y-Δ)	76A	55A	111A	76A	145A	104A	194A	132A	263A	180A
125	3-LEAD (DOL)	66A	46A	77A	53A	109A	75A	153A	105A	195A	134A
	6-LEAD (Y-Δ)	114A	80A	133A	91A	188A	130A	265A	181A	337A	232A

Based on 30 °C maximum ambient with cable length of 100 feet or less.

Continued on next page

Inline Booster Pump Systems (Continued)

Four Continuous Monitoring System Requirements for Sealed Booster Systems.

1. **Water Temperature:** Feed water on each booster must be continuously monitored and not allowed to exceed the motor nameplate maximum ambient temperature at any time. IF THE INLET TEMPERATURE EXCEEDS THE MOTOR NAMEPLATE MAXIMUM AMBIENT TEMPERATURE, THE SYSTEM MUST SHUTDOWN IMMEDIATELY TO PREVENT PERMANENT MOTOR DAMAGE. If feed water temperatures are expected to be above the allowable temperature, the motor must be derated. See Franklin's AIM manual Hot Water Applications section for derating guidelines. (The high temperature feed water derating is in addition to the exchange to DI water derating if the motor factory fill solution was exchanged to DI water.)

2. **Inlet Pressure:** The inlet pressure on each booster module must be continuously monitored. It must always be positive and higher than the NPSHR (Net Positive Suction Head Requirement) of the pump. A minimum of 20 PSIG (1.38 Bar) is required at all times, except for 10 seconds or less when the motor is starting and the system is coming up to pressure. Even during these 10 seconds the pressure must remain positive and be higher than the NPSHR (Net Positive Suction Head Requirement) of the pump.

   PSIG is the actual value displayed on a pressure gauge in the system piping. PSIG is the pressure above the atmospheric conditions. If at any time these pressure requirements are not being met, the motor must be de-energized immediately to prevent permanent damage to the motor. Once the motor is damaged, it is usually not immediately noticeable, but progresses and results in a premature motor failure weeks or months after the damage occurred.

   Motors that will be exposed to pressure in excess of 500 psi (34.47 Bar) must undergo special high pressure testing. Consult factory for details and availability.

3. **Discharge Flow:** The flow rate for each pump must not be allowed to drop below the motor minimum cooling flow requirement. IF THE MOTOR MINIMUM COOLING FLOW REQUIREMENT IS NOT BEING MET FOR MORE THAN 10 SECONDS, THE SYSTEM MUST BE SHUT DOWN IMMEDIATELY TO PREVENT PERMANENT MOTOR DAMAGE.

4. **Discharge Pressure:** The discharge pressure must be monitored to ensure that a downthrust load toward the motor is present within 3 seconds after start-up and continuously during operation. IF THE MOTOR DISCHARGE PRESSURE IS NOT ADEQUATE TO MEET THIS REQUIREMENT, THE SYSTEM MUST BE SHUT DOWN IMMEDIATELY TO PREVENT PERMANENT MOTOR DAMAGE.

Three-Phase Motors

APPLICATION

Variable Frequency Drive Submersible Motor Requirements

Franklin Electric's three-phase, encapsulated submersible motors can be used with variable frequency drives (VFD) when applied within the guidelines below.

All three-phase, encapsulated submersible motors must have the VFD sized based on the motor's nameplate maximum amps, not horsepower. The continuous rated amps of the VFD must be equal to or greater than the motor's nameplate maximum amps or warranty will be void.

Franklin Electric's single-phase, 2- and 3-wire, encapsulated submersible motors can only be used with the appropriate Franklin constant pressure controller.

Franklin Electric's submersible motor Application, Installation, Maintenance (AIM) manual should be checked for the latest guidelines and can be found online at www.franklin-electric.com.

WARNING: There is a potential shock hazard from contact with and/or touching the insulated cables connected to the variable frequency drive output anytime the motor has energy applied.

Output Filter Requirement Test:

NOTICE: An incoming power supply or line-side filter for the drive does not replace the need for additional output filters.

An output filter is required if the answer is yes to one or both of the items below:

#1 - Does the peak voltage at the motor terminals exceed 1000-volts or is the rise time of the VFD's voltage less than 2 micro-seconds? Per NEMA MG 1-2011, the rise time is defined as the time between 10% and 90% of the steady-state voltage (i.e., DC bus voltage).

#2 - Is the motor nameplate voltage more than 379 Volts and is the cable from drive-to-motor more than 50 ft (15.2 m)?

NOTICE:
More than 99% of the drives applied on water well submersible motors will require the purchase of additional output filtering based on question #1.

Output filters can be expensive. However, when needed, it is required for the motor to be considered for warranty. Make sure this item is not overlooked when quoting a job.

PWM dV/dt value can be defined as: the rate at which voltage is changing with time or how fast the voltage is accelerating. This information can be supplied by the drive manufacturer or the manufacturer's drive specification sheet. The dV/dt value cannot be measured with typical field equipment, even when using a true-RMS voltage/amperage multi-meter.

Franklin Electric has a line of VFDs that are specifically designed for Franklin application systems. These VFDs are used in the MonoDrive and SubDrive constant pressure systems. Franklin drive systems have the required additional output filtering installed; however, the SubDrive HPX does not.

Types of Output Filters:

A resistor-inductor-capacitor (RLC) filter has both a high pass filter & a low pass filter section and are considered the best practice, but a high pass reactor filter is also acceptable.

Filters should be recommended by the drive manufacturer; for the correct recommendations provide them with answers to all five of the items below.

REQUIRED ITEMS FOR PROPER VFD FILTER SIZING:

(1) VFD model (2) Carrier frequency setting (3) Motor nameplate voltage (4) Motor nameplate max amps (5) Cable length from the drive output terminals to the motor

Input Current & Motor Overload Protection:

- Motor input current should be set at the system's typical operating current when running at nameplate rated voltage and frequency (Hz).
- Motor overload protection should be set to trip at 115% of the system's typical operating current.
- Motor overload protection must trip equal to or faster than NEMA Class 10 motor overload curve requirements.

Motor Maximum Load Limits:

- The system must never operate in excess of the motor nameplate maximum amps.
- On 50 Hz motors, nameplate amps are maximum amps as these motors have a 1.0 service factor.

Variable Frequency Drive Submersible Motor Requirements (Continued)

Motor Operating Hertz, Cooling Requirements, and Underload Settings:

- Standard practice for large VFD installations is to limit the operation to 60 Hz max. Operating at greater than 60 Hz requires special system design considerations.
- The motor must never operate below 30 Hz. This is the minimum speed required to provide correct bearing lubrication.
- The motor's operating speed must always operate so the minimum water flow requirements of 0.5 ft/sec for 6-inch & 8-inch motors and 0.25 ft/sec for 4-inch motors is supplied.
- The motor underload protection is normally set to trip at 80% of the system's typical operating current. However, the underload trip point must be selected so that minimum flow requirements are always met.

Starting and Stopping Ramp Settings:

- The motor must reach or pass the 30 Hz operating speed within 1 second of the motor being energized. If this does not occur, the motor bearings will be damaged and the motor life reduced.
- The best stopping method is to turn power off followed by a natural coast to stop.
- A controlled stop from 30 Hz to 0 Hz is allowed if the time does not exceed 1 second.

Drive Carrier Frequency:

- The carrier frequency is set in the field. The drive typically has a selectable range between 2k and 12k Hz. The higher the carrier wave frequency setting, the greater the voltage spikes; the lower the carrier wave frequency setting, the rougher/poorer the shape of the power curve.
- The carrier frequency should be set within the range of 4k to 5k Hz for encapsulated submersible motors.

Application Function Setting:

- If the VFD has a setting of centrifugal pump or propeller fan it should be used.
- Centrifugal pumps and fans have similar load characteristics.

VFD Frequency of Starts:

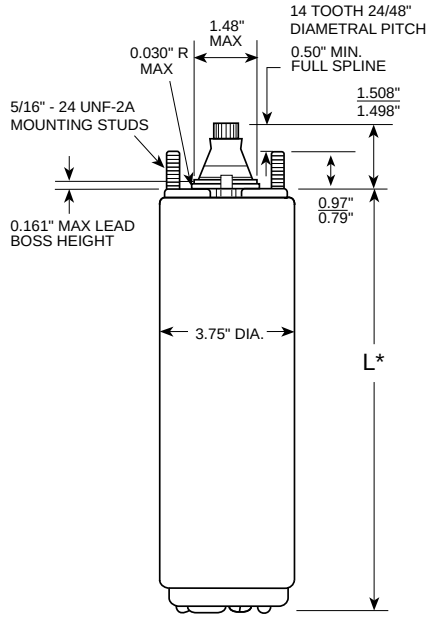
- Keeping the starts per day within the recommended numbers shown in the frequency of starts section of the AIM manual provides the best system life. However, since in-rush current is typically reduced when used with a properly configured VFD, large 3-phase submersible motors can be started more frequently. In all cases a minimum of 7 minutes must be allowed between a power off and the next restart attempt or consecutive restart attempts.

NEMA MG1 Above Ground Motor Standard Comments:

- Franklin Electric encapsulated submersible motors are not declared inverter duty motors by NEMA MG1 standards. The reason is NEMA MG1 standard part 31 does not include a section covering encapsulated winding designs.
- Franklin submersible motors can be used with VFDs without problems or warranty concerns providing Franklin's Application, Installation, Maintenance (AIM) manual guidelines are followed. See Franklin's on-line AIM manual for the latest guidelines.

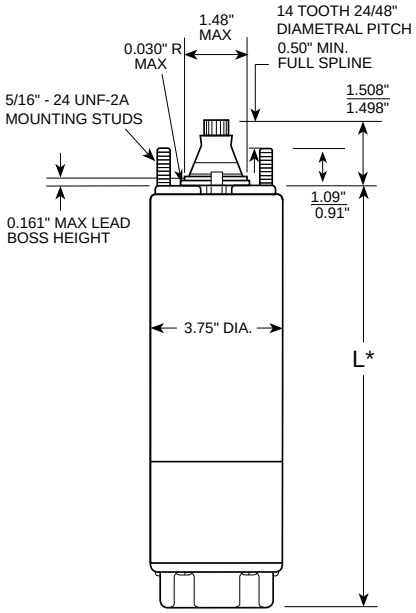
4" Super Stainless — Dimensions

(Standard Water Well)



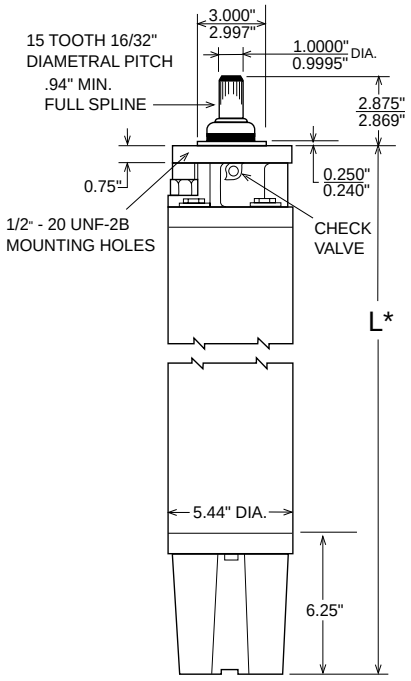
4" High Thrust — Dimensions

(Standard Water Well)



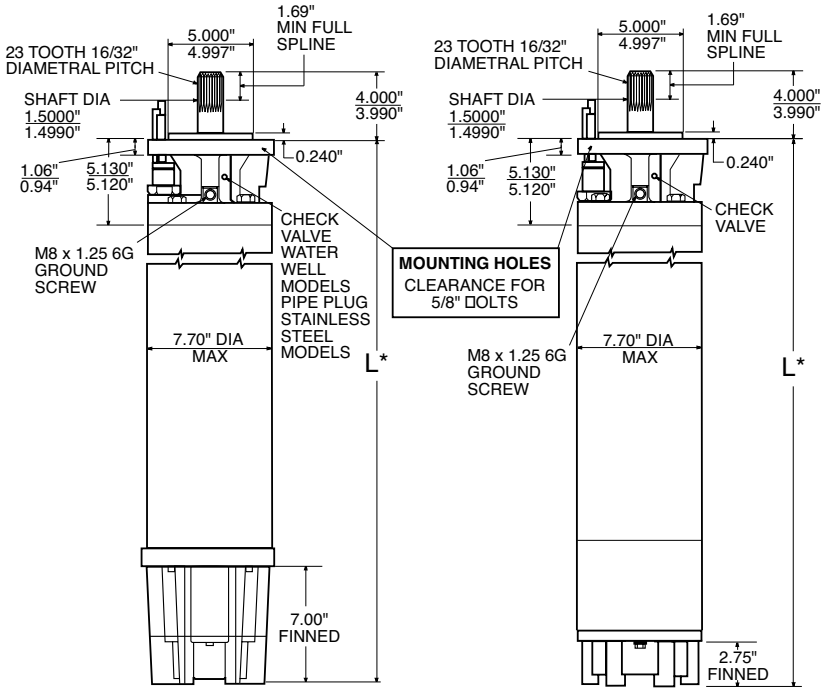
6" — Dimensions

(Standard Water Well)



8" — Dimensions

(Standard Water Well)



40 to 100 hp

75 to 200 hp

*** Motor lengths and shipping weights are available on Franklin Electric's web site (www.franklin-electric.com) or by calling Franklin's Technical Service Hotline (800-348-2420).**

Tightening Motor Lead Connector Jam Nut

4" Motors with Jam Nut:
15 to 20 ft-lb (20 to 27 Nm)

4" Motors with 2 Screw Clamp Plate:
35 to 45 in-lb (40 to 51 Nm)

6" Motors:
40 to 50 ft-lb (54 to 68 Nm)

8" Motors with 1-3/16" to 1-5/8" Jam Nut:
50 to 60 ft-lb (68 to 81 Nm)

8" Motors with 4 Screw Clamp Plate:
Apply increasing torque to the screws equally in a criss-cross pattern until 80 to 90 in-lb (9.0 to 10.2 Nm) is reached.

Jam nut tightening torques recommended for field assembly are shown. Rubber compression set within the first few hours after assembly may reduce the jam nut torque. This is a normal condition which does not indicate reduced seal effectiveness. Retightening is not required, but is permissible and recommended if original torque was questionable.

A motor lead assembly should not be reused. A new lead assembly should be used whenever one is removed from the motor, because rubber set and possible damage from removal may prevent proper resealing of the old lead.

All motors returned for warranty consideration must have the lead returned with the motor.

Pump to Motor Coupling

Assemble coupling with non-toxic FDA approved waterproof grease such as Mobile FM222, Texaco CYGNUS2661, or approved equivalent. This prevents abrasives from entering the spline area and prolongs spline life.

Pump to Motor Assembly

After assembling the motor to the pump, torque mounting fasteners to the following:

4" Pump and Motor: 10 lb-ft (14 Nm)

6" Pump and Motor: 50 lb-ft (68 Nm)

8" Pump and Motor: 120 lb-ft (163 Nm)

Shaft Height and Free End Play

Table 43

MOTOR	NORMAL SHAFT HEIGHT		DIMENSION SHAFT HEIGHT		FREE END PLAY	
					MIN.	MAX.
4"	1 1/2"	38.1 mm	1.508" / 1.498"	38.30 / 38.05 mm	0.010" 0.25 mm	0.045" 1.14 mm
6"	2 7/8"	73.0 mm	2.875" / 2.869"	73.02 / 72.88 mm	0.030" 0.76 mm	0.050" 1.27 mm
8" TYPE 1	4"	101.6 mm	4.000" / 3.990"	101.60 / 101.35 mm	0.008" 0.20 mm	0.032" 0.81 mm
8" TYPE 2.1	4"	101.6 mm	4.000" / 3.990"	101.60 / 101.35 mm	0.030" 0.76 mm	0.080" 2.03 mm

If the height, measured from the pump-mounting surface of the motor, is low and/or end play exceeds the limit, the motor thrust bearing is possibly damaged, and should be replaced.

Submersible Leads and Cables

A common question is why motor leads are smaller than specified in Franklin's cable charts.

The leads are considered a part of the motor and actually are a connection between the large supply wire and the motor winding. The motor leads are short and there is virtually no voltage drop across the lead.

In addition, the lead assemblies **operate under water**, while at least part of the supply cable must **operate in air.** Lead assemblies running under water operate cooler.

CAUTION: Lead assemblies on submersible motors are suitable only for use in water and may overheat and cause failure if operated in air.

System Troubleshooting

Motor Does Not Start

POSSIBLE CAUSE	CHECKING PROCEDURES	CORRECTIVE ACTION
A. No power or incorrect voltage	Check voltage at line terminals. The voltage must be ± 10% of rated voltage.	Contact power company if voltage is incorrect.
B. Fuses blown or circuit breakers tripped	Check fuses for recommended size and check for loose, dirty or corroded connections in fuse receptacle. Check for tripped circuit breakers.	Replace with proper fuse or reset circuit breakers.
C. Defective pressure switch	Check voltage at contact points. Improper contact of switch points can cause voltage less than line voltage.	Replace pressure switch or clean points.
D. Control box malfunction	For detailed procedure, see pages 48-57.	Repair or replace.
E. Defective wiring	Check for loose or corroded connections or defective wiring.	Correct faulty wiring or connections.
F. Bound pump	Check for misalignment between pump and motor or a sand bound pump. Amp readings will be 3 to 6 times higher than normal until the overload trips.	Pull pump and correct problem. Run new installation until the water clears.
G. Defective cable or motor	For detailed procedure, see pages 46 & 47.	Repair or replace.

Motor Starts Too Often

A. Pressure switch	Check setting on pressure switch and examine for defects.	Reset limit or replace switch.
B. Check valve - stuck open	Damaged or defective check valve will not hold pressure.	Replace if defective.
C. Waterlogged tank	Check air charge.	Clean or replace.
D. Leak in system	Check system for leaks.	Replace damaged pipes or repair leaks.

System Troubleshooting

Motor Runs Continuously

POSSIBLE CAUSE	CHECKING PROCEDURES	CORRECTIVE ACTION
A. Pressure switch	Check switch for welded contacts. Check switch adjustments.	Clean contacts, replace switch, or adjust setting.
B. Low water level in well	Pump may exceed well capacity. Shut off pump, wait for well to recover. Check static and drawdown level from well head.	Throttle pump output or reset pump to lower level. Do not lower if sand may clog pump.
C. Leak in system	Check system for leaks.	Replace damaged pipes or repair leaks.
D. Worn pump	Symptoms of worn pump are similar to those of drop pipe leak or low water level in well. Reduce pressure switch setting, if pump shuts off worn parts may be the fault.	Pull pump and replace worn parts.
E. Loose coupling or broken motor shaft	Check for loose coupling or damaged shaft.	Replace worn or damaged parts.
F. Pump screen blocked	Check for clogged intake screen.	Clean screen and reset pump depth.
G. Check valve stuck closed	Check operation of check valve.	Replace if defective.
H. Control box malfunction	See pages 48-57 for single-phase.	Repair or replace.

Motor Runs But Overload Protector Trips

A. Incorrect voltage	Using voltmeter, check the line terminals. Voltage must be within ± 10% of rated voltage.	Contact power company if voltage is incorrect.
B. Overheated protectors	Direct sunlight or other heat source can raise control box temperature causing protectors to trip. The box must not be hot to touch.	Shade box, provide ventilation or move box away from source.
C. Defective control box	For detailed procedures, see pages 48-57.	Repair or replace.
D. Defective motor or cable	For detailed procedures, see pages 45 & 46.	Repair or replace.
E. Worn pump or motor	Check running current, see tables 13, 22, 24, 25, & 27.	Replace pump and/or motor.

Table 46 Preliminary Tests - All Sizes Single- and Three-Phase

TEST	PROCEDURE	WHAT IT MEANS
Insulation Resistance (Fig. 10)	1. Open master breaker and disconnect all leads from control box or pressure switch (QD type control, remove lid) to avoid electric shock hazard and damage to the meter. 2. Use a megohmmeter set to 1000-volt (500-volt minimum). If using an ohmmeter, set to R X 100k. Zero the meter. 3. Connect one meter lead to any one of the motor leads and the other lead to the metal drop pipe. If the drop pipe is plastic, connect the meter lead to ground.	1. If the ohms value is normal (Table 47), the motor is not grounded and the cable insulation is not damaged. 2. If the ohms value is below normal, either the windings are grounded or the cable insulation is damaged. Check the cable at the well seal as the insulation is sometimes damaged by being pinched.
Winding Resistance (Fig 11.)	1. Open master breaker and disconnect all leads from control box or pressure switch (QD type control, remove lid) to avoid electric shock hazard and damage to the meter. 2. Use a multi-meter set to 20 ohms or an ohmmeter set to R X 1 for values under 10 ohms. Use next scale up for values over 10 ohms. Zero the meter. 3. On 3-wire motors measure the resistance of yellow to black (main winding) and yellow to red (start winding). On 2-wire motors: measure the resistance from line-to-line. Three-phase motors: measure the resistance line-to-line for all three combinations.	1. If all ohms values are normal (Tables 13, 22, 24, 25, & 27), the motor windings are neither shorted nor open, and the cable colors are correct 2. If any one value is less than normal, the motor is shorted. 3. If any one ohm value is greater than normal, the winding or the cable is open, or there is a poor cable joint or connection. 4. If some ohms values are greater than normal and some less on single-phase motors, the leads are mixed. See page 48 to verify cable colors.

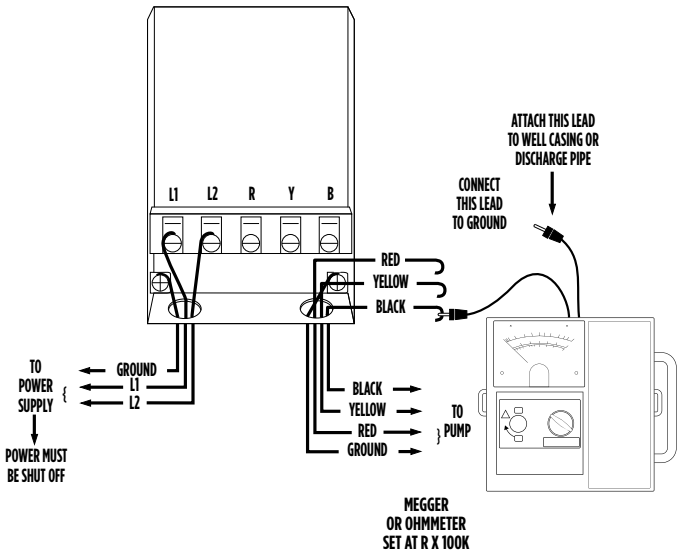


FIG. 10

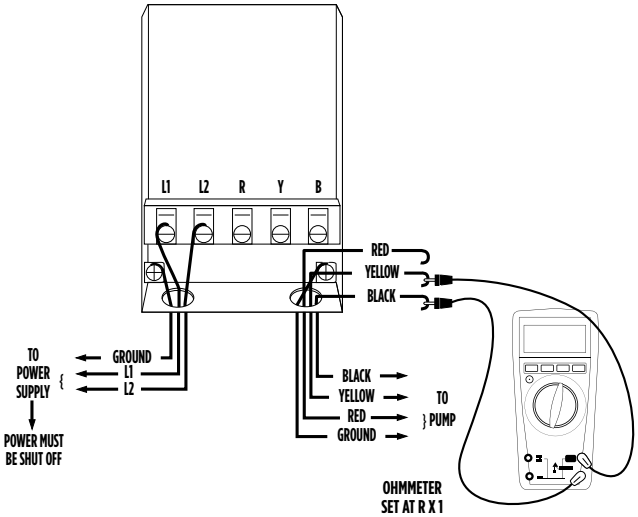


FIG. 11

Insulation Resistance Readings

Table 47 Normal ohm and Megohm Values Between All Leads and Ground

CONDITION OF MOTOR AND LEADS	MEGOHM VALUE	OHMS VALUE
A new motor (without drop cable)	200.0 (or more)	200,000,000 (or more)
A used motor which can be reinstalled in well	10.0 (or more)	10,000,000 (or more)
MOTOR IN WELL. READINGS ARE FOR DROP CABLE PLUS MOTOR.		
New motor	2.0 (or more)	2,000,000 (or more)
Motor in good condition	0.50 - 2.0	500,000 - 2,000,000
Insulation damage, locate and repair	Less than .50	Less than 500,000

Insulation resistance varies very little with rating. Motors of all hp, voltage, and phase rating have similar values of insulation resistance. The table above is based on readings taken with a megohm meter with a 500 VDC output. Readings may vary using a lower voltage ohmmeter; consult Franklin Electric if readings are in question.

Resistance of Drop Cable (ohms)

The values below are for copper conductors. If aluminum conductor drop cable is used, the resistance will be higher. To determine the actual resistance of the aluminum drop cable, divide the ohm readings from this chart by 0.61. This chart shows total resistance of cable from control to motor and back.

Winding Resistance Measuring

The winding resistance measured at the motor should fall within the values in Tables 13, 22, 24, 25, & 27. When measured through the drop cable, the resistance of the drop cable must be subtracted from the ohmmeter readings to get the winding resistance of the motor. See table below.

Table 47A DC Resistance in ohms per 100 ft of Wire (Two conductors) @ 50 °F

AWG OR MCM WIRE SIZE (COPPER)	14	12	10	8	6	4	3	2
OHMS	0.544	0.338	0.214	0.135	0.082	0.052	0.041	0.032

1	1/0	2/0	3/0	4/0	250	300	350	400	500	600	700
0.026	0.021	0.017	0.013	0.010	0.0088	0.0073	0.0063	0.0056	0.0044	0.0037	0.0032

Identification Of Cables When Color Code Is Unknown (Single-Phase 3-Wire Units)

If the colors on the individual drop cables cannot be found with an ohmmeter, measure:

Cable 1 to Cable 2
Cable 2 to Cable 3
Cable 3 to Cable 1

Find the highest resistance reading.

The lead not used in the highest reading is the yellow lead.

Use the yellow lead and each of the other two leads to get two readings:

Highest is the red lead.
Lowest is the black lead.

EXAMPLE:
The ohmmeter readings were:

Cable 1 to Cable 2 - 6 ohms
Cable 2 to Cable 3 - 2 ohms
Cable 3 to Cable 1 - 4 ohms

The lead not used in the highest reading (6 ohms) was

Cable 3—Yellow

From the yellow lead, the highest reading (4 ohms) was

To Cable 1—Red

From the yellow lead, the lowest reading (2 ohms) was

To Cable 2—Black

Single-Phase Control Boxes

Checking and Repairing Procedures (Power On)

WARNING: Power must be on for these tests. Do not touch any live parts.

A. VOLTAGE MEASUREMENTS

Step 1. Motor Off

1. Measure voltage at L1 and L2 of pressure switch or line contactor.
2. Voltage Reading: Should be ± 10% of motor rating.

Step 2. Motor Running

1. Measure voltage at load side of pressure switch or line contactor with pump running.
2. Voltage Reading: Should remain the same except for slight dip on starting. Excessive voltage drop can be caused by loose connections, bad contacts, ground faults, or inadequate power supply.
3. Relay chatter is caused by low voltage or ground faults.

B. CURRENT (AMP) MEASUREMENTS

1. Measure current on all motor leads.
2. Amp Reading: Current in red lead should momentarily be high, then drop within one second to values in Table 13. This verifies relay or solid state relay operation. Current in black and yellow leads should not exceed values in Table 13.
3. Relay or switch failures will cause red lead current to remain high and overload tripping.
4. Open run capacitor(s) will cause amps to be higher than normal in the black and yellow motor leads and lower than normal in the red motor lead.
5. A bound pump will cause locked rotor amps and overloading tripping.
6. Low amps may be caused by pump running at shut-off, worn pump, or stripped splines.
7. Failed start capacitor or open switch/relay are indicated if the red lead current is not momentarily high at starting.

CAUTION: The tests in this manual for components such as capacitors, relays, and QD switches should be regarded as indicative and not as conclusive. For example, a capacitor may test good (not open, not shorted) but may have lost some of its capacitance and may no longer be able to perform its function.

Ohmmeter Tests

QD, Solid State Control Box (Power Off)

A. START CAPACITOR AND RUN CAPACITOR IF APPLICABLE (CRC)

1. Meter Setting: R x 1,000.
2. Connections: Capacitor terminals.
3. Correct meter reading: Pointer should swing toward zero, then back to infinity.

B. Q.D. (BLUE) RELAY

Step 1. Triac Test

1. Meter setting: R x 1,000.
2. Connections: Cap and B terminal.
3. Correct meter reading: Infinity for all models.

Step 2. Coil Test

1. Meter Setting: R x 1.
2. Connections: L1 and B.
3. Correct meter reading: Zero ohms for all models.

C. POTENTIAL (VOLTAGE) RELAY

Step 1. Coil Test

1. Meter setting: R x 1,000.
2. Connections: #2 & #5.
3. Correct meter readings:

   For 115 Volt Boxes:
   0.7-1.8 (700 to 1,800 ohms).

   For 230 Volt Boxes:
   4.5-7.0 (4,500 to 7,000 ohms).

Step 2. Contact Test

1. Meter setting: R x 1.
2. Connections: #1 & #2.
3. Correct meter reading: Zero for all models.

Ohmmeter Tests

Integral Horsepower Control Box (Power Off)

A. OVERLOADS (Push Reset Buttons to make sure contacts are closed.)

1. Meter Setting: R x 1.
2. Connections: Overload terminals.
3. Correct meter reading: Less than 0.5 ohms.

B. CAPACITOR (Disconnect leads from one side of each capacitor before checking.)

1. Meter Setting: R x 1,000.
2. Connections: Capacitor terminals.
3. Correct meter reading: Pointer should swing toward zero, then drift back to infinity, except for capacitors with resistors which will drift back to 15,000 ohms.

C. POTENTIAL (VOLTAGE) RELAY

Step 1. Coil Test

1. Meter setting: R x 1,000.
2. Connections: #2 & #5.
3. Correct meter readings: 4.5-7.0 (4,500 to 7,000 ohms) for all models.

Step 2. Contact Test

1. Meter Setting: R x 1.
2. Connections: #1 & #2.
3. Correct meter reading: Zero ohms for all models.

D. CONTACTOR

Step 1. Coil

1. Meter setting: R x 100
2. Connections: Coil terminals
3. Correct meter reading: 1.8-14.0 (180 to 1,400 ohms)

Step 2. Contacts

1. Meter Setting: R X 1
2. Connections: L1 & T1 or L2 & T2
3. Manually close contacts
4. Correct meter reading: Zero ohms

CAUTION: The tests in this manual for components such as capacitors, relays, and QD switches should be regarded as indicative and not as conclusive. For example, a capacitor may test good (not open, not shorted) but may have lost some of its capacitance and may no longer be able to perform its function.

Single-Phase Motors & Controls

MAINTENANCE

Table 50 QD Control Box Parts 60 Hz

HP	VOLTS	CONTROL BOX MODEL NUMBER	QD (BLUE) RELAY	START CAPACITOR	MFD	VOLTS	RUN CAPACITOR	MFD	VOLTS
1/3	115	280 102 4915	223 415 905	275 464 125	159-191	110			
	230	280 103 4915	223 415 901	275 464 126	43-53	220			
1/2	115	280 104 4915	223 415 906	275 464 201	250-300	125			
	230	280 105 4915	223 415 902	275 464 105	59-71	220			
	230	282 405 5015 (CRC)	223 415 912	275 464 126	43-53	220	156 362 101	15	370
3/4	230	280 107 4915	223 415 903	275 464 118	86-103	220			
	230	282 407 5015 (CRC)	223 415 913	275 464 105	59-71	220	156 362 102	23	370
1	230	280 108 4915	223 415 904	275 464 113	105-126	220			
	230	282 408 5015 (CRC)	223 415 914	275 464 118	86-103	220	156 362 102	23	370

Table 50A QD Capacitor Replacement Kits

CAPACITOR NUMBER	KIT
275 464 105	305 207 905
275 464 113	305 207 913
275 464 118	305 207 918
275 464 125	305 207 925
275 464 126	305 207 926
275 464 201	305 207 951
156 362 101	305 203 907
156 362 102	305 203 908

Table 50B Overload Kits 60 Hz

HP	VOLTS	KIT (1)
1/3	115	305 100 901
1/3	230	305 100 902
1/2	115	305 100 903
1/2	230	305 100 904
3/4	230	305 100 905
1	230	305 100 906

(1) For Control Boxes with model numbers that end with 4915.

Table 50C QD Relay Replacement Kits

QD RELAY NUMBER	KIT
223 415 901	305 101 901
223 415 902	305 101 902
223 415 903	305 101 903
223 415 904	305 101 904
223 415 905	305 101 905
223 415 906	305 101 906
223 415 912 (CRC)	305 105 901
223 415 913 (CRC)	305 105 902
223 415 914 (CRC)	305 105 903

FOOTNOTES:

(1) Control boxes supplied with QD Relays are designed to operate on 230-volt systems. For 208-volt systems or where line voltage is between 200 volts and 210 volts use the next larger cable size, or use a boost transformer to raise the voltage.

(2) Voltage relays kits for 115-volts (305 102 901) and 230-volts (305 102 902) will replace current, voltage or QD Relays, and solid state switches.

Table 51 Integral Horsepower Control Box Parts 60 Hz

MOTOR SIZE	MOTOR RATING HP	CONTROL BOX (1) MODEL NO.	CAPACITORS				OVERLOAD (2) PART NO.	RELAY (3) PART NO.	CONTACTOR (2) PART NO.
			PART NO. (2)	MFD.	VOLTS	QTY.			
4"	1 - 1.5 STANDARD	282 300 8110 (See Note 5)	275 464 113 S 155 328 102 R	105-126 10	220 370	1 1	275 411 107	155 031 102	
		282 300 8110 (See Note 5)	275 464 137 S 155 328 101 R	105-126 15	220 370	1 1	275 411 114 S 275 411 113 M	155 031 102	
		282 300 8610	275 464 113 S 155 328 101 R	105-126 15	220 370	1 1	None (See Note 4)	155 031 102	
4"	2 STANDARD	282 301 8110	275 464 137 S 155 328 103 R	105-126 20	220 370	1 1	275 411 117 S 275 411 113 M	155 031 102	
4"	2 DELUXE	282 301 8310	275 464 137 S 155 328 103 R	105-126 20	220 370	1 1	275 411 117 S 275 411 113 M	155 031 102	155 325 102 L
4"	3 STANDARD	282 302 8110	275 463 123 S 155 327 109 R	208-250 45	220 370	1 1	275 411 118 S 275 411 115 M	155 031 102	
4"	3 DELUXE	282 302 8310	275 463 123 S 155 327 109 R	208-250 45	220 370	1 1	275 411 118 S 275 411 115 M	155 031 102	155 325 102 L
4" & 6"	5 STANDARD	282 113 8110	275 468 119 S 155 327 114 R	270-324 40	330 370	1 2	275 411 119 S 275 406 102 M	155 031 601	
4" & 6"	5 DELUXE	282 113 9310	275 468 119 S 155 327 114 R	270-324 40	330 370	1 2	275 411 119 S 275 406 102 M	155 031 601	155 326 101 L
6"	7.5 STANDARD	282 201 9210	275 468 119 S 275 468 118 S 155 327 109 R	270-324 216-259 45	330 330 370	1 1 1	275 411 102 S 275 406 122 M	155 031 601	
6"	7.5 DELUXE	282 201 9310	275 468 119 S 275 468 118 S 155 327 109 R	270-324 216-259 45	330 330 370	1 1 1	275 411 102 S 275 406 121 M	155 031 601	155 326 102 L
6"	10 STANDARD	282 202 9210	275 468 119 S 275468 120 S 155 327 102 R	270-324 350-420 35	330 330 370	1 1 2	275 406 103 S 155 409 101 M	155 031 601	
6"	10 STANDARD	282 202 9230	275 463 120 S 275 468 118 S 275 468 119 S 155 327 102 R	130-154 216-259 270-324 35	330 330 330 370	1 1 1 2	275 406 103 S 155 409 101 M	155 031 601	
6"	10 DELUXE	282 202 9310	275 468 119 S 275468 120 S 155 327 102 R	270-324 350-420 35	330 330 370	1 1 2	275 406 103 S 155 409 101 M	155 031 601	155 326 102 L
6"	10 DELUXE	282 202 9330	275 463 120 S 275 468 118 S 275 468 119 S 155 327 102 R	130-154 216-259 270-324 35	330 330 330 370	1 1 1 2	275 406 103 S 155 409 101 M	155 031 601	155 326 102 L
6"	15 DELUXE	282 203 9310	275 468 120 S 155 327 109 R	350-420 45	330 370	2 3	275 406 103 S 155 409 102 M	155 031 601	155 429 101 L
6"	15 DELUXE	282 203 9330	275 463 122 S 275 468 119 S 155 327 109 R	161-193 270-324 45	330 330 370	1 2 3	275 406 103 S 155 409 102 M	155 031 601	155 429 101 L
6"	15 X-LARGE	282 203 9621	275 468 120 S 155 327 109 R	350-420 45	330 370	2 3	275 406 103 S 155 409 102 M	155 031 601 2 required	155 429 101 L

FOOTNOTES:

(1) Surge arrestors 150 814 902 are suitable for all control boxes.

(2) S = Start, M = Main, L = Line, R = Run
Deluxe = Control box with line contactor.

(3) For 208-volt systems or where line voltage is between 200 volts and 210 volts, a low voltage relay is required. On 3 hp and smaller control boxes use relay part 155 031 103 in place of 155 031 102 and use the next larger cable size than specified in the 230-volt table. On 5 hp and larger use relay 155 031 602 in place of 155 031 601 and next larger wire. Boost transformers per page 15 are an alternative to special relays and cable.

(4) Control box model 282 300 8610 is designed for use with motors having internal overload protectors. If used with a 1.5 hp motor manufactured prior to date code 06H18, Overload/ Capacitor Kit 305 388 901 is required.

(5) Control box model 282 300 8110 with date code 11C19 (March 2011) and newer contain 15 MFD run capacitor and both start and run overloads. This box is designed for use with any Franklin 1.5 hp motor.

Table 52 Integral hp Capacitor Replacement Kits

CAPACITOR NUMBER	KIT
275 463 120	305 206 920
275 463 122	305 206 922
275 463 123	305 206 923
275 464 113	305 207 913
275 464 137	305 207 937
275 468 118	305 208 918
275 468 119	305 208 919
275 468 120	305 208 920
155 327 101	305 203 901
155 327 102	305 203 902
155 327 109	305 203 909
155 327 114	305 203 914
155 328 101	305 204 901
155 328 102	305 204 902
155 328 103	305 204 903

Table 52A Integral hp Overload Replacement Kits

OVERLOAD NUMBER	KIT
275 406 102	305 214 902
275 406 103	305 214 903
275 406 121	305 214 921
275 406 122	305 214 922
275 411 102	305 215 902
275 411 107	305 215 907
275 411 108	305 215 908
275 411 113	305 215 913
275 411 114	305 215 914
275 411 115	305 215 915
275 411 117	305 215 917
275 411 118	305 215 918
275 411 119	305 215 919

Table 52B Integral hp Voltage Relay Replacement Kits

RELAY NUMBER	KIT
155 031 102	305 213 902
155 031 103	305 213 903
155 031 601	305 213 961
155 031 602	305 213 962

Table 52C Integral hp Contactor Replacement Kits

CONTACTOR	KIT
155 325 102	305 226 902
155 326 101	305 347 903
155 326 102	305 347 902
155 429 101	305 347 901

FOOTNOTES:

(1) The following kit number changes were made for number consistency purposes only. Parts in the kit did not change.

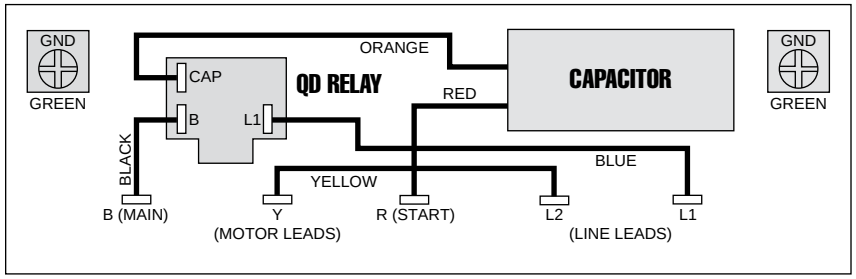
305 206 922 was 305 206 912

305 206 923 was 305 206 911

305 213 962 was 305 213 904

305 226 902 was 305 226 901

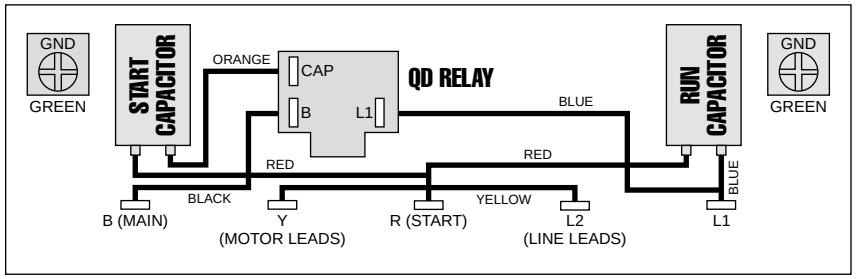
Control Box Wiring Diagrams



1/3 - 1 hp QD RELAY

280 10_ 4915

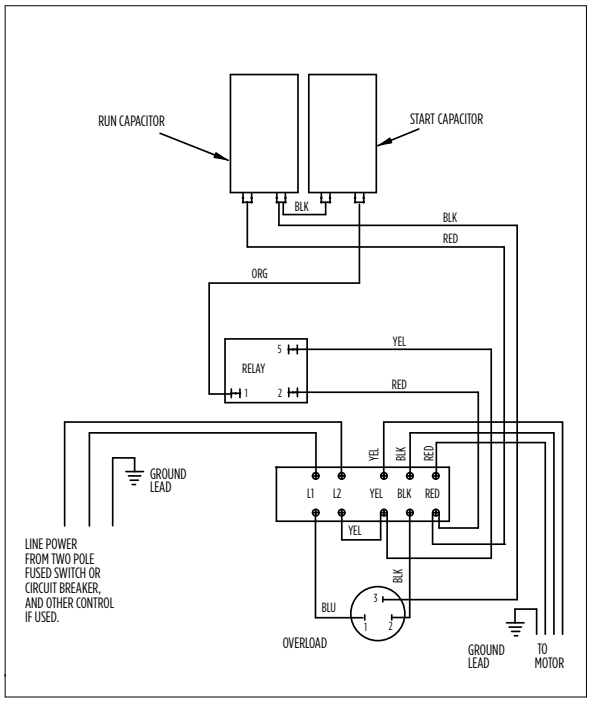
Sixth digit depends on hp



1/2 - 1 hp CRC QD RELAY

282 40_ 5015

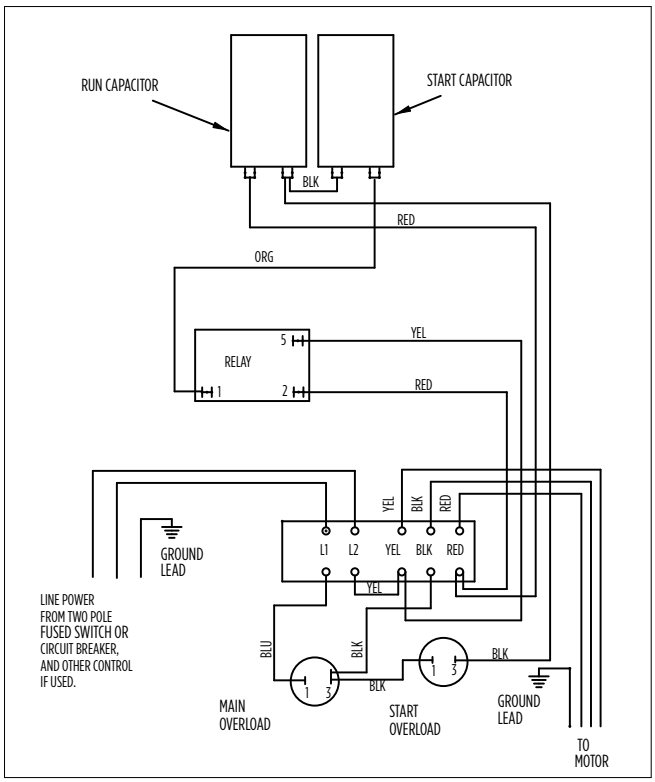
Sixth digit depends on hp



1 - 1.5 hp

282 300 8110

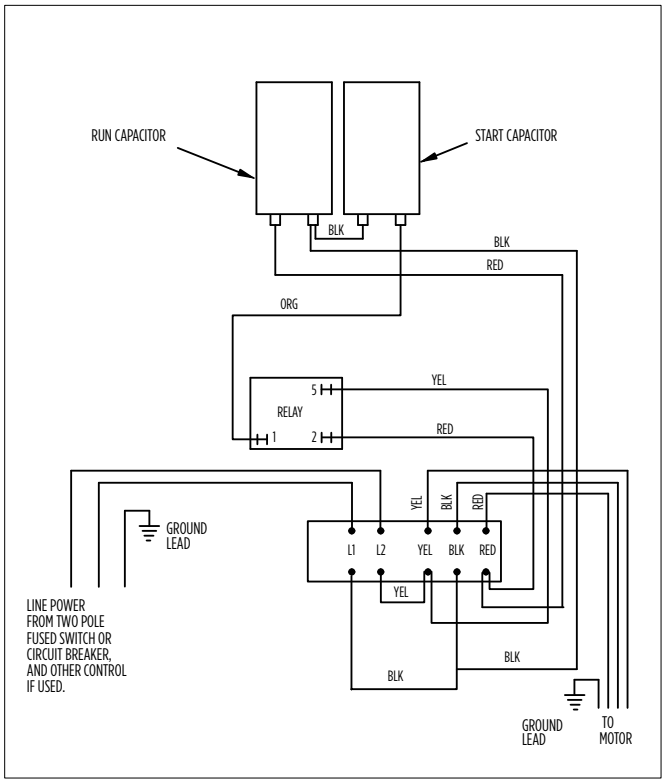
(Date Codes 11C19 & Older)



1 - 1.5 hp

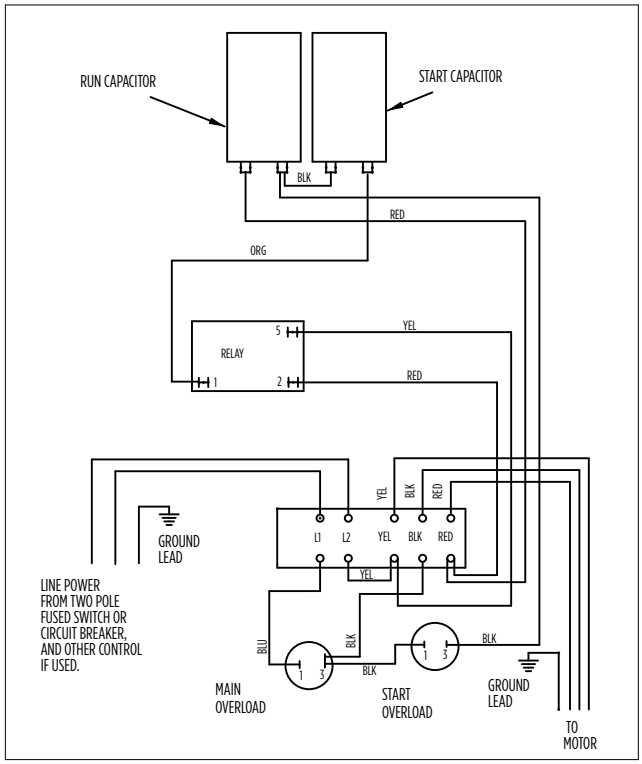
282 300 8110

(Date Codes 11C19 & Newer)

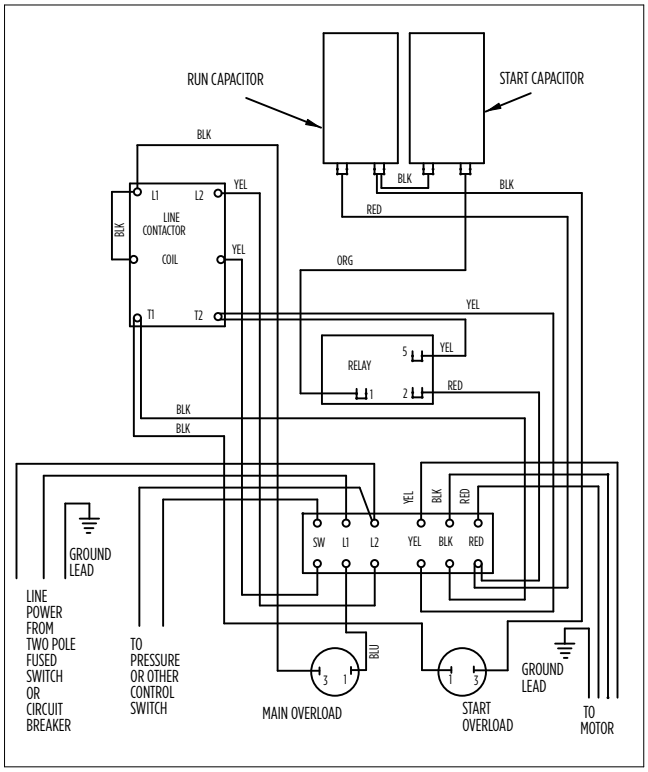


1 - 1.5 hp

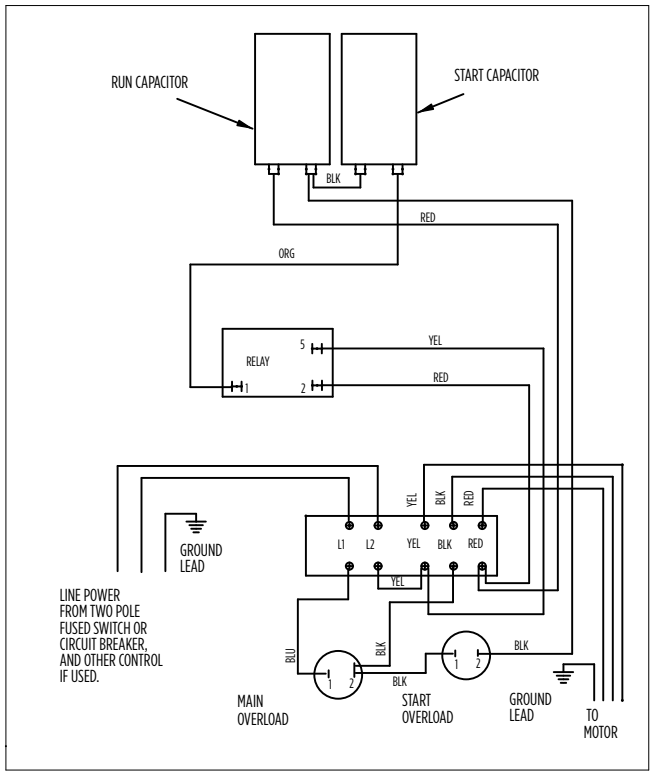
282 300 8610



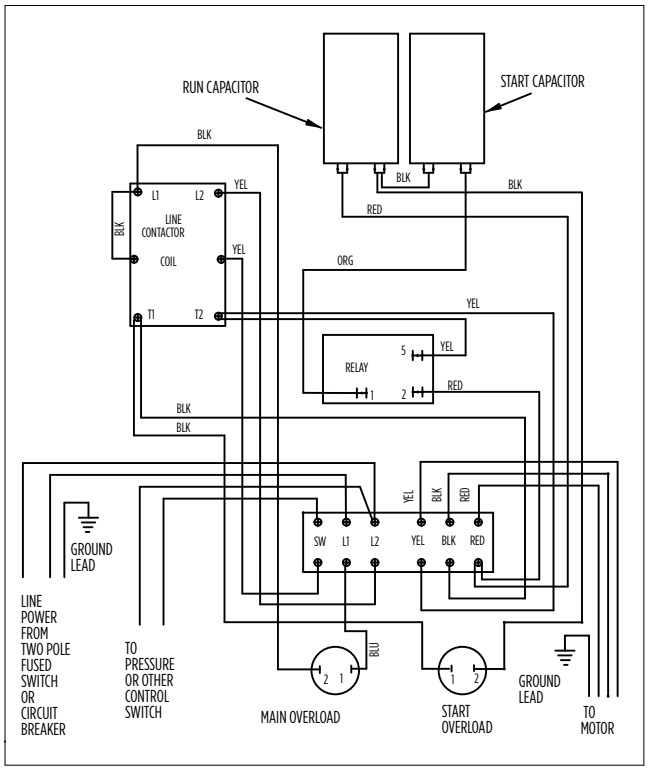
2 hp STANDARD
282 301 8110



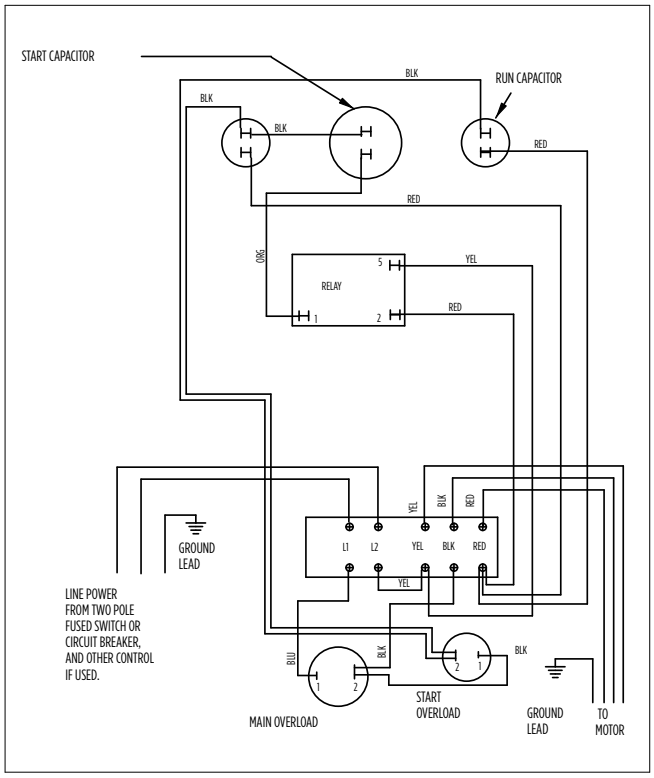
2 hp DELUXE
282 301 8310



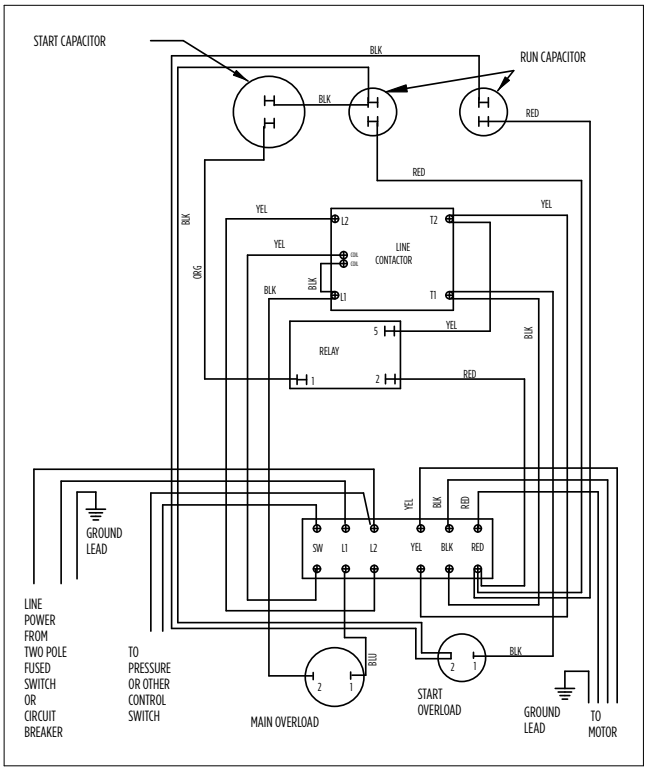
3 hp STANDARD
282 302 8110



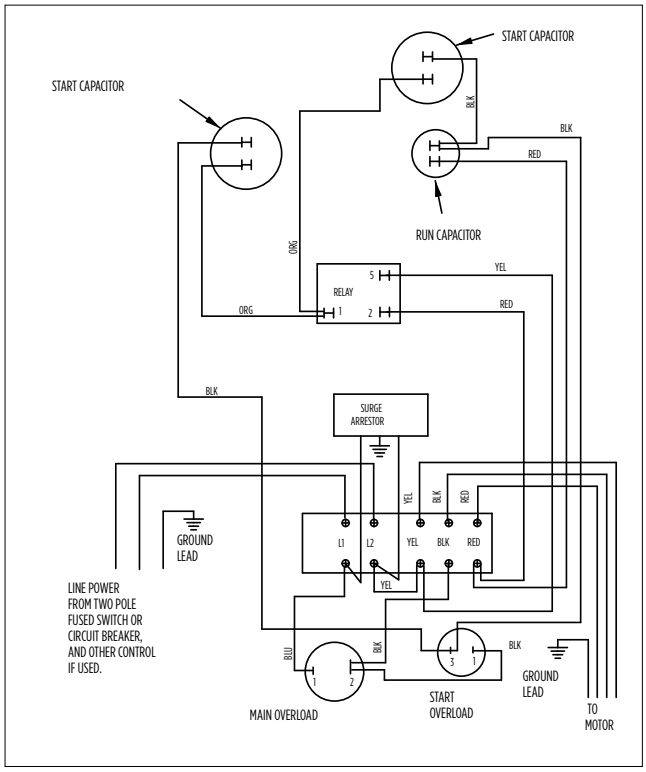
3 hp DELUXE
282 302 8310



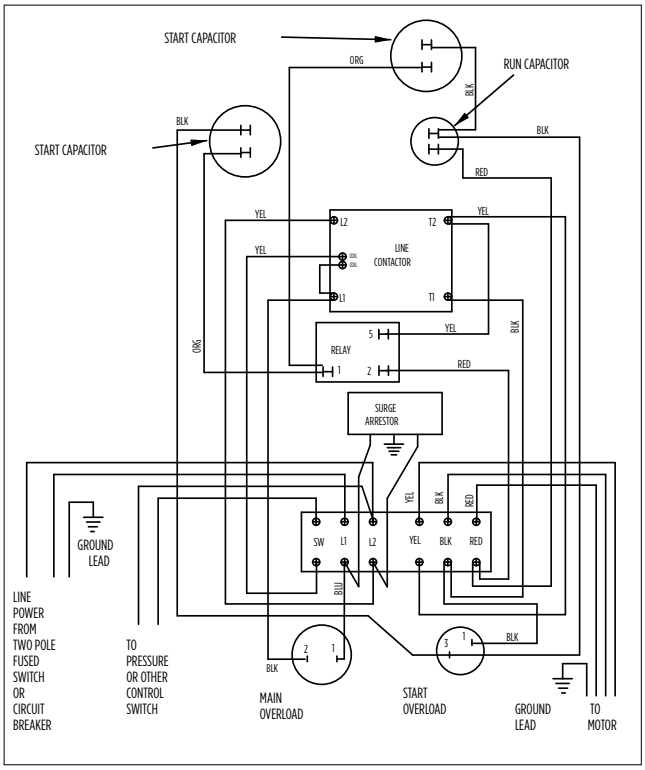
5 hp STANDARD
282 113 8110



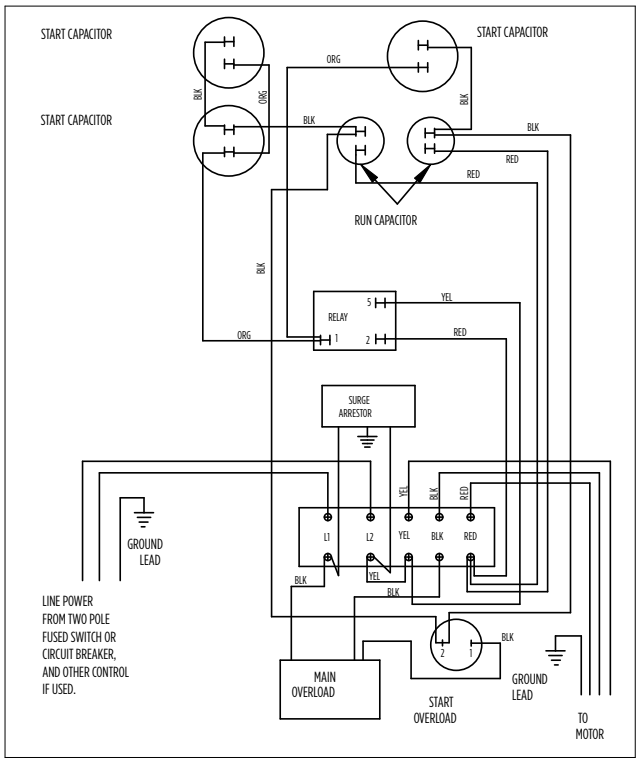
5 hp DELUXE
282 113 8310 or 282 113 9310



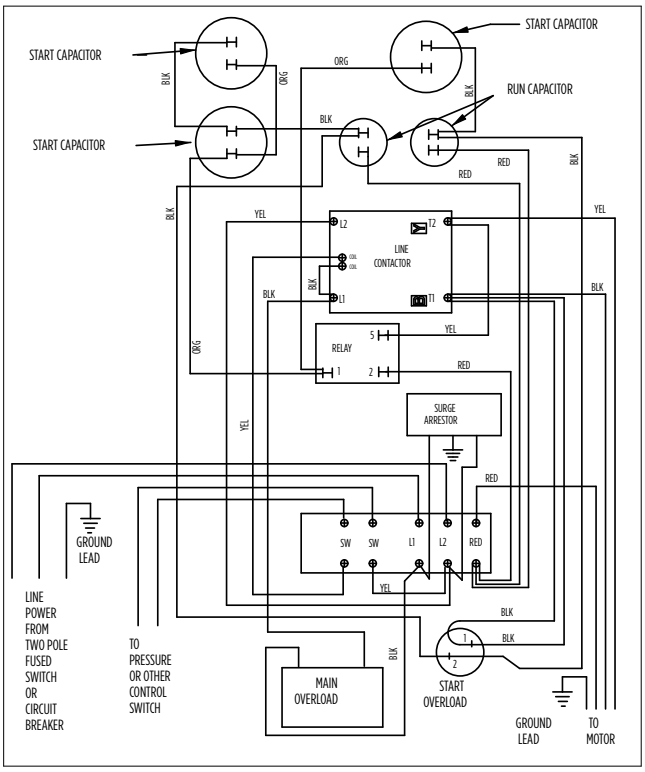
7.5 hp STANDARD
282 201 9210



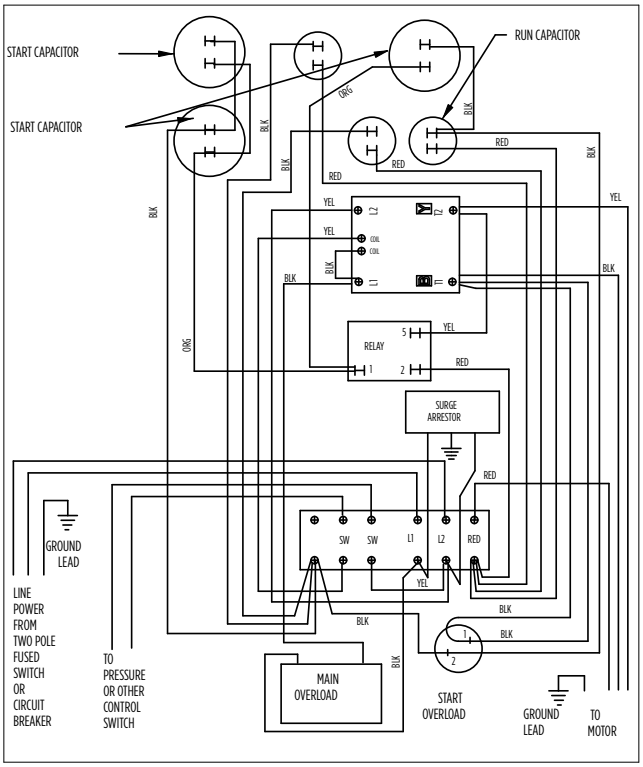
7.5 hp DELUXE
282 201 9310



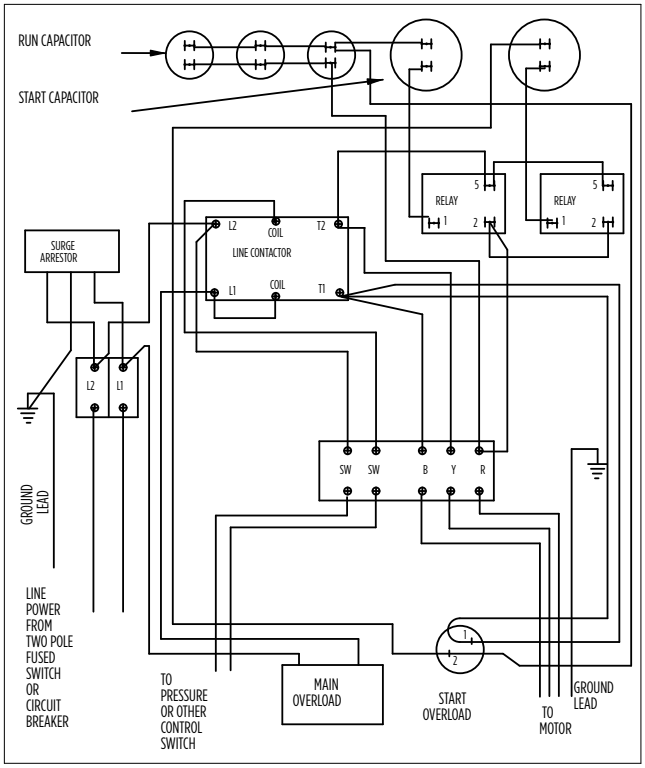
10 hp STANDARD
282 202 9210 or 282 202 9230



10 hp DELUXE
282 202 9230 or 282 202 9330



15 hp DELUXE
282 203 9310 or 282 203 9330



15 hp X-LARGE
282 203 9621

Electronic Products

APPLICATION

SubDrives & MonoDrives

The Franklin Electric SubDrive/MonoDrive controller is a variable-speed drive that delivers water at a constant pressure. MonoDrive and MonoDriveXT are designed to convert a conventional 3-wire 1/2 hp to 2 hp pump system to a variable speed constant pressure system by simply replaceing the 3-wire control box and pressure switch. The SubDrive 3-Phase models are designed for three-phase motors to provide constant pressure with three-phase performance using single-phase input power. The SubDrive2W is designed to convert a conventional 2-wire 1/2 hp, 3/4 hp and 1 hp pump system to a variable speed constant pressure system by simply replacing the pressure switch.

Applications

- Residential home
- Schools
- Restaurants
- Car washes
- Farms
- Landscape irrigation system

Protects Agianst

- Surge Protection
- Overheated Controller
- Locked pump
- Short Circuits
- Undervoltage
- Open Circuit
- Underload
- Broken pipe detection (NEMA 3R only excluding 2W)
- User-configuarable underload off time (NEMA 3R only excluding 2W)

WARNING: Serious or fatal electrical shock may result from failure to connect the motor, SubDrive/MonoDrive Controller, metal plumbing and all other metal near the motor or cable to the power supply ground terminal using wire no smaller than motor cable wires. To reduce the risk of electrical shock, disconnect power before working on or around the water system. Capacitors inside the SubDrive/MonoDrive Controller can still hold a lethal voltage even after power has been removed. Allow 10 minutes for dangerous internal voltage to discharge. Do not use motor in swimming areas.

Generator Sizing for SubDrive/MonoDrive

Basic generator sizing for the Franklin Electric SubDrive/MonoDrive system is 1.5 times maximum input Watts consumed by the drive, rounded up to the next normal sized generator.

Recommended minimum generator sizes:

MonoDrive

1/2 hp (0.37 kW) = 2000 Watts (2 kW)
3/4 hp (0.55 kW) = 3000 Watts (3 kW)
1 hp (0.75 kW) = 3500 Watts (3.5 kW)

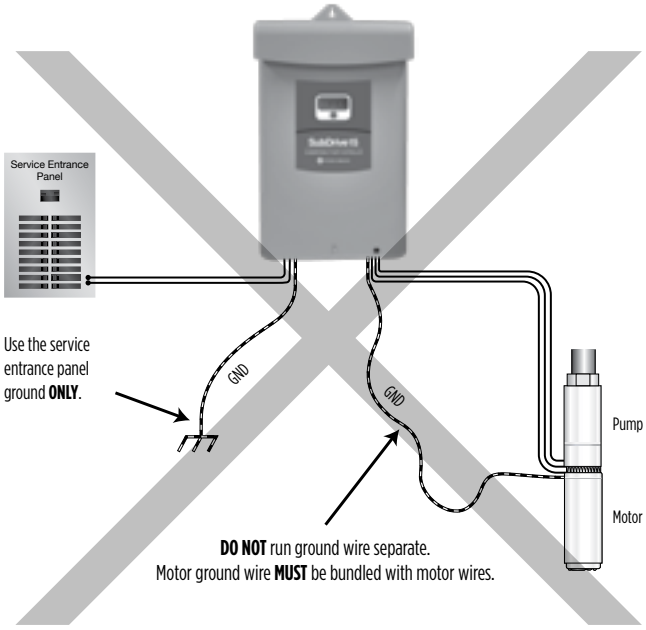
MonoDriveXT

1.5 hp (1.1kW) = 4000 Watts (4 kW)
2 hp (1.5 kW) = 5000 Watts (5 kW)

SubDrive15 = 3500 Watts (3.5 kW)
SubDrive20 = 5700 Watts (6 kW)
SubDrive30 = 7000 Watts (7 kW)
SubDrive2W = 6000 Watts (6 kW)

SubDrive75 = 3500 Watts (3.5 kW)
SubDrive100 = 5700 Watts (6 kW)
SubDrive150 = 7000 Watts (7 kW)
SubDrive300 = 11000 Watts (11 kW)
SubDrive2W = 6000 Watts (6 kW)

Note: Not to be used on a Ground Fault Circuit Interruptor (GFCI). If using an externally regulated generator, verify that the voltage and Hertz are appropriate to supply the drive.



Fuse/Circuit Breaker and Wire Sizing

The Listed fuse/Listed circuit breaker size and maximum allowable wire lengths for connection to the SubDrive/MonoDrive are given in the following tables:

Table 59: Circuit Breaker Sizing and Maximum Input Cable Lengths (in Feet)

Based on a 3% voltage drop

CONTROLLER MODEL	LISTED FUSE / LISTED CIRCUIT BREAKER AMPS	NOMINAL INPUT VOLTAGE	AWG COPPER WIRE SIZES, 167° F (75° C) INSULATION UNLESS OTHERWISE NOTED										
			14	12	10	8	6	4	3	2	1	1/0	2/0
MonoDrive	15	208	80	125	205	315	500	790	980	1290	1635	-	-
		230	95	150	250	385	615	970	1200	1580	2000	-	-
SubDrive15 / SubDrive75	15	208	70	110	185	280	450	710	880	1160	1465	-	-
		230	85	135	225	345	550	865	1075	1415	1795	-	-
SubDrive2W	20	230	-	125	205	315	505	795	985	1295	1645	-	-
MonoDriveXT	20	208	-	85	140	220	345	550	680	895	1135	-	-
		230	-	105	175	265	425	670	835	1095	1390	-	-
SubDrive20 / SubDrive100	25	208	-	-	115	180	285	450	555	730	925	-	-
	20	230	-	85	140	220	345	550	680	895	1130	-	-
SubDrive30 / SubDrive150	30	208	-	-	95	145	235	370	460	605	765	-	-
	25	230	-	-	115	180	285	455	560	740	935	-	-
SubDrive300	40	208	-	-	-	-	150	235	295	385	490	610	735
	40	230	-	-	-	115	185	290	360	470	600	745	895

XXXX Highlighted Numbers denote wire with 194° F (90° C) insulation only

Table 59A: Maximum Motor Cable Length (in feet)

CONTROLLER MODEL	FRANKLIN ELECTRIC MOTOR MODEL	HP	AWG COPPER WIRE SIZES, 140° F (60 °C) INSULATION					
			14	12	10	8	6	4
SubDrive15 / SubDrive75	234 514 xxxx	1.5 (1.1 kW)	420	670	1060	-	-	-
SubDrive20 / SubDrive100	234 315 xxxx	2.0 (1.5 kW)	320	510	810	1000	-	
SubDrive30 / SubDrive150	234 316 xxxx	3.0 (2.2 kW)	240	390	620	990	-	-
SubDrive300	234 317 xxxx	5.0 (3.7 kW)	-	230	370	590	920	-
SubDrive2W	244 505 xxxx	1/2 (.37 kW)	400	650	1000	-	-	-
	244 507 xxxx	3/4 (.55 kW)	300	480	760	1000	-	-
	244 508 xxxx	1.0 (.75 kW)	250	400	630	990	-	-
MonoDrive	214 505 xxxx	1/2 (.37 kW)	400	650	1020	-	-	-
	214 507 xxxx	3/4 (.55 kW)	300	480	760	1000	-	-
	214 508 xxxx	1.0 (.75 kW)	250	400	630	990	-	-
MonoDriveXT	214 508 xxxx	1.0 (0.75kW)	250	400	630	990	-	-
	224 300 xxxx	1.5 (1.1 kW)	190	310	480	770	1000	-
	224 301 xxxx	2.0 (1.5kW)	150	250	390	620	970	-

A 10-foot (3.05 m) section of cable is provided with the SubDrive/MonoDrive to connect the pressure sensor.

Notes:

- 1 ft = 0.305 m
- Maximum allowable wire lengths are measured between the controller and motor.
- Aluminum wires should not be used with the SubDrive/MonoDrive.
- All wiring to comply with the National Electrical Code and/or local codes.
- MonoDrive minimum breaker amps may be lower than AIM manual specifications for the motors listed due to the soft-starting characteristic of the MonoDrive controller.
- SubDrive minimum breaker amps may appear to exceed AIM manual specifications for the motors listed because SubDrive controllers are supplied from a single-phase service rather than three-phase.Amps (SFA). Motor overtemperature sensing is not provided by the drive.
- Motor Overload Portection: The drive electronics provide motor overload protection by preventing motor current from exceeding the maximum Service Factor Amps (SFA). Motor overtemperature sensing is not provided by the drive.

Pressure Tank

The SubDrive/MonoDrive needs only a small pressure tank to maintain constant pressure. (See Table X for recommended tank size.) For pumps rated 12 gpm (45.4 lpm) or more, a slightly larger tank is recommended for optimum pressure regulation. The SubDrive/MonoDrive can also use an existing tank with a much larger capacity.

Table 60: Minimum Pressure Tank Size (Total Capacity)

PUMP FLOW RATING	CONTROLLER MODEL	MINIMUM TANK SIZE
Less than 12 gpm (45.4 lpm)	SubDrive15, SubDrive 75 or MonoDrive	2 gallons (7.6 liters)
	SubDrive20 or SubDrive100	4 gallons (15.1 liters)
	SubDrive30, SubDrive150 or MonoDriveXT	4 gallons (15.1 liters)
	SubDrive300	8 gallons (30.3 liters)
12 gpm and higher (45.4 lpm)	SubDrive15, SubDrive 75 or MonoDrive	4 gallons (15.1 liters)
	SubDrive20 or SubDrive100	8 gallons (30.3 liters)
	SubDrive30, SubDrive150 or MonoDriveXT	8 gallons (30.3 liters)
	SubDrive300	20 gallons (75.7 liters)
All flows	SubDrive2W	20 gallons (75.7 liters)

Table 60A: Pressure Tank Pre-charge (PSI)

SYSTEM PRESSURE (AT PRESSURE SENSOR)	PRESSURE TANK SETTING (±2 PSI)
25	18
30	21
35	25
40	28
45	32
50 (Factory Set)	35
55	39
60	42
65	46
70	49
75	53
80	56

1 PSI = 0.068 bar
Note: Check tank pre-charge regularly to maintain optimum pressure regulation.

Table 60B: Minimum Pipe Diameter

MAXIMUM VELOCITY 8 FT/SEC. (2.4 M/S)	
MIN PIPE DIA	MAX GPM (LPM)
1/2"	4.9 (18.5)
3/4"	11.0 (41.6)
1"	19.6 (74.2)
1-1/4"	30.6 (115.8)
1-1/2"	44.1 (166.9)
2"	78.3 (296.4)
2-1/2"	176.3 (667.4)

Pumptec-Plus

Pumptec-Plus is a pump/motor protection device designed to work on any 230 V single-phase induction motor (PSC, CSCR, CSIR, and split phase) ranging in size from 1/2 to 5 horsepower. Pumptec-Plus uses a micro-computer to continuously monitor motor power and line voltage to provide protection against dry well, water logged tank, high and low voltage and mud or sand clogging.

Pumptec-Plus – Troubleshooting During Installation

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Unit Appears Dead (No Lights)	No Power to Unit	Check wiring. Power supply voltage should be applied to L1 and L2 terminals of the Pumptec-Plus. In some installations the pressure switch or other control devices is wired to the input of the Pumptec-Plus. Make sure this switch is closed.
Flashing Yellow Light	Unit Needs to Be Calibrated	Pumptec-Plus is calibrated at the factory so that it will overload on most pump systems when the unit is first installed. This overload condition is a reminder that the Pumptec-Plus unit requires calibration before use. See step 7 of the installation instructions.
	Miscalibrated	Pumptec-Plus should be calibrated on a full recovery well with the maximum water flow. Flow restrictors are not recommended.
Flashing Yellow Light During Calibration	2-Wire Motor	Step C of the calibration instructions indicate that a flashing green light condition will occur 2 to 3 seconds after taking the SNAPSHOT of the motor load. On some two-wire motors the yellow light will flash instead of the green light. Press and release the reset button. The green should start flashing.
Flashing Red and Yellow Lights	Power Interruption	During the installation of Pumptec-Plus power may be switched on and off several times. If power is cycled more than four times within a minute Pumptec-Plus will trip on rapid cycle. Press and release the reset button to restart the unit.
	Float Switch	A bobbing float switch may cause the unit to detect a rapid cycle condition on any motor or an overload condition on two-wire motors. Try to reduce water splashing or use a different switch.
Flashing Red Light	High Line Voltage	The line voltage is over 253 volts. Check line voltage. Report high line voltage to the power company.
	Unloaded Generator	If you are using a generator the line voltage may become too high when the generator unloads. Pumptec-Plus will not allow the motor to turn on again until the line voltage returns to normal. Overvoltage trips will also occur if line frequency drops too far below 60 Hz.
Solid Red Light	Low Line Voltage	The line voltage is below 207 volts. Check line voltage.
	Loose Connections	Check for loose connections which may cause voltage drops.
	Loaded Generator	If you are using a generator the line voltage may become too low when the generator loads. Pumptec-Plus will trip on undervoltage if the generator voltage drops below 207 volts for more than 2.5 seconds. Undervoltage trips will also occur if the line frequency rises too far above 60 Hz.

Pumptec-Plus and Pumptec with 3-lights

Pumptec-Plus and Pumptec with 3 lights - Troubleshooting After Installation

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Solid Yellow Light	Dry Well	Wait for the automatic restart timer to time out. During the time out period, the well should recover and fill with water. If the automatic reset timer of the Pumptec-Plus is set to the manual position, push the reset button to reactivate the unit. If the reset timer is set to manual in the Pumptec, turn off power for 5 seconds to reset the unit.
	Blocked Intake	Clear or replace pump intake screen.
	Blocked Discharge	Remove blockage in plumbing.
	Check Valve Stuck	Replace check valve.
	Broken Shaft	Replace broken parts.
	Severe Rapid Cycling	Machine gun rapid cycling can cause an underload condition. See flashing red and yellow lights section below.
	Worn Pump	Replace worn pump parts and recalibrate.
Flashing Yellow Light	Stalled Motor	Repair or replace motor. Pump may be sand or mud locked.
	Float Switch	A bobbing float switch can cause two-wire motors to stall. Arrange plumbing to avoid splashing water. Replace float switch.
	Ground Fault	Check insulation resistance on motor and control box cable.
Solid Red Light	Low Line Voltage	The line voltage is below 207 volts. Pumptec and Pumptec-Plus will try to restart the motor approximately every two minutes until the line voltage is normal.
	Loose Connections	Check for excessive voltage drops in the system electrical connections (i.e. circuit breakers, fuse clips, pressure switch, and Pumptec-Plus L1 and L2 terminals). Repair connections.
Flashing Red Light	High Line Voltage	The line voltage is over 253 volts. Check line voltage. Report high line voltage to the power company.
Flashing Red and Yellow Lights	Rapid Cycle	The most common cause for the rapid cycle condition is a waterlogged tank. Check for a ruptured bladder in the water tank. Check the air volume control or snifter valve for proper operation. Check setting on the pressure switch and examine for defects.
	Leaky Well System	Replace damaged pipes or repair leaks.
	Stuck Check Valve	Failed valve will not hold pressure. Replace valve.
	Float Switch	A bobbing float switch may cause the unit to detect a rapid cycle condition on any motor or an overload condition on 2-wire motors. To reset a Pumptec, remove power for 5 seconds. To reset a Pumptec-Plus, press and release the reset button. To eliminate float switch bounce, try to reduce water splash or use a different switch.

QD Pumptec and Pumptec with 2-lights or no lights

QD Pumptec and the old 2-light version of Pumptec are load sensing devices that monitor the load on submersible pumps/motors. If the load drops below a preset level for a minimum of 4 seconds the QD Pumptec or the Pumptec will shut off the motor.

The QD Pumptec is designed and calibrated expressly for use on Franklin Electric 230 V 3-wire motors (1/3 to 1 hp.) The QD Pumptec must be installed in QD relay boxes.

The Pumptec is designed for use on Franklin Electric 2- and 3-wire motors (1/3 to 1.5 hp) 115 and 230 V. The Pumptec is not designed for jet pumps.

QD Pumptec & Pumptec – Troubleshooting

SYMPTOM	CHECKS OR SOLUTION
If the QD Pumptec or Pumptec trips in about 4 seconds with some water delivery.	A. Is the voltage less than 90% of nameplate rating? B. Are the pump and motor correctly matched? C. Is the **QD Pumptec** or **Pumptec** wired correctly? For the **Pumptec** check the wiring diagram and pay special attention to the positioning of the power lead (230 V or 115 V). Pre-2006 Pumptec used different wiring guidelines. D. For **QD Pumptec** is your system 230 V 60 Hz or 220 V 50 Hz?
If the QD Pumptec or Pumptec trips in about 4 seconds with no water delivery.	A. The pump may be airlocked. If there ia a check valve on top of the pump, put another section of pipe between the pump and the check valve. B. The pump may be out of water. C. Check the valve settings. The pump may be dead-heading. D. Pump or motor shaft may be broken. E. Motor overload may be tripped. Check the motor current (amperage).
If the QD Pumptec or Pumptec will not timeout and reset.	A. Check switch position on side of circuit board on **Pumptec**. **QD Pumptec** check timer position on top/front of unit. Make sure the switch is not between settings. B. If the reset time switch is set to manual reset (position 0), **QD Pumptec** and **Pumptec** will not reset (turn power off for 5 sec. then back on to reset).
If your pump/motor will not run at all.	A. Check voltage. B. Check wiring. C. Remove the **QD Pumptec** from the control box. Reconnect wires in box to original state. If motor does not run the problem is not **QD Pumptec**. Bypass **Pumptec** by connecting L2 and motor lead with jumper. Motor should run. If not, the problem is not **Pumptec**. D. On **Pumptec** only check that **Pumptec** is installed between the control switch and the motor.
If your QD Pumptec or Pumptec will not trip when the pump breaks suction.	A. Be sure you have a Franklin motor. B. Check wiring connections. On **Pumptec** is lead power (230 V or 115 V) connected to correct terminal? Is motor lead connected to correct terminal? C. Check for ground fault in the motor and excessive friction in the pump. D. The well may be "gulping" enough water to keep **QD Pumptec** or **Pumptec** from tripping. It may be necessary to adjust the **QD Pumptec** or the **Pumptec** for these extreme applications. Call the Franklin Electric Service Hotline at 800-348-2420 for information. E. On **Pumptec** applications does the control box have a run capacitor? If so, **Pumptec** will not trip. (Except for Franklin 1.5 hp motors).
If your QD Pumptec or Pumptec chatters when running.	A. Check for low voltage. B. Check for waterlogged tank. Rapid cycling for any reason can cause the **QD Pumptec** or the **Pumptec** relay to chatter. C. On **Pumptec** make sure the L2 and motor wires are installed correctly. If they are reversed, the unit can chatter.

SubDrive2W, 75, 100, 150, 300, MonoDrive, and MonoDrive XT

Should an application or system problem occur, built-in diagnostics will protect the system. The "FAULT" light or digital display on the front of the SubDrive/MonoDrive Controller will flash a given number of times or display a number indicating the nature of the fault. In some cases, the system will shut itself off until corrective action is taken. Fault codes and their corrective actions are listed below. See SubDrive/MonoDrive Installation Manual for installation data.

Diagnostic Fault Codes

NUMBER OF FLASHES OR DIGITAL DISPLAY	FAULT	POSSIBLE CAUSE	CORRECTIVE ACTION
1	MOTOR UNDERLOAD	- Overpumped well - Broken shaft or coupling - Blocked screen, worn pump - Air/gas locked pump - SubDrive not set properly for pump end	- Frequency near maximum with less than 65% of expected load, 42% if DIP #3 is "on" - System is drawing down to pump inlet (out of water) - High static, light loading pump - reset DIP switch #3 to "on" for less sensitivity if not out of water - Check pump rotation (SubDrive only) reconnect if necessary for proper rotation - Air/gas locked pump - if possible, set deeper in well to reduce - Verify DIP switches are set properly
2	UNDERVOLTAGE	- Low line voltage - Misconnected input leads - Dragging or failed cooling fan	- Line voltage low, less than approximately 150 VAC (normal operating range = 190 to 260 VAC) - Check incoming power connection and correct or tighten if necessary correct incoming voltage - check circuit breaker of fuses, contact power company - Disconnect fan. Re-apply system power. If 2-flash goes away, replace fan. If 2-flash continues, replace controller. Check fan with 9-volt battery.
3	LOCKED PUMP	- Motor and/or pump misalignment - Dragging motor and/or pump - Abrasives in pump - Low Insulation to Ground	- Line voltage low, less than approximately 150 VAC (normal operating range = 190 to 260 VAC) - Amperage above max amps at 10 Hz - Remove and repair or replace as required - Check line to ground with a megohmmeter - Are output leads to motor longer than 1000 feet?
4 (MonoDrive & MonoDriveXT only)	INCORRECTLY WIRED	- MonoDrive only - Wrong resistance values on main and start	- Wrong resistance on DC test at start - Check wiring, check motor size, and DIP switch setting, adjust or repair as needed
5	OPEN CIRCUIT	- Loose connection - Failed motor or drop cable - Wrong motor - Damaged controller	- Open reading on DC test at start - Check drop cable and motor resistance, tighten output connections, repair or replace as necesssary, use "dry" motor to check drive functions, if drive will not run and exhibits open circuit fault, replace drive - Check ratings - Replace controller
6	OVER CURRENT	- When fault is indicated immediately after power-up, over current is due to short circuit. Check for loose connections, defective cable, defective splice or grounded motor.	- Amperage exceeded 50 amps on DC test at start or max amps during running - Incorrect output wiring, phase to phase short, phase to ground short in wiring or motor - If fault is present after resetting and removing motor leads, replace drive
		- When fault is indicated while motor is running, over current due to loose debris trapped in pump	- Check pump
7	OVERHEATED DRIVE	- High ambient temperature - Direct sunlight - Obstruction of airflow	- Drive heat sink has exceeded max rated temperature, needs to drop below 85 °C to restart - Fan blocked or inoperable, ambient above 125 °F, direct sunlight, air flow blocked - Replace fan or relocate drive as necessary
8 (SubDrive300 only)	OVER PRESSURE	- Improper pre-charge - Valve closing too fast - Pressure setting too close to relief valve rating	- Reset the pre-charge pressure to 70% of sensor setting. Reduce pressure setting well below relief valve rating. Use next size larger pressure tank. - Verify valve operation is within manufacturer's specifications. - Reduce system pressure setting to a value less than pressure relief rating.
RAPID	INTERNAL FAULT	- A fault was found internal to drive	- Unit may require replacement. Contact your supplier.
9 (SubDrive2W only)	OVER RANGE (Values outside normal operating range)	- Wrong hp/voltage - Internal fault	- Verify motor hp and voltage - Unit may require replacement. Contact your supplier.

SubDrive15, 20, 30, MonoDrive, and MonoDriveXT (NEMA 3R)

Diagnostic Fault Codes

NUMBER OF FLASHES	FAULT	POSSIBLE CAUSE	CORRECTIVE ACTION
F1	MOTOR UNDERLOAD	- Overpumped well - Broken shaft or coupling - Blocked screen, worn pump - Air/gas locked pump - SubDrive not set properly for pump end - Underload Sensitivity setting incorrect	- Frequency near maximum with load less than configured underload sensitivity (Potentiometer or Wi-Fi) - System is drawing down to pump inlet (out of water) - High static, light loading pump - reset Potentiometer for less sensitivity if not out of water - Check pump rotation (SubDrive only) reconnect if necessary for proper rotation - Air/gas locked pump - if possible, set deeper in well to reduce - Verify DIP switches are set properly - Check Underload Sensitivity Setting (Potentiometer or Wi-Fi setting, whichever is applicable)
F2	UNDERVOLTAGE	- Low line voltage - Misconnected input leads - Loose connection at breaker or panel	- Line voltage low, less than approximately 150 VAC (normal operating range = 190 to 260 VAC) - Check incoming power connections and correct or tighten if necessary - Correct incoming voltage - check circuit breaker or fuses, contact power company
F3	OVERCURRENT / LOCKED PUMP	- Motor and/or pump misalignment - Dragging motor and/or pump - Motor and/or pump locked - Abrasives in pump - Excess motor cable length	- Amperage above SFL at 30 Hz - Remove and repair or replace as required - Reduce motor cable length. Adhere to Maximum Motor Cable Length table.
F4 (MonoDrive & MonoDriveXT only)	INCORRECTLY WIRED	- MonoDrive only - Wrong resistance values on main and start	- Wrong resistance on DC test at start - Check wiring, check motor size and DIP switch setting, adjust or repair as needed
F5	OPEN PHASE	- Loose connection - Defective motor or drop cable - Wrong motor	- Open reading on DC test at start. - Check drop cable and motor resistance, tighten output connections, repair or replace as necessary, use “dry” motor to check drive functions. If drive will not run and exhibits underload fault replace drive
F6	SHORT CIRCUIT	- When fault is indicated immediately after power-up, short circuit due to loose connection, defective cable, splice or motor	- Amperage exceeded 25 amps on DC test at start or SF amps during running - Incorrect output wiring, phase to phase short, phase to ground short in wiring or motor - If fault is present after resetting and removing motor leads, replace drive
F7	OVERHEATED DRIVE	- High ambient temperature - Direct sunlight - Obstruction of airflow	- Drive heat sink has exceeded max rated temperature, needs to drop below 194 °F (90 °C) to restart - Fan blocked or inoperable, ambient above 122 °F (50 °C), direct sunlight, air flow blocked - Replace fan or relocate drive as necessary - Remove debris from fan intake/exhaust - Remove and clean optional air screen kit (if installed)
F9	INTERNAL PCB FAULT	- A fault was found internal to drive	- Contact your Franklin Electric Service Personnel - Unit may require replacement. Contact your supplier.
F12	OVERVOLTAGE	- High line voltage - Internal voltage too high	- Line voltage high - Check incoming power connections and correct or tighten if necessary - If line voltage is stable and measured below 260 VAC and problem persists, contact your Franklin Electric Service Personnel

Power down, disconnect leads to the motor and power up the SubDrive:

- If the SubDrive does not give an “open phase” fault (F5), then there is a problem with the SubDrive.

- Connect the SubDrive to a dry motor. If the motor goes through DC test and gives “underload” fault (F1), the SubDrive is working properly.

SubDrive15, 20, 30, MonoDrive, and MonoDriveXT (NEMA 3R)

Diagnostic Fault Codes

NUMBER OF FLASHES	FAULT	POSSIBLE CAUSE	CORRECTIVE ACTION
F14	BROKEN PIPE	- Broken pipe or large leak is detected in the system - Drive runs at full power for 10 minutes without reaching pressure setpoint - Large water draw, such as a sprinkler system, does not allow system to reach pressure setpoint	- Check system for large leak or broken pipe - If the system contains a sprinkler system or is being used to fill a pool or cistern, disable the Broken Pipe Detection
F15 (SD15/20/30 only)	PHASE IMBALANCE	- Motor phase currents differ by 20% or more. - Motor is worn internally - Motor cable resistance is not equal - Incorrect motor type setting (single- or three-phase)	- Check resistance of motor cable and motor windings - Verify motor type matched drive settings (single- or three-phase)
F16	GROUND FAULT	- Motor output cable is damaged or exposed to water - Phase to ground short	- Check motor cable insulation resistance with megger (while not connected to drive). Replace motor cable if needed.
F17	INVERTER TEMPERATURE SENSOR FAULT	- Internal temperature sensor is malfunctioning	- Contact your Franklin Electric Service Personnel - If problem persists, unit may require replacement. Contact your supplier.
F18 (SD20/30/MDXT only)	PFC TEMPERATURE SENSOR FAULT	- Internal temperature sensor is malfunctioning	- Contact your Franklin Electric Service Personnel - If problem persists, unit may require replacement. Contact your supplier.
F19	COMMUNICATION FAULT	- Cable connection between Display/Wi-Fi Board and Main Control Board is loose or disconnected - Internal circuit failure	- Check cable connection between Display/Wi-Fi Board and Main Control Board. - If problem persists, unit may require replacement. Contact your supplier.
F22	DISPLAY/WI-FI BOARD EXPECTED FAULT	- Connection between Display/Wi-Fi Board and Main Control Board was not detected at drive start-up	- Check cable connection between Display/Wi-Fi Board and Main Control Board. - If problem persists, unit may require replacement. Contact your supplier.
F23	MAIN BOARD STARTUP FAULT	- A fault was found internal to drive	- Contact your Franklin Electric Service Personnel - Unit may require replacement. Contact your supplier.
F24	INVALID DIP SWITCH SETTING	- No DIP Switch set or more than one (1) DIP Switch set for Motor size - No DIP Switch set or more than one (1) DIP Switch set for Pump size - Invalid combination of DIP switches for drive type (SD or MD mode), Motor hp, and Pump hp.	- Check DIP switch settings

Power down, disconnect leads to the motor and power up the SubDrive:

- If the SubDrive does not give an “open phase” fault (F5), then there is a problem with the SubDrive.

- Connect the SubDrive to a dry motor. If the motor goes through DC test and gives “underload” fault (F1), the SubDrive is working properly.

SubDrive2W, 75, 100, 150, 300, MonoDrive, and MonoDrive XT

Troubleshooting

CONDITION	INDICATOR LIGHT	POSSIBLE CAUSE	CORRECTIVE ACTION
NO WATER	NONE	- No supply voltage present	- If correct voltage is present, replace drive
	SOLID GREEN	- Pressure sensor circuit	- Verify water pressure is below system set point - Jumper wires together at pressure sensor, if pump starts, replace sensor - If pump doesn't start, check sensor connection at printed circuit board (PCB), if loose, repair - If pump doesn't start, jumper sensor connection at PCB, if pump starts, replace wire - If pump doesn't start with sensor PCB connection jumpered, replace drive
	SOLID RED OR SOLID RED AND GREEN	- Power surge, bad component	- Power system down to clear fault, verify voltage, if repetitive, replace drive
	FLASHING RED	- Fault detected	- Proceed to fault code description and remedy
	FLASHING GREEN	- Drive and motor are operating - Loose switch or cable connection - Gulping water at pump inlet	- Frequency max, amps low, check for closed valve, or stuck check valve - Frequency max, amps high, check for hole in pipe - Frequency max, amps erratic, check pump operation, dragging impellers - This is not a drive problem - Check all connections - Disconnect power and allow well to recover for short time, then retry
PRESSURE FLUCTUATIONS (POOR REGULATION)	FLASHING GREEN	- Pressure sensor placement and setting - Pressure gauge placement - Pressure tank size and pre-charge - Leak in system - Air entrainment into pump intake (lack of submergence)	- Correct pressure and placement as necessary - Tank may be too small for system flow - This is not a drive problem - Disconnect power and check pressure gauge for pressure drop - Set deeper in the well or tank; install a flow sleeve with airtight seal around drop pipe and cable - If fluctuation is only on branches before sensor, flip DIP switch #4 to "on" (07C and newer)
RUN ON WON'T SHUT DOWN	FLASHING GREEN	- Pressure sensor placement and setting - Tank pre-charge pressure - Impeller damage - Leaky system - Sized improperly (pump can't build enough head)	- Check frequency at low flows, pressure setting may be too close to pump max head - Verify precharge at 70% if tank size is larger than minimum, increase precharge (up to 85%) - Verify that the system will build and hold pressure
RUNS BUT TRIPS	FLASHING RED	- Check fault code and see corrective action	- Proceed to fault code description and remedy on reverse side
LOW PRESSURE	FLASHING GREEN	- Pressure sensor setting, pump rotation, pump sizing	- Adjust pressure sensor, check pump rotation - Check frequency at max flow, check max pressure
HIGH PRESSURE	FLASHING GREEN	- Pressure sensor setting - Shorted sensor wire	- Adjust pressure sensor - Remove sensor wire at PCB, if drive continues to run, replace drive - Verify condition of sensor wire and repair or replace if necessary
AUDIBLE NOISE	FLASHING GREEN	- Fan, hydraulic, plumbing	- For excessive fan noise, replace fan - If fan noise is normal, drive will need to be relocated to a more remote area - If hydraulic, try raising or lowering depth of pump - Pressure tank location should be at entrance of water line into house
NO LIGHTS	NONE	- Ribbon cable detached from LED printed circuit board	- Reattach cable - if cable is attached, replace drive
RFI-EMI INTERFERENCE	FLASHING GREEN	- See interference troubleshooting procedure	

SubDrive15, 20, 30, MonoDrive, and MonoDriveXT (NEMA 3R)

Troubleshooting

CONDITION	INDICATOR LIGHT	POSSIBLE CAUSE	CORRECTIVE ACTION
NO WATER	NONE	- No supply voltage present - Display board cable disconnected or loose	- Verify cable connection between main control board and display board - If correct voltage is present, replace drive
	GREEN "---" ON DISPLAY	- Pressure sensor circuit	- Verify water pressure is below system set point - If Pressure Input Board break-away tab is removed, ensure auxiliary device is connected and closed circuit - If Pressure Input Board break-away tab is removed and no auxiliary device is being used, manually short-circuit "AUX IN" connections - Jumper wires together at pressure sensor; if pump starts, replace sensor - If pump doesn't start, check sensor connection at Pressure Input Board;. if loose, repair - If pump doesn't start, jumper sensor connection at Pressure Input Board. If pump starts, replace wire - If pump doesn't start with sensor Pressure Input Board connection jumpered, replace Pressure Input Board - If pump doesn't start with new Pressure Input Board, replace drive
	RED FAULT CODE ON DISPLAY	- Fault detected	- Proceed to fault code description and remedy
	GREEN MOTOR FREQUENCY ON DISPLAY	- Drive and motor are operating - Loose switch or cable connection - Incorrect motor or pump settings - Motor may be running backwards - Gulping water at pump inlet	- Verify Maximum Frequency setting. If this setting was reduced below maximum value, increase - Verify motor/pump ratings and match to motor/pump settings on drive (DIP switch or Wi-Fi) - Verify motor connections - Frequency max, amps low, check for closed valve, or stuck check valve - Frequency max, amps high, check for hole in pipe - Frequency max, amps erratic, check pump operation, dragging impellers - This is not a drive problem - Check all connections - Disconnect power and allow well to recover for short time, then retry
PRESSURE FLUCTUATIONS (POOR REGULATION)	GREEN MOTOR FREQUENCY ON DISPLAY	- Pressure sensor placement and setting - Pressure gauge placement - Pressure tank size and pre-charge - Leak in system - Air entrainment into pump intake (lack of submergence)	- Correct pressure and placement as necessary - Tank may be too small for system flow - This is not a drive problem - Disconnect power and check pressure gauge for pressure drop - Change tank size configuration - Set deeper in the well or tank; install a flow sleeve with airtight seal around drop pipe and cable - If fluctuation is only on branches before sensor, enable Steady Flow
RUN ON WON'T SHUT DOWN	GREEN MOTOR FREQUENCY ON DISPLAY	- Pressure sensor placement and setting - Tank pre-charge pressure - Impeller damage - Leaky system - Sized improperly (pump can't build enough head)	- Check frequency at low flows, pressure setting may be too close to pump max head - Verify precharge at 70% if tank size is larger than minimum, increase precharge (up to 85%) - Verify that the system will build and hold pressure - Enable bump and/or aggressive bump - Increase minimum frequency
RUNS BUT TRIPS	FLASHING RED	- Check fault code and see corrective action	- Proceed to fault code description and remedy on reverse side

SubDrive15, 20, 30, MonoDrive, and MonoDriveXT (NEMA 3R)

Troubleshooting

CONDITION	INDICATOR LIGHT	POSSIBLE CAUSE	CORRECTIVE ACTION
LOW PRESSURE	GREEN MOTOR FREQUENCY ON DISPLAY	- Pressure sensor setting, pump rotation, pump sizing - High temperature	- Adjust pressure sensor, check pump rotation - Check frequency at max flow, check max pressure - High ambient and/or drive temperature will cause drive to foldback power and run with reduced performance
HIGH PRESSURE	GREEN MOTOR FREQUENCY ON DISPLAY	- Pressure sensor setting - Shorted sensor wire	- Adjust pressure sensor - Remove sensor wire at Pressure Input Board, if drive stops running, wire may be shorted - Remove sensor wire at Pressure Input Board, if drive continues to run, replace Pressure Input Board - Remove sensor wire at new Pressure Input Board, if drive continues to run, replace drive - Verify condition of sensor wire and repair or replace if necessary
AUDIBLE NOISE	GREEN MOTOR FREQUENCY ON DISPLAY	- Fan, hydraulic, plumbing	- For excessive fan noise, replace fan - If fan noise is normal, drive will need to be relocated to a more remote area - If hydraulic, try raising or lowering depth of pump - Pressure tank location should be at entrance of water line into house
NO DISPLAY	NONE	- Display board cable disconnected or loose	- Verify cable connection between main control board and display board
CANNOT CONNECT TO DRIVE WI-FI	FE CONNECT LIGHT ON SOLID	- Attempting to connect to incorrect drive - Out of Wi-Fi range of drive	- Ensure the Wi-Fi SSID (hotspot name) you are connecting to matches the drive you wish to connect to - Wi-Fi range is 100 feet line-of-site, must be closer to drive if walls or floors are between you and the drive - Wi-Fi module not responding, cycle power to drive - Cycle Wi-Fi radio on mobile device, refresh Wi-Fi connection list
	FE CONNECT LIGHT OFF	- Wi-Fi timeout expired	- If more than fifteen (15) minutes since last power cycle, cycle power to drive - If more than one (1) hour since last disconnection from Wi-Fi, cycle power to drive
RFI-EMI INTERFERENCE	GREEN MOTOR FREQUENCY ON DISPLAY	- Poor grounding - Wire routing	- Adhere to grounding and wire routing recommendations - An additional external filter may be needed. See Accessories section for ordering information

SubMonitor

SubMonitor Troubleshooting

FAULT MESSAGE	PROBLEM/CONDITION	POSSIBLE CAUSE
SF Amps Set Too High	SF Amps setting above 359 Amps.	Motor SF Amps not entered.
Phase Reversal	Reversed incoming voltage phase sequence.	Incoming power problem.
Underload	Normal line current.	Wrong SF Max Amps setting.
	Low line current.	Over pumping well. Clogged pump intake. Closed valve. Loose pump impeller. Broken shaft or coupling. Phase loss.
Overload	Normal line current.	Wrong SF Max Amps setting.
	High line current.	High or low line voltage. Ground fault. Pump or motor dragging. Motor stalled or bound pump.
Overheat	Motor temperature sensor has detected excess motor temperature.	High or low line voltage. Motor is overloaded. Excessive current unbalance. Poor motor cooling. High water temperature. Excessive electrical noise (VFD in close proximity).
Unbalance	Current difference between any two legs exceeds programmed setting.	Phase loss. Unbalanced power supply. Open Delta transformer.
Overvoltage	Line voltage exceeds programmed setting.	Unstable power supply.
Undervoltage	Line voltage below programmed setting.	Poor connection in motor power circuit. Unstable or weak power supply.
False Starts	Power has been interrupted too many times in a 10 second period.	Chattering contacts. Loose connections in motor power circuit. Arcing contacts.

Electronic Products

APPLICATION

A	Amp or amperage
AWG	American Wire Gauge
BJT	Bipolar Junction Transistor
°C	Degree Celsius
CB	Control Box
CRC	Capacitor Run Control
DI	Deionized
DOL	Direct on Line
Dv/dt	Rise Time of the Voltage
EFF	Efficiency
°F	Degree Fahrenheit
FDA	Food & Drug Administration
FL	Full Load
ft	Foot
ft-lb	Foot Pound
ft/s	Feet per Second
GFCI	Ground Fault Circuit Interrupter
gpm	Gallon per Minute
HERO	High Efficiency Reverse Osmosis
hp	Horsepower
Hz	Hertz
ID	Inside Diameter
IGBT	Insulated Gate Bipolar Transistor
in	Inch
kVA	Kilovolt Amp
kVAR	Kilovolt Amp Rating
kW	Kilowatt (1000 watts)
L1, L2, L3	Line One, Line Two, Line Three
lb-ft	Pound Feet
L/min	Liter per Minute
mA	Milliamp
max	Maximum
MCM	Thousand Circular Mils
mm	Millimeter
MOV	Metal Oxide Varister
NEC	National Electrical Code
NEMA	National Electrical Manufacturer Association
Nm	Newton Meter
NPSH	Net Positive Suction Head
OD	Outside Diameter
OL	Overload
PF	Power Factor
psi	Pounds per Square Inch
PWM	Pulse Width Modulation
QD	Quick Disconnect
R	Resistance
RMA	Return Material Authorization
RMS	Root Mean Squared
rpm	Revolutions per Minute
SF	Service Factor
SFhp	Service Factor Horsepower
S/N	Serial Number
TDH	Total Dynamic Head
UNF	Fine Thread
V	Voltage
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VFD	Variable Frequency Drive
W	Watts
XFMR	Transformer
Y-D	Wye-Delta
Ω	ohms

2015 EDITION

YOU JUST GOT A LITTLE MORE HELP FROM A FRIEND.

FRANKLIN ELECTRIC TECHNICAL SERVICE HOTLINE

800-348-2420 | 260-827-5102 FAX

Option 1 - Franklin Water | **Option 2** - Franklin Control System | **Option 3** - Little Giant Commercial

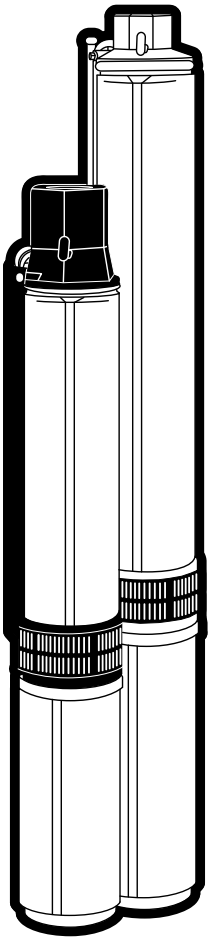
Call Franklin's toll free TECHNICAL SERVICE HOTLINE for answers to your pump and motor installation questions. When you call, a Franklin expert will offer assistance in troubleshooting and provide immediate answers to your system application questions. Technical support is also available online.

franklinwater.com | franklin-controls.com | solar.franklin-electric.com | constantpressure.com

Franklin Electric

Franklin Electric

4" and 6" SUBMERSIBLE PUMPS OWNER'S MANUAL



BEFORE INSTALLING PUMP, BE SURE TO READ THIS OWNER'S MANUAL CAREFULLY.

⚠CAUTION Fill pump with water before starting or pump will be damaged. The motor on this pump is guaranteed by the manufacturer. In event of failure it must be returned to an authorized service station for repairs. Motor warranty is void if repairs are not made by an authorized repair station.

INSPECT THE SHIPMENT

Examine the pump when it is received to be sure there has been no damage in shipping. Should any be evident, report it immediately to the dealer from whom the pump was purchased. Please check the pump package to see that it includes pump, motor, and motor leads (if your pump purchase includes a motor).

READ AND FOLLOW SAFETY INSTRUCTIONS

⚠ This is the safety alert symbol. When you see this symbol on your pump or in this manual, look for one of the following signal words and be alert to the potential for personal injury:

⚠DANGER warns about hazards that will cause serious personal injury, death or major property damage if ignored.

⚠WARNING warns about hazards that **can** cause serious personal injury, death or major property damage if ignored.

⚠CAUTION warns about hazards that **will** or **can** cause minor personal injury or major property damage if ignored.

The label **NOTICE** indicates special instructions, which are important but not related to hazards.

Carefully read and follow all safety instructions in this manual and on pump.

Keep safety labels in good condition.

Replace missing or damaged safety labels.

⚠WARNING

Hazardous voltage. Can shock, burn, or cause death.

Ground pump before connecting to power supply. Disconnect power before working on pump, motor or tank.

⚠WARNING Wire motor for correct voltage. See "Electrical" section of this manual and motor nameplate.

⚠WARNING Ground motor before connecting to power supply.

⚠WARNING Meet National Electrical Code, Canadian Electrical Code, and local codes for all wiring.

Follow wiring instructions in this manual when connecting motor to power lines.

106467101
Rev. 12
11.14

⚠WARNING

IMPORTANT INFORMATION FOR INSTALLERS OF THIS EQUIPMENT!

THIS EQUIPMENT IS INTENDED FOR INSTALLATION BY TECHNICALLY QUALIFIED PERSONNEL. FAILURE TO INSTALL IT IN COMPLIANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES, AND WITH FRANKLIN ELECTRIC RECOMMENDATIONS, MAY RESULT IN ELECTRICAL SHOCK OR FIRE HAZARD, UNSATISFACTORY PERFORMANCE, AND EQUIPMENT FAILURE. FRANKLIN INSTALLATION INFORMATION IS AVAILABLE FROM PUMP MANUFACTURERS AND DISTRIBUTORS, AND DIRECTLY FROM FRANKLIN ELECTRIC. CALL FRANKLIN TOLL FREE 800-348-2420 FOR INFORMATION. RETAIN THIS INFORMATION SHEET WITH THE EQUIPMENT FOR FUTURE REFERENCE.

⚠WARNING

SERIOUS OR FATAL ELECTRICAL SHOCK MAY RESULT FROM FAILURE TO CONNECT THE MOTOR, CONTROL ENCLOSURES, METAL PLUMBING, AND ALL OTHER METAL NEAR THE MOTOR OR CABLE, TO THE POWER SUPPLY GROUND TERMINAL USING WIRE NO SMALLER THAN MOTOR CABLE WIRES. TO REDUCE RISK OF ELECTRICAL SHOCK, DISCONNECT POWER BEFORE WORKING ON OR AROUND THE WATER SYSTEM. DO NOT USE MOTOR IN SWIMMING AREAS.

INSTALLATION RECORDS

It is good idea to keep an accurate record of your installation. Be sure to record the data below:

Purchased From:			
Date of Installation:			
Pump Model No.*			
Pump Date Code*			
Well Inside Dia.(in/mm):			
Depth of Well(ft/m):			
Depth of Water(ft/m):			
Pump Setting(ft/m):			
Drop Pipe Size:			
Wire Size(pump to control box):			
Wire Size(control box to power source):			
Horizontal Offset(between well & house):			
Make of Motor*			
Amps	**HP**	**Volts**	**Ph**
Make of Control Box			
HP		**Volts**	
Power Supply			
Volts		**HZ**	
Pressure Switch (PSI)			
Cut-in		**Cut-out**	

* This Information is on your pump or motor tag. It will help us identify your pump in case of later inquiries.

TEST RUNNING

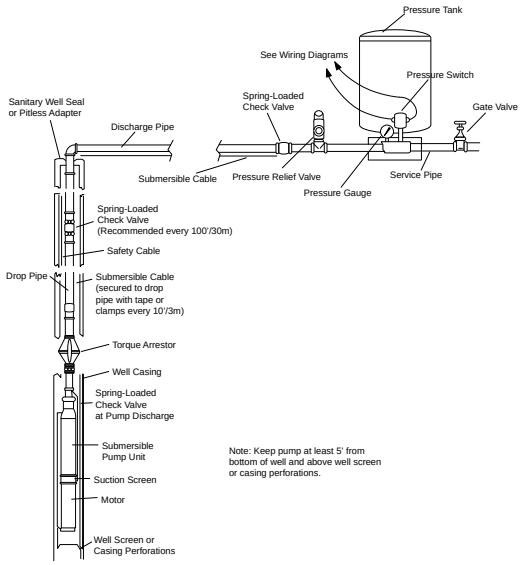
If test running pump before installation:

1. Insure that the power supply corresponds with that shown on the nameplate of the motor and control box. (if required).
2. Install pump and components appropriate for the test as shown in Fig. 1.
3. Make sure power supply is turned off and circuit breaker or disconnect switch is open. Make electrical connections appropriate to your motor as shown in Fig. 2, 3 or 4.
4. THREE-PHASE UNIT - A three-phase motor requires a magnetic starter equipped with quick-trip, ambient compensated heaters of correct size for the horsepower of the motor. To insure correct rotation of three-phase units, brace pump shell securely and apply power momentarily by snapping line switch quickly on and off.

If rotation is correct, reaction of the shell will be clockwise when viewed from pump discharge (that is, pump shaft will rotate counter clockwise). Interchange any two leads at magnetic starter to reverse rotation.

5. Run pump and motor unit for a few seconds to ensure that it is in working order.

FIGURE 1 - Installation Diagram



SUITABILITY OF WELL

Install the pump only in a well that has been properly developed. Water from an undeveloped well often contains an excessive amount of sand, dirt, and abrasives which can damage the pump. Check that the well is large enough to allow the pump to be set at the required depth. Do not set the pump below the casing perforations or well screen unless you make arrangements to ensure an adequate flow of water over the motor for cooling purposes. Determine the correct pump setting from the driller's record by taking into account the static water level and the drawdown at the proposed pumping rate. Keep the pump at least five feet from the bottom of a drilled well.

SPLICING THE POWER CABLE

Follow the instructions enclosed in the cable splicing kit you purchase.

DROP PIPE

Drop pipe is recommended for suspending submersible pumps into the well. Please refer to pipe manufacturer for recommendations on depth and pressure. Give special consideration to:

1. A safety cable to prevent loss of pump if pipe should break.

NOTICE: IT IS RECOMMENDED THAT STEEL CABLE BE USED FOR THE PURPOSES OF SECURING THE PUMP. 3/16" DIAMETER TO 1/4" DIAMETER BRAIDED STEEL CABLE IS SUFFICIENT TO SUPPORT MOST PUMP/MOTOR ASSEMBLIES. IT IS ALWAYS BEST TO CONFIRM THAT THE PUMP/MOTOR ASSEMBLY DOES NOT EXCEED THE MAXIMUM WEIGHT LIMIT OF THE CABLE SELECTED.

2. Torque arrestor just above pump to prevent chafing the cable when pump and pipe twist during the starting and stopping cycle. (See Figure 1)

Take great care to keep pipes clean and free from pebbles, scale and thread chips. Make sound, air-tight connections at all fittings. Pipe sealant is recommended.

CHECK VALVES

It is recommended that one or more check valves always be used in submersible pump installations. If the pump does not have a built-in check valve, an inline check valve should be installed in the discharge line within 25 feet of the pump and below the draw down level of the water supply. For deeper settings, check valves should be installed per the manufacturer's recommendations. More than one check valve is often needed, but more than the recommended number of check valves should not be used.

Swing type check valves are not acceptable and should never be used with submersible motors/pumps. Swing type check valves have a slower reaction time which can cause water hammer (see next page). Internal pump check valves or spring loaded check valves close quickly and help eliminate water hammer.

NOTE: Only positive sealing check valves should be used in submersible installations. Although drilling the check valve or using drain-back check valves may prevent back spinning, they create upthrust and water hammer problems.

Check valves are used to hold pressure in the system when the pump stops. They also prevent backspin, water hammer and upthrust. Any of these can lead to early pump or motor failure.

A. Backspin - With no check valve or a failed check valve, the water in the drop pipe and the water in the system can flow down the discharge pipe when the motor stops. This can cause the pump to rotate in a reverse direction. If the motor is started while it is backspinning,

an excessive force is placed across the pump-motor assembly that can cause impeller damage, motor or pump shaft breakage, excessive bearing wear, etc.

B. Upthrust - With no check valve, a leaking check valve, or drilled check valve, the unit starts under a zero head condition. This causes an uplifting or upthrust on the impeller-shaft assembly in the pump. This upward movement carries across the pump-motor coupling and creates an upthrust condition in the motor. Repeated upthrust can cause premature failure of both the pump and the motor.

C. Water Hammer - If the lowest check valve is more than 30 feet above the standing (lowest static) water level, or a lower check valve leaks and the check valve above holds, a vacuum is created in the discharge piping. On the next pump start, water moving at very high velocity fills the void and strikes the closed check valve and the stationary water in the pipe above it, causing a hydraulic shock. This shock can split pipes, break joints and damage the pump and/or motor. Water hammer can often be heard or felt. When discovered, the system should be shut down and the pump installer contacted to correct the problem.

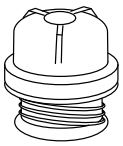
REMOVABLE POPPET CHECK VALVE

Some submersible pumps are supplied with a REMOVABLE check valve assembly for applications where the pump can become air locked. If the pump is supplied without a check valve, or if the check valve is removed, a spring-loaded inline check valve should be installed roughly 10 to 20 feet (3 to 6.09 meters) above the pump. This allows for the repriming of the pump after the pump has run out of water.

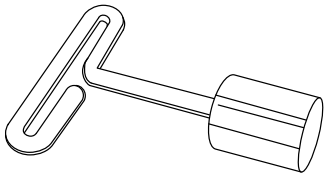
⚠WARNING Fluid draining back through the pump can cause the pump to rotate backwards. If pump/motor starts during this time; damage to the pump can occur.

The check valve can be removed with the use of the T-Handle Poppet Wrench (part no. 23498207), ordered separately, or, with standard needle nose pliers. The poppet assembly is left hand threaded and is removed by turning CLOCKWISE.

If reinstalling a Popppet Check Valve assembly, the assembly should be tightened to 15 inch-pounds.



Poppet Assembly



T-Handle Poppet Wrench

INSTALLATION OF PUMP, DROP PIPE, AND ASSOCIATED EQUIPMENT

Fig. 1 illustrates a typical well installation showing in-ground components. Franklin recommends the following procedure when installing the pump and drop pipe:

1. Prior to fastening the pump/motor assembly to the drop pipe, confirm that the motor's lead wires are securely housed under lead guard which was supplied with the pump. Fastening screws have been provided for use during the lead guard's installation.
2. Fasten the submersible cable to the drop pipe with clamps or appropriate tape every 10 ft. (3m) to prevent tangling and damage to the cable. The cable must remain slack when using plastic drop pipe to allow for stretching of pipe when installed in the well.
3. Take care not to scrape or pinch the submersible cable against the well casing.
4. Use an ohmmeter or megger to make insulation and continuity checks on the cable once the pump is installed. This locates any fault in the cable.
5. Make sure system check valves are installed properly. See previous sections of this manual for further information on check valve placement, type, and troubleshooting.
6. Install a torque arrestor just above the pump to prevent chafing the cable when pump and pipe twist during starting and stopping.
7. Attach a safety cable to pump to prevent loss of pump if pipe should break.

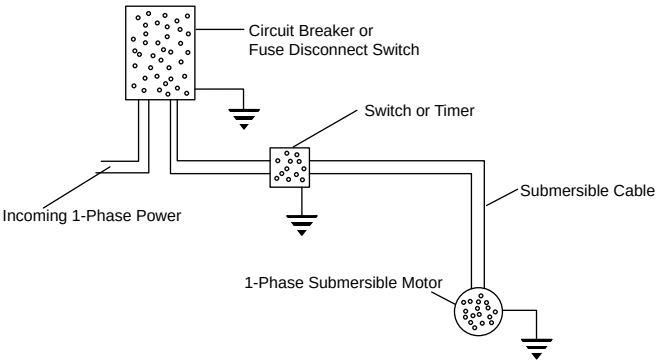
NOTICE: IT IS RECOMMENDED THAT STEEL CABLE BE USED FOR THE PURPOSES OF SECURING THE PUMP. 3/16" DIAMETER TO 1/4" DIAMETER BRAIDED STEEL CABLE IS SUFFICIENT TO SUPPORT MOST PUMP/MOTOR SYSTEMS. IT IS ALWAYS BEST TO CONFIRM THAT THE PUMP/MOTOR SYSTEM DOES NOT EXCEED THE MAXIMUM WEIGHT LIMIT OF THE CABLE SELECTED.

8. Place a sanitary well seal or pitless adapter with an approved cover plate over top of well per manufacturers recommendations.
9. Keep pump at least 5' (1.5m) from bottom of well and above well screen or casing perforations.

ELECTRICAL INFORMATION

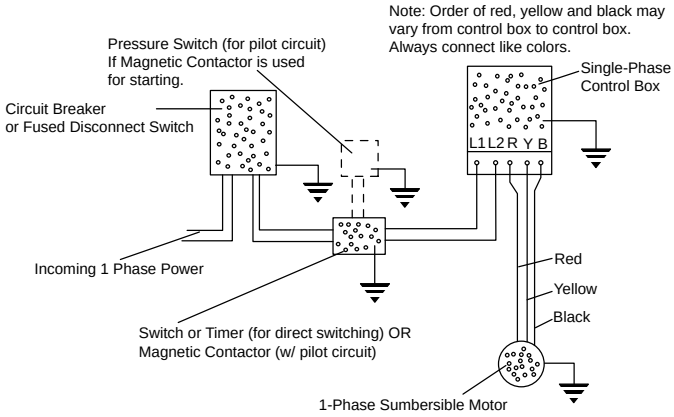
1. Employ a licensed electrician to perform the wiring. All wiring must be done in accordance with applicable national and local electrical codes.
2. Check that the power supply corresponds with the electrical rating of the submersible motor and the control box(if required). Make sure that the control box electrical rating matches the motor electrical rating.
3. Every installation requires a fused disconnect switch or circuit breaker.
4. Every installation must be grounded. There must be a reliable ground connection between the pump and the distribution panel. The motor lead incorporates a green grounding conductor.
5. Lightning arrestors are recommended for every installation. All stainless steel, single phase motors thru 5HP have built-in lightning arrestors. Any 6" motor or 4", 3-phase motor requires a separate lightning arrestor installed as close to the wellhead as possible. Install the arrestor in accordance with manufacturers recommendations. A lightning arrestor provides protection against induced voltage surges on
6. Mount the control box in an area protected from rain, snow, direct sunlight or other high temperatures as this may cause tripping of the overload protector. Also protect the control box from extreme cold (below 25°F/-32°C) as this may have adverse effects on starting capacitor.
7. A two-wire pump does not require a motor control box, since all electrical components are built inside the motor. Fig. 2 shows a typical wiring diagram for a two-wire installation.

FIGURE 2 - 2 WIRE, 1-Phase, 1/2 thru 1-1/2 HP Pump Wiring Diagram



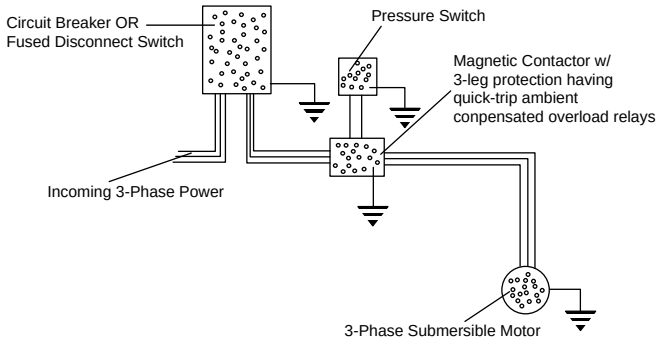
8. A three-wire, single-phase pump requires a motor control box incorporating overload relays. Fig. 3 shows a typical wiring diagram for a three-wire, single-phase installation. Note that a magnetic contactor must be used if the pressure switch electrical rating is not sufficient to handle the submersible motor electrical rating. The pressure switch would then be incorporated into a pilot circuit to control the magnetic contactor. Make the connections at the control box in accordance with the wiring diagram in the control box to avoid damage to the motor.

FIGURE 3 - 3-WIRE, 1-Phase, 1/2 thru 3 HP Pump Wiring Diagram



9. A three-phase pump does not require a motor control box . Fig. 4 shows a typical wiring diagram for a 3-wire, three-phase installation. A magnetic contractor with 3-leg protection having quick-trip ambient compensated overload relays must be used.

FIGURE 4 - 3-Wire, 3-Phase, 1-1/2 thru 50 HP Pump Wiring Diagram



10. Use an ohmeter to make continuity and insulation checks after the installation is completed.

11. Place the additional motor label with the pump label and place both in the disconnect switch or circuit breaker box for future reference.

WELL TEST

Check the pump and well performance before making the final connection to the discharge system.

1. Install a gate valve on the end of the pipe. Partially open the valve.
2. Start the pump.
3. Open valve gradually to give full flow.
4. If the discharge is not clear, let the pump run until water clears. If water does not clear in 30 minutes, stop the pump and take the necessary steps to correct the condition. After the water has appeared clear, check for sand by discharging into a clean bucket or suitable container.
5. Close valve until maximum required system flow rate is obtained (this should correspond to the cut-in pressure of the pressure switch). Ensure that the output of the pump at this setting is not greater than the yield of the well. This can be checked by monitoring the well drawdown level and ensuring that the level is stable at the maximum required system flow rate.

⚠CAUTION Never run pump unless it is completely submerged in water. If run without water, the pump and motor could be damaged. Note also that air drawn into the pump can cause an airlock under certain conditions.

LOW-YIELDING WELL

A low-yielding well exists when the output from the pump is greater than the yield of the well. It can reduce the water level to the suction screen so that a mixture of air and water enters the pump. Pumping may stop since the pump cannot generate pressure with insufficient water. In this case, the column of water already in the drop pipe holds the check valve closed and an airlock may develop inside the pump. Because the conditions ensure neither adequate lubrication of the pump nor proper cooling for the motor, damage can result if power is not cut off quickly. Use one or more of the following methods to correct and/or protect this installation.

1. Install additional length of drop pipe to place pump lower in well if possible.
2. Install a Franklin Pumptec or similar electronic drawdown sensor.
3. Install a floatless liquid level control. This device consists of an electrical relay activated by currents flowing through the ground-return circuits of electrodes hung in the well. The lower (STOP) electrode, just above the pump, ensures that the water level can never be pumped down to the suction screen. The upper (START) electrode, just below the lowest static water level, ensures that the pump can start again as soon as the well has recovered. A floatless liquid level control works in series with the pressure switch. Refer to the manufacturers instructions provided with control.
4. Install a flow control valve in the discharge line upstream from the pressure switch. This restricts the output from the pump without affecting the rate that water can be drawn from the pressure tank. Nevertheless, a heavy demand for water could empty the pressure tank, so a tank with a bonded diaphragm, air cell, or water bag is recommended.
5. Install a smaller pump to avoid over pumping the well. Have dealer size pump to the well yield.
6. Install a low-pressure cut-off switch. A low pressure cut off switch, or a pressure switch with such an arrangement built in, protects a shallow-well pump from losing its prime, but it does not always provide satisfactory protection to a submersible pump from the effects of over pumping the well. This is because it responds to a loss of pressure at the surface, which may occur after an air lock has formed inside the pump. We recommend either a floatless liquid level control or a flow control valve, in that order, in preference to a low-pressure cutoff switch as protection against over pumping.

DISCHARGE PLUMBING

Fig. 1 illustrates a typical well installation showing above ground components. Adhere to the following items when installing the discharge plumbing.

1. Install an above ground check valve upstream from the pressure switch.
2. Always install a pressure relief valve in the system. The relief valve should be capable of discharging the flow rate of the pump at the rated working pressure of the pressure tank. Locate the relief valve close to the pressure tank.
3. Install a pressure switch between the check valve and the pressure tank. Refer to Fig. 2, 3, or 4 for proper wiring connections of pressure switch.
4. Install a pressure tank as close as possible to the pressure switch. Refer to manufacturer's recommendations for installation.

TROUBLESHOOTING

1. PUMP FAILS TO START

a) Electrical trouble - call dealer or electrician.
b) Drawdown protection device has pump turned off.
c) Overload tripped.
d) Reset low pressure cutoff switch (if installed).

2. PUMP FAILS TO DELIVER WATER

a) Air lock in pump.
b) Clogged intake screen.
c) Insufficient well yield.

3. PUMP GIVES REDUCED OUTPUT

a) Insufficient well yield.
b) Worn pump.
c) Clogged intake screen.
d) Low voltage.
e) Incorrect rotation (3-phase only).

4. PUMP CYCLES TOO FREQUENTLY

a) Excessive pressure drop between pressure switch and pressure tank.
b) "Cut-in" pressure at pressure tank too high.
c) "Cut-out" pressure at pressure tank too low.
d) Waterlogged pressure tank.
e) Start and stop electrodes of floatless liquid level control set too close together.
f) Tank sized too small to meet system requirements.

5. OVERLOADS TRIP

a) Electrical trouble - call dealer or electrician.

6. PRESSURE SWITCH CYCLES RAPIDLY WHEN PUMP STARTS

a) Pressure switch too far from pressure tank.
b) Adjust air charge of tank to manufacturer's recommendations.

LIMITED WARRANTY*

THIS WARRANTY SETS FORTH THE COMPANY'S SOLE OBLIGATION AND PURCHASER'S EXCLUSIVE REMEDY FOR DEFECTIVE PRODUCT.

Franklin Electric Company, Inc. and its subsidiaries (hereafter "the Company") warrants that the products accompanied by this warranty are free from defects in material or workmanship of the Company.

The Company has the right to inspect any product returned under warranty to confirm that the product contains a defect in material or workmanship. The Company shall have the sole right to choose whether to repair or replace defective equipment, parts, or components.

The buyer must return the product to an authorized Franklin Electric Distribution outlet for warranty consideration. Returns to the place of purchase will only be considered for warranty coverage if the place of purchase is an authorized Franklin Electric Distributor at the time the claim is made. Subject to the terms and conditions listed below, the Company will repair or replace to the buyer any portion of this product which proves defective due to materials or workmanship of the Company.

The Company will consider products for warranty for 12 months from the date of installation or for 24 months from the date of manufacture, whichever occurs first.

The Company 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 affixing any product, part or component thereof.

The Company reserves the right to change or improve its products or any portions thereof without being obligated to provide such change or improvement to previously sold products.

THIS WARRANTY DOES NOT APPLY TO products damaged by acts of God, including lightning, normal wear and tear, normal maintenance services and the parts used in connection with such service, or any other conditions beyond the control of the Company.

THIS WARRANTY WILL IMMEDIATELY VOID if any of the following conditions are found:

1. Product is used for purposes other than those for which it was designed and manufactured;
2. Product was not installed in accordance with applicable codes, ordinances and good trade practices;
3. Product was not installed by a Franklin Certified Contractor; or
4. Product was damaged as a result of negligence, abuse, accident, misapplication, tampering, alteration, improper installation, operation, maintenance or storage, nor to an excess of recommended maximums as set forth in the product instructions.

NEITHER SELLER NOR THE COMPANY SHALL BE LIABLE FOR ANY INJURY, LOSS OR DAMAGE, DIRECT, INCIDENTAL OR CONSEQUENTIAL (INCLUDING, BUT NOT LIMITED TO, INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY, OR ANY OTHER INCIDENTAL OR CONSEQUENTIAL LOSS), ARISING OUT OF THE USE OR THE INABILITY TO USE THE PRODUCT, AND THE BUYER AGREES THAT NO OTHER REMEDY SHALL BE AVAILABLE TO IT.

THE WARRANTY AND REMEDY DESCRIBED IN THIS LIMITED WARRANTY IS AN EXCLUSIVE WARRANTY AND REMEDY AND IS IN LIEU OF ANY OTHER WARRANTY OR REMEDY, EXPRESS OR IMPLIED, WHICH OTHER WARRANTIES AND REMEDIES ARE HEREBY EXPRESSLY EXCLUDED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, TO THE EXTENT EITHER APPLIES TO A PRODUCT SHALL BE LIMITED IN DURATION TO THE PERIODS OF THE EXPRESSED WARRANTIES GIVEN ABOVE.

DISCLAIMER: Any oral statements about the product made by the seller, the Company, the representatives or any other parties, do not constitute warranties, shall not be relied upon by the buyer, and are not part of the contract for sale. Seller's and the Company's only obligation, and buyer's only remedy, shall be the replacement and/or repair by the Company of the product as described above. Before using, the user shall determine the suitability of the product for his intended use, and user assumes all risk and liability whatsoever in connection therewith.

Some states and countries do not allow the exclusion or limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitations 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 and country to country.

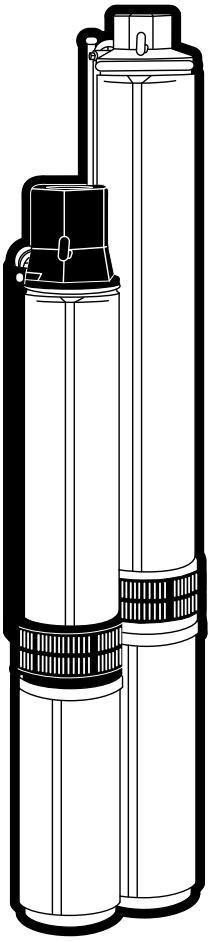
Franklin Electric, in its sole discretion, may update this limited warranty from time to time. Any conflicting information relating to warranty procedures, whether in a user manual or otherwise, is hereby superseded by this document. Nonetheless, all references to the term, or length of a warranty term, will remain consistent with the warranty in place at the time of purchase.

*Contact Franklin Electric Co., Inc. Export Division for International Warranty.

Franklin Electric

BOMBAS SUMERGIBLES DE 4" y 6" (10 y 15 cm)

MANUAL DEL PROPIETARIO DE



ANTES DE INSTALAR ESTA BOMBA CERCIÓRESE DE LEER MINUCIOSAMENTE ESTE MANUAL DEL PROPIETARIO.

⚠PRECAUCIÓN Para evitar dañar la bomba, llénela con agua antes de ponerla en marcha. El motor de esta bomba está garantizado por el fabricante y en caso de fallas debe devolverse a una estación de servicio autorizada para su reparación. La garantía del motor se anulará si las reparaciones son efectuadas por una estación de servicio no autorizada.

INSPECCIONE EL EMBARQUE

Tras recibirla, examine la bomba para cerciorarse de que no se haya dañado durante el envío. En caso de detectar algún daño evidente, informe inmediatamente al distribuidor a quien adquirió la bomba. Revise el embalaje de la bomba para cerciorarse de que incluya la bomba, el motor y sus cables (si la bomba que compró incluye un motor).

LEA Y ACATE LAS INSTRUCCIONES DE SEGURIDAD

⚠ Éste es el símbolo de alerta de seguridad. Cuando vea este símbolo en la bomba o en el manual, busque una de las siguientes palabras indicadoras y esté atento al peligro potencial de lesiones:

⚠PELIGRO advierte sobre peligros que, de ignorarse, causarán lesiones graves, letales o daños materiales importantes.

⚠ADVERTENCIA advierte sobre peligros que, de ignorarse, **pueden causar** lesiones graves, letales o daños materiales importantes.

⚠PRECAUCIÓN advierte sobre peligros que, de ignorarse, **causarán** o **pueden causar** lesiones leves o daños materiales importantes.

La etiqueta **AVISO** indica instrucciones especiales que son importantes, pero que no están relacionadas con peligros.

⚠ADVERTENCIA

Voltaje peligroso. Puede causar descargas, quemaduras o la muerte.

Ponga a tierra la bomba antes de conectarla al suministro eléctrico. Desconecte el suministro eléctrico antes de trabajar en la bomba, el motor o el tanque.

Lea y acate cuidadosamente todas las instrucciones de seguridad indicadas en este manual o en la bomba.

Mantenga las etiquetas de seguridad en buen estado.

Reemplace las etiquetas faltantes o estropeadas.

⚠ADVERTENCIA Cablee el motor según el voltaje correcto. En la sección sobre el sistema eléctrico de este manual y en la placa identificatoria del motor encontrará más información al respecto.

⚠ADVERTENCIA Si el cordón de alimentación es dañado, éste debe ser reemplazado únicamente por personal calificado o el fabricante.

⚠ADVERTENCIA Ponga a tierra el motor antes de conectarlo al suministro eléctrico.

⚠ADVERTENCIA Cumpla los requisitos del Código Eléctrico Nacional, el Código Eléctrico Canadiense y los códigos locales para todo el cableado.

⚠ADVERTENCIA Siga las instrucciones de cableado que se indican en este manual cuando conecte el motor a las líneas eléctricas.

⚠ ADVERTENCIA

¡INFORMACIÓN IMPORTANTE PARA LOS INSTALADORES DE ESTE EQUIPO!

ESTE EQUIPO DEBE SER INSTALADO POR PERSONAL TÉCNICAMENTE CALIFICADO. SI NO SE INSTALA ACATANDO LOS CÓDIGOS ELÉCTRICOS NACIONALES Y LOCALES, Y LAS RECOMENDACIONES DE FRANKLIN ELECTRIC, PUEDE CAUSAR DESCARGA ELÉCTRICA O PELIGRO DE INCENDIO, RENDIMIENTO INSATISFACTORIO Y FALLA DEL EQUIPO. LA INFORMACIÓN DE INSTALACIÓN PUEDE SOLICITARSE A LOS FABRICANTES Y DISTRIBUIDORES DE LA BOMBA, Y DIRECTAMENTE A FRANKLIN ELECTRIC. LLAME A FRANKLIN SIN COSTO AL 800-348-2420 PARA OBTENER MÁS INFORMACIÓN. CONSERVE ESTA HOJA INFORMATIVA CON EL EQUIPO PARA REFERENCIA FUTURA.

⚠ ADVERTENCIA

SE PUEDE PRODUCIR UNA DESCARGA ELÉCTRICA GRAVE O LETAL SI EL MOTOR, LA CAJA DE CONTROL, LA PLOMERÍA METÁLICA Y OTROS METALES CERCANOS AL MOTOR O CABLE, SE CONECTAN INCORRECTAMENTE AL TERMINAL DE PUESTA A TIERRA DEL SUMINISTRO ELÉCTRICO USANDO UN ALAMBRE DE CALIBRE INFERIOR A LOS DEL MOTOR. PARA REDUCIR EL RIESGO DE DESCARGA ELÉCTRICA, DESCONECTE EL SUMINISTRO ANTES DE EFECTUAR TRABAJOS EN O CERCA DEL SISTEMA DE AGUA. NO USE EL MOTOR EN ZONAS DE NATACIÓN.

⚠ ADVERTENCIA

ESTE APARATO NO SE DESTINA PARA UTILIZARSEPOR PERSONAS (INCLUYENDO NIÑOS) CUYAS CAPACIDADES FÍSICAS, SENSORIALES O MENTALES SEAN DIFERENTES O ESTÉN REDUCIDAS, O CAREZCAN DE EXPERIENCIA O CONOCIMIENTO, A MENOS QUE DICHAS PERSONAS RECIBAN UNA SUPERVISIÓN O CAPACITACIÓN PARA EL FUNCIONAMIENTO DEL APARATO POR UNA PERSONA RESPONSABLE DE SU SEGURIDAD. LOS NIÑOS DEBEN SUPERVISARSE PARA ASEGURAR QUE ELLOS NO EMPLEEN LOS APARATOS COMO JUGUETE.

ANTECEDENTES DE INSTALACIÓN

Es aconsejable mantener un registro preciso de su instalación. Cerciórese de anotar los datos siguientes:

Adquirido en:			
Fecha de instalación:			
No. de modelo de la bomba*			
Código de fecha de la bomba*			
Diá. interno del pozo (pulg/mm):			
Profundidad del pozo (pies/m):			
Profundidad del agua (pies/m):			
Ubicación de la bomba (pies/m):			
Tamaño de la cañería de bajada:			
Calibre del alambre (bomba a caja de control):			
Calibre del alambre (caja de control a suministro):			
Distancia horizontal (entre el pozo y la casa):			
Marca del motor*			
Amps	**HP**	**Voltios**	**Fase**
Marca de la caja de control			
HP		**Voltios**	
Suministro eléctrico			
Voltios		**HZ**	
Presostato (lb/pulg^2)			
Arranque		**Corte**	

* Esta información aparece en el rótulo de la bomba o del motor. Nos permitirá identificar la bomba en caso de averiguaciones posteriores.

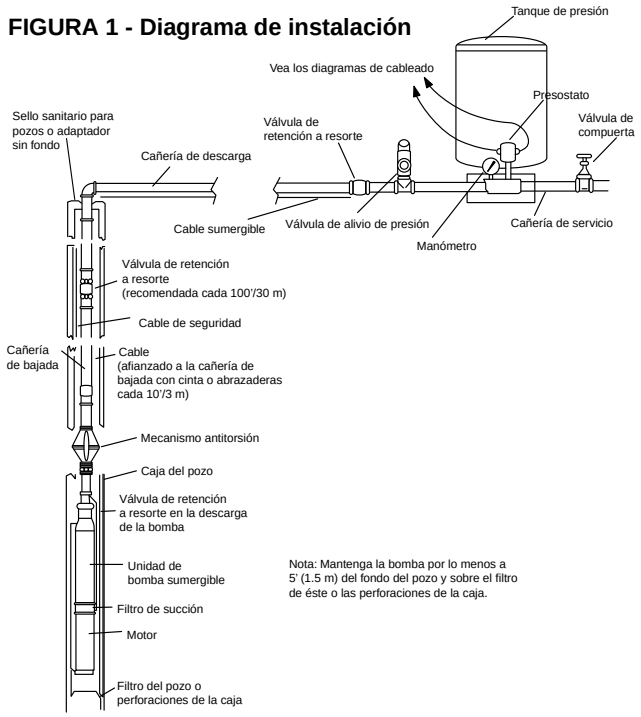
PRUEBE EL FUNCIONAMIENTO

Si antes de la instalación va a probar el funcionamiento de la bomba:

1. Cerciórese de que el suministro eléctrico corresponda con el que aparece en la placa identificatoria del motor y la caja de control. (si se requiere).
2. Instale la bomba y los componentes apropiados para la prueba tal como se muestra en la Fig. 1.
3. Cerciórese de que el suministro eléctrico esté apagado y el cortacircuito o interruptor de desconexión esté abierto. Haga las conexiones eléctricas apropiadas en el motor tal como se muestra en la Fig. 2, 3 ó 4.
4. UNIDAD TRIFÁSICA - Un motor trifásico requiere un arrancador magnético equipado con calentadores de compensación ambiental de disparo rápido y tamaño correcto para la potencia del motor. Para garantizar el giro correcto de las unidades trifásicas, afiance firmemente el armazón de la bomba y energícelo momentáneamente encendiendo y apagando rápidamente el conmutador de línea. Si el giro es correcto, el armazón reaccionará en sentido horario al mirarse desde la descarga de la bomba (es decir, el eje de la bomba girará en sentido antihorario). Para invertir el giro intercambie cualquiera de los dos cables en el arrancador magnético.

5. Haga funcionar la bomba y el motor unos cuantos segundos para verificar que estén en buen estado.

FIGURA 1 - Diagrama de instalación



IDONEIDAD DEL POZO

Instale la bomba sólo en un pozo que haya sido correctamente construido. El agua proveniente de un pozo mal construido suele contener una cantidad excesiva de arena y agentes abrasivos que pueden dañar la bomba. Cerciórese de que el pozo sea lo suficientemente grande para que permita instalar la bomba en la profundidad requerida. No instale la bomba debajo de las perforaciones de la caja ni del filtro del pozo, a menos que haga los ajustes necesarios para garantizar un flujo de agua adecuado sobre el motor para fines de enfriamiento. Determine la ubicación correcta de la bomba conforme los antecedentes que le proporcione el perforista, considerando el nivel estático del agua y el descenso del nivel según la tasa de bombeo propuesta. Mantenga la bomba por lo menos a cinco pies (1.5 m) del fondo del pozo perforado.

EMPALME DEL CABLE DE ALIMENTACIÓN

Siga las instrucciones que vienen adjuntas en el juego de empalme del cable que adquirió.

CAÑERÍA DE BAJADA

Se recomienda la bajada de cañería durante la suspensión de las bombas en el pozo. Favor de seguir las recomendaciones del fabricante a cerca de profundidad y presión. Preste especial atención a:

1. Un cable de seguridad para evitar la pérdida de la bomba si la cañería se rompe.

ATENCIÓN: SE RECOMIENDA USAR CABLE DE ACERO PARA ASEGURAR LA BOMBA. UN CABLE DE ACERO TRENZADO DE 3/16" A 1/4" DE DIÁMETRO ES SUFICIENTE PARA SOPORTAR LA MAYORÍA DE LOS ENSAMBLES BOMBAS/MOTOR. SIEMPRE ES MEJOR CONFIRMAR QUE EL ENSAMBLES BOMBAS/ MOTOR. NO EXCEDE EL LÍMITE MÁXIMO DE PESO PARA EL CABLE SELECCIONADO.

2. Mecanismo antitorsión justo arriba de la bomba para no escoriar el cable cuando la bomba y la cañería giren durante el ciclo de arranque y parada. (Consulte la Figura 1)

Cerciórese de mantener las cañerías limpias y libres de guijarros, escamas y virutas de roscas. Conecte todos los herrajes en forma segura y hermética. Se recomienda usar sellante de cañerías.

VÁLVULAS DE RETENCIÓN

Se recomienda usar una o más válvulas en instalaciones de bombas sumergibles. Si la bomba no tiene una válvula check incluida, ésta debe instalarse en la línea de descarga sin sobrepasar los 25 pies de distancia de la bomba. Para ajustes más profundos, las válvulas check deben de ser instaladas bajo las recomendaciones del fabricante. Frecuentemente se necesita más de una válvula check, sin embargo, no se debe de sobrepasar el número recomendado de válvulas check.

Válvulas check de tipo columpio no son aceptadas y nunca deberán ser usadas con motores/bombas sumergibles. Las válvulas tipo columpio tienen un tiempo de reacción más lento y puede causar un golpe de ariete (ver en siguiente página). Válvulas check internas o en la tubería cierran rápido, lo que evita el golpe de ariete.

NOTA: Sólo Se deben de usar válvulas check con sello positivo en instalaciones sumergibles. Aún drenando la válvula check o al usar válvulas check de drenado se puede prevenir el giro inverso

Las válvulas check son usadas para mantener la presión en un sistema cuando la bomba se detiene. También previenen el giro en reversa de la bomba, protegen del golpe de ariete y sobrecarga. Todos estos acontecimientos pueden causar fallas en la bomba y/o motor.

A. Giro Inverso – Sin válvula check o una válvula check con fallas, el agua en las tuberías del sistema de bombeo puede fluir de regreso en la tubería de descarga cuando el motor para. Esto puede causar que la bomba rote en dirección inversa. Si el motor se enciende mientras la bomba está girando en dirección inversa, una fuerza excesiva se ejerce en la conexión entre la bomba y el motor, lo que puede causar daños en los impulsores, rotura de la flecha, un gasto excesivo en la chumacera, etc.

B. Sobrecarga – Sin una válvula check o alguna otra herramienta que tenga la misma función la unidad enciende debajo de una condición de cero carga. Esto causa una sobrecarga en los impulsores de la bomba. Este movimiento se resiente en el acople entre la bomba y el motor y crea una condición de sobrecarga en el motor. Varias sobrecargas pueden causar daño prematuro en ambos el motor y la bomba.

C. Golpe de Ariete – Si la válvula check se encuentra a más de 30 pies sobre el nivel estático más bajo del agua, se crea un vacío en la tubería de descarga. En el siguiente arranque

de la bomba, el agua llena el espacio a una gran velocidad y golpea la válvula check y las tuberías, creando un shock hidráulico. Esto puede causar rotura de tuberías, daños en la bomba y/o el motor. El golpe de ariete puede ser sentido o escuchado. Cuando se descubre, el sistema debe de ser apagado y el instalador debe ser contactado para poder corregir el problema.

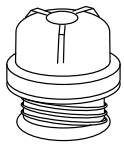
VÁLVULA DE RETENCIÓN RETIRABLE CON VÁSTAGO

Algunas bombas sumergibles incluyen una válvula check removible diseñada para aplicaciones donde la bomba puede tener entradas de aire. Si la bomba es entregada sin esta válvula check, o la válvula check es removida, debe instalarse una válvula activa a una altura máximo de 10-20 pies (3-6 metros) por encima de la bomba. Esto permite el re-cebado de la bomba después de que se queda sin agua.

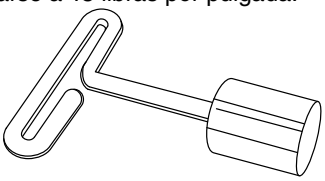
⚠ADVERTENCIA El líquido que se vacía de regreso por la bomba puede hacer que ésta gire hacia atrás. Si la bomba/motor arrancan durante este instante, la bomba podría dañarse.

La válvula de retención se puede retirar usando una llave de vástago con mango en T (No. de pieza 23498207), la cual se pide por separado, o bien con un alicate normal con puntas de aguja. El conjunto del vástago se rosca hacia la izquierda y se retira girándolo en sentido HORARIO.

Si va a reinstalar un conjunto de válvula de retención con vástago, éste debe apretarse a 15 libras por pulgada.



Conjunto del vástago



Llave de vástago con mango en T

INSTALACIÓN DE LA BOMBA, LA CAÑERÍA DE BAJADA Y EL EQUIPO AFÍN

En la Fig. 1 aparece una instalación de pozo típica mostrando los componentes bajo la superficie. Siga estos pasos cuando instale la bomba y la cañería de bajada:

1. Antes de sujetar el ensamble bomba/motor a la tubería, confirme que los cables del conector del motor están colocados de forma segura dentro del guardacable proporcionado con la bomba. De igual forma se proporcionan tornillos de sujeción para usarse durante la instalación del guardacable.
2. Afiance el cable sumergible a la cañería de bajada con abrazaderas o cinta apropiada a cada 10 pies (3 m) para que no se enrede ni dañe. Cuando se use cañería de bajada plástica, el cable debe permanecer flojo para compensar el alargamiento de la cañería cuando se instale en el pozo.
3. Tenga cuidado de no raspar ni apretar el cable sumergible contra la caja del pozo.
4. Use un ohmímetro o megóhmetro para revisar la continuidad y el aislamiento en el cable tras instalar la bomba. De esta forma localizará fallas en el cable.
5. Asegúrese de que las válvulas check del sistema estén instaladas correctamente. Vea las secciones anteriores del manual para mayor información sobre el acomodo de las válvulas check, los diferentes tipos y solución de problemas.
6. Instale un mecanismo antitorsión justo arriba de la bomba para no escoriar el cable cuando ésta y la cañería giren durante el ciclo de arranque y parada.
7. Conecte un cable de seguridad en la bomba para evitar la pérdida de la misma si la cañería se rompe.

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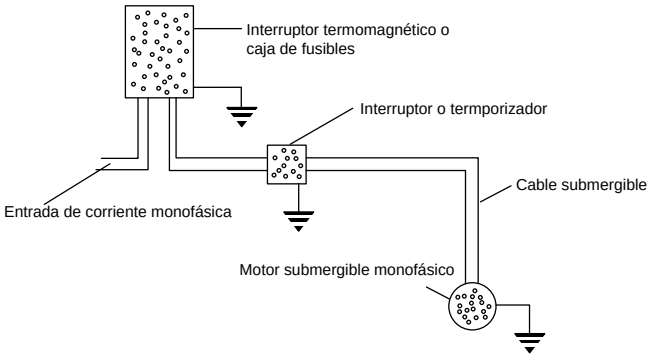
8. Coloque un sello sanitario para pozos o un adaptador sin fondo con una placa protectora aprobada en la parte superior del pozo siguiendo las recomendaciones del fabricante.
9. Mantenga la bomba por lo menos a 5’ (1.5 m) del fondo del pozo y sobre el filtro del mismo o en las perforaciones de la caja.

INFORMACIÓN ELÉCTRICA

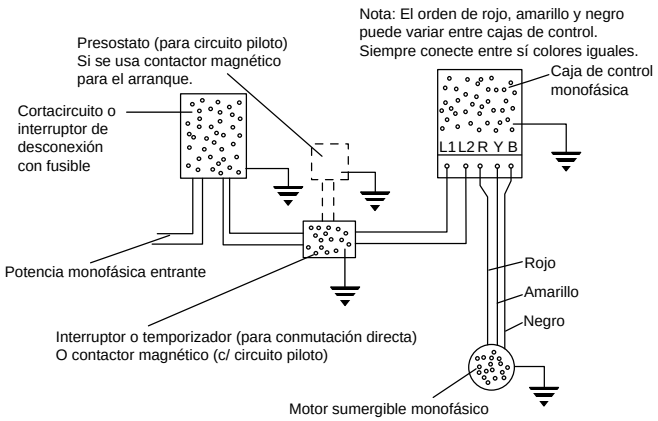
1. Contrate a un electricista licenciado para que realice el cableado. Todo el cableado debe hacerse conforme los códigos eléctricos nacionales y locales pertinentes.
2. Verifique que el suministro eléctrico corresponda con la corriente nominal del motor sumergible y la caja de control (si se requiere). Cerciórese de que la corriente nominal de la caja de control coincida con la corriente nominal del motor.
3. Cada instalación requiere un interruptor de desconexión con fusible o cortacircuito.
4. Cada instalación debe estar puesta a tierra. Debe existir una conexión a tierra segura entre la bomba y el panel de distribución. El cable del motor incluye un conductor verde de puesta a tierra.
5. Se recomienda usar pararrayos para cada instalación. Todos los motores monofásicos de acero inoxidable hasta 5HP tienen pararrayos incorporados. Todo motor trifásico de 6"ó 4" (15 y 10 cm) requiere un pararrayos aparte instalado lo más cerca posible del manantial. Instale el pararrayos según las recomendaciones del fabricante. El pararrayos brinda protección contra sobretensiones inducidas en las líneas eléctricas secundarias; no es eficaz contra golpes directos.
6. Monte la caja de control en un área protegida contra la lluvia, nieve, la luz directa del sol u otras temperaturas altas, ya que ello puede causar la disyunción del protector de sobrecarga. Proteja también la caja de control contra el frío extremo (inferior a 25°F/-32°C) ya que puede causar efectos adversos al arrancarse el condensador.
7. Una bomba de dos alambres no requiere una caja de control del motor, pues todos los componentes eléctricos están incorporados dentro del mismo. En la Fig. 2 aparece un diagrama de cableado típico de una instalación de dos alambres.

Figura 2 – Diagrama de Cableado de la bomba, 2 hilos, Monofásico, 0.5 – 1.5 hp



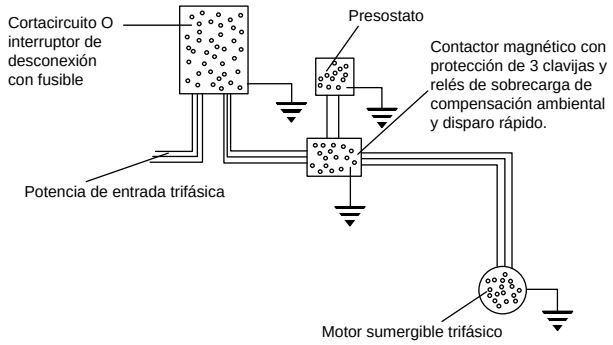
8. Una bomba monofásica de tres alambres requiere una caja de control del motor que incorpore relés de sobrecarga. En la Fig. 3 aparece un diagrama de cableado típico de una instalación monofásica de tres alambres. Tenga presente que se debe usar un contactor magnético si la corriente nominal del presostato no es suficiente para soportar la corriente nominal del motor sumergible. Luego el presostato debe incorporarse en un circuito piloto para controlar el contactor magnético. Para no dañar el motor haga las conexiones en la caja de control según el diagrama de cableado que viene en la misma.

FIGURA 3 - Diagrama de cableado de la bomba de 3 ALAMBRES, monofásica, de 1/2 a 3 HP



9. Una bomba trifásica no requiere una caja de control del motor. En la Fig. 4 aparece un diagrama de cableado típico de una instalación trifásica de 3 alambres. Se debe usar un contactor magnético con protección de 3 clavijas que tenga relés de sobrecarga de compensación ambiental y disparo rápido.

FIGURA 4 - Diagrama de cableado de la bomba de 3 ALAMBRES, trifásica, de 1-1/2 a 50 HP



10. Tras completar la instalación, use un ohmímetro para revisar la continuidad y el aislamiento.
11. Junte la etiqueta adicional del motor con la etiqueta de la bomba y colóquelas en el interruptor de desconexión o la caja del cortacircuito como referencia futura.

PRUEBA DEL POZO

Antes de hacer la conexión final al sistema de descarga, revise el rendimiento de la bomba y el pozo.

1. Instale una válvula de compuerta en el extremo de la cañería. Abra parcialmente la válvula.
2. Arranque la bomba.
3. Abra gradualmente la válvula para darle pleno flujo.
4. Si la descarga es turbia, deje que la bomba funcione hasta que el agua se aclare. Si no se aclara en 30 minutos, detenga la bomba y adopte las medidas necesarias para corregir el problema. Una vez que el agua se haya aclarado, vea si contiene arena descargándola en un cubo limpio u otro recipiente apto.
5. Cierre la válvula hasta generar el flujo máximo requerido por el sistema (éste debe corresponder a la presión de corte del presostato). Cerciórese de que el caudal de la bomba en este ajuste no sea superior al rendimiento del pozo. Ello se puede verificar supervisando el descenso del nivel del pozo y cerciorándose de que el nivel permanezca estable en el flujo de salida máximo requerido por el sistema.

⚠PRECAUCIÓN Nunca haga funcionar la bomba sino hasta que esté completamente sumergida. Si la hace funcionar sin agua, la bomba y el motor podrían dañarse. Tenga presente también que el aire que ingrese a la bomba puede originar una exclusa de aire.

POZO DE BAJO RENDIMIENTO

Un pozo es de bajo rendimiento cuando su producción es inferior al caudal de la bomba. Puede bajar el nivel del agua hasta llegar al filtro de succión, lo cual permite que ingrese una mezcla de aire y agua a la bomba. El bombeo puede detenerse ya que la bomba no puede generar presión con poca agua. En este caso, la columna de agua que ya está en la cañería de bajada mantiene cerrada la válvula de retención y dentro de la bomba se puede originar una exclusa de aire. Debido a que las condiciones no aseguran la lubricación adecuada de la bomba ni el enfriamiento correcto del motor, se puede producir daño si el suministro eléctrico no se corta rápidamente. Use uno o más de los métodos siguientes para corregir y/o proteger esta instalación.

1. Si es posible instale un tramo adicional de cañería de bajada para colocar la bomba más abajo en el pozo.
2. Instale un sensor electrónico de descenso del nivel Franklin Pumptec o uno similar.
3. Instale un control de nivel de líquido sin flotador. Este dispositivo consta de un relé eléctrico activado por corrientes que fluyen por los circuitos de retorno por tierra de los electrodos suspendidos en el pozo. El electrodo inferior (PARADA), justo arriba de la bomba, garantiza que el nivel del agua nunca baje hasta llegar al filtro de succión. El electrodo superior (ARRANQUE), justo debajo del nivel estático de agua más bajo, garantiza que la bomba pueda arrancar nuevamente apenas el pozo se haya recuperado. El control del nivel del líquido sin flotador funciona en serie con el presostato. En las instrucciones del fabricante que vienen con el control encontrará más información.
4. Instale una válvula reguladora de flujo en la línea de descarga aguas arriba del presostato. Ésta restringe el caudal de la bomba sin afectar la tasa a la cual se puede extraer el agua del tanque de presión. No obstante, una gran demanda de agua podría vaciar el tanque de presión, por lo que se recomienda usar un tanque con diafragma, alveolo o bolsa de agua.
5. Instale una bomba más pequeña para no bombear excesivamente el pozo. Pídale al distribuidor que ajuste la bomba según el rendimiento del pozo.
6. Instale un interruptor eléctrico de baja presión. Un interruptor eléctrico de baja presión o un presostato con tal disposición incorporada, protege la bomba de un pozo poco profundo para que no pierda el cebado, pero no siempre protege satisfactoriamente a la bomba sumergible de los efectos del bombeo excesivo del pozo. Esto se debe a que responde a una pérdida de presión en la superficie, la cual puede producirse después de que se ha formado una exclusa de aire dentro de la bomba. Como protección contra el bombeo excesivo recomendamos usar preferentemente un control de nivel de líquido sin flotador, o en su defecto una válvula reguladora de flujo, en lugar de un interruptor eléctrico de baja presión.

PLOMERÍA DE DESCARGA

En la Fig. 1 aparece una instalación de pozo típica mostrando los componentes sobre la superficie. Siga estos pasos cuando instale la plomería de descarga.

1. Instale una válvula de retención sobre la superficie aguas arriba del presostato.
2. Siempre instale una válvula de alivio de presión en el sistema. Dicha válvula debe poder descargar el flujo de salida de la bomba a la presión nominal de trabajo del tanque de presión. Ubique la válvula de alivio cerca del tanque de presión.
3. Instale un presostato entre la válvula de retención y el tanque de presión. En la Fig. 2, 3 ó 4 encontrará las conexiones de cableado del presostato.
4. Instale un tanque de presión lo más cerca posible del presostato. En las recomendaciones del fabricante encontrará información de instalación.

SOLUCIÓN DE PROBLEMAS

1. LA BOMBA NO ARRANCA

a) Problema eléctrico - llame al distribuidor o electricista.
b) La protección contra descenso del nivel apagó la bomba.
c) Sobrecarga disyuntada.
d) Reinicie el interruptor eléctrico de baja presión (si está instalado).

2. LA BOMBA NO SUMINISTRA AGUA

a) Exclusa de aire en la bomba.
b) Filtro de entrada obstruido.
c) Rendimiento del pozo insuficiente.

3. LA BOMBA PRODUCE UN CAUDAL REDUCIDO

a) Rendimiento del pozo insuficiente.
b) Bomba desgastada.
c) Filtro de entrada obstruido.
d) Voltaje bajo.
e) Giro incorrecto (trifásico solamente).

4. LA BOMBA CICLA CON DEMASIADA FRECUENCIA

a) Caída de presión excesiva entre el presostato y el tanque de presión.
b) Presión de arranque demasiado alta en el tanque de presión.
c) Presión de corte demasiado baja en el tanque de presión.
d) Tanque de presión anegado.
e) Electrodos de arranque y parada del control de nivel de líquido sin flotador, instalados demasiado cerca entre sí.
f) Tanque demasiado pequeño para cumplir los requisitos del sistema.

5. DISYUNCIÓN POR SOBRECARGAS

a) Problema eléctrico - llame al distribuidor o electricista.

6. EL PRESOSTATO CICLA RÁPIDAMENTE AL PONERSE EN MARCHA LA BOMBA

a) Presostato demasiado lejos del tanque de presión.
b) Ajuste el tanque de carga según las recomendaciones del fabricante.

GARANTÍA LIMITADA*

ESTA GARANTÍA ESTABLECE LA ÚNICA OBLIGACIÓN DE LA EMPRESA Y LA COMPENSACIÓN EXCLUSIVA AL COMPRADOR POR UN PRODUCTO DEFECTUOSO.

Franklin Electric Company, Inc. y sus filiales (de aquí en adelante, “la Empresa”) garantizan que los productos que cubre esta garantía carecen de defectos en cuanto al material o la mano de obra de la Empresa.

La Empresa tiene derecho a inspeccionar todo producto devuelto en garantía para confirmar si tiene defectos en el material o la mano de obra. La Empresa tendrá el derecho exclusivo de elegir si reparará o reemplazará el equipo, las piezas o los componentes defectuosos.

El comprador deberá enviar el producto a un distribuidor autorizado de Franklin Electric para hacer uso de la garantía. Las devoluciones al lugar de compra solo se considerarán para la cobertura de la garantía si el lugar de compra es un Distribuidor de Franklin Electric al momento en el que se haga la reclamación. Con sujeción a los términos y las condiciones que se enumeran a continuación, la Empresa le reparará o reemplazará al comprador cualquier parte de este producto que se compruebe estar defectuoso a causa de los materiales o la mano de obra de la Empresa.

La Empresa considerará que los productos están garantizados durante doce meses a partir de la fecha de su instalación, o durante 24 meses a partir de la fecha de manufactura, lo que ocurra primero.

La Empresa no se responsabilizará EN NINGÚN CASO ni estará obligada a responder por el costo del trabajo de campo u otros cargos en los que incurra un cliente al retirar y/o instalar un producto, una pieza o un componente de este.

La Empresa se reserva el derecho de cambiar o mejorar sus productos, o cualquier parte de ellos, sin tener la obligación de proveer dicho cambio o mejora a los productos que se han vendido con anterioridad.

ESTA GARANTÍA NO SE APLICA A los productos dañados por sucesos de fuerza mayor, incluyendo descargas eléctricas, el desgaste normal del producto, los servicios habituales de mantenimiento y las piezas que se utilicen en relación con dichos servicios, o por cualquier otra condición que escape al control de la Empresa.

ESTA GARANTÍA SE ANULARÁ DE INMEDIATO si se presenta cualquiera de las siguientes condiciones:

1. El producto se utilizó para otros propósitos distintos de aquellos para los que fue diseñado y fabricado;
2. El producto no se instaló de conformidad con los códigos, los reglamentos y las buenas prácticas comerciales vigentes;
3. El producto no fue instalado por un contratista certificado por Franklin; o
4. El producto resultó dañado por negligencia, abuso, accidente, aplicación indebida, modificación, alteración, instalación, operación, mantenimiento o almacenamiento inadecuados o como resultado del abuso de los límites recomendados y establecidos en las instrucciones del producto.

NI EL VENDEDOR NI LA COMPAÑÍA SERÁN RESPONSABLES POR NINGUNA LESIÓN, PÉRDIDA O DAÑO DIRECTO, INCIDENTAL O CONSECUENCIAL (INCLUIDOS, A TÍTULO ENUNCIATIVO, MAS NO LIMITATIVO, LOS DAÑOS INCIDENTALES Y CONSECUENCIALES POR PÉRDIDA DE GANANCIAS, VENTAS NO REALIZADAS, LESIONES A PERSONAS O LA PROPIEDAD, O CUALQUIER OTRA PÉRDIDA INCIDENTAL O CONSECUENCIAL) QUE SURJAN DEL USO O DE LA IMPOSIBILIDAD DEL USO DEL PRODUCTO, Y EL COMPRADOR ACEPTA QUE NO TENDRÁ DISPONIBLE NINGUNA OTRA COMPENSACIÓN.

LA GARANTÍA Y COMPENSACIÓN DESCRITOS EN ESTA GARANTÍA LIMITADA SON EXCLUSIVOS Y REEMPLAZAN A CUALQUIER OTRA GARANTÍA O COMPENSACIÓN, EXPRESAS O IMPLÍCITAS, Y POR EL PRESENTE SE EXCLUYEN OTRAS GARANTÍAS Y COMPENSACIONES INCLUYENDO, A TÍTULO ENUNCIATIVO, MAS NO LIMITATIVO, TODA GARANTÍA IMPLÍCITA DE COMERCIABILIDAD O IDONEIDAD PARA UN PROPÓSITO DETERMINADO, Y EN LA MEDIDA EN QUE ALGUNA DE LAS DOS SEA APLICABLE A UN PRODUCTO, ESTARÁ LIMITADA A LA DURACIÓN DE LOS PERIODOS DE LAS GARANTÍAS EXPRESAS MENCIONADOS ANTERIORMENTE.

DESCARGO DE RESPONSABILIDADES Cualquier declaración oral sobre el producto realizada por el vendedor, la Empresa, los representantes o cualquier otra parte, no constituye garantías. El usuario no debe depender de ellas, y no forman parte de este contrato de venta. La única obligación del vendedor y la Empresa, y la único compensación a disposición del comprador, será el reemplazo y/o la reparación del producto por parte de la Empresa, de la forma descrita anteriormente. Antes de usar el producto, el usuario determinará la idoneidad de este para su uso previsto, y el usuario asumirá todos los riesgos y la responsabilidad que se deriven de esta acción.

Algunos estados y países no permiten la exclusión o la limitación respecto a la duración de una garantía implícita, ni tampoco la exclusión o la limitación respecto a los daños incidentales o consecuenciales, de manera que es posible que la exclusión o las limitaciones mencionadas anteriormente, no sean aplicables en su caso. Esta garantía le concede derechos legales específicos, y también puede tener otros derechos que varían según el estado y el país.

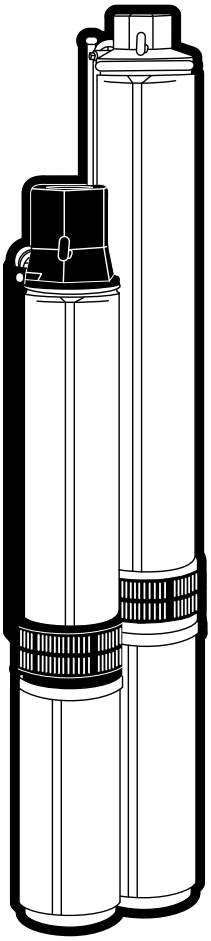
Franklin Electric, a su exclusivo criterio, puede actualizar esta garantía limitada ocasionalmente. Cualquier información conflictiva en relación a los procedimientos de la garantía, ya sea en un manual del usuario o no, queda suplantada por este documento. No obstante, todas las referencias al periodo o longitud del periodo de una garantía, permanecerán consistentes con la garantía vigente al momento de compra.

El usuario puede hacer válida la garantía directamente con el representante donde fue adquirido el producto. Para compras en México, puede contactar al importador Motores Franklin S.A. de C.V. En cualquier caso, deberá presentar el producto acompañado de la factura de compra o la presente póliza de garantía.

Para poder acceder a componentes, consumibles y accesorios, el usuario puede acudir directamente con el representante donde fue adquirido el producto. Para compras en México, puede contactar al importador Motores Franklin S.A. de C.V.
Importador: Motores Franklin S.A. de C.V.
Av. Churubusco 1600 B16
Monterrey, NL
CP 64560 MEXICO
Tel. 81 8000 1000

Franklin Electric

POMPES SUBMERSIBLES 4" ET 6"
MANUEL DU PROPRIETAIRE



AVANT D'INSTALLER LA POMPE, ETRE SUR DE LIRE CE MANUEL DE PROPRIETAIRE SOIGNEUSEMENT.

INSPECTION DE L'ÉQUIPEMENT

Sur reception de la pompe verifier si elle n'a pas été endommagée dans le transport. Si un dommage est apparent, le mentionner immediatement a votre detaillant ou pompe fut achetée. Vérifier si l'ensemble de pompe inclut: la pompe, le moteur et les conduits pour moteur (si l'achat de votre pompe inclut un moteur). Ces unités comprendront soit un clapet integre ou a montage exterieur a meme la tete de decharge. les modeles monophases, 3 fils, doivent avoir une boite de contrôle qui devra etre commandée séparément et assortie au moteur de la pompe (ex: une boite de contrôle Franklin pour un moteur Franklin). S'assurer que votre voltage correspond a celui du moteur.

LIRE ET SUIVRE LES INSTRUCTIONS DE SÉCURITÉ

Voici le symbole d'avertissement de sécurité. Quand vous verrez ce symbole sur votre pompe ou dans ce manuel, regardez pour un des mots-clefs ci-dessous et soyez conscient des dangers potentiels de blessures.

DANGER Avertis des dangers qui **vont** causer des blessures sérieuses, la mort ou des dommages majeurs à la propriété si ignorés.

AVERTISSEMENT Avertis des dangers qui **peuvent** causer des blessures sérieuses, la mort ou des dommages majeurs à la propriété si ignorés.

ATTENTION Avertis des dangers qui **peuvent** ou **vont** causer des blessures mineures à la personne et/ou des dommages majeurs à la propriété si ignorés.

La vignette **À NOTER** indique une attention spéciale qui est importante mais non reliée à la sécurité.

Bien lire et suivre toutes les instructions de sécurité écrites dans ce manuel et sur la pompe.

Garder les vignettes de sécurité en bonne condition.

Remplacer les vignettes endommagées ou manquantes.

AVERTISSEMENT

Haut Voltage. Peut électrocuter, brûler ou causer la mort.

Mettre la pompe à la masseavant de brancher au courant principal. Débrancher le courant avant de travailler sur la pompe, le moteur ou le réservoir.

AVERTISSEMENT Adapter le moteur au courant utilisé. Voir la section ÉLECTRIQUE de ce manuel et la plaque signalétique du moteur.

AVERTISSEMENT Brancher le moteur à la mise à la terre avant de brancher au courant principal.

AVERTISSEMENT Se conformer aux codes électriques nationaux, Canadiens et locaux pour tout branchement électrique.

AVERTISSEMENT Suivre les instructions de ce manuel pour le branchement du moteur au réseau principal.

⚠AVERTISSEMENT

INFORMATION IMPORTANTE POUR LES INSTALLATEURS DE CET APPAREIL!

CET APPAREIL EST PRÉVU POUR UNE INSTALLATION PAR UNE PERSONNE TECHNIQUEMENT QUALIFIÉE. LE NON-RESPECT DU CODE ÉLECTRIQUE NATIONAL OU PROVINCIAL PEUT ENTRAINER UN CHOC ÉLECTRIQUE OU UN INCENDIE, DES PERFORMANCES NON-SATISTAISANTE ET UNE DÉFAILLANCE DE L'ÉQUIPEMENT. LES INFORMATIONS D'INSTALLATION SONT DISPONIBLES DU MANUFACTURIER DE LA POMPE OU DIRECTEMENTDE CHEZ FRANKLIN ELECTIRC au 800-348-2420. GARDER CES INFORMATIONS PRÈS DE L'ÉQUIPEMENT POUR RÉFÉRENCE FUTURES.

⚠AVERTISSEMENT

UN CHOC ÉLECTRICE, MÊME FATAL PEUT SURVENIR SI LE BRANCHEMENT DU MOTEUR, DES ÉLÉMENTS DE CONTRÔLES, LA TUYAUTERIE EN MÉTAL ET/OU TOUT AUTRE PIÈCE EN MÉTAL PRÈS DU MOTEUR OU DU FIL NE SONT PAS BRANCHÉS À UNE MISE À LA TERRE UTILISANT UN FIL DE LA MÊME DIMENSION OU SUPÉRIEUR AU FILAGE MOTEUR. POUR ÉVITER LES RISQUES DE CHOCS ÉLECTRIQUES, DÉBRANCHEZ LE COURANT AVANT DE TRAVAILLER AVEC/OU SUR LE SYSTÈME D'EAU. NE PAS UTILISER LE MOTEUR DANS UNE ZONE DE BAIGNADE.

RECORD D'INSTALLATION

C'est une bonne idée de garder un record exact de votre installation. Voir à completer les données suivantes.

Acheté de:			
Date d'installation:			
No. de modèle de la pompe*			
Code de date de la pompe*			
Dia. int. du puits:			
Profondeur du puits:			
Profondeur jusqu'au niveau d'eau:			
Dimension du tuyau de descente:			
Dimension du fil:			
De la pompe à la boîte de contrôle:			
De la boîte de cont. à l'alim. élec.:			
Tuyauterie horizontale distante:			
Marque de moteur*			
Amp	**CV**	**Volts**	**Ph**
Marque de la boîte de contrôle			
CV		**Volts**	
Alimentation électrique			
Volts		**Ph**	

* Cette information est sur l'étiquette de la pompe ou moteur. Ceci nous aidera à identifier la pompe, si nécessaire.

EXAMINEZ LE FONCTIONNEMENT

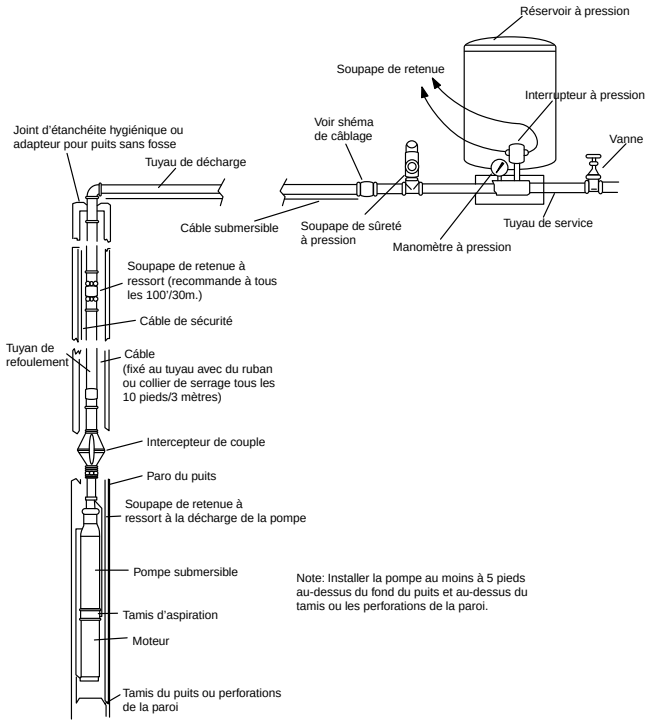
Si un essai doit ètre fait avant l'installation, verser 1 gallon d'eau dans la décharge, pour s'assurer que la pompe ne demarre pas à sec.

1. Vérifier si l'alimentation en courant électrique correspond aux indication données sur les plaques d'indentification du moteur et de la boîte de contrôle (si requise)
2. Installer la pompe et les composantes appropriées pour effectuer l'essai, tel qu'illustré à la figure 1.
3. S'assurer que l'alimentation électrique est à la position arrêt et que le coupe-circuit ou disjoncteur est ouvert. Faire les raccords électriques qui correspondent à votre moteur, tel qu'illustré aux figures 2,3, et 4.
4. MODÈLES TRIPHASÉS. Un moteur requiert un démarreur magnétique équipé d'éléments chauffants à déclenchement rapide, compensé pour température ambiante, correspondant à la force du moteur. Pour vous assure de la bonne rotation des modèles triphasés, soutenir la coquille de pompe solidement et y donner momentanément du courant en mettant

rapidement l'interrupteur de ligne à la position marche et arrêt. Si, en regardant par la décharge de la pompe, la coquille se déplace dans le sens des aiguilles d'une montre, la rotation est bonne. our modifier la rotation, interchanger deux des conduits pour moteur du démarreur magnétique.

5. Activer la pompe pour quelques secondes afin de vérifier si elle fonctionne bien.

FIGURE 1 - Diagramme D'installation



CONVENANCE DE PUITS

Installer la pompe seulement quand le puits à été préparé adéquatement. L'eau d'un puits qui n'a pas été developpé comme il se doit contient beaucoup de sable, saletés et matières abrasives qui pourraient endommager la pompe. Vérifier si le puits est assez grand pour pouvoir y installer la pompe à la profondeur voulue. Ne pas installer la pompe en bas des perforations de la paroi ou du tamis du puits, à moins que l'installation soit faite pour assurer un debit d'eau adequat audessus du moteur, pour les besoins de refroidissement. Déterminer, d'apres les records d'installation du foreur, où la pompe doit être installée en tenant compte du niveau statique de l'eau et du niveau de tirage d'eau, au taux de pompage proposé. Installer la pompe au moins à 5 pieds au-dessus du fond du puits foré.

RACCORDEMENT DU CÂBLE ÉLECTRIQUE

Suivre les instructions incluses avec la trousse de raccordement pour câble.

TUYAU DE DESCENTE

Un tuyau est recommané pour suspendre la pompe submersible dans le puits. Réferrez-vous au recommandations du fabricant du tuyau concernant la profondeur et la pression. Cependant, s'assurer d'avoir en main les items suivants:

1. Un câble de sécurité pour éviter de perdre la pompe, en cas de bris de tuyau.

NOTICE : IL EST RECOMMANDER DE SÉCURISÉ LA POMPE SUBMERSIBLE À L'AIDE D'UN CÂBLE D'ACIER. UN CÂBLE DE DIAMÈTRE DE 3/16" À 1/4" EST NORMALEMENT SUFFISANT POUR SUPPORTER UNE POMPE SUBMERSIBLE. IL EST RECOMMANDÉ DE BIEN S'ASSURÉ QUE LE CÂBLE POURRA BIEN SUPPORTER CETTE CHARGE.

2. Amortisseur de couple placé juste au-dessus de la pompe pour prévenir le frottement du fil, quand la pompe et le tuyau se tordent lors du démarrage et l'arrêt de la pompe.

Prende soin de garder les tuyaux propres et libres de cailloux, dépôts calcaires, etc... Assurer une étanchéité compléte à tous les raccords. Un enduit étanche pour tuyaux est recommandé.

SOUPAPES DE RETENUE

Il est recommandé d'utiliser un ou plusieurs clapets anti-retour lors d'une installation de pompe submersible. Si la pompe submersible n'a pas de clapet anti-retour incorporé, un clapet anti-retour doit être installé sur la conduite à une distance de 25 pieds de la pompe et sous le plus bas niveau de soutirage de la source d'eau. Pour les installations plus profondes, une valve de retenue devrait être installée selon les recommandations du fabricant. Plus qu'un clapet anti-retour devrait être utilisé pour la plupart des installations sans toutefois dépasser le nombre recommandé.

Les clapets de retenues de type « à bascule » ne sont pas recommandés et ne devraient jamais être utilisés avec une pompe submersible. Le temps de réponse de ces clapets sont trop lent et peuvent provoquer des coups de bélier (voir à la page suivante). Les clapets de retenue interne et à ressort ferment plus vite et éliminent les coups de béliers.

Note : Seulement les clapets de retenue à scellement positif doivent être utilisés dans une installation submersible. Quoique d'autres types de clapet tel que les clapets perforés et les clapets à drainage peuvent prévenir les impulseurs de fonctionnés à l'envers ceux-ci n'empêche pas les coups de bélier et créent un fonctionnement en élévation verticale. (Up thrust)

Les valves de retenue maintiennent la pression dans le système quand la pompe cesse de fonctionner. Ils empêchent également les impulseurs de fonctionnés à l'envers, en position d'élévation verticale et évite les coups de bélier. Ceux-ci peuvent provoquer une usure prématurée de la pompe et du moteur.

A. Fonctionnement à l'envers : Sans clapet de retour ou avec des clapet défectueux, l'eau contenue dans le réseau retourne à la source lorsque la moteur s'arrête. Ceci fait fonctionner les impulseurs en sens contraire. Si le moteur redémarre dans ces conditions, la force exercée sur la pompe et le moteur peut causer des dommages aux impulseurs, à l'arbre, composantes moteur, etc.

B. Élévation vertical : Sans clapet de retour ou avec des clapet défectueux ou perforés l'unité démarre dans des conditions de pression nul. Ceci aura pour effet de soulever l'ensemble des impulseurs. Ce mouvement se répercute également sur l'arbre du moteur. Il en résulte des dommages aux impulseurs et aux composantes du moteur

C. Coup de bélier : Si le clapet de retenue est plus élevé de 30 pieds du niveau statique le plus bas ou si un clapet plus bas à une fuite il se crée un vacuum dans le tuyau. Lorsque la pompe démarrera l'eau qui voyage avec une grande vélocité comblera le vide et frappera le clapet et la colonne d'eau supérieur ce qui aura pour effet de créer un choc hydraulique. Celui-ci peut fendre les tuyaux, brisé des joints et endommagé pompe et moteur. Les coups de bélier peuvent souvent être entendu ou ressenti. Si cela se produit fermer le système et consultez votre installateur pour corriger la situation.

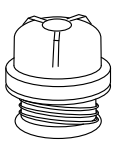
VÁLVULA DE RETENCIÓN RETIRABLE CON VÁSTAGO

Certaines pompes submersibles sont livrées avec un clapet de retenue amovible pour les applications où la pompe ne fonctionne plus à cause d'une bulle d'air . Si la pompe est fournie sans clapet anti-retour, ou si le clapet de retenue est retirée, un clapet anti-retour muni d'un ressort doit être installer de 10 à 20 pieds (3 à 6,09 mètres) au-dessus de la pompe. Cela permet de réamorcer la pompe après qu'elle est fonctionné sans eau.

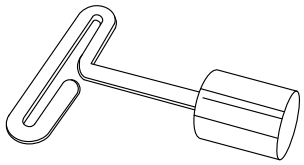
⚠AVERTISSEMENT El líquido que se vacía de regreso por la bomba puede hacer que ésta gire hacia atrás. Si la bomba/motor arrancan durante este instante, la bomba podría dañarse.

La válvula de retención se puede retirar usando una llave de vástago con mango en T (No. de pieza 23498207), la cual se pide por separado, o bien con un alicate normal con puntas de aguja. El conjunto del vástago se rosca hacia la izquierda y se retira girándolo en sentido HORARIO.

Si va a reinstalar un conjunto de válvula de retención con vástago, éste debe apretarse a 15 libras por pulgada.



Conjunto del vástago



Llave de vástago con mango en T

INSTALLATION DE LA POMPE, TUYAU DE DESCENTE ET L'EQUIPMENT S'YRATTACHANT

La figure 1 illustre une installation typique d'un puits avec les composantes installées dans le sol. A l'installation de la pompe et du tuyau de descente, suivre les instructions suivantes:

1. Avant d'installer la pompe submersible assurez-vous que les fils du moteur sont bien recouverts par le garde-fil fournit avec la pompe. Des vis d'attachement sont fournies pour bien maintenir le garde-fil en place.
2. Attacher le câble au tuyau de descente avec des colliers de serrage ou du ruban approprié a tous les 10 pieds (3m) pour éviter qu'il ne s'entortille et ne s'endommage. Le câble doit étre lâche quand l'installation set faite avec du tuyau de plastique, afin d'obtenir une installation sécuritaire dans le puits.
3. Prendre soin de ne pas égratigner ou pincer le câble contre la paroi du puits.
4. Vous servir d'un ohmmétre ou d'un mégahmètre pour procéder à des essais de continuité et d'isolation sur le câble, une fois la pompe installée. Ceci permettra de déceler toute défaillance dans le câble.
5. Assurez-vous que les valves de retenues du système sont installées correctement. Consultez les sections précédentes de ce manuel pour plus d'information sur l'installation, le choix et le dépannage des valves de retenues.
6. Si recommandé par votre marchand, installer un amortisseur de couple juste au-dessus de la pompe, pour prévenir le frottement du câble quand la pompe et le tuyau se tordent lors du démarrage et de l'arrêt de la pompe.
7. Attacher un câble de sécurité à la pompe, pour éviter de perdre celle-ci en cas de bris de tuyau.

NOTICE : IL EST RECOMMANDER DE SÉCURISÉ LA POMPE SUBMERSIBLE À L'AIDE D'UN CÂBLE D'ACIER. UN CÂBLE DE DIAMÈTRE DE 3/16" À 1/4" EST NORMALEMENT SUFFISANT POUR SUPPORTER UNE POMPE SUBMERSIBLE. IL EST RECOMMANDÉ DE BIEN S'ASSURÉ QUE LE CÂBLE POURRA BIEN SUPPORTER CETTE CHARGE O EN EL INTERVALO RECOMENDADO POR EL FABRICANTE DE LA VÁLVULA CHECK.

8. Installer un joint d'étanchéité hygiénique ou un couvert d'adapteur pour puits sans fosse au-dessus du puits, en suivant les recommandations du manfacturier.
9. Installer la pompe au moins à 5 pieds (1.5m) au-dessus du fonds du puits et au-dessus du tamis ou les perforations de la paroi.

INFORMATION ÉLECTRIQUE

1. Utiliser les services d'un électricien compétent pour l'installation du câblage. Tous les raccordements doivent être faits selon le code national et local d'électricité.

2. Vérifier si l'alimentation électrique correspond avec les indications donnees sur le moteur et la boîte de contrôle (se requise). S'assurer que les données de la boîte de contrôle correspondent avec les données électriques du moteur.

3. Chaque installation requiert un sectionneur à fusibles ou un coupe-circuit.

4. Chaque installation doit avoir une mise à la terre. Il doit y avoir un raccord efficace de mise à la terre entre la pompe et le panneau de distribution. le conduit pour moteur est incorporé d'un conducteur de mise à la terre vert.

5. Des paratonnerres sont recommandés pour chaque installation. Tous les moteurs jusqu à 5 cv monophasés 4" sont incorporés de paratonnerres. Tout moteur triphasé, soit 4" ou 6", requiert un paratonnerre séparé, installé le plus près possible de la tête de puits. (Note: une boîte de contrôle 5 cv, monphasé raccordée à un moteur 5 cv 6" requiert un paratonnerre séparé.) Installer le paratonnerre in suivant les recommandations du manufacturier. Un paratonnerre protège contre les surcharges des lignes secondaires mais ne protège pas contre les coups directs.

6. Installer la boîte de contrôle dans un endroit protégé de la pluie, neige, lumière directe du soleil ou des températures élevées qui pourraient faire déclencher le protecteur de surcharge. Aussi, protéger la boîte de contrôle des températures extrêmes de froid (sous 25 degres F/ -32 degres C) qui pourraient affecter le condensateur de démarrage.

7. Une pompe 2 fils ne nécessite pas une boîte de contrôle, les composantes électriques étant incorporées en dedans du moteur. La figure 2 vous montre un shéma typique de câblage pour une installation 2 fils.

8. Une pompe monophasée 3 fils requiert une boîte de contrôle comprenant des relais de surcharge. La figure 3 vous montre un schéma typique du câblage pour une installation monophasée, 3 fils. Prendre note d'utiliser un contacteur magnétique si la capacité électrique de l'interrupteur à pression n'est pas suffisante pour la capacité électrique du moteur submersible. L'interrupteur à pression serait alors incorporé dans un circuit pilote afin de côntroler le contacteur magnétique. Faire les raccordements à la boîte de contrôle, selon le schéma de câblage, dans la boite de contrôle, ceci afin d'éviter d'endommager le moteur.

FIGURE 2 - Schéma Câblage Pompe

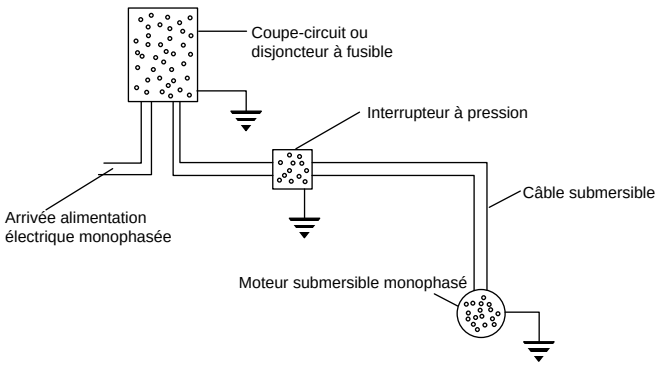
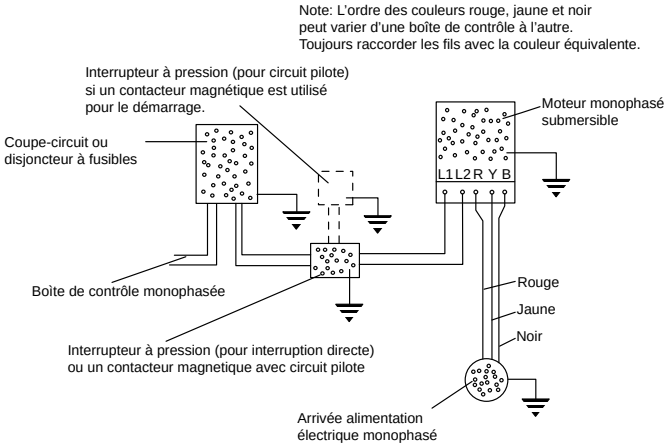
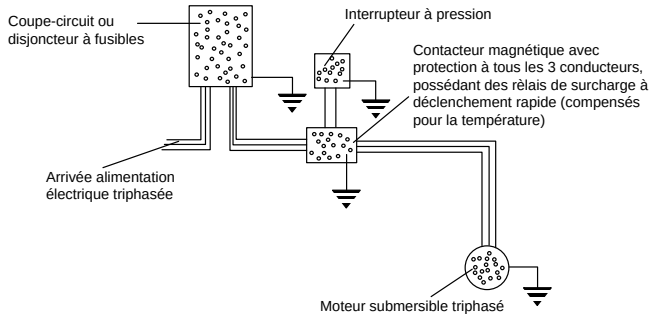


FIGURE 3 - Schéma De Cablage Pour Pompe 3 Fils Monophasée 1/3 c.v. à 1.5 c.v.



9. Une pompe triphasée 3 fils ne requiert pas une boîte de contrôle. La figure 4 bous montre un schéma typique de câblage pour une installation triphasée, 3 fils. Un contacteur magnétique avec protection à tous les 3 conducteurs possédant des relais de surcharge à déclenchement rapide (compensés pour la température) doit être utilisé.

FIGURE 4 - Schéma De Câblage Pour Pompe 1-1/2 c.v. à 5 c.v. 3 Fils Triphasée



10. Utiliser un ohmmètre ou un mégahmètre pour procéder à des essais de continuité et d'isolation, après que l'installation est complétée.

11. Apposer la plaque d'identification de la pompe sur l'étiquette de la pompe submersible FPS, Inc. et placer les deux sur le disjoncteur ou sur la boîte du coupe-circuit, pour références futures.

VÉRIFICATION DU PUITS

Vérifier la pompe et le rendement du puits, avant de faire le dernier raccordement au systéme de décharge.

1. Installer une vanne à l'extrémité du tuyau et ouvrir partiellement la vanne.
2. Démarre la pompe.
3. Ouvrir graduellement la vanne pour obtenir le débit maximal.
4. Si l'eau à la décharge n'est pas claire, laisser la pompe fonctionner jusqu'à ce qu'elle devienne claire. Si dans 30 minutes l'eau n'est pas claire, arrêter la pompe et prendre les moyens nécessaires pour corriger la situation. Après avoir obtenu une eau claire, vérifier le sable en déchargeant dans un seau propre ou tout autre contenant.
5. Fermer la vanne jusqu'à l'obtention maximale du débit d'eau requis. S'assurer qua la sortie de la pompe à ce niveau de réglage n'est pas supérieure au rendement du puits; en faire la vérification en surveillant le niveau de tirage d'eau et s'assurer que le niveau reste stable au débit d'eau maximal requis.

⚠CAUTION Ne pas faire fonctionner la pompe si elle n'est pas complétement subergée dan l'eau, autrement la pompe et le moteur pourraient s'endommager. Prende note également que l'air formé dans la pompe peut causer une poche d'air, à certaines conditions.

FAIBLE RENDEMENT DU PUITS

Un puits à faible rendement existe quand la sortie de la pompe est supérieure au rendement du puits. Il en résulte une diminution du niveau d'eau au tamis d'aspiration faisant entrer un mélange d'air et eau dans la pompe. Dans ce cas, la colonne d'eau qui se trouve déjà dans le tuyau de descente tiens la soupape de retenue fermée et développe ainsi une poche d'air à l'intérieur de la pompe. Dans ces conditions, la pompe n'est pas lubrifiée adéquatement et le moteur n'est pas refroidi proprement; et it pourrait en résulter des dommages si l'alimentation électrique n'est pas arrêtée rapidement. Suivre une ou plusieurs des recommandations suivantes pour corriger et/ou protéger l'installation:

1. Installer une longueur additionnelle de tuyau pour descendre la pompe plus bas dans le puits se possible.
2. Installer un mécanisme sensitif Pumptec mc de Franklin ou tout autre appareil électronique similaire.
3. Installer un contrôle pour niveau de liquide sans flotteur. Ce dispositif consiste en un relais électrique activé par des courants passant au travers des circuits de retour des électrodes suspendus dans le puits, L'électrode inférieur (arrêt) qui se trouve juste au'dessus de la pompe, permet au neveau d'eau de ne pas descendre plus bas que le tamis d'aspiration. L'électrode supérieur (démarrage), situé juste en-dessous du plus bas niveau d'eau statique, fait démarrer la pompe de nouveau, aussitôt que le puits à récupéré. Un contrôle pour niveau de liquide sans flotteur travaille en série avec l'interrupteur à pression. Vous référer aux instructions du manufacturier fournies avec le contrôle.
4. Installer une soupape de contrôle du débit dans la ligne de décharge avant l'interrupteur à pression. Ceci limite la sortie à partir de la pompe, sans affecter le rendement de l'eau tirée du réservoir à pression. Néanmoins, use forte demande d'eau pourrait vider le réservoir a pression; donc un réservoir à diaphragme ou tout autre dispositif est recommandé, car il empêche l'air d'être êvacué dans la ligne de service. Non seulement la décharge d'air dans les robinets serait désagréable, mais l'air évacué du réservoir à pression devrait être remplacé.
5. Installer une pompe plus petite, poue éviter un surpompage au puits. Vous référez à votre dépositaire pour le bon choix de la pompe.
6. Installer un interrupteur de basse pression. Un interrupteur de basse pression ou un interrupteur à pression avec un dispositif intégré protège la pompe pour puits peu profund contre la perte d'amorçage, mais ne donne pas toujours un rendement satisfaisant sur les pompes submersibles contre les effets de surpompage au puits; c'est parce qu'il réagit à une perte de pression à la surface, qui se produit lorsqu'une poche d'air s'est formée à l'intérieur de la pompe. Nous recommandons, soit un contrôle de niveau pour liquide sans flotteur ou une soupape de contrôle du débit, dans cet ordre, de preférénce à un interrupteur à pression d'arrêt, comme protection contre le surpompage.

PLOMBERIE DE DÉCHARGE

La figure 1 illustre une installation typique d'un puits avec les composantes installées à la surface. A l'installation de la plomberie de décharge, suivre les instructions suivantes:

1. Installer une soupape de retenue à ressort sur ligne de decharge avant l'interrupteur à pression.
2. Toujours installer une soupape de sûreté à pression dans le système. La soupape de sûreté devrait pouvoir être capable de décharger le débit d'eau de la pompe à la pression demandée du réservoir à pression.
3. Installer un interrrupteur à pression entre la soupape de retenue et le réservoir à pression, mais près du réservoir à pression. Vous référer aux figures 2,3, ou 4 pour le raccordement adéquat de l'interrupteur à pression.

GUIDE DE DÉPANNAGE

1. La pompe refuse de démarrer:

a) Problème d'électricité - appeler le détaillant ou l'électricien.
b) Dispositif de protection a nis la pompe en position arrêt.
c) Surcharge se déclenche.
d) Remettre en marche l'interrupteur de basse pression (si installé).

2. La pompe ne donne pas d'eau.

a) Poche d'air dans la pompe.
b) Écran du succion obstrué.
c) Rendement insuffisant du puits.

3. L'interrupteur de surcharge se déclenche.

a) Problème d'électricité - appeler le détaillant ou l'électricien.

4. Le débit de la pompe est réduit.

a) Rendement insuffisant du puits.
b) Pompe usée.
c) Écran du succion obstrué.
d) Bas voltage.
e) Rotation inexacte (triphasé seulement).

5. La pompe s'arrête et se remet en marche trop souvent.

a) Baisse de pression excessive entre l'interrupteur à pression et le réservoir.
b) Pression de mise en marche trop haute.
c) Pression d'arrêt trop faible.
d) Le réservoir est surchargé d'eau.
e) Les électrodes d'arrêt et de démarrage du contrôle pour niveau de liquide sans flotteur réglés trop prés.
f) Réservoir trop petit pour rencontrer les exigences du système.

6. L'interrupteur à pression arrête et se remet en marche rapidement quand la pompe démarre.

a) L'interrupteur à pression trop éloigné du réservoir à pression.
b) Ajuster le chargeur d'air du réservoir, en suivant les recommandations du manufacturier.

ATTENTION!

INFORMATIONS IMPORTANTES POUR LINSTALLATEUR DE CET EQUIPEMENT

CET EQUIPEMENT DOIT ETRE INSTALLE PAR UN TECHNICIEN QUALIFIE. SI L'INSTALLATION N'EST PAS CONFORME AUX LOIS NATIONALES OU LOCALES AINSI QU'AUX RECOMMANDATIONS DE FRANKLIN ELECTRIC, UN CHOC ELECTRIQUE, LE FEU, UNE PREFORMANCE NON ACCEPTABLE, VOIRE MEME LE NON'FONCTIONNEMENT PEUVENT SURVENIR. UN GUID D'INSTALLATION DE FRANKLIN ELECTRIC EST DESPONIBLE CHEZ LES MANUFACTURIERS DE POMPES, LES DISTRUBUTEURS, OU DIRECTEMENTCHES FRANKLIN. POUR DE PLUS AMPLES RENSEIGNEMENTS, APPELEZ SANS FRAIS LE 1-800-348-2420. CONSERVEZ CETTE FEUILLE D'INFORMATION AVEC L'EQUIPEMENT POUR CONSULTATION FUTURE

AVERTISSEMENT

UN CHOC ELECTRIQUE SERIEUZ OU MEME MORTEL EST POSSIBLE, SI L'ON NEGLIGE DE CONNECTER LE MOTEUR, LA PLONBERIE METALLIQUE, BOITES DE CONTRÔLE ET TOUT METAL PROCHE DU MOTEUR A UN CABLE ALLANT VERS UNE ALIMENTATION D'ENERGIE AVEC BORNE DE MISE A LA TERRE UTILISANT AU MOINS LE MEME CALIBRE QUE LES FILS DU MOTEUR. POUR REDUIRE LE RISQUE DE CHOC ELECTRIQUE. COUPER LE COURANT AVANT DE TRAVAILLER PRES OU UNE ZONE DE BAIGNADE.

ATENTION!

INFORMACION PARA EL INTALADO DE ESTE EQUIPO

PARA LA INSTALACION DE ESTE EQUIPO, SE REQUIERE DE PERSONAL TECNICO CALIFICADO. EL NO CUMPLIR CON LAS NORMAS ELECTRICAS NACIONALES Y LOCALES, ASI COMO CON LAS RECOMENDACIONES E FRANKLIN ELECTRIC DURANTE SU INSTALACION, PUEDE OCASIONAR: UN CHOQUE ELECTRICO, PELIGRO DE UN INCENDIO, OPERACION DEFECTUOSA E ESTAN DISPONIBLES CON LOS DISTRIBUIDORES, FABRICANTES DE BOMBAS O DIRECTAMENTE CON FRANKLIN ELECTRIC. PUEDE LLAMAR GRATUITAMENTE PARA MAYOR INFORMACION AL TELEFONO 800-348-2420. GUARDAR ESTA INFORMACION JUNTO AL EQUIPO PARA FUTURAS CONSULTAS.

ADVERTENCIA

PUEDE OCURRIR UN CHOQUE ELECTRICO, SERIO O FATAL DEBIDO A UNA ERRONEA CONECCION DEL: MOTOR O POR NO UTILIZAR UN CABLE PARA TIERRA DE CALIBRE IGUAL O MAYOR AL DE LA ALIMENTACION. PARA REDUCIR EL RIESGO DE CHOQUE ELECTRICO. DESCONECTAR LA ALIMENTACION ELECTRICA ANTES DE INICIAR A TRABAJAR EN EL SISTEMA HIDRAULICO. NO UTILIZAR ESTE MOTOR EN ALBERCAS O AREAS EN DONDE SE PRACTIQUE NATACION.

GARANTIE LIMITEE*

CETTE GARANTIE ÉNONCE LES SEULES OBLIGATIONS DE L'ENTREPRISE ET LES RECOURS EXCLUSIFS DE L'ACHETEUR EN CAS DE PRODUIT DÉFECTUEUX.

Franklin Electric Company, Inc. et ses filiales (ci-après « l'Entreprise ») garantit que les produits accompagnés de cette garantie sont exempts de défauts quant aux matériaux ou à la main-d'œuvre par l'Entreprise.

L'Entreprise a le droit d'inspecter tout produit retourné sous garantie pour confirmer qu'il présente un défaut de matériau ou de main-d'œuvre. Elle a le droit exclusif de choisir de réparer ou de remplacer le matériel, les pièces ou les composants défectueux.

L'acheteur doit retourner le produit à un point de distribution Franklin Electric autorisé pour examen. Si le retour est effectué au point d'achat, la couverture de la garantie ne sera prise en considération que si le lieu de vente en question est un distributeur Franklin Electric autorisé au moment de la réclamation. Sous réserve des conditions générales énoncées ci-dessous, l'Entreprise s'engage à réparer ou à remplacer toute partie du produit retourné par l'acheteur qui s'avère défectueuse en raison des matériaux ou de la main-d'œuvre provenant de l'Entreprise.

L'Entreprise n'envisagera l'application de la garantie que dans les 12 mois suivant la date d'installation du produit ou dans les 24 mois suivant sa fabrication, selon la première éventualité.

L'Entreprise ne pourra EN AUCUN CAS être tenue responsable du coût de la main-d'œuvre ou d'autres frais engagés par un client pour retirer ou fixer un produit, ou quelconque pièce ou composant qui le constitue.

L'Entreprise se réserve le droit de modifier ou d'améliorer ses produits ou toute partie de ceux-ci sans être obligée de fournir une telle modification ou amélioration aux produits déjà vendus.

LA PRÉSENTE GARANTIE NE S'APPLIQUE PAS AUX produits endommagés par un acte de la nature, y compris la foudre, l'usure normale, les services de maintenance normale et les pièces utilisées avec de tels services, ou toute autre condition au-delà du contrôle de l'Entreprise.

LA PRÉSENTE GARANTIE SERA IMMÉDIATEMENT ANNULÉE si l'une des conditions suivantes est constatée :

1. Le produit est utilisé à des fins autres que celles pour lesquelles il a été conçu et fabriqué;
2. Le produit n'a pas été installé conformément aux codes et aux règlements applicables et aux bonnes pratiques commerciales;
3. Le produit n'a pas été installé par un entrepreneur certifié par Franklin;
4. Le produit a été endommagé à la suite d'une négligence, d'un abus, d'un accident, d'une mauvaise application, de vandalisme, d'une altération, d'une installation, d'un fonctionnement, d'une maintenance ou d'un entreposage inapproprié ou d'un dépassement des maximums recommandés dans les instructions du produit.

NI LE VENDEUR, NI L'ENTREPRISE NE POURRONT ÊTRE TENUS RESPONSABLES DES BLESSURES, DES PERTES OU DES DOMMAGES DIRECTS, ACCESSOIRES OU INDIRECTS (Y COMPRIS, SANS S'Y LIMITER, LES DOMMAGES INDIRECTS RELATIFS À UN MANQUE À GAGNER, À UNE PERTE DE VENTES, À DES BLESSURES CORPORELLES, À DES DOMMAGES MATÉRIELS OU À TOUTE AUTRE PERTE ACCESSOIRE OU INDIRECTE) DÉCOULANT DE L'UTILISATION DU PRODUIT OU DE L'INCAPACITÉ DE L'EMPLOYER, ET L'ACHETEUR CONVIENT QU'AUCUN AUTRE RECOURS NE SERA POSSIBLE.

LA GARANTIE ET LE RECOURS DÉCRITS AUX PRÉSENTES SONT EXCLUSIFS ET ONT PRÉSÉANCE SUR TOUTE AUTRE GARANTIE OU TOUT AUTRE RECOURS EXPLICITE OU IMPLICITE. LES AUTRES GARANTIES ET RECOURS SONT AINSI EXPRESSÉMENT EXCLUS, Y COMPRIS, MAIS SANS S'Y LIMITER, TOUTE GARANTIE IMPLICITE DE QUALITÉ MARCHANDE OU DE CONFORMITÉ À UN USAGE PARTICULIER. LA DURÉE DE LA GARANTIE OU DU RECOURS APPLICABLE À UN PRODUIT SE LIMITE AUX PÉRIODES DE GARANTIE EXPLICITEMENT INDIQUÉES CI-DESSUS.

NON-RESPONSABILITÉ : Toute affirmation verbale à propos du produit effectuée par le vendeur, l'Entreprise, les représentants ou d'autres parties ne constitue pas une garantie, ne doit pas être interprétée comme telle par l'acheteur et ne fait pas partie du contrat de vente. Les seules obligations du vendeur et de l'Entreprise et les seuls recours de l'acheteur seront le remplacement ou la réparation par l'Entreprise du produit, comme décrit ci-dessus. Avant l'utilisation, l'utilisateur devra déterminer l'adéquation du produit avec l'usage auquel il est destiné; et l'utilisateur assume toutes les responsabilités et tous les risques liés à ce choix.

Certains États et pays n'autorisent pas l'exclusion ou la limitation de la durée d'une garantie implicite ou l'exclusion ou la limitation de dommages accessoires ou indirects, de sorte que l'exclusion ou les limitations énoncées ci-dessus peuvent ne pas s'appliquer à vous. Cette garantie vous accorde des droits juridiques précis, et vous pouvez également disposer d'autres droits, lesquels varient selon l'État et le pays.

Franklin Electric peut, à sa seule discrétion, mettre à jour la présente garantie limitée de temps à autre. Toute information contradictoire concernant les procédures de garantie, que ce soit dans un manuel d'utilisation ou ailleurs, est remplacée par la présente par ce document. Néanmoins, toutes les références à une période, ou à la durée d'une période de garantie, demeureront conformes à la garantie en vigueur au moment de l'achat.

* Communiquez avec la division de l'exportation de Franklin Electric Co., Inc. pour connaître la garantie internationale.

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Chapter 10

APPENDIX

10.1 Photographs

10.2 Drawings

END OF CHAPTER 10

AS-BUILT SIFEC
MARCH 2018
City of Iqaluit
Water Treatment Plant

PROCESS / MECHANICAL & HVAC EQUIPMENT ABBREVIATIONS LIST

ACU	AIR CONDITIONING UNIT	BRNR	BURNER
AD	AIR DRYER		
ADEQ	ADMINISTRATION EQUIPMENT	CDR	CONDENSER
AF	AIR FILTER	CFR	CHEMICAL FEEDER (POLYMER, LIME
AHU	AIR HANDLING UNIT		SLAKER, CHLORINATOR, ETC.)
ASD	ADJUSTABLE SPEED DRIVE	CHLR	CHILLER
		CLCL	COOLING COIL
B	BLOWER	CLT	CLUTCH
BFP	BACK FLOW PREVENTER	COL	COLLECTOR
BG	BUTTERFLY GATE	CON	CONVEYOR
BIOF	BIOFILTER	CP	COMPRESSOR
BLR	BOILER	CPRU	CONTROLLED PRESSURIZATION UNIT
BRM	BARMINUTOR	CPT	COMPACTOR

CRN	CRANE OR HOIST
CTF	CENTRIFUGE
CTRP	DIGESTED GAS CONDENSATE TRAP
CYL	CYLINDER
DIST	ROTARY DISTRIBUTOR
E	ENGINE
EF	EXHAUST FAN
EPR	EVAPORATOR
ETNK	EXPANSION TANK

F	FILTER
FG	FLAP GATE
FLC	FLOCCULATOR
G	GATE (POWER ASSISTED)
GDR	GRINDER
HEX	HEAT EXCHANGER
HTCL	HEATING COIL
HUM	HUMIDIFIER
INC	INCINERATOR

L	MIXER
LAG	LAGOONS
LCG	LEVEL CONTROL GATE
ORT	ODOUR REMOVAL TOWER
P	PUMP
PRV	PRESSURE REDUCING/REGULATING VALVE
PSV	PRESSURE/VACUUM RELIEF SAFETY VALVE
PTO	POWER TAKE OFF/REDUCER
PVL	PRESSURE VESSEL

RF	RETURN FAN
RHC	REHEAT COIL
RV	RELIEF VALVE/RUPTURE DISC (PROCESS RELIEF DAMPER)
SAF	SAFETY EQUIPMENT
SCRB	SCRUBBER
SCRN	SCREEN
SEP	SEPARATOR (CYCLONE, DRIP TRAP, STEAM SEPARATOR, AIR SEPARATOR)
SF	SUPPLY FAN
SG	SLIDE GATE

SHEQ	SHOP EQUIPMENT
SL	STOP LOG GATE
SLR	SILENCER
SSV	SAFETY SHUT OFF VALVE
STR	STRAINER (AUTOMATIC)
TG	TELESCOPIC GATE
TNK	TANK (NON-PRESSURIZED)
UH	UNIT HEATER
VC	CHECK VALVE (POWER ASSISTED)

INSTRUMENTATION EQUIPMENT ABBREVATIONS LIST

ACV	ANALYZER CONTROL VALVE
AE	ANALYZER ELEMENT
AFIC	ANALYTICAL RATIO INDICATING CONTROLLER
AI	ANALYZER INDICATOR
AIC	ANALYZER INDICATING CONTROLLER
AIT	ANALYZER INDICATING TRANSMITTER
AR	ANALYZER RECORDER
ARC	ANALYZER RECORDING CONTROLLER
ASH	ANALYZER SWITCH HIGH
ASHH	ANALYZER SWITCH HIGH HIGH
ASL	ANALYZER SWITCH LOW
ASLL	ANALYZER SWITCH LOW LOW
AT	ANALYZER TRANSMITTER
EXI	VOLTS/MILLIVOLTS TO CURRENT TRANSDUCER
EXP	VOLTS TO PRESSURE TRANSDUCER
FCV	FLOW CONTROL VALVE
FE	FLOW ELEMENT
FI	FLOW INDICATOR
FIC	FLOW INDICATING CONTROLLER
FIR	FLOW INDICATING RECORDER
FIT	FLOW INDICATING TRANSMITTER
FQ	FLOW TOTALIZER/INTEGRATOR
FQI	FLOW TOTALIZER INDICATOR
FQIT	FLOW TOTALIZER INDICATING TRANSMITTER
FR	FLOW RECORDER
FSH	FLOW SWITCH HIGH
FSHH	FLOW SWITCH HIGH HIGH
FSHL	FLOW SWITCH HIGH LOW
FSL	FLOW SWITCH LOW
FSLL	FLOW SWITCH LOW LOW
FT	FLOW TRANSMITTER
HC	HAND CONTROLLER
HIC	HAND INDICATING CONTROLLER
HS	HAND SWITCH
KY	TIME RELAY
LC	LEVEL CONTROLLER
LCV	LEVEL CONTROL VALVE
LE	LEVEL ELEMENT
LFC	LEVEL RATIO CONTROLLER
LG	LEVEL GAUGE
LI	LEVEL INDICATOR
LIC	LEVEL INDICATING CONTROLLER
LISH	LEVEL INDICATING SWITCH HIGH
LIT	LEVEL INDICATING TRANSMITTER
LR	LEVEL RECORDER
LSH	LEVEL SWITCH HIGH
LSHH	LEVEL SWITCH HIGH HIGH
LSHL	LEVEL SWITCH HIGH LOW
LSL	LEVEL SWITCH LOW
LSLL	LEVEL SWITCH LOW LOW
LSM	LEVEL SWITCH MIDDLE
LT	LEVEL TRANSMITTER
MCD	MOTORIZED CONTROL DAMPER
MSL	MOTION SWITCH
NE	MOISTURE PROBE
NI	MOISTURE INDICATOR
PCV	PRESSURE CONTROL VALVE
PDI	PRESSURE DIFFERENTIAL INDICATOR
PDIC	PRESSURE DIFF. INDICATING CONTROLLER
PDIT	PRESSURE DIFF. INDICATING TRANSMITTER
PDS	PRESSURE DIFFERENTIAL SWITCH
PDSH	PRESSURE DIFFERENTIAL SWITCH HIGH
PDSL	PRESSURE DIFFERENTIAL SWITCH LOW
PDT	PRESSURE DIFFERENTIAL TRANSMITTER
PE	PRESSURE ELEMENT
PHE	pH ELEMENT
PHR	pH RECORDER
PI	PRESSURE INDICATOR
PIC	PRESSURE INDICATING CONTROLLER
PIT	PRESSURE INDICATING TRANSMITTER
PR	PRESSURE RECORDER
PSH	PRESSURE SWITCH HIGH
PSHH	PRESSURE SWITCH HIGH HIGH
PSHL	PRESSURE SWITCH HIGH LOW
PSL	PRESSURE SWITCH LOW
PSLL	PRESSURE SWITCH LOW LOW
PT	PRESSURE TRANSMITTER
PXI	PRESSURE TO CURRENT TRANSDUCER
PXP	PRESSURE TO PRESSURE TRANSDUCER
PY	PRESSURE CONVERTER (SIGNAL BOOST)
SAMP	SAMPLER
SE	SPEED ELEMENT
SI	SPEED INDICATOR (TACHOMETER)
ST	SPEED TRANSMITTER
SV	SOLENOID VALVE
SY	SPEED CONVERTER (TRANSDUCER)
SZ	SPEED ACTUATOR (ENGINE)
TC	TEMPERATURE CONTROLLER
TCV	TEMPERATURE CONTROL VALVE
TE	TEMPERATURE ELEMENT
TI	TEMPERATURE INDICATOR
TIC	TEMPERATURE INDICATING CONTROL
TIS	TEMPERATURE INDICATING SWITCH
TIT	TEMPERATURE INDICATING TRANSMITTER
TQI	TORQUE INDICATOR
TQIC	TORQUE INDICATING CONTROL
TQIT	TORQUE INDICATING TRANSMITTER
TQR	TORQUE RECORDER
TQS	TORQUE SWITCH
TQSH	TORQUE SWITCH HIGH
TQT	TORQUE TRANSMITTER
TR	TEMPERATURE RECORDER
TSH	TEMPERATURE SWITCH HIGH
TSHH	TEMPERATURE SWITCH HIGH HIGH
TSL	TEMPERATURE SWITCH LOW
TSLL	TEMPERATURE SWITCH LOW LOW
TT	TEMPERATURE TRANSMITTER
TW	THERMAL WELL
TY	TEMPERATURE SELECT
UI	MULTIVARIABLE INDICATOR
UR	MULTIVARIABLE RECORDER
USH	MULTIVARIABLE SWITCH HIGH
WI	WEIGHT INDICATOR
WT	WEIGHT INDICATING TRANSMITTER
ZI	POSITION INDICATOR
ZIS	POSITION INDICATING SWITCH
ZIT	POSITION INDICATING TRANSMITTER
ZS	POSITION SWITCH
ZSC	POSITION SWITCH CLOSED
ZSO	POSITION SWITCH OPEN
ZT	POSITION TRANSMITTER

ELECTRICAL EQUIPMENT ABBREVIATIONS LIST

ACP	AREA CONTROL PANEL
AFN	ARTIFICIAL NEUTRAL
AJB	ANALOGUE JUNCTION BOX
AN	ALARM ANNUNCIATOR
ASD	ADJUSTABLE SPEED DRIVE
ATS	AUTOMATIC TRANSFER SWITCH
BAT	BATTERY
CAM	CCTV CAMERA
CAP	CAPACITOR
CB	CIRCUIT BREAKER
CCP	CENTRAL CONTROL PANEL
CDP	CONTROL DISTRIBUTION PANEL
CDT	CONTROL DISTRIBUTION TRANSFORMER
CHR	BATTERY CHARGER
CJB	CONTROL JUNCTION BOX
CPU	COMPUTER
CTS	CATHODIC TEST STATION
CX	HARMONIC FILTER CAPACITOR
DCD	DC DRIVE
DPW	DC POWER SUPPLY
DS	DISCONNECT SWITCH
DSF	DISCONNECT SWITCH FUSED
EDC	EDDY CURRENT CLUTCH
EJB	ELECTRICAL JUNCTION BOX
ELU	EMERGENCY LIGHTING UNITS
EP	EQUIPMENT PANEL – NO OPERATOR INTERFACE
EPB	ELECTRICAL PULL BOX
FAP	FIRE ALARM PANEL
GAD	GROUND ALARM DEVICE
GEN	GENERATOR
HTR	HEATER (RESISTANCE)
IMC	INDIVIDUAL MOTOR CONTROLLER (STAND ALONE STARTER)
L	INDUCTOR
LA	LIGHTNING ARRESTOR
LBS	LOAD BREAK SWITCH
LCP	LOCAL CONTROL PANEL
LDP	LIGHTING DISTRIBUTION PANEL
LDT	LIGHTING DISTRIBUTION TRANSFORMER
LIS	LOAD ISOLATING SWITCH
M	MOTOR
MCC	MOTOR CONTROL CENTRE
MET	ELECTRICAL METER
MHE	ELECTRICAL PULLPIT MANHOLE
MON	CCTV MONITOR
MOP	MOTORIZED OPERATOR
MPA	ANALOG MARSHALLING PANEL
MPC	MARSHALLING PANEL CONTROL
MPD	DIGITAL MARSHALLING PANEL
MTS	MANUAL TRANSFER SWITCH
MVC	MEDIUM VOLTAGE CONTROLLER
NGR	NEUTRAL GROUND RESISTOR
PAX	PUBLIC ADDRESS EQUIPMENT
PCN	POWER CONDITIONER
PDC	POWER DISTRIBUTION CENTRE
PDP	POWER DISTRIBUTION PANEL
PLC	PROGRAMMABLE LOGIC CONTROLLER
PO	POWER OUTLET
RTU	REMOTE TERMINAL UNIT
RX	HARMONIC FILTER REACTOR
SFU	SURGE FILTER UNIT
SPK	PUBLIC ADDRESS SPEAKER
SUB	SUBSTATION
SWC	CCTV SWITCHER
SWG	SWITCHGEAR
T	POWER TRANSFORMER
TCH	ON LINE TAP CHANGER
TEL	TELEPHONE JACK, HANDSET
TEX	TELEPHONE SWITCH
UPS	UNINTERUPTABLE POWER SUPPLY
VFD	VARIABLE SPEED DRIVE

NOTES

1. THIS DRAWING IS GENERAL IN NATURE, SOME ABBREVIATIONS SHOWN HERE MAY NOT BE USED ON THE CONTRACT DRAWINGS.

COMMODITY ABBREVIATIONS LIST

AA	AGITATION AIR
AS	AIR SCOUR
BA	BACKWASH AIR
BC	BIOFILTER CIRCULATION
BCTL	BOILER CHEMICAL TREATMENT, LOW PRESSURE
BCTM	BOILER CHEMICAL TREATMENT, MEDIUM PRESSURE
BDL	BOILER BLOWDOWN, LOW PRESSURE
BDM	BOILER BLOWDOWN, MEDIUM PRESSURE
BFE	BIOFILTER EFFLUENT
BFL	BOILER FEEDWATER, LOW PRESSURE
BFM	BOILER FEEDWATER, MEDIUM PRESSURE
BWW	BACKWASH WATER WASTE
BWS	BACKWASH WATER SUPPLY
C1	POTABLE WATER (DOMESTIC)
C2	NON-POTABLE WATER
C3	PLANT EFFLUENT WATER
C4	UNCHLORINATED PLANT EFFLUENT WATER
CDN	CONDENSATE, DRAINAGE
CEN	CENTRATE
CF	CENTRIFUGE FEED
CHS	CHEMICAL SOLUTION
CLG	CHLORINE GAS
CLL	CHLORINE LIQUID
CLS	CHLORINE SOLUTION
CLV	CHLORINE, VACUUM
CS	CIRCULATING SLUDGE
CSO	CAUSTIC SODA
CSS	CAUSTIC SODA SOLUTION
CSW	CHLORINE SOLUTION WATER
CVT	CHEMICAL VENT
CWR	CHILLED WATER RETURN
CWS	CHILLED WATER SUPPLY
DHF	DOMESTIC HOT WATER FLOW
DHR	DOMESTIC HOT WATER RETURN
DR	DRAINAGE (FLOOR, ETC.)
DS	DIGESTED SLUDGE
DWS	DEWATERED SLUDGE
EE	ENGINE EXHAUST
ES	EQUALIZED SLUDGE
FAS	FLUOROSILICIC ACID SUPPLY
FC	FERRIC CHLORIDE
FOA	FOUL AIR
FPS	FIRE PROTECTION SUPPLY
FS	FLOTATION SLUDGE
FW	FILTERED WATER
FTW	FILTER TO WASTEWATER
FLW	FLOCULATED WATER
G	B.C. NATURAL GAS SUPPLY (OFF-SITE)
GC	SLUDGE GAS, FOR CIRCULATION
GLR	GLYCOL RETURN
GLS	GLYCOL SUPPLY
GO	DEGRITTER OVERFLOW
GR	GRIT
GWR	GROUND WATER RELIEF
HRR	HEAT RESERVOIR RETURN
HRS	HEAT RESERVOIR SUPPLY
HSG	HIGH PRESSURE SLUDGE GAS
IA	INSTRUMENT AIR
LOR	LUBE OIL RETURN
LOS	LUBE OIL SUPPLY
LOW	LUBE OIL WASTE
LSG	LOW PRESSURE SLUDGE GAS
MG	MIXED GAS
ML	MIXED LIQUOR
MS	MIXED SLUDGE
MSG	MEDIUM PRESSURE SLUDGE GAS
NG	NATURAL GAS
OF	OVERFLOW
OPS	ZINC ORTHOPHOSPHATE SUPPLY
PA	PROCESS AIR
PE	PRIMARY ELEMENT
PI	PRIMARY INFLUENT
POL	POLYELECTROLYTE
PS	PRIMARY SLUDGE
PSU	PRESSURIZED SUPERNATANT
PWD	PROCESSED WASTE DRAINAGE
PY	PRIMARY SCUM
RFJ	REFRIGERANT HOT GAS BYPASS
RFL	REFRIGERANT LIQUID
RFS	REFRIGERANT SUCTION
RS	RAW SEWAGE
RSS	RETURN SECONDARY SLUDGE
RWL	RAIN WATER, LEADER
RW	RAW WATER
SA	SERVICE AIR
SAN	SANITARY DRAINAGE
SC	SCEENINGS
SCW	SLUDGE COOLING WATER
SDG	SULPHUR DIOXIDE GAS
SDL	SULPHUR DIOXIDE LIQUID
SDS	SULPHUR DIOXIDE SOLUTION
SDV	SULPHUR DIOXIDE, VACUUM
SE	SECONDARY EFFLUENT
SEP	SEPTAGE
SHS	SODIUM HYPOCHLORITE SOLUTION
SPY	SCREENED PRIMARY SCUM
STA	STARTING AIR
STML	STEAM, LOW PRESSURE
STMM	STEAM, MEDIUM PRESSURE
STW	STORMWATER DRAINAGE
SU	SUPERNATANT / SUBNATANT
SW	SEAL WATER
SY	SECONDARY SCUM
TBS	THICKENER BOTTOM SLUDGE
TD	TANK DRAINAGE
TFE	TRICKLING FILTER EFFLUENT
TOF	THICKENER OVERFLOW
TPS	THICKENED PRIMARY SLUDGE
TPY	THICKENED SCUM
TSPS	THICKENED SCREENED PRIMARY SLUDGE
TSPY	THICKENED SCREENED PRIMARY SCUM
TUF	THICKENER UNDERFLOW
TWSS	THICKENED WASTE SECONDARY SLUDGE
TW	TREATED WATER
V	VENT, PROCESS
VA	VACUUM, LABORATORY
VS	VENT, SANITARY
W	MUNICIPAL WATER SUPPLY
WSS	WASTE SECONDARY SLUDGE

NO.	REVISION	DATE	INITIAL
1	ISSUED FOR CONSTRUCTION	22/04/03	CKW
0	ISSUED FOR TENDER	19/02/03	CKW

Company Permit

PERMIT TO PRACTICE
EARTH TECH (CANADA) INC.
Signature AND SIGNED BY CHRIS WRIGHT, P.ENG.
Date AND SIGNED BY RICHARD FEILDEN, P.ENG.
PERMIT NUMBER: P 005
The Association of Professional Engineers, Geologists and Geophysicists of NWT / NU

Engineer Seal

ORIGINAL DRAWINGS STAMPED AND SIGNED
ON FEBRUARY 19, 2003

PROFESSIONAL ENGINEER NT/NU WRIGHT LICENSEE

GENERAL

ABBREVIATIONS

Iqaluit
CITY of IQALUIT,
Nunavut

CITY OF IQALUIT

IQALUIT WATER TREATMENT PLANT

EARTH TECH

Earth Tech (Canada) Inc.

DRAWN BY: CKW CHECKED BY: CKW	SCALE: N.T.S.	DATE: OCT. 2002	SHEET NO.
CADD SYSTEM AutoCAD	DWG NO. G–1	REV. 1	CONTRACT 55524

AS-BUILT SIFEC
MARCH 2018
City of Iqaluit
Water Treatment Plant

FUNCTIONAL IDENTIFICATION

	FIRST LETTER (4)		SUCCEEDING–LETTERS (3)			DESCRIPTION
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER	I/O TYPES TYPICAL ASSOCIATED CDACS
A	ANALYSIS		ALARM			DI
B	BURNER, COMBUSTION			CLOSE–STOP DECREASE		DO
C	CONDUCTIVITY, pH (ACIDITY)		CLOSE	CONTROL OR CONTROLLER		DI/AO
D	DENSITY	DIFFERENTIAL		OPEN–START–INCREASE		DO
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)			
F	FLOW RATE	RATIO (FRACTION)			FAIL	DI
G	GAS		GLASS VIEWING DEVICE			
H	HAND				H–HIGH–(ALARM) HH–HIGH–(SHUTDOWN)	DI
I	CURRENT (ELECTRICAL)		INDICATE			AI
J	POWER	SCAN				DO/AI
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION		DO/AO
L	LEVEL		LIGHT		L–LOW–(ALARM) LL–LOW–(SHUTDOWN)	DI
M	MOTOR	MOMENTARY	ON OR OPERATE		MIDDLE, INTERMEDIATE	DI
N	MOISTURE					DO
O	UNCLASSIFIED		OPEN ORIFICE, RESTRICTION POINT TEST) CONNECTION		OVERLOAD	DO
P	PRESSURE, VACUUM			PNEUMATIC		
Q	QUANTITY	INTEGRATE, TOTALIZE		INTEGRATE OR TOTALIZE		DI/AI
R	RADIATION		RECORD			AI
S	SPEED, FREQUENCY, SOLENOID	SAFETY		SWITCH, OR SAFETY		DI/DO
T	TEMPERATURE			TRANSMIT		AI
TQ	TORQUE					
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION	DI
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVRE		
W	WEIGHT, FORCE		WELL			
X	ON/OFF	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	DI/DO
Y	EVENT, STATE, PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT		
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED – FINAL CONTROL ELEMENT		

TYPICAL INSTRUMENT IDENTIFICATION

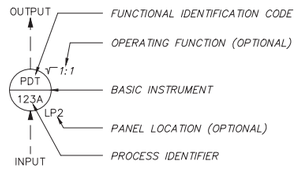
NOTE: IN ADDITION TO THE REQUIREMENTS DETAILED BELOW, REFER TO SCADA POINT NAMING CONVENTIONS WHEN INSTRUMENT INTERFACES TO SCADA.

FIELD TAG IDENTIFICATION

POSITION 1 2 3 4 5 6 7 8

- 1 2 3 4 – FUNCTIONAL IDENTIFICATION CODE
- 5 6 7 – PROCESS IDENTIFIER
- 8 – IF REQUIRED

SCHEMATIC IDENTIFICATION



a) FUNCTIONAL IDENTIFICATION CODE – (UP TO 4 CHARACTERS) *
- REFER TO DRAWING STD 1 FOR LISTING
- * NOTE THAT SCADA POINTS CAN ONLY HAVE 3 CHARACTERS

b) PROCESS IDENTIFIER – (3 NUMBERALS AND 1 CHARACTER)
- REFER TO DRAWING STD 1 FOR PROCESS IDENTIFIER NUMBERING CONVENTION.
- CHARACTER SUFFIX IN POSITION 8 DIFFERENTIATES SIMILAR DEVICES WITHIN A LOOP PROVIDED THAT THEY ARE NOT WIRED INTO SCADA – REFER TO SCADA POINT NAMING CONVENTION.

SCADA POINT NAMING CONVENTION

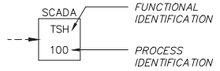
NOTE: ALL DEVICES INTERFACED WITH SCADA MUST FOLLOW THE SCADA POINT NAMING CONVENTION.

I/O POINT NAMING CONVENTION

POSITION W 2 3 4 5 6 7 8 9 10

- W – WATER
- 2 3 4 – RTU LOCATION REMOTE SITE OR PLANT MNEMONIC (3 CHARACTERS)
- 5 6 7 – 3 CHARACTER FUNCTIONAL IDENTIFIER
- 8 9 10 – 3 CHARACTER PROCESS IDENTIFIER (AS DETAILED RIGHT)

SCHEMATIC IDENTIFICATION



INSTRUMENT OPERATING FUNCTIONS

ANALYTICAL FUNCTIONS

RES Cl_2	RESIDUAL CHLORINE
SO_2	SULFUR DIOXIDE
COMB	COMBUSTIBLE GAS
H_2S	HYDROGEN SULFIDE
pH	pH
DO	DISSOLVED OXYGEN
O_2	OXYGEN

SWITCHING FUNCTIONS

HA	HAND–AUTO SELECTION
HOA	HAND–OFF–AUTO SELECTION
JOA	JOG–OFF–AUTO SELECTION
S/S	START–STOP
L/L	LEAD–LAG SELECTION
F/S	FAST–SLOW SELECTION
OCA	OPEN–CLOSE–AUTO SELECTION
OSC	OPEN–STOP–CLOSE SELECTION
SEL	SELECTOR SWITCH
O/O	ON–OFF SELECTION
M/A	MANUAL–AUTO SELECTION
L/R	LOCAL–REMOTE SELECTION
ESD	EMERGENCY SHUTDOWN
ACK	ACKNOWLEDGE (ALARM)
FOR	FORWARD–OFF–REVERSE
LOR	LOWER–OFF–REVERSE

OTHER FUNCTIONS

D/P	DIFFERENTIAL PRESSURE
IXP	CURRENT TO PRESSURE
IBD	INBOARD BEARING
OBD	OUTBOARD BEARING
VIB	VIBRATION

INSTRUMENT AND FUNCTION SYMBOLS

FIELD MOUNTED INSTRUMENT

INSTRUMENT WITH TWO SERVICE OR FUNCTION

LOCAL PANEL – MOUNTED INSTRUMENT. ACCESSIBLE

INSTRUMENT MOUNTED BEHIND LOCAL CONTROL PANEL. NOT READILY ACCESSIBLE

INSTRUMENT MOUNTED ON MAIN PANEL. ACCESSIBLE

INSTRUMENT MOUNTED BEHIND MAIN PANEL. NOT READILY ACCESSIBLE

FIELD MOUNT ANNUNCIATOR POINT (OPTIONAL ARROW TO INDICATE ROTATING BEACON)

MAIN PANEL MOUNT ANNUNCIATOR POINT

LOCAL PANEL MOUNT ANNUNCIATOR POINT

SCADA (SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM) INPUT, OUTPUT, OR FUNCTION.

SCADA INPUT, OUTPUT, OR FUNCTION. ACCESSIBLE

SPECIAL PURPOSE DIGITAL DEVICE FOR PROCESSING MAINLY ANALOG INFORMATION. EG. SLDC (SINGLE LOOP DIGITAL CONTROLLER)

SPECIAL PURPOSE DIGITAL DEVICE FOR PROCESSING MAINLY ANALOG INFORMATION. ACCESSIBLE

SPECIAL PURPOSE DIGITAL DEVICE FOR PROCESSING MAINLY DIGITAL INFORMATION. EG. PLC (PROGRAMMABLE LOGIC CONTROLLER)

SPECIAL PURPOSE DIGITAL DEVICE FOR PROCESSING MAINLY DIGITAL INFORMATION. ACCESSIBLE

COMPUTER – INTERNAL SYSTEM FUNCTION (i.e. COMPUTATION/SIGNAL CONDITIONING)

COMPUTER – INTERNAL SYSTEM FUNCTION NORMALLY ACCESSIBLE TO OPERATOR

PRIMARY ELEMENT SYMBOLS

ORIFICE PLATE

VENTURI OR FLOW TUBE

FLUME

WEIR

VARIABLE AREA FLOW INDICATOR (ROTAMETER)

FLOW ELEMENT INTEGRAL WITH TRANSMITTER (MASS FLOW, ETC)

DIAPHRAGM SEAL

IN–LINE PRESSURE SENSOR

VORTEX FLOW SENSOR

IN–LINE CAPACITANCE FLOW ELEMENT

MAGNETIC FLOWMETER

SONIC FLOWMETER (DOPPLER OR TRANSIT TIME)

POSITIVE DISPLACEMENT METER

THERMAL MASS FLOW ELEMENT

ANNUBAR

PITOT TUBE

PROPELLER OR TURBINE METER

CORIOLIS MASS FLOWMETER

FLOAT LEVEL ELEMENT

DISPLACEMENT LEVEL ELEMENT

BUBBLER LEVEL TUBE

ULTRASONIC/MICROWAVE LEVEL ELEMENT
RADIO FREQUENCY LEVEL ELEMENT
VIBRATING TUNING FORK LEVEL SWITCH
THERMAL SENSING RTD STRIP

INSTRUMENT SIGNAL SYMBOLS

INSTRUMENT SUPPLY, PROCESS TAPS

PNEUMATIC SIGNAL

ELECTRIC SIGNAL

CAPILLARY TUBE OR FILLED SYSTEM

ELECTROMAGNETIC OR SONIC SIGNAL (GUIDED)

ELECTROMAGNETIC OR SONIC SIGNAL (UNGUIDED)

SOFTWARE OR DATA LINK

MECHANICAL LINK

HYDRAULIC

MISCELLANEOUS SYMBOLS

INTERLOCK – SEE CONTROL STRATEGY DESCRIPTION

RESET FOR LATCH–TYPE OPERATOR

ANNUNCIATOR HORN

GROUND

INSTRUMENT LOOP SHIELD GROUND

BOND

LINE DESIGNATIONS

ELECTRIC POWER SUPPLY 120 VAC 60 HZ (UNLESS OTHERWISE NOTED)

SERVICE AIR SUPPLY

INSTRUMENT QUALITY AIR SUPPLY

WATER SUPPLY C1, C2, C3, ETC.

GENERAL NOTES

1. REFER TO DRAWING EIC01–01 FOR, EQUIPMENT AND PIPE COMMODITY DESIGNATIONS.

NO.	REVISION	DATE	INITIAL
2	RECORD DRAWING	23/04/04	DKB
1	ISSUED FOR CONSTRUCTION	22/04/03	CKW
0	ISSUED FOR TENDER	19/02/03	CKW

Company Permit

Engineer Seal

RECORD DRAWING
INFORMATION CONTAINED IN THESE DRAWINGS IS AS SUPPLIED BY:
SCHENDEL MECHANICAL CONTRACTING LTD.
THE COMPLETENESS AND ACCURACY OF THIS RECORD DRAWING IS NOT GUARANTEED.
INFORMATION SHOULD BE VERIFIED AT THE ACTUAL LOCATION BEFORE USE.

GENERAL

INSTRUMENTATION ABBREVIATIONS & SYMBOLS

Iqaluit
CITY of IQALUIT,
Nunavut

CITY OF IQALUIT

IQALUIT WATER TREATMENT PLANT

EARTH TECH

Earth Tech (Canada) Inc.

DRAWN BY: CKW	SCALE: N.T.S.	DATE: OCT. 2002	SHEET NO.
CHECKED BY: CKW			
CADD SYSTEM AutoCAD	DWG NO. GI–1	REV. 1	CONTRACT 55524

AS-BUILT SIFEC
MARCH 2018
City of Iqaluit
Water Treatment Plant

NOTES:

1. MM/VA ARE TAKEN FROM MCC CONTACTOR – NOT MOTOR.
2. LEVEL CONTROL VALVES LOGIC MAX. 50% OPEN.

LCP

YS 2051 | MM 2051 | UA 2051
YS 2061 | MM 2061 | UA 2061
YS 4111 | MM 4111 | UA 4111
YS 4101 | MM 4101 | UA 4101
LALL 2501 | LAL 2501 | LAH 2501 | LI 2501
PAL 4112
HSO 2501 | HSC 2501 | ZSO 2501 | ZSC 2501
AI 2501A | AAL 2501A | AAH 2501A
AI 2501B | AAL 2501B | AAH 2501B

MCP

OPEN/CLOSE ZSO 2051 / HS 2051 — DI / DO
AUTO S/S STATUS FAULT YS 2051 | MN 2051 | MM 2051 | UA 2051 — DI / DO / DI / DI
AUTO S/S STATUS FAULT YS 2061 | MN 2061 | MM 2061 | UA 2061 — DI / DO / DI / DI
AUTO S/S STATUS FAULT YS 4111 | MN 4111 | MM 4111 | UA 4111 — DI / DO / DI / DI
AUTO S/S STATUS FAULT YS 4101 | MN 4101 | MM 4101 | UA 4101 — DI / DO / DI / DI
LEVEL LI 2501 — AI
PAL 4112 — DI
OPEN CLOSE HSO 2501 | HSC 2501 | ZSO 2501 | ZSC 2501 — DO / DO / DI / DI
CL2 AI 2501A — AI
pH AI 2501B — AI

25-OPS-PP-3015

HS 2051 OCA

HS 2051 HOA MCC
HS 2061 HOA MCC
HS 4111 HOA MCC
HS 4101 HOA MCC

PI 2061
V2029
N.O. V2022
V2028
V2023
300-BWS-SS10-2005
300-BWS-SS10-2005

PI 2051
V2027
N.O. V2025
V2026
V2024
300-BWS-SS10-2013

ZSO 2501
SV 2501
PRV 2501
SET @ 100 kPag

200-BWS-SS10-2014

LIT 2501
LE 2501
PSL 4112

SERVICE WATER TO WTP
SERVICE WATER TO NPC
PID-I-6 DILUTION WATER

PID-I-8 ORTHOPHOSPHATE
PID-I-8 CAUSTIC SODA
25-CLS-PP-3011 V3050 V3051
PID-I-7 HYPOCHLORITE TYP. F-211,212,213
PID-I-3 BACKWASH WATER TYP. F-211,212,213
300-BWS-SS10-2005
PID-I-3 FILTERED WATER TYP. F-211,212,213
200-FW-SS10-2006
25-FAS-PP-3023 V3052 V3053
PID-I-8 HYDROFLUOROSILIC ACID TYP. F-211,212,213

200-FW-SS10-2006
25-FAS-PP-3023

MANUAL OPERATION TYP. IN CLEARWELL

TWL
BWL

V2038
V2039
300-BWS-SS10-2016
V2037
V2035
V2033
V2034

BACKWASH PUMP No. 1 — P 205
BACKWASH PUMP No. 2 — P 206

HS 2501A HOA | HS 2501B O/C
ZSO 2501
ZSC 2501
FCV 2501
V2040
75-TW-PVC-1013
AIT 2501
V2031
V2032
300-TW-PVC-2015
PID-I-11 TREATED WATER TO RESERVOIR
AE 2501 CL2
AE 2502 pH
D

NORTH CLEARWELL
CLEARWELL INLET CHAMBER
SOUTH CLEARWELL
PUMPING CHAMBER

FCV 2501
0.0 – 10.0ML/day
ON/OFF CONTROL

NO.	REVISION	DATE	INITIAL
2	RECORD DRAWING	19/07/04	LL
1	ISSUED FOR CONSTRUCTION	22/04/03	CKW
0	ISSUED FOR TENDER	19/02/03	CKW

Company Permit — Engineer Seal

RECORD DRAWING
INFORMATION CONTAINED IN THESE DRAWINGS IS AS SUPPLIED BY: SCHENDEL MECHANICAL CONTRACTING LTD. & VECTOR ELECTRIC & CONTROLS. THE COMPLETENESS AND ACCURACY OF THIS RECORD DRAWING IS NOT GUARANTEED. INFORMATION SHOULD BE VERIFIED ON LOCATION BEFORE USE.

PROCESS & INSTRUMENTATION

P & ID – CLEARWELL & BACKWASH SUPPLY

CITY of IQALUIT, Nunavut

CITY OF IQALUIT

IQALUIT WATER TREATMENT PLANT

EARTH TECH

Earth Tech (Canada) Inc.

DRAWN BY: CKW CHECKED BY: CKW/JVH	SCALE: NOT SCALED	DATE: FEBRUARY 2003	SHEET NO.
CADD SYSTEM AutoCAD	DWG NO. I–4	REV. 2	CONTRACT 55524

04/25/17 10:29am bbuchsdruecker C:\program files\adsk_common\temp\AcPublish_3248\55524-I 4 Record-July 2004.dwg Layout:I-4

AS-BUILT SIFEC
MARCH 2018
City of Iqaluit
Water Treatment Plant

LCP

MCP

UA 3041 — FAULT UA 3041 / S/S MN 3041 (DI / DO) — FLOW FC 1001E (AO)

UA 3031 — FAULT UA 3031 / S/S MN 3031 (DI / DO) — FLOW FC 1001D (AO)

UA 3061 — FAULT UA 3061 / S/S MN 3061 (DI / DO) — FLOW FC 1001G (AO)

UA 3051 — FAULT UA 3051 / S/S MN 3051 (DI / DO) — FLOW FC 1001F (AO)

PID-I-4
ZINC ORTHOPHOSPHATE DILUTION
FROM SERVICE WATER SYSTEM

ZINC ORTHOPHOSPHATE
DOSING SYSTEM

PSV 3031 SET @ 700 kPa

25-OPS-PP-3014

CALIBRATION COLUMN

V3013

V3012

25-OPS-PP-3012

V3024

FLUSHING CONNECTION

ZINC ORTHOPHOSPHATE DRUMS

V3014

V3015

25-OPS-PP-3013

P 304

P 303

M

FS

PI 3031

V3023

V3022

V3021

PULSATION DAMPER

V3020

V3019

SAMPLE PORT

CHANNEL_ID
25-OPS-PP-3017

PSV 3041 SET @ 700 kPa

PI 3041

V3016

V3017

V3018

25-OPS-PP-3016

25-OPS-PP-3015

PID-I-4
ORTHOPHOSPHATE TO
TREATED WATER
RESERVOIR

HYDRO FLUOROSILICIC ACID
DOSING SYSTEM

CALIBRATION COLUMN

V3026

V3025

25-FAS-PP-3018

V3027

FLUSHING CONNECTION

FLUOROSILICIC ACID DRUMS

25-FAS-PP-3020

PSV 3051 SET @ 700 kPa

PI 3051

V3037

V3036

V3035

V3028

P 305

25-FAS-PP-3019

PSV 3061 SET @ 700 kPa

25-FAS-PP-3021

PI 3061

V3030

V3031

V3032

V3029

P 306

25-FAS-PP-3022

PULSATION DAMPER

V3034

V3033 SAMPLE PORT

25-FAS-PP-3023

PID-I-4
TO CLEARWELL
INLET CHAMBER

NO.	REVISION	DATE	INITIAL
2	RECORD DRAWING	19/07/04	LL
1	ISSUED FOR CONSTRUCTION	22/04/03	CKW
0	ISSUED FOR TENDER	19/02/03	CKW

Company Permit

Engineer Seal

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PROCESS & INSTRUMENTATION

P & ID – FLUORIDE & ORTHOPHOSPHATE AND FLUOROSILICIC ACID SUPPLY

ᐃqaluit
ᐃᒪᓕᑦ
CITY of IQALUIT,
Nunavut

CITY OF IQALUIT

IQALUIT WATER TREATMENT PLANT

EARTH TECH

Earth Tech (Canada) Inc.

DRAWN BY: CKW CHECKED BY: CKW/JVH	SCALE: NOT NOTED	DATE: FEBT. 02002003	SHEET NO.
CADD SYSTEM AutoCAD	DWG NO. I–6	REV. 2	CONTRACT 55524

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AS-BUILT SIFEC
MARCH 2018
City of Iqaluit
Water Treatment Plant

LCP

MCP

UA 3631

UA 3621

LI 5001 | LAH 5001 | LAHH 5001 | LAL 5001 | LALL 5001

TI 5001

FI 5001 | FAH 5001

FAULT S/S UA 3631 MN 3631 DI DO

FLOW FC 1001 AO

FAULT S/S UA 3621 MN 3621 DI DO

FLOW FC 1001 AO

LEVEL LIT 5001 AI

TEMP TIT 5001 AI

FLOW FIT 5001 AI

CAUSTIC SODA

SET @ 700 kPa PSV 3621

25-CLS-PP-3031

PI 3621

V3042

V3041

PULSATION DAMPER

V3038

CALIBRATION COLUMN

V3045

25-CLS-PP-3030

PID-I-4 CAUSTIC SODA

25-CLS-PP-1011

V3040

FS

V3043

P 362

V3039

SAMPLE PORT

SET @ 700 kPa PSV 3631

V3044

FLUSHING CONNECTION

25-CLS-PP-3029

25-CLS-PP-3028

PI 3631

V3047

V3048

25-CLS-PP-3027

FS

V3046

CAUSTIC SODA DRUMS

V3049

P 363

LIT

LE 5001

TIT

TE 5001

TREATED WATER STORAGE RESERVOIR

FIT 5001

M

TO CITY DISTRIBUTION

PID-I-4 TREATED WATER

NO.	REVISION	DATE	INITIAL
2	RECORD DRAWINGS	11/05/04	LL
1	ISSUED FOR CONSTRUCTION	22/04/03	CKW
0	ISSUED FOR TENDER	19/02/03	CKW

Company Permit

Engineer Seal

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PROCESS & INSTRUMENTATION

P & ID – TEMPORARY CHLORINATION PLANT

CITY of IQALUIT, Nunavut

CITY OF IQALUIT

IQALUIT WATER TREATMENT PLANT

EARTH TECH

Earth Tech (Canada) Inc.

DRAWN BY: KWM CHECKED BY: CKW/JVH	SCALE: N.T.S.	DATE: OCT. 2002	SHEET NO.
CADD SYSTEM AutoCAD	DWG NO. I–7	REV. 2	CONTRACT 55524

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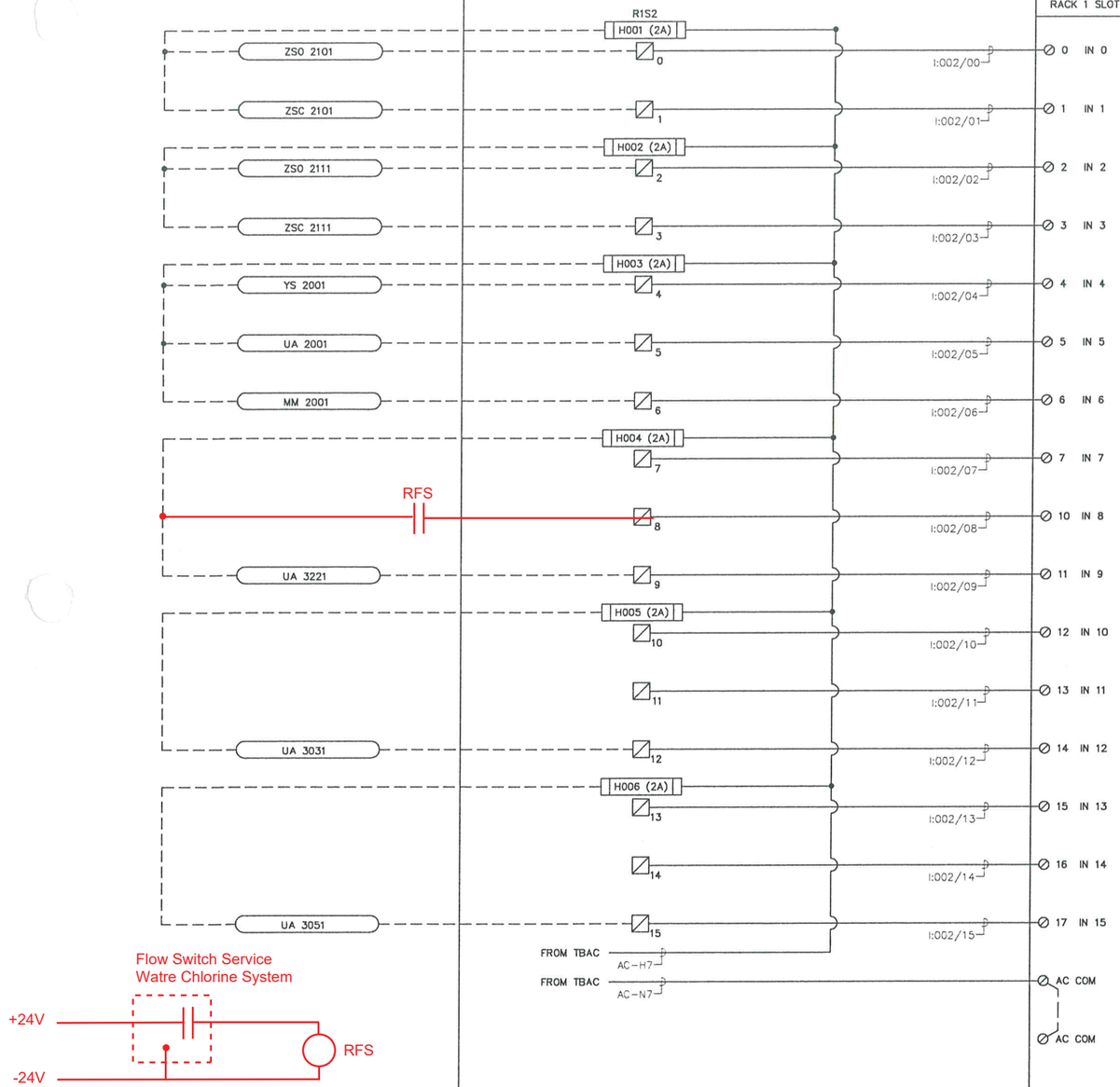
AS-BUILT SIFEC
MARCH 2018
City of Iqaluit
Water Treatment Plant

FIELD

UPPER FLOOR PLC PANEL



UPPER PLC PANEL 1746-IA16 120 VAC DIGITAL INPUT RACK 1 SLOT 2	PROGRAM SYMBOL	DESCRIPTION	DATA FIELD 1 LOGIC 0	DATA FIELD 2 LOGIC 1	REFERENCE DRAWING
0 IN 0	ZSO 2101	FILTER No.1 INLET VALVE	OPENED	TRAVELLING	ILD-FCV2101
1 IN 1	ZSC 2101	FILTER No.1 INLET VALVE	CLOSED	TRAVELLING	ILD-FCV2101
2 IN 2	ZSO 2111	FILTER No.2 INLET VALVE	OPENED	TRAVELLING	ILD-FCV2111
3 IN 3	ZSC 2111	FILTER No.2 INLET VALVE	CLOSED	TRAVELLING	ILD-FCV2111
4 IN 4	YS 2001	AIR SCOUR BLOWER 1	MANUAL	AUTO	ILD-AC200
5 IN 5	UA 2001	AIR SCOUR BLOWER 1	FAULT	HEALTHY	ILD-AC200
6 IN 6	MM 2001	AIR SCOUR BLOWER 1	STOPPED	RUNNING	ILD-AC200
7 IN 7	.	SPARE	.	.	.
10 IN 8	.	SERVICE WATER CHLORINE FLOW SWITCH	OFF	ON	.
11 IN 9	UA 3221	SODA ASH PUMP 1 FLOW SWITCH	ON	OFF	ILD-P322
12 IN 10	.	SPARE	.	.	.
13 IN 11	.	SPARE	.	.	.
14 IN 12	UA 3031	ZINC ORTHO DOSING PUMP 1 FLOW SWITCH	OFF	ON	ILD-P303
15 IN 13	.	SPARE	.	.	.
16 IN 14	.	SPARE	.	.	.
17 IN 15	UA 3051	HYDRO FLUORO DOSING PUMP 1 FLOW SWITCH	OFF	ON	ILD-P305

Flow Switch Service
Watre Chlorine System

(2A) FUSE HOLDER C/W INDICATOR
WEIDMUELLER WSI6/2 #10144O (120VAC)
WEIDMUELLER WSI6/2 #10145O (24VDC)

PANEL WIRING

PS1-H PANEL WIRE TAG

FIELD WIRING

UPPER PLC CABINET

LOWER PLC CABINET

MCC

WIRING & COLOR-CODING

- PLC DIGITAL I/O WIRING SHALL BE #16 AWG
- PLC ANALOG I/O WIRING SHALL BE 2C #18 AWG SHIELD CABLE
- 120VAC-H (BLACK)
- 120VAC-N (WHITE)
- 24VDC-P (BLUE)
- 24VDC-N (BROWN)

UPPER PLC PANEL
1746-IA16
DIGITAL INPUT MODULE
RACK 1 SLOT 2

SLOT	0	1	2	3	4	5	6	7	8	9	10	11	12
	POWER SUPPLY	CPU	I/O SCANNER		DI	DI	ISOLATED DO	ISOLATED DO	DO	AI	AO	AI	ISOLATED DO	SPACE

CONTRACTOR:
The Vector Group
ELECTRICAL • INSTRUMENTATION • AUTOMATION

VECTOR ELECTRIC AND CONTROLS
3524-78th AVENUE PH. (780) 469-7900
EDMONTON, ALBERTA FX. (780) 469-2122
T6B 2X9, CANADA
www.thevectorgroup.com

REV.	DATE	DESCRIPTION	BY	CHK	APPR
4	JUN 09/04	FIELD AS-BUILT DRAWING	TH		
3	NOV 20/03	FOR CONSTRUCTION	TH		
2	AUG 26/03	SHOP AS BUILT DRAWING	DK		
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CITY OF IQALUIT

IQALUIT WATER TREATMENT PLANT
UPPER PLC PANEL
DIGITAL INPUT WIRING DIAGRAM
RACK 1 SLOT 2 (1746-IA16)

REVISION: 4
SCALE: N.T.S.
FILE No. J1121
DRAWING No. 1121-UPLC-R1S2

AS-BUILT SIFEC
MARCH 2018
City of Iqaluit
Water Treatment Plant

FIELD

UPPER FLOOR PLC PANEL

PIT-1001

LI 5001

LI 4011

FROM TBDC — DC-H2

FROM TBDC — DC-N2

R1S10

0 — I:010/CH0+

0DC (2A)

0S — I:010/CH0-

1 — I:010/CH1+

1DC (2A)

1S

2 — I:010/CH2+

2DC (2A)

2S — I:010/CH2-

3 — I:010/CH3+

3-
3S — I:010/CH3-

SHEILD 0-3

4 — I:010/CH4+

4-
4S — I:010/CH4-

5 — I:010/CH5+

5-
5S — I:010/CH5-

6 — I:010/CH6+

6-
6S — I:010/CH6-

7 — I:010/CH7+

7-
7S — I:010/CH7-

SHEILD 4-7

UPPER PLC PANEL 1746-NI8 ANALOG INPUT RACK 1 SLOT 10	PROGRAM SYMBOL	DESCRIPTION	DATA FIELD 1 LOGIC 0	DATA FIELD 2 LOGIC 1	REFERENCE DRAWING
0 CH 0+	PIT-1001	Raw Water Inlet Pressure Transmitter	Pressure	mH2O	
1 CH 0-					
2 CH 1+	SPARE LOOP POWERED				
3 CH 1-					
4 CH 2+	SPARE LOOP POWERED				
5 CH 2-					
6 CH 3+	SPARE LOOP POWERED				
7 CH 3-					
SHEILD 0-3					
10	LI 5001	RESERVOIR LEVEL TRANSMITTER	LEVEL	%	ILD-LIT5001
11					
12	LI 4011	FILTER TO WASTE TANK LEVEL TRANSMITTER	LEVEL	0-4m	ILD-LIT4011
13					
14	SPARE				
15					
16	SPARE				
17					
SHEILD 4-7					

ZSO 2

(2A) — FUSE HOLDER C/W INDICATOR
WEIDMUELLER WSI6/2 #101440 (120VAC)
WEIDMUELLER WSI6/2 #101450 (24VDC)

PANEL WIRING

PS1-H — PANEL WIRE TAG

FIELD WIRING

UPPER PLC CABINET

LOWER PLC CABINET

MCC

WIRING & COLOR-CODING

- PLC DIGITAL I/O WIRING SHALL BE #16 AWG
- PLC ANALOG I/O WIRING SHALL BE 2C #18 AWG SHIELD CABLE
- 120VAC-H (BLACK)
- 120VAC-N (WHITE)
- 24VDC-P (BLUE)
- 24VDC-N (BROWN)

UPPER PLC PANEL
1746-NI8
ANALOG INPUT MODULE
RACK 1 SLOT 10

SLOT	0	1	2	3	4	5	6	7	8	9	10	11	12
POWER SUPPLY	CPU	I/O SCANNER	DI	DI	DI	ISOLATED DO	ISOLATED DO	DO	AI	AO		ISOLATED DO	SPACE

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CITY OF IQALUIT

IQALUIT WATER TREATMENT PLANT
UPPER PLC PANEL
ANALOG INPUT SCHEMATIC DIAGRAM
RACK 1 SLOT 10 (1746-NI8)

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Mechanical Operation & Maintenance Manual

for the

Iqaluit Water Treatment Plant

Iqaluit, Nunavut

Year of Completion: 2004

Original Scope: Design and upgrade existing Water Treatment Plant to meet current and future demands.

This manual has been updated to include:

Date	Description of Change
October, 2018	Inclusion of updates and upgrades made to the water treatment plant as per the 2017 Water and Wastewater Facilities Improvement Project (#SC711).

Iqaluit Water Treatment Plant

Project History

The City of Iqaluit:	City of Iqaluit Public Works & Engineering P.O. Box 460 Iqaluit, NU X0A 0H0 Matthew Hamp, Director of Public Works & Engineering Phone : (867) 979-5653 m.hamp@city.iqaluit.nu.ca
Project Engineer:	**2004 Upgrades** Earth Tech Canada Inc. (Currently AECOM) 4916 47th Street P.O. Box 1259 Yellowknife, NT X1A 2N9 Phone: 1 (867) 873-6316 **2017 Upgrades** Glenn Prosko, Project Manager Nunami-Stantec 10160 112 Street Edmonton AB T5K 2L6 Phone: (780) 969-3258 Glenn.Prosko@stantec.com
General Contractor:	**2004 Upgrades** 90 North Construction & Development Ltd. (No longer in operation) Suite 106, 6131-6th Street S.E. Calgary, AB T2H 1L9 **2017 Upgrades** Maxime Gaudreau, Project Manager Kudlik Construction Ltd. P.O. Box 727, 1519 Federal Road Iqaluit, NU X0A 0H0 Phone: (418) 802-8224 mgaudreau@kudlik.biz
Electrical Subcontractor:	**2004 Upgrades** KRT Electric 1505 Federal Rd, Iqaluit, NU P.O. Box 1259 Iqaluit, NU X0A 0H0

	Phone: 1 (867) 979-2639 **2017 Upgrades** Carl Fauteux, Vice-President Sifec North Inc. P.O. Box 556, Rankin Inlet, NU, X0C 0C0, Phone: (855) 437-4001 carl@sifec.ca
Mechanical Subcontractor:	**2004 Upgrades** Schendel Mechanical Contracting Ltd. 20310-107 Avenue Edmonton, AB T5T 3L7 Phone : (780) 447-3400 **2017 Upgrades** Carl Fauteux, Vice-President Sifec North Inc. P.O. Box 556, Rankin Inlet, NU, X0C 0C0, Phone: (855) 437-4001 carl@sifec.ca
Instrumentation Subcontractor:	**2004 Upgrades** Vector Electric & Controls 3524-78 Avenue Edmonton, AB X1A 2P4 Phone: (780) 469-7900 **2017 Upgrades** Carl Fauteux, Vice-President Sifec North Inc. P.O. Box 556, Rankin Inlet, NU, X0C 0C0, Phone: (855) 437-4001 carl@sifec.ca

Mechanical Operation & Maintenance Manual

for the

Iqaluit Water Treatment Plant

Iqaluit, Nunavut

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Chapter 3

BACKGROUND AND DESIGN DATA

3.1 General

Due to the population growth in the City of Iqaluit, prior to the upgrades in 2004, the existing water treatment plant was not able to meet future daily demands. To meet future demands, the existing water treatment plant (WTP) underwent major upgrade work in 2004.Within the WTP upgrades scope of work, the mechanical systems were also upgraded to properly support plant operation. In 2017, additional upgrade and maintenance work were carried out as part of the Water and Wastewater Facilities Improvement Project (SC#711), in which several process and electrical and instrumentation components were replaced and a few were newly installed. The mechanical component that was replaced included the exhaust fan in the Chlorine Room.

3.2 Existing Mechanical Systems

The facility's existing mechanical systems consists of several types of systems. The mechanical systems servicing the facility include the hydronic (glycol) heating system, the building ventilation system, - and the fuel oil system The existing heating system consists of two fuel oil (diesel) fired boilers servicing a hydronic system using glycol. Heating for the plant areas is accomplished by distribution of glycol through a direct piping system to terminal heating units (unit heaters, force flow heaters, baseboard radiation). The terminal heating units exhibit corrosion and is near the end of their asset lifecycle. The heating boilers were originally replaced in 1993.

Prior to the 2004 upgrades, the existing ventilation system, consisting of an exhaust fan and a natural vent opening to service the filter flow level, provided minimal ventilation for the plant areas. No ventilation had been provided to service the pump floor level. As a result, the plant operating equipment exhibited excessive corrosion due to the lack of ventilation to remove the humidity build-up within the plant.

The old fuel oil system consisted of an outdoor storage tank, an indoor day tank, and the fuel oil transfer system provides fuel for the heating boilers. The existing day tank was not equipped with a containment dike to meet current code requirements. The day tank steel support structure also did not meet minimum fire code requirements.

3.3 Facility Mechanical Systems Upgrades (2004)

As part of the 2004 WTP upgrade,, the mechanical systems were upgraded to meet heating, ventilation, safety, miscellaneous mechanical and applicable code requirements.

3.3.1 Hydronic (Glycol) Heating System Upgrades

Two existing diesel-fired, glycol heating boilers located in the Mechanical Room serve as the primary heating source for the building via a hydronic system utilizing glycol. Each boiler provides 100% of the system capacity at 88^{o}C glycol supply temperature, ensuring full heating capacity at all times. The boilers provide hot glycol to the air handling units heating coils, reheat coils, unit heaters, force flow heaters and wall radiation located throughout the building. Two primary glycol pumps circulate the glycol to the heating equipment as required.

As part of the upgrades to the heating system, three existing unit heaters and associated piping located in the reservoir were removed. Four existing unit heaters were replaced with three new units; the existing stairwell force flow heat at the Pump Floor Level was replaced, and six existing unit heaters at the Filter Floor Level were replaced with five new units. Two new unit heaters were added to service the new Filter Level Addition. Where possible, the new unit heaters were provided with stainless steel components for corrosion resistance. Each new unit heater has a heating capacity of 14.3 kW (49,000 Btu/hr). The force flow heater has a heating capacity of 15.0 kW (51,000 Btu/hr).

Other heating upgrades consisted of replacement of the wall radiator in the existing Office/Laboratory and Washroom, and addition of a wall radiator for the New Office. The wall radiator has a heating capacity range of 1.13 to 1.44 kW/m (1,200 Btu/hr/ft to 1,500 Btu/hr/ft), depending on its location.

Two reheat coils, each with a heating capacity of 1.7 kW (5,800 Btu/hr), were added to the ductwork of the new air handling units to service the Office/Laboratory and New Office.

The direct heating piping distribution system was revised to a reverse return system to provide more efficient heating fluid flow control, prevent short cycling of system and improve hot heating fluid circulation at the farthest terminal heating unit.

The two existing heating re-circulation pumps were replaced and upgraded to meet the requirements of the updated heating system, with the addition of an air separator to remove air from the heating system. The flow capacity of each pump is rated at 6.0 L/s (79 Imp. gpm) with each pump providing 100% of system flow requirements.

3.3.2 Ventilation System Upgrades

Ventilation system upgrades include addition of one air handling unit to service the Pump and Filter Floor Levels, and the addition of one air handling unit and two exhaust fans to service the Filter Level Addition. The existing washroom exhaust fan was replaced, and an exhaust fan was added to service the New Chlorine Room. In 2017, the Chlorine Room exhaust fan was replaced again as part of the Water and Wastewater Facilities Improvement project. Ventilation for the Pump/Filter Level is provided by an air handling unit that contains heating coil interlocked with an exhaust damper. Ventilation for the Filter Level is provided by an air handling unit that consists of pre-heat and heating coils interlocked with an exhaust fan. Additional Filter Level ventilation is provided by a second exhaust fan interlocked with the process aeration (air scour) blowers.

3.3.3 Fuel Oil System Upgrades

Fuel oil system upgrades consist of replacement of the existing day tank with an ULC approved self-contained storage tank. Other fuel oil system upgrades include the replacement of the day tank existing steel support structure with a new support structure capable of maintaining its integrity for a minimum of two hours during a fire. The replacement day tank is a Durex double wall tank with a storage capacity of 1136 Litres (250 Imp. gal.).

Since the scope of the 2004 and 2017 projects was an upgrade to existing systems, this mechanical operation and maintenance manual will address only items pertaining to the upgrades.

END OF CHAPTER 3

Chapter 4

SCHEMATICS AND FUNCTIONAL DATA

4.1 Typical Unit Heater & Force Flow Heater Flow Schematic (Refer to Drawing M-1 at the end of this section)

Typical Unit Heater & Force Flow Heater Flow Schematic

No.	Component	Location	Function Performed	Remarks
1	Unit Heaters & Force Flow Heaters	Pump & Filter Levels	Provides heating for Pump & Filter Levels	
2	Room Thermostat	Pump & Filter Levels	Temperature control for Unit Heater or Force Flow Heater	Room temperature to be maintained at set point.
3	Manual Air Vent	Unit Heater & Force Flow Heater Return Piping	Allows for venting/removal of trapped air from heating system	
4	Drain Valve	Unit Heater & Force Flow Heater Supply Piping	Allows for draining of glycol from Unit Heater or Force Flow Heater	Normally Closed & Capped
5	Union	Unit Heater & Force Flow Heater Supply Piping	Allows for removal of Unit Heater or Force Flow Heater from heating system.	
6	Union	Unit Heater & Force Flow Heater Return Piping	Allows for removal of Unit Heater or Force Flow Heater from heating system	
7	Isolation Valve	Unit Heater & Force Flow Heater Supply Piping	Valve used for isolation of Unit Heater or Force Flow Heater	Normally Open
8	Balancing/Isolation Valve	Unit Heater & Force Flow Heater Return Piping	Valve used for balancing/isolation of Unit Heater or Force Flow Heater	Normally Open Valve to be reset to balanced position if used for isolation

4.2 Typical Reheat Coil Flow Schematic (Refer to Drawing M-2 at the end of this section)

Typical Reheat Coil Flow Schematic

No.	Component	Location	Function Performed	Remarks
1	Reheat Coils	Air Handling Unit-1 Ductwork	Provides heating for Office/Laboratory & New Office	
2	Room Thermostat	Office/Laboratory & New Office	Temperature control for Reheat Coil	Room temperature to be maintained at set point.
3	Control Valve (2-way)	Reheat Coil Supply Piping	Regulates glycol flow to Reheat Coil	
4	Manual Air Vent	Reheat Coil Return Piping	Allows for venting/removal of trapped air from heating system	
5	Drain Valve	Reheat Coil Supply Piping	Allows for draining of glycol from Reheat Coil	Normally Closed & Capped
6	Union	Reheat Coil Supply Piping	Allows for removal of Reheat Coil from heating system	
7	Union	Reheat Coil Return Piping	Allows for removal of Reheat Coil from heating system	
8	Isolation Valve	Reheat Coil Supply Piping	Valve used for isolation of Reheat Coil	Normally Open
9	Balancing/Isolation Valve	Reheat Coil Return Piping	Valve used for balancing/isolation of Reheat Coil	Normally Open Valve to be reset to balanced position if used for isolation

4.3 Typical Air Handling Unit Preheat & Heating Coils Flow Schematic (Refer to Drawing M-3 at the end of this section)

Typical Air Handling Unit Preheat & Heating Coils Flow Schematic

No.	Component	Location	Function Performed	Remarks
1	Preheat & Heating Coils	Pump & Filter Levels	Provides heating for Pump & Filter Levels	
2	Temperature Control Valve (3-way)	Preheat & Heating Coil Supply & Return Piping	Regulates glycol flow Preheat or Heating coil provide desired AHU discharge supply air temperature	
3	Duct Mounted Thermostat	AHU Supply Air Discharge Ductwork	Measures AHU Supply Air Discharge Temperature & regulates 3-way control valve	AHU Supply Air Discharge temperature to be maintained at set point
4	Isolation Valve	Preheat & Heating Coil Supply Piping	Valve used for isolation of Preheat or Heating Coil	Normally Open
5	Isolation Valve	Preheat & Heating Coil Return Piping	Valve used for isolation of Preheat or Heating Coil	Normally Open
6	Union	Preheat & Heating Coil Supply Piping	Allows for removal of Preheat or Heating Coil from AHUs	
7	Union	Preheat & Heating Coil Return Piping	Allows for removal of Preheat or Heating Coil from AHUs	
8	Isolation Valve	Preheat & Heating Coil Supply Piping	Valve used for isolation of Preheat or Heating Coil Temperature Control Valve	Normally Open
9	Isolation Valve	Preheat & Heating Coil Return Piping	Valve used for isolation of Preheat or Heating Coil Temperature Control Valve	Normally Open
10	Isolation Valve	Preheat & Heating Coil Return Piping	Valve used for isolation of Preheat or Heating Coil Temperature Control Valve	Normally Open

Typical Air Handling Unit Preheat & Heating Coils Flow Schematic

No.	Component	Location	Function Performed	Remarks
11	Isolation Valve	Preheat & Heating Coil Return Piping	Valve used for bypass of Preheat or Heating Coil Temperature Control Valve	Normally Close
12	Isolation Valve	Preheat & Heating Coil Supply Piping	Valve used for isolation of Preheat or Heating Coil Temperature Control Valve	Normally Open
13	Balancing/Isolation Valve	Preheat & Heating Coil Return Piping	Valve used for balancing/isolation of Preheat or Heating Coil	Normally Open Valve to be reset to balanced position if used for isolation

4.4 Heating Pumps Flow Schematic (Refer to Drawing M-4 at the end of this section)

Heating Pumps Flow Schematic

No.	Component	Location	Function Performed	Remarks
1	Primary Heating Pump P-3	Mechanical Room	Circulates glycol throughout heating system	
2	Check Valve	Pump P-3 Discharge Piping	Prevents backflow of glycol	
3	Balancing/Isolation Valve	Pump P-3 Discharge Piping	Valve used for balancing/isolation of Pump P-3	Normally Open Valve to be reset to balanced position if used for isolation
4	Strainer	Strainer provided within Air Separator (No.15)	Provides for removal of solid material from glycol heating system	Strainer to be cleaned if plugged
5	FS – Flow Switch	Pump P-3 Discharge Piping	Indication of glycol flow for Pump P-3	
6	Isolation Valve	Pump P-3 Suction Piping	Valve used for isolation of Pump P-3	Normally Open
7	PI – Pressure Indicator	Pump P-3 Suction & Discharge Piping	Visual indication of Pump P-3 operating pressures and strainer condition	
8	Primary Heating Pump P-4	Mechanical Room	Circulates glycol throughout heating system	
9	Check Valve	Pump P-4 Discharge Piping	Prevents backflow of glycol	
10	Balancing/Isolation Valve	Pump P-4 Discharge Piping	Valve used for balancing/isolation of Pump P-4	Normally Open Valve to be reset to balanced position if used for isolation
11	Strainer	Strainer provided within Air Separator (No.15)	Provides for removal of solid material from heating system	Strainer to be cleaned if plugged

Heating Pumps Flow Schematic

No.	Component	Location	Function Performed	Remarks
12	FS – Flow Switch	Pump P-4 Discharge Piping	Indication of glycol flow for Pump P-4	
13	Isolation Valve	Pump P-4 Suction Piping	Valve used for isolation of Pump P-4	Normally Open
14	PI – Pressure Indicator	Pump P-4 Suction & Discharge Piping	Visual indication of Pump P-4 operating pressures and strainer condition	
15	Air Separator c/w Strainer	Mechanical Room	Automatic separation of trapped air from glycol heating system	
16	AAV – Automatic Air Vent	Air Separator	Automatic removal of trapped air from glycol heating system	
17	Drain Valve	Air Separator	Allows for draining of glycol from Air Separator	Normally Closed & Capped
18	Isolation Valve	Air Separator Outlet Piping	Valve used for isolation of Air Separator	Normally Open
19	Isolation Valve	Supply Header Supply Piping	Valve used for isolation of Heating System from Main Supply	Normally Open
20	TI – Temperature Indicator	Pumps P-3 & P-4 Common Supply Piping	Visual indication of heating system glycol supply temperature	
21	TI – Temperature Indicator	Heating System Common Return Piping	Visual indication of heating system glycol return temperature	
22	Isolation Valve	Return Header Return Piping	Valve used for isolation of Heating System from Main Return	Normally Open

4.5 Air Handling Unit AHU-1 Flow Schematic (Refer to Drawing M-5 at the end of this section)

Air Handling Unit AHU-1 Flow Schematic

No.	Component	Location	Function Performed	Remarks
1	Air Handling Unit AHU-1	Filter Floor Level	Provides ventilation for Pump & Filter Floor Level	
2	Supply Fan	AHU-1	Provides flow of air	
3	Intake Hood	Outside Wall	Allows outside air to be supplied to AHU-1	
4	Outside Air Damper Motor & Outside Air Dampers	AHU-1	Dampers opens to provide outside air for AHU-1	Dampers Normally Closed
5	Return Air Damper Motor & Return Air Dampers	AHU-1	Dampers opens to provide return air for AHU-1	Dampers Normally Open
6	30% Filter – Summer Position	AHU-1	Removal of dust & dirt 30% Filters to be installed at this location during summer time	
7	PD-1 – Pressure Differential Indicator	AHU-1	Visual indication of pressure differential across filter to indicate condition of filter	Filters to be replaced if plugged
8	TS-1 – Temperature Sensor – Mixed Air	AHU-1	Measures and modulates outside & return air dampers to maintain mixed air set point	
9	30% Filter – Winter Position	AHU-1	Removal of dust & dirt 30% Filters to be installed at this location during winter time	
10	PD-2 – Pressure Differential Indicator	AHU-1	Visual indication of pressure differential across filter to indicate condition of filter	Filters to be replaced if plugged

Air Handling Unit AHU-1 Flow Schematic

No.	Component	Location	Function Performed	Remarks
11	Heating Coil	AHU-1	Provides tempering of outside/return air to maintain supply air set point	
12	65% Final Filter	AHU-1	Removal of dust & dirt	Filters to be replaced if plugged
13	LTA – Low Temperature Alarm	AHU-1	Low supply air temperature protection Shutdown of AHU-1 if low limit is exceeded	
14	TS-2 – Temperature Sensor – Supply Air	AHU-1	Measures and modulates heating coil control valve to maintain supply air set point	
15	Room Thermostat	Filter Floor Level	Measures and controls AHU-1 to maintain room temperature set point	
16	Exhaust Hood	Outside Wall	Allows air to be relieved	
17	Relief Air Damper Motor & Relief Air Dampers	Filter Floor Level	Dampers opens to relieve air	Dampers Normally Closed
18	Exhaust Hood	Outside Wall	Allows air to be relieved	
19	Barometric Relief Air Dampers	Filter Floor Level	Dampers opens to relieve air	Dampers Normally Closed

4.6 Air Handling Unit AHU-2 Flow Schematic (Refer to Drawing M-6 at the end of this section)

Air Handling Unit AHU-2 Flow Schematic

No.	Component	Location	Function Performed	Remarks
1	Air Handling Unit AHU-2	Filter Floor Level	Provides ventilation for Filters Area	Interlocked with EF-2
2	Supply Fan	AHU-2	Provides flow of air	
3	Intake Hood	Outside Wall	Allows outside air to be supplied to AHU-2	
4	Outside Air Damper Motor & Outside Air Dampers	AHU-2	Dampers opens to provide outside air for AHU-2	Dampers Normally Closed
5	30% Filter – Summer Position	AHU-2	Removal of dust & dirt 30% Filters to be installed at this location during summer time	
6	PD – Pressure Differential Indicator	AHU-2	Visual indication of pressure differential across filter to indicate condition of filter	Filters to be replaced if plugged
7	Preheat Coil	AHU-2	Provides tempering of outside air to maintain supply air set point	
8	LTA – Low Temperature Alarm	AHU-2	Low supply air temperature protection Shutdown of AHU-2 if low limit is exceeded	
9	30% Filter – Winter Position	AHU-2	Removal of dust & dirt 30% Filters to be installed at this location during winter time	
10	PD – Pressure Differential Indicator	AHU-2	Visual indication of pressure differential across filter to indicate condition of filter	Filters to be replaced if plugged
11	Heating Coil	AHU-2	Provides tempering of outside air to maintain supply air set point	

Air Handling Unit AHU-2 Flow Schematic

No.	Component	Location	Function Performed	Remarks
12	65% Final Filter	AHU-2	Removal of dust & dirt	Filters to be replaced if plugged
13	TS-1 – Temperature Sensor – Supply Air	AHU-2	Measures and modulates preheat & heating coil control valves to maintain supply air set point	
14	Room Thermostat	Filters Area	Measures and controls AHU-2 to maintain room temperature set point	
15	Exhaust Fan EF-2	Filters Area	Provides exhaust for filters area	Interlocked with AHU-2
16	Exhaust Fan EF-2 Damper motor & Dampers	Filters Area	Dampers open to exhaust air	Dampers Normally Closed
17	HS-1 – Humidity Sensor Exhaust Air	EF-2 Ductwork	Measures humidity of the exhaust air	
18	Exhaust Fan EF-4	Filters Area	Provides exhaust for Air Scour Blowers	Interlocked with Air Scour Blowers
19	Exhaust Fan EF-4 Damper motor & Dampers	Filters Area	Dampers open to exhaust air	Dampers Normally Closed

4.7 Exhaust Fan EF-3 Flow Schematic (Refer to Drawing M-7 at the end of this section)

Exhaust Fan EF-3 Flow Schematic

No.	Component	Location	Function Performed	Remarks
1	Exhaust Fan EF-3	Chlorine Storage Room	Provides exhaust for Chlorine Storage Room	
2	Exhaust Fan EF-3 Damper Motor & Dampers & End Switch	Chlorine Storage Room	Dampers opens to exhaust air	Dampers Normally Closed
3	Manual Push Button	Entrance Lobby	Allows start-up & shutdown of EF-3	

4.8 Fuel Oil (Diesel) Flow Schematic (Refer to Drawing M-8 at the end of this section)

Fuel Oil (Diesel) Flow Schematic

No.	Component	Location	Function Performed	Remarks
1	Exhaust Fan EF-3	Chlorine Storage Room	Provides exhaust for Chlorine Storage Room	
2	Exhaust Fan EF-3 Damper Motor & Dampers & End Switch	Chlorine Storage Room	Dampers opens to exhaust air	Dampers Normally Closed

END OF CHAPTER 4

Chapter 5

COMPONENT DETAILS

5.1 Typical Unit Heater & Force Flow Heater Flow Schematic (Refer to Drawing M-1 at the end of Chapter 4)

Typical Unit Heater & Force Flow Heater Flow Schematic

No.	Component	Details	Setting	Remarks
1	Unit Heaters & Force Flow Heaters	Engineered Air Unit Heaters: H Series: M/N: H-3 Force Flow: CUH Series: M/N: CUH-7		Supplier: Engineered Air Edmonton, AB
2	Room Thermostat	Robertshaw M/N: 501-501C		Supplier: Automatic Controls Edmonton, AB
3	Manual Air Vent			Supplier: Bartle & Gibson Edmonton, AB
4	Drain Valve	M.A. Steward & Sons Kitz – Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton
5	Union			Supplier: Bartle & Gibson Edmonton
6	Union			Supplier: Bartle & Gibson Edmonton
7	Isolation Valve	M.A. Steward & Sons Kitz – Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton
8	Balancing/Isolation Valve	Dahl Brothers Canada Ltd. M/N: 13013		Supplier: Bartle & Gibson Edmonton

5.2 Typical Reheat Coil Flow Schematic (Refer to Drawing M-2 at the end of Chapter 4)

Typical Reheat Coil Flow Schematic

No.	Component	Details	Setting	Remarks
1	Reheat Coils	Engineered Air Custom Built for Project		Supplier: Engineered Air Edmonton, AB
2	Room Thermostat	Invensys M/N: TA168-001		Supplier: Automatic Controls Edmonton, AB
3	Control Valve (2-way)	Invensys Reheat Coil: M/N: VS-2213-536-9-02 Wall Radiation: M/N: VM2233P23A000		Supplier: Automatic Controls Edmonton, AB
4	Manual Air Vent			Supplier: Bartle & Gibson Edmonton
5	Drain Valve	M.A. Steward & Sons Kitz – Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton
6	Union			Supplier: Bartle & Gibson Edmonton
7	Union			Supplier: Bartle & Gibson Edmonton
8	Isolation Valve	M.A. Steward & Sons Kitz – Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton
9	Balancing/Isolation Valve	Dahl Brothers Canada Ltd. M/N: 13013		Supplier: Bartle & Gibson Edmonton

5.3 Typical Air Handling Unit Preheat & Heating Coils Flow Schematic (Refer to Drawing M-3 at the end of Chapter 4)

Typical Air Handling Unit Preheat & Heating Coils Flow Schematic

No.	Component	Details	Setting	Remarks
1	Preheat & Heating Coils	Engineered Air Custom Built for Project Inclusive of Air Handling Units		Supplier: Engineered Air Edmonton, AB
2	Temperature Control Valve (3-way)	Invensys M/N: VS-2313-536-9-03 or 05		Supplier: Automatic Controls Edmonton, AB
3	Duct Mounted Thermostat	Invensys M/N: TS-8201		Supplier: Automatic Controls Edmonton, AB
4	Isolation Valve	M.A. Steward & Sons Kitz – Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton
5	Isolation Valve	M.A. Steward & Sons Kitz – Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton
6	Union			Supplier: Bartle & Gibson Edmonton
7	Union			Supplier: Bartle & Gibson Edmonton
8	Isolation Valve	M.A. Steward & Sons Kitz – Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton
9	Isolation Valve	M.A. Steward & Sons Kitz – Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton
10	Isolation Valve	M.A. Steward & Sons Kitz – Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton
11	Isolation Valve	M.A. Steward & Sons Kitz – Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton
12	Isolation Valve	M.A. Steward & Sons Kitz – Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton

Typical Air Handling Unit Preheat & Heating Coils Flow Schematic

No.	Component	Details	Setting	Remarks
13	Balancing/Isolation Valve	Dahl Brothers Canada Ltd. M/N: 13013		Supplier: Bartle & Gibson Edmonton

5.4 Heating Pumps Flow Schematic (Refer to Drawing M-4 at the end of Chapter 4)

Heating Pumps Flow Schematic

No.	Component	Details	Setting	Remarks
1	Primary Heating Pump P-3	Armstrong M/N: Series 4360 3D		Supplier: Wolsely Mechanical Group Edmonton, AB
2	Check Valve	Val-Matic M/N: Series 1400		Supplier: Robins Flow Tech Edmonton, AB
3	Balancing/Isolation Valve	Armstrong M/N: CBV-G Straight		Supplier: Bartle & Gibson Edmonton, AB
4	Strainer/Air Separator	Armstrong M/N: VAS-3		Supplier: Wolsely Mechanical Group Edmonton, AB
5	FS – Flow Switch	MacDonnell M/N: Series FS4-3		Supplier: Emco Edmonton, AB
6	Isolation Valve	Apollo M/N: Series 143		Supplier: M.A. Steward & Sons Edmonton, AB
7	PI – Pressure Indicator	H.O. Trerice Co. M/N: 620B		Supplier: Ener-tech Mechanical Sales Edmonton, AB
8	Primary Heating Pump P-4	Armstrong M/N: Series 4360 3D		Supplier: Wolsely Mechanical Group Edmonton, AB
9	Check Valve	Val-Matic M/N: Series 1400		Supplier: Robins Flow Tech Edmonton, AB
10	Balancing/Isolation Valve	Armstrong M/N: CBV-G Straight		Supplier: Bartle & Gibson Edmonton, AB
11	Strainer/Air Separator	Armstrong M/N: VAS-3		Supplier: Wolsely Mechanical Group Edmonton, AB
12	FS – Flow Switch	MacDonnell M/N: Series FS4-3		Supplier: Emco Edmonton, AB
13	Isolation Valve	Apollo M/N: Series 143		Supplier: M.A. Steward & Sons Edmonton, AB

Heating Pumps Flow Schematic

No.	Component	Details	Setting	Remarks
14	PI – Pressure Indicator	H.O. Trerice Co. M/N: 620B		Supplier: Ener-tech Mechanical Sales Edmonton, AB
15	Air Separator/Strainer	Armstrong M/N: VAS-3		Supplier: Wolsely Mechanical Group Edmonton, AB
16	AAV – Automatic Air Vent			Supplier: Bartle & Gibson Edmonton, AB
17	Drain Valve	M.A. Steward & Sons Kitz-Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton, AB
18	Isolation Valve	M.A. Steward & Sons Kitz-Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton, AB
19	Isolation Valve	M.A. Steward & Sons Kitz-Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton, AB
20	TI – Temperature Indicator	H.O. Trerice Co. M/N: BX-9		Supplier: Ener-tech Mechanical Sales Edmonton, AB
21	TI – Temperature Indicator	H.O. Trerice Co. M/N: BX-9		Supplier: Ener-tech Mechanical Sales Edmonton, AB
22	Isolation Valve	M.A. Steward & Sons Kitz-Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton, AB

5.5 Air Handling Unit AHU-1 Flow Schematic (Refer to Drawing M-5 at the end of Chapter 4)

Air Handling Unit AHU-1 Flow Schematic

No.	Component	Details	Setting	Remarks
1	Air Handling Unit AHU-1	Engineered Air Custom Built for Project M/N: LM-3-C		Supplier: Engineered Air Edmonton, AB
2	Supply Fan	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB
3	Intake Hood			
4	Outside Air Damper Motor & Outside Air Dampers	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB
5	Return Air Damper Motor & Return Air Dampers	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB
6	30% Filter – Summer Position	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB
7	PD-1 – Pressure Differential Indicator	Engineered Air Inclusive of Air Handling Unit Dwyer: Series 2000		Supplier: Engineered Air Edmonton, AB
8	TS-1 – Temperature Sensor – Mixed Air	Invensys M/N: TS-8405		Supplier: Automatic Controls Edmonton, AB
9	30% Filter – Winter Position	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB
10	PD-2 – Pressure Differential Indicator	Engineered Air Inclusive of Air Handling Unit Dwyer: Series 2000		Supplier: Engineered Air Edmonton, AB
11	Heating Coil	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB

Air Handling Unit AHU-1 Flow Schematic

No.	Component	Details	Setting	Remarks
12	65% Final Filter	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB
13	LTA – Low Temperature Alarm	Johnson Controls M/N: A70BA		Supplier: Automatic Controls Edmonton, AB
14	TS-2 – Temperature Sensor – Supply Air	Invensys M/N: TS-8201		Supplier: Automatic Controls Edmonton, AB
15	Room Thermostat	Invensys M/N: MN-S4		Supplier: Automatic Controls Edmonton, AB
16	Exhaust Hood			
17	Relief Air Damper Motor & Relief Air Dampers	Damper Motor: Belimo M/N: LF120 or NF120 Damper: Tamco M/N: Series 9000		Supplier: E.H. Price Edmonton, AB
18	Exhaust Hood			
19	Barometric Relief Air Dampers	Ruskin M/N: MD35		Supplier: Aqua Air Systems Ltd Edmonton, AB

5.6 Air Handling Unit AHU-2 Flow Schematic (Refer to Drawing M-6 at the end of Chapter 4)

Air Handling Unit AHU-2 Flow Schematic

No.	Component	Details	Setting	Remarks
1	Air Handling Unit AHU-2	Engineered Air Custom Built for Project M/N: LM-3-C-MV		Supplier: Engineered Air Edmonton, AB
2	Supply Fan	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB
3	Intake Hood			
4	Outside Air Damper Motor & Outside Air Dampers	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB
5	30% Filter – Summer Position	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB
6	PD- – Pressure Differential Indicator	Engineered Air Inclusive of Air Handling Unit Dwyer: Series 2000		Supplier: Engineered Air Edmonton, AB
7	Preheat Coil	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB
8	LTA – Low Temperature Alarm	Johnson Controls M/N: A70BA		Supplier: Automatic Controls Edmonton, AB
9	30% Filter – Winter Position	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB
10	PD – Pressure Differential Indicator	Engineered Air Inclusive of Air Handling Unit Dwyer: Series 2000		Supplier: Engineered Air Edmonton, AB
11	Heating Coil	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB

Air Handling Unit AHU-2 Flow Schematic

No.	Component	Details	Setting	Remarks
12	65% Final Filter	Engineered Air Inclusive of Air Handling Unit		Supplier: Engineered Air Edmonton, AB
13	TS-1 – Temperature Sensor – Supply Air	Invensys M/N: TS-8201		Supplier: Automatic Controls Edmonton, AB
14	Room Thermostat	Invensys M/N: MN-S4		Supplier: Automatic Controls Edmonton, AB
15	Exhaust Fan EF-2	Penn Ventilation M/N: WFX10B		Supplier: Aqua Air Systems Ltd Edmonton, AB
16	Exhaust Fan EF-2 Damper motor & Dampers	Damper Motor: Belimo M/N: LF120 or NF120 Damper: Tamco M/N: Series 9000		Supplier: E.H. Price Edmonton, AB
17	HS-1 – Humidity Sensor – Exhaust Air	Invensys M/N: RH200A03		Supplier: Automatic Controls Edmonton, AB
18	Exhaust Fan EF-4	Penn Ventilation M/N: WFX08B		Supplier: Aqua Air Systems Ltd Edmonton, AB
19	Exhaust Fan EF-4 Damper motor & Dampers	Damper Motor: Belimo M/N: LF120 or NF120 Damper: Tamco M/N: Series 9000		Supplier: E.H. Price Edmonton, AB

5.7 Exhaust Fan EF-3 Flow Schematic (Refer to Drawing M-7 at the end of Chapter 4)

Exhaust Fan EF-3 Flow Schematic

No.	Component	Details	Setting	Remarks
1	Exhaust Fan EF-3	Twin City Fan & Blower M/N: 909 RBA		Supplier: Ventes Centech Inc. St-Eustache, QC
2	Exhaust Fan EF-3 Damper Motor & Dampers & End Switch	Damper Motor: Belimo M/N: LF120 or NF120 Damper: Tamco M/N: Series 9000		Supplier: E.H. Price Edmonton, AB
3	Manual Push Button	Allen Bradley M/N: Series 800H		Supplier: Westburne Edmonton, AB

5.8 Fuel Oil (Diesel) Flow Schematic (Refer to Drawing M-8 at the end of Chapter 4)

Fuel Oil (Diesel) Flow Schematic

No.	Component	Details	Setting	Remarks
1	Exhaust Fan EF-3	Watts M/N: V.A.G.S.T. Capacity: 250 Gallons		Supplier: Durex Steel & Alloy Industries Edmonton, AB
2	Exhaust Fan EF-3 Damper Motor & Dampers & End Switch	M.A. Steward & Sons Kitz-Super B M/N: 600WOG/150WSP		Supplier: Bartle & Gibson Edmonton, AB

END OF CHAPTER 5

Chapter 6

OPERATING PROCEDURES

6.1 General

Two existing diesel fuel oil, glycol heating boilers located in the Mechanical Room serve as the primary source of heating in the building with each boiler providing 100% of the system capacity. The use of glycol as a heating agent helps prevent freezing in the system.

Two air handling units, two exhaust fans and relief air openings located throughout the plant provide ventilation for the Pump and Filter Floor Levels, with additional exhaust fans servicing the Washroom and Chlorine Room.

Since this equipment provides the only heating and ventilation source for the building, it is important to ensure proper operation and maintenance is performed.

6.2 Glycol Heating System Operation

6.2.1 Unit Heaters and Force Flow Heaters (Refer to Drawing M-1)

Unit heaters and force flow heaters located in the plant provide heat to various areas. Each heater fan circuit is energized from a local disconnect switch with a local wall mounted electric thermostat cycling the heater fan motor to maintain the desired space temperature.

6.2.2 Reheat Coil (Refer to Drawing M-2)

Two reheat coils located in Air Handling Unit (AHU-1) distribution ductwork provides further tempering of the supply air as required for the Office/Laboratory and the New Office. Each office has a local wall mounted thermostat controlling both reheat coil and wall radiator zone valves to provide room heating to the desired room temperature.

6.2.3 Air Handling Unit Preheat & Heating Coils (Refer to Drawing M-3)

Refer to Air Handling Units AHU-1 & AHU-2 in this section.

6.2.4 Heating Pumps P-3 and P-4 (Refer to Drawing M-4)

Two glycol circulation pumps located in the Mechanical Room have been provided to handle the heating glycol circulation for the building with each pump providing 100% of the required glycol flow for the heating system. A manual switch on the Pump Control Panel will allow selection of either Pump P-3 or P-4 to operate. Only one pump is allowed to operate at a given time, and once a pump is selected, it runs continuously. Failure of the duty pump will activate the standby pump and sound the alarm horn at the Pump Control Panel. The alarm horn will be silenced when the duty pump is manually switched over at the Pump Control Panel.

Additional equipment has been installed to protect the heating system including; an air separator with strainer, flow switches and check valves. Check valves located at the discharge of the pumps prevents backflow of the system, and the flow switches ensure there is system flow before the boilers are allowed to start. Strainers located within the air separator will filter out any solid material circulating in the heating system. The air separator with automatic air vent (AAV) will automatically remove entrapped air from the system, reducing possibility of corrosion within the system.

6.3 Ventilation System Operation

6.3.1 Air Handling Unit AHU-1 System (Refer to Drawing M-5)

Air Handling Unit AHU-1 and two relief dampers provide ventilation for the Pump and Filters Level. The system is initially started by a local wall mounted thermostat to maintain the desired space temperature. When the supply fan status is activated, the mixed air dampers (outside & return dampers) will modulate to provide 20% (operator adjustable) minimum fresh air. The mixed air temperature sensor will modulate the mixed air dampers as required to maintain the mixed air set point, which is limited to 9^{o}C (48^{o}F). The supply

air discharge sensor will modulate the 3-way heating coil valve to maintain the supply air set point based on the space temperature reset schedule. The supply air set point of 23°C (73°F) is activated when the space temperature is below -1°C (30°F). When the space temperature is above 1°C (34°F), the supply air set point of 13°C (55°F) is activated instead. When the supply fan is off, the mixed air dampers will close and the heating coil valve will modulate to maintain a mixed air temperature of 13°C (55°F).

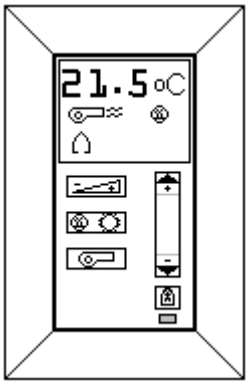
The motorized relief damper will open and modulate in conjunction with the mixing dampers to provide proper building pressurization. The barometric relief damper will open as required to relieve excess building pressure.

If the heating coil discharge temperature falls below 4°C (39°F), the low temperature thermostat will stop the supply fan to prevent the addition of cold air. The thermostat must be manually reset before the system can resume normal operation after inspection of low temperature problem.

An AHU-1 thermostat/controller user guide is provided in the following pages for operational reference.

AHU-1 MN-S4

User's Guide



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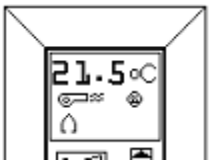
Phone (780) 417- 7000
Fax (780) 417-7001

Using The MN-S4 Sensor

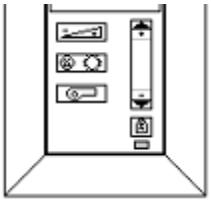
The IA Micronet MN-S4 sensor is your direct link to the IA MicroNet equipment controllers. This manual describes the sensor's functions and operation.

The Display



There are many elements on the MN-S4 display. The default screen displays the current space temperature. As you perform different functions, the display will change to indicate the current function. Various icons will appear on screen. Each icon will be described as it is encountered in the directions below.

The Keypad



SETPOINT ADJUST

Enters setpoint mode or cycles through the setpoint screens

HEAT/COOL

Selects either an override for the Heating Coil Valve OR for the Mixed Air Dampers

FAN CONTROL

Toggles command to the supply fan

OVERRIDE

Enables a five minute override for either the heating coil or for the dampers

SCREEN PAGING / ADJUSTMENT

Scrolls through the four display screens or used to adjust analog values

Press the **SCREEN PAGING / ADJUSTMENT** key to switch screens on the display. When you press this key, the display will show **–1-, -2-, -3-, -4-.** Once you release the key, the display will change to screen 1, 2, 3, or 4 respectively.

Screen Display Legend:
-1- Space Temperature
-2- Supply Air Temperature
-3- Mixed Air Temperature

-4- Supply Air Setpoint

Changing The Setpoint

Press the **SETPOINT ADJUST** key to access the various setpoint screens. When the key is pressed once, you will toggle to the first adjust screen. To scroll to the other adjustment screens, press the **SETPOINT ADJUST** key again. By pressing the key repeatedly, you will be able to cycle through all the adjust screens.

Screen Setpoint Adjustment Legend:
-1- Occupied Space Setpoint
-2- Supply Air Setpoint Adjustment (adds the adjustment value to the setpoint)
-3- Minimum Outside Air percentage (adjustable between 10% to 50%)
-4- Override Value of either the Heating Coil Valve or Mixed Air Dampers (depends on selection)

After you have cycled to the desired adjustment screen, the setpoint value will start blinking. You may now press the **SCREEN PAGING / ADJUSTMENT** key to adjust the current setpoint. As you press the **SCREEN PAGING / ADJUSTMENT**, the setpoint value changes. When you are ready to lock in the setpoint, release the keys and wait a few seconds. The display will stop blinking and the setpoint will now lock in.

Example of Changing the Minimum Outside Air Percentage:

- Press the **SETPOINT ADJUST** key three times (since it corresponds to the third adjustment screen).
- The screen will display –3– and then a blinking value will appear
- Press the **SCREEN PAGING / ADJUSTMENT** key either up or down to make the setpoint adjustment.
- Release the key and wait until the new setpoint stops blinking
- Display screen will revert back to the default screen of the space temperature.

Overriding the Heat Valve or Dampers

A five-minute override of either the heating valve or mixed air dampers can be made at the MN-S4 sensor. To start the override request, you must first press the OVERRIDE button. A five-minute counter will start. Pressing the **HEAT/COOL** button will bring up a mode selection screen. There will be a heat icon, a cool icon, or AUTO. By pressing the **SCREEN PAGING / ADJUSTMENT** key repeatedly, the different icons will begin to flash and select the override mode.

- Heat Icon = Heat Valve Override
- Cool Icon (Snowflake) = Damper Override
- Auto (Line) = No Override

After the override mode has been selected, you will need to set the override value of the selected equipment. Press the **SETPOINT ADJUST** key four times (since the override value corresponds to the fourth adjustment screen).

6.3.2 Air Handling Unit AHU-2 System (Refer to Drawing M-6)

Air Handling Unit AHU-2 and Exhaust Fans EF-2 and EF-4 provide ventilation for the Filters Area Level. The system is initiated by switching the fan control to Auto Mode on the local wall-mounted thermostat to open EF-2 exhaust dampers and start the exhaust fan in low speed. When EF-2 fan status is activated, AHU-2 outside air dampers will modulate open and start the supply fan in low speed. The supply air discharge sensor will modulate the 3-way preheat and heating coil valves in sequence to maintain the supply air set point of 12^{o}C (54^{o}F) which is adjustable at the thermostat. When the system is off, the preheat and heating coil valves will modulate at 100% open.

When the supply fan status is activated and 15 minutes after start-up, the humidity controls will be enabled. Both the supply and exhaust fans will switch to high speed if the exhaust air humidity rises above 40% relative humidity. When the exhaust air humidity falls below 30%, both the supply and exhaust fans will be stopped for 30 seconds and then restarted in low speed.

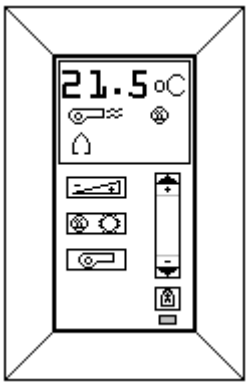
If the preheat coil discharge temperature falls below 4^{o}C (39^{o}F), the low temperature thermostat will stop the supply and exhaust fans. The thermostat must be manually reset before the system can resume normal operation after inspection of the low temperature problem.

Exhaust Fan EF-4, interlocked with the Scour Blowers, will run when one of the Scour Blower is started. When the system is activated, EF-4's normally closed discharge dampers will open to allow the discharge damper end switch to activate the start of EF-4.

An AHU-2 thermostat/controller user guide is provided in the following pages for operational reference.

AHU-2 MN-S4

User's Guide



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Using The MN-S4 Sensor

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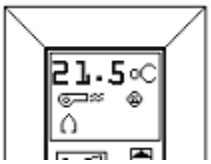
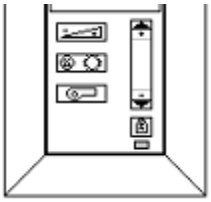
The Display



There are many elements on the MN-S4 display. The default screen displays the current space temperature. As you perform different functions, the display will change to indicate the current function. Various icons will appear on screen. Each icon will be described as it is encountered in the directions below.

The Keypad



SETPOINT ADJUST

Enters setpoint mode or cycles through the setpoint screens

HEAT/COOL

Selects either an override for the Preheat Coil Valve or the Heating Coil Valve

FAN CONTROL

Toggles command to the supply fan

OVERRIDE

Enables a five minute override for either the heating coil or for the dampers

SCREEN PAGING / ADJUSTMENT

Scrolls through the four display screens or used to adjust analog values

Press the **SCREEN PAGING / ADJUSTMENT** key to switch screens on the display. When you press this key, the display will show **–1-, -2-, -3-.** Once you release the key, the display will change to screen 1, 2, or 3 respectively.

Screen Display Legend:
-1- Space Temperature
-2- Exhaust Air Humidity
-3- Supply Fan Status

Changing The Setpoint

Press the **SETPOINT ADJUST** key to access the various setpoint screens. When the key is pressed once, you will toggle to the first adjust screen. To scroll to the other adjustment screens, press the **SETPOINT ADJUST** key again. By pressing the key repeatedly, you will be able to cycle through all the adjust screens.

Screen Setpoint Adjustment Legend:
-1- Supply Air Setpoint (Between 8°C and 12°C)
-2- Override Value of either the Heating Coil Valve or Preheat Coil Valve(depends on selection)

After you have cycled to the desired adjustment screen, the setpoint value will start blinking. You may now press the **SCREEN PAGING / ADJUSTMENT** key to adjust the current setpoint. As you press the **SCREEN PAGING / ADJUSTMENT**, the setpoint value changes. When you are ready to lock in the setpoint, release the keys and wait a few seconds. The display will stop blinking and the setpoint will now lock in.

Example of Changing the Supply Air Setpoint:

- Press the **SETPOINT ADJUST** key once (since it corresponds to the first adjustment screen).
- The screen will display –1– and then a blinking value will appear
- Press the **SCREEN PAGING / ADJUSTMENT** key either up or down to make the setpoint adjustment.
- Release the key and wait until the new setpoint stops blinking
- Display screen will revert back to the default screen of the supply air temperature.

Overriding the Heat Valve or the Preheat Valve

A five-minute override of either the preheat valve or heating valve can be made at the MN-S4 sensor. To start the override request, you must first press the OVERRIDE button. A five-minute counter will start. Pressing the **HEAT/COOL** button will bring up a mode selection screen. There will be a heat icon, a cool icon, or AUTO. By pressing the **SCREEN PAGING / ADJUSTMENT** key repeatedly, the different icons will begin to flash and select the override mode.

- Heat Icon = Preheat Valve Override
- Cool Icon (Snowflake) = Heat Valve Override
- Auto (Line) = No Override

After the override mode has been selected, you will need to set the override value of the selected equipment. Press the **SETPOINT ADJUST** key twice (since the override value corresponds to the second adjustment screen) and then enter the override percentage.

6.3.3 Exhaust Fan EF-3 (Refer to Drawing M-7)

Exhaust Fan EF-3 provides ventilation for the Chlorine Storage Room. The system is initiated by a manual switch located in the Entrance Lobby. When the system is activated, EF-3's normally closed inlet and discharge dampers will open to allow the discharge damper end switch to activate the start of EF-3.

6.4 Fuel Oil System Operation

6.4.1 Fuel Oil System (Refer to Drawing M-8)

The fuel oil required to operate the boilers is diesel fuel. The diesel fuel is stored in an outdoor above ground storage tank, located adjacent to the building. The fuel oil is pumped from the outdoor tank to a 1100 Litre (250 Imp. Gal.) double walled indoor day tank and gravity supplied to the boilers. The existing four level switches have been reinstalled on the new day tank and set at 10%, 20%, 80% and 90% tank full levels.

6.5 Troubleshooting

6.5.1 Alarms

The Water Treatment Plant process, mechanical and electrical operating systems and equipment is continuously monitored with the appropriate alarms to indicate if there is a system or equipment failure.

6.5.1.1 Alarms

Alarms with dial out to plant operator have been previously provided for the existing boiler system in event of a primary heating system failure.

The heating pumps system have been provided with a local alarm in event of a heating pump failure.

A fuel oil low level alarm is provided for the fuel oil system day tank.

6.5.2 Heating Operation Failure

6.5.2.1 Unit Heaters Not Operational

- Check for power to unit heater motor.
- Check unit heater thermostat control and setting.
- Check for possible obstructions in the heating piping including closed isolation valves.
- Check for air lock in heating system.
- Correct fault as required.

6.5.2.2 Reheat Coils Not Operational

- Check 2-way valve operation.
- Check 2-way valve thermostat control and settings.
- Check for possible obstructions in the heating piping including closed isolation valves.
- Check for air lock in heating system.
- Correct fault as required.

6.5.2.3 Air Handling Units Preheat & Heating Coils Not Operational

- Check 3-way valve operation.
- Check 3-way valve control system operating parameters and settings.
- Check for possible obstructions in the heating piping including closed isolation valves.
- Check for air lock in heating system.
- Correct fault as required.

6.5.2.4 Heating Pumps Will Not Start Up

- Check for power to heating pump.
- Check heating pump control system operating parameters and settings.

- Correct fault as required.

6.5.2.5 Boilers Locked Out On Low Flow

- Check flow switch operation.
- Check heating pump operation.
- Check for possible obstructions in the heating piping including closed isolation valves.
- Check strainers.
- Correct fault as required.

6.5.3 Air Handling Unit Operation Failure

6.5.3.1 Air Handling Unit Will Not Start Up

- Check low discharge temperature lockout controller.
- Check AHU control system operating parameters and settings.
- Check dampers, damper motors, linkages and end switches
- Correct fault as required.

6.5.3.2 Air Handling Unit Supply Fan Will Not Start Up

- Check for power to motor.
- Check for broken belts.
- Check blower wheel bearings and binding of blower wheel.
- Correct fault as required.

6.5.3.3 Air Handling Unit Low Supply Air Discharge Temperature

- Check AHU heating control system operating parameters and settings.
- Refer to Item 7.2.3 in this chapter
- Correct fault as required.

6.5.3.4 Air Handling Unit Low Discharge Air Volume

- Check for dirty/plugged filters.
- Check for dirty/plugged preheat/heating coils.
- Correct fault as required.

6.5.4 Exhaust Fan Operation Failure

6.5.4.1 Exhaust Fan Will Not Start Up

- Check control system operating parameters, settings and interlocks.
- Check dampers, damper motors, linkages and end switches
- Check for power to exhaust fan motor.
- Check for broken belts..
- Check blower wheel bearings and binding of blower wheel.
- Correct fault as required.

6.5.5 Relief Damper Operation Failure

6.5.5.1 Relief Damper Will Not Open Up

- Check control system operating parameters, settings and interlocks.
- Check dampers, damper motors, linkages and end switches

END OF CHAPTER 6

Chapter 7

MAINTENANCE

7.1 General

To ensure uninterrupted use, equipment should be regularly inspected, tested, and proper repairs made and recorded. The objective is to minimize equipment operating problems and prevent failures by making minor or necessary repairs before major difficulties occur. The importance of record keeping cannot be over-emphasized. Good maintenance protects the owner's interest with manufacturer warranties, continuity, or maintenance despite staff turnovers and equipment reliability track record.

Environmental and operating conditions are key elements affecting proper and reliable operation of equipment. Costly repairs can be minimized if the following items are attended to:

KEEP IT CLEAN

KEEP IT TIGHT

7.1.1 KEEP IT CLEAN

Day-to day accumulation of normal atmospheric particles, lint, metallic particles form mechanical equipment cause problems with equipment over a long period of time. An accumulation affects equipment reliability and operating life. ALL equipment should be regularly cleaned.

7.1.2 KEEP IT TIGHT

All contactors and control devices operate with high speed movement. This motion creates vibration that can loosen hardware and other parts. External vibration from equipment may cause the loosening of hardware and connections in any equipment. All hardware and connections should be tightened regularly. This simple procedure takes only a small amount of time and can save hours of searching for intermittent problems. All rotating

equipment such as motors are affected by vibrations. This can cause alignment problems which can result in bearing failures.

7.2 Renewal Parts

Availability of parts can be a major problem these days as distributors are keeping very low inventories in a move to economize. This may make any part a long delivery item. For this reason local distributors should be contacted and parts availability assessed. Any critical part affecting the reliability of the system should be ordered, recorded and stored by the maintenance department.

7.3 Parts and Equipment Ordering Procedure

During the first year of operation, the Contractor should be contacted for any replacement parts required. This will ensure that parts covered by warranty will be replaced under warranty. Failure to contact the Contractor may result in difficulties in obtaining warranty replacement.

Following the first year of operation, it is recommended that the Contractor also be contacted as many of the suppliers have a wholesale only policy. If it is necessary to purchase parts directly from the original supplier, the following information is required.

- Make
- Model No.
- Year of Installation
- Installing Contractor
- Description of Part Required (ie. Fan Bearing)
- Part No. if Available

When quoting a part number contained in manufacturer’s catalogue, always provide the date of the catalogue you are referring to, as these numbers are often subject to change. The equipment supplier will have the latest edition of the manufacturer’s catalogue.

If the original supplier is no longer in business, contact the contractor who will be able to suggest an alternate source of supply.

7.4 Scheduled Preventive Maintenance Program

Scheduled preventive maintenance is an effective means to improve services from systems and equipment. Where failure of equipment can result in shutdown, scheduled preventive maintenance is an economical alternative.

7.4.1 Causes of Equipment Failure

An effective maintenance program will attempt to remove or reduce causes of equipment failure. Common failure initiating causes are:

- Loose and broken belts
- Misaligned pulleys
- Dirty or plugged filters
- Dirty or plugged coils
- Worn bearings
- Improper lubrication and oiling or lack of
- Persistent overloading
- Above normal temperatures
- Below normal temperatures
- Obstruction of ventilation by foreign objects or material (blockage of air, dirt on components etc.)
- Normal deterioration from age
- Severe weather conditions

The scheduled preventive maintenance suggestions presented will be applicable to most equipment, but all of the suggestions given in any one section may not be applicable to the particular mechanical component being maintained. Most of the work may be done by the building operator but some may have to be left to the discretion of the building operator.

When equipment repair is necessary, please refer to the Manufacturer Data section provided in this manual. The frequency which the tasks should be done as indicated.

Most maintenance can be done by average personnel, with a minimum need for specialized service.

7.4.2 Maintenance Legend

D	Daily
W	Weekly
M	Monthly
SA	Semi-Annually
A	Annually
PMI	As per Manufacturer's Instructions
AN	As Necessary

7.5 Heating System

7.5.1 Unit Heaters and Force Flow Heaters

Refer to Unit Heater and Force Flow Heater Operation and Maintenance Data.

Check controls and thermostat	M
Clean unit heating coil	M
Visually inspect fan operation and electrical connections	M
Replace or clean force flow heater filters	M

7.5.2 Heating Pumps

Refer to Heating Pump Operation and Maintenance Data.

Record voltage and amperage	A
Check terminals for corrosion or loose leads	A
Blow out motor windings with compressed air	A
Check and clean strainers	AN

7.5.3 Removal of Heating Pump for Service

If the duty pump will not start, it may be necessary to remove the duty pump for servicing.

- Switch over to the Backup Heating Pump for duty service and open isolation valves.
- Close the pump isolation valves to isolate the pump and have an electrician disconnect the pump.
- After repair of the pump is completed, reinstall the pump in reverse order.
- Start-up pump to verify operation.
- The Heating pumps can be left as is, making the Backup Heating Pump as the duty pump or returning the heating pumps back to normal operating condition.

7.6 Ventilation System

7.6.1 Air Handling Units and Exhaust Fans

Refer to Air Handling Units and Exhaust Fans Operation and Maintenance Data.

Check for unusual noise or vibration and if observed, check bearings and belt	M
Check for belt slipping and wear	M
Check pulley sheaves for wear	A
Lubricate bearings	PMI
Check fan blades/wheel for grease and dirt and clean as required	A
Check all bolts and fasteners	M
Check filters and clean or replace as required	M
Check and clean preheat and heating coil fins	M
Check that outside air intake screens are clean	M
Check that all dampers operates without binding	M
Ensure spring tension is adequate to close dampers	M
Check motor amperage draw	A
Record voltage and amperage	A
Check terminals for corrosion or loose leads	A
Blow out motor windings with compressed air	A

7.6.2 Controls

Check safety controls and ensure shut down is activated	D
Check temperature sensor calibration	M
Clean all points and contacts on control system	M
Check control valves for positive shut off	M

END OF CHAPTER 7

Chapter 8

TESTING AND CERTIFICATION DATA

8.1 General

Testing and certification data of relevant newly installed or replaced equipment as per the 2017 Water and Wastewater Facilities Improvement Upgrade are appended at the end of this chapter.

END OF CHAPTER 8

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Exaust Fan Cl2 Room

Tag #: EF-03

Manufacturer		**Input**	
Make:	Twin City	Voltage (V):	
Model:	RBA - 909	Phase:	
Description		Frequency (Hz):	
Serial #:	17-594693-1-1	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	1695
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

947 CFM

Total eff: 66%

Belt driven CCW

Date of Inspection:	11-12-2017
Inspected By:	Pierre-Luc Lagoie
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Exaust Fan Motor WTP

Tag #: EF-3

Manufacturer		**Input**	
Make:	WEG	Voltage (V):	575
Model:	0218ET3H145T-S	Phase:	3
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,18
Explosion Proof:		Power (HP/W):	2 HP 1,5 KW
Dust-Ignition Proof:		RPM:	1745
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:	588V	Current - Phase A:	1,71A
Voltage - Phase B or B-C:	585V	Current - Phase B:	1,74A
Voltage - Phase C or C-A:	583V	Current - Phase C:	1,78A
Megger Phase A or A-B:	0 MΩ | A - ⏚ - 00 MΩ	Rotation (CW, CCW):	CCW
Megger Phase B or B-C:	0 MΩ | B - ⏚ - 00 MΩ	RPM:	
Megger Phase C or C-A:	0 MΩ | C - ⏚ - 00 MΩ	Overload Set (A):	2,2A

Inspection Comments & Recommendations

Nema nom eff. 86,5%

Date of Inspection:	12-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan Cl_2 room WTP

TAG NO: EF-3

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 11-12-2017

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan Cl_2 Room WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan CL_2 Room

TAG NO: EF-3

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE	DATE
CONTRACTOR'S REPRESENTATIVE	Dec 12, 2017 DATE
ENGINEER	14 Dec, 2017 DATE

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan Cl_2 Room WTP

TAG NO: EF-3

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan CL_2 Room WTP

TAG NO: EF-3

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE Dec 12/17

Chapter 9

MANUFACTURER DATA AND SERVICE INFORMATION

9.1 General

Manufacturer data and service information of relevant newly installed or replaced equipment as per the 2017 Water and Wastewater Facilities Improvement Upgrade are appended at the end of this chapter.

END OF CHAPTER 9

MECHANICAL &
ELECTRICAL

Volume 1 of 1

OPERATION & MAINTENANCE
MANUAL

CITY OF IQALUIT
WATER&WASTEWATER FACILITIES IMPROVEMENTS

IQALUIT, Nunavut

Project #:
SC711

March 2018

OWNER:	**CITY OF IQALUIT**
CONTRACT ADMINISTRATOR:	**COLLIERS PROJECT LEADERS**
CONSULTING ENGINEER:	**NUNAMI-STANTEC**
GENERAL CONTRACTOR:	**KUDLIK CONSTRUCTION INC.**
MECHANICAL & ELECTRICAL CONTRACTOR:	**SIFEC NORTH INC.**

MANUFACTURER/DISTRIBUTOR:

VENTES CENTECH INC.
Josée Gagnon
122 rue St-Laurent, Suite 200
St-Eustache, QC, J7P 5G1
Phone: (450) 473-4550
Fax: (450) 473-5525
jgagnon@centech.ca

6.1 TwinCity Chlorine Room Fan (WTP)

Twin City Exhaust Fan RBA909, corrosion resistant, spark resistant

FAN DETAILS

Job Name: Sifec

Twin City Fan & Blower
A Twin City Fan Company
Ventes Centech inc.
122 St-Laurent, St-Eustache (Qc) J7P 5G1
Tel: (450) 473-4550, Fax: (450) 473-5525
email: info@centech.ca
ISO 9001 CERTIFIED

Tag: N/A
Customer:
Job ID: 2017-09-13-1
Date: September 14, 2017

Description

Quantity	1
Model	RBA
Size	909
Width	SWSI
Arrangement	9A
Class	22
Rotation	CCW
Discharge	TAU
Wheel Diameter (in)	15.6
Drive method	Belt
Percentage width	100%
Percentage diameter	100%
Motor position	L

Performance

Volumetric Flow CFM	947
Operating SP (in WC)	3.000
Standard SP (in WC)	3.022
RPM	1595
Tip Speed (FPM)	6525
Oper. Power BHP	0.74
Standard Power BHP	0.75
Outlet Area (sq.ft)	0.44
Outlet Velocity (FPM)	2152
Max RPM for Class	4134
Static Efficiency	60.26%
Total Efficiency	66.00%
FEI	1.35
FEP (KW)	0.72
System FEI	N/A
System FEP (KW)	N/A

Air/Gas Properties

Altitude above sea level (ft)	0
Inlet Pressure (in WC)	-3.000
Inlet Temperature(°F)	70
Design Temperature (°F)	70
Gas Type	Operating air
Estimated Density (lb/ft³)	0.0744

Motor Data

Power (HP)	1-1/2
Enclosure	TEFC
Speed (RPM)	1800
Voltage	575V
Phase	3
Frequency	60Hz
Frame Size	145T

Modifiers

Apply Compressibility.

Sound

Octave Bands	1	2	3	4	5	6	7	8	LwA
Level at Inlet	89	85	83	78	70	65	59	53	79

Sound Power Levels in dB re.10^{-12} Watts:

Dis	ft	1	3	5	10
dBA at inlet		83	73	69	63

Estimated sound pressure level in dBA (re: 0.0002 microbar) based on a single * ducted installation:

*To estimate dBA level for ducted inlet and ducted outlet (into and out of the room) type installation, deduct 20 from the LwA value shown. Using a directivity factor of 2. Estimated Sound Pressure based on free field, spherical (Q = 2) radiation at stated distance.

Definitions:

LwA — The overall (single value) fan sound power level, 'A' weighted.

dBA — The environment for each fan installation influences its measured sound value, therefore dBA levels cannot be guaranteed. Consult AMCA Publication 303 for further details. A fan's dBA is influenced by nearby reflective surfaces.

Twin City Exhaust Fan RBA909, corrosion resistant, spark resistant

FAN DETAILS

Job Name: Sifec

Twin City Fan & Blower
A Twin City Fan Company
Ventes Centech inc.
122 St-Laurent, St-Eustache (Qc) J7P 5G1
Tel: (450) 473-4550, Fax: (450) 473-5525
email: info@centech.ca
ISO 9001 CERTIFIED

Tag: N/A
Customer:
Job ID: 2017-09-13-1
Date: September 14, 2017

Pricing Detail

RBA 909, Class 22, Arrangement 9A Bare fan	244lb
Drain W/ Plug	0 lb
Flange - Inlet, Punched	0 lb
Flange - Outlet, Punched	0 lb
Guard - Belt, OSHA Type	15 lb
Guard - Shaft & Bearing	11 lb
Spark Resistant Construction - Type A	0 lb
Shaft Seal - Std Type	0 lb
Spec Matl: Airstream - Aluminum	0 lb
Extended Lube Lines to Drive Side	0 lb
Spcl Paint on all Guards - OSHA Yellow	0 lb
Coating: Entire Fan; Epoxy Mastic; Carboguard 890 Series - Wash; Prep: Tool Clean & Wash; Curing: Air Dry	0 lb
Motor 1-1/2 HP, 1800 RPM, 575V, 3Ph, 60Hz , TEFC - Premium , 145T	86 lb
Variable Speed V-Belt Drive, 1.5 SF	5 lb
Mount TCF Motor	0 lb

Each Weight	361 lb
Extended Weight	361 lb

Twin City Exhaust Fan RBA909, corrosion resistant, spark resistant

FAN DETAILS

Job Name: Sifec

Twin City Fan & Blower
A Twin City Fan Company
Ventes Centech inc.
122 St-Laurent, St-Eustache (Qc) J7P 5G1
Tel: (450) 473-4550, Fax: (450) 473-5525
email: info@centech.ca
ISO 9001 CERTIFIED

Customer:
Job ID: 2017-09-13-1
Date: September 14, 2017

AMCA Statements

Tag:

1. Twin City Fan certifies that the model RBA is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Certified Ratings Program.
2. Performance certified is for Installation Type D: Ducted inlet, Ducted outlet.
3. Power rating (BHP) does not include transmission losses.
4. The AMCA licensed air performance data has been modified for installation, appurtenances or accessories, etc. not included in the certified data. The modified performance is not AMCA licensed but is provided to aid in selection and applications of the product.
5. dBA levels are not licensed by AMCA International.

DOE Statements

Note that the Fan Energy Index (FEI) is an overall efficiency (wire-to-air) metric which includes not only the impact of the fan efficiency, but also each of the drive components used to operate the fan.

The Fan Electrical Input Power (FEP) is the amount of power of a given fan at an operating point characterized by a value of flow and pressure.

Twin City Exhaust Fan RBA909, corrosion resistant, spark resistant

Job Name: Sifec

Fans & Blowers
Twin City

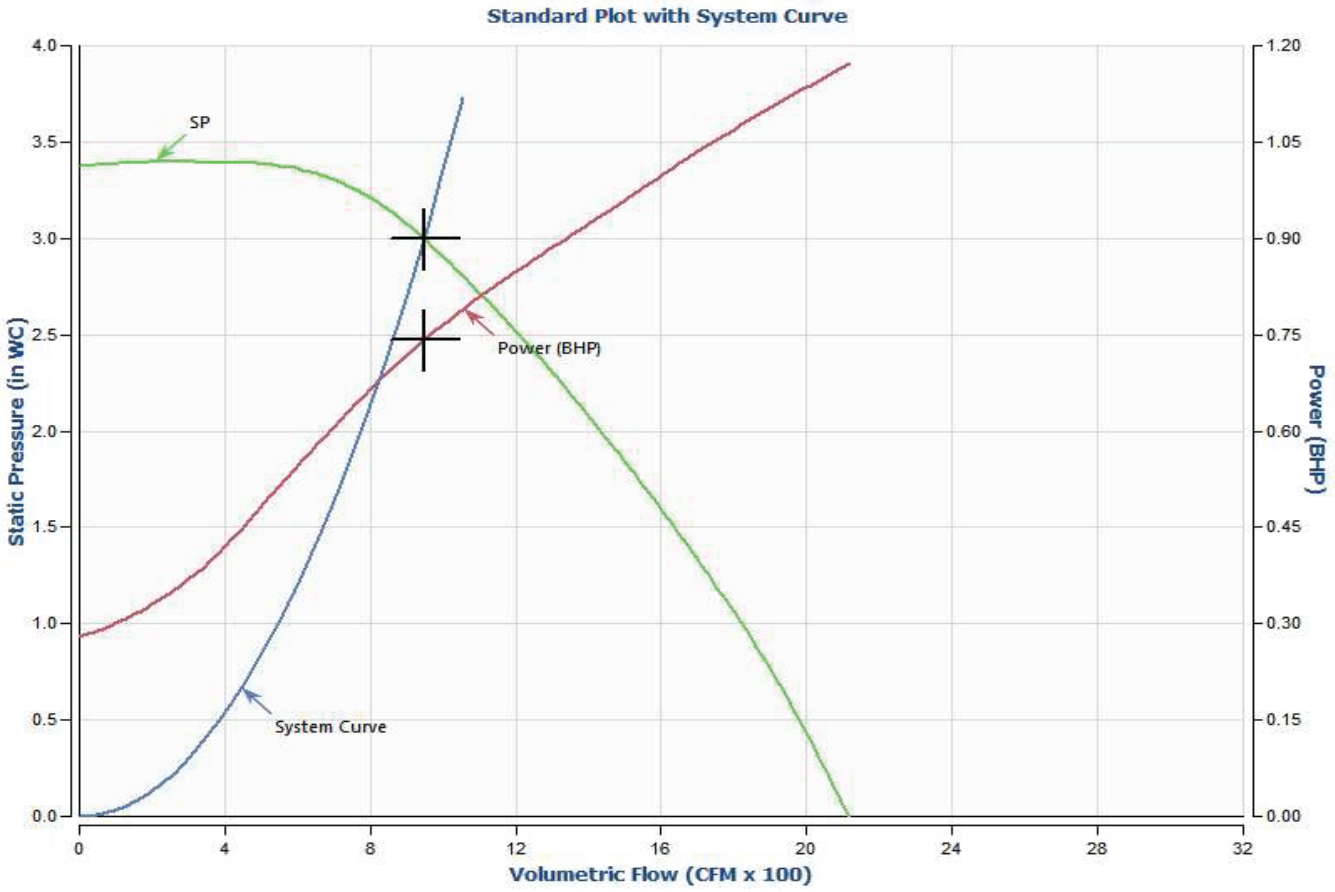
Customer:
Job ID: 2017-09-13-1
Date: September 14, 2017

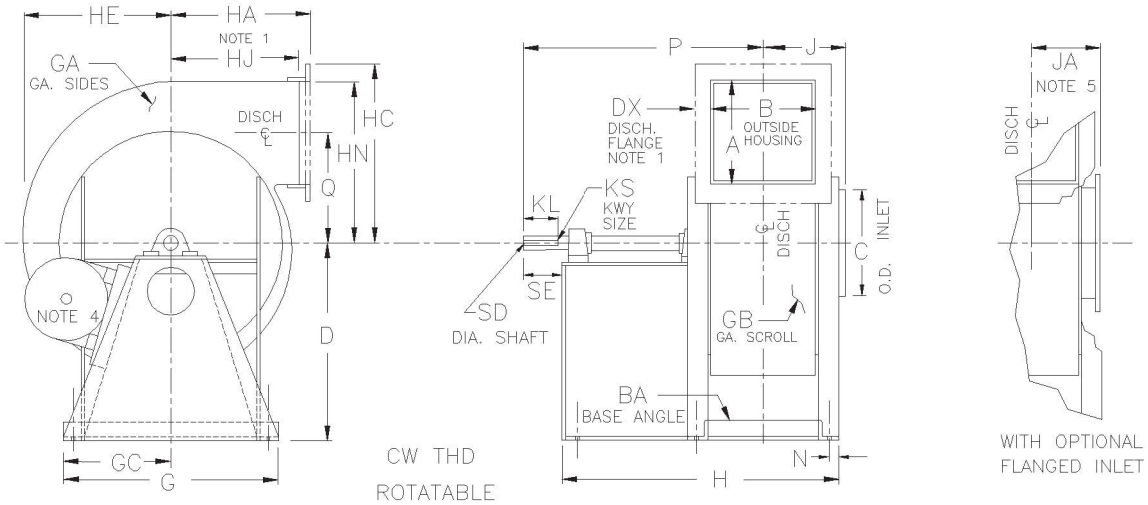
Tag:

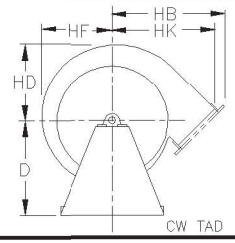
Fan information

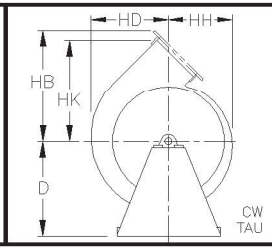
Size/Model 909/RBA	Class 22	Outlet Vel (FPM) 2152
Volumetric Flow (CFM) 947	Speed (RPM) 1595	Density (lb/ft³) 0.0744
SP (in WC) 3	Max Speed . . 4,134 RPM @ 70 °F	
	Power (BHP) 0.74	

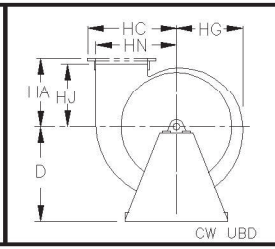
Adjusted for Apply Compressibility, Inlet Pres: -3 WC

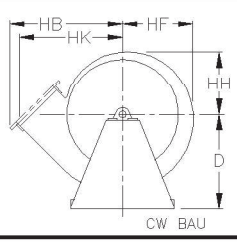


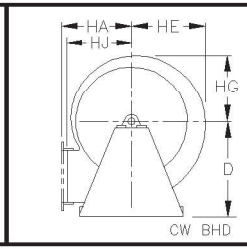










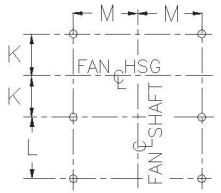


NOTES:

1. OUTLET FLANGES ARE OPTIONAL. FLANGES ARE PUNCHED PER AC15146.
2. 'CW' ROTATION IS SHOWN. 'CCW' IS SIMILAR BUT OPPOSITE.
3. FOR 'DBD' (DOWNBLAST) SEE DRAWING AC15071.
4. MOTOR LOCATION IS 'LEFT' FOR 'CW' ROT. AND 'RIGHT' FOR 'CCW' ROTATION. DIM. 'FR' IS MAX. MOTOR FRAME.
5. OPTIONAL FLANGED INLET PER DRAWING AC15143.

FOUNDATION PLAN

SIX 'BH' DIA BASE HOLES



'RBO', 'RBA', & 'RBW' ARR. NO. 9A & 9B CLASS 22

TWIN CITY FAN & BLOWER
MINNEAPOLIS, MINNESOTA 55442

DRAWN 8/10/94
REVISED
DWG NO AC-15074

JOB:

LOC.

ENG./ARCH.

CERT. BY:

S.O. NO.

SIZE	CLASS	DISCH	ROT.	MOTOR HP	MOT. LOC.	UNIT NO.

CFM	SP	RPM	BHP	OV	TS

ACCESSORIES REQ'D

SIZE	A	B	BA	BH	C	D 9A	D 9B	DX	FR 9A	FR 9B	G	GA	GB	GC	H 9A	H 9B	HA	HB	HC	HD	HE	SIZE
907	6.81	6.06	1.5X1.5	0.44	7.00	18.50	21.50	1.25	184T	215T	14.25	12	12	7.13	24.81	28.44	8.81	14.63	11.81	10.13	9.69	907
909	8.63	7.69	1.5X1.5	0.44	9.00	18.50	24.50	1.25	184T	256T	17.75	12	12	8.88	26.44	34.94	11.13	18.31	14.75	12.94	12.38	909
911	10.56	9.44	2.0X2.0	0.56	11.00	21.50	25.00	1.50	215T	256T	20.25	10	10	10.13	32.81	37.69	13.50	22.25	17.94	15.75	15.06	911
913	12.44	11.13	2.0X2.0	0.56	13.00	21.75	27.75	1.50	215T	286T	23.25	10	10	11.63	34.50	41.75	15.88	26.06	20.94	18.63	17.81	913
915	14.31	12.81	2.5X2.5	0.56	15.00	25.25	28.25	1.50	256T	286T	26.25	10	10	13.13	42.06	44.44	18.25	29.81	23.88	21.44	20.50	915
917	16.25	14.50	2.5X2.5	0.56	17.00	28.25	32.00	1.50	256T	326T	29.50	10	10	14.75	43.75	48.63	20.63	33.63	26.88	24.31	23.25	917
919	18.06	16.13	2.5X2.5	0.56	19.00	31.25	35.50	2.00	286T	365T	31.25	10	10	15.63	47.75	51.75	22.94	37.63	30.25	27.06	25.88	919

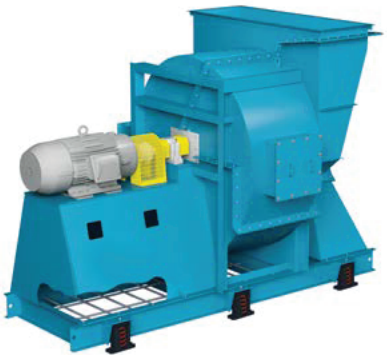
SIZE	HF	HG	HH	HJ	HK	HN	J	JA	K	KL	KS	L 9A	L 9B	M	N	P 9A	P 9B	Q	SD	SE	WHL DIA	SIZE
907	9.25	8.81	8.38	8.31	13.38	10.56	4.69	5.69	4.06	4.50	.38X.19	15.19	18.81	6.38	0.63	24.88	28.50	7.19	1.437	4.75	12.25	907
909	11.81	11.25	10.69	10.63	17.06	13.50	5.50	6.50	4.88	5.00	.38X.19	15.19	23.69	8.13	0.63	26.44	34.94	9.19	1.437	5.50	15.63	909
911	14.38	13.69	13.00	13.00	20.88	16.44	6.88	8.38	6.00	5.00	.38X.19	18.81	23.69	9.13	0.88	31.44	36.31	11.19	1.687	5.50	19.13	911
913	17.00	16.19	15.38	15.38	24.63	19.44	7.69	9.19	6.81	5.50	.38X.19	18.88	26.13	10.63	0.88	32.81	40.06	13.25	1.687	6.00	22.63	913
915	19.56	18.63	17.69	17.75	28.38	22.38	9.06	10.06	7.94	5.50	.50X.25	23.69	26.06	11.88	1.13	39.00	41.38	15.25	2.187	6.00	26.13	915
917	22.19	21.13	20.06	20.13	32.19	25.38	9.88	10.88	8.75	6.00	.50X.25	23.75	28.63	13.50	1.13	40.88	45.75	17.25	2.187	7.00	29.63	917
919	24.69	23.50	22.31	22.44	35.88	28.25	10.69	11.69	9.56	7.00	.50X.25	26.13	30.13	14.38	1.13	44.56	48.56	19.25	2.187	7.50	33.00	919

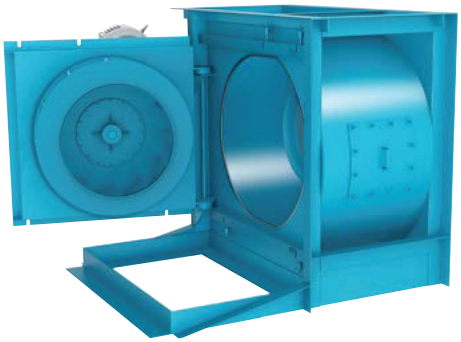
Twin City Exhaust Fan
RBA909, corrosion
resistant, spark resistant

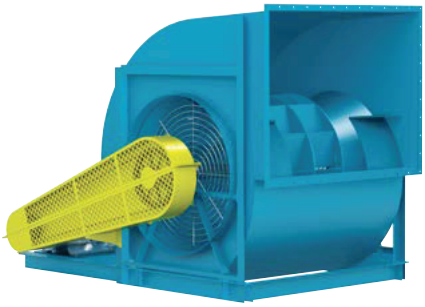
IM-995
September 2017

Centrifugal Fans

Installation, Operation & Maintenance Manual







Review AMCA Bulletin 410 Prior to Installation

This bulletin has been prepared to guide the users of industrial centrifugal fans in the proper installation, operation and maintenance procedures to insure maximum equipment life with trouble-free operation. For safe installation, startup and operational life of this equipment, it is important that all involved with the equipment be well versed in proper fan safety practices and read this bulletin. It is the user's responsibility to make sure that all requirements of good safety practices and any applicable safety codes are strictly adhered to. Because of the wide variety of equipment covered in this bulletin, the instructions given here are general in nature. Additional product and engineering information is available at www.tcf.com.

SAFETY NOTICE

Refer to the safety section(s) in this manual prior to installing or servicing the fan. The most current version of this installation and maintenance manual can be found on our website at www.tcf.com/resources/installation-maintenance-manuals.

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Fan & Blower Twin City

Centrifugal Fan Arrangements - Single Width, Single Inlet (SWSI)

Arrangement 1
Belt Driven or Direct Drive

Arrangement 3
Belt Driven

Arrangement 3F
Belt Driven

Arrangement 3SI
Belt Driven or Direct Drive

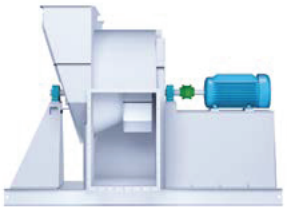
Arrangement 4
Direct Drive

Arrangement 4S
Direct Drive
(Swingout Door)

Arrangement 4VI
Direct Drive
(Vertical Inlet)

Arrangement 4HI
Direct Drive
(Horizontal Inlet)

Arrangement 7
Direct Drive



Arrangement 7SI
Direct Drive

Arrangement 8
Direct Drive

Arrangement 9
Belt Driven

Arrangement 9F
Belt Driven

Arrangement 9H
Belt Driven

Arrangement 9SS
Belt Driven
(Swingout Door)

Arrangement 9ST
Belt Driven
(Swingout Door)

Arrangement 10
Belt Driven

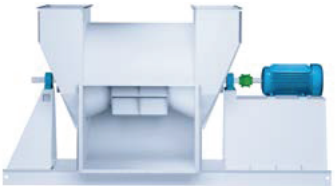
Centrifugal Fan Arrangements - Double Width, Double Inlet (DWDI)

Arrangement 3
Belt Driven or Direct Drive

Arrangement 3F
Belt Driven

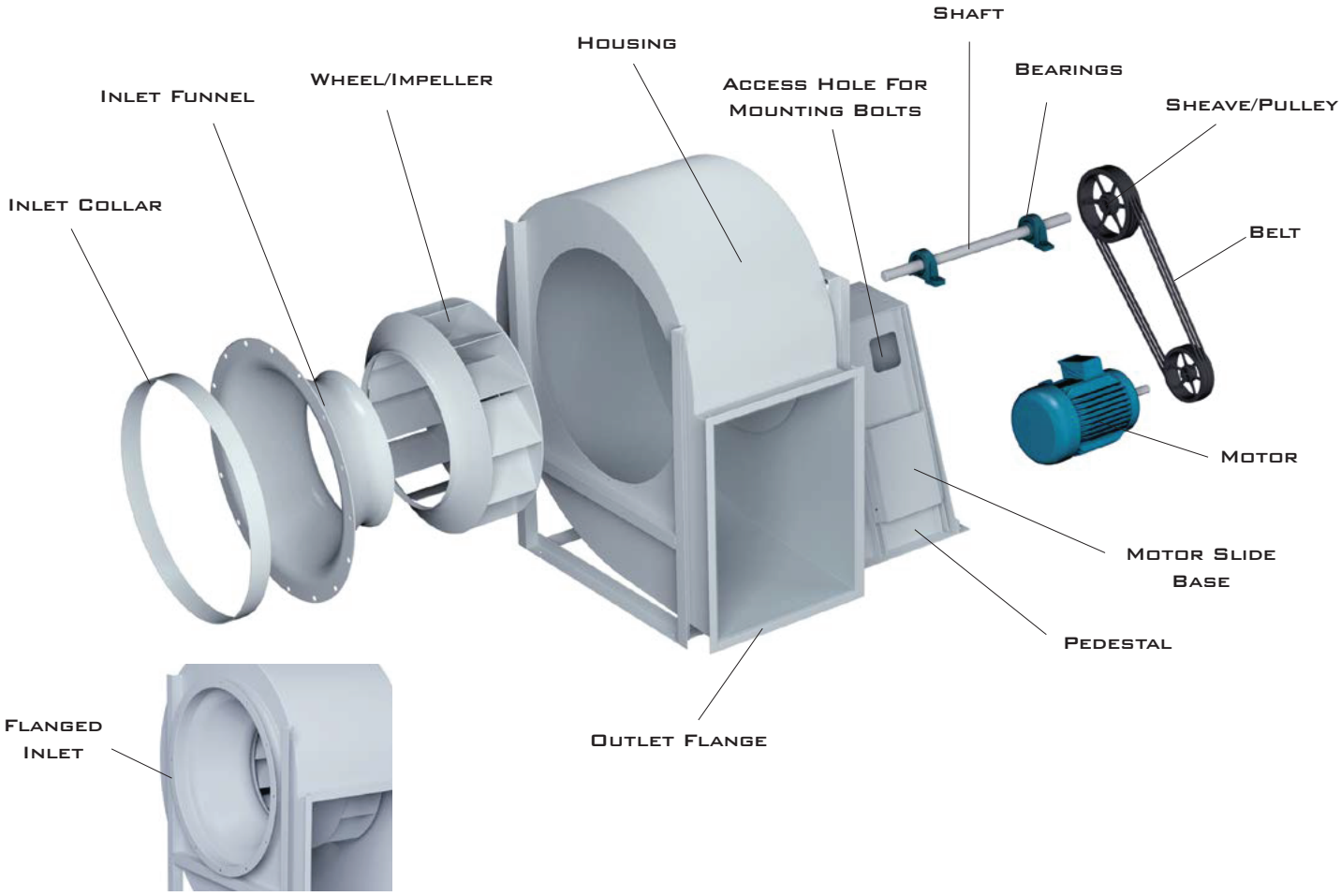
Arrangement 3DI
Belt Driven or Direct Drive

Arrangement 7
Direct Drive

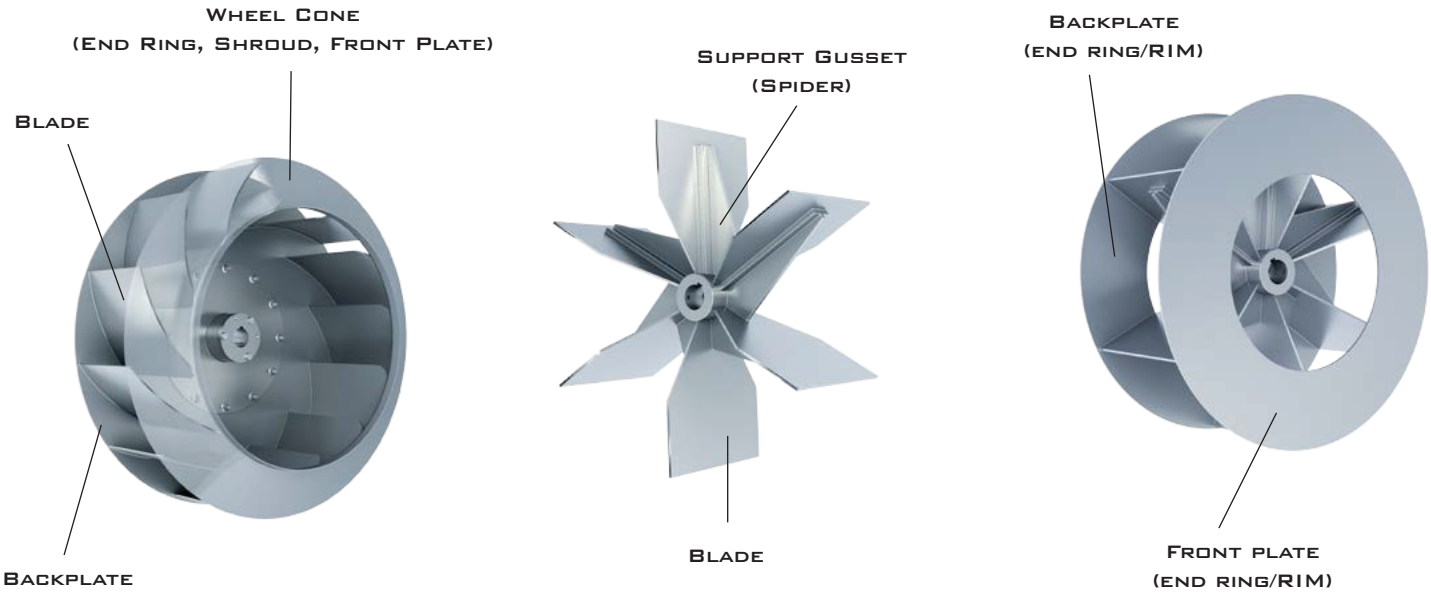


Arrangement 7DI
Direct Drive

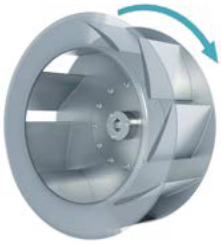
Exploded View - Centrifugal Fans



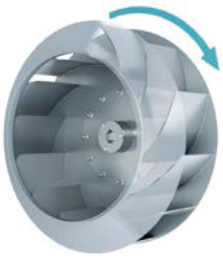
Wheel (Impeller) Nomenclature



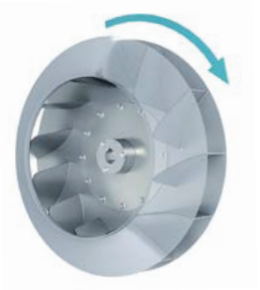
SWSI Wheel Types



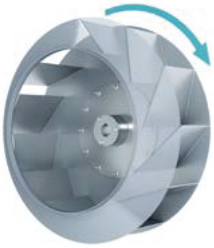
Airfoil



Backward Curved



Radial Tip

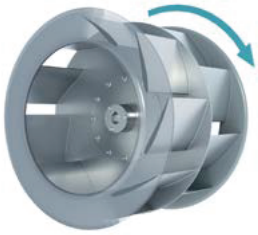


Backward Inclined

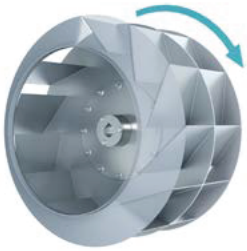
Radial Bladed

Forward Curved

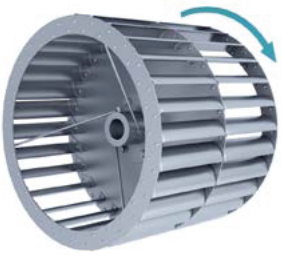
DWDI Wheel Types



Airfoil



Backward Inclined



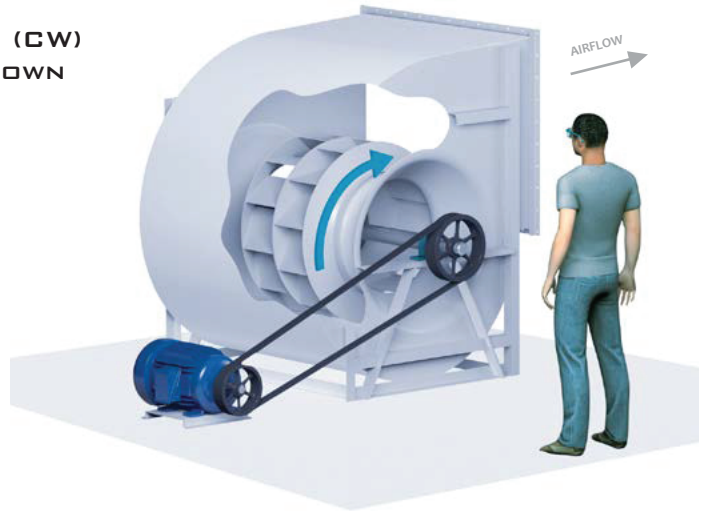
Forward Curved

Wheel Rotation

Rotation View From Drive Side

CLOCKWISE (CW)
EXAMPLE SHOWN

SWSI Centrifugal Fans



DWDI Centrifugal Fans

Safety & Hazard Warnings

For general safety practices for air moving equipment, see AMCA Bulletin 410. Twin City Fan & Blower offers many safety accessories. These safety devices include (but are not limited to) belt guards, shaft guards, inlet and discharge screens. The use and suitability of safety devices is the responsibility of the purchaser.

Facility related safety conditions include fans' accessibility and location. How easily can non-service personnel access the unit? Is the fan in a hazardous duty environment? Was the unit ordered for this duty? Other concerns must also be addressed. All fans should be powered through switches which are easily accessible to service personnel from the fan. Fan power must have the ability to be "locked out" by service personnel trained in lockout/tagout procedures per OSHA requirements (29CFR1910.147). When performing lockout, be aware of factors, such as building pressure and additional fans in the system that can influence unwanted fan rotation (wind milling). If you have any doubt about your ability to perform a task, seek a person qualified to do that task. Before any work is done on a fan, ensure that the fan is isolated from the electrical supply using a 'lockout/tagout system.'

Note: A stationary, non-rotating fan does not mean that the fan is isolated from the electrical supply. A non-rotating fan could be subject to controls or other circuit protection devices that may start the fan without notice.

The following safety precautions should be followed, where applicable:

- Do not attempt to slow a rotating impeller even when it is isolated from the electrical supply. Fan impellers have a high inertia and injury could result from an attempt to stop it. It is recommended that the impeller is isolated by closing off the inlet or outlet to prevent wind-driven rotation. If an impeller is chocked to prevent rotation, ensure that the chocks are removed prior to start up.
- Wear appropriate personal protective equipment. This may include protective clothing, eye protection, ear protection, respiratory equipment, hand and foot protection when installing or servicing the fan.
- Always use caution when entering a fan's air path. High velocity airflow can cause you to lose your balance.
- Motor, bearings and drives can be hot, and similarly if the fan is subject to processes that are hot, the fan housing could be hot.
- Fans are often used to move hazardous materials that could be dangerous. Always wear protective clothing and take precautions not to inhale dust/gases. If hazardous chemical vapors are present, respiratory equipment may be required.
- Sharp edges – wear protective gloves when handling, installing, or servicing a fan.
- Fans can operate at high decibel sound levels. Wear proper ear protection to protect from excessive noise levels.
- Access Doors – Do not open access doors when fan is in operation. The effects of suction and air pressure could result in injury.
- When working around pulleys and belts, keep hands away from pinch points. This pertains to when the fan is under or off power.

Throughout this manual, there are a number of HAZARD WARNINGS that must be read and adhered to in order to prevent possible personal injury and/or damage to equipment. Two signal words "WARNING" and "CAUTION" are used to indicate the severity of a hazard and are preceded by the safety alert symbol. It is the responsibility of all personnel involved in installation, operation and maintenance to fully understand the warning and caution procedures by which hazards are to be avoided.

WARNING: Used when serious injury or death MAY result from misuse or failure to follow specific instructions.

CAUTION: Used when minor or moderate injury or product / equipment damage MAY result from misuse or failure to follow specific instructions.

NOTICE: Indicates information considered important, but not hazard-related.

Shipping & Receiving

All Twin City Fan & Blower products are carefully constructed and inspected before shipment to insure the highest standards of quality and performance. Compare all components with the bill of lading or packing list to verify that the proper unit was received. Check each unit for any damage that may have occurred in transit. Any damage should be reported immediately to the carrier and the necessary damage report filed. Damage should be noted on the bill of lading.

Handling

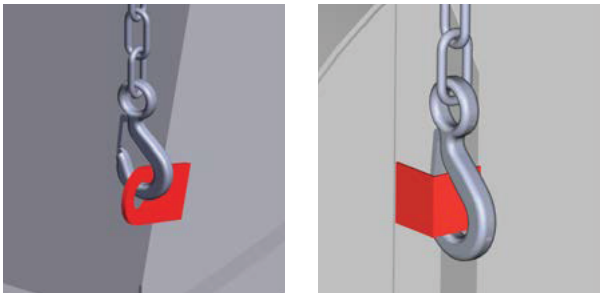
Handling of all air moving equipment should be conducted by trained personnel and be consistent with safe handling practices. Verify the lift capacity and operating condition of handling equipment. When using hoisting equipment, only qualified and trained personnel should operate the equipment.

Units shipped completely assembled may be lifted with slings and spreader bars. (Use well-padded chains, cables or nylon straps, rated to lift the required weight.) On most units, lifting lugs are designed to protect the fan and fan housing from damage. Never lift a fan by the inlet or discharge flange, shafting or drives, wheel or impeller, motor or motor base, or in any other manner that may bend or distort parts. Never lift with slings or timbers passed through the fan inlets.

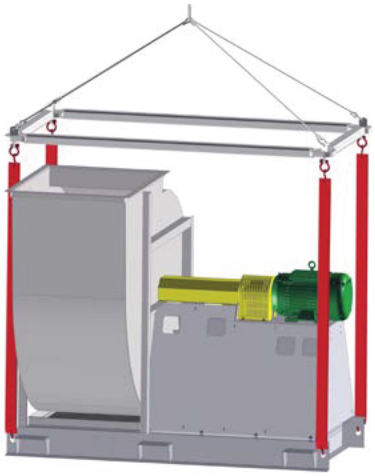
For fans provided without lifting lugs, use a forklift or pallet jack to handle the equipment. Consult a qualified person before lifting.

⚠ CAUTION

1. **Maintain handling equipment to avoid serious personal injury and do not stand under the load.**
2. **If supplied, only use the provided lifting lugs to lift the equipment.**
3. **Ensure that the lifting equipment is rated for the capacity to be lifted.**



Lifting lugs are provided on most units.



Lift fans mounted to a Unitary Base as shown

Partial or disassembled units require special handling. All parts should be handled in a method which protects the coatings and parts from damage. Components should be handled such that forces are not concentrated to avoid bending or distortion.

The housing should be lifted using suitably rated spreader bars and padded Chains or straps. Do not distort housing or side plates when lifting.

The shaft and wheel assembly may be lifted using a hoist and a spreader with slings around the shaft at either side of the wheel. Use the spreader bar to ensure that the slings do not push against the sides of the wheel as this may distort the wheel. Take care not to damage the shaft where the wheel or bearings will be mounted. Never lift or support the assembly by the wheel. Always support the assembly by the shaft when lifting or storing (see the section regarding proper storage of equipment.) Do not support the shaft or the wheel on the housing sides. See the Fan Installation section for additional details.

Wheels shipped separately can be lifted by slings running between the blades or through the hub. Never lift the wheel by a single blade or single point on the flange/shroud. Do not to put a chain within the hub bore. Always transport wheels by lifting, do not roll the wheel as this can damage coatings and change the balance of the wheel.

Bent shafting is a source of vibration and bearing failure, so be sure to handle the shaft with care. If the shaft is bent, replace the shaft. Any scratches on the shaft may be repaired with fine emery cloth or a stone. Remove only the displaced metal that forms a high point at the edge of the scratch.

⚠ CAUTION

1. **Bearing pedestals should be lifted using straps or padded chains. Under no circumstance should an attached or separated bearing pedestal be lifted by the shaft, bearings, drives, motor or wheel.**
2. **Note some rotor assemblies may have an off-center CoG and therefore a qualified person should be consulted before lifting.**

Unit Storage

If fan installation is to be delayed, store the unit in an environmentally stable and protected area. During storage, the fan should not be subjected to vibration from external sources or bearing damage may occur. The unit should be reasonably protected from any accidental impacts. Cover the fan to protect coatings and to prevent any foreign material or moisture from entering the inlet or discharge. Take care to protect the motor, drives and bearings.

Extended storage requires monthly inspections. Check for corrosion or damage to the unit and for debris within the fan.

Bearings tend to take on moisture if the atmosphere in which they are stored is not at a constant temperature. To avoid corrosion, it is necessary to keep the bearings full of grease and to rotate them periodically. Even when full of grease, bearings will take on moisture, so it is necessary to purge the bearings with new grease to expel moisture every thirty days. It is recommended that the bearings be purged with grease while being rotated by hand. Do not use high pressure greasers as they may ruin the bearing seals. Spherical roller bearings with split pillow block housings must be opened up and grease removed before start-up. Remove old/excess grease and regrease the bearing in accordance with the bearing manufacturer's instructions.

The drives and belts should be removed if the fan is to be stored for a prolonged period. The drives should be labeled for service and stored in a dry place. Belts should be removed, coiled without kinks, placed in a heavy carton, and stored in a dry, well-ventilated place. To prevent belt deterioration storage conditions should not exceed 85°F and 70% humidity. If belts show signs of deterioration, they should be replaced prior to startup.

Motors should be stored in a clean, dry, vibration-free location. The packaging should be opened up enough to allow air circulation around the motor. The winding temperature should be kept slightly above that of the surroundings to prevent condensation. This can be accomplished by energizing the internal heaters, if the motor is so equipped, or by using space heaters. If it is impossible to heat the windings, the motor should be wrapped tightly with a waterproof material which also encloses several bags of desiccant. Replace the desiccant regularly to prevent moisture problems. The motor rotor should also be rotated regularly (monthly) to assure the bearing parts are well greased. Shafts on motors equipped with shaft grounding rings must remain rust free. Failure to do so renders the grounding feature inoperative and may result in bearing failure under VFD operation. Consult the motor manufacturer for further detail on motor storage and start up after longer periods of storage. It may be necessary to regrease the bearings. If the fan's bearings or motor bearings have extended lubrication lines, it will be necessary to replace the grease by detaching from the motor/bearing and purging the line with new grease.

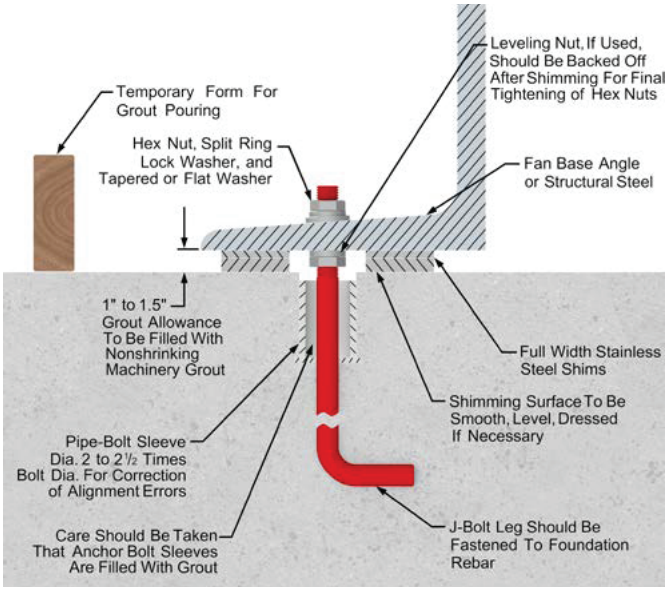
Fan & Blower
Twin City

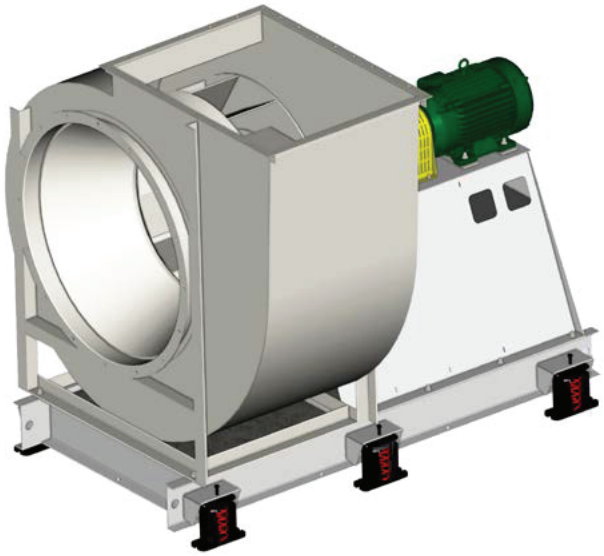
WARNING

Refer to handling section prior to lifting equipment.

Foundations & Supporting Structures (refer to lifting/safety section)

The best means of floor mounting a fan is on a well-designed, flat, level concrete foundation. The foundation should have a mass of at least three times that of the supported assembly. Rigid foundation stiffness must be between $1x10^6$ lbs./in. to $4x10^6$ lbs./in. depending upon size and speed. The foundation should extend 6" beyond the outer dimensions of the fan and driver; however, it should be no more than twice the area required for the equipment. If it is made larger, the mass should be increased accordingly to resist rocking modes of vibration. Anchor bolts should be carefully located by a competent tradesman as wheel to inlet, bearing location and motor location are critical to final fan alignment. J or T type anchor bolts of sufficient size should be used and should be tied into the reinforcing bar for the foundation. Pipe sleeves may be incorporated when pouring the concrete. After the concrete is poured, a pipe sleeve with a diameter of 2 to 2½ times the anchor bolt diameter should be provided around the anchor bolt for final adjustment. The mounting surface of the foundation should be smooth for good shim contact. When deciding the thickness of the foundation, approximately 1 to 1½" height should be allowed for shimming, grouting, leveling, washers, nuts, etc. The above represents industry best practice. Actual foundation design should be entrusted to a qualified engineer. Anchor bolts should be accurately placed to coincide with the predetermined fan securing holes, or the manufactured base, to ensure that the fan is not distorted (this may impact alignment and vibration.)





Fan mounted on an Inertia Base
Base and pedestal shown filled with reinforced concrete.

Fans mounted on a sub-floor or mezzanine must have adequate stiffness or be mounted on an inertia base with springs properly selected. An inertia base is recommended for arrangement 8 fans to ensure alignment of the rotor and drive.

If a structural steel base or platform is to be used, the structure must be designed for the weight of the fan, live loads imposed by rotation of the rotor and driver, and any external live loads. The structure should be designed to ensure that no natural frequency will occur within 30% of the fan speed. This is especially true if the structure supports more than one fan. Inertia bases are generally recommended to provide adequate mass and stiffness for fan operation.

Any ducting should have independent support. Do not use the fan to support ducting as the housing or pedestal may become distorted. The fan frame can be designed to carry some external loads. Consult the factory if this is a concern. Isolating the fan from ductwork with flex connections eliminates transmission of vibration. Fans handling hot gases require expansion joints at both the inlet and discharge to prevent excessive loads caused by thermal growth.

Fan Installation – Factory Assembled Units (refer to lifting/safety section)

All fan wheels are statically and dynamically balanced using state of the art equipment in the factory. Final trim balancing is performed on factory assembled fans, unless the specified electrical characteristics of the motor are outside the limits of the factory test equipment. If the motor and drives are supplied, the complete assembly is run tested and balanced. Infrequently, fans are supplied with unusual electrical characteristics and cannot be tested with the motor. In this situation the fans are run and balanced using a factory driver. Likewise, if motors and/or drives are not supplied, the fan is tested with the factory driver. Final balancing, at the buyer's expense, should be performed in the field after the motor and/or drives are installed. This service is available from TCF, otherwise this should be entrusted to a qualified technician.

Follow proper handling instructions as given earlier.

1. Move the fan to the final mounting position.
2. Remove skid, crates and packing materials carefully.
3. If vibration isolation is to be used, place isolation base on mounting bolts. Line up holes in fan base with bolts. See Item 10 in the "Optional Accessories" section for preparing inertia bases for use.
4. Place the fan on mounting structure. Carefully level the unit (checking the level on the shaft) on the foundation and shim as necessary using stainless steel shims on both sides of each anchor bolt. Back off leveling nuts if used. Be careful not to force the fan to the mounting structure/ foundation. This may cause the bearings to become misaligned or pinched causing vibration and premature failure.
5. Check the alignment of the bearings. Shim or reposition the bearings if necessary.
6. Check alignment of sheaves on belt driven fans.
7. Check tension of belts to see if it is sufficient. Sheaves on belt driven fans are often provided with taperlock bushings. When tightening bushing bolts, proceed in a progressive manner to avoid cocking the tapered surfaces between the bushing and the sheave. Torque per tables on the right.

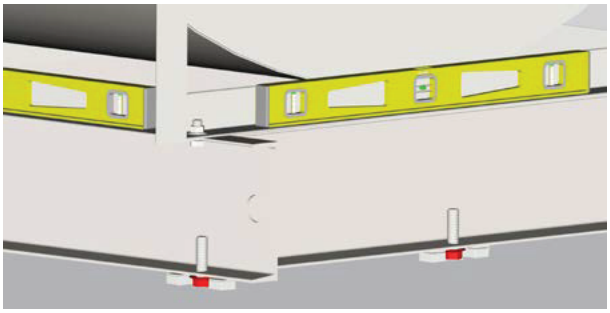
Click To View Our Sheave Installation video

8. Check alignment of factory mounted couplings, as they are subject to misalignment during shipment and installation. Realign to within 0.002" offset and parallel. Allow for thermal growth of the motor by setting the motor 0.001" low for each inch of shaft up to 0.005".

NOTICE

Most couplings need lubrication.

9. Check the tightness of the wheel on the shaft. Check the tightness of foundation bolts, motor bolts, sheaves, and bearings. Make sure there is no rubbing or binding and that the wheel-inlet cone clearances and overlap are correct.
10. Check that bearings are fully lubricated and check the oil level in the static oil lube systems. For spherical roller bearings with split pillow block housings, the bottom half of the housings should be 1/3 full of grease. For oil lube bearings, the oil level should submerge the bottom-most roller halfway into the oil.
11. Install any accessories shipped loose from the factory.



Carefully level the fan on the foundation

Tightening Torque

SIZE	FASTENER - TIGHTENING TORQUE (Ft. Lbs.)		
	GRADE 2	GRADE 5	GRADE 8
#10	—	—	—
¼-20	5.5	8	12
5⁄16-18	11	17	25
⅜-16	22	30	45
7⁄16-14	30	50	70
½-13	55	75	110
9⁄16-12	—	—	—
⅝-11	100	150	200
¾-10	150	270	380
⅞-9	165	430	600
1-8	250	645	900
1¼-7	500	1120	1500

SIZE	TAPER BUSHINGS - TIGHTENING TORQUE (Ft. Lbs.)		
	SPLIT		QD FOR DRIVE
	IN IRON	IN ALUM. HUB	
#10	—	—	6
¼-20	7.9	7.5	9
5⁄16-18	16	13	15
⅜-16	29	24	30
7⁄16-14	—	—	—
½-13	70	—	60
9⁄16-12	—	—	75
⅝-11	140	112	135
¾-10	—	—	—
⅞-9	—	—	—
1-8	—	—	—
1¼-7	—	—	—

The above torque values are for nonlubricated fasteners and Browning Bushings. For bearing setscrews, use manufacturer's recommendations. If other bushings are used, utilize bushing manufacturer's specifications.

Tolerance: +/- 5%
For wheel setscrews use Grade 2 values.

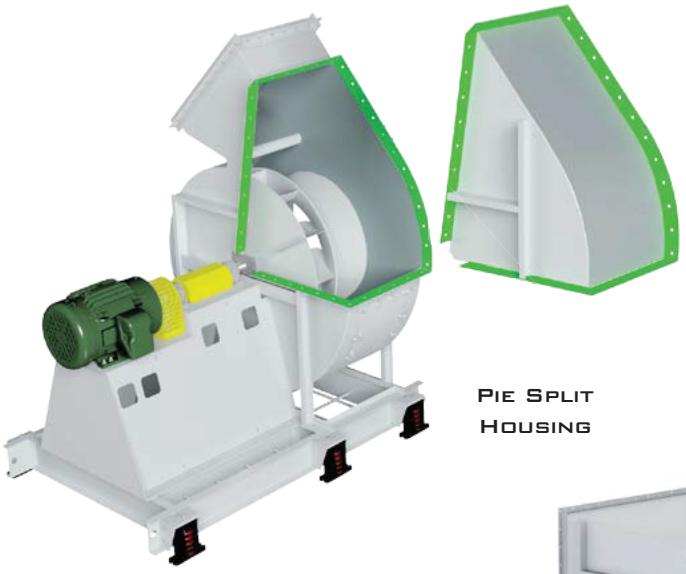
Fan Installation – Disassembled Units With Split Housings

(refer to lifting/safety section)

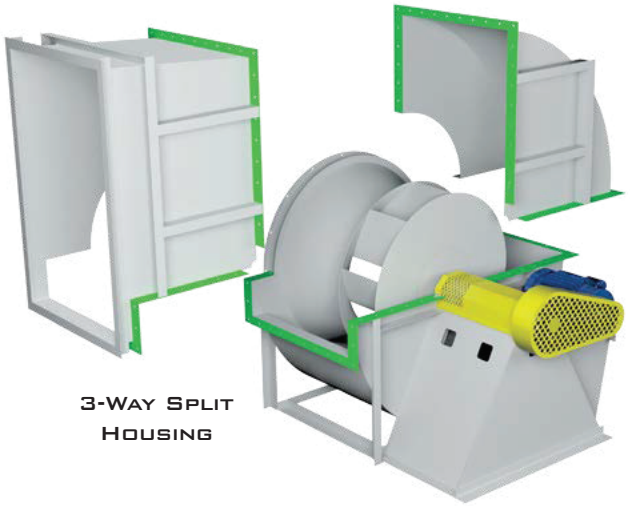
A unit is considered "disassembled" if any component required for proper operation is shipped or supplied separately or in pieces. Reference earlier instructions concerning proper handling of fan components and general safety. Wheel rotation is important. Rotation is viewed from the drive side unless otherwise noted on the drawing.

All units where assembly of the fan housing or bearing pedestal or drive stand is required will have tags or matchmarks on adjacent parts. These are used to identify which components are joined together. Units which require extensive assembly may require additional instructions located in other sections of this manual. Special instructions for some components and accessories are sent with the shipment.

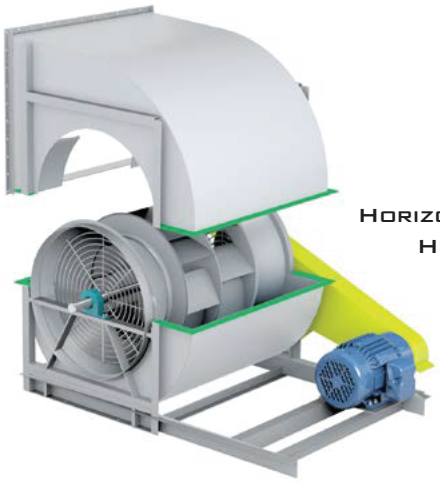
1. Move the lower half of the housing to its mounting location.
2. Remove skids, crates, and packing materials carefully.
3. If vibration isolation is to be used, place the vibration isolation base on mounting bolts. Line up holes in fan base with bolts. See Item 10 in the "Optional Accessories" section for preparing inertia bases for use.
4. Place the lower housing on the mounting structure. Carefully level the lower housing on the foundation and shim as necessary using stainless steel shims on both sides of each anchor bolt. **IMPORTANT: Back off leveling nuts if used.**
5. If the bearing pedestal(s) are separated they should be installed next.
   a. Move bearing pedestal(s) to mounting location.
   b. Set pedestal(s) on bolt(s).
   c. Do not distort bearing pedestal by forcing it to align with a non-level foundation. (The concrete foundation should be properly dressed.) Place shims on either side of the foundation studs and back off leveling nuts.
   d. Check the bearing centerline height. Adjust the height to match centerline height of the housing. High temperature units may require a lower housing centerline/inlet when cold so that it will be centered when hot.
   e. Bring the bearing pedestal into square with the housing using careful measurements or a large square.
   f. Shim and bolt the pedestal into position.



Pie Split Housing



3-Way Split Housing



Horizontal Split Housing

Fan Installation – Disassembled Units With Split Housings (Cont.)

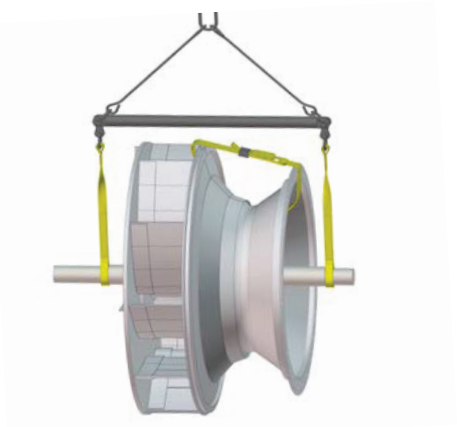
(refer to lifting/safety section)

6. If the wheel and shaft were shipped unassembled, you must now install the shaft in the wheel.
   a. First use solvent to clean the protective coating off the shaft. Check all surfaces for corrosion or nicks and clean if necessary with fine emery cloth or a stone. After thoroughly cleaning the shaft with solvent, do not touch it with bare hands as perspiration can cause rust or pitting over time.
   b. Remove keys from the shaft.
   c. Clean the inside of the wheel bore with solvent. Make sure the setscrews will not interfere when inserting the shaft into the wheel bore.
   d. Insert the shaft into the wheel from the back side of the wheel.
   e. When the shaft is flush with the wheel hub (Arr. 1, 9 and 8), dress the key if necessary, insert into the keyway and tighten the wheel setscrews.
   f. For Arrangement 3 fans, refer to the drawing for appropriate wheel and shaft dimensional relationship.
   g. Check the assembly drawing to make sure that the wheel and shaft have been assembled correctly.

Click To View Our Wheel Installation/Removal Video

Click To View Our Rotor Installation/Removal Video

7. The rotor can now be installed in the housing. Slide the bearings on if they are solid pillow blocks or loosely mount the bottom halves if they are split. Inlet vanes and/or inlet funnels may need to be installed over the shaft before installing and bolting the bearings to their supports (Arr. 3 and 7). Insert the inlets into the wheel inlet and tie them off for lifting and placing in the housing. Refer to steps 8 and 9 for order of assembly of components for double width and single width fans. The shaft should be cleaned and oiled where it will contact the bearings. Carefully lower the shaft assembly into the bearings. Use care when lowering the shaft onto the bearings so thrust bearings, collars, and liners are not damaged due to misalignment. The bearing housing should be parallel to the axis of the shaft to prevent loads caused by misalignment. Precision shim bearings as required. Lock bearings. Be sure expansion bearing (if supplied) is set to allow for thermal growth. Refer to bearing installation instructions in this installation manual.



8. Arrangement 3 (split-housed) units:
   a. Parts on a DWDI unit are assembled in the following order as viewed from opposite drive side: bearing bar assembly (or independent pedestal) and opposite bearing, funnel (housing side), wheel (housing side), funnel, drive side bearing bar assembly (pedestal), drive bearing and sheaves or coupling. Mount bearing bar assembly to housing. Center wheel in funnels.
   b. Assemble parts in above order on shaft.
   c. Proceed with connection of the shaft assembly to supports in step 7 above.
9. Parts on a SWSI unit are assembled in the following order as viewed from opposite drive side: bearing bar assembly and opposite bearing, funnel (housing side), wheel (housing side), drive side bearing bar assembly, drive bearing and sheaves. Mount bearing bar assembly to housing. **Refer to the wheel-funnel overlap section.**
   a. Assemble parts in above order on shaft.
   b. Proceed with connection of the shaft assembly to supports in step 7.
10. Install motor on the base if applicable. Carefully align shafts for drive installation.

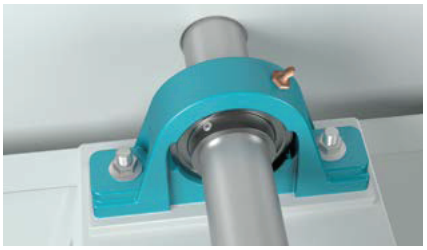
Fan & Blower Twin City

Bearing Installation (refer to safety section)

The following section gives some general instructions on bearing installation. If bearings are to be field installed, the specific installation manual for the bearings will be provided and should be followed carefully. If provided, check the assembly drawings and bearing manufacturer's instructions for location of the fixed and expansion bearings. The positions of these bearings cannot be interchanged. Always follow the bearing manufacturer's instructions.

Solid Pillow Block

1. Lightly lubricate the bearing bore and slide bearing into the proper position on the shaft. Sling the rotor assembly into place and loosely bolt the bearings in place.
2. When bearings are in place, shim appropriately and torque the base bolts using values from the Tightening Torque table on page 9. Tighten the collar setscrews to manufacturer's specification. The setscrews on both bearings should be aligned with one another. If the bearing has an adapter mount, hand tighten the locknut to establish the "zero" point. Next, tighten the number of turns per the instructions furnished with the bearing. Rotate by hand to be sure the bearings and shaft rotate freely.
3. Ensure the expansion bearing is centered within its housing. If bearings need to forced onto the shaft then apply force on the inner race/collar only (does not apply to adapter mount.) If an expansion bearing has been supplied, it should not be bolted to the pedestal until the fixed bearing has been bolted and locked. After locking the expansion bearing to the shaft, position the pillowblock to allow for axial expansion, approximately centered in the pillowblock, then bolt to the pedestal.
4. Unless the user orders differently, bearings are lubricated in the factory with a lithium complex, NLGI grade 2 grease. **Refer to the bearing lubrication schedule on the next page.**



Solid Pillow Block Bearings

Split Pillow Block Bearings

Spherical Roller Bearings with Split Pillow Block Housings

1. The bearings should be disassembled, taking care not to interchange parts between bearings. Tops of housings are not interchangeable with the bottom half pillowblock from another bearing. Pins locate the top half of the housing to prevent it from being installed in the reverse.
2. The lower bearing housing should be bolted loosely to the pedestal and seals; bearing and adapter sleeve should be placed loosely on the shaft.
3. The rotor assembly with the seals and bearings should next be positioned over the housings and carefully placed into the lower housings.
4. The stabilizing ring, sometimes referred to as the "C" ring, is installed in the bearing closest to the drive sheave or coupling unless otherwise noted in the drawing. The bearing race should be centered in the expansion bearing. The exception may be on Arrangement 3 or 7 fans with a high operating temperature. Refer to the fan drawing for location. The "C" ring is not used in the expansion bearing.
5. When installing adapter sleeves, tighten for reduction in clearance per manufacturer's instructions.
6. Bend down a tab on the lockwasher after finishing adjustment. Some brands of bearings do not utilize a lockwasher. Instead you will find allen-head setscrews in the locknut outside diameter. Tighten the setscrew after reduction in clearance is attained.
7. Grease or oil according to manufacturer's instructions. Grease/Lube will likely include the partial fill of the housing internal cavities.
8. Install the bearing housing cap bolts and bearing mounting bolts. Tighten bearing housing cap bolts and bearing mounting bolts. Torque to bearing manufacturer's instructions.

Sleeve Bearings

1. The bearings should be disassembled and cleaned with appropriate solvent, taking care not to interchange parts between bearings. Parts of one bearing are generally not interchangeable with parts from another bearing. Bearing caps are matched to the bottom half of the pillowblock and are not interchangeable with other pillowblocks.
2. The lower bearing housings should be bolted loosely to the pedestal. The lower liner should then be placed in the housing.
3. Oil the lower liners per manufacturer's instructions and carefully sling the rotor assembly into place, being very careful not to damage the bearing liners.
4. Install thrust collars and thrust plates in the fixed bearing
5. Make sure to install the oil slinger rings in their correct location and peen the ring screws in place.
6. When handling the liners, be careful not to damage the surfaces, as they are babbitted and are fragile.
7. The housings are generally tapped with a number of ports. Be sure the oil level gauge, circulating oil supply and discharge, thermocouples, etc., are correctly placed for accessibility.
8. Make sure that proper oil type and quantity is used. Refer to the fan general assembly drawing.
9. Make sure that the thrust collar screws, liner screws, cap bolts, and plunger are torqued to manufacturer's specifications. Bearing instructions are shipped with the fan. Instructions can also be found on the bearing manufacturer's website.

Safety & Bearing Lubrication Instructions

WARNING

1. **This equipment must not be operated without proper guarding of all moving parts. While performing maintenance be sure remote power switches are locked off. See installation manual for recommended safety practices.**
2. **Before starting: Check all setscrews for tightness and rotate wheel by hand to make sure it has not moved in transit.**

Fans with Unit Roller Bearings

Relubrication Schedule (Months)* Spherical Roller Bearing - Solid Pillow Blocks									
Shaft DIA	Speed (RPM)								
	500	1000	1500	2000	2500	3000	3500	4000	4500
1" thru 1 7/16" (25 – 35)	6	4	4	2	1	1	1	1	1/2
1 15/16" thru 2 3/16" (40 – 55)	4	2	1 1/2	1	1/2	1/2	1/2	1/2	1/2
2 7/16" thru 3 7/16" (60 – 85)	3	1 1/2	1	1/2	1/2	1/4	1/4		
3 15/16" thru 4 15/16" (90 – 125)	2 1/2	1	1/2	1/4					

*Suggested lubrication interval under ideal continuous operating conditions. Relubricate while running, if safety permits, until some purging occurs at seals. Adjust lubrication frequency depending on conditions of purged grease. Use one-half of listed interval for vertical shaft applications or for 24 hour operation. Hours of operation, temperature, and surrounding conditions will affect the relubrication frequency required.

1. Lubricate with a high quality NLGI No. 2 lithium-base grease having rust inhibitors and antioxidant additives, and a minimum oil viscosity of 500 SUS at 100°F (38°C). Some greases having these properties are:
   Shell - Gadus S2 V100 2 — Mobil - Ronex MP
   Mobil - Mobilith SHC100 — Mobil - Mobilith SHC220
2. Lubricate bearings prior to extended shutdown or storage and rotate shaft monthly to aid corrosion protection.

Fans with Ball Bearings

Relubrication Schedule (Months)* Ball Bearing Pillow Blocks									
Shaft DIA	Speed (RPM)								
	500	1000	1500	2000	2500	3000	3500	4000	4500
1/2" thru 1 11/16" (13 – 45)	6	6	5	3	3	2	2	2	1
1 15/16" thru 2 7/16" (50 – 60)	6	5	4	2	2	1	1	1	1
2 1/16" thru 2 15/16" (65 – 75)	5	4	3	2	1	1	1		
3 3/16" thru 3 15/16" (80 – 100)	4	3	2	1	1				

*Suggested lubrication interval under ideal continuous operating conditions. Relubricate while running, if safety permits, until some purging occurs at seals. Adjust lubrication frequency depending on conditions of purged grease. Use one-half of listed interval for vertical shaft applications or for 24 hour operation. Hours of operation, temperature, and surrounding conditions will affect the relubrication frequency required.

1. Lubricate with a high quality NLGI No. 2 lithium-base grease having rust inhibitors and antioxidant additives, and a minimum oil viscosity of 500 SUS at 100°F (38°C). Some greases having these properties are:
   Shell - Gadus S2 V100 2 — Mobil - Ronex MP
   Mobil - Mobilith SHC100 — Mobil - Mobilith SHC220
2. Lubricate bearings prior to extended shutdown or storage and rotate shaft monthly to aid corrosion protection.

Fans with Spherical Roller Bearings with Split Pillow Block Housings

Relubrication Schedule (Months)* Spherical Roller Bearing - Split Pillow Blocks										Grease to be added at each interval
Shaft DIA	Speed (RPM)									
	500	750	1000	1500	2000	2500	3000	3500	4000	
1 7/16" thru 1 15/16" (35 – 50)	6	4 1/2	4	4	3 1/2	2 1/2	2 1/2	1	1	0.50 oz.
2 3/16" thru 2 13/16" (55 – 70)	5	4 1/2	4	2 1/2	2 1/2	1 1/2	1/2	1/4	1/4	0.75 oz.
2 15/16" thru 3 15/16" (75 – 100)	4 1/2	4	3 1/2	2 1/2	1 1/2	1	1/2			2.00 oz.
4 7/16" thru 4 15/16" (110 – 135)	4	4	2 1/2	1	1/2					4.00 oz.
5 7/16" thru 6 15/16" (140 – 180)	4	2 1/2	1 1/2							8.5 oz.

*Suggested lubrication interval under ideal continuous operating conditions. Remove bearing cap and observe condition of used grease after lubricating. Adjust lubrication frequency as needed. Use one-half of listed interval for vertical shaft applications or for 24 hour operation. Hours of operation, temperature, and surrounding conditions will affect the relubrication frequency required. Clean and repack bearings annually. Remove old grease, pack bearing full and fill housing reservoir on both sides of bearings to bottom of shaft.

1. Lubricate with a high quality NLGI No. 2 lithium-base grease having rust inhibitors and antioxidant additives, and a minimum oil viscosity of 500 SUS at 100°F (38°C). Some greases having these properties are:
   Shell - Gadus S2 V100 2 — Mobil - Ronex MP
   Mobil - Mobilith SHC100 — Mobil - Mobilith SHC220
2. Lubricate bearings prior to extended shutdown or storage and rotate shaft monthly to aid corrosion protection.
3. Purge or remove old grease when changing lubrication brands or types.

Static Oil Lubrication

1. Use only high quality mineral oil with a VG grade indicated on the customer submittal drawing.
2. Static oil level should be at the center of the lower-most roller. (Do not overfill.)
3. Complete lubrication change should be made annually.

Fan & Blower Twin City

Drive Mounting
(refer to safety section)

Mount drives as follows:

1. Slip (do not pound) proper sheave onto corresponding shaft. Most drives utilize tapered bushings. Draw the bushing up evenly tightening in steps. To minimize bearing loading, mount sheaves as close to bearings as possible. It is preferable to use alignment tools that align the grooves of the sheave.

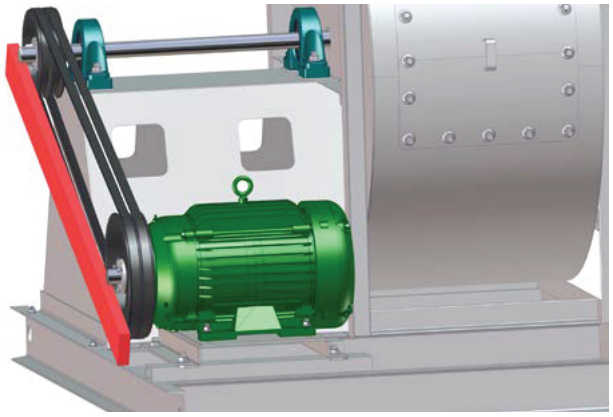
2. Laser alignment is common. The mechanic must be familiar with the alignment tool he is using. Otherwise, align sheaves with straightedge extended along sheaves, just making contact in two places on outside perimeters of both sheaves. This "four-point" alignment may also be checked with a string tied to the shaft behind one of the sheaves. The string is then pulled taut over the faces of the sheaves to check the alignment at the four points at the outside perimeters. Each sheave should be rotated about one-half revolution during this check to look for excessive runout or a bent shaft. Unless there is a bent shaft, runout can be corrected by adjustments to the bolt torque of the taper bushing.

3. Install and tighten the belts. Run the drive for a few minutes to seat the belts. When fitting the belts, slide the motor in to fit the belts on. Do not use a pry bar, as this may damage the belt cords. Tighten the belts to the proper tension. Ideal tension is just enough tension so that the belts do not slip under peak load or acceleration. Many drives are provided with tensioning data which identifies the load to apply at the center of the span and the allowable deflection from this force. A belt tension gauge is recommended for precise tensioning.

4. After initial installation of belts, recheck belt tension again after a few days of operation to adjust belt tension. (New belts require a break-in period of operation.)

WARNING

When working around belts and pulleys, keep hands away from pinch points.



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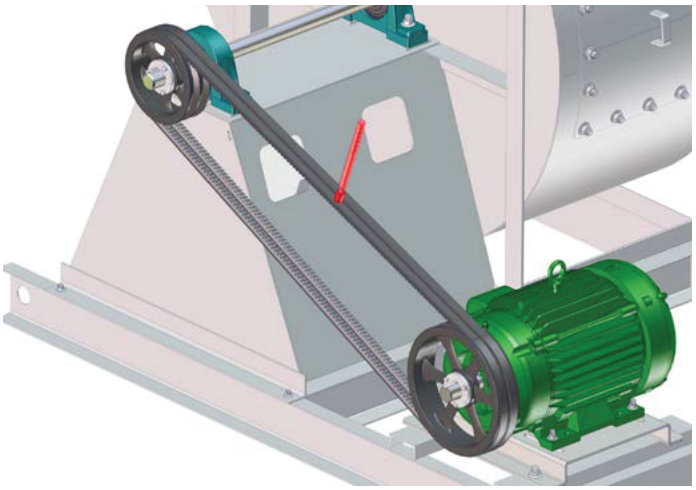


Fan & Blower
Twin City

CAUTION

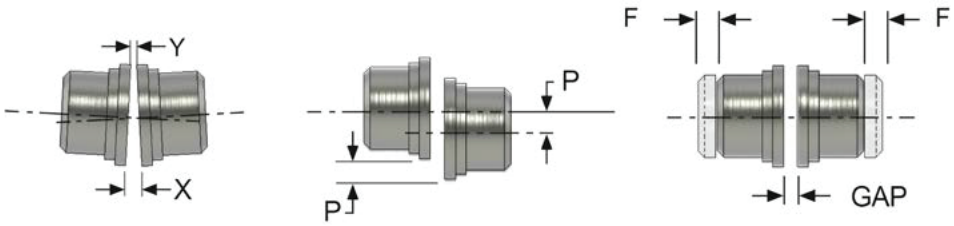
Placing fan sheave on motor can overspeed wheel and cause structural failure.

Flexible Couplings (refer to safety section)

These instructions are general for the installation of several types of flexible couplings and should not be used as a substitute for more specific manufacturer's instructions. The coupling manufacturer's installation data is available and will give specific dimensions for alignment limits, lubricants, etc. Refer to Item 7 in "Factory Assembled Units" section for coupling alignment requirements.

Before preparing to mount the coupling, make sure that all bearings, inlet vanes, shaft seals, or other components have been installed on the shaft.

When mounting and keying the coupling halves to the shaft, follow supplied instructions for heating and shrink fitting. Set the coupling halves for the normal gap specified by the manufacturer. Coupling gap is illustrated below. It is advisable to set the motor on the pedestal first to better determine the placement of the coupling on the shaft.



ANGULAR MISALIGNMENT | **PARALLEL MISALIGNMENT** | **GAP AND END FLOAT**

X-Y = ANGULAR MISALIGNMENT
P = PARALLEL OFFSET (MISALIGNMENT)
F = END FLOAT*

The two types of misalignment are illustrated above. Alternatively angular alignment is checked with feeler gauges between the hub faces. When angular alignment has been adjusted to manufacturer's specification, parallel alignment can be checked with a dial indicator on the hub or a straightedge and feeler gauges on the hub halves' O.D. When shimming has brought parallel alignment within specification, angular alignment and gap should again be checked, and adjustments made if necessary. A dial indicator or laser alignment may be used to more accurately take the measurements described above.

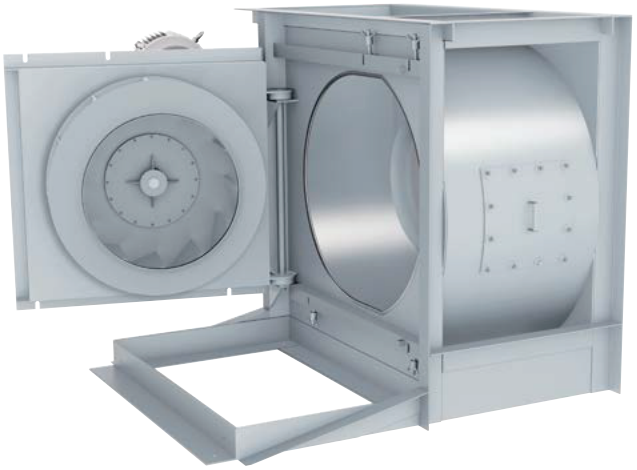
Special adjustments may need to be made for couplings used with some equipment. As an example, when used with motors with sleeve bearings, couplings may require provisions for limiting end float. Larger drivers may grow in operation (due to heat expansion) requiring the driver side to be set slightly low when not operating. A good rule of thumb is to set the motor low by 0.001 inches per inch of motor shaft diameter up to 0.005". Refer to specific instruction manuals or assembly drawings.

Thoroughly clean the coupling halves after completion of alignment. Reassemble the coupling and tighten bolts, washers and locknuts. Lubricate per manufacturer's recommendations.

* 1. End float is the permissible axial movement of the coupling hub(s) within the sleeves of the coupling
2. End float will allow for thermal movement
3. Limited end float couplings are often required in applications using Motors with sleeve bearings

Maintenance (refer to safety section)

Develop a regular maintenance schedule according to your needs and the criticality of the fan. Periodic inspections, lubrication, observations of sound and vibration will help prolong the life of the fan. If changes are noted check bolt tightness, foundation integrity, cleanliness of the wheel and or motor, bearing lubrication, drive components. Always keep records of the maintenance that is performed.



CAUTION

1. **Swingout fans should be opened for wheel cleaning and inspection only and should be closed immediately after cleaning. Isolate from the electrical supply before opening.**
2. **Do not run swingout fans the fan in the open position.**

Motor Maintenance

The three basic rules of motor maintenance are:

1. Keep the motor clean.
2. Keep the motor dry.
3. Keep the motor properly lubricated.

Blow dust off periodically (with low pressure air) to prevent motor from overheating.

Motor Lubrication Schedule

Motors Less than 10HP Running 8 Hrs/Day (clean environments)	Motors Between 15-40HP (clean environments)	Motors Running 24/7 or if in dirty/dusty environments
Lube every 5 Years	Lube every 3 years	Divide the service interval by 4

Do not over lubricate.

Some smaller motors are lubricated for life. Lubrication requirements are normally attached to the motor. Use the motor manufacturer's recommendations for relubrication. Often motor lubricants are not the same as the fan bearings. If this information is not available, the following schedule may be used.

Shaft grounding rings are recommended for some VFD applications. If the motor is equipped with a shaft grounding ring a yearly inspection for wear and shaft corrosion is recommended. Replace the ring if it is making minimal contact with the shaft. If corrosion is present, treat the shaft with colloidal silver per the ring manufacturer's instructions.

Drive Maintenance (refer to safety section)

V-belt drives need periodic inspection, retensioning and occasional belt replacement. When inspecting drives, look for dirt buildup, burrs or obstructions that can cause premature belt or drive replacement. If burrs are found, use fine emery cloth or a stone to remove them. Be careful that dust does not enter the bearings.

WARNING

When working around belts and pulleys, keep hands away from pinch points.

Check sheaves for wear. Excessive slippage of belts on sheaves can cause wear and vibration. Replace worn sheaves with new ones. Carefully align sheaves to avoid premature sheave failure. If fraying or other wear is observed to be mostly on one side of the belts, the drives may be misaligned. Realign and reinstall new belts. Tighten sheave bolts (or setscrews if appropriate).

When replacing belts, replace the entire set. Never use belt dressing on any belts, as it may cause belt wear.

Fan Bearing Maintenance (refer to safety section)

Proper lubrication of the fan drive bearings helps assure maximum bearing life. All fans are equipped with decals indicating the recommended relubrication intervals for normal operating conditions. **Refer to the Bearing Installation section for the lubrication schedules for ball bearings, solid pillow block spherical roller bearings and split pillow block spherical roller bearings.** Note that all speeds shown do not apply to all shaft sizes in that group. Consult the factory if in doubt of maximum speed for a particular bearing. Note that every installation is different and the frequency of relubrication should be adjusted accordingly.

Use 1/2 to 1/3 of the listed lubrication interval for high moisture applications. For vertical shaft mounts or dirty conditions use 1/2 the lubrication schedule.

Observation of the conditions of the grease expelled from unit ball or roller bearings at the time of relubrication is the best guide as to whether regreasing intervals and amount of grease added should be altered. Spherical roller bearings with split pillow block housings should not be lubricated until grease purges or overheating may result. Follow the lubrication interval and amount noted in the Bearing Installation section. Spherical roller bearings with split pillow block housings should be serviced once per year. Remove cap, clean out old grease and replace by filling the bottom half of the housing 1/3 full.

Greases are made with different bases. There are synthetic base greases, lithium base, sodium base, etc. Avoid mixing greases with different bases. They could be incompatible and result in rapid deterioration or breakdown of the grease. The lubrication sticker identifies a list of acceptable lubricants. All bearings are filled with a lithium complex grease before leaving the factory. When the fans are started, the bearings may discharge excess grease through the labrinth seals for a short period of time. Do not replace the initial discharge because leakage will cease when the excess grease has worked out. Sometimes the bearings have a tendency to run hotter during this period. This is no reason for alarm unless it lasts over 48 hours or temperatures exceed 200°F. When relubricating, use a sufficient amount of grease to purge the seals. Rotate bearings by hand during relubrication. If extended lubrication lines are fitted, lubricate the bearings while the fan is operating if it is safe to do so.

Wheel and Shaft Maintenance (refer to safety section)

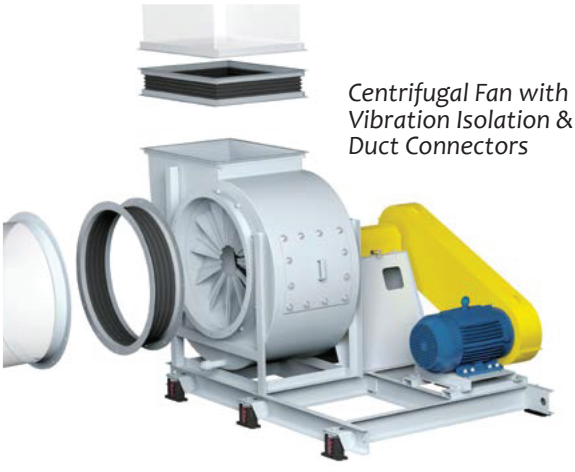
Periodically inspect the shaft and wheel for dirt buildup, corrosion, and signs of excess stress or fatigue. Clean the components. If the wheel is removed for any reason, make sure that it is securely attached to the shaft before restarting the fan.

Structural Maintenance (refer to safety section)

All structural components or devices used to support or attach the fan to a structure should be checked at regular intervals. Vibration isolators, bolts, foundations, etc., are all subject to failure from corrosion, erosion, and other causes. Improper mounting can lead to poor operation characteristics or fan fatigue and failure. Check metallic components for corrosion, cracks, or other signs of stress. Concrete should be checked to insure the structural integrity of the foundation.

Duct Connections
(refer to safety section)

The fan support structure is normally not designed to carry loads imposed by the weight of ducts, silencers, stacks, etc. Supporting these loads on the fan can cause housing distortion and may cause performance or vibration problems. Use of flexible connections is recommended for all fans and imperative when using vibration isolation or handling high temperature gases.

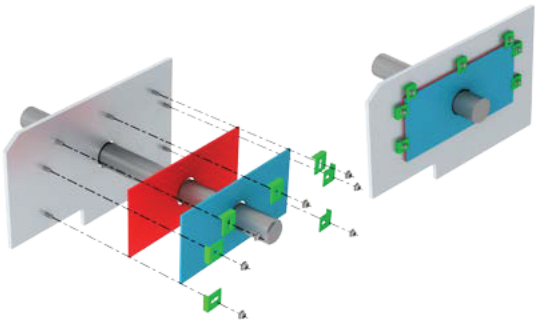


Centrifugal Fan with Vibration Isolation & Flexible Duct Connectors

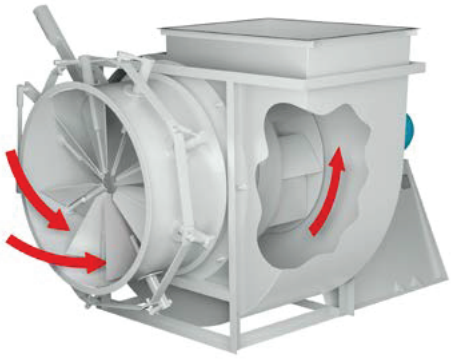
Optional Accessories

1. **Turning Gear** — A turning gear is sometimes used in high temperature applications where the fan is exposed to high temperature gases when not in operation. The wheel and shaft can expand unevenly due to the temperature when sitting idle, which can cause vibration at startup and/or a permanent set to the rotor. The turning gear slowly turns the fan from the outboard side while it is not operating, providing for even thermal expansion. It starts automatically when the fan shuts down and disengages automatically when the fan starts up again. More specific information will be provided for each application.

2. **Shaft Seals** — The standard shaft seal is a wire inserted fiberglass tacky cloth element retained with an aluminum retaining plate and clips. Other configurations of shaft seals are available for special applications, such as when it is necessary to keep the shaft seal as gas tight as possible. Shaft seal application manuals are provided in Fan Engineering FE-700 available on www.tcf.com. Other seals such as stuffing boxes, mechanical seals and carbon ring seals need special attention. It is imperative that after the fan has been leveled, shimmed, fastened to the foundation and ducted the shaft and seal be checked for concentricity and angularity. The seal must not bind when the shaft is rotated. Stuffing box packing material must not be compressed too tight by the gland or overheating will occur. Monitor temperature for a period of time. Connect a purge if specified. Carbon ring seals have pins which prevent ring rotation.



3. **Variable Inlet Vanes** — Variable inlet vanes are provided as assemblies internally in the inlet cone or externally in a flanged cylinder. The vanes are used to control volume and save power in installations where different volumetric operating conditions are used. Installation manuals are provided in other engineering supplements for specific fan types. Variable inlet vanes may be provided with powered operators in which case the manufacturer's installation and operating manuals will be provided. Inlet vanes are unidirectional. Vanes should be stroked periodically to prevent binding and possible seizure.



Orientation of Inlet Vanes Relative to Fan Rotation

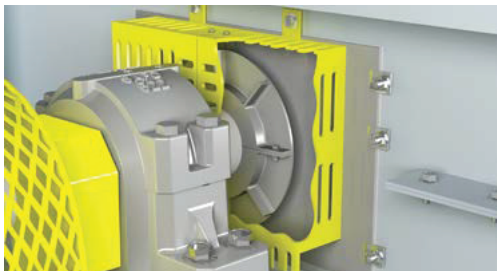
4. **Inlet Box and Inlet Box Dampers** — Inlet boxes may be provided to allow transition from a duct to the fan inlet. Inlet box dampers may also be provided for volumetric regulation similar to inlet vanes. Dampers are usually provided as a complete assembly and are installed with the damper axles parallel to the fan shaft. They should be installed to pre-spin the air in the direction of fan rotation. Damage may occur if the fan is operated regularly with damper settings less than 30% open. Operation below 30% should be limited to start-up or occasional periods of low duration.

Orientation of Damper Blades As Related to Fan Rotation

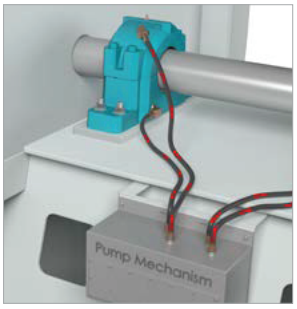
Optional Accessories (cont.)

5. **Outlet Dampers** — Outlet dampers are usually provided completely assembled like the inlet dampers. The damper is bolted to the fan discharge for volume control.

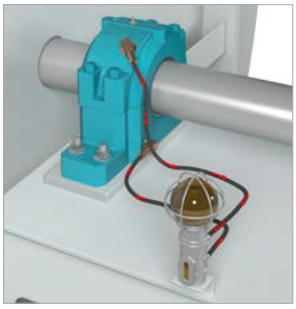
6. **Shaft Cooler** — Also referred to as "heat slingers" or "cooling wheels," these are small, radially bladed aluminum wheels that are split and bolted for installation between the inboard bearing and fan housing. The cooling fins face the bearing for grease applications and away from the bearing for oil applications to prevent oil from being drawn out of the bearing.



7. **Oil Circulating Systems** — Usually the following modifications will have to be made to the bearing if an oil circulating system is used.
   a. Four drain holes will be drilled in the bearing, two on each side of the bearing. Because of this, the bearing may be drained from either side. (Drain from both holes on one side of the bearing.)
   b. The bearing will be packed with grease to prevent corrosion until installed and started up. The drain holes will be plugged with plastic covers to make sure they are open. The customer MUST REMOVE most of the grease using solvent and remove the plastic covers prior to starting the oil circulating system.
   c. A wet sump can be added in case of circulating oil pump failure. Seals will be provided to accommodate the resultant splashing.
   d. The zerk on top of the bearing will be removed for that hole to be used as the oil inlet.

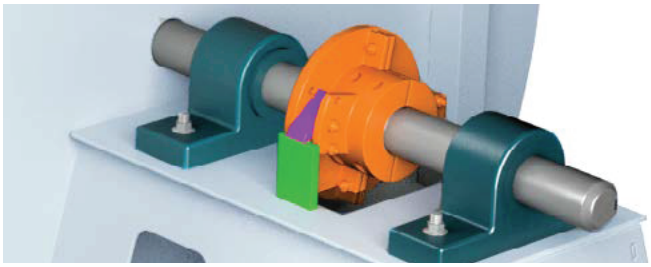


Oil Mist Lubrication System



Static Oil Lubrication System

8. **Anti-Rotation Clutch** — Damage will occur if the fan is operated in the wrong rotation. Run the motor uncoupled from the fan to establish the proper rotation.



Optional Accessories (cont.)

9. **Site-Feed Oilers** — Fans provided with optional, site-feed oilers, the oil level is to be set as indicated by the manufacturer's installation instructions provided with the fan.

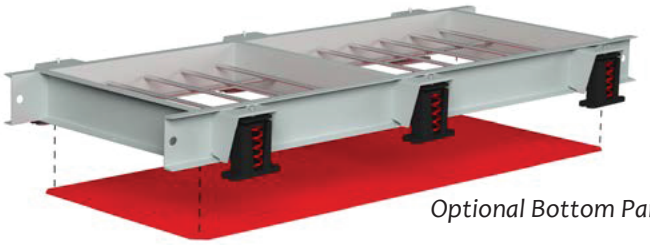
10. **Concrete Filled Bases:**

Inertia Bases – Inertia bases are spring isolated bases specifically designed to be filled with concrete (by others). The following instructions are a guide for filling a base with concrete. Remember to use safe practices when filling concrete into the base. It is best to fill concrete at or near the base's final resting area to reduce injury while transferring to the permanent location.

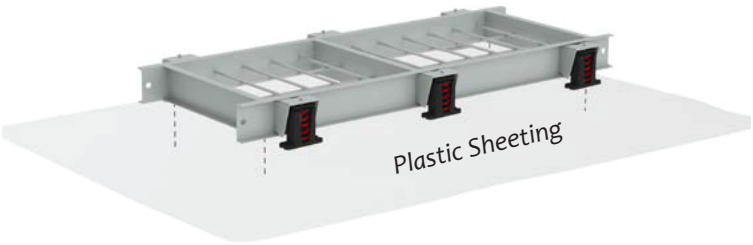
An inertia base is supplied with steel mesh or rebar added within the base frame with the intent of being filled with concrete and then mounted on springs. Bases may be supplied with or without an optional bottom pan (sealer sheet).

When an optional bottom pan is supplied from the factory, the base must be set on a flat, level surface with the bottom pan directly on the surface fully supporting the pan to maintain flatness on the bottom side. Pour concrete into the base and remove excess concrete on the top side of the base to maintain an even mounting surface for fan mounting. Be sure that the concrete has cured before lifting the base. Install isolators per the isolator installation manual.

Click To View Our
Inertia Base Installation Video



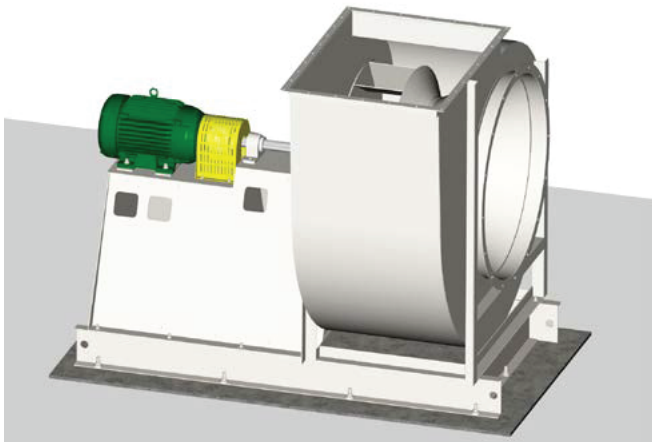
Optional Bottom Pan



When the optional bottom pan is not supplied, the base must be set on a flat, level surface that can fully support the weight of the concrete. Place a sheet of heavy-mil poly-film between the flat surface and the base frame. Pour concrete into the base and remove excess concrete on the top side of the base to maintain an even mounting surface for fan mounting. Be sure that the concrete has cured before lifting the base. Install isolators per the isolator installation manual.

Unitary Bases – Unitary bases are rigidly mounted to a foundation. Situations may arise where the base my require concrete to dampen vibration or increased stiffness. In situations where concrete must be added to the base the following guide must be utilized.

1. Rebar must be added to the cross section of the base (by others) so the concrete will have good adhesion points throughout the sections of the base. Typically rebar is installed at 12" centers however the placement of rebar should be reviewed for each individual application by a Civil Engineer if required.
2. Bases should be located in their final resting area prior to being filled with concrete. Bases should be shimmed and grouted. Once the grout is cured, concrete may be added. Pour concrete (by others) into the base and remove excess concrete on the top side of the base to maintain an even mounting surface for fan mounting.



Centrifugal Fan on Unitary Base

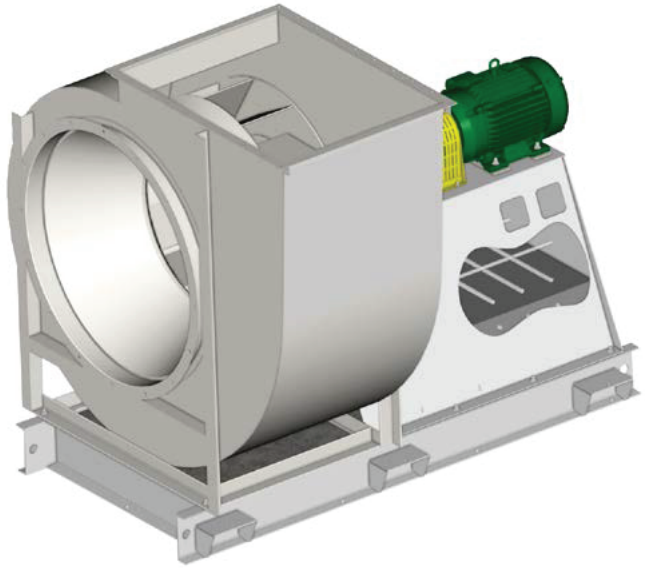
Click To View Our
Unitary Base Installation Video

Optional Accessories (cont.)

11. **Concrete Filled Pedestals** — Fans may require the bearing and/or motor pedestals to be filled with concrete (by others) for additional stiffness and rigidity, refer to the fan's drawing for requirements. Fans must utilize rebar in the pedestals so the concrete will have good adhesion points throughout.

    To fill the pedestal, the pedestal must be set on flat, level ground before concrete is added. It is recommended to locate the fan at the final location. The fan should be leveled, shimmed, and grouted prior to adding concrete.

    An optional bottom pan is available for the pedestal if it is unfeasible to add concrete at the final location. Pedestals must be placed on the ground for filling until the concrete cures. If no bottom pan is provided, a piece of plywood covered in plastic may be placed under the base while filling with concrete. Fill the pedestal with concrete (by others) to the level indicated on the drawings. After the concrete cures the fan may be installed. Do not utilize the fan's lifting lugs after concrete has been added to the fan. The lifting lugs are designed to lift the fan as it was shipped from the factory.

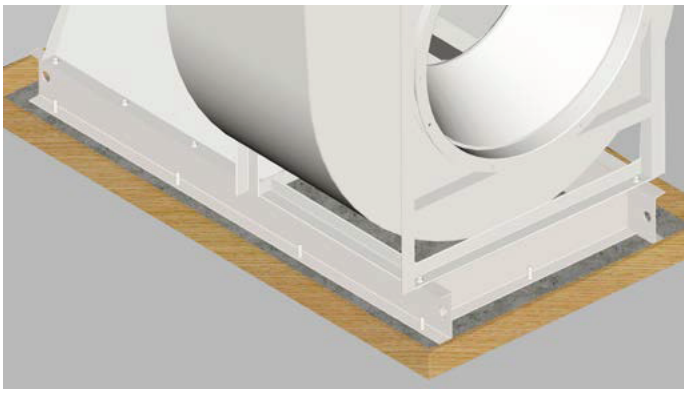


NOTICE

Concrete cure time varies depending on the base size, ambient temperature and cement mixture requested. Be sure concrete is 100% cured prior to moving equipment.

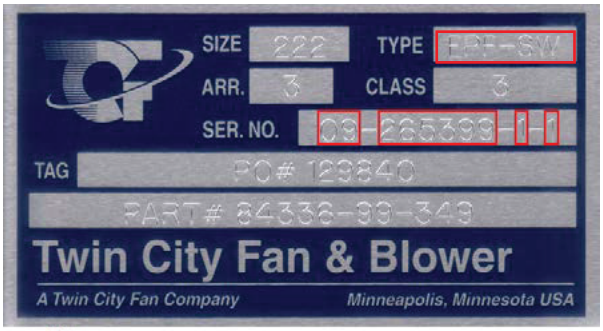
Grouting

Grouting is the final installation step. Check all shims before grouting to make sure that the fan is resting evenly on all points with anchor bolts secured to hold the shim. Back off leveling nuts if used. Use forms with sufficient space allowed for working the grout. The concrete foundation should be clean and well moistened before pouring grout. Use a commercial grade nonshrinking grout and be especially sure when pouring grout that the anchor bolt sleeves are filled. Prior to grouting, set a section of pipe (conduit, steel pipe or plastic) through the grout as a form in the low point which is able to wick/drain out the excess moisture. Refer to the Foundations and Supporting Structures section in the installation manual for a detail of a proper foundation, grout allowance and anchor bolt sleeves.

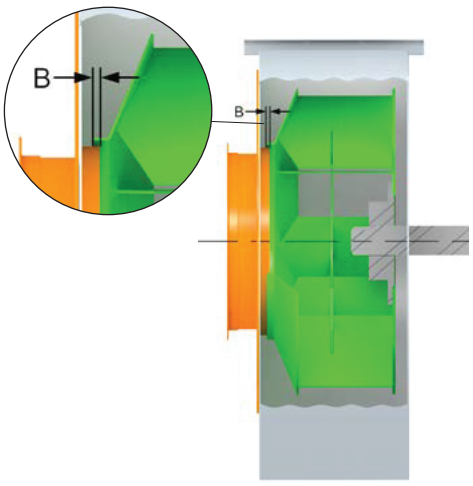


Serial Number & Fan Type

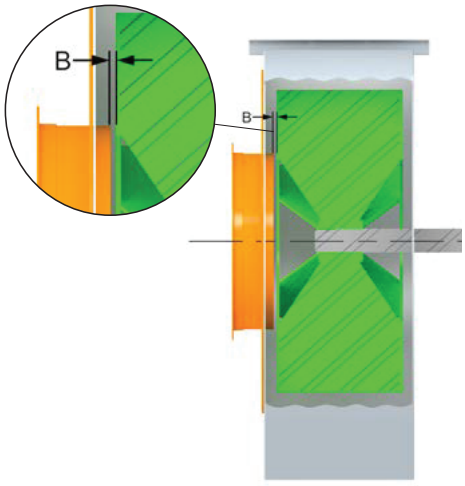
The serial number and fan type can be found on our permanent nameplate of the fan.



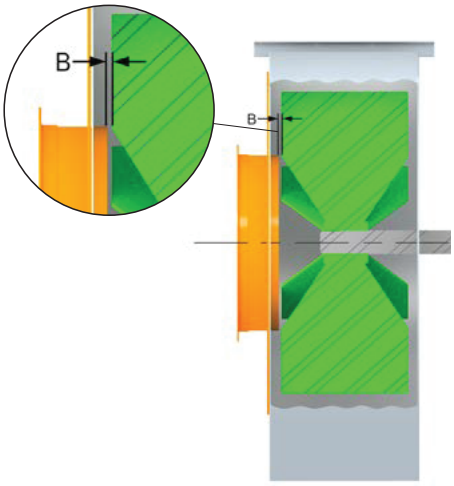
Wheel Placement



Model RBA



Model RBR

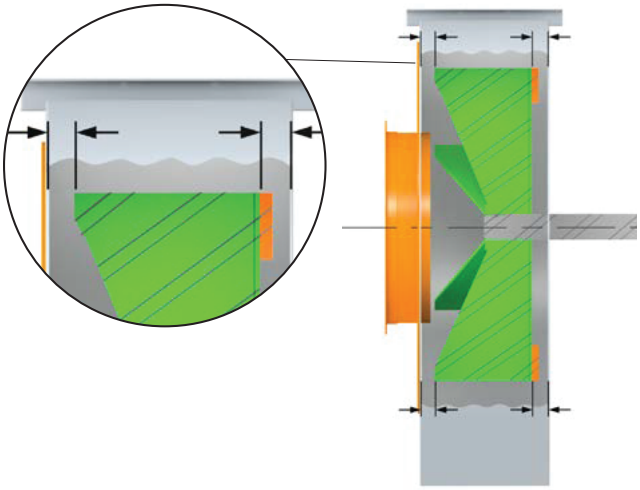


Model RBO

RBA Wheel Overlap																		
Size	907	909	911	913	915	917	919	921	923	926	929	933	937	941	945	949	954	960
B	0.25	0.38	0.47	0.53	0.59	0.69	0.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

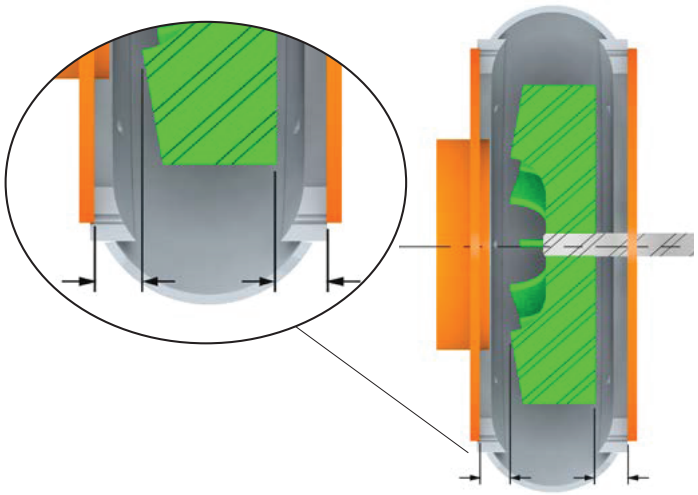
RBO, RBR Wheel Gap															
Size	913	915	917	919	921	923	926	929	933	937	941	945	949	954	960
B	0.53	0.53	0.59	0.69	0.78	0.88	0.97	1.03	1.22	1.38	1.56	1.69	1.81	1.88	2.16

Note: On Sizes 905-911 RBO and RBR wheel is to be centered in housing.



Model JRW, RBW, RBP

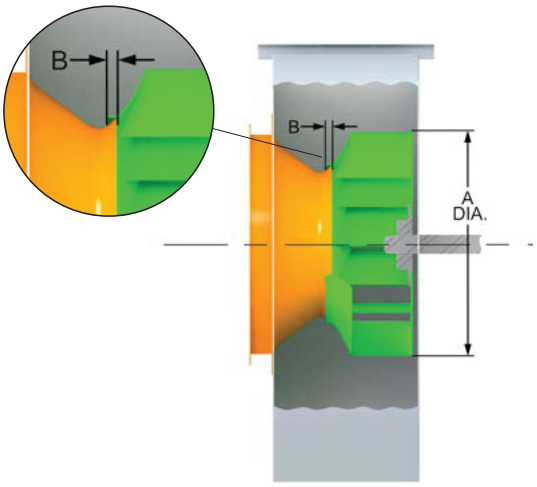
JRW, RBW, RBP Wheel Placement
Center wheel in housing. Do not include the backplate fins for centering.



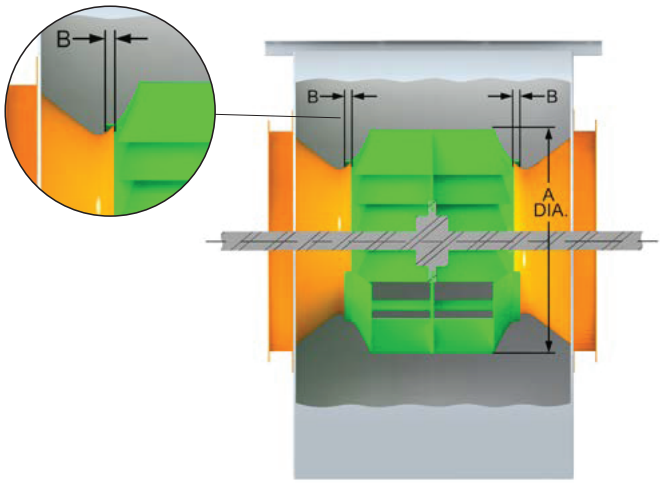
Model CIW

CIW Wheel Placement
Center wheel in housing.

Wheel Placement



Models BC-SW, BAF-SW, BAE-SW, BCS, HIB, BAV, RTF, HRT, HAF, BCV, DCV, TCBI



Models BC-DW, BAF-DW, BAE-DW

BC-SW, BC-DW, BAF SWSI & DWDI, BCS, BCV (Class I & II), DCV Wheel Overlap																					
Size	105	122	135	150	165	182	200	222	245	270	300	330	365	402	445	490	542	600	660	730	807	890
A	10.50	12.25	13.50	15.00	16.50	18.25	20.00	22.25	24.50	27.00	30.00	33.00	36.50	40.25	44.50	49.00	54.25	60.00	66.00	73.00	80.75	89.00
B	0.28	0.31	0.34	0.38	0.38	0.47	0.52	0.55	0.59	0.67	0.75	0.82	0.72	0.90	1.00	1.10	1.25	1.24	1.36	1.88	2.09	2.28

BAV, BAE-SW & BAE-DW Wheel Overlap																						
Size	122	135	150	165	182	200	222	245	270	300	330	365	402	445	490	542	600	660	730	807	890	982
A	12.25	13.50	15.00	16.50	19.00	20.82	23.16	25.51	28.11	31.23	34.36	38.00	41.90	46.33	51.01	56.48	62.47	68.71	73.00	80.75	89.00	98.25
B	0.31	0.34	0.38	0.44	0.38	0.41	0.45	0.50	0.55	0.61	0.67	0.75	0.82	0.91	1.00	1.11	1.23	1.35	1.50	1.65	1.82	2.02

Note: On swingout fans, the wheel and funnel should be positioned as close as possible (max gap 1/8") such that the door can be opened without the wheel and funnel interfering.

BCV (Class L) Wheel Overlap	
Size	B
090-105	0.28
122	0.31
135	0.34
150	0.38
165	0.44
182	0.56
200	0.63
222	0.69
245	0.75
270	0.88
300	0.97
330	1.06
365	1.31

HRT Wheel Overlap			
Size	A	B (Design 19)	B (Design 23)
270	27.00	0.50	0.50
300	30.00	0.69	0.69
330	33.00	0.69	0.69
360	36.50	0.81	0.81
400	40.25	1.03	0.97
450	44.50	1.13	1.06
490	49.00	1.25	1.13
540	54.25	1.38	1.25
600	60.00	1.31	1.31
660	66.00	1.56	1.44
730	73.00	1.75	1.63
800	80.75	1.06	1.31

HAF Wheel Overlap		
Size	A	B
220	25.00	0.50
240	27.50	0.55
270	30.38	0.61
300	33.50	0.67
330	37.00	0.74
360	41.00	0.75
400	45.25	0.83
450	50.00	0.91
490	55.13	1.01
540	61.00	1.12
600	67.50	1.23
660	74.25	1.36
730	82.00	1.50
800	90.75	1.66

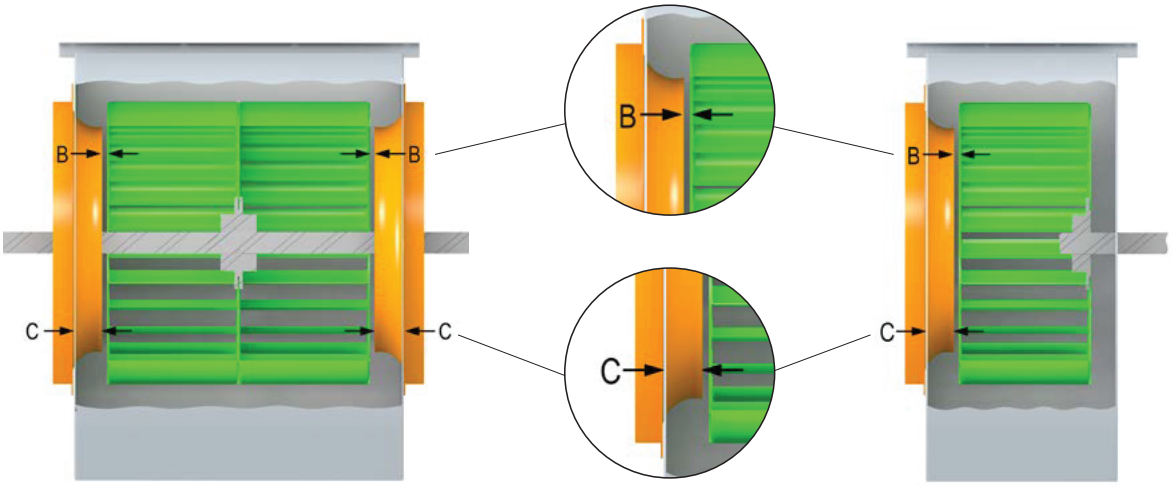
HIB, RTF Wheel Overlap					
Size	A	B	Size	A	B
180	20.50	0.31	400	45.25	0.69
200	22.50	0.34	450	50.00	0.75
220	25.00	0.38	490	55.13	0.81
240	27.50	0.44	540	61.00	0.91
270	30.38	0.47	600	67.50	1.00
300	33.50	0.50	660	74.25	1.13
330	37.00	0.56	730	82.00	1.22
360	41.00	0.63	800	90.75	1.34

TCBI (60 Hz) Wheel Overlap	
Size	B
3	0.34
5	0.38
7.5	0.38
10	0.38
15	0.31
20	0.31
25	0.31
30	0.31

TCBI (50 Hz) Wheel Overlap	
Size	B
3-50	0.56
5-50	0.56
7.5-50	0.56
10-50	0.56
15-50	0.56
20-50	0.63
25-50	0.63
30-50	0.63

Fan & Blower Twin City

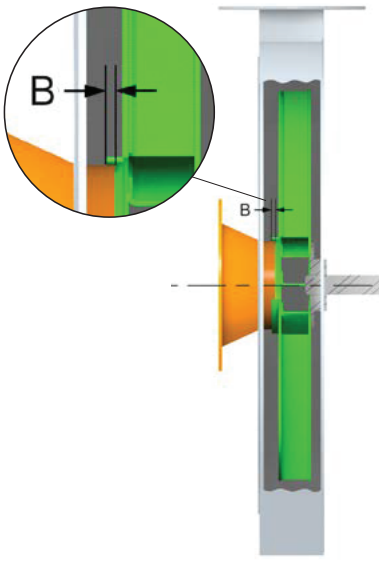
Wheel Placement



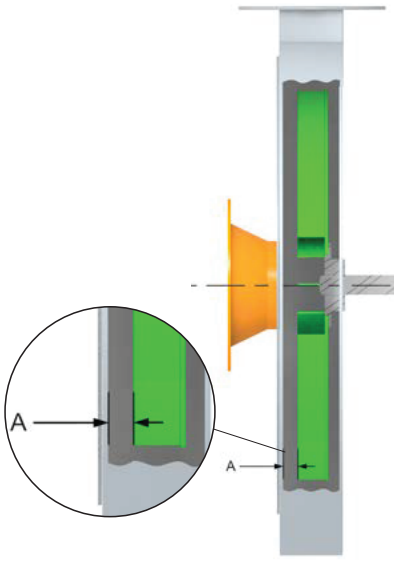
Models FC-DW, NFC-DW

Models FCV, NFC-SW

FCV, FC-DW, NFC-SW, NFC-DW Wheel Gap					
Size	B	C	Size	B	C
10.5	0.47	0.69	30	0.75	4.38
12	0.25	1.88	33	0.81	5.00
15	0.44	2.19	36	0.75	5.00
18	0.50	2.25	39	1.06	6.38
21	0.69	2.88	42	1.69	7.50
24	0.81	3.00	48	1.50	7.13
27	0.69	3.13	54	1.00	10.50



Model HRS



Model HRO

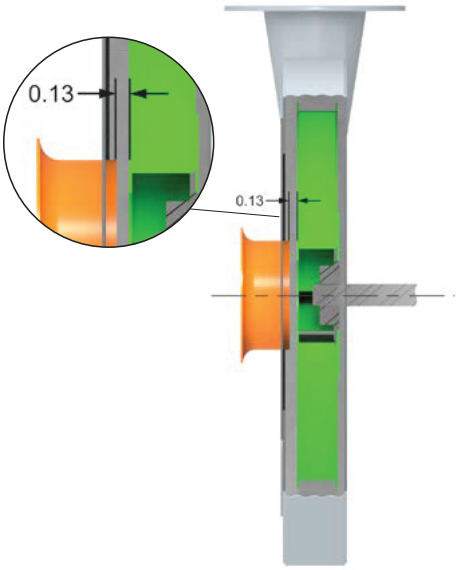
HRS Wheel Overlap		
Fan Size	Wheel Size	B
125	25	0.31
225		0.28
325		0.27
130	30	0.38
230		0.33
330		0.32
135	35	0.44
235		0.39
335		0.37
140	40	0.50
240		0.44
340		0.43
145	45	0.56
245		0.50
345		0.48

HRS Wheel Overlap		
Fan Size	Wheel Size	B
150	50	0.63
250		0.56
350		0.54
155	55	0.69
255		0.61
355		0.59
160	60	0.75
260		0.67
360		0.65
165	65	0.81
265		0.72
365		0.70
170	70	0.88
270		0.78
370		0.75

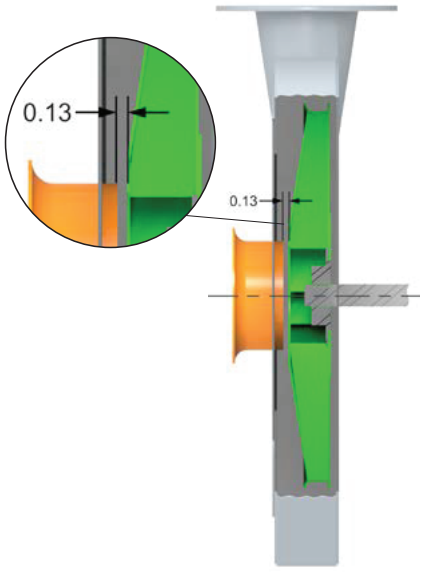
HRO Wheel Gap		
Fan Size	Wheel Size	B
125	25	0.82
325		0.80
130	30	0.99
330		0.99
135	35	1.14
335		1.12
140	40	1.32
340		1.29
145	45	1.46
345		1.42

HRO Wheel Gap		
Fan Size	Wheel Size	B
150	50	0.99
350		1.59
155	55	0.99
355		1.59
160	60	0.99
360		0.99
165	65	0.99
365		2.09
170	70	2.31
370		2.26

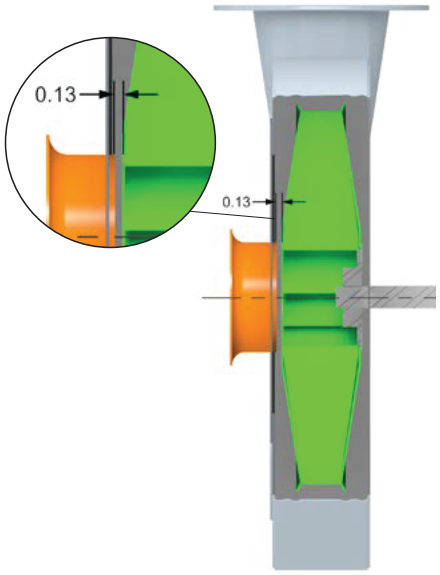
Wheel Placement



Models TBNS

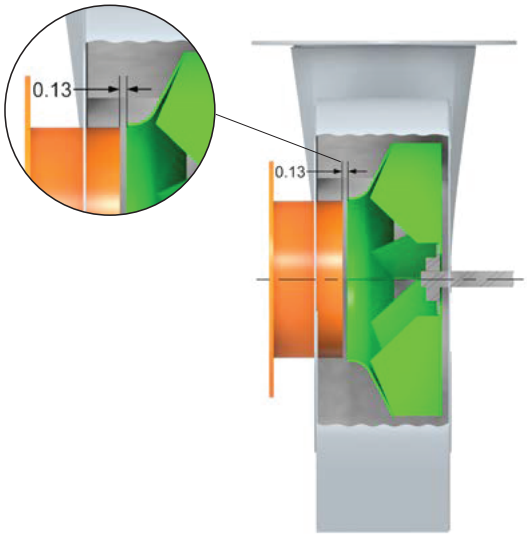


Models TBNA
"N" Series Wheel

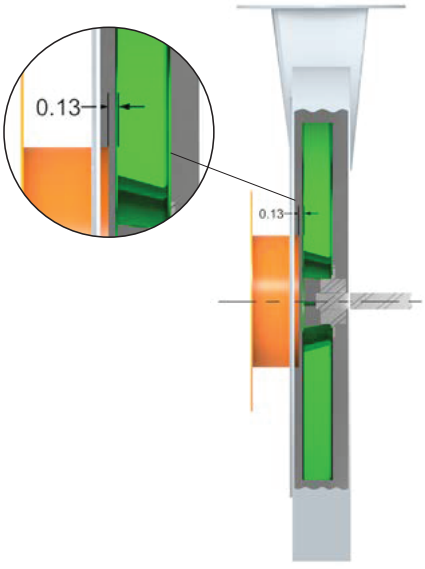


Models TBNA
"W" Series Wheel

TBNA, TBNS Wheel Gap
0.13" gap on all sizes



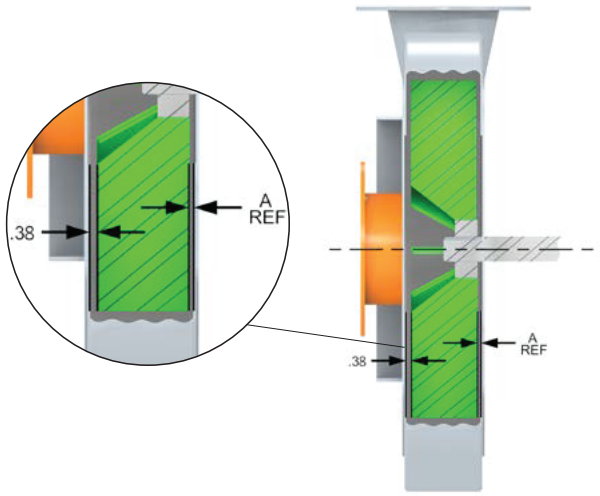
Model TBA



Model TBR

TBA, TBR Wheel Gap
0.13" gap on all sizes

Wheel Placement

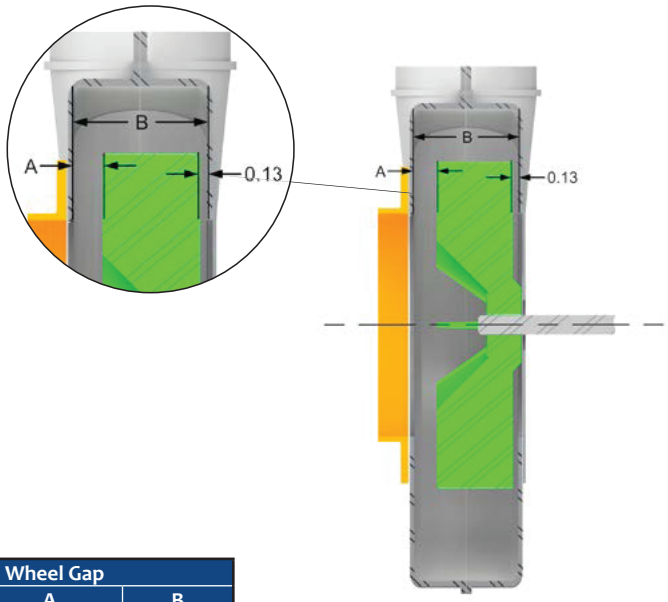


Model PBW

PBW Wheel Gap		
Housing Size	Wheel Size	A (REF)
3	19 & 22	0.36
4		
5	21 & 22	0.61
	23 & 26	0.36
6	21 & 22	0.86
	23 & 26	0.36

Note: *Distance from inside surface of housing to wheel blade is constant on all sizes and arrangements.*

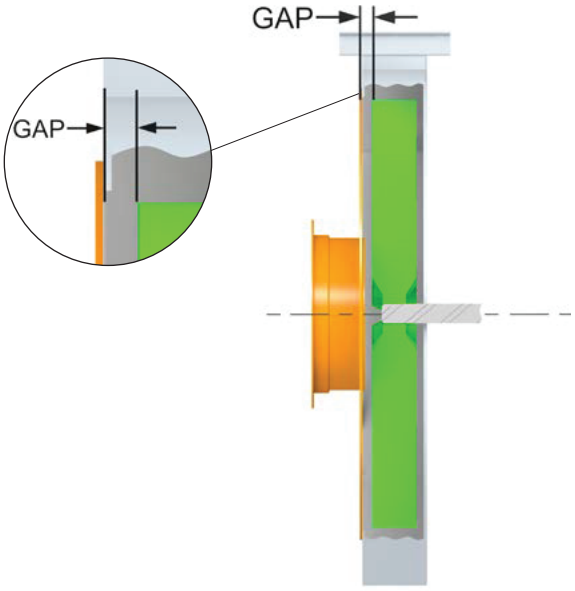
TPD, TPB Wheel Placement		
Wheel Size	A	B
8" Housing / Width		
R7 X 2.44	0.58	3.14
R8 X 2.50	0.52	
9" Housing / Width		
R8 X 2.50	0.56	3.18
R8.5 X 2.75	0.30	
R9 X 2.88	0.19	
R9.75 X 2.88	0.31	
R10.63 X 2.63	0.46	
BC10.25 X 3	0.25	
10" Housing / Width		
R9 x 2.88	0.23	3.22
R9.75 x 2.88	0.35	
R10.63 x 2.63	0.50	
R11 x 2.75	0.28	
R11.5 x 2.88	0.27	
R12 x 2.88	0.23	
R12.25 x 2.88	0.21	
BC10.25 x 3	0.29	
BC11 x 3	0.29	
12" Housing / Width		
R10.63 x 2.63	1.22	3.94
R11 x 2.75	1.00	
R11.5 x 2.88	0.99	
R12 x 2.88	0.95	
R12.25 x 2.88	0.93	
R13 x 3.25	0.55	
R14 x 3.25	0.61	
BC11 x 3	1.01	
BC13 x 3.25	0.57	
BC14 x 3.25	0.57	
14" Housing / Width		
R12.25 x 2.88	1.59	4.60
R13 x 3.25	1.21	
R14 x 3.25	1.27	
R14.75 x 4	0.48	
BC13 x 3.25	1.23	
BC14 x 3.25	1.23	



Model TPD, TPB

TPD, TPB Wheel Gap		
Wheel Size	A	B
15" Housing / Width		
R14 x 3.25	2.49	5.82
R15.5 x 5	0.70	
R16.5 x 4.38	1.37	
BC14 x 3.25	2.45	
BC15.5 x 5	0.81	
BC16.5 x 4.38	1.45	
18" Housing / Width		
R14 x 3.25	1.31	4.64
R16.5 x 4.38	0.19	
R18 x 4.38	0.36	
BC14 x 3.25	1.27	
BC16.5 x 4.38	0.27	
BC18 x 4.38	0.14	

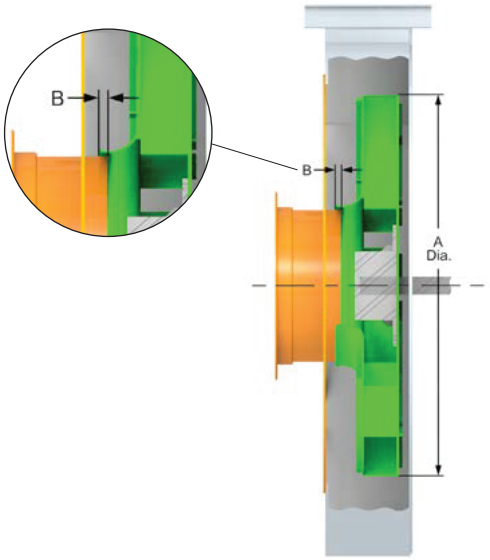
Wheel Placement



Models MBO, MBW, MBR

MBW, MBO, MBR Wheel Gap											
Size	196	224	252	280	308	336	365	421	477	533	589
MBW	0.50	0.44	0.38	0.25	0.38	0.44	0.56	0.63	0.75	0.75	0.88
MBO	0.50	0.44	0.38	0.25	0.38	0.44	0.56	0.63	0.75	0.75	0.88
MBR	0.25	0.25	0.25	0.25	0.25	0.38	0.50	see note below			

Note: *On Sizes 421-589 wheel is to be centered in housing.*



Model BCN

BCN Wheel Overlap						
Size	270	300	330	365	402	445
A	27.00	30.00	33.00	36.50	40.25	44.50
B	0.09	0.09	0.13	0.13	0.13	0.16

Size	490	542	600	660	730
A	49.00	54.25	60.00	66.00	73.00
B	0.16	0.19	0.22	0.22	0.25

Troubleshooting Guidelines

Use current safety practices when investigating fan or system performance problems. General safe practices and performance troubleshooting guidelines can be found in AMCA Publications 410 and 202, respectively. Fan application and field measurement procedures can be found in AMCA Publications 201 and 203.

Below is a list of possible areas to check when air or sound values do not match expectations. Most fan problems can be pinpointed to one of these common causes.

Air Capacity Problems

1. Resistance of the system is not at design rating. If resistance is lower than expected, both airflow and horsepower may be up. If resistance is higher than anticipated, air volume will be down.
2. Fan speed is not at design speed.
3. Air density is not at the design value. Also check air performance measurement techniques/procedures.
4. Devices for air modulation are closed or plugged. Also check filters.
5. Wheel mounted improperly or is rotating in reverse.
6. Parts of the system or fan have been damaged or need cleaning.

Noise Problems

1. Air performance is incorrect and the fan is not at design point of operation. Fan is being forced to operate in an unstable flow region near peak or to the left of the peak of the curve.
2. Bearing failure. Check bearings (lubrication).
3. Supply voltage high or inconsistent supply frequency. Adjustable frequency controllers can generate motor noise.
4. Objects which are installed in a high velocity airstream can generate noise. This includes flow sensors, turning vanes, etc.
5. Poor fan inlet conditions.
6. Acoustics or sound measurement procedure incorrect.

Vibration Problems

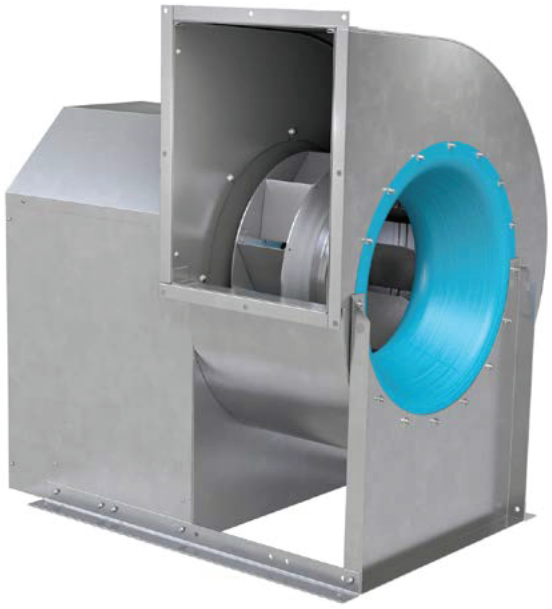
1. Misalignment of drive components. Check belt or coupling.
2. Poor foundation or mounting structure (resonances).
3. Foreign material attached to rotating components.
4. Damaged rotating components (bearings, shaft, fan, wheel, sheaves).
5. Broken, loose, or missing setscrews.
6. Loose bolts.
7. Vibration transmitted by another source.
8. Water accumulating in airfoil blades.
9. Fan is operating in stall or unstable flow region.

Motor Problems

1. Incorrect wiring.
2. Speed of fan too high.
3. Parts improperly installed; binding.
4. Bearings improperly lubricated.
5. WR^2 capability of motor too low for application.
6. Protection devices may be improperly sized.
7. VFD compatible electrically? Effective shaft grounding?
8. Is cabling and grounding correct?

Drive Problems

1. Belts improperly tensioned.
2. Drive alignment is poor. Check belt or coupling.
3. Coupling lubrication.



NOTICE

All fans manufactured by Twin City Fan & Blower are factory balanced prior to shipment. Installation variables, handling, and movement of the fan during shipment may cause the rotating assembly to shift. Balance should be checked once the fan is installed. If a final trim balance is required, it is the end user's responsibility to bring the fan back to factory specifications. Final trim balancing is not the responsibility of Twin City Fan & Blower. Refer to the Vibration Guidelines table below.

Vibration Guidelines

Condition	Fan Application Category	Rigidly Mounted mm/s (in./s)	Flexibly Mounted mm/s (in./s)
Start-up	BV-3	6.4 (0.25)	8.8 (0.35)
	BV-4	4.1 (0.16)	6.4 (0.25)
Alarm	BV-3	10.2 (0.40)	16.5 (0.65)
	BV-4	6.4 (0.25)	10.2 (0.40)
Shutdown	BV-3	12.7 (0.50)	17.8 (0.70)
	BV-4	10.2 (0.40)	15.2 (0.60)

Values shown are peak velocity, mm/s (inches/s), Filter out. Table taken from ANSI/AMCA Standard 204-05, Table 6.3. AMCA defines BV-3 for applications up to 400 HP; BV-4 for applications over 400 HP.

Fan & Blower Twin City

Installation/Start-up Checklist

Become familiar with the equipment by looking at the fan assembly drawing for special instructions and accessories.

Initial Fan Check

- ☐ Inspect fan for damage
- ☐ Check foundation
- ☐ Is the fan shimmed
- ☐ Are the bolts tight
- ☐ Check to see if the fan is distorted
  Note: Applies to direct or isolation mount.
- ☐ Check fan interior for debris & standing water

Fan Wheel

- ☐ Wheel clearance checked
- ☐ Wheel overlap checked
- ☐ Fasteners tight
- ☐ Wheel rotates freely

Springs (if equipped)

- ☐ Springs adjusted properly
- ☐ Flex joints allow movement
- ☐ Electrical conduit allows movement

Bearings

- ☐ Bearings aligned
- ☐ Bearings greased
  Note: Rotate while greasing
- ☐ Setscrews tight (if equipped)

Lube Lines

- ☐ Lube lines been charged with grease prior to connecting to bearings

V-Belts (if equipped)

- ☐ V-belt drives aligned
- ☐ Sheaves retightened
- ☐ Belt tension correct
- ☐ Motor bolts retightened

Couplings (if equipped)

- ☐ Coupling aligned
- ☐ Coupling gap checked
- ☐ Coupling lubricated

Accessories

- ☐ Guards installed correctly, do not rub
- ☐ VIV/damper rotates freely (if equipped)
- ☐ Other accessories per drawing

WARNING

Verify that proper safety precautions have been followed. Electrical power must be locked off.

Electrical Components

- ☐ Motor wired for proper voltage and starter
- ☐ Motor grounded
- ☐ Appropriate starter and heaters
- ☐ Leads are properly insulated
- ☐ Accessories wired per instructions supplied.

Energize

- ☐ Energize motor long enough to start assembly rotating, shut down
- ☐ Verify direction of wheel rotation, Rewire if necessary *Note: Refer to wheel rotation section*
- ☐ Run the fan up to speed
- ☐ Check for excess vibration and listen for unusual noise. Refer to the Vibration Guidelines table in the troubleshooting guidelines section for vibration limits
- ☐ Bearing temperatures should stabilize after a few hours. Less than 200°F
  Note: Use sense of smell to identify possible electrical, belt issues.

After one Week

- ☐ Verify bolt tightness.
- ☐ Verify belt tension and adjust as necessary

NOTICE

Always observe site specific and regulatory safety precautions.

Serial Number: _____

Completed By: _____

Date Completed: _____

Fan Maintenance Log

Model Number_____

Serial Number _____

Date	Completed Maintenance	Performed By	Comments

Fan Maintenance Log

Model Number_____

Serial Number _____

Date	Completed Maintenance	Performed By	Comments

Fan & Blower
Twin City

TWIN CITY FAN & BLOWER | WWW.TCF.COM

5959 Trenton Lane N | Minneapolis, MN 55442 | Phone: 763-551-7600 | Fax: 763-551-7601

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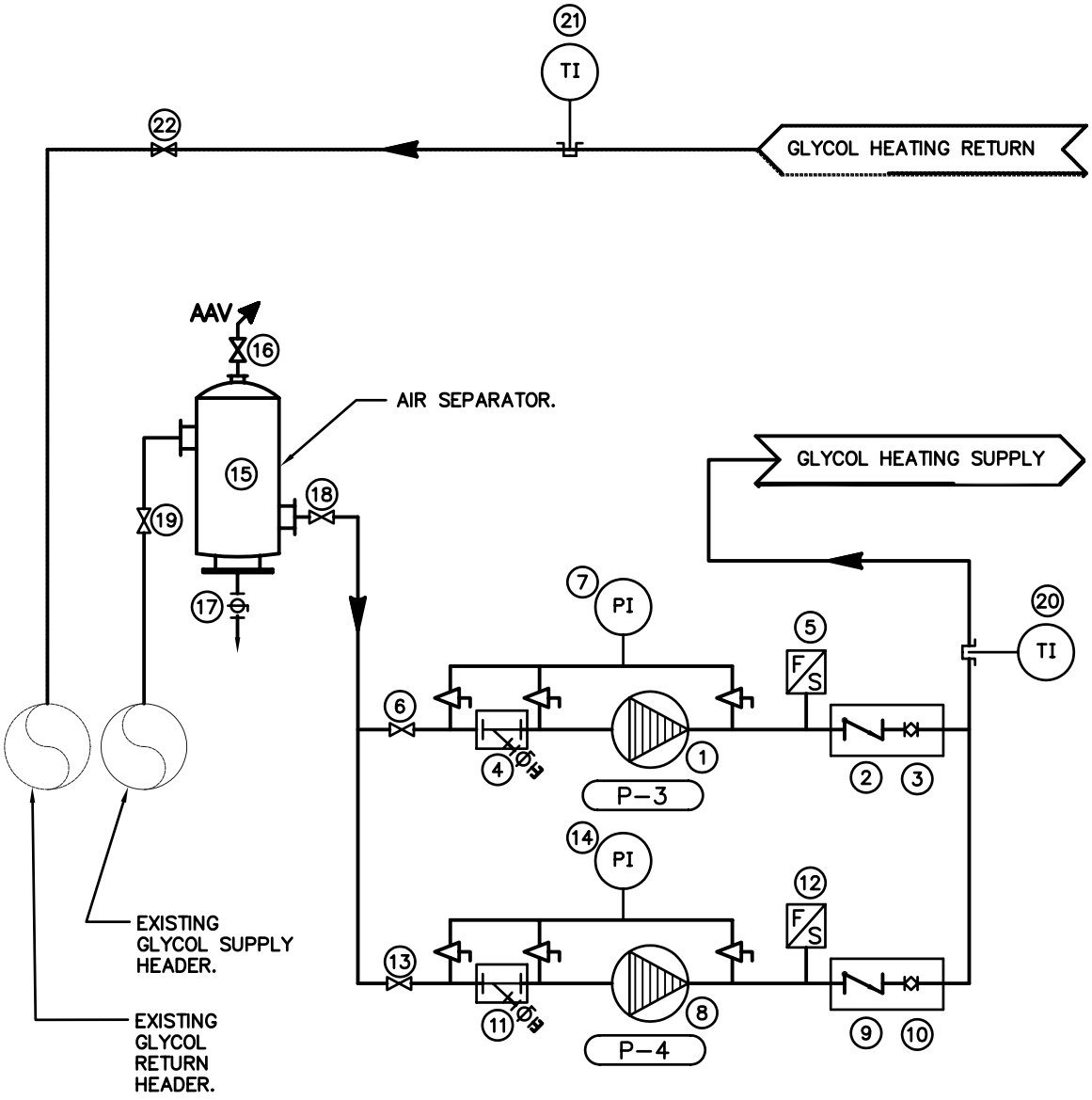
Chapter 10

APPENDIX

10.1 Photographs

10.2 Drawings

END OF CHAPTER 10



NEW HEATING PUMPS SCHEMATIC

N.T.S.

55524/0&M/MECH

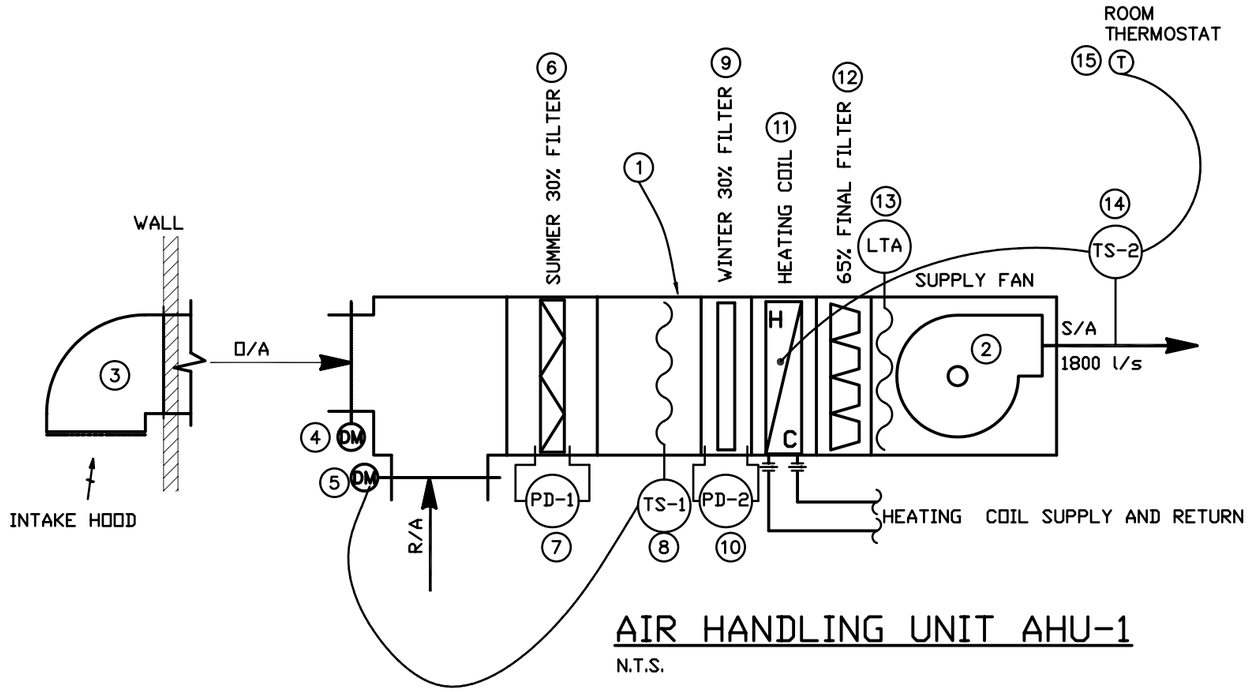
Iqaluit

DRAWING

M-4

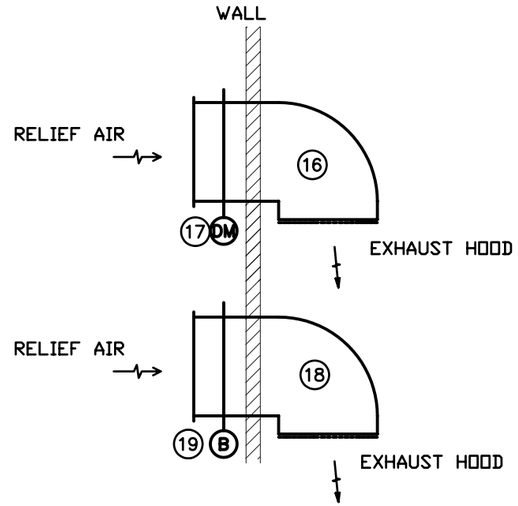
EARTH TECH

Earth Tech (Canada) Inc.
Edmonton, AB 780-488-6800
Yellowknife, NWT 867-873-6316



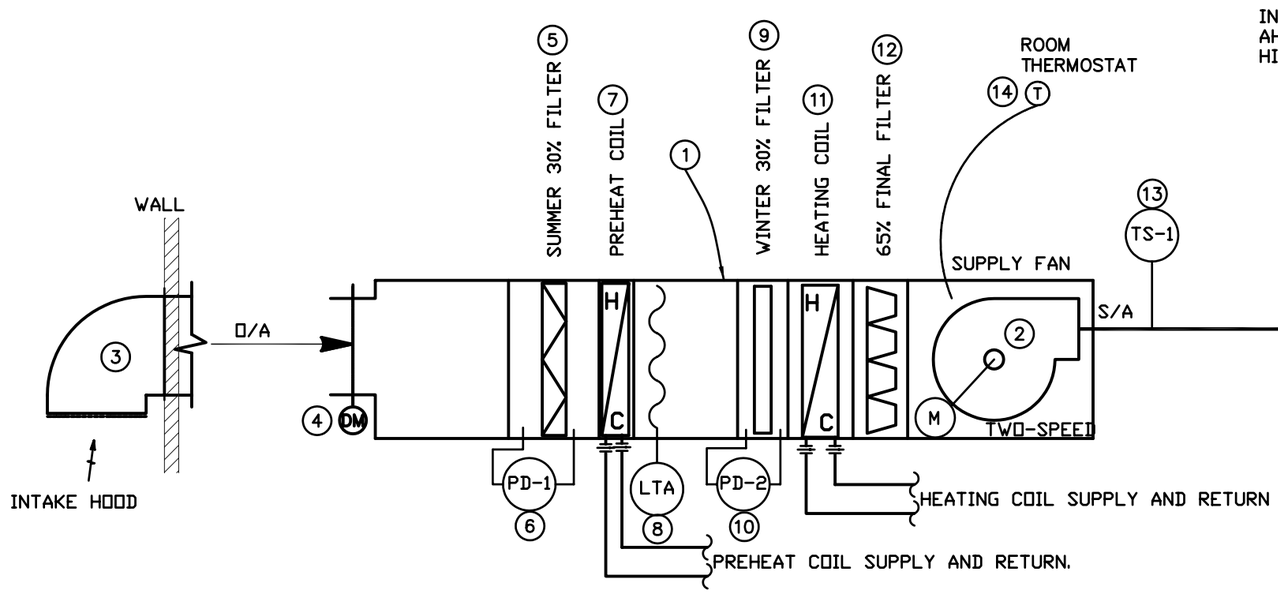
AIR HANDLING UNIT AHU-1

N.T.S.



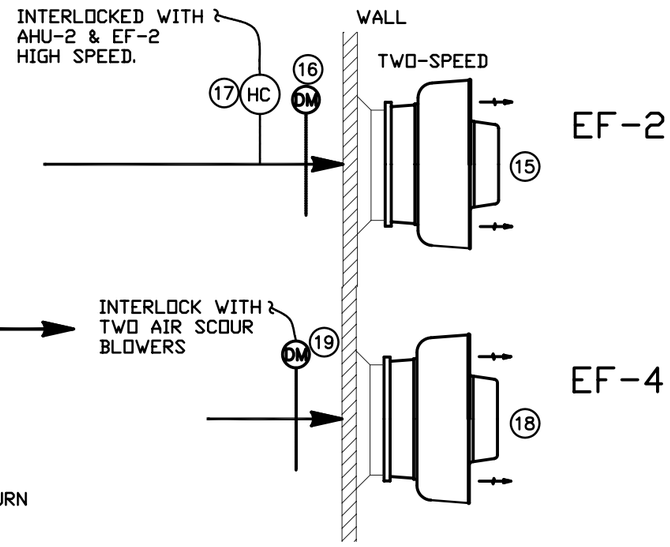
49503/O&M/MECH

Iqaluit	DRAWING	EARTH TECH
	M-5	Earth Tech (Canada) Inc. Edmonton, AB 780-488-6800 Yellowknife, NWT 867-873-6316



AIR HANDLING UNIT AHU-2

N.T.S.



EXHAUST FANS EF-2 & EF-4

N.T.S.

40503/D&M/MECH

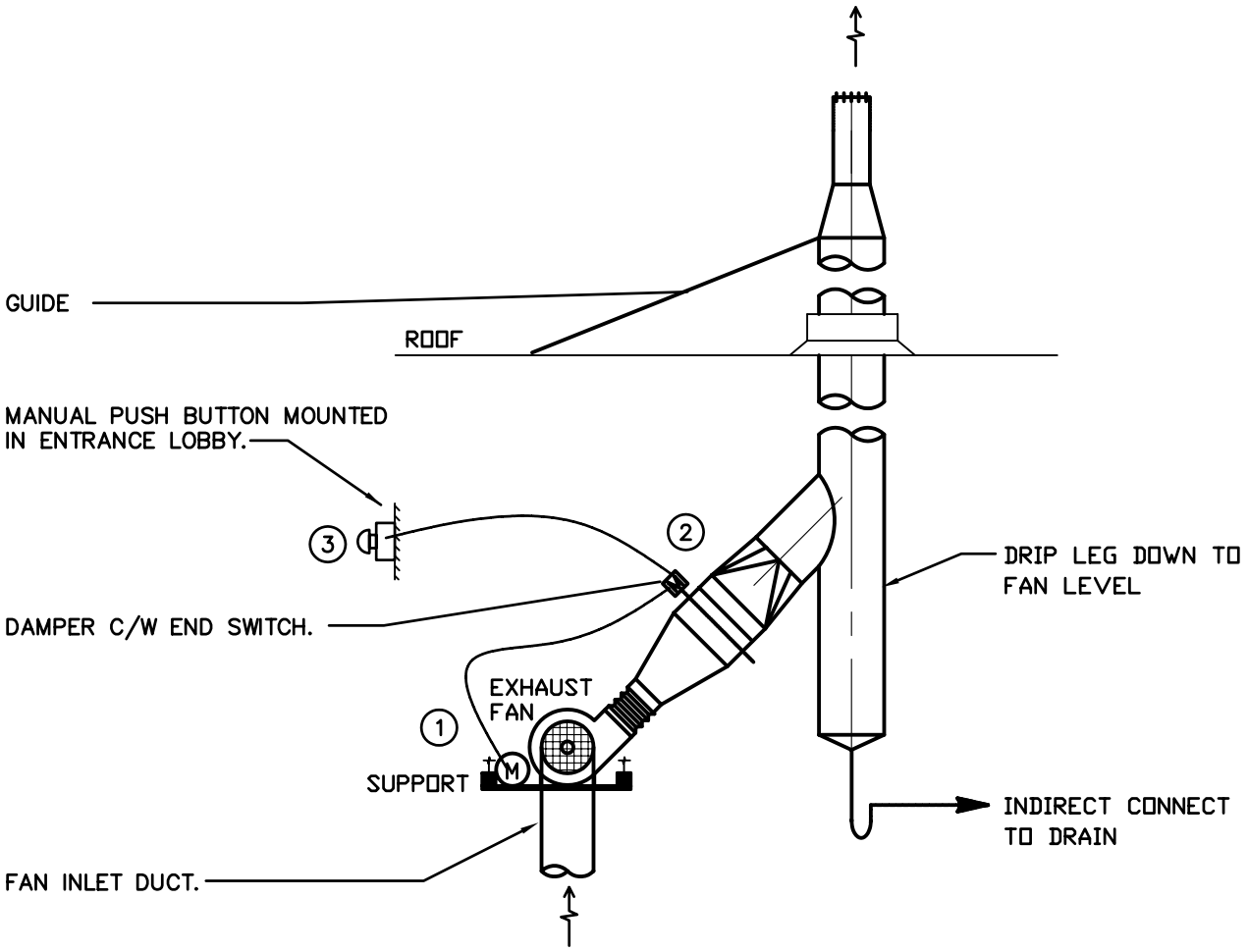
Iqaluit

DRAWING

M-6

EARTH TECH

Earth Tech (Canada) Inc.
Edmonton, AB 780-488-6800
Yellowknife, NWT 867-873-6316



EXHAUST FAN EF-3

N.T.S.

55524/08M/MECH

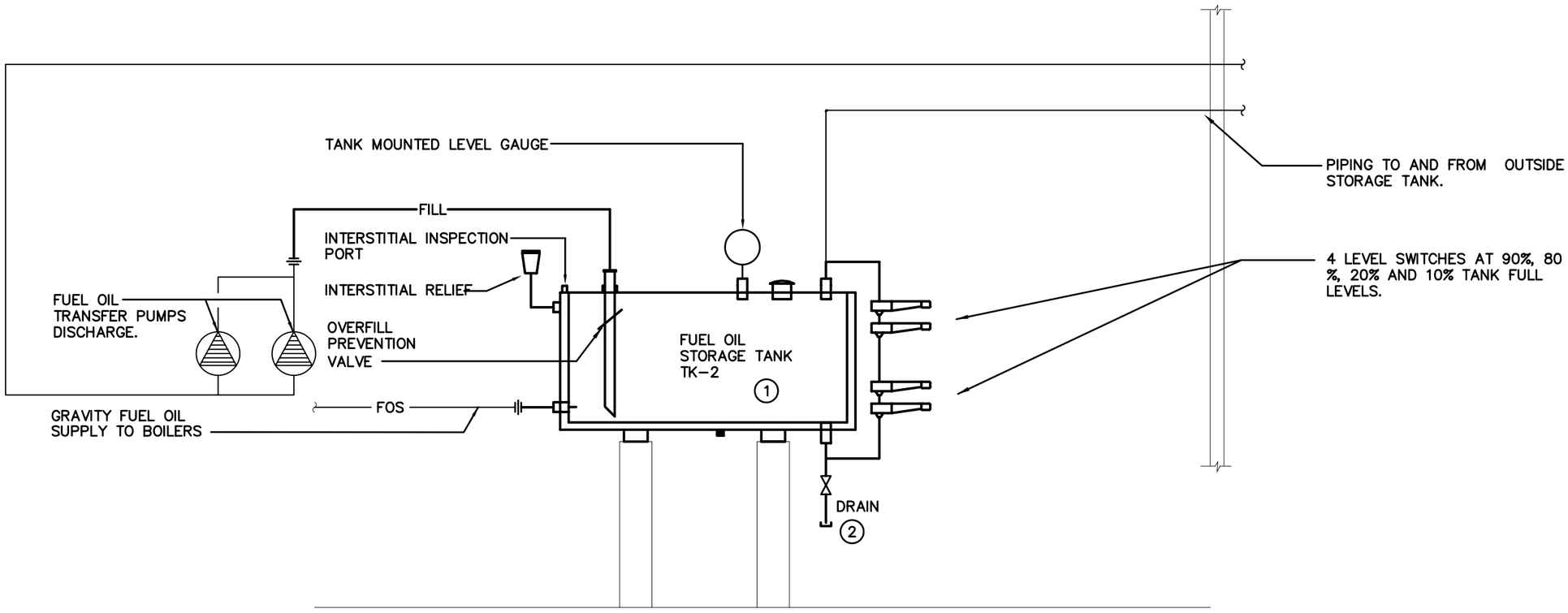
Iqaluit

DRAWING

M-7

EARTH TECH

Earth Tech (Canada) Inc.
Edmonton, AB 780-488-6800
Yellowknife, NWT 867-873-6316



NEW FUEL OIL DAY TANK

N.T.S.

49503/D&M/MECH

Iqaluit

DRAWING

M-8

EARTH TECH

Earth Tech (Canada) Inc.
Edmonton, AB 780-488-6800
Yellowknife, NWT 867-873-6316

Process Operation & Maintenance Manual

For the

Iqaluit Water Treatment Plant

Iqaluit, Nunavut

Year of Completion - 2004

Original Scope - Design and upgrade existing Water Treatment Plant to meet current and future demands.

This manual has been updated to include:

Date	Description of Change
October, 2018	Inclusion of updates and upgrades made to the water treatment plant as per the 2017 Water and Wastewater Facilities Improvement Project (#SC711).

Iqaluit Water Treatment Plant Upgrade

Project History

The City of Iqaluit:	City of Iqaluit Public Works & Engineering P.O. Box 460 Iqaluit, NU X0A 0H0 Matthew Hamp, Director of Public Works & Engineering Phone: (867) 979-5653 m.hamp@city.iqaluit.nu.ca
Project Engineer:	**2004 Upgrades** Earth Tech Canada Inc. (Currently AECOM) 4916 47th Street P.O. Box 1259 Yellowknife, NT X1A 2N9 Phone: 1 (867) 873-6316 **2017 Upgrades** Glenn Prosko, Project Manager Nunami-Stantec 10160 112 Street Edmonton AB T5K 2L6 Phone: (780) 969-3258 Glenn.Prosko@stantec.com
General Contractor:	**2004 Upgrades** 90 North Construction & Development Ltd. (No longer in operation) Suite 106, 6131-6th Street S.E. Calgary, AB T2H 1L9 **2017 Upgrades** Maxime Gaudreau, Project Manager Kudlik Construction Ltd. P.O. Box 727, 1519 Federal Road Iqaluit, NU X0A 0H0 Phone: (418) 802-8224 mgaudreau@kudlik.biz
Electrical Subcontractor:	**2004 Upgrades** KRT Electric 1505 Federal Rd, Iqaluit, NU P.O. Box 1259 Iqaluit, NU X0A 0H0 Phone: 1 (867) 979-2639

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Process Operation & Maintenance Manual
For the City of Iqaluit Water Treatment Plant
Iqaluit, Nunavut

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Chapter 3
BACKGROUND AND DESIGN DATA

3.1 Background

3.1.1. Old Water Treatment Plant

The City of Iqaluit uses Geraldine Lake as its raw water source. Geraldine Lake water quality is characterized as good quality raw water, apart from algal blooms in the summer months.

The old treatment plant had a maximum design output of 1,296 m^3/day and a useful output of 1,050 m^3/day. The 2002 average day demands on the plant exceeded the useful output by approximately 20%. The capacity of the filters was the main limitation of the treatment process. The old treatment plant comprised the following major components:

- Lake Geraldine dam structure and valve chamber,
- raw water intake pipeline and tempering system (upgraded in 1999);
- treatment plant inlet flow control valve,
- prechlorination and pH control (through lime contact) system,
- settling tanks,
- sand/gravel filtration system,
- fluoridation system,
- backwash system,
- on-site clearwell of 575m^3, and
- treated water storage reservoir 2,280m^3.

3.1.2. New Process Description

The upgraded plant has incorporated the following process changes:

- Increased capacity by constructing four new filters,
- flocculation units,
- provided additional backwash waste storage,
- updated chemical dosing systems,
- updated PLC-based control.

3.1.3. 2017 Upgrades and Improvement Work

In 2017, maintenance and upgrade work were carried out at the WTP as part of the Water and Wastewater Facilities Improvement Project (#SC711), in which the following elements were maintained, replaced or newly installed:

- A new replacement TwinCity exhaust fan in the Chlorine Room
- 5 new Hach TU5300sc Turbidity Meter
- 2 new Wallace & Tiernan Depolox 3 Plus Chlorine and pH analyzers
- A new replacement Wallace & Tiernan Chlorine Gas Detection System for Chlorine Room
- All Bray Control Valve Actuators were inspected, maintained and repaired. New Bray Valve Actuators were supplied as spares.
- A new flow switch was installed on the chlorinated water injection line in the Chlorine Room. This includes PLC low flow alarm.
- A new plant inlet pressure transmitter was installed and incorporated in the PLC/HMI.
- A new replacement electromagnetic flow meter was installed for reservoir discharge flow.
- Air scour blower #1 was inspected, deemed unrepairable, and thus replaced.
- The 6 chemical metering pumps were replaced, including installation of new chemical delivery piping (Hydrofluorosilic acid, Zinc Orthophostate, Caustic soda).
- Service water pump #1 was replaced.
- The backflow preventers for the chemical injection systems was replaced.
- Piping for the chlorinator was replaced.

3.2 Design Data

3.2.1. Design Capacity

The design life of the new WTP is 20 years to 2022. In 2022 the average day demand will be 4,520 m^3/day with a peak day demand of 9,040 m^3/day. The gross design capacity for the WTP is set at 9,500 m^3/day. These figures are based upon a projected population in 2021 of 11,300.

3.2.2. Raw Water Supply

Raw water enters the plant through an existing 250 mm main and a flow control valve. The flow control valve will be capable of accurately controlling flows from present minimum demands of about 1,000 m^3/day up to about 10,000 m^3/day, slightly above the plant design raw water flow.

3.2.3. UV Disinfection

As the raw water enters the WTP it is disinfected with UV light to inactivate pathogens. UV light is the primary disinfectant with chlorination as a secondary disinfectant to provide a residual through the distribution system. The design parameters of the UV system are as follows:

- Number of UV Reactors 1 Duty and 1 Standby
- Maximum flow per reactor 9 ML/Day
- UV Transmittance 90% (1cm Length)
- Maximum dose 40 mJ/cm^2

3.2.4. Flocculation Tanks

Flocculation tanks are provided downstream of the UV. These tanks will only be required to operate as flocculation tanks in the event that future coagulation is required to meet the final water quality targets. At this time mixers will be required in the tanks to maintain the floc particles in suspension. Two trains, each with three stages of flocculation are provided. The total volume of the flocculation stage is $300m^3$ resulting in a hydraulic retention time of 45 minutes at design capacity.

3.2.5. Filtration

The filtration process consists of dual media rapid gravity filters for the removal of particulate matter from the water. The design parameters of the filters are as follows:

- Number of filters 4
- Total Filter Area $47m^2$
- Individual filter area 11.75 m^2
- Max Filtration Rate 8.5 $m^3/m^2/hr$
- Media Type Anthracite/ sand dual media
- Expected Filter Run Time 48 hours

- Air Scour Rate 25 $m^3/m^2/hr$
- Backwash Rate 50 $m^3/m^2/hr$
- Backwash Duration 12 mins
- Expected Daily wash volume 232 m^3
- Filter to waste flow 100 m^3/h
- Expected filter to waste volume 23.5 m^3

3.2.6. Backwash and Filter to Waste Storage

Backwashing produces large amounts of waste water for a relatively short time, and because the capacity of the sanitary sewage system is limited, a Backwash Waste Holding Tank of 130 m^3 is provided. This tank will only be sufficient for the volume of one filter wash and therefore need to be drained at a controlled rate to the sewer prior to a second filter washing.

A second waste tank of 55 m^3 is provided to balance the "filter to waste" flow. This tank will also drain at a controlled rate to the sewer system.

A 60 mm diameter orifice plate has been included in the drain to sewer in order to restrict the flow to a maximum of 70 m^3/hour to prevent surcharging in the sewer. This orifice can be changed in the future should a different flow rate be required.

3.2.7. Chlorination

The chlorine system uses gas cylinders with an automatic switchover system. The chlorine is injected into the water system through a gas chlorinator and injector. The design parameters are as follows:

- Maximum dose rate 90 kg/Day
- Average dose rate 1.6 to 16 kg/Day

3.2.8. pH Adjustment

Caustic Soda will replace the lime system of the old plant as the chemical for pH adjustment. The system will be capable of dosing both at the plant inlet, if required for coagulation and at the final water for stabilisation. The design criteria are as follows:

- Maximum dose rate 17 L/h
- Minimum dose rate 0.017 L/h

3.2.9. Zinc Orthophosphate

Zinc orthophosphate is provided to reduce the corrosivity of the water. It is dosed into the water prior to the Treated Water Reservoir.

- Maximum Dose Rate 30 L/h
- Minimum Dose Rate 0.030 L/h

3.2.10. Hydrofluorosilicic Acid

Hydrofluorosilicic Acid is metered into the clearwell inlet chamber to provide a dose of 1mg/L as fluoride design criteria.

- Maximum Dose Rate 2.2 L/h
- Minimum Dose Rate 0.004 L/h

3.2.11. Plant Capacity and Storage

Treated water storage is important for providing sufficient disinfection and to balance the needs of the community with respect to fire storage, equalization storage and emergency storage.

The recommended minimum treated water storage for the present system demand is 4,811 m^3. The recommended treated water storage amount assumes no increase in the recommended fire storage component of the storage equation. When the plant was first upgraded in 2004, the total system storage of 2,875 m^3, met the requirements at that time. However, due to increased water demand, capacity of the treated water reservoir was increased in 2006, and the existing reservoir capacity was roughly doubled to 4560 m^3 with the addition of a second reservoir. Based on the photos of the 2006 As-Built drawings for the reservoir expansion project transmitted from the City, the dimensions and the operating level of the second reservoir were noted to be approximately equal to the original reservoir

capacity. However, as this only provides an estimate—an exact capacity is currently unknown—confirmation is needed from the City, with the As-Built drawings from the 2006 upgrade expansion project to be included as a reference. **Table 3.1** summarizes the current system storage requirements.

Table 3- 1 Reservoir Storage Requirements

Storage Requirements	Present (m^3)
A – Fire	720
B – Equalization 25% of Max Day Demand	2,260
C – Emergency 30% of Average day demand	1,356
In-Plant Needs	475
Total Storage Required	4,811
Total Storage Available (Clearwell and Reservoir)	*5,135*

The existing storage meets disinfection storage requirements for both existing plant capacity. The existing storage can also meet disinfection storage requirements at plant design capacity of 9,500 m^3/day if the chlorine residual is increased to approximately 1.0 mg/L.

3.2.12. Tempered Water System (Refer to Drawing M-2, Section 4)

Tempering of the Raw Water is required during the winter to prevent the raw water from freezing in route from the Dam to the Plant.

The Raw Water is tempered via shell and tube heat exchanger by the hydronic heating system to maintain the raw water temperature above 5°C.

A raw water pump circulates the Raw Water from a point at the raw water intake to the Plant back to the Dam Reservoir to the heat exchanger for tempering.

Chapter 4

SCHEMATICS AND FUNCTIONAL DATA

4.1 General

The following tables describe where the components to the various systems are located and the function that each performs. For each table there are drawings that can be referenced to better understand the flow of that part of the Water Treatment Plant (WTP).

4.1.1 City of Iqaluit Water & Wastewater Facilities Improvements

In December 2017, the City of Iqaluit carried out the Water & Wastewater Facilities Improvements Project (#SC711). Within the scope of this project, the following components were replaced or newly installed:

- AE1001 – Replaced
- AE1002 – Replaced
- PIT1001 – Newly Installed
- AE2102 – Replaced
- AE2111 – Replaced
- AE2121 – Replaced
- AE2131 – Replaced
- C200 – Replaced
- AE2501/2502 – Replaced
- P410 – Replaced
- P303/304 – Replaced
- P305/306 – Replaced
- P362/363 – Replaced
- FIT5001 – Replaced

4.2 Raw Water Flow (Refer to Drawing P-1 and P-2 at the end of this section)

The following table identifies the components related to the flow of water from the plant intake to the filters.

No.	Component	Location	Function Performed	Remarks
1	Intake Valve (V1000)	RW Intake Pipe, Main Floor	Shuts off water from Geraldine Lake	Normally Open
2	Isolation Valve (V1036)	On 350 mm Dia. RW Piping, Main Floor	Used to isolate solenoid valve that controls flow to the turbidity sensor	Normally Open
3	Solenoid Valve (SV1001)	On 350 Dia. RW Piping, Main Floor	Controls the flow to the turbidity sensor	PLC controlled

No.	Component	Location	Function Performed	Remarks
4	Turbidity Meter (AE1001)	On the RW Intake Piping just inside the Plant, Main Floor	A continuous on-line turbidimeter that measures the raw water turbidity	Measures turbidity
5	Drain Valve (V1034)	On 350Dia. RW Piping, Main Floor	Used to Drain the Main Raw Water line from Geraldine Lake	Normally Closed
6	Isolation Valve (V1035)	Tempered Water Piping, Main Floor	Used to isolate the Tempered water system from the raw water	Normally Open
7	Isolation Valve (V1037)	On 300 Dia. RW Piping, Main Floor	Used to isolate solenoid valve that controls flow to the pH sensor	Normally Open
8	Solenoid Valve (SV1002)	On 300 Dia. RW Piping, Main Floor	Controls the flow to the pH sensor	PLC controlled
9	pH Analyzer (AE1002)	On the RW Intake Piping just inside the Plant, Main Floor	Provides continuous on-line pH monitoring of the raw water pH	Reads raw water pH
10	Pressure Indicating Transmitter (PIT1001)	On the RW Intake Piping just inside the Plant, Main Floor	Converts detected raw water inlet pressure to analog signal and transmits reading to the PLC.	Sends info. to PLC
11	Isolation Valve (V1029)	RW Intake Piping, Main Floor	Used to Isolate the Flow Meter and the Flow Control Valve.	Normally Open
12	Flow Meter (FE1001)	RW Intake Piping, Main Floor	Indicates the flow of Raw Water into the Plant	Sends info to PLC
13	Flow Control Valve (FCV1001)	RW Intake Piping, Main Floor	Controls the amount of flow into the Plant.	PLC controlled
14	Isolation Valve (V1003)	RW Intake Piping, Main Floor	Used to Isolate the Flow Meter and the Flow Control Valve.	Normally Open
15	Bypass Valve (V1004)	Bypass RW Intake Piping, Main Floor	Allows the Raw Water to be bypassed around the Flow Control Valve and Flow Meter	Normally Closed

No.	Component	Location	Function Performed	Remarks
16	Drain Valve (V1005)	RW Intake Piping, Main Floor	Allows the water to be drained from this section of piping.	Normally Closed
17	Isolation Valve (V1006)	On 350 Dia. RW Piping, Main Floor	Used to isolate the air release valve	Normally Open
18	Air Release Valve (ARV1001)	RW Intake Piping, Main Floor	Allows air to be released from the intake line.	Normally Open
19	Isolation Valve (V1007)	RW Intake Piping, Main Floor	Allows for isolation of the UV unit (X120).	Normally Open
20	Isolation Valve (V1038)	On 350 Dia. RW Piping, Main Floor	Used to isolate the air release valve	Normally Open
21	Air Release Valve (ARV1002)	RW Intake Piping, Main Floor	Allows air to be released from the intake line	Normally Open
22	Isolation Valve (V1039)	Off the UV unit (X120), Main Floor	Used to isolate UV (X120) cooling solenoid	Normally Open
23	Solenoid Valve (SV201)	Off the UV unit (X120), Main Floor	Controls the flow of cooling water on the UV unit start-up.	UV panel Controlled
24	Isolation Valve (V1008)	RW Intake Piping, Main Floor	Allows for isolation of the UV unit (X121).	Normally Open
25	Isolation Valve (V1040)	Off the UV unit (X121), Main Floor	Used to isolate UV (X121) cooling solenoid	Normally Open
26	Solenoid Valve (SV211)	RW Intake Piping, Main Floor	Controls the flow of cooling water on the UV unit start-up.	UV panel Controlled
27	UV unit (X120)	RW Intake Piping, Main Floor	Partial disinfection of the Raw water	UV panel controlled
28	UV unit (X121)	RW Intake Piping, Main Floor	Partial disinfection of the Raw water	UV panel controlled

No.	Component	Location	Function Performed	Remarks
29	Drain Valve (V1041)	FLW Piping after UV units, Main Floor	Drains water from the UV unit (X120)	Normally Closed
30	Drain Valve (V1042)	FLW Piping after UV units, Main Floor	Drains water from the UV unit (X121)	Normally Closed
31	Isolation Valve (V1043)	On 350 Dia. RW Piping, Main Floor	Used to isolate the air release valve	Normally Open
32	Air Release Valve (ARV1003)	FLW Piping after UV units, Main Floor	Releases air from the piping just after the UV unit (X120)	Normally Open
33	Motorized Valve (V1009)	FLW Piping after UV units, Main Floor	After UV unit (X120) warms up the valve opens to let the plant make water, this valve also operates as an isolation valve	Normally Closed
34	Motorized Valve (V1012)	FLW Piping after UV units, Main Floor	After UV unit (X121) warms up the valve opens to let the plant make water, this valve also operates as an isolation valve	Normally Closed
35	Drain Valve (V1013)	FLW Piping, Main Floor	Drains the 350 mm main water intake when opened	Normally Closed
36	Isolation Valve (V1016)	FLW Piping, Main Floor	Isolation valve for mixing tank #1	Normally Open
37	Isolation Valve (V1017)	In Mixing Tank #1	Used to isolate Mixing Tank #1 from Mixing Tank #2	Normally Open
38	Isolation Valve (V1018)	FLW Piping, Main Floor	Isolation valve for mixing tank #2	Normally Open
39	Isolation Valve (V1019)	In Mixing Tank #2	Used to isolate Mixing Tank #2 from Mixing Tank #3	Normally Open
40	Isolation Valve (V1020)	FLW Piping, Main Floor	Isolation valve for mixing tank #3	Normally Open
41	Isolation Valve (V1021)	FLW Piping, Main Floor	Isolation valve for Flocculation Train #1	Normally Open
42	Isolation Valve (V1022)	FLW Piping, Main Floor	Isolation valve for mixing tank #4	Normally Open
43	Isolation Valve (V1023)	In Mixing Tank #4	Used to isolate Mixing Tank #4from Mixing Tank #5	Normally Open

No.	Component	Location	Function Performed	Remarks
44	Isolation Valve (V1024)	FLW Piping, Main Floor	Isolation valve for mixing tank #5	Normally Open
45	Isolation Valve (V1025)	In Mixing Tank #5	Used to isolate Mixing Tank #5from Mixing Tank #6	Normally Open
46	Isolation Valve (V1026)	FLW Piping, Main Floor	Isolation valve for mixing tank #6	Normally Open
47	Isolation Valve (V1027)	FLW Piping, Main Floor	Isolation valve for Flocculation Train #2	Normally Open
48	Isolation Valve (V1028)	FLW Piping, Main Floor	By-pass Isolation valve, used to by-pass the Flocculation Train's #1 & #2	Normally Open
49	Motorized Valve (FCV2101)	Filter Inlet Piping on Filter #1, Filters Room	Controls the flow of water into Filter #1	PLC Controlled
50	Motorized Valve (FCV2111)	Filter Inlet Piping on Filter #2, Filters Room	Controls the flow of water into Filter #2	PLC Controlled
51	Motorized Valve (FCV2121)	Filter Inlet Piping on Filter #3, Filters Room	Controls the flow of water into Filter #3	PLC Controlled
52	Motorized Valve (FCV2131)	Filter Inlet Piping on Filter #4, Filters Room	Controls the flow of water into Filter #4	PLC Controlled

4.3 Filtered/Treated Water Flow (Refer to Drawing P-3 and P-4 at the end of this section)
The following table identifies the components related to the flow of water from the plant filters to the off-site reservoir.

No.	Component	Location	Function Performed	Remarks
1	Filter #1	Filters room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
2	Level Indicating Transmitter (LIT2101)	Mounted on Filter #1 Tank wall, Filters Room	Indicates the water level in the filter	Signals the PLC
3	Isolation Valve (V2003)	On 300mm FW piping, Pumps Floor	Used to isolate the Pressure Indicating Transmitter	Normally Open

No.	Component	Location	Function Performed	Remarks
4	Isolation Valve (V2004)	Pumps Floor	Used to isolate the Pressure Indicating Transmitter	Normally Open
5	Pressure Indicating Transmitter (PIT2101)	Pumps Floor	Provides a reading to the PLC on the water pressure after the filters	Sends info. to PLC
6	Solenoid Valve (SV2102)	On 300mm FW piping, Pumps Floor	Controls the flow to the turbidity sensor	PLC Controlled
7	Turbidity Meter (AE2102)	On 300mm FW piping, Pumps Floor	Measures turbidity of treated water from Filter-1.	Measures turbidity
8	Drain Valve (V2002)	On 300mm FW piping, Pumps Floor	Used to drain the Filtered Water / Backwash Supply pipe	Normally Closed
9	Level Control Valve (LCV2104)	On 300mm FW piping, Pumps Floor	Controls the flow of water to the Clearwell	PLC Controlled
10	Filter #2	Filters room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
11	Level Indicating Transmitter (LIT2111)	Mounted on Filter #2 Tank wall, Filters Room	Indicates the water level in the filter	Signals the PLC
12	Isolation Valve (V2055)	On 300mm FW piping, Pumps Floor	Used to isolate the Pressure Indicating Transmitter	Normally Open
13	Isolation Valve (V2056)	Pumps Floor	Used to isolate the Pressure Indicating Transmitter	Normally Open
14	Pressure Indicating Transmitter (PIT2111)	Pumps Floor	Provides a reading to the PLC on the water pressure after the filters	Sends info. to PLC
15	Solenoid Valve (SV2112)	On 300mm FW piping, Pumps Floor	Controls the flow to the turbidity sensor	PLC Controlled

No.	Component	Location	Function Performed	Remarks
16	Turbidity Meter (AE2111)	On 300mm FW piping, Pumps Floor	Measures turbidity of treated water from Filter-2.	Measures turbidity
17	Drain Valve (V2054)	On 300mm FW piping, Pumps Floor	Used to drain the Filtered Water / Backwash Supply pipe	Normally Closed
18	Level Control Valve (LCV2114)	On 300mm FW piping, Pumps Floor	Controls the flow of water to the Clearwell	PLC Controlled
19	Filter #3	Filters room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
20	Level Indicating Transmitter (LIT2121)	Mounted on Filter #3 Tank wall, Filters Room	Indicates the water level in the filter	Signals the PLC
21	Isolation Valve (V2066)	On 300mm FW piping, Pumps Floor	Used to isolate the Pressure Indicating Transmitter	Normally Open
22	Isolation Valve (V2067)	Pumps Floor	Used to isolate the Pressure Indicating Transmitter	Normally Open
23	Pressure Indicating Transmitter (PIT2121)	Pumps Floor	Provides a reading to the PLC on the water pressure after the filters	Sends info. to PLC
24	Solenoid Valve (SV2122)	On 300mm FW piping, Pumps Floor	Controls the flow to the turbidity sensor	PLC Controlled
25	Turbidity Meter (AE2121)	On 300mm FW piping, Pumps Floor	Measures turbidity of treated water from Filter-3.	Measures turbidity
26	Drain Valve (V2065)	On 300mm FW piping, Pumps Floor	Used to drain the Filtered Water / Backwash Supply pipe	Normally Closed
27	Level Control Valve (LCV2124)	On 300mm FW piping, Pumps Floor	Controls the flow of water to the Clearwell	PLC Controlled

No.	Component	Location	Function Performed	Remarks
28	Filter #4	Filters room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
29	Level Indicating Transmitter (LIT2131)	Mounted on Filter #4 Tank wall, Filters Room	Indicates the water level in the filter	Signals the PLC
30	Isolation Valve (V2077)	On 300mm FW piping, Pumps Floor	Used to isolate the Pressure Indicating Transmitter	Normally Open
31	Isolation Valve (V2078)	Pumps Floor	Used to isolate the Pressure Indicating Transmitter	Normally Open
32	Pressure Indicating Transmitter (PIT2131)	Pumps Floor	Provides a reading to the PLC on the water pressure after the filters	Sends info. to PLC
33	Solenoid Valve (SV2132)	On 300mm FW piping, Pumps Floor	Controls the flow to the turbidity sensor	PLC Controlled
34	Turbidity Meter (AE2131)	On 300mm FW piping, Pumps Floor	Measures turbidity of treated water from Filter-4.	Measures turbidity
35	Drain Valve (V2076)	On 300mm FW piping, Pumps Floor	Used to drain the Filtered Water / Backwash Supply pipe	Normally Closed
36	Level Control Valve (LCV2134)	On 300mm FW piping, Pumps Floor	Controls the flow of water to the Clearwell	PLC Controlled
37	Chlorine Injection point	On 200mm FW piping, Pumps Floor	Point of chlorine injection for disinfection	
38	Caustic Soda Injection point	On 200mm FW piping, Pumps Floor	Point of caustic soda injection for pH adjustment	
39	Hydrofluorosilic Acid Injection point	On 200mm FW piping, Pumps Floor	Point of fluoride injection	

No.	Component	Location	Function Performed	Remarks
40	Contact Chamber	Clearwell Level	Where the chemicals come in contact and are mixed with the Filtered Water	
41	Isolation Valve (V2038)	North Clearwell	Used to isolate the North Clearwell	Normally Open
42	North Clearwell	Clearwell Level	Forms part of the overall treated water reservoir	
43	Isolation Valve (V2039)	South Clearwell 300mm piping	Used to isolate the North Clearwell from the South Clearwell and the Backwash Chamber	Normally Open
44	South Clearwell	Clearwell Level	Forms part of the overall treated water reservoir	
45	Isolation Valve (V2037)	Contact Chamber	Used to isolate the South Clearwell from the Contact Chamber and the Backwash Chamber	Normally Closed
46	Backwash Chamber	Clearwell Level	The chamber containing the Backwash Pumps and Plant Service Pumps	
47	Isolation Valve (V2035)	South Clearwell 300mm piping	Used to isolate the North Clearwell from the South Clearwell	Normally Open
48	Isolation Valve (V2034)	Backwash Chamber	Used to isolate the North & South Clearwells from the from the Backwash Chamber	Normally Closed
49	Isolation Valve (V2033)	Backwash Chamber	Used to isolate the South Clearwell from the Backwash Chamber	Normally Open
50	Level Indicating Transmitter (LIT2501)	Mounted on Filter Tank wall	Indicates the water level in the backwash tank (reservoir & clearwells)	Signals the PLC
51	Flow Control Valve (FCV2501)	300mm PVC piping in the Utilidor	Controls the amount of flow to the main treated water reservoir	PLC Controlled
52	Orthophosphate injection point	300mm PVC piping in the Utilidor	Point of Orthophosphate injection for pH adjustment	

No.	Component	Location	Function Performed	Remarks
53	Isolation Valve (V2040)	300mm PVC piping in the Utilidor	Used to isolate the flow to the pH/Cl_2 sensor	PLC controlled
54	Flow Meter (FIT001)	Below water storage reservoir	Provides reservoir outlet water flowrate	Measures flowrate
55	Chlorine Analyzer (AE2501)	300 mm piping in the Utilidor	Measures chlorine residuals in treated water from clear well	Measures Chlorine Residuals
56	pH Sensor (AE2502)	300 mm piping in the Utilidor	Reads pH in treated water from clear well	Measures pH
57	Service Pump #1 (P410)	75 mm piping in the Utilidor	Pumps treated water to WTP for service water	
58	Service Pump #2 (P411)	75 mm piping in the Utilidor	Pumps treated water to WTP for service water	
59	Reservoir Outlet Flow Meter (FIT5001)	Below water storage reservoir	An electromagnetic flow meter that measures water flow at outlet of reservoir	

4.4 Hydrofluorosilicic Acid Chemical (Refer to Drawing P-5 at the end of this section)
The following table identifies the components related to the flow of hydrofluorosilicic Acid. The referenced drawing shows the components but not their locations.

No.	Component	Location	Function Performed	Remarks
1	Hydrofluorosilicic Acid Drum	Filters Floor	Stores & provides Hydrofluorosilicic Acid for Chemical Addition into filtered water	
2	Hydrofluorosilicic Acid Injection Pump (P305)	Filters Floor	Injects Hydrofluorosilicic acid to Clearwell inlet chamber. Refer to supplier O&M for more detail	
3	Hydrofluorosilicic Acid Injection Pump (P306)	Filters Floor	Injects Hydrofluorosilicic acid to Clearwell inlet chamber. Refer to supplier O&M for more detail	
4	Check Valve (V3052)	Chemical Addition supply	Prevents backflow of Filtered Water into Chemical Addition system	

		piping to Contact Chamber		
5	Isolation Valve (V3053)	Chemical Addition supply piping to Contact Chamber	Used to isolate the Hydrofluorosilicic Acid system from other systems	Normally Open

4.5 Chlorine Chemical (Refer to Drawing P-6 at the end of this section)

The following table identifies the components related to the flow of chlorine. The referenced drawing shows the components but not their locations.

No.	Component	Location	Function Performed	Remarks
1	Chlorine Gas Cylinders	Filters Floor Chlorine room	Stores & provides Chlorine for Chemical Addition into filtered water	
2	Chlorinator & Injector Package	Main Floor Chlorine room	Refer to supplier O&M for more detail	
3	Check Valve (V3050)	Chemical Addition supply piping to Contact Chamber	Prevents backflow of Filtered Water into Chemical Addition system	
4	Isolation Valve (V3051)	Chemical Addition supply piping to Contact Chamber	Used to isolate the Chlorine system from other systems	Normally Open

4.6 Zinc Orthophosphate Chemical (Refer to Drawing P-5 at the end of this section)

The following table identifies the components related to the flow of Zinc Orthophosphate. The referenced drawing shows the components but not their locations.

No.	Component	Location	Function Performed	Remarks
1	Zinc Orthophosphate Drums	Filters Floor	Stores & provides Chlorine for Chemical Addition into filtered water	
2	Zinc Orthophosphate Injection Pump (P303)	Filters Floor	Doses zinc orthophosphate to treated water reservoir. Refer to supplier O&M for more detail	

No.	Component	Location	Function Performed	Remarks
3	Zinc Orthophosphate Injection Pump (P304)	Filters Floor	Doses zinc orthophosphate to treated water reservoir. Refer to supplier O&M for more detail	
4	Check Valve (V2031)	Chemical Addition supply piping to TW piping in the Utilidor	Prevents backflow of Filtered Water into Chemical Addition system	
5	Isolation Valve (V2032)	Chemical Addition supply piping to TW piping in the Utilidor	Used to isolate the Zinc Orthophosphate system from other systems	Normally Open

4.7 Caustic Soda Chemical (Refer to Drawing P-7 at the end of this section)

The following table identifies the components related to the flow of Caustic Soda. The referenced drawing shows the components but not their locations.

No.	Component	Location	Function Performed	Remarks
1	Caustic Soda Drum	Pumps Floor	Stores & provides Caustic Soda for Chemical Addition into filtered water	
2	Caustic Injection Pump (P362)	Pumps Floor	A microprocessor dosing pump that sends caustic soda to the Clearwell.	
3	Caustic Injection Pump (P363)	Pumps Floor	A microprocessor dosing pump that sends caustic soda to the Clearwell.	
4	Check Valve (V1015)	Chemical Addition supply piping to Contact Chamber	Prevents backflow of Filtered Water into Chemical Addition system	
5	Isolation Valve (V1031)	Chemical Addition supply piping to Contact Chamber	Used to isolate the Caustic Soda system from other systems	Normally Open

4.8 Backwash Flow (Refer to Drawings P-8 and P-9 at the end of this section)
The following table identifies the components related to the flow of water from the backwash pumps to the City sanitary sewer system.

No.	Component	Location	Function Performed	Remarks
1	Backwash Pump (P206)	Pumps Floor/Pumping Chamber	Provides Backwash supply from Treated Water	PLC Controlled
2	Isolation Valve (V2028)	300mm Backwash piping, Pumps Floor	Provides isolation for the Pressure Indicator	Normally Open
3	Isolation Valve (V2028)	300mm Backwash piping, Pumps Floor	Used to remove any debris that might block the Pressure Indicator	Normally Closed
4	Pressure Indicator (PI2061)	300mm Backwash piping, Pumps Floor	Indicates the output pressure of Pump P206	
5	Check Valve (V2023)	300mm Backwash piping, Pumps Floor	Prevents the backflow of water into the Pumping Chamber	
6	Isolation Valve (V2022)	300mm Backwash piping, Pumps Floor	Provides isolation for the check valve V2023 and Pump P206	Normally Open
7	Backwash Pump (P205)	Pumps Floor/Pumping Chamber	Provides Backwash supply from Treated Water	PLC Controlled
8	Isolation Valve (V2026)	300mm Backwash piping, Pumps Floor	Provides isolation for the Pressure Indicator	Normally Open
9	Isolation Valve (V2027)	300mm Backwash piping, Pumps Floor	Used to remove any debris that might block the Pressure Indicator	Normally Closed
10	Pressure Indicator (PI2051)	300mm Backwash piping, Pumps Floor	Indicates the output pressure of Pump P205	
11	Check Valve (V2024)	300mm Backwash piping, Pumps Floor	Prevents the backflow of water into the Pumping Chamber	

No.	Component	Location	Function Performed	Remarks
12	Isolation Valve (V2025)	300mm Backwash piping, Pumps Floor	Provides isolation for the check valve V2024 and Pump P205	Normally Open
13	Pump Relief Valve (PRV2501)	300mm Backwash piping, Pumps Floor	Provides relief for the Backwash supply pumps on start-up of a backwash sequence	PLC Controlled
14	Flow Control Valve (FCV2105)	300mm Backwash piping, Pumps Floor	Controls the flow of backwash water to Filter #1	PLC Controlled
15	Filter #1	Filters room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
16	Flow Control Valve (FCV2106)	400mm Backwash Waste piping, Pumps Floor	Controls the flow of backwash waste water from Filter #1 to Backwash Waste Chamber	PLC Controlled
17	Flow Control Valve (FCV2115)	300mm Backwash piping, Pumps Floor	Controls the flow of backwash water to Filter #2	PLC Controlled
18	Filter #2	Filters room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
19	Flow Control Valve (FCV2116)	400mm Backwash Waste piping, Pumps Floor	Controls the flow of backwash waste water from Filter #2 to Backwash Waste Chamber	PLC Controlled
20	Flow Control Valve (FCV2125)	300mm Backwash piping, Pumps Floor	Controls the flow of backwash water to Filter #3	PLC Controlled
21	Filter #3	Filters room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
22	Flow Control Valve (FCV2126)	400mm Backwash Waste piping, Pumps Floor	Controls the flow of backwash waste water from Filter #3 to Backwash Waste Chamber	PLC Controlled
23	Flow Control Valve (FCV2135)	300mm Backwash piping, Pumps Floor	Controls the flow of backwash water to Filter #4	PLC Controlled

No.	Component	Location	Function Performed	Remarks
24	Filter #4	Filters room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
25	Flow Control Valve (FCV2136)	400mm Backwash Waste piping, Pumps Floor	Controls the flow of backwash waste water from Filter #4 to Backwash Waste Chamber	PLC Controlled
26	Backwash Waste Tank	Clearwell Floor level	Contains the waste water from the backwash process	
27	Level Indicating Transmitter (LIT4001)	Mounted on Backwash Waste Tank wall	Indicates the water level in the backwash waste tank	Signals the PLC
28	Flow Meter (FE4001)	Waste Piping in the Utilidor	Indicates the flow of Backwash Waste Water leaving the Plant	Sends info to PLC
29	Flow Control Valve (FCV4001)	Waste Piping in the Utilidor	Controls the flow rate of Backwash Waste Water leaving the Plant	PLC Controlled
30	Orifice Plate	Waste Piping in the Utilidor	Back-up waste water flow rate control for all process waste leaving the Plant	

4.9 Filter to Waste Flow (Refer to Drawing P-10 – P-11 at the end of this section)
The following table identifies the components related to the flow of water from the plant filters to the City sanitary sewer system.

No.	Component	Location	Function Performed	Remarks
1	Filter #1	Filters Room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
2	Flow Control Valve (FCV2103)	200mm Backwash piping, Pumps Floor	Controls the flow of Filter to waste water from Filter #1 to the Surge Tank	PLC Controlled
3	Filter #2	Filters Room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
4	Flow Control Valve (FCV2113)	200mm Backwash piping, Pumps Floor	Controls the flow of Filter to waste water from Filter #2 to the Surge Tank	PLC Controlled

5	Filter #3	Filters Room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
6	Flow Control Valve (FCV2123)	200mm Backwash piping, Pumps Floor	Controls the flow of Filter to waste water from Filter #3 to the Surge Tank	PLC Controlled
7	Filter #4	Filters Room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
8	Flow Control Valve (FCV2133)	200mm Backwash piping, Pumps Floor	Controls the flow of Filter to waste water from Filter #4 to the Surge Tank	PLC Controlled
9	Surge Tank	Under Mixing Tanks, Access from the exterior of the Plant	Used for the storage of the filter to waste water enabling the waste water to be released gradually into the City sanitary system	
10	Level Indicating Transmitter (LIT4011)	Mounted on Surge Tank access wall	Indicates the water level in the Surge Tank	Signals the PLC
11	Flow Meter (FE4011)	Waste Piping in the Utilidor	Indicates the flow rate of Filter Waste Water leaving the Plant	Sends info to PLC
12	Flow Control Valve (FCV4011)	Waste Piping in the Utilidor	Controls the flow rate of Backwash Waste Water leaving the Plant	PLC Controlled
13	Orifice Plate	Waste Piping in the Utilidor	Back-up waste water flow rate control for all process waste leaving the Plant	

4.10 Air Scour Flow (Refer to Drawing P-12 at the end of this section)

The following table identifies the components related to the flow of water from the air blowers to the filters.

No.	Component	Location	Function Performed	Remarks
1	Air Scour Blower #1 (C200)	Pumps Floor	Provides the air for the air scour operation during the backwash sequence	PLC Controlled
2	Isolation valve (V2001)	100mm Air Scour piping, Pumps Floor	Used to isolate Blower #1 from the rest of the system	Normally Open

No.	Component	Location	Function Performed	Remarks
3	Air Scour Blower #2 (C201)	Pumps Floor	Provides the air for the air scour operation during the backwash sequence	PLC Controlled
4	Isolation valve (V2041)	100mm Air Scour piping, Pumps Floor	Used to isolate Blower #2 from the rest of the system	Normally Open
5	Flow Control Valve (FCV2107)	100mm Air Scour piping, Pumps Floor	Controls the flow of air into Filter #1	PLC Controlled
6	Filter #1	Filters room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
7	Flow Control Valve (FCV2117)	100mm Air Scour piping, Pumps Floor	Controls the flow of air into Filter #2	PLC Controlled
8	Filter #2	Filters room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
9	Flow Control Valve (FCV2127)	100mm Air Scour piping, Pumps Floor	Controls the flow of air into Filter #3	PLC Controlled
10	Filter #3	Filters room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	
11	Flow Control Valve (FCV2137)	100mm Air Scour piping, Pumps Floor	Controls the flow of air into Filter #4	PLC Controlled
12	Filter #4	Filters room	Filters raw water with a 300mm sand layer and a 700mm anthracite layer	

Note: All drain valves are Normally Closed

Chapter 5
COMPONENT DETAILS

5.1 General Overview

The following tables describe the components of the various systems and provide some basic details and settings. For each table, associated drawings can be referenced to better understand the location of the components in the Water Treatment Plant.

5.2 City of Iqaluit Water & Wastewater Facilities Improvements

In December 2017, the City of Iqaluit carried out the Water & Wastewater Facilities Improvements Project (#SC711). Within the scope of this project, the following components were replaced or newly installed:

- AE1001 – Replaced
- AE1002 – Replaced
- PIT1001 – Newly Installed
- AE2102 – Replaced
- AE2112 – Replaced
- AE2122 – Replaced
- AE2132 – Replaced
- C200 – Replaced
- AE2501/2502 – Replaced
- P410 – Replaced
- P303/304 – Replaced
- P305/306 – Replaced
- P362/363 – Replaced
- FIT5001 – Replaced

Additionally, all Bray Control Valves were inspected, maintained and repaired. Backflow preventers for all the chemical metering pumps (orthophosphate, hydrofluorosilicic acid and caustic soda) were also replaced.

5.3 **Raw Water Flow** (Refer to Drawing P-1 and P-2, Section 4)

The following table identifies the components related to the flow of water from the plant intake to the filters.

No.	Component	Details	Setting	Remarks
1	Intake Valve (V1000)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
2	Isolation Valve (V1036)	MAS G2 Ball Valve		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
3	Solenoid Valve (SV1001)	ASCO Red Hat II		Supplier: Emco Ltd. Edmonton, AB
4	Turbidity Sensor (AE1001)	Hatch TU5300sc sc2000 Universal Controller	0 – 20 NTU	Supplier: Hach Company Loveland, Colorado
5	Drain Valve (V1034)	MAS G2 Ball Valve		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
6	Isolation Valve (V1035)	MAS G2 Ball Valve		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
7	Isolation Valve (V1037)	MAS G2 Ball Valve		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
8	Solenoid Valve (SV1002)	ASCO Red Hat II		Supplier: Emco Ltd. Edmonton, AB
9	pH Sensor (AE1002)	Depolox 3 Plus D5CPT pH sensor	4.0 – 10.0	Supplier: Evoqua Water Technologies St. Laurent, QC
10	Isolation Valve (V1029)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB

No.	Component	Details	Setting	Remarks
11	Pressure Transmitter (PIT1001)	Cerebar S PMC71	0 to 750 kPa	Supplier: Endress & Hauser Montréal, QC
12	Flow Meter (FE1001)	Promag 50W	0-120 L/s	Supplier: Endress + Hauser Canada Ltd. Edmonton, AB
13	Flow Control Valve (FCV1001)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0121 actuator	Modulating	Supplier: Summit Valve & Controls Edmonton, AB
14	Isolation Valve (V1003)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
15	Bypass Valve (V1004)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
16	Drain Valve (V1005)	MAS G2 Ball Valve		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
17	Isolation Valve (V1006)	MAS G2 Ball Valve		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
18	Air Release Valve (ARV1001)	APCO Air Vent Valve		Supplier: Summit Valve & Controls Edmonton, AB
19	Isolation Valve (V1007)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
20	Isolation Valve (V1038)	MAS G2 Ball Valve		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
21	Air Release Valve (V1036)	APCO Air Vent Valve		Supplier: Summit Valve & Controls Edmonton, AB
22	Isolation Valve (V1039)	MAS G2 Ball Valve		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB

No.	Component	Details	Setting	Remarks
23	Solenoid Valve (SV201)	ASCO Red Hat II		Supplier: Emco Ltd. Edmonton, AB
24	Isolation Valve (V1008)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
25	Isolation Valve (V1040)	MAS G2 Ball Valve		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
26	Solenoid Valve (SV211)	ASCO Red Hat II		Supplier: Emco Ltd. Edmonton, AB
27	UV unit (X120)	UV Disinfection System	Max. dosage: 40 mJ/cm^2	Supplier: Trojan Technologies Inc. London, ON
28	UV unit (X121)	UV Disinfection System	Max. dosage: 40 mJ/cm^2	Supplier: Trojan Technologies Inc. London, ON
29	Drain Valve (V1041)	MAS G2 Ball Valve		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
30	Drain Valve (V1042)	MAS G2 Ball Valve		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
31	Isolation Valve (V1043)	MAS G2 Ball Valve		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
32	Air Release Valve (V1039)	APCO Air Vent Valve		Supplier: Summit Valve & Controls Edmonton, AB
33	Motorized Valve (V1009)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0301 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
34	Motorized Valve (V1012)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0301 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB

No.	Component	Details	Setting	Remarks
35	Drain Valve (V1013)	Kitz Ball Valve #58cc		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
36	Isolation Valve (V1016)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
37	Isolation Valve (V1017)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
38	Isolation Valve (V1018)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
39	Isolation Valve (V1019)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
40	Isolation Valve (V1020)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
41	Isolation Valve (V1021)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
42	Isolation Valve (V1022)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
43	Isolation Valve (V1023)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
44	Isolation Valve (V1024)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
45	Isolation Valve (V1025)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
46	Isolation Valve (V1026)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
47	Isolation Valve (V1027)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB

No.	Component	Details	Setting	Remarks
48	Isolation Valve (V1028)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
49	Motorized Valve (FCV2101)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0501 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
50	Flow Control Valve (FCV2111)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0501 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
51	Motorized Valve (FCV2121)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0501 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
52	Motorized Valve (FCV2131)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0501 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB

5.4 **Filtered/Treated Water Flow** (Refer to Drawing P-3 and P-4)

The following table identifies the components related to the flow of water from the plant filters to the off-site reservoir.

No.	Component	Details	Setting	Remarks
1	Filter #1	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
2	Level Indicating Transmitter (LIT2101)	MultiRanger, Echomax XPS-10	0.3 – 10 m	Supplier: Siemens Milltronics Edmonton, AB
3	Isolation Valve (V2003)	Kitz Ball Valve #58		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
4	Isolation Valve (V2004)	Kitz Ball Valve #58		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB

No.	Component	Details	Setting	Remarks
5	Pressure Indicating Transmitter (PIT2101)	Deltabar S PMD235	0 – 4.00 m H_2O	Supplier: Endress + Hauser Canada Ltd. Edmonton, AB
6	Solenoid Valve (SV2102)	ASCO Red Hat II		Supplier: Emco Ltd. Edmonton, AB
7	Turbidity Sensor (AE2102)	Hatch TU5300sc sc2000 Universal Controller	0 – 20 NTU	Supplier: Veolia Water Technologies St-Laurent, QC
8	Drain Valve (V2002)	Kitz Ball Valve #58cc		Supplier: Bartel & Gibson Co Ltd. Edmonton, AB
9	Level Control Valve (LCV2104)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0121 actuator	Modulating	Supplier: Summit Valve & Controls Edmonton, AB
10	Filter #2	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
11	Level Indicating Transmitter (LIT2111)	MultiRanger, Echomax XPS-10	0.3 – 10 m	Supplier: Siemens Milltronics Edmonton, AB
12	Isolation Valve (V2055)	Kitz Ball Valve		Supplier: Emco Ltd. Edmonton, AB
13	Isolation Valve (V2056)	Kitz Ball Valve		Supplier: Emco Ltd. Edmonton, AB
14	Pressure Indicating Transmitter (PIT2111)	Deltabar S PMD235	0 – 4.00 m H_2O	Supplier: Endress + Hauser Canada Ltd. Edmonton, AB
15	Solenoid Valve (SV2112)	ASCO Red Hat II		Supplier: Emco Ltd. Edmonton, AB
16	Turbidity Sensor (AE2111)	Hatch TU5300sc sc2000 Universal Controller	0 – 20 NTU	Supplier: Veolia Water Technologies St-Laurent, QC
17	Drain Valve (V2054)	Ball Valve		Supplier: Emco Ltd. Edmonton, AB

No.	Component	Details	Setting	Remarks
18	Level Control Valve (LCV2114)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0121 actuator	Modulating	Supplier: Summit Valve & Controls Edmonton, AB
19	Filter #3	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
20	Level Indicating Transmitter (LIT2121)	MultiRanger, Echomax XPS-10	0.3 – 10 m	Supplier: Siemens Milltronics Edmonton, AB
21	Isolation Valve (V2066)	Ball Valve		Supplier: Emco Ltd. Edmonton, AB
22	Isolation Valve (V2067)	Ball valve		Supplier: Emco Ltd. Edmonton, AB
23	Pressure Indicating Transmitter (PIT2121)	Deltabar S PMD235	0 – 4.00 m H_2O	Supplier: Endress + Hauser Canada Ltd. Edmonton, AB
24	Solenoid Valve (SV2122)	ASCO Red Hat II		Supplier: Emco Ltd. Edmonton, AB
25	Turbidity Sensor (AE2121)	Hatch TU5300sc sc2000 Universal Controller	0 – 20 NTU	Supplier: Veolia Water Technologies St-Laurent, QC
26	Drain Valve (V2065)	Ball Valve		Supplier: Emco Ltd. Edmonton, AB
27	Level Control Valve (LCV2124)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0121 actuator	Modulating	Supplier: Summit Valve & Controls Edmonton, AB
28	Filter #4	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
29	Level Indicating Transmitter (LIT2131)	MultiRanger, Echomax XPS-10	0.3 – 10 m	Supplier: Siemens Milltronics Edmonton, AB
30	Isolation Valve (V2077)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB

No.	Component	Details	Setting	Remarks
31	Isolation Valve (V2078)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
32	Pressure Indicating Transmitter (PIT2131)	Deltabar S PMD235	0 – 4.00 m H_2O	Supplier: Endress + Hauser Canada Ltd. Edmonton, AB
33	Solenoid Valve (SV2132)	ASCO Red Hat II		Supplier: Emco Ltd. Edmonton, AB
34	Turbidity Sensor (AE2131)	Hatch TU5300sc sc2000 Universal Controller	0 – 20 NTU	Supplier: Veolia Water Technologies St-Laurent, QC
35	Drain Valve (V2076)	Ball Valve		Supplier: Emco Ltd. Edmonton, AB
36	Level Control Valve (LCV2134)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0121 actuator	Modulating	Supplier: Summit Valve & Controls Edmonton, AB
37	Chlorine Injection point			
38	Caustic Soda Injection point			
39	Hydroflourosilic Acid Injection point			
40	Contact Chamber			
41	Isolation Valve (V2038)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
42	North Clearwell			
43	Isolation Valve (V2039)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
44	South Clearwell			
45	Isolation Valve (V2037)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB

No.	Component	Details	Setting	Remarks
46	Backwash Chamber			
47	Isolation Valve (V2035)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
48	Isolation Valve (V2034)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
49	Isolation Valve (V2033)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
50	Level Indicating Transmitter (LIT2501)	MultiRanger, Echomax XPS-10	0.3 – 10 m	Supplier: Siemens Milltronics Edmonton, AB
51	Flow Control Valve (FCV2501)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0301 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
52	Orthophosphate injection point			
53	Isolation Valve (V2056)	Kitz Ball Valve		Supplier: Emco Ltd. Edmonton, AB
54	pH/Cl Sensor (AE2501/2502)	Depolox 3 Plus D5CPT pH sensor	4.0 – 10.0 (pH) 0 – 5.0 mg/l (Free Cl_2)	Supplier: Evoqua Water Technologies St. Laurent, QC
55	Service Pump #1 (P410)	Model : Franklin Electric 100JS5S6-PE Submersible Pump Pump Motor : 236620920	6” 5HP 575V Rated Capacity: 100 GPM	Manufacturer/Supplier: Atlantis Pompe St-Foy, Québec, QC
56	Service Pump #2 (P411)	Model : Franklin Electric 100JS5S6-PE Submersible Pump Pump Motor : 236620920	6” 5HP 575V Rated Capacity: 100 GPM	Manufacturer/Supplier: Atlantis Pompe St-Foy, Québec, QC
57	Reservoir Outlet Flow Meter (FIT5001)	Proline Promag W 400 Flow Meter Sensor : Promag W Transmitter : Promag 400	0-150L/s	Manufacturer/Supplier: Endress & Hauser, Montréal, QC,

5.5 Hydrofluorosilicic Acid Chemical (Refer to Drawing P-5, Section 4)

The following table identifies the components related to the flow of Hydro-Fluorosilicic Acid. The referenced drawing shows the components but not their locations.

No.	Component	Details	Setting	Remarks
1	Hydrofluorosilicic Acid Drum	205 L		
2	Pumps Package (P305 / P306)	LMI series AD941-920SI Electronic Metering Pumps	Rated Max Capacity: 1.89 L/h Max Pressure: 250 psi	Supplier: York Fluid Controls Ltd. Brampton, Ontario
3	Check Valve (V3052)	Stainless Steel Swing Check Kitz class 200		Supplier: Emco Ltd. Edmonton, AB
4	Isolation Valve (V3053)	MA Stewart Stainless Steel G5 full port Ball Valve		Supplier: Emco Ltd. Edmonton, AB

5.6 Chlorine Chemical (Refer to Drawing P-6, Section 4)

The following table identifies the components related to the flow of Chlorine. The referenced drawing shows the components but not their locations.

No.	Component	Details	Setting	Remarks
1	Chlorine Cylinders	150 lbs. K Style Cylinder Storage @ 85 psi		
2	Chlorination Package	200 PPD Vacuum Regulator, Series V10K Chlorinator, etc.		Supplier: Alberta Mequipco Ltd. Calgary, AB
3	Check Valve (V3052)	Stainless Steel Swing Check Kitz class 200		Supplier: Emco Ltd. Edmonton, AB
4	Isolation Valve (V3053)	MA Stewart Stainless Steel G5 full port Ball Valve		Supplier: Emco Ltd. Edmonton, AB
5	Chlorine Gas Detection System (Monitor,	Wallace & Tiernan Acutec 35	Standard Detection Range: 0-10 ppm Minimum Range: 0-5 ppm	Supplier: Chloratech (Wallace & Tiernan)

	Sensor, Transmitter)		Maximum Range: 0-50 ppm	St-Augustin-de-Desmaures, QC
6	Exhaust Fan	TwinCity Exhaust Fan 909/RBA	Volumetric Flow: 947 CFM Total Efficiency: 66% Operating Power: 0.74 BHP	Supplier: Ventes Centech Inc. St-Eustache, QC

5.7 Zinc Orthophosphate Chemical (Refer to Drawing P-5, Section 4)

The following table identifies the components related to the flow of Zinc Orthophosphate. The referenced drawing shows the components but not their locations.

No.	Component	Details	Setting	Remarks
1	Zinc Orthophosphate Drum	205 L		
2	Pumps Package (P303 / P304)	LMI series C931-410SI Electronic Metering Pumps	Rated Max Capacity: 30 L/h Maximum Pressure: 60 psi	Supplier: York Fluid Controls Ltd. Brampton, Ontario
3	Check Valve (V3052)	Stainless Steel Swing Check Kitz class 200		Supplier: Emco Ltd. Edmonton, AB
4	Isolation Valve (V3053)	MA Stewart Stainless Steel G5 full port Ball Valve		Supplier: Emco Ltd. Edmonton, AB

5.8 Caustic Soda Chemical (Refer to Drawing P-7, Section 4)

The following table identifies the components related to the flow of Caustic Soda. The referenced drawing shows the components but not their locations.

No.	Component	Details	Setting	Remarks
1	Caustic Soda Drum	205 L		
2	Pumps Package (P362/363)	LMI series B931-362SI Electronic Metering Pumps	Rated Max Capacity: 17 L/h	Supplier: York Fluid Controls Ltd.

			Maximum Pressure: 50 psi	Brampton, Ontario
3	Check Valve (V3052)	Stainless Steel Swing Check Kitz class 200, etc.		Supplier: Emco Ltd. Edmonton, AB
4	Isolation Valve (V3053)	MA Stewart Stainless Steel G5 full port Ball Valve		Supplier: Emco Ltd. Edmonton, AB

5.9 Backwash Flow (Refer to Drawing P-8 and P-9, Section 4)

The following table identifies the components related to the flow of water from the backwash pumps to the City sanitary sewer system.

No.	Component	Details	Setting	Remarks
1	Backwash Pump (P206)	Verti-line –1200 14FHH (1 stage)		Supplier: National Process Equipment Edmonton, AB
2	Isolation Valve (V2028)	Ball Valve		Supplier: Ener-Tech Mechanical sales Ltd. Edmonton, AB
3	Isolation Valve (V2029)	Kitz Ball Valve		Supplier: Emco Ltd. Edmonton, AB
4	Pressure Indicator (PI2061)	Trerice #620B	0 – 400kPa	Supplier: Ener-Tech Mechanical sales Ltd. Edmonton, AB
5	Check Valve (V2023)	Check Rite model 15-XMZ A351-CF8M body A351-CF8 hinge		Supplier: Summit Valve & Controls Edmonton, AB
6	Isolation Valve (V2022)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
7	Backwash Pump (P205)	Verti-line –1200 14FHH (1 stage)		Supplier: National Process Equipment Edmonton, AB

No.	Component	Details	Setting	Remarks
8	Isolation Valve (V2026)	Ball Valve		Supplier: Ener-Tech Mechanical sales Ltd. Edmonton, AB
9	Isolation Valve (V2027)	Kitz Ball Valve		Supplier: Emco Ltd. Edmonton, AB
10	Pressure Indicator (PI2051)	Trerice #620B	0 – 400kPa	Supplier: Ener-Tech Mechanical sales Ltd. Edmonton, AB
11	Check Valve (V2024)	Check Rite model 15-XMZ A351-CF8M body A351-CF8 hinge		Supplier: Summit Valve & Controls Edmonton, AB
12	Isolation Valve (V2025)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
13	Pump Relief Valve (PRV2501)	Singer model 106-DWX-RPS c/w model 81-RP pilot, 120VAC solenoid, X129 SPDT limit switch, and 82-B booster pilot		Supplier: Summit Valve & Controls Edmonton, AB
14	Flow Control Valve (FCV2105)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0301 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
15	Filter #1	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
16	Flow Control Valve (FCV2106)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0501 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
17	Flow Control Valve (FCV2115)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0301 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
18	Filter #2	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA

No.	Component	Details	Setting	Remarks
19	Flow Control Valve (FCV2116)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0501 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
20	Flow Control Valve (FCV2125)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0301 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
21	Filter #3	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
22	Flow Control Valve (FCV2126)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0501 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
23	Flow Control Valve (FCV2135)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0301 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
24	Filter #4	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
25	Flow Control Valve (FCV2136)	Motorized Bray series 30-111, wafer style Butterfly Valve, c/w Bray S70-0501 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
26	Backwash Waste Tank			
27	Level Indicating Transmitter (LIT4001)	MultiRanger, Echomax XPS-10	0.3 – 10 m	Supplier: Siemens Milltronics Edmonton, AB
28	Flow Meter (FE4001)	Promag 50W	0-12 L/s	Supplier: Endress + Hauser Canada Ltd. Edmonton, AB
29	Flow Control Valve (FCV4001)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0031 actuator	Modulating	Supplier: Summit Valve & Controls Edmonton, AB

No.	Component	Details	Setting	Remarks
30	Orifice Plate		60 mm hole for a regulated flow of 70 L/min	

5.10 Filter to Waste Flow (Refer to Drawing P-10 and P-11, Section 4)

The following table identifies the components related to the flow of water from the plant filters to the City sanitary sewer system.

No.	Component	Details	Setting	Remarks
1	Filter #1	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
2	Flow Control Valve (FCV2103)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0121 actuator	Modulating	Supplier: Summit Valve & Controls Edmonton, AB
3	Filter #2	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
4	Flow Control Valve (FCV2113)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0121 actuator	Modulating	Supplier: Summit Valve & Controls Edmonton, AB
5	Filter #3	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
6	Flow Control Valve (FCV2123)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0121 actuator	Modulating	Supplier: Summit Valve & Controls Edmonton, AB
7	Filter #4	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
8	Flow Control Valve (FCV2133)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0121 actuator	Modulating	Supplier: Summit Valve & Controls Edmonton, AB
9	Surge Tank			

No.	Component	Details	Setting	Remarks
10	Level Indicating Transmitter (LIT4011)	Waterpilot FMX167	0 – 4.00 m	Supplier: Endress + Hauser Canada Ltd. Edmonton, AB
11	Flow Meter (FE4011)	Promag 50W	0-5 L/s	Supplier: Endress + Hauser Canada Ltd. Edmonton, AB
12	Flow Control Valve (FCV4011)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0031 actuator	Modulating	Supplier: Summit Valve & Controls Edmonton, AB
13	Orifice Plate		60 mm hole for a regulated flow of 70 L/min	

5.11 Air Scour Flow (Refer to Drawing P-12, Section 4)

The following table identifies the components related to the flow of water from the air blowers to the filters.

No.	Component	Details	Setting	Remarks
1	Air Scour Blower #1 (C200)	Delta Blower Package Aerzen model #GM 15L Blower	Max Differential Pressure: 700 mbar Max Volume Flow: 1038 m^3/h Max Motor Rating: 30 kW	Supplier: Aerzen Vaudreil-Dorion, QC
2	Isolation valve (V2001)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls Edmonton, AB
3	Air Scour Blower #2 (C201)	Delta Blower Package Aerzen model #GM 15L Blower	Max Differential Pressure: 700 mbar Max Volume Flow: 1038 m^3/h Max Motor Rating: 30 kW	Supplier: National Process Equipment Edmonton, AB
4	Isolation valve (V2041)	Bray series 31 trim 109, lug style Butterfly Valve		Supplier: Summit Valve & Controls

No.	Component	Details	Setting	Remarks
				Edmonton, AB
5	Flow Control Valve (FCV2107)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0031 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
6	Filter #1	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
7	Flow Control Valve (FCV2117)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0031 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
8	Filter #2	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
9	Flow Control Valve (FCV2127)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0031 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
10	Filter #3	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA
11	Flow Control Valve (FCV2137)	Motorized Bray series 30-109, wafer style Butterfly Valve, c/w Bray S70-0031 actuator	Open or Closed	Supplier: Summit Valve & Controls Edmonton, AB
12	Filter #4	Underdrains & Media	300mm sand layer & 700mm anthracite	Supplier: Leopold Zelienpole, PA

Chapter 6
OPERATING PROCEDURES

6.1 General

Raw water enters the Water Treatment Plant through a 250 mm line from the dam on Geraldine Lake above the Plant. Upon entering the Plant, the raw water flow is metered and controlled. A pressure transmitter, PIT-1001, installed as part of the 2017 Water and Wastewater Facilities Improvements Project, measures the raw water pressure. PIT-1001 does not require manual operation as it has been incorporated into the PLC/HMI software.

The raw water is then disinfected with UV light to inactivate any pathogens present. Downstream of the UV equipment, the water flows through a set of flocculation tanks, or through a flocculation tank bypass line on to the filters. From the filters, the filtered water flows into the contact chamber where the necessary chemicals are added. The treated water then flows into the clearwells, through the backwash pumping chamber, then to a separate reservoir and finally into the City distribution system.

This process will be automatically controlled using a Plant Control System (PCS) and will require minimal intervention unless there is an alarm indicated. Monitoring, fine tuning and scheduled maintenance of the Plant operating systems will ensure reliability and dependability with reduced system malfunctions and breakdowns.

6.2 Raw Water to Filter Flow (Refer to drawing P-1 and P-2, Section 4)

Operation of the Treated Water System is initiated by the Reservoir water level indicator located in the off-site Reservoir (Level Indicating Transmitter-5001) or the back-up level indicator located in the backwash pumping chamber (Level Indicating Transmitter-2501). Either water level indicators will initiate the Treated Water Operation. The flow control valve (FCV-1001) is opened on initiation of the treated water system operation. This allows the gravity feed raw water to flow through either of the UV reactors (X-120 or X-121). The water then flows on to flocculation tanks or through the flocculation by-pass line on to the filters. Flocculation time can be varied by utilizing various configurations (series or

parallel) of the flocculation tanks; however this will only be required if flash mixing and coagulant dosing systems are installed in the future. Presently the flocculation by-pass line will be utilized to divert the water to the filters. Each filter has a motorized control valve in its' influent channel which is either open or closed.

6.3 Filtered/Treated Water Flow (Refer to drawing P-3 and P-4, Section 4)

The UV treated water flows through the sand and anthracite filter media and through the filter effluent channel of each filter. The motorized flow control valve on the 200 mm filtered water line is opened to allow the water to flow to the contact chamber. In the contact chamber chlorine is added to the water along with hydrofluorosilic acid (for fluoride) and caustic soda (for pH adjustment). The flow from the contact chamber can be diverted to either of the two clearwells or into the backwash pumping chamber, normally the now treated and filtered water flows into the east clearwell then to the west clearwell and then to the backwash pumping chamber. The treated water continues on from the backwash pumping chamber through the last motorized valve, at this point there is an injection point for the orthophosphate and testing of the pH and chlorine, and finally on to the off-site reservoir.

6.4 Chemical Flows (Refer to drawing P-5, P-6 and P-7, Section 4)

The orthophosphate, hydrofluorosilicic acid and caustic soda all start at a small pumping skid consisting of two injection pumps with associated equipment and valving. Chlorine gas is added to service water for dosing hypochlorite into the clearwell via two chlorinator/injector systems. The chlorine system uses gas cylinders and the other chemicals (hydrofluorosilicic acid, caustic soda, zinc orthophosphate) use 205 L drums.

A new flow switch for chlorinated water injection was installed in December 2017 as part of the Water and Wastewater Facilities Improvements Project (#SC711). The flow switch does not require manual operation, as it has been incorporated into the PLC/HMI software and will automatically display an alarm when low flow is detected. The alarm will also trigger a call by the autodialer.

6.5 Backwash Flow (Refer to drawing P-8 and P-9,Section 4)

Filter backwash is initiated when the following scenarios occur:

- The filtered water valve is fully open;
- The filtered water turbidity > 0.3 NTU;
- The pressure indicating transmitter on the filtered water line senses a pressure drop across the filter media;
- The operator enables the backwash sequence on the PCS;
- Or the elapsed time has passed (variable set in the PCS).

On backwash start-up the pump relief valve (PRV-2501) is in the open position so that when the backwash pump starts the backwash water flow initially goes back to the backwash pumping chamber. The backwash waste valve and backwash supply valves are then opened. After a delay of about 3 minutes the PRV-2501 pilot solenoid will be energized allowing this valve to close slowly, thereby closing the pump bypass allowing backwash water to be introduced into the filter. The backwash water will flow from the filters into the backwash waste tank. The backwash waste water will then be metered out into the City sanitary sewer system. The backwash pump will deliver water to the filter for approximately 10 minutes at which time the PRV-2501 pilot solenoid will be de-energized allowing PRV-2501 to return to bypass mode. Backwash supply and backwash waste valves will be closed. The backwash pump will be shut down following 2 minutes after PRV-2501 is fully open and once the valve status is confirmed for all backwash related valves, the filter is then ready to enter the filter to waste mode at which time the filter will be ripened.

6.6 Filter to Waste Flow (Refer to drawing P-10 and P-11, Section 4)

The filter to waste flow allows the filter to ripen following the backwash sequence and pass filtered water with excess turbidity to storage. The filter influent valve will open allowing UV treated water to begin flowing through the filter. The filter to waste valve

will be modulated to maintain the filter water level. The filtered waste water flows to the filtered water waste tank and then is metered out into the City sanitary sewer system. Filter to waste will continue for a pre-set time (~ 10-15 minutes) or until the turbidity of the filtered water is < 0.3 NTU. At this time the filtered water valve will dopen and the filter to waste valve will close, thereby placing the filter into filtration mode.

6.7 Air Scour Flow (Refer to drawing P-12, Section 4)

At the start of the backwash cycle the air scour valve will open, followed by the starting of one of the air scour blowers. Air will be delivered to the filter for approximately 5 minutes followed by the blower shutting down, then the air scour valve closing.

6.8 Sampling and Monitoring Procedures

Daily physic-chemical analysis of the raw from to the WTP was implemented in 2017, with water parameters, such as raw water turbidity, pH and flow, chlorine (total and free), conductivity and fluorine levels, tested daily in the field. Sampling is done for both raw and treated water, with sampling done twice per day on treated water and once per day on the raw water. Filtered water is also tested in the field for chlorine residuals and for turbidity using a hand-held turbidimeter. For bacteriological analysis, parameters, such as turbidity, pH and temperature are also recorded in the lab test. The different types of physic-chemical parameters measured, and results of the field sampling are tabulated in a weekly and monthly manner shown in **Table 6- 1** and **Table 6-2** .

Table 6- 1 Daily Water Sampling Records Template

	Saturday		Sunday		Monday		Tuesday		Wednesday		Thursday		Friday		Total AM	Total PM
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
pH																
Temperature																
Chlorine Total																
Chlorine Free																
Fluoride																
Turbidity																
Chlorine Cylinder Weight																
Chlorine Flow Rate, Q_{cl}																
Zinc Orthophosphate																
Potable Water Temperature																
WTP Reservoir																
Storage Reservoirs Average (2)																
Volume of Water Flown out of WTP																
UV energy in the flow																
UV Power utilized																
Raw Water Meter Reading (Current)																
Raw Water Meter Reading (Previous)																
Consumption from Lake Geraldine																
Treated Water Meter Reading																
Volume of Water Flown to Town																
Chlorine Rota meter																
Pressure of Flow																
UV Transparency																
Filter Backwash #																

Notes

Table 6- 2 Monthly Treated Water Sampling Results Template

MONTH:	WEEK:	1		2		3		4		5			
		Weekly Reading										Total per month	
Parameters	Unit	Raw Water	Treated Water	Raw Water	Treated Water	Raw Water	Treated Water	Raw Water	Treated Water	Raw Water	Treated Water	Raw Water	Treated Water
pH	- log[H+]												
Temperature	°C												
Chlorine Total	mg/L												
Chlorine Free	mg/L												
Fluoride	mg/L												
Turbidity	NTU												
Chlorine Flow Rate, Qcl	m^3/sec												
Zinc Orthophosphate	mg/L												
Potable Water Temperature	°C												
UV energy in the flow	MJ/cm^2												
UV Power utilized	%												
Volume of Water Flown to Town	ML/Day												
Pressure of Flow	psi												
UV Transparency	%T												

6.9 Process Waste Streams

There are three main types of process waste streams from the water treatment process. The first type of waste stream derives from sampling for equipment and instruments, such as turbidity meters, the UV reactors, and chlorine analyzers. The second type of waste stream originates from filter backwash water from filters F-210, F-211, F-212 and F-213. Filter backwash is currently sent to the Waste Storage Tank, which is then discharged to the drain. Lastly, the third type of process waste stream is generated from flush connection and sampling ports in the chemical dosing system: zinc orthophosphate, hydrofluorosilicic acid and caustic soda. Waste water from flush and sampling points are also sent to drain. All drain connections are directly discharged to the sanitary sewer. Refer to **Table 6- 3** for a list of process waste streams generated, along with their corresponding discharge points and reference drawings.

Table 6- 3 Summary of Process Waste Streams

Waste Stream #	Stream Type	Description	Discharge Location	Reference P&ID
1	Sampling	Turbidity sampling from AE-1001	Drain	I-1
2	Sampling	pH Sampling from AE-1002	Drain	I-1
3	Sampling	UV Reactor X-120 Sample	Drain	I-1
4	Sampling	UV Reactor X-121 Sample	Drain	I-1
5	Filter Backwash Waste	Backwash waste from F-210	Waste Storage Tank	I-2
6	Filter Backwash Waste	Backwash waste from F-211	Waste Storage Tank	I-2
7	Filter Backwash Waste	Backwash waste from F-212	Waste Storage Tank	I-2
8	Filter Backwash Waste	Backwash waste from F-213	Waste Storage Tank	I-2
9	Sampling	pH/Cl Sampling from AE-2501/AE-2502	Drain	I-3/I-4
10	Flushing/Cleaning	Flushing Connection V3024 on Zinc Orthophosphate System	Drain	I-5/I-6
11	Sampling	Chemical Sample Port V3019 on Zinc Orthophosphate System	Drain	I-5/I-6
12	Flushing/Cleaning	Flushing Connection V3027 on Hydrofluorosilicic System	Drain	I-5/I-6
13	Sampling	Chemical Sample Port V3033 on Hydrofluorosilicic System	Drain	I-5/I-6
14	Flushing/Cleaning	Flushing Connection V3039 on Caustic Soda System	Drain	I-7
15	Sampling	Chemical Sample Port V3044 on Caustic Soda System	Drain	I-7

6.10 Hazardous Materials

The main hazardous materials found at the WTP include the different chemicals used for treatment of the potable water. **Table 6- 4** summarizes the characteristics of these chemicals. The MSDS for each chemical should, however, be consulted prior to handling. In cases where the chemical remains unused but is no longer suitable for application in water treatment (e.g. degradation or past expiration date), the chemicals are picked up from the WTP by Sea Lift for proper disposal at an alternative facility offsite.

Table 6- 4 Hazardous Materials Found in WTP

Hazardous Material	Hazard Type	Physical Characteristics	Material Incompatibility	Storage Location	Reference Drawing
Zinc Orthophosphate	Corrosive	Liquid Colourless Odourless	Aluminum Zinc Mild Steel Caustic materials	Main Floor	I-6/I-9
Hydrofluorosilicic (Acid Fluoride Barrel)	Corrosive	Liquid Colourless to pale yellow Pungent Odor	Glass and ceramics Metals Alkaline Materials Strong concentrated acids	Main Floor	I-6/I-9
Caustic Soda	Corrosive Aquatic Toxicity	Liquid Colourless Odourless	Sources of ignition Direct sunlight Strong Bases Strong Acids	Chemical Storage Room	I-7/I-9
Chlorine Gas (Gas Cylinder Barrel & Pail)	Severe irritant to skin and tissues Aquatic Toxicity	Gas Greenish-yellow Pungent odour	Organic Chemical (mineral oil, greases) Hydrocarbons Silicones Finely divided metals Alcohols and glycols Ammonia compounds Hydrogen Moisture	Main Floor	I-8/I-9

Chapter 7
TROUBLESHOOTING PROCEDURES

7.1 Alarms in General

The Water Treatment Plant process, mechanical and electrical operating systems and equipment is continuously monitored with the appropriate alarms indicated if there is a system or equipment failure.

7.2 Pre-Treatment Alarms

Alarm No.	Tripped By	Set Point	Consequence
FAL-1001	Low flow in raw water supply header *Alarm held out or 5minutes on plant start sequence*	2 L/s	Plant Shut Down
X-120 Minor Alarm	X-120 Control Panel	Various Conditions	None
X-120 Major Alarm	X-120 Control Panel	Various Conditions	Duty/Standby reactor change over
X-120 Critical Alarm	X-120 Control Panel	Various Conditions	Duty/Standby reactor change over
X-121 Minor Alarm	X-120 Control Panel	Various Conditions	None
X-121 Major Alarm	X-120 Control Panel	Various Conditions	Duty/Standby reactor change over
X-121 Critical Alarm	X-120 Control Panel	Various Conditions	Duty/Standby reactor change over
LAL-5001	Low level in the existing reservoir	3.5 m	WTP Start
LAH-5001	High level in the existing reservoir	4.46 m	WTP Stop
LAL-2501	Low level in the backwash pumping chamber	1.6 m	WTP Start
LAH-2501	High level in the backwash pumping chamber	3.6 m	WTP Stop

7.3 Filtration Alarms

Alarm No.	Tripped By	Set Point	Consequence
AAH-2101	Filtration Mode – High filtered water turbidity	>0.3 NTU	Backwash sequence initiated
	Filter to Waste Mode – High filtered water turbidity	<0.3 NTU	Change to filtration mode
ZOA-2101	Failure of filter influent valve to open		Filter will not enter filtration or filter to waste mode
ZCA-2101	Failure of filter influent valve to close		Filter will not enter backwash mode
ZOA-2103	Filter to waste valve is fully open		Filter shutdown. Backwash was not effective.
ZCA-2103	Filter to waste valve has failed to open		Filter shutdown. Filter to waste can't occur
ZOA-2104	Filtered water valve is fully open		Backwash required.
ZCA-2104	Filtered water valve has failed to open		Filtration can't proceed
ZOA-2105	Failure of backwash water supply valve to open		Backwash pumps (P-205/206) can't start, backwash can't proceed
ZCA-2105	Failure of backwash water supply valve to close		Filter to waste can't proceed
ZOA-2106	Failure of backwash waste valve to open		Backwash pumps (P-205/206) can't start, backwash can't proceed
ZCA-2106	Failure of backwash waste valve to close		Filter to waste can't proceed, filter influent valve remains closed

Alarm No.	Tripped By	Set Point	Consequence
ZOA-2107	Failure of air scour valve to open		Air scour blowers (C-200/201) can't start, backwash can't proceed
ZCA-2107	Failure of air scour valve to close		Backwash can't proceed.
UA-2001	Fault in C-200		If duty blower, set C-201 as duty pump.
UA-2011	Fault in C-201		If duty blower, set C-200 as duty pump.
LAH 2101	High level in filter	300mm above normal operating level	FCV 2101 filter inlet valve closed

7.4 Clearwell & Backwash Supply Alarms

Alarm No.	Tripped By	Set Point	Consequence
UA-2051	Fault with P-205		If duty pump, set P-206 as duty pump. If UA-2061 active, plant shut down
UA-2061	Fault with P-206		If duty pump, set P-205 as duty pump. If UA-2051 active, plant shut down
LAL-2501	Low level in backwash pumping chamber		Backwash sequence disabled
LAH-2501	High level in backwash pumping chamber		Plant shut down

7.5 Chlorination Alarms

Alarm No.	Tripped By	Set Point	Consequence
AAH-3401 Chlorine alarms are always active	Chlorine Leak	2 ppm	Ventilation in chlorine room stops. HN-3401 starts BA-3401 starts

7.6 Fluoride, Orthophosphate & Hypochlorite Alarms

Alarm No.	Tripped By	Set Point	Consequence
UA-3031	Pump failure		P-304 starts Plant Shutdown
UA-3041	Pump failure		P-303 starts Plant Shutdown
UA-3051	Pump failure		P-306 starts Plant Shutdown
UA-3061	Pump failure		P-305 starts Plant Shutdown
UA-3621	Pump failure		P-363 starts Plant Shutdown
UA-3631	Pump failure		P-362 starts Plant Shutdown

7.7 Waste Tankage Alarms

Alarm No.	Tripped By	Set Point	Consequence
LAH-4001	High level in the backwash waste tank	3.1 m	Filters are locked out from backwashing and P-205 and P-206 shutdown
LAH-4011	High level in the filter to waste tank	3.1 m	Filters are locked out from filter to waste mode
FAH-4001	High flow out of backwash tank	10 L/s	FCV-4001 closes
FAH-4011	High flow out of filter to waste tank	5 L/s	FCV-4001 closes

7.8 Service Water Pumps Alarms

Alarm No.	Tripped By	Set Point	Consequence
UA-4101	Pump failure		P-411 starts Plant Shutdown
UA-4111	Pump failure		P-410 starts Plant Shutdown
PAL-4112	Low Pressure in service water	245 kPag	Plant Shutdown

Chapter 8
MAINTENANCE PROCEDURES AND SERVICE INFORMATION

General

To ensure uninterrupted use, equipment should be regularly inspected, tested, and proper repairs made and recorded. The objective is to minimize equipment operating problems and prevent failures by making minor or necessary repairs before major difficulties occur. The importance of record keeping cannot be over-emphasized. Good maintenance protects the owner's interest with manufacturer warranties, continuity, or maintenance despite staff turnovers and equipment reliability track record.

Environmental and operating conditions are key elements affecting proper and reliable operation of equipment. Costly repairs can be minimized if the following items are attended to:

KEEP IT CLEAN
KEEP IT TIGHT

Keep It Clean

Day-to day accumulation of normal atmospheric particles, lint, metallic particles form mechanical equipment cause problems with equipment over a long period of time. Accumulation affects equipment reliability and operating life. **ALL** equipment should be regularly cleaned.

Keep It Tight

All contactors and control devices operate with high speed movement. This motion creates vibration that can loosen hardware and other parts. External vibration from equipment may cause the loosening of hardware and connections in any equipment. All hardware and connections should be tightened regularly. This simple procedure takes only a small amount of time and can save hours of searching for intermittent problems. All rotating

equipment such as motors are affected by vibrations. This can cause alignment problems, which can result in bearing failures.

Renewal Parts

Availability of parts can be a major problem these days as distributors are keeping very low inventories in a move to economize. This may make any part a long delivery item. For this reason local distributors should be contacted and parts availability assessed. Any critical part affecting the reliability of the system should be ordered, recorded and stored by the maintenance department.

Parts and Equipment Ordering Procedure

During the first year of operation, the Contractor should be contacted for any replacement parts required. This will ensure that parts covered by warranty will be replaced under warranty. Failure to contact the Contractor may result in difficulties in obtaining warranty replacement.

Following the first year of operation, it is recommended that the Contractor also be contacted as many of the suppliers have a wholesale only policy. If it is necessary to purchase parts directly from the original supplier, the following information is required.

Make
Model No.
Year of Installation
Installing Contractor
Description of Part Required (ie. Fan Bearing)
Part No. if Available

When quoting a part number contained in manufacturer's catalogue, always provide the date of the catalogue you are referring to, as these numbers are often subject to change. The equipment supplier will have the latest edition of the manufacturer's catalogue.
If the original supplier is no longer in business, contact the contractor who will be able to suggest an alternate source of supply.

Scheduled Preventive Maintenance Program

Scheduled preventive maintenance is an effective means to improve services from systems and equipment. Where failure of equipment can result in shutdown, scheduled preventive maintenance is an economical alternative.

Causes of Equipment Failure

An effective maintenance program will attempt to remove or reduce causes of equipment failure. Common failure initiating causes are:

1. Loose and broken belts
2. Misaligned pulleys
3. Dirty or plugged filters
4. Dirty or plugged coils
5. Worn bearings
6. Improper lubrication and oiling or lack of
7. Persistent overloading
8. Above normal temperatures
9. Below normal temperatures
10. Obstruction of ventilation by foreign objects or material (blockage of air, dirt on components etc.)
11. Normal deterioration from age
12. Severe weather conditions

The scheduled preventive maintenance suggestions presented will be applicable to most equipment, but all of the suggestions given in any one section may not be applicable to the particular mechanical component being maintained. Most of the work may be done by the building operator but some may have to be left to the discretion of the building operator.

When equipment repair is necessary, please refer to the Manufacturer Data section provided in this manual. The frequency which the tasks should be done as indicated.

Most maintenance can be done by average personnel, with a minimum need for specialized service.

Maintenance Legend

D		Daily
W		Weekly
M		Monthly
SA		Semi-Annually
A		Annually
PMI		Per Manufacturer's Instructions
AN		As Necessary

General Maintenance

Item	Maintenance Operations	Inspection Frequency	Remarks
Valves	Check for proper operation	A	
Motorized Valves	Follow maintenance schedule in the manufacturers manual	PMI	
UV Reactors	Maintenance as required by the list in the manufacturers manual	PMI	
Backwash Pumps	Follow maintenance schedule in the manufacturers manual	PMI	
Air Scour Blowers	Follow maintenance schedule in the manufacturers manual	PMI	
Service Water Pumps	Check pump operation and switch between duty and stand-by	M	
Chemical Metering Pumps	Follow maintenance schedule in the manufacturers manual	PMI	

Lubrication Schedule

Note:
For details of maintenance requirements or procedures for a specific piece of equipment, refer to the manufacturers specification sheets included in Chapter 9 of this manual.

Item	Part to be lubricated	Lubricant type	Frequency	Remarks

Chapter 9
TESTING AND CERTIFICATION DATA

CERTIFICATIONS

INSPECTION & COMMISSIONING SHEETS

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Air Scour Blower #1

Tag #: C-200

Manufacturer		**Input**	
Make:	Delta Blower	Voltage (V):	575
Model:	GM 15L	Phase:	3
Description		Frequency (Hz):	60
Serial #:	804858	Nominal Current (A):	22.3
Explosion Proof:		Power (HP/W):	25 HP
Dust-Ignition Proof:		RPM:	3530
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

See attached detailed report with pictures.

System cannot be repaired and must be completely replaced.

Date of Inspection:	1 nov. 2017
Inspected By:	Robert Boudria
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Backwash Pump #2

Tag #: P-206

Manufacturer		**Input**	
Make:	Verti-line	Voltage (V):	230/460 Crossed out, 575
Model:	1200 14FHH	Phase:	3
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	65/32.5
Explosion Proof:		Power (HP/W):	25 HP
Dust-Ignition Proof:		RPM:	1175
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:	597 V	Current - Phase A:	19,5 A
Voltage - Phase B or B-C:	598 V	Current - Phase B:	20,2 A
Voltage - Phase C or C-A:	597 V	Current - Phase C:	19,5 A
Megger Phase A or A-B:	347 V	Rotation (CW, CCW):	
Megger Phase B or B-C:	347 V	RPM:	
Megger Phase C or C-A:	347 V	Overload Set (A):	

Inspection Comments & Recommendations

After inspection, the pump is good working order.
No mechanical or electrical issues were identified.
Pump #2 performance was found to be similar to #1.
The HMI was also tested and was found to be working well.
The PLC does not automatically switch between pumps. This must be done manually.

Worthwhile to note, the motor's nameplate has been modified.
Initially the voltage indicated was "230/460", but this has been scratched out and "575" has been inscribed beside it. See attached picture. The "Amps" has not been updated to this new voltage.

Date of Inspection:	31 oct. 2017
Inspected By:	~~Pierre~~ Luc Lajoie / Robert Boudreau / Krasimir Mitev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Service Water Pump #1 - Pump End

Tag #:

Manufacturer		**Input**	
Make:	Myers	Voltage (V):	—
Model:	6bP590	Phase:	—
Description		Frequency (Hz):	—
Serial #:	9990699 or 9990810	Nominal Current (A):	—
Explosion Proof:		Power (HP/W):	5HP
Dust-Ignition Proof:		~~RPM~~: GPM:	90
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

The pump end was found defective:
- 3 out of 4 impellers are broken.
- The center shaft broke off.

Sifec recommands to replace the entire unit (pump + motor) and keep motor for spare part / backup.

See attached pictures.

Date of Inspection:	11/15/2017
Inspected By:	Robert Boudria
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Service Water Pump #1 - Motor

Tag #:

Manufacturer		**Input**	
Make:	Franklin Electric	Voltage (V):	575
Model:	2366209020	Phase:	3
Description		Frequency (Hz):	60
Serial #:	25 0147	Nominal Current (A):	6.6
Explosion Proof:		Power (HP/W):	5
Dust-Ignition Proof:		RPM:	3450
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	3.9 (no-load)
Voltage - Phase B or B-C:		Current - Phase B:	4.0 (no-load)
Voltage - Phase C or C-A:		Current - Phase C:	3.9 (no-load)
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

After motor was disconnected from pump head, and motor was cleaned, it was found to be servicable.

The coupling parts between pump and motor were found in bad condition and must be replaced.

Sifec recommends to replace the complete unit (pump + motor), but keep this motor on the shelf for spare part or backup.

See attached pictures.

Date of Inspection:	11/15/2017
Inspected By:	Robert Boudria
Signature:	

SIPEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Turbidity METER Filter-2

Tag #: AIT - 2112

Manufacturer		**Input**	
Make:	HACH	Voltage (V):	100-240 VAC +/-10%
Model:	SC200	Phase:	
Description		Frequency (Hz):	50-60Hz
Serial #:	1708C0149722	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver	4 to 20 mA	Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

4 - 20 mA
0 - 20 NTU

Date of Inspection:	08-17-2017
Inspected By:	Pierre-Luc Lajoie
Signature:	

ISO 9001 Certified

CALIBRATION TEST CERTIFICATE
SC200 Controller

Model	Serial Number	Date	SW Ver	Result
LXV404.99.00552	1708C0149722	08/17/2017	2.04	PASS

Tested Characteristic	Min	Max	Value	
Probe Recognition			-	PASS
Display			-	PASS
Keypad			-	PASS
Relays			-	PASS
Dielectric Withstanding (Hipot)			-	PASS
4-20mA Output 1 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 1 @ 20mA	19.95	20.05	19.98mA	PASS
4-20mA Output 2 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 2 @ 20mA	19.95	20.05	19.98mA	PASS

Test Equipment used for the verification of Hach manufactured instruments is calibrated using standards traceable to the National Institute of Standards and Technology (NIST).

For Technical Service, Price Information and Ordering in the U.S.A. call toll-free 1-800-227-4224. Outside the U.S.A. contact the Hach Office or Distributor serving you. On the Worldwide Web visit www.hach.com; E-mail: techhelp@hach.com

Filter 2

ISO 9001 Certified

TU5300 sc

Certificate of Final Inspection

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Part No.	Gerätenummer, n°d'appareil	**LXG445.99.10112**
Serial No.	Seriennummer, numéro de série	***1693967***
Method Compliance		EPA
General Function	Allgemeine Funktion, fonction générale :	
SC Communication		ok
Lid Detection		ok
Humidity protection system		ok
RFID Function		N. A.
Factory Calibration	Werkskalibrierung, Etalonnage d'usine:	
StablCal® Calibration Curve	StablCal® Kalibrierung, StablCal® Courbe d'étalonnage	
20 NTU and 600 NTU	20 NTU und 600 NTU, 20 NTU et 600 NTU	ok
Turbidity Data	Trübungswerte, data turbidité:	
Secondary Turbidity Standard >20 NTU	Sekundär Trübungsstandard >20 NTU, Etalon secondaire de turbidité >20 NTU	
set number	Satznummer; set de contrôle	*0001*
Reference Instrument	Referenzgerät, instrument de référence	29.3 NTU
Tolerance	Toleranz, tolérance:	± 5 %
E.U.T	Prüfling, objet d'essai	**29.4 NTU**
Secondary Turbidity Standard <0.1 NTU	Sekundär Trübungsstandard <0.1 NTU, Etalon secondaire de turbidité <0.1 NTU	
set number	Satznummer; set de contrôle	*0035*
Reference Instrument	Referenzgerät, instrument de référence	0.012 NTU
Tolerance	Toleranz, tolérance:	± 0.007 NTU
E.U.T	Prüfling, objet d'essai	**0.011 NTU**
Date	Datum, date:	Oct 25, 2016
Inspector	Bearbeiter, opérateur:	*Rene Zabel*
Sign	Unterschrift, signature :	Rene Zabel

Please add this certificate to your documents.

Bitte verwahren Sie dieses Zertifikat bei Ihren Unterlagen auf.

S'il vous plaît, conservez scrupuleusement ce certificat dans vos archives.

Dieses Informationsblatt enthält Angaben, die ausschließlich für den Export dieses Gerätes in die Volksrepublik China erforderlich sind.

This document contains information which is only required for the export of this instrument into the People's Republic of China.

Ce document contient les informations nécessaires pour l'exportation d'instruments vers la République Populaire de Chine.

本手册只包含出口到中华人民共和国的仪器的必要信息。

P/N: LXG445.xx.xxxxx Model: TU 5300sc/TU5400sc

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
CPU PCB (TU) CPU PCB	x	O	O	O	O	O
Enclosure 机壳	x	O	O	O	O	O
Measuring Unit 测量单元	x	O	O	O	O	O
Sensorcable 传感器电缆	x	O	O	O	O	O
Pumps/Motors/Actuators 泵/电机/励磁器	x	O	O	O	O	O
Metal Tubing and Fittings 金属管和接头	x	O	O	O	O	O
Accessory 附件	x	O	O	O	O	O
Drying Cartridge 干燥筒	x	O	O	O	O	O

○：表示该项目中涉及的所有物料，其包含的有害物质的含量低于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572-2011).

×：表示该项目中涉及的所有物料中至少有一种，其包含的有害物质的含量高于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in at least one Homogeneous Material of the part exceeds the concentration limit requirement as described in GB/T 26572-2011)

对销售之日的所售产品，本表显示，朗讯供应链的电子信息产品可能包含这些物质。注意：在所售产品中可能会也可能不会含有所有所列的部件
This table shows where these substances may be found in the supply chain of "Company" electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product.

除非另外特别的标注，此标志为针对所涉及产品的环保使用期标志. 某些可更换的零部件会有一个不同的环保使用期(例如，电池单元模块)贴在其产品上.
此环保使用期限只适用于产品是在产品手册中所规定的条件下工作.
The Environmentally Friendly Use Period (EFUP) for all enclosed products and their parts are per the symbol shown here, unless otherwise marked. Certain field-replaceable parts have a different EFUP (for example, battery modules) and so are marked to reflect such. The Environmentally Friendly Use Period is valid only when the product is operated under the conditions defined in the product manual.

HDQ927 Rev. 02

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EC-Declaration of Conformity

EG-Konformitätserklärung / CE-Declaración de conformidad / CE- Déclaration de Conformité / CE-Dichiarazione di Conformità

Manufacturer/Hersteller/Fabricante/Fabricant/Produttore:

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Part Number/Artikelnummer/ Numéro de artículo/Numéro article/Codice articolo:	**Model**/Modell/ Modelo/Modèle/Modello:	**Designation**/Beschreibung/ Designación/Désignation/Denominazione:
LXG445.xx.x01x2 / LXG445.xx.x11x2	**TU5300 sc (EPA/ISO)**	**Turbidity sensor without RFID** (3.0mNTU)
LXG445.xx.x02x2 / LXG445.xx.x12x2	**TU5400 sc (EPA/ISO)**	**Turbidity sensor without RFID** (0.3mNTU)
Including optional accessories /inklusive optionales Zubehör/ Incluyendo accesorios opcionales / Incluant les accessoires optionnels / Compresi gli accessori opzionali:		*)

The product complies with the essential requirements of the following Directive(s) / Das bezeichnete Produkt entspricht den wesentlichen Anforderungen der nachfolgend bezeichneten Richtlinie(n) / El producto es conforme con los requisitos esenciales de la (s) siguientes Directiva (s) / Le produit est conforme aux exigences essentielles de la (des) Directive(s) suivante(s) / Il prodotto è conforme ai requisiti essenziali della seguente Direttiva (e).

2014/30/EU	**EMC Directive**
2006/42/EC	**Machinery Directive**

The following harmonized standards were used to meet the requirements of the stated Directive(s) / Die folgende(n) harmonisierte(n) Norm(en) wurde(n) zur Einhaltung der Anforderungen der genannten Richtlinie(n) angewendet / Para cumplir los requisitos de las directivas mencionadas se han aplicado las siguientes normas armonizadas / Les normes harmonisées suivantes ont été utilisées pour satisfaire aux exigences de la (des) Directive(s) mentionnée(s) / Le seguenti norme armonizzate sono state usate per soddisfare i requisiti della Direttiva (e) indicate.

EN 61326-1: 2013-01	**Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements**

In addition the following standards have been applied in the development of the product / Darüber hinaus wurde(n) folgende(n) Norm(en) bei der Entwicklung des Produktes angewendet / Además, durante el desarrollo del producto, se han aplicado las siguientes normas / En complément, les normes suivantes ont été utilisées pour le développement du produit / Inoltre, sono stati applicati i seguenti Standard nello sviluppo del prodotto.

EN 61010-1: 2010-10	**Safety requirements for electrical equipment – General requirements**
EN 60825-1: 2014-08	**Safety of laser products - Part 1: Equipment classification and requirements**

*) See separate Declaration of Conformity of the optional accessories / Siehe separate Konformitätserklärung für das optionale Zubehör / Ver la Declaración de Conformidad para los accesorios opcionales / Voir déclaration de conformité des accessoires optionnels / Vedi dichiarazione di conformità separata delle accessori opzionali.

Authorised Person to compile the technical file / Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen / Persona autorizada para elaborar el expediente técnico / Personne autorisée à constituer le dossier technique / Persona autorizzata a costituire il fascicolo tecnico:

Michael Schuster – Product Compliance EU - HACH LANGE GmbH; Willstätter Str.11; 40549 Düsseldorf

This statement applies to all versions of the named product, which are prepared by the necessary technical documentation / Diese Erklärung gilt für alle Ausführungen des genannten Produktes, die nach der erforderlichen technischen Dokumentation hergestellt werden / Esta declaración se aplica a todas las versiones del producto designado, que son preparadas por la documentación técnica necesaria / Cette déclaration s'applique à toutes les versions du produit mentionné / Questa dichiarazione si applica a tutte le versioni del prodotto indicato, che sono stati preparati dalla documentazione tecnica necessaria.

Year of primary CE marking of the product / Jahr der ersten CE Kennzeichnung des Produktes / Año de la primera marca CE del producto / Année du premier marquage CE du produit / Anno del primo prodotto CE: **2014**

LXC445.xx.x1xx2 Rev.03

Düsseldorf, 2016/May/11

ppa. _____
Director Operations ppa. Christian Kraatz

i.V. _____
CE Coordinator i.V. Michael Schuster

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SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Cl2/PH Meter WTP (Raw Water)

Tag #: A.I.-1001

Manufacturer		**Input**	
Make:	EVOQUA	Voltage (V):	115V
Model:	EH Depolox 3 PLUS	Phase:	
Description		Frequency (Hz):	50/60
Serial #:	7105977	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	14W
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver	4@20 Mah	Limit Switch	
		HP/CL	03-12-2017 CF

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Output 1 To Cl2
Output 2
Output 3 PH → 4 To 20 Mah = PH4 To PH10

Date of Inspection:	08-11-2017
Inspected By:	Pierre-Luc Lajoie
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: CL/PH Meter WTP (Treated Water)

Tag #: A.T - 2501/2502

Manufacturer		**Input**	115V
Make:	EVOQUA	Voltage (V):	
Model:	EM Depolox 3 PLUS	Phase:	
Description		Frequency (Hz):	50/60
Serial #:	7105976	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	14W
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver		Limit Switch	
		PH/CL	08-12-2017 CA

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Output 1 T° → T° @ 5 Mg/L = 4 To 20 Mah → I: 09/00

Output 2 CL

Output 3 PH → 4 @ 10 PH = 4 To 20 Mah → I: 09/01

Date of Inspection:	08-12-2017
Inspected By:	Pierre Lebaje
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Flow Meter

Tag #: A.T-5000

Manufacturer		**Input**	
Make:	Endress and Hauser	Voltage (V):	24V
Model:	PROMAG W	Phase:	
Description		Frequency (Hz):	
Serial #:	MB 007716000	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Max 7500 USGal/Min
10" cl 150

Date of Inspection:	08-12-2017
Inspected By:	Pierre-Luc Tétreault
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Flow Switch CL WTP

Tag #: N/A

Manufacturer		**Input**	
Make:	Magnetrol	Voltage (V):	24 DC
Model:	TD-2000-030/Tec-A110-004	Phase:	
Description		Frequency (Hz):	
Serial #:	789772-01-004	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Date of Inspection:	08-11-2017
Inspected By:	Pierre-Luc Lajoie
Signature:	

SIPEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Turbidity METER Filter - 1

Tag #: AIT - 2102

Manufacturer		**Input**	
Make:	HACH	Voltage (V):	100 - 240 VAC +/- 10%.
Model:	SC200	Phase:	
Description		Frequency (Hz):	50 - 60 Hz
Serial #:	1610C0138351	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver	4 to 20 mA	Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

4 - 20 mA
0 - 20 NTU

Date of Inspection:	06-12-2017
Inspected By:	Pierre-Luc Lajoie
Signature:	

ISO 9001 Certified

CALIBRATION TEST CERTIFICATE
SC200 Controller

Model	Serial Number	Date	SW Ver	Result
LXV404.99.00552	1610C0138351	10/10/2016	2.01	PASS

Tested Characteristic	Min	Max	Value	
Probe Recognition			-	PASS
Display			-	PASS
Keypad			-	PASS
Relays			-	PASS
Dielectric Withstanding (Hipot)			-	PASS
4-20mA Output 1 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 1 @ 20mA	19.95	20.05	19.98mA	PASS
4-20mA Output 2 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 2 @ 20mA	19.95	20.05	20.00mA	PASS

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Filter 1

ISO 9001 Certified

TU5300 sc

Certificate of Final Inspection

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Part No.	Gerätenummer, n°d'appareil	**LXG445.99.10112**
Serial No.	Seriennummer, numéro de série	***1694338***
Method Compliance		EPA
General Function	Allgemeine Funktion, fonction générale :	
SC Communication		ok
Lid Detection		ok
Humidity protection system		ok
RFID Function		N. A.
Factory Calibration	Werkskalibrierung, Etalonnage d'usine:	
StablCal® Calibration Curve	StablCal® Kalibrierung, StablCal® Courbe d'étalonnage	
20 NTU and 600 NTU	20 NTU und 600 NTU, 20 NTU et 600 NTU	ok
Turbidity Data	Trübungswerte, data turbidité:	
Secondary Turbidity Standard >20 NTU	Sekundär Trübungsstandard >20 NTU, Etalon secondaire de turbidité >20 NTU	
set number	Satznummer; set de contrôle	*0001*
Reference Instrument	Referenzgerät, instrument de référence	29.3 NTU
Tolerance	Toleranz, tolérance:	± 5 %
E.U.T	Prüfling, objet d'essai	**29.7 NTU**
Secondary Turbidity Standard <0.1 NTU	Sekundär Trübungsstandard <0.1 NTU, Etalon secondaire de turbidité <0.1 NTU	
set number	Satznummer; set de contrôle	*0035*
Reference Instrument	Referenzgerät, instrument de référence	0.012 NTU
Tolerance	Toleranz, tolérance:	± 0.007 NTU
E.U.T	Prüfling, objet d'essai	**0.011 NTU**
Date	Datum, date:	Oct 26, 2016
Inspector	Bearbeiter, opérateur:	*Rene Zabel*
Sign	Unterschrift, signature :	Rene Zabel

Please add this certificate to your documents.

Bitte verwahren Sie dieses Zertifikat bei Ihren Unterlagen auf.

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Ce document contient les informations nécessaires pour l'exportation d'instruments vers la République Populaire de Chine.

本手册只包含出口到中华人民共和国的仪器的必要信息。

P/N: LXG445.xx.xxxxx Model: TU 5300sc/TU5400sc

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
CPU PCB (TU) CPU PCB	x	O	O	O	O	O
Enclosure 机壳	x	O	O	O	O	O
Measuring Unit 测量单元	x	O	O	O	O	O
Sensorcable 传感器电缆	x	O	O	O	O	O
Pumps/Motors/Actuators 泵/电机/励磁器	x	O	O	O	O	O
Metal Tubing and Fittings 金属管和接头	x	O	O	O	O	O
Accessory 附件	x	O	O	O	O	O
Drying Cartridge 干燥筒	x	O	O	O	O	O

○：表示该项目中涉及的所有物料，其包含的有害物质的含量低于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572-2011).

×：表示该项目中涉及的所有物料中至少有一种，其包含的有害物质的含量高于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in at least one Homogeneous Material of the part exceeds the concentration limit requirement as described in GB/T 26572-2011)

对销售之日的所售产品，本表显示，朗讯供应链的电子信息产品可能包含这些物质。注意：在所售产品中可能会也可能不会含有所有所列的部件
This table shows where these substances may be found in the supply chain of "Company" electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product.

除非另外特别的标注，此标志为针对所涉及产品的环保使用期标志. 某些可更换的零部件会有一个不同的环保使用期(例如，电池单元模块)贴在其产品上.
此环保使用期限只适用于产品是在产品手册中所规定的条件下工作.
The Environmentally Friendly Use Period (EFUP) for all enclosed products and their parts are per the symbol shown here, unless otherwise marked. Certain field-replaceable parts have a different EFUP (for example, battery modules) and so are marked to reflect such. The Environmentally Friendly Use Period is valid only when the product is operated under the conditions defined in the product manual.

HDQ927 Rev. 02

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EC-Declaration of Conformity

EG-Konformitätserklärung / CE-Declaración de conformidad / CE- Déclaration de Conformité / CE-Dichiarazione di Conformità

Manufacturer/Hersteller/Fabricante/Fabricant/Produttore:

HACH LANGE GmbH, Königsweg 10, 14163 Berlin; Germany – Tel. +49 (0)30-80986-0 - **www.de.hach.com**

Part Number/Artikelnummer/ Numéro de articulo/Numéro article/Codice articolo:	**Model**/Modell/ Modelo/Modèle/Modello:	**Designation**/Beschreibung/ Designación/Désignation/Denominazione:
LXG445.xx.x01x2 / LXG445.xx.x11x2	**TU5300 sc (EPA/ISO)**	**Turbidity sensor without RFID** (3.0mNTU)
LXG445.xx.x02x2 / LXG445.xx.x12x2	**TU5400 sc (EPA/ISO)**	**Turbidity sensor without RFID** (0.3mNTU)
Including optional accessories /inklusive optionales Zubehör/ Incluyendo accesorios opcionales / Incluant les accessoires optionnels / Compresi gli accessori opzionali:		*)

The product complies with the essential requirements of the following Directive(s) / Das bezeichnete Produkt entspricht den wesentlichen Anforderungen der nachfolgend bezeichneten Richtlinie(n) / El producto es conforme con los requisitos esenciales de la (s) siguientes Directiva (s) / Le produit est conforme aux exigences essentielles de la (des) Directive(s) suivante(s) / Il prodotto è conforme ai requisiti essenziali della seguente Direttiva (e).

2014/30/EU	**EMC Directive**
2006/42/EC	**Machinery Directive**

The following harmonized standards were used to meet the requirements of the stated Directive(s) / Die folgende(n) harmonisierte(n) Norm(en) wurde(n) zur Einhaltung der Anforderungen der genannten Richtlinie(n) angewendet / Para cumplir los requisitos de las directivas mencionadas se han aplicado las siguientes normas armonizadas / Les normes harmonisées suivantes ont été utilisées pour satisfaire aux exigences de la (des) Directive(s) mentionnée(s) / Le seguenti norme armonizzate sono state usate per soddisfare i requisiti della Direttiva (e) indicate.

EN 61326-1: 2013-01	**Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements**

In addition the following standards have been applied in the development of the product / Darüber hinaus wurde(n) folgende(n) Norm(en) bei der Entwicklung des Produktes angewendet / Además, durante el desarrollo del producto, se han aplicado las siguientes normas / En complément, les normes suivantes ont été utilisées pour le développement du produit / Inoltre, sono stati applicati i seguenti Standard nello sviluppo del prodotto.

EN 61010-1: 2010-10	**Safety requirements for electrical equipment – General requirements**
EN 60825-1: 2014-08	**Safety of laser products - Part 1: Equipment classification and requirements**

*) See separate Declaration of Conformity of the optional accessories / Siehe separate Konformitätserklärung für das optionale Zubehör / Ver la Declaración de Conformidad para los accesorios opcionales / Voir déclaration de conformité des accessoires optionnels / Vedi dichiarazione di conformità separata delle accessori opzionali.

Authorised Person to compile the technical file / Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen / Persona autorizada para elaborar el expediente técnico / Personne autorisée à constituer le dossier technique / Persona autorizzata a costituire il fascicolo tecnico:

Michael Schuster – Product Compliance EU - HACH LANGE GmbH; Willstätter Str.11; 40549 Düsseldorf

This statement applies to all versions of the named product, which are prepared by the necessary technical documentation / Diese Erklärung gilt für alle Ausführungen des genannten Produktes, die nach der erforderlichen technischen Dokumentation hergestellt werden / Esta declaración se aplica a todas las versiones del producto designado, que son preparadas por la documentación técnica necesaria / Cette déclaration s'applique à toutes les versions du produit mentionné / Questa dichiarazione si applica a tutte le versioni del prodotto indicato, che sono stati preparati dalla documentazione tecnica necessaria.

Year of primary CE marking of the product / Jahr der ersten CE Kennzeichnung des Produktes / Año de la primera marca CE del producto / Année du premier marquage CE du produit / Anno del primo prodotto CE: **2014**

LXC445.xx.x1xx2 Rev.03

Düsseldorf, 2016/May/11

ppa. _____
Director Operations ppa. Christian Kraatz

i.V. _____
CE Coordinator i.V. Michael Schuster

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Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Raw Turbity Meter WTP

Tag #: AIT - 601

Manufacturer		**Input**	
Make:	Hach	Voltage (V):	100 - 240
Model:	SC 200	Phase:	
Description		Frequency (Hz):	50/60
Serial #:	1708C015905	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:	4-20 mA	Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

4/- 20 mA 0 - 20 NTU

Date of Inspection:	08-12-2017
Inspected By:	Pierre-Luc Joyce
Signature:	

ISO 9001 Certified

CALIBRATION TEST CERTIFICATE
SC200 Controller

Model	Serial Number	Date	SW Ver	Result
LXV404.99.00552	1708C0159005	08/17/2017	2.04	PASS

Tested Characteristic	Min	Max	Value	
Probe Recognition			-	PASS
Display			-	PASS
Keypad			-	PASS
Relays			-	PASS
Dielectric Withstanding (Hipot)			-	PASS
4-20mA Output 1 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 1 @ 20mA	19.95	20.05	19.99mA	PASS
4-20mA Output 2 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 2 @ 20mA	19.95	20.05	19.98mA	PASS

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TU5300 sc

Certificate of Final Inspection

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Part No.	Gerätenummer, n°d'appareil	**LXG445.99.10112**
Serial No.	Seriennummer, numéro de série	***1762282***
Method Compliance		EPA
General Function	Allgemeine Funktion, fonction générale :	
SC Communication		ok
Lid Detection		ok
Humidity protection system		ok
RFID Function		N. A.
Factory Calibration	Werkskalibrierung, Etalonnage d'usine:	
StablCal® Calibration Curve	StablCal® Kalibrierung, StablCal® Courbe d'étalonnage	
20 NTU and 600 NTU	20 NTU und 600 NTU, 20 NTU et 600 NTU	ok
Turbidity Data	Trübungswerte, data turbidité:	
Secondary Turbidity Standard >20 NTU	Sekundär Trübungsstandard >20 NTU, Etalon secondaire de turbidité >20 NTU	
set number	Satznummer; set de contrôle	*0002*
Reference Instrument	Referenzgerät, instrument de référence	29.8 NTU
Tolerance	Toleranz, tolérance:	± 5 %
E.U.T	Prüfling, objet d'essai	**29.4 NTU**
Secondary Turbidity Standard <0.1 NTU	Sekundär Trübungsstandard <0.1 NTU, Etalon secondaire de turbidité <0.1 NTU	
set number	Satznummer; set de contrôle	*0141*
Reference Instrument	Referenzgerät, instrument de référence	0.011 NTU
Tolerance	Toleranz, tolérance:	± 0.007 NTU
E.U.T	Prüfling, objet d'essai	**0.011 NTU**
Date	Datum, date:	Oct 13, 2017
Inspector	Bearbeiter, opérateur:	*Marcel Fritzlar*
Sign	Unterschrift, signature :	

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P/N: LXG445.xx.xxxxx Model: TU 5300sc/TU5400sc

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
CPU PCB (TU) CPU PCB	x	O	O	O	O	O
Enclosure 机壳	x	O	O	O	O	O
Measuring Unit 测量单元	x	O	O	O	O	O
Sensorcable 传感器电缆	x	O	O	O	O	O
Pumps/Motors/Actuators 泵/电机/励磁器	x	O	O	O	O	O
Metal Tubing and Fittings 金属管和接头	x	O	O	O	O	O
Accessory 附件	x	O	O	O	O	O
Drying Cartridge 干燥筒	x	O	O	O	O	O

O：表示该项目中涉及的所有物料，其包含的有害物质的含量低于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572-2011).

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(indicates that the content of the toxic and hazardous substance in at least one Homogeneous Material of the part exceeds the concentration limit requirement as described in GB/T 26572-2011)

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This table shows where these substances may be found in the supply chain of "Company" electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product.

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HDQ927 Rev. 02

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EU-Declaration of Conformity

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Part Number/Artikelnummer/ Numéro de artículo/Numéro article/Codice articolo:	**Model**/Modell/ Modelo/Modèle/Modello:	**Designation**/Beschreibung/ Designación/Dèsignation/Denominazione:
LXG445.xx.x01x2 / LXG445.xx.x11x2	**TU5300 sc (EPA/ISO)**	**Turbidity sensor without RFID**
LXG445.xx.x02x2 / LXG445.xx.x12x2	**TU5400 sc (EPA/ISO)**	**Turbidity sensor without RFID**
Including optional accessories /inklusive optionales Zubehör/ Incluyendo accesorios opcionales / Incluant les accessoires optionnels / Compresi gli accessori opzionali:		*)

The product complies with the essential requirements of the following Directive(s) / Das bezeichnete Produkt entspricht den wesentlichen Anforderungen der nachfolgend bezeichneten Richtlinie(n) / El producto es conforme con los requisitos esenciales de la (s) siguientes Directiva (s) / Le produit est conforme aux exigences essentielles de la (des) Directive(s) suivante(s) / Il prodotto è conforme ai requisiti essenziali della seguente Direttiva (e).

2011/65/EU	**RoHS Directive**
2006/42/EC	**Machinery Directive**
2014/30/EU	**EMC Directive**

The following harmonized standards were used to meet the requirements of the stated Directive(s) / Die folgende(n) harmonisierte(n) Norm(en) wurde(n) zur Einhaltung der Anforderungen der genannten Richtlinie(n) angewendet / Para cumplir los requisitos de las directivas mencionadas se han aplicado las siguientes normas armonizadas / Les normes harmonisées suivantes ont été utilisées pour satisfaire aux exigences de la (des) Directive(s) mentionnée(s) / Le seguenti norme armonizzate sono state usate per soddisfare i requisiti della Direttiva (e) indicate.

EN 50581: 2012	**Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances**
EN 61326-1: 2013	**Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements**

In addition the following standards have been applied in the development of the product / Darüber hinaus wurde(n) folgende(n) Norm(en) bei der Entwicklung des Produktes angewendet / Además, durante el desarrollo del producto, se han aplicado las siguientes normas / En complément, les normes suivantes ont été utilisées pour le développement du produit / Inoltre, sono stati applicati i seguenti Standard nello sviluppo del prodotto.

EN 61010-1: 2010	**Safety requirements for electrical equipment – General requirements**
EN 60825-1: 2014	**Safety of laser products - Part 1: Equipment classification and requirements**

*) See separate Declaration of Conformity of the optional accessories / Siehe separate Konformitätserklärung für das optionale Zubehör / Ver la Declaración de Conformidad para los accesorios opcionales / Voir déclaration de conformité des accessoires optionnels / Vedi dichiarazione di conformità separata delle accessori opzionali.

Authorised Person to compile the technical file / Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen / Persona autorizada para elaborar el expediente técnico / Personne autorisée à constituer le dossier technique / Persona autorizzata a costituire il fascicolo tecnico:

Michael Schuster – Product Compliance EU - HACH LANGE GmbH; Willstätterstrasse 11; 40549 Düsseldorf

This statement applies to all versions of the named product, which are prepared by the necessary technical documentation / Diese Erklärung gilt für alle Ausführungen des genannten Produktes, die nach der erforderlichen technischen Dokumentation hergestellt werden / Esta declaración se aplica a todas las versiones del producto designado, que son preparadas por la documentación técnica necesaria / Cette déclaration s'applique à toutes les versions du produit mentionné / Questa dichiarazione si applica a tutte le versioni del prodotto indicato, che sono stati preparati dalla documentazione tecnica necessaria.

Year of primary CE marking of the product / Jahr der ersten CE Kennzeichnung des Produktes / Año de la primera marca CE del producto / Année du premier marquage CE du produit / Anno del primo prodotto CE: **2014**

Berlin, 2017/March/01

ppa.

Director Operations ppa. Christian Kraatz

i.V.

CE Coordinator i.V. Michael Schuster

LXG445.xx.x1xx2 Rev.04

Be Right™

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Pressur TRANSMITER RAW WATER - PIT 1001

Tag #: _____

Manufacturer		**Input**	
Make:	ENDRESS + HAUSER	Voltage (V):	11,5 ÷ 45 V DC
Model:	PMC 71 - 34538/101	Phase:	
Description		Frequency (Hz):	
Serial #:	MA037C1509C	Nominal Current (A):	4 ÷ 20 mA
Explosion Proof:	—	Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
/oltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

MWP- 2,7 MPa
4 ÷ 20 mA HART
SPAN - 0,01/1 MPa
CaL /Adj. - 0 ÷ 750 K Pa ← REAL SETTING
Ext. ord. cod - PMC71-XCC1PERDAAU+Z1
Mat. - AL203 1,4404/316L TYPE 4X/6P
P: -100 ÷ 1000 K Pa

Date of Inspection:	08/11/2017
Inspected By:	KRASIMIR MITREV
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: HydroFluorAsiLicic pump ACiD
Tag #: P-305

Manufacturer	LMI	**Input**	
Make:	ROYTRONIC EXCEL	Voltage (V):	95-240 VAC
Model:	AD941-920SI	Phase:	
Description		Frequency (Hz):	50/60 HZ
Serial #:	171143848 19-1	Nominal Current (A):	1.4 AMP
Explosion Proof:		Power (HP/W):	20 W
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

MAX Flow .50 GPH 250 PSI
1.89 L/H 17.237 BAR

ANALOG output: 4-20 mA = 0-120 SPM

Date of Inspection:	10-12-2017
Inspected By:	STEPHAN GAGNE
Signature:	

SIPEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: HYDROFluoRAsilicic pump ACID
Tag #: P-306

Manufacturer	LMI	**Input**	
Make:	ROYTRONIC EXCEL	Voltage (V):	95-240 VAC
Model:	AD941-920SI	Phase:	
Description		Frequency (Hz):	50/60 HZ
Serial #:	1711384819-2	Nominal Current (A):	1.4 Amp
Explosion Proof:		Power (HP/W):	20W
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

MAX Flow .50 GPH 250 PSI
1.89 l/H 17.237 BAR

ANALOG OUTPUT 4-20 mA = 0-120 SPM

Date of Inspection:	10-12-2017
Inspected By:	STEPHAN GAGNE
Signature:	Steph Gagné

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Cl2 GAS MONITOR WTP

Tag #:

Manufacturer	EVOQUA	**Input**	
Make:		Voltage (V):	10-15 - VDC 10-15 VDC
Model: KIT	W2T11692	Phase:	
Description		Frequency (Hz):	
Serial #:	A14-11-22701-HC	Nominal Current (A):	0-3 Amp
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	
RELAY	: 10A 120 VAC - 5A 250 VAC	OUTPUT	4-20 MA - 1000 ohm MAX

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Cl2 Monitor Module S/N A14-11-22701-HC
Cl2 TRANSMITTER S/N A-11-11-36259-OC
Cl2 SENSOR S/N A10-11-66685

Date of Inspection:	10-12-2017
Inspected By:	STEPHAN GAGNE
Signature:	

SIPEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711
Equipment: Soude caustique Pump - Microprocessor Dosing pump
Tag #: P-362

Manufacturer	LMI MILTON ROY	**Input**	
Make:		Voltage (V):	120 volts AC
Model:	B931-362SI	Phase:	
Description		Frequency (Hz):	50/60 HZ
Serial #:	171143848 24-2	Nominal Current (A):	1.50 Amp
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

MAX GPH 4.50
PSI 50

Date of Inspection:	10-12-2017
Inspected By:	STEPHAN GAGNE
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Soude Caustique Pump - Microprocessor Dosing pump

Tag #: P-363

Manufacturer	LMI MILTON ROY	**Input**	
Make:		Voltage (V):	120 Volts AC
Model:	B931-362SI	Phase:	
Description		Frequency (Hz):	50/60 HZ
Serial #:	17114384824-1	Nominal Current (A):	1.50 AMP
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

PSI - 50

MAX GPH - 4.50

Date of Inspection:	10-12-2017
Inspected By:	STEPHAN GAGNE
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves

Tag #: FCV - 1001

Manufacturer		**Input**	
Make:	Bray Serie 70	Voltage (V):	120
Model:	70-0121-11340-536	Phase:	
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17
Analog output 4@20Mah => open to close		Led Light Panphead	Nov 17

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service Raw Water
Torque 1200 lb/pi
Speed 30 sec / 1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	K Rasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves

Tag #: V-1012

Manufacturer		**Input**	
Make:	Bray Series 70	Voltage (V):	120
Model:	70-6651-113A0-536	Phase:	
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	3
Explosion Proof:		Power (HP/W):	8
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017
Digital output I:0		Led Light Replaced	Nov 2017

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service Raw Water OV
Torque 6500 lb-/pi
Speed 30 sec / 1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	KRASIMIR MITREV
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: V-1009

Manufacturer		**Input**	
Make:	Bray Serie 70	Voltage (V):	120
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017
Digital output open/close		Led ~~Switch~~ Light	Nov 2017

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service Raw Water UV
Torque 6500 lb-in
Speed 30 sec / 1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2101

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2.3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 KM
Digital output open/Close		Led Light installed	Nov 2017 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Raw Water filter 1
Torque: 6500 lb/pi
Speed: 30 sec / 1/4 Turn

Date of Inspection:	10-11-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2101

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2.3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KA
Digital output Open/Close		Led Light installed	Nov 17 KA

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: River water filter 2
Torque: 6500 lb/in
Speed: 30 sec/1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	KRASimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2121

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 RM
Digital output open/close		Led Light installed	Nov 17 RM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Raw water filter 3
Torque 6500 lbf/pi
speed 30 sec / 1/4 turn

Date of Inspection:	10-11-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuators

Tag #: FCV-2131

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-113AO-536	Phase:	
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KH
Digital output open/close		Led Light installed	Nov 17 KH

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Raw water filter 4
Torque: 6500 lb/in
Speed: 30 sec / 1/4 Turn

Date of Inspection:	10-11-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2103

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-021-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7 / 2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 RH
Analog output 4@20 Mah close to open		Led Light installed	Nov 17 KM

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 1 filtered water to Waste Tank
Torque : 1200 lb/pi
Speed : 30sec/1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2113

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0121-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7/2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KH
Analog output 4@20 mah = close to open		Led Light installed	Nov 17 KH

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 2 filtered water to Waste Tank
Torque: 1200 lb/in
speed: 30 sec / 1/4 turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2123

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0121-113A0-636	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7/2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Row 17 KM
analog output 4@20 mA => close to open		Led Light installed	Row 17 KM

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 3 Filtered Water to waste tank
Torque: 1200 lb-pi
Speed: 30 sec / 1/4 turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valves actuator

Tag #: FCV-2133

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120V
Model	70-0121-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7/2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KM
analog output 4 to 20mA => close to open		Led Light installed	Nov 17 KM

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 4 filtered Water to waste Tank
Torque: 1200 lb/pi
Speed: 30 sec/pi

Date of Inspection:	10-12-2017
Inspected By:	KRASIMIR MITREV
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Bray Control valve actuators

Tag #: FCV-2164

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0121-1130-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7 / 2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver		Limit Switch	Nov 17 KH
analog output 4 To 20mA = 7 close to open		Led Light installed	Nov 17 KH

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 1 filtered Water To Clearwell inlet chamber
Torque: 1200 lb/pi
Speed: 30 sec/pi

Date of Inspection:	10-11-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control valves actuator

Tag #: FCV-2114

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0121-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7/2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Raw 207 Km
analog output 4@20mA		Led Light installed	Raw 17 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 2 filtered water to clearwell inlet chamber
Torque: 1200 lb/pi
Speed: 30sec/¼ Turn

Date of Inspection:	10-12-2017
Inspected By:	K Rasmus Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray control valves actuator

Tag #: FCV-2124

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0121-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7/2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KM
analog output 4 to 20 mA => close to open		Led Light installed	Nov 17 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Filter 3 filtered water To clearwell intet Chamber
Torque : 1200 lbf/in
Speed : 30 sec/1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray control valve actuator

Tag #: FCV-2134

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0121-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0.7 / 2.1
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KM
Analog output 4 to 20 mA => close to open		Led light installed	Nov 17 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Filter 4 Filtered Water to clear well inlet Chamber
Torque : 1200 lb-in
Speed : 30 sec / 1/4 turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valve actuator

Tag #: FCV-2105

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-C651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2.3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 KM
analog output 4 To 20 mA => Close to open		Led Light installed	Nov 17 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Backwash water To Filter 1
Torque 6500 Lb/pi
Speed 30 sec / 1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	~~Ryan~~ Krasimir Mitrev
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray control Valve actuator

Tag #: FCV-2105

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-1130-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,3 / 3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov. 2017 KH
Digital output close/open		Led Light installed	Nov. 2017 K.H

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Backwash Water To Filter 2
Torque : 6500 lbf/in
Speed : 30 sec / 1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Hristev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valve actuator

Tag #: FCV -2125

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-1310-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2.3 / 3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 K.M.
Digital output open/close		Led Light installed	Nov 2017 K.M.

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Backwash Water To Filter 3
Torque : 6500 lb/in
Speed : 30 sec/¼ turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control valve actuator

Tag #: TCV-2106

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0451-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,3 / 3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 KM
Digital output open/close		Led Light Replaced	Nov 2017 KM

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Backwash waste Chanel Filter / To Waste storage Tank
Torque : 6500 Lbf/in
Speed : 30 sec/return

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valve actuator

Tag #: FCV-2116

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120V
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,3 / 3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 KM
Digital output open/close		Led Light Replaced	Nov 2017 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Filter 2 backwash waste channel to waste storage Tank
Torque: 6500 lb/pi
speed: 30 sec Turn 1/4

Date of Inspection:	10-11-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray control valve actuator

Tag #: FCV - 2126

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-11340-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 KH
Digital output open/close		Led Light replaced	Nov 2017 KH

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Filter 3 backwash waste channel To waste Storage Tank
Torque : 6500 lb/pi
Speed : 30 sec / 1/4 turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray control Valve actuator

Tag #: FCV-2136

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2.3 / 3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 KM
Digital Output open/close		Led light replaced	Nov 2017 KM

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Filter 4 backwash waste channel to waste storage Tank
Torque : 6600 lb/pi
Speed : 30 sec/1/4 Turn

Date of Inspection:	10-11-2017
Inspected By:	Krasimir Metrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valve actuator

Tag #: FCV-2135

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0651-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2.3/3
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 K.H.
digital output open/close		Led Light remplaced	Nov 17 K.H.

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Backwash Water To Filter 4
Torque : 6500 lb/in
Speed : 30 sec/turn

Date of Inspection:	10-13-2017
Inspected By:	KRASIMIR MITREV
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Bray Control Valve actuator

Tag #: FCV-2107

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-6051-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0,8
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 17 K.M.
Digital output open/close		Led light Remplaced	Nov 17 K.M.

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Backwash air To Filter 1

Torque : 500 lb-pi

Speed : 30 sec 1/4 Turn

Digital output On/off

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray control valve Actuator

Tag #: FCV-2117

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0051-1130-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0,8
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017
Digital output open/close		Led Light Reqplaced	Nov 2017

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Air Scour To Filter 2
Torque : 500 lb/in
Speed : 30 sec / 1/4 Turn
Digital output : I/O

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Bray Control Valve actuator

Tag #: FCV-2127

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0051-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0,8
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017
Digital output 1:0		Led Light Replacement	Nov 2017

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service: Air Scour To Filter 3
Torque: 500 lb/pi
Speed: 30 sec / 1/4 Turn
Digital Output 1:0

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711
Equipment: Bray Control Valve actuator
Tag #: FCV-2137

Manufacturer		**Input**	
Make:	Bray	Voltage (V):	120
Model:	70-0051-113A0-536	Phase:	1
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	0,8
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	Nov 2017 KH
Digital output 1:0		Led Light Replaced	Nov 2017 KH

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Service : Air steam to Filter 3
Torque : lbf/pi 500
Speed : 30 sec / 1/4 Turn

Date of Inspection:	10-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Service pump #1 (Pump)

Tag #: P-410

Manufacturer			
Make:		V):	
Model:			
Description		y (Hz):	
Serial #:		Current (A):	
Explosion Proof:		HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Franklin Electric
100JS5S6-PE MODEL/MODELE
94810003 ORDER NO./ NO. DECOMMANDE
SN 17M190100055P
Date Code 17M19
SUBMERSIBLE PUMP

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

3" FNPT

Date of Inspection:	17-12-17
Inspected By:	Pierre-Luc Lajoie
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Service pump #1 (Motor)

Tag #: P-410

Manufacturer		**Input**	
Make:	Franklin electric	Voltage (V):	575
Model:	2366209220	Phase:	3
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	6
Explosion Proof:		Power (HP/W):	5 HP
Dust-Ignition Proof:		RPM:	3450
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:	587 V	Current - Phase A:	5.8 A
oltage - Phase B or B-C:	587 V	Current - Phase B:	5.9 A
Voltage - Phase C or C-A:	584 V	Current - Phase C:	5.8 A
Megger Phase A or A-B:	0 MΩ / A - ∞	Rotation (CW, CCW):	V
Megger Phase B or B-C:	0 MΩ / B - ∞	RPM:	
Megger Phase C or C-A:	0 MΩ / C - ∞	Overload Set (A):	6.3 A

Inspection Comments & Recommendations

Date of Inspection:	12-12-2017
Inspected By:	KRASIMIR MITREV
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Zinc Orthophosphate dosing pump

Tag #: P-303

Manufacturer		**Input**	
Make:	LMI	Voltage (V):	
Model:		Phase:	
Description		Frequency (Hz):	
Serial #:		Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Date of Inspection:	
Inspected By:	
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Zinc Orthophosphate Dosing pump
Tag #: P-304

Manufacturer		**Input**	
Make:	LMI	Voltage (V):	
Model:		Phase:	
Description		Frequency (Hz):	
Serial #:		Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

Date of Inspection:	
Inspected By:	
Signature:	

SIFEC NORTH

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Exaust Fan Cl2 Room

Tag #: EF-03

Manufacturer		**Input**	
Make:	Twin City	Voltage (V):	
Model:	RBA - 909	Phase:	
Description		Frequency (Hz):	
Serial #:	17-594693-1-1	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	1695
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings			
Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

947 CFM
Total eff: 66%
Belt driven CCW

Date of Inspection:	11-12-2017
Inspected By:	Pierre-Luc Lagoie
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Exaust Fan Motor WTP

Tag #: EF-3

Manufacturer		**Input**	
Make:	WEG	Voltage (V):	575
Model:	0218ET3H145T-S	Phase:	3
Description		Frequency (Hz):	60
Serial #:		Nominal Current (A):	2,18
Explosion Proof:		Power (HP/W):	2 HP 1,5 KW
Dust-Ignition Proof:		RPM:	1745
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:		Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:	588 V	Current - Phase A:	1,71 A
Voltage - Phase B or B-C:	585 V	Current - Phase B:	1,74 A
Voltage - Phase C or C-A:	583 V	Current - Phase C:	1,78 A
Megger Phase A or A-B:	0 MΩ | A - ⏚ - ∞ MΩ	Rotation (CW, CCW):	CCW
Megger Phase B or B-C:	0 MΩ | B - ⏚ - ∞ MΩ	RPM:	
Megger Phase C or C-A:	0 MΩ | C - ⏚ - ∞ MΩ	Overload Set (A):	2,2 A

Inspection Comments & Recommendations

Nema nom eff. 86,5%

Date of Inspection:	12-12-2017
Inspected By:	Krasimir Mitrev
Signature:	

Inspection Report

Project Name : Iqaluit W&WW Facilities
Project #: SC711

Equipment: Turbidity Meter (Filter -4)

Tag #: AIT - 2132

Manufacturer		**Input**	
Make:	HACH	Voltage (V):	100-240 VAC +/- 10%, 50/60 Hz
Model:	sc200	Phase:	
Description		Frequency (Hz):	
Serial #:	1708C0159009	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter:		Sensor	
Transmitter to Receiver:	4 to 20 mA	Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

4 - 20 mA

0 - 20 NTU

Date of Inspection:	08-12-2017
Inspected By:	Pierre-Luc Lajoie
Signature:	

ISO 9001 Certified

CALIBRATION TEST CERTIFICATE
SC200 Controller

Model	Serial Number	Date	SW Ver	Result
LXV404.99.00552	1708C0159009	08/17/2017	2.04	PASS

Tested Characteristic	Min	Max	Value	
Probe Recognition			-	PASS
Display			-	PASS
Keypad			-	PASS
Relays			-	PASS
Dielectric Withstanding (Hipot)			-	PASS
4-20mA Output 1 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 1 @ 20mA	19.95	20.05	19.99mA	PASS
4-20mA Output 2 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 2 @ 20mA	19.95	20.05	19.99mA	PASS

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FILTER #4

ISO 9001 Certified

TU5300 sc

Certificate of Final Inspection

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Part No.	Gerätenummer, n°d'appareil	**LXG445.99.10112**
Serial No.	Seriennummer, numéro de série	***1762753***
Method Compliance		EPA
General Function	Allgemeine Funktion, fonction générale :	
SC Communication		ok
Lid Detection		ok
Humidity protection system		ok
RFID Function		N. A.
Factory Calibration	Werkskalibrierung, Etalonnage d'usine:	
StablCal® Calibration Curve	StablCal® Kalibrierung, StablCal® Courbe d'étalonnage	
20 NTU and 600 NTU	20 NTU und 600 NTU, 20 NTU et 600 NTU	ok
Turbidity Data	Trübungswerte, data turbidité:	
Secondary Turbidity Standard >20 NTU	Sekundär Trübungsstandard >20 NTU, Etalon secondaire de turbidité >20 NTU	
set number	Satznummer; set de contrôle	*0001*
Reference Instrument	Referenzgerät, instrument de référence	29.5 NTU
Tolerance	Toleranz, tolérance:	± 5 %
E.U.T	Prüfling, objet d'essai	**28.8 NTU**
Secondary Turbidity Standard <0.1 NTU	Sekundär Trübungsstandard <0.1 NTU, Etalon secondaire de turbidité <0.1 NTU	
set number	Satznummer; set de contrôle	*0154*
Reference Instrument	Referenzgerät, instrument de référence	0.012 NTU
Tolerance	Toleranz, tolérance:	± 0.007 NTU
E.U.T	Prüfling, objet d'essai	**0.011 NTU**
Date	Datum, date:	Oct 16, 2017
Inspector	Bearbeiter, opérateur:	*Barbara Bohnig*
Sign	Unterschrift, signature :	B Bohnig

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This document contains information which is only required for the export of this instrument into the People's Republic of China.

Ce document contient les informations nécessaires pour l'exportation d'instruments vers la République Populaire de Chine.

本手册只包含出口到中华人民共和国的仪器的必要信息。

P/N: LXG445.xx.xxxxx Model: TU 5300sc/TU5400sc

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
CPU PCB (TU) CPU PCB	x	O	O	O	O	O
Enclosure 机壳	x	O	O	O	O	O
Measuring Unit 测量单元	x	O	O	O	O	O
Sensorcable 传感器电缆	x	O	O	O	O	O
Pumps/Motors/Actuators 泵/电机/励磁器	x	O	O	O	O	O
Metal Tubing and Fittings 金属管和接头	x	O	O	O	O	O
Accessory 附件	x	O	O	O	O	O
Drying Cartridge 干燥筒	x	O	O	O	O	O

○：表示该项目中涉及的所有物料，其包含的有害物质的含量低于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572-2011).

×：表示该项目中涉及的所有物料中至少有一种，其包含的有害物质的含量高于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in at least one Homogeneous Material of the part exceeds the concentration limit requirement as described in GB/T 26572-2011)

对销售之日的所售产品，本表显示，朗讯供应链的电子信息产品可能包含这些物质。注意：在所售产品中可能会也可能不会含有所有所列的部件
This table shows where these substances may be found in the supply chain of "Company" electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product.

除非另外特别的标注，此标志为针对所涉及产品的环保使用期标志. 某些可更换的零部件会有一个不同的环保使用期(例如，电池单元模块)贴在其产品上.
此环保使用期限只适用于产品是在产品手册中所规定的条件下工作.
The Environmentally Friendly Use Period (EFUP) for all enclosed products and their parts are per the symbol shown here, unless otherwise marked. Certain field-replaceable parts have a different EFUP (for example, battery modules) and so are marked to reflect such. The Environmentally Friendly Use Period is valid only when the product is operated under the conditions defined in the product manual.

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EU-Konformitätserklärung / UE-Declaración de conformidad / UE- Déclaration de Conformité / UE-Dichiarazione di Conformità

Manufacturer/Hersteller/Fabricante/Fabricant/Produttore:

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Part Number/Artikelnummer/ Numéro de artículo/Numéro article/Codice articolo:	**Model**/Modell/ Modelo/Modèle/Modello:	**Designation**/Beschreibung/ Designación/Désignation/Denominazione:
LXG445.xx.x01x2 / LXG445.xx.x11x2	**TU5300 sc (EPA/ISO)**	**Turbidity sensor without RFID**
LXG445.xx.x02x2 / LXG445.xx.x12x2	**TU5400 sc (EPA/ISO)**	**Turbidity sensor without RFID**
Including optional accessories /inklusive optionales Zubehör/ Incluyendo accesorios opcionales / Incluant les accessoires optionnels / Compresi gli accessori opzionali:		*)

The product complies with the essential requirements of the following Directive(s) / Das bezeichnete Produkt entspricht den wesentlichen Anforderungen der nachfolgend bezeichneten Richtlinie(n) / El producto es conforme con los requisitos esenciales de la (s) siguientes Directiva (s) / Le produit est conforme aux exigences essentielles de la (des) Directive(s) suivante(s) / Il prodotto è conforme ai requisiti essenziali della seguente Direttiva (e).

2011/65/EU	**RoHS Directive**
2006/42/EC	**Machinery Directive**
2014/30/EU	**EMC Directive**

The following harmonized standards were used to meet the requirements of the stated Directive(s) / Die folgende(n) harmonisierte(n) Norm(en) wurde(n) zur Einhaltung der Anforderungen der genannten Richtlinie(n) angewendet / Para cumplir los requisitos de las directivas mencionadas se han aplicado las siguientes normas armonizadas / Les normes harmonisées suivantes ont été utilisées pour satisfaire aux exigences de la (des) Directive(s) mentionnée(s) / Le seguenti norme armonizzate sono state usate per soddisfare i requisiti della Direttiva (e) indicate.

EN 50581: 2012	**Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances**
EN 61326-1: 2013	**Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements**

In addition the following standards have been applied in the development of the product / Darüber hinaus wurde(n) folgende(n) Norm(en) bei der Entwicklung des Produktes angewendet / Además, durante el desarrollo del producto, se han aplicado las siguientes normas / En complément, les normes suivantes ont été utilisées pour le développement du produit / Inoltre, sono stati applicati i seguenti Standard nello sviluppo del prodotto.

EN 61010-1: 2010	**Safety requirements for electrical equipment – General requirements**
EN 60825-1: 2014	**Safety of laser products - Part 1: Equipment classification and requirements**

*) See separate Declaration of Conformity of the optional accessories / Siehe separate Konformitätserklärung für das optionale Zubehör / Ver la Declaración de Conformidad para los accesorios opcionales / Voir déclaration de conformité des accessoires optionnels / Vedi dichiarazione di conformità separata delle accessori opzionali.

Authorised Person to compile the technical file / Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen / Persona autorizada para elaborar el expediente técnico / Personne autorisée à constituer le dossier technique / Persona autorizzata a costituire il fascicolo tecnico:

Michael Schuster – Product Compliance EU - HACH LANGE GmbH; Willstätterstrasse 11; 40549 Düsseldorf

This statement applies to all versions of the named product, which are prepared by the necessary technical documentation / Diese Erklärung gilt für alle Ausführungen des genannten Produktes, die nach der erforderlichen technischen Dokumentation hergestellt werden / Esta declaración se aplica a todas las versiones del producto designado, que son preparadas por la documentación técnica necesaria / Cette déclaration s'applique à toutes les versions du produit mentionné / Questa dichiarazione si applica a tutte le versioni del prodotto indicato, che sono stati preparati dalla documentazione tecnica necessaria.

Year of primary CE marking of the product / Jahr der ersten CE Kennzeichnung des Produktes / Año de la primera marca CE del producto / Année du premier marquage CE du produit / Anno del primo prodotto CE: **2014**

Berlin, 2017/March/01

ppa.
Director Operations ppa. Christian Kraatz

i.V.
CE Coordinator i.V. Michael Schuster

LXG445.xx.x1xx2 Rev.04

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Inspection Report

Project Name : Iqaluit W&WW Facilities

Project #: SC711

Equipment: Turbidity Meter Filter-3

Tag #: AIT-2122

Manufacturer		**Input**	
Make:	HACH	Voltage (V):	100-240V AC
Model:	sc200	Phase:	
Description		Frequency (Hz):	50/60Hz (+/- 10%)
Serial #:	1610C0146753	Nominal Current (A):	
Explosion Proof:		Power (HP/W):	
Dust-Ignition Proof:		RPM:	
Control Loop Check		**Calibration**	
Element to Transmitter		Sensor	
Transmitter to Receiver	4 to 20 mA	Limit Switch	

Run Sheet Readings

Voltage - Phase A or A-B:		Current - Phase A:	
Voltage - Phase B or B-C:		Current - Phase B:	
Voltage - Phase C or C-A:		Current - Phase C:	
Megger Phase A or A-B:		Rotation (CW, CCW):	
Megger Phase B or B-C:		RPM:	
Megger Phase C or C-A:		Overload Set (A):	

Inspection Comments & Recommendations

4 - 20 mA
0 - 20 NTU

Date of Inspection:	08-11-2014
Inspected By:	
Signature:	

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CALIBRATION TEST CERTIFICATE
SC200 Controller

Model	Serial Number	Date	SW Ver	Result
LXV404.99.00552	1610C0146753	10/10/2016	2.01	PASS

Tested Characteristic	Min	Max	Value	
Probe Recognition			-	PASS
Display			-	PASS
Keypad			-	PASS
Relays			-	PASS
Dielectric Withstanding (Hipot)			-	PASS
4-20mA Output 1 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 1 @ 20mA	19.95	20.05	19.98mA	PASS
4-20mA Output 2 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 2 @ 20mA	19.95	20.05	20.00mA	PASS

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Filter 3

ISO 9001 Certified

TU5300 sc

Certificate of Final Inspection

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Part No.	Gerätenummer, n°d'appareil	**LXG445.99.10112**
Serial No.	Seriennummer, numéro de série	***1694186***
Method Compliance		EPA
General Function	Allgemeine Funktion, fonction générale :	
SC Communication		ok
Lid Detection		ok
Humidity protection system		ok
RFID Function		N. A.
Factory Calibration	Werkskalibrierung, Etalonnage d'usine:	
StablCal® Calibration Curve	StablCal® Kalibrierung, StablCal® Courbe d'étalonnage	
20 NTU and 600 NTU	20 NTU und 600 NTU, 20 NTU et 600 NTU	ok
Turbidity Data	Trübungswerte, data turbidité:	
Secondary Turbidity Standard >20 NTU	Sekundär Trübungsstandard >20 NTU, Etalon secondaire de turbidité >20 NTU	
set number	Satznummer; set de contrôle	*0001*
Reference Instrument	Referenzgerät, instrument de référence	29.3 NTU
Tolerance	Toleranz, tolérance:	± 5 %
E.U.T	Prüfling, objet d'essai	**30.4 NTU**
Secondary Turbidity Standard <0.1 NTU	Sekundär Trübungsstandard <0.1 NTU, Etalon secondaire de turbidité <0.1 NTU	
set number	Satznummer; set de contrôle	*0035*
Reference Instrument	Referenzgerät, instrument de référence	0.012 NTU
Tolerance	Toleranz, tolérance:	± 0.007 NTU
E.U.T	Prüfling, objet d'essai	**0.011 NTU**
Date	Datum, date:	Oct 25, 2016
Inspector	Bearbeiter, opérateur:	*Rene Zabel*
Sign	Unterschrift, signature :	Rene Zabel

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P/N: LXG445.xx.xxxxx Model: TU 5300sc/TU5400sc

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
CPU PCB (TU) CPU PCB	x	O	O	O	O	O
Enclosure 机壳	x	O	O	O	O	O
Measuring Unit 测量单元	x	O	O	O	O	O
Sensorcable 传感器电缆	x	O	O	O	O	O
Pumps/Motors/Actuators 泵/电机/励磁器	x	O	O	O	O	O
Metal Tubing and Fittings 金属管和接头	x	O	O	O	O	O
Accessory 附件	x	O	O	O	O	O
Drying Cartridge 干燥筒	x	O	O	O	O	O

○：表示该项目中涉及的所有物料，其包含的有害物质的含量低于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572-2011).

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(indicates that the content of the toxic and hazardous substance in at least one Homogeneous Material of the part exceeds the concentration limit requirement as described in GB/T 26572-2011)

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This table shows where these substances may be found in the supply chain of "Company" electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product.

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此环保使用期限只适用于产品是在产品手册中所规定的条件下工作.
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HDQ927 Rev. 02

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HACH LANGE GmbH, Königsweg 10, 14163 Berlin; Germany – Tel. +49 (0)30-80986-0 - **www.de.hach.com**

Part Number/Artikelnummer/ Numéro de articulo/Numéro article/Codice articolo:	**Model**/Modell/ Modelo/Modèle/Modello:	**Designation**/Beschreibung/ Designación/Désignation/Denominazione:
LXG445.xx.x01x2 / LXG445.xx.x11x2	**TU5300 sc (EPA/ISO)**	**Turbidity sensor without RFID** (3.0mNTU)
LXG445.xx.x02x2 / LXG445.xx.x12x2	**TU5400 sc (EPA/ISO)**	**Turbidity sensor without RFID** (0.3mNTU)
Including optional accessories /inklusive optionales Zubehör/ Incluyendo accesorios opcionales / Incluant les accessoires optionnels / Compresi gli accessori opzionali:		*)

The product complies with the essential requirements of the following Directive(s) / Das bezeichnete Produkt entspricht den wesentlichen Anforderungen der nachfolgend bezeichneten Richtlinie(n) / El producto es conforme con los requisitos esenciales de la (s) siguientes Directiva (s) / Le produit est conforme aux exigences essentielles de la (des) Directive(s) suivante(s) / Il prodotto è conforme ai requisiti essenziali della seguente Direttiva (e).

2014/30/EU	**EMC Directive**
2006/42/EC	**Machinery Directive**

The following harmonized standards were used to meet the requirements of the stated Directive(s) / Die folgende(n) harmonisierte(n) Norm(en) wurde(n) zur Einhaltung der Anforderungen der genannten Richtlinie(n) angewendet / Para cumplir los requisitos de las directivas mencionadas se han aplicado las siguientes normas armonizadas / Les normes harmonisées suivantes ont été utilisées pour satisfaire aux exigences de la (des) Directive(s) mentionnée(s) / Le seguenti norme armonizzate sono state usate per soddisfare i requisiti della Direttiva (e) indicate.

EN 61326-1: 2013-01	**Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements**

In addition the following standards have been applied in the development of the product / Darüber hinaus wurde(n) folgende(n) Norm(en) bei der Entwicklung des Produktes angewendet / Además, durante el desarrollo del producto, se han aplicado las siguientes normas / En complément, les normes suivantes ont été utilisées pour le développement du produit / Inoltre, sono stati applicati i seguenti Standard nello sviluppo del prodotto.

EN 61010-1: 2010-10	**Safety requirements for electrical equipment – General requirements**
EN 60825-1: 2014-08	**Safety of laser products - Part 1: Equipment classification and requirements**

*) See separate Declaration of Conformity of the optional accessories / Siehe separate Konformitätserklärung für das optionale Zubehör / Ver la Declaración de Conformidad para los accesorios opcionales / Voir déclaration de conformité des accessoires optionnels / Vedi dichiarazione di conformità separata delle accessori opzionali.

Authorised Person to compile the technical file / Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen / Persona autorizada para elaborar el expediente técnico / Personne autorisée à constituer le dossier technique / Persona autorizzata a costituire il fascicolo tecnico:

Michael Schuster – Product Compliance EU - HACH LANGE GmbH; Willstätter Str.11; 40549 Düsseldorf

This statement applies to all versions of the named product, which are prepared by the necessary technical documentation / Diese Erklärung gilt für alle Ausführungen des genannten Produktes, die nach der erforderlichen technischen Dokumentation hergestellt werden / Esta declaración se aplica a todas las versiones del producto designado, que son preparadas por la documentación técnica necesaria / Cette déclaration s'applique à toutes les versions du produit mentionné / Questa dichiarazione si applica a tutte le versioni del prodotto indicato, che sono stati preparati dalla documentazione tecnica necessaria.

Year of primary CE marking of the product / Jahr der ersten CE Kennzeichnung des Produktes / Año de la primera marca CE del producto / Année du premier marquage CE du produit / Anno del primo prodotto CE: **2014**

LXC445.xx.x1x2 Rev.03

Düsseldorf, 2016/May/11

ppa. _____
Director Operations ppa. Christian Kraatz

i.V. _____
CE Coordinator i.V. Michael Schuster

HACH®
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ISO 9001 Certified

CALIBRATION TEST CERTIFICATE
SC200 Controller

Model	Serial Number	Date	SW Ver	Result
LXV404.99.00552	1610C0138341	10/10/2016	2.01	PASS

Tested Characteristic	Min	Max	Value	
Probe Recognition			-	PASS
Display			-	PASS
Keypad			-	PASS
Relays			-	PASS
Dielectric Withstanding (Hipot)			-	PASS
4-20mA Output 1 @ 4mA	3.98	4.02	4.00mA	PASS
4-20mA Output 1 @ 20mA	19.95	20.05	20.00mA	PASS
4-20mA Output 2 @ 4mA	3.98	4.02	3.99mA	PASS
4-20mA Output 2 @ 20mA	19.95	20.05	19.98mA	PASS

Test Equipment used for the verification of Hach manufactured instruments is calibrated using standards traceable to the National Institute of Standards and Technology (NIST).

For Technical Service, Price Information and Ordering in the U.S.A. call toll-free 1-800-227-4224. Outside the U.S.A. contact the Hach Office or Distributor serving you. On the Worldwide Web visit www.hach.com; E-mail: techhelp@hach.com

ISO 9001 Certified

TU5300 sc

Certificate of Final Inspection

HACH®

Be Right™

Part No.	Gerätenummer, n°d'appareil	**LXG445.99.10112**
Serial No.	Seriennummer, numéro de série	***1694357***
Method Compliance		EPA
General Function	Allgemeine Funktion, fonction générale :	
SC Communication		ok
Lid Detection		ok
Humidity protection system		ok
RFID Function		N. A.
Factory Calibration	Werkskalibrierung, Etalonnage d'usine:	
StablCal® Calibration Curve	StablCal® Kalibrierung, StablCal® Courbe d'étalonnage	
20 NTU and 600 NTU	20 NTU und 600 NTU, 20 NTU et 600 NTU	ok
Turbidity Data	Trübungswerte, data turbidité:	
Secondary Turbidity Standard >20 NTU	Sekundär Trübungsstandard >20 NTU, Etalon secondaire de turbidité >20 NTU	
set number	Satznummer; set de contrôle	*0001*
Reference Instrument	Referenzgerät, instrument de référence	29.3 NTU
Tolerance	Toleranz, tolérance:	± 5 %
E.U.T	Prüfling, objet d'essai	**30.5 NTU**
Secondary Turbidity Standard <0.1 NTU	Sekundär Trübungsstandard <0.1 NTU, Etalon secondaire de turbidité <0.1 NTU	
set number	Satznummer; set de contrôle	*0035*
Reference Instrument	Referenzgerät, instrument de référence	0.012 NTU
Tolerance	Toleranz, tolérance:	± 0.007 NTU
E.U.T	Prüfling, objet d'essai	**0.011 NTU**
Date	Datum, date:	Oct 26, 2016
Inspector	Bearbeiter, opérateur:	*Rene Zabel*
Sign	Unterschrift, signature :	Rene Zabel

Please add this certificate to your documents.

Bitte verwahren Sie dieses Zertifikat bei Ihren Unterlagen auf.

S'il vous plaît, conservez scrupuleusement ce certificat dans vos archives.

Dieses Informationsblatt enthält Angaben, die ausschließlich für den Export dieses Gerätes in die Volksrepublik China erforderlich sind.

This document contains information which is only required for the export of this instrument into the People's Republic of China.

Ce document contient les informations nécessaires pour l'exportation d'instruments vers la République Populaire de Chine.

本手册只包含出口到中华人民共和国的仪器的必要信息。

P/N: LXG445.xx.xxxxx Model: TU 5300sc/TU5400sc

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
CPU PCB (TU) CPU PCB	x	O	O	O	O	O
Enclosure 机壳	x	O	O	O	O	O
Measuring Unit 测量单元	x	O	O	O	O	O
Sensorcable 传感器电缆	x	O	O	O	O	O
Pumps/Motors/Actuators 泵/电机/励磁器	x	O	O	O	O	O
Metal Tubing and Fittings 金属管和接头	x	O	O	O	O	O
Accessory 附件	x	O	O	O	O	O
Drying Cartridge 干燥筒	x	O	O	O	O	O

○：表示该项目中涉及的所有物料，其包含的有害物质的含量低于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572-2011).

×：表示该项目中涉及的所有物料中至少有一种，其包含的有害物质的含量高于 GB/T 26572-2011. 标准的限制要求
(indicates that the content of the toxic and hazardous substance in at least one Homogeneous Material of the part exceeds the concentration limit requirement as described in GB/T 26572-2011)

对销售之日的所售产品，本表显示，朗讯供应链的电子信息产品可能包含这些物质。注意：在所售产品中可能会也可能不会含有所有所列的部件
This table shows where these substances may be found in the supply chain of "Company" electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product.

除非另外特别的标注，此标志为针对所涉及产品的环保使用期标志. 某些可更换的零部件会有一个不同的环保使用期(例如，电池单元模块)贴在其产品上.
此环保使用期限只适用于产品是在产品手册中所规定的条件下工作.
The Environmentally Friendly Use Period (EFUP) for all enclosed products and their parts are per the symbol shown here, unless otherwise marked. Certain field-replaceable parts have a different EFUP (for example, battery modules) and so are marked to reflect such. The Environmentally Friendly Use Period is valid only when the product is operated under the conditions defined in the product manual.

HDQ927 Rev. 02

EUROPE:
HACH LANGE GMBH • Willstätterstraße 11 • D-40549 Düsseldorf • Germany • Phone +49(0)211-5288-0 • Fax +49(0)211-5288-143 • info-de@hach.com
USA and Rest of World:
Hach Company • P.O. Box 389 • Loveland • Colorado • 80539-0389 • USA • Tel 800-227-4224 • Fax: 970-669-2932 • techhelp@hach.com

EC-Declaration of Conformity

EG-Konformitätserklärung / CE-Declaración de conformidad / CE- Déclaration de Conformité / CE-Dichiarazione di Conformità

Manufacturer/Hersteller/Fabricante/Fabricant/Produttore:

HACH LANGE GmbH, Königsweg 10, 14163 Berlin; Germany – Tel. +49 (0)30-80986-0 - **www.de.hach.com**

Part Number/Artikelnummer/ Numéro de artículo/Numéro article/Codice articolo:	**Model**/Modell/ Modelo/Modèle/Modello:	**Designation**/Beschreibung/ Designación/Désignation/Denominazione:
LXG445.xx.x01x2 / LXG445.xx.x11x2	**TU5300 sc (EPA/ISO)**	**Turbidity sensor without RFID** (3.0mNTU)
LXG445.xx.x02x2 / LXG445.xx.x12x2	**TU5400 sc (EPA/ISO)**	**Turbidity sensor without RFID** (0.3mNTU)
Including optional accessories /inklusive optionales Zubehör/ Incluyendo accesorios opcionales / Incluant les accessoires optionnels / Compresi gli accessori opzionali:		*)

The product complies with the essential requirements of the following Directive(s) / Das bezeichnete Produkt entspricht den wesentlichen Anforderungen der nachfolgend bezeichneten Richtlinie(n) / El producto es conforme con los requisitos esenciales de la (s) siguientes Directiva (s) / Le produit est conforme aux exigences essentielles de la (des) Directive(s) suivante(s) / Il prodotto è conforme ai requisiti essenziali della seguente Direttiva (e).

2014/30/EU	**EMC Directive**
2006/42/EC	**Machinery Directive**

The following harmonized standards were used to meet the requirements of the stated Directive(s) / Die folgende(n) harmonisierte(n) Norm(en) wurde(n) zur Einhaltung der Anforderungen der genannten Richtlinie(n) angewendet / Para cumplir los requisitos de las directivas mencionadas se han aplicado las siguientes normas armonizadas / Les normes harmonisées suivantes ont été utilisées pour satisfaire aux exigences de la (des) Directive(s) mentionnée(s) / Le seguenti norme armonizzate sono state usate per soddisfare i requisiti della Direttiva (e) indicate.

EN 61326-1: 2013-01	**Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements**

In addition the following standards have been applied in the development of the product / Darüber hinaus wurde(n) folgende(n) Norm(en) bei der Entwicklung des Produktes angewendet / Además, durante el desarrollo del producto, se han aplicado las siguientes normas / En complément, les normes suivantes ont été utilisées pour le développement du produit / Inoltre, sono stati applicati i seguenti Standard nello sviluppo del prodotto.

EN 61010-1: 2010-10	**Safety requirements for electrical equipment – General requirements**
EN 60825-1: 2014-08	**Safety of laser products - Part 1: Equipment classification and requirements**

*) See separate Declaration of Conformity of the optional accessories / Siehe separate Konformitätserklärung für das optionale Zubehör / Ver la Declaración de Conformidad para los accesorios opcionales / Voir déclaration de conformité des accessoires optionnels / Vedi dichiarazione di conformità separata delle accessori opzionali.

Authorised Person to compile the technical file / Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen / Persona autorizada para elaborar el expediente técnico / Personne autorisée à constituer le dossier technique / Persona autorizzata a costituire il fascicolo tecnico:

Michael Schuster – Product Compliance EU - HACH LANGE GmbH; Willstätter Str.11; 40549 Düsseldorf

This statement applies to all versions of the named product, which are prepared by the necessary technical documentation / Diese Erklärung gilt für alle Ausführungen des genannten Produktes, die nach der erforderlichen technischen Dokumentation hergestellt werden / Esta declaración se aplica a todas las versiones del producto designado, que son preparadas por la documentación técnica necesaria / Cette déclaration s'applique à toutes les versions du produit mentionné / Questa dichiarazione si applica a tutte le versioni del prodotto indicato, che sono stati preparati dalla documentazione tecnica necessaria.

Year of primary CE marking of the product / Jahr der ersten CE Kennzeichnung des Produktes / Año de la primera marca CE del producto / Année du premier marquage CE du produit / Anno del primo prodotto CE: **2014**

LXC445.xx.x1x2 Rev.03

Düsseldorf, 2016/May/11

ppa. _____
Director Operations ppa. Christian Kraatz

i.V. _____
CE Coordinator i.V. Michael Schuster

HACH®
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CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Turbidity Meter WTP

TAG NO: Ait-1001, Ait-2102, Ait-2112, Ait-2122, Ait-2132

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

Georges Jean Tanoé — 15-12-2017
CONTRACTOR'S REPRESENTATIVE — DATE

A. Cook — 14 Dec 2017
ENGINEER — DATE

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl/PH Meter WTP

TAG NO: Ait-1001, Ait-2501/2502

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

Terry-Lee Jones — 15-11-2017
CONTRACTOR'S REPRESENTATIVE — DATE

D. Cook — 4 Dec, 2017
ENGINEER — DATE

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Meter (Reservoir)

TAG NO: A,T-5000

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Switch CL WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

Pierre-Luc Tessier — 15-11-2017

CONTRACTOR'S REPRESENTATIVE — DATE

D. Cook — 14 Dec 2017

ENGINEER — DATE

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Bray controle Valve actuator WTP

TAG NO: All WTP Control Valves

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 10/12/2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Soude caustique pump
Microprocessor Dosing pump x 2 WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 9-10-2017

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl_2 GAS MONITOR WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

STEPHAN GAGNE

CONTRACTOR'S REPRESENTATIVE — DATE 10-12-2017

D. Cook

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Hydrofluorasilicic Acid Pump X2 WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 8-12-2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Zinc Orthophosphate Dosing pump

TAG NO: P-303, P-304

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE _____ DATE _____

CONTRACTOR'S REPRESENTATIVE _____ DATE _____

D. Ceah
ENGINEER

14 Dec, 2017
DATE

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan Cl_2 Room WTP

TAG NO: EF-3

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 11-12-2017

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Pressure Transmitter Raw Water WTP

TAG NO: PT-1001

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 30-11-2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

The undersigned certifies that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Service pump #1

TAG NO: P-100

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 12-17-2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Turbidity Meter WTP

TAG NO: Ait-1001, Ait-2102, Ait-2112, Ait-2132, Ait-2122

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: CL/PH Meter WTP

TAG NO: A.i.t-1001, A.i.t-2501/2502

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 13, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Meter (Reservoir)

TAG NO: A.T - 5001

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 13, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Switch CL WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 13, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Bray Control Valve actuator

TAG NO: All WTP Control valve actuators

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: 50UDE caustique pump
Microprocessor Dosing pump x2 WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 9-10-2017

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl2 GAS MONITOR WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Hydrofluorasilicic Acid Pump x2
WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 8-12-2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Zinc Orthophosphate dosing pump

TAG NO: P-303, P304

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE

D. Cook — 14 Dec, 2017

ENGINEER — DATE

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan Cl_2 Room WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: DEC 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Pressure Transmitter Raw Water WTP

TAG NO: PIT-1001

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104

The undersigned has certifies that the equipment listed below has been operated and tested as per the Specifications using process water and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Service pump P-401

TAG NO: P-401

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Turbidity Meter WTP

TAG NO: Ait-1001, Ait-2102, Ait-2112, Ait-2122, Ait-2132

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 9, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl2/pH Meter WTP

TAG NO: Ait-1001, Ait-2501/2502

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 6, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Meter (Reservoir)

TAG NO: Ait-5000

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 08-12-2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Switch CL WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Bray Control Valve actuator WTP

TAG NO: All WTP Control valve actuators

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 14, 2017

ENGINEER — DATE: 14. Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: SOUDE CAUSTIQUE PUMP Microprocessor DOSING PUMP x2 WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 9-10-2017

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl2 Gas Monitor WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 13, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Hydrofluorasilicic Acid Pump x2
WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 8-12-2017

ENGINEER — DATE: 14 Dec 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Zinc Orthophosphate Dosing pump

TAG NO: P-303, P304

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE

W. Coade — 14 Dec, 2017

ENGINEER — DATE

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan CL_2 Room

TAG NO: EF-3

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE	DATE
CONTRACTOR'S REPRESENTATIVE	Dec 12, 2017 DATE
ENGINEER	14 Dec, 2017 DATE

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Pressure Transmitter Low Water WTP

TAG NO: P.T- 1001

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 1, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT PERFORMANCE
FORM 103

The undersigned certifies that the equipment listed below has been continuously operated for the time period specified and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Service Pump #1 WTP

TAG NO: P-410

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14, Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: CL/pH Meter WTP

TAG NO: Ait-1001, Ait-2501/2502

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE	DATE
CONTRACTOR'S REPRESENTATIVE	Dec 10, 2017 DATE
D. Cook ENGINEER	14 Dec. 2017 DATE

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Meter (Reservoir)

TAG NO: A,T-5000

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE	DATE
CONTRACTOR'S REPRESENTATIVE	Dec 10, 2017 DATE
ENGINEER	08-12-2017 DATE
D. Cook	14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Switch CL WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

Pierre-Luc Fajoie — CONTRACTOR'S REPRESENTATIVE

08-12-2017 — DATE

D. Cook — ENGINEER

14 Dec, 2017 — DATE

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Bray control valves actuator

TAG NO: All WTP Control Valve Actuators

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: SOUDE caustique Pump Microprocessor Dosing pump x2 WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 9-10-2017

ENGINEER — DATE 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl_2 GAS MONITOR @ WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 11, 2017

ENGINEER — DATE: 14 Dec 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Hydrofluorasilicic Acid Pump x2
WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 8-12-2017

ENGINEER — DATE: 14, Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Zinc Orthophosphate dosing pump

TAG NO: P-303, P-304

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE _____ DATE _____

CONTRACTOR'S REPRESENTATIVE _____ DATE _____

D. Cook
ENGINEER

14 Dec, 2017
DATE

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Turbidity Meter WTP

TAG NO: Ait-1001, Ait-2102, Ait-2112 Ait-2122, Ait-2132

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: 8-12-2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan Cl_2 Room WTP

TAG NO: EF-3

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 12, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Pressure Transmitter Low Water WTP

TAG NO: PIT-1001

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 3, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF SATISFACTORY EQUIPMENT INSTALLATION
FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirms that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Service pump #1 WTP

TAG NO: P-400

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE: Dec 13, 2017

ENGINEER — DATE: 14 Dec, 2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Turbidity Meter WTP

TAG NO: Ait-1001, Ait-2102, Ait-2112, Ait-2122, Ait-2132

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 18-11-2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl/PH Meter WTP

TAG NO: AIT-1001, AIT-2501/2502

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 28-11-2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Meter

TAG NO: AIT-5000

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

Pierre-Luc Tejore — 20-11-2017

CONTRACTOR'S REPRESENTATIVE — DATE

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Flow Switch CL WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

Pierre-Luc Tjoie — 08-12-2017

CONTRACTOR'S REPRESENTATIVE — DATE

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Gray Control Valves actuator

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 10/12/2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Soude caustique Pump
Microprocessor dosing pump x2 WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 9-10-2007

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Cl_2 GAS MONITOR

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 12-12-17

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Hydrofluorasilicic Acid Pump x2
WTP

TAG NO:

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 8-12-2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Zinc Orthophosphate Dosing pump

TAG NO: P-303, P304

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE DATE

CONTRACTOR'S REPRESENTATIVE DATE

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Exaust Fan CL_2 Room WTP

TAG NO: EF-3

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE Dec 12/17

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION
FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Pressure Transmitter Raw Water WTP

TAG NO: P,T - 1001

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 06-11-2017

CERTIFICATE OF EQUIPMENT INSTALLATION INSTRUCTION FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: Iqaluit Water and Wastewater Facility Improvements

ITEM OR EQUIPMENT: Service pump #1 WTP

TAG NO: P-4100

REFERENCE SPECIFICATION:

MANUFACTURER'S REPRESENTATIVE — DATE

CONTRACTOR'S REPRESENTATIVE — DATE 12-12-2017

P.O. Box 556, Rankin Inlet, NU, X0C 0G0, Tel: 1-866-437-4001

March 1st, 2018

Matthew Hemp
Director of Public Works & Engineering
City of Iqaluit
P.O. Box 460
Iqaluit, Nunavut X0A 0H0
(867) 899-7317
m.hamp@city.iqaluit.ca

SUBJECT: ***City of Iqaluit – Water/Wastewater Facilities Improvements Project #SC711***
Completion Date – February 27th, 2018

SIFEC NORTH INC. warranties the mechanical, electrical systems and related equipment according to the contract herein before mentioned, for a one year period effective from date of the interim inspection.

Carl Fauteux
Vice-President

Chapter 10
MANUFACTURER'S DATA AND AS-BUILTS

Manufacturer data for the equipment installed/replaced as part of the 2017 Water and Wastewater Facilities Improvement project are appended to this Chapter. Items not applicable to the Water Treatment Plant include upgrades done to the Wastewater Treatment Plant, the Booster Stations and the Lift Stations. As such, these items have been crossed off the Manufacturer's Data and Maintenance Procedures as provided by Contractor As-Builts.

MECHANICAL &
ELECTRICAL

Volume 1 of 1

OPERATION & MAINTENANCE
MANUAL

CITY OF IQALUIT
WATER&WASTEWATER FACILITIES IMPROVEMENTS

IQALUIT, Nunavut

Project #:
SC711

December 2017

OWNER:	**CITY OF IQALUIT**
CONTRACT ADMINISTRATOR:	**COLLIERS PROJECT LEADERS**
CONSULTING ENGINEER:	**NUNAMI-STANTEC**
GENERAL CONTRACTOR:	**KUDLIK CONSTRUCTION INC.**
MECHANICAL & ELECTRICAL CONTRACTOR:	**SIFEC NORTH INC.**

MECHANICAL & ELECTRICAL

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Chapter 1 DOCUMENT VERSION

Year of Completion: **2017**
Original Scope: **ELECTRICAL & MECHANICAL**

Date	Description of Change
12-11-2017	PRELIMINARY

MECHANICAL & ELECTRICAL

Project History

Owner:	**Matthew Hamp, Director of Public Works & Engineering** **City of Iqaluit** **P.O. Box 460** **Iqaluit, Nunavut X0A 0H0** **P: (867) 899-7317** **F: (867) 899-7328** **m.hamp@city.iqaluit.ca**
Contract Administrator:	**Dixon Weir, Project Manager** **Colliers Project Leaders** **150 Isabella Street** **Ottawa, Ontario K1S 1V7** **P: (613) 216-4345, Ext #3224** **Dixon.Weir@Colliersprojectleaders.com**
Project Engineer:	**Glenn Prosko, Project Manager** **Nunami-Stantec** **10160 112 Street** **Edmonton AB T5K 2L6** **P: (780) 969-3258** **Glenn.Prosko@stantec.com**
General Contractor:	**Maxime Gaudreau, Project Manager** **Kudlik Construction Ltd.** **P.O. Box 727, 1519 Federal Road** **Iqaluit, NU X0A 0H0** **P: (418) 802-8224** **mgaudreau@kudlik.biz**
Mechanical & Electrical Subcontractor:	**Carl Fauteux, Vice-President** **Sifec North Inc.** **P.O. Box 556,** **Rankin Inlet, NU, X0C 0C0,** **P: (855) 437-4001** **carl@sifec.ca**

Chapter 2 INTRODUCTION

2.1 GENERAL INFORMATION

This project consists of work for improvements to existing City of Iqaluit facilities. The work involves a variety of equipment from the following fields: Plumbing, HVAC, Automation, Electrical and Process. The project provides improvements at the following facilities:

- Water Treatment Plant
- ~~Booster Station #1~~
- ~~Booster Station #2~~
- ~~Lift Station #1~~
- ~~Lift Station #2~~

All the faulty & defective equipment that was part of this project were replaced with new units. This includes new analyzers, gas detectors, control valves, flow meters, fans, blowers, pumps, piping, etc.

The project also involved installation of a few new instruments, such as new pressure transmitters, new generator cooling line control valves & flow switches.

2.2 WATER TREATMENT PLANT

The following items are part of the scope at the Water Treatment Plant:

- A new replacement TwinCity exhaust fan in the Chlorine Room.
- 5 new Hach TU5300sc Turbidity Meter.
- 2 new Wallace & Tiernan Depolox 3 Plus Chlorine & pH analyzers.
- A new replacement Wallace & Tiernan Chlorine Gas Detection System for Chlorine Room.
- All Bray control valves were inspected, maintained & repaired. New Bray valves were supplied for spare parts.

- A new flow switch was installed on the chlorinated water injection line in Chlorine Room. This include PLC low flow alarm.
- A new pressure transmitter was installed and incorporated in the PLC/HMI.
- A new replacement electromagnetic flow meter was installed for reservoir discharge flow.
- Air scour blower #1 was inspected and deemed unrepairable. Under CO#2, it was replaced.
- Backwash Pump #2 was inspected and found to be functioning. No repairs needed.
- The 6 chemical metering pumps were replaced, including new skid and piping (Hydrofluorosilic acid, Zinc Orthophostate, Caustic soda).
- Service water pump #1 was replaced under CO#3.

2.3 BOOSTER STATION #1 & #2

The following items are part of the scope at Booster Stations:

- 2 new Hach TU5300sc Turbidity Meter.
- 2 new Wallace & Tiernan Depolox 3 Plus Chlorine analyzers.
- New ½" stainless sampling line at BS#1
- New generator/fire pump cooling line control system, including new solenoid control valves and new flow switches. All incorporated in the PLCs.
- New underfloor sanitary drain system at BS#2, including repairs to the underslab heating system.
- A new replacement for the recirculation pump #1.

2.4 LIFT STATION #1 & #2

The following items are part of the scope at the Lift Stations:

- 3 new MSA Gas Detection Systems, including probes for H2S and Combustible Gases.
- A new replacement discharge flow meter at LS#1
- Inspection of the generator ventilation damper controls. It was found to be working as per scope of work requirements. At LF#2.

- ~~Inspection & repairs of all pump room wall openings to ensure CEC compliance.~~
- ~~Inspection & replacement of all material to ensure properly rated for pump room, except duplex receptacle.~~

2.5 AS-BUILT PLANS OVERVIEW

2.5.1 Mechanical plans

Plan M1

2.5.2 Electrical plans

Plan E1

Plan E2

Plan E3

Plan E4

Plan E5

Chapter 3 OPERATION OF NEW EQUIPMENT

3.1 Flow Switch for Chlorinated Water Injection (Water Treatment Plant)

The new flow switch requires no manual operation. It has been incorporated in the PLC/HMI software, and will automatically display an alarm when a low flow is detected. The alarm also triggers a call by the autodialer.

3.2 Raw Water Pressure Transmitter PIT-1001 (WTP)

The new pressure transmitter requires no manual operations. It has been incorporated in the PLC/HMI software on the “Process Overview” page. It can be found on the top left of the screen.

~~3.3 Cooling Line Modifications for Fire Pump & Emergency Generator (Booster Station #1 & #2)~~

~~The fire pump & emergency generator cooling line modifications are the same for both stations. They include parallel solenoid control valves to control the flow, as well as a flow switch. These items do not require manual operation. They have been incorporated in the station PLC/HMI. The flow switch makes sure there is **flow** to the cooling line when the generator is online, and makes sure there is **no flow** when the generators are offline. An alarm is created when an issue is detected.~~

Chapter 4 MAINTENANCE

Below you will find a summary of the maintenance information that can be found in the individual O&M Manuals of the equipment. Further information, including schematics and step-by-step guides, can be found in the equipment's respective manual. These can be found in Chapters 6 to 15 below.

4.1 Exhaust Fan Chlorine Room (TwinCity Fan) – WTP

- General: Keep motor clean & dry
- 5-Months: Keep fan drive bearing lubricated (every 5 months, as per sticker on unit)
- 5-Years: Lubricate motor every 5 years
- As-Necessary: Inspect shaft and wheel, keep clean of dirt buildups, and for signs of fatigue
- As-Necessary: Inspect points of attachments to structure for signs of fatigue or loose connections
- As-Necessary: Inspect motor belt, re-tension or replace when necessary
- Refer to Manual attached to this document for further details and step-by-step instructions

4.2 Chlorine & pH Analyzers (Wallace & Tiernan Depolox 3 Plus) – WTP~~/BS#1/BS#2~~

- Daily: Inspect unit for leaks, including all pipe connections. Rectify all leaks immediately.
- Daily: Measure chlorine and pH using an external device, to ensure unit is properly calibrated.
- Weekly: With sample water turned on, check that there is sufficient "grit" in the measuring cell to keep electrode clean. Add more grit as necessary to keep probe clean
- Monthly: Remove and clean the strainer in the sample water supply line.
- Monthly: Remove and clean pH electrode, using diluted hydrochloric acid (10% max) and then rinsed in water. Recalibrate pH electrode.
- 2-Months: Check the zero point to ensure no drift has occurred
- 2-Months: Check potassium chloride electrolyte is level with the bottom of the electrolyte reservoir neck
- 2-Months: The particles of grit have a 2 month lifespan, and should be replaced after this period
- 2-Months: Inspect the 2 membrane in the electrode case. They should be white, and should be replaced if showing any signs of discoloration
- 6-Months: Replace the reference electrolyte.
- 2-Years: Replace pH electrode
- Refer to Manual attached to this document for further details and step-by-step instructions

4.3 Turbidity Analyzers (Hach TU5300sc) - WTP~~/BS#1/BS#2~~

- 2-Months: Clean the vial
- 2-Years: Replace the vial
- 2-Years: Replace the desiccant cartridge
- As Necessary: Clean the vial compartment
- As Necessary: Replace the tubing
- Refer to Manual attached to this document for further details and step-by-step instructions

4.4 Chlorine gas Detector (Wallace & Tiernan Accutech 35) – WTP

- Monthly: Test the sensor with actual gas. Calibrate using the zero potentiometer.
- Monthly: Clean the battery vent.
- Monthly: Verify the battery backup works by removing AC power.
- Refer to Manual attached to this document for further details and step-by-step instructions

4.5 Control Valves (Bray Series 70) – WTP

- No periodic maintenance required per manufacturer
- Refer to Manual attached to this document for further details & troubleshooting guide

4.6 Flow Switch (Magnetrol TD-1) – WTP~~/BS#1/BS#2~~

- As-Necessary: Probe may be cleaned by soaking/spraying with solvent or detergent and water. Lime deposits may be safely removed by soaking in 20% hydrochloric acid.
- Refer to Manual attached to this document for further details and troubleshooting guide

4.7 Solenoid Control Valves (ASCO series 8210G & GC Series S21)

- No periodic maintenance required per manufacturer

4.8 Pressure Transmitter (Endress & Hauser Cerepar PMC71) – WTP

- No periodic maintenance required per manufacturer

4.9 WTP Reservoir Discharge Flow Meter (Endress & Hauser Promag 400) – WTP

- No periodic maintenance required per manufacturer

4.10 Air Scour Blower (Delta Blower GM15L) – WTP

- After first 500h of operation, replace the lube oil & change the grease of drive shaft
- Weekly: Check the intake filter for contamination
- Weekly: Check the oil level
- Weekly: Check the belt guard for damage and contamination. Ensure it is totally stable
- 6-Months: Check the belts, replace if necessary
- 6-Months: Inspect the sheaves for wear, for alignment and for stability, replace if necessary
- 6-Months: Check that the pressure valve is operating correctly and clean it
- 6-Months: Replace the lube oil at a discharge temperature of over 140˚C
- 6-Months: Replace the grease of drive shaft at temperature of over 140˚C
- Yearly: Replace the intake filter
- Yearly: Replace the lube oil
- Yearly: Replace the grease of drive shaft
- 2-Years: Replace the belts
- 2-Years: Check alignment of the sheaves, correct if necessary
- 2-Years: Check non-return flap for wear and tightness, replace if necessary
- 2-Years: Check flexibe pipe connections on discharge and intake sides for tightness, replace if necessary
- 3-Years: Check hose lines for tightness, replace if necessary
- 3-Years: Complete machine check
- 7-Years: Lubricate the motor
- Refer to Manual attached to this document for further details and step-by-step instructions

4.11 Service Water Pump (Franklin Electric 6” 100GPM) – WTP

- No periodic maintenance required per manufacturer
- Refer to Manual attached to this document for further details and troubleshooting guide

4.12 Chemical Metering Pumps (LMI Series AD/B/C) – WTP

- Yearly: Replace the cartridge valve, O-rings, injection check valve spring
- Refer to Manual attached to this document for further details and step-by-step instructions

4.13 **Recirculation Pump (Aurora 382-BF) – BS#2**

- No specific maintenance schedule required for pump. It is recommended to be removed from well for inspection and cleaning periodically.
- Refer to Manual attached to this document for further details and step-by-step instructions

4.14 **Gas Detection System H2S & Combustible (MSA UltimaX5000) – LS#1/LS#2**

- Keep sensor window clean, free of particulate, oil, water, dirt. Clean using a cotton swab moistened with distilled water (or isopropyl alcohol if necessary) then dry using a separate dry cotton swab. After, make sure to remove any excessive water/alcohol to ensure completely clean surface.
- Periodically verify if sensors are properly calibrated
- Refer to Manual attached to this document for further details and step-by-step instructions

4.15 **Lift station Discharge Flow Meter (Endress & Hauser Promag 10W) – LS#1**

- No periodic maintenance required per manufacturer

MANUFACTURER/DISTRIBUTOR:

VENTES CENTECH INC.
Josée Gagnon
122 rue St-Laurent, Suite 200
St-Eustache, QC, J7P 5G1
Phone: (450) 473-4550
Fax: (450) 473-5525
jgagnon@centech.ca

6.1 TwinCity Chlorine Room Fan (WTP)

Twin City Exhaust Fan RBA909, corrosion resistant, spark resistant

FAN DETAILS

Job Name: Sifec

Twin City Fan & Blower
A Twin City Fan Company
Ventes Centech inc.
122 St-Laurent, St-Eustache (Qc) J7P 5G1
Tel: (450) 473-4550 Fax: (450) 473-5525
email: info@centech.ca
ISO 9001 CERTIFIED

Tag: N/A
Customer:
Job ID: 2017-09-13-1
Date: September 14, 2017

Description

Quantity	1
Model	RBA
Size	909
Width	SWSI
Arrangement	9A
Class	22
Rotation	CCW
Discharge	TAU
Wheel Diameter (in)	15.6
Drive method	Belt
Percentage width	100%
Percentage diameter	100%
Motor position	L

Performance

Volumetric Flow CFM	947
Operating SP (in WC)	3.000
Standard SP (in WC)	3.022
RPM	1595
Tip Speed (FPM)	6525
Oper. Power BHP	0.74
Standard Power BHP	0.75
Outlet Area (sq.ft)	0.44
Outlet Velocity (FPM)	2152
Max RPM for Class	4134
Static Efficiency	60.26%
Total Efficiency	66.00%
FEI	1.35
FEP (KW)	0.72
System FEI	N/A
System FEP (KW)	N/A

Air/Gas Properties

Altitude above sea level (ft)	0
Inlet Pressure (in WC)	-3.000
Inlet Temperature(°F)	70
Design Temperature (°F)	70
Gas Type	Operating air
Estimated Density (lb/ft³)	0.0744

Motor Data

Power (HP)	1-1/2
Enclosure	TEFC
Speed (RPM)	1800
Voltage	575V
Phase	3
Frequency	60Hz
Frame Size	145T

Modifiers

Apply Compressibility.

Sound

Octave Bands	1	2	3	4	5	6	7	8	LwA
Level at Inlet	89	85	83	78	70	65	59	53	79

-12

Sound Power Levels in dB re.10 Watts:

Dis	ft	1	3	5	10
dBA at inlet		83	73	69	63

Estimated sound pressure level in dBA (re: 0.0002 microbar) based on a single * ducted installation:

*To estimate dBA level for ducted inlet and ducted outlet (into and out of the room) type installation, deduct 20 from the LwA value shown. Using a directivity factor of 2. Estimated Sound Pressure based on free field, spherical (Q = 2) radiation at stated distance.

Definitions:

LwA The overall (single value) fan sound power level, 'A' weighted.

dBA The environment for each fan installation influences its measured sound value, therefore dBA levels cannot be guaranteed. Consult AMCA Publication 303 for further details. A fan's dBA is influenced by nearby reflective surfaces.

Twin City Exhaust Fan RBA909, corrosion resistant, spark resistant

FAN DETAILS

Job Name: Sifec

Twin City Fan & Blower
A Twin City Fan Company
Ventes Centech inc.
122 St-Laurent, St-Eustache (Qc) J7P 5G1
Tel: (450) 473-4550 Fax: (450) 473-5523
email: info@centech.ca
ISO 9001 CERTIFIED

Tag: N/A
Customer:
Job ID: 2017-09-13-1
Date: September 14, 2017

Pricing Detail

RBA 909, Class 22, Arrangement 9A Bare fan	244lb
Drain W/ Plug	0 lb
Flange - Inlet, Punched	0 lb
Flange - Outlet, Punched	0 lb
Guard - Belt, OSHA Type	15 lb
Guard - Shaft & Bearing	11 lb
Spark Resistant Construction - Type A	0 lb
Shaft Seal - Std Type	0 lb
Spec Matl: Airstream - Aluminum	0 lb
Extended Lube Lines to Drive Side	0 lb
Spcl Paint on all Guards - OSHA Yellow	0 lb
Coating: Entire Fan; Epoxy Mastic; Carboguard 890 Series - Wash; Prep: Tool Clean & Wash; Curing: Air Dry	0 lb
Motor 1-1/2 HP, 1800 RPM, 575V, 3Ph, 60Hz , TEFC - Premium , 145T	86 lb
Variable Speed V-Belt Drive, 1.5 SF	5 lb
Mount TCF Motor	0 lb

Each Weight	361 lb
Extended Weight	361 lb

Twin City Exhaust Fan RBA909, corrosion resistant, spark resistant

FAN DETAILS

Job Name: Sifec

Twin City Fan & Blower
A Twin City Fan Company
Ventes Centech inc.
122 St-Laurent, St-Eustache (Qc) J7P 5G1
Tel: (450) 473-4550 Fax: (450) 473-5523
email: info@centech.ca
ISO 9001 CERTIFIED

Customer:
Job ID: 2017-09-13-1
Date: September 14, 2017

AMCA Statements

Tag:

1. Twin City Fan certifies that the model RBA is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Certified Ratings Program.
2. Performance certified is for Installation Type D: Ducted inlet, Ducted outlet.
3. Power rating (BHP) does not include transmission losses.
4. The AMCA licensed air performance data has been modified for installation, appurtenances or accessories, etc. not included in the certified data. The modified performance is not AMCA licensed but is provided to aid in selection and applications of the product.
5. dBA levels are not licensed by AMCA International.

DOE Statements

Note that the Fan Energy Index (FEI) is an overall efficiency (wire-to-air) metric which includes not only the impact of the fan efficiency, but also each of the drive components used to operate the fan.

The Fan Electrical Input Power (FEP) is the amount of power of a given fan at an operating point characterized by a value of flow and pressure.

Twin City Exhaust Fan RBA909, corrosion resistant, spark resistant

Job Name: Sifec

Fans & Blowers
Twin City

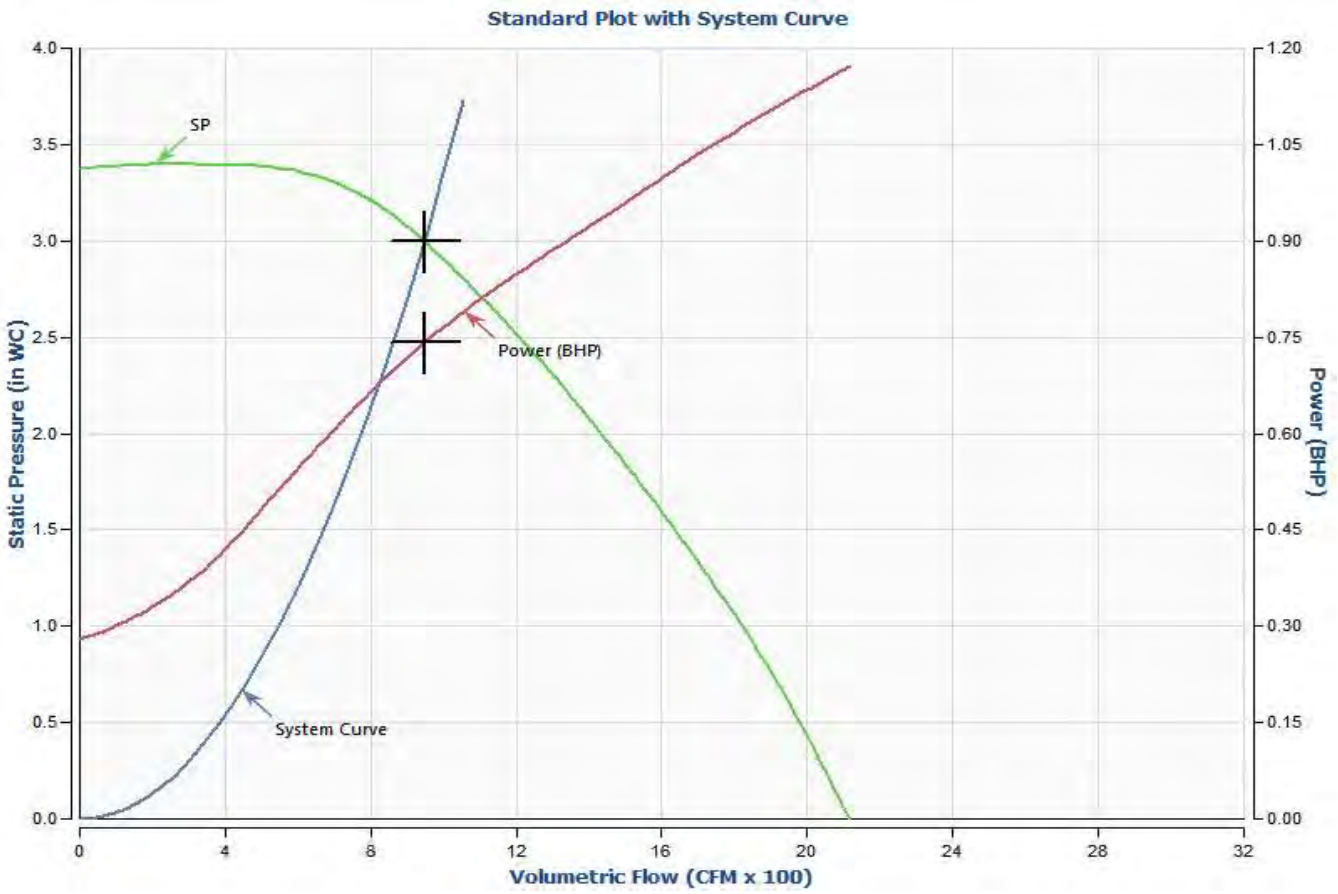
Customer:
Job ID: 2017-09-13-1
Date: September 14, 2017

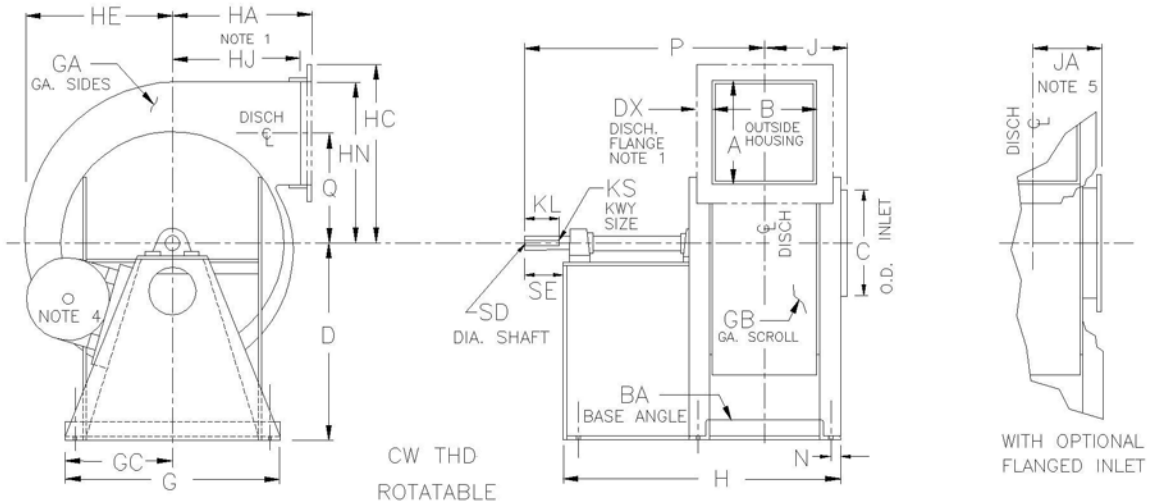
Tag:

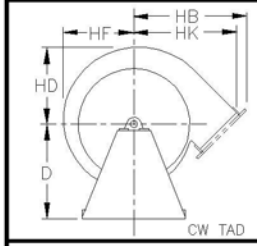
Fan information

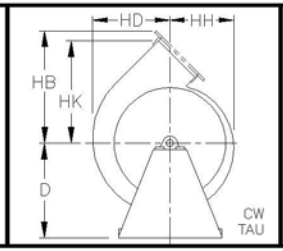
Size/Model 909/RBA	Class 22	Outlet Vel (FPM) 2152
Volumetric Flow (CFM) 947	Speed (RPM) 1595	Density (lb/ft³) 0.0744
SP (in WC) 3	Max Speed . . 4,134 RPM @ 70 °F	
	Power (BHP) 0.74	

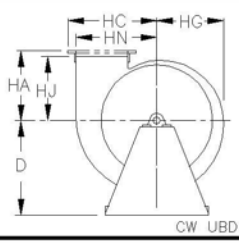
Adjusted for Apply Compressibility, Inlet Pres: -3 WC

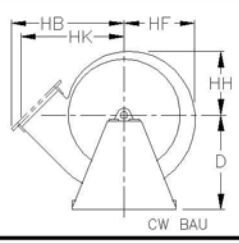


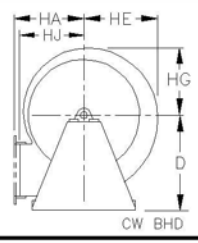










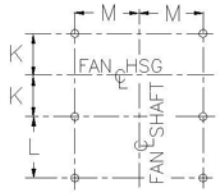


NOTES:

1. OUTLET FLANGES ARE OPTIONAL. FLANGES ARE PUNCHED PER AC15146.
2. 'CW' ROTATION IS SHOWN. 'CCW' IS SIMILAR BUT OPPOSITE.
3. FOR 'DBD' (DOWNBLAST) SEE DRAWING AC15071.
4. MOTOR LOCATION IS 'LEFT' FOR 'CW' ROT. AND 'RIGHT' FOR 'CCW' ROTATION. DIM. 'FR' IS MAX. MOTOR FRAME.
5. OPTIONAL FLANGED INLET PER DRAWING AC15143.

FOUNDATION PLAN

SIX 'BH' DIA BASE HOLES



'RBO', 'RBA', & 'RBW' ARR. NO. 9A & 9B CLASS 22

TWIN CITY FAN & BLOWER
MINNEAPOLIS, MINNESOTA 55442

DRAWN 8/10/94
REVISED
DWG NO AC-15074

JOB:

LOC.

ENG./ARCH.

CERT. BY:

S.O. NO.

SIZE	CLASS	DISCH	ROT.	MOTOR HP	MOT. LOC.	UNIT NO.

CFM	SP	RPM	BHP	OV	TS

ACCESSORIES REQ'D

SIZE	A	B	BA	BH	C	D 9A	D 9B	DX	FR 9A	FR 9B	G	GA	GB	GC	H 9A	H 9B	HA	HB	HC	HD	HE	SIZE
907	6.81	6.06	1.5X1.5	0.44	7.00	18.50	21.50	1.25	184T	215T	14.25	12	12	7.13	24.81	28.44	8.81	14.63	11.81	10.13	9.69	907
909	8.63	7.69	1.5X1.5	0.44	9.00	18.50	24.50	1.25	184T	256T	17.75	12	12	8.88	26.44	34.94	11.13	18.31	14.75	12.94	12.38	909
911	10.56	9.44	2.0X2.0	0.56	11.00	21.50	25.00	1.50	215T	256T	20.25	10	10	10.13	32.81	37.69	13.50	22.25	17.94	15.75	15.06	911
913	12.44	11.13	2.0X2.0	0.56	13.00	21.75	27.75	1.50	215T	286T	23.25	10	10	11.63	34.50	41.75	15.88	26.06	20.94	18.63	17.81	913
915	14.31	12.81	2.5X2.5	0.56	15.00	25.25	28.25	1.50	256T	286T	26.25	10	10	13.13	42.06	44.44	18.25	29.81	23.88	21.44	20.50	915
917	16.25	14.50	2.5X2.5	0.56	17.00	28.25	32.00	1.50	256T	326T	29.50	10	10	14.75	43.75	48.63	20.63	33.63	26.88	24.31	23.25	917
919	18.06	16.13	2.5X2.5	0.56	19.00	31.25	35.50	2.00	286T	365T	31.25	10	10	15.63	47.75	51.75	22.94	37.63	30.25	27.06	25.88	919

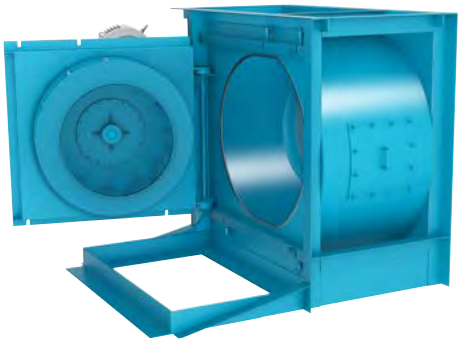
SIZE	HF	HG	HH	HJ	HK	HN	J	JA	K	KL	KS	L 9A	L 9B	M	N	P 9A	P 9B	Q	SD	SE	WHL DIA	SIZE
907	9.25	8.81	8.38	8.31	13.38	10.56	4.69	5.69	4.06	4.50	.38X.19	15.19	18.81	6.38	0.63	24.88	28.50	7.19	1.437	4.75	12.25	907
909	11.81	11.25	10.69	10.63	17.06	13.50	5.50	6.50	4.88	5.00	.38X.19	15.19	23.69	8.13	0.63	26.44	34.94	9.19	1.437	5.50	15.63	909
911	14.38	13.69	13.00	13.00	20.88	16.44	6.88	8.38	6.00	5.00	.38X.19	18.81	23.69	9.13	0.88	31.44	36.31	11.19	1.687	5.50	19.13	911
913	17.00	16.19	15.38	15.38	24.63	19.44	7.69	9.19	6.81	5.50	.38X.19	18.88	26.13	10.63	0.88	32.81	40.06	13.25	1.687	6.00	22.63	913
915	19.56	18.63	17.69	17.75	28.38	22.38	9.06	10.06	7.94	5.50	.50X.25	23.69	26.06	11.88	1.13	39.00	41.38	15.25	2.187	6.00	26.13	915
917	22.19	21.13	20.06	20.13	32.19	25.38	9.88	10.88	8.75	6.00	.50X.25	23.75	28.63	13.50	1.13	40.88	45.75	17.25	2.187	7.00	29.63	917
919	24.69	23.50	22.31	22.44	35.88	28.25	10.69	11.69	9.56	7.00	.50X.25	26.13	30.13	14.38	1.13	44.56	48.56	19.25	2.187	7.50	33.00	919

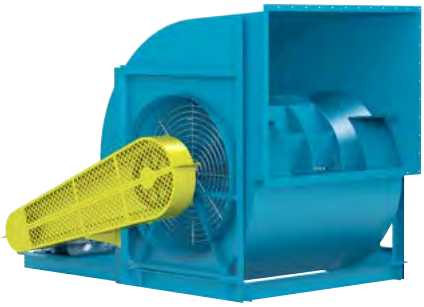
Twin City Exhaust Fan
RBA909, corrosion
resistant, spark resistant

IM-995
September 2017

Centrifugal Fans

Installation, Operation & Maintenance Manual





Review AMCA Bulletin 410 Prior to Installation

This bulletin has been prepared to guide the users of industrial centrifugal fans in the proper installation, operation and maintenance procedures to insure maximum equipment life with trouble-free operation. For safe installation, startup and operational life of this equipment, it is important that all involved with the equipment be well versed in proper fan safety practices and read this bulletin. It is the user's responsibility to make sure that all requirements of good safety practices and any applicable safety codes are strictly adhered to. Because of the wide variety of equipment covered in this bulletin, the instructions given here are general in nature. Additional product and engineering information is available at www.tcf.com.

SAFETY NOTICE

Refer to the safety section(s) in this manual prior to installing or servicing the fan. The most current version of this installation and maintenance manual can be found on our website at www.tcf.com/resources/installation-maintenance-manuals.

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Fan & Blower Twin City

Centrifugal Fan Arrangements - Single Width, Single Inlet (SWSI)

Arrangement 1
Belt Driven or Direct Drive

Arrangement 3
Belt Driven

Arrangement 3F
Belt Driven

Arrangement 3SI
Belt Driven or Direct Drive

Arrangement 4
Direct Drive

Arrangement 4S
Direct Drive
(Swingout Door)

Arrangement 4VI
Direct Drive
(Vertical Inlet)

Arrangement 4HI
Direct Drive
(Horizontal Inlet)

Arrangement 7
Direct Drive

Arrangement 7SI
Direct Drive

Arrangement 8
Direct Drive

Arrangement 9
Belt Driven

Arrangement 9F
Belt Driven

Arrangement 9H
Belt Driven

Arrangement 9SS
Belt Driven
(Swingout Door)

Arrangement 9ST
Belt Driven
(Swingout Door)

Arrangement 10
Belt Driven

Centrifugal Fan Arrangements - Double Width, Double Inlet (DWDI)

Arrangement 3
Belt Driven or Direct Drive

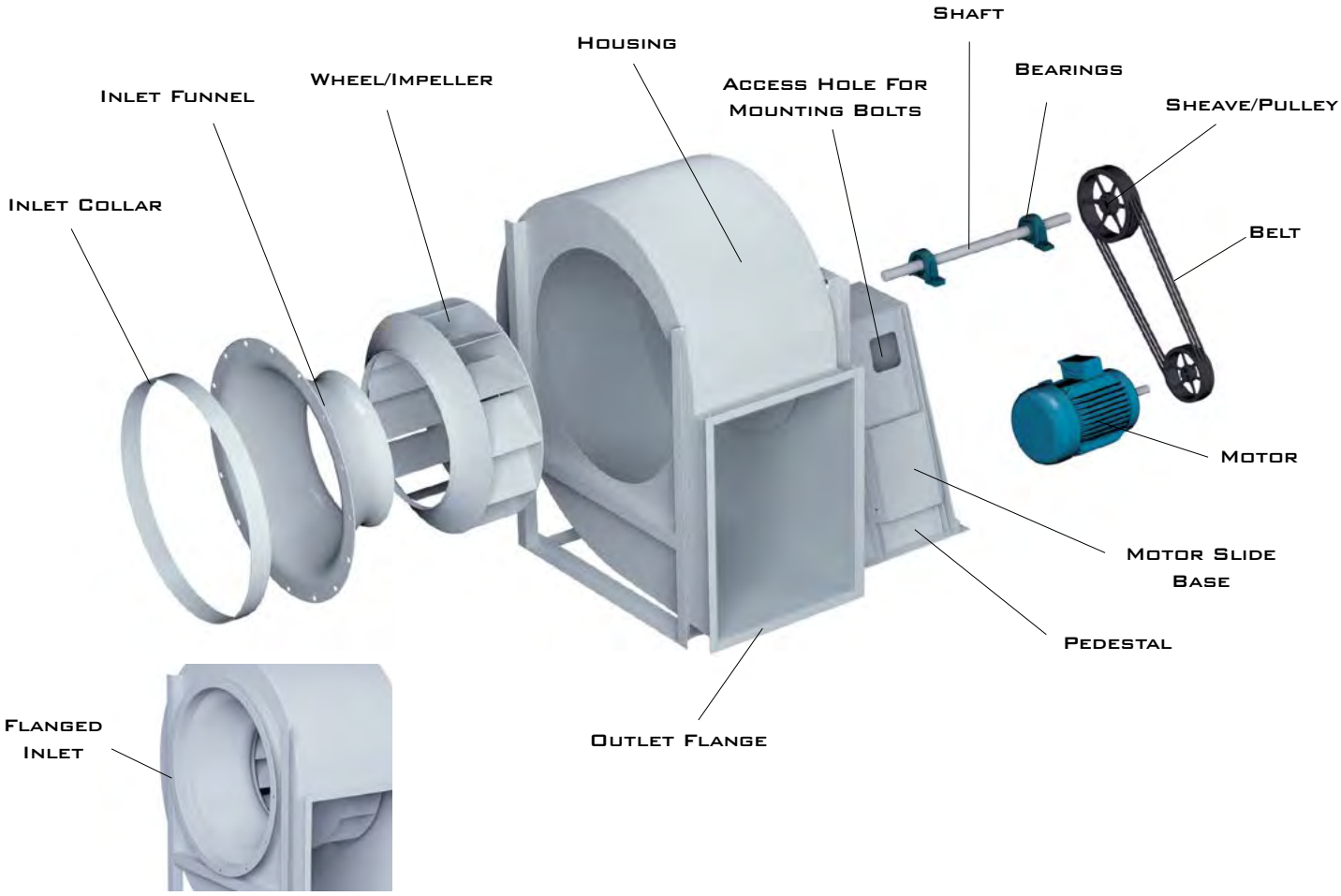
Arrangement 3F
Belt Driven

Arrangement 3DI
Belt Driven or Direct Drive

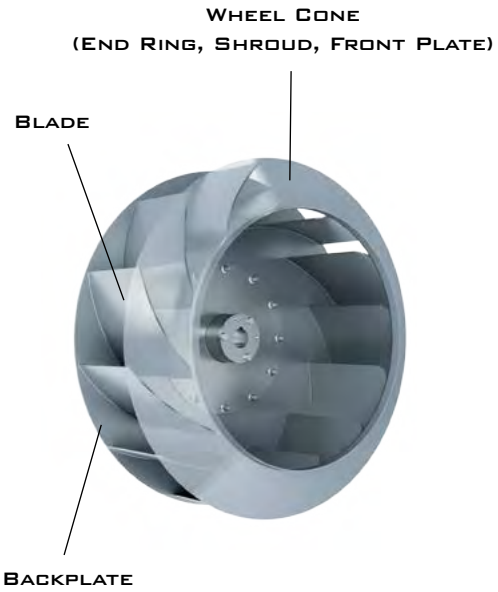
Arrangement 7
Direct Drive

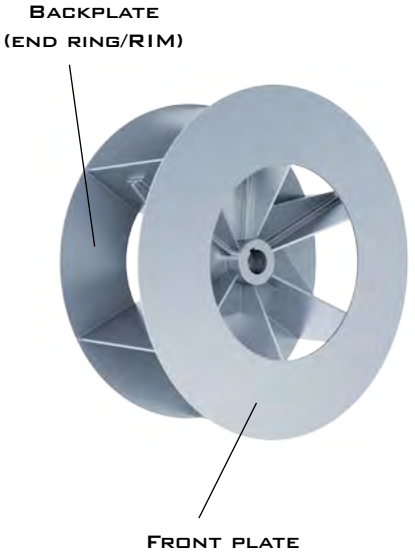
Arrangement 7DI
Direct Drive

Exploded View - Centrifugal Fans



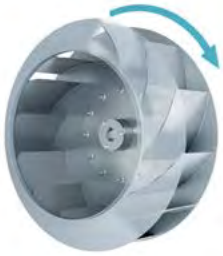
Wheel (Impeller) Nomenclature



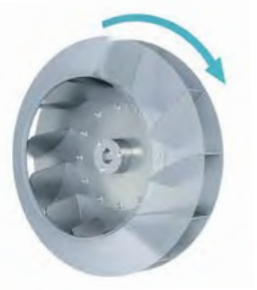


SWSI Wheel Types

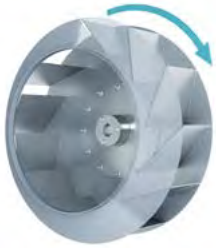
Airfoil



Backward Curved



Radial Tip



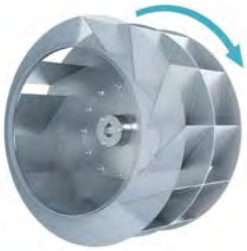
Backward Inclined

Radial Bladed

Forward Curved

DWDI Wheel Types

Airfoil



Backward Inclined

Forward Curved

Wheel Rotation

Rotation View From Drive Side

CLOCKWISE (CW)
EXAMPLE SHOWN

SWSI Centrifugal Fans

DWDI Centrifugal Fans

Safety & Hazard Warnings

For general safety practices for air moving equipment, see AMCA Bulletin 410. Twin City Fan & Blower offers many safety accessories. These safety devices include (but are not limited to) belt guards, shaft guards, inlet and discharge screens. The use and suitability of safety devices is the responsibility of the purchaser.

Facility related safety conditions include fans' accessibility and location. How easily can non-service personnel access the unit? Is the fan in a hazardous duty environment? Was the unit ordered for this duty? Other concerns must also be addressed. All fans should be powered through switches which are easily accessible to service personnel from the fan. Fan power must have the ability to be "locked out" by service personnel trained in lockout/tagout procedures per OSHA requirements (29CFR1910.147). When performing lockout, be aware of factors, such as building pressure and additional fans in the system that can influence unwanted fan rotation (wind milling). If you have any doubt about your ability to perform a task, seek a person qualified to do that task. Before any work is done on a fan, ensure that the fan is isolated from the electrical supply using a 'lockout/tagout system.'

Note: A stationary, non-rotating fan does not mean that the fan is isolated from the electrical supply. A non-rotating fan could be subject to controls or other circuit protection devices that may start the fan without notice.

The following safety precautions should be followed, where applicable:

- Do not attempt to slow a rotating impeller even when it is isolated from the electrical supply. Fan impellers have a high inertia and injury could result from an attempt to stop it. It is recommended that the impeller is isolated by closing off the inlet or outlet to prevent wind-driven rotation. If an impeller is chocked to prevent rotation, ensure that the chocks are removed prior to start up.
- Wear appropriate personal protective equipment. This may include protective clothing, eye protection, ear protection, respiratory equipment, hand and foot protection when installing or servicing the fan.
- Always use caution when entering a fan's air path. High velocity airflow can cause you to lose your balance.
- Motor, bearings and drives can be hot, and similarly if the fan is subject to processes that are hot, the fan housing could be hot.
- Fans are often used to move hazardous materials that could be dangerous. Always wear protective clothing and take precautions not to inhale dust/gases. If hazardous chemical vapors are present, respiratory equipment may be required.
- Sharp edges – wear protective gloves when handling, installing, or servicing a fan.
- Fans can operate at high decibel sound levels. Wear proper ear protection to protect from excessive noise levels.
- Access Doors – Do not open access doors when fan is in operation. The effects of suction and air pressure could result in injury.
- When working around pulleys and belts, keep hands away from pinch points. This pertains to when the fan is under or off power.

Throughout this manual, there are a number of HAZARD WARNINGS that must be read and adhered to in order to prevent possible personal injury and/or damage to equipment. Two signal words "WARNING" and "CAUTION" are used to indicate the severity of a hazard and are preceded by the safety alert symbol. It is the responsibility of all personnel involved in installation, operation and maintenance to fully understand the warning and caution procedures by which hazards are to be avoided.

WARNING: Used when serious injury or death MAY result from misuse or failure to follow specific instructions.

CAUTION: Used when minor or moderate injury or product / equipment damage MAY result from misuse or failure to follow specific instructions.

NOTICE: Indicates information considered important, but not hazard-related.

Shipping & Receiving

All Twin City Fan & Blower products are carefully constructed and inspected before shipment to insure the highest standards of quality and performance. Compare all components with the bill of lading or packing list to verify that the proper unit was received. Check each unit for any damage that may have occurred in transit. Any damage should be reported immediately to the carrier and the necessary damage report filed. Damage should be noted on the bill of lading.

Handling

Handling of all air moving equipment should be conducted by trained personnel and be consistent with safe handling practices. Verify the lift capacity and operating condition of handling equipment. When using hoisting equipment, only qualified and trained personnel should operate the equipment.

Units shipped completely assembled may be lifted with slings and spreader bars. (Use well-padded chains, cables or nylon straps, rated to lift the required weight.) On most units, lifting lugs are designed to protect the fan and fan housing from damage. Never lift a fan by the inlet or discharge flange, shafting or drives, wheel or impeller, motor or motor base, or in any other manner that may bend or distort parts. Never lift with slings or timbers passed through the fan inlets.

For fans provided without lifting lugs, use a forklift or pallet jack to handle the equipment. Consult a qualified person before lifting.

⚠ CAUTION

1. **Maintain handling equipment to avoid serious personal injury and do not stand under the load.**
2. **If supplied, only use the provided lifting lugs to lift the equipment.**
3. **Ensure that the lifting equipment is rated for the capacity to be lifted.**

Lifting lugs are provided on most units.

Lift fans mounted to a Unitary Base as shown

Partial or disassembled units require special handling. All parts should be handled in a method which protects the coatings and parts from damage. Components should be handled such that forces are not concentrated to avoid bending or distortion.

The housing should be lifted using suitably rated spreader bars and padded Chains or straps. Do not distort housing or side plates when lifting.

The shaft and wheel assembly may be lifted using a hoist and a spreader with slings around the shaft at either side of the wheel. Use the spreader bar to ensure that the slings do not push against the sides of the wheel as this may distort the wheel. Take care not to damage the shaft where the wheel or bearings will be mounted. Never lift or support the assembly by the wheel. Always support the assembly by the shaft when lifting or storing (see the section regarding proper storage of equipment.) Do not support the shaft or the wheel on the housing sides. See the Fan Installation section for additional details.

Wheels shipped separately can be lifted by slings running between the blades or through the hub. Never lift the wheel by a single blade or single point on the flange/shroud. Do not to put a chain within the hub bore. Always transport wheels by lifting, do not roll the wheel as this can damage coatings and change the balance of the wheel.

Bent shafting is a source of vibration and bearing failure, so be sure to handle the shaft with care. If the shaft is bent, replace the shaft. Any scratches on the shaft may be repaired with fine emery cloth or a stone. Remove only the displaced metal that forms a high point at the edge of the scratch.

⚠ CAUTION

1. **Bearing pedestals should be lifted using straps or padded chains. Under no circumstance should an attached or separated bearing pedestal be lifted by the shaft, bearings, drives, motor or wheel.**
2. **Note some rotor assemblies may have an off-center CoG and therefore a qualified person should be consulted before lifting.**

Unit Storage

If fan installation is to be delayed, store the unit in an environmentally stable and protected area. During storage, the fan should not be subjected to vibration from external sources or bearing damage may occur. The unit should be reasonably protected from any accidental impacts. Cover the fan to protect coatings and to prevent any foreign material or moisture from entering the inlet or discharge. Take care to protect the motor, drives and bearings.

Extended storage requires monthly inspections. Check for corrosion or damage to the unit and for debris within the fan.

Bearings tend to take on moisture if the atmosphere in which they are stored is not at a constant temperature. To avoid corrosion, it is necessary to keep the bearings full of grease and to rotate them periodically. Even when full of grease, bearings will take on moisture, so it is necessary to purge the bearings with new grease to expel moisture every thirty days. It is recommended that the bearings be purged with grease while being rotated by hand. Do not use high pressure greasers as they may ruin the bearing seals. Spherical roller bearings with split pillow block housings must be opened up and grease removed before start-up. Remove old/excess grease and regrease the bearing in accordance with the bearing manufacturer's instructions.

The drives and belts should be removed if the fan is to be stored for a prolonged period. The drives should be labeled for service and stored in a dry place. Belts should be removed, coiled without kinks, placed in a heavy carton, and stored in a dry, well-ventilated place. To prevent belt deterioration storage conditions should not exceed 85°F and 70% humidity. If belts show signs of deterioration, they should be replaced prior to startup.

Motors should be stored in a clean, dry, vibration-free location. The packaging should be opened up enough to allow air circulation around the motor. The winding temperature should be kept slightly above that of the surroundings to prevent condensation. This can be accomplished by energizing the internal heaters, if the motor is so equipped, or by using space heaters. If it is impossible to heat the windings, the motor should be wrapped tightly with a waterproof material which also encloses several bags of desiccant. Replace the desiccant regularly to prevent moisture problems. The motor rotor should also be rotated regularly (monthly) to assure the bearing parts are well greased. Shafts on motors equipped with shaft grounding rings must remain rust free. Failure to do so renders the grounding feature inoperative and may result in bearing failure under VFD operation. Consult the motor manufacturer for further detail on motor storage and start up after longer periods of storage. It may be necessary to regrease the bearings. If the fan's bearings or motor bearings have extended lubrication lines, it will be necessary to replace the grease by detaching from the motor/bearing and purging the line with new grease.

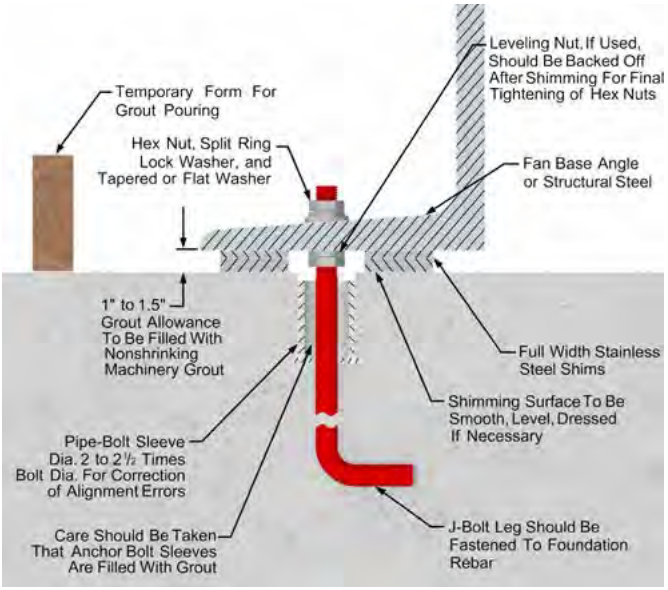
Fan & Blower
Twin City

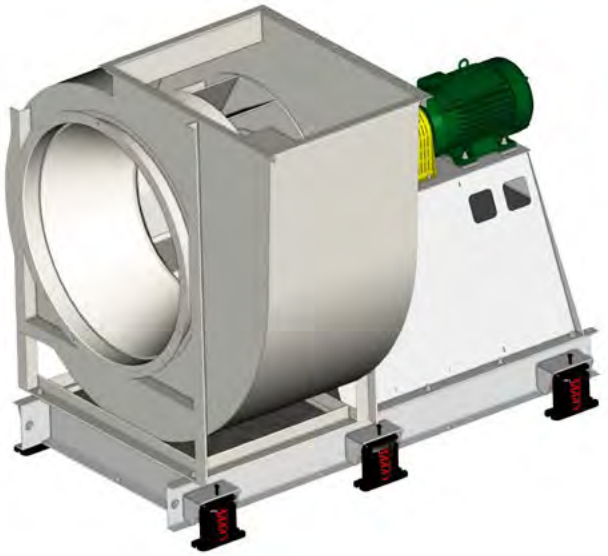
WARNING

Refer to handling section prior to lifting equipment.

Foundations & Supporting Structures (refer to lifting/safety section)

The best means of floor mounting a fan is on a well-designed, flat, level concrete foundation. The foundation should have a mass of at least three times that of the supported assembly. Rigid foundation stiffness must be between $1x10^6$ lbs./in. to $4x10^6$ lbs./in. depending upon size and speed. The foundation should extend 6" beyond the outer dimensions of the fan and driver; however, it should be no more than twice the area required for the equipment. If it is made larger, the mass should be increased accordingly to resist rocking modes of vibration. Anchor bolts should be carefully located by a competent tradesman as wheel to inlet, bearing location and motor location are critical to final fan alignment. J or T type anchor bolts of sufficient size should be used and should be tied into the reinforcing bar for the foundation. Pipe sleeves may be incorporated when pouring the concrete. After the concrete is poured, a pipe sleeve with a diameter of 2 to 2½ times the anchor bolt diameter should be provided around the anchor bolt for final adjustment. The mounting surface of the foundation should be smooth for good shim contact. When deciding the thickness of the foundation, approximately 1 to 1½" height should be allowed for shimming, grouting, leveling, washers, nuts, etc. The above represents industry best practice. Actual foundation design should be entrusted to a qualified engineer. Anchor bolts should be accurately placed to coincide with the predetermined fan securing holes, or the manufactured base, to ensure that the fan is not distorted (this may impact alignment and vibration.)





Fan mounted on an Inertia Base
Base and pedestal shown filled with reinforced concrete.

Fans mounted on a sub-floor or mezzanine must have adequate stiffness or be mounted on an inertia base with springs properly selected. An inertia base is recommended for arrangement 8 fans to ensure alignment of the rotor and drive.

If a structural steel base or platform is to be used, the structure must be designed for the weight of the fan, live loads imposed by rotation of the rotor and driver, and any external live loads. The structure should be designed to ensure that no natural frequency will occur within 30% of the fan speed. This is especially true if the structure supports more than one fan. Inertia bases are generally recommended to provide adequate mass and stiffness for fan operation.

Any ducting should have independent support. Do not use the fan to support ducting as the housing or pedestal may become distorted. The fan frame can be designed to carry some external loads. Consult the factory if this is a concern. Isolating the fan from ductwork with flex connections eliminates transmission of vibration. Fans handling hot gases require expansion joints at both the inlet and discharge to prevent excessive loads caused by thermal growth.

Fan Installation – Factory Assembled Units (refer to lifting/safety section)

All fan wheels are statically and dynamically balanced using state of the art equipment in the factory. Final trim balancing is performed on factory assembled fans, unless the specified electrical characteristics of the motor are outside the limits of the factory test equipment. If the motor and drives are supplied, the complete assembly is run tested and balanced. Infrequently, fans are supplied with unusual electrical characteristics and cannot be tested with the motor. In this situation the fans are run and balanced using a factory driver. Likewise, if motors and/or drives are not supplied, the fan is tested with the factory driver. Final balancing, at the buyer's expense, should be performed in the field after the motor and/or drives are installed. This service is available from TCF, otherwise this should be entrusted to a qualified technician.

Follow proper handling instructions as given earlier.

1. Move the fan to the final mounting position.
2. Remove skid, crates and packing materials carefully.
3. If vibration isolation is to be used, place isolation base on mounting bolts. Line up holes in fan base with bolts. See Item 10 in the "Optional Accessories" section for preparing inertia bases for use.
4. Place the fan on mounting structure. Carefully level the unit (checking the level on the shaft) on the foundation and shim as necessary using stainless steel shims on both sides of each anchor bolt. Back off leveling nuts if used. Be careful not to force the fan to the mounting structure/ foundation. This may cause the bearings to become misaligned or pinched causing vibration and premature failure.
5. Check the alignment of the bearings. Shim or reposition the bearings if necessary.
6. Check alignment of sheaves on belt driven fans.
7. Check tension of belts to see if it is sufficient. Sheaves on belt driven fans are often provided with taperlock bushings. When tightening bushing bolts, proceed in a progressive manner to avoid cocking the tapered surfaces between the bushing and the sheave. Torque per tables on the right.

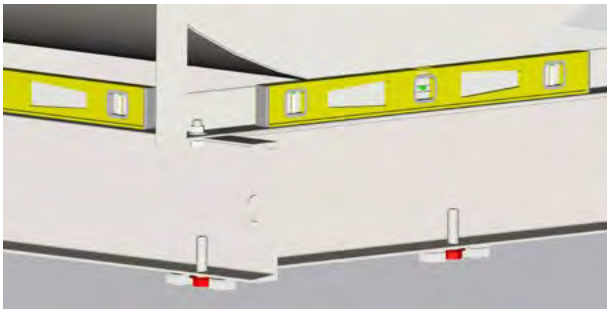
Click To View Our Sheave Installation video

8. Check alignment of factory mounted couplings, as they are subject to misalignment during shipment and installation. Realign to within 0.002" offset and parallel. Allow for thermal growth of the motor by setting the motor 0.001" low for each inch of shaft up to 0.005".

NOTICE

Most couplings need lubrication.

9. Check the tightness of the wheel on the shaft. Check the tightness of foundation bolts, motor bolts, sheaves, and bearings. Make sure there is no rubbing or binding and that the wheel-inlet cone clearances and overlap are correct.
10. Check that bearings are fully lubricated and check the oil level in the static oil lube systems. For spherical roller bearings with split pillow block housings, the bottom half of the housings should be 1/3 full of grease. For oil lube bearings, the oil level should submerge the bottom-most roller halfway into the oil.
11. Install any accessories shipped loose from the factory.



Carefully level the fan on the foundation

Tightening Torque

SIZE	FASTENER - TIGHTENING TORQUE (Ft. Lbs.)		
	GRADE 2	GRADE 5	GRADE 8
#10	—	—	—
¼-20	5.5	8	12
5/16-18	11	17	25
⅜-16	22	30	45
7/16-14	30	50	70
½-13	55	75	110
9/16-12	—	—	—
⅝-11	100	150	200
¾-10	150	270	380
⅞-9	165	430	600
1-8	250	645	900
1¼-7	500	1120	1500

SIZE	TAPER BUSHINGS - TIGHTENING TORQUE (Ft. Lbs.)		
	SPLIT		QD
	IN IRON	IN ALUM. HUB	FOR DRIVE
#10	—	—	6
¼-20	7.9	7.5	9
5/16-18	16	13	15
⅜-16	29	24	30
7/16-14	—	—	—
½-13	70	—	60
9/16-12	—	—	75
⅝-11	140	112	135
¾-10	—	—	—
⅞-9	—	—	—
1-8	—	—	—
1¼-7	—	—	—

The above torque values are for nonlubricated fasteners and Browning Bushings. For bearing setscrews, use manufacturer's recommendations. If other bushings are used, utilize bushing manufacturer's specifications.

Tolerance: +/- 5%
For wheel setscrews use Grade 2 values.

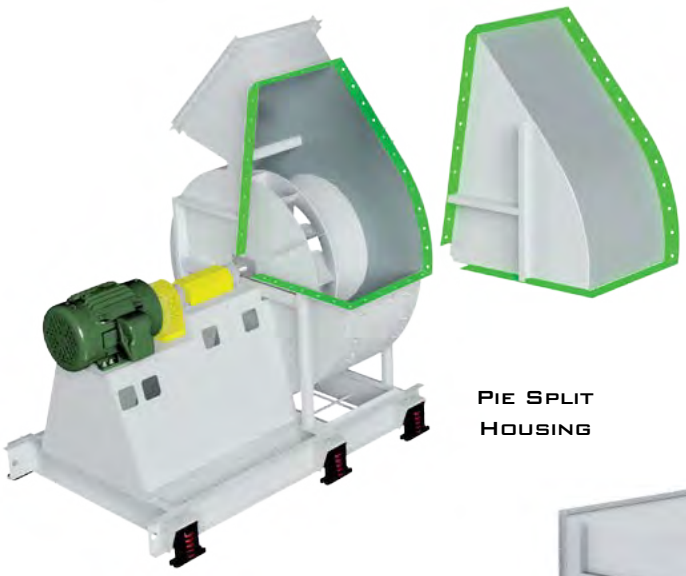
Fan Installation – Disassembled Units With Split Housings

(refer to lifting/safety section)

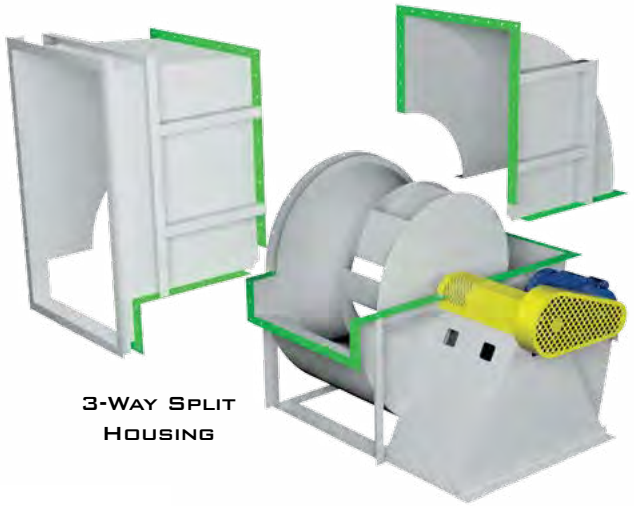
A unit is considered "disassembled" if any component required for proper operation is shipped or supplied separately or in pieces. Reference earlier instructions concerning proper handling of fan components and general safety. Wheel rotation is important. Rotation is viewed from the drive side unless otherwise noted on the drawing.

All units where assembly of the fan housing or bearing pedestal or drive stand is required will have tags or matchmarks on adjacent parts. These are used to identify which components are joined together. Units which require extensive assembly may require additional instructions located in other sections of this manual. Special instructions for some components and accessories are sent with the shipment.

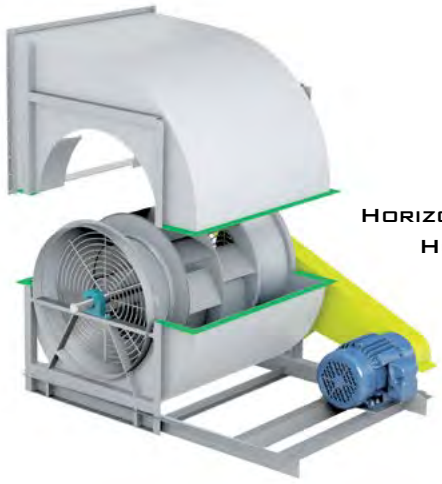
1. Move the lower half of the housing to its mounting location.
2. Remove skids, crates, and packing materials carefully.
3. If vibration isolation is to be used, place the vibration isolation base on mounting bolts. Line up holes in fan base with bolts. See Item 10 in the "Optional Accessories" section for preparing inertia bases for use.
4. Place the lower housing on the mounting structure. Carefully level the lower housing on the foundation and shim as necessary using stainless steel shims on both sides of each anchor bolt. **IMPORTANT: Back off leveling nuts if used.**
5. If the bearing pedestal(s) are separated they should be installed next.
   a. Move bearing pedestal(s) to mounting location.
   b. Set pedestal(s) on bolt(s).
   c. Do not distort bearing pedestal by forcing it to align with a non-level foundation. (The concrete foundation should be properly dressed.) Place shims on either side of the foundation studs and back off leveling nuts.
   d. Check the bearing centerline height. Adjust the height to match centerline height of the housing. High temperature units may require a lower housing centerline/inlet when cold so that it will be centered when hot.
   e. Bring the bearing pedestal into square with the housing using careful measurements or a large square.
   f. Shim and bolt the pedestal into position.



Pie Split Housing



3-Way Split Housing



Horizontal Split Housing

Fan Installation – Disassembled Units With Split Housings (Cont.)

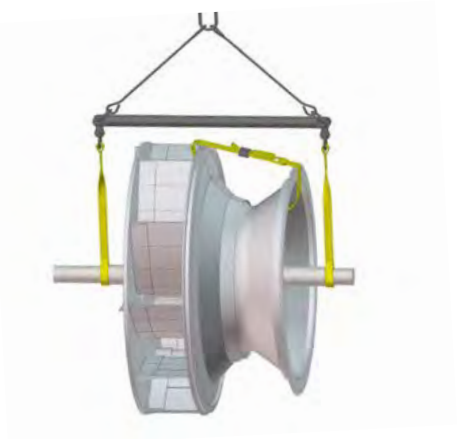
(refer to lifting/safety section)

6. If the wheel and shaft were shipped unassembled, you must now install the shaft in the wheel.
   a. First use solvent to clean the protective coating off the shaft. Check all surfaces for corrosion or nicks and clean if necessary with fine emery cloth or a stone. After thoroughly cleaning the shaft with solvent, do not touch it with bare hands as perspiration can cause rust or pitting over time.
   b. Remove keys from the shaft.
   c. Clean the inside of the wheel bore with solvent. Make sure the setscrews will not interfere when inserting the shaft into the wheel bore.
   d. Insert the shaft into the wheel from the back side of the wheel.
   e. When the shaft is flush with the wheel hub (Arr. 1, 9 and 8), dress the key if necessary, insert into the keyway and tighten the wheel setscrews.
   f. For Arrangement 3 fans, refer to the drawing for appropriate wheel and shaft dimensional relationship.
   g. Check the assembly drawing to make sure that the wheel and shaft have been assembled correctly.

Click To View Our Wheel Installation/Removal Video

Click To View Our Rotor Installation/Removal Video

7. The rotor can now be installed in the housing. Slide the bearings on if they are solid pillow blocks or loosely mount the bottom halves if they are split. Inlet vanes and/or inlet funnels may need to be installed over the shaft before installing and bolting the bearings to their supports (Arr. 3 and 7). Insert the inlets into the wheel inlet and tie them off for lifting and placing in the housing. Refer to steps 8 and 9 for order of assembly of components for double width and single width fans. The shaft should be cleaned and oiled where it will contact the bearings. Carefully lower the shaft assembly into the bearings. Use care when lowering the shaft onto the bearings so thrust bearings, collars, and liners are not damaged due to misalignment. The bearing housing should be parallel to the axis of the shaft to prevent loads caused by misalignment. Precision shim bearings as required. Lock bearings. Be sure expansion bearing (if supplied) is set to allow for thermal growth. Refer to bearing installation instructions in this installation manual.



8. Arrangement 3 (split-housed) units:
   a. Parts on a DWDI unit are assembled in the following order as viewed from opposite drive side: bearing bar assembly (or independent pedestal) and opposite bearing, funnel (housing side), wheel (housing side), funnel, drive side bearing bar assembly (pedestal), drive bearing and sheaves or coupling. Mount bearing bar assembly to housing. Center wheel in funnels.
   b. Assemble parts in above order on shaft.
   c. Proceed with connection of the shaft assembly to supports in step 7 above.
9. Parts on a SWSI unit are assembled in the following order as viewed from opposite drive side: bearing bar assembly and opposite bearing, funnel (housing side), wheel (housing side), drive side bearing bar assembly, drive bearing and sheaves. Mount bearing bar assembly to housing. **Refer to the wheel-funnel overlap section.**
   a. Assemble parts in above order on shaft.
   b. Proceed with connection of the shaft assembly to supports in step 7.
10. Install motor on the base if applicable. Carefully align shafts for drive installation.

Fan & Blower Twin City

Bearing Installation (refer to safety section)

The following section gives some general instructions on bearing installation. If bearings are to be field installed, the specific installation manual for the bearings will be provided and should be followed carefully. If provided, check the assembly drawings and bearing manufacturer's instructions for location of the fixed and expansion bearings. The positions of these bearings cannot be interchanged. Always follow the bearing manufacturer's instructions.

Solid Pillow Block

1. Lightly lubricate the bearing bore and slide bearing into the proper position on the shaft. Sling the rotor assembly into place and loosely bolt the bearings in place.
2. When bearings are in place, shim appropriately and torque the base bolts using values from the Tightening Torque table on page 9. Tighten the collar setscrews to manufacturer's specification. The setscrews on both bearings should be aligned with one another. If the bearing has an adapter mount, hand tighten the locknut to establish the "zero" point. Next, tighten the number of turns per the instructions furnished with the bearing. Rotate by hand to be sure the bearings and shaft rotate freely.
3. Ensure the expansion bearing is centered within its housing. If bearings need to forced onto the shaft then apply force on the inner race/collar only (does not apply to adapter mount.) If an expansion bearing has been supplied, it should not be bolted to the pedestal until the fixed bearing has been bolted and locked. After locking the expansion bearing to the shaft, position the pillowblock to allow for axial expansion, approximately centered in the pillowblock, then bolt to the pedestal.
4. Unless the user orders differently, bearings are lubricated in the factory with a lithium complex, NLGI grade 2 grease. **Refer to the bearing lubrication schedule on the next page.**

Solid Pillow Block Bearings

Split Pillow Block Bearings

Spherical Roller Bearings with Split Pillow Block Housings

1. The bearings should be disassembled, taking care not to interchange parts between bearings. Tops of housings are not interchangeable with the bottom half pillowblock from another bearing. Pins locate the top half of the housing to prevent it from being installed in the reverse.
2. The lower bearing housing should be bolted loosely to the pedestal and seals; bearing and adapter sleeve should be placed loosely on the shaft.
3. The rotor assembly with the seals and bearings should next be positioned over the housings and carefully placed into the lower housings.
4. The stabilizing ring, sometimes referred to as the "C" ring, is installed in the bearing closest to the drive sheave or coupling unless otherwise noted in the drawing. The bearing race should be centered in the expansion bearing. The exception may be on Arrangement 3 or 7 fans with a high operating temperature. Refer to the fan drawing for location. The "C" ring is not used in the expansion bearing.
5. When installing adapter sleeves, tighten for reduction in clearance per manufacturer's instructions.
6. Bend down a tab on the lockwasher after finishing adjustment. Some brands of bearings do not utilize a lockwasher. Instead you will find allen-head setscrews in the locknut outside diameter. Tighten the setscrew after reduction in clearance is attained.
7. Grease or oil according to manufacturer's instructions. Grease/Lube will likely include the partial fill of the housing internal cavities.
8. Install the bearing housing cap bolts and bearing mounting bolts. Tighten bearing housing cap bolts and bearing mounting bolts. Torque to bearing manufacturer's instructions.

Sleeve Bearings

1. The bearings should be disassembled and cleaned with appropriate solvent, taking care not to interchange parts between bearings. Parts of one bearing are generally not interchangeable with parts from another bearing. Bearing caps are matched to the bottom half of the pillowblock and are not interchangeable with other pillowblocks.
2. The lower bearing housings should be bolted loosely to the pedestal. The lower liner should then be placed in the housing.
3. Oil the lower liners per manufacturer's instructions and carefully sling the rotor assembly into place, being very careful not to damage the bearing liners.
4. Install thrust collars and thrust plates in the fixed bearing
5. Make sure to install the oil slinger rings in their correct location and peen the ring screws in place.
6. When handling the liners, be careful not to damage the surfaces, as they are babbitted and are fragile.
7. The housings are generally tapped with a number of ports. Be sure the oil level gauge, circulating oil supply and discharge, thermocouples, etc., are correctly placed for accessibility.
8. Make sure that proper oil type and quantity is used. Refer to the fan general assembly drawing.
9. Make sure that the thrust collar screws, liner screws, cap bolts, and plunger are torqued to manufacturer's specifications. Bearing instructions are shipped with the fan. Instructions can also be found on the bearing manufacturer's website.

Safety & Bearing Lubrication Instructions

WARNING

1. **This equipment must not be operated without proper guarding of all moving parts. While performing maintenance be sure remote power switches are locked off. See installation manual for recommended safety practices.**
2. **Before starting: Check all setscrews for tightness and rotate wheel by hand to make sure it has not moved in transit.**

Fans with Unit Roller Bearings

Relubrication Schedule (Months)* Spherical Roller Bearing - Solid Pillow Blocks									
Shaft DIA	Speed (RPM)								
	500	1000	1500	2000	2500	3000	3500	4000	4500
1" thru 1 7/16" (25 – 35)	6	4	4	2	1	1	1	1	1/2
1 11/16" thru 2 3/16" (40 – 55)	4	2	1 1/2	1	1/2	1/2	1/2	1/2	1/2
2 7/16" thru 3 3/16" (60 – 85)	3	1 1/2	1	1/2	1/2	1/4	1/4		
3 15/16" thru 4 15/16" (90 – 125)	2 1/2	1	1/2	1/4					

*Suggested lubrication interval under ideal continuous operating conditions. Relubricate while running, if safety permits, until some purging occurs at seals. Adjust lubrication frequency depending on conditions of purged grease. Use one-half of listed interval for vertical shaft applications or for 24 hour operation. Hours of operation, temperature, and surrounding conditions will affect the relubrication frequency required.

1. Lubricate with a high quality NLGI No. 2 lithium-base grease having rust inhibitors and antioxidant additives, and a minimum oil viscosity of 500 SUS at 100°F (38°C). Some greases having these properties are:
   Shell - Gadus S2 V100 2 — Mobil - Ronex MP
   Mobil - Mobilith SHC100 — Mobil - Mobilith SHC220
2. Lubricate bearings prior to extended shutdown or storage and rotate shaft monthly to aid corrosion protection.

Fans with Ball Bearings

Relubrication Schedule (Months)* Ball Bearing Pillow Blocks									
Shaft DIA	Speed (RPM)								
	500	1000	1500	2000	2500	3000	3500	4000	4500
1/2" thru 1 11/16" (13 – 45)	6	6	5	3	3	2	2	2	1
1 15/16" thru 2 7/16" (50 – 60)	6	5	4	2	2	1	1	1	1
2 1/16" thru 2 15/16" (65 – 75)	5	4	3	2	1	1	1		
3 3/16" thru 3 15/16" (80 – 100)	4	3	2	1	1				

*Suggested lubrication interval under ideal continuous operating conditions. Relubricate while running, if safety permits, until some purging occurs at seals. Adjust lubrication frequency depending on conditions of purged grease. Use one-half of listed interval for vertical shaft applications or for 24 hour operation. Hours of operation, temperature, and surrounding conditions will affect the relubrication frequency required.

1. Lubricate with a high quality NLGI No. 2 lithium-base grease having rust inhibitors and antioxidant additives, and a minimum oil viscosity of 500 SUS at 100°F (38°C). Some greases having these properties are:
   Shell - Gadus S2 V100 2 — Mobil - Ronex MP
   Mobil - Mobilith SHC100 — Mobil - Mobilith SHC220
2. Lubricate bearings prior to extended shutdown or storage and rotate shaft monthly to aid corrosion protection.

Fans with Spherical Roller Bearings with Split Pillow Block Housings

Relubrication Schedule (Months)* Spherical Roller Bearing - Split Pillow Blocks										Grease to be added at each interval
Shaft DIA	Speed (RPM)									
	500	750	1000	1500	2000	2500	3000	3500	4000	
1 7/16" thru 1 15/16" (35 – 50)	6	4 1/2	4	4	3 1/2	2 1/2	2 1/2	1	1	0.50 oz.
2 3/16" thru 2 13/16" (55 – 70)	5	4 1/2	4	2 1/2	2 1/2	1 1/2	1/2	1/4	1/4	0.75 oz.
2 15/16" thru 3 15/16" (75 – 100)	4 1/2	4	3 1/2	2 1/2	1 1/2	1	1/2			2.00 oz.
4 7/16" thru 4 15/16" (110 – 135)	4	4	2 1/2	1	1/2					4.00 oz.
5 7/16" thru 6 15/16" (140 – 180)	4	2 1/2	1 1/2							8.5 oz.

*Suggested lubrication interval under ideal continuous operating conditions. Remove bearing cap and observe condition of used grease after lubricating. Adjust lubrication frequency as needed. Use one-half of listed interval for vertical shaft applications or for 24 hour operation. Hours of operation, temperature, and surrounding conditions will affect the relubrication frequency required. Clean and repack bearings annually. Remove old grease, pack bearing full and fill housing reservoir on both sides of bearings to bottom of shaft.

1. Lubricate with a high quality NLGI No. 2 lithium-base grease having rust inhibitors and antioxidant additives, and a minimum oil viscosity of 500 SUS at 100°F (38°C). Some greases having these properties are:
   Shell - Gadus S2 V100 2 — Mobil - Ronex MP
   Mobil - Mobilith SHC100 — Mobil - Mobilith SHC220
2. Lubricate bearings prior to extended shutdown or storage and rotate shaft monthly to aid corrosion protection.
3. Purge or remove old grease when changing lubrication brands or types.

Static Oil Lubrication

1. Use only high quality mineral oil with a VG grade indicated on the customer submittal drawing.
2. Static oil level should be at the center of the lower-most roller. (Do not overfill.)
3. Complete lubrication change should be made annually.

Fan & Blower Twin City

Drive Mounting
(refer to safety section)

Mount drives as follows:

1. Slip (do not pound) proper sheave onto corresponding shaft. Most drives utilize tapered bushings. Draw the bushing up evenly tightening in steps. To minimize bearing loading, mount sheaves as close to bearings as possible. It is preferable to use alignment tools that align the grooves of the sheave.

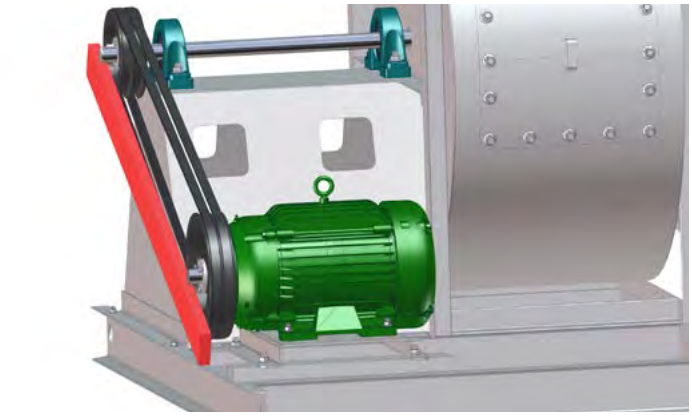
2. Laser alignment is common. The mechanic must be familiar with the alignment tool he is using. Otherwise, align sheaves with straightedge extended along sheaves, just making contact in two places on outside perimeters of both sheaves. This "four-point" alignment may also be checked with a string tied to the shaft behind one of the sheaves. The string is then pulled taut over the faces of the sheaves to check the alignment at the four points at the outside perimeters. Each sheave should be rotated about one-half revolution during this check to look for excessive runout or a bent shaft. Unless there is a bent shaft, runout can be corrected by adjustments to the bolt torque of the taper bushing.

3. Install and tighten the belts. Run the drive for a few minutes to seat the belts. When fitting the belts, slide the motor in to fit the belts on. Do not use a pry bar, as this may damage the belt cords. Tighten the belts to the proper tension. Ideal tension is just enough tension so that the belts do not slip under peak load or acceleration. Many drives are provided with tensioning data which identifies the load to apply at the center of the span and the allowable deflection from this force. A belt tension gauge is recommended for precise tensioning.

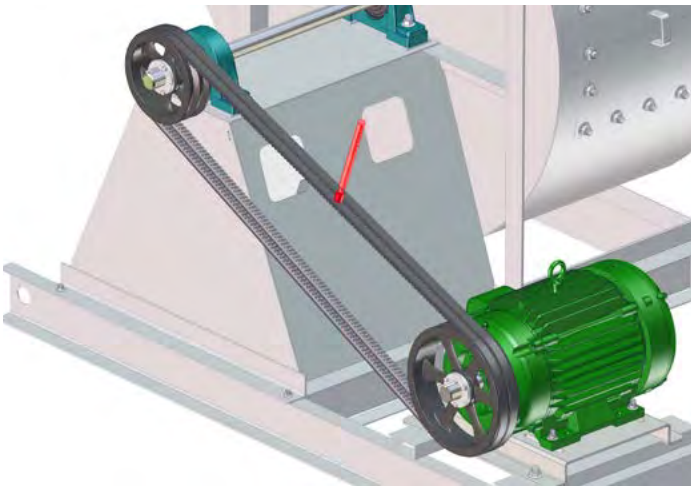
4. After initial installation of belts, recheck belt tension again after a few days of operation to adjust belt tension. (New belts require a break-in period of operation.)

WARNING

When working around belts and pulleys, keep hands away from pinch points.



Click To View Our
Sheave Installation video



CAUTION

Placing fan sheave on motor can overspeed wheel and cause structural failure.

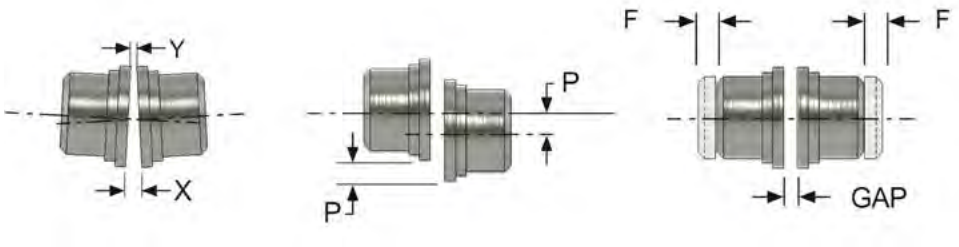
Fan & Blower
Twin City

Flexible Couplings (refer to safety section)

These instructions are general for the installation of several types of flexible couplings and should not be used as a substitute for more specific manufacturer's instructions. The coupling manufacturer's installation data is available and will give specific dimensions for alignment limits, lubricants, etc. Refer to Item 7 in "Factory Assembled Units" section for coupling alignment requirements.

Before preparing to mount the coupling, make sure that all bearings, inlet vanes, shaft seals, or other components have been installed on the shaft.

When mounting and keying the coupling halves to the shaft, follow supplied instructions for heating and shrink fitting. Set the coupling halves for the normal gap specified by the manufacturer. Coupling gap is illustrated below. It is advisable to set the motor on the pedestal first to better determine the placement of the coupling on the shaft.



ANGULAR MISALIGNMENT | **PARALLEL MISALIGNMENT** | **GAP AND END FLOAT**

X-Y = ANGULAR MISALIGNMENT
P = PARALLEL OFFSET (MISALIGNMENT)
F = END FLOAT*

The two types of misalignment are illustrated above. Alternatively angular alignment is checked with feeler gauges between the hub faces. When angular alignment has been adjusted to manufacturer's specification, parallel alignment can be checked with a dial indicator on the hub or a straightedge and feeler gauges on the hub halves' O.D. When shimming has brought parallel alignment within specification, angular alignment and gap should again be checked, and adjustments made if necessary. A dial indicator or laser alignment may be used to more accurately take the measurements described above.

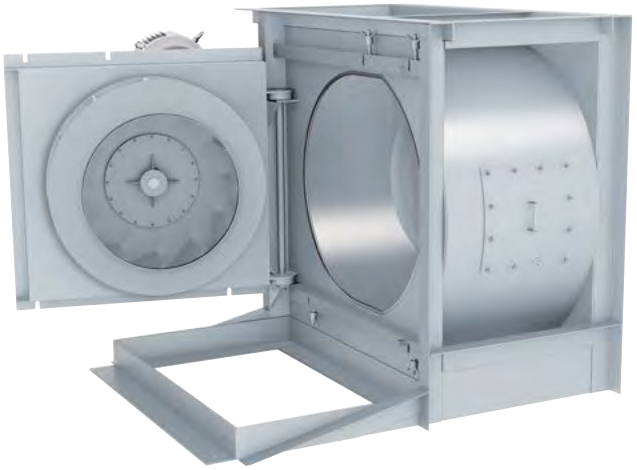
Special adjustments may need to be made for couplings used with some equipment. As an example, when used with motors with sleeve bearings, couplings may require provisions for limiting end float. Larger drivers may grow in operation (due to heat expansion) requiring the driver side to be set slightly low when not operating. A good rule of thumb is to set the motor low by 0.001 inches per inch of motor shaft diameter up to 0.005". Refer to specific instruction manuals or assembly drawings.

Thoroughly clean the coupling halves after completion of alignment. Reassemble the coupling and tighten bolts, washers and locknuts. Lubricate per manufacturer's recommendations.

* 1. End float is the permissible axial movement of the coupling hub(s) within the sleeves of the coupling
2. End float will allow for thermal movement
3. Limited end float couplings are often required in applications using Motors with sleeve bearings

Maintenance (refer to safety section)

Develop a regular maintenance schedule according to your needs and the criticality of the fan. Periodic inspections, lubrication, observations of sound and vibration will help prolong the life of the fan. If changes are noted check bolt tightness, foundation integrity, cleanliness of the wheel and or motor, bearing lubrication, drive components. Always keep records of the maintenance that is performed.



CAUTION

1. **Swingout fans should be opened for wheel cleaning and inspection only and should be closed immediately after cleaning. Isolate from the electrical supply before opening.**
2. **Do not run swingout fans the fan in the open position.**

Motor Maintenance

The three basic rules of motor maintenance are:

1. Keep the motor clean.
2. Keep the motor dry.
3. Keep the motor properly lubricated.

Blow dust off periodically (with low pressure air) to prevent motor from overheating.

Motor Lubrication Schedule

Motors Less than 10HP Running 8 Hrs/Day (clean environments)	Motors Between 15-40HP (clean environments)	Motors Running 24/7 or if in dirty/dusty environments
Lube every 5 Years	Lube every 3 years	Divide the service interval by 4

Do not over lubricate.

Some smaller motors are lubricated for life. Lubrication requirements are normally attached to the motor. Use the motor manufacturer's recommendations for relubrication. Often motor lubricants are not the same as the fan bearings. If this information is not available, the following schedule may be used.

Shaft grounding rings are recommended for some VFD applications. If the motor is equipped with a shaft grounding ring a yearly inspection for wear and shaft corrosion is recommended. Replace the ring if it is making minimal contact with the shaft. If corrosion is present, treat the shaft with colloidal silver per the ring manufacturer's instructions.

Drive Maintenance (refer to safety section)

V-belt drives need periodic inspection, retensioning and occasional belt replacement. When inspecting drives, look for dirt buildup, burrs or obstructions that can cause premature belt or drive replacement. If burrs are found, use fine emery cloth or a stone to remove them. Be careful that dust does not enter the bearings.

WARNING

When working around belts and pulleys, keep hands away from pinch points.

Check sheaves for wear. Excessive slippage of belts on sheaves can cause wear and vibration. Replace worn sheaves with new ones. Carefully align sheaves to avoid premature sheave failure. If fraying or other wear is observed to be mostly on one side of the belts, the drives may be misaligned. Realign and reinstall new belts. Tighten sheave bolts (or setscrews if appropriate).

When replacing belts, replace the entire set. Never use belt dressing on any belts, as it may cause belt wear.

Fan Bearing Maintenance (refer to safety section)

Proper lubrication of the fan drive bearings helps assure maximum bearing life. All fans are equipped with decals indicating the recommended relubrication intervals for normal operating conditions. **Refer to the Bearing Installation section for the lubrication schedules for ball bearings, solid pillow block spherical roller bearings and split pillow block spherical roller bearings.** Note that all speeds shown do not apply to all shaft sizes in that group. Consult the factory if in doubt of maximum speed for a particular bearing. Note that every installation is different and the frequency of relubrication should be adjusted accordingly.

Use 1/2 to 1/3 of the listed lubrication interval for high moisture applications. For vertical shaft mounts or dirty conditions use 1/2 the lubrication schedule.

Observation of the conditions of the grease expelled from unit ball or roller bearings at the time of relubrication is the best guide as to whether regreasing intervals and amount of grease added should be altered. Spherical roller bearings with split pillow block housings should not be lubricated until grease purges or overheating may result. Follow the lubrication interval and amount noted in the Bearing Installation section. Spherical roller bearings with split pillow block housings should be serviced once per year. Remove cap, clean out old grease and replace by filling the bottom half of the housing 1/3 full.

Greases are made with different bases. There are synthetic base greases, lithium base, sodium base, etc. Avoid mixing greases with different bases. They could be incompatible and result in rapid deterioration or breakdown of the grease. The lubrication sticker identifies a list of acceptable lubricants. All bearings are filled with a lithium complex grease before leaving the factory. When the fans are started, the bearings may discharge excess grease through the labrinth seals for a short period of time. Do not replace the initial discharge because leakage will cease when the excess grease has worked out. Sometimes the bearings have a tendency to run hotter during this period. This is no reason for alarm unless it lasts over 48 hours or temperatures exceed 200°F. When relubricating, use a sufficient amount of grease to purge the seals. Rotate bearings by hand during relubrication. If extended lubrication lines are fitted, lubricate the bearings while the fan is operating if it is safe to do so.

Wheel and Shaft Maintenance (refer to safety section)

Periodically inspect the shaft and wheel for dirt buildup, corrosion, and signs of excess stress or fatigue. Clean the components. If the wheel is removed for any reason, make sure that it is securely attached to the shaft before restarting the fan.

Structural Maintenance (refer to safety section)

All structural components or devices used to support or attach the fan to a structure should be checked at regular intervals. Vibration isolators, bolts, foundations, etc., are all subject to failure from corrosion, erosion, and other causes. Improper mounting can lead to poor operation characteristics or fan fatigue and failure. Check metallic components for corrosion, cracks, or other signs of stress. Concrete should be checked to insure the structural integrity of the foundation.

Duct Connections
(refer to safety section)

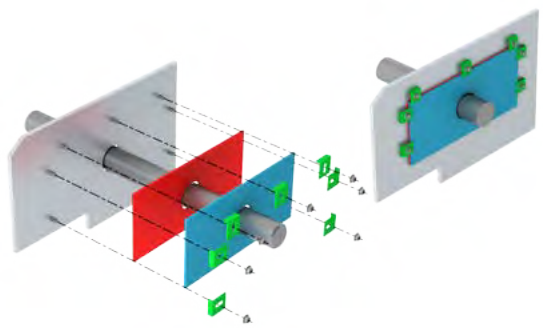
The fan support structure is normally not designed to carry loads imposed by the weight of ducts, silencers, stacks, etc. Supporting these loads on the fan can cause housing distortion and may cause performance or vibration problems. Use of flexible connections is recommended for all fans and imperative when using vibration isolation or handling high temperature gases.

Centrifugal Fan with Vibration Isolation & Flexible Duct Connectors

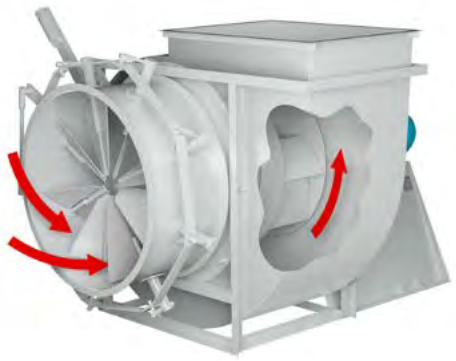
Optional Accessories

1. **Turning Gear** — A turning gear is sometimes used in high temperature applications where the fan is exposed to high temperature gases when not in operation. The wheel and shaft can expand unevenly due to the temperature when sitting idle, which can cause vibration at startup and/or a permanent set to the rotor. The turning gear slowly turns the fan from the outboard side while it is not operating, providing for even thermal expansion. It starts automatically when the fan shuts down and disengages automatically when the fan starts up again. More specific information will be provided for each application.

2. **Shaft Seals** — The standard shaft seal is a wire inserted fiberglass tacky cloth element retained with an aluminum retaining plate and clips. Other configurations of shaft seals are available for special applications, such as when it is necessary to keep the shaft seal as gas tight as possible. Shaft seal application manuals are provided in Fan Engineering FE-700 available on www.tcf.com. Other seals such as stuffing boxes, mechanical seals and carbon ring seals need special attention. It is imperative that after the fan has been leveled, shimmed, fastened to the foundation and ducted the shaft and seal be checked for concentricity and angularity. The seal must not bind when the shaft is rotated. Stuffing box packing material must not be compressed too tight by the gland or overheating will occur. Monitor temperature for a period of time. Connect a purge if specified. Carbon ring seals have pins which prevent ring rotation.



3. **Variable Inlet Vanes** — Variable inlet vanes are provided as assemblies internally in the inlet cone or externally in a flanged cylinder. The vanes are used to control volume and save power in installations where different volumetric operating conditions are used. Installation manuals are provided in other engineering supplements for specific fan types. Variable inlet vanes may be provided with powered operators in which case the manufacturer's installation and operating manuals will be provided. Inlet vanes are unidirectional. Vanes should be stroked periodically to prevent binding and possible seizure.



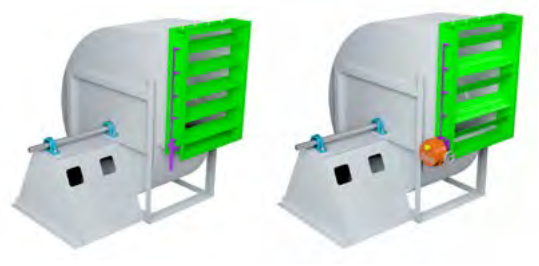
Orientation of Inlet Vanes Relative to Fan Rotation

4. **Inlet Box and Inlet Box Dampers** — Inlet boxes may be provided to allow transition from a duct to the fan inlet. Inlet box dampers may also be provided for volumetric regulation similar to inlet vanes. Dampers are usually provided as a complete assembly and are installed with the damper axles parallel to the fan shaft. They should be installed to pre-spin the air in the direction of fan rotation. Damage may occur if the fan is operated regularly with damper settings less than 30% open. Operation below 30% should be limited to start-up or occasional periods of low duration.

Orientation of Damper Blades As Related to Fan Rotation

Optional Accessories (cont.)

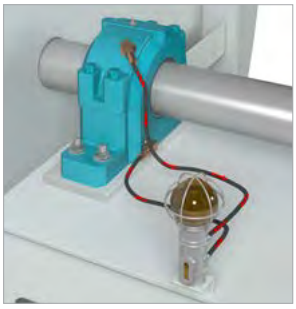
5. **Outlet Dampers** — Outlet dampers are usually provided completely assembled like the inlet dampers. The damper is bolted to the fan discharge for volume control.



6. **Shaft Cooler** — Also referred to as "heat slingers" or "cooling wheels," these are small, radially bladed aluminum wheels that are split and bolted for installation between the inboard bearing and fan housing. The cooling fins face the bearing for grease applications and away from the bearing for oil applications to prevent oil from being drawn out of the bearing.

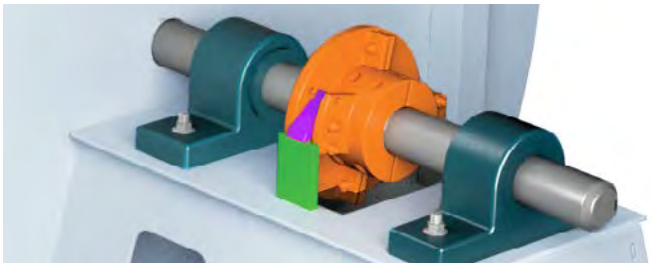
7. **Oil Circulating Systems** — Usually the following modifications will have to be made to the bearing if an oil circulating system is used.
   a. Four drain holes will be drilled in the bearing, two on each side of the bearing. Because of this, the bearing may be drained from either side. (Drain from both holes on one side of the bearing.)
   b. The bearing will be packed with grease to prevent corrosion until installed and started up. The drain holes will be plugged with plastic covers to make sure they are open. The customer MUST REMOVE most of the grease using solvent and remove the plastic covers prior to starting the oil circulating system.
   c. A wet sump can be added in case of circulating oil pump failure. Seals will be provided to accommodate the resultant splashing.
   d. The zerk on top of the bearing will be removed for that hole to be used as the oil inlet.

Oil Mist Lubrication System



Static Oil Lubrication System

8. **Anti-Rotation Clutch** — Damage will occur if the fan is operated in the wrong rotation. Run the motor uncoupled from the fan to establish the proper rotation.



Optional Accessories (cont.)

9. **Site-Feed Oilers** — Fans provided with optional, site-feed oilers, the oil level is to be set as indicated by the manufacturer's installation instructions provided with the fan.

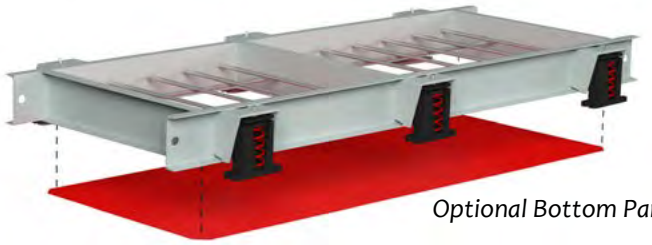
10. **Concrete Filled Bases:**

Inertia Bases – Inertia bases are spring isolated bases specifically designed to be filled with concrete (by others). The following instructions are a guide for filling a base with concrete. Remember to use safe practices when filling concrete into the base. It is best to fill concrete at or near the base's final resting area to reduce injury while transferring to the permanent location.

An inertia base is supplied with steel mesh or rebar added within the base frame with the intent of being filled with concrete and then mounted on springs. Bases may be supplied with or without an optional bottom pan (sealer sheet).

When an optional bottom pan is supplied from the factory, the base must be set on a flat, level surface with the bottom pan directly on the surface fully supporting the pan to maintain flatness on the bottom side. Pour concrete into the base and remove excess concrete on the top side of the base to maintain an even mounting surface for fan mounting. Be sure that the concrete has cured before lifting the base. Install isolators per the isolator installation manual.

Click To View Our
Inertia Base Installation Video

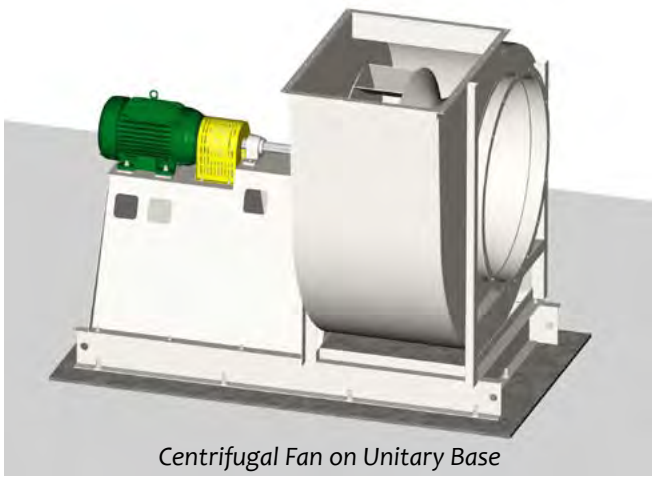


Optional Bottom Pan

When the optional bottom pan is not supplied, the base must be set on a flat, level surface that can fully support the weight of the concrete. Place a sheet of heavy-mil poly-film between the flat surface and the base frame. Pour concrete into the base and remove excess concrete on the top side of the base to maintain an even mounting surface for fan mounting. Be sure that the concrete has cured before lifting the base. Install isolators per the isolator installation manual.

Unitary Bases – Unitary bases are rigidly mounted to a foundation. Situations may arise where the base my require concrete to dampen vibration or increased stiffness. In situations where concrete must be added to the base the following guide must be utilized.

1. Rebar must be added to the cross section of the base (by others) so the concrete will have good adhesion points throughout the sections of the base. Typically rebar is installed at 12" centers however the placement of rebar should be reviewed for each individual application by a Civil Engineer if required.
2. Bases should be located in their final resting area prior to being filled with concrete. Bases should be shimmed and grouted. Once the grout is cured, concrete may be added. Pour concrete (by others) into the base and remove excess concrete on the top side of the base to maintain an even mounting surface for fan mounting.



Centrifugal Fan on Unitary Base

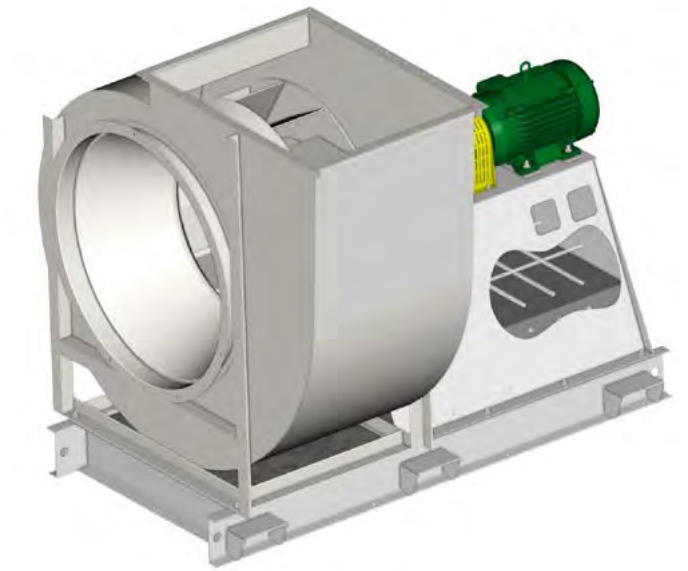
Click To View Our
Unitary Base Installation Video

Optional Accessories (cont.)

11. **Concrete Filled Pedestals** — Fans may require the bearing and/or motor pedestals to be filled with concrete (by others) for additional stiffness and rigidity, refer to the fan's drawing for requirements. Fans must utilize rebar in the pedestals so the concrete will have good adhesion points throughout.

    To fill the pedestal, the pedestal must be set on flat, level ground before concrete is added. It is recommended to locate the fan at the final location. The fan should be leveled, shimmed, and grouted prior to adding concrete.

    An optional bottom pan is available for the pedestal if it is unfeasible to add concrete at the final location. Pedestals must be placed on the ground for filling until the concrete cures. If no bottom pan is provided, a piece of plywood covered in plastic may be placed under the base while filling with concrete. Fill the pedestal with concrete (by others) to the level indicated on the drawings. After the concrete cures the fan may be installed. Do not utilize the fan's lifting lugs after concrete has been added to the fan. The lifting lugs are designed to lift the fan as it was shipped from the factory.

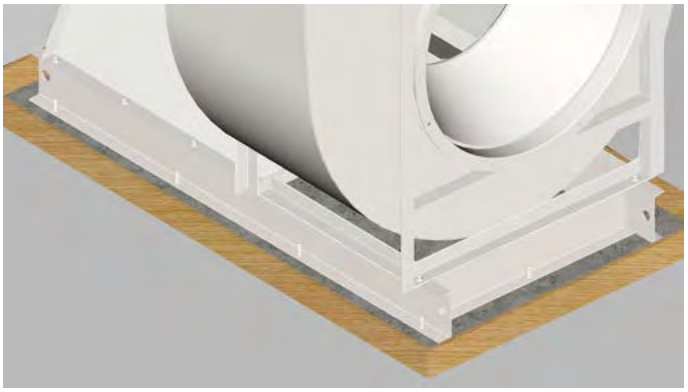


NOTICE

Concrete cure time varies depending on the base size, ambient temperature and cement mixture requested. Be sure concrete is 100% cured prior to moving equipment.

Grouting

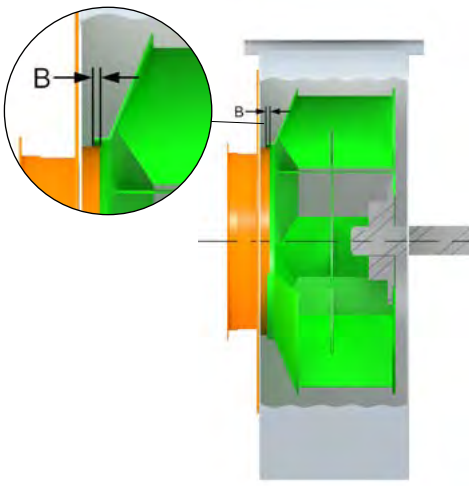
Grouting is the final installation step. Check all shims before grouting to make sure that the fan is resting evenly on all points with anchor bolts secured to hold the shim. Back off leveling nuts if used. Use forms with sufficient space allowed for working the grout. The concrete foundation should be clean and well moistened before pouring grout. Use a commercial grade nonshrinking grout and be especially sure when pouring grout that the anchor bolt sleeves are filled. Prior to grouting, set a section of pipe (conduit, steel pipe or plastic) through the grout as a form in the low point which is able to wick/drain out the excess moisture. Refer to the Foundations and Supporting Structures section in the installation manual for a detail of a proper foundation, grout allowance and anchor bolt sleeves.



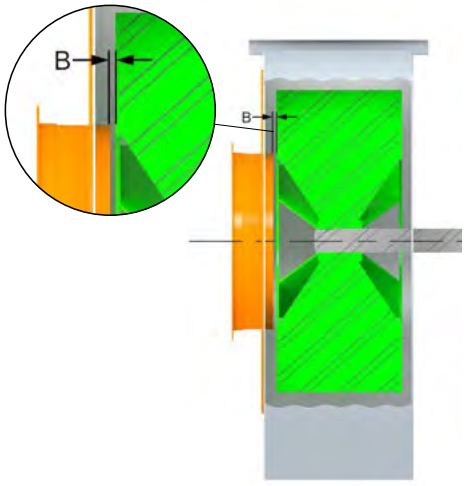
Serial Number & Fan Type

The serial number and fan type can be found on our permanent nameplate of the fan.

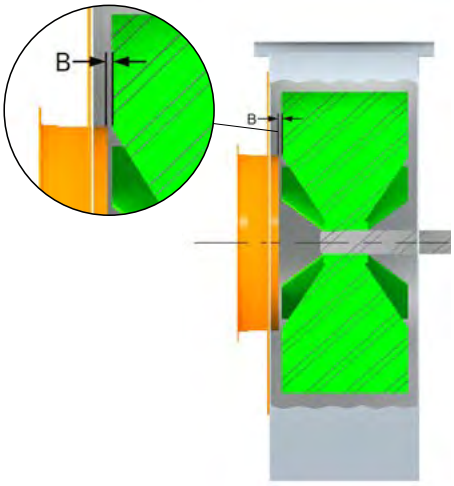
Wheel Placement



Model RBA



Model RBR

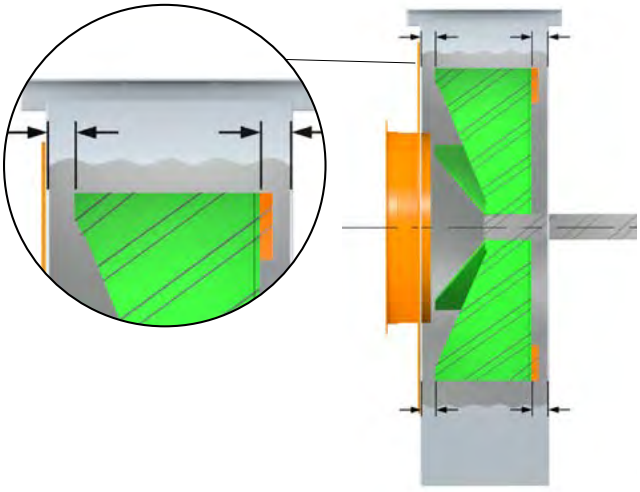


Model RBO

RBA Wheel Overlap																		
Size	907	909	911	913	915	917	919	921	923	926	929	933	937	941	945	949	954	960
B	0.25	0.38	0.47	0.53	0.59	0.69	0.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

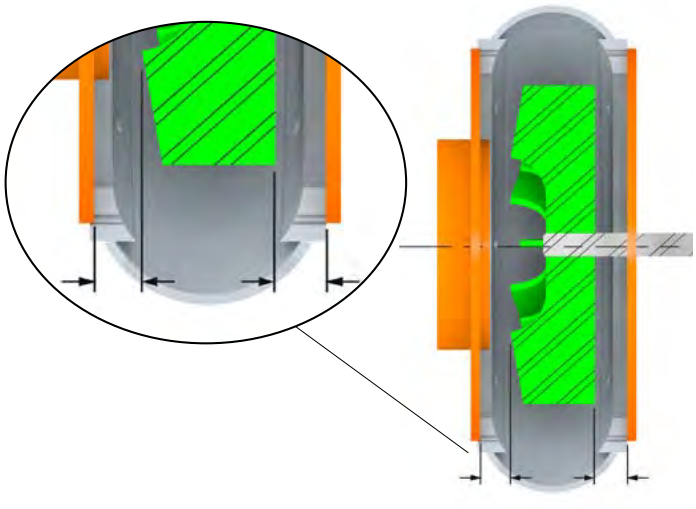
RBO, RBR Wheel Gap															
Size	913	915	917	919	921	923	926	929	933	937	941	945	949	954	960
B	0.53	0.53	0.59	0.69	0.78	0.88	0.97	1.03	1.22	1.38	1.56	1.69	1.81	1.88	2.16

Note: On Sizes 905-911 RBO and RBR wheel is to be centered in housing.



Model JRW, RBW, RBP

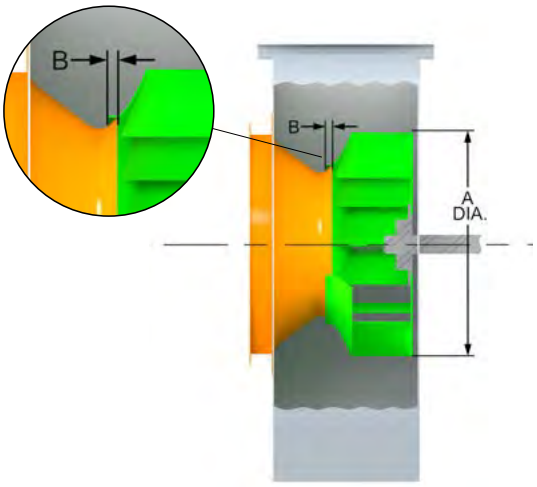
JRW, RBW, RBP Wheel Placement
Center wheel in housing. Do not include the backplate fins for centering.



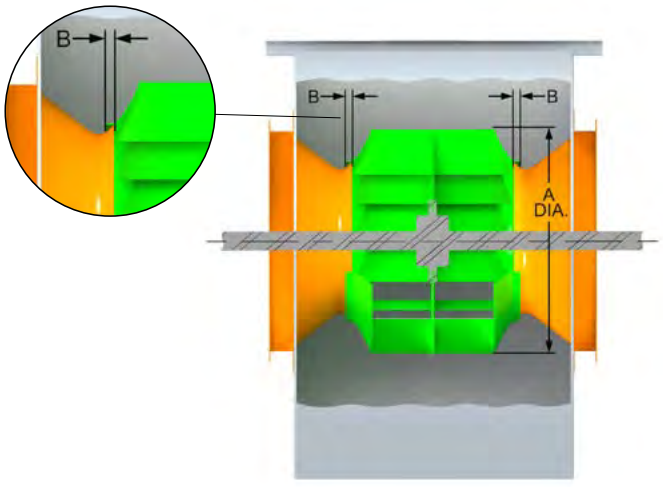
Model CIW

CIW Wheel Placement
Center wheel in housing.

Wheel Placement



Models BC-SW, BAF-SW, BAE-SW, BCS, HIB, BAV, RTF, HRT, HAF, BCV, DCV, TCBI



Models BC-DW, BAF-DW, BAE-DW

BC-SW, BC-DW, BAF SWSI & DWDI, BCS, BCV (Class I & II), DCV Wheel Overlap																					
Size	105	122	135	150	165	182	200	222	245	270	300	330	365	402	445	490	542	600	660	730	807	890
A	10.50	12.25	13.50	15.00	16.50	18.25	20.00	22.25	24.50	27.00	30.00	33.00	36.50	40.25	44.50	49.00	54.25	60.00	66.00	73.00	80.75	89.00
B	0.28	0.31	0.34	0.38	0.38	0.47	0.52	0.55	0.59	0.67	0.75	0.82	0.72	0.90	1.00	1.10	1.25	1.24	1.36	1.88	2.09	2.28

BAV, BAE-SW & BAE-DW Wheel Overlap																						
Size	122	135	150	165	182	200	222	245	270	300	330	365	402	445	490	542	600	660	730	807	890	982
A	12.25	13.50	15.00	16.50	19.00	20.82	23.16	25.51	28.11	31.23	34.36	38.00	41.90	46.33	51.01	56.48	62.47	68.71	73.00	80.75	89.00	98.25
B	0.31	0.34	0.38	0.44	0.38	0.41	0.45	0.50	0.55	0.61	0.67	0.75	0.82	0.91	1.00	1.11	1.23	1.35	1.50	1.65	1.82	2.02

Note: On swingout fans, the wheel and funnel should be positioned as close as possible (max gap 1/8") such that the door can be opened without the wheel and funnel interfering.

BCV (Class L) Wheel Overlap	
Size	B
090-105	0.28
122	0.31
135	0.34
150	0.38
165	0.44
182	0.56
200	0.63
222	0.69
245	0.75
270	0.88
300	0.97
330	1.06
365	1.31

HRT Wheel Overlap			
Size	A	B (Design 19)	B (Design 23)
270	27.00	0.50	0.50
300	30.00	0.69	0.69
330	33.00	0.69	0.69
360	36.50	0.81	0.81
400	40.25	1.03	0.97
450	44.50	1.13	1.06
490	49.00	1.25	1.13
540	54.25	1.38	1.25
600	60.00	1.31	1.31
660	66.00	1.56	1.44
730	73.00	1.75	1.63
800	80.75	1.06	1.31

HAF Wheel Overlap		
Size	A	B
220	25.00	0.50
240	27.50	0.55
270	30.38	0.61
300	33.50	0.67
330	37.00	0.74
360	41.00	0.75
400	45.25	0.83
450	50.00	0.91
490	55.13	1.01
540	61.00	1.12
600	67.50	1.23
660	74.25	1.36
730	82.00	1.50
800	90.75	1.66

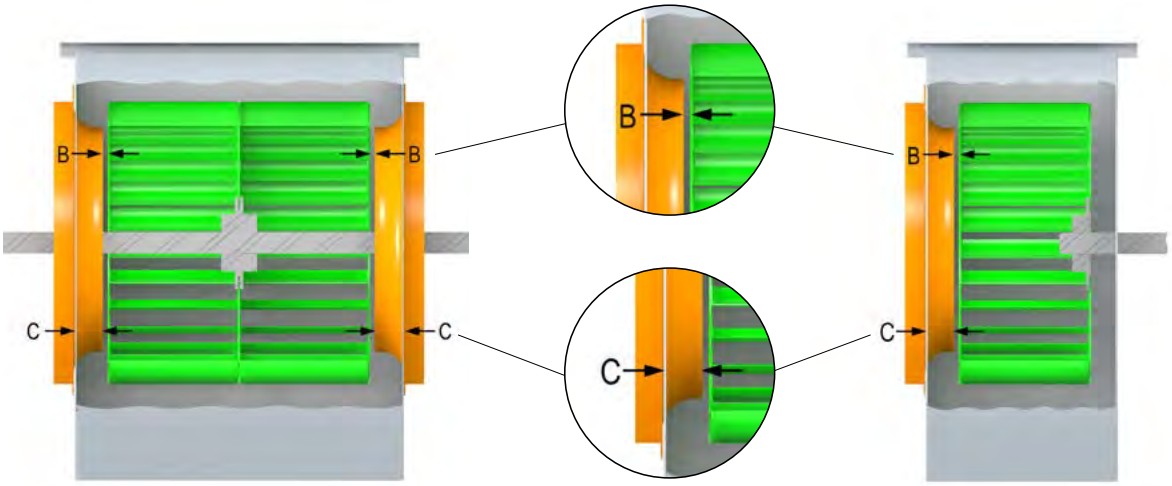
HIB, RTF Wheel Overlap					
Size	A	B	Size	A	B
180	20.50	0.31	400	45.25	0.69
200	22.50	0.34	450	50.00	0.75
220	25.00	0.38	490	55.13	0.81
240	27.50	0.44	540	61.00	0.91
270	30.38	0.47	600	67.50	1.00
300	33.50	0.50	660	74.25	1.13
330	37.00	0.56	730	82.00	1.22
360	41.00	0.63	800	90.75	1.34

TCBI (60 Hz) Wheel Overlap	
Size	B
3	0.34
5	0.38
7.5	0.38
10	0.38
15	0.31
20	0.31
25	0.31
30	0.31

TCBI (50 Hz) Wheel Overlap	
Size	B
3-50	0.56
5-50	0.56
7.5-50	0.56
10-50	0.56
15-50	0.56
20-50	0.63
25-50	0.63
30-50	0.63

Fan & Blower Twin City

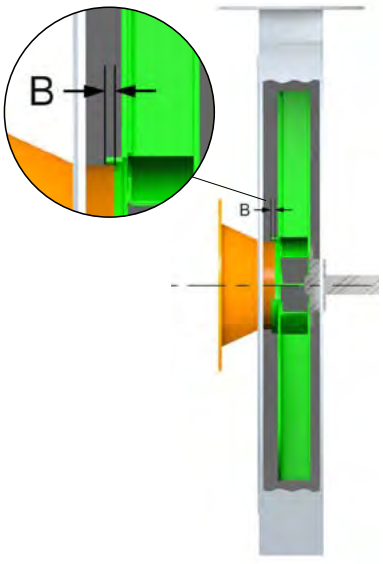
Wheel Placement



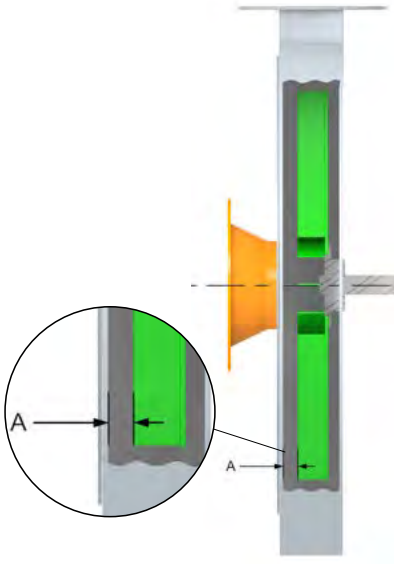
Models FC-DW, NFC-DW

Models FCV, NFC-SW

FCV, FC-DW, NFC-SW, NFC-DW Wheel Gap					
Size	B	C	Size	B	C
10.5	0.47	0.69	30	0.75	4.38
12	0.25	1.88	33	0.81	5.00
15	0.44	2.19	36	0.75	5.00
18	0.50	2.25	39	1.06	6.38
21	0.69	2.88	42	1.69	7.50
24	0.81	3.00	48	1.50	7.13
27	0.69	3.13	54	1.00	10.50



Model HRS



Model HRO

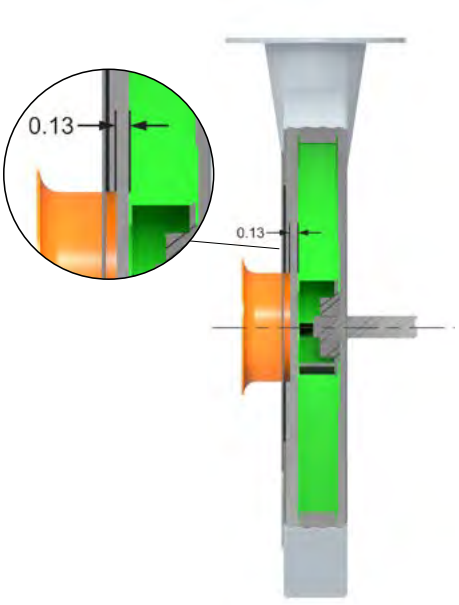
HRS Wheel Overlap		
Fan Size	Wheel Size	B
125	25	0.31
225		0.28
325		0.27
130	30	0.38
230		0.33
330		0.32
135	35	0.44
235		0.39
335		0.37
140	40	0.50
240		0.44
340		0.43
145	45	0.56
245		0.50
345		0.48

HRS Wheel Overlap		
Fan Size	Wheel Size	B
150	50	0.63
250		0.56
350		0.54
155	55	0.69
255		0.61
355		0.59
160	60	0.75
260		0.67
360		0.65
165	65	0.81
265		0.72
365		0.70
170	70	0.88
270		0.78
370		0.75

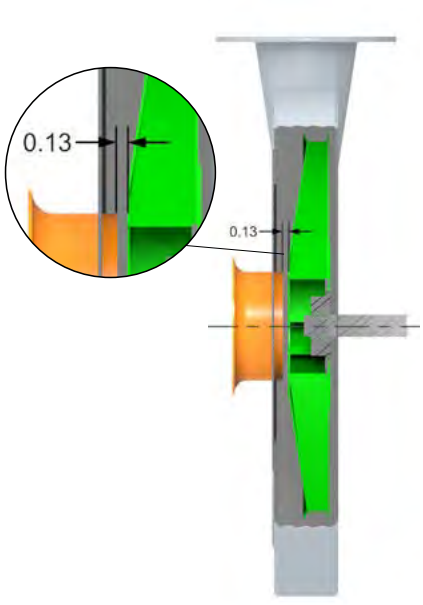
HRO Wheel Gap		
Fan Size	Wheel Size	B
125	25	0.82
325		0.80
130	30	0.99
330		0.99
135	35	1.14
335		1.12
140	40	1.32
340		1.29
145	45	1.46
345		1.42

HRO Wheel Gap		
Fan Size	Wheel Size	B
150	50	0.99
350		1.59
155	55	0.99
355		1.59
160	60	0.99
360		0.99
165	65	0.99
365		2.09
170	70	2.31
370		2.26

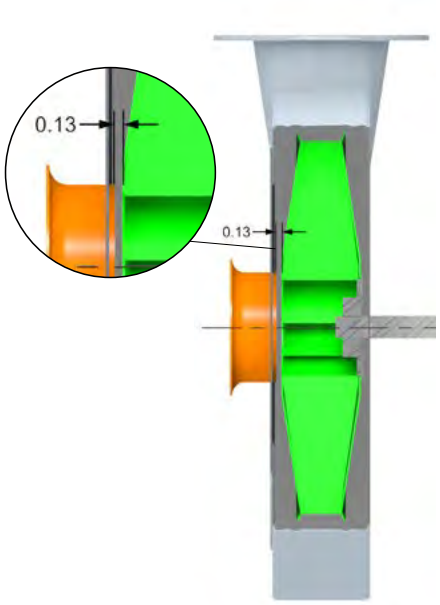
Wheel Placement



Models TBNS

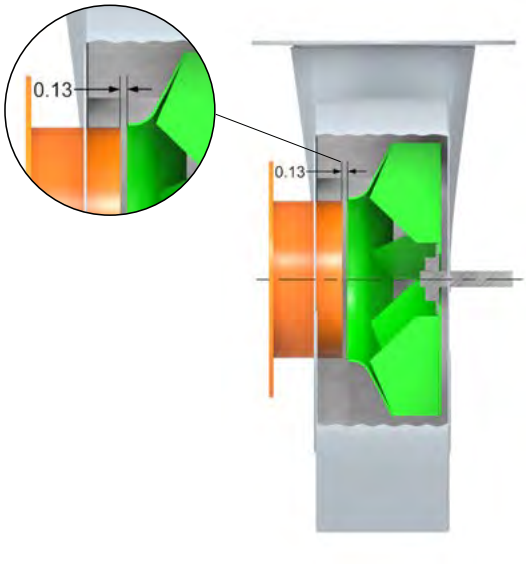


Models TBNA
"N" Series Wheel

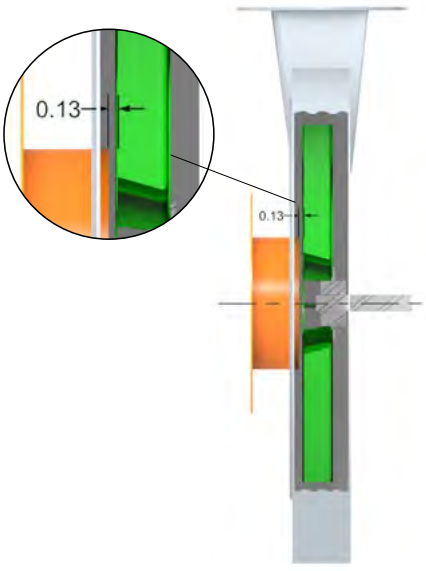


Models TBNA
"W" Series Wheel

TBNA, TBNS Wheel Gap
0.13" gap on all sizes



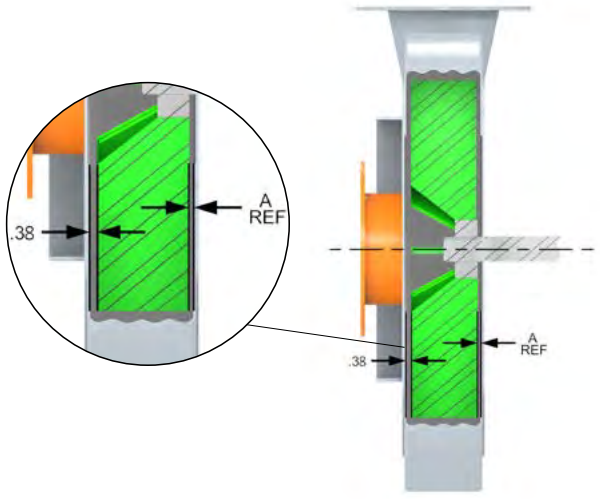
Model TBA



Model TBR

TBA, TBR Wheel Gap
0.13" gap on all sizes

Wheel Placement

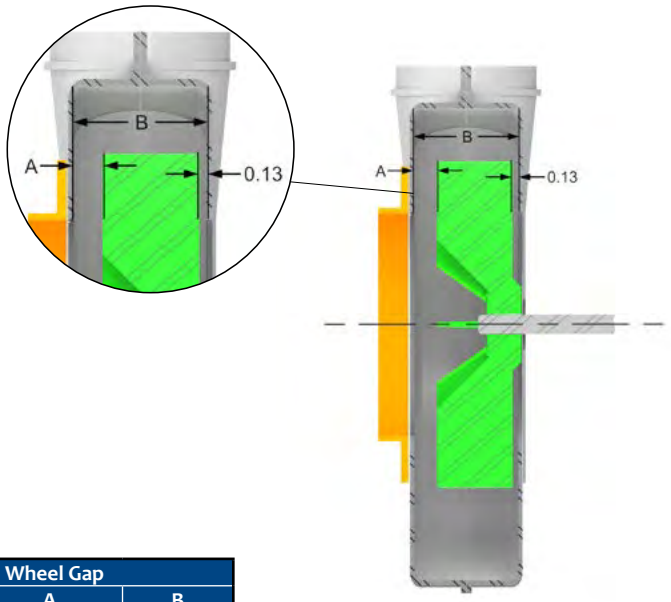


Model PBW

PBW Wheel Gap		
Housing Size	Wheel Size	A (REF)
3	19 & 22	0.36
4		
5	21 & 22	0.61
	23 & 26	0.36
6	21 & 22	0.86
	23 & 26	0.36

Note: *Distance from inside surface of housing to wheel blade is constant on all sizes and arrangements.*

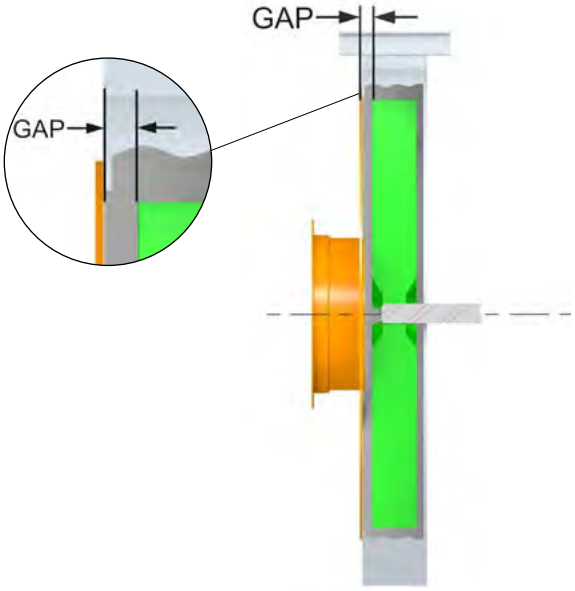
TPD, TPB Wheel Placement		
Wheel Size	A	B
8" Housing / Width		
R7 X 2.44	0.58	3.14
R8 X 2.50	0.52	
9" Housing / Width		
R8 X 2.50	0.56	3.18
R8.5 X 2.75	0.30	
R9 X 2.88	0.19	
R9.75 X 2.88	0.31	
R10.63 X 2.63	0.46	
BC10.25 X 3	0.25	
10" Housing / Width		
R9 x 2.88	0.23	3.22
R9.75 x 2.88	0.35	
R10.63 x 2.63	0.50	
R11 x 2.75	0.28	
R11.5 x 2.88	0.27	
R12 x 2.88	0.23	
R12.25 x 2.88	0.21	
BC10.25 x 3	0.29	
BC11 x 3	0.29	
12" Housing / Width		
R10.63 x 2.63	1.22	3.94
R11 x 2.75	1.00	
R11.5 x 2.88	0.99	
R12 x 2.88	0.95	
R12.25 x 2.88	0.93	
R13 x 3.25	0.55	
R14 x 3.25	0.61	
BC11 x 3	1.01	
BC13 x 3.25	0.57	
BC14 x 3.25	0.57	
14" Housing / Width		
R12.25 x 2.88	1.59	4.60
R13 x 3.25	1.21	
R14 x 3.25	1.27	
R14.75 x 4	0.48	
BC13 x 3.25	1.23	
BC14 x 3.25	1.23	



Model TPD, TPB

TPD, TPB Wheel Gap		
Wheel Size	A	B
15" Housing / Width		
R14 x 3.25	2.49	5.82
R15.5 x 5	0.70	
R16.5 x 4.38	1.37	
BC14 x 3.25	2.45	
BC15.5 x 5	0.81	
BC16.5 x 4.38	1.45	
18" Housing / Width		
R14 x 3.25	1.31	4.64
R16.5 x 4.38	0.19	
R18 x 4.38	0.36	
BC14 x 3.25	1.27	
BC16.5 x 4.38	0.27	
BC18 x 4.38	0.14	

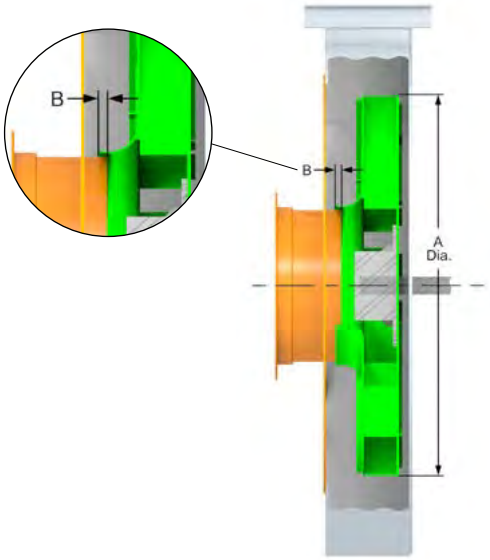
Wheel Placement



Models MBO, MBW, MBR

MBW, MBO, MBR Wheel Gap											
Size	196	224	252	280	308	336	365	421	477	533	589
MBW	0.50	0.44	0.38	0.25	0.38	0.44	0.56	0.63	0.75	0.75	0.88
MBO	0.50	0.44	0.38	0.25	0.38	0.44	0.56	0.63	0.75	0.75	0.88
MBR	0.25	0.25	0.25	0.25	0.25	0.38	0.50	see note below			

Note: *On Sizes 421-589 wheel is to be centered in housing.*



Model BCN

BCN Wheel Overlap						
Size	270	300	330	365	402	445
A	27.00	30.00	33.00	36.50	40.25	44.50
B	0.09	0.09	0.13	0.13	0.13	0.16

Size	490	542	600	660	730
A	49.00	54.25	60.00	66.00	73.00
B	0.16	0.19	0.22	0.22	0.25

Troubleshooting Guidelines

Use current safety practices when investigating fan or system performance problems. General safe practices and performance troubleshooting guidelines can be found in AMCA Publications 410 and 202, respectively. Fan application and field measurement procedures can be found in AMCA Publications 201 and 203.

Below is a list of possible areas to check when air or sound values do not match expectations. Most fan problems can be pinpointed to one of these common causes.

Air Capacity Problems

1. Resistance of the system is not at design rating. If resistance is lower than expected, both airflow and horsepower may be up. If resistance is higher than anticipated, air volume will be down.
2. Fan speed is not at design speed.
3. Air density is not at the design value. Also check air performance measurement techniques/procedures.
4. Devices for air modulation are closed or plugged. Also check filters.
5. Wheel mounted improperly or is rotating in reverse.
6. Parts of the system or fan have been damaged or need cleaning.

Noise Problems

1. Air performance is incorrect and the fan is not at design point of operation. Fan is being forced to operate in an unstable flow region near peak or to the left of the peak of the curve.
2. Bearing failure. Check bearings (lubrication).
3. Supply voltage high or inconsistent supply frequency. Adjustable frequency controllers can generate motor noise.
4. Objects which are installed in a high velocity airstream can generate noise. This includes flow sensors, turning vanes, etc.
5. Poor fan inlet conditions.
6. Acoustics or sound measurement procedure incorrect.

Vibration Problems

1. Misalignment of drive components. Check belt or coupling.
2. Poor foundation or mounting structure (resonances).
3. Foreign material attached to rotating components.
4. Damaged rotating components (bearings, shaft, fan, wheel, sheaves).
5. Broken, loose, or missing setscrews.
6. Loose bolts.
7. Vibration transmitted by another source.
8. Water accumulating in airfoil blades.
9. Fan is operating in stall or unstable flow region.

Motor Problems

1. Incorrect wiring.
2. Speed of fan too high.
3. Parts improperly installed; binding.
4. Bearings improperly lubricated.
5. WR^2 capability of motor too low for application.
6. Protection devices may be improperly sized.
7. VFD compatible electrically? Effective shaft grounding?
8. Is cabling and grounding correct?

Drive Problems

1. Belts improperly tensioned.
2. Drive alignment is poor. Check belt or coupling.
3. Coupling lubrication.

NOTICE

All fans manufactured by Twin City Fan & Blower are factory balanced prior to shipment. Installation variables, handling, and movement of the fan during shipment may cause the rotating assembly to shift. Balance should be checked once the fan is installed. If a final trim balance is required, it is the end user's responsibility to bring the fan back to factory specifications. Final trim balancing is not the responsibility of Twin City Fan & Blower. Refer to the Vibration Guidelines table below.

Vibration Guidelines

Condition	Fan Application Category	Rigidly Mounted mm/s (in./s)	Flexibly Mounted mm/s (in./s)
Start-up	BV-3	6.4 (0.25)	8.8 (0.35)
	BV-4	4.1 (0.16)	6.4 (0.25)
Alarm	BV-3	10.2 (0.40)	16.5 (0.65)
	BV-4	6.4 (0.25)	10.2 (0.40)
Shutdown	BV-3	12.7 (0.50)	17.8 (0.70)
	BV-4	10.2 (0.40)	15.2 (0.60)

Values shown are peak velocity, mm/s (inches/s), Filter out. Table taken from ANSI/AMCA Standard 204-05, Table 6.3. AMCA defines BV-3 for applications up to 400 HP; BV-4 for applications over 400 HP.

Fan & Blower Twin City

Installation/Start-up Checklist

Become familiar with the equipment by looking at the fan assembly drawing for special instructions and accessories.

Initial Fan Check

- ☐ Inspect fan for damage
- ☐ Check foundation
- ☐ Is the fan shimmed
- ☐ Are the bolts tight
- ☐ Check to see if the fan is distorted
  Note: Applies to direct or isolation mount.
- ☐ Check fan interior for debris & standing water

Fan Wheel

- ☐ Wheel clearance checked
- ☐ Wheel overlap checked
- ☐ Fasteners tight
- ☐ Wheel rotates freely

Springs (if equipped)

- ☐ Springs adjusted properly
- ☐ Flex joints allow movement
- ☐ Electrical conduit allows movement

Bearings

- ☐ Bearings aligned
- ☐ Bearings greased
  Note: Rotate while greasing
- ☐ Setscrews tight (if equipped)

Lube Lines

- ☐ Lube lines been charged with grease prior to connecting to bearings

V-Belts (if equipped)

- ☐ V-belt drives aligned
- ☐ Sheaves retightened
- ☐ Belt tension correct
- ☐ Motor bolts retightened

Couplings (if equipped)

- ☐ Coupling aligned
- ☐ Coupling gap checked
- ☐ Coupling lubricated

Accessories

- ☐ Guards installed correctly, do not rub
- ☐ VIV/damper rotates freely (if equipped)
- ☐ Other accessories per drawing

WARNING

Verify that proper safety precautions have been followed. Electrical power must be locked off.

Electrical Components

- ☐ Motor wired for proper voltage and starter
- ☐ Motor grounded
- ☐ Appropriate starter and heaters
- ☐ Leads are properly insulated
- ☐ Accessories wired per instructions supplied.

Energize

- ☐ Energize motor long enough to start assembly rotating, shut down
- ☐ Verify direction of wheel rotation, Rewire if necessary *Note: Refer to wheel rotation section*
- ☐ Run the fan up to speed
- ☐ Check for excess vibration and listen for unusual noise. Refer to the Vibration Guidelines table in the troubleshooting guidelines section for vibration limits
- ☐ Bearing temperatures should stabilize after a few hours. Less than 200°F
  Note: Use sense of smell to identify possible electrical, belt issues.

After one Week

- ☐ Verify bolt tightness.
- ☐ Verify belt tension and adjust as necessary

NOTICE

Always observe site specific and regulatory safety precautions.

Serial Number: _____

Completed By: _____

Date Completed: _____

Fan Maintenance Log

Model Number_____

Serial Number _____

Date	Completed Maintenance	Performed By	Comments

Fan Maintenance Log

Model Number_____

Serial Number _____

Date	Completed Maintenance	Performed By	Comments

TWIN CITY FAN & BLOWER | WWW.TCF.COM

5959 Trenton Lane N | Minneapolis, MN 55442 | Phone: 763-551-7600 | Fax: 763-551-7601

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Chapter 7 – Water Quality Analyzers (Division 25)

MANUFACTURER/DISTRIBUTOR:

Veolia Water Technologies (Hach)
Hugo Sabourin
4105 Rue Sartelon
St-Laurent, QC, H4S 2B3
Phone: (514) 334-7230
hugo.sabourin@veolia.com

Chloratech (Wallace & Tiernan)
Marie-Chantale Boudreault
212 rue Pierre-Couture
St-Augustin-de-Desmaures, QC, G3A 0A4
Phone: (418) 872-4200
pieces@chloratech.ca

7.1 Hach TU5300sc Turbidity Meter System (WTP, BS#1, BS#2)

TU5 SERIES TURBIDIMETERS

Applications
- Drinking Water
- Power
- Beverage
- Pharmaceutical

The next standard in the evolution of turbidity

Only the new TU5 Series Lab & Process Turbidimeters with 360° x 90° Detection™ deliver unprecedented confidence that a change in your reading is a change in your water.

Groundbreaking 360° x 90° Detection™ Technology

The TU5 Series employs a patented optical design that sees more of your sample than any other turbidimeter, delivering the best low level precision and sensitivity while minimizing variability from test to test.

Matching lab and online results

For the first time you will be able to remove the uncertainty of which measurement to trust, thanks to identical 360° x 90° Detection™ Technology in both instruments.

Everything about turbidity – faster

The TU5 Series dramatically reduces the time needed to get a turbidity measurement you can rely on, with 98% less online sample surface area to clean, sealed vials for calibration, and the elimination of the need for indexing and silicone oil in the lab. Not to mention, a smaller online sample volume means you will detect events almost immediately.

No surprises

Prognosys™ monitors your TU5 Series online instrument, proactively alerting you to maintenance needs before your measurement becomes questionable. And a Hach Service Agreement protects your investment and helps ensure that you stay in compliance and on budget.

USEPA and ISO 7027 reporting: The TU5 Series Turbidimeters apply the instrument design and meet performance criteria established by EPA Approved Hach Method 10258 and ISO 7027-1:2016, making them suitable for regulatory reporting.

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Be Right™

Technical Data*

TU5200

Light Source	Class 2 laser product, with embedded 650 nm (EPA 0.43 mW) or Class 1 laser product, with embedded 850 nm (ISO), max. 0.55 mW (complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50)
Range	EPA: 0 - 700 NTU / FNU / TE/F / FTU 0 - 100 mg/L 0 - 175 EBC ISO: 0 - 1000 NTU / FNU / TE/F / FTU 0 - 100 mg/L 0 - 250 EBC
Accuracy	±2 % plus 0.01 NTU from 0 - 40 NTU; ±10 % of reading from 40 - 1000 NTU based on Formazin primary standard (at 25 °C)
Resolution	0.0001 NTU / FNU / TE/F / FTU / EBC / mg/L
Repeatability	<40 NTU: Better than 1% of reading or ±0.002 NTU on Formazin at 25 °C, whichever is greater >40 NTU: Better than 3.5% of reading on Formazin at 25 °C
Stray Light	<10 mNTU
Units	NTU, FNU, TE/F, FTU, EBC; mg/L if calibrated with Degrees calibration curve
Operating Temperature Range	10 - 40 °C (50 - 104 °F)
Operating Humidity	80% at 30 °C (non condensing)
Sample Temperature	4 - 70 °C (39 - 158 °F)
Storage Conditions	-30 - 60 °C (-22 - 140 °F)
Power Requirements (Voltage)	100 - 240 VAC
Power Requirements (Hz)	50/60 Hz
Certifications	CE compliant US FDA accession number: 1420493-000 EPA version, 1420492-000 ISO version Complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50) Australian ACMA Marking
Dimensions (H x W x D)	195 mm x 409 mm x 278 mm
Weight	2.4 kg (5.29 lbs.)
Warranty	1 year

TU5300 sc / TU5400 sc

Light Source	Class 2 laser product, with embedded 650 nm (EPA 0.43 mW) or Class 1 laser product, with embedded 850 nm (ISO), max. 0.55 mW (complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50)
Range	EPA: 0 - 700 NTU / FNU / TE/F / FTU 0 - 100 mg/L 0 - 175 EBC ISO: 0 - 1000 NTU / FNU / TE/F / FTU 0 - 100 mg/L 0 - 250 EBC
Accuracy	±2% or 0.01 NTU from 0 - 40 NTU ±10% of reading from 40 - 1000 NTU based on Formazin primary standard
Resolution	0.0001 NTU / FNU / TE/F / FTU / EBC
Repeatability	Better than 1% of reading or ±0.002 NTU (TU5300) or ±0.0006 NTU (TU5400) on Formazin at 25 °C (77 °F), whichever is greater
Stray Light	<10 mNTU
Units	NTU, FNU, TE/F, FTU, EBC
Signal Average Time	5 - 90 seconds
Response Time	T90 <30 seconds at 100 mL/min
Sample Temperature	2 - 60 °C (35 - 140 °F)
Sample Pressure	6 bar (87 psi) maximum, compared to air at sample temperature range from 2 - 40 °C (35.6 - 104 °F)
Sample Flow Rate	100 - 1000 mL/min; optimal flow rate: 200 - 500 mL/min
Operating Temperature Range	0 - 50 °C (32 - 122 °F)
Operating Humidity	Relative humidity: 5 - 95% at different temperatures, non-condensing
Storage Conditions	-40 - 60 °C (-40 - 140 °F)
Certifications	CE compliant US FDA accession number: 1420493-000 EPA version, 1420492-000 ISO version Complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50) Australian ACMA Marking
Dimensions (H x W x D)	249 mm x 268 mm x 190 mm
Weight	5.95 lbs. (2.7 kg); 11 lbs. (5.0 kg) with all accessories
Warranty	1 year

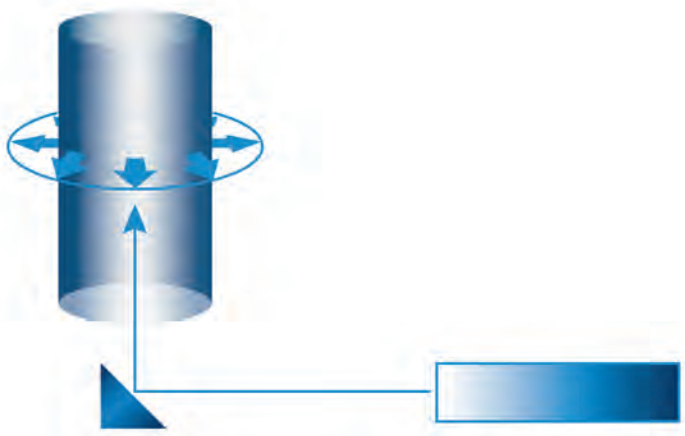
**Subject to change without notice.*

Principle of Operation

The TU5 Series turbidimeters measure turbidity by directing a laser into a sample to scatter off suspended particles. The light that is scattered at a 90° angle from the incident beam is reflected through a conical mirror in a 360° ring around the sample before it is captured by a detector.

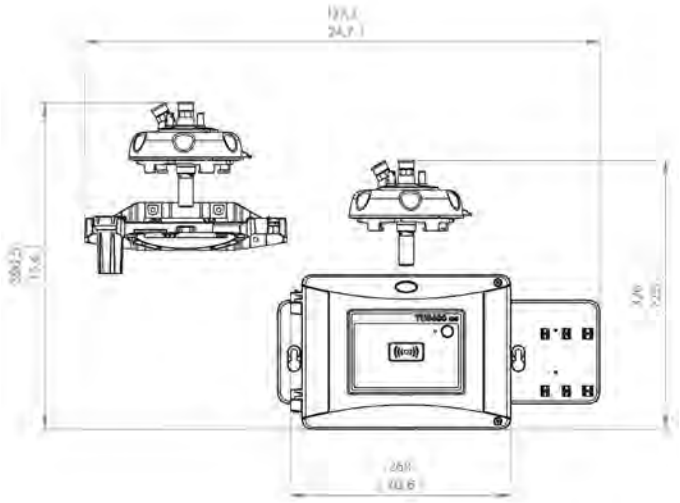
The amount of light scattered is proportional to the turbidity of the sample. If the turbidity of the sample is negligible, little light will be scattered and detected by the photocell and the turbidity reading will be low. High turbidity, on the other hand, will cause a high level of light scattering and result in a high reading.

The 360° x 90° optics of the TU5 series were optimized for high accuracy at low turbidity ranges and therefore the TU5 does not include ratio technology. Ratio technology is only applicable for high turbidity applications which have interference from color and large particles.

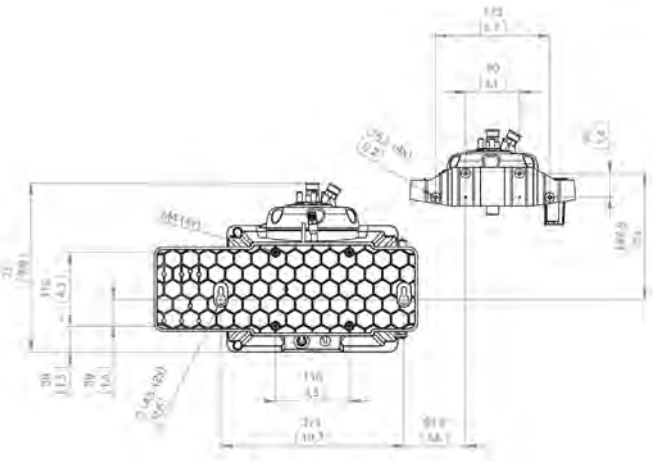


Dimensions

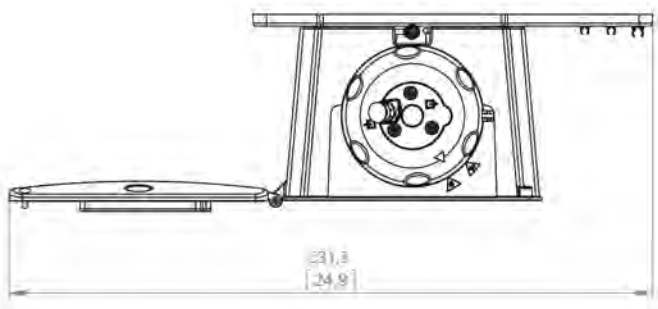
TU5300 sc and TU5400 sc front view



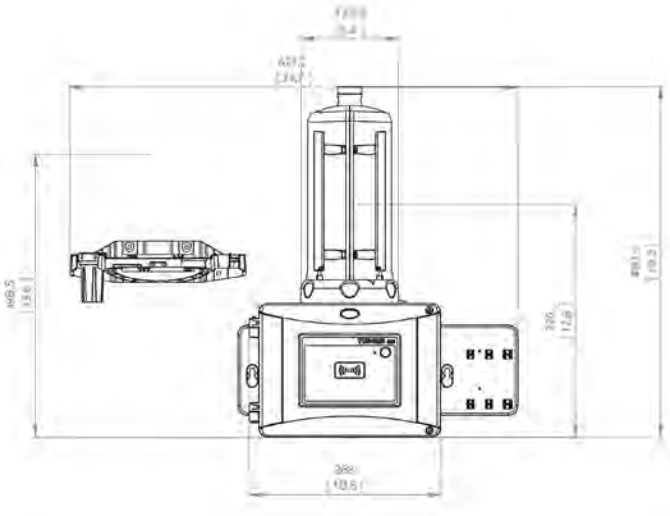
TU5300 sc and TU5400 sc rear view



TU5300 sc and TU5400 sc top view



TU5300 sc and TU5400 sc with automatic cleaning module



Order Information

TU5200 Benchtop Laser Turbidimeters

LPV442.99.03012 TU5200 Benchtop Laser Turbidimeter with RFID, EPA Version

LPV442.99.01012 TU5200 Benchtop Laser Turbidimeter without RFID, EPA Version

LPV442.99.03022 TU5200 Benchtop Laser Turbidimeter with RFID, ISO Version

LPV442.99.01022 TU5200 Benchtop Laser Turbidimeter without RFID, ISO Version

TU5300 sc/TU5400 sc Online Laser Turbidimeters

LXV445.99.10112 TU5300 sc Low Range Laser Turbidimeter, EPA Version

LXV445.99.10212 TU5400 sc Ultra-High Precision Low Range Laser Turbidimeter, EPA Version

LXV445.99.53112 TU5300 sc with Flow Sensor, Automatic Cleaning, RFID, and System Check, EPA Version

LXV445.99.53212 TU5400 sc with Flow Sensor, Automatic Cleaning, RFID, and System Check, EPA Version

Please note: Other turbidimeter configurations are available and RFID may not be available in all areas. Please contact your local Hach representative.

Please note: an SC controller is required for operation of the TU5300 sc or TU5400 sc.

Calibration and Verification

LZY835 StablCal® Calibration Set with RFID

LZY898 StablCal® Calibration Set without RFID

LZY901 Glass Rod Secondary Turbidity Standard <0.1 NTU/FNU

LZY834 Replacement Vial for TU5300 sc and TU5400 sc

LZV946 Sample Vials for TU5200

TU5 Series Accessories

LQV159.97.00002 Automatic Cleaning Module for TU5300 sc and TU5400 sc

LQV160.99.00002 Flow Sensor for TU5300 sc and TU5400 sc

LZY876 Desiccant Cartridge for TU5300 sc and TU5400 sc

LZY907.97.00002 Maintenance Kit for TU5300 sc and TU5400 sc

LQV157.99.50002 SIP10 Sipper Unit for TU5200

LZY903 Manual Vial Wiper for TU5200, TU5300 sc, and TU5400 sc

Service Options

Start-Up:

Instrument start-up, Basic instrument training to help you learn how to use your instrument from the first day you use it.

Service Agreement:

Hach offers a wide range of agreements for bench or field service to help you maximize your measurement reliability and instrument uptime.

Contact us to learn about what Hach Service option is right for you.

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In the interest of improving and updating its equipment, Hach Company reserves the right to alter specifications to equipment at any time.

HACH®

Be Right™

sc200™ UNIVERSAL CONTROLLER

Applications
- Drinking Water
- Wastewater
- Industrial Water
- Power

One Controller for the Broadest Range of Sensors.

Choose from 30 digital and analog sensor families for up to 17 different parameters.

Maximum Versatility

The sc200 controller allows the use of digital and analog sensors, either alone or in combination, to provide compatibility with Hach's broad range of sensors, eliminating the need for dedicated, parameter-specific controllers.

Ease of Use and Confidence in Results

Large, high-resolution, transreflective display provides optimal viewing resolution in any lighting condition. Guided calibration procedures in 19 languages minimize complexity and reduce operator error. Password-protected SD card reader offers a simple solution for data download and transfer. Visual warning system provides critical alerts.

Wide Variety of Communication Options

Utilize two to five analog outputs to transmit primary and secondary values for each sensor, or integrate Hach sensors and analyzers into MODBUS RS232/RS485, Profibus® DP, and HART networks.

Password protected SD card reader offers a simple solution for data download and transfer, and sc200 and digital sensor configuration file duplication and backup.

HACH®
Be Right™

Controller Comparison

Features	Previous Models sc100™ Controller	Previous Models GLI53 Controller	sc200™ Controller	Benefits
Display	64 x 128 pixels 33 x 66 mm (1.3 x 2.6 in.)	64 x 128 pixels 33 x 66 mm (1.3 x 2.6 in.)	160 x 240 pixels 48 x 68 mm (1.89 x 2.67 in.) Transreflective	• Improved user interface—50% bigger • Easier to read in daylight and sunlight
Data Management	irDA Port/PDA Service Cable	N/A	SD Card Service Cable	• Simplifies data transfer • Standardized accessories/max compatibility
Sensor Inputs	2 Max Direct Digital Analog via External Gateway	2 Max Analog Depending on Parameter	2 Max Digital and/or Analog with Sensor Card	• Simplifies analog sensor connections • Works with analog and digital sensors
Analog Inputs	N/A	N/A	1 Analog Input Signal Analog 4-20mA Card	• Enables non-sc analyzer monitoring • Accepts mA signals from other analyzers for local display • Consolidates analog mA signals to a digital output
4-20 mA Outputs	2 Standard	2 Standard	2 Standard Optional 3 Additional	• Total of five (5) 4-20 mA outputs allows multiple mA outputs per sensor input
Digital Communication	MODBUS RS232/RS485 Profibus DP V1.0	HART	MODBUS RS232/RS485 Profibus DP V1.0 HART 7.2	• Unprecedented combination of sensor breadth and digital communication options

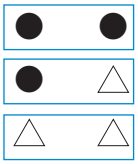
Choose from Hach's Broad Range of Digital and Analog Sensors

Parameter	Sensor	Digital or Analog
Ammonia	AMTAX™ sc, NH4D sc, AISE sc, AN-ISE sc	●
Chlorine	CLF10 sc, CLT10 sc, 9184 sc	●
Chlorine Dioxide	9185 sc	●
Conductivity	GLI 3400 Contacting, GLI 3700 Inductive	△
Dissolved Oxygen	LDO® Model 2, 5740 sc	●
Dissolved Oxygen	5500	△
Flow	U53, F53 Sensors	△
Nitrate	NITRATAX™ sc, NO3D sc, NISE sc, AN-ISE sc	●
Oil in Water	FP360 sc	●
Organics	UVAS sc	●
Ozone	9187 sc	●
pH/ORP	pHD	●
pH/ORP	pHD, pH Combination, LCP	△
Phosphate	PHOSPHAX™ sc	●
Sludge Level	SONATAX™ sc	●
Suspended Solids	SOLITAX™ sc, TSS sc	●
Turbidity	1720E, FT660 sc, SS7 sc, ULTRATURB sc, SOLITAX sc, TSS sc	●
Ultra Pure Conductivity	8310, 8311, 8312, 8315, 8316, 8317 Contacting	△
Ultra Pure pH/ORP	8362	△

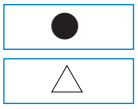
● = Digital △ = Analog

Connect up to two of any of the sensors listed above, in any combination, to meet your application needs. The diagrams below demonstrate the potential configurations. Operation of analog sensors requires the controller to be equipped with the appropriate sensor module. Contact Hach Technical Support for help with selecting the appropriate module.

2 Channel Configurations



1 Channel Configurations



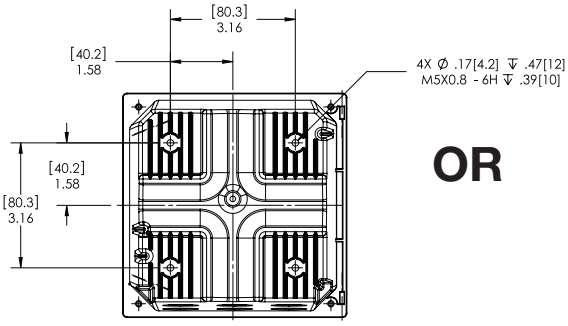
Specifications*

Dimensions (H x W x D)	5.7 in x 5.7 in x 7.1 in (144 mm x 144 mm x 181 mm)
Display	Graphic dot matrix LCD with LED backlighting, transreflective
Display Size	1.9 x 2.7 in. (48 mm x 68 mm)
Display Resolution	240 x 160 pixels
Weight	3.75 lbs. (1.70 kg)
Power Requirements (Voltage)	100 - 240 V AC, 24 V DC
Power Requirements (Hz)	50/60 Hz
Operating Temperature Range	-20 to 60 °C , 0 to 95% RH non-condensing
Analog Outputs	Two (Five with optional expansion module) to isolated current outputs, max 550 Ω , Accuracy: ± 0.1% of FS (20mA) at 25 °C, ± 0.5% of FS over -20 °C to 60 °C range Operational Mode: measurement or calculated value
Analog Output Functional Mode	Linear, Logarithmic, Bi-linear, PID
Security Levels	2 password-protected levels
Mounting Configurations	Wall, pole, and panel mounting
Enclosure Rating	NEMA 4X/IP66
Conduit Openings	1/2 in NPT Conduit
Relay: Operational Mode	Primary or secondary measurement, calculated value (dual channel only) or timer
Relay Functions	Scheduler (Timer), Alarm, Feeder Control, Event Control, Pulse Width Modulation, Frequency Control, and Warning
Relays	Four electromechanical SPDT (Form C) contacts, 1200 W, 5 A
Communication	MODBUS RS232/RS485, PROFIBUS DPV1, or HART 7.2 optional
Memory Backup	Flash memory
Electrical Certifications	EMC CE compliant for conducted and radiated emissions: - CISPR 11 (Class A limits) - EMC Immunity EN 61326-1 (Industrial limits) Safety cETLus safety mark for: - General Locations per ANSI/UL 61010-1 & CAN/CSA C22.2. No. 61010-1 - Hazardous Location Class I, Division 2, Groups A,B,C & D (Zone 2, Group IIC) per FM 3600 / FM 3611 & CSA C22.2 No. 213 M1987 with approved options and appropriately rated Class I, Division 2 or Zone 2 sensors cULus safety mark - General Locations per UL 61010-1 & CAN/CSA C22.2. No. 61010-1

Subject to change without notice.

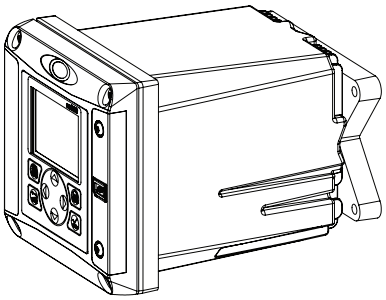
Dimensions

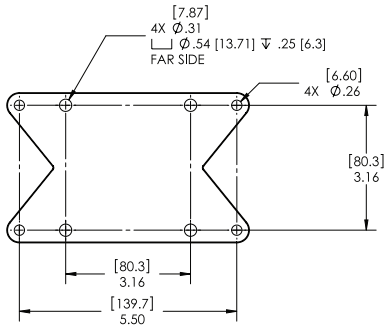
Surface Mounting Dimensions



Mounting Dimensions
(Rear View)

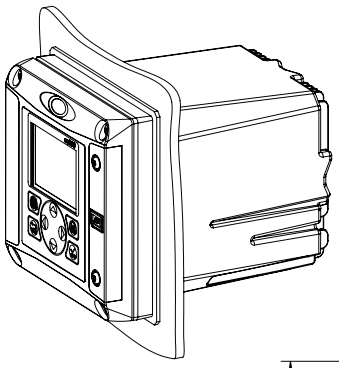
OR

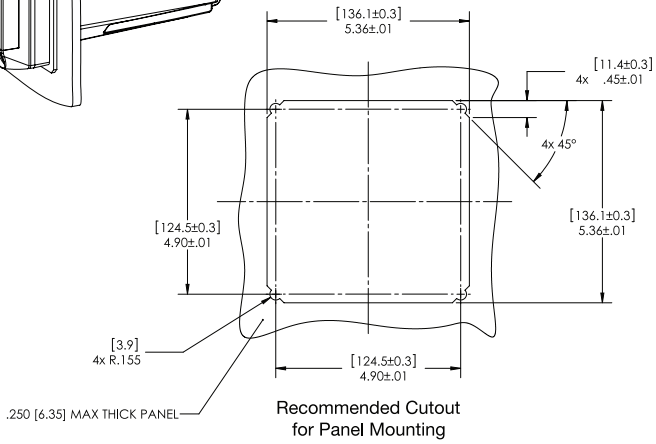




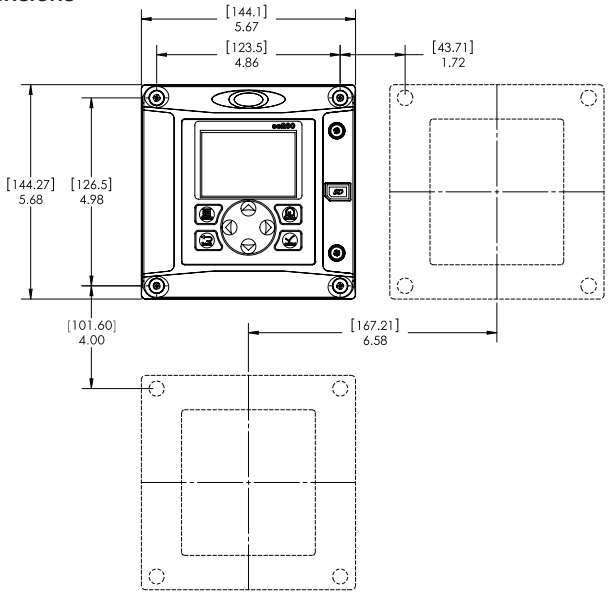
Bracket (supplied) for Surface Mounting
(Not compatible with Weather and Sun Shield p/n 9220600 when surface mounting.)

Panel Mounting Dimensions



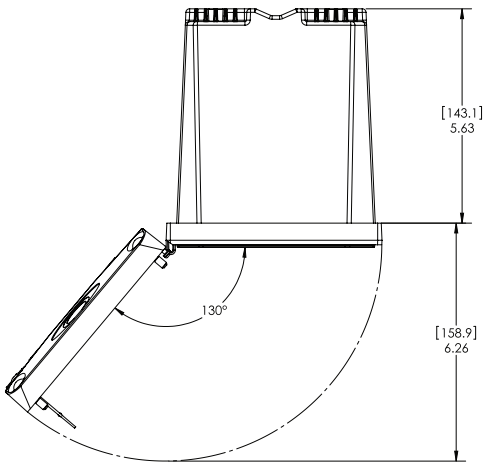


Recommended Cutout
for Panel Mounting

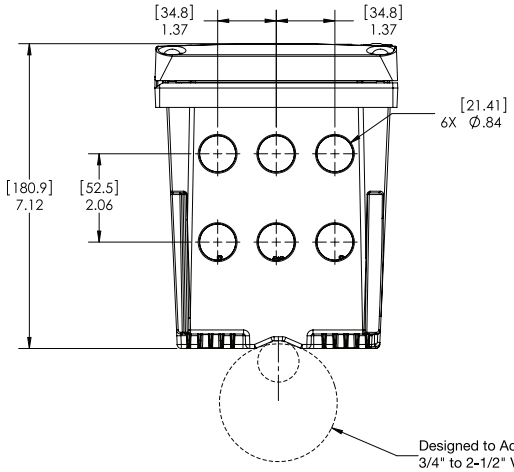


Minimum Spacing Dimensions
for Group Mounting

Top and Bottom Views



Door Opening Details



Ordering Information

sc200 for Hach Digital and Analog Sensors

LXV404.99.00552	sc200 controller, 2 channels, digital
LXV404.99.00502	sc200 controller, 1 channel, digital
LXV404.99.00102	sc200 controller, 1 channel, pH/DO
LXV404.99.00202	sc200 controller, 1 channel, Conductivity
LXV404.99.01552	sc200 controller, 2 channels, digital, Modbus RS232/RS485
LXV404.99.00112	sc200 controller, 2 channel, pH/DO

Note: Other Sensor combinations are available. Please contact Hach Technical Support or your Hach representative.

Note: Communication options (MODBUS, Profibus DPV1, and HART) are available. Please contact Hach Technical Support or your Hach representative.

sc200 for Ultrapure Sensors

9500.99.00602	sc200 controller, 1 channel, ultrapure conductivity
9500.99.00702	sc200 controller, 1 channel, ultrapure pH
9500.99.00662	sc200 controller, 2 channel, ultrapure conductivity
9500.99.00772	sc200 controller, 2 channel, ultrapure pH

Sensor and Communication Modules

9012900	Analog pH/ORP and DO module for GLI Sensors
9013000	Analog Conductivity module for GLI Sensors
9012700	Flow module
9012800	4-20 mA Input Module
9525700	Analog pH/ORP Module for Polymetron Sensors
9525800	Analog Conductivity Module for Polymetron Sensors
9013200	Modbus 232/485 Module
9173900	Profibus DP Module
9328100	HART Module
9334600	4-20 mA Output Module (Provides 3 additional mA Outputs)

Accessories

9220600	sc200 Weather and Sun Shield with UV Protection Screen
8809200	sc200 UV Protection Screen
9218200	SD card reader (USB) for connection to PC
9218100	4 GB SD card

HACH COMPANY World Headquarters: Loveland, Colorado USA

United States: 800-227-4224 tel 970-669-2932 fax orders@hach.com
Outside United States: 970-669-3050 tel 970-461-3939 fax int@hach.com
hach.com

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Hach Company reserves the right to alter specifications to equipment at any time.

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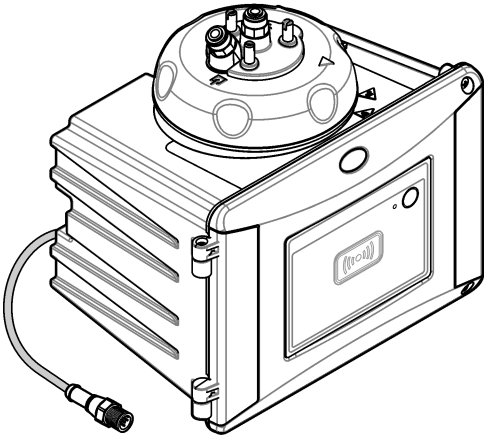
DOC023.53.90501

TU5300 sc/TU5400 sc

03/2017, Edition 4

Basic User Manual



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Maintenance on page 21

Troubleshooting on page 27

Additional information

An expanded user manual is available on the manufacturer's website. Videos on how to install, operate and do maintenance and troubleshooting on the TU5300 sc and the TU5400 sc turbidimeters are available on the *TU5 Series Turbidimeters* playlist at http://www.youtube.com/user/hachcompany.

Specifications

Specifications are subject to change without notice.

Specification	Details
Measurement method	Nephelometry with scattered light collected at a 90-degree angle to the incident light and 360 degrees around the sample vial
Primary compliance method	EPA approved Hach Method 10258[1]
Enclosure	Material: ASA Luran S 777K / RAL7000, TPE RESIN Elastocon® STK40, Thermoplastic Elastomer TPS-SEBS (60 Shore) and stainless steel
Dimensions (W x D x H)	268 x 249 x 190 mm (10.6 x 9.8 x 7.5 in.)
Weight	Instrument with the process head: 2.7 kg (6.0 lb); Instrument with the optional automatic cleaning module: 5.0 kg (11.0 lb)
Power requirements	12 VDC, 14 VA supplied by the SC controller
Protection class	III
Pollution degree	2
Installation category	II
Mounting	Indoor on a wall
Operating temperature	0 to 50 °C (32 to 122 °F)
Storage temperature	–40 to 60 °C (–40 to 140 °F)
Humidity	5 to 95% relative humidity, non-condensing
Sensor cable length	1.6 m (5.25 ft)[2]
Laser	**Class 2 laser product:** Contains a non user-serviceable class 2 laser.
Optical light source	650 nm, maximum 0.43 mW
Fittings	Sample inlet and outlet: ¼-in. OD tubing

1 http://www.hach.com

2 Extension cables are available. The maximum sensor cable length is 50 m (164 ft) when no accessories are connected to the instrument.

Specification	Details
Tubing requirements	Polyethylene, polyamide or polyurethane tubing. Calibrated ¼ in. OD, +0.03 or –0.1 mm (+0.001 or –0.004 in.)
Measurement units	TU5300 sc: NTU, FNU, TE/F, EBC or FTU; TU5400 sc: NTU, mNTU[3], FNU, mFNU, TE/F, EBC, FTU or mFTU.
Range	0 to 700 NTU, FNU, TE/F and FTU; 0 to 175 EBC
Method detection limit	TU5300 sc: 0.002 NTU at 25 °C (77 °F) (< 0.025 NTU range); TU5400 sc: 0.0001 NTU at 25 °C (77 °F) (< 0.025 NTU range)
Response time	T90 < 30 seconds at 100 mL/min
Accuracy	± 2% or ± 0.01 NTU (the larger value) from 0 to 40 NTU ± 10% of reading from 40 to 700 NTU based on Formazin primary standard at 25 °C (77 °F)
Linearity	Better than 1% for 0 to 40 NTU based on Formazin primary standard at 25 °C (77 °F).
Repeatability	TU5300 sc: 0.002 NTU or 1% (the larger value) at 25 °C (77 °F) (> 0.025 NTU range); TU5400 sc: 0.0006 NTU or 1% (the larger value) at 25 °C (77 °F) (> 0.025 NTU range)
Stray light	< 0.01 NTU
Resolution	0.0001 NTU (0.0001 to 0.9999/1.000 to 9.999/10.00 to 99.99/100.0 to 700 NTU) Default: TU5300 sc: 0.001 NTU and TU5400 sc: 0.0001 NTU
Air bubble compensation	Physical, mathematical
Sample requirements	Temperature: 2 to 60 °C (35.6 to 140 °F) Conductivity: 3000 µS/cm maximum at 25 °C (77 °F) Flow rate[4]: 100 to 1000 mL/min; optimal flow rate: 200 to 500 mL/min Pressure: 6 bar (87 psi) maximum compared to air, 2 to 40 °C (35.6 to 104 °F) sample; 3 bar (43.5 psi) maximum compared to air, 40 to 60 °C (104 to 140 °F) sample
Calibration options	StablCal® or Formazin: 1-point calibration (20 NTU) for 0 to 40 NTU measurement range, 2-point calibration (20 and 600 NTU) for 0 to 700 NTU (full) measurement range or 2- to 6-point custom calibration for a measurement range of 0 NTU to the highest calibration point.
Verification options	Glass verification rod (solid secondary standard) ≤ 0.1 NTU, StablCal or Formazin
Verification (RFID or Link2SC®)	Verification of the measurement value by comparison of the process and lab measurements with RFID or Link2SC.
Certifications	CE compliant; US FDA accession number: 1420493-xxx. This product complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50. Australian RCM.
Warranty	1 year (EU: 2 years)

General information

In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual. The manufacturer reserves the right to

[3] 1 mNTU = 0.001 NTU

[4] For the best results, operate the instrument at a flow rate of 200 mL/min when the maximum particle size is 20 µm. For larger particles (150 µm maximum), the best flow rate is 350 to 500 mL/min.

make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

Safety information

NOTICE

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

Use of hazard information

⚠ DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

Precautionary labels

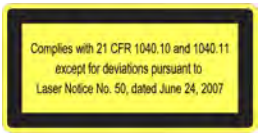
Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.
	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	This symbol indicates the need for protective eye wear.
	This symbol indicates a laser device is used in the equipment.

	This symbol indicates that the marked item can be hot and should not be touched without care.
	This symbol identifies a risk of chemical harm and indicates that only individuals qualified and trained to work with chemicals should handle chemicals or perform maintenance on chemical delivery systems associated with the equipment.
	This symbol indicates radio waves.

Class 2 laser product

DANGER	
	Personal injury hazard. Never remove covers from the instrument. This is a laser-based instrument and the user risks injury if exposed to the laser.

	Class 2 laser product, IEC60825-1:2014, 650 nm, maximum 0.43 mW Location: Rear of the instrument.
	Conforms to U.S. regulations 21 CFR 1040.10 and 1040.11 in accordance with Laser Notice No. 50. Location: Rear of the instrument.
	Caution—Class 2 laser radiation when the lid is open. Do not look into the laser beam. Location: Top of the vial compartment.

This instrument is a Class 2 Laser product. There is only visible laser radiation when the instrument is defective and when the instrument lid is open. This product complies with EN 61010-1, "Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use" and with IEC/EN 60825-1, "Safety of Laser Products" and with 21 CFR 1040.10 in accordance with Laser Notice No. 50. Refer to the labels on the instrument that supply laser information.

RFID module

Instruments with the optional RFID module receive and transmit information and data. The RFID module operates with a frequency of 13.56 MHz.

RFID technology is a radio application. Radio applications are subject to national conditions of authorization. The use of instruments with the optional RFID module is currently permitted in the regions that follow:

EU (European Union) countries, EFTA (European Free Trade Association) countries, Turkey, Serbia, Macedonia, Australia, Canada, US, Chile, Ecuador, Venezuela, Mexico, Brazil, South Africa, India, Singapore, Argentina, Columbia, Peru and Panama

The use of instruments with the optional RFID module outside of the above-mentioned regions can violate national laws. The manufacturer reserves the right also to get authorization in other countries. In case of doubt, contact the manufacturer.

Safety information for RFID modules

⚠ WARNING

Multiple hazards. Do not disassemble the instrument for maintenance. If the internal components must be cleaned or repaired, contact the manufacturer.

⚠ WARNING

Electromagnetic radiation hazard. Do not use the instrument in dangerous environments.

NOTICE

This instrument is sensitive to electromagnetic and electromechanical interference. These interferences can have an effect on the analysis performance of this instrument. Do not put this instrument near equipment that can cause interference.

Obey the safety information that follows to operate the instrument in accordance with local, regional and national requirements.

- Do not operate the instrument in hospitals and equivalent establishments or near medical equipment, such as pace makers or hearing aids.
- Do not operate the instrument near highly flammable substances, such as fuels, highly flammable chemicals and explosives.
- Do not operate the instrument near combustible gases, vapors or dust.
- Keep the instrument away from strong vibration or shock.
- The instrument can cause interference in immediate proximity to televisions, radios and computers.
- The warranty does not cover improper use or wear.

FCC conformance for RFID

This instrument may contain a registered radio frequency identification device (RFID). Refer to Table 1 for the Federal Communications Commission (FCC) registration information.

Table 1 Registration information

Parameter	Value
FCC identification number (FCC ID)	YCB-ZBA987
IC	5879A-ZBA987
Frequency	13.56 MHz

Certification

Canadian Radio Interference-Causing Equipment Regulation, IECS-003, Class A:

Supporting test records reside with the manufacturer.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

FCC Part 15, Class "A" Limits

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

1. Disconnect the equipment from its power source to verify that it is or is not the source of the interference.
2. If the equipment is connected to the same outlet as the device experiencing interference, connect the equipment to a different outlet.
3. Move the equipment away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

Product overview

⚠ DANGER	
	Chemical or biological hazards. If this instrument is used to monitor a treatment process and/or chemical feed system for which there are regulatory limits and monitoring requirements related to public health, public safety, food or beverage manufacture or processing, it is the responsibility of the user of this instrument to know and abide by any applicable regulation and to have sufficient and appropriate mechanisms in place for compliance with applicable regulations in the event of malfunction of the instrument.

The TU5300 sc and the TU5400 sc turbidimeters are used with an SC controller to measure low-range turbidity mostly in finished drinking water applications. Refer to Figure 1.

The TU5300 sc and the TU5400 sc turbidimeters measure scattered light at an angle of 90° in a 360° radius around the axis of the incident light beam.

An optional RFID module and an automatic system check option are available[5]. The RFID module is shown in Figure 1. The RFID module lets process and laboratory turbidity measurements be easily compared. A description of the automatic system check option is given in the expanded user manual on the manufacturer's website.

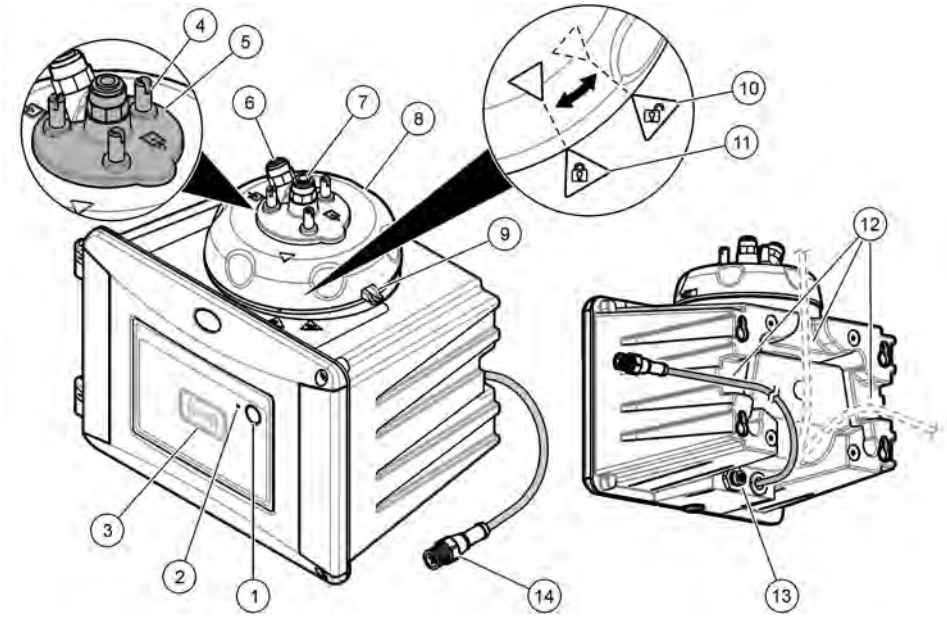
PROGNOSYS predictive diagnostic software is available for the TU5300 sc and TU5400 sc turbidimeters. To use PROGNOSYS, connect the turbidimeter to an SC controller with PROGNOSYS.

Videos on how to install, operate and do maintenance and troubleshooting on the TU5300 sc and the TU5400 sc turbidimeters are available on the *TU5 Series Turbidimeters* playlist at http://www.youtube.com/user/hachcompany.

For the accessories, refer to the expanded user manual on the manufacturer's website.

[5] The RFID module and automatic system check option is only available at the time of purchase.

Figure 1 Product overview



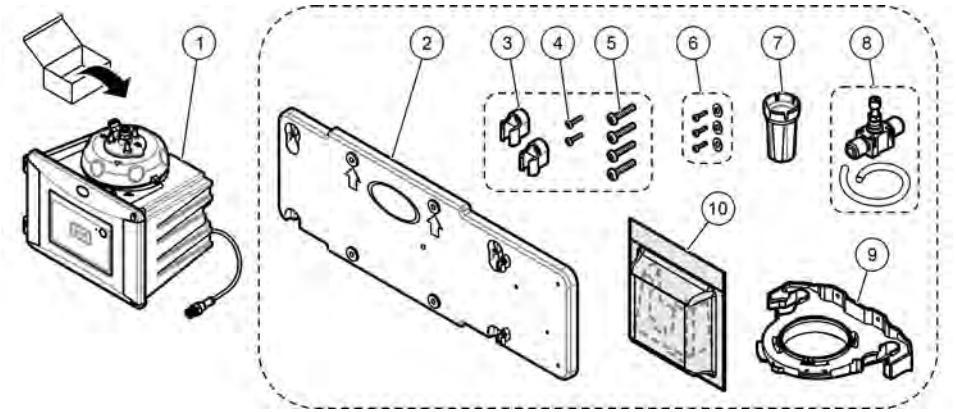
1 Programmable button	**8** Process head
2 Status indicator light[6]	**9** Overflow drain
3 RFID module indicator (optional)	**10** Process head (open)
4 Cleaning lid screws (3x)	**11** Process head (closed)
5 Cleaning lid	**12** Channels for cables
6 Sample inlet	**13** Extension connector for accessories
7 Sample outlet	**14** Sensor cable

Product components

Make sure that all components have been received. Refer to Figure 2. If any items are missing or damaged, contact the manufacturer or a sales representative immediately.

[6] Shows the instrument status. Refer to the expanded user manual on the manufacturer's website for more information.

Figure 2 Product components



1 TU5300 sc or TU5400 sc	**6** Cleaning lid screws and washers for hot water applications
2 Wall mount bracket (two tubing clips on bracket)	**7** Vial replacement tool
3 Tubing clips	**8** Flow regulator
4 Tubing clip screws, 2.2 x 6 mm	**9** Service bracket
5 Mounting screws, 4 x 16 mm	**10** Desiccant cartridge

Installation

⚠ CAUTION

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

Installation guidelines

NOTICE

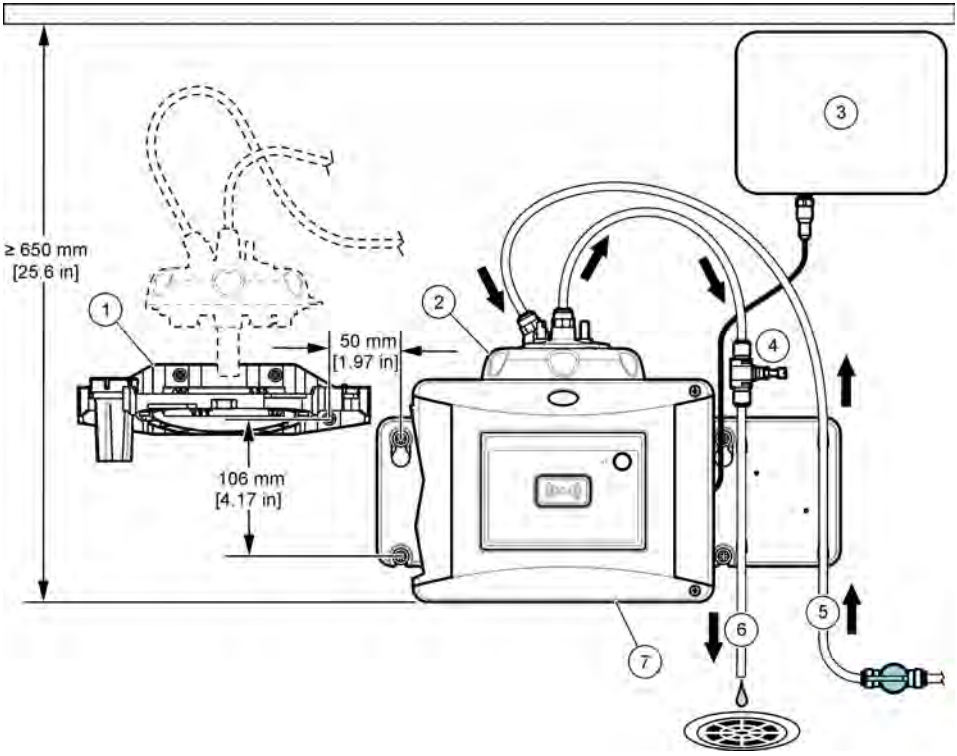
Make sure that there is a floor drain near the instrument. Examine the instrument daily for leaks.

This instrument is rated for an altitude of 3100 m (10,710 ft) maximum. Use of this instrument at an altitude higher than 3100 m can slightly increase the potential for the electrical insulation to break down, which can result in an electric shock hazard. The manufacturer recommends that users with concerns contact technical support.

Installation overview

Figure 3 shows the installation overview with no accessories and the clearances necessary. Refer to the expanded manual on the manufacturer's website for the system overview with all of the accessories.

Figure 3 Installation overview with no accessories



1 Service bracket	**5** Sample inlet
2 Process head	**6** Sample outlet
3 SC controller	**7** TU5300 sc or TU5400 sc
4 Flow regulator	

Wall mount

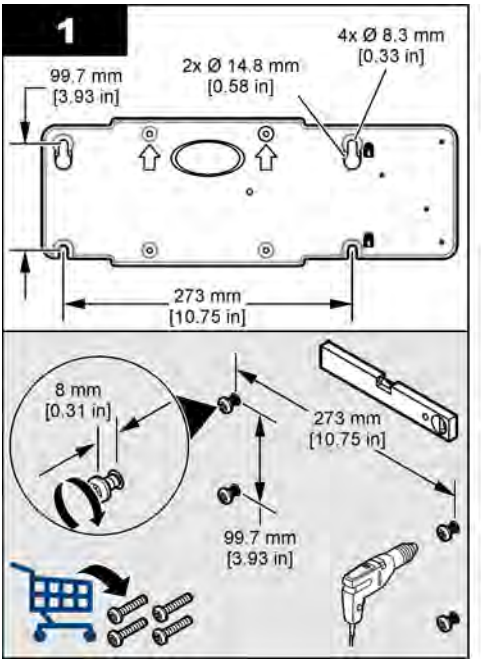
Install the instrument on a wall in a vertical position. Install the instrument so that it is level.

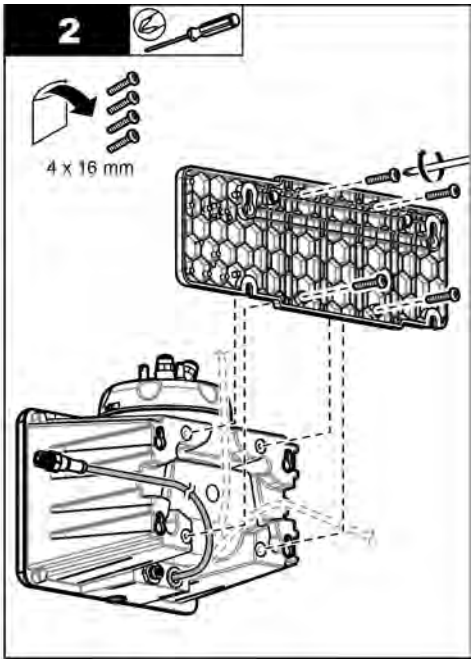
Install with the wall mount bracket

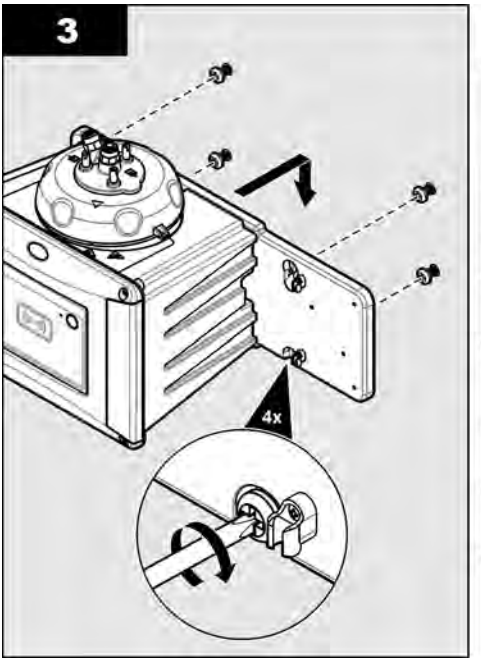
Refer to the illustrated steps that follow to install the instrument on a wall with the wall mount bracket. The mounting hardware to install the wall mount bracket on a wall is supplied by the user.

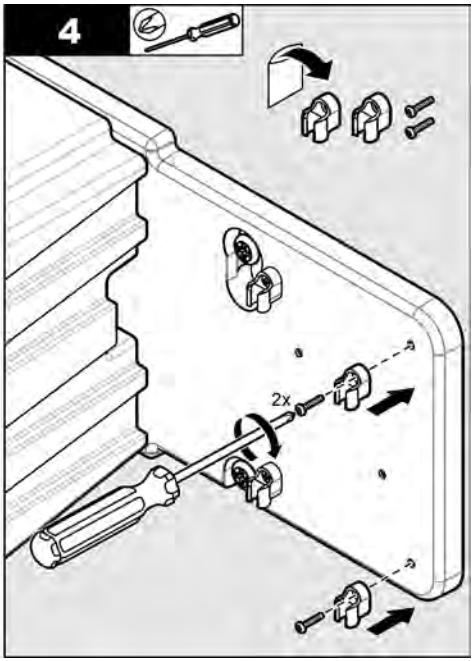
If a 1720D, 1720E, or FT660 instrument is replaced, remove the instrument from the wall. Then do steps 2 to 4 of the illustrated steps that follow to install the instrument on the existing hardware.

Note: *When the accessories are used, the installation location of the tubing clips is different. Refer to the documentation supplied with the accessories for tubing clip installation.*


1
99.7 mm
[3.93 in]
2x Ø 14.8 mm
[0.58 in]
4x Ø 8.3 mm
[0.33 in]
273 mm
[10.75 in]
8 mm
[0.31 in]
273 mm
[10.75 in]
99.7 mm
[3.93 in]

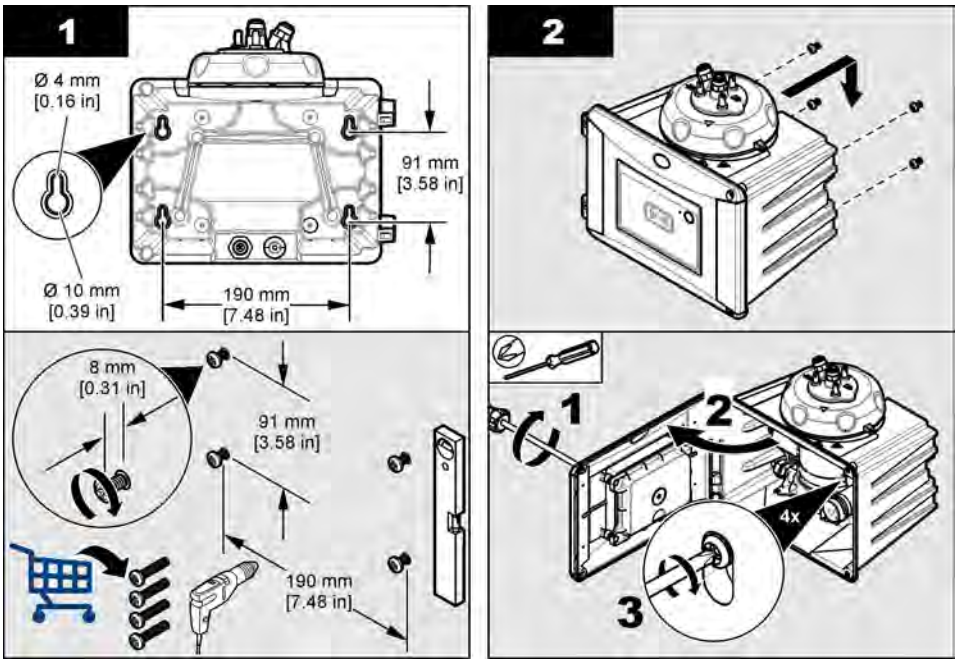

2
4 x 16 mm


3
4x


4
2x

Install directly on a wall

As an alternative, refer to the illustrated steps that follow to install the instrument directly on a wall. The mounting hardware is supplied by the user. Remove the thin, plastic film from the mounting holes on the back of the instrument.



Install the desiccant cartridge

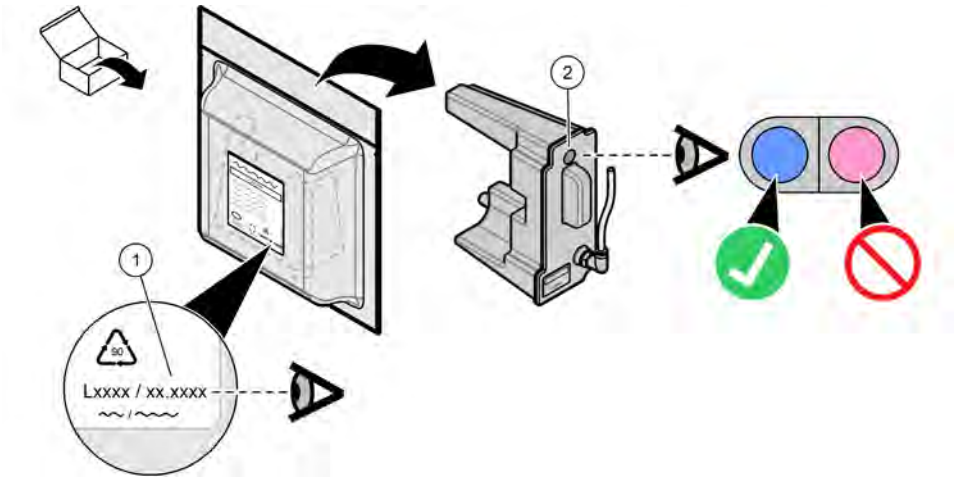
NOTICE

Make sure that the desiccant cartridge is installed or damage to the instrument will occur.

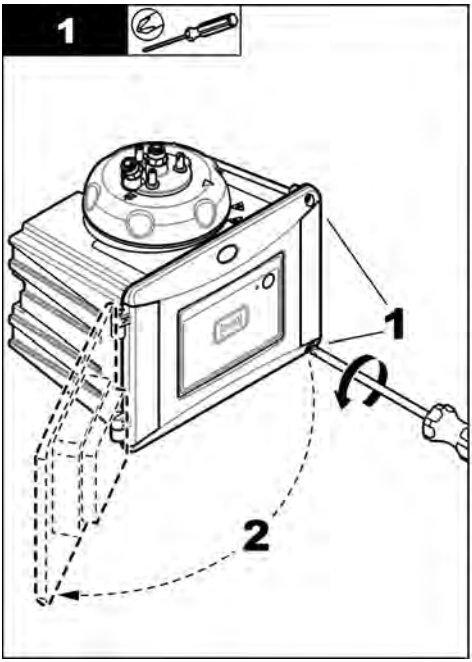
For initial installation, complete the steps below. For replacement, refer to the documentation supplied with the desiccant cartridge.

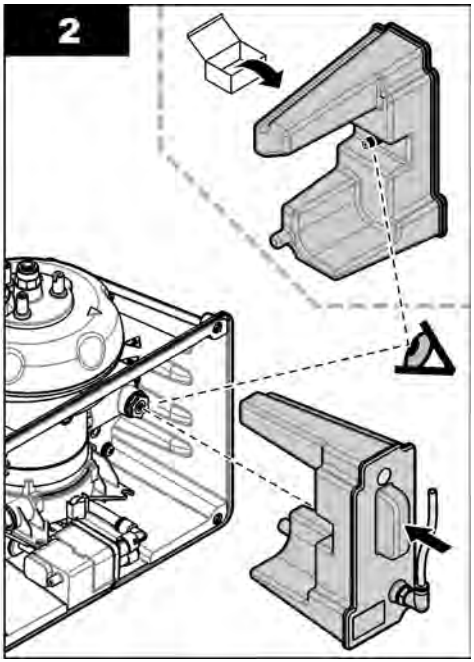
1. Look at the install by date on the packaging. Refer to Figure 4. Do not use if the current date is past the install by date.
2. Make sure that the indicator on the new desiccant cartridge is blue. Refer to Figure 4.
3. Install the new desiccant cartridge. Refer to the illustrated steps that follow.

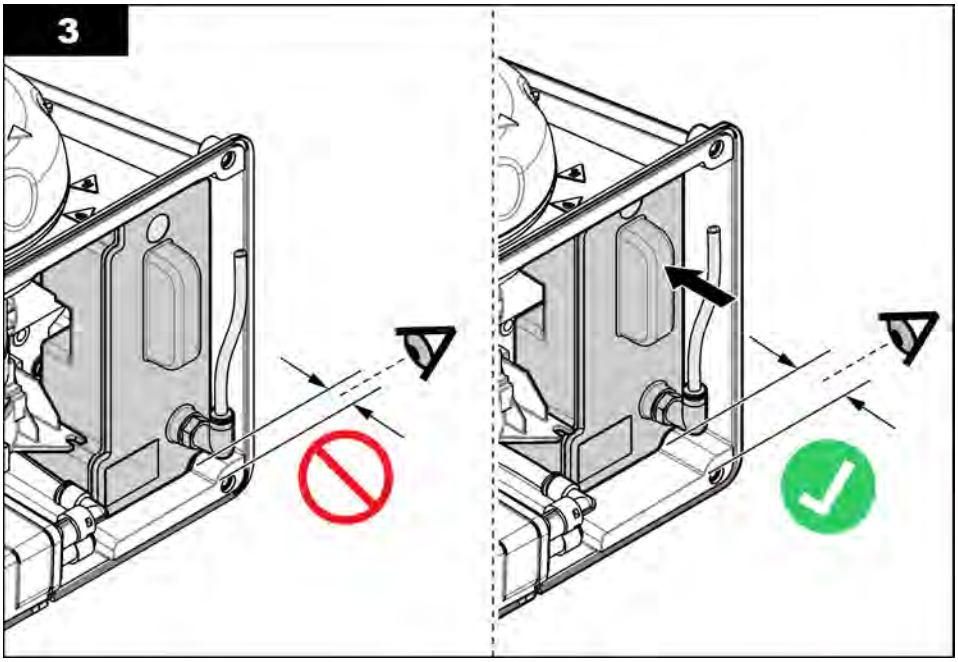
Figure 4 Examine the desiccant cartridge

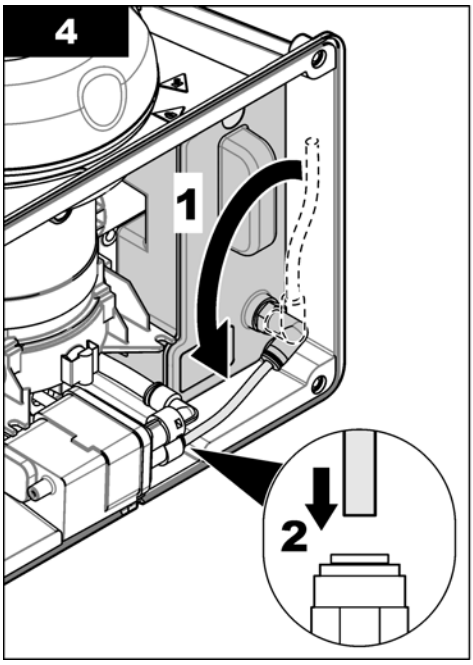


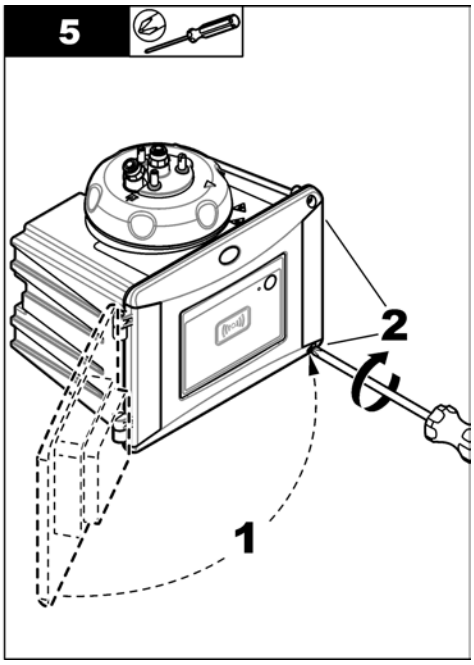
1 Install by date (mm.yyyy = month and year)	**2** Indicator (blue = not expired, pink = expired)






3


4
1
2


5
2
1

Replace the cleaning lid screws

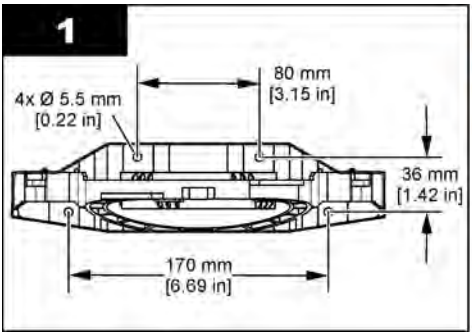
NOTICE
Do not overtighten the screws or breakage will occur. Hand tighten the screws.

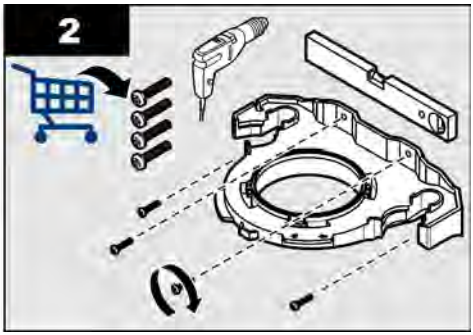
If the sample temperature is 40 to 60 °C (104 to 140 °F), the cleaning lid screws will become hot. To prevent burns, replace the standard cleaning lid screws with the cleaning lid screws and washers for hot water. Refer to Figure 1 on page 9 for the location of the cleaning lid screws.

Install the service bracket

The service bracket holds the process head (or the optional automatic cleaning module) when it is not installed on the instrument.

Refer to Installation overview on page 10 to install the service bracket the correct distance from the instrument. Refer to the illustrated steps that follow to install the service bracket.





Install the flow sensor (optional)

The optional flow sensor identifies if the sample flow is within specifications. A warning shows on the controller display and the status indicator light when a no flow, low flow or high flow warning occurs.

Install the optional flow sensor. Refer to the documentation supplied with the optional flow sensor.

Install the automatic cleaning module (optional)

The automatic cleaning module cleans the inside of the process vial at a selected time interval. Install the optional automatic cleaning module. Refer to the documentation supplied with the automatic cleaning module.

Connect to an SC controller

⚠ CAUTION	
	Personal injury hazard. Do not look into the vial compartment when the instrument is connected to power.

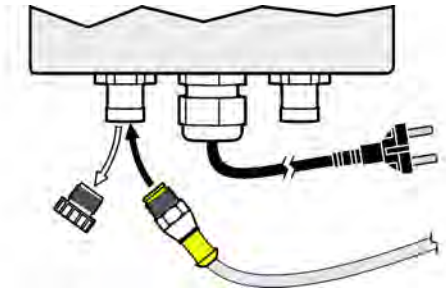
1. Install the latest software version on the SC controller before the instrument is connected to the SC controller. Get the latest software version from www.hach.com.

   Refer to the software installation instructions supplied in the box or supplied in the software download for the SC controller.
2. Remove power to the SC controller.
3. Connect the sensor cable to the quick-connect fitting of the SC controller. Refer to Figure 5. Keep the connector cap for later use.
4. Supply power to the SC controller.

   The SC controller looks for the instrument.
5. When the SC controller finds the instrument, push **enter**.

   On the main screen, the controller shows the turbidity value measured by the turbidimeter.

Figure 5 Connect the sensor cable to the SC controller



Plumbing

Plumb the instrument

⚠ WARNING

Explosion hazard. Make sure that the drain tube is free of all obstructions. If the drain tube has a blockage or is pinched or bent, high pressure can build up in the instrument.

⚠ WARNING

Personal injury hazard. The sample line contains water under high water pressure that can burn skin if hot. Qualified personnel must remove the water pressure and wear personal protective equipment during this procedure.

NOTICE

Do not let water get in the vial compartment or instrument damage will occur. Before the process head is installed on the instrument, make sure that there are no water leaks. Make sure that all tubing is fully seated. Make sure that the vial nut is tight.

NOTICE

Before the instrument is plumbed, make sure that the desiccant cartridge and vial are installed.

Items supplied by the user:

- Flow shutoff valve

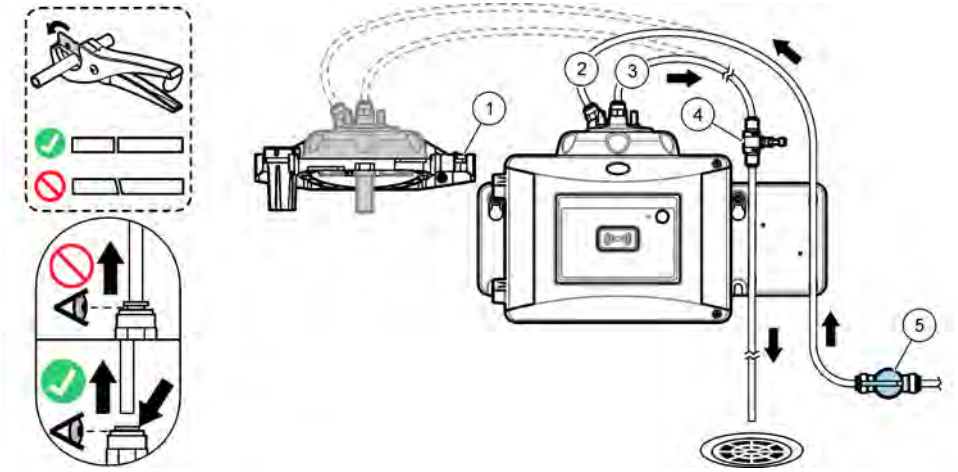
- Tubing[7]
- Tubing cutter

1. Plumb the instrument. Refer to the illustrated steps that follow and Figure 6.

   Note: *To plumb the instrument with accessories, refer to the documentation supplied with the accessories.*
2. If a service bracket is not installed near the instrument, do the steps that follow:

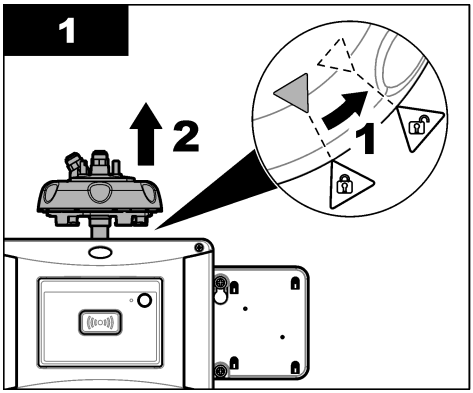
   a. Do not do illustrated steps 1 and 2.
   b. Do illustrated steps 3 and 4 with the process head on the instrument.
   c. Before step 5, remove the process head from the instrument.
   d. Hold the process head so that it is not above the instrument or put the process head on the optional process head holder.
   e. Do illustrated steps 5 and 6.
   f. When there are no leaks from the process head or the flow regulator, install the process head on the instrument (illustrated step 8).

Figure 6 Plumbing overview – no accessories



1 Service bracket	**4** Flow regulator
2 Sample inlet	**5** Flow shutoff valve
3 Sample outlet	

[7] Refer to Specifications on page 3 for the tubing requirements.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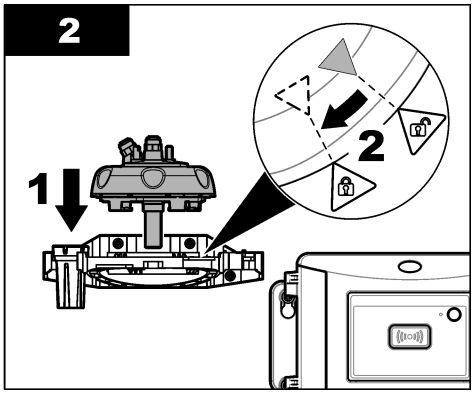
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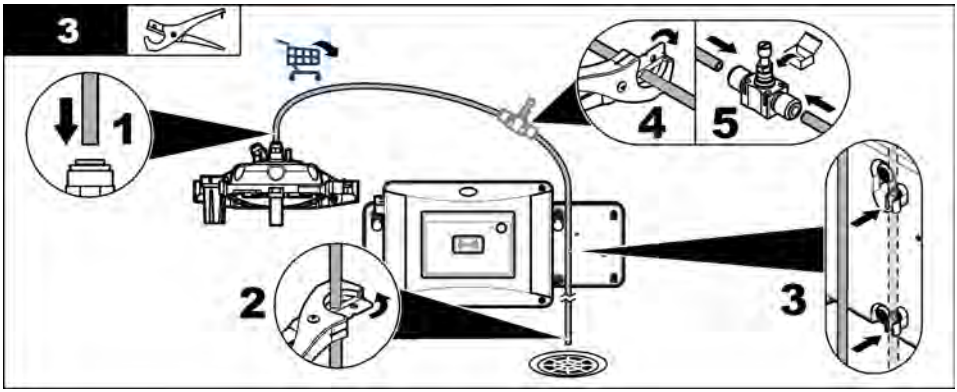
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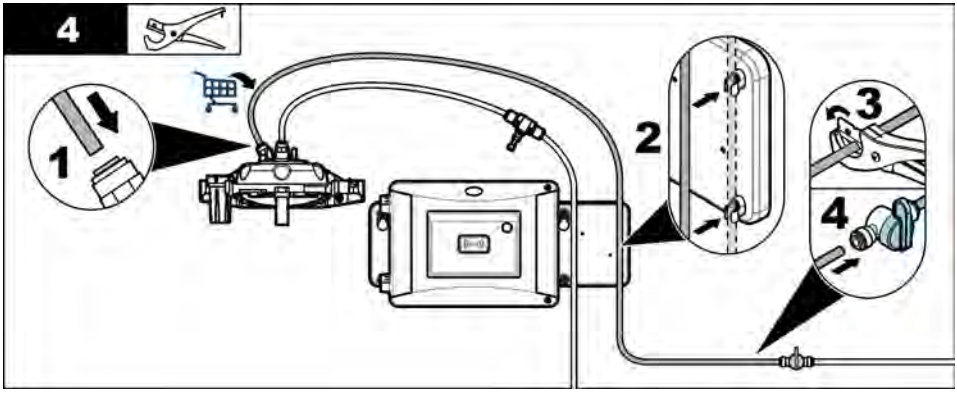
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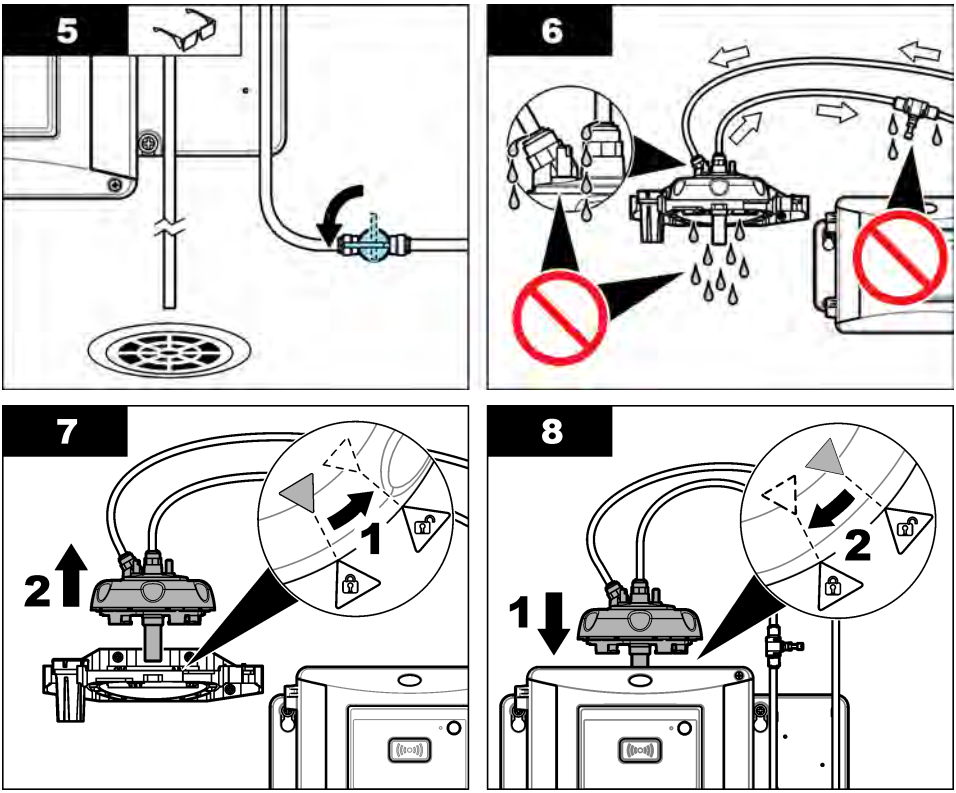


Set the flow rate

1. Measure the flow with the flow regulator fully open. Make sure that the flow is in the middle of the flow specification. Refer to Specifications on page 3.
2. Slowly close the flow regulator until the flow decreases by 20 to 30%.
   Note: *The flow regulator causes back pressure in the tubing and decreases the quantity of bubbles that can form in the vial.*

User navigation

Refer to the controller documentation for keypad description and navigation information.

Operation

Refer to the expanded user manual on the manufacturer's website to configure the instrument settings and to compare process and lab measurements.

Calibration

⚠ WARNING

Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current safety data sheets (MSDS/SDS) for safety protocols.

When the instrument is used for US EPA regulatory reporting, calibrations must be done according to US EPA guidance documents and methodologies. Contact local regulating authorities for additional compliance regulations.

The instrument is factory calibrated and the laser light source is stable. The manufacturer recommends that a calibration verification be done periodically to make sure that the system operates as intended. The manufacturer recommends calibration as local regulations require and after repairs or comprehensive maintenance work.

Use the optional calibration lid and a vial(s) with a StablCal standard or Formazin standard to calibrate the instrument. As an alternative, use a syringe and StablCal standard or Formazin standard to calibrate the instrument.

Refer to the expanded user manual on www.hach.com to calibrate the instrument and configure the calibration settings.

Verification

Use the optional calibration lid and a sealed-vial 10-NTU StablCal standard (or a StablCal 10 NTU standard and a syringe) to do a primary calibration verification. As an alternative, use the optional calibration lid and the optional glass verification rod (< 0.1 NTU) to do a secondary calibration verification.

Do a calibration verification immediately after each calibration to measure the verification standard and record the measured value to the instrument.

Do calibration verifications between calibrations according to the regulatory recommendations to identify if the instrument operates correctly and is calibrated.

When a calibration verification is done between calibrations, the verification standard is measured. The measured value is compared to the recorded value of the verification standard.

Refer to the expanded user manual on www.hach.com to do a verification and configure the verification settings.

Maintenance

⚠ WARNING

Burn hazard. Obey safe handling protocols during contact with hot liquids.

⚠ CAUTION

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

⚠ CAUTION

Personal injury hazard. Never remove covers from the instrument. This is a laser-based instrument and the user risks injury if exposed to the laser.

⚠ CAUTION

Personal injury hazard. Glass components can break. Handle with care to prevent cuts.

NOTICE

Do not disassemble the instrument for maintenance. If the internal components must be cleaned or repaired, contact the manufacturer.

NOTICE

Stop the sample flow to the instrument and let the instrument become cool before maintenance is done.

To set the output behavior during maintenance, push **menu** and select SENSOR SETUP>TU5x00 sc>DIAG/TEST>MAINTENANCE>OUTPUT MODE.

Maintenance schedule

Table 2 shows the recommended schedule of maintenance tasks. Facility requirements and operating conditions may increase the frequency of some tasks.

Table 2 Maintenance schedule

Task	1 to 3 months	1 to 2 years	As necessary
Clean the vial on page 23 ***Note:*** *The cleaning interval is dependent on the water quality.*	X		
Clean the vial compartment on page 24			X
Replace the vial on page 25		X	
Replace the desiccant cartridge on page 27 ***Note:*** *The replacement interval is dependent on the ambient humidity, ambient temperature and sample temperature.*		X[8]	
Replace the tubing on page 27			X

Clean spills

⚠ CAUTION

Chemical exposure hazard. Dispose of chemicals and wastes in accordance with local, regional and national regulations.

1. Obey all facility safety protocols for spill control.
2. Discard the waste according to applicable regulations.

Clean the instrument

NOTICE

Do not use solvents to clean the instrument.

The instrument is maintenance free. Regular cleaning is not necessary for normal operation. If the exterior of the instrument becomes dirty, wipe the instrument surfaces with a clean, moist cloth.

[8] Two years or as identified by instrument notification.

Clean the vial

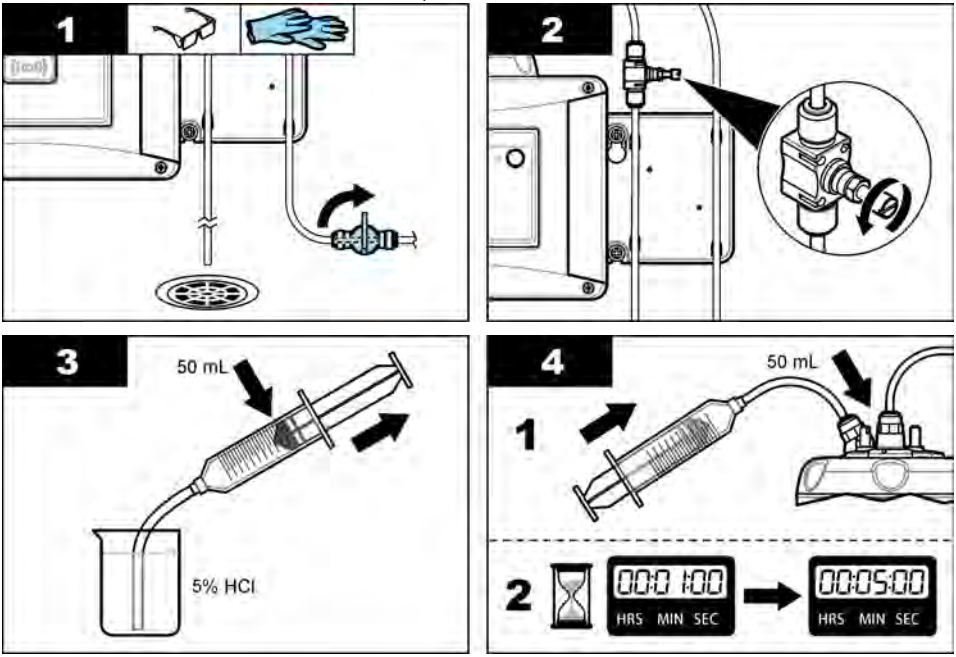
⚠ WARNING

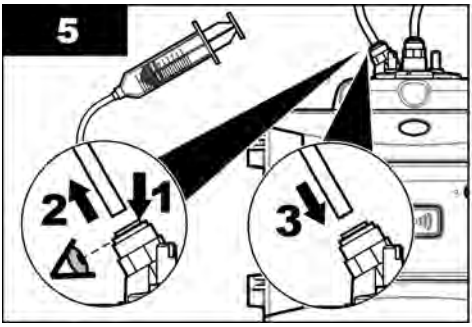
Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current safety data sheets (MSDS/SDS) for safety protocols.

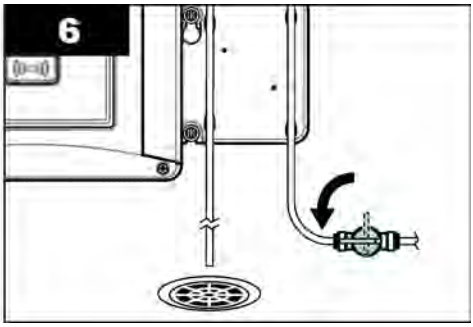
When the turbidity reading shows that there is contamination in the process vial or "VIAL CLARITY" shows on the controller display, clean the vial.

1. Push **menu**.
2. Select SENSOR SETUP>TU5x00 sc>DIAG/TEST>MAINTENANCE>VIAL CLEANING.
3. Complete the steps that show on the controller display. The date the vial was cleaned is automatically saved after the last screen shows.
4. If the optional automatic cleaning module is installed, push **menu** and select SETUP>TU5x00 sc>START WIPE to start the automatic cleaning process.
5. If the optional automatic cleaning module is not installed, clean the vial with the optional vial wiper if available. Refer to Clean the vial with the optional wiper on page 24.
6. If the turbidity readings do not go back to the original values, do the illustrated steps that follow to clean the vial.

   Note: *Hold the output values of the SC controller as necessary before the illustrated steps are done. Refer to the SC controller documentation to hold the outputs.*





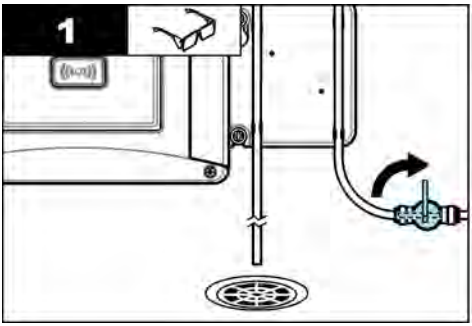


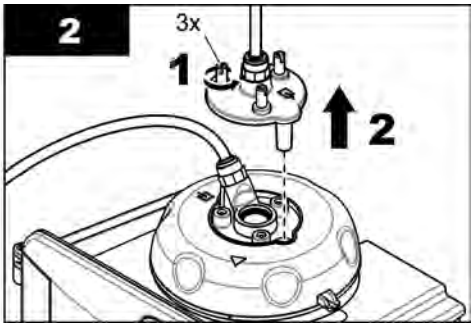
Clean the vial with the optional wiper

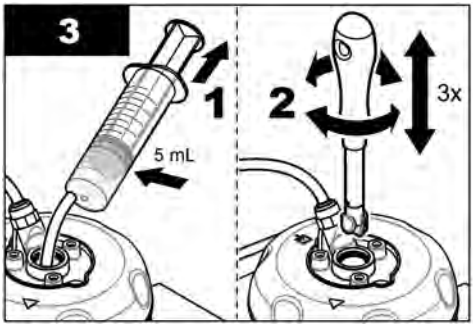
NOTICE

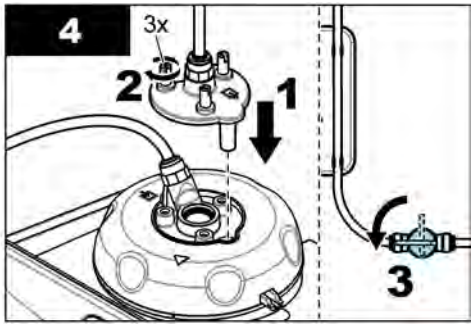
Carefully remove most of the water in the vial. Carefully put the vial wiper into the process vial so that no water spills out.

Clean the process vial with the optional vial wiper as shown in the illustrated steps that follow.









Clean the vial compartment

Clean the vial compartment only when the compartment has contamination. Make sure that the tool to clean the vial compartment has a soft surface and does not damage the instrument. Table 3 shows the options on how to clean the vial compartment.

Table 3 Cleaning options

Contaminant	Options
Dust	Vial compartment wiper, micro fiber cloth, lint-free cloth
Liquid, oil	Cloth, water and cleaning agent

Replace the vial

NOTICE

Keep water out of the vial compartment or instrument damage will occur. Before the automatic cleaning module is installed on the instrument, make sure that there are no water leaks. Make sure that all tubing is fully seated. Make sure that the vial nut is tight.

NOTICE

Hold the automatic cleaning module vertically when it is installed on the instrument or the vial can break. If the vial breaks, water will get in the vial compartment and instrument damage will occur.

NOTICE

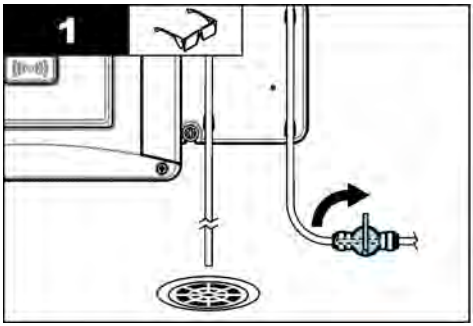
Do not to touch or scratch the glass of the process vial. Contamination or scratches on the glass can cause measurement errors.

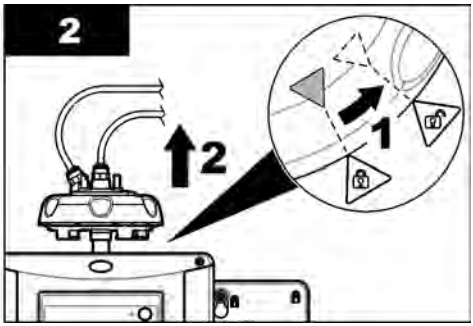
Note: *Make sure that no particles fall into the vial compartment.*

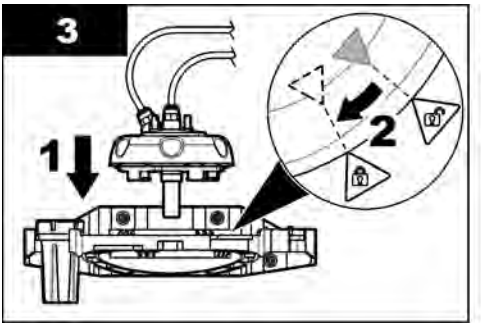
1. Push **menu**.
2. Select SENSOR SETUP>DIAG/TEST>MAINTENANCE>VIAL REPLACEMENT.
3. Complete the steps that show on the controller display. The date the vial was replaced is automatically saved after the last screen shows.

   Refer to the illustrated steps that follow to replace the vial. To protect the new vial from contamination, use the vial replacement tool to install the vial.

   At illustrated step 3, put the process head on its side on a flat surface if a service bracket is not installed near the instrument.



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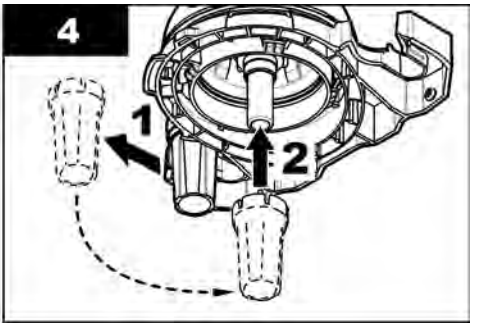
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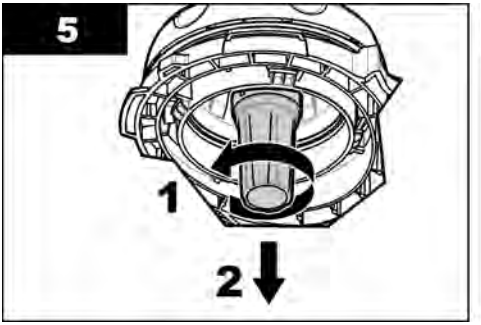
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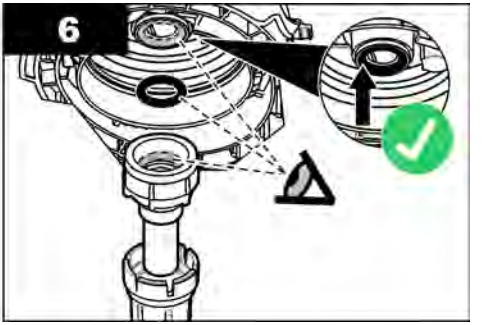
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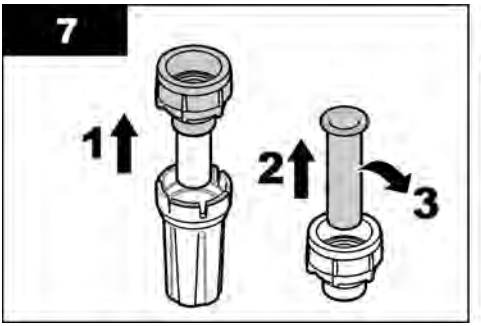
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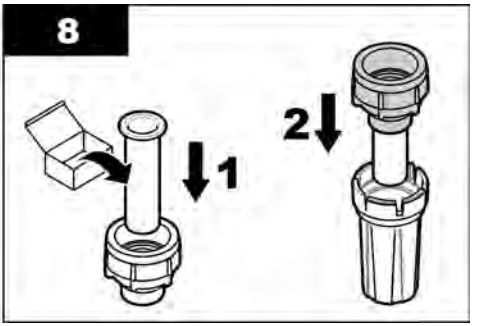
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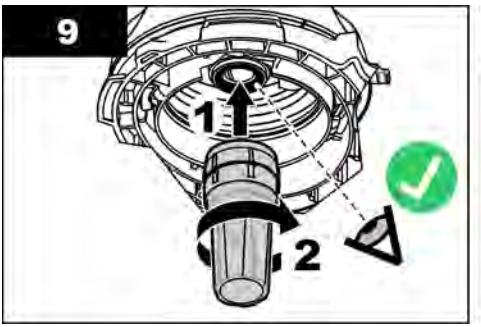
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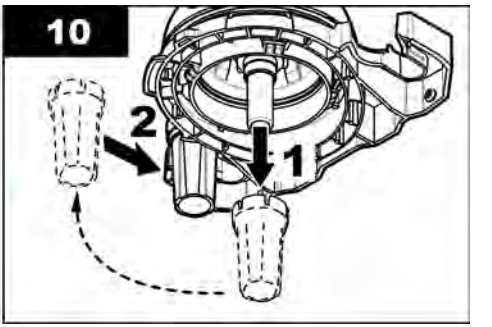
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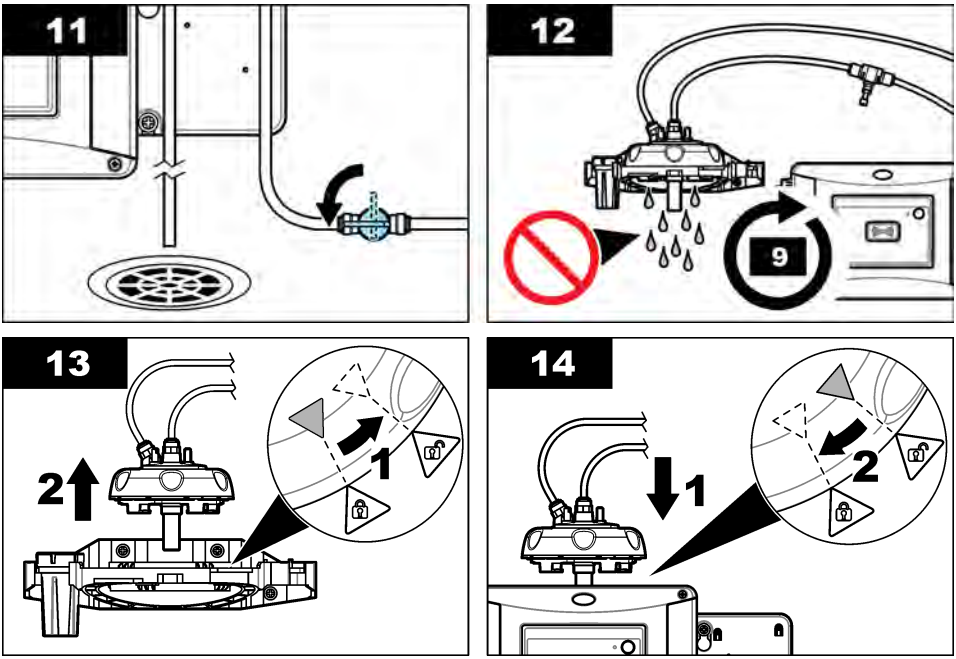

Replace the desiccant cartridge

The controller display will show when a desiccant cartridge replacement is due. Refer to the documentation included in the desiccant cartridge bag to replace the desiccant cartridge.

Replace the tubing

Replace the tubing when the tubing has a blockage or has damage.

Turn the flow shutoff valve to stop flow to the instrument. Then refer to Plumb the instrument on page 17 to replace the tubing.

Troubleshooting

Refer to the expanded user manual on www.hach.com for troubleshooting information.

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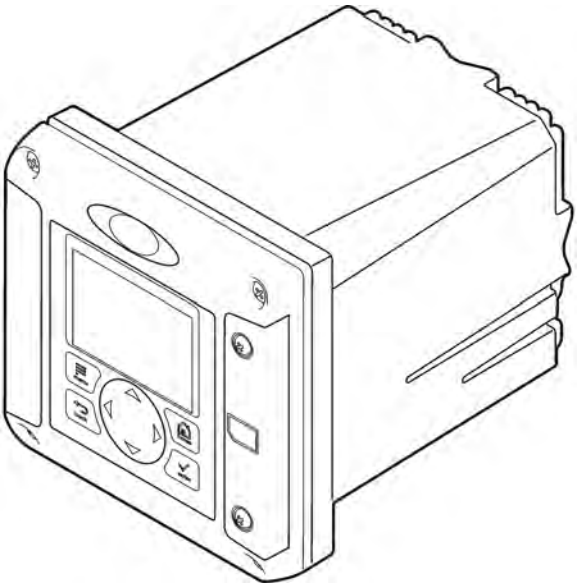
sc200 Controller

07/2016, Edition 8

User Manual



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Specifications

Specifications are subject to change without notice.

Specification	Details
Component description	Microprocessor-controlled and menu-driven controller that operates the sensor and displays measured values.
Operating temperature	-20 to 60 ºC (-4 to 140 ºF); 95% relative humidity, non-condensing with sensor load <7 W; -20 to 50 ºC (-4 to 104 ºF) with sensor load <28 W
Storage temperature	-20 to 70 ºC (-4 to 158 ºF); 95% relative humidity, non-condensing
Enclosure[1]	NEMA 4X/IP66 metal enclosure with a corrosion-resistant finish
Power requirements	**AC powered controller:** 100-240 VAC ±10%, 50/60 Hz; Power 50 VA with 7 W sensor/network module load, 100 VA with 28 W sensor/network module load (optional Modbus, RS232/RS485, Profibus DPV1 or HART network connection).
	24 VDC powered controller: 24 VDC—15%, + 20%; Power 15 W with 7 W sensor/network module load, 40 W with 28 W sensor/network module load (optional Modbus, RS232/RS485, Profibus DPV1 or HART network connection).
Altitude requirements	Standard 2000 m (6562 ft) ASL (Above Sea Level)
Pollution degree/Installation category	Polution Degree 2; Installation Category II
Outputs	Two analog (0-20 mA or 4-20 mA) outputs. Each analog output can be assigned to represent a measured parameter such as pH, temperature, flow or calculated values. Optional module supplies three additional analog outputs (5 total).
Relays	Four SPDT, user-configured contacts, rated 250 VAC, 5 Amp resistive maximum for the AC powered controller and 24 VDC, 5A resistive maximum for the DC powered controller. Relays are designed for connection to AC Mains circuits (i.e., whenever the controller is operated with 115 - 240 VAC power) or DC circuits (i.e., whenever the controller is operated with 24 VDC power).
Dimensions	½ DIN—144 x 144 x 180.9 mm (5.7 x 5.7 x 7.12 in.)
Weight	1.7 kg (3.75 lb)
Compliance information[2]	CE approved (with all sensor types). Listed for use in general locations to UL and CSA safety standards by ETL (with all sensor types). Certain AC mains powered models are listed for use in general safety locations to UL and CSA safety standards by Underwriters Laboratories (with all sensor types).
Digital communication	Optional Modbus, RS232/RS485, Profibus DPV1 or HART network connection for data transmission
Data logging	Secure Digital Card (32 GB maximum) or special RS232 cable connector for data logging and performing software updates. The controller will keep approximately 20,000 data points per sensor.
Warranty	2 years

General information

In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual. The manufacturer reserves the right to

[1] Units that have the Underwriters Laboratories (UL) certification are intended for indoor use only and do not have a NEMA 4X/IP66 rating.

[2] DC powered units are not listed by UL.

make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

Safety information

NOTICE

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

Use of hazard information

⚠ DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	This symbol indicates that a risk of electrical shock and/or electrocution exists.
	This symbol indicates the presence of devices sensitive to Electro-static Discharge (ESD) and indicates that care must be taken to prevent damage with the equipment.
	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.

Certification

Canadian Radio Interference-Causing Equipment Regulation, IECS-003, Class A:

Supporting test records reside with the manufacturer.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

FCC Part 15, Class "A" Limits

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

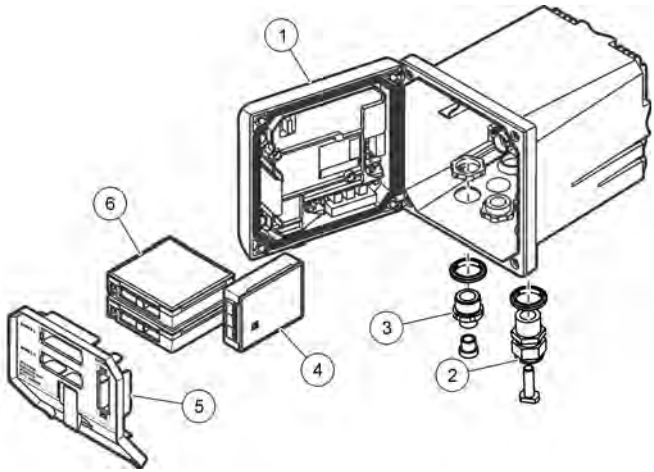
1. Disconnect the equipment from its power source to verify that it is or is not the source of the interference.
2. If the equipment is connected to the same outlet as the device experiencing interference, connect the equipment to a different outlet.
3. Move the equipment away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

Product overview

The controller displays sensor measurements and other data, can transmit analog and digital signals, and can interact with and control other devices through outputs and relays. Outputs, relays, sensors and sensor modules are configured and calibrated through the user interface on the front of the controller.

Figure 1 shows the product components. Components may vary according to controller configuration. Contact the manufacturer if parts are damaged or missing.

Figure 1 System components



1 Controller	**4** Network module (optional)
2 Strain relief assembly (optional depending on controller version)	**5** High-voltage barrier
3 Digital connection fitting (optional depending on controller version)	**6** Sensor modules (optional)

Sensors and sensor modules

The controller accepts up to a maximum of two sensor modules or two digital sensors (depending on the controller configuration), along with one communication module. A single digital sensor and a single sensor module can be installed in combination. A variety of sensors can be wired to the sensor modules. Sensor wiring information is given in the specific sensor manuals and in the user instructions for specific modules.

Relays outputs and signals

The controller has four configurable relay switches and two analog outputs. An optional analog output module can increase the number of analog outputs to five.

Device scans

With two exceptions, the controller automatically scans for connected devices without user input when it is powered on. The first exception is when the controller is powered on for the first time before initial use. The second exception is after the controller configuration settings have been set to their default values and the controller is powered on. In both cases, the controller first displays the language, date and time edit screens. After the language, date and time entries are accepted, the controller performs a device scan. Refer to Connect a digital sc sensor on page 20 for instructions about how to scan for devices when the controller is already powered on.

Controller enclosure

The controller enclosure is NEMA 4X/IP66-rated and has a corrosion-resistant finish designed to withstand corrosive environmental constituents such as salt spray and hydrogen sulfide. Protection against environmental damage is strongly recommended for outdoor use.
Note: *Units that have the Underwriters Laboratories (UL) certification are intended for indoor use only and do not have a NEMA 4X/IP66 rating.*

Controller mounting options

The controller can be mounted to a panel, to a wall or to a vertical or horizontal pipe. A neoprene sealing gasket is included and can be used to reduce vibration. The gasket can be used as a template for panel mounting before the inner gasket component is separated.

Installation

Mounting components and dimensions

⚠ CAUTION

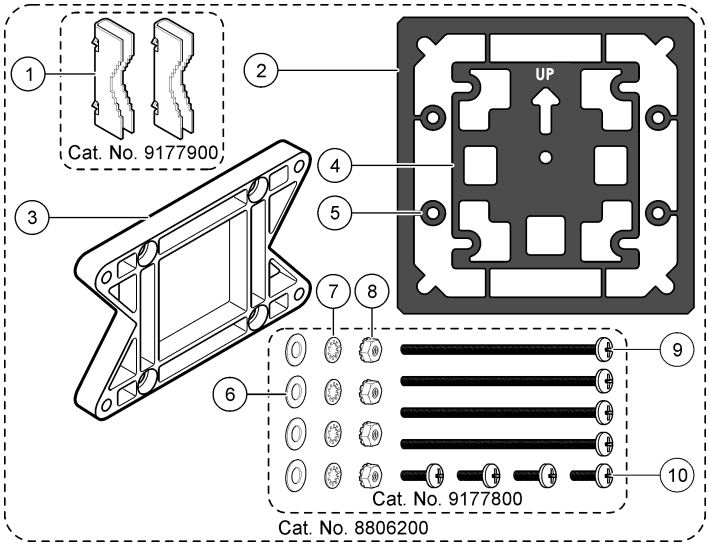
Personal injury hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

The controller can be installed on a surface, panel or pipe (horizontal or vertical). For mounting options and instructions, refer to Figure 2, Figure 3 on page 8, Figure 4 on page 9, Figure 5 on page 10 and Figure 6 on page 11.

For horizontal pipe mounts, the mounting feet (Figure 2) must be attached to the mounting bracket in a vertical position.

For both horizontal and vertical pipe mounts, attach the mounting bracket to the controller as shown in Figure 5 on page 10.

Figure 2 Mounting components



1 Mounting foot (2x)	**6** Flat washer, ¼-inch ID (4x)
2 Sealing gasket for panel mount, Neoprene	**7** Lock washer, ¼-inch ID (4x)
3 Bracket for wall and pipe mounting	**8** M5 x 0.8 Keps hexnut (4x)
4 Vibration isolation gasket for pipe mount	**9** Pan head screws, M5 x 0.8 x 100mm (4x) (Used for variable diameter pipe mount installations)
5 Vibration isolation washer for pipe mount (4x)	**10** Pan head screws, M5 x 0.8 x 15 mm (4x)

Note: *A bracket for panel mounting is available as an optional accessory.*

Controller mounting

Figure 3 Surface mounting dimensions

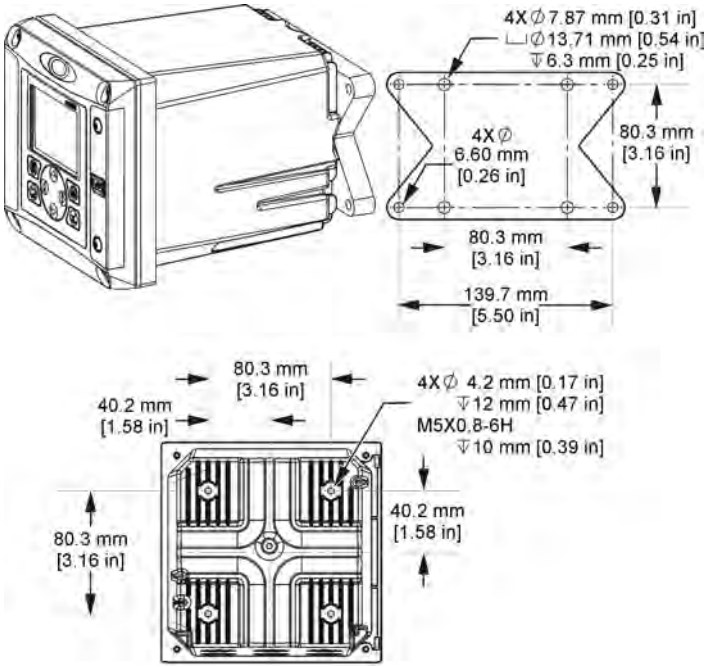
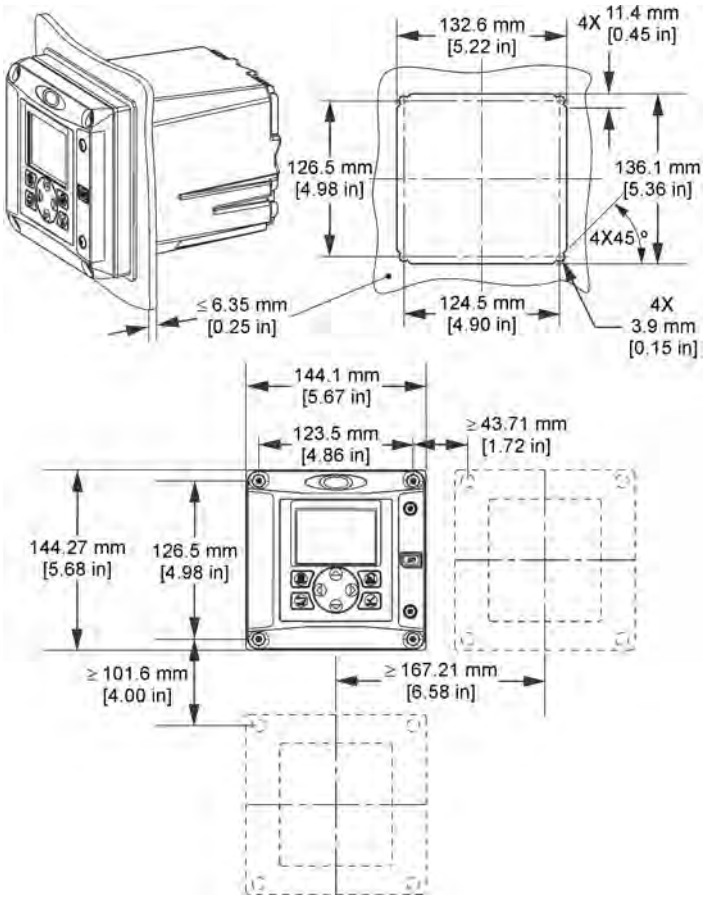


Figure 4 Panel mounting dimensions



Note: *If using the bracket (optional) for panel mounting, push the controller through the hole in the panel and then slide the bracket over the controller on the back side of the panel. Use the four 15 mm pan head screws (supplied) to attach the bracket to the controller and secure the controller to the panel.*

Figure 5 Pipe mounting (vertical pipe)

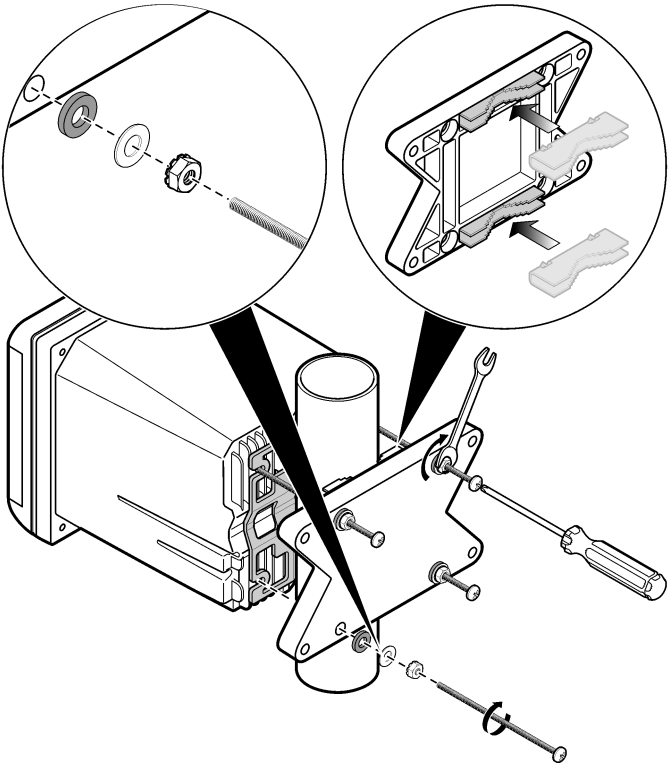
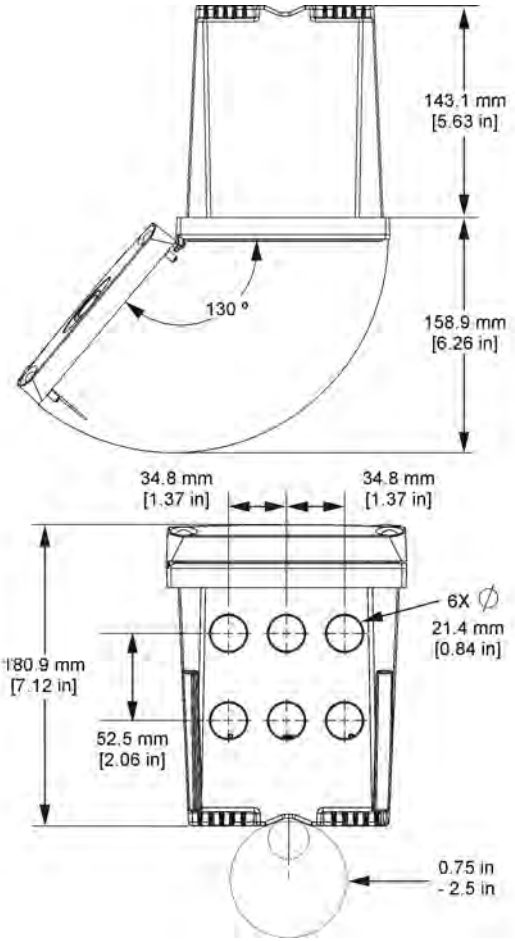


Figure 6 Top and bottom views



High-voltage barrier

High-voltage wiring for the controller is located behind the high-voltage barrier in the controller enclosure. The barrier must remain in place except when installing modules or when a qualified installation technician is wiring for power, alarms, outputs or relays. Do not remove the barrier while power is applied to the controller.

Electrostatic discharge (ESD) considerations

NOTICE	
	Potential Instrument Damage. Delicate internal electronic components can be damaged by static electricity, resulting in degraded performance or eventual failure.

Refer to the steps in this procedure to prevent ESD damage to the instrument:

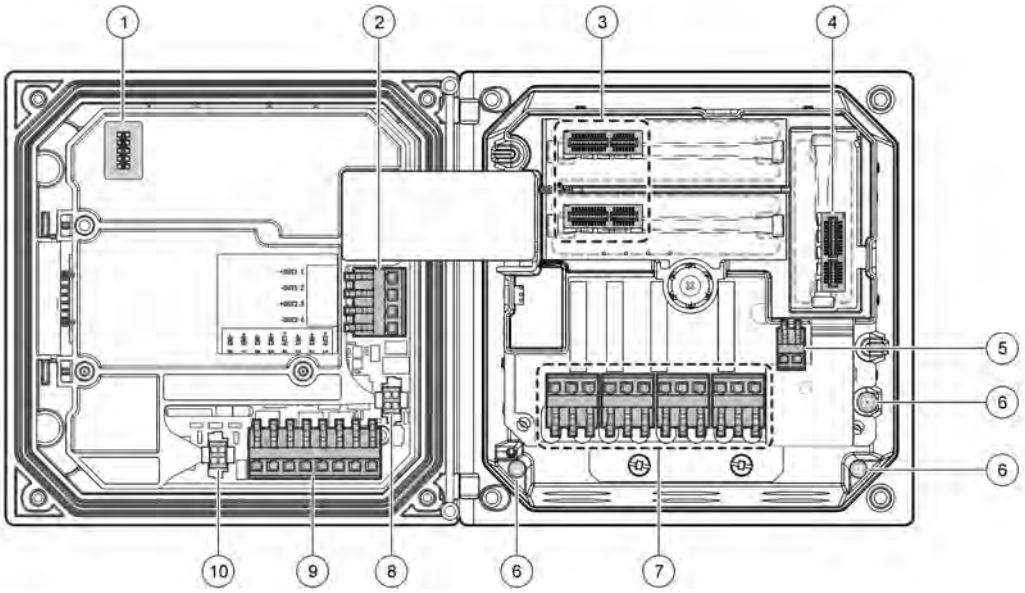
- Touch an earth-grounded metal surface such as the chassis of an instrument, a metal conduit or pipe to discharge static electricity from the body.

- Avoid excessive movement. Transport static-sensitive components in anti-static containers or packages.
- Wear a wrist strap connected by a wire to earth ground.
- Work in a static-safe area with anti-static floor pads and work bench pads.

Wiring overview

Figure 7 shows an overview of the wiring connections inside the controller with the high voltage barrier removed. The left side of the figure shows the back side of the controller cover.
Note: *Remove connector caps from the connectors before module installation.*

Figure 7 Wiring connections overview



1 Service cable connection	**5** AC and DC power connector[3]	**9** Discrete input wiring connector[3]
2 4-20 mA output[3]	**6** Ground terminals	**10** Digital sensor connector[3]
3 Sensor module connector	**7** Relay connections[3]	
4 Communication module connector (e.g., Modbus, Profibus, HART, optional 4-20 mA module, etc.)	**8** Digital sensor connector[3]	

Wiring for power

⚠ WARNING

Potential Electrocution Hazard. Always disconnect power to the instrument when making electrical connections.

[3] Terminals can be removed for improved access.

⚠ WARNING

Potential Electrocution Hazard. If this equipment is used outdoors or in potentially wet locations, a **Ground Fault Interrupt** device must be used for connecting the equipment to its mains power source.

⚠ DANGER

Electrocution Hazard. Do not connect AC power to a 24 VDC powered model.

⚠ WARNING

Potential Electrocution Hazard. A protective earth (PE) ground connection is required for both 100-240 VAC and 24 VDC wiring applications. Failure to connect a good PE ground connection can result in shock hazards and poor performance due to electromagnetic interferences. ALWAYS connect a good PE ground to the controller terminal.

NOTICE

Install the device in a location and position that gives easy access to the disconnect device and its operation.

The controller can be purchased as either a 100-240 VAC powered model or a 24 VDC powered model. Follow the appropriate wiring instructions for the purchased model.

The controller can be wired for line power by hard-wiring in conduit or wiring to a power cord. Regardless of the wire used, the connections are made at the same terminals. A local disconnect designed to meet local electrical code is required and must be identified for all types of installation. In hard-wired applications, the power and safety ground service drops for the instrument must be 18 to 12 AWG.

Notes:

- The voltage barrier must be removed before making any electrical connections. After making all connections, replace the voltage barrier before closing the controller cover.
- A sealing type strain relief and a power cord less than 3 meters (10 feet) in length with three 18-gauge conductors (including a safety ground wire) can be used to maintain the NEMA 4X/IP66 environmental rating.
- Controllers can be ordered with AC power cords pre-installed. Additional power cords may also be ordered.
- The DC power source that supplies power to the 24 VDC powered controller must maintain voltage regulation within the specified 24 VDC-15% +20% voltage limits. The DC power source must also provide adequate protection against surges and line transients.

Wiring procedure

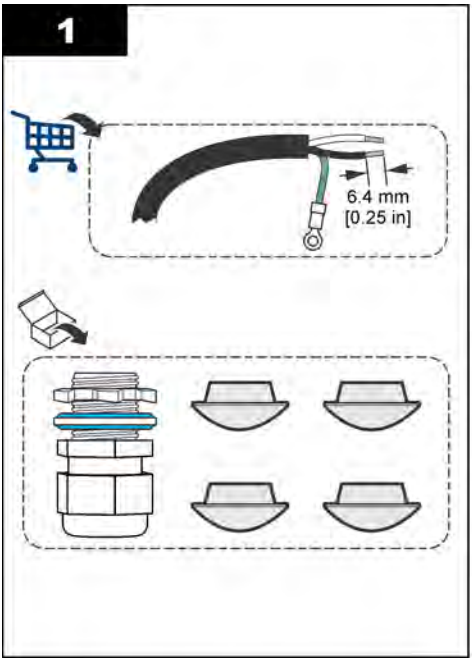
Refer to the illustrated steps that follow and Table 1 or Table 2 to wire the controller for power. Insert each wire into the appropriate terminal until the insulation is seated against the connector with no bare wire exposed. Tug gently after insertion to make sure that there is a secure connection. Seal any unused openings in the controller box with conduit opening sealing plugs.

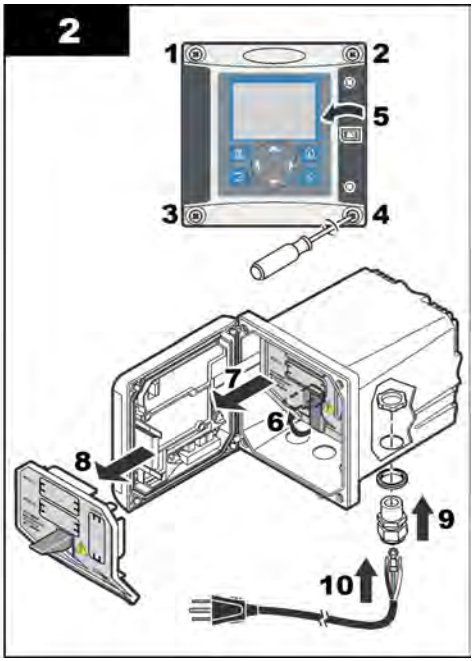
Table 1 AC power wiring information (AC powered models only)

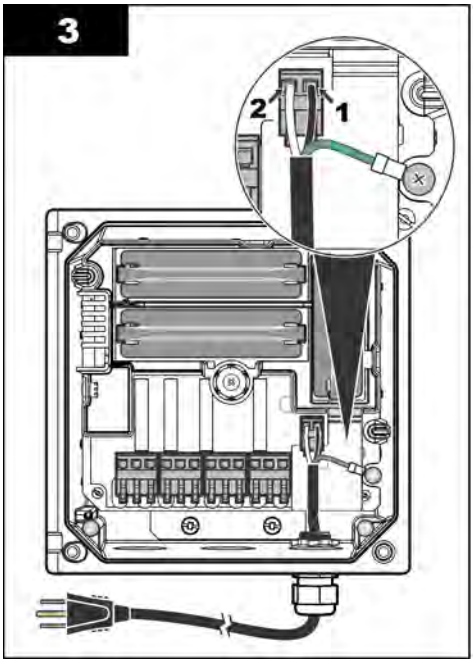
Terminal	Description	Color—North America	Color—EU
1	Hot (L1)	Black	Brown
2	Neutral (N)	White	Blue
—	Protective Earth (PE) Ground lug	Green	Green with yellow stripe

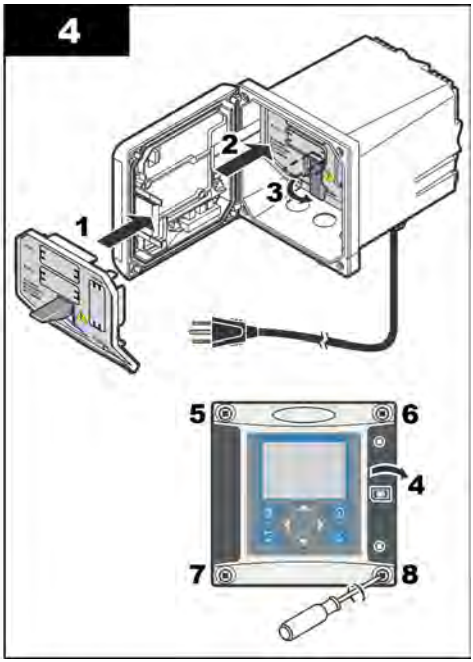
Table 2 DC power wiring information (DC powered models only)

Terminal	Description	Color—North America	Color—EU
1	+24 VDC	Red	Red
2	24 VDC return	Black	Black
—	Protective Earth (PE) Ground lug	Green	Green with yellow stripe









Alarms and relays

The controller is equipped with four unpowered, single pole relays rated 100-250 VAC, 50/60 Hz, 5 amp resistive maximum. Contacts are rated 250 VAC, 5 amp resistive maximum for the AC powered controller and 24 VDC, 5A resistive maximum for the DC powered controller. The relays are not rated for inductive loads.

Wiring relays

⚠ WARNING
Potential Electrocution Hazard. Always disconnect power to the instrument when making electrical connections.

⚠ WARNING
Potential fire hazard. The relay contacts are rated 5A and are not fused. External loads connected to the relays must have current limiting devices provided to limit current to < 5 A.

⚠ WARNING
Potential fire hazard. Do not daisy-chain the common relay connections or jumper wire from the mains power connection inside the instrument.

⚠ WARNING
Potential electrocution hazard. In order to maintain the NEMA/IP environmental ratings of the enclosure, use only conduit fittings and cable glands rated for at least NEMA 4X/IP66 to route cables in to the instrument.

AC line (100—250 V) powered controllers

The wiring compartment is not designed for voltage connections in excess of 250 VAC.

24 VDC powered controllers

⚠ WARNING

Potential electrocution hazard. AC mains powered controllers (115 V–230 V) are designed for relay connections to AC mains circuits (i.e., voltages greater than 16 V-RMS, 22.6 V-PEAK or 35 VDC).

⚠ WARNING

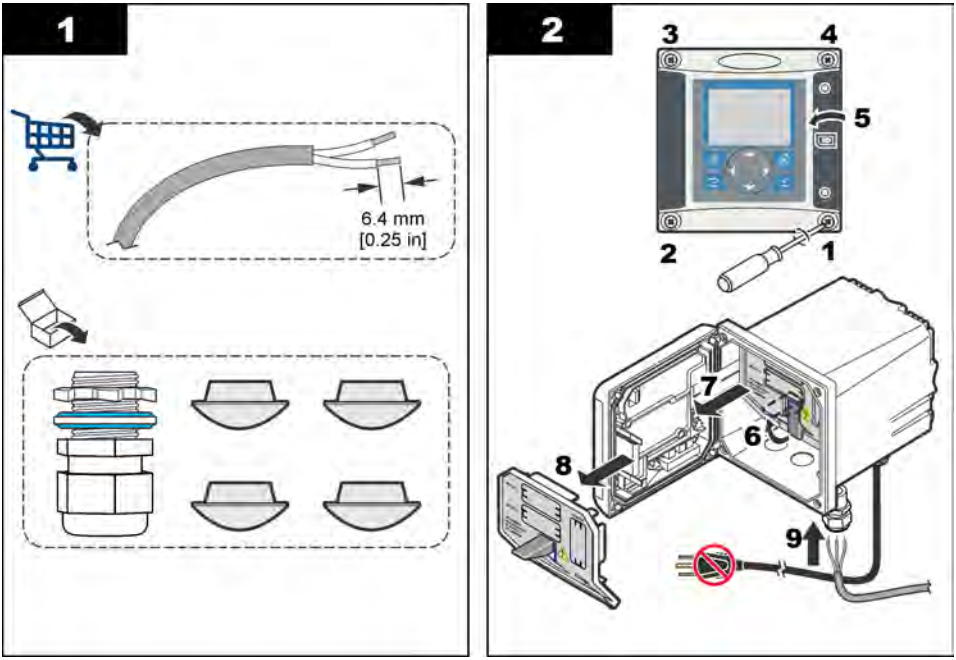
Potential electrocution hazard. 24 V powered controllers are designed for relay connections to low voltage circuits (i.e., voltages less than 16 V-RMS, 22.6 V-PEAK or 35 VDC).

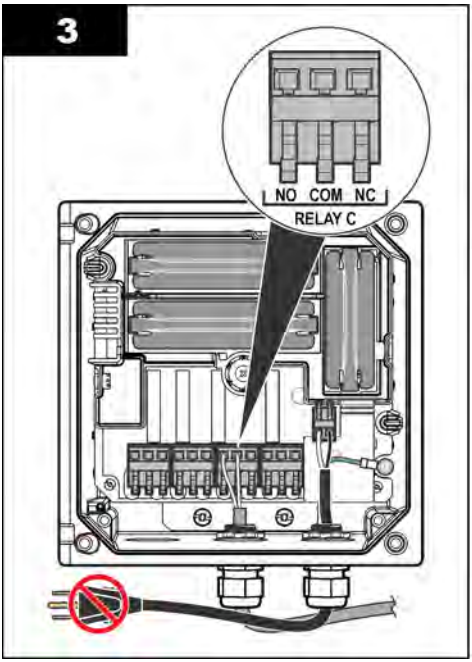
The 24 VDC controller relays are designed for the connection to low voltage circuits (i.e., voltages less than 30 V-RMS, 42.2 V-PEAK or 60 VDC). The wiring compartment is not designed for voltage connections above these levels.

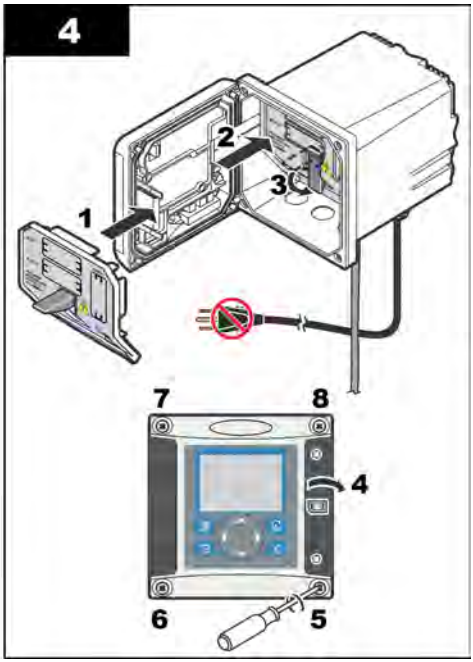
The relay connector accepts 18–12 AWG wire (as determined by load application). Wire gauge less than 18 AWG is not recommended.

The Normally Open (NO) and Common (COM) relay contacts will be connected when an alarm or other condition is active. The Normally Closed (NC) and Common relay contacts will be connected when an alarm or other condition is inactive (unless the Fail Safe is set to Yes) or when power is removed from the controller.

Most relay connections use either the NO and COM terminals or the NC and COM terminals. The numbered installation steps show connection to the NO and COM terminals.







Analog output connections

⚠ WARNING

Potential Electrocution Hazard. Always disconnect power to the instrument when making electrical connections.

⚠ WARNING

Potential electrocution hazard. In order to maintain the NEMA/IP environmental ratings of the enclosure, use only conduit fittings and cable glands rated for at least NEMA 4X/IP66 to route cables in to the instrument.

Two isolated analog outputs (1 and 2) are provided (Figure 8). Such outputs are commonly used for analog signaling or to control other external devices.

Make wiring connections to the controller as shown in Figure 8 and Table 3.
Note: *Figure 8 shows the back of the controller cover and not the inside of the main controller compartment.*

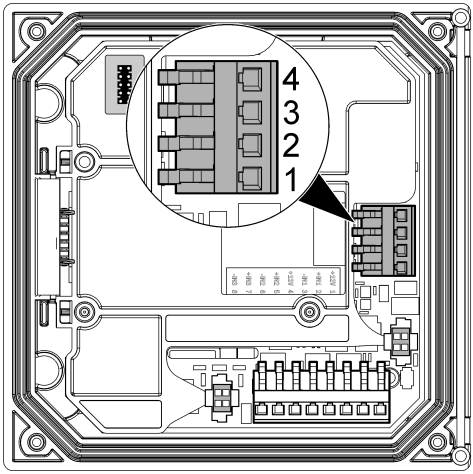
Table 3 Output connections

Recorder wires	Circuit board position
Output 2–	4
Output 2+	3
Output 1–	2
Output 1+	1

1. Open the controller cover.
2. Feed the wires through the strain relief.
3. Adjust the wire as necessary and tighten the strain relief.

4. Make connections with twisted-pair shielded wire and connect the shield at the controlled component end or at the control loop end.
   - Do not connect the shield at both ends of the cable.
   - Use of non-shielded cable may result in radio frequency emission or susceptibility levels higher than allowed.
   - Maximum loop resistance is 500 ohm.
5. Close the controller cover and tighten the cover screws.
6. Configure outputs in the controller.

Figure 8 Analog output connections



Discrete input wiring connections

⚠ WARNING

Potential Electrocution Hazard. Always disconnect power to the instrument when making electrical connections.

⚠ WARNING

Potential electrocution hazard. In order to maintain the NEMA/IP environmental ratings of the enclosure, use only conduit fittings and cable glands rated for at least NEMA 4X/IP66 to route cables in to the instrument.

Three discrete inputs are provided for switch closure inputs or logic level voltage inputs. Make wiring connections and configure jumper settings to the controller as shown in Figure 9, Table 4 and Figure 10.

Note: Figure 9 *shows the back of the controller cover and not the inside of the main controller compartment.*

Figure 9 Discrete input wiring connections

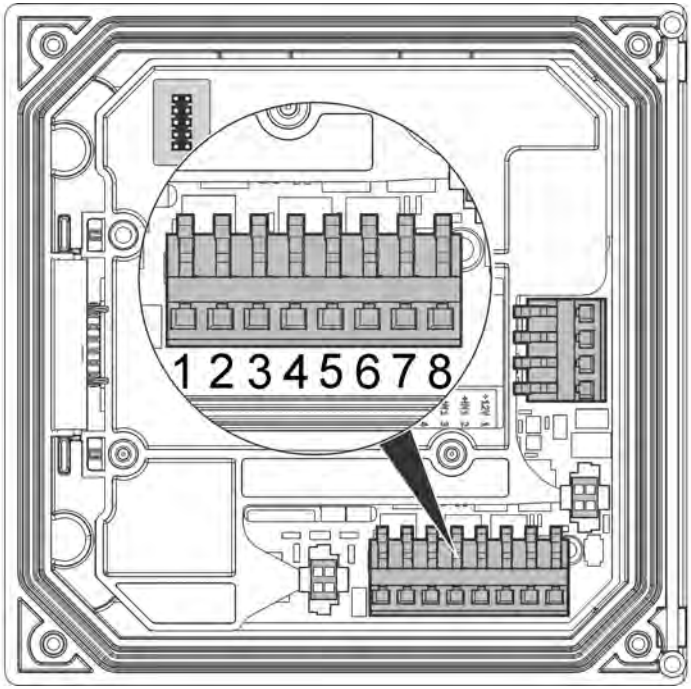
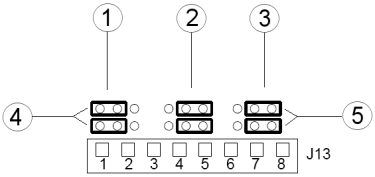


Table 4 Input connections

Discrete inputs	Connector position - Switch input	Connector position - Voltage input
Input 1+	3	2
Input 1-	2	3
Input 2+	6	5
Input 2-	5	6
Input 3+	8	7
Input 3-	7	8

Figure 10 Jumper settings



1 Input 1 configuration jumpers	**4** Jumpers positioned to the left for switch inputs
2 Input 2 configuration jumpers	**5** Jumpers positioned to the right for voltage inputs
3 Input 3 configuration jumpers	

1. Open the controller cover.
2. Feed the wires through the cable gland.
3. Adjust the wire as necessary and tighten the cable gland.
4. The jumpers are positioned immediately behind the connector. Remove the connector for improved access to the jumpers and configure the jumper settings according to the type of input as shown in Figure 10.
5. Close the controller cover and tighten the cover screws.
6. Configure inputs in the controller.

Note: *In* ***switch input*** *mode the controller supplies 12 volts to the switch and is not isolated from the controller. In* ***voltage input*** *mode the inputs are isolated from the controller (user input voltage from 0 to 30 volts).*

Connect a digital sc sensor

Note: *To connect an analog sensor, refer to the instructions supplied in the module or sensor manual.*

A digital sc sensor can be connected to the controller using the keyed quick-connect fitting (Figure 11). A digital sensor can be connected with the controller powered on or off.

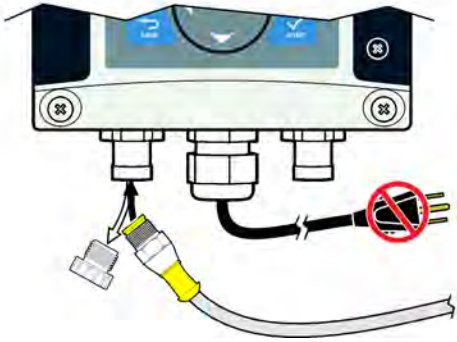
When a sensor is connected with the controller powered on, the controller does not automatically perform a device scan. To make the controller perform a device scan, navigate to the Test/Maintenance menu and select Scan Devices. If a new device is found, the controller performs the installation process without further user action.

When a sensor is connected with the controller powered off, the controller will perform a device scan when it is powered on again. If a new device is found, the controller performs the installation process without further user action.

Retain the connector cap to seal the connector opening in case the sensor must be removed.

Figure 11 Digital sensor quick connect

1.



Connect the optional digital communication output

The manufacturer supports Modbus RS485, Modbus RS232, Profibus DPV1 and HART communication protocols. The optional digital output module is installed in the location indicated by item 4 in Figure 7 on page 12. Refer to the instructions supplied with the network module for more details.

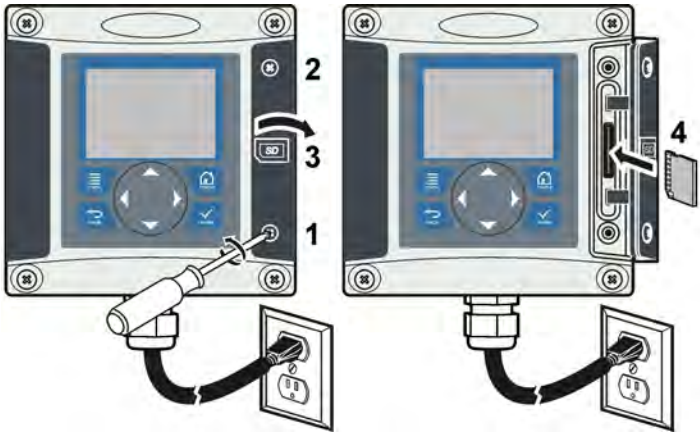
For information about Modbus registers, go to http://www.de.hach.com or http://www.hach.com and search *Modbus registers* or go to any sc200 product page.

Install a Secure Digital (SD) memory card

For instructions on how to install an SD card in the controller, refer to Figure 12. Information on how to use the SD memory card can be found in Using the secure digital memory (SD) card on page 42.

To remove an SD card, push down on the edge of the card and release, then pull the card up and out of the slot. After the card is removed, close the slot cover and tighten the cover screws.

Figure 12 SD card installation

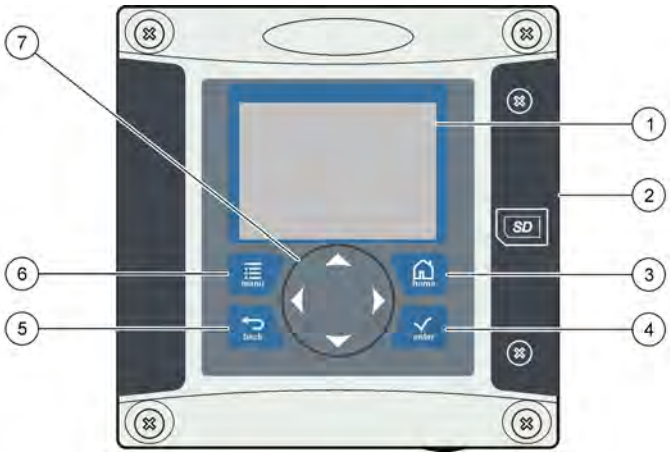


User interface and navigation

User interface

The keypad has four menu keys and four directional keys as shown in Figure 13.

Figure 13 Keypad and front panel overview



1 Instrument display	**5** **BACK** key. Moves back one level in the menu structure.
2 Cover for secure digital memory card slot	**6** **MENU** key. Moves to the Settings Menu from other screens and submenus.
3 **HOME** key. Moves to the Main Measurement screen from other screens and submenus.	**7** Directional keys. Used to navigate through the menus, change settings, and increment or decrement digits.
4 **ENTER** key. Accepts input values, updates, or displayed menu options.	

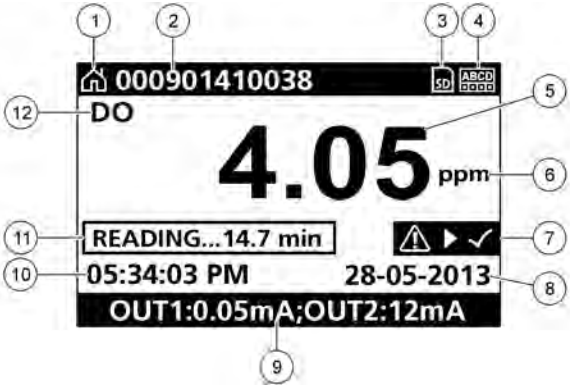
Inputs and outputs are set up and configured through the front panel using the keypad and display screen. This user interface is used to set up and configure inputs and outputs, create log information and calculated values, and calibrate sensors. The SD interface can be used to save logs and update software.

Display

Figure 14 shows an example of the main measurement screen with a DO sensor connected to the controller.

The front panel display screen shows sensor measurement data, calibration and configuration settings, errors, warnings and other information.

Figure 14 Example of Main Measurement screen



1 Home screen icon	**7** Warning status bar
2 Sensor name	**8** Date
3 SD Memory card icon	**9** Analog output values
4 Relay status indicator	**10** Time
5 Measurement value	**11** Progress bar
6 Measurement unit	**12** Measurement parameter

Table 5 Icon descriptions

Icon	Description
Home screen	The icon may vary depending on the screen or menu being displayed. For example, if an SD card is installed, an SD card icon appears here when the user is in the SD Card Setup menu.
SD memory card	This icon appears only if an SD card is in the reader slot. When a user is in the SD Card Setup menu, this icon appears in the upper left corner.
Warning	A warning icon consists of an exclamation point within a triangle. Warning icons appear on the right of the main display below the measurement value. Push the **ENTER** key then select the device to view any problems associated with that device. The warning icon will no longer be displayed once all problems have been corrected or acknowledged.
Error	An error icon consists of an exclamation point within a circle. When an error occurs, the error icon and the measurement screen flash alternately in the main display. To view errors, push the **MENU** key and select **Diagnostics**. Then select the device to view any problems associated with that device.

Additional display formats

- From the Main Measurement screen push the **UP** and **DOWN** arrow keys to switch between measurement parameters
- From the Main Measurement screen push the **RIGHT** arrow key to switch to a split display of up to 4 measurement parameters. Push the **RIGHT** arrow key to include additional measurements. Push the **LEFT** arrow key as needed to return to the Main Measurement screen
- From the Main Measurement screen push the **LEFT** arrow key to switch to the graphical display (see Graphical display on page 23 to define the parameters). Push the **UP** and **DOWN** arrow keys to switch measurement graphs

Graphical display

The graph shows concentration and temperature measurements for each channel in use. The graph supplies easy monitoring of trends and shows changes in the process.

1. From the graphical display screen use the up and down arrow keys to select a graph and push the **HOME** key.
2. Select an option:

Option	Description
MEASUREMENT VALUE	Set the measurement value for the selected channel. Select between Auto Scale and Manually Scale. For manual scaling enter the minimum and maximum measurement values
DATE & TIME RANGE	Select the date and time range from the available options

System startup

When initially powered up, the Language, Date Format and Date/Time screens appear in order. After these options are set, the controller performs a device scan and displays the message **Scanning for devices. Please wait...** If a new device is found, the controller performs an installation process before displaying a main measurement screen.

If the scan finds previously installed devices without configuration changes, the main measurement screen of the device in the number one position appears immediately after the scan is complete.

If a device has been removed from the controller or is not found during the next power-cycled or menu-driven scan, the controller displays a **Device missing** message and prompts to delete the missing device.

If no sensor is connected to an installed analog module, the controller will indicate an error. If devices are connected but not found by the controller, refer to Troubleshooting on page 46.

Set the language, date and time for the first time

The controller displays the language, date and time edit screens when the controller is powered on for the first time, and when it is powered on after the configuration settings have been set to their default values.
After the language, date and time options are set for the first time, update the options as necessary through the sc200 setup menu.

1. In the Language screen, highlight a language in the options list and push the **ENTER** key. English is the default language for the controller.
   The selected language is saved. The Date Format screen appears.
2. In the Date Format screen, highlight a format and push the **ENTER** key.
   The date and time format is saved. Next, the Date /Time screen appears.
3. In the Date/Time screen, push the **RIGHT** or **LEFT** arrow keys to highlight a field, then push the **UP** and **DOWN** arrow keys to update the value in the field. Update the other fields as necessary.
4. Push the **ENTER** key.
   The changes are saved and the controller performs a start-up scan for devices. If connected devices are found, the controller displays the main measurement screen for the device in the number one position. If the controller fails to find connected devices, refer to Troubleshooting on page 46.

Controller configuration information

General information about configuration options is listed in the table.

1. To navigate to the menu options, from the Settings Menu, select sc200 Setup.

Option	Description
Security setup	Sets the passcode preferences (refer to Security setup on page 25)
Output setup	Configures the controller analog outputs (refer to Configure the controller analog outputs on page 27)

Option	Description
Relay setup	Configures the controller relays (refer to Configure relays on page 30)
Display setup	Configures the controller display (refer to Display setup on page 39)
Set Date/Time	Sets the controller time and date (refer to Update the date and time on page 40)
Datalog setup	Configures data logging options. Available only if Calculation has been setup. At least one sensor must be attached to enter a calculation (refer to Set the datalog mode and interval on page 40)
Manage Data	Select the device from the list of installed components to view the data or event log
Error Hold Mode	**Hold Outputs**—Holds outputs at last known value when controller loses communication with the sensor. **Transfer Outputs**—Switches to transfer mode when controller loses communication with the sensor. Outputs transfer to a pre-defined value.
Calculation	Configures the controller math function (refer to Set up a calculation on page 40)
sc200 Information	**S/W VER:**—Displays the current version of controller software **Bootloader VER:**—Displays the current Bootloader version. The Bootloader is a file that loads the main operating system for the controller **S/N:**—Displays the controller serial number **Version:**—Displays the current version of controller hardware
Discrete Input Setup	Configures three discrete input channels (refer to Set up the discrete inputs on page 41)
Language	Assigns the language used in the controller (refer to Update the display language on page 42)

2. Select an option and push **ENTER** to activate the menu item.

Advanced operation

Security setup

Enable or disable the passcode

By default the passcode option is disabled and all configuration settings and calibrations can be changed. When the passcode function is enabled, access to Sensor calibration and Test/Maint menus requires a passcode.
To enable the passcode:

1. From the Settings Menu, select sc200 Setup and push the **ENTER** key.
2. Select Security Setup and push the **ENTER** key.
3. Select Set Passcode and push the **ENTER** key.
4. Select Disabled or Enabled and push the **ENTER** key.
   The passcode is enabled.
5. Push the **BACK** key to return to the sc200 Setup Menu, or push the **MENU** key to return to the Settings Menu.

Edit the passcode

The passcode is factory set to SC200. The Edit Passcode menu option appears in the Security Setup menu only after the passcode feature is enabled and a valid passcode has been entered.
A passcode consists of up to six upper or lower-case alpha, numeric and special characters. Passcodes are case-sensitive.

To edit the passcode:

1. Make sure the passcode is enabled. Refer to Enable or disable the passcode on page 25 for information on how to enable the passcode.
2. From the Settings menu, select Security Setup and push **ENTER**.
3. Use the arrow keys to enter the current valid passcode and push **ENTER**.
   The Edit Passcode option appears in the Security Setup menu.
4. Select Edit Pass Code and push **ENTER**.
   The Edit Pass Code screen appears.
5. Use the arrow keys to edit the passcode and push **ENTER**.
   The new passcode is saved and the Security Setup menu appears.
   Note: *All menus stay accessible until the* ***HOME*** *key is pushed or the controller is restarted.*
6. Push the **HOME** key or perform a controller restart.
   The new passcode settings are saved, and the new passcode is required to enter the Security Setup, Datalog Setup and Test/Maint menus.

Protect features

This option is only displayed if an analyzer or sensor that supports this feature is connected to the controller. Security categories are displayed that are defined by the connected analyzer or sensor. The user can then enable or disable password protection against individual menu options within these categories.

Configure a 4-20 mA input module

An analog module must be installed in the controller.

1. Determine what output the connected device is using (0-20 mA or 4-20 mA). This information will be used to set the scale.
2. Determine what the 20 mA value is equal to (e.g, 100 psi).
3. Determine what the low end (0 or 4 mA) value is equal to (e.g., 10 psi). This information will be used to set the display range.
4. From the Settings Menu, select Sensor Setup.
5. Select Configure.
6. Update the options.
   a. Highlight an option and push **ENTER**.
   b. Make a selection or update the entries.
   c. Push **ENTER** to save the changes.

Option	Description
Edit name	Edits the module name
Edit units	Edits the measurement units
Edit parameter	Edits the parameter name
Display range **For the 0-20 mA scale:** • **Set the 20 mA value** • **Set the 0 mA value** **For the 4-20 mA scale:** • **Set the 20 mA value** • **Set the 4 mA value**	Sets the values used for the selected scale (0-20 mA or 4-20 mA)

Option	Description
Signal average	Sets how often signals are averaged. Higher values produce a smoother signal but increase the time it takes for a signal to respond to a change in the process value.
Set resolution— **X.XXX, XX.XX, XXX.X, XXXX**	Sets the number of decimal places used in the display.
Select scale— **4-20 mA or 0-20 mA**	Sets scale used for the 4-20 mA input
Data log interval—5 sec, 30 sec, 1 min, 2 min, 5 min, 10 min, 15 min, 30 min, 60 min	Sets how often data is logged to the internal controller memory.
Reset defaults—Push ENTER to reset configuration settings or push the BACK key to cancel.	Resets configuration settings to the default values.

For additional information, refer to the *sc200 4–20 Analog Input Module User Manual*.

Configure a 4-20 mA output module

The Network Setup option appears in the Settings Menu only if an analog output module or other network module such as Modbus or Profibus is installed in the controller.

Outputs for analog output modules are set at 4-20 mA. Outputs can be assigned to represent a measured parameter such as pH, temperature, flow or calculated values.

1. From the Settings menu, select Network Setup.
2. Select Edit Name and enter a name for the module. Push **ENTER** to save the name.
3. Select an output (A, B, C, D) and push **ENTER**.
   a. Highlight an option and push **ENTER**.
   b. Make a selection from the list or update the entries.
   c. Push **ENTER** to save the changes.

Option	Description
Select Source	Selects the output to configure—None, sensor 1 name, sensor 2 name, calculation (if set up). For sensor output, Select Parameter sets the measurement options. When the measurement is autorange, Set Range sets the range.
Set Low Value	Sets the 4 mA value (default: 0.000). (Range and units depend on sensor)
Set High Value	Sets the 20 mA value (default: 1.000). (Range and units depend on sensor)
Set Transfer	Sets the transfer value. Range 3.0 to 25.0 mA (default 4.000).
Set Filter	Sets a time-average filter value of 0 (default) to 120 seconds.

For additional information, refer to the *sc200 4-20 Output Module User Manual*.

Configure the controller analog outputs

The controller analog outputs can be assigned to represent the measured parameter or secondary measurements such as temperature and calculations. To configure the options, highlight a menu option, push **ENTER** and select an option or update the entries. Push **ENTER** after an option is selected or the entries are updated.

1. From the Settings menu, select sc200 Setup.
2. Select Output Setup.
3. Select Output 1 or Output 2.

4. Choose Select Source and select a source from the list. Typically the source is one of the sensors attached to the system. If an analog input card is installed, the analog input may be used as a source.
5. From the Output Setup menu, choose Select Parameter and choose an option from the list. Parameters will vary depending on the type of sensors installed.
6. From the Output Setup menu, select Set Function and choose a function. Further setup options will vary depending on which function is chosen.

Option	Description
Linear	Signal is linearly dependent on the process value
PID	Signal works as a PID (Proportional, Integral, Derivative) controller
Logarithmic	Signal is represented logarithmically within the process variable range
Bilinear	Signal is represented as two linear segments within the process variable range

7. From the Output Setup menu, select Activation. Use the information in the table below the chosen function to configure the options.
8. If Transfer is or will be selected as the Error Hold Mode, or if the Transfer will be used during calibration or other functions within the sensor menu, select Set Transfer from the Output Setup menu and enter the transfer value.
9. From the Output Setup menu, select Set Filter and enter the filter value.
10. From the Output Setup menu, select Scale and choose the scale (0-20 mA or 4-20 mA).

- **Linear**

Option	Description
Set low value	Sets the low endpoint of the process variable range
Set high value	Sets the high endpoint of the process variable range

- **PID**

Option	Description
Set mode (Auto or Manual)	Auto—the signal is automatically controlled by the algorithm within the analyzer using proportional, integral, and derivative inputs. Manual—the signal is controlled by the user through manual adjustment of the % change value. This option is shown as Manual Output after the manual set mode is selected.
Phase (Direct or Reverse)	The direction in which the signal responds to process change. Direct—signal increases as the process increases. Reverse—signal increases as process decreases.
Set setpoint	Creates a desired control point of process
Prop band	A function of the difference between the measured signal and the desired setpoint.
Integral	The period of time from the injection point of a reagent to contact with the measuring device.
Derivative	Used to compensate for the 2nd order effects of the process. The majority of applications can be controlled without the use of the derivative setting.
Transit time	Stops all PID control for a selected period of time as the sample travels from the control pump to the measurement sensor.

- **Logarithmic**

Option	Description
Set 50% value	Sets the value corresponding to 50% of the process variable range.
Set high value	Sets the upper value of the process variable range.

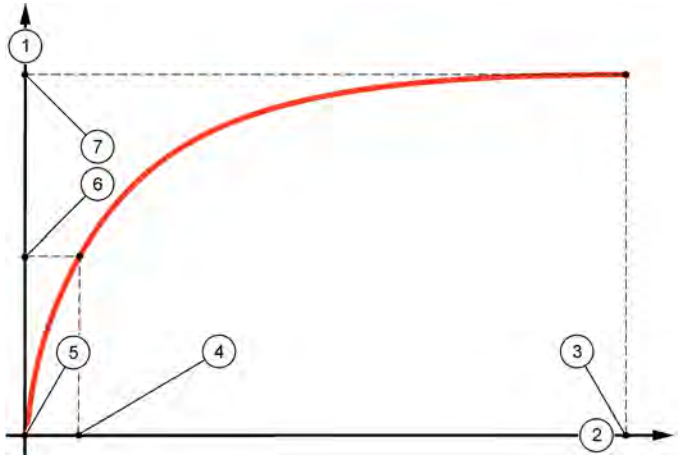
- **Bilinear**

Option	Description
Set low value	Sets the low endpoint value of the process variable range.
Set high value	Sets the high endpoint value of the process variable range.
Set knee point value	Sets the value at which the process variable range divides into another linear segment.
Set knee point current	Sets the value of the current at the knee point value.

Logarithmic output mode

Figure 15 shows in graph form the operation of the logarithmic output mode.

Figure 15 Logarithmic output

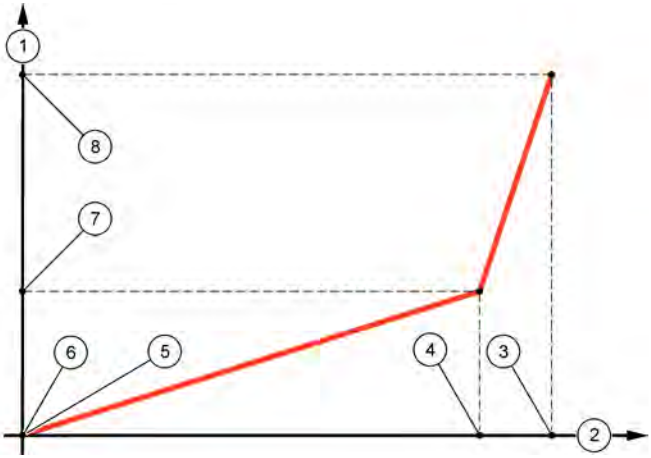


1 Output current axis	**5** Minimum output current (0-4 mA)
2 Source value axis	**6** 50% output current
3 High value	**7** Maximum output current (20 mA)
4 50% value	

Bilinear output mode

Figure 16 shows in graph form the operation of the bilinear output mode.

Figure 16 Bilinear output



1 Output current axis	**5** Low value
2 Source value axis	**6** Minimum output current (0-4 mA)
3 High value	**7** Knee point current
4 Knee point value	**8** Maximum output current (20 mA)

Configure relays

The Normally Open (NO) and Common (COM) relay contacts will be connected when an alarm or other condition is active. The Normally Closed (NC) and Common relay contacts will be connected when an alarm or other condition is inactive (unless the Fail Safe is set to Yes), or when power is removed from the controller. To select a menu option, highlight the option and push **ENTER**.

1. From the sc200 Setup menu, select Relay Setup.
2. Select a relay from the list.
3. From the Relay Setup menu, choose Select Source and push **ENTER**. Normally, a source is one of the sensors attached to the system, but the controller can also function as a source. If an analog input module is installed, the source may be the analog input.
4. From the Relay Setup menu, select Set Parameter and choose from the list of parameters. The list of parameter options will vary with the type of attached sensor.
5. From the Relay Setup menu, select Set Function and choose from the list. Further setup will depend on the function chosen.

Option	Description
Scheduler Function (available if the controller is selected as the relay source)	Relay switches at certain times independently of any process value
Alarm Function	Relay activates when upper or lower alarm value is exceeded
Feeder Control Function	Relay indicates if a process value exceeds or falls below a setpoint
Event Control Function	Relay toggles if a process value reaches an upper or lower limit
Pulse Width Modulation (PWM) Control Function	Relay uses a Pulse Width Modulation control depending on a process value

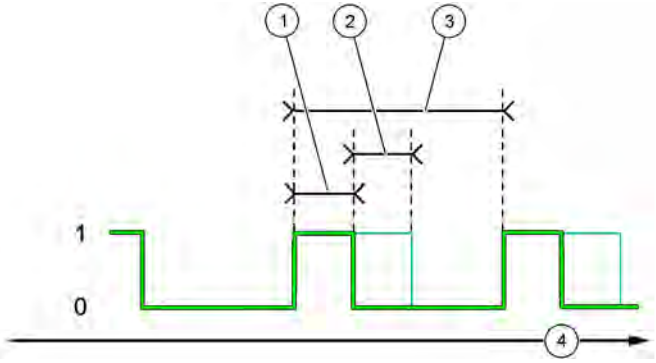
Option	Description
Frequency control	Relay switches with a frequency depending on a process value
Warning	Relay indicates warning and error conditions in probes

6. From the Relay Setup menu, select Set Transfer and choose Active or Inactive.
7. From the Relay Setup menu, select Fail Safe and choose Yes or No.
8. From the Relay Setup menu, select Activation.
   The activation options for the selected function appear. Use the information in the table below each function to update the options.
9. Test the relay function to make sure it is properly energizing the connected device. To do relay testing, go to the Setting menu, then select **Test/Maint>Test Relay**.

- **Scheduler Function (refer to Figure 17)**

Option	Description
Hold outputs	Holds outputs in the present ON or OFF state
Run days	Sets the weekday(s) that the relay operates. Options: Sunday, Monday, Tuesday., Wednesday, Thursday, Friday, Saturday
Start time	Sets the start time.
Interval	Sets the time between activation cycles (Default value: 5 min).
Duration	Sets the period of time the relay is energized (Default value: 30 sec).
Off delay	Sets the time for additional hold/output time after the relay has been turned off.

Figure 17 Scheduler function



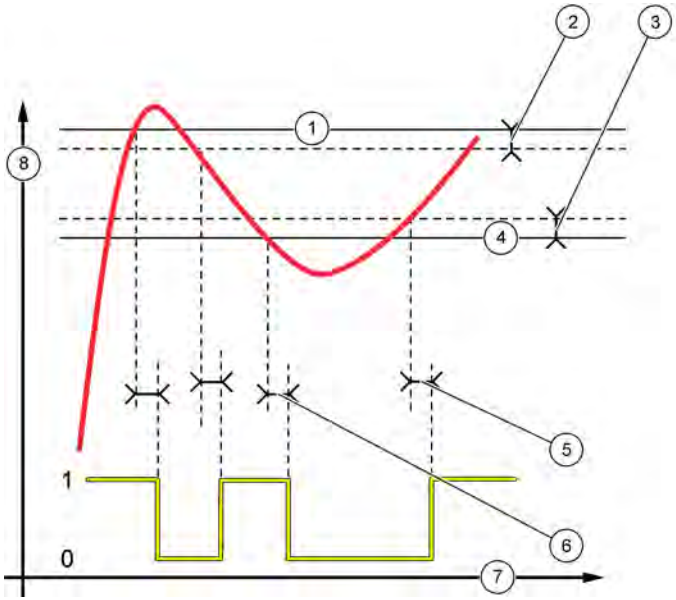
1 Duration	**3** Interval
2 OFF delay	**4** Time (x-axis)

- **Alarm Function (refer to Figure 18)**

Option	Description
Low alarm	Sets the value where the relay will turn on in response to decreasing measured value. For example, if the low alarm is set for 1.0 and the measured value drops to 0.9, the relay activates.
High alarm	Sets the value where the relay will turn on in response to increasing measured value. For example, if the high alarm is set for 1.0 and the measured value increases to 1.1, the relay activates.

Option	Description
Low deadband	Sets the range where the relay remains on after the measured value increases above the low alarm value. For example, if the low alarm is set for 1.0 and the low deadband is set for 0.5, the relay remains on between 1.0 and 1.5. Default is 5% of the range.
High deadband	Sets the range where the relay remains on after the measured value decreases below the high alarm value. For example, if the high alarm is set for 4.0 and the high deadband is set for 0.5, the relay remains on between 3.5 and 4.0. Default is 5% of the range.
Off delay	Sets a time (0-300 seconds) to delay the relay from normally turning off (Default: 0 seconds).
On delay	Sets a delay time for the relay to turn on (Default: 0 seconds).

Figure 18 Alarm function



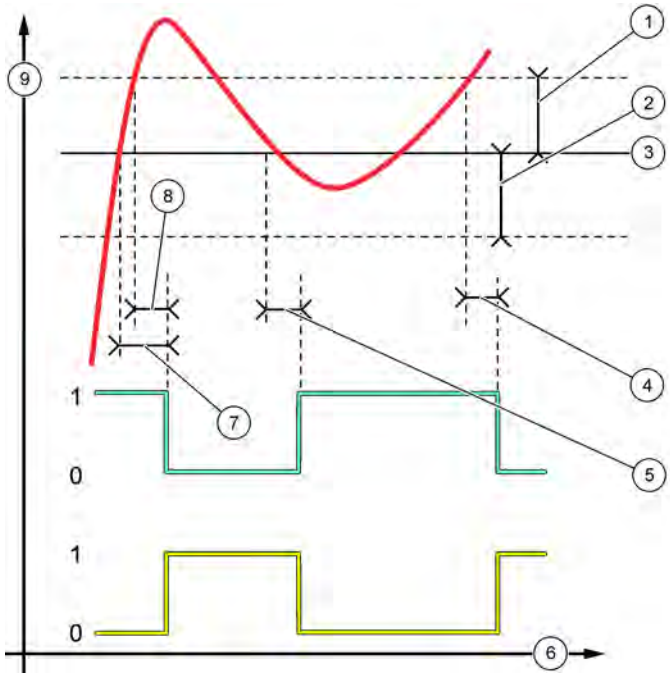
1 High alarm	**5** ON delay
2 High deadband	**6** OFF delay
3 Low deadband	**7** Time (x-axis)
4 Low alarm	**8** Source (y-axis)

- **Feeder Control Function (refer to Figure 19 and Figure 20)**

Option	Description
Phase	Defines the relay status if the process value exceeds the setpoint. High (default)—turns the relay on when the process value exceeds the setpoint. Low—turns the relay on when the process value falls below the setpoint.
Set setpoint	Sets the process value at which the relay toggles. The default value is different for each sensor.
Deadband	Sets the area for an amount of change necessary after the relay setpoint is reached in order to satisfy a condition.

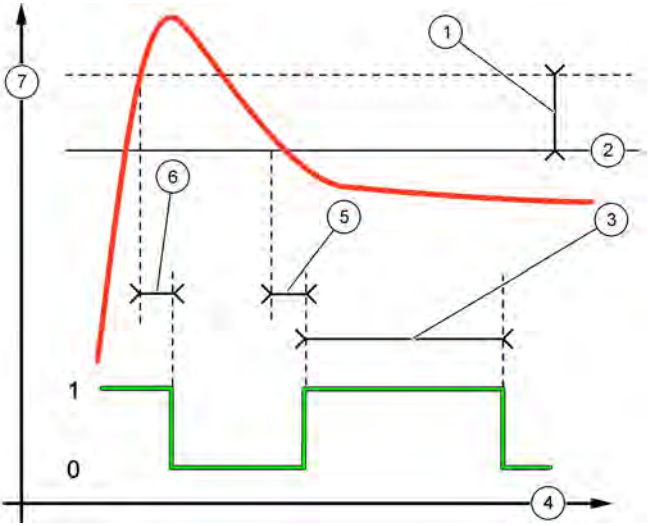
Option	Description
Overfeed timer	Sets a time period for de-activating an active relay if the process setpoint cannot be reached. Once an overfeed alarm is present, it must be manually reset.
Off delay	Sets a delay time for the relay to turn off (default: 0 seconds).
On delay	Sets a delay time for the relay to turn on (default: 0 seconds).

Figure 19 Feeder control function



1 Deadband (Phase = Low)	**6** Time (x-axis)
2 Deadband (Phase = High)	**7** ON delay (phase set high)
3 Setpoint	**8** OFF delay (phase set low)
4 OFF delay (phase set high)	**9** Source (y-axis)
5 ON delay (phase set low)	

Figure 20 Feeder control function (Phase low, Overfeed timer)

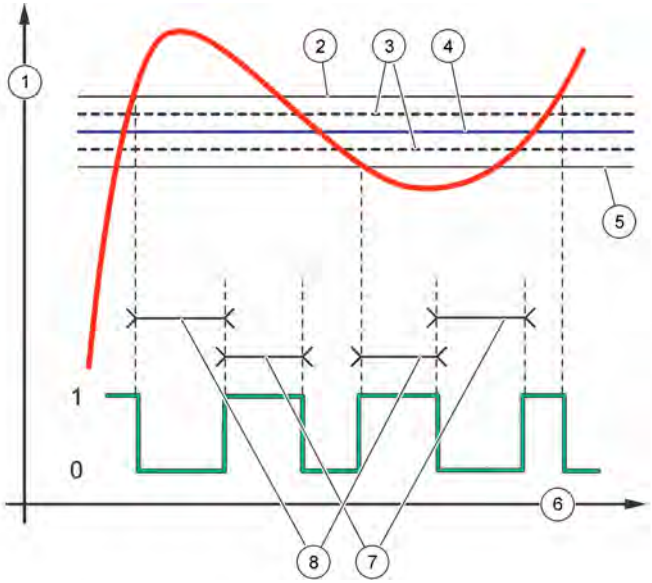


1 Deadband	**5** ON delay
2 Setpoint	**6** OFF delay
3 Overfeed timer	**7** Source (y-axis)
4 Time (x-axis)	

- **Event Control Function (refer to Figure 21, Figure 22 and Figure 23)**

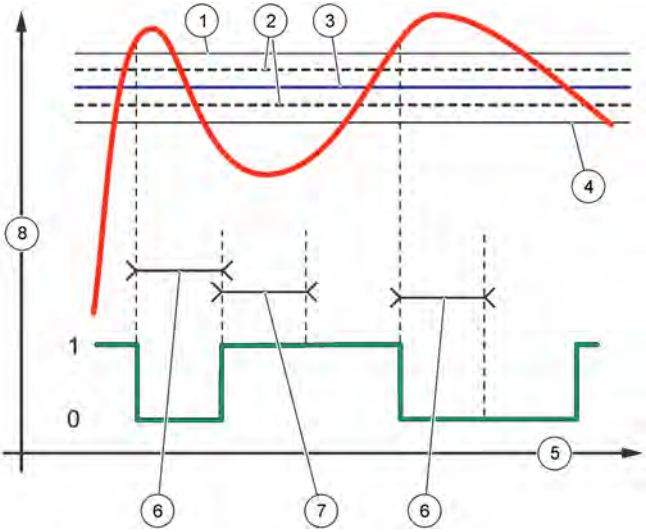
Option	Description
Set setpoint	Sets the value where the relay will turn on.
Deadband	Sets a hysteresis so the relay will not swing unregulated when the process value converges to the setpoint.
OnMax timer	Sets the maximum time the relay can stay on independent from the measured value (default: + 0 min).
OffMax timer	Sets the maximum time the relay can stay off independent from the measured value (default: + 0 min).
OnMin timer	Sets the minimum time the relay can stay on independent from the measured value (default: + 0 min).
OffMin timer	Sets the minimum time the relay can stay off independent from the measured value (default: + 0 min).

Figure 21 Event control function (no delay)



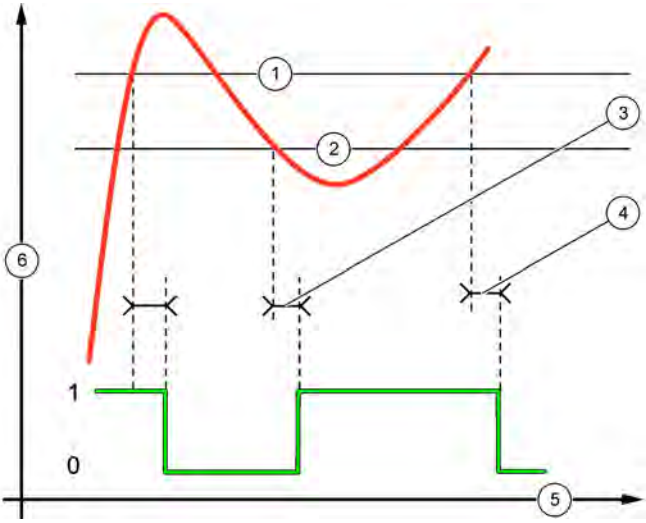
1 Source (y-axis)	**5** Low alarm
2 High alarm	**6** Time (x-axis)
3 Deadband	**7** OnMax-time
4 Setpoint	**8** OffMax-time

Figure 22 Event control function (OnMin timer, OffMin timer)



1 High alarm	**5** Time (x-axis)
2 Deadband	**6** OffMin timer
3 Setpoint	**7** OnMin timer
4 Low alarm	**8** Source (y-axis)

Figure 23 Event control function (ON/OFF delay)

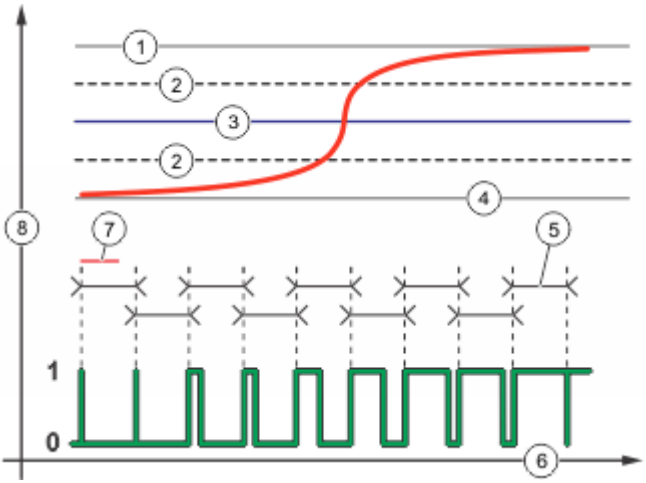


1 High alarm	**4** OFF delay
2 Low alarm	**5** Time (x-axis)
3 ON delay	**6** Source (y-axis)

- **Pulse Width Modulation Control Function (refer to Figure 24)**

Option	Description
Set mode	Auto—the relay output works as a PID controller. Manual—the signal is controlled by the user through manual adjustment of the % change value. This option is shown as Manual Output after the manual set mode is selected.
Phase	Reverses the leading sign of the control deviation for the PID controller (default: Reverse). The phase selects whether the relay will operate at the first part of a cycle (direct phase) or the second part (reverse phase).
Set setpoint	Creates a setpoint value.
Dead zone	The range above and below the setpoint. In this set range, the PID controller does not take action to change the Pulse Width Modulation On/Off Ratio output signal until the limits of the dead zone are reached.
Period	Sets the cycle duration of the PWM output signal (default: 5 seconds).
Min width	Sets the minimum PWM ratio (default: 1.0 second).
Max width	Sets the maximum PWM ratio (default: 4.0 seconds).
Prop band	Sets the proportional part of the PID controller. The proportional part of the controller supplies an output signal which is linearly dependent to the control deviation. The proportional part reacts on any changes at the input but starts to oscillate easily if the value is set high. The proportional part cannot completely compensate for disturbances.
Integral	Sets the integral part of the PID controller (default: 000 minutes). The integration part of the controller supplies an output signal. The output signal increases linearly if the control deviation is constant. The integration part responds slower than the proportional part and can completely compensate disturbances. The higher the integration part, the slower it responds. If the integration part is set too low, it starts to oscillate.

Figure 24 Pulse Width Modulation function (linear mode)

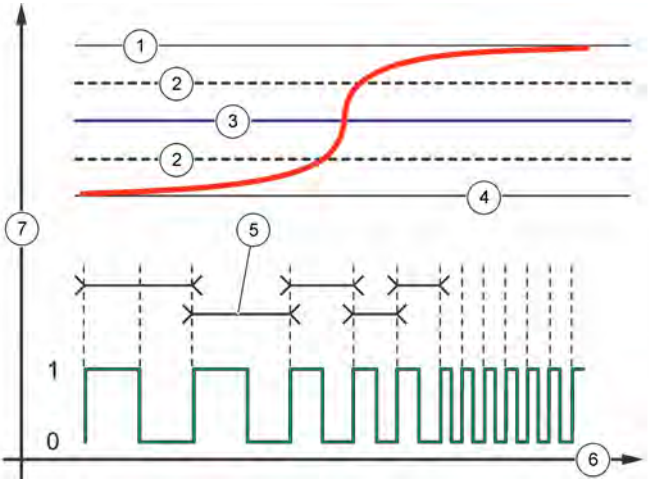


1 High alarm	**5** Period
2 Deadband	**6** Time (x-axis)
3 Setpoint	**7** Phase
4 Low alarm	**8** Selected source (y-axis)

- **Frequency Control Function (refer to Figure 25)**

Option	Description
Set mode	Auto—The relay works as a PID controller. Manual—the signal is controlled by the user through manual adjustment of the % change value. This option is shown as Manual Output after the manual set mode is selected.
Phase	Reverses the leading sign of the control deviation for the PID controller (default: Reverse). The phase selects whether the relay will operate at the first part of a cycle (direct phase) or the second part (reverse phase).
Set setpoint	Sets the process value which is controlled by the PID controller.
Dead zone	In this set range, the PID controller does not take action to change the output frequency until within the limits of the dead zone.
Pulse width	Sets the cycle duration (0-600 seconds) of the PWM output signal. (default: 0.5 seconds) The cycle duration is equal to the duty cycle of the output signal.
Minimum pulses	Sets the minimum number of pulses per minute at which the relay can operate. Range: 0.001–4.000 (default: 1.000)
Maximum pulses	Sets the maximum number of pulses per minute at which the relay can operate. Range: 0.001–60.000 (default: 04.000). This value cannot be set lower than Minimum Pulses value.
Prop band	Sets the proportional part of the PID controller. The proportional part of the controller supplies an output signal which is linearly dependent to the control deviation. The proportional part reacts on any changes at the input but starts to oscillate easily if the value is set high. The proportional part cannot fully compensate for disturbances.
Integral	Sets the derivative part of the PID controller (default: 000 minutes). The integration part of the controller generates an output signal. The output signal increases linearly if the control deviation is constant. The integration part responds slower than the proportional part and can fully compensate disturbances. The higher the integration part, the slower it responds. If the integration part is set too low, it starts to oscillate.

Figure 25 Frequency control function



1 High limit	**5** Cycle duration
2 Deadband	**6** Time (x-axis)
3 Setpoint	**7** Selected source (y-axis)
4 Low limit	

- **Warning Function**

Option	Description
Warning	Sets the level for warning activation. Refer to the sensor manual for the numbers for individual warning messages.

Display setup

Configures the controller display.

1. From the Settings menu, select sc200 Setup and push **ENTER**.
2. Select Display Setup and push **ENTER**.

Option	Description
Adjust Order	View and modify the measurement display order. • **See Current Order**—View the current display order • **Add Measurements**—Add selected measurements to the display • **Remove Measurements**—Remove selected measurements from the display • **Reorder List**—Select one or more measurements and change their order in the display • **See Default Order**—View the default display order • **Set to Default**—Set the display order to the default configuration ***Note:*** *Some of the above will not be available if no adjustment is possible for that option (e.g.* ***Reorder List*** *and* ***Remove Measurements*** *will not be available if only one measurement is selected for display).*
Display Contrast	Adjust the contrast to a value between the minimum of +1 and the maximum of +9
Edit Name	Assigns a name to the controller

Update the date and time

1. From the Settings menu, select sc200 Setup and push **ENTER**.
2. Select Set Date/Time and push **ENTER**.
3. Select Date Format from the Set Date/Time screen and push **ENTER**.
4. Select a format and push **ENTER**.
5. Select Date/Time from the Set Date/Time screen and push **ENTER**.
6. Update the entries.
   a. Use the right and left arrow keys to highlight a field.
   b. Use the up and down arrow keys to change the values in the field and push **ENTER**.
   c. At the end of the date field, push the right arrow to wrap down to the time fields.
   d. Use the up and down and arrow keys to update the time fields.
7. Push **ENTER** to save the changes.
   The controller returns to the Set Date/Time menu.

Set the datalog mode and interval

Datalog Setup is available if a calculation has been set up.

1. From the Settings menu, select sc200 Setup and push **ENTER**.
2. Select Datalog Setup and push **ENTER**.
3. Select Set Mode and push **ENTER**.
4. Select an option (Snap Shot, Average, Maximum, Minimum) and push **ENTER**.
5. From the Datalog Setup menu, select Set Interval and push **ENTER**.
6. Select an interval from the list and push **ENTER**.

Set up a calculation

1. From the Settings menu, select sc200 Setup and push **ENTER**.
2. Select Calculation and push **ENTER**. Select a menu option and choose from the displayed list or update the entry. Refer to the table below for more information about each option.

Option	Description
Set variable X	Selects the sensor for the x variable
Set parameter X	Selects the sensor measurement for the x variable
Set variable Y	Selects the sensor for the y variable
Set parameter Y	Selects the sensor measurement for the y variable
Set formula	Select the math function to implement: • **None**—Disables the math function • **X-Y**—Subtraction function • **X+Y**—Addition function • **X/Y**—Division function • **[X/Y]%**—Percentage function • **[X+Y]/2**—Average function • **[X*Y]**—Multiplication function • **[X-Y]%/X**—Difference function
Display format	Selects the number of digits and decimal points

Option	Description
Set units	Selects the units for the calculated reading
Set parameter	Selects the parameter for the calculated reading

3. Push **ENTER** to save the selection or setting and return to the Calculation menu.

Set up the discrete inputs

Use these inputs to switch closure inputs or logic level voltage inputs.

1. Press the **MENU** key.
2. Select sc200 Setup and push **ENTER**.
3. Select Discrete Input Setup and push **ENTER**.
4. Select the desired channel (Input 1, Input 2 or Input 3) and push **ENTER**.
5. Select a control logic option and push **ENTER**.

Option	Description
Disable	This channel is disabled and not used.
On/High	This channel is active when either the switch input is On (or closed), or the logic level voltage input is at a High level.
Off/Low	This channel is active when either the switch input is Off (or opened), or the logic level voltage input is at a Low level.

6. Select a warning option and push **ENTER**.

Option	Description
Off	An active discrete input does not trigger a device warning.
On	An active discrete input triggers a device warning.

7. Select an output mode option and push **ENTER**.

Option	Description
Active	Output level continues to represent operating conditions.
Hold	Output level is held static.
Transfer	Output level moves to a pre-configured value.

8. Select the sensors that will have their outputs (analog and relay) affected when one of the discrete inputs becomes active. Push **ENTER**.
9. Use the arrows to select the On Delay value (the duration time delay between the discrete input activation and the configured response of the controller). Push **ENTER**.
10. Use the arrows to select the Off Delay value (the duration time delay between the discrete input de-activation and the configured response of the controller). Push **ENTER**.
11. Repeat steps 4–10 for each desired channel.
12. If a discrete input needs to be changed after initially set up:
    a. Repeat steps 1–4 and an Input Settings menu appears with the following options:
       - Control Logic
       - Set Warning
       - Output Mode
       - On Delay
       - Off Delay
    b. Select the desired option and push **ENTER**.

c. Make the desired changes and push **ENTER** to save the changes and return to the Inputs Setting menu.

Update the display language

The display language can be changed through the Setup menu.

1. From the Settings Menu, select sc200 Setup and push **ENTER**.
2. Select Language and push **ENTER**.
   The list of language options appears. English is the default language for the controller.
3. Highlight the language to be used for the controller and push **ENTER**.
   The selected language is saved and is used for the controller display. The display returns to the sc200 Setup menu.

Using the secure digital memory (SD) card

An SD card must be installed in the controller.

- The SD card can be used to update software and firmware and to download event and data logs. If the SD card is installed while the controller is in the Settings Menu, push the **HOME** key and then the **MENU** key to verify the option is visible. The SD icon will also be visible in the upper status bar of the main measurement screen when a card is installed.
- Data log files on the SD card are available in XML and binary formats.
- DataCom is used to convert files from binary to CSV format. Refer to the DataCom manual for more information on how to use the application. For a copy of the DataCom manual, software updates or other downloadable resources, go to http://www.de.hach.com or http://www.hach.com. Search *DataCom* or go to any sc200 product page.

Updating software

Notes:

- The controller does not automatically transfer information to or from an SD card.
- When the SD card is put in multiple controllers, each controller has a separate set of folders in the SD card memory. To make sure software updates are in the correct folder for the controller in use, it is best to use a separate dedicated SD card for each controller.

1. From the Settings Menu, select SD Card Setup and push the **ENTER** key.
2. Select Upgrade Software and push the **ENTER** key.

   Note: *If the Upgrade Software option does not appear, do the steps in* Firmware updates with SD cards on page 44.
3. Select a device from the list and push the **ENTER** key. The list of options includes the controller and all connected devices that have software placed in the appropriate folder on the SD card.
4. If more than one version of the upgrade software is available, select the version with the highest number and push the **ENTER** key.
5. Push the **ENTER** key to begin the software transfer.
   The display will show "Transferring files. Please wait..." The percentage of completion appears in the bottom left corner of the display. The upgrade cannot be halted once it has begun.

   - When the transfer is successful, the display will show "Transfer complete" along with a prompt to push **ENTER** to restart the controller or to push the **BACK** key and exit to the SD Card Setup menu. Controller updates take effect when the controller is restarted. A restart is not necessary for sensor updates.
   - If the transfer is unsuccessful, the display will show "Transfer failed" and an error message. Press the **ENTER** key to acknowledge the warning and exit out of the menu. Error messages are different for each sensor. Refer to the applicable sensor manual.

Saving data and event logs with SD cards

Notes:

- Data and event logs can be downloaded to an SD card and viewed with any device capable of reading an SD card.
- Data logs store the measurement data at selected intervals in a packed binary format (.flg file).
- Event logs store a variety of events that occur on the devices such as configuration changes, alarms and warning conditions. Event logs are set up during the sensor or module configuration process. Event logs are stored in a CSV format.

1. From the Settings Menu, select SD Card Setup and push the **ENTER** key.
2. Select Save Logs and push the **ENTER** key.
3. If more than one device appears on the screen, all devices are selected by default. To deselect an item, highlight the selection and push the left arrow key. Select the devices from which logs will be saved and push the **ENTER** key.
4. Select the time period from which logs are to be saved.

Option	Description
Last Day	All logs from the last full 24 hours, starting from 12:00 a.m., and any additional time remaining on the current day
Last Week	All logs from the last full week (7 days) starting from 12:00 a.m., and any additional time remaining on the current day
Last Month	All logs from the last full month (30 days) starting from 12:00 a.m., and any additional time remaining on the current day
All	Save all logs in memory
New	All logs that are new since the last time logs were saved to the SD card

5. Push the **ENTER** key to confirm the choice, and push the **ENTER** key again to begin the file transfers.
6. Allow time for the files to transfer. The display will show Transferring files. Please wait... and the percentage of files transferred.
   If the transfer is successful, the display will show "Transfer complete." If the transfer is not successful, the display will show "Transfer failed."
7. Do one of the following:
   a. Push the **ENTER** key to exit back to the SD Card Setup menu.
   b. Push the **HOME** key to return to the measurement screen.
   c. Push the **BACK** keys to return to the Settings Menu.

Access data and event log files on the SD card

A PC with an SD Card reader device or USB adapter is necessary to view the event and data logs kept on the SD Card. Excel 2003 or higher (for XML files) or the Data Com application (for binary flg files) is necessary to open the event and data logs.
Data logs have the following structure: Device Name, Device Serial Number, Device Identification, Data Log, Time Stamp.

Event logs have the following structure: Device Name, Device Serial Number, Device Identification, Event Log, Time Stamp.

To view data or event log files stored on the SD card:

1. Attach the card reader device to the PC (if necessary) and install the SD card that contains the files in the reader device.
2. In the SD card directory, open the HACH folder.
3. Select the Logs folder.
4. Select a device folder.

The event and data log files in the folder are shown.

5. To view XML data log files:
   a. Make sure the HachDatalog.xsl style sheet exists in the device folder.
   b. Open the Excel application.
   c. Go to File, Open.
   d. Select the data log file.
   e. In the Import XML dialog box, select **Open the file with the following style sheet applied** and select **HachDatalog.xml**.
   f. Click OK to view the data.
6. To view binary data log (.flg) files:
   a. Make sure the device driver (.flg.drv) file exists in the device folder.
   b. Open Data Com.
   c. In the File Viewer section, click Open.
   d. Select the data log file.
   The data log file is shown in the box and a comma separated values (csv) file with the same file name is created. This csv file can be opened in Excel.

Firmware updates with SD cards

The latest firmware updates can be placed on an SD card. The SD card can then be used to update the controller or device firmware.

A PC and a USB card reader or other device capable of reading an SD card are necessary.

1. Find the zip file at http://www.hach-lange.com or http://www.hach.com and copy it to the PC.
2. Extract file(s) from the zip folder and save them to the SD card.
3. Remove the SD card and update the controller and device firmware. Refer to Updating software on page 42.

Backup settings to an SD card

Saves the configuration of a device to the SD card.

1. Push the **MENU** key.
2. Select SD Card Setup and push **ENTER**.
3. Select Manage Configuration and push **ENTER**.
4. Select Backup Settings and push **ENTER**.
5. Select the devices to be backed up. All devices are selected by default. To deselect an item, highlight the selection and push the left arrow key. Push **ENTER** to begin the file transfers. If backup files already exist on the SD card, a confirmation window appears. Select the devices again and push **ENTER**. Wait for the "Transfer complete" message.
6. Push **ENTER** again to return to the Manage Configuration menu.

Restore settings to the controller

This menu selection only appears if a (serial number-specific) backup file for the controller or one of the sensors connected to it exists on the SD Card. This menu selection loads the configuration of a specific device from the SD card to the same device (serial number-controlled function).

1. Push the **MENU** key.
2. Select SD Card Setup and push **ENTER**.
3. Select Manage Configuration and push **ENTER**.
4. Select Restore Settings and push **ENTER**.
5. Select the device that will be restored. All devices are selected by default. To deselect an item, highlight the selection and push the left arrow key. Push **ENTER** to begin the file transfers.

6. When the transfer is complete, push **ENTER**.
7. To have the settings take effect immediately, restart the controller. Push the **BACK** key to exit the Manage Configuration menu.

Transfer settings to another device

All device settings including calibration, sensor name, selected temperature and measurement units and data logging settings are transferred.

1. Push the **MENU** key.
2. Select SD Card Setup and push **ENTER**.
3. Select Manage Configuration and push **ENTER**.
4. Select Transfer Settings and push **ENTER**. Two options appear:
   - Retrieve Settings
   - Copy Settings
5. To retrieve settings from the controller (or a device connected to it) and put the settings on the SD card:
   a. Select Retrieve Settings and push **ENTER**.
   b. Select the devices that contain the information to be transferred. All devices are selected by default. To deselect an item, highlight the selection and push the left arrow key. Push **ENTER** to begin the file transfers. Wait for the "Transfer complete" message.
   c. If files already exist on the SD card, a confirmation window appears. Select the devices again and push **ENTER**. Wait for the "Transfer complete" message.
   d. Push **ENTER** to return to the Manage Configuration menu.
6. To copy settings from the SD card to a controller (or a device connected to it):
   a. Select Transfer Settings and push **ENTER**.
   b. Select Copy Settings and push **ENTER**.
   c. Select the devices on the SD card. All devices are selected by default. To deselect an item, highlight the selection and push the left arrow key. Push **ENTER** to begin the file transfers.
7. When the transfer is complete, push **ENTER** to restart the connected devices.
8. Push **ENTER** to restart the controller or push **BACK** to return to the Manage Configuration menu.

Using the service port

The service port is used to download data files from the controller and install new versions of controller and sensor firmware. To download data and update software, use the service port in combination with DataCom and a service cable (LZX887).

Using DataCom

When using the service port, it is necessary to use DataCom. DataCom is a PC Application Utility that downloads data log and event log files from the controller and installed sensors. Files are downloaded from the controller through the controller service port or they can be placed on a Secure Digital Memory (SD) card installed in the controller. In addition, DataCom is used to upload software for the controller and sensors. The DataCom application must be installed on a PC to read the files.

Refer to the DataCom manual for more information on how to use the application. The DataCom manual, software updates and other downloadable resources are available at http://www.de.hach.com or http://www.hach.com on any sc200 product page.

Maintenance

⚠ DANGER

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

Cleaning the controller

⚠ DANGER

Always remove power from the controller before performing maintenance activities.

Note: *Never use flammable or corrosive solvents to clean any part of the controller. Use of these solvents may degrade the environmental protection of the unit and may void the warranty.*

1. Make sure the controller cover is securely closed.
2. Wipe the controller exterior with a cloth dampened with water, or with a mixture of water and mild detergent.

Fuse replacement

Fuses are not user-serviceable items. The need for fuse replacement in controllers indicates severe technical failure and is therefore considered to be a service activity. If a blown fuse is suspected, contact Technical Support.

Battery replacement

The lithium ion backup battery is not user replaceable. Contact technical support for replacement.

Troubleshooting

Problem	Resolution
No current output	Verify current output configuration.
	Test current output signal using the Test/Maintenance submenu. Input a current value and verify the output signal at the controller connections.
	Contact Technical Support.
Incorrect current output	Verify current output configuration.
	Test current output signal using the Test/Maintenance submenu. Input a current value and verify the output signal at the controller connections. If the output is incorrect, perform an output calibration.

Problem	Resolution
No relay activation	Make sure relay connections are secure.
	If using an external power source, make sure the relay wiring is correct.
	Make sure the relay configuration is correct.
	Test the relay activation through the Test/Maintenance menu. The relay should energize and de-energize as selected.
	Make sure the controller is not in calibration mode and that the relay is not being held.
	Reset the Overfeed Timer to make sure the timer has not expired.
Secure Digital Memory (SD) card not recognized by the controller	Make sure the SD card is properly oriented. The copper traces should face toward the controller display.
	Make sure the SD card is fully seated in the slot and the spring lock is engaged.
	Make sure the SD card is properly formatted with a Fat 32 format. The MMC format is not supported. Follow the instructions of the card manufacturer to format the SD card on a PC.
	Make sure the card is not larger than 32 GB.
	Make sure an SD card is being used. Other types of cards (such as xSD, micro SD, mini SD) will not work properly.
Information not saving, or not saving properly to the SD card.	Make sure the SD card is properly formatted with the FAT 32 format. The MMC format is not supported. Follow the instructions of the card manufacturer to format the SD card on a PC.
	If the SD card has previously been in use, format the card with the Fat 32 format, install the card in the controller, and try downloading files.
	Try a different SD card.
SD card full	Read the SD card with a PC or other card reader device. Save important files and then delete some or all of the files on the SD card.
Controller cannot find software updates on the SD card.	Make sure an appropriate folder is created by installing the SD card in the controller. An update folder will automatically be created.
	Install the SD card on a PC and make sure the software files are located in the appropriate update folder.
	If the same SD card is used with multiple controllers, each controller will have a separate folder on the system. Make sure the software updates are in the folder dedicated to the controller in use.
Display is lit but shows no characters or characters are faint or blurry.	Adjust the display contrast
	Make sure protective film has been removed from display.
	Clean the outside of the controller, including the display screen.

Problem	Resolution
Controller will not power up, or powers up intermittently	Make sure the AC power connections are properly terminated in the controller.
	Make sure the power strip, line power, wall plug are all properly plugged in.
	Contact Technical Support
Network or sensor module not recognized	Make sure the module is properly installed.
	Make sure the module selector switch is set to the proper number.
	Remove sensor module and install the module into the second analog slot. Apply power to the controller and allow the controller to perform a device scan.
	Contact Technical Support.
Sensor not recognized ***Note:*** *Example of possible display message: *****	If the sensor is an analog sensor and a corresponding module is installed in the controller, refer to the instructions supplied with the Network or Sensor Module.
	Make sure the digital connector wiring harness is seated on the inside of the door assembly and that the wiring harness is not damaged.
	If the digital sensor is connected to the controller with a digital termination box, user supplied junction box, digital extension cables, or a user-supplied extension cable, connect the sensor directly to the controller and perform a device scan. If the controller recognizes the sensor, check that all the wiring in the junction boxes or extension cables is correct.
	Make sure that only two sensors are installed in the controller. Although two analog module ports are available, if a digital sensor and two analog modules are installed, only two of the three devices will be seen by the controller.
	Contact Technical Support
Device Missing error message appears	Perform a Device Scan from the Test/Maintenance menu.
	Power cycle the controller

Test and Maintenance menu

1. From the Settings Menu, select Test/Maint and push **ENTER**.

Option	Description
Scan devices	Performs a scan for active and missing devices.
Output cal • **Output 1** • **Output 2**	Lets the user calibrate the 4–20 mA outputs with a 250 ohm resistor in series to the mA output terminals. The settings for each output are adjusted until the correct value (4 mA or 20 mA) is supplied. Calibrate 4 mA output (Min: 0 Max: 25000) Calibrate 20 mA output (Min: 35000 Max: 65533)
Hold outputs	Sets the value the controller sends to an external system for a defined period of time. After the time period, the instrument goes back to reporting real time values. Set activation—Launch or release Set Outmode—Hold Outputs (default) or Transfer Outputs Set Channels—All (default) or select from hardware list

Option	Description
Test output • **Output 1** • **Output 2**	Lets the user select a mA value that is sent by the controller for verification. Min: 0 mA (default +04.00) Max: 25.00 mA
Status	View status of all modules, sensors and relays.
Test relay—A, B, C, D	Energize or De-energize the selected relay
Overfeed reset	Resets the Overfeed Timer.
Reset default config	Resets the controller configuration settings to the default values (language, date and time, relay function and data output function).
Restart sc200	Performs a controller restart
Simulation (only displays if sensors or modules are connected)	After the sim value is entered, the controller outputs this value as if it was the value sent from the sensor. The simulation stops after the user exits the screen. Source- • <Module 1> • <Module 2> (Footer displays current source selection) Parameter—Source measurement type (footer displays current source selection) Sim value—Use arrow keys to change value (footer displays current source selection)
Modbus stats	Displays Error and Good count stats for selected port. • Sensor port 1, 2, 3 or 4 • Network port • Service port • Clear stats
System data	Displays the current system current, temperature and voltage data.

Warning and error conditions

Follow the steps below to acknowledge controller warnings.

1. From the Settings menu, select Diagnostics and push **ENTER**.
2. Select the device (controller, sensor, network card) with the warning or error and push **ENTER**.
3. Select the warning, error or event list and push **ENTER**.
4. Select Yes and push **ENTER** to acknowledge the warning.
   Note: *Errors cannot be acknowledged.*
5. For more information on a specific warning, error or event, refer to the device manual.

Device scan information

Display message	Action
Installing device...please wait	The controller has found a new device. No action is necessary. The controller automatically performs an installation process for the new device and displays the main measurement screen of the device installed in the number one position.
Device missing <device id>	A previously installed device has been removed from the controller or is not detected. • Push the **Enter** key to continue. • Push the left arrow key to select or de-select a missing device. • Push the **Enter** key to delete the missing device. The controller will display the main measurement screen for the device in the number one position. ***Note:*** *This message also displays when a device is missing and a new device has been installed. After the missing device is deleted, the controller automatically installs the new device and displays Installing device...please wait. The controller then displays the main measurement screen for the device installed in the number one position.*

Replacement parts and accessories

Note: *Product and Article numbers may vary for some selling regions. Contact the appropriate distributor or refer to the company website for contact information.*

Description	Item number
4 GB Secure Digital Memory (SD) card	9218100
Connector kit for digital sensor	9201000
Controller installation kit	8806200
DataCom cable	LZX887
Mounting bracket inserts	9177900
Plug, conduit opening (set of 3)	5868700
Power cord kit, with strain relief, 125 VAC, U.S.-style plug	9202900
Power cord kit, with strain relief, 230 VAC, European-style plug	9203000
Screw driver	6134300
SD card reader	9218200
SD card cover kit for sc200 controller	9200900
Screws for controller installation kit	9177800
Cord grip kit (1)	9178000
Sealing washer for cord grip assembly	1033814
UV protection screen	8809200
Weather and sun shield w/ UV protection screen	9220600
Sensor and communication modules	
Conductivity module	9013000

Description	Item number
Flow module	9012700
4-20 mA input module	9012800
pH and DO module	9012900
4-20 mA output module	9334600
HART network module kit	9328100
Modbus network module	9013200
Profibus network module	9173900
Profibus M12 connector kit	9178500
Profibus M12 socket (hard wire to quick connector adapter)	9178200
Profibus M12 T-splitter	9178400

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7.2 Wallace & Tiernan Depolox 3 Plus Chlorine & pH Analyzer (WTP, BS#1, BS#2)

Wallace & Tiernan/Siemens Chlorine Analyzer w/ pH & Temperature Probes

Depolox 3 Plus D5CPT

DEPOLOX® 3 PLUS RESIDUAL ANALYZER

WALLACE & TIERNAN® ANALYZERS/CONTROLLERS

The DEPOLOX® 3 plus residual analyzer continuously measures free or total (combined) chlorine, chlorine dioxide or ozone in drinking water applications. Utilizing proven and universally accepted amperometric measurement technology, this analyzer directly measures these disinfectant residuals and provides a 4-20 mA output signal for control or recording purposes. Integral alarm relays are provided. The analyzer is also available in an arrangement for measuring temperature and pH or fluoride.

FEATURES

Three electrode measuring cell

For disinfectant measurement, a three electrode technology measuring cell is used. This cell eliminates the need for the constant zero adjustment typical of other analyzers. Reliability and stability are vastly improved while maintenance is dramatically reduced. This technology is used in both the bare-electrode and membrane-type cells.

Reagentless chlorine measurement

The internally buffered membrane-type sensor measures free or total chlorine without the need for reagents. This includes samples with varying pH. With no chemical addition, the sample can be added back to the supply or simply drained without concern for discharge restrictions.

Flexible arrangements

There are two electronic control configurations: a single input version for disinfectant only measurement and a dual-input version for disinfectant and pH or fluoride measurement. In addition, a sample temperature output signal is available from both the single and dual input arrangements, dependent on the choice of flow cell. There are a total of five flow cell configurations: two that incorporate the integral bare-electrode measuring cell (DEPOLOX 3 plus and DEPOLOX 5 flow cell); two that accommodate the membrane-type measuring

Key Benefits

- Chlorine measurement without reagents
- Flexible arrangements - four flow cell and two electronic control units are available
- Advanced electronics housed in a NEMA 4X enclosure
- Reliable and stable measurement of residuals
- User-friendly menu driven access to set-up, calibration and diagnostics

Wallace & Tiernan/Siemens Chlorine Analyzer w/ pH & Temperature Probes

Depolox 3 Plus D5CPT

cell (DEPOLOX 3 plus membrane-type and VariaSens™ flow cell); and a simple Y-type flow-thru probe holder for fluoride only measurement.

Advanced electronics

Housed in a NEMA 4X enclosure, the analyzer controls provide up to three isolated 4-20 mA output signals for disinfectant residual, temperature, and pH or fluoride. Configurable alarm relays and an RS 485 digital interface are also available. A backlit LCD display and a six-button keypad provide for a wide range of information, setup, calibration and diagnostic menus.

Choice of flow cell technology

To ensure a stable, representative measurement signal, a constant flow rate is required. This is provided by a choice of flow cells, dependant on the type of measurement technology that is used:

Bare-electrode type cell for free chlorine

This measurement technology features an integral, bare-electrode flow cell for free chlorine. Utilizing the three electrode cell design described above, this unique combination of analyzer/sensor provides a very quick response time (90% change < 20 sec.) with high accuracy (±2% F.S.) to meet fluctuating disinfection demands or applications where there is a high degree of hardness, which prohibits the use of a membrane-type sensor. The well-proven principle of hydromechanical grit cleaning of the electrode surfaces maintains the sensitivity of the bare-electrode sensors extending the interval time between calibrations. A sample with a constant pH is required. Alternatively, the addition of a pH sensor, utilizing the dual input electronic package, provides for a pH-compensated free Cl_2 measurement without the need to buffer the sample.

DEPOLOX® 3 plus flow cell

This economical flow block assembly consists of a transparent Plexiglas body with an integral flow regulator to supply a consistent sample flow to the measuring electrodes. An integral PT 100 sensor provides for temperature compensation of the chlorine residual reading as well as a temperature measurement output signal. An additional sensor probe for pH or Fluoride can be added through the flow cell cover.

DEPOLOX® 5 flow cell

This deluxe flow block assembly includes all of the features of the above DEPOLOX® 3 plus cell, except that an integral multi-sensor provides a PT 1000 temperature measurement and output and monitors sample flow to provide a loss-of-flow alarm contact.

Membrane-type cell

There are four disinfectant specific, membrane-type sensors available for measuring either free chlorine, total chlorine, chlorine dioxide, or ozone. Utilizing the three electrode measurement technology, these sensors incorporate a membrane for diffusion of the oxidant into the working electrode. An internal, buffered electrolyte reduces the effect of pH on chlorine measurement. Therefore, external pH buffering or pH compensation is not required for samples with a varying pH. Temperature compensation of the chlorine residual reading is built into the sensor.

DEPOLOX 3 plus membrane - type flow cell

This simple flow block housing is designed to provide a constant flow of water past the membrane surface of the removable sensor. Sensors can easily be changed to monitor different disinfectants. A water jet, designed into the flow block, removes any bubbles from the membrane surface, which can affect accuracy and stability. An additional sensor probe for pH or Fluoride can be added through the flow cell cover. Note that a measured temperature output is not available with this flow cell.

VariaSens™ Flow Cell

In addition to the above, this flow block assembly utilizes an integral flow regulator to maintain the sample flow at a constant 33 l/h. An integral multi-sensor provides a PT 1000 temperature measurement and output and monitors sample flow to provide a loss-of-flow alarm contact.

Fluoride-Only Measurement

If fluoride is the only parameter to be measured, then a simple, flowthrough probe assembly can be provided. This consists of a Y-type flow-thru probe holder and a sample valve. Note that temperature measurement and output is not available with this configuration.

BARE-EL. MEASURING CELL

DEPOLOX® 5 CELL

MEMBRANE MEASURING CELL

VARIASENS™ FLOW CELL

TECHNICAL DATA – DISINFECTANT MEASUREMENT

Measurand	Free C l_2 (membrane)	Total Cl_2	ClO_2	O_3	Free Cl_2 (bare electrode)
Range	0-0.20 to 0-20 mg/l	0-0.20 to 0-20 mg/l	0-0.20 to 0-20 mg/l	0-0.20 to 0-10 mg/l	0-0.20 to 0-20 mg/l
Accuracy	0.05 mg/l or ± 6% F.S. Whichever is greater	0.05 mg/l or ± 6% F.S. Whichever is greater	0.05 mg/l or ± 6% F.S. Whichever is greater	0.05 mg/l or ± 6% F.S. Whichever is greater	0.01 mg/l or ± 2% F.S. Whichever is greater
Sensitivity	0.01 mg/l or ± 1% F.S. Whichever is greater	0.01 mg/l or ± 1% F.S. Whichever is greater	0.01 mg/l or ± 1% F.S. Whichever is greater	0.01 mg/l or ± 1% F.S. Whichever is greater	0.01 mg/l or ± 1% F.S. Whichever is greater
Repeatability	0.02 mg/l or ± 3% F.S. Whichever is greater	0.02 mg/l or ± 3% F.S. Whichever is greater	0.02 mg/l or ± 3% F.S. Whichever is greater	0.02 mg/l or ± 3% F.S. Whichever is greater	0.01 mg/l or ± 2% F.S. Whichever is greater
Stability	± 5% F.S. under typ. Conditions for 1 month	± 5% F.S. under typ. Conditions for 1 month	± 5% F.S. under typ. Conditions for 1 month	± 5% F.S. under typ. Conditions for 1 month	2% F.S. under typ. Conditions for 1 month
Response Time	90% change < 5 minutes	90% change < 5 minutes	90% change < 20 seconds	90% change < 50 seconds	90% change < 20 seconds
Sample Temperature	41° to 113° F (+ 5° to 45° C)	41° to 113° F (+ 5° to 45° C)	41° to 113° F (+ 5° to 45° C)	41° to 113° F (+ 5° to 45° C)	41° to 122° F (+ 5° to 50° C)
Sample Flow (Potable Water Only)	6 l/h to 35 l/h constant	6 l/h to 35 l/h constant	6 l/h to 35 l/h constant	6 l/h to 35 l/h constant	33 l/h ± 5 liter, constant
Inlet Pressure	2 to 60 psi	2 to 60 psi	2 to 60 psi	2 to 60 psi	2 to 60 psi
Outlet Pressure	0 psi	0 psi	0 psi	0 psi	0 psi
Conductivity	> 10 mS/cm up to 2500 mS/cm	> 10 mS/cm up to 2500 mS/cm	> 1 mS/cm up to 40 mS/cm	> 1 mS/cm up to 40 mS/cm	> 250 mS/cm up to 100 mS/cm

pH dependence

Bare-Electrode sensor – pH 4 to pH 9 – must be stable; pH compensation available with dual input unit membrane-type sensor (free and total chlorine) – usable range pH 6 to pH 10; maximum interference 5% per pH unit membrane-type sensor (ClO_2 and O_3) - none

pH Measurement

Measurement Range: pH 4 to 10 (standard);
pH 0 to 14 (optional)

Sample Temperature Range:

-23ºF to 176ºF (-5ºC to 80ºC)

Sensitivity: 0.01 pH

Conductivity: >300µS/cm

Fluoride Measurement

Measurement Range: 0.2 to 2.0 mg/l
Sample Temperature Range:
32ºF to 176ºF (0ºC to 80ºC)
Sensitivity: 0.01 mg/l fluoride
Conductivity: >300µS/cm

Electronics

Power Requirements: 115 V
±10%, 50/60 Hz, 14VA or 230 V
±10%, 50/60 Hz, 14VA
Ambient Temperature: 32ºF to 122ºF (0ºC to 50ºC)
Enclosure Rating: NEMA 4X
Readout: 16-character, two-line, backlit LCD display

Electronics

Output Signal: 4-20 mA max. 1000 ohm load, electrically isolated for up to 50 V to ground
1 for Disinfection Sensor
1 for Temperature (where available from flow cell)
1 for pH or Fluoride (dual input arrangement only)

External Alarms: Two electromechanical relays, user configurable (high, low, high/low, gen. fault, or off), for disinfectant. Selectable for N.O. or N.C. and latching or non-latching operation; (Optional)
Two electromechanical relays, user configurable for pH or fluoride.

Relay Contact Ratings: 5A 1/6 HP 125, 250 VAC or 5A 30 VDC 30 Watt max.

Digital Input: One dry contact input for sample water or circulating pump monitoring.

Digital Communication: RS485 interface for connection to programmable controller or central instrumentation and control systems via RS485 W&T protocol.

Access Code: A three-digit security code can be entered via the keypad to prevent unauthorized access to the operating parameters.

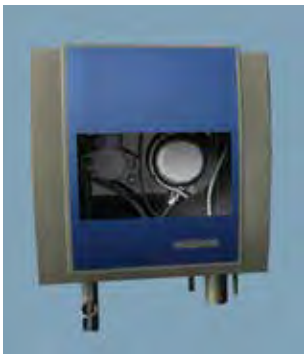
Wallace & Tiernan/Siemens Chlorine Analyzer w/ pH & Temperature Probes

Depolox 3 Plus D5CPT

FLOW SWITCH

STOP VALVE

MICRO/2000® RESIDUAL ANALYZER



DEOX/2000® DECHLORINATION ANALYZER

Options

Sensor Cable Length: DEPOLOX® 3 plus bare-electrode and DEPOLOX® 5 flow cells: 3.3 ft (1 m) standard.

DEPOLOX® 3 plus membrane and VariaSens™ flow cells: Disinfectant membrane-type sensors - 6'6" ft (2 m) standard; 16'3" (5 m), 32'8" (10 m), 49'2" (15m), 82'0" (25 m) and 164'0" (50 m) optional; pH and Fluoride sensors – 4'10' (1.5 m) standard; 16'3" (5 m), 32'8" (10 m) and 49'2" (15 m) optional.

Flow Switch: Mounts on the inlet to the DEPOLOX® 3 plus bare-electrode and membrane flow cells. Provides alarm to electronic controls when there is a loss of sample to the flow cell. Not required with DEPOLOX® 5 and VariaSens flow cells.

Stop Valve: Mounts on the inlet to the wetside or on the flow switch. Provides easy shut-off of the sample flow for maintenance and service.

Chart Recorders: Available as circular chart type. Supplied with 400 24-hour or 100 7-day circular charts, one year's supply of fiber-tip pens. Available chart ranges: 0-0.2; 0-0.5; 0-1.00; 0-2.00; 0.5.00; 0-10.0; and 0-20.0.

Shipping Weight: Membrane wetside - 5 lbs.

Bare electrode wetside - 9 lbs.

Electronic enclosure (single or dual input) - 8 lbs.

Other residual analyzers available from Evoqua Water Technologies

Micro/2000® residual analyzer: A high-accuracy, extremely reliable monitoring and control instrument for potable water, wastewater, and cooling water treatment. Suitable for measuring free and total chlorine, chlorine dioxide, and potassium permanganate residuals.

Deox/2000® dechlorination analyzer: A precise instrument for accurately measuring both SO_2 and total chlorine residuals in wastewater effluent.

Wallace & Tiernan/Siemens Chlorine Analyzer w/ pH & Temperature Probes

Depolox 3 Plus D5CPT

EVOQUA WATER TECHNOLOGIES

Auf der Weide 10, 89312 Günzburg, Germany
+49 (8221) 904-0 www.evoqua.com

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Wallace & Tiernan®

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Depolox® 3 *plus* RESIDUAL ANALYZER

FOR MEASURING CHLORINE, CHLORINE DIOXIDE, OZONE, AND/OR pH OR FLUORIDE

BOOK NO. WT.050.560.001.UA.IM.0714

W3T140188 - U.S.
W3T172611/Issue 06 - Germany

Depolox® 3 *plus*
RESIDUAL ANALYZER
FOR MEASURING CHLORINE, CHLORINE DIOXIDE, OZONE, AND/OR pH OR FLUORIDE

BOOK NO. WT.050.560.001.UA.IM.0714

W3T140188 - U.S.

W3T172611/Issue 06 - Germany

EQUIPMENT SERIAL NO. _____

DATE OF START-UP _____

START-UP BY _____

Prompt service available from nationwide authorized service contractors.

ORDERING INFORMATION

In order for us to fill your order immediately and correctly, please order material by description and part number, as shown in this book. Also, please specify the serial number of the equipment on which the parts will be installed.

WARRANTY

Seller warrants for a period of one year after shipment that the equipment or material of its manufacture is free from defects in workmanship and materials. Corrosion or other decomposition by chemical action is specifically excluded as a defect covered hereunder, except this exclusion shall not apply to chlorination equipment. Seller does not warrant (a) damage caused by use of the items for purposes other than those for which they were designed, (b) damage caused by unauthorized attachments or modifications, (c) products subject to any abuse, misuse, negligence or accident, (d) products where parts not made, supplied, or approved by Seller are used and in the sole judgment of the Seller such use affects the products' performance, stability or reliability, and (e) products that have been altered or repaired in a manner in which, in the sole judgment of Seller, affects the products' performance, stability or reliability. **SELLER MAKES NO OTHER WARRANTY OF ANY KIND, AND THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS OF THE MATERIAL OR EQUIPMENT FOR ANY PARTICULAR PURPOSE EVEN IF THAT PURPOSE IS KNOWN TO SELLER.** If Buyer discovers a defect in material or workmanship, it must promptly notify Seller in writing; Seller reserves the right to require the return of such defective parts to Seller, transportation charges prepaid, to verify such defect before this warranty is applicable. In no event shall such notification be received by Seller later than 13 months after the date of shipment. No action for breach of warranty shall be brought more than 15 months after the date of shipment of the equipment or material.

LIMITATION OF BUYER'S REMEDIES. The **EXCLUSIVE REMEDY** for any breach of warranty is the replacement f.o.b. shipping point of the defective part or parts of the material or equipment. Any equipment or material repaired or replaced under warranty shall carry the balance of the original warranty period, or a minimum of three months. Seller shall not be liable for any liquidated, special, incidental or consequential damages, including without limitation, loss of profits, loss of savings or revenue, loss of use of the material or equipment or any associated material or equipment, the cost of substitute material or equipment, claims of third parties, damage to property, or goodwill, whether based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory; provided, however, that such limitation shall not apply to claims for personal injury.

Statements and instructions set forth herein are based upon the best information and practices known to Evoqua Water Technologies, but it should not be assumed that every acceptable safety procedure is contained herein. Of necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

725 Wooten Road
Colorado Springs, Co 80915

INTRODUCTION

The Depolox® 3 *plus* Residual Analyzer is a low cost economical analyzer for potable water that continuously measures either free or total chlorine, chlorine dioxide or ozone residuals using proven amperometric measurement technology. There is also an arrangement available for measuring pH or flouride. All arrangements include a temperature measuring and monitoring device.

The Depolox® 3 *plus* analyzer consists of two separate components: a "wet side" package containing the sensor/cell and an electronic control package.

The electronic package is available for either 115 or 230 volt operation. A single input arrangement is used when only a disinfectant measurement (free or total chlorine, chlorine dioxide, ozone) is required. A dual input arrangement is available when either pH or fluoride measurement is required in addition to a disinfectant measurement. Note that for pH- or fluoride-only measurement, the dual input electronic package is required and the dual input cannot be used for two disinfectant measurements. All arrangements have temperature measurement. The electronic package provides for operator input via plain-text-assisted, self-explanatory menus and a sealed keypad. The large, two-line (16 characters each) display of disinfectant residual alternates every five seconds with the disinfectant value, temperature, and either pH or fluoride values when the analyzer is set up for these measurements.

There are two wetside configurations available: Membrane and Bare Electrode. Both consist of a flow-through cell with a transparent plexiglass body that houses one or two measuring sensors. The cell's transparency permits visual checks on the flow of sample water and measuring conditions. The Membrane wetside can be fitted with any one of four membrane-type sensors (free chlorine, total chlorine, chlorine dioxide or ozone) for disinfectant measurement. A second sensor can be added for pH or fluoride measurement. The bare electrode wetside is available for free chlorine measurement only. This arrangement can be used where a quick response time is required or if there is a high hardness in the sample water that could foul a membrane sensor. A second sensor can be added for pH or fluoride measurement. Note that free chlorine measurement by this wetside is affected by changes in pH. It is possible to compensate for pH changes by using a dual input arrangement with the pH sensor option for automatically calculating the residual value in response to changes in pH between 6.00 to 8.75.

Refer to Table A for part numbers for the various analyzer combinations.

Table A - Analyzer Type Selection Sheet Using Package Numbers

ELECTRONIC PACKAGE (Select one)	PART #
Chlorine ONLY (SINGLE SENSOR)	
115V	W2T365288
230V	W2T365292
Chlorine AND/OR pH OR Fluoride (DUAL SENSOR)	
115V	W2T365290
230V	W2T365293
SENSOR 1 - DISINFECTANT (SINGLE OR DUAL) (Select one unless using pH or Fluoride alone)	
Depolox® 3 *plus* Bare Electrode (With PT100 Temperature Sensor)	
Free Chlorine Measurement Package (For Fluctuating pH, Dual Electronics with pH Recommended)	W2T9694
OR	
Depolox® 5 Bare Electrode (With PT1000 Temperature Sensor)	
Free Chlorine Measurement Package (For Fluctuating pH, Dual Electronics with pH Recommended)	W2T7957
OR	
Depolox® 3 *plus* Membrane Sensor	
Membrane Flow Block Assembly	W2T9681
OR	
VariaSens™	
Membrane Flow Block Assembly	W2T7958
CO2 Buffer Package (For Free Chlorine)	W3T138155
AND (SELECT 1)	
Free Cl2 Probe FC1	W2T8665
Total Cl2 ProbeTC1	W2T9687
ClO2 Probe CD7	W2T8664
Ozone Probe OZ7	W2T8666
AND (SELECT 1)	
2m Cable	W2T416786
5m Cable	W2T420222
10m Cable	W3T149888
15m Cable	W2T416799
25m Cable	W3T149743
50m Cable	W3T149744

Table A - Analyzer Type Selection Sheet Using Package Numbers (Cont'd)

AND/OR (Options for Bare and Membrane)	
(For use with Depolox® 3 *plus* wetsides only)	
Flow Switch Alarm	W2T9690
Stop Valve	W2T9689
Note: Flow Switch and Stop Valve are integral to Depolox® 5 Bare Electrode and VariaSens™ Wet Side.	
SENSOR 2 (FOR DUAL INPUT ONLY)	
pH Sensor	W2T12126
OR	
Fluoride Kit - Refillable	W2T417005
OR	
Fluoride Kit - Gel Type	W3T124078
OR	
Impedence Converter	W2T9651
OR (If Fluoride or pH ONLY)	
Fluoride/pH Standalone Wetside	W2T12125
Note: The standard 1 meter cable for the pH and fluoride probes is provided pre-attached to the dual electronics. No additional cable is required.	

Options:

- Flow switch (to provide alarm for loss of sample water)
  (Integral to Depolox® 5 bare electrode and VariaSens™ wetside)
- Stop valve (to shut off sample flow)
  (Integral to Depolox® 5 bare electrode and VariaSens™ wetside)
- Impedance transformer (for pH or Fluoride probe)

NOTE: When ordering material, always specify model and serial number of apparatus.

Electromagnetic Compatibility and Other Requirements

Depolox® 3 *plus* devices conform with the following requirements:

- EN 61326-1: 2006 (EMC)
- EN 61010-1: 2006 (LVD)

Depolox® 3 *plus* devices are designed for use in industry, domestic, business, and trade sectors.

Declaration of Conformity

Depolox® 3 *plus* devices comply with the requirements of the EU directives 2006/95/EC "Low Voltage Directive" and 2004/108/EC "Electromagnetic Compatibility" and the harmonized European Standards listed therein.

Intended Use

The Depolox® 3 *plus* consists of one or two combined measuring and reference sensors for chlorine, chlorine dioxide, ozone, temperature, pH, and fluoride; a measuring water monitoring device; and an electronics module. The system is for measuring the concentration of chlorine, chlorine dioxide, ozone and temperature as well as pH or fluoride, and to display and transmit measurements, in potable water.

WARNING: TO AVOID INJURY TO PERSONS CAUSED BY ELECTRICITY ONLY AUTHORIZED AND QUALIFIED ELECTRICIANS MAY INSTALL THE DEVICE AND OPEN THE HOUSING. THE DEVICE MAY ONLY BE OPERATED WHEN THE HOUSING IS CLOSED AND MUST BE CONNECTED TO THE PROTECTIVE CONDUCTOR. MODIFICATIONS TO THE DEVICE WHICH EXCEED THOSE DESCRIBED IN THIS MANUAL ARE NOT PERMISSIBLE.

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Very Important Safety Precautions SP-1,-2
Regional Offices 1.010-1
Technical Data ..... Section 1
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VERY IMPORTANT SAFETY PRECAUTIONS

This page provides very important safety information related to safety in installation, operation, and maintenance of this equipment.

WARNING

TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, OBSERVE THE FOLLOWING:

ALL USERS OF THIS EQUIPMENT SHOULD BE MADE AWARE OF THE PROBLEMS ASSOCIATED WITH HANDLING HAZARDOUS MATERIALS IN EITHER LIQUID OR GASEOUS FORM AND OF THE EFFECTS OF EXPOSURE TO THEIR FUMES. REFERENCE SHOULD BE MADE TO THE LITERATURE AVAILABLE FROM THE SUPPLIERS OF THESE CHEMICALS, PARTICULAR ATTENTION BEING PAID TO THE INFORMATION AND ADVICE ON PROTECTIVE CLOTHING.

THIS EQUIPMENT IS CONNECTED TO LINE VOLTAGE. IT IS ESSENTIAL THAT THE UTMOST CARE IS TAKEN WHEN WORK IS CARRIED OUT ON EQUIPMENT WHERE LINE VOLTAGES ARE PRESENT. IT IS RECOMMENDED THAT ALL POWER SUPPLIES ARE SWITCHED OFF WHENEVER POSSIBLE.

WHEN DEALING WITH HAZARDOUS MATERIAL, IT IS THE RESPONSIBILITY OF THE EQUIPMENT USER TO OBTAIN AND FOLLOW ALL SAFETY PRECAUTIONS RECOMMENDED BY THE MATERIAL MANUFACTURER.

DO NOT DISCARD THIS INSTRUCTION BOOK UPON COMPLETION OF INSTALLATION. INFORMATION PROVIDED IS ESSENTIAL TO PROPER AND SAFE OPERATION AND MAINTENANCE.

ADDITIONAL OR REPLACEMENT COPIES OF THIS INSTRUCTION BOOK ARE AVAILABLE FROM:

Evoqua Water Technologies
725 Wooten Road
Colorado Springs, CO 80915
Phone: (800) 524-6324

NOTE

Minor part number changes may be incorporated into Evoqua Water Technologies products from time to time that are not immediately reflected in the instruction book. If such a change apparently has been made in your equipment and does not appear to be reflected in your instruction book, contact your local Evoqua Water Technologies sales office for information.

Please include the equipment serial number in all correspondence. It is essential for effective communication and proper equipment identification.

REGIONAL OFFICES

INSTALLATION, OPERATION, MAINTENANCE, AND SERVICE INFORMATION

Direct any questions concerning this equipment that are not answered in the instruction book to the Reseller from whom the equipment was purchased. If the equipment was purchased directly from Evoqua Water Technologies, Colorado Springs, CO contact the office indicated below.

UNITED STATES

725 Wooten Road
Colorado Springs, CO 80915
TEL: (800) 524-6324

CANADA

If the equipment was purchased directly from Evoqua Water Technologies, Canada, contact the nearest office indicated below.

ONTARIO

Evoqua Water Technologies Ltd.
2045 Drew Road
Mississauga, Ontario
L5S 1S4
(905) 944-2800

QUEBEC

Evoqua Technologies des Eaux Itee
505 Levy Street
St. Laurent, Quebec
H4R 2N9
(450) 582-4266

SECTION 1

SECTION 1 - TECHNICAL DATA

List of Contents

PARA. NO.

Depolox® 3 *plus* Electronics 1.1
Sensor Feature List 1.2
pH Sensor 1.3
Fluoride Sensor Kit 1.4

1.1 Depolox® 3 *plus* Electronics

Power supply	115 V ± 10%, 50 - 60 Hz, 14 VA F1 Fuse T630 mA, 5 x 20 mm or 230 V ± 10%, 50 - 60 Hz, 14 VA F1 Fuse T630 mA, 5 x 20 mm
Input A: Disinfectant measuring ranges	Free and Total Chlorine 0.20 / 0.50 / 1.00 / 2.00 / 5.00 / 10.0 / 20.0 mg/l
Input A: Chlorine Dioxide ranges	0.20 / 0.50 / 1.00 / 2.00 / 5.00 / 10.0 / 20.0 mg/l
Input A: Ozone ranges	0.20 / 0.50 / 1.00 / 2.00 / 5.00 / 10.0 / 20.0 mg/l
Input A: Sample water temperature range	Depolox® 3 plus and Depolox® 5 Bare Electrode 41 to 122°F (5 to 50°C) Membrane Probes 41 to 113°F (5 to 45°C)
Input B: pH measuring ranges (Dual sensor)	pH 4.00 to pH 10.00, pH 0 to pH 14.00 (Effective range for internal pH compensation pH 6.0 to pH 8.75)
Input B: Fluoride measuring range (Dual sensor)	0.20 to 2.00 mg/l
Measurement inputs	1 x disinfection sensor 1 x temperature 1 x pH or fluoride sensor (Dual Input only) electrically isolated for up to 50 V to ground
mA outputs 4 - 20 mA	1x for disinfection 1 x temperature 1x for pH or fluoride (with Dual Sensor) max. 1000 ohm load, electrically isolated for up to 50 V to ground
Relay outputs	2 freely configurable alarm contacts for disinfectant signal 2 for ph or fluoride (with Dual Sensor) Electrically isolated up to 500 V to ground
Relay Contact Rating	5A 1/6 HP 125, 250 V AC or 5A 30 V DC 30 W max. Interference suppression via suppressor diodes.

3x Digital input	Dry contact input Electrically non-isolated
Interface	RS485 for connection to programmable controller or central instrumentation and control systems via RS485 Evoqua Water Technologies protocol.
Ambient operating temperature	32 to 122°F (0 to 50°C)
IP Rating	IP66

1.2 Sensor Feature List

	free C12 (bare electrode)	FC1 (membrane type)	TC1 (membrane type)
Principle of operation	Potentiostatic 3-electrode-amperometric, bare electrode	Potentiostatic 3-electrode-amperometric, membrane type	Potentiostatic 3-electrode-amperometric, membrane type
Measurand	free chlorine Cl	free chlorine Cl	total chlorine Cl
Application	Potable water, high hardness and fast response requirements	Potable water, prefered for low conductivity and variable pH	Potable water, prefered for low conductivity and variable pH
Range	0 to 20 ppm	0 to 20 ppm	0 to 20 ppm
Zero cal.	Required	Not required	Not required
Accuracy	0.01 mg/l or 2% F.S. whichever is greater	0.05 mg/l or 6% F.S. whichever is greater	0.05 mg/l or 6% F.S. whichever is greater
Sensitivity	0.01 mg/l or 1% F.S. whichever is greater	0.01 mg/l or 1 % F.S. whichever is greater	0.01 mg/l or 1% F.S. whichever is greater
Repeatability	0.01 mg/l or 2% F.S. whichever is greater	0.02 mg/l or 3% F.S. whichever is greater	0.02 mg/l or 3% F.S. whichever is greater
Stability	2% F.S. under typical conditions for 1 month	5% F.S. under typical conditions for 1 month	5% F.S. under typical conditions for 1 month
Response time (T_{90})	90% change in less than 20 seconds	90% change in less than 5 minutes	90% change in less than 5 minutes
Sample temp.	41 to 122° F (+5 to 50° C)	41 to 113° F (+5 to 45° C)	41 to 113° F (+5 to 45° C)
Storage temp.	14 to 140° F (-10 to 60° C)	14 to 122° F (-10 to +50° C)	14 to 122° F (-10 to +50° C)
pH dependence	pH 4 to pH 9 must have stable pH (max. pH variation 0.l pH); pH compensation available with dual input units.	Usable range pH 6 to pH 10; maximum interference 5% per pH unit.	Usable range pH 6 to pH 10; maximum interference 5% per pH unit.
Conductivity	> 250 µS/cm	>10 µS/cm up to 2500 µS/cm	> 10 µS/cm up to 2500 µS/cm
Sample water flow	33 1/h +/- 5 liter, constant	6 1/h to 35 1/h, constant	6 l/h to 35 1/h, constant
Inlet pressure	2 to 60 psi (0.15 to 4 bar)	2 to 60 psi (0.15 to 4 bar)	2 to 60 psi (0.15 to 4 bar)
Outlet pressure	0 psi	0 psi	0 psi
Temperature compensation	Yes, Pt 100 or Pt 1000 sensor	Yes, Pt 1000	Yes, Pt 1000
Flow switch (opt.)	Yes	Yes	Yes
Flow regulator	Yes	Yes	Yes
Reagents	None	None	None
Cleaning	Dynamic grit	None	None
Typical life time	membrane: 1 year electrolyte: 6 months	membrane: 1 year electrolyte: 6 months	membrane: 1 year electrolyte: 6 months

1.2 Sensor Feature List (Cont'd)

	CD7 (membrane type)	OZ7 (membrane type)
Principle of operation	Potentiostatic 2-electrode-amperometric-, membrane type	Potentiostatic 2-electrode-amperometric-, membrane type
Measurand	Chlorine Dioxide (ClO_2)	Ozone (O_3)
Application	All water with suspended solids less than 0.8 mm	All water with suspended solids less than 0.8 mm
Interference	Ozone and periacetic acid	Chlorine Dioxide and peri-acetic acid
Range	0 to 20 ppm	0 to 20 ppm
Zero cal.	Not required	Not required
Accuracy	0.05 mg/l or 6% F.S. whichever is greater	0.05 mg/l or 6% F.S. whichever is greater
Sensitivity	0.01 mg/l or 1 % F.S. whichever is greater	0.01 mg/l or 1 % F.S. whichever is greater
Repeatability	0.02 mg/l or 3% F.S. whichever is greater	0.02 mg/l or 3% F.S. whichever is greater
Stability	± 5% F.S. under typical conditions for 1 month	± 5% F.S. under typical conditions for 1 month
Response time (T90)	90% change in less than 20 seconds	90% change in less than 50 seconds
Sample temp.	41 to 113° F (+5 to 45° C)	41 to 113° F (+5 to 45° C)
Storage temp.	14 to 122° F (-10 to +50° C)	14 to 122° F (-10 to +50° C)
pH dependence	None	None
Conductivity	> 1 µS/cm up to 40 mS/cm	> 1 µS/cm up to 40 mS/cm
Sample water flow	6 l/h to 35 l/h, constant	6 l/h to 35 l/h, constant
Inlet pressure	2 to 60 psi (0.15 to 4 bar)	2 to 60 psi (0.15 to 4 bar)
Outlet pressure	0 psi	0 psi
Temperature compensation	Yes	Yes
Flow switch (opt.)	Yes	Yes
Flow regulator	Yes	Yes
Reagents	None	None
Cleaning	None	None
Typical life time	membrane: 1 year electrolyte: 6 month	membrane: 1 year electrolyte: 6 month

1.3 pH Sensor

Range	pH 0 to pH 14, pH 4 to pH 10
Temperature range	32 to 122° F (0 to 50° C) for the sample water
Pressure	max. 60 psig (4 bar)
Conductivity	>300µS/cm

NOTE: When used for pH compensated Free chlorine measurement, the pH range must be between 6 and 8.75. pH compensation available with Free chlorine bare electrode only.

NOTE: Where the standard 1.5-meter sensor cable is not long enough (for special installations up to 50-meter cable length), an impedance transformer is used to convert the very high-resistance electrode signal of the pH to a low-resistance signal. The impedance transformer is screwed onto the pH sensor cable. The impedance transformer is powered by an integral battery. Battery lifetime is approximately five years.

1.4 Fluoride Sensor Kit (Refillable and Gel Type)

Range	0.20 to 2.00 mg/L
pH Range	pH 5 to pH 8
Temperature Range	32 to 122° F (0 to 50° C)
Pressure	max. 60 psig (4 bar)
Conductivity	>300µS/cm

NOTE: An impedance transformer is used to convert the very high-resistance electrode signal of the fluoride sensor to a low-resistance signal. The impedance transformer is screwed onto the fluoride sensor cable. It is powered by an integral battery. Battery lifetime is approximately five years.

SECTION 2

SECTION 2 - INSTALLATION

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2.1 Depolox® 3 *plus*

NOTE: For safe and effective installation a knowledge of the connected devices is required with respect to operation, electrical connections, measurement signals, cable assignment, fuses and the safety regulations which have to be observed. The installation of the device therefore is only to be done by qualified and authorized skilled electricians.
Incorrectly connected devices may be damaged or destroyed when switching on or during operation, or may cause malfunctions in other devices. Be careful not to confuse measuring cables and other cables and not to let them come into contact with one another. Do not connect or disconnect live cables.

2.1.1 Unpacking

Check the transport packing for damage. Notify the carrier immediately if there is damage, otherwise your claim for compensation will be nullified.

If the device has suffered damage, get into touch with the responsible Evoqua Water Technologies representative immediately. Keep the packaging until the system has been properly installed and is in operation.

2.1.2 Check Voltages

The line voltage of the Depolox® 3 *plus* is set at the factory in accordance with the instructions given at the time of the order (230 V or 115 V).

Check this setting from the rating plate immediately after unpacking the device, and in any case before it is installed.

If the line voltage setting does not match your supply, the setting will have to be altered (refer to paragraph 2.1.3, Adjust Line Voltage/Change the Fuse).

2.1.3 Adjust Line Voltage/Change Fuse

The rating plate on the top of the device shows the line voltage which was set at the factory. If this does not match the voltage at the site of installation, the device will have to be adjusted.

NOTE: Operating the device with the wrong voltage can lead to the device fuse blowing or other damage or malfunction. Adjustment of the line voltage must take place before installation and before the connection of cables. The device may be opened and adjusted by an electrician only.

For connection to power with two hot wires (L1, L2), replace the metal pin on the F2 socket by a fuse corresponding to the voltage (see Figure 2.1).

The switch to adjust the voltage is inside the housing. To open up the housing, unscrew the screws on each side of the cover and lift off the cover of the housing, being careful not to damage the ribbon cable. The cables must not be twisted. Unlock ribbon cable from circuit board and place cover aside while setting the switch selections and making all electrical connections.

After completing all selections and connections, reattach the cover ribbon cable to the circuit board and tighten cover screws.

<u>WARNING</u>: DO NOT USE POWER TOOLS TO TIGHTEN COVER SCREWS. DO NOT EXCEED 0.5 LBSFT/FT TORQUE IN TIGHTENING THE COVER SCREWS.

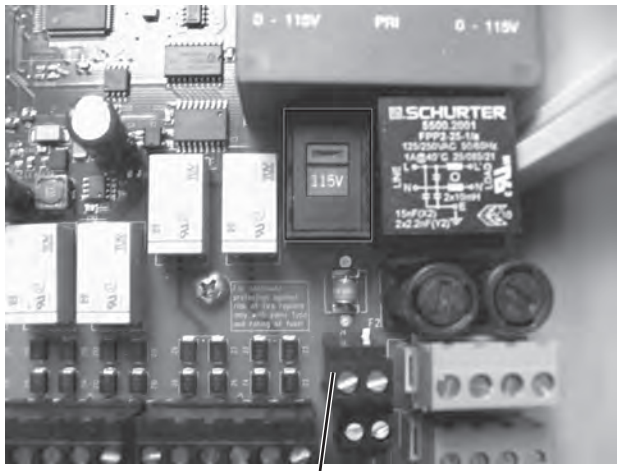


Figure 2.1 - Rating Plate

The slide switch to adjust the voltage allows a choice between 230 V and 115 V.

2.1.4 Select Sensor Types

The setting for the measuring signal of the disinfection sensors must correspond to the connected sensor. Select the sensor at the ten-position DIP switch S3 on the board (factory setting is for Bare Electrode).

WARNING: DO NOT CHANGE SWITCH SETTINGS UNTIL UNIT IS DISCONNECTED FROM LINE POWER. CHANGING THE SWITCH SETTINGS WHILE THE UNIT IS POWERED UP WILL DAMAGE THE ELECTRONICS AND LOCK UP THE SYSTEM PROGRAM, AND VOID SYSTEM WARRANTY.

WARNING: WRONG SETTING CAN CAUSE DAMAGE TO THE SENSOR AND THE DEPOLOX® 3 *PLUS* ELECTRONICS.

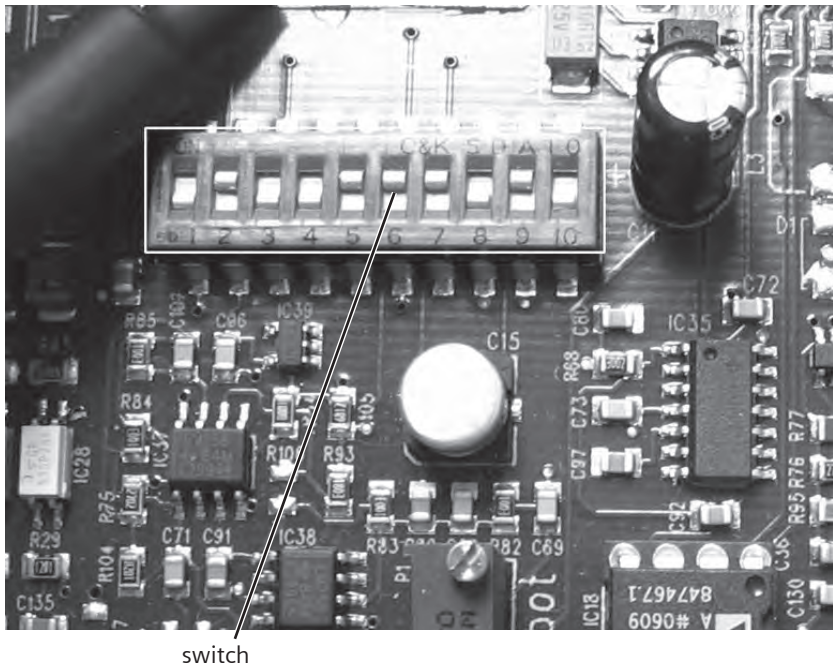
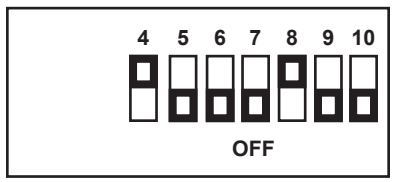


Figure 2.2 - DIP Switch

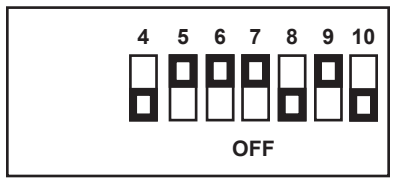
NOTE: Disconnect line power before changing DIP switch settings. Failure to disconnect power will damage electronics and void warranty.

3-Elect. "Depolox® 3 *plus*"
(Bare Electrode):
(Default factory setting)



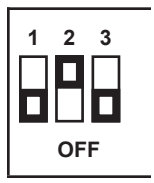
NOTE: Disconnect line power before changing DIP switch settings. Failure to disconnect power will damage electronics and void warranty.

All membrane sensors:
(FC1, TC1, CD7, OZ7)

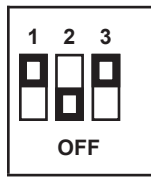


In case the cell current is >200µA (e.g., in waters with high conductivity), change the setting of positions 1 through 3 as follows:

DIP Switch (default 200µA):



DIP Switch
(only if sensor current >200µA to max. 1000 µA):



The other positions remain as before.

2.1.5 Installing the Depolox® 3 *plus* Electronics Module

The Depolox® 3 *plus* electronics module is built in a wall-mounted housing and should be mounted near the flow-through assembly.

2.1.6 Electrical Connections

Connect the sensor cables, alarm signal lines and the power cable according to the wiring diagrams (see Dwgs. 50.560.155.010, .020 and .050).

Do not switch on the power.

WARNING: ONLY AUTHORIZED AND QUALIFIED ELECTRICIANS ARE PERMITTED TO INSTALL THE DEVICE AND OPEN THE HOUSING. THE UNIT MAY ONLY BE PUT INTO OPERATION WHEN THE HOUSING IS CLOSED, AND MUST BE CONNECTED TO EARTH GROUND. MODIFICATIONS TO THE UNIT THAT GO BEYOND THOSE DESCRIBED IN THE MANUAL ARE NOT PERMISSIBLE.

CAUTION: To ensure safe and correct start up, knowledge of the operation, connected electrical load, measurement signals, cable assignment and fuse protection of the connected devices and machines and the relevant safety regulations is required. Start up of the unit may therefore only be performed by qualified and authorized electricians.

Incorrectly connected devices can be damaged, possibly irreparably, or cause faults in other equipment when they are switched on or in operation. Ensure that the measuring and control cables are not confused or make contact with one another. Never connect or disconnect any cables to which high voltage is applied!

NOTE: The power supply line must have a 6A fuse.
Recommendation: Provide an on/off facility for the unit at the installation site.

WARNING: A WARNING IS GIVEN IN INSTANCES WHERE FAILURE TO OBSERVE THE INSTRUCTION COULD RESULT IN INJURY TO PERSONNEL.

CAUTION: Cautions are given where failure to observe the instruction may result in equipment damage, or pollution to an allied system.

2.1.7 Digital Input

The flow switch (optional) must be connected to the digital input terminals 1-2 DI1, 3-4 DI2, 5-6 DI3.

The digital input “Digital IN” is set for a potentially isolated external contact, e.g., for the flow switch.

If the flow switch is not used, jumper unused terminals, otherwise, “Digital IN” error will occur.

2.1.8 Start-Up

WARNING: THE DEPOLOX® 3 *PLUS* MODULE HAS NO POWER SWITCH OF ITS OWN AND IS IN OPERATION AS SOON AS THERE IS A CONNECTION TO THE POWER SUPPLY. CONNECTED DEVICES HAVE TO BE SWITCHED OFF DURING INPUT OF OPERATING DATA IN ORDER TO PREVENT UNCONTROLLED START-UP OR MALFUNCTIONS. ONLY WHEN THE OPERATING DATA IS INPUT AND CHECKED MAY OTHER DEVICES BE SWITCHED ON.

Start-up can only be effected after correct installation of the sample water line, leak test, and electrical connection to the systems.

Start operation of the measuring cell (refer to paragraph 3.3.1, Start-Up of the Measuring Cell, or to paragraph 2.3, Membrane Sensors.

Check that the setting of the 10-position DIP switch, S3, “Chlorine Cell” (refer to paragraph 2.1.4, Select Sensor Type) is correct. Start by switching on the mains power to the control module.

WARNING: DO NOT CHANGE SWITCH SETTINGS UNTIL UNIT IS DISCONNECTED FROM LINE POWER. CHANGING THE SWITCH SETTINGS WHILE THE UNIT IS POWERED UP WILL DAMAGE THE ELECTRONICS AND LOCK UP THE SYSTEM PROGRAM, AND VOID SYSTEM WARRANTY.

First, the program version is displayed, for example:

EAE1053
FRG 49
V:X_XX/XX
Free Chlorine

Continue as follows (refer to Section 3 - Operation, as necessary):

a. Select measuring range in the SETUP menu.

b. Select pH/Fluoride measuring range.

c. Select code definition.

d. Select hold function.

e. Select language.

f. Select the bus address in the SETUP menu (if operated in a bus system).

g. Select disinfectant.

h. Select pH or Fluoride mode (optional, SETUP).

i. Select temperature.

2.2 Bare Electrode (Free Chlorine) Sensor Kit

The flow block assembly with the sensors should be installed in a frost-protected location and, where possible, in a heated room.

The sample water should provide a minimum of approximately 2 psi (0.2 bar) water gauge pressure at the measuring cell inlet.

The sample water line should be as short as possible. In the water line to the measuring cell a strainer (size 0.5 mm) must be installed.

The sample water inlet must be connected to a stop valve (connection 1/4" - 18 NPT). The tapping point for the sample water must be positioned to ensure a bubble-free flow of water and a complete mixing of the disinfectant.

The drain line must be unpressurized.

2.3 Membrane Sensors (See Dwg. 50.560.160.020 in Section 3)

WARNING: DO NOT TOUCH THE REFERENCE ELECTRODE! DO NOT TOUCH THE MEMBRANE!

Before unscrewing the membrane cap, remove the elastomer seal to allow air into the vent hole. Not doing this will cause a vacuum to occur which will damage the membrane when unscrewing the cap. Do not remove the yellow-grey layer on the reference electrode.

Unscrew the membrane cap from the electrode shaft and fill it to the top with the enclosed electrolyte. Strike the electrode shaft against the membrane cap to remove air bubbles. Clean the gold working electrode with the enclosed lapping paper (special abrasive paper). To do this, place the special abrasive paper on a paper towel. While holding on to a corner of the paper move the tip of the electrode of the vertically held probe one or two times over the rough side of the special abrasive paper. Ensure that the elastomer seal completely covers the vent hole. While holding the electrode shaft in a vertical position, screw on the cap onto the shaft. Surplus electrolyte will escape through the vent hole in the membrane cap below the elastomer seal. Do not hold the vent hole or press on the elastomer seal! If you detect air bubbles in the electrolyte, repeat the filling process. Wash away the escaped electrolyte with water.

NOTE: The membrane cap must be completely screwed to the electrode shaft so that no gap remains between membrane cap and electrode shaft. The sensor requires a one- to two-hour run in time before a first calibration can be performed. The final calibration should be done after one day.

2.3.1 Insert Membrane Sensor Into Flow Block Assembly

Position the sensor through the flow block cap such that the sensor body touches the bottom of the water inlet assembly. The water flow should point directly to the membrane. It may be necessary to turn the flow block cap to find the correct position for the sensor in the water inlet assembly. Remove any air bubbles from the membrane as they disturb the measurement. Connect the sensor cables to the electronic module.

Under these conditions the sensor should give proper readings for three to six months.

For connection to the Depolox® 3 *plus* electronics, refer to Dwgs. 50.560.155.020.

The sensor requires a one to two hour run in time before a first calibration can be performed. The final calibration should be done after one day.

2.4 pH Sensor

NOTE: This is required for pH-compensated Free chlorine measurement when used with the Bare Electrode Cell.

To insert the pH sensor into the flow block assembly, remove the cap from the pH sensor, attach the impedance transformer (if required) to the top of the sensor, connect the cable to the impedance transformer (or probe if not used), and put the sensor into the smaller hole in the flow block assembly cover or standalone wetside.

The cable for the pH and Fluoride probe is pre-attached to the dual electronics unit. Connect cable end to probe. No additional wiring is required.

2.5 Fluoride Sensor Kit

To insert the fluoride sensor into the flow block assembly, prepare the sensor as described in paragraph 3.6.2, Preparation of the Electrode.

Connect the end of the sensor cable to the impedance transformer, attach the cable to the other side of impedance converter, add electrolyte to the sensor (if required), and place the sensor into the hole in the flow block assembly cover or standalone wetside.

The cable for the pH and Fluoride probe is pre-attached to the dual electronics unit. Connect cable end to probe. No additional wiring is required.

2.6 Flow Switch (Optional) (Depolox® 3 *plus* Wet Side Only)

In general, the flow switch is only connected to the digital input of the Depolox® 3 *plus*. In case of other applications, ensure that the rating of this Reed contact (100 V AC and 0.5 A) is not exceeded even for a short time. In case inductive loads (e.g., relays or contactors) are switched, the contact has to be protected against induction sparks.

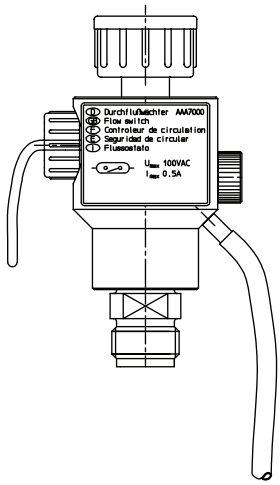


Figure 2.3 - Flow Switch

See Dwgs. 50.560.100.020 and .030 for flow switch location.

2.7 Stop Valve (Optional) (Depolox® 3 *plus* Wet Side Only)

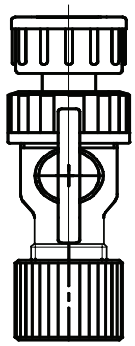
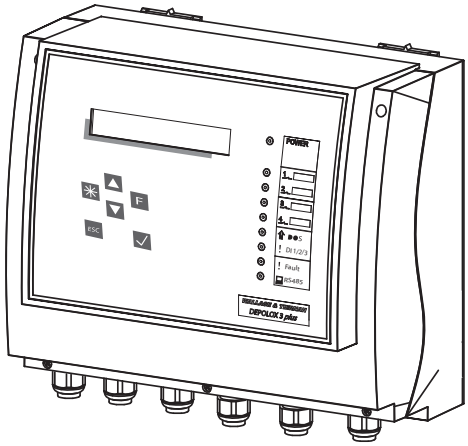
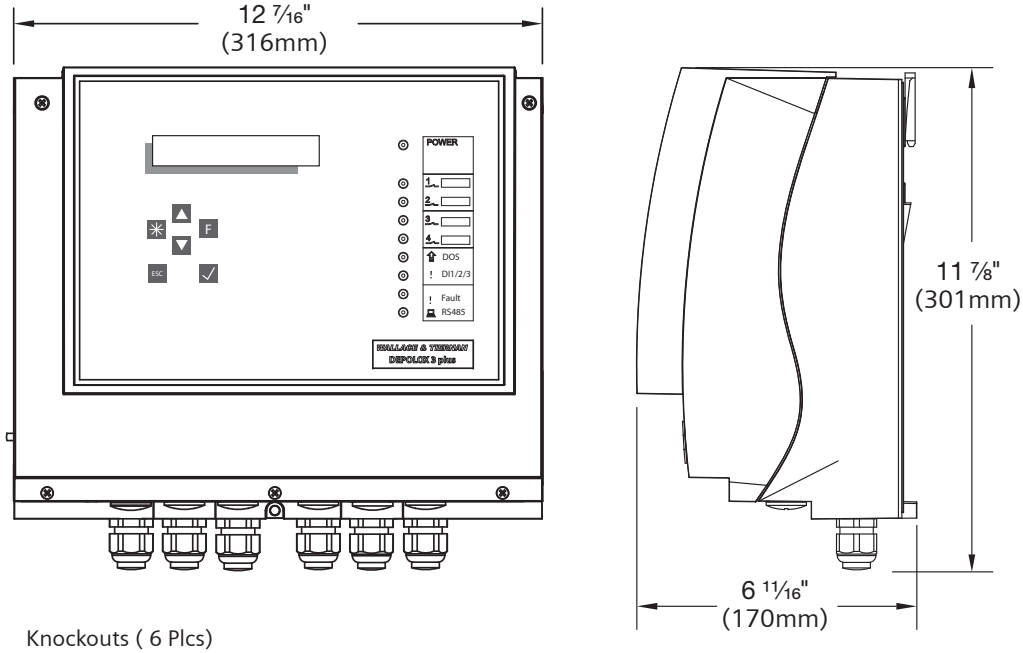
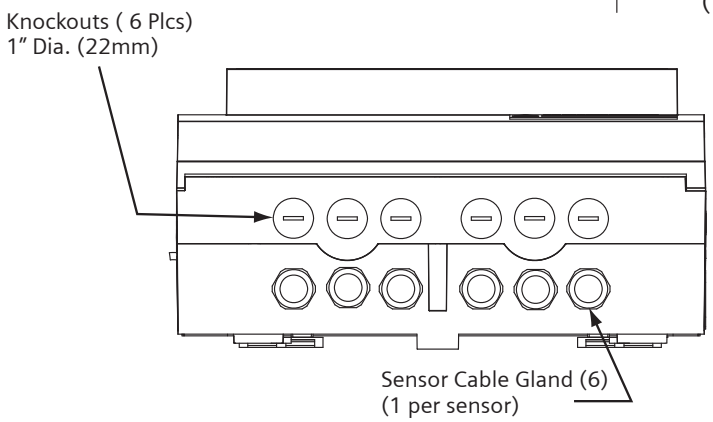


Figure 2.4 - Stop Valve

See Dwgs. 50.560.100.020 and .030 for stop valve location.



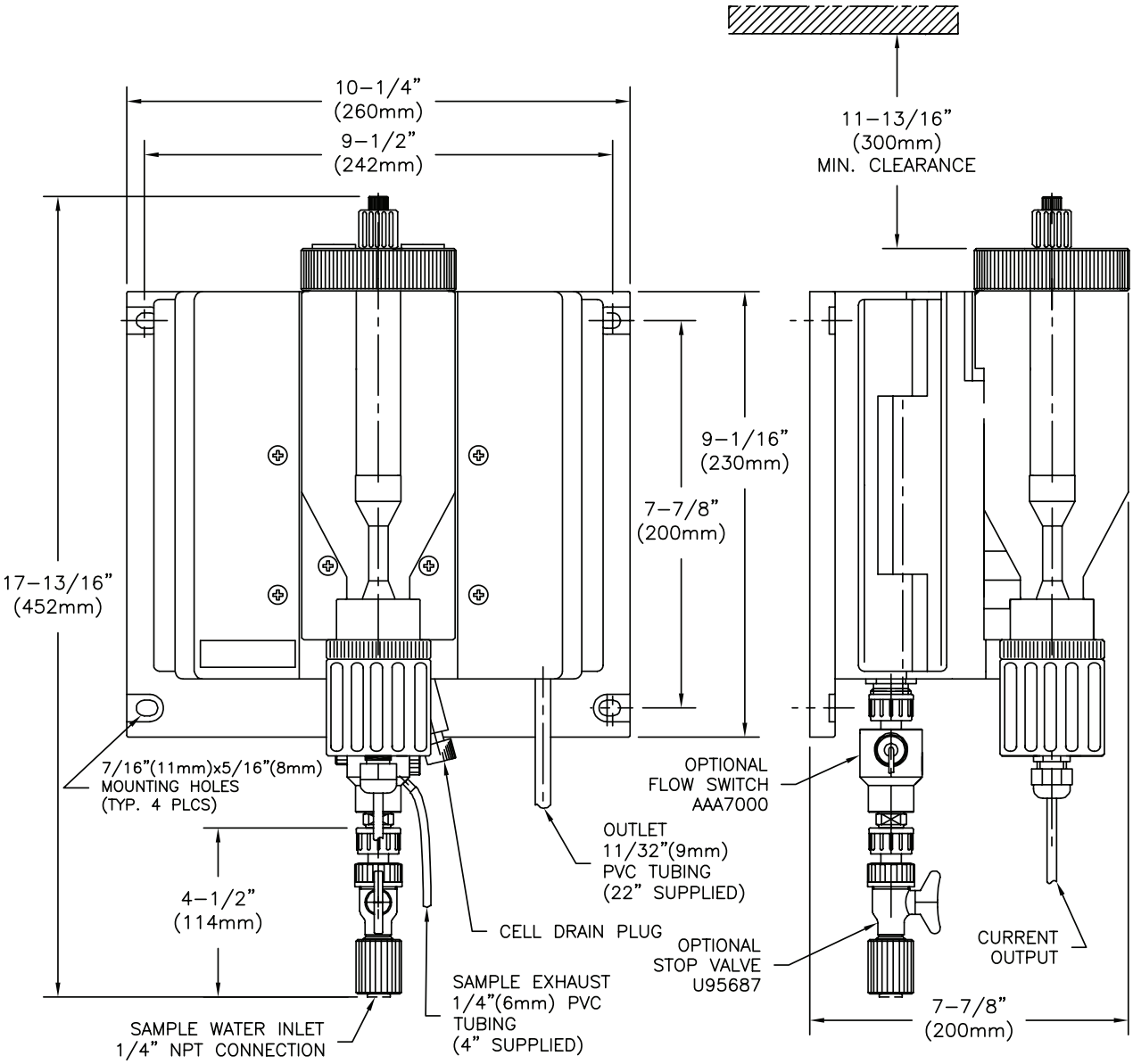




DEPOLOX® 3 *plus* ELECTRONIC MODULE - DIMENSIONS

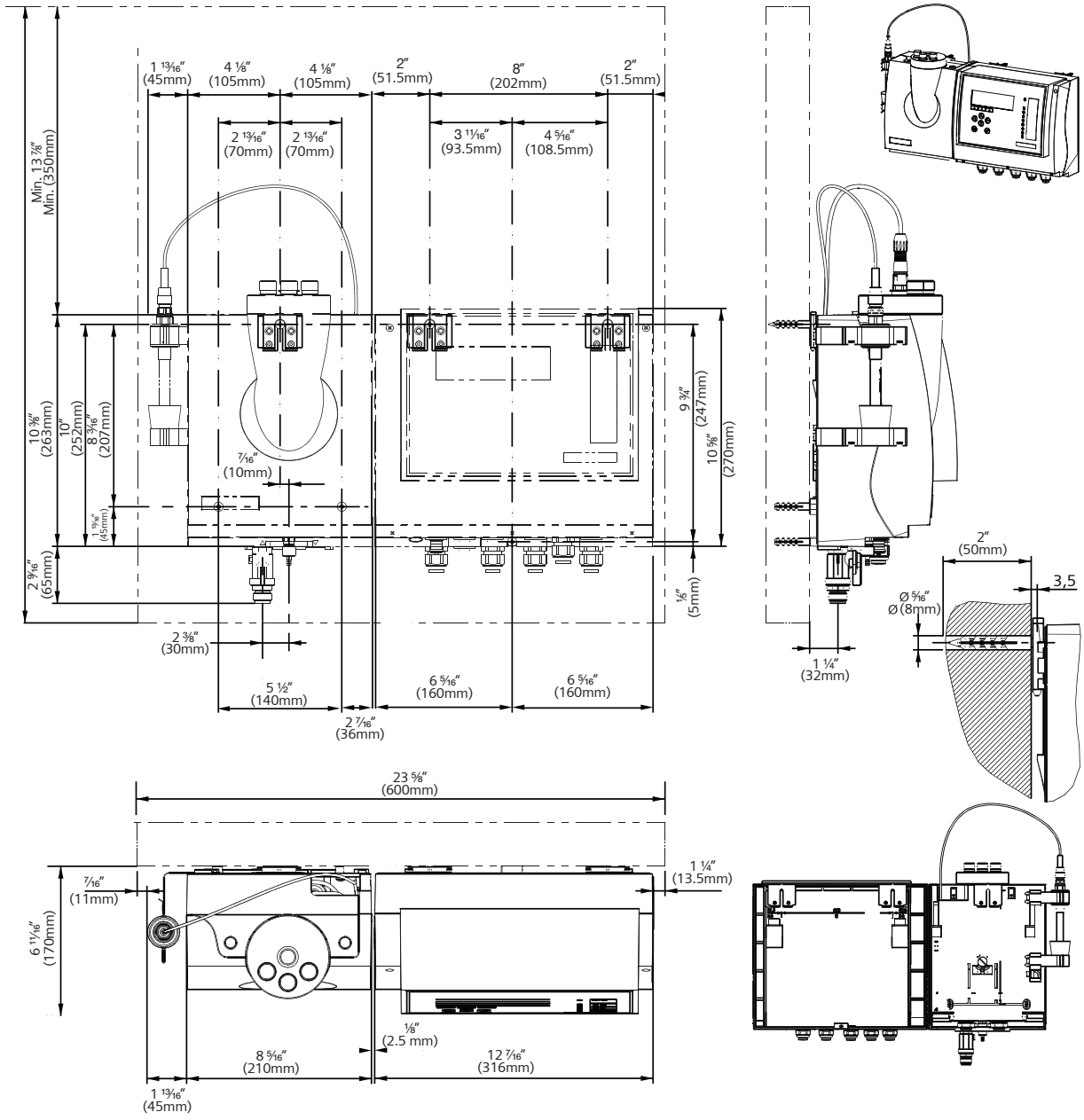
50.560.100.010

ISSUE 2 7-14



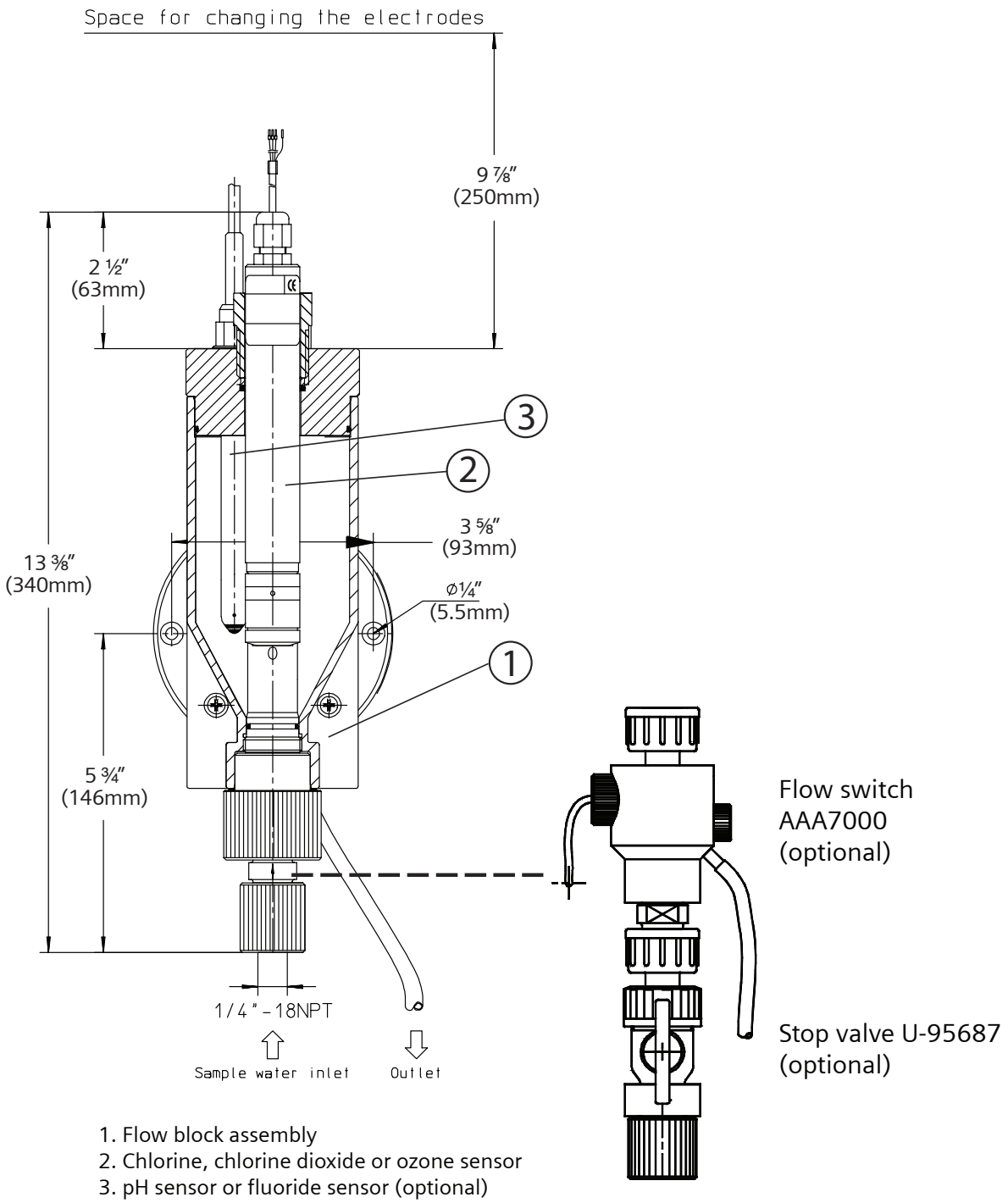
W2T9694 DEPOLOX® 3 *plus* BARE ELECTRODE MEASURING CELL - DIMENSIONS
(With PT 100 Temperature Sensor)

50.560.100.020
ISSUE 4 7-14



W2T7957 DEPOLOX® 5 BARE ELECTRODE MEASURING CELL - DIMENSIONS
(With PT 1000 Temperature Sensor)

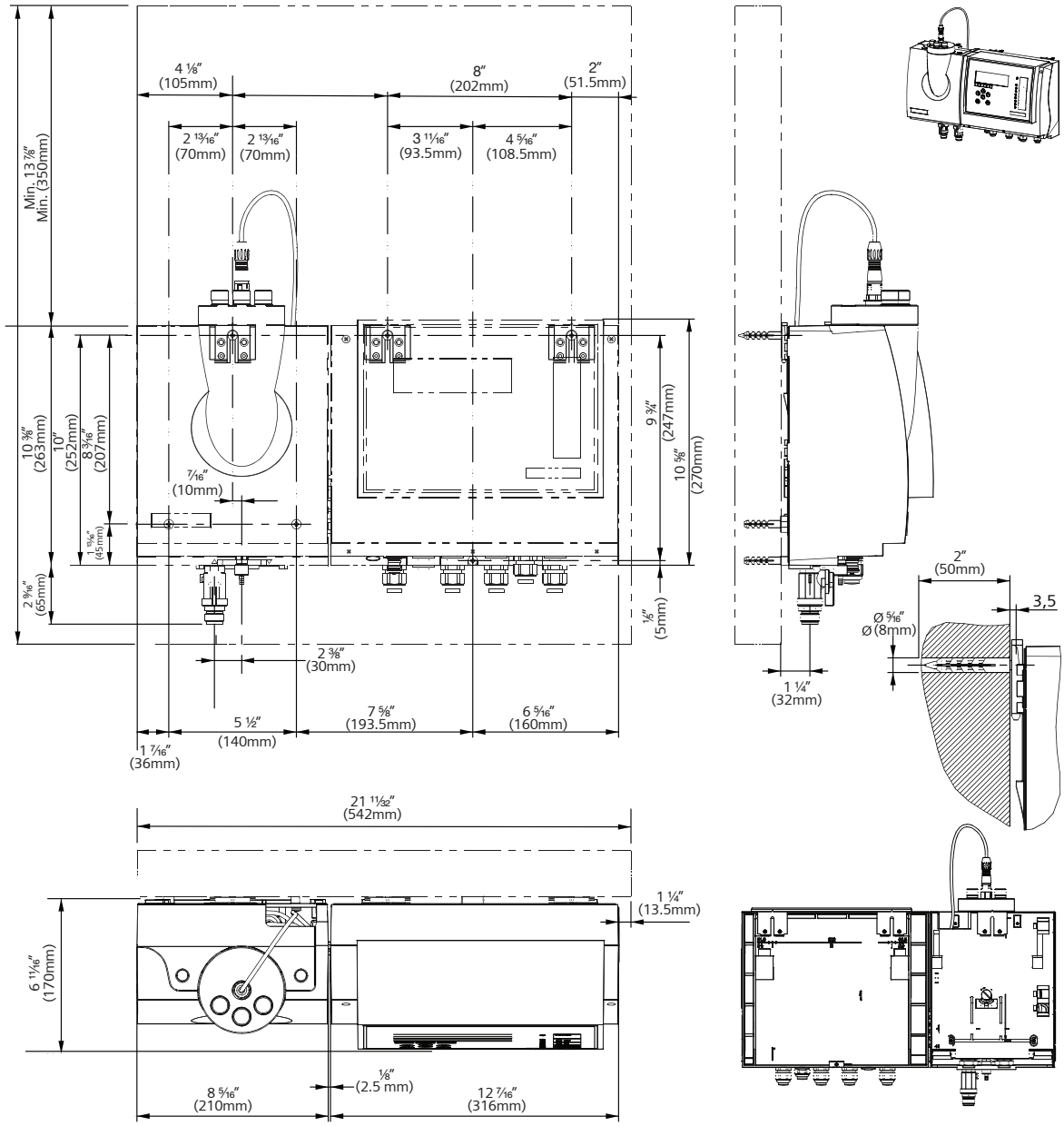
50.560.100.050
ISSUE 2 8-10



1. Flow block assembly
2. Chlorine, chlorine dioxide or ozone sensor
3. pH sensor or fluoride sensor (optional)

W2T9681 DEPOLOX® 3 *plus* MEMBRANE MEASUREMENT PACKAGE - DIMENSIONS
Sensors & Flow Block Assembly

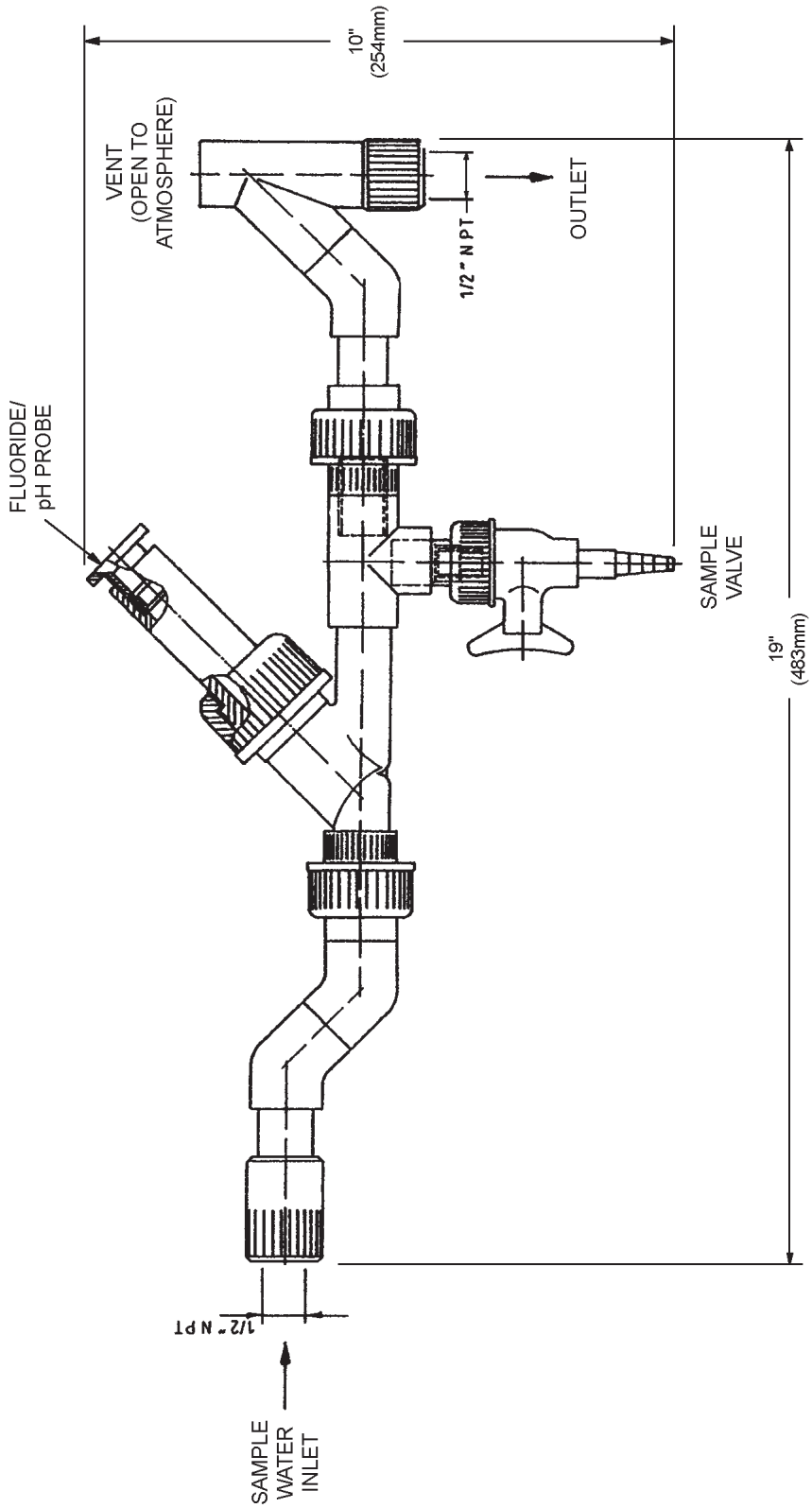
50.560.100.030
ISSUE 5 7-14



W2T7958 VARIASENS™ MEMBRANE MEASURING CELL - DIMENSIONS

50.560.100.060

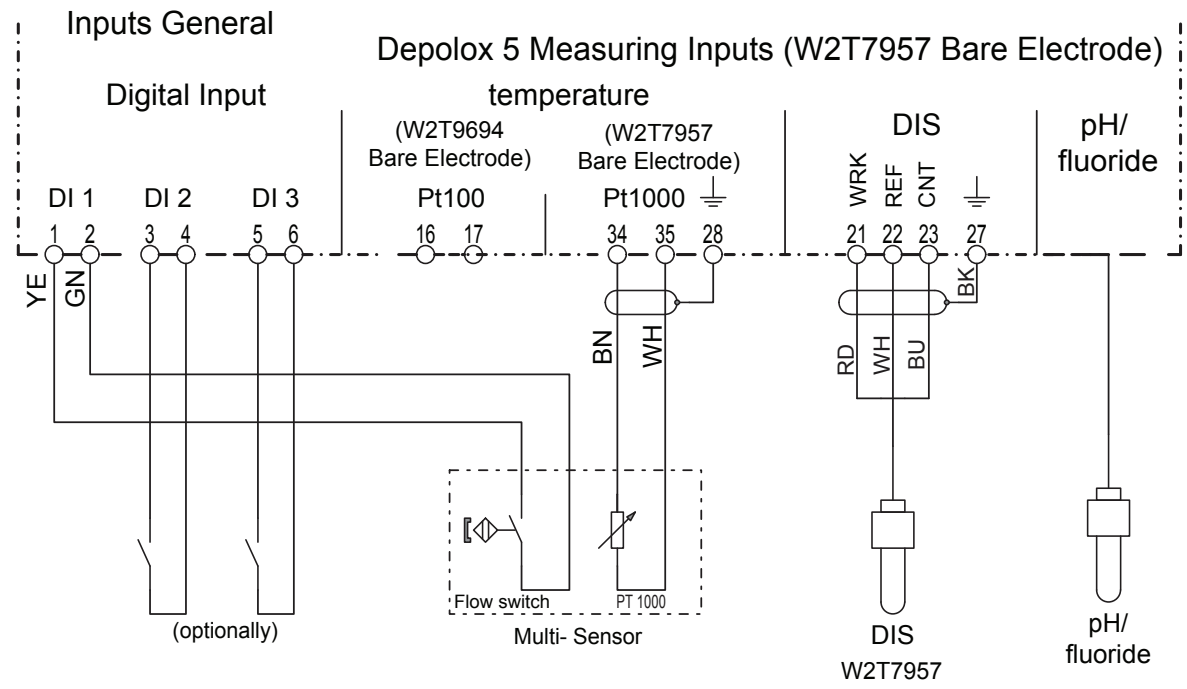
ISSUE 2 8-10

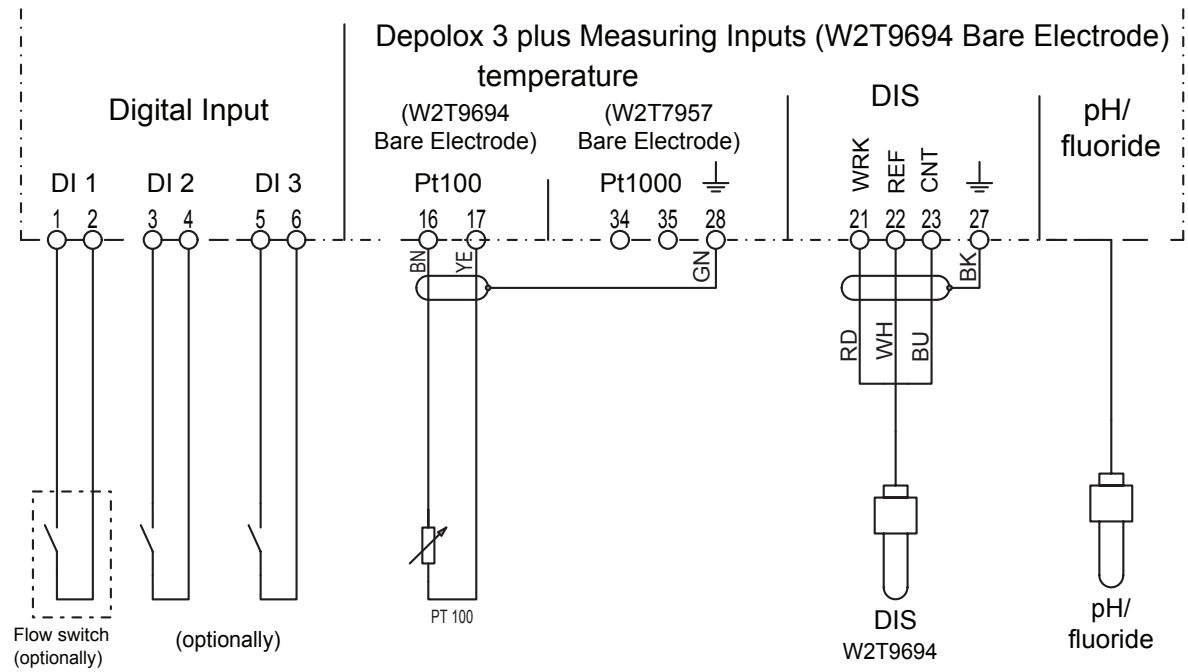


W2T12125 FLUORIDE/pH STANDALONE WETSIDE - DIMENSIONS

50.560.100.040

ISSUE 2 7-10





NOTE: FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

Depolox® ANALYZERS WITH BARE ELECTRODE SENSOR KIT - WIRING

50.560.155.010

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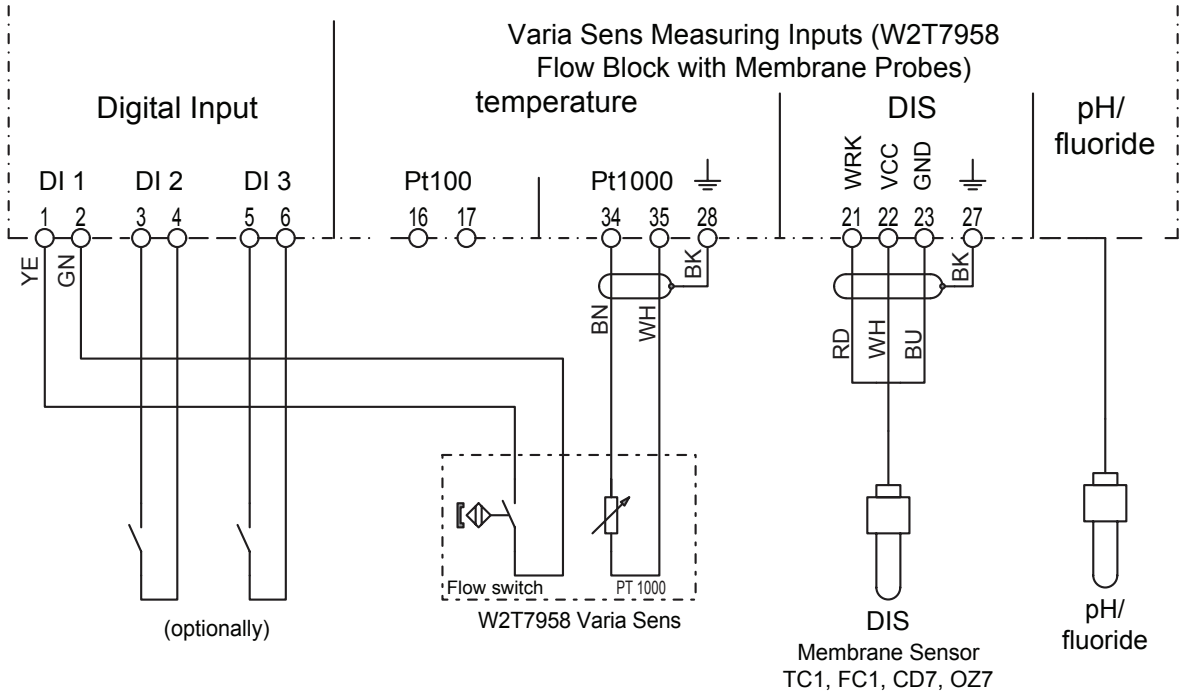
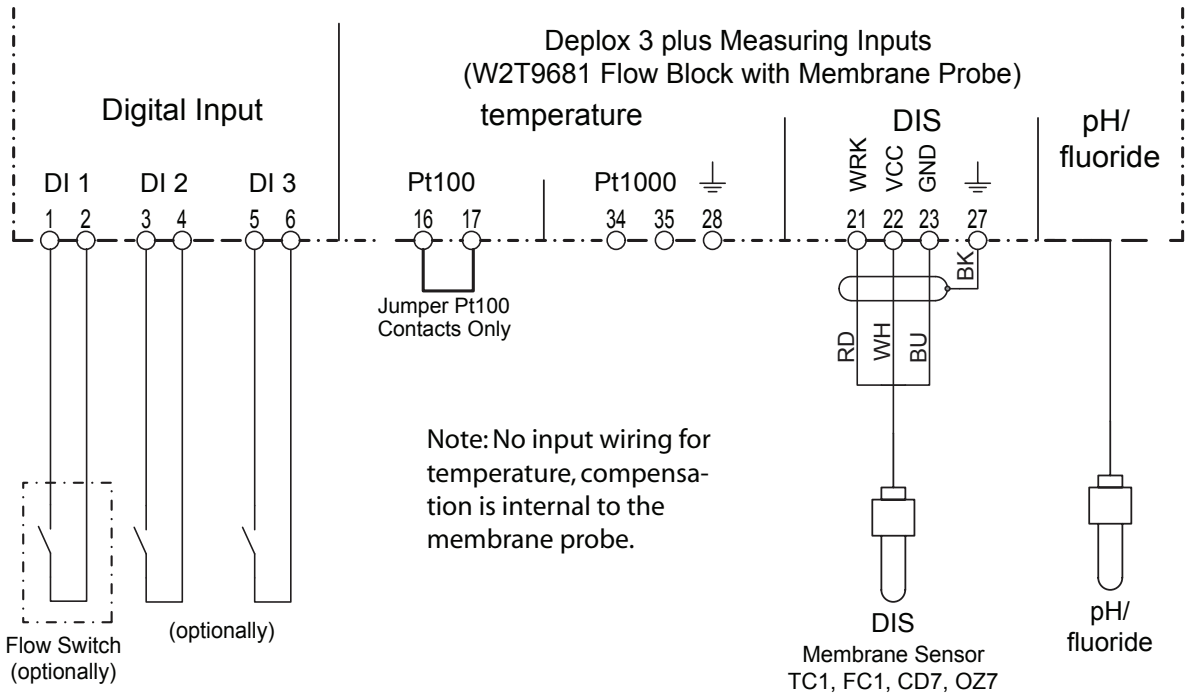


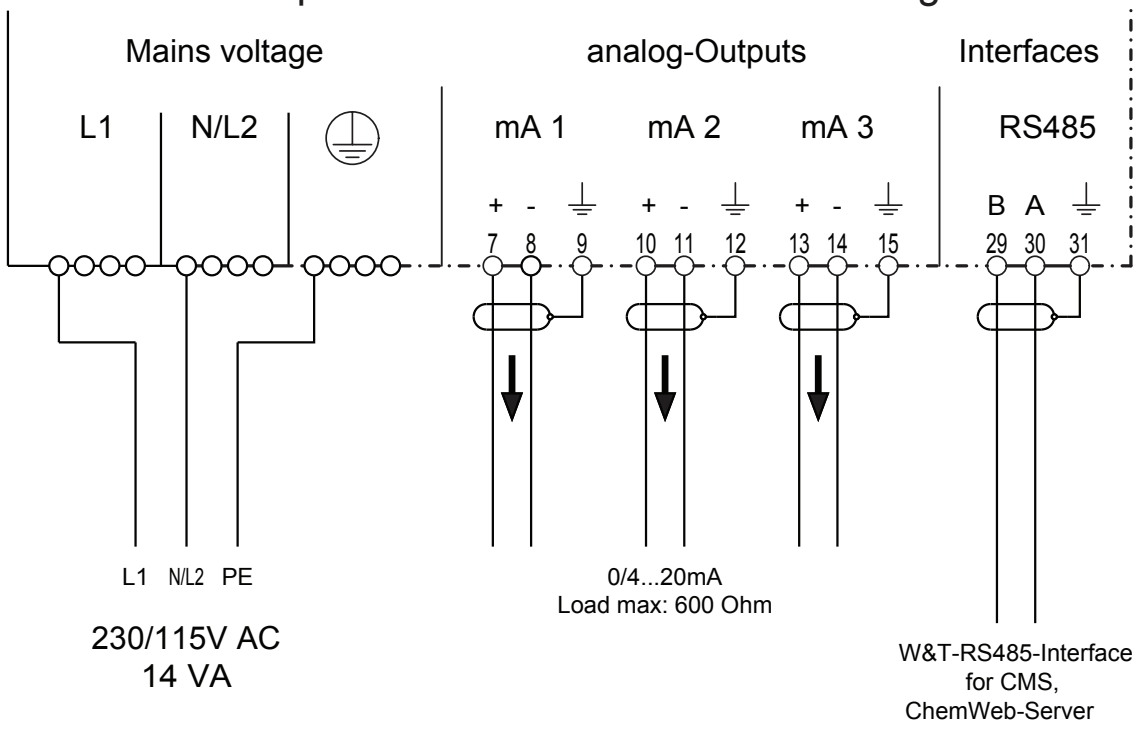


NOTE: FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

Depolox® ANALYZERS WITH MEMBRANE SENSOR KIT - WIRING

50.560.155.020
ISSUE 5 7-14

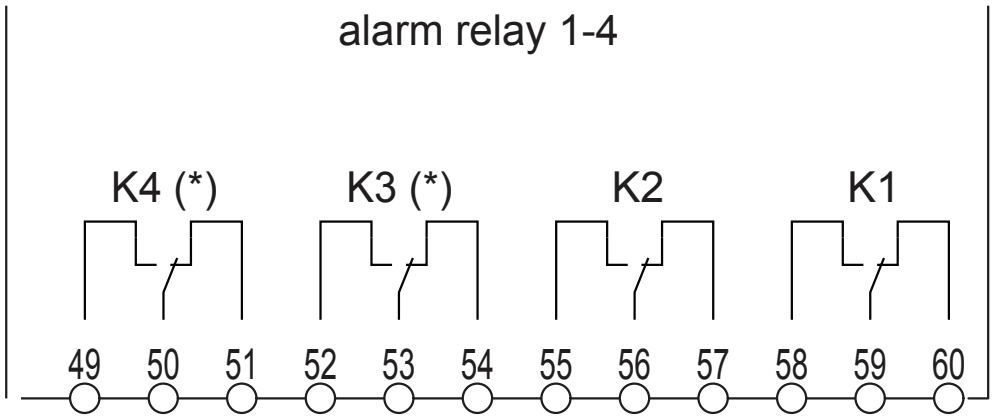
Depolox 3 Plus Main and mA - Wiring



NOTE: When mA outputs are activated, all three outputs are active.
Install jumper across "+" and "-" terminals of any unused output.

---

alarm relay 1-4



(*) only on dual electronics

NOTE: FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

Depolox® 3 *PLUS* - ALARM RELAY CONNECTIONS; MAIN AND mA - WIRING

50.560.155.050
ISSUE 4 7-14

SECTION 3

SECTION 3 - OPERATION

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3.1 Depolox® 3 *plus* - Operation

3.1.1 General Description

The Depolox® 3 *plus* module is a microprocessor-controlled electronic amplifier for the measurement of Disinfectants, and/or for pH value or fluoride in water.

The built-in RS485 interface can be used to transfer the measured values and operating modes to a PC or SCADA system.

3.1.2 Display and Keypad

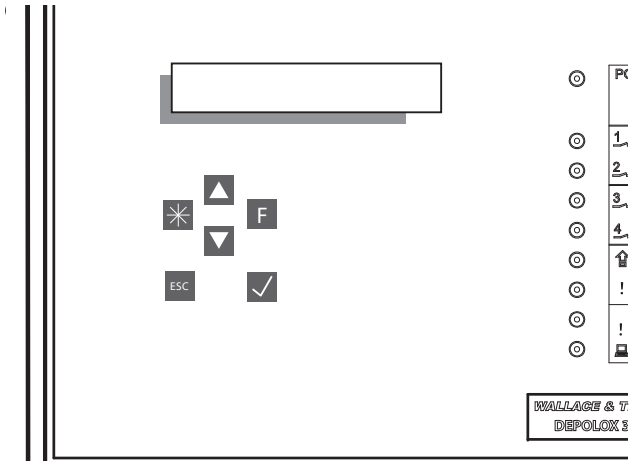


Figure 3.1 - Display and Keypad

3.1.2.1 Keypad Functions

ACKNOWLEDGE ALARM - De-energize the alarm relays (this does not reset the alarm message)

ESCAPE - Terminate input without saving new value. Jump back to the menu title and return to basic display by pressing the key once more.

UP ARROW - Skip one level upwards, increase value or display previous option.

DOWN ARROW - Skip one level downwards, reduce value or display next option.

Display next menu (jump from menu title to menu title)

ENTER - change into change mode (“>” is displayed before the value), - save new setting.

NOTE: Check that any alterations have been ENTERED before exiting the menu. Protect the menus from unauthorized operation with a code number of your choice (1 to 999) (refer to paragraph 3.1.3, Code Number).

Press the keypads only with the fingers, do not use hard or pointed objects like pencils, etc., as these could damage the sealed keypad.

3.1.2.2 Selecting the Menus

- From the basic display, access to the other menu paths is achieved by pressing the **F** key.
- Sub menus are accessed using the keys ▲ and ▼. To exit from a sub menu to a main menu and then to the basic display press the **ESC** key.

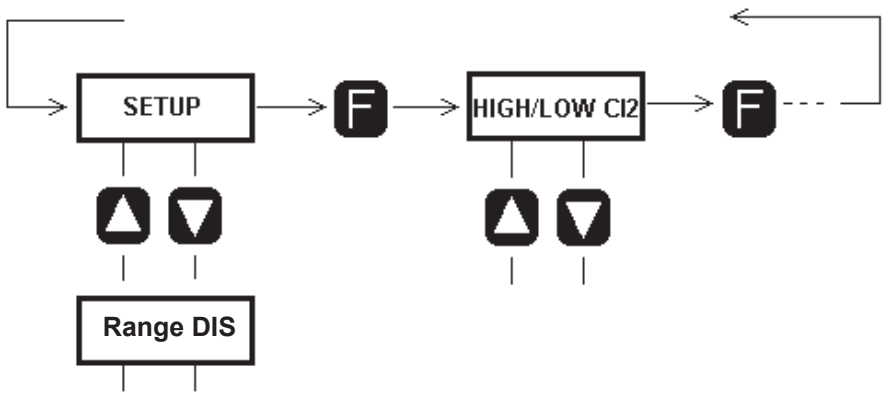


Figure 3.2 - Menu Selection

3.1.2.3 Changing the Settings

a. Select the menu to be changed.

b. Press the ✓ key, “>” is displayed.

c. Using the arrow keys increase or decrease the value or skip to the next selection.

d. Store the changed setting by pressing the ✓ key.

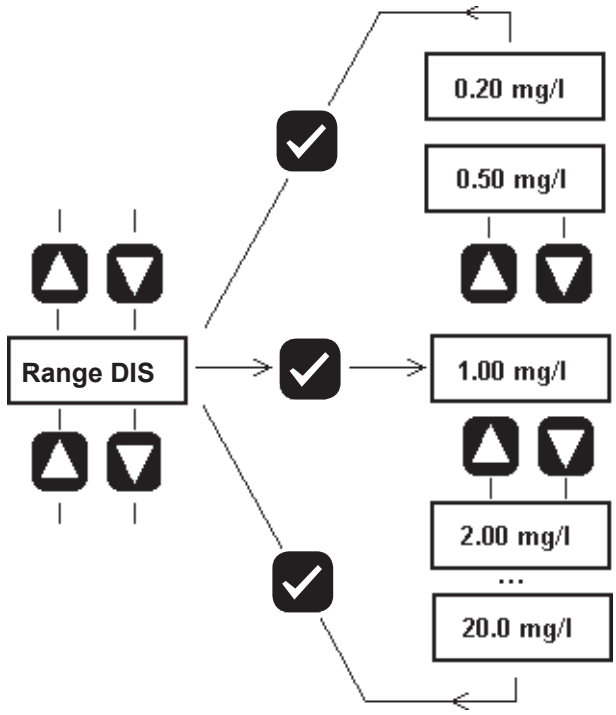


Figure 3.3 - Setting Changes

As long as the new value has not been stored by pressing the ✓ key, pressing the **ESC** key will return to the former setting. Select the next menu to be accessed with the arrow keys ▲ and ▼.

3.1.3 Menu Summaries

These summaries contain all menus of the respective versions. Depending on the setting a few menus are not necessary and therefore not displayed.

Table 3.1 - Menu List / Disinfection Only

ROOT	CALIBRATION	HIGH/LOW	ALARM RELAY 1/2	ALARM RELAY 3/4	SETUP	SETUP mA	SIGNAL DIAG.	SYSTEM DIAG.
DIS Value	DIS zero *	DIS min	Relay Assign 1	Relay Assign 3	Range DIS	mA Output	Cell DIS	Keypad Test
Temperature*	DIS span	DIS max	Relay Function 1	Relay Function 3		mA 1 Assign	Temperature *	Display Test
Menu Extend		DIS setpoint	Relay Delay 1	Relay Delay 3		mA 2 Assign		System Reset
		DIS deadband	Relay Assign 2	Relay Assign 4	Code Definition	mA 3 Assign	mA Out 1	System Shutdown
			Relay Function 2	Relay Function 4	Hold Function		mA Out 2	RS485
			Relay Delay 2	Relay Delay 4	Language		mA Out 3	Software Release
					RS485 addr. DIS		Local Operation	
					DIS Sensor		Rel.: 1 2 3 4	
					Select		DI: 1 2 3	
					Temperature		VF Conv. 1	

* Bare Electrode only.

Table 3.2 - Menu List / Disinfection + pH

ROOT	CALIBRATION	HIGH/LOW DIS	ALARM RELAY 1/2	ALARM RELAY 3/4	SETUP	SETUP mA	SIGNAL DIAG.	SYSTEM DIAG.
DIS Value	DIS zero*	DIS max.	Relay Assign 1	Relay Assign 3	Range DIS	Cal. code	Cell DIS	Keypad Test
pH Value	DIS span	DIS min.	Relay Function 1	Relay Function 3	Range pH	Cal. DIS 4mA	pH sensor	Display Test
Temperature	Offset pH	DIS Setpoint	Relay Delay 1	Relay Delay 3	Code Definition	Cal. DIS 20mA	Temperature	System Reset
Menu Extent	Calibr. at pH 7.00	DIS Deadband	Relay Assign 2	Relay Assign 4	Hold Function	Cal. pH 4mA	mA Out 1	System Shutdown
	Calibration pH	pH max.	Relay Function 2	Relay Function 4	Language	Cal. pH 20mA	mA Out 2	RS485
	Calibration Temp.	pH min.	Relay Delay 2	Relay Delay 4	RS485 addr.	mA output	mA Out 3	Software Release
		pH Deadband			DIS Sensor	mA 1 Assign.	Local Operation	
					Select (pH)	mA 2 Assign.	Rel.: 1 2 3 4	
					Mode Cl2 free*	mA 3 Assign.	DI: 1 2 3	
					Temperature		VF Conv. 1	
							VF Conv. 2 *	
							VF Conv. 3 (temp)	

* Bare Electrode only.

Table 3.3 - Menu List / Disinfection + Fluoride

ROOT	CALIBRATION	HIGH/LOW	ALARM RELAY 1/2	ALARM RELAY 3/4	SETUP	SETUP mA	SIGNAL DIAG.	SYSTEM DIAG.
DIS Value	DIS zero*	DIS max.	Relay Assign 1	Relay Assign 3	Range DIS	mA Output	Cell DIS	Keypad Test
	DIS span	DIS min.	Relay Function 1	Relay Function 3	Code Definition	mA 1 Assign	Fluor Sensor	Display Test
Fluor Value		DIS Setpoint	Relay Delay 1	Relay Delay 3	Hold Function	mA 2 Assign	Temperature	System Reset
Temperature	Fluor offset	DIS Deadband	Relay Assign 2	Relay Assign 4	Language	mA 3 Assign	mA Output 1	System Shutdown
Menu Extend	Fluor zero	Fluor max.	Relay Function 2	Relay Function 4	RS485 addr.		mA Output 2	RS485
	Fluor span	Fluor min.	Relay Delay 2	Relay Delay 4	DIS Sensor		mA Output 3	Software Release
	Calibration Temp	Fluor Deadband			Select (Fluoride)		Local Operation	
					Temperature		Rel.: St:	
							Di: St:	
							VF Conv. AE1	
							VF Conv. AE2	
							A/D AE3	

* Bare Electrode only.

3.1.3.1 Display Menu

Display	Value Range (defaults bold)	Description
Free Chlorine **0.00mg/l**	range	**1. measurement with unit and sensor type** Free Chlorine Total Cl_2 TC1 Free Cl_2 FC1 Ozone OZ7 Chlorine Dioxide
pH-value **7.00pH** or **Fluor** **0.00mg/l**	range	**2. measurement with unit** selectable between pH or fluor measurement
Temperature **20°C**	range	**3. measurement with unit**
menu	short **long**	**menu length** - short menu; only main display and calibration is shown - leng menu: all menus are shown
Code	**000** 999	**Code** input of the code number Only if this value is the same as defined in “Code-Def.” - menu, you can adjust settings. If not the error message “code ???” is shown. This menu only appears if the user code is not 000.

3.1.3.2 Calibration Menu

Display	Value Range (defaults bold)	Description
CALIBRATION		**Calibration-Menu** All calibration settings take place via this menu path.
DIS zero	range	**Disinfection - zero adjustment** Pressing the Check-button sets the disinfection reading to zero.
DIS span	range	**Disinfection - span adjustment** You put in the result of the Comparison measurement to calibrate the disinfection span.
offset pH	-1.00 pH +1.00 pH **0.00 pH**	**pH-Offset-Adjustment** (only in case of pH-selection) This value is added to the actual pH reading.
calibr. at pH7	range	**pH-Calibration** (only in case of pH-selection) First point of the pH-calibration.
calibration pH	range	**pH-Calibration** (only in case of pH-selection) Second point of the pH-calibration.
offset fluor	-1.00 mg/l +1.00 mg/l **0.00** mg/l	**Fluoride-Offset-Adjustment** (only in case of fluoride-selection) This value is added to the actual fluoride reading.
Fluor zero	range	**Fluoride-Calibration** (only in case of fluoride-selection) First point of the fluoride-calibration (two point calibration).
Fluor span	range	**Fluoride-Calibration** (only in case of fluoride-selection) Second point of the fluoride-calibration (two point calibration).
calibration temp	**20.0°C** -5.0°C +5.0°C	**Calibration of sample water temperature** You can adjust the reading of the sample water measurement (-5...+5°C).

3.1.3.3 High/Low Menu

Display	Value Range (defaults bold)	Description
HIGH/LOW		**High/Low - Limits**
DIS max	range **0.80 mg/l**	**Max. limit-value for the disinfection measurement**
DIS min	range **0.10 mg/l**	**Min. limit-value for the disinfection measurement**
DIS setpoint	range **0.10 mg/l**	**Dosing contact**
DIS deadband	1 Digit 25 Digit **3 Digit**	**Deadband for the disinfection limits**
pH max	range **7.80 pH**	**Max. limit-value for the pH measurement** (only in case of pH-selection)
pH min	range **6.80 pH**	**Min. limit-value for the pH measurement** (only in case of pH-selection)
pH deadband	1 Digit 25 Digit **3 Digit**	**Deadband for the pH limits** (only in case of pH-selection)
Fluor max	range **2.00 mg/l**	**Max. limit-value for the fluoride measurement** (only in case of fluoride-selection)
Fluor min	range **0.20 mg/l**	**Min. limit-value for the fluoride measurement** (only in case of fluoride-selection)
Fluor deadband	1 Digit 25 Digit **3 Digit**	**Deadband for the fluoride limits** (only in case of fluoride-selection)

3.1.3.4 Alarm Relay 1/2 Menu

Display	Value Range (defaults bold)	Description
ALARM RELAY 1/2		**Definitions for alarm realy 1 and 2**
relay assign. 1	DIS max DIS min pH max pH min Fluor max Fluor min DI1 DI2 DI3 gen. fault dosing cont.	**Assignment for alarm relay 1** (multiple selection possible)
realy function 1	**N.O. unlatched** N.C. unlatched N.O. latched res N.C. latched res N.O. latched ack N.C. latched ack	**Operation mode and function for alarm relay 1** N.O.: normally open N.C.: normally closed unlatched: relay not latching latched res.: latching, reset latched ack.: latching, reset with acknowledge (not visible when dosing contact is selected)
relay delay 1	**0 min** 600 min	**Delay time for alarm relay 1** (not visible when dosing contact is selected)
relay assign. 2	DIS max DIS min pH max pH min Fluor max Fluor min DI1 DI2 DI3 gen. fault	**Assignment for alarm relay 2** (multiple selection possible)
realy function 2	N.O. unlatched N.C. unlatched N.O. latched res N.C. latched res N.O. latched ack N.C. latched ack	**Operation mode and function for alarm relay 2** N.O.: normally open N.C.: normally closed unlatched: relay not latching latched res.: latching, reset latched ack.: latching, reset with acknowledge
relay delay 2	**0 min** 600 min	**Delay time for alarm relay 2**

3.1.3.5 Alarm Relay 3/4 Menu

Display	Value Range (defaults bold)	Description
ALARM RELAY 3/4		**Definitions for alarm realy 3 and 4**
relay assign. 3	DIS max DIS min pH max pH min Fluor max Fluor min DI1 DI2 DI3 gen. fault	**Assignment for alarm relay 3** (multiple selection possible)
realy function 3	**N.O. unlatched** N.C. unlatched N.O. latched res N.C. latched res N.O. latched ack N.C. latched ack	**Operation mode and function for alarm relay 3** N.O.: normally open N.C.: normally closed unlatched: relay not latching latched res.: latching, reset latched ack.: latching, reset with acknowledge
relay delay 3	**0 min** 600 min	**Delay time for alarm relay 3**
relay assign. 4	DIS max DIS min pH max pH min Fluor max Fluor min DI1 DI2 DI3 gen. fault	**Assignment for alarm relay 4** (multiple selection possible)
realy function 4	N.O. unlatched N.C. unlatched N.O. latched res N.C. latched res N.O. latched ack N.C. latched ack	**Operation mode and function for alarm relay 4** N.O.: normally open N.C.: normally closed unlatched: relay not latching latched res.: latching, reset latched ack.: latching, reset with acknowledge
relay delay 4	**0 min** 600 min	**Delay time for alarm relay 4**

3.1.3.6 Setup Menu

Display	**Value Range** (defaults bold)	Description
SETUP		**Setup-menu**
range DIS	0 - 0.20 mg/l 0 - 0.50 mg/l 0 - 1.00 mg/1 0 - 2.00 mg/l **0 - 5.00 mg/l** 0 - 10.0 mg/l 0 - 20.0 mg/l	**Range for the disinfection measurement**
range pH	**4 - 10.00 pH** 0 - 14.00 pH	**Range for the pH measurement**
code definition	**000** 999	**Definition of the lock code**
hold function	**on** off	**Hold-Function** If switched on, the readings of the measurements are frozen as long as you stay in the calibration (no peeks on the line recorder, no switching of the alarm relays).
language	german **english** french spanish	**Language of the menus**
RS485 address	00 31	**Bus address for RS485-Mode**
DIS-sensor	3-electr.system Membrane sensor TC1 FC1 OZ7 CD7 Off	**Selection of the connected disinfection sensor** Selection of membrane sensor or 3 electrode system (bare electrode) on the PCB with dip switches.
select	**pH** Fluor Off	**Selection of the second input sensor**
temperature	PT100 **PT1000** Off	**Selection of the used temperature sensor** Depolox® 3 *plus* - PT100, Depolox® 5 - PT1000, Membrane Probes - Off.
mode Cl2 free	**normal** pH compensated	**Selection of the calculation for the disinfection sensor** (only in case of 3-electr.system + pH + temperature on)

3.1.3.7 Setup mA Menu

Display	**Value Range** (defaults bold)	Description
SETUP mA		**Setup-Menu** (general setup, communication connections)
mA output	0 - 20 mA 4 - 20 mA **AUS**	**Mode of the mA-Outputs** AUS = Off
mA1-assign.	**DIS** pH Fluor temperature	**Assignment of the mA-output 1**
mA2-assign.	DIS **pH** Fluor temperature	**Assignment of the mA-output 2**
mA3-assign.	DIS pH Fluor **temperature**	**Assignment of the mA-output 3**

3.1.3.8 Signal Diagnosis Menu

Display	Value Range (defaults bold)	Description
SIGNAL DIAG.		**Signal Diagnosis Menu**
cell DIS	+3.5 µA 5µA/mg/l (1µA) 0 h	**Informations about the DIS-cell** With pressing the Check-Button, you can step between following informations: - actual reading of the cell current - calibration data (zero and span) - past hours since the last calibration
pH sensor	+59 mV 59mV/pH (+5mV) 0 h	**Informations about the pH-sensor** With pressing the Acknowledge-Button, you can step between following informations: - actual reading of the cell voltage - calibration data (zero and span) - past hours since the last calibration
fluor sensor	+59 mV 59mV/pH (+5mV) 0 h	**Informations about the fluor-sensor** With pressing the Acknowledge-Button, you can step between following informations: - actual reading of the cell voltage - calibration data (zero and span) - past hours since the last calibration
temperature	21.3° C (+2.7° C) 0 h	**Informations about the temperature measurement** With pressing the Acknowledge-Button, you can step between following informations: - actual reading of the uncalibrated temperature - calibration offset - past hours since the last calibration
mA output 1 **4 mA 0%**		**Informations about mA-output 1** The output value is shown in mA and in %
mA output 2 **4 mA 0%**		**Informations about mA-output 2** The output value is shown in mA and in %
mA output 3 **4 mA 0%**		**Informations about mA-output 3** The output value is shown in mA and in %
local operation	**normal** service	**Special mode for system service** Relay outputs are frozen in non-alarm states. mA output is frozen. Analyzer will not return to main display. Operating mode is automatically set to normal when leaving the diagnostics menu group or cycling power.

Signal Diagnosis Menu (Cont'd)

Display	Value Range (defaults bold)	Description
REL: 1 2 3 4 **St: 1 0 0 0**		**Informations about the relay status** 1: alarm relay 1 (0: unpowered/1: powered) 2: alarm relay 2 3: alarm relay 3 4: alarm relay 4 Press Enter and then the up or down arrow to select the relay, to change the relay state for testing press Enter. After leaving this menu the relay goes back to previous state.
DI: 1 2 3 **St: 1 0 0**		**Informations about the digital status** 1: digital input 1 0: closed (inactive) 2: digital input 2 1: open (active) 3: digital input 3
VF Conv. AE1 **14.07 kHz**		**Actual measurement of the input 1** (disinfection)
VF Conv. AE2 **14.07 kHz**		**Actual measurement of the input 2** (pH or fluoride)
A/D (PT1000) AE3 **356 Digit** **or** **A/D (PT100) AE3** **356 Digit**		**Actual measurement of the input 3** (temperature)

3.1.3.9 System Diagnostics Menu

Display	Value Range (defaults bold)	Description
SYSTEM DIAG.		**System Diagnosis Menu**
keypad test	press Acknowl. press Up press Down press Star press ESC press F	**Test of all buttons of the keypad**
display test		**Test of the display** All dots of the matrix display are on.
system restart	**no** yes	**Restart of the system (RESET)**
system shutdown	**no** yes	**Shutdown the system** All functions are disabled, only a dot is shown in the display. Wakeup is initialized with pressing any button.
RS485		**Informations about the RS485 Communication** A valid communication on the RS485 interface is shown with the message “RxD”, “TxD” and INT”.
softwarerelease	V: 1.00 19.JUL.2006 EAE1053 FRG 49	**Informations about the internal software release** Alternating display

3.1.4 Code Number

To protect the settings against unauthorized access or an inadvertent change, the settings should be locked using a freely selectable code number. The settings can be displayed, but not changed. If an attempt is made, then “Code???” is displayed before reverting to the former setting.

After switching on, after a RESET or generally after one hour without pressing a key, the code number is set to 0. If the unit is locked, settings can only be changed after entry of the correct code number. Locking can be selected in the “Lock Setting” menu.

To alter the number again, enter the new code number in the SETUP menu under “Lock code set”. If you then want to block access to unauthorized operators, immediately change the code in the SETUP menu to another number and set to “Locked” in the “Lock Setting menu”.

In order to provide general access, select “Unlocked”. This means that changes are possible at any time without having to enter a code. Code is no longer displayed in the main menu. However, another code number can now be entered and access denied to all those operators who do not know the new number.

The unit is delivered with the “Lock code set” = 0, “Lock setting” = Unlocked. If the code number is forgotten enter the back entry code 911.
You can only alter the values in the protected menus once you have set the correct code number in the SETUP menu and thus proved that you are an authorized operator.

3.1.5 High - Low Alarms

The Depolox® 3 *plus* has independent alarms that can be allocated to the measured values for chlorine (and optionally for pH or fluoride).

Menu Setting	Alarm Condition	Action
High	X ≥ alarm value	alarm message on
	X ≤ (alarm value - deadband)	alarm message off
Low	X ≤ alarm value	alarm message on
	X ≥ (alarm value - deadband)	alarm message off

The deadband can be set in the range of one to 25 digits.

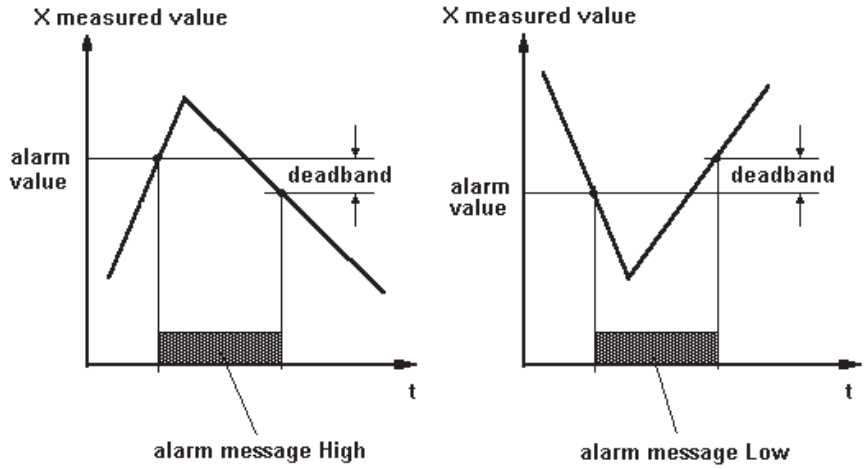


Figure 3.4 - High / Low Alarms

3.1.6 Alarm Relays

Depolox® 3 *plus* features the following alarm relays:

- Two relays in single electronics unit.
- Four relays in dual electronics unit.

Definitions for switching the relays:

DIS max:	relay reacts to the set value
DIS min:	relay reacts to the set value
pH max:	relay reacts to the set value
pH min:	relay reacts to the set value
Fluor max:	relay reacts to the set value
Fluor min:	relay reacts to the set value
DI1, DI2, DI3:	relay is activated as long as there is a signal on the digital input
general fault:	relay is activated as long as there is an alarm message
dosing contact:	relay is energized as long as the actual value is below the setpoint (for relay 1 only)

Selections:

normally open (N.O.):	relay is energized in case of an alarm.
fail safe (N.C.):	relay is de-energized in case of an alarm
non latching:	relay is de-energized as soon as the alarm condition has ceased
latching:	relay stays energized after the alarm until the star key "✳" is pressed to acknowledge the alarm

3.1.7 Dosing Contact for Chlorine

The chlorine alarm relay 1 can be used to switch-on a pump or solenoid valve for dosing chlorine.

The relay is energized if "AR 1 Definition" is set to "dosing contact" and the actual value is < setpoint.

3.1.8 mA Outputs

For each sensor there is an mA current signal output (e.g., for connecting an additional display). The range fixed at 4...20mA corresponds to the measuring range. For example, for a Membrane range of 0 to 5 mg/l:

0 mg/l: 4 mA
5 mg/l: 20 mA

The signal that is output corresponds to the measured value. The connected impedance must not be higher than 1000 Ohm. Broken wires or open mA loops will be detected.

3.1.9 Restoring Factory Settings (Initialize)

If the instrument does not respond correctly to software adjustments or corrections, or if software or hardware conditions have changed significantly, the operator may restore factory settings to return the software to normal operating parameters by performing the following operation.

Remove power to the electronics. Return power, while pressing and holding the ✳ button until "INIT" appears, then release. Factory settings have now been restored.

NOTE: Restoring the factory settings does not guarantee correct operation and may produce a reduced accuracy, until calibration, if operation does occur.

3.2 Depolox® 3 *plus* - Calibration

3.2.1 Free Chlorine (W2T9694 and W2T7957 Bare Electrode) Calibration

When calibrating with the pH compensation option, note that the pH value must be calibrated or verified first so that the subsequent Cl_2 calibration is automatically adjusted by the correct pH value.

To achieve this, the prompt "pH correct, yes/no?" appears in the menu. When confirmed by "Yes," direct access is granted to chlorine calibration "Zero Calibration," below. If answered with "No," pH calibration follows.

NOTE: The relays and mA outputs follow the measured values. If necessary, switch off the alarm relays.

- Zero Calibration

  a. Starting from the basic display press the **F** key until the "CALIBRATION" menu is displayed. Press the ▼ key until the "Cl_2 zero" menu is found.

  b. Close the shut-off valve at the flow block assembly, stopping all flow to unit. Wait until the displayed value ceases changing.

  c. Press the ✓ key twice in order to set the display to "0.00".

  d. Go to the root menu. Display will be 0.00 mg/l

     In case of calibration error *Cal. Cl_2?*: Ensure that the sample water is completely stopped and repeat calibration. If the calibration er-

ror condition continues, it may be necessary to adjust the cell voltage Upot: Go to SIGNAL DIAG. and menu "Cl_2 cell current".

NOTE: New units are factory calibrated. No Upot adjustments are required on new units during initial calibrations.

If the display still does not read 0.00 mg/l after calibration, adjust the potentiometer Upot so that the displayed cell current is ±0.5 µA (turning clockwise reduces the current) (see Figure 3.5). The current will change very slowly. Wait one half hour and check again. Perform calibration again.

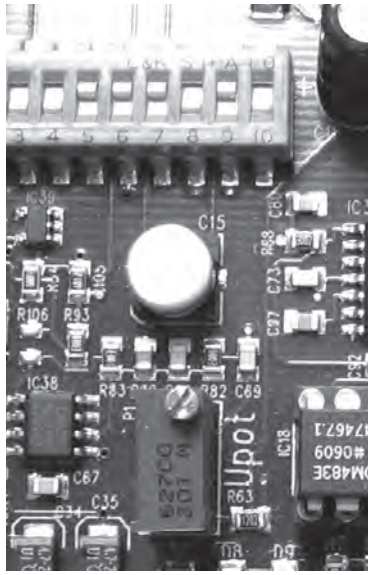


Figure 3.5 - Upot Adjustment

e. Let the sample water flow again.

NOTE: When there is no key pressed for five minutes, the Depolox® 3 *plus* returns to the basic display.

- Span calibration

a. After zero calibration wait at least two minutes. Then take a sample at the measuring cell. Determine the residual value of this sample.

b. Press the ▼ key until the menu "DIS span" is reached. Press the ✓ key to open the menu.

c. Press keys ▼ or ▲ until the displayed value agrees with the manually measured value.

d. Store the value using the ✓ key. The chlorine measuring cell is now calibrated. In case of an error message, refer to paragraph 4.1.1, Errors.

e. Return to the basic display by pressing the **ESC** key twice.

3.2.2 Membrane Sensor Calibration (All Membrane Types)

a. Take a sample at the measuring cell. Determine the residual value of this sample.

b. Starting from the basic display, press the **F** key until the "Calibration" menu is displayed.

c. Press the ▼ key until the menu "DIS span" is reached. Press the ✓ key to open the menu.

d. Press keys ▼ or ▲ until the displayed value agrees with the manually measured value.

e. Store the value using the ✓ key. The disinfectant measuring cell is now calibrated. In case of an error message refer to paragraph 4.1.1, Errors.

f. Return to the basic display by pressing the **ESC** key twice.

3.2.3 pH Calibration

NOTE: pH measurement is optional.

WARNING: DO NOT CONTINUE TO USE BUFFER SOLUTIONS AFTER USE-BY DATE. BUFFER SOLUTIONS THAT HAVE BEEN OPENED CAN ONLY BE KEPT FOR A LIMITED PERIOD. READ THE LABEL ON THE BOTTLE.

NOTE: Sample water and buffer solution should have the same temperature.

In case sample water temperature deviates from the reference temperature of 77° F (25° C), calibrate the resp. value shown in the temperature table (see label on buffer solution).

There are two methods for pH calibration. The first adjusts the zero and the span settings for the pH range. The second calibration is an "offset," in which the pH sensor is exposed to a known pH solution and the displayed value is adjusted, up or down, to match the known value. This calibration can also be performed on the process water with the sensor in the flow cell. Verify that the pH of the process water has been accurately determined.

NOTE: The offset calibration is typically all that is recommended to calibrate pH when first starting the unit or replacing the sensor. The Depolox® 3 *plus* zero and span values are factory set in order to properly work with the sensor. Complete the zero and span calibrations, if there is a problem, only after completing the offset calibration.

- pH OFFSET Calibration

  a. With sensor in flow block, test sample pH.

  b. Press the **F** key until the "CALIBRATION" menu is displayed. Press the ▼ key until the "pH offset" menu is found.

  c. Press the ✓ key.

  d. Press ▼ or ▲ keys until the offset value is the difference of the displayed pH value compared to the manually measured value. Store this value using the ✓ key. (Example: For pH7 solution, the basic display reads 7.15pH. The offset value will be adjusted to -0.15 because the value is to come down from 7.15pH to 7.00pH.)

  e. Return to the basic display by pressing the **ESC** key twice.

- pH Zero Calibration (Isothermal Intersection, pH7):

  a. Starting at the basic display press the **F** key until the "CALIBRATION" menu is displayed. Press the ▼ key until the "pH zero" menu is found.

  b. Withdraw the pH sensor. Fill 10 to 20 ml "pH7.00" buffer solution into a 100 ml beaker. Dip the sensor at least 20mm deep in the buffer solution pH7.00 and agitate lightly until the displayed pH value remains constant.

  c. Press the ✓ key.

  d. Press the ▼ or ▲ keys until the displayed value agrees with the value of the pH buffer solution. Store this value using the ✓ key.

- pH Span Calibration:

  a. Rinse the sensor in distilled water (in order to avoid spreading the buffer solution).

  b. Press the key ▼ until the "pH span" menu is reached.

  c. Pour 10 to 20ml pH4 or pH10 buffer solution into another beaker. Dip the pH sensor at least 20mm deep in the buffer solution and agitate lightly until the displayed pH value remains constant. (In case another buffer solution is used: the pH value of the buffer solution must be less than pH6 or greater than pH8.)

  d. Press the ✓ key to open the "pH Span" menu.

e. Press keys ▼ or ▲ until the displayed value agrees with the value of the pH buffer solution. Store this value using the ✓ key. The measuring cell is now calibrated.

f. Replace the sensor into the flow block.

g. Dispose of the buffer solutions, rinse with enough water.

h. Return to the basic display by pressing the **ESC** key twice or skip to fluoride calibration.

In case of error, both calibration points must be calibrated again.

3.2.4 Fluoride Calibration

NOTE: Fluoride measurement is optional.

WARNING: DO NOT CONTINUE TO USE BUFFER SOLUTIONS AFTER USE-BY DATE. BUFFER SOLUTIONS WHICH HAVE BEEN OPENED CAN ONLY BE KEPT FOR A LIMITED PERIOD. READ THE LABEL ON THE BOTTLE.

NOTE: Sample water and buffer solution should have the same temperature.

In case sample water temperature deviates from the reference temperature of 77° F (25° C), calibrate the resp. value shown in the temperature table (see label on buffer solution).

There are two methods for fluoride calibration. The first adjusts the zero and the span settings for the fluoride range. The second calibration is an “offset,” in which the fluoride sensor is exposed to a known fluoride concentration solution and the displayed value is adjusted, up or down, to match the known value. This calibration can also be performed on the process water with the sensor in the flow cell. Verify that the fluoride concentration of the process water has been accurately determined.

NOTE: The offset calibration is typically all that is recommended to calibrate fluoride when first starting the unit or replacing the sensor. The Depolox® 3 *plus* zero and span values are factory set in order to properly work with the sensor. Complete the zero and span calibrations, if there is a problem, only after completing the offset calibration.

- Fluoride OFFSET Calibration

  a. With sensor in flow block, test sample Fluoride residual.

  b. Press the **F** key until the “CALIBRATION” menu is displayed. Press the ▼ key until the “Fluoride offset” menu is found.

c. Press the ✓ key.

d. Press ▼ or ▲ keys until the offset value is the difference of the displayed fluoride value compared to the manually measured fluoride solution value. Store this value using the ✓ key. (Example: The flow is measured at 0.20 mg/l fluoride solution. The basic display reads 0.28 mg/l fluoride. The offset value will be adjusted to "- 0.08 mg/l fluoride" because the value is to come down from 0.28 mg/l to 0.20 mg/l.)

e. Return to the basic display by pressing the **ESC** key twice.

- Calibration at 0.20 mg/l:

a. Starting at the basic display press the **F** key until the "CALIBRATION" menu is displayed. Press the ▼ key until the "Fluor zero" menu is found.

b. Withdraw the fluoride sensor. Fill 10 to 20 ml "0.20 mg/l" buffer solution into a 100 ml beaker. Dip the sensor at least 20mm deep in the buffer solution 0.20 mg/l and agitate lightly until the displayed value remains constant.

c. Press the ✓ key.

d. Press keys ▼ or ▲ until the displayed value agrees with the value of the buffer solution. Store this value using the ✓ key.

- Calibration at 2.00 mg/l:

a. Rinse the sensor in distilled water (in order to avoid spreading the buffer solution).

b. Press the key ▼ until the "Fluor span" menu is reached.

c. Fill 10 to 20ml "2.00 mg/l" buffer solution into another beaker. Dip the fluoride sensor at least 20mm deep in the buffer solution and agitate lightly until the displayed value remains constant.

d. Press the ✓ key to open the "Fluor Span" menu.

e. Press keys ▼ or ▲ until the displayed value agrees with the value of the buffer solution. Store this value using the ✓ key. The measuring cell is now calibrated.

f. Refit the sensor into the flow block.

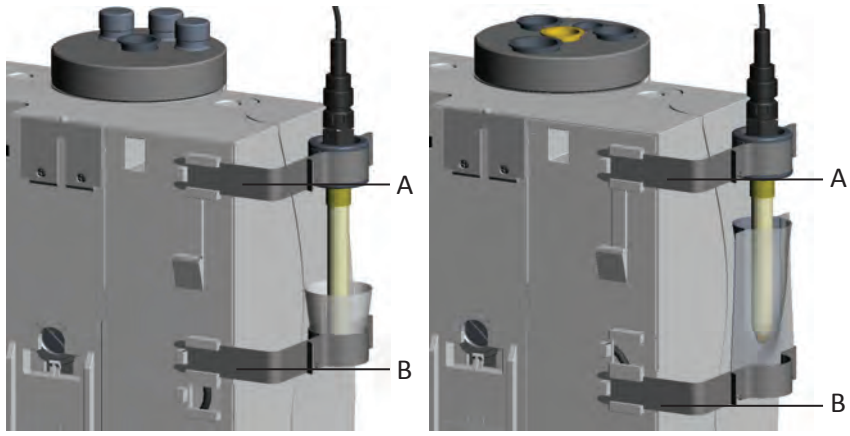
g. Dispose of the buffer solutions, rinse with enough water.

h. Return to the basic display by pressing the **ESC** key twice.

In case of error both calibration points must be calibrated again.

Calibration Aids

Two clips are installed in the housing cover of the Depolox® 5 Bare Electrode and the VariaSens™. These clips can be inserted into the rear panel of the housing. The clip (A) for the sensor will be inserted into the upper catch. When the electrodes are calibrated in the beaker with the calibration solution, the second clip (B) will be inserted into the catch (left figure). The lower clip position is provided for calibrating with the calibration solution bag (right figure).



A	Upper clip
B	Lower clip

3.2.5 Temperature Calibration

1. Starting from the basic display in the main menu select the “Calibration” menu.

2. Select the “Temperature” menu item

The “Calibr. temperature” window appears on the graphic display.

3. Select “Cal. temperature”.

4. Use the arrow keys to enter the correct value.

5. Press “Enter” key to confirm entry.

NOTE: °C or °F can be selected in the “Temp. unit” menu. In the “PT1000“ menu, the automatic temperature compensation with the multi-sensor can be switched on or off.

3.3 Free Chlorine (W2T9694 Bare Electrode) Sensor Kit

3.3.1 Start-Up of the Measuring Cell

a. Unscrew nut (2) and remove cover (3) (see Dwg. 50.560.000.010 in Section 5).

b. Hold electrode assembly together with electrolyte reservoir (4-11) at the cover (10) and pull it out of the cell block (13) without turning.

c. Remove felt ring (transport protection of the membrane, 6)

d. Exchange plug (4) with separately supplied plug fitted with membrane for venting the electrolyte reservoir.

e. Place electrode assembly with electrolyte reservoir back into the cell block. Keying pin in the electrode assembly must snap into position.

f. Fill a half capful of grit into the cell block.

g. Place cover (3) and tighten by nut (2).

h. Allow sample water flow by opening the inlet valve(s).

i. After one hour the measuring signal has stabilized so far that a first calibration should be made as function test.

NOTE: For the first starting-up: After 24 hours of running time a further calibration is necessary. Air bubbles building up at the inner surface of the cell block and preventing somewhat the rotation of the grit will disappear after a running-in period of 24 to 48 hours.

3.3.2 Adjusting the Flow Regulator

The flow regulator is adjusted to a flow of 33 l/h (=0.55 l/min.). If necessary adjust the regulator as follows:

NOTE: Units are factory calibrated. Adjustment is only required if maintenance is performed on the flow valve.

a. Remove the left or right hinge pin at the measuring cell and tilt the housing front to the side.

b. At the inner side of the front is the flow regulator. In the middle of the regulator is the adjusting screw. Turn the screw with a coin or a screwdriver (>10 mm). Turn to the right to reduce flow; turn to the left to increase flow.

c. Check flow and reassemble.

d. Perform calibration.

3.3.3 Free Chlorine (Depolox® 5 Bare Electrode) Flow Block Assemby

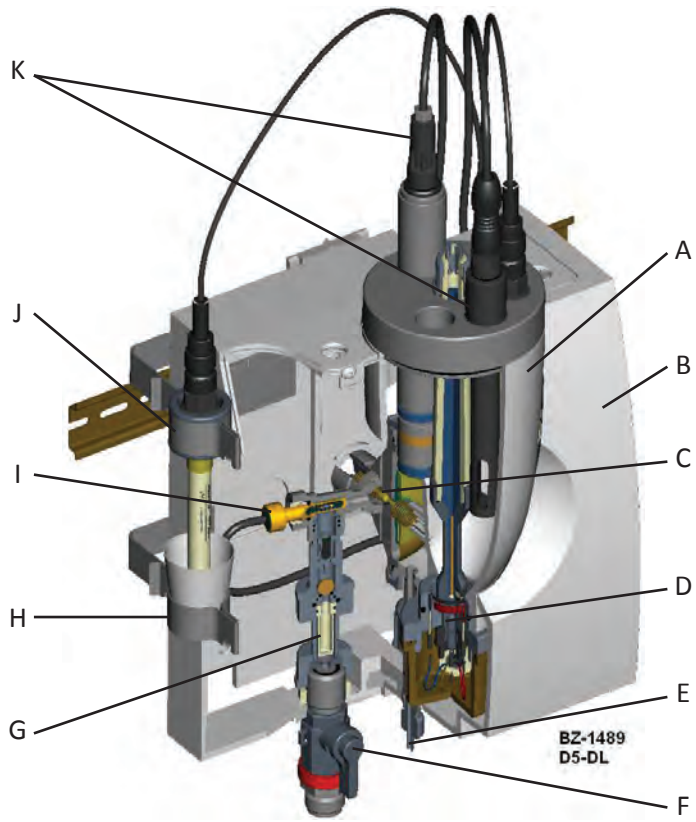
The Depolox® 5 bare electrode flow block assembly contains the following:

- Cell body with cover
- Flow control valve
- 3 electrode cell for Cl_2, ClO_2, O_3, or $KMnO_4$
- Multi-sensor
- Drain
- Fine filter (For use only when membrane sensors are used.)
- Sample water inlet with check valve and ball valve

Two clips are installed in the housing cover. These are used to facilitate pH and fluoride calibration. Insert these clips into the rear panel of the housing. Insert one clip into the upper catch to attach the sensor. Insert the second clip into the center catch inorder to measure the buffer or calibration solution using the plastic cups provided.

The cell body can be equipped with up to five sensors.

A	Cell body with cover
B	Plastic housing
C	Flow control valve
D	3 electrode cell for Cl_2, ClO_2, O_3 or $KMnO_4$
E	Drain
F	Ball valve
G	Fine filter
H	Lower clip and cup
I	Multi-sensor
J	Upper clip
K	Sensors



3.3.4 Adding Grit (Depolox® 5 Bare Electrode)

1. Remove the protection plugs on the cell body cover of the Depolox® 5 flow block.

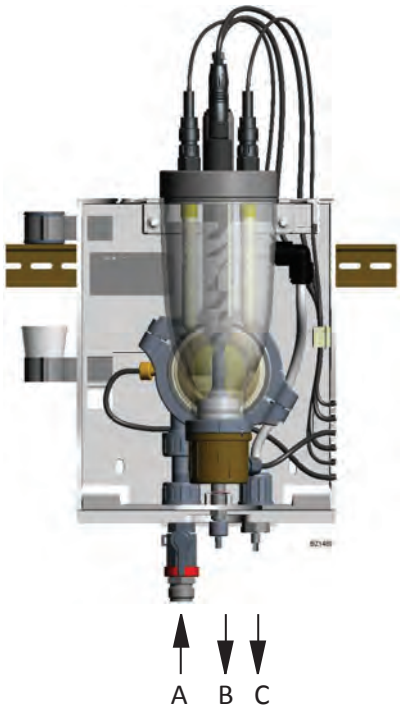
2. Fill half a cap from the plastic bottle with grit and pour it into the cell body (approx. 1/2 cm^3 grit).

3. Replace the protection plugs on the cell body cover of the Depolox® 5 flow block.

NOTE: Make sure that the opening is clean; rinse off with distilled water, if necessary.

NOTE: The system must be recalibrated approx. 4 hours after each time the grit is replaced. The calibration must be checked after one day.

3.3.5 Connecting the Sample Water (Depolox® 5 Bare Electrode and VariaSens™ Flow Block)



A	Sample water inlet with ball valve
B	Drain on the drain screw
C	Sample water outlet

Connecting the sample water inlet:

1. Never use copper tubing.

2. The pressure in the sample water inlet must always be within a range of min. 3 to max. 58 psi. At the same time, the pressure in the sample water inlet must generally be 3 psi higher than in the sample water outlet.

- If the preliminary pressure is below 3 psi, a pressure booster pump must be used.
- If the pressure exceeds 58 psi, a pressure reducing valve must be used.

3. To prevent long loop lag times, ensure that the pipes in the sample water inlet are as short as possible.

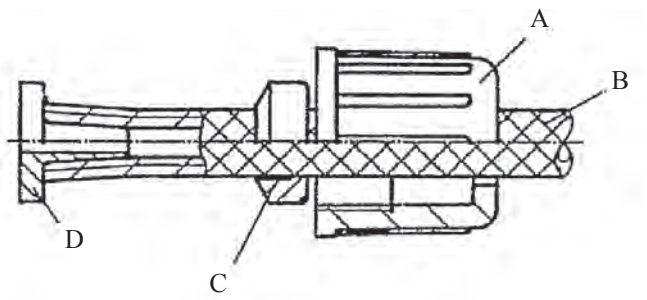
4. An external strainer with a mesh width of 0.02 inch is provided for the sample water inlet.

With hose connection:

<u>NOTE:</u> The water-tightness of the hose screw connection is only guaranteed if the following installation instructions are followed!

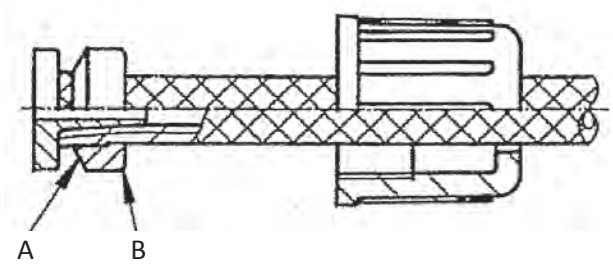
1. Release the union nut (A) on the hose screw connection.

2. Insert the hose (B) until it hits the hose bushing (D).



A	Union nut
B	Hose
C	Locking ring
D	Hose bushing

3. Push the locking ring out until the union nut engages the connecting threads.



A	30° pitch on this side
B	Rounding on this side

Locking ring for PVC hose with 2 clamping points:

With rigid pipework:

1. Connect the sample water pipework to the ball valve connection threads.

2. Ensure that the sample water pipework is installed without mechanical stress.

Connecting the sample water outlet:

NOTE: Never use copper tubing.

1. No back-pressure is permitted in the cell body. The sample water outlet must be open.

2. The sample water outlet must be installed so that no siphon effect can occur.

Recommendation: Position the outlet above the drain line opening.

With hose connection:

See hose connection instructions described in sample water inlet connection.

With rigid pipework:

1. Connect the sample water pipework to the connection nozzle.

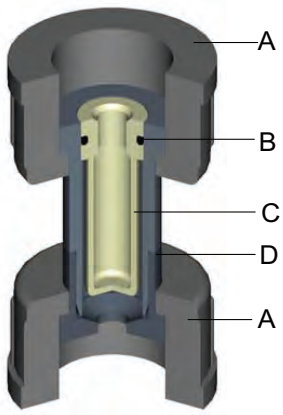
2. Ensure that the sample water pipework is installed without mechanical stress.

Connecting the drain:

1. Ensure that the drain screw is always closed.

3.3.6 Installing the Fine Filter

NOTE: A fine filter must only be installed when membrane sensors are employed. The fine filter (C) is included in the enclosed accessory set.



1. Release both knurled nuts (A).
2. Remove complete filter unit (D).
3. Place the fine filter (C) into the filter unit. Ensure that the O-ring (B) is seated correctly in the groove on the fine filter.
4. Reinstall the complete filter unit (D). Ensure that it is seated in the correct position.
5. Retighten both knurled nuts (A).

3.3.7 Bare Electrode Theory of Operation

The free chlorine that is measured in water for disinfection purposes comes in three forms. Free chlorine consists of elemental chlorine (Cl_2), hypochlorous acid (HClO), and hypochlorite ions (ClO-).

Hypochlorous acid is found in the acidic to neutral pH range undissociated in water. Only when the pH value rises does it break down into H+ and ClO- ions.

To understand the mode of functioning of chlorine as a disinfectant, it is necessary to know the chemical reactions that take place when water is chlorinated. Firstly there is the hydrolysis of the chlorine. This is the reaction of the chlorine with water. When chlorine gas is dissolved in water the formation of hypochlorous acid and hydrochloric acid results. All other disinfectants based on chlorine also react with water and form hypochlorous acid. The hypochlorous acid is the active substance for the disinfection process. Figure 3.6 shows the dependence of the form of chlorine on the pH value of the water. With rising

pH value, the share of hypochlorous acid decreases by dissociating to form H3O+ and ClO-. In other words, the hypochlorous acid needed as the active substance in disinfection becomes less with increasing pH value while the share of ClO- ions that are meaningless for disinfection rises.

The Free Chlorine (Bare Electrode) measuring cell consists of a three-electrode system with external potentiostatic closed-loop control. The working electrode and the counter electrode of the half-ring type are made of a platinum alloy. A silver/silver-chloride electrode serves as reference electrode; the contact between reference electrode and sample water is established by two membranes. The reference electrode is mounted in PVC brackets and completely submerged in electrolyte.

The electrolyte container is transparent, thus enabling a visual check to be made of the amount of electrolyte in the reservoir. Replenishment of the electrolyte is possible without shutting down the measuring cell system. A membrane in the plug of the electrolyte reservoir provides the necessary equalization of pressure.

The measuring cell is connected to a digital measuring amplifier which maintains an adjustable constant potential (Upot) between working and reference electrodes by means of potentiostatic closed-loop control.

About 33 l/hr of the water to be analyzed flows past this system of electrodes. The current generated in the measuring cell is directly proportional to the concentration of the oxidizing agent in the sample water. This current is then passed to the microprocessor-based electronic system Depolox® 3 *plus* for processing. A flow switch gives a signal to the Depolox® 3 *plus* if the flow is reduced (optional).

The surfaces of the electrodes are continuously cleaned by a special kind of cleaning grit in the electrode cell. The transparent plexiglass body of the cell makes it possible to observe the circulation of the grit in the cell.

If a double input electronics is used, a pH-value measurement will be inserted into the hole in the removable cover of the measuring cell. With the pH valve, used in conjunction with the chlorine measurement, it is possible to correct for variations caused by shifting pH.

The following features ensure accurate, repeatable measured data and reduce the frequency of zero point recalibration:

- potentiostatic control
- continuous hydromechanical electrode cleaning system
- regulated sample water flow.

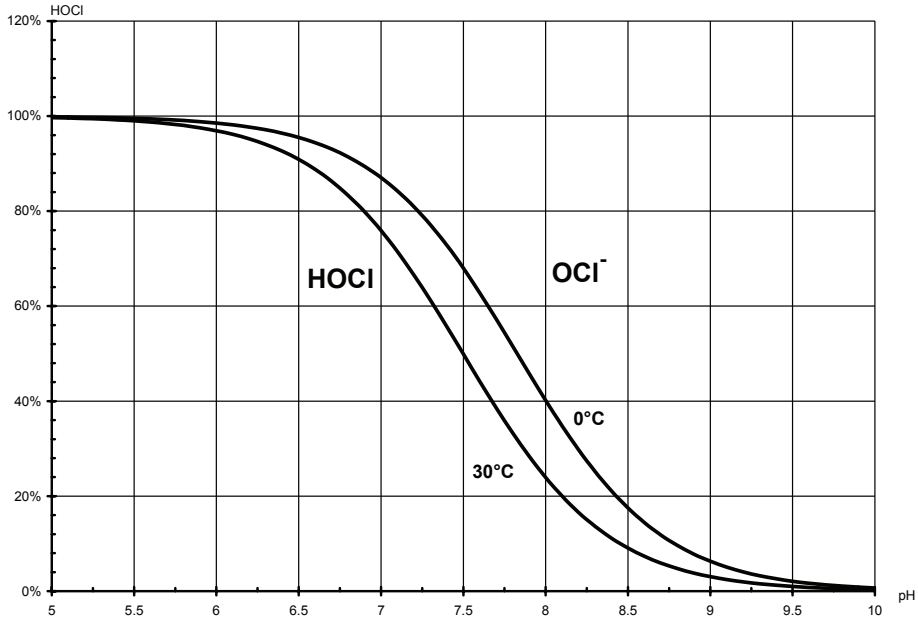


Figure 3.6 - Dissociation characteristics of HOCl and ClO- with pH value and showing effects of temperature

3.4 Membrane Sensor Kits

3.4.1 Start-Up the Flow Block Assembly

On completion of plant installation by trained, qualified personnel and prior to start-up, check that the sample water pipeline is securely connected and tested for leakage and that the sensor(s) are in place.

a. Open the sample water supply.

b. Check that the sample water stream directly points to the membrane of the Membrane sensor, if necessary turn the cover of the flow block assembly. Do not tolerate any air bubbles at the membrane of the sensor.

Start the Depolox® 3 *plus* module as described in paragraph 2.1.8, Start-Up.

3.4.2 System Shut-Down

- To switch-off the system for the short term:

  Switch off the electrical supply and close the sample water shut-off valve.

- To switch-off the system for the long term, for repairs, etc.:

  a. Switch off the entire system and isolate from the electrical supply

  b. Close the water shut-off valve on the flow block inlet

c. Allow water to drain from the flow block.

d. Remove one sensor after the other from the flow block.

e. Clean the sensors and store them as described below.

f. Cover the holes in the cover of the flow block with the protective caps.

To re-start the system, refer to paragraph 2.3, Membrane Sensor.

- To store the sensors after use:

  Remove the elastomer seal from the vent hole. Unscrew the membrane cap. Rinse the membrane and the reference electrode with distilled water. Carefully dry the reference electrode with a paper towel. Let the cap dry in a dust free place. Screw the dry membrane cap loosely onto the sensor. The membrane must not touch the gold working electrode.

3.4.3 VariaSens™ Flow Block Assembly

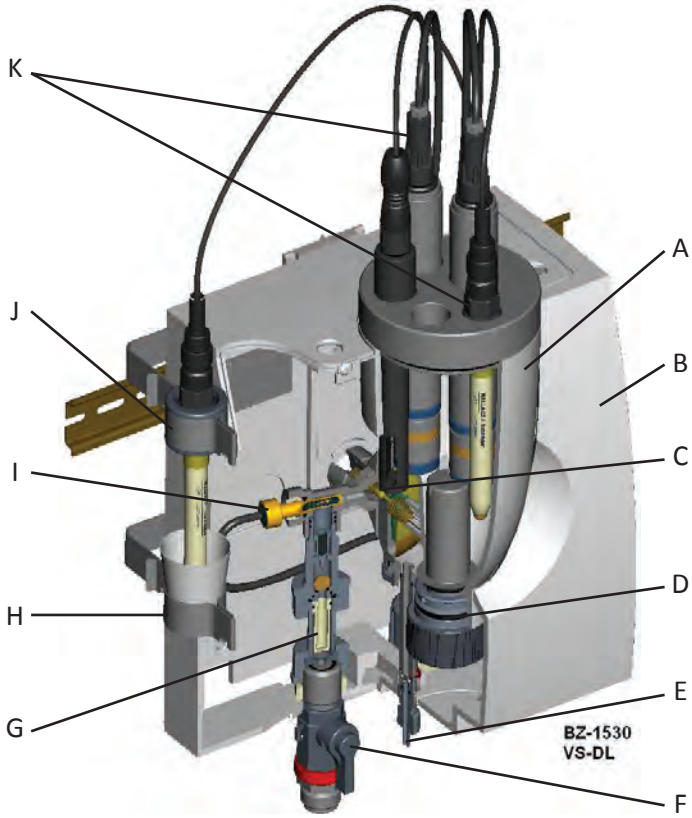
The VariaSens™ flow block assembly contains the following:

- Cell body with cover
- Flow control valve
- Multi-sensor
- Drain
- Fine filter (For use only when membrane sensors are used.)
- Sample water inlet with check valve and ball valve

Two clips are installed in the housing cover. These are used to facilitate pH and fluoride calibration. Insert these clips into the rear panel of the housing. Insert one clip into the upper catch to attach the sensor. Insert the second clip into the center catch inorder to measure the buffer or calibration solution using the plastic cups provided.

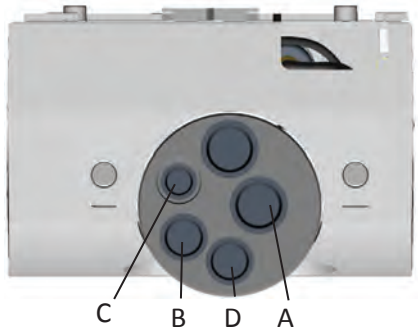
The cell body can be equipped with up to five sensors.

A	Cell body with cover
B	Plastic housing
C	Flow control valve
D	Drain
E	Ball valve
F	Fine filter
G	Lower clip and cup
H	Multi-sensor
I	Upper clip
J	Sensors



3.4.4 Insert the Sensors and Connect

Arrangement of the sensors:



AAD4165 VariaSens™

A	Membrane sensor: FC1, CD7, OZ7, TC1
B, C, D	Fluoride / pH

1. Remove the protection caps from the sensors.

2. Install sensors (see figure above) in the cell body cover.

The sensors are marked as follows:

Membrane sensor for free chlorine, chlorine dioxide, ozone and total chlorine (A)

pH: Sensor for fluoride or pH value, marked "F^-" or "pH" (B, C, D)

Keep the dust protection caps and watering caps of the sensors for subsequent use.

Cable extension:
The sensor cable for free chlorine and total chlorine may be extended to a max. of 50 m.

If the pH or fluoride sensor cables must be extended (max. 50 m), an impedance converter must be attached to the sensor. The impedance converter converts the very high-resistance sensor signal into a low-resistance signal. The impedance converter is supplied by an installed battery. The life of the battery is approx. 5 years; the impedance converter should be sent to the factory for battery replacement.

3.4.5 Decommissioning

CAUTION: Danger of uncontrolled dosing of chlorine or pH correction medium: Shut down dosing system, close positioner!

If the installation site of the flow block assembly is not frost-free, the system must be shut down prior to any possible frost formation.

1. Switch off the power supply.

2. Drain the sample water supply line and drainage line (hold container underneath).

3. Empty cell bodies and remove grit.

4. Dismantle the filter housing and the check valve housing.

5. When the remaining water has drained from the flow control valve, refit the filter housing and the check valve housing.

6. Remove the sensors from the cell body cover and disconnect from the cable (see section 2.3 "Membrane sensors").

7. Apply a KCl solution to the protection caps of the pH electrodes and fit onto the electrodes.

   The fluoride electrodes can be stored wet in the short term in a 100 mg/l fluoride solution at pH 7. Fill the electrodes in the tank with 100 mg/l fluoride solution and mount on the electrodes. However, the electrodes should be stored in a dry condition if they are to be warehoused for several months. In this case, drain the fill solution from the electrode chamber and wash the membrane and chamber with distilled water.

8. Store the sensors in a frost-free place.

   The water must be drained if frost occurs.

   Insert electrode in a beaker with water or electrolyte and store in a frost-free place.

9. Procedure for membrane sensors, see section 2.3 “Membrane sensors”.

   “Storing the membrane sensor for free chlorine FC1”
   “Storing the membrane sensor for chlorine dioxide CD7”
   “Storing the membrane sensor for ozone OZ7”
   “Storing the membrane sensor for total chlorine TC1”

3.4.6 Membrane Sensor Theory of Operation

The Membrane Sensor Kit consists of a flow through cell with a transparent Plexi-glass body that houses the chlorine sensors (and optionally the pH or the fluoride sensor). The cell’s transparency permits visual checks on the flow of sample water and measuring conditions.

The Membrane Sensor measures the sum of free chlorine and chloramines. The Sensor includes a membrane-covered potentiostatic 3 electrode system. The silver/silver-iodide reference electrode and gold working electrode are positioned inside the membrane cap filled with a potassium iodide electrolyte solution. The stainless steel counter electrode is located outside the membrane cap for added stability. Chlorine, diffusing through the membrane, causes a reaction at the working electrode, creating a current, which is a direct measure of Total Chlorine. An amplifier in the electrode shaft conditions this signal including temperature compensation and passes it to the microprocessor-based electronic system Depolox® 3 *plus* for processing.

Air bubbles on the membrane may prevent chlorine from passing through the membrane, resulting in a false reading of the probe. A water jet, designed into the flow block assembly, is used to remove any potential air bubbles from the membrane.

The sensor has a very low dependence on pH-value, so you can use it in water with varying pH-value. The sensor should be used only in potable water applications.

The sensor is designed such that a zero residual chlorine will yield zero current. Therefore only a single point calibration is needed.

The flow block assembly, housing the Membrane Sensor, is designed to provide a constant flow of water past the membrane surface. This and the potentiostatic three-electrode system ensure accurate and repeatable measured data.

- **FC1, OZ7, CD7:** The FC1 for Free Chlorine, the OZ7 for Ozone, and the CD7 for Chlorine Dioxide all work similarly, however, they utilize a silver/silver chloride reference electrode, a different electrolyte, and a different membrane to allow for the selectivity required for the different measurands.

3.4.6.1 Membrane Sensor for Free Chlorine FC1

The FC1 membrane sensor is a special sensor for measuring the concentration of free chlorine in water. The sensor incorporates a pH buffer in the electrolyte and is suitable for water with various pH values. The sensor may only be used in clear water of potable water quality.

CAUTION: The electrode fingers (reference electrodes) and membrane are extremely sensitive! Do not touch, soil or damage! Before unscrewing the filled membrane cap, push the elastomer seal to one side to permit the inflow of air through the vent underneath it! Otherwise, the membrane may be damaged due to developing negative pressure. Do not sand down the light yellowish-gray deposit of the electrode finger or wipe it in the direction of the gold working electrode! The electrolyte may spray out of the valve opening. Flush eyes and skin immediately with water after contact. Rinse away spilled electrolyte with water. The electrolyte contains potassium halide and is acidic.

Commissioning the Membrane Sensor for Free Chlorine FC1

1. Unscrew the membrane cap from the electrode shaft.

2. Place the membrane cap and the G-holder on a clean, non-absorbent pad and fill both with the included electrolyte bubble-free up to the top thread on the inside of the cap.

3. Rub gold working electrode with the included lapping paper (special emery). To do this, lay the lapping paper on a paper towel, take hold of the corner and while holding the measuring cell vertically (without G-holder), slide the electrode end two to three times over the rough side of the lapping paper.

4. Check whether the elastomer seal completely closes the valve opening.

5. Hold the electrode shaft vertically and carefully push the electrode finger into the filled G-holder.

6. Then place the electrode shaft on the filled membrane cap and slowly screw the membrane cap in place by hand.

<u>CAUTION</u>: Because excess electrolyte escapes through the valve opening, do not clamp it shut and do not press on the elastomer seal.

7. Rinse away the escaped electrolyte with water.

<u>NOTE</u>: The membrane cap must be completely screwed onto the electrode shaft so that there is no gap between the two! After approximately one hour, the membrane sensor is sufficiently run in so that it can be initially calibrated. The calibration must be repeated after approx. one day.

Inserting the Membrane Sensor for Free Chlorine FC1 Into the Flow-Through Adapter

1. Push the sensor through the cover into the flow-through adapter until it touches the inflow mating connector. It may be necessary to position the flow-through adapter cover correctly by turning it.

NOTE: Remove air bubbles from the surface of the membrane, bubbles on the membrane will interfere with the measurement!

2. Connect the measuring signal cable to the FC1.

Storing the Membrane Sensor for Free Chlorine FC1

1. Lift elastomer seal and unscrew membrane cap.

2. Remove G-holder (with tweezers, if necessary) and rinse together with the membrane cap and electrode finger with clean (distilled) water. Leave in a dust-free place to dry.

3. Then loosely screw the dry membrane cap onto the electrode shaft (place G-holder loosely into the membrane cap; not attached to electrode finger).

NOTE: The membrane may not touch the gold working electrode.

Restarting: Refer to “Commissioning the membrane sensor for free chlorine FC1”.

Error in Membrane Sensor for Free Chlorine FC1

Trouble-shoot and debug if the measuring signal is too low or irregular:

1. Remove air bubbles on the membrane (e.g. tap the inflow mating connector); air bubbles prevent the chlorine from diffusing through the membrane and distort the measurement.

NOTE: Air bubbles on the remaining parts of the sensor are normal after initial commissioning or restarting; they evaporate after one or two days.

2. Replenish electrolyte.

3. Open membrane sensor. To do this, push the elastomer seal to one side to permit the inflow of air and unscrew the membrane cap.

CAUTION: Do not unscrew the membrane holder from the membrane cap under any circumstances!

4. As a rule, the G-holder remains in the membrane cap.

5. Pour out the electrolyte.

6. Wash the electrode finger with clean (distilled) water and allow it to air dry.

7. Rub gold working electrode with the included lapping paper (special emery). To do this, lay the lapping paper on a paper towel, take hold of the corner and while holding the measuring cell vertically, slide the electrode end two to three times over the rough side of the lapping paper.

For further procedure, see "Commissioning the membrane sensor for free chlorine FC1". If the sensor's measuring signal is still too low or irregular, a new membrane cap must be used. The measuring cell requires one to two hours before it can be calibrated.

3.4.6.2 Membrane Sensor for Chlorine Dioxide CD7

The CD7 membrane sensor enables the chlorine dioxide content in all types of water to be determined selectively, without cross-sensitivity to chlorine, bromine and hydrogen peroxide, however, with cross-sensitivity to ozone and peracetic acid. The sensor does not demonstrate a pH value dependency and is therefore very suitable for water with various pH values.

CAUTION: The electrode fingers (reference electrodes) and membrane are extremely sensitive! Do not touch, soil or damage! Before unscrewing the filled membrane cap, push the elastomer seal to one side to permit the inflow of air through the vent underneath it! Otherwise, the membrane may be damaged due to developing negative pressure. Do not sand down the light yellowish-gray deposit of the electrode finger or wipe it in the direction of the gold working electrode!

Commissioning the Membranesensor for Chlorine Dioxide CD7

1. Screw off the membrane cap from the electrode shaft and fill with the included gel electrolyte.

2. Tap on the membrane cap with the electrode shaft until air bubbles are removed.

3. Rub gold working electrode with the included lapping paper (special emery). To do this, lay the lapping paper on a paper towel, take hold of the corner and while holding the measuring cell vertically, slide the electrode end one to two times over the rough side of the lapping paper.

4. Check whether the elastomer seal completely closes the valve opening.

5. Then place the electrode shaft on the filled membrane cap and slowly screw the membrane cap in place by hand.

NOTE: Because excess electrolyte escapes through the hose valve, do not clamp it shut and do not press on the elastomer seal.

6. Rinse way the escaped electrolyte with water.

NOTE: The membrane cap must be completely screwed onto the electrode shaft so that there is no gap between the two! After approximately two hours, the membrane sensor is sufficiently run in so that it can be initially calibrated. The calibration must be repeated after approx. one day.

Inserting the Membrane Sensor for Chlorine Dioxide CD7 Into the Flow-Through Adapter

1. Push the sensor through the cover into the flow-through adapter until it touches the inflow mating connector. It may be necessary to position the flow-through adapter cover correctly by turning it.

NOTE: Remove air bubbles from the surface on the membrane, bubbles on the membrane will interfere with the measurement!

2. Connect the measuring signal cable to the CD7.

Storing the Membrane Sensor for Chlorine Dioxide CD7

1. Lift elastomer seal and unscrew membrane cap.

2. Wash the membrane cap and electrode finger with clean (distilled) water.

3. Leave the electrode finger to dry in a dust-free place.

4. Leave the cap to dry in a dust-free place.

5. Then screw the dry membrane cap loosely onto the electrode shaft.

CAUTION: The membrane may not touch the gold working electrode.

Restarting: Refer to "Commissioning the membranesensor for chlorine dioxide CD7".

Error in Membrane Sensor for Chlorine Dioxide CD7

Trouble-shoot and debug if the measuring signal is too low or irregular:

1. Remove air bubbles on the membrane (e.g. tap the inflow mating connector); air bubbles prevent the chlorine dioxide from diffusing through the membrane and distort the measurement.

NOTE: Air bubbles on the remaining parts of the sensor are normal after initial commissioning or restarting; they disapate after one or two days.

2. Replenish electrolyte.

3. Open membrane sensor. To do this, push the elastomer seal to one side to permit the inflow of air and unscrew the membrane cap.

4. Pour out the electrolyte.

5. Wash the electrode finger and the membrane cap with clean (distilled) water and allow it to air dry.

For further procedure, see "Commissioning the membranesensor for chlorine dioxide CD7".

If the sensor's measuring signal is still too low or irregular, a new membrane cap must be used. The measuring cell requires one to two hours before it can be calibrated.

3.4.6.3 Membrane Sensor for Ozone OZ7

The OZ7 membrane sensor enables the ozone content in all types of water to be determined selectively, without cross-sensitivity to chlorine, bromine and hydrogen peroxide, however, with cross-sensitivity to chlorine dioxide and peracetic acid. The sensor does not demonstrate a pH value dependency and is therefore very suitable for water with various pH values.

CAUTION: The electrode fingers (reference electrodes) and membrane are extremely sensitive! Do not touch, soil or damage! Before unscrewing the filled membrane cap, push the elastomer seal to one side to permit the inflow of air through the vent underneath it! Otherwise, the membrane may be damaged due to developing negative pressure. Do not sand down the light yellowish-gray deposit of the electrode finger or wipe it in the direction of the gold working electrode!

Commissioning the Membrane Sensor for Ozone OZ7

CAUTION: When unscrewing the filled membrane cap, both elastomer seals lying one on top of the other above the type imprint must be pushed to the side to allow air to flow into the electrolyte chamber, otherwise the membrane will be destroyed due to developing negative pressure.

1. Remove the black insulating tube from the electrode finger.

2. Open the container with the membrane cap, empty out the water and remove the membrane cap.

3. Fill the membrane cap up to the top of the threads inside the cap with the included gel electrolyte.

NOTE: Ensure that only one elastomer seal is in the slot and that the valve opening closes.

4. Rub gold working electrode with the included lapping paper (special emery). To do this, lay the lapping paper on a paper towel, take hold of the corner and while holding the measuring cell vertically, slide the electrode end one to two times over the rough side of the lapping paper.

5. Then place the electrode shaft on the filled membrane cap and slowly screw the membrane cap in place by hand.

NOTE: Because the excess electrolyte escapes through the hose valve, do not clamp it shut.

6. Then push the second elastomer seal in the slot over the first one.

NOTE: The elastomer seals may not form creases.

7. Rinse away the escaped electrolyte with water.

NOTE: The membrane cap must be completely screwed onto the electrode shaft so that there is no gap between the two! After approximately two hours, the membrane sensor is sufficiently run in so that it can be initially calibrated. The calibration must be repeated after approx. one day.

Inserting the Membrane Sensor for Ozone OZ7 into the Flow-Through Adapter

1. Push the sensor through the cover into the flow-through adapter until it touches the inflow mating connector. It may be necessary to position the flow-through adapter cover correctly by turning it.

NOTE: Remove air bubbles from the surface of the membrane, bubbles on the membrane will interfere with the measurement!

2. Connect the measuring signal cable to the OZ7.

Storing the Membrane Sensor for Ozone OZ7

1. Lift elastomer seal and unscrew membrane cap.

2. Wash the membrane cap and electrode finger with clean (distilled) water.

3. Allow the electrode finger and the cap to dry in a dust-free place.

4. Then screw the dry membrane cap loosely onto the electrode shaft.

NOTE: Ensure that the membrane never touches the measuring electrode.

Restarting: Refer to “Commissioning the membrane sensor for ozone OZ7”.

Error in Membrane Sensor for Ozone OZ7

Trouble-shoot and debug if the output signal is too low or irregular:

1. Remove air bubbles on the membrane (e.g. tap the inflow mating connector); air bubbles prevent the ozone from diffusing through the membrane and distort the measurement.

NOTE: Air bubbles on the remaining parts of the sensor are normal after initial commissioning or restarting; they disapate after one or two days.

2. Replenish electrolyte.

3. Open membrane sensor. To do this, push the elastomer seal to one side to permit the inflow of air and unscrew the membrane cap. Pour out the electrolyte.

4. Wash the electrode finger and the membrane cap with clean (distilled) water and allow to air dry.

For further procedure, see “Commissioning the membrane sensor for ozone OZ7”.

If the sensor's measuring signal is still too low or irregular, a new membrane cap must be used. The measuring cell requires one to two hours before it can be calibrated.

3.4.6.4 Membrane Sensor for Total Chlorine TC1

The membrane sensor measures the total amount of free and combined chlorine (chloramine). The sensor incorporates a pH buffer in the electrolyte and is suitable for water with various pH values. The sensor may only be used in clear water of potable water quality.

CAUTION: The electrode fingers (reference electrodes) and membrane are extremely sensitive! Do not touch, soil or damage! Before unscrewing the filled membrane cap, push the elastomer seal to one side to permit the inflow of air through the vent underneath it! Otherwise, the membrane may be damaged due to developing negative pressure. Do not sand down the light yellowish-gray deposit of the electrode finger or wipe it in the direction of the gold working electrode!

Commissioning the Membrane sensor for Total Chlorine TC1

1. Screw off the membrane cap from the electrode shaft and fill to the top of the threads on inside of cap with the included gel electrolyte.

2. Rub gold working electrode with the included lapping paper (special emery). To do this, lay the lapping paper on a paper towel, take hold of the corner and while holding the measuring cell vertically, slide the electrode end one to two times over the rough side of the lapping paper.

3. Check whether the elastomer seal completely closes the valve opening.

4. Then place the electrode shaft on the filled membrane cap and slowly screw the membrane cap in place by hand.

NOTE: Because excess electrolyte escapes through the hose valve, do not clamp it shut and do not press on the elastomer seal.

5. Rinse away the escaped electrolyte with water.

NOTE: The membrane cap must be completely screwed (hand-tight) onto the electrode shaft so that there is no gap between the two! After approximately one hour, the membrane sensor is sufficiently run in so that it can be initially aligned. The alignment must be repeated after one day.

Inserting the Membrane Sensor for Total Chlorine TC1 Into the Flow-Through Adapter

1. Push the sensor through the cover into the flow-through adapter until it touches the inflow mating connector.It may be necessary to position the flow-through adapter cover correctly by turning it.

NOTE: Remove air bubbles from the surface of the membrane, bubbles on the membrane will interfere with the measurement!

2. Connect the measuring signal cable to the measuring device.

Storing the Membrane Sensor for Total Chlorine TC1

1. Lift elastomer seal and unscrew membrane cap.

2. Wash the membrane cap and electrode finger with clean (distilled) water. Allow the electrode finger to air dry.

3. Leave the cap to dry in a dust-free place.

4. Then screw the dry membrane cap loosely onto the electrode shaft.

CAUTION: The membrane may not touch the gold working electrode.

Restarting: Refer to “Commissioning the membranesensor for total chlorine TC1”.

5. Store the conductivity sensor in a dry place.

6. To restart, follow the instructions to start up the corresponding sensors.

Error in Membrane Sensor for Total Chlorine TC1

Trouble-shoot and debug if the measuring signal is too low or irregular:

1. Remove air bubbles on the membrane (e.g. tap the inflow mating connector); air bubbles prevent the chlorine from diffusing through the membrane and distort the measurement.

NOTE: Air bubbles on the remaining parts of the sensor are normal after initial commissioning or restarting; they disapate after one or two days.

2. Replenish electrolyte.

3. Open membrane sensor. To do this, push the elastomer seal to one side to permit the inflow of air and unscrew the membrane cap.

4. Pour out the electrolyte.

5. Wash the electrode finger and the membrane cap with clean (distilled) water and allow to dry in a dust-free place.

For further procedure, see "Commissioning the membrane sensor for total chlorine TC1".

If the sensor's measuring signal is still too low or irregular, a new membrane cap must be used. Thereafter, the measuring cell requires one to two hours before it can be calibrated.

WARNING: DO NOT TOUCH THE REFERENCE ELECTRODE! BEFORE UNSCREWING THE MEMBRANE CAP, REMOVE THE ELASTOMER SEAL TO ALLOW AIR INTO THE VENT HOLE. NOT DOING THIS WILL CAUSE A VACUUM TO OCCUR WHICH WILL DAMAGE THE MEMBRANE WHEN UNSCREWING THE CAP. DO NOT REMOVE THE YELLOW-GREY LAYER ON THE REFERENCE ELECTRODE.

NOTE: It is important that the membrane is in the direct sample water flow. Because of this the flow-through assembly has a special form where the sensor fits in.

3.5 pH Sensor

3.5.1 Description

The Wallace & Tiernan® pH sensor has a ceramic diaphragm and a silver/silver-chloride reference electrode. The 3.0 mol KCl gel electrolyte does not require replenishment.

To protect the sensitive measuring membrane the sensor is shipped with a protection cap over its glass tip. This cap contains 3 mol KCl solution to keep the sensor in a constant state of readiness. Leave the cap in place on the sensor until it is about to be installed. Do not discard the cap but keep it and use it to protect the sensor whenever it is removed from service. Then fill the cap with water (not distilled) and place it over the tip of sensor.

The pH sensor has a threaded plug-in head. Care must be taken to ensure that the O-ring is present when connecting the head. A standard 1.5 m long, shielded coaxial (measuring) cable is supplied with the pH sensor. At one end the cable has a special plug which is screwed on to the threaded plug-in head of the sensor. The other end of the shielded special cable is connected directly to the intended terminal connection in the control module.

3.6 Fluoride Sensor Kit

3.6.1 Description

The fluoride sensor (refillable and gel type) is equipped with a rubber cap over the fluoride sensitive membrane. Lift the cap before placing the electrode into the sample water. Soak the probe in 100 ppm standard solution for 24 hours prior to use to saturate membrane.

NOTE: Do not touch or scratch the membrane, the electrode could be damaged.

If the sensor is not used for a long period of time, place the cap again on the electrode with some reference electrode filling solution in it.

As a standard, a shielded coax cable, 1.5 m long, is supplied together with the sensor.

3.6.2 Preparation of the Electrode

See instructions included with sensor.

3.7 RS485 Interface

3.7.1 Printer Facility

The Depolox® 3 *plus* is not able to send data directly to a printer.

3.7.2 Description of the RS485 Bus Interface

The serial RS485 bus interface of the Depolox® 3 *plus*, built-in as a standard, is used for data transmission to a PC, to an external plant control or to the MF485 interface card (e.g., for connection to a printer).

The serial RS485 bus interface of the Depolox® 3 *plus* is designed as a symmetrical two-wires bus line to EIA RS 485 (DIN 66259 part 4 resp. ISO 8482), that enables data transfer with high transfer rate (19.2 KBaud) and long distances (up to 1200 m).

Characteristics:

- Data transfer in both directions
- twin wire connection (half duplex)
- Bus structure (addressable interface, up to 32 bus users)

The interface works with differential voltage signals, ensuring high interference susceptibility.

The bus system consists of a maximum of 32 passive users and one active user. Only the active user (computer system) is entitled to start communication. The Depolox® 3 *plus* is always a passive user.

3.7.2.1 Cable

A shielded and twisted two-wire cable (twisted pair) is to be used. The shield improves the electromagnetic compatibility. An unshielded cable can be used if acceptable within the surroundings, that means, if no electromagnetic interferences are expected.

The bus cable is connected from one user to the next. Stub cables of a maximum length of 0.3 m are allowed. The surge impedance of the cable should be between 100 and 130 ohm, the cable capacitance preferably <60 pF/m and the cross section 0.22 mm² (e.g., Li2CY(TP) 2x0.22 mm²). If using a shielded cable we recommend to connect the shield on both sides with low resistance (large cross sections and short cables) to protection ground, to have optimum interference compatibility.

3.7.2.2 Interface Connection

The bus cable for the communication with the Depolox® 3 *plus* should be connected to the following terminals:

Bus line A: Terminal 28
Bus line B: Terminal 27

NOTE: The RS485 interface of the Depolox® 3 *plus* is not galvanically isolated. Each Depolox® 3 *plus* occupies two bus addresses of its own (e.g., 0 for chlorine, 1 for pH or for fluoride). This means that in a bus system with Depolox® 3 *plus*-modules, each of the modules behaves as two separate bus users.

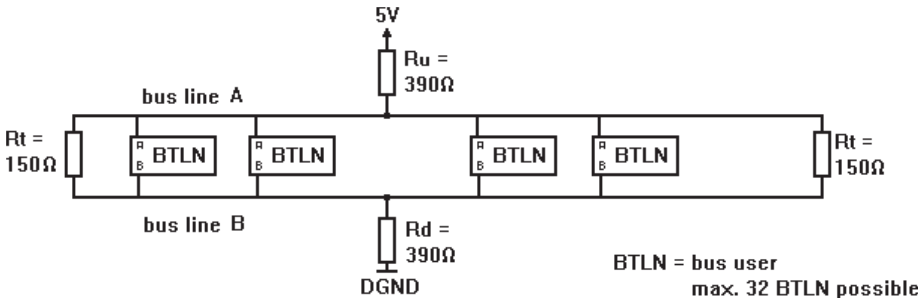


Figure 3.7 - Interface Connection

Both ends of the bus cable must be connected to a moving load Rt (150 Ohm). Symmetry is assured at only one point of the bus. With a voltage supply of 5 V, the resistors Rd and Ru (390 Ohm each) connect to ground and 5 V. These resistor values fit for transmission of up to 19200 Bit/s and a maximum bus length of 1200 m. Symmetry and bus ends should be executed in the same way at potentially isolated and non-isolated bus systems.

Resistors may be switched on via DIP switch in the terminals box. (See Figure 3.8.)

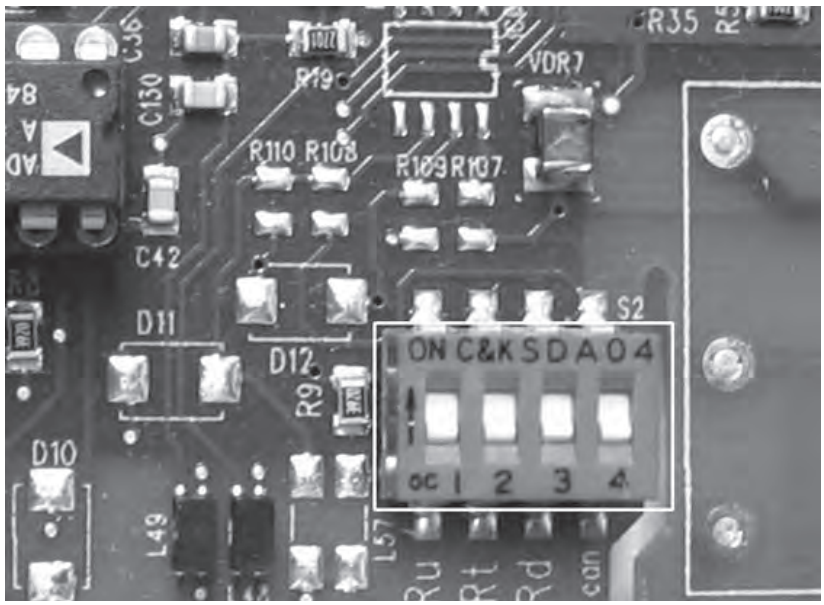


Figure 3.8 - Terminals Box

3.7.2.3 Bus Connection

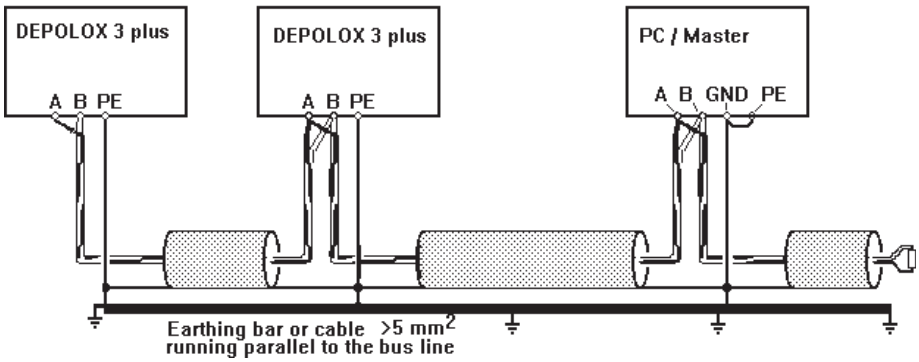


Figure 3.9 - Potentially Not Isolated RS485 Bus System

3.7.3 Specification of Bus Interface

1	Synchronization mode:	Asynchronous	
2	Transmission rate:	19200 Baud	
3	Data format (asynchronous):	- Start bit:	1 Bit
		- Data bit:	8 Bit
		- Parity bit:	even
		- Stop bit:	1 Bit
4	Signal polarity:	Differential voltage interface Logical “1” = (A-B >= 0.2V) Logical “0” = (A-B <= -0.2V)	
5	Handshake:	No handshake because of request control with fixed blocks	
6	Transmission code:	Evoqua Water Technologies-Protocol (master-slave) multipoint communication, maximum 32 users	
7	Galvanically not isolated		

3.7.4 Transmission Protocol

For the communication between master (active user, e.g., computer) and slave (passive user), two different kinds of frames are used:

- Request - Frame
- Set - Frame

The slave answers to these frames with the following frames:

- Answer frame
- Positive confirmation
- Negative confirmation

The bytes of these frames always have the same formats:

- 1 Start bit (always “0”)
- 8 Data bits
- 1 Parity bit (even)
- 1 Stop bit (always “1”)

3.7.4.1 Description of the Bytes of the Frames

- Synchronization bytes: Used for the synchronization of the user units to the others.

- Start byte (SB): Marks the begin of a frame.

  The value depends on the type of the frame:

Request frame	10H
Set frame	68H
Answer frame	68H
Positive confirmation	A2H
Negative confirmation	DCH

- Slave address: To every module in the RS485 bus a special bus address is allocated (slave address). The address can be a number between 0 and 31 Dec.

NOTE: The Depolox® 3 *plus* module uses up to two bus addresses because of the two-fold function of the module (Cl_2 measurement, pH or fluoride measurement).

- Destination address: Determines the transmission variable in the address reference list, that is to be read or written.

- Check byte: Determines the type of information to be read from the slave. Also the data format is defined.

  Data format of the check byte (Bit 0 through 3):

Bit (3210)	Dez.	Format:
0000	0	Default (to address reference list)
0001	1	Default (to address reference list)
0010	2	Boolean
0011	3	Boolean
0100	4	unsigned Character
0101	5	signed Character
0110	6	unsigned Integer
0111	7	signed Integer
1000	8	unsigned long Integer
1001	9	signed long Integer
1010	10	Floating Point
1011	11	Floating Point
1100	12	ASCII
1101	13	ASCII
1110	14	Mixed data format
1111	15	Mixed data format

Additional functions of the check byte (Bit 4 through 7):

Bit (7654)	Function
1000	Minimum value of the variable
0100	Maximum value of the variable
0010	Default value of the variable
0001	additional information of the variable

If no bit is set in bits 5 through 7, the actual value is written or read. Otherwise the corresponding additional information is sent by the slave.

- Special case: With “negative confirmation,” the check byte includes an additional information about the error occurred. With “positive confirmation,” the check byte is set to 00Hex.

Value:	Function:
01H	End of address table
02H	Wrong data format
04H	Additional information not available
08H	Variable to set not within min. and max. limits
10H	reading access not permitted
20H	reading access permitted but wrong password
40H	writing access not permitted
80H	writing access permitted but wrong password
C0H	writing access not permitted (wrong operation mode)

- Number byte: Defines the number of bytes to read or to write.

- Frame Check: The sum of the control bytes of a frame is stored in the frame check.

  FC = (unsigned char) SB + SA + ZA + KB + AB

- Data unit: Includes data informations be sent by slave or master.

- Data check: The check sum of the data bytes of a frame is stored in the data check.

  CD = (unsigned char) sum of DU

- End byte: Marks the end of a frame. Value is always 16Hex.

3.7.4.2 Request - Frame

This is necessary to read data or additional information from a slave.

Format of the request frame:

Byte:	0-2	3	4	5	6	7	8	9
Name:	SYN	SB	SA	ZA	KB	AB	FC	EB

Byte:	Name:	occupied by:
0-2	SYN	Synchronization bytes
3	SB	Start byte 10H
4	SA	Slave address
5	ZA	destination address
6	KB	check byte
7	AB	number of bytes
8	FC	frame Check
9	EB	end byte 16H

With the request frame, single words, values covering more addresses, or additional information of the destination address can be read. If the contents of a single destination address are requested, the number byte is set to 00Hex. In the answer frame, the data format and the number of bytes are entered from the address reference list to the check byte and the number byte.

If a number byte is set in the request frame (request covering more addresses), the data format in the answer frame is set to 04Hex (unsigned char). The number byte of the answer frame receives the value of the number byte of the request frame. A data format eventually entered in the request frame is ignored.

If the additional information of a destination address is requested, the check byte must include the identification for this additional information. The data format and the number byte are ignored. The check byte and the answer byte are set according to the reference list. Valid request frames are answered with an answer frame. Invalid request frames are answered with "negative confirmation."

Example: Requesting the contents of destination address 02H from slave 07H:

00H	00H	00H	10H	07H	02H	00H	00H	19H	16H
	SYN		SB	SA	ZA	KB	AB	FC	EB

3.7.4.3 Set - Frame

The set frame is used for writing data to a slave.

Format of the set frame:

Byte:	0-2	3	4	5	6	7	8	9-X	Y	Z
Name:	SYN	SB	SA	ZA	KB	AB	FC	DU	DC	EB

Byte:	Name:	Function:
0-2	SYN	Synchronization bytes
3	SB	Start byte 68H
4	SA	Slave address
5	ZA	Destination address
6	KB	Check byte
7	AB	Number byte
8	FC	Frame Check
9-X	DU	Data bytes
Y	DC	Data Check
Z	EB	End byte 16H

With the set frame, single words, values covering more addresses, or additional information can be written.

If the contents of a single destination address are written, the number byte must correspond to the number byte of the address reference list. The data format must be set to “default” or to the data format from the address reference list.

If more variables are to be set covering more addresses, the data format must be set to “default.” The number byte means the number of bytes to write; only whole variables have to be written. Valid set frames are answered with a “positive confirmation.” Invalid set frames are answered with “negative confirmation.”

Example: Setting the contents of destination address 02H of the slave 07H to 904 (Dec).

0H	00H	00H	68H	07H	02H	06H	02H	79H	03H	88H	8BH	16H
	SYN		SB	SA	ZA	KB	AB	FC	DU		DC	EB

3.7.4.4 Answer - Frame

The answer frame is transmitted by the slave because of a request frame of the master.

Format of the answer frame:

Byte:	0-2	3	4	5	6	7	8	9-X	Y	Z
Name:	SYN	SB	SA	ZA	KB	AB	FC	DU	DC	EB

Byte:	Name:	Function:
0-2	SYN	Synchronization bytes
3	SB	Start byte 68H
4	SA	Slave address
5	ZA	Destination address
6	KB	Check byte
7	AB	Number byte
8	FC	Frame Check
9-X	DU	Data bytes
Y	DC	Data Check
Z	EB	End byte 16H

If no data format and no number of bytes (AB) is set in the request frame in the check byte, the data format and the number of bytes are entered into the answer frame from the address list.

Example: Request frame

00H	00H	00H	10H	07H	02H	00H	00H	19H	16H
	SYN		SB	SA	ZA	KB	AB	FC	EB

Answer to the example Request - Frame:

00H	00H	00H	68H	07H	02H	06H	02H	79H	00H	00H	8BH	16H
	SYN		SB	SA	ZA	KB	AB	FC	DU		DC	EB

3.7.4.5 Positive and Negative Confirmation

The “positive confirmation” is transmitted by the slave, if a set frame of the master has been executed validly. A “negative confirmation” is transmitted by the slave, if a set frame or a request frame couldn’t be executed validly.

Format of the positive/negative confirmation:

Byte:	0-2	3	4	5	6	7	8	9
Name:	SYN	SB	SA	ZA	KB	AB	FC	EB

Byte:	Name:	Function:	
0-2	SYN	Synchronization bytes	
3	SB	Positive:	Start byte A2H
		Negative:	Start byte DCH
4	SA	Slave address	
5	ZA	Ziel address	
6	KB	Check byte	
7	AB	Number byte	
8	FC	Frame Check	
9	EB	End byte 16H	

The check byte is occupied by 00Hex for positive confirmation and by an error code for negative confirmation.

Example: Positive confirmation

00H	00H	00H	A2H	07H	02H	00H	00H	ABH	16H
	SYN		SB	SA	ZA	KB	AB	FC	EB

Example: Negative confirmation

00H	00H	00H	DCH	07H	02H	02H	00H	A5H	16H
	SYN		SB	SA	ZA	KB	AB	FC	EB

3.7.5 Address Reference List

<u>NOTE</u>: To each Depolox® 3 *plus* two addresses are allocated. Each of the two addresses lead to a corresponding address reference list (e.g., Adr00 for Cl_2 measurement, Adr01 for pH or fluoride measurement).

KEY	
Abbreviations of the data formats	BOOL-boolean, UCHAR-unsigned char, SCHAR-signed char, USINT-unsigned integer, SINT-signed integer, ULONG-unsigned long, SLONG-signed long, FLOAT- float, ASCII-ASCII-code, MIX-mixed format
Abbreviations of access	L-read, S-write, LP-read with password, SP-write with password
Data structure 1	Byte1-2: Measured valuet (signed int), Byte3-4: range-start (signed int), Byte 5-6: range-end (signed int), Byte7-11: unit (ASCII), Byte12: divider (character)

Table 3.4 - Address Reference List

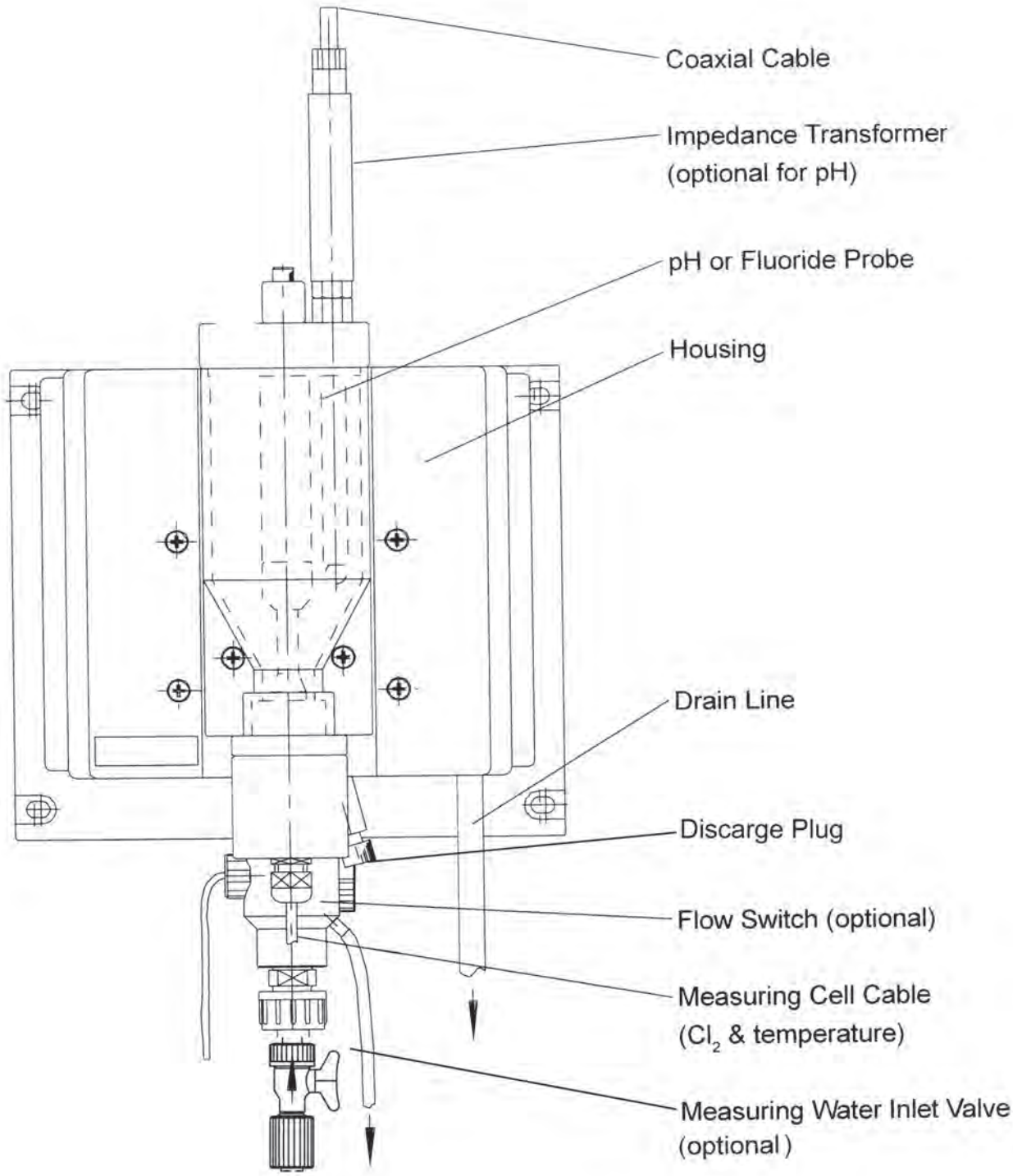
ADDR.	DESCRIPTION	FORMAT	LENGTH	RANGE	UNIT	FACTOR	STATUS	DESCRIPTION	BYTES
0.	Date of software version	ASCII	12	-	-	-	L	-	0
1.	Module name	ASCII	28	-	-	-	L	-	12
2.	Password of interface	USINT	2	0...999	-	1.0	L, S	-	40
3.	Module type	ASCII	12	1	-	-	L	-	42
4.	Measurement value DES	USCHAR	12	Meas. range	mg/l	0.10 0.01	L	Data Structure 1	54
5.	Measurement value pH/Fluoride	USCHAR	12	Meas. range	pH mg/l	0.01	L	Data Structure 1	66
6.	Measurement value temperature	USCHAR	12	Meas. range	°C	0.10	L	Data Structure 1	78
7.	Errors	USLONG	4	-	-	-	L	0x00000001: Digital input 1 0x00000002: Digital input 2 0x00000004: Digital input 3 0x00000008: Calibration error DES 0x00000010: Calibration error pH 0x00000020: Calibration error Fluor 0x00000040: Cell error 0x00000080: Cell error pH 0x00000100: Cell error Fluor 0x00000200: Temperature 0x00000400: Load mA output 0x00000800: ADU1 0x00001000: ADU2 0x00002000: ADU3 0x00004000: Values out of range 0x00008000: Max DES 0x00010000: Min DES 0x00020000: Max pH 0x00040000: Min pH 0x00080000: Max Fluor 0x00100000: Min Fluor 0x00200000: System 0x00400000: OVR DES 0x00800000: OVR pH 0x01000000: OVR Fluor 0x02000000: HOCl pH 0x04000000: -- 0x08000000: -- 0x10000000: -- 0x20000000: -- 0x40000000: -- 0x80000000: --	90
8.	Cell current DES	FLOAT	4	-	µA	1.0	L	-	94
9.	Cell voltage pH/Fluor	FLOAT	4	-	mV	1.0	L	-	98
10.	State of LEDs and DI and relays	USINT	2	-	-	-	L	0x0001: LED Alarm 1 0x0002: LED Alarm 2 0x0004: LED Alarm 3 0x0008: LED Alarm 4 0x0010: LED DOS 0x0020: LED DI 0x0040: LED Failure 0x0080: DI1 0x0100: DI2 0x0200: DI3 0x0400: Relay K1 0x0800: Relay K2 0x1000: Relay K3 0x2000: Relay K4	102
11.	Menu language	USCHAR	1	-	-	-	L, SP	0x01: German 0x02: English 0x04: French 0x08: Spanish	104
12.	Function mA output	USCHAR	1	-	-	-	L, SP	0x01: Off 0x02: 0-20mA 0x04: 4-20mA	105

Table 3.4 - Address Reference List (Cont'd)

ADDR.	DESCRIPTION	FORMAT	LENGTH	RANGE	UNIT	FACTOR	STATUS	DESCRIPTION	BYTES
13.	mA 1 assign	USCHAR	1	-	-	-	L, SP	0x01: DES 0x02: pH/Fluor 0x04: Temperature	106
14.	mA 2 assign	USCHAR	1	-	-	-	L, SP	Adr. 13	107
15.	mA 3 assign	USCHAR	1	-	-	-	L, SP	Adr. 13	108
16.	RS485 address	SINT	2	0...31	-	1.0	L, SP	-	109
17.	Relay assign Alarm 1	USINT	2	-	-	-	L, SP	0x0001: DES max 0x0002: DES min 0x0004: pH max 0x0008: pH min 0x0010: Fluor max 0x0020: Fluor min 0x0040: DI1 0x0080: DI2 0x0100" DI3 0x0200: Error 0x400: Dosing contact	111
18.	Relay function Alarm 1	USCHAR	1	-	-	-	L, SP	0x01: N.O. n.sp. 0x02: N.C. n.sp. 0x04: N.O. sp.reset 0x08: N.C. sp.reset 0x10: N.O. sp.acknowledge 0x20: N.C. sp.acknowledge 0x80: Dosing contact	113
19.	Alarm 1 delay	USINT	2	0...600	min	1.0	L, SP	-	114
20.	Relay assign alarm 2	USINT	2	-	-	-	L, SP	0x0001: DES max 0x0002: DES min 0x0004: pH max 0x0008: pH min 0x0010: Fluor max 0x0020: Fluor min 0x0040: DI1 0x0080: DI2 0x0100: DI3 0x0200: Error	116
21.	Relay function Alarm 2	USCHAR	1	-	-	-	L, SP	See Adr. 18	118
22.	Delay Alarm 2	USINT	2	0...600	min	1.0	L, SP	-	119
23.	Relay assign Alarm 3	USINT	2	-	-	-	L, SP	See Adr. 20	121
24.	Relay function Alarm 3	USCHAR	1	-	-	-	L, SP	See Adr. 18	123
25.	Delay Alarm 3	USINT	2	0...600	min	1.0	L, SP	-	124
26.	Relay assign Alarm 4	USINT	2	-	-	-	L, SP	See Adr. 20	126
27.	Relay function Alarm 4	USCHAR	1	-	-	-	L, SP	See Adr. 18	128
28.	Delay Alarm 4	USINT	2	0-600	min	1.0	L, SP	-	129
29.	Limit DES max	SINT	2	Meas. range	mg/l	0.10 0.01	L, SP	-	131
30.	Limit DES min	SINT	2	Meas. range	mg/l	0.10 0.01	L, SP	-	133
31.	DES setpoint	SINT	2	Meas. range	mg/l	0.10 0.01	L, SP	-	135
32.	DES hysteresis	SINT	2	1...25	Digit	1.0	L, SP	-	317
33.	Limit pH max	SINT	2	Meas. range	pH	0.01	L, SP	-	139
34.	Limit pH min	SINT	2	Meas. range	pH	0.01	L, SP	-	141
35.	pH hysteresis	SINT	2	1...25	Digit	1.0	L, SP	-	143
36.	Limit Fluor max	SINT	2	Meas. range	mg/l	0.01	L, SP	-	145
37.	Limit Fluor min	SINT	2	Meas. range	mg/l	0.01	L, SP	-	147
38.	Fluor hysteresis	SINT	2	1...25	Digit	1.0	L, SP	-	149
39.	Range DES	USCHAR	1	-	-	-	L, SP	0x01: 0-20.0 mg/l 0x02: 0-10.0 mg/l 0x04: 0-5.00 mg/l 0x08: 0-2.00 mg/l 0x10: 0-1.00 mg/l 0x20: 0-0.50 mg/l 0x40: 0-0.20 mg/l	151
40.	Range pH	USCHAR	1	-	-	-	L, SP	0x01: 4-10.00 pH 0x02: 0-14.00 pH	152
41.	Hold function	USCHAR	1	-	-	-	L, SP	0x01: Off 0x02: On	153
42.	DES-Sensor	USCHAR	1	-	-	-	L, SP	0x01: 3pot cell 0x02: TC1 0x04: FC1 0x08: OZ7 0x10: CD7 0x20: Off	154

Table 3.4 - Address Reference List (Cont'd)

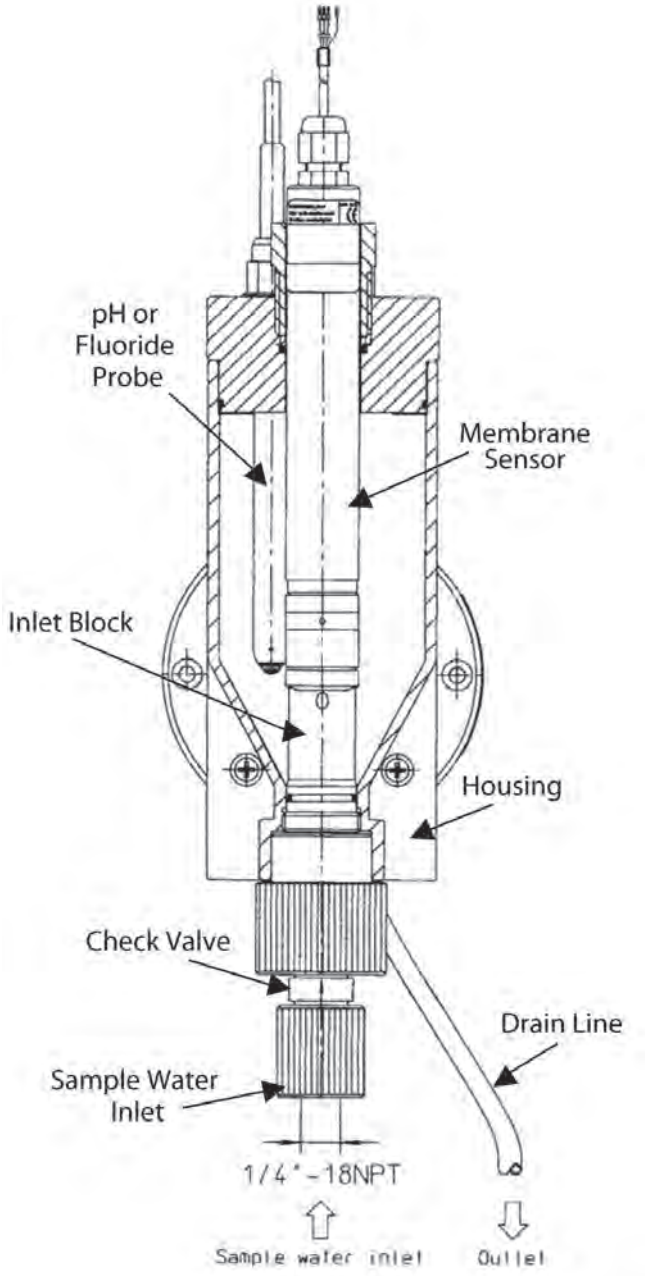
ADDR.	DESCRIPTION	FORMAT	LENGTH	RANGE	UNIT	FACTOR	STATUS	DESCRIPTION	BYTES
43.	Input 2	USCHAR	1	-	-	-	L, SP	0x01: pH 0x02: Fluor 0x04: Off	155
44.	Temperature	USCHAR	1	-	-	-	L, SP	0x01: PT1000 0x02: PT100 0x04: Off	156
45.	Mode Cl2 free	USCHAR	1	-	-	-	L, SP	0x01: Normal 0x02: pH compensated	157
46.	Local Operation	USCHAR	1	-	-	-	L, SP	0x01: Normal 0x02: Service	158
47.	Menu	USCHAR	1	-	-	-	L, SP	0x01: Short 0x02: Long	159
48.	Software number	ASCII	16	-	-	-	L	-	160
49.	Software version	ASCII	16	-	-	-	L	-	176
50.	Software date	ASCII	16	-	-	-	L	-	192
51.	Calibration values DES	ASCII	16	-	-	-	L	-	208
52.	Calibration values pH/Fluor	ASCII	16	-	-	-	L	-	224
53.	Calibration values Temperature	ASCII	16	-	-	-	L	-	240
54.	Interval DES	SINT	2	0...5000	h	h	L	-	256
55.	Interval pH/Fluor	SINT	2	0...5000	h	h	L	-	258
56.	Interval Temperature	SINT	2	0...5000	h	h	L	-	260
57.									262
58.									
59.									



W2T9694 DEPOLOX® 3 *plus* BARE ELECTRODE SENSOR KIT - ASSEMBLY

50.560.160.010

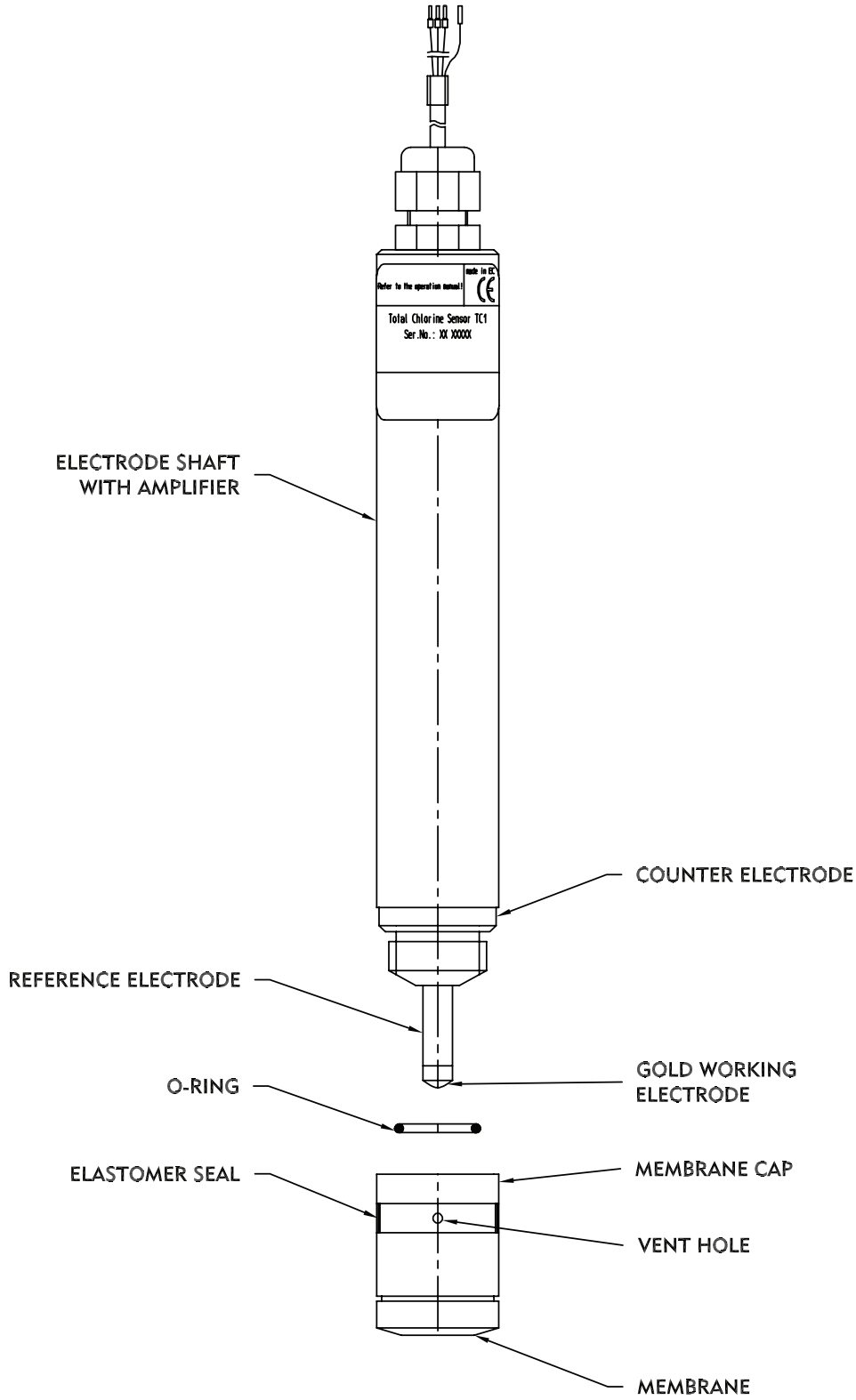
ISSUE 5 7-14



W2T9681 MEMBRANE SENSOR AND FLOWBLOCK - ASSEMBLY

50.560.160.015

ISSUE 4 7-14



MEMBRANE SENSOR KIT - ASSEMBLY

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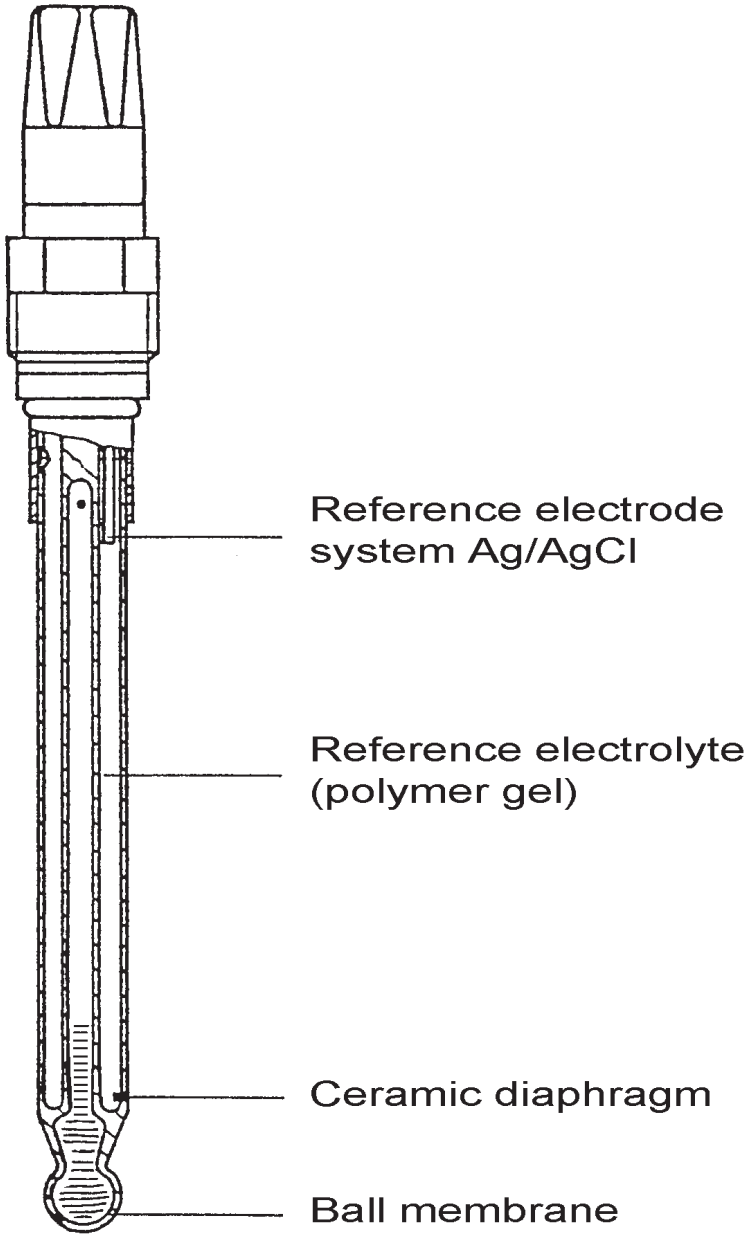

pH/FLUORIDE SENSOR - ASSEMBLY

50.560.160.030

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SECTION 4

SECTION 4 - SERVICE

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4.1 Depolox® 3 *plus*

Table 4.1 - Errors

Error Message	Cause	Remedy
High/Low Alarms:		
*min DIS ? * *max DIS ? * *min pH ? * *max pH ? * *min Fluor ? * *max Fluor ? *	Alarm value exceeded	Check dosing Check sample water flow
General Faults:		
*mA-output? *	mA loop impedance too high Loop interrupted	Check mA loop <1000 ohm Jump if not used
*cell DIS ? * *cell pH ? *	Sensor wrongly connected Sensor cables interchanged or (In ph compensated mode) pH is out of range	Check wiring Perform calibration or Adjust pH
*cell Fluor ? *	Sensor defective	Replace sensor
*Circ.Fail. ? *	Internal failure	Contact Evoqua Water Technologies
*temperature ? *	Temperature failure	Check temp. Sensor, wiring
<u>Warnings</u> *Range ? *	Alarm value out of range Range changed subsequently Setpoint Cl_2 out of range	Adjust range or limit value Adjust range or setpoint
*ADU 1 ? * *ADU 2 ? * *ADU 3 ? *	Internal failure	Call Evoqua Water Technologies service
*Cal. DIS ? * *Cal. pH ? * *Cal. Fluor ? *	Calibration error	Perform new calibration Check buffer solutions Replace electrolyte
*OVR DIS ? * *OVR pH ? * *OVR Fluor ? *	Value exceeds range Range does not fit Dosing too high	Check range and dosing
*DI1 ? * *DI2 ? * *DI3 ? *	Signal at the digital input	Check for the origin of the signal, e.g., sample water flow too low Jump if not used

Table 4.1 - Errors (Cont'd)

Error Message	Cause	Remedy
Additional Errors		
Device has no display	No mains power Defective fuse or wrong setting of mains voltage	Turn on external mains switch Check voltage setting and replace fuse, see paragraph 2.1.3
Displayed/output value wrong	Wrong calibration Old electrolyte or clogged membrane Wrong wiring or setting	New calibration Sensor maintenance Check sensor, wiring and setting
Device not responding correctly to software adjustments or corrections.	Incorrect software programming or corrupted memory.	Initialize software, see paragraph 3.1.9.

In case of an alarm:

- the alarm LED will become illuminated
- the display will detail the specific alarm every five seconds for one second for each alarm.
- if an alarm relay is associated to the alarm condition, the delay time will begin. At the end of the delay time the relay will be triggered.

NOTE: Refer to Table 4.2 - Relay / Display Operation During Alarm Conditions, for details.

Table 4.2 - Relay / Display Operation During Alarm Conditions

Alarm / ErrorType	Assigned to Relay	Alarm Status Sequence	Relay Type Latch / Non-latch	Press Alarm Ack key	Relay	Display	LED
Hi / Lo Alarm	yes	no alarm	Non-latch	NA	non-alarm state	no message	off
		alarm		NA	Alarm State	alarm message	on
		no alarm		NA	non-alarm state	no message	off
Hi / Lo Alarm	yes	no alarm	Latch	no	non-alarm state	no message	off
		alarm		no	alarm state	alarm message	on
		alarm		yes	non-alarm state	alarm message	blink
		no alarm		no	non-alarm state	no message	off
Hi / Lo Alarm	yes	no alarm	Latch	no	non-alarm state	no message	off
		alarm		no	alarm state	alarm message	on
		no alarm		no	alarm state	alarm message	on
		no alarm		yes	non-alarm state	no message	off
Hi / Lo Alarm	no	no alarm	NA	NA	NA	no message	off
		alarm	NA	NA	NA	alarm message	blink
		no alarm	NA	NA	NA	no message	off
General Fault	yes	no alarm	Non-latch	NA	non-alarm state	no message	off
		alarm		NA	Alarm State	alarm message	on
		no alarm		NA	non-alarm state	no message	off
General Fault	yes	no alarm	Latch	no	non-alarm state	no message	off
		alarm		no	alarm state	alarm message	on
		alarm		yes	non-alarm state	alarm message	blink
		no alarm		no	non-alarm state	no message	off
General Fault	yes	no alarm	Latch	no	non-alarm state	no message	off
		alarm		no	alarm state	alarm message	on
		no alarm		no	alarm state	alarm message	on
		no alarm		yes	non-alarm state	no message	off
General Fault	no	no alarm	NA	NA	NA	no message	off
		alarm	NA	NA	NA	alarm message	blink
		no alarm	NA	NA	NA	no message	off
Warning	no	no alarm	NA	NA	NA	no message	off
		alarm		NA	NA	alarm message	on
		no alarm		NA	NA	no message	off
Digital Input	yes	no alarm	Non-latch	NA	non-alarm state	no message	off
		alarm		NA	Alarm State	alarm message	on
		no alarm		NA	non-alarm state	no message	off
Digital Input	yes	no alarm	Latch	no	non-alarm state	no message	off
		alarm		no	alarm state	alarm message	on
		alarm		yes	non-alarm state	message	blink
		no alarm		no	non-alarm state	no message	off
Digital Input	yes	no alarm	Latch	no	non-alarm state	no message	off
		alarm		no	alarm state	alarm message	on
		no alarm		no	alarm state	alarm message	on
		no alarm		yes	non-alarm state	no message	off
Digital Input	no	no alarm	NA	NA	NA	no message	off
		alarm		NA	NA	alarm message	blink
		no alarm		NA	NA	no message	off

4.2 Maintaining W2T9694 Bare Electrode Flow Block Assembly

4.2.1 Maintenance

- Daily checks

  Each day check the complete unit for leaks, including all pipe unions and glands, and rectify all leaks immediately.

NOTE: All air leaks must receive immediate attention as they will have a detrimental effect on the operation of the cell unit. Should an air leak occur upstream of the measuring cell assembly, bubbles are seen passing through the cell block. With a leak down stream of the cell assembly, bubbles are seen only in the drain hose from the cell block.

Measure the actual free chlorine residual by any standard colorimetric or titration method ensuring the equipment manufacturers instructions are strictly observed.

Draw the sample water from the sample drain nipple (see Dwg. 50.560.160.010 in Section 3).

NOTE: It is very important to obtain consistent results when measuring the residual value of the test sample and it is recommended that precisely the same method is used every time a sample is tested.

If the indicated residual on the controller or amplifier display varies from the measured residual by more than is acceptable to the user, carry out the calibration procedure referred to in paragraph 3.2.1, Free Chlorine (Bare Electrode) Calibration.

If the variation still remains after recalibration, refer to “Bimonthly check,” below.

- Weekly checks

  With the sample water turned on, check that there is sufficient grit in the measuring cell block to keep the electrodes clean. This will be indicated by the amount of grit being swirled about in the vortex of the cell. Lack of grit will lead to insufficient cleaning and more grit must be added.

NOTE: When fresh grit is added to the cell block a temporary rise in cell output will normally occur which, generally, will last for two to three hours. It is important that no calibration adjustments are made during this period.

- Monthly checks

  Remove and clean, if fitted, the detachable element of the strainer in the sample water supply line. Check the calibration of the cell (refer to paragraph 3.2.1, Free Chlorine (Bare Electrode) Calibration)

- Bimonthly checks (see Dwg. 50.560.000.010)

  a. Check the zero point to ensure no drift has occurred.

  b. Check that the potassium chloride electrolyte is level with the bottom of the electrolyte reservoir neck and top up if necessary. This operation can be carried out by removing the plug (4) in the top of the electrolyte reservoir and filling with a syringe.

  c. The particles of grit used for continuous electrode cleaning take approximately two months to wear down. After this period of time the grit should be replaced. The procedure for grit replacement is detailed later.

  d. The membranes in the electrode case (6) form an interface between the reference electrolyte and the sample water. If the quality of the water passing through the cell is poor, especially if the water has a high iron content, inspect the two porous membranes (6) located in the electrode case. They should be white in color and any obvious discoloration is a sign that the membranes are becoming clogged up and should be replaced.

- Semi-annual checks

  Every six months the reference electrolyte should be replaced. Electrolyte replacement can be incorporated into a grit replacement operation. Having removed the reservoir (see steps a through f in the procedure on Grit Replacement that follows), the electrolyte should be discarded safely and the reservoir thoroughly washed in distilled water. Check the condition of the porous membranes and replace if needed. Refill the reservoir to the neck with fresh electrolyte and continue from step g in the Grit Replacement procedure.

- Grit Replacement (See Dwg. 50.560.000.010)

  When they become worn, grit particles should be replaced by taking the following steps:

  a. Close the shut-off valve at the cell inlet.

  b. Drain the cell by unscrewing the drain plug.

c. When the cell block is empty, install the drain plug.

d. Unscrew the electrolyte reservoir clamping nut (2) and remove the cell cover (3).

e. Withdraw the complete electrode/electrolyte reservoir assembly (4 to 11) from its housing. This can be achieved by exerting a gentle pressure at the top of the electrolyte reservoir. Rinse off the reservoir to remove any remaining grit particles.

f. Being careful of the cable connector, replace the assembly ensuring that the keying pin in the base of the cell block locates into its corresponding hole in the electrode housing (8).

g. Empty a half capful of grit into the cell block and replace the cover. The assembly should then be secured in its housing with the clamping nut.

h. Open the sample water shut-off valve at the inlet to the measuring cell assembly.

i. Leave the cell running for an hour, to allow the system to settle down, and then carry out the zero calibration procedure. This procedure may be repeated after 24 hours if required.

- Electrode and membrane replacement

The membranes, which form the contact point between reference electrode and sample water, cannot be cleaned. With very good water quality, membrane life may extend for up to three years continuous use. After this period of time however, they should be replaced. Where the quality of the sample water is particularly poor, fouling of the membranes may occur with a corresponding loss in cell efficiency (Refer to the note in “Bimonthly check,” above, for further details).

With the electrode/electrolyte reservoir assembly withdrawn from the cell block as described above, the electrodes may be removed and replaced as follows (see Dwg. 50.560.000.010):

a. Slacken the cable gland locking nut and unscrew the cable gland (11) taking care to avoid rotating the cable.

b. Unscrew the cover (10) and remove the push-fit connections from each electrode (and the temperature sensor if fitted).

c. Unscrew the nut (9) which clamps the electrolyte reservoir to the electrode housing (8) and separate the two items.

d. If the reference electrode (7) is to be replaced, hold the electrolyte reservoir vertical with the electrode uppermost. The electrode may now be unscrewed, by holding it just below the wire stem, and replaced.

e. To replace the two membranes (6) in the reservoir housing a pair of pointed tweezers (or similar) should be used. Insert the points into the holes in the pvc body of the membrane and gently pull and turn until the membrane is removed.

f. Fit new membrane using the same technique.

NOTE: The two half ring type platinum electrodes are arranged one above the other in the top recess of the electrode housing (8), with the counter electrode uppermost. To replace the working electrode it is necessary to first remove the counter electrode.

g. Gently push the stem (blue spot) of the counter electrode until the half ring can be grasped and the electrode removed from the housing.

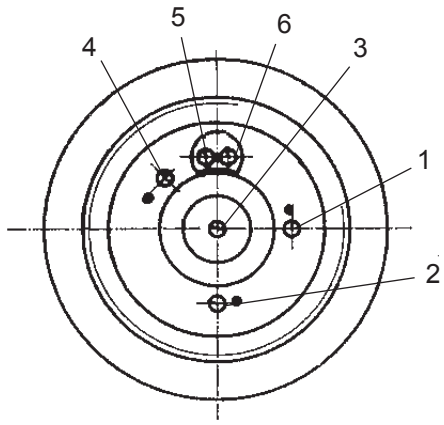
h. If the working electrode (red spot) is to be replaced repeat step g with the working electrode.

i. Carefully clean any grit or other deposits from the electrode recess in the upper housing ensuring no moisture enters the electrode stem bore.

j. Fit the replacement working electrode into thetop of the housing and gently (to avoid disturbing the 'O' rings in the bore) push the electrode down into position.

k. Repeat step j with the counter electrode.

l. Reassemble the reservoir to the electrode housing and, ensuring the bottom cover (10) is on the cable, reconnect the signal wires as shown in Figure 4.1:



(1) Counter electrode (blue spot) blue wire
(2) Working electrode (red spot) pink wire
(3) Reference electrode white wire
(4) Earth grey wire
(5) Temperature sensor brown wire
(6) Temperature sensor yellow & green wire

Figure 4.1

m. Reassemble the cover (10) and cable gland (11) to the electrode housing.

n. Refit the electrode/electrolyte reservoir assembly and secure with the clamping nut (2).

o. Reconnect the water inlet line, outlet line and the cell drain line.

p. Leave the cell running for an hour, to allow the system to settle down, and then carry out the zero calibration procedure. This procedure may be repeated after 24 hours if required.

4.2.2 Troubleshooting

The following troubleshooting table is provided for determining and correcting most common troubles.

Table 4.3 - Troubleshooting - Free Chlorine (Bare Electrode) Sensor Kit

FAULT CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
Insufficient sample water flow	drain hose free fall restricted	Ensure 1500mm free fall
	dirt in cell unit	clean cell
	air bubbles	check lines
	blocked strainer	clean strainer
	shut-off valve closed	open
	regulating valve not working correctly	strip and clean regulator
Air leaks	faulty o-rings	grease or replace
	faulty pipe connections	check and make good where needed
	booster	check and make good where needed
Electrode current too low	dirty electrodes	clean with fine sand paper, add more grit
	worn electrodes	replace
	electrodes touching	adjust
Unsteady output from electrodes	membrane clogged	replace
	air bubbles on inner surface of membrane	adjust
Zero or span not adjustable	zero current too high or too low	wait until 24-hour running-in period is completed
		measure the electrode voltage across terminals 30 and 31 and adjust Upot to 0.25V. Zero current must be <±5µA
		shut-off valve not closed at zero calibration
	cell current too low or too high	check µA-range
		increase sample water flow
		see also “Electrode current too low,” above
Indicated value oscillates considerably at constant chlorine concentration	considerable fluctuations in water pressure	check pressure
	fluctuation in pH value	check pH value
	inlet to cell body or flow regulator clogged	clean inlet or flow regulator
	flow regulator defective	check or replace

4.3 Maintaining W2T7957 Bare Electrode Flow Block Assembly

Replacing Cell Sand in W2T7957 Three-Electrode Cell

The cell sand required for constant cleaning of the electrodes grinds itself down over time until it is very fine. It must be replaced regularly. Cell sand is delivered in a plastic bottle:

1. Remove flow block assembly cover.
2. Close the ball valve on the sample water inlet.
3. Open the drain valve and drain the cell body (hold container underneath).
4. Close the drain valve when the cell body is empty.
5. Remove the sensors. Loosen the cable union (hold the cable while doing this as it may not be allowed to rotate).
6. Loosen the lower cap on the 3 electrode cell.
7. Remove the signal cable.
8. Unscrew the upper knurled nut on the electrolyte container.
9. Remove the electrolyte tank out of the cell body from below using the electrode mount.
10. Wash the cell sand out of the electrode mount.
11. Insert the electrode mount back into the cell body using the electrolyte container.
12. The cell body's dowl pin must be locked into place in the appropriate hole in the electrode mount.

NOTE: Screw the upper knurled nut back onto the electrolyte container.

13. Reconnect the signal cable acc. to color.

CNT	Counter electrode	Blue point	Blue cable
WRK	Working electrode	Red point	Pink cable
Ref	Reference electrode (middle)		White cable

14. Screw the cap back on.
15. Fill half a cap from the plastic bottle with cell sand and pour it into the cell body (approx. 1/2 cm^3 cell sand) (see section 3.3.4 "Adding Grit (Bare Electrode)").

16. Reinsert electrodes.

17. Reopen the check valve on the sample water inlet.

18. Perform calibration after approximately three hours running-in time.

NOTE: You must calibrate each time the cell sand is replaced. The calibration must be checked after one day. We recommend checking and, if necessary, replacing the electrodes and diaphragms when replacing the cell sand (see "Replacing electrolyte, electrodes and porous membranes").

W2T7957 Three-Electrode Cell Check Electrolyte Level

1. Check whether the electrolyte is filled approx. 3 cm over the water level (narrowing of the KCL container) and replenish, if necessary.

2. To do this, remove the plug in the upper part of the electrolyte tank and inject the electrolyte (use the syringe in the accessory set). The porous membranes in the electrolyte tank form the connection between the reference electrolytes and the sample water. If the sample water quality is poor (e.g. high iron content), both porous membranes in the electrolyte housing should be replaced. The porous membranes should be white (any coloration is an indication that the porous membranes are clogged and should be replaced).

3. Calibrate after approximately three hours.

NOTE: The calibration must be checked after one day.

Replacing Electrolyte, Electrodes and Porous Membranes

1. Remove flow block assembly cover.

2. Close the ball valve on the sample water inlet.

3. Open the drain valve and drain the cell body (hold container underneath).

4. Close the drain valve when the cell body is empty.

5. Remove the sensors. Loosen the cable union (hold the cable while doing this as it may not be allowed to rotate).

6. Loosen the lower cap on the 3 electrode cell.

7. Remove the signal cable.

Replace Electrolyte

8. Unscrew the upper knurled nut on the electrolyte container.

9. Remove the electrolyte tank out of the cell body from below using the electrode mount.

10. Remove the electrolyte container from the electrode mount. To do this, unscrew the knurled nut in the electrode mount.

11. Remove the electrolyte container out the electrode mount from the top.

12. Remove the drain plug from the electrolyte container.

13. Turn the electrolyte container upside down and drain the electrolytes by lightly shaking it.

Replacing Reference Electrode

14. If necessary, replace the reference electrode. The reference electrode can be unscrewed from the electrolyte container. Lightly wet the O-ring before installinga new reference electrode.

Replacing Porous Membranes

15. The porous membranes, which form the contact between the reference electrodes and sample water, cannot be cleaned. If the water quality is very good, the porous membranes can remain installed for up to three years; they should be replaced thereafter (no exceptions). If the sample water quality is poor, the porous membranes may be soiled. This influences the measuring accuracy.

16. Remove both porous membranes from the electrolyte container using a suitable tool (e.g. tweezers).

17. Push new porous membranes into the electrolyte container. Lightly wet the O-rings.

18. Insert the electrolyte container back into the electrode mount. Lightly wet the O-ring here as well.

19. Fill the container with fresh electrolyte (approx. 3 cm above the water level or narrowing of the electrolyte container).

20. Insert the drain plug into the electrolyte container.

21. Insert the electrode mount back into the cell body using the electrolyte container.

NOTE: The cell body's dowl pin must be locked into place in the appropriate hole in the electrode mount.

22. Screw the upper knurled nut back onto the electrolyte container.

23. Reconnect the signal cable acc. to colour.

CNT	Counter electrode	Blue point	Blue cable
WRK	Working electrode	Red point	Pink cable
Ref	Reference electrode (middle)		White cable

24. Screw the cap back on.

25. Fill half a cap from the plastic bottle with cell sanc and pour it into the cell body (approx. 1/2 cm³ cell sand) (see section 3.3.4 “Adding Grit (Bare Electrode)”).

26. Reinsert electrodes.

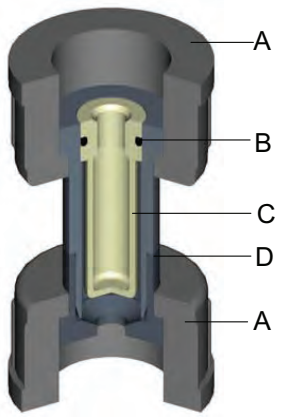
27. Reopen the check valve on the sample water inlet.

28. Perform calibration after approximately three hours running-in time.

NOTE: Perform a calibration after one hour running-in time and, if required, after 24 hours. You must calibrate each time the cell sand is replaced. The calibration must be checked after one day. Note the electrolyte’s expiration date. We recommend replacing the cell sand when replacing the electrodes and porous membranes.

Cleaning/Replacing the Fine Filter

A fine filter must only be installed when membrane sensors are employed. The fine filter must be cleaned or replaced in order to protect the membrane sensor’s delicate membrane against soiling or damage.



A	Knurled nut
B	O-ring
C	Fine filter
D	Filter unit

1. Release both knurled nuts (A)

2. Remove complete filter unit (D)

3. Remove the fine filter (C)

To do this, screw the M6 screw slightly into the fine filter and pull the fine filter out of the filter unit.
OR
Press the fine filter (C) with a suitable tool (not pointed) out of the filter unit.

4. Rinse the fine filter (C) with water, replace if necessary.

5. Place the fine filter (C) into the filter unit (D).

6. Ensure that the O-ring is fitted correctly (insert as far as possible).

7. Fit the filter unit (D). Ensure that it is fitted in the correct position.

8. Tighten both knurled nuts (A).

4.3.1 Maintaining Membrane Sensors

For the membrane sensor maintenance procedure, see section 2.3 “Membrane sensors”.

- “Membrane sensor for free chlorine FC1”
- “Membrane sensor for chlorine dioxide CD7”
- “Membrane sensor for ozone OZ7”
- “Membrane sensor for total chlorine TC1”

To keep the sensor in a constant state of readiness, leave the cap in place on the sensor until it is about to be installed. Do not discard the cap, but keep it and use it to protect the sensor whenever it is removed from service. Then fill the cap with water (not distilled) and place it over the tip of sensor.

The pH sensor has a threaded plug-in head. Care must be taken to ensure that the O-ring is present when connecting the head. A standard 1.5 m long, shielded coaxial (measuring) cable is supplied with the pH sensor. At one end the cable has a special plug which is screwed on to the threaded plug-in head of the sensor. The other end of the shielded special cable is connected directly to the intended terminal connection in the control module.

4.3.2 Maintaining pH Electrode

Clean and calibrate if there are fluctuations in the measured values. A routine schedule cannot be given here because the cleaning schedule depends heavily on the general condition of the sample water. In general, calibrate approx. every 4 weeks. Remove dirt on the glass membrane and diaphragm to prevent measuring errors. In particular, the ceramic electrode diaphragm may also be soiled or coated with lime deposits.

Remove contaminants deposited on the surface of the membrane glass; use diluted hydrochloric acid (up to 10%), if necessary. The electrodes should not

be cleaned in a dry state because this is more likely to smear the layer of dirt over the surface rather than removing it. Under no circumstances may the membrane be treated with abrasive cleaning agents.

The electrode must be rinsed subsequently with nothing other than water.

Remove lime deposits on the glass membrane and the diaphragm by immersing the electrode into hydrochloric acid (up to 10%). Rinse thoroughly with water or distilled water here as well; pH electrodes age. This is often the cause for a slow display of the pH value or a drop in the slope. pH electrodes typically last 1 to 2 years. However, routine maintenance of the electrodes recommended.

4.3.3 Maintaining Fluoride Electrode

If using the refillable electrolyte probe, routinely check the electrolyte level in the electrode (at least once per week). The fill level should always be just under the filling hole, approx. 25mm above the sample water. Replenish the electrolyte, if necessary. Routinely calibrate the measuring system to guarantee safe operation and accuracy.

If using the gel electrolyte probe, remove contaminants deposited on the surface of the membrane glass; use diluted hydrochloric acid (up to 10%), if necessary. The electrodes should not be cleaned in a dry state because this is more likely to smear the layer of dirt over the surface rather than removing it. Under no circumstances may the membrane be treated with abrasive cleaning agents.

Do not touch the glass surfaces with the cloth.

4.4 Membrane Sensor Kit

4.4.1 Maintenance

Daily: Check the entire system including all screw fittings for leakage and repair any leaks immediately. Using the cell outlet (see Dwg. 50.560.100.030 in Section 2), carry out a manual measurement every day.

NOTE: The same test method should always be used in order to obtain consistent comparisons between results. Air bubbles at the membrane effect the accuracy of measurement. The cause must be determined and rectified.

When there is an obvious difference between the displayed value and the manually measured value then a calibration must be performed (refer to paragraph 3.2.2, Membrane Calibration). If the deviation remains, even after calibration, then the electrodes should be cleaned in accordance with the manufacturers instructions (see instruction sheet contained in the sensor packaging).

Monthly: Perform a calibration.

4.4.2 Maintenance of the Membrane Probes

NOTE: Do not touch the membrane or reference electrode.

Before unscrewing the membrane cap, remove the elastomer seal to allow air into the vent hole. Unscrew the membrane cap, clean the reference electrode with distilled water and then dry with a clean paper towel. Cover the vent hole with the elastomer seal. Refill the cap with new electrolyte (refer to paragraph 2.3, Membrane Sensor). If the signal is still low or unstable, it may be necessary to replace the cap with a new one (refer to Section 6 - Spare Parts List).

After this procedure, the probe requires a run-in time of about one to two hours before recalibration.

4.4.3 Troubleshooting

The following troubleshooting table is provided for determining and correcting most common troubles.

Table 4.4 - Troubleshooting - Membrane Sensor Kit

FAULT CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
Insufficient flow of measuring water	free runoff prevented; back pressure too high	check for free drain or return
	dirt in cell	clean measuring cell
	air bubbles	check sample water take-off
	screen in water inlet blocked	clean
	inlet valve closed	open valve
Air bubbles	leaking O-rings	replace O-rings
	incorrect fittings	check and if necessary tighten or replace
DIS Electrode current too low	electrolyte exhausted	perform sensor maintenance
	membrane defective	replace membrane cap
DIS Span cannot be adjusted	measuring cell gives insufficient current	perform sensor maintenance
		The minimum current difference between un-chlorinated and chlorinated water with 1 mg/l residual DIS must be at least >2µA. If the difference is smaller, carry out maintenance.
Strong fluctuations in display, though chlorine concentration is constant	sample water flow too low	check; if necessary, clean inlet
	electrolyte exhausted	perform sensor maintenance

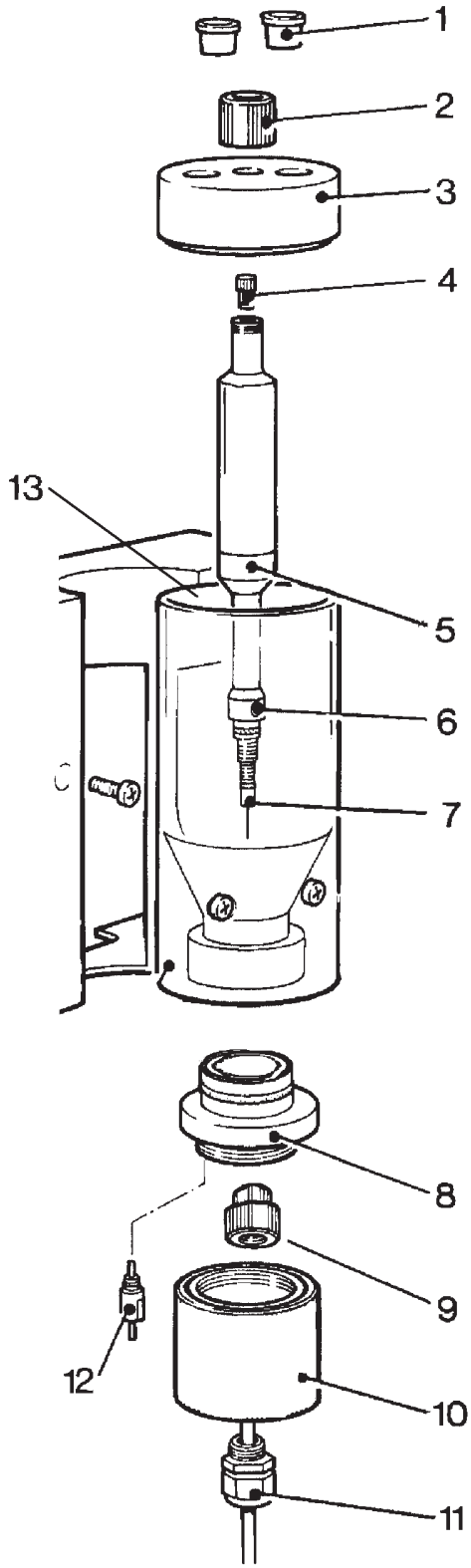
SECTION 5

SECTION 5 - ILLUSTRATIONS

List Of Contents

DWG. NO.

Parts
W2T9694 Bare Electrode Sensor Kit..... 50.560.000.010A&B
W2T9694 Bare Electrode Residual Analyzer 50.560.000.020A-E
W2T9681 Membrane Flow Block Assembly..... 50.560.000.030A&B
W2T7957 Depolox® 5..... 50.580.000.010A-D
W2T7958 VariaSens™..... 50.580.000.020A-C



NOTE: FOR PARTS LIST, SEE DWG. 50.560.000.010B.

W2T9694 BARE ELECTRODE SENSOR KIT - PARTS

50.560.000.010A

ISSUE 3 8-10

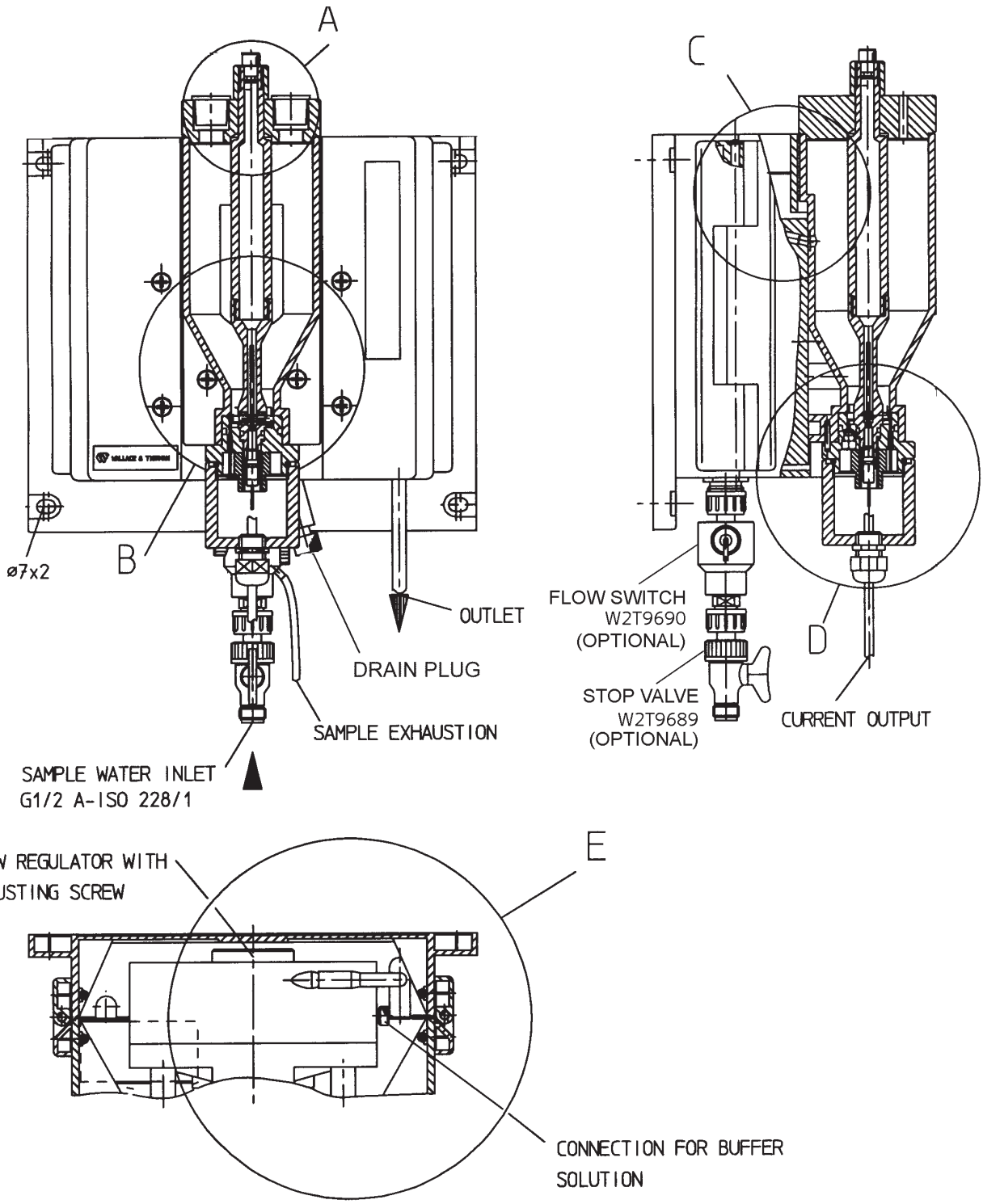
KEY NO.	PART NO.	QTY.	DESCRIPTION
1	W2T9673	2	CAP
2	W2T9645	1	NUT
3	W2T9643	1	COVER
4	W2T9652	1	PLUG
5	W2T9653	1	ELECTROLYTE RESERVOIR
6	W2T11582	2	MEMBRANE
7	W2T11581	1	REFERENCE ELECTRODE
8	W2T11012	1	ELECTRODE HOUSING (W/ WORKING & COUNTER ELECTRODE)
9	W2T9644	1	NUT
10	W2T418060	1	COVER
11	W2T418190	1	CABLE CONNECTOR
12	W2T9674	1	TEMPERATURE SENSOR
13	W2T9804	1	CELL BLOCK

WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

W2T9694 BARE ELECTRODE SENSOR KIT - PARTS LIST

50.560.000.010B

ISSUE 3 8-10

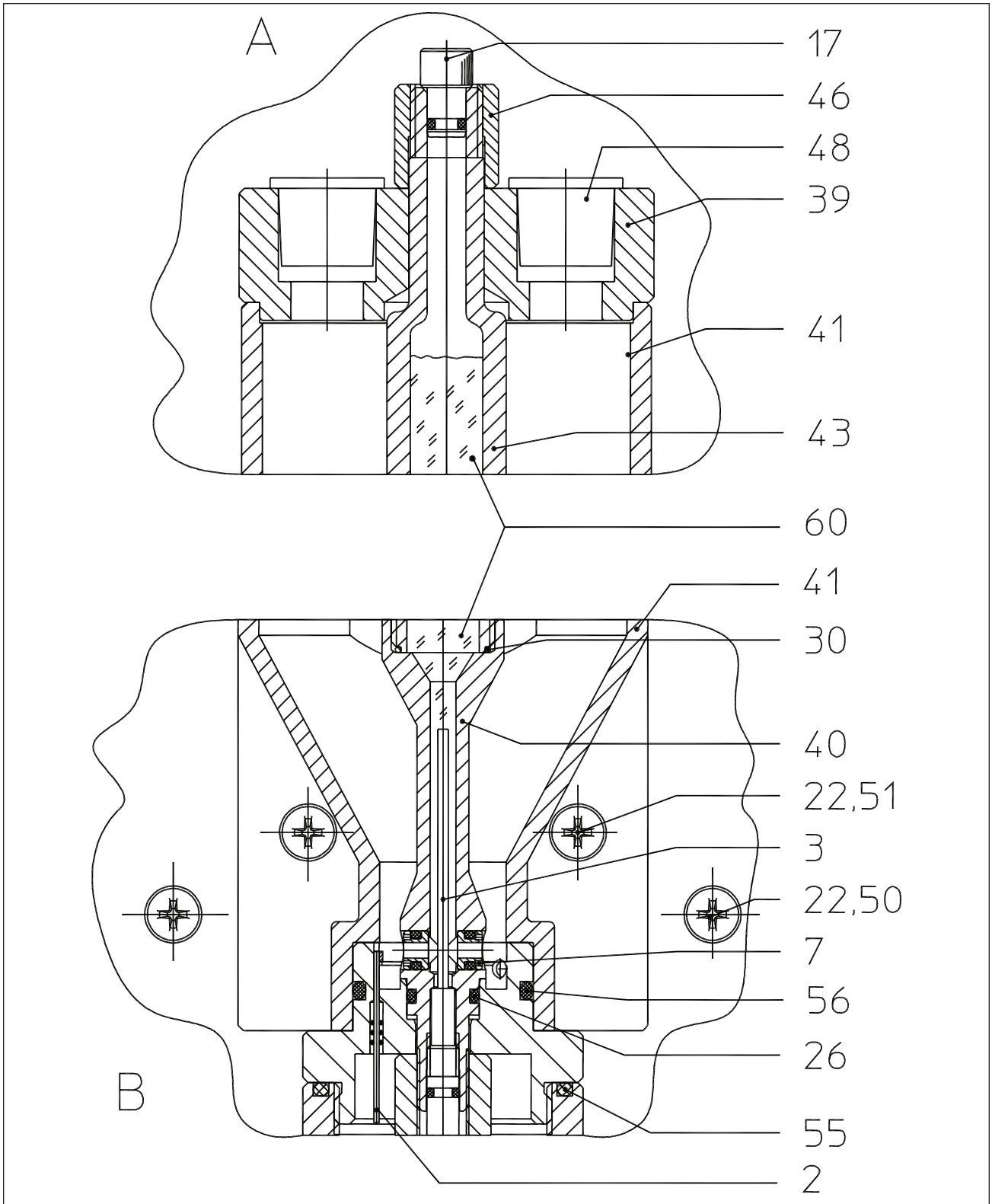


NOTE: FOR PARTS LIST, SEE DWG. 50.560.000.020E.

W2T9694 BARE ELECTRODE RESIDUAL ANALYZER - PARTS

50.560.000.020A

ISSUE 4 8-10

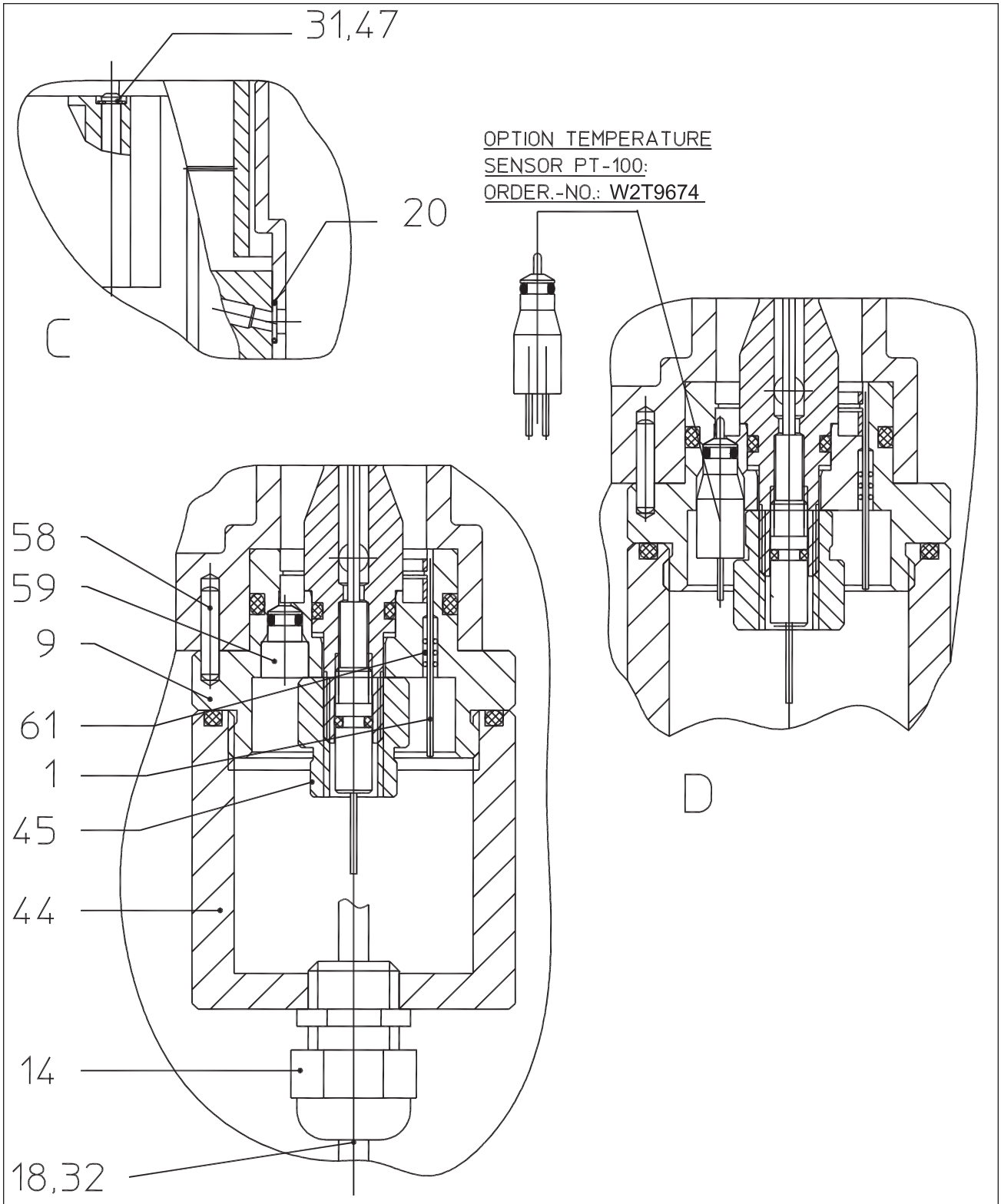


NOTE: FOR PARTS LIST, SEE DWG. 50.560.000.020E.

W2T9694 BARE ELECTRODE RESIDUAL ANALYZER - PARTS

50.560.000.020B

ISSUE 3 8-10

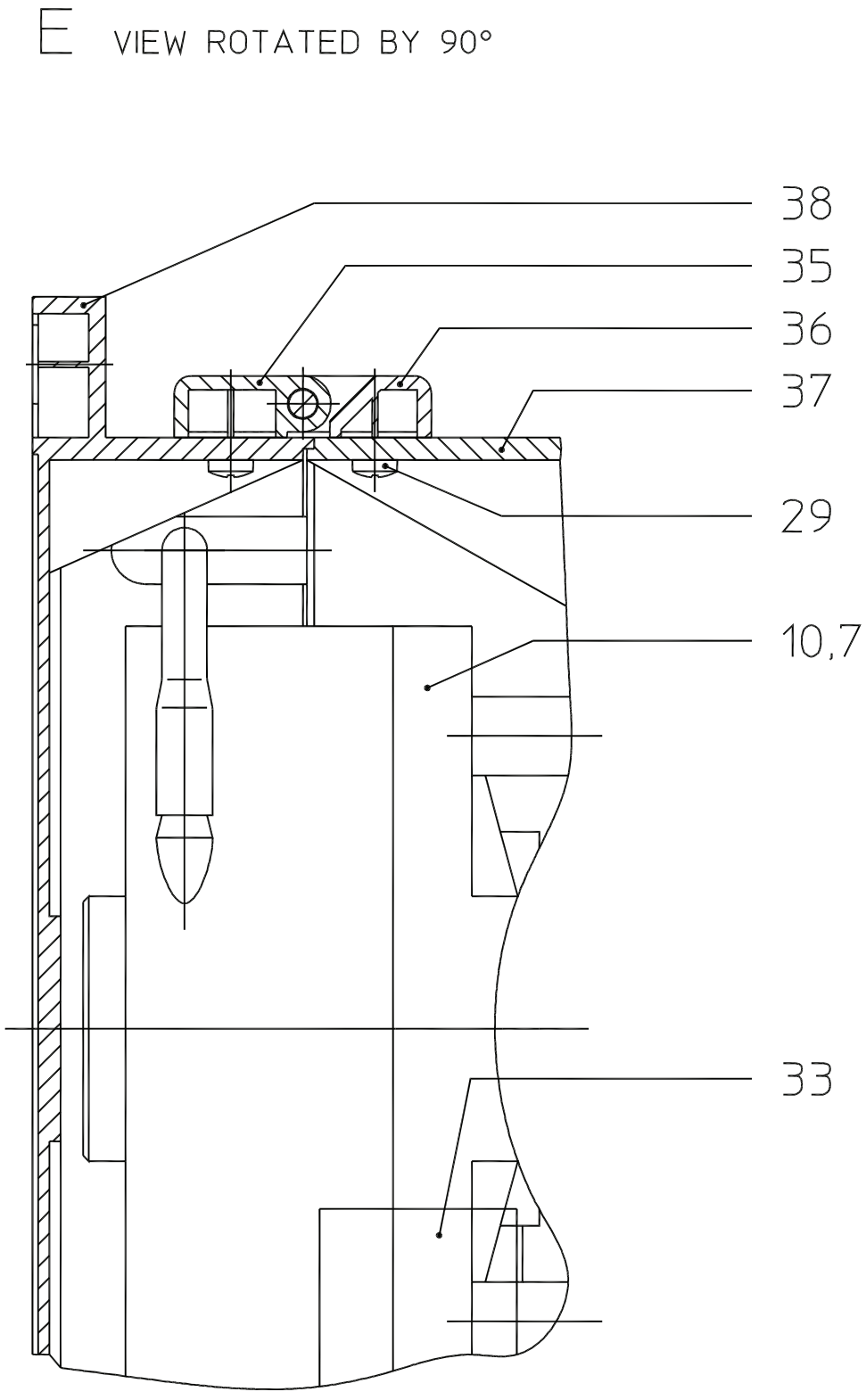


NOTE: FOR PARTS LIST, SEE DWG. 50.560.000.020E.

W2T9694 BARE ELECTRODE RESIDUAL ANALYZER - PARTS

50.560.000.020C

ISSUE 3 8-10



NOTE: FOR PARTS LIST, SEE DWG. 50.560.000.020E.

W2T9694 BARE ELECTRODE RESIDUAL ANALYZER - PARTS

50.560.000.020D

ISSUE 3 8-10

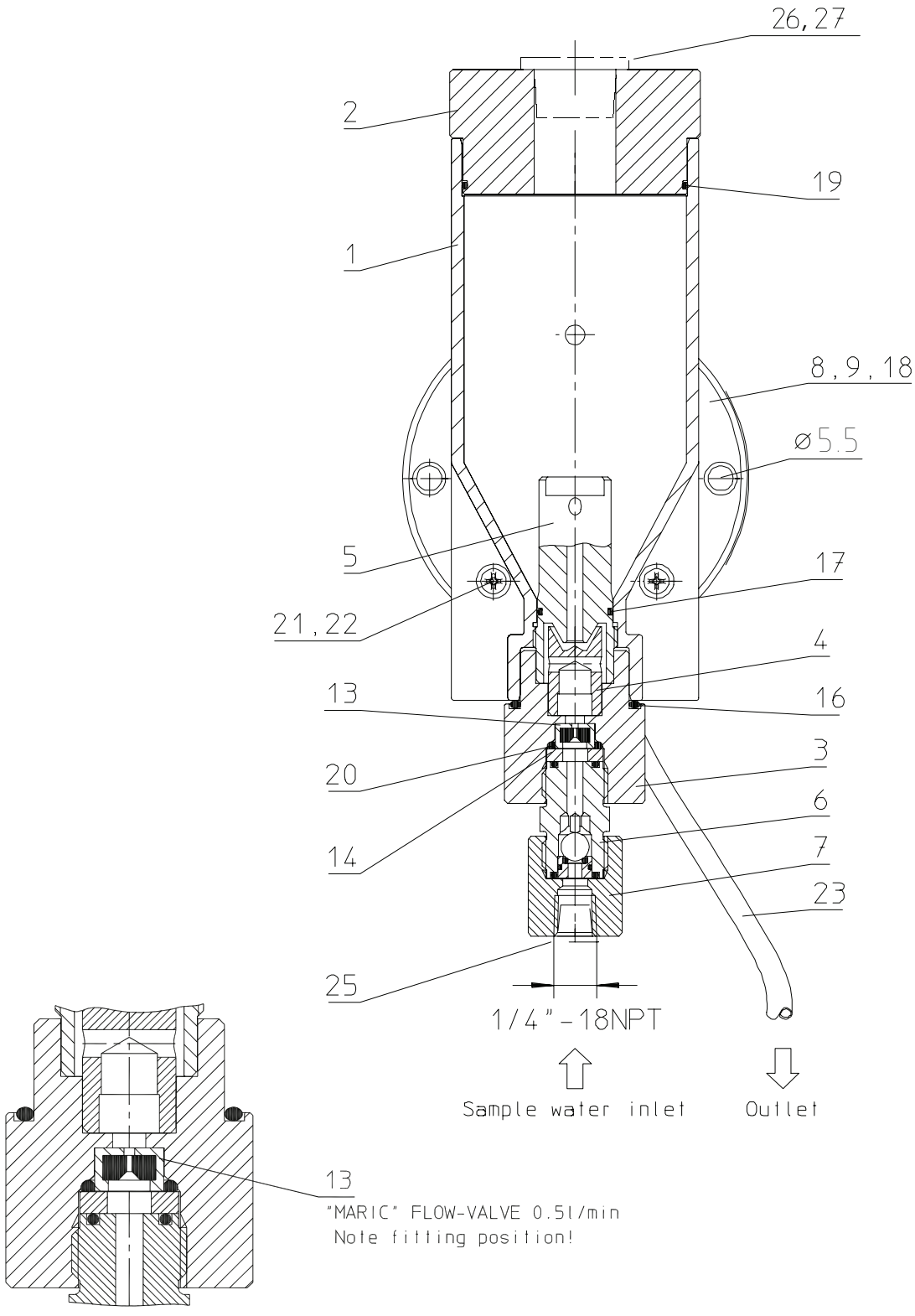
KEY NO.	PART NO.	QTY.	DESCRIPTION
▲ 1	W3T127848	1	ELECTRODE
▲ 2	W3T127849	1	ELECTRODE
3	W2T11581	1	ELECTRODE
7	W2T11582	2	MEMBRANE COMPLETE
▲ 9	W3T149176	1	ELECTRODES PICK UP
10	W2T418189	1	FLOW CONTROL VALVE
14	W2T418190	1	CABLE TERMINAL SCREW
17	W2T9652	1	PLUG UNIT
18	W2T440058	1	CELLULAR CABLE
20	W2T18570	2	O-RING
22	W2T11355	6	WASHER
26	W2T9670	1	O-RING
29	W2T499222	20	EJOT PT-SCREW
30	W2T438267	1	O-RING
31	W2T479373	2	WASHER
32	W2T499252	1	CABLE CLAMP
33	W3T149177	1	NAME PLATE
● 34	W2T499254	1	CAP
35	W3T149178	2	HINGE
36	W3T149179	2	HINGE
37	W3T149180	1	HOUSING UPPER PART
38	W3T149261	1	HOUSING LOWER PART
39	W2T9643	1	CELLULAR COVER
40	W3T139776	1	ELECTRODE CASE
41	W2T9804	1	CELL BLOCK
43	W3T149262	1	TANK
44	W2T418060	1	COVER
45	W2T9644	1	KNURLED NUT
46	W2T9645	1	NUT
47	W2T418061	2	CONNECTING PIECE
● 48	W2T9673	2	CAP
50	W2T11146	4	SCREW
51	W2T419109	2	SCREW
● 53	W3T149263	1	FELT WASHER
55	W2T9671	1	O-RING
▲ 56	W2T11147	1	O-RING
58	W2T9672	1	CYLINDER PIN
▲ 59	W3T149264	1	PLUG
60	W2T9646	0.031	KCl ELECTROLYTE (PART OF KCl ELECTROLYTE SET)
▲ 61	W2T12058	6	O-RING

NOTE: ▲ INCLUDED IN ELECTRODE HOUSING.
● ONLY FOR TRANSPORT.

WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

W2T9694 BARE ELECTRODE RESIDUAL ANALYZER - PARTS LIST

50.560.000.020E
ISSUE 3 10-10



NOTE: FOR PARTS LIST, SEE DWG. 50.560.000.030B.

W2T9681 MEMBRANE FLOW BLOCK ASSEMBLY - PARTS

50.560.000.030A

ISSUE 3 8-10

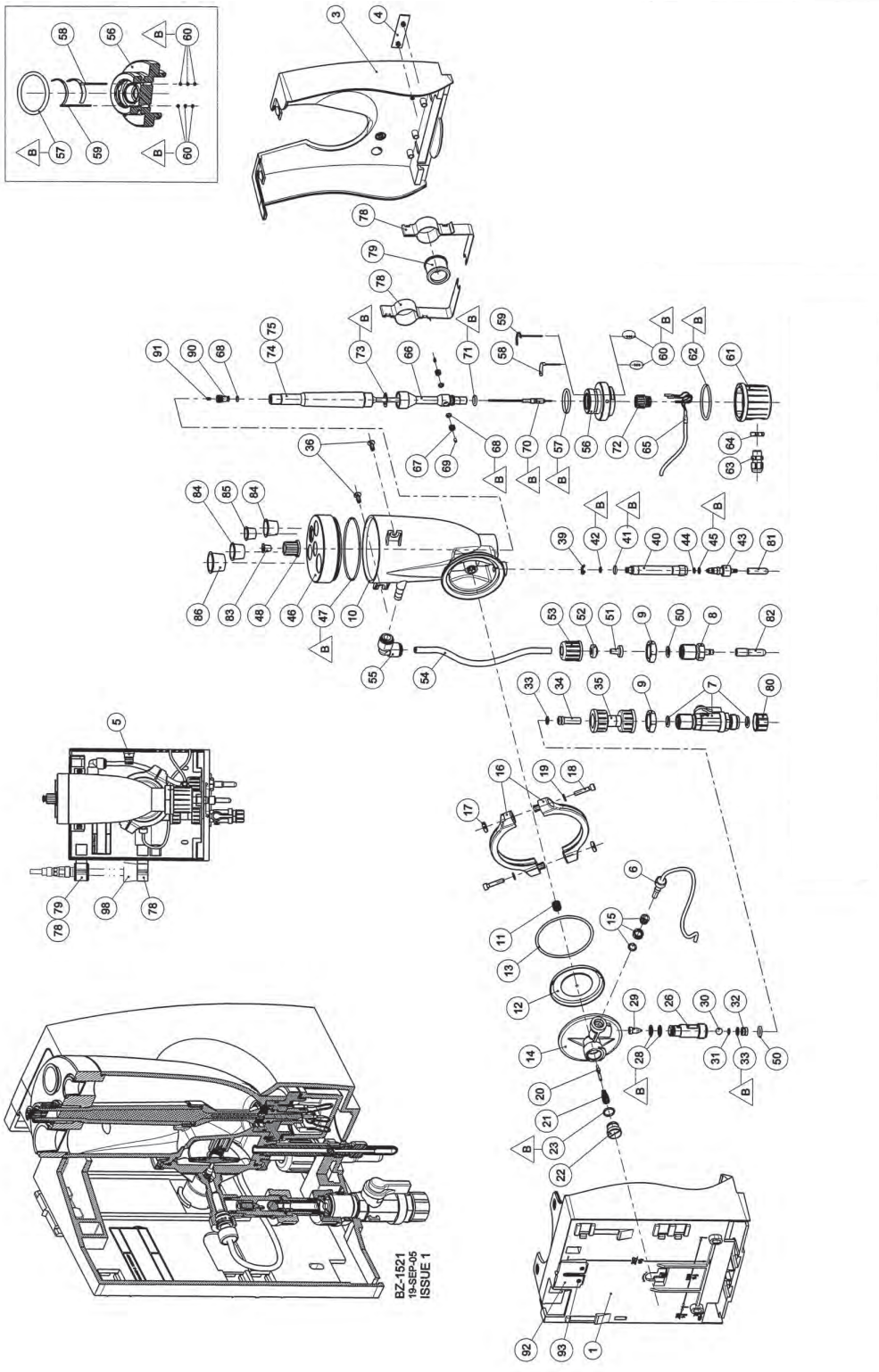
KEY NO.	PART NO.	QTY.	DESCRIPTION
1	W2T9663	1	CELL BLOCK
2	W3T149265	1	CELL COVER
5	W3T149266	1	INLET BLOCK
6	W2T9665	1	CHECK VALVE
7	W2T9666	1	ADAPTOR
8	W3T149267	1	EXHAUSTION
9	W2T499033	1	UNION
13	W2T9983	1	FLOW VALVE
14	W2T9664	1	CLAMPING RING
16	W2T12574	1	O-RING
17	W2T9667	1	O-RING
18	W2T18570	1	O-RING
19	W2T9668	1	O-RING
20	W2T17826	1	O-RING
21	W2T419109	2	SCREW
22	W2T11355	2	PLAIN WASHER
23	W2T8534	0.3m	TUBE
25	W2T19352	1	PLUG
26	W2T12043	1	PLUG
27	W2T16513	1	PLUG

WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

W2T9681 MEMBRANE FLOW BLOCK ASSEMBLY - PARTS LIST

50.560.000.030B

ISSUE 3 10-10



NOTE: FOR PARTS LIST, SEE DWGS. 50.580.000.010B-D.

W2T7957 DEPOLOX® 5 - PARTS

50.580.000.010A
ISSUE 1 8-10

KEY NO.	PART NO.	DESCRIPTION
1	W3T149386	BASE HOUSING
1,92,93	W3T149385	BASE HOUSING, PRE-ASSEMBLED
3	W3T149387	HOUSING COVER
4	W3T149388	PRODUCT ID
5	W2T499035	CABLE CLIP
6	W2T416793	MULTI SENSOR
7	W2T420400	SHUT-OFF VALVE
8	W3T149389	OUTLET CONNECTION
9	W2T499055	LOW CROWN NUT
10	W2T416781	CELL BODY
11	W3T149390	COMPRESSION RING
12	W2T116782	MEMBRANE UNIT
13	W2T499041	O-RING
14	W3T149661	CONTROL VALVE BODY
15	W2T416386	PLASTIC CARTRIDGE
16	W3T149662	V PROFILE CLAMP
17	W3T149663	SQUARE NUT
18	W2T442619	PAN HEAD SCREW
19	W2T11355	WASHER
20	W3T149664	VALVE NEEDLE
21	W3T149665	COMPRESSION RING
22	W3T149666	ADJUSTING SCREW
23	W3T149667	O-RING
26	W3T149668	CHECK VALVE HOUSING
28	W2T13117	O-RING
29	W3T149669	FLOAT, INCLUDES MAGNET
30	W3T149670	BALL
31	W3T149671	O-RING
32	W3T149672	UNION END
33	W3T149673	O-RING
34	W3T149674	FINE FILTER
33,34	W3T149675	FINE FILTER, COMPLETE
35	W2T361801	FILTER HOUSING
36	W2T499042	PLASTIC SELF-TAPPING SCREW
39	W2T416444	SECURING RING
40	W2T416597	DRAIN TUBE

WHEN ORDERING MATERIAL ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS

W2T7957 DEPOLOX® 5 - PARTS LIST

50.580.000.010B

ISSUE 1 10-10

KEY NO.	PART NO.	DESCRIPTION
41	W2T416529	O-RING
42	W2T416530	O-RING
43	W2T416783	DRAIN SCREW
44	W3T149682	FLAT GASKET
45	W2T18871	O-RING
46	W2T420306	CELL BODY COVER
47	W2T416528	O-RING
48	W2T9645	KNURLED NUT
50	W2T12552	O-RING
51	W3T149683	HOSE BUSHIN G
52	W3T149684	LOCKING RING
53	W3T149685	UNION NUT
50-53	W3T149686	HOSE CONNECTION PARTS
54	W3T149687	HOSE
55	W2T499043	REDUCING ELBOW
56	W3T127850	ELECTRODE MOUNT
57	W2T11147	O-RING
58	W3T127848	WORKING ELECTRODE
59	W3T127849	COUNTER ELECTRODE
60	W2T12058	O-RING
61	W3T149688	SEALING CAP
62	W2T9671	O-RING
63	W3T149689	CABLE UNION
64	W2T499056	HEXAGON NUT
65	W3T149690	CONNECTOR CABLE COMBINATION
66	W3T139776	ELECTRODE CASE
67-69	W2T11582	DIAPHRAGM COMPLETE
70	W2T11581	REFERENCE ELECTRODE
71	W2T9670	O-RING
72	W2T9644	KNURLED NUT
73	W2T438267	FLAT GASKET
74	W2T11564	KCL ELECTRODE SET, 100ml
75	W3T149262	CONTAINER
78	W3T149721	CLIP, COATED
79	W3T149722	ELECTRODE MOUNT
80	W2T499247	SCREW CAP

WHEN ORDERING MATERIAL ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS

W2T7957 DEPOLOX® 5 - PARTS LIST

50.580.000.010C

ISSUE 1 10-10

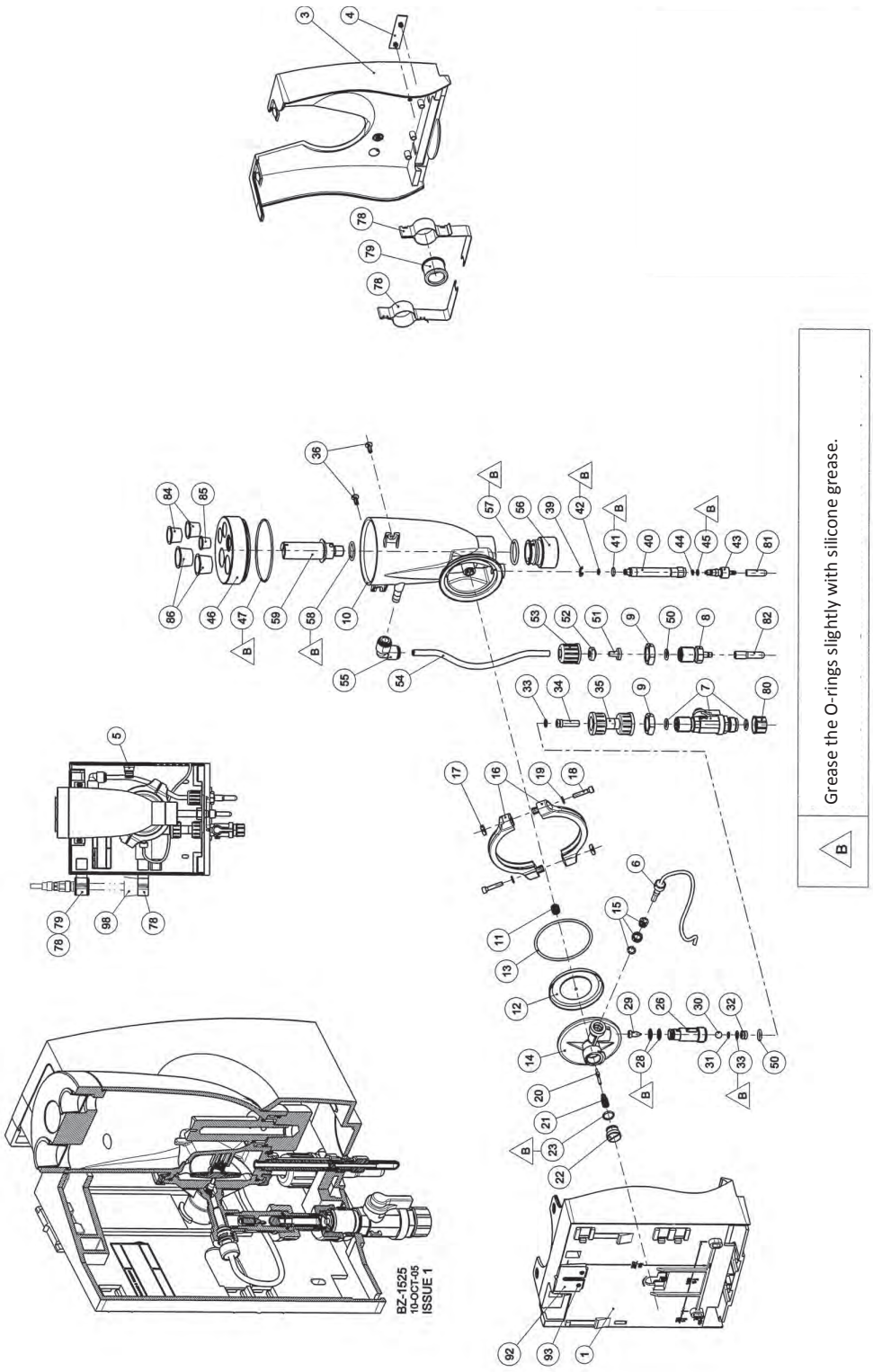
KEY NO.	PART NO.	DESCRIPTION
81	W2T499046	PROTECTION CAP
82	W2T499047	PROTECTION CAP
83	W2T499254	PROTECTION CAP
84	W2T9673	PROTECTION CAP
85	W2T499050	PROTECTION CAP
86	W2T499051	PROTECTION CAP
68,90,91	W2T9652	PLUG COMPLETE
92	W3T149723	WALL HOOKS
93	W2T499245	SHEET METAL SCREW
98	W2T499052	BREAKER, 1 PC
98	W3T149724	BREAKER, 75 PC
Accessories	W3T149263	FELT WASHER, TRANSPORT LOCK
Accessories	W3T149686	HOSE CONNECTION PARTS, ID 6 x WDG 1
Accessories	W3T149725	HOSE CONNECTION PARTS, ID 6 x WDG 3
Accessories	W2T416995	ELECTRODE CLEANING SAND “QK”
Accessories	W3T149726	MOUNTING SET

WHEN ORDERING MATERIAL ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS

W2T7957 DEPOLOX® 5 - PARTS LIST

50.580.000.010D

ISSUE 1 10-10



NOTE: FOR PARTS LIST, SEE DWGS. 50.580.000.020B&C.

W3T158742 VARIASENS™ WETSIDE - PARTS

50.580.000.020A

ISSUE 2 2-11

KEY NO.	PART NO.	DESCRIPTION
1	W3T160628	BASE HOUSING
1,92,93	W3T164571	BASE HOUSING, PRE-ASSEMBLED
3	W3T160629	HOUSING COVER
4	W3T160908	PRODUCT ID
5	W2T499035	CABLE CLIP
6	W3T172029	MULTI SENSOR
7	W3T166170	SHUT-OFF VALVE
8	W3T158593	OUTLET CONNECTION
9	W2T499055	LOW CROWN NUT
10	W3T158561	CELL BODY
11	W3T164226	COMPRESSION RING
12	W3T158569	MEMBRANE UNIT
13	W3T160654	O-RING
14	W3T158595	CONTROL VALVE BODY
15	W2T504209	PLASTIC CARTRIDGE
16	W3T160649	V PROFILE CLAMP
17	W3T158567	SQUARE NUT
18	W2T442619	PAN HEAD SCREW
19	W2T11355	WASHER
20	W3T158572	VALVE NEEDLE
21	W2T376069	COMPRESSION RING
22	W3T158573	ADJUSTING SCREW
23	W3T160357	O-RING
26	W3T160648	CHECK VALVE HOUSING
28	W2T13117	O-RING
29	W3T169827	FLOAT, INCLUDES MAGNET
30	W3T149670	BALL
31	W3T149671	O-RING
32	W3T149672	UNION END
33	W3T149673	O-RING
34	W3T168189	FINE FILTER
33,34	W3T150633	FINE FILTER, COMPLETE
35	W3T158602	FILTER HOUSING
36	AAC5002	PLASTIC SELF-TAPPING SCREW
39	W3T172041	SECURING RING
40	W3T158576	DRAIN TUBE

WHEN ORDERING MATERIAL ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS

W3T158742 VARIASENS™ WETSIDE - PARTS LIST

50.580.000.020B

ISSUE 1 2-11

KEY NO.	PART NO.	DESCRIPTION
41	PXC95968	O-RING
42	AAC7126	O-RING
43	W3T158575	DRAIN SCREW
44	W3T166261	FLAT GASKET
45	W2T18871	O-RING
46	W3T158738	CELL BODY COVER
47	AAC4906	O-RING
50	W2T12552	O-RING
51	W3T149683	HOSE BUSHING
52	W3T169815	LOCKING RING
53	W3T149685	UNION NUT
50-53	W3T149686	HOSE CONNECTION PARTS
54	W3T158601	HOSE
55	W2T505093	REDUCING ELBOW
56	W3T158740	PRESS-OUT PLUG
57	W2T11147	O-RING
58	W3T167941	O-RING
59	W3T158793	FLOW BODY
78	W3T166169	CLIP, COATED
79	W3T172045	ELECTRODE MOUNT
80	W2T499247	SCREW CAP
81	W2T499046	PROTECTION CAP
82	W2T499047	PROTECTION CAP
84	W2T9673	PROTECTION CAP
85	W2T499050	PROTECTION CAP
86	W2T499051	PROTECTION CAP
92	W3T160627	WALL HOOKS
93	W2T499245	SHEET METAL SCREW
98	W2T499052	BREAKER, 1 PC
98	W3T158600	BREAKER, 75 PC
Accessories	W3T149686	HOSE CONNECTION PARTS, ID 6 x WDG 1
Accessories	W3T149725	HOSE CONNECTION PARTS, ID 6 x WDG 3
Accessories	W3T149726	MOUNTING SET

WHEN ORDERING MATERIAL ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS

W3T158742 VARIASENS™ WETSIDE - PARTS LIST

50.580.000.020C

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SECTION 6

SECTION 6 - SPARE PARTS LIST

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W2T9694 Free Chlorine (Bare Electrode) Sensor Kit 6.1
Membrane Sensor Kits 6.2
W2T7957 Bare Electrode Retrofit Set 6.2.1
W2T7958 VariaSens Retrofit Set 6.2.2
pH Sensor 6.3
Fluoride Sensor Kits 6.4
Fluoride/pH Cables 6.5
Fuses 6.6
Circuit Boards 6.7

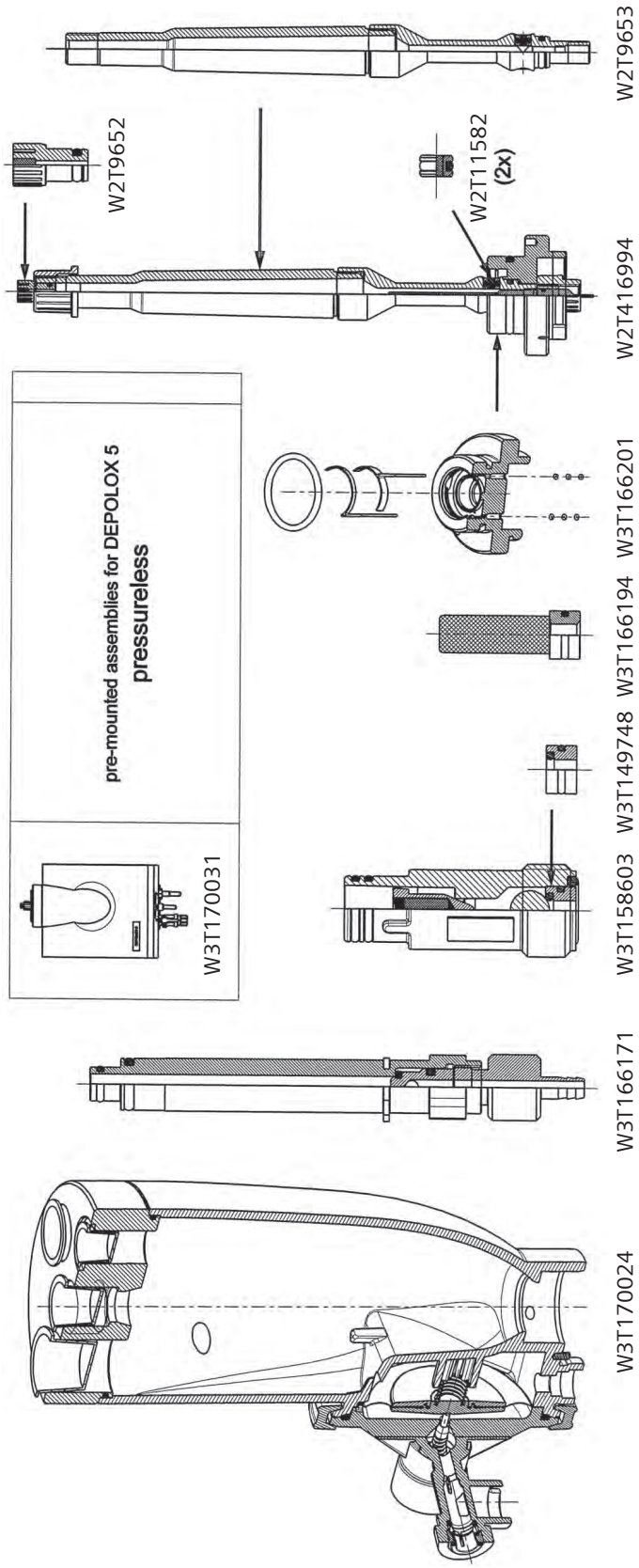
6.1 W2T9694 Free Chlorine (Bare Electrode) Sensor Kit

DESCRIPTION	PART NO.
Spare part set for two years operation	W2T9012
Spare part set for five years operation	W2T9013
Individual spare parts:	
Electrode housing (with working and counter electrode)	W2T11012
Membrane (two required)	W2T11582
Electrolyte for reference electrode	W2T9646
Grit (25 g)	W2T9647
PT100 Temperature Sensor	W2T9674

6.2 Membrane Sensor Kits

DESCRIPTION	PART NO.
Mem Sen Pack TCl (Total Chlorine) PM Kit (includes membrane cap, elastomer seal, O-ring, electrolyte, abrasive paper, instruction)	W2T9688
Mem Sen Pack FC1 (Free Chlorine) PM Kit	W2T8663
Mem Sen Pack OZ7 (Ozone) PM Kit	W2T8661
Mem Sen Pack CD7 (Chlorine Dioxide) PM Kit	W3T134190
2m Cable	W2T416786
5m Cable	W2T420222
10m Cable	W3T149888
15m Cable	W2T416799
25m Cable	W3T149743
50m Cable	W3T149744

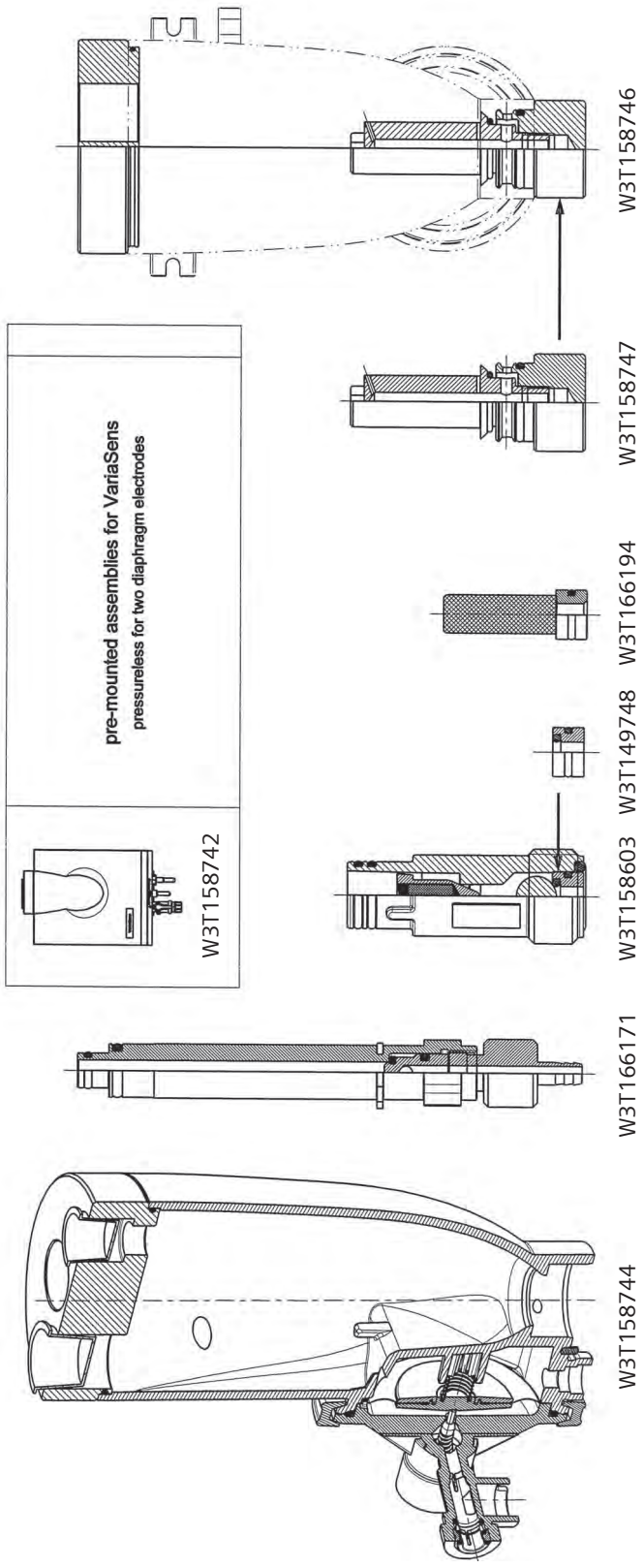
6.2.1 Bare Electrode Retrofit Set W2T7957



6.2.1.1 Bare Electrode Retrofit Set Parts List W2T7957

Part. No.	Description
W2T7957	Flow block assembly
W3T149745	Cell body D5-DL, complete
W3T149746	Drain unit
W3T149747	Back pressure unit
W3T149748	Ball seat, complete
W3T149675	Fine filter
W3T149749	Electrode support, complete
W2T416994	Electrode cell, complete, electrode not included
W2T9652	Plug complete
W2T11582	Diaphragm complete
W2T9653	Electrode housing
W2T350531	Spare parts set, BASIS-KIT
W3T129462	Spare parts set, 4 years Operation

6.2.2 VariaSens™ Retrofit Set W2T7958



6.2.2.1 VariaSens™ Retrofit Set Parts List W2T7958

Part. No.	Description
W2T7958	Flow block assembly
W3T149750	Cell body VS-DL, complete
W3T149746	Drain unit
W3T149747	Back pressure unit
W3T149748	Ball seat, complete
W3T149675	Fine filter
W3T149751	Flow body, complete
W3T149752	Retrofit kit D5-DL/VS-DL
W2T350531	Spare parts set, BASIS-KIT
W3T129463	Spare parts set, 4 years Operation

6.3 pH Sensor

DESCRIPTION	PART NO.
pH sensor	W2T12126
Impedance transformer (optional)	W2T9651

6.4 Fluoride Sensor Kits

DESCRIPTION	PART NO.
Complete Refillable Fluoride Sensor Kit (W2T9656 & W2T9651)	W2T417005
Refillable Fluoride sensor	W2T9656
Complete Gel Fluoride Sensor Kit (W2T8660 & W2T9651)	W3T124078
Gel Fluoride sensor	W2T8660
Impedance transformer	W2T9651
100 mg/l calibration solution	W2T18257
Fluoride filling solution	W2T8827

6.5 Fluoride/pH Cables

DESCRIPTION	PART NO.
Fluoride/pH Cable - 5m	W3T115466
Fluoride/pH Cable - 10m	W3T127847
Fluoride/pH Cable - 15m	W3T150921
Fluoride/pH Cable - 25m	W3T150922
Fluoride/pH Cable - 50m	W3T150923

6.6 Fuses

DESCRIPTION	PART NO.
Fuse, 115V and 230V Electronics	W2T420282

6.7 Circuit Boards

DESCRIPTION	PART NO.
Single Channel Electronics	W2T416999
Dual Channel Electronics	W2T417000

NOTE: Circuit boards shipped with voltage set at default 230V. See section 2.1.3 for instruction on changing voltage if necessary.

MANUFACTURER/DISTRIBUTOR:

Chloratech (Wallace & Tiernan)
Marie-Chantale Boudreault
212 rue Pierre-Couture
St-Augustin-de-Desmaures, QC, G3A 0A4
Phone: (418) 872-4200
pieces@chloratech.ca

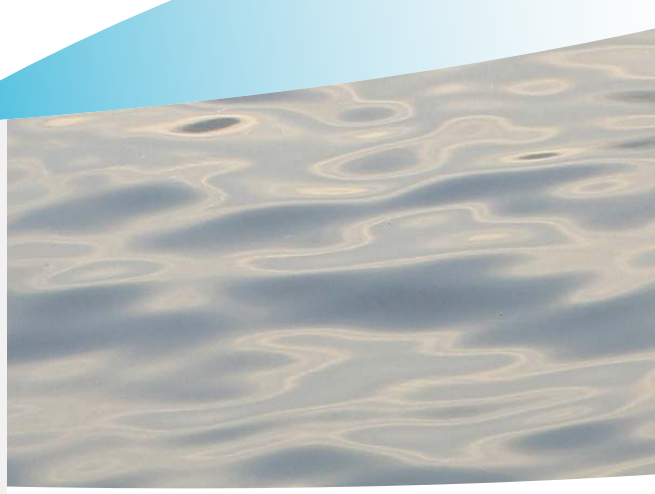
~~**ControValve (MSA)**~~
~~Raymond Butz~~
~~9610 Rue B. Ignace~~
~~Brossard, QC, J4Y 2R4~~
~~Phone: (450) 444-5858~~
~~wferreira@controvalve.com~~

8.1 Wallace & Tiernan Acutec 35 Gas Monitor System (WTP)

Wallace & Tiernan/Siemens
Chlorine Gas Detector

Acutec 35

EVOQUA
WATER TECHNOLOGIES



WALLACE & TIERNAN® SYSTEMS ACUTEC™ 35 GAS DETECTION SYSTEM

The Acutec™ 35 system utilizes the latest on-line gas monitoring technology to provide a flexible and reliable, self-testing detection system in a compact modular design. With sensors to detect the presence of chlorine, ammonia, or sulfur dioxide gases in ambient air, the Acutec 35 system is ideal for detecting leaks from storage containers, process piping, or gas feed equipment in any type of water, wastewater, or industrial plant environment.

THE BEST GAS DETECTION SYSTEM UNDER THE SUN

The Acutec 35 system's modular design allows for a wide range of configurations that can be simply and neatly installed, using standard enclosures.

The receiver module is available in a choice of either a Detector or Monitor version, which has an LED display, and an mA output signal. Both provide two selectable levels of alarm. A low level warning alarm may simply indicate transient leak conditions, whereas a second alarm can initiate a full alert in the event of more serious leaks. And, for real peace of mind, there is an optional Auto-Test unit. This incorporates an integral gas generator that automatically tests the sensor each day, sounding alarms in the event of sensor failure. This added safety feature also reduces the costs incurred with manual procedures.

Combine the features of the Acutec 35 system with the fact that it comes with the backing and technical support of one of the world's most respected chemical feed and disinfection companies, and you will see why the Acutec 35 system is the best gas detection system under the sun. Every single component in the Acutec 35 system is precision manufactured and vigorously tested to ensure accuracy and reliability.

KEY BENEFITS

- Gas detection for Chlorine, Ammonia or Sulfur Dioxide
- Simple and neat installation of module components
- Easy access to control panel via a hinged cover on the NEMA 4X enclosure
- Audible horn to provide local warning.
- Choice of Detector or Monitor version
- Sunlight readable 4 digit LED on the monitor
- Single or multipoint gas detection systems
- Automatic integral gas generator

Wallace & Tiernan/Siemens
Chlorine Gas Detector

Acutec 35

INSTALLATION

The flexibility of the modular system allows for simple installation of single or multipoint gas detection systems. Each point of detection requires the installation of one sensor/transmitter and one receiver module. The sensor/transmitter is installed in the area to be monitored and the receiver module can be located up to 1000 feet away. A power supply module, sufficient for use with up to two receivers, is housed with the Receivers in a NEMA 4X enclosure.

All enclosures are provided with knockouts on all four sides to facilitate wiring using the 1/2" FNPT (12.7 mm) conduit hubs provided. Equally suitable for indoor or outdoor applications, these NEMA 4X-rated polystyrene enclosures are fitted with a tough hinged polycarbonate window for clear visibility of all indicators and easy access to the control panel. Included within the enclosure is a piezoelectric horn to provide audible local warning.

Receiver Module

Two versions of the receiver are available. The detector signals the presence of specified gas and includes two gas alarm set points and three configurable and assignable gas alarm relays. It is also supplied with a separate sensor alarm and relay. The monitor provides, in addition to the above, an LED display of gas concentrations in PPM and an isolated 4-20mA output.

Each module is switch-programmable for full scale range. A single switch on the front panel provides alarm acknowledgement, reset functions, alarm relay inhibition, on-demand activation of Auto-Test, and LED indicator testing. In addition, LED light bars provide a visual indication of alarm status.

Power Supply Mode

This module, designed for installation alongside the receiver module, can accept any AC input between 85-25, 5 VAC, transforming the supply to a 12 VDC output for the receiver module without and modification or adjustment. Loss of input power is indicated by a built-in power failure alarm relay. One module provides the power to operate one or two receiver modules, an integral audible alarm and the charging of the optional battery back-up.

Control Enclosure

A single or dual point standard enclosure is provided for housing the power supply module and either one or two receiver modules. The enclosure is rated NEMA 4X with a ringed polycarbonate window. An integral audible alarm horn is included as standard.

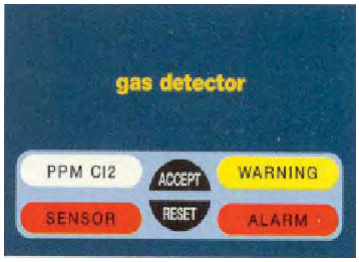
Sensor/Transmitter

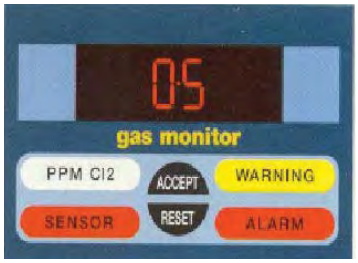
A highly efficient electrochemical gas sensor for location in areas where gas leakage could occur is combined with an equally efficient transmitter; both housed in a NEMA 4X enclosure. Digitally converted measurements of gas concentrations are then sent to the receiver module located anywhere up to 1000 feet away.

An optional auto-test facility is available for fitting to a sensor. Consisting of an electrochemical generator, it automatically tests the sensor everyday, triggering an alarm if a fault is found. The auto-test option also provided early warning of reduced sensitivity that can occur over time, allowing users to determine when sensors need replacing.

Battery Back-Up System

The battery back-up option consists of a sealed lead-acid battery mounted in its own enclosure. In the event of power failure, it will maintain all receiver functions for a minimum of 12 hours on a single point system, or six hours on a dual point system. Battery charging is fully automatic and continuous through the power supply module.





Wallace & Tiernan/Siemens
Chlorine Gas Detector

Acutec 35

TECHNICAL DATA

Gases Detected Chlorine, Sulfur Dioxide, Ammonia

Gas Ranges

	Std. Range	Min. Range	Max. Range
Cl_2	0-10 ppm	0-5 ppm	0-50 ppm
SO_2	0-20 ppm	0-10 ppm	0-100 ppm
NH_3	0-100 ppm	0-50 ppm	0-500 ppm

Power Requirements

85-255 VAC, 50/60 HZ 1 Amp - Self-regulating

Ambient Temperature
0° to 105°F (-18° to 40°C) continuous
-10° to 120°F (-23° to 49°C) intermittent

Humidity 0-99% non-condensing

Gas Alarm Setpoints
2 independent setpoints
Warning Level - adjustable from 5% to 100% of range
Alarm Level - adjustable from 5% to 100% of range

Alarm Indicators High intensity LED bars

Function
- WARNING indicator non-latching
- Alarm indicator latching

Alarm Relays
Three assignable alarm relays for either alarm setpoint 10A at 120 VAC, 5A at 250 VAC, resistive, SPDT configurable for normal/fail-safe, latching/non-latching, and fast/slow operation.

Alarm Relay and Indicator Reset
Activated from front panel switch or through remote reset.

Sensor Alarm
Indicates loss of sensor/transmitter input or failure of Optional sensor Auto-Test.

Sensor Alarm Relay and Indicator
Front panel LED indicator and relay; 10A, at 120 VAC, 5A at 250 VAC, resistive SPDT factory set to fail-safe operation.

Monitor Concentration Display
4-digit LED, sunlight readable.

Monitor Concentration Output Signal
Isolated 4-20 mA DC, 1000 ohms maximum load.

Power Supply Output Voltage

Regulated 13.7 VDC, 1A supplied to 1 or 2 receivers. Also, for recharging external battery, audible back-up and for integral Alarm horn power.

Audible Alarm Horn
Weatherproof 12 VDC piezoelectric horn 85-dB output Signal for local alarming.

Power Failure Alarm Relay
Loss of AC input power.
1 relay 10A at 120 VAC, 5A at 250 VAC, SPDT resistive.

Enclosure
NEMA 4X Polystyrene with knockouts on four sides for 1/2" (12.7 mm) FNPT conduit hubs.
Four single point enclosure -4 conduit hubs are provided.
Four dual point enclosure -7 conduit hubs are provided.

Gas Sensor Type
Electrochemical gas diffusion

Gas Sensor Connection Distance
Up to 1000 feet (300 m) to receiver.

Two wire cable.
For a dual point unit, 50 ft. (15 m) of cable is provided.
For a single point unit, 25 ft. (8 m) of cable is provided.

Sensor Operating Life 2 years

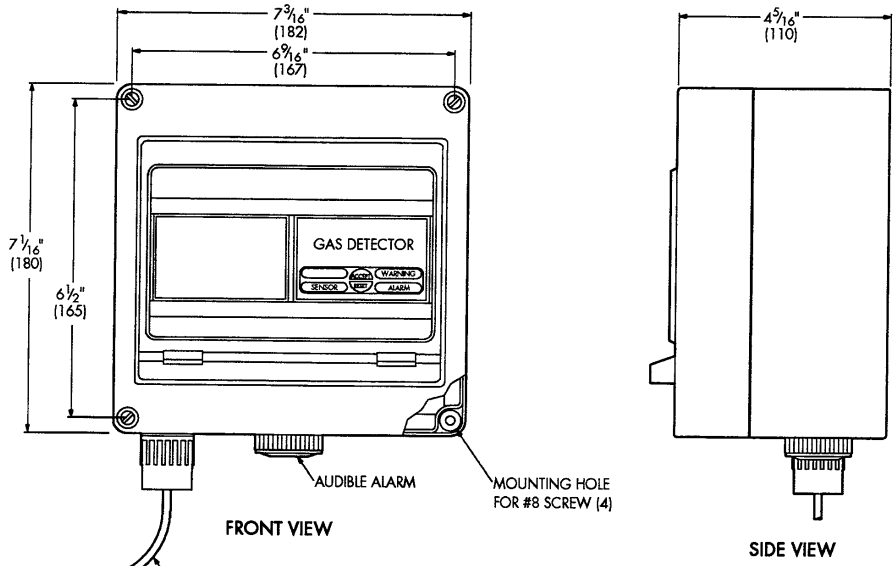
Sensor Storage Life 5 years

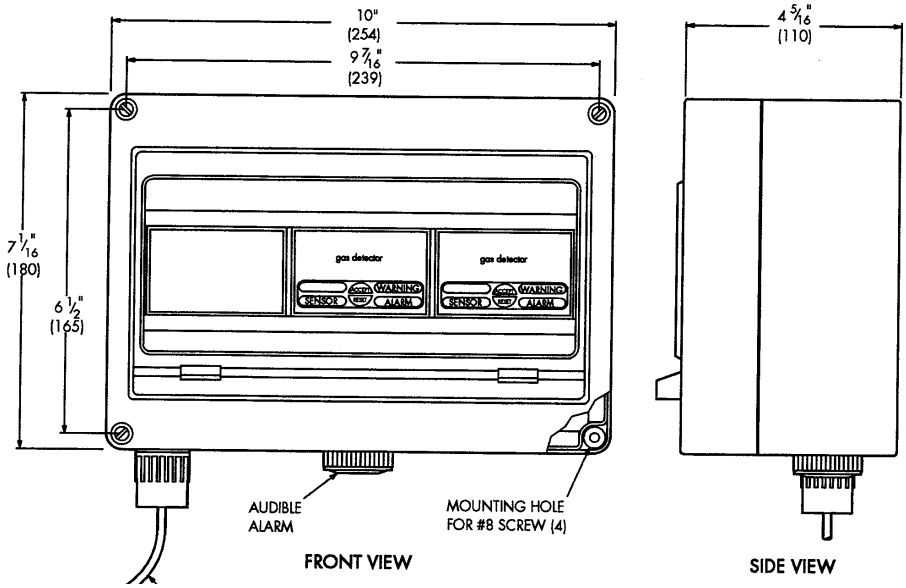
Optional Battery Back-Up

Battery Type:	12 VDC, 4 Amp HR sealed lead acid
Battery Capacity:	For single point unit, min. 12 hrs. (avg.24 hrs.) For dual point unit, min. 6 hrs. (avg. 12 hrs.)
Charge Control:	Current limited to 0.75A max.
Charge Time:	10 hours typically from fully discharged
Low Voltage Cutoff:	Relay disconnect at 10 VDC
Fault Protection:	Relay disconnect on shorted charger wiring
Battery Life:	Min. 3 yrs. in operation

Wallace & Tiernan/Siemens
Chlorine Gas Detector

Acutec 35





* For complete dimensions, see WT.050.130.100 for single point, WT.050.130.102 for dual point, and WT.050.130.104 for battery backup.

181 Thorn Hill Road, Warrendale, PA 15086

+1 (866) 926-8420 (toll-free) **+1 (978) 614-7233** (toll) **www.evoqua.com**

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Wallace & Tiernan®

an EVOQUA brand

ACUTEC™ 35
GAS DETECTION SYSTEM

BOOK NO. WT.050.130.000.UA.IM.0614

ACUTEC™ 35
GAS DETETECTION SYSTEM

BOOK NO. WT.050.130.000.UA.IM.0614

W3T129671

EQUIPMENT SERIAL NO. _____

DATE OF START-UP _____

START-UP BY _____

Prompt service available from nationwide authorized service contractors.

ORDERING INFORMATION

In order for us to fill your order immediately and correctly, please order material by description and part number, as shown in this book. Also, please specify the serial number of the equipment on which the parts will be installed.

WARRANTY

Seller warrants for a period of one year after shipment that the equipment or material of its manufacture is free from defects in workmanship and materials. Corrosion or other decomposition by chemical action is specifically excluded as a defect covered hereunder, except this exclusion shall not apply to chlorination equipment. Seller does not warrant (a) damage caused by use of the items for purposes other than those for which they were designed, (b) damage caused by unauthorized attachments or modifications, (c) products subject to any abuse, misuse, negligence or accident, (d) products where parts not made, supplied, or approved by Seller are used and in the sole judgment of the Seller such use affects the products' performance, stability or reliability, and (e) products that have been altered or repaired in a manner in which, in the sole judgment of Seller, affects the products' performance, stability or reliability. **SELLER MAKES NO OTHER WARRANTY OF ANY KIND, AND THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS OF THE MATERIAL OR EQUIPMENT FOR ANY PARTICULAR PURPOSE EVEN IF THAT PURPOSE IS KNOWN TO SELLER.** If Buyer discovers a defect in material or workmanship, it must promptly notify Seller in writing; Seller reserves the right to require the return of such defective parts to Seller, transportation charges prepaid, to verify such defect before this warranty is applicable. In no event shall such notification be received by Seller later than 13 months after the date of shipment. No action for breach of warranty shall be brought more than 15 months after the date of shipment of the equipment or material.

LIMITATION OF BUYER'S REMEDIES. The **EXCLUSIVE REMEDY** for any breach of warranty is the replacement f.o.b. shipping point of the defective part or parts of the material or equipment. Any equipment or material repaired or replaced under warranty shall carry the balance of the original warranty period, or a minimum of three months. Seller shall not be liable for any liquidated, special, incidental or consequential damages, including without limitation, loss of profits, loss of savings or revenue, loss of use of the material or equipment or any associated material or equipment, the cost of substitute material or equipment, claims of third parties, damage to property, or goodwill, whether based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory; provided, however, that such limitation shall not apply to claims for personal injury.

Statements and instructions set forth herein are based upon the best information and practices known to Evoqua Water Technologies, but it should not be assumed that every acceptable safety procedure is contained herein. Of necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

725 Wooten Road
Colorado Springs, Co 80915

INTRODUCTION

The Evoqua Water Technologies Series 50-130 Acutec™ 35 Gas Detection system is an on-line monitoring system for the detection of chlorine (Cl_2), sulfur dioxide (SO_2), or ammonia (NH_3) gas in ambient air. Alarm contacts are provided to transfer at user selectable setpoints. Monitor modules provide a digital readout of gas level and a 4-20 mA output. Single or Dual Units are available, using any combination of gas detectors and monitors or alarm units.

One Receiver Module is connected to each gas Sensor/Transmitter with a two-conductor cable, and provides information on the gas concentration in the sensor area. Receivers are powered by the Power Supply Module supplied with the Gas Detector system.

The Series 50-130 Sensor/Transmitter consists of an electrochemical gas sensor and an electronic amplifier that transmits a gas concentration signal to a Receiver Module located in the Control Unit. An optional gas generator may be ordered which enables the Receiver to automatically test the sensor every 24 hours.

NOTE: When ordering material always specify model and serial number of apparatus.

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Service ..... Section 4
Parts Illustrations ..... Section 5
Spare Parts List ..... Section 6

VERY IMPORTANT SAFETY PRECAUTIONS

This page titled "Very Important Safety Precautions" provides, in brief, information of urgent importance relative to safety in the installation, operation, and maintenance of this equipment.

WARNING

TO AVOID POSSIBLE SEVERE PERSONAL INJURY AND EQUIPMENT DAMAGE, OBSERVE THE FOLLOWING PRECAUTIONS:

GASES DETECTED ARE HAZARDOUS SUBSTANCES, AND IF BREATHED IN HIGH CONCENTRATIONS CAN CAUSE DEATH. THE OPERATION OF THIS DETECTOR MUST BE CHECKED AND VERIFIED FREQUENTLY ON A REGULAR SCHEDULE.

TO AVOID INJURY FROM ELECTRICAL SHOCK, TURN POWER SOURCES OFF BEFORE SERVICING EQUIPMENT.

TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO EQUIPMENT, THIS PRODUCT SHOULD ONLY BE USED WITH POWER SUPPLIES THAT HAVE A SINGLE HOT WIRE WITH RESPECT TO EARTH. THE WIRE CONNECTED TO POWER SUPPLY TERMINAL "N" MUST BE NEUTRAL. POWER AND EARTH GROUND MUST BE PROPERLY CONNECTED AS SHOWN.

THE GENERAL SENSOR RESPONSE TEST, AS DESCRIBED IN THIS MANUAL, MUST BE PERFORMED WHENEVER A NEW SENSOR IS INSTALLED.

AFTER ANY MAINTENANCE THE DETECTOR SHOULD BE TESTED FOR RESPONSE TO ASSURE NORMAL OPERATION.

REPLACE SENSOR IMMEDIATELY IF SENSOR FAILS GAS TEST.

HANDLE BATTERIES WITH CARE, BEING CERTAIN NOT TO SHORT TERMINALS, AS SEVERE ARCING OR EXPLOSION COULD OCCUR.

TO ENSURE PROPER AND SAFE OPERATION OF THIS EQUIPMENT, USE ONLY EVOQUA WATER TECHNOLOGIES LISTED PARTS EXCEPT COMMERCIALLY AVAILABLE PARTS AS IDENTIFIED BY COMPLETE DESCRIPTION ON PARTS LIST. THE USE OF UNLISTED PARTS CAN RESULT IN EQUIPMENT MALFUNCTIONS CAUSING POSSIBLE SEVERE PERSONAL INJURY.

THIS EQUIPMENT SHOULD BE INSTALLED, OPERATED AND SERVICED ONLY BY TRAINED, QUALIFIED PERSONNEL WHO ARE THOROUGHLY FAMILIAR WITH THE ENTIRE CONTENTS OF THIS INSTRUCTION BOOK.

VERY IMPORTANT SAFETY PRECAUTIONS (CONT'D)

DO NOT DISCARD THIS INSTRUCTION BOOK UPON COMPLETION OF INSTALLATION. INFORMATION PROVIDED IS ESSENTIAL TO PROPER AND SAFE OPERATION AND MAINTENANCE.

ADDITIONAL OR REPLACEMENT COPIES OF THIS INSTRUCTION BOOK ARE AVAILABLE FROM:

Evoqua Water Technologies
725 Wooten Road
Colorado Springs, CO 80915
Phone: (800) 524-6324

NOTE

Minor part number changes may be incorporated into Evoqua Water Technologies products from time to time that are not immediately reflected in the instruction book. If such a change apparently has been made in your equipment and does not appear to be reflected in your instruction book, contact your local Evoqua Water Technologies sales office for information.

Please include the equipment serial number in all correspondence. It is essential for effective communication and proper equipment identification.

REGIONAL OFFICES

INSTALLATION, OPERATION, MAINTENANCE, AND SERVICE INFORMATION

Direct any questions concerning this equipment that are not answered in the instruction book to the Reseller from whom the equipment was purchased. If the equipment was purchased directly from Evoqua Water Technologies, Colorado Springs, CO contact the office indicated below.

UNITED STATES

725 Wooten Road
Colorado Springs, CO 80915
TEL: (800) 524-6324

CANADA

If the equipment was purchased directly from Evoqua Water Technologies, Canada, contact the nearest office indicated below.

ONTARIO

Evoqua Water Technologies Ltd.
2045 Drew Road
Mississauga, Ontario
L5S 1S4
(905) 944-2800

QUEBEC

Evoqua Technologies des Eaux Itee
505 Levy Street
St. Laurent, Quebec
H4R 2N9
(450) 582-4266

SECTION 1

SECTION 1 – TECHNICAL DATA

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1.1 Technical Data

Gas Ranges			
Gas	**Standard Range**	**Minimum Range**	**Maximum Range**
Chlorine	0 - 10 ppm	0 - 5 ppm	0 - 50 ppm
Sulfur Dioxide	0 - 20 ppm	0 - 10 ppm	0 - 100 ppm
Ammonia	0 - 100 ppm	0 - 50 ppm	0 - 500 ppm

Gas sensors are shipped factory set to standard ranges, but may be calibrated to other ranges as shown.

Setpoints	Adjustable, 5 - 100% of Range
Enclosure Ratings	NEMA 4X (except battery enclosure)
Distance, Transmitter to Receiver	1000 ft. (maximum)
Operating Temperature	0 to 105 °F, continuous -10 to 120 °C, intermittent
Humidity	0 - 99%, non-condensing
Power	85 - 255 VAC, 50/60 Hz, 15 W
Contacts	Alarm (configurable): 3 SPDT Trouble: 1 SPDT Power Failure: 1 SPDT
Contact Rating	10 A at 120 VAC, 5 A at 250 VAC, Resistive
Battery Back-up (optional)	12 V, 4 A/hr, 6 Hrs minimum
Analog Output (optional)	4-20 mA, Isolated, 1000 ohms maximum
Sensor Life	2 years (maximum)
Gas Generator Life	1 year

NOTE: The Auto-Test option is for indoor use only, and should only be used with detectors set to the standard range or lower, as shown in the GAS RANGES table. If used with higher ranges, the generator may not produce enough gas to test the sensor.

1.2 Interferences

Electrochemical sensors are, by nature, not 100% selective; therefore, they can exhibit response to other gases present in ambient air.

The following tables list the possible interferences that may occur when using the different gas sensors. The tables indicate the relative response of the sensor to 1 ppm of the listed gas, expressed in terms of relative ppm signal. For example: exposure of a chlorine sensor to a gas sample containing 1 ppm of nitrogen dioxide (NO_2) would produce a signal equal to 0.4 ppm of chlorine. A negative sign (-) indicates an interference that can cause low gas measurements if there is a mixture of the measured gas and another gas.

CHLORINE	
Interference Gas	**Response**
Bromine	1.0
Fluorine	1.0
Chlorine Dioxide	1.0
Ozone	1.0
Nitrogen Dioxide	0.4
Hydrogen Sulfide	-0.1
Hydrogen Cyanide	-0.05
Methyl Mercaptan	-0.04
Sulfur Dioxide	-0.01

SULFUR DIOXIDE	
Interference Gas	**Response**
Nitrogen Dioxide	0.8
Hydrogen Cyanide	0.15
Nitric Oxide	0.04
Acetylene	0.02
Ethanol	0.05
Hydrogen	0.005
Bromine	-0.1
Fluorine	-0.1
Chlorine Dioxide	-0.1
Ozone	-0.1

AMMONIA	
Interference Gas	**Response**
Methyl Mercaptan	7
Hydrogen Sulfide	2
Hydrogen	0.1
Nitrogen Dioxide	-0.2
Chlorine	-0.2

SECTION 2

SECTION 2 – INSTALLATION

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  Dimensions
  Single Point Detection System..... 50.130.100.001
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  Sensor/Transmitter..... 50.130.100.003
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  Installation Wiring
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2.1 Overview

The Series 50-130 Gas Detection System consists of modular components that can be used in a variety of configurations to fit specific application requirements. Following is a brief description of the major system components. More detailed information follows later in this manual.

- BASE UNIT: Includes a Power Supply Module housed in a NEMA 4X enclosure. Single-Point Units accepts one Receiver Module, and Dual-Point Units accept two Receiver Modules. All units are provided with an audible horn.

- POWER SUPPLY MODULE: Provides power for one or two Receiver Modules, for the audible horn, and for charging an external Battery Back-up. The power supply accepts 85 to 255 volts, ac (50/60 Hz) and mounts on a DIN rail.

- DETECTOR RECEIVER MODULE: Receives a signal from a one Sensor/Transmitter, can be set for two alarm levels and provides three alarm contacts. The Receiver Module mounts on a standard DIN rail. Receiver Modules include a Reset/Acknowledge button, provide power for Sensor/Transmitters, and control Autotest Generators.

- MONITOR RECEIVER MODULE: Same as the Detector Module, but also includes a digital display of gas level and a 4-20 mA output.

- SENSOR/TRANSMITTER: Consists of an electrochemical gas sensor connected to a NEMA 4X transmitter, which sends a signal to a Receiver Module.

- AUTOTEST GENERATOR: An electrochemical gas generator which attaches to Sensor/Transmitters and automatically tests sensor response daily.

NOTE: The Auto-Test option is for indoor use only, and should only be used with detectors set to the standard range or lower, as shown in Section 1.1 – Technical Data. If used with higher ranges, the generator may not produce enough gas to test the sensor.

- BATTERY BACK-UP: The Battery Back-up option for gas detection systems consists of a separate wall-mounted enclosure which houses a battery and a control circuit board. The battery is a sealed, lead-acid type and is rated four ampere-hours.

2.2 General Installation

NOTE: Power supply or Receiver modules may be shipped with protective transparent plastic covers. These covers should be peeled off and discarded.

System enclosures, Battery Back-up units, and Sensor/Transmitters are all designed for surface mounting using screws or bolts inserted through the recessed mounting holes at each corner of the enclosures. Mounting hole dimensions are shown on the appropriate diagram. Included with each system enclosure are mounting hole templates which can be used to mark hole centers on walls or mounting panels. Mounting recesses are suitable for #8 machine screws or wood screws.

Refer to paragraph 3.4.1, Sensor Installation, for specific information on locating gas sensors.

Enclosures are supplied with conduit hubs and seal rings for water-tight connection of 1/2" NPT threaded conduit. Plastic cable glands may also be purchased to connect cables without conduit.

Install the 1/2" conduit hubs in any enclosure knockout labeled PG16. Note that some knockouts have more than one designation, such as PG11/16. Those with two designations will have concentric circles for knockouts. The inner circle marks the lower PG number while the outer circle marks the higher number. Place a thin bladed screwdriver into the circular slot or the desired knockout size and tap firmly with a hammer (see Figure 2.1). Place the seal over the hub threads on the outside of the enclosure and attach the hub with the supplied nut.

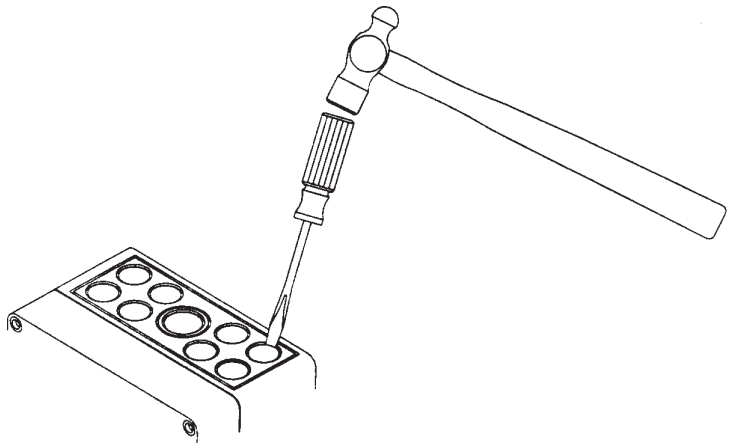


Figure 2.1

The Acutec™ unit should not be exposed to direct sunlight. Continuous ambient temperature should not exceed 105 °F. When this temperature is likely to be approached, it is recommended that relays be used in the non-energized mode, and the display be set to normal intensity (Monitor Units only). See Section 3 for details.

2.3 Mounting Power Supply and Receiver Modules (See Dwg. 50.130.000.001)

Power Supply and Receiver Modules are mounted to a standard 35 x 7.5 mm DIN rail in the detection system enclosure. The spring loaded clip with the loop holds the module to the rail. To install modules, first slide the bottom of the module under the rail. Then pull the loop out with a small screwdriver while lowering the top of the module onto the rail. To remove modules, reverse this procedure.

2.4 Electrical Connections (See Dwgs. 50.130.130.001 And 50.130.130.002)

Field wiring required for the Detection System includes connection of ac power, connection of two-conductor cable between the Receiver and the Sensor/Transmitter, connection of the Battery Back-up unit (when purchased), and connection of the audible horn to Receiver Modules. A 25-foot length of two-conductor cable is supplied for each Sensor/Transmitter. Longer lengths of up to 1000 feet may be used when required.

The ac input power is connected to the lower left of the Power Module, as shown in the Installation Wiring drawings. A ground terminal is provided on the mounting track for connection of earth ground. For safe operation and to avoid noise interference, it is important that earth ground be connected to this terminal first, and then to the power input earth ground terminal on the Power Supply Module, as shown.

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO EQUIPMENT, THIS PRODUCT SHOULD ONLY BE USED WITH POWER SUPPLIES THAT HAVE A SINGLE HOT WIRE WITH RESPECT TO EARTH. THE WIRE CONNECTED TO POWER SUPPLY TERMINAL "N" MUST BE NEUTRAL. POWER AND EARTH GROUND MUST BE PROPERLY CONNECTED AS SHOWN.

NOTE: Field wiring must conform to local electrical codes.

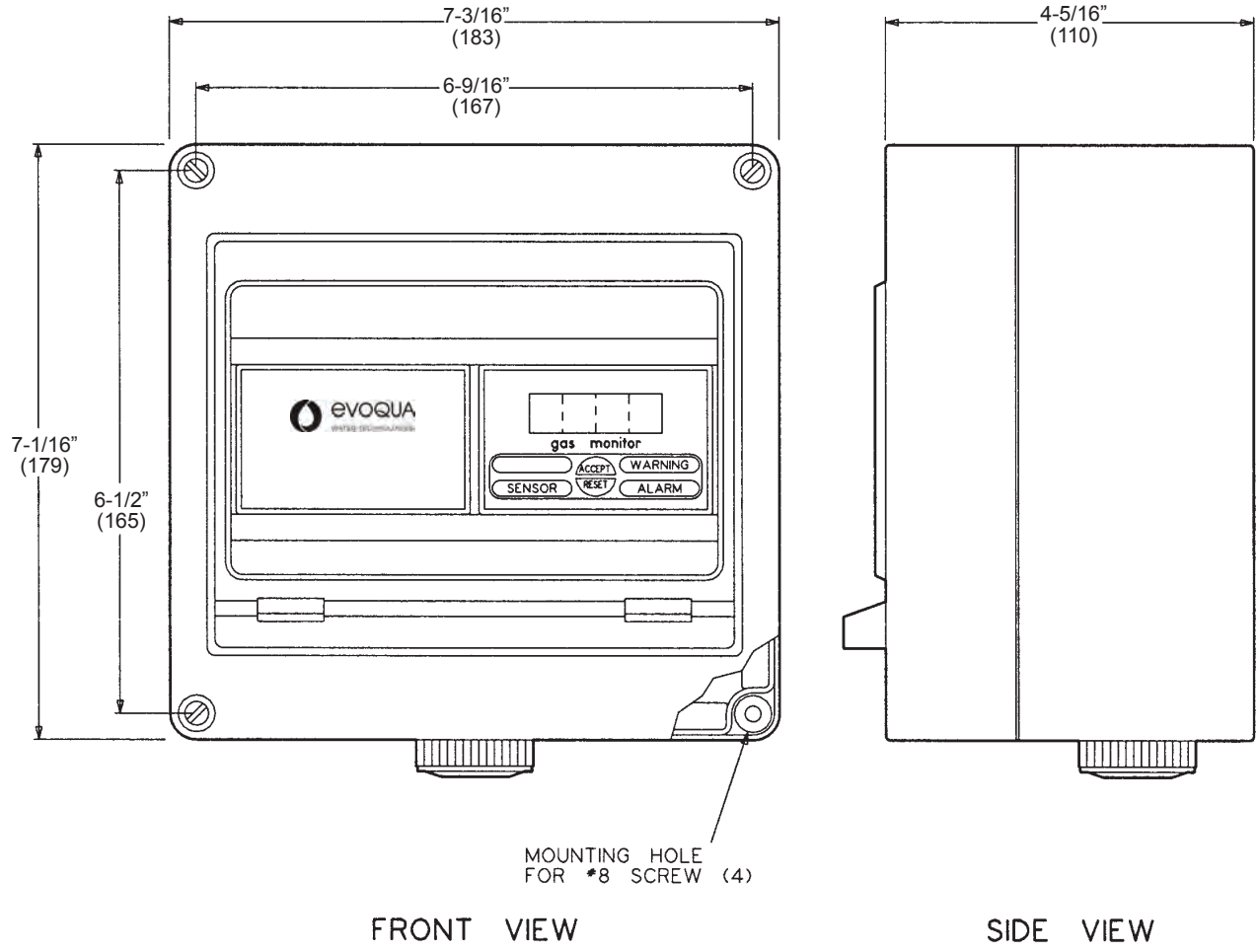
The wiring drawings show internal wiring of the systems. Sensor/Transmitter connections are shown in paragraph 3.4.1, Sensor Installation.

All terminal blocks are plug-in type, and can be unplugged allowing replacement of modules without removing individual wires.

Electrical connection is made between the Battery Back-up unit and the Power Supply Module. The circuit board mounted on the battery contains a two-position plug-in terminal block marked plus and minus. The plus terminal is connected to terminal B+ of the power supply and the minus terminal is connected to B- of the power supply.

2.5 Installation of Power Supply Module

The Power Supply Module used in the gas detection system operates on ac supplies of 85 volts to 255 volts, at 50/60 Hz. No adjustments or modifications are required of the user.



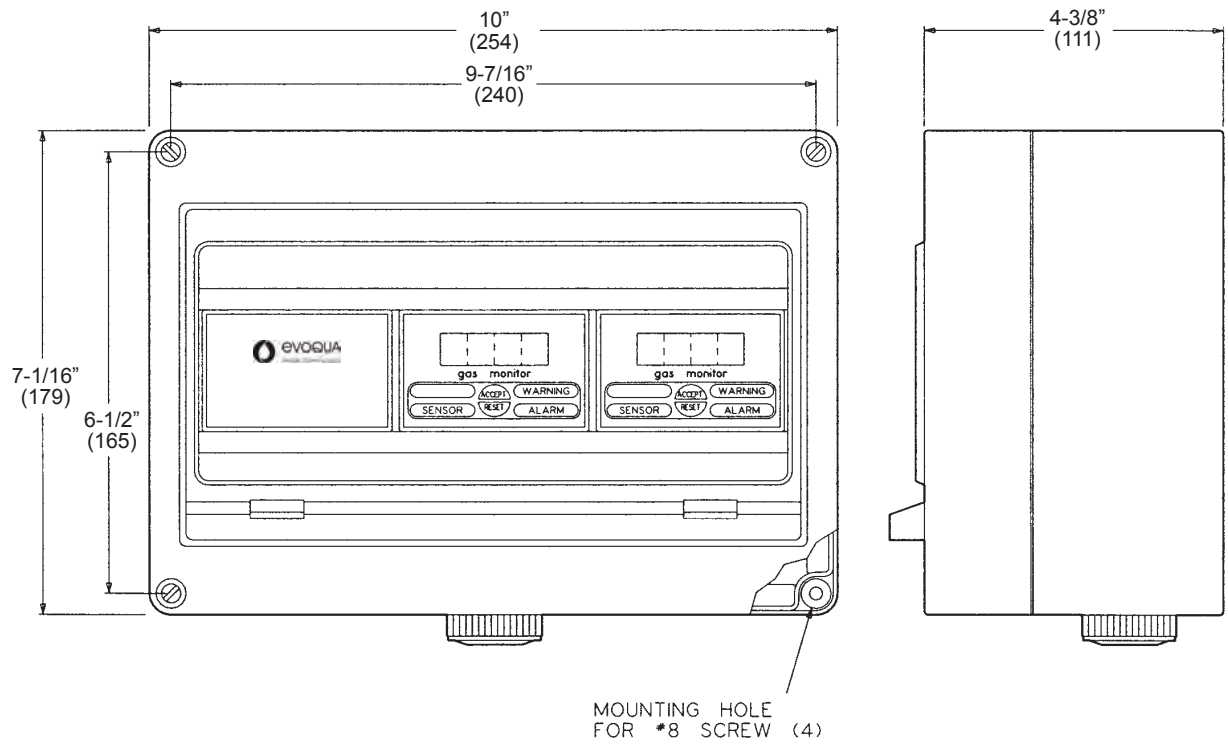
FRONT VIEW

SIDE VIEW

NOTE: ( ) INDICATES DIMENSIONS IN MILLIMETERS.

SINGLE POINT DETECTION SYSTEM - DIMENSIONS

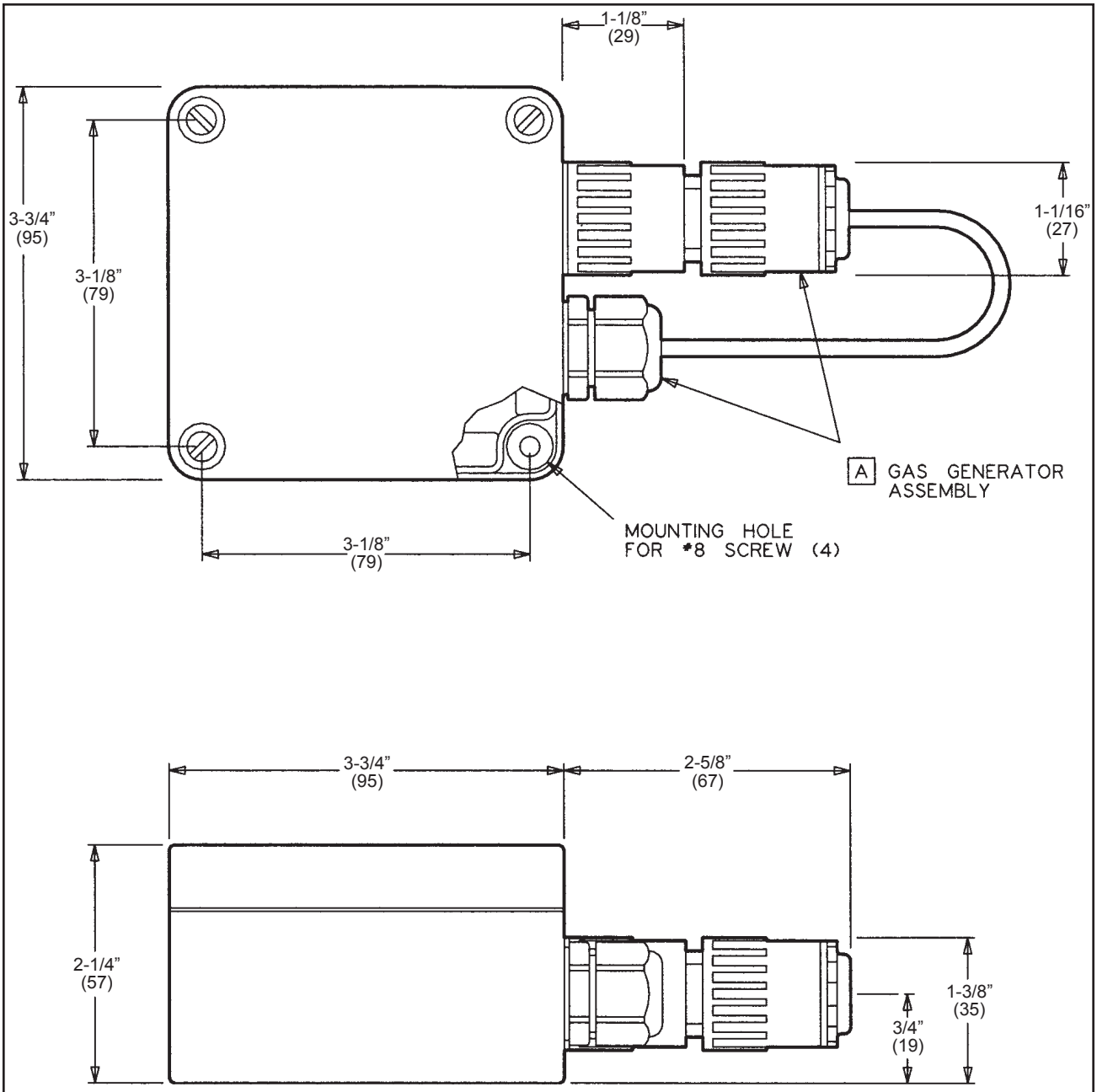
50.130.100.001
ISSUE 4 6-14



NOTE: ( ) INDICATES DIMENSIONS IN MILLIMETERS.

DUAL POINT DETECTION SYSTEM - DIMENSIONS

50.130.100.002
ISSUE 4 6-14



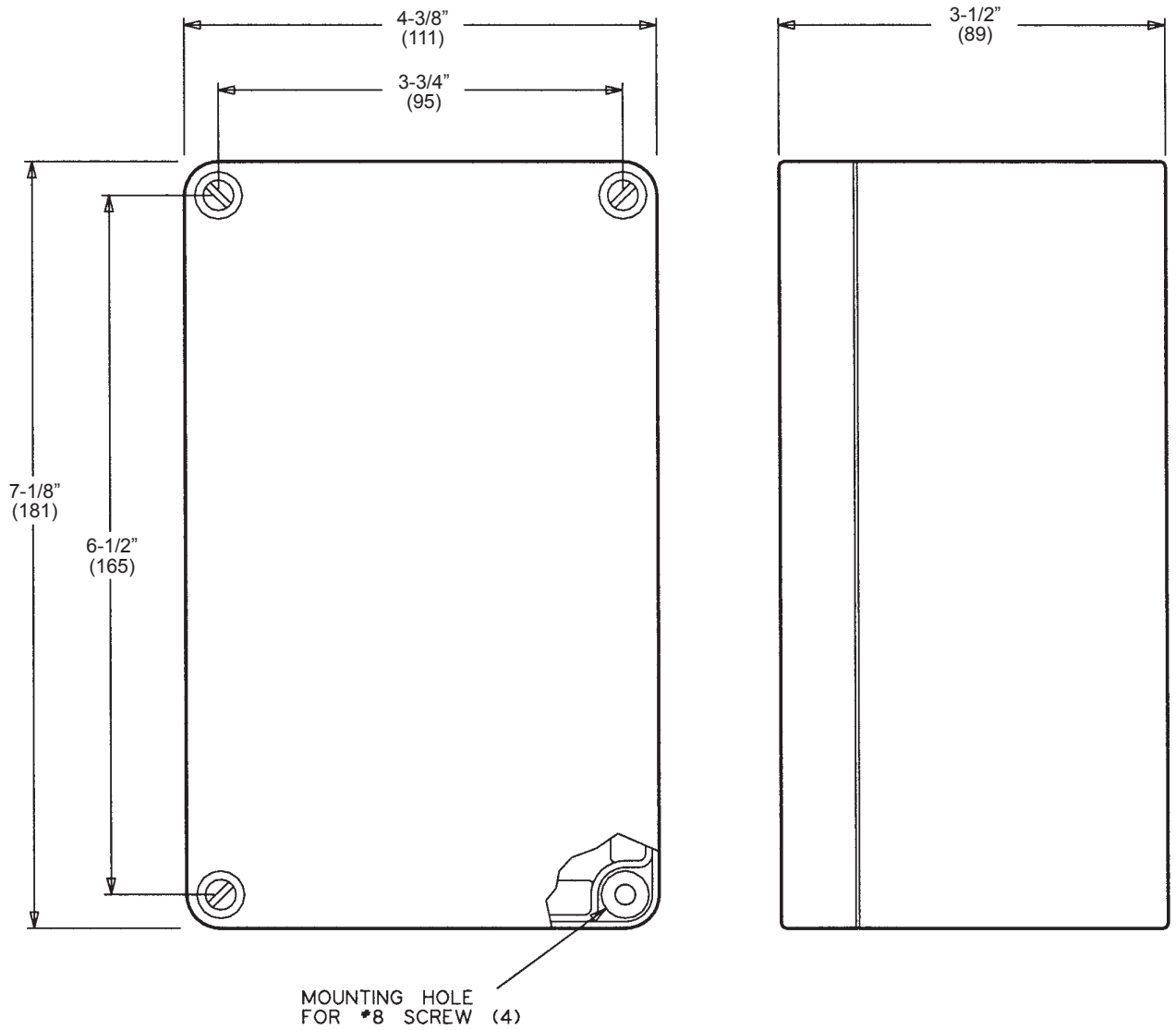
NOTE: ( ) INDICATES DIMENSIONS IN MILLIMETERS.

A ACCESSORY ITEM FURNISHED ONLY IF SPECIFICALLY LISTED IN QUOTATION.

WHEN THE GAS GENERATOR IS USED, THE UNIT MUST BE MOUNTED AS SHOWN.

SENSOR/TRANSMITTER - DIMENSIONS
With Generator

50.130.100.003
ISSUE 2 7-98



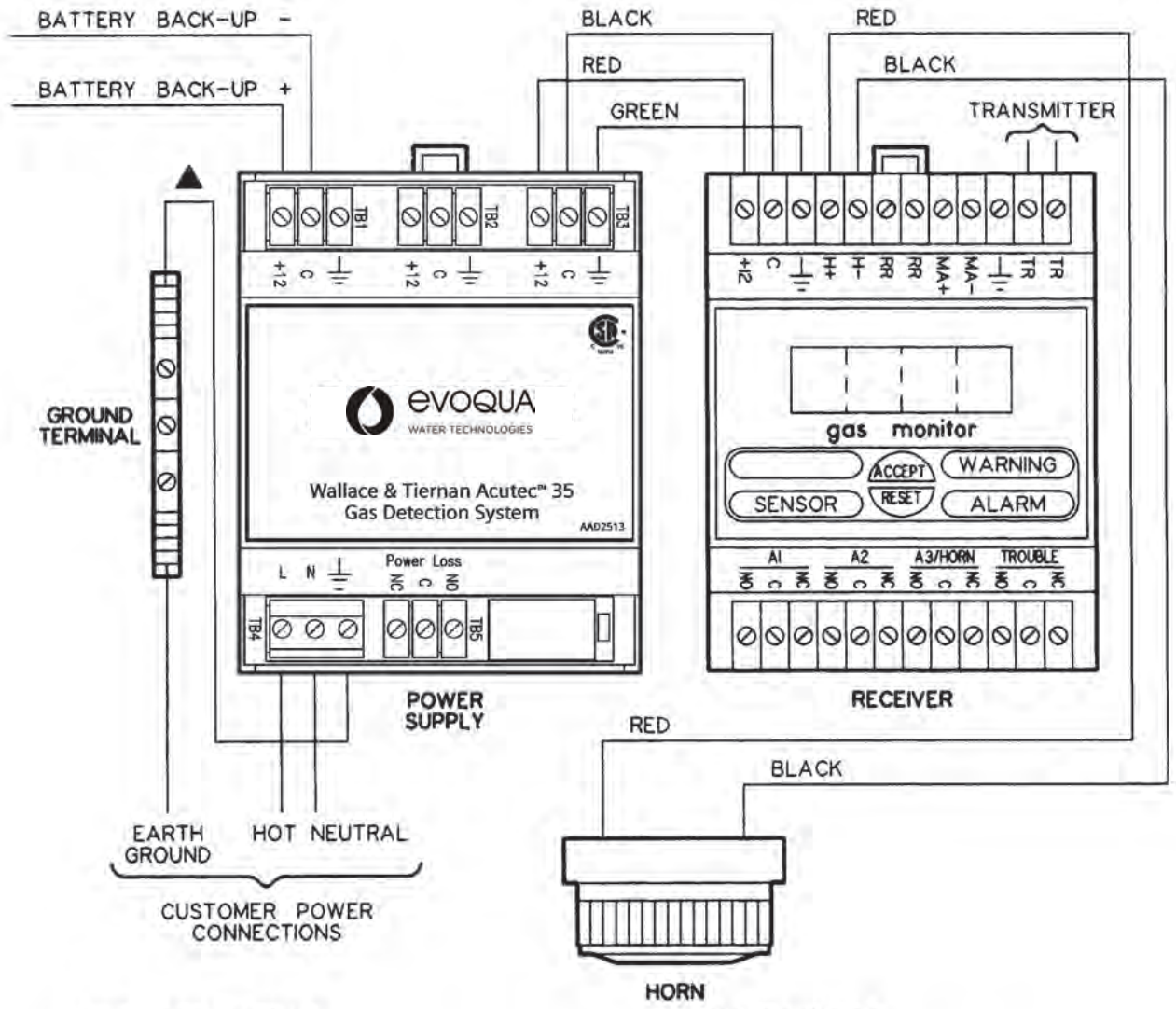
FRONT VIEW

SIDE VIEW

NOTE: ( ) INDICATES DIMENSIONS IN MILLIMETERS.

BATTERY BACK-UP - DIMENSIONS

50.130.100.004
ISSUE 2 7-98



POWER SUPPLY MODULE

H: AC "HOT"
N: AC "NEUTRAL"
⏚: EARTH GROUND

POWER LOSS
NC: NORMALLY CLOSED
C: COMMON
NO: NORMALLY OPEN

+12: DC SUPPLY, POSITIVE
C: DC SUPPLY, COMMON
⏚: EARTH GROUND

RECEIVER MODULE

+12: DC SUPPLY, POSITIVE
C: DC SUPPLY, COMMON
⏚: EARTH GROUND
H+: HORN, POSITIVE
H-: HORN, NEGATIVE
RR: REMOTE RESET
RR: REMOTE RESET
MA+: mA OUT, POSITIVE
MA-: mA OUT, NEGATIVE
⏚: EARTH GROUND
TR: TRANSMITTER INPUT
TR: TRANSMITTER INPUT

OUTPUT CONTACTS

A1
NO: ALARM 1 NORMALLY OPEN
C: ALARM 1 COMMON
NC: ALARM 1 NORMALLY CLOSED

A2
NO: ALARM 2 NORMALLY OPEN
C: ALARM 2 COMMON
NC: ALARM 2 NORMALLY CLOSED

A3/HORN
NO: ALARM 3 NORMALLY OPEN
C: ALARM 3 COMMON
NC: ALARM 3 NORMALLY CLOSED

TROUBLE
NC: TROUBLE NORMALLY CLOSED
C: TROUBLE COMMON
NO: TROUBLE NORMALLY OPEN

NOTE: ▲ WIRING BY EVOQUA WATER TECHNOLOGIES.
— FIELD WIRING MUST CONFIRM TO LOCAL ELECTRICAL CODES.

SINGLE POINT DETECTION SYSTEM - INSTALLATION WIRING

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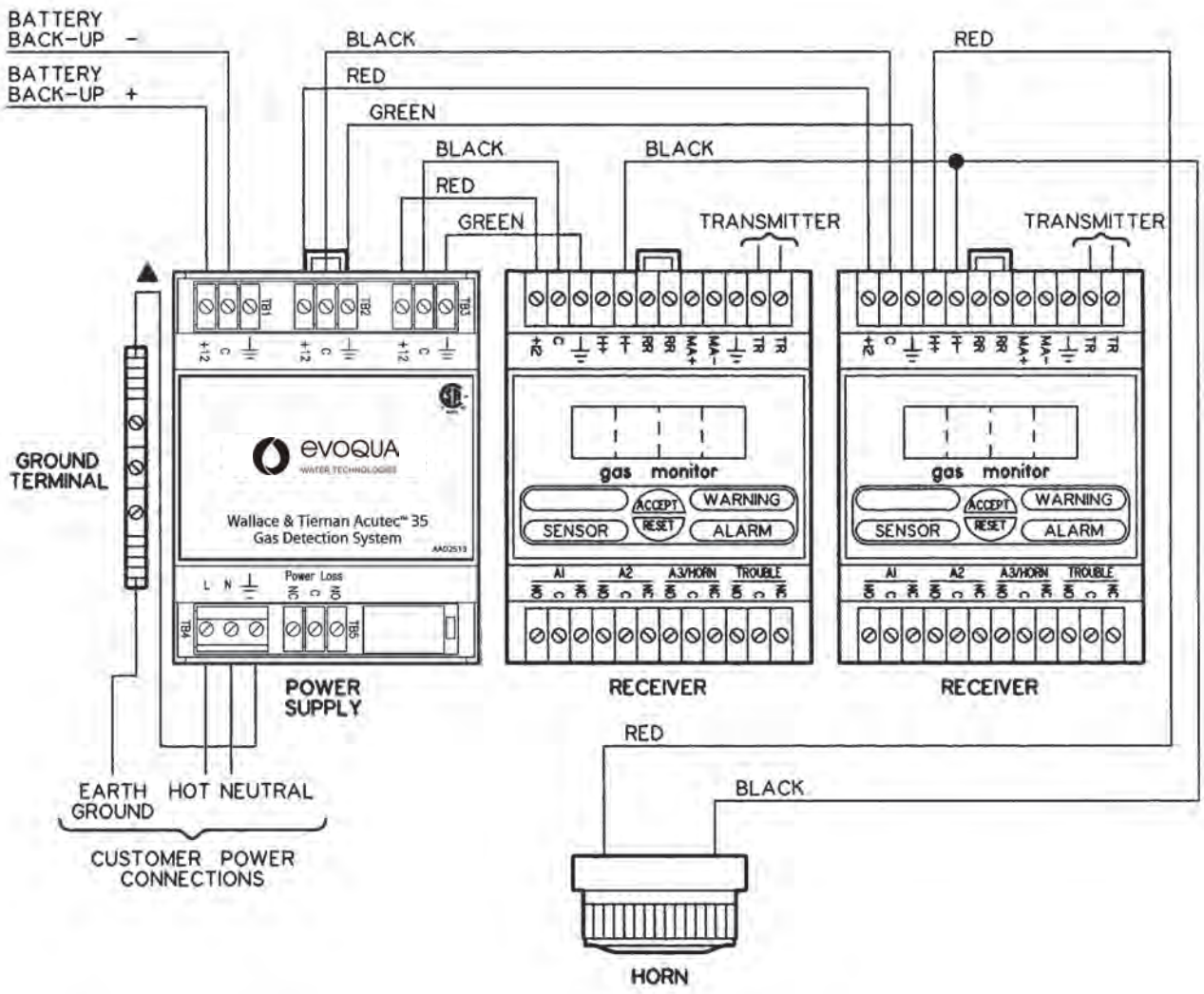

POWER SUPPLY MODULE

H: AC "HOT"
N: AC "NEUTRAL"
⏚: EARTH GROUND

POWER LOSS
NC: NORMALLY CLOSED
C: COMMON
NO: NORMALLY OPEN

+12: DC SUPPLY, POSITIVE
C: DC SUPPLY, COMMON
⏚: EARTH GROUND

RECEIVER MODULE

+12: DC SUPPLY, POSITIVE
C: DC SUPPLY, COMMON
⏚: EARTH GROUND
H+: HORN, POSITIVE
H-: HORN, NEGATIVE
RR: REMOTE RESET
RR: REMOTE RESET
MA+: mA OUT, POSITIVE
MA-: mA OUT, NEGATIVE
⏚: EARTH GROUND
TR: TRANSMITTER INPUT
TR: TRANSMITTER INPUT

OUTPUT CONTACTS

A1
NO: ALARM 1 NORMALLY OPEN
C: ALARM 1 COMMON
NC: ALARM 1 NORMALLY CLOSED

A2
NO: ALARM 2 NORMALLY OPEN
C: ALARM 2 COMMON
NC: ALARM 2 NORMALLY CLOSED

A3/HORN
NO: ALARM 3 NORMALLY OPEN
C: ALARM 3 COMMON
NC: ALARM 3 NORMALLY CLOSED

TROUBLE
NC: TROUBLE NORMALLY CLOSED
C: TROUBLE COMMON
NO: TROUBLE NORMALLY OPEN

NOTE: ▲ WIRING BY EVOQUA WATER TECHNOLOGIES.
— FIELD WIRING MUST CONFIRM TO LOCAL ELECTRICAL CODES.

DUAL POINT DETECTION SYSTEM - INSTALLATION WIRING

50.130.130.002
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SECTION 3

SECTION 3 – OPERATION

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- Auto-Test Enable 3.2.7

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3.1 Power Supply Operation (See Dwg. 50.130.000.001)

The power supply provides a regulated 13.7 Vdc to Receiver Modules and to the Battery Back-up through three sets of terminals at the top of the module. Total output current is rated at one amp.

The power supply provides a SPDT relay contact which de-energizes when ac power is lost.

3.2 Receiver Module Operation

Receiver Modules provide the following features:

- LED power on indicator with gas symbol designation.
- LED indicator lamps for WARNING and ALARM.
- Three SPDT alarm relays, switch programmable to operate on Warning or Alarm level, for latching or non-latching operation, and to be maintained normally energized or normally de-energized. In addition, Alarm Relay 3 may be configured to control an external horn.
- LED indicator lamp for SENSOR TROUBLE condition.
- One SPDT Trouble Relay, for remotely indicating a SENSOR TROUBLE condition.
- Isolated remote reset input terminals for remote alarm acknowledgement.
- Supplies power for operation of a Sensor/Transmitter up to 1000 feet away.
- Controls the Autotest Gas Generator.

In addition, Monitor type Receivers provide the following functions:

- LED digital display of gas concentration in ppm.
- Isolated 4-20 mA output signal proportional to gas concentration.

3.2.1 Configuration Switches

Receivers for different gases are identical except for the gas symbol attached to the green power LED. Operating range, setpoints, relay configuration, display intensity, alarm delay, and Auto-Test activation are selectable using four banks of DIP switches located on the configuration circuit board inside the Receiver module.

The configuration switches can be adjusted as follows:

<u>CAUTION</u>: To protect internal components from possible damage, this procedure should be performed in a static free environment.

a. Remove all power from the gas detector unit.

b. Unplug the terminal connectors on the top and bottom of the receiver module. Refer to Figure 3.1.

c. Remove the receiver module from the enclosure by pulling out the plastic clip at the top of the module while removing the module from the rail in the back of the enclosure.

d. Turn the receiver module over. There are four plastic tabs on the back side of the unit. Gently spread the plastic tabs out and lift the back panel off the receiver, being careful not to break the tabs.

e. Gently push up on the terminal connectors. This will allow the electronic assembly to be lifted out of the housing.

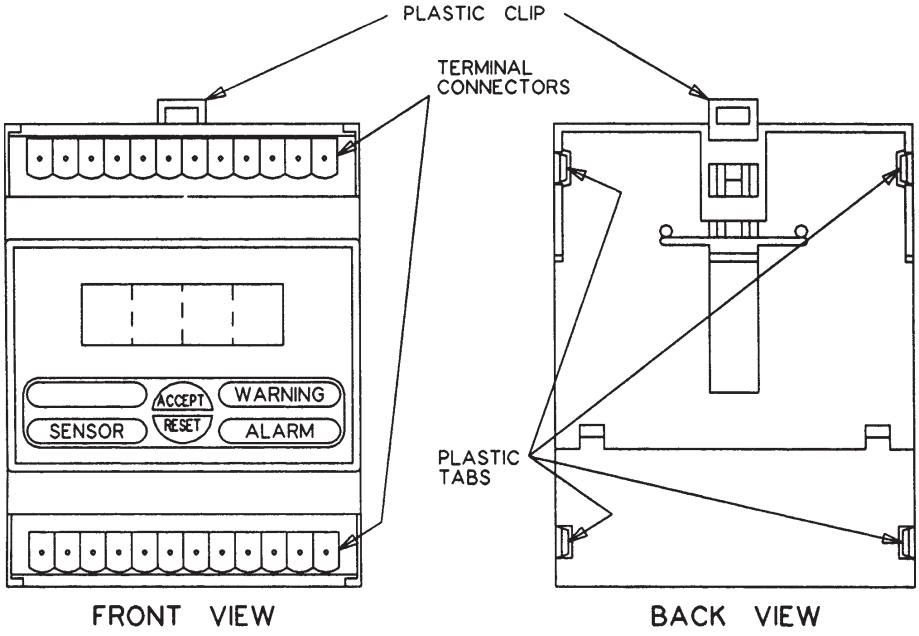


Figure 3.1 - Front and Back Views of Receiver Module

f. Position the electronic assembly as shown in Figure 3.2. Identify DIP SWITCH BANKS A through D.

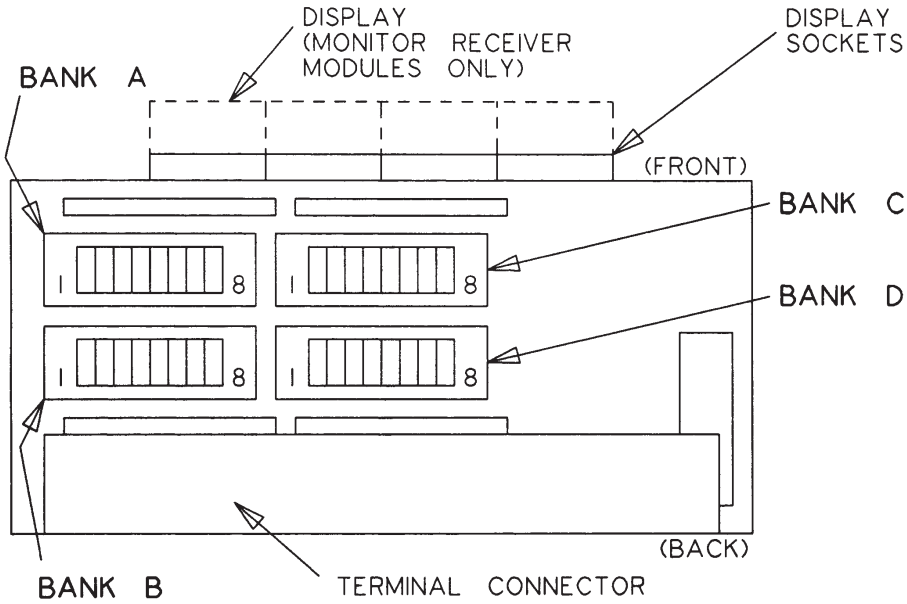


Figure 3.2 - Top View of Module Electronics Without Housing

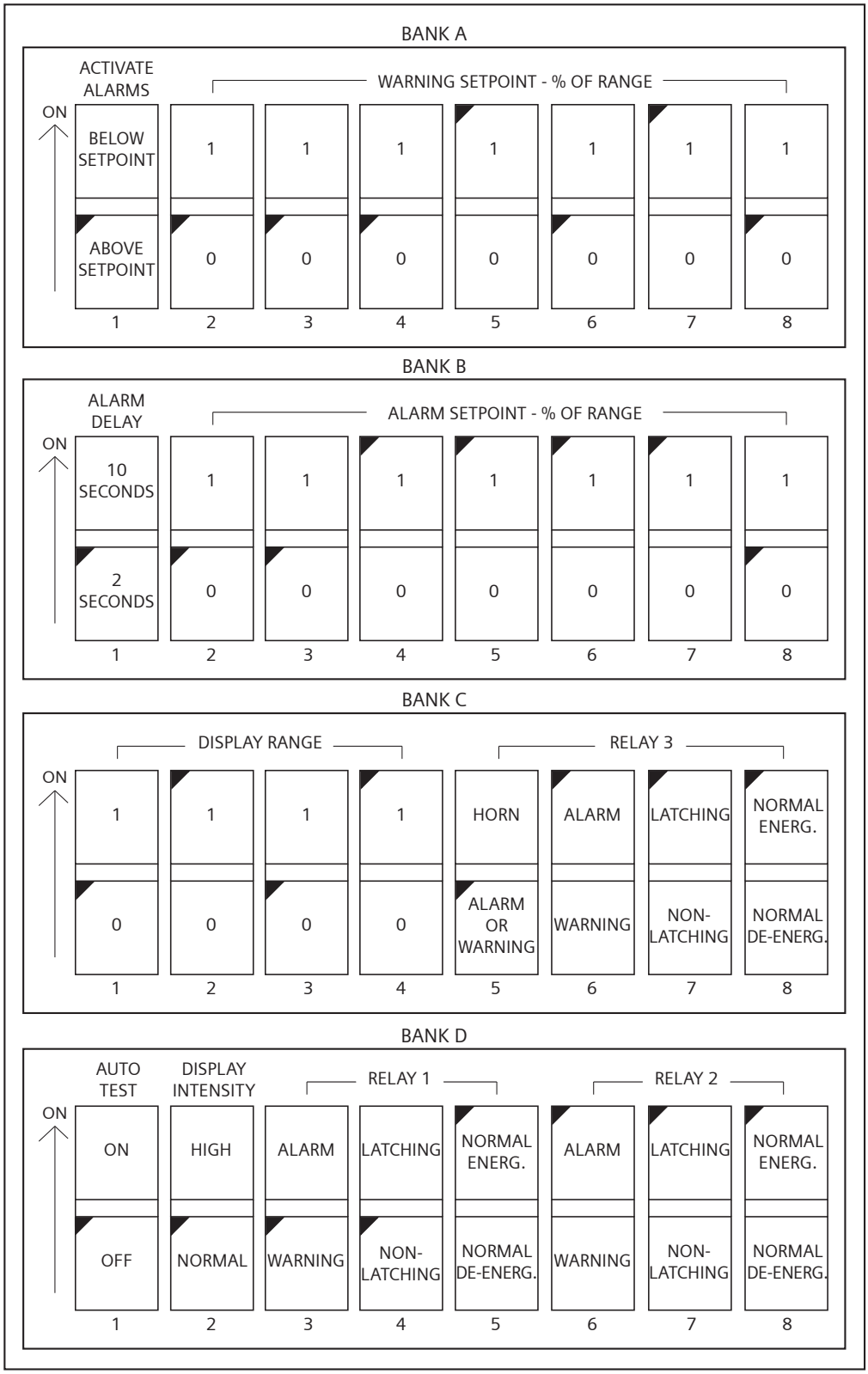
g. Adjust the Receiver DIP switch functions as needed, by referring to the Figure 3.3.

Switches can be set using the tip of a ball point pen or other tool with a small point on one end. Switches are two-position, up indicating “on” or a value of “1” and down indicating “off” or a value of “0”.

h. After adjusting the DIP switches, reassemble the receiver by repeating steps a through e in the reverse order, while observing the following:

(1) When returning the electronic assembly to the housing, the LEDs and displays must line up with the module enclosure windows.

(2) The bottom panel must be installed with the plastic clip at the top of the receiver module.



◤ **Shows Factory Settings**

Figure 3.3 - Receiver Dip Switch Functions

3.2.2 Range Selection

Receivers are factory configured for the Standard Operating Range and Setpoints as listed below.

Factory Settings of Range and Setpoints			
Gas	**Standard Range**	**Warning Setpoint**	**Alarm Setpoint**
Chlorine	0 - 10 ppm	1 ppm	3 ppm
Sulfur Dioxide	0 - 20 ppm	2 ppm	5 ppm
Ammonia	0 - 100 ppm	25 ppm	35 ppm

Display range selection is made using binary numbers to represent the full scale operating range for the receiver. The RANGE SELECTION table, below, provides the proper switch settings for the ranges available on each receiver. Range selection is made using switches C1 to C4. The 4-20mA output signal is proportional to the selected range.

Range Selection	
Display Range	**Switch Settings**
0 - 1.00	0000
0 - 2.00	0001
0 - 3.00	0010
0 - 4.0	0011
0 - 5.0	0100
0 - 10.0	0101
0 - 20.0	0110
0 - 25.0	0111
0 - 50	1000
0 - 100	1001
0 - 200	1010
0 - 500	1011

3.2.3 Setpoint Selection

The Warning and Alarm setpoints are factory configured to the values shown in FACTORY SETTINGS OF RANGE AND SETPOINTS table, above, and can be changed by using the configuration switches identified in the DIP SWITCH FUNCTIONS chart. The Warning setpoint is set using switches A2 to A8 and the Alarm setpoint is set using switches B2 to B8. A binary number is used to select setpoints as a percent of operating range.

For instance, if you have a receiver range of 0 to 10 ppm and want to adjust a setpoint for 3 ppm, set the appropriate DIP switches to the binary number for 30% from the SETPOINT SELECTION table, below.

Setpoint Selection					
%	Switch Pos.	%	Switch Pos.	%	Switch Pos.
5	0000101	37	0100101	69	1000101
6	0000110	38	0100110	70	1000110
7	0000111	39	0100111	71	1000111
8	0001000	40	0101000	72	1001000
9	0001001	41	0101001	73	1001001
10	0001010	42	0101010	74	1001010
11	0001011	43	0101011	75	1001011
12	0001100	44	0101100	76	1001100
13	0001101	45	0101101	77	1001101
14	0001110	46	0101110	78	1001110
15	0001111	47	0101111	79	1001111
16	0010000	48	0110000	80	1010000
17	0010001	49	0110001	81	1010001
18	0010010	50	0110010	82	1010010
19	0010011	51	0110011	83	1010011
20	0010100	52	0110100	84	1010100
21	0010101	53	0110101	85	1010101
22	0010110	54	0110110	86	1010110
23	0010111	55	0110111	87	1010111
24	0011000	56	0111000	88	1011000
25	0011001	57	0111001	89	1011001
26	0011010	58	0111010	90	1011010
27	0011011	59	0111011	91	1011011
28	0011100	60	0111100	92	1011100
29	0011101	61	0111101	93	1011101
30	0011110	62	0111110	94	1011110
31	0011111	63	0111111	95	1011111
32	0100000	64	1000000	96	1100000
33	0100001	65	1000001	97	1100001
34	0100010	66	1000010	98	1100010
35	0100011	67	1000011	99	1100011
36	0100100	68	1000100	100	1100100

The Gas Detector is factory set to alarm when gas concentrations above the chosen setpoints are exceeded; however, if switch A1 is set to the ON position, alarms will be initiated when gas concentration is below the setpoint.

3.2.4 Relay Configuration

- **FACTORY CONFIGURATION OF RELAYS** —

  * Relay 1 – Configured to trip above the Warning setpoint and set for normally energized, non-latching operation.
  * Relay 2 – Configured to trip above the Alarm setpoint and set for normally energized, latching operation.
  * Relay 3 – Configured to trip above the Alarm setpoint and set for normally energized, latching operation, not for horn operation.
  * Alarm Delay – Configured for two-second delay.

- **WARNING OR ALARM** — Each relay can be assigned to either the Warning or Alarm setpoint. As shown in the DIP SWITCH FUNCTIONS chart, switches D3, D6, and C6 configure each relay. When Warning is selected, the relay will activate when the Warning lamp on the front panel lights. When Alarm is selected, the relay will activate with the Alarm lamp on the front panel.

- **NORMALLY ENERGIZED/DE-ENERGIZED** — Relays one through three are factory set to the normally energized mode, providing “Fail-Safe” operation. This means the relays are energized in a normal condition and will de-energize for a Warning or Alarm condition, or if power is lost to the system. However, operation in this mode will reduce the period of operation on Battery Back-up. The relays may be set to the normally de-energized mode by setting switches C8, D5, and D8 to the off position. To avoid battery drain and internal heat generation, unused relays should be set to Normally De-Energized.

- **LATCHING OR NON-LATCHING** — Relays may be either Latching or Non-latching. A latching relay activates when gas concentration exceeds the setpoint, but will only de-activate when the push-button on the front of the receiver is pressed after the gas concentration has fallen below the setpoint. A non-latching relay will automatically de-activate when the gas concentration falls below the setpoint. Selection of the latch/non-latch function uses switches D4, D7, and C7.

- **EXTERNAL HORN RELAY** — Relay 3 provides an additional configuration option not available on relays 1 or 2. Switch C5 allows Relay 3 to be configured for use in activating an external audible horn. When switch C5 is on, any external horn tied to Relay 3 will sound intermittently when the warning setpoint is exceeded and will go to steady-on when the alarm setpoint is exceeded. The relay will de-activate when the push-button switch is pressed or when the remote reset terminals are connected, silencing the external horn.

3.2.5 Alarm Delay

A time delay precedes the activation of alarm relays to eliminate false alarms due to electrical transients. The delay is factory set to two seconds, but can be changed to 10 seconds with switch B1. The delay time affects both the alarm indicator lamps and the associated relays.

3.2.6 Display Intensity (Monitor Units Only)

The LED numeric display is factory set in the normal intensity mode, and can be set for high intensity by the user; however, to avoid internal heating, and battery drain, it is recommended that the display remain at normal intensity. Switch D2 is used to select normal or high intensity display mode.

3.2.7 Auto-Test Enable

The receiver module is shipped from the factory with the Auto-Test option disabled. If the Autotest Gas Generator (optional) is installed on the system, the receiver module cover must be removed and the autotest switch (D1) must be moved to the “on” position.

NOTE: The Auto-Test option is for indoor use only, and should only be used with detectors set to the standard range or lower, as listed in Section 1.1 – Technical Data. If used with higher ranges, the generator may not produce enough gas to test the sensor.

3.3 Receiver Module Startup

Receiver front panels contain three LED bars which indicate Warning, Alarm, and Sensor Trouble conditions. A fourth, green bar LED is marked with the type of gas which the receiver operates with. Monitor type receivers have a four digit numeric LED display which indicates gas concentration in ppm.

When power is first applied, all alarm functions will be inhibited for five minutes while the system is allowed to stabilize. This is indicated by Warning and Alarm lamps flashing in an alternating pattern. Monitors will display the Full Scale Range setting for three seconds, then the Warning Setpoint for three seconds, followed by the Alarm Setpoint for three seconds. The display will then indicate the detected gas level, which will appear to be high until the sensor stabilizes.

NOTE: It is strongly recommended that sensors be powered overnight upon initial startup before adjustments are made and before connections are made to alarm relays. Sensors which are powered for the first time may remain in an alarm state beyond the five minute inhibit period and may take several hours to fully stabilize.

3.3.1 Alarm Acknowledge and Reset

The front panel of the Receiver contains one push-button, marked Accept/ Reset, which is used for a number of different functions. When the Receiver is in normal operation, a gas leak that exceeds the warning setpoint will cause the Warning indicator to flash and the internal horn to sound intermittently. If the alarm setpoint is exceeded, the Alarm indicator will flash and the horn will sound steadily. Pressing the button the first time will silence the audible horn, and will change the Warning and Alarm indicators from flash to steady-on. The Warning indicator will automatically shut off when gas concentration falls below the setpoint, but the Alarm indicator will remain on. Pressing the button after the gas has cleared will reset the Alarm indicator.

Operation of the alarm relays depends on the configuration selected for each one (see paragraph 3.2.1, Configuration Switches).

3.3.2 Sensor Trouble Alarm and Relays

Receivers contain a Trouble Relay which is associated with the Sensor Trouble indicator. A Sensor Trouble Alarm will be activated if the transmitter input is disconnected or shorted or if the Detector fails to pass an auto-test. If these conditions occur, the Sensor Trouble indicator will light, the horn will sound intermittently, and the Trouble Relay will change state. Note that the Trouble Relay is a fail-safe relay. Under normal conditions, the coil of this relay is energized, and it de-energizes when a Sensor Trouble Alarm occurs or if power fails. After the trouble condition clears, press the push-button or close the remote reset contacts to reset the Sensor Trouble Alarm.

3.3.3 Auto-Test Function

NOTE: The Auto-Test option is for indoor use only, and should only be used with detectors set to the standard range or lower, as listed in Section 1.1 – Technical Data. If used with higher ranges, the generator may not produce enough gas to test the sensor.

The optional Auto-Test feature verifies the proper operation of gas detection systems automatically. It is enabled when configuration switch D1 is in the “on” position. Auto-Test uses an electrochemical Gas Generator attached to the gas sensor and controlled from the receiver. Every 24 hours, the microcomputer in the receiver activates the Gas Generator and monitors the output of the gas sensor.

During the time when an Auto-Test is in progress, the alarm relays are inhibited. This is indicated by the warning and alarm indicators alternately flashing. Typically, an auto-test will last only a few seconds. After completion of the test the alarm response will be delayed to allow gas to clear from the sensor/ generator and for the sensor to recover. The system will be fully inhibited for

two minutes, followed by an eight minute period during which the detector will respond only to gas levels of greater than 50% of full scale.

When the Auto-Test is activated, the generator will turn on for a maximum of five minutes. If no sensor response is detected during this time, the generator will turn off and the receiver will wait for 15 minutes before initiating another Auto-Test. If it fails this second test, a Sensor Trouble Alarm will be initiated, as described earlier. The Receiver will auto-test two more times at one hour intervals. If the sensor passes either of these tests, the Sensor Trouble Alarm will reset.

3.3.4 Lamp and Horn Test

When the Receiver is in the normal mode, pressing the push-button and holding it for two seconds will illuminate all digital display segments and LED indicator bars, and will sound the internal horn. Upon releasing the button, the receiver will return to its previous state.

3.3.5 Relay Inhibit

Alarm relays in the Receiver can be inhibited for up to four hours to allow calibration or testing of Sensor/Transmitters without activating external alarm or control devices.

To initiate the inhibit mode, with the Receiver in the normal mode, press and hold the push-button for approximately five seconds. The lamp test will occur first, but continue to hold the button down. Once the lamps have shut off, release the button. The warning and alarm lamps will begin to flash alternately for a few seconds. If the Auto-Test configuration switch is in the “on” position and the push-button is not pressed, the Sensor trouble lamp will flash after the Alarm/Warning lamps have stopped flashing. If no action is taken, the Receiver will return to the normal mode.

If the push-button is pressed and released while the warning and alarm lamps are in alternating flash, the Receiver will go into the relay inhibit mode. The warning and alarm lamps will continue their alternating rapid flash, and the Receiver will remain in inhibit for four hours or until the button is pressed again. During this period, the display will indicate gas concentration, and the 4-20 mA output will be held at the level it was at before inhibit was initiated, but the relays will not activate. Transmitters may be calibrated while the inhibit is on without setting off external alarms.

When the receiver is in inhibit, the display reads the actual signal down to 0 ppm, and will read negative if the sensor is out of calibration. Normally, the microcomputer sets the display to zero when the signal is less than two percent of full scale, to avoid false readings due to drift and environmental conditions. Because relays are inhibited and the display blanking is bypassed, the inhibit mode is convenient for calibrating the Sensor/Transmitter.

3.3.6 Manual Auto-Test

Gas detection systems purchased with the optional Autotest Generator may be tested by manual activation of the Generator from the receiver module. This function will operate only if the Auto-Test configuration switch D1 is “on”. To manually start the Auto-Test function, with the Receiver in the normal mode, follow the sequence described in paragraph 3.3.5, Relay Inhibit, but press the push-button when the Sensor trouble lamp is flashing. The horn will sound a quick beep and the green gas indicator will begin to flash, indicating that the generator is running. The system will go through a normal Auto-Test sequence, exactly the same as the sequence used every 24 hours. The display will show increasing gas values as the sensor begins to respond. When the microcomputer identifies a successful test, the horn will sound one beep. The relay inhibit indication will remain on until the sensor has had time to recover.

If the test fails, a Sensor trouble response will be initiated. Pressing the push-button will silence the horn, but the Sensor trouble contact and light will remain latched on, and cannot be reset until after a 10-minute period. The Sensor/Transmitter should be checked. Either the Sensor or Generator has failed, or something is physically blocking the path between the two. Methods for testing individual gas sensors can be found in Section 4 – Service.

3.3.7 Remote Reset

Receivers are provided with input terminals for connection of a remote reset switch. The remote reset input provides horn silence and alarm reset functions using a switch located at any remote point. When receivers are located at sites with telemetry equipment, the remote reset input may be connected to a relay contact in the telemetry system.

The remote reset input accomplishes the same acknowledge and reset functions as the push-button on the front panel. When a switch closure is detected across the remote reset terminals, the detector horn will silence and any latching relays will reset, provided that the gas condition has cleared. The remote reset input will not activate any of the testing or inhibit functions of the receiver.

3.3.8 Analog Output

Monitor Receivers provide an isolated 4-20 mA output signal for interface with recorders, data loggers, or computer systems. The span of the 4-20 mA signal is the same as the range of the receiver selected during the receiver configuration. The output will drive loads of 0 to 1000 ohms.

3.4 Sensor/Transmitter Operation

Gas sensors are attached directly to transmitter boxes with a water-tight seal. A short sensor cable plugs into the transmitter circuit board. The optional Gas Generator is attached to the sensor and connects to a terminal block on the circuit board.

The Receiver provides power to the Sensor/Transmitter through a two-conductor cable, which is also used to transmit the signal back to the Receiver. The Sensor/Transmitter may not be used with a separate power source.

3.4.1 Sensor Installation (See Dwg. 50.130.150.001)

Sensor/Transmitters must be mounted with the sensor horizontal.

NOTE: Gas sensors are shipped with a protective red plastic cap over the end. This cap should be left in place to avoid damage to the sensor physically or from chemical vapors, until ready for service. This cap must be removed when the sensor is placed in service.

Installation wiring requires connection of a two-conductor cable from the receiver to TB1 as shown. This connection is not polarity sensitive; either conductor can be connected to either terminal.

The Autotest Generator is connected to TB2. Polarity must be observed as shown.

NOTE: The Auto-Test option is for indoor use only, and should only be used with detectors set to the standard range or lower, as listed in Section 1.1 – Technical Data. If used with higher ranges, the Generator may not produce enough gas to test the sensor.

It is recommended that when first installed, a sensor should be connected to a Receiver and allowed to stabilize for approximately 12 hours. The sensor should then be zeroed as described in Section 4 – Service.

3.4.2 Sensor Location (Chlorine, Sulfur Dioxide, And Ammonia)

Chlorine and Sulfur Dioxide gases are heavier than air and will tend to accumulate near the floor in a closed room with little air movement. Ideally, these sensors should be located one to two feet off the floor in closed storage rooms, but may be located at higher elevations where good air flow will quickly mix any leaking gas throughout the space.

Ammonia gas is lighter than air and will tend to accumulate near the ceiling in a closed room with little air movement. Ideally, this sensor should be located near the ceiling in closed storage rooms, but may be located at lower elevations where good air flow will quickly mix any leaking gas throughout the space.

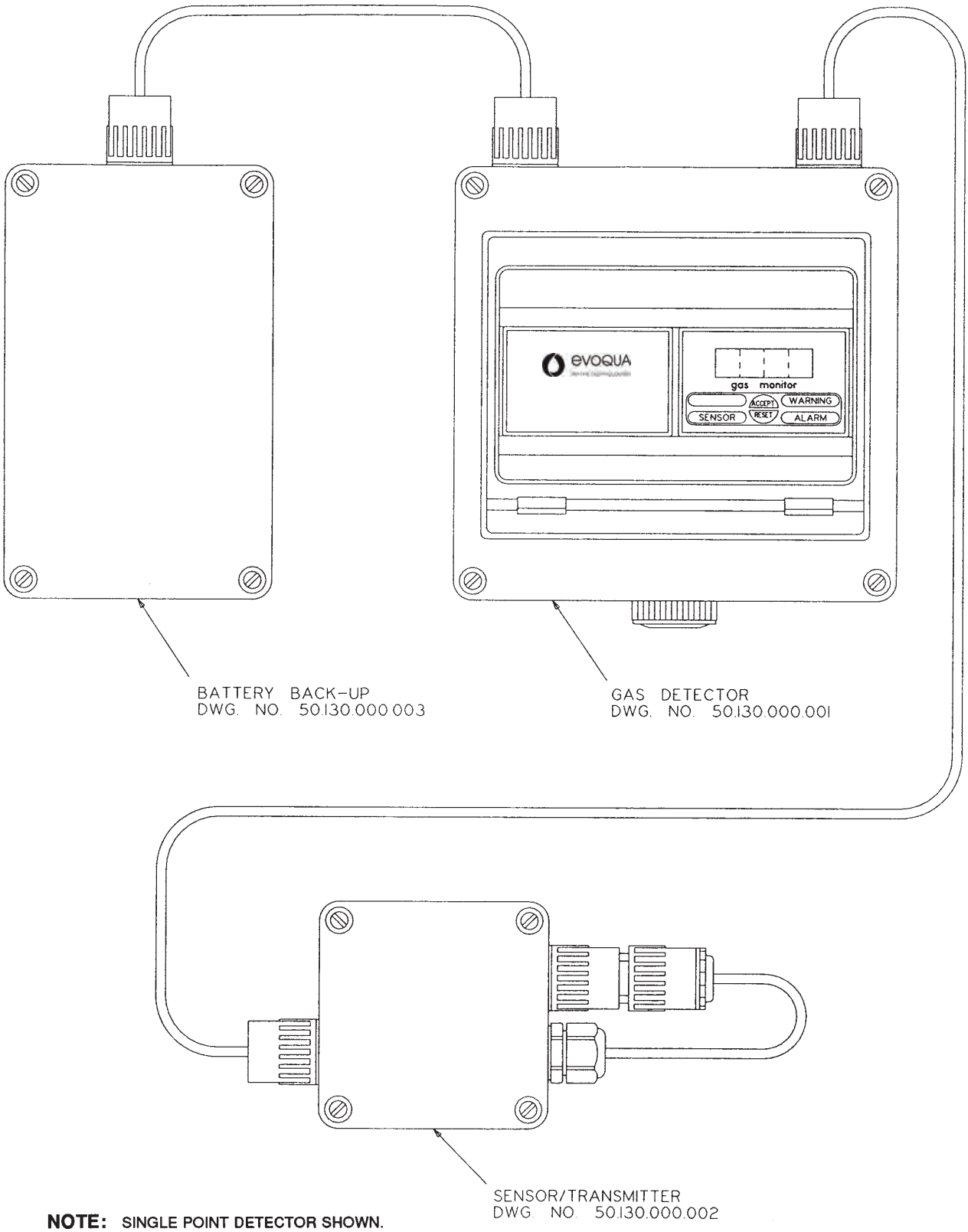
Outdoor sensor locations require that prevailing wind patterns, likely personnel work areas, and most probable leak sources all be evaluated to determine where sensors will detect gas most reliably. Autotest Generators are not for outdoor use. However, because of outside influences, such as wind direction, outside operation is questionable.

3.5 Battery Back-Up Operation

When power is applied to the power supply module, a relay on the Battery Back-up circuit board energizes and places the Battery Back-up into operation. To unlatch battery, see paragraph 4.1, Removing Unit From Service. There are no user adjustments in the Battery Back-up unit. If the battery is not fully charged, the power supply will begin supplying charge current to the battery, and will float charge the battery as long as the power supply is on.

If the power supply loses its input power, the Battery Back-up will immediately supply power to receiver modules to maintain detection system operation without interruption. The back-up period varies depending on whether the detector is single or dual channel, on whether displays are in normal or high intensity mode, and on how many relays are configured for fail-safe operation. Minimum expected Battery Back-up is 12 hours for single channel and six hours for dual channel.

The circuit board attached to the battery serves two functions. First, it limits battery charging current to a maximum of 0.75 amps. This prevents possible damage to the battery due to an excessively high charge current. Second, a low-voltage drop-out relay isolates the battery from the detection system when the battery voltage falls below 10 volts. This protects the battery against damage caused by the deep discharge.



NOTE: SINGLE POINT DETECTOR SHOWN.

GAS DETECTOR SYSTEM - ASSEMBLY

50.130.160.001

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SECTION 4

SECTION 4 – SERVICE

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4.1 Removing Unit From Service

The low-voltage drop-out relay on the Battery Back-up unit is energized as soon as power is applied to the power supply module. Once energized, the coil current is supplied from the power supply module initially, but will be supplied from the battery if power is removed from the power supply module, or if the module is disconnected from the battery. If the gas detection system supported by the Battery Back-up is started up for testing and then shut down, the Battery Back-up relay should be de-energized manually; otherwise, the relay coil will continue to drain the battery until the 10 volt level is reached. This will shorten the life of the battery, and the battery will be discharged when the detection system is started up again.

To de-energize the relay, slide the control circuit board off the battery terminals until the relay coil drops out (there will be a click), and then slide it back on. As soon as the battery connection is broken, the relay coil will drop out, and will not energize until power is again applied to the power supply module. This procedure is recommended any time the detection system is removed from service.

4.2 Sensor Service

4.2.1 General Sensor Response Test

Gas sensors should be checked regularly for proper response. For systems not equipped with Auto-Test, at least monthly manual sensor response testing is recommended.

The sensor response test described below should also be used if the Auto-Test system detects a sensing failure and lights the Sensor trouble lamp. If the sensor responds to manually applied gas but not to the Autotest Generator, replace the generator.

The sensor response test will activate alarm relays unless they are inhibited as described in paragraph 3.3.5, Relay Inhibit. Sensor response to the test gas may be observed by: viewing the digital display on Monitor Receivers, by monitoring the voltage at the test points in the transmitter, by viewing the Warning and Alarm lights on the Receiver, or by observing the operation of alarm relays in the receiver.

4.2.2 Chlorine Sensor Response Test

A high concentration of chlorine gas can be obtained from powdered calcium hypochlorite (HTH) available from any swimming pool supply. Place a teaspoon of calcium hypochlorite into a plastic bottle and keep the bottle capped until ready to test the sensor. Open the bottle and place the mouth near the sensor. After the sensor response has been verified, immediately remove the bottle

as prolonged exposure to high concentrations of chlorine will shorten the life of the sensor. If no response is observed, the sensor may need to be replaced. See paragraph 4.8, Troubleshooting.

4.2.3 Sulfur Dioxide Sensor Response Test

Sulfur Dioxide sensors can be tested with fresh powdered sodium bisulfite placed in a squeeze bottle. A vapor of a few ppm can be squeezed toward the sensor. If the sensor does not respond, it may need to be replaced. See paragraph 4.8, Troubleshooting.

NOTE: If the sodium bisulfite is not fresh, it may not produce a high enough concentration to test the sensor.

4.2.4 Ammonia Sensor Response Test

Ammonia sensors can be tested using ordinary ammonia solution used for cleaning. Open a bottle of ammonia solution and carefully move the mouth of the bottle near the sensor. Do not splash liquid ammonia solution on the sensor or it could damage the sensor. When the mouth of the bottle is approximately one inch from the sensor, a rapid response should be observed. Immediately remove the ammonia bottle as prolonged exposure to high concentrations of ammonia will shorten the life of the sensor. If the sensor does not respond it may need to be replaced. See paragraph 4.8, Troubleshooting.

4.3 Sensor Replacement (See Dwg. 50.130.150.001)

Open the Transmitter and unplug the Sensor cable from the transmitter circuit board. Unscrew the Sensor from the nut on the inside of the enclosure and screw in the replacement Sensor.

Connect the new Sensor to the pins on the transmitter board and replace the Transmitter cover. After a new Sensor has been connected, allow 12 hours for the new Sensor to completely stabilize. Then perform zero and span adjustments as described in this section.

WARNING: THE GENERAL SENSOR RESPONSE TEST, AS DESCRIBED ABOVE, MUST BE PERFORMED WHENEVER A NEW SENSOR IS INSTALLED.

NOTE: It is strongly recommended that sensors be powered overnight upon initial startup before adjustments are made and before connections are made to alarm relays. Sensors that are powered for the first time may remain in an alarm state beyond the five-minute inhibit period and may take several hours to fully stabilize.

4.4 Gas Generator Replacement (See Dwg. 50.130.150.001)

To replace, disconnect the Generator leads from the terminal block marked TB2. Loosen the cable gland, pull the wires out of the enclosure, and unscrew the Generator from the sensor. Reverse the process to install the new Generator. Observe the wiring polarity when installing the new Generator.

Once installed, the new Generator should be tested by running the Manual Auto-Test procedure described in paragraph 3.3.6. If no sensor response is observed, recheck the Generator connection to be sure the polarity is correct and that switch D1 in the Receiver Module is in the "on" position. If the sensor still does not respond, test the sensor with the appropriate Sensor Response Test described in paragraph 4.2. If the sensor does not respond, replace it. If the sensor responds properly, contact Evoqua Water Technologies for assistance with the Generator.

4.5 Sensor Calibration (See Dwg. 50.130.150.001)

The zero may drift with temperature, and it is recommended that the sensor zero be adjusted upon initial installation and every month after. At minimum, seasonal adjustments should be made to avoid false alarms due to zero drift.

For applications where precise indication of gas level is required, Sensor/Transmitters should be spanned every three to six months. The best calibration sources are generally 10% accurate, and a Sensor/Transmitter will normally change sensitivity by less than 25% over 12-months time. If on-site calibration is not practical, it is recommended that a new, factory calibrated Sensor/Transmitter be purchased every two years.

NOTE: It is essential that the transmitter zero and span adjustments be re-calibrated whenever sensors or transmitter circuit boards are replaced independently.

Calibration of the Sensor/Transmitter requires a digital volt meter (DVM), a source of calibration gas and a calibration adapter for the sensor.

For CHLORINE, electrochemical generators are typically used for calibration gas. SULFUR DIOXIDE gas can be obtained in disposable cylinders from specialty gas suppliers. AMMONIA calibration gas can be obtained in refillable high pressure cylinders from specialty gas suppliers. For more information on calibration gas equipment, contact your Evoqua Water Technologies equipment distributor.

Proper tubing should be used to connect gas sources to sensors, particularly chlorine. Polyethylene tubing is recommended for all gases.

Prior to calibration, remove the cover from the Sensor/Transmitter enclosure and connect a DVM to the test points as shown in Figure 4.1. The test points will provide a 0-1.00 Vdc signal proportional to transmitter range. For example, a range of 0 to 10 ppm, 0 ppm is 0.00 volts and 10.0 ppm is 1.00 volts.

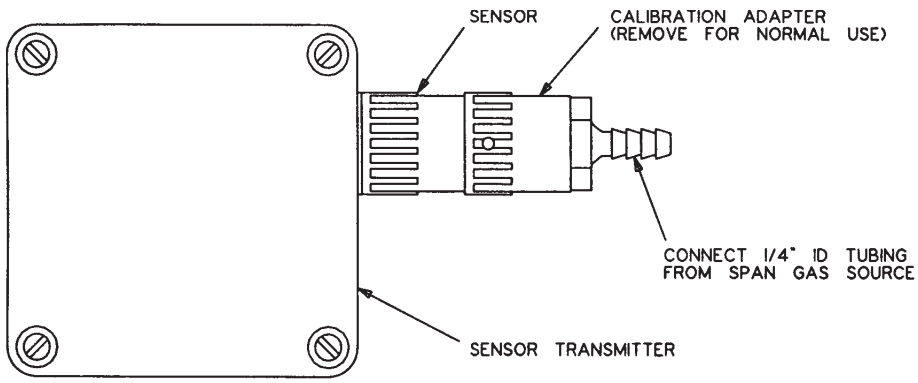

Figure 4.1 - Sensor/Transmitter Enclosure

NOTE: If alarm relays at the receiver are connected to devices that should not be activated during calibration, place the receiver into "alarm inhibit" as described in paragraph 3.3.5, Relay Inhibit, prior to calibrating the Sensor/ Transmitter.

4.5.1 Zero Adjustment (See Dwg. 50.130.150.001)

Before adjusting the zero, allow the sensor to fully stabilize by leaving it on for approximately 12 hours. Ambient air must be "clean".

The zero can be adjusted with just a DVM. Connect the meter to the test points, and adjust the zero potentiometer until a stable value of 0.00 volts is obtained.

4.5.2 Transmitter Span (See Dwg. 50.130.150.001)

Before adjusting the span, the sensor must be fully stabilized and the zero adjusted. See paragraph 4.5.1, Zero Adjustment.

If a Sensor/Transmitter is equipped with an Autotest Generator, it must first be unscrewed from the sensor. The Calibration Adapter can then be attached to the sensor.

The calibration gas is connected to the calibration adapter with an appropriate tube. When used, gas generators must be allowed to stabilize according to the manufacturer's directions. Calibration gas is applied at approximately 500 cc/min and should be allowed to flow to the sensor for 10 minutes before adjusting the span.

Connect the DVM to the transmitter test points. Adjust the span potentiometer until a stable voltage reading is obtained according to the following equation:

V = Span Gas Concentration ÷ Transmitter Range

As an example, if the calibration gas is 3 ppm and the Sensor/Transmitter range is 0 to 5 ppm, the voltage should be adjusted to 3 ÷ 5 = 0.6V.

If the receiver was placed in the "inhibit" mode prior to calibration, press the pushbutton switch on the receiver to return the system to normal operation.

4.5.3 Range Adjustment (See Dwg. 50.130.150.001)

Sensor/Transmitters are factory calibrated at the Standard Ranges as listed in Section 1.1 – Technical Data, but can be changed within the limits listed in that Section.

The range can be changed by first setting the range configuration switches, C1 to C4, in the Receiver Module as described in paragraph 3.2, Receiver Module Operation. The transmitter span must then be adjusted as described above.

4.6 Battery Replacement (See Dwg. 50.130.000.003)

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, HANDLE BATTERIES WITH CARE, BEING CERTAIN NOT TO SHORT TERMINALS, AS SEVERE ARCING OR EXPLOSION COULD OCCUR.

Remove the battery enclosure cover. Pull the plug off the circuit board. Cut the strap holding the battery in place, then pull the battery out. Slide circuit board off battery terminals.

To install the new battery, reverse above procedure. A new strap is supplied with replacement batteries. The battery should be installed with the terminals to the rear of the enclosure.

4.7 Routine Service

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, DUE TO UNDETECTED LEAKS OF DANGEROUS GAS, THE FOLLOWING SERVICE MUST BE PERFORMED TO VERIFY OPERATION OF THIS GAS DETECTOR.

- **MONTHLY**

  a. Test sensor response with actual gas if Autotest Generator is not installed. However, if a higher degree of confidence is desired, the sensor may be tested more often.

  b. Adjust sensor zero potentiometer.

  c. Clean battery vent.

  d. Verify that the Battery Back-up works by removing ac power.

- **QUARTERLY**

  Adjust the sensor span potentiometer (optional—requires a gas calibration device). (Not supplied by Evoqua Water Technologies.)

NOTE: Span adjustment is recommended only when a precise indication of gas level is required.

4.8 Troubleshooting

Trouble	Remedy
Receiver LEDs and indicators do not light when power is applied to the system.	1. Check the fuse. If the fuse is blown, replace the fuse. If not, go to step 2. 2. Check wiring from the Power Supply Module to the Receiver Module (see Dwgs. 50.130.130.001 and 50.130.130.002). Be sure polarity is correct. If wiring is correct, go to step 3. 3. With a voltmeter, check the power supply at the "+12" terminal (positive) and "C" terminal (negative) on the Receiver. If the reading is between 13.6 to 13.9 Vdc, replace the Receiver. If the voltage is above 13.9 V, go to step 5. If the voltage is below 13.6 V, go to step 4. 4. Measure the ac input voltage at the Power Supply Module. If the voltage is not within the rated range (see Section 1.1 - Technical Data), check ac supply. If the voltage is within the rated range, replace the Power Supply Module. 5. If the voltage measured in step 3 is above 13.9 V, connect another Receiver Module or a resistive load of approximately 100 ohm and 2 watts to the Power Supply output terminals. If the voltage drops to within 13.6 - 13.9 V, replace the Receiver. If not, replace the Power Supply Module.
Receiver module powers up correctly, but does not respond when test gas is applied to sensor/transmitter.	1. Disconnect the Transmitter connections at the two "TR" terminals of the Receiver. Check the voltage on the terminals with a voltmeter. The voltage should be approximately 12 Vdc. If this voltage is not present, replace the Receiver Module. If it is measured, go to step 2. 2. Connect a milliamp meter between the two "TR" terminals of the Receiver. The current should be 15 to 25 mA. If this current is not measured, replace the Receiver Module. If it is measured, refer to the Sensor/Transmitter paragraphs in this Section.

WARNING LABELS AND TAGS

The following warning labels and tags are attached to the equipment.

P60391: Gases detected are hazardous substances, and if breathed in high concentrations can cause death. To maintain normal operation of this detector you must observe the following precautions.

1. DETECTOR OPERATION MUST BE CHECKED AND VERIFIED FREQUENTLY ON A REGULAR SCHEDULE.
2. To avoid injury from electrical shock, turn power sources off before servicing this equipment.
3. The Evoqua Water Technologies instruction book provided with this detector DETAILS installation, operation and maintenance.
4. Operation AND maintenance of this equipment must be restricted to trained, qualified personnel who are completely familiar with these instructions.

P60402: PERSONAL INJURY OR DEATH MAY RESULT FROM EXPOSURE TO THE DESIGNATED GAS. TEST ASSEMBLY WITH DESIGNATED GAS UPON START-UP, MONTHLY, AND IF EXPOSED TO CHEMICALS. REPLACE OR REPAIR ASSEMBLY IMMEDIATELY UPON TEST FAILURE. REFER TO THE EVOQUA WATER TECHNOLOGIES MANUAL.

P60392: *TO AVOID INJURY FROM ELECTRICAL ARCING, TURN POWER SOURCES OFF BEFORE SERVICING THIS EQUIPMENT.

CAUTION LABEL

The following caution label is attached to the equipment.

P60392: *LEAD ACID BATTERY, DISPOSE OF PROPERLY.

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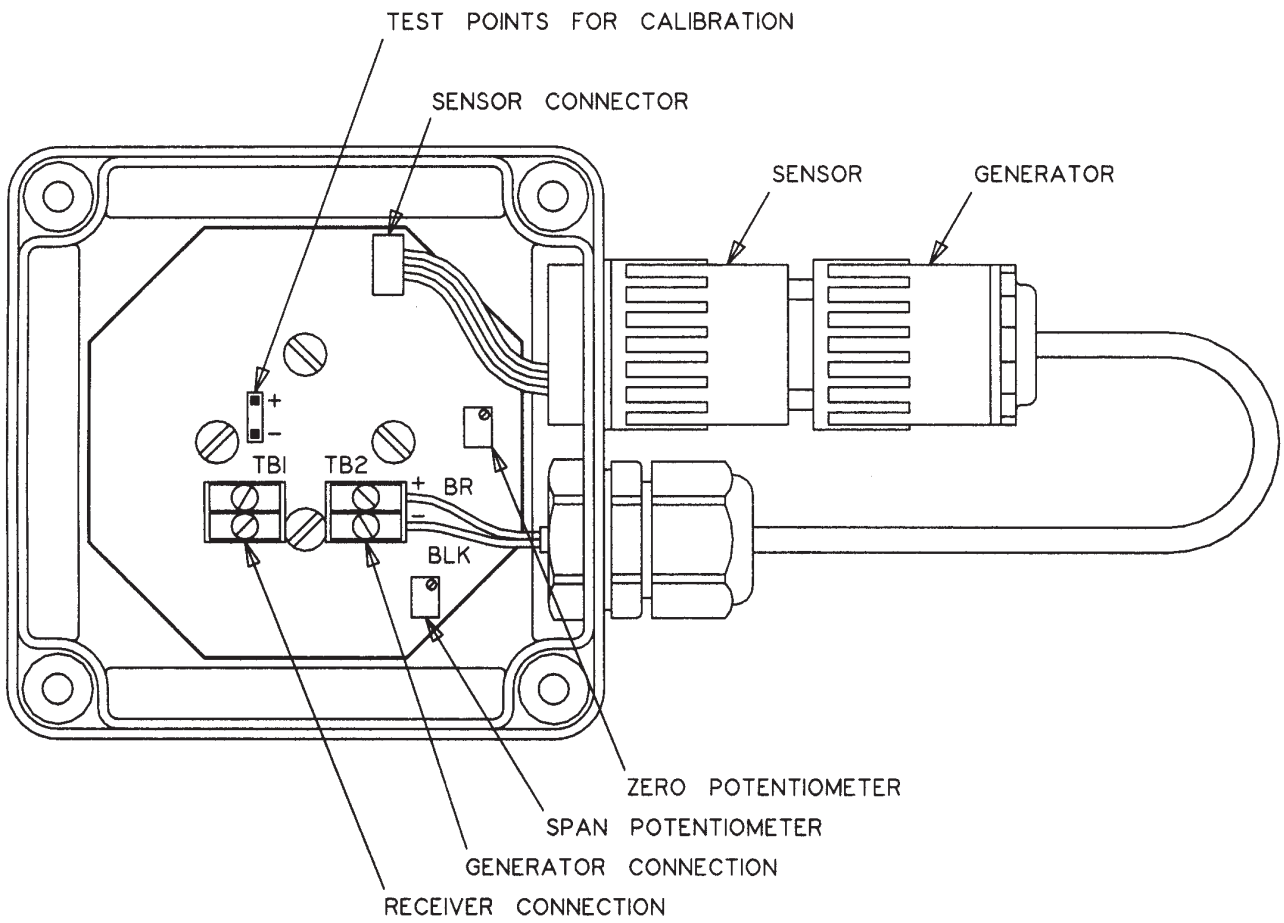
* Both on same label.



NOTE: GAS SENSORS ARE SHIPPED WITH A PROTECTIVE RED PLASTIC CAP OVER THE END. THIS CAP SHOULD BE LEFT IN PLACE TO AVOID DAMAGE TO THE SENSOR PHYSICALLY OR FROM CHEMICAL VAPORS, UNTIL READY FOR SERVICE. THIS CAP MUST BE REMOVED WHEN THE SENSOR IS PLACED IN SERVICE.

SENSOR/TRANSMITTER - SERVICE

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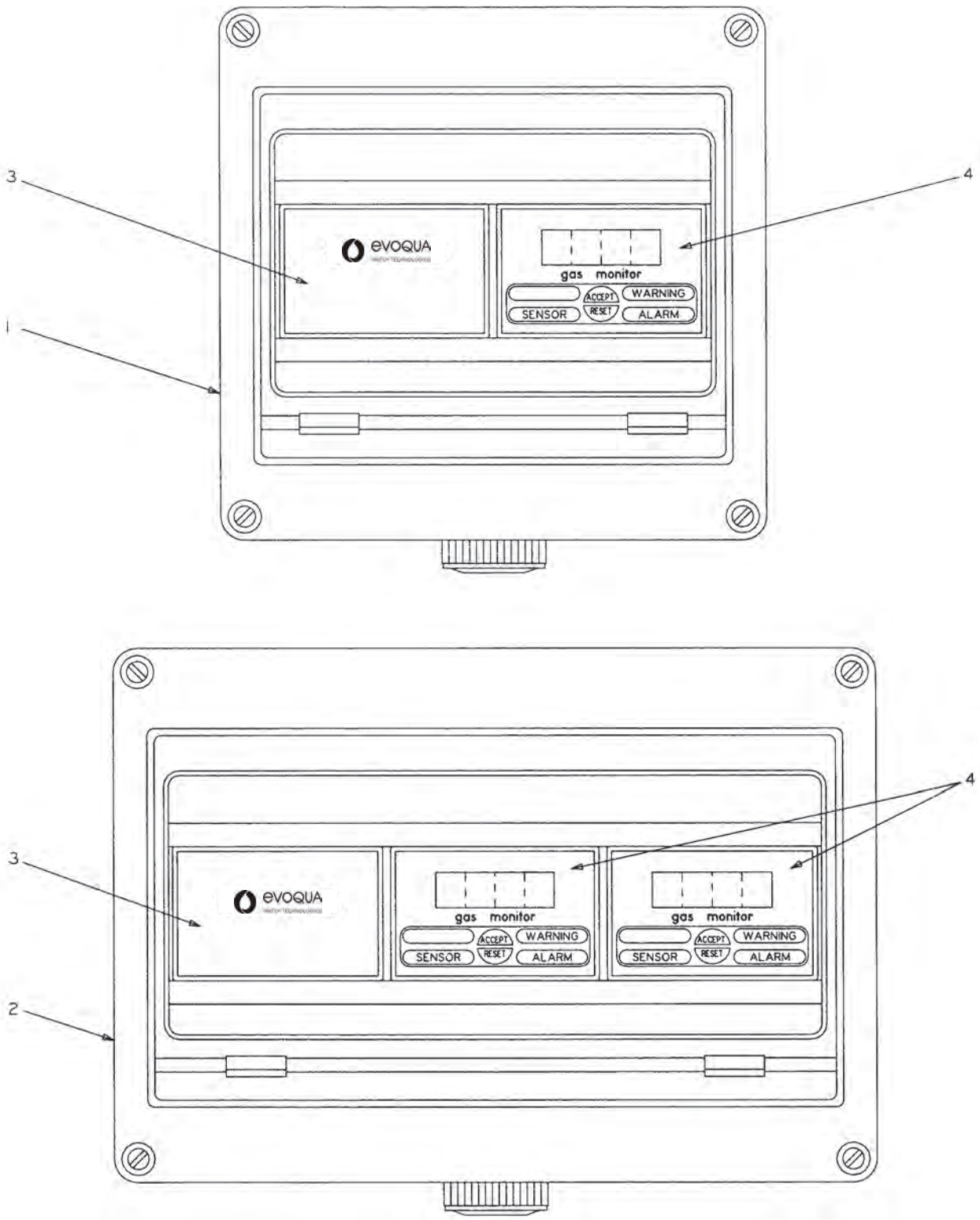
SECTION 5

SECTION 5 – ILLUSTRATIONS

List Of Contents

DRAWING NO.

Parts
Gas Detector System..... 50.130.000.001A&B
Sensor/Transmitter Unit 50.130.000.002
U29319 Battery Back-Up..... 50.130.000.003



NOTE: MONITOR UNITS SHOWN.

GAS DETECTOR SYSTEM - PARTS

50.130.000.001A

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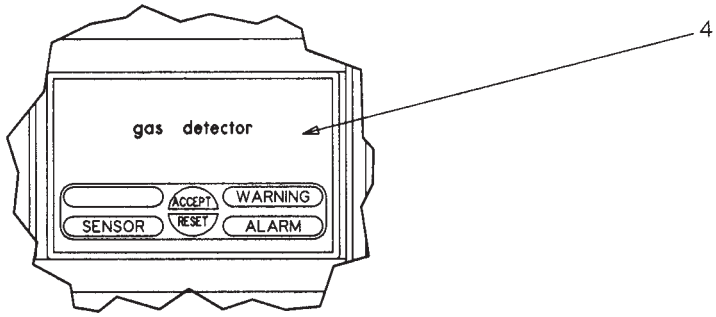

TYPICAL DETECTOR UNIT

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	U29317	1	Single Point Detector, Base Unit
2	U29318	1	Dual Point Detector, Base Unit
3	U29316	1	Power Supply Modual
4	----	1	Receiver (See Table Below)
-	P60391	2	Warning Label (Not Shown)

GAS DETECTION SYSTEM PART NUMBERS

SYSTEM	GAS TYPE	RECEIVER TYPE	RECEIVER	SENSOR/ ▲ TRANSMITTER
U29360	Cl_2	Detector	U29320	U29335
U29361	Cl_2	Monitor	U29323	U29335
U29362	SO_2	Detector	U29322	U29337
U29363	SO_2	Monitor	U29325	U29337
U29364	NH_3	Detector	U29321	U29336
U29365	NH_3	Monitor	U29324	U29336

NOTE: ▲ These parts shown on drawing 50.130.000.002.

WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

GAS DETECTOR SYSTEM - PARTS LIST

50.130.000.001B
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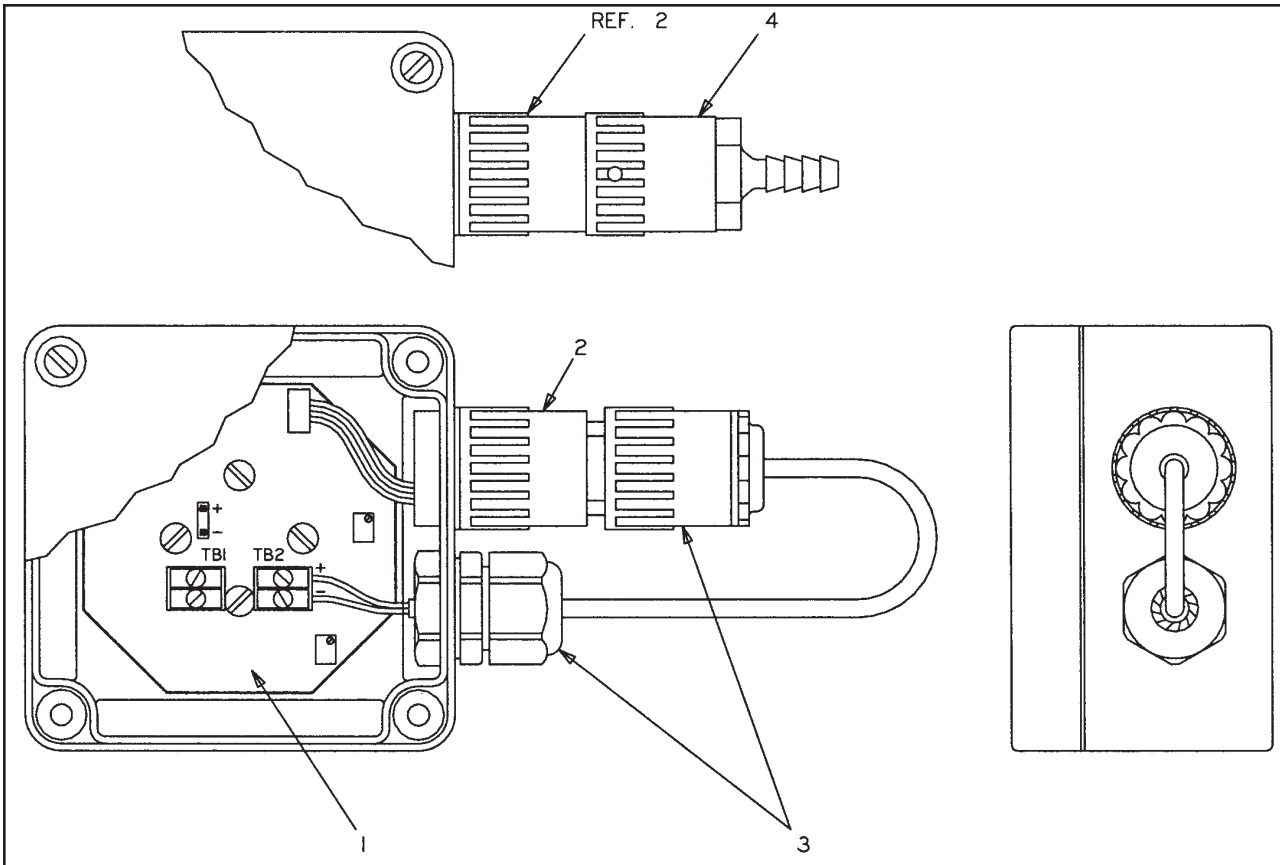
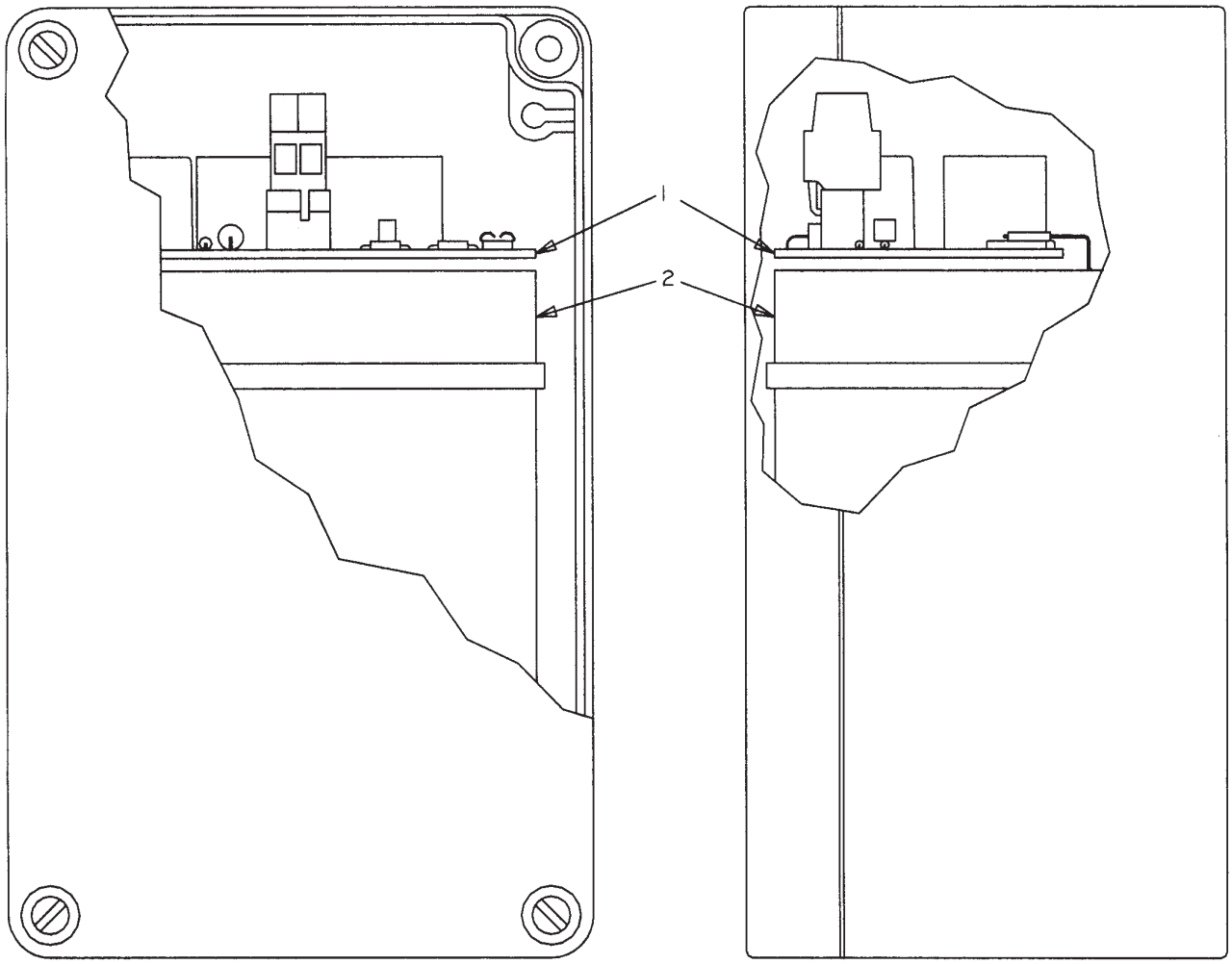


KEY NO.	PART NO.	QTY.	DESCRIPTION
1	◊ U29332	1	CHLORINE SENSOR CIRCUIT BOARD
	OR		
	□ U29334	1	SULFUR DIOXIDE SENSOR CIRCUIT BOARD
	OR		
	★ U29333	1	AMMONIA SENSOR CIRCUIT BOARD
2	◊ U29329	1	CHLORINE SENSOR
	OR		
	□ U29331	1	SULFUR DIOXIDE SENSOR
	OR		
	★ U29330	1	AMMONIA SENSOR
▲ 3	U29326	1	CHLORINE GAS GENERATOR
	OR		
	U29328	1	SULFUR DIOXIDE GAS GENERATOR
	OR		
	U29327	1	AMMONIA GAS GENERATOR
▲ 4	P60394	1	CALIBRATION ADAPTER
--	P60402	1	WARNING LABEL (NOT SHOWN)

NOTE: ◊ PART OF U29335. □ PART OF U29337. ★ PART OF U29336.
▲ NOT PART OF U29335, U29337 OR U29336.

U29335 - CHLORINE; U29337 - SULFUR DIOXIDE; U29336 - AMMONIA
SENSOR/TRANSMITTER UNIT - PARTS

50.130.000.002
ISSUE 0 11-93



FRONT VIEW

SIDE VIEW

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	U29315	1	BATTERY CIRCUIT BOARD
2	U29314	1	BATTERY
--	P60392	1	WARNING LABEL (NOT SHOWN)

U29319 BATTERY BACK-UP - PARTS

50.130.000.003
ISSUE 0 11-93

SECTION 6

SECTION 6 – SPARE PARTS LIST

QTY	DESCRIPTION	PART NO.
1	Calibration Adapter	P 60394
1	Battery	U 29314
1	Chlorine Sensor (Cl_2)	U 29329
1	Sulfur Dioxide Sensor (SO_2)	U 29331
1	Ammonia Sensor (NH_3)	U 29330
1	Chlorine Generator (Cl_2)	U 29326
1	Sulfur Dioxide Generator (SO_2)	U 29328
1	Ammonia Generator (NH_3)	U 29327
Specify Feet	Transmitter Cable	P 40231

MANUFACTURER/DISTRIBUTOR:

DM Valve (Bray)
Oscar Castillo
3540 Rue Poirier
St-Laurent, QC, H4R 2J5
Phone: (514) 332-4260
Oscar@dmvalve.com

Deschênes – Trois-Rivières (ASCO, GC Valve)
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Trois-Rivières, QC, G8Z 4P3
Phone: (819) 693-2244
mcormier@deschenes.qc.ca

9.1 Bray Series 70 Valve Actuator (WTP)

Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

SERIES 70

ELECTRIC ACTUATORS TECHNICAL MANUAL

Bray®

BRAY.COM

THE HIGH PERFORMANCE COMPANY

Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

Technical Manual - Table of Contents

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Sizes 003-065

Sizes 130-180

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Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

Specifications

CONSTRUCTION	
Housing	ASTM B85 pressure die cast aluminum Polyester powder coated Seacorr coated (optional)
Exposed Fasteners	Stainless steel
Travel Stops	Externally adjustable at both 0 and 90 degrees
Conduit Entries	S70-003 to S70-006: 2 x 1/2" NPT or 2 x M20 S70-008 to S70-180: 2 x 3/4" NPT or 2 x M25
Worm Gearing	Worm: Chromoly, self locking Worm gear: Aluminum bronze
Spur Gearing	AGMA class 9, nitride hardened alloy steel
Bearings	Indicator shaft and motor gear: Permanently sealed ball bearing Worm shaft: Sintered bronze bushing with heavy duty thrust bearing
Lubrication	High temperature synthetic grease
Motor	120/220 VAC: Single phase, reversible, permanent split capacitor induction motor 24V: Permanent magnet-brush DC motor
Capacitor	110/220 VAC: Metalized polyester
Heater	Optional, 5 watt PTC style
Terminal Strip	Switch Plate: 12 - 22 AWG (2.0 - 0.65mm) Servo: 14 - 24 AWG (1.63 - 0.51mm)
Torque Limiting	Optional, open and close preset at factory
Limit Switches	SPDT: 120VAC -10A-1/3 HP 220VAC -10A-1/2 HP 250VDC - 1/4A 12VDC - 2A

PERFORMANCE	
Output Torque	See Torque Chart
Voltages	See Motor Chart
Ambient Temperature	-20°F to 150°F (-29°C to 65°C)
Motor Insulation	120/ 220 VAC: Class F, 311°F (155°C) thermal trip at 275°F (135°C) 24V: Class B, slow blow fuse 5A@250VAC
Continuous Duty	Will operate continuously at a max. ambient temperature of 104°F (40°C)
Intermittent Duty (25%):	One motor-on period followed by three motor-off periods
Manual Operation	Pull to engage, push to disengage
Enclosure	Designed to meet NEMA Type 4, 4x and IP65 specifications
Certifications	UL, CSA and CE approved (most models) UL approved (USA & Canadian Std) for hazardous location S70-708 to S70-720: 120VAC Class I, DIV 1 & 2, Group C, D Class II, DIV 1 & 2, Group E, F, G

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Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

Battery Backup Unit (BBU) 24V Specifications

CONSTRUCTION AND PERFORMANCE	
Housing	ASTM B85 pressure die cast aluminum Polyester powder coated Seacorr coated (optional)
Exposed Fasteners	Stainless steel
Batteries	Two 12V 1.4AH sealed lead acid batteries wired in series
Battery Monitoring	Local LED indicator and voltage free 2-wire normally open contact for remote monitoring
Battery Charging	Automatic smart charge
Battery Conservation	Shut-off batteries after one minute or when actuator stops
Operating Temperature	-4°F (-20°C) to 122°F (50°C) LED light may not function below -20°F (-29°C)
Power Protection	Two 5 amp fuses, one for the external power output circuit and the other for the battery output circuit
Current Draw @ 24 VAC	BBU only maximum 10mA standby (0.25 VA) Max. 420mA charging (10 VA)
Current Draw of Actuator with BBU	600 lb-in - 1.9A (with load) 2,000 lb-in - 2.7A (with load) 5,000 lb-in - 4.1A (with load)
Power Requirements	24-27VAC or 30-38VDC (the minimum voltage is required to provide proper battery charging) Use dedicated Class 2 non-bonded transformer rated 100VA per BBU
Power Output	BBU output with 24VAC supply is 30-38 VDC On failure of AC supply, battery output is 24-25.5 VDC BBU will provide fail open or fail close operation

BATTERY SPECIFICATIONS	
Batteries	Two 12 volt 1.4 ampere-hour (AH) rechargeable sealed lead acid battery wired in series
Features	Valve regulated, spill proof construction allows safe operation in any position Rugged impact resistant ABS case and cover (UL94-HB) U.L. Recognized under file number MH 20845
Specifications	Battery case: ABS plastic Maximum discharge current (7 minutes): 4.2 amperes Shelf Life (% of nominal capacity at 68°F (20°C) 1 month = 97% 3 months = 91% 6 months = 83%
Operating Temperature	Charge: -4°F to 122°F (-20°C to 50°C) Discharge: -40°F to 140°F (-40°C to 60°C) The BBU should be powered up for a minimum of 12 hours

Although charging will not work at -4°F (-20°C), the batteries will still hold their charge for an extended period of time as described under Shelf Life. See Bray Series 70 BBU Operation and Maintenance Manual for detailed information.

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Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

Torque and Motor Data

		S70-003	S70-006	S70-008 S70-708*	S70-012 S70-712*	S70-020 S70-720*	S70-030	S70-050	S70-065	S70-130	S70-180
Torque	lb-in	300	600	800	1200	2000	3000	5000	6500	13000	18000
	Nm	34	68	90	136	226	339	565	734	1469	2034
Actuator Weight Approx.	lbs	11	11	25	25	25	45	45	45	118	118
	kg	5	5	11	11	11	20	20	20	54	54
MANUAL OVERRIDE											
Handwheel Dia.	in	3.5	3.5	8	8	8	12	12	12	12	12
	mm	89	89	203	203	203	300	300	300	300	300
Gear Ratio		30:1	30:1	30:1	30:1	30:1	30:1	30:1	30:1	90:1	90:1
Rim Pull	lbs	16	32	18	28	46	37	62	80	80	80
	kg	7.2	14.5	8.2	12.7	20.8	16.8	28.1	36.3	36.3	36.3

* Hazardous Location Units

120VAC

Travel Time 90° (Sec)		S70-003		S70-006		S70-008 S70-708*		S70-012 S70-712*		S70-020 S70-720*		S70-030		S70-050		S70-065		S70-130		S70-180	
		Current Draw in Amps																			
60 Hz	50 Hz	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA
10	12					1.20	2.10	1.40	2.30												
15	18					0.78	2.10	1.20	2.10	1.70	2.30										
18	22											1.80	3.00	2.30	3.10						
30	36	0.60	1.00	0.80	1.00	0.60	2.10	0.78	2.10	1.00	2.10	1.20	3.00	1.60	3.00	2.30	3.10				
110	132																	2.30	3.10	2.50	3.10

* Hazardous Location Units

220VAC

Travel Time 90° (Sec)		S70-003		S70-006		S70-008 S70-708		S70-012 S70-712		S70-020 S70-720		S70-030		S70-050		S70-065		S70-130		S70-180	
		Current Draw in Amps																			
60 Hz	50 Hz	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA	FLA	LRA
10	12					0.50	0.76	0.60	0.81												
15	18					0.38	0.90	0.50	0.76	0.55	0.90										
18	22											0.78	1.40	1.10	1.40						
30	36	0.60	0.75	0.65	0.75	0.38	0.90	0.45	0.90	0.50	0.81	0.75	1.2	0.90	1.40	1.10	1.40				
110	132																	1.30	2.70	1.50	2.70

FLA - Full Load Amperage
LRA - Locked Rotor Amperage

24VAC

Travel Time 90° (Sec)		S70-006	S70-020	S70-050
		Current Draw in Amps		
60 Hz	50 Hz	FLA	FLA	FLA
60	72	1.80	2.00	4.00

24VDC

Travel Time 90° (Sec)	S70-006	S70-020	S70-050
	Current Draw in Amps		
	FLA	FLA	FLA
40	1.80		
60		2.00	4.00

Travel Time - Motors

30, 40, 60, 110 second motors are continuous duty
10, 15, 18 second motors are intermittent duty

For all other information such as dimensional drawings, wiring diagrams, and EDS files please visit bray.com or contact your local Bray representative.

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Bray Valve Electric Actuator
S70-065 On/Off
S70-012 Modulating

Actuator Mounting

Imperial (in)

Actuator Size	Inner Bolt Circle				Outer Bolt Circle				Stem Hole			
	Bolt Circle		No. Holes	Bolt Size	Bolt Circle		No. Holes	Bolt Size	Dia.	Across Flats	Depth	Keyway Width
S70-003	F07	2.76	4	5/16 - 18	-	-	-	-	0.75	0.51	1.75	-
S70-006	F07	2.76	4	5/16 - 18	-	-	-	-	0.75	0.51	1.75	-
S70-008 S70-708	F07	2.76	4	5/16 - 18	F12	4.92	4	1/2 - 13	1.18	0.87	2.20	-
S70-012 S70-712	F07	2.76	4	5/16 - 18	F12	4.92	4	1/2 - 13	1.18	0.87	2.20	-
S70-020 S70-720	F07	2.76	4	5/16 - 18	F12	4.92	4	1/2 - 13	1.18	0.87	2.20	-
S70-030	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	1.97	-	2.60	2 x 7/16
S70-050	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	1.97	-	2.60	2 x 7/16
S70-065	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	1.97	-	2.60	2 x 7/16
S70-130	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	1.97	-	5.40	4 x 7/16
S70-130	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	2.50	-	5.40	4 x 5/8
S70-180	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	1.97	-	5.40	4 x 7/16
S70-180	F12	4.92	4	1/2 - 13	F16	6.50	4	3/4 - 10	2.50	-	5.40	4 x 5/8

Metric (mm)

Actuator Size	Inner Bolt Circle				Outer Bolt Circle				Stem Hole			
	Bolt Circle		No. Holes	Bolt Size	Bolt Circle		No. Holes	Bolt Size	Dia.	Across Flats	Depth	Keyway Width
S70-003	F07	70	4	M8 x 1.25	-	-	-	-	19	13	44.5	-
S70-006	F07	70	4	M8 x 1.25	-	-	-	-	19	13	44.5	-
S70-008	F07	70	4	M8 x 1.25	F12	125	4	M12 x 1.25	30	22	55.9	-
S70-012	F07	70	4	M8 x 1.25	F12	125	4	M12 x 1.25	30	22	55.9	-
S70-020	F07	70	4	M8 x 1.25	F12	125	4	M12 x 1.25	30	22	55.9	-
S70-030	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	50.04	-	66	2 x 12.0
S70-050	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	50.04	-	66	2 x 12.0
S70-065	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	50.04	-	66	2 x 12.0
S70-130	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	50.04	-	137.2	4 x 12.0
S70-130	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	63.50	-	137.2	4 x 16.0
S70-180	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	50.04	-	137.2	4 x 12.0
S70-180	F12	125	4	M12 x 1.75	F16	165	4	M20 x 1.75	63.50	-	137.2	4 x 16.0

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S70-065 On/Off
S70-012 Modulating

Standard Drawings

Standard Dimensional Drawings	
Imperial Standard	GA-17500
Metric Standard	GA-17499
Imperial Hazardous Location	ES11A-0526
Imperial 13,000-18,000 lb-in	ES11A-0708
Metric 13,000-18,000 lb-in	ES12A-0708

Standard Wiring Diagrams	
120/220 VAC On/Off w/ IRB	WD-000044
120/220 VAC Servo NXT	WD-000338
120/220 VAC Servo Pro	WD-000116
24 VAC On/Off w/Aux Switch - S70-003 to 006	WD-000276
24 VAC On/Off w/Aux Switch - S70-008 to 020	WD-000234
24 VAC On/Off w/Aux Switch - S70-030 to 065	WD-000111
24 VAC Servo Pro	WD-000145
BBU 24V On/Off w/ Aux Switch - S70-003 to 006	WD-000285
BBU 24V On/Off w/ Aux Switch - S70-008 to 020	WD-000289
BBU 24V On/Off w/ Aux Switch - S70-030 to 065	WD-000270
BBU 24V Servo Pro w/ Aux Switch - S70-003 to 006	WD-000159
BBU 24V Servo Pro w/ Aux Switch - S70-008 to 065	WD-000266

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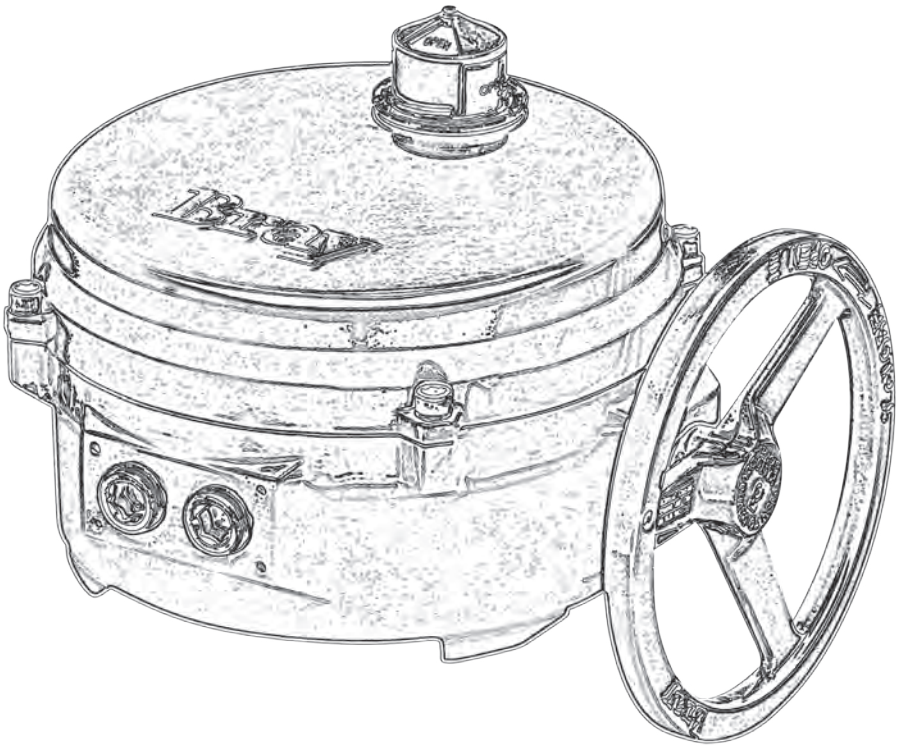
Bray

Your Global Flow Control Partner™

Series 70
24V On/Off Electric Actuator
Operation and Maintenance Manual



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FOR MORE INFORMATION ON THIS PRODUCT AND OTHER BRAY PRODUCTS PLEASE VISIT OUR WEBSITE – www.bray.com

Read and Follow These Instructions
Save These Instructions

1. Definition of Terms

WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	Used without the safety alert symbol indicates a potential situation which, if not avoided, may result in an undesirable result or state, including property damage.

2. Safety

This device left the factory in proper condition to be safely installed and operated in a hazard-free manner. The notes and warnings in this document must be observed by the user to ensure hazard-free operation of this device.

All necessary precautions need to be taken to prevent damage due to rough handling, impact, or improper storage. Do not use abrasive compounds to clean the device, or scrape its surfaces with any objects.

Configuration and setup procedures for this device are described in this manual. Proper configuration and setup are required for the safe operation of this device.

The control system in which this device is installed must have proper safeguards to prevent injury to personnel, or damage to equipment, should a failure of system components occur.

WARNING

Installation, commissioning, operation and maintenance of the unit must be performed under strict observation of all applicable codes, standards and safety regulations.

The actuator must only be installed, commissioned, operated and repaired by qualified personnel.

As per this document, a qualified person is one who is trained in:

- The operation and maintenance of electrical equipment and systems in accordance with established safety practices.
- Procedures to energize, de-energize, ground, tag and lockout electrical circuits and equipment in accordance with established safety practices.
- The proper use and care of personal protective equipment (PPE) in accordance with established safety practices.

This document does not cover every detail about every version of the product described. It does not take into account every potential occurrence concerning the installation, operation, maintenance and use of this device.

If situations transpire that are not documented in sufficient detail, please request the required information from the Bray Distributor or Representative responsible for your area.

3. Storage

Store units on a shelf or wooden pallet in order to protect against floor dampness.

Cover the units to protect against dust and dirt.

To prevent condensation inside these units, maintain a near constant external temperature and store in a well-ventilated, clean, dry room away from vibration. For units with an internal heater, power should be supplied to the heater via conduit entry with an appropriate sealing gland.

WARNING

Actuators are not weatherproof unless they are properly installed on the valve or prepared for storage. Bray will not accept responsibility for deterioration caused on-site.

4. Operating your Actuator

4.1. Operating by Hand

To engage the manual override, simply pull the handwheel to its outermost position. A yellow stripe is revealed to visually indicate manual override engagement as shown in Figure 1.

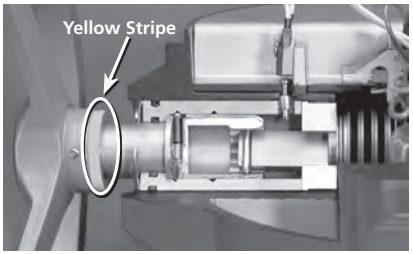

Figure 1. Handwheel is engaged, revealing the yellow stripe.

Once the manual override is engaged, rotating the handwheel in the clockwise direction will rotate the output shaft in the clockwise (close) direction and vice-versa.

To disengage the manual override, the handhwheel needs to be pushed towards the actuator until the 'yellow stripe' is hidden.

CAUTION

A label on the handwheel hub warns users not to exceed a specific 'rim pull' force, for each size of actuator.

If the 'rim pull' force is exceeded, the roll pin securing the handwheel onto the manual override shaft is designed to shear, thus preventing serious internal gearing damage.

4.2. Operating Electrically

To control the actuator remotely from a process controller, user must apply 24 VAC or 24 VDC to the actuator. This control signal voltage can be applied locally or remotely from a process controller.

CAUTION

Verify that the main electric power supplied to the actuator is in compliance with the specifications on the actuator label

Engaging the handwheel before or during the application of a control signal voltage will prevent the actuator motor from operating.

If torque switches are installed in the actuator, an overtorque condition will also prevent the actuator motor from operating.

5. Mounting the Actuator

All Bray Series 70 electric actuators are suitable for direct mounting on Bray butterfly valves. With proper mounting hardware, the S70 actuator can be installed onto other quarter-turn valves or devices as well.

NOTICE

The standard mounting position for the actuator is to orient the base of the actuator parallel to the pipeline.

If the actuator is to be mounted on a vertical pipe, it is recommended that the unit be positioned with the conduit entries on the bottom to prevent condensation entering the actuator through its conduits.

Follow the steps below to mount the actuator onto the valve.

1. Manually operate the actuator until the output shaft of the actuator is in line with the valve stem. If possible, select an intermediate position for both the valve and actuator.
2. If required, place the proper adapter onto the valve stem. It is recommended that a small amount of 'anti-seize' lubricant be applied to the adapter to ease assembly.
3. Mount the actuator onto the valve stem. It may be necessary to operate the actuator manually to align the valve and actuator bolt patterns.
4. Install the furnished mounting studs by threading them all the way into the actuator base.
5. Fasten the mounting studs in place with furnished hex nuts and lock washers.

6. Commissioning

6.1. Wiring Your Actuator

WARNING

Turn off all power and lockout/tagout service panel before installing or modifying any electrical wiring.

1. Take the actuator cover off and place it in a safe location.
2. Each actuator is provided with two conduit entries. Use one for power and the other for control wiring.
3. Wire the actuator as per the wiring diagram attached to the inside of the actuator cover.

NOTICE

a. A minimum of 18 AWG wire is recommended for all field wiring.

b. The terminals on the actuator switch plate, On/Off Controller or Servo NXT accepts wire sizes ranging from 14 to 22 AWG.

c. The conduit connections must be properly sealed to maintain the weatherproof integrity of the actuator enclosure.

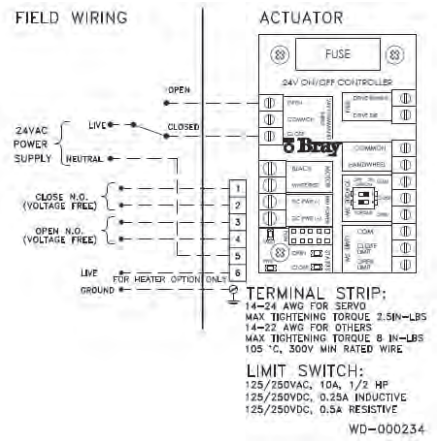

Figure 2. Sample field wiring diagram for Series 70 24V On/Off Actuator with auxiliary switches.

6.2. Setting Travel Limit Switches Cams

Bray uses its patented cam design along with 2 SPDT mechanical switches to set the 'Open' and 'Close' position of the valve.

The green cam actuates the 'open' switch when the actuator reaches the 'open' position. Similarly, the red cam actuates the 'close' switch when the actuator reaches the 'close' position.

Standard factory setting of the travel limit switches allows 90° travel between open and close positions. Cams for each switch are adjustable for applications where less than 90° degree travel is desired between the open and closed positions.

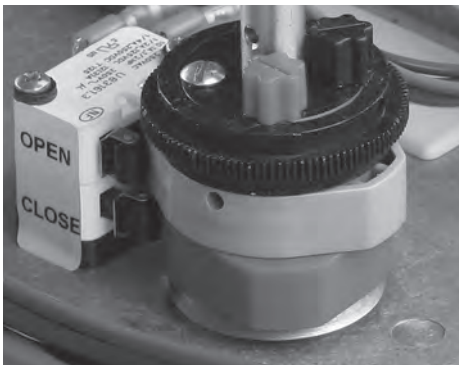

Figure 3. Two SPDT Travel Limit Switches.

Follow the steps below to adjust the travel limit cams.

1. Remove the indicator rotor by pulling it away from the indicator shaft as shown in Figure 4.

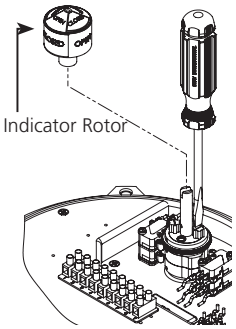

Figure 4. Indicator rotor pulled up from the indicator shaft.

2. Manually operate the actuator clockwise until the valve reaches the desired 'close' position.
3. Loosen the cam locking screw shown in Figure 5.

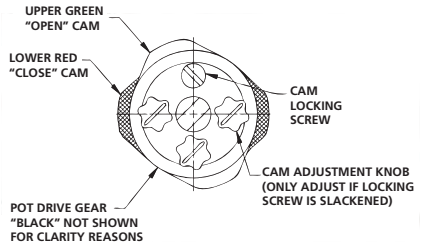

Figure 5. Top view of the indicator cam shaft.

NOTE: It is possible that the rotation of one cam will move the other cam. If this occurs, hold the other knobs or cams during adjustment.

4. Rotate the red cam adjustment knob by hand or with a flat head screwdriver until the red cam lobe activates (depresses) the 'close' switch from a clockwise direction.
5. Manually operate the actuator counterclockwise until the valve reaches the desired 'open' position.
6. Rotate the green cam adjustment knob until the green cam lobe activates (depresses) the 'open' switch from a counterclockwise direction.
7. After both travel switch adjustments have been completed, tighten the cam locking screw and place the indicator rotor back on the indicator shaft.

6.3. Setting Mechanical Travel Stops

Mechanical travel stops are designed to prevent overtravel while manually operating the actuator. They are not designed to stop the electric motor.

Mechanical travel stops are located outside the actuator base for easy readjustment. Stainless steel lock nuts with O-ring seals hold the travel stops securely in place as shown in Figure 6.

Figure 6. Mechanical Travel Stops (CW Close).

Follow the steps below to set the mechanical travels stops.

1. Manually drive the actuator to the closed position.
2. Once the actuator is in the closed position, rotate the handwheel clockwise:
   - ½ turn for Housing Size 6.
   - 1 turn for Housing Size 12.
   - ½ turn for Housing Size 30.

NOTE:

Maximum Actuator Torque	Housing Size
600 Lb-In	6
2000 Lb-In	12
5000 Lb-In	30

3. Adjust the closed travel stop bolt until it contacts the output segment gear and lock it in position with the locknut.
4. Manually drive the actuator to the open position.
5. Once the actuator is in the open posiiton, rotate the handwheel counterclockwise:
   - ½ turn for Housing Size 6.
   - 1 turn for Housing Size 12.
   - ½ turn for Housing Size 30.
6. Adjust the open travel stop bolt until it contacts the output segment gear and lock it in position with the locknut.

6.4 Configuring your 24V On/Off Controller

Every Series 70 24V On/Off Actuator is fitted with a 24V On/Off Controller as shown in Figure 7.

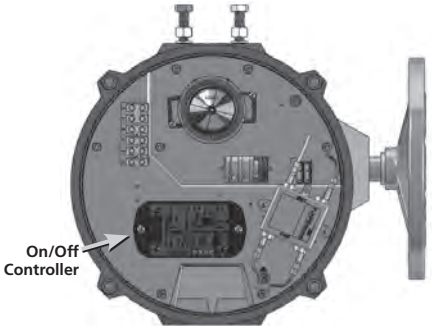

Figure 7. S70 24V On/Off Actuator.

The 24V On/Off Controller offers 3-wire control for the actuator.

To drive the actuator in the open direction, 24 VDC or 24 VAC power must be applied between the 'Open' and 'Common' terminals of the controller.

Similarly, to drive the actuator in the close direction, 24VDC or 24VAC power must be applied to the 'Close' and 'Common' terminals of the controller.

When the command signal is first applied, the Controller will wait for 1 second before powering the actuator motor. This delay is necessary to prevent a simultaneous reversal of the motor if an abrupt change in command signal direction occurs (instant reverse delay).

Once the actuator has reached the 'Open' or 'Close' position, the travel limit switch is activated and the controller turns off power to the motor.

NOTICE
Verify that the main electric power supplied to the actuator is in compliance with the specifications on the product label

6.5 DIP Switch Setting

The DIP switches on the 24V On/Off Controller are dependent on the installation of mechanical torque switches in the actuator. Table 1 shows the DIP switch settings for the 24V On/Off Controller.

Table 1

Mechanical Torque Switches installed	DIP Switch 1	DIP Switch 2
YES	OFF	ON
NO	OFF	OFF

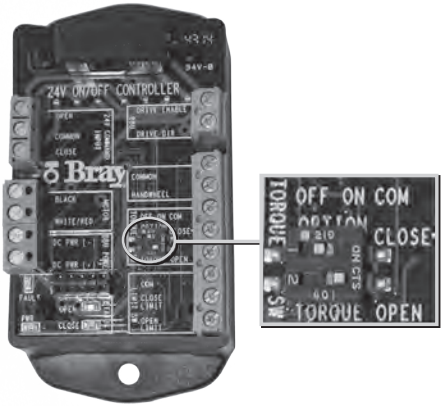

Figure 8. DIP switch settings when mechanical torque switches are installed in an actuator.

NOTICE
An engaged torque switch will prevent the actuator motor from operating in the over torque direction.

The 24V On/Off Controller has four LED's for status and fault indication as shown in Figure 9.

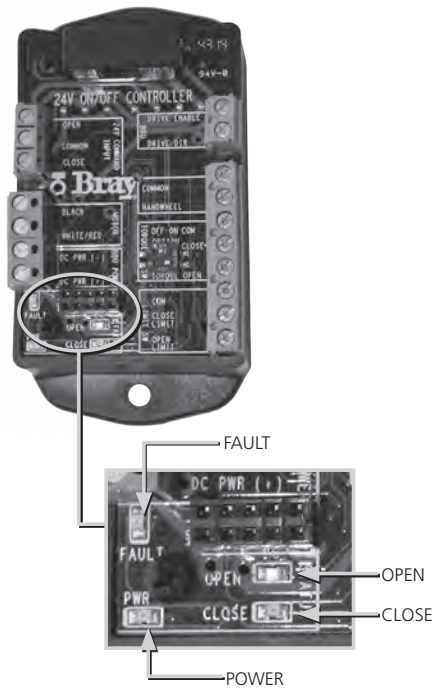

Figure 9. 24V On/Off Controller LEDs.

The LED flash codes for the 24V On/Off Controller are described in Table 2 below.

Table 2

LED Behavior	Meaning
'Pwr' LED flashes green every ½ second	The actuator has power and is operational.
'Fault' LED glows red	Hand-wheel is engaged/ pulled out
	The Open or Close Torque switch is engaged
	Both the travel limit switches are engaged at the same time
'Open' LED glows green	Actuator is being driven in the open direction.
'Close' LED glows red	Actuator is being driven in the close direction

7. Field or Factory Installable Options

7.1. Heater

To prevent condensation from forming inside the actuator, Bray offers an optional heater as a field or a factory installable option.

The heater is thermostatically controlled. It self-regulates by increasing or decreasing its electrical resistance relative to its temperature.

Figure 10. Heater installed on an S70 switch plate.

NOTICE

a. The heater must have a constant power supply to be effective.

b. The heater surface can reach temperatures in excess of 200° Celsius.

WARNING

The heater surface can reach temperatures in excess of 200° Celsius

7.2. Control Station

Bray's Control Station gives the operator the ability to locally drive the actuator with electrical power; overriding the control signal from the process controller.

The control station has a red (close) and green (open) light to provide end of travel indication. It also has two 3-position switches as shown in Figure 11.

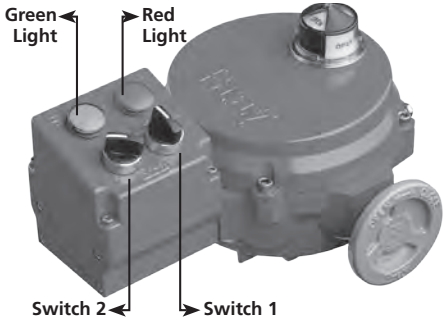

Figure 11. S70 with the Control Station.

Switch 1 lets the operator choose between the following three modes of operation:

1. **Local:** In this mode, using switch 2 the operator can drive the actuator to open or close position, or stop the actuator; overriding any control signal from the process controller.
2. **Off:** In this mode, the actuator can only be operated manually.
3. **Remote:** In this mode, the Actuator is controlled remotely from a process controller using a 24 VDC or 24 VAC signal.

NOTE:

a. Control Station can also be ordered with key lockable switches.

b. Control Station requires a dedicated set of auxiliary switches. These switches are required for turning on or off the lights on the control station to locally indicate actuator position.

c. Control Station does not contain terminal strips. All wiring is done directly to the switches and lights via 2 x 3/4" NPT holes in the bottom of the control station housing. Wire the process controller to the control station in accordance to the wiring diagram provided.

d. Ordering the Control Station with optional pin connector receptacles will eliminate the necessity of field wiring.

7.3. Auxiliary Switches

Auxiliary switches are a pair of dry-contact (voltage free) SPDT mechanical switches used to indicate travel position to remote customer control systems.

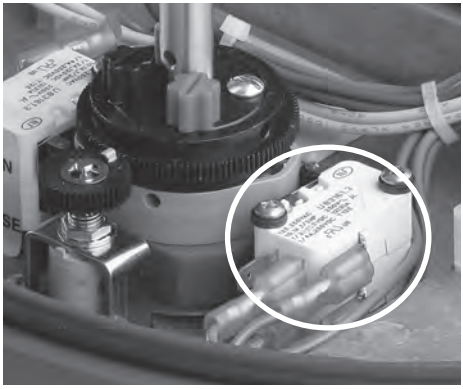

Figure 12. Fixed auxiliary switches installed in an actuator.

NOTE:

a. Fixed Auxiliary switches activate 3° before the travel limit switches. They are available as a factory and field installable option.

b. Adjustable auxiliary switches can be set to any position. They are available as a factory or field installable option.

7.4. Torque Switches

Mechanical Torque switches are designed to interrupt power to the motor windings when the actuator torque exceeds the calibrated factory setting.

Mechanical Torque switches are a factory installed and calibrated option available for all Series 70 units.

7.5. Battery Backup Unit

To meet customer needs, Bray offers a Battery Backup Unit (BBU) for the 24 V Series 70 Electric Actuator.

In the event of power failure, the BBU will switch the actuator to battery power to reach its fail position. After the actuator has reached its fail position, the BBU goes to 'Standby Mode' until external power is restored.

Once external power has been restored, the actuator returns to the position corresponding to the control signal present.

Figure 13. S70 with Battery Backup Unit.

Battery Backup Unit is available as a factory installable option. For more information, please refer to the 'S70 24V Actuator with BBU' Manual. This manual is available on the company website (www.bray.com).

7.6. Spinner

A spinner is available as an attachment to the actuator handwheel to ease and speed the manual operation of the actuator.

Figure 14. S70 with Handwheel Spinner Attached.

NOTE:

Care should be exercised in the use of spinner equipped handwheels.

Rapid operation of the handwheel to close the valve may cause water hammer.

Rapid travel into a travel stop may also cause damage.

7.7. Receptacles (Quick Connectors)

For quick and easy field wiring, Bray offers plug-in receptacles. Cordsets to fit these connectors can also be ordered in several lengths.

Figure 15. S70 with a 5-pin receptacle and the corresponding cordset.

Appendix A

A.1. Troubleshooting Guide

The Series 70 24V On/Off actuator is easy to configure and operate, but if problems do occur, the following guide can assist in troubleshooting.

The first step is to observe the 'Pwr' LED on the 24V On/Off Controller to verify that proper electrical power has been connected. If the 'Pwr' LED is flashing green, it means that the actuator has been powered correctly.

Next, observe the Fault LED. If the 'Fault' LED on the 24V On/Off Controller is turned on red, refer to Table 2 on page 7 of the manual to determine the root cause of the fault. After the root cause of the fault has been addressed, the 'Fault' LED should turn off.

If the problem still persists refer to the Actuator Troubleshooting Chart below.

A.2. Actuator Troubleshooting Chart

Problem	Possible Cause	Solutions
Actuator motor does not run in either direction and the 'Pwr' LED on the 24V On/Off Controller is flashing green	Manual override/handwheel is engaged.	Push handwheel in all the way
	Wiring is incorrect	Check wiring and power supply
Actuator operates in reverse directions	Field wiring is reversed	Rewire field wiring per wiring diagram
Actuator does not fully close valve (or open valve)	Limit switches are set incorrectly	Readjust travel limit switches
	Mechanical travel stops are set incorrectly	Adjust mechanical travel stops
	Valve torque requirement is higher than actuator output	Manually override out of seat, try angle seating or larger actuator
	Optional torque switches are activating	Valve torque exceeds actuator torque rating - consult factory
	Voltage power supply is low	Check power source
Corrosion inside unit	Water leaking in	Check all seals and possible water entry through conduit
Actuation only runs in one direction	Wiring is incorrect	Correct field wiring
	Incorrect control signal	Check/correct the control signal wire

A.3. Troubleshooting Example

The following example demonstrates a typical troubleshooting process.

Assume these starting conditions:

1. The handwheel is engaged (pulled away from the actuator).
2. The 24V On/Off Controller has been configured to enable torque switches but torque switches are not physically installed on the actuator.
3. 24VAC signal has been properly applied between the 'Open' and 'Close' terminals of the 24V On/Off Controller. The 'Pwr' LED is flashing indicating the control signal has been properly applied.

The 'Fault' LED on the 24V On/Off Controller is turned on red. Evaluate all possible reasons for the 'Fault' LED to be turned on as per Table 2 on page 7 of this manual.

1. Observe if the handwheel is engaged. In this case, the handwheel is engaged. Disengage the handwheel by pushing it in to eliminate a possible reason for the 'Fault' LED to be turned on red.
2. Evaluate if the limit switches have been correctly wired.
3. Check if the 24V On/Off Controller has been configured correctly to enable or disable the torque switches. In this case, torque switches have not been installed in the actuator but the 24V On/Off Controller has been configured to enable the torque switches. Correctly configure the 24V On/Off controller correctly to disable the toque switches as per Table 1 (on page 6).
4. The 'Fault' LED on the 24V On/Off Controller turns off and the actuator is now ready for service.

Appendix B

B.1. Basic Tools

Common To All Units	
Terminal connections, cam adjustment	Screwdriver, ¼" tip flat tip blade
All switches, terminal strip, torque switch plate	Screwdriver, No.1 Phillips
Switchplate screws	Screwdriver, No. 2 Phillips
Housing Size 6	
Mounting nuts	Wrench, ½"
Cover captivated capscrews	Hex key, ¼"
Travel stop adjusting bolts	Wrench, 7/16"
Travel stop jam nuts	Wrench, 7/16"
Conduit Entry Plug (½" NPT)	Hex key, ⅜"
Housing Size 12	
Mounting nuts (small pattern)	Wrench, ½"
Mounting nuts (large pattern)	Wrench, ¾"
Cover captivated capscrews	Hex key, 5/16"
Travel stop adjusting bolts	Wrench, 9/16"
Travel stop jam nuts	Wrench, 9/16"
Conduit Entry Plug (¾" NPT)	Hex key, 9/16"
Housing Size 30	
Mounting nuts (small pattern)	Wrench, ¾"
Mounting nuts (large pattern)	Wrench, 1⅛"
Cover captivated capscrews	Hex Key, ⅜"
Travel stop adjusting bolts	Wrench, ¾"
Travel stop jam nuts	Wrench, ¾"
Conduit Entry Plug (¾" NPT)	Hex key, 9/16"

Bray CONTROLS

A Division of BRAY INTERNATIONAL, Inc.
13333 Westland East Blvd. • Houston, Texas 77041
Tel: 281.894.5454 Fax: 281.894.9499 www.bray.com

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Chapter 10 Flow Switch (Division 25)

MANUFACTURER/DISTRIBUTOR:

Conval Québec
Lysane Guindon
9485 Transcanadienne Ouest
Montréal, QC, H4S 1V3
Phone: (514) 332-2301
lguindon@convalquebec.com

10.1 Magnetrol TD1 Flow Switch (WTP, ~~BS#1, BS#2)~~

Magnetrol Flow Switch TD1-2D00-030 w/ TEC-A110-004

Instrument Data Sheet

www.magnetrol.com - 705 Enterprise Street-Aurora, IL 60504 USA 630-969-4000 Fax 630-969-9489

Conval Québec
9485 Transcanadienne Ouest
Montréal, QC H4S 1V3
Phone Number 514-332-2301 Fax Number 514-636-0104

Thermal Dispersion

Rev.	Date	Approved By
0	2017-07-2	

SWITCH INFORMATION	SUPPLY VOLTAGE	DC - 19.2 to 28.8 VDC
	MOUNTING	INTEGRAL
	AMBIENT TEMP. RANGE	-40°F to +160°F (-40°C to +71°C)
	TIME DELAY	None
	OUTPUT RELAY	(1) DPDT Relay with Gold Flash Contacts
	RELAY RATING(Resistive)	8A@120/250 VAC, 8A@30 VDC, 0.5A@125 VDC
	ENCLOSURE MATERIAL	Aluminium (A356)
	ELECTRICAL ENTRY	(2) x 3/4" NPT(F)
	ENCLOSURE CLASS	FM or CSA (XP, NI, GP), NEMA 4X/7/9, IP66
PROBE INFORMATION	PROBE TYPE	TWIN TIP
	PROBE MATERIAL	316/316L SS
	PROCESS CONNECTION	3/4" NPT, 316/316L SS
	NORMAL RATING	1850 psig(127,6 barg)@100°F(38°C)
	RATING @ MAXIMUM TEMP.	1585 psig(109,3 barg)@250°F(121°C)
	INSERTION LENGTH*	4,00 (102)
	MAGNETROL MODEL NUMBER	TD1-2D00-030 with TEC-A110-004

Notes:

*Units are inches(millimeters) unless otherwise noted.

Magnetrol Flow Switch
TD1-2D00-030 w/ TEC-A110-004

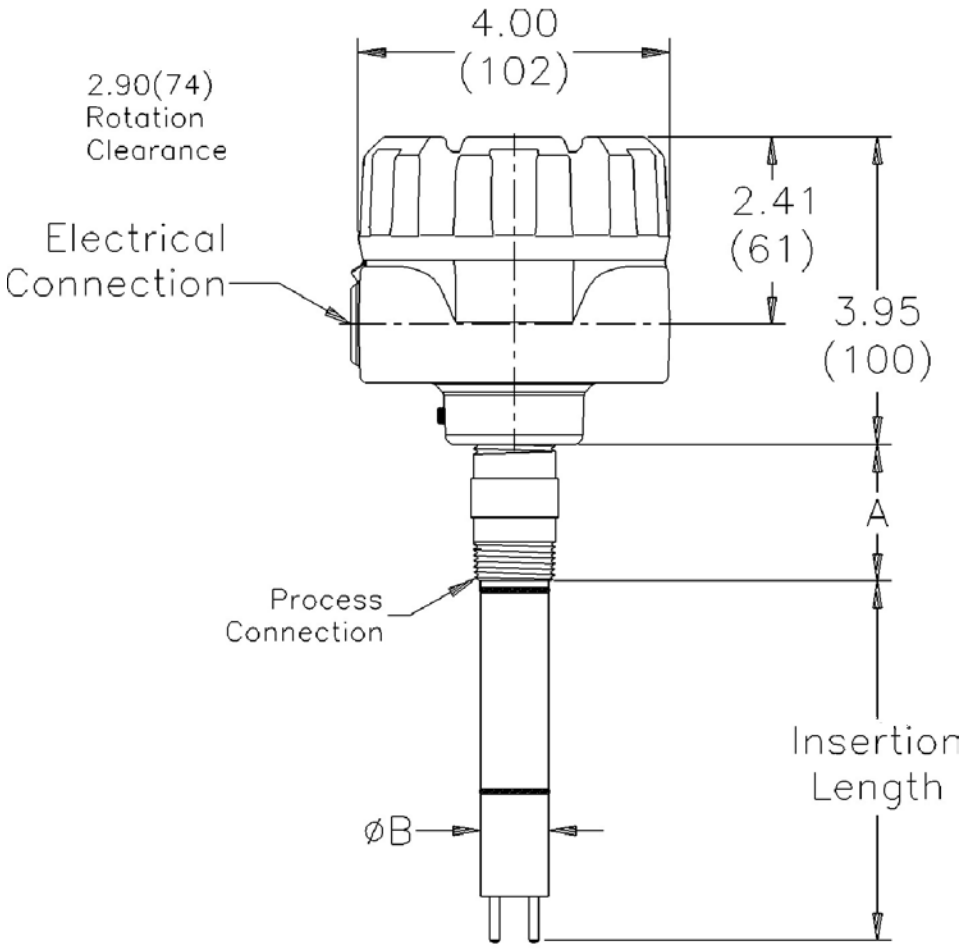
Dimensional Drawing

www.magnetrol.com - 705 Enterprise Street-Aurora, IL 60504 USA 630-969-4000 Fax 630-969-9489

MODEL # : TD1-2D00-030 with TEC-A110-004

ITEM NUMBER: 1 QUANTITY: 1

Revision	Date
0	2017-07-25



TAG NUMBERS:

ELECTRICAL CONNECTION

(2) x 3/4" NPT(F)

PROCESS CONNECTION

3/4" NPT

INSERTION LENGTH

4,00 (102)

SIGNIFICANT DIMENSIONS

A = 1,75(44)

B = 0,88(23)

CUSTOMER NAME: Les Entreprise Sifec Nord Inc.

CUSTOMER REFERENCE:

PROJECT NAME:

CERTIFIED BY: For quotation reference only

(Not for construction unless certified)

Date: 2017-07-26

Units are inches(millimeters) unless otherwise noted.

THERMATEL®
MODEL TD1/TD2

Installation and Operating Manual

Model TD1
with twin tip sensor

Model TD2
with spherical tip sensor

Thermal Dispersion

Flow/Level/Interface

Switch

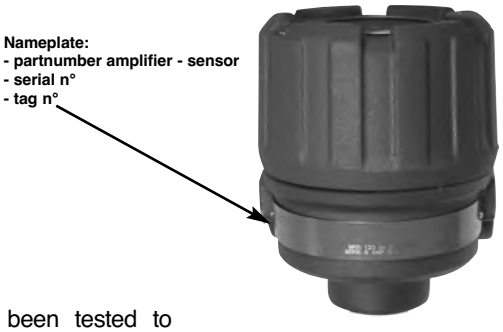
Model TD2
with hygienic
stainless steel enclosure &
spherical tip sensor

Model TD2
with low flow body sensor

Magnetrol®

UNPACKING

Unpack the instrument carefully. Make sure all components have been removed from the foam protection. Inspect all components for damage. Report any concealed damage to the carrier within 24 hours. Check the contents of the carton/crates against the packing slip and report any discrepancies to Magnetrol. Check the nameplate model number to be sure it agrees with the packing slip and purchase order. Check and record the serial number for future reference when ordering parts.

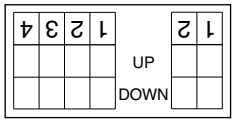


CE 0038 0344

These units are in compliance with:

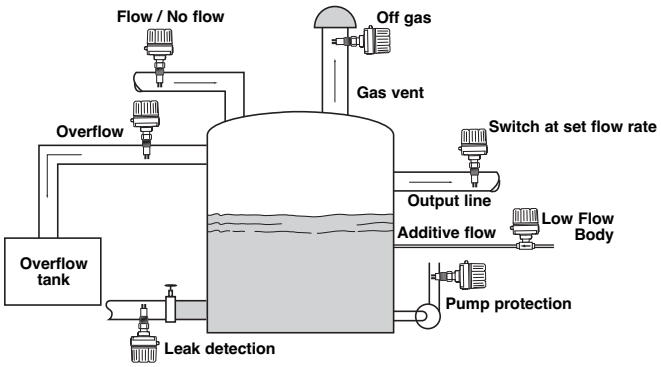
1. The EMC directive 2004/108/EC. The units have been tested to EN 61326: 1997 + A1 + A2.
2. Directive 94/9/EC for equipment or protective system intended for use in potentially explosive atmospheres. EC-type examination certificate number ISSeP13ATEX024X or ISSeP13ATEX025X. Standards applied EN60079-0:2012, EN60079-1:2007, EN60079-11:2012 and EN60079-26:2007.
3. The PED directive 97/23/EC (pressure equipment directive). Safety accessories per category IV module H1.

Set up Sticker



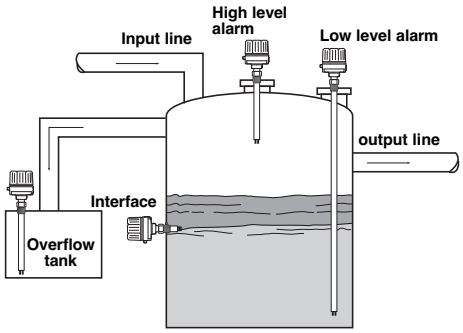
MOUNTING

FLOW

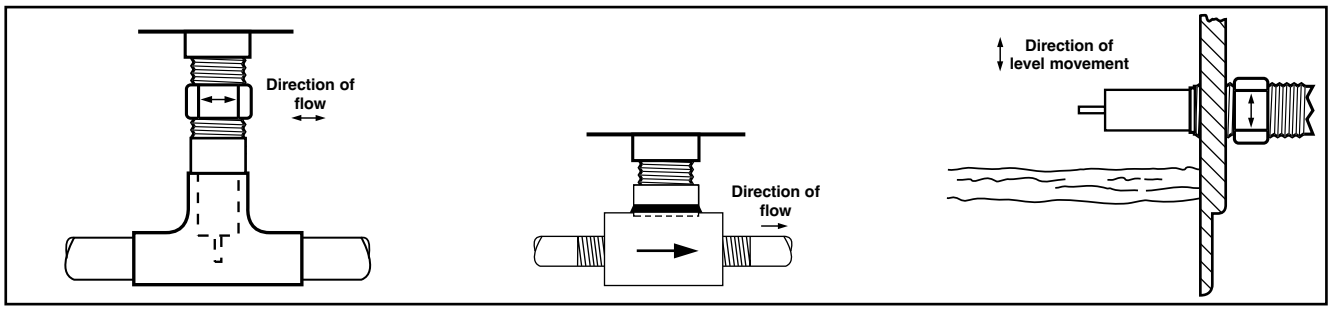


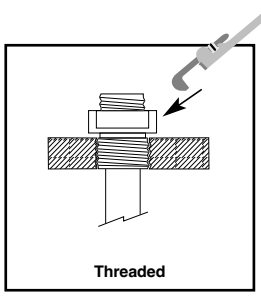
- Liquid or Gas flow detection
- Maintain a minimum flow rate
  - Pump protection
  - Cooling air/water
  - Lubrication systems
  - Chemical feed pumps
- Detect presence of flow
  - Relief valves / Flare lines
- Water for Injection (WFI)
- Filtration systems
- Separation systems
- CIP systems
- Air, CO_2, N_2 flow

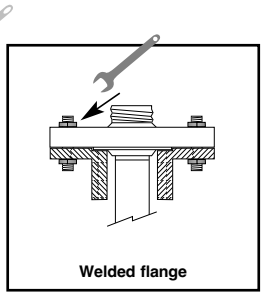
LEVEL

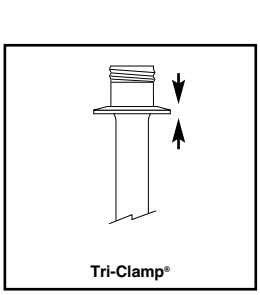


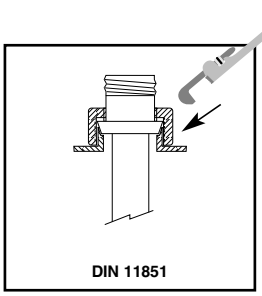
- High level or Low level
- Interface between different media
  - Oil/water
  - Liquid/foam
- Suitable for any liquid level detection including: High viscosity, High solids content, Aeration, Foam
- Insensitive to dielectric, specific grafity, viscosity




Threaded


Welded flange


Tri-Clamp®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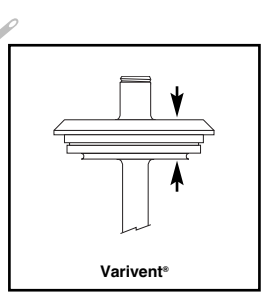
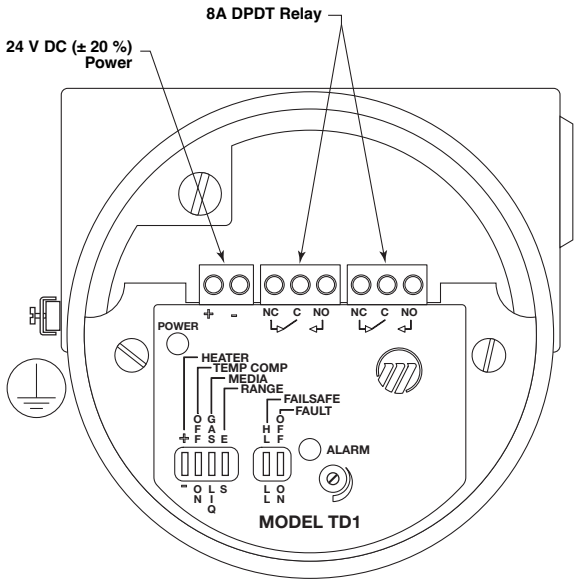
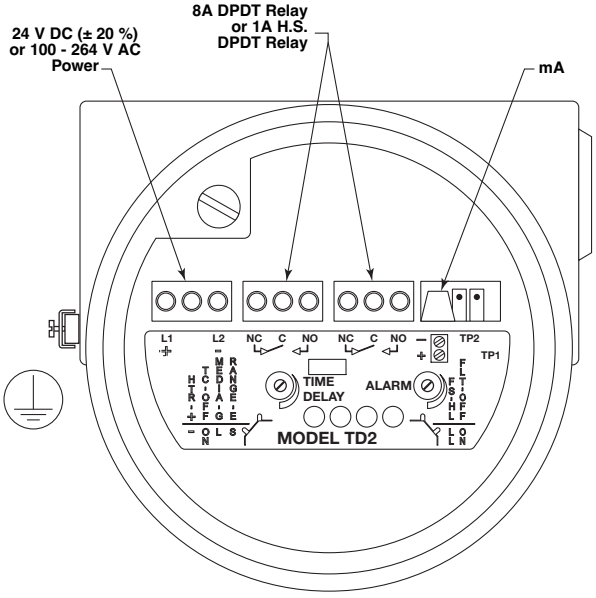

Varivent®

WIRING

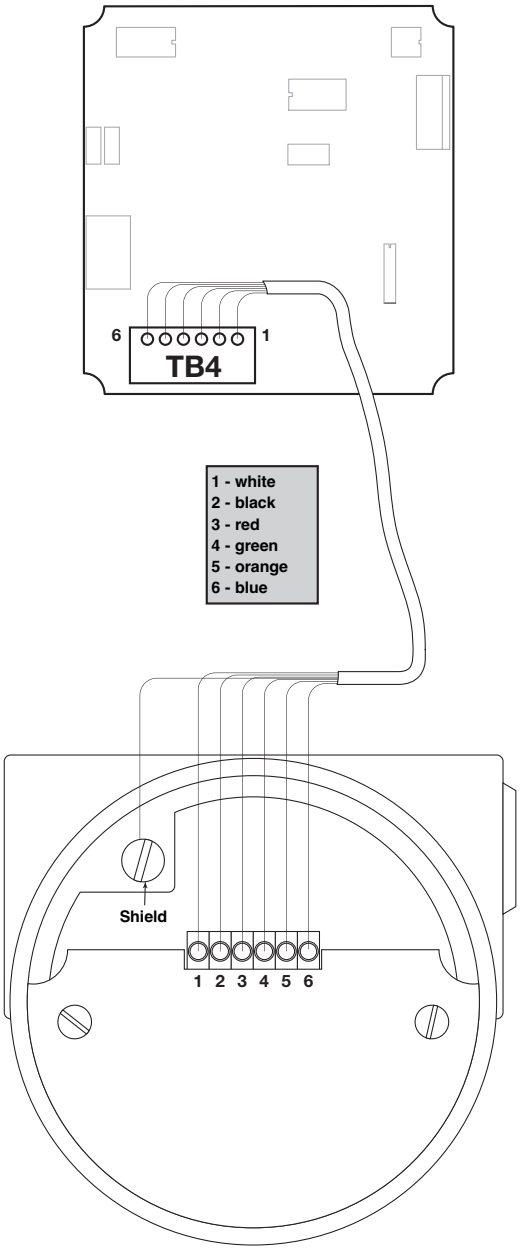


TD1 Wiring



Integral TD2 Wiring

Note: For ATEX II 1G / zone 0: mA signal can only be connected when a Thermatel sensor of 1 mm wall thickness is used.



Remote TD2 Wiring

RELAY CONNECTIONS

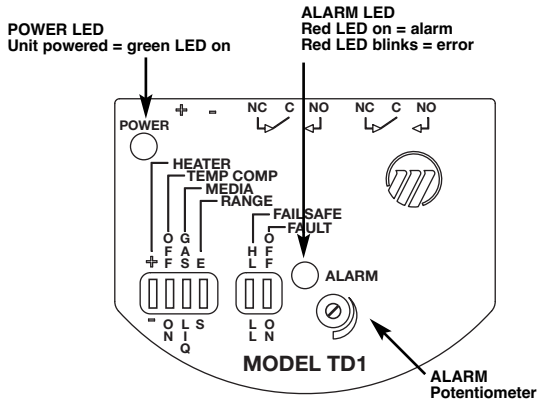
Power	*Level*	*Fail-safe position*	*Relay coil*	*Relay terminals*	
				NC to C	*NO to C*
On	High	HLFS	De-energized	Closed	Open
		LLFS	Energized	Open	Closed
	Low	HLFS	Energized	Open	Closed
		LLFS	De-energized	Closed	Open
Fail	High	HLFS	De-energized	Closed	Open
		LLFS	De-energized	Closed	Open
	Low	HLFS	De-energized	Closed	Open
		LLFS	De-energized	Closed	Open

CHART NOTES AND DEFINITIONS:

1. Equipment controlled by Thermatel® relays is assumed to be powered from one source, while the Thermatel® unit itself is assumed to be powered from a different source.
2. “Fail” means a loss of power to the Thermatel® unit.
3. HLFS (High Level Fail-safe) means a flow rate or level which is equal to or above the set point.
4. LLFS (Low Level Fail-safe) means a flow rate or level which is equal to or below the set point.
5. When the relay coil is de-energized, a connection is made between the terminals COM (common) and NC (normally closed), and there is no connection between COM and NO (normally open).
6. When the relay coil is energized, a connection is made between the terminals COM and NO, and there is no connection between COM and NC.

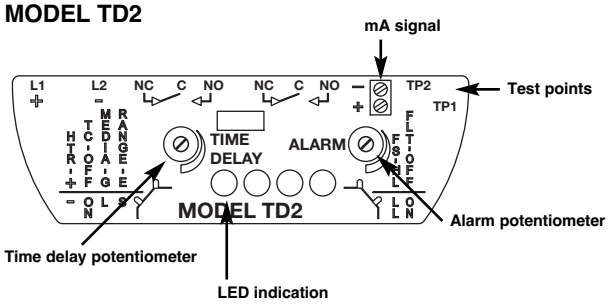
Indication and functions

MODEL TD1



Note: during initial power-on, red LED will blink slowly.

MODEL TD2



Note: during initial power-on, all LED's will turn on and individually OFF = unit ready.

ALARM (TD1/TD2)

FAIL-SAFE (TD1/TD2):

HLFS (High Level Fail-safe):
Relay is energized when flow < setpoint or sensor dry (or in the low conductive liquid).
Relay is de-energized when flow ≥ setpoint or sensor is immerged (or in the higher conductive liquid).

LLFS (Low Level Fail-safe):
Relay is energized when flow > setpoint or sensor is immerged (or in the higher thermal conductive liquid).
Relay is de-energized when flow ≤ setpoint or sensor dry (or in the lower thermal conductive liquid).

mA SIGNAL (TD2):

The mA is a non linear signal of the actual process conditions;
- for flow: mA output increases as the flow rate increases
- for level: mA output increases when in a wet condition.

The mA value depends upon sensor and application.

Error reporting is determined by setting of the Fail Safe mode;
- failsafe low ≤ 3,6 mA
- failsafe high ≥ 22 mA

TESTPOINTS (TD2):

Measure and record the voltage between TP1 and TP2. This voltage will change as the set point potentiometer is adjusted. Voltage readings will be between 0 and 5 VDC. This value may be used for future reference or adjustment of set point. This value can be recorded and checked in the future to ensure that the set point has not changed since last calibration.

TIME DELAY POTENTIOMETER (TD2):

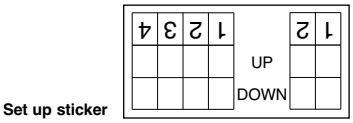
Before calibration, turn fully counterclockwise until click (max. 30 turns) = 0 s.

LED INDICATION (TD1/TD2):
(in accordance with fail-safe mode)

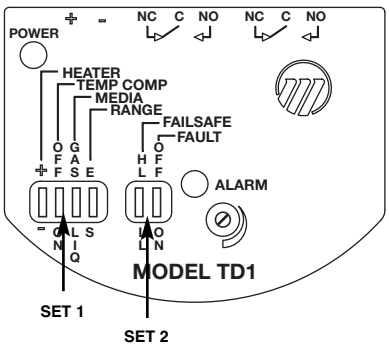
green	LED ON = safe (one or more of the 2 green LED's) (TD2)
yellow	LED ON = reaching switch point (TD2)
Red	LED ON = alarm (TD1/TD2)
	LED BLINKS = error (TD1/TD2).

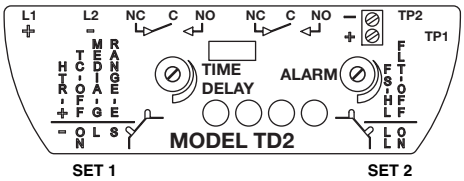
Switch setup

The TD1/TD2 switch settings are pre-set from factory. The factory default settings are marked on the sticker on the electronics. These positions may need to be changed, depending upon the application – consult the following table.



Set up sticker





SET 1

TD1/TD2	Purpose	Settings
HEATER / HTR (4)	Control heat to sensor	+ for flow applictions - for level applications
TEMP COMP / TC (3)	De-activate temperature compensation	OFF: use only in case recommended by factory ON: default setting
MEDIA (2)	Gas or Liquid	G: Gases L: Liquids, default setting for TMH/TML sensors
RANGE (1)	Increase sensitivity	E: for water flow applications S: default setting

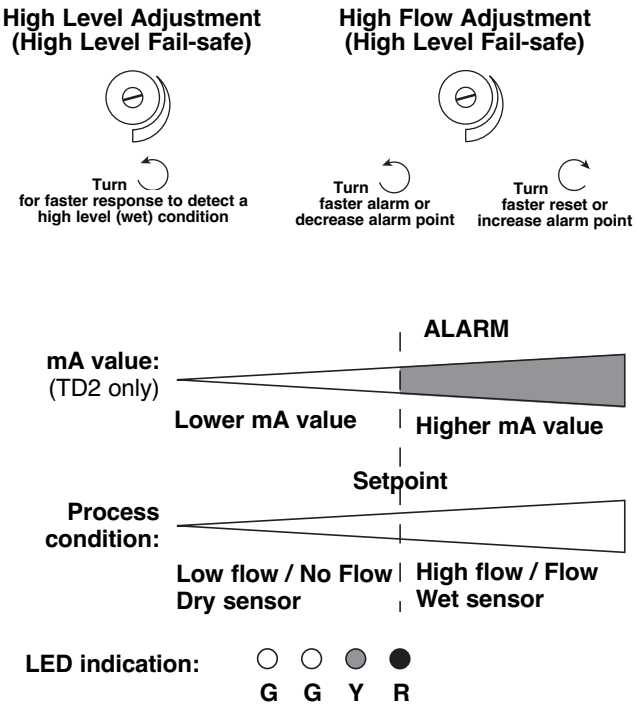
SET 2

TD1/TD2	Purpose	Settings
FAILSAFE / FS (2)	Failsafe setting	HL: High Level Fail-safe LL: Low Level Fail-safe
FAULT / FLT (1)	De-activate fault indication	OFF: use only in case recommended by factory ON: default setting

CALIBRATION

NOTE: Ensure that settings on page 3 have been verified before calibrating this unit.
Adjust level, interface or flow to the desired alarm condition of the actual liquid or gas. Units are preferably field calibrated under operating conditions or bench calibrated if the real conditions can be simulated. Consult factory when this cannot be established.

High flow / High level - Interface



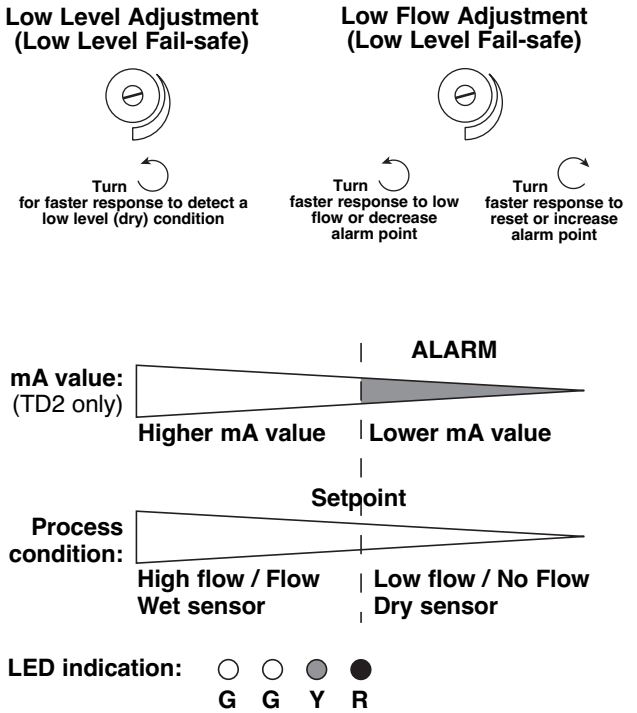
1. Set Time delay to minimum (turn max 30 turns counterclockwise or until a clicking sound is heard) - only TD2.
2. Set Failsafe switch in “High” mode.
3. Set Alarm potentiometer until red LED is ON. Allow some time for the switch to stabilize (check mA output - only TD2).

   Relay will be de-energized, if flow or level is higher than the actual set point or the unit sees the most thermal conductive media.
4. Reset Alarm potentiometer until Red LED is OFF and both green LED’s (only TD2) light UP (turn clockwise) – tweek the potentiometer slowly back and forth until the desired set point is reached = Red LED ON.
5. Only for level applications: turn alarm potentiometer counterclockwise one additional turn.

   Typical response time for level is within 3 - 5 s.

   Typical response time for flow is within 2 - 15 s, depending on the appliction.

Low flow / No flow / Low level - Interface



1. Set Time delay to minimum (turn max 30 turns counterclockwise or until a clicking sound is heard) - only TD2.
2. Set Failsafe switch in “Low” mode
3. Set Alarm potentiometer until: (turn counterclockwise) red LED is ON. Allow some time for the switch to stabilize (check mA output - only TD2).

   Relay will be de-energized, if flow or level is lower than the actual set point or the unit sees the least thermal conductive media.
4. Reset Alarm potentiometer until Red LED is OFF and both green LED’s (only TD2) light UP (turn clockwise) – tweek the potentiometer slowly back and forth until the desired set point is reached = Red LED ON.
5. Only for level applications: turn alarm potentiometer clockwise ½ additional turn.

   Typical response time for level is within 5 - 10 s.

   Typical response time for flow is within 2 - 15 s, depending on the appliction.

FAULT INDICATION

TD1/TD2 have continuous diagnostics to ensure that the signal from the sensor is within a select range. If the electronics detect an “out of range” signal, the switch has registered an instrument error.

TD1: Alarm LED blinks and the relay de-energizes.

TD2: 3,6 mA signal when unit is set for low level fail-safe.
22 mA signal when unit is set for high level fail-safe.
Alarm LED blinks and the relay de-energizes.

If a fault is detected, refer to section “TROUBLESHOOTING”.

TROUBLESHOOTING

The TD1/TD2 switches have various settings to handle a wide variety of flow and level applications. If the switch is not performing properly, check the switch settings on page 4 or the following:

Symptom	Problem	Solution / Action
Red LED does not go ON	Switch point cannot be established for air flow detection	Check whether probe is extended into the flow. Change Heater to “-”
Green LED OFF (TD1) All LED’s OFF (TD2)	No power	1. Check power supply 2. Check wiring at wiring terminals
Red LED blinks and ≤ 3,6 mA or ≥ 22 mA (TD2)	An instrument error has been registered	By changing the switch settings, the unit may return to normal operation mode. If not, consult factory.

Symptom	Application	Action*
Unable to adjust set point to obtain alarm Fault LED blinks	Air Flow Detection	Ensure that the probe is extended into the flow Change HEATER (Model TD1) / HTR (Model TD2) to “–”
Switch indicates a fault (red LED will blink)	Liquid Level – Sensor Wet	Verify HEATER (TD1) / HTR (TD2) is set to “–” Change HEATER/HTR to “+” Light goes off—contact factory to discuss application. Light stays on—check resistance to determine if a problem exists with the probe or electronics. Refer to Section “RESISTANCE VALUES”. Probe and/or electronics may need to be replaced.
	Liquid Level – Sensor Dry	Verify HEATER (TD1) / HTR (TD2) is set to “–” Turn off FAULT (TD1) / FLT (TD2) Light goes off—operate in this mode Light stays on—check resistance to determine if a problem exists with the probe or electronics. Refer to Section “RESISTANCE VALUES”. Probe and/or electronics may need to be replaced.
	Liquid Flow – Sensor Dry or No Air Flow	Turn off FAULT (TD1) / FLT (TD2) Light goes off—run HEATER/HTR at “+” and FAULT/FLT “off” or run HEATER/HTR at “-” Light stays on—check resistance to determine if a problem exists with the probe or electronics. Refer to Section “RESISTANCE VALUES”. Probe and/or electronics may need to be replaced.
	Liquid Flow – Sensor Wet No Flow	Switch HEATER/HTR to “-” Light goes off—run HEATER/HTR at “+” and FAULT/FLT “off” or run HEATER/HTR at “-” Light stays on—check resistance to determine if a problem exists with the probe or electronics. Refer to Section “RESISTANCE VALUES”. Probe and/or electronics may need to be replaced.

TROUBLESHOOTING

Symptom	Application	Action*
Switch indicates a fault (red LED will blink)	Liquid Flow – Flow Present	Turn off TEMP COMP (TD1) / TC (TD2) Light goes off—operate in this mode Light stays on—check resistance to determine if a problem exists with the probe or electronics. Refer to Section “RESISTANCE VALUES”. Probe and/or electronics may need to be replaced.
	Air Flow – Flow Present	Switch HEATER/HTR to “-” Light goes off—Operate at lower heater power (with less sensitivity). Turn TEMP COMP/TC off if problem continues (requires re-calibration) or operate at HEATER/HTR “+” and make sure FAULT/FLT switch is “off” Light stays on—Return HEATER/HTR switch to "+" and turn TEMP COMP/TC "off". If light goes off then recalibrate and operate in this mode. If light stays on check resistance to determine if a problem exists with the probe or electronics. Refer to Section “RESISTANCE VALUES”. Probe and/or electronics may need to be replaced.

* Changing HEATER/HTR, TEMP COMP/TC or media switch position requires recalibration.

RESISTANCE VALUES

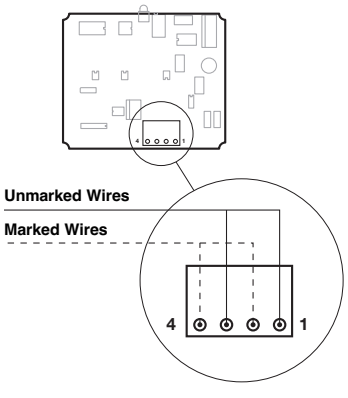
The following tables provide the expected resistance values for the sensor. Refer to the indicated figures for pin locations. Refer to section “REPLACEMENT PARTS / Probe replacement” for removing bezel and circuit boards.

TD1

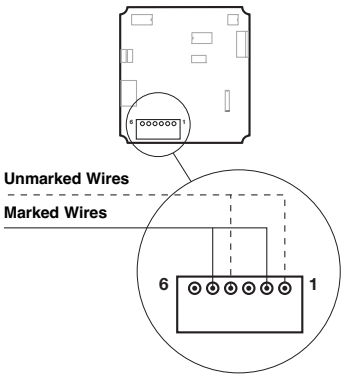
Pin	Expected Resistance
1 to 3	90 to 180 ohms (275 ohms with high temperature probe)
2 to 4	90 to 180 ohms (275 ohms with high temperature probe)

TD2 – Integral Electronics
TD2 – Remote Electronic Enclosure

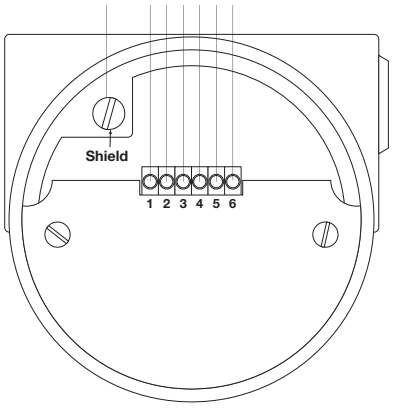
Pin	Expected Resistance
1 to 3 or 4	90 to 180 ohms (90 to 275 ohms with high temperature probe)
2 to 5 or 6	90 to 180 ohms (90 to 275 ohms with high temperature probe)
1 to 2, 3 to 4, 5 to 6	0 to 12 ohms



TD1 Probe Connections



TD2 Integral Probe Connections



TD2 Remote Probe Connections

MAINTENANCE

Cleaning

The probe may be cleaned by soaking, spraying solvents or detergent and water onto the sensor tubes, or by ultrasonic cleaning. Lime deposits may be safely removed by soaking in 20 % hydrochloric acid. Warming to +65 °C (+150 °F) is permissible to speed this process.

For unusual cleaning problems, contact the factory and determine the exact materials of construction and chemical compatibility before using strong acids or unusual cleansers.

REPLACEMENT PARTS

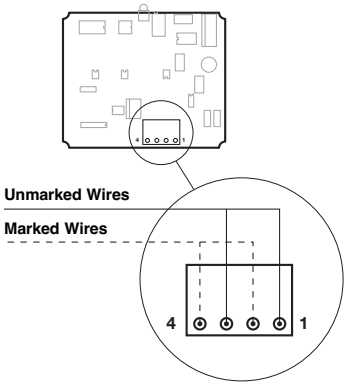
Note: The switch will require recalibration (see page 5) following probe or electronics replacement.

Probe replacement

INTEGRAL ELECTRONICS

Removal of probe

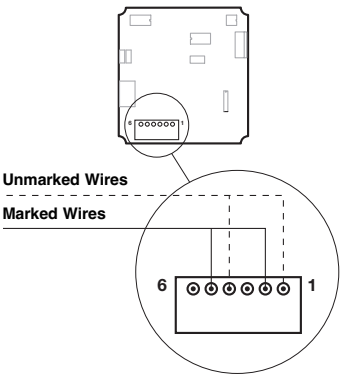
1. Make sure the power source is turned off.
2. Unscrew and remove housing cover.
3. Remove the bezel by:
   a. TD1 – removing the fastening screws.
   b. TD2 – put a screwdriver blade through hole in center and gently pull the handle away from the terminal strips.
4. Remove the fastening screws for the bracket. Remove bracket and attached circuit boards.
5. Loosen the screws on the terminal block to remove the four leads from the probe. Note that the TD1 uses a four position terminal block and the TD2 uses a six position terminal block.
6. Unscrew probe from enclosure.



TD1 Probe Connections

Installation of replacement probe

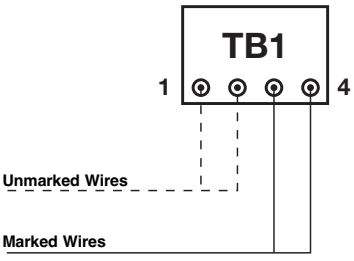
1. The probe's leads have been separated at the factory.
   One set of leads is marked with a "1," the second set is unmarked. Connect leads from RTD #1:
   TD1 – Connect between terminals 1 and 3.
   TD2 – Connect between terminals 2 and 5.
2. Connect the second set of leads:
   TD1 – Connect between terminals 2 and 4.
   TD2 – Connect between terminals 1 and 4.
3. Replace bezel and housing cover.
   TD1 – Replace bezel and refasten screws.
   TD2 – Reinstall bracket assembly. Ensure that the tab at the bottom of the bracket engages in the hole in the bottom of housing. Reinstall bracket mounting screws. Replace bezel by gently pressing down on the center of the bezel. Ensure that the outer edge of bezel is evenly seated in the housing.
4. Replace housing cover.
5. Apply power.
6. Recalibrate as described on page 5.



TD2 Integral Probe Connections

REMOTE ELECTRONICS (TD2 ONLY)

1. Make sure the power source is turned off.
2. Remove the cover from the sensor enclosure.
3. Loosen the screws on the four position terminal block (TB1) to remove the leads from the probe.
4. Unscrew probe from enclosure.
   a. The probe's leads have been separated at the factory. Connect leads from RTD #1, which are grouped and marked, to pins 3 & 4 (the two terminals on TB1 closest to the sensor label).
   b. Connect the other pair of leads, which are not marked, to pins 1 & 2 (the remaining two positions on TB1).
5. Replace housing cover.
6. Apply power.
7. Recalibrate as described on page 5.



TD2 Remote Probe Connections

REPLACEMENT PARTS

Replacement parts – Model TD1

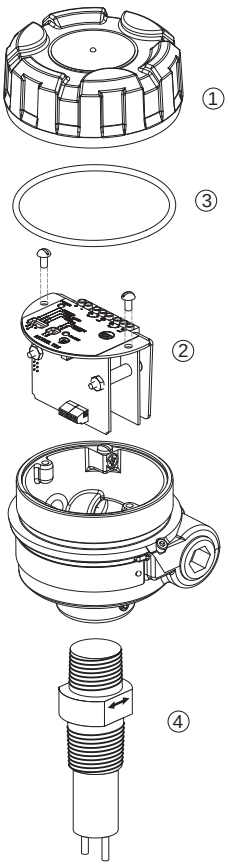
Partn°: T D 1 – – – – – – – –

Digit in partn°: X 1 2 3 – 4 5 6 7 – 8 9 10

X = product with a specific customer requirement

Serial n°: – – – – – – – – – – – –

See nameplate, always provide complete partn° and serial n° when ordering spares.



(1) Housing cover	
Digit 10	**Replacement part**
0 or 1	004-9193-003
2 or 3	004-9193-007

	Replacement part
(2) Electronic module	089-7250-001
(3) "O"-ring	012-2201-237
(4) Sensor	consult factory

REPLACEMENT PARTS

Replacement parts – Model TD2

Partn°: T D 2 – – – – – – –

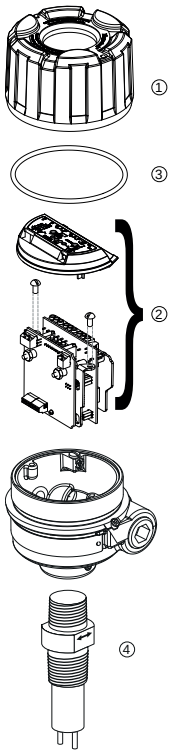
Digit in partn°: X 1 2 3 – 4 5 6 7 – 8 9 10

X = product with a specific customer requirement

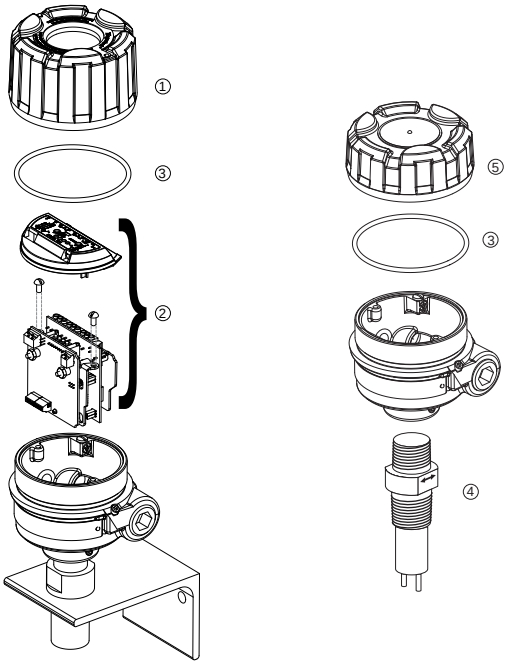
Serial n°: – – – – – – – – – – –

See nameplate, always provide complete partn° and serial n° when ordering spares.

INTEGRAL ELECTRONICS



REMOTE ELECTRONICS



(1) Housing cover		
Digit 7	**Digit 10**	**Replacement part**
0	0 or 1	004-9192-009
	2 or 3	004-9192-011
	4 or 5	036-5702-003
1	0 or 1	036-4410-010
	2 or 3	not applicable
	4 or 5	036-5702-002

(3) "O"-ring	
Digit 10	**Replacement part**
0, 1, 2 or 3	012-2201-237
4 or 5	012-2201-155

	Replacement part
(4) Sensor	consult factory

(5) Housing cover		
Digit 8	**Digit 10**	**Replacement part**
1	0 or 1	004-9193-003
	2 or 3	004-9193-007
	4 or 5	not applicable

(2) Electronic module					
Digit 4	**Digit 5**	**Digit 8**	**Digit 9**	**Digit 10**	**Replacement part**
7	D	0	3 or G	0, 1, 2 or 3	089-7250-002
			C		089-7250-010
			7	4 or 5	089-7253-001
		1	3 or G	0, 1, 2 or 3	089-7250-004
			C		089-7250-012
			7	4 or 5	not applicable
	H	0	3 or G	0, 1, 2 or 3	089-7250-006
			C		
			7	4 or 5	089-7253-003
		1	3 or G	0, 1, 2 or 3	089-7250-008
			C		
			7	4 or 5	not applicable
8	D	0	3 or G	0, 1, 2 or 3	089-7250-003
			C		089-7250-011
			7	4 or 5	089-7253-002
		1	3 or G	0, 1, 2 or 3	089-7250-005
			C		089-7250-013
			7	4 or 5	not applicable
	H	0	3 or G	0, 1, 2 or 3	089-7250-007
			C		
			7	4 or 5	089-7253-004
		1	3 or G	0, 1, 2 or 3	089-7250-009
			C		
			7	4 or 5	not applicable

MODEL IDENTIFICATION

A complete measuring system consists of:

1. THERMATEL® electronics
2. Connecting cable (only applicable for remote mount TD2 units)
3. THERMATEL® sensor
4. Optional: Order code for thread-on mounting flanges
5. Optional: Retractable probe assembly, consult factory for details
6. Optional: Factory calibration, consult factory

TD1

TD2

1. Code for Thermatel® TD1 electronics

T D 1 - 2 D 0 0 - 0	Integral mount electronics for 24 V DC power supply and with 1 DPDT 8 A DPDT output relay

APPROVAL

3	Weatherproof
C	ATEX/IEC flameproof enclosure with intrinsically safe probe circuitry

HOUSING / CABLE ENTRY

0	IP66, Cast aluminium, 3/4" NPT cable entry (2 entries - 1 plugged)
1	IP66, Cast aluminium, M20 x 1,5 cable entry (2 entries - 1 plugged)

	T	D	1	2	D	0	0	0		

complete code for Thermatel® TD1 electronics

X = product with a specific customer requirement

MODEL IDENTIFICATION

1. Code for Thermatel® TD2 electronics with housing for industrial use

T D 2	Electronics with continuous LED indication and mA output

POWER SUPPLY

7	240 V AC (100-264 V AC)
8	24 V DC (± 20 %)

OUTPUT

D 0	8 A DPDT relay
H 0	1 A Hermetically sealed DPDT relay

ACCESSORIES

0	Blind housing cover
1	Housing cover with glass window (for aluminium housings only)

MOUNTING CONFIGURATION

0	Integral electronics
1	Remote electronics

APPROVAL ①

3	Weatherproof
C	Zone 0 – for level applications ATEX/IEC flameproof enclosure with intrinsically safe probe circuitry - no mA output available - only available with 8 A DPDT relay option
G	Zone 1 – for level and flow applications ATEX/IEC flameproof enclosure

① Consult factory for zone 0 applications in combination with hermetically sealed relay.

HOUSING / CABLE ENTRY

0	IP66, Cast aluminium, 3/4" NPT cable entry (2 entries - 1 plugged)
1	IP66, Cast aluminium, M20 x 1,5 cable entry (2 entries - 1 plugged)
2	IP66, Cast stainless steel, 3/4" NPT cable entry (2 entries - 1 plugged)
3	IP66, Cast stainless steel, M20 x 1,5 cable entry (2 entries - 1 plugged)

[ ]	T	D	2			0		

complete code for Thermatel® TD2 electronics with housing for industrial use

X = product with a specific customer requirement

MODEL IDENTIFICATION

1. Code for Thermatel® electronics with housing for hygienic use

T D 2	Electronics with continuous LED indication and mA output

POWER SUPPLY

7	240 V AC (100-264 V AC)
8	24 V DC (± 20 %)

OUTPUT

D 0	8 A DPDT relay
H 0	1 A Hermetically sealed DPDT relay

ACCESSORIES

0	Blind housing cover
1	Housing cover with glass window

MOUNTING / HOUSING MATERIAL / APPROVAL
Integral mount electronics
304 SST – IP 67

0 7	Weatherproof

CABLE ENTRY

5	M20 x 1,5 (2 entries – 1 plugged)
4	1/2" NPT (1 entry)

[ ] T D 2 – [ ] [ ] 0 [ ] – 0 7 [ ] **complete code for Thermatel® electronics with housing for hygienic use**

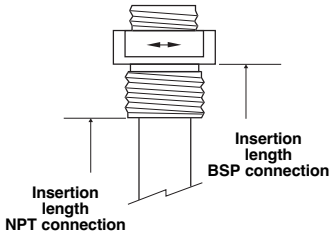
→ X = product with a specific customer requirement

2. Code for connecting cable used with weatherproof remote mount TD2 electronics (6-wire cable/shielded). Consult factory for cable suitable for flameproof enclosure.

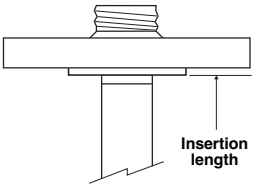
0 0 3 - 1 5 0	From 3 m (10 ft) min. to 150 m (500 ft) max. Specify in increments of 1 m (3.28 ft)

0 3 7 – 3 1 9 8 – [ ] [ ] [ ] **complete code for connecting cable**

CONNECTIONS

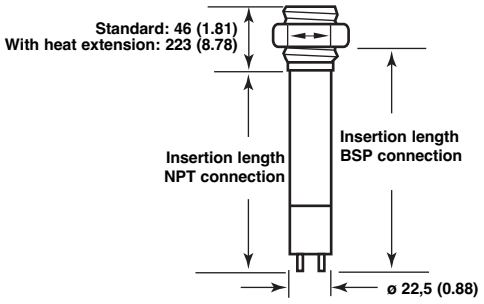


Threaded

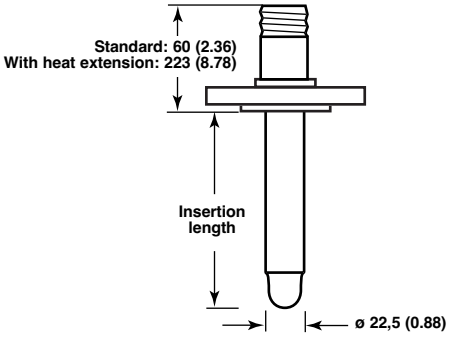


Welded flange ANSI - EN (DIN)

DIMENSIONS IN mm (inches) – TMA/TMB/TMC/TMD



Threaded Sensor

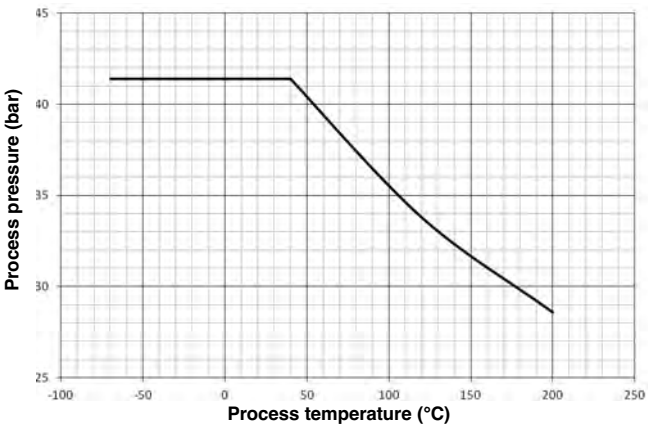


Flanged Sensor

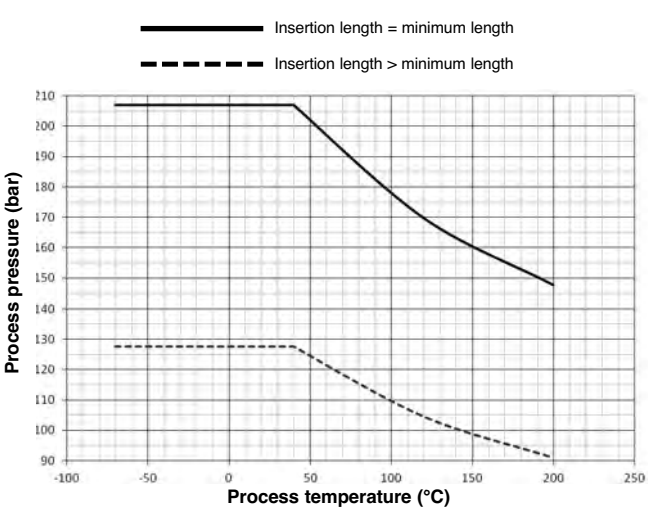
PRESSURE/TEMPERATURE RATING – TMA/TMB/TMC/TMD

Sensor	Material code	Insertion length	Maximum process pressure @ +40 °C (+100 °F)	@ +120 °C (+250 °F)	@ +200 °C (+400 °F)
TMA, TMB	A	All	41,4 bar (600 psi)	33,8 bar (490 psi)	28,6 bar (415 psi)
TMC, TMD	A, D	= minimum length	207 bar (3000 psi)	170 bar (2460 psi)	148 bar (2140 psi)
		> minimum length	128 bar (1850 psi)	105 bar (1517 psi)	91,0 bar (1320 psi)
TMC, TMD	B	= minimum length	207 bar (3000 psi)	181 bar (2627 psi)	161 bar (2340 psi)
		> minimum length	103 bar (1500 psi)	90,6 bar (1313 psi)	80,7 bar (1170 psi)
TMC, TMD	C	= minimum length	172 bar (2500 psi)	147 bar (2125 psi)	137 bar (1980 psi)
		> minimum length	82,8 bar (1200 psi)	70,3 bar (1020 psi)	65,5 bar (950 psi)

TMA/TMB sensors



TMC/TMD sensors with material code A or D



MODEL IDENTIFICATION

3. Code for Thermatel® TD1/TD2 – STANDARD SENSOR

T M A	Spherical tip	- standard	max +120 °C (+250 °F)①
T M B	Spherical tip	- with heat extension	max +200 °C (+400 °F)
T M C	Twin tip	- standard	max +120 °C (+250 °F)①
T M D	Twin tip	- with heat extension	max +200 °C (+400 °F)

① TMA/TMC sensors can handle process temperatures up to +200 °C (+400 °F) with remote electronics.

MATERIAL OF CONSTRUCTION FOR SENSOR AND PROCESS CONNECTION①

A	316/316L (1.4401/1.4404) stainless steel②	
B	Hastelloy® C (2.4819)	– TMC/TMD only
C	Monel® (2.4360)	– TMC/TMD only
D	316/316L (1.4401/1.4404) stainless steel	– TMC/TMD only

① Sensors with material code B or C are not available with retractable probe assembly.
② Not suitable for zone 0 applications in combination with hermetically sealed relay.

PROCESS CONNECTION – SIZE/TYPE

Threaded

1 1 0	3/4" NPT
2 1 0	1" NPT
2 2 0	1" BSP (G 1")

ANSI flanges

2 3 0	1"	150 lbs ANSI RF
2 4 0	1"	300 lbs ANSI RF
2 5 0	1"	600 lbs ANSI RF
3 3 0	1 1/2"	150 lbs ANSI RF
3 4 0	1 1/2"	300 lbs ANSI RF
3 5 0	1 1/2"	600 lbs ANSI RF
4 3 0	2"	150 lbs ANSI RF
4 4 0	2"	300 lbs ANSI RF
4 5 0	2"	600 lbs ANSI RF

EN (DIN) flanges

B B 0	DN 25	PN 16/25/40	EN 1092-1	Type A
B C 0	DN 25	PN 63/100	EN 1092-1	Type B2
C B 0	DN 40	PN 16/25/40	EN 1092-1	Type A
C C 0	DN 40	PN 63/100	EN 1092-1	Type B2
D A 0	DN 50	PN 16	EN 1092-1	Type A
D B 0	DN 50	PN 25/40	EN 1092-1	Type A
D D 0	DN 50	PN 63	EN 1092-1	Type B2
D E 0	DN 50	PN 100	EN 1092-1	Type B2

INSERTION LENGTH – Specify per cm (0.39") increment

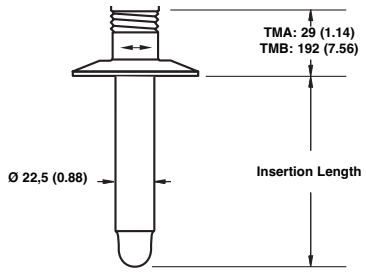
0 0 5	Minimum 5 cm (2")	– sensors with NPT/flanged connection
0 0 8	Minimum 8 cm (3.15")	– sensors with BSP connection
3 3 0	Maximum 330 cm (130")	

	T	M					0			

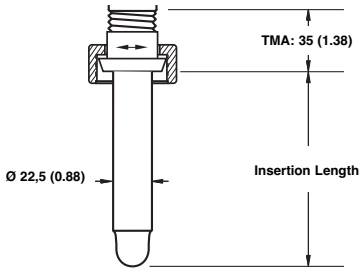
complete code for Thermatel® TD1/TD2 STANDARD SENSOR

→ X = product with a specific customer requirement

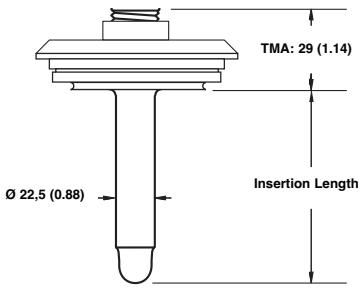
DIMENSIONS IN mm (inches) – HYGIENIC TMA/TMB



Tri-Clamp®



DIN 11851

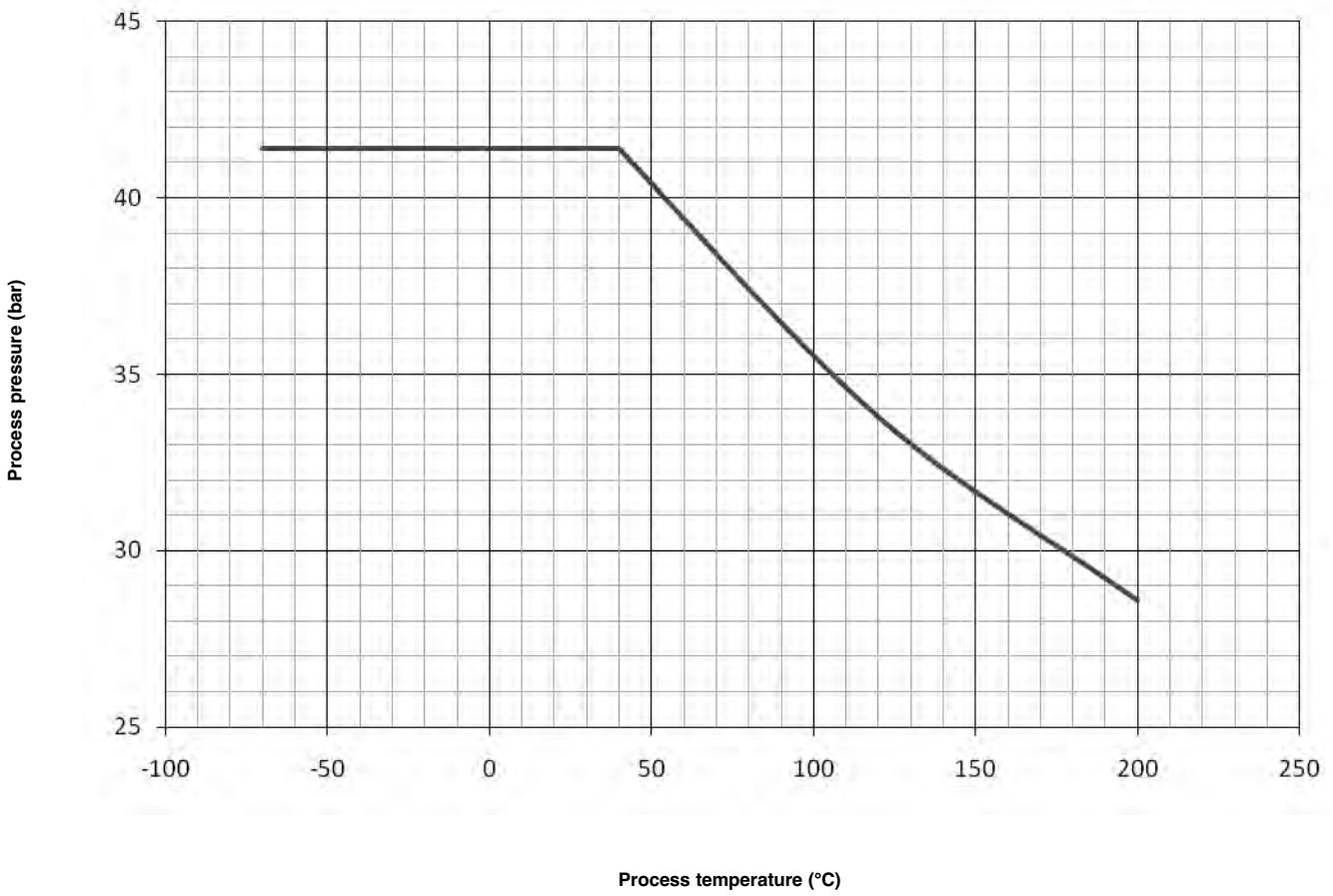


Varivent®

PRESSURE/TEMPERATURE RATING – HYGIENIC TMA/TMB

Note: max. process pressure is downrated to the design pressure of the selected process connection.

Maximum process pressure		
@ +40 °C (+100 °F)	@ +120 °C (+250 °F)	@ +200 °C (+400 °F)
41,4 bar (600 psi)	33,8 bar (490 psi)	28,6 bar (415 psi)



3. Code for Thermatel® TD2 – HYGIENIC SENSOR

T M A	Spherical tip - standard	max +120 °C (+250 °F)
T M B	Spherical tip - with heat extension	max +200 °C (+400 °F)

SENSOR MATERIAL (0,82 μm Ra (32 Ra) surface finish)

A	316/316L (1.4401/1.4404) stainless steel

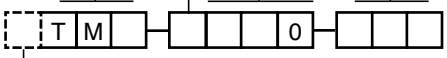
PROCESS CONNECTION – SIZE/TYPE ①

3 T 0	1 1/2" Tri-Clamp®
4 T 0	2" Tri-Clamp®
B S 0	DN 25 DIN 11851 - only available with TMA
C S 0	DN 40 DIN 11851 - only available with TMA
D S 0	DN 50 DIN 11851 - only available with TMA
V V 0	DN 65 Varivent® type N - only available with TMA

① Consult factory for other process connections (NEUMO BioControl®, G1A, ...)

INSERTION LENGTH – Specify per cm (0.39") increment

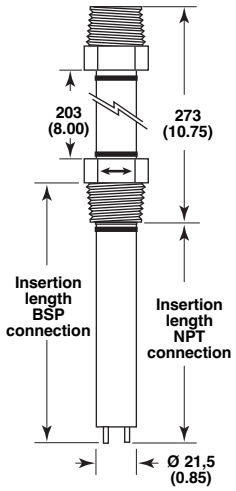
0 0 7	Minimum 7 cm (2.76")
3 3 0	Maximum 330 cm (130")

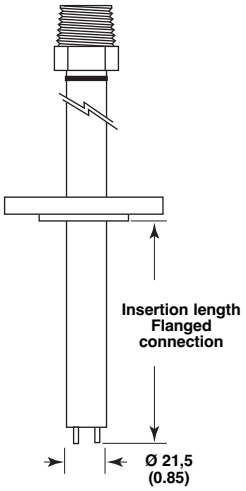


complete code for Thermatel® TD2 HYGIENIC SENSOR

X = product with a specific customer requirement

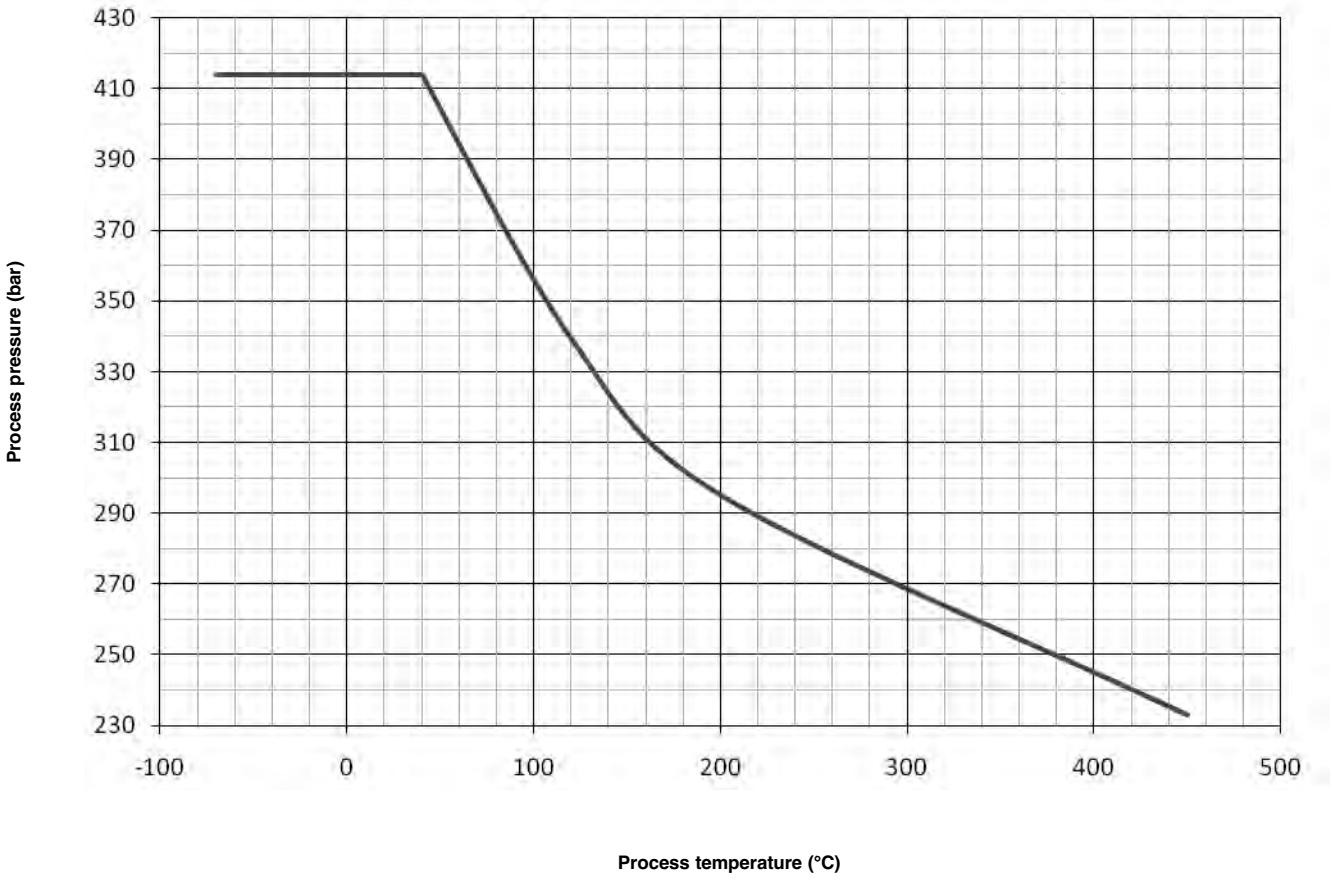
DIMENSIONS IN mm (inches) – TMH





PRESSURE/TEMPERATURE RATING – TMH

Maximum process pressure			
@ +40 °C (+100 °F)	@ +120 °C (+250 °F)	@ +200 °C (+400 °F)	@ +450 °C (+850 °F)
414 bar (6000 psi)	339 bar (4920 psi)	295 bar (4280 psi)	233 bar (3380 psi)



3. Code for Thermatel® TD1/TD2 – HIGH TEMPERATURE / HIGH PRESSURE SENSOR

T M H	High temperature / high pressure twin tip – max +450 °C (+850 °F) / max 414 bar (6000 psi)①

① Not available with retractable probe assembly.

MATERIAL OF CONSTRUCTION FOR SENSOR AND PROCESS CONNECTION

A	316/316L (1.4401/1.4404) stainless steel①
B	Hastelloy® C (2.4819)
D	316/316L (1.4401/1.4404) stainless steel

① Not suitable for zone 0 applications in combination with hermetically sealed relay.

PROCESS CONNECTION – SIZE/TYPE

Threaded

1 1 0	3/4" NPT
2 1 0	1" NPT
2 2 0	1" BSP (G 1")

ANSI flanges

2 3 0	1"	150 lbs	ANSI RF
2 4 0	1"	300 lbs	ANSI RF
2 5 0	1"	600 lbs	ANSI RF
2 7 0	1"	900/1500 lbs	ANSI RF
3 3 0	1 1/2"	150 lbs	ANSI RF
3 4 0	1 1/2"	300 lbs	ANSI RF
3 5 0	1 1/2"	600 lbs	ANSI RF
3 7 0	1 1/2"	900/1500 lbs	ANSI RF
3 8 0	1 1/2"	2500 lbs	ANSI RF
4 3 0	2"	150 lbs	ANSI RF
4 4 0	2"	300 lbs	ANSI RF
4 5 0	2"	600 lbs	ANSI RF
4 7 0	2"	900/1500 lbs	ANSI RF
4 8 0	2"	2500 lbs	ANSI RF

EN (DIN) flanges

B B 0	DN 25	PN 16/25/40	EN 1092-1 Type A
B C 0	DN 25	PN 63/100	EN 1092-1 Type B2
B G 0	DN 25	PN 250	EN 1092-1 Type B2
C B 0	DN 40	PN 16/25/40	EN 1092-1 Type A
C C 0	DN 40	PN 63/100	EN 1092-1 Type B2
C G 0	DN 40	PN 250	EN 1092-1 Type B2
C J 0	DN 40	PN 400	EN 1092-1 Type B2
D A 0	DN 50	PN 16	EN 1092-1 Type A
D B 0	DN 50	PN 25/40	EN 1092-1 Type A
D D 0	DN 50	PN 63	EN 1092-1 Type B2
D E 0	DN 50	PN 100	EN 1092-1 Type B2
D G 0	DN 50	PN 250	EN 1092-1 Type B2
D J 0	DN 50	PN 400	EN 1092-1 Type B2

INSERTION LENGTH – Specify per cm (0.39") increment

0 0 5	Minimum 5 cm (2")	– sensors with NPT/flanged connection
0 0 8	Minimum 8 cm (3.15")	– sensors with BSP connection
0 9 1	Maximum 91 cm (36")	

complete code for Thermatel® TD1/TD2 HIGH TEMPERATURE /HIGH PRESSURE SENSOR

X = product with a specific customer requirement

MODEL IDENTIFICATION

3. Code for Thermatel® TD1/TD2 – MINI SENSOR

T M M	Mini twin tip – max +120 °C (+250 °F)①

① TMM sensors can handle process temperatures up to +200 °C (+400 °F) with remote electronics.

MATERIAL OF CONSTRUCTION FOR SENSOR AND PROCESS CONNECTION

A	316/316L (1.4401/1.4404) stainless steel①

① Not suitable for zone 0 applications in combination with hermetically sealed relay.

PROCESS CONNECTION – SIZE/TYPE
Threaded

0 1 0	1/2" NPT
1 1 0	3/4" NPT
2 1 0	1" NPT

INSERTION LENGTH – **STANDARD**

0 0 3	2,5 cm (1")

INSERTION LENGTH – **SELECTABLE** – Specify per cm (0.39") increment

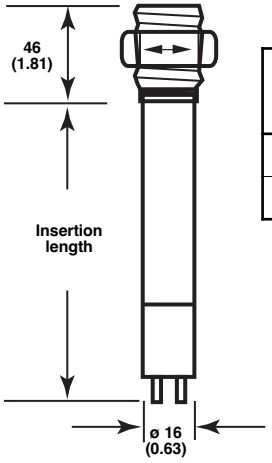
0 0 5	Minimum 5 cm (2")
3 3 0	Maximum 330 cm (130")

	T	M	M	A		1	0		

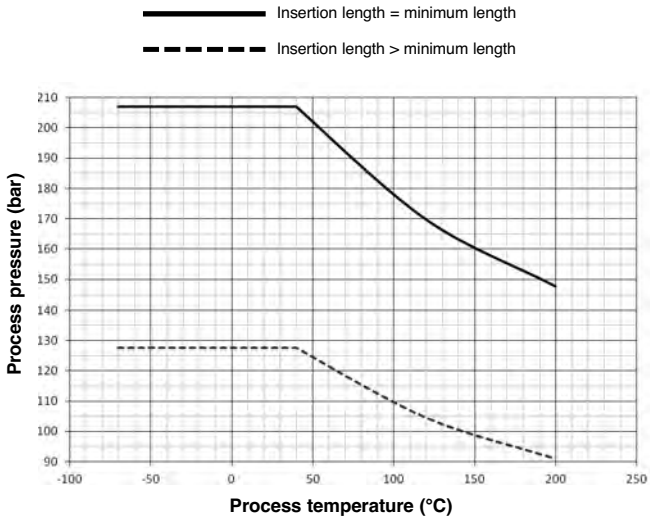
complete code for Thermatel® TD1/TD2 MINI SENSOR

X = product with a specific customer requirement

DIMENSIONS IN mm (inches) & PRESSURE/TEMPERATURE RATING – TMM



Insertion length	Maximum process pressure		
	@ +40 °C (+100 °F)	@ +120 °C (+250 °F)	@ +200 °C (+400 °F)
= 2,5 cm (1")	207 bar (3000 psi)	170 bar (2460 psi)	148 bar (2140 psi)
> 2,5 cm (1")	128 bar (1850 psi)	105 bar (1517 psi)	91,0 bar (1320 psi)



RECOMMENDED FLOW RANGES – TMM

Size	Water	Air
1/2" "T"	0,75 to 680 l/h (0.2 to 180 GPH)	0,85 to 120 Nm³/h (0.5 to 70 SCFM)
3/4" "T"	2 to 900 l/h (0.5 to 240 GPH)	2,5 to 170 Nm³/h (1.5 to 100 SCFM)
1" "T"	3,8 to 1600 l/h (1 to 420 GPH)	5 to 290 Nm³/h (3 to 170 SCFM)

MODEL IDENTIFICATION

3. Code for Thermatel® TD1/TD2 – LOW FLOW BODY SENSOR

T M L	Low flow body – max +120 °C (+250 °F)① / max 400 bar (5800 psi)

① TML sensors can handle process temperatures up to +200 °C (+400 °F) with remote electronics.

MATERIAL OF CONSTRUCTION FOR SENSOR AND PROCESS CONNECTION

A	316/316L (1.4401/1.4404) stainless steel ①

① Not suitable for zone 0 applications in combination with hermetically sealed relay.

PROCESS CONNECTION – SIZE/TYPE
Threaded

T 1 0	1/4" NPT-F
V 1 0	1/2" NPT-F
T 0 0	1/4" BSP (G 1/4")
V 0 0	1/2" BSP (G 1/2")

MOUNTING BRACKET

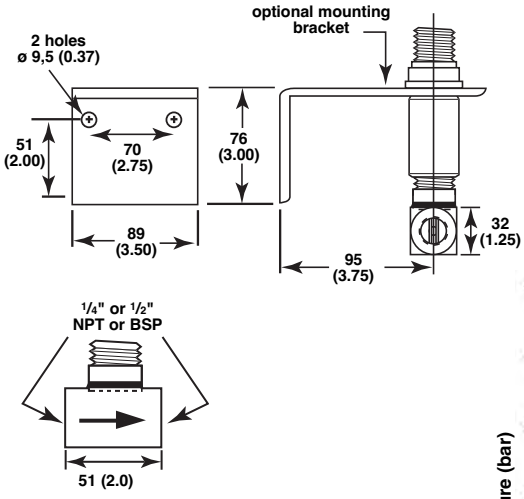
0 0 0	None
1 0 0	With carbon steel mounting bracket

	T	M	L	A			0		0	0

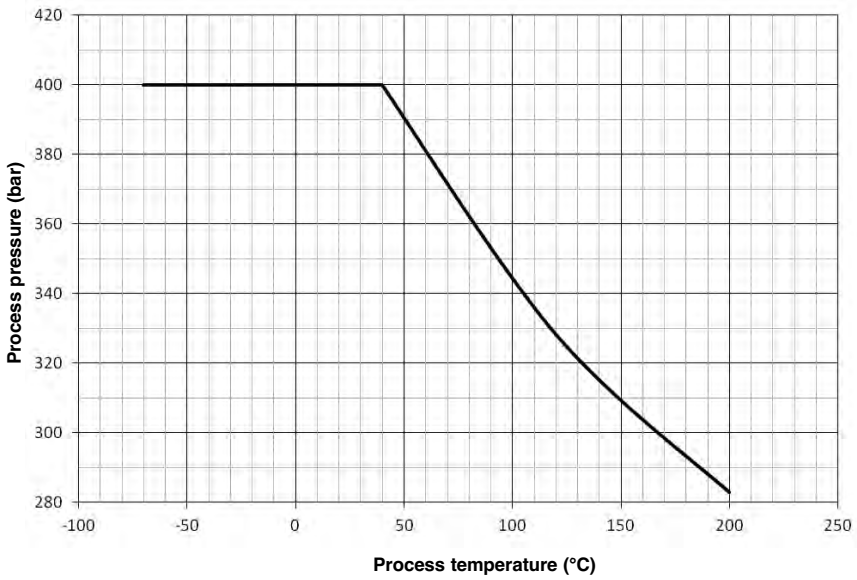
complete code for Thermatel® TD1/TD2 LOW FLOW BODY SENSOR

X = product with a specific customer requirement

DIMENSIONS IN mm (inches) & PRESSURE/TEMPERATURE RATING – TML



Maximum process pressure		
@ +40 °C (+100 °F)	@ +120 °C (+250 °F)	@ +200 °C (+400 °F)
400 bar (5800 psi)	328 bar (4760 psi)	283 bar (4100 psi)



RECOMMENDED FLOW RANGES – TML

Size	Water	Air
1/4" flow body	0,02 to 5,7 l/h (0.0055 to 1.5 GPH)	0,006 to 5,75 Nm³/h (0.21 to 200 SCFH)
1/2" flow body	0,04 to 11,5 l/h (0.01 to 3 GPH)	0,015 to 11,5 Nm³/h (0.53 to 400 SCFH)

MODEL IDENTIFICATION

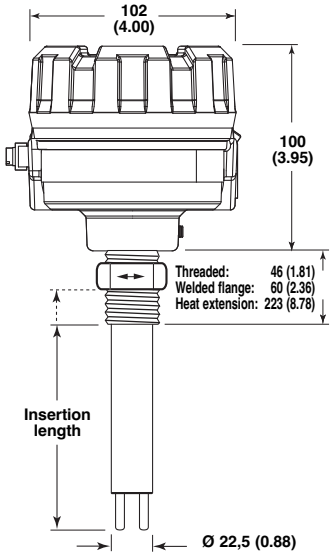
4. Optional sensor mounting flanges

Thread-on mounting flanges can only be used in combination with 3/4" NPT process connection sensor. Consult factory for other sizes or materials.

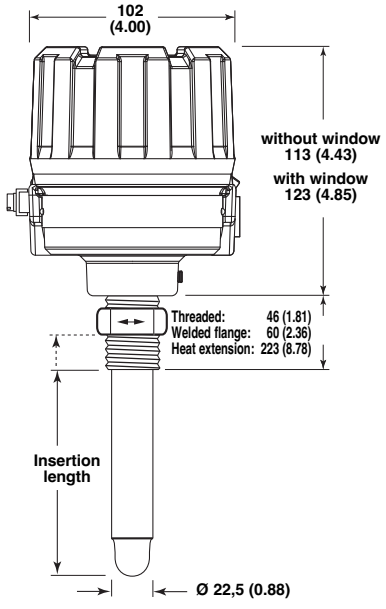
Thread-on flanges for use with 3/4" NPT-M connections

ANSI B16.5 flanges		Part No.		
		Carbon steel	316/316L SST	Hastelloy C
1"	150 lbs RF	004-5867-041	004-5867-043	004-5867-052
1 1/2"	150 lbs RF	004-5867-021	004-5867-001	004-5867-031
2"	150 lbs RF	004-5867-022	004-5867-002	004-5867-032
3"	150 lbs RF	004-5867-023	004-5867-003	004-5867-033
4"	150 lbs RF	004-5867-024	004-5867-004	004-5867-034
6"	150 lbs RF	004-5867-025	004-5867-005	004-5867-035
1"	300 lbs RF	004-5867-042	004-5867-044	004-5867-053
1 1/2"	300 lbs RF	004-5867-026	004-5867-006	004-5867-036
2"	300 lbs RF	004-5867-027	004-5867-007	004-5867-037
3"	300 lbs RF	004-5867-028	004-5867-008	004-5867-038
4"	300 lbs RF	004-5867-029	004-5867-009	004-5867-039
6"	300 lbs RF	004-5867-030	004-5867-010	004-5867-040
1"	600 lbs RF	004-5867-051	004-5867-050	consult factory
1 1/2"	600 lbs RF	004-5867-046	004-5867-045	consult factory
2"	600 lbs RF	004-5867-049	004-5867-048	consult factory

DIMENSIONS IN mm (inches) – WITH HOUSING FOR INDUSTRIAL USE

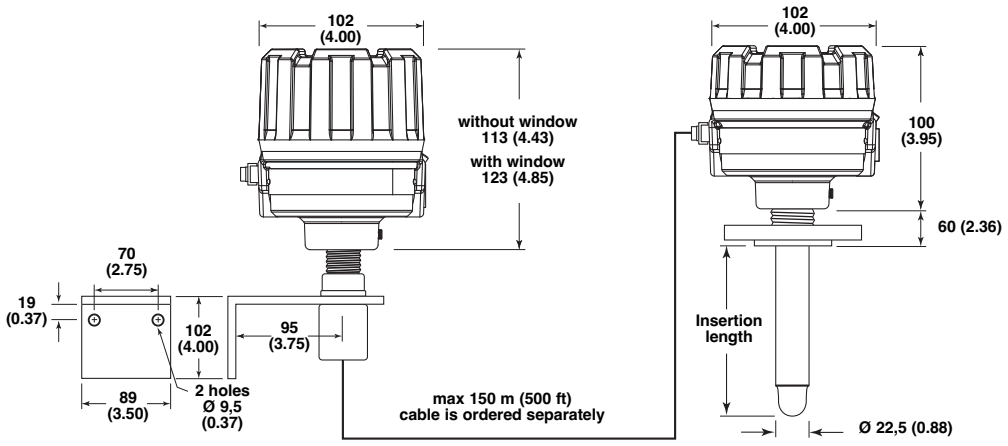


Model TD1 with TMC/TMD twin tip sensor



Model TD2 with integral electronics and TMA/TMB spherical tip sensor

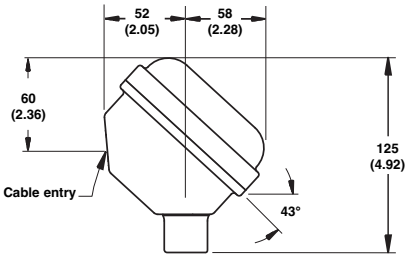
DIMENSIONS IN mm (inches) – WITH HOUSING FOR INDUSTRIAL USE

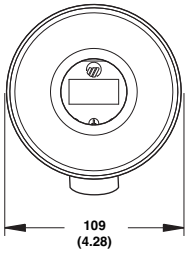


Model TD2 with remote electronics

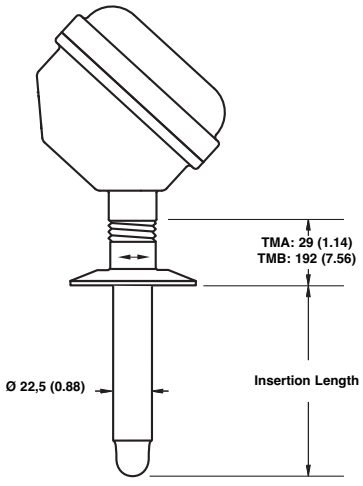
Remote TMA spherical tip sensor with flanged connection

DIMENSIONS IN mm (inches) – WITH HOUSING FOR HYGIENIC USE

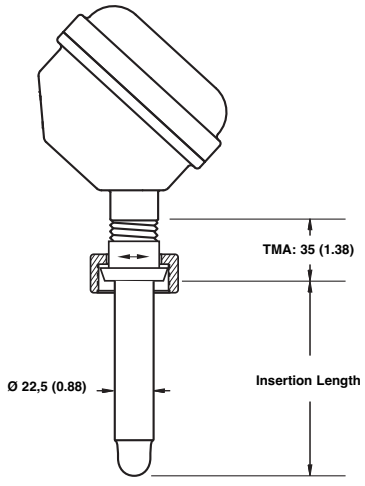




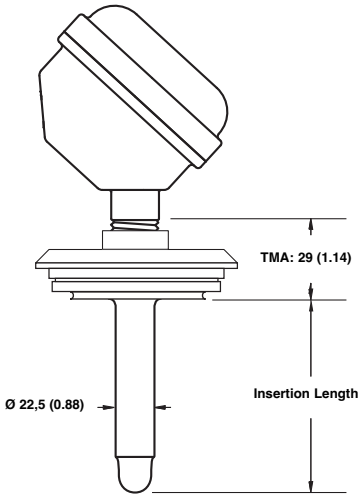
43° View



Tri-Clamp®



DIN 11851



Varivent®

SPECIFICATIONS

Electronics specifications – with housing for industrial use

Description		*TD1*	*TD2*
Power supply		19,2 to 28,8 V DC	19,2 to 28,8 V DC 100 to 264 V AC, 50-60 Hz
Power consumption		3,5 W @ 24 V DC	4 W @ 24 V DC or 5 W @ 264 V AC
Flow range		TMA-A, TMB-A, TMC-A, TMD-A, TMM:	0,003 to 1,5 m/s (0.01 to 5.0 FPS) – water 0,03 to 150 m/s (0.1 to 500 FPS) – air
		TMM installed in a"T"-piece:	see table on page 20
		TMC-B, TMC-C, TMC-D, TMD-B, TMD-C,TMD-D, TMH:	0,003 to 0,3 m/s (0.01 to 1.0 FPS) – water 0,03 to 150 m/s (0.1 to 500 FPS) – air
		TML:	see table on page 21
Output	Alarm	DPDT relay: 8 A @ 120 V AC / 250 V AC 8 A @ 30 V DC; 0,5 A @ 125 V DC	
		Hermetically sealed relay not available	Hermetically sealed DPDT relay: 1A @ 28 V DC; 0,5 A @ 125 V DC
	Continuous	Not applicable	non linear mA for trending (not for all models - see electronics part number on page 12)
	Error	Via alarm relay	3,6 mA (Low Level Fail-safe) – 22 mA (High Level Fail-safe) and alarm relay
Time delay		Not available	0 to 100 s adjustable (in addition to sensor response time)
User interface		- Local switches for gain setting, function setting and High/Low Level Fail-safe - Calibration and time delay via potentiometer	
Display		LED's for Power/Alarm status	2 green LED's (safe condition), 1 yellow LED (alarm setpoint being approached) 1 red LED (alarm condition)
Approvals		ATEX II 2 G Ex d IIC T5..T4 Gb, flameproof enclosure - TD2 for zone 1 ATEX II 1/2 G Ex d+ib, d [ib] IIC T5..T4 Ga/Gb, flameproof enclosure - TD1 & TD2 (TD2 only with 8A DPDT relay) IEC Ex d + ib, d [ib] IIC T5/T4 Gb/Ga - TD1 & TD2 IEC Ex d IIC T5/T4 Gb - TD2 only Other approvals are available, consult factory for more details	
SIL (Safety Integrity Level)		Functional safety to SIL1 as 1oo1 / SIL2 as 1oo2 in accordance to IEC 61508 – SFF of 69,3 % (TD1) and 73 % (TD2) – full FMEDA reports and declaration sheets available	
Housing material		IP66/Aluminium A356T6 (<0.20 % copper) or stainless steel	
Net weight		Aluminium: 1,1 kg (2.4 lbs) - integral electronics only Stainless steel: 2,6 kg (5.7 lbs) - integral electronics only	

Electronics specifications – with housing for hygienic use

Description		*Specification*
Power supply		19,2 to 28,8 V DC 100 to 264 V AC, 50-60 Hz
Power consumption		4 W @ 24 V DC or 5 W @ 264 V AC
Flow range		0,003 to 1,5 m/s (0.01 to 5.0 FPS) – water 0,03 to 150 m/s (0.1 to 500 FPS) – air
Output	Alarm	8 A DPDT relay @ 30 V DC / 250 V AC 1 A hermetically sealed DPDT relay @ 28 V DC
	Continuous	non-linear mA for trending
	Error	3,6 mA (Low Level Fail-safe) – 22 mA (High Level Fail-safe) and alarm relay
Time delay		0 to 100 s adjustable (in addition to sensor response time)
User interface		- Local switches for gain setting, function setting and High/Low Level Fail-safe - Calibration and time delay via potentiometer
Display		2 green LED's (safe condition) 1 yellow LED (alarm setpoint being approached) 1 red LED (alarm condition)
Approvals		EHEDG (per TNO) and 3A certification
SIL (Safety Integrity Level)		Functional safety to SIL1 as 1oo1 in accordance to IEC 61508 – SFF of 73 % Full FMEDA reports and declaration sheets available at request
Housing material		304 stainless steel, IP 67
Net weight		1,1 kg (2.4 lbs) - electronics only

SPECIFICATIONS

Performance

Description	*Specification*
Response time	1-10 s typical (dependent on sensor type, application and set point)
Repeatability	< 1 % @ constant temperature
Ambient temperature	ATEX/IEC Ex d - T4 & non Ex: -40 °C to +70 °C (-40 °F to +160 °F) ATEX/IEC Ex d - T5: -40 °C to +40 °C (-40 °F to +104 °F) Storage: -50 °C to +75 °C (-58 °F to +170 °F)
Humidity	0-99 %, non-condensing
Electromagnetic compatibility	Meets CE requirements (EN 61326: 1997 + A1 + A2)

Sensor specifications

Description	*Spherical tip - Twin tip sensors INDUSTRIAL TMA/TMB - TMC/TMD*	*HTHP sensor TMH*
Materials	316/316L (1.4401/1.4404) Hastelloy® C (2.4819) – TMC/TMD only Monel® (2.4360) – TMC/TMD only	316/316L (1.4401/1.4404) Hastelloy® C (2.4819)
Sensor diameter	22,5 mm (0.88")	21,5 mm (0.85")
Process connection	Threaded: NPT or BSP Flanged: various ANSI or EN (DIN) flanges	
Sensor length	5 - 330 cm (2" - 130")	5 - 91 cm (2" - 36")
Process temperature	TMA/TMC①: -70 °C to +120 °C (-100 °F to +250 °F) TMB/TMD: -70 °C to +200 °C (-100 °F to +400 °F)	-70 °C to +450 °C (-100 °F to +850 °F)
Max process pressure	See info on page 14	See info on page 18

① Use remote electronics (TD2) for temperatures > +120 °C (+250 °F) up to max +200 °C (+400 °F) or sensors with heat extension (TMB/TMD) when using integral electronics.

Description	*Mini twin tip sensor TMM*	*Low flow body TML*
Materials	316/316L (1.4401/1.4404)	
Sensor diameter	16 mm (0.63")	1/4" or 1/2" pipe size
Process connection	Threaded: 1/2", 3/4" or 1" NPT	Threaded: 1/4" or 1/2" NPT-F or BSP
Sensor length	2,5 - 330 cm (1" - 130")	Not applicable
Process temperature	-70 °C to +120 °C (-100 °F to +250 °F)①	
Max process pressure	See info on page 20	See info on page 21

① Use remote electronics (TD2) for temperatures > +120 °C (+250 °F) up to max +200 °C (+400 °F).

Description	*Spherical tip sensors HYGIENIC TMA/TMB*
Materials	316/316L (1.4401/1.4404)
Surface finish	0,82 µm Ra (32 Ra)
Sensor diameter	22,5 mm (0.88")
Process connection	Tri-Clamp®, DIN 11851, Varivent®
Sensor length	7 - 330 cm (2.76" - 130")
Process temperature	TMA: -70 °C to +120 °C (-100 °F to +250 °F) TMB: -70 °C to +200 °C (-100 °F to +400 °F)
Max process pressure	See info on page 16

IMPORTANT

SERVICE POLICY

Owners of Magnetrol products may request the return of a control; or, any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Magnetrol International will repair or replace the control, at no cost to the purchaser, (or owner) ***other than transportation cost*** if:

a. Returned within the warranty period; and,
b. The factory inspection finds the cause of the malfunction to be defective material or workmanship.

If the trouble is the result of conditions beyond our control; or, is **NOT** covered by the warranty, there will be charges for labour and the parts required to rebuild or replace the equipment.
In some cases, it may be expedient to ship replacement parts; or, in extreme cases a complete new control, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the control to be replaced. In such cases, credit for the materials returned, will be determined on the basis of the applicability of our warranty.
No claims for misapplication, labour, direct or consequential damage will be allowed.

RETURNED MATERIAL PROCEDURE

So that we may efficiently process any materials that are returned, it is essential that a “Return Material Authorisation” (RMA) form will be obtained from the factory. It is mandatory that this form will be attached to each material returned. This form is available through Magnetrol’s local representative or by contacting the factory. Please supply the following information:

1. Purchaser Name
2. Description of Material
3. Serial Number and Ref Number
4. Desired Action
5. Reason for Return
6. Process details

Any unit that was used in a process must be properly cleaned in accordance with the proper health and safety standards applicable by the owner, before it is returned to the factory.
A material Safety Data Sheet (MSDS) must be attached at the outside of the transport crate or box.
All shipments returned to the factory must be by prepaid transportation. Magnetrol ***will not accept*** collect shipments.
All replacements will be shipped Ex Works.

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SUPERSEDES: June 2012

UNDER RESERVE OF MODIFICATIONS

Magnetrol®

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Chapter 11 Pressure/Flow Measurement (Division 25)

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Montréal, QC, H4T 2A7
Phone: (514) 940-2293
freddy.gutierrez-vega@ca.endress.com

11.1 Endress & Hauser Cerebar PMC71 Pressure Transmitter (WTP)

Item	Qty.	Unit	Ordercode Description	Unit Price CAD	Total Net CAD
0010	1	PC	PMC71-3U538/101 PMC71-XCC1PERDAAU+ Z1 **Cerabar S PMC71** Pressure, capacitive. Compact. Application: pressure/level. Membrane: Ceraphire, dry, vacuum proof. :: Mechanically robust, overload resistant. :: High reliability through process monitoring. :: High long term stability. :: Modular.		
			additional specifications Low range value 0.000 kPa Upper range value 750.000 kPa Display main line cont. Measured value[PV] Damping [s] 2 If CRN is required, check availability in technical documentation! Tag plate Stainless Steel 52006326 PIT 1001		
		X	Approval: CSA C/US General Purpose		
		C	Output; Operating: 4-20mA HART; inside		
		C	Housing; Cover Sealing; Cable Entry: T14 Alu IP66/67 NEMA6P; EPDM; NPT1/2 thread, T14 = side cover		
		1P	Sensor Range; Sensor Overload Limit: 10bar/1MPa/150psi gauge; 40bar/4MPa/600psi		
		E	Calibration; Unit: Customised pressure; see additional spec.		
		RD	Process Connection: Thread ANSI MNPT1/2 hole 11.4mm, 316L		
		A	Seal: FKM Viton		
		A	Additional Option 1: Not selected		
		U	Additional Option 2: Mounting bracket, wall/pipe, 316L		
		Z1	> > Marking: Tagging (TAG), see additional spec.		
			Production Time: 7 Day(s). Delivery time extra.		
0020	1	PC	71098440 **2-valve manifold**		

Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Cerabar S PMC71, PMP71, PMP75

Process pressure measurement
Pressure transmitter with ceramic and metal sensors
Overload-resistant and function-monitored; Communication via HART, PROFIBUS PA or FOUNDATION Fieldbus

Application

The Cerabar S pressure transmitter is used for the following measuring tasks:
- Absolute pressure and gauge pressure in gases, steams or liquids in all areas of process engineering and process measurement technology
- Level, volume or mass measurements in liquids
- High process temperature
  - without diaphragm seals up to 150 °C (302 °F)
  - with typical diaphragm seals up to 400 °C (752 °F)
- High pressure up to 700 bar (10500 psi)
- International usage thanks to a wide range of approvals

Your benefits

- Very good reproducibility and long-term stability
- High reference accuracy: up to ±0.075 %, as PLATINUM version: ±0.05 %
- Turn down up to 100:1, higher on request
- Used for process pressure monitoring up to SIL3, certified to IEC 61508 by TÜV SÜD
- HistoROM®/M-DAT memory module
- Function-monitored from the measuring cell to the electronics
- Continuous modularity for differential pressure, hydrostatics and pressure (Deltabar S – Deltapilot S – Cerabar S), e.g.
  - replaceable display
  - universal electronics
- Quick commissioning with Quick Setup menu
- Menu-guided operation
- Extensive diagnostic functions
- Device versions compliant with ASME-BPE

TI383P/00/EN/05.10
No 71111803

Endress+Hauser
People for Process Automation

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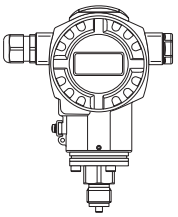
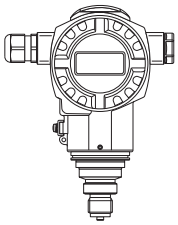
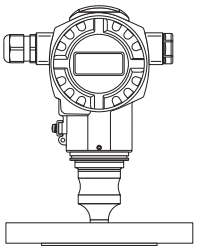
Function and system design

Device selection

Cerabar S – Product family	**PMC71**  P01-PMC71xxx-16-xx-xx-xx-000 **With capacitance measuring cell and ceramic process isolating diaphragm (Ceraphire®)**	**PMP71**  P01-PMP71xxx-16-xx-xx-xx-000 **With piezoresistive measuring cell and metal welded process isolating diaphragm**	**PMP75**  P01-PMP75xxx-16-xx-xx-xx-000 **With diaphragm seal**
Field of application	– Gauge pressure and absolute pressure – Level		
Process connections	– Diverse thread – DN 32 – DN 80 – ANSI 1 1/2" – 4" – JIS 50 A – 100 A	– Diverse thread – DN 25 – DN 80 – ANSI 1 1/2" – 4" – JIS 25 A – 100 A – Oval flange adapter – Prepared for diaphragm seal mount	– Wide range of diaphragm seals
Measuring ranges	From –100/0 to 100 mbar (–1.5/0 to 1.5 psi) to –1/0 to 40 bar (–15/0 to 600 psi)	From –100/0 to 100 mbar (–1.5/0 to 1.5 psi) to –1/0 to 700 bar (–15/0 to 10500 psi)	From –400/0 to 400 mbar (–6/0 to 6 psi) to –1/0 to 400 bar (–15/0 to 6000 psi)
OPL [1]	Max. 60 bar (900 psi)	Max. 1050 bar (15750 psi)	Max. 600 bar (9000 psi)
Process temperature range	–25 to +125°C (-13 to +257 °F)/ –20 to +150 °C (-4 to 302 °F)[2]	–40 to +125 °C (-40 to +257 °C)	-70 to 400 °C (-94 to 752 °F) Dependent on the filling oil
Ambient temperature range	■ Without LCD display: –40 to +85 °C (–40 to +185 °F)[3] ■ With LCD display: –20 to +70 °C (–4 to +158 °F) ■ Separate housing: -20 to +50 °C (-4 to +122 °F) ■ Diaphragm seal systems depending on the version		
Reference accuracy	– Up to ±0.075 % of the set span – PLATINUM version: up to ±0.05 % of the set span		Up to ±0.075 % of the set span
Supply voltage	– Version for non-hazardous areas: 10.5 to 45 V DC – Ex ia: 10.5 to 30 V DC		
Output	4 to 20 mA with superimposed HART protocol, PROFIBUS PA or FOUNDATION Fieldbus		
Options	– PMP71, PMP75: gold-rhodium coated process isolating diaphragm – PMP71, PMP75: NACE-compliant materials – PMC71, PMP71, PMP75: inspection certificate 3.1 – HistoROM®/M-DAT memory module – Separate housing		
Specialties	– Metal-free measurement with PVDF connection – Special cleaning of the transmitter to remove paint-wetting substances, for use in paint shops	– Process connections with minimum oil volume – Gas-tight, elastomer-free	– Wide range of diaphragm seals – For high medium temperatures – Process connections with minimum oil volume – Completely welded versions

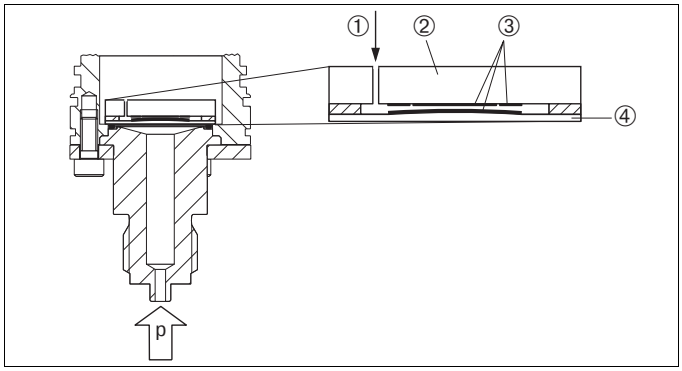
1) OPL: over pressure limit; dependent on the lowest-rated element, with regard to pressure, of the selected components

2) High-temperature version "T" for feature 100 "Additional option 1" or for feature 110 "Additional option 2"

3) PMP71 and PMP75: lower temperatures on request

Measuring principle

Ceramic process isolating diaphragm used for PMC71 (Ceraphire®)

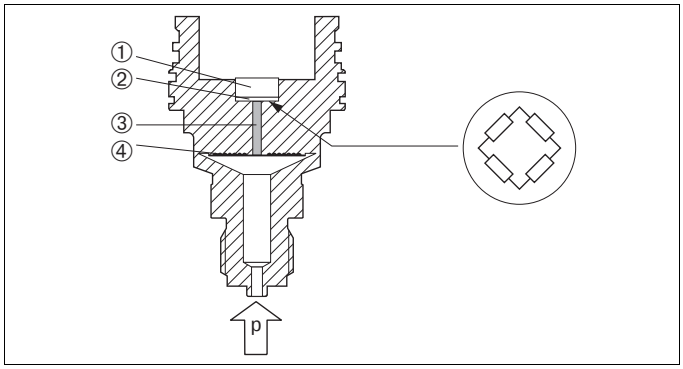


P01-PMC71xxx-03-xx-xx-xx-000

Ceramic sensor

1 *Air pressure (gauge pressure sensors)*
2 *Ceramic substrate*
3 *Electrodes*
4 *Ceramic process isolating diaphragm*

Metal process isolating diaphragm used for PMP71 and PMP75



P01-PMP7xxxx-03-xx-xx-xx-000

Metal sensor

1 *Silicon measuring element, substrate*
2 *Wheatstone bridge*
3 *Channel with fill fluid*
4 *Metal process isolating diaphragm*

Ceramic process isolating diaphragm used for PMC71 (Ceraphire®)

The ceramic sensor is a dry sensor, i.e. the process pressure acts directly on the robust ceramic process isolating diaphragm and deflects it. A pressure-dependent change in capacitance is measured at the electrodes of the ceramic substrate and the process isolating diaphragm. The measuring range is determined by the thickness of the ceramic process isolating diaphragm.

Advantages:
- Guaranteed overload resistance up to 40 times the nominal pressure
- Thanks to ultrapure 99.9% ceramic (Ceraphire®, see also "www.endress.com/ceraphire")
  – extremely high chemical stability, comparable with Alloy
  – less relaxation
  – high mechanical stability
- Suitable for vacuums
- Secondary containment for enhanced integrity
- Process temperatures up to 150 °C (302 °F)

Metal process isolating diaphragm used for PMP71 and PMP75

PMP71

The operating pressure deflects the process isolating diaphragm and a fill fluid transfers the pressure to a resistance bridge (semiconductor technology). The pressure-dependent change in the bridge output voltage is measured and evaluated.

Advantages:
- Can be used for process pressures up to 700 bar (10500 psi) absolute pressure
- High long-term stability
- Guaranteed overload resistance up to 4 times the nominal pressure
- Secondary containment for enhanced integrity
- Significantly less thermal effect compared to diaphragm seal systems

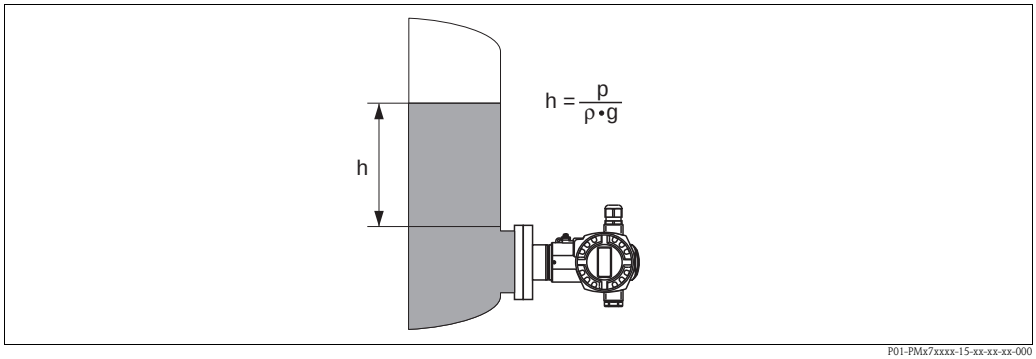
PMP75

The operating pressure acts on the process isolating diaphragm of the diaphragm seal and is transferred to the process isolating diaphragm of the sensor by a diaphragm seal fill fluid. The process isolating diaphragm is deflected and a fill fluid transfers the pressure to a resistance measuring bridge. The pressure-dependent change in the bridge output voltage is measured and evaluated.

Advantages:
- Depending on the version, can be used for process pressures up to 400 bar (6000 psi) and extreme process temperatures
- High long-term stability
- Guaranteed overload resistance up to 4 times the nominal pressure
- Secondary containment for enhanced integrity

Level measurement (level, volume and mass)

Design and operation mode



Level measurement

h *Height (level)*
p *Pressure*
ρ *Density of the medium*
g *Gravitation constant*

Your benefits

- Selection of the level operating mode which is optimum for your application in the device software.
- Volume and mass measurements in any tank shapes by means of a freely programmable characteristic curve.
- Choice of diverse level units with automatic unit conversion.
- A specific unit can be defined.
- Has a wide range of uses, even in the following cases:
  - in the event of foam formation
  - in tanks with agitators of screen fittings
  - in the event of liquid gases

Communication protocol

- 4 to 20 mA with HART communication protocol
- PROFIBUS PA
  - The Endress+Hauser devices meet the requirements of the FISCO model.
  - Due to the low current consumption of 13 mA ± 1 mA, the following number of devices can be operated on one bus segment if installing as per FISCO:
    - up to 7 Cerabar S for Ex ia, CSA IS and FM IS applications
    - up to 27 Cerabar S for all other applications, e.g. in non-hazardous areas, Ex nA etc.

  Further information on PROFIBUS PA can be found in Operating Instructions BA034S "PROFIBUS DP/PA: Guidelines for planning and commissioning" and in the PNO Guideline.
- FOUNDATION Fieldbus
  - The Endress+Hauser devices meet the requirements of the FISCO model.
  - Due to the low current consumption of 15 mA ± 1 mA, the following number of devices can be operated on one bus segment if installing as per FISCO:
    - up to 6 Cerabar S for Ex ia, CSA IS and FM IS applications
    - up to 24 Cerabar S for all other applications, e.g. in non-hazardous areas, Ex nA etc.

  Further information on FOUNDATION Fieldbus, such as requirements for bus system components can be found in Operating Instructions BA013S "FOUNDATION Fieldbus Overview".

Input

Measured variable

Absolute pressure and gauge pressure, from which level (level, volume or mass) is derived

Measuring range

PMC71 – with ceramic process isolating diaphragm (Ceraphire®) for gauge pressure

Nominal value	Range limit		Smallest calibratable span [4]	MWP [1]	OPL [2]	Vacuum resistance	Versions in the order code [3]
	lower (LRL)	upper (URL)					
	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar_{abs} (psi_{abs})]	
100 mbar (1.5 psi)	–0.1 (–1.5)	+0.1 (+1.5)	0.005 (0.075)	2.7 (40.5)	4 (60)	0.7 (10.5)	1C
250 mbar (4 psi)	–0.25 (–4)	+0.25 (+4)	0.005 (0.075)	3.3 (49.5)	5 (75)	0.5 (7.5)	1E
400 mbar (6 psi)	–0.4 (–6)	+0.4 (+6)	0.005 (0.075)	5.3 (79.5)	8 (120)	0	1F
1 bar (15 psi)	–1 (–15)	+1 (+15)	0.01 (0.15)	6.7 (100.5)	10 (150)	0	1H
2 bar (30 psi)	–1 (–15)	+2 (+30)	0.02 (0.3)	12 (180)	18 (270)	0	1K
4 bar (60 psi)	–1 (–15)	+4 (+60)	0.04 (0.6)	16.7 (250.5)	25 (375)	0	1M
10 bar (150 psi)	–1 (–15)	+10 (+150)	0.1 (1.5)	26.7 (400.5)	40 (600)	0	1P
40 bar (600 psi)	–1 (–15)	+40 (+600)	0.4 (0.6)	40 (600)	60 (900)	0	1S

PMC71 – with ceramic process isolating diaphragm (Ceraphire®) for absolute pressure

Nominal value	Range limit		Smallest calibratable span [4]	MWP [1]	OPL [2]	Versions in the order code [3]
	lower (LRL)	upper (URL)				
	[bar_{abs} (psi_{abs})]	[bar_{abs} (psi_{abs})]	[bar (psi)]	[bar_{abs} (psi_{abs})]	[bar_{abs} (psi_{abs})]	
100 mbar (15 psi)	0	+0.1 (+1.5)	0.005 (0.075)	2.7 (40.5)	4 (60)	2C
250 mbar (4 psi)	0	+0.25 (+4)	0.005 (0.075)	3.3 (49.5)	5 (75)	2E
400 mbar (6 psi)	0	+0.4 (+6)	0.005 (0.075)	5.3 (79.5)	8 (120)	2F
1 bar (15 psi)	0	+1 (+15)	0.01 (0.15)	6.7 (100.5)	10 (150)	2H
2 bar (30 psi)	0	+2 (+30)	0.02 (0.3)	12 (180)	18 (270)	2K
4 bar (60 psi)	0	+4 (+60)	0.04 (0.6)	16.7 (250.5)	25 (375)	2M
10 bar (150 psi)	0	+10 (+150)	0.1 (1.5)	26.7 (400.5)	40 (600)	2P
40 bar (600 psi)	0	+40 (+600)	0.4 (0.6)	40 (600)	60 (900)	2S

1) The MWP (maximum working pressure) for the measuring device depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection (→ 32 ff) has to taken into consideration in addition to the measuring cell (→ see Table above). Also observe pressure-temperature dependency. For the appropriate standards and further information, see → 31, "Pressure specifications" section.
2) OPL: over pressure limit depends on the lowest-rated element, with regard to pressure, of the selected components.
3) Version in the order code → see also → 76 ff, feature 40 "Sensor range; Sensor over pressure limit (= OPL)"
4) Turn down > 100:1 on request or can be set at the device

PMP71 and PMP75 – metal process isolating diaphragm for gauge pressure

Nominal value	Range limit		Smallest calibratable span [5]	MWP [1]	OPL [2]	Vacuum resistance [3]	Versions in the order code [4]
	lower (LRL)	upper (URL)				Silicone oil/ Inert oil	
	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar_{abs} (psi_{abs})]	
400 mbar (6 psi)	–0.4 (–6)	+0.4 (+6)	0.005 (0.075)	4 (60)	6 (90)	0.01/0.04 (0.15/0.6)	1F
1 bar (15 psi)	–1 (–15)	+1 (+15)	0.01 (0.15)	6.7 (100)	10 (150)		1H
2 bar (30 psi)	–1 (–15)	+2 (+30)	0.02 (0.3)	13.3 (200)	20 (300)		1K
4 bar (60 psi)	–1 (–15)	+4 (+60)	0.04 (0.6)	18.7 (280.5)	28 (420)		1M
10 bar (150 psi)	–1 (–15)	+10 (+150)	0.1 (1.5)	26.7 (400.5)	40 (600)		1P
40 bar (600 psi)	–1 (–15)	+40 (+600)	0.4 (6)	100 (1500)	160 (2400)		1S
100 bar (1500 psi)	–1 (–15)	+100 (+1500)	1.0 (15)	100 (1500)	400 (6000)		1U
400 bar (6000 psi)	–1 (–15)	+400 (+6000)	4.0 (60)	400 (6000)	600 (9000)		1W
700 bar (10500) [6]	–1 (–15)	+700 (+10500)	7.0 (105)	700 (10500)	1050 (15750)		1X

PMP71 and PMP75 – metal process isolating diaphragm for absolute pressure

Nominal value	Range limit		Smallest calibratable span [5]	MWP [1]	OPL [2]	Vacuum resistance [3]	Versions in the order code [4]
	lower (LRL)	upper (URL)				Silicone oil/ Inert oil	
	[bar_{abs}]	[bar_{abs}]	[bar]	[bar_{abs}]	[bar_{abs}]	[bar_{abs}]	
400 mbar (6 psi)	0	+0.4 (+6)	0.005 (0.075)	4 (60)	6 (90)	0.01/0.04 (0.15/0.6)	2F
1 bar (15 psi)	0	+1 (+15)	0.01 (0.15)	6.7 (100)	10 (150)		2H
2 bar (30 psi)	0	+2 (+30)	0.02 (0.3)	13.3 (200)	20 (300)		2K
4 bar (60 psi)	0	+4 (+60)	0.04 (0.6)	18.7 (280.5)	28 (420)		2M
10 bar (150 psi)	0	+10 (+150)	0.1 (1.5)	26.7 (400.5)	40 (600)		2P
40 bar (600 psi)	0	+40 (+600)	0.4 (6)	100 (1500)	160 (2400)		2S
100 bar (1500 psi)	0	+100 (+1500)	1.0 (15)	100 (1500)	400 (6000)		2U
400 bar (6000 psi)	0	+400 (+6000)	4.0 (60)	400 (6000)	600 (9000)		2W
700 bar (10500) [6]	0	+700 (+10500)	7.0 (105)	700 (10500)	1050 (15750)		2X

1) The MWP (maximum working pressure) for the measuring device depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection (→ 🖹 32 ff) has to taken into consideration in addition to the measuring cell (→ see Table above). Also observe pressure-temperature dependency. For the appropriate standards and further information, see → 🖹 31, "Pressure specifications" section.
2) OPL: over pressure limit depends on the lowest-rated element, with regard to pressure, of the selected components.
3) The vacuum resistance applies for the measuring cell under reference operating conditions. The pressure and temperature application limits of the selected filling oil must also be observed for the PMP75. → 🖹 72, "Filling oil" section.
4) Version in the order code → 🖹 76 ff, feature 40 "Sensor range; Sensor over pressure limit (= OPL)"
5) Turn down > 100:1 on request or can be set at the device
6) PMP71 only, PMP75 on request

Explanation of terms

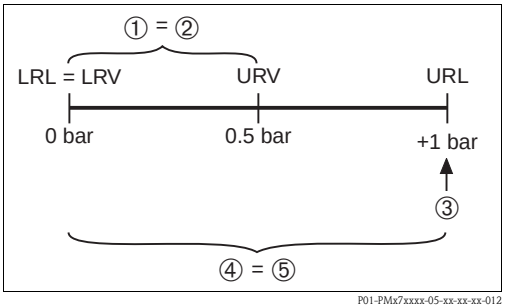
Explanation of the terms "turn down (TD)", "set span" and "zero-based span"

Case 1:
- |Lower range value (LRV)| ≤ |Upper range value (URV)|

Example:
- Lower range value (LRV) = 0 bar
- Upper range value (URV) = 0.5 bar (7.5 psi)
- Nominal value (URL) = 1 bar (15 psi)

Turn down:
- TD = URL / |URV| = 2:1

Set span:
- URV – LRV = 0.5 bar (7.5 psi)
  This span is based on the zero point.



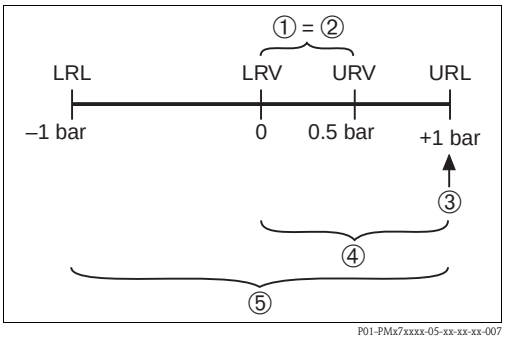
Example: 1 bar (15 psi) measuring cell

Case 2:
- |Lower range value (LRV)| ≤ |Upper range value (URV)|

Example:
- Lower range value (LRV) = 0 bar
- Upper range value (URV) = 0.5 bar (7.5 psi)
- Nominal value (URL) = 1 bar (15 psi)

Turn down:
- TD = URL / |URV| = 2:1

Set span:
- URV – LRV = 0.5 bar (7.5 psi)
  This span is based on the zero point.



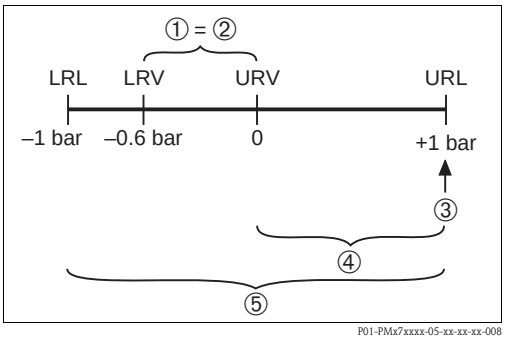
Example: 1 bar (15 psi) measuring cell

Case 3:
- |Lower range value (LRV)| ≥ |Upper range value (URV)|

Example:
- Lower range value (LRV) = –0.6 bar (–9 psi)
- Upper range value (URV) = 0 bar
- Nominal value (URL) = 1 bar (15 psi)

Turn down:
- TD = URL / |LRV| = 1.67:1

Set span:
- URV – LRV = 0.6 bar (9 psi)
  This span is based on the zero point.



Example: 1 bar (15 psi) measuring cell

1 Set span
2 Zero-based span
3 Nominal value ≙ upper range limit (URL)
4 Nominal measuring range
5 Sensor measuring range
LRL Lower range limit
URL Upper range limit
LRV Lower range value
URV Upper range value

Output

Output signal

- 4 to 20 mA with superimposed digital communication protocol HART 5.0, 2-wire
- Digital communication signal PROFIBUS PA (Profile 3.0), 2-wire
  - signal coding: Manchester Bus Powered (MBP): Manchester II
  - data transmission rate: 31.25 KBit/s voltage mode
- Digital communication signal FOUNDATION Fieldbus, 2-wire
  - signal coding: Manchester Bus Powered (MBP): Manchester II
  - data transmission rate: 31.25 KBit/s voltage mode

Signal range – 4 to 20 mA HART

3.8 mA to 20.5 mA

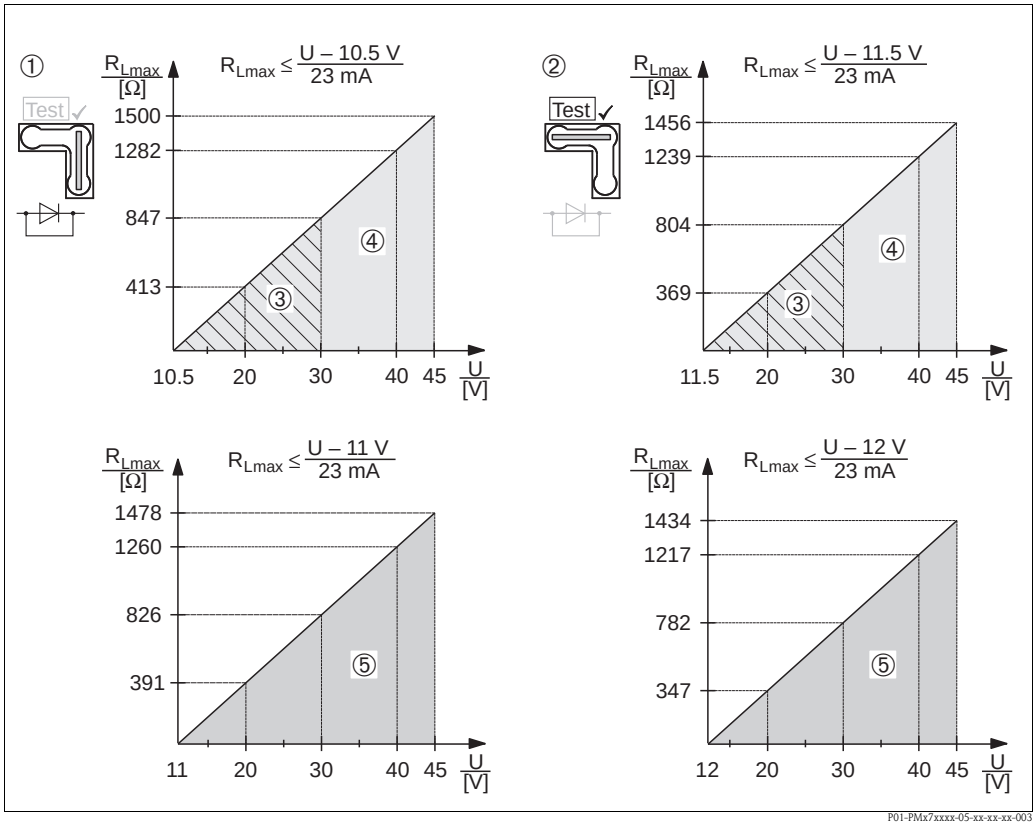
Signal on alarm

As per NAMUR NE43

- 4 to 20 mA HART
  Options:
  - Max. alarm*: can be set from 21 to 23 mA
  - Hold measured value: last measured value is held
  - Min. alarm: 3.6 mA

  * Factory setting: 22 mA
- PROFIBUS PA: can be set in the Analog Input block,
  Options: Last Valid Out Value, Fsafe Value (factory setting), Status Bad
- FOUNDATION Fieldbus: can be set in the Analog Input block,
  Options: Last Good Value, Fail Safe Value (factory setting), Wrong Value

Load – 4 to 20 mA HART



Load diagram, observe the position of the jumper and the explosion protection (→ See also Page 17, "Measuring a 4 to 20 mA test signal" section.)

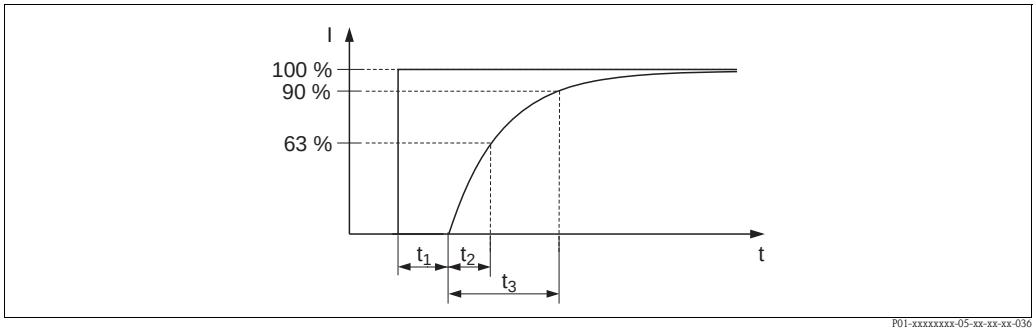
1 Jumper for 4 to 20 mA test signal set to "Non-test" position
2 Jumper for 4 to 20 mA test signal set to "Test" position
3 Power supply 10.5 (11.5) to 30 V DC for 1/2 G, 1 GD, 1/2 GD, FM IS, CSA IS, IECEx ia, NEPSI Ex ia
4 Power supply 10.5 (11.5) to 45 V DC for devices for non-hazardous areas, 1/2 D, 1/3 D, 2 G Ex d, 3 G Ex nA, FM XP, FM DIP, FM NI, CSA XP, CSA dust ignition proof, NEPSI Ex d
5 Power supply 11 (12) to 45 V DC for PMC71, Ex d[ia], NEPSI Ex d[ia]
R_{Lmax} Maximum load resistance
U Supply voltage

Note!
When operating via a handheld terminal or via a PC with an operating program, a minimum communication resistance of 250 Ω must exist within the loop.

Resolution

- Current output: 1 μA
- Display: can be set (factory setting: presentation of the maximum accuracy of the transmitter)

Dead time, time constant



Presentation of the dead time and the time constant

Dynamic behavior, current output

Type	Dead time t_1	Time constant (T63), t_2	Time constant (T90), t_3
PMC71	90 ms	120 ms	276 ms
PMP71	45 ms	■ 400 mbar (6 psi) measuring cell: 70 ms ■ Measuring cells ≥ 1 bar (15 psi): 35 ms	■ 400 mbar (6 psi) measuring cell: 161 ms ■ Measuring cells ≥ 1 bar (15 psi): 81 ms
PMP75	PMP71 + influence of the diaphragm seal		

Dynamic behavior, HART

Type	Dead time t_1	Time constant (T63), t_2	Time constant (T90), t_3
PMC71	340 ms	120 ms	276 ms
PMP71	295 ms	■ 400 mbar (6 psi) measuring cell: 70 ms ■ Measuring cells ≥ 1 bar (15 psi): 35 ms	■ 400 mbar (6 psi) measuring cell: 161 ms ■ Measuring cells ≥ 1 bar (15 psi): 81 ms
PMP75	PMP71 + influence of the diaphragm seal		

Reading cycle

- HART commands: 3 to 4 per second on average.
  The Cerabar S commands the BURST MODE function for cyclic value transmission via the HART communication protocol.

Response time

≤ 250 ms

Cycle time (update time)

On average 250 to 330 ms.

Dynamic behavior, PROFIBUS PA

A typical cyclic parametrization for the PLC of 20 values per second results in the following behavior:

Type	Dead time t_1	Time constant (T63), t_2	Time constant (T90), t_3
PMC71	340 ms	120 ms	620 ms
PMP71	295 ms	■ 400 mbar (6 psi) measuring cell: 70 ms ■ Measuring cells ≥ 1 bar (15 psi): 35 ms	■ 400 mbar (6 psi) measuring cell: 161 ms ■ Measuring cells ≥ 1 bar (15 psi): 81 ms
PMP75	PMP71 + influence of the diaphragm seal		

Response time

- Cyclic: approx. 10 ms per request
- Acyclic: < 50 ms

All values are typical values.

Cycle time (update time)

The cycle time in a bus segment in cyclic data communication depends on the number of devices, on the segment coupler used and on the internal PLC cycle time.

Dynamic behavior, FOUNDATION Fieldbus

A typical configuration for the macro cycle time (host system) of 250 ms results in the following behavior:

Type	Dead time t_1	Time constant (T63), t_2	Time constant (T90), t_3
PMC71	340 ms	120 ms	620 ms
PMP71	295 ms	■ 400 mbar (6 psi) measuring cell: 70 ms ■ Measuring cells ≥ 1 bar (15 psi): 35 ms	■ 400 mbar (6 psi) measuring cell: 161 ms ■ Measuring cells ≥ 1 bar (15 psi): 81 ms
PMP75	PMP71 + influence of the diaphragm seal		

Reading cycle

- Cyclic: up to 5/s, dependent on the number and type of function blocks used in a closed-control loop
- Acyclic: 10/s

Response time

- Cyclic: < 80 ms
- Acyclic: < 40 ms

All values are typical values.

Cycle time (update time)

250 ms

Damping

A damping affects all outputs (output signal, display).

- Via onsite display, handheld terminal or PC with operating program, continuous from 0 to 999 s
- Additionally for HART and PROFIBUS PA: via DIP switch on the electronic insert, switch position "on" = set value and "off"
- Factory setting: 2 s

Data of the FOUNDATION Fieldbus interface

Basic data

Device Type	1007F (hex)
Device Revision	06 (hex)
DD Revision	01 (hex)
CFF Revision	01 (hex)
ITK Version	5.0
ITK Certification Driver No.	IT054600
Link-Master (LAS) capable	Yes
Link Master / Basic Device selectable	Yes; Factory setting: Basic Device
Number of VCRs	44
Number of Link Objects in VFD	50

Virtual communication references (VCRs)

Permanent Entries	44
Client VCRs	0
Server VCRs	5
Source VCRs	8
Sink VCRs	0
Subscriber VCRs	12
Publisher VCRs	19

Link settings

Slot time	4
Min. inter PDU delay	12
Max. response delay	10

Transducer Blocks

Block	Content	Output values
TRD1 Block	Contains all parameters related to the measurement	■ Pressure or level (channel 1) ■ Process temperature (channel 2)
Service Block	Contains service information	■ Pressure after damping (channel 3) ■ Pressure peakhold indicator (channel 4) ■ Counter for max. pressure transgressions (channel 5)
Diagnostic Block	Contains diagnostic information	Error code via DI channels (channel 0 to 16)
Display Block	Contains parameters to configure the onsite display	No output values

Function blocks

Block	Content	Number of blocks	Execution time	Functionality
Resource Block	The Resource Block contains all the data that uniquely identify the device. It is an electronic version of a nameplate of the device.	1		enhanced
Analog Input Block 1 Analog Input Block 2	The AI Block receives the measuring data from the Sensor Block, (selectable via a channel number) and makes the data available to other function blocks at its output. Enhancement: digital outputs for process alarms, fail safe mode.	2	45 ms	enhanced
Digital Input Block	This block contains the discrete data of the Diagnose Block (selectable via a channel number 0 to 16) and provides them for other blocks at the output.	1	40 ms	standard
Digital Output Block	This block converts the discrete input and thus initiates an action (selectable via a channel number) in the DP Flow Block or in the Service Block. Channel 1 resets the counter for max. pressure transgressions.	1	60 ms	standard
PID Block	The PID Block serves as a proportional-integral-derivative controller and is used almost universally for closed-loop-control in the field including cascade and feedforward. Input IN can be indicated on the display. The selection is performed in the Display Block (DISPLAY_MAIN_LINE_CONTENT).	1	120 ms	standard
Arithmetic Block	This block is designed to permit simple use of popular measurement math functions. The user does not have to know how to write equations. The math algorithm is selected by name, chosen by the user for the function to be performed.	1	50 ms	standard
Input Selector Block	The Input Selector Block facilitates the selection of up to four inputs and generates an output based on the configured action. This block normally receives its inputs from AI Blocks. The block performs maximum, minimum, average and 'first good' signal selection. Inputs IN1 to IN4 can be indicated on the display. The selection is performed in the Display Block (DISPLAY_MAIN_LINE_CONTENT).	1	35 ms	standard
Signal Characterizer Block	The Signal Characterizer Block has two sections, each with an output that is a non-linear function of the respective input. The non-linear function is generated by a single look-up table with 21 arbitrary x-y pairs.	1	30 ms	standard
Integrator Block	The Integrator Block integrates a variable as a function of the time or accumulates the counts from a Pulse Input Block. The block may be used as a totalizer that counts up until reset or as a batch totalizer that has a setpoint, where the integrated or accumulated value is compared to pre-trip and trip settings, generating a binary signal when the setpoint is reached.	1	35 ms	standard
Analog Alarm Block	This block contains all process alarm conditions (working like a comparator) and represents them at the output.	1	35 ms	standard

Additional function block information:

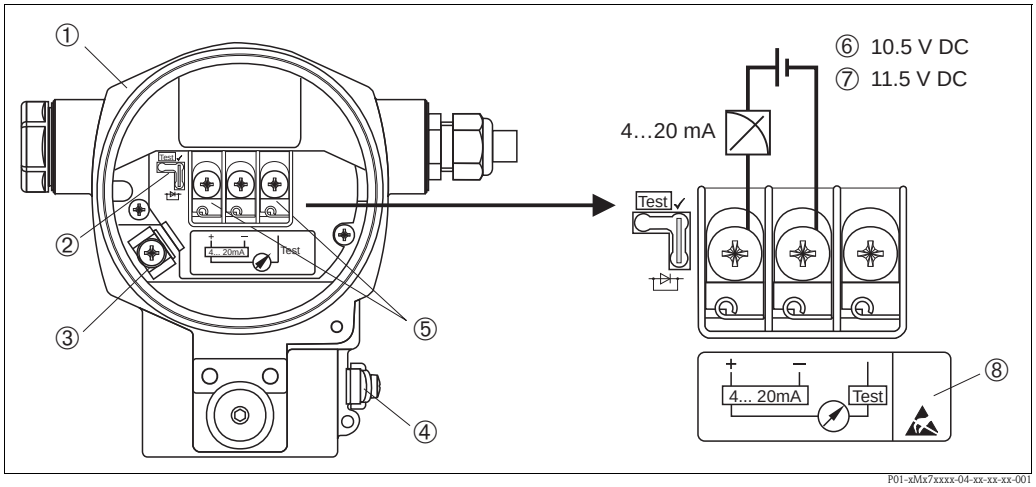
Instantiate Function Block	YES
Number of instantiate blocks	15

Power supply

Electrical connection

Note!
- When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.
  → 89 ff, "Safety Instructions" and "Installation/Control Drawings" sections.
- Devices with integrated overvoltage protection must be grounded. → 29.
- Protective circuits against reverse polarity, HF influences and overvoltage peaks are installed.

4 to 20 mA HART



Electrical connection 4 to 20 mA HART

1 Housing
2 Jumper for 4 to 20 mA test signal
→ 17, "Measuring a 4 to 20 mA test signal" section.
3 Internal ground terminal
4 External ground terminal
5 4 to 20 mA test signal between positive and test terminal
6 Minimum supply voltage = 10.5 V DC, jumper is set as illustrated in the diagram.
7 Minimum supply voltage = 11.5 V DC, jumper is set to "Test" position.
8 Devices with integrated overvoltage protection are labeled OVP (overvoltage protection) here (→ 29).

PROFIBUS PA

The digital communication signal is transmitted to the bus via a 2-wire connection. The bus also provides the power supply. For further information on the network structure and grounding, and for further bus system components such as bus cables, see the relevant documentation, e.g. Operating Instructions BA034S "PROFIBUS DP/PA: Guidelines for planning and commissioning" and the PNO Guideline.

Cable specifications:
- Use a twisted, shielded two-wire cable, preferably cable type A

Note!
For further information on the cable specifications, see Operating Instructions BA034S "PROFIBUS DP/PA: Guidelines for planning and commissioning", the PNO Guideline 2.092 PROFIBUS PA User and Installation Guideline" and IEC 61158-2 (MBP).

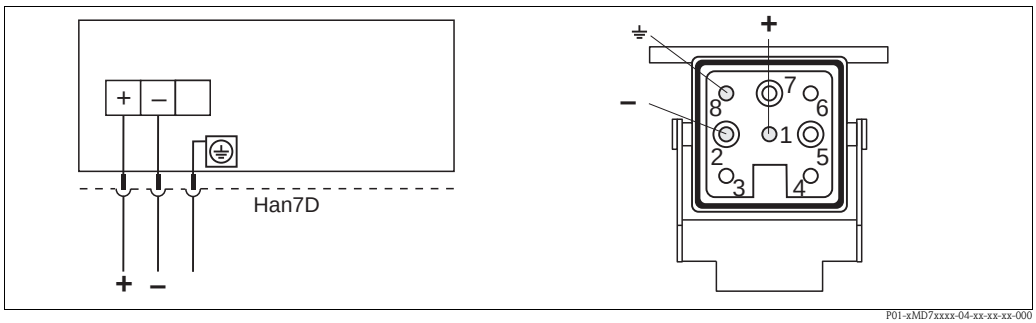
FOUNDATION Fieldbus

The digital communication signal is transmitted to the bus via a 2-wire connection. The bus also provides the power supply. For further information on the network structure and grounding and for further bus system components such as bus cables, see the relevant documentation, e.g. Operating Instructions BA013S "FOUNDATION Fieldbus Overview" and the FOUNDATION Fieldbus Guideline.

Cable specifications:
- Use a twisted, shielded two-wire cable, preferably cable type A

Note!
For further information on the cable specifications, see Operating Instructions BA013S "FOUNDATION Fieldbus Overview", FOUNDATION Fieldbus Guideline and IEC 61158-2 (MBP).

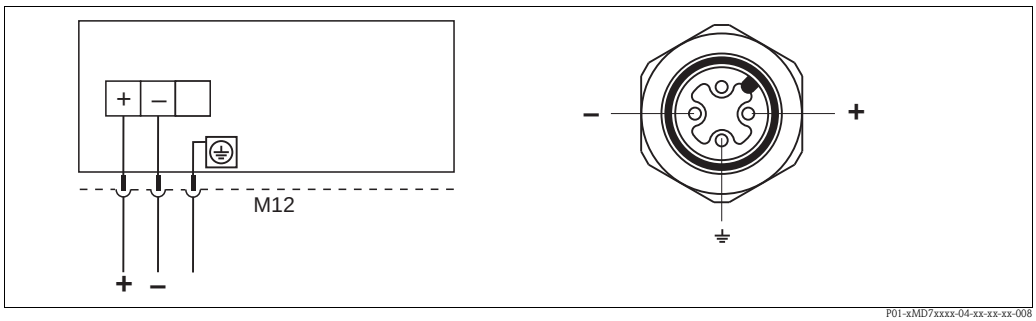
Devices with Harting plug Han7D



Left: electrical connection for devices with Harting plug Han7D
Right: view of the plug connector at the device

Material: CuZn

Devices with M12 plug



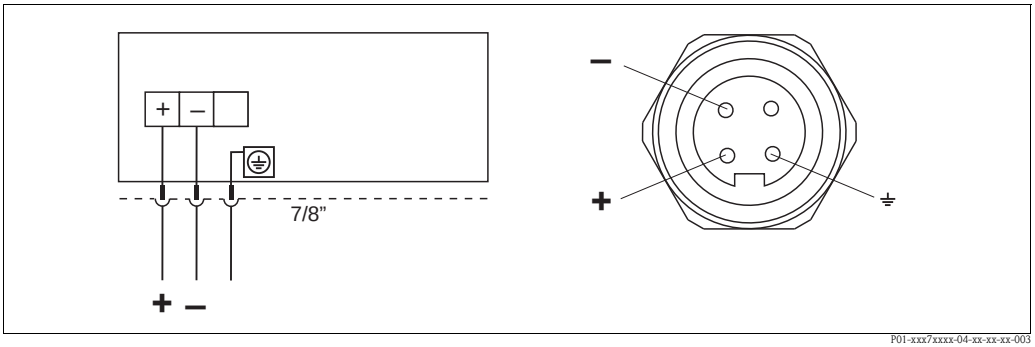
Left: electrical connection for devices with M12 plug
Right: view of the plug at the device

Endress+Hauser offers the following accessories for devices with an M12 plug:
Plug-in jack M 12x1, straight
- Material: body PA; coupling nut CuZn, nickel-plated
- Degree of protection (fully locked): IP67
- Order number: 52006263

Plug-in jack M 12x1, elbowed
- Material: body PBT/PA; coupling nut GD-Zn, nickel-plated
- Degree of protection (fully locked): IP67
- Order number: 71091284

Cable 4x0.34 mm² (20 AWG) with M12 socket, elbowed, screw plug, length 5 m (16 ft)
- Material: body PUR; coupling nut CuSn/Ni; cable PVC
- Degree of protection (fully locked): IP67
- Order number: 52010285

Devices with 7/8" plug



Left: electrical connection for devices with 7/8" plug
Right: view of the plug at the device

External thread: 7/8 - 16 UNC
- Material: housing / body CuZn, nickel-plated
- Protection: IP68
- Order number: 52010285

Cable gland

Approval	Type	Clamping area
Standard, II1/2G Exia, IS	Plastic M20x1.5	5 to 10 mm (0.2 to 0.39 in)
ATEX II1/2D, II1/3D, II1/2GD Exia, II1GD Exia, II3G Ex nA	Metal M20x1.5 (Ex e)	7 to 10.5 mm (0.28 to 0.41 in)

Terminals

For wire cross-sections of 0.5 to 2.5 mm² (20 to 14 AWG)

Measuring a 4 to 20 mA test signal

A 4 to 20 mA test signal may be measured via the positive and test terminal without interrupting the measurement. The minimum supply voltage of the device can be reduced by simply changing the position of the jumper. As a result, operation is also possible with lower voltage sources. Observe the position of the jumper in accordance with the following table.

Jumper position for test signal	Description
	– Measuring 4 to 20 mA test signal via the plus and test terminal: possible. (Thus, the output current can be measured without interruption via the diode.) – Delivery status – Minimum supply voltage: 11.5 V DC
	– Measuring 4 to 20 mA test signal via the plus and test terminal: not possible. – Minimum supply voltage: 10.5 V DC

Supply voltage

Note!
- When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.
- All explosion protection data are given in separate documentation which is available upon request. The Ex documentation is supplied as standard with all devices approved for use in explosion hazardous areas.
  → 📄 89 ff, "Safety Instructions" and "Installation/Control Drawings" sections.

4 to 20 mA HART

- Version for non-hazardous areas, jumper for 4 to 20 mA test signal in "Test" position (delivery status): 11.5 to 45 V DC
- Version for non-hazardous areas, jumper for 4 to 20 mA test signal in "Non-test" position: 10.5 to 45 V DC

PROFIBUS PA

- Version for non-hazardous areas: 9 to 32 V DC

FOUNDATION Fieldbus

- Version for non-hazardous areas: 9 to 32 V DC

Current consumption

- PROFIBUS PA: 13 mA ± 1 mA, switch-on current corresponds to IEC 61158-2, Clause 21
- FOUNDATION Fieldbus: 15 mA ± 1 mA, switch-on current corresponds to IEC 61158-2, Clause 21

Cable entry

→ 📄 76 ff, feature 30 "Housing; Cable entry; Protection".

Cable specification

- Endress+Hauser recommends using shielded, twisted-pair two-wire cables.
- Terminals for core cross-sections 0.5 to 2.5 mm^2 (20 to 14 AWG)
- Cable outer diameter: 5 to 9 mm (0.2 to 0.35 in)

Residual ripple

Without influence on 4 to 20 mA signal up to ± 5 % residual ripple within the permitted voltage range [according to HART hardware specification HCF_SPEC-54 (DIN IEC 60381-1)]

Influence of power supply

≤ 0.0006% of URL/1 V

Performance characteristics – general

Reference operating conditions

- As per IEC 60770
- Ambient temperature T_U = constant, in the range of: +21 to +33 °C (+70 to 91 °F)
- Humidity φ = constant, in the range of: 5 to 80 % rH
- Ambient pressure p_A = constant, in the range of: 860 to 1060 mbar (12.47 to 15.37 psi)
- Position of the measuring cell = constant, in range: horizontally ±1°
- Input of LOW SENSOR TRIM and HIGH SENSOR TRIM for lower range value and upper range value
- Zero based span
- Material of process isolating diaphragm PMC71: Al_2O_3 (aluminum oxide ceramic)
- Material of process isolating diaphragm PMP71 and PMP75: AISI 316L/1.4435
- Filling oil PMP71 and PMP75: silicone oil
- Supply voltage: 24 V DC ± 3 V DC
- Load with HART: 250 Ω

Uncertainty of measurement for small absolute pressure ranges

The smallest extended uncertainty of measurement that can be returned by our standards is:
- 0.4% of the measured value in the range 1 to 30 mbar (0.0145 to 0.435 psi)
- 1% of the measured value in the range < 1 mbar (0.0145 psi)

Long-term stability

PMC71/PMP75:
- For measuring ranges ≥ 1 bar (15 psi): ± 0.05 % of URL/year

PMC71:
- 100 mbar to 40 bar (1.5 psi to 600 psi): ±0.2 % of URL/10 years
- 100 mbar to 40 bar (1.5 psi to 600 psi) (absolute pressure sensor): ±0.3 % of URL/10 years

PMP71 gauge pressure sensors:

	1 year	5 years	10 year
Measuring ranges [bar (psi)]	**% of URL**		
1 (15)	±0.020	±0.080	±0.180
10 (150)	±0.025	±0.050	±0.075
40 (600)	±0.025	±0.075	±0.100
100 (1500)	±0.050	±0.150	±0.200
400 (6000)	±0.050	–	±1

Influence of the installation position

- PMC71 [1]: ≤ 0.18 mbar (3 psi)
- PMP71 [1, 2]
  - Process connections thread G 1 A, G 1 1/2, G 2, 1 1/2 MNPT, 2 MNPT, M 44x1,25, EN/DIN, ANSI and JIS flanges: ≤ 10 mbar (0.15 psi)
  - Process connections thread: G 1/2, 1/2 MNPT, JIS G 1/2, JIS R 1/2, M20x1.5: ≤ 4 mbar (0.06 psi)

1) Device rotated 180°, process connection pointing upwards.
2) The value is doubled for devices with inert oil.

Note!
Position-dependent zero shift can be corrected. → 🖹 24, "General installation instructions" section and → 🖹 72 ff, "Installation instructions, diaphragm seal systems" section

Performance characteristics – ceramic process isolating diaphragm

Reference accuracy – PMC71

The reference accuracy comprises the non-linearity (terminal based), hysteresis and non-reproducibility as per IEC 60770. The data refer to the calibrated span.

Measuring cell	Gauge pressure sensor	Absolute pressure sensor
100 mbar (1.5 psi)	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD	■ TD 1:1 to TD 5:1 = ±0.075 ■ TD > 5:1 = ±0.015 x TD
250 mbar (4 psi)	■ TD 1:1 to TD 15:1 = ±0.075 ■ TD > 15:1 = ±0.005 x TD	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD
400 mbar (6 psi), 1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi)	■ TD 1:1 to TD 15:1 = ±0.075 ■ TD > 15:1 = ±0.005 x TD	■ TD 1:1 to TD 15:1 = ±0.075 ■ TD > 15:1 = ±0.005 x TD
40 bar (600 psi)	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD
Platinum version: 1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi)	■ TD 1:1 = ±0.05	■ TD 1:1 = ±0.05

Total performance – PMC71

The "Total performance" specification comprises the non-linearity including hysteresis, non-reproducibility as well as the thermal change in the zero point.
For devices with NBR or HNBR seals, the values must be multiplied by a factor of 3.
All specifications apply to the temperature range –10 to +60 °C (+14 to +140 °F) and a turn down of 1:1.

Measuring cell	PMC71	PMC71 high-temperature version
	% of URL	
100 mbar (1.5 psi), 250 mbar (4 psi), 400 mbar (6 psi)	±0.2	±0.46
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi)	±0.15	±0.46

Total error - PMC71

The total error comprises the long-term stability and the total performance.
For devices with NBR or HNBR seals, the values must be multiplied by a factor of 3.
All specifications apply to the temperature range –10 to +60 °C (+14 to +140 °F) and a turn down of 1:1.

Measuring cell	PMC71	PMC71 high-temperature version
	% of URL/year	
100 mbar (1.5 psi), 250 mbar (4 psi), 400 mbar (6 psi)	±0.25	±0.51
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi)	±0.2	±0.51

Warm-up period – PMC71

- 4 to 20 mA HART: < 10 s
- PROFIBUS PA: 6 s
- FOUNDATION Fieldbus: 50 s

Thermal change of the zero output and the output span – PMC71

PMC71

Measuring cell	**–10 to +60°C (+14 to +140 °F)**	**–20 to –10 °C, +60 to +125 °C (–4 to +14°F, +140 to +257°F)**
	% of the set span	
100 mbar (1.5 psi), 250 mbar (4 psi), 400 mbar (6 psi)	±(0.088 x TD + 0.088)	±(0.138 x TD + 0.138)
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi)	±(0.088 x TD + 0.04)	±(0.175 x TD + 0.075)

PMC71 high-temperature version

Gauge pressure measuring cell	**–10 to +60°C (+14 to +140°F)**	**to +150°C (to +302°F)**
	% of the set span	
100 mbar (1.5 psi), 250 mbar (4 psi), 400 mbar (6 psi)	±(0.088 x TD + 0.088)	±(0.75 x TD)
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi)	±(0.088 x TD + 0.040)	±(0.50 x TD)
Absolut pressure measuring cell		
100 mbar (1.5 psi)	±(0.088 x TD + 0.088)	±(1.25 x TD)
250 mbar (4 psi), 400 mbar (6 psi)	±(0.088 x TD + 0.088)	±(0.75 x TD)
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi)	±(0.088 x TD + 0.040)	±(0.75 x TD)
40 bar (600 psi)	±(0.088 x TD + 0.040)	±(0.50 x TD)

Performance characteristics – metal process isolating diaphragm

Reference accuracy – PMP71, PMP75

The reference accuracy comprises the non-linearity (terminal based), hysteresis and non-reproducibility as per IEC 60770. The data refer to the calibrated span.

Measuring cell	Sensor	PMP71 and PMP75 without capillary	PMP75 with capillary
400 mbar (6 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 = ±0.15 ■ TD > 1:1 = ±0.15 x TD	■ TD 1:1 = ±0.15 ■ TD > 1:1 = ±0.15 x TD
1 bar (15 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 to TD 2.5:1 = ±0.075 ■ TD > 2.5:1 = ±0.03 x TD	■ TD 1:1 to TD 2.5:1 = ±0.1 ■ TD > 2.5:1 = ±0.04 x TD
2 bar (30 psi)	Gauge pressure	■ TD 1:1 to TD 5:1 = ±0.075 ■ TD > 5:1 = ±0.015 x TD	■ TD 1:1 to TD 2.5:1 = ±0.1 ■ TD > 2.5:1 = ±0.04 x TD
2 bar (30 psi)	Absolute pressure	■ TD 1:1 to TD 5:1 = ±0.075 ■ TD > 5:1 = ±0.015 x TD	■ TD 1:1 to TD 5:1 = ±0.075 ■ TD > 5:1 = ±0.015 x TD
4 bar (60 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD
10 bar (150 psi), 40 bar (600 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 to TD 15:1 = ±0.075 ■ TD > 15:1 = ±0.005 x TD	■ TD 1:1 to TD 15:1 = ±0.075 ■ TD > 15:1 = ±0.005 x TD
100 bar (1500 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD	■ TD 1:1 to TD 10:1 = ±0.075 ■ TD > 10:1 = ±0.0075 x TD
400 bar (6000 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 to TD 5:1 = ±0.15 ■ TD > 5:1 = ±0.03 x TD	■ TD 1:1 to TD 5:1 = ±0.15 ■ TD > 5:1 = ±0.03 x TD
700 bar (10500 psi)	Absolute pressure	■ TD 1:1 to TD 5:1 = ±0.15 ■ TD > 5:1 = ±0.03 x TD	—
Platinum version [1] 1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi), 100 bar (1500 psi)	Gauge pressure/ absolute pressure	■ TD 1:1 = ±0.05	—

1) Platinum version not for flush-mounted process connections G 1/2 and M20.

Total performance – PMP71

The "Total performance" specification comprises the non-linearity including hysteresis, non-reproducibility as well as the thermal change of the zero point.
All specifications apply to the temperature range –10 to +60 °C (+14 to +140 °F) and a turn down of 1:1.

Measuring cell	PMP71	PMP71 with gold-rhodium-coated process isolating diaphragm
	% of URL	
400 mbar (6 psi)	±0.25	±1.25
1 bar (15 psi)	±0.15	±0.75
2 bar (30 psi)	±0.15	±0.45
4 bar (60 psi)	±0.15	±0.3
10 bar (150 psi), 40 bar (600 psi)	±0.15	±0.15
100 bar (1500 psi)	±0.25	±0.25
400 bar (6000 psi)	±0.3	±0.3
700 bar (10500 psi)	±0.3	±0.3

Total error - PMP71

The total error comprises the total performance and long-term stability.
All specifications apply to the temperature range –10 to +60 °C (+14 to +140 °F) and a turn down of 1:1.

Measuring cell	% of URL/year
400 mbar (6 psi)	■ ±0,3
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi)	■ ±0.2
100 bar (1500 psi)	■ ±0.3
400 bar (6000 psi)	■ ±0.35
700 bar (10500 psi)	■ ±0.35

Warm-up period – PMP71, PMP75

- 4 to 20 mA HART: < 10 s
- PROFIBUS PA: 6 s
- FOUNDATION Fieldbus: 50 s

Thermal change of the zero output and the output span – PMP71 and PMP75

Note!
When using a PMP75, the influence from the respective diaphragm seal must be taken into account.
(→ 🖹 70 ff "Planning instructions, diaphragm seal systems".

PMP71 and PMP75 (basic device), internal process isolating diaphragm

Measuring cell	Material of the process isolating diaphragm		–10 to +60°C (+14 to +140 °F)	–40 to –10 °C, +60 to +85 °C (–40 to +14 °F, +140 to +185 °F)
	316 L	Gold-rhodium	% of the set span	
400 mbar (6 psi)	x	x	±(0.2 x TD + 0.015)	±(0.4 x TD + 0.03)
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi)	x	x	±(0.1 x TD + 0.01)	±(0.4 x TD + 0.02)
40 bar (600 psi)	x	-	±(0.1 x TD + 0.01)	±(0.4 x TD + 0.02)
100 bar (1500 psi)	x	-	±(0.2 x TD + 0.015)	±(0.4 x TD + 0.03)
400 bar (6000 psi)	x	-	±(0.35 x TD + 0.02)	±(0.7 x TD + 0.04)
700 bar (10500 psi)	x	-	±(0.4 x TD + 0.03)	±(0.7 x TD + 0.04)

PMP71, flush-mounted process isolating diaphragm made of 316L with gold-rhodium coating

Measuring cell	–10 to +60°C (+14 to +140 °F)	–40 to –10 °C, +60 to +85 °C (–40 to +14 °F, +140 to +185 °F)
	% of the set span	
400 mbar (6 psi)	±(0.2 x TD + 0.015) x 5	±(0.4 x TD + 0.03) x 5
1 bar (15 psi), 2 bar (30 psi), 4 bar (60 psi), 10 bar (150 psi), 40 bar (600 psi)	±(0.1 x TD + 0.01) x 5	±(0.4 x TD + 0.02) x 5
100 bar (1500 psi)	±(0.2 x TD + 0.015) x 5	±(0.4 x TD + 0.03) x 5
400 bar (6000 psi)	±(0.35 x TD + 0.02) x 5	±(0.7 x TD + 0.04) x 5
700 bar (10500 psi)	±(0.4 x TD + 0.03) x 5	±(0.7 x TD + 0.04) x 5

Operating conditions (Installation)

General installation instructions

- For PMP75: See → 📄 72, "Installation instructions" section.
- The position-dependent zero point shift can be corrected directly at the device via operating keys, and also in hazardous areas in the case of devices with external operation. Diaphragm seals also shift the zero point, depending on the installation position
  (→ See also → 📄 72, "Installation instructions" section).
- The housing of the Cerabar S can be rotated 380°. See → 📄 26, "Turning the housing" section.
- Endress+Hauser offers a mounting bracket for installing the device on pipes or walls.
  → See also → 📄 25, "Wall and pipe-mounting" section.
- Use flushing rings for flange and cell diaphragm seals if buildup or clogging can be expected at the diaphragm seal connection. The flushing ring can be fitted between the process connection and diaphragm seal. Material buildup in front of the process isolating diaphragm can be flushed away, and the pressure chamber vented, via the two lateral flushing holes.

Measuring arrangement for devices without diaphragm seals – PMC71, PMP71

Cerabar S transmitters without diaphragm seals are mounted as per the norms for a manometer (DIN EN 837-2). We recommend the use of shutoff devices and siphons. The orientation depends on the measuring application.

Pressure measurement in gases

- Mount Cerabar S with shutoff device above the tapping point so that any condensate can flow into the process.

Pressure measurement in steams

- Mount Cerabar S with siphon below the tapping point.
  The siphon reduces the temperature to almost the ambient temperature.
- Fill the siphon with liquid before commissioning.

Pressure measurement in liquids

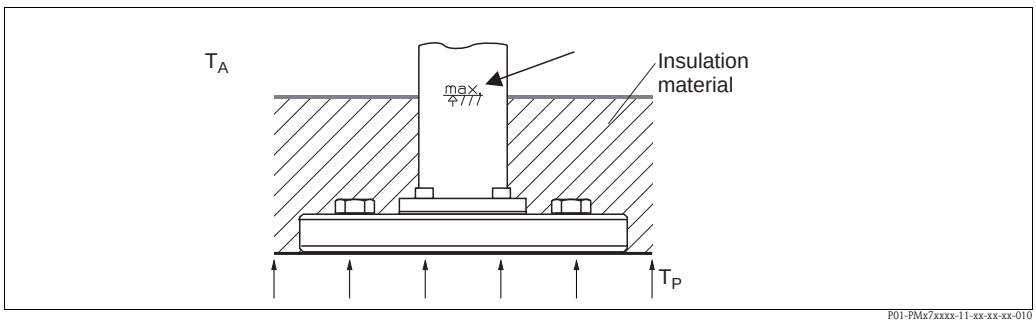
- Mount Cerabar S with shutoff device below or at the same level as the tapping point.

Level measurement

- Mount Cerabar S below the lowest measuring point.
- Do not mount the device at the following positions:
  In the filling curtain, in the tank outlet or at a point in the container which could be affected by pressure pulses from an agitator or a pump.
- The adjustment and functional test can be carried out more easily if you mount the device downstream of a shutoff device.

Heat insulation – PMC71 high-temperature version

The PMC71 high-temperature version must only be insulated up to a certain height. The maximum permitted insulation height is indicated on the devices and applies to an insulation material with a heat conductivity ≤ 0.04 W/(m x K) and to the maximum permitted ambient and process temperature (→ see table below). The data were determined under the most critical application "quiescent air".



P01-PMx7xxxx-11-xx-xx-xx-010

Maximum insulation height, here indicated on a PMC71 with a flange

	PMC71 high-temperature version
Ambient temperature (T_A)	≤ 70 °C (158 °F)
Process temperature (T_P)	≤ 150 °C (302 °F)

Measuring arrangement for devices with diaphragm seals – PMP75

- See → 📄 70, "Planning instructions, diaphragm seal systems" section.

Wall and pipe-mounting

Endress+Hauser offers a mounting bracket for installing the device on pipes or walls.
See also → 📄 76 ff, feature 110, "Additional option 2" or separate accessory (part number: 71102216).
For the dimensions, see → 📄 60.

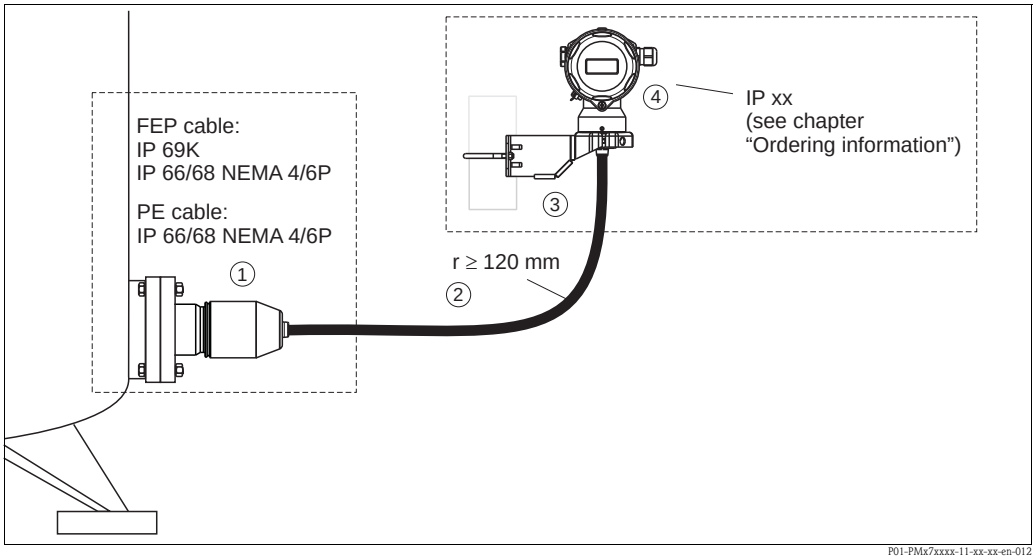
"Separate housing" version

With the "separate housing" version, you are able to mount the housing with the electronics insert at a distance from the measuring point. This version facilitates trouble-free measurement:
- Under particularly difficult measuring conditions (at installation locations that are cramped or difficult to access)
- If rapid cleaning of the measuring point is required
- If the measuring point is exposed to vibrations
- For compact installations

You can choose between different cable versions:
- PE (2 m (6.6 ft), 5 m (16 ft) and 10 m (33 ft))
- FEP (5 m (16 ft)).

→ 📄 78 ff, feature 110, "Additional option 2", version "G".

For the dimensions, → 📄 60.



In the case of the "separate housing" version, the sensor is delivered with the process connection and cable ready mounted. The housing and a mounting bracket are enclosed as separate units. The cable is provided with a socket at both ends. These sockets are simply connected to the housing and the sensor.

1 Process connection with sensor
2 Cable, both ends are fitted with a socket
3 Mounting bracket provided, suitable for pipe and wall mounting
4 Housing with electronic insert

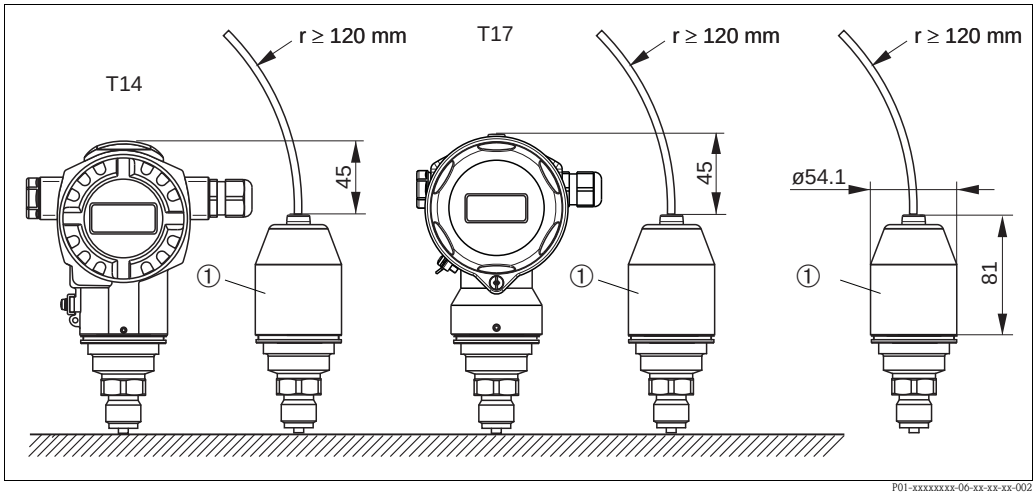
Degree of protection for the process connection and sensor with the use of
- FEP cable:
  - IP 69K
  - IP 66 NEMA 4/6P
  - IP 68 (1.83 mH_2O for 24 h) NEMA 4/6P
- PE cable:
  - IP 66 NEMA 4/6P
  - IP 68 (1.83 mH_2O for 24 h) NEMA 4/6P

Technical data of the PE and FEP cable:
- Minimum bending radius: 120 mm (4.72 in)
- Cable extraction force: max. 450 N (101 lbf)
- Resistance to UV light

Use in hazardous area:
- Intrinsically safe installations (Ex ia/IS)
- FM/CSA IS: for Div. 1 installation only

Reduction of the installation height

If the separate housing is used, the installation height of the process connection is reduced compared to the dimensions of the standard version.

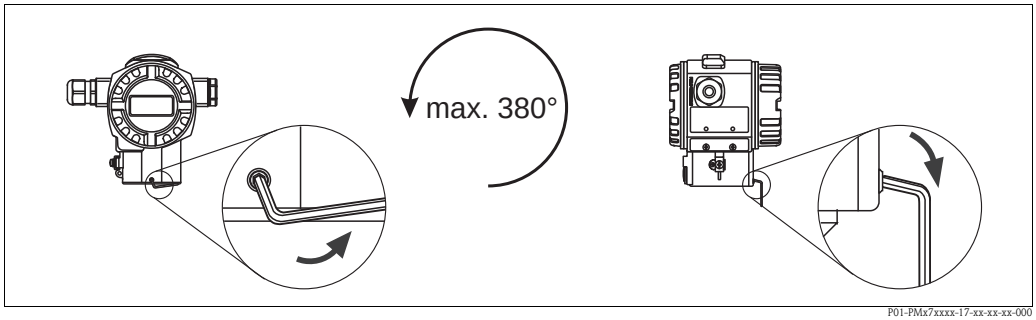


Reduction of the installation height of the process connection when using the separate housing.
1 Process connection adapter.

Turning the housing

The housing can be rotated 380° by loosening the Allen screw.

Your benefits
- Simple mounting by optimally aligning the housing
- Good, accessible device operation
- Optimum readability of the onsite display (optional).



Aligning the housing by releasing the setscrew
T14 housing: 2 mm (0.08 in) Allen screw; T17 housing: 3 mm (0.12 in) Allen screw

Oxygen applications

Oxygen and other gases can react explosively to oils, grease and plastics, such that, among other things, the following precautions must be taken:
– All components of the system, such as measuring devices, must be cleaned in accordance with the BAM (DIN 19247) requirements.
– Dependent on the materials used, a certain maximum temperature and a maximum pressure for oxygen applications must not be exceeded.

The devices suitable for gaseous oxygen applications are listed in the following table with the specification p_{max}.

Order code for devices [1]cleaned for oxygen applications	p_{max} for oxygen applications	T_{max} for oxygen applications
PMC71 – * * * ** * ** 2 * *, Devices with sensors, nominal value < 10 bar (150 psi)	Over pressure limit (OPL) of sensor[2, 3]	60 °C (140 °F)
PMC71 – * * * ** * ** 2 * *, Devices with sensors, nominal value ≥ 10 bar (150 psi)	30 bar (450 psi)	60 °C (140 °F)
PMP71 – * * * ** * * ** N * *	Dependent on the lowest-rated element, with regard to pressure, of the selected components: over pressure limit (OPL) of the sensor[1], process connection (1.5 x PN) or fill fluid (160 bar (2400 psi))	85 °C (185 °F)
PMP75 – * * * ** * * * ** N * *	Dependent on the lowest-rated element, with regard to pressure, of the selected components: over pressure limit (OPL) of the sensor[1], process connection (1.5 x PN) or fill fluid (160 bar (2400 psi))	85 °C (185 °F)

1) Only devices, not accessories or enclosed accessories.

2) → 📄 76 ff "Ordering information", feature 40 "Sensor range; Sensor over pressure limit (= OPL)

3) PMC71 with PVDF thread or flange p_{max} = 15 bar (225 psi)

Silicone-free applications

Special cleaning of the transmitter to remove paint-wetting substances, for use in paint shops → 📄 78 "Ordering information PMC71", feature 80 "Seal", version "L" and "M".

Ultrapure gas applications

Endress+Hauser also offers devices for special applications, such as ultrapure gas, cleaned from oil and grease. No special restrictions regarding the process conditions apply to these devices.

→ 📄 76, "Ordering information PMC71", feature 80 "Seal" or → 📄 82, "Ordering information PMP71", feature 90 "Fill fluid".

Applications with hydrogen

With regard to materials in which hydrogen formation takes place, hydrogen atoms can diffuse through the metal process isolating diaphragm. This can result in incorrect measurement results.
Endress+Hauser offers process isolating diaphragms with gold-rhodium coating for this application.

→ 📄 80 "Ordering information PMP71" and → 📄 84 "Ordering information PMP75", feature 60 "Membrane material" version "6".

Operating conditions (Environment)

Ambient temperature range

Version	PMC71 high-temperature version	PMC71	PMP71 [1]	PMP75 [1]
Without LCD display	–20 to +70 °C (-4 to +158 °F)	–40 to +85 °C (-40 to +185 °F)		
With LCD display [2]		–20 to +70 °C (-4 to +158 °F)		
With M12 connector, elbowed		-25 to +85 °C (-13 to +185 °F)		
With separate housing	–20 to +50 °C (-40 to +140 °F) (installation without insulation)			—
Diaphragm seal systems	—	—	—	→ 🖹 70

1) Lower temperatures on request

2) Extended temperature application range (-40 °C to +85 °C (-40 °F to +185 °F)) with restrictions in optical properties such as display speed and contrast

Note!
For high-temperature applications, either a PMP75 with a temperature isolator or with a capillary can be used. If vibrations also occur in the application, Endress+Hauser recommends using a PMP75 with a capillary. If a PMP75 with a temperature isolator or capillary is used, we recommend a suitable retaining unit for mounting (see "Wall and pipe-mounting" section on → 🖹 25).

For devices for use in hazardous areas, see Safety Instructions, Installation or Control Drawing. (→ 🖹 89 ff, "Safety Instructions" and "Installation/Control Drawings" sections)

Storage temperature range

- –40 to +90 °C (-40 to +194 °F)
- Onsite display: –40 to +85 °C (-40 to +185 °F)
- Separate housing: -40 to +60 °C (-40 to +140 °F)

Degree of protection

- → See Page 76 ff, feature 30 "Housing; Cable entry; Protection".
- Degree of protection IP 68 for T17 housing: 1.83 mH_2O for 24 h
- Separate housing → 🖹 25

Climate class

Class 4K4H (air temperature: –20 to 55 °C (-4 to 131 °F), relative humidity: 4 to 100 %)
fulfilled as per DIN EN 60721-3-4 (condensation possible. With PMC71, avoid condensate in the device).

Vibration resistance

Device/accessory	Test standard	Vibration resistance
PMC71 [1]	GL	Guaranteed for 3 to 25 Hz: ±1.6 mm (0.063 in); 25 to 100 Hz: 4 g in all 3 planes
PMP71		
PMP75 [2, 3]		
With mounting bracket	IEC 61298-3	Guaranteed for 10 to 60 Hz: ±0.15 mm (0.0059 in); 60 to 500 Hz: 2 g in all 3 planes

1) Not for high-temperature version with Ex d[ia], CSA XP or FM XP

2) With aluminum T14 housing only

3) For high-temperature applications, either a PMP75 with a temperature isolator or with a capillary can be used. If vibrations also occur in the application, Endress+Hauser recommends using a PMP75 with a capillary. If a PMP75 with a temperature isolator or capillary is used, it must be mounted with a mounting bracket (→ 🖹 25).

Electromagnetic compatibility

- Electromagnetic compatibility to EN 61326 and NAMUR recommendation EMC (NE21). For details refer to the Declaration of Conformity.
- With enhanced immunity against electromagnetic fields as per EN 61000-4-3: 30 V/m with closed cover [1]
- Maximum deviation: < 0.5 % of span
- All EMC measurements were performed with a turn down (TD) = 2:1.

1) For devices with T14 housing

Overvoltage protection (optional)

- Overvoltage protection:
  - Nominal functioning DC voltage: 600 V
  - Nominal discharge current: 10 kA
- Surge current check $\hat{i}$ = 20 kA as per DIN EN 60079-14: 8/20 µs satisfied
- Arrester AC current check I = 10 A satisfied

→ 📄 76 ff, feature 100 "Additional option 1" and feature 110 "Additional option 2", version "M Overvoltage protection".

Note!
Devices with integrated overvoltage protection must be grounded.

Operating conditions (Process)

Process temperature limits

PMC71 (with ceramic process isolating diaphragm)

- –25 to +125 °C (–13 to +257 °F)
- High-temperature version: –20 to +150 °C (–4 to +302 °F); → 76, feature 100 "Additional option 1", version "T".
- With applications involving saturated steam, a Cerabar S with a metal process isolating diaphragm must be used, or a siphon for temperature isolation should be provided during installation.
- Observe the process temperature range of the seal in the following table.

Versions for feature 80 in the order code	Seal	Process temperature range
A, L	FKM Viton	–25 to +125 °C/150 °C (-13 to +257 °F/302 °F) [1]
B[2]	EPDM (FDA 21CFR177.2600; 3A Class II; USP Class VI) DVGW (KTW, W270, W534), WRAS, ACS, NSF61	–20 to +125 °C/150 °C (-13 to +257 °F/302 °F) [1]
B	EPDM	–20 to +125 °C (-4 to +257 °F)
D, M	Kalrez, Compound 4079	+5 to +125 °C/150 °C (-41 to +257 °F/302 °F) [1]
E	Chemraz, Compound 505	–10 to +125 °C/150 °C (14 to +257 °F/302 °F) [1]
F[2]	HNBR (FDA 21CFR177.2600; 3A Class II; KTW; AFNOR; BAM)	–25 to +125 °C (-13 to +257 °F
F	NBR	–10 to +100 °C (14 to +212 °F)
G	FKM Viton, FDA	–5 to +125 °C (-23 to +257 °F)
1	FKM Viton, cleaned from oil and grease	–10 to +125 °C/150 °C (14 to +257 °F/302 °F) [1]
2	FKM Viton, cleaned for oxygen service	–10 to +60 °C (14 to +140 °F)
The process temperature ranges specified here refer to permanent application of the PMC71. They may be exceeded for a short time (e.g. for cleaning).		

1) 150 °C (302 °F): for high-temperature version

2) These seals are used for devices with 3A-approved process connections.

Applications with jumps in temperature

Extreme jumps in temperature can result in temporary measuring errors. Temperature compensation takes effect after several minutes. Internal temperature compensation is faster the smaller the jump in temperature and the longer the time interval involved.
For further information please contact your local Endress+Hauser Sales Center.

PMP71 (with metal process isolating diaphragm)

Description	Temperature operating range
Process connections with internal process isolating diaphragm	–40 to +125 °C (-40 to +257 °F) (+150 °C (302 °F) for max. one hour)
Process connections with flush-mounted process isolating diaphragm, G 1 A, G 1 1/2 A, G 2 A, 1 NPT, 1 1/2 NPT, 2 NPT, M 44 x 1.25, EN/DIN, ANSI and JIS flanges	–40 to +100 °C (-40 to +212 °F)
Process connections with flush-mounted process isolating diaphragm, G 1/2 A, M20x1.5	–20 to +85 °C (-4 to 185 °F)

PMP75 (with diaphragm seal)

- Depending on the diaphragm seal and filling oil from -70 °C (-94 °F) to +400 °C (+752 °F). Observe the temperature application limits → 🖹 70.

Note!
- Do not use diaphragm seals with 0.09 mm (0.0035 in) PTFE foil on AISI 316L (1.4435/1.4404) for vacuum applications, upper temperature limit +204 °C (+399 °F).
- For oxygen applications, observe → 🖹 27, "Oxygen applications" section.

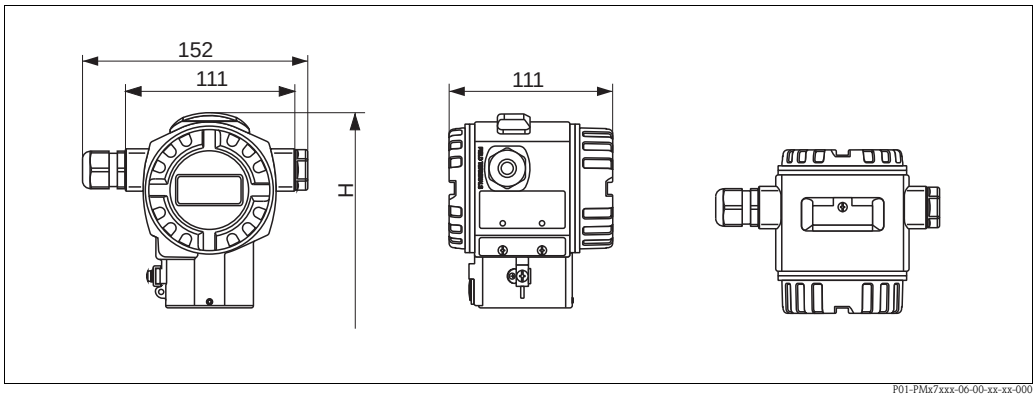
Pressure specifications

- The maximum pressure for the measuring device depends on the lowest-rated element with regard to pressure.
  See the following sections:
  – → 🖹 7 ff, "Measuring range" section
  – "Mechanical construction" section.
  The MWP (maximum working pressure) is specified on the nameplate. This value refers to a reference temperature of 20°C (68°F), or 100°F (38 °C) for ANSI flanges, and may be applied to the device for an unlimited time. Observe the temperature dependency of the MWP.
- The pressure values permitted at higher temperatures can be found in the following standards:
  – EN 1092-1: 2001 Tab. 18 [1]
  – ASME B 16.5a – 1998 Tab. 2-2.2 F316
  – ASME B 16.5a – 1998 Tab. 2.3.8 N10276
  – JIS B 2220
- The test pressure corresponds to the over pressure limit of the device (OPL = 1.5 x MWP [2]) and may be applied for only a limited time period in order to avoid permanent damage.
- The Pressure Equipment Directive (EC Directive 97/23/EC) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the measuring device.
- In the case of sensor range and process connections where the over pressure limit (OPL) of the process connection is smaller than the nominal value of the sensor, the device is set at the factory, at the very maximum, to the OPL value of the process connection. If you want to use the entire sensor range, select a process connection with a higher OPL value (1.5 x PN; MWP = PN).
- In oxygen applications, the values for "p_{max} and T_{max} for oxygen applications" as per → 🖹 27, "Oxygen applications" may not be exceeded.

1) With regard to their stability-temperature property, the materials 1.4435 and 1.4404 are grouped together under 13EO in EN 1092-1: 2001 Tab. 18. The chemical composition of the two materials can be identical.
2) The equation does not apply for PMP71 and PMP75 with a 40 bar (600 psi) or 100 bar (1500 psi) measuring cell.

Mechanical construction

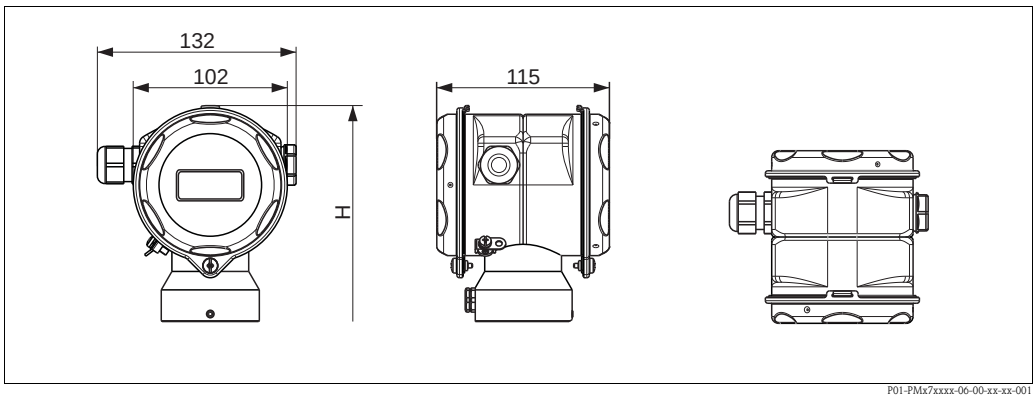
Dimensions of T14 housing, optional display on the side



P01-PMx7xxx-06-00-xx-xx-000

Front view, left-hand side view, top view
→ Installation height H, see process connection in question. Housing weight → 60.

Dimensions of T17 housing (hygienic), optional display on the side

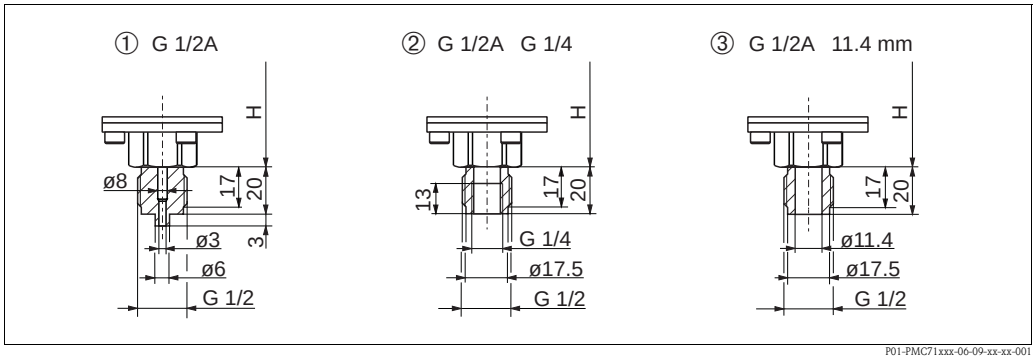


P01-PMx7xxxx-06-00-xx-xx-001

Front view, left-hand side view, top view
→ Installation height H, see process connection in question. Housing weight → 60.

Process connections PMC71 (with ceramic process isolating diaphragm)

Thread, internal process isolating diaphragm

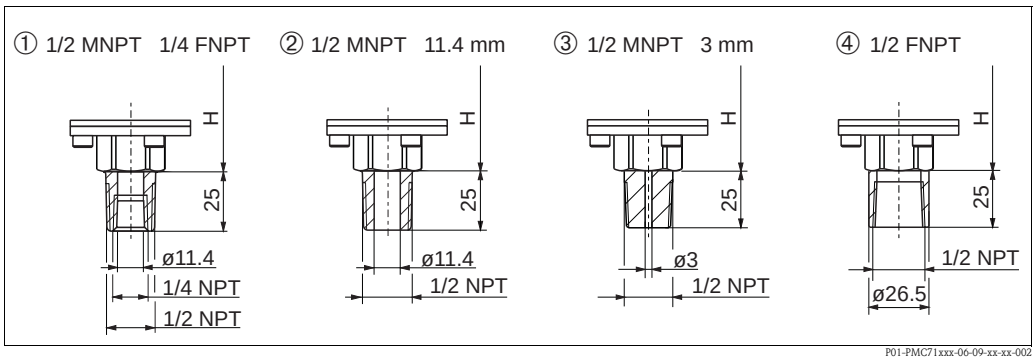


Process connections PMC71, thread ISO 228
Installation height → 📄 34.

1 Thread ISO 228 G 1/2 A EN 837;
Material version GA: AISI 316L, version GB: Alloy C276, version GC: Monel,
version GD: PVDF (max.: 15 bar (225 psi), –10 to +60 °C/+14 to +140 °F), only mount version "GD" with a mounting bracket (→ see also Page 25); weight: 0.63 kg (1.39 lbs)

2 Thread ISO 228 G 1/2 A G 1/4 (female);
Material version GE: AISI 316L, version GF: Alloy C276, version GG: Monel;
Weight: 0.63 kg (1.39 lbs)

3 Thread ISO 228 G 1/2 A hole 11.4 mm;
Material version GH: AISI 316L, version GJ: Alloy C276, version GK: Monel;
Weight: 0.63 kg (1.39 lbs)



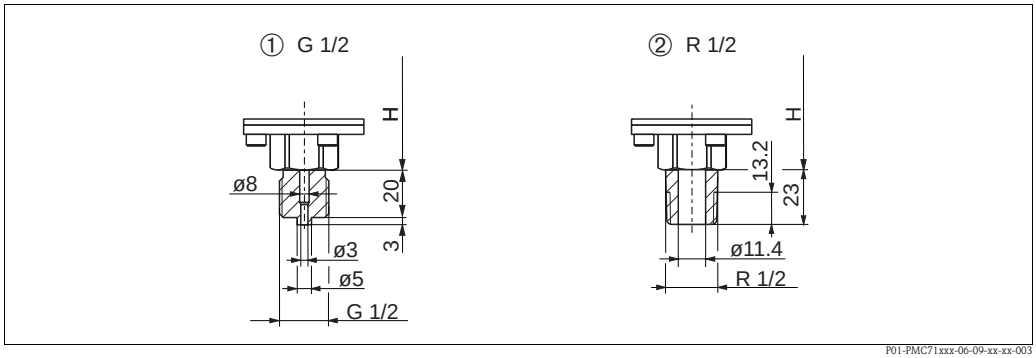
Process connections PMC71, thread ANSI
Installation height → 📄 34.

1 Thread ANSI 1/2 MNPT 1/4 FNPT;
Material version RA: AISI 316L, version RB: Alloy C276, version RC: Monel;
Weight: 0.63 kg (1.39 lbs)

2 Thread ANSI 1/2 MNPT hole 11.4 (0.45 in);
Material version RD: AISI 316L, version RE: Alloy C276, version RF: Monel;
Weight: 0.63 kg (1.39 lbs)

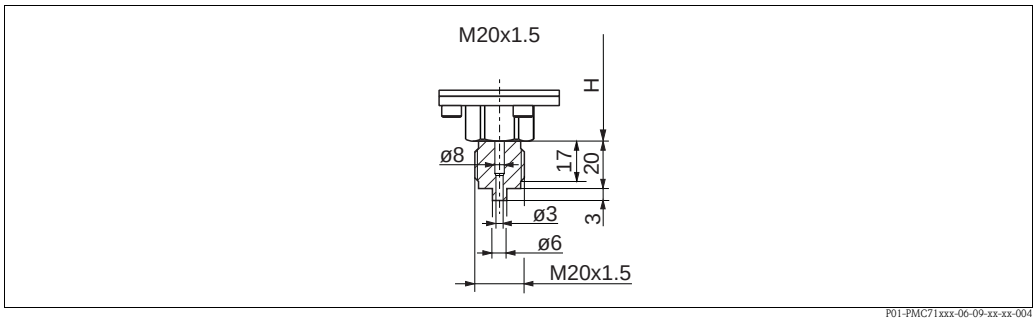
3 Thread ANSI 1/2 MNPT hole 3 mm (0.12 in);
Material version RG: PVDF (max.: 15 bar (225 psi), –10 to +60 °C/+14 to +140 °F) - only mount with a mounting bracket
(→ 📄 25); Weight: 0.63 kg (1.39 lbs)

4 Thread ANSI 1/2 FNPT;
Material version RH: AISI 316L, version RJ: Alloy C276, version RK: Monel;
Weight: 0.63 kg (1.39 lbs)



Process connections PMC71, thread JIS
Installation height H → 🖹 34.

1 Version GL: thread JIS B0202 G 1/2 (male), material: AISI 316L; weight: 0.63 kg (1.39 lbs)
2 Version RL: thread JIS B0203 R 1/2 (male), material: AISI 316L; weight: 0.63 kg (1.39 lbs)

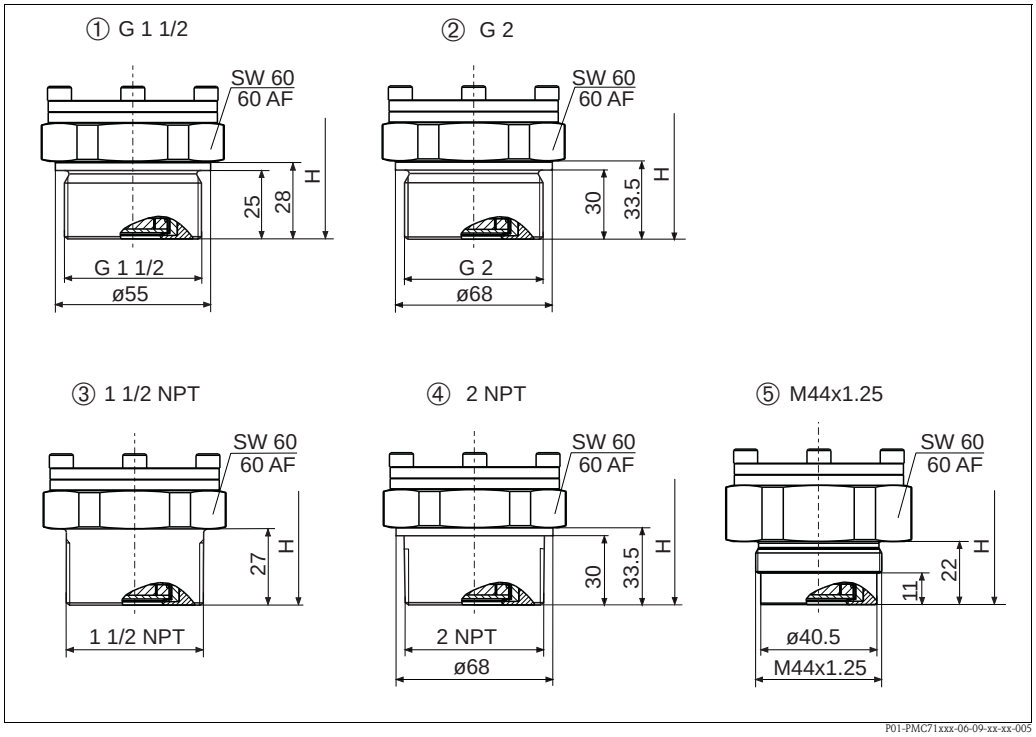


Process connections PMC71 thread DIN 13 M 20x1.5 hole 3 mm (0.12 in)
Material version GP: AISI 316L, version GQ: Alloy C276; weight: 0.63 kg (1.39 lbs)
Installation height H → 🖹 34.

Installation height H for devices with threaded connection and internal process isolating diaphragm

Description	T14 housing	T17 housing
PMC71	155 mm (6.1 in)	171 mm (6.73 in)
PMC71 with Ex d[ia], CSA XP or FM XP	225 mm (8.86 ft)	241 mm (9.94 in) (Ex d = 311 mm (12.2 in))
PMC71 high-temperature version	235 mm (9.25 in)	251 mm (9.88 in)
PMC 71 high-temperature version with Ex d[ia], CSA XP or FM XP	305 mm (12 in)	321 mm (12.6 in) (Ex d = 391 mm (15.4 in))

Thread, flush-mounted process isolating diaphragm



Process connections PMC71,
→ Installation height see table below.

1 Thread ISO 228 G 1 1/2 A;
Material version 1G: AISI 316L, version 1H: Alloy C276, version 1J: Monel;
Weight: 0.63 kg (1.39 lbs)

2 Thread ISO 228 G 2 A;
Material version 1K: AISI 316L, version 1L: Alloy C276, version 1M: Monel;
Weight: 0.63 kg (1.39 lbs)

3 Thread ANSI 1 1/2 MNPT;
Material version 2D: AISI 316L, version 2E: Alloy C276, version 2F: Monel;
Weight: 0.63 kg (1.39 lbs)

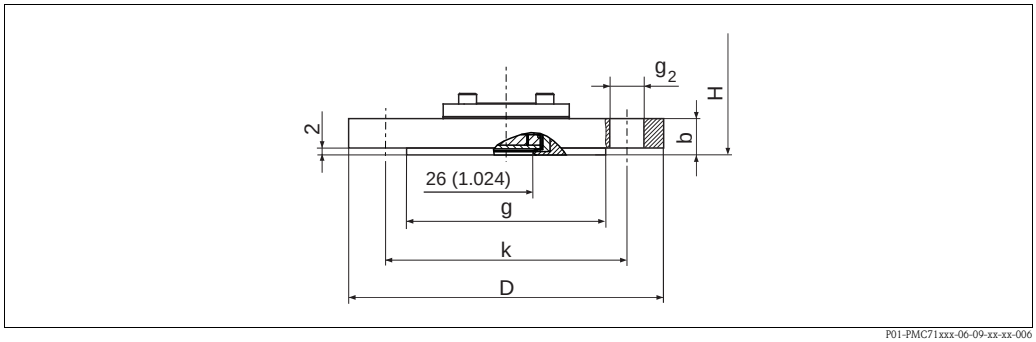
4 Thread ANSI 2 MNPT;
Material version 2G: AISI 316L, version 2H: Alloy C276, version 2J: Monel;
Weight: 0.63 kg (1.39 lbs)

5 Thread DIN 13 M 44x1.25;
Material version 1R: AISI 316L, version 1S: Alloy C276; weight: 0.63 kg (1.39 lbs)

Installation height H for devices with threaded connection and flush-mounted process isolating diaphragm

Description	T14 housing	T17 housing
PMC71/PMC71 high-temperature version	215 mm (8.46 in)	231 mm (9.09 in)
PMC71/PMC71 high-temperature version: with Ex d[ia], CSA XP or FM XP	280 mm (11 in)	296 mm (11.7 in)

EN/DIN flanges, connection dimensions as per EN 1092-1/DIN 2527



Process connection PMC71, EN/DIN flange with raised face (flush-mounted process isolating diaphragm)
Installation height H → 📄 38.

	Flange [1]							Boltholes			
Version	**Material**	**Nominal diameter**	**Nominal pressure**	**Shape[2]**	**Diameter** **D** [mm]	**Thickness** **b** [mm]	**Raised face** **g** [mm]	**Quantity**	**Diameter** **g_2** [mm]	**Hole circle** **k** [mm]	**Flange weight [3]** [kg]
CP	AISI 316L	DN 32	PN 10-40	B1 (D)	140	18	77	4	18	100	1.9
CQ	AISI 316L	DN 40	PN 10-40	B1 (D)	150	18	87	4	18	110	2.2
BR	PVDF [4]	DN 50	PN 10-16	B1 (D)	165	21.4	102	4	18	125	0.6
B3	AISI 316L	DN 50	PN 10-40	B1 (D)	165	20	102	4	18	125	3.0
C3	AISI 316L	DN 50	PN 63 (64)	B2 (D)	180	26	102	4	22	135	4.6
BS	PVDF[4]	DN 80	PN 10-16	B1 (D)	200	21.4	138	8	18	160	1.0
B4	AISI 316L	DN 80	PN 10-40	B1 (D)	200	24	138	8	18	160	5.4

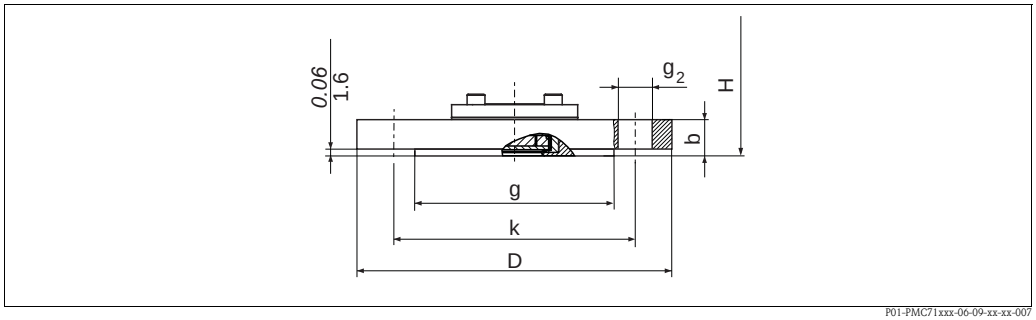
1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Hastelloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

2) Designation as per DIN 2527 in brackets

3) Housing weight → 📄 60

4) Max.: 15 bar (225 psi), –10 to +60 °C (+14 to +140 °F)

ANSI flanges, connection dimensions as per ANSI B 16.5, raised face RF



Process connection PMC71, ANSI flange with raised face RF (flush-mounted process isolating diaphragm)
Installation height H → 🖹 38.

	Flange [1]						Boltholes			
Version	**Material**	**Nominal diameter**	**Class**	**Diameter D**	**Thickness b**	**Raised face g**	**Quantity**	**Diameter g_2**	**Hole circle k**	**Flange weight [2]**
		[in]	[lb./sq.in]	[in (mm)]	[in (mm)]	[in (mm)]		[in (mm)]	[in (mm)]	[kg]
AE	AISI 316/316L [3]	1 1/2	150	5 (127)	0.69 (17.5)	2.88 (73.2)	4	0.62 (15.7)	3.88 (98.6)	1.0
AQ	AISI 316/316L [3]	1 1/2	300	6.12 (155.4)	0.81 (20.6)	2.88 (73.2)	4	0.88 (22.4)	4.5 (114.3)	2.6
AF	AISI 316/316L[3]	2	150	6 (152.4)	0.75 (19.1)	3.62 (91.9)	4	0.75 (19.1)	4.75 (120.7)	2.4
JR	ECTFE [4]	2	150	6 (152.4)	0.75 (19.1)	3.62 (91.9)	4	0.75 (19.1)	4.75 (120.7)	2.4
A3	PVDF[5]	2	150	6 (152.4)	0.75 (19.1)	3.62 (91.9)	4	0.75 (19.1)	4.75 (120.7)	0.5
AR	AISI 316/316L [3]	2	300	6.5 (165.1)	0.88 (22.4)	3.62 (91.9)	8	0.75 (19.1)	5 (127)	3.2
AG	AISI 316/316L [3]	3	150	7.5 (190.5)	0.94 (23.9)	5 (127)	4	0.75 (19.1)	6 (152.4)	4.9
JS	ECTFE [4]	3	150	7.5 (190.5)	0.94 (23.9)	5 (127)	4	0.75 (19.1)	6 (152.4)	4.9
A4	PVDF[5]	3	150	7.5 (190.5)	0.94 (23.9)	5 (127)	4	0.75 (19.1)	6 (152.4)	0.9
AS	AISI 316/316L [3]	3	300	8.25 (209.5)	1.12 (28.4)	5 (127)	8	0.88 (22.4)	6.62 (168.1)	6.8
AH	AISI 316/316L [3]	4	150	9 (228.6)	0.94 (23.9)	6.19 (157.2)	8	0.75 (19.1)	7.5 (190.5)	7.1
JT	ECTFE [4]	4	150	9 (228.6)	0.94 (23.9)	6.19 (157.2)	8	0.75 (19.1)	7.5 (190.5)	7.1
AT	AISI 316/316L [3]	4	300	10 (254)	1.25 (31.8)	6.19 (157.2)	8	0.88 (22.4)	7.88 (200.2)	11.6

1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Hastelloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

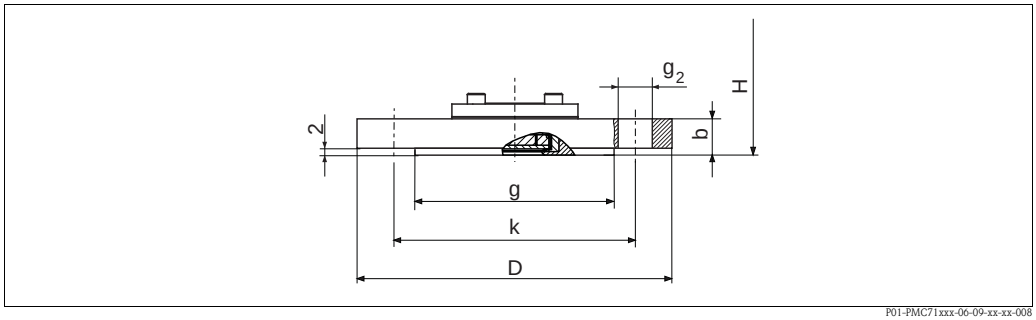
2) Housing weight → 🖹 60

3) Combination of AISI 316 for required pressure resistance and AISI 316L for required chemical resistance (dual rated)

4) ECTFE coating on AISI 316/316L. When operating in hazardous areas, avoid electrostatic charge of the plastic surfaces.

5) Max.: 15 bar (225 psi), –10 to +60 °C (+14 to +140 °F)

JIS flanges, connection dimensions as per JIS B 2220 BL, raised face RF



Process connection PMC71, JIS flange with raised face RF (flush-mounted process isolating diaphragm), material: AISI 316L (1.4435)
→ Installation height H, see table below.

	Flange [1]					Boltholes			
Version	**Nominal diameter**	**Nominal pressure**	**Diameter** **D** [mm]	**Thickness** **b** [mm]	**Raised face** **g** [mm]	**Quantity**	**Diameter** **g_2** [mm]	**Hole circle** **k** [mm]	**Flange weight [2]** [kg]
KF	50 A	10 K	155	16	96	4	19	120	2.0
KL	80 A	10 K	185	18	127	8	19	150	3.3
KH	100 A	10 K	210	18	151	8	19	175	4.4

1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Alloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

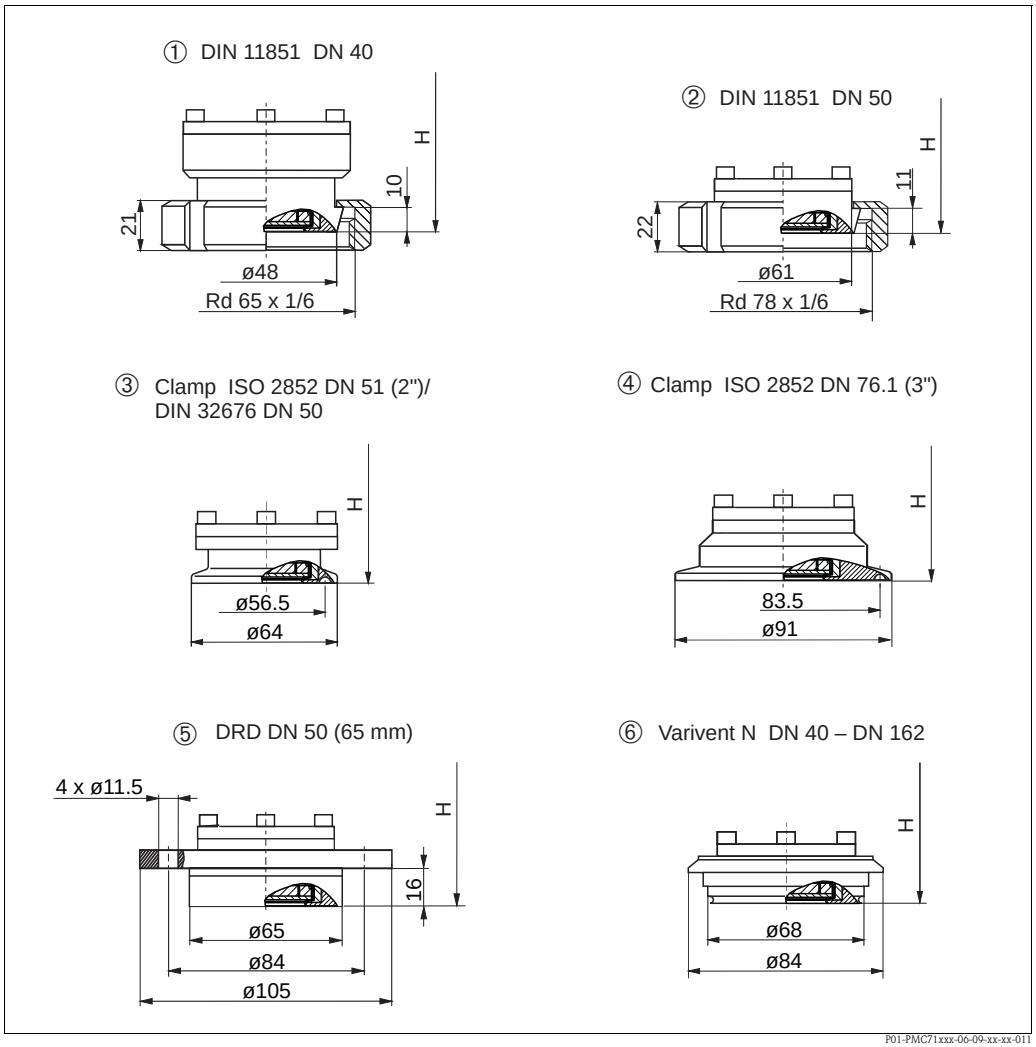
2) Housing weight see → 🗎 60

Installation height H for devices with flange

Description	T14 housing	T17 housing
PMC71	215 mm (8.46 in)	231 mm (9.09 in)
PMC71 with Ex d[ia], CSA XP or FM XP	280 mm (11 in)	296 mm (11.7 in)

Hygienic connections, flush-mounted process isolating diaphragm

Note!
Many process connections with an EPDM or HNBR seal are approved for the PMC71 in accordance with the guidelines of the 3A Sanitary Standard. To ensure that the 3A approval is valid for the PMC71 version, a 3A-approved process connection together with an EPDM or HNBR seal must be selected when ordering → 🖹 78 "Ordering information PMC71", feature 80 "Seal", version B or F.



Process connections PMC71, hygienic connections, material AISI 316L
Surface roughness of the surfaces in contact with the medium $R_a \leq 0.8\,\mu m$ (31.5 µin) as standard. Lower surface roughness on request.

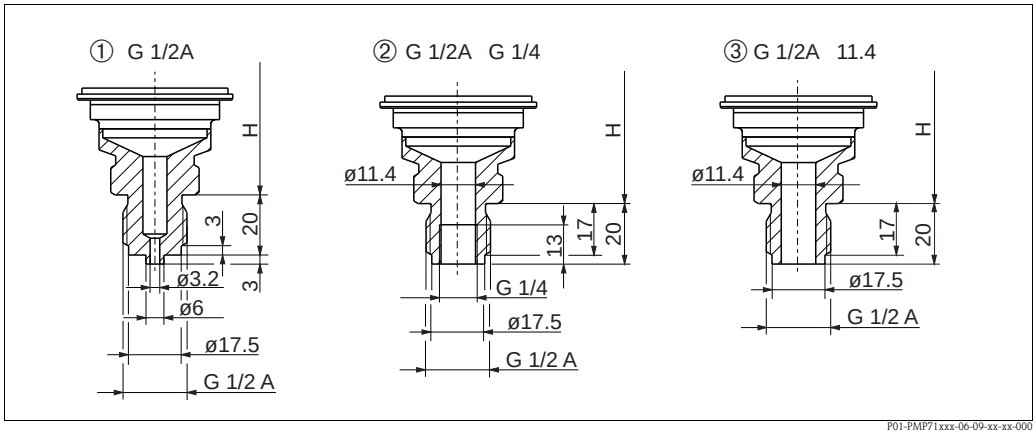
1 Version MP: DIN 11851 DN 40 PN 25, 3A with HNBR or EPDM seal
2 Version MR: DIN 11851 DN 50 PN 25, 3A with HNBR or EPDM seal
3 Version TD: Tri-Clamp ISO 2852 (2"), DIN 32675 DN 50, 3A with HNBR or EPDM seal
4 Version TF: Tri-Clamp ISO 2852 (3"), 3A with HNBR or EPDM seal
5 Version TK: DRD DN 50 (65 mm) PN 25, 3A with HNBR or EPDM seal
6 Version TR: Varivent type N for pipes 40 – 162, PN 40, 3A with HNBR or EPDM seal

Installation height H for devices with hygienic connection and flush-mounted process isolating diaphragm

Description	T14 housing	T17 housing
PMC71/PMC71 high-temperature version	215 mm (8.46 in)	231 mm (9.09 in)
PMC71/PMC71 high-temperature version: with Ex d[ia], CSA XP or FM XP	280 mm (11 in)	296 mm (11.7 in)

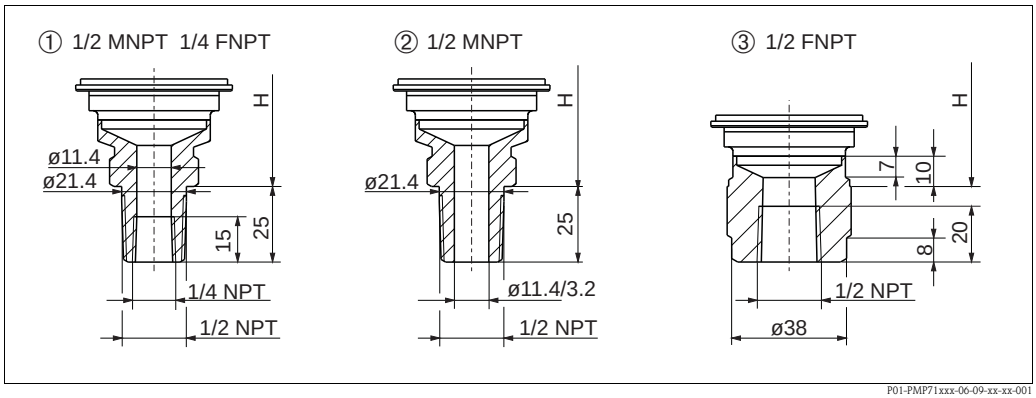
Process connections PMP71 (with metal process isolating diaphragm)

Thread, internal process isolating diaphragm



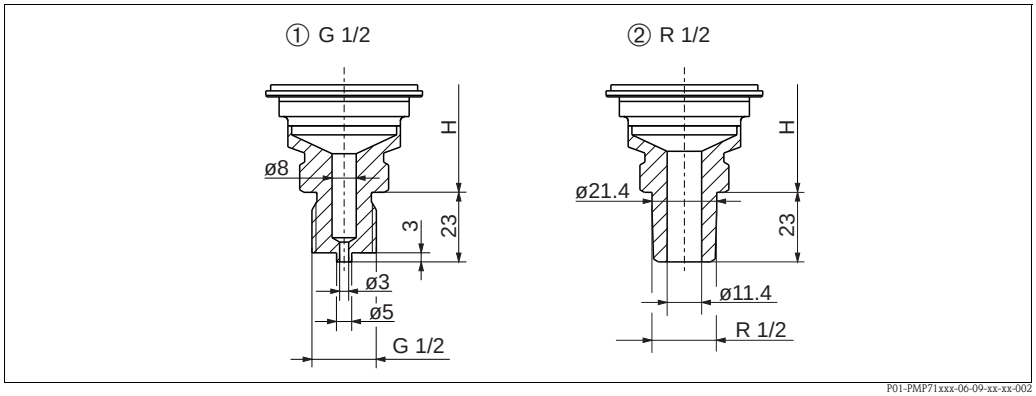
Process connections PMP71, thread ISO 228
Installation height H → 🖹 41.

1 Thread ISO 228 G 1/2 A EN 837;
Material version GA: AISI 316L, version GB: Alloy C276; weight: 0.6 kg (1.32 lbs)
2 Thread ISO 228 G 1/2 A G 1/4 (female);
Material version GE: AISI 316L, version GF: Alloy C276; weight: 0.6 kg (1.32 lbs)
3 Thread ISO 228 G 1/2 A hole 11.4 mm (0.45 in);
Material version GH: AISI 316L, version GJ: Alloy C276; weight: 0.6 kg (1.32 lbs)



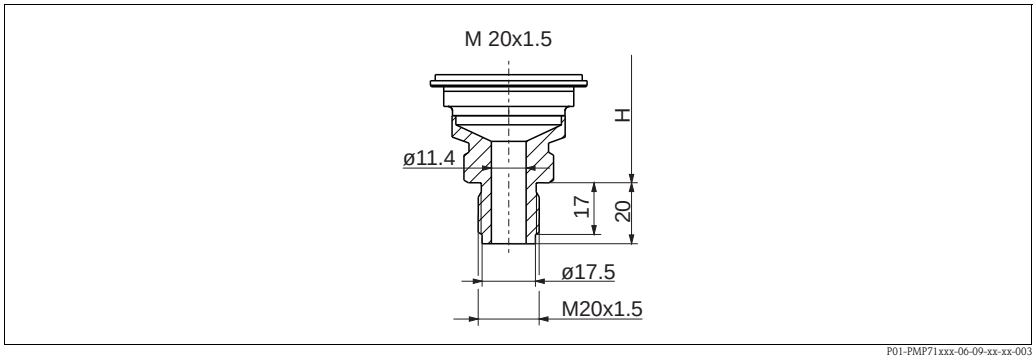
Process connections PMP71, thread ANSI
Installation height H → 🖹 41.

1 Thread ANSI 1/2 MNPT 1/4 FNPT;
Material version RA: AISI 316L, version RB: Alloy C276; weight: 0.6 kg (1.32 lbs)
2 Thread ANSI 1/2 MNPT hole: 400 bar (6000 psi) = 11.4 mm (0.45 in);
700 bar (10500 pis) = 3.2 mm (0.13 in)
Material version RD: AISI 316L, version RE: Alloy C276; weight: 0.6 kg (1.32 lbs)
3 Thread ANSI 1/2 FNPT;
Material version RH: AISI 316L, version RJ: Alloy C276; weight: 0.7 kg (1.54 lbs)



Process connections PMP71, thread JIS
→ Installation height H see table below.

1 Version GL: thread JIS B0202 G 1/2 (male), material: AISI 316L; weight: 0.6 kg (1.32 lbs)
2 Version RL: thread JIS B0203 R 1/2 (male), material: AISI 316L; weight: 0.6 kg (1.32 lbs)

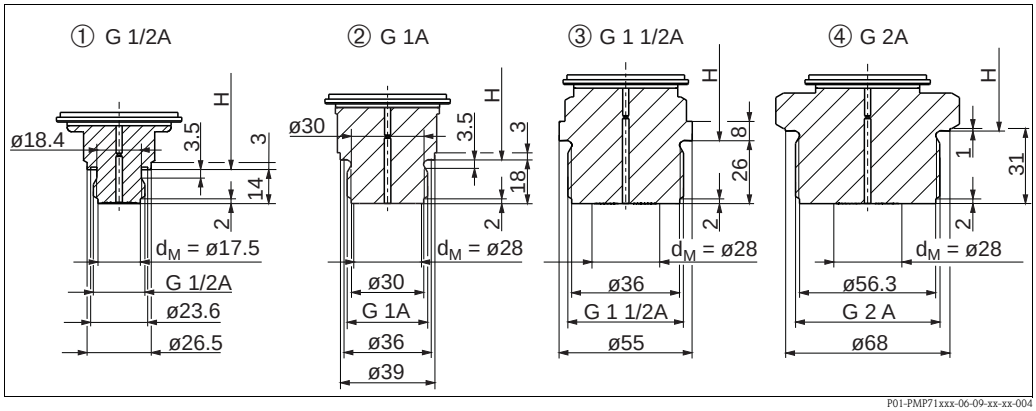


Process connections PMP71 thread DIN 13 M 20x1.5 hole 11.4 mm (0.45 in)
Material version GP: AISI 316L, version GQ: Alloy C276; weight: 0.6 kg (1.32 lbs)
→ Installation height H, see table below.

Installation height H for devices with threaded connection and internal process isolating diaphragm

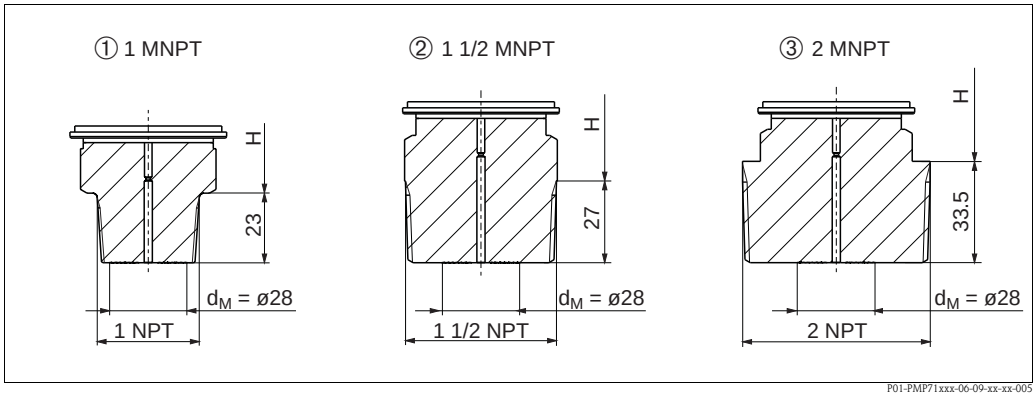
	T14 housing	**T17 housing**
Height H	165 mm (6.5 in)	181 mm (7.13 in)
	Note! The versions with a 700 bar (10500 psi) sensor are approx. 20 mm (0.79 in) higher.	

Thread, flush-mounted process isolating diaphragm



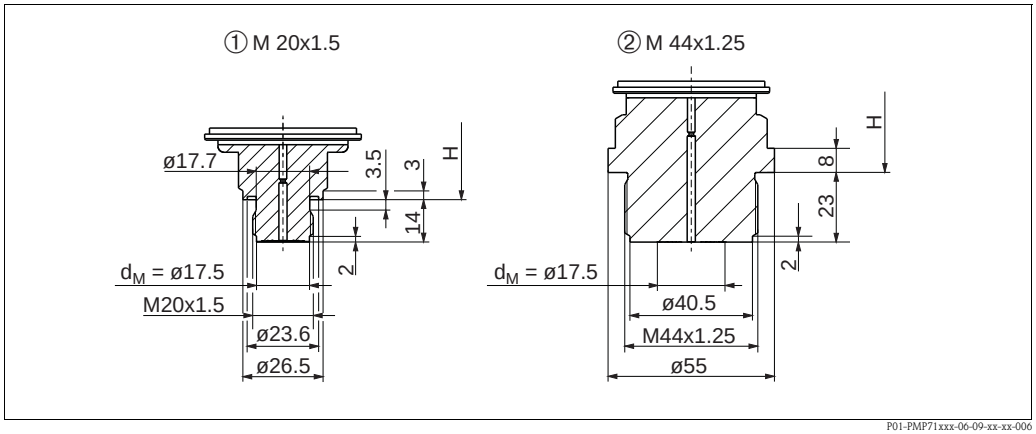
Process connections PMP71, thread ISO 228
Installation height H → 🖹 43.

1 Thread ISO 228 G 1/2 A DIN 3852 (Viton seal included);
Material version 1A: AISI 316L, version 1B: Alloy C276; weight: 0.4 kg (0.88 lbs)
2 Thread ISO 228 G 1 A;
Material version 1D: AISI 316L, version 1E: Alloy C276; weight: 0.7 kg (1.54 lbs)
3 Thread ISO 228 G 1 1/2 A
Material version 1G: AISI 316L, version 1H: Alloy C276; weight: 1.1 kg (2.43 lbs)
4 Thread ISO 228 G 2 A
Material version 1K: AISI 316L, version 1L: Alloy C276; weight: 1.5 kg (3.31 lbs)



Process connections PMP71, thread ANSI
Installation height H → 🖹 43.

1 Thread ANSI 1 MNPT;
Material version 2A: AISI 316L, version 2B: Alloy C276; weight: 0.7 kg (1.54 lbs)
2 Thread ANSI 1 1/2 MNPT;
Material version 2D: AISI 316L, version 2E: Alloy C276; weight: 1.0 kg (2.21 lbs)
3 Thread ANSI 2 MNPT
Material version 2G: AISI 316L, version 2H: Alloy C276; weight: 1.3 kg (2.87 lbs)



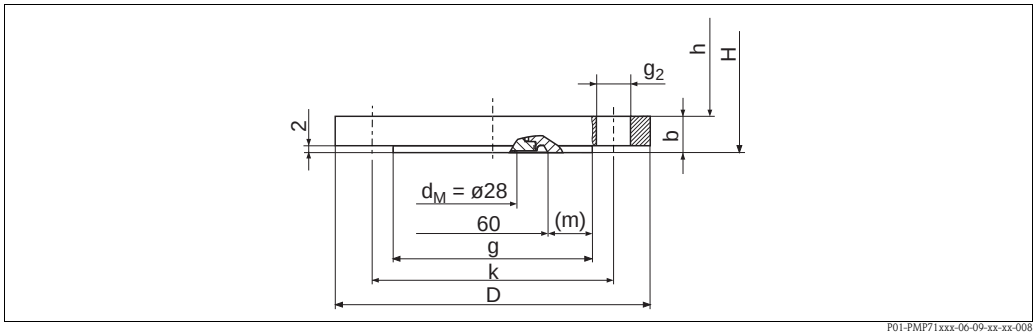
Process connections PMP71, thread DIN
→ Installation height H see table, below.

1 Thread DIN 16288 M20;
Material version 1N: AISI 316L, version 1P: Alloy C276; weight: 0.4 kg (0.88 lbs)
2 Thread DIN 13 M 44 x 1.25;
Material version 1R: AISI 316L, version 1S: Alloy C276; weight: 1.1 kg (2.43 lbs)

Installation height H for devices with threaded connection and flush-mounted process isolating diaphragm

Description	T14 housing	T17 housing
G 1/2	163 mm (6.42 in)	179 mm (7.05 in)
G 1	167 mm (6.57 in)	183 mm (7.2 in)
G 1 1/2 A	163 mm (6.42 in)	179 mm (7.05 in)
G 2 A	162 mm (6.38 in)	178 mm (7.01 in)
1 MNPT	162 mm (6.38 in)	178 mm (7.01 in)
1 1/2 MNPT	165 mm (6.5 in)	181 mm (7.13 in)
2 MNPT	159 mm (6.26 in)	175 mm (6.89 in)
M 20x1.5	163 mm (6.42 in)	179 mm (7.05 in)
M 44x1.25	170 mm (6.69 in)	186 mm (7.32 in)

EN/DIN flanges, connection dimensions as per EN 1092-1/DIN 2527



Process connection PMP71, EN/DIN flange with raised face, material AISI 316L

H: device height = height of the device without flange h + flange thickness b
Height h → 🖹 45.

	Flange [1]							Boltholes			
Version	**Nominal diameter**	**Nominal pressure**	**Shape [2]**	**Diameter D** [mm]	**Thickness b** [mm]	**Raised face g** [mm]	**Width of raised face (m)** [mm]	**Quantity**	**Diameter g_2** [mm]	**Hole circle k** [mm]	**Flange weight [3]** [kg]
CN	DN 25	PN 10-40	B1 (D)	115	18	68 [4]	4	4	14	85	1.2
CP	DN 32	PN 10-40	B1 (D)	140	18	78 [4]	9	4	18	100	1.9
CQ	DN 40	PN 10-40	B1 (D)	150	18	88 [4]	14	4	18	110	2.2
B3	DN 50	PN 10-40	B1 (D)	165	20	102	-	4	18	125	3.0
B4	DN 80	PN 10-40	B1 (D)	200	24	138	-	8	18	160	5.3

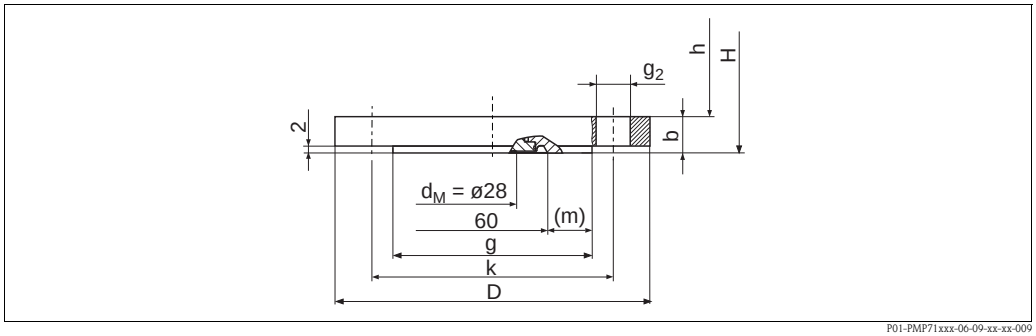
1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Alloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

2) Designation as per DIN 2527 in brackets

3) Housing weight → 🖹 60

4) With these process connections the raised face is smaller than described in the standard. Due to a smaller raised face a special seal must be used. Refer to a manufacturer of seals or your local Endress+Hauser Sales Center.

ANSI flanges, connection dimensions as per ANSI B 16.5, raised face RF
JIS flanges, connection dimensions as per B 2220 BL, raised face RF



Process connection PMP71, ANSI flange or JIS flange with raised face RF (see table below)

H: device height = height of device without flange h + flange thickness b. For the height h → 🖹 45.

	Flange [1]							Boltholes			
Version	**Material**	**Nominal diameter**	**Class/ nominal pressure**	**Diameter** **D** [in (mm)]	**Thickness** **b** [in (mm)]	**Diameter of raised face** **g** [in (mm)]	**Width of raised face** **(m)** [in (mm)]	**Quantity**	**Diameter** **g_2** [in (mm)]	**Hole circle** **k** [in (mm)]	**Flange weight [2]** [kg]
ANSI flanges											
AN	AISI 316/316L [3]	1 in	300 lb./sq.in	4.88 (124)	0.69 (17.5)	2.76 [4] (70)	0.2 (5)	4	0.75 (19.1)	3.5 (88.9)	1.3
AE	AISI 316/316L [3]	1 1/2 in	150 lb./sq.in	5 (127)	0.69 (17.5)	2.88 [4] (73.2)	0.52 (6.6)	4	0.62 (15.7)	3.88 (98.6)	1.5
AQ	AISI 316/316L [3]	1 1/2 in	300 lb./sq.in	6.12 (155.4)	0.81 (20.6)	2.88 [4] (73.2)	0.52 (6.6)	4	0.88 (22.4)	4.5 (114.3)	2.6
AF	AISI 316/316L [3]	2 in	150 lb./sq.in	6 (152.4)	0.75 (19.1)	3.62 (91.9)	-	4	0.75 (19.1)	4.75 (120.7)	2.4
AR	AISI 316/316L [3]	2 in	300 lb./sq.in	7.5 (190.5)	0.88 (22.3)	3.62 (91.9)	-	8	0.75 (19.1)	5 (127)	3.2
AG	AISI 316/316L [3]	3 in	150 lb./sq.in	7.5 (190.5)	0.94 (23.9)	5 (127)	-	4	0.75 (19.1)	6 (152.4)	4.9
AS	AISI 316/316L [3]	3 in	300 lb./sq.in	8.25 (209.5)	1.12 (28.4)	5 (127)	-	8	0.88 (22.4)	6.62 (168.1)	6.7
AH	AISI 316/316L [3]	4 in	150 lb./sq.in	9 (228.6)	0.94 (23.9)	6.19 (157.2)	-	8	0.75 (19.1)	7.5 (190.5)	7.1
AT	AISI 316/316L [3]	4 in	300 lb./sq.in	10 (254)	1.25 (31.8)	6.19 (157.2)	-	8	0.88 (22.4)	7.88 (200.2)	11.6
JIS flanges											
KA	AISI 316L	25 A	20 K	*125*	*16*	67 [4]	0.14 (3.5)	4	*19*	*90*	1.5
KF	AISI 316L	50 A	10 K	*155*	*16*	*96*	-	4	*19*	*120*	2.0
KL	AISI 316L	80 A	10 K	*185*	*18*	*127*	-	8	*19*	*150*	3.3
KH	AISI 316L	100 A	10 K	*210*	*18*	*151*	-	8	*19*	*175*	4.4

1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Alloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

2) Housing weight → 🖹 60

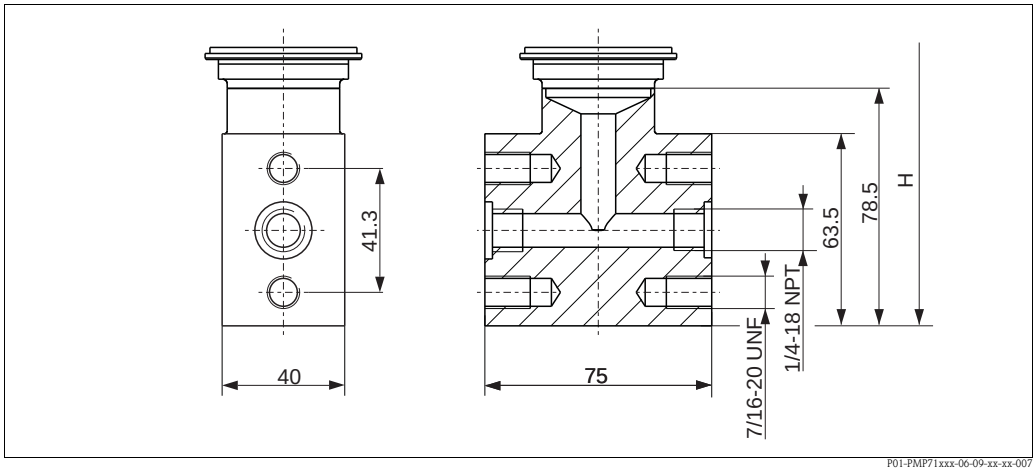
3) Combination of AISI 316 for required pressure resistance and AISI 316L for required chemical resistance (dual rated)

4) With these process connections the raised face is smaller than described in the standard. Due to a smaller raised face a special seal must be used. Refer to a manufacturer of seals or your local Endress+Hauser Sales Center.

Height h for devices with flange

	T14 housing	**T17 housing**
Height h	165 mm (6.5 in)	181 mm (7.13 in)

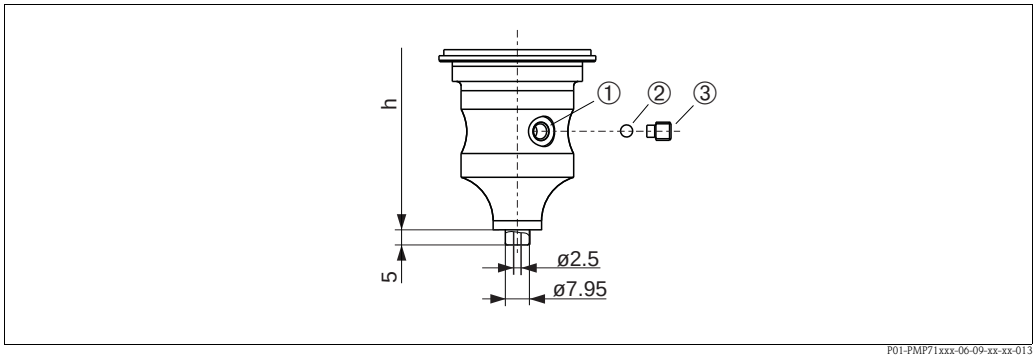
Oval flange



Version UR: oval flange adapter 1/4-18 NPT as per IEC 61518, material 316L (1.4404), mounting: 7/16-20 UNF; Weight: 1.9 kg (4.19 lbs)

	T14 housing	**T17 housing**
Height H	199 mm (7.83 in)	215 mm (8.46 in)

Prepared for diaphragm seal mount

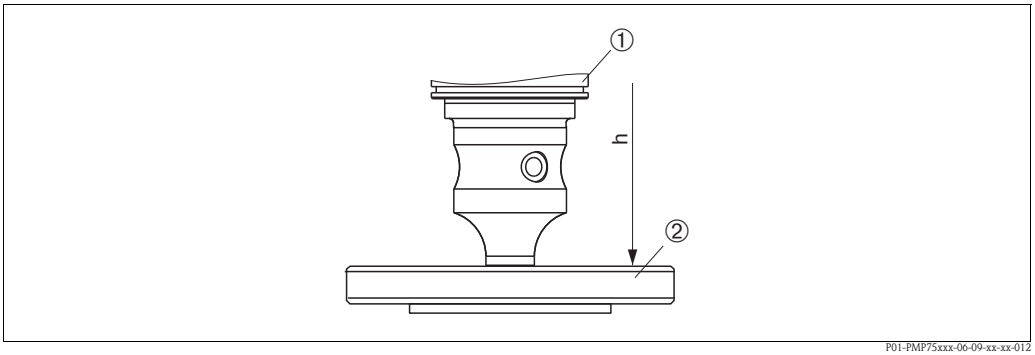


Version U1: material AISI 316L (1.4404), prepared for diaphragm seal mount

1 Hole for filling fluid
2 Bearing DIN 5401 (1.3505)
3 Setscrew with hexagonal recess 4 mm (0.16 in), material A2-70

	T14 housing	**T17 housing**
Height h	190 mm (7.48 in)	204 mm (8.03 in)

PMP75 basic device



PMP75 basic device with diaphragm seal

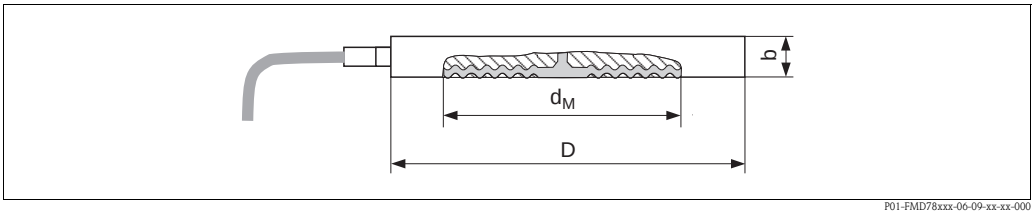
1 PMP75 basic device
2 Diaphragm seal, here e.g. flange diaphragm seal

	T14 housing	T17 housing
Height h	190 mm (7.48 in)	204 mm (8.03 in)

Process connections PMP75 (with diaphragm seal)

Note!
- The weights of the diaphragm seals are given in the tables. See → 60 for the weight of the housing.
- The following drawings are drawings that illustrate how the system works in principle. In other words, the dimensions of a diaphragm seal supplied can deviate from the dimensions given in this document.
- With the use of high-temperature oils the design can deviate strongly.
- Observe the information in the "Planning instructions, diaphragm seal systems" section → 70 ff.
- For further information please contact your local Endress+Hauser Sales Center.

Diaphragm seal cell structure

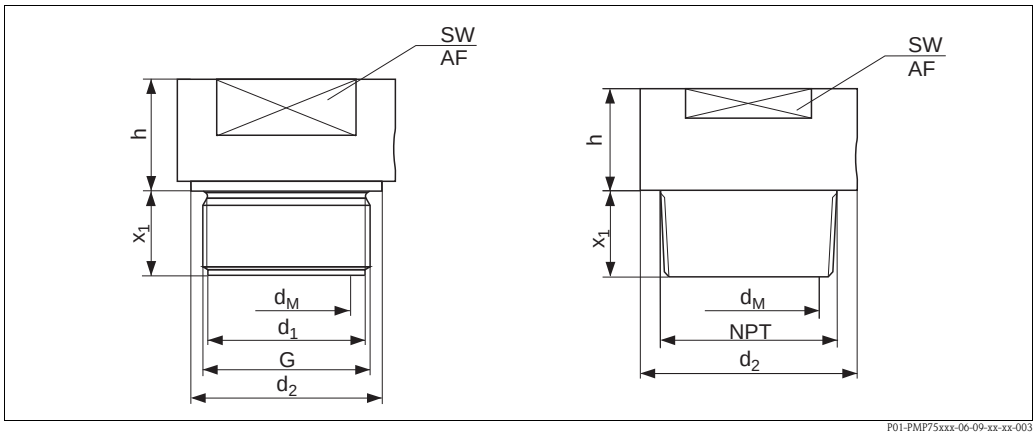


Process connection PMP75, material AISI 316L

	Flange				Diaphragm seal	
Version	**Nominal diameter**	**Nominal pressure** [1]	**Max. diameter D** [mm]	**Thickness b** [mm]	**Max. diameter of the process isolating diaphragm d_M** [mm]	**Weight of two diaphragm seals** [kg]
UI	DN 50	PN 16-400	102	20	59	2.6
UJ	DN 80	PN 16-400	138	20	89	4.6
UK	DN 100	PN 16-400	162	20	89	6.2
	[in]	[lb/sq.in]	[in (mm)]	[in (mm)]	[in (mm)]	[kg]
UL	2	150-2500	4.01 (102)	0.79 (20)	2.32 (59)	2.6
UM	3	150-2500	5.35 (136)	0.79 (20)	3.50 (89)	4.6
UR	4	150-2500	6.22 (158)	0.79 (20)	3.50 (89)	6.2

1) The specified nominal pressure applies to the diaphragm seal. The maximum pressure for the measuring device is dependent on the lowest-rated element, with regard to pressure, of the selected components. See also → 31, "Pressure specifications" section.

Thread, flush-mounted process isolating diaphragm

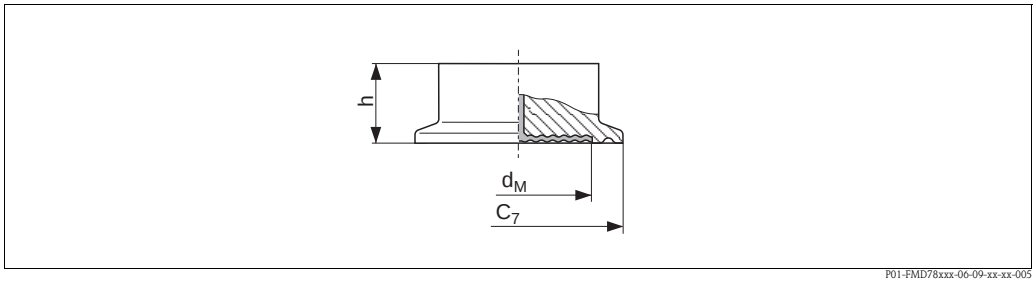


Process connections PMP75, left: thread ISO 228, right: thread ANSI

Threaded connections								Diaphragm seal		
Version	**Material**	**Thread**	**Nominal pressure**	**Diameter**	**Diameter**	**Screw-in length**	**Across flats**	**Max. diameter of the process isolating diaphragm**	**Height**	**Diaphragm seal weight**
			PN	**d_1**	**d_2**	**x_1**	**SW/AF**	**d_M**	**h**	
				[mm]	[mm]	[mm]		[mm]	[mm]	[kg]
1D	AISI 316L	G 1 A	400	30	39	21 [1]	41	30	19	0.4
1E	Alloy C276									0.5
1G	AISI 316L	G 1 1/2 A	400	44	55	30	50	42	20	0.9
1H	Alloy C276									1.0
1K	AISI 316L	G 2	400	56	68	30	65	50	20	1.9
1L	Alloy C276									2.1
2A	AISI 316L	1 MNPT	400	–	48	28	41	24	37	0.6
2B	Alloy C276									0.7
2D	AISI 316L	1 1/2 MNPT	400	–	60	30	41	36	20	0.9
2E	Alloy C276									1.0
2G	AISI 316L	2 MNPT	400	–	78	30	65	38	35	1.8
2H	Alloy C276									2.0

1) 28 mm (1.1 in) in conjunction with high-temperature oil

Tri-Clamp ISO 2852

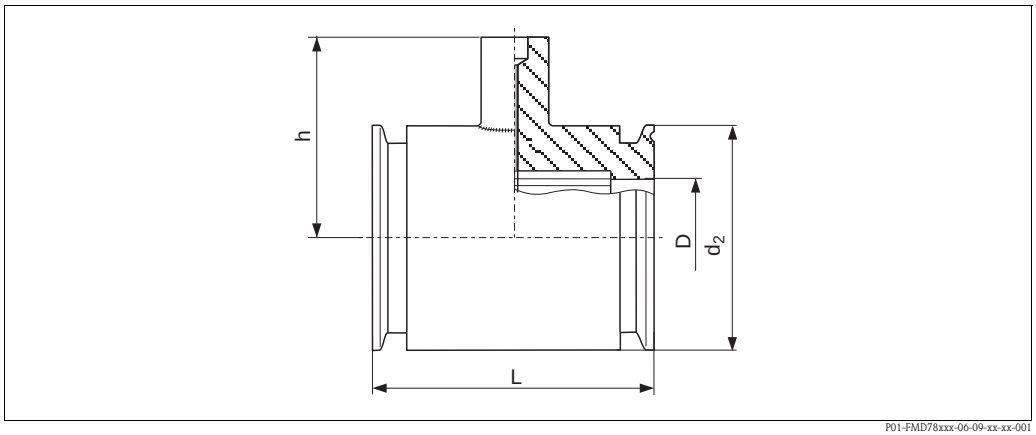


Process connection PMP75, material: AISI 316L, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard.

Version	Nominal diameter ISO 2852	Nominal diameter DIN 32676	Nominal diameter [in]	Diameter C_7 [mm]	Max. diameter of the process isolating diaphragm d_M [mm]	Height h [mm]	Diaphragm seal weight [kg]
TB	DN 25	DN 25	1	50.5	24	37	0.32
TC[1]	DN 38	DN 40	1 1/2	50.5	34	30	1.0
TD [1]	DN 51	DN 50	2	64	48	30	1.1
TF	DN 76.1	–	3	91	73	30	1.2

1) Diaphragm seal versions optionally in conformity with ASME-BPE for use in biochemical processes, wetted surfaces $R_a \leq 0.38$ µm, electropolished; to be ordered using feature 110 "Additional option", version "P" in the order code.

Tri-Clamp pipe diaphragm seal ISO 2852

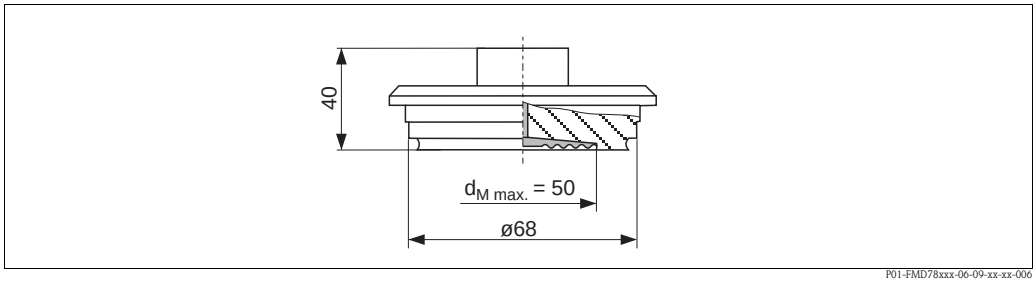


Process connection PMP75, material AISI 316L, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard. Lower surface roughness on request.

Version	Nominal diameter ISO 2852	Nominal diameter	Diameter D [in]	Diameter d_2 [mm]	Height h [mm]	Face-to-face length L [mm]	Diaphragm seal weight [kg]
SB	DN 25	1	22.5	50.5	67	126	1.7
SC[1]	DN 38	1 1/2	35.5	50.5	67	126	1.0
SD [1]	DN 51	2	48.6	64	79	100	1.7

1) Including 3.1 and pressure test as per Pressure Equipment Directive, category II

Varivent N for pipes DN 40 – DN 162

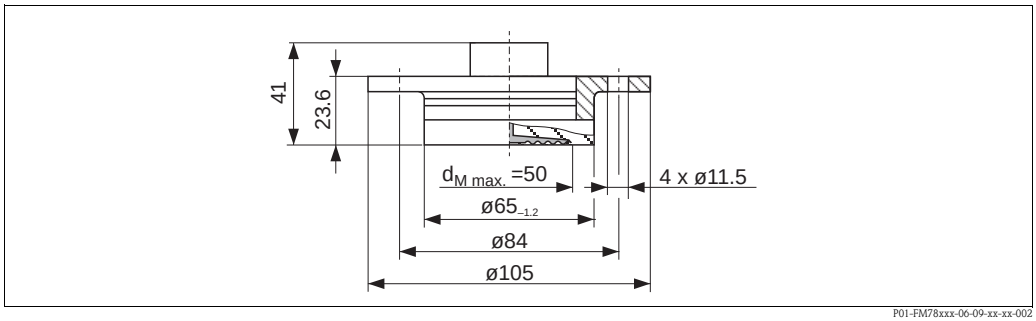


Process connection PMP75, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard.

Version	Material	Nominal pressure	Diaphragm seal weight [kg]
TR [1]	AISI 316L	PN 40	1.3

1) Diaphragm seal versions optionally in conformity with ASME-BPE for use in biochemical processes, wetted surfaces $R_a \leq 0.38$ µm (15 µin), electropolished; to be ordered using feature 110 "Additional option", version "P" in the order code.

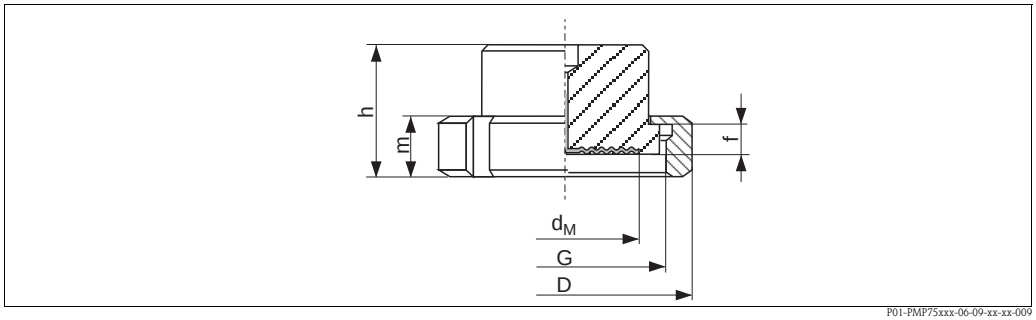
DRD DN50 (65 mm)



Process connection PMP75, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard. Lower surface roughness on request.

Version	Material	Nominal pressure	Diaphragm seal weight [kg]
TK	AISI 316L	PN 25	0.75

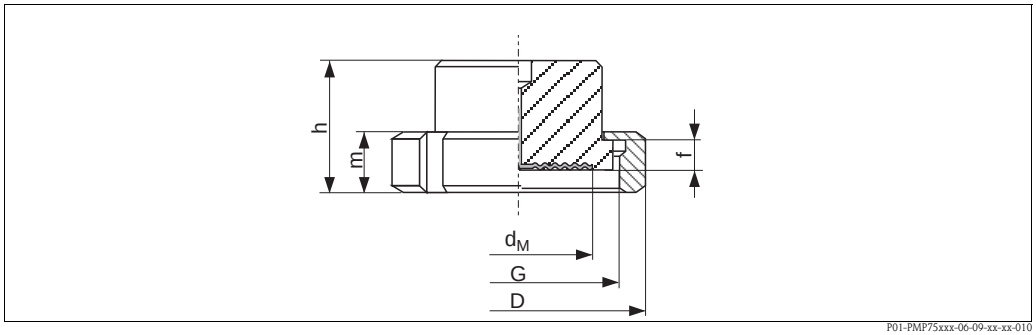
SMS nozzles with coupling nut



Process connection PMP75, material AISI 316L, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard. Lower surface roughness on request.

Version	Nominal diameter	Nominal pressure	Diameter	Adapter height	Thread	Height	Height	Max. diameter of the process isolating diaphragm	Diaphragm seal weight
			D	f	G	m	h	d_M	
	[inch]	[bar]	[mm]	[mm]		[mm]	[mm]	[mm]	[kg]
TG	1	PN 25	54	3.5	Rd 40 – 1/6	20	42.5	24	0.25
TH	1 1/2	PN 25	74	4	Rd 60 – 1/6	25	57	36	0.65
TI	2	PN 25	84	4	Rd 70 – 1/6	26	62	48	1.05

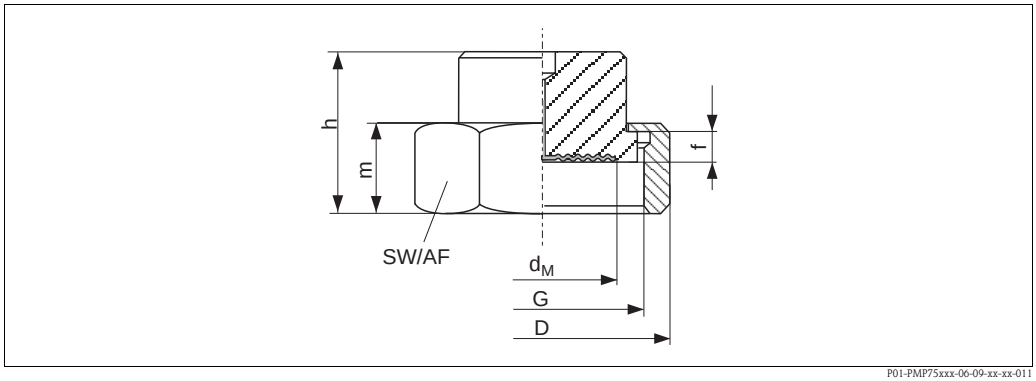
APV-RJT nozzles with coupling nut



Process connection PMP75, material AISI 316L, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard. Lower surface roughness on request.

Version	Nominal diameter	Nominal pressure	Diameter	Adapter height	Thread	Height	Height	Max. diameter of the process isolating diaphragm	Diaphragm seal weight
		PN	D	f	G	m	h	d_M	
	[inch]	[bar]	[mm]	[mm]		[mm]	[mm]	[mm]	[kg]
TL	1	PN 40	77	6.5	1 13/16 – 1/8"	22	42.6	21	0.45
TM	1 1/2	PN 40	72	6.4	2 5/16 – 1/8"	22	42.6	28	0.75
TN	2	PN 40	86	6.4	2 7/8 – 1/8"	22	42.6	38	1.2

APV-ISS nozzles with coupling nut

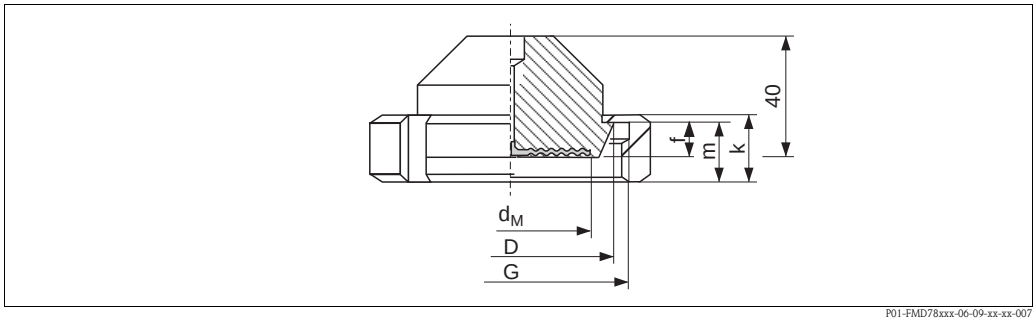


P01-PMP75xxx-06-09-xx-xx-011

Process connection PMP75, material AISI 316L, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8\ \mu m$ (31.5 µin) as standard. Lower surface roughness on request.

Version	Nominal diameter	Nominal pressure	Diameter	Adapter height	Thread	Height	Across flats	Height	Max. diameter of the process isolating diaphragm	Diaphragm seal weight
			D	f	G	m	AF	h	d_M	
	[inch]	[bar]	[mm]	[mm]		[mm]		[mm]	[mm]	[kg]
TP	1	PN 40	54.1	4	1 1/2" – 1/8"	30	46.8	50	24	0.4
TQ	1 1/2	PN 40	72	4	2" – 1/8"	30	62	50	34	0.6
TS	2	PN 40	89	4	2 1/2" – 1/8"	30	77	50	45	1.1

Taper adapter with coupling nut, DIN 11851

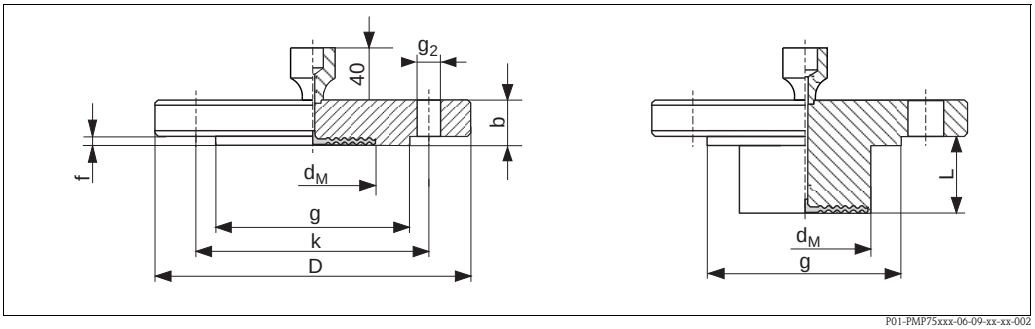


P01-FMD78xxx-06-09-xx-xx-007

Process connection PMP75, material AISI 316L, surface roughness of the surfaces in contact with the medium $R_a \leq 0.8\ \mu m$ (31.5 µin) as standard. Lower surface roughness on request.

	Taper adapter				Slotted nut			Diaphragm seal	
Version	Nominal diameter	Nominal pressure	Diameter	Adapter height	Thread	Height	Height	Max. diameter of the process isolating diaphragm	Diaphragm seal weight
			D	f	G	k	m	d_M	
			[mm]	[mm]		[mm]	[mm]	[mm]	[kg]
MR	DN 50	PN 25	68.5	11	Rd 78 x 1/6"	22	19	52	1.1
MS	DN 65	PN 25	86	12	Rd 95 x 1/6"	35	21	66	2.0
MT	DN 80	PN 25	100	12	Rd 110 x 1/4"	30	26	81	2.55

EN/DIN flanges, connection dimensions as per EN 1092-1/DIN 2527 and DIN 2501-1



Process connection PMP75, EN/DIN flange with flush-mounted process isolating diaphragm, material AISI 316L

	Flange [1]							Boltholes			Diaphragm seal	
Version	Nominal diameter	Nominal pressure	Shape[2]	Diameter D [mm]	Thickness b [mm]	Raised face g [mm]	Raised face f [mm]	Quantity	Diameter g_2 [mm]	Hole circle k [mm]	Max. diameter of the process isolating diaphragm d_M [mm]	Diaphragm seal weight [kg]
CN	DN 25	PN 10-40	B1 (D)	115	18	68	3	4	14	85	32	2.1
DN	DN 25	PN 63-160	E	140	24	68	2	4	18	100	28	2.5
EN	DN 25	PN 250	E	150	28	68	2	4	22	105	28	3.7
E1	DN 25	PN 400	E	180	38	68	2	4	26	130	28	7.0
CP	DN 32	PN 10-40	B1 (D)	140	18	77	2.6	4	18	100	34	1.9
CQ	DN 40	PN 10-40	B1 (D)	150	18	87	2.6	4	18	110	48	2.2
B3	DN 50	PN 10-40	B1 (D)	165	20	102	3	4	18	125	59	3.0
C3	DN 50	PN 63	B2 (E)	180	26	102	3	4	22	135	59	4.6
EF	DN 50	PN 100-160	E	195	30	102	3	4	26	145	59	6.2
ER	DN 50	PN 250	E	200	38	102	3	8	26	150	59	7.7
E3	DN 50	PN 400	E	235	52	102	3	8	30	180	59	14.7
B4	DN 80	PN 10-40	B1 (D)	200	24	138	3.5	8	18	160	89	5.3
C4	DN 80	PN 100	B2 (E)	230	32	138	4	8	24	180	89	8.9
C5	DN 100	PN 100	B2 (E)	265	36	175	5	8	30	210	89	13.7
D3 [3]	DN 50	PN 10-40	B1 (D)	165	20	102	3	4	18	125	47	[3]
D4 [3]	DN 80	PN 10-40	B1 (D)	200	24	138	3.5	8	18	160	72	[3]

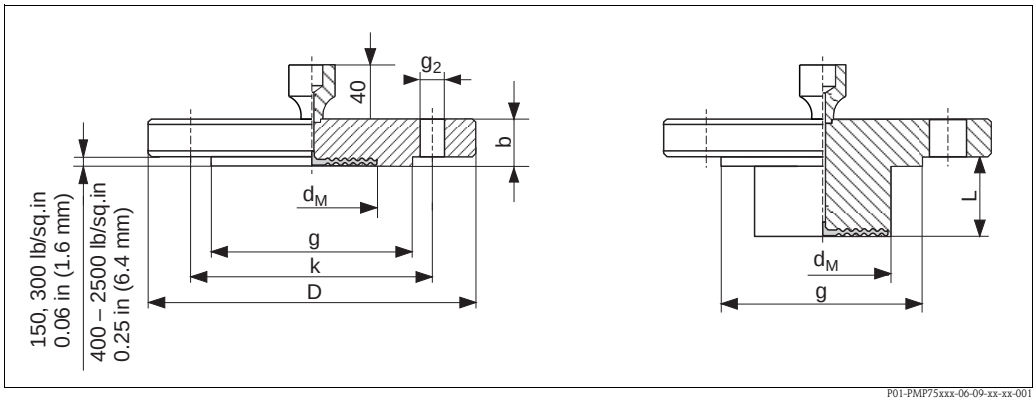
1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Hastelloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

2) Designation as per DIN 2527 in brackets

3) Available with 50 mm (1.97 in), 100 mm (3.94 in) and 200 mm (7.87 in) extended diaphragm seal, for extended diaphragm seal diameter and weight see the following table

Version	Nominal diameter	Nominal pressure	Extended diaphragm seal length [mm]	Extended diaphragm seal diameter d_3 [mm]	Diaphragm seal weight [kg]
D3	DN 50	PN 10-40	50 / 100 / 200	48.3	3.2 / 3.8 / 4.4
D4	DN 80	PN 10-40	50 /100 / 200	76	6.2 / 6.7 / 7.8

ANSI flanges, connection dimensions as per ANSI B 16.5, raised face RF



Process connection PMP75, ANSI flange with and without extended diaphragm seal

	Flange [1]						Boltholes			Diaphragm seal	
Version	**Material[2]**	**Nominal diameter**	**Class**	**Diameter** **D**	**Thickness** **b**	**Raised face** **g**	**Quantity**	**Diameter** **g_2**	**Hole circle** **k**	**Max. diameter of the process isolating diaphragm** **d_M**	**Diaphragm seal weight**
		[in]	[lb./sq.in]	[in (mm)]	[in (mm)]	[in (mm)]		[in (mm)]	[in (mm)]	[in (mm)]	[kg]
AC	AISI 316/316L	1	150	4.25 (108)	0.56 (14.2)	2 (50.8)	4	0.62 (15.7)	3.12 (79.2)	1.26 (32)	1.2
AN	AISI 316/316L	1	300	4.88 (124)	0.69 (17.5)	2.76 (70)	4	0.75 (19.1)	3.5 (88.9)	1.26 (32)	1.3
HC	AISI 316/316L	1	400/600	4.88 (124)	0.69 (17.5)	2 (50.8)	4	0.75 (19.1)	3.5 (88.9)	1.26 (32)	1.4
HN	AISI 316/316L	1	900/1500	5.88 (149.4)	1.12 (28.4)	2 (50.8)	4	1 (25.4)	4 (101.6)	1.26 (32)	3.2
HO	AISI 316/316L	1	2500	6.25 (158.8)	1.38 (35.1)	2 (50.8)	4	1 (25.4)	4.25 (108)	1.26 (32)	4.6
AE	AISI 316/316L	1 1/2	150	5 (127)	0.69 (17.5)	2.88 (73.2)	4	0.62 (15.7)	3.88 (96.6)	1.89 (48)	1.5
AQ	AISI 316/316L	1 1/2	300	6.12 (155.4)	0.81 (20.6)	2.88 (73.2)	4	0.88 (22.4)	4.5 (114.3)	1.89 (48)	2.6
AF	AISI 316/316L	2	150	6 (152.4)	0.75 (19.1)	3.62 (91.9)	4	0.75 (19.1)	4.75 (120.7)	2.32 (59)	2.2
J3 [3]	AISI 316/316L	2	150	6 (152.4)	0.75 (19.1)	3.62 (91.9)	4	0.75 (19.1)	4.75 (120.7)	1.85 (47)	[3]
AR	AISI 316/316L	2	300	6.5 (165.1)	0.88 (22.4)	3.62 (91.9)	8	0.75 (19.1)	5 (127)	2.32 (59)	3.4
HF	AISI 316/316L	2	400/600	6.5 (165.1)	1 (25.4)	3.62 (91.9)	8	0.75 (19.1)	5 (127)	2.32 (59)	4.3
HR	AISI 316/316L	2	900/1500	8.5 (215.9)	1.5 (38.1)	3.62 (91.9)	8	1 (25.4)	6.5 (165.1)	2.32 (59)	10.3
H3	AISI 316/316L	2	2500	9.25 (235)	2 (50.8)	3.62 (91.9)	8	1.12 (28.4)	6.75 (171.5)	2.32 (59)	15.8
AG	AISI 316/316L	3	150	7.5 (190.5)	0.94 (23.9)	5 (127)	4	0.75 (19.1)	6 (152.4)	3.50 (89)	5.1
AS	AISI 316/316L	3	300	8.25 (209.5)	1.12 (28.4)	5 (127)	8	0.75 (19.1)	6 (152.4)	3.50 (89)	7.0
J4[3]	AISI 316/316L	3	150	7.5 (190.5)	0.94 (23.9)	5 (127)	4	0.75 (19.1)	6 (152.4)	2.83 (72)	[3]
J7 [3]	AISI 316/316L	3	300	8.25 (209.5)	1.12 (28.4)	5 (127)	8	0.88 (22.4)	6.62 (168.1)	2.83 (72)	[3]
AH	AISI 316/316L	4	150	9 (228.6)	0.94 (23.9)	6.19 (157.2)	8	0.75 (19.1)	7.5 (190.5)	3.50 (89)	7.2
AT	AISI 316/316L	4	300	10 (254)	1.25 (31.8)	6.19 (157.2)	8	0.88 (22.4)	7.88 (200.2)	3.50 (89)	11.7
J5[3]	AISI 316/316L	4	150	9 (228.6)	0.94 (23.9)	6.19 (157.2)	8	0.75 (19.1)	7.5 (190.5)	3.50 (89)	[3]
J8 [3]	AISI 316/316L	4	300	10 (254)	1.25 (31.8)	6.19 (157.2)	8	0.88 (22.4)	7.88 (200.2)	3.50 (89)	[3]

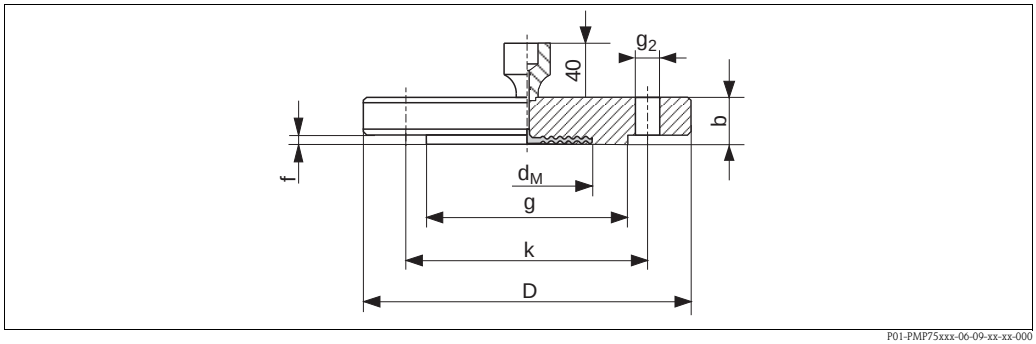
1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Alloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

2) Combination of AISI 316 for required pressure resistance and AISI 316L for required chemical resistance (dual rated)

3) xxAvailable with 2", 4", 6" or 8" extended diaphragm seal, for extended diaphragm seal diameter and weight see the following table

Version	**Nominal diameter** [in]	**Class** [lb./sq.in]	**Extended diaphragm seal length (L)** [in (mm)]	**Extended diaphragm seal diameter d_3** [in (mm)]	**Diaphragm seal weight** [kg]
J3	2	150	2 (50.8)	1.9 (48.3)	3.0
			4 (101.6)		3.4
			6 (152.4)		3.9
			8 (203.2)		4.4
J4	3	150	2 (50.8)	2.99 (75.9)	6.0
			4 (101.6)		6.6
			6 (152.4)		7.1
			8 (203.2)		7.8
J7	3	300	2 (50.8)	2.99 (75.9)	7.9
			4 (101.6)		8.5
			6 (152.4)		9.0
			8 (203.2)		9.6
J5	4	150	2 (50.8)	3.7 (94)	8.6
			4 (101.6)		9.9
			6 (152.4)		11.2
			8 (203.2)		12.4
J8	4	300	2 (50.8)	3.7 (94)	13.1
			4 (101.6)		14.4
			6 (152.4)		15.7
			8 (203.2)		16.9

JIS flanges, connection dimensions as per JIS B 2220 BL, raised face RF



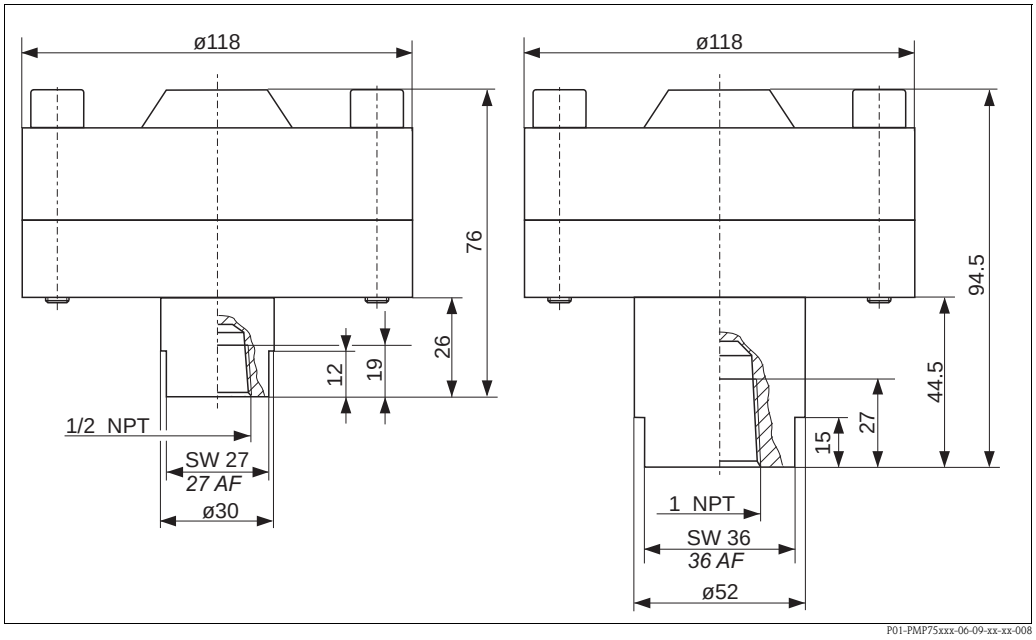
Process connection PMP75, JIS flange with raised face RF, material AISI 316L

	Flange [1]						Boltholes			Diaphragm seal	
Version	**Nominal diameter**	**Nominal pressure**	**Diameter** **D** [mm]	**Thickness** **b** [mm]	**Diameter raised face** **g** [mm]	**Raised face height** **f** [mm]	**Quantity**	**Diameter** g_2 [mm]	**Hole circle** **k** [mm]	**Max. diameter of the process isolating diaphragm** d_M [mm]	**Diaphragm seal weight** [2] [kg]
KC	25 A	10 K	125	14	67	1	4	19	90	32	1.5
KF	50 A	10 K	155	16	96	2	4	19	120	59	2.3
KL	80 A	10 K	185	18	127	2	8	19	150	89	3.3
KH	100 A	10 K	210	18	151	2	8	19	175	89	4.4

1) The roughness of the surface in contact with the medium, including the raised face of the flanges (all standards) made of Alloy C, Monel or tantalum, is Ra 0.8 µm (31.5 µin). Lower surface roughness on request.

2) Housing weight → 🖹 60

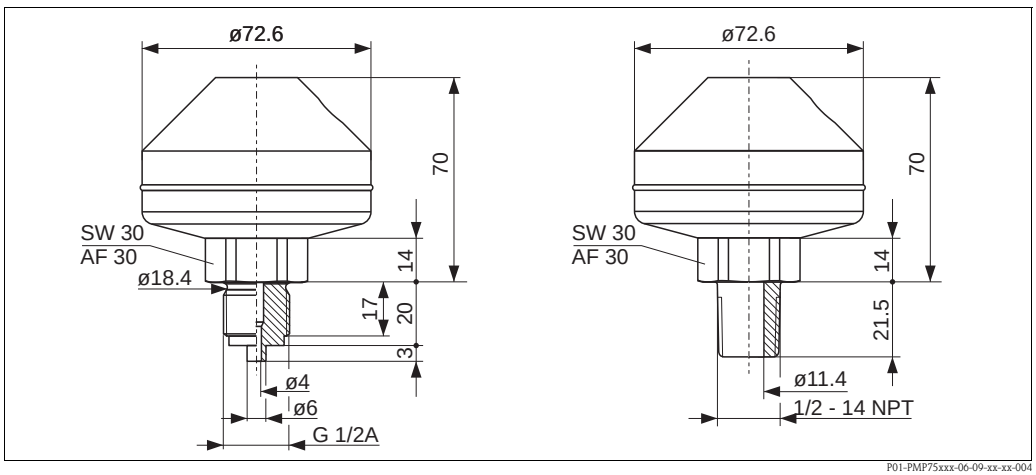
Thread 1/2 NPT and 1 NPT, separator



Process connection PMP75, versions "UG" and "UH", threaded, material AISI 316L, seal Viton

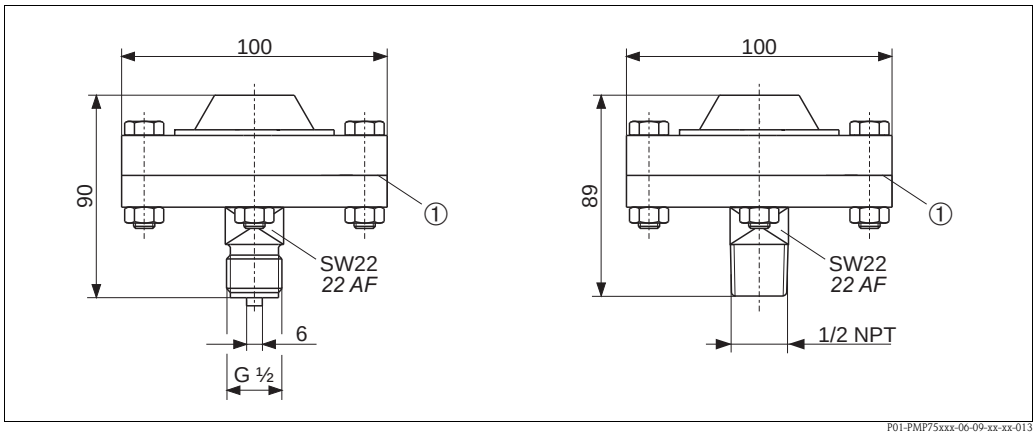
Version	Description	Nominal pressure	Diaphragm seal weight [kg]
UG	1/2 NPT	PN 250	4.75
UH	1 NPT	PN 250	5.0

Thread ISO 228 G 1/2 A and ANSI 1/2 MNPT, separator



Process connection PMP75, versions "UA" and "UB", welded, material AISI 316L

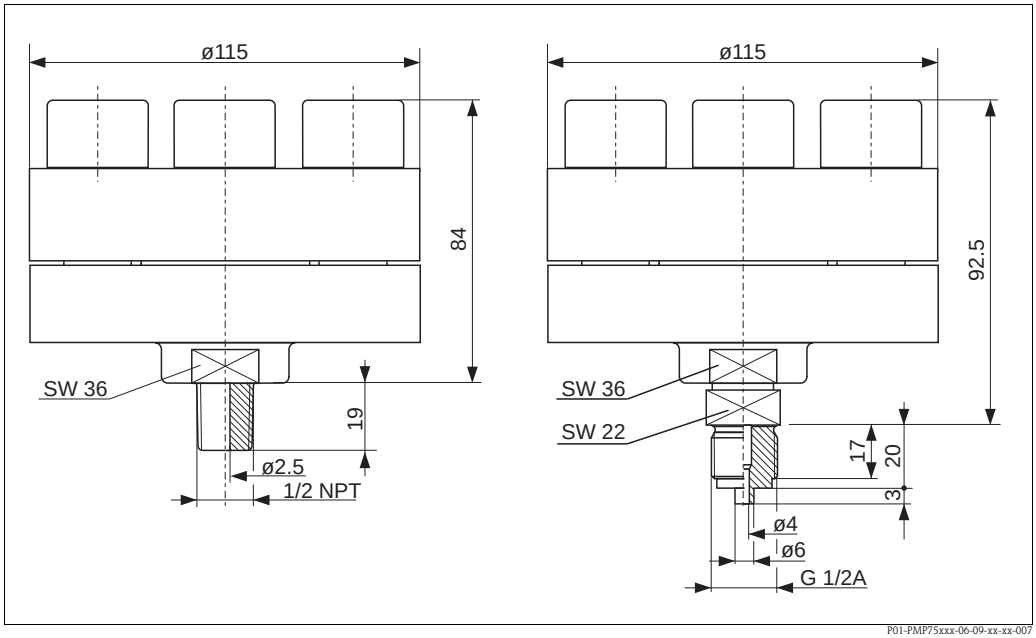
Version	Description	Nominal pressure	Diaphragm seal weight [kg]
UA	ISO 228 G 1/2 A	PN 160	1.43
UB	ANSI 1/2 MNPT	PN 160	1.43



Process connection PMP75, left: version "UC" with threaded connection ISO 228 G 1/2 B, right: version "UD" with threaded connection ANSI 1/2 MNPT
Materials: AISI 316L (1.44.04), screws made of 1.4571

1 PTFE seal as standard max. 260 °C (500 °F) (higher temperatures on request)

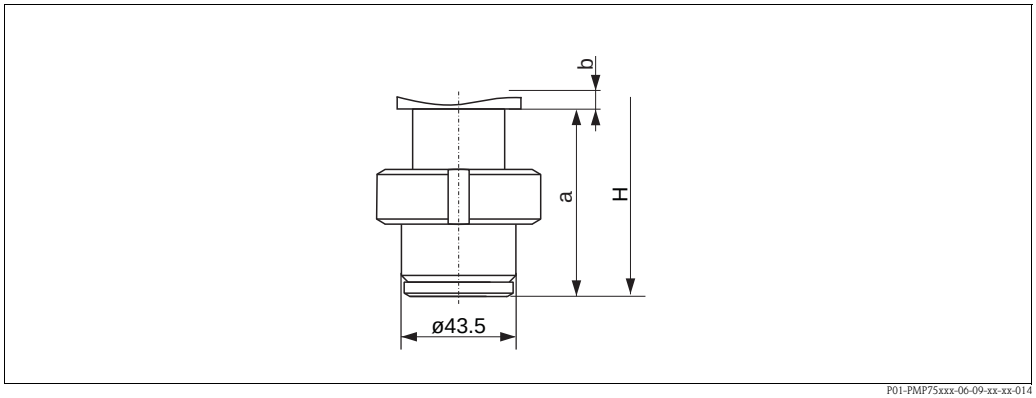
Version	Measuring range	Description	Nominal pressure	Diaphragm seal weight [kg]
UC	≤ 40 bar	ISO 228 G 1/2 B	PN 40	1.43
UD	≤ 40 bar	ANSI 1/2 MNPT	PN 40	1.43



Process connection PMP75, versions "UC" and "UD", threaded, with integrated sealing lip
Materials: AISI 316L (1.44.04), screws made of 1.4571

Version	Measuring range	Description	Nominal pressure	Diaphragm seal weight [kg]
UC	> 40 bar	ISO 228 G 1/2 A	PN 400	4.75
UD	> 40 bar	ANSI 1/2 MNPT	PN 400	4.75

Universal process adapter



Process connection PMP75, material: b = top section AISI 316L (1.4404), a = bottom section AISI 316L (1.4435); Surface roughness of the surfaces in contact with the medium $R_a \leq 0.8$ µm (31.5 µin) as standard. Lower surface roughness on request.

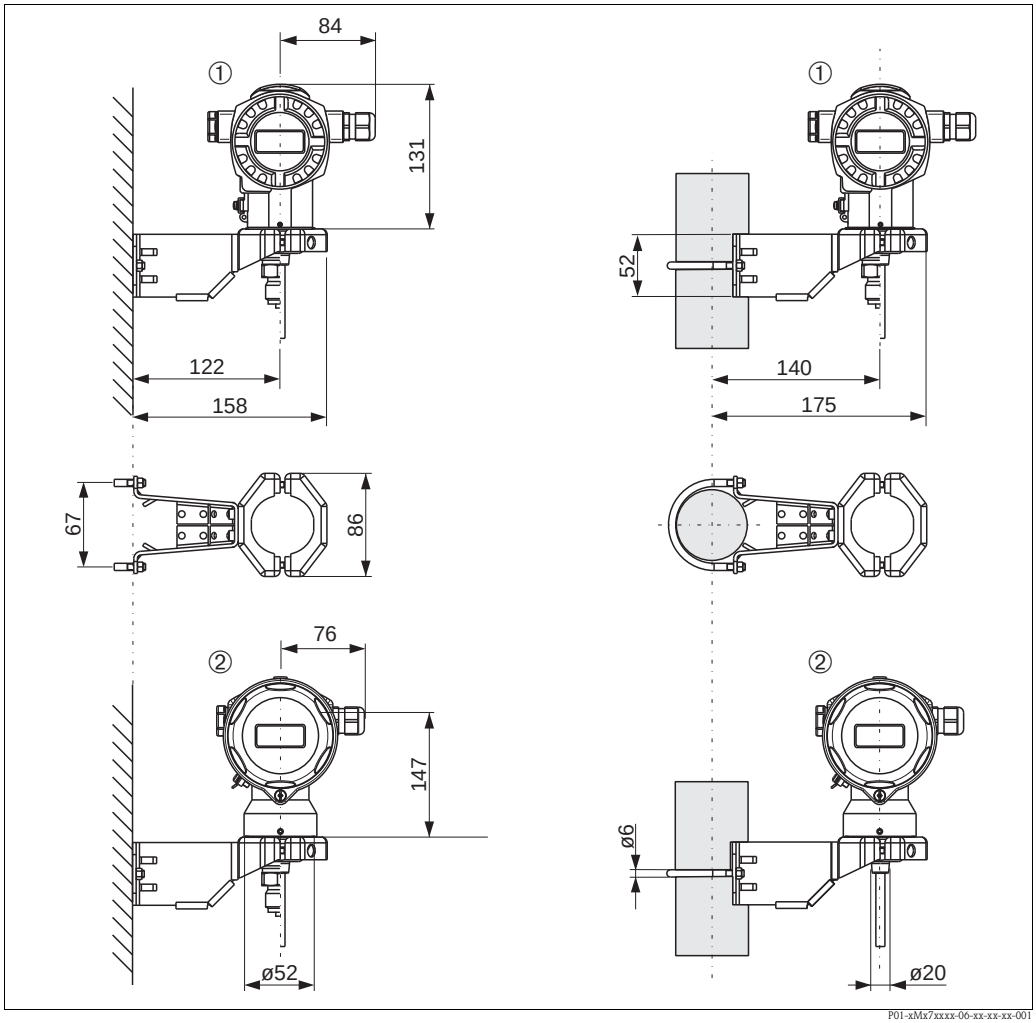
Version 00 [1]: universal process adapter incl. silicone molded seal FDA 21CFR177.2600/USP Class VI-70C, EHEDG, 3A

Installation height H for devices with universal process adapter

Description	Device height H, universal process adapter
T14 housing, optional display on the side	197 mm (7.76 in)
T15 housing without display, flat cover	203 mm (7.99 in)
T15 housing with display, high cover	215.5 mm (8.48 in)
T17 housing, optional display on the side	213 mm (8.39 in)

1) Endress+Hauser supplies these slotted nuts in stainless steel AISI 304 (DIN/EN material number 1.4301) or in AISI 304L (DIN/EN material number 1.4307).

Wall and pipe mounting with mounting bracket



① *Dimensions of T14 housing, optional display on the side. For the weight, see the following section.*

② *Dimensions of T17 housing, optional display on the side. For the weight, see the following section.*

Weight

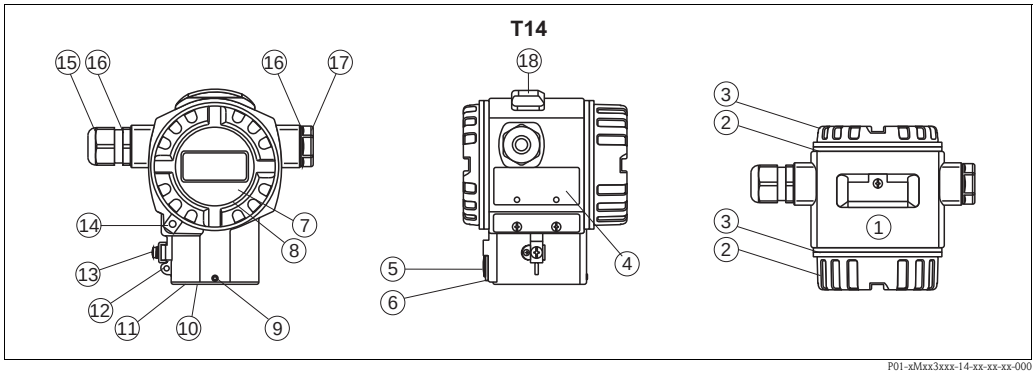
Housing

	T14		T17	Separate housing
	Aluminum	AISI 316L	AISI 316L	
With electronic insert and display	1.2 kg (2.65 lbs)	2.1 kg (4.63 lbs)	1.2 kg (2.65 lbs)	Weight of housing + 0.5 kg (1.10 lbs). Weight of sensor + 0.5 kg (1.10 lbs).
With electronic insert without display	1.1 kg (2.43 lbs)	2.0 kg (4.41 lbs)	1.1 kg (2.43 lbs)	

Process connections

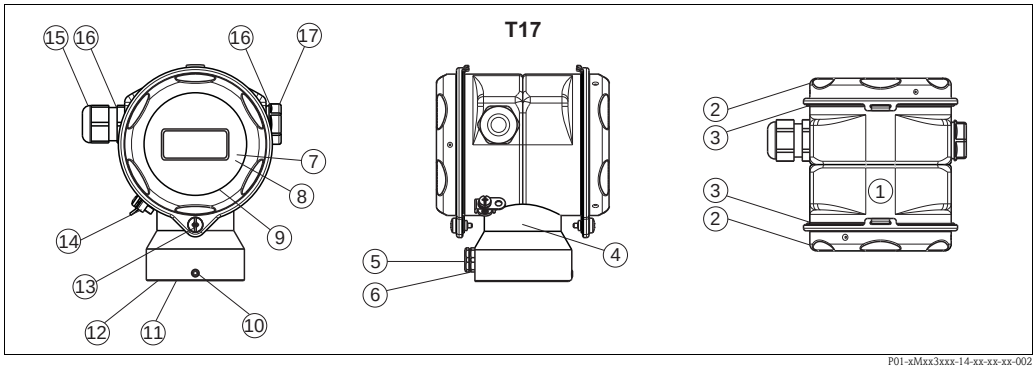
- Process connections PMC71 (with ceramic process isolating diaphragm): → 📄 33 ff
- Process connections PMP71 (with metal process isolating diaphragm): → 📄 40 ff
- Process connections PMP75 (with diaphragm seal): → 📄 47 ff

Material (not wetted) **Housing**



Front view, left-hand side view, top view

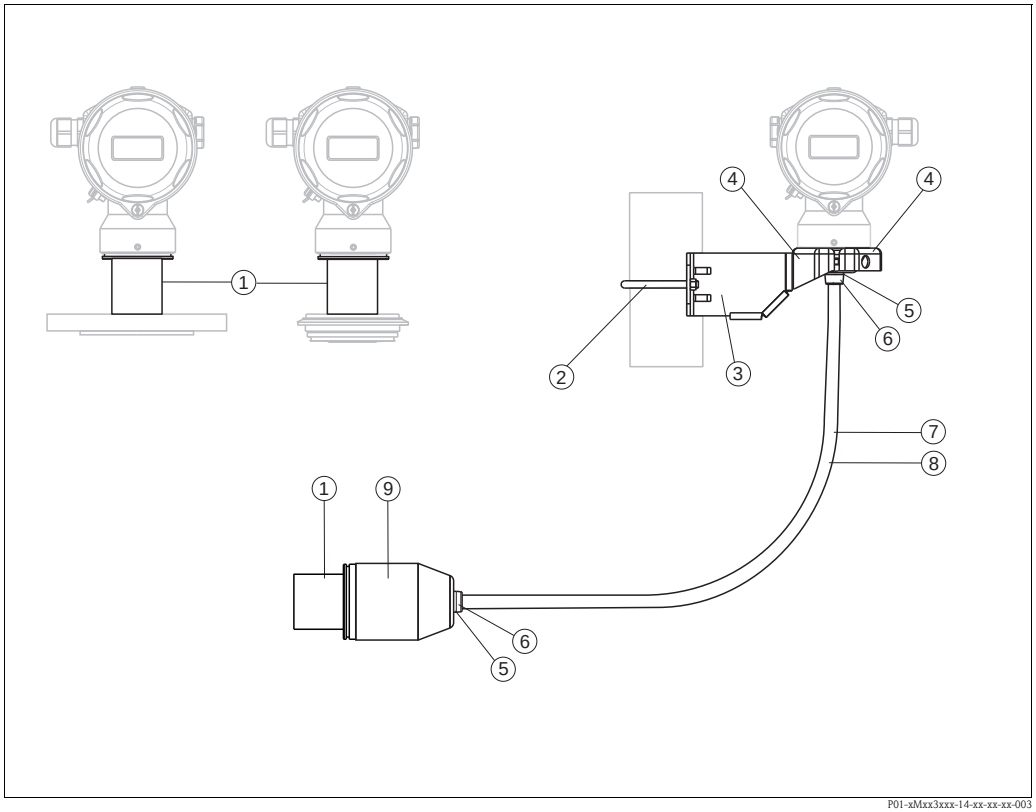
Item number	Component part	Material
1	T14 and T15 housing, RAL 5012 (blue)	Die-cast aluminum with protective powder-coating on polyester base
	T14 housing	Precision cast AISI 316L (1.4435)
2	Cover, RAL 7035 (gray)	Die-cast aluminum with protective powder-coating on polyester base
	Cover	Precision cast AISI 316L (1.4435)
3	Cover seal	EPDM
4	Nameplates	AISI 304 (1.4301)
5	Pressure compensation filter	PA6 GF10
6	Pressure compensation filter, O-ring	Silicone (VMQ)
7	Sight glass	Mineral glass
8	Sight glass seal	Silicone (VMQ)
9	Screw	A4
10	Sealing ring	EPDM
11	Snap ring	PA66-GF25
12	Snap ring for nameplates	AISI 304 (1.4301)/ AISI 316 (1.4401
13	External ground terminal	AISI 304 (1.4301)
14	Cover clamp	Clamp AISI 316L (1.4435, screw A4
15	Cable gland	Polyamide (PA)
16	Seal of cable gland and blind plug	Silicone (VMQ)
17	Blind plug	PBT-GF30 FR, for dust ignition-proof: AISI 316L (1.4435)
18	External operation (keys and key cover), RAL 7035 (gray)	Polycarbonate PC-FR, screw A4



Front view, left-hand side view, top view

Item number	Component part	Material
1	T17 housing	AISI 316L (1.4404)
2	Cover	
3	Cover seal	EPDM
4	Nameplates	Lasered
5	Pressure compensation filter	PA6 GF10
6	Pressure compensation filter, O-ring	Silicone (VMQ)
7	Sight glass for non-hazardous area, ATEX Ex ia, NEPSI Zone 0/1 Ex ia, IECEx Zone 0/1 Ex ia, FM NI, FM IS, CSA IS	Polycarbonate (PC)
8	Sight glass for ATEX 1/2 D, ATEX 1/3 D, ATEX 1 GD, ATEX 1/2 GD, ATEX 3 G, FM DIP, CSA dust ignition-proof	Mineral glass
9	Sight glass seal	EPDM
10	Screw	A2-70
11	Sealing ring	EPDM
12	Snap ring	PA6
13	Screw	A4-50
14	External ground terminal	AISI 304 (1.4301)
15	Cable gland	Polyamide PA, for dust ignition-proof: CuZn nickel-plated
16	Seal of cable gland and blind plug	Silicone (VMQ)
17	Blind plug	PBT-GF30 FR, for dust ignition-proof: AISI 316L (1.4435)

Connecting parts



Front view, left-hand side view, top view

Item number	Component part	Material
1	Connection between the housing and process connection	AISI 316L (1.4404)
2	Mounting bracket	Bracket AISI 304 (1.4301), AISI 304L (1.4306
3		Screw and nuts A2-70
4		Half-shells: AISI 304L (1.4306)
5	Seal for cable from separate housing	EPDM
6	Gland for cable from separate housing	AISI 316L (1.4404)
7	PE cable for separate housing	Abrasion-proof cable with strain-relief Dynema members; shielded using aluminum-coated film; insulated with polyethylene (PE-LD), black; copper wires, twisted, UV-resistant
8	FEP cable for separate housing	Abrasion-proof cable; shielded using galvanized steel wire netting; insulated with fluorinated ethylene propylene (FEP), black; copper wires, twisted, UV-resistant
9	Process connection adapter for separate housing	AISI 316L (1.4404)

Filling oil

See "Ordering information" (→ 🖹 76)

Miscellaneous:

- Diaphragm seal capillary: AISI 316 Ti (1.4571)
- Protective hose for diaphragm seal capillary: AISI 304 (1.4301)

Material (wetted)

Note!
Process-wetted device components are listed in the "Mechanical construction" (→ 🖹 32) and "Ordering information" (→ 🖹 76) sections.

TSE Certificate of Suitability

The following applies to all process wetted device components:
- They do not contain any materials derived from animals.
- No additives or operating materials derived from animals are used in production or processing.

Process connections

- "Clamp connections" and "Hygienic connections" (see also "Ordering information" section): AISI 316L (DIN/EN material number 1.4435)
- Endress+Hauser supplies process connections with threaded connections and DIN/ EN flanges made of stainless steel as per AISI 316L (DIN/EN material number 1.4404 (AISI 316) or 14435). With regard to their stability-temperature property, the materials 1.4404 and 1.4435 are grouped together under 13E0 in EN 1092-1 Tab.18. The chemical composition of the two materials can be identical.
- Some process connections are also available in the material Alloy C276 (DIN/EN material number 2.4819). See the information in the "Mechanical construction" section.

Process isolating diaphragm

- PMC71: Al_2O_3 aluminum oxide ceramic (FDA 21CFR186.1256, USP Class VI), ultrapure 99.9 % (→ see also www.endress.com/ceraphire)
- PMP71:
  - AISI 316L (DIN/EN material number 1.4435)
  - AISI 316L with gold-rhodium coating
  - Alloy C276 (DIN/EN material number 2.4819)
- PMP75:
  - AISI 316L (DIN/EN material number 1.4435)
  - AISI 316L with gold-rhodium coating
  - AISI 316L with 0.09 mm PTFE foil (not for vacuum applications)
  - AISI 316L with 0.25 mm PTFE foil (not for vacuum applications, only for non-hazardous areas)
  - Alloy C276 (DIN/EN material number 2.4819)
  - Monel
  - Tantalum

Seals

See ordering information, → 🖹 76 ff

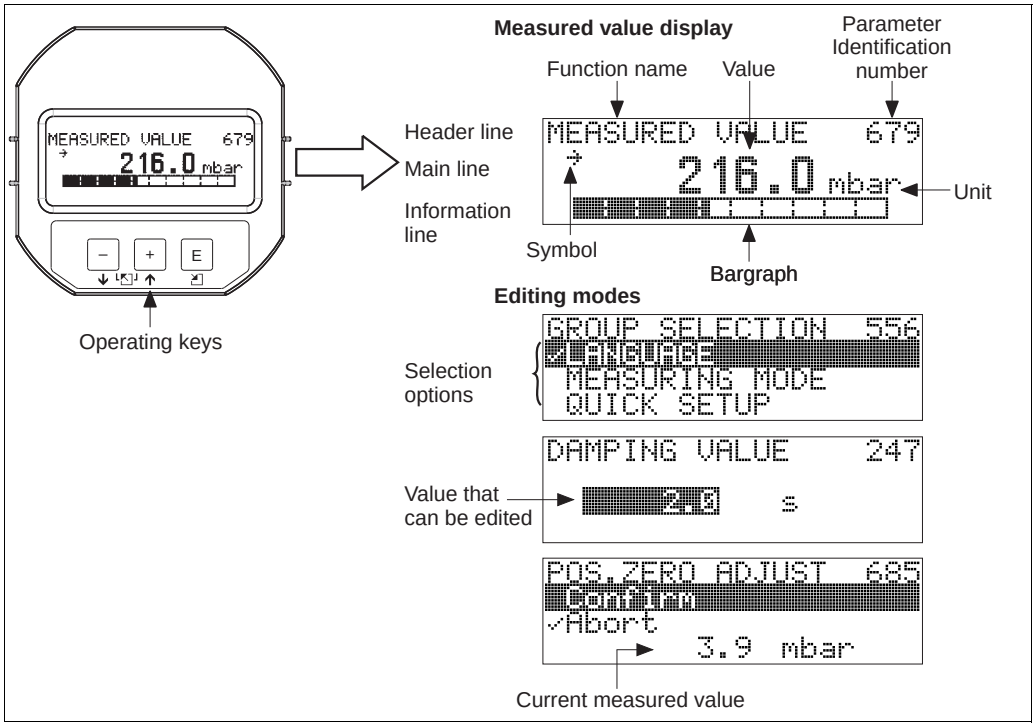
Human interface

Operating elements

Onsite display (optional)

A 4-line liquid crystal display (LCD) is used for display and operation. The onsite display shows measured values, dialog text as well as fault and notice messages in plain text, thereby supporting the user in every stage of operation. The display of the device can be turned in 90° steps.
Depending on the installation position of the device, this makes it easy to operate the device and read the measured value.

Functions:
- 8-digit measured value display including sign and decimal point, bar graph for 4 to 20 mA HART as current display; or for PROFIBUS PA as graphic display of the standardized value of the AI Block; for FOUNDATION Fieldbus as graphic display of the transducer output.
- Simple and complete menu guidance thanks to separation of the parameters into several levels and groups.
- Each parameter is given a 3-digit ID number for easy navigation.
- Option for configuring the display according to individual requirements and preferences, such as language, alternating display, display of other measured values such as sensor temperature, contrast setting.
- Comprehensive diagnostic functions (fault and warning message, peak-hold indicators, etc.).
- Rapid and safe commissioning with the Quick Setup menus.



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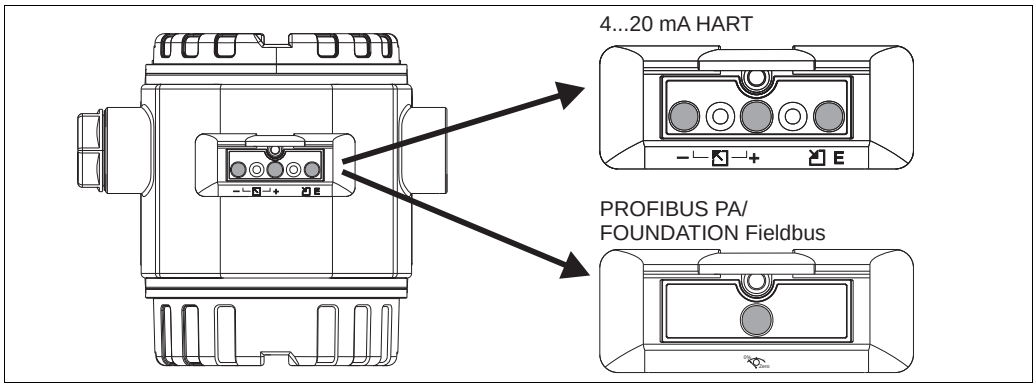
Operating elements

Operating keys on the exterior of the device

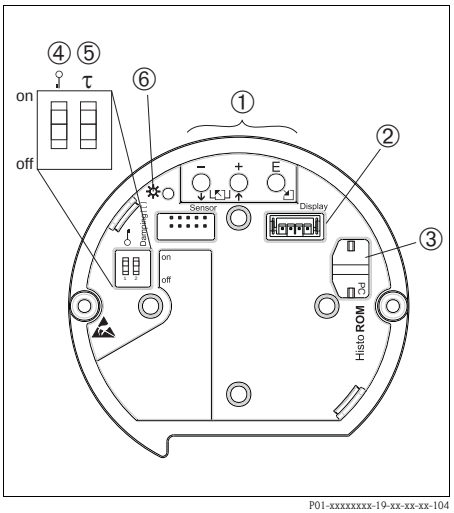
With the T14 housing (aluminum or stainless steel), the operating keys are located either outside of the housing, under the protection cap or inside on the electronic insert. With the T17 housing (stainless steel), the operating keys are located inside the housing on the electronic insert.



P01-PMx7xxxx-19-xx-xx-xx-038

The operating keys located externally on the device work on the Hall sensor principle. As a result, no additional openings are required in the device. This guarantees:
- Complete protection against environmental influences such as moisture and contamination.
- Simple operation without any tools.
- No wear.

Operating keys and elements located internally on the electronic insert



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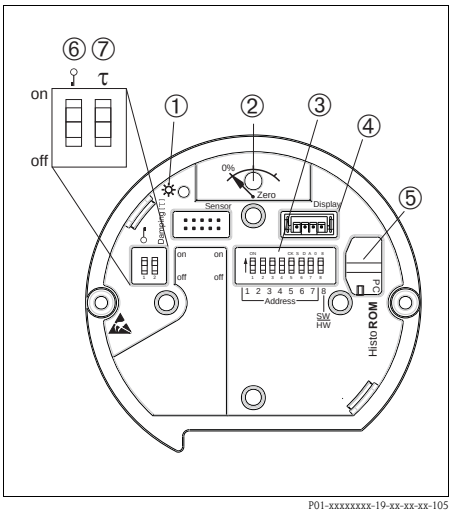
Electronic insert HART

1 *Operating keys*
2 *Slot for optional display*
3 *Slot for optional HistoROM®/M-DAT*
4 *DIP-switch for locking/unlocking parameters relevant to the measured values*
5 *DIP-switch for damping on/off*
6 *Green LED to indicate value being accepted*



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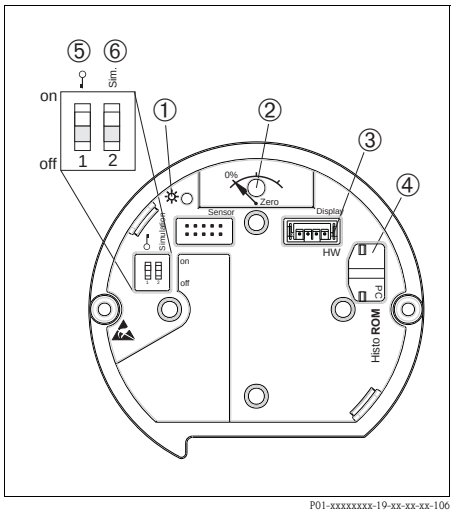
Electronic insert PROFIBUS PA

1 *Green LED to indicate value being accepted*
2 *Key for position adjustment and device reset*
3 *DIP-switch for bus address*
4 *Slot for optional display*
5 *Slot for optional HistoROM®/M-DAT*
6 *DIP-switch for locking/unlocking parameters relevant to the measured values*
7 *DIP-switch for damping on/off*



P01-xxxxxxxx-19-xx-xx-xx-106

Electronic insert FOUNDATION Fieldbus

1 *Green LED to indicate value being accepted*
2 *Key for position adjustment and device reset*
3 *Slot for optional display*
4 *Slot for optional HistoROM®/M-DAT*
5 *DIP-switch for locking/unlocking parameters relevant to the measured values*
6 *DIP-switch for simulation mode on/off*

Local operation

Function	External operation (operating keys, optional, not T17 housing)	Internal operation (electronic insert)	Display (optional)
Position adjustment (zero point correction)	X	X	X
Setting lower-range value and upper-range value – reference pressure present at the device	X (HART only)	X (HART only)	X
Device reset	X	X	X
Locking and unlocking parameters relevant to the measured value	- - -	X	X
Value acceptance indicated by green LED	X	X	X
Switching damping on and off	- - -	X (HART and PA only)	X
Setting bus address (PA)	- - -	X	X
Switching simulation mode on and off (FOUNDATION Fieldbus)	- - -	X	X

Remote operation

Depending on the position of the write protection switch on the device, all software parameters are accessible.

HART

Remote operation via:
- Handheld terminal Field Communicator 375 (see "Hardware and software for onsite and remote operation" section → 68)
- FieldCare (see "Hardware and software for onsite and remote operation" section → 68 ff) with Commubox FXA195 (see "Hardware and software for onsite and remote operation" section → 68 ff)
- Field Xpert:
  Field Xpert is an industrial PDA with integrated 3.5" touchscreen from Endress+Hauser based on Windows Mobile. It communicates via wireless with the optional VIATOR Bluetooth modem connected to a HART device point-to-point or wireless via WiFi and Endress+Hauser's Fieldgate FXA520. Field Xpert also works as a stand-alone device for asset management applications. For details, refer to BA060S/04/EN.

PROFIBUS PA

Remote operation via:
- FieldCare (see "Hardware and software for onsite and remote operation" section → 68 ff)
  – Profiboard: For connecting a PC to PROFIBUS
  – Proficard: For connecting a laptop to PROFIBUS

FOUNDATION Fieldbus

Remote operation via:
- Handheld terminal Field Communicator 375 (see "Hardware and software for onsite and remote operation" section → 68 ff)
- Use an FF-configuration program for example NI-FBUS Configurator, to
  – connect devices with "FOUNDATION Fieldbus signal" into an FF-network
  – set FF-specific parameters
  Operation with NI-FBUS Configurator:
  The NI-FBUS Configurator is an easy-to-use graphical environment for creating linkages, loops, and a schedule based on the fieldbus concepts.
  You can use the NI-FBUS Configurator to configure a fieldbus network as follows:
  – Set block and device tags
  – Set device addresses
  – Create and edit function block control strategies (function block applications)
  – Configure vendor-defined function and transducer blocks
  – Create and edit schedules
  – Read and write to function block control strategies (function block applications)
  – Invoke Device Description (DD) methods

– Display DD menus
– Download a configuration
– Verify a configuration and compare it to a saved configuration
– Monitor a downloaded configuration
– Replace a virtual device by a real device
– Save and print a configuration

Note!
For further information please contact your local Endress+Hauser Sales Center.

Hardware and software for onsite and remote operation

Commubox FXA195

For intrinsically safe HART communication with FieldCare via the USB interface. For details refer to TI404F/00/EN.

Commubox FXA291

The Commubox FXA291 connects Endress+Hauser field devices with a CDI interface (=Endress+Hauser Common Data Interface) to the USB interface of a personal computer or a notebook. For details refer to TI405C/07/EN.

Note!
For the following Endress+Hauser devices you need the "ToF adapter FXA291" as an additional accessory:

- Cerabar S PMC71, PMP7x
- Deltabar S PMD7x, FMD7x
- Deltapilot S FMB70

ToF adapter FXA291

The ToF adapter FXA291 connects the Commubox FXA291 with devices of the ToF platform, pressure equipment and the Gammapilot via the USB port of a computer or laptop. For details refer to KA271F.

Field Communicator 375

With a handheld terminal, all the parameters can be configured anywhere along the bus line via menu operation.

HistoROM®/M-DAT (optional)

HistoROM®/M-DAT is a memory module which can be attached to every electronic insert. The HistoROM®/M-DAT can be retrofitted at any stage (order number: 52027785).

Your benefits

- Quick and safe commissioning of the same measuring points by copying the configuration data of one transmitter to another transmitter.
- Reliable process monitoring thanks to cyclical recording of pressure and sensor temperature measured values.
- Simple diagnosis by recording diverse events such as alarms, configuration changes, counters for measuring range undershoot and overshoot for pressure and temperature as well as user limit overshoot and undershoot for pressure and temperature etc.
- Analysis and graphic evaluation of the events and process parameters via software (contained in scope of supply).

HistoROM®/M-DAT can be ordered via feature 100 "Additional option 1" or feature 110 "Additional option 2" or as a spare part. → 🖹 76 ff. A CD with an Endress+Hauser operating program is also included in the scope of delivery.
You can copy data from one transmitter to another transmitter when operating a FOUNDATION Fieldbus device via an FF configuration program. You need the Endress+Hauser FieldCare operating program and the Commubox FXA291 service interface and the ToF adapter FXA291 to be able to access the data and events saved in the HistoROM®/M-DAT.
FieldCare and the service interface Commubox FXA291 and the ToF adapter FXA291.

FieldCare

FieldCare is an Endress+Hauser asset management tool based on FDT technology. With FieldCare, you can configure all Endress+Hauser devices as well as devices from other manufacturers that support the FDT standard.

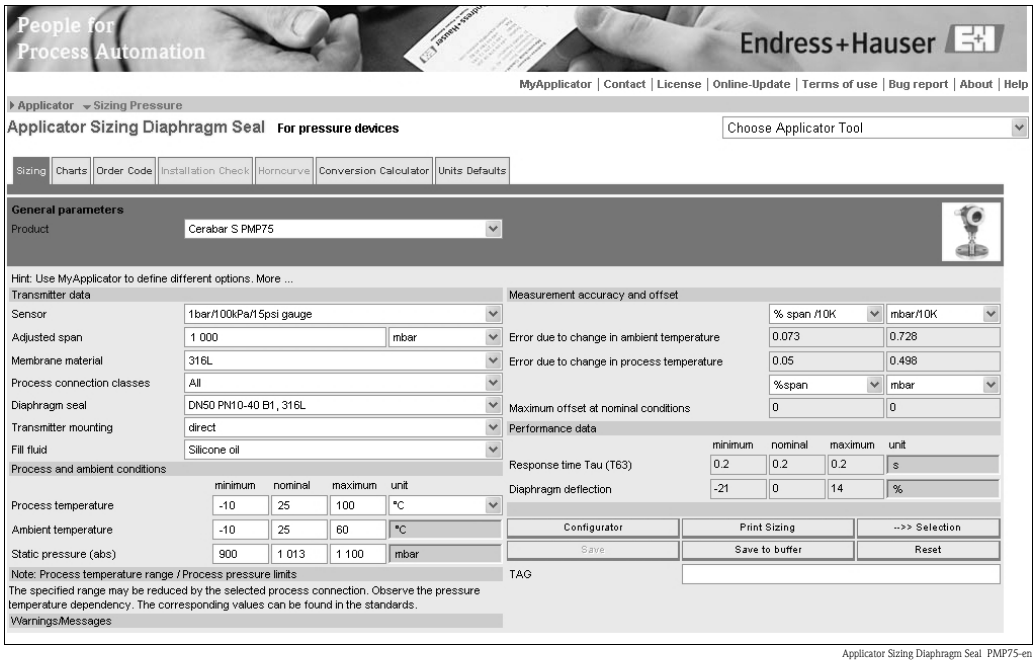
FieldCare supports the following functions:
- Configuration of transmitters in offline and online mode
- Loading and saving device data (upload/download)
- HistoROM®/M-DAT analysis
- Documentation of the measuring point

Connection options:
- HART via Commubox FXA195 and the USB port on a computer
- PROFIBUS PA via segment coupler and PROFIBUS interface card
- Service interface with Commubox FXA291 and ToF adapter FXA291 (USB).

For further information → www.endress.com

Planning instructions, diaphragm seal systems

Note!
The performance and the permitted range of application of a diaphragm seal system depend on the process isolating diaphragm used, the filling oil, the coupling, the unit design and on the process and ambient conditions present in the individual application.
To help you select the right diaphragm seal system for your applications, Endress+Hauser provides its customers with the free "Applicator Sizing Diaphragm Seal" tool, which is available on CD or online at "www.endress.com/applicator".



Applicator Sizing Diaphragm Seal PMP75-en

For more detailed information or the layout of the optimum diaphragm seal solution for your application, please contact your local Endress+Hauser Sales Center.

Applications

Diaphragm seal systems should be used if the process and the device should be separated. Diaphragm seal systems offer clear advantages in the following instances:
- In the case of extreme process temperatures
- For aggressive media
- In the case of process media that crystallize
- In the case of corrosive or highly various process media or process media with solids content
- In the case of heterogeneous and fibrous process media
- If extreme measuring point cleaning is necessary, or for very humid mounting locations
- If the measuring point is exposed to severe vibrations
- For mounting locations that are difficult to access

Design and operation mode

Diaphragm seals are separating equipment between the measuring system and the process.

A diaphragm seal system consists of:
- A diaphragm seal
- A capillary tube or temperature isolator if necessary
- Fill fluid
- A pressure transmitter

The process pressure acts via the process isolating diaphragm of a diaphragm seal on the liquid-filled system, which transfers the process pressure onto the sensor of the pressure transmitter.
Endress+Hauser delivers all diaphragm seal systems as welded versions. The system is hermetically sealed, which ensures the highest reliability.

The diaphragm seal determines the application range of the system by:
- The process isolating diaphragm diameter
- The process isolating diaphragm stiffness and material
- The design (oil volume)

Diameter of the process isolating diaphragm

The greater the diameter of the process isolating diaphragm (less stiff), the smaller the temperature effect on the measurement result.

Process isolating diaphragm stiffness

The stiffness depends on the diameter of the process isolating diaphragm, the material, any existing coating and the thickness and shape of the process isolating diaphragm. The process isolating diaphragm thickness and the shape are determined by the design. The stiffness of a process isolating diaphragm of a diaphragm seal influences the temperature operating range and the measuring error caused by temperature effects.

Capillary

Capillaries with an internal diameter of 1 mm (0.04 in) are used as standard.
The capillary tube influences the thermal change, the ambient temperature operating range and the response time of a diaphragm seal system as a result of its length and internal diameter.

Filling oil

When selecting the filling oil, the medium and ambient temperature as well as the operating pressure are of crucial importance. Observe the temperatures and pressures during commissioning and cleaning. A further selection criterion is the compatibility of the filling oil with the requirements of the process medium. For this reason, only filling oils that are harmless to health are used in the food industry, such as vegetable oil or silicone oil.
→ See also the following section "Diaphragm seal filling oils".
The filling oil used influences the thermal change, the temperature operating range of a diaphragm seal system and the response time. A temperature change results in a volume change of the filling oil. The volume change is dependent on the expansion coefficient and the volume of the filling oil at calibration temperature (constant in the range: +21 to +33 °C (+70 to 91 °F)).
For example, the filling oil expands in the event of a temperature increase. The additional volume presses against the process isolating diaphragm of a diaphragm seal. The stiffer a diaphragm is, the greater its return force, which counteracts a volume change and acts on the measuring cell together with the operating pressure, thus shifting the zero point.

Pressure transmitter

The pressure transmitter influences the temperature operating range, the T_K zero point and the response time as a result of its volume change. The volume change is the volume that has to be shifted to pass through the complete measuring range.
Pressure transmitters from Endress+Hauser are optimized with regard to minimum volume change.

Diaphragm seal filling oils

Version [1]	Filling oil	Permissible temperature range [2] at 0.05 bar (0.725 psi) ≤ p_{abs} ≤ 1 bar (14.5 psi)	Permissible temperature range [2] at p_{abs} ≥ 1 bar (14.5 psi)	Density [g/cm³] / [SGU]	Viscosity [mm²/s] / [cSt] at 25 °C (77 °F)]	Coefficient of thermal expansion [1/K]	Notes
A, H, 1 or 2	Silicone oil	–40 to +180°C (–40 to +356°F)	–40 to +250°C (–40 to +482 °F)	0.96	100	0.00096	Suitable for foods FDA 21 CFR 175.105
G, 3 or 4	High-temperature oil	–10 to +200°C (+14 to +392 °F)	–10 to +400°C (+14 to +752 °F)	1.07	37	0.0007	High temperatures
F or N	Inert oil	–40 to +80°C (–40 to +176 °F)	–40 to +175°C (–40 to +347 °F)	1.87	27	0.000876	For ultrapure gas and oxygen applications
D, 5 or 6	Vegetable oil	–10 to +120°C (+14 to +248 °F)	–10 to +200°C (+14 to +392 °F)	0.94	9.5	0.00101	Suitable for foods FDA 21 CFR 172.856
7 or 8	Low-temperature oil	–70 to +80°C (–94 to +176 °F)	–70 to +180°C (–94 to +349 °F)	0.92	4.4	0.00108	Low temperatures

1) Version for feature 90 in the order code (→ 🖹 84 ff)

2) Observe temperature limits of the device (→ 🖹 30) and the system (→ 🖹 70).

Installation instructions

Diaphragm seal systems

- Endress+Hauser offer flushing rings as accessories to clean process isolating diaphragms without taking the transmitters out of the process.
  For further information please contact your local Endress+Hauser Sales Center.
- The diaphragm seal together with the transmitter form a closed, calibrated system, which is filled through ports in the diaphragm seal and in the measuring system of the transmitter. These ports are sealed and must not be opened.
- For devices with a temperature isolator or capillary, a suitable fastening device (mounting bracket) is recommended.
- For more detailed installation instructions, Endress+Hauser provides its customers with the free "Applicator Sizing Diaphragm Seal" tool, which is available on CD or can be downloaded online at "www.endress.com/applicator".

Capillary

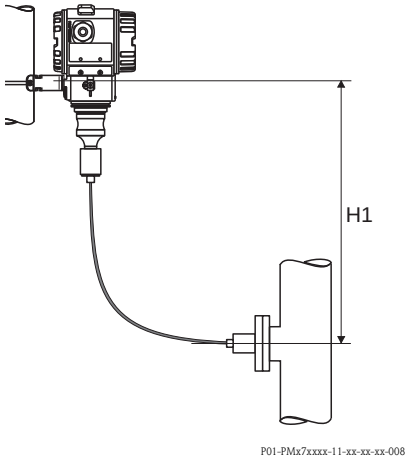
In order to obtain more precise measurement results and to avoid a defect in the device, mount the capillaries as follows:

- vibration-free (in order to avoid additional pressure fluctuations)
- not in the vicinity of heating or cooling lines
- insulate if the ambient temperature is below or above the reference temperature
- with a bending radius of ≥ 100 mm (3.94 in).
- When using diaphragm seal systems with capillaries, sufficient strain relief must be allowed for in order to prevent the capillary bending down (capillary bending radius ≥ 100 mm (3.94 in)).
- In the case of devices with diaphragm seals and capillaries, the zero point shift caused by the hydrostatic pressure of the filling liquid column in the capillaries must be taken into account when selecting the measuring cell. If a measuring cell with a small measuring range is selected, a position adjustment can cause range violation.

Vacuum applications

For applications under vacuum, Endress+Hauser recommends mounting the pressure transmitter below the diaphragm seal. This prevents vacuum load of the diaphragm seal caused by the presence of fill fluid in the capillary.

When the pressure transmitter is mounted above the diaphragm seal, the maximum height difference H1 in accordance with the illustration below must not be exceeded. The maximum height difference is dependent on the density of the filling oil and the smallest ever pressure that is permitted to occur at the diaphragm seal (empty tank), see the following illustration, on the right.



Installation above the diaphragm seal

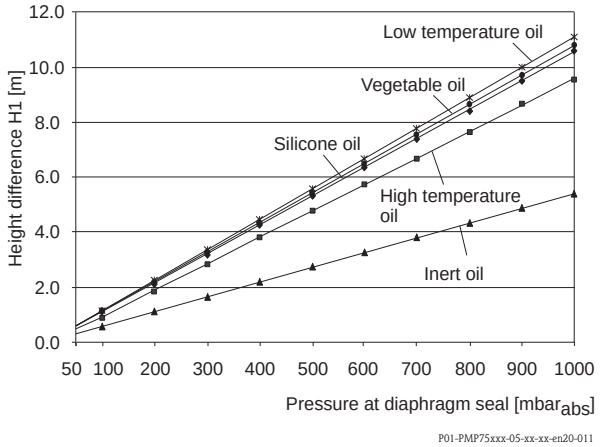
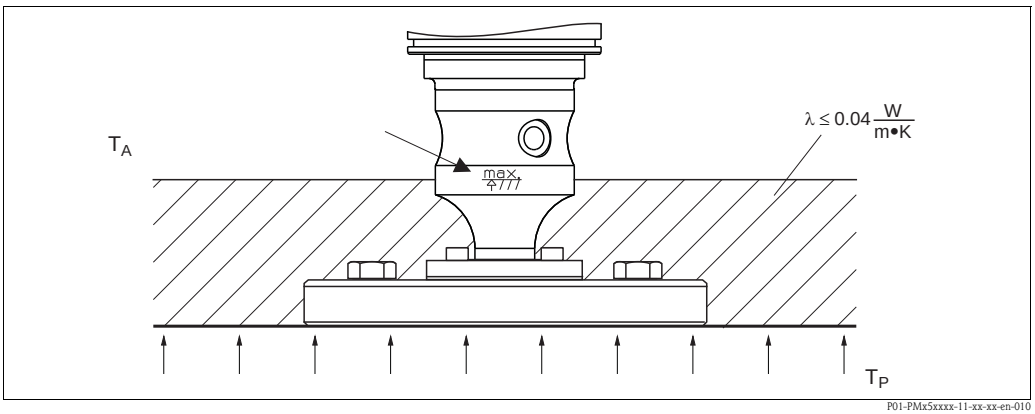


Diagram of maximum installation height above the diaphragm seal for vacuum applications

Heat insulation

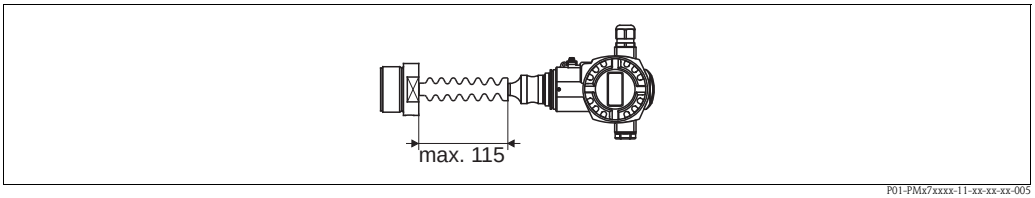
The PMP75 must only be insulated up to a certain height. The maximum permitted insulation height is indicated on the devices and applies to an insulation material with a heat conductivity ≤ 0.04 W/(m x K) and to the maximum permitted ambient and process temperature. The data were determined under the most critical application "quiescent air".



Maximum insulation height, here indicated on a PMP75 with a flange

Mounting with temperature isolator

Endress+Hauser recommends the use of temperature isolators in the event of constant extreme medium temperatures which cause the maximum permissible electronics temperature of +85 °C (185 °F) to be exceeded.
Depending on the filling oil used, diaphragm seal systems with temperature isolators can be used for maximum temperatures of up to 260 °C (500 °F). → Temperature application limits, see → 72, "Diaphragm seal filling oils" section.
To minimize the influence of rising heat, Endress+Hauser recommends the device be mounted horizontally or with the housing pointing downwards.
The additional installation height also brings about a zero point shift of maximum 21 mbar (0.315 psi) due to the hydrostatic column in the temperature isolator. You can correct this zero point shift at the device.



PMP75 with temperature isolator, material 316L (1.4404)

Certificates and approvals

CE mark

The device meets the legal requirements of the relevant EC directives.
Endress+Hauser confirms that the device has been successfully tested by applying the CE mark.

Ex approvals

- ATEX
- FM
- CSA
- NEPSI
- IECEx
- TIIS
- GOST
- Also combinations of different approvals

All explosion protection data are given in separate documentation which is available upon request. The Ex documentation is supplied as standard with all devices approved for use in explosion hazardous areas.
→ 89 ff, "Safety Instructions" and "Installation/Control Drawings" sections.

Suitability for hygienic processes

The Cerabar S is suitable for use in hygienic processes.
Overview of suitable process connections from Page 33.
Many versions meet the requirements of 3A-Sanitary Standard No. 74 and are certified by the EHEDG.
Suitable fittings and seals must be used to ensure hygiene-compliant design according to the specifications of 3A and EHEDG.

Note!
The gap-free connections can be cleaned without residue using the usual cleaning methods.

Marine certificate

- GL
- ABS

Functional safety SIL/ IEC 61508 Declaration of Conformity (optional)

The Cerabar S devices with a 4 to 20 mA output signal have been developed in accordance with the IEC 61508 standard. These devices can be used to monitor the process level and pressure up to SIL 3.
For a detailed description of the safety functions with Cerabar S, settings and functional safety data, see the "Functional safety manual – Cerabar S" SD190P.
For devices up to SIL 3 / IEC 61508 Declaration of Conformity, see → 76 ff, feature 100 "Additional option 1" and feature 110 "Additional option 2" version E "SIL / IEC 61508 Declaration of Conformity".

Overfill protection

WHG

CRN approvals

Some device versions have CRN approval. For a CRN-approved device, a CRN-approved process connection (→ 32 ff, "Process connection") has to be ordered with a CSA approval (→ 76 ff, feature 10 "Approval").
PMP75 devices with a capillary are not CRN-approved. These devices are fitted with a separate plate bearing the registration number 0F10525.5C.

Pressure Equipment Directive (PED)

The devices PMC71, PMP71 and PMP75 correspond to Article 3 (3) of the EC directive 97/23/EC (Pressure Equipment Directive) and have been designed and manufactured according to good engineering practice.

The following also applies:
– PMP71 with threaded connection and internal process isolating diaphragm PN > 200 as well as oval flange adapter PN > 200:
  Suitable for stable gases in group 1, category I
– PMP75 with pipe diaphragm seal ≥ 1.5"/PN 40:
  Suitable for stable gases in group 1, category II
– PMP75 with separators PN > 200 ≥ 1.5"/PN40:
  Suitable for stable gases in group 1, category I
– PMP75 with threaded connection PN > 200

Standards and guidelines

DIN EN 60770 (IEC 60770):
Transmitters for use in industrial-process control systems
Part 1: Methods for performance evaluation

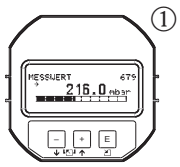
DIN 16086:
Electrical pressure measuring instruments, pressure sensors, pressure transmitters, pressure measuring instruments, concepts, specifications on data sheets

EN 61326-X:
EMC product family standard for electrical equipment for measurement, control and laboratory use.

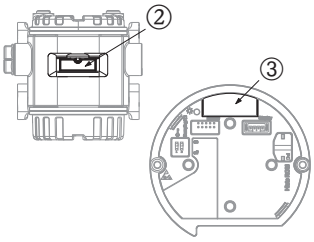
Ordering information

PMC71

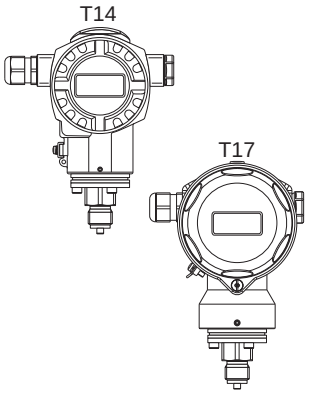
This overview does not mark options which are mutually exclusive.



10	Approval:	
	A	For non-hazardous areas
	E	Combined certificates ATEX II Ex ia + FM IS + CSA IS ATEX II 1/2G Ex ia IIC T6 + FM/CSA IS Class I, II, III Division 1 Group A - G
	1	ATEX II 1/2 G Ex ia IIC T6
	6	ATEX II 1/2 G Ex ia IIC T6, overfill protection WHG
	2	ATEX II 1/2 D Ex ia IIC T6
	8	ATEX II 1 GD Ex ia IIC T6
	3	ATEX II 1/2 GD Ex ia IIC T6
	5	ATEX II 2 G Ex d[ia] IIC T6
	7	ATEX II 3 G Ex nA II T6
	S	FM IS, Class I, II, III Division 1, Groups A – G; NI Class I Division 2, Groups A – D; AEx ia
	T	FM XP, Class I Division 1, Groups A – D; AEx d
	R	FM NI, Class I, Division 2, Groups A – D
	U	CSA IS, Class I, II, III Division 1, Groups A – G; Class I Division 2, Groups A – D, Ex ia
	V	CSA XP, Class I Division 1, Groups B – D; Ex d
	G	NEPSI Ex d[ia] IIC T4/T6
	H	NEPSI Ex ia IIC T6
	L	TIIS Ex d (ia) IIC T6
	M	TIIS Ex d (ia) IIC T4
	I	IECEx Zone 0/1 Ex ia IIC T6



20		Output; Operation:	
	A	4 to 20 mA HART, operation outside, LCD (→ see Fig. ①, ②)	
	B	4 to 20 mA HART, operation inside, LCD (→ see Fig. ①, ③)	
	C	4 to 20 mA HART, operation inside (→ see Fig. ③)	
	M	PROFIBUS PA, operation outside, LCD (→ see Fig. ①, ②)	
	N	PROFIBUS PA, operation inside, LCD (→ see Fig. ①, ③)	
	O	PROFIBUS PA, operation inside (→ see Fig. ③)	
	P	FOUNDATION Fieldbus, operation outside, LCD (→ see Fig. ①, ③)	
	Q	FOUNDATION Fieldbus, operation inside, LCD (→ see Fig. ①, ③)	
	R	FOUNDATION Fieldbus, operation inside (→ see Fig. ③)	



30			Housing; Cable entry; Protection:	
		A	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Gland M 20x1.5	
		B	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread G 1/2	
		C	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread 1/2 NPT	
		D	Aluminum T14 housing, optional display on the side, IP66/67/NEMA 4X/ 6P, M 12x1 PA plug,	
		E	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, 7/8" FF plug	
		F	Aluminum T14 housing, optional display on the side, IP 65/NEMA 4X, Han7D plug, 90°	
		1	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Gland M 20x1.5	
		2	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread G 1/2	
		3	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread 1/2 NPT	
		4	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, M 12x1 PA plug	
		5	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, 7/8" FF plug	
		6	AISI 316L T14 housing, optional display on the side, IP 65/NEMA 4X, Han7D plug, 90°	
		R	T17 316L Hygiene IP66/68 NEMA6P; M20 gland, T17 = side cover	
		S	T17 316L Hygiene IP66/68 NEMA6P; G1/2 thread, T17 = side cover	
		T	T17 316L Hygiene IP66/68 NEMA6P; NPT1/2 thread, T17 = side cover	
		U	T17 316L Hygiene IP66/68 NEMA6P; M12 plug, T17 = side cover	
		V	T17 316L Hygiene IP66/68 NEMA6P; 7/8" plug, T17 = side cover	

40				Sensor range; Sensor over pressure limit (= OPL):	
				Sensors for gauge pressure	
				Measurement limits: –100 % (–1 bar) to +100 % of sensor nominal value	
				Sensor rated value (URL)	**OPL (over pressure limit)**
			1C	100 mbar/10 kPa/1.5 psi g	4 bar/400 kPa/60 psi g
			1E	250 mbar/25 kPa/3.75 psi g	5 bar/500 kPa/75 psi g
			1F	400 mbar/40 kPa/6 psi g	8 bar/800 kPa/120 psi g
			1H	1 bar/100 kPa/15 psi g	10 bar/1 MPa/150 psi g
			1K	2 bar/200 kPa/30 psi g	18 bar/1.8 MPa/270 psi g
			1M	4 bar/400 kPa/60 psi g	25 bar/2.5 MPa/375 psi g
			1P	10 bar/1 MPa/150 psi g	40 bar/4 MPa/600 psi g
			1S	40 bar/4 MPa/600 psi g	60 bar/6 MPa/900 psi g

40 Sensor range; Sensor over pressure limit (= OPL):

Sensors for absolute pressure

	Sensor rated value (URL)	OPL (over pressure limit)
2C	100 mbar/10 kPa/1.5 psi abs	4 bar/400 kPa/60 psi abs
2E	250 mbar/25 kPa/3.75 psi abs	5 bar/500 kPa/75 psi abs
2F	400 mbar/40 kPa/6 psi abs	8 bar/800 kPa/120 psi abs
2H	1 bar/100 kPa/15 psi abs	10 bar/1 MPa/150 psi abs
2K	2 bar/200 kPa/30 psi abs	18 bar/1.8 MPa/270 psi abs
2M	4 bar/400 kPa/60 psi abs	25 bar/2.5 MPa/375 psi abs
2P	10 bar/1 MPa/150 psi abs	40 bar/4 MPa/600 psi abs
2S	40 bar/4 MPa/600 psi abs	60 bar/6 MPa/900 psi abs

50 Calibration; Unit:

1	Sensor range; mbar/bar
2	Sensor range; kPa/MPa
3	Sensor range; mmH_2O/mH_2O
4	Sensor range; inH_2O/ftH_2O
6	Sensor range; psi
B	Customer-specific; see additional specification
C	Factory calibration certificate, 5-point; see additional specification
D	DKD certificate; see additional specification
K	Platinum; see additional specification
L	Platinum and factory calibration certificate, 5-point; see additional specification
M	Platinum and DKD certificate; see additional specification

70 Process connection; Material:

	Thread, internal process isolating diaphragm
GA	Thread ISO 228 G 1/2 A EN 837, AISI 316L (CRN)
GB	Thread ISO 228 G 1/2 A EN 837, Alloy C (CRN)
GC	Thread ISO 228 G 1/2 A EN 837, Monel
GD	Thread ISO 228 G 1/2 A EN 837, PVDF (max. 15 bar/225 psi, –10 to +60°C/+14 to +140°F)
GE	Thread ISO 228 G 1/2 A G 1/4 (female), AISI 316L (CRN)
GF	Thread ISO 228 G 1/2 A G 1/4 (female), Alloy C (CRN)
GG	Thread ISO 228 G 1/2 A G 1/4 (female), Monel
GH	Thread ISO 228 G 1/2 A hole 11.4 mm, AISI 316L (CRN)
GJ	Thread ISO 228 G 1/2 A hole 11.4 mm, Alloy C (CRN)
GK	Thread ISO 228 G 1/2 A hole 11.4 mm, Monel
RA	Thread ANSI 1/2 MNPT 1/4 FNPT, AISI 316L (CRN)
RB	Thread ANSI 1/2 MNPT 1/4 FNPT, Alloy C (CRN)
RC	Thread ANSI 1/2 MNPT 1/4 FNPT, Monel
RD	Thread ANSI 1/2 MNPT, hole 11.4 mm, AISI 316L (CRN)
RE	Thread ANSI 1/2 MNPT, hole 11.4 mm, Alloy C (CRN)
RF	Thread ANSI 1/2 MNPT, hole 11.4 mm, Monel
RG	Thread ANSI 1/2 MNPT hole 3 mm, PVDF (max. 15 bar/225 psi, –10 to +60°C/+14 to +140°F)
RH	Thread ANSI 1/2 FNPT, AISI 316L (CRN)
RJ	Thread ANSI 1/2 FNPT, Alloy C
RK	Thread ANSI 1/2 FNPT, Monel
GL	Thread JIS B0202 G 1/2 (male), AISI 316L
RL	Thread JIS B0203 R 1/2 (male), AISI 316L
GP	Thread DIN 13 M 20x1.5 EN 837 hole 3 mm, AISI 316L
GQ	Thread DIN 13 M 20x1.5 EN 837 hole 3 mm, Alloy C
	Thread, flush-mounted process isolating diaphragm
1G	Thread ISO 228 G 1 1/2 A, AISI 316L
1H	Thread ISO 228 G 1 1/2 A, Alloy C
1J	Thread ISO 228 G 1 1/2 A, Monel
1K	Thread ISO 228 G 2 A, AISI 316L
1L	Thread ISO 228 G 2 A, Alloy C
1M	Thread ISO 228 G 2 A, Monel
2D	Thread ANSI 1 1/2 MNPT, AISI 316L (CRN)
2E	Thread ANSI 1 1/2 MNPT, Alloy C (CRN)
2F	Thread ANSI 1 1/2 MNPT, Monel (CRN)
2G	Thread ANSI 2 MNPT, AISI 316L (CRN)
2H	Thread ANSI 2 MNPT, Alloy C
2J	Thread ANSI 2 MNPT, Monel
1R	Thread DIN 13 M 44x1.25, AISI 316L
1S	Thread DIN 13 M 44x1.25, Alloy C
	EN/DIN flanges, flush-mounted process isolating diaphragm
CP	DN 32 PN 10-40 B1, AISI 316L

70	Process connection; Material:
CQ	DN 40 PN 10-40 B1, AISI 316L
BR	DN 50 PN 10-16 A, PVDF (max. 15 bar/225 psi, –10 to +60°C/+14 to +140°F)
B3	DN 50 PN 10-40 B1, AISI 316L
C3	DN 50 PN 63 B2, AISI 316L
BS	DN 80 PN 10-16 A, PVDF (max. 15 bar/225 psi, –10 to +60°C/+14 to +140°F)
B4	DN 80 PN 10-40 B1, AISI 316L
	ANSI flanges, flush-mounted process diaphragms
AE	1 1/2" 150 lbs RF, AISI 316/316L (CRN)
AQ	1 1/2" 300 lbs RF, AISI 316/316L (CRN)
AF	2" 150 lbs RF, AISI 316/316L (CRN)
JR	2" 150 lbs RF, AISI 316L with ECTFE-coating
A3	2" 150 lbs RF, PVDF (max. 15 bar/225 psi, –10 to +60°C/+14 to +140°F)
AR	2" 300 lbs RF, AISI 316/316L (CRN)
AG	3" 150 lbs RF, AISI 316/316L (CRN)
JS	3" 150 lbs RF, AISI 316L with ECTFE-coating
A4	3" 150 lbs RF, PVDF (max. 15 bar/225 psi, –10 to +60°C/+14 to +140°F)
AS	3" 300 lbs RF, AISI 316/316L (CRN)
AH	4" 150 lbs RF, AISI 316/316L (CRN)
JT	4" 150 lbs RF, AISI 316L with ECTFE-coating
AT	4" 300 lbs RF, AISI 316/316L (CRN)
	JIS flanges, flush-mounted process isolating diaphragm
KF	10K 50A RF, AISI 316L
KL	10K 80A RF, AISI 316L
KH	10K 100A RF, AISI 316L
	Hygienic connections, flush-mounted process isolating diaphragm
MP	DIN 11851 DN 40 PN 25, AISI 316L, slotted nut, EHEDG, 3A with HNBR/EPDM seal (CRN)
MR	DIN 11851 DN 50 PN 25, AISI 316L, slotted nut, EHEDG, 3A with HNBR/EPDM seal (CRN)
TD	Tri-Clamp ISO 2852 DN 51 (2"), AISI 316L, EHEDG, 3A with HNBR/EPDM seal (CRN)
TF	Tri-Clamp ISO 2852 DN 76.1 (3"), AISI 316L, EHEDG, 3A with HNBR/EPDM seal (CRN)
TK	DRD DN50 (65 mm), PN 25, AISI 316L, with HNBR/EPDM seal
TR	Varivent type N for tubes DN 40 – DN 162, PN 40, AISI 316L, EHEDG, 3A with HNBR/EPDM seal (CRN)

80	Seal:
A	FKM Viton
B	EPDM
D	Kalrez
E	Chemraz
F	NBR (FDA)/3A: HNBR (FDA)
L	FKM Viton, cleaned for silicone-free applications
M	Kalrez, cleaned for silicone-free applications
1	FKM Viton, cleaned from oil and grease
2	FKM Viton, cleaned for oxygen service Note application limits pressure/temp.

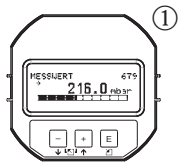
100	Additional option 1:
A	Not selected
E	SIL/IEC 61508 Declaration of Conformity
T	High-temperature version
B	Material test certificate for wetted components, inspection certificate as per EN 10204 3.1 acc. to specification 52005759
M	Overvoltage protection
J	Software setting, see additional spec. Min alarm current HART burst mode PV Min alarm current + HART burst mode PV
N	HistoROM/M-DAT
S	GL/ABS marine certificate
V	Mounting on shut-off valve from above
2	Test report acc. to EN 10204 2.2
3	Routine test with certificate, inspection certificate as per EN 10204 3.1
4	Overpressure test with certificate, inspection certificate as per EN 10204 3.1

110	Additional option 2:
A	Not selected
E	SIL2/IEC61508 Declaration of Conformity
G	Separate housing, cable length see additional spec. + mounting bracket, wall/pipe, 316L

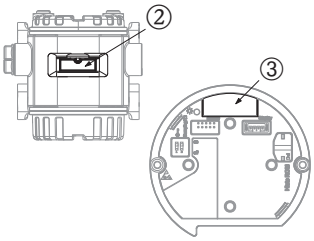
110										**Additional option 2:**	
										T	High-temperature version
										M	Overvoltage protection
										J	Software setting, see additional spec.
											Min alarm current
											HART burst mode PV
											Min alarm current + HART burst mode PV
										N	HistoROM/M-DAT
										S	GL/ABS marine certificate
										U	Mounting bracket for wall/pipe, AISI 304
										2	Test report acc. to EN10204 2.2
										3	Routine test with certificate, inspection certificate as per EN 10204 3.1
										4	Overpressure test with certificate, inspection certificate as per EN 10204 3.1
										5	Helium leak test EN 1518 with test certificate, inspection certificate as per EN 10204 3.1
995											**Identification:**
										1	Measuring point TAG, see additional specification
										2	Bus address, see additional specification
PMC71											Order code

PMP71

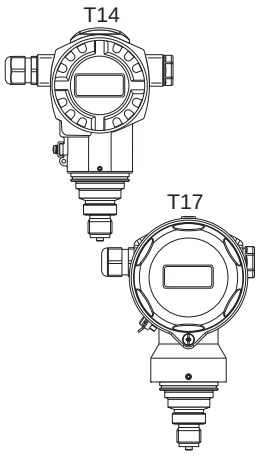
This overview does not mark options which are mutually exclusive.



10	Approval:
A	For non-hazardous areas
1	ATEX II 1/2 G Ex ia IIC T6
6	ATEX II 1/2 G Ex ia IIC T6, overfill protection WHG
2	ATEX II 1/2 D
4	ATEX II 1/3 D
8	ATEX II 1 GD Ex ia IIC T6
3	ATEX II 1/2 GD Ex ia IIC T6
5	ATEX II 2 G Ex d IIC T6
7	ATEX II 3 G Ex nA II T6
S	FM IS, Class I, II, III Division 1, Groups A – G; NI Class I Division 2, Groups A – D; AEx ia
T	FM XP, Class I Division 1, Groups A – D; AEx d
Q	FM DIP, Class II, III Division 1, Groups E – G
R	FM NI, Class I, Division 2, Groups A – D
U	CSA IS, Class I, II, III Division 1, Groups A – G; Class I Division 2, Groups A – D, Ex ia
V	CSA XP, Class I Division 1, Groups B – D; Ex d
W	CSA Class II, III Division 1, Groups E – G (Dust-Ex)
G	NEPSI Ex d IIC T6
H	NEPSI Ex ia IIC T6
L	TIIS Ex d IIC T6
I	IECEx Zone 0/1 Ex ia IIC T6
B	Combined certificates: ATEX II 1/2 G Ex ia IIC T6 + II 2 G Ex d IIC T6
C	Combined certificates: FM IS and XP Class I Division 1, Groups A – D
D	Combined certificates: CSA IS and XP Class I Division 1, Groups A – D
E	Combined certificates: FM/CSA IS and XP Class I Division 1, Groups A – D
F	Combined certificates: ATEX II Ex ia / Ex d + FM/CSA IS + XP ATEX II 1/2G Ex ia IIC T6+ ATEX II 2G Ex d IIC T6+ FM/CSA IS + XP Cl.I Div.1 Gr.A-D



20		Output; Operation:
A	4 to 20 mA HART, operation outside, LCD (→ see Fig. ①, ②)
B	4 to 20 mA HART, operation inside, LCD (→ see Fig. ①, ③)
C	4 to 20 mA HART, operation inside (→ see Fig. ③)
M	PROFIBUS PA, operation outside, LCD (→ see Fig. ①, ②)
N	PROFIBUS PA, operation inside, LCD (→ see Fig. ①, ③)
O	PROFIBUS PA, operation inside (→ see Fig. ③)
P	FOUNDATION Fieldbus, operation outside, LCD (→ see Fig. ①, ③)
Q	FOUNDATION Fieldbus, operation inside, LCD (→ see Fig. ①, ③)
R	FOUNDATION Fieldbus, operation inside (→ see Fig. ③)



30			Housing; Cable entry; Protection:
A	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Gland M 20x1.5
B	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread G 1/2
C	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread 1/2 NPT
D	Aluminum T14 housing, optional display on the side, IP66/67/NEMA 4X/ 6P, M 12x1 PA plug,
E	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, 7/8" FF plug
F	Aluminum T14 housing, optional display on the side, IP 65/NEMA 4X, Han7D plug, 90°
1	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Gland M 20x1.5
2	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread G 1/2
3	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread 1/2 NPT
4	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, M 12x1 PA plug
5	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, 7/8" FF plug
6	AISI 316L T14 housing, optional display on the side, IP 65/NEMA 4X, Han7D plug, 90°
R	T17 316L Hygiene IP66/68 NEMA6P; M20 gland, T17 = side cover
S	T17 316L Hygiene IP66/68 NEMA6P; G1/2 thread, T17 = side cover
T	T17 316L Hygiene IP66/68 NEMA6P; NPT1/2 thread, T17 = side cover
U	T17 316L Hygiene IP66/68 NEMA6P; M12 plug, T17 = side cover
V	T17 316L Hygiene IP66/68 NEMA6P; 7/8" plug, T17 = side cover

40				Sensor range; Sensor over pressure limit (= OPL):	
Sensors for gauge pressure		
Measurement limits: –100 % (–1 bar) to +100 % of sensor nominal value		
				Sensor rated value (URL)	**OPL (over pressure limit)**
1F	400 mbar/40 kPa/6 psi g	6 bar/600 kPa/90 psi g
1H	1 bar/100 kPa/15 psi g	10 bar/1 MPa/150 psi g
1K	2 bar/200 kPa/30 psi g	20 bar/2 MPa/300 psi g

40				Sensor range; Sensor over pressure limit (= OPL):	
			1M	4 bar/400 kPa/60 psi g	28 bar/2.8 MPa/420 psi g
			1P	10 bar/1 MPa/150 psi g	40 bar/4 MPa/600 psi g
			1S	40 bar/4 MPa/600 psi g	160 bar/16 MPa/2400 psi g
			1U	100 bar/10 MPa/1500 psi g	400 bar/40 MPa/6000 psi g
			1W	400 bar/40 MPa/6000 psi g	600 bar/60 MPa/9000 psi g
			1X	700 bar/70 MPa/10500 psi g	1050 bar/105 MPa/15700 psi g
			Sensors for absolute pressure		
				Sensor rated value (URL)	**OPL (over pressure limit)**
			2F	400 mbar/40 kPa/6 psi abs	6 bar/600 kPa/90 psi abs
			2H	1 bar/100 kPa/15 psi abs	10 bar/1 MPa/150 psi abs
			2K	2 bar/200 kPa/30 psi abs	20 bar/2 MPa/300 psi abs
			2M	4 bar/400 kPa/60 psi abs	28 bar/2.8 MPa/420 psi abs
			2P	10 bar/1 MPa/150 psi abs	40 bar/4 MPa/600 psi abs
			2S	40 bar/4 MPa/600 psi abs	160 bar/16 MPa/2400 psi abs
			2U	100 bar/10 MPa/1500 psi abs	400 bar/40 MPa/6000 psi g
			2W	400 bar/40 MPa/6000 psi g	600 bar/60 MPa/9000 psi g
			2X	700 bar/70 MPa/10500 psi g	1050 bar/105 MPa/15700 psi g

50						Calibration; Unit:
					1	Sensor range; mbar/bar
					2	Sensor range; kPa/MPa
					3	Sensor range; mmH_2O/mH_2O
					4	Sensor range; inH_2O/ftH_2O
					6	Sensor range; psi
					B	Customer-specific; see additional specification
					C	Factory calibration certificate, 5-point; see additional specification
					D	DKD certificate; see additional specification
					K	Platinum; see additional specification
					L	Platinum and factory calibration certificate, 5-point; see additional specification
					M	Platinum and DKD certificate; see additional specification

60							Material of the process isolating diaphragm:
						1	AISI 316L
						2	Alloy C276
						6	AISI 316L with gold-rhodium coating

70								Process connection; Material:
								Thread, internal process isolating diaphragm:
							GA	Thread ISO 228 G 1/2 A EN 837, AISI 316L
							GB	Thread ISO 228 G 1/2 A EN 837, Alloy C
							GE	Thread ISO 228 G 1/2 A G 1/4 (female), AISI 316L
							GF	Thread ISO 228 G 1/2 A G 1/4 (female), Alloy C
							GH	Thread ISO 228 G 1/2 A hole 11.4 mm, AISI 316L
							GJ	Thread ISO 228 G 1/2 A hole 11.4 mm, Alloy C
							RA	Thread ANSI 1/2 MNPT 1/4 FNPT, AISI 316L (CRN)
							RB	Thread ANSI 1/2 MNPT 1/4 FNPT, Alloy C (CRN)
							RD	Thread ANSI 1/2 MNPT hole, AISI 316L (CRN)
							RE	Thread ANSI 1/2 MNPT hole, Alloy C (CRN)
							RH	Thread ANSI 1/2 FNPT, AISI 316L (CRN)
							RJ	Thread ANSI 1/2 FNPT, Alloy C
							GL	Thread JIS B0202 G 1/2 (male), AISI 316L
							RL	Thread JIS B0203 R 1/2 (male), AISI 316L
								Thread, internal process isolating diaphragm
							GP	Thread DIN 13 M 20x1.5 EN 837 hole 11.4 mm, AISI 316L
							GQ	Thread DIN 13 M 20x1.5 EN 837 hole 11.4 mm, Alloy C
								Thread, flush-mounted process isolating diaphragm
							1A	Thread ISO 228 G 1/2 A, DIN 3852, AISI 316L
							1B	Thread ISO 228 G 1/2 A, DIN 3852, Alloy C
							1D	Thread ISO 228 G 1 A, AISI 316L
							1E	Thread ISO 228 G 1 A, Alloy C
							1G	Thread ISO 228 G 1 1/2 A, AISI 316L
							1H	Thread ISO 228 G 1 1/2 A, Alloy C
							1K	Thread ISO 228 G 2 A, AISI 316L
							1L	Thread ISO 228 G 2 A, Alloy C
							2A	Thread ANSI 1 MNPT, AISI 316L
							2B	Thread ANSI 1 MNPT, Alloy C (CRN)
							2D	Thread ANSI 1 1/2 MNPT, AISI 316L (CRN)
							2E	Thread ANSI 1 1/2 MNPT, Alloy C (CRN)
							2G	Thread ANSI 2 MNPT, AISI 316L (CRN)

70	Process connection; Material:
	2H Thread ANSI 2 MNPT, Alloy C
	1N Thread DIN 16288 M 20x1.5, AISI 316L
	1P Thread DIN 16288 M 20x1.5, Alloy C
	1R Thread DIN 13 M 44x1.25, AISI 316L
	1S Thread DIN 13 M 44x1.25, Alloy C
	EN/DIN flanges, flush-mounted process isolating diaphragm
	CN DN 25 PN 10-40 B1, AISI 316L
	CP DN 32 PN 10-40 B1, AISI 316L
	CQ DN 40 PN 10-40 B1, AISI 316L
	B3 DN 50 PN 10-40 B1, AISI 316L
	B4 DN 80 PN 10-40 B1, AISI 316L
	ANSI flanges, flush-mounted process isolating diaphragm
	AN 1" 300 lbs RF, AISI 316/316L (CRN)
	AE 1 1/2" 150 lbs RF, AISI 316/316L (CRN)
	AQ 1 1/2" 300 lbs RF, AISI 316/316L (CRN)
	AF 2" 150 lbs RF, AISI 316/316L (CRN)
	AR 2" 300 lbs RF, AISI 316/316L (CRN)
	AG 3" 150 lbs RF, AISI 316/316L (CRN)
	AS 3" 300 lbs RF, AISI 316/316L (CRN)
	AH 4" 150 lbs RF, AISI 316/316L (CRN)
	AT 4" 300 lbs RF, AISI 316/316L (CRN)
	JIS flanges, flush-mounted process isolating diaphragm
	KA 20K 25A RF, AISI 316L
	KF 10K 50A RF, AISI 316L
	KL 10K 80A RF, AISI 316L
	KH 10K 100A RF, AISI 316L
	Other
	UR Oval flange adapter 1/4-18 NPT, mounting: 7/16-20 UNF, AISI 316L (CRN)
	U1 Prepared for diaphragm seal mount, AISI 316L (CRN)

90	Fill fluid:
	A Silicone oil
	F Inert oil
	K Inert oil, cleaned from oil and grease
	N Inert oil, cleaned for oxygen service (observe application limits pressure/temperature)

100	Additional option 1:
	A Not selected
	E SIL/IEC 61508 Declaration of Conformity
	B Material test certificate for wetted components, inspection certificate as per EN 10204 3.1 acc. to specification 52005759
	C NACE MR0175 (wetted parts)
	D Material test certificate for wetted components as per EN 10204 3.1 and NACE MR0175 material, inspection certificate as per EN 10204 acc. to specification 52010806
	M Overvoltage protection
	V Mounting on shut-off valve from above
	J Software setting, see additional spec. Min alarm current HART burst mode PV Min alarm current + HART burst mode PV
	N HistoROM/M-DAT
	S GL/ABS marine certificate
	2 Test report acc. to EN10204 2.2
	3 Routine test with certificate, inspection certificate as per EN 10204 3.1
	4 Overpressure test with certificate, inspection certificate as per EN 10204 3.1

110	Additional option 2:
	A Not selected
	E SIL/IEC 61508 Declaration of Conformity
	G Separate housing, cable length see additional spec. + mounting bracket, wall/pipe, 316L
	M Overvoltage protection
	J Software setting, see additional spec. Min alarm current HART burst mode PV Min alarm current + HART burst mode PV
	N HistoROM/M-DAT
	S GL/ABS marine certificate

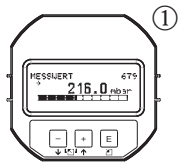
110											**Additional option 2:**	
											U	Mounting bracket for wall/pipe, AISI 304
											2	Test report acc. to EN 10204 2.2
											3	Individual testing with test certificate, inspection certificate as per EN10204 3.1
											4	Overpressure test with certificate, inspection certificate as per EN 10204 3.1
											5	Helium leak test EN 1528 with test certificate, inspection certificate as per EN 10204 3.1

995												**Identification:**
											1	Measuring point TAG, see additional specification
											2	Bus address, see additional specification

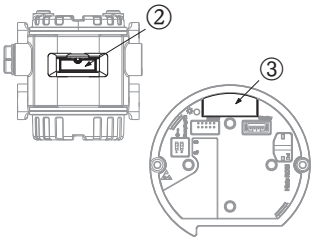
PMP71											Order code

PMP75

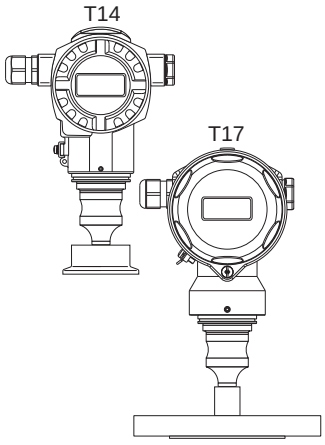
This overview does not mark options which are mutually exclusive.



10	Approval:
A	For non-hazardous areas
1	ATEX II 1/2 G Ex ia IIC T6
6	ATEX II 1/2 G Ex ia IIC T6, overfill protection WHG
2	ATEX II 1/2 D
4	ATEX II 1/3 D
8	ATEX II 1 GD Ex ia IIC T6
3	ATEX II 1/2 GD Ex ia IIC T6
5	ATEX II 2 G Ex d IIC T6
7	ATEX II 3 G Ex nA II T6
S	FM IS, Class I, II, III Division 1, Groups A – G; NI Class I Division 2, Groups A – D; AEx ia
T	FM XP, Class I Division 1, Groups A – D; AEx d
Q	FM DIP, Class II, III Division 1, Groups E – G
R	FM NI, Class I, Division 2, Groups A – D
U	CSA IS, Class I, II, III Division 1, Groups A – G; Class I Division 2, Groups A – D, Ex ia
V	CSA XP, Class I Division 1, Groups B – D; Ex d
W	CSA Class II, III Division 1, Groups E – G (Dust-Ex)
G	NEPSI Ex d IIC T6
H	NEPSI Ex ia IIC T6
L	TIIS Ex d IIC T6
I	IECEx Zone 0/1 Ex ia IIC T6
B	Combined certificates: ATEX II 1/2 G Ex ia IIC T6 + II 2 G Ex d IIC T6
C	Combined certificates: FM IS and XP Class I Division 1, Groups A – D
D	Combined certificates: CSA IS and XP Class I Division 1, Groups A – D
E	Combined certificates: FM/CSA IS and XP Class I Division 1, Groups A – D
F	Combined certificates: ATEX II Ex ia / Ex d + FM/CSA IS + XP ATEX II 1/2G Ex ia IIC T6+ ATEX II 2G Ex d IIC T6+ FM/CSA IS + XP Cl.I Div.1 Gr.A-D



20	Output; Operation:
A	4 to 20 mA HART, operation outside, LCD (→ see Fig. ①, ②)
B	4 to 20 mA HART, operation inside, LCD (→ see Fig. ①, ③)
C	4 to 20 mA HART, operation inside (→ see Fig. ③)
M	PROFIBUS PA, operation outside, LCD (→ see Fig. ①, ②)
N	PROFIBUS PA, operation inside, LCD (→ see Fig. ①, ③)
O	PROFIBUS PA, operation inside (→ see Fig. ③)
P	FOUNDATION Fieldbus, operation outside, LCD (→ see Fig. ①, ③)
Q	FOUNDATION Fieldbus, operation inside, LCD (→ see Fig. ①, ③)
R	FOUNDATION Fieldbus, operation inside (→ see Fig. ③)



30	Housing; Cable entry; Protection:
A	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Gland M 20x1.5
B	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread G 1/2
C	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread 1/2 NPT
D	Aluminum T14 housing, optional display on the side, IP66/67/NEMA 4X/ 6P, M 12x1 PA plug,
E	Aluminum T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, 7/8" FF plug
F	Aluminum T14 housing, optional display on the side, IP 65/NEMA 4X, Han7D plug, 90°
1	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Gland M 20x1.5
2	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread G 1/2
3	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, Thread 1/2 NPT
4	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, M 12x1 PA plug
5	AISI 316L T14 housing, optional display on the side, IP 66/67/NEMA 4X/ 6P, 7/8" FF plug
6	AISI 316L T14 housing, optional display on the side, IP 65/NEMA 4X, Han7D plug, 90°
R	T17 316L Hygiene IP66/68 NEMA6P; M20 gland, T17 = side cover
S	T17 316L Hygiene IP66/68 NEMA6P; G1/2 thread, T17 = side cover
T	T17 316L Hygiene IP66/68 NEMA6P; NPT1/2 thread, T17 = side cover
U	T17 316L Hygiene IP66/68 NEMA6P; M12 plug, T17 = side cover
V	T17 316L Hygiene IP66/68 NEMA6P; 7/8" plug, T17 = side cover

40	Sensor range; Sensor over pressure limit (= OPL):		
	Sensors for gauge pressure		
	Measurement limits: −100 % (−1 bar) to +100 % of sensor nominal value		
		Sensor rated value (URL)	**OPL (over pressure limit)**
1F		400 mbar/40 kPa/6 psi	6 bar/600 kPa/90 psi
1H		1 bar/100 kPa/15 psi	10 bar/1 MPa/150 psi
1K		2 bar/200 kPa/30 psi	20 bar/2 MPa/300 psi
1M		4 bar/400 kPa/60 psi	28 bar/2.8 MPa/420 psi

40	Sensor range; Sensor over pressure limit (= OPL):		
	1P	10 bar/1 MPa/150 psi	40 bar/4 MPa/600 psi
	1S	40 bar/4 MPa/600 psi	160 bar/16 MPa/2400 psi
	1U	100 bar/10 MPa/1500 psi	400 bar/40 MPa/6000 psi
	1W	400 bar/40 MPa/6000 psi	600 bar/60 MPa/9000 psi
	Sensors for absolute pressure		
		Sensor rated value (URL)	**OPL (over pressure limit)**
	2F	400 mbar/40 kPa/6 psi abs	6 bar/600 kPa/90 psi abs
	2H	1 bar/100 kPa/15 psi abs	10 bar/1 MPa/150 psi abs
	2K	2 bar/200 kPa/30 psi abs	20 bar/2 MPa/300 psi abs
	2M	4 bar/400 kPa/60 psi abs	28 bar/2.8 MPa/420 psi abs
	2P	10 bar/1 MPa/150 psi abs	40 bar/4 MPa/600 psi abs
	2S	40 bar/4 MPa/600 psi abs	160 bar/16 MPa/2400 psi abs
	2U	100 bar/10 MPa/1500 psi abs	400 bar/40 MPa/6000 psi g
	2W	400 bar/40 MPa/6000 psi g	600 bar/60 MPa/9000 psi g

50	Calibration; Unit:	
	1	Sensor range; mbar/bar
	2	Sensor range; kPa/MPa
	3	Sensor range; mmH_2O/mH_2O
	4	Sensor range; inH_2O/ftH_2O
	6	Sensor range; psi
	B	Customer-specific; see additional specification
	C	Factory calibration certificate, 5-point; see additional specification
	D	DKD calibration: see additional specification

60	Material of the process isolating diaphragm:	
	1	AISI 316L
	2	Alloy C276
	3	Monel
	5	Tantalum
	6	AISI 316L with gold-rhodium coating
	7	AISI 316L with 0.09 mm PTFE foil (not for vacuum applications)
	8	AISI 316L with 0.25 mm PTFE foil (not for vacuum applications, only for non-hazardous areas)

70	Process connection, material:	
		Thread, flush-mounted process isolating diaphragm
	1D	Thread ISO 228 G 1 A, AISI 316L
	1E	Thread ISO 228 G 1 A, Alloy C
	1G	Thread ISO 228 G 1 1/2 A, AISI 316L
	1H	Thread ISO 228 G 1 1/2 A, Alloy C
	1K	Thread ISO 228 G 2 A, AISI 316L
	1L	Thread ISO 228 G 2 A, Alloy C
	2A	Thread ANSI 1 MNPT, AISI 316L
	2B	Thread ANSI 1 MNPT, Alloy C (CRN)
	2D	Thread ANSI 1 1/2 MNPT, AISI 316L (CRN)
	2E	Thread ANSI 1 1/2 MNPT, Alloy C (CRN)
	2G	Thread ANSI 2 MNPT, AISI 316L (CRN)
	2H	Thread ANSI 2 MNPT, Alloy C (CRN)
		Clamp connections
	TB	Tri-Clamp, ISO 2852 DN 25 (1"), DIN 32676 DN 25, AISI 316L (CRN), EHEDG
	TC	Tri-Clamp, ISO 2852 DN 38 (1 1/2"), DIN 32676 DN 40, AISI 316L (CRN), EHEDG
	TD	Tri-Clamp, ISO 2852 DN 51 (2")/DN 50, AISI 316L (CRN), EHEDG
	TF	Tri-Clamp, ISO 2852 DN 76.1 (3"), AISI 316L (CRN), EHEDG
		Pipe diaphragm seal Clamp connections
	SB	Tri-Clamp, ISO 2852 DN 25 (1"), AISI 316L (CRN)
	SC	Tri-Clamp, ISO 2852 DN 38 (1 1/2"), AISI 316L, 3.1 + Pressure test acc. to PED Cat.II (CRN)
	SD	Tri-Clamp, ISO 2852 DN 51 (2"), AISI 316L, 3.1 + Pressure test acc. to PED Cat.II (CRN)
		Hygienic connections
	MR	DIN 11851 DN 50 PN 25, slotted nut, AISI 316L, EHEDG, 3A
	MS	DIN 11851 DN 65 PN 25, slotted nut, AISI 316L, EHEDG, 3A
	MT	DIN 11851 DN 80 PN 25, slotted nut, AISI 316L, EHEDG, 3A
	M3	DIN 11851 DN 50 PN 25, threaded adapter, AISI 316L, EHEDG
	M4	DIN 11851 DN 65 PN 25, threaded adapter, AISI 316L, EHEDG
	M5	DIN 11851 DN 80 PN 25, threaded adapter, AISI 316L, EHEDG
	TG	SMS 1" PN 25, AISI 316L, EHEDG
	TH	SMS 1 1/2" PN 25, AISI 316L, EHEDG
	TI	SMS 2" PN 25, AISI 316L, EHEDG
	TL	APV-RJT 1" PN 40, AISI 316L

70		Process connection, material:
	TM	APV-RJT 1 1/2" PN 40, AISI 316L
	TN	APV-RJT 2" PN 40, AISI 316L
	TP	APV-ISS 1" PN 40, AISI 316L
	TQ	APV-ISS 1 1/2" PN 40, AISI 316L
	TS	APV-ISS 2" PN 40, AISI 316L
	TK	DRD DN50 (65 mm) PN 25, AISI 316L
	TR	Varivent Type N for pipes DN 40 – DN 162 PN 40, AISI 316L, EHEDG
	00	Universal process adapter 44 mm including silicon molded seal, EHEDG, 3A (CRN)
		EN/DIN flanges, flush-mounted process isolating diaphragm
	CN	DN 25 PN 10-40 B1, AISI 316L
	DN	DN 25 PN 63-160 E, AISI 316L
	EN	DN 25 PN 250 E, AISI 316L
	E1	DN 25 PN 400 E, AISI 316L
	CP	DN 32 PN 10-40 B1, AISI 316L
	CQ	DN 40 PN 10-40 B1, AISI 316L
	B3	DN 50 PN 10-40 B1, AISI 316L
	C3	DN 50 PN 63 B2, AISI 316L
	EF	DN 50 PN 100-160 E, AISI 316L
	ER	DN 50 PN 250 E, AISI 316L
	E3	DN 50 PN 400 E, AISI 316L
	B4	DN 80 PN 10-40 B1, AISI 316L
	C4	DN 80 PN 100 B2, AISI 316L
	C5	DN 100 PN 100 B2, AISI 316L
		EN/DIN flanges with extended diaphragm seal, flush-mounted process isolating diaphragm
	D3	DN 50 PN 10-40 B1, extended diaphragm seal 50 mm/100 mm/200 mm, AISI 316L
	D4	DN 80 PN 10-40 B1, extended diaphragm seal 50 mm/100 mm/200 mm, AISI 316L
		ANSI flanges, flush-mounted process isolating diaphragm
	AC	1" 150 lbs RF, AISI 316/316L (CRN)
	AN	1" 300 lbs RF, AISI 316/316L (CRN)
	HC	1" 400/600 lbs RF, AISI 316/316L (CRN)
	HN	1" 900/1500 lbs RF, AISI 316/316L (CRN)
	H0	1" 2500 lbs RF, AISI 316/316L (CRN)
	AE	1 1/2" 150 lbs RF, AISI 316/316L (CRN)
	AQ	1 1/2" 300 lbs RF, AISI 316/316L (CRN)
	AF	2" 150 lbs RF, AISI 316/316L (CRN)
	AR	2" 300 lbs RF, AISI 316/316L (CRN)
	HF	2" 400/600 lbs RF, AISI 316/316L (CRN)
	HR	2" 900/1500 lbs RF, AISI 316/316L (CRN)
	H3	2" 2500 lbs RF, AISI 316/316L
	AG	3" 150 lbs RF, AISI 316/316L (CRN)
	AS	3" 300 lbs RF, AISI 316/316L (CRN)
	AH	4" 150 lbs RF, AISI 316/316L (CRN)
	AT	4" 300 lbs RF, AISI 316/316L (CRN)
		ANSI flanges with extended diaphragm seal, flush-mounted process isolating diaphragm
	J3	2" 150 lbs RF, extended diaphragm seal 2"/4"/6"/8", AISI 316/316L (CRN)
	J4	3" 150 lbs RF, extended diaphragm seal 2"/4"/6"/8", AISI 316/316L (CRN)
	J7	3" 300 lbs RF, extended diaphragm seal 2"/4"/6"/8", AISI 316/316L (CRN)
	J5	4" 150 lbs RF, extended diaphragm seal 2"/4"/6"/8", AISI 316/316L (CRN)
	J8	4" 300 lbs RF, extended diaphragm seal 2"/4"/6"/8", AISI 316/316L (CRN)
		JIS flanges, flush-mounted process isolating diaphragm
	KC	10K 25A RF, AISI 316L
	KF	10K 50A RF, AISI 316L
	KL	10K 80A RF, AISI 316L
	KH	10K 100A RF, AISI 316L
		Other
	UA	Thread ISO 228 G 1/2 A PN 160, separator, EN 837, welded, AISI 316L
	UB	Thread ANSI 1/2 MNPT PN 160, separator, welded, AISI 316L (CRN)
	UC	Thread ISO 228 G 1/2 B, separator, EN 837, threaded, AISI 316L
	UD	Thread ANSI 1/2 MNPT, separator, threaded, AISI 316L
	UG	Thread 1/2 NPT PN 250, separator, threaded, AISI 316L
	UH	Thread 1 NPT PN 250, separator, threaded, AISI 316L

90		Fill fluid, temperature isolation:
	A	Silicone oil
	B	...m capillary, inert oil
	C	...ft capillary, inert oil
	D	Vegetable oil

90	Fill fluid, temperature isolation:
F	Inert oil
G	High-temperature oil, temp. isolator 100 mm
H	Silicone oil, temp. isolator 100 mm
K	Inert oil, cleaned from oil and grease
N	Inert oil, cleaned for oxygen services
1	... m capillary, silicone oil
2	... ft capillary, silicone oil
3	... m capillary, high-temperature oil
4	... ft capillary, high-temperature oil
5	... m capillary, vegetable oil
6	... ft capillary, vegetable oil
7	... m capillary, low-temperature oil
8	... ft capillary, low-temperature oil

100	Additional option 1:
A	Not selected
E	SIL2/IEC61508 Declaration of Conformity
B	Material test certificate for wetted components, inspection certificate as per EN 10204 3.1 acc. to specification 52005759
C	NACE MR0175 (wetted parts)
D	Material test certificate for wetted parts, inspection certificate as per EN 10204 3.1 and NACE MR0175 material, inspection certificate as per EN 10204 acc. to specification 52010806
M	Overvoltage protection
J	Software setting, see additional spec.
	Min alarm current
	HART burst mode PV
	Min alarm current + HART burst mode PV
N	HistoROM/M-DAT
S	GL/ABS marine certificate
2	Test report acc. to EN10204 2.2
3	Routine test with certificate, inspection certificate as per EN 10204 3.1
4	Overpressure test with certificate, inspection certificate as per EN 10204 3.1

110	Additional option 2:
A	Not selected
E	SIL2/IEC61508 Declaration of Conformity
G	Separate housing, cable length see additional spec. + mounting bracket, wall/pipe, 316L
M	Overvoltage protection
J	Software setting, see additional spec.
	Min alarm current
	HART burst mode PV
	Min alarm current + HART burst mode PV
N	HistoROM/M-DAT
P	Ra < 0.38 µm/15.75 µin, electropolished + EN10204-3.1 material (wetted) inspection certificate; in conjunction with process connection versions "TC", "TD" and "TR" please order roughness test separately
S	GL/ABS marine certificate
U	Mounting bracket for wall/pipe, AISI 304
2	Test report acc. to EN 10204 2.2
3	Routine test with certificate, inspection certificate as per EN 10204 3.1
4	Overpressure test with certificate, inspection certificate as per EN 10204 3.1

995	Identification:
1	Measuring point TAG, see additional specification
2	Bus address, see additional specification

PMP75	Order code

Additional documentation

Field of Activities	■ Pressure measurement, powerful instruments for process pressure, differential pressure, level and flow: FA004P/00/EN
Technical Information	■ Deltabar S: TI382P/00/EN ■ Deltapilot S: TI416P/00/EN ■ EMC test procedures TI241F/00/EN
Operating Instructions	4 to 20 mA HART: ■ Cerabar S: BA271P/00/EN ■ Description of device functions Cerabar S/Deltabar S/Deltapilot S: BA274P/00/EN PROFIBUS PA: ■ Cerabar S: BA295P/00/EN ■ Description of device functions Cerabar S/Deltabar S/Deltapilot S: BA296P/00/EN FOUNDATION Fieldbus: ■ Cerabar S: BA302P/00/EN ■ Description of device functions Cerabar S/Deltabar S/Deltapilot S: BA303P/00/EN
Brief Operating Instructions	■ 4 to 20 mA HART, Cerabar S: KA1019P/00/EN ■ PROFIBUS PA, Cerabar S: KA1022P/00/EN ■ FOUNDATION Fieldbus, Cerabar S: KA1025P/00/EN
Functional safety manual (SIL)	■ Cerabar S (4 to 20 mA): SD190P/00/EN

Safety Instructions

Certificate/type of protection	Device	Electronics	Documentation	Version in the order code
ATEX II 1/2 G Ex ia IIC T6	PMC71, PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XA244P	1
ATEX II 1/2 D	PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– XA246P – XA289P	2
ATEX II 1/2 D Ex ia IIC	PMC71	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– XA247P – XA290P	2
ATEX II 1/3 D	PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– XA248P – XA291P	4
ATEX II 2 G Ex d IIC T6	PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XA249P	5
ATEX II 2 G Ex d[ia] IIC T6	PMC71	– 4 to 20 mA HART, PROFIBUS PA., FOUNDATION Fieldbus	– XA250P	5
ATEX II 3 G Ex nA II T6	PMC71, PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XA251P	7
ATEX II 1/2 GD Ex ia IIC T6	PMC71, PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XA253P	3
ATEX II 1 GD Ex ia IIC T6	PMC71, PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XA276P	8
ATEX II 1/2 G Ex ia IIC T6 + ATEX II 2 G Ex d IIC T6	PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XA252P	B

Certificate/type of protection	Device	Electronic insert	Documentation	Version in the order code
IECEx Zone 0/1 Ex ia IIC T6	PMC71, PMP71, PMP75	– 4 to 20 mA HART	– XB005P	I

Certificate/type of protection	Device	Electronic insert	Documentation	Version in the order code
NEPSI Ex ia IIC T6	PMC71, PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XC003P	H
NEPSI Ex d IIC T6	PMP71, PMP75	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XC005P	G
NEPSI Ex d[ia] IIC T6	PMC71	– 4 to 20 mA HART, PROFIBUS PA, FOUNDATION Fieldbus	– XC005P	G

Certificate/type of protection	Device	Electronics	Documentation	Version in the order code
TIIS Ex d [ia] IIC T6	PMC71	– 4 to 20 mA HART	– TC17436	L
TIIS Ex d [ia] IIC T4	PMC71	– 4 to 20 mA HART	– TC17398, TC17399	M
TIIS Ex d IIC T6	PMP71 (700 bar version)	– 4 to 20 mA HART	– TC17445	L
TIIS Ex d IIC T6	PMP71, PMP75	– 4 to 20 mA HART	– TC17446	L

Installation/Control Drawings

Certificate/type of protection	Device	Electronics	Documentation	Version in the order code
FM IS Class I, II, III, Division 1, Groups A – G; NI, Class I Division 2, Groups A – D; AEx ia	PMC71, PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– ZD147P – ZD188P	S
CSA IS Class I, II, III, Division 1, Groups A – G; Class I Division 2, Groups A – G	PMC71, PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– ZD148P – ZD189P	U
FM IS + XP Class I, Division 1, Groups A – D	PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– ZD187P – ZD190P	C
CSA IS + XP Class I Division 1, Groups A – D	PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– ZD154P – ZD191P	D
FM/CSA IS + XP Class I Division 1, Groups A – D	PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– ZD154P + ZD187P – ZD190P + ZD191P	E
CSA +XP Class I Division 1, Groups B - D, Class II Division 1, Groups E - G, Class III	PMP71, PMP75	– 4 to 20 mA HART – PROFIBUS PA, FOUNDATION Fieldbus	– Under development	-

Overfill protection

- WHG: ZE260P/00/DE

Instruments International

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Endress+Hauser
People for Process Automation

TI383P/00/EN/05.10
No 71111803
CSS/FM+SGML 6.0

71111803

11.2 Endress & Hauser Promag 400 Flow Meter (WTP)

Item	Qty.	Unit	Ordercode Description	Unit Price CAD	Total Net CAD
			Production time upon request		
0022	1	PC	5W4C2F-70M0/101 5W4C2F-C6ALHA0DUA1K0B+ ACDADBLDL4Z1 **Promag W 400, 5W4C2F, DN250 10"** Electromagnetic flowmeter Inline version. The specialist in the water and wastewater industry for the most demanding applications. International drinking water approvals. Installation length: DVGW/ISO conform. Corrosion-resistant transmitter version. Same housing for compact/remote version. :: Certified corrosion protection (optional); state-of-the-art transmitter for W + WW. :: For direct underground installation or permanent underwater use (optional).		

additional specifications

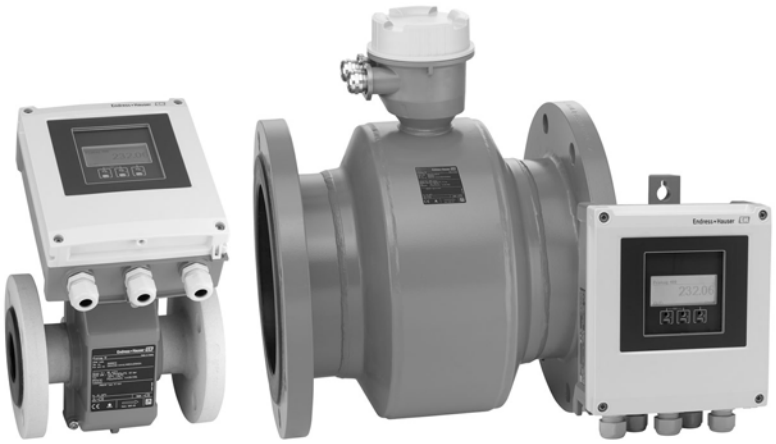
Curr. output 1	Volume flow	
Current span	4...20 mA NAMUR	
Value 0/4 mA	0.00000	m3/h
Value 20 mA	1,440.00000	m3/h
Failsafe mode current output	Max.	
Damping output 1	1.00000	s
Operating mode	Pulse	
Assign pulse output	Volume flow	
Pulse value (per pulse)	1.00000	m3
Pulse width	100.000	ms
Failsafe mode pulse output	No pulses	
1x TAG-stainless steel label	50105107 FIT-5001	

C6 Approval: CSA C/US NI Cl.I Div.2 Gr. ABCD
A Design: Insertion length short ISO/DVGW until DN400, DN450-2000 1:1
L Power Supply: 100-240VAC/24VAC/DC
H Output; Input: 4-20mA HART, pulse/freq.,switch output
A Housing: Compact, alu, coated
0 Cable, Remote Version: Not used
D Electrical Connection: Thread NPT1/2
U Liner: Polyurethane
A1K Process Connection: Cl.150, carbon steel, flange ASME B16.5

Item	Qty.	Unit	Ordercode Description	Unit Price CAD	Total Net CAD
			0 Electrodes: 1.4435/316L B Calibration Flow: 0.2% AC > Operation Language Display: French DA > > Customized Parameterization: Output 1 DB > > Customized Parameterization: Output 2 LD > > Additional Approval: CRN L4 > > Additional Approval: NSF 61 Drinking water approval Z1 > > Marking: Tagging (TAG), see additional spec. Production Time: 2 Weeks(s). Delivery time extra.		
0023	2	PC	DK5GD-2FAUL **Promag, disque de masse/de protection** Includes 1 grounding disc/protection disc 2FA Nominal Diameter: DN250 10", 1.4435/316L U Liner: Polyurethane L Process Connection: Cl.150 ANSI B16.5 Production Time: 7 Day(s). Delivery time extra.		
0026	1	PC	10W1H-ULGA1RG5B4AA **Promag 10W1H, DN100 4"** Electromagnetic flowmeter **additional specifications** Language English Assign line 1 Volume flow Assign line 2 Totalizer 1 Assign current output Volume flow Current span 4-20 mA HART US Value 20 mA 300.000 USgal/min Time constant 1.000 s Assign pulse output Volume flow Pulse value (per pulse) 2.00000 USgal Pulse width 100.000 ms Output signal Passive - negative Failsafe mode current/pulse output Min. value Assign totalizer 1 Volume flow Unit totalizer 1 USgal 1x TAG-stainless steel label 50105107 TAG a confirmer U Liner: Polyurethane L Process Connection: Cl.150, A105, flange ANSI		

Technical Information
Proline Promag W 400

Electromagnetic flowmeter



The flowmeter with integrated web server & sensor with EN ISO 12944 corrosion protection

Application

- The measuring principle is practically independent of pressure, density, temperature and viscosity
- The specialist for very demanding applications in the water and wastewater industry

Device properties
- International drinking water approvals
- Degree of protection IP68 (Type 6P enclosure)
- Approved for custody transfer to MI-001/OIML R49
- Transmitter housing made of durable polycarbonate or aluminum
- Same housing concept for compact/remote version
- Integrated data logger for measured values monitoring

Your benefits

- For direct underground installation or permanent underwater use
- Safe, reliable long-term operation – robust and completely welded sensor
- Energy-saving flow measurement – no pressure loss due to cross-section constriction
- Maintenance-free – no moving parts
- Safe operation – no need to open device thanks to touch control display, backlighting
- Time-saving local operation without additional software and hardware – integrated web server
- Integrated verification – Heartbeat Technology™

Endress+Hauser
People for Process Automation

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Document information

Symbols used

Electrical symbols

Symbol	Meaning	Symbol	Meaning
⎓	Direct current	~	Alternating current
⎓~	Direct current and alternating current	⏚	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
⊜	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.	⏚	**Equipotential connection** A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice.

Symbols for certain types of information

Symbol	Meaning
✓	**Permitted** Procedures, processes or actions that are permitted.
✓✓	**Preferred** Procedures, processes or actions that are preferred.
✗	**Forbidden** Procedures, processes or actions that are forbidden.
ℹ	**Tip** Indicates additional information.
📖	Reference to documentation
📄	Reference to page
🖼	Reference to graphic
👁	Visual inspection

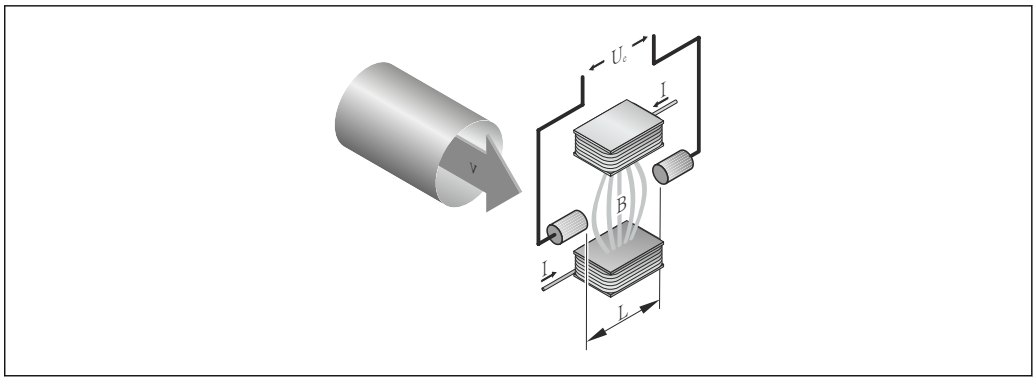
Symbols in graphics

Symbol	Meaning	Symbol	Meaning
1, 2, 3,...	Item numbers	1., 2., 3., ...	Series of steps
A, B, C, ...	Views	A-A, B-B, C-C, ...	Sections
EX	Hazardous area	EX	Safe area (non-hazardous area)
≈➡	Flow direction		

Function and system design

Measuring principle

Following *Faraday's law of magnetic induction*, a voltage is induced in a conductor moving through a magnetic field.



A0017035

Ue Induced voltage
B Magnetic induction (magnetic field)
L Electrode spacing
I Current
v Flow velocity

In the electromagnetic measuring principle, the flowing medium is the moving conductor. The voltage induced (U_e) is proportional to the flow velocity (v) and is supplied to the amplifier by means of two measuring electrodes. The flow volume (Q) is calculated via the pipe cross-section (A). The DC magnetic field is created through a switched direct current of alternating polarity.

Formulae for calculation

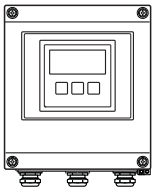
- Induced voltage $U_e = B \cdot L \cdot v$
- Volume flow $Q = A \cdot v$

Measuring system

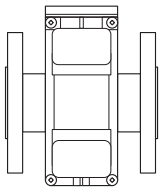
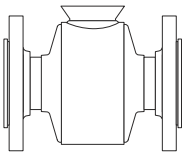
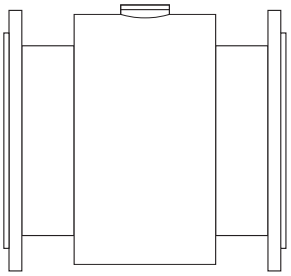
The device consists of a transmitter and a sensor.

Two device versions are available:
- Compact version - transmitter and sensor form a mechanical unit.
- Remote version - transmitter and sensor are mounted in separate locations.

Transmitter

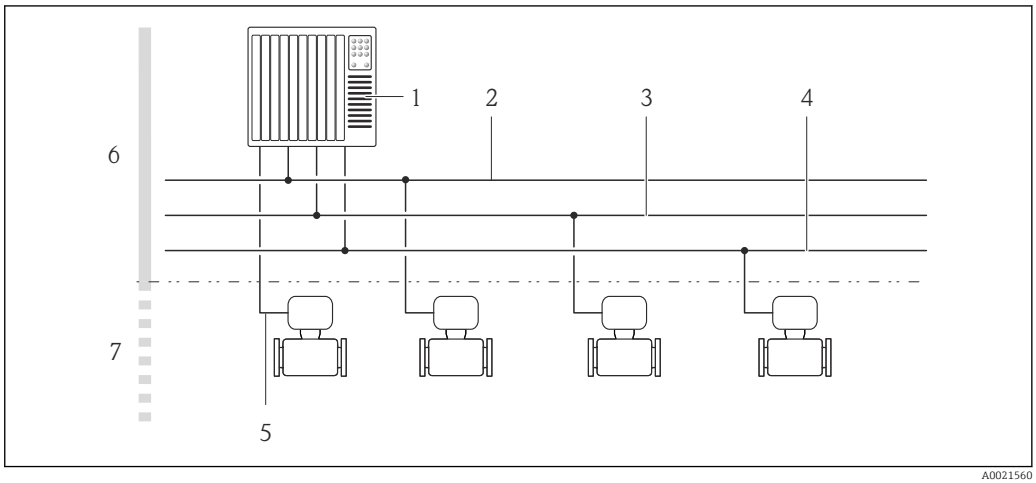
Promag 400  A0017117	Device versions and materials ▪ Compact version: compact housing – Polycarbonate plastic – Aluminum, AlSi10Mg, coated ▪ Remote version: wall-mount housing – Polycarbonate plastic – Aluminum, AlSi10Mg, coated Configuration: ▪ External operation via four-line, illuminated local display with touch control and guided menus ("Make-it-run" wizards) for applications ▪ Via operating tools (e.g. FieldCare) ▪ Via Web browser (e.g. Microsoft Internet Explorer) ▪ Also for device version with EtherNet/IP output: – Via Add-on Profile Level 3 for automation system from Rockwell Automation – Via Electronic Data Sheet (EDS) ▪ Also for device version with PROFIBUS DP output: Via PDM driver for Siemens automation system

Sensor

Promag W *Fixed flange: DN 25 to 300 (1 to 12")*  A0017040 *Fixed flange: DN 25 to 300 (1 to 12")*  A0022673 *Fixed flange: DN 350 to 2000 (14 to 78")*  A0017041	▪ Nominal diameter range: DN 25 to 2000 (1 to 78") ▪ Materials: – Sensor housing: aluminum, AlSi10Mg, coated; carbon steel with protective varnish – Sensor connection housing (standard): aluminum, AlSi10Mg, coated Sensor connection housing (option): polycarbonate – Measuring tubes [1]: DN 25 to 300 (1 to 12"): stainless steel, 1.4301/1.4306/304/304L DN 350 to 2000 (14 to 78"): stainless steel, 1.4301/304 – Liner: hard rubber, polyurethane – Electrodes: stainless steel, 1.4435 (316L); Alloy C22, 2.4602 (UNS N06022); tantalum – Process connections: Stainless steel, 1.4404/1.4571/F316L Carbon steel, A105/A181/A350LF2/A515(70)/FE410WB/S235JRG2/S235J+N/S275JR/P235GH/P250GH/P265GH – Seals: as per DIN EN 1514-1 – Ground disks: stainless steel, 1.4435 (316L); Alloy C22, 2.4602 (UNS N06022); tantalum

1) For carbon steel flange material with Al/Zn protective coating (DN 25 to 300 (1 to 12")), protective varnish (IP68) (DN 50 to 300 (2 to 12")) or protective varnish ≥ DN 350 (14")

Equipment architecture



1 *Possibilities for integrating measuring devices into a system*

1 *Control system (e.g. PLC)*
2 *EtherNet/IP*
3 *PROFIBUS DP*
4 *Modbus RS485*
5 *4-20 mA HART, pulse/frequency/switch output*
6 *Non-hazardous area*
7 *Non-hazardous area and Zone 2/Div. 2*

Safety

IT security

We only provide a warranty if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the device settings.

IT security measures in line with operators' security standards and designed to provide additional protection for the device and device data transfer must be implemented by the operators themselves.

Input

Measured variable

Direct measured variables

- Volume flow (proportional to induced voltage)
- Electrical conductivity

In custody transfer: only volume flow

Calculated measured variables

Mass flow

Measuring range

Typically v = 0.01 to 10 m/s (0.03 to 33 ft/s) with the specified accuracy

Electrical conductivity: 5 to 10 000 µS/cm

Flow characteristic values in SI units

Nominal diameter		Recommended flow	Factory settings		
		Min./max. full scale value (v ~ 0.3/10 m/s)	Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cut off (v ~ 0.04 m/s)
[mm]	[in]	[m³/h]	[m³/h]	[m³]	[m³/h]
25	1	9 to 300 dm³/min	75 dm³/min	0.5 dm³	1 dm³/min
32	–	15 to 500 dm³/min	125 dm³/min	1 dm³	2 dm³/min

Nominal diameter		Recommended flow	Factory settings		
		Min./max. full scale value (v ~ 0.3/10 m/s)	Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cut off (v ~ 0.04 m/s)
[mm]	[in]	[m³/h]	[m³/h]	[m³]	[m³/h]
40	1 ½	25 to 700 dm³/min	200 dm³/min	1.5 dm³	3 dm³/min
50	2	35 to 1 100 dm³/min	300 dm³/min	2.5 dm³	5 dm³/min
65	–	60 to 2 000 dm³/min	500 dm³/min	5 dm³	8 dm³/min
80	3	90 to 3 000 dm³/min	750 dm³/min	5 dm³	12 dm³/min
100	4	145 to 4 700 dm³/min	1 200 dm³/min	10 dm³	20 dm³/min
125	–	220 to 7 500 dm³/min	1 850 dm³/min	15 dm³	30 dm³/min
150	6	20 to 600	150	0.025	2.5
200	8	35 to 1 100	300	0.05	5
250	10	55 to 1 700	500	0.05	7.5
300	12	80 to 2 400	750	0.1	10
350	14	110 to 3 300	1 000	0.1	15
375	15	140 to 4 200	1 200	0.15	20
400	16	140 to 4 200	1 200	0.15	20
450	18	180 to 5 400	1 500	0.25	25
500	20	220 to 6 600	2 000	0.25	30
600	24	310 to 9 600	2 500	0.3	40
700	28	420 to 13 500	3 500	0.5	50
750	30	480 to 15 000	4 000	0.5	60
800	32	550 to 18 000	4 500	0.75	75
900	36	690 to 22 500	6 000	0.75	100
1 000	40	850 to 28 000	7 000	1	125
–	42	950 to 30 000	8 000	1	125
1 200	48	1 250 to 40 000	10 000	1.5	150
–	54	1 550 to 50 000	13 000	1.5	200
1 400	–	1 700 to 55 000	14 000	2	225
–	60	1 950 to 60 000	16 000	2	250
1 600	–	2 200 to 70 000	18 000	2.5	300
–	66	2 500 to 80 000	20 500	2.5	325
1 800	72	2 800 to 90 000	23 000	3	350
–	78	3 300 to 100 000	28 500	3.5	450
2 000	–	3 400 to 110 000	28 500	3.5	450

Flow characteristic values in US units

Nominal diameter		Recommended flow	Factory settings		
		Min./max. full scale value (v ~ 0.3/10 m/s)	Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cut off (v ~ 0.04 m/s)
[in]	[mm]	[gal/min]	[gal/min]	[gal]	[gal/min]
1	25	2.5 to 80	18	0.2	0.25
–	32	4 to 130	30	0.2	0.5
1 ½	40	7 to 190	50	0.5	0.75
2	50	10 to 300	75	0.5	1.25
–	65	16 to 500	130	1	2
3	80	24 to 800	200	2	2.5
4	100	40 to 1250	300	2	4
–	125	60 to 1950	450	5	7
6	150	90 to 2650	600	5	12
8	200	155 to 4850	1200	10	15
10	250	250 to 7500	1500	15	30
12	300	350 to 10600	2400	25	45
14	350	500 to 15000	3600	30	60
15	375	600 to 19000	4800	50	60
16	400	600 to 19000	4800	50	60
18	450	800 to 24000	6000	50	90
20	500	1000 to 30000	7500	75	120
24	600	1400 to 44000	10500	100	180
28	700	1900 to 60000	13500	125	210
30	750	2150 to 67000	16500	150	270
32	800	2450 to 80000	19500	200	300
36	900	3100 to 100000	24000	225	360
40	1000	3800 to 125000	30000	250	480
42	–	4200 to 135000	33000	250	600
48	1200	5500 to 175000	42000	400	600
54	–	9 to 300 Mgal/d	75 Mgal/d	0.0005 Mgal/d	1.3 Mgal/d
–	1400	10 to 340 Mgal/d	85 Mgal/d	0.0005 Mgal/d	1.3 Mgal/d
60	–	12 to 380 Mgal/d	95 Mgal/d	0.0005 Mgal/d	1.3 Mgal/d
–	1600	13 to 450 Mgal/d	110 Mgal/d	0.0008 Mgal/d	1.7 Mgal/d
66	–	14 to 500 Mgal/d	120 Mgal/d	0.0008 Mgal/d	2.2 Mgal/d
72	1800	16 to 570 Mgal/d	140 Mgal/d	0.0008 Mgal/d	2.6 Mgal/d
78	–	18 to 650 Mgal/d	175 Mgal/d	0.0010 Mgal/d	3.0 Mgal/d
–	2000	20 to 700 Mgal/d	175 Mgal/d	0.0010 Mgal/d	2.9 Mgal/d

To calculate the measuring range, use the *Applicator* sizing tool → 109

Recommended measuring range

"Flow limit" section → 🖹 43

For custody transfer, the applicable approval determines the permitted measuring range and the pulse value.

Operable flow range

Over 1000 : 1

For custody transfer, the operable flow range is 100 : 1 to 250 : 1, depending on the nominal diameter. Further details are specified by the applicable approval.

Input signal

External measured values

Various pressure transmitters and temperature measuring devices can be ordered from Endress +Hauser: see "Accessories" section → 🖹 109

It is recommended to read in external measured values to calculate the following measured variables: Corrected volume flow

HART protocol

The measured values are written from the automation system to the measuring device via the HART protocol. The pressure transmitter must support the following protocol-specific functions:
- HART protocol
- Burst mode

Fieldbuses

The measured values can be written from the automation system to the measuring via:
- PROFIBUS DP
- Modbus RS485
- EtherNet/IP

Status input

Maximum input values	▪ DC 30 V ▪ 6 mA
Response time	Adjustable: 5 to 200 ms
Input signal level	▪ Low signal: DC –3 to +5 V ▪ High signal: DC 12 to 30 V
Assignable functions	▪ Off ▪ Reset totalizers 1-3 separately ▪ Reset all totalizers ▪ Flow override

Output

Output signal

Current output

Current output	Can be set as: ▪ 4-20 mA NAMUR ▪ 4-20 mA US ▪ 4-20 mA HART ▪ 0-20 mA
Maximum output values	▪ DC 24 V (no flow) ▪ 22.5 mA
Load	0 to 700 Ω
Resolution	0.5 µA

Damping	Adjustable: 0.07 to 999 s
Assignable measured variables	▪ Volume flow ▪ Mass flow ▪ Flow velocity ▪ Conductivity ▪ Electronic temperature

Pulse/frequency/switch output

Function	▪ With the order code for "Output; Input", option **H**: output 2 can be set as a pulse or frequency output ▪ With the order code for "Output; Input", option **I**: output 2 and 3 can be set as a pulse, frequency or switch output ▪ With the order code for "Output; Input", option **J**: output 2 firmly assigned as certified pulse output
Version	Passive, open collector
Maximum input values	▪ DC 30 V ▪ 250 mA
Voltage drop	For 25 mA: ≤ DC 2 V
Pulse output	
Pulse width	Adjustable: 0.05 to 2 000 ms
Maximum pulse rate	10 000 Impulse/s
Pulse value	Adjustable
Assignable measured variables	▪ Volume flow ▪ Mass flow
Frequency output	
Output frequency	Adjustable: 0 to 12 500 Hz
Damping	Adjustable: 0 to 999 s
Pulse/pause ratio	1:1
Assignable measured variables	▪ Volume flow ▪ Mass flow ▪ Conductivity ▪ Flow velocity ▪ Electronic temperature
Switch output	
Switching behavior	Binary, conductive or non-conductive
Switching delay	Adjustable: 0 to 100 s
Number of switching cycles	Unlimited
Assignable functions	▪ Off ▪ On ▪ Diagnostic behavior ▪ Limit value: – Off – Volume flow – Mass flow – Conductivity – Flow velocity – Totalizer 1-3 – Electronic temperature ▪ Flow direction monitoring ▪ Status – Empty pipe detection – Low flow cut off

PROFIBUS DP

Signal encoding	NRZ code
Data transfer	9.6 kBaud...12 MBaud

Modbus RS485

Physical interface	In accordance with EIA/TIA-485-A standard
Terminating resistor	Integrated, can be activated via DIP switch on the transmitter electronics module

EtherNet/IP

Standards	In accordance with IEEE 802.3

Signal on alarm

Depending on the interface, failure information is displayed as follows:

Current output

4-20 mA

Failure mode	Selectable (as per NAMUR recommendation NE 43): ▪ Minimum value: 3.6 mA ▪ Maximum value: 22 mA ▪ Defined value: 3.59 to 22.5 mA ▪ Actual value ▪ Last valid value

0-20 mA

Failure mode	Choose from: ▪ Maximum alarm: 22 mA ▪ Defined value: 0 to 22.5 mA

HART

Device diagnostics	Device condition can be read out via HART Command 48

Pulse/frequency/switch output

Pulse output

Failure mode	Choose from: ▪ Actual value ▪ No pulses

Frequency output

Failure mode	Choose from: ▪ Actual value ▪ 0 Hz ▪ Defined value: 0 to 12 500 Hz

Switch output

Failure mode	Choose from: ▪ Current status ▪ Open ▪ Closed

PROFIBUS DP

Status and alarm messages	Diagnostics in accordance with PROFIBUS PA Profile 3.02

Modbus RS485

Failure mode	Choose from: ▪ NaN value instead of current value ▪ Last valid value

EtherNet/IP

Device diagnostics	Device condition can be read out in Input Assembly

Local display

Plain text display	With information on cause and remedial measures
Backlight	Red backlighting indicates a device error.

Status signal as per NAMUR recommendation NE 107

Operating tool

- Via digital communication:
  - HART protocol
  - PROFIBUS DP
  - Modbus RS485
  - EtherNet/IP
- Via service interface

Plain text display	With information on cause and remedial measures

Additional information on remote operation → 101

Web browser

Plain text display	With information on cause and remedial measures

Light emitting diodes (LED)

Status information	Status indicated by various light emitting diodes The following information is displayed depending on the device version: ▪ Supply voltage active ▪ Data transmission active ▪ Device alarm/error has occurred ▪ EtherNet/IP network available ▪ EtherNet/IP connection established

Low flow cut off

The switch points for low flow cut off are user-selectable.

Galvanic isolation

The following connections are galvanically isolated from each other:
- Inputs
- Outputs
- Power supply

Protocol-specific data

HART

Manufacturer ID	0x11
Device type ID	0x67
HART protocol revision	7
Device description files (DTM, DD)	Information and files under: www.endress.com
HART load	Min. 250 Ω
Dynamic variables	Read out the dynamic variables: HART command 3 The measured variables can be freely assigned to the dynamic variables. **Measured variables for PV (primary dynamic variable)** ▪ Off ▪ Volume flow ▪ Mass flow ▪ Conductivity ▪ Flow velocity ▪ Electronic temperature **Measured variables for SV, TV, QV (secondary, tertiary and quaternary dynamic variable)** ▪ Volume flow ▪ Mass flow ▪ Conductivity ▪ Flow velocity ▪ Electronic temperature ▪ Totalizer 1 ▪ Totalizer 2 ▪ Totalizer 3
Device variables	Read out the device variables: HART command 9 The device variables are permanently assigned. A maximum of 8 device variables can be transmitted: ▪ 0 = volume flow ▪ 1 = mass flow ▪ 2 = conductivity ▪ 3 = flow velocity ▪ 4 = electronic temperature ▪ 5 = totalizer 1 ▪ 6 = totalizer 2 ▪ 7 = totalizer 3

PROFIBUS DP

Manufacturer ID	0x11
Ident number	0x1562
Profile version	3.02
Device description files (GSD, DTM, DD)	Information and files under: ▪ www.endress.com ▪ www.profibus.org
Output values (from measuring device to automation system)	**Analog input 1 to 4** ▪ Mass flow ▪ Volume flow ▪ Flow velocity ▪ Conductivity ▪ Electronic temperature **Digital input 1 to 2** ▪ Empty pipe detection ▪ Low flow cut off ▪ Verification status **Totalizer 1 to 3** ▪ Mass flow ▪ Volume flow

Input values (from automation system to measuring device)	**Analog output 1 (fixed assignment)** External density **Digital output 1 to 2 (fixed assignment)** ▪ Digital output 1: switch positive zero return on/off ▪ Digital output 2: start verification **Totalizer 1 to 3** ▪ Totalize ▪ Reset and hold ▪ Preset and hold ▪ Stop ▪ Operating mode configuration: – Net flow total – Forward flow total – Reverse flow total
Supported functions	▪ Identification & Maintenance Simplest device identification on the part of the control system and nameplate ▪ PROFIBUS upload/download Reading and writing parameters is up to ten times faster with PROFIBUS upload/download ▪ Condensed status Simplest and self-explanatory diagnostic information by categorizing diagnostic messages that occur
Configuration of the device address	▪ DIP switches on the I/O electronics module ▪ Via operating tools (e.g. FieldCare)

Modbus RS485

Protocol	Modbus Applications Protocol Specification V1.1
Device type	Slave
Slave address range	1 to 247
Broadcast address range	0
Function codes	▪ 03: Read holding register ▪ 04: Read input register ▪ 06: Write single registers ▪ 08: Diagnostics ▪ 16: Write multiple registers ▪ 23: Read/write multiple registers
Broadcast messages	Supported by the following function codes: ▪ 06: Write single registers ▪ 16: Write multiple registers ▪ 23: Read/write multiple registers
Supported baud rate	▪ 1 200 BAUD ▪ 2 400 BAUD ▪ 4 800 BAUD ▪ 9 600 BAUD ▪ 19 200 BAUD ▪ 38 400 BAUD ▪ 57 600 BAUD ▪ 115 200 BAUD
Data transfer mode	▪ ASCII ▪ RTU
Data access	Each device parameter can be accessed via Modbus RS485. For Modbus register information

EtherNet/IP

Protocol	▪ The CIP Networks Library Volume 1: Common Industrial Protocol ▪ The CIP Networks Library Volume 2: EtherNet/IP Adaptation of CIP		
Communication type	▪ 10Base-T ▪ 100Base-TX		
Device profile	Generic device (product type: 0x2B)		
Manufacturer ID	0x49E		
Device type ID	0x1067		
Baud rates	Automatic $^{10}/_{100}$ Mbit with half-duplex and full-duplex detection		
Polarity	Auto-polarity for automatic correction of crossed TxD and RxD pairs		
Supported CIP connections	Max. 3 connections		
Explicit connections	Max. 6 connections		
I/O connections	Max. 6 connections (scanner)		
Configuration options for measuring device	▪ DIP switches on the electronics module for IP addressing ▪ Manufacturer-specific software (FieldCare) ▪ Add-on Profile Level 3 for Rockwell Automation control systems ▪ Web browser ▪ Electronic Data Sheet (EDS) integrated in the measuring device		
Configuration of the EtherNet interface	▪ Speed: 10 MBit, 100 MBit, auto (factory setting) ▪ Duplex: half-duplex, full-duplex, auto (factory setting)		
Configuration of the device address	▪ DIP switches on the electronics module for IP addressing (last octet) ▪ DHCP ▪ Manufacturer-specific software (FieldCare) ▪ Add-on Profile Level 3 for Rockwell Automation control systems ▪ Web browser ▪ EtherNet/IP tools, e.g. RSLinx (Rockwell Automation)		
Device Level Ring (DLR)	No		
Fix Input			
RPI	5 ms to 10 s (factory setting: 20 ms)		
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0x66	56
	T → O configuration:	0x64	32
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0x66	56
	T → O configuration:	0x64	32
Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0xC7	-
	T → O configuration:	0x64	32
Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0xC7	-
	T → O configuration:	0x64	32

Input Assembly	▪ Current device diagnostics ▪ Volume flow ▪ Mass flow ▪ Conductivity ▪ Totalizer 1 ▪ Totalizer 2 ▪ Totalizer 3		
Configurable Input			
RPI	5 ms to 10 s (factory setting: 20 ms)		
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0x66	56
	T → O configuration:	0x65	88
Exclusive Owner Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0x66	56
	T → O configuration:	0x65	88
Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x68	398
	O → T configuration:	0xC7	-
	T → O configuration:	0x65	88
Input only Multicast		Instance	Size [byte]
	Instance configuration:	0x69	-
	O → T configuration:	0xC7	-
	T → O configuration:	0x65	88
Configurable Input Assembly	▪ Volume flow ▪ Mass flow ▪ Electronic temperature ▪ Conductivity ▪ Totalizer 1 to 3 ▪ Flow velocity ▪ Volume flow unit ▪ Mass flow unit ▪ Temperature unit ▪ Conductivity unit ▪ Unit totalizer 1-3 ▪ Flow velocity unit ▪ Verification result ▪ Verification status The range of options increases if the measuring device has one or more application packages.		
Fix Output			
Output Assembly	▪ Activation of reset totalizers 1-3 ▪ Activation of reference density compensation ▪ Reset totalizers 1-3 ▪ External density ▪ Density unit ▪ Activation verification ▪ Start verification		

Configuration	
Configuration Assembly	Only the most common configurations are listed below. ▪ Software write protection ▪ Mass flow unit ▪ Mass unit ▪ Volume flow unit ▪ Volume unit ▪ Density unit ▪ Conductivity ▪ Temperature unit ▪ Totalizer 1-3: – Assignment – Unit – Operating mode – Failure mode ▪ Alarm delay

Power supply

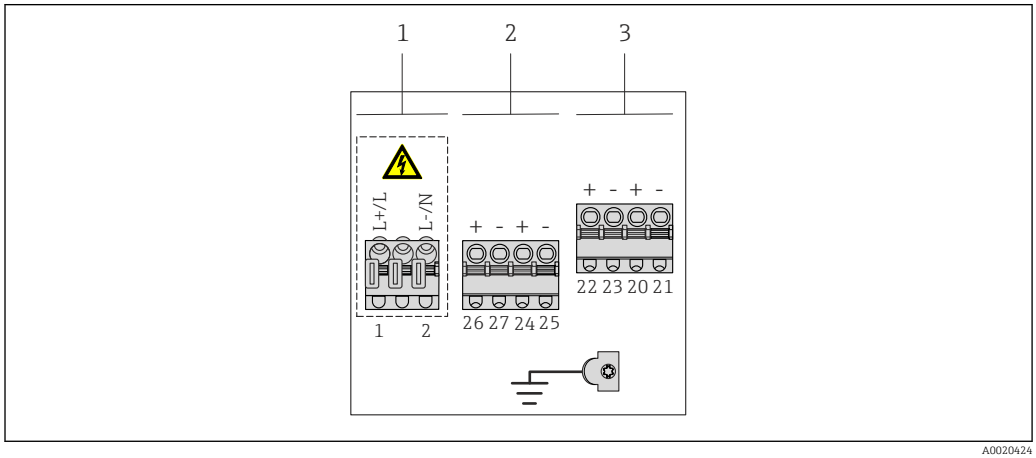
Terminal assignment

Transmitter

0-20 mA/4-20 mA HART connection version with additional outputs and inputs

The sensor can be ordered with terminals.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	**Power supply**	
Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"



A0020424

1 *Supply voltage*
2 *Output 1 (26/27) and output 2 (24/25)*
3 *Output 3 (22/23) and input 1 (20/21)*

Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+/L)	2 (L-/N)
Option **L** (wide range power unit)	AC100 to 240 V	
	AC/DC24 V	

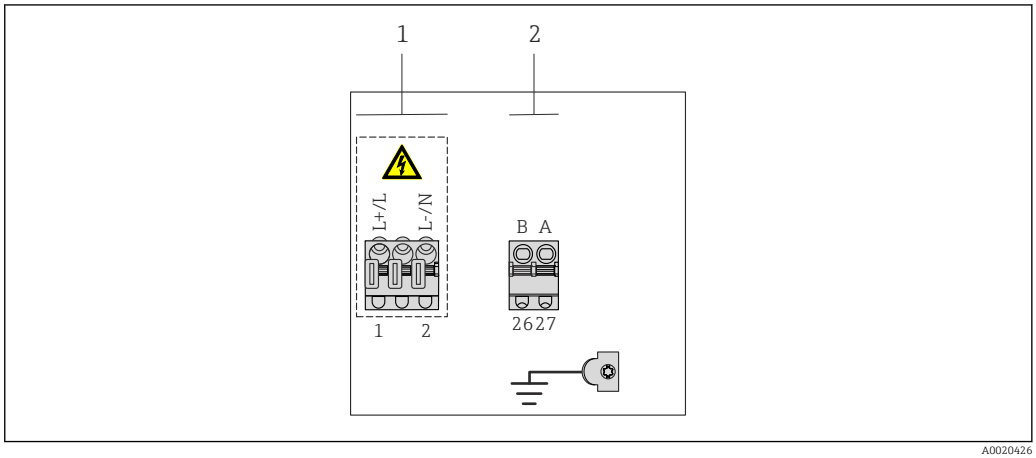
Signal transmission 0-20 mA/4-20 mA HART with additional outputs and inputs

Order code for "Output" and "Input"	Terminal numbers							
	Output 1		Output 2		Output 3		Input	
	26 (+)	27 (-)	24 (+)	25 (-)	22 (+)	23 (-)	20 (+)	21 (-)
Option **H**	▪ 4-20 mA HART (active) ▪ 0-20 mA (active)		Pulse/frequency output (passive)		Switch output (passive)		-	
Option **I**	▪ 4-20 mA HART (active) ▪ 0-20 mA (active)		Pulse/frequency/ switch output (passive)		Pulse/frequency/ switch output (passive)		Status input	
Option **J**	▪ 4-20 mA HART (active) ▪ 0-20 mA (active)		Permanently assigned Pulse output adjusted (passive)		Pulse/frequency/ switch output (passive)		Status input	

PROFIBUS DP connection version

The sensor can be ordered with terminals.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	Power supply	
Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"



1 Supply voltage (wide range power unit)
2 PROFIBUS DP

Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+/L)	2 (L-/N)
Option **L** (wide range power unit)	AC100 to 240 V	
	AC/DC24 V	

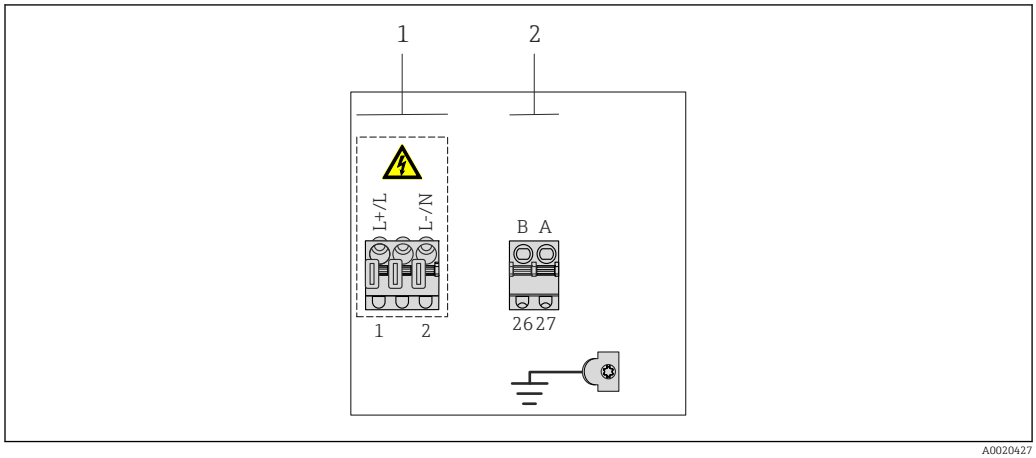
PROFIBUS DP signal transmission

Order code for "Output" and "Input"	Terminal numbers	
	26 (RxD/TxD-P)	27 (RxD/TxD-N)
Option **L**	B	A
Order code for "Output": Option L: PROFIBUS DP, for use in non-hazardous areas and Zone 2/div. 2		

Modbus RS485 connection version

The sensor can be ordered with terminals.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	Power supply	
Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"



1 *Supply voltage (wide range power unit)*
2 *Modbus RS485*

Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+/L)	2 (L-/N)
Option **L** (wide range power unit)	AC100 to 240 V	
	AC/DC24 V	

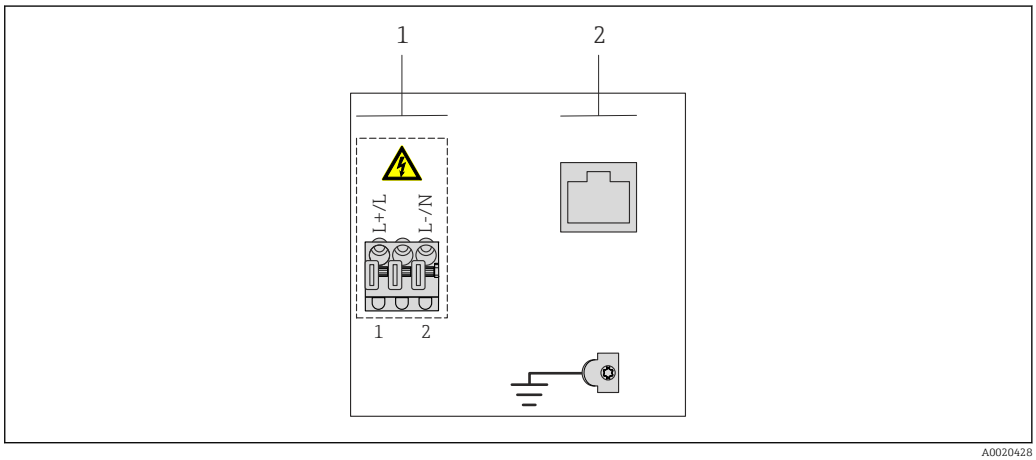
Signal transmission Modbus RS485

Order code for "Output" and "Input"	Terminal numbers	
	26 (+)	27 (-)
Option **M**	B	A

EtherNet/IP connection version

The sensor can be ordered with terminals or a device plug.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	Power supply	
Terminals	Terminals	▪ Option **A**: coupling M20x1 ▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"
Device plug	Terminals	▪ Option **L**: plug M12x1 + thread NPT ½" ▪ Option **N**: plug M12x1 + coupling M20 ▪ Option **P**: plug M12x1 + thread G ½" ▪ Option **U**: plug M12x1 + thread M20



1 Supply voltage (wide range power unit)
2 EtherNet/IP

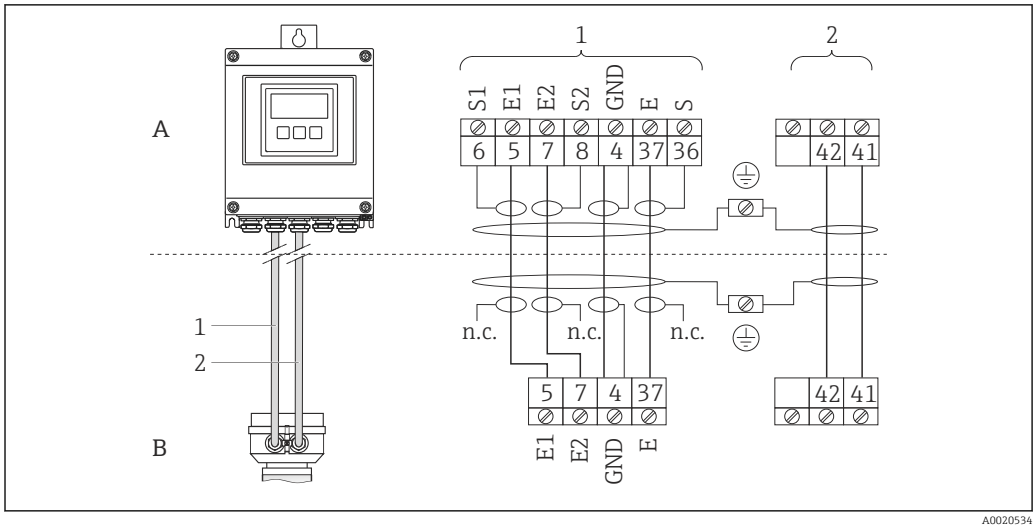
Supply voltage

Order code for "Power supply"	Terminal numbers	
	1 (L+/L)	2 (L-/N)
Option **L** (wide range power unit)	AC100 to 240 V	
	AC/DC24 V	

EtherNet/IP signal transmission

Order code for "Output"	Connection via
Option **N**	EtherNet/IP connector

Remote version



2 *Remote version terminal assignment*

A Transmitter wall-mount housing
B Sensor connection housing
1 Electrode cable
2 Coil current cable
n.c. Not connected, insulated cable shields

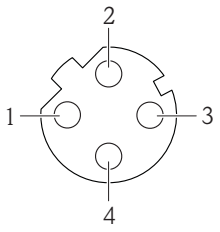
Terminal No. and cable colors: 6/5 = brown; 7/8 = white; 4 = green; 36/37 = yellow

Pin assignment, device plug

Order codes for the M12x1 connectors, see the "Order code for electrical connection" column: EtherNet/IP

EtherNet/IP

Device plug for signal transmission (device side)



Pin		Assignment	Coding	Plug/socket
1	+	Tx	D	Socket
2	+	Rx		
3	-	Tx		
4	-	Rx		

Recommended plug:
- Binder, series 763, part no. 99 3729 810 04
- Phoenix, part no. 1543223 SACC-M12MSD-4Q
- When using the device in a hazardous location, use a suitably certified plug.

Supply voltage

Transmitter

Order code for "Power supply"	Terminal voltage	Frequency range
Option **L**	AC100 to 240 V	50/ 60 Hz, ±4 Hz
	AC/DC24 V	50/ 60 Hz, ±4 Hz

Power consumption

Order code for "Output"	Maximum power consumption
Option **H**: 4-20mA HART, pulse/frequency/switch output, switch output	30 VA/8 W
Option **I**: 4-20mA HART, 2 x pulse/frequency/switch output, status input	30 VA/8 W

Order code for "Output"	Maximum power consumption
Option **J**: 4-20mA HART, certified pulse output, pulse/ frequency/switch output, status input	30 VA/8 W
Option **L**: PROFIBUS DP	30 VA/8 W
Option **M**: Modbus RS485	30 VA/8 W
Option **N**: EtherNet/IP	30 VA/8 W

Current consumption

Transmitter

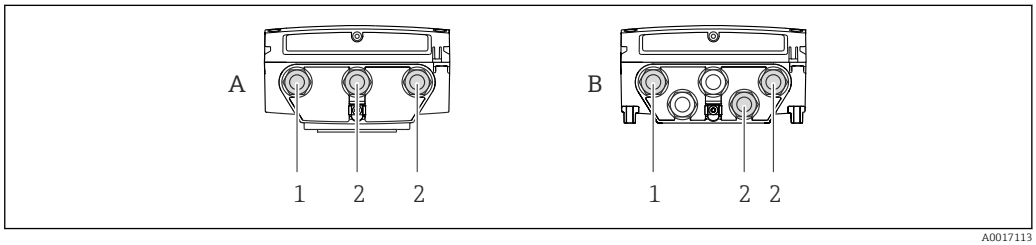
Order code for "Power supply"	Maximum Current consumption	Maximum switch-on current
Option **L**: AC 100 to 240 V	145 mA	25 A (< 5 ms)
Option **L**: AC/DC 24 V	350 mA	27 A (< 5 ms)

Power supply failure

- Totalizers stop at the last value measured.
- Configuration is retained in the plug-in memory (HistoROM DAT).
- Error messages (incl. total operated hours) are stored.

Electrical connection

Connecting the transmitter



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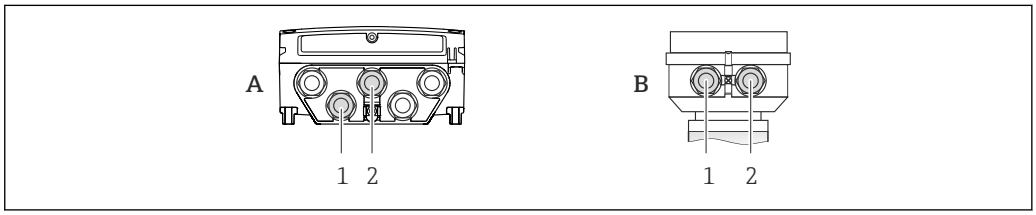
3 Supply voltage and signal transmission connection

A Compact version
B Remote version wall-mount housing
1 Cable entry for supply voltage
2 Cable entry for signal transmission

Remote version connection

Connecting cable



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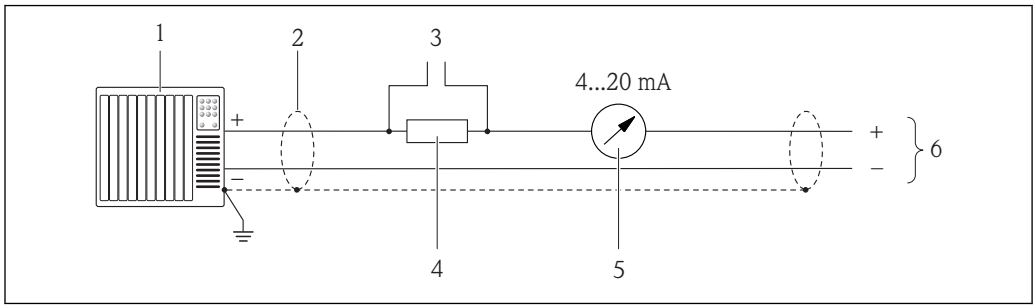
4 Connecting cable connection: electrode and coil current cable

A Transmitter wall-mount housing
B Sensor connection housing
1 Electrode cable
2 Coil current cable

- Fix the cable run or route it in an armored conduit.
  Cable movements can influence the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalization between sensor and transmitter .

Connection examples

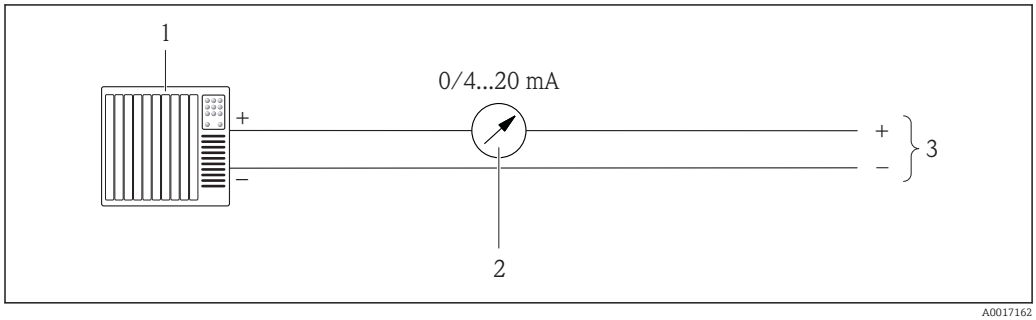
Current output 4-20 mA HART



5 Connection example for 4-20 mA HART current output (active)

1 Automation system with current input (e.g. PLC)
2 Cable shield, observe cable specifications → 29
3 Connection for HART operating devices
4 Resistor for HART communication (≥ 250 Ω): observe maximum load
5 Analog display unit: observe maximum load
6 Transmitter

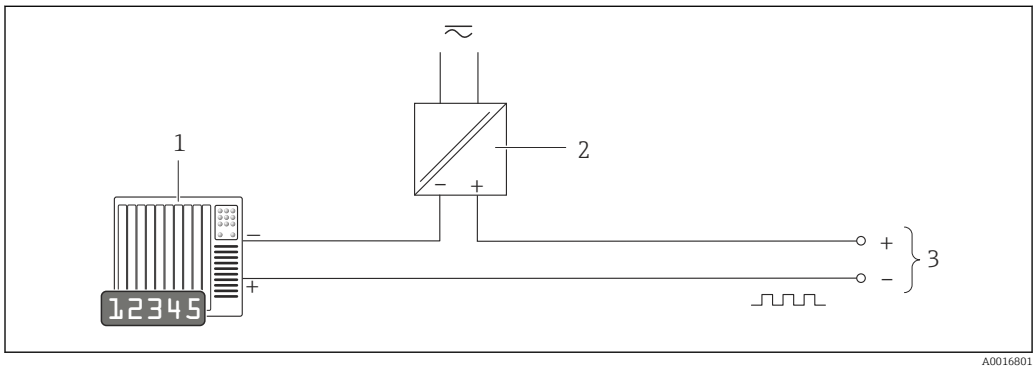
Current output 4-20 mA



6 Connection example for 0-20 mA current output (active) and 4-20 mA current output (active)

1 Automation system with current input (e.g. PLC)
2 Analog display unit: observe maximum load
3 Transmitter

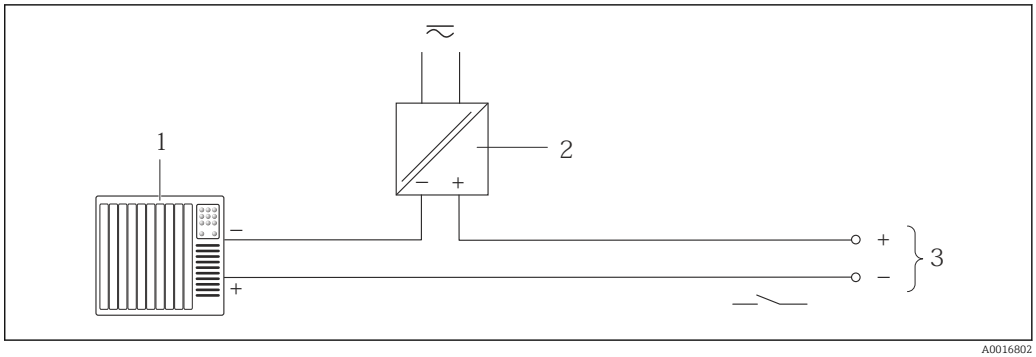
Pulse/frequency output



7 Connection example for pulse/frequency output (passive)

1 Automation system with pulse/frequency input (e.g. PLC)
2 Power supply
3 Transmitter: observe input values

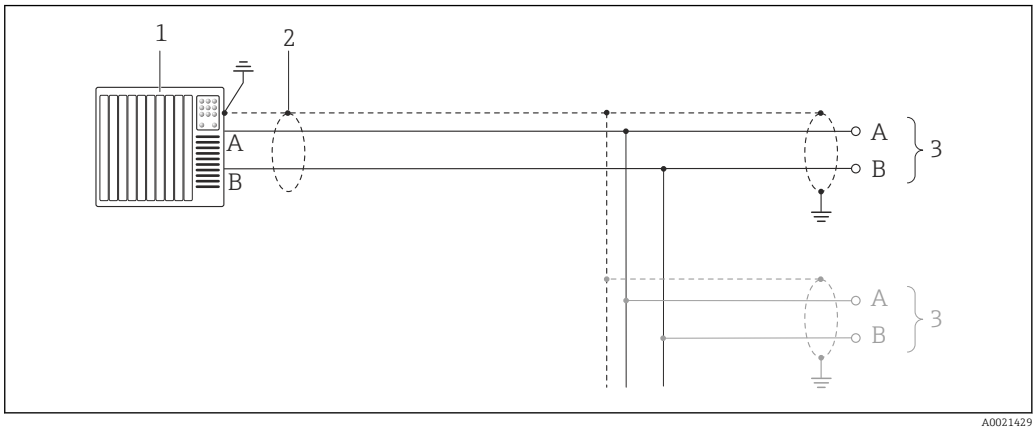
Switch output



8 Connection example for switch output (passive)

1 Automation system with switch input (e.g. PLC)
2 Power supply
3 Transmitter: observe input values

PROFIBUS DP

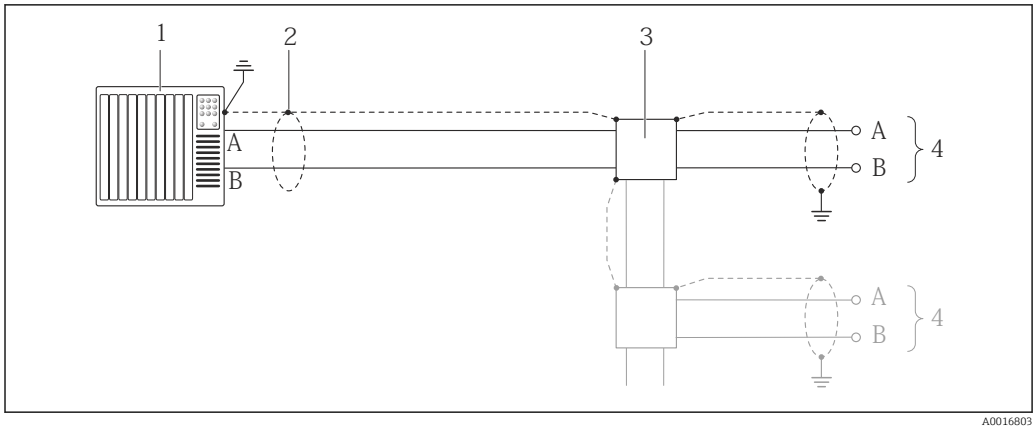


9 Connection example for PROFIBUS DP, non-hazardous area and Zone 2/Div. 2

1 Control system (e.g. PLC)
2 Cable shield: the cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications → 29
3 Transmitter

If baud rates > 1.5 MBaud an EMC cable entry must be used and the cable shield must continue as far as the terminal wherever possible.

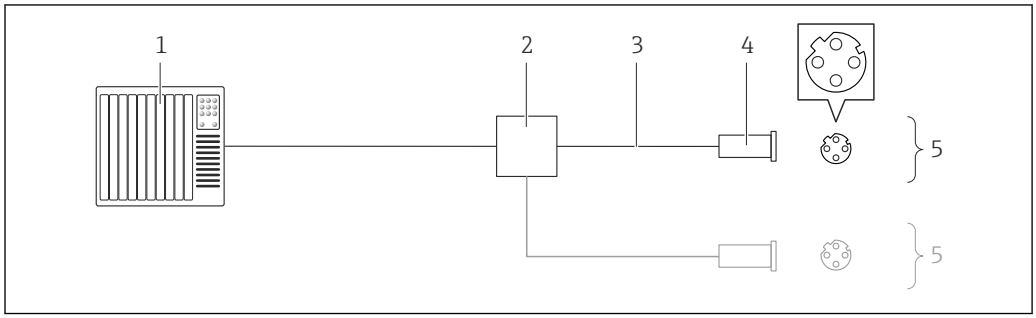
Modbus RS485



10 Connection example for Modbus RS485, non-hazardous area and Zone 2/Div. 2

1 *Control system (e.g. PLC)*
2 *Cable shield: the cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications → 29*
3 *Distribution box*
4 *Transmitter*

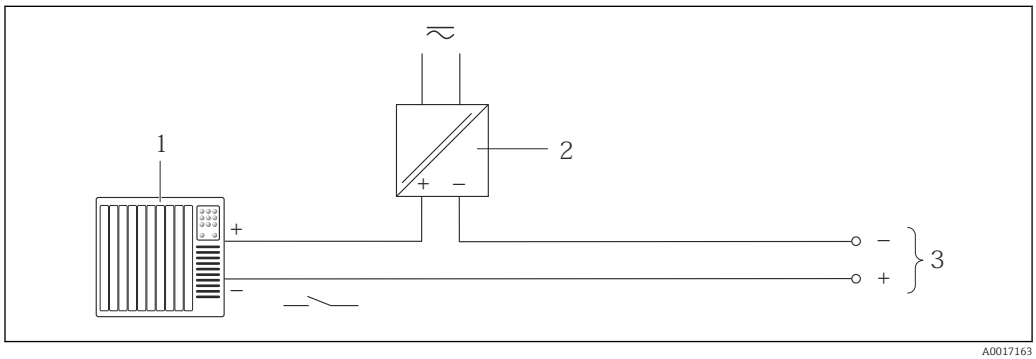
EtherNet/IP



11 Connection example for EtherNet/IP

1 *Control system (e.g. PLC)*
2 *Ethernet switch*
3 *Observe cable specifications → 30*
4 *Device plug*
5 *Transmitter*

Status input



12 Connection example for status input

1 *Automation system with status output (e.g. PLC)*
2 *Power supply*
3 *Transmitter: observe input values*

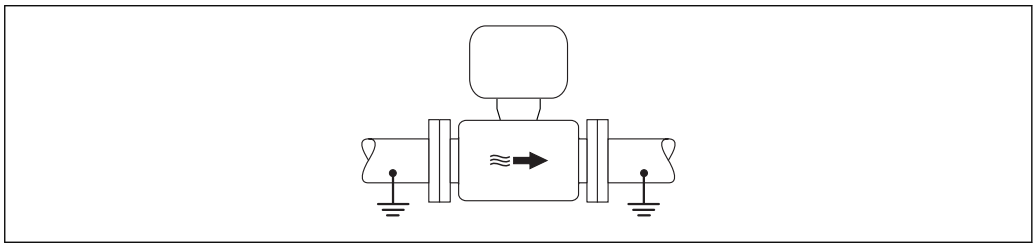
Potential equalization

Requirements

Please consider the following to ensure correct measurement:
- Same electrical potential for the fluid and sensor
- Remote version: same electrical potential for the sensor and transmitter
- Company-internal grounding concepts
- Pipe material and grounding

Connection examples for standard situations

Metal, grounded pipe



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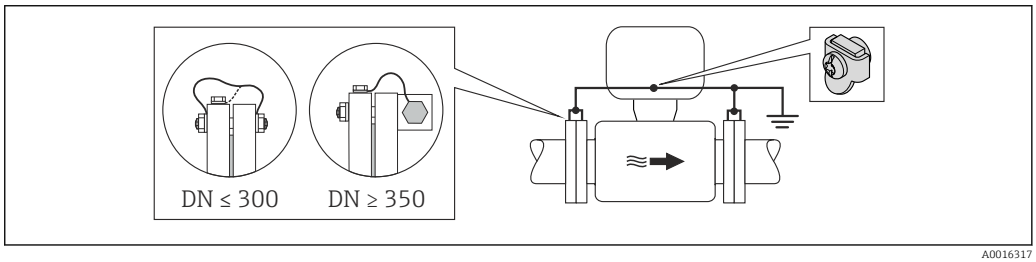
13 *Potential equalization via measuring tube*

Connection example in special situations

Unlined and ungrounded metal pipe

This connection method also applies in situations where:
- The customary potential equalization is not used
- Equalizing currents are present

Ground cable	Copper wire, at least6 mm² (0.0093 in²)



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14 *Potential equalization via ground terminal and pipe flanges*

Note the following when installing:
- Connect both sensor flanges to the pipe flange via a ground cable and ground them.
- Connect the connection housing of the transmitter or sensor to ground potential by means of the ground terminal provided for the purpose. To mount the ground cable:
  - If DN ≤ 300 (12"): Mount the ground cable directly on the conductive flange coating of the sensor with the flange screws.
  - If DN ≥ 350 (14"): Mount the ground cable directly on the metal transport bracket.

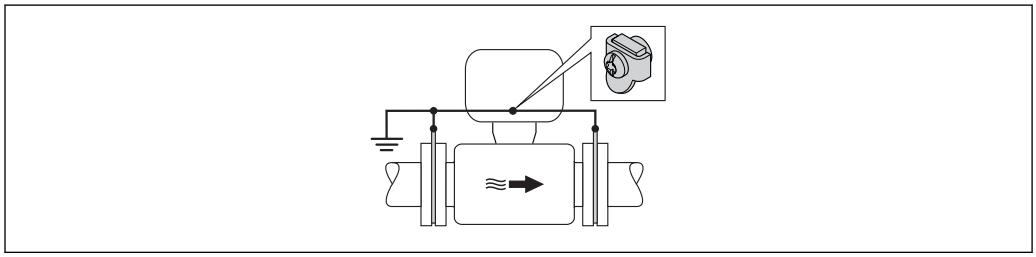
For remote device versions, the ground terminal in the example always refers to the sensor and **not** to the transmitter.

The necessary ground cable can be ordered from Endress+Hauser .

Plastic pipe or pipe with insulating liner

This connection method also applies in situations where:
- The customary potential equalization is not used
- Equalizing currents are present

Ground cable	Copper wire, at least6 mm² (0.0093 in²)



15 *Potential equalization via ground terminal and ground disks*

Note the following when installing:
The ground disks must be connected to the ground terminal via the ground cable and be connected to ground potential.

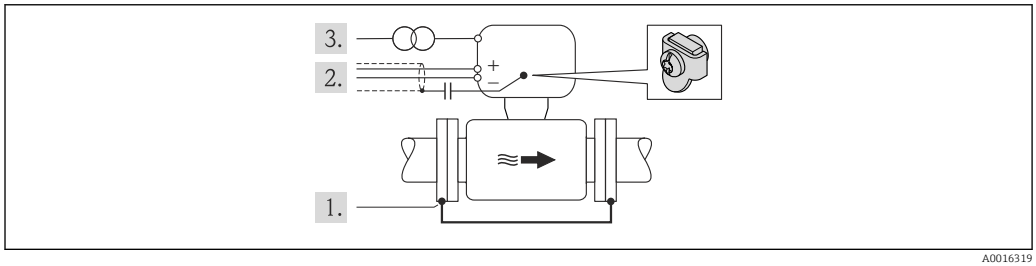
For remote device versions, the ground terminal in the example always refers to the sensor and **not** to the transmitter.

The ground cable and ground disks can be ordered from Endress+Hauser → 108.

Pipe with a cathodic protection unit

This connection method is only used if the following two conditions are met:
- Metal pipe without liner or pipe with electrically conductive liner
- Cathodic protection is integrated in the personal protection equipment

Ground cable	Copper wire, at least6 mm² (0.0093 in²)



Prerequisite: The sensor is installed in the pipe in a way that provides electrical insulation.

1. Connect the two flanges of the pipe to one another via a ground cable.
2. Guide the shield of the signal lines through a capacitor.
3. Connect the measuring device to the power supply such that it is floating in relation to the protective ground (isolation transformer).

For remote device versions, the ground terminal in the example always refers to the sensor and **not** to the transmitter.

The necessary ground cable can be ordered from Endress+Hauser .

Terminals

Transmitter
- Supply voltage cable: plug-in spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)
- Signal cable: plug-in spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)
- Electrode cable: spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)
- Coil current cable: spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)

Sensor connection housing
Spring terminals for wire cross-sections0.5 to 2.5 mm² (20 to 14 AWG)

Cable entries

Cable entry thread

- M20 x 1.5
- Via adapter:
  - NPT ½"
  - G ½"

Cable gland

- For standard cable: M20 × 1.5 with cable ϕ6 to 12 mm (0.24 to 0.47 in)
- For reinforced cable: M20 × 1.5 with cable ϕ9.5 to 16 mm (0.37 to 0.63 in)

If metal cable entries are used, use a grounding plate.

Cable specification

Permitted temperature range

- −40 °C (−40 °F) to +80 °C (+176 °F)
- Minimum requirement: cable temperature range ≥ ambient temperature +20 K

Power supply cable

Standard installation cable is sufficient.

Signal cable

Current output

- For 0-20 mA and 4-20 mA: standard installation cable is sufficient.
- For 4-20 mA HART: Shielded cable recommended. Observe grounding concept of the plant.

Pulse/frequency/switch output

Standard installation cable is sufficient.

Status input

Standard installation cable is sufficient.

PROFIBUS DP

The IEC 61158 standard specifies two types of cable (A and B) for the bus line which can be used for every transmission rate. Cable type A is recommended.

Cable type	A
Characteristic impedance	135 to 165 Ω at a measuring frequency of 3 to 20 MHz
Cable capacitance	<30 pF/m
Wire cross-section	>0.34 mm² (22 AWG)
Cable type	Twisted pairs
Loop resistance	≤110 Ω/km
Signal damping	Max. 9 dB over the entire length of the cable cross-section
Shielding	Copper braided shielding or braided shielding with foil shield. When grounding the cable shield, observe the grounding concept of the plant.

Modbus RS485

The EIA/TIA-485 standard specifies two types of cable (A and B) for the bus line which can be used for every transmission rate. Cable type A is recommended.

Cable type	A
Characteristic impedance	135 to 165 Ω at a measuring frequency of 3 to 20 MHz
Cable capacitance	<30 pF/m
Wire cross-section	>0.34 mm² (22 AWG)
Cable type	Twisted pairs

Loop resistance	≤110 Ω/km
Signal damping	Max. 9 dB over the entire length of the cable cross-section
Shielding	Copper braided shielding or braided shielding with foil shield. When grounding the cable shield, observe the grounding concept of the plant.

EtherNet/IP

The standard ANSI/TIA/EIA-568-B.2 Annex specifies CAT 5 as the minimum category for a cable used for EtherNet/IP. CAT 5e and CAT 6 are recommended.

For more information on planning and installing EtherNet/IP networks, please refer to the "Media Planning and Installation Manual. EtherNet/IP" of ODVA Organization.

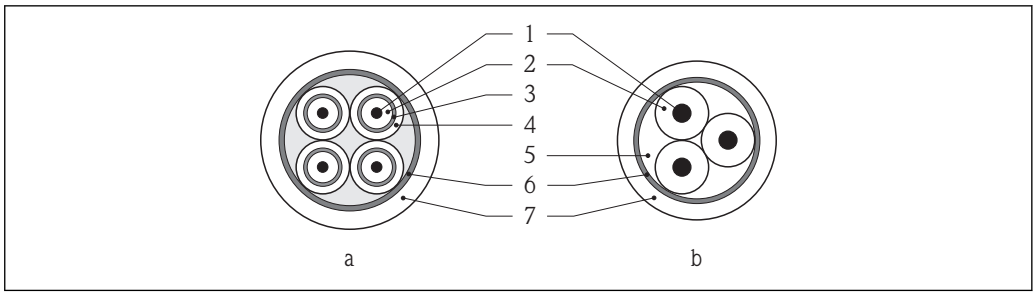
Connecting cable for remote version

Electrode cable

Standard cable	3 ×0.38 mm² (20 AWG) with common, braided copper shield (ϕ ~7 mm (0.28 in) and individual shielded cores
Cable for empty pipe detection (EPD)	4 ×0.38 mm² (20 AWG) with common, braided copper shield (ϕ ~7 mm (0.28 in) and individual shielded cores
Conductor resistance	≤50 Ω/km (0.015 Ω/ft)
Capacitance: core/shield	≤420 pF/m (128 pF/ft)
Operating temperature	–20 to +80 °C (–68 to +176 °F)

Coil current cable

Standard cable	2 ×0.75 mm² (18 AWG) with common, braided copper shield (ϕ ~ 7 mm (0.28")) and individually shielded cores
Conductor resistance	≤37 Ω/km (0.011 Ω/ft)
Capacitance: core/core, shield grounded	≤120 pF/m (37 pF/ft)
Operating temperature	–20 to +80 °C (–68 to +176 °F)
Test voltage for cable insulation	≤ AC 1433 V r.m.s. 50/60 Hz or ≥ DC 2026 V



16 *Cable cross-section*

a *Electrode cable*
b *Coil current cable*
1 *Core*
2 *Core insulation*
3 *Core shield*
4 *Core jacket*
5 *Core reinforcement*
6 *Cable shield*
7 *Outer jacket*

A connecting cable can be ordered from Endress+Hauser for IP68:
- Pre-terminated cables that are already connected to the sensor.
- Pre-terminated cables, where the cables are connected by the customer onsite (incl. tools for sealing the connection compartment)

Reinforced connecting cables

Reinforced connecting cables with an additional, reinforcing metal braid should be used for:
- When laying the cable directly in the ground
- Where there is a risk of damage from rodents
- If using the device below IP68 degree of protection

Reinforced connecting cables with an additional, reinforcing metal braid can be ordered from Endress+Hauser .

Operation in zones of severe electrical interference

The measuring system meets the general safety requirements → 106 and EMC specifications → 40.

Grounding is by means of the ground terminal provided for the purpose inside the connection housing. The stripped and twisted lengths of cable shield to the ground terminal must be as short as possible.

Performance characteristics

Reference operating conditions

In accordance with DIN EN 29104
- Medium temperature: +28 ± 2 °C (+82 ± 4 °F)
- Ambient temperature: +22 ± 2 °C (+72 ± 4 °F)
- Warm-up period:30 min

Installation
- Inlet run > 10 × DN
- Outlet run > 5 × DN
- Sensor and transmitter grounded.
- The sensor is centered in the pipe.

No special requirements must be observed at the inlet and outlet runs to keep within the in-service maximum permissible errors for custody transfer.

To calculate the measuring range, use the *Applicator* sizing tool → 109

Maximum measured error

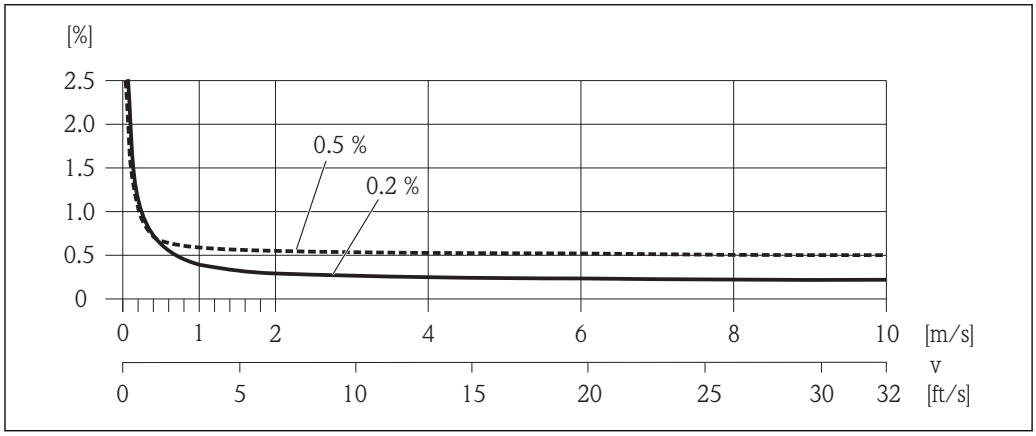
Error limits under reference operating conditions

o.r. = of reading

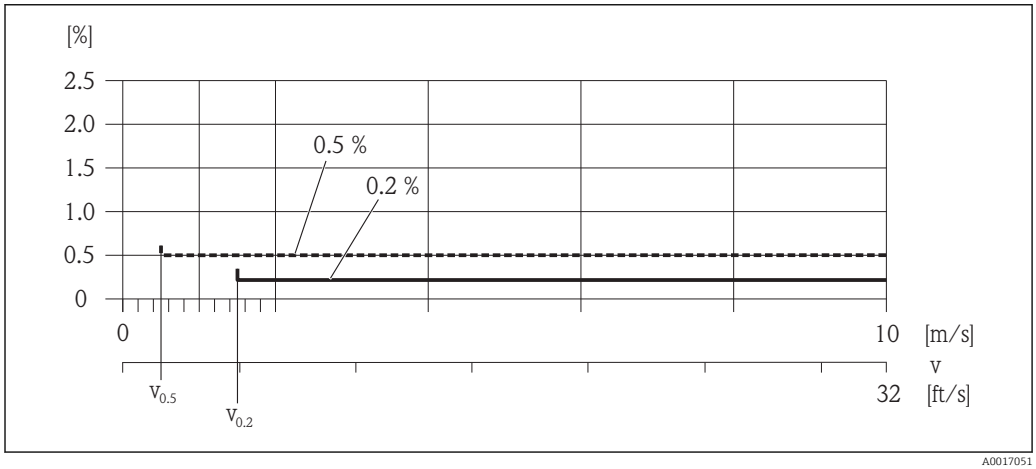
Volume flow

- ±0.5 % o.r. ± 1 mm/s (0.04 in/s)
- Optional: ±0.2 % o.r. ± 2 mm/s (0.08 in/s)

Fluctuations in the supply voltage do not have any effect within the specified range.



17 *Maximum measured error in % o.r.*



18 *Flat Spec in % o.r.*

Flat Spec flow values0.5 %

Nominal diameter		$v_{0.5}$	
[mm]	[in]	[m/s]	[ft/s]
25 to 600	1 to 24	0.5	1.64

Flat Spec flow values0.2 %

Nominal diameter		$v_{0.2}$	
[mm]	[in]	[m/s]	[ft/s]
25 to 600	1 to 24	1.5	4.92

Electrical conductivity

Max. measured error not specified.

Accuracy of outputs

o.r. = of reading

The outputs have the following base accuracy specifications.

Current output

Accuracy	Max. ±5 µA

Pulse/frequency output

Accuracy	Max. ±50 ppm o.r. (across the complete ambient temperature range)

Repeatability

o.r. = of reading

Volume flow
max. ±0.1 % o.r. ± 0.5 mm/s (0.02 in/s)

Electrical conductivity
Max. ±5 % o.r.

Influence of ambient temperature

o.r. = of reading

Current output

Temperature coefficient	Max. ±0.005% o.r./°C

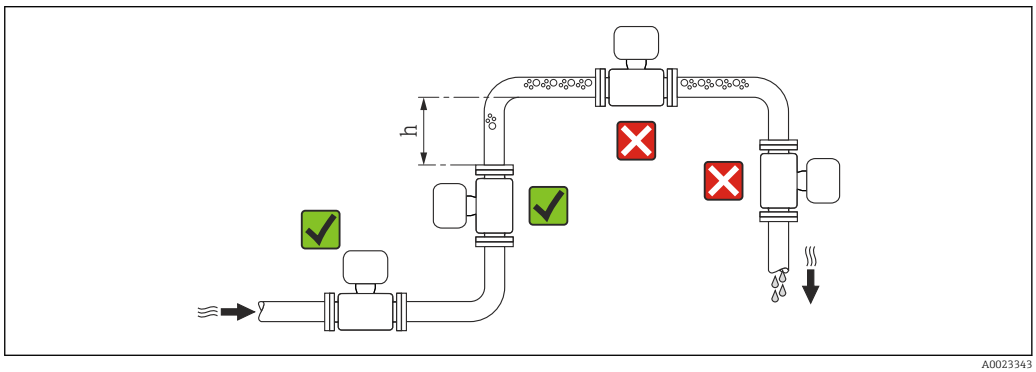
Pulse/frequency output

Temperature coefficient	No additional effect. Included in accuracy.

Installation

No special measures such as supports are necessary. External forces are absorbed by the construction of the device.

Mounting location



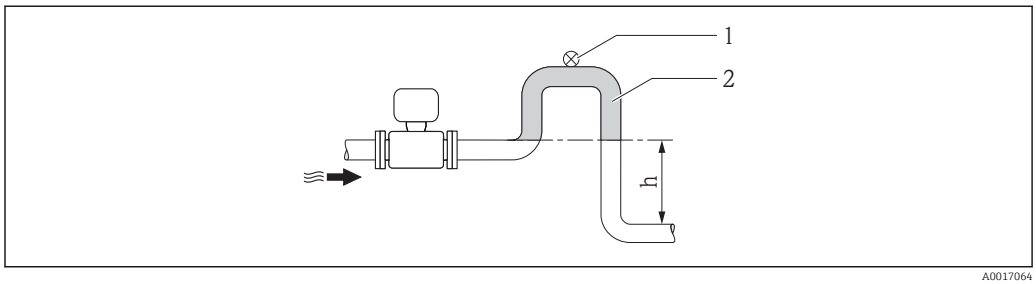
Preferably install the sensor in an ascending pipe, and ensure a sufficient distance to the next pipe elbow: h ≥ 2 × DN

To prevent measuring errors arising from accumulation of gas bubbles in the measuring tube, avoid the following mounting locations in the pipe:
- Highest point of a pipeline.
- Directly upstream of a free pipe outlet in a down pipe.

Installation in down pipes

Install a siphon with a vent valve downstream of the sensor in down pipes whose length h ≥ 5 m (16.4 ft). This precaution is to avoid low pressure and the consequent risk of damage to the measuring tube. This measure also prevents the system losing prime.

For information on the liner's resistance to partial vacuum

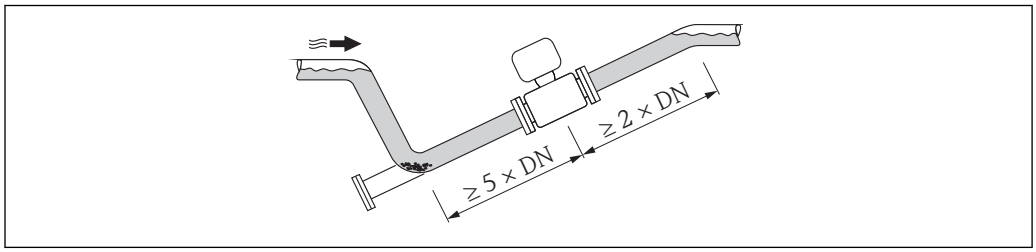


19 *Installation in a down pipe*

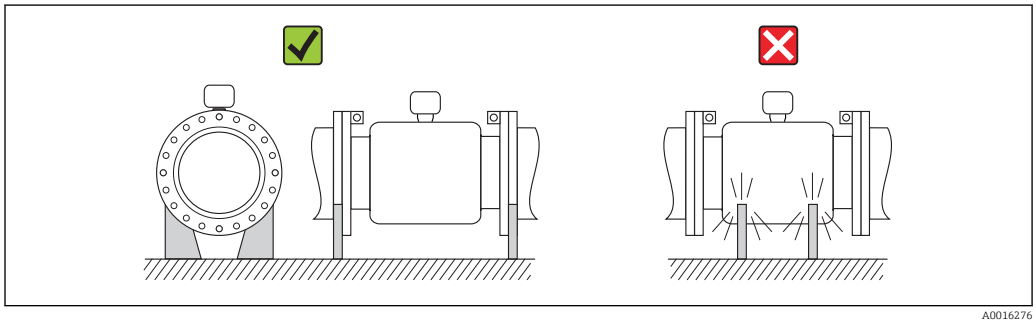
1 *Vent valve*
2 *Pipe siphon*
h *Length of down pipe*

Installation in partially filled pipes

A partially filled pipe with a gradient necessitates a drain-type configuration. The empty pipe detection (EPD) function offers additional protection by detecting empty or partially filled pipes.



For heavy sensors DN ≥ 350 (14")



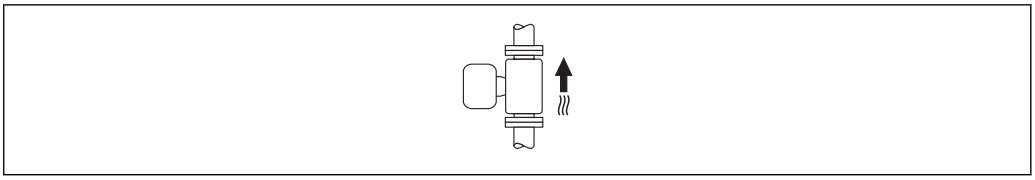
Orientation

The direction of the arrow on the sensor nameplate helps you to install the sensor according to the flow direction (direction of medium flow through the piping).

An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube.

The measuring device also offers the empty pipe detection function to detect partially filled measuring pipes in the event of outgassing fluids or variable process pressures.

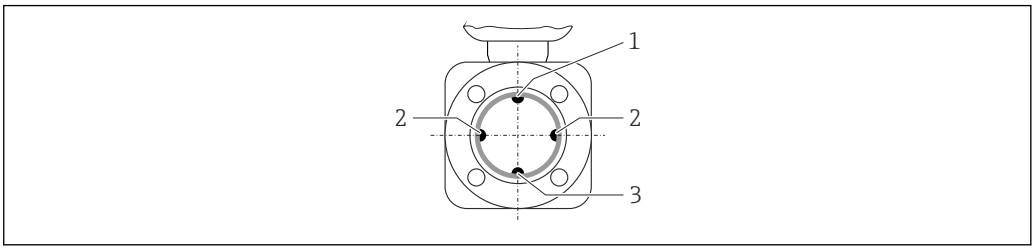
Vertical



A0015591

Optimum for self-emptying pipe systems and for use in conjunction with empty pipe detection.

Horizontal



A0016260

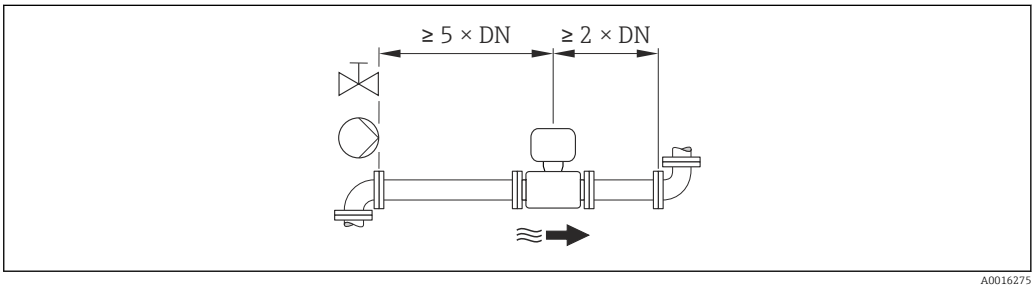
1 *EPD electrode for empty pipe detection*
2 *Measuring electrodes for signal detection*
3 *Reference electrode for potential equalization*

- The measuring electrode plane must be horizontal. This prevents brief insulation of the two measuring electrodes by entrained air bubbles.
- Empty pipe detection only works if the transmitter housing is pointing upwards as otherwise there is no guarantee that the empty pipe detection function will actually respond to a partially filled or empty measuring tube.

Inlet and outlet runs

If possible, install the sensor upstream from fittings such as valves, T-pieces or elbows.

Observe the following inlet and outlet runs to comply with accuracy specifications:



A0016275

To keep within the in-service maximum permissible errors for custody transfer no additional requirements apply with regard to the graphic illustrated above.

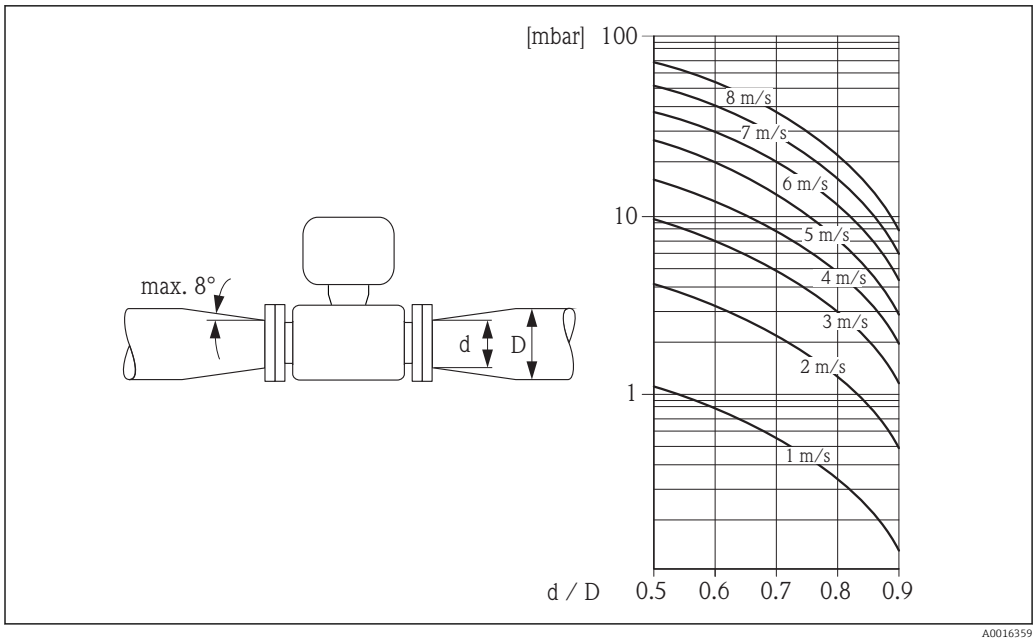
Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids.

The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders:

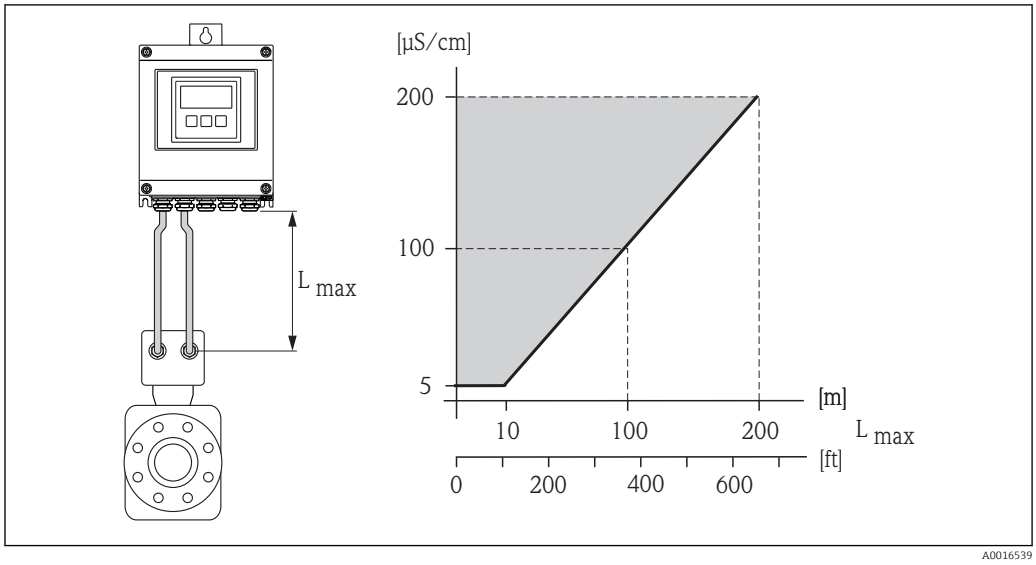
- Calculate the ratio of the diameters d/D.
- From the nomogram read off the pressure loss as a function of flow velocity (downstream from the reduction) and the d/D ratio.

The nomogram only applies to liquids with a viscosity similar to that of water.



Length of connecting cable

To ensure correct measuring results when using the remote version, observe the maximum permitted cable length L_{max}. This length is determined by the conductivity of the fluid.
If measuring liquids in general: 5 µS/cm

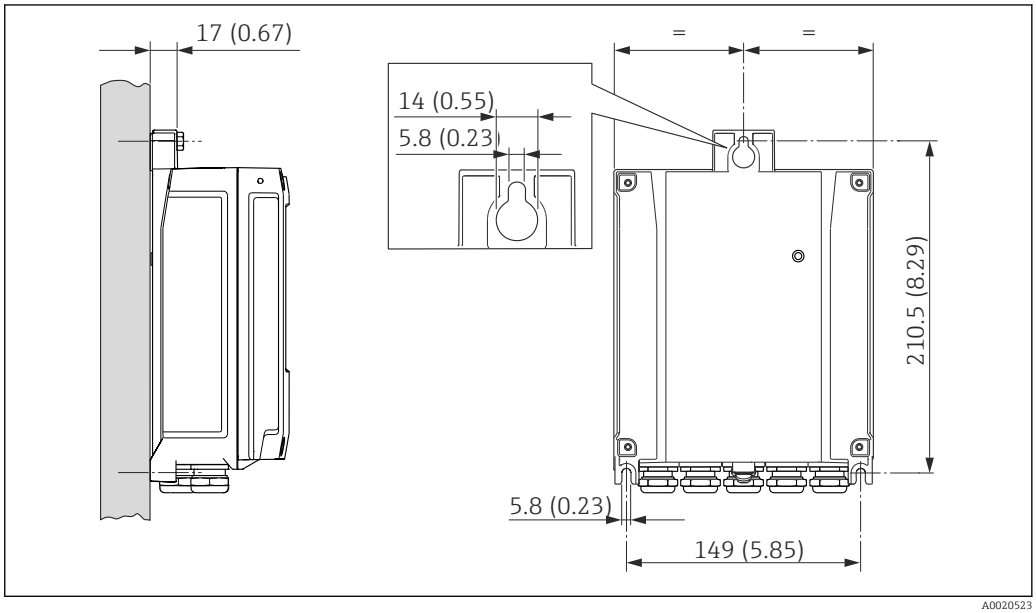


20 *Permitted length of connecting cable for remote version*

Area shaded gray = permitted range
L_{max} = length of connecting cable in [m] ([ft])
[µS/cm] = fluid conductivity

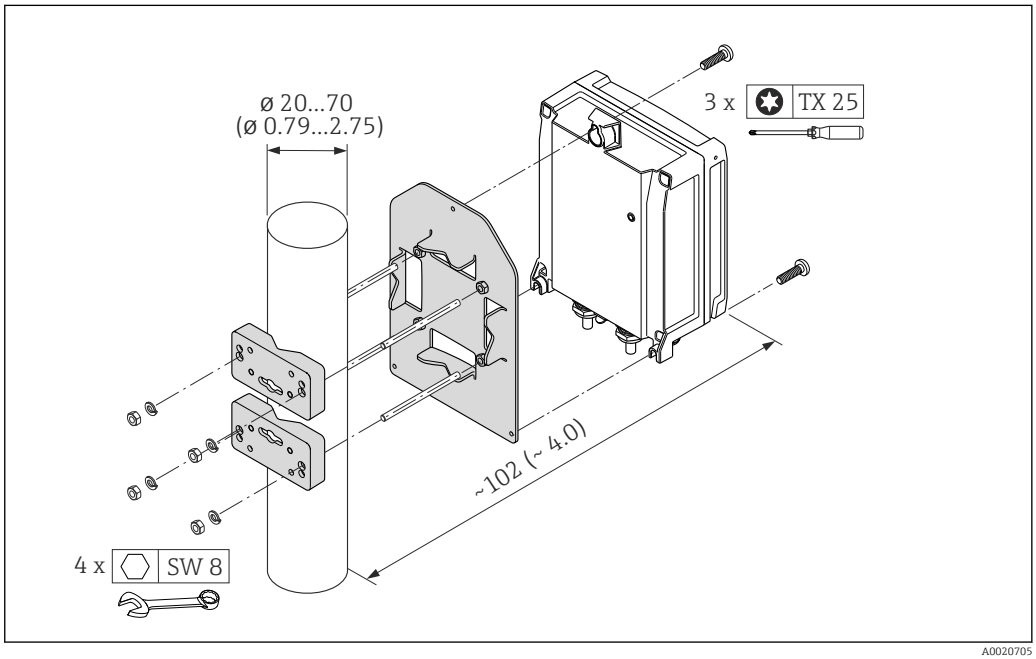
Installing the wall-mount housing

Wall mounting



21 *Engineering unit mm (in)*

Post mounting



22 *Engineering unit mm (in)*

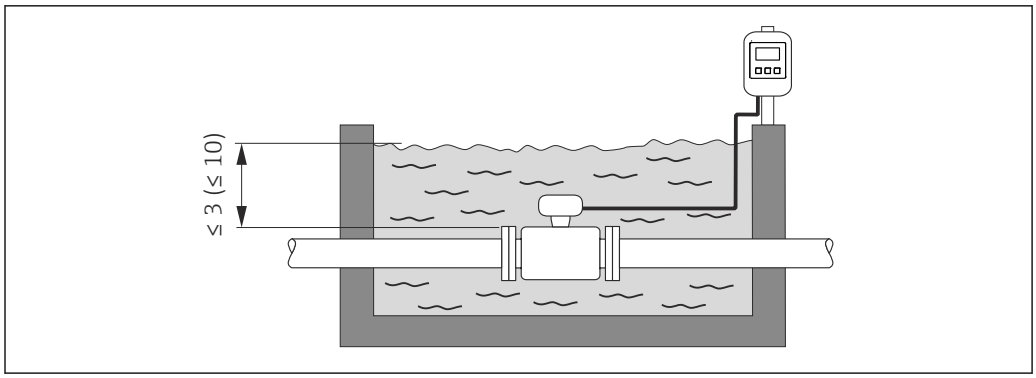
Special mounting instructions

Display protection

To ensure that the optional display protection can be easily opened, maintain the following minimum head clearance: 350 mm (13.8 in)

Permanent immersion in water

A fully welded remote version with IP68 protection is optionally available for permanent immersion in water ≤ 3 m (10 ft) or in exceptional cases for use for up to 48 hours at ≤ 10 m (30 ft). The measuring device meets the requirements of corrosion categories C5-M and Im1/Im2/Im3. The fully welded design along with the connection compartment sealing system ensure that moisture cannot enter the measuring device.



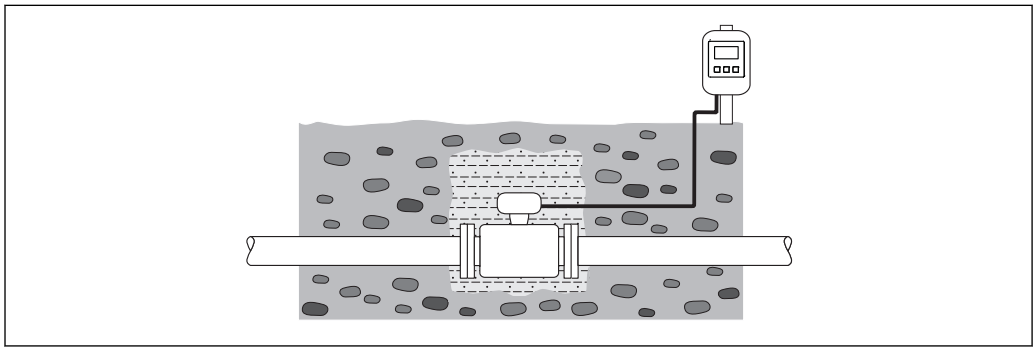
A0017296

23 Engineering unit in m(ft)

Replacement of cable gland on connection housing → 29

Buried applications

A remote version with IP68 protection is optionally available for buried applications. The measuring device satisfies the certified corrosion protection Im1/Im2/Im3 in accordance with EN ISO 12944. It can be used directly underground without the need for additional protective measures. The device is mounted in accordance with the usual regional installation regulations (e.g. EN DIN 1610).



A0017298

Environment

Ambient temperature range

Transmitter	−40 to +60 °C (−40 to +140 °F)
Local display	−20 to +60 °C (−4 to +140 °F), the readability of the display may be impaired at temperatures outside the temperature range.
Sensor	▪ Process connection material, carbon steel: −10 to +60 °C (+14 to +140 °F) ▪ Process connection material, stainless steel: −40 to +60 °C (−40 to +140 °F) Mount the transmitter separately from the sensor if both the ambient and fluid temperatures are high.
Liner	Do not exceed or fall below the permitted temperature range of the liner .

If operating outdoors:
- Install the measuring device in a shady location.
- Avoid direct sunlight, particularly in warm climatic regions.
- Avoid direct exposure to weather conditions.

- If the compact version of the device is insulated at low temperatures, the insulation must also include the device neck.
- Protect the display against impact.
- Protect the display from abrasion by sand in desert areas.

A display protector can be ordered from Endress+Hauser: "Accessories" section → 108

Storage temperature

The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.

- Protect the measuring device against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Select a storage location where moisture cannot collect in the measuring device as fungus or bacteria infestation can damage the liner.
- If protection caps or protective covers are mounted these should never be removed before installing the measuring device.

Atmosphere

If a plastic transmitter housing is permanently exposed to certain steam and air mixtures, this can damage the housing.

If you are unsure, please contact your Endress+Hauser Sales Center for clarification.

Degree of protection

Transmitter
- As standard: IP66/67, type 4X enclosure
- When housing is open: IP20, type 1 enclosure

Sensor
- As standard: IP66/67, type 4X enclosure
- Optionally available for remote version:
  - IP66/67, type 4X enclosure; fully welded, with protective varnish EN ISO 12944 C5-M. Suitable for use in corrosive atmospheres.
  - IP68, type 6P enclosure; fully welded, with protective varnish as per EN ISO 12944 C5-M. Suitable for permanent immersion in water ≤3 m (10 ft) or 48 hours at depths ≤10 m (30 ft).
  - IP68, type 6P enclosure; fully welded, with protective varnish as per EN ISO 12944 Im1/Im2/Im3. Suitable for permanent immersion in saline water ≤3 m (10 ft) or 48 hours at depths ≤ 10 m (30 ft) or in buried applications.

Shock resistance

Compact version
6 ms 30 g, according to IEC 60068-2-27

Remote version
- Transmitter: 6 ms 30 g, according to IEC 60068-2-27
- Sensor: 6 ms 50 g, according to IEC 60068-2-27

Vibration resistance

Compact version
- Vibration sinusoidal, 1 g peak, according to IEC 60068-2-6
- Vibration broad-band random, 1.54 g rms, according to IEC 60068-2-64

Remote version
- Transmitter
  - Vibration sinusoidal, 1 g peak, according to IEC 60068-2-6
  - Vibration broad-band random, 1.54 g rms, according to IEC 60068-2-64
- Sensor:
  - Vibration sinusoidal, 2 g peak, according to IEC 60068-2-6
  - Vibration broad-band random, 2.70 g rms, according to IEC 60068-2-64

Mechanical load

- Protect the transmitter housing against mechanical effects, such as shock or impact; the use of the remote version is sometimes preferable.
- Never use the transmitter housing as a ladder or climbing aid.

Electromagnetic compatibility (EMC)

- As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21)
- Complies with emission limits for industry as per EN 55011 (Class A)
- Device version with PROFIBUS DP: Complies with emission limits for industry as per EN 50170 Volume 2, IEC 61784

The following applies for PROFIBUS DP: If baud rates > 1.5 MBaud an EMC cable entry must be used and the cable shield must continue as far as the terminal wherever possible.

For details refer to the Declaration of Conformity.

Process

Medium temperature range

- 0 to +80 °C (+32 to +176 °F) for hard rubber, DN 50 to 2000 (2 to 78")
- –20 to +50 °C (–4 to +122 °F) for polyurethane, DN 25 to 1200 (1 to 48")

In custody transfer mode, the permitted fluid temperature is 0 to +50 °C (+32 to +122 °F).

Conductivity

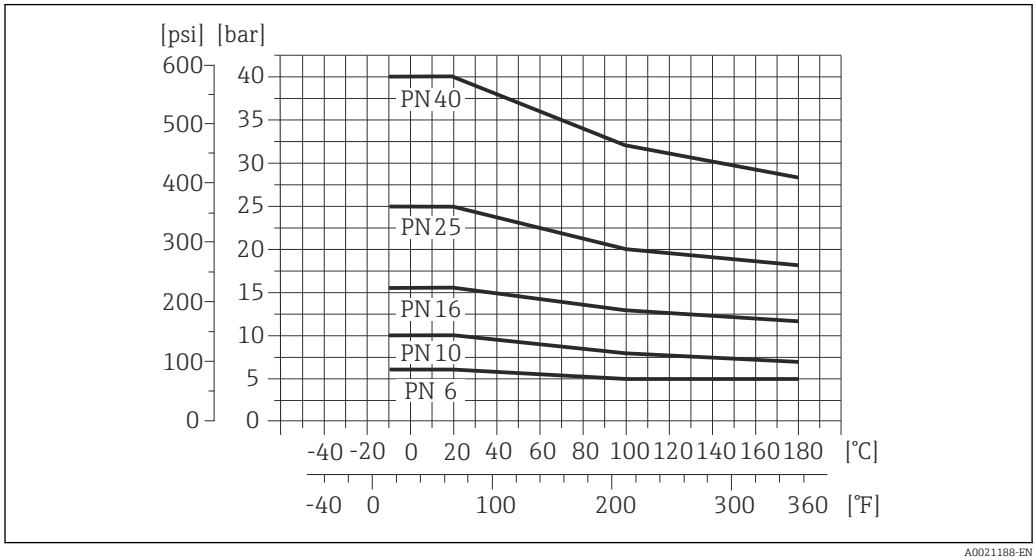
≥ 5 µS/cm for liquids in general

Note that in the case of the remote version, the requisite minimum conductivity also depends on the cable length → 36.

Pressure-temperature ratings

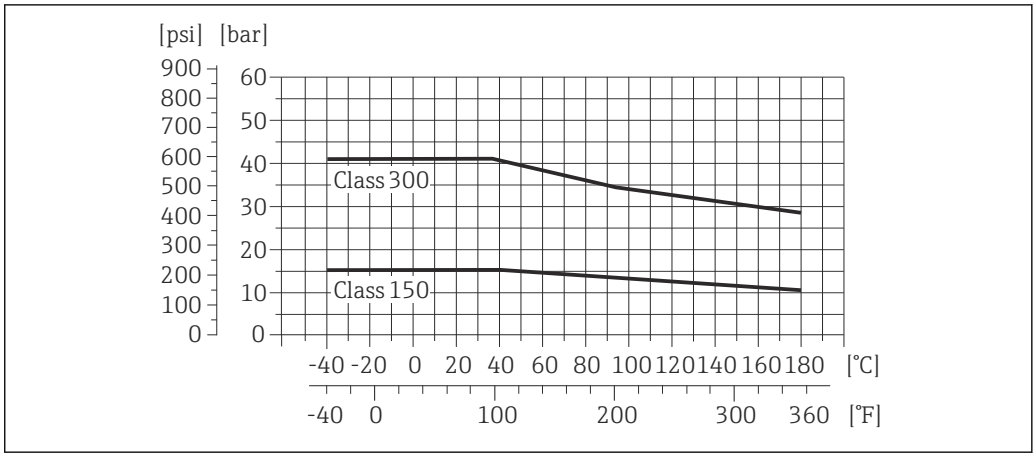
The following pressure-temperature ratings refer to the entire device and not just the process connection.

Process connection: fixed flange according to EN 1092-1 (DIN 2501)

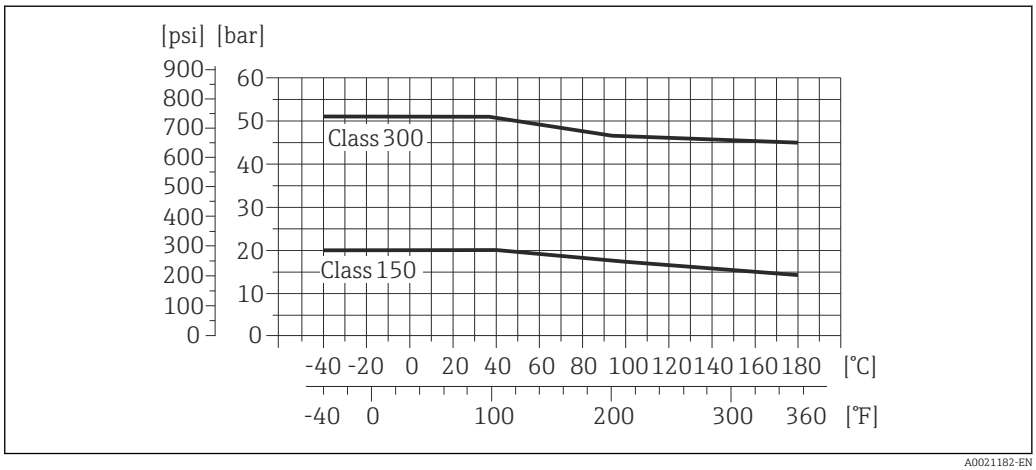


24 Process connection material: stainless steel, 1.4404/1.4571/F316L; carbon steel, A105/FE410WB/P250GH/S235JRG2/S235JR+N

Process connection: fixed flange according to ASME B16.5

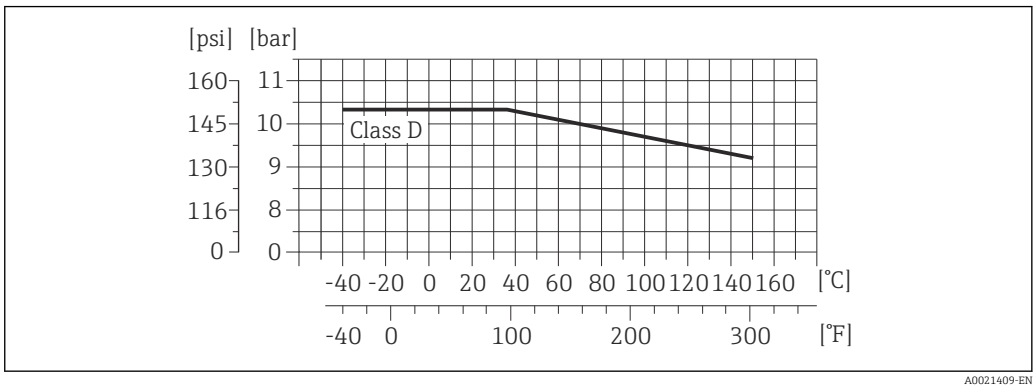


25 *Process connection material: stainless steel, F316L similar to 1.4404*



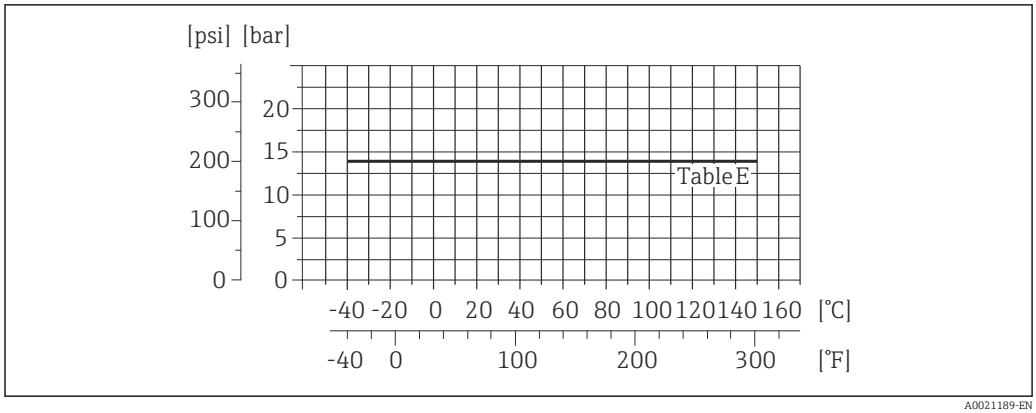
26 *Process connection material: carbon steel, A105/A515(70)*

Process connection: fixed flange according to AWWA C207



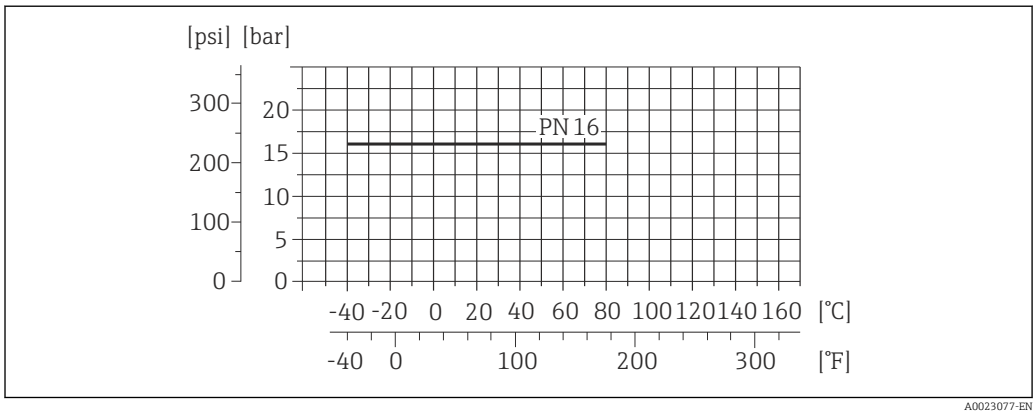
27 *Process connection material: carbon steel, A105/A181/P265GH/S275JR*

Process connection: fixed flange according to AS 2129



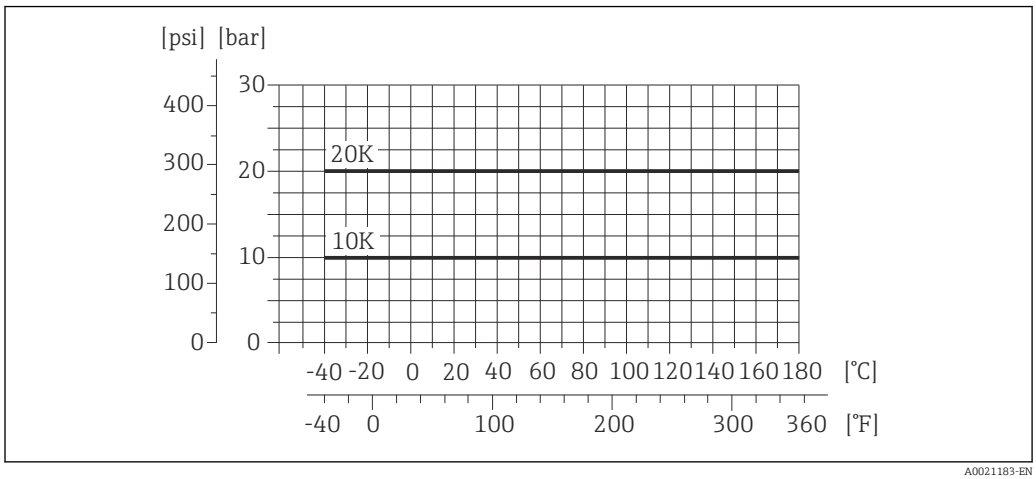
28 Process connection material: carbon steel, A105/FE410WB/P235GH/P265GH/S235JRG2

Process connection: fixed flange according to AS 4087



29 Process connection material: carbon steel, A105/P265GH/S275JR

Process connection: fixed flange according to JIS B2220



30 Process connection material: stainless steel, F316L similar to 1.4404; carbon steel, A105/A350LF2

Pressure tightness

Liner: hard rubber

Nominal diameter		Limit values for absolute pressure in [mbar] ([psi]) for fluid temperatures:		
[mm]	[in]	+25 °C (+77 °F)	+50 °C (+122 °F)	+80 °C (+176 °F)
50…2000	2…78	0 (0)	0 (0)	0 (0)

Liner: polyurethane

Nominal diameter		Limit values for absolute pressure in [mbar] ([psi]) for fluid temperatures:	
[mm]	[in]	+25 °C (+77 °F)	+50 °C (+122 °F)
25...1200	1...48	0 (0)	0 (0)

Flow limit

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum velocity of flow is between 2 to 3 m/s (6.56 to 9.84 ft/s). Also match the velocity of flow (v) to the physical properties of the fluid:
- v < 2 m/s (6.56 ft/s): for abrasive fluids (e.g. potter's clay, lime milk, ore slurry)
- v > 2 m/s (6.56 ft/s): for fluids producing buildup (e.g. wastewater sludges)

A necessary increase in the flow velocity can be achieved by reducing the sensor nominal diameter.

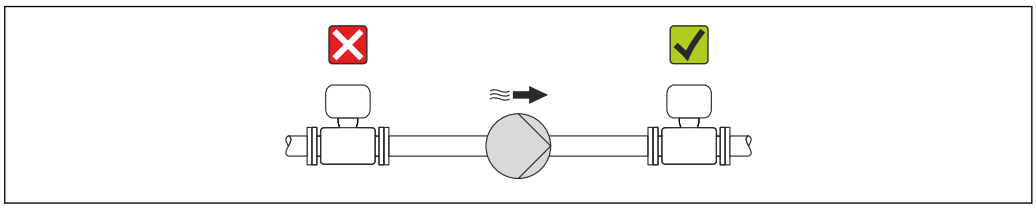
For an overview of the measuring range full scale values, see the "Measuring range" section → 7

For custody transfer, the applicable approval determines the permitted measuring range.

Pressure loss

- No pressure loss occurs if the sensor is installed in a pipe with the same nominal diameter.
- Pressure losses for configurations incorporating adapters according to DIN EN 545 → 35

System pressure



A0015594

Never install the sensor on the pump suction side in order to avoid the risk of low pressure, and thus damage to the liner.

Furthermore, install pulse dampers if reciprocating, diaphragm or peristaltic pumps are used.

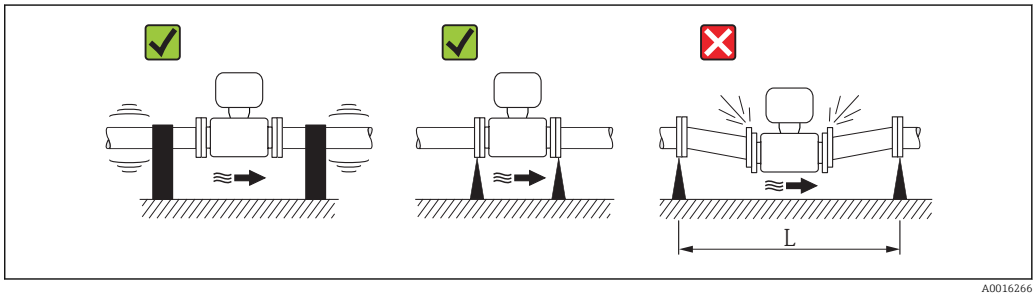
- For information on the liner's resistance to partial vacuum → 42
- For information on the shock resistance of the measuring system → 39
- For information on the vibration resistance of the measuring system → 39

Vibrations

In the event of very strong vibrations, the pipe and sensor must be supported and fixed.

It is also advisable to mount the sensor and transmitter separately.

- For information on the shock resistance of the measuring system → 39
- For information on the vibration resistance of the measuring system → 39



A0016266

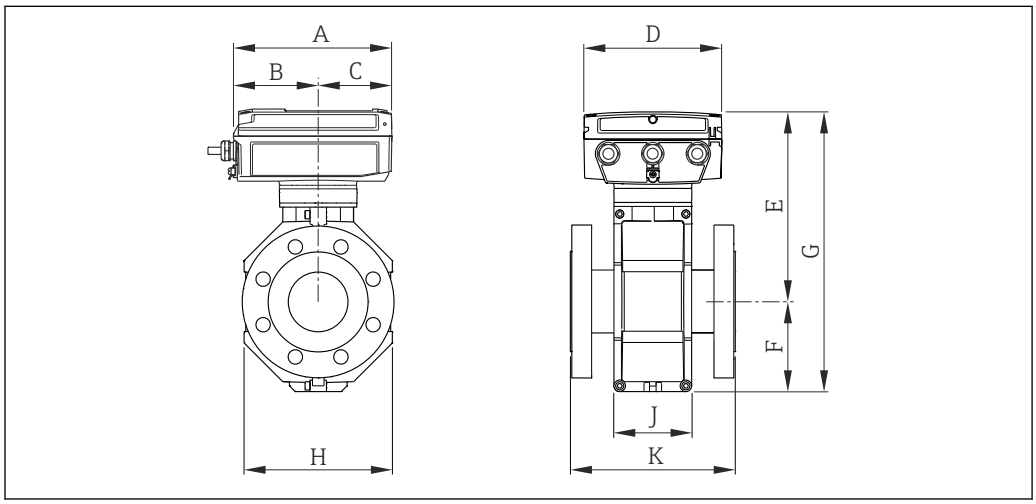
31 *Measures to avoid device vibrations (L > 10 m (33 ft))*

Mechanical construction

Dimensions in SI units

Compact version

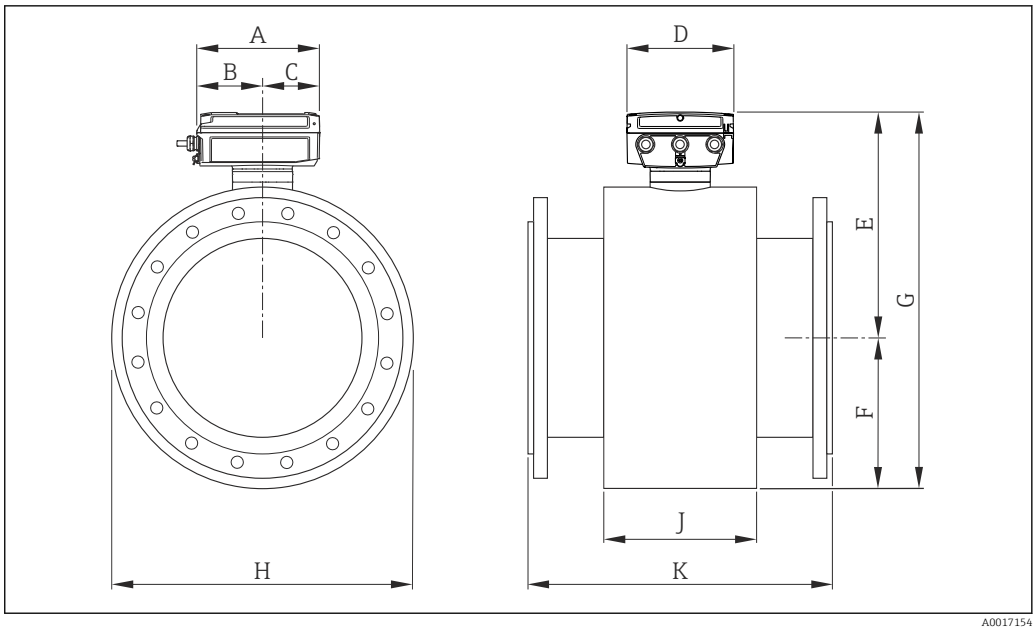
Order code for "Housing", option M "Compact, polycarbonate" or option A "Compact, aluminum, coated"



A0020352

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	J [mm]	K [2] [mm]
25	193	103	90	167	222	84	306	120	94	200
32	193	103	90	167	222	84	306	120	94	200
40	193	103	90	167	222	84	306	120	94	200
50	193	103	90	167	222	84	306	120	94	200
65	193	103	90	167	247	109	356	180	94	200
80	193	103	90	167	247	109	356	180	94	200
100	193	103	90	167	247	109	356	180	94	250
125	193	103	90	167	287	150	437	260	140	250
150	193	103	90	167	287	150	437	260	140	300
200	193	103	90	167	312	180	492	324	156	350
250	193	103	90	167	337	205	542	400	166	450
300	193	103	90	167	362	230	592	460	166	500

1) EN (DIN), AS, JIS; For flanges according to AS, only nominal diameters DN 80, 100 and 150 to 300 are available.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

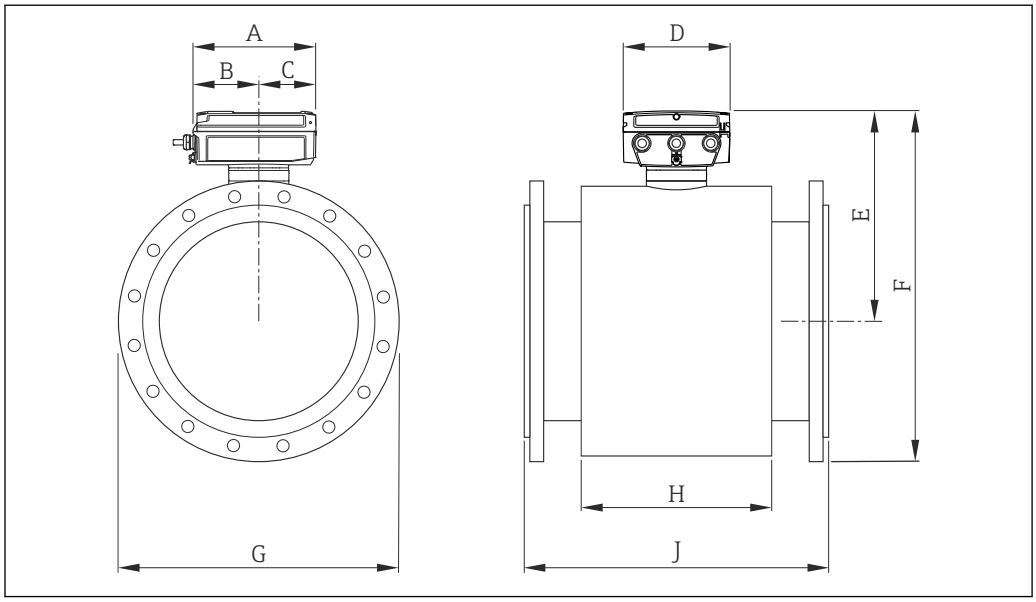


A0017154

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	J [mm]	K [2] [mm]
350	193	103	90	167	432	282	714	564	276	550
375	193	103	90	167	458	308	766	616	276	600
400	193	103	90	167	458	308	766	616	276	600
450	193	103	90	167	483	333	816	666	292	650
500	193	103	90	167	508	359	867	717	292	650
600	193	103	90	167	560	410	970	821	402	780
700	193	103	90	167	662	512	1174	1024	589	910
750	193	103	90	167	662	512	1174	1024	626	975
800	193	103	90	167	683	534	1217	1067	647	1040
900	193	103	90	167	760	610	1370	1220	785	1170
1000	193	103	90	167	836	686	1522	1372	862	1300
1050	193	103	90	167	862	712	1574	1424	912	1365
1200	193	103	90	167	961	811	1772	1622	992	1560
1350	193	103	90	167	1062	912	1974	1824	1252	1755
1400	193	103	90	167	1137	987	2124	1974	1252	1820
1500	193	103	90	167	1161	1011	2172	2022	1392	1950
1600	193	103	90	167	1206	1056	2262	2112	1482	2080
1650	193	103	90	167	1243	1093	2336	2186	1482	2145
1800	193	103	90	167	1338	1188	2526	2376	1632	2340
2000	193	103	90	167	1388	1238	2626	2476	1732	2600

1) EN (DIN), AS; For flanges according to AS, only nominal diameters DN 350, 400, 500 and 600 are available.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Housing", option M "Compact, polycarbonate" or option A "Compact, aluminum, coated"; order code for "Design", option A "Insertion length short"

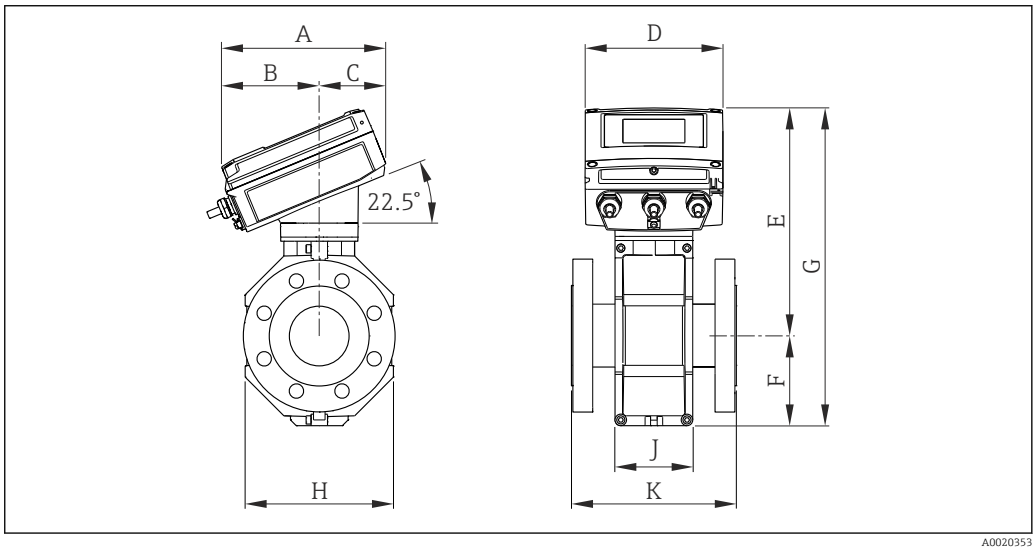


A0017153

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	H [mm]	J [mm]
350	193	103	90	167	386	290	550
375	193	103	90	167	412	290	600
400	193	103	90	167	412	290	600
450	193	103	90	167	440	290	600
500	193	103	90	167	465	290	600
600	193	103	90	167	506	290	600
700	193	103	90	167	571	424	700
750	193	103	90	167	608	454	750
800	193	103	90	167	627	500	800
900	193	103	90	167	677	580	900
1000	193	103	90	167	727	660	1000
1050	193	103	90	167	763	755	1050
1200	193	103	90	167	841	828	1200
1350	193	103	90	167	953	1008	1350
1400	193	103	90	167	953	1008	1400
1500	193	103	90	167	1053	1147	1500
1600	193	103	90	167	1053	1147	1600
1650	193	103	90	167	1104	1284	1650
1800	193	103	90	167	1161	1379	1800
2000	193	103	90	167	1272	1569	2000

DN [mm]	Dimension F					Dimension G				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]
350	631	638	702	653	648	490	505	520	533	525
375	–	–	–	–	687	–	–	–	–	550
400	682	694	760	710	702	540	565	580	597	580
450	737	747	823	757	760	595	615	640	635	640
500	787	800	926	814	817	645	670	715	699	705
600	883	896	1026	912	918	755	780	840	813	825
700	1001	1018	1145	1034	1026	860	895	910	927	910
750	–	–	–	1100	1106	–	–	–	984	995
800	1115	1135	1240	1157	1157	975	1015	1025	1060	1060
900	1215	1235	1240	1261	1265	1075	1115	1125	1168	1175
1000	1315	1342	1355	1372	1355	1175	1230	1225	1289	1255
1050	–	–	–	1436	–	–	–	–	1346	–
1200	1544	1569	1584	1597	1586	1405	1455	1255	1511	1490
1350	–	–	–	1795	–	–	–	–	1683	–
1400	1768	1791	1796	–	–	1630	1675	1685	–	–
1500	–	–	–	1980	–	–	–	–	1854	–
1600	1968	2011	2019	–	–	1830	1915	1930	–	–
1650	–	–	–	2120	–	–	–	–	2032	–
1800	2183	2218	2226	2259	–	2045	2115	2130	2197	–
2000	2404	2434	2444	2453	–	2265	2325	2345	2362	–

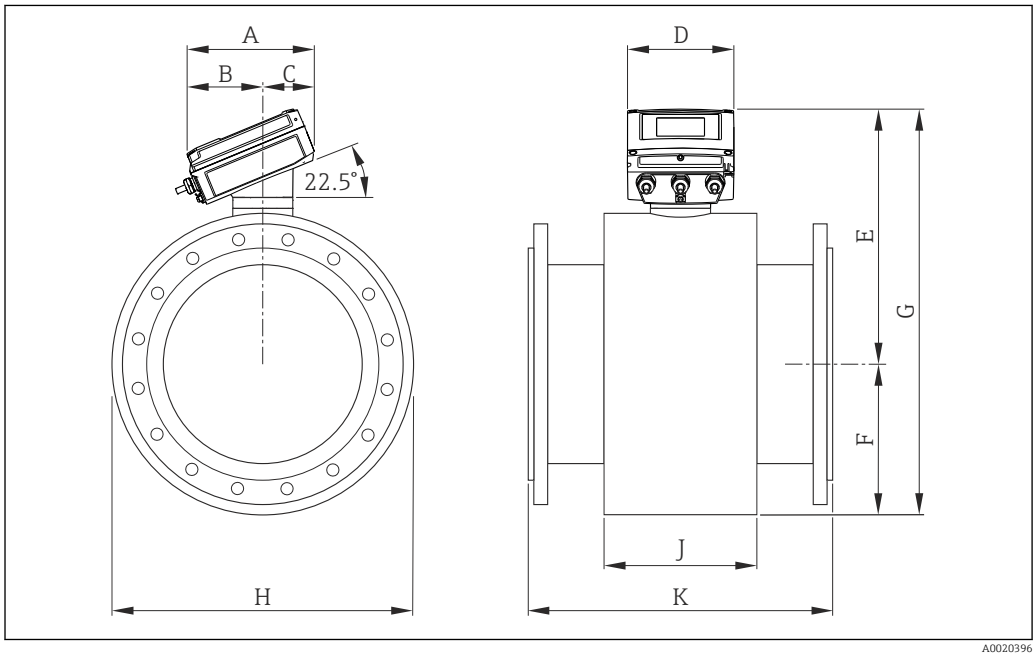
Order code for "Housing", option Q "Compact, polycarbonate, inclined" or option R "Compact, aluminum, coated, inclined"



A0020353

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	J [mm]	K [2] [mm]
25	199	119	80	167	267	84	351	120	94	200
32	199	119	80	167	267	84	351	120	94	200
40	199	119	80	167	267	84	351	120	94	200
50	199	119	80	167	267	84	351	120	94	200
65	199	119	80	167	292	109	401	180	94	200
80	199	119	80	167	292	109	401	180	94	200
100	199	119	80	167	292	109	401	180	94	250
125	199	119	80	167	332	150	482	260	140	250
150	199	119	80	167	332	150	482	260	140	300
200	199	119	80	167	357	180	537	324	156	350
250	199	119	80	167	382	205	587	400	166	450
300	199	119	80	167	407	230	637	460	166	500

1) EN (DIN), AS, JIS; For flanges according to AS, only nominal diameters DN 80, 100 and 150 to 300 are available.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.



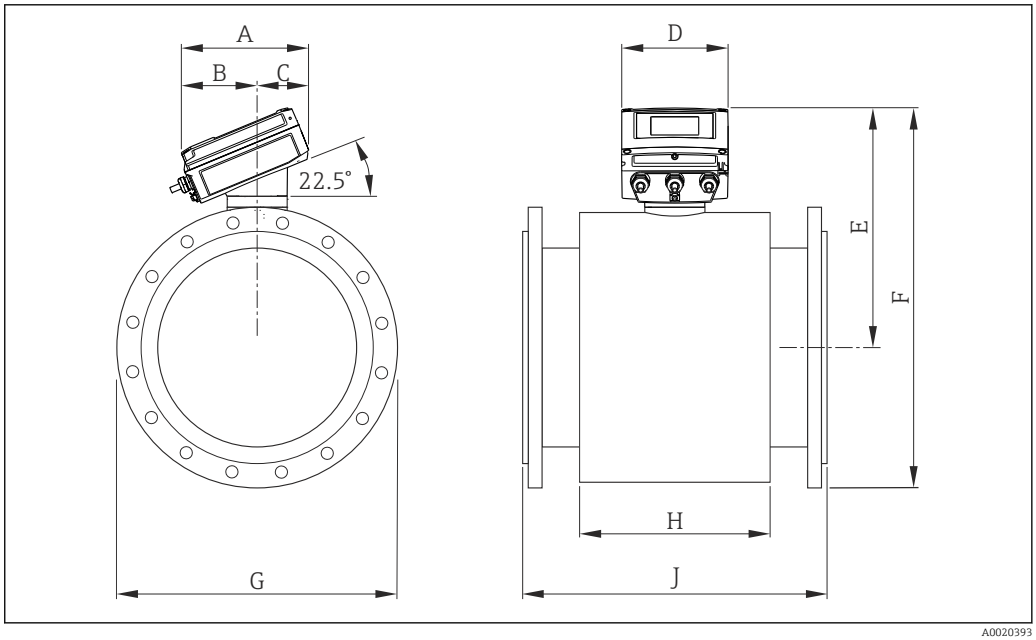
A0020396

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	J [mm]	K [2] [mm]
350	199	119	80	167	477	282	759	564	276	550
375	199	119	80	167	503	308	811	616	276	600
400	199	119	80	167	503	308	811	616	276	600
450	199	119	80	167	528	333	861	666	292	650
500	199	119	80	167	553	359	912	717	292	650
600	199	119	80	167	605	410	1015	821	402	780
700	199	119	80	167	707	512	1219	1024	589	910
750	199	119	80	167	707	512	1219	1024	626	975

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	J [mm]	K [2] [mm]
800	199	119	80	167	728	534	1262	1067	647	1040
900	199	119	80	167	805	610	1415	1220	785	1170
1000	199	119	80	167	881	686	1567	1372	862	1300
1050	199	119	80	167	907	712	1619	1424	912	1365
1200	199	119	80	167	1006	811	1817	1622	992	1560
1350	199	119	80	167	1107	912	2019	1824	1252	1755
1400	199	119	80	167	1182	987	2169	1974	1252	1820
1500	199	119	80	167	1206	1011	2217	2022	1392	1950
1600	199	119	80	167	1251	1056	2307	2112	1482	2080
1650	199	119	80	167	1288	1093	2381	2186	1482	2145
1800	199	119	80	167	1383	1188	2571	2376	1632	2340
2000	199	119	80	167	1433	1238	2671	2476	1732	2600

1) EN (DIN), AS; For flanges according to AS, only nominal diameters DN 350, 400, 500 and 600 are available.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Housing", option Q "Compact, polycarbonate, inclined" or option R "Compact, aluminum, coated, inclined"; order code for "Design", option A "Insertion length short"



A0020393

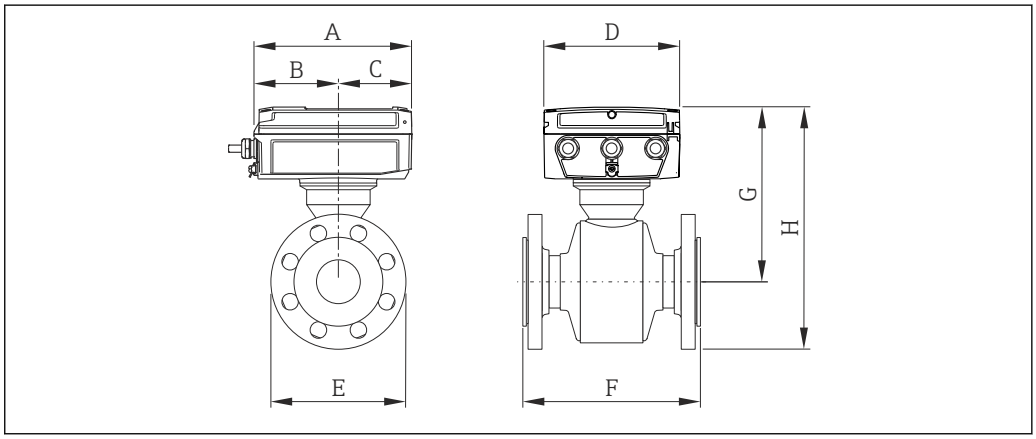
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	H [mm]	J [mm]
350	199	119	80	167	431	290	550
375	199	119	80	167	457	290	600
400	199	119	80	167	457	290	600
450	199	119	80	167	485	290	600
500	199	119	80	167	510	290	600
600	199	119	80	167	551	290	600

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	H [mm]	J [mm]
700	199	119	80	167	616	424	700
750	199	119	80	167	653	454	750
800	199	119	80	167	672	500	800
900	199	119	80	167	722	580	900
1000	199	119	80	167	772	660	1000
1050	199	119	80	167	808	755	1050
1200	199	119	80	167	886	828	1200
1350	199	119	80	167	998	1008	1350
1400	199	119	80	167	953	1008	1400
1500	199	119	80	167	1098	1147	1500
1600	199	119	80	167	1098	1147	1600
1650	199	119	80	167	1149	1284	1650
1800	199	119	80	167	1206	1379	1800
2000	199	119	80	167	1317	1569	2000

	Dimension F					Dimension G				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN [mm]	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]
350	676	683	618	698	693	490	505	520	533	525
375	–	–	–	–	732	–	–	–	–	550
400	727	739	672	755	747	540	565	580	597	580
450	782	792	732	802	805	595	615	640	635	640
500	832	845	795	859	862	645	670	715	699	705
600	928	941	898	957	963	755	780	840	813	825
700	1046	1063	1008	1079	1071	860	895	910	927	910
750	–	–	–	1145	1151	–	–	–	984	995
800	1160	1180	1112	1202	1202	975	1015	1025	1060	1060
900	1260	1280	1212	1306	1310	1075	1115	1125	1168	1175
1000	1360	1387	1327	1417	1400	1175	1230	1225	1289	1255
1050	–	–	–	1481	–	–	–	–	1346	–
1200	1589	1614	1556	1642	1631	1405	1455	1255	1511	1490
1350	–	–	–	1840	–	–	–	–	1683	–
1400	1813	1836	1768	–	–	1630	1675	1685	–	–
1500	–	–	–	2025	–	–	–	–	1854	–
1600	2013	2056	1991	–	–	1830	1915	1930	–	–
1650	–	–	–	2165	–	–	–	–	2032	–
1800	2228	2263	2198	2304	–	2045	2115	2130	2197	–
2000	2449	2479	2416	2498	–	2265	2325	2345	2362	–

Order code for "Sensor option", option CA in combination with order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N

- Order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N available for order in conjunction with order code for "Housing", option M "Compact, polycarbonate"
- Order code for "Calibration flow", options H/K also available for order in conjunction with order code for "Housing", option A "Compact, aluminum, coated"



A0021328

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	F [mm]	G [mm]
25	193	103	90	167	200	188
32	193	103	90	167	200	188
40	193	103	90	167	200	188
50	193	103	90	167	200	188
65	193	103	90	167	200	200
80	193	103	90	167	200	205
100	193	103	90	167	250	218
125	193	103	90	167	250	231
150	193	103	90	167	300	252
200	193	103	90	167	350	278
250	193	103	90	167	450	311
300	193	103	90	167	500	336

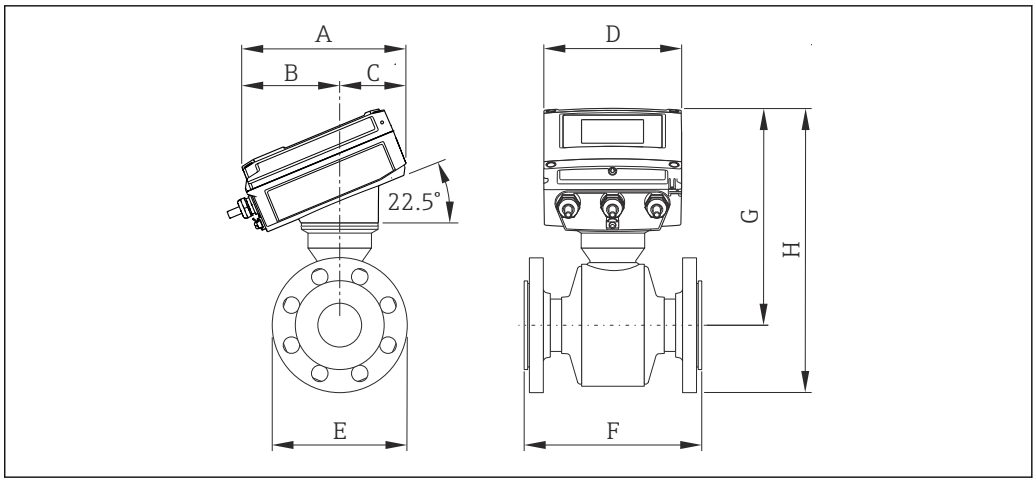
Dimension E										
	EN (DIN)				ASME		AS		JIS	
DN [mm]	PN 10 [mm]	PN 16 [mm]	PN 25 [mm]	PN 40 [mm]	Class 150 [mm]	Class 300 [mm]	Table E [mm]	PN 16 [mm]	10K [mm]	20K [mm]
25	–	–	–	140	140	140	140	–	140	140
32	–	–	–	140	–	–	–	–	140	140
40	–	–	–	150	140	155	–	–	140	140
50	–	–	–	165	153	165	150	150	155	155
65	–	185	–	185	–	–	–	–	175	175
80	–	200	–	200	191	210	185	185	185	200
100	–	220	–	325	229	254	215	215	210	225

Dimension E										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
125	–	250	–	270	–	–	–	–	250	270
150	–	285	–	300	280	318	280	280	280	305
200	340	340	360	–	343	–	335	335	330	350
250	395	405	425	–	407	–	405	405	400	430
300	445	460	485	–	483	–	455	455	445	480

Dimension H										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	–	–	–	258	258	258	258	–	258	258
32	–	–	–	258	–	–	–	–	258	258
40	–	–	–	262	258	265	–	–	258	258
50	–	–	–	270	263	270	262	262	265	265
65	–	293	–	293	–	–	–	–	288	288
80	–	305	–	305	300	309	298	298	298	305
100	–	328	–	380	331	344	325	325	323	330
125	–	355	–	365	–	–	–	–	355	365
150	–	394	–	402	391	410	393	393	393	404
200	448	448	458	–	448	–	445	445	443	452
250	508	513	523	–	514	–	513	513	511	526
300	558	566	578	–	578	–	563	563	558	576

Order code for "Sensor option", option CA in combination with order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N

- Order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N available for order in conjunction with order code for "Housing", option Q "Compact, polycarbonate, inclined"
- Order code for "Calibration flow", options H/K also available for order in conjunction with order code for "Housing", option R "Compact, aluminum, coated, inclined"



A0021329

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	F [mm]	G [mm]
25	199	119	80	167	200	232
32	199	119	80	167	200	232
40	199	119	80	167	200	232
50	199	119	80	167	200	232
65	199	119	80	167	200	244
80	199	119	80	167	200	249
100	199	119	80	167	250	262
125	199	119	80	167	250	275
150	199	119	80	167	300	296
200	199	119	80	167	350	322
250	199	119	80	167	450	355
300	199	119	80	167	500	380

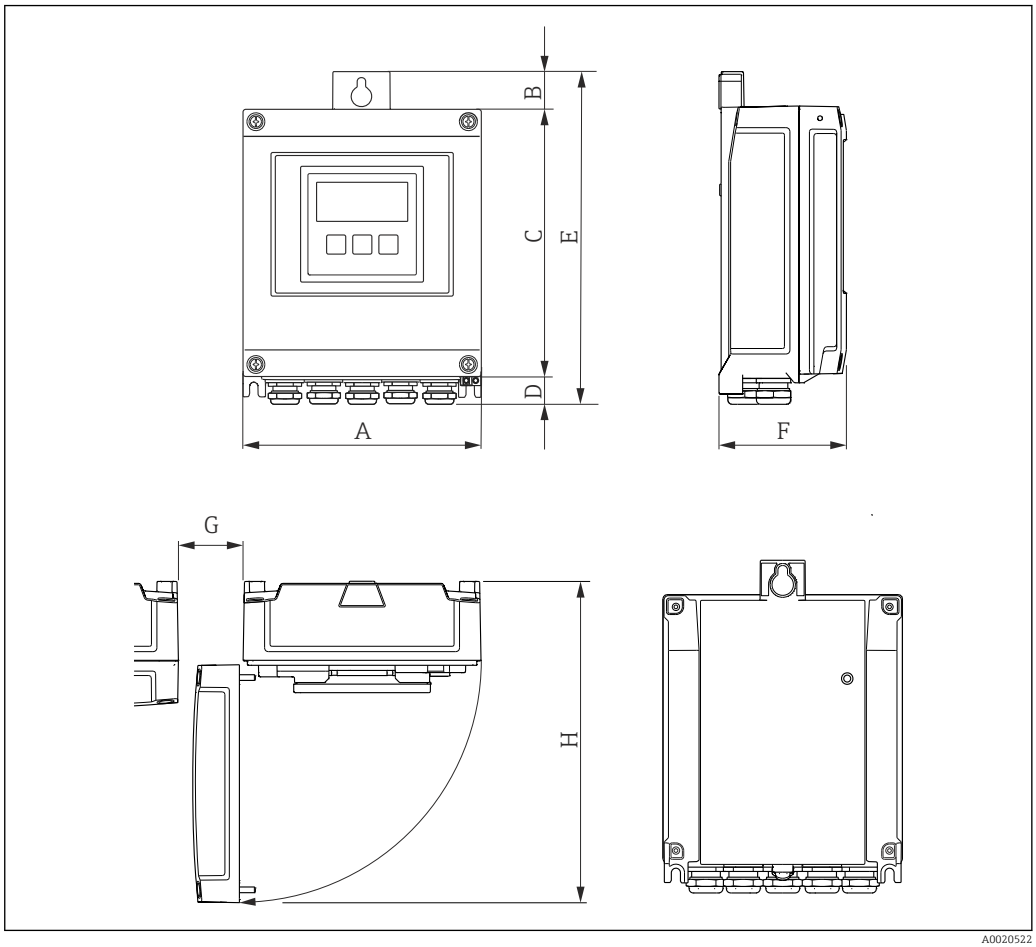
Dimension E										
	EN (DIN)				ASME		AS		JIS	
DN [mm]	PN 10 [mm]	PN 16 [mm]	PN 25 [mm]	PN 40 [mm]	Class 150 [mm]	Class 300 [mm]	Table E [mm]	PN 16 [mm]	10K [mm]	20K [mm]
25	–	–	–	140	140	140	140	–	140	140
32	–	–	–	140	–	–	–	–	140	140
40	–	–	–	150	140	155	–	–	140	140
50	–	–	–	165	153	165	150	150	155	155
65	–	185	–	185	–	–	–	–	175	175
80	–	200	–	200	191	210	185	185	185	200
100	–	220	–	325	229	254	215	215	210	225
125	–	250	–	270	–	–	–	–	250	270
150	–	285	–	300	280	318	280	280	280	305
200	340	340	360	–	343	–	335	335	330	350

Dimension E										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
250	395	405	425	–	407	–	405	405	400	430
300	445	460	485	–	483	–	455	455	445	480

Dimension H										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	–	–	–	302	302	302	302	–	302	302
32	–	–	–	302	–	–	–	–	302	302
40	–	–	–	307	302	310	–	–	302	302
50	–	–	–	315	309	315	307	307	310	310
65	–	337	–	337	–	–	–	–	332	332
80	–	349	–	349	345	354	342	342	342	349
100	–	372	–	425	377	389	370	370	367	375
125	–	400	–	410	–	–	–	–	400	410
150	–	439	–	446	436	455	436	436	436	449
200	492	492	502	–	494	–	490	490	487	497
250	553	558	568	–	559	–	558	558	555	570
300	603	610	623	–	622	–	608	608	603	620

Transmitter remote version

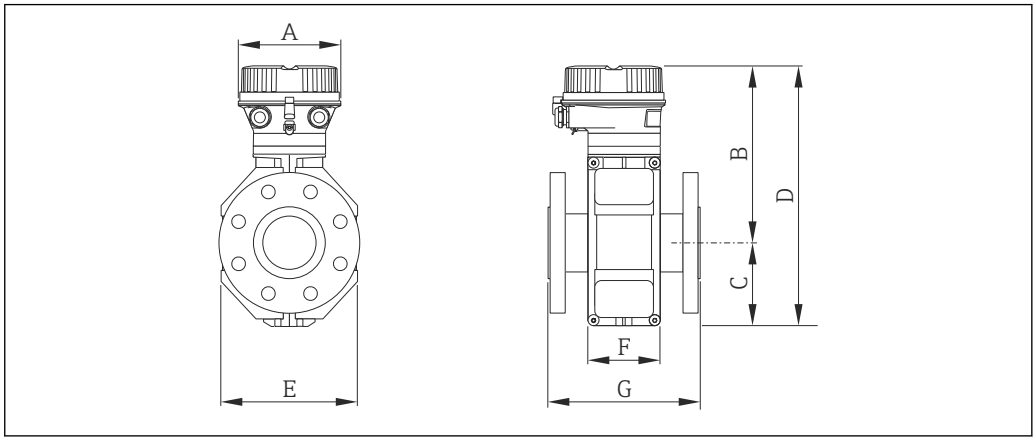
Order code for "Housing", option N "Remote, polycarbonate" or option P "Remote, aluminum coated"



A0020522

A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]
167	24	187	21	232	80	50	240

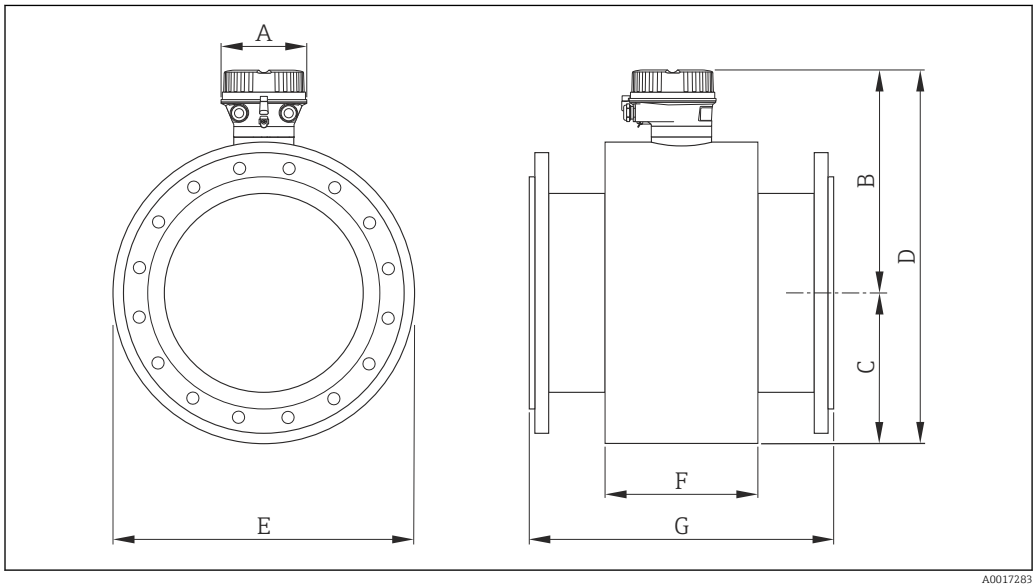
Sensor remote version



A0017282

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [2] [mm]
25	136	207	84	291	120	94	200
32	136	207	84	291	120	94	200
40	136	207	84	291	120	94	200
50	136	207	84	291	120	94	200
65	136	232	109	341	180	94	200
80	136	232	109	341	180	94	200
100	136	232	109	341	180	94	250
125	136	272	150	422	260	140	250
150	136	272	150	422	260	140	300
200	136	297	180	477	324	156	350
250	136	322	205	527	400	156	450
300	136	347	230	577	460	166	500

1) EN (DIN), AS, JIS; For flanges according to AS, only nominal diameters DN 80, 100 and 150 to 300 are available.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.



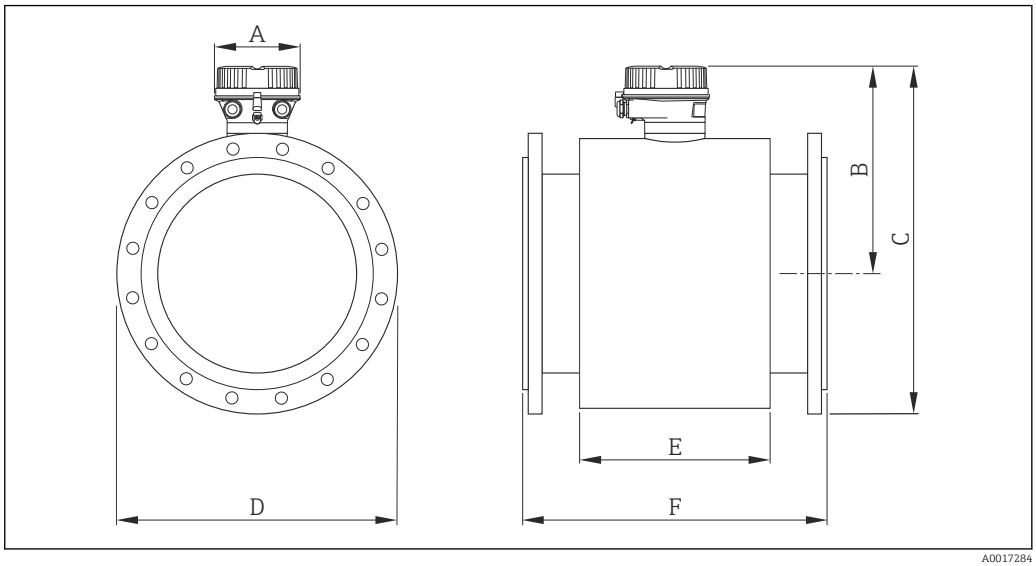
A0017283

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [2] [mm]
350	136	407	282	689	564	276	550
375	136	433	308	741	616	276	600
400	136	433	308	741	616	276	600
450	136	458	333	791	666	292	650
500	136	483	359	842	717	292	650
600	136	535	411	946	821	402	780
700	136	637	512	1149	1024	589	910
750	136	637	512	1149	1024	626	975
800	136	658	534	1192	1067	647	1040

DN [1] [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [2] [mm]
900	136	735	610	1345	1220	785	1170
1000	136	811	686	1497	1372	862	1300
1050	136	837	712	1549	1424	912	1365
1200	136	936	811	1747	1622	992	1560
1350	136	1037	912	1949	1824	1252	1755
1400	136	1112	987	2099	1974	1252	1820
1500	136	1136	1011	2147	2022	1392	1950
1600	136	1181	1056	2237	2112	1482	2080
1650	136	1218	1093	2311	2186	1482	2145
1800	136	1313	1188	2501	2376	1632	2340
2000	136	1363	1238	2601	2476	1732	2600

1) EN (DIN), AS; For flanges according to AS, only nominal diameters DN 350, 400, 500 and 600 are available.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Design", option A "Insertion length short"



A0017284

DN [mm]	A [mm]	B [mm]	E [mm]	F [mm]
350	136	358	290	550
375	136	384	290	600
400	136	384	290	600
450	136	412	290	600
500	136	437	290	600
600	136	478	290	600
700	136	543	424	700
750	136	579	454	750
800	136	599	500	800
900	136	649	580	900

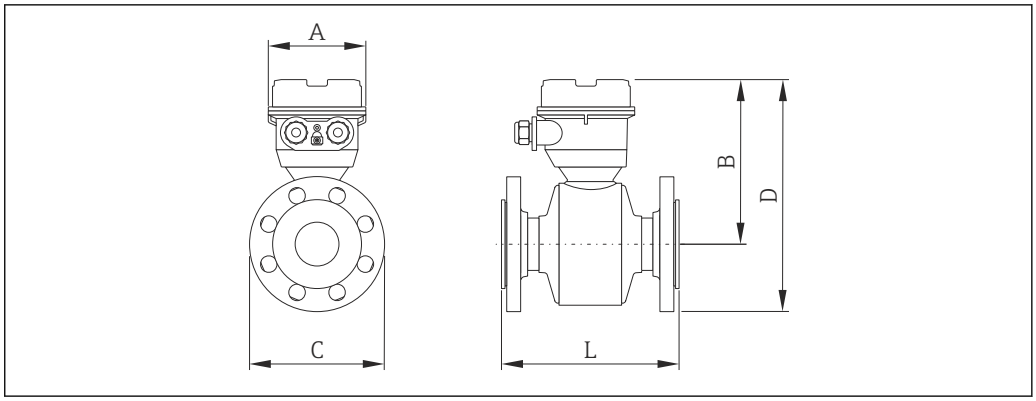
DN [mm]	A [mm]	B [mm]	E [mm]	F [mm]
1000	136	699	660	1000
1050	136	735	755	1050
1200	136	813	828	1200
1350	136	925	1008	1350
1400	136	925	1008	1400
1500	136	1025	1147	1500
1600	136	1025	1147	1600
1650	136	1076	1284	1650
1800	136	1133	1379	1800
2000	136	1244	1569	2000

	Dimension C					Dimension D				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN	PN 6	PN 10	PN 16	AWWA		PN 6	PN 10	PN 16	AWWA	
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
350	603	610	616	625	620	490	505	520	533	525
375	–	–	–	–	659	–	–	–	–	550
400	654	666	672	682	674	540	565	580	597	580
450	709	719	729	729	732	595	615	640	635	640
500	759	772	791	786	789	645	670	715	699	705
600	855	868	903	884	890	755	780	840	813	825
700	973	990	1009	1006	998	860	895	910	927	910
750	–	–	–	1072	1078	–	–	–	984	995
800	1087	1107	1123	1129	1129	975	1015	1025	1060	1060
900	1187	1207	1223	1233	1237	1075	1115	1125	1168	1175
1000	1287	1314	1338	1344	1327	1175	1230	1225	1289	1255
1050	–	–	–	1408	–	–	–	–	1346	–
1200	1516	1541	1567	1569	1558	1405	1455	1255	1511	1490
1350	–	–	–	1767	–	–	–	–	1683	–
1400	1740	1763	1779	–	–	1630	1675	1685	–	–
1500	–	–	–	1952	–	–	–	–	1854	–
1600	1940	1983	2002	–	–	1830	1915	1930	–	–
1650	–	–	–	2092	–	–	–	–	2032	–
1800	2155	2190	2209	2231	–	2045	2115	2130	2197	–
2000	2376	2406	2427	2425	–	2265	2325	2345	2362	–

Order code for "Sensor option", option CA...CE "Corrosion protection"

Option	Description
CA	IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M
CB	IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CC	IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3

Option	Description
CD	Buried IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 Im2/Im3
CE	Buried IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 Im2/Im3



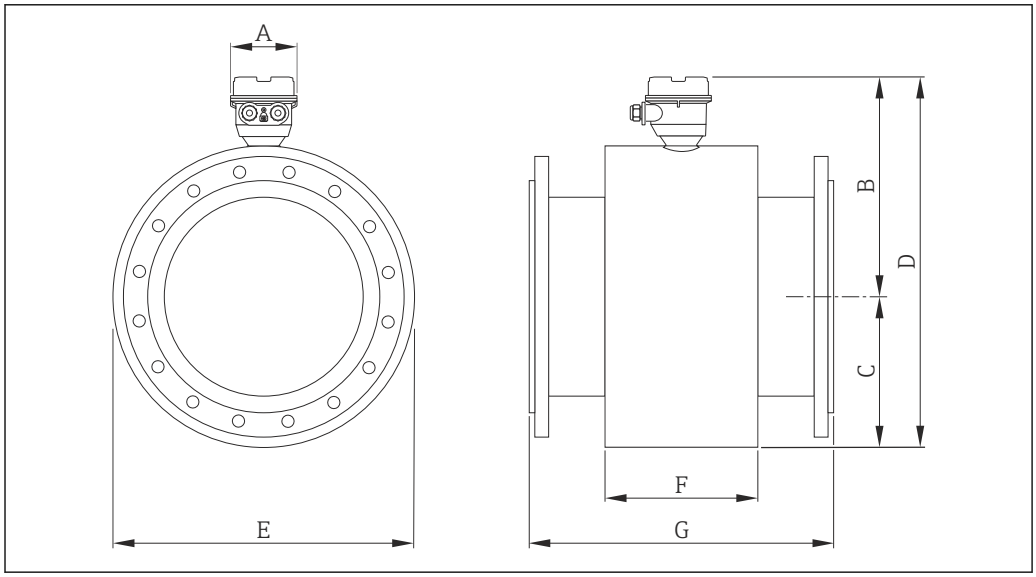
A0020399

DN [mm]	A [mm]	B [mm]	L [mm]
25	112	189	200
32	112	189	200
40	112	189	200
50	112	189	200
65	112	202	200
80	112	207	200
100	112	219	250
125	112	232	250
150	112	254	300
200	112	279	350
250	112	313	450
300	112	338	500

Dimension C										
	EN (DIN)				ASME		AS		JIS	
DN [mm]	PN 10 [mm]	PN 16 [mm]	PN 25 [mm]	PN 40 [mm]	Class 150 [mm]	Class 300 [mm]	Table E [mm]	PN 16 [mm]	10K [mm]	20K [mm]
25	–	–	–	140	110	140	140	–	140	140
32	–	–	–	140	–	–	–	–	140	140
40	–	–	–	150	125	155	–	–	140	140
50	–	–	–	165	150	165	150	150	155	155
65	–	185	–	185	–	–	–	–	175	175
80	–	200	–	200	190	209.6	185	185	185	200
100	–	220	–	325	230	254	215	215	210	225
125	–	250	–	270	–	–	–	–	250	270
150	–	285	–	300	280	317.5	280	280	280	305

Dimension C										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
200	340	340	360	–	345	–	335	335	330	350
250	395	405	425	–	405	–	405	405	400	430
300	445	460	485	–	485	–	455	455	445	480

Dimension D										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	–	–	–	260	260	260	260	–	260	260
32	–	–	–	260	–	–	–	–	260	260
40	–	–	–	264	260	267	–	–	260	260
50	–	–	–	272	265	272	264	264	267	267
65	–	295	–	295	–	–	–	–	290	290
80	–	307	–	307	302	311	300	300	300	307
100	–	330	–	382	333	346	327	327	325	332
125	–	357	–	367	–	–	–	–	357	367
150	–	396	–	404	393	412	395	395	395	406
200	450	450	460	–	450	–	447	447	445	454
250	510	515	525	–	516	–	515	515	513	528
300	560	568	580	–	580	–	565	565	560	578



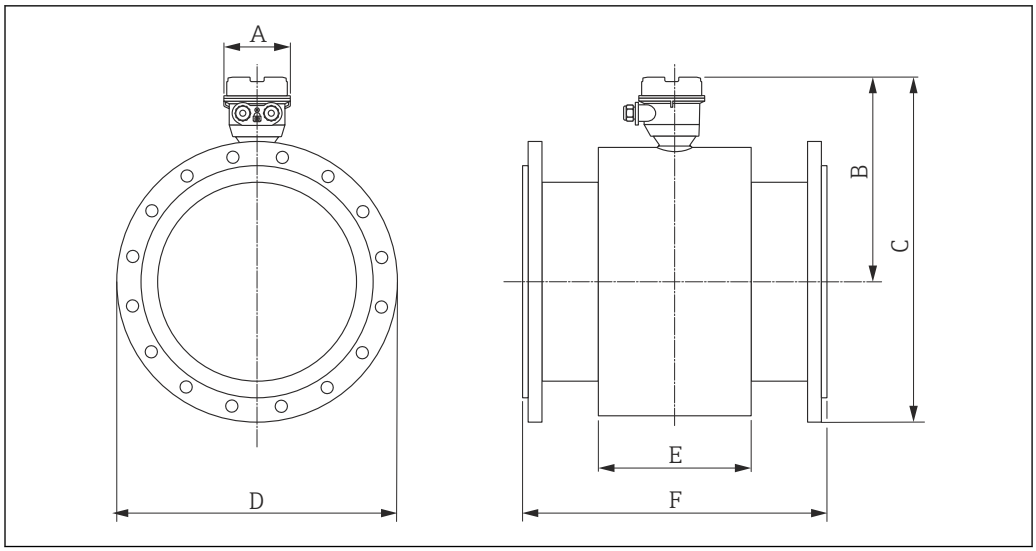
A0020435

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [1] [mm]
350	112	395	282	677	564	276	550
375	112	421	308	729	616	276	600
400	112	421	308	729	616	276	600
450	112	446	333	779	666	292	650
500	112	472	359	830	717	292	650
600	112	524	411	934	821	402	780
700	112	625	512	1137	1024	589	910
750	112	625	512	1137	1024	626	975
800	112	647	534	1180	1067	647	1040
900	112	723	610	1333	1220	785	1170
1000	112	799	686	1485	1372	862	1300
1050	112	825	712	1537	1424	912	1365
1200	112	924	811	1735	1622	992	1560
1350	112	1025	912	1937	1824	1252	1755
1400	112	1100	987	2087	1974	1252	1820
1500	112	1124	1011	2135	2022	1392	1950
1600	112	1169	1056	2225	2112	1482	2080
1650	112	1206	1093	2299	2186	1482	2145
1800	112	1301	1188	2489	2376	1632	2340
2000	112	1351	1238	2589	2476	1732	2600

1) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Design", option A "Insertion length short" and order code for "Sensor option", option CA…CE "Corrosion protection"

Option	Description
CA	IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M
CB	IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CC	IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CD	Buried IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 Im2/Im3
CE	Buried IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 Im2/Im3



A0018158

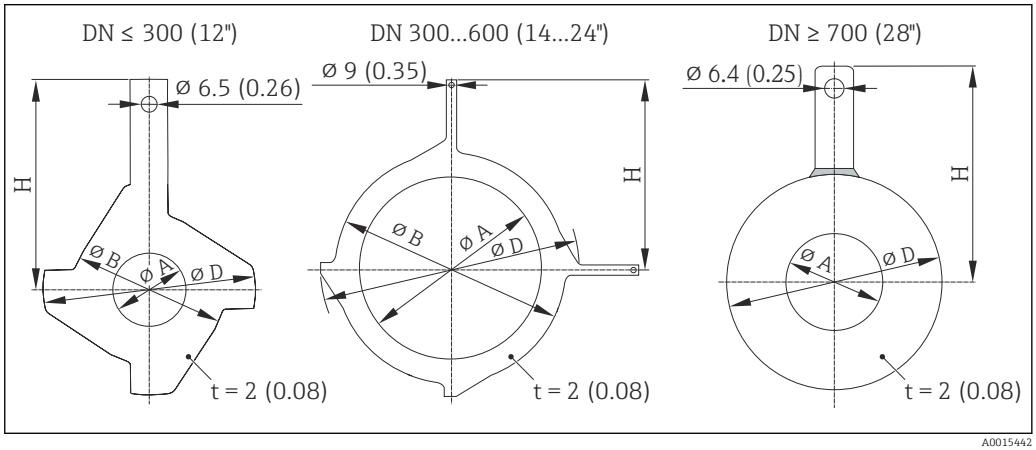
DN [mm]	A [mm]	B [mm]	E [mm]	F [mm]
350	112	350	290	550
375	112	376	290	600
400	112	376	290	600
450	112	403	290	600
500	112	428	290	600
600	112	478	290	600
700	112	549	424	700
750	112	586	454	750
800	112	605	500	800
900	112	655	580	900
1000	112	705	660	1000
1050	112	741	755	1050
1200	112	819	828	1200
1350	112	931	1008	1350
1400	112	931	1008	1400
1500	112	1031	1147	1500
1600	112	1031	1147	1600
1650	112	1082	1284	1650
1800	112	1139	1379	1800
2000	112	1250	1569	2000

	Dimension C					Dimension D				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN [mm]	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]
350	595	603	610	–	613	490	505	520	–	525
375	–	–	–	–	651	–	–	–	–	550

DN [mm]	Dimension C					Dimension D				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]	PN 6 [mm]	PN 10 [mm]	PN 16 [mm]	AWWA [mm]	[mm]
400	646	659	666	–	666	540	565	580	–	580
450	701	711	723	–	723	595	615	640	–	640
500	751	763	786	–	781	645	670	715	–	705
600	856	868	898	–	891	755	780	840	–	825
700	979	996	1004	1012	1004	860	895	910	927	910
750	–	–	–	1078	1084	–	–	–	984	995
800	1093	1113	1118	1135	1135	975	1015	1025	1060	1060
900	1193	1213	1218	1239	1243	1075	1115	1125	1168	1175
1000	1293	1320	1333	1350	1333	1175	1230	1225	1289	1255
1050	–	–	–	1414	–	–	–	–	1346	–
1200	1522	1547	1562	1575	1564	1405	1455	1255	1511	1490
1350	–	–	–	1773	–	–	–	–	1683	–
1400	1746	1769	1774	–	–	1630	1675	1685	–	–
1500	–	–	–	1958	–	–	–	–	1854	–
1600	1946	1989	1997	–	–	1830	1915	1930	–	–
1650	–	–	–	2098	–	–	–	–	2032	–
1800	2161	2196	2204	2237	–	2045	2115	2130	2197	–
2000	2382	2412	2422	2431	–	2265	2325	2345	2362	–

Accessories

Ground disks for flange connections



32 Engineering unit mm (in)

DN [mm]	Pressure rating	A [mm]	B [mm]	D [mm]	H [mm]
25	1)	26	62	77.5	87.5
32	1)	35	80	87.5	94.5
40	1)	41	82	101	103

DN [mm]	Pressure rating	A [mm]	B [mm]	D [mm]	H [mm]
50	1)	52	101	115.5	108
65	1)	68	121	131.5	118
80	1)	80	131	154.5	135
100	1)	104	156	186.5	153
125	1)	130	187	206.5	160
150	1)	158	217	256	184
200	1)	206	267	288	205
250	1)	260	328	359	240
300	1)	312	375	413	273
350	DIN, PN 6	343	433	479	365
350	DIN, PN 10	343	400	479	365
350	ASME, Class 150	343	400	479	365
400	DIN, PN 6	393	470	542	395
400	DIN, PN 10	393	469	542	395
400	ASME, Class 150	393	469	542	395
450	DIN, PN 6	439	525	583	417
450	DIN, PN 10	439	535	583	417
450	ASME, Class 150	439	535	583	417
500	DIN, PN 6	493	575	650	460
500	DIN, PN 10	493	588	650	460
500	ASME, Class 150	493	588	650	460
600	DIN, PN 6	593	676	766	522
600	DIN, PN 10	593	688	766	522
600	ASME, Class 150	593	688	766	522
700	DIN, PN 6	697	–	786	460
700	DIN, PN 10	693	–	813	480
700	AS, PN 16	687	–	807	490
700	AWWA, Class D	693	–	832	494
750	AWWA, Class D	743	–	833	523
800	DIN, PN 6	799	–	893	520
800	DIN, PN 10	795	–	920	540
800	AS, PN 16	789	–	914	550
800	AWWA, Class D	795	–	940	561
900	DIN, PN 6	897	–	993	570
900	DIN, PN 10	893	–	1020	590
900	AS, PN 16	886	–	1014	595
900	AWWA, Class D	893	–	1048	615
1000	DIN, PN 6	999	–	1093	620
1000	DIN, PN 10	995	–	1127	650

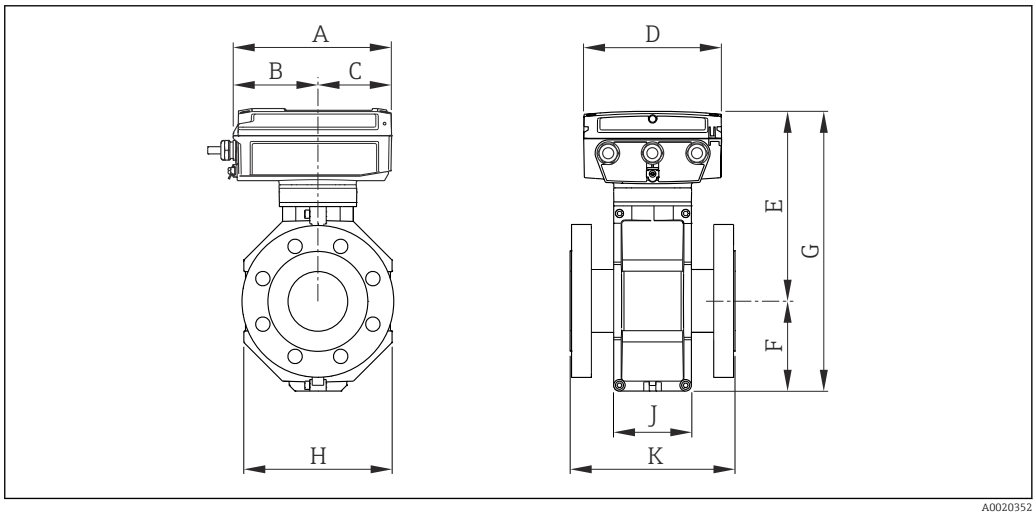
DN [mm]	Pressure rating	A [mm]	B [mm]	D [mm]	H [mm]
1000	AS, PN 16	988	–	1131	660
1000	AWWA, Class D	995	–	1163	675
1050	AWWA, Class D	1044	–	1220	704
1200	DIN, PN 6	1203	–	1310	733

1) Ground disks can be used for all the flange standards/pressure ratings which can be supplied in the standard version.

Dimensions in US units

Compact version

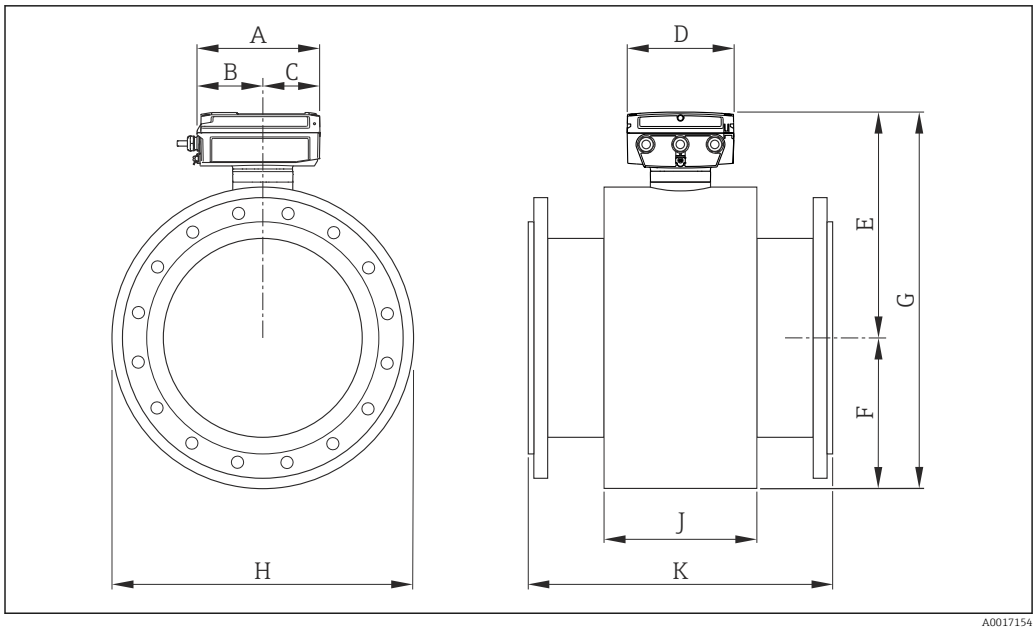
Order code for "Housing", option M "Compact, polycarbonate" or option A "Compact, aluminum, coated"



A0020352

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	J [in]	K [2] [in]
1	7.60	4.06	3.54	6.57	8.74	3.31	12.1	4.72	3.70	7.87
1 ½	7.60	4.06	3.54	6.57	8.74	3.31	12.1	4.72	3.70	7.87
2	7.60	4.06	3.54	6.57	8.74	3.31	12.1	4.72	3.70	7.87
3	7.60	4.06	3.54	6.57	9.72	4.29	14.0	7.09	3.70	7.87
4	7.60	4.06	3.54	6.57	9.72	4.29	14.0	7.09	3.70	9.84
6	7.60	4.06	3.54	6.57	11.3	5.91	17.2	10.2	5.51	11.8
8	7.60	4.06	3.54	6.57	12.3	7.09	19.4	12.8	6.14	13.8
10	7.60	4.06	3.54	6.57	13.3	8.07	21.4	15.8	6.14	17.7
12	7.60	4.06	3.54	6.57	14.3	9.06	23.4	18.1	6.54	19.7

1) ASME
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

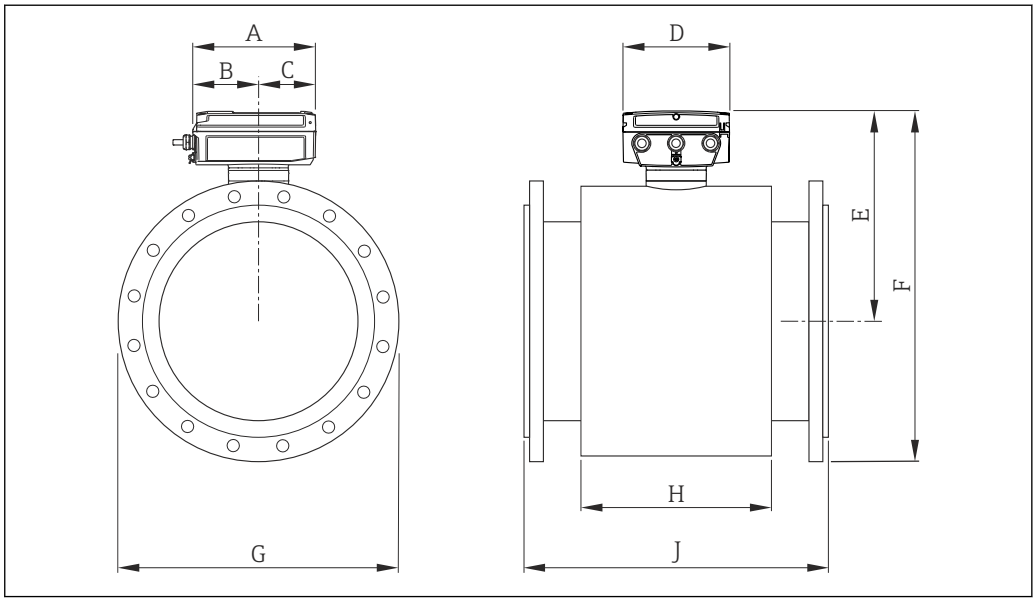


A0017154

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	J [in]	K [2] [in]
14	7.60	4.06	3.54	6.57	17.0	11.1	28.1	22.2	10.9	21.7
15	7.60	4.06	3.54	6.57	18.0	12.1	30.1	24.2	10.9	23.6
16	7.60	4.06	3.54	6.57	18.0	12.1	30.1	24.2	10.9	23.6
18	7.60	4.06	3.54	6.57	19.0	13.1	32.1	26.2	11.5	25.6
20	7.60	4.06	3.54	6.57	20.0	14.1	34.1	28.2	11.5	25.6
24	7.60	4.06	3.54	6.57	22.1	16.2	38.3	32.3	15.8	30.7
28	7.60	4.06	3.54	6.57	26.1	20.1	46.2	40.3	23.2	35.8
30	7.60	4.06	3.54	6.57	26.1	20.1	46.2	40.3	24.6	38.4
32	7.60	4.06	3.54	6.57	26.9	21.0	47.9	42.0	25.5	40.9
36	7.60	4.06	3.54	6.57	29.9	24.0	53.9	48.0	30.9	46.0
40	7.60	4.06	3.54	6.57	32.9	27.0	59.9	54.0	33.9	51.2
42	7.60	4.06	3.54	6.57	33.9	28.0	61.9	56.0	35.9	53.7
48	7.60	4.06	3.54	6.57	37.8	31.9	69.7	63.8	39.0	61.4
54	7.60	4.06	3.54	6.57	41.8	35.9	77.7	71.8	42.3	69.1
60	7.60	4.06	3.54	6.57	45.7	39.8	85.5	79.6	54.8	76.8
66	7.60	4.06	3.54	6.57	48.9	43.0	91.9	86.0	58.4	84.4
72	7.60	4.06	3.54	6.57	52.7	46.8	99.5	93.5	64.2	92.1
78	7.60	4.06	3.54	6.57	54.7	48.7	103.4	97.5	68.2	102.3

1) ASME, AWWA; flanges ≤ 24 in only available according to ASME, flanges ≥ 28 in only available according to AWWA.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Housing", option M "Compact, polycarbonate" or option A "Compact, aluminum, coated"; order code for "Design", option A "Insertion length short"



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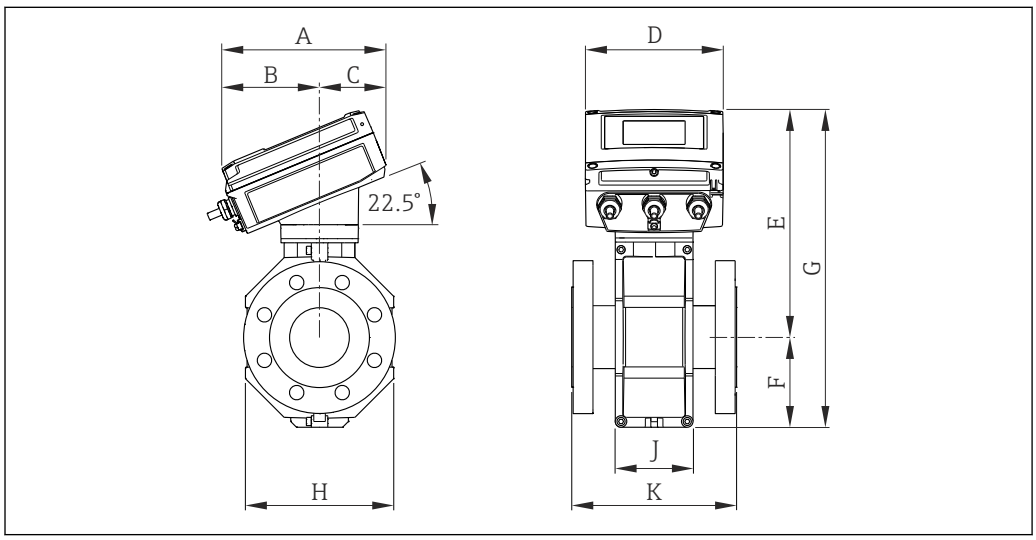
DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	H [in]	J [in]
14	7.60	4.06	3.54	6.57	15.2	11.4	21.6
15	7.60	4.06	3.54	6.57	16.2	11.4	23.6
16	7.60	4.06	3.54	6.57	16.2	11.4	23.6
18	7.60	4.06	3.54	6.57	17.3	11.4	23.6
20	7.60	4.06	3.54	6.57	18.3	11.4	23.6
24	7.60	4.06	3.54	6.57	19.9	11.4	23.6
28	7.60	4.06	3.54	6.57	22.5	16.7	27.6
30	7.60	4.06	3.54	6.57	23.9	17.9	29.5
32	7.60	4.06	3.54	6.57	24.7	19.7	31.5
36	7.60	4.06	3.54	6.57	26.6	22.8	35.4
40	7.60	4.06	3.54	6.57	28.6	26.0	39.4
42	7.60	4.06	3.54	6.57	30.0	29.7	41.3
48	7.60	4.06	3.54	6.57	33.1	32.6	47.2
54	7.60	4.06	3.54	6.57	37.5	39.7	53.1
60	7.60	4.06	3.54	6.57	41.4	45.2	59.0
66	7.60	4.06	3.54	6.57	43.4	50.6	64.9
72	7.60	4.06	3.54	6.57	45.7	54.3	70.8
78	7.60	4.06	3.54	6.57	50.1	61.8	78.7

	Dimension F					Dimension G				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN	PN 6	PN 10	PN 16	AWWA		PN 6	PN 10	PN 16	AWWA	
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
14	24.8	25.1	27.6	25.7	25.5	19.3	19.9	20.5	21.0	20.7
15	–	–	–	–	27	–	–	–	–	21.7
16	26.8	27.3	30.0	27.0	27.6	21.3	22.2	22.8	23.5	22.8
18	29.0	29.4	32.4	29.8	29.9	23.4	24.2	25.2	25.0	25.2
20	31.0	31.5	36.5	32.0	32.1	25.4	26.4	28.1	27.5	27.8
24	34.7	35.3	40.4	35.9	36.1	29.7	30.7	33.1	32.0	32.5
28	39.4	40.1	45.1	40.7	40.4	33.9	35.2	35.8	36.5	35.8
30	–	–	–	43.3	43.5	–	–	–	38.7	39.2
32	43.9	44.7	48.8	45.5	45.5	38.4	40.0	40.4	41.7	41.7
36	47.8	48.6	48.8	49.6	49.8	42.3	43.9	44.3	46.0	46.3
40	51.7	52.8	53.4	54.0	53.3	46.3	48.4	48.2	50.7	49.4
42	–	–	–	56.5	–	–	–	–	53.0	–
48	60.8	61.7	62.4	62.9	62.4	55.3	57.3	49.4	59.5	58.7
54	–	–	–	70.6	–	–	–	–	66.3	–
60	–	–	–	77.9	–	–	–	–	73.0	–
66	–	–	–	83.4	–	–	–	–	80.0	–
72	85.9	87.3	87.6	88.9	–	80.5	83.3	83.9	86.5	–
78	94.6	95.8	96.2	96.6	–	89.2	91.5	92.3	93.0	–

Order code for "Housing", option Q "Compact, polycarbonate, inclined" or option R "Compact, aluminum, coated, inclined"



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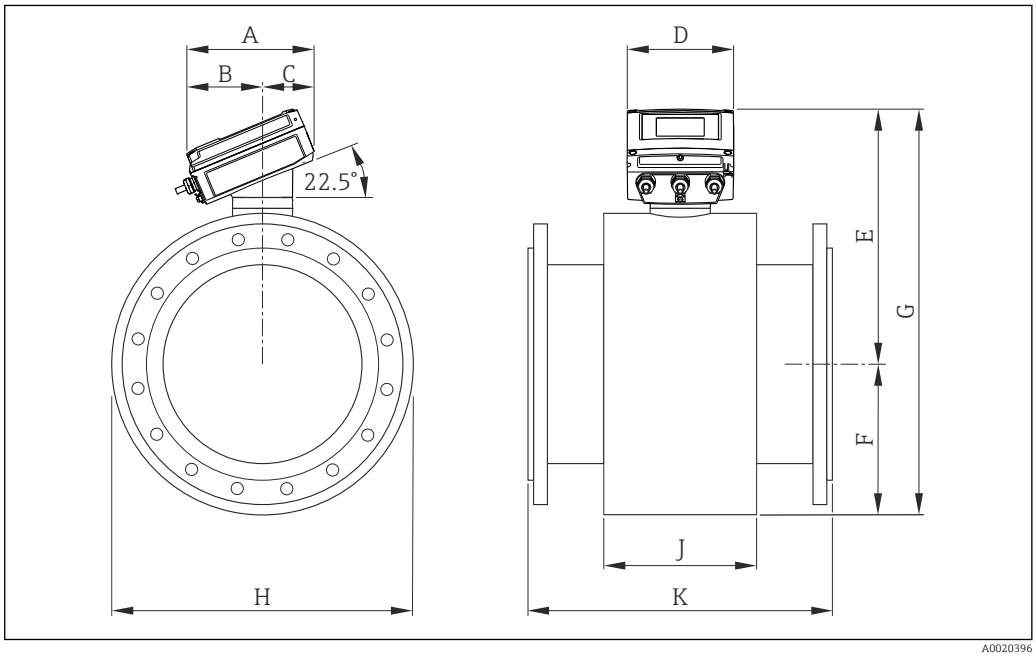
DN [1]	A	B	C	D	E	F	G	H	J	K [2]
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
1	7.83	4.69	3.15	6.57	10.5	3.31	13.8	4.72	3.70	7.87
1 ½	7.83	4.69	3.15	6.57	10.5	3.31	13.8	4.72	3.70	7.87
2	7.83	4.69	3.15	6.57	10.5	3.31	13.8	4.72	3.70	7.87

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	J [in]	K [2] [in]
3	7.83	4.69	3.15	6.57	11.5	4.29	15.8	7.09	3.70	7.87
4	7.83	4.69	3.15	6.57	11.5	4.29	15.8	7.09	3.70	9.84
6	7.83	4.69	3.15	6.57	13.1	5.91	19.0	10.2	5.51	11.8
8	7.83	4.69	3.15	6.57	14.0	7.09	21.1	12.8	6.14	13.8
10	7.83	4.69	3.15	6.57	15.0	8.07	23.1	15.8	6.14	17.7
12	7.83	4.69	3.15	6.57	16.0	9.06	25.1	18.1	6.54	19.7

1) ASME
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.



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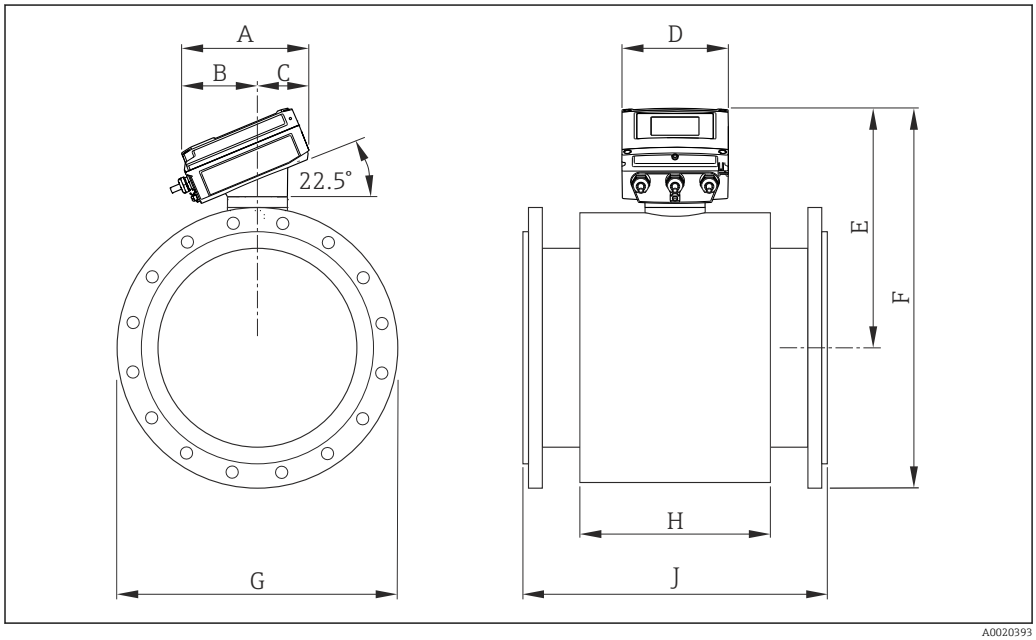
DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	J [in]	K [2] [in]
14	7.83	4.69	3.15	6.57	18.8	11.1	29.9	22.2	10.9	21.7
15	7.83	4.69	3.15	6.57	19.8	12.1	31.9	24.2	10.9	23.6
16	7.83	4.69	3.15	6.57	19.8	12.1	31.9	24.2	10.9	23.6
18	7.83	4.69	3.15	6.57	20.8	13.1	33.9	26.2	11.5	25.6
20	7.83	4.69	3.15	6.57	21.8	14.1	35.9	28.2	11.5	25.6
24	7.83	4.69	3.15	6.57	23.8	16.2	40.0	32.3	15.8	30.7
28	7.83	4.69	3.15	6.57	27.8	20.2	48.0	40.3	23.2	35.8
30	7.83	4.69	3.15	6.57	27.8	20.2	48.0	40.3	24.6	38.4
32	7.83	4.69	3.15	6.57	28.7	21.0	49.7	42.0	25.5	40.9
36	7.83	4.69	3.15	6.57	32.7	24.0	55.7	48.0	30.9	46.0
40	7.83	4.69	3.15	6.57	34.7	27.0	61.7	54.0	33.9	51.2
42	7.83	4.69	3.15	6.57	35.7	28.0	63.7	56.0	35.9	53.7
48	7.83	4.69	3.15	6.57	39.6	31.9	71.5	63.8	39.0	61.4
54	7.83	4.69	3.15	6.57	43.6	35.9	79.5	71.8	42.3	69.1

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	J [in]	K [2] [in]
60	7.83	4.69	3.15	6.57	47.5	39.8	87.3	79.6	54.8	76.8
66	7.83	4.69	3.15	6.57	50.7	43.0	93.7	86.0	58.4	84.4
72	7.83	4.69	3.15	6.57	54.4	46.8	101.2	93.5	64.2	92.1
78	7.83	4.69	3.15	6.57	56.4	48.8	105.2	97.5	68.2	102.3

1) ASME, AWWA; flanges ≤ 24 in only available according to ASME, flanges ≥ 28 in only available according to AWWA.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Housing", option Q "Compact, polycarbonate, inclined" or option R "Compact, aluminum, coated, inclined"; order code for "Design", option A "Insertion length short"



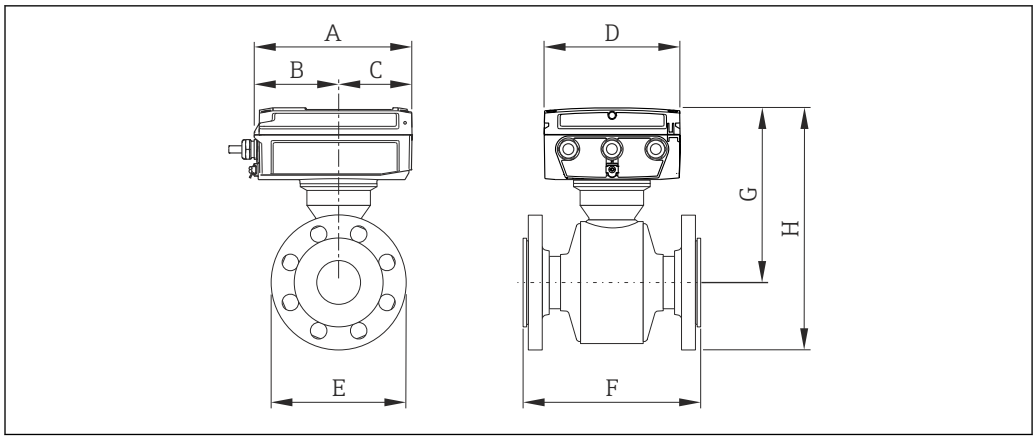
DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	H [in]	J [in]
14	7.83	4.69	3.15	6.57	17.0	11.4	21.6
15	7.83	4.69	3.15	6.57	18.0	11.4	23.6
16	7.83	4.69	3.15	6.57	18.0	11.4	23.6
18	7.83	4.69	3.15	6.57	19.1	11.4	23.6
20	7.83	4.69	3.15	6.57	20.1	11.4	23.6
24	7.83	4.69	3.15	6.57	21.7	11.4	23.6
28	7.83	4.69	3.15	6.57	24.3	16.7	27.6
30	7.83	4.69	3.15	6.57	25.7	17.9	29.5
32	7.83	4.69	3.15	6.57	26.5	19.7	31.5
36	7.83	4.69	3.15	6.57	28.4	22.8	35.4
40	7.83	4.69	3.15	6.57	30.4	26.0	39.4
42	7.83	4.69	3.15	6.57	31.8	29.7	41.3
48	7.83	4.69	3.15	6.57	34.9	32.6	47.2
54	7.83	4.69	3.15	6.57	39.3	39.7	53.1

DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	H [in]	J [in]
60	7.83	4.69	3.15	6.57	43.2	45.2	59.0
66	7.83	4.69	3.15	6.57	45.2	50.6	64.9
72	7.83	4.69	3.15	6.57	47.5	54.3	70.8
78	7.83	4.69	3.15	6.57	51.9	61.8	78.7

	Dimension F					Dimension G				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN [in]	PN 6 [in]	PN 10 [in]	PN 16 [in]	AWWA [in]	[in]	PN 6 [in]	PN 10 [in]	PN 16 [in]	AWWA [in]	[in]
14	26.6	26.9	24.3	27.5	27.3	19.3	19.9	20.5	21.0	20.7
15	–	–	–	–	28.8	–	–	–	–	21.7
16	28.6	29.1	26.5	28.8	29.4	21.3	22.2	22.8	23.5	22.8
18	30.8	31.2	28.8	31.6	31.7	23.4	24.2	25.2	25.0	25.2
20	32.8	33.3	31.3	33.8	33.9	25.4	26.4	28.1	27.5	27.8
24	36.5	37.1	35.4	37.7	37.9	29.7	30.7	33.1	32.0	32.5
28	41.2	41.9	39.7	42.5	42.2	33.9	35.2	35.8	36.5	35.8
30	–	–	–	45.1	45.3	–	–	–	38.7	39.2
32	45.7	46.5	43.8	47.3	47.3	38.4	40.0	40.4	41.7	41.7
36	49.6	50.4	47.7	51.4	49.8	42.3	43.9	44.3	46.0	46.3
40	53.5	54.6	52.2	55.8	55.1	46.3	48.4	48.2	50.7	49.4
42	–	–	–	58.3	–	–	–	–	53.0	–
48	62.6	63.5	61.3	64.7	64.2	55.3	57.3	49.4	59.5	58.7
54	–	–	–	72.4	–	–	–	–	66.3	–
60	–	–	–	79.7	–	–	–	–	73.0	–
66	–	–	–	85.2	–	–	–	–	80.0	–
72	87.7	89.1	86.5	90.7	–	80.5	83.3	83.9	86.5	–
78	96.4	97.6	95.1	98.4	–	89.2	91.5	92.3	93.0	–

Order code for "Sensor option", option CA in combination with order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N

- Order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N available for order in conjunction with order code for "Housing", option M "Compact, polycarbonate"
- Order code for "Calibration flow", options H/K also available for order in conjunction with order code for "Housing", option A "Compact, aluminum, coated"



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DN [in]	A [in]	B [in]	C [in]	D [in]	F [in]	G [in]
1	7.60	4.06	3.54	6.57	7.87	7.40
2	7.60	4.06	3.54	6.57	7.87	7.40
3	7.60	4.06	3.54	6.57	7.87	8.07
4	7.60	4.06	3.54	6.57	9.84	8.58
6	7.60	4.06	3.54	6.57	11.8	9.92
8	7.60	4.06	3.54	6.57	13.8	10.9
10	7.60	4.06	3.54	6.57	17.7	12.2
12	7.60	4.06	3.54	6.57	19.7	13.2

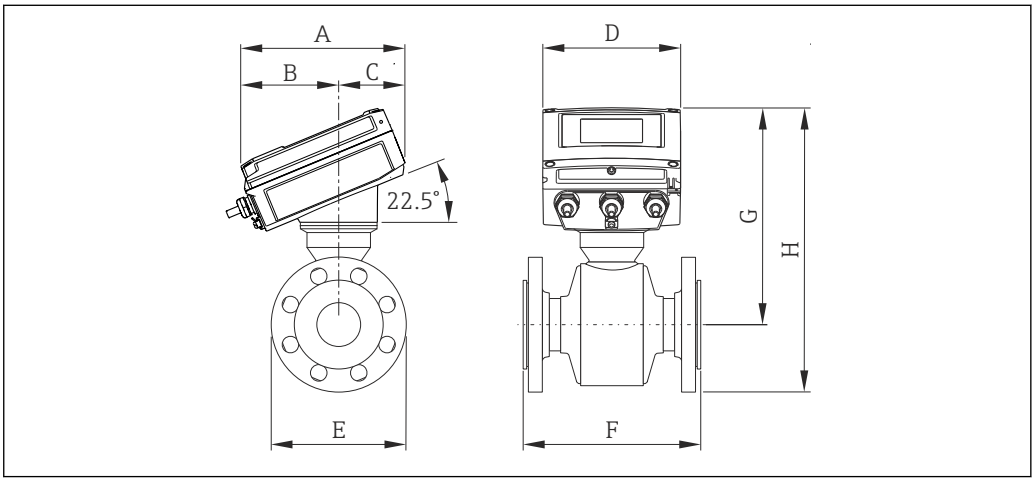
Dimension E										
	EN (DIN)				ASME		AS		JIS	
DN [in]	PN 10 [in]	PN 16 [in]	PN 25 [in]	PN 40 [in]	Class 150 [in]	Class 300 [in]	Table E [in]	PN 16 [in]	10K [in]	20K [in]
1	–	–	–	5.51	5.51	5.51	5.51	–	5.51	5.51
2	–	–	–	6.50	6.02	6.50	5.91	5.91	6.10	6.10
3	–	7.87	–	7.87	7.52	8.27	7.28	7.28	7.28	7.87
4	–	8.66	–	12.8	9.02	10.0	8.46	8.46	8.27	8.86
6	–	11.2	–	11.8	11.0	12.5	11.0	11.0	11.0	12.0
8	13.4	13.4	14.2	–	13.5	–	13.2	13.2	13.0	13.8
10	15.6	15.9	16.7	–	16.0	–	15.9	15.9	15.8	16.9
12	17.5	18.1	19.1	–	19.0	–	17.9	17.9	17.5	18.9

Dimension H										
	EN (DIN)				ASME		AS		JIS	
DN [in]	PN 10 [in]	PN 16 [in]	PN 25 [in]	PN 40 [in]	Class 150 [in]	Class 300 [in]	Table E [in]	PN 16 [in]	10K [in]	20K [in]
1	–	–	–	10.2	10.2	10.2	10.2	–	10.2	10.2
2	–	–	–	10.6	10.4	10.6	10.3	10.3	10.4	10.4

Dimension H										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
3	–	12	–	12	11.8	12.2	11.7	11.7	11.7	12
4	–	12.9	–	15	13	13.5	12.8	12.8	12.7	13
6	–	15.5	–	15.8	15.4	16.1	15.5	15.5	15.5	15.9
8	17.6	17.6	18	–	17.6	–	17.5	17.5	17.4	17.8
10	20	20.2	20.6	–	20.2	–	20.2	20.2	20.1	20.7
12	22	22.3	22.8	–	22.8	–	22.2	22.2	22	22.7

Order code for "Sensor option", option CA in combination with order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N

- Order code for "Calibration flow", options A/B/D/E/F/G/H/K/M/N available for order in conjunction with order code for "Housing", option Q "Compact, polycarbonate, inclined"
- Order code for "Calibration flow", options H/K also available for order in conjunction with order code for "Housing", option R "Compact, aluminum, coated, inclined"



A0021329

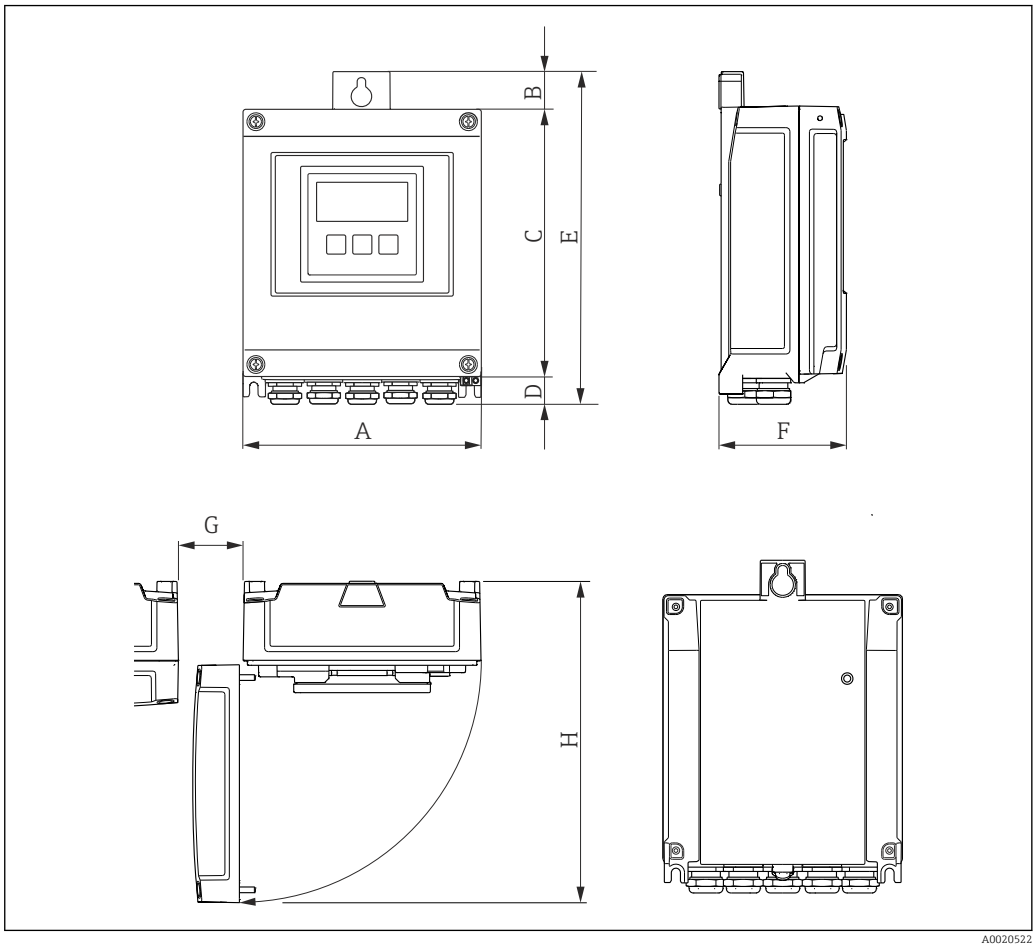
DN	A	B	C	D	F	G
[in]	[in]	[in]	[in]	[in]	[in]	[in]
1	7.83	4.69	3.15	6.57	7.87	9.13
2	7.83	4.69	3.15	6.57	7.87	9.13
3	7.83	4.69	3.15	6.57	7.87	9.80
4	7.83	4.69	3.15	6.57	9.84	10.3
6	7.83	4.69	3.15	6.57	11.8	11.7
8	7.83	4.69	3.15	6.57	13.8	12.7
10	7.83	4.69	3.15	6.57	17.7	14.0
12	7.83	4.69	3.15	6.57	19.7	15.0

Dimension E										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
1	–	–	–	5.51	5.51	5.51	5.51	–	5.51	5.51
2	–	–	–	6.50	6.02	6.50	5.91	5.91	6.10	6.10
3	–	7.87	–	7.87	7.52	8.27	7.28	7.28	7.28	7.87
4	–	8.66	–	12.8	9.02	10.0	8.46	8.46	8.27	8.86
6	–	11.2	–	11.8	11.0	12.5	11.0	11.0	11.0	12.0
8	13.4	13.4	14.2	–	13.5	–	13.2	13.2	13.0	13.8
10	15.6	15.9	16.7	–	16.0	–	15.9	15.9	15.7	16.9
12	17.5	18.1	19.1	–	19.0	–	17.9	17.9	17.5	18.9

Dimension H										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
1	–	–	–	11.9	11.9	11.9	11.9	–	11.9	11.9
2	–	–	–	12.4	12.2	12.4	12.1	12.1	12.2	12.2
3	–	13.7	–	13.7	13.6	13.9	13.5	13.5	13.5	13.7
4	–	14.6	–	16.7	14.8	15.3	14.6	14.6	14.4	14.8
6	–	17.3	–	17.6	17.2	17.9	17.2	17.2	17.2	17.7
8	19.4	19.4	19.8	–	19.4	–	19.3	19.3	19.2	19.6
10	21.8	22.0	22.4	–	22.0	–	22.0	22.0	21.9	22.4
12	23.7	24.0	24.5	–	24.5	–	23.9	23.9	23.7	24.4

Transmitter remote version

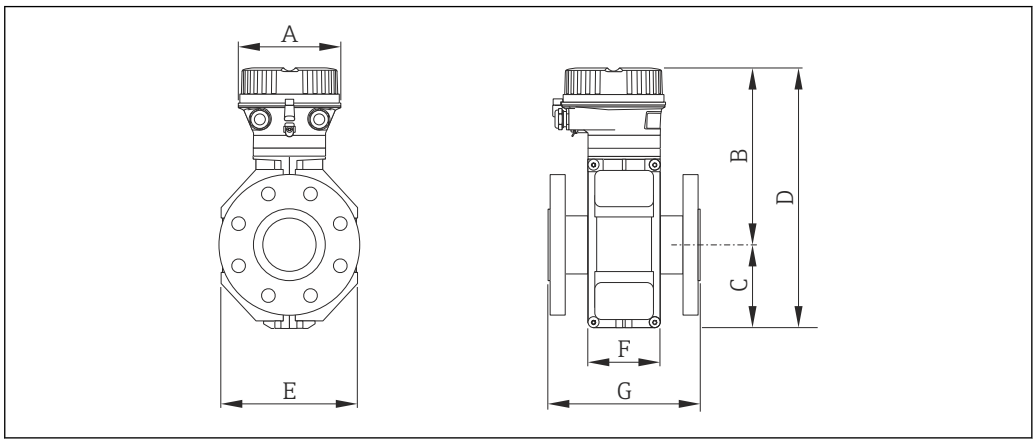
Order code for "Housing", option N "Remote, polycarbonate" or option P "Remote, aluminum coated"



A0020522

A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]
6.57	0.94	7.36	0.83	9.13	3.15	1.97	9.5

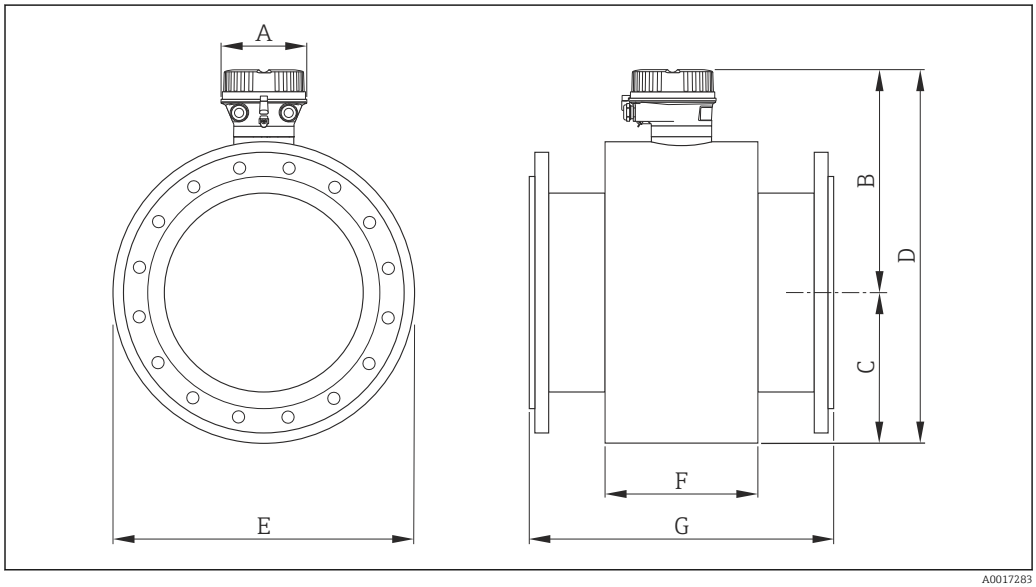
Sensor remote version



A0017282

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [2] [in]
1	5.35	8.15	3.31	11.5	4.72	3.70	7.87
1 ½	5.35	8.15	3.31	11.5	4.72	3.70	7.87
2	5.35	8.15	3.31	11.5	4.72	3.70	7.87
3	5.35	9.13	4.29	13.4	7.09	3.70	7.87
4	5.35	9.13	4.29	13.4	7.09	3.70	9.84
6	5.35	10.7	5.91	16.6	10.2	5.51	11.8
8	5.35	11.7	7.09	18.8	12.8	6.14	13.8
10	5.35	12.7	8.07	20.8	15.8	6.14	17.7
12	5.35	13.7	9.06	22.8	18.1	6.54	19.7

1) ASME
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.



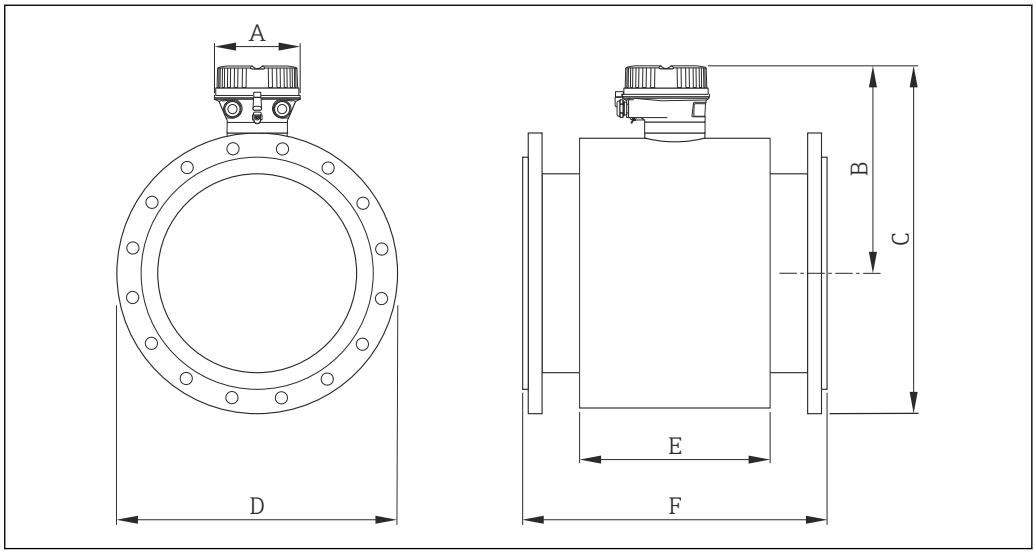
A0017283

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [2] [in]
14	5.35	16.0	11.1	29.3	22.2	10.9	21.7
15	5.35	17.0	12.1	31.3	24.2	10.9	23.6
16	5.35	17.0	12.1	31.3	24.2	10.9	23.6
18	5.35	18.0	13.1	33.3	26.2	11.5	25.6
20	5.35	19.0	14.1	35.3	28.2	11.5	25.6
24	5.35	21.1	16.2	39.4	32.3	15.8	30.7
28	5.35	25.1	20.1	45.2	40.3	23.2	35.8
30	5.35	25.1	20.1	45.2	40.3	24.6	38.4
32	5.35	25.9	21.0	46.9	42.0	25.5	40.9
36	5.35	28.9	24.0	52.9	48.0	30.9	46.0
40	5.35	31.9	27.0	58.9	54.0	33.9	51.2
42	5.35	32.9	28.0	60.9	56.0	35.9	53.7
48	5.35	36.8	31.9	68.7	63.8	39.0	61.4

DN [1] [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [2] [in]
54	5.35	40.8	35.9	76.7	71.8	42.3	69.1
60	5.35	44.7	39.8	84.5	79.6	54.8	76.8
66	5.35	47.9	43.0	91.0	86.0	58.4	84.4
72	5.35	51.7	46.8	98.4	93.5	64.2	92.1
78	5.35	53.6	48.7	102.4	97.5	68.2	102.3

1) ASME, AWWA; flanges ≤ 24 in only available according to ASME, flanges ≥ 28 in only available according to AWWA.
2) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Design", option A "Insertion length short"



A0017284

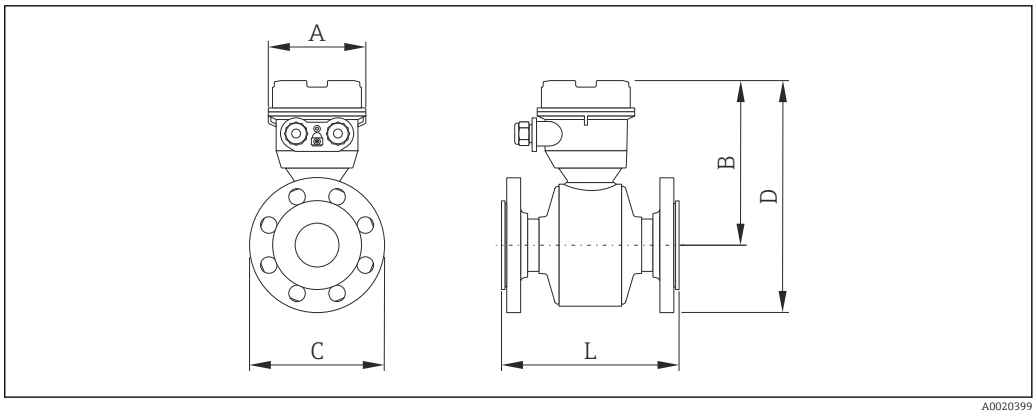
DN [in]	A [in]	B [in]	E [in]	F [in]
14	5.35	14.1	11.4	21.6
15	5.35	15.1	11.4	23.6
16	5.35	15.1	11.4	23.6
18	5.35	16.2	11.4	23.6
20	5.35	17.2	11.4	23.6
24	5.35	18.8	11.4	23.6
28	5.35	21.6	16.7	27.6
30	5.35	23.0	17.9	29.5
32	5.35	23.6	19.7	31.5
36	5.35	25.6	22.8	35.4
40	5.35	27.5	26.0	39.4
42	5.35	28.9	29.7	41.3
48	5.35	32.0	32.6	47.2
54	5.35	36.4	39.6	53.1
60	5.35	40.4	45.2	59.0
66	5.35	42.4	50.6	64.9

DN [in]	A [in]	B [in]	E [in]	F [in]
72	5.35	44.6	54.2	70.8
78	5.35	49.0	61.8	78.7

	Dimension C					Dimension D				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN	PN 6	PN 10	PN 16	AWWA		PN 6	PN 10	PN 16	AWWA	
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
14	23.7	24.0	24.3	24.6	24.4	19.3	19.9	20.5	21.0	20.7
15	–	–	–	–	25.9	–	–	–	–	21.7
16	25.8	26.2	26.5	26.9	26.5	21.3	22.2	22.8	23.5	22.8
18	27.9	28.3	28.7	28.7	28.8	23.4	24.2	25.2	25.0	25.2
20	29.9	30.4	31.1	30.9	31.1	25.4	26.4	28.1	27.5	27.8
24	33.7	34.2	35.6	34.8	35.0	29.7	30.7	33.1	32.0	32.5
28	38.5	39.2	39.7	39.8	39.5	33.9	35.2	35.8	36.5	35.8
30	–	–	–	42.4	42.4	–	–	–	38.7	39.2
32	43.0	43.8	44.2	44.6	44.6	38.4	40.0	40.4	41.7	41.7
36	46.9	47.7	48.2	48.7	48.9	42.3	43.9	44.3	46.0	46.3
40	50.8	51.9	52.7	53.1	52.4	46.3	48.4	48.2	50.7	49.4
42	–	–	–	55.6	–	–	–	–	53.0	–
48	59.9	60.8	61.7	62.0	61.5	55.3	57.3	49.4	59.5	58.7
54	–	–	–	69.6	–	–	–	–	66.3	–
60	–	–	–	76.9	–	–	–	–	73.0	–
66	–	–	–	82.4	–	–	–	–	80.0	–
72	84.9	86.3	87.0	87.9	–	80.5	83.3	83.9	86.5	–
78	93.6	94.7	95.6	95.5	–	89.2	91.5	92.3	93.0	–

Order code for "Sensor option", option CA...CE "Corrosion protection"

Option	Description
CA	IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M
CB	IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CC	IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CD	Buried IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 Im2/Im3
CE	Buried IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 Im2/Im3



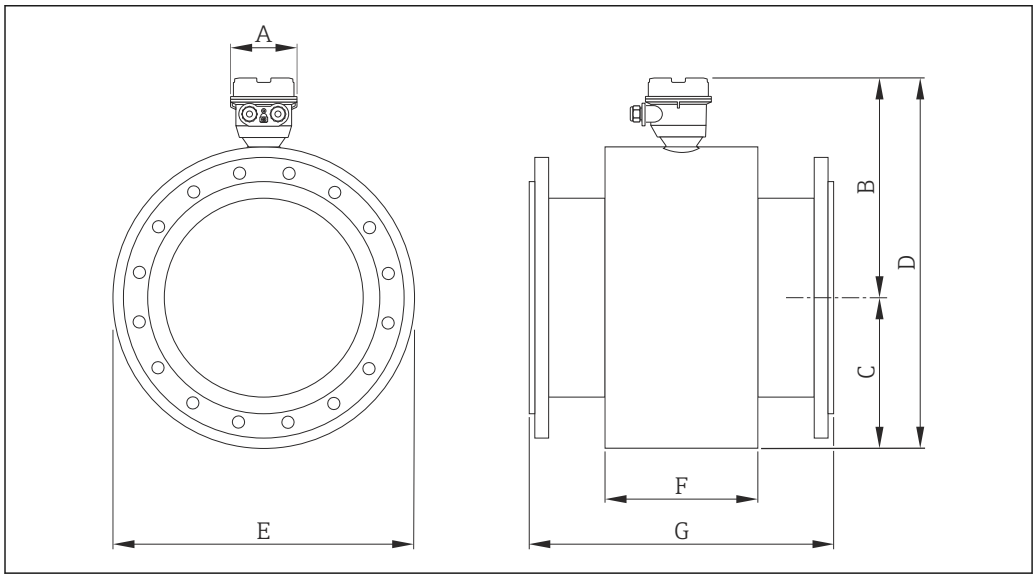
A0020399

DN [in]	A [in]	B [in]	E [in]
1	4.41	7.44	7.87
2	4.41	7.44	7.87
3	4.41	8.15	7.87
4	4.41	8.62	9.84
6	4.41	10.0	11.8
8	4.41	11.0	13.8
10	4.41	12.3	17.7
12	4.41	13.3	19.7

Dimension C										
	EN (DIN)				ASME		AS		JIS	
DN [in]	PN 10 [in]	PN 16 [in]	PN 25 [in]	PN 40 [in]	Class 150 [in]	Class 300 [in]	Table E [in]	PN 16 [in]	10K [in]	20K [in]
1	–	–	–	5.51	4.33	5.51	5.51	–	5.51	5.51
2	–	–	–	6.50	5.91	6.50	5.91	5.91	6.10	6.10
3	–	7.87	–	7.87	7.48	8.25	7.28	7.28	7.28	7.87
4	–	8.66	–	12.8	9.06	10.0	8.46	8.46	8.27	8.86
6	–	11.2	–	11.8	11.0	12.5	11.0	11.0	11.0	12.0
8	13.4	13.4	14.2	–	13.6	–	13.2	13.2	13.0	13.8
10	15.6	15.9	16.7	–	16.0	–	15.9	15.9	15.8	16.9
12	17.5	18.1	19.1	–	19.1	–	17.9	17.9	17.5	18.9

Dimension D										
	EN (DIN)				ASME		AS		JIS	
DN [in]	PN 10 [in]	PN 16 [in]	PN 25 [in]	PN 40 [in]	Class 150 [in]	Class 300 [in]	Table E [in]	PN 16 [in]	10K [in]	20K [in]
1	–	–	–	10.2	10.2	10.2	10.2	–	10.2	10.2
2	–	–	–	10.7	10.4	10.7	10.4	10.4	10.5	10.5
3	–	12.1	–	12.1	11.9	12.2	11.8	11.8	11.8	12.1

Dimension D										
	EN (DIN)				ASME		AS		JIS	
DN	PN 10	PN 16	PN 25	PN 40	Class 150	Class 300	Table E	PN 16	10K	20K
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
4	–	13.0	–	15.0	13.1	13.6	12.9	12.9	12.8	13.1
6	–	15.6	–	15.9	15.5	16.2	15.6	15.6	15.6	16.0
8	17.7	17.7	18.1	–	17.7	–	17.6	17.6	17.5	17.9
10	20.1	20.3	20.7	–	20.3	–	20.3	20.3	20.2	20.8
12	22.0	22.4	22.8	–	22.8	–	22.2	22.2	22.0	22.8



A0020435

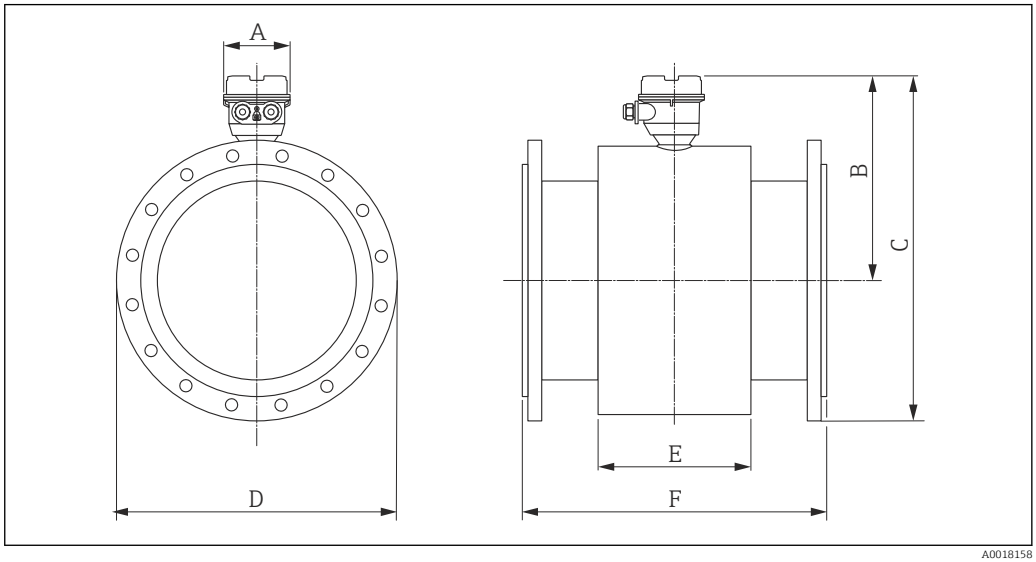
DN	A	B	C	D	E	F	G [1)]
[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
14	4.41	15.6	11.1	26.7	22.2	10.9	21.7
15	4.41	16.6	12.1	28.7	24.2	10.9	23.6
16	4.41	16.6	12.1	28.7	24.2	10.9	23.6
18	4.41	17.6	13.1	30.7	26.2	11.5	25.6
20	4.41	18.6	14.1	32.7	28.2	11.5	25.6
24	4.41	20.6	16.2	36.8	32.3	15.8	30.7
28	4.41	24.6	20.2	44.8	40.3	23.2	35.8
30	4.41	24.6	20.2	44.8	40.3	24.6	38.4
32	4.41	25.5	21.0	46.5	42.0	25.5	40.9
36	4.41	28.5	24.0	52.5	48.0	30.9	46.0
40	4.41	31.5	27.0	58.5	54.0	33.9	51.2
42	4.41	32.5	28.0	60.5	56.0	35.9	53.7
48	4.41	36.4	31.9	68.3	63.8	39.0	61.4
54	4.41	40.4	35.9	76.3	71.8	42.3	69.1
60	4.41	44.3	39.8	84.1	79.6	54.8	76.8
66	4.41	47.5	43.0	90.5	86.0	58.4	84.4

DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [1] [in]
72	4.41	51.2	46.8	98.0	93.5	64.2	92.1
78	4.41	53.2	48.7	101.9	97.5	68.2	102.3

1) The length is independent of the selected pressure rating. Length in accordance with DVGW/ISO.

Order code for "Design", option A "Insertion length short" and order code for "Sensor option", option CA...CE "Corrosion protection"

Option	Description
CA	IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M
CB	IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CC	IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 C5-M/Im1/Im2/Im3
CD	Buried IP68, Type 6P, fact-potted; corrosion protection EN ISO 12944 Im2/Im3
CE	Buried IP68, Type 6P, cust-potted; corrosion protection EN ISO 12944 Im2/Im3



A0018158

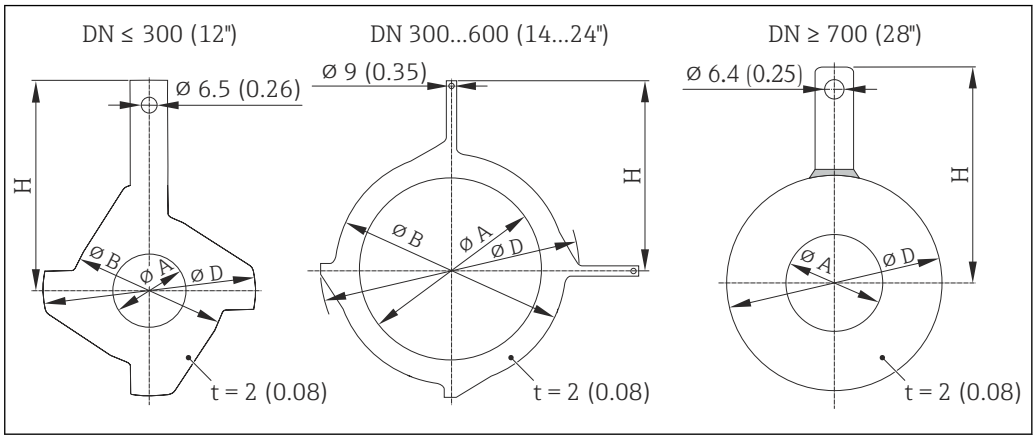
DN [in]	A [in]	B [in]	E [in]	F [in]
14	4.41	13.8	11.4	21.7
15	4.41	14.8	11.4	23.6
16	4.41	14.8	11.4	23.6
18	4.41	15.9	11.4	23.6
20	4.41	16.9	11.4	23.6
24	4.41	18.8	11.4	23.6
28	4.41	21.6	16.7	27.6
30	4.41	23.1	17.9	29.5
32	4.41	23.8	19.7	31.5
36	4.41	25.8	22.8	35.4
40	4.41	27.8	26.0	39.4
42	4.41	29.2	29.7	41.3

DN [in]	A [in]	B [in]	E [in]	F [in]
48	4.41	32.2	32.6	47.2
54	4.41	36.7	39.7	53.2
60	4.41	40.6	45.2	59.1
66	4.41	42.6	50.6	65.0
72	4.41	44.8	54.3	70.9
78	4.41	49.2	61.8	78.7

	Dimension C					Dimension D				
	EN (DIN)			ASME	AS	EN (DIN)			ASME	AS
DN [in]	PN 6 [in]	PN 10 [in]	PN 16 [in]	AWWA [in]	[in]	PN 6 [in]	PN 10 [in]	PN 16 [in]	AWWA [in]	[in]
14	23.4	23.7	24.0	–	24.1	19.3	19.9	20.5	–	20.7
15	–	–	–	–	25.6	–	–	–	–	21.7
16	25.4	25.9	26.2	–	26.2	21.3	22.2	22.8	–	22.8
18	27.6	28.0	28.5	–	28.5	23.4	24.2	25.2	–	25.2
20	29.6	30.0	30.9	–	30.7	25.4	26.4	28.1	–	27.8
24	33.7	34.2	35.4	–	35.1	29.7	30.7	33.1	–	32.5
28	38.5	39.2	39.5	39.8	39.5	33.9	35.2	35.8	36.5	35.8
30	–	–	–	42.4	42.7	–	–	–	38.7	39.2
32	43.0	43.8	44.0	44.7	44.7	38.4	40.0	40.4	41.7	41.7
36	47.0	47.8	48.0	48.8	48.9	42.3	43.9	44.3	46.0	46.3
40	50.9	52.0	52.5	53.1	52.5	46.3	48.4	48.2	50.7	49.4
42	–	–	–	55.7	–	–	–	–	53.0	–
48	59.9	60.9	61.5	62.0	61.6	55.3	57.3	49.4	59.5	58.7
54	–	–	–	69.8	–	–	–	–	66.3	–
60	–	–	–	77.1	–	–	–	–	73.0	–
66	–	–	–	82.6	–	–	–	–	80.0	–
72	85.1	86.5	86.8	88.1	–	80.5	83.3	83.9	86.5	–
78	93.8	95.0	95.4	95.7	–	89.2	91.5	92.3	93.0	–

Accessories

Ground disks for flange connections



33 *Engineering unit mm (in)*

DN [in]	Pressure rating	A [in]	B [in]	D [in]	H [in]
1	1)	1.02	2.44	3.05	3.44
1 ¼	1)	1.38	3.15	3.44	3.72
1 ½	1)	1.61	3.23	3.98	4.06
2	1)	2.05	3.98	4.55	4.25
2 ½	1)	2.68	4.76	5.18	4.65
3	1)	3.15	5.16	6.08	5.31
4	1)	4.09	6.14	7.34	6.02
5	1)	5.12	7.36	8.13	6.30
6	1)	6.22	8.54	10.1	7.24
8	1)	8.11	10.5	11.3	8.07
10	1)	10.2	12.9	14.1	9.45
12	1)	12.3	14.8	16.3	10.8
14	DIN, PN 6	13.5	16.5	18.9	14.4
14	DIN, PN 10	13.5	15.8	18.9	14.4
14	ASME, Class 150	13.5	15.8	18.9	14.4
16	DIN, PN 6	15.5	18.5	21.3	15.6
16	DIN, PN 10	15.5	18.5	21.3	15.6
16	ASME, Class 150	15.5	18.5	21.3	15.6
18	DIN, PN 6	17.3	20.7	23.0	16.4
18	DIN, PN 10	17.3	21.1	23.0	16.4
18	ASME, Class 150	17.3	21.1	23.0	16.4
20	DIN, PN 6	19.4	23.3	25.6	18.1
20	DIN, PN 10	19.4	23.2	25.6	18.1
20	ASME, Class 150	19.4	23.2	25.6	18.1

DN [in]	Pressure rating	A [in]	B [in]	D [in]	H [in]
24	DIN, PN 6	23.4	27.3	30.2	20.6
24	DIN, PN 10	23.4	27.1	30.2	20.6
24	ASME, Class 150	23.4	27.1	30.2	20.6
28	DIN, PN 6	27.4	–	30.9	18.1
28	DIN, PN 10	27.3	–	32.0	18.9
28	AS, PN 16	27.1	–	31.8	19.3
28	AWWA, Class D	27.3	–	32.8	19.5
30	AWWA, Class D	29.3	–	32.8	20.6
32	DIN, PN 6	31.5	–	35.2	20.5
32	DIN, PN 10	31.3	–	36.2	21.3
32	AS, PN 16	31.1	–	36.0	21.7
32	AWWA, Class D	31.3	–	37.0	22.1
36	DIN, PN 6	35.3	–	39.1	22.4
36	DIN, PN 10	35.2	–	40.2	23.2
36	AS, PN 16	34.9	–	39.9	23.4
36	AWWA, Class D	35.2	–	41.3	24.2
40	DIN, PN 6	39.3	–	43.0	24.4
40	DIN, PN 10	39.2	–	44.4	25.6
40	AS, PN 16	38.9	–	44.5	26.0
40	AWWA, Class D	39.2	–	45.8	26.6
42	AWWA, Class D	41.1	–	48.0	27.7
48	DIN, PN 6	47.4	–	51.6	28.9

1) Ground disks can be used for all the flange standards/pressure ratings which can be supplied in the standard version.

Weight

Compact version

Weight data:
- Including the transmitter
  - Order code for *"Housing"*, option M, Q: 1.3 kg (2.9 lb)
  - Order code for *"Housing"*, option A, R: 2.0 kg (4.4 lb)
- Excluding packaging material

Weight in SI units

Standard version

EN 1092-1 (DIN 2501)			
DN [mm]	Pressure rating	Weight [kg]	
		Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
25	PN 40	5	5.7
32	PN 40	6	6.7
40	PN 40	8	8.7
50	PN 40	9	9.7
65	PN 16	10	10.7

EN 1092-1 (DIN 2501)			
DN [mm]	Pressure rating	Weight [kg]	
		Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
80	PN 16	12	12.7
100	PN 16	14	14.7
125	PN 16	20	20.7
150	PN 16	24	24.7
200	PN 10	43	43.7
250	PN 10	63	63.7
300	PN 10	68	68.7
350	PN 6	105	105.7
375	PN 6	120	120.7
400	PN 6	120	120.7
450	PN 6	161	161.7
500	PN 6	156	156.7
600	PN 6	208	208.7
700	PN 6	304	304.7
800	PN 6	357	357.7
900	PN 6	485	485.7
1 000	PN 6	589	589.7
1 200	PN 6	850	850.7
1 400	PN 6	1 300	1 300.7
1 600	PN 6	1 700	1 700.7
1 800	PN 6	2 200	2 200.7
2 000	PN 6	2 800	2 800.7

AS 4087, PN 16		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
80	12	12.7
100	14	14.7
150	24	24.7

JIS B2220, 10K		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
25	5	5.7
32	5	5.7
40	6	6.7
50	7	7.7
65	9	9.7

JIS B2220, 10K		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
80	11	11.7
100	13	13.7
125	19	19.7
150	23	23.7
200	40	40.7
250	68	68.7
300	70	70.7

Order code for "Design", option A

Option A *"Insertion length short; ISO/DVGW to DN400, DN450-2000 1:1"*

EN 1092-1 (DIN 2501)			
DN [mm]	Order code for "Housing", option M, Q Polycarbonate plastic [1]		
	Weight [kg]		
	PN 6	PN 10	PN 16
450	100	113	139
500	115	133	179
600	156	163	224
700	191	241	288
800	241	316	350
900	309	394	441
1000	360	469	563
1200	530	718	840
1400	785	1115	1201
1600	1059	1625	1842
1800	1419	2108	2354
2000	1878	2631	2926

1) Values for aluminum transmitter, AlSi10Mg, coated: + 0.7 kg

AS 2129, Table E		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
450	144	144.7
500	183	183.7
600	261	261.7
700	347	347.7
750	434	434.7
800	494	494.7
900	691	691.7

AS 2129, Table E		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
1000	762	762.7
1200	1238	1238.7

AS 4087, PN 16		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
450	134	134.7
500	183	183.7
600	261	261.7
700	368	368.7
750	446	446.7
800	504	504.7
900	703	703.7
1000	760	760.7
1200	1220	1220.7

Order code for "Calibration flow", options H and K, or options H/K or order code for "Sensor option", option CA

Option	Description
H	MID Type Examination Cert MI-001
K	OIML R49 Class 2
CA	IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M

EN 1092-1 (DIN 2501)			
DN [mm]	Pressure rating	Weight [kg]	
		Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
25	PN 40	9	9.7
32	PN 40	10	10.7
40	PN 40	11	11.7
50	PN 40	12	12.7
65	PN 16	13	13.7
80	PN 16	15	15.7
100	PN 16	17	17.7
125	PN 16	22	22.7
150	PN 16	27	27.7
200	PN 10	38	38.7
250	PN 10	51	51.7
300	PN 10	60	60.7

AS 2129, PN 16		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
80	15	15.7
100	17	17.7
125	22	22.7
150	27	27.7

JIS B2220, 10K		
DN [mm]	Weight [kg]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
25	9	9.7
32	10	10.7
40	10	10.7
50	11	11.7
65	12	12.7
80	13	13.7
100	15	15.7
125	20	20.7
150	25	25.7
200	34	34.7
250	50	50.7
300	57	57.7

Weight in US units

Standard version

ASME B16.5, Class 150		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
1	11	12.5
1½	18	19.5
2	20	21.5
3	26	27.5
4	31	32.5
6	53	54.5
8	95	96.5
10	161	162.5
12	238	239.5
14	386	387.5
16	452	453.5
18	562	563.5

ASME B16.5, Class 150		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
20	628	629.5
24	893	894.5

AWWA C207, Class D		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
28	882	883.5
30	1014	1015.5
32	1213	1214.5
36	1764	1765.5
40	1985	1986.5
42	2426	2427.5
48	3087	3088.5
54	4851	4852.5
60	5954	5955.5
66	8159	8160.5
72	9041	9042.5
78	10143	10144.5

Order code for "Design", option A

Option A *"Insertion length short; ISO/DVGW to DN400, DN450-2000 1:1"*

ASME B16.5, Class 150		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
18	423	424.5
20	505	506.5
24	668	667.5

AWWA C207, Class D		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
28	589	590.5
30	703	704.5
32	847	848.5
36	1039	1040.5
40	1297	1298.5
42	1480	1481.5

AWWA C207, Class D		
DN [in]	Weight [lbs]	
	Order code for "Housing", option M, Q Polycarbonate plastic	Order code for "Housing", option A, R Aluminum, AlSi10Mg, coated
48	1989	1990.5
54	2809	2810.5
60	3517	3518.5
66	4701	4702.5
72	5665	5666.5
78	6866	6867.5

Order code for "Sensor option", option CA

Option CA *"IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M*

ASME B16.5, Class 150	
DN [in]	Weight [lbs]
1	17.6
1½	19.8
2	24.3
3	33.1
4	41.9
6	61.7
8	97.0
10	134.5
12	189.6

Transmitter remote version

Wall-mount housing

Depends on the material of the wall-mount housing:
- Polycarbonate plastic: 1.3 kg (2.9 lb)
- Aluminum, AlSi10Mg, coated: 2.0 kg (4.4 lb)

Sensor remote version

Weight data:
- Including sensor connection housing
- Excluding the connecting cable
- Excluding packaging material

Weight in SI units

Standard version

EN 1092-1 (DIN 2501)		
DN [mm]	Pressure rating	Weight [kg]
25	PN 40	5
32	PN 40	6
40	PN 40	7

EN 1092-1 (DIN 2501)		
DN [mm]	**Pressure rating**	**Weight [kg]**
50	PN 40	9
65	PN 16	10
80	PN 16	12
100	PN 16	14
125	PN 16	20
150	PN 16	24
200	PN 10	43
250	PN 10	63
300	PN 10	68
350	PN 6	103
375	PN 6	118
400	PN 6	118
450	PN 6	159
500	PN 6	154
600	PN 6	206
700	PN 6	302
800	PN 6	355
900	PN 6	483
1 000	PN 6	587
1 200	PN 6	848
1 400	PN 6	1298
1 600	PN 6	1698
1 800	PN 6	2198
2 000	PN 6	2798

AS 4087, PN 16	
DN [mm]	**Weight [kg]**
80	12
100	14
125	20
150	24

JIS B2220, 10K	
DN [mm]	**Weight [kg]**
25	5
32	5
40	6
50	7
65	9

JIS B2220, 10K	
DN [mm]	**Weight [kg]**
80	11
100	13
125	19
150	23
200	40
250	67
300	70

Order code for "Design", option A

Option A *"Insertion length short; ISO/DVGW to DN400, DN450-2000 1:1"*

EN 1092-1 (DIN 2501)			
DN [mm]	**Weight [kg]**		
	PN 6	**PN 10**	**PN 16**
450	98	111	139
500	113	131	179
600	154	161	224
700	190	240	288
800	240	315	350
900	308	393	441
1000	359	468	563
1200	529	717	840
1400	784	1114	1200
1600	1058	1624	1841
1800	1418	2107	2353
2000	1877	2630	2925

AS 2129, Table E	
DN [mm]	**Weight [kg]**
450	142
500	181
600	259
700	346
750	433
800	493
900	690
1000	761
1200	1237

AS 4087, PN 16	
DN [mm]	**Weight [kg]**
450	132
500	181
600	259
700	367
750	445
800	503
900	702
1000	759
1200	1219

Order code for "Calibration flow", options H and K or order code for "Sensor option", option CA

Option	Description
H	MID Type Examination Cert MI-001
K	OIML R49 Class 2
CA	IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M

EN 1092-1 (DIN 2501)		
DN [mm]	**Pressure rating**	**[kg]**
25	PN 40	6.5
32	PN 40	8
40	PN 40	8.5
50	PN 40	10
65	PN 16	11
80	PN 16	13
100	PN 16	15
125	PN 16	20
150	PN 16	25
200	PN 10	36
250	PN 10	49
300	PN 10	58

AS 4087, PN 16	
DN [mm]	**[kg]**
80	13
100	15
150	25

JIS B2220, 10K	
DN [mm]	**Weight [kg]**
25	6.5
32	7.5
40	7.5
50	9
65	10
80	11
100	13
125	18
150	23
200	32
250	48
300	55

Weight in US units

Standard version

ASME B16.5, Class 150	
DN [in]	**Weight [lbs]**
1	11
1½	15
2	20
3	26
4	31
6	53
8	95
10	161
12	238
14	381
16	448
18	558
20	624
24	889

AWWA C207, Class D	
DN [in]	**Weight [lbs]**
28	878
30	1010
32	1208
36	1760
40	1980

AWWA C207, Class D	
DN [in]	**Weight [lbs]**
42	2421
48	3083
54	4847
60	5949
66	8154
72	9036
78	10139

Order code for "Design", option A

Option A *"Insertion length short; ISO/DVGW to DN400, DN450-2000 1:1"*

ASME B16.5, Class 150	
DN [in]	**Weight [lbs]**
18	420
20	501
24	664

AWWA C207, Class D	
DN [in]	**Weight [lbs]**
28	587
30	701
32	845
36	1036
40	1294
42	1477
48	1987
54	1273
60	3515
66	4699
72	5662
78	6864

Order code for "Sensor option", option CA

Option CA *"IP66/67, Type 4X, fully welded; corrosion protection EN ISO 12944 C5-M"*

ASME B16.5, Class 150	
DN [in]	**Weight [lbs]**
1	13
1½	15.5
2	20

ASME B16.5, Class 150	
DN [in]	Weight [lbs]
3	29
4	37
6	57
8	93
10	130
12	185

Measuring tube specification

Nominal diameter		Pressure rating				Measuring tube internal diameter			
		EN (DIN)	ASME AWWA	AS 2129 AS 4087	JIS	Hard rubber		Polyurethane	
[mm]	[in]					[mm]	[in]	[mm]	[in]
25	1	PN 40	Class 150	–	20K	–	–	24	0.94
32	–	PN 40	–	–	20K	–	–	32	1.26
40	1 ½	PN 40	Class 150	–	20K	–	–	38	1.50
50	2	PN 40	Class 150	Table E, PN 16	10K	50	1.97	50	1.97
65	–	PN 16	–	–	10K	66	2.60	66	2.60
80	3	PN 16	Class 150	Table E, PN 16	10K	79	3.11	79	3.11
100	4	PN 16	Class 150	Table E, PN 16	10K	102	4.02	102	4.02
125	–	PN 16	–	–	10K	127	5.00	127	5.00
150	6	PN 16	Class 150	Table E, PN 16	10K	156	6.14	156	6.14
200	8	PN 10	Class 150	Table E, PN 16	10K	204	8.03	204	8.03
250	10	PN 10	Class 150	Table E, PN 16	10K	258	10.2	258	10.2
300	12	PN 10	Class 150	Table E, PN 16	10K	309	12.2	309	12.2
350	14	PN 6	Class 150	Table E, PN 16	–	342	13.5	342	13.5
375	15	–	–	PN 16	–	392	15.4	–	–
400	16	PN 6	Class 150	Table E, PN 16	–	392	15.4	392	15.4
450	18	PN 6	Class 150	–	–	437	17.2	437	17.2
500	20	PN 6	Class 150	Table E, PN 16	–	492	19.4	492	19.4
600	24	PN 6	Class 150	Table E, PN 16	–	594	23.4	594	23.4
700	28	PN 6	Class D	Table E, PN 16	–	692	27.2	692	27.2
750	30	–	Class D	Table E, PN 16	–	742	29.2	742	29.2
800	32	PN 6	Class D	Table E, PN 16	–	794	31.3	794	31.3
900	36	PN 6	Class D	Table E, PN 16	–	891	35.1	891	35.1
1000	40	PN 6	Class D	Table E, PN 16	–	994	39.1	994	39.1
–	42	–	Class D	–	–	1043	41.1	1043	41.1
1200	48	PN 6	Class D	Table E, PN 16	–	1197	47.1	1197	47.1
–	54	–	Class D	–	–	1339	52.7	–	–
1400	–	PN 6	–	–	–	1402	55.2	–	–
–	60	–	Class D	–	–	1492	58.7	–	–
1600	–	PN 6	–	–	–	1600	63.0	–	–
–	66	–	Class D	–	–	1638	64.5	–	–

Nominal diameter		Pressure rating				Measuring tube internal diameter			
		EN (DIN)	ASME AWWA	AS 2129 AS 4087	JIS	Hard rubber		Polyurethane	
[mm]	[in]					[mm]	[in]	[mm]	[in]
1 800	72	PN 6	Class D	–	–	1 786	70.3	–	–
2 000	78	PN 6	Class D	–	–	1 989	78.3	–	–

Materials

Transmitter housing

Compact version, standard

- Order code for "Housing", option **A** "Compact, aluminum coated": Aluminum, AlSi10Mg, coated
- Order code for "Housing", option **M**: polycarbonate plastic
- Window material:
  - For order code for "Housing", option **A**: glass
  - For order code for "Housing", option **M**: plastic

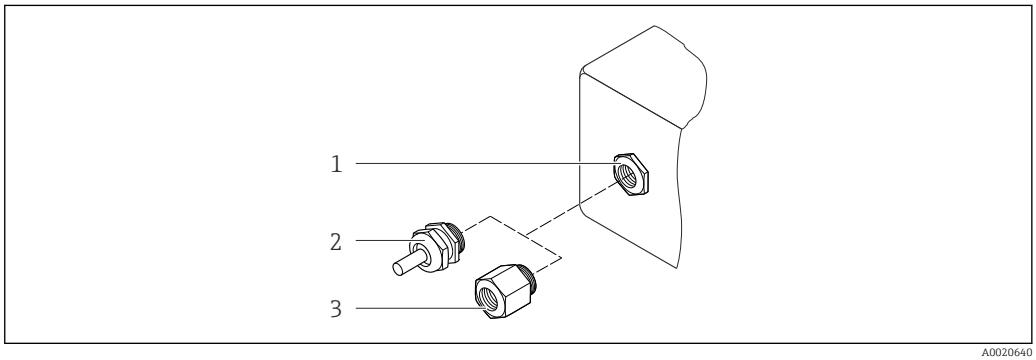
Compact version, inclined

- Order code for "Housing", option **R** "Compact, aluminum coated": Aluminum, AlSi10Mg, coated
- Order code for "Housing", option **Q**: polycarbonate plastic
- Window material:
  - For order code for "Housing", option **R**: glass
  - For order code for "Housing", option **Q**: plastic

Remote version (wall-mount housing)

- Order code for "Housing", option **P** "Compact, aluminum coated": Aluminum, AlSi10Mg, coated
- Order code for "Housing", option **N**: polycarbonate plastic
- Window material:
  - For order code for "Housing", option **P**: glass
  - For order code for "Housing", option **N**: plastic

Cable entries/cable glands



34 *Possible cable entries/cable glands*

1 *Cable entry in transmitter housing, wall-mount housing or connection housing with internal thread M20 x 1.5*
2 *Cable gland M20 x 1.5*
3 *Adapter for cable entry with internal thread G ½" or NPT ½"*

Compact and remote versions and sensor connection housing

Cable entry/cable gland	Material
Cable gland M20 × 1.5	Plastic
Remote version: cable gland M20 × 1.5 Option of reinforced connecting cable	▪ Sensor connection housing: Nickel-plated brass ▪ Transmitter wall-mount housing: Plastic
Adapter for cable entry with internal thread G ½" or NPT ½"	Nickel-plated brass

Device plug

Electrical connection	Material
Plug M12x1	▪ Socket: Stainless steel, 1.4404 (316L) ▪ Contact housing: Polyamide ▪ Contacts: Gold-plated brass

Connecting cable for remote version

Electrode and coil current cable
- Standard cable: PVC cable with copper shield
- Reinforced cable: PVC cable with copper shield and additional steel wire braided jacket

Sensor housing

- DN 25 to 300 (1 to 12"):
  - Aluminum, AlSi10Mg, coated
  - Carbon steel with Al/Zn protective coating
- DN 50 to 300 (2 to 12"):
  Carbon steel with protective varnish (IP68)
- DN 350 to 2000 (14 to 78"):
  Carbon steel with protective varnish

Sensor connection housing

- Standard: aluminum, AlSi10Mg, coated (IP66/67)
- Option:
  - Polycarbonate for IP68 with DN 50 to 300 (2 to 12")
  - Polycarbonate for order code "Sensor option", option CA...CE "Corrosion protection" with DN 350 to 2000 (14 to 78")

Measuring tubes

- DN 25 to 300 (1 to 12") [1]: stainless steel, 1.4301/1.4306/304/304L
- DN 350 to 1200 (14 to 48") [1]: stainless steel, 1.4301/304
- DN 1350 to 2000 (54 to 78") [1]: stainless steel, 1.4301 similar to 304

Liner

- DN 25 to 1200 (1 to 48"): polyurethane
- DN 50 to 2000 (2 to 78"): hard rubber

Electrodes

- Stainless steel, 1.4435 (316L)
- Alloy C22, 2.4602 (UNS N06022)
- Tantalum

1) For carbon steel flange material with Al/Zn protective coating (DN 25 to 300 (1 to 12")), protective varnish (IP68) (DN 50 to 300 (2 to 12")) or protective varnish ≥ DN 350 (14")

Process connections

EN 1092-1 (DIN 2501)

- DN 25 to 1200 [1]:
  - Stainless steel, 1.4404/1.4571/F316L
  - Carbon steel, A105/FE410WB/P250GH/S235JRG2/S235JR+N
- DN 1350 to 2000 [1]:
  - Stainless steel ,1.4404/1.4571
  - Carbon steel, P250GH/S235JRG2
- DN 450 to 2000 [2]:
  Carbon steel, A105/S235JRG2

EN 1092-1 (DIN 2501), PN6:
DN 350 to 1000 [1]:
Carbon steel, A105/FE410WB/S235JRG2

ASME B16.5

- DN 25 to 1200 (1 to 48"):
  Stainless steel, F316L similar to 1.4404
- DN 25 to 300 (1 to 12") [2]:
  Carbon steel, A105 similar to 1.0432
- DN 350 to 1200 (14 to 48") [2]:
  Carbon steel, A105/A515 Grade 70

AWWA C207

- DN 48":
  Carbon steel, A105/A181/P265GH/S275JR
- DN 54 to 72":
  Carbon steel, P265GH similar to 1.0425
- DN 48 to 78" [2]:
  Carbon steel, A105/A181/P265GH/S275JR

AS 2129

- DN 50 to 1200:
  Carbon steel, A105/S235JRG2
- DN 350 to 1200 [2]:
  Carbon steel, A105/FE410WB/P235GH/P265GH/S235JRG2

AS 4087

- DN 50 to 1200:
  Carbon steel, A105/S275JR
- DN 350 to 1200 [2]:
  Carbon steel, A105/P265GH/S275JR

JIS B2220

- Stainless steel, F316L similar to 1.4404
- Carbon steel, A105/A350LF2 [1]

Seals

In accordance with DIN EN 1514-1

Accessories

Display protection

Stainless steel, 1.4301 (304L)

2) Order Code for "Design", Option A "Insertion length short"

Ground disks

- Stainless steel, 1.4435 (316L)
- Alloy C22, 2.4602 (UNS N06022)
- Tantalum

Fitted electrodes

Measurement, reference and empty pipe detection electrodes available as standard with:
- 1.4435 (316L)
- Alloy C22, 2.4602 (UNS N06022)
- Tantalum

Optionally available with DN 350 to 2000 (14 to 78"):
Exchangeable measuring electrodes made from 1.4435 (316L)

Process connections

- EN 1092-1 (DIN 2501) [3]
  - DN ≤ 300: fixed flange (PN 10/16/25/40) = form A
  - DN ≥ 350: fixed flange (PN 6/10/16/25) = flat face
  - DN 450 to 2000 [4]: fixed flange (PN 6/10/16) = flat face
- ASME B16.5
  - DN 25 to 600 (1 to 24"): fixed flange (Class 150)
  - DN 350 to 2000 (14 to 78") [4]: fixed flange (Class 150)
  - DN 25 to 150 (1 to 6"): fixed flange (Class 300)
- AWWA C207
  - DN 48 to 72": fixed flange (Class D)
  - DN 48 to 78" [4]: fixed flange (Class D)
- AS 2129
  - DN 50 to 1200: fixed flange (Table E)
  - DN 350 to 1200 [4]: fixed flange (Table E)
- AS 4087
  - DN 50 to 1200): fixed flange (PN 16)
  - DN 350 to 1200 [4]: fixed flange (PN 16)
- JIS B2220
  - DN 50 to 300: fixed flange (10K)
  - DN 25 to 300: fixed flange (20K)

For information on the materials of the process connections → 99

Surface roughness

Electrodes with 1.4435 (316L); Alloy C22, 2.4602 (UNS N06022); tantalum:
≤ 0.3 to 0.5 µm (11.8 to 19.7 µin)
(All data relate to parts in contact with fluid)

Operability

Operating concept

Operator-oriented menu structure for user-specific tasks
- Commissioning
- Operation
- Diagnostics
- Expert level

Quick and safe commissioning
- Guided menus ("Make-it-run" wizards) for applications
- Menu guidance with brief explanations of the individual parameter functions

3) Dimensions as per DIN 2501, DN 65 (2 ½") PN 16 and DN 600 (24") PN 16 only as per EN 1092-1
4) Order code for "Design", option A "Insertion length short"

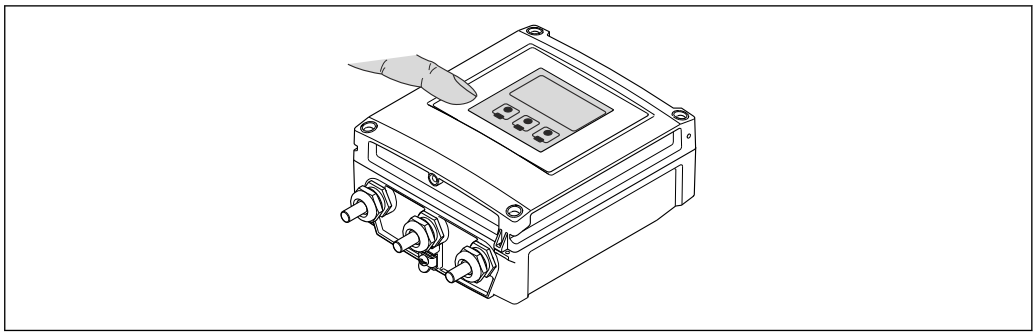
Reliable operation
- Operation in the following languages:
  - Via local display:
    English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Bahasa (Indonesian), Vietnamese, Czech
  - Via "FieldCare" operating tool:
    English, German, French, Spanish, Italian, Chinese, Japanese
  - Via integrated Web browser (only available for device versions with HART, PROFIBUS DP and EtherNet/IP):
    English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Bahasa (Indonesian), Vietnamese, Czech
- Uniform operating philosophy applied to device, operating tools and Web browser
- If replacing the electronic module, transfer the device configuration via the plug-in memory (HistoROM DAT) which contains the process and measuring device data and the event logbook. No need to reconfigure.

Efficient diagnostics increase measurement availability
- Troubleshooting measures can be called up via the device, operating tools and Web browser
- Diverse simulation options, logbook for events that occur and optional line recorder functions

In custody transfer mode, operation is only possible to a limited extent once the device has been put into circulation or has been lead-sealed.

Local operation

Via display module



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Display elements
- 4-line display
- White background lighting; switches to red in event of device errors
- Format for displaying measured variables and status variables can be individually configured
- Permitted ambient temperature for the display: –20 to +50 °C (–4 to +122 °F)
  The readability of the display may be impaired at temperatures outside the temperature range.

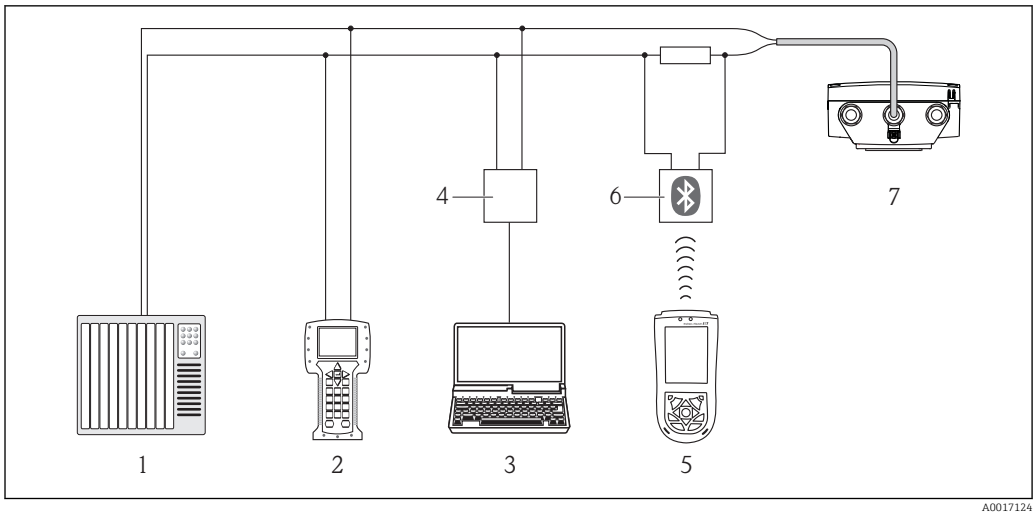
Operating elements
External operation via touch control; 3 optical keys: ⊕, ⊖, Ⓔ

Additional functionality
- Data backup function
  The device configuration can be saved in the display module.
- Data comparison function
  The device configuration saved in the display module can be compared to the current device configuration.
- Data transfer function
  The transmitter configuration can be transmitted to another device using the display module.

Remote operation

Via HART protocol

This communication interface is available in device versions with a HART output.

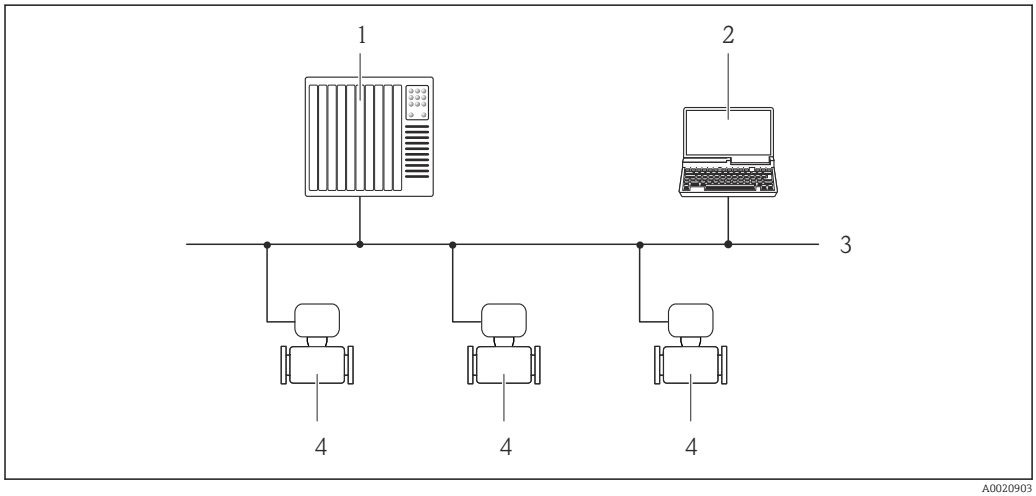


35 Options for remote operation via HART protocol

1 Control system (e.g. PLC)
2 Field Communicator 475
3 Computer with operating tool (e.g. FieldCare, AMS Device Manager, SIMATIC PDM)
4 Commubox FXA195 (USB)
5 Field Xpert SFX350 or SFX370
6 VIATOR Bluetooth modem with connecting cable
7 Transmitter

Via PROFIBUS DP network

This communication interface is available in device versions with PROFIBUS DP.

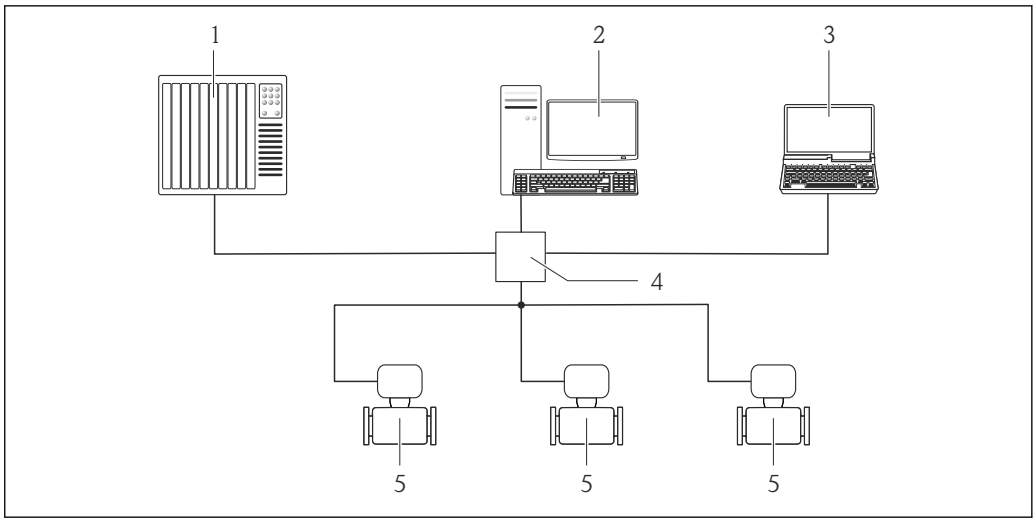


36 Options for remote operation via PROFIBUS DP network

1 Automation system
2 Computer with PROFIBUS network card
3 PROFIBUS DP network
4 Measuring device

Via Ethernet-based fieldbus

This communication interface is available in device versions with EtherNet/IP.



37 *Options for remote operation via Ethernet-based fieldbus*

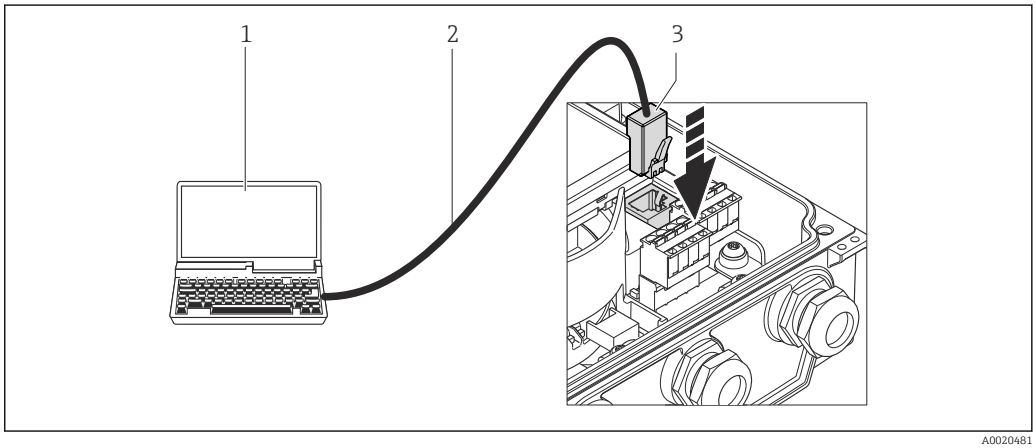
1 *Control system, e.g. "RSLogix" (Rockwell Automation)*
2 *Workstation for measuring device operation: with Add-on Profile Level 3 for "RSLogix 5000" (Rockwell Automation) or with Electronic Data Sheet (EDS)*
3 *Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"*
4 *Ethernet switch*
5 *Measuring device*

Service interface

Via service interface (CDI-RJ45)

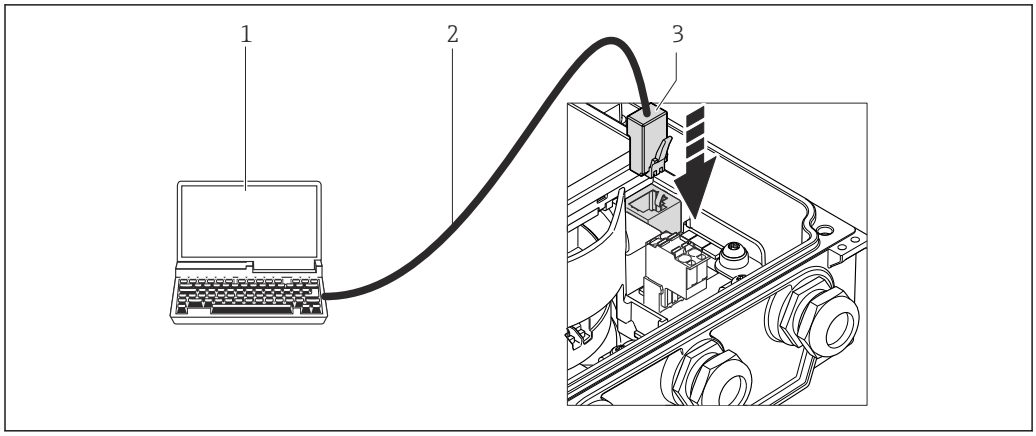
This communication interface is present in the following device version:
- Order code for "Output", option **H**: 4-20/0-20 mA HART, pulse/frequency/switch output
- Order code for "Output", option **I**: 4-20/0-20 mA HART, pulse/frequency/switch output, status input
- Order code for "Output", option **L**: PROFIBUS DP
- Order code for "Output", option **N**: EtherNet/IP
- Order code for "Output", option **M**: Modbus RS485

HART



1 *Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"*
2 *Standard Ethernet connecting cable with RJ45 plug*
3 *Service interface (CDI -RJ45) of the measuring device with access to the integrated Web server*

PROFIBUS DP



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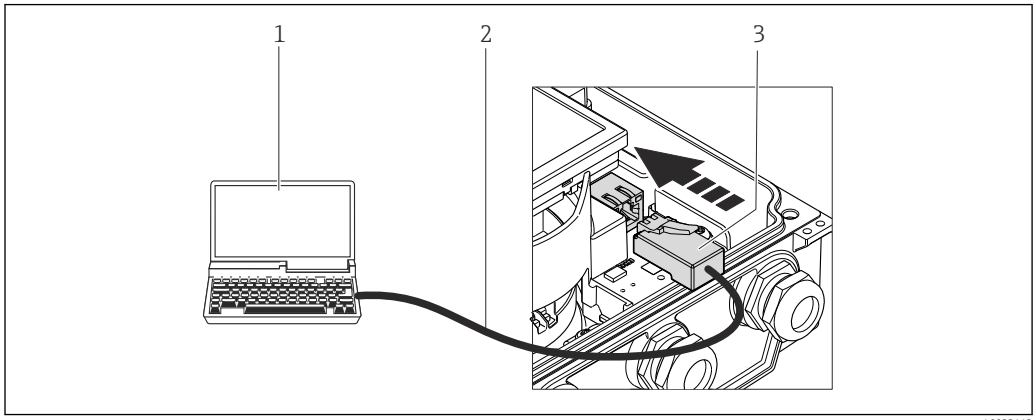
1 Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"
2 Standard Ethernet connecting cable with RJ45 plug
3 Service interface (CDI -RJ45) of the measuring device with access to the integrated Web server

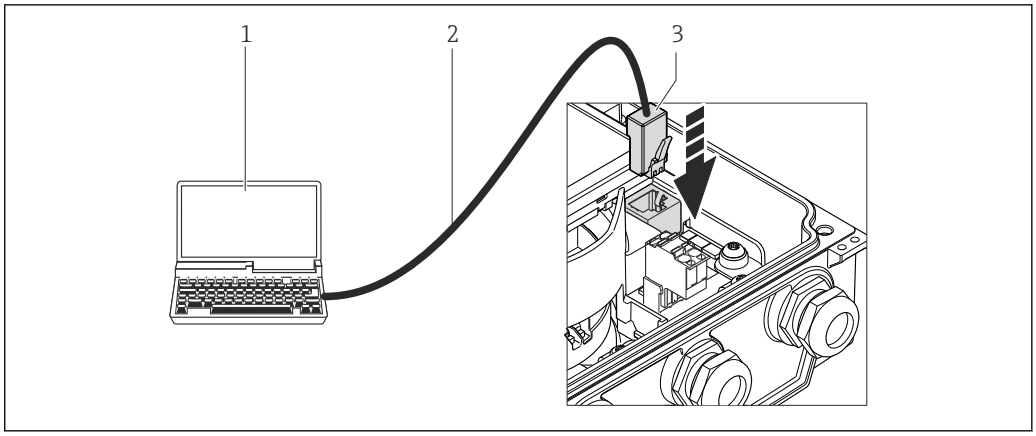
EtherNet/IP



A0023113

1 Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"
2 Standard Ethernet connecting cable with RJ45 plug
3 Service interface (CDI -RJ45) of the measuring device with access to the integrated Web server

Modbus RS485



1 Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or with "FieldCare" operating tool with COM DTM "CDI Communication TCP/IP"
2 Standard Ethernet connecting cable with RJ45 plug
3 Service interface (CDI -RJ45) of the measuring device with access to the integrated Web server

Certificates and approvals

CE mark

The measuring system is in conformity with the statutory requirements of the applicable EC Directives. These are listed in the corresponding EC Declaration of Conformity along with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

C-Tick symbol

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

Ex approval

The measuring device is certified for use in hazardous areas and the relevant safety instructions are provided in the separate "Safety Instructions" (XA) document. Reference is made to this document on the nameplate.

The separate Ex documentation (XA) containing all the relevant explosion protection data is available from your Endress+Hauser sales center.

ATEX, IECEx

Currently, the following versions for use in hazardous areas are available:

Drinking water approval

- ACS
- KTW/W270
- NSF 61
- WRAS BS 6920

Certification PROFIBUS

PROFIBUS interface

The measuring device is certified and registered by the PROFIBUS User Organization (PNO). The measuring system meets all the requirements of the following specifications:
- Certified in accordance with PROFIBUS PA Profile 3.02
- The device can also be operated with certified devices of other manufacturers (interoperability)

Modbus RS485 certification

The measuring device meets all the requirements of the MODBUS/TCP conformity test and has the "MODBUS/TCP Conformance Test Policy, Version 2.0". The measuring device has successfully passed all the test procedures carried out and is certified by the “MODBUS/TCP Conformance Test Laboratory” of the University of Michigan.

EtherNet/IP certification

The measuring device is certified and registered by the ODVA (Open Device Vendor Association). The measuring system meets all the requirements of the following specifications:
- Certified in accordance with the ODVA Conformance Test
- EtherNet/IP Performance Test
- EtherNet/IP PlugFest compliance
- The device can also be operated with certified devices of other manufacturers (interoperability)

Measuring instrument approval

Promag W 400 is (optionally) approved as a cold water meter (MI-001) for volume measurement in service subject to legal metrological control in accordance with the European Measuring Instruments Directive 2004/22/EC (MID).

Promag W 400 is qualified to OIML R49 and has an OIML Certificate of Conformity (optional).

Other standards and guidelines

- EN 60529
  Degrees of protection provided by enclosures (IP code)
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC/EN 61326
  Emission in accordance with Class A requirements. Electromagnetic compatibility (EMC requirements).
- ANSI/ISA-61010-1 (82.02.01): 2004
  Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1 General Requirements
- CAN/CSA-C22.2 No. 61010-1-04
  Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1 General Requirements
- NAMUR NE 21
  Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment
- NAMUR NE 32
  Data retention in the event of a power failure in field and control instruments with microprocessors
- NAMUR NE 43
  Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53
  Software of field devices and signal-processing devices with digital electronics
- NAMUR NE 105
  Specifications for integrating fieldbus devices in engineering tools for field devices
- NAMUR NE 107
  Self-monitoring and diagnosis of field devices
- NAMUR NE 131
  Requirements for field devices for standard applications

Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser web site: www.endress.com → Choose your country → Products → Select measuring technology, software or components → Select product (picklists: measurement method, product family etc.) → Device support (right-hand column): Configure the selected product → The Product Configurator for the selected product is opened.
- From your Endress+Hauser Sales Center: www.addresses.endress.com

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Product generation index

Release date	Product root	Modification
01.06.2012	8S1B	Original
01.01.2015	8S1C	DN 08 to 50 measuring tube material 1.4435/316L DN 40 to 50 reduction in length DN 40 to 50 reduction in weight

Additional information is available from your sales center or at:
www.service.endress.com → Downloads

Application packages

Many different application packages are available to enhance the functionality of the device. Such packages might be needed to address safety aspects or specific application requirements.

The application packages can be ordered with the device or subsequently from Endress+Hauser. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Cleaning

Package	Description
Electrode cleaning circuit (ECC)	The electrode cleaning circuit (ECC) function has been developed to have a solution for applications where magnetite (Fe_3O_4) deposits frequently occur (e.g. hot water). Since magnetite is highly conductive this build up leads to measuring errors and ultimately to the loss of signal. The application package is designed to AVOID build up of highly conductive matter and thin layers (typical of magnetite).

Diagnostics functions

Package	Description
HistoROM extended function	Comprises extended functions concerning the event log and the activation of the measured value memory. Event log: Memory volume is extended from 20 message entries (basic version) to up to 100 entries. Data logging (line recorder): ▪ Memory capacity for up to 1000 measured values is activated. ▪ 250 measured values can be output via each of the 4 memory channels. The recording interval can be defined and configured by the user. ▪ Data logging is visualized via the local display or FieldCare.

Heartbeat Technology

Package	Description
Heartbeat Verification +Monitoring	**Heartbeat Monitoring:** Continuously supplies monitoring data, which are characteristic of the measuring principle, for an external condition monitoring system. This makes it possible to: ▪ Draw conclusions - using these data and other information - about the impact the measuring application has on the measuring performance over time. ▪ Schedule servicing in time. ▪ Monitor the product quality, e.g. gas pockets. **Heartbeat Verification:** Makes it possible to check the device functionality on demand when the device is installed, without having to interrupt the process. ▪ Access via onsite operation or other operating interfaces, such as FieldCare for instance. ▪ End-to-end, traceable documentation of the verification results, including report. ▪ Makes it possible to extend calibration intervals in accordance with operator's risk assessment.

Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Device-specific accessories

For the transmitter

Accessories	Description
Display protection	Is used to protect the display against impact or scoring from sand in desert areas. For details, see Special Documentation SD00333F
Connecting cable for remote version	Coil current and electrode cables, various lengths, reinforced cables available on request.
Ground cable	Set, consisting of two ground cables for potential equalization.
Post mounting kit	Post mounting kit for transmitter.
Compact → remote conversion kit	For converting a compact device version to a remote device version.
Promag 50/53 → Promag 400 conversion kit	For converting a Promag with transmitter 50/53 to a Promag 400.

For the sensor

Accessories	Description
Ground disks	Are used to ground the fluid in lined measuring tubes to ensure proper measurement. For details, see Installation Instructions EA00070D

Communication-specific accessories

Accessories	Description
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface. For details, see "Technical Information" TI00404F
HART Loop Converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values. For details, see "Technical Information" TI00429F and Operating Instructions BA00371F
Wireless HART adapter SWA70	Is used for the wireless connection of field devices. The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity. For details, see Operating Instructions BA00061S
Fieldgate FXA320	Gateway for the remote monitoring of connected 4-20 mA measuring devices via a Web browser. For details, see "Technical Information" TI00025S and Operating Instructions BA00053S
Fieldgate FXA520	Gateway for the remote diagnostics and remote configuration of connected HART measuring devices via a Web browser. For details, see "Technical Information" TI00025S and Operating Instructions BA00051S

Field Xpert SFX350	Field Xpert SFX350 is a mobile computer for commissioning and maintenance. It enables efficient device configuration and diagnostics for HART and FOUNDATION Fieldbus devices in the **non-Ex area**. For details, see Operating Instructions BA01202S
Field Xpert SFX370	Field Xpert SFX370 is a mobile computer for commissioning and maintenance. It enables efficient device configuration and diagnostics for HART and FOUNDATION Fieldbus devices in the **non-Ex area** and the **Ex area**. For details, see Operating Instructions BA01202S

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: ▪ Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, accuracy or process connections. ▪ Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters throughout the entire life cycle of a project. Applicator is available: ▪ Via the Internet: https://wapps.endress.com/applicator ▪ On CD-ROM for local PC installation.
W@M	Life cycle management for your plant W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle. The application already contains the data of your Endress+Hauser device. Endress +Hauser also takes care of maintaining and updating the data records. W@M is available: ▪ Via the Internet: www.endress.com/lifecyclemanagement ▪ On CD-ROM for local PC installation.
FieldCare	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition. For details, see Operating Instructions BA00027S and BA00059S
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop. For details, see "Technical Information" TI00405C

System components

Accessories	Description
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all relevant measured variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a SD card or USB stick. For details, see "Technical Information" TI00133R and Operating Instructions BA00247R

Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- The CD-ROM provided for the device (depending on the device version, the CD-ROM might not be part of the delivery!)
- The *W@M Device Viewer* : Enter the serial number from the nameplate (www.endress.com/deviceviewer)
- The *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2-D matrix code (QR code) on the nameplate.

Standard documentation

Brief Operating Instructions

Measuring device	Documentation code
Promag W 400	KA01114D

Operating Instructions

Measuring device	Documentation code			
	HART	PROFIBUS DP	Modbus RS485	EtherNet/IP
Promag W 400	BA01063D	BA01234D	BA01231D	BA01214D

Supplementary device-dependent documentation

Special documentation

Contents	Documentation code
Modbus RS485 Register Information	SD01379D
Heartbeat Technology	SD01183D
Information on Custody Transfer Measurement	SD01230D

Installation Instructions

Contents	Documentation code
Installation Instructions for spare part sets	Specified for each individual accessory

Registered trademarks

HART®
Registered trademark of the HART Communication Foundation, Austin, USA

PROFIBUS®
Registered trademark of the PROFIBUS User Organization, Karlsruhe, Germany

Modbus®
Registered trademark of SCHNEIDER AUTOMATION, INC.

EtherNet/IP™
Trademark of ODVA, Inc.

Microsoft®
Registered trademark of the Microsoft Corporation, Redmond, Washington, USA

Applicator®, FieldCare®, Field Xpert™, HistoROM®, Heartbeat Technology™
Registered or registration-pending trademarks of the Endress+Hauser Group

www.addresses.endress.com

Endress+Hauser

People for Process Automation

Chapter 12 Rotary Lobe Blower (Division 43)

MANUFACTURER/DISTRIBUTOR:

Aerzen
Hicham Bouyakhf
1995 Montée Labossière
Vaudreuil-Dorion, J7V 8P2
Phone: (450) 424-3966
hicham.bouyakhf@aerzen.ca

12.1 **Aerzen/Delta Blower GM15L Air Scour Blower (WTP)**

Aerzen Canada
1995 Montée Labossière, Vaudreuil-Dorion, Québec J7V 8P2

Customer Reference: Iqaluit - remplacement Delta Blower 15 L
Aerzen Reference: SQ-17-019256

Submitted by: Hicham Bouyakhf
hichamb@aerzen.ca

SCOPE OF SUPPLY

1 Aerzen Generation 5 Blower Package - GM 15L DN 100 - Pressure - including:

Aerzen GM 15L Blower
Drive Motor: 25hp, 1800rpm, TEFC, 575V/60Hz

Base with integrated reactive type discharge silencer
Intake filter silencer
Hinged motor support as automatic belt tensioning device
Set of vibration isolation mounts
Narrow v-belt drive with guard - 1 set
Spring loaded relief valve preset to: 750 mbar
Discharge manifold with externally accessible integrated check valve
Flexible connector with clamps for schedule 40 pipe, discharge

Instruments
Pressure gauge c/w isolation ball valve (1x)
Dirty filter indicator (1x)

Optional Spare Parts
1 Year Spare Kit

Connection Points:
Intake Connection: Local
Discharge Connection: DN 100 - 4"

Exclusions: See page 2

Aerzen Canada
1995 Montée Labossière, Vaudreuil-Dorion, Québec J7V 8P2

Customer Reference: Iqaluit - remplacement Delta Blower 15 L
Aerzen Reference: SQ-17-019256

PERFORMANCE DATA

Aerzen Blower Package - GM 15L DN 100 - Pressure

Configuration: **G5**

Conditions:		1			
Flow at inlet conditions	m³/min	14			
	Icfm	494			
Inlet pressure (abs.)	bar	1.010			
	Psi	14.6			
Pressure differential	mbar(g)	480			
	Psig	7.0			
Inlet temperature	°C	20			
Discharge temperature	°C	68			
Blower speed	RPM	4008			
Blower maximum speed	RPM	4800			
% of maximum blower speed		84%			
Power required at shaft (with accessories) **	kW	15.3			
	HP	20.5			
Motor rating	HP	25.0			

Noise level without acoustic hood	dB(A)	92
Noise level with acoustic hood	dB(A)	71

Tolerances as per EN 10204, in accordance with standard ISO 1217:
Flow at inlet conditions / Power required at shaft +/- 5%

Blower package noise level:
Free field measurement at 1m from the complete blower package (tolerance +/- 2 dB(A))

Tests and measurements:
Blower stage: 1.5 hour flow test at the factory (Germany) on a calibrated test bed, at maximum operating conditions and according to DIN 1945. acceptance tolerance: +/- 5%.
A complete test report is available upon request.

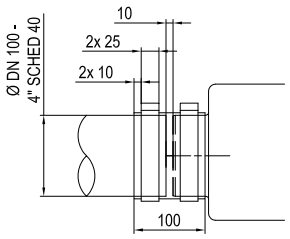
On Site Commissioning
Available upon request, charges to be advised.
- Any commissioning activity is subject to two weeks prior notice and completion of commissioning checklist.
- Any on-site activity outside the time indicated will be billed according to the Aerzen Standard Rate Sheet

Exclusions
Control Panels, Motor Starters, Piping and Electrical Connections
* Unloading valves are required for reduced voltage starters

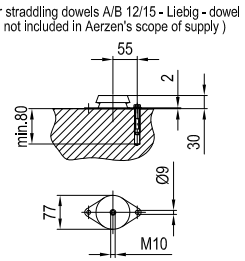
Warranty
Blowers including accessories are warranted for a period of 12mo / max 18mo after delivery and after provisional acceptance of the work against defects in workmanship and design. This warranty does not cover wearing parts unless such parts are defective during shipping / commissioning.
As per Aerzen standard warranty terms.

** Power at shaft excludes drive motor and belt drive

NOTICE: THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF AERZEN CANADA INC. AND ITS SUBSIDIARIES AND SHALL NOT BE REPRODUCED BY ANY MEANS IN WHOLE OR IN PART OR USED AS THE BASIS FOR MANUFACTURE WITHOUT WRITTEN PERMISSION.

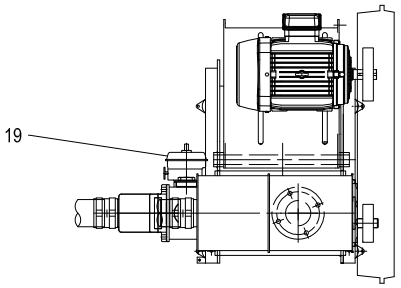


CONNECTION DETAILS



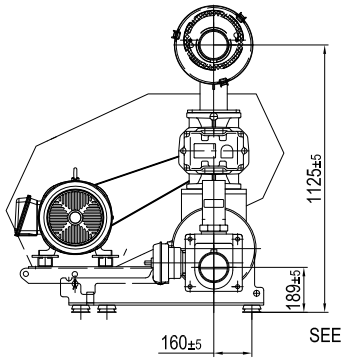
ANCHORING BY OTHER ANCHORING DETAILS

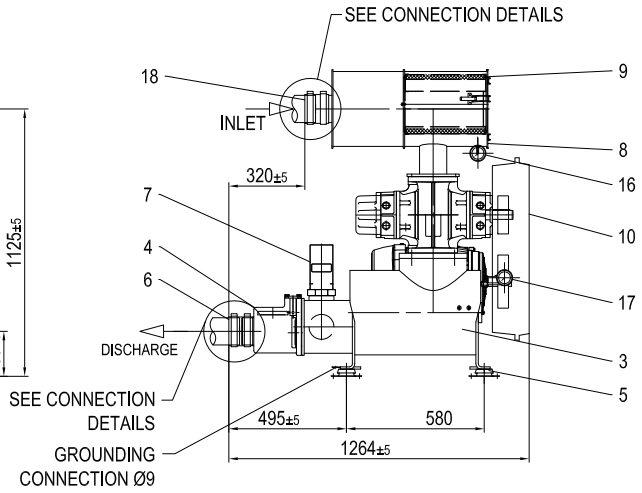
NOTE	QTY.	POS	DESCRIPTION
	1	1	BLOWER - GM 15L - 120 KG
D	1	2	ELECTRIC MOTOR - WEG 250T REPRESENTED
	1	3	BASE FRAME / DISCHARGE SILENCER - DN 100
	1	4	CONNECTION HOUSING WITH CHECK VALVE - DN 100
	4	5	VIBRATION ISOLATORS - DN 100
	1	6	DISCHARGE FLEXIBLE SLEEVE - DN 100 / 4" SCHED. 40
	1	7	PRESSURE RELIEF VALVE - DN 80 - SET TO 750 mbar
	1	8	INLET FILTER / SILENCER ASSEMBLY - DN 100
	1	9	INLET FILTER ELEMENT
	1	10	BELT GUARD
	1	11	DRIVER SHEAVE
E	1	12	DRIVER BUSHING
	1	13	DRIVEN SHEAVE
E	1	14	DRIVEN BUSHING
	1	15	V-BELT SET
	1	16	FILTER MAINTENANCE INDICATOR -MANN
	1	17	DISCHARGE PRESSURE GAUGE W/ ISOLATION BALL VALVE - WIKA
G	1	18	INLET FLEXIBLE SLEEVE - DN 100 / 4" SCHED. 40
G	1	19	UNLOADING VALVE

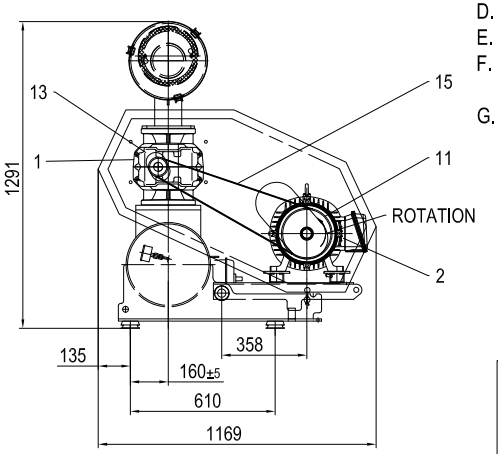


NOTES:

A. ASSEMBLY WEIGHT WITHOUT MOTOR: 357KG
B. PAINT: AERZEN STANDARD BLUE
C. 1M OF FREE SPACE AT THE FRONT OF THE PACKAGE IS RECOMENDED FOR MAINTENANCE ACCESS
D. MOTOR: WEG 250T REPRESENTED
E. NOT SHOWN ON DRAWING
F. FOR VARIABLE SPEED APPLICATIONS, CONSTANT TORQUE VFD ARE REQUIRED
G. OPTIONAL







AERZEN
AERZEN CANADA INC
1995 MONTEE LABOSSIERE, VAUDREUIL QC J7V 8P2
(450) 424-3966 PH, (450) 424-3985 FX

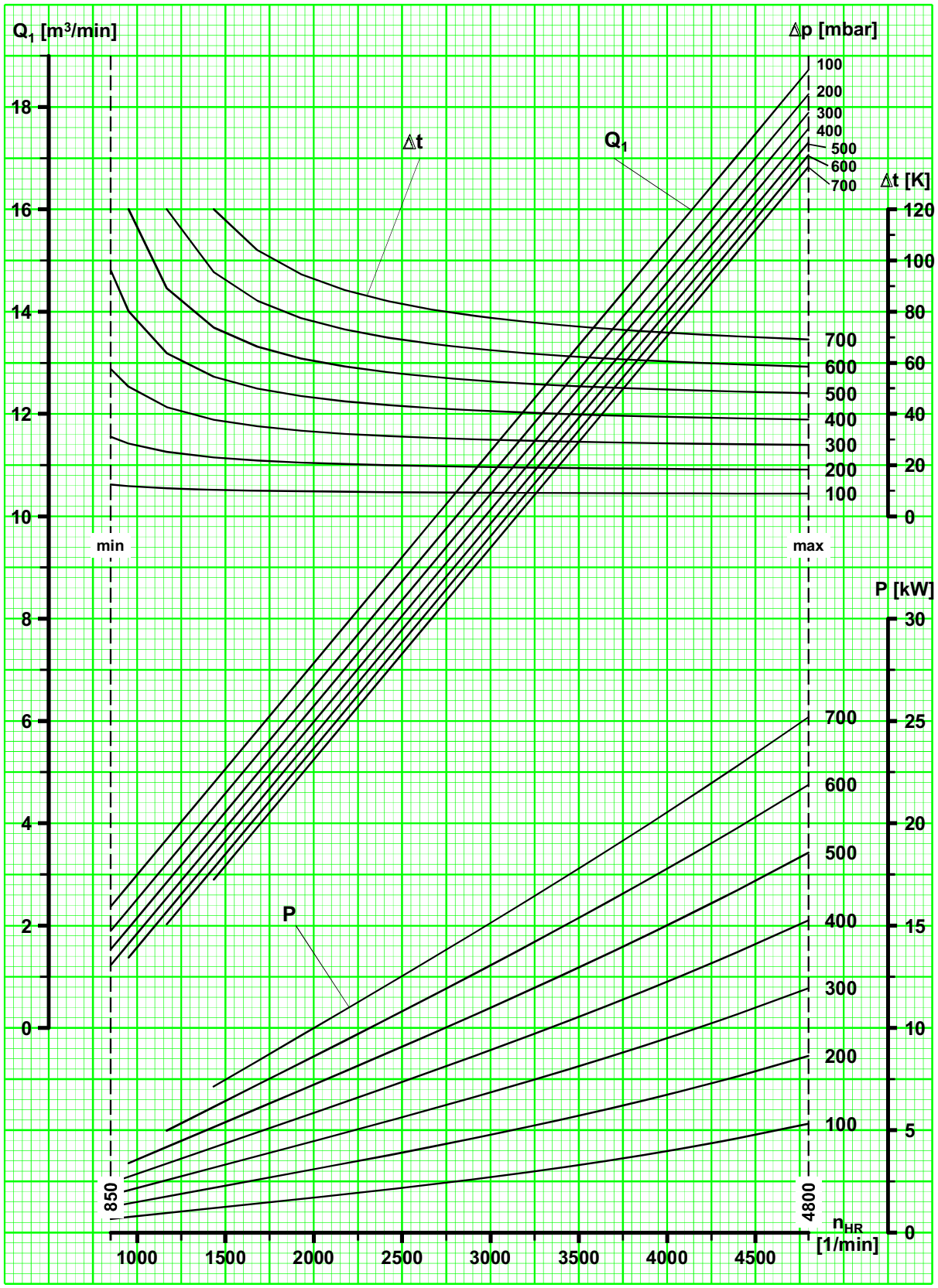
THIRD ANGLE PROJECTION

REVISION DETAILS						
REV	DRAWN BY	DATE	REVIEWED	DATE	DETAILS	AREA
B	LPM	16-10-12	LPM	16-10-12	UPDATE DIM GENERAL ARRANGMENT DRAWING	
A	D.L.	08/02/11	D.L.	02/08/11	RELEASE	-

TITLE: G5 - GM 15L DN 100 - PRESSURE
DWG NO.: 2ZG-9173
DRAWN BY: D. LEVESQUE
REVIEWED BY: D. LEVESQUE
DATE: FEBRUARY 08, 2011
REV: B
SCALE: NONE
SIZE: A
SHEET: 1 OF 1

Aerzener Maschinenfabrik GmbH
Reherweg 28 - D-31855 Aerzen - Telefon (0 51 54) 81 0 - info@aerzener.de - www.aerzener.com

4000323911 | ZTD | 00



Q_1 : Ansaugvolumenstrom (Luft) bei p_1 = 1,0 bar und t_1 = 20°C	intake volume flow (air) at p_1 = 1.0 bar and t_1 = 20°C	débit aspiré (air) pour p_1 = 1,0 bar et t_1 = 20°C
n_{HR} : Hauptrotordrehzahl	main rotor speed	vitesse du rotor principal
n_V : Antriebswellendrehzahl	drive shaft speed	vitesse de l'arbre d'entraînement
P : Leistungsbedarf an der Kupplung	power required at the coupling	puissance absorbée à l'accouplement
t : Temperaturerhöhung	temperature rise	élévation de température
p : Druckerhöhung	pressure difference	pression différentielle

Leistungsdiagramm - Überdruck - für Drehkolbengebläsestufe
performance diagram - overpressure - for stage of rotary piston blower
courbes de fonctionnement - fonctionnement en pression - pour étage de surpresseur à pistons rotatifs

GM 15 L

n_V / n_{HR} = 1	04/2016 TRD - Hallemann	G2 - 410 - XL SAP - 4000323911 - 00

TECO Westinghouse MOTORS (CANADA) INC.	
	Date: October 19, 2015

Technical Documentation

PDH02545

Optim TEFC | AEHH8N

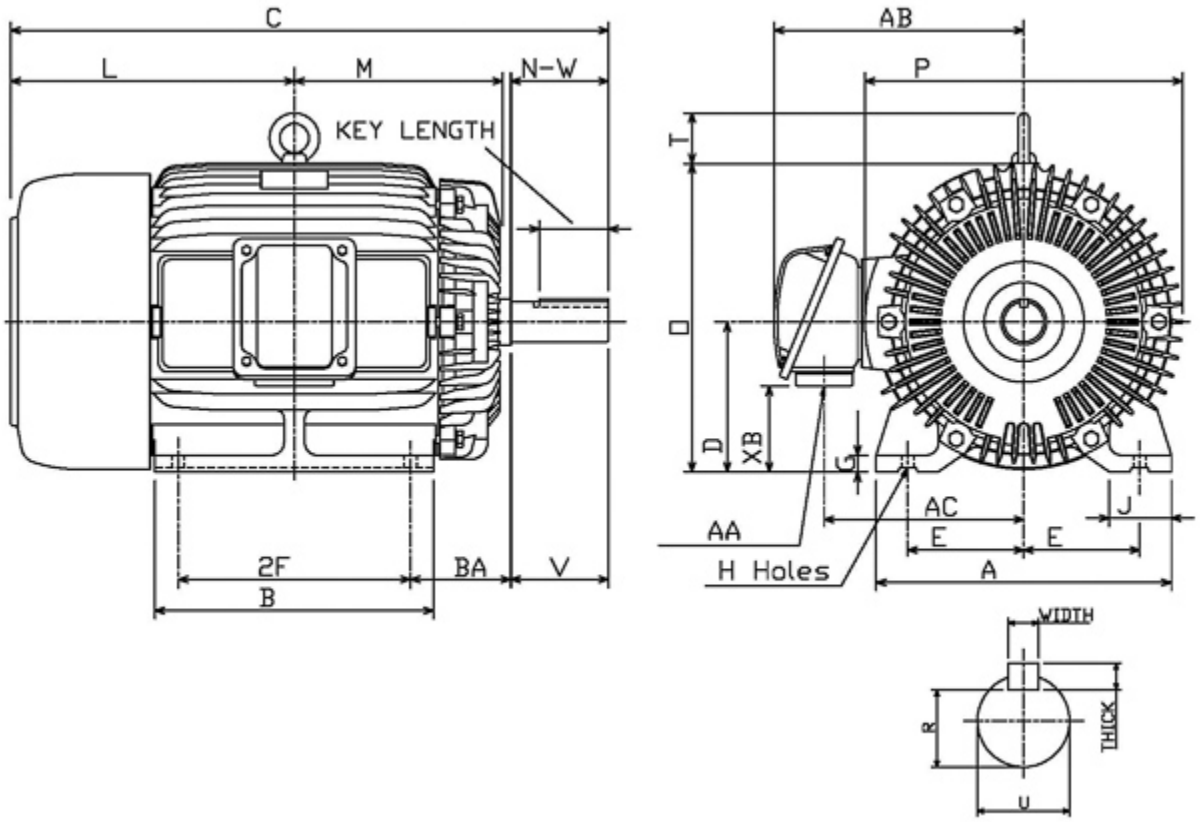
Date: October 19, 2015

TECO Westinghouse
MOTORS (CANADA) INC.

Date: October 19, 2015

Dimensional Drawing

Catalogue	Model	HP	Pole	kW	Rating	Voltage	Hz	RPM
PDH02545	AEHH8N	25	4	19	Continuous	575 V	60	1800



Frame Size	Mounting					A	B	C	CD	D
	E	2F	2F2	H	BA					
284T	5.5	9.5		0.53	4.75	14	11.7	26.8		7

G	J	K	L	M	O	P	T	Key			Keyseat
								Width	Thick	Length	R
0.7	2.95		12.68	9.23	14.52	15.04	1.97	0.5	0.5	3.28	1.591

Terminal Housing				Aux Box		C/D Flange					
AA	AB	AC	XB	AE	AX	BB	AH	AK	BD	AJ	BF
1.25 NPT	12.28	9.84	3.97								

Shaft Extension			Bearings		Approx. Weight Lbs	SPL dBA/3ft	Ins. Class	S.F.	Drive Method	Dimensions
N-W	U	V	DE	NDE						
4.62	1.875	4.5	6311ZZ	6310ZZ	464	68	F	1.15	Direct Coupling / Belt Drive	Inches

TECO Westinghouse
MOTORS (CANADA) INC.

Date: October 19, 2015

Technical Data Sheet

Motor Type: AEHH8N	Catalogue No: PDH02545

Nameplate Information

HP	Pole	RPM	Frame	Voltage	Hz	Phase
25	4	1765	284T	575	60	3
Enclosure	Ins. Class	Service Factor	Time Rating	NEMA Design	Rated Amb.	Rated Altitude
TEFC	F	1.15	Continuous	C	-40 to 40 °C	<3300 ft

Typical Performance

Efficiency (%)				Power Factor (%)		
Full Load		3/4 Load	1/2 Load	Full Load	3/4 Load	1/2 Load
Nom.	Min.					
93.6	92.4	93.6	93.6	86.0	83.0	77.0

Torque				Current (A)		
Full Load (lb-ft)	Locked Rotor (% FLT)	Pull Up (% FLT)	Break Down (% FLT)	No Load	Full Load	Locked Rotor
74.37	205	165	240	5.7	23.3	146

NEMA KVA Code	Inertia (WR^2)			Safe Stall Time (s)		Noise Level Sound Press. dB(A)
	Rotor ($lb\text{-}ft^2$)	NEMA Load ($lb\text{-}ft^2$)	Max. Allowable ($lb\text{-}ft^2$)	Cold	Hot	
G	4.586	122.0	255.0	28	20	68

VFD Duty Information

Speed Range			VFD		S.F.
Constant Torque	Variable Torque	Constant Power	Carrier	Type	
6-60Hz	3-60Hz	60-120Hz	≤ 5 kHz	VPWM or CPWM	1.0 Only

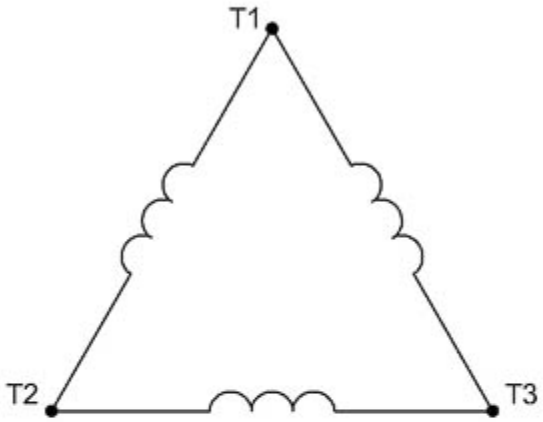
Additional Information

Bearings		Approx. Weight
DE	NDE	lbs
6311ZZ	6310ZZ	464

Hazardous Locations Information

CSA Certified	
Class I, Div 2, Groups B, C & D Class I, Zone 2, Groups IIB+H2, IIB & IIA	
Temp Code (Sinewave / VFD)	T3C / T3B

Connection Diagram



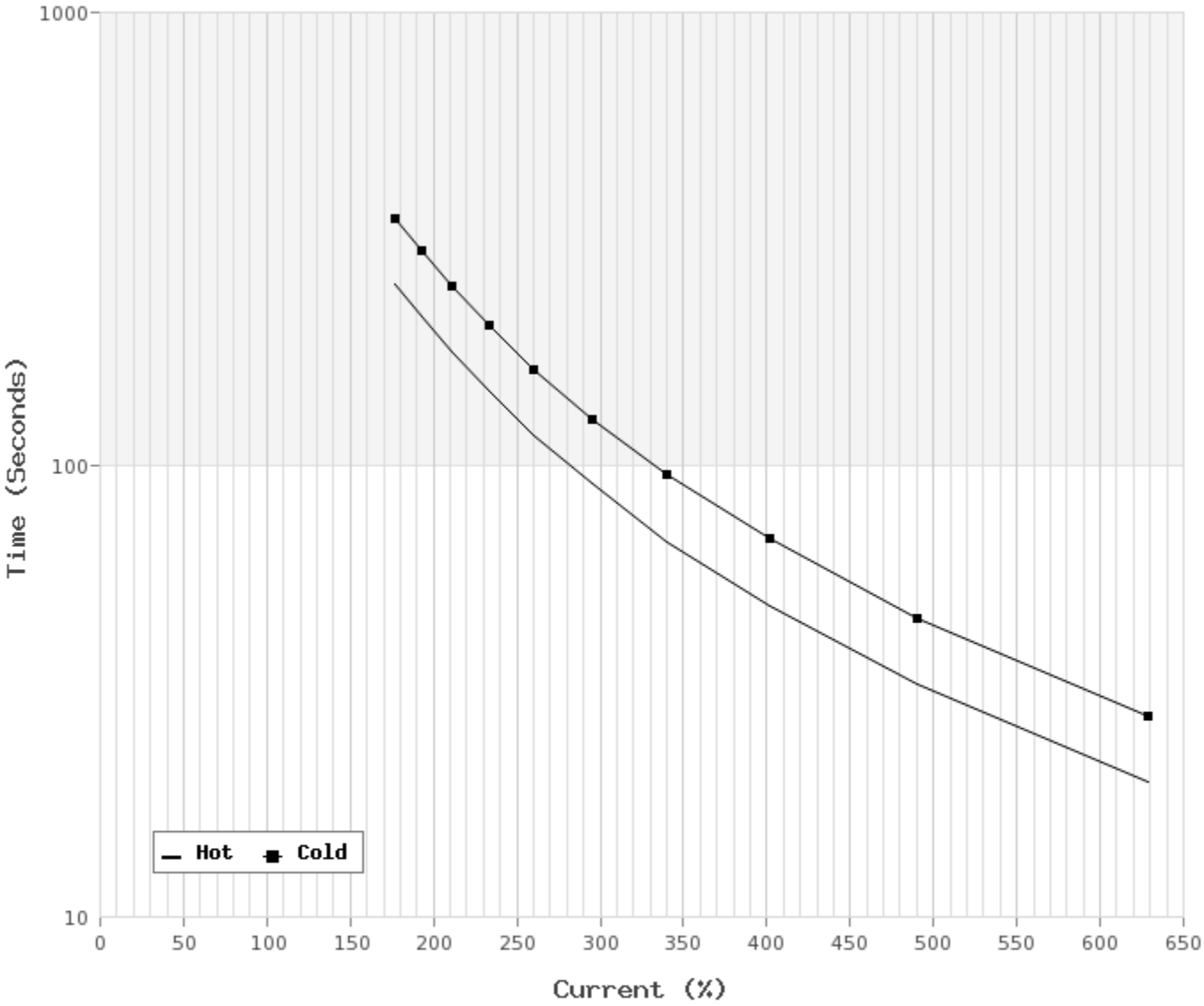
3 LEAD SINGLE VOLTAGE DELTA					
VOLTAGE	CONN.	L1	L2	L3	
-	DELTA	1	2	3	

WD_3D

TECO Westinghouse MOTORS (CANADA) INC.	
	Date: October 19, 2015

Thermal Limit Curves

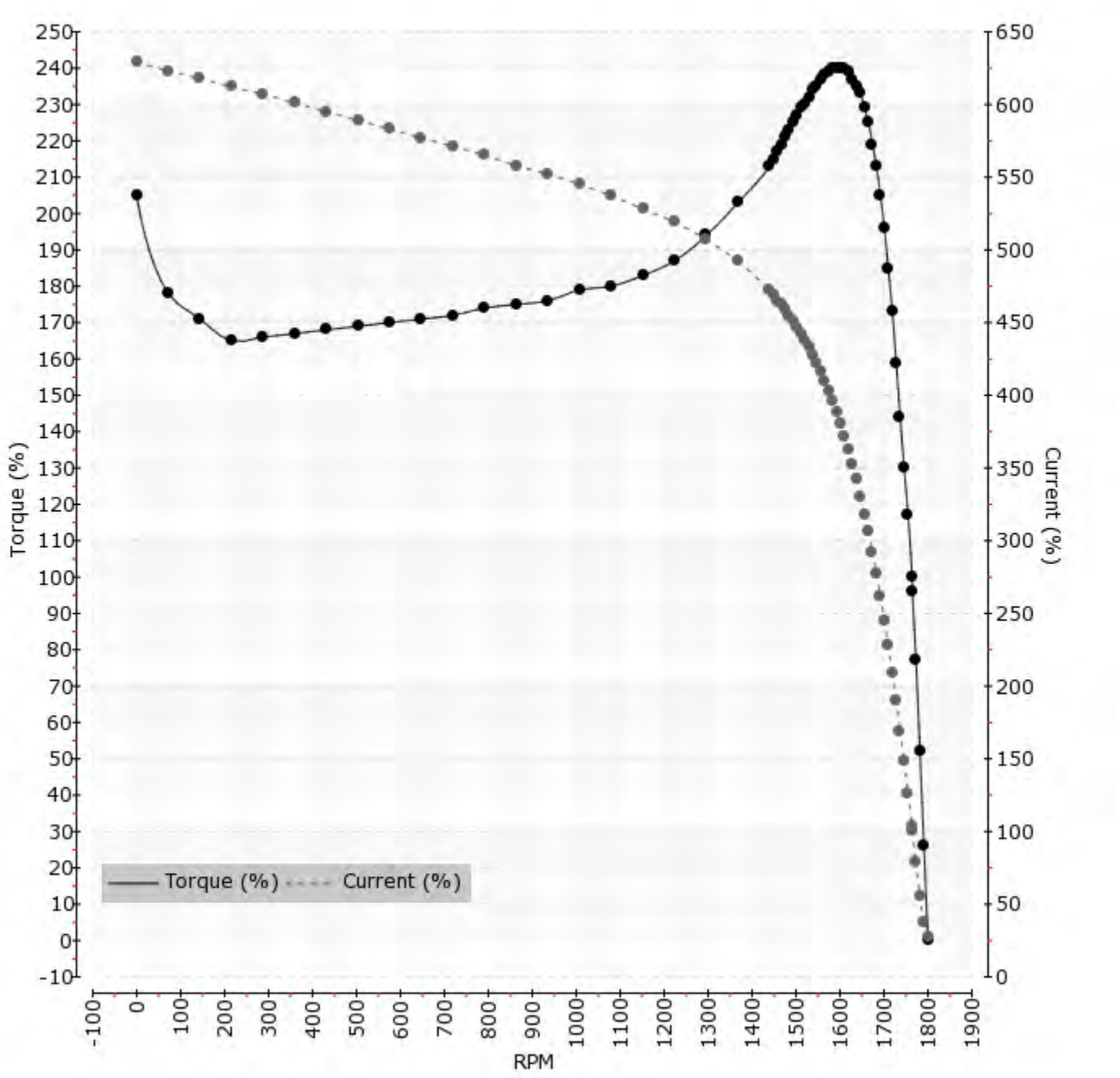
Motor Type: AEHH8N		Catalogue No: PDH02545		Family: Optim TEFC	
HP	25	Safe Stall Time		Full Load A	0.0 / 23.3 A
Voltage	0 / 575V 60Hz	Hot	20 s	Locked Rotor A	628 %
RPM	1800	Cold	28 s	Locked Rotor A	0.0 / 146 A



TECO Westinghouse MOTORS (CANADA) INC.	
	Date: October 19, 2015

T-N and I-N Curves

Motor Type: AEHH8N		Catalogue No: PDH02545		Family: Optim TEFC	
HP	25	Full Load T	74.37 lb-ft	Full Load A	23.3 A
Voltage	575V 60Hz	Locked Rotor T	205 %	Locked Rotor A	146.0 A
RPM	1800	Pull Up T	165 %	Break Down T	240 %



OPERATING INSTRUCTIONS

ROTARY PISTON BLOWER
DELTA BLOWER

Read the instructions prior to performing any task!
Keep for future reference!

G4-006 P EN

Translation of the original operating instructions
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Technical documentation department of Aerzener Maschinenfabrik GmbH
Technische Redaktion und Illustration
Heiko Nickel / Angela Pedack

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1 General Information

1.1 Information about these instructions

These instructions allow for the safe and efficient handling of this machine. These instructions are an integral part of the machine and must be kept in the immediate vicinity of the machine so that it is accessible for personnel at all times. Keep these instructions in a safe place for future reference.

Personnel must read these instructions carefully and have understood them before beginning work. A fundamental requirement for working safely is compliance with all specified safety notes and guidelines in these instructions.

In addition, the local occupational health and general safety regulations apply to the machine's range of applications.

The diagrams in these instructions serve to provide the user with a basic understanding and may deviate somewhat from the actual design.

The following is a list of additional, supplementary documents:

Declaration of Conformity pursuant to the Machinery Directive	CE MRL 1012-1
Installation drawing	
Drive motor instruction manual	
Pressure valve instruction manual	G4-002...
Lube oil safety data sheet: only when using an AERZEN lube oil	SDB...
Further documentation as per the order confirmation	

1.2 Explanation of symbols

Safety instructions

Safety instructions in this manual are illustrated using symbols. The safety instructions are organised into signalling words which designate the level of danger posed.

DANGER!
This combination of symbol and signalling word points to an imminently dangerous situation that could be fatal or lead to serious injury if it is not avoided.

WARNING!
This combination of symbol and signalling word points to a potentially dangerous situation that could be fatal or lead to serious injury if it is not avoided.

CAUTION!
This combination of symbol and signalling word points to a potentially dangerous situation that could lead to minor injuries if it is not avoided.

NOTICE!
This combination of symbol and signalling word points to a potentially dangerous situation that could lead to material damage if it is not avoided.

ENVIRONMENT!
This combination of symbol and signalling word points to a potential risk for the environment.

Safety instructions as part of operating guidelines

Safety instructions may relate to certain individual operating guidelines. These safety instructions are integrated into the operating guidelines themselves so as to simplify the task of reading while carrying out work. The signalling words mentioned above are used.

For example:

1. Loosen screw.
2. **CAUTION!**
   Pinch hazard on the cover!

   Close cover carefully.
3. Tighten screw.

Tips and recommendations

This symbol draws attention to useful tips and recommendations as well as information about efficient and trouble-free operation.

Special safety instructions

To draw attention to exceptional hazards, the following symbols are used as part of the safety instructions:

Warning signs	Type of danger
	Warning – automatic start-up.
	Warning – hand injuries.
	Warning – high-voltage.
	Warning – flammable substances.
	Warning – danger zone.

Additional designations

To draw attention to operating guidelines, events, listings, references and other elements in this manual, the following designations are used:

Designation	Explanation
1., 2., 3. ...	Step-by-step operating guidelines
	References to sections of this manual and to relevant documentation
	Lists without a designated sequence
[push-button]	Control elements (e.g. push-buttons, switches), display elements (e.g. signal lamps)
'Display'	Screen elements (e.g. buttons, allocation of function keys)

1.3 Copyright protection

The contents of this manual is protected by copyright. The use of this manual is permitted within the framework of machine use. Any other use is excluded unless there is written approval by the manufacturer.

1.4 Addresses

1.4.1 Manufacturer

Manufacturer

Address	Aerzener Maschinenfabrik GmbH Reherweg 28 31855 Aerzen Germany
Telephone	+49 (0) 51 54 8 10
Fax	+49 (0) 51 54 8 11 91
E-mail	info@aerzener.de
Internet	www.aerzen.com

1.4.2 Customer service

Our customer service staff are on hand to provide you with technical information:

After sales service/service contact

Address	Aerzener Maschinenfabrik GmbH Reherweg 28 31855 Aerzen Germany
Service hotline	+49 171 3 51 18 34
E-mail	info@aerzener.de
Internet	www.aerzen.com

In addition, we are always interested in receiving information and feedback pertaining to machine use that could be useful in helping us improve our products.

2 Safety

This section gives an overview of all important safety aspects relevant to the protection of persons and to safe and trouble-free operation. Further task-based safety instructions are contained in the section on the individual phases of the machine's service life.

Non-compliance with the handling and safety instructions provided in this manual can lead to serious hazards.

The following section outlines the residual risks and hazards during the service life of the product that may arise as a result of non-compliance with safety instructions or the disabling of safety devices.

In order to reduce health and safety risks and to avoid dangerous situations, observe the safety and warning notes in this manual.

2.1 Residual risks / fundamental risks

The following section states the general residual risks that have been established on the basis of a risk analysis.

- To reduce the risk of personal injury, property damage and environmental contamination and to avoid dangerous situations, observe the safety instructions described here and the safety instructions in the chapters on machine use.

2.1.1 Electrical hazards

Electric current

DANGER!

Risk of fatal injury from electric current!

Coming into contact with live parts poses an immediate and potentially fatal risk of an electric shock. Damage to insulation or individual components can prove fatal.

- Work on the electrical system should only be carried out by qualified electrical personnel.
- If the power supply's insulation is damaged, switch off the machine immediately and have the damage repaired.
- Before starting to work on active parts of the electrical systems and operating equipment, ensure that the machine is completely disconnected from any power source and remains so for the for the duration of the work.

  When doing this observe the following 5 safety rules:
  - Disconnect the machine completely.
  - Secure the machine against restarting.
  - Confirm that the machine is completely disconnected from any power source.
  - Earth and short-circuit the device.
  - Cover or shut off adjacent live parts.
- Never bypass or deactivate fuses.
- When changing fuses, comply with the correct specified amperage.
- Keep moisture away from live parts. Moisture can cause the machine to short-circuit.

Stored charges

DANGER!

There is a risk of fatal injury from stored charges!

Electrical charges can be stored in electronic components and maintained even after the deactivation and separation of the electric power supply. Coming into contact with these components can lead to fatal injuries.

- Observe all applicable safety rules.
- Before performing any work on the listed components, disconnect them completely from the power supply.
- Observe a waiting period of 15 minutes under all circumstances! This will allow the internal capacitors to discharge.
- Measure to ensure there is no live voltage!

Operating faults caused by short-circuiting

WARNING!

Risk of injury from operating faults!

If the electrical system short circuits this can render the entire system inoperable. Operating faults can lead to serious injuries.

– Connect the machine's earthing connections and acoustic hood to the local equipotential bonding rail.
– Install a fault-current circuit breaker in order to prevent sparks and contact voltage in the event of a fault.
– After all work on the machine has been carried out, ensure that the earthing connection and equipotential bonding are connected correctly.

2.1.2 Hazards associated with the acoustic hood

Inside the acoustic hood

DANGER!

Risk of injury if the acoustic hood is open during operation!

By opening the acoustic hood while the machine is in operation there is a risk of direct contact with hazardous zones, e.g. hot surfaces or rotating or moving components.

– Never open the acoustic hood while the machine is in operation or in stand-by mode.
– Never stand on or reach into the acoustic hood while the machine is in operation.
– Always lock the acoustic hood with the key provided and keep it locked.
– Only allow authorised personnel access to the key.

Falling parts

CAUTION!

Risk of injury from unsecured parts of the acoustic hood!

Unsecured parts of the acoustic hood can lead to injuries if they fall from the machine.

– Secure loose elements against falling.
– Always wear protective gear.
– Have a second person help you.

Air flow at the air outlet

CAUTION!

Risk of injury from the strong air flow at the air outlet of the acoustic hood!

Strong air flows at the air outlet on the acoustic hood can suck in dirt particles from the environment and disperse them.

– Avoid standing in the direct vicinity of the air flow.
– Wear safety goggles and a safety mask.

Noise

WARNING!

Risk of injury from noise!

The noise level present at the installation area can cause hearing damage. The magnitude of the noise level is dependent on operational data, among other factors.

– Never undertake measures to bypass or deactivate sound insulation.
– Wear hearing protection while working.
– Only stand in the high-noise-level area if it is absolutely necessary.

Risk of falling

CAUTION!

Risk of injury from standing on the acoustic hood!

Standing on the acoustic hood carries with it a risk of injury from the potential collapse of the roof elements. Persons could fall into the internal area of the machine.

– Never stand on the acoustic hood.
– Never exert pressure on roof elements.

Spark-generating work

WARNING!

Risk of fire and injury / damage to property from spark-generating work in the immediate vicinity of the machine!

Welding or cutting work on the machine or in the immediate vicinity of the machine can cause fire to break out. This can result in damage to property or personal injury.

Sparks and incandescent or flammable objects could be sucked in through the air openings on the acoustic hood or through the intake silencer. The ventilator can fan flames leading to the formation of smouldering objects. The insulation material may, under unfavourable conditions, begin to smoulder.

– Avoid allowing sparks to fly in the direction of the machine.
– Never carry out work that generates sparks while the machine is in operation.

Risk of fire and injury

WARNING!

Risk of fire from easily-flammable materials that are sucked into the machine!

Easily-flammable material, fluids or gases can be sucked into the machine and cause it to catch fire. This can lead to serious or fatal injuries.

– Never allow flammable materials to be sucked into the machine.
– In case of emergencies, have extinguishing agents (fire blanket, fire extinguisher, fire-extinguishing powder for fire class A, B, C) at hand.
– Immediately report suspicious materials, liquids or gases to the responsible persons.
– In case of fire, stop your work immediately and make an emergency call.

Use of non-original belts

WARNING!

Risk of fire and injury from using non-original belts!

If, for a number of possible reasons, the machine is running sluggishly or is blocked, the belts may slip if non-original belts are being used. This results in heat generation which may lead to a fire.

– Only use original belts from the machine manufacturer.
– Adhere strictly to the designated belt type, as only this type will have the required characteristics.
– Never select and use random belts.
– Activate motor overload protection and observe the setting values.

2.1.3 Risks of machines with belt guard

Lärm

WARNING!

Risk of injury from noise!

The noise level present at the installation area can cause severe hearing damage. The magnitude of the noise level is dependent on operational data, among other factors.

– Never undertake measures to bypass or deactivate sound insulation.
– Wear hearing protection while working.
– Only stand in the high-noise-level area if it is absolutely necessary.

Spark-generating work

WARNING!

Risk of fire and injury / damage to property from spark-generating work in the immediate vicinity of the machine!

Welding or cutting work on the machine or in the immediate vicinity of the machine can cause fire.

Sparks and incandescent or flammable objects could be sucked in through the intake silencer. The air flow can fan flames leading to the formation of smouldering objects. The insulation material may, under unfavourable conditions, begin to smoulder.

– Avoid allowing sparks to fly in the direction of the machine.
– Never carry out work that generates sparks while the machine is in operation.

Risk of fire and injury

WARNING!

Risk of fire from easily-flammable materials that are sucked into the machine!

Easily-flammable material, fluids or gases can be sucked into the machine and cause it to catch fire. This can lead to serious or fatal injuries.

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- Only use original belts from the machine manufacturer.
- Adhere strictly to the designated belt type, as only this type will have the required characteristics.
- Never select and use random belts.
- Activate motor overload protection and observe the setting values.

2.1.4 Hazards at the installation and operating areas

Securing the machine against restarting

DANGER!

An unauthorised or unregulated restart can have fatal consequences.

An unauthorised or unregulated restart of the machine can lead to serious or fatal injuries. There may be people located in the hazard zone. Activating the energy supply and starting the machine could result in those people being fatally injured.

- Prevent the machine from restarting by:
  - disconnecting the electrical power supply.
  - activating the EMERGENCY STOP function
  - operating the main circuit breaker
  - attaching a padlock to the main circuit breaker
  - checking and ensuring that the machine is completely disconnected from the power source
  - displaying a sign on the machine that prohibits a machine start
  - displaying a sign on the remote station that prohibits a machine start
- Before restarting, ensure that safety devices are installed and functioning correctly and that there are no potential hazards to the safety of any persons.

Water contact with live components

DANGER!

Risk of fatal injury from water contact with live components!

Risk of fatal injury from cleaning operations using water. Water may be brought into contact with live components through inattention. Water spray may enter electrical and electronic components.

- Do not use water.
- When performing cleaning operations, proceed with care and make sure that no water comes into contact with live components.
- Water spray must not enter electrical and electronic components.
- Respective areas must under no circumstances be cleaned using a high-pressure jet.

Unexpected machine start

WARNING!

Risk of injury or personal shock if the machine starts suddenly!

For example, an upstream control command could be sent to the machine so that it starts operating!

- Deactivate the machine for all work and secure it against restarting.
- Be prepared for a machine start to occur at any time. Be prepared to react calmly to surprises.

Sharp edges and corners

CAUTION!

Risk of injury from sharp edges and corners!

Sharp edges and corners can cause excoriations and cuts on the skin.

- If working in the vicinity of sharp edges and corners, proceed with caution.
- If in doubt, wear protective gloves.

Intake components

WARNING!

Risk of injury from intake components!

Intake-side silencers, at their inlets, suck in ambient air with great force.

- During operation, never place body parts or objects in front of the inlet of the silencer.
- Maintain a safe distance from intake components.

Sudden gas emission

CAUTION!

Risk of injury from the sudden gas emission!

Components such as intake pressure valves and start-up relief devices may open suddenly during operation and emit hot compressed gas. Dust particles may be blown around.

- Never attempt to look inside the blow-off opening.
- Wear safety goggles when in the immediate vicinity of these components.
- Never close the blow-off opening.
- Always keep the blow-off opening clean.

Vibrations

WARNING!

Risk of injury from vibrations!

Vibrations may, in the long term, lead to injuries and chronic damage to personal health. The vibration source is decoupled from the surrounding environment by means of a vibration damper.

- Do not deactivate the vibration damper.
- Avoid coming into contact with vibrating areas.

Build-up of fluids

CAUTION!

Risk of injury from slipping as a result of a build-up of fluids!

Slipping on fluids that have built up on the floor area may lead to a fall. A fall may result in injury.

– Immediately remove built-up fluids with a suitable medium.
– Wear non-slip safety shoes.
– Place a warning notice and mandatory sign on or in the vicinity of any area where there could be a build-up of fluids on the floor area.

2.1.5 Mechanical hazards

Rotating components

WARNING!

Risk of injury from rotating components!

Rotating components may cause serious injury.

– During operation never reach into or perform work on rotating components.
– Never open covers during operation.
– Observe the lag time: before opening covers, make sure that no components are still moving.
– When in a hazard area, wear tight-fitting protective work clothing with minimal tensile strength.

Risk of crushing and shearing injuries

WARNING!

Risk of crushing and shearing injury from the hinged motor support!

Risk of injury from moving or adjusting the hinged motor support!

– When transporting the machine, always have the hinged motor support fixed in place.
– Never step or reach into the swivelling range of the hinged motor support.

2.1.6 Thermal hazards

Hot surfaces

WARNING!

Risk of injury from hot surfaces!

Component surfaces may become very hot during operation. Skin contact with hot surfaces causes serious burns.

- For all work performed in the vicinity of hot surfaces, always wear protective work clothing and protective gloves.
- Before beginning any work, ensure that all surfaces have cooled down to the environment temperature.

Hot media

WARNING!

There is a risk of injury from the sudden emission of hot media from the valve, e.g. a pressure valve!

The emission of hot media may lead to scalding.

- Never stand in the immediate vicinity of the outlet vent.
- Never attempt to look inside the outlet vent.
- Never close or cover the outlet vent.

2.1.7 Risks from pressurised components

Pressurised components

WARNING!

Risk of injury from compressed conveyed materials!

When disassembling pressurised components, or in the case of a fault in a pressurised component such as pipes, containers, hoses or valves, hot conveying material can escape with a strong gas flow. This can result in serious injury.

- Before beginning work, fully relieve pressurised components of pressure.
- Check that components are not pressurised.
- Replace malfunctioning components immediately.
- Only disassemble pressurised components when they are not under pressure.

Noise during disassembly

CAUTION!

Risk of injury from noise during the disassembly of pressurised gas pipes!

For the disassembly of pressurised components, such as pipes, containers, hoses or valves, hot conveying material is released, resulting in noise. This can cause hearing damage.

– Before beginning work, fully relieve pressurised components of pressure.
– Check that components are not pressurised.
– Only disassemble pressurised components when they are not under pressure.

2.1.8 Risks from hazardous substances

Hazardous substances

WARNING!

Risk of poisoning from hazardous substances! Risk of skin irritation and allergic reactions!

Substances such as lubricants and cleaning agents contain hazardous ingredients. These may lead to serious poisoning, skin irritation or allergic reactions.

– Observe the safety data sheets.
– Avoid shaking these substances and avoid fog formation.
– If inhalation occurs, bring the affected person out into the fresh air immediately. Seek medical help.
– If a substance is swallowed, seek medical help immediately. The mouth must be rinsed out thoroughly with water.
– Avoid skin and eye contact:
  Before working with these substances apply suitable hand protection cream.
  Wear plastic or rubber protective gloves.
– Remove contamination of the workspace correctly and in an environmentally friendly way. Lubricants and cleaning agents must not enter the sewerage system or run into soil.
– When working with these substances do not eat, drink or smoke.

Hazardous dust

WARNING!

Risk of injury from rising dust!

Dust deposits may rise during machine operation.

Inhaling this dust may, in the long term, lead to lung damage or other health problems.

– Avoid the relevant hazardous area.
– For all work in the hazard zone wear light respiratory protection.

2.1.9 Risks from flammable substances

Fire hazard

WARNING!

Risk of fire from spark-generating work and ignition sources in the immediate vicinity of the machine!

Easily-flammable substances, fluids or gases may catch fire and cause serious or fatal injury.

– Take measures to protect against the build-up of steam in deep-lying or closed areas.
– Take measures to protect against electro-static pressure charging.
– Do not smoke in the hazard zone or in the direct vicinity of the machine.
  Do not use naked lights, fire or ignition sources of any kind.
– Immediately report suspicious materials, liquids or gases to the responsible persons.
– Have extinguishing agents (fire-extinguishing powder) for fire class A, B, and C at hand.
– In case of fire, stop your work immediately. Leave the hazard zone until it is safe to return and notify the fire brigade.

Improper fire protection

WARNING!

There is a risk of injury and material damage from limited or improper fire protection!

If, in case of fire, the fire extinguisher is not operational or not suited to the specific class of fire, there is a risk of serious or fatal injury and considerable material damage.

- Ensure that only suitable fire extinguishers (fire-extinguishing powder for fire class A, B, and C) are at hand.
- Inspect fire extinguishers every two years to ensure they are functioning correctly.
- Refill a fire extinguisher after each use.
- Only use extinguishing agents and replacement parts that correspond to the specified, recognised model on the fire extinguisher.
- In case of use, observe the safety and operating instructions on the fire extinguisher.

2.1.10 Risks associated with conveyance of nitrogen

Leaking gas

DANGER!

Risk of suffocation from build-up of leaking gases during nitrogen conveyance!

Gaseous nitrogen displaces the oxygen in the room. High concentrations can cause persons to suffocate. Symptoms here include the loss of physical mobility and loss of consciousness. The person affected do not notice that they are “suffocating”. Escaped nitrogen can accumulate in recesses, wells, acoustic hoods etc.

- Avoid the occurrence of leaks.
- Ventilate the installation site properly.
- Set the lag time for the fan of the acoustic hood and pay close attention to it.
- After a machine downtime, ventilate the machine for a period.
- Guide leaking gases directly out of the machine.
- Guide leaking gases directly into a collective line.

Leaking gases during machine downtime

DANGER!

Risk of suffocation from build-up of leaking gases during machine downtime!

Depending on the type of sealing used, gaseous nitrogen can escape into the environment during machine downtime. This can lead to a build-up of gases inside the acoustic hood or at the installation site. High concentrations can cause persons to suffocate.

– Interrupt the flow of nitrogen into the conveying system.
– Guide nitrogen away using a collective line.
– Ventilate the installation site properly.

Build-up of gas

DANGER!

Risk of suffocation from build-up of nitrogen during conveyance!

The opening of the valve releases nitrogen from the system. There may be a build-up of gas with high concentrations of nitrogen.

Gaseous nitrogen displaces the oxygen in the room. High concentrations of nitrogen can cause persons to suffocate. Symptoms here include the loss of physical mobility and loss of consciousness. The persons affected do not notice that they are “suffocating”.

Escaped nitrogen can accumulate in recesses, wells, acoustic hoods etc.

– Avoid a build-up of gas
– Guide gases directly out of the machine.
– Guide gases directly into a collective line.
– Ventilate the installation site properly.

2.2 Intended use

Fig. 1: Correct use

The **positive displacement blower** machine is intended for conveying and compressing air and non-flammable gases.

The **positive displacement blower** machine is intended for operation with non-flammable gases in a non-explosive atmosphere.

The **positive displacement blower** machine has been designed and constructed solely for its “intended use” in the industrial field, as described here.

Observe and comply with the job-based operating data and operational limits!

This intended use also includes compliance with all information in this instruction manual.

Any application that deviates from the intended use, or any other type of non-standard application, is considered misuse.

Operating data that deviate from the standard must be coordinated with the manufacturer.

2.3 Foreseeable misuse

Serious injury

DANGER!

Danger in case of misuse! Dangerous situations could occur that may lead to fatal or serious injury!

- Never disregard the instructions for “intended use”.
- Never operate the machine in an operating area other than the one intended.
- Never convey or compress gases that are not listed in the order confirmation and the technical data.
- Never disregard the following information on misuse.

Serious material damage

NOTICE!

Danger in case of misuse! Dangerous situations could occur that may lead to serious machine damage!

- Never disregard the instructions for “intended use”.
- Never operate the machine in an operating area other than the one intended.
- Never convey or compress gases that are not listed in the order confirmation and the technical data.
- Never disregard the following information on misuse.

Misuse

Fig. 2: Prohibited use

The machine is not intended for:

- Conveying media in solid, liquid or powder form.
- Conveying caustic media.
- Conveying corrosive media.
- Conveying flammable or poisonous gases, vapours or mists.
- Alteration, retrofitting or modification of the overall design or of individual equipment parts, with the aim of altering the field of application or scope of use.

Further examples of misuse

The following operating modes/applications and uses are considered improper and must be avoided!

- **Operation:**
  - outside the scope of intended use.
  - outside the scope of the intended operating data.
  - using gases other than those originally intended.
  - with the machine operating in the incorrect direction of rotation.
  - in a potentially-explosive atmosphere.
  - with closed flange connections.
  - with missing or damaged components.
  - without a correctly connected control system, fault transmitter, EMERGENCY STOP function.
  - without any or with damaged protective equipment.
  - with contaminated intake filter/starting strainer.
  - without sufficient ventilation of the room.
  - activation while the machine is coming to a stop or when it is rotating backwards.
  - pole changing to a lower rotational speed before the drive motor has come to a standstill.
  - non-compliance with maintenance intervals.
  - filling beyond the maximum oil level.
- **Operation without:**
  - air filter
  - pressure valve
  - intake silencer
  - oil
- **Applications:**
  - using the machine to “purge” blockages in the conveying pipes. exceeding the maximum permissible discharge pressure.
  - using the pressure valve to regulate the operating data.

- **Installation:**
  - installation on inclined, sloped or lamellar surfaces.
  - installation outdoors without due consideration of particular protective measures for avoiding the effects of weather conditions.
  - attachment of transportation equipment to the acoustic hood.
  - open flames or spark formation in the immediate vicinity of the machine.

2.4 Responsibility of the operator

Operator

The operator is the person who operates the machine himself, for commercial or business purposes, or who assigns the use/application of the machine to a third party. During operation, the operator holds legal responsibility pertaining to the product, for the protection of the user, personnel or third party.

Operator's obligations

The machine is used for commercial purposes. The operator of the machine is thus subject to the applicable legal obligations for occupational safety.

Alongside the safety instructions in this instruction manual, the safety, occupational and environmental regulations relevant to the field of application must also be complied with.

The operator is obligated to:

- Inform himself about the applicable occupational protection regulations. As part of a hazard assessment, the operator must also establish the hazards that could result from special working conditions at the machine location. He must implement these for the operation of the machine in the form of operating instructions. The necessary safety data sheets can be obtained from the relevant manufacturer.
- During the entire service life of the machine, check that the operating instructions created by the manufacturer correspond to the current status of the applicable regulations. If necessary, adjust the operating instructions accordingly.
- Clearly structure and specify the responsibilities for installation, operation, fault rectification, maintenance and cleaning.
- Ensure that all persons who come into contact with the machine have read and understood these instructions. in addition, the operator must regularly provide personnel training as pertains to machine use and inform personnel of the related hazards.
- Provide personnel with the necessary protective equipment and communicate to personnel that the wearing of this protective equipment is compulsory.

In addition, the operator is responsible for ensuring that the machine is in perfect technical condition.

For this reason the following applies:

- The maintenance intervals described in this instruction manual must be complied with.
- All safety devices must be regularly inspected to ensure they are in good working order.

Additional obligations

The operator must ensure that the following requirements are complied with and put into practice:

- The machine is only operated in its original delivered condition. In cases where the operator adds his own fittings or makes modifications, the manufacturer's declaration of conformity is rendered void.
- Any working behaviour that jeopardises the safety of the machine is prohibited.
- The machine must always be kept in a technically-perfect and operationally-safe condition. Replace damaged or non-operational components immediately. If in doubt, be sure to contact the manufacturer or the responsible contact person.
- Do not operate the machine when the protective equipment has been disassembled or disabled.
- Observe all warnings and notices displayed on the machine and make sure they are readable. You must replace loose or illegible signs. Ask the manufacturer for replacements.
- Install the separately provided components listed in the scope of delivery onto the machine and incorporate these into the overall safety concept.
- Do not disassemble or incorrectly fit any electrical, mechanical or hydraulic connections.
- For protection against potential damage caused by lightning, make sure a suitable earthing system is in place.
- If the conveyed medium tends to form condensate, the condensate must be bled off (e.g. using discharge tanks, residual gas pipes or by briefly opening the lower condensation holes).
- Separate dusty material before it enters the machine. Material that collects in the conveying chamber or the rotors presents a particular danger for the working safety of the machine.

Operator's obligations at the installation site

The operator must ensure that the following requirements are complied with and put into practice:

- Machine use only in a stable three-phase power supply. Voltage fluctuations / drops beyond the tolerance level may cause serious damage to the drive system.
- Activate motor overload protection.

- For system variants without a main circuit breaker featuring an EMERGENCY STOP function, the safety circuit of the machine should be incorporated into the EMERGENCY STOP concept for the overall system. Ensure the accessibility of additional EMERGENCY STOP switches in the vicinity of the machine.
  The machine must be equipped with one or more EMERGENCY STOP command devices for the purposes of operation.
  The EMERGENCY STOP function must be available and operational at all times, independent of the operating mode.
- It must not be possible for a powered-down machine to start automatically.
- For the purposes of operation, the machine must be equipped with a command device that shuts down the machine in dangerous situations.
  The power supply to the motor must be cut off.
  If this is not possible, the “standstill” operating condition must be monitored and maintained.
- Avoid electrostatic charges. Connect an equipotential bonding.
- For accidents and emergencies, incorporate emergency measures for the machine into the overall emergency measures. Make particular efforts to integrate these measures into the evacuation and rescue plan and the fire warning plan.

2.5 Replacement parts

Use of incorrect replacement parts

CAUTION!

Safety risk from using incorrect replacement parts!

Incorrect, defective or unsuitable replacement parts or copies of original components may endanger personal safety and lead to damage, faults or the total failure of the machine.

– Only use the manufacturer’s original replacement parts or parts approved by the manufacturer.
– If in doubt, always contact the manufacturer.

Purchase replacement parts from an authorized dealer or from the manufacturer directly. For contact information see Customer service *on page 11*.

Replacement parts

Replacement parts that have not been provided by AERZEN have not been tested or approved. They do not correspond to the original components. The use of such products can potentially have an effect on the default design characteristics of the system. The manufacturer assumes no liability for damage resulting from the use of non-original components.

2.6 Requirements for personnel

2.6.1 Qualifications

The various tasks described in this instruction manual represent a variety of requirements in terms of the qualifications of the persons responsible for carrying out these tasks.

Insufficient qualifications

WARNING!

Risk if persons are not sufficiently qualified!

Insufficiently qualified persons are unable to gauge the risks presented by the use the machine and put themselves, and others, at risk of serious or fatal injury.

- Only allow work to carried out by suitably qualified persons.
- Observe the information on qualifications in this manual.
- Keep insufficiently qualified persons away from the operating range of the machine.

For the purposes of all work with this machine, only allow persons who are expected to carry out their work reliably to do so. Persons whose reaction times have been impaired, e.g. through drug or alcohol consumption or medication, must not be permitted to work.

This instruction manual contains the following qualification requirements for the various tasks:

Authorised electricians
Authorised electricians, on the basis of their field-specific training, expertise, experience and knowledge of the relevant standards and requirements, are able to carry out their work on electrical systems safely while independently recognising and avoiding hazards.

Authorised electricians are specially trained for the environment in which they work and are familiar with the relevant standards and requirements.

Authorised electricians with additional qualifications
Authorised electricians have the additional qualifications needed for working in the field of frequency converters and EMC. Authorised electricians are familiar with the relevant standards and requirements.

Written documentation acts as proof of a completed safety instructional course and evidence of the necessary additional knowledge.

Due to their additional qualifications, these authorised electricians are able to carry out work on electrical systems with frequency converters and can independently recognise and avoid possible hazards. The additional skills that constitute this qualification should be taught through regular practical application.

Manufacturer's customer service division
Certain work may only be performed by the customer service division of the manufacturer. On the basis of its special, field-specific training, expertise and experience, the customer service division is up to the task of performing highly-skilled work.

The customer service division is a competent point of contact for all stages of the machine's service life. It is able to perform all work on the machine with the highest efficiency.

Service personnel
Service personnel are able to carry out their work on the basis of their field-specific training, expertise, experience and knowledge of the relevant standards and requirements. Personnel recognise hazards independently and avoid risks.

Service personnel in particular possess practical experience and extensive field-specific expertise for the variety of tasks.

- Transport
- Set-up / installation
- Commissioning
- Maintenance
- Fault rectification
- Disassembly

Depending on the designated job, the person must have additional qualifications:

- Operation and handling of compressors.
- Parameterisation of compressors.
- Optimisation work within the persmissible operating data range.

Skilled staff for industrial waste
Skilled staff for industrial waste posses comprehensive, field-specific expertise relating to the disposal and recycling of industrial waste. Skilled staff transports the industrial waste to the waste disposal company and holds responsibility for proper sorting of waste. The staff incorporates this sorting into the recycling and disposal processes.

Trained persons
A trained person has been expressly instructed and, if necessary, trained on site by the responsible management about the tasks delegated to him or her and the risks that are posed by improper behaviour. A trained person has been instructed regarding the necessary protective equipment and protective measures. He or she is in a position to work cautiously and to recognise hazards and react accordingly. The trained person may not interfere with the handling and operation of the machine.

Depending on the designated job, the person must have the following expertise:

- Transport and handling of packaged units.
- Ability to perform visual inspections of the machine.

User
The machine user is trained by the system operator in terms of operation, maintenance work and basic fault rectification. He or she is informed of possible operational hazards and improper behaviour. Tasks that go beyond those for which the machine user is trained or instructed may only be carried out if these tasks are listed in this instruction manual and the operator has expressly designated these tasks to the user.

2.6.2 Unauthorised personnel

Unauthorised personnel in the installation area

WARNING!

Risk of fatal injury for unauthorised persons in the installation area!

Unauthorised persons who do not fulfil the requirements described here, are not familiar with the hazards in the installation area. Therefore, unauthorised persons are at risk of serious or fatal injury.

- Keep unauthorised persons away from the installation area.
- If in doubt, instruct such persons to leave the installation area.
- Stop all work as long as unauthorised persons are in the installation area.

2.6.3 Training

The operator must regularly provide safety training for personnel. For tracking purposes, a training report must be drafted with the following mandatory content:

- Date of training
- Name of the training participant
- Content of the training
- Name of the training instructor
- Signatures of the participant and instructor

Date	Name	Type of training	Training requirements are:	a signature

2.7 Personal protective equipment

Personal protective equipment serves to protect persons from breaches of safety and health hazards when working.

Personnel, when working near or with the machine, must wear the personal protective equipment described separately in the various sections of this instruction manual.

Description of personal protective equipment

The following is a description of the personal protective equipment:

Hearing protection
Hearing protection serves to protect against hearing damage from noise generation.

Industrial hard hat
Industrial hard hats protect the head against falling or stray objects and loads and from collisions against stationary objects.

Protective gloves
Protective gloves protect hands from friction, abrasion, puncture hazards or more serious injuries and from contact with hot surfaces.

They are oil-resistant and protect hands from coming into contact with lubricants.

Protective work clothing
Protective work clothing is tight-fitting work clothing with minimal tensile strength, tight sleeves and without protruding parts.

Safety goggles
Safety goggles serve to protect the eyes against flying particles and splashing liquids.

Safety shoes
Safety shoes protect feet from being crushed, from falling objects and from slipping on slippery surfaces.

2.8 Safety devices

Correct functioning of safety devices

WARNING!

Risk of fatal injury from non-functioning safety devices!

Non-functioning or deactivated safety devices may cause serious or fatal injury.

– Before beginning work, check that all safety devices are functioning correctly and are correctly installed.
– Never deactivate or bypass safety devices.
– Ensure that all safety devices are accessible at all times.

2.8.1 EMERGENCY STOP function

The EMERGENCY STOP function serves, in cases where there is a hazard or when one is averting a hazard, to bring the machine quickly to a safe stop (standstill).

Depending on the customer's specifications, machine variants are available with or without a power circuit breaker system.

Depending on the model, the machine:

- may not feature a control system
- may not feature an EMERGENCY STOP function

Before operating the machine:

Check whether the EMERGENCY STOP function is in place and installed.

It must function perfectly.

EMERGENCY STOP control device

Fig. 3: Example: EMERGENCY STOP control device

An EMERGENCY STOP control device includes a special command unit which is connected to the control system.

The EMERGENCY STOP function allows for the machine to be shut down safely and immediately in case of a potential or existing hazard.

The power supply to all turning components is interrupted immediately when the EMERGENCY STOP function is activated.

It is also possible to install additional EMERGENCY STOP control devices.

Without a power circuit breaker system

- For this variant, an EMERGENCY STOP control device is not installed on the machine at the factory.
- The machine is delivered without an EMERGENCY STOP apparatus.
- The operator must provide a power circuit breaker system with electrical overload protection, an On/Off command unit and an EMERGENCY STOP function.
- Activate Stop Category 0.
- Detail the performance data of the electrical installation in accordance with the operating data of the motor. Take into consideration the necessary data, for example: voltage, current, frequency.
- The connection to the power supply is made using the installed and delivered power cabinet.
- The lines running to the power supply are fed directly to the electric motor and are connected inside a terminal box.
- Feed the connection lead through the cable conduit to the terminal box.
- Protect the motor against overheating.
- A main circuit breaker must be installed.

With a power circuit breaker system

- Depending on the model, an EMERGENCY STOP control device is installed at the factory in the power circuit breaker system.
  - If the factory-installed power circuit breaker system *does not* feature an EMERGENCY STOP command device, this must be provided by the operator.
    Activate Stop Category 0.
  - If the factory-installed power circuit breaker system *does* feature an EMERGENCY STOP command device, Stop Category 0 is performed.
- A main circuit breaker must be installed if it is not part of the power circuit breaker system.
- The power supply is connected at the power cabinet.
- Observe the wiring diagram!

Notes on installation by the operator

The EMERGENCY STOP facility must:

- be installed and integrated into the safety line of the system controller.
- be clearly recognisable, highly visible and quickly accessible.
- shut down dangerous operation quickly without causing any additional risks.
- if necessary, trigger specific safety measures or authorise the triggering of safety measures.
- be installed in such a way that the machine user can activate it immediately in an emergency.
- be designed in such a way that, in cases where there is an interruption in the power supply or the power supply is activated after an interruption, no situations can occur in which there is a threat of personal injury or material damage.
- supplement other protective measures without acting as a substitute for them.

Requirements for installation by the operator

The EMERGENCY STOP function must be available and operational at all times, independent of the operating mode.

The EMERGENCY STOP facility must not require the entire machine to be voltage-free. In situations where a risk is detected, it must be possible for the user to stop the machine in order to protect against a hazard. For the purposes of a controlled shut-down, electrical voltage may be necessary. The electrical system is still under voltage.

If several EMERGENCY STOP devices are in place, all of these devices must be able to shut down the machine.

The EMERGENCY STOP function must, after being triggered, remain effective until authorisation is given for a restart.

It must not be possible to attempt to block the EMERGENCY STOP device without a “stop” command being issued.

Ensure that it is only be possible to release the EMERGENCY STOP device by means of authorised activation.

This authorisation must not cause the machine to start operating again automatically but rather it should make a machine restart possible.

2.8.2 Hinged support with lifting device

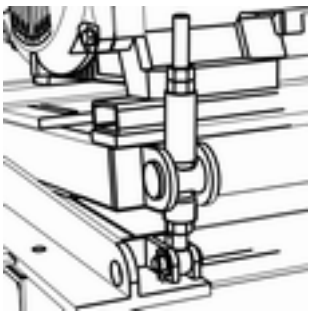


Fig. 4: Hinged support

The hinged support serves to protect against mechanical hazards.

- The hinged support holds the motor hinge in place during transport and assembly. It prevents uncontrolled movement of the motor hinge.
- When operating the machine, the hinged support must be released and positioned accordingly.

2.8.3 Acoustic hood

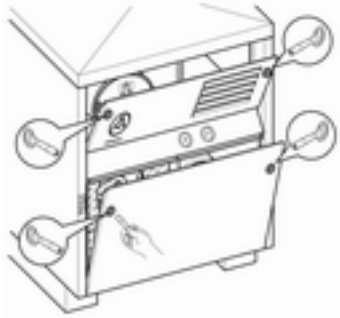


Fig. 5: Acoustic hood, front view (example)

The acoustic hood serves to protect against mechanical and thermal hazards.

- The acoustic hood is an essential safety component of the product.
- The elements of the acoustic hood must be locked with the provided special locks during operation and in stand-by mode.
- Operation with an open acoustic hood is not permissible.
- The locking key for the acoustic hood is a component of the overall safety concept. Access to the key must only be possible for personnel who have been briefed in the safe operation of the machine and the contents of the instruction manual.

Fig. 6: Acoustic hood, rear view (example)

2.8.4 Belt guard

Belt guard

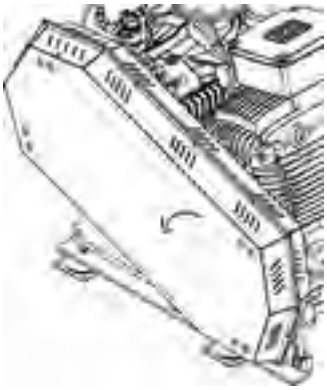


Fig. 7: Belt guard

The belt guard serves to protect against rotating components.

- A belt guard is always used in machines without an acoustic hood. It serves to protect against rotating components.

2.8.5 Cover of the belt pulley

Cover of the belt pulley

Fig. 8: Cover

The cover serves to protect against rotating components.

- The belt guard features two plastic covers.
- These serve to protect the rotating belt pulleys and prevent persons from reaching directly into the belt drive.

2.9 Safety classification

The following symbols and notices are displayed on the machine. They relate to the immediate vicinity in which they are located.

Unreadable signage

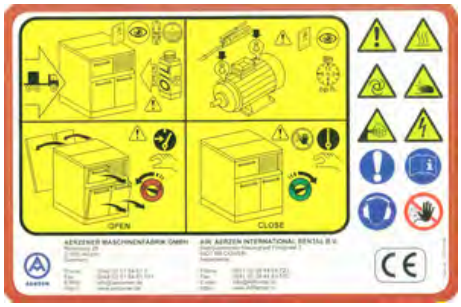
WARNING!

There is a risk from unreadable signage!

There is a risk of injury resulting from dirty or unreadable signs. It may be impossible to recognise hazards and to follow the necessary operating information.

– Keep all safety, warning and operating information in a thoroughly readable condition.
– Replace damaged signs or stickers immediately.

Safety and warning signs

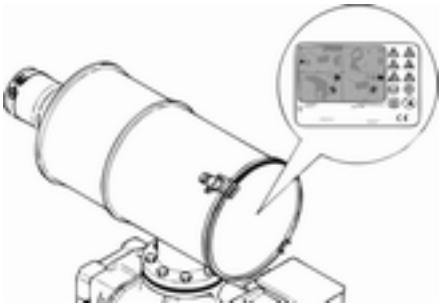


The layout of warning signs involves a set of stickers affixed to the machine. These constitute warning, instruction and prohibition signs. Furthermore, signs relating to lubricants and their handling are only visible when the acoustic hood is closed.

Fig. 9: Layout of warning signs

Placement of the sticker set on the acoustic hood.

Fig. 10: Position on the acoustic hood



Placement of the sticker set on the intake silencer.

Fig. 11: Position on the belt guard model

Warning sign on the AERZEN pressure valve.

Fig. 12: Position on the AERZEN pressure valve

Access for unauthorised persons forbidden

Only persons given authorisation by the operator may enter the hazard area.

Electrical voltage

Only qualified electrical personnel may work in the signposted working area.

Unauthorised persons are not permitted to enter the signposted working area or open the signposted cabinet.

Automatic start-up

The sudden start-up of operational machines in the rest position is possible at any time.

Take heed of the stand-by mode! A sudden start is possible.

Hot surfaces

Hot surfaces, such as hot machine parts, containers or materials - but also hot liquids - are not always noticeable. Do not touch them without protective gloves.

Hand injuries

Keep hands away from areas that carry this warning sign.

There is a risk that hands could be crushed, trapped or injured in some other way.

Gas emission

Risk from sudden gas emission.

The opening of the pressure valve results in the emission of gas and accompanying noise emissions. There is a risk of hearing damage and injuries to eyes or skin.

Pressure in the piping

Pipelines may be placed under pressure.

Before carrying out disassembly work, deactivate the pressure in the pipelines.

Draw-in of gas

Pipelines can suck in large volumes of air in the immediate vicinity of the intake openings.

Avoid the air-intake area. Shut down the machine before undertaking any activities in this area.

2.10 Instruction signs

Wear hearing protection

In areas where this symbol is displayed there is a risk of hearing damage. Therefore, wear hearing protection when in these areas.

Information on wearing hearing protection	
< 80 dBA	Hearing protection is not prescribed as mandatory but should be worn as a matter of personal responsibility.
80 to 85 dBA	Hearing protection is recommended
> 85 dBA	**Hearing protection must be worn**

Observe the instruction manual

Only use the labelled machine once you have read the instruction manual.

2.11 Hazards in the operating and/or display area

Hazard area
Operating and/or display area

The hazard area is located in the marked zone (in the acoustic hood interior zone). The opening of acoustic hood elements and protective covers during operation is not permissible. Opening is permissible only for maintenance work or for troubleshooting and provided all safety precautions are observed. The operating and/or display area is the position marked in green (example).

Fig. 13: Hazard area and operating and/or display area (top-down view)

Hazard area
Operating and/or display area

The hazard area is located in the marked zone. The opening of the protective cover is not permissible. The operating and/or display area is the position marked in green (example).

Fig. 14: Hazard area and operating and/or display area (top-down view)

2.12 Securing the machine against restarting

Sudden restart

DANGER!

An unauthorised or unregulated restart can have fatal consequences.

An unauthorised or unregulated restart of the machine can lead to serious or fatal injuries. There may be people located in the hazard zone. Activating the energy supply and starting the machine could result in those people being fatally injured.

- Prevent the machine from restarting by:
  - disconnecting the electrical power supply.
  - activating the EMERGENCY STOP function
  - operating the main circuit breaker
  - attaching a padlock to the main circuit breaker
  - checking and ensuring that the machine is completely disconnected from the power source
  - displaying a sign on the machine that prohibits a machine start
  - displaying a sign on the remote station that prohibits a machine start
- Before restarting, ensure that safety devices are installed and functioning correctly and that there are no potential hazards to the safety of any persons.

EMERGENCY STOP button (option)

1. Press the EMERGENCY STOP button
   ⇨ The power supply is shut off.
2. Activate the main circuit breaker.
   ⇨ The machine is free of current.
3. Attach a padlock to the main circuit breaker.
4. Ensure that the machine is completely disconnected from the power source.
5. Inform supervisory personnel of work in the hazard area.
6. Place a sign on the machine and (where applicable) remote station that notifies persons of the work being carried out in the hazard area and forbids activation of the machine. The sign must contain the following information:
   - Shut-down on:
   - Shut-down at:
   - Shut-down by:
   - Important: Do not switch on!
   - Important: Only switch on the machine once it has been ensured that there is no risk to personal safety.

EMERGENCY STOP feature (operator-installed)

The particular approach to preventing a restart is dependent on the operator-installed EMERGENCY STOP feature.

1. Secure the machine against restarting in accordance with the operator's instructions.
2. Follow the instructions of the responsible supervisory personnel.
3. Once all work has been completed, ensure that there is no risk to personal safety.
4. Ensure that all safety and protective equipment is installed and operational.

2.13 Environmental protection

Environmentally hazardous materials

ENVIRONMENT!

Improper handling of environmentally hazardous materials presents a threat to the environment!

Incorrect handling of environmentally hazardous materials, particularly in the case of improper disposal, can cause considerable damage to the environment.

– Always observe the information below on the handling of environmentally hazardous materials and their disposal.
– If environmentally hazardous materials are inadvertently released into the environment, take appropriate action immediately. If in doubt, inform the responsible local authority about the damage and seek advice on taking appropriate measures.

The following environmentally hazardous materials are used:

Lubricants

Lubricants such as greases and oils contain poisonous substances. They must not be released into the environment. Disposal must be carried out by a certified waste management company.

AERtronic batteries

Batteries contain poisonous heavy metals. They require special waste treatment and must be deposited at local collection points or disposed of by specialist companies.

Insulation fibres

The insulation fibres in insulation material and insulation mats are carcinogenic. Disposal of insulation fibres must be carried out by a certified waste management operator.

Electronics

Electrical and electronic components may contain poisonous material. These components must be collected separately and deposited at local collection points or disposed of by specialist companies.

Anti-corrosion agents

Anti-corrosion agents may contain poisonous substances. They must not be released into the environment. Disposal must be carried out by a certified waste management company.

3 Design and operation

3.1 Overview of assemblies

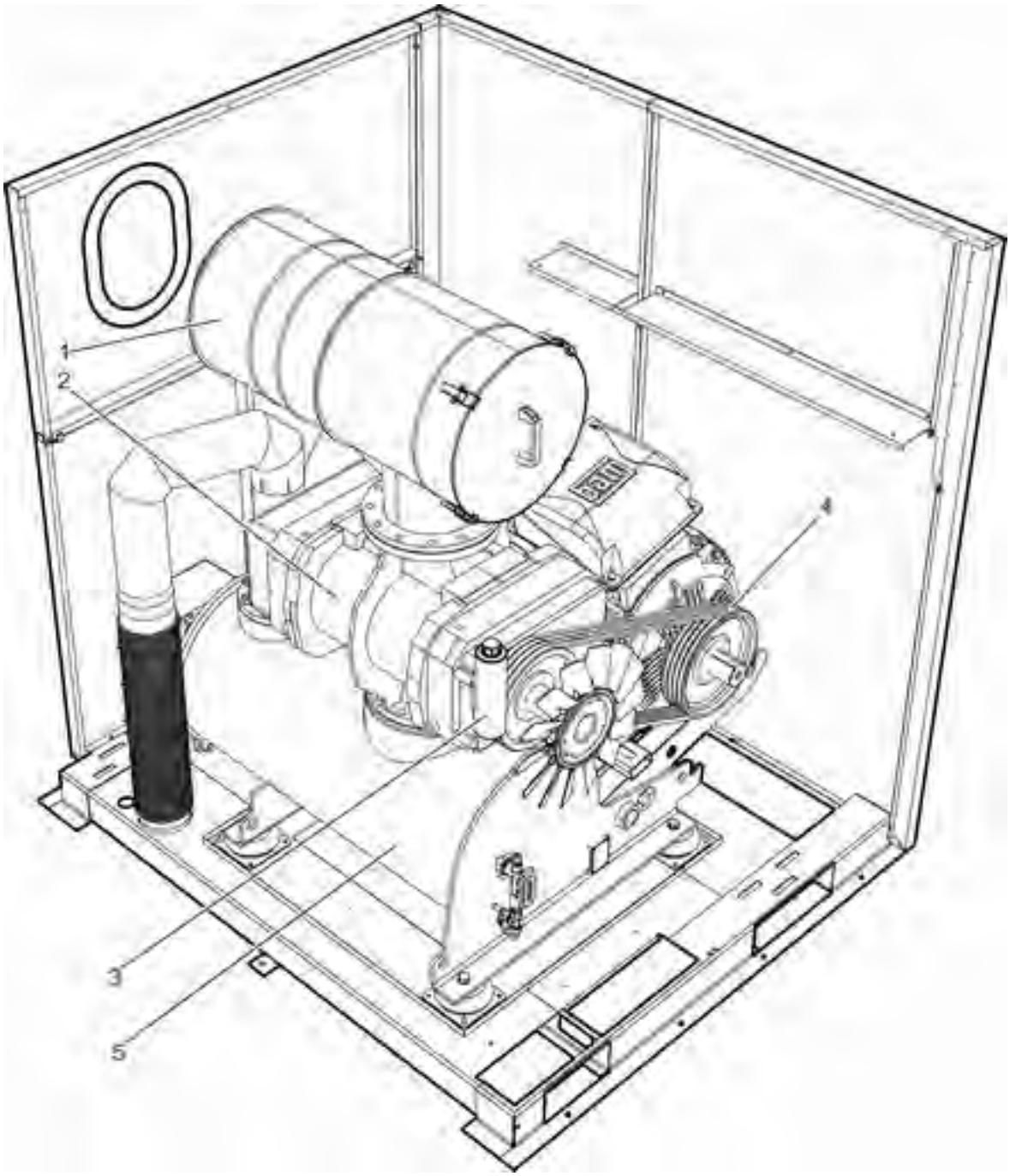


Fig. 15: Overview

1 Intake side
2 Machine stage
3 Oil system
4 Drive system
5 Discharge side

3.2 Overview of assemblies

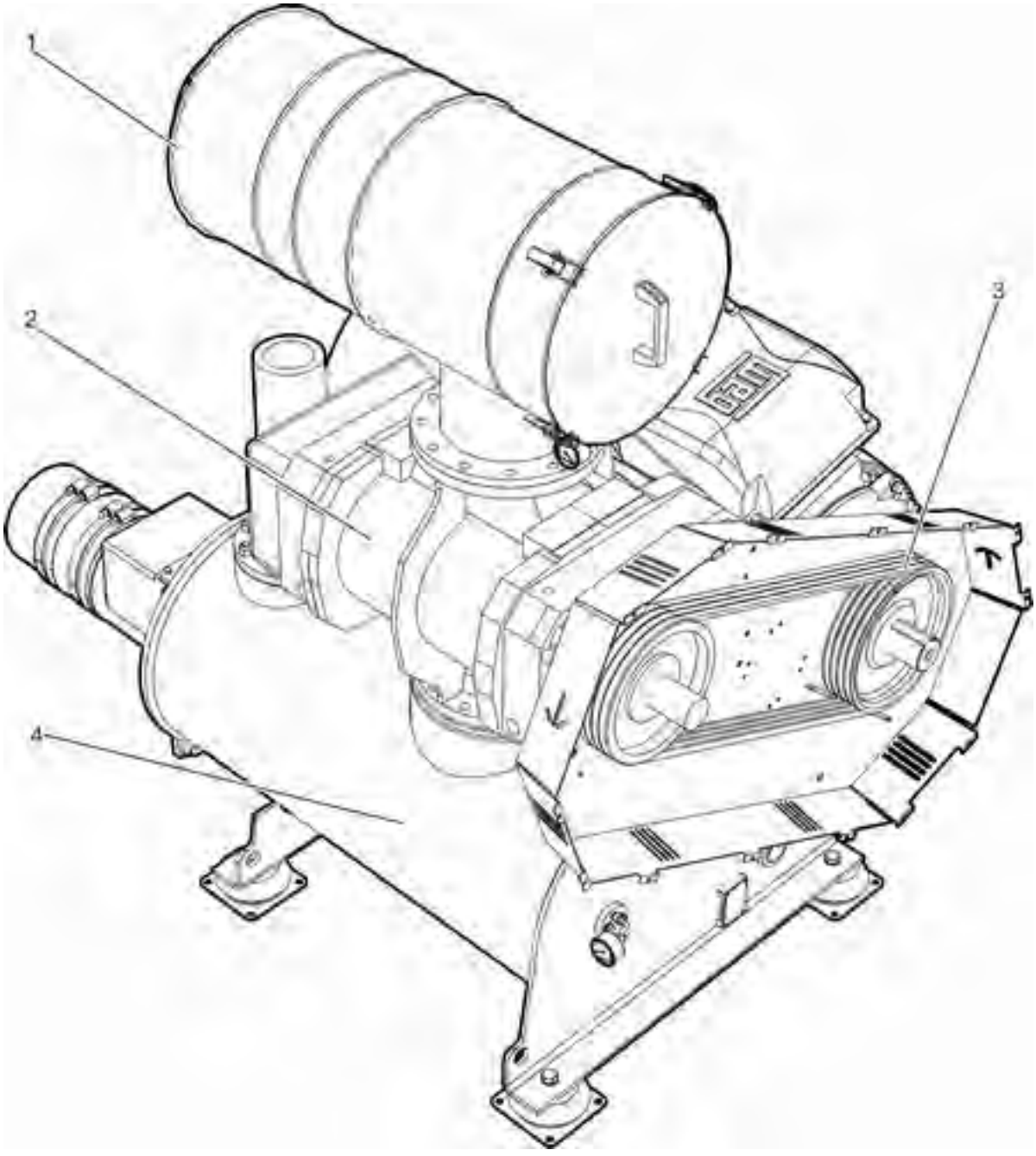


Fig. 16: Overview

1 Intake side
2 Machine stage
3 Drive system
4 Discharge side

3.3 Operating principle

The medium to be conveyed is connected using an elastic rubber sleeve or the compensator of the discharge-side connecting casing.

The medium to be conveyed enters through the intake silencer. This offers the possibility of a intake-side pipe connection. There is a replaceable filter element located inside the intake silencer. Dirt levels in the filter element can be displayed using a service indicator or the control system display.

The positive displacement blower conveys and compresses the medium to be conveyed. The medium then flows through the discharge silencer, via a non-return flap, into the customer's system. The positive displacement blower is powered by a drive motor using a belt drive. The belt drive derives tension automatically from the weight of the motor. The drive motor is powered by connecting its power lines in the terminal box.

A pressure valve is installed on the base support or on the connection housing. The working pressure can be displayed by a pressure gauge or in the control system screen.

The acoustic hood is ventilated by a fan. This is installed at the shaft end of the machine stage.

3.4 Operating modes

On-site operation

Operation of the machine is carried out directly on site.

Remote operation

Operation of the machine is carried out via control station.

Automatic operation

Automatic operation of the machine is carried out by sensors or a system switch.

Load operation

Load operation is the operating mode in which the machine processes the specified operating data.

3.5 Operating methods

3.5.1 Operating information for pneumatic conveyance

Pneumatic conveyance

When the machine is being used for the purposes of pneumatic conveyance, pressure surges must not occur when switching between different delivery lines.

Pressure surges can be prevented by making the switching process for the intake-side and discharge-side valves take at least five seconds. This pre-accelerates the gas column in the pipework. The gas can no longer accelerate suddenly. This prevents damage to the machine.

The distance between the switchover valve and the intake-side flange must be at least 10 x DN. DN = nominal diameter of the pipework.

This safety note applies to both pressure and vacuum mode.

3.5.2 Operating information for air-separation systems

Operating information for air-separation systems

When the machine is being used in air-separation systems with alternating air-separation columns, pressure surges must not occur when switching between different delivery lines.

Pressure surges can be prevented by making the switching process for the intake-side and discharge-side valves take at least five seconds. This pre-accelerates the gas column in the pipework. The gas can no longer accelerate suddenly. This prevents damage to the machine.

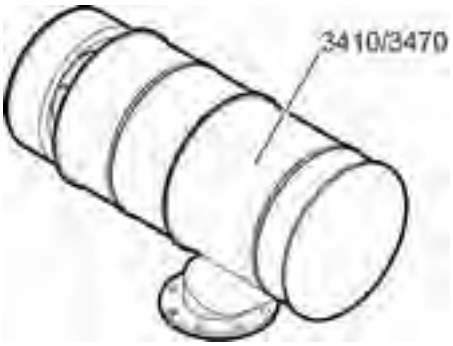
The distance between the switchover valve and the intake-side flange must be at least 10 x DN. DN = nominal diameter of the pipework.

This safety note applies to both positive pressure and vacuum pressure mode.

3.5.3 Description of assemblies

For the purposes of explaining its functionality, the machine is divided into several assemblies. Each assembly consists of a number of components which, combined, perform a specific machine function. One assembly can consist of sub-assemblies and additional components.

3.5.3.1 Intake side

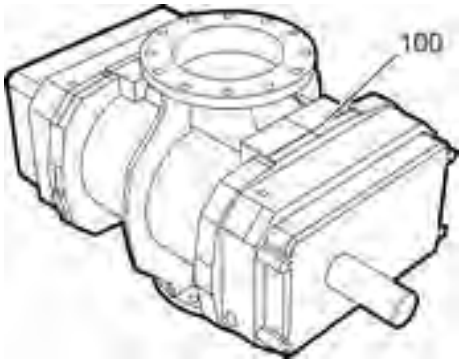


3410 Intake silencer, housing
3470 Intake silencer, filter element

The intake-side assembly comprises the components of the conveying system's intake side. The intake-side assembly includes all components located upstream of the machine stage gas inlet. The medium to be conveyed is drawn into the machine stage by these components. An intake silencer serves to reduce noise emissions. A filter ensures clean intake gas.

Fig. 17: Intake side

3.5.3.2 Machine stage

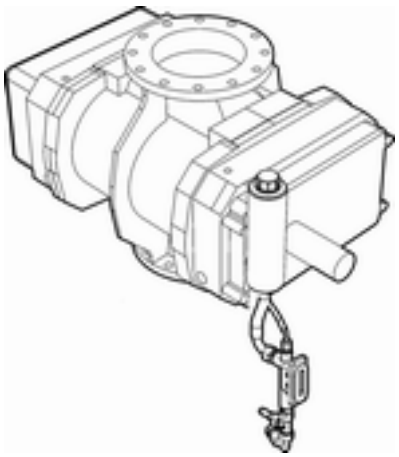


100 Machine stage

The machine stage is the core of the machine and includes all components for gas compression. The gas compression process takes place in the machine stage.

Fig. 18: Machine stage

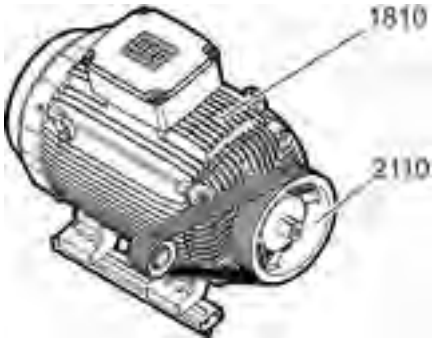
3.5.3.3 Oil system



The oil system contains all components necessary for providing lube oil to the machine stage.

Fig. 19: Oil system

3.5.3.4 Drive system

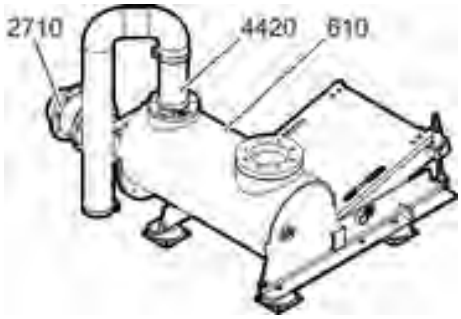


1810 Motor
2110 Belt drive

The drive system comprises the drive motor and the drive elements, e.g. the belts and sheaves. The drive system provides a high revolution speed for the rotational motion of the machine stage.

Fig. 20: Drive system

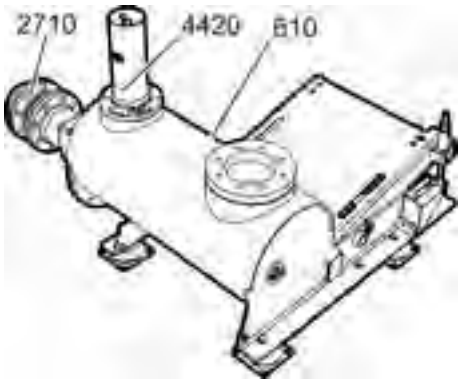
3.5.3.5 Discharge side



610 Base support
4420 Pressure valve
2710 Flexible pipe connection

The discharge-side assembly represents the components of the discharge-side conveying system. The discharge-side assembly includes all components fitted downstream from the machine stage gas outlet. All components are pressurised during operation and have hot surfaces. A discharge silencer serves to reduce noise emissions.

Fig. 21: Discharge side with base support



610 Base support
4420 Pressure valve
2710 Flexible pipe connection

The discharge-side assembly represents the components of the discharge-side conveying system. The discharge-side assembly includes all components fitted downstream from the machine stage gas outlet. All components are pressurised during operation and have hot surfaces. A discharge silencer serves to reduce noise emissions.

Fig. 22: Discharge side with base support

3.6 Control elements (optional)

3.6.1 Factory-installed control element

Factory-installed control element

Observe the AERtronic instruction manual.

The AERtronic instruction manual is included with the product.

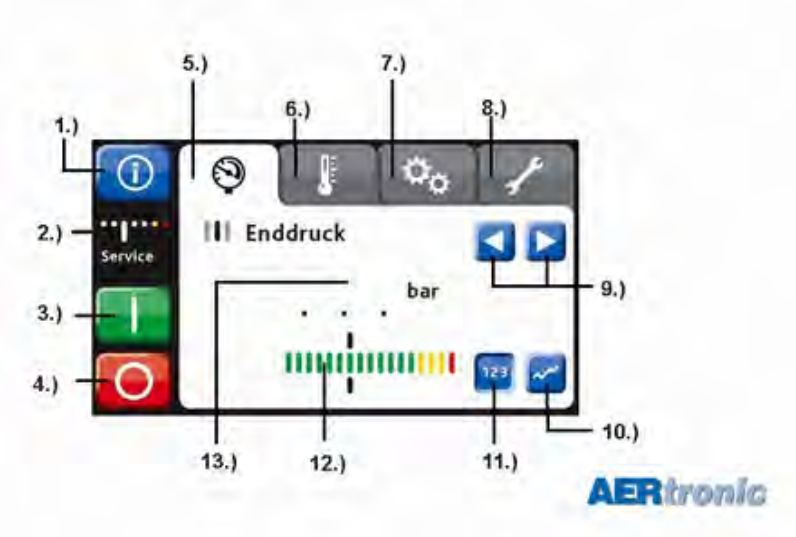


Fig. 23: Operator interface

1 Information menu
2 Service display
3 Local/ LOCATION / START
4 Local/ LOCATION / STOP
5 Pressure ranges register
6 Temperature ranges register
7 Additional operating parameters register
8 Service and setup register
9 Selection buttons of the given display menu within a register
10 Graphic representation
11 Numerical representation
12 Bar graph display
13 Measurement value display

3.6.2 Customer-installed control element

Customer-installed control element

Depending on the model and version - with or without a corresponding controller - the control elements are not part of the scope of delivery. The installation and design of the control elements is then the responsibility of the customer.

3.7 Accessories

The accessories are the total collection of components belonging to the machine or to the supplementary equipment.

3.7.1 Drive motor

Motor connection requirements

The cable and lead sheathing must be resistant to the normal wear expected due to the movement of the hinged motor support and the effects of contaminants in the atmosphere.

General requirements

- Fine-core cable is recommended for the connecting leads.
- The connecting hardware must be suitable for the cross-section and type of the connecting leads.
- Cables, leads and connections must not be subjected to excessive bending and tensile forces. Install the connecting cable via a stayed cable bridge (not provided) to prevent the terminal box being subjected to forces or stress.
- Install cables and leads in such a way that they cannot sustain any external damage.
- Avoid contact with the machine, excessive friction and excessive radiant heat.
- The connecting cable must be resistant to light movements, e.g. the changes in the rotational speed of the motor.

General requirements

- Fine-core cable is recommended for the connecting leads.
- The connecting hardware must be suitable for the cross-section and type of the connecting leads.
- It may be necessary to remove the intake console and the acoustic hood cover to connect the motor, depending on the size and output of the machine.
- Cables, leads and connections must not be subjected to excessive bending and tensile forces. Install the connecting cable via a stayed cable bridge (not provided) to prevent the terminal box being subjected to forces or stress.
- Install cables and leads in such a way that they cannot sustain any external damage.
- Avoid contact with the machine, excessive friction and excessive radiant heat.
- The connecting cable must be resistant to light movements, e.g. the changes in the rotational speed of the motor.

Requirements for the electricity network

NOTICE!

There is a risk of material damage from voltage fluctuations / drops!

Voltage fluctuations / drops beyond the tolerance interval may lead to serious damage to the drive system.

Requirements for operating positive displacement machines with electric induction motors in a three-phase AC supply system:

– Use suitable protective equipment that will shut the motor down and safeguard it against an automatic restart if impermissible electrical operating data is detected.
– Connect the motor and control voltage to a stable common network to ensure that the power contactor is no longer latched if the power supply fails.
– Comply with voltage and frequency limits. *Chapter 11.9.1 'Voltage fluctuations' on page 185*

Connection

- Only authorised electricians may perform the connection.
- Electricians must observe all applicable regulations when connecting the drive motor.
- Observe the tightening torques of the terminal screws.
- Secure all connections against inadvertent release or loosening.
- Ensure that the nominal electrical data is complied with during operation.

Permissible starting frequency

up to 160 kW	6 starts per hour
from 200 kW	3 cold starts or 2 warm starts per hour

Refer to the operating manual provided by the drive motor manufacturer for further specifications and information.

3.7.1.1 Drive motor - factory installation

Factory installation

Observe the information on the type plate and in the drive motor instruction manual.

Refer to the drive motor instruction manual for electrical operating data, maintenance intervals and suitable lubricants.

3.7.2 AERtronic

AERtronic

Fig. 24: AERtronic Display

The AERtronic is used as a control device and as a display and monitoring device.

The AERtronic is fitted with a colour graphics display with a touch-screen interface.

When starting for the first time, these settings can be changed.

Other handling and operation of the controller is defined on the display; the user is guided through the menu by prompts in a structured manner.

The AERtronic includes all the functions necessary for start and shut-down procedures and displays the operating parameters and prompts.

Observe the operating manual for the purposes of commissioning and operation!

AERZEN reserves the right to change, expand or improve the hardware and software of this product as required. This does not include any obligation to update units already shipped.

3.7.3 Instrumentation

The instrumentation consists of several assemblies.

1.) Pressure and temperature sensors in conjunction with the AERZEN AERtronic controller.

2.) Pressure and temperature switches in conjunction with the display instruments.

Shut-down locking

- The shut-down devices are set at the factory.
- All shut-downs must be self-locking. Once the shut-down has been given clearance, the machine must not be able to start automatically.
- Prior to a restart, the cause of the fault must be determined and eliminated. Start-up must then take place manually.

NOTICE!
The switching points of the switches/sensors are fixed and must not be changed.

Pressure and temperature switches

If, to safeguard the machine, an intake pressure, discharge pressure or discharge temperature switch is used, it must also be ensured that the drive motor switches off when the limit switch is triggered.

Contacts open →Drive motor off.

Pressure switch (optional)

It is also possible to use an additional pressure switch. A calibrated gauge is used to adjust the switching limit point. The scale on the switch only serves as a guide.

3.7.4 Frequency converter / operation

Assembly group description

Observe the frequency converter manufacturer's operating manual!

NOTICE!

- If the electric motor is driven by frequency converters, we strongly recommend using an engine throttle and power choke. These are specifically designed for the frequency converter and filter dangerous harmonics from the drive current. This prevents damage to the motor winding. The electromagnetic compatibility of the system is also improved. Reactions of the frequency converter in the current are reduced.
- The maximum current limit of the motor must not be exceeded. Observe the information on the motor name plate.
- To prevent operational faults the function "Interception circuit" must not be parameterised in the control of the frequency converter. When the frequency converter is switched off, a restart should only be possible after a complete shut-down of the blower or compressor.
- The machine must shutdown without braking. The activation of a brake ramp or quick stop is not permissible.

For machine use, observe the following

- Take into account the electrical and mechanical properties of the drive motor.
- The minimum frequency must always be fixed. This frequency must never fall below the fixed minimum during operation.
- The maximum frequency is to be set by taking into account the maximum rotational speed of the motor and the maximum machine speed.
- The run-up time of the drive motor from standstill up to minimum speed can be 3 to 6 seconds.
- The frequency converter must be designed with a constant load moment for operation with a working machine.

- Rotational speeds must not fall below minimum nor exceed maximum values.
- When exceeding the value, e.g. due to excessively long cables, frequency converter type etc. a motor throttle / motor filter coil to match the frequency converter is to be used.

NOTICE!
Not using these components can lead to damage of the motor isolation and a motor breakdown.

- The highest admissible voltage increase speed of the motor is 1,200 V/µs.
- The maximum rotational changeover speed must not exceed 1 Hz per second during operation.
- Minimum frequency = 20 Hz // maximum frequency = 50 Hz results in a control time of 30 seconds from minimum to maximum.

Pole changing

For a motor speed changeover from a high to a low speed, the drive motor must have reached zero rotational speed each time.

Changeover from a low to a high speed can take place directly and instantaneously.

3.7.5 Machine terminal box

Terminal box

The machine's terminal box contains the electrical and electronic components that are not located directly on the machine (e.g. sensors).

It contains terminals for connecting electrical and electronic components with the external power supply.

When the terminal box is closed, accidental or unintended contact with voltage-carrying components is not possible.

The distribution cabinet is locked due to internal components which are charged with dangerous voltage. It can only be opened using special tools (distribution cabinet key, triangular/ square wrench).

3.7.6 Intake pressure gauge

Vacuum pressure mode

The gauge displays the intake pressure.

It is a display instrument without a switching function.

The gauge is connected on the intake side.

Fig. 25: Gauge

3.7.7 Discharge pressure gauge

Positive pressure mode

The gauge displays the discharge pressure of the compressed gas.

It is a display instrument without a switching function.

The gauge is connected on the discharge side.

Fig. 26: Gauge

3.7.8 Nitrogen gauge

Nitrogen mode

The gauge is used when conveying nitrogen.

The gauge displays the pressure in the inlet pipe.

It is a display instrument without a switching function.

The gauge is connected on the intake side.

Fig. 27: Gauge

3.7.9 Maintenance indicator

Positive pressure mode

The maintenance indicator shows the dirt levels in the intake filter.

The maintenance requirements of the intake filter depend on the dirt levels of the medium taken in.

Replace the filter element when the following display values are reached and no later:

Fig. 28: Variation a)

At -45 mbar (red display field): replace intake filter

After the filter has been changed, reset the pointer to its initial position by “pressing” the reset button.

Fig. 29: Variation b)

When the level of contamination increases, the red trailing pointer will be pulled over with the black pointer and stay at the maximum intake pressure.

Replace the filter element when the trailing pointer reaches the red area of the scale.

Once the filter has been replaced, reposition the trailing pointer between 0 and -10 mbar.

3.7.10 Intake silencer

Intake silencer

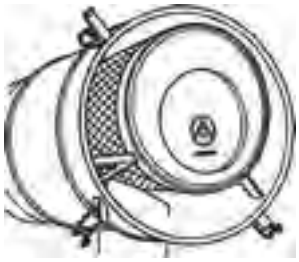


Fig. 30: Opening intake silencer with filter

The intake silencer contains the intake filter. The intake filter prevents harmful particulate matter entering the conveying chamber of the machine.

The intake filter corresponds to filter class G4

NOTICE!
Risk of machine damage! Never operate the machine without the intake filter.

Machine damage caused by the intake filter

NOTICE!

There is a risk of machine damage from the use of contaminated, damaged or non-original intake filters!

Heavily contaminated or damaged intake filters reduce performance, affect functionality and may cause machine damage. Copies and reproductions of intake filters do not have the necessary properties.

– Inspect for damage.
– Comply with maintenance intervals.
– Only use original replacement parts.

3.7.11 Discharge silencer

Discharge silencer

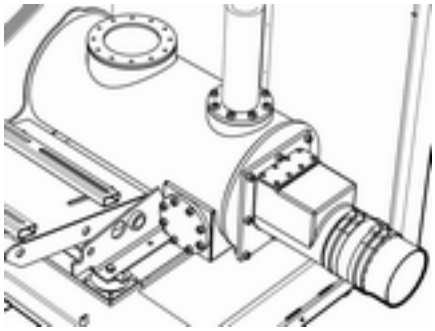


Fig. 31: Discharge silencer

The base support serves as the base for the whole bodywork of the machine. The base support also acts as a discharge silencer. The discharge silencer is an absorbtion-agent-free component. The acoustic energy inside the discharge silencer is reduced by means of air deflection.

3.7.12 Pressure valve

AERZEN pressure valve

Fig. 32: Pressure valve

Observe the valve instruction manual. It is included with the product.

The pressure valve is used in the conveyance of air.

The pressure valve is set at the factory.

If the set value is exceeded, the valve opens and releases excess conveyed material into the atmosphere.

The pressure valve is NOT a control component and is not to be used as such.

The pressure valve can be used up to a temperature of 200°C.

NOTICE!

Risk of premature wear and tear and breakdown! The valve is not intended for controlling the operating data!

The deactivation of the valve, e.g. by increasing the opening pressure, may lead to serious material damage! Risk of total machine failure!

The valve outlet must not be made narrower or closed. Keep the cross-section unobstructed!

3.7.13 Non-return flap

Non-return flap

Fig. 33: Non-return flap

The non-return flap prevents the compressed conveyed medium from entering the machine stage once the compressor has been switched off. This prevents the machine stage from running "in reverse".

3.7.14 Start-up relief device for DN50 to DN80

Start-up relief device

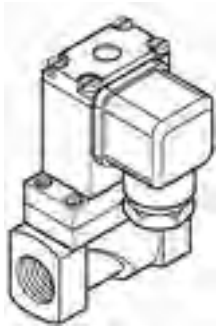


Fig. 34: DN 50 / 80

NOTICE!
Risk of premature wear and tear and breakdown! The start-up relief device is not intended for controlling the operating data!

A solenoid valve offers the possibility of relieved start-up for DN 50/80 (“star-delta connection”). The valve closes if voltage is present.

The valve may only close after the switch from “star to delta”.

For pole changing: In “star-double-star starting”, the solenoid valve is to be switched so that it opens before the high-speed operation and closes after ramping up.

The start-up relief device is not necessary for drives with frequency converters.

3.7.15 Start-up relief device for DN80 to DN400

Start-up relief device

Fig. 35: DN 80 to DN 400

NOTICE!
Risk of premature wear and tear and breakdown! The start-up relief is not intended for controlling the operating data!

The use of the start-up relief device as a controller for operating data leads to premature wear and tear and breakdown!

The start-up relief device can be used in machines that are run by an electric motor with a “star-delta connection”.

This allows for a relieved start-up against existing mains pressure.

In the case of drives with pole-changing motors, it is also possible to use a start-up relief device with a solenoid valve.

This provides a relieved start-up at higher speeds.

After a correct set-up, the start-up relief device operates maintenance-free.

The start-up relief is not necessary for drives with frequency converters.

3.7.16 Belt drive

Belt drive

Fig. 36: Belt drive

The belt pulleys are mostly fitted and aligned in the factory.

The belt pulley for the machine stage is fitted to the drive shaft using a taper interference fit. The position and orientation of this belt pulley therefore affects the alignment of the drive motor belt pulley.

Check the alignment:

- Before first commissioning
- According to the maintenance plan
- After replacing the pulley(s)

The maximum permitted belt pulley offset is 0.5 mm.

It is extremely important that only original replacement parts be used for the purposes of belt-pulley operation!

Only use replacement parts that are recommended and approved by AERZEN!

Original replacement parts

NOTICE!

Risk of material damage! Pulleys must only come from one manufacturer and from one production batch.

– Otherwise varying belt tensions can occur which can result in uneven running and premature wear.
– As a result of a risk of snapping, the belt pulleys must be suitable for the peripheral speed encountered!

3.7.17 Acoustic hood

Acoustic hood

Fig. 37: Acoustic hood, version diagram

The acoustic hood serves to reduce noise and acts as an isolating safety device.

The acoustic hood is a component for product safety with lockable door elements.

Always keep the acoustic hood closed during operation.

The key must only be accessible for authorised personnel.

An earthing strap or threaded hole is located on the outer edge of the floor tray.

Lock

Operation with an open acoustic hood is not permissible!

- *Always lock the elements of the acoustic hood with the key provided.*
- *The key must only be accessible for trained persons.*

Fan

The acoustic hood is ventilated by a mechanical fan.

The fan is connected at the factory. The fan is activated in parallel with a machine start.

Intake from a pipeline

The acoustic hood makes intake-side suction possible from the system pipeline.

The pipeline is guided through the acoustic hood to the machine through prefabricated openings.

The following steps must be complied with: *Chapter 5.3 'Installation' on page 90*

Acoustic hood heater

NOTICE!

There is a risk of material damage from low ambient temperatures!

Provide acoustic hood heating at ambient temperatures of under -10°C!

This prevents damage to the machine by heating up the housing and preheating the lube oil and medium to be conveyed.

3.8 Required tools

The following tools are required:

Auxiliary materials, aids
including collection containers for oil, drain hose, cleaning rags.

Conveyor rails
The conveyor rails must be made of steel. They act as slide-in modules in the forklift tunnel of the acoustic hood. The cables are pulled by the conveyor rails and joined above the machine using the lifting beams.

Drills
Drills for making fastening holes.

Electric drill
Electric drills, e.g. for drilling fixing holes.

General measurement tools and equipment
For example a steel ruler, plumb line, folding yardstick, spirit level.

General tool kit
including various screwdrivers, combination wrenches, set of socket spanners, set of Allen wrenches, hammers.

Lifting beams
Transverse truss required for crane transport for absorbing cable force.

Lifting equipment
For lifting loads, e.g. ropes, belt anchorages, shackles, eyebolts with nuts.

Locking key
The locking key is a component of the overall safety concept. This must be stored safely and should only be made accessible to trained personnel. It is intended for the proper opening and closing of the acoustic hood elements.

Oil funnel
The oil funnel is used for the precise filling of lubricant oil.

Ratchet wrench
The ratchet wrench is used to adjust the hinged motor support fastener.

Test pump
The test pump is used to simulate system pressure in the measurement lines during commissioning. This allows for the operation of the pressure switch or the pressure sensors to be checked.

Tools for authorised electricians
Basic electrical engineering equipment, e.g. multimeter, voltage detector, insulated tools.

Transport equipment
for transporting packaged units and the machine, e.g. with lift trucks, forklifts.

4 Transport, packaging and storage

4.1 Transport

4.1.1 Safety instructions

Improper transport

WARNING!

Risk of injury and damage from improper transport!

Improper transport may result in personal injury.

- Proceed with caution upon delivery and unloading of the machine and during in-house transport.
- Observe the symbols and information on the packaging.
- Only use the intended anchorage points.
- Observe the machine's centre of gravity.
- Attach lifting equipment accordingly and hang the load so that it is balanced.
- Remove the packaging shortly before setting up the machine.

Industrial trucks

WARNING!

There is a risk of fatal injury from industrial trucks!

Transport with industrial trucks can result in objects and other loads falling accidentally and causing serious or fatal injury. There is also the risk of the driver failing to see persons and running them over.

- Industrial trucks should only be operated by trained drivers (e.g. forklift drivers).
- Only walk past an industrial truck if the driver has signalled that he has recognised the person in his path.
- Only use approved industrial vehicles with sufficient load carrying capacity.
- Never transport materials over persons or the areas in which persons are located.

Suspended loads

WARNING!

There is a risk of fatal injury from suspended loads!

During lifting work, loads may come loose and fall. This can result in serious or fatal injury.

- Never walk under or into the range of a suspended load.
- Move loads under supervision only.
- Observe lashing points.
- Ensure that the lashing equipment is fitted securely.
- Do not hang lashing equipment on protruding machine parts or on the lugs of attached components.
- Only use approved hoists and lashing equipment with sufficient load carrying capacity.
- Do not use torn or scoured hoists such as ropes or pulleys.
- Do not attach hoists such as ropes or belts to sharp edges and corners and do not tie or twist them.
- Set down the load when leaving the work area.

Disregard for the machine's centre of gravity

WARNING!

There is a risk of the unit toppling and falling over if there is disregard for the machine's centre of gravity!

If the machine's centre of gravity is disregarded the packaged unit may topple and cause life-threatening injury.

- Take into account the machine's centre of gravity.
- Observe the packaging information on the machine's centre of gravity.
- Attach lashing equipment in such a way that it is located above the centre of gravity.
- Raise the load carefully and ensure that it does not topple. If necessary, change the position of the lashing equipment.

Risk of slipping

CAUTION!

There is a risk of injury from slipping on the packaging foil!

The packaging foil features a slippery surface that can cause persons to slip if they stand on it. Moisture, creases, edges and tension straps on the packaging foil carry the risk of slipping or stumbling. The packaging foil is not suitable for supporting weight. A fall may result in injury.

– Never stand on the packaging foil.
– Never lean on the packaging foil or use it for support.

Requirements for staff

Requirements for transport:

Transport of packaged units

Personnel:
- Trained persons

Transport of unpacked machines

Personnel:
- Service personnel

Protective equipment

Requirements for transport:

Protective equipment:
- Protective work clothing
- Safety shoes
- Protective gloves

Special tools

Requirements for transport:

NOTICE!

Risk of damage to the machine! Chains, steel cables and similar equipment are not suitable lifting equipment.

Special tool:
- Lifting equipment
- Transport equipment

Special tool:
- Lifting beams
- Locking key
- Conveyor rails

Dimensions of the transport beams

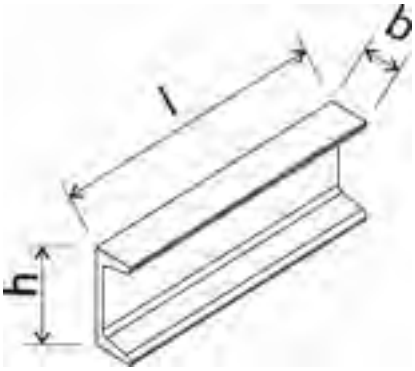


Fig. 38: U-beam

Nominal diameter Discharge nozzles	U-beam dimensions h x b x t (mm)	Profile length (mm)
DN 50	80 x 60 x min. 4	950
DN 80	80 x 60 x min. 4	1285
DN 100	100 x 80 x min. 4	1500
DN 125	100 x 80 x min. 4	1500
DN 150	120 x 80 x min. 5	1950
DN 200	120 x 80 x min. 5	2210
DN 250	120 x 80 x min. 5	2350
DN 300	120 x 80 x min. 7	3000
Material: S 235 JR		

U-beam length of min. 150 mm longer than the dimensions of the acoustic hood.

4.1.2 Delivery method

4.1.2.1 Delivery of the machine

The machine is shipped using a freight forwarder. In accordance with the given requirements the machine is sealed in foil and may be additionally packed in wood.

Transport on a truck

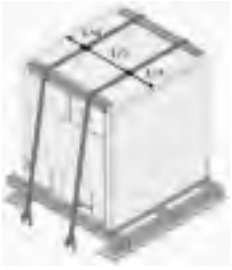


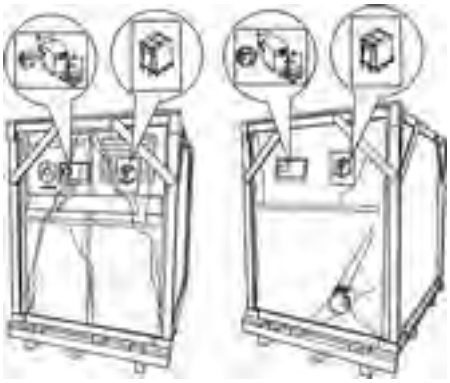
Fig. 39: Transport on a truck

1. Strap the packaged unit to the truck in accordance with the diagram.
2. Always use appropriate edge protection to avoid damage to the packaged unit.

4.1.3 Packaging

4.1.3.1 Symbole auf der Verpackung

Symbols on the packaging



The following symbols are displayed on the packaging. Always observe these symbols during transport.

Fig. 40: Symbols on the front/rear side

Explanations

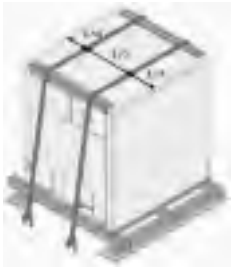
Centre of gravity

1. Displays the centre of gravity and weight of the machine.

   Observe the location of the centre of gravity for lifting work and transport.

Fig. 41: Centre of gravity

Transport on a truck



2. Strap the packaged unit to the truck in accordance with the diagram.
3. Always use appropriate edge protection to avoid damage to the packaged unit.

Fig. 42: Transport on a truck

Explanations

Comply with the order (pos.1-pos.3) of the work stages.

Transport without a palette

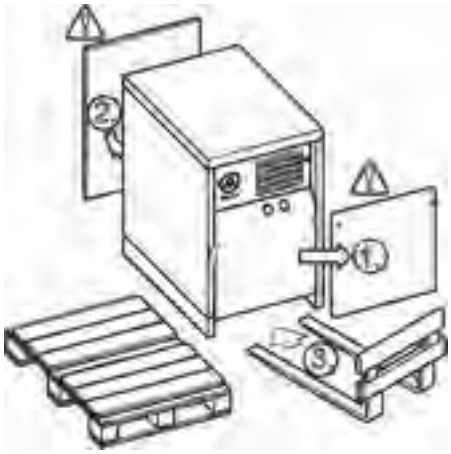


Fig. 43: Transport without a palette

1. Open the operating side of the acoustic hood (pos.1).
2. Open the rear side of the acoustic hood (pos.2).
3. Separate the machine from the transport palette by removing the holding screws.
4. Drive the fork of the forklift under the machine (pos.3).

WARNING!
Risk of injury if the machine topples or falls!
Observe the machine's centre of gravity.

5. Determine the machine's centre of gravity by raising it carefully.
6. Transport the machine so that it is balanced. The machine must not lean to one side.
7. Remove the lifting equipment at the installation area.

4.1.3.2 Handling packaging

Handling packaging

The various packaged items are packed in accordance with the anticipated transport conditions. In as far as it is possible, environmentally-friendly materials are used for the packaging.

The packaging is intended to protect individual components from transport damage, corrosion and other forms of damage. For this reason, do not destroy the packaging and only remove it shortly before assembly.

Only remove packaging for transport to the installation area if it has been expressly permitted.

Removing packaging

Packaging materials made of solid wood (e.g. wooden palettes, wooden crates) comply with the IPPC standard. This material is re-usable. When disposing of the material, national and local requirements must be complied with.

From the machine

1. **CAUTION!**
Risk of injury from rough packaging material and protruding nails!

Remove packaging material.

2. First detach the packaging and then remove it.

3. Separate the machine from the transport pallet by removing the holding screws.
4. **ENVIRONMENT!**
   Packaging material is valuable. It can be used several times or processed and then re-used. The improper disposal of packaging material can present a risk to the environment.
5. Sort packaging according to the material used and dispose of it properly. *Chapter 10.3 'Disposal' on page 164*

From the machine

1. First detach the packaging and then remove it.
2. Separate the machine from the transport pallet by removing the holding screws.
3. **ENVIRONMENT!**
   Packaging material is valuable. It can be used several times or processed and then re-used. The improper disposal of packaging material can present a risk to the environment.
4. Sort packaging according to the material used and dispose of it properly. *Chapter 10.3 'Disposal' on page 164*

4.1.4 Transport inspection

Completeness

Checking for completeness
Check the goods for completeness immediately after delivery. Register missing parts and contact the manufacturer.

Check the delivery for completeness on the basis of the packing slip.

- The packing slip is provided with the product.

Transport damage

Transport damage
Register transport damage claims as soon as damage is discovered. Compensation claims for damage are only valid within the applicable claim periods.

Check the delivery immediately for transport damage.

In case of perceptible external damage, proceed as follows:

- Do not accept the delivery or only accept it under certain conditions.
- Note the scope of the damage in the transport documents or on the delivery docket provided by the carrier.
- Register the claim.

4.1.5 Transport of packaged units

4.1.5.1 Transport using industrial vehicles

Fig. 44: Transport with acoustic hood

1. **NOTICE!**
   Risk of toppling loads! The transport of packaged units may only be carried out using lifting equipment that reaches under the machine and fits into the transport palette fully.
2. Insert the equipment into the provided opening in the transport palette.
3. Take into account the centre of gravity! See the labelling on the packaging.
4. **DANGER!**
   Risk of fatal injury from toppling components!

   Determine the packaged unit's centre of gravity by raising it carefully.
5. Transport the machine so that it is balanced. The packaged unit must not lean to one side.

4.1.5.2 Transport using a crane

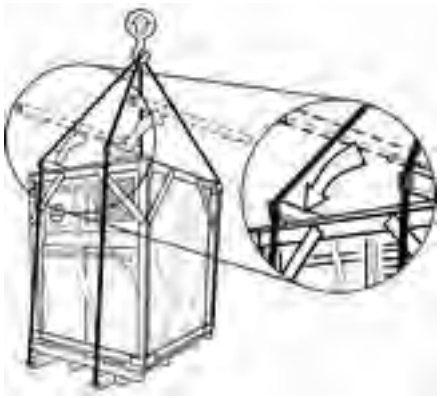


Fig. 45: Transport of packaged units

1. Guide the conveyor rails through the openings of the transport palette.
2. Place the lifting beams on to the acoustic hood. Span length of a minimum of 150 mm longer than the dimensions of the acoustic hood.
3. Guide lifting equipment, such as cables or straps through the conveyor rails and join them above the machine using the lifting beams.
4. Take into account the centre of gravity! See the labelling on the packaging.
5. **DANGER!**
   Risk of fatal injury from toppling components!

   Determine the packaged unit's centre of gravity by raising it carefully.
6. Transport the machine so that it is balanced. The packaged unit must not lean to one side.

4.1.5.3 Transport using industrial vehicles

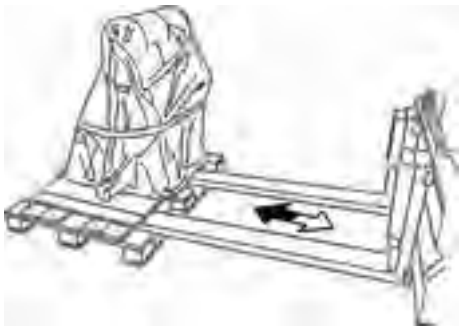


Fig. 46: Transport with belt guards

1. **NOTICE!**
   Risk of toppling loads! The transport of packaged units may only be carried out using lifting equipment that reaches under the machine and fits into the transport palette fully.
2. Insert the equipment into the provided opening in the transport palette.
3. Take into account the centre of gravity! See the labelling on the packaging.
4. **DANGER!**
   Risk of fatal injury from toppling components!

   Determine the packaged unit's centre of gravity by raising it carefully.
5. Transport the machine so that it is balanced. The packaged unit must not lean to one side.

4.1.5.4 Transport using a crane

Fig. 47: Transport of packaged units

DANGER!
Risk of fatal injury from toppling components!

NOTICE!
Risk of damage to the machine from lifting equipment such as cables or straps.

Transport of the packaged unit with a crane is not permissible! The transport palette is not designed for crane transport.

4.1.6 Transport to the installation site

4.1.6.1 Transport using industrial vehicles

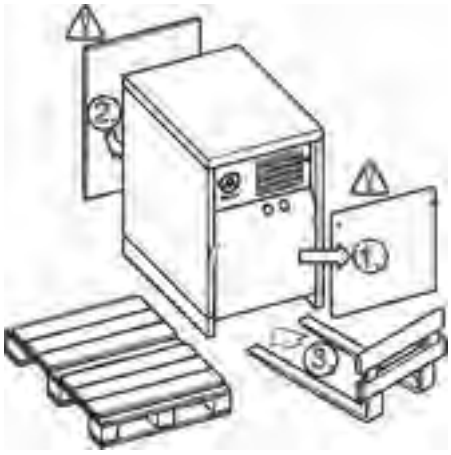


Fig. 48: Transport with acoustic hood

1. Completely remove packaging material.
2. Open the operating side of the acoustic hood (pos.1).
3. Open the rear side of the acoustic hood (pos.2).
4. Separate the machine from the transport palette by removing the holding screws.
5. Drive the transport fork under the machine (pos.3).
6. Take into account the centre of gravity! See the labelling on the packaging.
7. **DANGER!**
   Risk of fatal injury from toppling components!

   Determine the machine's centre of gravity by raising it carefully.
8. Transport the machine so that it is balanced. The machine must not lean to one side.
9. Remove the lifting equipment at the installation area.

4.1.6.2 Transport using a crane

Fig. 49: Transport with acoustic hood

1. Completely remove packaging material.
2. Remove the front and rear elements of the acoustic hood and store them safely.
3. Guide the conveyor rails through the openings of the forklift tunnel.
4. Place the lifting beams on to the acoustic hood. Span length of a minimum of 150 mm longer than the dimensions of the acoustic hood.
5. Guide lifting equipment, such as cables or straps through the conveyor rails and join them above the machine using the lifting beams.
6. Separate the machine from the transport palette by removing the holding screws.
7. Take into account the centre of gravity! See the labelling on the packaging.
8. **DANGER!**
   Risk of fatal injury from toppling components!

   Determine the machine's centre of gravity by raising it carefully.
9. Transport the machine so that it is balanced. The machine must not lean to one side.
10. Remove the lifting equipment at the installation area.

4.1.6.3 Transport using industrial vehicles

DANGER!
Risk of fatal injury from toppling components!

Transport of the packaged unit using an industrial vehicle is not permissible!

4.1.6.4 Transport using a crane

Fig. 50: Transport with belt guards

1. Completely remove packaging material.
2. Separate the machine from the transport palette by removing the holding screws.
3. **NOTICE!**
   Risk of machine damage if the material in the intake nozzle falls! Inspect for cleanliness.

   Dismantle the intake silencer on the flange joint.
4. **NOTICE!**
   Risk of damage from the force exerted by lifting equipment on accessory components!

   Only transport the machine with the hinged motor support fixed in place.

   Attach the lifting equipment carefully to the fastening device.
5. Take into account the centre of gravity! See the labelling on the packaging.
6. **DANGER!**
   Risk of fatal injury from toppling components!

   Determine the machine's centre of gravity by raising it carefully.
7. Transport the machine so that it is balanced. The machine must not lean to one side.
8. Remove the lifting equipment at the installation area.
9. Mount the intake silencer.

4.2 Storage and preservation

4.2.1 Storage

Storage notes

Store the packaged unit under the following conditions:

- Keep flange connections closed. Avoid entry of foreign substances.
- Do not store outdoors.
- Store in a dry and dust-free place.
- Do not expose it to any agressive media.

- Protect the packaged unit from exposure to the sun.
- Avoid mechanical vibrations.
- Avoid extreme temperature fluctuations.
- Avoid adverse water affects.
- Storage temperature: -10 to +40 °C.
- Relative humidity: maximum 80 %.
- If a vibration-free storage area is not available, move the movable components by 2 - 3 rotations every 6 - 8 weeks.

NOTICE!
Risk of corrosion! To avoid potential damage to the machine, an inspection of the overall scope of supply should be undertaken by the manufacturer every 2 years.

There may be information on the packaged unit regarding storage that goes beyond the requirements listed here. Comply with this information.

Storage information for periods of over 12 months

Additional measures:

- Packaging with VPI paper.
- Sealed in PVC foil.

Storage information for periods of over 12 months in a tropical climate

Additional measures:

- Drying agent (VPI power in a bag) inside the packaging.
- Packaging with VPI paper.
- Sealed in PVC foil.

Storage in air-conditioned spaces with minimal humidity has a positive influence on corrosion protection!

Packaging during storage

- Inspect the general condition of the packaging regularly. Immediately rectify damage to the packaging. If necessary, refresh or replace the anti-corrosion protection *'Carrying out preservation treatment' on page 84*
- After opening the packaging:
  - Inspect uncoated parts for sufficient corrosion protection.
  - Protect against humidity and damaging environmental influences.
  - Sealing flaps from the connection openings must not be removed.
- Replace the drying agent regularly in accordance with climactic conditions.

NOTICE!
Risk of corrosion! Customised packaging is required for tropical climate zones and in the case of special customer requirements.

Damaged packaging

NOTICE!
Risk of corrosion! As a result of damaged packaging, moisture and damaging environmental influences could directly affect the product.

Measures in case of damaged packaging

- Immediately rectify damage to the packaging. If necessary, refresh or replace the preservation material.
- Dry the machine, if necessary.
- Inspect the drying agent, replace if necessary.
- Repair or replacement of the packaging.

4.2.2 Preservation

Preservation

Factory preservation protects the product for a certain time period in accordance with the relevant storage and packaging information.

Factory preservation/standard		
Conveying chamber	BIO-CHEM food tech oil	biodegradable, does not contaminate groundwater
Oil chamber	Mobil SHC 626	operating lubricant oil
Shelf-life	up to 12 months	with compliance with storage conditions
Repeat	after 12 months	
Extended shelf-life (no standard)	more than 12 months	only with suitable long-term preservation and packaging

Preservation from assembly to commissioning		
Treat the conveying chamber and move the rotors by 2-3 rotations.	more than 6 weeks of non-use	avoidance of corrosive and standstill damage

Preservation after period of non-use		
Preservation of conveying chamber, oil chamber	more than 6 months	special preservation measures necessary

Carrying out preservation treatment

Preservation measures:

1. Open the packaging. Check the machine for good accessibility.
2. **WARNING!**
   Risk of poisoning from inhaling oil vapour! Wear a mouthguard, protective gloves and protective clothing.

   Preservation treatment of the conveying chamber: spray suitable preservative oil over the intake nozzle at the machine stage.

   NOTICE!
   Risk of filter damage! Do not spray preservative oil into the intake filter. Filter elements must not be treated with preservative oil.
3. **WARNING!**
   Risk of poisoning from inhaling oil vapour! Wear a mouthguard, protective gloves and protective clothing.

   Preservation treatment of the oil chamber: Spray suitable preservative oil over the oil fill opening / oil drain opening at the machine stage.

   ⇨ Let excess preservative oil flow out of the oil drain opening.
4. Close the oil fill opening / oil drain opening.
5. **WARNING!**
   Risk of poisoning from inhaling oil vapour! Wear a mouthguard, protective gloves and protective clothing.

   Treat the outer, uncoated surfaces with suitable preservative oil.
6. Inspect the sealing flaps.

7. Inspect and fix the packaging.

5 Set-up/installation

5.1 Safety instructions

Improper set-up/installation

WARNING!

Risk of injury from improper set-up / installation!

Improper set-up / installation may lead to serious personal or material damage.

- Before beginning work ensure there is sufficient space for installation.
- Check the tidiness and cleanliness of the working site.
- Only use commercially-available tools or, if necessary, special tools.
  Unsuitable or damaged tools may cause injury!
- Secure parts against falling during installation.
- Mount parts correctly.
  Comply with the specified screw-tightening torques.

Electrical system

DANGER!

Risk of fatal injury from electrical current!

There is a risk of fatal injury from touching live components. Live electrical components may make uncontrolled movements and cause extremely serious, or even fatal injury.

- Before beginning work, switch off the electric power supply and secure it against restarting.

Electrostatic charges

WARNING!

Risk of injury from electrostatic charges!

The belt drive may generate electrostatic charges.

- Before commissioning put in place equipotential bonding.
- Only use electrically-conductive belts.

Requirements for staff

Requirements for set-up and installation:

Set-up and installation of electrical components

Personnel: ■ Authorised electricians

Set-up and installation of mechanical components

Personnel: ■ Service personnel

Protective equipment

Requirements for set-up and installation:

Protective equipment:
- ■ Protective work clothing
- ■ Safety shoes
- ■ Protective gloves
- ■ Safety goggles
- ■ Industrial hard hat

Special tools

Requirements for set-up and installation:

Special tool:
- ■ Tools for authorised electricians
- ■ Electric drill
- ■ Drills
- ■ General tool kit
- ■ General measurement tools and equipment

Special tool: ■ Locking key

5.2 Requirements for the installation site

Ground properties

Inspect the ground properties. These should be as follows:

- stable
- even
- free of vibrations
- without any incline
- without holes

NOTICE!
Risk of deformation of the acoustic hood substructure! Do not install or mount the machine on “hollow” or lamellar foundations.

Subsurface requirements for the cement floor.
The cement floor should have a recommended surface pressure resistance of 30 - 40 N/mm².

Flatness tolerance according to DIN 18202						
	Distance between measuring points in (m)					
	0.1	1	4	10	>15	/
Dimension tolerance in (mm)	2	4	10	12	15	/

Angular tolerance according to DIN 18202						
	Distance between measuring points in (m)					
	up to 1	over 1 up to 3	over 3 up to 6	over 6 up to 15	over 15 up to 30	over 30
Dimension tolerance in (mm)	±6	±8	±12	±16	±20	±30

Surroundings

- Ensure there is a suitable fresh air supply.
- Avoid heat accumulation.

NOTICE!
Risk of corrosion! There must not be any excessive levels of dust, acids, steam or explosive or flammable gases at the installation site!

Installation with belt guards

The machine is only suitable for indoor installation.

Machine installation site

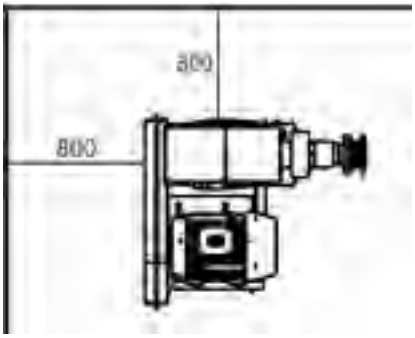


Fig. 51: Overall dimensions

- Comply with the overall dimensions for maintenance work. Observe the installation drawing.
- Provide measures for sound insulation.
- Take the following precautionary measures:
  - If possible, switch off the machine before entering the operating area. Otherwise wear hearing protection.
  - Provide appropriate signage at the installation site.
  - The installation site must only be accessible for trained persons.
  - Choose an installation site where the duration of time persons spend in the immediate vicinity of the machine is extremely limited.

Installation with acoustic hood

The machine is suitable for indoor installation.

Outdoor installation of the machine is not permitted! For this, there are particular protective measures for avoiding the effects of weather conditions. Machines with acoustic hoods are appropriately designed for this purpose.

Machine installation site

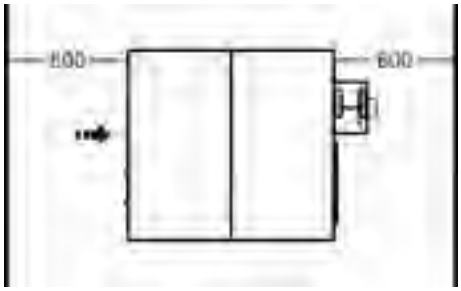


Fig. 52: Overall dimensions

- Comply with the overall dimensions for maintenance work. Also consult the installation drawing.
- Take the following precautionary measures:
  - If possible, switch off the machine before entering the operating area.
  - Otherwise wear hearing protection.
  - The installation site must only be accessible for trained persons.
  - Provide appropriate signage at the installation site.
  - Choose an installation site where the duration of time persons spend in the immediate vicinity of the machine is extremely limited.

5.3 Installation

Models with acoustic hoods; aligning/dowelling

Fig. 53: Spirit level alignment

1. Carefully align the machine.
2. Position it so that it is balanced.

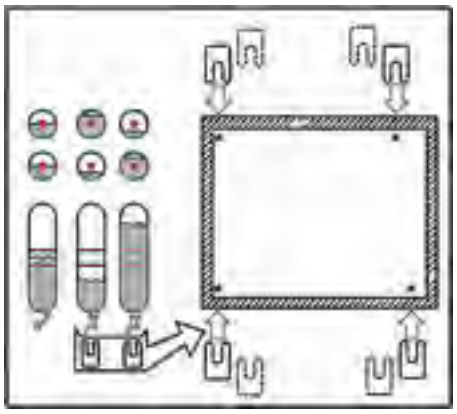


Fig. 54: Shim alignment

3.

NOTICE!
Risk of total machine damage! Installing a machine at an angle may, as a result of an undefined oil level, can lead to a total machine loss. Observe the level and angle tolerances.

If necessary, use the intended shims on the bolting surfaces.

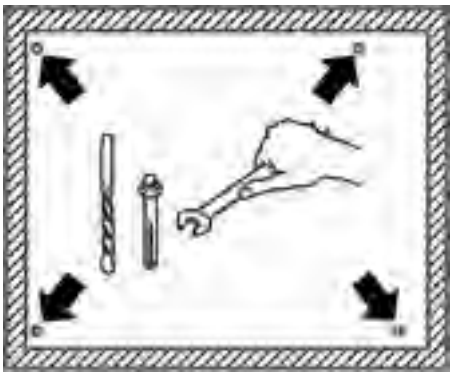


Fig. 55: Mounting holes

4. Recommendation: Drill and dowel four mounting holes and screw the machine into these.

Models without acoustic hoods; aligning/dowelling

1. Carefully align the machine.
2. Position it so that it is balanced.
3. **NOTICE!**
   Risk of total machine damage! Installing a machine at an angle may, as a result of an undefined oil level, can lead to a total machine loss. Observe the level and angle tolerances.

   If necessary, use the intended shims on the bolting surfaces.
4. A single bolt per machine foot is sufficient. Drilling, dowelling and screwing tight the mounting holes

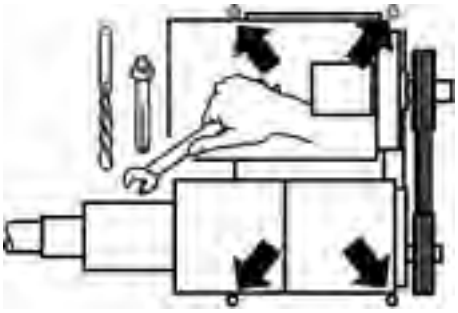


Fig. 56: Mounting holes

5.4 Connecting the system pipeline

System pipeline

NOTICE!
Risk of machine damage! The connected pipeline must not exert forces or moments that affect the machine.

Secure and fasten the system pipeline.

Observe the labelling and dimensions on the installation drawing.

1. Remove the sealing cover from the connection openings.

Bushings/2 clamps

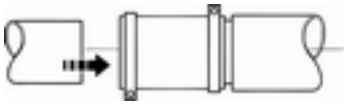


Fig. 57: 2 clamps

2. Connect the system pipeline.
   ⇨ Make sure that the clamps are offset by 180° to one another.

Bushings/4 clamps

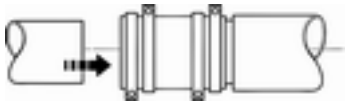


Fig. 58: 4 clamps

3. Connect the system pipeline.
   ⇨ Make sure that the clamps are offset by 180° to one another.

Connection of a compensator

Fig. 59: Connection of a compensator

4. Connect the system pipeline.
5. Close off the pipeline duct using a shim.

5.5 Connecting the drive motor

5.5.1 Preparing the connection

Preparation with acoustic hood

1. *Chapter 3.7.1 'Drive motor' on page 57*
2. **DANGER!**
   Risk of fatal injury in the case of incorrect electrical connection data!

   Compare the electrical connection data of the drive motor with those of the operator-side grid.
3. Shut down the power from the operator-side grid.
4. Observe the cable routing on the installation drawing!

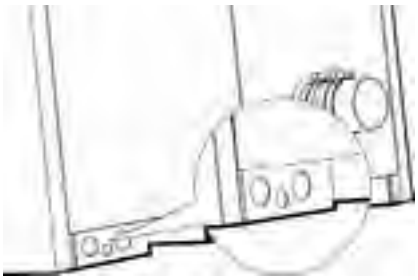


Fig. 60: Position on the acoustic hood

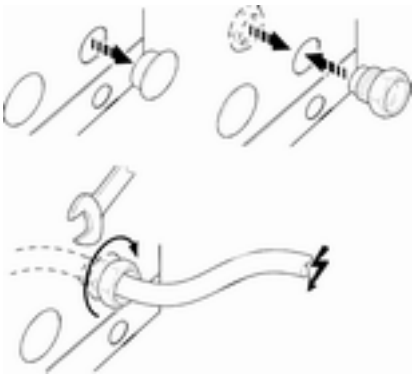


Fig. 61: Preparation

5. Prepare the cable feedthroughs.
6. **DANGER!**
   Risk of fatal injury from electric current!

   Check that there is no live current in the connection cable.
7. Lay the connection cable through the cable feedthroughs.

5.5.2 Routing cables

Routing the connection cable

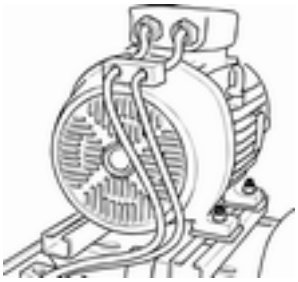


Fig. 62: Cable laying alignment

1. Route the connection cable in accordance with the installation drawing.
2. **NOTICE!**
   Risk of damage! The minimum bending radius must not be undershot!

   Observe the bending radii.

   ⇨ Bending radius of the connection cable = 15 x cable sheath diameter

5.5.3 Connecting the drive motor

Motor connection

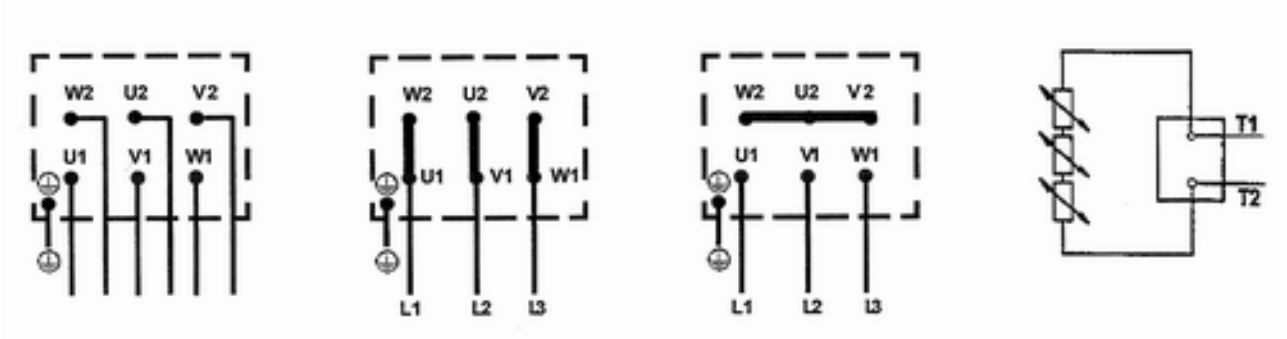


Fig. 63: Connection layout

Star-delta connection	Delta connection	Star connection	Thermal winding shield

1. Open the motor terminal box.
2. Check the alignment of the terminal box.
   ⇨ The terminal box must be aligned with openings for the cable feedthroughs facing in the direction of the motor fan.
3. Attach a screwed cable gland to the terminal box.
4. Guide the motor cable through the screwed cable gland.
5. Connect the cable connections with the motor terminals correctly, in accordance with the connection layout.
6. Close the terminal box.
7. Ensure that the connection cable is not damaged by the movement of the hinged motor support.

5.6 Connecting the drive motor

5.6.1 Preparing the connection

Preparation with belt guards

1. *Chapter 3.7.1 'Drive motor' on page 57.*
2.

   DANGER!
   Risk of fatal injury in the case of incorrect electrical connection data!

   Compare the electrical connection data of the drive motor with those of the grid operator.
3. Shut down the power from the operator-side grid.
4.

   DANGER!
   Risk of fatal injury from electric current!

   Check that there is no live current in the connection cable.

5.6.2 Routing cables

Routing the connection cable

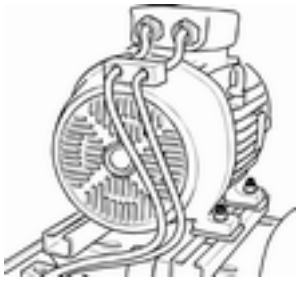


Fig. 64: Routing cables

1. Route the connection cable in accordance with the installation drawing.
2.

> **NOTICE!**
> Risk of damage! The minimum bending radius must not be undershot!

Observe the bending radii.

⇨ Bending radius of the connection cable = 15 x cable sheath diameter

5.6.3 Connecting the drive motor

Motor connection

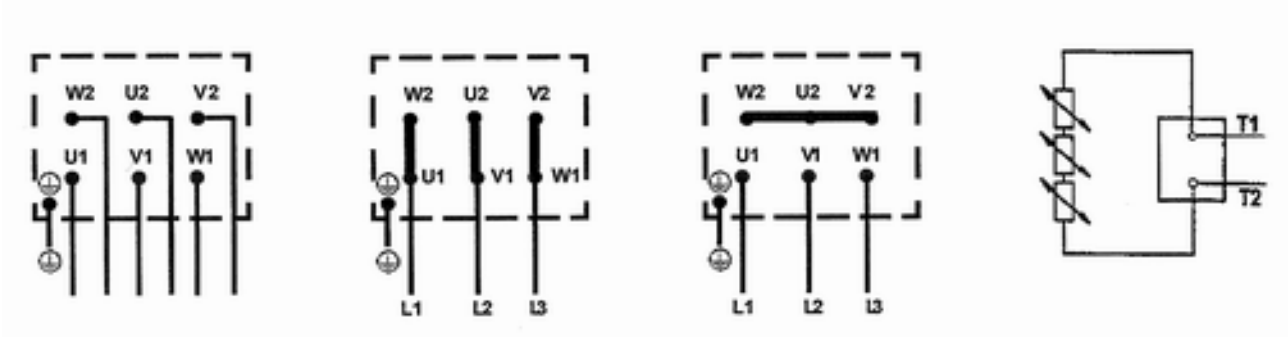


Fig. 65: Connection layout

Star-delta connection	Delta connection	Star connection	Thermal winding shield

1. Open the motor terminal box.
2. Check the alignment of the terminal box.
   ⇨ The terminal box must be aligned with openings for the cable feedthroughs facing in the direction of the motor fan.
3. Attach a screwed cable gland to the terminal box.
4. Guide the motor cable through the screwed cable gland.
5. Connect the cable connections with the motor terminals correctly, in accordance with the connection layout.
6. Close the terminal box.
7. Ensure that the connection cable is not damaged by the movement of the hinged motor support.

5.7 Connecting the machine's terminal strip

Machine terminal strip

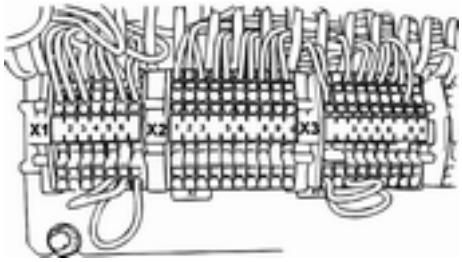


Fig. 66: Terminal box connections

1. Open the terminal box.
2. Observe the wiring scheme.

   The wiring scheme can be found in the terminal box or in the product documentation.
3. **DANGER!**
   Risk of fatal injury from electrical current!

   Ensure that the connecting cable is not live.
4. *Connection layout according to the AERZEN wiring scheme!*

   Guide the external connecting cable to the terminal box.
5. Guide the connecting cable correctly through the cable entry (dummy cover) to the terminals.
6. The cable entry (dummy cover) can be equipped on site with screwed cable glands.
7. Close the terminal box properly.

5.8 Connecting the earthing

Connecting the earthing

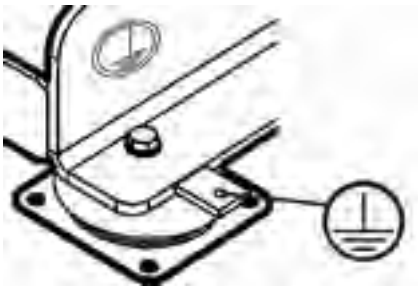


Fig. 67: Example connection

1. *The exact position of these connections can be found in the installation drawing.*

   Earth the machine on the provided connections.
2. Observe the cross-sections of the earthing strap! ↳ *Chapter 11.9.2 'Earthing strap cross-section ' on page 185*.
3. Beware of uncovered metal contact surfaces.
4. Screw contacts tightly together.

5.9 Connecting the earthing

Connecting the earthing

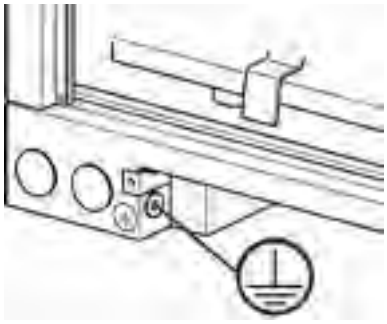


Fig. 68: Example connection

1. *The exact position of these connections can be found in the installation drawing.*

   Earth the machine on the provided connections.
2. Observe the cross-sections of the earthing strap!.
   See *Chapter 11.9.2 'Earthing strap cross-section ' on page 185*.
4. Beware of uncovered metal contact surfaces.
5. Screw contacts tightly together.

5.10 Laying the insulation mat

Laying the insulation mat

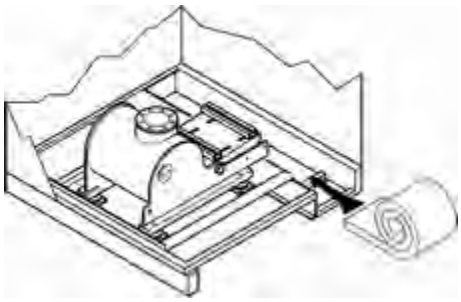


Fig. 69: Laying of the insulation mat

- Depending on the scope of delivery, the insulation mat is delivered separately.
- Lay the insulation mat in the exhaust duct of the acoustic hood.

6 Initial start-up

6.1 Safety instructions

Improper commissioning

WARNING!

Risk of injury from improper commissioning!

Improper commissioning may lead to serious injury and considerable material damage.

– Before commissioing, ensure that all installation work has been carried out and completed in accordance with the information and notes in this instruction manual.
– Before commissioing, ensure that there are no persons in the hazard area.

Requirements for staff

Requirements for commissioning:

Commissioning of electrical components

Personnel:
- Authorised electricians

Commissioning of mechanical components

Personnel:
- Service personnel

Protective equipment

Requirements for commissioning:

Protective equipment:
- Protective work clothing
- Safety shoes
- Hearing protection
- Protective gloves
- Safety goggles
- Industrial hard hat

Special tools

Requirements for commissioning:

Special tool:
- Ratchet wrench
- Oil funnel
- Test pump
- General tool kit
- General measurement tools and equipment
- Tools for authorised electricians

Special tool:
- Locking key

6.2 Preparation for commissioning

Preparation

1. Check that the machine has been correctly installed. See requirements at the installation site ↳ *Chapter 5.2 'Requirements for the installation site' on page 88*.
2. Check that the packaging has been fully removed.
3. Check that all seals and covers on the piping connections have been removed.
4. Check that the piping connections are clean. Remove any dirt, dust or foreign matter from the intake area.
5. Ensure that the supply air and exhaust air openings on the acoustic hood are unobstructed.

Ventilation

6. *Take the ambient temperature into consideration. Operating conditions ↳ Chapter 11.4 'Technical performance data' on page 170*

   Ensure that the installation site is adequately ventilated.

Take noise protection into consideration.

7. *Natural vibrations and sound emissions may be induced in piping and foundations!*

   Prevent natural vibrations and associated sound emissions with suitable measures, e.g. insulation.

Ventilating the manometer

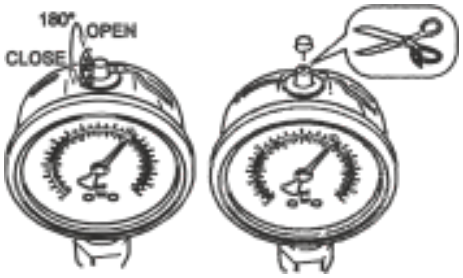


Fig. 70: Ventilating the manometer

8. Prepare the manometer in line with its specific design.

- Cut off the rubber connections on the upper section.
- Turn the bleeder flap to OPEN.

Maintenance indicator (a)

Fig. 71: Variation a)

9. Set to zero.

- Press the front reset button and set the pointer to the zero position.

Maintenance indicator

Fig. 72: Variation b)

10. Set to zero.

- Remove the plugs on the front.
- Adjust the set screw using a screwdriver.
- Observe the “+” and “-” markings.
- Position the red trailing pointer between 0 and -10 mbar.

Aligning the sheaves

11. Check the alignment of the sheaves.

- The maximum permitted sheave offset is 0.5 mm.

Connecting the piping

12. Connect the depressurised system piping.

Preparing the hinged motor support

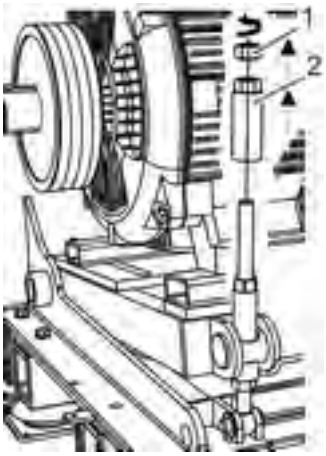


Fig. 73: Hinged motor support preparation

13. Remove counternut (pos.1) and locking sleeve (pos.2.

Removing sealing plugs

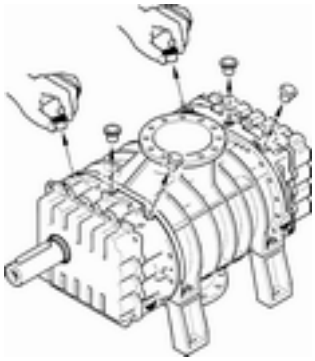


Fig. 74: Sealing plug configuration

14. Remove the sealing plugs from the balancing holes.

The sealing plugs may be coated in machine paint as part of the manufacturing process.

The number of sealing plugs varies depending on the machine type!

Depending on the design, they may already have been removed before shipping.

NOTICE!
Risk of damage if sealing plugs are not removed! If sealing plugs are not removed, there is a risk that the machine will start to leak oil. Lube oil could enter the conveying chamber.

No lube oil

Fig. 75: Do not fill with lubricant oil

15.

NOTICE!
Risk of damage! Lube oil must not enter these bore holes!

These bore holes are solely intended to discharge leaking gases. Filling with oil results in the need for considerable repairs.

Checking the acoustic hood fan

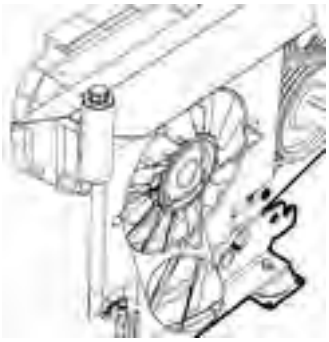


Fig. 76: Fan cover

16. Check the fan wheel for smooth movement and contact-free operation.

    If necessary, adjust the cover plate.

Frequency converter installation and connection

17.

> *Observe the manufacturer's instruction manual!*

Position and assemble the frequency converter.

- Connect it according to the manufacturer's instructions.
- See also the assembly group description for frequency converters. *Chapter 3.7.4 'Frequency converter / operation' on page 60*

Checking the EMERGENCY STOP function

18. Check whether the EMERGENCY STOP function is in place and installed.

- Check for correct operation.
- Enter the test result in the test book.

6.3 Starting commissioning

Oil filling

1. Open the maintenance elements of the acoustic hood.

Models with acoustic hoods

Fig. 77: Filling with oil

2.

> *When working with operating materials such as lube oil, wear personal protective equipment.*

> **ENVIRONMENT!**
> Environmental risks from incorrect handling of lubricants!

Fill with lube oil. *Chapter 8.3.1 'First oil filling' on page 130*

Checking the oil level

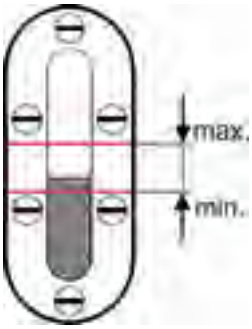


Fig. 78: Sight glass for oil level display

3. Check the lube oil level and correct it if necessary.

Models without acoustic hoods

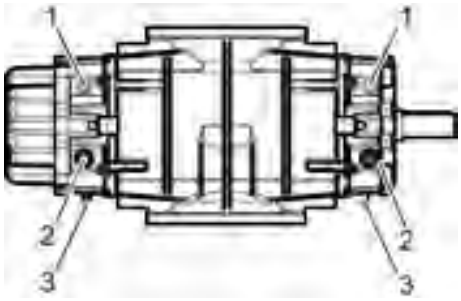


Fig. 79: GM3S-GM80L

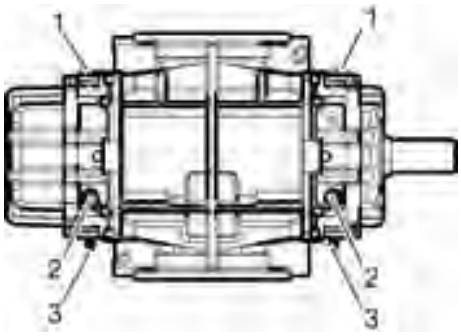


Fig. 80: GM90L-GM400L

4.

When working with operating materials such as lube oil, wear personal protective equipment.

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Loosen the RED-marked locking screw (pos. 1). Fill with lube oil. *'Filling with oil (models without acoustic hoods)' on page 131*

Checking the oil level

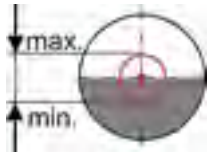


Fig. 81: Oil level display (Pos. 2)

5. Check the lube oil level and correct it if necessary.

Establishing an electrical connection

6. **DANGER!**
Risk of fatal injury from electric current!

Supply electrical components with electricity.

See *Chapter 5.5 'Connecting the drive motor' on page 92*.

7. Connect and activate motor overload protection. *Chapter 11.9.3 ' Motor overload protection' on page 185*

8. Observe the permissible starting frequency of the drive motor. *'Permissible starting frequency' on page 58*

Checking direction of rotation/ models with acoustic hood

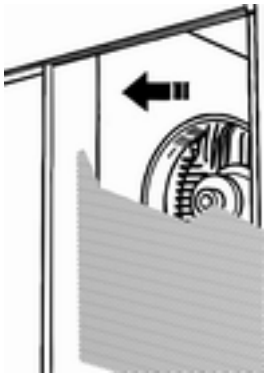


Fig. 82: Motor direction of rotation

9. **WARNING!**
Risk of injury from rotating components!

NOTICE!
Risk of machine damage from incorrect direction of rotation!

Check the direction of rotation **without belts** in place.

- If in place, remove the perforated plate cover of the drive motor's sheave.
- Observe the rotational direction signage on the machine stage and on the drive motor.
- Start the drive motor briefly (approx. 1 to 2 seconds).
- Viewed towards the front of the drive shaft, the drive motor turns anti-clockwise.
  - Direction of rotation is correct = continue commissioning.
- From the viewing position, the drive motor turns right in front of the drive shaft.
  - Direction of rotation is incorrect = correct the electrical connection.
- Where applicable, attach the perforated plate cover of the drive motor.

Checking the direction of rotation/ models without acoustic hood

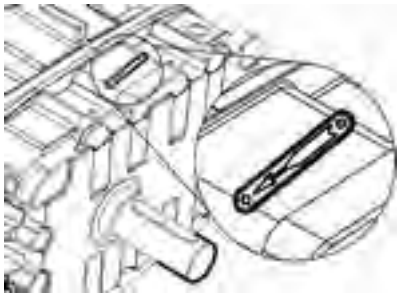


Fig. 83: Direction of rotation

10.

WARNING!
Risk of injury from rotating components!

NOTICE!
Risk of machine damage from incorrect direction of rotation!

Inspect the direction of rotation **without belts** in place.

- Remove the cover from the belt guard.
- Observe the rotational direction signage on the machine stage.
- Start the drive motor briefly (approx. 1 to 2 seconds).
- Viewed towards the front of the drive shaft, the drive motor turns anti-clockwise.
  - Direction of rotation is correct = continue commissioning.
- From the viewing position, the drive motor turns right in front of the drive shaft.
  - Direction of rotation is incorrect = correct the electrical connection.
- Mount the cover of the belt guard.

Disconnecting the electrical power supply

11.

WARNING!
Risk of injury from an automatic start-up!

Deactivate the machine and secure it against restarting.

Fitting the belt

12.

For designs with a lifting device, the hinged motor support can be found in the corresponding position. The belt can be fitted directly.

Pre-tensioning the belts

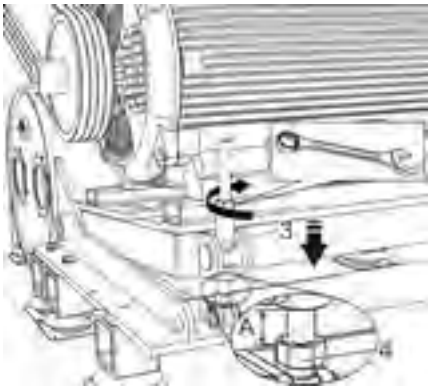


Fig. 84: Pre-tensioning belts

13. **CAUTION!**
Risk of injury from tensioning components!

Turn guide bushing (pos.3) clockwise with the ratchet wrench until the belts are pre-tensioned.

⇨ The hinged motor support is partly held by the belt drive and rests lightly on the guide bushing (pos.3).

Adjusting the guide bushing

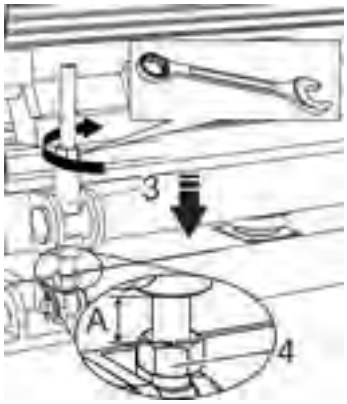


Fig. 85: Adjusting the gauge of the guide bushing

14. Set gauge A.

- Set self-locking nut (pos.4) to gauge A. Turn guide bushing (pos.3) on to the self-locking nut (pos.4) using the ratchet wrench.

DN/discharge side	Gauge A in mm
80	20
100	25
125	30
150	35
200	40
250	45
300	50
Delta Blower G5	

Tensioning the belts

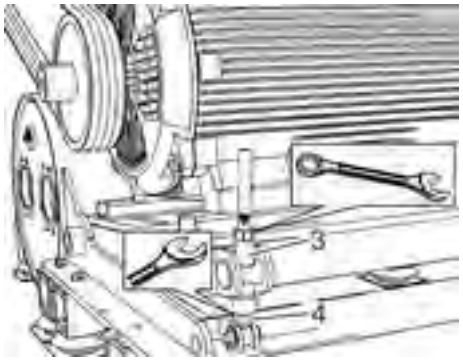


Fig. 86: Tensioning the belts

15. **CAUTION!**
Risk of injury from moving and rotating components!

Tension the belts.

- Secure the guide bushing (pos.3) with the self-locking nut (pos.4).
- The hinged motor support is supported entirely by the belt drive.

Carrying out a test run

16. **CAUTION!**
Risk of injury from moving components!

Carry out a test run of the belt drive and check that it is operating correctly.

Characteristics:

- quiet, even operation.
- even load.
- no excessive vibrations.
- no whistling noises.
- no increased wear.

Checking the protective cover/ models without acoustic hood

Fig. 87: Protective cover

17. Check the spacing of the pre-mounted protective cover for the motor drive shaft.
    - The protective cover should be at a distance of approx. 10 mm from the motor drive shaft.
    - By loosening the fastening screws, the protective cover can be moved.
    - Check the protective cover for firm seating and, if necessary, tighten it.

Adjusting the protective cover/ models without acoustic hood

Fig. 88: Adjusting the protective cover

18. If the protective cover is supplied separately, adjust the cover plates accordingly. The cover plates can be snapped off at the required length.

Assembling and adjusting the protective cover/models without acoustic hood

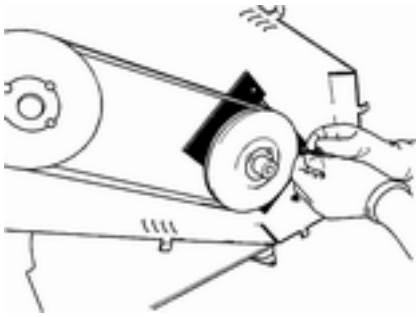


Fig. 89: Assembly/adjusting

19. **WARNING!**
Risk of injury from rotating components!

Assemble the protective cover after tensioning the belts.

- The protective cover should be at a distance of approx. 10 mm from the motor drive shaft.
- Operation is only permissible with a mounted cover!

Assembling the acoustic hood

20. Close the maintenance element of the acoustic hood.

Connecting the power supply

21. **WARNING!**
Risk of injury from electric current!

Supply electrical components with electricity.

Inspecting shut-downs

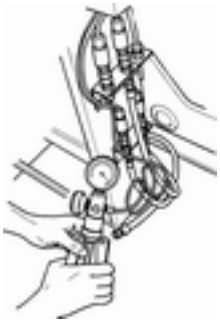


Fig. 90: Test pump

22. Check the correct operation of all pressure switches/sensors that can trigger a shut-down.
    - Connect the test pump to the corresponding measurement line.
    - Simulate the tripping pressure.
    - Check to see if a shut-down process is triggered.
    - Remove the measurement line from the test pump.
    - Fit the measurement line to the measuring point on the machine.

Opening the system line

23. Open valves on the system side.

Starting briefly

24.

WARNING!
Risk of injury from rotating components!

WARNING!
Risk of injury from pressurised components!

Do not loosen or remove any locking screws or pipe connections.

Switch on the drive motor.

- After approx. 20 seconds, switch it off.
- Make sure the motor coasts down smoothly.

Checking the frequency converter for correct operation

25.

Read and follow the manufacturer's operating instructions!

DANGER!
Risk of fatal injury from electric current and residual energy for all work performed on frequency converters!

See also the assembly group description for frequency converters. ↳ *Chapter 3.7.4 'Frequency converter / operation' on page 60*

Starting the drive motor

26.

WARNING!
Risk of injury from rotating components!

As long as there are no malfunctions: restart the drive motor.

- Check the EMERGENCY STOP function.
- Check the machine's protective equipment.

Checking after first commissioning

27.

WARNING!
Risk of injury from pulling or opening pressurised lubricating and control oil pipes.

Perform the following checks:

↳ *Chapter 6.4 'Performing checks after commissioning' on page 111*

Acoustic hood protection

28.

WARNING!
Risk of injury if protective equipment is not present.

Correctly close the elements of the acoustic hood.

- Store the acoustic hood key safely.
- Only allow access for authorised personnel.

Belt protection

29.

WARNING!
Risk of injury if protective equipment is not present.

Mount the belt protection cover.

Operational readiness

30. If there are no malfunctions, the machine is ready for operation.

After the first few hours of operation, preservative oil may gather in the parting faces as a result of the machine warming up.

6.4 Performing checks after commissioning

Inspection	After the first 3 op. hrs	After the first 25 op. hrs
Screws	after the machine has cooled down re-tighten if necessary	
Pressure valve	check for correct operation	
Oil level	check, correct if necessary	check, correct if necessary
Aligning the sheaves		check, correct if necessary
Condition of the belts		check, change if necessary, establish cause
Control system, fault transmitter, pressure and temperature sensors	check for correct operation	
Motor overload protection	connected and active	
Accumulation of preservative oil		check, remove if necessary
op. hrs = operating hours		

7 Operation

7.1 Safety instructions

Improper operation

WARNING!

Risk of injury from improper operation!

Improper operation may lead to serious injury and considerable material damage.

- Carry out all activities in accordance with the information and notes in this instruction manual.
- Before beginning work, observe the following:
  - Ensure that all covers and safety devices are installed and operating correctly.
  - Ensure that there are no persons in the hazard area.
- Never deactivate or bypass safety devices during operation.

Open acoustic hood

WARNING!

Risk of injury from operation with an open acoustic hood!

Open acoustic hoods may lead to dangerous situations and cause injury during machine operation.

- Always keep the acoustic hood closed during operation.

Adjusting valves

DANGER!

Risk of injury when adjusting valves!

When the machine is running and an attempt is made to adjust a valve, body parts may be injured by rotating components. Take into account the stand-by mode and/or automatic start-up

Only make adjustments if:

- The machine is not running.
- The machine is secured against a restart.

Explosion and fire hazards

DANGER!

There is a risk of explosion and fire from ignition hazards!

Avoid allowing ignition hazards (open flames, flying sparks, weld spatter) into the vicinity of the machine. Sparks and incandescent or flammable objects could be sucked in through the supply air openings on the acoustic hood or through the intake silencer. The fan may ignite these elements causing fire or an explosion.

– Avoid ignition hazards.
– Never carry out work that generates sparks while the machine is in operation.
– Ventilate the installation site properly.

Requirements for staff

Requirements for operation:

Operating the machine

Personnel:
- User

Adjusting valves

Personnel:
- User
- Authorised electricians

Protective equipment

Requirements for operation:

Protective equipment:
- Protective work clothing
- Safety shoes
- Hearing protection

Special tools

Adjusting valves:

Special tool:
- Locking key

7.2 Shut-down in case of emergency

In hazardous situations, the movements of components must be stopped as quickly as possible and the electric power supply must be shut off.

Shut-down in case of emergency

In an emergency, proceed as follows:

1. Activate the EMERGENCY STOP immediately.
2. Inform the responsible staff.

3. Switch off the main circuit breaker and secure it against restarting.
4. Assign qualified personnel the task of rectifying the fault.
5. **WARNING!**
   An unauthorised or unregulated restart can have fatal consequences.

   Before commissioning, ensure that all safety devices are installed and operational.

7.3 Switching on

Operating modes

Depending on the operating mode, the machine can be switched on in the following ways:

When starting and stopping the drive motor, observe all of the machine's protective measures. Power take-offs must be actuated by a potential-free contact or be actuated directly. The start-up of the power take-offs runs in parallel to the drive motor.

AERtronic

The starting and stopping of the drive motor must be carried out by AERtronic. A potential-free contact is already in place.

7.3.1 On-site operation

On-site manual operation

DANGER!
Risk of injury if protective equipment is missing!

Manually activate the starter switch on the machine on site.

⇨ The machine starts and comes on stream.

7.3.2 Remote operation

Via remote station

DANGER!
Risk of fatal injury if protective equipment is missing!

WARNING!
Risk of injury if the machine starts suddenly!

Activate the starter switch in the remote station.

⇨ The machine is started remotely and comes on stream.

Remote station with AERtronic

- Remotely via potential-free contact
- Remotely via MODBUS RTU
- Remotely via PROFIBUS DP

7.3.3 Automatic operation

Automatic activation

DANGER!
Risk of fatal injury if protective equipment is missing!

WARNING!
Risk of injury if the machine starts suddenly!

The starting command is carried out by sensors or a system switch.

⇨ The machine starts automatically and comes on stream.

7.4 Displaying operating parameters

AERtronic (optional)

A detailed explanation is contained in the separate operating manual AS-002.

Fig. 91: AERtronic display

Analogue instruments (optional)

Depending on their deisgn, analogue instruments display the given operating data, e.g. discharge pressure, discharge temperature, oil pressure.

Control system (optional)

Depending on the customer's control system, additional operating parameters can be recorded and displayed.

7.5 Switching off

Operating mode

Depending on the operating setup, the machine can be switched off in the following ways:

7.5.1 Switching off on site

Switching off manually (on site)

WARNING!
Risk of injury from unbraked shut-down!

Manually activate the cut-out switch on the machine.

⇨ The machine is switched off and shuts down. The machine does not stop immediately.

7.5.2 Switching off remotely

Via remote station

WARNING!
Risk of injury from unbraked shut-down!

Activate the cut-out switch in the remote station.

⇨ The machine is switched off and shuts down. The machine does not stop immediately.

7.5.3 Switching off automatically

Switching off automatically

WARNING!
Risk of injury from unbraked shut-down!

The shut-down command is carried out by sensors or a system switch.

⇨ The machine is switched off and shuts down. The machine does not stop immediately.

7.5.4 Switching off in nitrogen operation

Switching off in nitrogen operation

1. *Switch off as described above!*

Switch off the machine.

2. **DANGER!**
Risk of fatal injury from gas leaks!

For longer downtimes disconnect the unit from the gas network.

⇨ Otherwise there is a possibility that gas leaks will occur during downtime.

7.6 Decommissioning

Decommissioning means the shut-down of a machine for a longer period.

Measures

1. Switch off the machine properly and secure it against an unintentional start.
2. Disconnect fuses.
3. Close the shut-off valves of the delivery lines.
4. Prevent condensate from entering the machine.
5. For a downtime of over six weeks: preserve the conveying chamber.

Avoiding damage caused by down-time and corrosion

For a downtime of over six weeks
Preserve the conveying chamber. *'Preservation' on page 83*
Move the rotors every six weeks by 2-3 rotations.

7.7 Measures for recommissioning

7.7.1 Commissioning after adjustment works

after adjustments

Work stages *'Commissioning' on page 121*

7.7.2 Commissioning after maintenance work

after maintenance

Work stages *Chapter 8.5 'Commissioning after maintenance' on page 155*

7.7.3 Commissioning after fault rectification

After fault rectification

Work stages *Chapter 9.5 'Commissioning after fault rectification' on page 160*

7.8 Adjusting valves

DANGER!
Risk of injury when adjusting valves or equipment!

Preparation/models with acoustic hood

1. Agree adjustments with the responsible staff at the location.
2. Switch off the machine.
3. Activate the EMERGENCY STOP function.
4. Switch off the main circuit breaker and secure it against restarting.
5. Ensure there is no live electricity.
6. Open the maintenance elements.

Preparation/models without acoustic hood

1. Agree adjustments with the responsible staff at the location.
2. Switch off the machine.
3. Activate the EMERGENCY STOP function.
4. Switch off the main circuit breaker and secure it against restarting.
5. Ensure there is no live electricity.
6. Disassemble the belt guard.

7.8.1 Adjusting the start unloading device

DN 80 to DN 400

Fig. 92: Start unloading device

The start unloading device is preset with a maximum closing time at the factory. An adjustment is only necessary if the start unloading device does not close or the closing time is too long.

↳ *Chapter 11.10.3 'Start-up unloading device DN 80 to DN 400' on page 186*

Settings with star-delta starting

The start unloading device closes fully after:

- *the switch from star to delta.*
- *the nominal speed is reached.*

The closing procedure can be both heard and seen (on the gauge for discharge pressure).

Setting the closing time

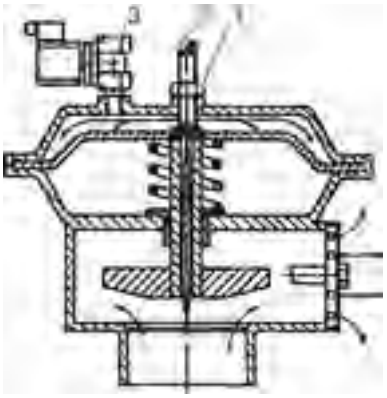


Fig. 93: Start unloading device positions

1. Open the maintenance elements.
2. Loosen the counternut (pos.1).
3. Move the spindle (pos.2) clockwise.
   ⇨ The closing time is reduced.
4. Move the spindle (pos.2) anti-clockwise.
   ⇨ The closing time is extended.
5. Set the closing time.
6. Tighten counternut (pos.1).
7. Mount all protective hardware and covers.
8. Close the maintenance elements.
9. **NOTICE!**
   Risk of damage! Observe the starting frequency of the drive motor!

   Start the machine.
10. Check the closing time.
11. If the closing time is in the permissible adjustment range:
    ⇨ adjustments are complete.
12. If the closing time is not in the permissible adjustment range:
    ⇨ repeat the adjustment steps.

Settings for pole changing

Set start unloading device to a lower speed in accordance with star-delta starting.

The closing time in the lower speed range must be set as long as possible, so that an acceptably long closing time is still available for the upper speed range.

If this is not possible, then an additional solenoid valve is used.

The solenoid valve (pos.3) keeps the start unloading device open to the atmosphere when ramping up to “high-speed” mode directly.

Reasons for the above:

- The differences in conveyed amounts are too large.
- High-speed operation is started from low-speed operation in “star-double-star starting“.

The solenoid valve (pos.3) keeps the start unloading device open to the atmosphere during star-double-star starting.

The solenoid valve closes after ramping up.

7.8.2 Commissioning after adjustments

Commissioning

1. Inform the responsible on-site person about the result of the work carried out and agree commissioning steps with that person.
2. Check all previously loosened screw connections for tightness.
3. Ensure that there are no persons in the hazard area.
4. Re-attach all safety hardware.
5. Remove all used tools, materials and other equipment from the workspace.
6. Release the safety on the main circuit breaker and activate it.
7. Release the EMERGENCY STOP function.
   ⇨ Start operation in accordance with the instruction in the “Operation” chapter. *Chapter 7.3 ‘Switching on’ on page 114*
8. Inform the responsible on-site person about the result of the work carried out.

8 Maintenance

8.1 Safety instructions

Improperly performed maintenance work

WARNING!

Risk of injury from improper maintenance work!

Improper maintenance may lead to serious personal or material damage.

- Only perform maintenance work when the machine has been taken out of commission.
- Secure the machine against restarting.
- Allow the machine to cool down to the ambient temperature.
- Before beginning work, ensure there is sufficient space for installation work.
- Check the tidiness and cleanliness of the work area.
- Only perform maintenance work with suitable tools.
- Ensure removed components are re-installed correctly.
- Re-install all fastening elements and observe the screw tightening torques.

Securing the machine against restarting

WARNING!

An unauthorised or unregulated restart can have fatal consequences.

An unauthorised or unregulated restart of the machine can lead to serious or fatal injuries. There may be people located in the hazard area.

- Before beginning work, switch off the energy supply and secure it against restarting.

Electrical system

DANGER!

Risk of fatal injury from electrical current!

There is a risk of fatal injury from touching live components. Live electrical components may make uncontrolled movements and cause extremely serious injury.

- Before beginning work, switch off the electric power supply and secure it against restarting.

Rotating or moving components

WARNING!

Risk of injury from rotating or moving components!

Rotating or moving components can cause serious injury.

- Never touch rotating or moving components.
- Never reach into the area of the belts that could cause injury by crushing.
- Keep a safe distance from rotating or moving components.
- When in a hazard area, wear tight-fitting protective work clothing with minimal tensile strength.

Hot operating materials

WARNING!

Risk of injury from hot operating substances!

Operating substances may reach high temperatures during operation. Skin contact with hot operating substances causes serious burns.

- For all work performed with hot operating substances, always wear protective work clothing and protective gloves.
- Before any work with operating substances, check whether they are hot. If necessary, allow them to cool down to the ambient temperature.

Requirements for staff

The maintenance work described here may only be performed by the designated personnel. The personnel entrusted with the respective maintenance tasks are listed in the maintenance plan.

For the preparation of the maintenance plan, the following is necessary:

Personnel:
- Authorised electricians
- Service personnel

For cleaning after maintenance, the following is necessary:

Personnel:
- User

Commissioning after maintenance requires:

Personnel:
- Authorised electricians
- Service personnel

Protective equipment

For maintenance, the following is necessary:

Protective equipment:
- Protective work clothing
- Safety shoes
- Protective gloves
- Safety goggles
- Industrial hard hat

Special tools

For maintenance, the following is necessary:

Special tool:
- Ratchet wrench
- Oil funnel
- General tool kit
- General measurement tools and equipment
- Auxiliary materials, aids

Special tool:
- Locking key

8.2 Maintenance schedule

The following section describes the maintenance work that is required for optimal and fault-free operation of the machine.

If regular inspections reveal an increased level of abrasion, reduce the maintenance intervals in accordance with the signs of wear and tear. For questions on maintenance work and intervals contact the manufacturer. See contact details.

8.2.1 Maintenance schedule for normal operation

Interval	Maintenance work	Personnel
After the first 500 op. hrs	Replace the lube oil. *This interval is skipped when using Delta Lube lube oil.* ↳ *Chapter 8.3.5 'Changing oil' on page 141* For a gas-tight shaft seal, change the grease. ↳ *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139*	Service personnel
Weekly	Check the intake filter for contamination. (display unit, max. permissible -45 mbar)	User
	Check the oil level. ↳ *Chapter 8.3.2 'Checking the oil level' on page 132* Correct if necessary. ↳ *Chapter 8.3.3 'Correcting the oil level' on page 134*	User
	If the maximum value (-45 mbar) is exceeded, change the intake filter. ↳ *Chapter 8.3.6 'Replacing the intake filter' on page 147*	Service personnel
	Check the belt guard for total stability and for damage and contamination. ↳ *Chapter 8.3.15 'Checking the belt guard' on page 154* Remove any dirt from the outer belt guard.	User
	If it is insufficiently stable or damaged, contact customer service.	Manufacturer's customer service division
Drive motor relubrication intervals	Observe the instruction manual and signage of the drive motor!	Service personnel
After every 4,000 op. hrs or every 6 months	Check and clean the inlet and exhaust air openings on the acoustic hood. ↳ *Chapter 8.3.14 'Checking the inlet and exhaust air openings on the acoustic hood' on page 153* Check the condition of the belts. If necessary, replace them. ↳ *Chapter 8.3.9 'Replacing belts' on page 148* Inspect the sheaves for unusual wear and tear or obvious damage. Inspect for alignment and stability. ↳ *Chapter 8.3.7 'Checking the sheaves' on page 147* Check that the pressure valve is operating correctly and clean it. ↳ *Chapter 8.3.10 'Checking the pressure valve' on page 150* Replace the lube oil at a discharge temperature of over 140 °C. *This interval is skipped when using Delta Lube 06 lube oil.* ↳ *Chapter 8.3.5 'Changing oil' on page 141* When using AERZEN special rotary piston oil with a gas-tight shaft seal, replace the grease at a discharge temperature of over 140 °C. ↳ *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139* Replace grease when using lube oil with an ISO VG 220 viscosity class in conjunction with a gas-tight shaft seal. ↳ *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139*	Service personnel

Interval	Maintenance work	Personnel
	If necessary, replace the sheaves.	Manufacturer's customer service division
	Check that the pressure valve is operating correctly. ↳ *Chapter 8.3.10 'Checking the pressure valve' on page 150*	Service personnel
After every 8,000 op. hours or every 12 months	Replace the intake filter. ↳ *Chapter 8.3.6 'Replacing the intake filter' on page 147* Replace the lube oil. *Observe the following specifications regarding DELTA LUBE 06!* ↳ *Chapter 8.3.5 'Changing oil' on page 141* Lube oil: Replace Delta Lube 06: only for pressure differentials > 800 mbar ↳ *Chapter 8.3.5 'Changing oil' on page 141* Replace the grease. ↳ *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139*	Service personnel
	Check the control system for correct operation.	Manufacturer's customer service division
After every 16,000 op. hrs or every 2 years	Lube oil: Replace Delta Lube 06. ↳ *Chapter 8.3.5 'Changing oil' on page 141* Replace the belts. ↳ *Chapter 8.3.9 'Replacing belts' on page 148* Check the alignment of the sheaves. If necessary, correct it. ↳ *Chapter 8.3.7 'Checking the sheaves' on page 147* Check non-return flap for wear and tightness. Replace if necessary. ↳ *Chapter 8.3.12 'Checking the non-return flap' on page 151* Check flexible pipe connections on the discharge and intake sides for tightness. Replace if necessary. ↳ *Chapter 8.3.16 'Checking pipelines for tightness.' on page 154*	Service personnel
After every 20,000 op. hrs or every 3 years	Check hose lines for tightness. Replace if necessary. Recommendation: replace hose lines every 6 years.	Service personnel
	Recommended main inspection/maintenance. Inspection, changing of replacement and expendable parts. Entire machine check.	Manufacturer's customer service division

op. hrs = operating hours

8.2.2 Maintenance schedule for arduous operating conditions

For example:

- year-round ambient temperatures over 30°C
- high dust levels

Interval	Maintenance work	Personnel
After the first 500 op. hrs	Change the oil. *This interval is skipped when using Delta Lube lube oil.* ↳ *Chapter 8.3.5 'Changing oil' on page 141* For a gas-tight shaft seal, change the grease. ↳ *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139*	Service personnel
Weekly	Check the intake filter for contamination. (display unit, max. permissible -45 mbar)	User
	Check the oil level. ↳ *Chapter 8.3.2 'Checking the oil level' on page 132* Correct if necessary. ↳ *Chapter 8.3.3 'Correcting the oil level' on page 134*	User
	If the maximum value (-45 mbar) is exceeded, change the intake filter. ↳ *Chapter 8.3.6 'Replacing the intake filter' on page 147*	Service personnel
	Check the belt guard for total stability and for damage and contamination. ↳ *Chapter 8.3.15 'Checking the belt guard' on page 154* Remove any dirt from the outer belt guard.	User
	If the belt guard is not completely stable or is damaged, contact customer service.	Manufacturer's customer service division
After every 2,000 op. hrs or every 3 months	Replace the intake filter. ↳ *Chapter 8.3.6 'Replacing the intake filter' on page 147* Check that the pressure valve is operating correctly and clean it. ↳ *Chapter 8.3.10 'Checking the pressure valve' on page 150*	Service personnel
Drive motor relubrication intervals	Observe the instruction manual and signage of the drive motor!	Service personnel
After every 4,000 op. hrs or every 6 months	Check and clean the inlet and exhaust air openings on the acoustic hood. ↳ *Chapter 8.3.14 'Checking the inlet and exhaust air openings on the acoustic hood' on page 153* Check the condition of the belts. If necessary, replace them. ↳ *Chapter 8.3.9 'Replacing belts' on page 148* Inspect the sheaves for unusual wear and tear or obvious damage. Inspect for alignment and stability. ↳ *Chapter 8.3.7 'Checking the sheaves' on page 147* Replace the lube oil at a discharge temperature of over 140 °C. *This interval is skipped when using Delta Lube 06 lube oil.* ↳ *Chapter 8.3.5 'Changing oil' on page 141*	Service personnel

Interval	Maintenance work	Personnel
	When using AERZEN special rotary piston oil with a gas-tight shaft seal, replace the grease at a discharge temperature of over 140 °C. *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139* Replace grease when using lube oil with an ISO VG 220 viscosity class in conjunction with a gas-tight shaft seal. *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139*	
	If necessary, replace the sheaves.	Manufacturer's customer service division
	Check that the pressure valve is operating correctly. *Chapter 8.3.10 'Checking the pressure valve' on page 150*	Service personnel
After every 8,000 op. hours or every 12 months	Replace the intake filter. *Chapter 8.3.6 'Replacing the intake filter' on page 147* Replace the lube oil. *Chapter 8.3.5 'Changing oil' on page 141* Lube oil: Replace Delta Lube 06. *Chapter 8.3.5 'Changing oil' on page 141* Replace the grease. *Chapter 8.3.4 'Replacing the grease on gas-tight drive shafts' on page 139* Check non-return flap for wear and tightness. Replace if necessary. *Chapter 8.3.12 'Checking the non-return flap' on page 151*	Service personnel
	Check the control system for correct operation.	Manufacturer's customer service division
After every 16,000 op. hrs or every 2 years	Replace the belts. *Chapter 8.3.9 'Replacing belts' on page 148* Check the alignment of the sheaves. If necessary, correct it. *Chapter 8.3.7 'Checking the sheaves' on page 147* Check flexible pipe connections on the discharge and intake sides for tightness. Replace if necessary. *Chapter 8.3.16 'Checking pipelines for tightness.' on page 154*	Service personnel
After every 20,000 op. hrs or every 3 years	Check hose lines for tightness. Replace if necessary. Recommendation: replace hose lines every 6 years.	Service personnel
	Recommended main inspection/maintenance. Inspection, changing of replacement and expendable parts. Entire machine check.	Manufacturer's customer service division

op. hrs = operating hours

8.3 Maintenance work

Preparation

1. Agree maintenance work with the responsible staff at the location.
2. Switch off the machine.
3. Activate the EMERGENCY STOP function.
4. Switch off the main circuit breaker and secure it against restarting.
5.

   DANGER!
   Risk of injury from electric current!

   Ensure there is no live electricity.
6.

   DANGER!
   Risk of injury during maintenance work!

   Open the maintenance elements.
7.

   DANGER!
   Risk of injury during maintenance work!

   Open the belt guard cover.

8.3.1 First oil filling

Filling oil/models with acoustic hood

Fig. 94: Filling with oil

1. Check the drain valve for firm seating.
2. Check that the sealing cap of the drain valve is firmly in place.
3. Open the oil container.
4. Ensure that the ventilation pipe in the oil filling container is unobstructed.
5.

CAUTION!
Risk of skin irritation from lube oil!

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Observe the oil quantity ↳ *Chapter 11.7.4 'Lubricant quantities' on page 182* and specification ↳ *Chapter 11.7.1 'Lubricant oil specifications' on page 177*.

First, fill 3/4 of the listed quantity of oil.

6. Wait 5 - 10 minutes. The lube oil continues to flow.
   ⇨ The oil level regulates itself in the oil system and in the oil chambers.
7. Check the oil level.
8. Fill the rest of the lube oil up to the mark on the sight glass. Observe the after-run time of the lube oil.
   ⇨ The oil level is correct when it is between min. and max.
9. Close the oil filling container.
10.

ENVIRONMENT!
Risk of environmental damage from incorrect storage of lube oil!

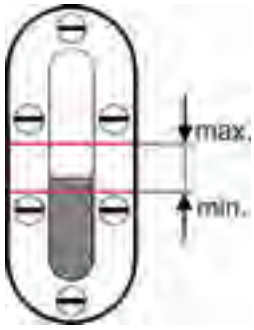


Fig. 95: Sight glass for oil level display

Clean the workspace thoroughly.

Dispose of residual lube oil in an environmentally-friendly way.

Clean all auxiliary equipment.

Filling with oil (models without acoustic hoods)

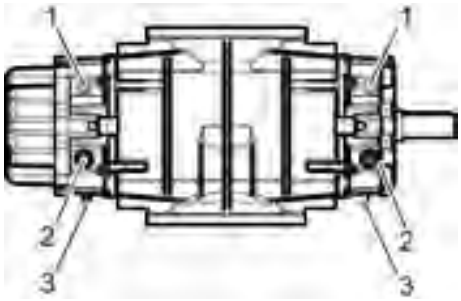


Fig. 96: GM 3S - GM 80L

1 Oil fill openings, marked in red
2 Oil level displays
3 Drain valves

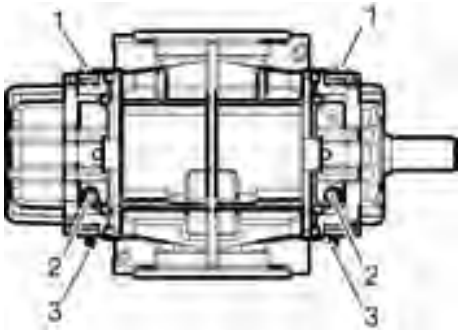


Fig. 97: GM 90S - GM 400L

1. Check the drain valves (pos. 3) for firm seating.

2. Check the sealing caps of the drain valves (pos. 3) for firm seating.

3. Open the oil fill openings (pos.1) – the RED-marked locking screws.

4. Observe the oil quantity distribution.

Guide value:

- 1/3 of the entire lube oil quantity in the driving side.
- 2/3 of the entire lube oil quantity in the wheel side.
  The display in the oil level sight glass is crucial.

5.

CAUTION!
Risk of skin irritation from lube oil!

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Observe the oil quantity ↳ *Chapter 11.7.4 'Lubricant quantities' on page 182* and specification ↳ *Chapter 11.7.1 'Lubricant oil specifications' on page 177*.

Fill with lube oil. To do this, fill with approx. 3/4 of the entire oil quantity. Fill this reduced total oil quantity according to the oil quantity distribution (approx. 1/3 driving side, approx. 2/3 wheel side) into both oil chambers.

6. Observe the oil level. Wait 5 - 10 minutes. The lube oil continues to flow.

⇨ The oil level regulates itself in the oil system and in the oil chambers.

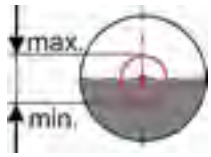


Fig. 98: Sight glass for oil level display (pos. 2)

7. Check the lube oil level.
8. Fill the rest of the lube oil up to the mark on the sight glass.
   ⇨ The oil level is correct when it is between min. and max.
9. Close the oil fill opening (pos. 1) tightly with a seal.
10. **ENVIRONMENT!**
    Risk of environmental damage from incorrect storage of lube oil!

    Clean the workspace thoroughly.

    Dispose of residual lube oil in an environmentally-friendly way.

    Clean all auxiliary equipment.

8.3.2 Checking the oil level

Oil system/models with acoustic hood

Fig. 99: Oil system

1 Oil fill opening (oil filling container)
2 Oil level display
3 Oil drain

Checking the oil level

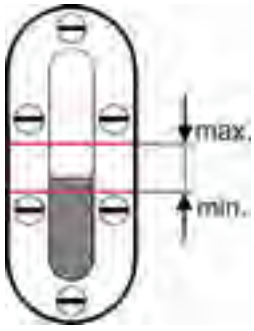
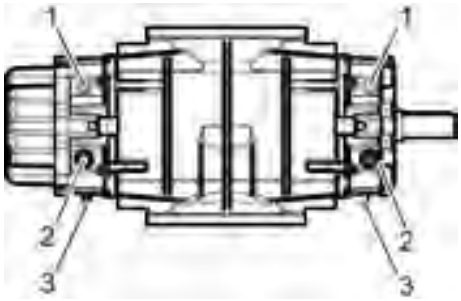


Fig. 100: Sight glass for oil level display

Check the lube oil level, correct if necessary.

Oil system/models without acoustic hood



1 Oil fill openings, marked in red
2 Oil level displays
3 Drain valves

Fig. 101: GM 3S - GM 80L

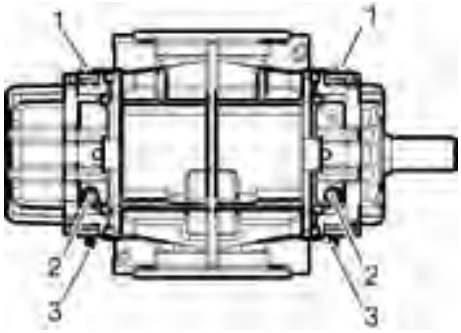


Fig. 102: GM 90S - GM 400L

Checking the oil level

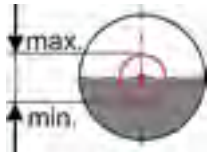


Fig. 103: Sight glass for oil level display

→ Check the lube oil level and correct it if necessary.

8.3.3 Correcting the oil level

8.3.3.1 Oil level too high

Oil drainage (models with acoustic hood)

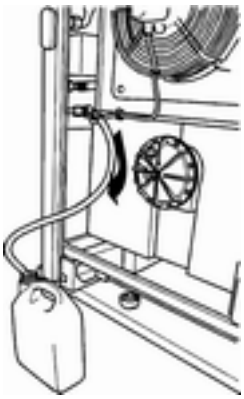


Fig. 104: Draining oil

1. **WARNING!**
   Risk of scalding from hot lube oil!

   NOTICE!
   Material damage to the drain hose from lube oil temperatures over 60°C!

   Allow the lube oil to cool down to the ambient temperature.

2. *Observe the volume of the waste oil and the oil-resistant receptacle.* ↳ *'Machine lube oil levels' on page 182*

   Have a receptacle ready.

3. Open the oil opening on the oil filling container.

   ⇨ Lube oil flows out more evenly from the oil drain.

4. Feed the drain hose into the receptacle.

Fig. 105: Fitting the drain hose

5. **CAUTION!**
   Risk of skin irritation from old lube oil!

   Remove the sealing cap from the drain valve.

   Twist the drain hose onto the drain valve.

   ⇨ The drain valve opens automatically.

6. **CAUTION!**
   Risk of slipping from oil spillage!

   Guide excess lube oil into the receptacle.

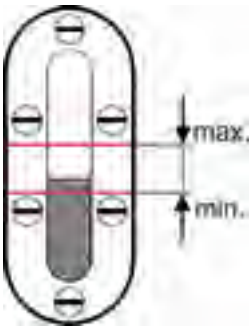


Fig. 106: Sight glass for oil level display

7. Observe and check the oil level.
8. If the permissible oil level is reached, remove the drain hose.
   ⇨ The drain valve closes automatically.
9. Screw the sealing cap onto the drain valve.
10. Close the oil fill opening.
11. **ENVIRONMENT!**
    Risk of environmental damage from waste oil!

    Collect waste lube oil and residual oil properly and dispose of it in an environmentally-friendly manner.

    Clean the workspace thoroughly.

    Clean all auxiliary equipment.

Oil drainage (models without acoustic hoods)

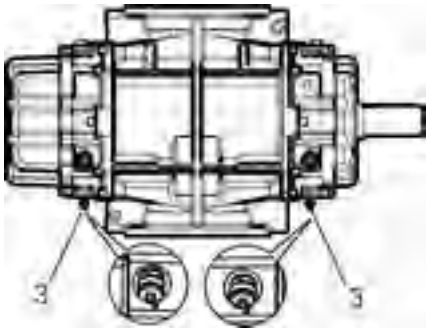


Fig. 107: Oil drain

3 Drain valves

1. **WARNING!**
   Risk of scalding from hot lube oil!

   Allow the lube oil to cool down to the ambient temperature.
2. *Observe the volume of the waste oil and the oil-resistant receptacle.* ↳ *'Machine lube oil levels' on page 182.*

   Have a receptacle ready.
3. Select an oil chamber with an excessively high filling capacity.
4. Open the oil fill opening.
   ⇨ Lube oil flows out more evenly from the oil drain.

5. **CAUTION!**
Risk of skin irritation from old lube oil!

A locking screw or a shut-off valve can be used as an alternative to the drain valve.

The oil chamber can be opened by:

– *removing the locking screw*
or by
– *removing the sealing plug on the shut-off valve. Open the shut-off valve.*

Remove the sealing cap from the drain valve.

If the sealing cap is very tightly in place, secure the drain valve using a wrench and loosen the sealing cap with an additional wrench.

6. **NOTICE!**
Material damage to the drain hose from lube oil temperatures over 60°C!

Feed the drain hose into the receptacle.

7. Twist the drain hose onto the drain valve.

⇨ The drain valve opens automatically.

8. **CAUTION!**
Risk of slipping from oil spillage!

Guide any excess lube oil into the receptacle.

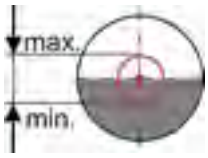


Fig. 108: Sight glass for oil level display

9. Observe and check the oil level.

10. If the oil level has been corrected, remove the drain hose.

⇨ The drain valve closes automatically.

A sealing screw or a shut-off valve can be used as an alternative to the drain valve.

The oil chamber can be closed by:

– *mounting the locking screw with a new sealing ring*
or by
– *closing the shut-off valve. Seal the output of the shut-off valve with sealing plugs.*

11. Screw the sealing cap onto the drain valve.
12. Close the oil fill opening.
13. **ENVIRONMENT!**
Risk of environmental damage from waste oil!

Collect waste lube oil and residual oil properly and dispose of it in an environmentally-friendly manner.

Clean the workspace thoroughly.

Clean all auxiliary equipment.

8.3.3.2 Oil level too low

Oil drainage/models with acoustic hood

Fig. 109: Filling with oil

1. Check the drain valve for firm seating.
2. Check the sealing cap of the drain valve for firm seating.
3. Open the oil filling container.
4. Ensure that the ventilation pipe in the oil filling container is unobstructed.
5. **CAUTION!**
Risk of skin irritation from lube oil!

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Specifications ↳ *Chapter 11.7.1 'Lubricant oil specifications' on page 177*

Fill the lube oil in stages and in small quantities.

6. Observe the oil level. Wait 5 - 10 minutes. The lube oil continues to flow.
   ⇨ The oil level regulates itself in the oil system and in the oil chambers.

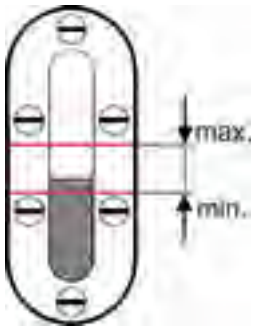


Fig. 110: Sight glass for oil level display

7. Check the oil level.
8. If the lube oil level is between the min.-/max. marks:
   ⇨ the oil level is OK.
9. If the lube oil level is beyond the min.-/max. marks:
   ⇨ Correct the oil level.
10. Close the oil filling container.
11. **ENVIRONMENT!**
    Risk of environmental damage from incorrect storage of lube oil!

    Clean the workspace thoroughly.

    Dispose of residual lube oil in an environmentally-friendly way.

    Clean all auxiliary equipment.

Filling with oil (models without acoustic hoods)

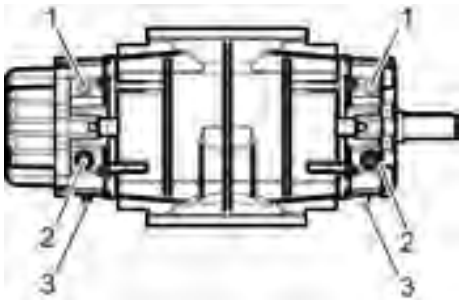


Fig. 111: GM 3S - GM 80L

1 Oil fill openings, marked in red
2 Oil level displays
3 Drain valves

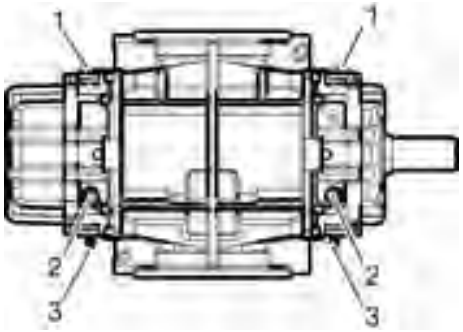


Fig. 112: GM 90S - GM 400L

1. Select the required oil chamber.
2. Check the drain valve (pos. 3) for firm seating.
3. Check sealing cap of the drain valve (pos. 3) for firm seating.
4. Open the oil fill opening, the RED-marked locking screw.

5. **CAUTION!**
Risk of skin irritation from lube oil!

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Observe the specifications *Chapter 11.7.1 'Lubricant oil specifications' on page 177*.

Fill the lube oil in stages and in small quantities.

6. Observe the oil level. Wait 5 - 10 minutes. The lube oil continues to flow.

⇨ The oil level regulates itself in the oil system and in the oil chambers.

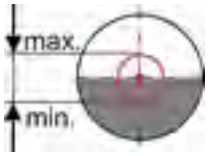


Fig. 113: Sight glass for oil level display (pos. 2)

7. Check the lube oil level.
8. If the lube oil level is between the min.-/max. marks:

⇨ the oil level is OK.

9. If the lube oil level is beyond the min.-/max. marks:

⇨ Correct the oil level.

10. Close the oil fill opening tightly with a seal.
11. If necessary, repeat the process at the other oil chamber.
12. **ENVIRONMENT!**
Risk of environmental damage from incorrect storage of lube oil!

Clean the workspace thoroughly.

Dispose of residual lube oil in an environmentally-friendly way.

Clean all auxiliary equipment.

8.3.4 Replacing the grease on gas-tight drive shafts

The replacement of grease is only required for the gas-tight version of the drive shaft (optional).

Press the grease a few operating hours before the lubricating oil change. The used, excess grease reaches the oil chamber of the machine stage and is discharged with the lubricating oil change.

Pressing the grease

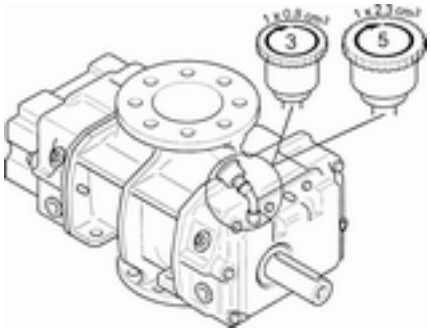


Fig. 114: Stauffer lubricator

1. **WARNING!**
   Risk of burning from hot housing surfaces!

   Allow the housing surfaces to cool down to ambient temperature.
2. Press the grease by turning the Stauffer lubricator.

   CAUTION!
   Risk of skin irritation from escaping grease!

   Observe the grease amount and number of turns. *'Grease filling quantity for machine stage' on page 183*
3. After pressing the required amount of grease, turn the Stauffer lubricator one revolution backwards. The volume of grease can then expand when it is heated.
4. Open the Stauffer lubricators and fill them with grease. Observe the specification of the grease. *Chapter 11.7.3 'Grease specifications' on page 180*

8.3.5 Changing oil

Oil drainage (models with acoustic hood)

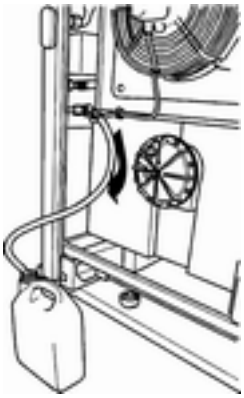


Fig. 115: Draining oil

1. **WARNING!**
   Risk of scalding from hot lube oil!

   NOTICE!
   Material damage to the drain hose from lube oil temperatures over 60°C!

   Allow the lube oil to cool down to the ambient temperature.
2. *Observe the volume of the waste oil and the oil-resistant receptacle.* ↬ *'Machine lube oil levels' on page 182*

   Have a receptacle ready.
3. Open the oil opening on the oil filling container.
   ⇨ Lube oil flows out more evenly from the oil drain.
4. Feed the drain hose into the receptacle.
5. **CAUTION!**
   Risk of skin irritation from old lube oil!

   Remove the sealing cap from the drain valve.

   Twist the drain hose onto the drain valve.

   ⇨ The drain valve opens automatically.

Fig. 116: Fitting the drain hose

6. **CAUTION!**
   Risk of slipping from oil spillage!

   Guide all emerging lube oil into the receptacle.
7. Remove the drain hose.
   ⇨ The drain valve closes automatically.
8. Screw the sealing cap onto the drain valve.
9. Close the oil filling container.

10. **ENVIRONMENT!**
Risk of environmental damage from waste oil!

Collect waste lube oil and residual oil properly and dispose of it in an environmentally-friendly manner.

Clean the workspace thoroughly.

Clean all auxiliary equipment.

Filling with oil

Fig. 117: Filling with oil

1. Check the drain valve for firm seating.
2. Check the sealing cap of the drain valve for firm seating.
3. Open the oil filling container.
4. Ensure that the ventilation pipe in the oil filling container is unobstructed.
5. **CAUTION!**
Risk of skin irritation from lube oil!

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Observe the oil quantity ↳ *Chapter 11.7.4 'Lubricant quantities' on page 182* and specification ↳ *Chapter 11.7.1 'Lubricant oil specifications' on page 177*.

First, fill 3/4 of the listed total quantity of lube oil.

6. Wait 5 - 10 minutes. The lube oil continues to flow.

⇨ The oil level regulates itself in the oil system and in the oil chambers.

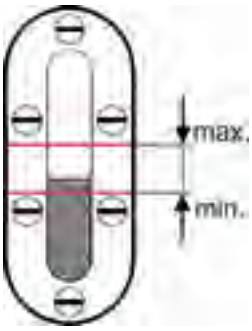


Fig. 118: Sight glass for oil level display

7. Check the oil level.
8. If the lube oil level is between the min.-/max. marks:
   ⇨ The oil level is OK.
9. If the lube oil level is beyond the min.-/max. marks:
   ⇨ Correct the oil level.
10. Close the oil filling container.
11. **ENVIRONMENT!**
    Risk of environmental damage from incorrect storage of lube oil!

    Clean the workspace thoroughly.

    Dispose of residual lube oil in an environmentally-friendly way.

    Clean all auxiliary equipment.

Oil drainage (models without acoustic hoods)

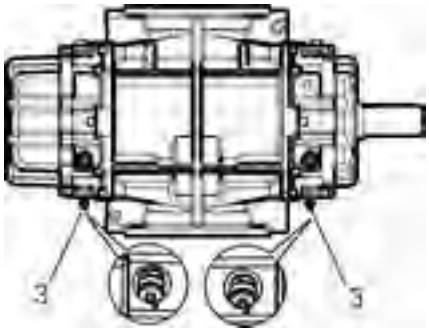


Fig. 119: Oil drain

1. **WARNING!**
   Risk of scalding from hot lube oil!

   Allow the lubricating oil to cool down to ambient temperature.
2. *Observe the volume of the waste oil and the oil-resistant receptacle.* ↳ *'Machine lube oil levels' on page 182*

   Have a receptacle ready.
3. Open the oil fill opening.
   ⇨ Lube oil flows out more evenly from the oil drain.

4. **CAUTION!**
Risk of skin irritation from old lube oil!

Remove the sealing cap from the drain valve.

A locking screw or a shut-off valve can be used as an alternative to the drain valve.

The oil chamber can be opened by:

– *removing the locking screw*
or by
– *removing the sealing plug on the shut-off valve. Open the shut-off valve.*

5. **NOTICE!**
Material damage to the drain hose from lubricating oil temperatures over 60°C!

Place the drain hose into the receptacle.

6. Twist the drain hose onto the drain valve.
⇨ The drain valve opens automatically.

7. **CAUTION!**
Risk of slipping from oil spillage!

Guide all emerging lube oil into the receptacle.

8. Remove the drain hose.
⇨ The drain valve closes automatically.

A sealing screw or a shut-off valve can be used as an alternative to the drain valve.

The oil chamber can be closed by:

– *mounting the locking screw with a new sealing ring*
or by
– *closing the shut-off valve. Seal the output of the shut-off valve with sealing plugs.*

9. Screw the sealing cap onto the drain valve.

10. Close the oil fill opening.

11. **ENVIRONMENT!**
Risk of environmental damage from waste oil!

Collect waste lube oil and residual oil properly and dispose of it in an environmentally-friendly manner.

Clean the workspace thoroughly.

Clean all auxiliary equipment.

Filling with oil

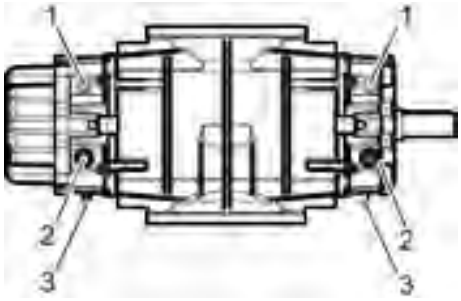


Fig. 120: GM 3S - GM 80L

1 Oil fill openings, marked in red
2 Oil level displays
3 Drain valves

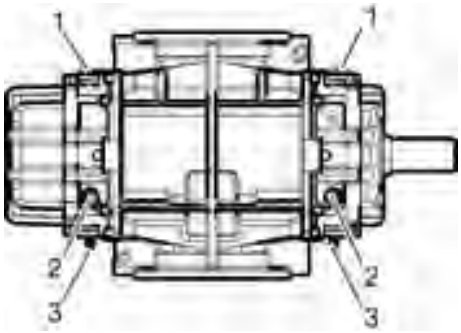


Fig. 121: GM 90S - GM 400L

1. Check the drain valves (pos. 3) for firm seating.

2. Check the sealing caps of the drain valves (pos. 3) for firm seating.

3. Open the oil fill openings (pos.1), the RED-marked locking screws.

4. Observe the oil quantity distribution.

Guide value:

- 1/3 of the entire lube oil quantity in the driving side.
- 2/3 of the entire lube oil quantity in the wheel side.
  The display in the oil level sight glass is crucial.

5. **CAUTION!**
Risk of skin irritation from lube oil!

ENVIRONMENT!
Environmental risks from incorrect handling of lubricants!

Observe the oil quantity *Chapter 11.7.4 'Lubricant quantities' on page 182* and specification *Chapter 11.7.1 'Lubricant oil specifications' on page 177*.

Fill with lube oil. To do this, fill with approx. 3/4 of the entire oil quantity. Fill this reduced total oil quantity according to the oil quantity distribution (approx. 1/3 driving side, approx. 2/3 wheel side) into both oil chambers.

6. Observe the oil level. Wait 5 - 10 minutes. The lube oil continues to flow.

   ⇨ The oil level regulates itself in the oil system and in the oil chambers.

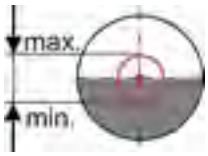


Fig. 122: Sight glass for oil level display (pos. 2)

7. Check the lube oil level.
8. Fill the rest of the lube oil up to the mark on the sight glass.

   ⇨ The oil level is correct when it is between min. and max.

9. Close the oil fill opening (pos. 1) tightly with a seal.
10. **ENVIRONMENT!**
Risk of environmental damage from incorrect storage of lube oil!

Clean the workspace thoroughly.

Dispose of residual lube oil in an environmentally-friendly way.

Clean all auxiliary equipment.

8.3.6 Replacing the intake filter

Replacing the intake filter

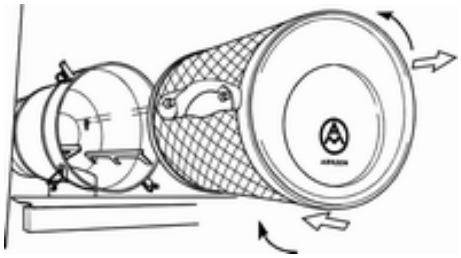


Fig. 123: Replacing the intake filter

1. **CAUTION!**
   Risk of air contamination from scattered dust particles.

   Open the cap locks of the intake silencer.
2. Remove the maintenance flap.
3. Loosen the intake filter by turning it anti-clockwise and remove it.
4. **NOTICE!**
   Risk of machine damage from objects inside the intake silencer that enter the intake opening.

   Remove residual dust inside the intake silencer.
5. Replace the intake filter.
6. Fasten the intake filter in place by turning it clockwise. Check that it is aligned correctly.
7. Fasten the maintenance flap on the housing of the intake silencer using the catch.
8. Reset the maintenance indicator (in accordance with the given variation).

8.3.7 Checking the sheaves

For wear and tear and damage

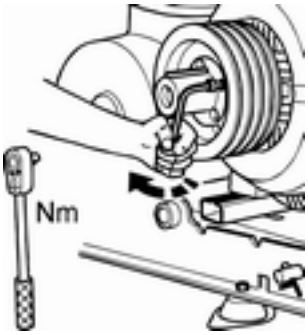


Fig. 124: Sheaves

1. Check for unusual wear and tear or obvious damage.
2. Check for correct alignment and stability.
3. If necessary, replace the sheaves.
4. Assemble the sheaves.
5. Fit the belt.

8.3.8 Moving/checking the protective cover of the sheaves

Moving on models without acoustic hood

Fig. 125: Protective cover

1. Loosen the fitting of the protective cover before lifting the hinged motor support.
   ⇨ The protective cover can now be moved.
2. Lift the hinged motor support, e.g. for changing the belts.
3. Lower the hinged motor support.
   ⇨ The weight of the motor creates tension in the belts.
4. Push the protective cover in the direction of the motor shaft and tighten it.

Testing on models without acoustic hood

1. Check the spacing of the protective cover of the motor shaft.
   During operation, the protective cover should be at a distance of approx. 10 mm from the motor drive shaft.
2. Check the protective cover for firm seating and, if necessary, tighten it.

8.3.9 Replacing belts

Raising the hinged motor support

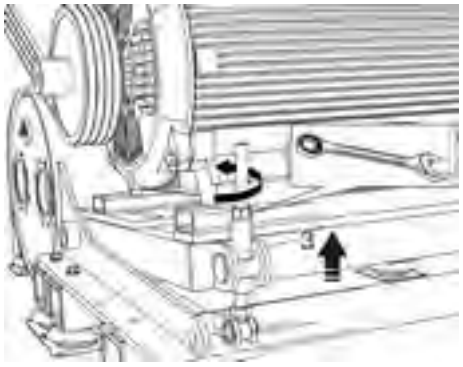


Fig. 126: Raising the hinged motor support

1. **WARNING!**
   Risk of injury from moving or rotating components!
   Lift the hinged motor support using the hinge jig.
2. Turn guide bushing (pos.3) anti-clockwise using the ratchet wrench.
   ⇨ The hinged motor support is raised.
3. Raise the hinged motor support until the belts are fully relieved of tension.
4. *Only replace belts as a set!*

5. Replace belts.

WARNING!
Risk of getting caught by rotating sheaves!

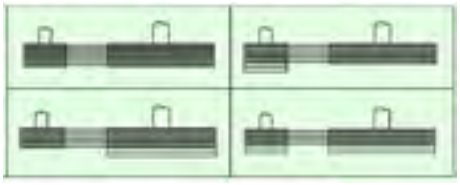


Fig. 127: Permissible belt layout

6. Observe the permissible groove layout.

Pre-tensioning the belts

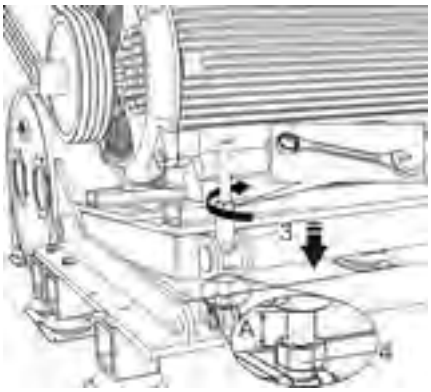


Fig. 128: Pre-tensioning the belts

7.

CAUTION!
Risk of injury from tensioning components!

Turn guide bushing (pos.3) clockwise with the ratchet wrench until the belts are pre-tensioned.

⇨ The hinged motor support is partly held by the belt drive and rests lightly on the guide bushing (pos.3).

Adjusting the guide bushing

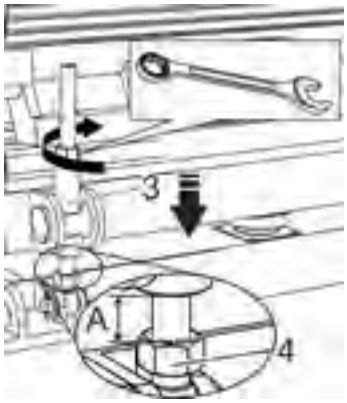


Fig. 129: Adjusting the gauge of the guide bushing

8. Set gauge A.

- Set self-locking nut (pos.4) to gauge A. Turn guide bushing (pos.3) on to the self-locking nut (pos.4) using the ratchet wrench.

DN/discharge side	Gauge A in mm
80	20
100	25
125	30
150	35
200	40
250	45
300	50
Delta Blower G5	

Tensioning the belts

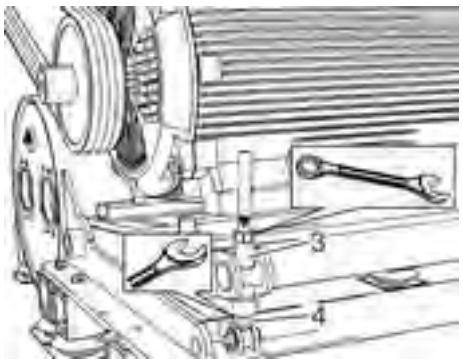


Fig. 130: Tensioning the belts

9. ▶

CAUTION!
Risk of injury from moving and rotating components!

Tension the belts.

- Secure the guide bushing (pos.3) with the self-locking nut (pos.4).
- The hinged motor support is supported entirely by the belt drive.

Checking the protective cover

Fig. 131: Protective cover of the sheaves

10. ▶ Check the spacing of the protective cover of the motor shaft.

The protective cover should be at a distance of approx. 10 mm from the motor drive shaft.

By loosening the fastening screws, the protective cover can be moved.

Check the protective cover for firm seating and, if necessary, tighten it.

8.3.10 Checking the pressure valve

Movement test

- G2", G3", DN 50, DN 80, DN 125

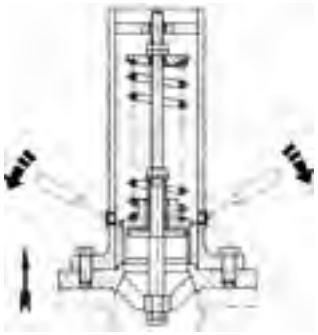


Fig. 132: using a screwdriver

1. ▶ Remove the protective caps or locking screws from the maintenance holes in the protective cylinder.

2. ▶ Guide a screwdriver into each hole.

3. ▶ Raise the valve bell with the screw drivers using leverage force.

⇨ The valve's opening function must be operational and the valve must move.

4. ▶ Lower the valve bell.

5. ▶ Remove the screwdrivers.

⇨ An intact valve will close.

6. ▶ Insert the protective caps or sealing screws into the maintenance holes in the protective cylinder.

Movement test

- DN 150, DN 200, DN 300

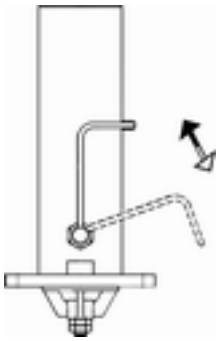


Fig. 133: using the stirrup

1. Raise the valve bell using the stirrup.
   ⇨ The valve's opening function must be operational and the valve must move.
2. Release the pressure on the stirrup and lower the valve bell.
   ⇨ An intact valve will close.

8.3.11 Checking that sealing plugs have been removed

Ensuring that the balancing holes are unobstructed

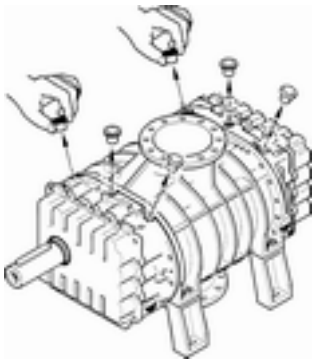


Fig. 134: Sealing plug configuration

1. Check that the (plastic) sealing plugs have been removed from the balancing holes.

   The sealing plugs are coated in machine-colour paint as part of the manufacturing process.

   The number of sealing plugs varies depending on the machine type!

   Depending on the design, they may already have been removed before shipping or during preparations for commissioning.

   ⇨ If there are no more sealing plugs in place: Finish the check.
2. The balancing holes are sealed.
   ⇨ Remove the sealing plugs. Finish the check.

8.3.12 Checking the non-return flap

Checking for wear and tear and tightness

Fig. 135: Non-return flap

1. Loosen the fastening screws.

   Light impact on the flange cover of the non-return flap loosens the sealing and makes disassembly easier.
2. Remove the non-return flap from the housing.
3. Carry out a visual inspection.

4. If no damage and/or hardening is visible, the sealing is acceptable.

   ⇨ Re-use the non-return flap.

5. If damage and/or hardening is visible, the sealing is not acceptable.

   ⇨ Replace the non-return flap.

Assembling the non-return flap

1. Remove dirt, grease and used sealing agent from the flange surface.
2. Apply sealing agent (liquid surface sealant) to the flange surface of the housing.
3. Guide the non-return flap into the housing.

Remove any bleeding sealing agent with a cloth. Observe the curing time of the sealing material!

4. Screw on the flange cover.

8.3.13 Cleaning the nozzle of the start-up relief device

Cleaning the nozzle

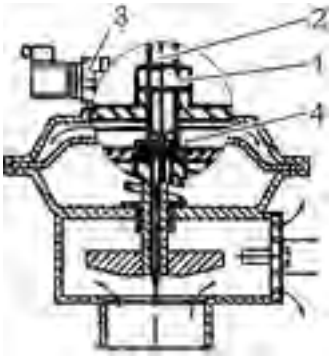


Fig. 136: Start-up relief device

1. Loosen the counternut (pos. 1).
2. Remove the spindle (pos. 2).

   ⇨ The nozzle (pos. 4) in the hole is accessible.

3. **WARNING!**
   Risk of injury from escaping dirt particles!

   Blow compressed air into the nozzle (pos. 4).

   ⇨ Unobstructed cross-section of the nozzle.

4. Mount the spindle (pos. 2).
5. Setting the closing time of the start-up relief device. *Chapter 11.10.3 'Start-up unloading device DN 80 to DN 400' on page 186*
6. Secure the spindle (pos. 2) with the nut (pos. 1).

8.3.14 Checking the inlet and exhaust air openings on the acoustic hood

Checking the inlet and exhaust air openings

1. Visual inspection of the supply air and exhaust air openings on the acoustic hood.
2. Clean the openings. Remove dirt.

Checking fan operation

1. Check the direction of flow in the operating position with a closed acoustic hood. Observe the information in the installation drawing.
2. If exhaust air is extracted from the acoustic hood, the check is finished.
   ⇨ The acoustic hood fan is operating correctly.
3. If no exhaust air emerges from the acoustic hood, the fan is malfunctioning.
   ⇨ Replace the fan.

Replacing the fan

1. Open the maintenance elements of the acoustic hood.
2.

   WARNING!
   Risk of injury from rotating components!

   Loosen the screws for attaching the fan.
3. Pull the fan from the shaft and replace it.
4. Seal the screw for attaching with liquid thread locker.
5. Screw on the fan.
6. Close the maintenance elements of the acoustic hood.
7. Check the cooling air flow during machine operation.

8.3.15 Checking the belt guard

Damage and stability

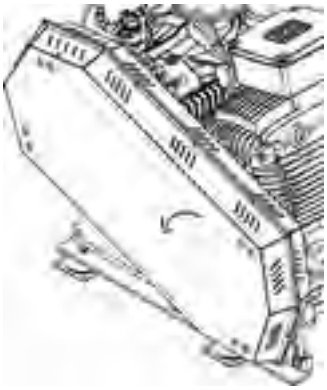


Fig. 137: Belt guard

1. **WARNING!**
   Risk of injury from hot surfaces!

   Check for damage and thorough stability.

   (stable on the base support and machine stage)
2. Remove dirt from the belt guard.
3. If necessary, tighten the belt guard fastener. If damaged, replace it.
4. Beware of any lubricant bleeding out of the drive motor. If lubricant bleeds out, inform the responsible staff at the location.

   Seal any leaks.

8.3.16 Checking pipelines for tightness.

Checking discharge-side pipelines for tightness

1. Check pipelines for tightness (visual inspection).

   Ensure that the pipelines have been depressurised!
2. If there are leaks
   ⇨ Replace seals or bushing.
3. Reinforce the pipelines if necessary.
4. Disassemble leaking pipe connections.
5. Use new seals or bushing.
6. Assemble pipe connections.

8.4 Cleaning after maintenance

Cleaning after maintenance work

1. **NOTICE!**
   Risk of damage! Do not used high pressure cleaners, steam jet pumps, grease removal agents, thinners, compressed air etc. as cleaning methods.
2. Dust and dirt must be cleaned with suitable cloths.

3. Clean components susceptible to scratches, display units and touch panels of control systems, gauges etc. with a soft, wet towel.
4. Remove all cleaning agents from the immediate vicinity of the machine before commissioning.
5. Dispose of cloths in an environmentally-friendly way.

8.5 Commissioning after maintenance

Commissioning after maintenance

1. Inform the responsible on-site person about the result of the work carried out and agree commissioning steps with that person.
2. Check all previously loosened screw connections for tightness.
3. Mount all protective hardware and covers that were previously removed.
4. Remove all used tools, materials and other equipment from the workspace.
5. Clean the workspace. Remove operating substances, operating material, processing material and similar materials and dispose of them appropriately.
6. Ensure that there are no persons in the hazard area.
7. Release the main circuit breaker and activate it.
8. Release the EMERGENCY STOP function.
   ⇨ Start operation in accordance with the instructions in the “Operation” chapter.
9. Inform the responsible on-site person about the result of the work carried out.

8.6 Checks after maintenance work

Inspection	After the first 3 op. hrs	After the first 25 op. hrs
Pressure valve	check for correct operation	
Oil level	check, correct if necessary	check, correct if necessary
Aligning the sheaves		check, correct if necessary
op. hrs = operating hours		

9 Malfunctions

The following chapters describe possible causes of faults and steps to be taken to rectify them.

If faults cannot be rectified using the following instructions, contact the manufacturer.

9.1 Safety instructions

Improper fault rectification

WARNING!

Risk of injury from improper operation fault rectification!

Improper fault rectification may lead to serious personal or material damage.

- Only perform maintenance work when the machine has been taken out of commission.
- Secure the machine against restarting.
- Allow the machine to cool down to the ambient temperature.
- Before beginning work, ensure that there is sufficient space for installation work.
- Check the tidiness and cleanliness of the workspace.
- Only attempt to rectify faults with suitable tools.
- Ensure removed components are re-installed correctly.
- Re-install all fastening elements and observe the screw tightening torques.
- Before restarting, check that:
  - all safety and protective equipment is installed and functioning correctly.
  - there are no persons in the hazard area.

Electrical system

DANGER!

Risk of fatal injury from electrical current!

There is a risk of fatal injury from touching live components. Live electrical components may make uncontrolled movements and cause extremely serious injury.

- Before beginning work, switch off the electric power supply and secure it against restarting.

Securing the machine against restarting

WARNING!

An unauthorised or unregulated restart can have fatal consequences.

An unauthorised or unregulated restart of the machine can lead to serious or fatal injuries. There may be people located in the hazard area.

– Before beginning work, switch off the energy supply and secure it against restarting.

Requirements for staff

The fault rectification work described here may only be performed by the designated personnel. The personnel entrusted with the respective fault rectification tasks are listed in the table of fault descriptions in addition to their designated tasks.

Requirements in the event of malfunctions and for preparations for fault rectification work:

Personnel:
- Authorised electricians
- Service personnel

For commissioning after rectification of a malfunction, the following is necessary:

Personnel:
- Authorised electricians
- Service personnel

Protective equipment

For fault rectification work the following is necessary:

Protective equipment:
- Protective work clothing
- Protective gloves
- Safety shoes

Special tools

For fault rectification work the following is necessary:

Special tool:
- General tool kit
- Ratchet wrench
- Tools for authorised electricians
- General measurement tools and equipment

Special tool:
- Locking key

Behaviour in the event of faults

1. **DANGER!**
   Risk of injury during fault rectification!
2. In the event of a malfunction, activate the EMERGENCY STOP immediately.
3. Switch off the main circuit breaker and secure it.
4. Immediately inform the responsible staff on location about the fault.
5. **DANGER!**
   Risk of fatal injury from electric current!
6. Ensure there is no live current.
7. Ground and short-circuit the unit.
8. Cover or shut off adjacent live parts.
9. Establish the cause of the fault.

9.2 Fault displays

AERtronic (optional) fault message

Fig. 138: AERtronic display

A detailed explanation of fault messages is contained in the separate operating manual AS-002.

Control system fault message

Depending on the customer's control system, additional fault messages can be recorded and displayed.

9.3 Fault diagnosis and troubleshooting

If, among the faults listed here, a fault occurs that can only be rectified by the manufacturer, contact customer service immediately. *Chapter 1.4.2 'Customer service' on page 11*

Fault description	Cause	Remedy	Personnel
Abnormal running sounds	Sheaves are not aligned properly.	Check and, if necessary, correct alignment. ↳ *Chapter 8.3.7 'Checking the sheaves' on page 147*	Service personnel
	Bearing damage.	Replace bearings.	Manufacturer's customer service division
	Foreign bodies in gear wheels.	Check gear wheels, rectify the damaged areas and if necessary, replace them.	Manufacturer's customer service division
	Shaft deflection.	Locate shaft deflection, replace it.	Manufacturer's customer service division
Start unloading device does not close.	Nozzle is contaminated.	Clean the nozzle. ↳ *Chapter 8.3.13 'Cleaning the nozzle of the start-up relief device' on page 152*	Service personnel
The machine becomes too hot.	Intake filter contaminated (display unit: max. -45 mbar).	Replace the intake filter. ↳ *Chapter 8.3.6 'Replacing the intake filter' on page 147*	Service personnel
	The ambient temperature is too high.	Ensure there is adequate ventilation.	User
	Openings of the acoustic hood for supply air and exhaust air are contaminated.	Clean the openings. ↳ *Chapter 8.3.14 'Checking the inlet and exhaust air openings on the acoustic hood' on page 153*	User
	The acoustic hood fan is malfunctioning.	Replace the fan. ↳ *'Replacing the fan' on page 153*	Service personnel
	The permissible operating data have been exceeded.	Check operating data, comply with correct data. ↳ *Chapter 11.3 'Operating data' on page 170*	User
	Foreign bodies on the belt guard.	Remove dirt.	User
Oil present in conveyed medium.	Wear and tear on seals.	Replace seals.	Manufacturer's customer service division
	Oil level too high.	Correct the oil level. ↳ *Chapter 8.3.3 'Correcting the oil level' on page 134*	Service personnel
	Balancing holes are sealed.	Remove the sealing cap. ↳ *Chapter 8.3.11 'Checking that sealing plugs have been removed' on page 151*	Service personnel
Intake volume is too low.	Intake filter contaminated (display unit: max. -45 mbar).	Replace the intake filter. ↳ *Chapter 8.3.6 'Replacing the intake filter' on page 147*	Service personnel
Intake volume is too low.	Intake piping is leaking.	Seal intake piping.	Service personnel

Fault description	Cause	Remedy	Personnel
The motor requires too much power.	The operating data differs from the order data.	Check operating data, comply with correct data.	User
	Mechanical damage.	Replace malfunctioning components.	Service personnel
Belts are vibrating.	Wear and tear on belts.	Replace the belts. ↳ *Chapter 8.3.9 'Replacing belts' on page 148*	Service personnel
	Sheaves are not aligned properly.	Check and, if necessary, correct them. ↳ *Chapter 8.3.7 'Checking the sheaves' on page 147*	Service personnel
Machine turns in reverse after being shut down.	Non-return flap is leaking or malfunctioning.	Replace the component. ↳ *Chapter 8.3.12 'Checking the non-return flap' on page 151*	Service personnel

9.4 Status and error messages (component suppliers)

Control system fault message

Depending on the customer's control system, additional fault messages can be recorded and displayed.

9.5 Commissioning after fault rectification

Commissioning after fault rectification

1. Check all previously loosened screw connections for tightness.
2. Mount all protective hardware and covers that were previously removed.
3. Remove all used tools, materials and other equipment from the workspace.
4. Clean the workspace. Remove operating substances, operating material, processing material and similar materials and dispose of them appropriately.
5. Inform the responsible on-site person about the result of the fault.
6. Ensure that there are no persons in the hazard area.
7. Release the main circuit breaker and activate it.
8. Release the EMERGENCY STOP function.
9. Confirm the removal of the fault in the control system.
10. Start operation in accordance with the instructions in the "Operation" chapter. ↳ *Chapter 7.3 'Switching on' on page 114*
11. Inform the responsible on-site person about the result of the work carried out

9.6 Checks after malfunction rectification

Inspection	After the first 3 op. hrs	After the first 25 op. hrs
Pressure valve	check for correct operation	
Oil level	check, correct if necessary	check, correct if necessary
Aligning the belt pulley		check, correct if necessary
op. hrs = operating hours		

10 Disassembly and disposal

Protecting the environment and conserving resources are among AERZEN'S foremost priorities.

Once the machine's service life is over, it must be disassembled and disposed of in an environmentally-friendly way. The following is a set of recommendations for environmentally-friendly disposal.

10.1 Safety instructions

Improper disassembly

WARNING!

Risk of injury from improper disassembly!

Stored residual energy, sharp components, edges and corners on or in the machine or on the necessary tools can cause injury.

- Before beginning work, ensure there is sufficient space.
  Allow the machine to cool down to the ambient temperature.
- Proceed with caution when working with open, sharp-edged components.
- Ensure the tidiness and cleanliness of the work-space! Components and tools that are loosely stacked or lying around can cause accidents.
- Disassemble components correctly. Take into consideration the weight of each component. If necessary, use hoists.
- Secure components, so they do not topple or fall.
- If in doubt, contact the manufacturer.

Electric current

DANGER!

Risk of fatal injury from electrical current!

Disassembly of live components can cause serious or fatal injury.

- Switch off the power to the operating cable.
- Check there is no live current.

Disassembling the delivery line

WARNING!

Risk of injury from compressed conveyed materials!

For the disassembly of pressurised components such as pipes, containers, hoses or valves, hot conveying material escapes with a strong gas flow. This can result in serious injury.

– Before beginning work, fully relieve pressurised components of pressure.
– Check that components are not pressurised.
– Only disassemble pressurised components when they are not under pressure.

Requirements for staff

Requirements for disassembly:

Disassembly of electrical components

Personnel:
- Authorised electricians

Personnel:
- Authorised electricians with additional qualifications

Requirements for disassembly:

Disassembly of mechanical components

Personnel:
- Service personnel

Protective equipment

Requirements for disassembly:

Protective equipment:
- Protective work clothing
- Safety shoes
- Hearing protection
- Protective gloves
- Safety goggles
- Industrial hard hat

Special tools

Requirements for disassembly:

Special tool:
- General tool kit
- Tools for authorised electricians
- Auxiliary materials, aids
- Lifting equipment
- Transport equipment

Special tool:
- Locking key

10.2 Disassembly

Preparing for disassembly:

1. Immediately inform the responsible staff on site about the disassembly.
2. Switch off the machine and secure it against restarting.
3. Seal off the pressure line and remove it.
4. Physically separate the entire electric power supply from the machine. Release stored residual energy.
5. If necessary, disconnect the machine control system from a connected process control system.
6. Remove operating and auxiliary materials and residual processing materials and dispose of them in an environmentally-friendly way.
7. In addition, clean assemblies and components thoroughly. Dismantle them in accordance with local regulations for occupational safety and environmental protection.
8. Remove the machine's foundation bolts.
9. During disassembly, there should be a general sorting of parts in accordance with disposal categories. *'Categories for sorting' on page 166*

10.3 Disposal

The machine is composed primarily of steel, casting material and various non-ferrous metals. In general, metallic materials are fully recyclable.

Proper disposal

In as far as no agreement has been made on the return or disposal of the machine, send dismantled components for recycling:

- Scrap metals.
- Send plastics for recycling.
- Sort and dispose of other components according to material composition.

Improper disposal

ENVIRONMENT!

Environmental risk from improper disposal!

Improper disposal can present a risk to the environment.

– Have insulating material, electronic waste, electronic components, auxiliary materials and chemicals disposed of by a professional waste disposal company.
– If in doubt, contact the local authorities or specialist companies for information on environmentally-friendly waste disposal.

Oil and lubricants

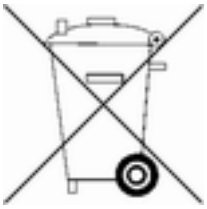
ENVIRONMENT!

Environmental risk from oil!

The improper disposal of oil and lubricants can present a risk to the environment.

– Collect oil carefully, store it and dispose of it properly or recycle it.
– If in doubt, contact the local authorities or specialist waste disposal companies for information on environmentally-friendly waste disposal.

Battery



ENVIRONMENT!

Environmental risk from batteries!

The improper disposal of batteries, e.g. from the control system, can present a risk to the environment.

– Collect batteries and dispose of them properly at local collection points.
– If in doubt, contact the local authorities or specialist waste disposal companies for information on environmentally-friendly waste disposal.

Requirements for personnel

Disposal requirements:

Personnel: ■ Skilled staff for industrial waste

Protective equipment

Disposal requirements:

Protective equipment:
- Protective work clothing
- Safety shoes
- Hearing protection
- Protective gloves
- Safety goggles
- Industrial hard hat

Special tools

Disposal requirements:

Special tool:
- Lifting equipment

Categories for sorting

Scrap iron	Non-ferrous metal (except for scrap iron)	Insulation material	Electronic waste (encoder electronics)	Auxiliary materials and chemicals
Scrap ■ Scrap steel ■ Foundry scrap ■ Scrap from non-rusting steels ■ Stainless steel scrap	Aluminium	Various isolators (in terminal boxes)	Electrical tools	Lubricant and gear oils Grease
Used metal/2A materials ■ Steel beams ■ Steel sheets	Copper	Voltage and current transformers	Measurement, control and regulatory systems	Cleaning agents and solvents
Machines made of metal ■ Without electronics	Brass	Electric cables and leads		Paint residue
	Motor windings	Instrument wiring		Anti-corrosion agents
		Surge absorbers		Cloths (soaked in agents or chemicals)

Scrap iron	Non-ferrous metal (except for scrap iron)	Insulation material	Electronic waste (encoder electronics)	Auxiliary materials and chemicals
		Heat insulation materials		AERtronic batteries
This does not include: ■ Hazardous adhesions ■ Sealed hollow parts (due to danger of deflagration or hazardous contents)	Valve disposal ■ Remove the medium before disposal! Neutralise residual medium in the valves.		This does not include: ■ PCB capacitors	■ Solvents, cleaning agents and paint residue must not be allowed to mix! ■ Sort oils separately according to emulsions and solvents. ■ Agents and chemicals must be collected in separate, labelled containers.

Disposal of accessories

Motor

- For safety reasons, disposal may only be carried out by specialists for industrial waste or by return to the manufacturer!
- The encoder electronics are electronic waste.

Frequency inverter

- For safety reasons, disposal may only be carried out by specialists for industrial waste or by return to the manufacturer!
- The encoder electronics are electronic waste.

DANGER!
Danger due to explosion of the capacitor and the formation of toxic gases!

11 Technical specifications

11.1 Dimensions and weights

General information

The following dimensions and weights relate to standard variants and can vary depending on the specific design.

Exact details can be found on the installation drawing.

Information on weight can be found on the packing note and the designation on the type plate.

Dimensions, including packaging, are included in the forwarding order.

Dimensions and weights

Positive pressure operation						
Size	**Width (W) mm**	**Depth (D) mm**	**Height (H) mm**	**Nominal diameter DN**	**Weight without acoustic hood, without motor and without belt drive approx. kg**	**Weight with acoustic hood, excluding motor and belt drive approx. kg**
GM 3 S	800	800	1055	50	160	220
GM 4 S	925	1135	1280	80	210	320
GM 7 L	925	1135	1280	80	210	320
GM 10 S / DN80	925	1135	1280	80	240	350
GM 10 S / DN100	1250	1350	1500	100	350	510
GM 15 L	1250	1350	1500	100	360	530
GM 25 S	1250	1350	1500	125	420	580
GM 30 L	1500	1800	1900	150	660	980
GM 35 S	1500	1800	1900	150	760	1040
GM 50 L / DN150	1500	1800	1900	150	810	1130
GM 50 L / DN200	1700	2055	2111	200	840	1310
GM 60 S	1700	2055	2111	200	1000	1460
These dimensions and weights relate to the standard design and are approximate values. The information can vary depending on the order.						

Positive pressure operation						
Size	**Width (W) mm**	**Depth (D) mm**	**Height (H) mm**	**Nominal diameter DN**	**Weight without acoustic hood, without motor and without belt drive approx. kg**	**Weight with acoustic hood, excluding motor and belt drive approx. kg**
GM 80 L	1900	2200	2308	250	2720	3570
GM 90 S	1900	2200	2308	250	2780	3630
GM 130 L	2100	2850	2345	300	2265	3230
GM 150 S	2100	2850	2345	300	2510	3470
These dimensions and weights relate to the standard design and are approximate values. The information can vary depending on the order.						

11.2 Dimension specifications sheet

An accompanying dimension specifications sheet is provided with the product documentation.

These documents contain important dimensions for installation and set-up.

11.3 Operating data

11.4 Technical performance data

Operating and application limits

Positive pressure operation			
Size	**Differential pressure max. mbar**	**volume flow max. m^3/h**	**Motor rating max. kW**
GM 3 S	1000	247	7.5
GM 4 S	1000	282	15
GM 7 L	700	493	15
GM 10 S / DN80	1000	542	22
GM 10 S / DN100	1000	696	30
GM 15 L	700	1038	30
GM 25 S	1000	1452	55
GM 30 L	700	2082	75
GM 35 S	1000	2418	90
GM 50 L / DN150	700	2610	75
GM 50 L / DN200	700	3306	90
GM 60 S	1000	3540	132
GM 80 L	700	5034	160
GM 90 S	1000	5418	200
GM 130 L	700	8040	200
GM 150 S	1000	9120	355
These operating limits are maximum values. Difficult operating conditions can adversely affect these data.			

Environmental limits

Data	Value	Unit
Temperature range	-10 to 40	°C
Relative humidity	0 to 80	%
Chemical-free atmosphere		

Maximum installation elevation

Data	Value	Unit
max. installation elevation above NN*	1000	m

In case of deviations in installation heights, observe the order-specific design data sheet.

Environmental limits

Data	Value	Unit
Temperature range	-10 to 40	°C
Mounting of acoustic hood heating	less than -10	°C
Relative humidity	0 to 80	%
Chemical-free atmosphere		

operating period

Data	Value	Unit
Maximum continuous operating period	24	hrs
Pause until next operation	/	hrs

11.5 Type plate(s) and placement

Placement on the machine stage

Manufacturer/type plate on the machine stage.

Pos.1 Manufacturer plate
Pos.2 Type plate

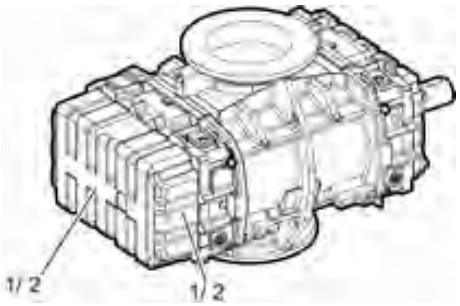


Fig. 139: Layout example

Manufacturer plate - Pos. 1

Manufacturer plate

Fig. 140: Manufacturer plate

Type plate - Pos. 2

Fig. 141: Type plate

Pos.1 Machine type
Pos.2 Factory/serial number
Pos.3 Order no.
Pos.4 Machine rotational speed
Pos.5 Power consumption
Pos.6 Year of manufacture
Pos.7 Weight
Pos.8 Motor rotational speed
Pos.9 Conveyed amount
Pos.10 Intake pressure (absolute) - p1
Pos.11 Positive pressure, discharge - p2e

Placement on the acoustic hood

The manufacturer/type plate is on the operating side of the acoustic hood.

Pos.1 / acoustic hood Manufacturer and type plate

Fig. 142: Acoustic hood signage

Manufacturer/type plate - pos. 1

Fig. 143: Acoustic hood manufacturer/performance data plate

Pos.1 Manufacturer, including address
Pos.2 Machine type
Pos.3 Customer order no.
Pos.4 Factory/serial number
Pos.5 Year of manufacture
Pos.6 Intake volume flow
Pos.7 Max. intake pressure (absolute)-p1
Pos.8 max. Discharge pressure (absolute) -p2
Pos.9 Nominal power of motor
Pos.10 Machine weight (total)

Type designation

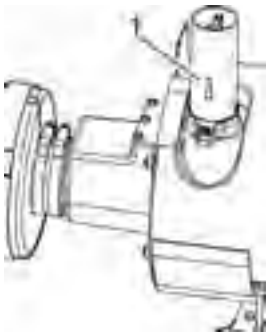
The type designation is derived from the following table:

Explanation using example: GM 90 S

Designation	Explanation	Details
GM	Product designation	Positive displacement blower
90	Maximum flow volume in m³/min (approx.)	
S	Design	L: Pressure differences up to 700 mbar
		S: Pressure differences up to 1000 mbar

Pressure valve signage

When using the AERZEN pressure valve, the type plate is on the valve housing.



Pos.1/pressure valve Manufacturer and type plate

Fig. 144: Pressure valve signage

Pressure valve type plate

Fig. 145: Pressure valve, manufacturer/performance data plate

Pos.1 Manufacturer, including address
Pos.2 Material
Pos.3 Nominal diameter
Pos.4 Year of manufacture
Pos.5 Customer order no.
Pos.6 Application temperatures
Pos.7 Valve set pressure
Pos.8 Narrowest cross-section
Pos.9 Maximum permissible pressure
Pos.10 Max. flow volume
Pos.11 Medium type

11.6 Noise emissions

Information on noise emissions

This information is determined in accordance with the performance data. ↳ *Chapter 11.4 'Technical performance data' on page 170*.

No-load operation or operation below the maximum performance values reduces noise emissions.

Machines without an acoustic hood have considerably higher noise emissions. Observe the measures for noise emission reduction ↳ *Chapter 5.2 'Requirements for the installation site' on page 88*

Measurement requirements

- applied basic standard DIN EN ISO 2151
- measured according to basic standard DIN EN ISO 3744
- with acoustic hood
- connected, insulated pipelines
- tolerance: ±2 dB(A)

Positive pressure

Size	A-weighted sound pressure level, L_{pA}dB(A)
GM 3 S	72
GM 4 S	72
GM 7 L	72
GM 10 S / DN 80	74
GM 10 S / DN 100	74
GM 15 L	75
GM 25 S	75
GM 30 L	77
GM 35 S	77
GM 50 L / DN 150	77
GM 50 L / DN 200	78
GM 60 S	80
GM 80 L	82
GM 90 S	83
GM 130 L	86
GM 150 S	86

11.7 Operating materials

11.7.1 Lubricant oil specifications

Lube oil specification

Choice of lubricants

When operating the machine, only use lubricants that comply with this specification!

The quality of lube oil has a considerable effect on the service life of the machine.

When selecting the type of lube oil, the application conditions and the relevant additives and viscosity class are decisive.

Taking the operating conditions into account, only use the following oils with the corresponding viscosities and additives.

* Ambient temperature = the temperature in the immediate vicinity of the machine all year round.

Low-load operation

Using these machines for **"low-load operation with minor pressure differences"** requires prior consultation with AERZEN Customer Service or the sales company. To select a suitable lubricant, the operating conditions, load and operating data need to be taken into account.

Lube oil properties

General requirements of the lube oil properties

Kinematic viscosity at operating oil temperature.	min. 10 - 13 cSt (mm^2/s)
Kinematic viscosity at -10°C	min. ≤ 3,500 cSt (mm^2/s)

Minimum properties of the oil additive

EP wear-protection additives for use in rolling bearing drives
Oxidisation stability up to 110°C oil sump temperature
Foam suppressor
Detergent for deposit solutions
Neutrality with regard to seal materials of fluoropolymer elastomer (Viton)
Neutrality with regard to one-component resin primers
Sufficient shear stability

11.7.1.1 Lube oils

Standard first oil filling

Delta Lube 06	
Intake temperature (machine stage)	up to 50°C
Final compression temperature (machine stage)	up to 140°C
Ambient temperature*	no constraints
Order No.	178 132
This lube oil is used as initial oil filling for standard use conditions.	

11.7.1.1.1 Alternative lube oils

One or two-shift operation/intermittent operation

AERZEN special rotary piston oil	
Intake temperature (machine stage)	up to 50°C
Final compression temperature (machine stage)	up to 140°C
Ambient temperature*	no constraints
Order No.	160 755 002

Continuous operation: 24 hours a day

ISO VG 150	
Fully-synthetic poly-alpha-olefin (PAO), drive or compressor oil	
Intake temperature (machine stage)	up to 50°C
Final compression temperature (machine stage)	up to 140°C
Ambient temperature*	no constraints
Example: MOBIL SHC 629	

Operation with a final compression temperature of over 140°C

ISO VG 220	
Synthetic lube oil with a base oil of type polyglycol	
Continuous oil temperature	120°C - 140°C
Final compression temperature (machine stage)	over 140°C
Ambient temperature*	no constraints
Example: ESSO Glycolube 220, ARAL Degol GS 220	

11.7.1.2 Changing oil types

Delta Lube 06, AERZEN special rotary piston oil --> fully synthetic PAO lubricants

The AERZEN lubricants (Delta Lube 06, AERZEN special rotary piston oil) are fully compatible with fully synthetic PAO lubricants.

Measures: If you change to another oil type, no specific measures need be taken. However, to preserve the working properties of the new oil, the oil that is replaced should be drained completely and, after 100 operating hours and in addition to any scheduled oil changes, a full oil change including oil filter change (if there are any filters) should be performed. Only oil of the same type should be used for topping up.

Delta Lube 06, AERZEN special rotary piston oil, fully synthetic PAO lubricants --> polyglycol oils (PAG)

The AERZEN lubricants (Delta Lube 06, AERZEN special rotary piston oil) as well as PAO lubricants are ***not*** compatible with polyglycol oils (PAG) or perfluorinated polyether oils, e.g. Fomblin.

Measures: In order to change the oil type, the machine must be completely dismantled and the entire oil system thoroughly cleaned of residue. A rinsing is recommended before first commissioning. Only oil of the same type should be used for topping up.

11.7.2 Lubricant oil in the food and pharmaceutical industry

For rotary piston blowers, lubricating oils can be used which have approval according to the specification USDA H1.

Operational experience is **only** available for the following lubricating oils.

AERZEN issues no approval for any other oils.

It is recommended that you carry out an oil analysis after 1,000 op. hrs in coordination with the oil manufacturer.

ISO VG 100	
Continuous oil temperature	up to 100°C
Compressor discharge temperature	up to 120°C
Lubricant to be used: **Klüberöl 4UH1-100 N**	

ISO VG 220	
Continuous oil temperature	over 100°C
Compressor discharge temperature	over 120°C
Lubricant to be used: **Klüberöl 4UH1-220 N**	

11.7.3 Grease specifications

Only for the gas-tight version of the drive shaft!

Greases for the gasket of the drive shaft

Grease KHC-2P-30	
Using the lubricating oils according to AERZEN lubricating oil specification, *excluding polyglycols*	
Filling at the factory	**KLÜBER PETAMO GHY 133 N**

Grease MPG2K-40	
Using the a polyglycol oil according to AERZEN lubricating oil specification	
Filling at the factory	**KLÜBER SYNTHESO PROBA 270**

Information on grease

- Avoid mixing different greases.
- Lubrication is only permitted with the same grease.
- If these greases are not available, completely remove the grease and replace it with another grease in accordance with KHC-2P-30 or MPG2K-40.
- Observe the seal compatibility with Viton!

11.7.4 Lubricant quantities

Machine lube oil levels

The following values for lube oil levels are guide values. The main factor in determining the oil fill quantity is the displays of the relevant oil level pointer.

Models with acoustic hoods

Total oil quantity Oil level middle sight glass on the acoustic hood			
Operating material	**Machine type**	**Filling quantity, approx.**	**Unit**
Lube oil	GM 3 S	0.55	Litre (l)
	GM 4 S	1.00	
	GM 7 L	1.00	
	GM 10 S	1.40	
	GM 15 L	1.40	
	GM 25 S	1.75	
	GM 30 L	1.75	
	GM 35 S	3.75	
	GM 50 L	4.50	
	GM 60 S	7.50	
	GM 80 L	7.50	
	GM 90 S	12.50	
	GM 130 L	12.50	
	GM 150 S	12.00	

Models without acoustic hoods

Total oil quantity Oil level at centre of sight glasses on machine stage			
Operating material	**Machine type**	**Filling quantity, approx.**	**Unit**
Lube oil	GM 3 S	0.55	Litre (l)
	GM 4 S	0.55	
	GM 7 L	0.55	
	GM 10 S	0.86	
	GM 15 L	0.86	

Total oil quantity Oil level at centre of sight glasses on machine stage			
Operating material	**Machine type**	**Filling quantity, approx.**	**Unit**
	GM 25 S	1.20	
	GM 30 L	1.20	
	GM 35 S	3.00	
	GM 50 L	3.50	
	GM 60 S	6.50	
	GM 80 L	6.50	
	GM 90 S	11.50	
	GM 130 L	11.50	
	GM 150 S	11.00	

Grease filling quantity for machine stage

Only for the gas-tight version of the drive shaft!

Operating material	Machine type	Filling quantity, approx.	Unit
Grease	GM 3 S	5	cm^3
	GM 4 S	5	
	GM 7 L	5	
	GM 10 S	5	
	GM 15 L	5	
	GM 25 S	5	
	GM 30 L	5	
	GM 35 S	10	
	GM 50 L	10	
	GM 60 S	10	
	GM 80 L	10	
	GM 90 S	10	
	GM 130 L	10	
	GM 150 S	20	

Stauffer lubricators

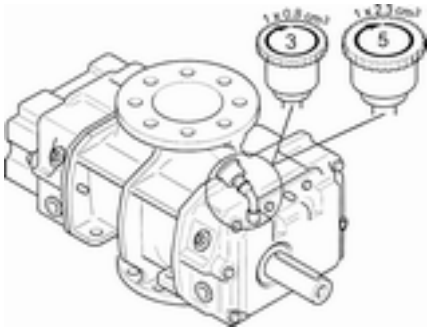


Fig. 146: Stauffer lubricator

Grease amount per Stauffer lubricator for each rotation

Stauffer lubricator size	Rotation	Grease amount in cm^3
3	1	0.8
5	1	2.3

Drive motor grease quantity

Observe the separate motor documentation and the information on the type plate of the motor.

Operating substance	Motor size	Filling quantity, approx.	Unit
Grease	Observe the information in the motor documentation and on the type plate!		

11.8 Coatings

Corrosion protection

The housing surfaces receive the following coatings to protect them against corrosion:

Standard coating	
Undercoat	Corrosion protection on alkyd resin basis
End coating	Alkyd resin surface coating

Coating for heightened corrosion protection	
Undercoat	Corrosion protection on 2-component, epoxy resin, micaceous iron oxide basis
Intermediate coating	
End coating	Polyurethane surface coating

11.9 Electrical details

11.9.1 Voltage fluctuations

Permissible voltage fluctuations

Permissible voltage fluctuations are described in the international standard IEC 60038 subject to country-specific supply voltage tolerances.

Machine use only in a stable three-phase power supply. Voltage fluctuations / drops beyond the tolerance level may cause serious damage to the drive system.

11.9.2 Earthing strap cross-section

Earthing strap

	kW	mm²
to	55	14
to	200	70
to	315	2 x 70

11.9.3 Motor overload protection

Installation value

max. ... % value, nominal engine current
110 %

11.10 Accessory information

11.10.1 Intake filter

Technical data

Intake filter		Unit
Filter resistance in clean condition	> 10	mbar
max. filter resistance	45	mbar

11.10.2 Start-up relief device DN 50 to DN 80

Technical data

Start-up relief device DN 50 to DN 80		
Voltage	230	V
Frequency	50	Hz
Protection type	IP 65	

Start-up relief device DN 50 to DN 80		
Output	8	W
open without current		

11.10.3 Start-up unloading device DN 80 to DN 400

Technical data

Start-up unloading device DN 80 to DN 400		Unit
Voltage	230	V
Frequency	50	Hz
Protection type	IP 65	
Power	8	W
closed without current		

11.10.4 Balancing grade

Balancing type

The vibration behaviour of the machines is determined not only by the balancing grade of the drive shafts but also by the balancing grade of the drive elements.

The drive shafts of the pistons and rotors are balanced according to the half-key principle. Belt pulleys and couplings must therefore correspond to balancing type “H”.

12 Notes on the Declaration of Conformity

This document is provided for informational purposes only and gives an account of the contents of the Declaration of Conformity. The original document is provided with the product or is sent in a separate document.

AERZEN

CE MRL 1012_1

Declaration of Conformity

pursuant to the EC Machinery Directive 2006/42/EC, Annex II 1A	
Translation of Original Declaration of conformity	CE
Manufacturer	**Representative pursuant to the Machinery Directive** **Representative for technical documentation**
Aerzener Maschinenfabrik GmbH	Mr Björn Irtel
Phone: +49 5154 81-0	Aerzener Maschinenfabrik GmbH
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Internet: www.aerzen.com	E-mail: info@aerzener.de
Reherweg 28	Internet: www.aerzen.com
31855 Aerzen, Germany	Reherweg 28
	31855 Aerzen, Germany

Product	
Designation	
Type	
Serial no.	
Order no.	
Year of construction	

We hereby declare that the above product complies with all applicable provisions of the Machinery Directive 2006/42/EC.

The aforementioned product fulfils the requirements of the following applicable directives:

► Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast) 2006/42/EC

The following harmonised standards were applied:

► DIN EN ISO 12100:2011-03 Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010) 2011-03 DIN EN ISO 12100:2011-03

► DIN EN 1012-1:2011-02 Compressors and vacuum pumps - Safety requirements - Part 1: Air compressors; German version EN 1012-1:2010 2011-02 DIN EN 1012-1:2011-02

Information on Signatory	Managing director	Signature	Location, date of issue

27.10.2014, Docld CE MRL 1012_1 01_2014, 1, en_GB

13 Glossary

•Bar chart display

A bar chart display is a display method which uses a scale to represent the size of a signal with a representative bar that changes in length depending on the signal size.

•Belt run

The belt section between two sheaves is termed a “belt run”.

•Discharge temperature

Temperature measured at the discharge sockets of the machine stage.

•EMERGENCY STOP function

A function intended to alleviate the danger of impending hazards in terms of injury or damage to persons and machines during operation or to reduce the danger of hazards that are already present.

A function that is activated by one single action by an individual person.

The purposeful shut-down of the machine to avoid a dangerous situation. Voltage-carrying components are still active.

Emergency stop.

•Machine

A machine is an assembly of linked parts or components, at least one of which moves. A machine is fitted or intended to be fitted with a drive system. The machine has a proper intended use and is assembled for a specific purpose. Another technical term for “machine” is “unit”.

•Machine stage

A machine stage is an incomplete machine. It is an assembly that almost constitutes a machine, but that does not fulfil a specific function. A machine stage is only intended to be installed in and added to other machines or other incomplete machines.

•Modbus RTU

Modbus RTU transfers data in binary form. This ensures a good data throughput rate. The data cannot be evaluated directly by persons, rather they must first be converted into a readable format.

•PROFIBUS-DP

PROFIBUS DP involves the communication of central control equipment via a fast serial connection with decentralized input /output modules.

•Sentinel filter

Another filter downstream from a filter

It fulfils an end cleaning function and a safety function.

•Stop category 0

Stop category 0.

Shut-down by means of immediate interruption of the power supply to the machine.

Shut-down by means of mechanical separation (uncoupling) of components that pose a danger and their mechanical drive elements and, if necessary, by means of a braking procedure.

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Chapter 13 Chemical Metering Pumps (Division 43)

MANUFACTURER/DISTRIBUTOR:

York Fluid Controls Limited
Gavin MacDonald
2 Westwyn Court
Brampton, Ontario, L6T 4T5
Phone: (705) 822-8182
gavin@yorkfluid.com

13.1 LMI Series B/C Metering Pumps (WTP)

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

Metering Pumps

LMI
MILTON ROY

Excellence through Versatility

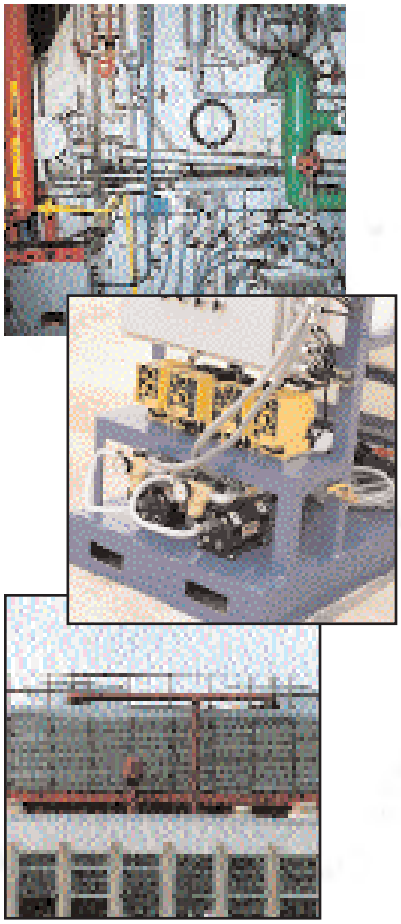
Liquid Metronics Incorporated has been providing quality products and service to the water treatment industry worldwide for over 25 years.

Leading the way in the metering pump industry, LMI introduced the first full line of electronic metering pumps and accessories. The breadth of LMI's product line extends from low-cost metering pumps for domestic potable water treatment to highly sophisticated custom designs for specific customer applications.

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

Today, LMI continues to shape the future of the industry by offering the next generation of our trademark yellow and black metering pumps, the LiquiPro™ Series. This series of electronic metering pumps offers simple installation and maintenance with its unique cartridge valve design, as well as quick and easy "hands free" priming three, four function and auto prime valves.

Utilizing superior designs and industry experience, as well as a state-of-the-art facility and highly trained service representatives, LMI offers Water Treatment Professionals the quality and reliability they've come to expect.



Waste Water Treatment

Cooling Water Treatment

Boiler Water Treatment

Municipal Water Treatment

Fertilizer Injection

Laboratory Fluid Metering

Fluoridation

Paper Chemical Feed

Domestic Potable Water

Swimming Pool

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

How A Metering Pump Works

LMI's solenoid-driven metering pumps are used for the precise injection of chemicals i system. The mechanically actuated diaphragm design has only one moving part whic lubricated. The simplicity and efficiency of this design results in a pump that consum enabling the pump to be totally enclosed in a chemically resistant housing for installat environments.

Durable Stroke Adjustment Mechanism

A rigid stroke bracket and large stroke knob offer precise, repeatable performance and simple adjustment over entire output range.

NEMA 4X/ IP65 Housings

Totally enclosed, chemically resistant polypropylene housing for the ultimate protection against corrosive environments.

EPU

LMI's Electromagnetic Power Unit (EPU) is designed for efficiency and consistent performance over a wide operating and temperature range.

Multi-Function Valves

The industry standard for over 25 years, features Fluorofilm™ diaphragms for long life and ramp style knobs for "hands free" priming with standard 3FV or optional 4FV. The auto prime valve option offers auto degassing for pumping chemicals prone to gassing.

Fluorofilm™ Liquiframs™

The unique manufacturing process of LMI diaphragms ensures outstanding chemical resistance and flexibility for long life.

Cartridge Valves

Unique cartridge valves have closely guided balls and triple sequential valve seats for optimum performance over entire pressure range.

Variety of Liquid Ends

A wide selection of liquid handling assemblies including PVDF, PVC, Acrylic, Polypropylene, 316 SS, and UHMWPE. Configurations for viscous chemicals and slurries provide flexibility in all applications.

Accurate Speed Control

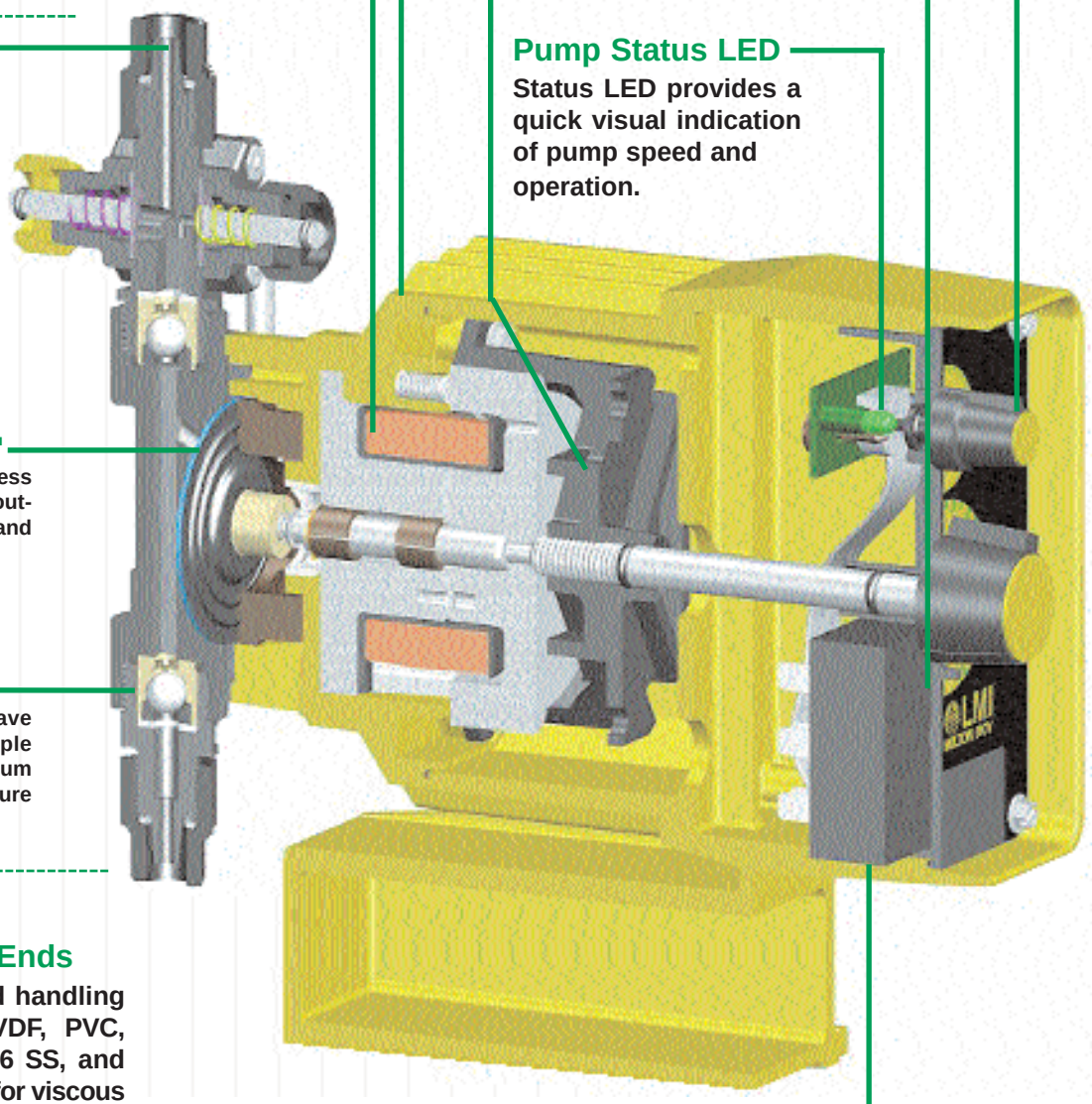
Provides precise stroke rate and a turndown ratio up to 1000:1 for unmatched versatility.

Fully Encapsulated Electronics

Completely enclosed electronics provide protection against moisture, corrosive atmospheres and damage from vibration or mechanical shock.

Pump Status LED

Status LED provides a quick visual indication of pump speed and operation.



Manual or External Control

Dual-manual control of speed and stroke length or external control by means of a 4-20 mA or pulse input for flow proportional applications and system integration.

Electronic Metering Pumps

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

LMI's family of electronic metering pumps offer:

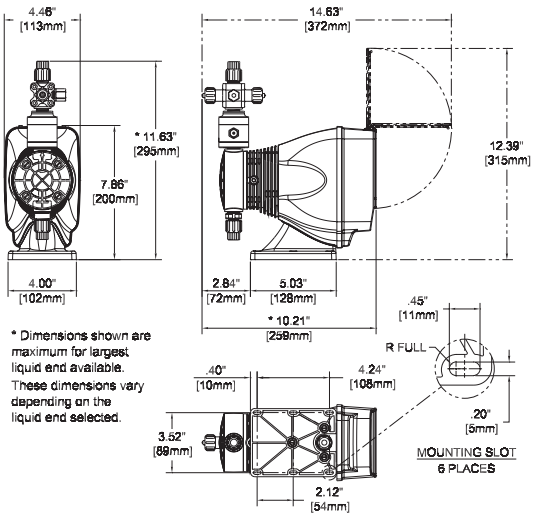
- Adjustable stroke frequency and the flexibility of up to 1000:1 turndown ratio
- Manually adjustable stroke length provides accurate pump output adjustment
- NEMA 4X / IP65 enclosures for protection against corrosive environments
- Time tested electronics for reliable, repeatable performance
- Totally encapsulated electronics for protection against moisture and corrosive conditions
- Priming valves with Flourofilm™ diaphragms and ramp style knobs for **"**hands free**"** priming

Series AA

Key Features / Benefits

- Rigid stroke bracket assembly for highly accurate/consistent dosing performance
- Advanced control options for simplified system integration (pulse multiply/divide, 4-20 mA, remote on/off)
- 5-level power control option to reduce system shock and extend the life of the pump
- External pacing for flow proportional applications

	Max Output		Max Pressure	
Model	GPH	l/h	PSI	Bar
AAX4	0.58	2.2	250	17.3
AAX5	1.0	3.8	110	7.6
AAX6	2.0	7.6	50	3.5
AAX7	0.42	1.6	140	9.7
AAX8	0.75	2.8	80	5.5



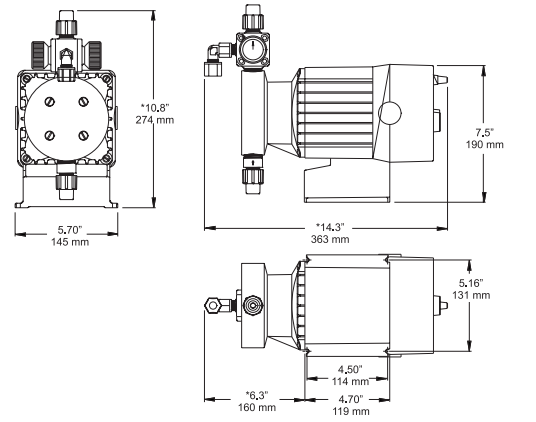
Series B / Series C

Series B

	Max Output		Max Pressure	
Model	GPH	l/h	PSI	Bar
BX1	1.6	6.1	150	10.3
BX2	2.5	9.5	100	6.9
BX3	4.5	17.0	50	3.5
BX4	7.0	26.5	30	2.07

Series C

	Max Output		Max Pressure	
Model	GPH	l/h	PSI	Bar
CX0	1.3	4.9	300	20.7
CX1	2.5	9.5	150	10.3
CX2	4.0	15.1	100	6.9
CX3	8.0	30.3	60	4.1
CX4	20.0	75.7	25	1.7
C76	4.0	15.1	175	12.1
C77	10.0	38.0	80	5.5
C78	25.0	95.0	30	2.07

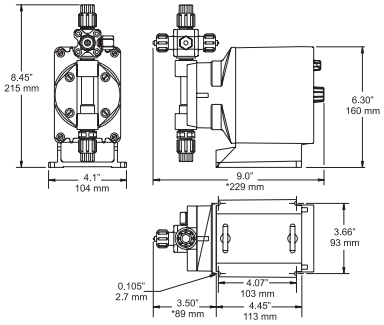


Series P

Key Features/Benefits

- High quality construction for durability
- Compact size; ideal for OEM applications
- Fixed speed versions for simple, low cost applications

	Max Output		Max Pressure	
Model	GPH	l/h	PSI	Bar
PX2	0.21	0.79	150	10.3
PX3	0.42	1.6	110	7.6
PX4	0.58	2.2	250	17.3
PX5	1.0	3.8	110	7.6
PX6	2.0	7.6	50	3.5



Liquid Handling Assemblies

LMI offers a wide selection of liquid handling assemblies with flexible tubing and pipe thread connections. Configurations for viscous chemicals and slurries provide total flexibility in all applications

- PVC
- Acrylic
- Polypropylene
- PVDF
- UHMWPE
- 316 SS

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

Repair & Preventative Maintenance Kits

RPM Pro Pac™ kits include the recommended replacement parts for the LiquiPro™ Series Metering Pumps. These kits provide an easy, economical solution to annual pump maintenance.

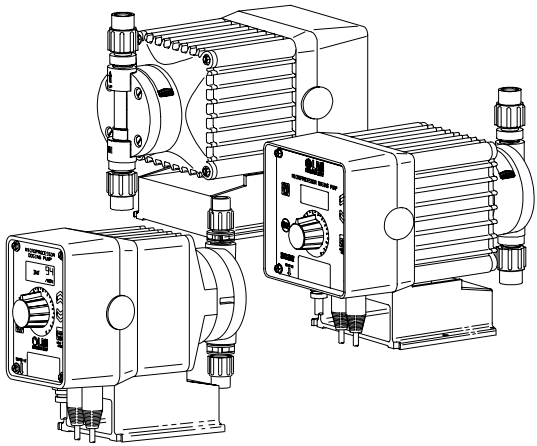
Accessories

LMI offers a complete line of accessories to customize and complete your installation.

- Auto prime valve 4FV/3FV/Bleed 4FV
- Agitators
- Back Pressure Valves
- Calibration Cylinders
- Conduit Connection Kit
- Corp Stop & Nozzle Assemblies
- Digi-Pulse™ Flow Monitors
- Extension Cable Assemblies
- Flow Indicator
- Fluoride Saturator
- Flowmeter
- Remote Programmable Flowmeter
- Liquid & Low Level Switches
- Micropace™ Control Modules
- Pressure Relief Valves
- Primer Flush Kit
- Pulse Transmitter
- Pump Mounting Accessories
- Remote Auto Flush Controllers
- Seal Ring Kit
- Splash Guard
- Suction Tubing Accessories
- Syphon Breaker
- Tanks
- Tubing Connector Assemblies

Instruction Manual

Series A9, B9, and C9
Electronic Metering Pumps



For file reference, please record the following data:

Model No: _____

Serial No: _____

Installation Date: _____

Installation Location: _____

When ordering replacement parts for your LMI Series A9, B9 and C9 Metering Pump or Accessory, please include complete Model Number and Serial Number of your unit.

LMI
LIQUID METRONICS DIVISION
MILTON ROY
A unit of Sundstrand Corporation

8 Post Office Square
Acton, MA 01720 USA
TEL: (978) 263-9800
FAX: (978) 264-9172
http://www.lmipumps.com

Replaces same of Rev. A 8/96
1796. B 11/97

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1.0 Introduction

The Series A9, B9 and C9 electronic metering pumps offer an extensive range of features, including microprocessor control for accurate and flexible automation in response to instrument signals. The microprocessor design employs a customized liquid crystal display (LCD) and tactile response keypad. The “state-of-the-art” surface mount electronics are fully encapsulated to ensure protection in its working environment. All external inputs and outputs are opto-isolated from the microprocessor.

This manual supplement describes programming and operation. It also describes details of the pumps external inputs and outputs and how they are connected.

For complete details on Installation, Maintenance and Troubleshooting, please refer to Electronic Metering Pumps Manual (P/N 1615).

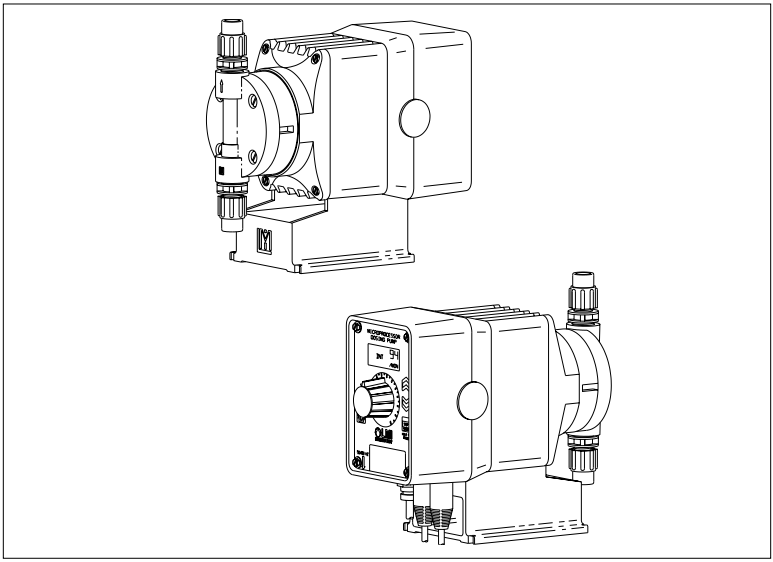
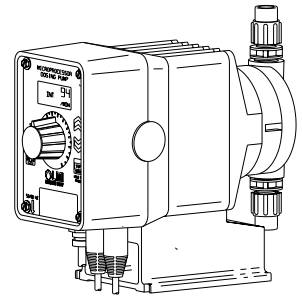


Figure 1: LMI Series A9 Electronic Metering Pump

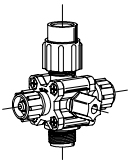
2.0 Unpacking

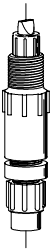
You should find the following items in the box:



Electronic
Metering Pump

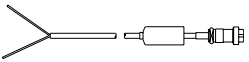
Four Function Valve
(optional)



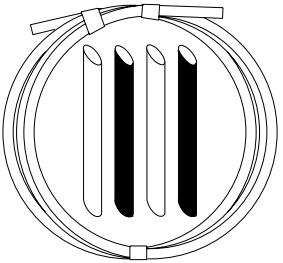


Injection
Check Valve

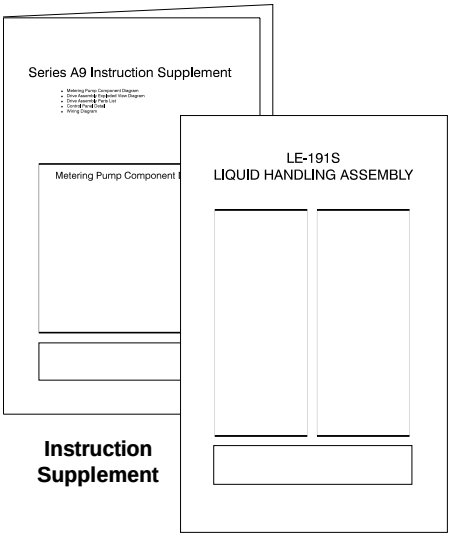
Foot Valve



Milliamp Input Cable
(P/N 33807)

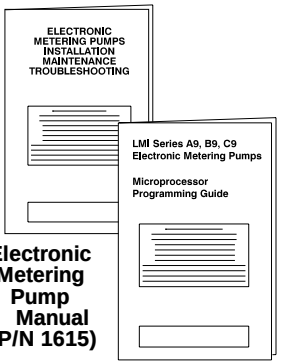


Tubing &
Suction Tubing
Straightener



Instruction
Supplement

Liquid Handling
Assembly Sheet



Electronic
Metering
Pump
Manual
(P/N 1615)

A9, B9, C9
Supplement
to Manual
(P/N 1796)

Figure 2: Unpacking Items

3.0 Features

- ☐ Stroke frequency adjustment from 0 SPH (strokes per hour) to 100 SPM (strokes per minute)
- ☐ Internal (manual) or external mode select
- ☐ Flexible slope adjustable response to mA input signals
- ☐ Divide or multiply (batch) incoming pulses (1 to 999)
- ☐ Batch accumulate option
- ☐ Integral blowdown controller feature
- ☐ Keypad locking
- ☐ Low-level shutoff with alarm output
- ☐ Programmable flow monitoring with alarm output (with FM-200-9 Digi-Pulse™)
- ☐ 6-level pressure control
- ☐ Continuous non-volatile memory (EEPROM)--no battery required
- ☐ Remote ON/OFF control
- ☐ Pulse (pacing) output
- ☐ Automatic line voltage compensation and over voltage protection
- ☐ Programmable menu for optional features/parameters
- ☐ Serial communication interface option for computer control (LiquiComm™)

4.0 How to Interpret the Model Number

The silver data plate (located on the front of the pump) tells you how your pump is configured.

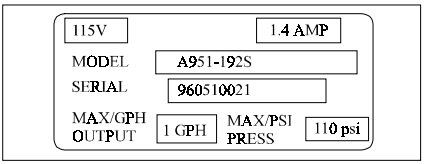


Figure 3a : Data Plate

Included on the data plate is the model number of the pump. Each number in the model number represents the following in Figure 3b.

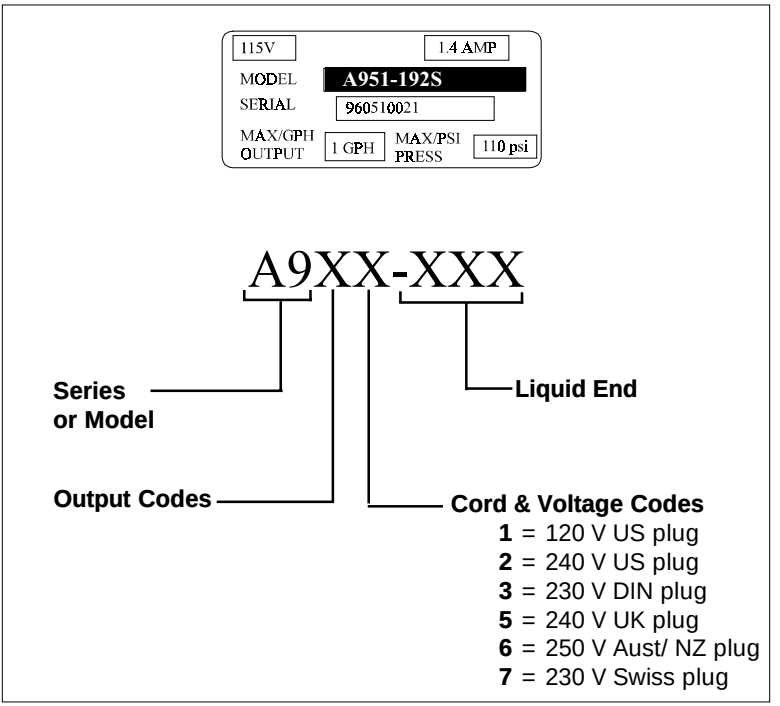


Figure 3b : Part Number Representation

5.0 Pre-Installation and Installation Instructions

Specific precautions should be taken when working with all LMI metering pumps.

Please read Section 3.0 in the Electronic Metering Pumps manual (P/N 1615) for pre-installation instructions.

For complete installation instructions, see Section 4.0 in the same manual.

6.0 Accessories

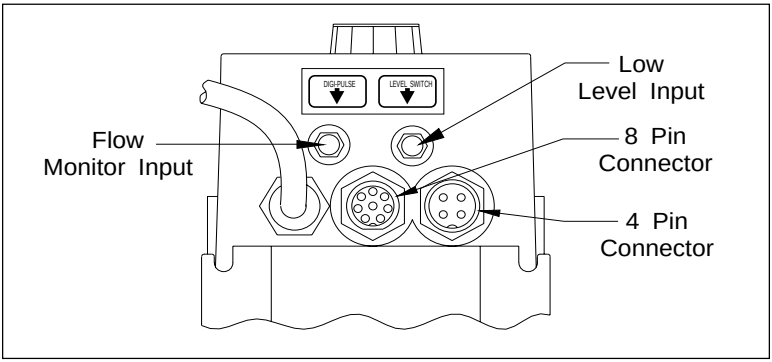
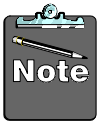


Figure 4: External Input and Output Connections



For specific descriptions of pump inputs and outputs, see Appendix A in the rear of this manual.

6.1 MilliAmp Input Cable (P/N 33807)

Each pump includes a 2-conductor cable assembly which connects to the 8-pin connector. It is available for pacing in response to a 0 to 20 mA (4-20 mA) instrument signal only.

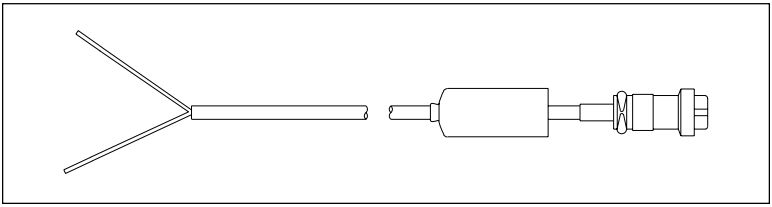


Figure 5: 2-Conductor Cable (P/N 33807)

PIN	WIRE	SIGNAL
3	White	+0-20 mA (+) Input
4	Black	-0-20 mA (-) Input

Table 1: Pin Out Table - milliAmp Input Cable

6.2 Optional 4-Pin Cable (P/N 33796)

The optional 4-pin external cable is used for connecting incoming pulse or pacing signals such as those triggered by a manual switch, reed switch, opto-coupler or by NPN or PNP transistors. The remote ON/OFF input is also accessed through the standard 4-pin connector.

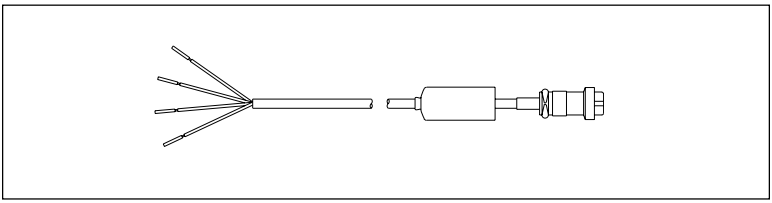


Figure 6: 4-Pin Cable (P/N 33796)

PIN	WIRE	SIGNAL
1	White	+15V Output
2	Black	Pacing input
3	Green	+15V Ground
4	Red	Remote ON/OFF & Computer Input

Table 2: Pin Out Table - 4-Pin Cable (P/N 33796)

6.3 Optional 8-Pin Cable (P/N 33738)

The optional 8-pin external cable assembly can be used to control stroke frequency in response to a 0 to 20 mA or 4 to 20 mA instrument signal. It provides an input for "flow monitoring." This cable assembly also provides output signals for pacing (pulse output), alarm (general) and computer alarm.

If a 0 to 20 or 4 to 20 mA signal is the only signal functioning, it is suggested that you use the Milliamp Input Cable, which is discussed on page 8.

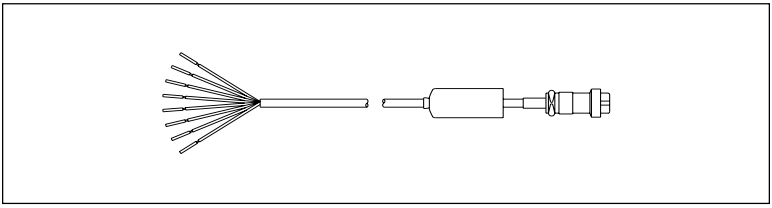


Figure 7: 8-Pin Cable (P/N 33738)

PIN	WIRE	SIGNAL
1	Red	+15V Output
2	Black	+15V Ground
3	Violet	+0-20 or 4-20 mA (+) Input
4	Green	-0-20 or 4-20 mA (-) Input
5	Orange	Pulse Output
6	Yellow	Alarm Output
7	Brown	Flow Input
8	Blue	Computer Alarm Output & Computer Output

Table 3: Pin Out Table - 8-Pin Cable (P/N 33738)

6.4 Optional "Hall Effect" Cable (P/N 33833)

An optional cable assembly is available for pacing your pump directly from an LMI Flowmeter fitted with a Hall Effect sensor. This cable connects to the Flowmeter as shown in Figure 8 (there is no need for a Programmable Divider; its function is built into the pump).

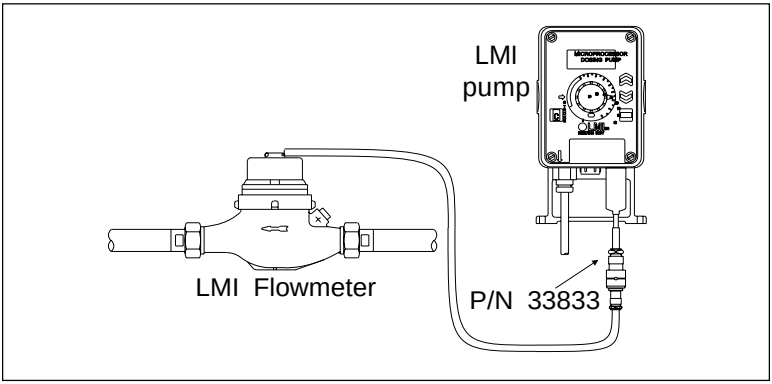


Figure 8: Optional "Hall Effect" Cable (P/N 33833)

6.5 LiquiComm™ Computer Interface Package

The optional LiquiComm™ package may be used to control and monitor up to 32 pumps from a computer over a serial RS485 interface as shown in Figure 9. Please contact LMI for further details.

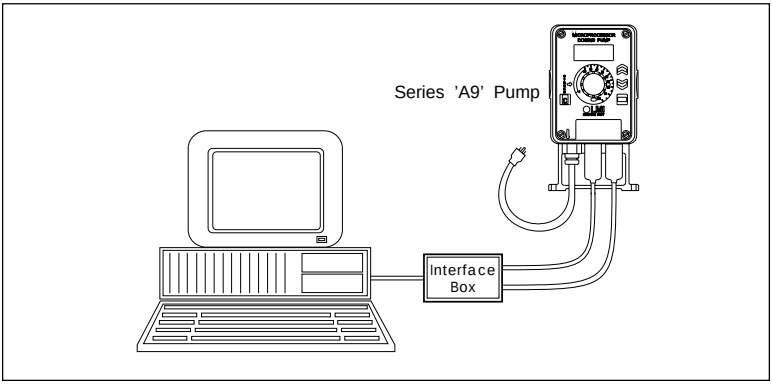


Figure 9: LiquiComm™ Computer Interface

7.0 Keypad/Display: Description and Function

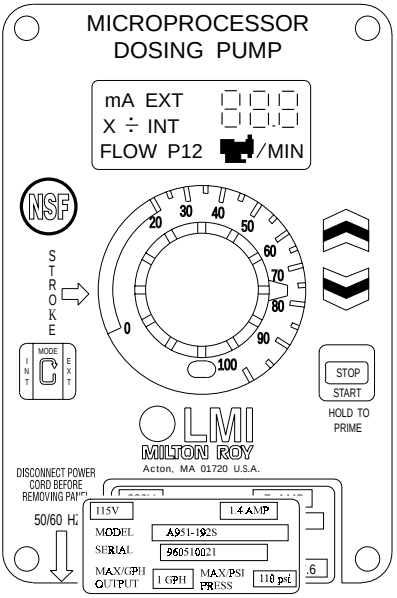


Figure 10: A9 Keypad

7.1 LCD Screen

The LCD screen is the window in which all values and menu choices are displayed (see Figure 11).

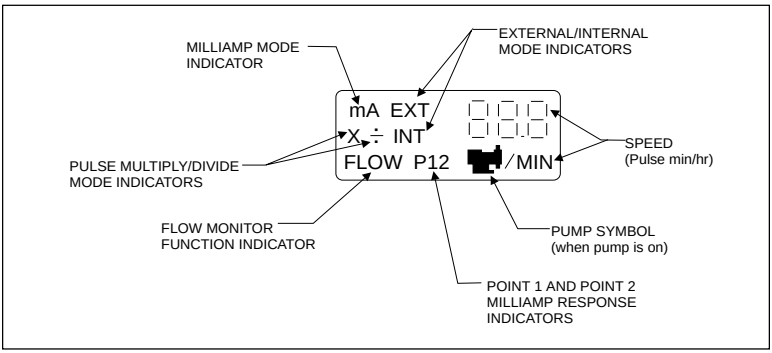


Figure 11: Liquid Crystal Display

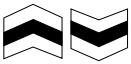
7.2 Start/Stop

The

(Start/Stop) key turns the pump on or off. If the pump is not running, pressing this key will cause the pump to start running. The symbol appears on the display while the pump is running. Each time the pump strokes, the symbol clears. If the pump is running, pressing the

(Start/Stop) key will stop the pump. The

(Start/Stop) key is also used to prime the pump as described on page 15.

7.3 Up and Down Key 

Use the (Up) and (Down) keys when: changing the stroke frequency; altering the pressure level; activating and deactivating the keypad lock; programming the divide and multiply values and milliamp response; accessing the setup menu; and changing certain parameters included in the setup menu. All of these functions are covered in greater detail later in this supplement.

7.4 Mode Key

Use the

(Mode) key when: changing to or from external or internal mode; accessing the pressure level; activating and deactivating the keypad lock; and accessing specific advanced features in the setup menu.

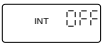
8.0 Operation of the Series A9, B9, and C9

These pumps feature EEPROM nonvolatile memory. The pump will always power up in the last used mode. When shipped from the factory the pump will power up in the "Internal" (manual) mode, with the pump OFF and a speed setting of 100 SPM.

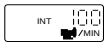
If the power to the pump is cut less than 15 seconds after the last programmed values have been set, the latest changes will NOT be stored in nonvolatile memory. Allow at least 15 seconds before disconnecting from power to ensure that the latest changes are stored.

8.1 Pump Start/Stop

Press the

(Start/Stop) key to start or stop the pump. When the pump is OFF, the LCD screen will alternate between 

and

every 16 seconds. When you start the pump, the
symbol appears on the LCD 

. Each time the pump strokes, the
symbol disappears. Press the

(Start/Stop) key again to stop the pump.

"INT" signifies that the pump is in the"Internal" (Manual) mode.

8.2 Speed

The speed may be changed with the pump ON or OFF. To increase or decrease the speed, press or hold the (Up) or (Down) key. The range runs from 0 SPH to 100 SPM. While normally the speed will be set in SPM, if settings of SPH are desired, hold the (Down) key until the display reads 0, then continue to hold it for an additional three (3) seconds. The display will then show H60, which is 60 SPH. The speed can be further reduced to 0 SPH with the (Down) key.

For example:

8.3 Priming

The priming function allows a fixed-time prime period of one (1) minute and enables priming of the pump in either Internal or External control modes. The priming function overrides the need for an external signal to cause the pump to stroke while in the External mode. Press and hold the (Start/Stop) key STOP START for three (3) seconds. The pump will start running at a speed of 60 SPM. If desired, alter the speed as noted above. The pump will stop one (1) minute from the time the STOP START (Start/Stop) key was last pressed, or you can stop the pump by pressing the STOP START (Start/Stop) key again. The display alternates between the pump speed and /MIN.

Flow Monitoring (see page 26) is inactive in the Prime mode.

8.4 Pressure Level Control

The maximum pressure rating of your pump can be adjusted to reduce pulsation shock in your discharge line. The pumps have a 6-point pressure control scale. The minimum setting is 0 and the maximum is 5. To access the pressure setting, press the

(Mode) key and (Up) key at the same time and hold for two (2) seconds. The current pressure setting

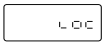
may be altered using the (Up) or (Down) keys.

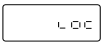
The pressure may be changed with the pump ON or OFF and in either Internal or External mode.

8.5 Keypad Lock

The pump has two (2) lock modes to prevent casual tampering. The small "LOC" de-activates all key functions *except*

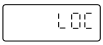
(Start/Stop) and Prime. To activate this "LOC" mode, press the

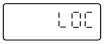
(Mode) key and (Down) key at the same time and hold for two (2) seconds. The LCD will read 

for five (5) seconds and then return to the previous display. This display 

re-appears when any key except the

(Start/Stop) key is pressed.

The large "LOC" disables *all* keypad entries, including Start/Stop. Activate this by pressing the Mode, Down, and Up keys at the same time and holding for two (2) seconds. The LCD will read 

for five (5) seconds and then return to the previous display. This display 

re-appears whenever any key is pressed.

To de-activate either lock mode, press the (Mode) key and (Down) key at the same time, and hold for two (2) seconds. The or will disappear.

8.6 Low-Level Switch (P/N 29190 or 29190E)

When the Low-Level Switch is fitted to the pump and a fault condition exists, the "E1" error code will flash on the LCD screen .

For more information on the Low-Level Switch, see the Low-Level Switch Assembly information sheet (P/N 1368) and page 30 of this supplement.

When a fault condition exists, the pump is stopped and the alarm and computer alarm lines are activated to allow remote monitoring. After clearing the fault (by filling the tank), the pump will automatically restart.

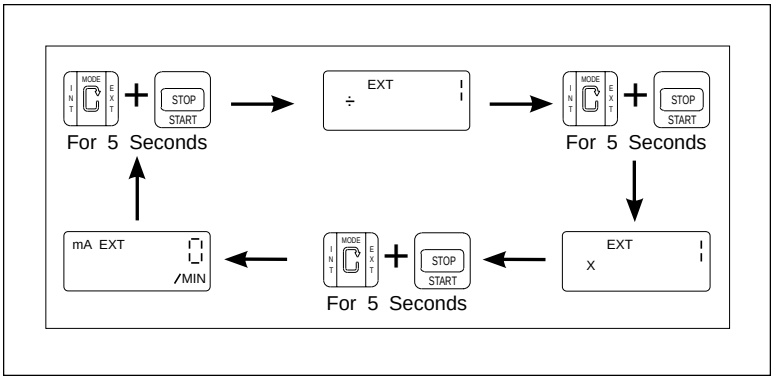
9.0 External Control Modes

To access the pulse divide, pulse multiply or milliamp response, the pump must be changed from Internal (manual) mode to External mode. To do this, first be sure the pump is stopped. Press the (Mode) key and hold it for three (3) seconds. The LCD screen displays the last External mode that was programmed. If this is the first time the pump has been put in the External mode, the factory default will be displayed on the LCD screen. The factory default mode is "External Pulse Divide" with a divide value of one (1) . The display will alternate between SPM and OFF.

External Mode Select: Pulse Divide, Pulse Multiply, and mA Response

Any of three external modes may be selected when the pump is stopped by pressing and holding the (Mode) key and (Start/Stop) key for five (5) seconds, then releasing. As noted above, the default is Pulse Divide. Pressing and releasing these keys brings you to the Pulse Multiply mode . In this mode, the LCD screen alternates between the pulse multiply value and OFF. Pressing and releasing these keys one more time brings you to the third external mode, mA response . In this mode the LCD screen alternates between SPM and the mA value.

Summary of External Mode Select



9.1 Programming the Pulse Divide Value

The divide value is altered by using the (Up) and (Down) keys. To do this, the pump must be in the External Divide mode and be OFF. The valid range for the divide value runs from 1 to 999. With the pump running in the Divide mode, the speed in SPM is calculated based on the rate of incoming pulses and the divide value, and displayed on the LCD screen .

If the calculated speed is less than one (1) SPM, the LCD screen will display 0 SPM. If the calculated speed is GREATER THAN 100 SPM, the E3 error code will be displayed periodically until the fault condition is corrected

. This error does NOT activate the alarm outputs or stop the pump.

9.2 Programming the Pulse Multiply (Batch) Value

The multiply value is altered by using the (Up) and (Down) keys to change the value. The pump must be OFF and in the External Multiply mode. Like the divide value, the valid range for the multiply value runs from 0 to 999 pulses. When the pump is ON, a single external pulse will initiate a batch of pump strokes. The number of remaining pulses are displayed on the LCD screen

. When 0 is reached, the display resets to the multiply value. The pump is now ready for another pulse input.

If a pulse is received before the countdown to 0 is complete, the E4 error code is displayed, and the pump batch count resets to the programmed multiply value. The batch countdown then continues from its programmed value. As the countdown continues, the E4 error code

will be displayed intermittently until the fault is corrected. The strokes that remained from the first batch are *NOT* accounted for. To clear the fault display, the pump must be stopped and restarted.

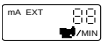
To allow true flow proportioning, the speed in the Multiply mode is equal to the speed set in the Internal (manual) mode. That is, if the Internal mode speed is set at 60 SPM, in the External Multiply mode the pump counts down at 60 SPM.

Batch Accumulate

The Batch Accumulate function allows you to opt to have any extra input pulses received in the multiply mode accumulate up to a maximum batch of 999. If Batch Accumulate is enabled and a pulse is received during the countdown, the programmed multiply value will be added to the current displayed value. Pulses causing the maximum batch of 999 to be exceeded will result in an E4 error message. When Batch Accumulate is enabled, the LCD screen alternates between the current multiply value and "ACC" . The Batch Accumulate function is activated in the Setup Menu (see "Advanced Features and Setup Menu" on page 25).

9.3 Programming the mA Response

The pump accepts a 0-20 mA or 4-20 mA signal directly. The response to this signal is fully programmable. In the mA mode, the pump speed is determined by the programmed response curve, as defined by points "P1" and "P2." The factory default set values for P1 and P2 are (4 mA, 0 SPM) and (20 mA, 100 SPM) respectively. This is illustrated in Figure 12.

While in the mA mode, the pump speed  and the mA value are displayed alternately every four (4) seconds while the pump is running.

9.4 Programming Points 1 and 2 (SPM)

To program points P1 and P2, first ensure the pump is in the mA mode and OFF. If you wish to program the response in "SPM",

switch to the internal mode. The speed must be set to a SPM value [INT 100 /MIN]. Return to the External mA mode.

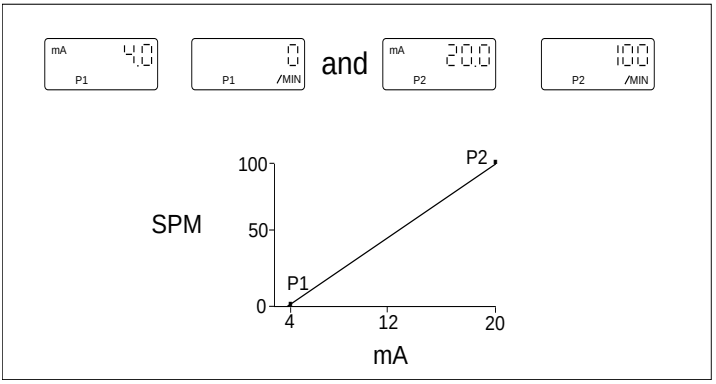


Figure 12

Press either the (Up) or (Down) key. The LCD screen will display [Pro]. After five (5) seconds, the display will show the mA value for P1 [mA 4.0 P1]. This value may be altered using the (Up) or (Down) key within five (5) seconds (i.e. [mA 6.0 P1]). Five (5) seconds following the last key press, the stroke rate for P1 will be displayed [0 P1 /MIN]. This value may be altered within five (5) seconds using the Up or Down key (i.e. [80 P2 /MIN]).

Five (5) seconds after the last key press, the mA value for P2 is displayed [mA 20.0 P2]. Edit as described in the above paragraph (i.e. [mA 18.0 P2]). Likewise, five (5) seconds after the last key press the stroke rate for P2 is displayed. Edit as described above (i.e. [10 P2 /MIN]).

The above examples would result in the inverse control profile shown in Figure 13.

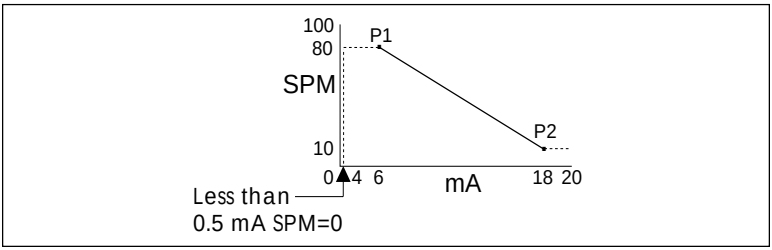


Figure 13

If the mA input goes below the value programmed for P1 or above the P2 value, the response will "plateau," as indicated by the dotted lines above.

The valid input range is from 0.5 to 21 mA. Below 0.5 mA, the pump will be off. Above 21 mA, the E5 error code will be displayed intermittently EXT E5 .

9.5 Programming Points 1 and 2 (SPH)

If you wish to program the response in strokes per hour, start by being in the External mA mode. Next, switch to the Internal mode. If the Internal setting is in strokes per minute, change to strokes per hour by holding the (Down) key until the display reads 0 SPM. Continue to hold it for another three (3) seconds. The display will now read SPH INT H50. Set the speed to any SPH value (the actual setting has no bearing on mA response). Return to the External mA mode.

In the External mA mode, pressing the (Down) key or (Up) key will change the display to . After five (5) seconds, the display will show the mA value for P1 . This value may be altered by using the (Up) key or (Down) key within five (5) seconds (i.e.). Five (5) seconds following the last key press, the stroke rate for P1 will be displayed . This value may be altered within five (5) seconds using the (Up) or (Down) key (i.e.).

Five (5) seconds after the last key press, the mA value for P2 will be displayed . Edit as described above (i.e.). Likewise, five (5) seconds after the last keypress, the stroke rate for P2 is displayed and may be altered as above (i.e.).

The above example would result in the inverse control profile shown in Figure 14.

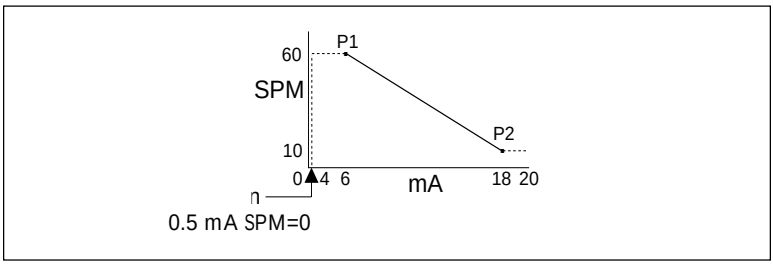


Figure 14

The valid input range is from 0.5 to 21 mA. Below 0.5 mA, the pump will be off. Above 21 mA, the E5 error code will be displayed intermittently .

When programming strokes per hour, the maximum rate is 60. P1 and P2 must BOTH BE SPM or BOTH BE SPH.

10.0 Advanced Features and the Setup Menu

Advanced features such as Batch Accumulate, Computer Interfacing, Automatic Voltage Compensation, Flow Monitoring and Integral Blowdown may be selected and altered in the Setup Menu of the Series A9, B9, and C9. The following configuration chart describes each menu item, its description, and available settings.

Menu Item	Description/ Function	Setting	Notes
	Software Revision	Read Only	
1	Batch Accumulate	0 = Disable 1 = Enable	Applies to External Multiply mode
2	Computer Communication	0 = Disable 1 = Enable	Allows computer interface to be established with LiquComm™ software. Remote Start/Stop and Computer Alarm lines are used in communication.
3	Automatic Voltage Compensation	0 = Disable 1 = Enable	Becomes active two (2) minutes after power up.
4	Flow Monitoring	0 = Disable 1 = Enable	Used in conjunction with FM-200 Digi-Pulse™ Flow Monitors. "Flow" displayed and flashes with each pulse from FM-200.
5	Flow Monitoring Pulse Detection Pulse Detection Setting	1 to 255	Sets the number of missing pulses before alarm output is activated. Menu item number is not included with LCD display. This setting is displayed irrespective of Menu Item 4 setting.
6	Input Pulse Width	0-15	Allows pulse widths of 1 to 60 mSec to be set. Setting of 0 gives a debounce time of approximately 1 mSec.
7	Integral Blowdown	0 = Disable 1 = Enable	Allows Activation of the integral blowdown feature.
8	Integral Blowdown Solenoid ON Time (Seconds)	0 to 255	Set solenoid ON time in seconds.
9	Integral Blowdown Pump ON Time (Seconds)	0 to 255	Set pump ON time in seconds.
	Note: Allow 15 seconds after programming before disconnecting from power to ensure latest changes are stored in nonvolatile memory.		

10.1 Accessing the Setup Menu

To access the Setup Menu, ensure that the pump is OFF and in the Internal mode. Using the (Up) key, bring the stroke rate to 100 SPM. At this point, keep the (Up) key pressed for five (5) seconds. The LCD screen then displays the current software revision, indicating that you have entered the Setup Menu mode . Press the (Mode) key to scroll through the Menu Items. Use the (Up) or (Down) key to enable or disable menu functions and program values.

To exit the Menu mode, press the (Start/Stop) key. Or, if no keys are pressed for 13 seconds, the display reverts to .

10.2 Menu Items

10.2.1 Menu Item 1: Batch Accumulate Enable/Disable

Batch Accumulate may be enabled (1) or disabled (0) . Use the (Up) or (Down) key to change the selection.

10.2.2 Menu Item 2: Computer Communication

Press the Mode key to get to Menu Item 2, Computer Communication. Setting the value to one (1) enables computer communication using the LiquiComm™ Interface Box and Software.

When Computer Communication is enabled, the Remote Start/ Stop and Computer Alarm lines are deactivated and used for the computer communication link.

10.2.3 Menu Item 3: Automatic Voltage Compensation

Menu Item 3 enables (1) or disables (0) automatic voltage compensation. This unique feature allows a constant power level to be delivered to the EPU of the pump, even when the voltage of the external power source is fluctuating. This results in smooth pump output in spite of fluctuating voltage and prevents overheating.

Automatic voltage compensation becomes active two minutes after power up.

10.2.4 Menu Items 4 and 5: Flow Monitoring

This feature is used in conjunction with the LMI Series FM-200-9 Digi-Pulse™ Flow Monitor (refer to Digi-Pulse™ Flow Monitor Instructions P/N 1708). This device is designed to monitor the output flow from a pump. It may be set to deliver a pulse signal output for each successful pump stroke registered. If the flow stops or lessens, the pulse outputs will cease. With the FM-200-9 connected to the flow monitor input, the presence or lack of pulses can be detected (see Figure 15).

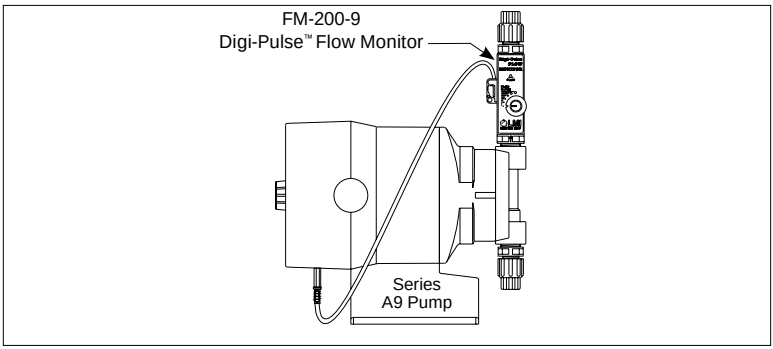


Figure 15

Press the (Mode) key a fourth time and then the (Up) or (Down) key to allow flow monitoring to be enabled (1) or disabled (0). When flow monitoring is enabled, "Flow" is displayed on the LCD screen. Again, pressing the (Mode) key displays the number of missing pulses to be detected. This may be set to any value from 1 to 255. The factory default is 8. A setting of 1 is the most sensitive, a setting of 255 the least sensitive.

For example, if the setting is 5, and five (5) strokes of the pump occur without any pulse being received from the FM-200-9, the LCD screen will display an E2 error code. The pump will stop, and the alarm outputs will be activated (i.e.). Pressing the (Start/Stop) key clears the error.

The word "Flow" blinks every time the A9 , B9, or C9 receives a signal from the Digi-Pulse™. This serves as an aid in setting up the Digi-Pulse™ itself .

10.2.5 Menu Item 6: Input Signal Pulse Width (Debounce)

Menu Item 6 determines the "debounce" period (pulse width) to be applied to incoming pulse (pacing) signals. The default value is 15, which corresponds to a debounce value of 60 mSec . Each unit corresponds to approximately 4 mSec. This means that in order to be recognized, an input signal must be at least 60 mSec in duration. This setting may need to be reduced from its maximum setting for high frequency input pulse signals such as those from a Hall Effect flowmeter.

10.2.6 Menu Items 7, 8 and 9 Activate the Integral Blowdown Feature

These Menu Items will require additional accessories and customer supplied components. For complete details please refer to A9, B9 and C9 with Integral Blowdown (P/N 1753).

This Integral Blowdown feature provides cooling tower control from your LMI microprocessor pump when used in conjunction with a pulse output type flowmeter (batch mode) or 4-20 mA signal (milliamp mode). These signals can then be input into the pump to provide activation of both the pump and a customer supplied solenoid valve.

LMI's Relay Pack, Model RP-100A, must be ordered separately to provide power to the customer supplied solenoid.

A. Batch Mode

Programming Menu

Menu Item 1 Batch Accumulate: Select 0 = (Disable) or 1= (Enable)

Menu Item 7 Integral Blowdown: Select 1 = (Enable)

Menu Item 8 Solenoid ON time: Select 0 to 255 (Seconds)

Select "INT" mode and set the manual strokes per minute.

Select "EXT X" (multiply) mode (batch mode) and program stroke count.

On receipt of a pulse from the flowmeter, the pump strokes the programmed number of pulses. The batch value (multiply [X] value) and manual SPM determines the length of time the pump will be on.

On receipt of a pulse from the flowmeter, the solenoid valve is opened. The solenoid remains open for the length of time programmed in Menu Item 8. If another flowmeter pulse is received before the above is completed the solenoid ON time is extended by the time programmed in Menu Item 8.

B. Milliamp Mode

Programming Menu

Menu Item 7 Integral Blowdown: Select 1 = (Enable)
Menu Item 8 Solenoid ON time: Select 0 to 255 (seconds)
Menu Item 9 Pump ON time: Select 0 to 255 (seconds)
Select EXT mA mode (milliamp mode) and program the mA response (Point 1 and Point 2).

The pump strokes at a rate determined by the mA input signal for the length of time determined by Menu Item 9. The solenoid remains open for the length of time programmed in Menu Item 8 of the menu. The cycle time for this operation is determined by the longer of solenoid ON time or the pump ON time.

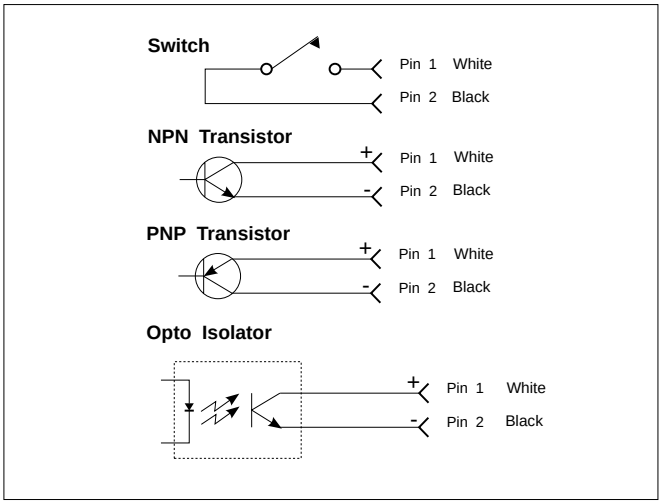
Appendix A: Input/Output Description

4-Pin Connector

Pacing (Pulse) Input / Opto-isolated Input

Methods of Triggering Series A9, B9, and C9 Pumps

Reference: 4-Pin Cable (P/N 33796)

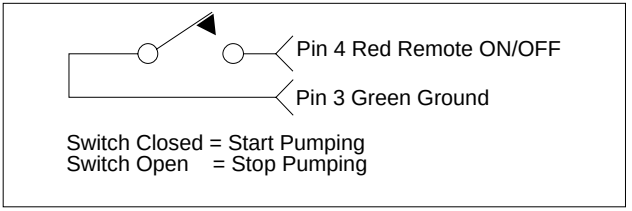


Switch or transistor must be capable of switching 2 mA at 15 VDC. When in the Divide mode, the switch must close then open to trigger.
Minimum time in low impedance state (i.e. switch closed) is 60 mSec by default.
Setup Menu Item 6 sets this value in multiples of 4 mSec.
Example: Default = 4 x 15 = 60 mSec

Remote On/Off (Opto-isolated Input)

Switching this line to ground starts the pump. Releasing this line, stops the pump. The (Start/Stop) key will always override the Remote Start/Stop.

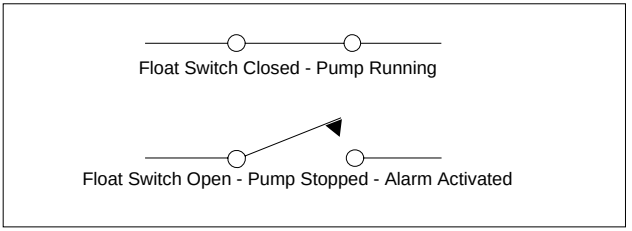
Reference: 4-Pin Cable (P/N 33796)



Switch must be capable of switching 2 mA at +15 VDC. Minimum time in low impedance state (i.e. Switch closed) is approximately one (1) second.

Low-Level Input (P/N 29190 and 29190E)

Opening the float switch (i.e. breaking the line from ground) stops the pump and activates the alarm output.



Switch must be capable of switching 2 mA at +15 VDC.

Minimum time in low impedance state (i.e. switch closed) is approximately 1 second. (For use with LMI Float Switches [P/N 29190 and 29190 E]. For further information, please refer to instructions included with the switches and to page 17 of this supplement.)

8-Pin Connector

Analog 0-20 mA Input

+0 to 20 mA White
-0 to 20 mA Black

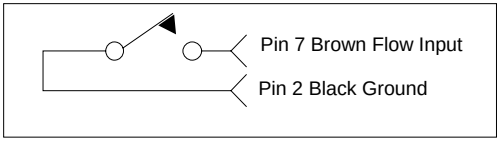
+0 to 20 mA Violet
- 0 to 20 mA Green

This is reverse polarity protected with a 22 Ohm impedance, a resolution or 0.1 mA and an accuracy of +/- 0.2 mA typically.

Flow Input (Opto-isolated Input)
(See also Flow Monitoring on page 26)

If an FM-200-9 is used, use the Digi-Pulse™ phone jack. If some other device is used, this function can be accessed as shown below.

Reference: 8-Pin Cable (P/N 33738)



Switch must closed for approximately three (3) mSec and then open for the input to be accepted (i.e. switch to ground, then release).

Switch must be capable of switching 2 mA at +15 VDC.

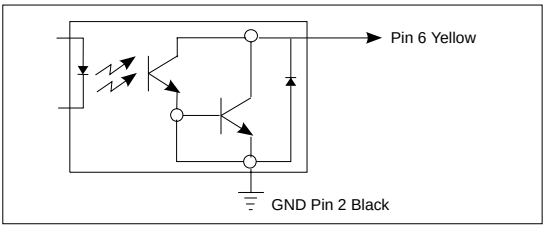
15V Output

The +15V Output (pin 1 Red) is regulated and capable of delivering 30 mA current.

Alarm Output

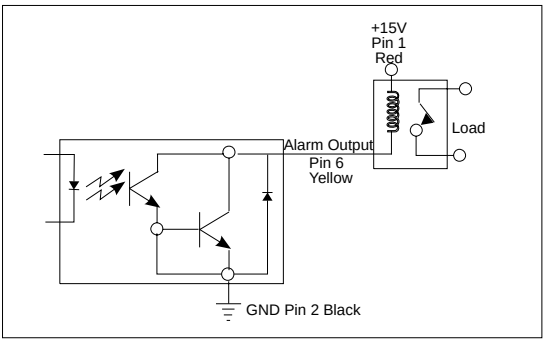
This is an opto-isolated open collector Darlington pair capable of switching 25 mA at +24 VDC to within 1V of ground typically.

Reference: 8-Pin Cable (P/N 33738)



The output pair turns ON when an alarm condition occurs (i.e. low level or missing pulse) and remains ON until the alarm condition is cleared.

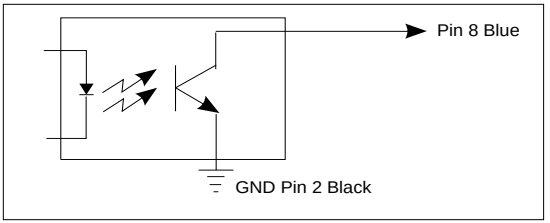
Application: Relay Switching



Computer Alarm Output

This is an opto isolated, open collector output capable of switching 2 mA at +24 VDC to within 0.4V of ground typically.

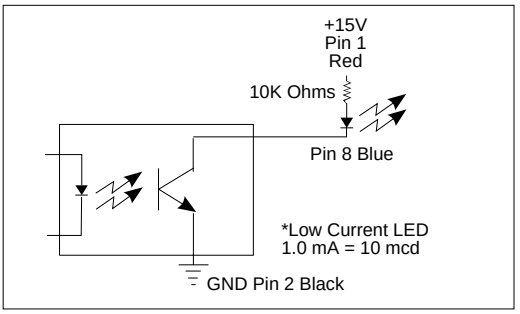
Reference: 8-Pin Cable (P/N 33738)



This output tracks the alarm output (i.e. the conditions for activating and de-activating this output are the same as for the alarm output).

This output may be used to directly switch small loads such as computer inputs and low current LEDs. It may also be used to initiate switching of larger loads if suitable buffer circuitry is provided.

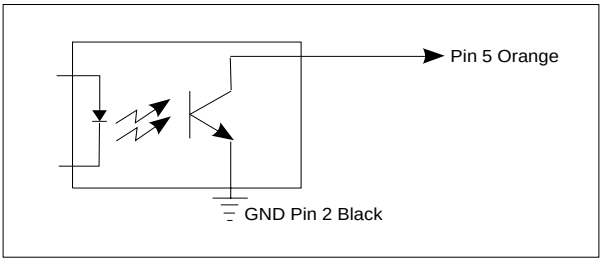
Application: Low Current LED Switching



This is an opto-isolated, open collector output capable of switching 2 mA at +24 VDC to within 0.4V of ground typically.

Pacing Output (Opto-isolated Output)

Reference: 8-Pin Cable (P/N 33738)



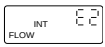
The output transistor turns ON at the start of a stroke and remains ON for approximately 100 mSec.

Appendix B: Summary of Error Messages

E1

is caused by a Low-Level fault with a Low-Level Switch connected to the pump. The pump is stopped and the alarm outputs are activated. This operates in all Internal and External modes. The pump automatically restarts when the fault is cleared.

E2



indicates that the pump has lost prime (or the flow had reduced) when an FM200-9 is connected and Flow Monitoring is enabled. Again, the pump is stopped and output alarms activated. Restart the pump when the fault is cleared.

E3

is displayed in the External mode if the stroke rate exceeds 100 SPM. The pump is NOT stopped and NO alarm outputs are activated with this fault. To stop E3 flashing, clear the fault condition, then stop and restart the pump.

E4

is displayed in the External X (Batch) mode in two situations: 1) If "Batch Accumulate" is disabled and a pulse signal is received while the pump is counting down. The pump is not stopped, and the alarms are not activated. To clear the E4 message, the pump must be stopped and restarted. 2) If "Batch Accumulate" is enabled and the cumulative batch value exceeds 999, E4 will be displayed. The E4 message can only be cleared if the pump is stopped and restarted.

E5

is displayed in the mA External mode if the mA input value exceeds 21.0 mA, whether the pump is running or stopped. Again, the alarms are NOT activated. Once the mA signal goes below 21.0 mA, the E5 error message is cleared.

LMI
LIQUID METRONICS DIVISION
MILTON ROY
A unit of Sundstrand Corporation

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13.2 LMI Series AD Metering Pumps (WTP)

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

Data Sheet

ROYTRONIC EXCEL™ Series AD Electronic Metering Pumps

Model AD

Model Code Configuration

Drive

Control Code

2 - Dual Manual Control
Stroke frequency and length manually adjustable, LCD display, low level indication (remote input). Display configurable to indicate theoretical pump flow.

8 - Pulse/Analog Input w/ Dual Manual Control
Pulse or 4-20 mA signal input controls frequency, LCD display, manual stroke length control, frequency manually adjustable when in local control, pulse multiply/divide functions, 24 V output for remote device. Includes dual low level float switch input. Display configurable to indicate theoretical pump flow.

9 - Pulse/Analog Input w/Dual Manual Control & Enhanced Controls
Advanced Features - Pulse or 4/20 mA signal input controls frequency, graphical display, manual stroke length control, Frequency manually adjustable when in local control, Pulse multiply/divide functions, 24 V output for remote device, dual low level float switch input, Remote on/off signal input. Outputs include: 4-20 mA, pulse, & Alarm. Remote internal/external mode input. Display configurable to indicate theoretical pump flow.

Output Code with FastPrime™ Liquid End

Max Capacity	Max Pressure
1 - 0.21 GPH (0.8 l/h)	250 psi (17.2 Bar)
4 - 0.5 GPH (1.9 l/h)	250 psi (17.2 Bar)
5 - 1.0 GPH (3.8 l/h)	110 psi (7.6 Bar)
6 - 2.0 GPH (7.6 l/h)	50 psi (3.4 Bar)

Voltage Code

1 – 110-120V US Plug
2 – 220-240V US Plug
3 – 220-240V DIN Plug
5 – 220-240V UK Plug
6 – 220-240V Aust/NZ Plug
7 – 220-240V Swiss Plug
8 – 110-120V No Plug

Liquid End

Liquid End Code

See Accompanying Pages for Options

Liquifram™ Size Code

1 – 0.2 in²
2 – 0.4 in²
3 – 0.8 in²
4 – 1.6 in²

Material Code

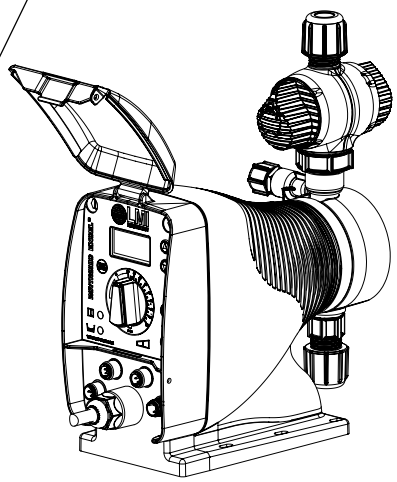
See Accompanying Pages for Options

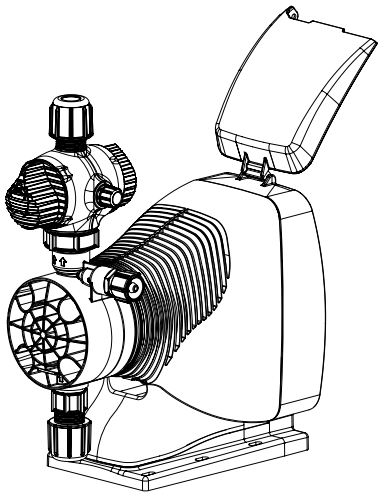
Head/Valve Code

S – FastPrime™ Head + 4FV
N – FastPrime™ Head
H – AutoPrime™ Head + 4FV
A – AutoPrime™ Head
V – High Viscosity Head
P – High Viscosity with Ported Head

Connection Code

I – Inch Tube connections with tubing
M – Metric Tube connection without tubing
U – Inch Tube connection with Black UV resistant suction/discharge tubing
P – 1/2" NPT - 1/2" BSP Pipe (SS 1/4" NPT)





Certified to NSF/ANSI 61 & 372

Certified to NSF/ANSI Standard 50

Specifications

Series	Strokes Per Minute (Adjustable) Min	Max	Stroke Length (Adjustable) Recommended Minimum	Average Input Power @ Max Speed and Pressure	Max. Shipping Weight
AD 2X* AD 8X* AD 9X*	1	120	20%	25 watts	10 lbs (4.75 kg)

* where X = output code

LMI

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Replaces same of Rev.D 6/2012
2039.E 11/2014

Standard FastPrime™ Liquid End Configuration Data & Materials of Construction

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquifram™	Seat/O-Ring	Accs. Valve	Tubing & Connections Discharge & Suction
AD91 ■ AD81 ■ AD21 ■	910SI†	1	Acrylic/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	915SI†	1	PP/PP	Ceramic	Fluorofilm™	PTFE	4FV	PE 1/4" O.D.
	918SI†	1	PVC/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	919SI†	1	Acrylic/PVDF	PTFE	Fluorofilm™	Polyprel®	4FV	PE 1/4" O.D.
	917NP	1	316ss/316ss	316ss	Fluorofilm™	316ss/PTFE	—	1/4" NPT
	812SI†	1	PVDF/PVDF	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	813SI†	1	PVDF/PVDF	Ceramic	Fluorofilm™	PTFE	4FV	PE 1/4" O.D.
	818SI†	1	PVC/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	718SI†	1	PVC/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquifram™	Seat/O-Ring	Accs. Valve	Tubing & Connections Discharge & Suction
AD94 ■ AD84 ■ AD24 ■	920SI†	2	Acrylic/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	925SI†	2	PP/PP	Ceramic	Fluorofilm™	PTFE	4FV	PE 1/4" O.D.
	928SI†	2	PVC/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	929SI†	2	Acrylic/PVDF	PTFE	Fluorofilm™	Polyprel®	4FV	PE 1/4" O.D.
	927NP	2	316ss/316ss	316ss	Fluorofilm™	316ss/PTFE	—	1/4" NPT
	822SI†	2	PVDF/PVDF	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	823SI†	2	PVDF/PVDF	Ceramic	Fluorofilm™	PTFE	4FV	PE 1/4" O.D.
	828SI†	2	PVC/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	728SI†	2	PVC/PVC	Ceramic	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	624VI*	2	PP/PP	316ss	Fluorofilm™	PTFE	—	PE.5"O.D. Vinyl.938"O.D.
	626VI	2	Acrylic/PP	316ss	Fluorofilm™	PTFE	—	PE.5"O.D. Vinyl.938"O.D.

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquifram™	Seat/O-Ring	Accs. Valve	Tubing & Connections Discharge & Suction
AD95 ■ AD85 ■ AD25 ■	930SI†	3	Acrylic/PVC	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	935SI†	3	PP/PP	Ceramic	Fluorofilm™	PTFE	4FV	PE 3/8" O.D.
	938SI†	3	PVC/PVC	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	939SI†	3	Acrylic/PVDF	PTFE	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	937NP	3	316ss/316ss	316ss	Fluorofilm™	316ss/PTFE	—	1/4" NPT
	832SI†	3	PVDF/PVDF	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	833SI†	3	PVDF/PVDF	Ceramic	Fluorofilm™	PTFE	4FV	PE 3/8" O.D.
	838SI†	3	PVC/PVC	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	738SI†	3	PVC/PVC	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	634VI*	3	PP/PP	316ss	Fluorofilm™	PTFE	—	PE.5"O.D. Vinyl.938"O.D.
	636VI	3	Acrylic/PP	316ss	Fluorofilm™	PTFE	—	PE.5"O.D. Vinyl.938"O.D.

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquifram™	Seat/O-Ring	Accs. Valve	Tubing & Connections Discharge & Suction
AD96 ■ AD86 ■ AD26 ■	940SI†	4	Acrylic/PVC	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	945SI†	4	PP/PP	Ceramic	Fluorofilm™	PTFE	4FV	PE 3/8" O.D.
	948SI†	4	PVC/PVC	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	949SI†	4	Acrylic/PVDF	PTFE	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	947NP	4	316ss/316ss	316ss	Fluorofilm™	316ss/PTFE	—	1/4" NPT
	842SI†	4	PVDF/PVDF	Ceramic	Fluorofilm™	Polyprel®	4FV	PE 3/8" O.D.
	843SI†	4	PVDF/PVDF	Ceramic	Fluorofilm™	PTFE	4FV	PE 3/8" O.D.
	848SI†	4	PVC/PVC	Ceramic	Fluorofilm™	Polyprel®		
	748SI†	4	PVC/PVC	Ceramic	Fluorofilm™	Polyprel®		
	644VI*	4	PP/PP	316ss	Fluorofilm™	PTFE		
	646VI	4	Acrylic/PP	316ss	Fluorofilm™	PTFE		

LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

Output Information with FastPrime™ Liquid End

Series	Gallons per Hour Min	Gallons per Hour Max	Liters per Hour Min	Liters per Hour Max	mL/cc per Minute Min	mL/cc per Minute Max	mL/cc per Stroke Min	mL/cc per Stroke Max	Maximum Injection Pressure
ADX1	0.002	0.21	0.01	0.8	0.132	13.2	0.011	0.11	250 psi (17.2 Bar)
ADX4	0.005	0.5	0.02	1.9	0.315	31.5	0.026	0.26	250 psi (17.2 Bar)
ADX5	0.01	1.0	0.04	3.8	0.630	63.0	0.053	0.53	110 psi (7.6 Bar)
ADX6	0.02	2.0	0.08	7.6	1.260	126.0	0.105	1.05	50 psi (3.4 Bar)

(Where X = Control Code 2,8,9).

AutoPrime™ Liquid End Configuration Data & Materials of Construction

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquiframm™	Seat/O-Ring	Accs. Valve	Tubing & Connections
AD91 ■ AD81 ■ AD21 ■	A10HI†	1	Acrylic/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	A18HI†	1	PVC/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquiframm™	Seat/O-Ring	Accs. Valve	Tubing & Connections
AD94 ■ AD84 ■ AD24 ■	A20HI†	2	Acrylic/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.
	A28HI†	2	PVC/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 1/4" O.D.

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquiframm™	Seat/O-Ring	Accs. Valve	Tubing & Connections
AD95 ■ AD85 ■ AD25 ■	A30HI†	3	Acrylic/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 3/8" O.D.
	A38HI†	3	PVC/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 3/8" O.D.

Drive Assembly	Liquid End	Size Code	Materials of Construction: Head/Fittings	Balls	Liquiframm™	Seat/O-Ring	Accs. Valve	Tubing & Connections
AD96 ■ AD86 ■ AD26 ■	A40HI†	4	Acrylic/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 3/8" O.D.
	A48HI†	4	PVC/PVC	Ceramic**	Fluorofilm™	PTFE/Polyprel®	4FV	PE 3/8" O.D.

Output Information with AutoPrime™ Liquid End — Estimated

Series	Gallons per Hour Min	Gallons per Hour Max	Liters per Hour Min	Liters per Hour Max	mL/cc per Minute Min	mL/cc per Minute Max	mL/cc per Stroke Min	mL/cc per Stroke Max	Maximum Injection Pressure
ADX1	0.0015	0.15	0.006	0.6	0.095	9.5	0.008	0.079	250 psi (17.2 Bar)
ADX4	0.0033	0.33	0.012	1.2	0.21	20.8	0.017	0.17	250 psi (17.2 Bar)
ADX5	0.008	0.8	0.030	3.0	0.50	50.5	0.042	0.42	110 psi (7.6 Bar)
ADX6	0.018	1.8	0.068	6.8	1.14	113.6	0.095	0.95	50 psi (3.4 Bar)

(Where X = Control Code 2,8,9).

AUTOPRIME™ liquid ends have 3 check valves: suction on the bottom; discharge on the front; autoprime bleed on the top. By design, a repeatable portion of the process fluid continuously bleeds through the top check valve to be returned to the chemical supply. The result is the assurance that any gas in the head is automatically relieved thus eliminating air-binding. Depending on application, output may be reduced up to 50%. Variables include supplier piping, stroke length and speed setting.

■ See front page for voltage code specifications.

† To specify black, UV resistant tubing, change 'I' to 'U'. To specify head only and no 4FV, change S to N for FastPrime or change H to A for AutoPrime. To specify 1/2" NPT Male, change "I" to "P".

* To specify Ported Head, change "V" to "P".

** Autoprime™ cartridge ball is Hastelloy.

4FV indicates that the pump is equipped with an LMI Four Function Valve. This diaphragm type, anti-syphon/pressure relief valve is installed on the pump head. It provides anti-syphon protection and aids priming, even under pressure.

Fluorofilm™ is a copolymer of PTFE and PFA. Polyprel® is an elastomeric PTFE copolymer.

Polyprel is a regist

Fluorofilm and Liqu

Viton® is a register

LMI Chemical Metering Pumps
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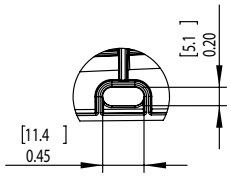
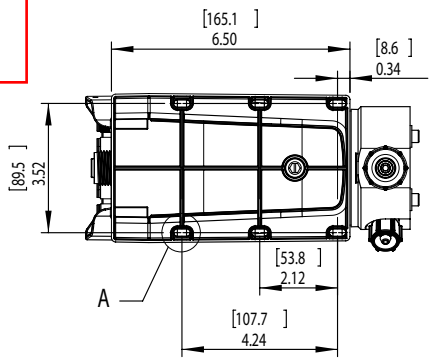
LMI Chemical Metering Pumps
Part #AD941-920SI
Part# B934-362SI
Part# C931-410SI

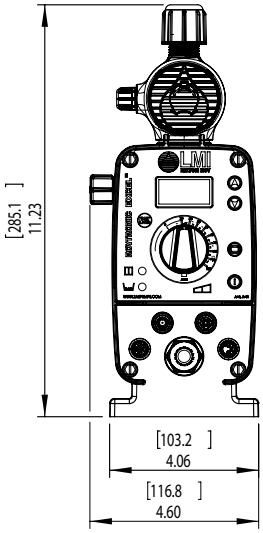
MOUNTING INFORMATION

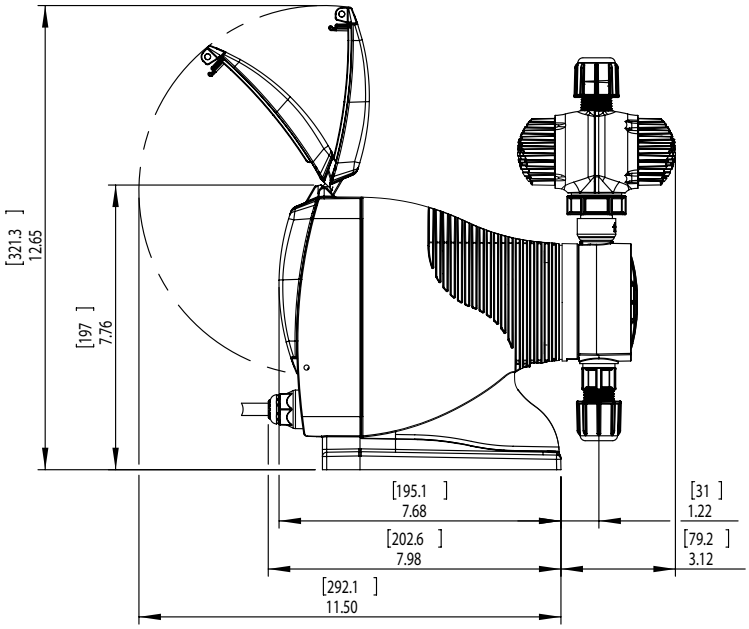
VIEW A



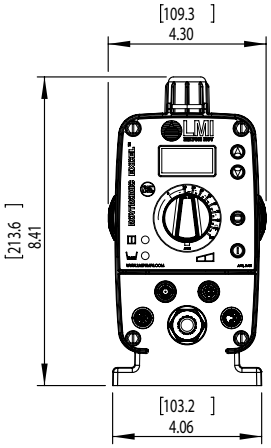


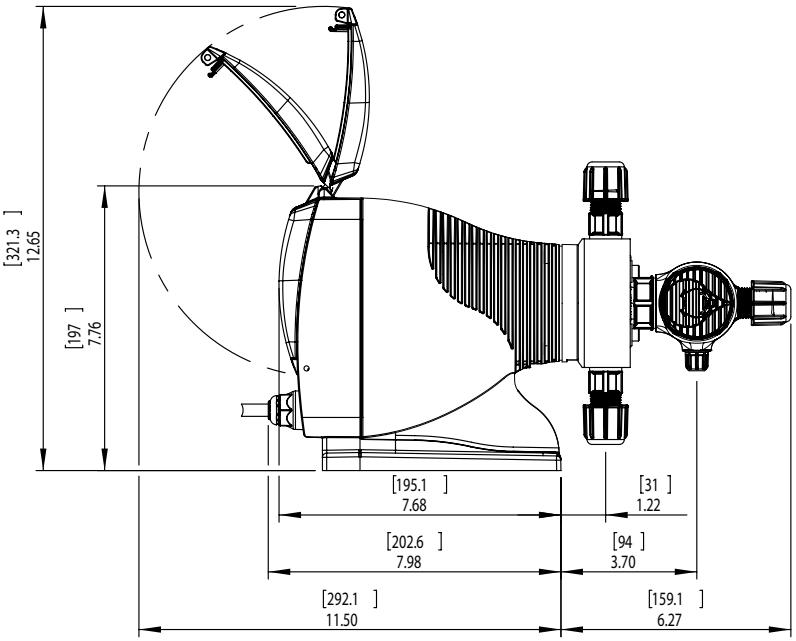
FASTPRIME LIQUID ENDS





AUTOPRIME LIQUID ENDS





NOTE: ALL DIMENSIONS ARE IN INCHES [MM]. DIMENSIONS SHOWN ARE FOR LARGEST LIQUID END. DIMENSIONS WILL VARY DEPENDING ON LIQUID END SELECTED.

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ROYTRONIC is a registered trademark of Milton Roy, LLC.

LMI®

an Accudyne Industries brand

ROYTRONIC EXCEL™ Series AD

Electronic Metering Pumps

Instruction Manual/Programming Guide

Manual No : 2024
Rev. : E
Rev. Date : 11/2015

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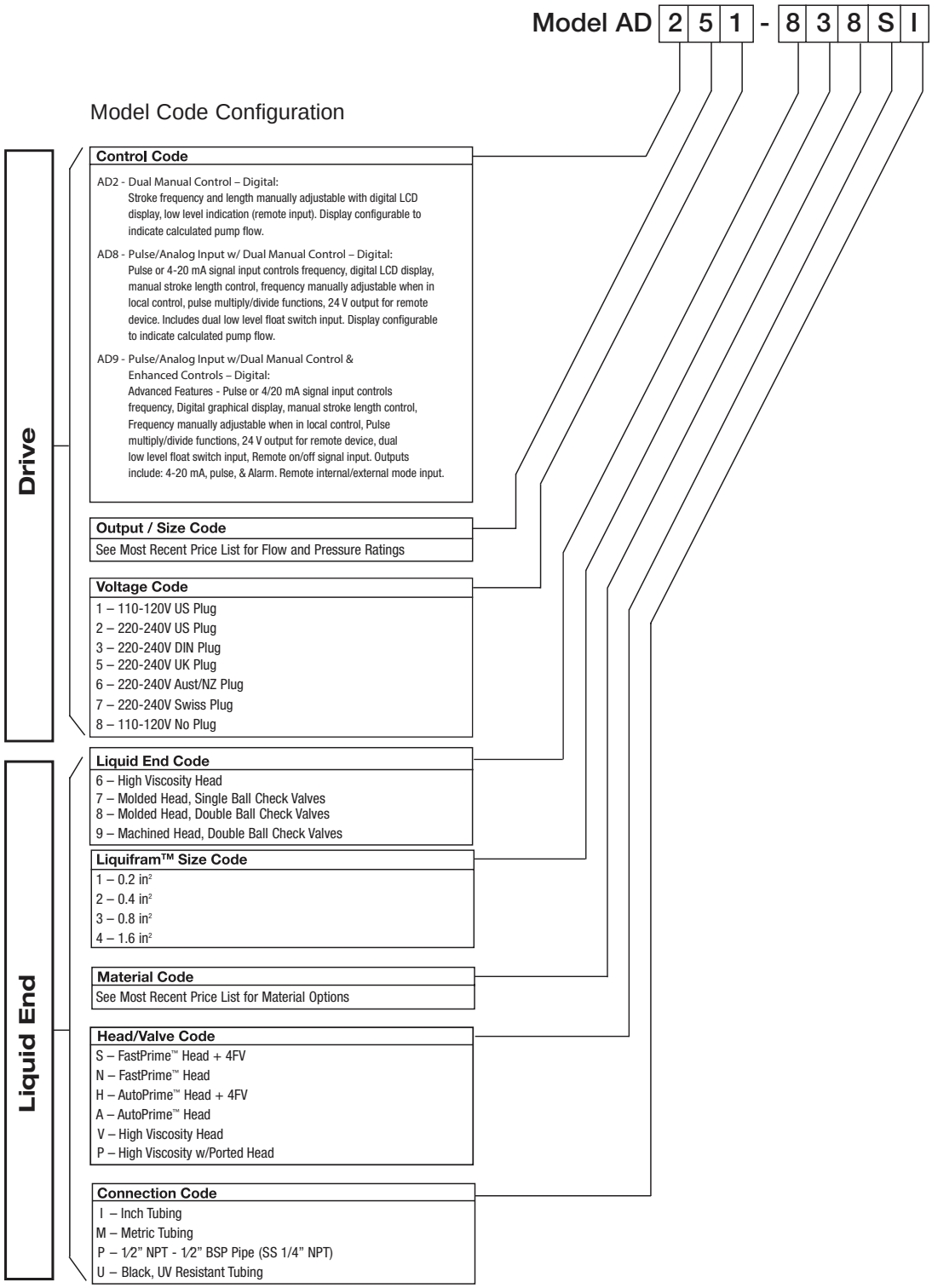

**Note: Not all configurations are available. Please See your local distributor or price list for available options.*

ROYTRONIC EXCEL™ Series AD

PRECAUTIONS

The following precautions should be taken when working with LMI® metering pumps.
Please read this section carefully prior to installation.

Protective Clothing

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on the solution being pumped. Refer to SDS precautions from your solution supplier.

Water Pre-Prime

All LMI® pumps are pre-primed with water when shipped from the factory. If your solution is not compatible with water, disassemble the Pump Head Assembly. Thoroughly dry the pump head, valves, seal rings, balls and LIQUIFRAM™ (diaphragm). Reassemble head assembly tightening screws in a crisscross pattern. Refill the pump head with the solution to be pumped before priming the pump. (This will aid in priming.)

Liquid Compatibility

The evaluation performed by UL was tested with water only. LMI® pumps are tested to NSF 50 for use on muriatic acid (40%) and sodium hypochlorite (12.5%). The pumps are certified to NSF 61 with: sodium hypochlorite (12.5%), sulfuric acid (98.5%), sodium hydroxide (50%), and hydrochloric acid (30%). Determine if the materials of construction included in the liquid handling portion of your pump are adequate for the solution (chemical) to be pumped. Always refer to the solution supplier and the LMI® Chemical Resistance Chart for compatibility of your specific LMI® metering pump. Contact your local LMI® distributor for further information.

Tubing Connections

Inlet and outlet tubing or pipe sizes must not be reduced. Make certain that all tubing is SECURELY ATTACHED to fittings prior to start-up (see Section 2.3, Tubing Connections). ALWAYS use LMI® supplied tubing with your pump, as the tubing is specifically designed for use with the pump fittings. It is recommended that all tubing be shielded to prevent possible injury in case of rupture or accidental damage. If tubing is exposed to sunlight, black UV resistant tubing should be installed. Check tubing frequently for cracks and replace as necessary.

Vinyl Tubing

Your carton may contain a roll of clear vinyl tubing; this is only for connection to the return line of the FASTPRIME™ Head and must not be used as discharge tubing.

Fittings and Machine Threads

All fittings should be hand-tightened. An additional 1/8 - 1/4 turn after the fitting is snug may be necessary to provide a leak-proof seal. Excessive overtightening or use of a pipe wrench can cause damage to the fittings, seals, or pump head.

Most LMI® pumps have straight screw machine threads on the head and fittings and are sealed by the O-rings. DO NOT use PTFE tape or pipe dope to seal threads. PTFE Tape may only be used on the 1/2" NPT thread side of the Injection Check Valve, the stainless steel liquid end connections, except for the head's discharge port, or if piping is directly connected to the pipe threads of the suction or discharge fittings.

Plumbing

Always adhere to your local plumbing codes and requirements. Be sure installation does not constitute a cross connection. Check local plumbing codes for guidelines. LMI® is not responsible for improper installations.

Back Pressure / Anti-Syphon Valve

If you are pumping downhill or into low or no system pressure, a back pressure/anti-syphon device such as LMI®'s Four Function Valve should be installed to prevent over pumping or syphoning. Contact your LMI® distributor for further information.

Electrical Connections

To reduce the risk of electrical shock, the metering pump must be plugged into a properly grounded grounding-type receptacle with ratings conforming to the data on the pump control panel. The pump must be connected to a good ground. DO NOT USE ADAPTERS! All wiring must conform to local electrical codes. If the supply cord is damaged, it must be replaced by the manufacturer, stocking distributor, or authorized repair center in order to avoid a hazard.

Fuse (all models) and Battery (AD9 only)

Caution, Battery may explode if mistreated. Do not recharge, disassemble or dispose of in fire. The battery and fuse are internal, factory serviceable parts, and must be replaced by the factory or a qualified distributor with parts of the same type and rating.

Flooding

Install this pump in a location where flooding cannot occur.

Ground Fault Circuit Interrupter

To reduce the risk of electric shock, install only on a circuit protected by a Ground Fault Circuit Interrupter (GFCI).

Line Depressurization

To reduce the risk of chemical splash during disassembly or maintenance, all installations should be equipped with line depressurization capability. Using LMI®'s Four-Function Valve (4 FV) is one way to include this feature.

Over Pressure Protection

To ensure safe operation of the pump it is recommended that some type of safety/pressure relief valve be installed to protect the piping and other system components from failing due to excessive pressure.

Chemical Concentration

There is a potential for elevated chemical concentration during periods of no flow, for example, during backwash in the system. Steps, such as turning the pump off, should be taken during operation or installation to prevent this. See your distributor about other external control options to help mitigate this risk.

Retightening Components

Plastic materials will typically exhibit creep characteristics when under pressure over a period of time and to insure a proper fit it may be necessary to retighten the head bolts periodically. To insure proper operation, we recommend tightening the bolts to 25 inch-pounds after the first week of operation and on a monthly basis thereafter.

Flow Display

The default flow value as shown on the pump display is accurate at maximum pressure and 100% stroke length. If your operating conditions differ from this, then calibration is necessary in order to display an accurate measure of the flow.

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SECTION 1 - INTRODUCTION

LMI® is the world's most versatile manufacturer of economical and efficient metering pumps. This manual addresses the installation, maintenance and troubleshooting procedures for manually and externally controlled pumps. LMI® has a worldwide network of stocking representatives and authorized repair centers to give you prompt and efficient service.

Note:

Please review this manual carefully. Pay particular attention to warnings and precautions. Always follow good safety procedures, including the use of proper clothing, eye and face protection.

1.1 SPECIFICATIONS

	AD2XY (where X is any number; where Y is 1, or 8)	AD2XY (where X is any number; where Y is 2,3,4,5,6,7, or 9)	AD8XY, or AD9XY (where X is any number; where Y is any number)
Operating Temperature	14 to 113°F –10 to 45°C	14 to 113°F –10 to 45°C	14 to 113°F –10 to 45°C
Voltage	110 to 120 V	220 to 240 V	95 to 240 V
Frequency	50 to 60 Hz	50 to 60 Hz	50 to 60 Hz
Max. Current	2.0 A	1.0 A	1.4 A
Wattage	25 W	22 W	20 W

Table 1

	AD2	AD8	AD9
Battery	N/A	N/A	Panasonic BR1225 or Renata CR1225 or Energizer/Eveready CR1220
Fuse	Bel Fuse 5HT1.25-R Time-lag, 5mm x 20mm	Bel Fuse 5HT 2-R Time-lag, 5mm x 20mm	Bel Fuse 5H 2-R Time-lag, 5mm x 20mm

Table 2

Note:

The battery and fuse are internal, factory serviceable parts, and must be replaced by the factory or a qualified distributor with parts of the same type and rating.

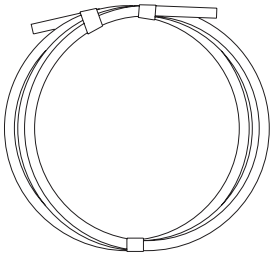
SECTION 1 - INTRODUCTION

1.2 UNPACKING CHECK LIST

Your carton will contain many or all of the following items. Please notify the carrier immediately if there are any signs of damage to the pump or its parts.

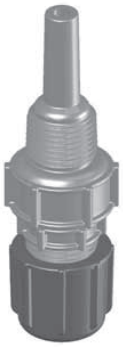
Metering Pump

Foot Valve



Tubing (0 to 3 Rolls)

Ceramic Foot Valve Weight



Injection Check Valve

Four-Function Valve (Optional)

External Control Cable (0, 1, or 2 Cables)

Tube Connection Hardware

Figure 1. Unpacking Check Sheet

SECTION 2 - INSTALLATION

2.1 PUMP LOCATION AND INSTALLATION

Locate pump in an area convenient to solution tank and electrical supply.

The pump should be accessible for routine maintenance, and should not be operated in ambient temperatures above 113°F (45°C). If the pump will be exposed to direct sunlight, LMI® black, UV resistant tubing should be installed.

This pump is cord connected and not intended for permanent mounting to a building. However, temporary mounting to stabilize the pump during operation may be necessary as long as tools are not required for the installation or removal of the pump.

2.2 PUMP MOUNTING

The pump can be mounted in one of two ways:

A. FLOODED SUCTION (ideal installation); or

B. SUCTION LIFT - when suction lift is less than 5 feet (1.5 m) for solutions having a specific gravity of water or viscosity of less than 100 cSt (centistokes). For denser or more viscous solutions, consult distributor.

Note that suction conditions can affect the performance of the pump. This effect is more pronounced with lower pressure pumps. Consult your distributor for additional information.

Your LMI® metering pump must be mounted so that the suction and discharge valves are vertical. **NEVER position pump head and fittings horizontally**.

2.2.1 Flooded Suction

For flooded suction the pump is mounted at the base of the storage tank. This installation is the most trouble-free, and is recommended for very low outputs, solutions that gasify, and high-viscosity solutions. Since the suction tubing is filled with solution, priming is accomplished quickly and the chance of losing prime is reduced. A foot valve is not necessary in a flooded suction installation.

When pumping downhill or into low or no pressure system, a back pressure/anti-syphon device should be installed to prevent overpumping or syphoning. Although popular for all solutions, LMI® recommends flooded suction installations for all high-viscosity fluid applications.

INCORRECT
Avoid this type of false flooded suction

CORRECT

Figure 2. Flooded Suction Pump Mounting

2.2.2 Suction Lift - Wall Bracket Mount

The pump may be mounted using an LMI® Wall Mount Bracket Assembly (part no. 34643) directly above the solution tank. A pump mounted in this manner allows for easy changing of solution tanks or drums.

2.2.3 Suction Lift - Tank Mount

The pump may be mounted on a LMI® 10-gallon tank (part no. 27421), 35-gallon tank (part no. 27400), and 50-gallon tank (part no. 26350).

2.2.4 Suction Lift - Shelf Mount

The pump may be mounted on a shelf (customer supplied) maintaining a suction lift of less than 5 ft (1.5 m).

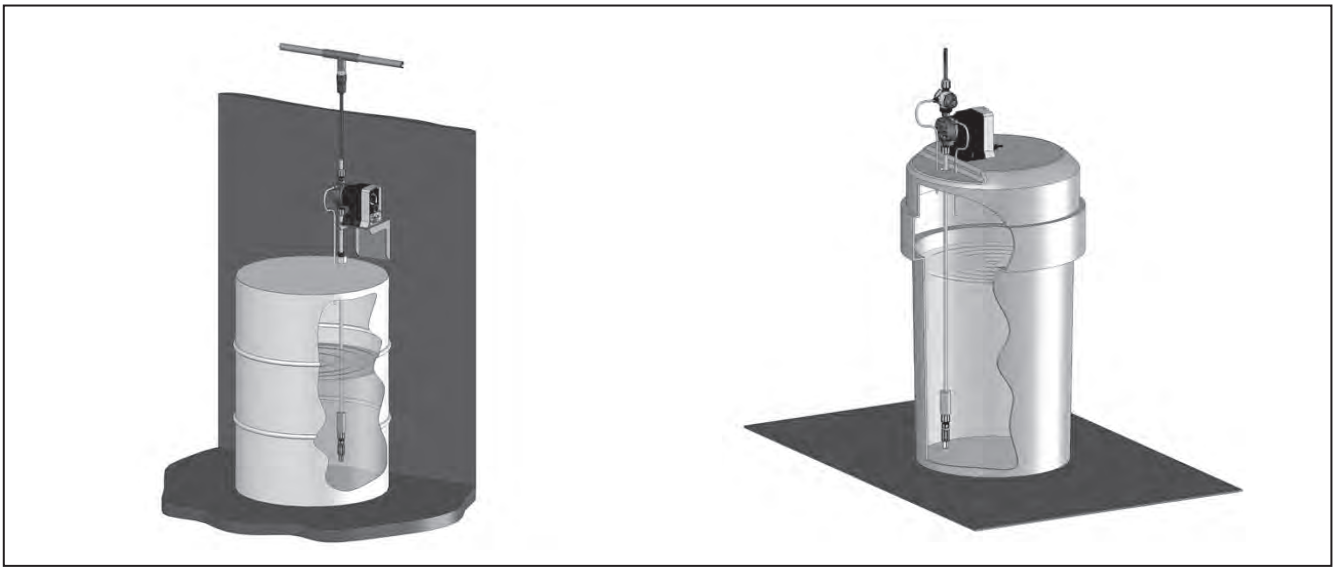


Figure 3

SECTION 2 - INSTALLATION

2.3 TUBING CONNECTIONS

1. Insert tubing through Coupling Nut. Tubing should enter the smaller end of the Coupling Nut first, orienting the larger opening of the Coupling Nut toward the tubing end.

2a. For 1/4” OD tubing: Position the Female Ferrule so that 1/4” to 3/8” (5-10 mm) of tubing protrudes from the Female Ferrule. Orient the raised collar of the Ferrule toward the Coupling Nut (reference *Figure 4*).

2b. For 3/8” or 1/2” OD tubing: Position a Female Ferrule about 1 inch (25 mm) from end of tubing. Orient the raised collar of the Female Ferrule toward the Coupling Nut. Then, insert the Male Ferrule onto the end of the tube, pushing the tube into the bottom of the groove in the Male Ferrule. Then slide the Female Ferrule down the tubing and with your fingers, press tightly into the Male Ferrule (reference *Figure 5*).

3. Firmly hand tighten the Coupling Nut onto the fitting.

Note:
Tightening with pliers may cause the Ferrules to break.

⚠ CAUTION

A. USE ONLY LMI® TUBING. ALWAYS USE LMI® SUPPLIED TUBING WITH YOUR PUMP, AS THE TUBING IS SPECIFICALLY DESIGNED FOR USE WITH THE PUMP FITTINGS.

B. DO NOT USE CLEAR VINYL TUBING ON THE DISCHARGE SIDE OF THE PUMP. THE PRESSURE CREATED BY THE PUMP CAN RUPTURE VINYL TUBING.

C. BEFORE INSTALLATION, ALL TUBING MUST BE CUT WITH A CLEAN SQUARE END.

D. VALVE AND HEAD CONNECTIONS FROM THE FACTORY ARE CAPPED OR PLUGGED TO RETAIN PRE-PRIME WATER. REMOVE AND DISCARD THESE CAPS OR PLUGS BEFORE CONNECTING TUBING.

DO NOT USE PLIERS OR PIPE WRENCH ON COUPLING NUTS OR FITTINGS.

DO NOT REUSE FERRULES. USE ONLY NEW FERRULES.

Replacement Ferrules, and Coupling Nuts are available as the following kit numbers.

Tube Size	Kit Number
1/2” Tube	77382
3⁄8” Tube	77383
1/2” Tube	77384
3 x 6 mm Tube	77378
6 x 8 mm Tube	77379
9 x 12 mm Tube	77380
*One kit is needed for each end of the tube.	

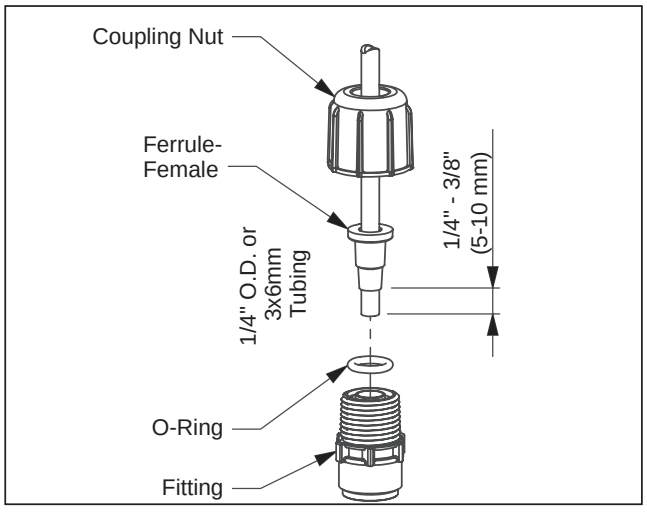


Figure 4

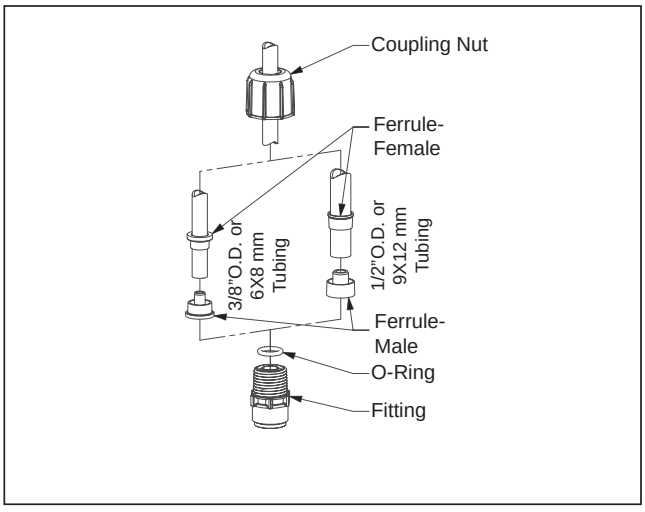
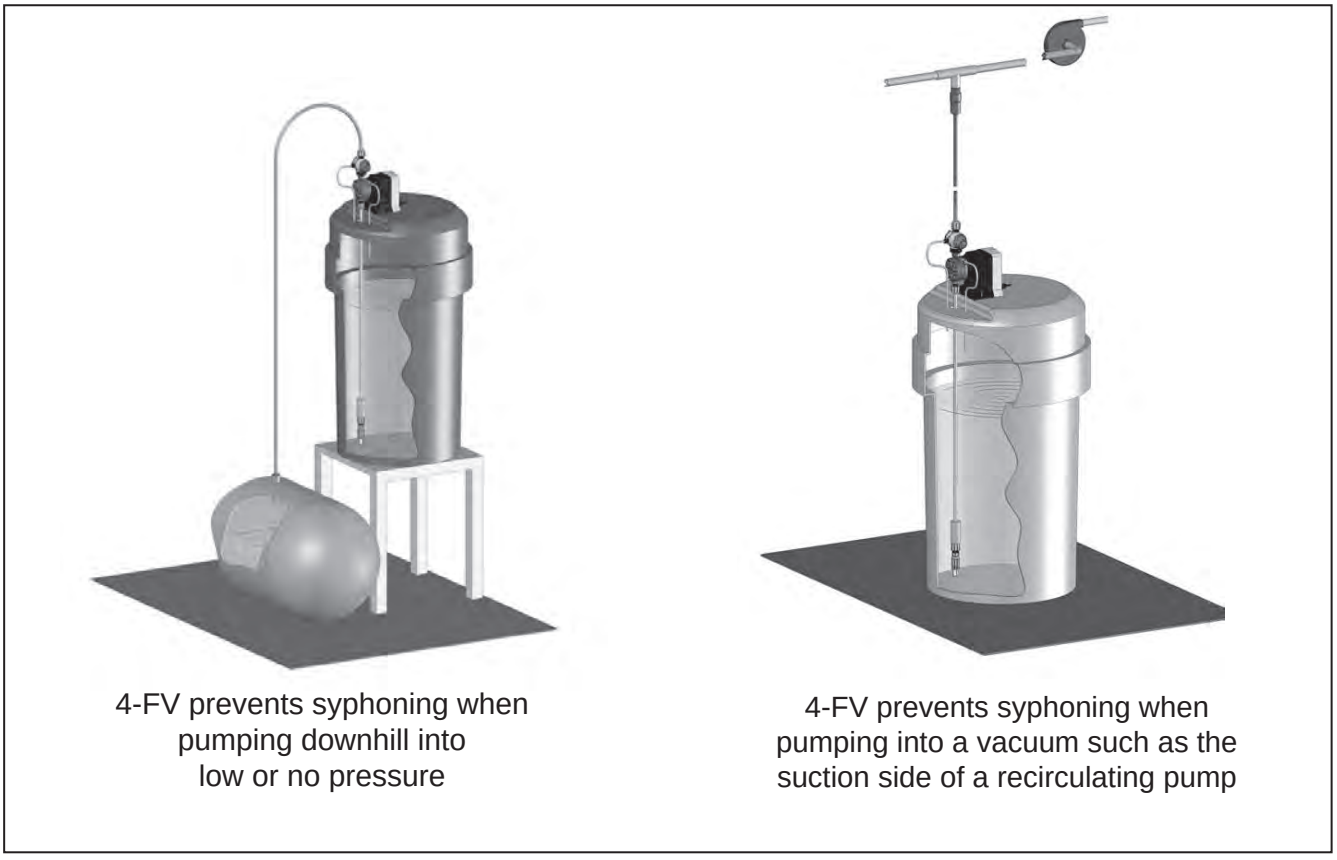


Figure 5

2.4 FOUR-FUNCTION VALVES (4-FV)

Your pump may be equipped with a 4-FV, or standard discharge valve. If your pump is not equipped with a four-function valve and you feel it is needed in your application, it can be purchased as an accessory. Contact your local LMI® stocking distributor. The features of a 4-FV are listed below.

1. **Pressure Relief:** If the discharge line is over pressurized, the valve opens sending solution back to the supply tank.
2. **Line Depressurization:** Opening the relief knob provides line drain back to the supply tank.
3. **Anti-Syphon:** Prevents syphoning when pumping solution downhill or into a vacuum.
4. **Back Pressure:** Supplies approximately 20 psi back pressure to prevent overpumping when little or no system back pressure is present.



4-FV prevents syphoning when pumping downhill into low or no pressure

4-FV prevents syphoning when pumping into a vacuum such as the suction side of a recirculating pump

Figure 6. Typical Installations Requiring the Anti-Syphon Feature of a Four-Function Valve

SECTION 2 - INSTALLATION

2.5 FOUR-FUNCTION VALVE INSTALLATION

To install a 4-FV, the 4-FV Fitting and Coupling Nut should be assembled with the appropriate cartridges into the discharge port of the pump. Use a 13/16” or 20 mm socket to tighten fitting. Tightening to 50 inch-pounds is recommended. Do not over tighten.

To assemble the Four-Function Valve Body, insert the large opening on the Four-Function Valve Body into the 4-FV Coupling Nut and hand tighten. You can position the valve to have the Bleed Nut pressure relief port in any convenient location by tightening the 4-FV Coupling Nut with the Bleed Nut positioned 90º CCW from desired location, then holding the 4-FV Coupling Nut stationary while turning the 4-FV Body the final 90º to desired position. Next, insert the ¼” tubing through the Bleed Nut. Ensure that about ¼” (6 mm) of tubing is protruding through the tip of the Bleed Nut. Firmly hand tighten the Bleed Nut in the hole on the side of the 4-FV. This tubing should be routed back to the supply tank. To ensure proper function of the priming function, the end of this tubing should not be submerged in the solution.

⚠ CAUTION **THIS RETURN LINE TUBING MUST BE SECURED TO ENSURE PUMPED SOLUTION WILL SAFELY RETURN TO SUPPLY.**

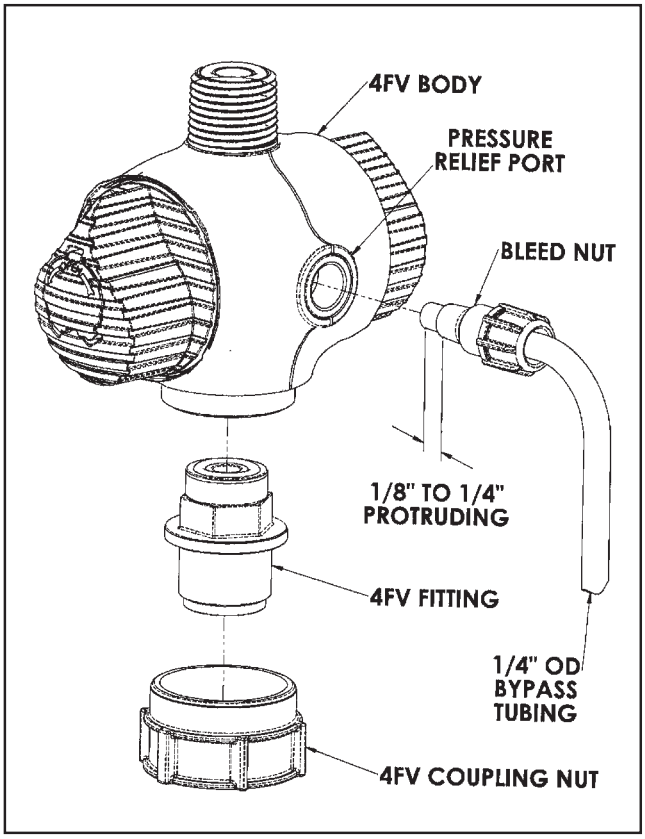


Figure 7. Four-Function Valve Tubing Connection

SECTION 2 - INSTALLATION

2.6 FASTPRIME™

The FASTPRIME™ Head is equipped with a valve that allows for opening the head to atmospheric pressure. When installing a pump equipped with a FASTPRIME™ Head connect the 3/8” outer diameter clear vinyl tubing provided with the pump to the barbed nozzle. Route the vinyl return line back to the solution tank. This tubing must not be submerged in the solution.

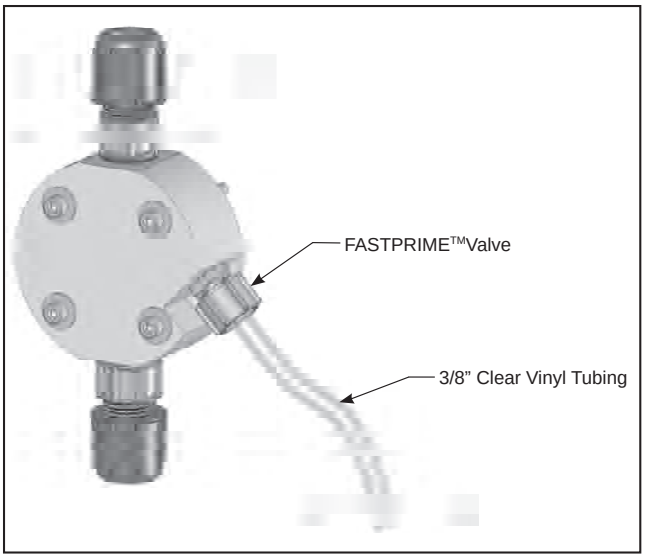


Figure 8. FASTPIME™ Head

2.7 AUTOPRIME™

Pumps installed with the AUTOPRIME™ Liquid End are equipped with a valve that allows for constant removal of vapors and gasses inherent with effervescent chemicals such as Sodium Hypochlorite and Hydrogen Peroxide. The valve keeps the pump primed automatically. When installing a pump equipped with an AUTOPRIME™ Liquid End, connect the 1/2” OD Polyethylene tubing to the top vertical fitting, and route this line back to the supply tank. To ensure priming, this tubing should not be submerged in the solution. The horizontal fitting is the discharge, and the bottom vertical fitting is the suction.

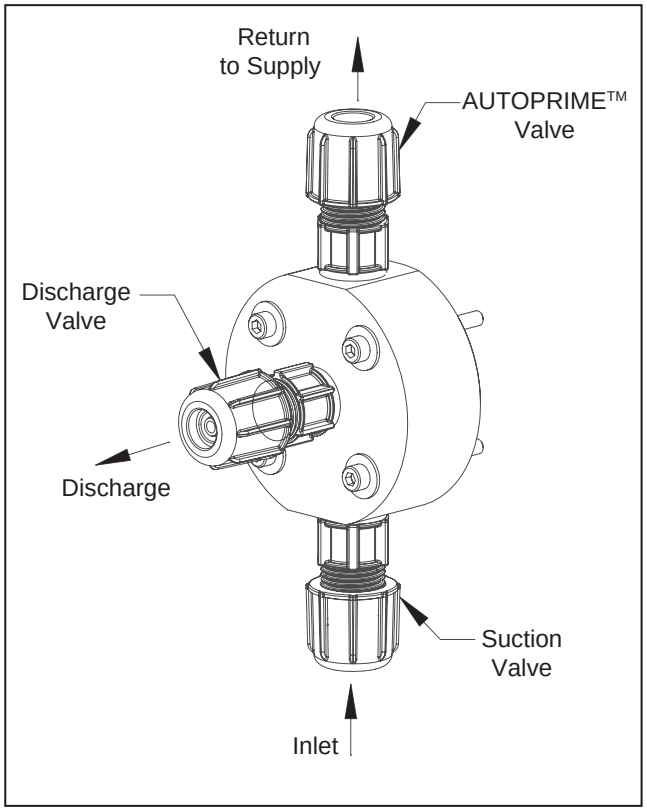


Figure 9. AUTOPRIME™ Liquid End Example

SECTION 2 - INSTALLATION

2.8 FOOT VALVE / SUCTION TUBING INSTALLATION

The Foot Valve acts as a check valve to keep the pump primed in suction lift applications.

The foot valve is designed to be submersed in the solution tank or drum and must sit in a vertical position at the bottom. Position approximately 2 inches (50 mm) off the bottom if the tank or drum contains sediment.

Note:

Pump models equipped with high-viscosity liquid ends are not equipped with foot valves. Flooded suction is recommended. A 1/2" NPT connector is included for flooded suction installations.

The ceramic weight, when installed, positions the foot valve in a vertical position.

1. Attach the foot valve to one end of the suction tubing (see Tubing Connections, Section 2.3).
2. Slide the ceramic weight over the tubing end until it contacts the top of the foot valve coupling nut.
3. Place foot valve and tubing into the solution tank. Check that the foot valve is vertical and approximately 2 inches (50 mm) from the bottom of the tank or drum (see illustration). Connect the other end of the tubing to the suction side of the pump head (bottom side) (see Tubing Connections, Section 2.3).

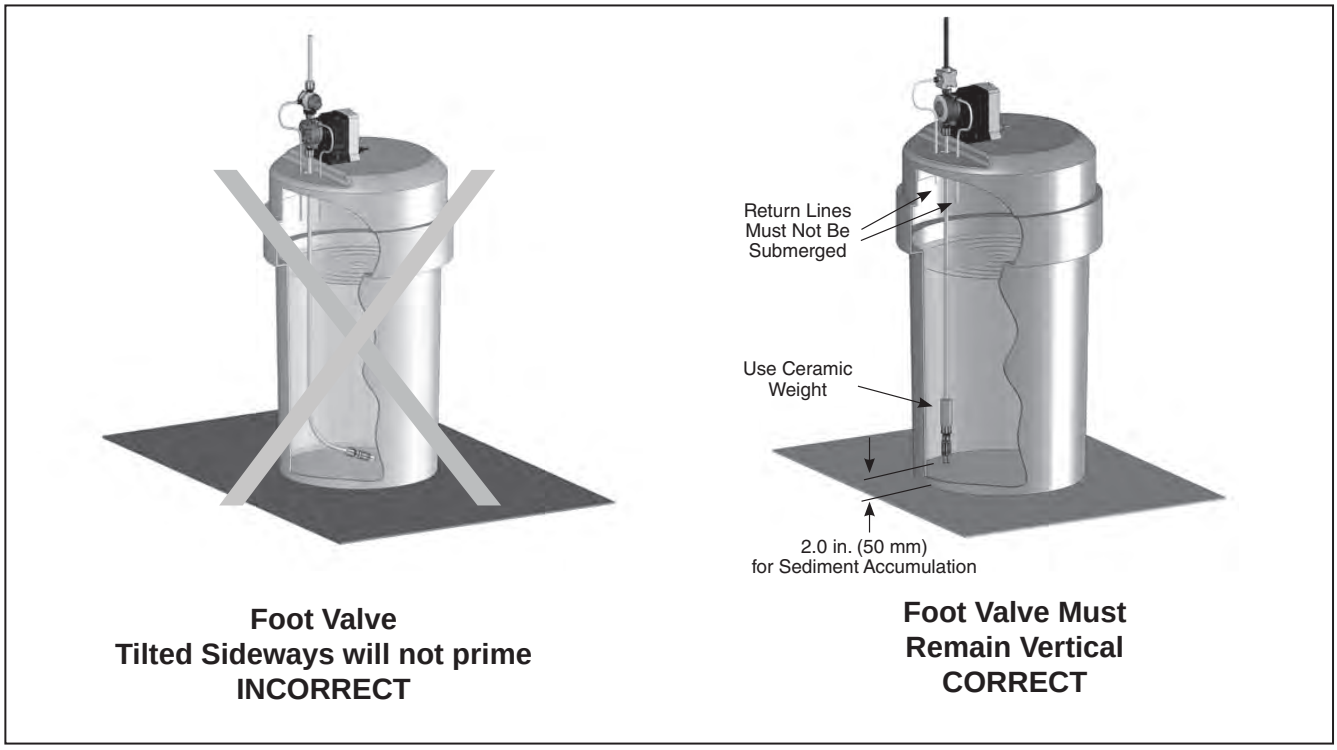


Figure 10. Foot Valve / Suction Tubing Installation

2.9 INJECTION CHECK VALVE AND DISCHARGE TUBING INSTALLATION

The Injection Check Valve prevents backflow from a treated line. Install the injection check valve at the location where chemical is being injected into the system. Any size Female NPT fitting or pipe tee with a reducing bushing to ½" Female NPT will accept the injection check valve. PTFE tape should only be used on threads that are connected with pipes.

When installing the Injection Check Valve, be sure to position it so that the valve enters the bottom of your pipe in a vertical position. Variations left and right within 80° acceptable (See illustration).

After cutting an appropriate length of tubing, connect tubing to the injection check valve then back to the discharge side of the pump head. Make sure it does not crimp or come into contact with hot or sharp surfaces (see Tubing Connections, Section 2.3).

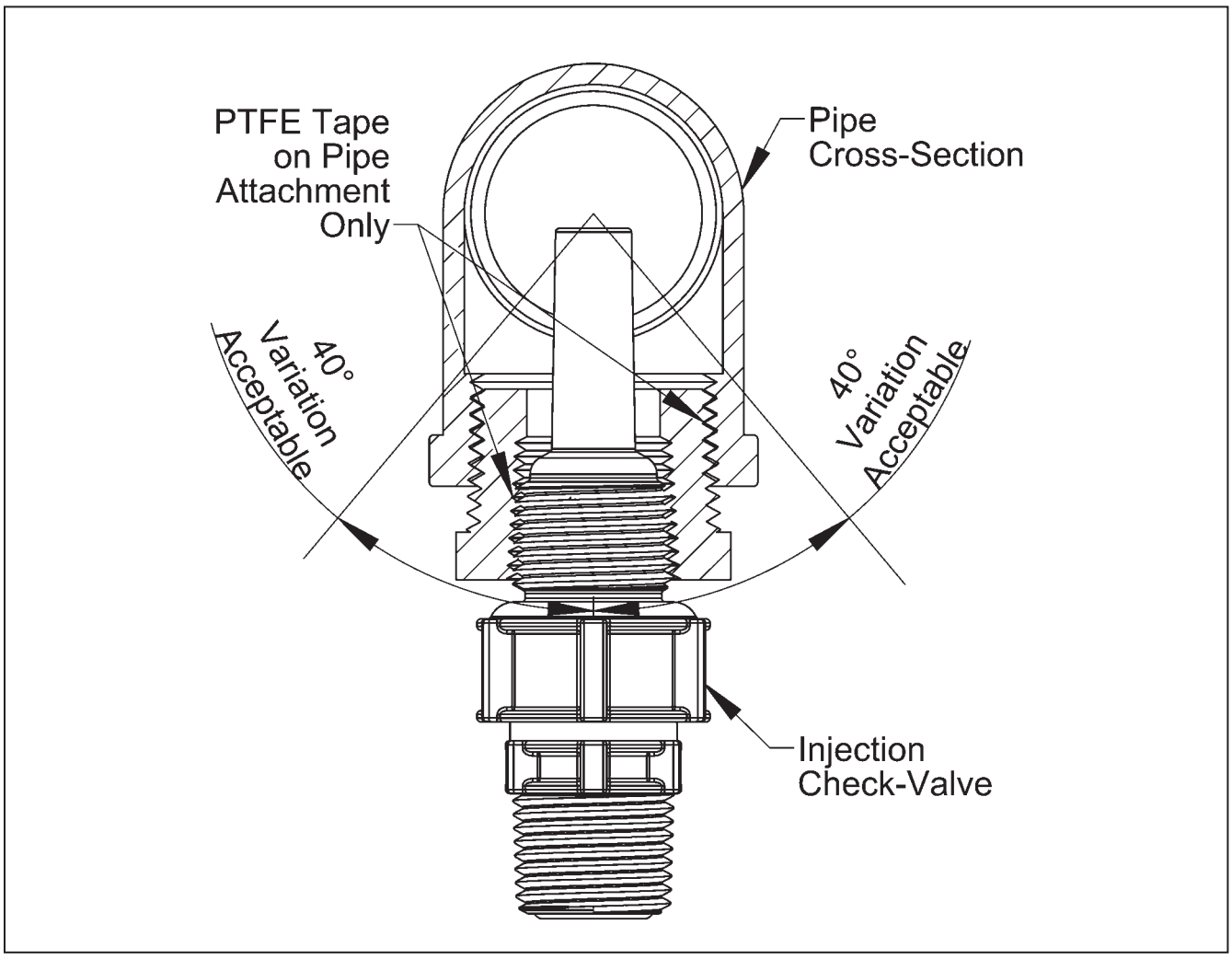


Figure 11. Typical Injection Check Valve Installation

SECTION 3 - OPERATION

3.1 OUTPUT ADJUSTMENT CONTROLS

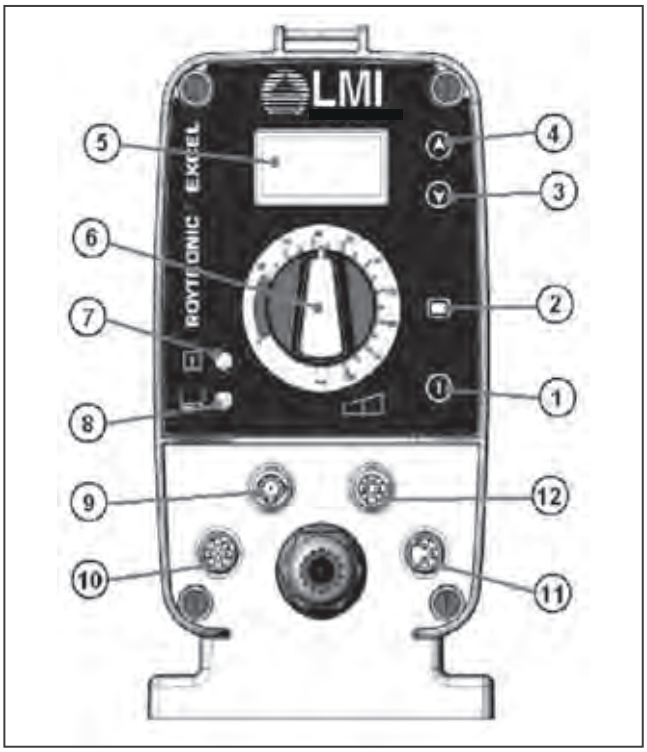
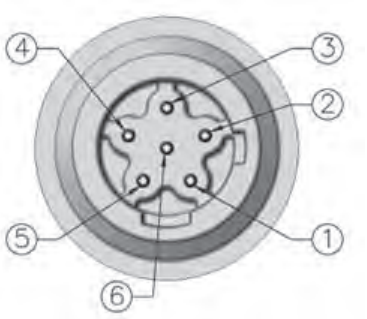


Figure 12

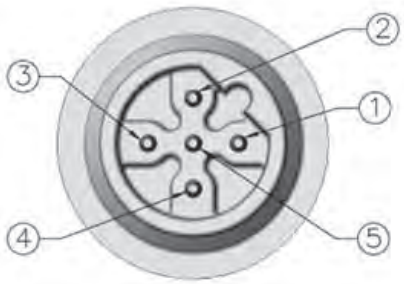
1. ⏻ **Power Button:** This button allows convenient starting and stopping of the pump.
2. ▭ **Mode Selection Button:** For pumps with external control capability (AD8, AD9) this button switches pump operation between internal and external modes. When operating in internal mode the Pulse Indicator Light will flash green while pumping. When operating in external mode the Pulse Indicator Light will flash yellow while pumping.
3. ▼ **Down Button:** This button reduces the stroke speed of the pump. It will reduce the stroke speed by 1 each time it is pressed. If this button is held down, it will rapidly reduce the stroke speed. When a speed of 1 stroke per minute (SPM) is reached the speed can be further reduced by pressing this button again to enter stroke per hour settings.
4. ▲ **Up Button:** This button increases the stroke speed of the pump. It will increase the stroke speed by 1 each time it is pressed. If this button is held down, it will rapidly increase the stroke speed. When a speed of 59 strokes per hour (SPH) is reached the speed can be further increased by pressing this button again to enter stroke per minute settings.
5. **LCD Display:** This display will show the stroke speed of the pump. Pumps with theoretical (AD2, AD8, AD9) or actual (AD9 when combined with a flow meter) flow will display the flow here.
6. **Stroke Adjustment Knob:** This knob provides adjustment of the stroke length. Turning this knob clockwise ↻ increases the stroke length, which results in a higher amount of chemical displaced per stroke. It is recommended that the stroke range stay between 20% and 100%.
7. **Pulse Indicator Light:** This light will flash green when pumping in internal mode and will flash yellow when pumping in external mode. The light is on between strokes and off during the actual stroke.
8. **Low-Level Indicator Light:** For units with Single-Level Float Sensors this light will turn red when the Low-Level Sensor registers empty. This will turn the pump off. For units compatible with Dual-Level Sensors (AD8, AD9) the light will turn yellow when a low level is registered, and red when an empty level is registered. The pump will turn off when it registers an empty level.

9. Output, Alarm & Remote Mode Connector (6-Pin): This connector is used for the special functions associated with the AD9 controls. For the AD9 this connector is associated with the 4-20ma out, Alarm Out, and Internal/ External remote modes.



1. Alarm Out (Red/White) - Programmed as either an Alarm Output or Internal/External mode indicator. As an Alarm Output, pins 1 and 2 will give a closure (solid state) triggered by: empty tank indication, input pulse error, exceed batch error, or flow switch activation.For remote mode indication it is open for internal mode and closed for external.
2. Alarm Return (Red) - Return side for the above pin 1 Alarm Out.
3. Remote Internal/External Mode (AD9) (Green) - This pin is programmed as Internal/ External remote mode control for an AD9. If programmed as the Internal/External control, a closure will put the AD9 into external mode.
4. Pulse Out (AD9) (Red/Yellow) - On the AD9 this pin gives a 100ms pulse output for each pump stroke.
5. 4-20mA Out (AD9) (Red/Black) - On the AD9 this pin is the positive 4-20ma output. This output will show you 4ma when the pump is idle, 20ma at max stroke speed.
6. Ground/Return Connection (Red / Blue) - Common Ground

10. External Control Connector (5-Pin):

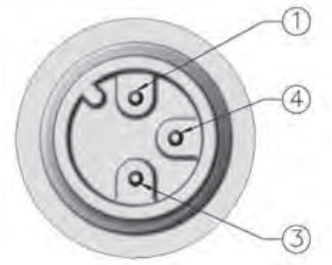


This connector is for the connection of various options and accessories that can be used to externally control the pump. The pin functions (and the wire color for the standard LMI® external control cable) are as follows:

1. Remote On/Off Signal (Brown)
2. Ground/Return Connection (White)
3. External Pulse Signal (Blue)
4. 24V 75 mA* Power Supply (Black)
5. 4-20mA Input Signal (Green/Yellow)

SECTION 3 - OPERATION

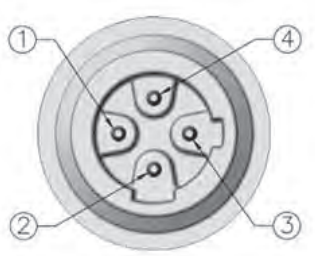
11. Low-Level Connector (3-Pin):



This connector is for the connection of a Low-Level Sensor (49246) or a Dual-Level Sensor (49249). The Tank Empty input connections are always active for all models in all functional modes. The Tank Low input connections are always active for models equipped with dual level functionality (AD8, AD9). If the fluid level drops below the top float on a Dual-Level Sensor, the Low-Level Indicator Light will turn yellow. If the fluid level drops below the float on a Low-Level Sensor, or the bottom float on a Dual-Level Sensor, the Low-Level Indicator Light will turn red, and the pump will stop. The pump is designed to recognize an open circuit as full and a closed circuit as low or empty. There is a five second delay between triggering the sensor, and the pump's reaction. This is intended to avoid triggering during refilling your supply tank. The pin functions are as follows:

1. Tank Empty Signal
3. Tank Low Signal
4. Ground/Return Connection

12. Flow Monitor / Meter Connector (4-Pin):



This connector will be used with a Milton Roy flow meter or the Milton Roy DIGI-PULSE™ flow monitor (FM-ROY-9). The pin functions are as follows:

1. Flow Meter In – A closure between this pin and ground registers a pulse for the flow meter/monitor.
2. 24 Volt 75 mA* Supply – Supply voltage for a Milton Roy flow meter.
3. Ground/Return Connection – Common ground
4. Flow Meter Sense – The condition of this pin will set the pump into the Digipulse or Flow Meter mode. This will automatically occur when the Milton Roy device is connected. A connection to ground indicates the use of a flow meter, while an open circuit indicates a flow monitor.

Note:

The total current output of the 5-pin and 4-pin connectors should not exceed 75 mA.

3.2 START-UP AND ADJUSTMENT

1. The pump is normally self-priming if suction lift is 5 ft (1.5m) or less and the steps below are followed.
2. Pumps are shipped from the factory with water in the pump head to aid in priming.

3.2.1 Start-Up/Priming for FASTPRIME™ Heads (LE-XXXNX)

⚠ CAUTION **READ THIS ENTIRE SECTION COMPLETELY BEFORE PROCEEDING.**

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now start priming the pump.

1. Plug in or switch the pump on.
2. While the pump is running, set the Speed Adjustment Knob and the Stroke Adjustment Knob at 100%.
3. Turn The FASTPRIME™ knob 1 to 2 turns counter-clockwise ↺.
4. The suction tubing should begin to fill with solution from the tank.
5. A small amount of solution will begin to discharge out the return line of the FASTPRIME™ valve. Once this happens, turn the knob clockwise ↻ until hand tight and **SHUT THE PUMP OFF**.
6. The pump is now primed.
7. Proceed to output adjustment, Section 3.3.

Note:

If the pump does not self-prime, remove the fitting on the discharge side of the pump head. Remove the check valve and pour water or solution into the port until the head is filled. Replace valve, then follow start up/priming steps.

3.2.2 Start-Up/Priming for Pump Supplied with 4-FV (LE-XXXSX or LE-XXXHX)

⚠ CAUTION **READ THIS ENTIRE SECTION COMPLETELY BEFORE PROCEEDING.**

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now start priming the pump.

1. Plug in or switch the pump on.
2. While the pump is running, set the Speed Adjustment Knob and the Stroke Adjustment Knob at 100%.
3. Open the relief side (black knob) of the 4-FV by turning to the stop (about 1/8 turn).
4. The suction tubing should begin to fill with solution from the tank.
5. A small amount of solution will begin to discharge out the return line of the 4-FV. Once this happens, return the knob to the 12:00 position and **SHUT THE PUMP OFF**.
6. The pump is now primed.
7. Proceed to output adjustment, Section 3.3.

Note:

If the pump does not self-prime, remove the 4-FV on the discharge side of the pump head. Remove the check valve and pour water or solution into the port until the head is filled. Replace valve, then follow start up / priming steps.

SECTION 3 - OPERATION

3.2.3 Start-Up/Priming for AUTOPRIME™ Heads (LE-XXXAX or LE-XXXHX)

CAUTION **READ THIS ENTIRE SECTION COMPLETELY BEFORE PROCEEDING.**

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may prime the pump.

1. Plug in or switch on the pump.
2. While the pump is running, set the speed knob and the stroke knob at 100%.
3. The suction tubing should begin to fill with solution from the tank as the AUTOPRIME™ valve purges air from the pump head.
4. Once the solution begins to exit the pump head through both the discharge valve and the AUTOPRIME™ valve, **SHUT THE PUMP OFF**.
5. The pump is now primed.
6. Proceed to output adjustment, Section 3.3.

3.3 OUTPUT ADJUSTMENT

Once the pump has been primed, an appropriate output adjustment MUST be made. Pump output should be calculated and adjustments made accordingly.

3.3.1 Total Pump Output

Calculate the approximate output of the pump as follows:

PUMP OUTPUT :
MAX PUMP OUTPUT X % SPEED X % STROKE
Example: AD251-938SI

Use Max Output (from dataplate on side of pump) = 1 GPH (1 gallon per hour).

If the pump is set at 60 strokes per minute (out of a possible 120 SPM) and 70% stroke length, the approximate pump output is:

1.0 x 60/120 x 0.70 = 0.35 GPH.

Multiply by 24 (hours in one day) to calculate in gallons per day.

Note:

When converting between different units, remember these conversion factors:

1 Gallon = 3.785 Liters

1 Day = 1,440 Minutes

120 SPM = 7,200 SPH

CAUTION **IT IS IMPORTANT TO NOTE THAT THIS IS ONLY AN APPROXIMATE OUTPUT AND IT DOES NOT ACCOUNT FOR TOLERANCE VARIATIONS IN PUMP COMPONENTS OR FLOW VARIATIONS DUE TO PRESSURE SENSITIVITY, OR VISCOSITY EFFECTS. VARIATIONS DUE TO THESE EFFECTS CAN BE SIGNIFICANT, NECESSITATING CALIBRATION FOR YOUR PUMP.**

3.3.2 Calibrating the Displayed Flow (AD2, AD8)

The Roytronic Excel Pumps are equipped to display a theoretical flow rate based upon the pump's stroke speed and stroke length. These calculations are based upon factory test conditions which may be significantly different from your application. It is necessary for the user to perform the following calibration procedure when the pump is connected to your system, and using the actual chemical. This one-point calibration procedure will greatly improve the accuracy of the pump's calculated flow. The closer the pump's stroke length is to the typical use stroke length, the more accurate the result. We recommend using the approximate settings determined in section 3.3.1 as a starting point for calibration.

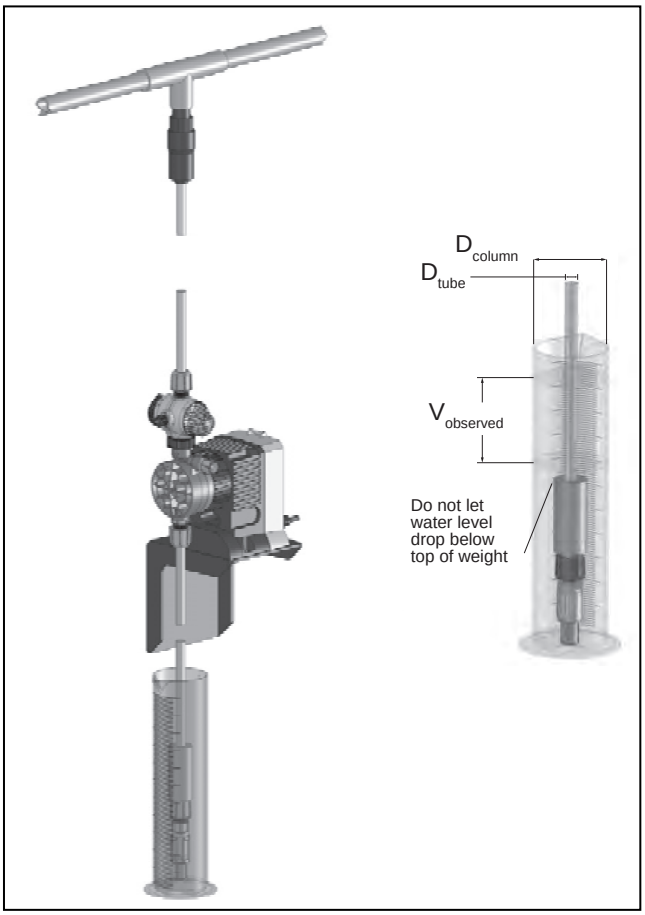


Figure 13

1. Prepare a flow measuring device such as a graduated cylinder or a scale sensitive to a gram.
2. Ensure the pump is primed following the procedures in 3.2.
3. Put the pump into Internal Mode and use the Power Button ⏻ to turn the pump off.
4. Hold the Up Button ▲ and Down Button ▼ in at the same time for 8 seconds until 'CAL' is displayed on the LCD Display, then release the buttons. Note 'FLO' will be displayed first. Continue to press the buttons until 'CAL' is displayed.
5. Push the Power Button ⏻ and release until a "0" is displayed.
6. Note the reading on the calibration device. If using a graduated cylinder note the starting liquid level. If using a scale note the displayed weight, or reset the scale's display to zero.
7. Push the Power Button ⏻ and release to start the pump. Notice that the display will count the total number of strokes. (The screen will show SPH).
8. Allow the pump to run; the accuracy will improve with more strokes. Use the Power Button ⏻ to stop the pump. The number of strokes will be displayed up to 999 strokes. If you will be pacing the pump externally, note the number of strokes.
9. Press and release the Power Button ⏻ again. This will display the pump's estimated volume pumped in mL. (The screen will show ml/h).

SECTION 3 - OPERATION

10. Use the Up Ⓐ and Down Ⓥ Buttons to match the displayed volume to the measured volume. If using a graduated cylinder, the presence of the tubing will cause the measurement to be slightly higher than actual. The measurement should be adjusted using the formulas shown below. If using a scale, the number of grams can be divided by the specific gravity of your chemical to determine the number of mL pumped. If the pump will be controlled externally, the output volume per stroke can be determined by dividing the measured output by the number of strokes.
11. Once the displayed value has been adjusted, hold and release the Power Button ⏻ to return the pump to internal mode.

$$V_{Actual} = V_{Observed} * R$$

where $$R = 1 - (D_{Tubes} / D_{Column})^2$$

For accuracy, it is important that the water level does not drop below the top of the ceramic foot valve weight.

Note:

If you will be using the pump at a different stroke length, or pressure, the pump should be recalibrated under those conditions using the procedure above to ensure accuracy.

3.4 METHODS OF EXTERNALLY TRIGGERING OR PACING AD8 AND AD9 PUMPS

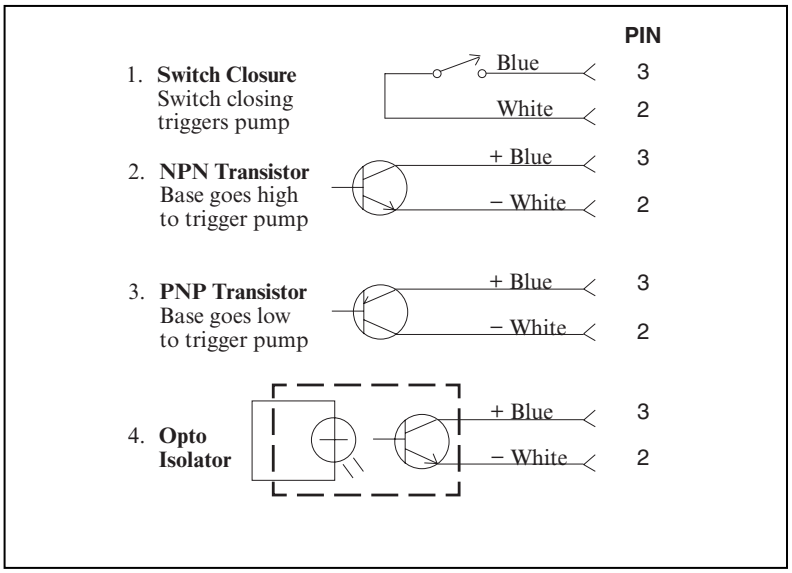
Method of Triggering AD8 and AD9 Pumps through External Control Connector.

Switch or transistors must be capable of switching 24V DC at 15 milliamperes. Minimum time in low impedance state (ON) is 25 milliseconds. Minimum time in high impedance state (OFF) is 50 milliseconds.

The remote on/off input (using pins 1 and 2) is active in all modes. In the out-of-box configuration, the pump will run when contacts are open. The pump is monitoring these pins for a change in closure condition. Regardless of the pump being on or off, when the contacts close, then the pump will turn on. When the contacts open, the pump will turn off.

The Power Button overrides the remote on/off and can still be used to turn the pump on and off. If the contacts are closed when the on/off button is pressed, the pump will turn off. To restart the pump remotely, the contacts must be opened and then closed again.

These pumps have two operating modes: Local (Pulse Indicator Light flashes green) and Remote (Pulse Indicator Light flashes yellow). Pressing the Mode Selection Button switches between Local and Remote modes. The default configuration for operating mode is Local mode.



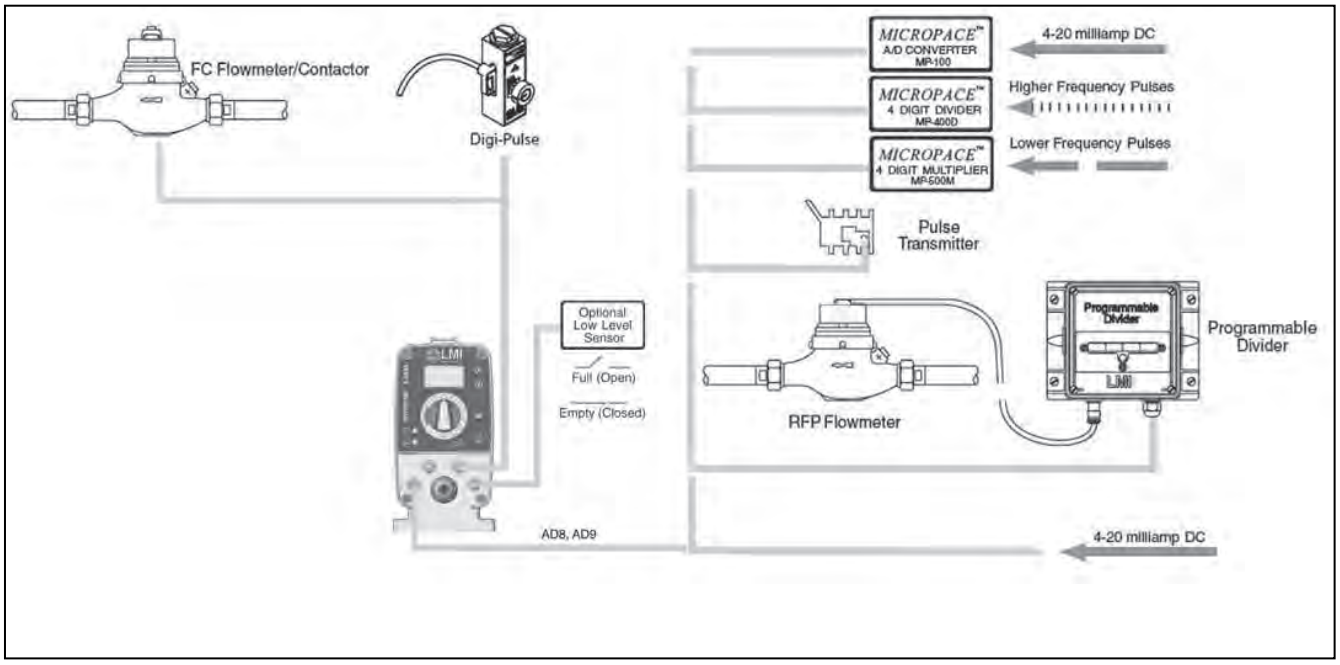


Figure 14. Methods of Externally Triggering or Pacing AD8 and AD9 Pumps

SECTION 3 - OPERATION

3.4.1 Control Modes

3.4.1.1 Local/Internal Mode

1. When in local mode Roytronic Excel pumps run at the speed indicated on the LCD Display.
2. The stroking speed can be adjusted from the maximum speed of 120 strokes per minute (SPM) down to 1 stroke per hour (SPH).

3.4.1.2 Changing Displayed Flow Units (AD2, AD8)

1. When in Internal Mode use the Power Button to turn the pump off.
2. Hold the Up Button and Down Button in at the same time until 'FLO' is displayed on the LCD Display, then release the buttons.
3. Use the Up or Down Buttons to select the desired units of measure.
4. Press the Power Button and the pump will return to internal mode with the desired units displayed.

3.4.1.3 Remote Mode (for AD8)

In Remote mode the pump can be controlled in a variety of ways: pulse divide, pulse multiply, or analog milliamp input. To cycle through the available modes, start in external mode, then press and hold the Power Button and Mode Selection Button simultaneously for about five seconds.

3.4.1.3.1 Divide Mode (for AD8)

The pump is in Divide Mode when a division symbol (÷) is shown on the left-hand side of the LCD Display. Use the Up Button and Down Button to select the number of incoming pulses received before a stroke occurs. Once the Power Button is pushed to turn the pump on, the LCD Display will show the approximate stroke rate of the pump based on the incoming pulses.

If it is necessary to change the pulse duration required to recognize a pulse from the factory default of 60 ms, hold both the Up Button and Down Button until a number appears followed by the letter 'm'. This number is the minimum required time in milliseconds needed to count as a pulse. Use the Up Button and Down Button to adjust this number as needed. If no button is pressed for about 4 seconds, the pump will save the value and return to the previous screen.

3.4.1.3.2 Multiply Mode (for AD8)

The pump is in Multiply Mode when a multiplication symbol (X) is shown on the left-hand side of the LCD Display. Use the Up Button and Down Button to select the number of strokes that will occur for each incoming pulse. Once the Power Button is pushed to turn the pump on, the LCD Display will count down the number of strokes starting at the multiplier value each time a pulse input is recognized. The strokes will occur every half second until it has counted down to zero. The pump will then wait for the next pulse input.

If it is necessary to change the pulse duration required to recognize a pulse from the factory default of 60 ms, hold both the Up Button and Down Button until a number appears followed by the letter 'm'. This number is the minimum required time in milliseconds needed to count as a pulse. Use the Up Button and Down Button to adjust this number as needed. If no button is pressed for about 4 seconds, the pump will save the value and return to the previous screen.

3.4.1.3.3 Analog Mode (for AD8)

The pump is in Analog Mode when ‘mA’ is shown on the left-hand side of the LCD Display.

Pressing the Up or Down Button will display ‘P1’ and the milliamp input that corresponds to zero strokes. The Up and Down Buttons can be used to adjust this value. Pressing the Power Button (or waiting for about 8 seconds) will display ‘P2’ and the milliamp input that corresponds to max stroke rate. Note that the maximum stroke rate will be either 120 strokes per minute or 59 strokes per hour. This depends on the stroke speed set in Internal Mode.

SECTION 4 - MAINTENANCE

4.0 SPARE PARTS REPLACEMENT AND ROUTINE MAINTENANCE

LMI® metering pumps are designed for trouble-free operation, yet routine maintenance of elastomeric parts is essential for optimum performance. This involves replacing the LIQUIFRAM™, cartridge valves, O-rings, and the injection check valve spring. LMI® recommends replacing these parts at least once a year; however, frequency will depend on your particular application.

4.1 DEPRESSURIZING THE DISCHARGE LINE (FOR PUMPS EQUIPPED WITH A 4-FV ONLY)

⚠ CAUTION **ALWAYS WEAR PROTECTIVE CLOTHING, FACE SHIELD, SAFETY GLASSES AND GLOVES WHEN PERFORMING ANY MAINTENANCE OR REPLACEMENT ON YOUR PUMP.**

⚠ CAUTION **TO REDUCE THE RISK OF CHEMICAL SPLASH DURING DISASSEMBLY OR MAINTENANCE, ALL INSTALLATIONS SHOULD BE EQUIPPED WITH LINE DEPRESSURIZATION CAPABILITY. USING LMI®'S FOUR-FUNCTION VALVE (4-FV) IS ONE WAY TO INCLUDE THIS FEATURE.**

⚠ CAUTION **READ STEPS 1 AND 2 BELOW BEFORE PROCEEDING.**

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

⚠ CAUTION **BE SURE YOUR RELIEF TUBING IS CONNECTED TO YOUR 4-FV AND RUNS BACK TO YOUR SOLUTION DRUM OR TANK.**

2. Turn the black knob on the 4-FV 1/8 turn to the stop. Turn and hold the yellow knob for a few seconds. The discharge line is now depressurized. Keep both valve knobs open until solution drains back down the discharge tubing into the solution tank or drum. Then release the yellow knob, and turn the black knob to its normal position.

4.2 DEPRESSURIZING THE DISCHARGE LINE (FOR DOUBLE BALL FASTPRIME™ HEADS ONLY)

⚠ CAUTION **ALWAYS WEAR PROTECTIVE CLOTHING, FACE SHIELD, SAFETY GLASSES AND GLOVES WHEN PERFORMING ANY MAINTENANCE OR REPLACEMENT ON YOUR PUMP.**

⚠ CAUTION **READ STEPS 1 AND 2 BELOW BEFORE PROCEEDING.**

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

⚠ CAUTION **BE SURE YOUR RELIEF TUBING IS CONNECTED TO YOUR FASTPRIME™ VALVE AND RUNS BACK TO YOUR SOLUTION DRUM OR TANK.**

2. Turn the FASTPRIME™ knob one-and-a-half turns counter-clockwise. The discharge line is now depressurized. Keep valve open until solution drains back down the discharge tubing into solution drum or tank. Then turn the knob clockwise to tighten knob to closed position.

4.3 LIQUIFRAM™ (DIAPHRAGM) REPLACEMENT

⚠ CAUTION **ALWAYS WEAR PROTECTIVE CLOTHING, FACE SHIELD, SAFETY GLASSES AND GLOVES WHEN WORKING NEAR OR PERFORMING ANY MAINTENANCE OR REPLACEMENT ON YOUR PUMP. SEE SDS INFORMATION FROM SOLUTION SUPPLIER FOR ADDITIONAL PRECAUTIONS.**

LMI® metering pumps are designed for trouble-free operation, yet routine maintenance of elastomeric parts is essential for optimum performance. This involves replacing the LIQUIFRAM™, cartridge valves, O-rings and the injection check valve spring. LMI® recommends replacing these parts at least once a year; however, frequency will depend on your particular application.

When replacing the LIQUIFRAM™, the cartridge valves, or O-rings, the injection check valve spring should also be replaced (see next Section 4.4). A Spare Parts Kit or RPM PRO PAC™ kit containing these parts may be obtained from your local distributor.

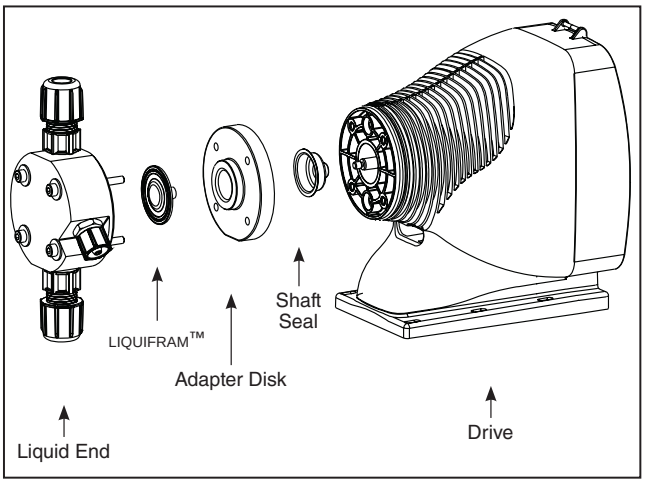


Figure 15. LIQUIFRAM™ (Diaphragm) Replacement

Replacing the LIQUIFRAM™:

1. Carefully depressurize, drain, and disconnect the discharge line (see previous sections in this manual).
2. Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump head has been flushed, lift the Foot Valve out of the solution and continue to pump air into the pump head until the pump head is purged of water or neutralizing solution.

Note:

If the liquid cannot be pumped due to LIQUIFRAM™ rupture, carefully disconnect the suction and discharge tubing using protective clothing, gloves and face shield, immerse the head in water or other neutralizing solution.

3. Remove the four metric screws and washers from the head using an M4 Allen wrench.
4. Start the pump. While running, set the Stroke Adjustment Knob to 0% and then turn the pump off.
5. With the unit off, unscrew the LIQUIFRAM™ by carefully grasping the outer edge and turning it counter-clockwise ↺. Discard old LIQUIFRAM™. Remove the Adapter Disk (located behind the LIQUIFRAM™) and ensure that the diameter of the raised section is the same as the diameter of the replacement LIQUIFRAM™.
6. Check condition of the Shaft Seal. Replace Shaft Seal if necessary.
7. Replace the Adapter Disk so that the drain hole of the disk is oriented downward, and the mounting holes line up with the mounting holes of the pump.

⚠ CAUTION **BE CAREFUL NOT TO SCRATCH THE FLUOROFILM™ FACE OF THE NEW LIQUIFRAM™.**

8. Screw on the new LIQUIFRAM™ clockwise until turned all the way in. Start the pump and turn the stroke knob to 100%. Stop the pump.
9. Remount the pump head using the four (4) screws and washers. Tighten in a criss-cross pattern. Torque screws to 25 inch-pounds. After one week of operation, recheck the screws and tighten if necessary.

SECTION 4 - MAINTENANCE

4.4 CARTRIDGE VALVE AND O-RING REPLACEMENT

⚠ CAUTION **ALWAYS WEAR PROTECTIVE CLOTHING, FACE SHIELD, SAFETY GLASSES AND GLOVES WHEN WORKING ON OR PERFORMING ANY MAINTENANCE OR REPLACEMENT ON YOUR PUMP. SEE SDS INFORMATION FROM SOLUTION SUPPLIER FOR ADDITIONAL PRECAUTIONS.**

Refer to the LMI® Metering Pump Price List for the proper Spare Parts Kit or RPM PRO PAC™ kit number or contact your local LMI® stocking distributor.

1. Carefully depressurize and disconnect the discharge line (see Section 4.1 or 4.2 in this manual).
2. Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump has been flushed, lift the Foot Valve out and continue to pump to let air into the pump head until pump is purged of water or neutralizing solution.

Note:

If the liquid cannot be pumped due to LIQUIFRAM™ rupture, carefully disconnect the suction and discharge tubing using protective clothing, gloves and face shield. Remove the four screws and washers from the head and immerse the head in water or other neutralizing solution.

Spare part replacement kits include specific instructions for valve replacement. Please follow the instructions included with the replacement kit.

3. Carefully disconnect one tubing connection and fitting at a time, then remove and replace the worn valve and O-rings. If necessary, carefully loosen stuck valves by prying side to side using a small screwdriver through the center hole of the valve.

Note:

Before disassembling the check valves, note the orientation of the valve.

4. Install new check valves in each location. Ensure that the cartridges are oriented correctly.

4.5 INJECTION CHECK VALVE PARTS REPLACEMENT

⚠ CAUTION **DEPRESSURIZE AND DRAIN PIPELINE (OR ISOLATE INJECTION CHECK VALVE POINT USING VALVES) SO THAT INJECTION CHECK VALVE CAN SAFELY BE DISASSEMBLED.**

⚠ CAUTION **ALWAYS WEAR PROTECTIVE CLOTHING, FACE SHIELD, SAFETY GLASSES AND GLOVES WHEN WORKING NEAR OR PERFORMING ANY MAINTENANCE OR REPLACEMENT ON YOUR PUMP. SEE SDS INFORMATION FROM SOLUTION SUPPLIER FOR ADDITIONAL PRECAUTIONS.**

Refer to the LMI® Metering Pump Price List for the proper Spare Parts Kit or RPM PRO PAC™ kit number or contact your local LMI® stocking distributor.

1. Isolate Injection Check Valve and depressurize pipe or drain pipeline.
2. Carefully depressurize and disconnect the discharge line (see Section 5.1 or 5.2 in this manual).

Spare part replacement kits include specific instructions for valve replacement. Please follow the instructions included with the replacement kit.

3. Carefully disconnect the tubing leading to the Injection Check Valve, then remove the Injection Check Valve Fitting. Remove and replace the worn spring, seat, ball, and O-ring.

Note:
Before disassembling the check valves, note the orientation of the valve.

4. Install a new spring, seat, ball, and O-ring. Ensure that the parts are oriented correctly.

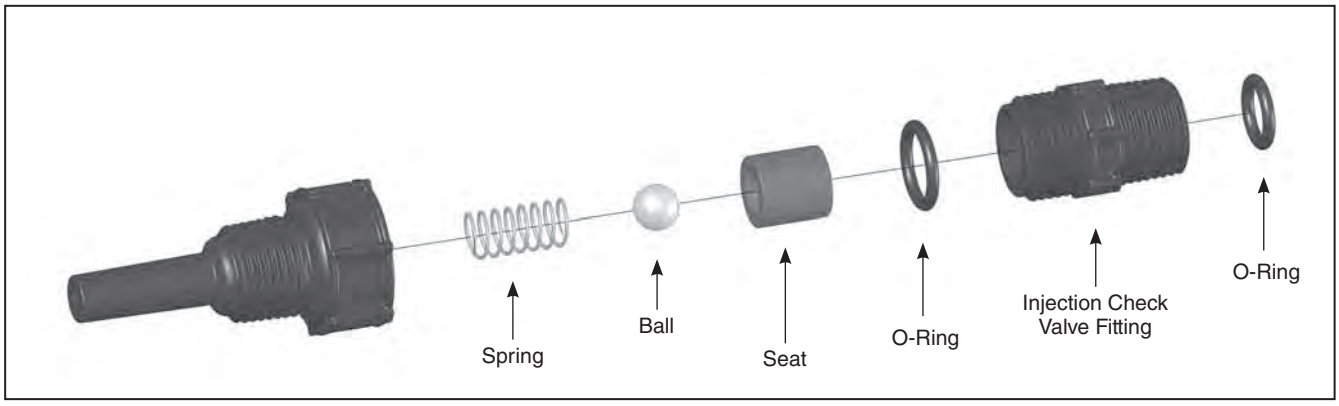


Figure 16. Injection Check Valve Parts Replacement

SECTION 4 - MAINTENANCE

4.6 FASTPRIME™ VALVE O-RING REPLACEMENT

⚠ CAUTION **ALWAYS WEAR PROTECTIVE CLOTHING, FACE SHIELD, SAFETY GLASSES AND GLOVES WHEN PERFORMING ANY MAINTENANCE OR REPLACEMENT ON YOUR PUMP.**

Refer to the LMI® Metering Pump Price List for the proper Spare Parts Kit or RPM PRO PAC™ kit number or contact your local LMI® stocking distributor.

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

⚠ CAUTION **BE SURE YOUR RELIEF TUBING IS CONNECTED TO YOUR FASTPRIME™ VALVE AND RUNS BACK TO YOUR SOLUTION DRUM OR TANK.**

2. Turn the FASTPRIME™ Knob one-and-a-half turns counter-clockwise. This will depressurize the head. Keep valve open. Carefully remove the return line by gently pulling tubing and moving it from side to side to gradually back tubing off of the barbed fitting.
3. Hold return line tubing upright until solution drains back into solution drum or tank.
4. Using a 3/4” (or 19mm) socket or wrench remove Retaining Nut, and pull out the entire FASTPRIME™ Valve assembly. Remove and replace the two small O-rings.
5. Reinsert the FASTPRIME™ Valve assembly and retighten the Retaining Nut. Then turn the FASTPRIME™ Knob clockwise to tighten knob to closed position. To avoid damaging the parts, it is important that the flange on the FASTPRIME™ Valve is flush with the Retaining Nut prior to reassembly.
6. Recut 1 to 2 inches off the tip of the return line and ensure the end is squared. Press the return line tubing on completely past the barbs.

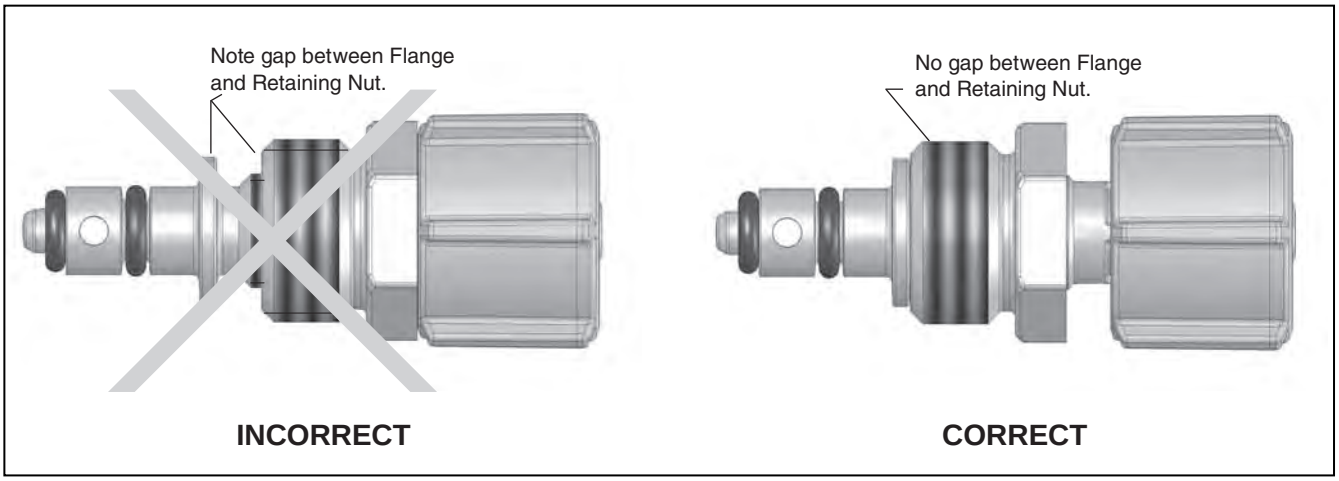


Figure 17a

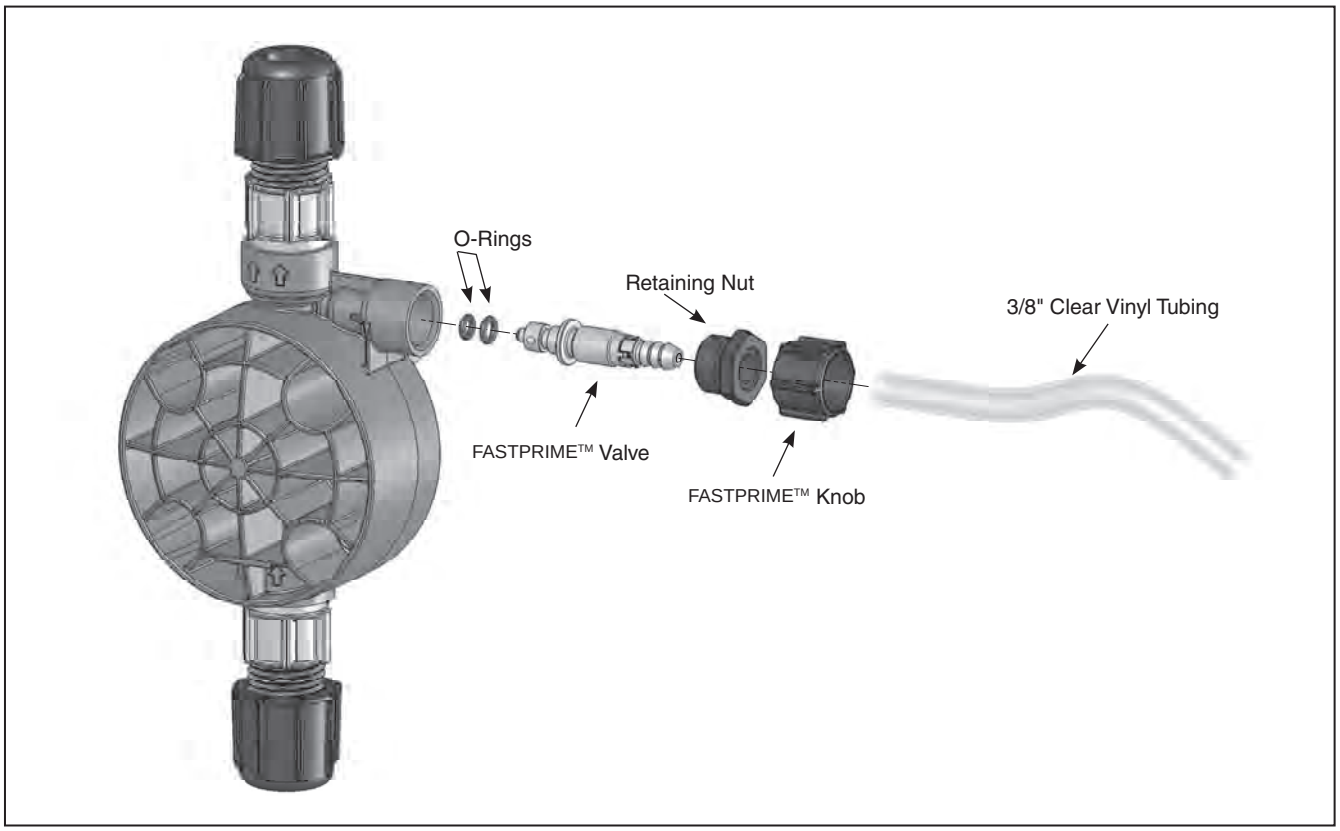


Figure 17b. FASTPRIME™ Valve O-Ring Replacement

SECTION 4 - MAINTENANCE

4.7 DRIVE PARTS LIST

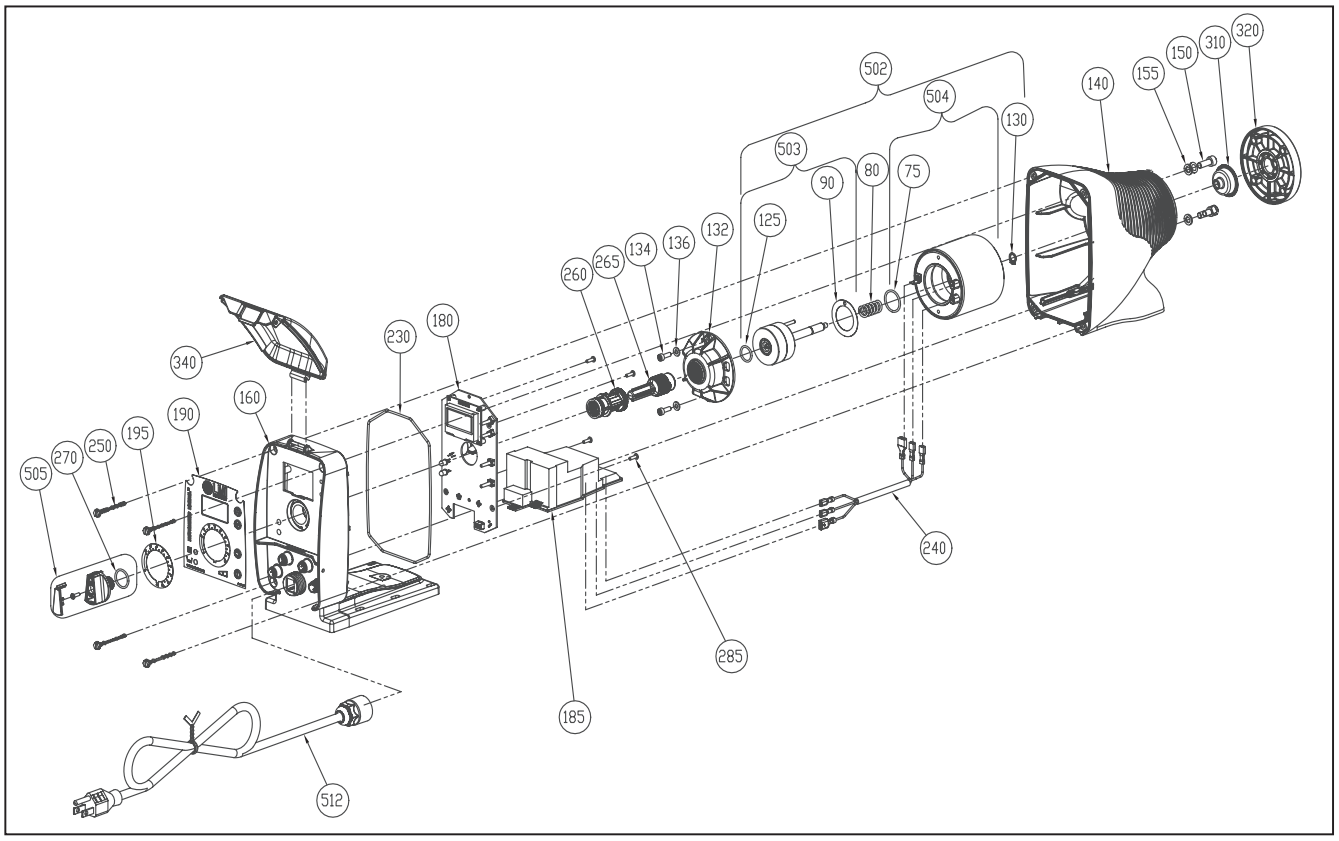


Figure 18. Drive Parts List

Bubble Number	Description
75	EPU O-Ring
80	EPU Return Spring
90	EPU Shim
125	Plunger O-Ring
130	Retaining Ring
132	Stroke Bracket
134	Stroke Bracket Screw
136	Stroke Bracket Washer
140	Drive Housing
150	EPU Attachment Bolt
155	EPU Attachment Washer
160	Control Panel
180	Control Board
185	Power Board
190	Nameplate

Bubble Number	Description
195	Stroke Dial
230	Control Panel O-Ring
240	Wire Harness
250	Drive Assembly Screws
260	Female Stroke Shaft
265	Male Stroke Shaft
270	Stroke Shaft O-Ring
285	PCB Attachment Screw
310	Shaft Seal
320	Adapter Disk
340	Clear Cover
502	EPU Assembly
503	Plunger Assembly
504	Pole Piece Assembly
505	Stroke Knob Assembly
512	Power Cord Assembly

Table 3. Drive Parts List

4.8 EPU WIRING DIAGRAM

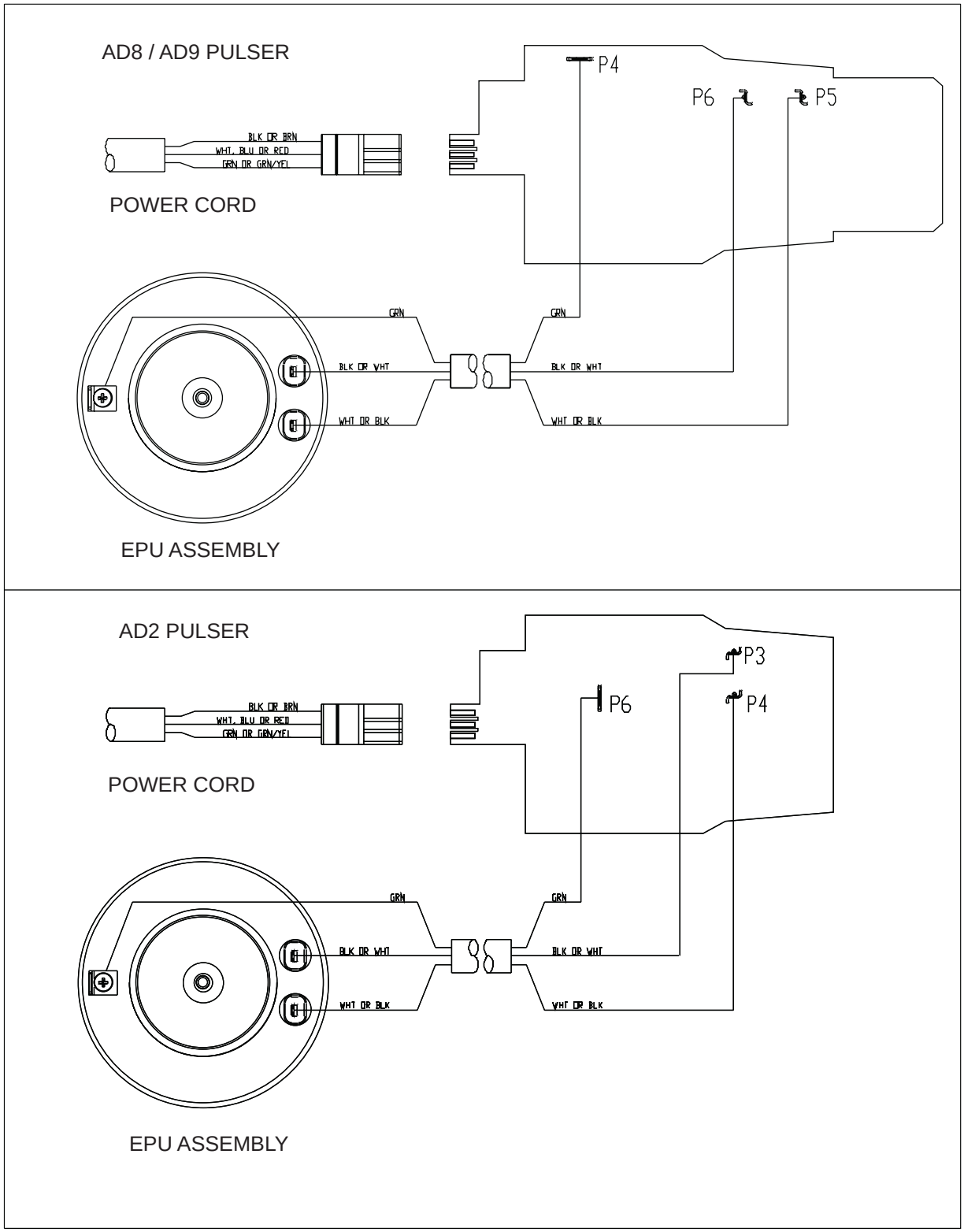


Figure 19. EPU Wiring Diagram

SECTION 4 - MAINTENANCE

4.9 LIQUID END PARTS

For the latest and most accurate information on your liquid end, please refer to the Liquid End Sheets available in the LMI® Online Library at: www.lmipumps.com.

1. Select “Online Literature Library” in the Navigation Bar on left.
2. Once on Online Literature Library use “Product” drop down to select “Liquid Handling Assemblies.”
3. Select “Gallery” or ”Index” to view Liquid End sheets.

The following images are for reference and may not represent your particular liquid end.

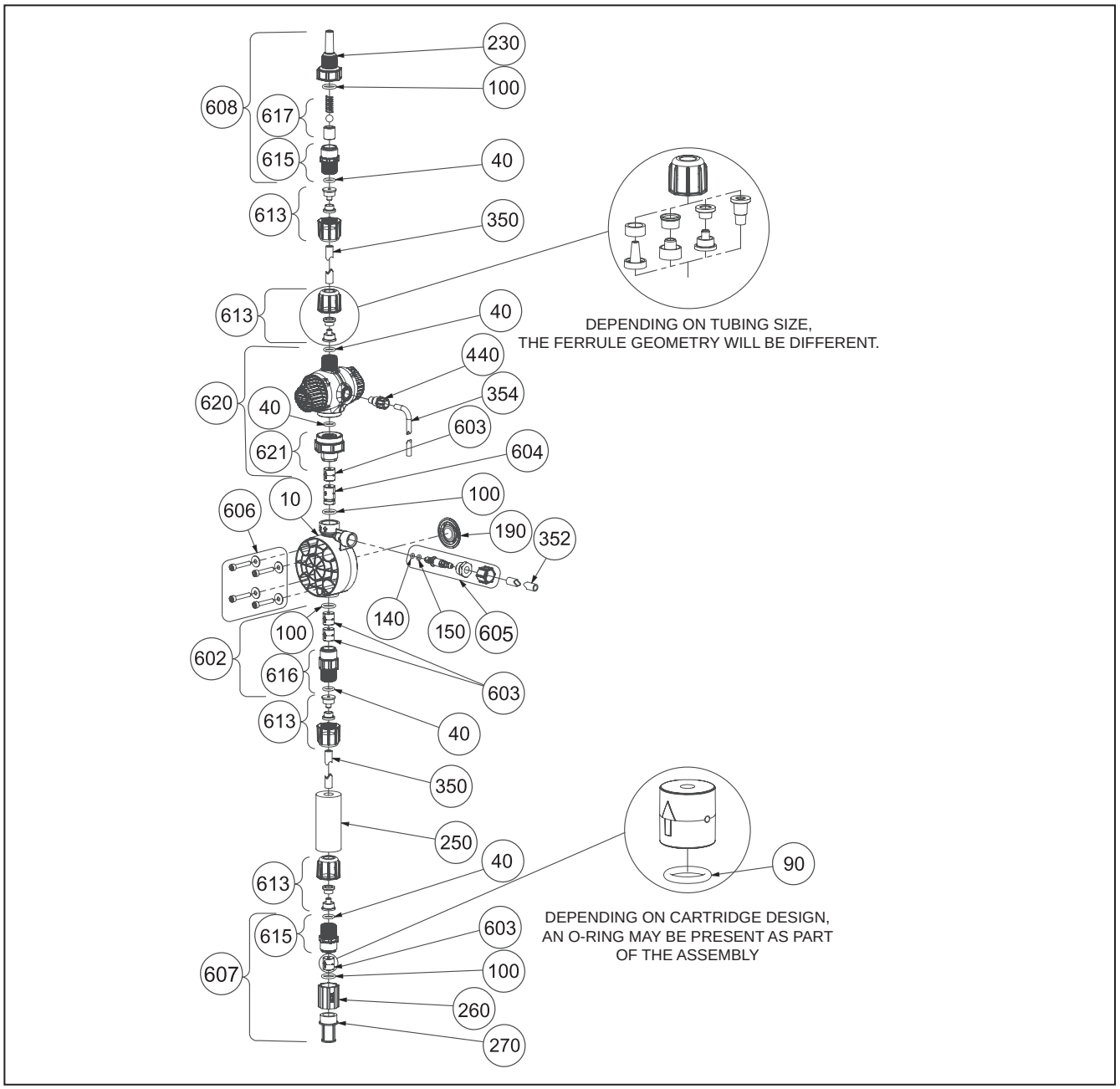


Figure 20. FASTPRIME™ Liquid End Assembly

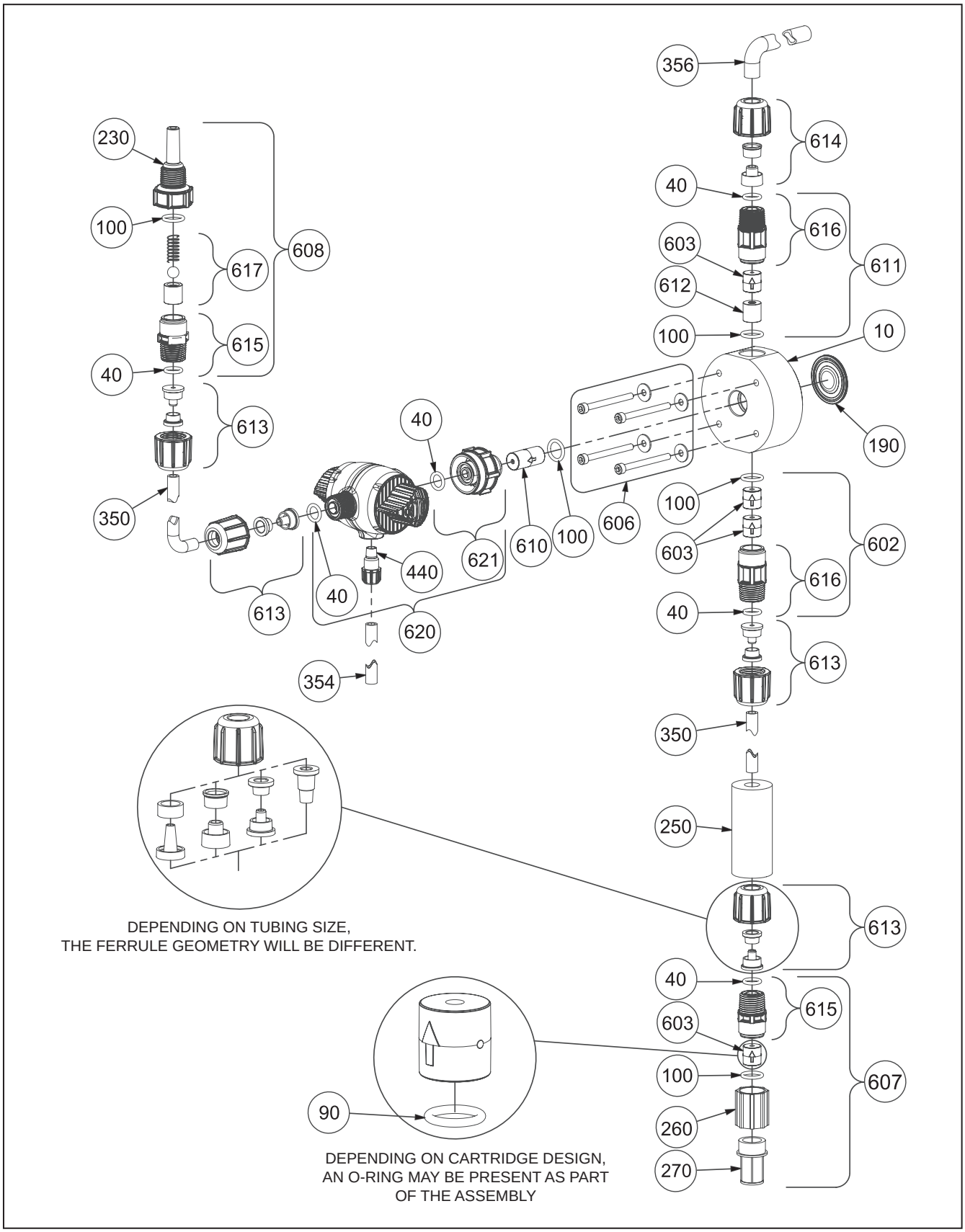


Figure 21. AUTOPRIME™ Liquid End Assembly

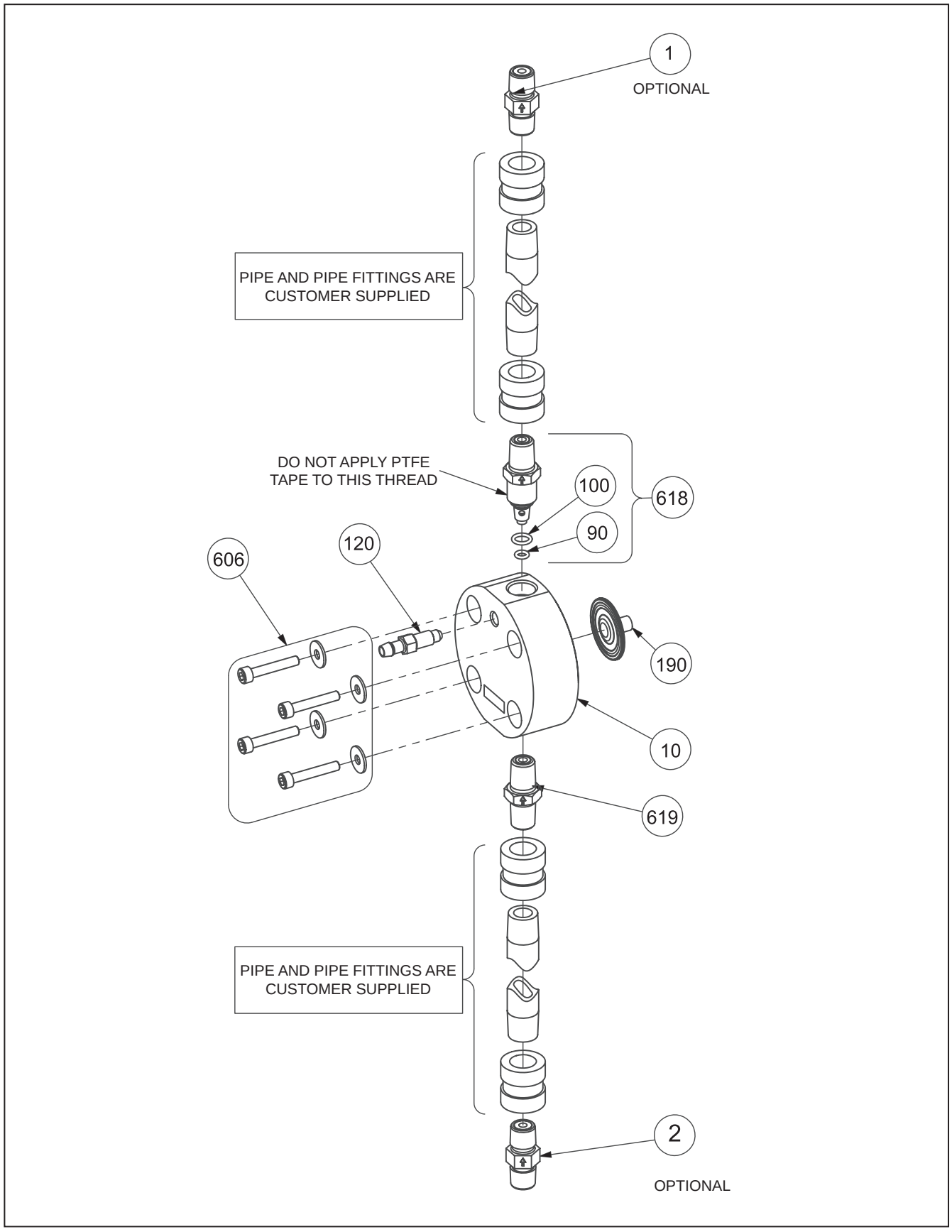
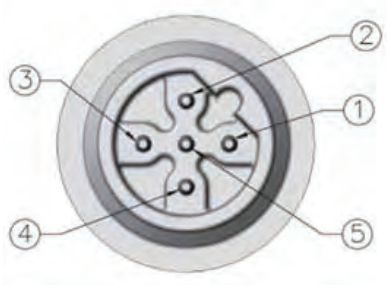


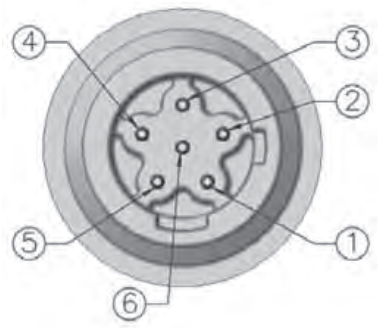
Figure 22. Stainless Steel Liquid End Assembly



5 PIN CONNECTOR

USE 5 PIN CABLE (LMI P/N 48414)

PIN	WIRE	SIGNAL
1	Brown	Remote On-Off
2	White	Ground-Return
3	Blue	External Pulse Input
4	Black	Power Supply, 24V 75 mA
5	Green-Yellow	4-20 mA Input



6 PIN CONNECTOR

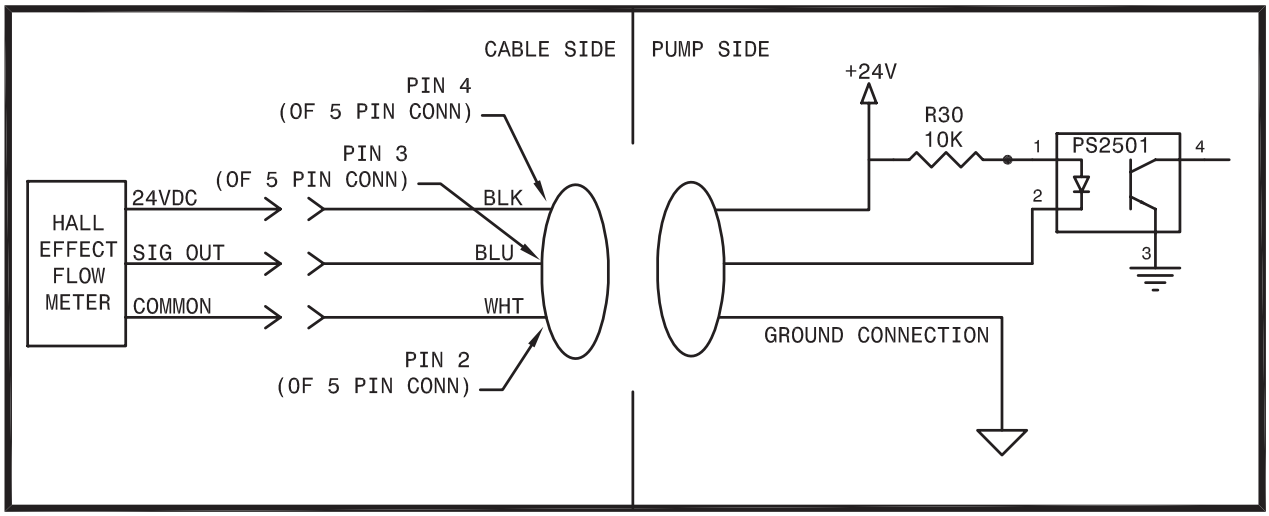
USE 6 PIN CABLE (LMI P/N 49035)

PIN	WIRE	SIGNAL
1	Red-White	Alarm Output or Internal-External indicator
2	Red	Alarm Return
3	Green	Remote Internal-External mode
4	Red-Yellow	Pulse Output
5	Red-Black	4-20 mA Output
6	Red-Blue	Ground-Return

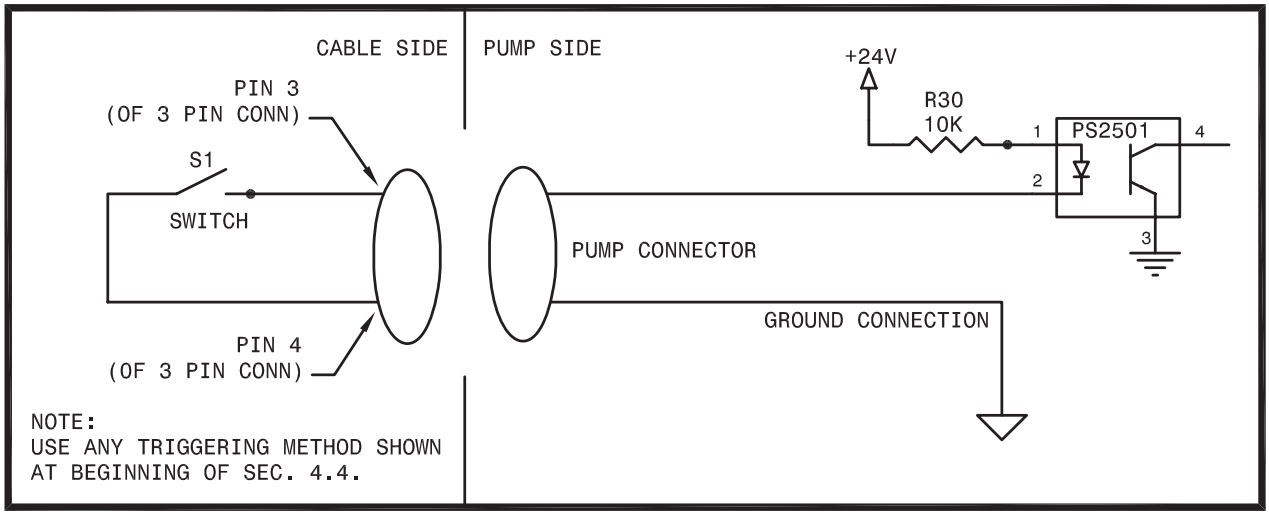
SECTION 5 - WIRING DIAGRAMS

INPUT WIRING DIAGRAM

HALL EFFECT FLOWMETER
INPUT CONNECTION REFERENCE:



TANK ON
INPUT CONNECTION REFERENCE:



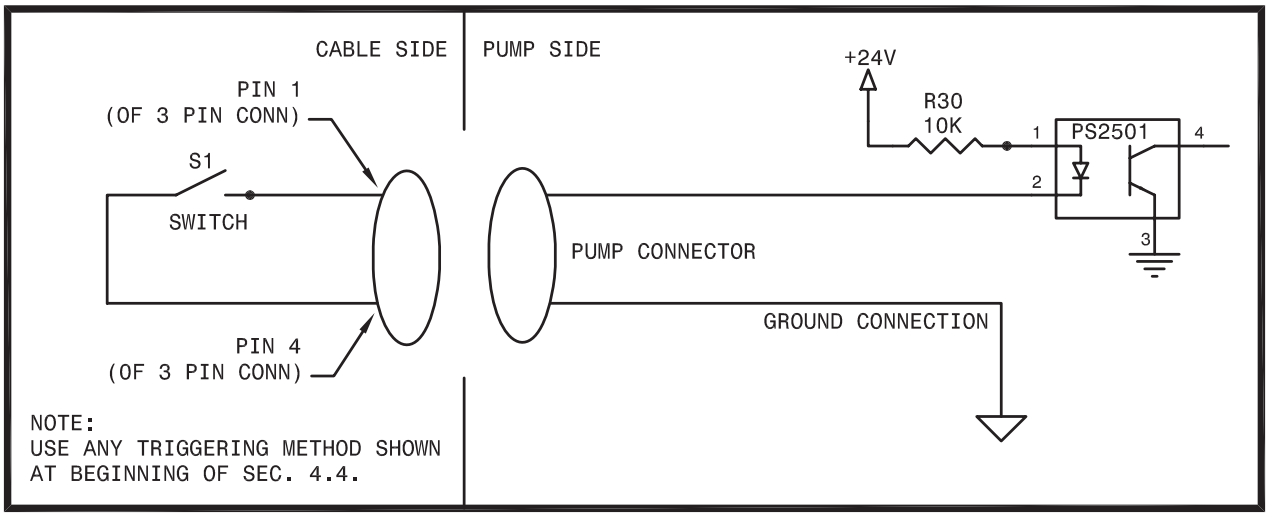
NOTE:

A Cable Cord set for this application is included with an optional LMI® dual switch assembly P/N 49249.

SECTION 5 - WIRING DIAGRAMS

INPUT WIRING DIAGRAM

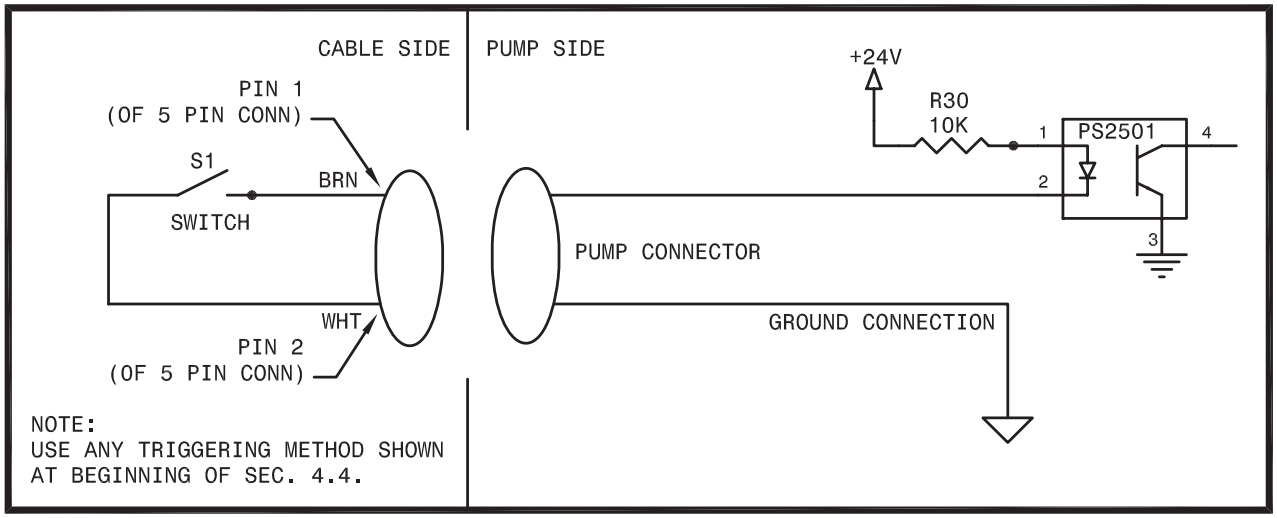
TANK EMPTY
INPUT CONNECTION REFERENCE:



NOTE:

A Cable cord set for this application is included with an optional LMI® low level switch assembly P/N 49246 or a LMI® dual level switch assembly P/N 49249.

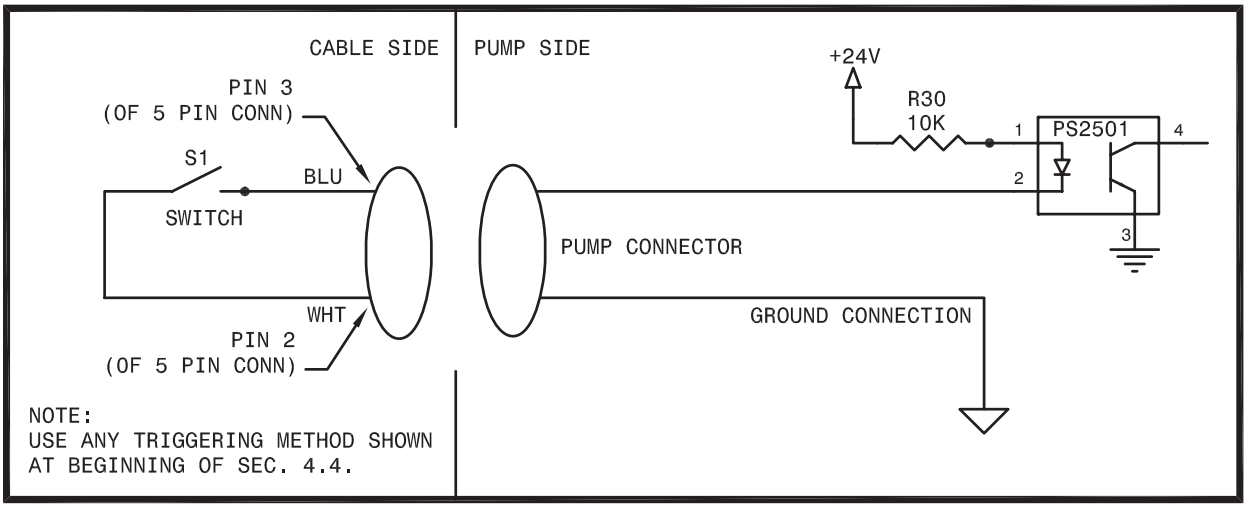
REMOTE ON-OFF
INPUT CONNECTION REFERENCE:



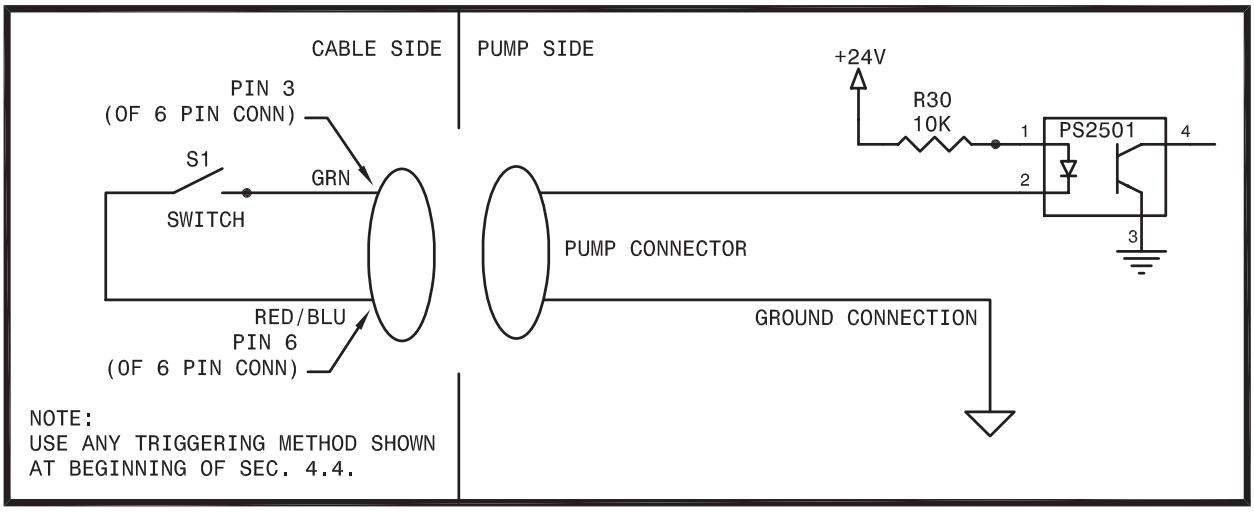
SECTION 5 - WIRING DIAGRAMS

INPUT WIRING DIAGRAM

EXTERNAL PULSE INPUT CONNECTION REFERENCE:



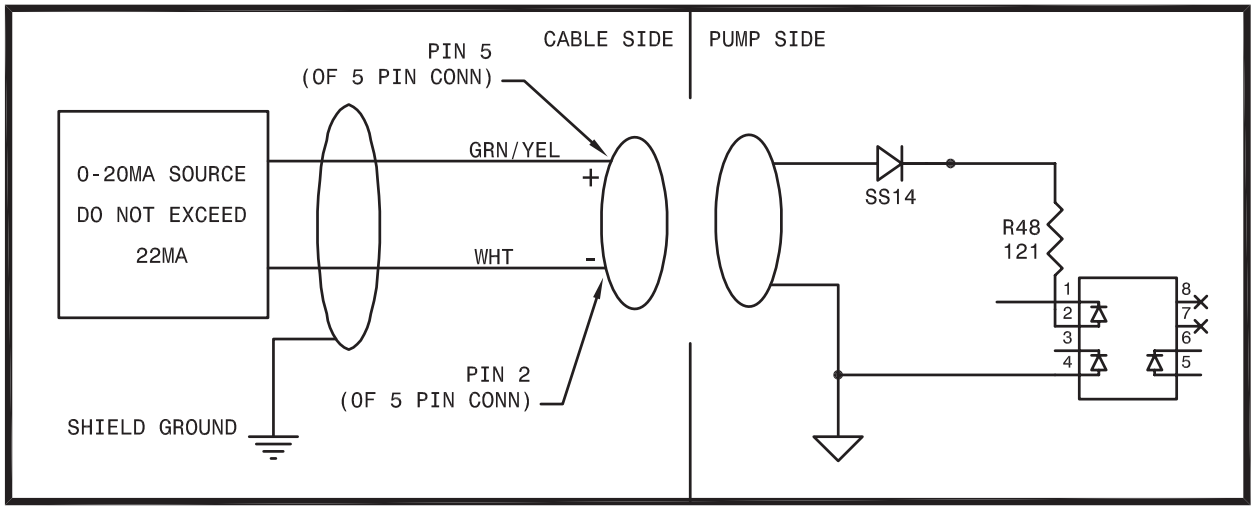
INTERNAL / EXTERNAL CONTROL INPUT CONNECTION REFERENCE:



SECTION 5 - WIRING DIAGRAMS

INPUT WIRING DIAGRAM

4 - 20 MA
INPUT CONNECTION REFERENCE:



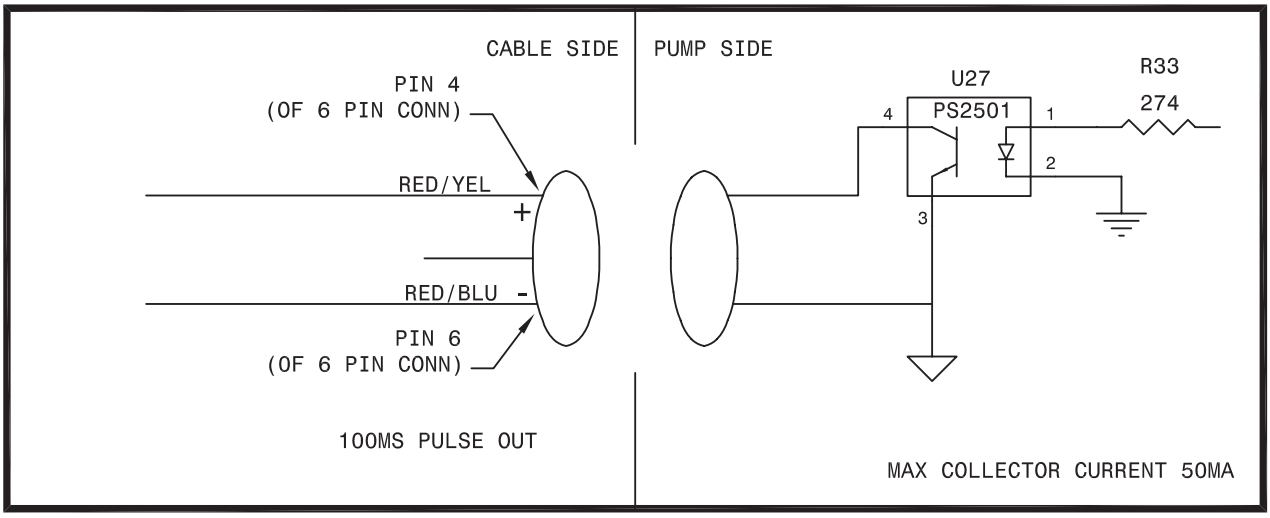
NOTE:

0 to 20 input impedence is dynamic and will work with supply currents needing 130 Ohm or above impedence.

SECTION 5 - WIRING DIAGRAMS

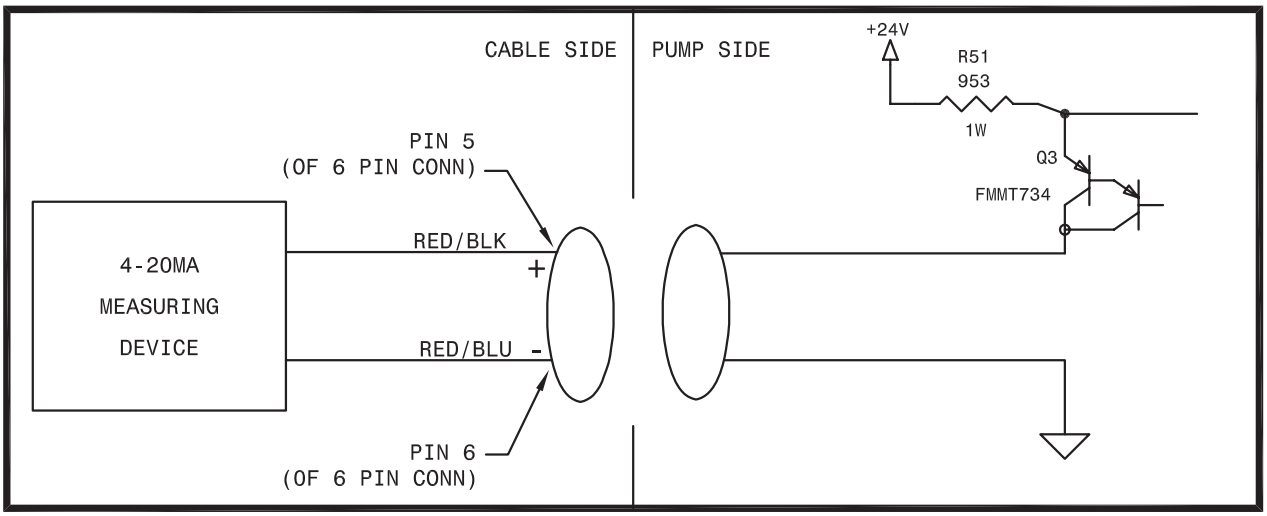
OUTPUT WIRING DIAGRAM

PULSE
OUTPUT CONNECTION REFERENCE:



NOTE:
When using a "PULL UP" option use a 10K resistor and a 24VDC source (can be used with Pin 5 of 5 Pin CONN).

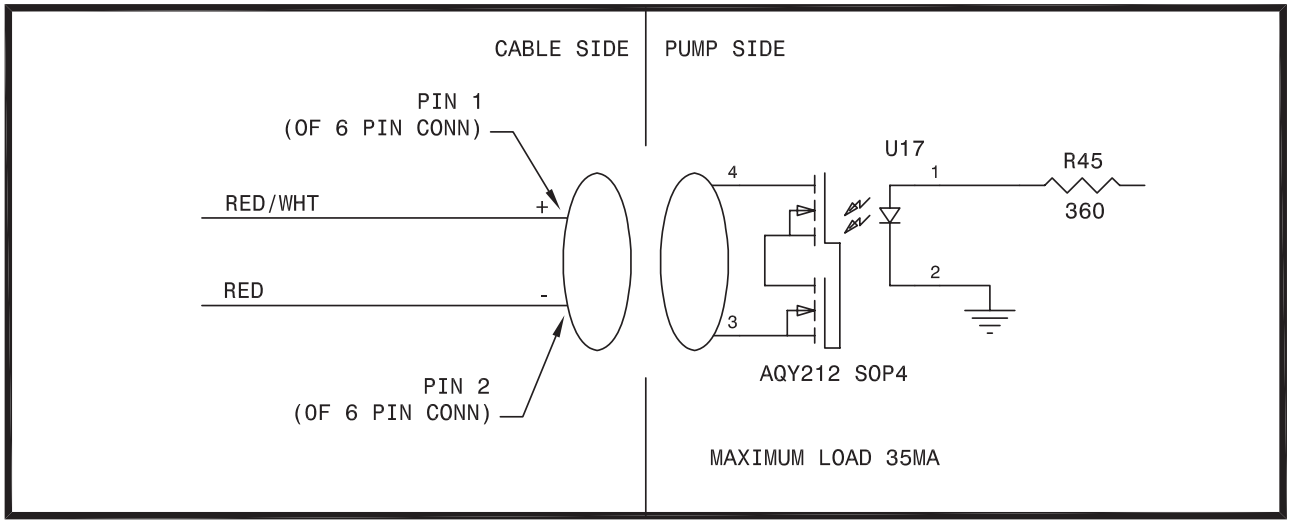
4 TO 20 MA
OUTPUT CONNECTION REFERENCE:



SECTION 5 - WIRING DIAGRAMS

OUTPUT WIRING DIAGRAM

ALARM
OUTPUT CONNECTION REFERENCE:



NOTE:

Use to switch on 24V source or less. Do not use to switch on AC line Voltage without Relay. Relay coils should be 24VDC or less with maximum Current of 35 mA.

SECTION 6 - TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	SOLUTION
Pump Will Not Prime	1. Pump not turned on or plugged in.	1. Turn on pump/plug in pump.
	2. Output dials not set properly.	2. Always prime pump with speed and stroke at 100%.
	3. Foot Valve not in vertical position on bottom of tank.	3. Foot Valve must be vertical *(see Foot Valve Installation, Section 2.7)*.
	4. Pump suction lift too high.	4. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	5. Suction tubing is curved or coiled in tank.	5. Suction tubing must be vertical. Use LMI® ceramic weight supplied with pump *(see Section 2.7)*.
	6. Fittings are over tightened.	6. Do not overtighten fittings. This causes seal rings to distort and not seat properly which causes pump to leak back or lose prime.
	7. Air trap in suction valve tubing.	7. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! *(see Section 2.2.1)*.
	8. Too much pressure at discharge (Pumps without multi-function valve.)	8. Shut off valves in pressurized line. Disconnect tubing at injection check valve *(see Priming Section 3.2)*. When pump is primed, reconnect discharge tubing.
	9. Air leak around fitting.	9. Check for missing or damaged O-rings at ends of fittings.
Pump Loses Prime	1. Solution container ran dry.	1. Refill container with solution and reprime *(see Section 3.2)*.
	2. Foot Valve is not in a vertical position on the bottom of the tank.	2. Foot Valve must be vertical *(see Foot Valve Installation, Section 2.7)*.
	3. Pump suction lift is too high.	3. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	4. Suction tubing is curved or coiled in tank.	4. Suction tubing must be vertical. Use LMI® ceramic weight supplied with pump *(see Section 2.7)*.
	5. Fittings are over tightened.	5. DO NOT OVERTIGHTEN FITTINGS. This causes seal rings to distort and not seat properly which causes pump to leak back or lose prime.
	6. Air trap in suction valve tubing.	6. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! *(see Section 2.2.1)*.
	7. Air leak on suction side.	7. Check for pinholes, cracks. Replace if necessary.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Leakage at tubing	1. Worn tubing ends.	1. Cut about 1 in (25 mm) off tubing and then replace as before.
	2. Loose or cracked fitting.	2. Replace fitting if cracked. Carefully hand tighten fittings. **DO NOT USE PIPE WRENCH**. An additional 1/8 or 1/4 turn may be necessary.
	3. Worn seal rings.	3. Replace balls and seal rings*(see Section 4.4*).
	4. Solution attacking Liquid Handling Assembly.	4. Consult your local distributor for alternate materials.
Low Output or Failure to Pump Against Pressure	1. Pump's maximum pressure rating is exceeded by injection pressure.	1. Injection pressure cannot exceed pump's maximum pressure. See pump data plate.
	2. Worn Seal Rings.	2. Worn seal rings or cartridge valves may need replacement *(see Section 4.4)*.
	3. Ruptured LIQUIFRAM™.	3. Replace LIQUIFRAM™ *(see Section 4.3)*.
	4. Incorrect stroke length.	4. Recalibrate Output *(see Section 3.3.2)*.
	5. Tubing run on discharge may be too long.	5. Longer tubing runs may create frictional losses sufficient to reduce pump's pressure rating Consult factory for more information.
	6. Clogged Foot Valve strainer.	6. Remove Foot Valve strainer when pumping slurries or when solution particles cause strainer to clog.
Failure to Run	1. Pump not turned on or plugged in.	1. Turn on or plug in pump.
	2. EPU failure.	2. Disassemble pump and measure resistance across the EPU terminals. If this measures as an open circuit then the EPU should be replaced. *(see Section 4.8)*.
	3. Pulser failure.	3. The pulser should be replaced if EPU checks out OK. Consult supplier or factory.
Excessive Pump Output	1. Syphoning. (Pumping downhill without a multi-function valve).	1. Move injection point to a pressurized location or install an LMI® 4-FV *(see Section 2.4)*.
	2. Little or no pressure at injection point.	2. If pressure at injection point is less than 25 psi (1.7 Bar), an LMI® 4-FV should be installed *see Section 2.4)*.
	3. Excessive strokes per minute.	3. Replace pulser or resistor. Consult factory.

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LMI®

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ROYTRONIC EXCEL™
Series AD9 Programming Guide
Electronic Metering Pumps

Manual No : 2032
Rev. : D
Rev. Date : 11/2015

LMI®

an Accudyne Industries brand

SECTION 1 - INTRODUCTION

The Series AD9 electronic metering pump offers an extensive range of features, including microprocessor control for accurate and flexible automation in response to instrument signals. The microprocessor design employs a graphical display and tactile response keypad. All external inputs and outputs are opto-isolated from the microprocessor.

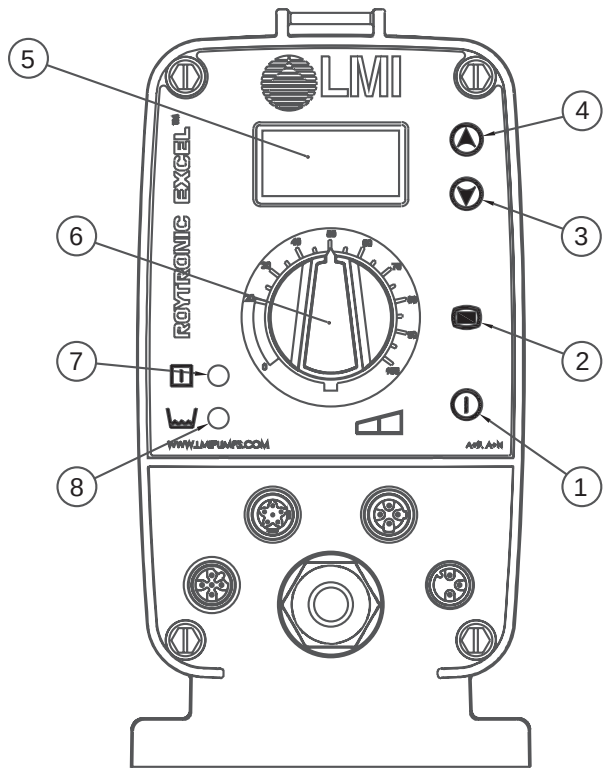
This manual is a supplement which describes programming and operation for the AD9 series. For complete details on Installation, Maintenance and Troubleshooting, please refer to the ROYTRONIC EXCEL™ Instruction Manual (P/N 2024).

⚠ CAUTION **SPECIFIC PRECAUTIONS SHOULD BE TAKEN WHEN WORKING WITH ALL LMI® METERING PUMPS. PLEASE REFER TO THE PRECAUTIONS SECTION, SEC. 1.0, OF THE ROYTRONIC EXCEL™ INSTRUCTION MANUAL (P/N 2024).**

SECTION 2 - FEATURES

1. Stroke speed adjustment 1-59 SPH (strokes per hour) to 1-120 SPM (strokes per minute).
2. Operating mode selection.
3. Flexible slope adjustable response to mA input signals.
4. Divide or multiply (batch) incoming pulses (1 to 9999).
5. Batch accumulation option.
6. Timed event mode for internal operation.
7. Percent-of-time operation for internal and external modes.
8. Keypad locking.
9. Low-level warning and empty-level shutoff with alarm output.
10. Programmable flow monitoring with alarm output (with FM-ROY-9 DIGI-PULSE™).
11. Continuous non-volatile memory (EEPROM)-no battery required.
12. Remote ON/OFF control.
13. Remote Internal/External mode control.
14. Pulse (pacing) output.
15. Universal voltage input (95-240V) with automatic line voltage compensation and over voltage protection.
16. Programmable menu for optional features parameters.
17. Theoretical flow display.
18. Single-Point and Two-Point calibration.
19. Fixed-time priming mode.
20. Configurable output alarms.
21. 4-20mA output for remote monitoring of stroke speed.

SECTION 3 - KEYPAD/DISPLAY: DESCRIPTION AND FUNCTION



1. POWER Button
2. MODE Button
3. DOWN Button
4. UP Button
5. Graphical Display
6. Stroke Adjustment Knob
7. Pump ON/OFF LED
8. Low-Level Indicator LED

Figure 1. ROYTRONIC EXCEL™ Series AD9 Control Panel

3.1 POWER BUTTON

The POWER button turns the pump ON or OFF. If the pump is not running, pressing this button will cause the pump to start running. If the pump is running, pressing the POWER button will stop the pump. The POWER button is also used to prime the pump as described in *Sec. 4.3.* When in a programming screen or a selection menu, the POWER button is generally used to enter/select the associated item.

3.2 MODE SELECTION BUTTON

The MODE button is used to enter the main selection menu. The MODE button can also often be used to exit the current programming menu. Details of its use will be covered in greater detail later in this supplement.

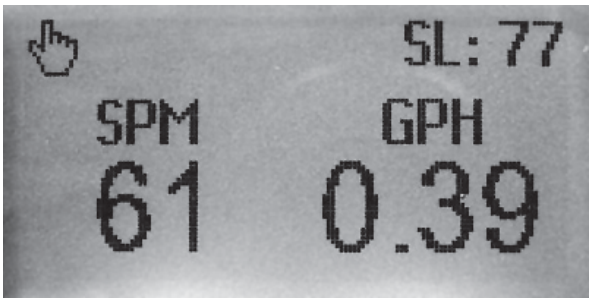
3.3 UP AND DOWN BUTTONS

The UP and DOWN buttons are used to change parameters (i.e. stroke frequency) as well as to navigate the selection menus. These functions are covered in greater detail later in this supplement.

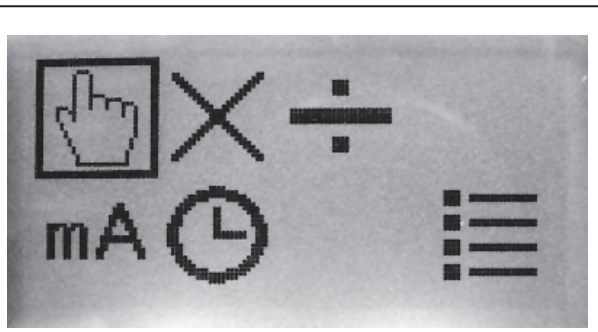
SECTION 3 - KEYPAD/DISPLAY: DESCRIPTION AND FUNCTION

3.4 GRAPHICAL DISPLAY

A graphical display is used to show the current operational state of the pump as well as a variety of specialized programming menus.



Manual Operating Mode Display



Control Mode Selection Display

3.5 STROKE ADJUSTMENT KNOB

The Stroke Adjustment Knob is used to adjust the stroke length of the pump. As this knob is adjusted, the stroke length and associated flow will be displayed on the current operating mode display.

3.6 PUMP ON/OFF LED

When the pump is started, the Pump ON/OFF LED will be green when in internal mode and yellow when in an external mode. The LED will also briefly pulse OFF during an actual pump stroke. When the pump is not running, the Pump ON/OFF LED will be OFF.

3.7 LOW LEVEL INDICATOR LED

The Low Level Indicator LED will normally be OFF. However, in the event that an external level sensor is connected to the pump, the LED will turn yellow if a Tank Low input signal is detected or red if a Tank Empty input signal is detected. If both Tank Low and Tank Empty conditions are present, the Tank Empty takes priority. The pump will not stroke when in a Tank Empty condition.

SECTION 4 - OPERATION OF THE SERIES AD9

This pump features EEPROM nonvolatile memory. The pump will always power up in the last used mode. When shipped from the factory the pump will power up in the Manual mode (*see Sec. 5.1*), with the pump OFF and a speed setting of 120 SPM.

NOTE:

If the power to the pump is cut less than 15 seconds after the last programmed values have been set, the latest changes will NOT be stored in nonvolatile memory. Allow at least 15 seconds before disconnecting from power to ensure that the latest changes are stored.

4.1 PUMP START/STOP

Press the ⏻ POWER button to start or stop the pump. When the pump is OFF, the I Pump ON/OFF LED will be OFF. When the pump is ON, the I Pump ON/OFF LED will illuminate. Each time the pump strokes, the I Pump ON/OFF LED will flash OFF.

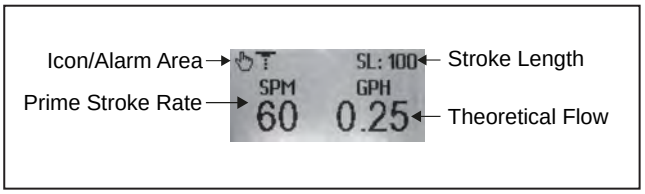
4.2 PUMP SPEED

The speed may be changed with the pump ON or OFF. To increase or decrease the speed, press or hold the ▲ UP or ▼ DOWN button. The range runs from 0 SPH to 120 SPM. While normally the speed will be set in SPM, if settings of SPH are desired, hold the ▼ DOWN button until the display reads 1 SPM, then continue to hold it down. The display will then show SPH 59. The speed can be further reduced to 1 SPH with the ▼ DOWN button.

4.3 PRIMING THE PUMP

The priming function allows a fixed-time prime period of 60 seconds and enables priming of the pump in any control mode. To begin priming, hold down the ⏻ POWER button for approximately 5 seconds. The pump will begin operating. Use the ▲ UP and ▼ DOWN buttons to vary the stroking speed. To stop priming before the priming cycle is complete, push the ⏻ POWER button. The pump will automatically stop after 60 seconds, and revert to the last used control mode.

Display Overview:



1. **Icon/Alarm Area:** The T icon indicates the pump is in prime mode. Depending on advanced pump configuration options and any alarms alerts detected, other icons may be present as well (*see Sec. 4.5*).
2. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
3. **Prime Stroke Rate:** Indicates the stroke speed of the pump while priming (1-120 SPM).
4. **Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

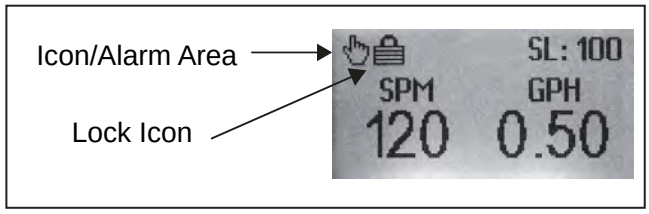
NOTE:

The prime stroke rate is independent of the current control mode stroke rate.

SECTION 4 - OPERATION OF THE SERIES AD9

4.4 LOCKING/UNLOCKING THE PUMP

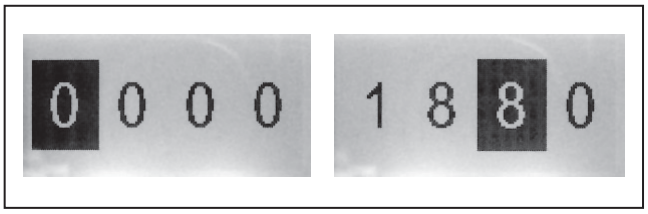
The pump has several lock modes to prevent casual tampering. For a complete description of the lock modes and how to configure them, *see Sec. 6.4*. A Lock Icon in the Icon/Alarm Area indicates that the pump has been locked.



To activate the pump lock, depress the ▼ DOWN and ▬ MODE buttons simultaneously for about 1 second until the Lock Icon appears in the Icon/Alarm area.

To unlock a locked pump, depress the ▼ DOWN and ▬ MODE buttons simultaneously for about 1 second until the Lock Icon disappears in the Icon/Alarm area or until prompted for the unlock pass code (*see below*).

To enter the unlock pass code, use the ▲ UP and ▼ DOWN buttons to edit each digit. Use the ⏻ POWER button to advance to the next digit. If the pass code is incorrect, the pump will remain locked.



Example of entering an unlock pass code

NOTE:

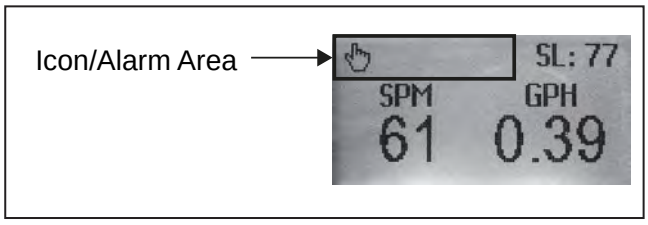
Activating the pump lock is effective immediately. Do not activate unless you have made note of the unlock pass code, which is configured in Sec. 6.4. If the pass code is misplaced while the lock is active, the pump must be returned to the factory in order to be reset.

After approximately 2 minutes of inactivity, the unlock pass code display will close and revert back to the current control mode display.

SECTION 4 - OPERATION OF THE SERIES AD9

4.5 ALARM/ICON AREA

The upper left portion of every Control Mode Display contains an icon/alarm notification area, which graphically displays operational information. If no alarm conditions exist, the display will only show configuration information. If one or multiple alarm conditions exist, the display will alternate every few seconds between showing configuration information and showing alarm information. Alarm information will always be preceded by the ⚠ icon.



Configuration Icon Definitions:

ICON	NAME	DESCRIPTION
	Manual Control Mode	Pump is in Manual Control Mode (See Sec. 5.1)
	Pulse Multiply Control Mode	Pump is in Pulse Multiply Control Mode (See Sec. 5.2)
	Pulse Divide Control Mode	Pump is in Pulse Divide Control Mode (See Sec. 5.3)
	Analog Control Mode	Pump is in Analog Control Mode (See Sec. 5.4)
	Timed Event Control Mode	Pump is in Timed Event Control Mode (See Sec. 5.5)
	Prime	The pump is priming (See Sec. 4.3)
	Keypad Locked	The keypad is locked (See Sec. 4.4)
	Digi-Pulse™ Flow Monitoring	Digi-Pulse™ flow switch monitoring is enabled (See Sec. 6.9)
	Percent-of-Time	Percent-of-Time Functionality Enabled (See Sec. 6.10)
	Batch Mode	Batch Mode Enabled (See Sec. 6.2)
	1-Point Calibration	Pump user-calibrated : 1-point (See Sec. 6.6.1)
	2-Point Calibration	Pump user-calibrated : 2-point (See Sec. 6.6.2)

Table1. Configuration Icon Definitions

SECTION 4 - OPERATION OF THE SERIES AD9

Alarm Icon Definitions:

ICON	NAME	DESCRIPTION
	Stroke length alarm	The pump is user-calibrated and the stroke length is operating outside the allowable range
	Digi-Pulse™ flow switch alarm **	Digi-Pulse™ Flow Monitoring is enabled and the missed strokes threshold has been reached
	Analog input alarm	The 4-20ma input current exceeds 21.5 mA
	Incoming pulse rate alarm	The input pulse rate results in a stroke rate exceeding 120 SPM
	Batch alarm	Pulses are received before current batch action is completed
	Low tank alarm	Corresponds to the external Tank Level Low input
	Empty tank alarm**	Corresponds to the external Tank Empty input

*** = The pump will stop stroking in this condition*

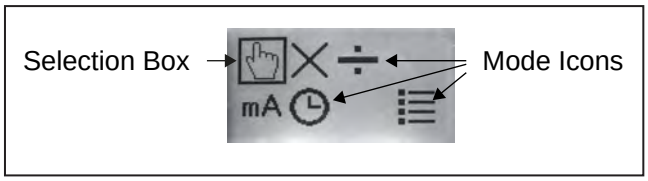
Table 2. Alarm Icon Definitions

SECTION 5 - CONTROL MODE SELECTION MENU

This menu is used to select the control mode or enter into the advanced configuration menu. There are 2 internal control modes and 3 external control modes. In order to operate the pump in an external control mode, a remote device must be connected to the pump through the 5-Pin connector.

With the pump turned OFF, push the ▭ MODE button to bring up the Control Mode Selection Menu. Use the ▲ UP and ▼ DOWN buttons to scroll through the modes. Once the desired mode is selected, use the ⏻ POWER button to enter that mode. Push and hold the ▭ MODE button for approximately 2 seconds to exit the menu.

Display Overview:



Control Mode Selection Menu

1. **Mode Icons:** Each icon represents a different control mode, as follows:
   - = Manual Mode - Internal (*Sec. 5.1*).
   - = Pulse Multiply Mode - External (*Sec. 5.2*).
   - = Pulse Divide Mode - External (*Sec. 5.3*).
   - mA = Analog mA Mode - External (*Sec. 5.4*).
   - = Timed Event Mode - Internal (*Sec. 5.5*).
   - = Advanced Configuration Options (*Sec. 6.0*).
2. **Selection Box:** Indicates the currently selected item.

NOTE:

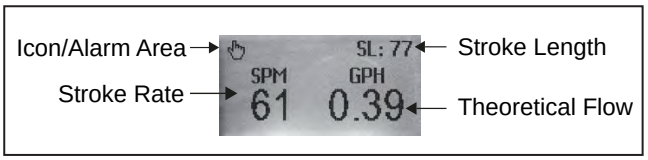
After approximately 2 minutes of inactivity, the mode selection menu will automatically close and revert back to the prior display.

While in this menu, all external outputs will return to their default "OFF" state and all external inputs will be ignored.

5.1 MANUAL MODE (INTERNAL)

This mode is used when external devices are not being used to control the pump. While in manual mode, the stroke speed is varied by using the ▲ UP and ▼ DOWN buttons. To turn the pump ON or OFF, push the ⏻ POWER button or toggle the remote ON/OFF. The I Pump ON/OFF LED will illuminate green when the pump is ON.

Display Overview:



Manual Mode Display

1. **Icon/Alarm Area:** The ☝ icon indicates the pump is in the manual mode. Depending on advanced pump configuration options and any alarms alerts detected, other icons may be present as well (*see Sec. 4.5*).
2. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
3. **Stroke Rate:** Indicates the stroke speed of the pump (1-59SPH or 1-120 SPM).
4. **Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

SECTION 5 - CONTROL MODE SELECTION MENU

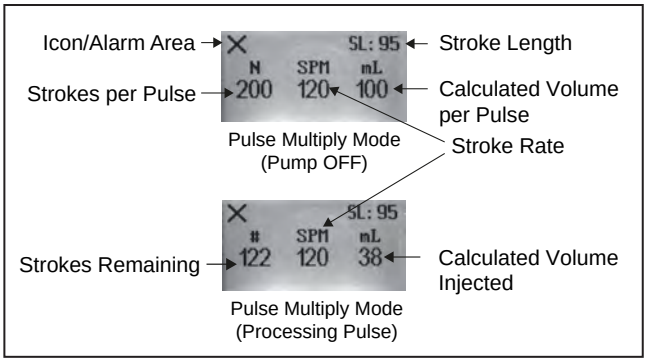
5.2 PULSE MULTIPLY MODE (EXTERNAL)

This mode is used to control the pump with an external device connected to the appropriate contacts of the 5-Pin connector. With the pump OFF, use the ▲ UP and ▼ DOWN buttons to vary the strokes-per-pulse parameter. To turn the pump ON or OFF, push the ⏻ POWER button, or toggle the remote ON/OFF. The I Pump ON/OFF LED will illuminate yellow when the pump is ON. With the pump turned ON, and a pulse is received, the pump will begin running, with the remaining pulses counting down on the display.

If a pulse is received before the countdown is complete and Batch Mode is OFF (*see Sec. 6.2*), the error code (*see Sec. 4.5*) is displayed and the pump batch count then restarts from the strokes-per-pulse setpoint. The fault will be corrected when the pump completes the current batch OR the pump is stopped.

If a pulse is received before the countdown is complete and Batch Mode is ON (*see Sec. 6.2*), the pump will accumulate strokes (up to a maximum of 9999), allowing all strokes to be accounted for.

Display Overview:

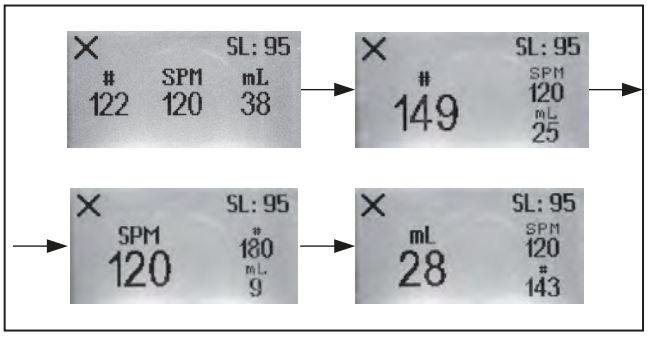


1. **Icon/Alarm Area:** The ✕ icon indicates the pump is in the pulse multiply mode. Depending on advanced pump configuration options and any alarms/alerts detected, other icons may be present as well (*see Sec. 4.5*).
2. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
3. **Stroke Rate:** Indicates the stroke speed of the pump (1-59 SPH or 1-120 SPM). To allow true flow proportioning, this is set in manual mode (*see Sec. 5.1*).
4. **Strokes per Pulse (Pump OFF only):** Number of strokes (1-9999) to occur for each valid pulse input. *See Sec. 6.3* to define a valid pulse.
5. **Strokes Remaining (Pump ON only):** Number of strokes remaining for the current batch cycle.
6. **Calculated Volume per Pulse (Pump OFF only):** The calculated flow based on stroke count, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).
7. **Calculated Volume Injected (Pump ON only):** The calculated flow based on strokes made, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

NOTE:

The pump will ignore the pulse input while the pump is OFF.

Depressing the ▲ UP and ▼ DOWN buttons simultaneously will cycle through alternate display formats , as shown below:

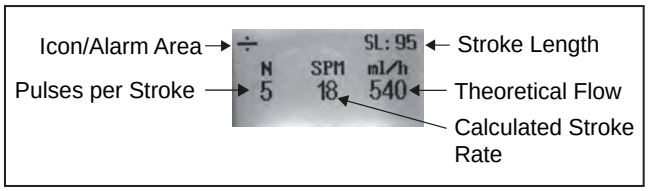


SECTION 5 - CONTROL MODE SELECTION MENU

5.3 PULSE DIVIDE MODE (EXTERNAL)

This mode is used to control the pump with an external device connected to the appropriate contacts of the 5-Pin connector. With the pump OFF, use the ⏫ UP and ⏬ DOWN buttons to vary the pulses-per-stroke parameter. To turn the pump ON or OFF, push the ⏻ POWER button or toggle the remote ON/OFF. The I Pump ON/OFF LED will illuminate yellow when the pump is ON. With the pump turned ON, the pump will pulse after the programmed number of pulses has been received.

Display Overview:



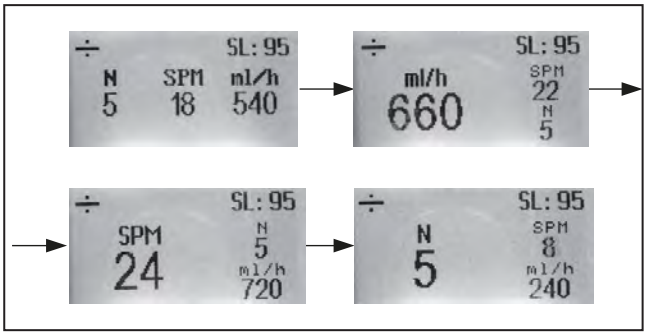
1. **Icon/Alarm Area:** The ÷ icon indicates the pump is in the pulse divide mode. Depending on advanced pump configuration options and any alarms/alerts detected, other icons may be present as well (*see Sec. 4.5*).
2. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
3. **Calculated Stroke Rate:** Indicates the calculated stroke rate of the pump (0-120 SPM) based on the rate of incoming pulses and the divide value.
4. **Pulses per Stroke:** Number (1-9999) of valid pulses to detect before performing a pump stroke. *See Sec. 6.3* to define a valid pulse.
5. **Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

NOTE:

The pump will display the calculated stroke rate and theoretical flow with the pump ON and OFF.

A ⚠ fault will be indicated if the calculated stroke rate exceeds 120 SPM (see Sec. 4.5).

Depressing the ⏬ UP and ⏫ DOWN buttons simultaneously will cycle through alternate display formats, as shown below:

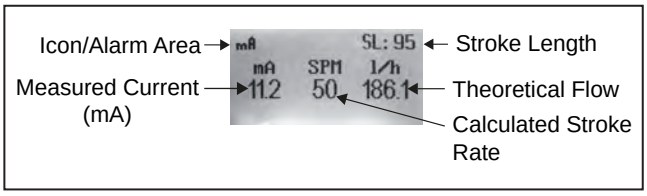


SECTION 5 - CONTROL MODE SELECTION MENU

5.4 ANALOG MODE (EXTERNAL)

This mode is used to control the pump with an external device connected to the appropriate contacts of the 5-Pin connector. With the pump OFF, press the ▲ UP or ▼ DOWN button to change the response curve (*see Sec. 5.4.1*). To manually turn the pump ON or OFF, push the ⏻ POWER button or toggle the remote ON/OFF. The I Pump ON/OFF LED will illuminate yellow when the pump is ON.

Display Overview:



1. **Icon/Alarm Area:** The **mA** icon indicates the pump is in the analog mode. Depending on advanced pump configuration options and any alarms/alerts detected, other icons may be present as well (*see Sec. 4.5*).
2. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
3. **Calculated Stroke Rate:** Indicates the calculated stroke speed of the pump (0-59 SPH, 0-120 SPM) based on the analog set points and measured current.
4. **Measured Current:** Measured current value (0-24.0 mA).
5. **Theoretical Flow:** The theoretical flow based on calculated stroke speed, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

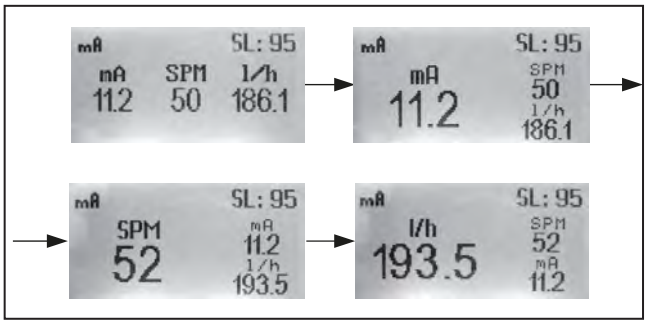
NOTE:

The pump will display the calculated stroke rate and theoretical flow with the pump ON and OFF.

A >mA fault (see Sec. 4.5) will be indicated if the 4-20mA input exceeds 21.5mA.

The pump will not stroke if the 4-20ma input signal is 0.5mA or less.

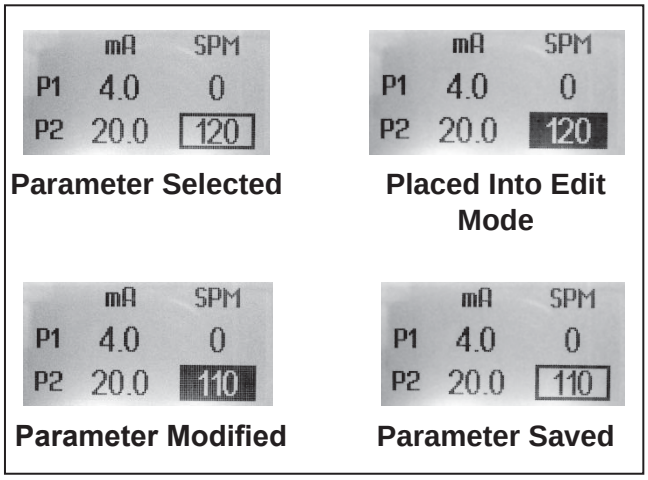
Depressing the ▲ UP and ▼ DOWN buttons simultaneously will cycle through alternate display formats, as shown below:



SECTION 5 - CONTROL MODE SELECTION MENU

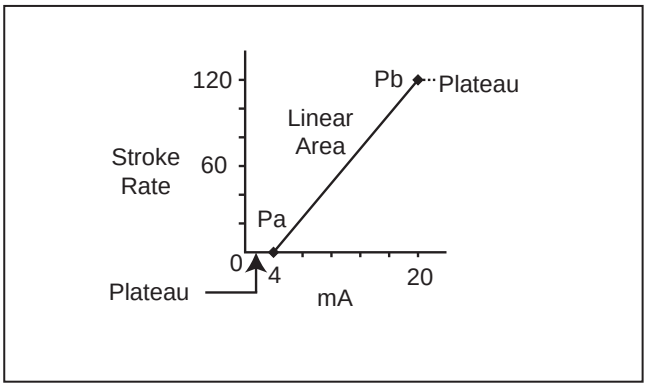
5.4.1 Programming the Analog Mode Response Curve

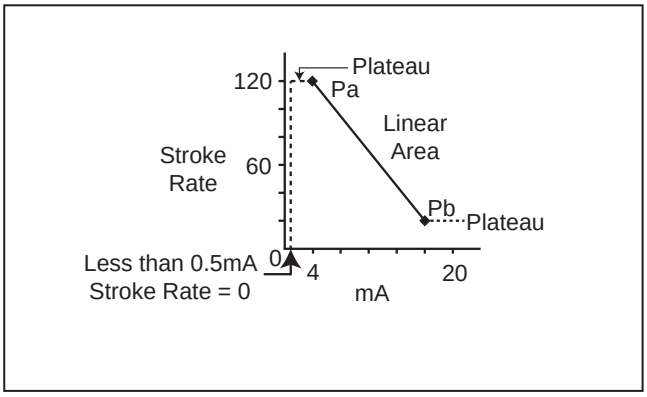
Use the ▲ UP or ▼ DOWN button to move the selection box to the parameter you wish to change. Use the ⏻ POWER button to toggle to the parameter's edit mode - a black background indicates the parameter is in edit mode. While in edit mode, use the ▲ UP and ▼ DOWN buttons to set the value. Use the ⏻ POWER button to exit edit mode and save the setting.



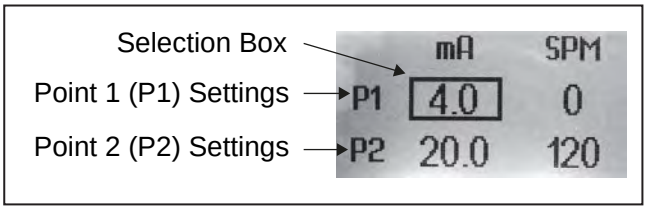
Use either the ▭ MODE button or navigate using the ▲ UP or ▼ DOWN buttons to exit the programming mode. The valid range for the mA value is 0.0 to 20.0 mA. The valid range for the SPM value is 0 to 120 SPM or 0-59 SPH.

The programming of points P1 and P2 when plotted will result in a graph similar to one of the 2 charts below (Pa = lowest programmed mA value; Pb = highest programmed mA value). The pump will vary its stroke speed linearly between points Pa and Pb based on the mA input signal. If the mA input signal exceeds Pb, the stroke speed will remain (plateau) at the speed corresponding to Pb. If the mA input drops to less than Pa, the stroke speed will remain (plateau) at the speed corresponding to Pa. Regardless of settings, if the mA input drops to 0.5 mA or below, the pump will stop stroking.





Display Overview:



1. **Selection Box:** indicates the currently selected item.
2. **Point 1 (P1) Settings:** the settings (mA and stroke rate) corresponding to set point P1.
3. **Point 2 (P2) Settings:** the settings (mA and stroke rate) corresponding to set point P2.

NOTE :

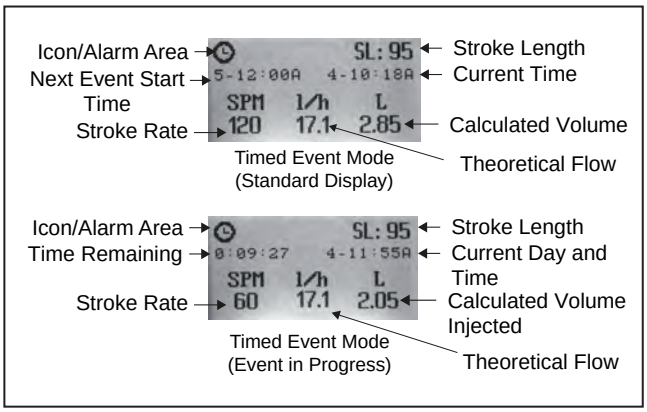
Parameter changes are saved when editing is complete and go into effect immediately.

SECTION 5 - CONTROL MODE SELECTION MENU

5.5 TIMED EVENT MODE (INTERNAL)

With the pump OFF, press the ▲ UP or ▼ DOWN button to view and/or program the timed events (*see Section. 5.5.1*). To turn the pump ON or OFF, push the ⏻ POWER button or toggle the remote ON/OFF. The I Pump ON/OFF LED will illuminate green when the pump is ON.

Display Overview:



1. **Icon/Alarm Area:** The ◷ icon indicates the pump is in the Timed Event mode. Depending on advanced pump configuration options and any alarms/alerts detected, other icons may be present as well (*see Sec. 4.5*).
2. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
3. **Next Event Start Day and Time:** The Day and Time of the next timed event. See below for the displayed format. The '*' character in this field indicates that no events are enabled (*see Sec. 5.5.1 for event programming information*).
4. **Current Day and Time:** The current Day and Time (*see below for time format description*).
5. **Stroke Rate:** Indicates the stroke speed of the pump (1-59SPH or 1-120 SPM) for the currently running event or the next scheduled event.
6. **Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).
7. **Calculated Volume:** The calculated volume based on event duration, stroke rate, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).
8. **Time Remaining (Event in Progress Only):** Remaining time of event.
9. **Calculated Volume Injected (Event in Progress Only):** The calculated volume based on strokes made, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

NOTE:

The displayed format for time is: D – H:MMx, where D = Day of Week (1-7), H = Hour (1-12), MM = Minute (0-59), x = A for AM or P for PM.

SECTION 5 - CONTROL MODE SELECTION MENU

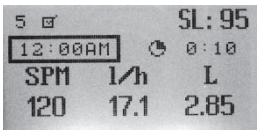
5.5.1 Programming Timed Events

One timed event may be programmed to execute for each of 7 days. Each event has a uniquely programmable start time, duration, and stroke rate.

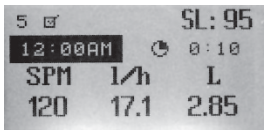
Use the ▲ UP or ▼ DOWN button to move the selection box to the parameter you wish to change. Use the ⏻ POWER button to toggle the parameter's edit mode. A black background indicates the parameter is in edit mode. The Event Enabled parameter will be toggled ON/OFF rather than going into an edit mode.

While in edit mode, use the ▲ UP and ▼ DOWN buttons to set the value. The valid range for the day value is 1-7. As the day value is changed, the start time, duration, and stroke rate will be updated to reflect the programming for the selected day. A checked event enabled box indicates that the currently displayed event is enabled. The valid range for the duration value is 1 minute to 24 hours. The valid range for the SPM value is 0 to 120 SPM or 0-59 SPH.

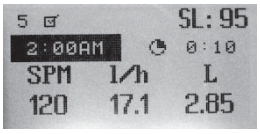
Use the ⏻ POWER button to exit the edit mode and save the setting. Use the ▭ MODE button to exit the programming mode.



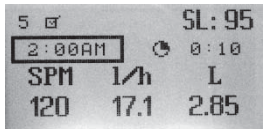
Parameter Selected



Placed Into Edit Mode

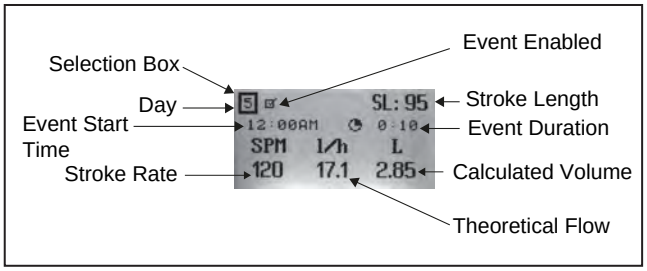


Parameter Modified



Parameter Saved

Display Overview:



1. **Selection Box:** Indicates the currently selected item.
2. **Day:** Day of currently displayed event.
3. **Event Enabled:** Indicates whether currently displayed event is enabled (checked = enabled).
4. **Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
5. **Event Start Time:** The Day and Time of the next timed event (*see Sec. 5.5 for time format*).
6. **Event Duration:** Duration / Run-Time of currently displayed event (format Hours:Minutes).
7. **Stroke Rate:** Indicates the stroke speed of the pump (1-59SPH or 1-120 SPM) for the currently running event or the next scheduled event.
8. **Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).
9. **Calculated Volume:** The calculated based on event duration, stroke rate, stroke length, and calibration settings (*see Sec. 6.6 for calibration information*).

NOTE:

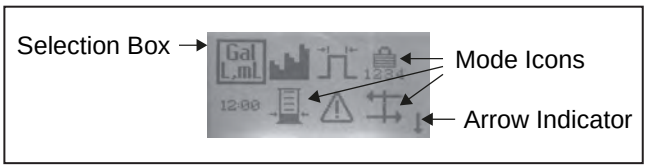
Parameter changes are saved when editing is complete and go into effect immediately.

After approximately 2 minutes of inactivity, the programming menu will automatically close and revert back to the main analog mode display.

SECTION 6 - ADVANCED CONFIGURATION MENU

Use the ▲ UP and ▼ DOWN buttons to select the desired mode. Push and hold the ⏻ POWER button for approximately 1 second to select the desired mode. Push and hold the MODE button for approximately 2 seconds to exit the menu.

Display Overview:



1. **Mode Icons:** Each icon represents a different control mode, as follows:
   - = Set Units (Sec. 6.1)
   - = Set Batch Mode (Sec. 6.2)
   - = Set Pulse Width (Sec. 6.3)
   - = Set Lock Mode Configuration (Sec. 6.4)
   - = Set Clock (Sec. 6.5)
   - = Calibrate Pump (Sec. 6.6)
   - = Set Alarm / Internal-External Output (Sec. 6.7)
   - = Set Remote Internal-External Mode Input (Sec. 6.8)
   - = Digi-Pulse™ Setup (Sec. 6.9)
   - = Set Percent-of-Time Operation (Sec. 6.10)
   - = Load Factory Defaults (Sec. 6.11)
   - = View Pump Information (Sec. 6.12)
2. **Selection Box:** Indicates the currently selected item.
3. **Arrow Indicator:** An arrow appearing on the upper or lower right of the display indicates that more icons are available via scrolling.

NOTE:

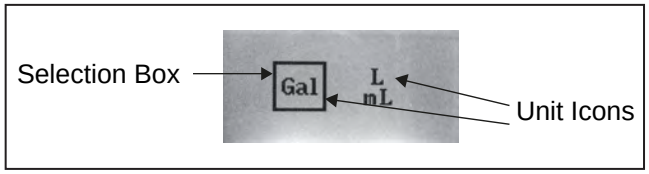
Parameter changes are saved when editing is complete and go into effect immediately.

After approximately 2 minutes of inactivity, the mode selection menu will automatically close and revert back to the most recent control mode display.

6.1 SET UNITS

Use the ▲ UP and ▼ DOWN buttons to select the desired units. Push the ⏻ POWER button to selected the item and return to the advanced configuration menu.

Display Overview:



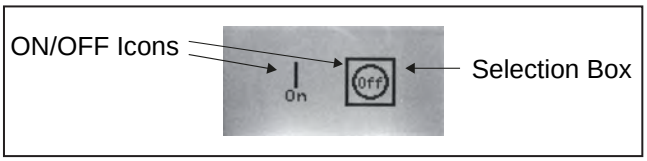
1. **Unit Icons:**
   - Gal = English Units (i.e. Gallons per hour - GPH).
   - L / mL = Metric Units (i.e. Liters, milliliters).
2. **Selection Box:** Indicates the currently selected item.

SECTION 6 - ADVANCED CONFIGURATION MENU

6.2 SET BATCH MODE

Batch mode applies only to the Pulse Multiply Mode (*see Section. 5.2*). Use the ▲ UP and ▼ DOWN buttons to select On or Off. Push the ⏻ POWER button to select the item and return to the advanced configuration menu. Use the ▭ MODE button to return to the advanced configuration menu without saving changes.

Display Overview:

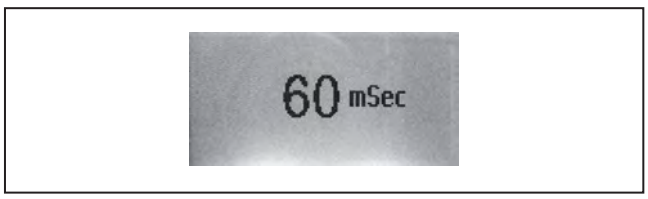


1. **ON/OFF Icons:**
   - On = Batch Mode ON (Stroke counter will accumulate when pulses are detected during an existing pump cycle)
   - Off = Batch Mode OFF (Stroke counter will reset if a pulse is detected during an existing pump cycle)
2. **Selection Box:** Indicates the currently selected item.

6.3 SET PULSE WIDTH

Use the ▲ UP and ▼ DOWN arrows to change the value for the pulse width. The valid range is 4 mSec - 60 mSec (in 4 mSec increments). Push the ⏻ POWER button to save the value and return to the advanced configuration menu. Use the ▭ MODE button to return to the advanced configuration menu without saving changes.

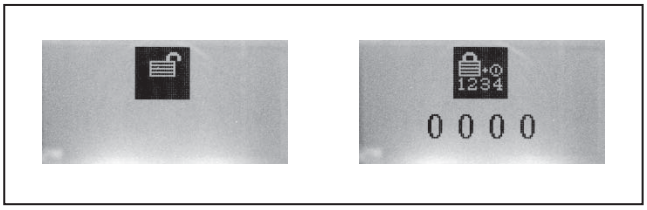
Display Overview:



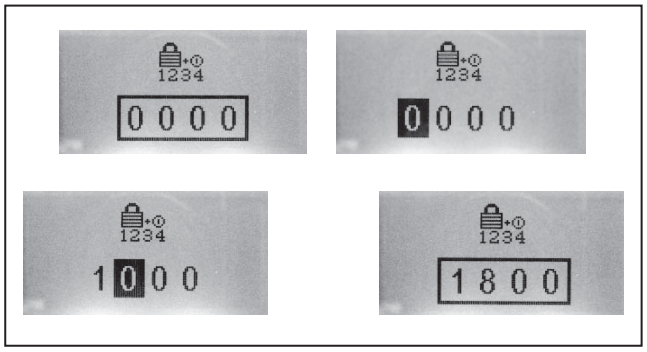
Pulse width (in milliseconds)

6.4 SET LOCK MODE CONFIGURATION

This menu is used to select the desired lock mode and to set the pass code; when you exit this menu, the lock is not activated (*see Sec. 4.4 to activate the lock*). Use the ▲ UP or ▼ DOWN button to select the desired parameter. Use the ⏻ POWER button to toggle to parameter's edit mode. A black background indicates the parameter is in edit mode. While in edit mode, use the ▲ UP and ▼ DOWN buttons to set the value. While setting the unlock pass code, use the POWER button to advance to the next digit, and the ▭ MODE button to go back to the prior digit. Use the ▭ MODE button to return to the advanced configuration menu.



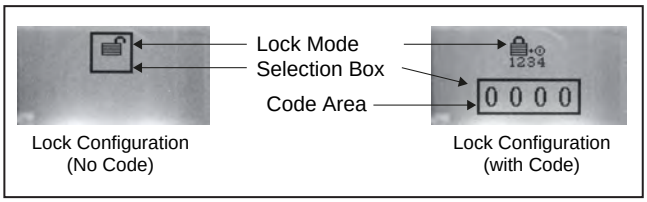
Example: Editing Lock Mode



Example: Editing Unlock Pass Code

SECTION 6 - ADVANCED CONFIGURATION MENU

Display Overview:



1. Lock Mode:

The icon corresponding to the current lock mode configuration.

= Always unlocked (default).

= All buttons locked out except the ⏻ POWER button.

= All buttons locked out.

= All buttons locked out except the ⏻ POWER button and an unlock pass code required to unlock pump.

= All buttons locked out and an unlock pass code required to unlock pump.

2. Code Area (on appropriate lock modes only): Displays 4-digit unlock pass code.

3. Selection Box: Indicates the currently selected item.

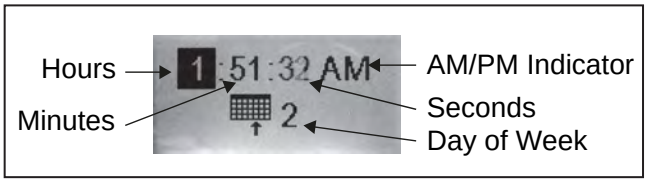
NOTE:

Make note of the pass code you have selected. This will be required to unlock the pump. If the pass code is misplaced and the lock is activated, the pump must be returned to the factory in order to be reset (see Section 4.4 to unlock the pump).

6.5 12:00 SET CLOCK

The clock will only be displayed when operating in Timed Event Mode (*see Sec. 5.5*). Use the ▲ UP or ▼ DOWN button to edit the highlighted parameter. Use the ⏻ POWER button to advance to the next parameter. Use the ▭ MODE button to go back to the prior parameter.

Display Overview:



1. Hours (1-12).
2. Minutes (0-59).
3. Seconds (0-59).
4. AM/PM Indicator (AM or PM).
5. Day of Week (1-7).

SECTION 6 - ADVANCED CONFIGURATION MENU

6.6 PUMP CALIBRATION

Pump calibration will increase the accuracy of the various displayed flow rates and volumes. In Single-Point Calibration (*see first diagram below*), the pump is calibrated to a specific stroke length and flow rate (P1), changing the slope of the flow line as indicated in the diagram. The "Calibration Region" extends to +/- 10% of the calibrated stroke length. As a result, the Single-Point Calibration should only be used if the stroke-length is to be maintained within 10% of the calibration setting.

In Two-Point Calibration (*see second diagram below*), the pump is calibrated to two specific stroke length and flow rate combinations (Pa and Pb), changing the slope and the offset of the flow line as indicated in the diagram. Pa and Pb stroke lengths must differ by at least 10%. The "Calibration Region" extends from -10% of Pa to +10% of Pb stroke lengths. The Two-Point Calibration will always result in a larger "Calibration Region" than the Single-Point Calibration.

When a pump has been calibrated, the 1 or 2 icon is displayed in the Icon/Alarm area of the display (*see Sec. 4.5*). If the stroke length is adjusted outside the calibration region, the **SL** alarm icon will be displayed in the Icon/Alarm area of the display.

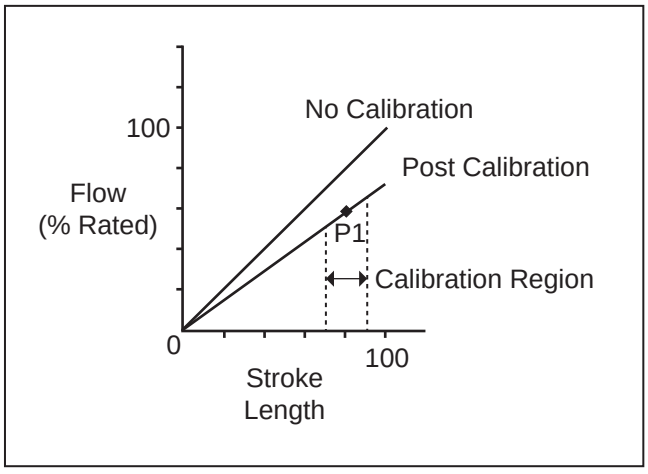


Figure 2. Single-Point Calibration

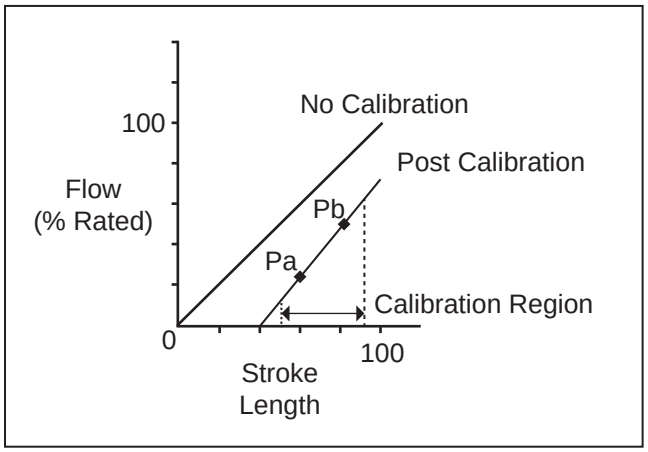
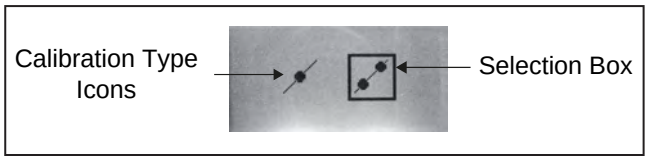


Figure 3. Two-Point Calibration

Use the ▲ UP or ▼ DOWN button to select the desired calibration mode. Use the ⏻ POWER button to select the mode (*see Sec. 6.6.1 for single-point calibration procedure or Sec. 6.6.2 for two-point calibration procedure*). Use the ▭ MODE button to return to the advanced configuration menu without making changes.

Display Overview:



1. **Calibration Type Icons:** The icons corresponding to the following calibration types:

   = Single-Point Calibration

   = Two-Point Calibration
2. **Selection Box:** Indicates the currently selected item.

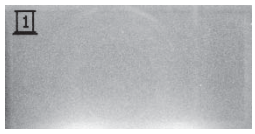
SECTION 6 - ADVANCED CONFIGURATION MENU

6.6.1 Single-Point Calibration Procedure

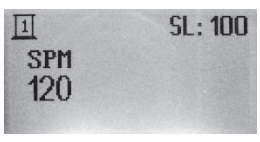
During calibration, accuracy improves as stroke count increases. As a result, a minimum of 100 strokes should be used to calibrate the pump. The maximum number of strokes in the calibration process is 9999. The stroke length cannot be changed during calibration step 3 below. If the stroke length is changed, a **SL** error icon will display, the pump will stop, and the stroke count and pump output will be reset to zero. Stroke speed may only be adjusted in step 2. In general, the ⊟ MODE button may be used to step back in the calibration procedure.

Procedure:

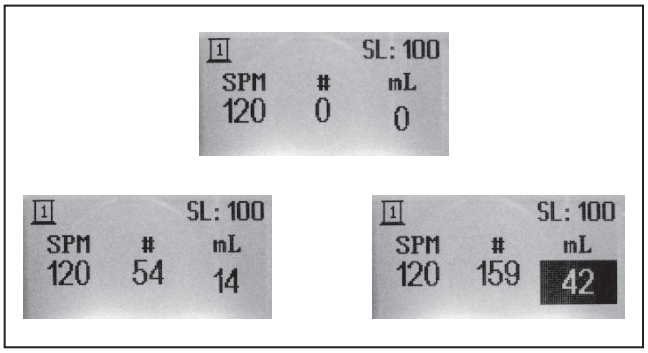
1. Upon selecting single-point calibration, the [1] icon will be displayed indicating that pump is ready to begin calibration.



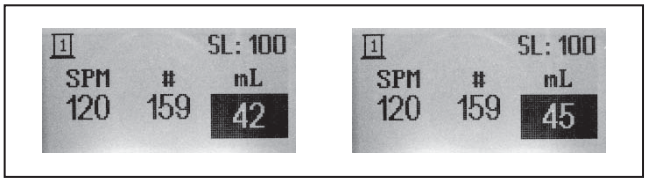
2. Press the ⏻ POWER button. The pump will begin pulsing. Adjust the stroke length knob to the desired setting for calibration. Use the ▲ UP or ▼ DOWN buttons to adjust the stroke speed to the desired setting for calibration. Press the ⏻ POWER button when adjustments are complete. The pump will stop pulsing.



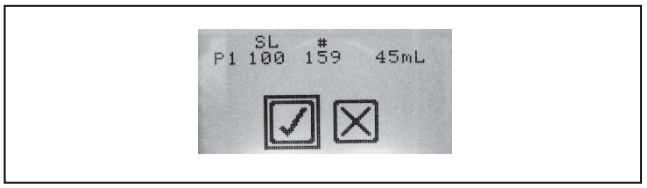
3. Press the ⏻ POWER button to begin calibration of the pump. The pump will start pulsing. The display will begin counting the strokes and displaying the accumulated volume. The volume displayed is based upon the pre-existing settings. Press the ⏻ POWER button when the desired number of strokes has occurred.



4. Use the ▲ UP or ▼ DOWN buttons to edit the highlighted volume as necessary. Press the ⏻ POWER button when complete.



5. Use the ▲ UP or ▼ DOWN buttons to select whether to ☑ (Save) or ☒ (abandon) the displayed calibration settings. Press the ⏻ POWER button to accept the selection and then return to the main calibration menu.



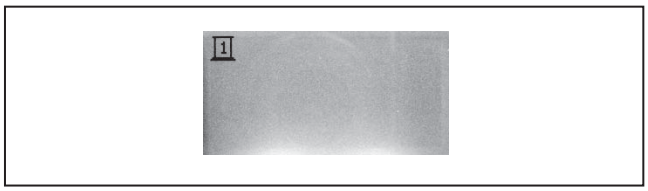
SECTION 6 - ADVANCED CONFIGURATION MENU

6.6.2 Two-Point Calibration Procedure

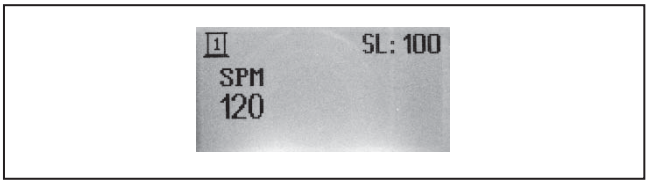
During calibration, accuracy improves as stroke count increases. As a result, a minimum of 100 strokes should be used to calibrate the pump. The maximum number of strokes in the calibration process is 9999. The stroke length cannot be changed during calibration steps 3 and 7. If the stroke length is changed, a **SL** error icon will display, the pump will stop, and the stroke count and pump output will be reset to zero. Stroke speed may only be adjusted in calibration steps 2 and 6. In general, the MODE button may be used to move back in the calibration procedure.

Procedure:

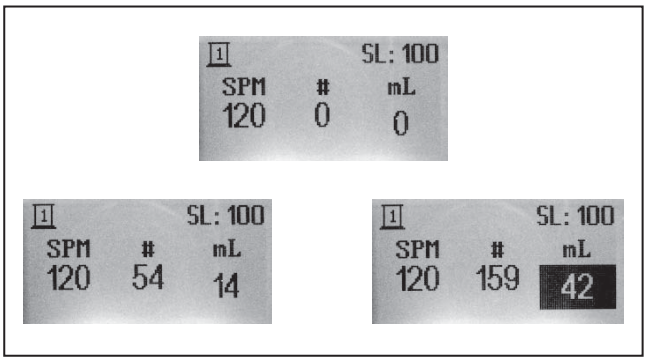
1. Upon selecting two-point calibration, the 1 icon will be displayed indicating that the pump is ready to begin calibration of point one.



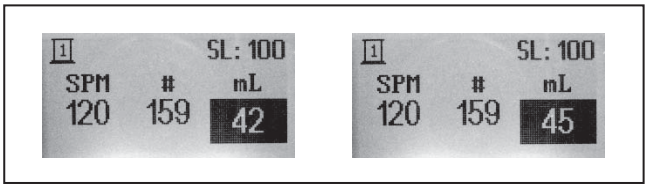
2. Press the ⏻ POWER button. The pump will begin pulsing. Adjust the stroke length knob to the desired setting for calibration of point 1. Use the ▲ UP or ▼ DOWN buttons to adjust the stroke speed to the desired setting for calibration of point 1. Press the ⏻ POWER button when adjustments are complete. The pump will stop pulsing.



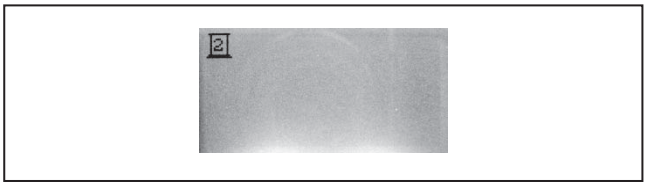
3. Press the ⏻ POWER button to begin the calibration of point 1. The pump will start pulsing. The display will begin counting the strokes and displaying the accumulated volume. The volume displayed is based upon the pre-existing settings. Press the ⏻ POWER button when the desired number of strokes has occurred.



4. Use the ▲ UP or ▼ DOWN buttons to edit the highlighted volume as necessary. Press the ⏻ POWER button when complete.

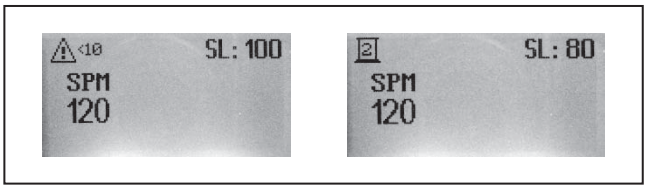


5. The 2 icon will now be displayed, indicating that the pump is ready to begin calibration of point two.

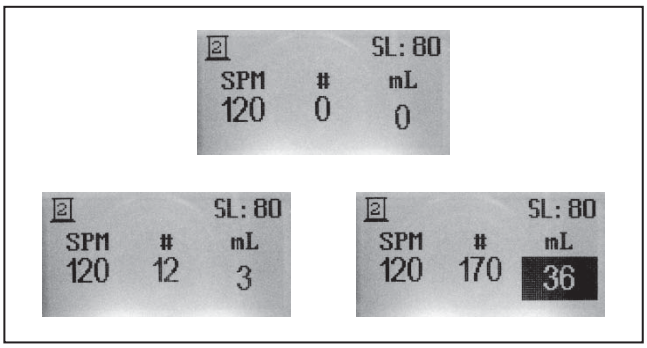


SECTION 6 - ADVANCED CONFIGURATION MENU

6. Press the ⏻ POWER button. The pump will begin pulsing. Adjust the stroke length knob to the desired setting for calibration of point 2. Use the ▲ UP or ▼ DOWN buttons to adjust the stroke speed to the desired setting for calibration of point 2. Press the ⏻ POWER button when adjustments are complete. The pump will stop pulsing. The two stroke length settings must be at least 10% apart. If not, a <10 error icon will display.

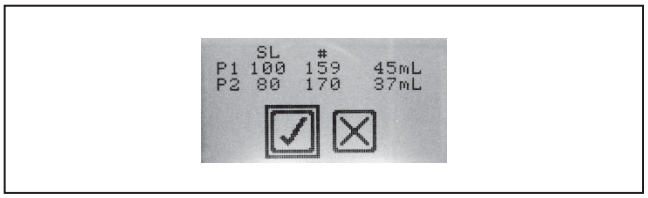


7. Press the ⏻ POWER button to begin calibration of point 2. The pump will start pulsing. The display will begin counting the strokes and displaying the accumulated volume. The volume displayed is based upon the pre-existing settings. Press the ⏻ POWER button when the desired number of strokes has occurred.



8. Use the ▲ UP or ▼ DOWN buttons to edit the highlighted volume as necessary. Press the ⏻ POWER button when complete.

9. Use the ▲ UP or ▼ DOWN buttons to select whether to ☑ (Save) or ☒ (abandon) the displayed calibration settings. Press the ⏻ POWER button to accept the selection and then return to the main calibration menu.



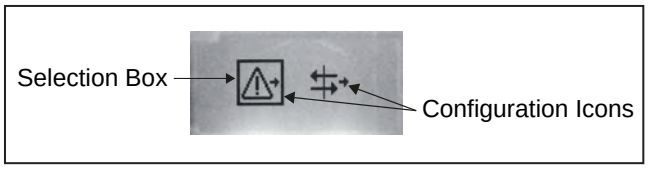
SECTION 6 - ADVANCED CONFIGURATION MENU

6.7 ⚠ CONFIGURE ALARM OUTPUT

This feature is used to configure the alarm output, which is indicated on the appropriate contacts of the 6-Pin connector. The alarm output can be configured in one of two ways: it can be used to indicate the alarm status or it can be used to indicate whether the pump is in an internal or external control mode. If the alarm output is configured to indicate the alarm status, then open contacts indicate that there is no alarm. When an alarm is active, the contacts will be closed. If the alarm output is configured to indicate the internal external mode status, then open contacts indicates the pump is in an internal mode; closed contacts indicates the pump is in an external mode.

Use the ▲ UP or ▼ DOWN button to select the desired configuration. Use the ⏻ POWER button to select the configuration. If alarm output indicates alarm status is selected, the Alarm Output Mask configuration menu will display next (*see Sec. 6.7.1*). Use the ▭ MODE button to return to the advanced configuration menu without making changes.

Display Overview:



1. **Configuration Icons:**

   ⚠→ = Alarm output indicates alarm status.

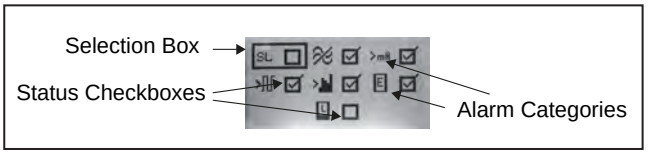
   ⇄→ = Alarm output indicates Internal/External Mode status.

2. **Selection Box:** Indicates the currently selected item

6.7.1 Configure Alarm Output Mask

Use the ▲ UP or ▼ DOWN button to select the desired alarm to enable/disable. Use the ⏻ POWER button to toggle the associated status check box. Use either the ▭ MODE button or navigate using the ▲ UP or ▼ DOWN buttons to save the data and return to the configure alarm output menu.

Display Overview:



1. **Alarm Categories** (*see Sec. 4.5 for descriptions of each alarm condition*)

   SL = Stroke length alarm.

   = DIGI-PULSE™ flow switch alarm.

   = Analog input alarm.

   = Incoming pulse rate alarm.

   = Batch alarm.

   E = Empty tank alarm.

   L = Low tank alarm.

2. **Status Check boxes:** Indicates if the alarm output will be enabled (checked) or ignored (unchecked) when the associated alarm condition is detected.
3. **Selection Box:** Indicates the currently selected item.

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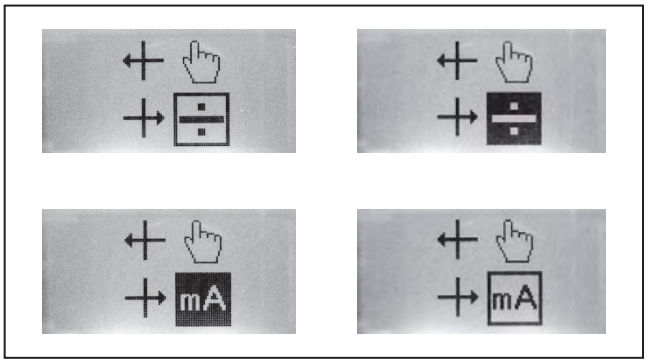
6.8 SET REMOTE INTERNAL-EXTERNAL MODE INPUT

This feature is used to switch from an internal control mode to an external control mode remotely by using the appropriate contacts of the 6-Pin connector. There are two internal control modes and 3 external control modes (*see Sec. 5.0*). The remote internal/external inputs are only monitored when the contacts are switched from open to closed, or vice versa. As a result, the control mode can always be changed from the pump, regardless of the closure status of these contacts.

If the pump is in an internal mode and the contacts on the remote internal/external input are closed, the pump will switch to the programmed external mode. If the pump is in an external mode and the contacts are opened, the pump will switch to the programmed internal mode.

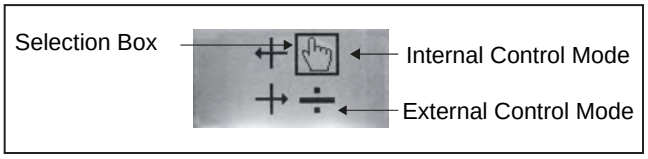
If the pump is in an internal mode and the contacts are opened, no action will be taken-the pump will remain in the pre-existing control mode. In this case, if the pre-existing control mode differs from the programmed control mode, the pre-existing control mode takes priority. Conversely, if the pump is in an external mode and the contacts are closed, no action will be taken.

Use the ⏻ POWER button to toggle to parameter's edit mode. A black background indicates the parameter is in edit mode. While in edit mode, use the ▲ UP and ▼ DOWN buttons to set the value. Use the POWER button to exit edit mode and save the setting. Use the ▭ MODE button to return to the advanced configuration menu.



Example: Editing the External Control Mode Parameter

Display Overview:



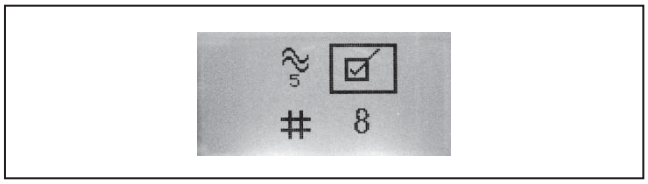
1. **Internal Control Mode:** The following are valid internal type control modes:
   - = Manual
   - = Timed Event
2. **External Control Mode:** The following are valid external type control modes:
   - = Pulse Multiply
   - = Pulse Divide
   - mA = Analog (mA)
3. **Selection Box:** Indicates the currently selected item.

SECTION 6 - ADVANCED CONFIGURATION MENU

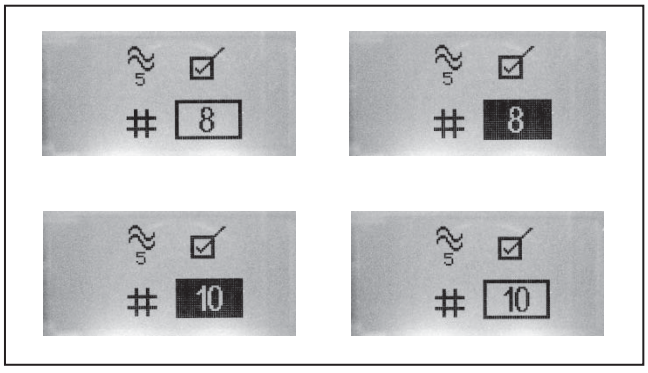
6.9 DIGI-PULSE™ FLOW MONITORING SETUP

This feature is used in conjunction with the LMI® Series FM-ROY-9 Digi-Pulse™ Flow Monitor (refer to DIGI-PULSE™ Flow Monitor Instructions P/N 1865). This device is designed to monitor the output flow from a pump. It may be set to deliver a pulse signal output for each successful pump stroke registered. If the flow stops or lessens, the pulse outputs will cease. With the FMROY- 9 connected to the 4-Pin connector, the presence or lack of pulses can be detected.

Use the ⏫ UP or ⏬ DOWN button to select the icon. Use the ⏻ POWER button to toggle the Function Enabled Indicator. Use the ⏻ POWER button to toggle the Missing Pulses parameter's edit mode. While in edit mode, use the ⏫ UP and ⏬ DOWN buttons to set the value. Use the ▭ MODE button to return to the advanced configuration menu.

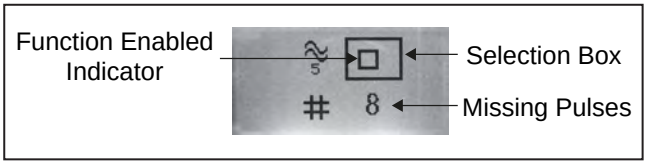


Example: Enabling the Function



Example: Editing the Missing Pulses Parameter

Display Overview:



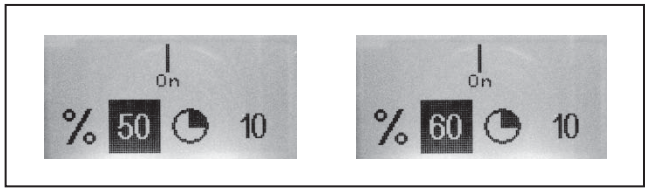
1. **Function Enabled Indicator:** Check box indicating if DIGI-PULSE™ Flow Monitoring functionality is enabled (checked=enabled).
2. **Missing Pulses:** Number of missing pulses to detect before issuing pump alarm. The valid range is 0-255. The factory default is 8. A setting of 1 is the most sensitive; a setting of 255 is the least sensitive.
3. **Selection Box:** Indicates the currently selected item.

When flow monitoring is enabled, the icon is displayed in the Icon/Alarm area of the display (*see Sec. 4.5*). If, for example, the Missing Pulses parameter is set to 5 and 5 strokes of the pump occur without any pulse being received from the FM-ROY-9, the alarm icon will be displayed in the Alarm/Icon area of the display (*see Sec. 4.5*). The pump will stop and the alarm outputs will be activated, if enabled (*see Sec. 6.7*). Pressing the ⏻ POWER button clears the alarm.

SECTION 6 - ADVANCED CONFIGURATION MENU

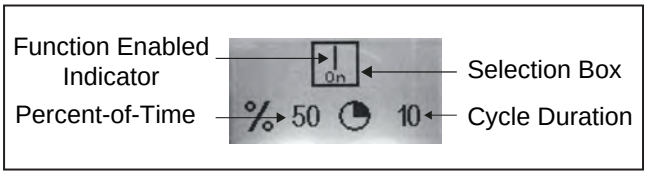
6.10 % SET PERCENT-OF-TIME OPERATION

This feature allows time-based cycling of the pump in Manual, Pulse Divide, and Analog Control Modes. The pump cycles on and off based on the configuration parameters. Use the ▲ UP or ▼ DOWN button to select the % icon. Use the ⏻ POWER button to toggle the Function Enabled Indicator. Use the ⏻ POWER button to toggle the parameter's edit mode (Percent of Time and Cycle Duration parameters). While in edit mode, use the ▲ UP and ▼ DOWN buttons to set the value. Use the ▭ MODE button to return to the advanced configuration menu.



Example: Editing Percent-of-Time Parameter

Display Overview:



1. **Function Enabled Indicator:** Indicates if Percent-of-Time functionality is enabled.
   Off = Function OFF / Disabled.
   On = Function ON / Enabled.
2. **Percent of Time (Function ON only):** Percent of time cycle to enable pump stroking (0-100).
3. **Cycle Duration (Function ON only):** Total cycle time in minutes (1-1440).
4. **Selection Box:** Indicates the currently selected item.

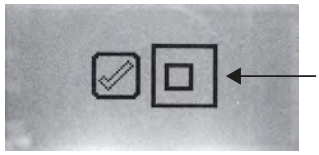
For example, if % = 20 and ◔ = 10, then the pump will cycle continuously as follows: run for 2 minutes, stop for 8 minutes. When this feature is enabled, the % icon is displayed in the Icon/Alarm area of the display (*see Sec. 4.5*).

SECTION 6 - ADVANCED CONFIGURATION MENU

6.11 LOAD FACTORY DEFAULTS

This feature will return the pump parameters to their factory default settings. Push the ⏻ POWER button to highlight the confirmation box. Push the ▲ UP or ▼ DOWN button to check or uncheck the box. Push the ⏻ POWER button to load factory defaults and return pump to default state (*see Sec. 4.0*). Use the ▭ MODE button to return to the advanced configuration menu without saving changes.

Display Overview:

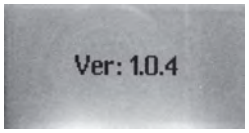


1. **Confirmation Box:** Check this box to confirm operation

6.12 VIEW PUMP INFORMATION

This feature displays the pump firmware version. Use the ▭ MODE button to return to the advanced configuration menu.

Display Overview:



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www.lmipumps.com

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an Accudyne Industries brand

Chapter 14 Submersible Water Pump (Division 43)

MANUFACTURER/DISTRIBUTOR:

Atlantis Pompe St-Foy
Éric Forbes
1844 Boul. Hamel Ouest
Québec, QC, G1N 3Z2
Phone: (418) 681-7301
eforbes@atlantispompe.com

14.1 Franklin Electric Submersible Water Pump 6” 5HP 575V (WTP)

Franklin Electric
Pump End
#94810003
5HP, 100GPM, 6"

J-CLASS SandHandler

6" High Capacity Pumps

Ideal for farm, home, irrigation, industry, municipal and commercial applications, equipped with the power, performance and reliability you expect from Franklin Electric.

Flow ratings of 50, 75, 100 and 125 gpm with TDH up to 1200 ft.

Horsepower ranges from 1-1/2 to 40 hp.

Features:

- Heavy-duty stainless steel discharge head and motor bracket
- Stainless steel shaft, shell, intake screen and cable guard provides corrosion resistance and longer pump life
- Glass-filled Noryl®* impeller stage assemblies provide exceptional strength and durability
- Ceramic shaft sleeve and rubber discharge bearing minimize bearing wear and shaft misalignment
- 3" NPT tapping in heavy-duty stainless steel discharge head
- Modular motor bracket enabling 4" or 6" motor mount for 5-10 horsepower units
- One-year unconditional warranty against failure from sand locking in abrasive well conditions

* Noryl® is a registered trademark of G.E.

System Solutions

Franklin Electric
The Company You Trust Deep Down

Franklin Electric
Pump End
#94810003
5HP, 100GPM, 6"

Ordering Information

6" Pump Ends:

1.5 - 25 HP 6" PUMP ENDS							
GPM	HP	STAGES	MOTOR FIT	ORDERING INFO.		DIMENSIONS	WT.
				MODEL NO.	ORDER NO.	PEA	
50	1.5	3	4"	50JS15S6-PE	94815003	13.51	30
	2	4	4"	50JS2S6-PE	94815004	15.13	31
	3	5	4"	50JS3S6-PE	94815005	16.76	32
	5	8	4" & 6"	50JS5S6-PE	94815008	21.63	36
	7.5	11	4" & 6"	50JS75S6-PE	94815011	26.51	40
	10	15	4" & 6"	50JS10S6-PE	94815015	32.94	46
75	3	3	4"	75JS3S6-PE	94817503	13.51	30
	5	5	4" & 6"	75JS5S6-PE	94817505	16.76	32
	7.5	7	4" & 6"	75JS75S6-PE	94817507	20.01	35
	10	9	4" & 6"	75JS10S6-PE	94817509	23.26	38
	15	13	6"	75JS15S6-PE	94817513	29.76	43
	20	17	6"	75JS20S6-PE	94817517	36.19	48
	25	23	6"	75JS25S6-PE	94817523	46.00	54
100	5	3	4" & 6"	100JS5S6-PE	94810003	14.62	30
	7.5	5	4" & 6"	100JS7S6-PE	94810005	18.51	32
	10	6	4" & 6"	100JS10S6-PE	94810006	20.49	34
	15	9	6"	100JS15S6-PE	94810009	26.31	38
	20	13	6"	100JS20S6-PE	94810013	34.07	43
	25	16	6"	100JS25S6-PE	94810016	39.94	47
125	5	2	4" & 6"	125JS5S6-PE	94812502	12.94	29
	7.5	3	4" & 6"	125JS7S6-PE	94812503	15.05	30
	10	4	4" & 6"	125JS10S6-PE	94812504	17.13	31
	15	7	6"	125JS15S6-PE	94812507	23.37	35
	20	9	6"	125JS20S6-PE	94812509	27.54	38
	25	11	6"	125JS25S6-PE	94812511	31.70	40
	30	13	6"	125JS30S6-PE	94812513	35.87	43
	40	18	6"	125JS40S6-PE	94812518	46.27	48

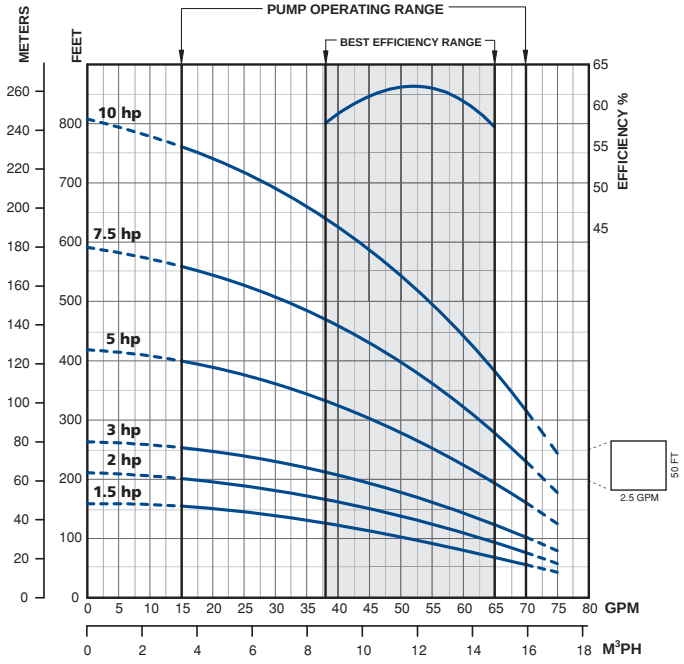
Note: All dimensions are in inches. Discharge is 3" NPT. Maximum diameter across cable guard is 5.5" on all models. Weight in pounds.

6" High Capacity P

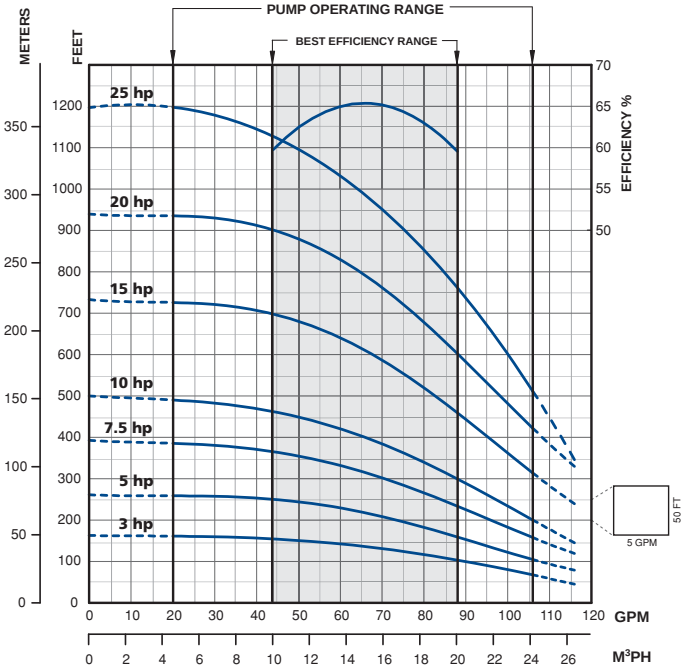
Franklin Electric
Pump End
#94810003
5HP, 100GPM, 6"

Perfomance Curves:

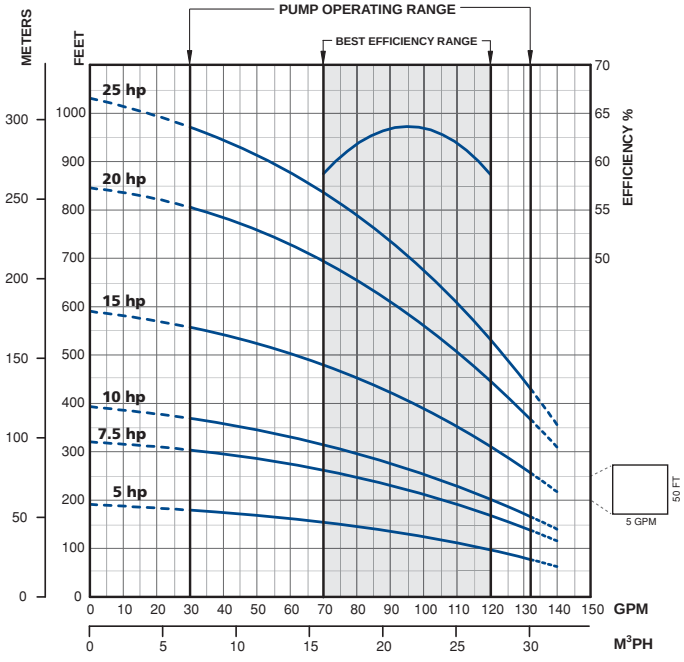
50 gpm:



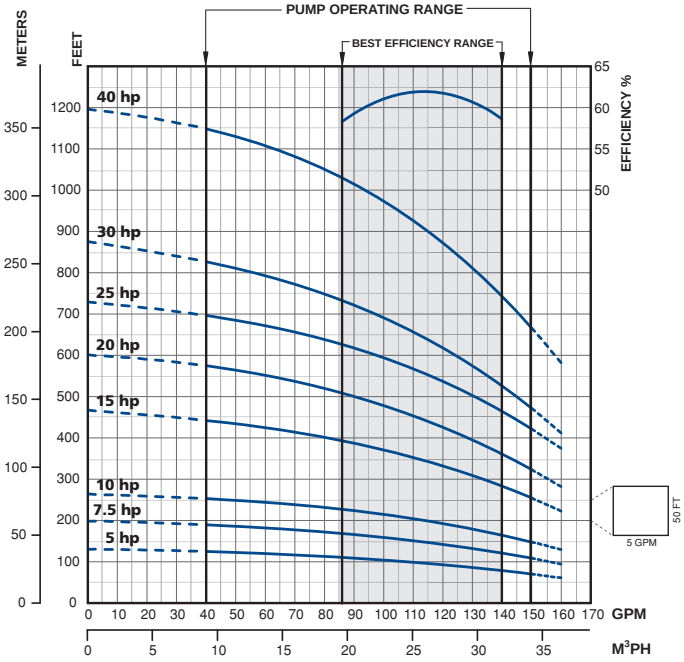
75 gpm:



100 gpm:



125 gpm:



Franklin Electric
The Company You Trust Deep Down

Franklin Electric
Pump End
#2366209020
5HP, 575V

6" SUBMERSIBLE MOTORS

These motors are built for dependable operation in 6" diameter or larger water wells.

BASIC FEATURES

- Double flanged NEMA mounting design
- Stainless steel splined shaft
- StatorShield™, Franklin's six-feature encapsulation system
- High-capacity, Kingsbury-type, water-lubricated thrust bearing
- Factory-filled with Franklin's non-toxic water soluble fill solution
- Field replaceable lead using Franklin's exclusive Water-Bloc™ technology
- Full 3,450 rpm 60 Hz design point
- External sand slinger on shaft
- Mechanical face seal at shaft exit
- Copper bar rotor
- All models variable frequency drive (VFD) compatible
- Single-phase models must be used with a Franklin Electric control box

SPECIAL FEATURES

- Sand Fighter™ and 316 stainless steel models are equipped with Franklin's exclusive Sand Fighter™ sealing system for sand or other abrasives, as well as Franklin's exclusive on-winding SubTrol™ heat sensor for use with SubMonitor™
- Consult factory for other voltage, hertz, and horsepower ratings not listed in this catalog
- Specifications are subject to change without notice; contact Franklin Electric if current materials are required for bid specifications
- Overmolded motor leads on all 10 GA leads

Franklin Electric
Pump End
#2366209020
5HP, 575V

6" SUBMERSIBLE MOTORS - SPECIFICATIONS AND MATERIALS

MOTOR SPECIFICATIONS

Hz	Model	Phase	HP Range	kW Range	Poles	RPM	Max. Ambient Temp.	Duty Rating
50	Standard*	1	5 - 15	3.7 - 11	2	2875	86 °F / 30 °C	Continuous*
50		3	5 - 40	3.7 - 45			86 °F / 30 °C	
50		3	50 - 60	37 - 45			122 °F / 50 °C	
50	High-Temp 90°C**	3	5 - 40	3.7 - 30			195 °F / 90 °C	
60		1	5 - 15	3.7 - 11		3450	86 °F / 30 °C	
60	Standard*	3	5 - 40	3.7 - 30			86 °F / 30 °C	
60		3	50 - 60	37 - 45			122 °F / 50 °C	
60	High-Temp 90°C**	3	5 - 40	3.7 - 30			195 °F / 90 °C	

At 0.5 ft/sec flow past motor; motors are rated for continuous duty up to 86°F (30 °C) water temperature

**At 0.5 ft/sec flow past motor, motors are rated for continuous duty up to 195°F (90 °C) water temperature and up to 86 °F (30 °C) water temperature with NO FLOW in lakes or in wells 12 inches or larger in diameter.*

CONSTRUCTION MATERIALS

Component	Construction Type				
	Standard Water Well	Sand Fighter™	Corrosion Resistant (316 SS)	Hi-Temp 90°C (300 SS Shell)	Hi-Temp 90°C (316 SS)
UL Insulation Class Rating	Class F	Per standard water well	Per standard water well	Class F	Class F
Motor Ambient Temp. Rating	86 °F / 30 °C (5-40 hp) 122 °F / 50 °C (50-60 hp)			194 °F / 90 °C (5-40 hp)	194 °F / 90 °C (5-40 hp)
Stator Resin Type	Standard (5-40 hp) / Hi-Temp (50-60 hp)			FE Hi-Temp	FE Hi-Temp
Motor Fill Solution (Water Soluble/Non-Toxic)	FES91			FES92	FES92
Top End Bell & Thrust Housing	Epoxy-coated gray iron		316 SS	Epoxy-coated gray iron	316 SS
On Winding SubTrol™ heat sensor	No (5-40 hp) / Yes (50-60 hp)	Yes	Yes	Not Available	Not Available
Stator Shell	300 series SS	Per standard water well	316 SS	300 series SS	316 SS
Stator Ends	Carbon steel			Carbon steel	316 SS
Shaft Extension	300 Series SS (5-30 hp) / 17-4 SS (40-60 hp)		17-4 SS	300 SS (5-20 hp), 17-4 SS (25-40 hp)	17-4 SS
Bushing	Bronze		316 SS	Bronze	316 SS
Bushing Retainer	300 series SS			300 series SS	316 SS
Shaft Mechanical Seal	Carbon ceramic (5-40 hp) Sand Fighter™ Seal System (50-60 hp)	Sand Fighter™ Seal System	Sand Fighter™ Seal System	Sand Fighter™ Seal System	Sand Fighter™ Seal System
Mechanical Seal / Rubber Components	Nitrile (5-40 hp) / FKM (50-60 hp)	Per standard water well	Per standard water well	FKM	FKM
Diaphragm Material	Nitrile (5-40 hp) / FKM (50-60 hp)			FKM	FKM
Diaphragm Plate	300 series SS		316 SS	300 series SS	316 SS
Diaphragm Spring	300 series SS		25-6 MO SS	300 series SS	25-6 MO SS
Shaft Slinger	Nitrile (5-40 hp) / FKM (50-60 hp)		Nitrile	FKM	FKM
Lead Wire	Overmolded		Per standard water well	XLPO	XLPO
Lead Potting	Epoxy			Epoxy	Epoxy
Lead Jam Nut	Brass		316 SS	Brass	316 SS
Thrust Bearing Rating (86 °F / 30 °C)	3500 lbs (5-30 hp) 6000 lbs (40-60 hp)		Per standard water well	Standard 5-20 hp • 4,500 lbs Standard 25-40 hp • 7,500 lbs	Standard 5-20 hp • 4,500 lbs Standard 25-40 hp • 7,500 lbs
Method Of Connecting System Ground To Motor	Ground wire in power lead connector			Ground wire in power lead connector	Ground wire in power lead connector

NOTE: Specifications subject to change without notice; contact Franklin Electric if current material types are required for bid specifications

Franklin Electric
Pump End
#2366209020
5HP, 575V

6" SUBMERSIBLE MOTORS - ORDERING INFORMATION

SINGLE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	In Stock	Thrust Rating	Wt. (lbs)
	Water Well	230	60	1.15	DOL (3)	2261109020	Yes	3500	110
5	Sand Fighter™	230	60	1.15	DOL (3)	2261108020	Yes	3500	110
	316 SS	230	60	1.15	DOL (3)	2261103920	-	3500	110
7.5	Water Well	230	60	1.15	DOL (3)	2261119020	Yes	3500	123
	Sand Fighter™	230	60	1.15	DOL (3)	2261118020	Yes	3500	123
	316 SS	230	60	1.15	DOL (3)	2261113920	-	3500	123
10	Water Well	230	60	1.15	DOL (3)	2261129020	Yes	3500	141
	Sand Fighter™	230	60	1.15	DOL (3)	2261128020	Yes	3500	141
	316 SS	230	60	1.15	DOL (3)	2261123920	-	3500	141
15	Water Well	230	60	1.15	DOL (3)	2261139020	Yes	3500	154
	Sand Fighter™	230	60	1.15	DOL (3)	2261138020	Yes	3500	154
	316 SS	230	60	1.15	DOL (3)	2261133920	-	3500	154

THREE-PHASE MODELS

HP	Description	Volts	Hz	S.F.	Motor Lead	Model No.	In Stock	Thrust Rating	Wt. (lbs)
	Water Well	200	60	1.15	DOL (3)	2366509020	Yes	3500	101
		220	50	1.0	DOL (3)	2366809020	-	3500	101
		230	60	1.15	DOL (3)	2366009020	Yes	3500	101
		230	60	1.15	Y-Δ (6)	2367209020	-	3500	106
		380	60	1.15	DOL (3)	2366609020	-	3500	101
		380	60	1.15	Y-Δ (6)	2367809020	-	3500	106
		415	50	1.0	DOL (3)	2366909020	-	3500	101
		460/380	60/50	1.15/1.0	DOL (3)	2366109020	Yes	3500	101
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367109020	-	3500	106
		575	60	1.15	DOL (3)	2366209020	-	3500	101
5	Sand Fighter™	200	60	1.15	DOL (3)	2366508120	Yes	3500	101
		220	50	1.0	DOL (3)	2366808120	-	3500	101
		230	60	1.15	DOL (3)	2366008120	Yes	3500	101
		380	60	1.15	DOL (3)	2366608120	-	3500	101
		460/380	60/50	1.15/1.0	DOL (3)	2366108120	Yes	3500	101
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367108120	-	3500	106
		575	60	1.15	DOL (3)	2366208120	Yes	3500	101
	316 SS w/SubTrol™	200	60	1.15	DOL (3)	2366504020	-	3500	101
		230	60	1.15	DOL (3)	2366004020	Yes	3500	101
		380	60	1.15	DOL (3)	2366604020	-	3500	101
		460/380	60/50	1.15/1.0	DOL (3)	2366104020	Yes	3500	101
		460/380	60/50	1.15/1.0	Y-Δ (6)	2367104020	-	3500	106
		575	60	1.15	DOL (3)	2366204020	-	3500	101
	Hi-Temp 90°C	200	60	1.15	DOL (3)	2766500003	-	4500	116
		230	60	1.15	DOL (3)	2766000003	-	4500	116
		380	60	1.15	DOL (3)	2766600003	-	4500	116
		460/380	60/50	1.15/1.0	DOL (3)	2766100003	-	4500	116
		460/380	60/50	1.15/1.0	Y-Δ (6)	2767100003	-	4500	121
		575	60	1.15	DOL (3)	2766200003	-	4500	116
	Hi-Temp 90°C - 316 SS	200	60	1.15	DOL (3)	2766503003	-	4500	116
		230	60	1.15	DOL (3)	2766003003	-	4500	116
		380	60	1.15	DOL (3)	2766603003	-	4500	116
		460/380	60/50	1.15/1.0	DOL (3)	2766103003	-	4500	116
		575	60	1.15	DOL (3)	2766203003	-	4500	116

2015 EDITION

AIM MANUAL

SUBMERSIBLE MOTORS

APPLICATION | INSTALLATION | MAINTENANCE

60 Hz, Single-Phase and Three-Phase Motors

franklinwater.com

Franklin Electric

COMMITMENT **TO QUALITY**

FRANKLIN ELECTRIC GLOBAL HEADQUARTERS &
ENGINEERING DEVELOPMENT CENTER, FORT WAYNE, INDIANA

Franklin Electric is committed to provide customers with defect free products through our program of continuous improvement. Quality shall, in every case, take precedence over quantity.

ATTENTION!
IMPORTANT INFORMATION FOR INSTALLERS OF THIS EQUIPMENT!

THIS EQUIPMENT IS INTENDED FOR INSTALLATION BY TECHNICALLY QUALIFIED PERSONNEL. FAILURE TO INSTALL IT IN COMPLIANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES, AND WITHIN FRANKLIN ELECTRIC RECOMMENDATIONS, MAY RESULT IN ELECTRICAL SHOCK OR FIRE HAZARD, UNSATISFACTORY PERFORMANCE, AND EQUIPMENT FAILURE. FRANKLIN INSTALLATION INFORMATION IS AVAILABLE FROM PUMP MANUFACTURERS AND DISTRIBUTORS, AND DIRECTLY FROM FRANKLIN ELECTRIC. CALL FRANKLIN TOLL FREE 800-348-2420 FOR INFORMATION.

WARNING

SERIOUS OR FATAL ELECTRICAL SHOCK MAY RESULT FROM FAILURE TO CONNECT THE MOTOR, CONTROL ENCLOSURES, METAL PLUMBING, AND ALL OTHER METAL NEAR THE MOTOR OR CABLE, TO THE POWER SUPPLY GROUND TERMINAL USING WIRE NO SMALLER THAN MOTOR CABLE WIRES. TO REDUCE RISK OF ELECTRICAL SHOCK, DISCONNECT POWER BEFORE WORKING ON OR AROUND THE WATER SYSTEM. DO NOT USE MOTOR IN SWIMMING AREAS.

ATTENTION!
INFORMATIONS IMPORTANTES POUR L'INSTALLATEUR DE CET EQUIPEMENT.

CET EQUIPEMENT DOIT ETRE INTALLE PAR UN TECHNICIEN QUALIFIE. SI L'INSTALLATION N'EST PAS CONFORME AUX LOIS NATIONALES OU LOCALES AINSI QU'AUX RECOMMANDATIONS DE FRANKLIN ELECTRIC, UN CHOC ELECTRIQUE, LE FEU, UNE PERFORMANCE NON ACCEPTABLE, VOIRE MEME LE NON-FONCTIONNEMENT PEUVENT SURVENIR. UN GUIDE D'INSTALLATION DE FRANKLIN ELECTRIC EST DISPONIBLE CHEZ LES MANUFACTURIERS DE POMPES, LES DISTRIBUTEURS, OU DIRECTEMENT CHEZ FRANKLIN. POUR DE PLUS AMPLES RENSEIGNEMENTS, APPELEZ SANS FRAIS LE 800-348-2420.

AVERTISEMENT

UN CHOC ELECTRIQUE SERIEUX OU MEME MORTEL EST POSSIBLE, SI L'ON NEGLIGE DE CONNECTER LE MOTEUR, LA PLOMBERIE METALLIQUE, BOITES DE CONTROLE ET TOUT METAL PROCHE DU MOTEUR A UN CABLE ALLANT VERS UNE ALIMENTATION D'ENERGIE AVEC BORNE DE MISE A LA TERRE UTILISANT AU MOINS LE MEME CALIBRE QUE LES FILS DU MOTEUR. POUR REDUIRE LE RISQUE DE CHOC ELECTRIQUE. COUPER LE COURANT AVANT DE TRAVAILLER PRES OU SUR LE SYSTEM D'EAU. NE PAS UTILISER CE MOTEUR DANS UNE ZONE DE BAIGNADE.

ATENCION!
INFORMACION PARA EL INSTALADOR DE ESTE EQUIPO.

PARA LA INSTALACION DE ESTE EQUIPO, SE REQUIERE DE PERSONAL TECNICO CALIFICADO. EL NO CUMPLIR CON LAS NORMAS ELECTRICAS NACIONALES Y LOCALES, ASI COMO CON LAS RECOMENDACIONES DE FRANKLIN ELECTRIC DURANTE SU INSTALACION, PUEDE OCASIONAR, UN CHOQUE ELECTRICO, PELIGRO DE UN INCENDIO, OPERACION DEFECTUOSA E INCLUSO LA DESCOMPOSTURA DEL EQUIPO. LOS MANUALES DE INSTALACION Y PUESTA EN MARCHA DE LOS EQUIPOS, ESTAN DISPONIBLES CON LOS DISTRIBUIDORES, FABRICANTES DE BOMBAS O DIRECTAMENTE CON FRANKLIN ELECTRIC. PUEDE LLAMAR GRATUITAMENTE PARA MAYOR INFORMACION AL TELEFONO 800-348-2420.

ADVERTENCIA

PUEDE OCURRIR UN CHOQUE ELECTRICO, SERIO O FATAL DEBIDO A UNA ERRONEA CONECCION DEL MOTOR, DE LOS TABLEROS ELECTRICOS, DE LA TUBERIA, DE CUALQUIER OTRA PARTE METALICA QUE ESTA CERCA DEL MOTOR O POR NO UTILIZAR UN CABLE PARA TIERRA DE CALIBRE IGUAL O MAYOR AL DE LA ALIMENTACION. PARA REDUCIR EL RIESGO DE CHOQUE ELECTRIC, DESCONECTAR LA ALIMENTACION ELECTRICA ANTES DE INICIAR A TRABAJAR EN EL SISTEMA HIDRAULICO. NO UTILIZAR ESTE MOTOR EN ALBERCAS O AREAS EN DONDE SE PRACTIQUE NATACION.

60 Hz, Single-Phase and Three-Phase

SUBMERSIBLE MOTOR

Application • Installation • Maintenance Manual

The submersible motor is a reliable, efficient and trouble-free means of powering a pump. Its needs for a long operational life are simple. They are:

1. A suitable operating environment
2. An adequate supply of electricity
3. An adequate flow of cooling water over the motor
4. An appropriate pump load

All considerations of application, installation, and maintenance of submersible motors relating to these four areas are presented in this manual. Franklin Electric's web page, www.franklin-electric.com, should be checked for the latest updates.

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Storage

Franklin Electric submersible motors are a water-lubricated design. The fill solution consists of a mixture of deionized water and Propylene Glycol (a non-toxic antifreeze). The solution will prevent damage from freezing in temperatures to -40 °F (-40 °C); motors should be stored in areas that do not go below this temperature. The solution will partially freeze below 27 °F (-3 °C), but no damage occurs. Repeated freezing and thawing should be avoided to prevent possible loss of fill solution.

There may be an interchange of fill solution with well water during operation. Care must be taken with motors removed from wells during freezing conditions to prevent damage.

When the storage temperature does not exceed 100 °F (37 °C), storage time should be limited to two years. Where temperatures reach 100° to 130 °F, storage time should be limited to one year.

Loss of a few drops of liquid will not damage the motor as an excess amount is provided, and the filter check valve will allow lost liquid to be replaced by filtered well water upon installation. If there is reason to believe there has been a considerable amount of leakage, consult the factory for checking procedures.

Frequency of Starts

The average number of starts per day over a period of months or years influences the life of a submersible pumping system. Excessive cycling affects the life of control components such as pressure switches, starters, relays, and capacitors. Rapid cycling can also cause motor spline damage, bearing damage, and motor overheating. All these conditions can lead to reduced motor life.

The pump size, tank size, and other controls should be selected to keep the starts per day as low as practical for longest life. The maximum number of starts per 24-hour period is shown in Table 3.

Motors should run a minimum of one minute to dissipate heat build up from starting current. Six inch and larger motors should have a minimum of 15 minutes between starts or starting attempts.

Table 3 Number of Starts

MOTOR RATING		MAXIMUM STARTS PER 24 HR PERIOD	
HP	KW	SINGLE-PHASE	THREE-PHASE
Up to 0.75	Up to 0.55	300	300
1 thru 5.5	0.75 thru 4	100	300
7.5 thru 30	5.5 thru 22	50	100*
40 and over	30 and over	-	100

* Keeping starts per day within the recommended numbers provides the best system life. However, when used with a properly configured Reduced Voltage Starter (RVS) or Variable Frequency Drive (VFD), 7.5 thru 30 hp three-phase motors can be started up to 200 times per 24 hour period.

Mounting Position

Franklin submersible motors are designed primarily for operation in the vertical, shaft-up position.

During acceleration, the pump thrust increases as its output head increases. In cases where the pump head stays below its normal operating range during startup and full speed condition, the pump may create upward thrust. This creates upward thrust on the motor upthrust bearing. This is an acceptable operation for short periods at each start, but running continuously with upthrust will cause excessive wear on the upthrust bearing.

With certain additional restrictions as listed in this section and the Inline Booster Pump Systems sections of this manual, motors are also suitable for operation in positions from shaft-up to shaft-horizontal. As the mounting position becomes further from vertical and closer to horizontal, the probability of shortened thrust bearing life increases. For normal motor life expectancy with motor positions other than shaft-up, follow these recommendations:

1. Minimize the frequency of starts, preferably to fewer than per 24-hour period. Six and eight inch motors should have a minimum of 20 minutes between starts or starting attempts
2. Do not use in systems which can run even for short periods at full speed without thrust toward the motor.

Transformer Capacity - Single-Phase or Three-Phase

Distribution transformers must be adequately sized to satisfy the kVA requirements of the submersible motor. When transformers are too small to supply the load, there is a reduction in voltage to the motor.

Table 4 references the motor horsepower rating, single-phase and three-phase, total effective kVA required, and the smallest transformer required for open or closed three-phase systems. Open systems require larger transformers since only two transformers are used.

Other loads would add directly to the kVA sizing requirements of the transformer bank.

Table 4 Transformer Capacity

MOTOR RATING		TOTAL EFFECTIVE KVA REQUIRED	SMALLEST KVA RATING-EACH TRANSFORMER	
HP	KW		OPEN WYE OR DELTA 2- TRANSFORMERS	CLOSED WYE OR DELTA 3- TRANSFORMERS
1.5	1.1	3	2	1
2	1.5	4	2	1.5
3	2.2	5	3	2
5	3.7	7.5	5	3
7.5	5.5	10	7.5	5
10	7.5	15	10	5
15	11	20	15	7.5
20	15	25	15	10
25	18.5	30	20	10
30	22	40	25	15
40	30	50	30	20
50	37	60	35	20
60	45	75	40	25
75	55	90	50	30
100	75	120	65	40
125	93	150	85	50
150	110	175	100	60
175	130	200	115	70
200	150	230	130	75

NOTE: Standard kVA ratings are shown. If power company experience and practice allows transformer loading higher than standard, higher loading values may be used to meet total effective kVA required, provided correct voltage and balance is maintained.

Effects of Torque

During starting of a submersible pump, the torque developed by the motor must be supported through the pump, delivery pipe or other supports. Most pumps rotate in the direction which causes unscrewing torque on right-handed threaded pipe or pump stages. All threaded joints, pumps and other parts of the pump support system must be capable of withstanding the maximum torque repeatedly without loosening or breaking. Unscrewing joints will break electrical cable and may cause loss of the pump-motor unit.

To safely withstand maximum unscrewing torques with a minimum safety factor of 1.5, tightening all threaded joints to at least 10 lb-ft per motor horsepower is recommended (Table 4A). It may be necessary to tack or strap weld pipe joints on high horsepower pumps, especially at shallower settings.

Table 4A Torque Required (Examples)

MOTOR RATING		MINIMUM SAFE TORQUE-LOAD
HP	KW	
1 hp & Less	0.75 kW & Less	10 lb-ft
20 hp	15 kW	200 lb-ft
75 hp	55 kW	750 lb-ft
200 hp	150 kW	2000 lb-ft

Use of Engine Driven Generators – Single-Phase or Three-Phase

Table 5 lists minimum generator sizes based on typical 80 °C rise continuous duty generators, with 35% maximum voltage dip during starting, for Franklin's three-wire motors, single- or three-phase.

This is a general chart. The generator manufacturer should be consulted whenever possible, especially on larger sizes.

There are two types of generators available: externally and internally regulated. Most are externally regulated. They use an external voltage regulator that senses the output voltage. As the voltage dips at motor start-up, the regulator increases the output voltage of the generator.

Internally regulated (self-excited) generators have an extra winding in the generator stator. The extra winding senses the output current to automatically adjust the output voltage.

Generators must be sized to deliver at least 65% of the rated voltage during starting to ensure adequate starting torque. Besides sizing, generator frequency is important as the motor speed varies with the frequency (Hz). Due to pump affinity laws, a pump running at 1 to 2 Hz below motor nameplate frequency design will not meet its performance curve. Conversely, a pump running at 1 to 2 Hz above may trip overloads.

Generator Operation

Always start the generator before the motor is started and always stop the motor before the generator is shut down. The motor thrust bearing may be damaged if the generator is allowed to coast down with the motor running. This same condition occurs when the generator is allowed to run out of fuel.

Follow generator manufacturer's recommendations for de-rating at higher elevations or using natural gas.

Table 5 Engine Driven Generators

NOTE: This chart applies to 3-wire or 3-phase motors. For best starting of 2-wire motors, the minimum generator rating is 50% higher than shown.

MOTOR RATING		MINIMUM RATING OF GENERATOR			
		EXTERNALLY REGULATED		INTERNALLY REGULATED	
HP	KW	KW	KVA	KW	KVA
1/3	0.25	1.5	1.9	1.2	1.5
1/2	0.37	2	2.5	1.5	1.9
3/4	0.55	3	3.8	2	2.5
1	0.75	4	5.0	2.5	3.13
1.5	1.1	5	6.25	3	3.8
2	1.5	7.5	9.4	4	5
3	2.2	10	12.5	5	6.25
5	3.7	15	18.75	7.5	9.4
7.5	5.5	20	25.0	10	12.5
10	7.5	30	37.5	15	18.75
15	11	40	50	20	25
20	15	60	75	25	31
25	18.5	75	94	30	37.50
30	22	100	125	40	50
40	30	100	125	50	62.5
50	37	150	188	60	75
60	45	175	220	75	94
75	55	250	313	100	125
100	75	300	375	150	188
125	93	375	469	175	219
150	110	450	563	200	250
175	130	525	656	250	313
200	150	600	750	275	344

WARNING: To prevent accidental electrocution, automatic or manual transfer switches must be used any time a generator is used as standby or back up on power lines. Contact power company for use and approval.

Use of Check Valves

It is recommended that one or more check valves always be used in submersible pump installations. If the pump does not have a built-in check valve, a line check valve should be installed in the discharge line within 25 feet of the pump and below the draw down level of the water supply. For deeper settings, check valves should be installed per the manufacturer's recommendations. More than one check valve may be required, but more than the recommended number of check valves should not be used.

Swing type check valves are **not** acceptable and should never be used with submersible motors/pumps. Swing type check valves have a slower reaction time which can cause water hammer (see next page). Internal pump check valves or spring loaded check valves close quickly and help eliminate water hammer.

Check valves are used to hold pressure in the system when the pump stops. They also prevent backspin, water hammer and upthrust. Any of these can lead to early pump or motor failure.

NOTE: Only positive sealing check valves should be used in submersible installations. Although drilling the check valves or using drain-back check valves may prevent back spinning, they create upthrust and water hammer problems.

A. **Backspin –** With no check valve or a failed check valve, the water in the drop pipe and the water in the system can flow down the discharge pipe when the motor stops. This can cause the pump to rotate in a reverse direction. If the motor is started while it is backspinning, an excessive force is placed across the pump-motor assembly that can cause impeller damage, motor or pump shaft breakage, excessive bearing wear, etc.

B. **Upthrust –** With no check valve, a leaking check valve, or drilled check valve, the unit starts under a zero head condition. This causes an uplifting or upthrust on the impeller-shaft assembly in the pump. This upward movement carries across the pump-motor coupling and creates an upthrust condition in the motor. Repeated upthrust can cause premature failure of both the pump and the motor.

C. **Water Hammer –** If the lowest check valve is more than 30 feet above the standing (lowest static) water level, or a lower check valve leaks and the check valve above holds, a vacuum is created in the discharge piping. On the next pump start, water moving at very high velocity fills the void and strikes the closed check valve and the stationary water in the pipe above it, causing a hydraulic shock. This shock can split pipes, break joints and damage the pump and/or motor. Water hammer can often be heard or felt. When discovered, the system should be shut down and the pump installer contacted to correct the problem.

All Motors

APPLICATION

Wells – Large Diameter, Uncased, Top Feeding and Screened Sections

Franklin Electric submersible motors are designed to operate with a cooling flow of water over and around the full length of the motor.

If the pump installation does not provide the minimum flow shown in Table 6, a flow inducer sleeve (flow sleeve) must be used. The conditions requiring a flow sleeve are:

- Well diameter is too large to meet Table 6 flow requirements
- Pump is in an open body of water
- Pump is in a rock well or below the well casing
- The well is "top-feeding" (a.k.a. cascading)
- Pump is set in or below screens or perforations

Water Temperature and Flow

Franklin Electric's standard submersible motors, except Hi-Temp designs (see note below), are designed to operate up to maximum service factor horsepower in water up to 86 °F (30 °C). A flow of 0.25 ft/s for 4" motors rated 3 hp and higher, and 0.5 ft/s for 6" and 8" motors is required for proper cooling. Table 6 shows minimum flow rates, in gpm, for various well diameters and motor sizes.

If a standard motor is operated in water over 86 °F (30 °C), water flow past the motor must be increased to maintain safe motor operating temperatures. See HOT WATER APPLICATIONS on page 7.

NOTE: Franklin Electric offers a line of Hi-Temp motors designed to operate in water at higher temperatures or lower flow conditions. Consult factory for details.

Table 6 Required Cooling Flow

MINIMUM GPM REQUIRED FOR MOTOR COOLING IN WATER UP TO 86 °F (30 °C)			
CASING OR SLEEVE ID INCHES (MM)	4" MOTOR (3-10 HP) 0.25 FT/S GPM (L/M)	6" MOTOR 0.50 FT/S GPM (L/M)	8" MOTOR 0.50 FT/S GPM (L/M)
4 (102)	1.2 (4.5)	-	-
5 (127)	7 (26.5)	-	-
6 (152)	13 (49)	9 (34)	-
7 (178)	20 (76)	25 (95)	-
8 (203)	30 (114)	45 (170)	10 (40)
10 (254)	50 (189)	90 (340)	55 (210)
12 (305)	80 (303)	140 (530)	110 (420)
14 (356)	110 (416)	200 (760)	170 (645)
16 (406)	150 (568)	280 (1060)	245 (930)

0.25 ft/s = 7.62 cm/sec 0.50 ft/s = 15.24 cm/sec 1 inch = 2.54 cm

Flow Inducer Sleeve

If the flow rate is less than specified, then a flow inducer sleeve must be used. A flow sleeve is always required in an open body of water. FIG. 1 shows a typical flow inducer sleeve construction.

EXAMPLE: A 6" motor and pump that delivers 60 gpm will be installed in a 10" well.

From Table 6, 90 gpm would be required to maintain proper cooling. In this case adding an 8" or smaller flow sleeve provides the required cooling.

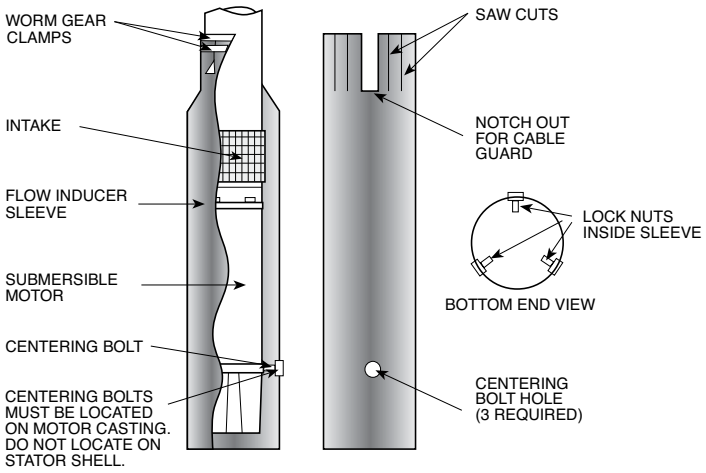

FIG. 1

Head Loss From Flow Past Motor

Table 7 lists the approximate head loss due to flow between an average length motor and smooth casing or flow inducer sleeve.

Table 7 Head Loss in Feet (Meters) at Various Flow Rates

MOTOR DIAMETER		4"	4"	4"	6"	6"	6"	8"	8"
CASING ID IN INCHES (MM)		4 (102)	5 (127)	6 (152)	6 (152)	7 (178)	8 (203)	8.1 (206)	10 (254)
Flow Rate in gpm (l/m)	25 (95)	0.3 (.09)							
	50 (189)	1.2 (.37)							
	100 (378)	4.7 (1.4)	0.3 (.09)		1.7 (.52)				
	150 (568)	10.2 (3.1)	0.6 (.18)	0.2 (.06)	3.7 (1.1)				
	200 (757)		1.1 (.34)	0.4 (.12)	6.3 (1.9)	0.5 (.15)		6.8 (2.1)	
	250 (946)		1.8 (.55)	0.7 (.21)	9.6 (2.9)	0.8 (.24)		10.4 (3.2)	
	300 (1136)		2.5 (.75)	1.0 (.30)	13.6 (4.1)	1.2 (.37)	0.2 (.06)	14.6 (4.5)	
	400 (1514)				23.7 (7.2)	2.0 (.61)	0.4 (.12)	24.6 (7.5)	
	500 (1893)					3.1 (.94)	0.7 (.21)	37.3 (11.4)	0.6 (0.2)
	600 (2271)					4.4 (1.3)	1.0 (.30)	52.2 (15.9)	0.8 (0.3)
	800 (3028)								1.5 (0.5)
	1000 (3785)								2.4 (0.7)

Hot Water Applications (Standard Motors)

Franklin Electric offers a line of Hi-Temp motors which are designed to operate in water with various temperatures up to 194 °F (90 °C) without increased flow. When a standard pump-motor operates in water hotter than 86 °F (30 °C), a flow rate of at least 3 ft/s is required. When selecting the motor to drive a pump in over 86 °F (30 °C) water, the motor horsepower must be de-rated per the following procedure.

1. Using Table 7A, determine pump gpm required for different well or sleeve diameters. If necessary, add a flow sleeve to obtain at least 3 ft/s flow rate.

Table 7A Minimum gpm (l/m) Required for 3 ft/s (.91 m/sec) Flow Rate

CASING OR SLEEVE ID		4" HIGH THRUST MOTOR		6" MOTOR		8" MOTOR	
INCHES	(MM)	GPM	(L/M)	GPM	(L/M)	GPM	(L/M)
4	(102)	15	(57)				
5	(127)	80	(303)				
6	(152)	160	(606)	52	(197)		
7	(178)			150	(568)		
8	(203)			260	(984)	60	(227)
10	(254)			520	(1970)	330	(1250)
12	(305)					650	(2460)
14	(356)					1020	(3860)
16	(406)					1460	(5530)

Continued on next page

2. Determine pump horsepower required from the pump manufacturer's curve.

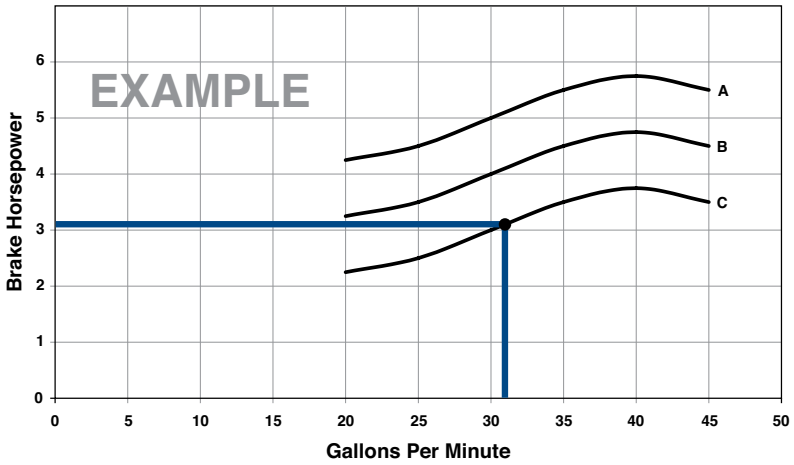

FIG. 2 MANUFACTURER'S PUMP CURVE

3. Multiply the pump horsepower required by the heat factor multiplier from Table 8.

Table 8 Heat Factor Multiplier at 3 ft/s (.91 m/sec) Flow Rate

MAXIMUM WATER TEMPERATURE	1/3 - 5 HP .25 - 3.7 KW	7 1/2 - 30 HP 5.5 - 22 KW	OVER 30 HP OVER 22 KW
140 °F (60 °C)	1.25	1.62	2.00
131 °F (55 °C)	1.11	1.32	1.62
122 °F (50 °C)	1.00	1.14	1.32
113 °F (45 °C)	1.00	1.00	1.14
104 °F (40 °C)	1.00	1.00	1.00
95 °F (35 °C)	1.00	1.00	1.00

4. Select a rated hp motor on Table 8A whose Service Factor Horsepower is at least the value calculated in Item 3.

Table 8A Service Factor Horsepower

HP	KW	SFHP	HP	KW	SFHP	HP	KW	SFHP	HP	KW	SFHP
1/3	0.25	0.58	3	2.2	3.45	25	18.5	28.75	100	75	115.00
1/2	0.37	0.80	5	3.7	5.75	30	22.0	34.50	125	93	143.75
3/4	0.55	1.12	7.5	5.5	8.62	40	30.0	46.00	150	110	172.50
1	0.75	1.40	10	7.5	11.50	50	37.0	57.50	175	130	201.25
1.5	1.10	1.95	15	11.0	17.25	60	45.0	69.00	200	150	230.00
2	1.50	2.50	20	15.0	23.00	75	55.0	86.25			

Hot Water Applications - Example

EXAMPLE: A 6" pump end requiring 39 hp input will pump 124 °F water in an 8" well at a delivery rate of 140 gpm. From Table 7A, a 6" flow sleeve will be required to increase the flow rate to at least 3 ft/s.

Using Table 8, the 1.62 heat factor multiplier is selected because the hp required is over 30 hp and water temperature is above 122 °F. Multiply 39 hp x 1.62 (multiplier), which equals 63.2 hp. This is the minimum rated service factor horsepower usable at 39 hp in 124 °F. Using Table 8A, select a motor with a rated service factor horsepower above 63.2 hp. A 60 hp motor has a service factor horsepower of 69, so a 60 hp motor may be used.

Drawdown Seals

Allowable motor temperature is based on atmospheric pressure or higher surrounding the motor. “Drawdown seals,” which seal the well to the pump above its intake to maximize delivery are not recommended, since the suction created can be lower than atmospheric pressure.

Grounding Control Boxes and Panels

The National Electrical Code requires that the control box or panel-grounding terminal always be connected to supply ground. If the circuit has no grounding conductor and no metal conduit from the box to supply panel, use a wire at least as large as line conductors and connect as required by the National Electrical Code, from the grounding terminal to the electrical supply ground.

WARNING: Failure to ground the control frame can result in a serious or fatal electrical shock hazard.

Grounding Surge Arrestors

An above ground surge arrestor must be grounded, metal to metal, all the way to the lowest draw down water strata for the surge arrestor to be effective. GROUNDING THE ARRESTOR TO THE SUPPLY GROUND OR TO A DRIVEN GROUND ROD PROVIDES LITTLE OR NO SURGE PROTECTION FOR THE MOTOR.

Control Box, Pumptec Products, and Panel Environment

Franklin Electric control boxes, Pumptec products and three-phase panels meet UL requirements for NEMA Type 3R enclosures. They are suitable for indoor and outdoor applications within temperatures of +14 °F (-10 °C) to 122 °F (50 °C). Operating control boxes below +14 °F can cause reduced starting torque and loss of overload protection when overloads are located in control boxes.

Control boxes, Pumptec products, and three-phase panels should never be mounted in direct sunlight or high temperature locations. This will cause shortened capacitor life (where applicable) and unnecessary tripping of overload protectors. A ventilated enclosure painted white to reflect heat is recommended for an outdoor, high temperature location.

A damp well pit, or other humid location, accelerates component failure from corrosion.

Control boxes with voltage relays are designed for vertical upright mounting only. Mounting in other positions will affect the operation of the relay.

Equipment Grounding

WARNING: Serious or fatal electrical shock may result from failure to connect the motor, control enclosures, metal plumbing, and all other metal near the motor or cable to the power supply ground terminal using wire no smaller than motor cable wires.

The primary purpose of grounding the metal drop pipe and/or metal well casing in an installation is safety. It is done to limit the voltage between nonelectrical (exposed metal) parts of the system and ground, thus minimizing dangerous shock hazards. Using wire at least the size of the motor cable wires provides adequate current-carrying capability for any ground fault that might occur. It also provides a low resistance path to ground, ensuring that the current to ground will be large enough to trip any overcurrent device designed to detect faults (such as a ground fault circuit interrupter, or GFCI).

Normally, the ground wire to the motor would provide the primary path back to the power supply ground for any ground fault. There are conditions, however, where the ground wire connection could become compromised. One such example would be the case where the water in the well is abnormally corrosive or aggressive. In this example, a grounded metal drop pipe or casing would then become the primary path to ground.

However, the many installations that now use plastic drop pipes and/or casings require further steps to be taken for safety purposes, so that the water column itself does not become the conductive path to ground.

When an installation has abnormally corrosive water AND the drop pipe or casing is plastic, Franklin Electric recommends the use of a GFCI with a 10 mA set-point. In this case, the motor ground wire should be routed through the current-sensing device along with the motor power leads. Wired this way, the GFCI will trip only when a ground fault has occurred AND the motor ground wire is no longer functional.

3-Wire Control Boxes

Single-phase three-wire submersible motors require the use of control boxes. Operation of motors without control boxes or with incorrect boxes can result in motor failure and voids warranty.

Control boxes contain starting capacitors, a starting relay, and, in some sizes, overload protectors, running capacitors, and contactors.

Ratings through 1 hp may use either a Franklin Electric solid state QD or a potential (voltage) type starting relay, while larger ratings use potential relays.

Potential (Voltage) Relays

Potential relays have normally closed contacts. When power is applied, both start and main motor windings are energized, and the motor starts. At this instant, the voltage across the start winding is relatively low and not enough to open the contacts of the relay.

As the motor accelerates, the increasing voltage across the start winding (and the relay coil) opens the relay contacts. This opens the starting circuit and the motor continues to run on the main winding alone, or the main plus run capacitor circuit. After the motor is started the relay contacts remain open.

CAUTION: The control box and motor are two pieces of one assembly. Be certain that the control box and motor hp and voltage match. Since a motor is designed to operate with a control box from the same manufacturer, we can promise warranty coverage only when a Franklin control box is used with a Franklin motor.

2-Wire Motor Solid State Controls

BIAC Switch Operation

When power is applied the bi-metal switch contacts are closed, so the triac is conducting and energizes the start winding. As rpm increases, the voltage in the sensor coil generates heat in the bi-metal strip, causing the bi-metal strip to bend and open the switch circuit. This removes the starting winding and the motor continues to run on the main winding alone.

Approximately 5 seconds after power is removed from the motor, the bi-metal strip cools sufficiently to return to its closed position and the motor is ready for the next start cycle. If, during operation, the motor speed drops, the lowered voltage in the sensor coil allows the bi-metal contacts to close, and bring the motor back to operating speed.

Rapid Cycling

The BIAC starting switch will reset within approximately 5 seconds after the motor is stopped. If an attempt is made to restart the motor before the starting switch has reset, the motor may not start; however, there will be current in the main winding until the overload protector interrupts the circuit. The time for the protector to reset is longer than the reset of the starting switch. Therefore, the start switch will have closed and the motor will operate.

A waterlogged tank will cause fast cycling. When a waterlogged condition does occur, the user will be alerted to the problem during the off time (overload reset time) since the pressure will drop drastically. When the waterlogged tank condition is detected, the condition should be corrected to prevent nuisance tripping of the overload protector.

Bound Pump (Sandlocked)

When the motor is not free to turn, as with a sandlocked pump, the BIAC switch creates a “reverse impact torque” in the motor in either direction. When the sand is dislodged, the motor will start and operate in the correct direction.

CAUTION: Restarting the motor within 5 seconds after power is removed may cause the motor overload to trip.

QD Relays (Solid State)

There are two elements in the relay: a reed switch and a triac. The reed switch consists of two tiny rectangular blade-type contacts, which bend under magnetic flux. It is hermetically sealed in glass and is located within a coil, which conducts line current. When power is supplied to the control box, the main winding current passing through the coil immediately closes the reed switch contacts. This turns on the triac, which supplies voltage to the start winding, thus starting the motor.

Once the motor is started, the operation of the QD relay is an interaction between the triac, the reed switch, and the motor windings. The solid state switch senses motor speed through the changing phase relationship between start winding current and line current. As the motor approaches running speed, the phase angle between the start current and the line current becomes nearly in phase. At this point, the reed switch contacts open, turning off the triac. This removes voltage from the start winding and the motor continues to run on the main winding only. With the reed switch contacts open and the triac turned off, the QD relay is ready for the next starting cycle.

Single-Phase Motors

APPLICATION

2- or 3-Wire Cable, 60 Hz (Service Entrance to Motor - Maximum Length In Feet)

Table 11

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE												
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000
115	1/2	.37	100	160	250	390	620	960	1190	1460	1780	2160	2630	3140	3770
230	1/2	.37	400	650	1020	1610	2510	3880	4810	5880	7170	8720			
	3/4	.55	300	480	760	1200	1870	2890	3580	4370	5330	6470	7870		
	1	.75	250	400	630	990	1540	2380	2960	3610	4410	5360	6520		
	1.5	1.1	190	310	480	770	1200	1870	2320	2850	3500	4280	5240		
	2	1.5	150	250	390	620	970	1530	1910	2360	2930	3620	4480		
	3	2.2	**120**	190	300	470	750	1190	1490	1850	2320	2890	3610		
	5	3.7	0	0	**180**	280	450	710	890	1110	1390	1740	2170	2680	
	7.5	5.5	0	0	0	**200**	310	490	610	750	930	1140	1410	1720	
	10	7.5	0	0	0	0	**250**	390	490	600	750	930	1160	1430	1760
	15	11	0	0	0	0	**170**	**270**	340	430	530	660	820	1020	1260

Table 11A

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE												
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000
115	1/2	.37	100	160	250	390	620	960	1190	1460	1780	2160	2630	3140	3770
230	1/2	.37	400	650	1020	1610	2510	3880	4810	5880	7170	8720			
	3/4	.55	300	480	760	1200	1870	2890	3580	4370	5330	6470	7870	9380	
	1	.75	250	400	630	990	1540	2380	2960	3610	4410	5360	6520	7780	9350
	1.5	1.1	190	310	480	770	1200	1870	2320	2850	3500	4280	5240	6300	7620
	2	1.5	150	250	390	620	970	1530	1910	2360	2930	3620	4480	5470	6700
	3	2.2	**120**	190	300	470	750	1190	1490	1850	2320	2890	3610	4470	5550
	5	3.7	0	**110**	180	280	450	710	890	1110	1390	1740	2170	2680	3330
	7.5	5.5	0	0	**120**	200	310	490	610	750	930	1140	1410	1720	2100
	10	7.5	0	0	0	**160**	250	390	490	600	750	930	1160	1430	1760
	15	11	0	0	0	0	**170**	270	340	430	530	660	820	1020	1260

1 Foot = .3048 Meter

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors 60 °C or 75 °C in free air or water, not in magnetic enclosures, conduit or direct buried.

Lengths NOT in bold meet the NEC ampacity requirements for either individual conductors or jacketed 60 °C or 75 °C cable and can be in conduit or direct buried. Flat molded and web/ribbon cable are considered jacketed cable.

If any other cable is used, the NEC and local codes should be observed.

Cable lengths in Tables 11 & 11A allow for a 5% voltage drop running at maximum nameplate amperes. If 3% voltage drop is desired, multiply Table 11 and 11A lengths by 0.6 to get maximum cable length.

The portion of the total cable length, which is between the supply and single-phase control box with a line contactor, should not exceed 25% of total maximum allowable to ensure reliable contactor operation. Single-phase control boxes without line contactors may be connected at any point in the total cable length.

Tables 11 & 11A are based on copper wire. If aluminum wire is used, it must be two sizes larger than copper wire and oxidation inhibitors must be used on connections.

EXAMPLE: If Tables 11 & 11A call for #12 copper wire, #10 aluminum wire would be required.

Contact Franklin Electric for 90 °C cable lengths.

See pages 15, 50, and 51 for applications using 230 V motors on 208 V power systems.

Single-Phase Motors

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Two or More Different Cable Sizes Can Be Used

Depending on the installation, any number of combinations of cable may be used.

For example, in a replacement/upgrade installation, the well already has 160 feet of buried #10 cable between the service entrance and the wellhead. A new 3 hp, 230-volt, single-phase motor is being installed to replace a smaller motor. The question is: Since there is already 160 feet of #10 AWG installed, what size cable is required in the well with a 3 hp, 230-volt, single-phase motor setting at 310 feet?

From Tables 11 & 11A, a 3 hp motor can use up to 300 feet of #10 AWG cable.

The application has 160 feet of #10 AWG copper wire installed.

Using the formula below, 160 feet (actual) ÷ 300 feet (max allowable) is equal to 0.533. This means 53.3% (0.533 x 100) of the allowable voltage drop or loss, which is allowed between the service entrance and the motor, occurs in this wire. This leaves us 46.7% (1.00 - 0.533 = 0.467) of some other wire size to use in the remaining 310 feet "down hole" wire run.

The table shows #8 AWG copper wire is good for 470 feet. Using the formula again, 310 feet (used) ÷ 470 feet (allowed) = 0.660; adding this to the 0.533 determined earlier; 0.533 + 0.660 = 1.193. This combination is greater than 1.00, so the voltage drop will not meet US National Electrical Code recommendations.

Tables 11 & 11A show #6 AWG copper wire is good for 750 feet. Using the formula, 310 ÷ 750 = 0.413, and using these numbers, 0.533 + 0.413 = 0.946, we find this is less than 1.00 and will meet the NEC recommended voltage drop.

This works for two, three or more combinations of wire and it does not matter which size wire comes first in the installation.

$$\text{Formula:} \quad \frac{\text{Actual Length}}{\text{Max Allowed}} + \frac{\text{Actual Length}}{\text{Max Allowed}} = 1.00$$

EXAMPLE: 3 hp, 230-Volt, Single-Phase Motor

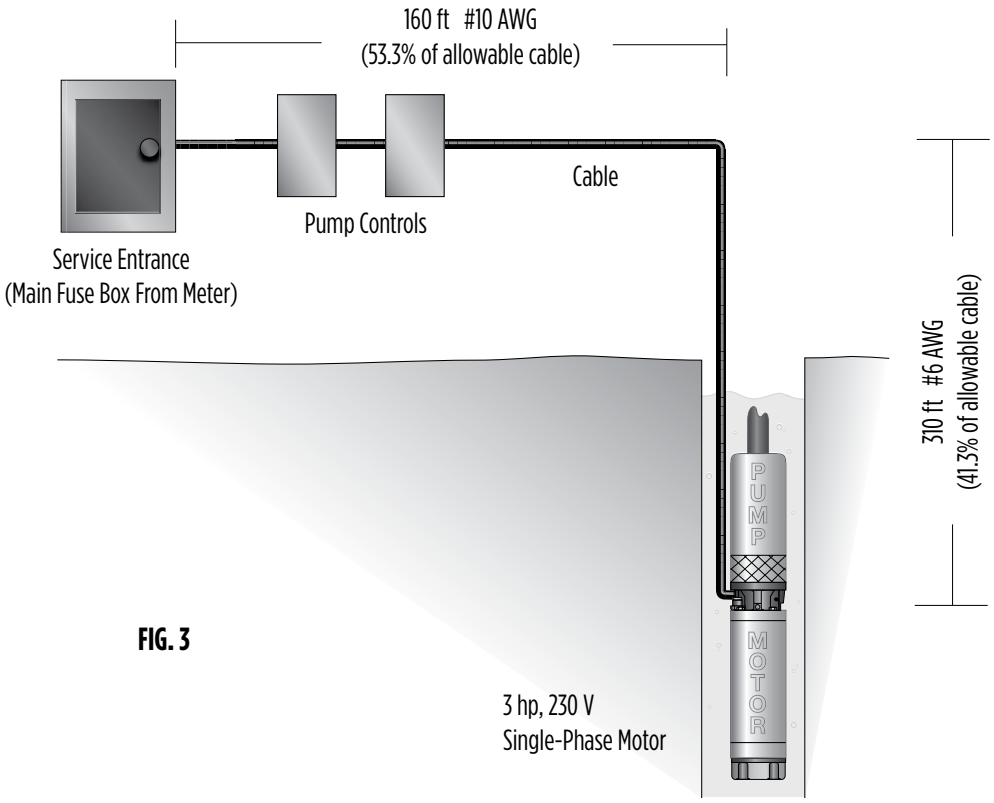

FIG. 3

Single-Phase Motors

APPLICATION

Table 13 Single-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		WINDING (1) RES. IN OHMS	EFFICIENCY %		POWER FACTOR %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	(2) AMPS	WATTS	(2) AMPS	WATTS	M=MAIN RES. S=START RES.	S.F.	F.L.	S.F.	F.L.		
4" 2-WIRE	244504	1/2	0.37	115	60	1.6	10.0	670	12.0	960	1.0-1.3	62	56	73	58	64.4	R
	244505	1/2	0.37	230	60	1.6	5.0	670	6.0	960	4.2-5.2	62	56	73	58	32.2	R
	244507	3/4	0.55	230	60	1.5	6.8	940	8.0	1310	3.0-3.6	64	59	74	62	40.7	N
	244508	1	0.75	230	60	1.4	8.2	1210	10.4	1600	2.2-2.7	65	62	74	63	48.7	N
	244309	1.5	1.1	230	60	1.3	10.6	1770	13.1	2280	1.5-2.1	64	63	83	76	66.2	M
4" 3-WIRE	214504	1/2	0.37	115	60	1.6	Y10.0 B10.0 R0	670	Y12.0 B12.0 R0	960	M1.0-1.3 S4.1-5.1	62	56	73	58	50.5	M
	214505	1/2	0.37	230	60	1.6	Y5.0 B5.0 R0	670	Y6.0 B6.0 R0	960	M4.2-5.2 S16.7-20.5	62	56	73	58	23	M
	214507	3/4	0.55	230	60	1.5	Y6.8 B6.8 R0	940	Y8.0 B8.0 R0	1310	M3.0-3.6 S10.7-13.1	64	59	74	62	34.2	M
	214508	1	0.75	230	60	1.4	Y8.2 B8.2 R0	1210	10.4 10.4 R0	1600	M2.2-2.7 S9.9-12.1	65	62	74	63	41.8	L
4" 3-WIRE W/CRC CB	214505	1/2	0.37	230	60	1.6	Y3.2 B3.7 R2.0	655	Y4.3 B4.0 R2.0	890	M4.2-5.2 S16.7-20.5	67	57	90	81	23	M
	214507	3/4	0.55	230	60	1.5	Y4.4 B5.0 R3.2	925	Y5.7 B5.2 R3.1	1220	M3.0-3.6 S10.7-13.1	69	60	92	84	34.2	M
	214508	1	0.75	230	60	1.4	Y5.6 B5.7 R3.4	1160	Y8.1 B6.2 R3.3	1490	M2.2-2.7 S9.9-12.1	70	64	92	86	41.8	L
4" 3-WIRE	214508 W/1-1.5 CB	1	0.75	230	60	1.4	Y6.6 B6.6 R1.3	1130	Y8.0 B7.9 R1.3	1500	M2.2-2.7 S9.9-12.1	70	66	82	72	43	L
	224300	1.5	1.1	230	60	1.3	Y10.0 B9.9 R1.3	1620	Y11.5 B11.0 R1.3	2080	M1.7-2.1 S7.5-9.2	70	69	85	79	51.4	J
	224301	2	1.5	230	60	1.25	Y10.0 B9.3 R2.6	2025	Y13.2 B11.9 R2.6	2555	M1.8-2.3 S5.5-7.2	73	74	95	94	53.1	G
	224302 (3)	3	2.2	230	60	1.15	Y14.0 B11.2 R6.1	3000	Y17.0 B12.6 R6.0	3400	M1.1-1.4 S4.0-4.8	75	75	99	99	83.4	H
	224303 (4)	5	3.7	230	60	1.15	Y23.0 B15.9 R11.0	4830	Y27.5 B19.1 R10.8	5500	M.71-.82 S1.8-2.2	78	77	100	100	129	G
6"	226110 (5)	5	3.7	230	60	1.15	Y23.0 B14.3 R10.8	4910	Y27.5 B17.4 R10.5	5570	M.55-.68 S1.3-1.7	77	76	100	99	99	E
	226111	7.5	5.5	230	60	1.15	Y36.5 B34.4 R5.5	7300	Y42.1 B40.5 R5.4	8800	M.36-.50 S.88-1.1	73	74	91	90	165	F
	226112	10	7.5	230	60	1.15	Y44.0 B39.5 R9.3	9800	Y51.0 B47.5 R8.9	11300	M.27-.33 S.80-.99	76	77	96	96	204	E
	226113	15	11	230	60	1.15	Y62.0 B52.0 R17.5	13900	Y75.0 B62.5 R16.9	16200	M.17-.22 S.68-.93	79	80	97	98	303	E

(1) Main winding - yellow to black Start winding - yellow to red

(2) Y = Yellow lead - line amps
B = Black lead - main winding amps
R = Red lead - start or auxiliary winding amps

(3) Control Boxes date coded 02C and older have **35 MFD** run capacitors. Current values should be Y14.0 @ FL and Y17.0 @ Max Load.
B12.2 B14.5
R4.7 R4.5

(4) Control Boxes date coded 01M and older have **60 MFD** run capacitors and the current values on a 4" motor will be Y23.0 @ FL - Y27.5 @ Max Load.
B19.1 B23.2
R8.0 R7.8

(5) Control Boxes date coded 01M and older have **60 MFD** run capacitors and the current values on a 6" motor will be Y23.0 @ FL -Y27.5 @ Max Load.
B18.2 B23.2
R8.0 R7.8

Performance is typical, not guaranteed, at specified voltages and specified capacitor values. Performance at voltage ratings not shown is similar, except amps vary inversely with voltage.

Single-Phase Motors

APPLICATION

Table 14 Single-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
4" 2-WIRE	244504	1/2	0.37	115	35	20	30	30	15	30
	244505	1/2	0.37	230	20	10	15	15	8	15
	244507	3/4	0.55	230	25	15	20	20	10	20
	244508	1	0.75	230	30	20	25	25	11	25
	244309	1.5	1.1	230	35	20	30	35	15	30
4" 3-WIRE	214504	1/2	0.37	115	35	20	30	30	15	30
	214505	1/2	0.37	230	20	10	15	15	8	15
	214507	3/4	0.55	230	25	15	20	20	10	20
	214508	1	0.75	230	30	20	25	25	11	25
4" 3-WIRE W/CRC CB	214505	1/2	0.37	230	20	10	15	15	8	15
	214507	3/4	0.55	230	25	15	20	20	10	20
	214508	1	0.75	230	30	20	25	25	11	25
4" 3-WIRE	214508 W/ 1-1.5 CB	1	0.75	230	30	20	25	25	11	25
	224300	1.5	1.1	230	35	20	30	30	15	30
	224301	2	1.5	230	30	20	25	30	15	25
	224302	3	2.2	230	45	30	40	45	20	40
	224303	5	3.7	230	80	45	60	70	30	60
6"	226110	5	3.7	230	80	45	60	70	30	60
	226111	7.5	5.5	230	125	70	100	110	50	100
	226112	10	7.5	230	150	80	125	150	60	125
	226113	15	11	230	200	125	175	200	90	175

Single-Phase Motors

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Auxiliary Running Capacitors

Added capacitors must be connected across "Red" and "Black" control box terminals, in parallel with any existing running capacitors. The additional capacitor(s) should be mounted in an auxiliary box. The values of additional running capacitors most likely to reduce noise are given below. The tabulation gives the **max.** S.F. amps normally in each lead with the added capacitor.

Although motor amps decrease when auxiliary run capacitance is added, the load on the motor does not. If a motor is overloaded with normal capacitance, it will still be overloaded with auxiliary run capacitance, even though motor amps may be within nameplate values.

Table 15 Auxiliary Capacitor Sizing

MOTOR RATING		NORMAL RUNNING CAPACITOR(S)	AUXILIARY RUNNING CAPACITORS FOR NOISE REDUCTION			MAXIMUM AMPS WITH RUN CAP		
HP	VOLTS	MFD	MFD	MIN. VOLTS	FRANKLIN PART	YELLOW	BLACK	RED
1/2	115	0	60(1)	370	TWO 155327101	8.4	7.0	4.0
1/2	230	0	15(1)	370	ONE 155328101	4.2	3.5	2.0
3/4		0	20(1)	370	ONE 155328103	5.8	5.0	2.5
1		0	25(1)	370	ONE EA. 155328101 155328102	7.1	5.6	3.4
1.5		10	20	370	ONE 155328103	9.3	7.5	4.4
2		20	10	370	ONE 155328102	11.2	9.2	3.8
3		45	NONE	370		17.0	12.6	6.0
5		80	NONE	370		27.5	19.1	10.8
7.5		45	45	370	ONE EA. 155327101 155328101	37.0	32.0	11.3
10		70	30	370	ONE 155327101	49.0	42.0	13.0
15		135	NONE			75.0	62.5	16.9

(1) Do not add running capacitors to 1/3 through 1 hp control boxes, which use solid state switches or QD relays. Adding capacitors will cause switch failure. If the control box is converted to use a voltage relay, the specified running capacitance can be added.

Buck-Boost Transformers

When the available power supply voltage is not within the proper range, a buck-boost transformer is often used to adjust voltage to match the motor. The most common usage on submersible motors is boosting a 208 volt supply to use a standard 230 volt single-phase submersible motor and control. While tables to give a wide range of voltage boost or buck are published by transformer manufacturers, the following table shows Franklin's recommendations. The table, based on boosting the voltage 10%, shows the minimum rated transformer kVA needed and the common standard transformer kVA.

Table 15A Buck-Boost Transformer Sizing

MOTOR HP	1/3	1/2	3/4	1	1.5	2	3	5	7.5	10	15
LOAD KVA	1.02	1.36	1.84	2.21	2.65	3.04	3.91	6.33	9.66	11.70	16.60
MINIMUM XFMR KVA	0.11	0.14	0.19	0.22	0.27	0.31	0.40	0.64	0.97	1.20	1.70
STANDARD XFMR KVA	0.25	0.25	0.25	0.25	0.50	0.50	0.50	0.75	1.00	1.50	2.00

Buck-Boost transformers are power transformers, not control transformers. They may also be used to lower voltage when the available power supply voltage is too high.

Three-Phase Motors

APPLICATION

Table 16 Three-Phase 60 °C Cable, 60 Hz (Service Entrance to Motor) Maximum Length in Feet

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	710	1140	1800	2840	4420													
	3/4	0.55	510	810	1280	2030	3160													
	1	0.75	430	690	1080	1710	2670	4140	5140											
	1.5	1.1	310	500	790	1260	1960	3050	3780											
	2	1.5	240	390	610	970	1520	2360	2940	3610	4430	5420								
	3	2.2	180	290	470	740	1160	1810	2250	2760	3390	4130								
	5	3.7	**110**	170	280	440	690	1080	1350	1660	2040	2490	3050	3670	4440	5030				
	7.5	5.5	0	0	200	310	490	770	960	1180	1450	1770	2170	2600	3150	3560				
	10	7.5	0	0	0	**230**	370	570	720	880	1090	1330	1640	1970	2390	2720	3100	3480	3800	4420
	15	11	0	0	0	**160**	**250**	390	490	600	740	910	1110	1340	1630	1850	2100	2350	2570	2980
	20	15	0	0	0	0	**190**	**300**	380	460	570	700	860	1050	1270	1440	1650	1850	2020	2360
	25	18.5	0	0	0	0	0	**240**	**300**	**370**	460	570	700	840	1030	1170	1330	1500	1640	1900
	30	22	0	0	0	0	0	0	**250**	**310**	**380**	470	580	700	850	970	1110	1250	1360	1590
230 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	930	1490	2350	3700	5760	8910												
	3/4	0.55	670	1080	1700	2580	4190	6490	8060	9860										
	1	0.75	560	910	1430	2260	3520	5460	6780	8290										
	1.5	1.1	420	670	1060	1670	2610	4050	5030	6160	7530	9170								
	2	1.5	320	510	810	1280	2010	3130	3890	4770	5860	7170	8780							
	3	2.2	240	390	620	990	1540	2400	2980	3660	4480	5470	6690	8020	9680					
	5	3.7	**140**	230	370	590	920	1430	1790	2190	2690	3290	4030	4850	5870	6650	7560	8460	9220	
	7.5	5.5	0	**160**	260	420	650	1020	1270	1560	1920	2340	2870	3440	4160	4710	5340	5970	6500	7510
	10	7.5	0	0	**190**	310	490	760	950	1170	1440	1760	2160	2610	3160	3590	4100	4600	5020	5840
	15	11	0	0	0	**210**	330	520	650	800	980	1200	1470	1780	2150	2440	2780	3110	3400	3940
	20	15	0	0	0	0	**250**	400	500	610	760	930	1140	1380	1680	1910	2180	2450	2680	3120
	25	18.5	0	0	0	0	0	**320**	400	500	610	750	920	1120	1360	1540	1760	1980	2160	2520
	30	22	0	0	0	0	0	**260**	**330**	**410**	510	620	760	930	1130	1280	1470	1650	1800	2110
380 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	2690	4290	6730															
	3/4	0.55	2000	3190	5010	7860														
	1	0.75	1620	2580	4060	6390	9980													
	1.5	1.1	1230	1970	3100	4890	7630													
	2	1.5	870	1390	2180	3450	5400	8380												
	3	2.2	680	1090	1710	2690	4200	6500	8020	9830										
	5	3.7	400	640	1010	1590	2490	3870	4780	5870	7230	8830								
	7.5	5.5	270	440	690	1090	1710	2640	3260	4000	4930	6010	7290	8780						
	10	7.5	**200**	**320**	510	800	1250	1930	2380	2910	3570	4330	5230	6260	7390	8280	9340			
	15	11	0	0	**370**	590	920	1430	1770	2170	2690	3290	4000	4840	5770	6520	7430	8250	8990	
	20	15	0	0	0	**440**	700	1090	1350	1670	2060	2530	3090	3760	4500	5110	5840	6510	7120	8190
	25	18.5	0	0	0	**360**	570	880	1100	1350	1670	2050	2510	3040	3640	4130	4720	5250	5740	6590
	30	22	0	0	0	0	**470**	730	910	1120	1380	1700	2080	2520	3020	3430	3920	4360	4770	5490
	40	30	0	0	0	0	0	**530**	660	820	1010	1240	1520	1840	2200	2500	2850	3170	3470	3990
	50	37	0	0	0	0	0	0	**540**	**660**	820	1000	1220	1480	1770	2010	2290	2550	2780	3190
	60	45	0	0	0	0	0	0	0	**560**	**690**	850	1030	1250	1500	1700	1940	2150	2350	2700
	75	55	0	0	0	0	0	0	0	0	**570**	**700**	**860**	1050	1270	1440	1660	1850	2030	2350
	100	75	0	0	0	0	0	0	0	0	0	**510**	**630**	**760**	910	1030	1180	1310	1430	1650
	125	93	0	0	0	0	0	0	0	0	0	0	0	**620**	**740**	**840**	**950**	1060	1160	1330
	150	110	0	0	0	0	0	0	0	0	0	0	0	0	**620**	**700**	**790**	**880**	**960**	1090
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	0	**650**	**750**	**840**	**920**	1070
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**630**	**700**	**760**	**880**

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

Continued on next page

Three-Phase Motors

APPLICATION

Table 17 Three-Phase 60 °C Cable (Continued)

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
460 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	3770	6020	9460															
	3/4	0.55	2730	4350	6850															
	1	0.75	2300	3670	5770	9070														
	1.5	1.1	1700	2710	4270	6730														
	2	1.5	1300	2070	3270	5150	8050													
	3	2.2	1000	1600	2520	3970	6200													
	5	3.7	590	950	1500	2360	3700	5750												
	7.5	5.5	420	680	1070	1690	2640	4100	5100	6260	7680									
	10	7.5	310	500	790	1250	1960	3050	3800	4680	5750	7050								
	15	11	0	**340**	540	850	1340	2090	2600	3200	3930	4810	5900	7110						
	20	15	0	0	**410**	650	1030	1610	2000	2470	3040	3730	4580	5530						
	25	18.5	0	0	0	**530**	830	1300	1620	1990	2450	3010	3700	4470	5430					
	30	22	0	0	0	**430**	680	1070	1330	1640	2030	2490	3060	3700	4500	5130	5860			
	40	30	0	0	0	0	**500**	790	980	1210	1490	1830	2250	2710	3290	3730	4250			
	50	37	0	0	0	0	0	**640**	800	980	1210	1480	1810	2190	2650	3010	3420	3830	4180	4850
	60	45	0	0	0	0	0	**540**	**670**	**830**	1020	1250	1540	1850	2240	2540	2890	3240	3540	4100
	75	55	0	0	0	0	0	0	0	**680**	**840**	1030	1260	1520	1850	2100	2400	2700	2950	3440
	100	75	0	0	0	0	0	0	0	0	**620**	**760**	**940**	1130	1380	1560	1790	2010	2190	2550
	125	93	0	0	0	0	0	0	0	0	0	0	**740**	**890**	**1000**	1220	1390	1560	1700	1960
	150	110	0	0	0	0	0	0	0	0	0	0	0	**760**	**920**	**1050**	**1190**	1340	1460	1690
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	**810**	**930**	**1060**	**1190**	1300	1510
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	**810**	**920**	**1030**	**1130**	1310
575 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	5900	9410																
	3/4	0.55	4270	6810																
	1	0.75	3630	5800	9120															
	1.5	1.1	2620	4180	6580															
	2	1.5	2030	3250	5110	8060														
	3	2.2	1580	2530	3980	6270														
	5	3.7	920	1480	2330	3680	5750													
	7.5	5.5	660	1060	1680	2650	4150													
	10	7.5	490	780	1240	1950	3060	4770	5940											
	15	11	**330**	530	850	1340	2090	3260	4060											
	20	15	0	**410**	650	1030	1610	2520	3140	3860	4760	5830								
	25	18.5	0	0	**520**	830	1300	2030	2530	3110	3840	4710								
	30	22	0	0	**430**	680	1070	1670	2080	2560	3160	3880	4770	5780	7030	8000				
	40	30	0	0	0	**500**	790	1240	1540	1900	2330	2860	3510	4230	5140	5830				
	50	37	0	0	0	0	**640**	1000	1250	1540	1890	2310	2840	3420	4140	4700	5340	5990	6530	7580
	60	45	0	0	0	0	0	**850**	1060	1300	1600	1960	2400	2890	3500	3970	4520	5070	5530	6410
	75	55	0	0	0	0	0	**690**	**860**	**1060**	1310	1600	1970	2380	2890	3290	3750	5220	4610	5370
	100	75	0	0	0	0	0	0	0	**790**	**970**	**1190**	1460	1770	2150	2440	2790	3140	3430	3990
	125	93	0	0	0	0	0	0	0	0	**770**	**950**	**1160**	1400	1690	1920	2180	2440	2650	3070
	150	110	0	0	0	0	0	0	0	0	0	**800**	**990**	**1190**	1440	1630	1860	2080	2270	2640
	175	130	0	0	0	0	0	0	0	0	0	0	**870**	**1050**	**1270**	**1450**	1650	1860	2030	2360
	200	150	0	0	0	0	0	0	0	0	0	0	0	**920**	**1110**	**1260**	**1440**	1620	1760	2050

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See 11 for additional details.

Continued on next page

Three-Phase Motors

APPLICATION

Table 18 Three-Phase 60 °C Cable (Continued)

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	160	250	420	660	1030	1620	2020	2490	3060	3730	4570	5500	6660	7540				
	7.5	5.5	110	180	300	460	730	1150	1440	1770	2170	2650	3250	3900	4720	5340				
	10	7.5	**80**	130	210	340	550	850	1080	1320	1630	1990	2460	2950	3580	4080	4650	5220	5700	6630
	15	11	0	0	**140**	240	370	580	730	900	1110	1360	1660	2010	2440	2770	3150	3520	3850	4470
	20	15	0	0	0	**170**	280	450	570	690	850	1050	1290	1570	1900	2160	2470	2770	3030	3540
	25	18.5	0	0	0	**140**	**220**	360	450	550	690	850	1050	1260	1540	1750	1990	2250	2460	2850
	30	22	0	0	0	0	**180**	294	370	460	570	700	870	1050	1270	1450	1660	1870	2040	2380
230 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	210	340	550	880	1380	2140	2680	3280	4030	4930	6040	7270	8800	9970				
	7.5	5.5	150	240	390	630	970	1530	1900	2340	2880	3510	4300	5160	6240	7060	8010	8950	9750	
	10	7.5	**110**	180	280	460	730	1140	1420	1750	2160	2640	3240	3910	4740	5380	6150	6900	7530	8760
	15	11	0	0	**190**	310	490	780	970	1200	1470	1800	2200	2670	3220	3660	4170	4660	5100	5910
	20	15	0	0	**140**	230	370	600	750	910	1140	1390	1710	2070	2520	2860	3270	3670	4020	4680
	25	18.5	0	0	0	**190**	300	480	600	750	910	1120	1380	1680	2040	2310	2640	2970	3240	3780
	30	22	0	0	0	**150**	**240**	390	490	610	760	930	1140	1390	1690	1920	2200	2470	2700	3160
380 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	600	960	1510	2380	3730	5800	7170	8800										
	7.5	5.5	400	660	1030	1630	2560	3960	4890	6000	7390	9010								
	10	7.5	300	480	760	1200	1870	2890	3570	4360	5350	6490	7840	9390						
	15	11	210	340	550	880	1380	2140	2650	3250	4030	4930	6000	7260	8650	9780				
	20	15	**160**	260	410	660	1050	1630	2020	2500	3090	3790	4630	5640	6750	7660	4260	9760		
	25	18.5	0	**210**	330	540	850	1320	1650	2020	2500	3070	3760	4560	5460	6190	7080	7870	8610	9880
	30	22	0	0	**270**	430	700	1090	1360	1680	2070	2550	3120	3780	4530	5140	5880	6540	7150	8230
	40	30	0	0	0	**320**	510	790	990	1230	1510	1860	2280	2760	3300	3750	4270	4750	5200	5980
	50	37	0	0	0	**250**	**400**	630	810	990	1230	1500	1830	2220	2650	3010	3430	3820	4170	4780
	60	45	0	0	0	0	**340**	540	660	840	1030	1270	1540	1870	2250	2550	2910	3220	3520	4050
	75	55	0	0	0	0	0	**450**	550	690	855	1050	1290	1570	1900	2160	2490	2770	3040	3520
	100	75	0	0	0	0	0	0	**420**	**520**	640	760	940	1140	1360	1540	1770	1960	2140	2470
	125	93	0	0	0	0	0	0	0	**400**	**490**	**600**	730	930	1110	1260	1420	1590	1740	1990
	150	110	0	0	0	0	0	0	0	0	**420**	**510**	**620**	750	930	1050	1180	1320	1440	1630
	175	130	0	0	0	0	0	0	0	0	**360**	**440**	**540**	660	780	970	1120	1260	1380	1600
	200	150	0	0	0	0	0	0	0	0	0	0	**480**	**580**	**690**	790	940	1050	1140	1320
460 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	880	1420	2250	3540	5550	8620												
	7.5	5.5	630	1020	1600	2530	3960	6150	7650	9390										
	10	7.5	460	750	1180	1870	2940	4570	5700	7020	8620									
	15	11	310	510	810	1270	2010	3130	3900	4800	5890	7210	8850							
	20	15	**230**	380	610	970	1540	2410	3000	3700	4560	5590	6870	8290						
	25	18.5	**190**	310	490	790	1240	1950	2430	2980	3670	4510	5550	6700	8140					
	30	22	0	**250**	410	640	1020	1600	1990	2460	3040	3730	4590	5550	6750	7690	8790			
	40	30	0	0	**300**	480	750	1180	1470	1810	2230	2740	3370	4060	4930	5590	6370			
	50	37	0	0	0	**370**	590	960	1200	1470	1810	2220	2710	3280	3970	4510	5130	5740	6270	7270
	60	45	0	0	0	**320**	**500**	810	1000	1240	1530	1870	2310	2770	3360	3810	4330	4860	5310	6150
	75	55	0	0	0	0	**420**	660	810	1020	1260	1540	1890	2280	2770	3150	3600	4050	4420	5160
	100	75	0	0	0	0	0	**500**	**610**	760	930	1140	1410	1690	2070	2340	2680	3010	3280	3820
	125	93	0	0	0	0	0	0	**470**	**590**	**730**	880	1110	1330	1500	1830	2080	2340	2550	2940
	150	110	0	0	0	0	0	0	0	**510**	**630**	**770**	950	1140	1380	1570	1790	2000	2180	2530
	175	130	0	0	0	0	0	0	0	0	**550**	**680**	**830**	1000	1220	1390	1580	1780	1950	2270
	200	150	0	0	0	0	0	0	0	0	0	**590**	**730**	**880**	1070	1210	1380	1550	1690	1970
575 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	1380	2220	3490	5520	8620													
	7.5	5.5	990	1590	2520	3970	6220													
	10	7.5	730	1170	1860	2920	4590	7150	8910											
	15	11	490	790	1270	2010	3130	4890	6090											
	20	15	370	610	970	1540	2410	3780	4710	5790	7140	8740								
	25	18.5	**300**	490	780	1240	1950	3040	3790	4660	5760	7060								
	30	22	**240**	400	645	1020	1600	2500	3120	3840	4740	5820	7150	8670						
	40	30	0	**300**	480	750	1180	1860	2310	2850	3490	4290	5260	6340	7710	8740				
	50	37	0	0	**380**	590	960	1500	1870	2310	2830	3460	4260	5130	6210	7050	8010	8980	9790	
	60	45	0	0	0	**500**	**790**	1270	1590	1950	2400	2940	3600	4330	5250	5950	6780	7600	8290	9610
	75	55	0	0	0	**420**	**660**	1030	1290	1590	1960	2400	2950	3570	4330	4930	5620	6330	6910	8050
	100	75	0	0	0	0	**400**	**780**	960	1180	1450	1780	2190	2650	3220	3660	4180	4710	5140	5980
	125	93	0	0	0	0	0	**600**	**740**	920	1150	1420	1740	2100	2530	2880	3270	3660	3970	4600
	150	110	0	0	0	0	0	0	**650**	**800**	**990**	1210	1480	1780	2160	2450	2790	3120	3410	3950
	175	130	0	0	0	0	0	0	0	**700**	**860**	1060	1300	1570	1910	2170	2480	2780	3040	3540
	200	150	0	0	0	0	0	0	0	0	**760**	**930**	1140	1370	1670	1890	2160	2420	2640	3070

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

Three-Phase Motors

APPLICATION

Table 19 Three-Phase 75 °C Cable, 60 Hz (Service Entrance to Motor) Maximum Length in Feet

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	710	1140	1800	2840	4420													
	3/4	0.55	510	810	1280	2030	3160													
	1	0.75	430	690	1080	1710	2670	4140	5140											
	1.5	1.1	310	500	790	1260	1960	3050	3780											
	2	1.5	240	390	610	970	1520	2360	2940	3610	4430	5420								
	3	2.2	180	290	470	740	1160	1810	2250	2760	3390	4130								
	5	3.7	**110**	170	280	440	690	1080	1350	1660	2040	2490	3050	3670	4440	5030				
	7.5	5.5	0	0	200	310	490	770	960	1180	1450	1770	2170	2600	3150	3560				
	10	7.5	0	0	**150**	230	370	570	720	880	1090	1330	1640	1970	2390	2720	3100	3480	3800	4420
	15	11	0	0	0	**160**	250	390	490	600	740	910	1110	1340	1630	1850	2100	2350	2570	2980
	20	15	0	0	0	0	**190**	300	380	460	570	700	860	1050	1270	1440	1650	1850	2020	2360
	25	18.5	0	0	0	0	0	**240**	300	370	460	570	700	840	1030	1170	1330	1500	1640	1900
	30	22	0	0	0	0	0	**200**	**250**	310	380	470	580	700	850	970	1110	1250	1360	1590
230 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	930	1490	2350	3700	5760	8910												
	3/4	0.55	670	1080	1700	2580	4190	6490	8060	9860										
	1	0.75	560	910	1430	2260	3520	5460	6780	8290										
	1.5	1.1	420	670	1060	1670	2610	4050	5030	6160	7530	9170								
	2	1.5	320	510	810	1280	2010	3130	3890	4770	5860	7170	8780							
	3	2.2	240	390	620	990	1540	2400	2980	3660	4480	5470	6690	8020	9680					
	5	3.7	**140**	230	370	590	920	1430	1790	2190	2690	3290	4030	4850	5870	6650	7560	8460	9220	
	7.5	5.5	0	**160**	260	420	650	1020	1270	1560	1920	2340	2870	3440	4160	4710	5340	5970	6500	7510
	10	7.5	0	0	**190**	310	490	760	950	1170	1440	1760	2160	2610	3160	3590	4100	4600	5020	5840
	15	11	0	0	0	**210**	330	520	650	800	980	1200	1470	1780	2150	2440	2780	3110	3400	3940
	20	15	0	0	0	**160**	**250**	400	500	610	760	930	1140	1380	1680	1910	2180	2450	2680	3120
	25	18.5	0	0	0	0	**200**	320	400	500	610	750	920	1120	1360	1540	1760	1980	2160	2520
	30	22	0	0	0	0	0	**260**	330	410	510	620	760	930	1130	1280	1470	1650	1800	2110
380 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	2690	4290	6730															
	3/4	0.55	2000	3190	5010	7860														
	1	0.75	1620	2580	4060	6390	9980													
	1.5	1.1	1230	1970	3100	4890	7630													
	2	1.5	870	1390	2180	3450	5400	8380												
	3	2.2	680	1090	1710	2690	4200	6500	8020	9830										
	5	3.7	400	640	1010	1590	2490	3870	4780	5870	7230	8830								
	7.5	5.5	270	440	690	1090	1710	2640	3260	4000	4930	6010	7290	8780						
	10	7.5	**200**	320	510	800	1250	1930	2380	2910	3570	4330	5230	6260	7390	8280	9340			
	15	11	0	0	370	590	920	1430	1770	2170	2690	3290	4000	4840	5770	6520	7430	8250	8990	
	20	15	0	0	**280**	440	700	1090	1350	1670	2060	2530	3090	3760	4500	5110	2840	6510	7120	8190
	25	18.5	0	0	0	**360**	570	880	1100	1350	1670	2050	2510	3040	3640	4130	4720	5250	5740	6590
	30	22	0	0	0	**290**	470	730	910	1120	1380	1700	2080	2520	3020	3430	3920	4360	4770	5490
	40	30	0	0	0	0	0	**530**	660	820	1010	1240	1520	1840	2200	2500	2850	3170	3470	3990
	50	37	0	0	0	0	0	**440**	**540**	660	820	1000	1220	1480	1770	2010	2290	2550	2780	3190
	60	45	0	0	0	0	0	**370**	**460**	**560**	690	850	1030	1250	1500	1700	1940	2150	2350	2700
	75	55	0	0	0	0	0	0	0	**460**	**570**	700	860	1050	1270	1440	1660	1850	2030	2350
	100	75	0	0	0	0	0	0	0	0	**420**	**510**	**630**	760	910	1030	1180	1310	1430	1650
	125	93	0	0	0	0	0	0	0	0	0	0	**510**	**620**	**740**	840	950	1060	1160	1330
	150	110	0	0	0	0	0	0	0	0	0	0	0	**520**	**620**	**700**	**790**	880	960	1090
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	**560**	**650**	**750**	**840**	920	1070
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	**550**	**630**	**700**	**760**	880

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

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Three-Phase Motors

APPLICATION

Table 20 Three-Phase 75 °C Cable (Continued)

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
460 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	3770	6020	9460															
	3/4	0.55	2730	4350	6850															
	1	0.75	2300	3670	5770	9070														
	1.5	1.1	1700	2710	4270	6730														
	2	1.5	1300	2070	3270	5150	8050													
	3	2.2	1000	1600	2520	3970	6200													
	5	3.7	590	950	1500	2360	3700	5750												
	7.5	5.5	420	680	1070	1690	2640	4100	5100	6260	7680									
	10	7.5	310	500	790	1250	1960	3050	3800	4680	5750	7050								
	15	11	0	**340**	540	850	1340	2090	2600	3200	3930	4810	5900	7110						
	20	15	0	0	410	650	1030	1610	2000	2470	3040	3730	4580	5530						
	25	18.5	0	0	**330**	530	830	1300	1620	1990	2450	3010	3700	4470	5430					
	30	22	0	0	**270**	430	680	1070	1330	1640	2030	2490	3060	3700	4500	5130	5860			
	40	30	0	0	0	**320**	**500**	790	980	1210	1490	1830	2250	2710	3290	3730	4250			
	50	37	0	0	0	0	**410**	640	800	980	1210	1480	1810	2190	2650	3010	3420	3830	4180	4850
	60	45	0	0	0	0	0	**540**	**670**	830	1020	1250	1540	1850	2240	2540	2890	3240	3540	4100
	75	55	0	0	0	0	0	**440**	**550**	**680**	840	1030	1260	1520	1850	2100	2400	2700	2950	3440
	100	75	0	0	0	0	0	0	0	**500**	**620**	**760**	940	1130	1380	1560	1790	2010	2190	2550
	125	93	0	0	0	0	0	0	0	0	0	**600**	**740**	**890**	1000	1220	1390	1560	1700	1960
	150	110	0	0	0	0	0	0	0	0	0	0	**630**	**760**	**920**	1050	1190	1340	1460	1690
	175	130	0	0	0	0	0	0	0	0	0	0	0	**670**	**810**	**930**	1060	1190	1300	1510
	200	150	0	0	0	0	0	0	0	0	0	0	0	**590**	**710**	**810**	**920**	1030	1130	1310
575 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	5900	9410																
	3/4	0.55	4270	6810																
	1	0.75	3630	5800	9120															
	1.5	1.1	2620	4180	6580															
	2	1.5	2030	3250	5110	8060														
	3	2.2	1580	2530	3980	6270														
	5	3.7	920	1480	2330	3680	5750													
	7.5	5.5	660	1060	1680	2650	4150													
	10	7.5	490	780	1240	1950	3060	4770	5940											
	15	11	**330**	530	850	1340	2090	3260	4060											
	20	15	0	**410**	650	1030	1610	2520	3140	3860	4760	5830								
	25	18.5	0	0	520	830	1300	2030	2530	3110	3840	4710								
	30	22	0	0	**430**	680	1070	1670	2080	2560	3160	3880	4770	5780	7030	8000				
	40	30	0	0	0	**500**	790	1240	1540	1900	2330	2860	3510	4230	5140	5830				
	50	37	0	0	0	**410**	**640**	1000	1250	1540	1890	2310	2840	3420	4140	4700	5340	5990	6530	7580
	60	45	0	0	0	0	**540**	850	1060	1300	1600	1960	2400	2890	3500	3970	4520	5070	5530	6410
	75	55	0	0	0	0	0	**690**	860	1060	1310	1600	1970	2380	2890	3290	3750	5220	4610	5370
	100	75	0	0	0	0	0	0	**640**	**790**	970	1190	1460	1770	2150	2440	2790	3140	3430	3990
	125	93	0	0	0	0	0	0	0	**630**	**770**	**950**	1160	1400	1690	1920	2180	2440	2650	3070
	150	110	0	0	0	0	0	0	0	0	**660**	**800**	**990**	1190	1440	1630	1860	2080	2270	2640
	175	130	0	0	0	0	0	0	0	0	0	**700**	**870**	**1050**	1270	1450	1650	1860	2030	2360
	200	150	0	0	0	0	0	0	0	0	0	0	**760**	**920**	**1110**	1260	1440	1620	1760	2050

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

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Three-Phase Motors

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Table 21 Three-Phase 75 °C Cable

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	160	250	420	660	1030	1620	2020	2490	3060	3730	4570	5500	6660	7540				
	7.5	5.5	110	180	300	460	730	1150	1440	1770	2170	2650	3250	3900	4720	5340				
	10	7.5	**80**	130	210	340	550	850	1080	1320	1630	1990	2460	2950	3580	4080	4650	5220	5700	6630
	15	11	0	0	140	240	370	580	730	900	1110	1360	1660	2010	2440	2770	3150	3520	3850	4470
	20	15	0	0	**120**	170	280	450	570	690	850	1050	1290	1570	1900	2160	2470	2770	3030	3540
	25	18.5	0	0	0	**140**	220	360	450	550	690	850	1050	1260	1540	1750	1990	2250	2460	2850
	30	22	0	0	0	**120**	**180**	294	370	460	570	700	870	1050	1270	1450	1660	1870	2040	2380
230 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	210	340	550	880	1380	2140	2680	3280	4030	4930	6040	7270	8800	9970				
	7.5	5.5	150	240	390	630	970	1530	1900	2340	2880	3510	4300	5160	6240	7060	8010	8950	9750	
	10	7.5	**110**	180	280	460	730	1140	1420	1750	2160	2640	3240	3910	4740	5380	6150	6900	7530	8760
	15	11	0	**130**	190	310	490	780	970	1200	1470	1800	2200	2670	3220	3660	4170	4660	5100	5910
	20	15	0	0	**140**	230	370	600	750	910	1140	1390	1710	2070	2520	2860	3270	3670	4020	4680
	25	18.5	0	0	**120**	190	300	480	600	750	910	1120	1380	1680	2040	2310	2640	2970	3240	3780
	30	22	0	0	0	**150**	240	390	490	610	760	930	1140	1390	1690	1920	2200	2470	2700	3160
380 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	600	960	1510	2380	3730	5800	7170	8800										
	7.5	5.5	400	660	1030	1630	2560	3960	4890	6000	7390	9010								
	10	7.5	300	480	760	1200	1870	2890	3570	4360	5350	6490	7840	9390						
	15	11	210	340	550	880	1380	2140	2650	3250	4030	4930	6000	7260	8650	9780				
	20	15	**160**	260	410	660	1050	1630	2020	2500	3090	3790	4630	5640	6750	7660	4260	9760		
	25	18.5	0	**210**	330	540	850	1320	1650	2020	2500	3070	3760	4560	5460	6190	7080	7870	8610	9880
	30	22	0	0	**270**	430	700	1090	1360	1680	2070	2550	3120	3780	4530	5140	5880	6540	7150	8230
	40	30	0	0	**210**	320	510	790	990	1230	1510	1860	2280	2760	3300	3750	4270	4750	5200	5980
	50	37	0	0	0	**250**	400	630	810	990	1230	1500	1830	2220	2650	3010	3430	3820	4170	4780
	60	45	0	0	0	0	**340**	540	660	840	1030	1270	1540	1870	2250	2550	2910	3220	3520	4050
	75	55	0	0	0	0	**290**	450	550	690	855	1050	1290	1570	1900	2160	2490	2770	3040	3520
	100	75	0	0	0	0	0	**340**	**420**	520	640	760	940	1140	1360	1540	1770	1960	2140	2470
	125	93	0	0	0	0	0	0	**340**	**400**	**490**	600	730	930	1110	1260	1420	1590	1740	1990
	150	110	0	0	0	0	0	0	0	**350**	**420**	**510**	620	750	930	1050	1180	1320	1440	1630
	175	130	0	0	0	0	0	0	0	0	**360**	**440**	**540**	660	780	970	1120	1260	1380	1600
	200	150	0	0	0	0	0	0	0	0	0	**410**	**480**	**580**	690	790	940	1050	1140	1320
460 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	880	1420	2250	3540	5550	8620												
	7.5	5.5	630	1020	1600	2530	3960	6150	7650	9390										
	10	7.5	460	750	1180	1870	2940	4570	5700	7020	8620									
	15	11	310	510	810	1270	2010	3130	3900	4800	5890	7210	8850							
	20	15	230	380	610	970	1540	2410	3000	3700	4560	5590	6870	8290						
	25	18.5	**190**	310	490	790	1240	1950	2430	2980	3670	4510	5550	6700	8140					
	30	22	0	**250**	410	640	1020	1600	1990	2460	3040	3730	4590	5550	6750	7690	8790			
	40	30	0	0	**300**	480	750	1180	1470	1810	2230	2740	3370	4060	4930	5590	6370			
	50	37	0	0	**250**	370	590	960	1200	1470	1810	2220	2710	3280	3970	4510	5130	5740	6270	7270
	60	45	0	0	0	**320**	500	810	1000	1240	1530	1870	2310	2770	3360	3810	4330	4860	5310	6150
	75	55	0	0	0	0	**420**	660	810	1020	1260	1540	1890	2280	2770	3150	3600	4050	4420	5160
	100	75	0	0	0	0	**310**	**500**	610	760	930	1140	1410	1690	2070	2340	2680	3010	3280	3820
	125	93	0	0	0	0	0	**390**	**470**	**590**	730	880	1110	1330	1500	1830	2080	2340	2550	2940
	150	110	0	0	0	0	0	0	**420**	**510**	**630**	770	950	1140	1380	1570	1790	2000	2180	2530
	175	130	0	0	0	0	0	0	0	**450**	**550**	**680**	830	1000	1220	1390	1580	1780	1950	2270
	200	150	0	0	0	0	0	0	0	0	**480**	**590**	**730**	880	1070	1210	1380	1550	1690	1970
575 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	1380	2220	3490	5520	8620													
	7.5	5.5	990	1590	2520	3970	6220													
	10	7.5	730	1170	1860	2920	4590	7150	8910											
	15	11	490	790	1270	2010	3130	4890	6090											
	20	15	370	610	970	1540	2410	3780	4710	5790	7140	8740								
	25	18.5	**300**	490	780	1240	1950	3040	3790	4660	5760	7060								
	30	22	**240**	400	645	1020	1600	2500	3120	3840	4740	5820	7150	8670						
	40	30	0	**300**	480	750	1180	1860	2310	2850	3490	4290	5260	6340	7710	8740				
	50	37	0	0	**380**	590	960	1500	1870	2310	2830	3460	4260	5130	6210	7050	8010	8980	9790	
	60	45	0	0	**330**	500	790	1270	1590	1950	2400	2940	3600	4330	5250	5950	6780	7600	8290	9610
	75	55	0	0	0	**420**	660	1030	1290	1590	1960	2400	2950	3570	4330	4930	5620	6330	6910	8050
	100	75	0	0	0	0	**400**	780	960	1180	1450	1780	2190	2650	3220	3660	4180	4710	5140	5980
	125	93	0	0	0	0	0	**600**	740	920	1150	1420	1740	2100	2530	2880	3270	3660	3970	4600
	150	110	0	0	0	0	0	**520**	**650**	800	990	1210	1480	1780	2160	2450	2790	3120	3410	3950
	175	130	0	0	0	0	0	0	**570**	**700**	860	1060	1300	1570	1910	2170	2480	2780	3040	3540
	200	150	0	0	0	0	0	0	**500**	**610**	**760**	930	1140	1370	1670	1890	2160	2420	2640	3070

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

Three-Phase Motors

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Table 22 Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
4"	234501	1/2	0.37	200	60	1.6	2.8	585	3.4	860	6.6-8.4	70	64	17.5	N
	234511			230	60	1.6	2.4	585	2.9	860	9.5-10.9	70	64	15.2	N
	234541			380	60	1.6	1.4	585	2.1	860	23.2-28.6	70	64	9.2	N
	234521			460	60	1.6	1.2	585	1.5	860	38.4-44.1	70	64	7.6	N
	234531			575	60	1.6	1.0	585	1.2	860	58.0-71.0	70	64	6.1	N
	234502	3/4	0.55	200	60	1.5	3.6	810	4.4	1150	4.6-5.9	73	69	24.6	N
	234512			230	60	1.5	3.1	810	3.8	1150	6.8-7.8	73	69	21.4	N
	234542			380	60	1.5	1.9	810	2.5	1150	16.6-20.3	73	69	13	N
	234522			460	60	1.5	1.6	810	1.9	1150	27.2-30.9	73	69	10.7	N
	234532			575	60	1.5	1.3	810	1.6	1150	41.5-50.7	73	69	8.6	N
	234503	1	0.75	200	60	1.4	4.5	1070	5.4	1440	3.8-4.5	72	70	30.9	M
	234513			230	60	1.4	3.9	1070	4.7	1440	4.9-5.6	72	70	26.9	M
	234543			380	60	1.4	2.3	1070	2.8	1440	12.2-14.9	72	70	16.3	M
	234523			460	60	1.4	2	1070	2.4	1440	19.9-23.0	72	70	13.5	M
	234533			575	60	1.4	1.6	1070	1.9	1440	30.1-36.7	72	70	10.8	M
	234504	1.5	1.1	200	60	1.3	5.8	1460	6.8	1890	2.5-3.0	76	76	38.2	K
	234514			230	60	1.3	5	1460	5.9	1890	3.2-4.0	76	76	33.2	K
	234544			380	60	1.3	3	1460	3.6	1890	8.5-10.4	76	76	20.1	K
	234524			460	60	1.3	2.5	1460	3.1	1890	13.0-16.0	76	76	16.6	K
	234534			575	60	1.3	2	1460	2.4	1890	20.3-25.0	76	76	13.3	K
	234305	2	1.5	200	60	1.25	7.7	1960	9.3	2430	1.8-2.4	76	76	50.3	K
	234315			230	60	1.25	6.7	1960	8.1	2430	2.3-3.0	76	76	45.0	K
	234345			380	60	1.25	4.1	1960	4.9	2430	6.6-8.2	76	76	26.6	K
	234325			460	60	1.25	3.4	1960	4.1	2430	9.2-12.0	76	76	22.5	K
	234335			575	60	1.25	2.7	1960	3.2	2430	14.6-18.7	76	76	17.8	K
	234306	3	2.2	200	60	1.15	10.9	2920	12.5	3360	1.3-1.7	77	77	69.5	K
	234316			230	60	1.15	9.5	2920	10.9	3360	1.8-2.2	77	77	60.3	K
	234346			380	60	1.15	5.8	2920	6.6	3360	4.7-6.0	77	77	37.5	K
	234326			460	60	1.15	4.8	2920	5.5	3360	7.2-8.8	77	77	31.0	K
	234336			575	60	1.15	3.8	2920	4.4	3360	11.4-13.9	77	77	25.1	K
	234307	5	3.7	200	60	1.15	18.3	4800	20.5	5500	.68-.83	78	78	116	K
	234317			230	60	1.15	15.9	4800	17.8	5500	.91-1.1	78	78	102	K
	234347			380	60	1.15	9.6	4800	10.8	5500	2.6-3.2	78	78	60.2	K
	234327			460	60	1.15	8.0	4800	8.9	5500	3.6-4.4	78	78	53.7	K
	234337			575	60	1.15	6.4	4800	7.1	5500	5.6-6.9	78	78	41.8	K
	234308	7.5	5.5	200	60	1.15	26.5	7150	30.5	8200	.43-.53	78	78	177	K
	234318			230	60	1.15	23.0	7150	26.4	8200	.60-.73	78	78	152	K
	234348			380	60	1.15	13.9	7150	16.0	8200	1.6-2.0	78	78	92.7	K
	234328			460	60	1.15	11.5	7150	13.2	8200	2.3-2.8	78	78	83.8	K
	234338			575	60	1.15	9.2	7150	10.6	8200	3.6-4.5	78	78	64.6	K
	234549	10	7.5	380	60	1.15	19.3	10000	21.0	11400	1.2-1.6	75	75	140	L
	234595			460	60	1.15	15.9	10000	17.3	11400	1.8-2.3	75	75	116.0	L
	234598			575	60	1.15	12.5	10000	13.6	11400	2.8-3.5	75	75	92.8	L
	234646	15	11	380	60	1.15	27.6	14600	31.2	16800	.86-1.1	77	76	178	J
	234626			460	60	1.15	22.8	14600	25.8	16800	1.2-1.5	77	76	147	J
	234636			575	60	1.15	18.2	14600	20.7	16800	1.9-2.4	77	76	118	J

Three-Phase Motors

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Table 23 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
4"	234501	1/2	0.37	200	10	5	8	10	4	15
	234511			230	8	4.5	6	8	4	15
	234541			380	5	2.5	4	5	2	15
	234521			460	4	2.25	3	4	2	15
	234531			575	3	1.8	3	3	1.4	15
	234502	3/4	0.55	200	15	7	10	12	5	15
	234512			230	10	5.6	8	10	5	15
	234542			380	6	3.5	5	6	3	15
	234522			460	5	2.8	4	5	3	15
	234532			575	4	2.5	4	4	1.8	15
	234503	1	0.75	200	15	8	15	15	6	15
	234513			230	15	7	10	12	6	15
	234543			380	8	4.5	8	8	4	15
	234523			460	6	3.5	5	6	3	15
	234533			575	5	2.8	4	5	2.5	15
	234504	1.5	1.1	200	20	12	15	20	8	15
	234514			230	15	9	15	15	8	15
	234544			380	10	5.6	8	10	4	15
	234524			460	8	4.5	8	8	4	15
	234534			575	6	3.5	5	6	3	15
	234305	2	1.5	200	25	15	20	25	11	20
	234315			230	25	12	20	25	10	20
	234345			380	15	8	15	15	6	15
	234325			460	15	6	10	11	5	15
	234335			575	10	5	8	10	4	15
	234306	3	2.2	200	35	20	30	35	15	30
	234316			230	30	17.5	25	30	12	25
	234346			380	20	12	15	20	8	15
	234326			460	15	9	15	15	6	15
	234336			575	15	7	10	11	5	15
	234307	5	3.7	200	60	35	50	60	25	50
	234317			230	50	30	40	45	20	40
	234347			380	30	17.5	25	30	12	25
	234327			460	25	15	20	25	10	20
	234337			575	20	12	20	20	8	20
	234308	7.5	5.5	200	90	50	70	80	35	70
	234318			230	80	45	60	70	30	60
	234348			380	45	25	40	40	20	40
	234328			460	40	25	30	35	15	30
	234338			575	30	17.5	25	30	12	25
	234349	10	7.5	380	70	40	60	60	25	60
	234329			460	60	30	45	50	25	45
	234339			575	45	25	35	40	20	35
	234549			380	70	35	60	60	25	60
	234595			460	60	30	45	50	25	45
	234598			575	45	25	35	40	20	35
	234646	15	11	380	90	50	70	80	35	70
	234626			460	80	45	60	70	30	60
	234636			575	60	35	50	60	25	50

Three-Phase Motors

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Table 24 Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
6" STD.	236650	5	3.7	200	60	1.15	17.5	4700	20.0	5400	.77-.93	79	79	99	H
	236600			230	60	1.15	15	4700	17.6	5400	1.0-1.2	79	79	86	H
	236660			380	60	1.15	9.1	4700	10.7	5400	2.6-3.2	79	79	52	H
	236610			460	60	1.15	7.5	4700	8.8	5400	3.9-4.8	79	79	43	H
	236620			575	60	1.15	6	4700	7.1	5400	6.3-7.7	79	79	34	H
	236651	7.5	5.5	200	60	1.15	25.1	7000	28.3	8000	.43-.53	80	80	150	H
	236601			230	60	1.15	21.8	7000	24.6	8000	.64-.78	80	80	130	H
	236661			380	60	1.15	13.4	7000	15	8000	1.6-2.1	80	80	79	H
	236611			460	60	1.15	10.9	7000	12.3	8000	2.4-2.9	80	80	65	H
	236621			575	60	1.15	8.7	7000	9.8	8000	3.7-4.6	80	80	52	H
	236652	10	7.5	200	60	1.15	32.7	9400	37	10800	.37-.45	79	79	198	H
	236602			230	60	1.15	28.4	9400	32.2	10800	.47-.57	79	79	172	H
	236662			380	60	1.15	17.6	9400	19.6	10800	1.2-1.5	79	79	104	H
	236612			460	60	1.15	14.2	9400	16.1	10800	1.9-2.4	79	79	86	H
	236622			575	60	1.15	11.4	9400	12.9	10800	3.0-3.7	79	79	69	H
	236653	15	11	200	60	1.15	47.8	13700	54.4	15800	.24-.29	81	81	306	H
	236603			230	60	1.15	41.6	13700	47.4	15800	.28-.35	81	81	266	H
	236663			380	60	1.15	25.8	13700	28.9	15800	.77-.95	81	81	161	H
	236613			460	60	1.15	20.8	13700	23.7	15800	1.1-1.4	81	81	133	H
	236623			575	60	1.15	16.6	13700	19	15800	1.8-2.3	81	81	106	H
	236654	20	15	200	60	1.15	61.9	18100	69.7	20900	.16-.20	82	82	416	J
	236604			230	60	1.15	53.8	18100	60.6	20900	.22-.26	82	82	362	J
	236664			380	60	1.15	33	18100	37.3	20900	.55-.68	82	82	219	J
	236614			460	60	1.15	26.9	18100	30.3	20900	.8-1.0	82	82	181	J
	236624			575	60	1.15	21.5	18100	24.2	20900	1.3-1.6	82	82	145	J
	236655	25	18.5	200	60	1.15	77.1	22500	86.3	25700	.12-.15	83	83	552	J
	236605			230	60	1.15	67	22500	76.4	25700	.15-.19	83	83	480	J
	236665			380	60	1.15	41	22500	46	25700	.46-.56	83	83	291	J
	236615			460	60	1.15	33.5	22500	38.2	25700	.63-.77	83	83	240	J
	236625			575	60	1.15	26.8	22500	30	25700	1.0-1.3	83	83	192	J
	236656	30	22	200	60	1.15	90.9	26900	104	31100	.09-.11	83	83	653	J
	236606			230	60	1.15	79	26900	90.4	31100	.14-.17	83	83	568	J
	236666			380	60	1.15	48.8	26900	55.4	31100	.35-.43	83	83	317	J
	236616			460	60	1.15	39.5	26900	45.2	31100	.52-.64	83	83	284	H
	236626			575	60	1.15	31.6	26900	36.2	31100	.78-.95	83	83	227	J
	236667	40	30	380	60	1.15	66.5	35600	74.6	42400	.26-.33	83	83	481	J
	236617			460	60	1.15	54.9	35600	61.6	42400	.34-.42	83	83	397	J
	236627			575	60	1.15	42.8	35600	49.6	42400	.52-.64	83	83	318	H
	236668	50	37	380	60	1.15	83.5	45100	95	52200	.21-.25	82	83	501	H
	236618			460	60	1.15	67.7	45100	77	52200	.25-.32	82	83	414	H
	236628			575	60	1.15	54.2	45100	61.6	52200	.40-.49	82	83	331	H
	276668			380	60	1.15	82.4	45100	94.5	52200	.21 - .25	82	83	501	H
	276618			460	60	1.15	68.1	45100	78.1	52200	.25 - .32	82	83	414	H
	276628			575	60	1.15	54.5	45100	62.5	52200	.40 - .49	82	83	331	H
	276029	60/50	37/45	380	60	1.15	98.1	53500	111.8	61700	.15 - .18	84	84	627	H
	276009			460	60	1.15	81.0	53500	92.3	61700	.22 - .27	84	84	518	H
	276059			575	60	1.15	64.8	53500	73.9	61700	.35 - .39	84	84	414	H
	236669	60	45	380	60	1.15	98.7	53500	111	61700	.15-.18	84	84	627	H
	236619			460	60	1.15	80.5	53500	91	61700	.22-.27	84	84	518	H
	236629			575	60	1.15	64.4	53500	72.8	61700	.35-.39	84	84	414	H
	276669			380	60	1.15	98.1	53500	111.8	61700	.15 - .18	84	84	627	H
	276619			460	60	1.15	81.0	53500	92.3	61700	.22 - .27	84	84	518	H
	276629			575	60	1.15	64.8	53500	73.9	61700	.35 - .39	84	84	414	H

Model numbers above are for three-lead motors. Six-lead motors with different model numbers have the same running performance, but when Wye connected for starting have locked rotor amps 33% of the values shown. Six-lead individual phase resistance = table X 1.5.

Three-Phase Motors

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Table 25 6" Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
6" HI-TEMP 90 °C	276650	5	3.7	200	60	1.15	17.2	5200	19.8	5800	.53 - .65	73	72	124	K
	276600			230	60	1.15	15.0	5200	17.2	5800	.68 - .84	73	72	108	K
	276660			380	60	1.15	9.1	5200	10.4	5800	2.0 - 2.4	73	72	66.0	K
	276610			460	60	1.15	7.5	5200	8.6	5800	2.8 - 3.4	73	72	54.0	K
	276620			575	60	1.15	6.0	5200	6.9	5800	4.7 - 5.7	73	72	43.0	K
	276651	7.5	5.5	200	60	1.15	24.8	7400	28.3	8400	.30 - .37	77	76	193	K
	276601			230	60	1.15	21.6	7400	24.6	8400	.41 - .50	77	76	168	K
	276661			380	60	1.15	13.1	7400	14.9	8400	1.1 - 1.4	77	76	102	K
	276611			460	60	1.15	10.8	7400	12.3	8400	1.7 - 2.0	77	76	84.0	K
	276621			575	60	1.15	8.6	7400	9.9	8400	2.6 - 3.2	77	76	67.0	K
	276652	10	7.5	200	60	1.15	32.0	9400	36.3	10700	.21 - .26	80	79	274	L
	276602			230	60	1.15	27.8	9400	31.6	10700	.28 - .35	80	79	238	L
	276662			380	60	1.15	16.8	9400	19.2	10700	.80 - .98	80	79	144	L
	276612			460	60	1.15	13.9	9400	15.8	10700	1.2 - 1.4	80	79	119	L
	276622			575	60	1.15	11.1	9400	12.7	10700	1.8 - 2.2	80	79	95.0	L
	276653	15	11	200	60	1.15	48.5	14000	54.5	15900	.15 - .19	81	80	407	L
	276603			230	60	1.15	42.2	14000	47.4	15900	.19 - .24	81	80	354	L
	276663			380	60	1.15	25.5	14000	28.7	15900	.52 - .65	81	80	214	L
	276613			460	60	1.15	21.1	14000	23.7	15900	.78 - .96	81	80	177	L
	276623			575	60	1.15	16.9	14000	19.0	15900	1.2 - 1.4	81	80	142	L
	276654	20	15	200	60	1.15	64.9	18600	73.6	21300	.10 - .12	80	80	481	K
	276604			230	60	1.15	56.4	18600	64.0	21300	.14 - .18	80	80	418	K
	276664			380	60	1.15	34.1	18600	38.8	21300	.41 - .51	80	80	253	K
	276614			460	60	1.15	28.2	18600	32.0	21300	.58 - .72	80	80	209	K
	276624			575	60	1.15	22.6	18600	25.6	21300	.93 - 1.15	80	80	167	K
	276655	25	18.5	200	60	1.15	80.0	22600	90.6	25800	.09 - .11	83	82	665	L
	276605			230	60	1.15	69.6	22600	78.8	25800	.11 - .14	83	82	578	L
	276665			380	60	1.15	42.1	22600	47.7	25800	.27 - .34	83	82	350	L
	276615			460	60	1.15	34.8	22600	39.4	25800	.41 - .51	83	82	289	L
	276625			575	60	1.15	27.8	22600	31.6	25800	.70 - .86	83	82	231	L
	276656	30	22	200	60	1.15	95.0	28000	108.6	31900	.07 - .09	81	80	736	K
	276606			230	60	1.15	82.6	28000	94.4	31900	.09 - .12	81	80	640	K
	276666			380	60	1.15	50.0	28000	57.2	31900	.23 - .29	81	80	387	K
	276616			460	60	1.15	41.3	28000	47.2	31900	.34 - .42	81	80	320	K
	276626			575	60	1.15	33.0	28000	37.8	31900	.52 - .65	81	80	256	K
	276667	40	30	380	60	1.15	67.2	35900	76.0	42400	.18 - .23	84	83	545	L
	276617			460	60	1.15	55.4	35900	62.8	42400	.23 - .29	84	83	450	L
	276627			575	60	1.15	45.2	35900	50.2	42400	.34 - .43	84	83	360	L

Model numbers above are for three-lead motors. Six-lead motors with different model numbers have the same running performance, but when Wye connected for starting have locked rotor amps 33% of the values shown. Six-lead individual phase resistance = table X 1.5.

Three-Phase Motors

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Table 26 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX		RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
	STD	HI-TEMP	HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
6" STD. & HI-TEMP	236650	276650	5	3.7	200	60	35	45	50	25	45
	236600	276600			230	45	30	40	45	20	40
	236660	276660			380	30	17.5	25	30	12	25
	236610	276610			460	25	15	20	25	10	20
	236620	276620			575	20	12	15	20	8	15
	236651	276651	7.5	5.5	200	80	45	70	80	35	70
	236601	276601			230	70	40	60	70	30	60
	236661	276661			380	45	25	35	40	20	35
	236611	276611			460	35	20	30	35	15	30
	236621	276621			575	30	17.5	25	25	11	25
	236652	276652	10	7.5	200	100	60	90	100	45	90
	236602	276602			230	90	50	80	90	40	80
	236662	276662			380	60	35	45	50	25	45
	236612	276612			460	45	25	40	45	20	40
	236622	276622			575	35	20	30	35	15	30
	236653	276653	15	11	200	150	90	125	150	60	125
	236603	276603			230	150	80	110	125	60	110
	236663	276663			380	80	50	70	80	35	70
	236613	276613			460	70	40	60	60	30	60
	236623	276623			575	60	30	45	50	25	45
	236654	276654	20	15	200	200	110	175	175	80	175
	236604	276604			230	175	100	150	175	70	150
	236664	276664			380	100	60	90	100	45	90
	236614	276614			460	90	50	70	80	35	70
	236624	276624			575	70	40	60	70	30	60
	236655	276655	25	18.5	200	250	150	200	225	100	200
	236605	276605			230	225	125	175	200	90	175
	236665	276665			380	125	80	110	125	50	110
	236615	276615			460	110	60	90	100	45	90
	236625	276625			575	90	50	70	80	35	70
	236656	276656	30	22	200	300	175	250	300	125	250
	236606	276606			230	250	150	225	250	100	200
	236666	276666			380	150	90	125	150	60	125
	236616	276616			460	125	70	110	125	50	100
	236626	276626			575	100	60	90	100	40	80
	236667	276667	40	30	380	200	125	175	200	90	175
	236617	276617			460	175	100	150	175	70	150
	236627	276627			575	150	80	110	125	60	110
	236668	276668	50	37	380	250	150	225	250	110	225
	236618	276618			460	225	125	175	200	90	175
	236628	276628			575	175	100	150	175	70	150
	236669	276669	60	45	380	300	175	250	300	125	250
	236619	276619			460	250	150	225	250	100	225
	236629	276629			575	200	125	175	200	80	175

Three-Phase Motors

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Table 27 Three-Phase Motor Specifications (60 Hz) 3525 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	KILOWATTS	AMPS	KILOWATTS		S.F.	F.L.		
8" STD.	239660	40	30	380	60	1.15	64	35	72	40	.16-.20	86	86	479	J
	239600			460	60	1.15	53	35	60	40	.24-.30	86	86	396	J
	239610			575	60	1.15	42	35	48	40	.39-.49	86	86	317	J
	239661	50	37	380	60	1.15	79	43	88	49	.12-.16	87	87	656	K
	239601			460	60	1.15	64	43	73	49	.18-.22	87	87	542	K
	239611			575	60	1.15	51	43	59	49	.28-.34	87	87	434	K
	239662	60	45	380	60	1.15	92	52	104	60	.09-.11	88	87	797	K
	239602			460	60	1.15	76	52	86	60	.14-.17	88	87	658	K
	239612			575	60	1.15	61	52	69	60	.22-.28	88	87	526	K
	239663	75	55	380	60	1.15	114	64	130	73.5	.06-.09	88	88	1046	L
	239603			460	60	1.15	94	64	107	73.5	.10-.13	88	88	864	L
	239613			575	60	1.15	76	64	86	73.5	.16-.21	88	88	691	L
	239664	100	75	380	60	1.15	153	85	172	97.5	.05-.06	89	89	1466	L
	239604			460	60	1.15	126	85	142	97.5	.07-.09	89	89	1211	L
	239614			575	60	1.15	101	85	114	97.5	.11-.13	89	89	969	L
	239165	125	93	380	60	1.15	202	109	228	125	.03-.04	87	86	1596	K
	239105			460	60	1.15	167	109	188	125	.05-.07	87	86	1318	K
	239115			575	60	1.15	134	109	151	125	.08-.11	87	86	1054	K
	239166	150	110	380	60	1.15	235	128	266	146	.02-.03	88	87	1961	K
	239106			460	60	1.15	194	128	219	146	.04-.05	88	87	1620	K
	239116			575	60	1.15	164	128	182	146	.06-.08	88	87	1296	K
	239167	175	130	380	60	1.15	265	150	302	173	.02-.04	88	88	1991	J
	239107			460	60	1.15	219	150	249	173	.04-.05	88	88	1645	J
	239117			575	60	1.15	175	150	200	173	.06-.08	88	88	1316	J
	239168	200	150	380	60	1.15	298	169	342	194	.02-.03	88	88	2270	J
	239108			460	60	1.15	246	169	282	194	.03-.05	88	88	1875	J
	239118			575	60	1.15	197	169	226	194	.05-.07	88	88	1500	J

Table 27A 8" Three-Phase Motor Specifications (60 Hz) 3525 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	KILOWATTS	AMPS	KILOWATTS		S.F.	F.L.		
8" HI-TEMP	279160	40	30	380	60	1.15	69.6	38	78.7	43	.11 - .14	79	78	616	M
	279100			460	60	1.15	57.5	38	65.0	43	.16 - .19	79	78	509	M
	279110			575	60	1.15	46.0	38	52.0	43	.25 - .31	79	78	407	M
	279161	50	37	380	60	1.15	84.3	47	95.4	53	.07 - .09	81	80	832	M
	279101			460	60	1.15	69.6	47	78.8	53	.11 - .14	81	80	687	M
	279111			575	60	1.15	55.7	47	63.0	53	.18 - .22	81	80	550	M
	279162	60	45	380	60	1.15	98.4	55	112	62	.06 - .07	83	82	1081	N
	279102			460	60	1.15	81.3	55	92.1	62	.09 - .11	83	82	893	N
	279112			575	60	1.15	65.0	55	73.7	62	.13 - .16	83	82	715	N
	279163	75	56	380	60	1.15	125	68	141	77	.05 - .06	83	82	1175	L
	279103			460	60	1.15	100	68	114	77	.07 - .09	83	82	922	L
	279113			575	60	1.15	80	68	92	77	.11 - .14	83	82	738	L
	279164	100	75	380	60	1.15	159	88	181	100	.04 - .05	86	85	1508	M
	279104			460	60	1.15	131	88	149	100	.05 - .07	86	85	1246	M
	279114			575	60	1.15	105	88	119	100	.08 - .10	86	85	997	M
	279165	125	93	380	60	1.15	195	109	223	125	.03 - .04	86	85	1793	L
	279105			460	60	1.15	161	109	184	125	.04 - .06	86	85	1481	L
	279115			575	60	1.15	129	109	148	125	.07 - .09	86	85	1185	L
	279166	150	110	380	60	1.15	235	133	269	151	.02 - .03	85	84	2012	K
	279106			460	60	1.15	194	133	222	151	.03 - .05	85	84	1662	K
	279116			575	60	1.15	155	133	178	151	.05 - .07	85	84	1330	K

Model numbers above are for three-lead motors. Six-lead motors with different model numbers have the same running performance, but when Wye connected for starting have locked rotor amps 33% of the values shown. Six-lead individual phase resistance = table X 1.5.

Three-Phase Motors

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Table 28 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
8" STD.	239660	40	30	380	200	125	175	200	80	175
	239600			460	175	100	150	175	70	150
	239610			575	150	80	110	125	60	110
	239661	50	37	380	250	150	200	225	100	200
	239601			460	200	125	175	200	80	175
	239611			575	175	90	150	150	70	150
	239662	60	45	380	300	175	250	300	125	250
	239602			460	250	150	200	225	100	200
	239612			575	200	110	175	175	80	175
	239663	75	55	380	350	200	300	350	150	300
	239603			460	300	175	250	300	125	250
	239613			575	250	150	200	225	100	200
	239664	100	75	380	500	275	400	450	200	400
	239604			460	400	225	350	400	175	350
	239614			575	350	200	300	300	125	300
	239165	125	93	380	700	400	600	600	250	600
	239105			460	500	300	450	500	225	450
	239115			575	450	250	350	400	175	350
	239166	150	110	380	800	450	600	700	300	600
	239106			460	600	350	500	600	250	500
	239116			575	500	300	400	450	200	400
	239167	175	130	380	800	500	700	800	350	700
	239107			460	700	400	600	700	300	600
	239117			575	600	350	450	600	225	450
	239168	200	150	380	1000	600	800	1000	400	800
	239108			460	800	450	700	800	350	700
	239118			575	600	350	500	600	250	500

Table 28A 8" Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
8" HI-TEMP	279160	40	30	380	225	125	175	200	90	175
	279100			460	175	110	150	175	70	150
	279110			575	150	90	125	125	60	125
	279161	50	37	380	250	150	225	225	110	225
	279101			460	200	125	175	200	90	175
	279111			575	175	100	150	150	70	150
	279162	60	45	380	300	175	250	300	125	250
	279102			460	275	150	225	250	100	225
	279112			575	200	125	175	175	80	175
	279163	75	56	380	400	200	350	350	150	350
	279103			460	300	175	275	300	125	275
	279113			575	275	150	225	225	100	225
	279164	100	75	380	500	300	450	450	200	450
	279104			460	400	250	350	400	175	350
	279114			575	350	200	300	300	125	300
	279165	125	93	380	700	400	600	600	250	600
	279105			460	500	300	450	500	225	450
	279115			575	450	250	350	400	175	350
	279166	150	110	380	800	450	600	700	300	600
	279106			460	600	350	500	600	250	500
	279116			575	500	300	400	450	200	400

Three-Phase Motors

APPLICATION

Overload Protection of Three-Phase Submersible Motors

Class 10 Protection Required

The characteristics of submersible motors are different than standard motors and special overload protection is required.

If the motor is locked, the overload protection must trip within 10 seconds to protect the motor windings. Subtrol/ SubMonitor, a Franklin-approved adjustable overload relay, or a Franklin-approved fixed heater must be used.

Fixed heater overloads must be the ambient-compensated quick-trip type to maintain protection at high and low air temperatures.

All heaters and amp settings shown are based on total line amps. When determining amperage settings or making heater selections for a six-lead motor with a Wye-Delta starter, divide motor amps by 1.732.

Pages 29, 30 and 31 list the correct selection and settings for some manufacturers. Approval for other manufacturers' types not listed may be requested by calling Franklin's Technical Service Hotline at 800-348-2420.

Refer to notes on page 30.

Table 29 - 60 Hz 4" Motors

HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
				FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
1/2	0.37	200	00	K31	L380A	3.2	3.4
		230	00	K28	L343A	2.7	2.9
		380	00	K22	L211A	1.7	1.8
		460	00	-	L174A	1.4	1.5
		575	00	-	-	1.2	1.3
3/4	0.55	200	00	K34	L510A	4.1	4.4
		230	00	K32	L420A	3.5	3.8
		380	00	K27	L282A	2.3	2.5
		460	00	K23	L211A	1.8	1.9
		575	00	K21	L193A	1.5	1.6
1	0.75	200	00	K37	L618A	5.0	5.4
		230	00	K36	L561A	4.4	4.7
		380	00	K28	L310A	2.6	2.8
		460	00	K26	L282A	2.2	2.4
		575	00	K23	L211A	1.8	1.9
1.5	1.1	200	00	K42	L750A	6.3	6.8
		230	00	K39	L680A	5.5	5.9
		380	00	K32	L420A	3.3	3.6
		460	00	K29	L343A	2.8	3.0
		575	00	K26	L282A	2.2	2.4
2	1.5	200	0	K50	L111B	8.6	9.3
		230	0	K49	L910A	7.5	8.1
		380	0	K36	L561A	4.6	4.9
		460	00	K33	L463A	3.8	4.1
		575	00	K29	L380A	3.0	3.2
3	2.2	200	0	K55	L147B	11.6	12.5
		230	0	K52	L122B	10.1	10.9
		380	0	K41	L750A	6.1	6.6
		460	0	K37	L618A	5.1	5.5
		575	0	K34	L510A	4.1	4.4
5	3.7	200	1	K62	L241B	19.1	20.5
		230	1	K61	L199B	16.6	17.8
		380	0	K52	L122B	10.0	10.8
		460	0	K49	L100B	8.3	8.9
		575	0	K42	L825A	6.6	7.1
7.5	5.5	200	1	K68	L322B	28.4	30.5
		230	1	K67	L293B	24.6	26.4
		380	1	K58	L181B	14.9	16.0
		460	1	K55	L147B	12.3	13.2
		575	1	K52	L122B	9.9	10.6
10	7.5	380	1	K62	L241B	19.5	21.0
		460	1	K60	L199B	16.1	17.3
		575	1	K56	L165B	12.9	13.6
15	11	380	2 (1)	K70	L322B	29	31.2
		460	2 (1)	K67	L265B	24.0	25.8
		575	2 (1)	K62	L220B	19.3	20.7

Three-Phase Motors

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Table 30 – 60 Hz 6" Standard & Hi-Temp Motors

HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
				FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
5	3.7	200	1	K61	L220B	17.6	19.1
		230	1	K61	L199B	15.4	16.6
		380	0	K52	L122B	9.4	10.1
		460	0	K49	L100B	7.7	8.3
		575	0	K42	L825A	6.1	6.6
7.5	5.5	200	1	K67	L322B	26.3	28.3
		230	1	K64	L293B	22.9	24.6
		380	1	K57	L165B	13.9	14.9
		460	1	K54	L147B	11.4	12.3
		575	1	K52	L111B	9.1	9.8
10	7.5	200	2(1)	K72	L426B	34.4	37.0
		230	2(1)	K70	L390B	29.9	32.2
		380	1	K61	L220B	18.1	19.5
		460	1	K58	L181B	15.0	16.1
		575	1	K55	L147B	12.0	12.9
15	11	200	3(1)	K76	L650B	50.7	54.5
		230	2	K75	L520B	44.1	47.4
		380	2(1)	K68	L322B	26.7	28.7
		460	2(1)	K64	L265B	22.0	23.7
		575	2(1)	K61	L220B	17.7	19.0
20	15	200	3	K78	L787B	64.8	69.7
		230	3(1)	K77	L710B	56.4	60.6
		380	2	K72	L426B	34.1	36.7
		460	2	K69	L352B	28.2	30.3
		575	2	K64	L393B	22.7	24.4
25	18.5	200	3	K86	L107C	80.3	86.3
		230	3	K83	L866B	69.8	75.0
		380	2	K74	L520B	42.2	45.4
		460	2	K72	L426B	34.9	37.5
		575	2	K69	L352B	27.9	30.0
30	22	200	4(1)	K88	L126C	96.7	104.0
		230	3	K87	L107C	84.1	90.4
		380	3(1)	K76	L650B	50.9	54.7
		460	3(1)	K74	L520B	42.0	45.2
		575	3(1)	K72	L390B	33.7	36.2
40	30	380	3	K83	L866B	69.8	75.0
		460	3	K77	L710B	57.7	62.0
		575	3	K74	L593B	46.1	49.6
50	37	380	3	K87	L107C	86.7	93.2
		460	3	K83	L950B	71.6	77.0
		575	3	K77	L710B	57.3	61.6
60	45	380	4(1)	K89	L126C	102.5	110.2
		460	4(1)	K87	L107C	84.6	91.0
		575	4(1)	K78	L866B	67.7	72.8

Footnotes for Tables 29, 30, 31, and 31A

NOTE 1: Furnas intermediate sizes between NEMA starter sizes apply where (1) is shown in tables, size 1.75 replacing 2, 2.5 replacing 3, 3.5 replacing 4, and 4.5 replacing 5. Heaters were selected from Catalog 294, table 332 and table 632 (starter size 00, size B). Size 4 starters are heater type 4 (JG). Starters using these heater tables include classes 14, 17, and 18 (inNOVA), classes 36 and 37 (reduced voltage), and classes 87, 88, and 89 (pump and motor control centers). Overload relay adjustments should be set no higher than 100% unless necessary to stop nuisance tripping with measured amps in all lines below nameplate maximum. Heater selections for class 16 starters (Magnetic Definite Purpose) will be furnished upon request.

NOTE 2: General Electric heaters are type CR123 usable only on type CR124 overload relays and were selected from Catalog GEP-1260J, page 184. Adjustment should be set no higher than 100%, unless necessary to stop nuisance tripping with measured amps in all lines below nameplate maximum.

NOTE 3: Adjustable overload relay amp settings apply to approved types listed. Relay adjustment should be set at the specified SET amps. Only if tripping occurs with amps in all lines measured to be within nameplate maximum amps should the setting be increased, not to exceed the MAX value shown.

NOTE 4: Heaters shown for ratings requiring NEMA size 5 or 6 starters are all used with current transformers per manufacturer standards. Adjustable relays may or may not use current transformers depending on design.

Three-Phase Motors

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Table 31 - 60 Hz 8" Motors

MOTOR MODEL PREFIX	HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
					FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
239660	40	30	380	3	K78	L866B	68	73
239600			460	3	K77	L710B	56	60
239610			575	3	K73	L520B	45	48
239661	50	37	380	3	K86	L107C	81	87
239601			460	3	K78	L866B	68	73
239611			575	3	K77	L710B	56	60
239662	60	45	380	4(1)	K89	L126C	101	108
239602			460	4(1)	K86	L107C	83	89
239612			575	4(1)	K78	L787B	64	69
239663	75	55	380	4	K92	L142C	121	130
239603			460	4(1)	K89	L126C	100	107
239613			575	4(1)	K85	L950C	79	85
239664	100	75	380	5(1)	K28	L100B	168	181
239604			460	4	K92	L155C	134	144
239614			575	4	K90	L142C	108	116
239165	125	93	380	5	K32	L135B	207	223
239105			460	5(1)	K29	L111B	176	189
239115			575	5(1)	K26	L825A	140	150
239166	150	110	380	5	-	L147B	248	267
239106			460	5(1)	K32	L122B	206	221
239116			575	5(1)	K28	L100B	169	182
239167	175	130	380	6	K26	-	270	290
239107			460	5	K33	L147B	233	250
239117			575	5	K31	L111B	186	200
239168	200	150	380	6	K27	-	316	340
239108			460	5	K33	L165B	266	286
239118			575	5	K32	L135B	213	229

Table 31A - 60 Hz 8" Hi-Temp 75°C Motors

MOTOR MODEL PREFIX	HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
					FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
279160	40	30	380	3	K83	L866B	73	79
279100			460	3	K77	L710B	60	65
279110			575	3	K74	L593B	48	52
279161	50	37	380	3	K87	L107C	89	95
279101			460	3	K83	L866B	73	79
279111			575	3	K77	L710B	59	63
279162	60	45	380	4(1)	K89	L126C	104	112
279102			460	4(1)	K87	L107C	86	92
279112			575	4(1)	K78	L866B	69	74
279163	75	56	380	4	K92	L155C	131	141
279103			460	4(1)	K89	L126C	106	114
279113			575	4(1)	K87	L950C	86	92
279164	100	75	380	5(1)	K28	L100B	168	181
279104			460	5(1)	K26	L825A	139	149
279114			575	4	K90	L142C	111	119
279165	125	93	380	5	K32	L135B	207	223
279105			460	5(1)	K29	L111B	171	184
279115			575	5(1)	K26	L825A	138	148
279166	150	110	380	5	-	L147B	250	269
279106			460	5(1)	K32	L122B	206	222
279116			575	5(1)	K28	L100B	166	178

Note: Other relay types from these and other manufacturers may or may not provide acceptable protection, and they should not be used without approval of Franklin Electric.

Some approved types may only be available for part of the listed motor ratings. When relays are used with current transformers, relay setting is the specified amps divided by the transformer ratio.

Recommended Adjustable Overload Relays

Advance Controls: MDR3 Overload

AEG Series: B17S, B27S, B27-2

ABB Type: RVH 40, RVH65, RVP160, T25DU, T25CT, TA25DU

AGUT: MT03, R1K1, R1L0, R1L3, TE set Class 5

Allen Bradley: Bulletin 193, SMP-Class 10 only

Automatic Switch Types: DQ, LR1-D, LR1-F, LR2 Class 10

Benshaw: RSD6 (Class 10) Soft Start

Bharita C-H: MC 305 ANA 3

Clipsal: 6CTR, 6MTR

Cutler-Hammer: C316F, C316P, C316S, C310-set at 6 sec max, Advantage Class10

Fanal Types: K7 or K7D through K400

Franklin Electric: Subtrol-Plus, SubMonitor, IPS, SSP, IPS-RV, and SPS-RV

Fuji Types: TR-0Q, TR-0QH, TR-2NQ, TR- 3NQ, TR-4NQ, TR-6NQ, RCa 3737-ICQ & ICQH

Furnas Types: US15 48AG & 48BG, 958L, ESP100-Class 10 only, 3RB10-Class 10

General Electric: CR4G, CR7G, RT*1, RT*2, RTF3, RT*4, CR324X-Class 10 only

Kasuga: RU Set Operating Time Code = 10 & time setting 6 sec max

Klockner-Moeller Types: Z00, Z1, Z4, PKZM1, PKZM3 & PKZ2

Lovato: RC9, RC22, RC80, RF9, RF25 & RF95

Matsushita: FKT-15N, 15GN, 15E, 15GE, FT-15N, FHT-15N

Mitsubishi: ET, TH-K12ABKP, TH-K20KF, TH-K20KP, TH-K20TAKF, TH-K60KF, TH-K60TAKF

Omron: K2CM Set Operating Timing Code = 10 & time setting 6 sec max, SE-KP24E time setting 6 sec max

Riken: PM1, PM3

Samwha: EOCRS Set for Class 5, EOCR-ST, EOCR-SE, EOCR-AT time setting 6 sec max

Siemens Types: 3UA50, -52, -54, -55, -58, -59, -60, -61, -62, -66, -68, -70, 3VUI3, 3VE, 3UB (Class 5)

Sprecher and Schuh Types: CT, CT1, CTA 1, CT3K, CT3-12 thru CT3-42, KTA3, CEF1 & CET3 set at 6 sec max, CEP 7 Class 10, CT4, 6, & 7, CT3, KT7

Square D/Telemecanique: Class 9065 Types: TD, TE, TF, TG, TJ, TK, TR, TJE &TJF (Class 10), LR1-D, LR1-F, LR2 Class 10, Types 18A, 32A, SS-Class 10, SR-Class 10 and 63-A-LB Series. Integral 18,32,63, GV2-L, GV2-M, GV2-P, GV3-M (1.6-10 amp only) LR9D, SF Class 10, ST Class 10, LT6 (Class 5 or 10), LRD (Class 10), Motor Logic (Class10)

Toshiba Type: 2E RC820, set at 8 sec max.

WEG: RW2

Westinghouse Types: FT13, FT23, FT33, FT43, K7D, K27D, K67D, Advantage (Class 10), MOR, IQ500 (Class 5)

Westmaster: 0LWR00 and 0LWT00 suffix D thru P

Form 2207 – Action Facts

SUBMERSIBLE MOTOR INSTALLATION RECORD

INFORMATION SUPPLEMENT

1.0 MOTOR

1.1 Verify motor nameplate data meets the application – hp, voltage, phase, and Hertz.

1.2 Check that the motor shaft rotates freely by hand on the second of two complete rotations. (On large motors, this usually requires a motor coupling with a cheater handle welded to it.)

1.3 Check that the motor lead assembly is not damaged.

1.4 Measure insulation resistance to ground at 500 volts – BEFORE SUBMERGED. It should be a minimum of 200 megohms or 200,000,000 ohms.

1.5 Measure insulation resistance to ground at 500 volts – AFTER SUBMERGED. It should be a minimum of 0.5 megohms or 500,000 ohms.

1.6 Verify the system is operating within the ±10% of nameplate voltage requirement.

1.7 Verify the system will not ever operate in excess of the maximum amps indicated on the nameplate.

1.8 Verify the system is operating at 5% or less current unbalance.

Notice:

- If current unbalance exceeds 5%, the maximum operating amps must be derated to the nameplate Full Load Amps.
- Warning - System current unbalance can not exceed 10% without causing heating and mechanical wear issues.
- The submersible motor amperage % unbalance is typically 6x greater than its voltage % unbalance.
- Thus, 0.8% voltage unbalance = greater than 5% current unbalance, and 1.7% voltage unbalance = greater than 10% current unbalance.

2.0 PUMP

2.1 Verify the pump nameplate and curve data meets the application hp, rpm, and flow/TDH requirements.

2.2 Verify the pump NPSH requirement will be met at all times.

2.3 Check that the pump shaft rotates freely by hand before installation.

2.4 Check that the pump shaft moves up about ¼ inch when it is coupled to the motor.

2.5 Check that the pump guard is not pinching the motor leads, especially where it enters and exits the guard.

Notice:

- Pumps and motors 5 hp and above should be assembled in a vertical position to ensure correct alignment.
- A motor-pump assembly 5 hp and above should never be lifted from a non-vertical position by the pump discharge because it can bend the shaft in one or both of the products.

3.0 POWER SUPPLY (3-PHASE)

3.1 Verify the transformer kVA rating is adequate for the motor per the Franklin Application (AIM) manual requirement.

3.2 Verify that all transformers have the same kVA rating.

3.3 Verify the 3-Ph pump panel fuses or its circuit breaker are correctly sized per the Franklin Application (AIM) manual requirement.

3.4 Verify the 3-Ph pump panel motor contactor is correctly sized per the Franklin Application (AIM) manual requirement.

3.5 Verify the 3-Ph pump panel motor overload is ambient compensated.

3.6 Verify the 3-Ph pump panel motor overload has a NEMA Class 10 trip curve.

3.7 Verify the 3-Ph pump panel motor overload heaters or its dial setting are correctly selected based on the system's operating point and not just arbitrarily set at the maximum motor operating amps.

3.8 At no time should the system operating amps or the motor overload system running point setting be higher than the motor nameplate maximum amp rating.

Notice:

- Electronic overloads should be set at the normal system operation point.
- Electronic overloads have a built-in multiplier of 115-125% times the input amps to determine the overload trip point.

4.0 POWER SUPPLY (1-PHASE)

4.1 Verify the transformer kVA rating is adequate for the motor per the Franklin Application (AIM) manual requirement.

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SUBMERSIBLE MOTORS INSTALLATION RECORD

4.2 Verify the motor control box and the motor are made by the same manufacturer.

4.3 Verify the motor control box hp rating and its voltage match the motor rating exactly. If not, a premature failure of the control box or motor should be expected.

5.0 HIGH SURGE PROTECTION

5.1 Verify the submersible motor has a dedicated surge arrestor.
All submersible motors require a dedicated surge arrestor.
Motors 5 hp and smaller marked "Equipped with Lightning Arrestors", have a built-in surge arrestor.

5.2 Verify the surge arrestor is mounted as close to the motor as practical.
The location is usually in the pump panel, but sometimes it is placed at the well head in a separate electrical box.

5.3 Verify the surge arrestor is grounded below the lowest drawdown water level.
This is usually accomplished by attaching the drop cable ground wire to the motor lead or the motor ground lug.

5.4 Verify the ground conductor size meets the minimum requirements of the National Electric Code and all other relevant national, state, regional and local codes.

5.5 Verify the motor is connected to both the electrical system ground and the motor.

6.0 ELECTRICAL DROP CABLE

6.1 Verify the temperature rating of the drop cable – typically 60 °C, 75 °C, 90 °C or 125 °C.

6.2 Verify if the cable is single conductor or jacketed conductor. Web cable is considered jacketed cable by regulating agencies.

6.3 Verify the conductor size – typically AWG, MCM or mm^2.

6.4 Verify if the conductor material is copper; if not, determine the material and contact the factory for acceptability.

6.5 Verify the drop cable meets or exceeds the requirements of the Franklin Application (AIM) manual.

Notice:

- If the service entrance to pump panel or the pump panel to motor cable is not a copper material, contact the factory for the correct length derating factors.

7.0 MOTOR COOLING

7.1 Verify that the well water temperature does not exceed the maximum ambient temperature indicated on the nameplate of the motor.

7.2 Verify there is a minimum of 10 feet of clear water between the bottom of the motor and the bottom of the well.

7.3 Verify that all water entering the well is coming from below the lowest part of the motor.

7.4 Verify the system pumping rate will never deliver less flow than is required by the Franklin Application (AIM) manual to flow by-and-around the full length of the motor for cooling purposes.

7.5 Verify that 3-phase motors above 7.5 hp in a vertical potable water well should not exceed 100 starts in 24 hours and each start should include a minimum of 3 minutes ON and 10 minutes OFF.

Notice:

- If any water is entering the well above the lowest part of the motor, a flow sleeve is required.

8.0 MOTOR-PUMP INSTALLATION

8.1 Verify that the drop cable is supported to the drop pipe every 10 feet.

8.2 Verify at least one spring loaded (non-drilled) check valve is in the drop pipe.
Preferably, the first check valve should be located at the top of the first pipe joint above the pump discharge (~20 feet) if the pump does not have a check built in to its discharge.

8.3 Verify all pipe joints are as tight as practical.
The minimum torque should never be less than 10 foot-pounds times the motor nameplate hp rating.

8.4 Verify the rotation of the pump is correct.
It is preferable to do this by checking the flow and current in both directions on 3-phase motors.
This can be done by having the electrician swap any two leads.
This is considered "best practice" since pumps under some conditions can supply amp readings and a visual flow observation that can be extremely misleading.

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SUBMERSIBLE MOTORS INSTALLATION RECORD

RMA Number

KEY DEALER #

DISTRIBUTOR	INSTALLER	END USER
Name:	Name:	Name:
City:	City:	City:
State: Zip:	State: Zip:	State: Zip:

Well ID or GPS: _____ _____ _____ Water Temperature: _____ ☐ °F ☐ °C

Application/Water Use (e.g. potable water, irrigation, municipal, fountain, etc.): _____

Date Installed (mm/yy): _____ Date Failed (mm/yy): _____ Motor Position Shaft-Up: ☐ Yes ☐ No

Operating Cycle: ON Time Per Start _____ ☐ Hrs. ☐ Mins. Time OFF Between Stop & Restart _____ ☐ Hrs. ☐ Mins.

MOTOR

Model: _____ Serial Number: _____ Date Code (if updated): _____

MOTOR OVERLOAD

System Typical Operating Current: _____ Amps @ _____ Volts

Overload: ☐ FE SubMonitor Input Amps _____ D3 Attached ☐ Yes ☐ No Fault Settings Attached ☐ Yes ☐ No

☐ Other Manufacturer Model: _____ Dial Set at: _____ or Heater# _____

NEMA Class: ☐ 10 ☐ 20 ☐ 30 Ambient Compensated: ☐ Yes ☐ No

Power to Motor by: ☐ Full Volt Starter ☐ VFD ☐ Soft Starter VFD or Soft Starter Mfr. & Model: _____

PUMP

Manufacturer: _____

Model: _____

Stages: _____

Design Rating: _____ gpm @ _____ ft TDH

Horsepower Required by Pump End: _____

Actual Pump Delivery: _____ gpm @ _____ psi

What Controls When System Runs & Stops:

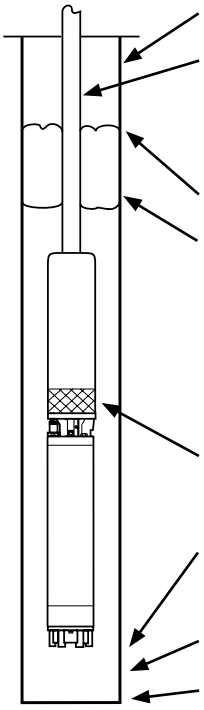
_____

(e.g. pressure, level, flow, manual on/off, timer, time clock etc.)

YOUR NAME / DATE

_____ / _____

WELL DATA (All measurements from well head down.)



Casing Diameter _____ in

Drop Pipe Diameter _____ in

Drop Pipe Material _____ PVC _____ Steel _____ Poly _____ Other

Number of Sticks of Drop Pipe _____

Static Water Level _____ ft

Drawdown (pumping) Water Level _____ ft

Spring Assist Check Valves:
(Measured from Well Head Down)

#1 _____ #2 _____ #3 _____ #4 _____ ft

☐ Solid ☐ Drilled Poppet ☐ Break-Off Plug

Pump Inlet Setting _____ ft

Flow Sleeve ☐ No ☐ Yes, Dia. _____ in

Case Ends _____ ft

☐ Well Screen ☐ Perforated Casing

#1 from ____ to ____ ft & #2 from ____ to ____ ft

Well Depth _____ ft

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Franklin Electric

Form 2207 – Page 2

SUBMERSIBLE MOTORS INSTALLATION RECORD

RMA Number

TRANSFORMERS

Number of Transformers: ☐ Two ☐ Three Transformers Supply Motor Only: ☐ Yes ☐ No ☐ Unsure

Transformer #1: _____ kVA Transformer #2: _____ kVA Transformer #3: _____ kVA

POWER CABLES & GROUND WIRE

1 **Service Entrance to Pump Control Panel:**

Length: _____ ft. & Gauge: _____ AWG/MCM

Material: ☐ Copper ☐ Aluminum Construction: ☐ Jacketed ☐ Individual Conductors ☐ Web ☐ Twisted

Temperature Rating of Cable: ☐ 60C ☐ 75C ☐ 90C ☐ 125C or Insulation Type: _____ (e.g. THHN)

2 **Pump Control Panel to Motor:**

Length: _____ ft. & Gauge: _____ AWG/MCM

Material: ☐ Copper ☐ Aluminum Construction: ☐ Jacketed ☐ Individual Conductors ☐ Web ☐ Twisted

Temperature Rating of Cable: ☐ 60C ☐ 75C ☐ 90C ☐ 125C or Insulation Type: _____ (e.g. THHN)

3 **Ground Wire Size:** From Control Panel to Motor: _____ AWG/MCM

Control Grounded to (mark all that apply):

☐ Well Head ☐ Metal Casing ☐ Motor ☐ Driven Rod ☐ Power Supply

INCOMING VOLTAGE

No Load L1-L2 _____ L2-L3 _____ L1-L3 _____

Full Load L1-L2 _____ L2-L3 _____ L1-L3 _____

RUNNING AMPS & CURRENT BALANCE

Full Load L1 _____ L2 _____ L3 _____

% Unbalance: _____

CONTROL PANEL

1 **Pump Panel Manufacturer/Fabricator:** _____

2 **Short Circuit Protection – Fuses or Circuit Breaker**

Option #1 – Fuse

Manufacturer: _____ Model: _____ Rating: _____ Amps

Type: ☐ Time-Delay ☐ Standard

Option #2 – Circuit Breaker

Manufacturer: _____ Model: _____ Rating: _____ Amps Setting: _____

3 **Starter – Full Voltage, Reduced Voltage, Soft-Starter or VFD (Variable Frequency Drive)**

Option #1 – Full Voltage

Manufacturer: _____ Model: _____ Size: _____ Contacts: ☐ NEMA ☐ IEC

Option #2 – Reduced Voltage

Manufacturer: _____ Model: _____ Ramp Time to Full Voltage: _____ sec.

Option #3 – Soft-Starter or VFD

Manufacturer: _____ Model: _____ Max. Continuous Amp Output Rating: _____

Min. Setting: _____ Hz & GPM: _____ Max. Setting: _____ Hz & GPM: _____

Start Ramp Time to 30 Hz: _____ sec. Stop Mode: ☐ Power Off Coast ☐ 30-0 Hz Ramp _____ sec.

Special Output Filter Purchased: ☐ Yes ☐ No

Output Filter Manufacturer: _____ Model: _____ % Reactance: _____

4 **Surge Arrestor:** ☐ No ☐ Yes, Manufacturer: _____ Model: _____

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Franklin Electric

Booster Install Record

SUBMERSIBLE MOTOR

RMA Number

Date _____/_____/_____ Filled In By _____

INSTALLATION

Owner/User _____ Telephone (_____) _____

Address _____ City _____ State _____ Zip _____

Installation Site, If Different _____

Contact _____ Telephone (_____) _____

System Application _____

_____

_____

System Manufactured By _____ Model _____ Serial No. _____

System Supplied By _____ City _____ State _____ Zip _____

Is this a "HERO" system (10.0 - 10.5 PH)? ☐ Yes ☐ No

MOTOR

Model No. _____ Serial No. _____ Date Code _____

Horsepower _____ Voltage _____ ☐ Single-Phase ☐ Three-Phase Diameter _____ in.

Slinger Removed? ☐ Yes ☐ No Check Valve Plug Removed? ☐ Yes ☐ No

Motor Fill Solution ☐ Standard ☐ DI Water Model No. _____ Serial No. _____ Date Code _____

PUMP

Manufacturer _____ Model _____ Serial No. _____

Stages _____ Diameter _____ Flow Rate Of _____ gpm At _____TDH

Booster Case Internal Diameter _____ Material _____

CONTROLS AND PROTECTIVE DEVICES

SubMonitor? ☐ Yes ☐ No If Yes, Warranty Registration No. _____

If Yes, Overload Set? ☐ Yes ☐ No _____ Set At _____

Underload Sets? ☐ Yes ☐ No _____ Set At _____

VFD or Reduced Voltage Starter? ☐ Yes ☐ No If Yes, Type _____

Mfr. _____ Setting _____ % Full Voltage In _____ sec

Pump Panel? ☐ Yes ☐ No If Yes, Mfr. _____ Size _____

Magnetic Starter/Contactor Mfr. _____ Model _____ Size _____

Heaters Mfr. _____ No. _____ If Adjustable Set At _____

Fuses Mfr. _____ Size _____ Type _____

Surge Arrestor Mfr. _____ Model _____

Controls Are Grounded to _____ with No. _____ Wire

Inlet Pressure Control	☐ Yes	☐ No	If Yes, Mfr. _____	Model _____	Setting _____ psi	Delay _____ sec
Inlet Flow Control	☐ Yes	☐ No	If Yes, Mfr. _____	Model _____	Setting _____ gpm	Delay _____ sec
Outlet Pressure Control	☐ Yes	☐ No	If Yes, Mfr. _____	Model _____	Setting _____ psi	Delay _____ sec
Outlet Flow Control	☐ Yes	☐ No	If Yes, Mfr. _____	Model _____	Setting _____ gpm	Delay _____ sec
Water Temperature Control	☐ Yes	☐ No	If Yes, Mfr. _____	Model _____		Delay _____ sec

Set At _____ °F or _____ °C Located _____

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Franklin Electric

Booster Installation Record

SUBMERSIBLE MOTOR

INSULATION CHECK

Initial Megs: Motor & Lead Only	Black (T1/U1)_____	Yellow (T2/V1)_____	Red (T3/W1)_____
Installed Megs: Motor, Lead, & Cable	Black (T1/U1)_____	Yellow (T2/V1)_____	Red (T3/W1)_____

VOLTAGE TO MOTOR

Non-Operating:	B-Y (T1/U1 - T2/V1)_____	Y-R (T2/V1 - T3/W1)_____	R-B (T3/W1 - T1/U1)_____
At Rated Flow of _____gpm	B-Y (T1/U1 - T2/V1)_____	Y-R (T2/V1 - T3/W1)_____	R-B (T3/W1 - T1/U1)_____
At Open Flow _____gpm	B-Y (T1/U1 - T2/V1)_____	Y-R (T2/V1 - T3/W1)_____	R-B (T3/W1 - T1/U1)_____

AMPS TO MOTOR

At Rated Flow of _____gpm	Black (T1/U1)_____	Yellow (T2/V1)_____	Red (T3/W1)_____
At Open Flow _____gpm	Black (T1/U1)_____	Yellow (T2/V1)_____	Red (T3/W1)_____
At Shut-Off*	Black (T1/U1)_____	Yellow (T2/V1)_____	Red (T3/W1)_____

*Do **NOT** run at Shut-Off more than two (2) minutes.

Inlet Pressure _____psi Outlet Pressure _____psi Water Temperature _____ °F or _____ °C

If you have any questions or problems, call the Franklin Electric Toll-Free Hot Line: 1-800-348-2420

Comments: _____

_____

_____

_____

PLEASE SKETCH THE SYSTEM

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Franklin Electric

Three-Phase Motors

APPLICATION

SubMonitor Three-Phase Protection

Applications

SubMonitor is designed to protect 3-phase pumps/motors with service factor amp ratings (SFA) from 5 to 350 A (approx. 3 to 200 hp). Current, voltage, and motor temperature are monitored using all three legs and allows the user to set up the SubMonitor quickly and easily.

Protects Against

- Under/Overload
- Under/Overvoltage
- Current Unbalance
- Overheated Motor (if equipped with Subtrol Heat Sensor)
- False Start (Chattering)
- Phase Reversal

This product is lead free.

Power Factor Correction

In some installations, power supply limitations make it necessary or desirable to increase the power factor of a submersible motor. Table 32 lists the capacitive kVAR required to increase the power factor of large Franklin three-phase submersible motors to the approximate values shown at maximum input loading.

Capacitors must be connected on the line side of the overload relay, or overload protection will be lost.

Table 32 kVAR Required 60 Hz

MOTOR		KVAR REQUIRED FOR PF OF:		
HP	KW	0.90	0.95	1.00
5	3.7	1.2	2.1	4.0
7.5	5.5	1.7	3.1	6.0
10	7.5	1.5	3.3	7.0
15	11	2.2	4.7	10.0
20	15	1.7	5.0	12.0
25	18.5	2.1	6.2	15.0
30	22	2.5	7.4	18.0
40	30	4.5	11.0	24.0
50	37	7.1	15.0	32.0
60	45	8.4	18.0	38.0
75	55	6.3	18.0	43.0
100	75	11.0	27.0	60.0
125	93	17.0	36.0	77.0
150	110	20.0	42.0	90.0
175	130	9.6	36.0	93.0
200	150	16.0	46.0	110.0

Values listed are total required (not per phase).

Three-Phase Motors

APPLICATION

Three-Phase Starter Diagrams

Three-phase combination magnetic starters have two distinct circuits: a power circuit and a control circuit.

The power circuit consists of a circuit breaker or fused line switch, contacts, and overload heaters connecting incoming power lines L1, L2, L3 and the three-phase motor.

The control circuit consists of the magnetic coil, overload contacts, and a control device such as a pressure switch. When the control device contacts are closed, current flows through the magnetic contactor coil, the contacts close, and power is applied to the motor. Hand-Off-Auto switches, start timers, level controls, and other control devices may also be in series in the control circuit.

Line Voltage Control

This is the most common type of control encountered. Since the coil is connected directly across the power lines L1 and L2, the coil must match the line voltage.

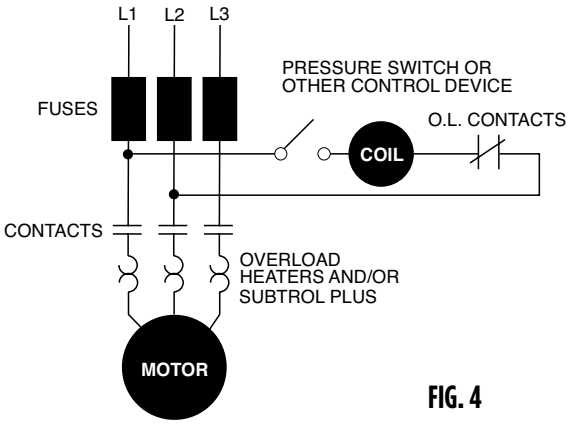


FIG. 4

Low Voltage Transformer Control

This control is used when it is desirable to operate push buttons or other control devices at some voltage lower than the motor voltage. The transformer primary must match the line voltage and the coil voltage must match the secondary voltage of the transformer.

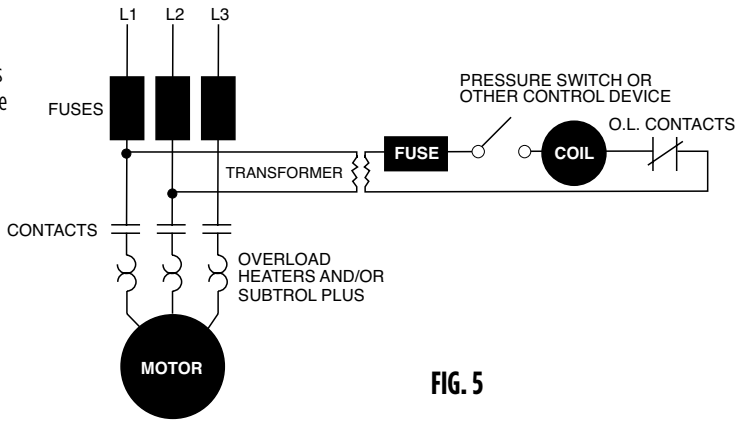


FIG. 5

External Voltage Controls

Control of a power circuit by a lower circuit voltage can also be obtained by connecting to a separate control voltage source. The coil rating must match the control voltage source, such as 115 or 24 volts.

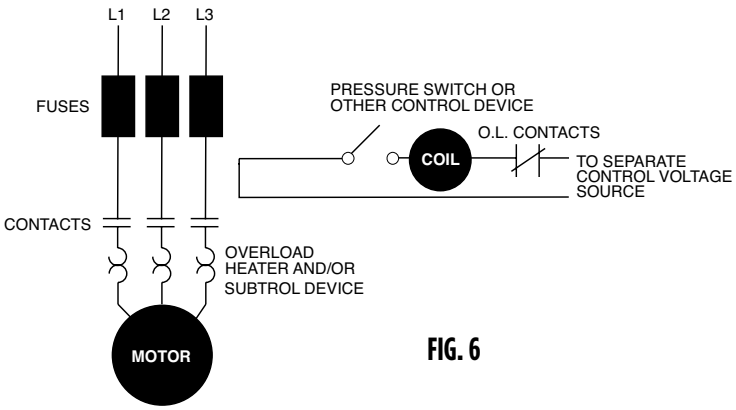


FIG. 6

Three-Phase Motors

APPLICATION

Three-Phase Power Unbalance

A full three-phase supply is recommended for all three-phase motors, consisting of three individual transformers or one three-phase transformer. So-called "open" Delta or Wye connections using only two transformers can be used, but are more likely to cause problems, such as poor performance, overload tripping or early motor failure due to current unbalance.

Transformer rating should be no smaller than listed in Table 4 for supply power to the motor alone.

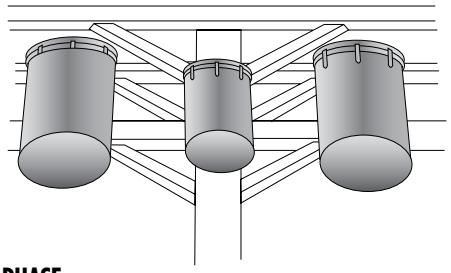


FIG. 7
FULL THREE-PHASE

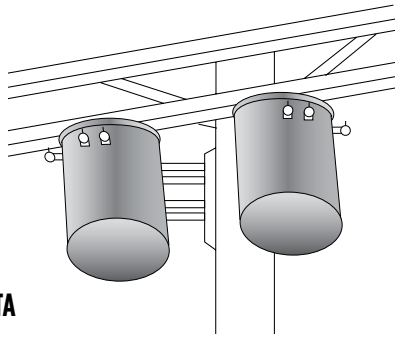


FIG. 8
OPEN DELTA

Checking and Correcting Rotation and Current Unbalance

1. Establish correct motor rotation by running the motor in both directions. Normal rotation is CCW viewing the shaft end. Rotation can be changed by interchanging any two of the three motor leads. The rotation that gives the most water flow is typically the correct rotation.
2. After correct rotation has been established, check the current in each of the three motor leads and calculate the current unbalance as explained in 3 below.

   If the current unbalance is 2% or less, leave the leads as connected.

   If the current unbalance is more than 2%, current readings should be checked on each leg using each of three possible hook-ups. Roll the motor leads across the starter in the same direction to prevent motor reversal.
3. To calculate percent of current unbalance:
   - A. Add the three line amps values together
   - B. Divide the sum by three, yielding average current
   - C. Pick the amp value which is furthest from the average current (either high or low)
   - D. Determine the difference between this amp value(furthest from average) and the average
   - E. Divide the difference by the average. Multiply the result by 100 to determine percent of unbalance
4. Current unbalance should not exceed 5% at max amp load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the "power side" of the system. If the reading farthest from average moves with the same motor lead, the primary source of unbalance is on the "motor side" of the starter. In this instance, consider a damaged cable, leaking splice, poor connection, or faulty motor winding.

Phase designation of leads for CCW rotation viewing shaft end.

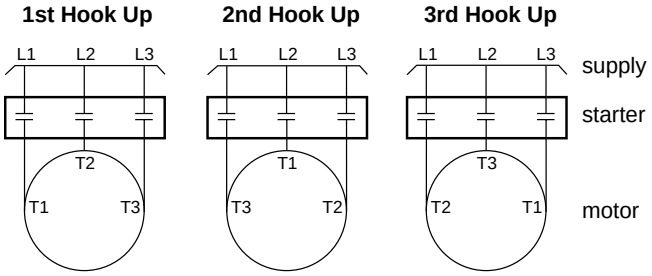
To reverse rotation, interchange any two leads.

Phase 1 or "A" - Black, T1, or U1

Phase 2 or "B" - Yellow, T2, or V1

Phase 3 or "C" - Red, T3, or W1

NOTICE: Phase 1, 2, and 3 may not be L1, L2, and L3.



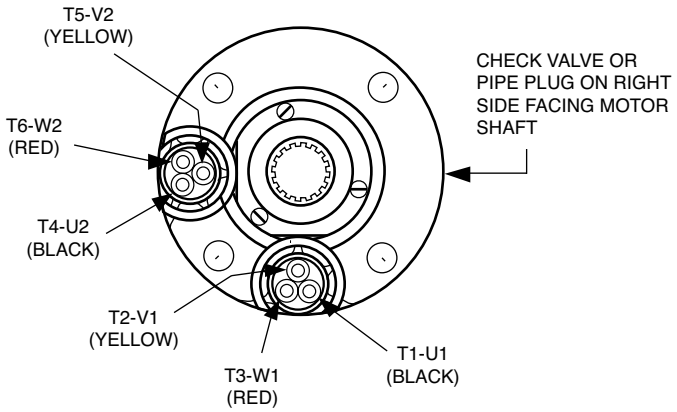
EXAMPLE:

T1 = 51 amps	T3 = 50 amps	T2 = 50 amps T2 = 46
amps	T1 = 49 amps	T3 = 48 amps T3 = 53
+ amps	+ T2 = 51 amps	+ T1 = 52 amps
Total = 150 amps	Total = 150 amps	Total = 150 amps
$\frac{150}{3}$ = 50 amps	$\frac{150}{3}$ = 50 amps	$\frac{150}{3}$ = 50 amps
50 - 46 = 4 amps	50 - 49 = 1 amp	50 - 48 = 2 amps
$\frac{4}{50}$ = 0.08 or 8%	$\frac{1}{50}$ = 0.02 or 2%	$\frac{2}{50}$ = 0.04 or 4%

Three-Phase Motor Lead Identification

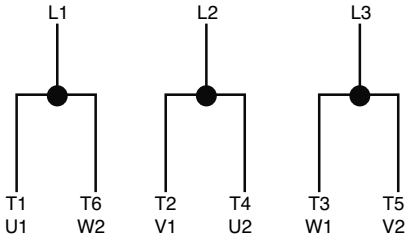
WARNING: When installing 6-lead motors extra care must be used to ensure lead identification at the surface. Leads must be marked and connected per diagram. Motor leads are not connected red to red, yellow to yellow, etc.

Line Connections — Six-Lead Motors

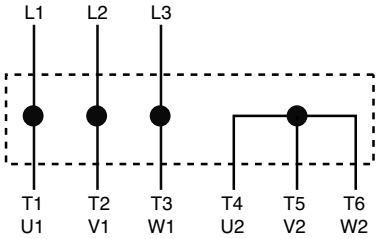


90° Lead Spacing

Connections for across-the-line starting, running, and any reduced voltage starting except WYE-DELTA type starters.



WYE-DELTA starters connect the motor as shown below during starting, then change to the running connection shown at the left.



Each motor lead is numbered with two markers, one near each end. To reverse rotation, interchange any two line connections.

Phase Converters

There are a number of different types of phase converters available. Each generates three-phase power from a single-phase power line.

In all phase converters, the voltage balance is critical to current balance. Although some phase converters may be well balanced at one point on the system-operating curve, submersible pumping systems often operate at differing points on the curve as water levels and operating pressures fluctuate. Other converters may be well balanced at varying loads, but their output may vary widely with fluctuations in the input voltage.

The following guidelines have been established for submersible installations to be warrantable when used with a phase converter.

1. Limit pump loading to rated horsepower. Do not load into motor service factor.
2. Maintain at least 3 ft/s flow past the motor. Use a flow sleeve when necessary.
3. Use time delay fuses or circuit breakers in pump panel. Standard fuses or circuit breakers do not provide secondary motor protection.
4. SubMonitor will not work with electronic solid state or electro mechanical phase converters.
5. Current unbalance must not exceed 10%.

Reduced Voltage Starters

All Franklin three-phase submersible motors are suitable for full-voltage starting. Under this condition the motor speed goes from zero to full speed within a half second or less. The motor current goes from zero to locked rotor amps, then drops to running amps at full speed. This may dim lights, cause momentary voltage dips to other electrical equipment, and shock power distribution transformers.

In some cases the power companies may require reduced-voltage starters to limit this voltage dip. There are also times when reduced-voltage starters may be desirable to reduce motor starting torque thus reducing the stress on shafts, couplings, and discharge piping. Reduced-voltage starters also slow the rapid acceleration of the water on start-up to help control upthrust and water hammer.

Reduced-voltage starters may not be required if the maximum recommended cable length is used. With maximum recommended cable length there is a 5% voltage drop in the cable at running amps, resulting in about 20% reduction in starting current and about 36% reduction in starting torque compared to having rated voltage at the motor. This may be enough reduction in starting current so that reduced-voltage starters are not required.

Three-Lead Motors: Autotransformer or solid-state reduced-voltage starters may be used for soft-starting standard three-phase motors.

When autotransformer starters are used, the motor should be supplied with at least 55% of rated voltage to ensure adequate starting torque. Most autotransformer starters have 65% and 80% taps. Setting the taps on these starters depends on the percentage of the maximum allowable cable length used in the system. If the cable length is less than 50% of the maximum allowable, either the 65% or the 80% taps may be used. When the cable length is more than 50% of allowable, the 80% tap should be used.

Six-Lead Motors: Wye-Delta starters are used with six-lead Wye-Delta motors. All Franklin 6" and 8" three-phase motors are available in six-lead Wye-Delta construction. Consult the factory for details and availability. Part winding starters are not compatible with Franklin Electric submersible motors and should not be used.

Wye-Delta starters of the open-transition type, which momentarily interrupt power during the starting cycle, are not recommended. Closed-transition starters have no interruption of power during the start cycle and can be used with satisfactory results.

Reduced-voltage starters have adjustable settings for acceleration ramp time, typically preset at 30 seconds. They must be adjusted so the motor is at full voltage within THREE SECONDS MAXIMUM to prevent excessive radial and thrust bearing wear.

If Subtrol-Plus or SubMonitor is used the acceleration time must be set to TWO SECONDS MAXIMUM due to the 3 second reaction time of the Subtrol-Plus or SubMonitor.

Solid-state starters AKA soft starts may not be compatible with Subtrol-Plus/ SubMonitor. However, in some cases a bypass contactor has been used. Consult the factory for details.

During shutdown, Franklin Electric's recommendation is for the power to be removed, allowing the pump/motor to coast down. Stopping the motor by ramping down the voltage is possible, but should be limited to three (3) seconds maximum.

Inline Booster Pump Systems

Franklin Electric offers three different types of motors for non-vertical applications.

1. The **Booster** motors are specifically designed for booster applications. They are the **"Best Choice" for sealed Reverse Osmosis applications.** These motors are the result of two years of focused development and bring additional value and durability to booster module systems. These motors are only available to OEMs or Distributors who have demonstrated capability in Booster Module systems design and operation and adhere to Franklin's Application Manual requirements.

2. The **Hi-Temp** motors have many of the internal design features of the Booster motor. It's additional length allows for higher temperature handling and the Sand Fighter sealing system provides greater abrasion resistance. One or both of these conditions are often experienced in open atmosphere applications such as lakes, ponds, etc.

3. The **Standard Vertical Water Well** (40-125 hp) motors can be adapted to non-vertical applications when applied per the below guidelines. However, they will be more sensitive to application variances than the other two designs.

All of the above motors must be applied per the guidelines listed below. In addition, for all applications where the motor is applied in a sealed system, a Submersible Motor Booster Installation Record (Form 3655) or its equivalent must be completed at start-up and received by Franklin Electric within 60 days. A sealed system is one where the motor and pump intake are mounted in a sleeve and the water feeding the pump intake is not open to the atmosphere.

Continued on next page

Inline Booster Pump Systems (Continued)

Design And Operational Requirements

1. **Non-Vertical Operation:** Vertical Shaft-up (0°) to Horizontal (90°) operation is acceptable as long as the pump transmits "down-thrust" to the motor within 3 seconds after start-up and continuously during operation. However, it is best practice to provide a positive slope whenever it is possible, even if it is only a few degrees.

2. **Motor, Sleeve, and Pump Support System:** The booster sleeve ID must be sized according to the motor cooling and pump NPSHR requirements. The support system must support the motor's weight, prevent motor rotation, and keep the motor and pump aligned. The support system must also allow for thermal axial expansion of the motor without creating binding forces.

3. **Motor Support Points:** A minimum of two support points are required on the motor. One in the motor/pump flange connection area and one in the bottom end of the motor area. The motor castings, not the shell area, are recommended as support points. If the support is a full length support and/or has bands in the shell area, they must not restrict heat transfer or deform the shell.

4. **Motor Support Material and Design:** The support system shall not create any areas of cavitation or other areas of reduced flow less than the minimum rate required by this manual. They should also be designed to minimize turbulence and vibration and provide stable alignment. The support materials and locations must not inhibit the heat transfer away from the motor.

5. **Motor and Pump Alignment:** The maximum allowable misalignment between the motor, pump, and pump discharge is 0.025 inch per 12 inches of length (2 mm per 1000 mm of length). This must be measured in both directions along the assembly using the motor/pump flange connection as the starting point. The booster sleeve and support system must be rigid enough to maintain this alignment during assembly, shipping, operation, and maintenance.

6. **Lubrication and Heat Resistance:** The best motor lubrication and heat resistance is obtained with the factory based propylene glycol fill solution. Only when an application MUST HAVE deionized (DI) water should the factory fill solution be replaced. When a deionized water fill is required, the motor must be derated as indicated on the below chart. The exchange of the motor fill solution to DI water must be done by an approved Franklin service shop or representative using a vacuum fill system per Franklin's Motor Service Manual instruction. The motor shell then must be permanently stamped with a D closely behind the Serial Number.

   The maximum pressure that can be applied to the motor internal components during the removal of the factory fill solution is 7 psi (0.5 bar.)

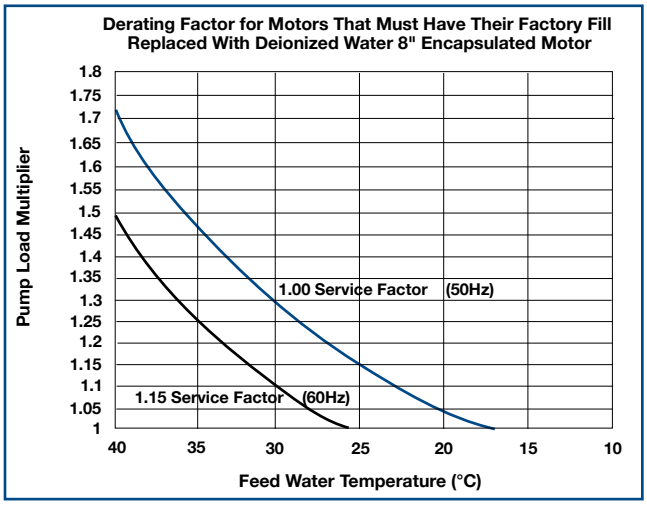


FIG. 9

First: Determine maximum Feed Water Temperature that will be experienced in this application. If the feed water exceeds the maximum ambient of the motor, both the DI water derating and a hot water application derating must be applied.

Second: Determine the Pump Load Multiplier from the appropriate Service Factor curve. (Typical 1.15 Service Factor is for 60 Hz ratings & 1.00 Service Factor for 50 Hz ratings).

Third: Multiply the Pump Load Requirement times the pump load multiplier number indicated on the vertical axis to determine the Minimum Motor Nameplate Rating.

Fourth: Select a motor with a nameplate equal or higher than the above calculated value.

7. **Motor Alterations - Sand Slinger & Check Valve Plug:** On 6" and 8" motors, the rubber sand slinger located on the shaft must be removed. If a pipe plug is covering the check valve, it must be removed. The special Booster motor already has these modifications.

8. **Frequency of Starts:** Fewer than 10 starts per 24-hour period are recommended. Allow at least 20 minutes between shutdown and start-up of the motor.

9. **Controls-Soft Starters and VFDs:** Reduced voltage starters and variable speed drives (inverter drives) may be used with Franklin three-phase submersible motors to reduce starting current, upthrust, and mechanical stress during start-up. The guidelines for their use with submersible motors are different than with normal air cooled motor applications. Refer to the Franklin Electric Application, Installation, and Maintenance (AIM) manual Reduced Voltage Starters section or Variable Speed Submersible Pump Operation, Inverter Drives sections for specific details including required filtering.

Continued on next page

Inline Booster Pump Systems (Continued)

10. **Motor Overload Protection:** Submersible motors require properly sized ambient compensated Class 10 quick-trip overloads per Franklin's AIM manual guidelines to protect the motor. Class 20 or higher overloads are NOT acceptable. Franklin's SubMonitor is strongly recommended for all large submersibles since it is capable of sensing motor heat without any additional wiring to the motor. Applications using Soft Starters with a SubMonitor require a start-up bypass - consult the factory for details. SubMonitor can not be used in applications using a VFD control.

11. **Motor Surge Protection:** Properly sized, grounded and dedicated motor surge arrestors must be installed in the supply line of the booster module as close to the motor as possible. This is required on all systems including those using soft-starters and variable speed drives (inverter drives).

12. **Wiring:** Franklin's lead assemblies are only sized for submerged operation in water to the motor nameplate maximum ambient temperature and may overheat and cause failure or serious injury if operated in air. Any wiring not submerged must meet applicable national and local wiring codes and Franklin Cable Chart Tables 16-21. (Notice: wire size, wire rating, and insulation temperature rating must be known when determining its suitability to operate in air or conduit. Typically, for a given size and rating, as the insulation temperature rating increases its ability to operate in air or conduit also increases.)

13. **Check Valves:** Spring-loaded check valves must be used on start-up to minimize motor upthrusting, water hammer, or in multiple booster (parallel) applications to prevent reverse flow.

14. **Pressure Relief Valves:** A pressure relief valve is required and must be selected to ensure that, as the pump approaches shut-off, it never reaches the point that the motor will not have adequate cooling flow past it.

15. **System Purge (Can Flooding):** An air bleeder valve must be installed on the booster sleeve so that flooding may be accomplished prior to booster start-up. Once flooding is complete, the booster should be started and brought up to operating pressure as quickly as possible to minimize the duration of an upthrust condition. At no time should air be allowed to gather in the booster sleeve because this will prevent proper cooling of the motor and permanently damage it.

16. **System Flush – Must Not Spin Pump:** Applications may utilize a low flow flushing operation. Flow through the booster sleeve must not spin the pump impellers and the motor shaft. If spinning takes place, the bearing system will be permanently damaged and the motor life shortened. Consult the booster pump manufacturer for maximum flow rate through the pump when the motor is not energized.

17. **Open Atmosphere Booster Pump Systems:** When an open booster is placed in a lake, tank, etc. that is open to atmospheric pressure, the water level must provide sufficient head pressure to allow the pump to operate above its NPSHR requirement at all times and all seasons. Adequate inlet pressure must be provided prior to booster start-up.

Table 38 Franklin Cable chart (See item 12 Wiring above)

CABLE TEMP. RATING (°C)	MOTOR NAMEPLATE RATED AMPS FULL LOAD	#10 AWG		#8 AWG		#6 AWG		#4 AWG		#2 AWG	
		IN AIR	IN CONDUIT	IN AIR	IN CONDUIT	IN AIR	IN CONDUIT	IN AIR	IN CONDUIT	IN AIR	IN CONDUIT
75	3-LEAD (DOL)	40A	28A	56A	40A	76A	52A	100A	68A	136A	92A
	6-LEAD (Y-Δ)	69A	48A	97A	69A	132A	90A	173A	118A	236A	159A
90	3-LEAD (DOL)	44A	32A	64A	44A	84A	60A	112A	76A	152A	104A
	6-LEAD (Y-Δ)	76A	55A	111A	76A	145A	104A	194A	132A	263A	180A
125	3-LEAD (DOL)	66A	46A	77A	53A	109A	75A	153A	105A	195A	134A
	6-LEAD (Y-Δ)	114A	80A	133A	91A	188A	130A	265A	181A	337A	232A

Based on 30 °C maximum ambient with cable length of 100 feet or less.

Continued on next page

Inline Booster Pump Systems (Continued)

Four Continuous Monitoring System Requirements for Sealed Booster Systems.

1. **Water Temperature:** Feed water on each booster must be continuously monitored and not allowed to exceed the motor nameplate maximum ambient temperature at any time. IF THE INLET TEMPERATURE EXCEEDS THE MOTOR NAMEPLATE MAXIMUM AMBIENT TEMPERATURE, THE SYSTEM MUST SHUTDOWN IMMEDIATELY TO PREVENT PERMANENT MOTOR DAMAGE. If feed water temperatures are expected to be above the allowable temperature, the motor must be derated. See Franklin's AIM manual Hot Water Applications section for derating guidelines. (The high temperature feed water derating is in addition to the exchange to DI water derating if the motor factory fill solution was exchanged to DI water.)

2. **Inlet Pressure:** The inlet pressure on each booster module must be continuously monitored. It must always be positive and higher than the NPSHR (Net Positive Suction Head Requirement) of the pump. A minimum of 20 PSIG (1.38 Bar) is required at all times, except for 10 seconds or less when the motor is starting and the system is coming up to pressure. Even during these 10 seconds the pressure must remain positive and be higher than the NPSHR (Net Positive Suction Head Requirement) of the pump.

   PSIG is the actual value displayed on a pressure gauge in the system piping. PSIG is the pressure above the atmospheric conditions. If at any time these pressure requirements are not being met, the motor must be de-energized immediately to prevent permanent damage to the motor. Once the motor is damaged, it is usually not immediately noticeable, but progresses and results in a premature motor failure weeks or months after the damage occurred.

   Motors that will be exposed to pressure in excess of 500 psi (34.47 Bar) must undergo special high pressure testing. Consult factory for details and availability.

3. **Discharge Flow:** The flow rate for each pump must not be allowed to drop below the motor minimum cooling flow requirement. IF THE MOTOR MINIMUM COOLING FLOW REQUIREMENT IS NOT BEING MET FOR MORE THAN 10 SECONDS, THE SYSTEM MUST BE SHUT DOWN IMMEDIATELY TO PREVENT PERMANENT MOTOR DAMAGE.

4. **Discharge Pressure:** The discharge pressure must be monitored to ensure that a downthrust load toward the motor is present within 3 seconds after start-up and continuously during operation. IF THE MOTOR DISCHARGE PRESSURE IS NOT ADEQUATE TO MEET THIS REQUIREMENT, THE SYSTEM MUST BE SHUT DOWN IMMEDIATELY TO PREVENT PERMANENT MOTOR DAMAGE.

Three-Phase Motors

APPLICATION

Variable Frequency Drive Submersible Motor Requirements

Franklin Electric's three-phase, encapsulated submersible motors can be used with variable frequency drives (VFD) when applied within the guidelines below.

All three-phase, encapsulated submersible motors must have the VFD sized based on the motor's nameplate maximum amps, not horsepower. The continuous rated amps of the VFD must be equal to or greater than the motor's nameplate maximum amps or warranty will be void.

Franklin Electric's single-phase, 2- and 3-wire, encapsulated submersible motors can only be used with the appropriate Franklin constant pressure controller.

Franklin Electric's submersible motor Application, Installation, Maintenance (AIM) manual should be checked for the latest guidelines and can be found online at www.franklin-electric.com.

WARNING: There is a potential shock hazard from contact with and/or touching the insulated cables connected to the variable frequency drive output anytime the motor has energy applied.

Output Filter Requirement Test:

NOTICE: An incoming power supply or line-side filter for the drive does not replace the need for additional output filters.

An output filter is required if the answer is yes to one or both of the items below:

#1 - Does the peak voltage at the motor terminals exceed 1000-volts or is the rise time of the VFD's voltage less than 2 micro-seconds? Per NEMA MG 1-2011, the rise time is defined as the time between 10% and 90% of the steady-state voltage (i.e., DC bus voltage).

#2 - Is the motor nameplate voltage more than 379 Volts and is the cable from drive-to-motor more than 50 ft (15.2 m)?

NOTICE:
More than 99% of the drives applied on water well submersible motors will require the purchase of additional output filtering based on question #1.

Output filters can be expensive. However, when needed, it is required for the motor to be considered for warranty. Make sure this item is not overlooked when quoting a job.

PWM dV/dt value can be defined as: the rate at which voltage is changing with time or how fast the voltage is accelerating. This information can be supplied by the drive manufacturer or the manufacturer's drive specification sheet. The dV/dt value cannot be measured with typical field equipment, even when using a true-RMS voltage/amperage multi-meter.

Franklin Electric has a line of VFDs that are specifically designed for Franklin application systems. These VFDs are used in the MonoDrive and SubDrive constant pressure systems. Franklin drive systems have the required additional output filtering installed; however, the SubDrive HPX does not.

Types of Output Filters:

A resistor-inductor-capacitor (RLC) filter has both a high pass filter & a low pass filter section and are considered the best practice, but a high pass reactor filter is also acceptable.

Filters should be recommended by the drive manufacturer; for the correct recommendations provide them with answers to all five of the items below.

REQUIRED ITEMS FOR PROPER VFD FILTER SIZING:

(1) VFD model (2) Carrier frequency setting (3) Motor nameplate voltage (4) Motor nameplate max amps (5) Cable length from the drive output terminals to the motor

Input Current & Motor Overload Protection:

- Motor input current should be set at the system's typical operating current when running at nameplate rated voltage and frequency (Hz).
- Motor overload protection should be set to trip at 115% of the system's typical operating current.
- Motor overload protection must trip equal to or faster than NEMA Class 10 motor overload curve requirements.

Motor Maximum Load Limits:

- The system must never operate in excess of the motor nameplate maximum amps.
- On 50 Hz motors, nameplate amps are maximum amps as these motors have a 1.0 service factor.

Variable Frequency Drive Submersible Motor Requirements (Continued)

Motor Operating Hertz, Cooling Requirements, and Underload Settings:

- Standard practice for large VFD installations is to limit the operation to 60 Hz max. Operating at greater than 60 Hz requires special system design considerations.
- The motor must never operate below 30 Hz. This is the minimum speed required to provide correct bearing lubrication.
- The motor's operating speed must always operate so the minimum water flow requirements of 0.5 ft/sec for 6-inch & 8-inch motors and 0.25 ft/sec for 4-inch motors is supplied.
- The motor underload protection is normally set to trip at 80% of the system's typical operating current. However, the underload trip point must be selected so that minimum flow requirements are always met.

Starting and Stopping Ramp Settings:

- The motor must reach or pass the 30 Hz operating speed within 1 second of the motor being energized. If this does not occur, the motor bearings will be damaged and the motor life reduced.
- The best stopping method is to turn power off followed by a natural coast to stop.
- A controlled stop from 30 Hz to 0 Hz is allowed if the time does not exceed 1 second.

Drive Carrier Frequency:

- The carrier frequency is set in the field. The drive typically has a selectable range between 2k and 12k Hz. The higher the carrier wave frequency setting, the greater the voltage spikes; the lower the carrier wave frequency setting, the rougher/poorer the shape of the power curve.
- The carrier frequency should be set within the range of 4k to 5k Hz for encapsulated submersible motors.

Application Function Setting:

- If the VFD has a setting of centrifugal pump or propeller fan it should be used.
- Centrifugal pumps and fans have similar load characteristics.

VFD Frequency of Starts:

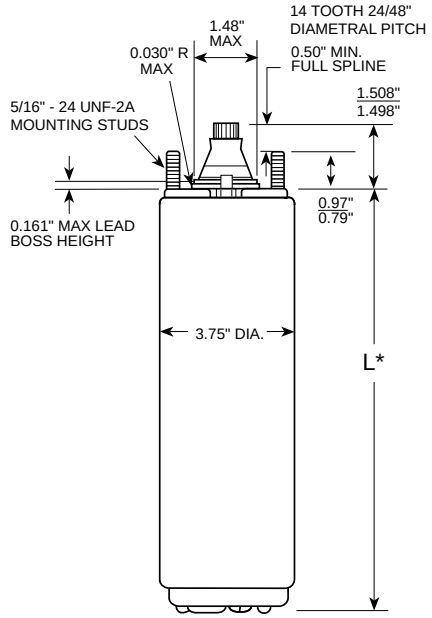
- Keeping the starts per day within the recommended numbers shown in the frequency of starts section of the AIM manual provides the best system life. However, since in-rush current is typically reduced when used with a properly configured VFD, large 3-phase submersible motors can be started more frequently. In all cases a minimum of 7 minutes must be allowed between a power off and the next restart attempt or consecutive restart attempts.

NEMA MG1 Above Ground Motor Standard Comments:

- Franklin Electric encapsulated submersible motors are not declared inverter duty motors by NEMA MG1 standards. The reason is NEMA MG1 standard part 31 does not include a section covering encapsulated winding designs.
- Franklin submersible motors can be used with VFDs without problems or warranty concerns providing Franklin's Application, Installation, Maintenance (AIM) manual guidelines are followed. See Franklin's on-line AIM manual for the latest guidelines.

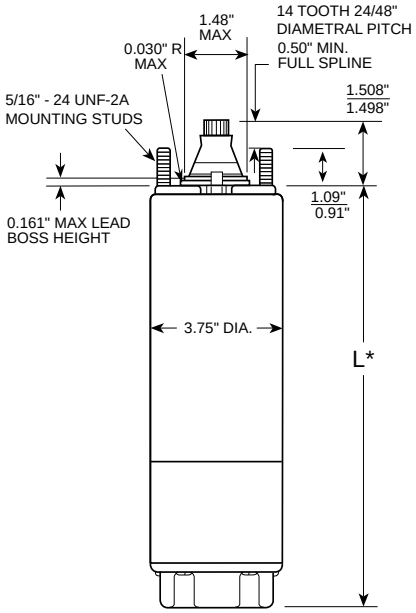
4" Super Stainless — Dimensions

(Standard Water Well)



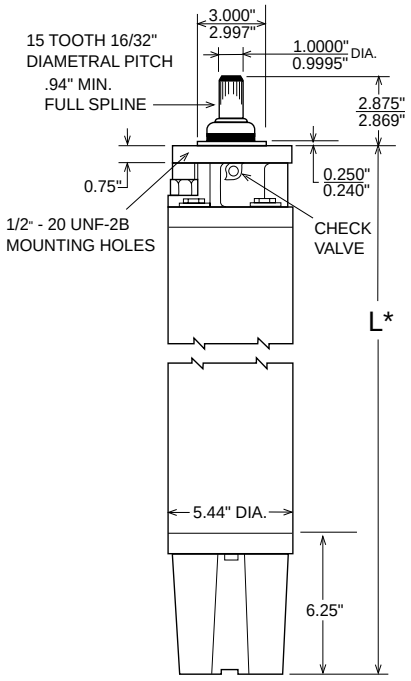
4" High Thrust — Dimensions

(Standard Water Well)



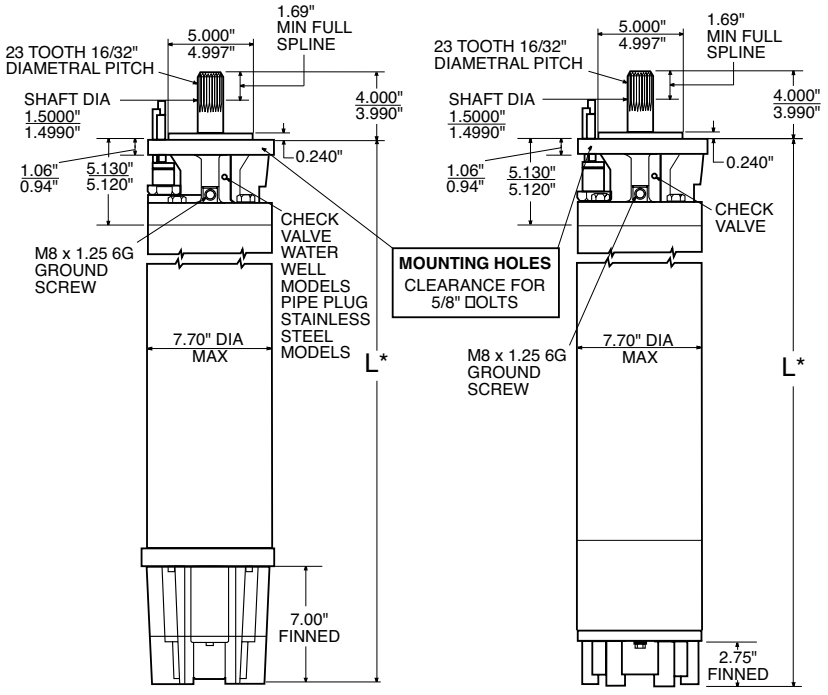
6" — Dimensions

(Standard Water Well)



8" — Dimensions

(Standard Water Well)



40 to 100 hp

75 to 200 hp

*** Motor lengths and shipping weights are available on Franklin Electric's web site (www.franklin-electric.com) or by calling Franklin's Technical Service Hotline (800-348-2420).**

Tightening Motor Lead Connector Jam Nut

4" Motors with Jam Nut:
15 to 20 ft-lb (20 to 27 Nm)

4" Motors with 2 Screw Clamp Plate:
35 to 45 in-lb (40 to 51 Nm)

6" Motors:
40 to 50 ft-lb (54 to 68 Nm)

8" Motors with 1-3/16" to 1-5/8" Jam Nut:
50 to 60 ft-lb (68 to 81 Nm)

8" Motors with 4 Screw Clamp Plate:
Apply increasing torque to the screws equally in a criss-cross pattern until 80 to 90 in-lb (9.0 to 10.2 Nm) is reached.

Jam nut tightening torques recommended for field assembly are shown. Rubber compression set within the first few hours after assembly may reduce the jam nut torque. This is a normal condition which does not indicate reduced seal effectiveness. Retightening is not required, but is permissible and recommended if original torque was questionable.

A motor lead assembly should not be reused. A new lead assembly should be used whenever one is removed from the motor, because rubber set and possible damage from removal may prevent proper resealing of the old lead.

All motors returned for warranty consideration must have the lead returned with the motor.

Pump to Motor Coupling

Assemble coupling with non-toxic FDA approved waterproof grease such as Mobile FM222, Texaco CYGNUS2661, or approved equivalent. This prevents abrasives from entering the spline area and prolongs spline life.

Pump to Motor Assembly

After assembling the motor to the pump, torque mounting fasteners to the following:

4" Pump and Motor: 10 lb-ft (14 Nm)

6" Pump and Motor: 50 lb-ft (68 Nm)

8" Pump and Motor: 120 lb-ft (163 Nm)

Shaft Height and Free End Play

Table 43

MOTOR	NORMAL SHAFT HEIGHT		DIMENSION SHAFT HEIGHT		FREE END PLAY	
					MIN.	MAX.
4"	1 1/2"	38.1 mm	1.508" / 1.498"	38.30 / 38.05 mm	0.010" 0.25 mm	0.045" 1.14 mm
6"	2 7/8"	73.0 mm	2.875" / 2.869"	73.02 / 72.88 mm	0.030" 0.76 mm	0.050" 1.27 mm
8" TYPE 1	4"	101.6 mm	4.000" / 3.990"	101.60 / 101.35 mm	0.008" 0.20 mm	0.032" 0.81 mm
8" TYPE 2.1	4"	101.6 mm	4.000" / 3.990"	101.60 / 101.35 mm	0.030" 0.76 mm	0.080" 2.03 mm

If the height, measured from the pump-mounting surface of the motor, is low and/or end play exceeds the limit, the motor thrust bearing is possibly damaged, and should be replaced.

Submersible Leads and Cables

A common question is why motor leads are smaller than specified in Franklin's cable charts.

The leads are considered a part of the motor and actually are a connection between the large supply wire and the motor winding. The motor leads are short and there is virtually no voltage drop across the lead.

In addition, the lead assemblies **operate under water**, while at least part of the supply cable must **operate in air.** Lead assemblies running under water operate cooler.

CAUTION: Lead assemblies on submersible motors are suitable only for use in water and may overheat and cause failure if operated in air.

System Troubleshooting

Motor Does Not Start

POSSIBLE CAUSE	CHECKING PROCEDURES	CORRECTIVE ACTION
A. No power or incorrect voltage	Check voltage at line terminals. The voltage must be ± 10% of rated voltage.	Contact power company if voltage is incorrect.
B. Fuses blown or circuit breakers tripped	Check fuses for recommended size and check for loose, dirty or corroded connections in fuse receptacle. Check for tripped circuit breakers.	Replace with proper fuse or reset circuit breakers.
C. Defective pressure switch	Check voltage at contact points. Improper contact of switch points can cause voltage less than line voltage.	Replace pressure switch or clean points.
D. Control box malfunction	For detailed procedure, see pages 48-57.	Repair or replace.
E. Defective wiring	Check for loose or corroded connections or defective wiring.	Correct faulty wiring or connections.
F. Bound pump	Check for misalignment between pump and motor or a sand bound pump. Amp readings will be 3 to 6 times higher than normal until the overload trips.	Pull pump and correct problem. Run new installation until the water clears.
G. Defective cable or motor	For detailed procedure, see pages 46 & 47.	Repair or replace.

Motor Starts Too Often

A. Pressure switch	Check setting on pressure switch and examine for defects.	Reset limit or replace switch.
B. Check valve - stuck open	Damaged or defective check valve will not hold pressure.	Replace if defective.
C. Waterlogged tank	Check air charge.	Clean or replace.
D. Leak in system	Check system for leaks.	Replace damaged pipes or repair leaks.

System Troubleshooting

Motor Runs Continuously

POSSIBLE CAUSE	CHECKING PROCEDURES	CORRECTIVE ACTION
A. Pressure switch	Check switch for welded contacts. Check switch adjustments.	Clean contacts, replace switch, or adjust setting.
B. Low water level in well	Pump may exceed well capacity. Shut off pump, wait for well to recover. Check static and drawdown level from well head.	Throttle pump output or reset pump to lower level. Do not lower if sand may clog pump.
C. Leak in system	Check system for leaks.	Replace damaged pipes or repair leaks.
D. Worn pump	Symptoms of worn pump are similar to those of drop pipe leak or low water level in well. Reduce pressure switch setting, if pump shuts off worn parts may be the fault.	Pull pump and replace worn parts.
E. Loose coupling or broken motor shaft	Check for loose coupling or damaged shaft.	Replace worn or damaged parts.
F. Pump screen blocked	Check for clogged intake screen.	Clean screen and reset pump depth.
G. Check valve stuck closed	Check operation of check valve.	Replace if defective.
H. Control box malfunction	See pages 48-57 for single-phase.	Repair or replace.

Motor Runs But Overload Protector Trips

A. Incorrect voltage	Using voltmeter, check the line terminals. Voltage must be within ± 10% of rated voltage.	Contact power company if voltage is incorrect.
B. Overheated protectors	Direct sunlight or other heat source can raise control box temperature causing protectors to trip. The box must not be hot to touch.	Shade box, provide ventilation or move box away from source.
C. Defective control box	For detailed procedures, see pages 48-57.	Repair or replace.
D. Defective motor or cable	For detailed procedures, see pages 45 & 46.	Repair or replace.
E. Worn pump or motor	Check running current, see tables 13, 22, 24, 25, & 27.	Replace pump and/or motor.

Table 46 Preliminary Tests - All Sizes Single- and Three-Phase

TEST	PROCEDURE	WHAT IT MEANS
Insulation Resistance (Fig. 10)	1. Open master breaker and disconnect all leads from control box or pressure switch (QD type control, remove lid) to avoid electric shock hazard and damage to the meter. 2. Use a megohmmeter set to 1000-volt (500-volt minimum). If using an ohmmeter, set to R X 100k. Zero the meter. 3. Connect one meter lead to any one of the motor leads and the other lead to the metal drop pipe. If the drop pipe is plastic, connect the meter lead to ground.	1. If the ohms value is normal (Table 47), the motor is not grounded and the cable insulation is not damaged. 2. If the ohms value is below normal, either the windings are grounded or the cable insulation is damaged. Check the cable at the well seal as the insulation is sometimes damaged by being pinched.
Winding Resistance (Fig 11.)	1. Open master breaker and disconnect all leads from control box or pressure switch (QD type control, remove lid) to avoid electric shock hazard and damage to the meter. 2. Use a multi-meter set to 20 ohms or an ohmmeter set to R X 1 for values under 10 ohms. Use next scale up for values over 10 ohms. Zero the meter. 3. On 3-wire motors measure the resistance of yellow to black (main winding) and yellow to red (start winding). On 2-wire motors: measure the resistance from line-to-line. Three-phase motors: measure the resistance line-to-line for all three combinations.	1. If all ohms values are normal (Tables 13, 22, 24, 25, & 27), the motor windings are neither shorted nor open, and the cable colors are correct 2. If any one value is less than normal, the motor is shorted. 3. If any one ohm value is greater than normal, the winding or the cable is open, or there is a poor cable joint or connection. 4. If some ohms values are greater than normal and some less on single-phase motors, the leads are mixed. See page 48 to verify cable colors.

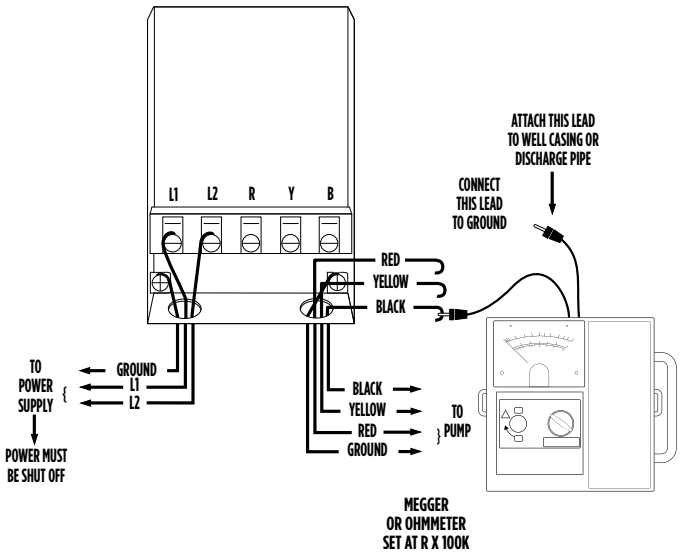


FIG. 10

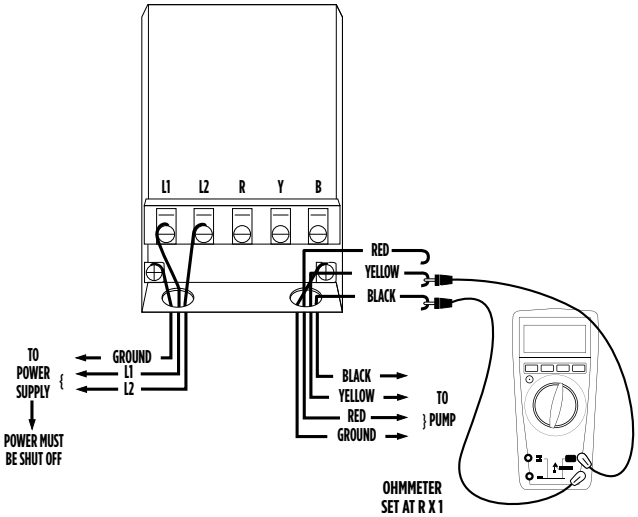


FIG. 11

Insulation Resistance Readings

Table 47 Normal ohm and Megohm Values Between All Leads and Ground

CONDITION OF MOTOR AND LEADS	MEGOHM VALUE	OHMS VALUE
A new motor (without drop cable)	200.0 (or more)	200,000,000 (or more)
A used motor which can be reinstalled in well	10.0 (or more)	10,000,000 (or more)
MOTOR IN WELL. READINGS ARE FOR DROP CABLE PLUS MOTOR.		
New motor	2.0 (or more)	2,000,000 (or more)
Motor in good condition	0.50 - 2.0	500,000 - 2,000,000
Insulation damage, locate and repair	Less than .50	Less than 500,000

Insulation resistance varies very little with rating. Motors of all hp, voltage, and phase rating have similar values of insulation resistance. The table above is based on readings taken with a megohm meter with a 500 VDC output. Readings may vary using a lower voltage ohmmeter; consult Franklin Electric if readings are in question.

Resistance of Drop Cable (ohms)

The values below are for copper conductors. If aluminum conductor drop cable is used, the resistance will be higher. To determine the actual resistance of the aluminum drop cable, divide the ohm readings from this chart by 0.61. This chart shows total resistance of cable from control to motor and back.

Winding Resistance Measuring

The winding resistance measured at the motor should fall within the values in Tables 13, 22, 24, 25, & 27. When measured through the drop cable, the resistance of the drop cable must be subtracted from the ohmmeter readings to get the winding resistance of the motor. See table below.

Table 47A DC Resistance in ohms per 100 ft of Wire (Two conductors) @ 50 °F

AWG OR MCM WIRE SIZE (COPPER)	14	12	10	8	6	4	3	2
OHMS	0.544	0.338	0.214	0.135	0.082	0.052	0.041	0.032

1	1/0	2/0	3/0	4/0	250	300	350	400	500	600	700
0.026	0.021	0.017	0.013	0.010	0.0088	0.0073	0.0063	0.0056	0.0044	0.0037	0.0032

Identification Of Cables When Color Code Is Unknown (Single-Phase 3-Wire Units)

If the colors on the individual drop cables cannot be found with an ohmmeter, measure:

Cable 1 to Cable 2
Cable 2 to Cable 3
Cable 3 to Cable 1

Find the highest resistance reading.

The lead not used in the highest reading is the yellow lead.

Use the yellow lead and each of the other two leads to get two readings:

Highest is the red lead.
Lowest is the black lead.

EXAMPLE:
The ohmmeter readings were:

Cable 1 to Cable 2 - 6 ohms
Cable 2 to Cable 3 - 2 ohms
Cable 3 to Cable 1 - 4 ohms

The lead not used in the highest reading (6 ohms) was

Cable 3—Yellow

From the yellow lead, the highest reading (4 ohms) was

To Cable 1—Red

From the yellow lead, the lowest reading (2 ohms) was

To Cable 2—Black

Single-Phase Control Boxes

Checking and Repairing Procedures (Power On)

WARNING: Power must be on for these tests. Do not touch any live parts.

A. VOLTAGE MEASUREMENTS

Step 1. Motor Off

1. Measure voltage at L1 and L2 of pressure switch or line contactor.
2. Voltage Reading: Should be ± 10% of motor rating.

Step 2. Motor Running

1. Measure voltage at load side of pressure switch or line contactor with pump running.
2. Voltage Reading: Should remain the same except for slight dip on starting. Excessive voltage drop can be caused by loose connections, bad contacts, ground faults, or inadequate power supply.
3. Relay chatter is caused by low voltage or ground faults.

B. CURRENT (AMP) MEASUREMENTS

1. Measure current on all motor leads.
2. Amp Reading: Current in red lead should momentarily be high, then drop within one second to values in Table 13. This verifies relay or solid state relay operation. Current in black and yellow leads should not exceed values in Table 13.
3. Relay or switch failures will cause red lead current to remain high and overload tripping.
4. Open run capacitor(s) will cause amps to be higher than normal in the black and yellow motor leads and lower than normal in the red motor lead.
5. A bound pump will cause locked rotor amps and overloading tripping.
6. Low amps may be caused by pump running at shut-off, worn pump, or stripped splines.
7. Failed start capacitor or open switch/relay are indicated if the red lead current is not momentarily high at starting.

CAUTION: The tests in this manual for components such as capacitors, relays, and QD switches should be regarded as indicative and not as conclusive. For example, a capacitor may test good (not open, not shorted) but may have lost some of its capacitance and may no longer be able to perform its function.

Ohmmeter Tests

QD, Solid State Control Box (Power Off)

A. START CAPACITOR AND RUN CAPACITOR IF APPLICABLE (CRC)

1. Meter Setting: R x 1,000.
2. Connections: Capacitor terminals.
3. Correct meter reading: Pointer should swing toward zero, then back to infinity.

B. Q.D. (BLUE) RELAY

Step 1. Triac Test

1. Meter setting: R x 1,000.
2. Connections: Cap and B terminal.
3. Correct meter reading: Infinity for all models.

Step 2. Coil Test

1. Meter Setting: R x 1.
2. Connections: L1 and B.
3. Correct meter reading: Zero ohms for all models.

C. POTENTIAL (VOLTAGE) RELAY

Step 1. Coil Test

1. Meter setting: R x 1,000.
2. Connections: #2 & #5.
3. Correct meter readings:

   For 115 Volt Boxes:
   0.7-1.8 (700 to 1,800 ohms).

   For 230 Volt Boxes:
   4.5-7.0 (4,500 to 7,000 ohms).

Step 2. Contact Test

1. Meter setting: R x 1.
2. Connections: #1 & #2.
3. Correct meter reading: Zero for all models.

Ohmmeter Tests

Integral Horsepower Control Box (Power Off)

A. OVERLOADS (Push Reset Buttons to make sure contacts are closed.)

1. Meter Setting: R x 1.
2. Connections: Overload terminals.
3. Correct meter reading: Less than 0.5 ohms.

B. CAPACITOR (Disconnect leads from one side of each capacitor before checking.)

1. Meter Setting: R x 1,000.
2. Connections: Capacitor terminals.
3. Correct meter reading: Pointer should swing toward zero, then drift back to infinity, except for capacitors with resistors which will drift back to 15,000 ohms.

C. POTENTIAL (VOLTAGE) RELAY

Step 1. Coil Test

1. Meter setting: R x 1,000.
2. Connections: #2 & #5.
3. Correct meter readings: 4.5-7.0 (4,500 to 7,000 ohms) for all models.

Step 2. Contact Test

1. Meter Setting: R x 1.
2. Connections: #1 & #2.
3. Correct meter reading: Zero ohms for all models.

D. CONTACTOR

Step 1. Coil

1. Meter setting: R x 100
2. Connections: Coil terminals
3. Correct meter reading: 1.8-14.0 (180 to 1,400 ohms)

Step 2. Contacts

1. Meter Setting: R X 1
2. Connections: L1 & T1 or L2 & T2
3. Manually close contacts
4. Correct meter reading: Zero ohms

CAUTION: The tests in this manual for components such as capacitors, relays, and QD switches should be regarded as indicative and not as conclusive. For example, a capacitor may test good (not open, not shorted) but may have lost some of its capacitance and may no longer be able to perform its function.

Single-Phase Motors & Controls

MAINTENANCE

Table 50 QD Control Box Parts 60 Hz

HP	VOLTS	CONTROL BOX MODEL NUMBER	QD (BLUE) RELAY	START CAPACITOR	MFD	VOLTS	RUN CAPACITOR	MFD	VOLTS
1/3	115	280 102 4915	223 415 905	275 464 125	159-191	110			
	230	280 103 4915	223 415 901	275 464 126	43-53	220			
1/2	115	280 104 4915	223 415 906	275 464 201	250-300	125			
	230	280 105 4915	223 415 902	275 464 105	59-71	220			
	230	282 405 5015 (CRC)	223 415 912	275 464 126	43-53	220	156 362 101	15	370
3/4	230	280 107 4915	223 415 903	275 464 118	86-103	220			
	230	282 407 5015 (CRC)	223 415 913	275 464 105	59-71	220	156 362 102	23	370
1	230	280 108 4915	223 415 904	275 464 113	105-126	220			
	230	282 408 5015 (CRC)	223 415 914	275 464 118	86-103	220	156 362 102	23	370

Table 50A QD Capacitor Replacement Kits

CAPACITOR NUMBER	KIT
275 464 105	305 207 905
275 464 113	305 207 913
275 464 118	305 207 918
275 464 125	305 207 925
275 464 126	305 207 926
275 464 201	305 207 951
156 362 101	305 203 907
156 362 102	305 203 908

Table 50B Overload Kits 60 Hz

HP	VOLTS	KIT (1)
1/3	115	305 100 901
1/3	230	305 100 902
1/2	115	305 100 903
1/2	230	305 100 904
3/4	230	305 100 905
1	230	305 100 906

(1) For Control Boxes with model numbers that end with 4915.

Table 50C QD Relay Replacement Kits

QD RELAY NUMBER	KIT
223 415 901	305 101 901
223 415 902	305 101 902
223 415 903	305 101 903
223 415 904	305 101 904
223 415 905	305 101 905
223 415 906	305 101 906
223 415 912 (CRC)	305 105 901
223 415 913 (CRC)	305 105 902
223 415 914 (CRC)	305 105 903

FOOTNOTES:

(1) Control boxes supplied with QD Relays are designed to operate on 230-volt systems. For 208-volt systems or where line voltage is between 200 volts and 210 volts use the next larger cable size, or use a boost transformer to raise the voltage.

(2) Voltage relays kits for 115-volts (305 102 901) and 230-volts (305 102 902) will replace current, voltage or QD Relays, and solid state switches.

Table 51 Integral Horsepower Control Box Parts 60 Hz

MOTOR SIZE	MOTOR RATING HP	CONTROL BOX (1) MODEL NO.	CAPACITORS				OVERLOAD (2) PART NO.	RELAY (3) PART NO.	CONTACTOR (2) PART NO.
			PART NO. (2)	MFD.	VOLTS	QTY.			
4"	1 - 1.5 STANDARD	282 300 8110 (See Note 5)	275 464 113 S 155 328 102 R	105-126 10	220 370	1 1	275 411 107	155 031 102	
		282 300 8110 (See Note 5)	275 464 137 S 155 328 101 R	105-126 15	220 370	1 1	275 411 114 S 275 411 113 M	155 031 102	
		282 300 8610	275 464 113 S 155 328 101 R	105-126 15	220 370	1 1	None (See Note 4)	155 031 102	
4"	2 STANDARD	282 301 8110	275 464 137 S 155 328 103 R	105-126 20	220 370	1 1	275 411 117 S 275 411 113 M	155 031 102	
4"	2 DELUXE	282 301 8310	275 464 137 S 155 328 103 R	105-126 20	220 370	1 1	275 411 117 S 275 411 113 M	155 031 102	155 325 102 L
4"	3 STANDARD	282 302 8110	275 463 123 S 155 327 109 R	208-250 45	220 370	1 1	275 411 118 S 275 411 115 M	155 031 102	
4"	3 DELUXE	282 302 8310	275 463 123 S 155 327 109 R	208-250 45	220 370	1 1	275 411 118 S 275 411 115 M	155 031 102	155 325 102 L
4" & 6"	5 STANDARD	282 113 8110	275 468 119 S 155 327 114 R	270-324 40	330 370	1 2	275 411 119 S 275 406 102 M	155 031 601	
4" & 6"	5 DELUXE	282 113 9310	275 468 119 S 155 327 114 R	270-324 40	330 370	1 2	275 411 119 S 275 406 102 M	155 031 601	155 326 101 L
6"	7.5 STANDARD	282 201 9210	275 468 119 S 275 468 118 S 155 327 109 R	270-324 216-259 45	330 330 370	1 1 1	275 411 102 S 275 406 122 M	155 031 601	
6"	7.5 DELUXE	282 201 9310	275 468 119 S 275 468 118 S 155 327 109 R	270-324 216-259 45	330 330 370	1 1 1	275 411 102 S 275 406 121 M	155 031 601	155 326 102 L
6"	10 STANDARD	282 202 9210	275 468 119 S 275468 120 S 155 327 102 R	270-324 350-420 35	330 330 370	1 1 2	275 406 103 S 155 409 101 M	155 031 601	
6"	10 STANDARD	282 202 9230	275 463 120 S 275 468 118 S 275 468 119 S 155 327 102 R	130-154 216-259 270-324 35	330 330 330 370	1 1 1 2	275 406 103 S 155 409 101 M	155 031 601	
6"	10 DELUXE	282 202 9310	275 468 119 S 275468 120 S 155 327 102 R	270-324 350-420 35	330 330 370	1 1 2	275 406 103 S 155 409 101 M	155 031 601	155 326 102 L
6"	10 DELUXE	282 202 9330	275 463 120 S 275 468 118 S 275 468 119 S 155 327 102 R	130-154 216-259 270-324 35	330 330 330 370	1 1 1 2	275 406 103 S 155 409 101 M	155 031 601	155 326 102 L
6"	15 DELUXE	282 203 9310	275 468 120 S 155 327 109 R	350-420 45	330 370	2 3	275 406 103 S 155 409 102 M	155 031 601	155 429 101 L
6"	15 DELUXE	282 203 9330	275 463 122 S 275 468 119 S 155 327 109 R	161-193 270-324 45	330 330 370	1 2 3	275 406 103 S 155 409 102 M	155 031 601	155 429 101 L
6"	15 X-LARGE	282 203 9621	275 468 120 S 155 327 109 R	350-420 45	330 370	2 3	275 406 103 S 155 409 102 M	155 031 601 2 required	155 429 101 L

FOOTNOTES:

(1) Surge arrestors 150 814 902 are suitable for all control boxes.

(2) S = Start, M = Main, L = Line, R = Run
Deluxe = Control box with line contactor.

(3) For 208-volt systems or where line voltage is between 200 volts and 210 volts, a low voltage relay is required. On 3 hp and smaller control boxes use relay part 155 031 103 in place of 155 031 102 and use the next larger cable size than specified in the 230-volt table. On 5 hp and larger use relay 155 031 602 in place of 155 031 601 and next larger wire. Boost transformers per page 15 are an alternative to special relays and cable.

(4) Control box model 282 300 8610 is designed for use with motors having internal overload protectors. If used with a 1.5 hp motor manufactured prior to date code 06H18, Overload/ Capacitor Kit 305 388 901 is required.

(5) Control box model 282 300 8110 with date code 11C19 (March 2011) and newer contain 15 MFD run capacitor and both start and run overloads. This box is designed for use with any Franklin 1.5 hp motor.

Table 52 Integral hp Capacitor Replacement Kits

CAPACITOR NUMBER	KIT
275 463 120	305 206 920
275 463 122	305 206 922
275 463 123	305 206 923
275 464 113	305 207 913
275 464 137	305 207 937
275 468 118	305 208 918
275 468 119	305 208 919
275 468 120	305 208 920
155 327 101	305 203 901
155 327 102	305 203 902
155 327 109	305 203 909
155 327 114	305 203 914
155 328 101	305 204 901
155 328 102	305 204 902
155 328 103	305 204 903

Table 52A Integral hp Overload Replacement Kits

OVERLOAD NUMBER	KIT
275 406 102	305 214 902
275 406 103	305 214 903
275 406 121	305 214 921
275 406 122	305 214 922
275 411 102	305 215 902
275 411 107	305 215 907
275 411 108	305 215 908
275 411 113	305 215 913
275 411 114	305 215 914
275 411 115	305 215 915
275 411 117	305 215 917
275 411 118	305 215 918
275 411 119	305 215 919

Table 52B Integral hp Voltage Relay Replacement Kits

RELAY NUMBER	KIT
155 031 102	305 213 902
155 031 103	305 213 903
155 031 601	305 213 961
155 031 602	305 213 962

Table 52C Integral hp Contactor Replacement Kits

CONTACTOR	KIT
155 325 102	305 226 902
155 326 101	305 347 903
155 326 102	305 347 902
155 429 101	305 347 901

FOOTNOTES:

(1) The following kit number changes were made for number consistency purposes only. Parts in the kit did not change.

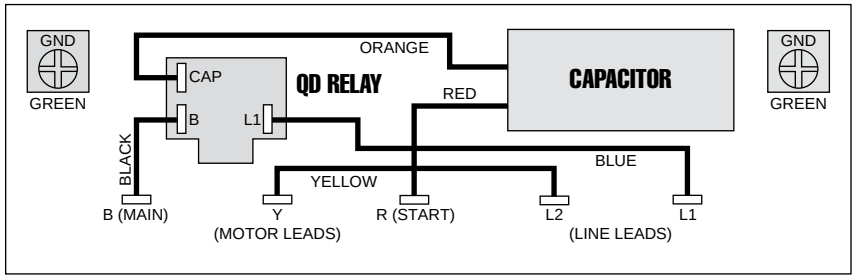
305 206 922 was 305 206 912

305 206 923 was 305 206 911

305 213 962 was 305 213 904

305 226 902 was 305 226 901

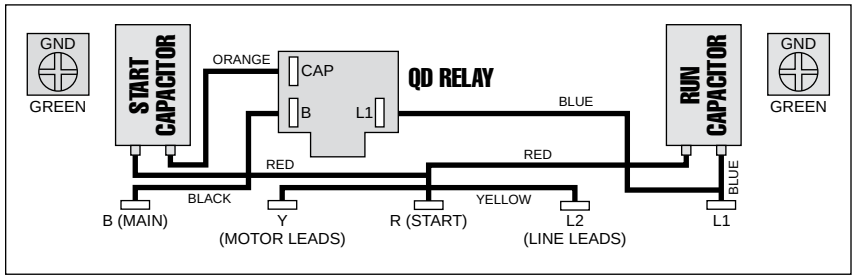
Control Box Wiring Diagrams



1/3 - 1 hp QD RELAY

280 10_ 4915

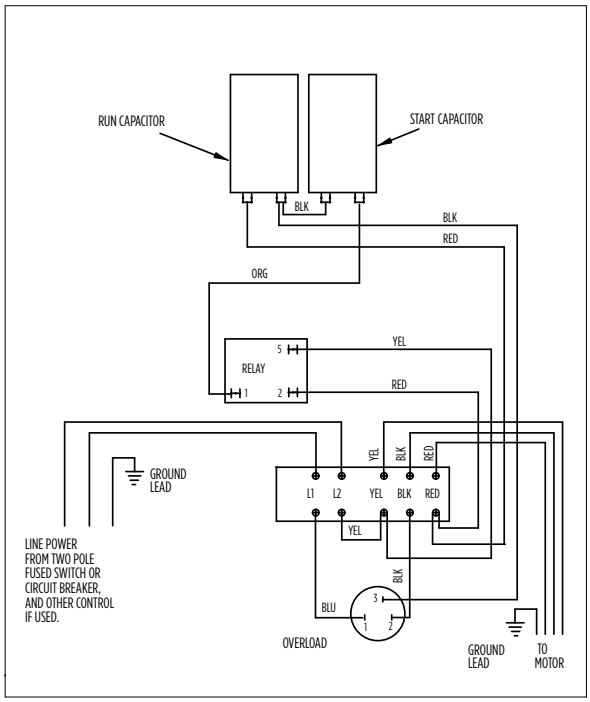
Sixth digit depends on hp



1/2 - 1 hp CRC QD RELAY

282 40_ 5015

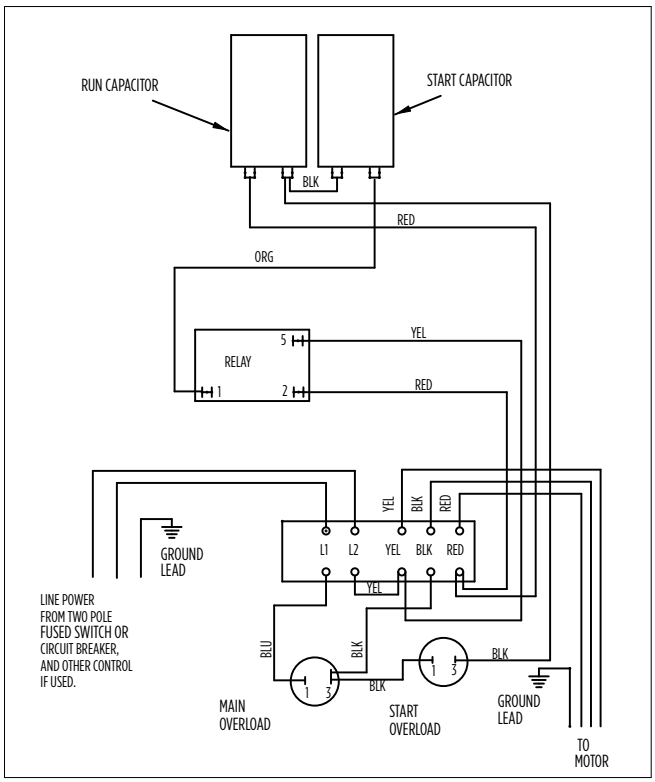
Sixth digit depends on hp



1 - 1.5 hp

282 300 8110

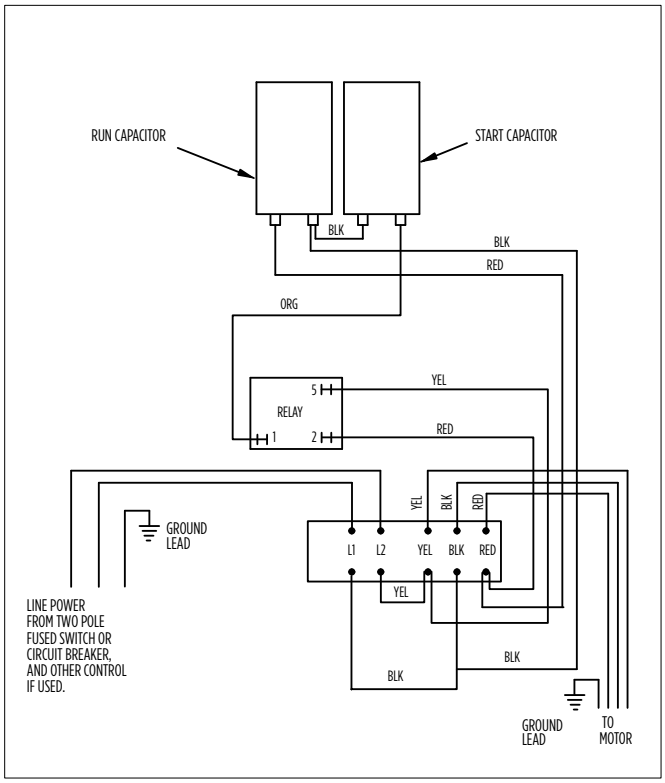
(Date Codes 11C19 & Older)



1 - 1.5 hp

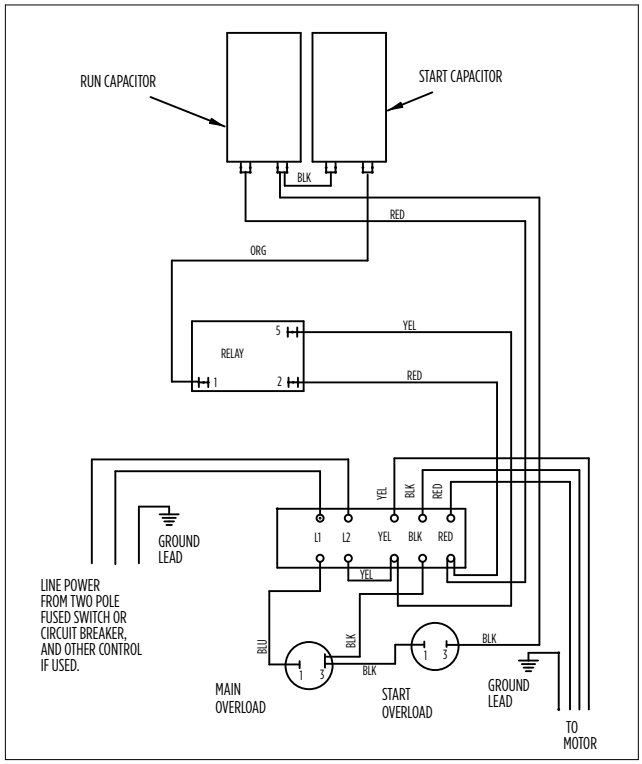
282 300 8110

(Date Codes 11C19 & Newer)

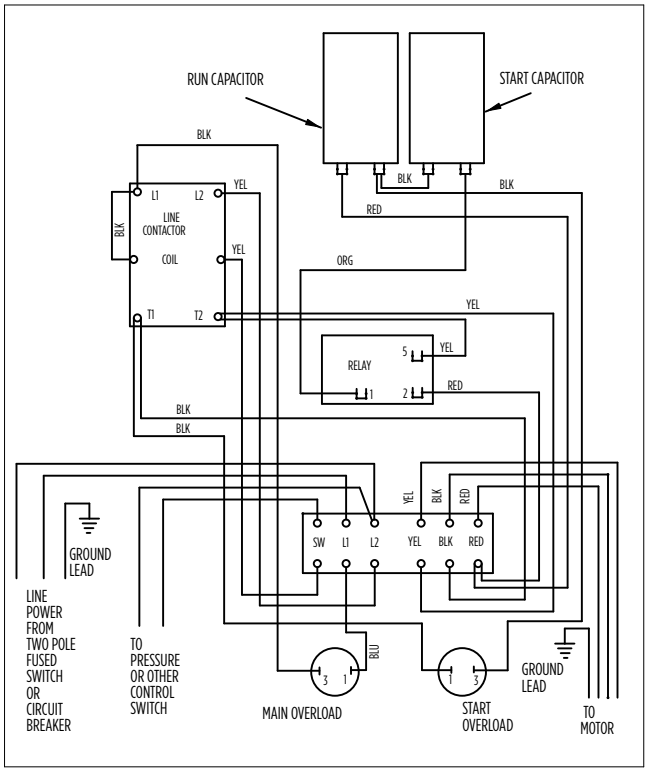


1 - 1.5 hp

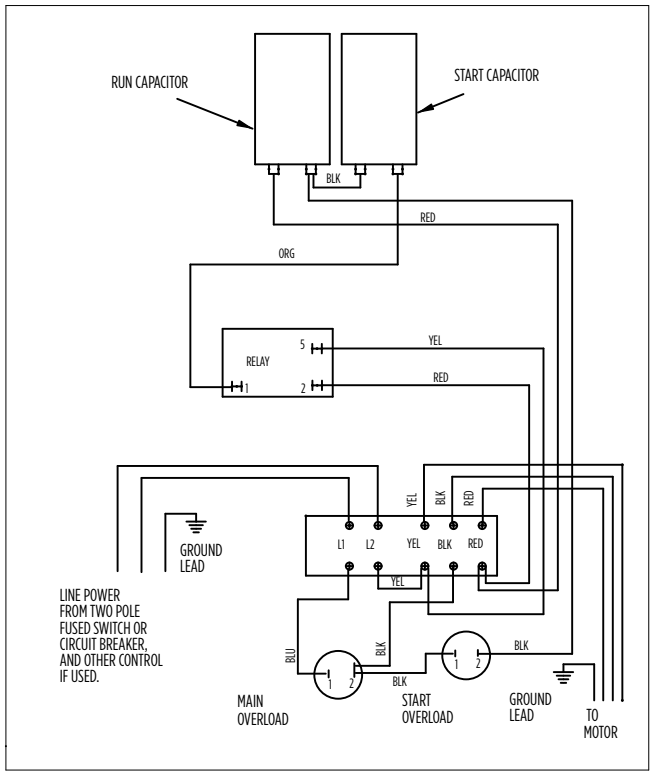
282 300 8610



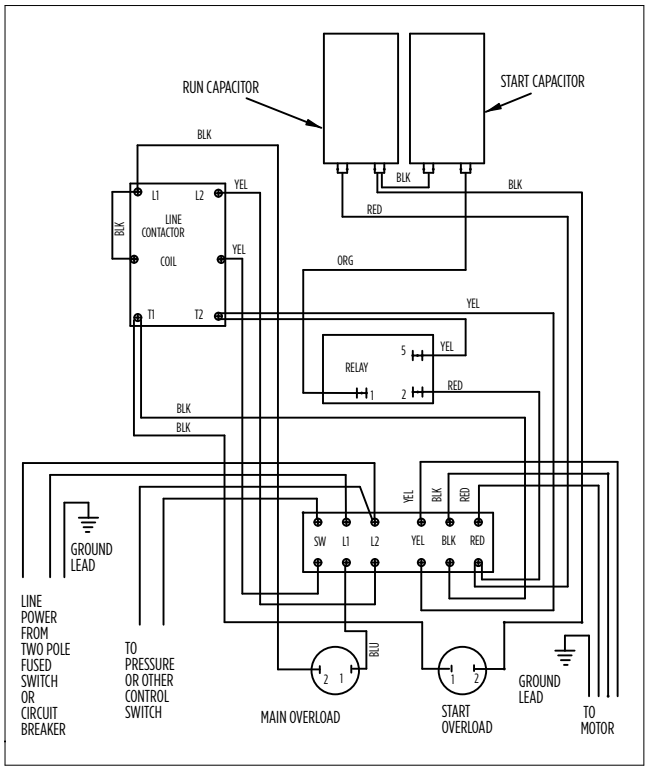
2 hp STANDARD
282 301 8110



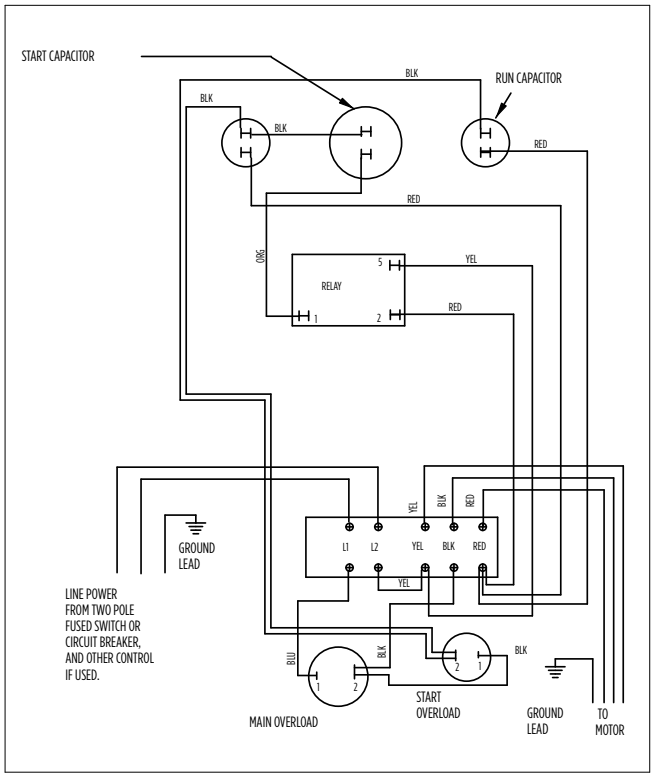
2 hp DELUXE
282 301 8310



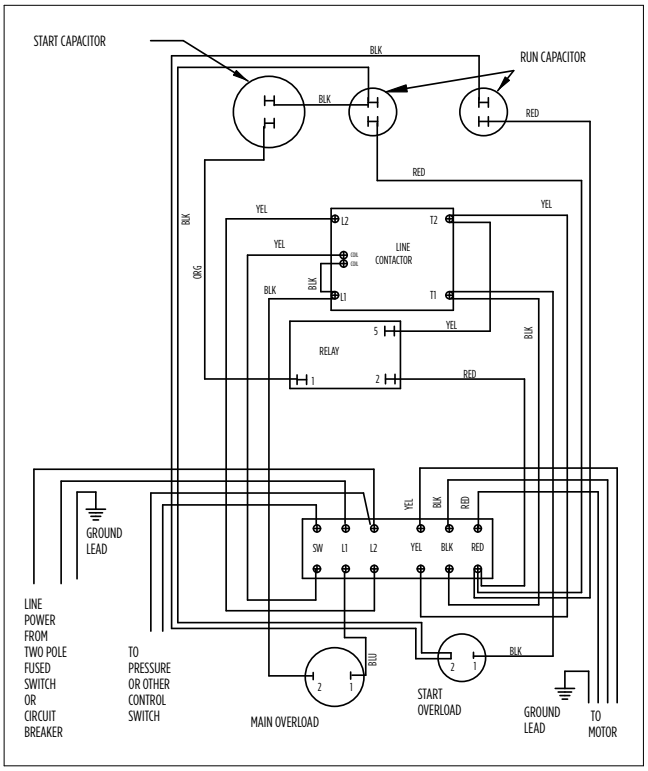
3 hp STANDARD
282 302 8110



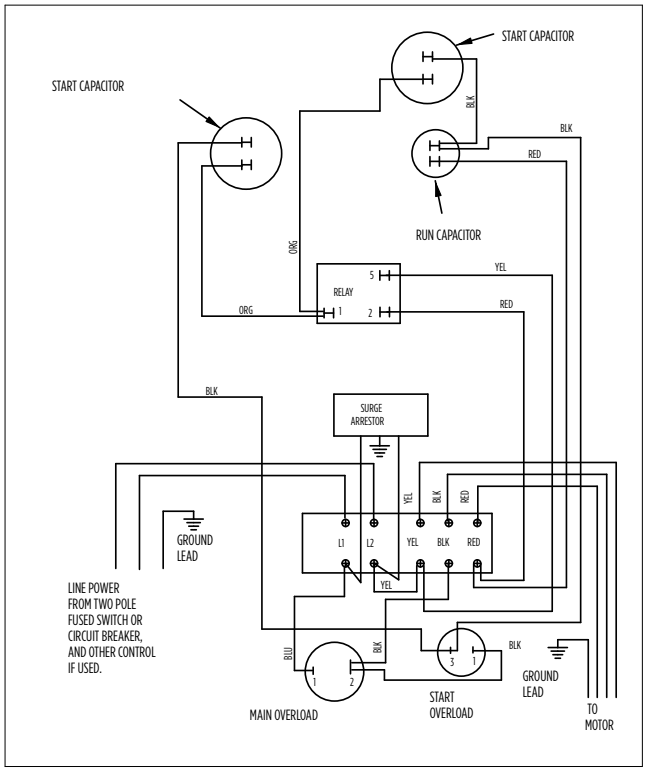
3 hp DELUXE
282 302 8310



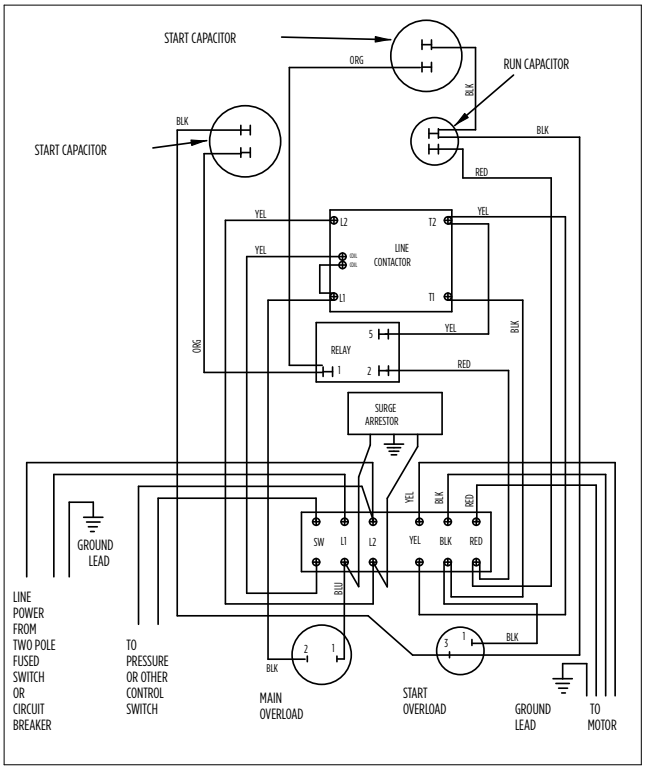
5 hp STANDARD
282 113 8110



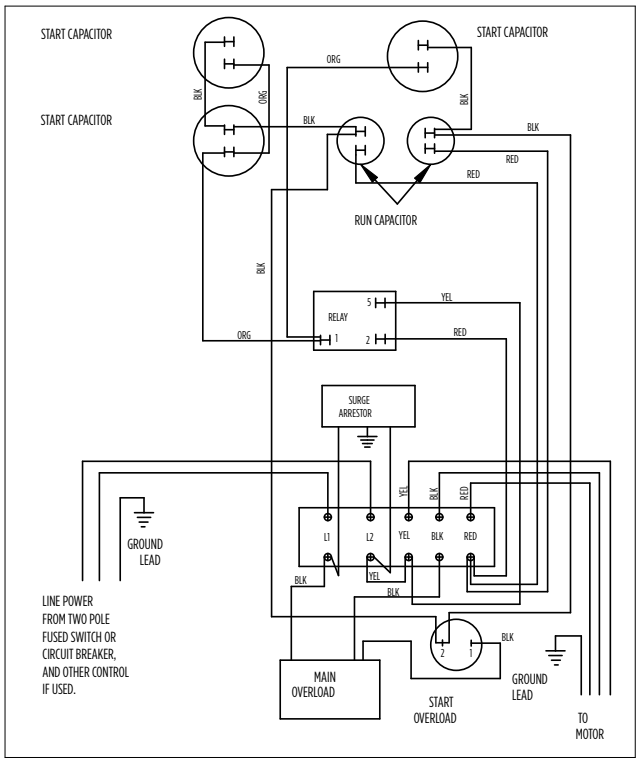
5 hp DELUXE
282 113 8310 or 282 113 9310



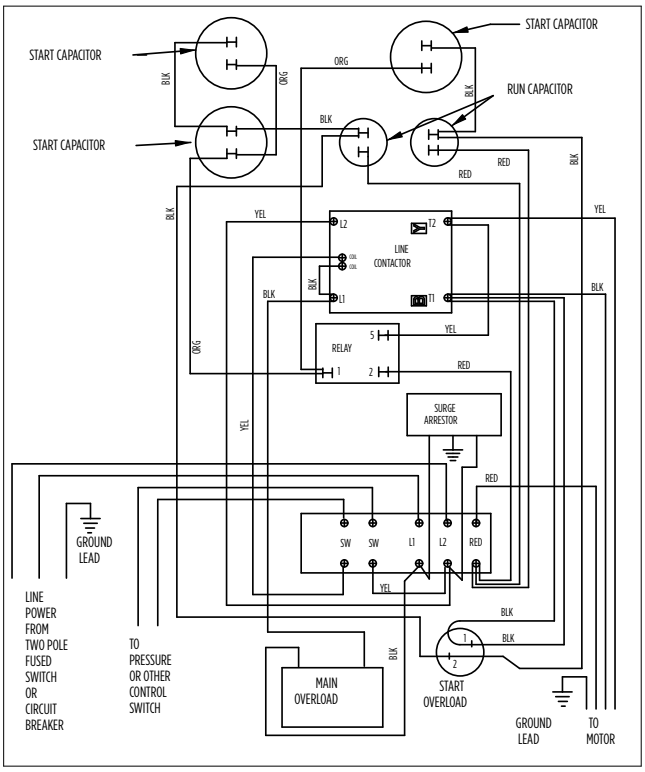
7.5 hp STANDARD
282 201 9210



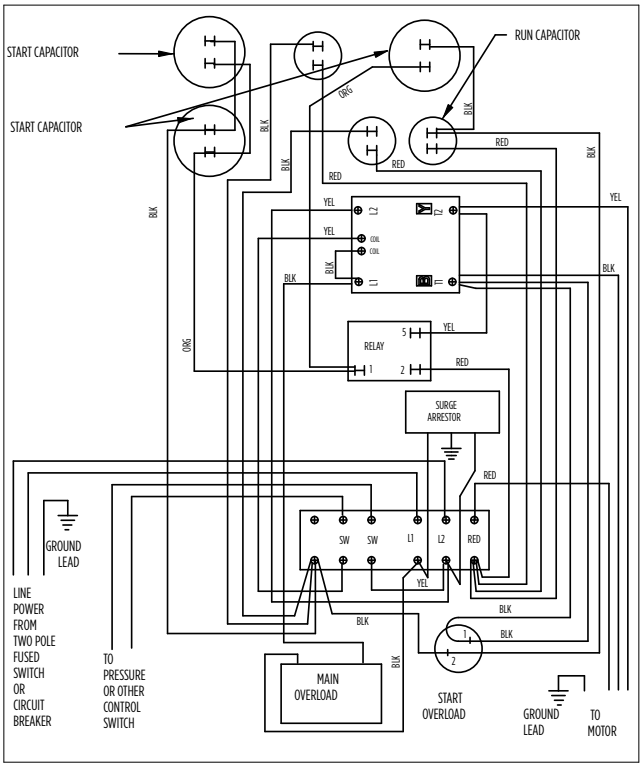
7.5 hp DELUXE
282 201 9310



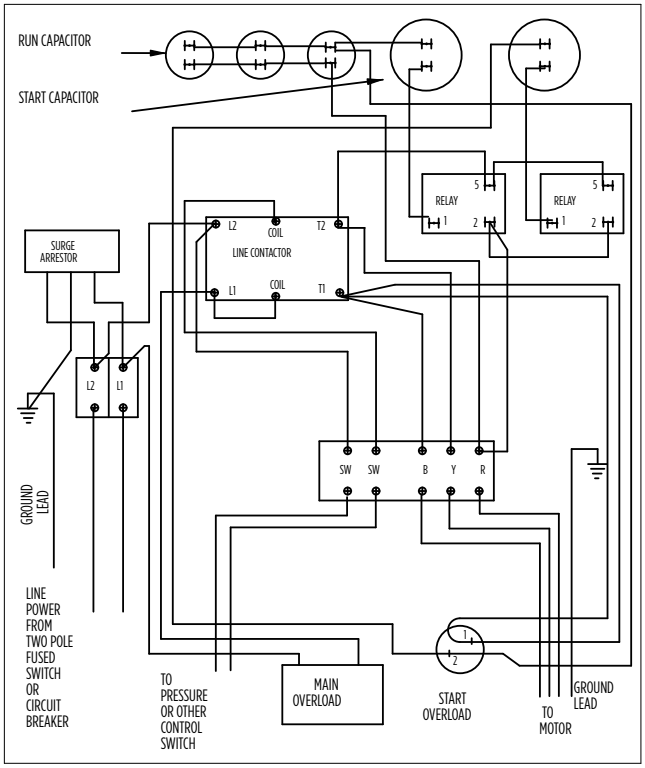
10 hp STANDARD
282 202 9210 or 282 202 9230



10 hp DELUXE
282 202 9230 or 282 202 9330



15 hp DELUXE
282 203 9310 or 282 203 9330



15 hp X-LARGE
282 203 9621

Electronic Products

APPLICATION

SubDrives & MonoDrives

The Franklin Electric SubDrive/MonoDrive controller is a variable-speed drive that delivers water at a constant pressure. MonoDrive and MonoDriveXT are designed to convert a conventional 3-wire 1/2 hp to 2 hp pump system to a variable speed constant pressure system by simply replaceing the 3-wire control box and pressure switch. The SubDrive 3-Phase models are designed for three-phase motors to provide constant pressure with three-phase performance using single-phase input power. The SubDrive2W is designed to convert a conventional 2-wire 1/2 hp, 3/4 hp and 1 hp pump system to a variable speed constant pressure system by simply replacing the pressure switch.

Applications

- Residential home
- Schools
- Restaurants
- Car washes
- Farms
- Landscape irrigation system

Protects Agianst

- Surge Protection
- Overheated Controller
- Locked pump
- Short Circuits
- Undervoltage
- Open Circuit
- Underload
- Broken pipe detection (NEMA 3R only excluding 2W)
- User-configuarable underload off time (NEMA 3R only excluding 2W)

WARNING: Serious or fatal electrical shock may result from failure to connect the motor, SubDrive/MonoDrive Controller, metal plumbing and all other metal near the motor or cable to the power supply ground terminal using wire no smaller than motor cable wires. To reduce the risk of electrical shock, disconnect power before working on or around the water system. Capacitors inside the SubDrive/MonoDrive Controller can still hold a lethal voltage even after power has been removed. Allow 10 minutes for dangerous internal voltage to discharge. Do not use motor in swimming areas.

Generator Sizing for SubDrive/MonoDrive

Basic generator sizing for the Franklin Electric SubDrive/MonoDrive system is 1.5 times maximum input Watts consumed by the drive, rounded up to the next normal sized generator.

Recommended minimum generator sizes:

MonoDrive

1/2 hp (0.37 kW) = 2000 Watts (2 kW)
3/4 hp (0.55 kW) = 3000 Watts (3 kW)
1 hp (0.75 kW) = 3500 Watts (3.5 kW)

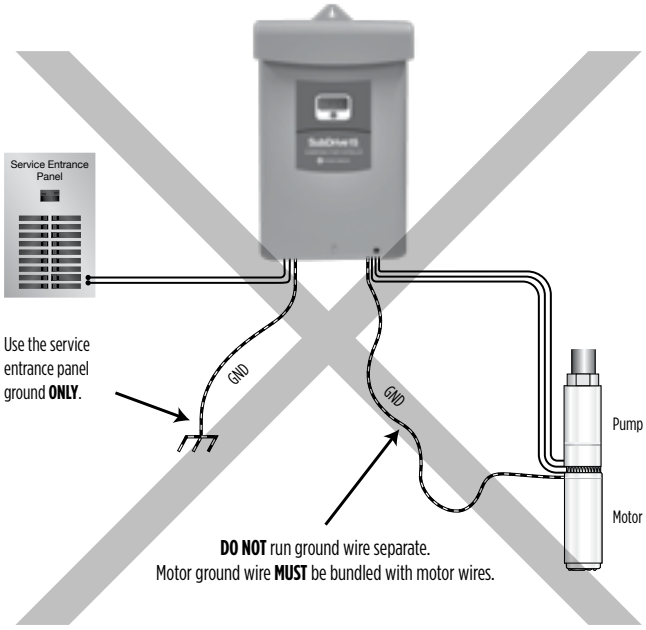
MonoDriveXT

1.5 hp (1.1kW) = 4000 Watts (4 kW)
2 hp (1.5 kW) = 5000 Watts (5 kW)

SubDrive15 = 3500 Watts (3.5 kW)
SubDrive20 = 5700 Watts (6 kW)
SubDrive30 = 7000 Watts (7 kW)
SubDrive2W = 6000 Watts (6 kW)

SubDrive75 = 3500 Watts (3.5 kW)
SubDrive100 = 5700 Watts (6 kW)
SubDrive150 = 7000 Watts (7 kW)
SubDrive300 = 11000 Watts (11 kW)
SubDrive2W = 6000 Watts (6 kW)

Note: Not to be used on a Ground Fault Circuit Interruptor (GFCI). If using an externally regulated generator, verify that the voltage and Hertz are appropriate to supply the drive.



Fuse/Circuit Breaker and Wire Sizing

The Listed fuse/Listed circuit breaker size and maximum allowable wire lengths for connection to the SubDrive/MonoDrive are given in the following tables:

Table 59: Circuit Breaker Sizing and Maximum Input Cable Lengths (in Feet)

Based on a 3% voltage drop

CONTROLLER MODEL	LISTED FUSE / LISTED CIRCUIT BREAKER AMPS	NOMINAL INPUT VOLTAGE	AWG COPPER WIRE SIZES, 167° F (75° C) INSULATION UNLESS OTHERWISE NOTED										
			14	12	10	8	6	4	3	2	1	1/0	2/0
MonoDrive	15	208	80	125	205	315	500	790	980	1290	1635	-	-
		230	95	150	250	385	615	970	1200	1580	2000	-	-
SubDrive15 / SubDrive75	15	208	70	110	185	280	450	710	880	1160	1465	-	-
		230	85	135	225	345	550	865	1075	1415	1795	-	-
SubDrive2W	20	230	-	125	205	315	505	795	985	1295	1645	-	-
MonoDriveXT	20	208	-	85	140	220	345	550	680	895	1135	-	-
		230	-	105	175	265	425	670	835	1095	1390	-	-
SubDrive20 / SubDrive100	25	208	-	-	115	180	285	450	555	730	925	-	-
	20	230	-	85	140	220	345	550	680	895	1130	-	-
SubDrive30 / SubDrive150	30	208	-	-	95	145	235	370	460	605	765	-	-
	25	230	-	-	115	180	285	455	560	740	935	-	-
SubDrive300	40	208	-	-	-	-	150	235	295	385	490	610	735
	40	230	-	-	-	115	185	290	360	470	600	745	895

XXXX Highlighted Numbers denote wire with 194° F (90° C) insulation only

Table 59A: Maximum Motor Cable Length (in feet)

CONTROLLER MODEL	FRANKLIN ELECTRIC MOTOR MODEL	HP	AWG COPPER WIRE SIZES, 140° F (60 °C) INSULATION					
			14	12	10	8	6	4
SubDrive15 / SubDrive75	234 514 xxxx	1.5 (1.1 kW)	420	670	1060	-	-	-
SubDrive20 / SubDrive100	234 315 xxxx	2.0 (1.5 kW)	320	510	810	1000	-	
SubDrive30 / SubDrive150	234 316 xxxx	3.0 (2.2 kW)	240	390	620	990	-	-
SubDrive300	234 317 xxxx	5.0 (3.7 kW)	-	230	370	590	920	-
SubDrive2W	244 505 xxxx	1/2 (.37 kW)	400	650	1000	-	-	-
	244 507 xxxx	3/4 (.55 kW)	300	480	760	1000	-	-
	244 508 xxxx	1.0 (.75 kW)	250	400	630	990	-	-
MonoDrive	214 505 xxxx	1/2 (.37 kW)	400	650	1020	-	-	-
	214 507 xxxx	3/4 (.55 kW)	300	480	760	1000	-	-
	214 508 xxxx	1.0 (.75 kW)	250	400	630	990	-	-
MonoDriveXT	214 508 xxxx	1.0 (0.75kW)	250	400	630	990	-	-
	224 300 xxxx	1.5 (1.1 kW)	190	310	480	770	1000	-
	224 301 xxxx	2.0 (1.5kW)	150	250	390	620	970	-

A 10-foot (3.05 m) section of cable is provided with the SubDrive/MonoDrive to connect the pressure sensor.

Notes:

- 1 ft = 0.305 m
- Maximum allowable wire lengths are measured between the controller and motor.
- Aluminum wires should not be used with the SubDrive/MonoDrive.
- All wiring to comply with the National Electrical Code and/or local codes.
- MonoDrive minimum breaker amps may be lower than AIM manual specifications for the motors listed due to the soft-starting characteristic of the MonoDrive controller.
- SubDrive minimum breaker amps may appear to exceed AIM manual specifications for the motors listed because SubDrive controllers are supplied from a single-phase service rather than three-phase.Amps (SFA). Motor overtemperature sensing is not provided by the drive.
- Motor Overload Portection: The drive electronics provide motor overload protection by preventing motor current from exceeding the maximum Service Factor Amps (SFA). Motor overtemperature sensing is not provided by the drive.

Pressure Tank

The SubDrive/MonoDrive needs only a small pressure tank to maintain constant pressure. (See Table X for recommended tank size.) For pumps rated 12 gpm (45.4 lpm) or more, a slightly larger tank is recommended for optimum pressure regulation. The SubDrive/MonoDrive can also use an existing tank with a much larger capacity.

Table 60: Minimum Pressure Tank Size (Total Capacity)

PUMP FLOW RATING	CONTROLLER MODEL	MINIMUM TANK SIZE
Less than 12 gpm (45.4 lpm)	SubDrive15, SubDrive 75 or MonoDrive	2 gallons (7.6 liters)
	SubDrive20 or SubDrive100	4 gallons (15.1 liters)
	SubDrive30, SubDrive150 or MonoDriveXT	4 gallons (15.1 liters)
	SubDrive300	8 gallons (30.3 liters)
12 gpm and higher (45.4 lpm)	SubDrive15, SubDrive 75 or MonoDrive	4 gallons (15.1 liters)
	SubDrive20 or SubDrive100	8 gallons (30.3 liters)
	SubDrive30, SubDrive150 or MonoDriveXT	8 gallons (30.3 liters)
	SubDrive300	20 gallons (75.7 liters)
All flows	SubDrive2W	20 gallons (75.7 liters)

Table 60A: Pressure Tank Pre-charge (PSI)

SYSTEM PRESSURE (AT PRESSURE SENSOR)	PRESSURE TANK SETTING (±2 PSI)
25	18
30	21
35	25
40	28
45	32
50 (Factory Set)	35
55	39
60	42
65	46
70	49
75	53
80	56

1 PSI = 0.068 bar
Note: Check tank pre-charge regularly to maintain optimum pressure regulation.

Table 60B: Minimum Pipe Diameter

MAXIMUM VELOCITY 8 FT/SEC. (2.4 M/S)	
MIN PIPE DIA	MAX GPM (LPM)
1/2"	4.9 (18.5)
3/4"	11.0 (41.6)
1"	19.6 (74.2)
1-1/4"	30.6 (115.8)
1-1/2"	44.1 (166.9)
2"	78.3 (296.4)
2-1/2"	176.3 (667.4)

Pumptec-Plus

Pumptec-Plus is a pump/motor protection device designed to work on any 230 V single-phase induction motor (PSC, CSCR, CSIR, and split phase) ranging in size from 1/2 to 5 horsepower. Pumptec-Plus uses a micro-computer to continuously monitor motor power and line voltage to provide protection against dry well, water logged tank, high and low voltage and mud or sand clogging.

Pumptec-Plus – Troubleshooting During Installation

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Unit Appears Dead (No Lights)	No Power to Unit	Check wiring. Power supply voltage should be applied to L1 and L2 terminals of the Pumptec-Plus. In some installations the pressure switch or other control devices is wired to the input of the Pumptec-Plus. Make sure this switch is closed.
Flashing Yellow Light	Unit Needs to Be Calibrated	Pumptec-Plus is calibrated at the factory so that it will overload on most pump systems when the unit is first installed. This overload condition is a reminder that the Pumptec-Plus unit requires calibration before use. See step 7 of the installation instructions.
	Miscalibrated	Pumptec-Plus should be calibrated on a full recovery well with the maximum water flow. Flow restrictors are not recommended.
Flashing Yellow Light During Calibration	2-Wire Motor	Step C of the calibration instructions indicate that a flashing green light condition will occur 2 to 3 seconds after taking the SNAPSHOT of the motor load. On some two-wire motors the yellow light will flash instead of the green light. Press and release the reset button. The green should start flashing.
Flashing Red and Yellow Lights	Power Interruption	During the installation of Pumptec-Plus power may be switched on and off several times. If power is cycled more than four times within a minute Pumptec-Plus will trip on rapid cycle. Press and release the reset button to restart the unit.
	Float Switch	A bobbing float switch may cause the unit to detect a rapid cycle condition on any motor or an overload condition on two-wire motors. Try to reduce water splashing or use a different switch.
Flashing Red Light	High Line Voltage	The line voltage is over 253 volts. Check line voltage. Report high line voltage to the power company.
	Unloaded Generator	If you are using a generator the line voltage may become too high when the generator unloads. Pumptec-Plus will not allow the motor to turn on again until the line voltage returns to normal. Overvoltage trips will also occur if line frequency drops too far below 60 Hz.
Solid Red Light	Low Line Voltage	The line voltage is below 207 volts. Check line voltage.
	Loose Connections	Check for loose connections which may cause voltage drops.
	Loaded Generator	If you are using a generator the line voltage may become too low when the generator loads. Pumptec-Plus will trip on undervoltage if the generator voltage drops below 207 volts for more than 2.5 seconds. Undervoltage trips will also occur if the line frequency rises too far above 60 Hz.

Pumptec-Plus and Pumptec with 3-lights

Pumptec-Plus and Pumptec with 3 lights - Troubleshooting After Installation

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Solid Yellow Light	Dry Well	Wait for the automatic restart timer to time out. During the time out period, the well should recover and fill with water. If the automatic reset timer of the Pumptec-Plus is set to the manual position, push the reset button to reactivate the unit. If the reset timer is set to manual in the Pumptec, turn off power for 5 seconds to reset the unit.
	Blocked Intake	Clear or replace pump intake screen.
	Blocked Discharge	Remove blockage in plumbing.
	Check Valve Stuck	Replace check valve.
	Broken Shaft	Replace broken parts.
	Severe Rapid Cycling	Machine gun rapid cycling can cause an underload condition. See flashing red and yellow lights section below.
	Worn Pump	Replace worn pump parts and recalibrate.
Flashing Yellow Light	Stalled Motor	Repair or replace motor. Pump may be sand or mud locked.
	Float Switch	A bobbing float switch can cause two-wire motors to stall. Arrange plumbing to avoid splashing water. Replace float switch.
	Ground Fault	Check insulation resistance on motor and control box cable.
Solid Red Light	Low Line Voltage	The line voltage is below 207 volts. Pumptec and Pumptec-Plus will try to restart the motor approximately every two minutes until the line voltage is normal.
	Loose Connections	Check for excessive voltage drops in the system electrical connections (i.e. circuit breakers, fuse clips, pressure switch, and Pumptec-Plus L1 and L2 terminals). Repair connections.
Flashing Red Light	High Line Voltage	The line voltage is over 253 volts. Check line voltage. Report high line voltage to the power company.
Flashing Red and Yellow Lights	Rapid Cycle	The most common cause for the rapid cycle condition is a waterlogged tank. Check for a ruptured bladder in the water tank. Check the air volume control or snifter valve for proper operation. Check setting on the pressure switch and examine for defects.
	Leaky Well System	Replace damaged pipes or repair leaks.
	Stuck Check Valve	Failed valve will not hold pressure. Replace valve.
	Float Switch	A bobbing float switch may cause the unit to detect a rapid cycle condition on any motor or an overload condition on 2-wire motors. To reset a Pumptec, remove power for 5 seconds. To reset a Pumptec-Plus, press and release the reset button. To eliminate float switch bounce, try to reduce water splash or use a different switch.

QD Pumptec and Pumptec with 2-lights or no lights

QD Pumptec and the old 2-light version of Pumptec are load sensing devices that monitor the load on submersible pumps/motors. If the load drops below a preset level for a minimum of 4 seconds the QD Pumptec or the Pumptec will shut off the motor.

The QD Pumptec is designed and calibrated expressly for use on Franklin Electric 230 V 3-wire motors (1/3 to 1 hp.) The QD Pumptec must be installed in QD relay boxes.

The Pumptec is designed for use on Franklin Electric 2- and 3-wire motors (1/3 to 1.5 hp) 115 and 230 V. The Pumptec is not designed for jet pumps.

QD Pumptec & Pumptec – Troubleshooting

SYMPTOM	CHECKS OR SOLUTION
If the QD Pumptec or Pumptec trips in about 4 seconds with some water delivery.	A. Is the voltage less than 90% of nameplate rating? B. Are the pump and motor correctly matched? C. Is the **QD Pumptec** or **Pumptec** wired correctly? For the **Pumptec** check the wiring diagram and pay special attention to the positioning of the power lead (230 V or 115 V). Pre-2006 Pumptec used different wiring guidelines. D. For **QD Pumptec** is your system 230 V 60 Hz or 220 V 50 Hz?
If the QD Pumptec or Pumptec trips in about 4 seconds with no water delivery.	A. The pump may be airlocked. If there ia a check valve on top of the pump, put another section of pipe between the pump and the check valve. B. The pump may be out of water. C. Check the valve settings. The pump may be dead-heading. D. Pump or motor shaft may be broken. E. Motor overload may be tripped. Check the motor current (amperage).
If the QD Pumptec or Pumptec will not timeout and reset.	A. Check switch position on side of circuit board on **Pumptec**. **QD Pumptec** check timer position on top/front of unit. Make sure the switch is not between settings. B. If the reset time switch is set to manual reset (position 0), **QD Pumptec** and **Pumptec** will not reset (turn power off for 5 sec. then back on to reset).
If your pump/motor will not run at all.	A. Check voltage. B. Check wiring. C. Remove the **QD Pumptec** from the control box. Reconnect wires in box to original state. If motor does not run the problem is not **QD Pumptec**. Bypass **Pumptec** by connecting L2 and motor lead with jumper. Motor should run. If not, the problem is not **Pumptec**. D. On **Pumptec** only check that **Pumptec** is installed between the control switch and the motor.
If your QD Pumptec or Pumptec will not trip when the pump breaks suction.	A. Be sure you have a Franklin motor. B. Check wiring connections. On **Pumptec** is lead power (230 V or 115 V) connected to correct terminal? Is motor lead connected to correct terminal? C. Check for ground fault in the motor and excessive friction in the pump. D. The well may be "gulping" enough water to keep **QD Pumptec** or **Pumptec** from tripping. It may be necessary to adjust the **QD Pumptec** or the **Pumptec** for these extreme applications. Call the Franklin Electric Service Hotline at 800-348-2420 for information. E. On **Pumptec** applications does the control box have a run capacitor? If so, **Pumptec** will not trip. (Except for Franklin 1.5 hp motors).
If your QD Pumptec or Pumptec chatters when running.	A. Check for low voltage. B. Check for waterlogged tank. Rapid cycling for any reason can cause the **QD Pumptec** or the **Pumptec** relay to chatter. C. On **Pumptec** make sure the L2 and motor wires are installed correctly. If they are reversed, the unit can chatter.

SubDrive2W, 75, 100, 150, 300, MonoDrive, and MonoDrive XT

Should an application or system problem occur, built-in diagnostics will protect the system. The "FAULT" light or digital display on the front of the SubDrive/MonoDrive Controller will flash a given number of times or display a number indicating the nature of the fault. In some cases, the system will shut itself off until corrective action is taken. Fault codes and their corrective actions are listed below. See SubDrive/MonoDrive Installation Manual for installation data.

Diagnostic Fault Codes

NUMBER OF FLASHES OR DIGITAL DISPLAY	FAULT	POSSIBLE CAUSE	CORRECTIVE ACTION
1	MOTOR UNDERLOAD	- Overpumped well - Broken shaft or coupling - Blocked screen, worn pump - Air/gas locked pump - SubDrive not set properly for pump end	- Frequency near maximum with less than 65% of expected load, 42% if DIP #3 is "on" - System is drawing down to pump inlet (out of water) - High static, light loading pump - reset DIP switch #3 to "on" for less sensitivity if not out of water - Check pump rotation (SubDrive only) reconnect if necessary for proper rotation - Air/gas locked pump - if possible, set deeper in well to reduce - Verify DIP switches are set properly
2	UNDERVOLTAGE	- Low line voltage - Misconnected input leads - Dragging or failed cooling fan	- Line voltage low, less than approximately 150 VAC (normal operating range = 190 to 260 VAC) - Check incoming power connection and correct or tighten if necessary correct incoming voltage - check circuit breaker of fuses, contact power company - Disconnect fan. Re-apply system power. If 2-flash goes away, replace fan. If 2-flash continues, replace controller. Check fan with 9-volt battery.
3	LOCKED PUMP	- Motor and/or pump misalignment - Dragging motor and/or pump - Abrasives in pump - Low Insulation to Ground	- Line voltage low, less than approximately 150 VAC (normal operating range = 190 to 260 VAC) - Amperage above max amps at 10 Hz - Remove and repair or replace as required - Check line to ground with a megohmmeter - Are output leads to motor longer than 1000 feet?
4 (MonoDrive & MonoDriveXT only)	INCORRECTLY WIRED	- MonoDrive only - Wrong resistance values on main and start	- Wrong resistance on DC test at start - Check wiring, check motor size, and DIP switch setting, adjust or repair as needed
5	OPEN CIRCUIT	- Loose connection - Failed motor or drop cable - Wrong motor - Damaged controller	- Open reading on DC test at start - Check drop cable and motor resistance, tighten output connections, repair or replace as necesssary, use "dry" motor to check drive functions, if drive will not run and exhibits open circuit fault, replace drive - Check ratings - Replace controller
6	OVER CURRENT	- When fault is indicated immediately after power-up, over current is due to short circuit. Check for loose connections, defective cable, defective splice or grounded motor.	- Amperage exceeded 50 amps on DC test at start or max amps during running - Incorrect output wiring, phase to phase short, phase to ground short in wiring or motor - If fault is present after resetting and removing motor leads, replace drive
		- When fault is indicated while motor is running, over current due to loose debris trapped in pump	- Check pump
7	OVERHEATED DRIVE	- High ambient temperature - Direct sunlight - Obstruction of airflow	- Drive heat sink has exceeded max rated temperature, needs to drop below 85 °C to restart - Fan blocked or inoperable, ambient above 125 °F, direct sunlight, air flow blocked - Replace fan or relocate drive as necessary
8 (SubDrive300 only)	OVER PRESSURE	- Improper pre-charge - Valve closing too fast - Pressure setting too close to relief valve rating	- Reset the pre-charge pressure to 70% of sensor setting. Reduce pressure setting well below relief valve rating. Use next size larger pressure tank. - Verify valve operation is within manufacturer's specifications. - Reduce system pressure setting to a value less than pressure relief rating.
RAPID	INTERNAL FAULT	- A fault was found internal to drive	- Unit may require replacement. Contact your supplier.
9 (SubDrive2W only)	OVER RANGE (Values outside normal operating range)	- Wrong hp/voltage - Internal fault	- Verify motor hp and voltage - Unit may require replacement. Contact your supplier.

SubDrive15, 20, 30, MonoDrive, and MonoDriveXT (NEMA 3R)

Diagnostic Fault Codes

NUMBER OF FLASHES	FAULT	POSSIBLE CAUSE	CORRECTIVE ACTION
F1	MOTOR UNDERLOAD	- Overpumped well - Broken shaft or coupling - Blocked screen, worn pump - Air/gas locked pump - SubDrive not set properly for pump end - Underload Sensitivity setting incorrect	- Frequency near maximum with load less than configured underload sensitivity (Potentiometer or Wi-Fi) - System is drawing down to pump inlet (out of water) - High static, light loading pump - reset Potentiometer for less sensitivity if not out of water - Check pump rotation (SubDrive only) reconnect if necessary for proper rotation - Air/gas locked pump - if possible, set deeper in well to reduce - Verify DIP switches are set properly - Check Underload Sensitivity Setting (Potentiometer or Wi-Fi setting, whichever is applicable)
F2	UNDERVOLTAGE	- Low line voltage - Misconnected input leads - Loose connection at breaker or panel	- Line voltage low, less than approximately 150 VAC (normal operating range = 190 to 260 VAC) - Check incoming power connections and correct or tighten if necessary - Correct incoming voltage - check circuit breaker or fuses, contact power company
F3	OVERCURRENT / LOCKED PUMP	- Motor and/or pump misalignment - Dragging motor and/or pump - Motor and/or pump locked - Abrasives in pump - Excess motor cable length	- Amperage above SFL at 30 Hz - Remove and repair or replace as required - Reduce motor cable length. Adhere to Maximum Motor Cable Length table.
F4 (MonoDrive & MonoDriveXT only)	INCORRECTLY WIRED	- MonoDrive only - Wrong resistance values on main and start	- Wrong resistance on DC test at start - Check wiring, check motor size and DIP switch setting, adjust or repair as needed
F5	OPEN PHASE	- Loose connection - Defective motor or drop cable - Wrong motor	- Open reading on DC test at start. - Check drop cable and motor resistance, tighten output connections, repair or replace as necessary, use “dry” motor to check drive functions. If drive will not run and exhibits underload fault replace drive
F6	SHORT CIRCUIT	- When fault is indicated immediately after power-up, short circuit due to loose connection, defective cable, splice or motor	- Amperage exceeded 25 amps on DC test at start or SF amps during running - Incorrect output wiring, phase to phase short, phase to ground short in wiring or motor - If fault is present after resetting and removing motor leads, replace drive
F7	OVERHEATED DRIVE	- High ambient temperature - Direct sunlight - Obstruction of airflow	- Drive heat sink has exceeded max rated temperature, needs to drop below 194 °F (90 °C) to restart - Fan blocked or inoperable, ambient above 122 °F (50 °C), direct sunlight, air flow blocked - Replace fan or relocate drive as necessary - Remove debris from fan intake/exhaust - Remove and clean optional air screen kit (if installed)
F9	INTERNAL PCB FAULT	- A fault was found internal to drive	- Contact your Franklin Electric Service Personnel - Unit may require replacement. Contact your supplier.
F12	OVERVOLTAGE	- High line voltage - Internal voltage too high	- Line voltage high - Check incoming power connections and correct or tighten if necessary - If line voltage is stable and measured below 260 VAC and problem persists, contact your Franklin Electric Service Personnel

Power down, disconnect leads to the motor and power up the SubDrive:

- If the SubDrive does not give an “open phase” fault (F5), then there is a problem with the SubDrive.

- Connect the SubDrive to a dry motor. If the motor goes through DC test and gives “underload” fault (F1), the SubDrive is working properly.

SubDrive15, 20, 30, MonoDrive, and MonoDriveXT (NEMA 3R)

Diagnostic Fault Codes

NUMBER OF FLASHES	FAULT	POSSIBLE CAUSE	CORRECTIVE ACTION
F14	BROKEN PIPE	- Broken pipe or large leak is detected in the system - Drive runs at full power for 10 minutes without reaching pressure setpoint - Large water draw, such as a sprinkler system, does not allow system to reach pressure setpoint	- Check system for large leak or broken pipe - If the system contains a sprinkler system or is being used to fill a pool or cistern, disable the Broken Pipe Detection
F15 (SD15/20/30 only)	PHASE IMBALANCE	- Motor phase currents differ by 20% or more. - Motor is worn internally - Motor cable resistance is not equal - Incorrect motor type setting (single- or three-phase)	- Check resistance of motor cable and motor windings - Verify motor type matched drive settings (single- or three-phase)
F16	GROUND FAULT	- Motor output cable is damaged or exposed to water - Phase to ground short	- Check motor cable insulation resistance with megger (while not connected to drive). Replace motor cable if needed.
F17	INVERTER TEMPERATURE SENSOR FAULT	- Internal temperature sensor is malfunctioning	- Contact your Franklin Electric Service Personnel - If problem persists, unit may require replacement. Contact your supplier.
F18 (SD20/30/MDXT only)	PFC TEMPERATURE SENSOR FAULT	- Internal temperature sensor is malfunctioning	- Contact your Franklin Electric Service Personnel - If problem persists, unit may require replacement. Contact your supplier.
F19	COMMUNICATION FAULT	- Cable connection between Display/Wi-Fi Board and Main Control Board is loose or disconnected - Internal circuit failure	- Check cable connection between Display/Wi-Fi Board and Main Control Board. - If problem persists, unit may require replacement. Contact your supplier.
F22	DISPLAY/WI-FI BOARD EXPECTED FAULT	- Connection between Display/Wi-Fi Board and Main Control Board was not detected at drive start-up	- Check cable connection between Display/Wi-Fi Board and Main Control Board. - If problem persists, unit may require replacement. Contact your supplier.
F23	MAIN BOARD STARTUP FAULT	- A fault was found internal to drive	- Contact your Franklin Electric Service Personnel - Unit may require replacement. Contact your supplier.
F24	INVALID DIP SWITCH SETTING	- No DIP Switch set or more than one (1) DIP Switch set for Motor size - No DIP Switch set or more than one (1) DIP Switch set for Pump size - Invalid combination of DIP switches for drive type (SD or MD mode), Motor hp, and Pump hp.	- Check DIP switch settings

Power down, disconnect leads to the motor and power up the SubDrive:

- If the SubDrive does not give an “open phase” fault (F5), then there is a problem with the SubDrive.

- Connect the SubDrive to a dry motor. If the motor goes through DC test and gives “underload” fault (F1), the SubDrive is working properly.

SubDrive2W, 75, 100, 150, 300, MonoDrive, and MonoDrive XT

Troubleshooting

CONDITION	INDICATOR LIGHT	POSSIBLE CAUSE	CORRECTIVE ACTION
NO WATER	NONE	- No supply voltage present	- If correct voltage is present, replace drive
	SOLID GREEN	- Pressure sensor circuit	- Verify water pressure is below system set point - Jumper wires together at pressure sensor, if pump starts, replace sensor - If pump doesn't start, check sensor connection at printed circuit board (PCB), if loose, repair - If pump doesn't start, jumper sensor connection at PCB, if pump starts, replace wire - If pump doesn't start with sensor PCB connection jumpered, replace drive
	SOLID RED OR SOLID RED AND GREEN	- Power surge, bad component	- Power system down to clear fault, verify voltage, if repetitive, replace drive
	FLASHING RED	- Fault detected	- Proceed to fault code description and remedy
	FLASHING GREEN	- Drive and motor are operating - Loose switch or cable connection - Gulping water at pump inlet	- Frequency max, amps low, check for closed valve, or stuck check valve - Frequency max, amps high, check for hole in pipe - Frequency max, amps erratic, check pump operation, dragging impellers - This is not a drive problem - Check all connections - Disconnect power and allow well to recover for short time, then retry
PRESSURE FLUCTUATIONS (POOR REGULATION)	FLASHING GREEN	- Pressure sensor placement and setting - Pressure gauge placement - Pressure tank size and pre-charge - Leak in system - Air entrainment into pump intake (lack of submergence)	- Correct pressure and placement as necessary - Tank may be too small for system flow - This is not a drive problem - Disconnect power and check pressure gauge for pressure drop - Set deeper in the well or tank; install a flow sleeve with airtight seal around drop pipe and cable - If fluctuation is only on branches before sensor, flip DIP switch #4 to "on" (07C and newer)
RUN ON WON'T SHUT DOWN	FLASHING GREEN	- Pressure sensor placement and setting - Tank pre-charge pressure - Impeller damage - Leaky system - Sized improperly (pump can't build enough head)	- Check frequency at low flows, pressure setting may be too close to pump max head - Verify precharge at 70% if tank size is larger than minimum, increase precharge (up to 85%) - Verify that the system will build and hold pressure
RUNS BUT TRIPS	FLASHING RED	- Check fault code and see corrective action	- Proceed to fault code description and remedy on reverse side
LOW PRESSURE	FLASHING GREEN	- Pressure sensor setting, pump rotation, pump sizing	- Adjust pressure sensor, check pump rotation - Check frequency at max flow, check max pressure
HIGH PRESSURE	FLASHING GREEN	- Pressure sensor setting - Shorted sensor wire	- Adjust pressure sensor - Remove sensor wire at PCB, if drive continues to run, replace drive - Verify condition of sensor wire and repair or replace if necessary
AUDIBLE NOISE	FLASHING GREEN	- Fan, hydraulic, plumbing	- For excessive fan noise, replace fan - If fan noise is normal, drive will need to be relocated to a more remote area - If hydraulic, try raising or lowering depth of pump - Pressure tank location should be at entrance of water line into house
NO LIGHTS	NONE	- Ribbon cable detached from LED printed circuit board	- Reattach cable - if cable is attached, replace drive
RFI-EMI INTERFERENCE	FLASHING GREEN	- See interference troubleshooting procedure	

SubDrive15, 20, 30, MonoDrive, and MonoDriveXT (NEMA 3R)

Troubleshooting

CONDITION	INDICATOR LIGHT	POSSIBLE CAUSE	CORRECTIVE ACTION
NO WATER	NONE	- No supply voltage present - Display board cable disconnected or loose	- Verify cable connection between main control board and display board - If correct voltage is present, replace drive
	GREEN "---" ON DISPLAY	- Pressure sensor circuit	- Verify water pressure is below system set point - If Pressure Input Board break-away tab is removed, ensure auxiliary device is connected and closed circuit - If Pressure Input Board break-away tab is removed and no auxiliary device is being used, manually short-circuit "AUX IN" connections - Jumper wires together at pressure sensor; if pump starts, replace sensor - If pump doesn't start, check sensor connection at Pressure Input Board;. if loose, repair - If pump doesn't start, jumper sensor connection at Pressure Input Board. If pump starts, replace wire - If pump doesn't start with sensor Pressure Input Board connection jumpered, replace Pressure Input Board - If pump doesn't start with new Pressure Input Board, replace drive
	RED FAULT CODE ON DISPLAY	- Fault detected	- Proceed to fault code description and remedy
	GREEN MOTOR FREQUENCY ON DISPLAY	- Drive and motor are operating - Loose switch or cable connection - Incorrect motor or pump settings - Motor may be running backwards - Gulping water at pump inlet	- Verify Maximum Frequency setting. If this setting was reduced below maximum value, increase - Verify motor/pump ratings and match to motor/pump settings on drive (DIP switch or Wi-Fi) - Verify motor connections - Frequency max, amps low, check for closed valve, or stuck check valve - Frequency max, amps high, check for hole in pipe - Frequency max, amps erratic, check pump operation, dragging impellers - This is not a drive problem - Check all connections - Disconnect power and allow well to recover for short time, then retry
PRESSURE FLUCTUATIONS (POOR REGULATION)	GREEN MOTOR FREQUENCY ON DISPLAY	- Pressure sensor placement and setting - Pressure gauge placement - Pressure tank size and pre-charge - Leak in system - Air entrainment into pump intake (lack of submergence)	- Correct pressure and placement as necessary - Tank may be too small for system flow - This is not a drive problem - Disconnect power and check pressure gauge for pressure drop - Change tank size configuration - Set deeper in the well or tank; install a flow sleeve with airtight seal around drop pipe and cable - If fluctuation is only on branches before sensor, enable Steady Flow
RUN ON WON'T SHUT DOWN	GREEN MOTOR FREQUENCY ON DISPLAY	- Pressure sensor placement and setting - Tank pre-charge pressure - Impeller damage - Leaky system - Sized improperly (pump can't build enough head)	- Check frequency at low flows, pressure setting may be too close to pump max head - Verify precharge at 70% if tank size is larger than minimum, increase precharge (up to 85%) - Verify that the system will build and hold pressure - Enable bump and/or aggressive bump - Increase minimum frequency
RUNS BUT TRIPS	FLASHING RED	- Check fault code and see corrective action	- Proceed to fault code description and remedy on reverse side

SubDrive15, 20, 30, MonoDrive, and MonoDriveXT (NEMA 3R)

Troubleshooting

CONDITION	INDICATOR LIGHT	POSSIBLE CAUSE	CORRECTIVE ACTION
LOW PRESSURE	GREEN MOTOR FREQUENCY ON DISPLAY	- Pressure sensor setting, pump rotation, pump sizing - High temperature	- Adjust pressure sensor, check pump rotation - Check frequency at max flow, check max pressure - High ambient and/or drive temperature will cause drive to foldback power and run with reduced performance
HIGH PRESSURE	GREEN MOTOR FREQUENCY ON DISPLAY	- Pressure sensor setting - Shorted sensor wire	- Adjust pressure sensor - Remove sensor wire at Pressure Input Board, if drive stops running, wire may be shorted - Remove sensor wire at Pressure Input Board, if drive continues to run, replace Pressure Input Board - Remove sensor wire at new Pressure Input Board, if drive continues to run, replace drive - Verify condition of sensor wire and repair or replace if necessary
AUDIBLE NOISE	GREEN MOTOR FREQUENCY ON DISPLAY	- Fan, hydraulic, plumbing	- For excessive fan noise, replace fan - If fan noise is normal, drive will need to be relocated to a more remote area - If hydraulic, try raising or lowering depth of pump - Pressure tank location should be at entrance of water line into house
NO DISPLAY	NONE	- Display board cable disconnected or loose	- Verify cable connection between main control board and display board
CANNOT CONNECT TO DRIVE WI-FI	FE CONNECT LIGHT ON SOLID	- Attempting to connect to incorrect drive - Out of Wi-Fi range of drive	- Ensure the Wi-Fi SSID (hotspot name) you are connecting to matches the drive you wish to connect to - Wi-Fi range is 100 feet line-of-site, must be closer to drive if walls or floors are between you and the drive - Wi-Fi module not responding, cycle power to drive - Cycle Wi-Fi radio on mobile device, refresh Wi-Fi connection list
	FE CONNECT LIGHT OFF	- Wi-Fi timeout expired	- If more than fifteen (15) minutes since last power cycle, cycle power to drive - If more than one (1) hour since last disconnection from Wi-Fi, cycle power to drive
RFI-EMI INTERFERENCE	GREEN MOTOR FREQUENCY ON DISPLAY	- Poor grounding - Wire routing	- Adhere to grounding and wire routing recommendations - An additional external filter may be needed. See Accessories section for ordering information

SubMonitor

SubMonitor Troubleshooting

FAULT MESSAGE	PROBLEM/CONDITION	POSSIBLE CAUSE
SF Amps Set Too High	SF Amps setting above 359 Amps.	Motor SF Amps not entered.
Phase Reversal	Reversed incoming voltage phase sequence.	Incoming power problem.
Underload	Normal line current.	Wrong SF Max Amps setting.
	Low line current.	Over pumping well. Clogged pump intake. Closed valve. Loose pump impeller. Broken shaft or coupling. Phase loss.
Overload	Normal line current.	Wrong SF Max Amps setting.
	High line current.	High or low line voltage. Ground fault. Pump or motor dragging. Motor stalled or bound pump.
Overheat	Motor temperature sensor has detected excess motor temperature.	High or low line voltage. Motor is overloaded. Excessive current unbalance. Poor motor cooling. High water temperature. Excessive electrical noise (VFD in close proximity).
Unbalance	Current difference between any two legs exceeds programmed setting.	Phase loss. Unbalanced power supply. Open Delta transformer.
Overvoltage	Line voltage exceeds programmed setting.	Unstable power supply.
Undervoltage	Line voltage below programmed setting.	Poor connection in motor power circuit. Unstable or weak power supply.
False Starts	Power has been interrupted too many times in a 10 second period.	Chattering contacts. Loose connections in motor power circuit. Arcing contacts.

Electronic Products

APPLICATION

A	Amp or amperage
AWG	American Wire Gauge
BJT	Bipolar Junction Transistor
°C	Degree Celsius
CB	Control Box
CRC	Capacitor Run Control
DI	Deionized
DOL	Direct on Line
Dv/dt	Rise Time of the Voltage
EFF	Efficiency
°F	Degree Fahrenheit
FDA	Food & Drug Administration
FL	Full Load
ft	Foot
ft-lb	Foot Pound
ft/s	Feet per Second
GFCI	Ground Fault Circuit Interrupter
gpm	Gallon per Minute
HERO	High Efficiency Reverse Osmosis
hp	Horsepower
Hz	Hertz
ID	Inside Diameter
IGBT	Insulated Gate Bipolar Transistor
in	Inch
kVA	Kilovolt Amp
kVAR	Kilovolt Amp Rating
kW	Kilowatt (1000 watts)
L1, L2, L3	Line One, Line Two, Line Three
lb-ft	Pound Feet
L/min	Liter per Minute
mA	Milliamp
max	Maximum
MCM	Thousand Circular Mils
mm	Millimeter
MOV	Metal Oxide Varister
NEC	National Electrical Code
NEMA	National Electrical Manufacturer Association
Nm	Newton Meter
NPSH	Net Positive Suction Head
OD	Outside Diameter
OL	Overload
PF	Power Factor
psi	Pounds per Square Inch
PWM	Pulse Width Modulation
QD	Quick Disconnect
R	Resistance
RMA	Return Material Authorization
RMS	Root Mean Squared
rpm	Revolutions per Minute
SF	Service Factor
SFhp	Service Factor Horsepower
S/N	Serial Number
TDH	Total Dynamic Head
UNF	Fine Thread
V	Voltage
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VFD	Variable Frequency Drive
W	Watts
XFMR	Transformer
Y-D	Wye-Delta
Ω	ohms

2015 EDITION

YOU JUST GOT A LITTLE MORE HELP FROM A FRIEND.

FRANKLIN ELECTRIC TECHNICAL SERVICE HOTLINE

800-348-2420 | 260-827-5102 FAX

Option 1 - Franklin Water | **Option 2** - Franklin Control System | **Option 3** - Little Giant Commercial

Call Franklin's toll free TECHNICAL SERVICE HOTLINE for answers to your pump and motor installation questions. When you call, a Franklin expert will offer assistance in troubleshooting and provide immediate answers to your system application questions. Technical support is also available online.

franklinwater.com | franklin-controls.com | solar.franklin-electric.com | constantpressure.com

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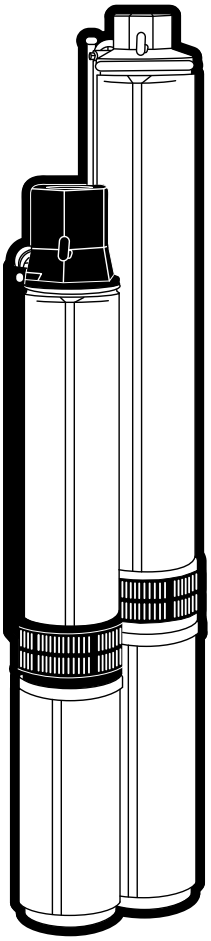
4" and 6" SUBMERSIBLE PUMPS OWNER'S MANUAL



BEFORE INSTALLING PUMP, BE SURE TO READ THIS OWNER'S MANUAL CAREFULLY.

⚠CAUTION Fill pump with water before starting or pump will be damaged. The motor on this pump is guaranteed by the manufacturer. In event of failure it must be returned to an authorized service station for repairs. Motor warranty is void if repairs are not made by an authorized repair station.

INSPECT THE SHIPMENT

Examine the pump when it is received to be sure there has been no damage in shipping. Should any be evident, report it immediately to the dealer from whom the pump was purchased. Please check the pump package to see that it includes pump, motor, and motor leads (if your pump purchase includes a motor).

READ AND FOLLOW SAFETY INSTRUCTIONS

⚠ This is the safety alert symbol. When you see this symbol on your pump or in this manual, look for one of the following signal words and be alert to the potential for personal injury:

⚠DANGER warns about hazards that will cause serious personal injury, death or major property damage if ignored.

⚠WARNING warns about hazards that **can** cause serious personal injury, death or major property damage if ignored.

⚠CAUTION warns about hazards that **will** or **can** cause minor personal injury or major property damage if ignored.

The label **NOTICE** indicates special instructions, which are important but not related to hazards.

Carefully read and follow all safety instructions in this manual and on pump.

Keep safety labels in good condition.

Replace missing or damaged safety labels.

⚠WARNING

Hazardous voltage. Can shock, burn, or cause death.

Ground pump before connecting to power supply. Disconnect power before working on pump, motor or tank.

⚠WARNING Wire motor for correct voltage. See "Electrical" section of this manual and motor nameplate.

⚠WARNING Ground motor before connecting to power supply.

⚠WARNING Meet National Electrical Code, Canadian Electrical Code, and local codes for all wiring.

Follow wiring instructions in this manual when connecting motor to power lines.

106467101
Rev. 12
11.14

⚠WARNING

IMPORTANT INFORMATION FOR INSTALLERS OF THIS EQUIPMENT!

THIS EQUIPMENT IS INTENDED FOR INSTALLATION BY TECHNICALLY QUALIFIED PERSONNEL. FAILURE TO INSTALL IT IN COMPLIANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES, AND WITH FRANKLIN ELECTRIC RECOMMENDATIONS, MAY RESULT IN ELECTRICAL SHOCK OR FIRE HAZARD, UNSATISFACTORY PERFORMANCE, AND EQUIPMENT FAILURE. FRANKLIN INSTALLATION INFORMATION IS AVAILABLE FROM PUMP MANUFACTURERS AND DISTRIBUTORS, AND DIRECTLY FROM FRANKLIN ELECTRIC. CALL FRANKLIN TOLL FREE 800-348-2420 FOR INFORMATION. RETAIN THIS INFORMATION SHEET WITH THE EQUIPMENT FOR FUTURE REFERENCE.

⚠WARNING

SERIOUS OR FATAL ELECTRICAL SHOCK MAY RESULT FROM FAILURE TO CONNECT THE MOTOR, CONTROL ENCLOSURES, METAL PLUMBING, AND ALL OTHER METAL NEAR THE MOTOR OR CABLE, TO THE POWER SUPPLY GROUND TERMINAL USING WIRE NO SMALLER THAN MOTOR CABLE WIRES. TO REDUCE RISK OF ELECTRICAL SHOCK, DISCONNECT POWER BEFORE WORKING ON OR AROUND THE WATER SYSTEM. DO NOT USE MOTOR IN SWIMMING AREAS.

INSTALLATION RECORDS

It is good idea to keep an accurate record of your installation. Be sure to record the data below:

Purchased From:			
Date of Installation:			
Pump Model No.*			
Pump Date Code*			
Well Inside Dia.(in/mm):			
Depth of Well(ft/m):			
Depth of Water(ft/m):			
Pump Setting(ft/m):			
Drop Pipe Size:			
Wire Size(pump to control box):			
Wire Size(control box to power source):			
Horizontal Offset(between well & house):			
Make of Motor*			
Amps	**HP**	**Volts**	**Ph**
Make of Control Box			
HP		**Volts**	
Power Supply			
Volts		**HZ**	
Pressure Switch (PSI)			
Cut-in		**Cut-out**	

* This Information is on your pump or motor tag. It will help us identify your pump in case of later inquiries.

TEST RUNNING

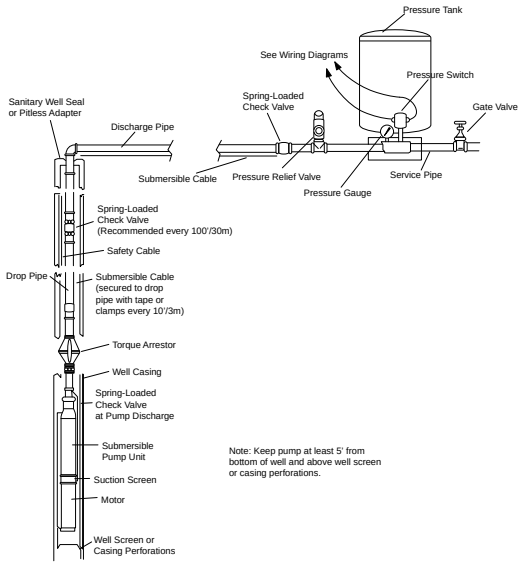
If test running pump before installation:

1. Insure that the power supply corresponds with that shown on the nameplate of the motor and control box. (if required).
2. Install pump and components appropriate for the test as shown in Fig. 1.
3. Make sure power supply is turned off and circuit breaker or disconnect switch is open. Make electrical connections appropriate to your motor as shown in Fig. 2, 3 or 4.
4. THREE-PHASE UNIT - A three-phase motor requires a magnetic starter equipped with quick-trip, ambient compensated heaters of correct size for the horsepower of the motor. To insure correct rotation of three-phase units, brace pump shell securely and apply power momentarily by snapping line switch quickly on and off.

If rotation is correct, reaction of the shell will be clockwise when viewed from pump discharge (that is, pump shaft will rotate counter clockwise). Interchange any two leads at magnetic starter to reverse rotation.

5. Run pump and motor unit for a few seconds to ensure that it is in working order.

FIGURE 1 - Installation Diagram



SUITABILITY OF WELL

Install the pump only in a well that has been properly developed. Water from an undeveloped well often contains an excessive amount of sand, dirt, and abrasives which can damage the pump. Check that the well is large enough to allow the pump to be set at the required depth. Do not set the pump below the casing perforations or well screen unless you make arrangements to ensure an adequate flow of water over the motor for cooling purposes. Determine the correct pump setting from the driller's record by taking into account the static water level and the drawdown at the proposed pumping rate. Keep the pump at least five feet from the bottom of a drilled well.

SPLICING THE POWER CABLE

Follow the instructions enclosed in the cable splicing kit you purchase.

DROP PIPE

Drop pipe is recommended for suspending submersible pumps into the well. Please refer to pipe manufacturer for recommendations on depth and pressure. Give special consideration to:

1. A safety cable to prevent loss of pump if pipe should break.

NOTICE: IT IS RECOMMENDED THAT STEEL CABLE BE USED FOR THE PURPOSES OF SECURING THE PUMP. 3/16" DIAMETER TO 1/4" DIAMETER BRAIDED STEEL CABLE IS SUFFICIENT TO SUPPORT MOST PUMP/MOTOR ASSEMBLIES. IT IS ALWAYS BEST TO CONFIRM THAT THE PUMP/MOTOR ASSEMBLY DOES NOT EXCEED THE MAXIMUM WEIGHT LIMIT OF THE CABLE SELECTED.

2. Torque arrestor just above pump to prevent chafing the cable when pump and pipe twist during the starting and stopping cycle. (See Figure 1)

Take great care to keep pipes clean and free from pebbles, scale and thread chips. Make sound, air-tight connections at all fittings. Pipe sealant is recommended.

CHECK VALVES

It is recommended that one or more check valves always be used in submersible pump installations. If the pump does not have a built-in check valve, an inline check valve should be installed in the discharge line within 25 feet of the pump and below the draw down level of the water supply. For deeper settings, check valves should be installed per the manufacturer's recommendations. More than one check valve is often needed, but more than the recommended number of check valves should not be used.

Swing type check valves are not acceptable and should never be used with submersible motors/pumps. Swing type check valves have a slower reaction time which can cause water hammer (see next page). Internal pump check valves or spring loaded check valves close quickly and help eliminate water hammer.

NOTE: Only positive sealing check valves should be used in submersible installations. Although drilling the check valve or using drain-back check valves may prevent back spinning, they create upthrust and water hammer problems.

Check valves are used to hold pressure in the system when the pump stops. They also prevent backspin, water hammer and upthrust. Any of these can lead to early pump or motor failure.

A. Backspin - With no check valve or a failed check valve, the water in the drop pipe and the water in the system can flow down the discharge pipe when the motor stops. This can cause the pump to rotate in a reverse direction. If the motor is started while it is backspinning,

an excessive force is placed across the pump-motor assembly that can cause impeller damage, motor or pump shaft breakage, excessive bearing wear, etc.

B. Upthrust - With no check valve, a leaking check valve, or drilled check valve, the unit starts under a zero head condition. This causes an uplifting or upthrust on the impeller-shaft assembly in the pump. This upward movement carries across the pump-motor coupling and creates an upthrust condition in the motor. Repeated upthrust can cause premature failure of both the pump and the motor.

C. Water Hammer - If the lowest check valve is more than 30 feet above the standing (lowest static) water level, or a lower check valve leaks and the check valve above holds, a vacuum is created in the discharge piping. On the next pump start, water moving at very high velocity fills the void and strikes the closed check valve and the stationary water in the pipe above it, causing a hydraulic shock. This shock can split pipes, break joints and damage the pump and/or motor. Water hammer can often be heard or felt. When discovered, the system should be shut down and the pump installer contacted to correct the problem.

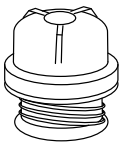
REMOVABLE POPPET CHECK VALVE

Some submersible pumps are supplied with a REMOVABLE check valve assembly for applications where the pump can become air locked. If the pump is supplied without a check valve, or if the check valve is removed, a spring-loaded inline check valve should be installed roughly 10 to 20 feet (3 to 6.09 meters) above the pump. This allows for the repriming of the pump after the pump has run out of water.

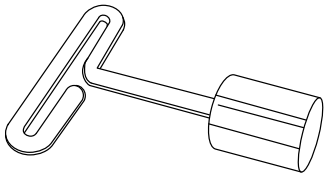
⚠WARNING Fluid draining back through the pump can cause the pump to rotate backwards. If pump/motor starts during this time; damage to the pump can occur.

The check valve can be removed with the use of the T-Handle Poppet Wrench (part no. 23498207), ordered separately, or, with standard needle nose pliers. The poppet assembly is left hand threaded and is removed by turning CLOCKWISE.

If reinstalling a Popppet Check Valve assembly, the assembly should be tightened to 15 inch-pounds.



Poppet Assembly



T-Handle Poppet Wrench

INSTALLATION OF PUMP, DROP PIPE, AND ASSOCIATED EQUIPMENT

Fig. 1 illustrates a typical well installation showing in-ground components. Franklin recommends the following procedure when installing the pump and drop pipe:

1. Prior to fastening the pump/motor assembly to the drop pipe, confirm that the motor's lead wires are securely housed under lead guard which was supplied with the pump. Fastening screws have been provided for use during the lead guard's installation.
2. Fasten the submersible cable to the drop pipe with clamps or appropriate tape every 10 ft. (3m) to prevent tangling and damage to the cable. The cable must remain slack when using plastic drop pipe to allow for stretching of pipe when installed in the well.
3. Take care not to scrape or pinch the submersible cable against the well casing.
4. Use an ohmmeter or megger to make insulation and continuity checks on the cable once the pump is installed. This locates any fault in the cable.
5. Make sure system check valves are installed properly. See previous sections of this manual for further information on check valve placement, type, and troubleshooting.
6. Install a torque arrestor just above the pump to prevent chafing the cable when pump and pipe twist during starting and stopping.
7. Attach a safety cable to pump to prevent loss of pump if pipe should break.

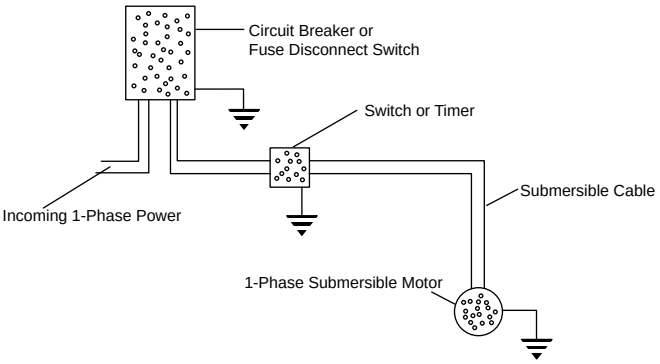
NOTICE: IT IS RECOMMENDED THAT STEEL CABLE BE USED FOR THE PURPOSES OF SECURING THE PUMP. 3/16" DIAMETER TO 1/4" DIAMETER BRAIDED STEEL CABLE IS SUFFICIENT TO SUPPORT MOST PUMP/MOTOR SYSTEMS. IT IS ALWAYS BEST TO CONFIRM THAT THE PUMP/MOTOR SYSTEM DOES NOT EXCEED THE MAXIMUM WEIGHT LIMIT OF THE CABLE SELECTED.

8. Place a sanitary well seal or pitless adapter with an approved cover plate over top of well per manufacturers recommendations.
9. Keep pump at least 5' (1.5m) from bottom of well and above well screen or casing perforations.

ELECTRICAL INFORMATION

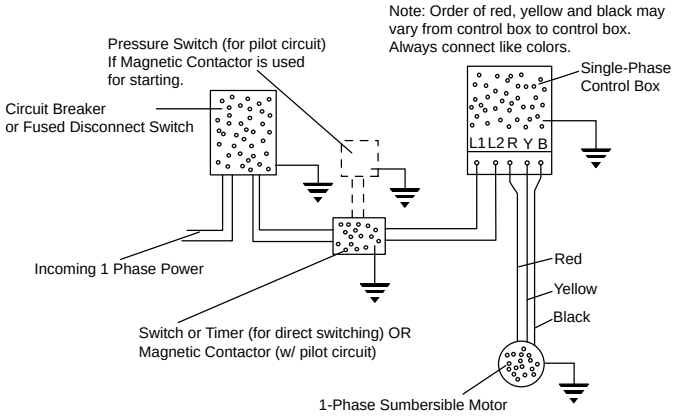
1. Employ a licensed electrician to perform the wiring. All wiring must be done in accordance with applicable national and local electrical codes.
2. Check that the power supply corresponds with the electrical rating of the submersible motor and the control box(if required). Make sure that the control box electrical rating matches the motor electrical rating.
3. Every installation requires a fused disconnect switch or circuit breaker.
4. Every installation must be grounded. There must be a reliable ground connection between the pump and the distribution panel. The motor lead incorporates a green grounding conductor.
5. Lightning arrestors are recommended for every installation. All stainless steel, single phase motors thru 5HP have built-in lightning arrestors. Any 6" motor or 4", 3-phase motor requires a separate lightning arrestor installed as close to the wellhead as possible. Install the arrestor in accordance with manufacturers recommendations. A lightning arrestor provides protection against induced voltage surges on
6. Mount the control box in an area protected from rain, snow, direct sunlight or other high temperatures as this may cause tripping of the overload protector. Also protect the control box from extreme cold (below 25°F/-32°C) as this may have adverse effects on starting capacitor.
7. A two-wire pump does not require a motor control box, since all electrical components are built inside the motor. Fig. 2 shows a typical wiring diagram for a two-wire installation.

FIGURE 2 - 2 WIRE, 1-Phase, 1/2 thru 1-1/2 HP Pump Wiring Diagram



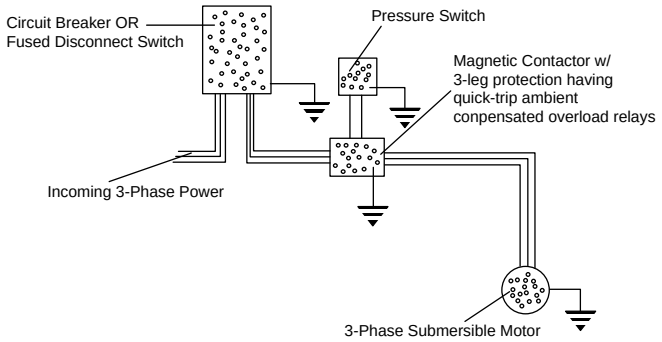
8. A three-wire, single-phase pump requires a motor control box incorporating overload relays. Fig. 3 shows a typical wiring diagram for a three-wire, single-phase installation. Note that a magnetic contactor must be used if the pressure switch electrical rating is not sufficient to handle the submersible motor electrical rating. The pressure switch would then be incorporated into a pilot circuit to control the magnetic contactor. Make the connections at the control box in accordance with the wiring diagram in the control box to avoid damage to the motor.

FIGURE 3 - 3-WIRE, 1-Phase, 1/2 thru 3 HP Pump Wiring Diagram



9. A three-phase pump does not require a motor control box . Fig. 4 shows a typical wiring diagram for a 3-wire, three-phase installation. A magnetic contractor with 3-leg protection having quick-trip ambient compensated overload relays must be used.

FIGURE 4 - 3-Wire, 3-Phase, 1-1/2 thru 50 HP Pump Wiring Diagram



10. Use an ohmeter to make continuity and insulation checks after the installation is completed.

11. Place the additional motor label with the pump label and place both in the disconnect switch or circuit breaker box for future reference.

WELL TEST

Check the pump and well performance before making the final connection to the discharge system.

1. Install a gate valve on the end of the pipe. Partially open the valve.
2. Start the pump.
3. Open valve gradually to give full flow.
4. If the discharge is not clear, let the pump run until water clears. If water does not clear in 30 minutes, stop the pump and take the necessary steps to correct the condition. After the water has appeared clear, check for sand by discharging into a clean bucket or suitable container.
5. Close valve until maximum required system flow rate is obtained (this should correspond to the cut-in pressure of the pressure switch). Ensure that the output of the pump at this setting is not greater than the yield of the well. This can be checked by monitoring the well drawdown level and ensuring that the level is stable at the maximum required system flow rate.

⚠CAUTION Never run pump unless it is completely submerged in water. If run without water, the pump and motor could be damaged. Note also that air drawn into the pump can cause an airlock under certain conditions.

LOW-YIELDING WELL

A low-yielding well exists when the output from the pump is greater than the yield of the well. It can reduce the water level to the suction screen so that a mixture of air and water enters the pump. Pumping may stop since the pump cannot generate pressure with insufficient water. In this case, the column of water already in the drop pipe holds the check valve closed and an airlock may develop inside the pump. Because the conditions ensure neither adequate lubrication of the pump nor proper cooling for the motor, damage can result if power is not cut off quickly. Use one or more of the following methods to correct and/or protect this installation.

1. Install additional length of drop pipe to place pump lower in well if possible.
2. Install a Franklin Pumptec or similar electronic drawdown sensor.
3. Install a floatless liquid level control. This device consists of an electrical relay activated by currents flowing through the ground-return circuits of electrodes hung in the well. The lower (STOP) electrode, just above the pump, ensures that the water level can never be pumped down to the suction screen. The upper (START) electrode, just below the lowest static water level, ensures that the pump can start again as soon as the well has recovered. A floatless liquid level control works in series with the pressure switch. Refer to the manufacturers instructions provided with control.
4. Install a flow control valve in the discharge line upstream from the pressure switch. This restricts the output from the pump without affecting the rate that water can be drawn from the pressure tank. Nevertheless, a heavy demand for water could empty the pressure tank, so a tank with a bonded diaphragm, air cell, or water bag is recommended.
5. Install a smaller pump to avoid over pumping the well. Have dealer size pump to the well yield.
6. Install a low-pressure cut-off switch. A low pressure cut off switch, or a pressure switch with such an arrangement built in, protects a shallow-well pump from losing its prime, but it does not always provide satisfactory protection to a submersible pump from the effects of over pumping the well. This is because it responds to a loss of pressure at the surface, which may occur after an air lock has formed inside the pump. We recommend either a floatless liquid level control or a flow control valve, in that order, in preference to a low-pressure cutoff switch as protection against over pumping.

DISCHARGE PLUMBING

Fig. 1 illustrates a typical well installation showing above ground components. Adhere to the following items when installing the discharge plumbing.

1. Install an above ground check valve upstream from the pressure switch.
2. Always install a pressure relief valve in the system. The relief valve should be capable of discharging the flow rate of the pump at the rated working pressure of the pressure tank. Locate the relief valve close to the pressure tank.
3. Install a pressure switch between the check valve and the pressure tank. Refer to Fig. 2, 3, or 4 for proper wiring connections of pressure switch.
4. Install a pressure tank as close as possible to the pressure switch. Refer to manufacturer's recommendations for installation.

TROUBLESHOOTING

1. PUMP FAILS TO START

a) Electrical trouble - call dealer or electrician.
b) Drawdown protection device has pump turned off.
c) Overload tripped.
d) Reset low pressure cutoff switch (if installed).

2. PUMP FAILS TO DELIVER WATER

a) Air lock in pump.
b) Clogged intake screen.
c) Insufficient well yield.

3. PUMP GIVES REDUCED OUTPUT

a) Insufficient well yield.
b) Worn pump.
c) Clogged intake screen.
d) Low voltage.
e) Incorrect rotation (3-phase only).

4. PUMP CYCLES TOO FREQUENTLY

a) Excessive pressure drop between pressure switch and pressure tank.
b) "Cut-in" pressure at pressure tank too high.
c) "Cut-out" pressure at pressure tank too low.
d) Waterlogged pressure tank.
e) Start and stop electrodes of floatless liquid level control set too close together.
f) Tank sized too small to meet system requirements.

5. OVERLOADS TRIP

a) Electrical trouble - call dealer or electrician.

6. PRESSURE SWITCH CYCLES RAPIDLY WHEN PUMP STARTS

a) Pressure switch too far from pressure tank.
b) Adjust air charge of tank to manufacturer's recommendations.

LIMITED WARRANTY*

THIS WARRANTY SETS FORTH THE COMPANY'S SOLE OBLIGATION AND PURCHASER'S EXCLUSIVE REMEDY FOR DEFECTIVE PRODUCT.

Franklin Electric Company, Inc. and its subsidiaries (hereafter "the Company") warrants that the products accompanied by this warranty are free from defects in material or workmanship of the Company.

The Company has the right to inspect any product returned under warranty to confirm that the product contains a defect in material or workmanship. The Company shall have the sole right to choose whether to repair or replace defective equipment, parts, or components.

The buyer must return the product to an authorized Franklin Electric Distribution outlet for warranty consideration. Returns to the place of purchase will only be considered for warranty coverage if the place of purchase is an authorized Franklin Electric Distributor at the time the claim is made. Subject to the terms and conditions listed below, the Company will repair or replace to the buyer any portion of this product which proves defective due to materials or workmanship of the Company.

The Company will consider products for warranty for 12 months from the date of installation or for 24 months from the date of manufacture, whichever occurs first.

The Company 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 affixing any product, part or component thereof.

The Company reserves the right to change or improve its products or any portions thereof without being obligated to provide such change or improvement to previously sold products.

THIS WARRANTY DOES NOT APPLY TO products damaged by acts of God, including lightning, normal wear and tear, normal maintenance services and the parts used in connection with such service, or any other conditions beyond the control of the Company.

THIS WARRANTY WILL IMMEDIATELY VOID if any of the following conditions are found:

1. Product is used for purposes other than those for which it was designed and manufactured;
2. Product was not installed in accordance with applicable codes, ordinances and good trade practices;
3. Product was not installed by a Franklin Certified Contractor; or
4. Product was damaged as a result of negligence, abuse, accident, misapplication, tampering, alteration, improper installation, operation, maintenance or storage, nor to an excess of recommended maximums as set forth in the product instructions.

NEITHER SELLER NOR THE COMPANY SHALL BE LIABLE FOR ANY INJURY, LOSS OR DAMAGE, DIRECT, INCIDENTAL OR CONSEQUENTIAL (INCLUDING, BUT NOT LIMITED TO, INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY, OR ANY OTHER INCIDENTAL OR CONSEQUENTIAL LOSS), ARISING OUT OF THE USE OR THE INABILITY TO USE THE PRODUCT, AND THE BUYER AGREES THAT NO OTHER REMEDY SHALL BE AVAILABLE TO IT.

THE WARRANTY AND REMEDY DESCRIBED IN THIS LIMITED WARRANTY IS AN EXCLUSIVE WARRANTY AND REMEDY AND IS IN LIEU OF ANY OTHER WARRANTY OR REMEDY, EXPRESS OR IMPLIED, WHICH OTHER WARRANTIES AND REMEDIES ARE HEREBY EXPRESSLY EXCLUDED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, TO THE EXTENT EITHER APPLIES TO A PRODUCT SHALL BE LIMITED IN DURATION TO THE PERIODS OF THE EXPRESSED WARRANTIES GIVEN ABOVE.

DISCLAIMER: Any oral statements about the product made by the seller, the Company, the representatives or any other parties, do not constitute warranties, shall not be relied upon by the buyer, and are not part of the contract for sale. Seller's and the Company's only obligation, and buyer's only remedy, shall be the replacement and/or repair by the Company of the product as described above. Before using, the user shall determine the suitability of the product for his intended use, and user assumes all risk and liability whatsoever in connection therewith.

Some states and countries do not allow the exclusion or limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitations 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 and country to country.

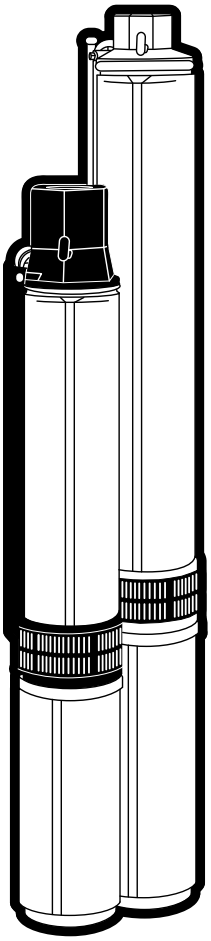
Franklin Electric, in its sole discretion, may update this limited warranty from time to time. Any conflicting information relating to warranty procedures, whether in a user manual or otherwise, is hereby superseded by this document. Nonetheless, all references to the term, or length of a warranty term, will remain consistent with the warranty in place at the time of purchase.

*Contact Franklin Electric Co., Inc. Export Division for International Warranty.

Franklin Electric

BOMBAS SUMERGIBLES DE 4" y 6" (10 y 15 cm)

MANUAL DEL PROPIETARIO DE



ANTES DE INSTALAR ESTA BOMBA CERCIÓRESE DE LEER MINUCIOSAMENTE ESTE MANUAL DEL PROPIETARIO.

⚠PRECAUCIÓN Para evitar dañar la bomba, llénela con agua antes de ponerla en marcha. El motor de esta bomba está garantizado por el fabricante y en caso de fallas debe devolverse a una estación de servicio autorizada para su reparación. La garantía del motor se anulará si las reparaciones son efectuadas por una estación de servicio no autorizada.

INSPECCIONE EL EMBARQUE

Tras recibirla, examine la bomba para cerciorarse de que no se haya dañado durante el envío. En caso de detectar algún daño evidente, informe inmediatamente al distribuidor a quien adquirió la bomba. Revise el embalaje de la bomba para cerciorarse de que incluya la bomba, el motor y sus cables (si la bomba que compró incluye un motor).

LEA Y ACATE LAS INSTRUCCIONES DE SEGURIDAD

⚠ Éste es el símbolo de alerta de seguridad. Cuando vea este símbolo en la bomba o en el manual, busque una de las siguientes palabras indicadoras y esté atento al peligro potencial de lesiones:

⚠PELIGRO advierte sobre peligros que, de ignorarse, causarán lesiones graves, letales o daños materiales importantes.

⚠ADVERTENCIA advierte sobre peligros que, de ignorarse, **pueden causar** lesiones graves, letales o daños materiales importantes.

⚠PRECAUCIÓN advierte sobre peligros que, de ignorarse, **causarán** o **pueden causar** lesiones leves o daños materiales importantes.

La etiqueta **AVISO** indica instrucciones especiales que son importantes, pero que no están relacionadas con peligros.

⚠ADVERTENCIA

Voltaje peligroso. Puede causar descargas, quemaduras o la muerte.

Ponga a tierra la bomba antes de conectarla al suministro eléctrico. Desconecte el suministro eléctrico antes de trabajar en la bomba, el motor o el tanque.

Lea y acate cuidadosamente todas las instrucciones de seguridad indicadas en este manual o en la bomba.

Mantenga las etiquetas de seguridad en buen estado.

Reemplace las etiquetas faltantes o estropeadas.

⚠ADVERTENCIA Cablee el motor según el voltaje correcto. En la sección sobre el sistema eléctrico de este manual y en la placa identificatoria del motor encontrará más información al respecto.

⚠ADVERTENCIA Si el cordón de alimentación es dañado, éste debe ser reemplazado únicamente por personal calificado o el fabricante.

⚠ADVERTENCIA Ponga a tierra el motor antes de conectarlo al suministro eléctrico.

⚠ADVERTENCIA Cumpla los requisitos del Código Eléctrico Nacional, el Código Eléctrico Canadiense y los códigos locales para todo el cableado.

⚠ADVERTENCIA Siga las instrucciones de cableado que se indican en este manual cuando conecte el motor a las líneas eléctricas.

⚠ ADVERTENCIA

¡INFORMACIÓN IMPORTANTE PARA LOS INSTALADORES DE ESTE EQUIPO!

ESTE EQUIPO DEBE SER INSTALADO POR PERSONAL TÉCNICAMENTE CALIFICADO. SI NO SE INSTALA ACATANDO LOS CÓDIGOS ELÉCTRICOS NACIONALES Y LOCALES, Y LAS RECOMENDACIONES DE FRANKLIN ELECTRIC, PUEDE CAUSAR DESCARGA ELÉCTRICA O PELIGRO DE INCENDIO, RENDIMIENTO INSATISFACTORIO Y FALLA DEL EQUIPO. LA INFORMACIÓN DE INSTALACIÓN PUEDE SOLICITARSE A LOS FABRICANTES Y DISTRIBUIDORES DE LA BOMBA, Y DIRECTAMENTE A FRANKLIN ELECTRIC. LLAME A FRANKLIN SIN COSTO AL 800-348-2420 PARA OBTENER MÁS INFORMACIÓN. CONSERVE ESTA HOJA INFORMATIVA CON EL EQUIPO PARA REFERENCIA FUTURA.

⚠ ADVERTENCIA

SE PUEDE PRODUCIR UNA DESCARGA ELÉCTRICA GRAVE O LETAL SI EL MOTOR, LA CAJA DE CONTROL, LA PLOMERÍA METÁLICA Y OTROS METALES CERCANOS AL MOTOR O CABLE, SE CONECTAN INCORRECTAMENTE AL TERMINAL DE PUESTA A TIERRA DEL SUMINISTRO ELÉCTRICO USANDO UN ALAMBRE DE CALIBRE INFERIOR A LOS DEL MOTOR. PARA REDUCIR EL RIESGO DE DESCARGA ELÉCTRICA, DESCONECTE EL SUMINISTRO ANTES DE EFECTUAR TRABAJOS EN O CERCA DEL SISTEMA DE AGUA. NO USE EL MOTOR EN ZONAS DE NATACIÓN.

⚠ ADVERTENCIA

ESTE APARATO NO SE DESTINA PARA UTILIZARSEPOR PERSONAS (INCLUYENDO NIÑOS) CUYAS CAPACIDADES FÍSICAS, SENSORIALES O MENTALES SEAN DIFERENTES O ESTÉN REDUCIDAS, O CAREZCAN DE EXPERIENCIA O CONOCIMIENTO, A MENOS QUE DICHAS PERSONAS RECIBAN UNA SUPERVISIÓN O CAPACITACIÓN PARA EL FUNCIONAMIENTO DEL APARATO POR UNA PERSONA RESPONSABLE DE SU SEGURIDAD. LOS NIÑOS DEBEN SUPERVISARSE PARA ASEGURAR QUE ELLOS NO EMPLEEN LOS APARATOS COMO JUGUETE.

ANTECEDENTES DE INSTALACIÓN

Es aconsejable mantener un registro preciso de su instalación. Cerciórese de anotar los datos siguientes:

Adquirido en:			
Fecha de instalación:			
No. de modelo de la bomba*			
Código de fecha de la bomba*			
Diá. interno del pozo (pulg/mm):			
Profundidad del pozo (pies/m):			
Profundidad del agua (pies/m):			
Ubicación de la bomba (pies/m):			
Tamaño de la cañería de bajada:			
Calibre del alambre (bomba a caja de control):			
Calibre del alambre (caja de control a suministro):			
Distancia horizontal (entre el pozo y la casa):			
Marca del motor*			
Amps	**HP**	**Voltios**	**Fase**
Marca de la caja de control			
HP		**Voltios**	
Suministro eléctrico			
Voltios		**HZ**	
Presostato (lb/pulg^2)			
Arranque		**Corte**	

* Esta información aparece en el rótulo de la bomba o del motor. Nos permitirá identificar la bomba en caso de averiguaciones posteriores.

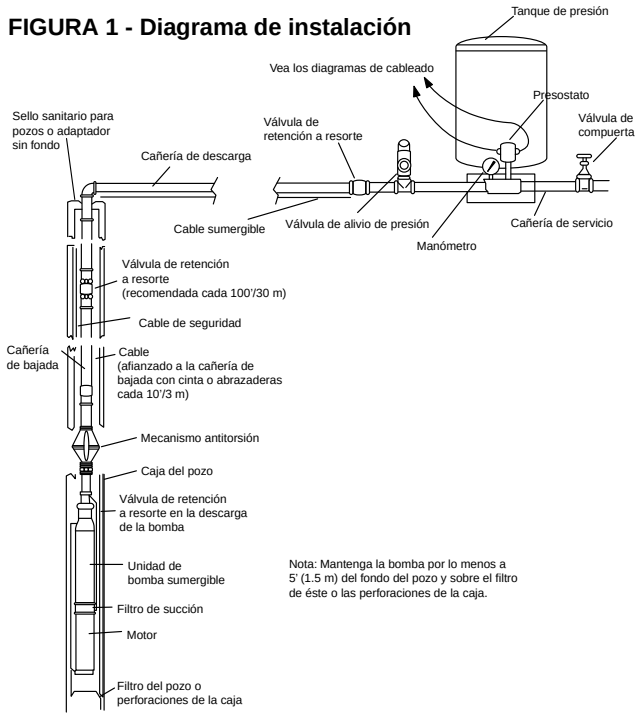
PRUEBE EL FUNCIONAMIENTO

Si antes de la instalación va a probar el funcionamiento de la bomba:

1. Cerciórese de que el suministro eléctrico corresponda con el que aparece en la placa identificatoria del motor y la caja de control. (si se requiere).
2. Instale la bomba y los componentes apropiados para la prueba tal como se muestra en la Fig. 1.
3. Cerciórese de que el suministro eléctrico esté apagado y el cortacircuito o interruptor de desconexión esté abierto. Haga las conexiones eléctricas apropiadas en el motor tal como se muestra en la Fig. 2, 3 ó 4.
4. UNIDAD TRIFÁSICA - Un motor trifásico requiere un arrancador magnético equipado con calentadores de compensación ambiental de disparo rápido y tamaño correcto para la potencia del motor. Para garantizar el giro correcto de las unidades trifásicas, afiance firmemente el armazón de la bomba y energícelo momentáneamente encendiendo y apagando rápidamente el conmutador de línea. Si el giro es correcto, el armazón reaccionará en sentido horario al mirarse desde la descarga de la bomba (es decir, el eje de la bomba girará en sentido antihorario). Para invertir el giro intercambie cualquiera de los dos cables en el arrancador magnético.

5. Haga funcionar la bomba y el motor unos cuantos segundos para verificar que estén en buen estado.

FIGURA 1 - Diagrama de instalación



IDONEIDAD DEL POZO

Instale la bomba sólo en un pozo que haya sido correctamente construido. El agua proveniente de un pozo mal construido suele contener una cantidad excesiva de arena y agentes abrasivos que pueden dañar la bomba. Cerciórese de que el pozo sea lo suficientemente grande para que permita instalar la bomba en la profundidad requerida. No instale la bomba debajo de las perforaciones de la caja ni del filtro del pozo, a menos que haga los ajustes necesarios para garantizar un flujo de agua adecuado sobre el motor para fines de enfriamiento. Determine la ubicación correcta de la bomba conforme los antecedentes que le proporcione el perforista, considerando el nivel estático del agua y el descenso del nivel según la tasa de bombeo propuesta. Mantenga la bomba por lo menos a cinco pies (1.5 m) del fondo del pozo perforado.

EMPALME DEL CABLE DE ALIMENTACIÓN

Siga las instrucciones que vienen adjuntas en el juego de empalme del cable que adquirió.

CAÑERÍA DE BAJADA

Se recomienda la bajada de cañería durante la suspensión de las bombas en el pozo. Favor de seguir las recomendaciones del fabricante a cerca de profundidad y presión. Preste especial atención a:

1. Un cable de seguridad para evitar la pérdida de la bomba si la cañería se rompe.

ATENCIÓN: SE RECOMIENDA USAR CABLE DE ACERO PARA ASEGURAR LA BOMBA. UN CABLE DE ACERO TRENZADO DE 3/16" A 1/4" DE DIÁMETRO ES SUFICIENTE PARA SOPORTAR LA MAYORÍA DE LOS ENSAMBLES BOMBAS/MOTOR. SIEMPRE ES MEJOR CONFIRMAR QUE EL ENSAMBLES BOMBAS/ MOTOR. NO EXCEDE EL LÍMITE MÁXIMO DE PESO PARA EL CABLE SELECCIONADO.

2. Mecanismo antitorsión justo arriba de la bomba para no escoriar el cable cuando la bomba y la cañería giren durante el ciclo de arranque y parada. (Consulte la Figura 1)

Cerciórese de mantener las cañerías limpias y libres de guijarros, escamas y virutas de roscas. Conecte todos los herrajes en forma segura y hermética. Se recomienda usar sellante de cañerías.

VÁLVULAS DE RETENCIÓN

Se recomienda usar una o más válvulas en instalaciones de bombas sumergibles. Si la bomba no tiene una válvula check incluida, ésta debe instalarse en la línea de descarga sin sobrepasar los 25 pies de distancia de la bomba. Para ajustes más profundos, las válvulas check deben de ser instaladas bajo las recomendaciones del fabricante. Frecuentemente se necesita más de una válvula check, sin embargo, no se debe de sobrepasar el número recomendado de válvulas check.

Válvulas check de tipo columpio no son aceptadas y nunca deberán ser usadas con motores/bombas sumergibles. Las válvulas tipo columpio tienen un tiempo de reacción más lento y puede causar un golpe de ariete (ver en siguiente página). Válvulas check internas o en la tubería cierran rápido, lo que evita el golpe de ariete.

NOTA: Sólo Se deben de usar válvulas check con sello positivo en instalaciones sumergibles. Aún drenando la válvula check o al usar válvulas check de drenado se puede prevenir el giro inverso

Las válvulas check son usadas para mantener la presión en un sistema cuando la bomba se detiene. También previenen el giro en reversa de la bomba, protegen del golpe de ariete y sobrecarga. Todos estos acontecimientos pueden causar fallas en la bomba y/o motor.

A. Giro Inverso – Sin válvula check o una válvula check con fallas, el agua en las tuberías del sistema de bombeo puede fluir de regreso en la tubería de descarga cuando el motor para. Esto puede causar que la bomba rote en dirección inversa. Si el motor se enciende mientras la bomba está girando en dirección inversa, una fuerza excesiva se ejerce en la conexión entre la bomba y el motor, lo que puede causar daños en los impulsores, rotura de la flecha, un gasto excesivo en la chumacera, etc.

B. Sobrecarga – Sin una válvula check o alguna otra herramienta que tenga la misma función la unidad enciende debajo de una condición de cero carga. Esto causa una sobrecarga en los impulsores de la bomba. Este movimiento se resiente en el acople entre la bomba y el motor y crea una condición de sobrecarga en el motor. Varias sobrecargas pueden causar daño prematuro en ambos el motor y la bomba.

C. Golpe de Ariete – Si la válvula check se encuentra a más de 30 pies sobre el nivel estático más bajo del agua, se crea un vacío en la tubería de descarga. En el siguiente arranque

de la bomba, el agua llena el espacio a una gran velocidad y golpea la válvula check y las tuberías, creando un shock hidráulico. Esto puede causar rotura de tuberías, daños en la bomba y/o el motor. El golpe de ariete puede ser sentido o escuchado. Cuando se descubre, el sistema debe de ser apagado y el instalador debe ser contactado para poder corregir el problema.

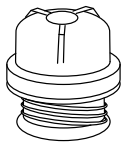
VÁLVULA DE RETENCIÓN RETIRABLE CON VÁSTAGO

Algunas bombas sumergibles incluyen una válvula check removible diseñada para aplicaciones donde la bomba puede tener entradas de aire. Si la bomba es entregada sin esta válvula check, o la válvula check es removida, debe instalarse una válvula activa a una altura máximo de 10-20 pies (3-6 metros) por encima de la bomba. Esto permite el re-cebado de la bomba después de que se queda sin agua.

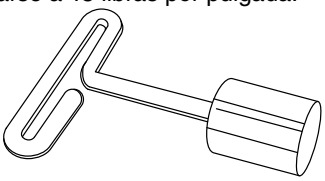
⚠ADVERTENCIA El líquido que se vacía de regreso por la bomba puede hacer que ésta gire hacia atrás. Si la bomba/motor arrancan durante este instante, la bomba podría dañarse.

La válvula de retención se puede retirar usando una llave de vástago con mango en T (No. de pieza 23498207), la cual se pide por separado, o bien con un alicate normal con puntas de aguja. El conjunto del vástago se rosca hacia la izquierda y se retira girándolo en sentido HORARIO.

Si va a reinstalar un conjunto de válvula de retención con vástago, éste debe apretarse a 15 libras por pulgada.



Conjunto del vástago



Llave de vástago con mango en T

INSTALACIÓN DE LA BOMBA, LA CAÑERÍA DE BAJADA Y EL EQUIPO AFÍN

En la Fig. 1 aparece una instalación de pozo típica mostrando los componentes bajo la superficie. Siga estos pasos cuando instale la bomba y la cañería de bajada:

1. Antes de sujetar el ensamble bomba/motor a la tubería, confirme que los cables del conector del motor están colocados de forma segura dentro del guardacable proporcionado con la bomba. De igual forma se proporcionan tornillos de sujeción para usarse durante la instalación del guardacable.
2. Afiance el cable sumergible a la cañería de bajada con abrazaderas o cinta apropiada a cada 10 pies (3 m) para que no se enrede ni dañe. Cuando se use cañería de bajada plástica, el cable debe permanecer flojo para compensar el alargamiento de la cañería cuando se instale en el pozo.
3. Tenga cuidado de no raspar ni apretar el cable sumergible contra la caja del pozo.
4. Use un ohmímetro o megóhmetro para revisar la continuidad y el aislamiento en el cable tras instalar la bomba. De esta forma localizará fallas en el cable.
5. Asegúrese de que las válvulas check del sistema estén instaladas correctamente. Vea las secciones anteriores del manual para mayor información sobre el acomodo de las válvulas check, los diferentes tipos y solución de problemas.
6. Instale un mecanismo antitorsión justo arriba de la bomba para no escoriar el cable cuando ésta y la cañería giren durante el ciclo de arranque y parada.
7. Conecte un cable de seguridad en la bomba para evitar la pérdida de la misma si la cañería se rompe.

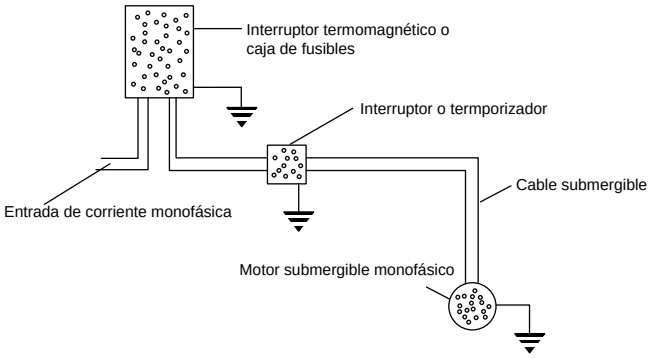
ATENCIÓN: SE RECOMIENDA USAR CABLE DE ACERO PARA ASEGURAR LA BOMBA. UN CABLE DE ACERO TRENZADO DE 3/16" A 1/4" DE DIÁMETRO ES SUFICIENTE PARA SOPORTAR LA MAYORÍA DE LOS SISTEMAS BOMBA/MOTOR. SIEMPRE ES MEJOR CONFIRMAR QUE EL SISTEMA BOMBA/MOTOR NO EXCEDE EL LÍMITE MÁXIMO DE PESO PARA EL CABLE SELECCIONADO.

8. Coloque un sello sanitario para pozos o un adaptador sin fondo con una placa protectora aprobada en la parte superior del pozo siguiendo las recomendaciones del fabricante.
9. Mantenga la bomba por lo menos a 5’ (1.5 m) del fondo del pozo y sobre el filtro del mismo o en las perforaciones de la caja.

INFORMACIÓN ELÉCTRICA

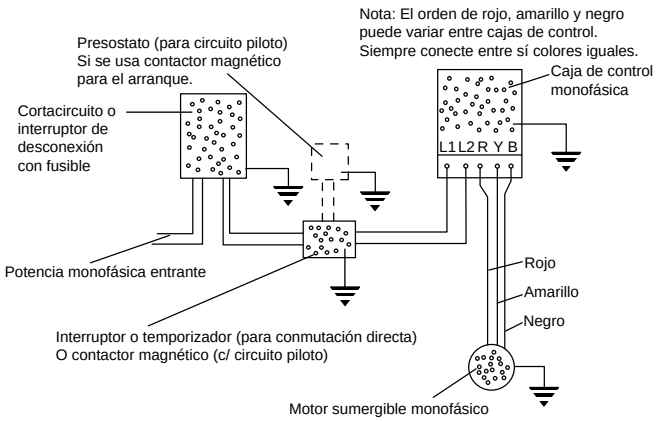
1. Contrate a un electricista licenciado para que realice el cableado. Todo el cableado debe hacerse conforme los códigos eléctricos nacionales y locales pertinentes.
2. Verifique que el suministro eléctrico corresponda con la corriente nominal del motor sumergible y la caja de control (si se requiere). Cerciórese de que la corriente nominal de la caja de control coincida con la corriente nominal del motor.
3. Cada instalación requiere un interruptor de desconexión con fusible o cortacircuito.
4. Cada instalación debe estar puesta a tierra. Debe existir una conexión a tierra segura entre la bomba y el panel de distribución. El cable del motor incluye un conductor verde de puesta a tierra.
5. Se recomienda usar pararrayos para cada instalación. Todos los motores monofásicos de acero inoxidable hasta 5HP tienen pararrayos incorporados. Todo motor trifásico de 6"ó 4" (15 y 10 cm) requiere un pararrayos aparte instalado lo más cerca posible del manantial. Instale el pararrayos según las recomendaciones del fabricante. El pararrayos brinda protección contra sobretensiones inducidas en las líneas eléctricas secundarias; no es eficaz contra golpes directos.
6. Monte la caja de control en un área protegida contra la lluvia, nieve, la luz directa del sol u otras temperaturas altas, ya que ello puede causar la disyunción del protector de sobrecarga. Proteja también la caja de control contra el frío extremo (inferior a 25°F/-32°C) ya que puede causar efectos adversos al arrancarse el condensador.
7. Una bomba de dos alambres no requiere una caja de control del motor, pues todos los componentes eléctricos están incorporados dentro del mismo. En la Fig. 2 aparece un diagrama de cableado típico de una instalación de dos alambres.

Figura 2 – Diagrama de Cableado de la bomba, 2 hilos, Monofásico, 0.5 – 1.5 hp



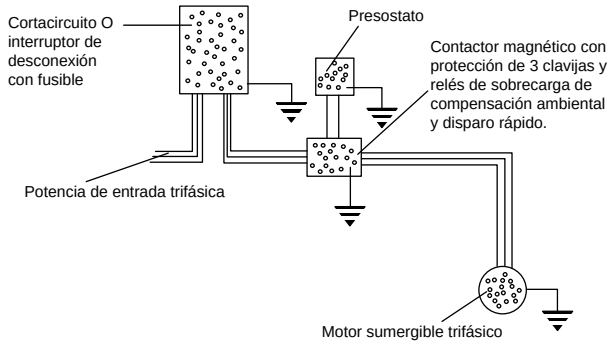
8. Una bomba monofásica de tres alambres requiere una caja de control del motor que incorpore relés de sobrecarga. En la Fig. 3 aparece un diagrama de cableado típico de una instalación monofásica de tres alambres. Tenga presente que se debe usar un contactor magnético si la corriente nominal del presostato no es suficiente para soportar la corriente nominal del motor sumergible. Luego el presostato debe incorporarse en un circuito piloto para controlar el contactor magnético. Para no dañar el motor haga las conexiones en la caja de control según el diagrama de cableado que viene en la misma.

FIGURA 3 - Diagrama de cableado de la bomba de 3 ALAMBRES, monofásica, de 1/2 a 3 HP



9. Una bomba trifásica no requiere una caja de control del motor. En la Fig. 4 aparece un diagrama de cableado típico de una instalación trifásica de 3 alambres. Se debe usar un contactor magnético con protección de 3 clavijas que tenga relés de sobrecarga de compensación ambiental y disparo rápido.

FIGURA 4 - Diagrama de cableado de la bomba de 3 ALAMBRES, trifásica, de 1-1/2 a 50 HP



10. Tras completar la instalación, use un ohmímetro para revisar la continuidad y el aislamiento.
11. Junte la etiqueta adicional del motor con la etiqueta de la bomba y colóquelas en el interruptor de desconexión o la caja del cortacircuito como referencia futura.

PRUEBA DEL POZO

Antes de hacer la conexión final al sistema de descarga, revise el rendimiento de la bomba y el pozo.

1. Instale una válvula de compuerta en el extremo de la cañería. Abra parcialmente la válvula.
2. Arranque la bomba.
3. Abra gradualmente la válvula para darle pleno flujo.
4. Si la descarga es turbia, deje que la bomba funcione hasta que el agua se aclare. Si no se aclara en 30 minutos, detenga la bomba y adopte las medidas necesarias para corregir el problema. Una vez que el agua se haya aclarado, vea si contiene arena descargándola en un cubo limpio u otro recipiente apto.
5. Cierre la válvula hasta generar el flujo máximo requerido por el sistema (éste debe corresponder a la presión de corte del presostato). Cerciórese de que el caudal de la bomba en este ajuste no sea superior al rendimiento del pozo. Ello se puede verificar supervisando el descenso del nivel del pozo y cerciorándose de que el nivel permanezca estable en el flujo de salida máximo requerido por el sistema.

⚠PRECAUCIÓN Nunca haga funcionar la bomba sino hasta que esté completamente sumergida. Si la hace funcionar sin agua, la bomba y el motor podrían dañarse. Tenga presente también que el aire que ingrese a la bomba puede originar una exclusa de aire.

POZO DE BAJO RENDIMIENTO

Un pozo es de bajo rendimiento cuando su producción es inferior al caudal de la bomba. Puede bajar el nivel del agua hasta llegar al filtro de succión, lo cual permite que ingrese una mezcla de aire y agua a la bomba. El bombeo puede detenerse ya que la bomba no puede generar presión con poca agua. En este caso, la columna de agua que ya está en la cañería de bajada mantiene cerrada la válvula de retención y dentro de la bomba se puede originar una exclusa de aire. Debido a que las condiciones no aseguran la lubricación adecuada de la bomba ni el enfriamiento correcto del motor, se puede producir daño si el suministro eléctrico no se corta rápidamente. Use uno o más de los métodos siguientes para corregir y/o proteger esta instalación.

1. Si es posible instale un tramo adicional de cañería de bajada para colocar la bomba más abajo en el pozo.
2. Instale un sensor electrónico de descenso del nivel Franklin Pumptec o uno similar.
3. Instale un control de nivel de líquido sin flotador. Este dispositivo consta de un relé eléctrico activado por corrientes que fluyen por los circuitos de retorno por tierra de los electrodos suspendidos en el pozo. El electrodo inferior (PARADA), justo arriba de la bomba, garantiza que el nivel del agua nunca baje hasta llegar al filtro de succión. El electrodo superior (ARRANQUE), justo debajo del nivel estático de agua más bajo, garantiza que la bomba pueda arrancar nuevamente apenas el pozo se haya recuperado. El control del nivel del líquido sin flotador funciona en serie con el presostato. En las instrucciones del fabricante que vienen con el control encontrará más información.
4. Instale una válvula reguladora de flujo en la línea de descarga aguas arriba del presostato. Ésta restringe el caudal de la bomba sin afectar la tasa a la cual se puede extraer el agua del tanque de presión. No obstante, una gran demanda de agua podría vaciar el tanque de presión, por lo que se recomienda usar un tanque con diafragma, alveolo o bolsa de agua.
5. Instale una bomba más pequeña para no bombear excesivamente el pozo. Pídale al distribuidor que ajuste la bomba según el rendimiento del pozo.
6. Instale un interruptor eléctrico de baja presión. Un interruptor eléctrico de baja presión o un presostato con tal disposición incorporada, protege la bomba de un pozo poco profundo para que no pierda el cebado, pero no siempre protege satisfactoriamente a la bomba sumergible de los efectos del bombeo excesivo del pozo. Esto se debe a que responde a una pérdida de presión en la superficie, la cual puede producirse después de que se ha formado una exclusa de aire dentro de la bomba. Como protección contra el bombeo excesivo recomendamos usar preferentemente un control de nivel de líquido sin flotador, o en su defecto una válvula reguladora de flujo, en lugar de un interruptor eléctrico de baja presión.

PLOMERÍA DE DESCARGA

En la Fig. 1 aparece una instalación de pozo típica mostrando los componentes sobre la superficie. Siga estos pasos cuando instale la plomería de descarga.

1. Instale una válvula de retención sobre la superficie aguas arriba del presostato.
2. Siempre instale una válvula de alivio de presión en el sistema. Dicha válvula debe poder descargar el flujo de salida de la bomba a la presión nominal de trabajo del tanque de presión. Ubique la válvula de alivio cerca del tanque de presión.
3. Instale un presostato entre la válvula de retención y el tanque de presión. En la Fig. 2, 3 ó 4 encontrará las conexiones de cableado del presostato.
4. Instale un tanque de presión lo más cerca posible del presostato. En las recomendaciones del fabricante encontrará información de instalación.

SOLUCIÓN DE PROBLEMAS

1. LA BOMBA NO ARRANCA

a) Problema eléctrico - llame al distribuidor o electricista.
b) La protección contra descenso del nivel apagó la bomba.
c) Sobrecarga disyuntada.
d) Reinicie el interruptor eléctrico de baja presión (si está instalado).

2. LA BOMBA NO SUMINISTRA AGUA

a) Exclusa de aire en la bomba.
b) Filtro de entrada obstruido.
c) Rendimiento del pozo insuficiente.

3. LA BOMBA PRODUCE UN CAUDAL REDUCIDO

a) Rendimiento del pozo insuficiente.
b) Bomba desgastada.
c) Filtro de entrada obstruido.
d) Voltaje bajo.
e) Giro incorrecto (trifásico solamente).

4. LA BOMBA CICLA CON DEMASIADA FRECUENCIA

a) Caída de presión excesiva entre el presostato y el tanque de presión.
b) Presión de arranque demasiado alta en el tanque de presión.
c) Presión de corte demasiado baja en el tanque de presión.
d) Tanque de presión anegado.
e) Electrodos de arranque y parada del control de nivel de líquido sin flotador, instalados demasiado cerca entre sí.
f) Tanque demasiado pequeño para cumplir los requisitos del sistema.

5. DISYUNCIÓN POR SOBRECARGAS

a) Problema eléctrico - llame al distribuidor o electricista.

6. EL PRESOSTATO CICLA RÁPIDAMENTE AL PONERSE EN MARCHA LA BOMBA

a) Presostato demasiado lejos del tanque de presión.
b) Ajuste el tanque de carga según las recomendaciones del fabricante.

GARANTÍA LIMITADA*

ESTA GARANTÍA ESTABLECE LA ÚNICA OBLIGACIÓN DE LA EMPRESA Y LA COMPENSACIÓN EXCLUSIVA AL COMPRADOR POR UN PRODUCTO DEFECTUOSO.

Franklin Electric Company, Inc. y sus filiales (de aquí en adelante, “la Empresa”) garantizan que los productos que cubre esta garantía carecen de defectos en cuanto al material o la mano de obra de la Empresa.

La Empresa tiene derecho a inspeccionar todo producto devuelto en garantía para confirmar si tiene defectos en el material o la mano de obra. La Empresa tendrá el derecho exclusivo de elegir si reparará o reemplazará el equipo, las piezas o los componentes defectuosos.

El comprador deberá enviar el producto a un distribuidor autorizado de Franklin Electric para hacer uso de la garantía. Las devoluciones al lugar de compra solo se considerarán para la cobertura de la garantía si el lugar de compra es un Distribuidor de Franklin Electric al momento en el que se haga la reclamación. Con sujeción a los términos y las condiciones que se enumeran a continuación, la Empresa le reparará o reemplazará al comprador cualquier parte de este producto que se compruebe estar defectuoso a causa de los materiales o la mano de obra de la Empresa.

La Empresa considerará que los productos están garantizados durante doce meses a partir de la fecha de su instalación, o durante 24 meses a partir de la fecha de manufactura, lo que ocurra primero.

La Empresa no se responsabilizará EN NINGÚN CASO ni estará obligada a responder por el costo del trabajo de campo u otros cargos en los que incurra un cliente al retirar y/o instalar un producto, una pieza o un componente de este.

La Empresa se reserva el derecho de cambiar o mejorar sus productos, o cualquier parte de ellos, sin tener la obligación de proveer dicho cambio o mejora a los productos que se han vendido con anterioridad.

ESTA GARANTÍA NO SE APLICA A los productos dañados por sucesos de fuerza mayor, incluyendo descargas eléctricas, el desgaste normal del producto, los servicios habituales de mantenimiento y las piezas que se utilicen en relación con dichos servicios, o por cualquier otra condición que escape al control de la Empresa.

ESTA GARANTÍA SE ANULARÁ DE INMEDIATO si se presenta cualquiera de las siguientes condiciones:

1. El producto se utilizó para otros propósitos distintos de aquellos para los que fue diseñado y fabricado;
2. El producto no se instaló de conformidad con los códigos, los reglamentos y las buenas prácticas comerciales vigentes;
3. El producto no fue instalado por un contratista certificado por Franklin; o
4. El producto resultó dañado por negligencia, abuso, accidente, aplicación indebida, modificación, alteración, instalación, operación, mantenimiento o almacenamiento inadecuados o como resultado del abuso de los límites recomendados y establecidos en las instrucciones del producto.

NI EL VENDEDOR NI LA COMPAÑÍA SERÁN RESPONSABLES POR NINGUNA LESIÓN, PÉRDIDA O DAÑO DIRECTO, INCIDENTAL O CONSECUENCIAL (INCLUIDOS, A TÍTULO ENUNCIATIVO, MAS NO LIMITATIVO, LOS DAÑOS INCIDENTALES Y CONSECUENCIALES POR PÉRDIDA DE GANANCIAS, VENTAS NO REALIZADAS, LESIONES A PERSONAS O LA PROPIEDAD, O CUALQUIER OTRA PÉRDIDA INCIDENTAL O CONSECUENCIAL) QUE SURJAN DEL USO O DE LA IMPOSIBILIDAD DEL USO DEL PRODUCTO, Y EL COMPRADOR ACEPTA QUE NO TENDRÁ DISPONIBLE NINGUNA OTRA COMPENSACIÓN.

LA GARANTÍA Y COMPENSACIÓN DESCRITOS EN ESTA GARANTÍA LIMITADA SON EXCLUSIVOS Y REEMPLAZAN A CUALQUIER OTRA GARANTÍA O COMPENSACIÓN, EXPRESAS O IMPLÍCITAS, Y POR EL PRESENTE SE EXCLUYEN OTRAS GARANTÍAS Y COMPENSACIONES INCLUYENDO, A TÍTULO ENUNCIATIVO, MAS NO LIMITATIVO, TODA GARANTÍA IMPLÍCITA DE COMERCIABILIDAD O IDONEIDAD PARA UN PROPÓSITO DETERMINADO, Y EN LA MEDIDA EN QUE ALGUNA DE LAS DOS SEA APLICABLE A UN PRODUCTO, ESTARÁ LIMITADA A LA DURACIÓN DE LOS PERIODOS DE LAS GARANTÍAS EXPRESAS MENCIONADOS ANTERIORMENTE.

DESCARGO DE RESPONSABILIDADES Cualquier declaración oral sobre el producto realizada por el vendedor, la Empresa, los representantes o cualquier otra parte, no constituye garantías. El usuario no debe depender de ellas, y no forman parte de este contrato de venta. La única obligación del vendedor y la Empresa, y la único compensación a disposición del comprador, será el reemplazo y/o la reparación del producto por parte de la Empresa, de la forma descrita anteriormente. Antes de usar el producto, el usuario determinará la idoneidad de este para su uso previsto, y el usuario asumirá todos los riesgos y la responsabilidad que se deriven de esta acción.

Algunos estados y países no permiten la exclusión o la limitación respecto a la duración de una garantía implícita, ni tampoco la exclusión o la limitación respecto a los daños incidentales o consecuenciales, de manera que es posible que la exclusión o las limitaciones mencionadas anteriormente, no sean aplicables en su caso. Esta garantía le concede derechos legales específicos, y también puede tener otros derechos que varían según el estado y el país.

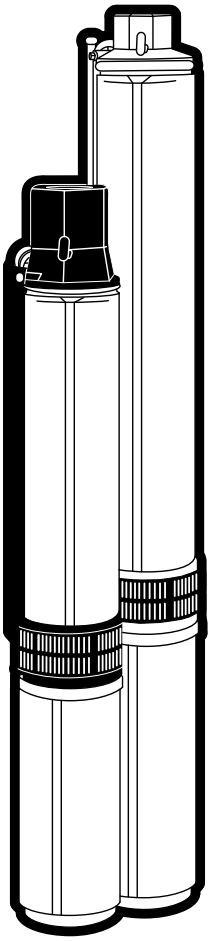
Franklin Electric, a su exclusivo criterio, puede actualizar esta garantía limitada ocasionalmente. Cualquier información conflictiva en relación a los procedimientos de la garantía, ya sea en un manual del usuario o no, queda suplantada por este documento. No obstante, todas las referencias al periodo o longitud del periodo de una garantía, permanecerán consistentes con la garantía vigente al momento de compra.

El usuario puede hacer válida la garantía directamente con el representante donde fue adquirido el producto. Para compras en México, puede contactar al importador Motores Franklin S.A. de C.V. En cualquier caso, deberá presentar el producto acompañado de la factura de compra o la presente póliza de garantía.

Para poder acceder a componentes, consumibles y accesorios, el usuario puede acudir directamente con el representante donde fue adquirido el producto. Para compras en México, puede contactar al importador Motores Franklin S.A. de C.V.
Importador: Motores Franklin S.A. de C.V.
Av. Churubusco 1600 B16
Monterrey, NL
CP 64560 MEXICO
Tel. 81 8000 1000

Franklin Electric

POMPES SUBMERSIBLES 4" ET 6"
MANUEL DU PROPRIETAIRE



AVANT D'INSTALLER LA POMPE, ETRE SUR DE LIRE CE MANUEL DE PROPRIETAIRE SOIGNEUSEMENT.

INSPECTION DE L'ÉQUIPEMENT

Sur reception de la pompe verifier si elle n'a pas été endommagée dans le transport. Si un dommage est apparent, le mentionner immediatement a votre detaillant ou pompe fut achetée. Vérifier si l'ensemble de pompe inclut: la pompe, le moteur et les conduits pour moteur (si l'achat de votre pompe inclut un moteur). Ces unités comprendront soit un clapet integre ou a montage exterieur a meme la tete de decharge. les modeles monophases, 3 fils, doivent avoir une boite de contrôle qui devra etre commandée séparément et assortie au moteur de la pompe (ex: une boite de contrôle Franklin pour un moteur Franklin). S'assurer que votre voltage correspond a celui du moteur.

LIRE ET SUIVRE LES INSTRUCTIONS DE SÉCURITÉ

Voici le symbole d'avertissement de sécurité. Quand vous verrez ce symbole sur votre pompe ou dans ce manuel, regardez pour un des mots-clefs ci-dessous et soyez conscient des dangers potentiels de blessures.

DANGER Avertis des dangers qui **vont** causer des blessures sérieuses, la mort ou des dommages majeurs à la propriété si ignorés.

AVERTISSEMENT Avertis des dangers qui **peuvent** causer des blessures sérieuses, la mort ou des dommages majeurs à la propriété si ignorés.

ATTENTION Avertis des dangers qui **peuvent** ou **vont** causer des blessures mineures à la personne et/ou des dommages majeurs à la propriété si ignorés.

La vignette **À NOTER** indique une attention spéciale qui est importante mais non reliée à la sécurité.

Bien lire et suivre toutes les instructions de sécurité écrites dans ce manuel et sur la pompe.

Garder les vignettes de sécurité en bonne condition.

Remplacer les vignettes endommagées ou manquantes.

AVERTISSEMENT

Haut Voltage. Peut électrocuter, brûler ou causer la mort.

Mettre la pompe à la masseavant de brancher au courant principal. Débrancher le courant avant de travailler sur la pompe, le moteur ou le réservoir.

AVERTISSEMENT Adapter le moteur au courant utilisé. Voir la section ÉLECTRIQUE de ce manuel et la plaque signalétique du moteur.

AVERTISSEMENT Brancher le moteur à la mise à la terre avant de brancher au courant principal.

AVERTISSEMENT Se conformer aux codes électriques nationaux, Canadiens et locaux pour tout branchement électrique.

AVERTISSEMENT Suivre les instructions de ce manuel pour le branchement du moteur au réseau principal.

⚠AVERTISSEMENT

INFORMATION IMPORTANTE POUR LES INSTALLATEURS DE CET APPAREIL!

CET APPAREIL EST PRÉVU POUR UNE INSTALLATION PAR UNE PERSONNE TECHNIQUEMENT QUALIFIÉE. LE NON-RESPECT DU CODE ÉLECTRIQUE NATIONAL OU PROVINCIAL PEUT ENTRAINER UN CHOC ÉLECTRIQUE OU UN INCENDIE, DES PERFORMANCES NON-SATISTAISANTE ET UNE DÉFAILLANCE DE L'ÉQUIPEMENT. LES INFORMATIONS D'INSTALLATION SONT DISPONIBLES DU MANUFACTURIER DE LA POMPE OU DIRECTEMENTDE CHEZ FRANKLIN ELECTIRC au 800-348-2420. GARDER CES INFORMATIONS PRÈS DE L'ÉQUIPEMENT POUR RÉFÉRENCE FUTURES.

⚠AVERTISSEMENT

UN CHOC ÉLECTRICE, MÊME FATAL PEUT SURVENIR SI LE BRANCHEMENT DU MOTEUR, DES ÉLÉMENTS DE CONTRÔLES, LA TUYAUTERIE EN MÉTAL ET/OU TOUT AUTRE PIÈCE EN MÉTAL PRÈS DU MOTEUR OU DU FIL NE SONT PAS BRANCHÉS À UNE MISE À LA TERRE UTILISANT UN FIL DE LA MÊME DIMENSION OU SUPÉRIEUR AU FILAGE MOTEUR. POUR ÉVITER LES RISQUES DE CHOCS ÉLECTRIQUES, DÉBRANCHEZ LE COURANT AVANT DE TRAVAILLER AVEC/OU SUR LE SYSTÈME D'EAU. NE PAS UTILISER LE MOTEUR DANS UNE ZONE DE BAIGNADE.

RECORD D'INSTALLATION

C'est une bonne idée de garder un record exact de votre installation. Voir à completer les données suivantes.

Acheté de:			
Date d'installation:			
No. de modèle de la pompe*			
Code de date de la pompe*			
Dia. int. du puits:			
Profondeur du puits:			
Profondeur jusqu'au niveau d'eau:			
Dimension du tuyau de descente:			
Dimension du fil:			
De la pompe à la boîte de contrôle:			
De la boîte de cont. à l'alim. élec.:			
Tuyauterie horizontale distante:			
Marque de moteur*			
Amp	**CV**	**Volts**	**Ph**
Marque de la boîte de contrôle			
CV		**Volts**	
Alimentation électrique			
Volts		**Ph**	

* Cette information est sur l'étiquette de la pompe ou moteur. Ceci nous aidera à identifier la pompe, si nécessaire.

EXAMINEZ LE FONCTIONNEMENT

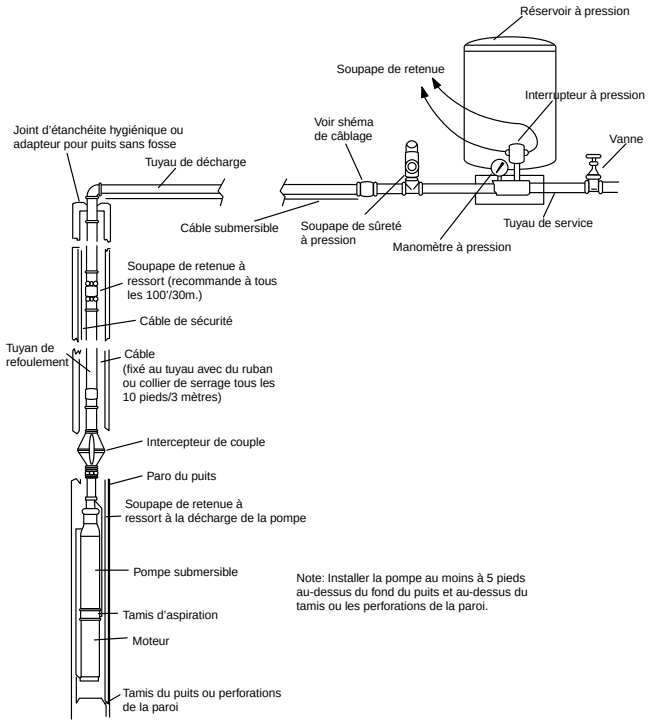
Si un essai doit ètre fait avant l'installation, verser 1 gallon d'eau dans la décharge, pour s'assurer que la pompe ne demarre pas à sec.

1. Vérifier si l'alimentation en courant électrique correspond aux indication données sur les plaques d'indentification du moteur et de la boîte de contrôle (si requise)
2. Installer la pompe et les composantes appropriées pour effectuer l'essai, tel qu'illustré à la figure 1.
3. S'assurer que l'alimentation électrique est à la position arrêt et que le coupe-circuit ou disjoncteur est ouvert. Faire les raccords électriques qui correspondent à votre moteur, tel qu'illustré aux figures 2,3, et 4.
4. MODÈLES TRIPHASÉS. Un moteur requiert un démarreur magnétique équipé d'éléments chauffants à déclenchement rapide, compensé pour température ambiante, correspondant à la force du moteur. Pour vous assure de la bonne rotation des modèles triphasés, soutenir la coquille de pompe solidement et y donner momentanément du courant en mettant

rapidement l'interrupteur de ligne à la position marche et arrêt. Si, en regardant par la décharge de la pompe, la coquille se déplace dans le sens des aiguilles d'une montre, la rotation est bonne. our modifier la rotation, interchanger deux des conduits pour moteur du démarreur magnétique.

5. Activer la pompe pour quelques secondes afin de vérifier si elle fonctionne bien.

FIGURE 1 - Diagramme D'installation



CONVENANCE DE PUITS

Installer la pompe seulement quand le puits à été préparé adéquatement. L'eau d'un puits qui n'a pas été developpé comme il se doit contient beaucoup de sable, saletés et matières abrasives qui pourraient endommager la pompe. Vérifier si le puits est assez grand pour pouvoir y installer la pompe à la profondeur voulue. Ne pas installer la pompe en bas des perforations de la paroi ou du tamis du puits, à moins que l'installation soit faite pour assurer un debit d'eau adequat audessus du moteur, pour les besoins de refroidissement. Déterminer, d'apres les records d'installation du foreur, où la pompe doit être installée en tenant compte du niveau statique de l'eau et du niveau de tirage d'eau, au taux de pompage proposé. Installer la pompe au moins à 5 pieds au-dessus du fond du puits foré.

RACCORDEMENT DU CÂBLE ÉLECTRIQUE

Suivre les instructions incluses avec la trousse de raccordement pour câble.

TUYAU DE DESCENTE

Un tuyau est recommané pour suspendre la pompe submersible dans le puits. Réferrez-vous au recommandations du fabricant du tuyau concernant la profondeur et la pression. Cependant, s'assurer d'avoir en main les items suivants:

1. Un câble de sécurité pour éviter de perdre la pompe, en cas de bris de tuyau.

NOTICE : IL EST RECOMMANDER DE SÉCURISÉ LA POMPE SUBMERSIBLE À L'AIDE D'UN CÂBLE D'ACIER. UN CÂBLE DE DIAMÈTRE DE 3/16" À 1/4" EST NORMALEMENT SUFFISANT POUR SUPPORTER UNE POMPE SUBMERSIBLE. IL EST RECOMMANDÉ DE BIEN S'ASSURÉ QUE LE CÂBLE POURRA BIEN SUPPORTER CETTE CHARGE.

2. Amortisseur de couple placé juste au-dessus de la pompe pour prévenir le frottement du fil, quand la pompe et le tuyau se tordent lors du démarrage et l'arrêt de la pompe.

Prende soin de garder les tuyaux propres et libres de cailloux, dépôts calcaires, etc... Assurer une étanchéité compléte à tous les raccords. Un enduit étanche pour tuyaux est recommandé.

SOUPAPES DE RETENUE

Il est recommandé d'utiliser un ou plusieurs clapets anti-retour lors d'une installation de pompe submersible. Si la pompe submersible n'a pas de clapet anti-retour incorporé, un clapet anti-retour doit être installé sur la conduite à une distance de 25 pieds de la pompe et sous le plus bas niveau de soutirage de la source d'eau. Pour les installations plus profondes, une valve de retenue devrait être installée selon les recommandations du fabricant. Plus qu'un clapet anti-retour devrait être utilisé pour la plupart des installations sans toutefois dépasser le nombre recommandé.

Les clapets de retenues de type « à bascule » ne sont pas recommandés et ne devraient jamais être utilisés avec une pompe submersible. Le temps de réponse de ces clapets sont trop lent et peuvent provoquer des coups de bélier (voir à la page suivante). Les clapets de retenue interne et à ressort ferment plus vite et éliminent les coups de béliers.

Note : Seulement les clapets de retenue à scellement positif doivent être utilisés dans une installation submersible. Quoique d'autres types de clapet tel que les clapets perforés et les clapets à drainage peuvent prévenir les impulseurs de fonctionnés à l'envers ceux-ci n'empêche pas les coups de bélier et créent un fonctionnement en élévation verticale. (Up thrust)

Les valves de retenue maintiennent la pression dans le système quand la pompe cesse de fonctionner. Ils empêchent également les impulseurs de fonctionnés à l'envers, en position d'élévation verticale et évite les coups de bélier. Ceux-ci peuvent provoquer une usure prématurée de la pompe et du moteur.

A. Fonctionnement à l'envers : Sans clapet de retour ou avec des clapet défectueux, l'eau contenue dans le réseau retourne à la source lorsque la moteur s'arrête. Ceci fait fonctionner les impulseurs en sens contraire. Si le moteur redémarre dans ces conditions, la force exercée sur la pompe et le moteur peut causer des dommages aux impulseurs, à l'arbre, composantes moteur, etc.

B. Élévation vertical : Sans clapet de retour ou avec des clapet défectueux ou perforés l'unité démarre dans des conditions de pression nul. Ceci aura pour effet de soulever l'ensemble des impulseurs. Ce mouvement se répercute également sur l'arbre du moteur. Il en résulte des dommages aux impulseurs et aux composantes du moteur

C. Coup de bélier : Si le clapet de retenue est plus élevé de 30 pieds du niveau statique le plus bas ou si un clapet plus bas à une fuite il se crée un vacuum dans le tuyau. Lorsque la pompe démarrera l'eau qui voyage avec une grande vélocité comblera le vide et frappera le clapet et la colonne d'eau supérieur ce qui aura pour effet de créer un choc hydraulique. Celui-ci peut fendre les tuyaux, brisé des joints et endommagé pompe et moteur. Les coups de bélier peuvent souvent être entendu ou ressenti. Si cela se produit fermer le système et consultez votre installateur pour corriger la situation.

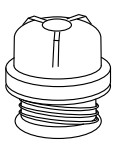
VÁLVULA DE RETENCIÓN RETIRABLE CON VÁSTAGO

Certaines pompes submersibles sont livrées avec un clapet de retenue amovible pour les applications où la pompe ne fonctionne plus à cause d'une bulle d'air . Si la pompe est fournie sans clapet anti-retour, ou si le clapet de retenue est retirée, un clapet anti-retour muni d'un ressort doit être installer de 10 à 20 pieds (3 à 6,09 mètres) au-dessus de la pompe. Cela permet de réamorcer la pompe après qu'elle est fonctionné sans eau.

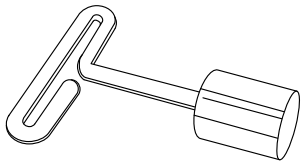
⚠AVERTISSEMENT El líquido que se vacía de regreso por la bomba puede hacer que ésta gire hacia atrás. Si la bomba/motor arrancan durante este instante, la bomba podría dañarse.

La válvula de retención se puede retirar usando una llave de vástago con mango en T (No. de pieza 23498207), la cual se pide por separado, o bien con un alicate normal con puntas de aguja. El conjunto del vástago se rosca hacia la izquierda y se retira girándolo en sentido HORARIO.

Si va a reinstalar un conjunto de válvula de retención con vástago, éste debe apretarse a 15 libras por pulgada.



Conjunto del vástago



Llave de vástago con mango en T

INSTALLATION DE LA POMPE, TUYAU DE DESCENTE ET L'EQUIPMENT S'YRATTACHANT

La figure 1 illustre une installation typique d'un puits avec les composantes installées dans le sol. A l'installation de la pompe et du tuyau de descente, suivre les instructions suivantes:

1. Avant d'installer la pompe submersible assurez-vous que les fils du moteur sont bien recouverts par le garde-fil fournit avec la pompe. Des vis d'attachement sont fournies pour bien maintenir le garde-fil en place.
2. Attacher le câble au tuyau de descente avec des colliers de serrage ou du ruban approprié a tous les 10 pieds (3m) pour éviter qu'il ne s'entortille et ne s'endommage. Le câble doit étre lâche quand l'installation set faite avec du tuyau de plastique, afin d'obtenir une installation sécuritaire dans le puits.
3. Prendre soin de ne pas égratigner ou pincer le câble contre la paroi du puits.
4. Vous servir d'un ohmmétre ou d'un mégahmètre pour procéder à des essais de continuité et d'isolation sur le câble, une fois la pompe installée. Ceci permettra de déceler toute défaillance dans le câble.
5. Assurez-vous que les valves de retenues du système sont installées correctement. Consultez les sections précédentes de ce manuel pour plus d'information sur l'installation, le choix et le dépannage des valves de retenues.
6. Si recommandé par votre marchand, installer un amortisseur de couple juste au-dessus de la pompe, pour prévenir le frottement du câble quand la pompe et le tuyau se tordent lors du démarrage et de l'arrêt de la pompe.
7. Attacher un câble de sécurité à la pompe, pour éviter de perdre celle-ci en cas de bris de tuyau.

NOTICE : IL EST RECOMMANDER DE SÉCURISÉ LA POMPE SUBMERSIBLE À L'AIDE D'UN CÂBLE D'ACIER. UN CÂBLE DE DIAMÈTRE DE 3/16" À 1/4" EST NORMALEMENT SUFFISANT POUR SUPPORTER UNE POMPE SUBMERSIBLE. IL EST RECOMMANDÉ DE BIEN S'ASSURÉ QUE LE CÂBLE POURRA BIEN SUPPORTER CETTE CHARGE O EN EL INTERVALO RECOMENDADO POR EL FABRICANTE DE LA VÁLVULA CHECK.

8. Installer un joint d'étanchéité hygiénique ou un couvert d'adapteur pour puits sans fosse au-dessus du puits, en suivant les recommandations du manfacturier.
9. Installer la pompe au moins à 5 pieds (1.5m) au-dessus du fonds du puits et au-dessus du tamis ou les perforations de la paroi.

INFORMATION ÉLECTRIQUE

1. Utiliser les services d'un électricien compétent pour l'installation du câblage. Tous les raccordements doivent être faits selon le code national et local d'électricité.

2. Vérifier si l'alimentation électrique correspond avec les indications donnees sur le moteur et la boîte de contrôle (se requise). S'assurer que les données de la boîte de contrôle correspondent avec les données électriques du moteur.

3. Chaque installation requiert un sectionneur à fusibles ou un coupe-circuit.

4. Chaque installation doit avoir une mise à la terre. Il doit y avoir un raccord efficace de mise à la terre entre la pompe et le panneau de distribution. le conduit pour moteur est incorporé d'un conducteur de mise à la terre vert.

5. Des paratonnerres sont recommandés pour chaque installation. Tous les moteurs jusqu à 5 cv monophasés 4" sont incorporés de paratonnerres. Tout moteur triphasé, soit 4" ou 6", requiert un paratonnerre séparé, installé le plus près possible de la tête de puits. (Note: une boîte de contrôle 5 cv, monphasé raccordée à un moteur 5 cv 6" requiert un paratonnerre séparé.) Installer le paratonnerre in suivant les recommandations du manufacturier. Un paratonnerre protège contre les surcharges des lignes secondaires mais ne protège pas contre les coups directs.

6. Installer la boîte de contrôle dans un endroit protégé de la pluie, neige, lumière directe du soleil ou des températures élevées qui pourraient faire déclencher le protecteur de surcharge. Aussi, protéger la boîte de contrôle des températures extrêmes de froid (sous 25 degres F/ -32 degres C) qui pourraient affecter le condensateur de démarrage.

7. Une pompe 2 fils ne nécessite pas une boîte de contrôle, les composantes électriques étant incorporées en dedans du moteur. La figure 2 vous montre un shéma typique de câblage pour une installation 2 fils.

8. Une pompe monophasée 3 fils requiert une boîte de contrôle comprenant des relais de surcharge. La figure 3 vous montre un schéma typique du câblage pour une installation monophasée, 3 fils. Prendre note d'utiliser un contacteur magnétique si la capacité électrique de l'interrupteur à pression n'est pas suffisante pour la capacité électrique du moteur submersible. L'interrupteur à pression serait alors incorporé dans un circuit pilote afin de côntroler le contacteur magnétique. Faire les raccordements à la boîte de contrôle, selon le schéma de câblage, dans la boite de contrôle, ceci afin d'éviter d'endommager le moteur.

FIGURE 2 - Schéma Câblage Pompe

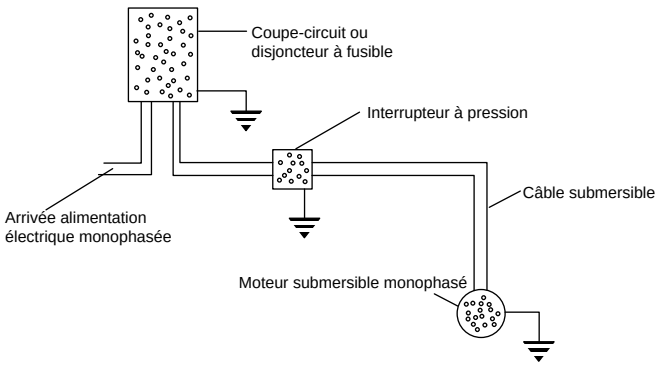
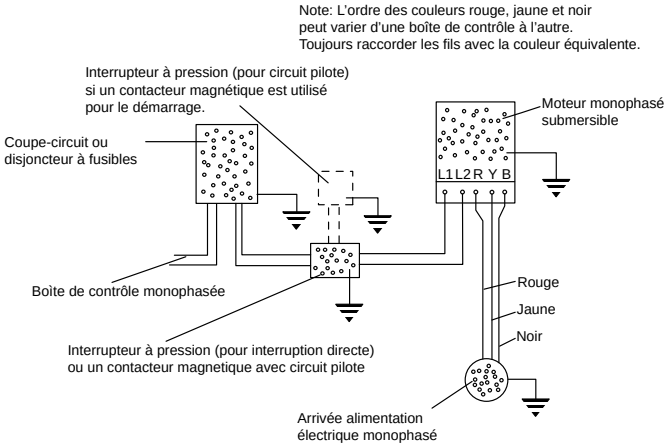
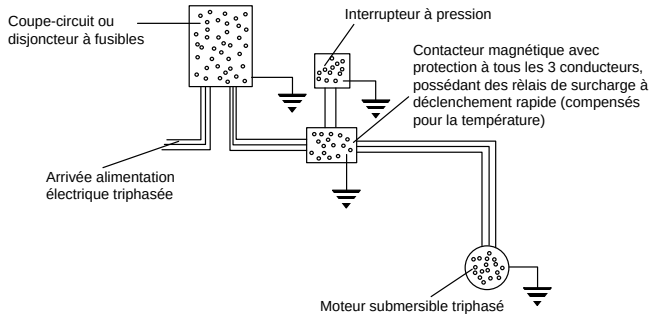


FIGURE 3 - Schéma De Cablage Pour Pompe 3 Fils Monophasée 1/3 c.v. à 1.5 c.v.



9. Une pompe triphasée 3 fils ne requiert pas une boîte de contrôle. La figure 4 bous montre un schéma typique de câblage pour une installation triphasée, 3 fils. Un contacteur magnétique avec protection à tous les 3 conducteurs possédant des relais de surcharge à déclenchement rapide (compensés pour la température) doit être utilisé.

FIGURE 4 - Schéma De Câblage Pour Pompe 1-1/2 c.v. à 5 c.v. 3 Fils Triphasée



10. Utiliser un ohmmètre ou un mégahmètre pour procéder à des essais de continuité et d'isolation, après que l'installation est complétée.

11. Apposer la plaque d'identification de la pompe sur l'étiquette de la pompe submersible FPS, Inc. et placer les deux sur le disjoncteur ou sur la boîte du coupe-circuit, pour références futures.

VÉRIFICATION DU PUITS

Vérifier la pompe et le rendement du puits, avant de faire le dernier raccordement au systéme de décharge.

1. Installer une vanne à l'extrémité du tuyau et ouvrir partiellement la vanne.
2. Démarre la pompe.
3. Ouvrir graduellement la vanne pour obtenir le débit maximal.
4. Si l'eau à la décharge n'est pas claire, laisser la pompe fonctionner jusqu'à ce qu'elle devienne claire. Si dans 30 minutes l'eau n'est pas claire, arrêter la pompe et prendre les moyens nécessaires pour corriger la situation. Après avoir obtenu une eau claire, vérifier le sable en déchargeant dans un seau propre ou tout autre contenant.
5. Fermer la vanne jusqu'à l'obtention maximale du débit d'eau requis. S'assurer qua la sortie de la pompe à ce niveau de réglage n'est pas supérieure au rendement du puits; en faire la vérification en surveillant le niveau de tirage d'eau et s'assurer que le niveau reste stable au débit d'eau maximal requis.

⚠CAUTION Ne pas faire fonctionner la pompe si elle n'est pas complétement subergée dan l'eau, autrement la pompe et le moteur pourraient s'endommager. Prende note également que l'air formé dans la pompe peut causer une poche d'air, à certaines conditions.

FAIBLE RENDEMENT DU PUITS

Un puits à faible rendement existe quand la sortie de la pompe est supérieure au rendement du puits. Il en résulte une diminution du niveau d'eau au tamis d'aspiration faisant entrer un mélange d'air et eau dans la pompe. Dans ce cas, la colonne d'eau qui se trouve déjà dans le tuyau de descente tiens la soupape de retenue fermée et développe ainsi une poche d'air à l'intérieur de la pompe. Dans ces conditions, la pompe n'est pas lubrifiée adéquatement et le moteur n'est pas refroidi proprement; et it pourrait en résulter des dommages si l'alimentation électrique n'est pas arrêtée rapidement. Suivre une ou plusieurs des recommandations suivantes pour corriger et/ou protéger l'installation:

1. Installer une longueur additionnelle de tuyau pour descendre la pompe plus bas dans le puits se possible.
2. Installer un mécanisme sensitif Pumptec mc de Franklin ou tout autre appareil électronique similaire.
3. Installer un contrôle pour niveau de liquide sans flotteur. Ce dispositif consiste en un relais électrique activé par des courants passant au travers des circuits de retour des électrodes suspendus dans le puits, L'électrode inférieur (arrêt) qui se trouve juste au'dessus de la pompe, permet au neveau d'eau de ne pas descendre plus bas que le tamis d'aspiration. L'électrode supérieur (démarrage), situé juste en-dessous du plus bas niveau d'eau statique, fait démarrer la pompe de nouveau, aussitôt que le puits à récupéré. Un contrôle pour niveau de liquide sans flotteur travaille en série avec l'interrupteur à pression. Vous référer aux instructions du manufacturier fournies avec le contrôle.
4. Installer une soupape de contrôle du débit dans la ligne de décharge avant l'interrupteur à pression. Ceci limite la sortie à partir de la pompe, sans affecter le rendement de l'eau tirée du réservoir à pression. Néanmoins, use forte demande d'eau pourrait vider le réservoir a pression; donc un réservoir à diaphragme ou tout autre dispositif est recommandé, car il empêche l'air d'être êvacué dans la ligne de service. Non seulement la décharge d'air dans les robinets serait désagréable, mais l'air évacué du réservoir à pression devrait être remplacé.
5. Installer une pompe plus petite, poue éviter un surpompage au puits. Vous référez à votre dépositaire pour le bon choix de la pompe.
6. Installer un interrupteur de basse pression. Un interrupteur de basse pression ou un interrupteur à pression avec un dispositif intégré protège la pompe pour puits peu profund contre la perte d'amorçage, mais ne donne pas toujours un rendement satisfaisant sur les pompes submersibles contre les effets de surpompage au puits; c'est parce qu'il réagit à une perte de pression à la surface, qui se produit lorsqu'une poche d'air s'est formée à l'intérieur de la pompe. Nous recommandons, soit un contrôle de niveau pour liquide sans flotteur ou une soupape de contrôle du débit, dans cet ordre, de preférénce à un interrupteur à pression d'arrêt, comme protection contre le surpompage.

PLOMBERIE DE DÉCHARGE

La figure 1 illustre une installation typique d'un puits avec les composantes installées à la surface. A l'installation de la plomberie de décharge, suivre les instructions suivantes:

1. Installer une soupape de retenue à ressort sur ligne de decharge avant l'interrupteur à pression.
2. Toujours installer une soupape de sûreté à pression dans le système. La soupape de sûreté devrait pouvoir être capable de décharger le débit d'eau de la pompe à la pression demandée du réservoir à pression.
3. Installer un interrrupteur à pression entre la soupape de retenue et le réservoir à pression, mais près du réservoir à pression. Vous référer aux figures 2,3, ou 4 pour le raccordement adéquat de l'interrupteur à pression.

GUIDE DE DÉPANNAGE

1. La pompe refuse de démarrer:

a) Problème d'électricité - appeler le détaillant ou l'électricien.
b) Dispositif de protection a nis la pompe en position arrêt.
c) Surcharge se déclenche.
d) Remettre en marche l'interrupteur de basse pression (si installé).

2. La pompe ne donne pas d'eau.

a) Poche d'air dans la pompe.
b) Écran du succion obstrué.
c) Rendement insuffisant du puits.

3. L'interrupteur de surcharge se déclenche.

a) Problème d'électricité - appeler le détaillant ou l'électricien.

4. Le débit de la pompe est réduit.

a) Rendement insuffisant du puits.
b) Pompe usée.
c) Écran du succion obstrué.
d) Bas voltage.
e) Rotation inexacte (triphasé seulement).

5. La pompe s'arrête et se remet en marche trop souvent.

a) Baisse de pression excessive entre l'interrupteur à pression et le réservoir.
b) Pression de mise en marche trop haute.
c) Pression d'arrêt trop faible.
d) Le réservoir est surchargé d'eau.
e) Les électrodes d'arrêt et de démarrage du contrôle pour niveau de liquide sans flotteur réglés trop prés.
f) Réservoir trop petit pour rencontrer les exigences du système.

6. L'interrupteur à pression arrête et se remet en marche rapidement quand la pompe démarre.

a) L'interrupteur à pression trop éloigné du réservoir à pression.
b) Ajuster le chargeur d'air du réservoir, en suivant les recommandations du manufacturier.

ATTENTION!

INFORMATIONS IMPORTANTES POUR LINSTALLATEUR DE CET EQUIPEMENT

CET EQUIPEMENT DOIT ETRE INSTALLE PAR UN TECHNICIEN QUALIFIE. SI L'INSTALLATION N'EST PAS CONFORME AUX LOIS NATIONALES OU LOCALES AINSI QU'AUX RECOMMANDATIONS DE FRANKLIN ELECTRIC, UN CHOC ELECTRIQUE, LE FEU, UNE PREFORMANCE NON ACCEPTABLE, VOIRE MEME LE NON'FONCTIONNEMENT PEUVENT SURVENIR. UN GUID D'INSTALLATION DE FRANKLIN ELECTRIC EST DESPONIBLE CHEZ LES MANUFACTURIERS DE POMPES, LES DISTRUBUTEURS, OU DIRECTEMENTCHES FRANKLIN. POUR DE PLUS AMPLES RENSEIGNEMENTS, APPELEZ SANS FRAIS LE 1-800-348-2420. CONSERVEZ CETTE FEUILLE D'INFORMATION AVEC L'EQUIPEMENT POUR CONSULTATION FUTURE

AVERTISSEMENT

UN CHOC ELECTRIQUE SERIEUZ OU MEME MORTEL EST POSSIBLE, SI L'ON NEGLIGE DE CONNECTER LE MOTEUR, LA PLONBERIE METALLIQUE, BOITES DE CONTRÔLE ET TOUT METAL PROCHE DU MOTEUR A UN CABLE ALLANT VERS UNE ALIMENTATION D'ENERGIE AVEC BORNE DE MISE A LA TERRE UTILISANT AU MOINS LE MEME CALIBRE QUE LES FILS DU MOTEUR. POUR REDUIRE LE RISQUE DE CHOC ELECTRIQUE. COUPER LE COURANT AVANT DE TRAVAILLER PRES OU UNE ZONE DE BAIGNADE.

ATENTION!

INFORMACION PARA EL INTALADO DE ESTE EQUIPO

PARA LA INSTALACION DE ESTE EQUIPO, SE REQUIERE DE PERSONAL TECNICO CALIFICADO. EL NO CUMPLIR CON LAS NORMAS ELECTRICAS NACIONALES Y LOCALES, ASI COMO CON LAS RECOMENDACIONES E FRANKLIN ELECTRIC DURANTE SU INSTALACION, PUEDE OCASIONAR: UN CHOQUE ELECTRICO, PELIGRO DE UN INCENDIO, OPERACION DEFECTUOSA E ESTAN DISPONIBLES CON LOS DISTRIBUIDORES, FABRICANTES DE BOMBAS O DIRECTAMENTE CON FRANKLIN ELECTRIC. PUEDE LLAMAR GRATUITAMENTE PARA MAYOR INFORMACION AL TELEFONO 800-348-2420. GUARDAR ESTA INFORMACION JUNTO AL EQUIPO PARA FUTURAS CONSULTAS.

ADVERTENCIA

PUEDE OCURRIR UN CHOQUE ELECTRICO, SERIO O FATAL DEBIDO A UNA ERRONEA CONECCION DEL: MOTOR O POR NO UTILIZAR UN CABLE PARA TIERRA DE CALIBRE IGUAL O MAYOR AL DE LA ALIMENTACION. PARA REDUCIR EL RIESGO DE CHOQUE ELECTRICO. DESCONECTAR LA ALIMENTACION ELECTRICA ANTES DE INICIAR A TRABAJAR EN EL SISTEMA HIDRAULICO. NO UTILIZAR ESTE MOTOR EN ALBERCAS O AREAS EN DONDE SE PRACTIQUE NATACION.

GARANTIE LIMITEE*

CETTE GARANTIE ÉNONCE LES SEULES OBLIGATIONS DE L'ENTREPRISE ET LES RECOURS EXCLUSIFS DE L'ACHETEUR EN CAS DE PRODUIT DÉFECTUEUX.

Franklin Electric Company, Inc. et ses filiales (ci-après « l'Entreprise ») garantit que les produits accompagnés de cette garantie sont exempts de défauts quant aux matériaux ou à la main-d'œuvre par l'Entreprise.

L'Entreprise a le droit d'inspecter tout produit retourné sous garantie pour confirmer qu'il présente un défaut de matériau ou de main-d'œuvre. Elle a le droit exclusif de choisir de réparer ou de remplacer le matériel, les pièces ou les composants défectueux.

L'acheteur doit retourner le produit à un point de distribution Franklin Electric autorisé pour examen. Si le retour est effectué au point d'achat, la couverture de la garantie ne sera prise en considération que si le lieu de vente en question est un distributeur Franklin Electric autorisé au moment de la réclamation. Sous réserve des conditions générales énoncées ci-dessous, l'Entreprise s'engage à réparer ou à remplacer toute partie du produit retourné par l'acheteur qui s'avère défectueuse en raison des matériaux ou de la main-d'œuvre provenant de l'Entreprise.

L'Entreprise n'envisagera l'application de la garantie que dans les 12 mois suivant la date d'installation du produit ou dans les 24 mois suivant sa fabrication, selon la première éventualité.

L'Entreprise ne pourra EN AUCUN CAS être tenue responsable du coût de la main-d'œuvre ou d'autres frais engagés par un client pour retirer ou fixer un produit, ou quelconque pièce ou composant qui le constitue.

L'Entreprise se réserve le droit de modifier ou d'améliorer ses produits ou toute partie de ceux-ci sans être obligée de fournir une telle modification ou amélioration aux produits déjà vendus.

LA PRÉSENTE GARANTIE NE S'APPLIQUE PAS AUX produits endommagés par un acte de la nature, y compris la foudre, l'usure normale, les services de maintenance normale et les pièces utilisées avec de tels services, ou toute autre condition au-delà du contrôle de l'Entreprise.

LA PRÉSENTE GARANTIE SERA IMMÉDIATEMENT ANNULÉE si l'une des conditions suivantes est constatée :

1. Le produit est utilisé à des fins autres que celles pour lesquelles il a été conçu et fabriqué;
2. Le produit n'a pas été installé conformément aux codes et aux règlements applicables et aux bonnes pratiques commerciales;
3. Le produit n'a pas été installé par un entrepreneur certifié par Franklin;
4. Le produit a été endommagé à la suite d'une négligence, d'un abus, d'un accident, d'une mauvaise application, de vandalisme, d'une altération, d'une installation, d'un fonctionnement, d'une maintenance ou d'un entreposage inapproprié ou d'un dépassement des maximums recommandés dans les instructions du produit.

NI LE VENDEUR, NI L'ENTREPRISE NE POURRONT ÊTRE TENUS RESPONSABLES DES BLESSURES, DES PERTES OU DES DOMMAGES DIRECTS, ACCESSOIRES OU INDIRECTS (Y COMPRIS, SANS S'Y LIMITER, LES DOMMAGES INDIRECTS RELATIFS À UN MANQUE À GAGNER, À UNE PERTE DE VENTES, À DES BLESSURES CORPORELLES, À DES DOMMAGES MATÉRIELS OU À TOUTE AUTRE PERTE ACCESSOIRE OU INDIRECTE) DÉCOULANT DE L'UTILISATION DU PRODUIT OU DE L'INCAPACITÉ DE L'EMPLOYER, ET L'ACHETEUR CONVIENT QU'AUCUN AUTRE RECOURS NE SERA POSSIBLE.

LA GARANTIE ET LE RECOURS DÉCRITS AUX PRÉSENTES SONT EXCLUSIFS ET ONT PRÉSÉANCE SUR TOUTE AUTRE GARANTIE OU TOUT AUTRE RECOURS EXPLICITE OU IMPLICITE. LES AUTRES GARANTIES ET RECOURS SONT AINSI EXPRESSÉMENT EXCLUS, Y COMPRIS, MAIS SANS S'Y LIMITER, TOUTE GARANTIE IMPLICITE DE QUALITÉ MARCHANDE OU DE CONFORMITÉ À UN USAGE PARTICULIER. LA DURÉE DE LA GARANTIE OU DU RECOURS APPLICABLE À UN PRODUIT SE LIMITE AUX PÉRIODES DE GARANTIE EXPLICITEMENT INDIQUÉES CI-DESSUS.

NON-RESPONSABILITÉ : Toute affirmation verbale à propos du produit effectuée par le vendeur, l'Entreprise, les représentants ou d'autres parties ne constitue pas une garantie, ne doit pas être interprétée comme telle par l'acheteur et ne fait pas partie du contrat de vente. Les seules obligations du vendeur et de l'Entreprise et les seuls recours de l'acheteur seront le remplacement ou la réparation par l'Entreprise du produit, comme décrit ci-dessus. Avant l'utilisation, l'utilisateur devra déterminer l'adéquation du produit avec l'usage auquel il est destiné; et l'utilisateur assume toutes les responsabilités et tous les risques liés à ce choix.

Certains États et pays n'autorisent pas l'exclusion ou la limitation de la durée d'une garantie implicite ou l'exclusion ou la limitation de dommages accessoires ou indirects, de sorte que l'exclusion ou les limitations énoncées ci-dessus peuvent ne pas s'appliquer à vous. Cette garantie vous accorde des droits juridiques précis, et vous pouvez également disposer d'autres droits, lesquels varient selon l'État et le pays.

Franklin Electric peut, à sa seule discrétion, mettre à jour la présente garantie limitée de temps à autre. Toute information contradictoire concernant les procédures de garantie, que ce soit dans un manuel d'utilisation ou ailleurs, est remplacée par la présente par ce document. Néanmoins, toutes les références à une période, ou à la durée d'une période de garantie, demeureront conformes à la garantie en vigueur au moment de l'achat.

* Communiquez avec la division de l'exportation de Franklin Electric Co., Inc. pour connaître la garantie internationale.

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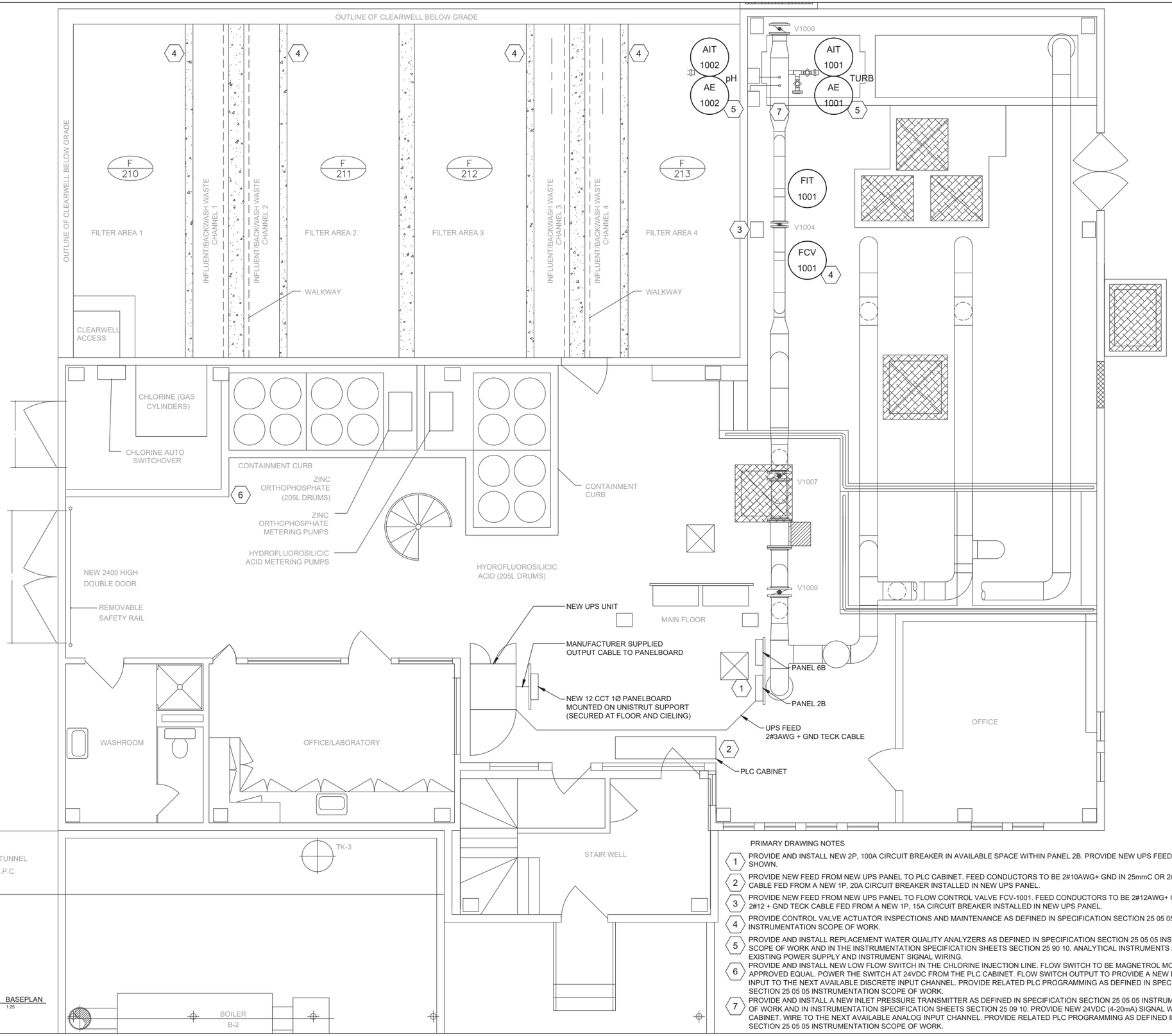

PRIMARY DRAWING NOTES

1. PROVIDE AND INSTALL NEW 2P, 100A CIRCUIT BREAKER IN AVAILABLE SPACE WITHIN PANEL 2B. PROVIDE NEW UPS FEED CONDUCTORS AS SHOWN.
2. PROVIDE NEW FEED FROM NEW UPS PANEL TO PLC CABINET. FEED CONDUCTORS TO BE 2#10AWG+ GND IN 25mmC OR 2#10 + GND TECK CABLE FED FROM A NEW 1P, 20A CIRCUIT BREAKER INSTALLED IN NEW UPS PANEL.
3. PROVIDE NEW FEED FROM NEW UPS PANEL TO FLOW CONTROL VALVE FCV-1001. FEED CONDUCTORS TO BE 2#12AWG+ GND IN 25mmC OR 2#12 + GND TECK CABLE FED FROM A NEW 1P, 15A CIRCUIT BREAKER INSTALLED IN NEW UPS PANEL.
4. PROVIDE CONTROL VALVE ACTUATOR INSPECTIONS AND MAINTENANCE AS DEFINED IN SPECIFICATION SECTION 25 05 05 INSTRUMENTATION SCOPE OF WORK.
5. PROVIDE AND INSTALL REPLACEMENT WATER QUALITY ANALYZERS AS DEFINED IN SPECIFICATION SECTION 25 05 05 INSTRUMENTATION SCOPE OF WORK AND IN THE INSTRUMENTATION SPECIFICATION SHEETS SECTION 25 90 10. ANALYTICAL INSTRUMENTS ARE TO REUSE EXISTING POWER SUPPLY AND INSTRUMENT SIGNAL WIRING.
6. PROVIDE AND INSTALL NEW LOW FLOW SWITCH IN THE CHLORINE INJECTION LINE. FLOW SWITCH TO BE MAGNETROL MODEL TD-1 OR APPROVED EQUAL. POWER THE SWITCH AT 24VDC FROM THE PLC CABINET. FLOW SWITCH OUTPUT TO PROVIDE A NEW DISCRETE PLC INPUT TO THE NEXT AVAILABLE DISCRETE INPUT CHANNEL. PROVIDE RELATED PLC PROGRAMMING AS DEFINED IN SPECIFICATION SECTION 25 05 05 INSTRUMENTATION SCOPE OF WORK.
7. PROVIDE AND INSTALL A NEW INLET PRESSURE TRANSMITTER AS DEFINED IN SPECIFICATION SECTION 25 05 05 INSTRUMENTATION SCOPE OF WORK AND IN INSTRUMENTATION SPECIFICATION SHEETS SECTION 25 09 10. PROVIDE NEW 24VDC (4-20mA) SIGNAL WIRING TO PLC CABINET. WIRE TO THE NEXT AVAILABLE ANALOG INPUT CHANNEL. PROVIDE RELATED PLC PROGRAMMING AS DEFINED IN SPECIFICATION SECTION 25 05 05 INSTRUMENTATION SCOPE OF WORK.

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Consultants

Legend

Notes

AS-BUILT SIFEC
MARCH 2018
City of Iqaluit
Water Treatment Plant

Revision	By	Appd.	YY.MM.DD
0 ISSUED FOR USE	TT	T.D.C.	17.07.12
Issued	By	Appd.	YY.MM.DD
File Name:	Dwn.	Chkd.	Dsgn. YY.MM.DD

Permit-Seal

Client/Project
CITY OF IQALUIT

WATER AND WASTEWATER FACILITY IMPROVEMENTS
Iqaluit, Nunavut

Title
WATER TREATMENT PLANT
MAIN FLOOR

Project No.	Scale	
110126056	AS SHOWN	
Drawing No.	Sheet	Revision
E1	of	0

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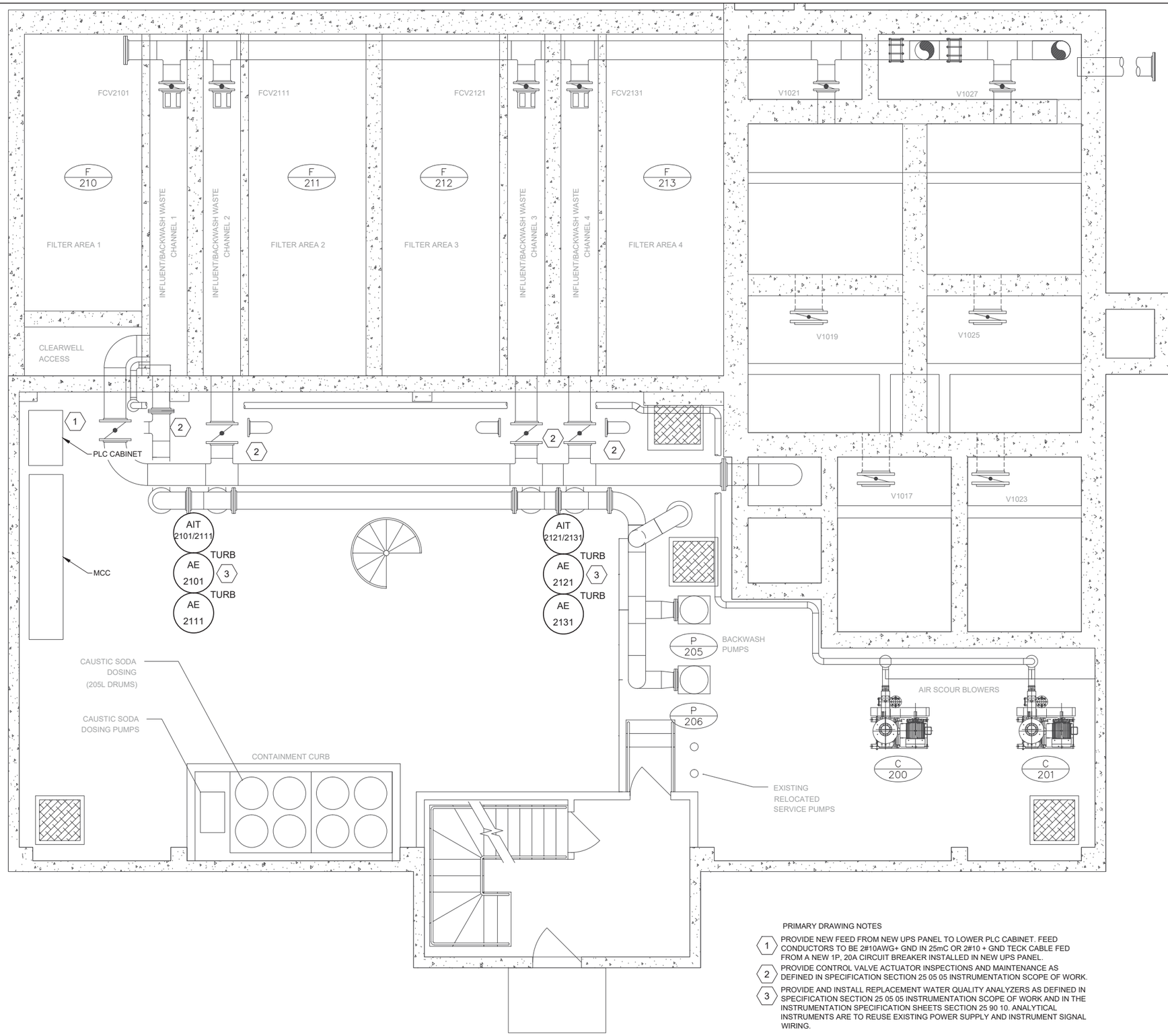
22/03/2018 4:40 PM By Tomas Marsh
ORIGINAL SHEET - ISO A0



1 / E2 BASEPLAN
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PRIMARY DRAWING NOTES

1. PROVIDE NEW FEED FROM NEW UPS PANEL TO LOWER PLC CABINET. FEED CONDUCTORS TO BE 2#10AWG+ GND IN 25mC OR 2#10 + GND TECK CABLE FED FROM A NEW 1P, 20A CIRCUIT BREAKER INSTALLED IN NEW UPS PANEL.
2. PROVIDE CONTROL VALVE ACTUATOR INSPECTIONS AND MAINTENANCE AS DEFINED IN SPECIFICATION SECTION 25 05 05 INSTRUMENTATION SCOPE OF WORK.
3. PROVIDE AND INSTALL REPLACEMENT WATER QUALITY ANALYZERS AS DEFINED IN SPECIFICATION SECTION 25 05 05 INSTRUMENTATION SCOPE OF WORK AND IN THE INSTRUMENTATION SPECIFICATION SHEETS SECTION 25 90 10. ANALYTICAL INSTRUMENTS ARE TO REUSE EXISTING POWER SUPPLY AND INSTRUMENT SIGNAL WIRING.

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Legend

Notes

AS-BUILT SIFEC
MARCH 2018
City of Iqaluit
Water Treatment Plant

Revision	By	Appd.	YY.MM.DD
0 ISSUED FOR BID	TT	T.D.C.	17.07.12
Issued	By	Appd.	YY.MM.DD

File Name: Dwn. Chkd. Dsgn. YY.MM.DD

Permit-Seal

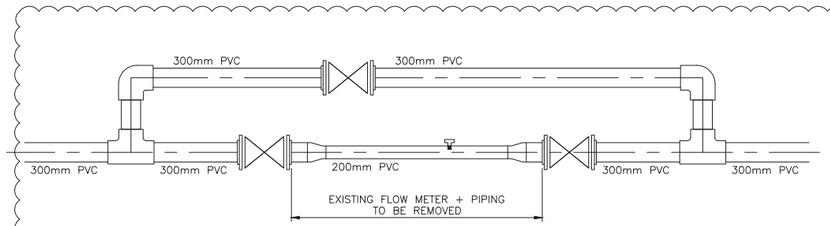
Client/Project
CITY OF IQALUIT

WATER AND WASTEWATER FACILITY IMPROVEMENTS
Iqaluit, Nunavut

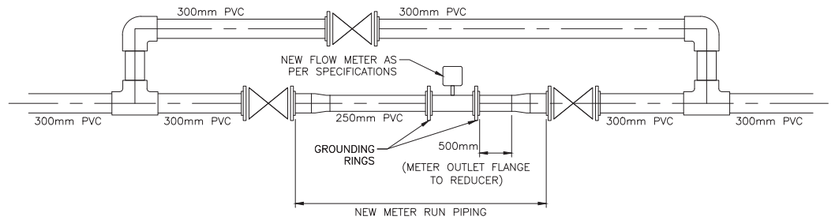
Title
WATER TREATMENT PLANT FILTER ROOM

Project No.	Scale	
110126056	AS SHOWN	
Drawing No.	Sheet	Revision
E2	of	0

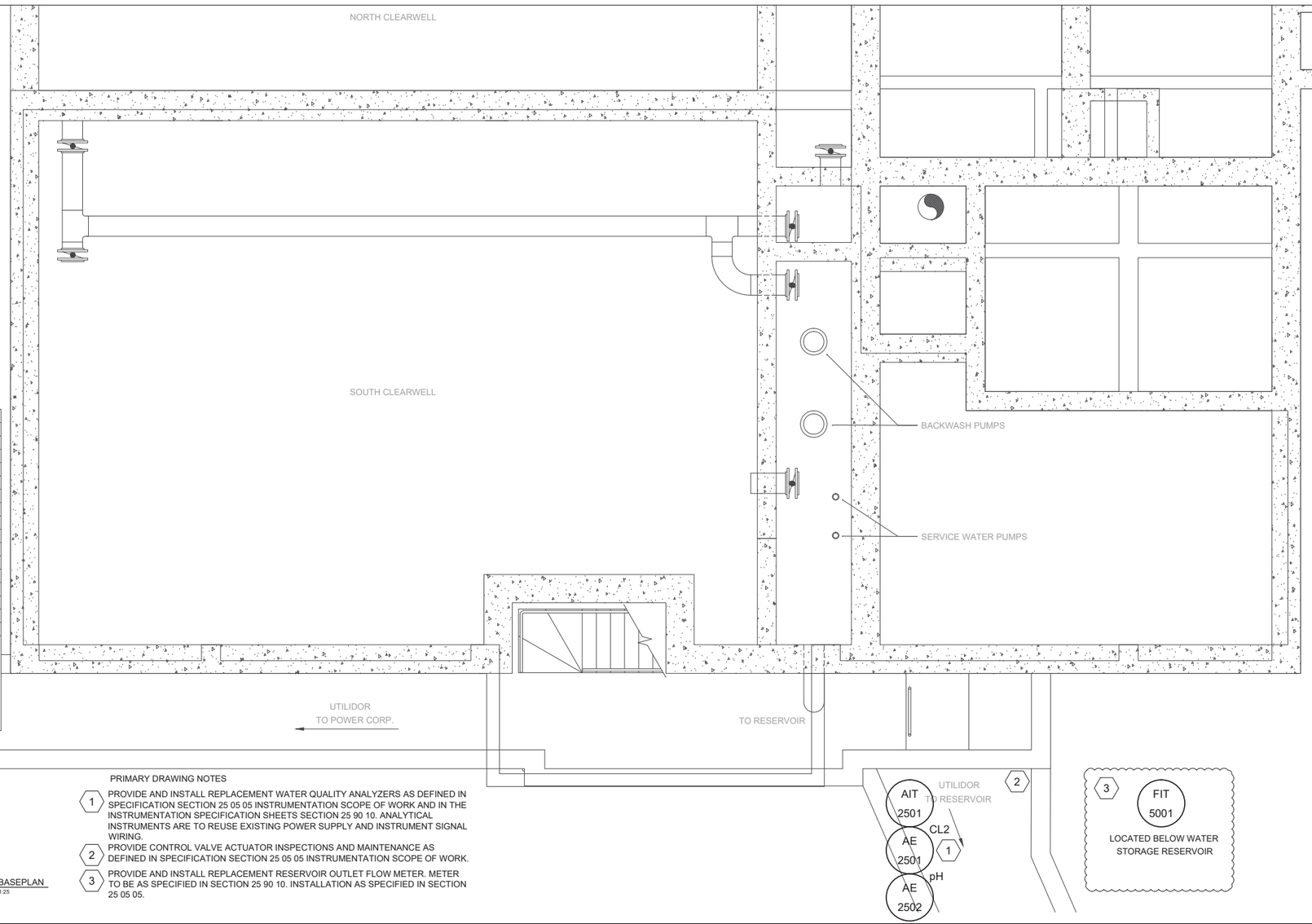
C:\Users\thomas\Documents\Project Files\Autodesk Revit 2016\2016 - HVAC-ALL(D) SIDOM.rvt
2017/07/12 4:58 PM by Thomas Thomas
ORIGINAL SHEET - ISO A0



2 E3 EXISTING RESERVOIR OUTLET FLOW METER
N.T.S.



3 E3 NEW RESERVOIR OUTLET MAGNETIC FLOW METER
N.T.S.



1 E3 BASEPLAN
1:25

PRIMARY DRAWING NOTES

1. PROVIDE AND INSTALL REPLACEMENT WATER QUALITY ANALYZERS AS DEFINED IN SPECIFICATION SECTION 25 05 05 INSTRUMENTATION SCOPE OF WORK AND IN THE INSTRUMENTATION SPECIFICATION SHEETS SECTION 25 90 10. ANALYTICAL INSTRUMENTS ARE TO REUSE EXISTING POWER SUPPLY AND INSTRUMENT SIGNAL WIRING.
2. PROVIDE CONTROL VALVE ACTUATOR INSPECTIONS AND MAINTENANCE AS DEFINED IN SPECIFICATION SECTION 25 05 05 INSTRUMENTATION SCOPE OF WORK.
3. PROVIDE AND INSTALL REPLACEMENT RESERVOIR OUTLET FLOW METER. METER TO BE AS SPECIFIED IN SECTION 25 90 10. INSTALLATION AS SPECIFIED IN SECTION 25 05 05.

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Legend

Notes

AS-BUILT SIFEC
MARCH 2018
City of Iqaluit
Water Treatment Plant

Revision	By	Appd.	YY.MM.DD
1 ISSUED FOR ADDENDUM	T.T.	T.D.C.	17.07.31
0 ISSUED FOR IID	T.T.	T.D.C.	17.07.12
Issued	By	Appd.	YY.MM.DD
File Name:	Dwn.	Chkd.	Dsgn. YY.MM.DD

Permit-Seal

Client/Project
CITY OF IQALUIT

WATER AND WASTEWATER
FACILITY IMPROVEMENTS
Iqaluit, Nunavut

Title
WATER TREATMENT PLANT
CLEARWELL

Project No.	Scale	
110126056	AS SHOWN	
Drawing No.	Sheet	Revision
E3	of	1

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Last Saved by: tthomas 2017-07-31 3:39:39 PM
ORIGINAL SHEET - ISO A1

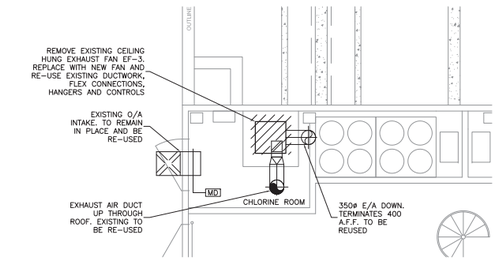
LEGEND

DEMOLTION HATCH

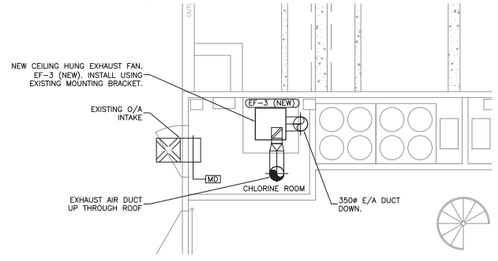
CONTROL VALVE	STANDARD CLEAN-OUT IN LINE END OF RUN
BALL VALVE	STANDARD CLEAN-OUT THROUGH FLOOR END OF RUN
FLOW SWITCH	STANDARD CLEAN-OUT THROUGH FLOOR IN LINE
PIPE CAP	PIPING SLOPE
PIPE BREAK	FIXTURE TRAP
FLOW ARROW	BUILDING TRAP
PIPING ELBOW DOWN	SANITARY DRAIN (ABOVE GRADE OR FLOOR)
PIPING ELBOW UP	SANITARY DRAIN (BELOW GRADE OR FLOOR)
PIPING TEE UP	
PIPING TEE DOWN	SANITARY VENT UP
PIPING TEE	
SANITARY PIPING DOWN	SANITARY THROUGH ROOF
SANITARY PIPING UP	EXISTING FINNED TUBE RADIATION
SANITARY TEE UP	
SANITARY TEE DOWN	
SANITARY BRANCH	

WATER TREATMENT PLANT

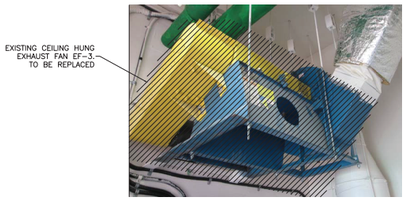
1 M1 EXISTING WTP BUILDING PHOTOGRAPH
SCALE: NTS



2 M1 EXISTING WTP DEMOLITION PLAN
SCALE: 1:50



3 M1 EXISTING WTP NEW EXHAUST FAN PLAN
SCALE: 1:50



4 M1 CEILING HUNG EXHAUST FAN PHOTOGRAPH
SCALE: NTS

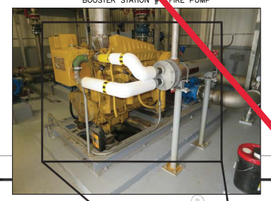
FAN SCHEDULE

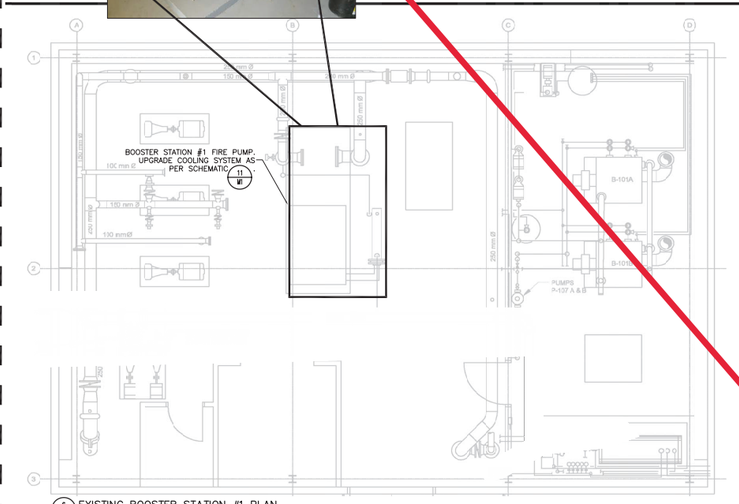
FAN No.	SERVICE	LOCATION	MANUFACTURER	MODEL No.	AIR FLOW (L/s)	EXTERNAL STATIC PRESS. (Pa)	MOTOR (Hp)	FAN RPM	ELECTRICAL (V/Ph/Hz)	MOUNTING ARR'GT	TYPE	REMARKS
EF-3 (NEW)	EXHAUST AIR	CHLORINE ROOM	TWIN CITY FAN	RBA 909	447	747	.74	1642	575/3/60	CEILING HUNG	CENTRIFUGAL	TEFC ENCLOSURE, CORROSION RESISTANT, EPOXY COATED, SPARK RESISTANT

WATER BOOSTER STATION No 1

1 M1 EXISTING BOOSTER STATION #1 PHOTOGRAPH
SCALE: NTS

BOOSTER STATION #1 FIRE PUMP

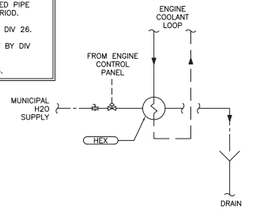




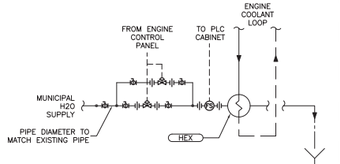
6 M1 EXISTING BOOSTER STATION #1 PLAN
SCALE: NTS

GENERAL NOTES:

1. NEW COOLING WATER FLOW SCHEMATIC 11/M1 APPLIES TO BOOSTER STATION #1 FIRE PUMP AND BOOSTER STATION #2 FIRE PUMP/GENERATOR.
2. INSULATE NEW PIPE TO MATCH EXISTING.
3. CONTRACTOR TO CONFIRM REQUIRED PIPE SIZE ON SITE DURING TENDER PERIOD.
4. FLOW SWITCH & CV PROVIDED BY DIV 26.
5. INSTALL OF FLOW SWITCH AND CV BY DIV 23.
6. CONTROLS AND WIRING BY DIV 26.



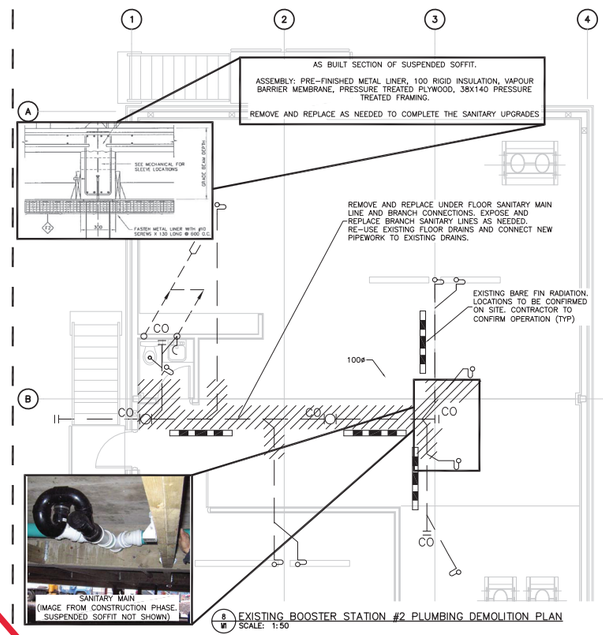
10 M1 EXISTING COOLING WATER FLOW
SCALE: NTS



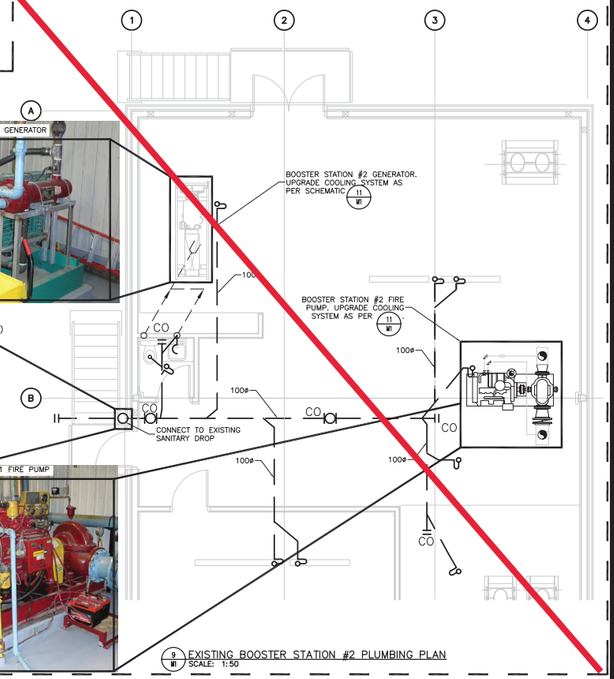
11 M1 NEW COOLING WATER FLOW
SCALE: NTS

WATER BOOSTER STATION No 2

7 M1 EXISTING BOOSTER STATION #2 PHOTOGRAPH
SCALE: NTS



8 M1 EXISTING BOOSTER STATION #2 PLUMBING DEMOLITION PLAN
SCALE: 1:50



9 M1 EXISTING BOOSTER STATION #2 PLUMBING PLAN
SCALE: 1:50

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Legend

Notes

AS-BUILT SIFEC
MARCH 2018
City of Iqaluit

Revision	By	Appd.	YY.MM.DD
0 ISSUED FOR BID	BM	LF	17.07.12

Issued	By	Appd.	YY.MM.DD
Nb Name:	Dwn.	Chkd.	Dsgn. YY.MM.DD

Permit-Seal

Client/Project
CITY OF IQALUIT

WATER AND WASTEWATER FACILITY IMPROVEMENTS
Iqaluit, Nunavut

Title
MECHANICAL UPGRADES

Project No.	Scale	
110126056		
Drawing No.	Sheet	Revision
M1	1 of 1	0

ORIGINAL SHEET - ANSI A1